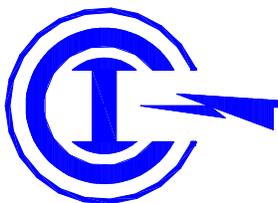


Serial Number: _____
(Please refer to this number for service)

Treadmill Stimulus Detection Instruction Manual

05/06/2021

Copyright Columbus Instruments 2021



Columbus Instruments

950 North Hague Avenue
Columbus, Ohio 43204-2121 U.S.A.
E-mail: sales@colinst.com

Phone: (614) 276-0861
Fax: (614) 276-0529
<http://www.colinst.com>

Table of Contents

Treadmill Stimulus Detection Instruction Manual

Section	Page
Table of Contents	1
1. Introduction	3
1.0 System Overview	3
1.1 System Specifications	4
1.1.0 Stimulus Detection	4
1.2 Calculation of Data	5
1.2.0 Number of Stimuli (NOS)	5
1.2.1 Number of Visits (NOV)	5
1.2.2 Number of Complete Exhaustions (NOC)	5
1.2.3 Number of Measured Exhaustions (NOM)	5
1.2.4 Time-Score Percentage (TSP)	5
1.2.5 Visit-Score of Visits (VSV)	6
1.2.6 Distance (DST)	6
2. Hardware Setup	7
2.0 Typical Item Inventory	7
2.1 Adding the Treadmill Stimulus Detection to the Treadmill Controller	8
2.2 Connecting the Exer 3/6 Treadmill	9
2.3 Connecting the Modular Treadmill	10
3. Stand-Alone Experiment without the PC	11
3.0 Mode	11
3.1 Session No	11
3.2 NOACHs	12
3.3 Yoked Stim.	12
3.4 Max_NOV	12
3.5 Max_NOS	12
3.6 Max_NOC	12
3.7 Max_NOM	13
3.8 TS_Percent	13
3.9 VS_Visits	13
3.10 Rep_Rate	13
3.11 Begin Experiment	14
3.12 Experiment: Data View	15
3.13 Experiment: Setup View	15
4. Performing a PC-Controlled Experiment	17
4.0 Treadmill Stimulus Detection Setup	17
5. User Menu	19
5.0 Serial Number	20
5.1 Run-time Meter	20
5.2 Baud Rate	20
5.3 Unit ID	21
5.4 Exit	21

(intentionally left blank)

SECTION 1

INTRODUCTION

1.0 System Overview

The Columbus Instruments Treadmill Stimulus Detection is designed to work with the electrical or air-puff stimulus employed in our Exer 3/6 and Modular Treadmills. It will monitor the stimuli presented to each channel (lane) and then calculate various data outputs from them. Combined with the Treadmill Controller's output odometer signal, the actual distance traveled for each subject can be calculated.

For humane treatment, the presentation of stimuli can be stopped when a certain number of stimuli have been delivered or when a certain number of visits to the detection grids have been met. They are recorded as number of stimuli (NOS) and number of visits (NOV) respectively.

Likewise, there are four other data types for automatic detection of exhaustion which can also stop the presentation of stimuli. They are recorded as the number of complete exhaustions (NOC), the number of measured exhaustions (NOM), the time-score percentage (TSP) and the visit-score of visits (VSV). The temporal resolution of distance traveled and the exhaustion data are directly related to the host Treadmill Controller's stimulus repetition rate (REP RATE: 1, 2 or 3Hz).

A new feature, Yoked Stimulus, allows the stimuli delivered to an odd-numbered channel to be reproduced on the next even-numbered channel. This ensures that quarantined control subjects receive the same stimuli as the test subjects within an experiment session. The Exer 3/6 Treadmill in "Rat" mode can support only two channels yoked: 1 & 2. The "Mouse" mode can support all six channels: 1 & 2, 3 & 4 and 5 & 6. The Modular Treadmill can support up to eight channels yoked. The four odd channels: 1, 3, 5, & 7 would connect to the motor assembly. The four even channels: 2, 4, 6 & 8, as they do not have to run, can sit separate from the motor assembly by themselves.

When the treadmill system is controlled by the Treadmill Software, another data output: "Time on the Belt" (TOB) can be calculated. During an experiment, all of the data reported by all components of the system, are logged at user-defined intervals to an output *.CSV file. This common file-type can then be imported into various spreadsheet tabulation programs such as Excel.

1.1 System Specifications

1.1.0 Treadmill Stimulus Detection

Power Requirement:	6 watts, 115 or 230VAC, 50/60Hz (factory selected).
Power Fuses:	2A Slow-Blow.
Physical Dimensions:	36.8 x 30.5 x 10.9cm (14.5" x 12.0" x 4.3").
Physical Weight:	2.8 kilograms (6.1 pounds).
User Controls:	3 x Push-Button Rotary Encoders.
CI-Bus Connections:	8p8c (RJ45 Ethernet) Modular Jack (x2).
Source Stimulus:	15-pin Female D-SUB "From Controller" port.
Output Stimulus:	25-pin Female D-SUB "To Treadmill" port.

1.2 Calculation of Data

The Treadmill Controller provides a signal (REP RATE) which gates or controls the presentation of the stimulus at the treadmill. Circuitry, connected to the detection grids of each lane, determines if the subject is present and has been given the stimulus. These stimulus signals are monitored by the Treadmill Stimulus Detection. Up to 180 seconds (3 minutes) of the signals for all channels are recorded for evaluation and detection of exhaustion events.

The Treadmill Controller also provides an odometer signal which indicates the distance traveled by the treadmill belt. By combining this signal with the presence detection of the stimulus grids, the distance traveled by each subject can be determined.

During an experiment, when any of the following data parameters are set to zero (0), they simply report their output and will NOT stop the presentation of stimuli.

1.2.0 Number of Stimuli (NOS)

This is an accumulative count of stimuli given to the subject.

1.2.1 Number of Visits (NOV)

This is an accumulative count of visits to the detection grids when stimuli has been given . A visit is scored when an absence during the presentation of the stimulus is followed by any number of consecutive given stimuli. This data type will not be tabulated for the even numbered channels when the stimulus is yoked.

1.2.2 Number of Complete Exhaustions (NOC)

A complete exhaustion event is observed when the subject rests on the detection grids and receives stimulus without attempting to reengage the treadmill. Therefore, a complete exhaustion can be detected by any visit in duration equal to or greater than the specified period (in seconds). The complete exhaustion visit duration is long, typically five (5) seconds, and the maximum count is one (1). This data type will not be tabulated for the even numbered channels when the stimulus is yoked.

1.2.3 Number of Measured Exhaustions (NOM)

A measured exhaustion event is observed when the subject repeatedly rests on the detection grids and receives stimulus for an short duration of time, but attempts to reengage the treadmill. Therefore, a measured exhaustion can be detected by any visit in duration equal to or greater than the specified period (in seconds). This duration is shorter than the complete exhaustion period, typically two (2) seconds, and the maximum count is more than two (2), typically three (3). This data type will not be tabulated for the even numbered channels when the stimulus is yoked.

1.2.4 Time-Score Percent (TSP)

Exhaustion can also be detected by the percentage of time the subject receives stimuli over any given rolling period of time (in seconds). The specified period is converted into the number of stimulus records needed for evaluation which is directly proportional to the Treadmill Controller's stimulus REP RATE. For example, 10 seconds becomes 10 records at 1Hz, 20 records at 2Hz and 30 records at 3Hz. Then the total number of stimuli recorded is divided by the number of records and multiplied by 100. This data type will not be tabulated for the even numbered channels when the stimulus is yoked.

1.2.5 Visit-Score of Visits (VSV)

Exhaustion can also be detected by the number of visits over any given rolling period of time (in seconds). The specified period is converted into the number of stimulus records needed for evaluation which is directly proportional to the Treadmill Controller's stimulus REP RATE (1, 2 or 3Hz). The total number of visits are counted within the number of records and reported. This data type will not be tabulated for the even numbered channels when the stimulus is yoked.

1.2.6 Distance (DST)

A quantized-accumulation of the distance traveled by the treadmill belt is collected while the stimulus is not present. The accumulated distance will be added to each channel's total distance if the stimulus was not given (the subject is presumably running on the belt). If the stimulus was delivered, then the subject is resting on the detection grids and not running. The size of the quantized-accumulation of distance is inversely proportional to the Treadmill Controller's REP RATE and directly proportional to the SPEED.

SECTION 2 HARDWARE SETUP

2.0 Typical Item Inventory

A typical Treadmill Stimulus Detection system may contain the following items:



- The Treadmill Stimulus Detection with AC power cord.
- 1 x CAT5 network cable, 0.3 (1-foot), 8p8c (RJ-45).
- 1 or more D-SUB detection cables, 1.8m (6-foot), 25-pin 25-conductor male-male.
- 1 x Instruction Manual.

Note: It is recommended to use an AC power strip to provide a common access to AC power for all components of the Treadmill system and the host computer. Most AC power strips incorporate a master switch that can switch ON and OFF the AC power to the entire system and protect against electrostatic discharge. It also provides a beneficial common ground between all components to help prevent unintentional ground loops which may exist between the individual AC power outlets within the same room.

2.1 Adding the Treadmill Stimulus Detection to the Treadmill Controller

1. Switch OFF the Treadmill Controller and remove all of the 15-pin male-to-male shock cables from the treadmill system.
2. Then place the Treadmill Stimulus Detection on top. Be sure to center the cabinet's feet over the top of the locating pins.
3. Using one (1) of the 15-pin male-male shock cables, connect the "Shocker" port of the Treadmill Controller to the "From Controller" port of the Treadmill Stimulus Detection.



(other cables removed for clarity)

4. Remove the CI-Bus terminator from the Treadmill Controller.
5. Use the short 0.3m (1-foot) CAT-5 network cable and connect the adjacent "CI-Bus" ports of the Treadmill Stimulus Detection and Treadmill Controller together.
6. Then plug the CI-Bus terminator into the top port of the Treadmill Stimulus Detection.



(other cables removed for clarity)

7. Connect the Treadmill Stimulus Detection to the same source of AC power as the Treadmill Controller.

2.2 Connecting the Exer 3/6 Treadmill

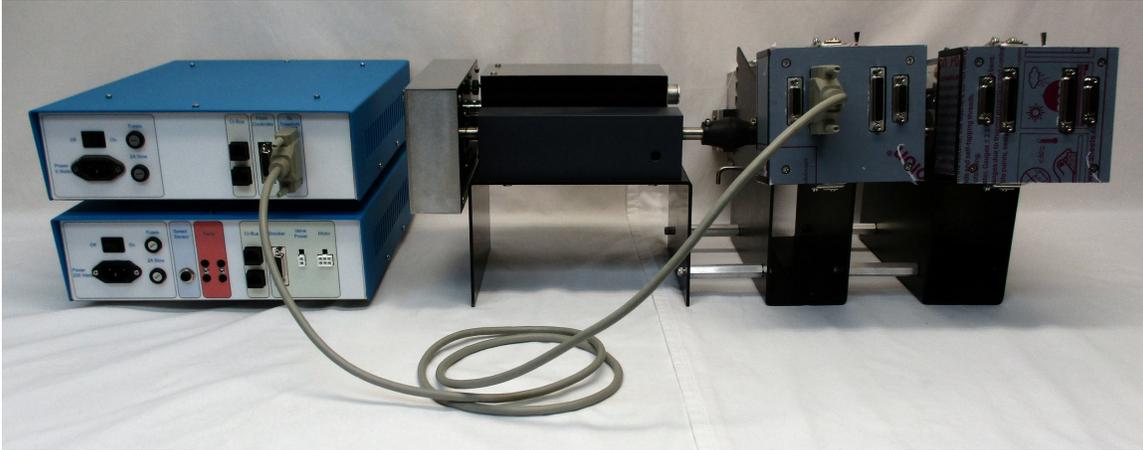
1. Using a 25-pin male-male detection cable, connect the “To Treadmill” port of the Treadmill Stimulus Detection to the 25-pin male D-SUB port on the back side of the treadmill.



(other cables removed for clarity)

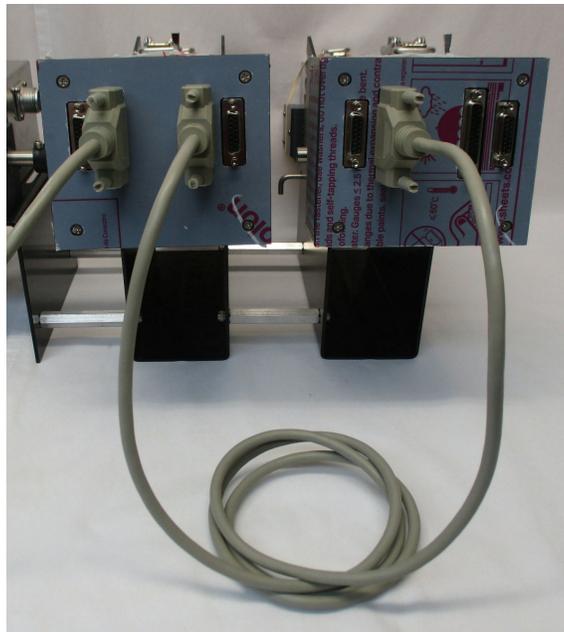
2.2 Connecting the Modular Treadmill

1. Using a 25-pin male-male detection cable, connect the “Detection” port of the Treadmill Stimulus Detection to the 25-pin male D-SUB port on the back of the treadmill lane most close to the motor assembly. Physically, this lane will be channel #1.



(other cables removed for clarity)

2. Using additional 25-pin male-male detection cables, connect the free 25-pin male D-SUB port from channel #1 to the next lane, using the port most close to lane #1. Physically, this will be channel #2. Repeat this procedure for additional lanes up to a total of four (up to eight if they are yoked).



(other cables removed for clarity)

Warning! The stimulus detection ports on the Modular Treadmill are keyed and not interchangeable. The input port is on the left and the daisy-chain output port (for the next lane) is on the right.

SECTION 3

STAND-ALONE EXPERIMENT WITHOUT THE PC

The Treadmill Stimulus Detection should have its experiment parameters setup first. Then the animals should be loaded into the Treadmill and the stimulus intensity and repetition rate set. Next the experiment is started on the Treadmill Stimulus Detection. Finally, the treadmill belt is set into motion.

The list of experiment parameters are as follows:

- Mode
 - Session Number
 - Number of Active Channels
 - Yoked Stimulus
 - Number of Visits
 - Number of Stimuli
 - Number of Complete Exhaustions
 - Number of Measured Exhaustions
 - Time-Score Percent
 - Vist-Score of Visits
 - Repetition Rate
 - Begin Experiment

- The “CHANNEL” knob is used to navigate the list of parameters. Clockwise rotations will move you up the list toward the top. Counter-clockwise rotations will move you down the list toward the bottom to begin an experiment.
- Press the **RESET** button to select a parameter to edit (an underline cursor will appear to indicate you are editing) and to save any changes (the cursor will disappear to indicate you are back to viewing).
- Use the “UP/DOWN” knob to adjust the parameter while editing.

3.0 Mode

Mode: Manual
 PC

The first option at the top of the list. “**Manual**” should be selected (indicated by a solid dot).

3.1 Session No

Session No: 1

This option is not necessary, but kept for backwards compatibility with previous models which directly connected to a printer for outputting the results of an experiment. If desired, the parameter can be set over the range of 0 to 99.

3.2 NOACHs

NOACHs:	6
---------	---

Number Of Active CHannels: This should equal the number of subjects to be run in the experiment session. Typically, this will be up to three (3) rats or six(6) mice with an Exer 3/6 Treadmill or up to four (4) on a Modular Treadmill system, eight (8) if yoked. The range is from 1 to 8.

3.3 Yoked Stim.

Yoked Stim.:	N
--------------	---

This is used to yoke the stimulus presentation of an odd numbered channel to the next even. Channel 2 is yoked to channel 1, channel 4 is yoked to channel 3, etc.. In a study, individual test and control subjects may be paired together. Through the use of yoked lane dividers and walls, the control subjects are quarantined to sit on the grids of the even channels and will not run. Then their paired test subject is allowed to run normally, unrestricted on the odd channels. When the test subject receives stimulus, the quarantined control subject will also receive the same stimulus. The choice is No or Yes.

3.4 Max_NOV

Max_NOV:	10
----------	----

Maximum Number of Visits: For humane reasons, the presentation of the stimulus can be stopped when a set number of visits to the grids have been met. The range is from 0 to 999. When set to zero (0), the presentation will not stop and the total number of visits will be recorded.

3.5 Max_NOS

Max_NOS:	10
----------	----

Maximum Number of Stimuli: For humane reasons, the presentation of the stimulus can be stopped when the subject has received a set number of stimuli. The range is from 0 to 999. When set to zero (0), the presentation will not stop and the total number of stimuli received will be recorded.

3.6 Max_NOC

Max_NOC:	1
Period:	5s

Maximum Number of Complete Exhaustions: The presentation of stimulus can be stopped when any visit to the detection grids is greater than or equal to the specified period in seconds. The period can range from 1 to 180 seconds, five (5) typical. As the subject can reach complete exhaustion only once, the number range is either zero (0) or one (1). When set to zero (0), the presentation of stimulus will not stop and the count of visits greater than or equal to the set period will be recorded.

3.7 Max_NOM

Max_NOM:	3
Period:	2s

Maximum Number of Measured Exhaustions: The presentation of stimulus can be stopped when the set number of visits to the detection grids with a duration greater than or equal to the specified period in seconds has been met. The period can range from 1 to 180 seconds, two (2) typical. The number range is from 0 to 99, three (3) typical. When set to zero (0), the presentation of stimulus will not stop and the count of visits greater than or equal to the set period will be recorded.

3.8 TS_Percent

TS_Percent:	50%
Period:	20s

Time-Score Percent: The presentation of stimulus can be stopped when exhaustion has been detected by measuring the percentage of time the subject receives stimulus over a specified rolling period in seconds. The period can range from 1 to 180 seconds. The percentage range is from 0 to 99%, 50% typical. When set to zero (0), the presentation of stimulus will not stop and the current time-score percentage will be recorded.

3.9 VS_Visits

VS_Visits:	10
Period:	20s

Visit-Score of Visits: The presentation of stimulus can be stopped when exhaustion has been detected by measuring the number of visits to the detection grids over a specified rolling period in seconds. The period can range from 1 to 180 seconds. The number range is from 0 to 99. Practically, the number of visits is limited by the equation: $VS_Visits \leq Period * Rep_Rate / 2$. However, no checks or corrections are made if the equation is not true. When set to zero (0) or if the noted equation is not true, the presentation of stimulus will not stop and the current number of visits within the specified period will be recorded.

3.10 Rep_Rate

Rep_Rate:	1Hz
-----------	-----

This parameter is non-editable. It is used to inspect and verify the REP RATE of the Treadmill Controller which is automatically detected and displayed in real time: [0, 1, 2, 3] Hz. If zero (0), check the cable connections of the system. The “REP RATE” indicator on the Treadmill Controller and any enabled treadmill lanes should flash in unison.

3.11 Begin Experiment

Press <Enter> to
begin experiment

Once all the previous parameters have been set, now is the time to load the subjects into the treadmill lanes. Refer to the Treadmill Controller manual for a sample loading and stimulus initialization procedure.

- Press the **RESET** button on the Treadmill Stimulus Detection to begin monitoring the stimulus on all enabled channels.
- Press the **ODOMETER RESET** button on the Treadmill Controller to initialize the odometer to zero or load the duration values.
- Then press the **MODE** button accordingly to set the treadmill belt in motion.

Warning! Do NOT change the REP RATE setting of the Treadmill Controller once an experiment has started, the exhaustion data types will not tabulate correctly.

3.12 Experiment: Data View

CH1:ON	NOV:	0
Dist:		0.0m

Once the experiment has started, the screen will display the Data View. The currently selected channel to display is in the upper left corner. The channel will be “**ON**” if the stimulus is enabled or “**OFF**” if it has been stopped. The upper right corner will display the various data types and their current value. If the label of the data type appears in all upper-case letters (ex. “**NOV**”) then that data type has the ability to automatically stop the presentation of stimulus. If it appears in all lower-case letters (ex. “**nov**”) then it cannot. The bottom line reports the total distance traveled by the subject of that channel.

CH1:ON	vsv:	3
Dist:		13.4m

CH2:OFF	*NOC:	1
Dist:		56.2m

The “CHANNEL” knob is used to select one of the active channels and to view it’s data on the screen.

The “UP/DOWN” knob is used to select one of the data types to view. When the stimulus has been automatically stopped, an asteriks (*) will appear next to the label of the data type which triggered it. When stopped, the current values of all data types for that channel will be frozen for later review.

If you would like to manually stop the presentation of stimulus for the currently selected channel, then press the **ENTER** button. The channel will toggle from “**ON**” to “**OFF**” and all of the data types will be frozen at their current values for review. You may resume the presentation of stimulus by pressing the **ENTER** button again. A channel that has been automatically (*) stopped cannot be resumed.

3.13 Experiment: Setup View

Session No:	1
NOACHs:	6

Pressing the **FUNCTION** button will toggle the screen between Data View and Setup View. This screen allows reviewing of the experiment parameters while an experimet is running. Use the “CHANNEL” knob to review all of the experimet settings. Press the **FUNCTION** button to return to “Data View”.

When the current experiment has finished, use the console controls to copy the important data from the screen. Then press the **RESET** button to discard all results and return to the top of the list of experiment parameters.

(intentionally left blank)

SECTION 4

PERFORMING A PC-CONTROLLED EXPERIMENT

Use of the Treadmill Software allows an additional data output to be calculated: Time on the Belt (TOB). Of course, all data from the treadmill system are collected and logged into the experiment data file.

4.0 Treadmill Stimulus Detection Setup

No specific setup is needed for a PC-controlled experiment. The software will automatically take control of the Treadmill Stimulus Detection and direct it to display the appropriate screens and information when necessary.

However, for backward compatibility with previous models, you can use the following procedure to manually select PC mode:

1. If the Treadmill Stimulus Detection is in an experiment “Data View” or “Setup View” screen, press the **RESET** button to terminate the experiment and return to the top of the list of experiment parameters. Else, simply use the “CHANNEL” knob and navigate to the “Mode” parameter at the top of the list.

Mode: Manual
 PC

2. Press the **RESET** button to edit the option and turn the “UP/DOWN” knob to select “PC” (indicated by a solid dot).

Mode: Manual
 PC

4. Press the **RESET** button to accept. The screen will display:

Waiting...

The Treadmill Stimulus Detection will wait for software instructions and the console controls no longer have effect. However, you can press the **RESET** button to cancel computer control, revive the console controls and return to the top of the list of experiment parameters.

Refer to the “**Treadmill Controller and Treadmill Software Instruction Manual**” for the procedures for running a PC-controlled experiment.

(intentionally left blank)

SECTION 5 USER MENU

When required, the User Menu can be accessed to retrieve and set device specific parameters. Computer control is blocked and experiments cannot be run while accessing the User Menu. Use the following procedure to access the user menu:

1. If the Treadmill Stimulus Detection is in an experiment “Data View” or “Setup View” screen, press the **RESET** button to terminate the experiment and return to the top of the list of experiment parameters. Else, simply use the “CHANNEL” knob and navigate to the “Mode” parameter at the top of the list.
2. Press and hold the **FUNCTION** button.
3. Press and hold the **ENTER** button.
4. Then press and release the **RESET** button.
5. Release the **FUNCTION** and **ENTER** buttons.

Mode: <input checked="" type="radio"/> Manual <input type="radio"/> PC

The screen will display:

User Menu

And then position you at the top of the list of options on the menu:

- Serial Number
 - Run-Time Meter
 - Baud Rate
 - Unit ID
 - Exit
-
- The “CHANNEL” knob is used to navigate the options on the User Menu. Clockwise rotations will move you up the list toward the top. Counter-clockwise rotations will move you down the list toward the bottom to exit the menu.
 - Press the **RESET** button to select an option to edit (an underline cursor will appear to indicate you are editing) and to save any changes (the cursor will disappear to indicate you are back to viewing).
 - Use the “UP/DOWN” knob to adjust the settings/values while editing.

5.0 Serial Number

```
Serial Number:  
123456-230
```

This is read-only. It is an electronic copy of the information written on the external Columbus Instruments serial tag. This information will help with service if the serial tag is absent.

5.1 Run-Time Meter

```
Run-time Meter:  
DHM: 2:04:17
```

This is read-only. It is the running total of time the device has been switched “On”. The time is reported in days:hours:minutes (DHM).

5.2 Baud Rate

```
Baud Rate:  
19200
```

This is used to set the CI-Bus communication speed. The baud rate can be changed through the course of an experiment through computer control. If the unit fails to respond to computer queries, this option can be used to view and change the communication baud rate as necessary.

The list of baud rates are as follows:

- 19200 (typical)
- 38400
- 57600
- 115200
- 128000
- 230400
- 1M
- 2M

5.3 Unit ID

Unit ID:
230

This is used to set the CI-Bus address of the Treadmill Stimulus Detection. The Unit ID should be unique and not match the address of another device which is connected to the same CI-Bus Hub. The Unit ID can range from 1 to 254 (230 typical).

Notes about Device Addressing

A Treadmill Controller, Treadmill Stimulus Detection and the Incline Controller can all be used together as a group to control the faculties of one treadmill system. The Treadmill Software supports up to four (4) groups. The Unit ID of the devices in each group must adhere to the following specification:

System Group	Treadmill Controller	Stimulus Detection	Incline Controller
1	220	230	235
2	221	231	236
3	222	232	237
4	223	233	238

5.4 Exit

Exit

This option is used to exit the menu and return back to typical operation.