# The MotionMonitor xGen Hardware Guide: Digital Delsys Trigno Legacy EMG Device Configuration

## Overview

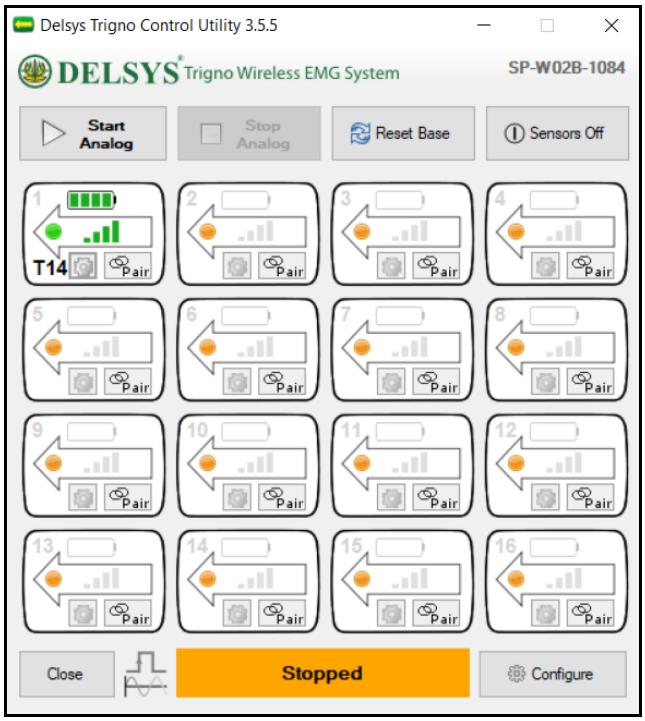
- This guide outlines the steps required to configure digital Delsys Trigno Legacy EMG systems in ***The MotionMonitor xGen*** software. This includes Delsys Trigno systems not configured to run through the Delsys Discover application.
- ***The MotionMonitor xGen*** communicates with the Trigno sensors through the Delsys Trigno Control Utility application.
- Supported sensors include Trigno Legacy and IM sensors, standard Trigno Avanti sensors, as well as Avanti Quattro, FSR, Goniometer, Mini and Duo sensors.
- This document is divided into 3 sections:
    1. Delsys Trigno Control Utility Settings.
    2. Configuring ***The MotionMonitor xGen*** to Connect to the digital Delsys Trigno Legacy EMG system.
    3. Configuring a synchronizing pulse for the digital Delsys Trigno Legacy EMG system in ***The MotionMonitor xGen***.
- Assumptions:
    - Delsys EMGWorks 4.8.0 or later has been installed on the computer running ***The MotionMonitor xGen***.
    - The Delsys Trigno Legacy EMG system is powered on and connected to the computer running ***The MotionMonitor xGen*** via USB.
    - The Delsys Trigno Legacy EMG system is recognized by the computer running ***The MotionMonitor xGen*** in device manager and the appropriate drivers have been installed.

**Section 1: Delsys Trigno Control Utility Settings.**

Preconditions:

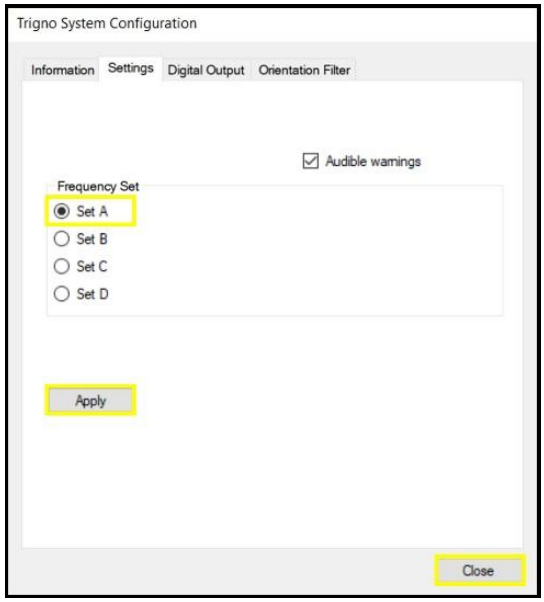
- The Delsys Trigno Legacy EMG system is recognized by the computer.

1. **Detecting Connected Sensors.**
   - Launch the **Delsys Trigno Control Utility** application.
   - Confirm that any undocked and powered on sensors are detected in the application.

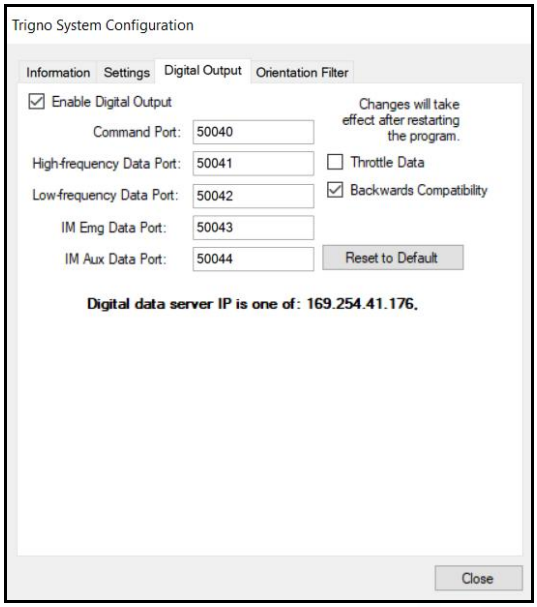



   - Pair sensors as necessary, following the pairing method for the sensor type. ***Note****: Sensors will stream to* ***The MotionMonitor xGen*** *based on the order they are paired in the Delsys Trigno Control Utility. Any unused or empty sensor positions will be ignored when streaming and the empty slot will be removed in the Channels or Trackers list received in* ***The MotionMonitor xGen****. For instance, if there is no sensor connected as sensor 2, the next sensor that is connected will stream to* ***The MotionMonitor xGen*** *as sensor 2. Any sensor types that contain multiple channels, for instance the Duo, Quattro and Goniometer sensors, will utilize multiple channels within the Delsys Trigno Control Utility that cannot be paired with another sensor.*
   - Anytime sensors have been paired within the Trigno Control Utility, the application must be restarted before any updates will take effect and data can be streamed to ***The MotionMonitor xGen***.
   - The Delsys Trigno Control Utility application can be minimized but must remain open. ***Note****: Do not click on the "Start Analog" button in this application.*

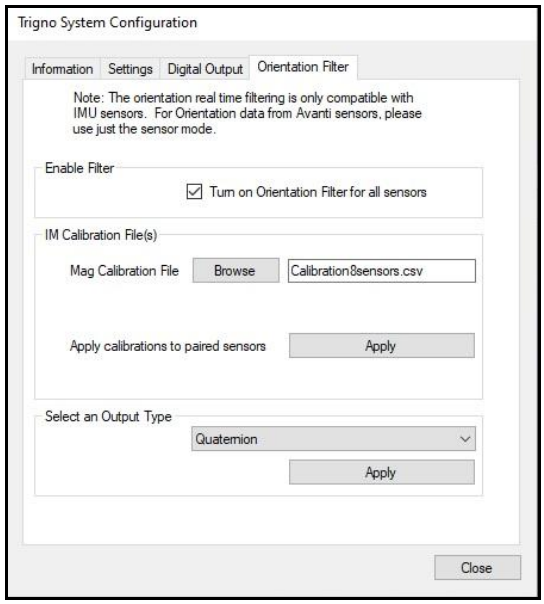
2. **Trigno System Configuration Settings**
    - These settings typically only need to be modified when first setting up a Delsys Trigno Legacy EMG system or when changing the configuration.
    - The **Settings** tab allows for changing the RF Frequency Set used by the Delsys Trigno Legacy EMG system. ***Note**: If the Frequency Set is changed, all sensors will need to be re-paired within the Delsys Trigno Control Utility.*




    - The **Digital Output** tab is used to control the digital integration settings used by **The MotionMonitor xGen**. The **Enable Digital Output** checkbox should be enabled, and the default port settings should be used. **Backwards Compatibility** should be enabled to ensure communication with legacy devices.



- The **Orientation Filter** tab is used for enabling orientation filters and specifying the calibration file for specific legacy IMU type sensors. ***Note**: The Enable Filter setting will be enabled/disabled by **The MotionMonitor xGen** application based on the type of sensors that are detected and whether Orientation-type Auxiliary data are specified in **The MotionMonitor xGen**. Legacy IMU sensors and newer Avanti sensors are not compatible and cannot be run together in the orientation mode. This checkbox should only be enabled when using legacy IMU type sensors.*



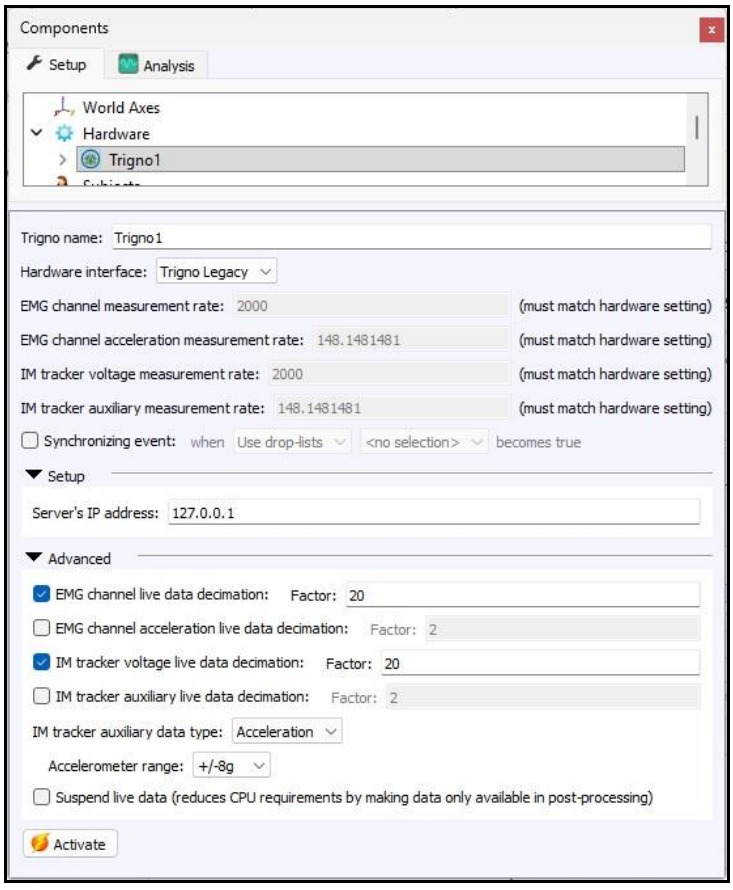

- The Trigno Control Utility application must be restarted for any updated settings to take effect and before data are streamed to ***The MotionMonitor xGen***.
- The Delsys Trigno Control Utility application can be minimized but must remain open. ***Note**: Do not click on the "Start Analog" button in this application.*

**Section 2: Configuring *The MotionMonitor xGen* to Connect to the digital Delsys Trigno Legacy EMG system.**

Preconditions:

- The Delsys Trigno Legacy EMG system sensors have been configured in the Delsys Trigno Control Utility application, and the Delsys Trigno Control Utility is running.

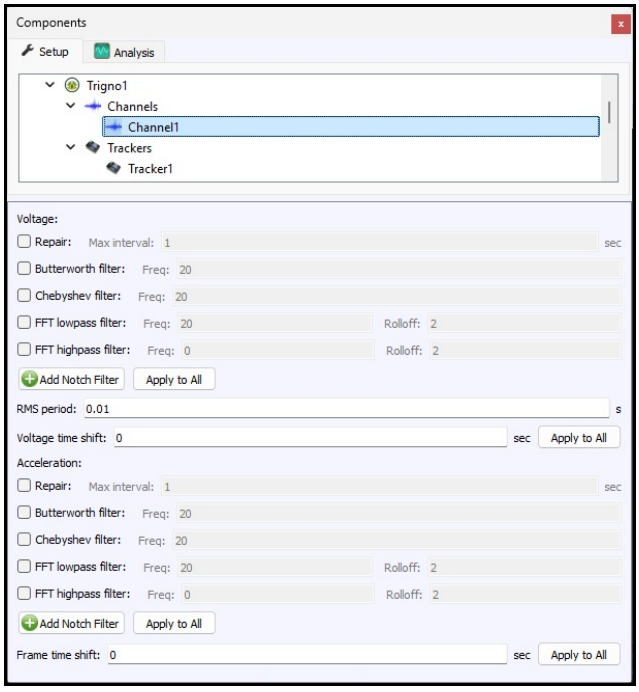
1. **Configure Trigno hardware.**
   - In ***The MotionMonitor xGen*****,** go to the **Components Window -> Setup tab -> Hardware**, and add or click on the **Trigno** hardware component.
   - Select **Trigno Legacy** from the Hardware interface drop-list.
   - Expand the Setup node to show the Server's IP address, which should be set to 127.0.0.1.
   - Measurement rates are hardcoded based on the data type.




   - Expand the Advanced node to show the drop-list selectors for the **IM tracker auxiliary data type**, Acceleration or Orientation, and the Accelerometer rage.
   - Click the **Activate** button to initialize communication with the Trigno device.

2. **Optional settings.**
    - Enable **Suspend Live data** to conserve computer resources.
    - Enable and specify the Live data decimation factors to conserve computer resources by limiting the measurement rate of data being used in the Live window for the various types of data available from the Trigno device. ***Note**: The full measurement rate will be captured when performing recordings.*
    - Enable a **Synchronizing event** for active synchronization with other data streams.

3. **Verify Device Activation and Apply Filters.**
    - After successfully activating the Trigno device, the sensors will populate under the Channels and Trackers nodes under the Trigno hardware device, depending on the sensor types.
    - Filter and RMS settings and time shifts can be enabled or disabled here, pre or post data collection.

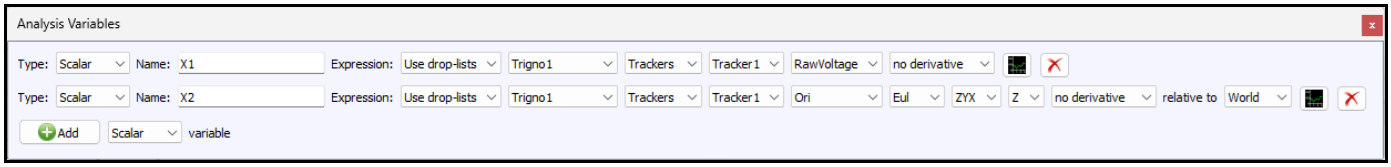


4. Once the device has been activated, data is available and can be displayed in graphs or used in formulas. Sample data definitions for Channel and Tracker sensor types are displayed below.

   The following image shows the Raw Voltage being defined for Channel 1.


   RMS Voltage, Raw Voltage and Voltage can be selected from the drop-list. RMS voltage calculates the RMS for the defined variable using the smoothing settings enabled for that Channel or Tracker under the Setup Components Hardware node. Raw Voltage will always return the raw voltage, regardless of any enabled smoothing parameters. Voltage will report the voltage including any smoothing, if enabled. Mean Frequency and Median Frequency for the voltage and Acceleration for the sensor can also be selected for most Channel sensor types.

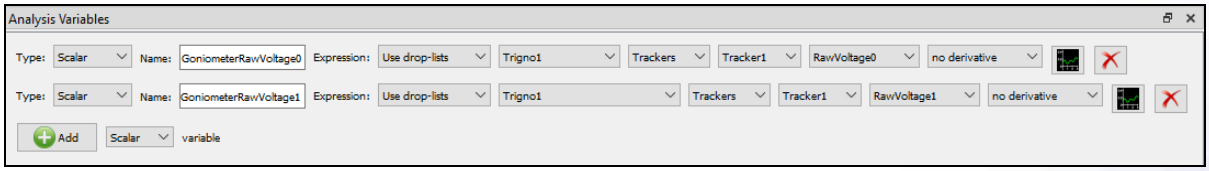
   The following image shows the Raw Voltage and an Euler rotation sequence relative to the World axes for Tracker 1.




   In addition to the data types available for Channel type sensors, Tracker type sensors have the option of Orientation or Acceleration data, depending on the IM tracker auxiliary data type selected in the parameters panel.

   Other supported Avanti type sensors, including the Duo, Quattro, Goniometer and FSR have multiple channels available in the drop-list to select from.

   The following image depicts data defined from the goniometer sensor which outputs 2 voltages corresponding to angle measurements in two orthogonal planes, Raw Voltage 0 and 1.




   Goniometer voltage data can be converted into angles using a formula where the voltage and a voltage-to-degrees ratio are multiplied together. This ratio needs to be determined experimentally. Alternatively, a Transducer hardware device can be

used to perform the conversion from volts to degrees using the same ratio described above. The Transducer hardware device can be advantageous because it also provides a means for calibrating the voltage to a "zero" reading. For more information on Transducers refer to the Knowledge based article found in https://themotionmonitor.com/support/.

5. Save your setup in a Workspace for easy reloading in the future:
    - Save the Workspace using the File|Save Workspace As menu item.
    - Load the Workspace later with File|Open Workspace menu item.

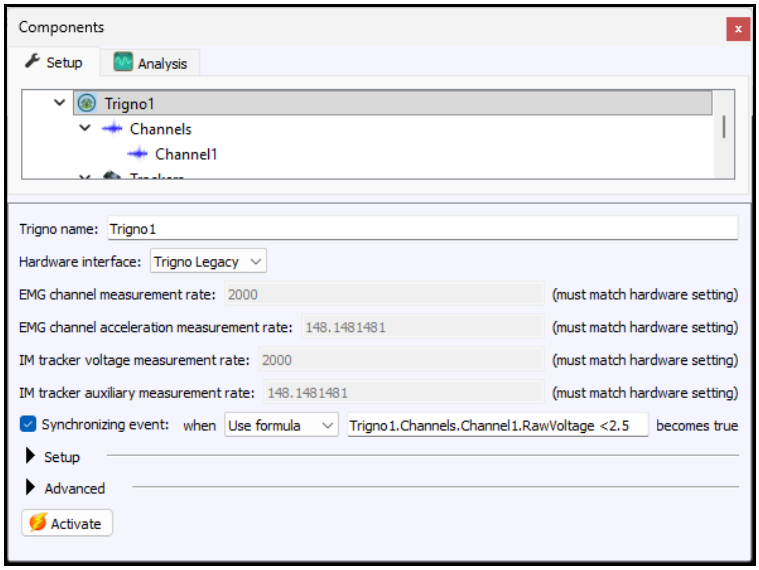
**Section 3: Configuring a synchronizing pulse for the digital Delsys Trigno Legacy EMG system in *The MotionMonitor xGen*.**

Preconditions:

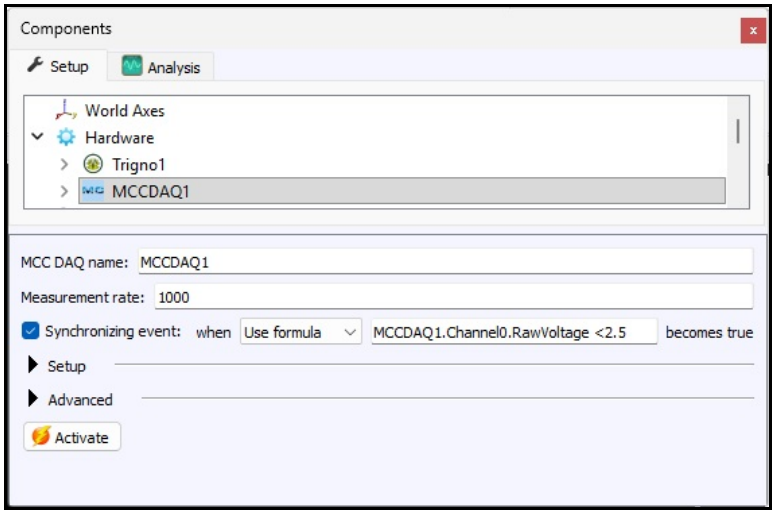
- The Delsys Trigno Legacy EMG system sensors have been configured in the Delsys Trigno Control Utility application, and the Delsys Trigno Control Utility is running.

1. **Ensure the Delsys sensor is properly connected to the event marker or signal generating the synchronizing pulse.**
   - For active synchronization, a common signal must be received by multiple hardware devices in ***The MotionMonitor xGen***. Commonly this is done by splitting the output signal form a handheld event marker with the signal being split between a Delsys Smart Sensor and another hardware's analog input signal. The image below shows a battery-operated Event Marker being used with a Trigno system. In the configuration below, one BNC cable is connected to the Delsys Smart Sensor and the other BNC cable will be connected to a BNC A/D board.

2. **Enable the synchronizing event.**
    - From the **Components Window -> Setup tab -> Hardware**, click on the **Trigno** hardware component.
    - Enable the Synchronizing event from the parameters panel.




    - Specify the Boolean condition for the synchronization pulse. For instance, if the synchronizing event is a signal that goes from 5 volts to 0 volts, the Boolean condition might be defined as Trigno1.Channels.Channel1.RawVoltage < 2.5.




    - Set a similar event for other hardware devices that are receiving the common synchronization signal.
    - ***Note:*** *The synchronizing event for each hardware must be defined using data from that hardware device.*