Computer Sports Medicine, Inc., (CSMi)

HUMAC2015®/EMG
APPLICATION PROGRAM
User's Guide

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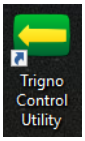
SECTION 1.INTRODUCTION

This document describes the HUMAC/EMG System. The HUMAC/EMG is compatible with the Delsys Trigno and Noraxon myMOTION Systems.

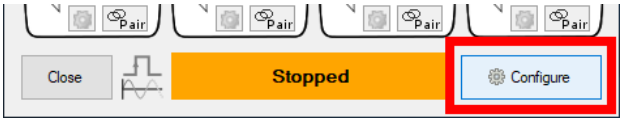
Starting the Delsys Application

The Delsys Trigno Control Utility must be started before the HUMAC System.

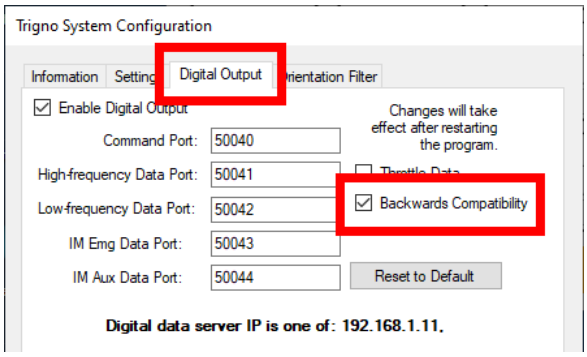
1. Start the Trigno Control Utility.



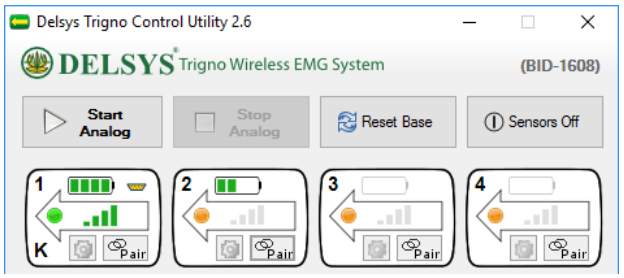
2. The first time you run the Trigno Control Utility you must configure Compatibility mode.
   a. At the bottom of the Trigno utility, click the **CONFIGURE** button.



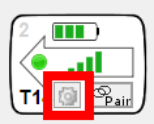
   b. From the **DIGITAL OUTPUT** tab, select **BACKWARDS COMPATIBILITY**.



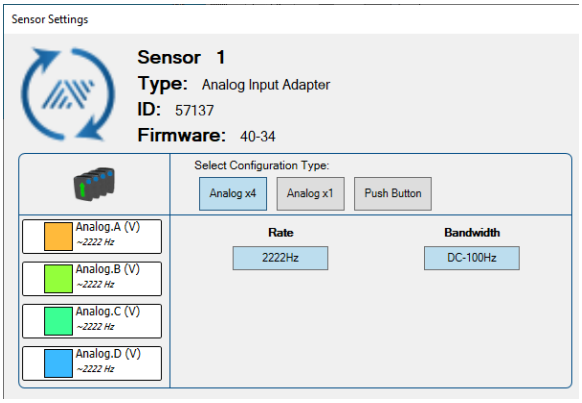
3. Pair the sensors with the Trigno Control Utility. ***IMPORTANT:*** *The Trigno Auxiliary Adapter (K-type ±5V Analog Adapter https://www.delsys.com/trigno-analog-adapter) must be paired as sensor number 1.*



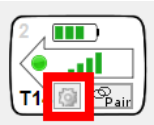
4. Complete the pairing of all sensors.
5. If you are using the new Avanti sensors, you must configure the sensor the first time it is paired with the Trigno utility.
    a. Analog Sensor (Channel 1).
        i. From the **SENSOR** icon, click the **GEAR** (configure) button.



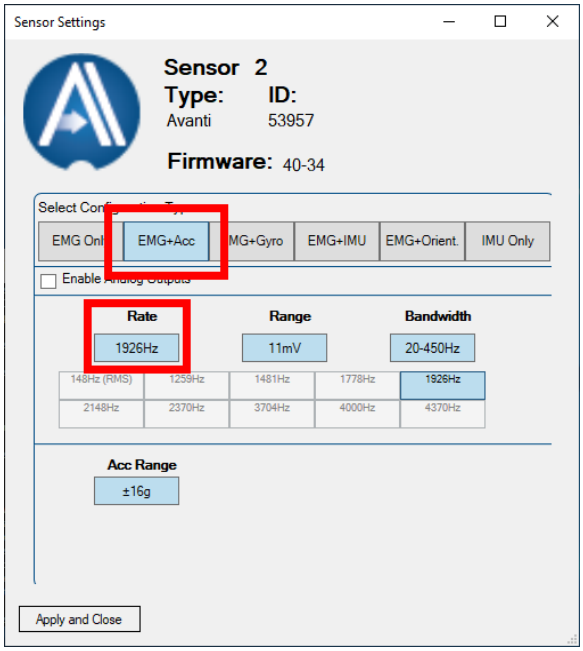
        ii. Confirm the following settings from the **SENSOR SETTINGS** form.



        iii. Set the **CONFIGURATION** to **EMG+ACC**
        iv. Set the **RATE** to **1926HZ**.
        v. Click the **APPLY AND CLOSE** button.
    b. EMG Sensors (Channel 2+).
        i. From the **SENSOR** icon, click the **GEAR** (configure) button.



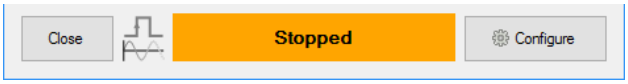
        ii. Set the **CONFIGURATION** to **EMG+ACC**
        iii. Set the **RATE** to **1926HZ**.



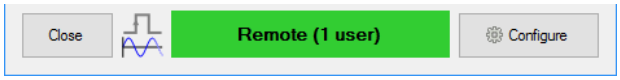
iv. Click the **APPLY AND CLOSE** button.

c. ***IMPORTANT:*** *The next time you use the Trigno system, simply start the Start the Trigno Control Utility and press the button (original design) or use the magnet (Avianti design) to re-pair the sensors. The Trigno utility will remember the previous settings. If you click the PAIR button on the Trigno Control Utility, you will need to set the configuration again.*

6. The HUMAC connects to the Trigno system during active data collection. When you first start the HUMAC program, the Trigno utility will show *"Stopped"*.



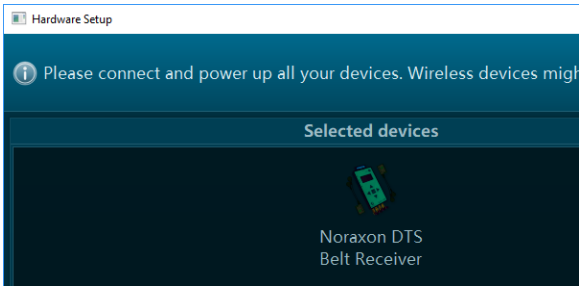
7. During the during active data collection the Trigno will show *"Remote (1 user)"*.



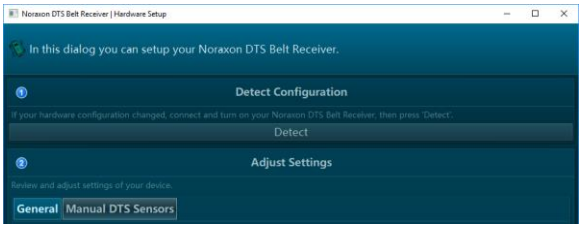
Starting the Noraxon Application

The Noraxon Connection Utility will automatically start when the HUMAC Program is stared.

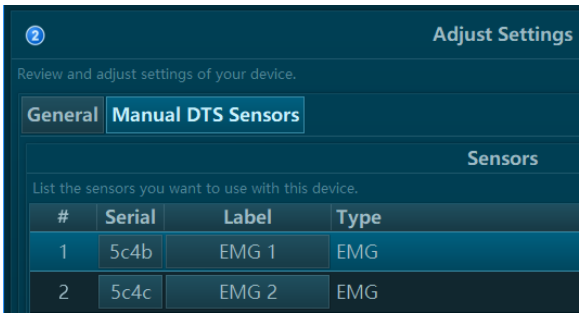
1. The HUMAC program will launch the Noraxon MR setup program.
2. Select your Noraxon hardware, e.g. NORAXON DTS BELT RECEIVER.



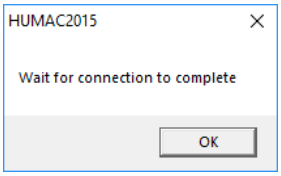
3. Click the **CONFIGURE** button.
4. From the Hardware Setup form, in the ❶Detect Configuration area click the **DETECT** button.



5. The system should report the connection is successful. Click the **OK** button to continue.
6. In the ❷ Adjust Settings area click the **MANUAL DTS SENSORS** button and enter your sensor Serial Numbers. ***Note:*** *The HUMAC Torque channel should be Sensor #1 and the Position Channel should be Sensor #2. The EMG sensors should start at #3.*



7. Click the **OK** button to save your changes.
8. From the HUMAC Wait for connection form, click the **OK** button to continue.



SECTION 2.SELECTING THE EMG SYSTEM

To select the EMG system you will be using:

1. From the FILE menu, select **PREFERENCES**.
2. In the **EMG** area, **SYSTEM** picklist, select your EMG System.

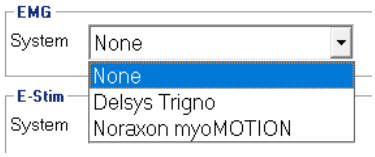


Figure 1 EMG System Selection

Note: *You must select and EMG System to edit EMG protocols. The EMG System does not need to be connected to the HUMAC to edit protocols. The EMG System must only be connected to collect EMG data.*

SECTION 3.SETTING THE AUXILIARY OUTPUTS

The Auxiliary Outputs should be set for the Delsys system.

1. From the **UTILITIES** menu, select **AUXILIARY OUTPUTS**.
2. Set the values as in Figure 2.
3. Click the OK button to save your changes.

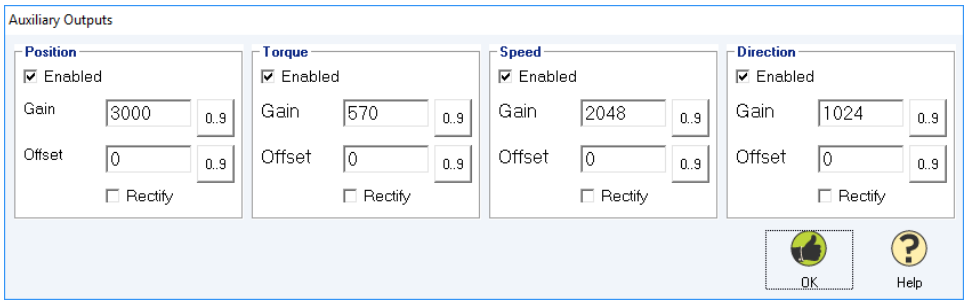


Figure 2 Delsys Auxiliary Output Settings

SECTION 4.PROTOCOLS

Testing & Exercise

When running a test or exercise session, the **PROTOCOL** form now includes an **EMG** option.

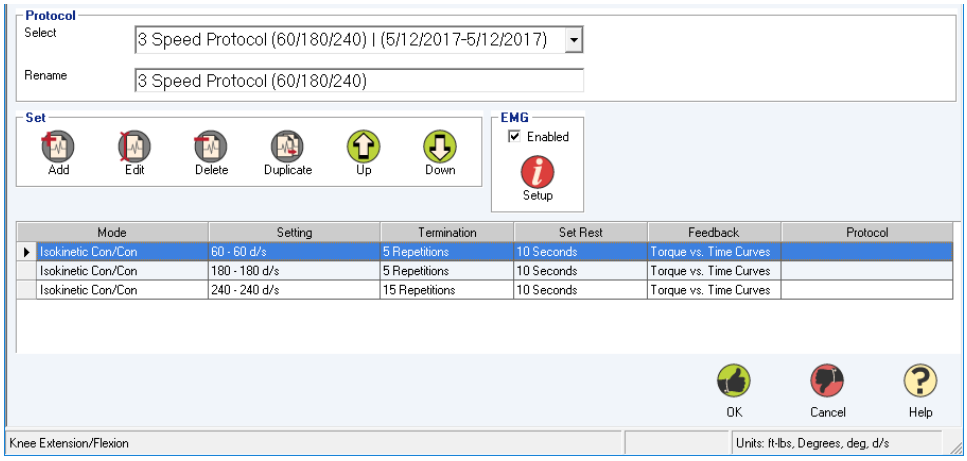


Figure 3 HUMAC Test Protocol With EMG Option

Note: *The EMG area will be disabled if no EMG System is selected from the* ***FILE, PREFERENCES*** *form.*

- To include EMG data collection during a test, check the **EMG**, **ENABLED** checkbox.
- To edit the EMG protocol (sensor locations, displays) click the **SETUP** button. The HUMAC displays the EMG Editor form.

SECTION 5.EMG SYSTEM PROTOCOLS

The EMG System protocol editor allows you to define EMG settings which can be re-used across patients. In this example we'll define a *"Quadriceps"* **CONFIGURATION** with the following settings:

- Sample data from EMG Channel 1, EMG Channel 2, the NORM TORQUE and NORM POSITION channels.
- Display the EMG Channel 1 raw data, EMG Channel 1 RMS value, EMG Channel 2 raw data, NORM TORQUE data and NORM Position Data.

Note: *You can also define EMG protocols from within the HUMAC System Protocol editor. (**UTILITIES PROTOCOLS**). EMG protocols defined inside the system protocol editor are tied to that specific system protocol.*

1. From the **UTILITIES** menu, select **EMG PROTOCOLS**.
2. The HUMAC will display the EMG System Protocol Editor.

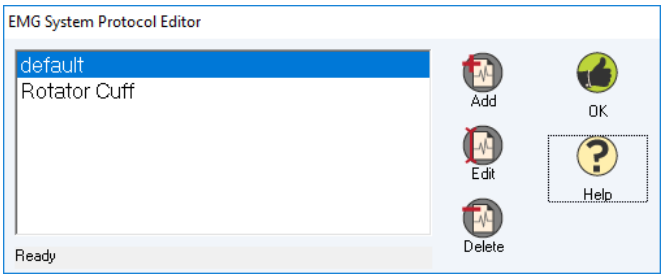


Figure 4 EMG System Protocol Editor

3. Click the **ADD** button.
4. The HUMAC duplicates the default EMG settings and displays the EMG Protocol Editor.

Defining the Configuration

The **CONFIGURATION** is the set of EMG hardware **CHANNELS** you will be sampling and real-time HUMAC **DISPLAYS** you want. **CONFIGURATIONS** are similar to extremity protocols which can be saved and re-used across patients.

1. In the **CONFIGURATONS**, **NAME** field, enter "*Quadriceps".* The new name will be displayed in the list when you leave the field.

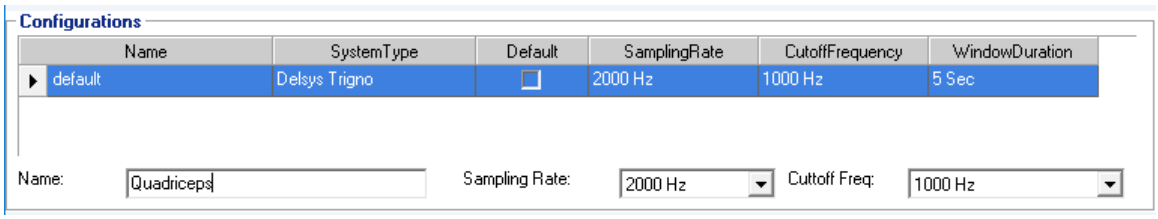


Figure 5 EMG Configurations

ITEM	DESCRIPTION
NAME	The configuration name, e.g. *"Quadriceps"*.
SAMPLING RATE*	The hardware-based sampling rate.
CUTOFF FREQ*	The hardware-based cutoff frequency applied to all data channels.

Note: *The HUMAC EMG software is designed to support different EMG Systems. Not all EMG Systems include all hardware-based features listed below, e.g.* ***VARIABLE SAMPLING****,* ***FILTERING****, and* ***GAIN****.*

Defining the Channels

The CHANNELS are the list of data channels supported by your EMG hardware.

In this example, we'll place EMG2 on the Rectus Femoris and EMG3 on the Vastus Medialis. ***Note:*** *EMG1 on the Delsys is used for the NORM Torque, Position, Velocity and Direction signals.*

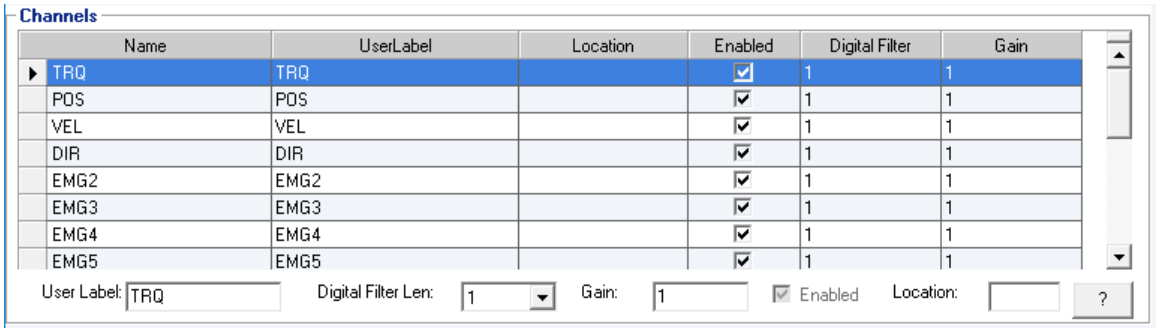


Figure 6 EMG Channels - Default

1. In the **CHANNELS** area, select the **EMG2** row.
2. Enter "Rectus Femoris" in the **USER LABEL** field.
3. Click the **LOCATION ?** button to display a map of the sensor locations.

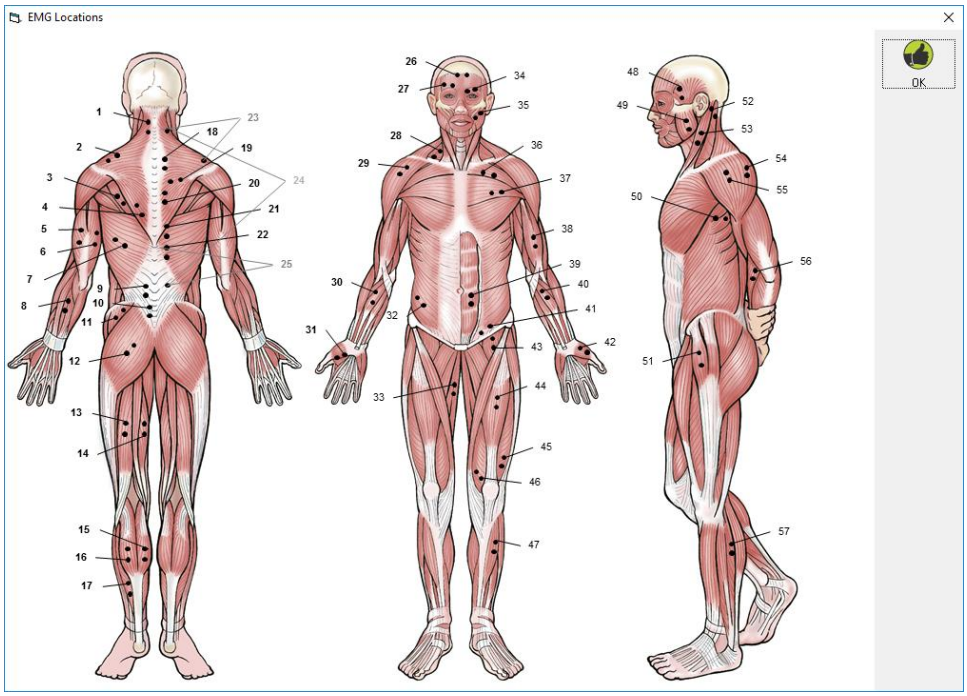


Figure 7 EMG Sensor Locations

4. We see the Rectus Femoris is location 44 on the sensor map. Click the **OK** button to close the form.
5. Enter 44 in the **LOCATION** field.
6. Continue the above process to define EMG3 as *"Vastus Medialis"*.
7. The channel display should look as follows.

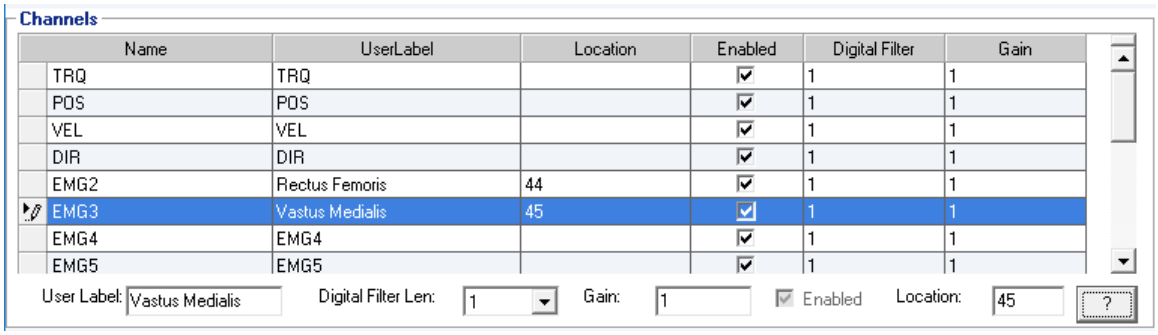


Figure 8 EMG Channels - Defined

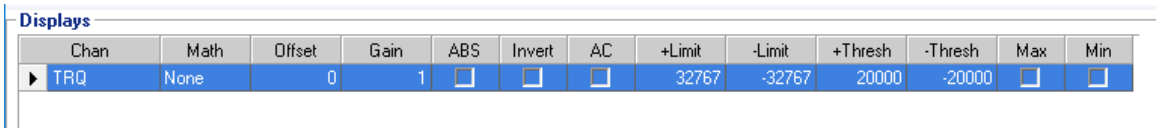
ITEM	DESCRIPTION
NAME	The Channel Name. This is defined by CSMi for your EMG system.
USER LABEL	A custom name you can apply to the CHANNEL.
LOCATION	The EMG Sensor Location. When entering locations, click the ? button to display a muscle map with numbered locations.
ENABLED	The Channel is enabled for data collection. ***Note:*** *Channels cannot be disabled with the Delsys system.*

ITEM	DESCRIPTION
DIGITAL FITLER LENGTH	The EMG hardware-based digital filter length.
GAIN	The EMG hardware-based input gain.

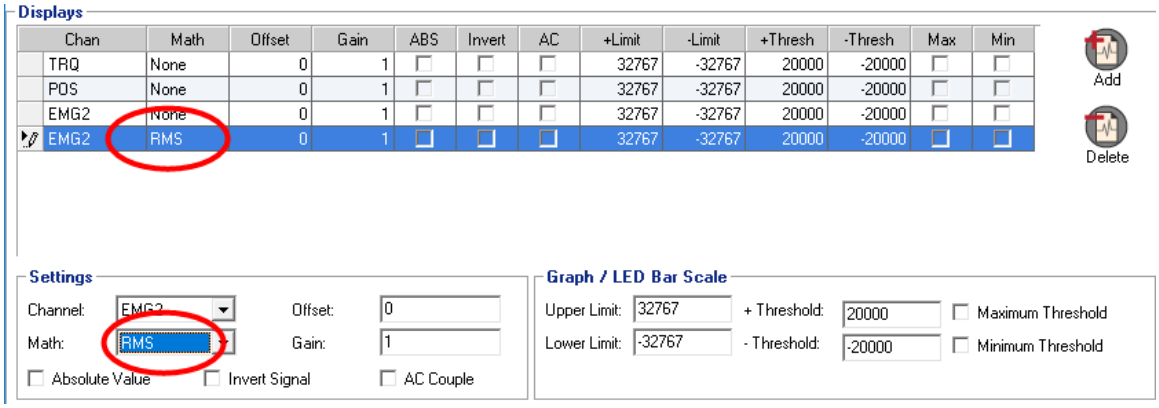
Defining the Displays

Display the EMG Channel 1 raw data, EMG Channel 1 RMS value, EMG Channel 2 raw data, NORM TORQUE data and NORM Position Data.

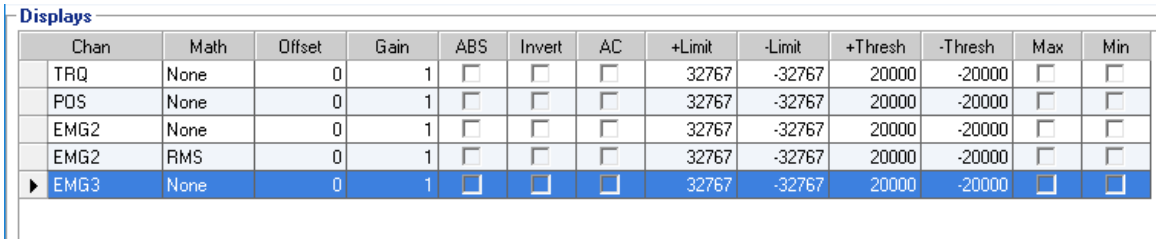
1. In the **CHANNELS** area, select the **TRQ** row.
2. In the Displays area, click the ADD button.
3. The HUMAC will add the **TRQ** channel to the list of **DISPLAYS**.



4. Repeat the above adding the **POS** and **EMG2** channels.
5. Now we're going to add an **RMS** display of the EMG2 channel.
6. In the **CHANNELS** area, select the **EMG2** row and click the **ADD** button.



7. In the **DISPLAYS** area, select the **EMG2** row. In the **SETTINGS** area set the **MATH** to **RMS**.
8. In the **CHANNELS** area, select the **EMG3** row and click the **ADD** button. The DISPLAYS area should look like the following.



Note:

- *You can modify the **DISPLAYS** by selecting the row and updating the values in the **SETTINGS** and **GRAPH / LED BAR SCALE** areas.*
- *When running a test, the HUMAC store the raw data for each selected **CHANNEL**. The selected **DISPLAYS** have no effect on the stored data. A channel does not have to be displayed to have the data stored.*

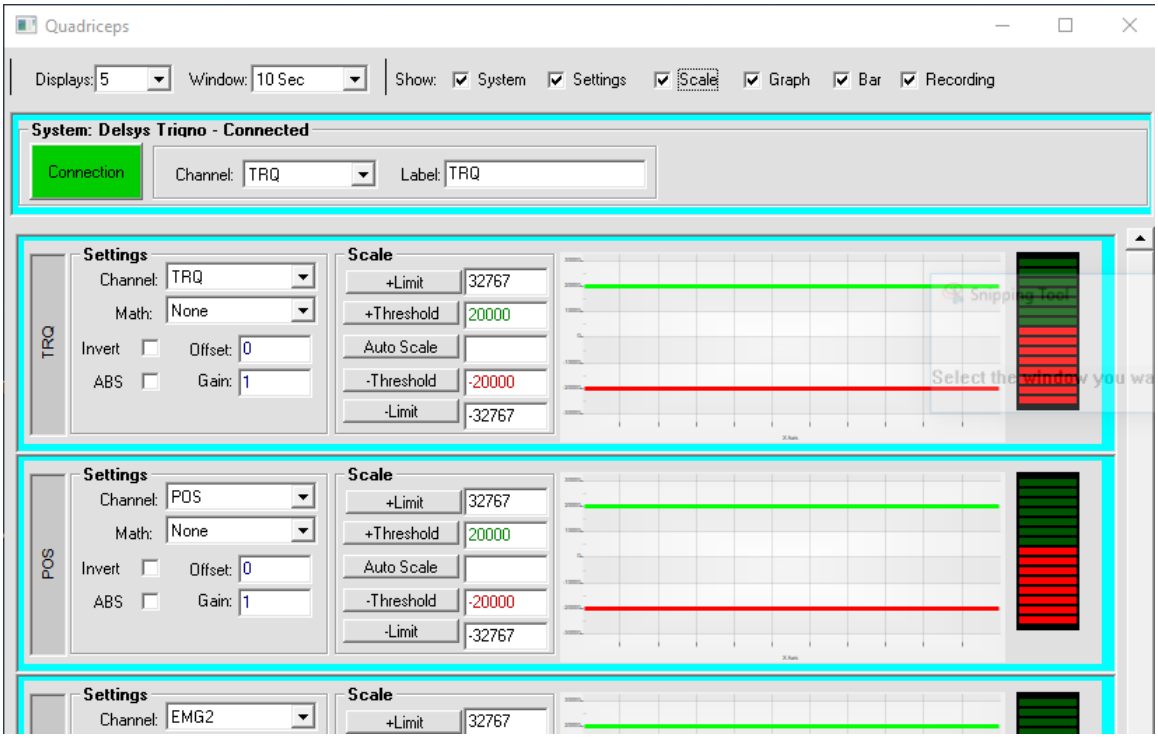
ITEM	DESCRIPTION
CHANNEL	The EMG hardware channel number.
MATH	Math functions we want applied to the data, e.g. RMS, FIR filter.
OFFSET	Software-based offset (numeric value) applied to the displayed data.
GAIN	Software-based gain multiplier applied to the displayed data.
ABSOLUTE VALUE	Display the absolute value of the signal.
INVERT SIGNAL	Invert the displayed signal.
AC COUPLE	Apply an AC Coupling (7Hz high-pass) filter to the signal.
UPPER	Maximum Y-Axis value plot value.
+THRESHOLD	Upper Y-Axis marker displayed as a horizontal line on the plot.
-THRESHOLD	Lower Y-Axis marker displayed as a horizontal line on the plot.
LOWER	Minimum Y-Axis value plot value.
MAXIMUM THRESHOLD	When checked the +TREHSOLD will automatically track the maximum peak data value.
MINIMUM THRESHOLD	When checked the -TREHSOLD will automatically track the minimum peak data value.

SECTION 6.REAL-TIME DISPLAY

1. The HUMAC utilizes a separate real-time display window which can be resized and moved independent of the HUMAC program.

Main Controls

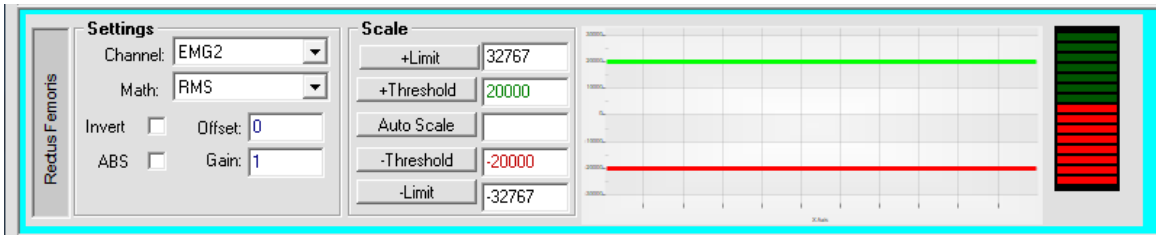
At the top of the Real-Time display are the main controls.



ITEM	DESCRIPTION
DISPLAYS	The number of real-time displays shown. The HUMAC defaults to the number defined in your CONFIGURATION.
WINDOW	The number of seconds of real-time data in each plot window.
SYSTEM	Display/hide the SYSTEM area.
SETTINGS	Display/hide the SETTINGS area.
GRAPH	Display/hide the real-time plots.
BAR	Display/hide the real-time bars.
RECORDING	Display/hide the RECORDING area (at the bottom of the form).
SCALE	Display/hide the SCALE area.

Real-Time Plots

The HUMAC creates a separate real-time plot window for each **DISPLAY**.



ITEM	DESCRIPTION
USER LABEL	The USER LABEL defined in the CHANNELS display *"Rectus Femoris"*. This is listed vertically along the left side of the display.
SETTINGS	The hardware channel, math, offset and gain functions defined in the **SETTINGS** area of the **DISPLAY** form.
SCALE	The plot scale values defined in the **GRAPH/LED BAR SCALE** area of the **DISPLAYS** form.
+LIMIT	When +LIMIT is displayed the maximum y-axis value is set to the displayed value (32767). There are three was to change this value: 1. Manually enter a new value in the data area. 2. Click the +LIMIT button to set the value in the data area to the maximum of the displayed data. 3. Click the AUTOSCALE button to set the +LIMIT and – LIMIT to the maximum of the displayed data +25%.
+THRESHOLD / MAXIMUM	Upper Y-Axis marker displayed as a horizontal line on the plot. There are two was to change this value: 1. Manually enter a new value in the data area. 2. Click the +THRESHOLD button to change it to MAXIMUM. In this mode, the THRESHOLD tracks the MAXIMUM as a "lazy hand".
AUTOSCALE	Click the AUTOSCALE button to set the +LIMIT and – LIMIT to the maximum of the displayed data +25%.
-THRESHOLD / MINIMUM	Lower y-axis marker displayed as a horizontal line on the plot. There are two was to change this value: 1. Manually enter a new value in the data area. 2. Click the -THRESHOLD button to change it to MINIMUM. In this mode, the THRESHOLD tracks the MINIMUM as a "lazy hand".
-LIMIT	When -LIMIT is displayed the maximum y-axis value is set to the displayed value (-32767). There are three was to change this value: 1. Manually enter a new value in the data area. 2. Click the -LIMIT button to set the value in the data area to the minimum of the displayed data. Click the AUTOSCALE button to set the +LIMIT and – LIMIT to the maximum of the displayed data +25%.

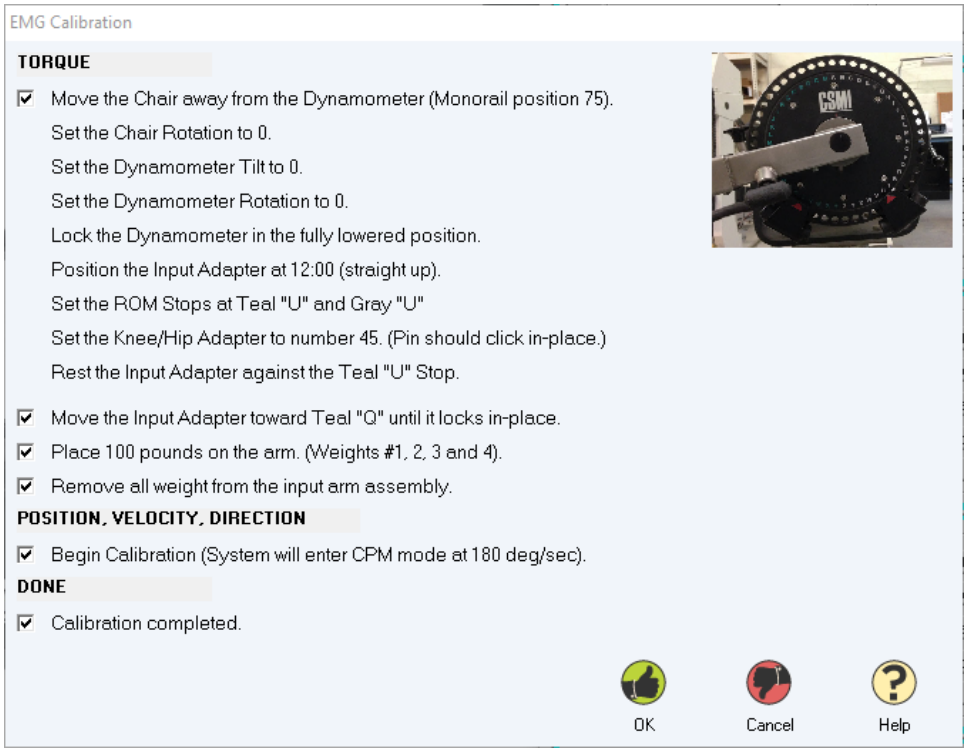
Note: *When changes are made from this screen, the HUMAC will ask if you want to update your* ***CONFIGURATION*** *with the new values.*

SECTION 7.CALIBRATION

Calibrating the EMG System allows the Delsys to report data in Foot-Pounds, Degrees and Degrees/Second. To calibrate the EMG System:

1. From the **EMG** menu, select **CALIBRATION**.

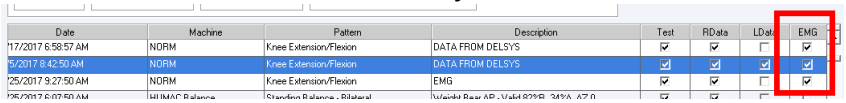
IMPORTANT: *Before begging the POSITION, VELOCITY, DIRECTION calibration, the HUMAC will instruction you to remove all the weights. This is important as these calibrations are performed with the input adapter in CPM mode at 180 deg/sec.*



SECTION 8.REPORTS

The HUMAC/EMG System includes a custom report. To generate an EMG report:

1. Click the **PATIENT** button and select a patient.
2. Click the **REPORT** button to open the reporting page.
3. Select the test. ***Note:*** *The EMG column indicates if EMG data was collected with the test.*



4. From the **REPORT TYPE**, select **ISOKINETIC EMG REPORT**.

5. Click the **PRINT** or the **PREVIEW** button.

Plotted Data

The HUMAC plots the Torque vs. Time and RMS EMG vs. Time.

Measured Parameters

PARAMETER	DEFINITION
Peak Torque	Peak Torque value.
Peak EMG	Peak of the EMG RMS value.
Integrated EMG	Area under the EMR RMS plot.

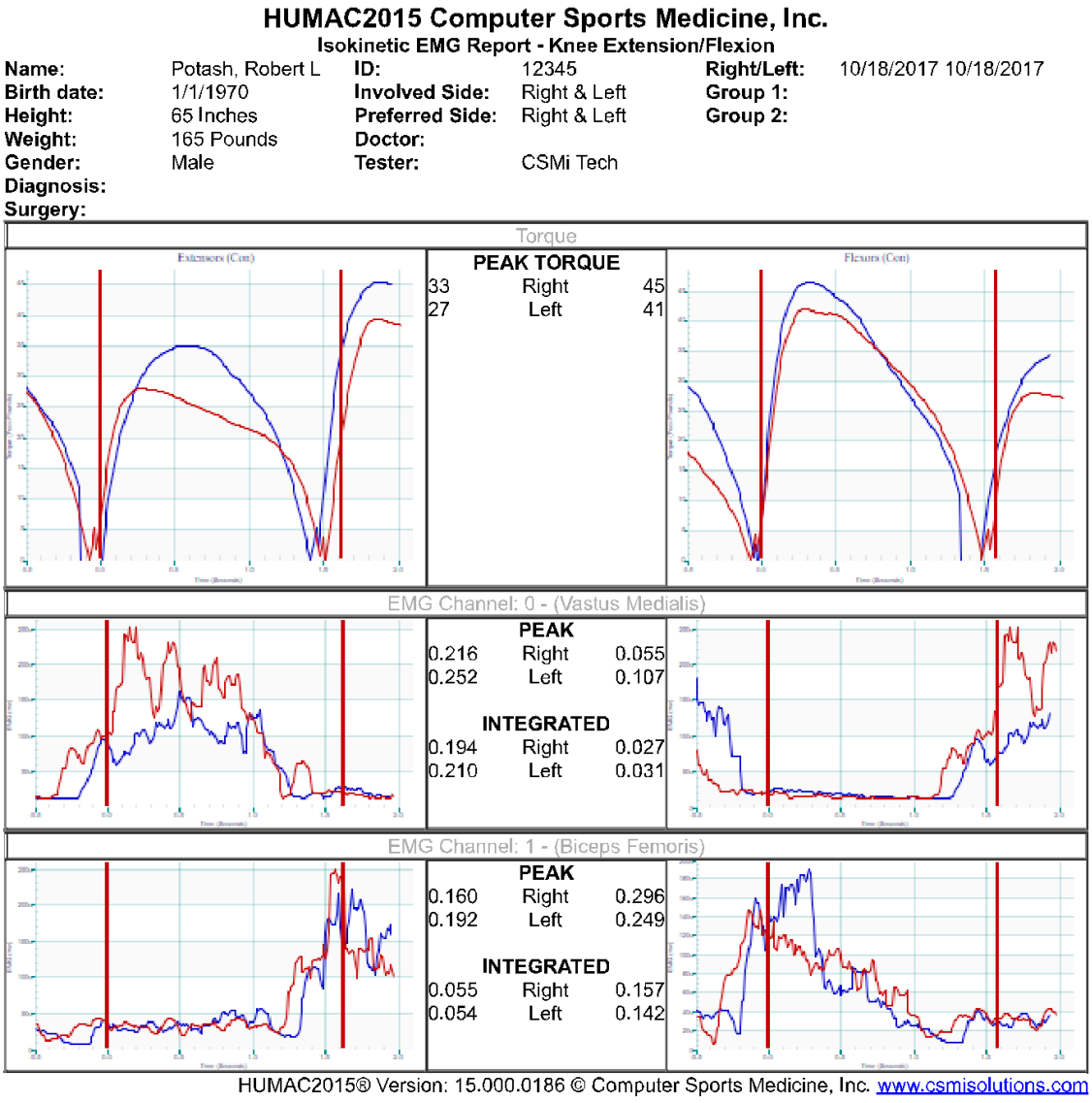
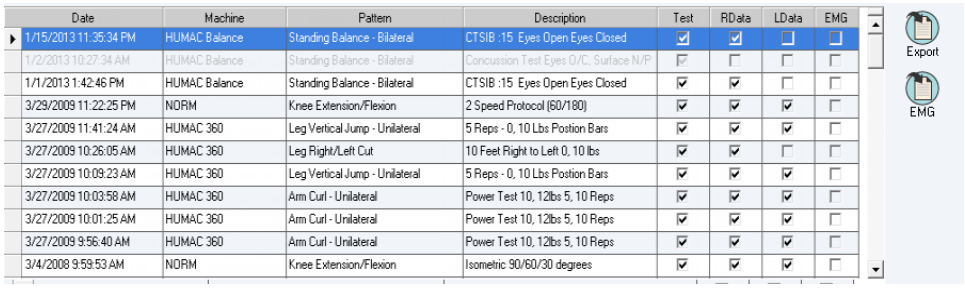


Figure 9 EMG Isokinetic Test Report

SECTION 9.EXPORTING EMG DATA

The real-time data can be exported to a CSV file.

1. From the **DATABASE** menu, select **EXPORT**.
2. Select the row with the data you want to export and click the **EXPORT** button. ***Note:*** *The EMG column indicates if EMG data is included with the test.*



Date	Machine	Pattern	Description	Test	RData	LData	EMG
1/15/2013 11:35:34 PM	HUMAC Balance	Standing Balance - Bilateral	CTSIB :15 Eyes Open Eyes Closed	☑	☑	☐	☐
1/2/2013 10:27:34 AM	HUMAC Balance	Standing Balance - Bilateral	Concussion Test Eyes O/C, Surface N/P	☑	☐	☐	☐
1/1/2013 1:42:46 PM	HUMAC Balance	Standing Balance - Bilateral	CTSIB :15 Eyes Open Eyes Closed	☑	☑	☐	☐
3/29/2009 11:22:25 PM	NORM	Knee Extension/Flexion	2 Speed Protocol (60/180)	☑	☑	☑	☐
3/27/2009 11:41:24 AM	HUMAC 360	Leg Vertical Jump - Unilateral	5 Reps - 0, 10 Lbs Postion Bars	☑	☑	☑	☐
3/27/2009 10:26:05 AM	HUMAC 360	Leg Right/Left Cut	10 Feet Right to Left 0, 10 lbs	☑	☑	☐	☐
3/27/2009 10:09:23 AM	HUMAC 360	Leg Vertical Jump - Unilateral	5 Reps - 0, 10 Lbs Postion Bars	☑	☑	☑	☐
3/27/2009 10:03:58 AM	HUMAC 360	Arm Curl - Unilateral	Power Test 10, 12lbs 5, 10 Reps	☑	☑	☑	☐
3/27/2009 10:01:25 AM	HUMAC 360	Arm Curl - Unilateral	Power Test 10, 12lbs 5, 10 Reps	☑	☑	☑	☐
3/27/2009 9:56:40 AM	HUMAC 360	Arm Curl - Unilateral	Power Test 10, 12lbs 5, 10 Reps	☑	☑	☑	☐
3/4/2008 9:59:53 AM	NORM	Knee Extension/Flexion	Isometric 90/60/30 degrees	☑	☑	☑	☐

Export

EMG

[FILENAME]	C:\Users\Public\Documents\CSMi\HUMAC2015\EXPORT\Sample.csv							
[TEST DATE]	5/12/2017							
[TEST TIME]	1:56:02 PM							
[CONFIGURATION NAME]	EMG Label Test - 1							
[EMG APPLICATION INFO]	HUMAC EMG							
[EMG APPLICATION Version]	V01.00.02							
[EMG TYPE]	Delsys Trigno							
[EMG FIRMWARE VERSION]								
[EMG SAMPLING RATE]	0 Hz							
[EMG CUTOFF FREQUENCY]	1100 Hz							
[WSTACK TYPE]	N/A							
[WSTACK FIRMWARE VERSION]								
[CHANNEL LABELS]	TRQ	POS	Rectus Femoris	Vastus Medialis	EMG4	EMG5	EMG6	EMG7
[CHANNEL LOCATIONS]								
[CHANNEL GAINS]	1	1	1	1	1	1	1	1
[CHANNEL DFILTER LENGTHS]	1	1	1	1	1	1	1	1
[RECORD HEADER]	Record #	TimeStamp	TRQ	POS	EMG2	EMG3	EMG4	EMG5
[RECORD]	1	0.001	-1070	16243	31706	31604	0	0
[RECORD]	2	0.002	882	16243	31712	31742	0	0
[RECORD]	3	0.003	882	15992	31709	31742	0	0