

PRiME Gen1 User's Manual

Version 1.0

Quick Overview

1. Start the “PRiME Main Program” application on the desktop.
2. Click the *Start* button in the upper right-hand corner of the PRiME application
 - a. At this point, the PRiME system is considered on and fully functional, assuming all hardware components of the PRiME have been connected properly and powered on.
3. **For triggering applications**, select the desired triggering channel (left side of the trigger display on the bottom), adjust the threshold as needed. Use the *Invert* feature to trigger off a feature that is negative-going. Use the *d/dt* feature to trigger off features with a sharp rise or fall (for instance, when the T-wave is greater than the R-wave, or for more reliable triggering on the IBP waveform)
4. **To save data**, enter a valid filename directly or by using the Browse icon to the right of the filename area. Click the record button (button will be “lit” when recording). To stop recording, click the record button again (button will be dark).
 - a. If the file exists, new data will be appended to the existing data.
 - b. If the file does not exist, a new file will be created, **but the directory structure MUST EXIST**, or the program will crash.
5. **To adjust which ECG channels are displayed**, click the name of the lead (located to the left of the ECG display) and select the desired lead to display. This only effects which signals are displayed in the Prime Main Program.

Description of Features

A. Adaptive Filter To Further Reduce Noise in ECG Signal

If the adaptive filter is not effective at removing noise in the ECG signals, more aggressive filtering can be performed by adjusting the “Beta” slider (left-center of screen). The *Low* setting is the default and is usually sufficient. The current state of the adaptive filter can be reset by clicking the *Reset* button in the upper-left corner, beneath the *Start* button. A Beta setting of *None* will disable any more filter updates, but retain the current state of the filter.

The adaptive filter is only effective for gradient-induced noise. As the IBP signals are not affected by the gradients, no adaptive filtering is performed on those signals.

a. Reducing Noise in ECG

- i. **Try increasing the Beta to *Med* or *High*.** It may take several seconds for the filter to adapt.
- ii. **Try resetting the filter** by clicking on the *Reset* button. Sometimes, a previous scan or spoiler on the MRI can cause the filter to “adapt” to a bad state. Resetting the filter and allowing it to re-adapt can solve this problem.

- iii. Generally, the High setting will also start corrupting the true ECG signal. If this happens, reset the filter taps, set the Beta to *High* until the ECG starts getting corrupted (or the noise is no longer being filtered), and set the Beta to *None* to prevent further changes to the filter state.
- iv. Click on the yellow *Filter* LED (to the left of each ECG display). The LED will darken, indicating it is displaying the ECG data before the adaptive filter. In rare cases, the adaptive filter struggles to adapt to the noise and can make it worse. **If the unfiltered data looks better, you should disable the filter** (see below).
 - 1. **The Filter LED only applies to the LabVIEW Display** and does not affect the data being sent to the PRiME-PSC device and Sensis/MacLab displays.
- v. **To disable the adaptive filtering**, set Beta is set to *None*, and press the *Reset* button (upper-left corner beneath the *Start* button). This will disable updates to the filter, then reset the filter to an initial state where no filtering is performed. The Beta must be set to *None* before clicking *Reset*.

B. Triggering

The PRiME system can output a digital trigger to the MRI system (or any other system capable of accepting a digital trigger) for gated imaging scans. The MRI system must be set to accept an external trigger (which this manual will not describe). The PRiME system can trigger off any signal collected by the device, including raw ECG electrodes (such as limb leads), calculated leads (such as lead I, lead II), and IBP signals.

The threshold is a simple level threshold, which generates a short (~10ms) trigger when the trigger signal goes above the threshold.

a. Setting Trigger Parameters

- i. To set the channel which generates the trigger, click on the *Channel* name (located to the left of the Trigger Display). A list of available channels will be displayed, simply click on the desired channel.
- ii. The selected channel will be displayed in the Trigger Display. Please note that this signal is filtered for better triggering and may appear slightly different than how it appears in the ECG or IBP displays.
- iii. To set the threshold, type the desired threshold directly or use the up/down arrow keys. When typing directly, you should hit the Enter/Return key to make sure the threshold is updated.
 - 1. On the Trigger display, the threshold is represented by a red, dotted line
- iv. If the desired signal feature is negative going, select the green Invert LED, which will light when active. This will invert the trigger signal prior to applying the threshold
- v. To trigger off the differentiation of the signal, select the green d/dt LED, which will light when active.
 - 1. This is useful when the T-wave is a higher amplitude than the R-wave
 - 2. This is also useful when triggering from an IBP waveform as it tends to trigger at the same location in the IBP waveform.

C. Saving Data

The PRiME software can save all acquired signals to a tab-delimited text file for later analysis and debugging. **This feature is intended for debugging purposes only.** The file includes all 6 ECG leads (both prior to adaptive filtering and post adaptive filtering), both IBP signals, and all 3 gradient control

signals. The file does not contain information on the adaptive filter (beta value, taps, or weights), timestamps, triggering information, or any patient information other than the physiological signals themselves.

a. How to save data

- i. Enter a valid filename, either by directly typing in the name or by selecting the “Browse” icon (folder icon) to the far right of the filename entry box.
 1. If entering a filename directly, the **directory structure MUST EXIST** or the program will crash. **New files will be created**, but new directories will not.
- ii. Click on the Record button to begin recording, and again to stop recording.
 1. The Record button will light to indicate recording is active.
 2. **Data will be appended to existing files**

D. Output to Hemodynamic Recording System

The PRiME system can be connected to the normal ECG and IBP transducer inputs of a hemodynamic recording system such as the Siemens SENSIS or GE MacLab. The ECG signals are not calibrated and values sent to the hemodynamic recording system are not guaranteed to be identical to the true signals. IBP signals can be calibrated to display accurately.

a. How to increase ECG amplitude on SENSIS/MacLab

- i. When the ECG is displaying on the SENSIS/MacLab system with a very low amplitude, it can be inconvenient to adjust the scaling directly on the SENSIS/MacLab
 1. **To increase the amplitude of all ECG channels**, increase the *ECG Output Scaling* parameter (located on the left side, center) on the PRiME Main Program.
 - a. This does not affect the IBP signals.
 - b. This will affect the scaling of the signals displayed in the PRiME Main program, and may require adjustment of the threshold as well.

b. How to calibrate the IBP signals

- i. A step-by-step calibration procedure will be added at a later time.
- ii. Once calibrated, it is important that proper scaling and offset numbers are entered into the PRiME calibration program. There are **TWO** sets of calibration numbers: one which ensures accurate display on the hemodynamic recording system, and a second set which ensures accurate display on the PRiME Main program. **For the standalone executable**, only the first set can currently be adjusted.
 1. Hemodynamic Recording System Display
 - a. Calibration numbers are located to the left of the IBP display
 - b. For NIH, as of 09/07/2016, the proper calibration numbers are:

	Scale	Offset
IBP1	0.7539	-1550
IBP2	0.76	-1550

2. PRiME Main Program Display
 - a. Labview Plot scaling factors must be entered through the plot properties. This cannot be done when using the standalone executable (at this time).

b. For NIH, as of 09/07/2016, the proper calibration numbers are:

	Labview Plot Multiplier	Labview Plot Offset
IBP1	0.0156	24
IBP2	0.0156	23

- iii. After the calibration numbers are adjusted and verified, right click on each entry field, select “Data Operations” from the context menu, then “Save Current Value as Default”. This will save the values

Troubleshooting Guide

This sections describes various problems, and their solutions, which may occur during setup and use of the PRiME system.

Invasive Blood Pressure (IBP) is not displayed on GE Maclab screen.

ECG data is properly displayed on the GE Maclab screen, but the IBP data is not displayed. Attempts to zero the transducers fail with no error message. This problem has not been observed on the Siemens Sensis system.

1. If the IBP is displayed on the main PRiME application screen but not the GE Maclab screen, this is a known issue with how PRiME interacts with the Maclab system. There is a workaround to restore the IBP display on the Maclab screen.
 - a. Stop the PRiME application software by hitting the stop button.
 - b. Turn off the gray National Instruments Box located atop the PRiME PC.
 - c. There is a black rocker switch on the right rear side of the box.
 - d. Flip the switch to turn off power, wait 10 seconds, then turn power back on
 - e. Restart the main PRiME application
 - f. The IBP should now properly display on the GE Maclab screen
2. If the IBP is not displayed on the main PRiME application screen, then there is most likely a cable problem between the IBP transducers and the PRiME-PSC box located in the X-Ray room near the foot of the X-Ray table with the other stack of equipment.
 - a. There are two custom IBP adapter cables that plug into the PRiME-PSC box. One side of the IBP adapter cable is a white connector which mates with the standard IBP transducer. The other side of the IBP adapter cable is a 9-pin connector (DB9) with black housing. Check that both sides of both IBP adapter cables are securely attached.
 - b. There are two additional cables coming out the side of the PRiME-PSC box. The larger cable has blue connector on both ends, the second cable is smaller with a beige connector. Both cables lead to the side of the stainless steel access box on the floor. Ensure both ends of both cables are securely attached.

ECG and IBP only display a repeating series of pulses

The ECG and IBP display a repeating series of 5 pulses, both on GE Maclab/Siemens Sensis system and on the main PRiME application. These pulses are generated by the PRiME system when there is no communication between the PRiME control room hardware (PRiME-CSaAF) and the PRiME-Acquisition hardware (black box located next to the patient bed).

1. Ensure that the PRiME-Acquisition hardware is turned on and has a charged battery.
2. Cycle power on PRiME-PSA
3. Ensure that both fiber optics cables are firmly inserted into the PRiME-Acquisition box
4. Ensure that both fiber optics cables are firmly inserted into the PRiME-CSaAF hardware located on the top of the PRiME PC.