



G-*F*orce

User Manual

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Section 1: Preliminary Information

Thank you for your LMI G-Force purchase. Inside the box, you will find the G-Force, a type-C USB cable, a pre-paired USB Blue Tooth Low Energy (BLE) Dongle, and wall charging unit.

1.1 Warranty Information

This unit is warranted in the USA by LMI against materials and workmanship defects for 1 year from date of original purchase. If you transfer ownership, the warranty is automatically transferred to the new owner and remains in effect for the original 1 year period. Product that proves defective will be repaired or replaced (at our discretion) at no charge during the warranty period, provided it is returned, shipping prepaid, to LMI.

This warranty does not apply in case of accidental damage, misuse or as a result of service or modification by users other than LMI, or by hardware, software, interfacing, or peripherals not provided by LMI.

Please retain this document for your records. No other express warranty is provided. The repair or replacement of a product is your exclusive solution. Any implied warranty of merchantability or fitness is limited to the 1 year duration of this written warranty. Some States do not allow the exclusion or limitations of incidental or consequential damages, so the above exclusion or limitations may not apply to you.

1.2 LMI Customer Service



LMI Customer Service can be reached at **(810) 714-5811** Monday through Friday between 8:00 a.m. and 5:00 p.m. Eastern Time.

Call LMI Customer Service to:

- ◆ Place orders
- ◆ Request a RMA
- ◆ Inquire about the status of an order or repair

1.3 Returns for Service

- ◆ Please contact Customer Service to obtain a Return Material Authorization (RMA) number. Include a detailed description of the problem.
- ◆ Pack the equipment properly. Use the original shipping container, if possible. LMI cannot assume responsibility for damage caused by improper packaging.
- ◆ Send the equipment to the following address:

LMI Corporation
Attn: Repair Department
101 N. Alloy Drive
Fenton, MI 48430

1.4 Technical Support and Training

LMI Technical Support experts are only a phone call away. Contact Technical Support at **810-714-5811** Monday through Friday between 8:00 a.m. and 5:00 p.m. Eastern Standard Time for the following reasons:

- ◆ To assist in setup and configuring LMI equipment
- ◆ To help implement data collection applications
- ◆ To troubleshoot LMI equipment

You can also reach LMI Technical Support By Email at techsupport@lmicorporation.com. You can email your questions anytime. Please include your name, phone number, and a *detailed description* of the problem.

LMI On-Site Training

LMI Technical Support provides on-site training for all LMI products. Contact LMI Support Services at **810-714-5811** for pricing & scheduling information.

Schedule a day at your facility or at LMI in Fenton, Michigan. Please visit us on the web at www.lmicorporation.com for more information.

Section 2: G-Force Operation and Functions

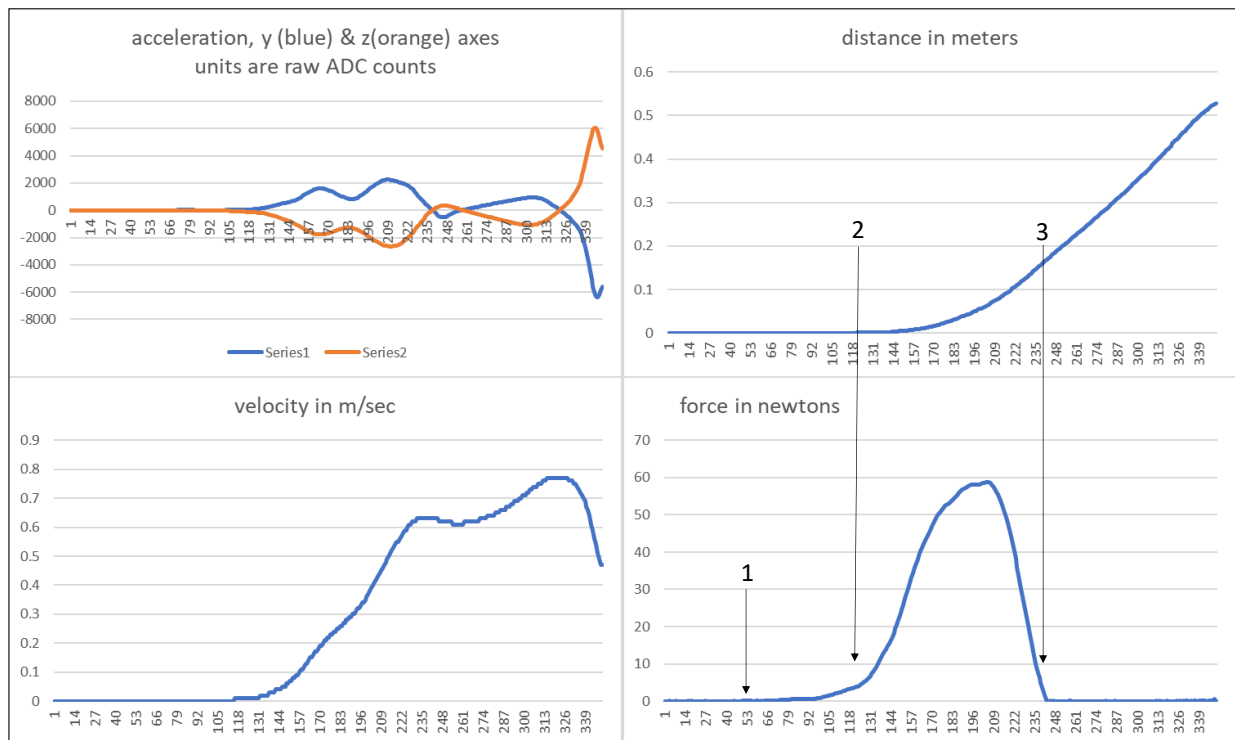
2.1 Overview

The LMI G-Force is a user-configurable tool which measures the force required to close a vehicle door, the velocity of the door after the closing force has been applied, and the work done by the operator to close the door. The device has a simple user interface consisting of three buttons, one tri-color LED, and one suction cup/plunger. It is powered by a long-lasting Lithium-Ion battery that operates continuously for more than 10 hours without recharging.

Using an internal accelerometer coupled with a gyroscope, the G-Force can display velocity, force, or work for quick and easy “on the fly” measurements for doors, decklids, and liftgates. Users can connect the G-Force to LMI’s UGI software to wirelessly collect and export data for later analysis and tracking.

Theory of Operation

The G-Force uses an inertial measurement unit to measure and record the acceleration or angular velocity imparted by the user to the door being tested. The accelerometer data is integrated over time to get velocity over time. This operational method is used for standard vehicle doors. The G-Force also contains a gyroscope that is used to record angular velocity of liftgates and decklids. A high performance load cell measures force. In all cases, the velocity is integrated over time to obtain the distance traveled by the door. Force is applied during a portion of this distance and this data is incrementally multiplied and summed to calculate the total work done by the user, as indicated by the representative curve examples shown below:



These curves were taken on the front passenger side door of a pickup truck, opened just past the first detent. Data was taken at a sample rate of 200Hz reporting peak velocity (other sample rates are available for use on other style and sizes of doors).

The x axis on these curves are time slots. Each of the 350 slots is $1/200 = 5$ milliseconds long. Total length of test window is $350 \times .005 = 1.75$ seconds. The important thing to note from the force and distance curves is that work is only done between arrows 2 and 3, where both the distance and force are non-zero. The force between arrows 1 and 2 is the pre-load necessary to get the door moving.

2.2 Gauge Layout

Buttons:

Up Arrow button: used to scroll through menu options and SEND data.

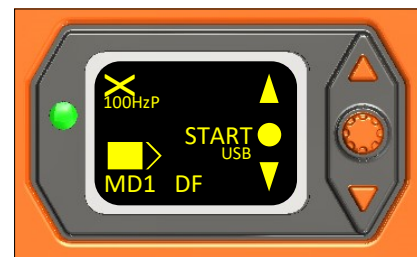
Center button: used to enter menu and START a measurement test.

Down Arrow button: used to scroll through menu options and REDO test.

LED:

The LED will flash different colors to indicate different states of the G-Force.

- When flashing red: Not connected to BLE dongle, waiting to begin a test.
- When flashing green: In setup mode, not connected to BLE dongle.
- When flashing blue: In setup mode, connected to BLE dongle.



Test Start Screen



USB Charging Port:

Type-C USB connection that is used to both charge the G-Force and update models.

Load Sensor Push Button:

This button operates as a load sensor in combination with a surface that helps ensure repeatability.

Suction Cup/Plunger:

The G-Force attaches to the door through the use of a suction cup and plunger. Attach the suction cup to the vehicle by pumping the plunger until the red line cannot be seen. To remove the G-Force press up on the bottom tab of the suction cup.

Angle Adjustment Lever:

Allows the screen of the G-Force to pivot for a better viewing angle. Unlatch, then move the face plate of the G-Force to the desired angle, then re-latch to lock the angle in place.

Contour/Height Adjuster:

Used to stabilize and better fit the contours of the door being measured. Turn clockwise to extend the feet and counter-clockwise to retract the feet.

2.3 Taking a Measurement—Doors

NOTE: The G-Force factory default mode (*Basic mode*) allows the user to perform a measurement test, view the results, and then (if required) send those results to LMI's Universal Gauge Interface data collection software. The information below pertains to using the G-Force in Basic mode. See section 3.2 for information on additional modes.

1. Place the G-Force as close to the edge of the door as possible with one hand while pumping the plunger with the other. When the red line on the plunger is no longer visible, the G-Force is securely attached.

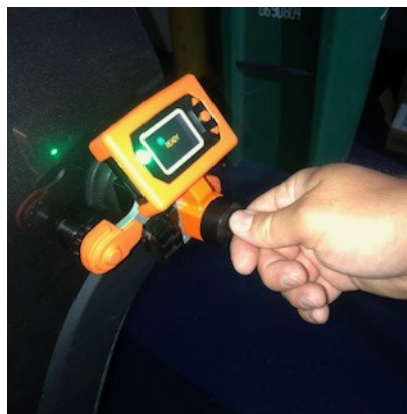


G-Force securely attached



*G-Force **NOT** securely attached*

2. Open the door to the desired location and press the center button on the G-Force. The red LED will stay lit and the screen will display WAIT while the G-Force readies the test. It is important to hold the door as still as possible while the red LED is lit. When the LED turns green and the screen displays READY, close the door by pressing on the black load sensor button with your thumb and index finger as shown below:



Pressing the load sensor

Note: If the Velocity Only featured is enabled, the user can perform a velocity-only test by pushing on the door instead of the G-Force. See Section 3.3 for information on the Velocity Only feature.

3. When the test is complete, the results will be displayed on the G-Force screen. The user is then prompted with a choice to either SEND the data (if using LMI's UGI data collection software) or REDO the test. Once the data is sent or the REDO button is pressed, the G-Force will return to the Start test screen and another measurement can be taken.

2.4 Taking a Measurement—Liftgates and Decklids

A note on liftgates and decklids: Model 7 and Model 8 of the G-Force are set up by default to work with liftgates and decklids. If a user wishes to create their own model, they will need to use the G-Force Utility to change the Door Description to LG. Naming the door LG internally switches the G-Force from the door closure algorithm to the liftgate algorithm, which changes the orientation axes and integrates an internal gyroscope that is used to calculate the velocity as the door moves through an arc. In addition to this the user can select the angle relative to G-Force that will automatically start the test when the liftgate reaches the angle set in the Start Angle field (see page 18). Models 7 and 8 have this angle set to 180 degrees, which means that the user can manually start the test when the angle from which they wish to test is displayed on the G-Force.

The example below assumes the user has selected the default Model 7 door named LG1.

1. Place the G-Force as close to the edge of the liftgate as possible with one hand while pumping the plunger with the other. When the red line on the plunger is no longer visible, the G-Force is securely attached. With the liftgate resting against the striker plate, press the center button on the G-Force to begin the test. The display will look like the example to right and the LED will be solid red in color.



2. Slowly raise the liftgate until the desired angle is shown on the display. While holding the liftgate as still as possible, press the center button (START) on the G-Force. The solid red LED will turn blue and while the word WAIT is shown on the display. When the test is ready, the LED will turn solid green and READY will be shown on the display.

3. If Force is desired in addition to velocity, close the liftgate by pushing on the black load sensor button. Push directly on the liftgate if only velocity is needed.

2.5 Taking a Measurement—Sliders

While the G-force cannot measure force and work of a sliding door on a vehicle, it can report velocity. Using sldr as the Door Description will reorient the axis so that the G-Force can be used on a sliding door. Model 9 is pre-configured for sliders. However, sample rate, spec limits, or door order, can be changed through the G-Force Utility software.

Section 3: G-Force Specifics

3.1 Navigating the LMI G-Force



Main Menu

To enter the Menu screen of the G-Force, press and hold down the center button until the LED goes out (approximately three seconds), then press the down arrow button. From the Menu screen, the operator has the following choices:

Select Model: Allows the user to choose one of ten models within the G-Force.

Setup Mode: Places the G-Force in setup mode for loading/modifying models and doors through the G-Force Utility.

User Mode: Places the G-Force in one of four different user modes (see Section 3.2).

User: Allows for the choice of one of four possible users, one of three shifts, and one of six lines. These details will be included in the data export when the collected data is downloaded to the G-Force Utility software. This data is only recorded when the G-Force is in Data Collect mode.

Velocity Only: Allows for door closure without pressing on the Load Sensor Push button, meaning the user can perform the test with a direct push on the door itself. **When activated, neither force nor work will be measured.**

3.2 User Modes

The G-Force has four user-selectable modes of operation:

Basic: This method allows the operator to instantly view readings from the display on the gauge. Simply grab the gauge and take measurements. Measurements taken in this mode can also be sent to LMI's UGI data collection software by pressing the up arrow (*SEND*) after the completion of each test (see Section 7).

Inline: Allows the user to send velocity, force, or work measurements to LMI's UGI data collection software in a two-way communication platform. In Inline mode, a signal from the user's assembly line communication system would feed UGI a signal based off an incoming VIN or part number. UGI in turn would then send a signal to the G-Force which would change the model number selected for that particular vehicle. Contact your LMI Sales Representative for more information.

Auditor: For use as a stand-alone auditing tool to determine both the lowest *latched* closing velocity and highest *non-latched* closing velocity. This mode is useful for field/yard auditing where a PC is not with the user. See Appendix B for more details. See Appendix A for setup and operation.

Data Collection: Allows the G-Force to be used as a stand-alone data collection device with preset trace fields. The maximum storage capacity will vary with the amount of information saved, but if storing only one parameter, the G-Force can hold approximately 500 tests. See Appendix B for setup and operation.

3.3 Factory Default Models

The G-Force comes with 10 preconfigured models that can be used on a variety of door types straight from the box. These preconfigured models are listed below. Note that each model is fully customizable through the use of the LMI G-Force Utility configuration software and LMI BLE dongle.

Note: To set up a model for liftgate or deck lid testing, the Door Name must begin with LG. This places that door in Liftgate mode, which utilizes a special algorithm to correctly measure travel through an extended arc.

Model Name	Door Name	Velocity Algorithm	Difference and Default Use
MD1	DF	100Hz Peak	Reports peak velocity at a sample rate of 100Hz. Recommended for most doors.
MD2	DF	200Hz Peak	Reports peak velocity at a sample rate of 200Hz. Recommended for smaller doors or use with short closing distances.
MD3	DF	400Hz Peak	Reports peak velocity at a sample rate of 400Hz. Useful when using as a go/no go gauge on an assembly line.
MD4	DF	100Hz V@d	Reports velocity at a default distance of 100mm with a sample rate of 100Hz.
MD5	DF	200Hz V@d	Reports velocity at a default distance of 100mm with a sample rate of 200Hz.
MD6	DF	400Hz V@d	Reports velocity at a default distance of 100mm with a sample rate of 400Hz.
MD7	LG	100Hz Peak	Used for liftgates and decklids that are open past the balance point of the hinge.
MD8	LG	200Hz Peak	Used for balance point closures of liftgates and decklids.
MD9 SLDR	SLDR	100Hz Peak Slider Enabled	Reports velocity of the push at a 100 Hz sample rate on a sliding door 10mm from the latch position. Sample time of 2.5 sec.
MD10	DF	100Hz Peak	Reports peak velocity at a sample rate of 100Hz. Recommended for most doors.

3.4 An Explanation of Sample Rates

When selecting and/or configuring a model, the user has a few different choices when it comes to sample rate. For the majority of door closing applications, LMI recommends using 100Hz Peak or Closing. Lower sample rates provide more time to complete the test, meaning the door can be open wider and the push can be slower without getting a *buffer full* message. The *buffer full* message simply means the door did not hit the striker in the time allotted to complete the test. If using 400Hz or 200Hz, lower the sample rate down to 100Hz. If already set to 100Hz, the user will need to push the door a little harder to finish the test within 3.5 seconds.

The sample rate is an inverse relationship between the time available to complete a test and the amount of time between each sampled measurement point along the transit of the door. Lower sample rates will result in more time to complete the test. With the sample rate set to LMI's recommendation of 100Hz, the test will have 3.5 seconds for completion, from the start of the push to the striking of the latch. At 200Hz, this time is halved to 1.75 seconds and halved again at a sample rate of 400Hz.

LMI only recommends using the 200Hz and 400Hz sample rates on small doors that do not open far, such as glove boxes, aircraft panel doors, etc.

3.5 The Difference Between Peak and Closing Velocity

Peak Velocity will report back the highest velocity reached throughout the test.

Closing Velocity will report back the velocity at a chosen distance away from the latch of the vehicle. The chosen distance cannot be greater than the total length of the distance from the door at start position to the closed position.

LMI recommends using Peak velocity unless the user is trying to match a legacy system that captured a measurement at a set distance away from the striker plate.

3.6 Charging the LMI G-Force

The G-Force contains a rechargeable lithium-ion battery that can send approximately 4000 readings when fully charged. The G-Force can be charged through the included AC adapter and USB cable or via PC using included USB cable. The G-Force will always be ready for use if charged after or in-between shifts. A dead battery requires approximately 6 hours to fully charge.

Note: The include AC adapter has several face plates for use in countries with different supply voltages. Please use the correct plug adapter for your country.

Note: If using the BLE wireless dongle with the G-Force, is it important to unplug the dongle in between shifts to preserve battery life within the G-Force.

3.7 Mastering Statement

The LMI G-Force comes calibrated from the factory. There is no need for the user to perform calibration on the G-Force. This calibration is stored in the microprocessor of the gauge, even if batteries are removed or replaced.

Calibration of axes ensures the accuracy of all 6 axes (+/-x, +/- y, +/-z) relative to the earth's axis. Calibration consists of reading and storing the offsets and sensitivities for each axis. The offset is the reading from a channel when that channel is in the zero gravity field (perpendicular to the earth's surface). Then each axis is put parallel to the earth's surface in both the +1g and -1g orientation to capture the sensitivities.

Calibration can be verified by pressing and holding the Up button for three seconds, then pressing the Center button. This starts an "All Axes Test." Hold the gauge steady at any angle and verify that A is within +/- .02 of 1.00g. Press the up button to return to the default screen.

Section 4: G-Force Utility Software

4.1 G-Force Utility System Overview and Requirements

The LMI G-Force Utility is a software program that allows users to connect and disconnect the G-Force, edit and save gage parameters, and edit model information.

Additionally, the software will allow users to load custom configurations, view live readings, download velocity/force curves, collect and report basic closure data, and adjust gauge parameters for each of the ten models within the G-Force gauge.

User Requirements:

- Administrative rights on an administrative account are required for installation purposes.
- Basic Read/Write User Rights are necessary for application use.
- Access to at least one USB port on the PC.

Minimum Computer Requirements:

- Operating System: Windows 10
- Screen Resolution: 1024x768
- Memory: 4GB
- Processor Speed: Intel I3
- USB Port: 1

Recommended Computer Requirements:

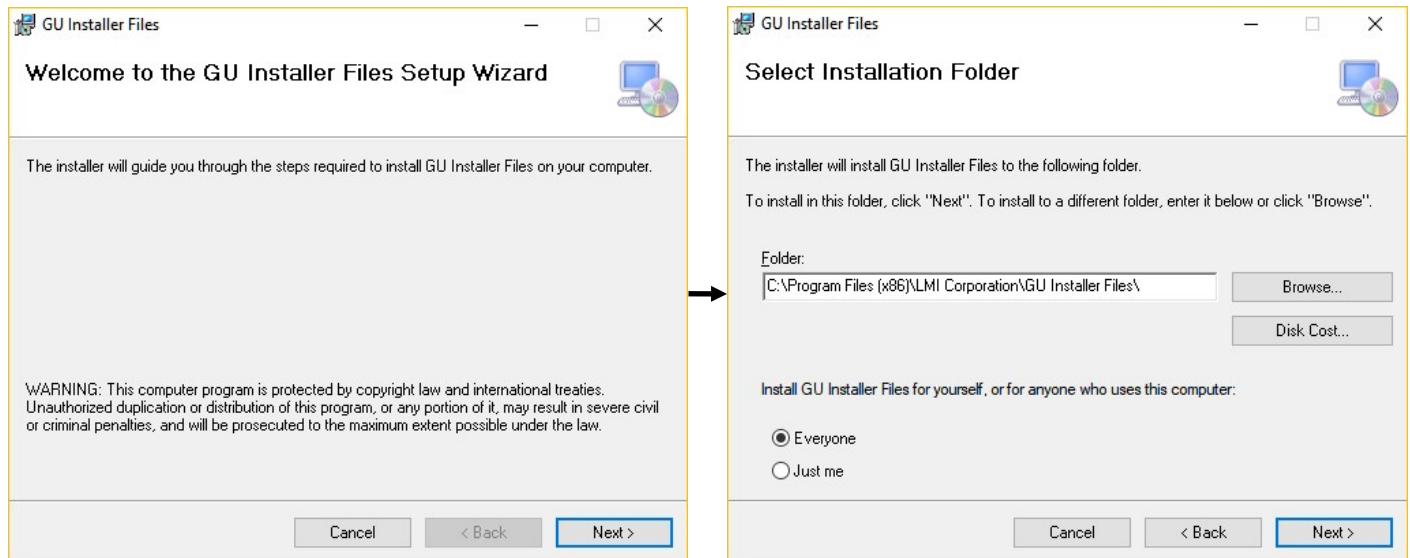
- Operating System: Windows 10
- Screen Resolution: 1920x1080
- Memory: 8GB
- Processor Speed: Intel I7
- USB Port: 1

4.2 G-Force Utility License Agreement

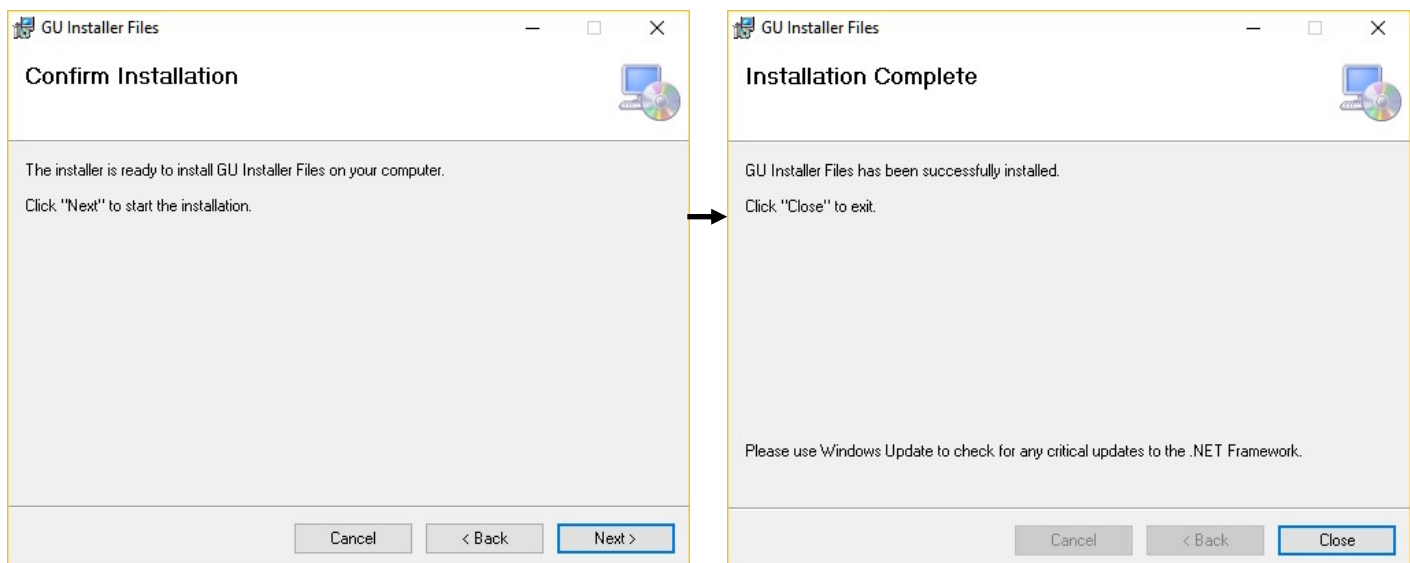
The full EULA for LMI's G-Force Utility software can be found when installing the software. You must agree to the EULA before installation can be complete. If you wish to review the EULA after installation, it can be found by clicking on the Information icon on the utility's home screen and then clicking the link titled *Download Software Agreement*.

4.3 G-Force Utility Installation

The G-Force Utility software can be found on the USB drive that shipped with your G-Force or from our [website](#). The user must have administrator credentials and be logged in under an administrator account on the PC for proper install. Double-click on the installer to begin installation and follow the screens below:



Note: LMI highly recommends installing for Everyone and leaving the default folder selected when installing. Continued on next page.



After the G-Force Utility is installed, either connect the G-Force to the PC via the included USB cable (recommended) or plug the LMI BLE dongle into a COM port on the PC.

4.4 G-Force Utility Operation

The G-Force utility software allows the user to update models, download curves, and associate the G-Force to a LMI BLE dongle.

There are two ways connect to the G-Force Utility software: wireless via the LMI BLE dongle or wired through the included USB cable. LMI highly recommends using the wired method as it is much faster to download data and upload models. If you do wish to connect to the software wirelessly, please consult Appendix A at the back of this manual.

Note: Before updating models, please ensure that you have rights access for the USB ports on the PC running the G-Force Utility.

4.5 Connecting the G-Force

To begin the connection process, plug the G-Force into the included USB type-C cable and a USB port on the computer running the software. *USB* should appear on the display of the G-Force. If the G-Force is off or asleep, press the center button to wake it up. It should be on the Test Start screen. Double-click the G-Force Utility icon to start the program.

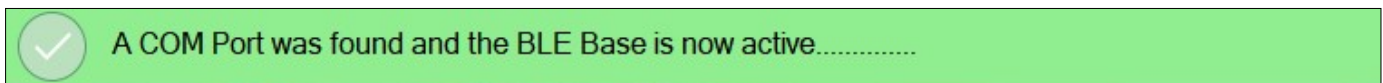


The Wireless Base Information screen will pop up and display the serial number of the connected G-Force under the Gauge List:

Gauge List		
		
		
Gauge ID	Status	
72EEC4	Connected	

Gauge List showing the connected G-Force

At the bottom of the screen, the following message will be displayed:



If the message is **not** displayed and/or the serial number does not show up under Gauge ID, verify that the display of the G-Force is on the Test Start screen and that *USB* is displayed on the screen. Hover over the Restart App button under Wireless Base Information. If it still does not display, press the Restart App button.



If the Gauge ID does not populate after this, unplug the G-Force and then plug it back in. The software will automatically scan the USB ports on the PC looking for the gauge.

4.6 Gauge Icon Menu

Under the Gauge List are six icons that interact with the G-Force:



Refresh the Whitelist*: Used only with BLE Wireless Connection. Queries the Whitelist to find newly added devices.



Add G-Force to Whitelist*: Used only with BLE Wireless Connection. Adds a G-Force to the list of available devices.



Delete the Whitelist*: Used only with BLE Wireless Connection. Clears the list of available devices.



Chart Download: One-button download of a chart for velocity, force, distance, or acceleration.



Data Download: Download raw numerical data for charting use inside Excel or SPC software.



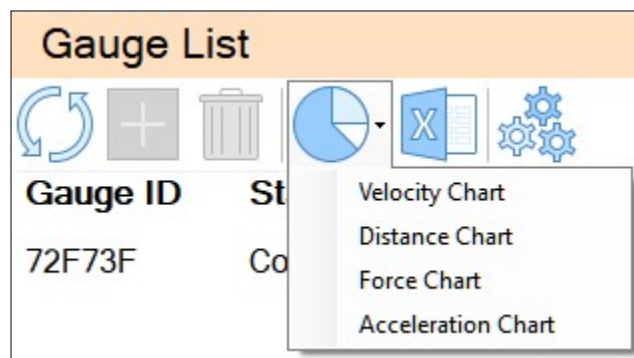
G-Force Settings: Allows the user to change global and per model/door settings within the G-Force.

**For more information about using the wireless features of the G-Force, please consult Section 5.1 on page 19.*

4.7 Chart Download



Charts can be download by clicking on the Chart download button under the Gauge List or through the G-Force Settings page. Begin by taking a measurement and pressing the SEND (up arrow) button. The G-Force will store the data from the last measurement in temporary memory. Plug in the G-Force to the PC via the USB cable. After the software finds the G-Force, select either the velocity, distance, force, or acceleration chart from the Chart Download dropdown menu:



The selected chart will then open up in a separate window where the user can view the chart as well as select any of the other three charts. In addition to this, once the velocity, distance, and force charts are shown in the window, the user has the ability to overlay velocity over distance and force over distance.



Example of a downloaded force chart

From the chart window, the user can also select from the following icons for a more in-depth look at the chart:



Prints out the selected chart.



Zooms in on the selected curve.



Zooms out on the selected curve



Resets the chart to default view.



Allows the user to overlay velocity over force once both charts have been downloaded.



When selected, this allows the user to see the exact value of any point on the curve by hovering over the curve.

4.8 Data Download



Users have the option of downloading raw numerical data from a curve for plotting in Excel or a third-party SPC software using the download data button. Users can choose to download chart data for velocity, force, work, or acceleration after clicking on the Download Chart Data arrow.

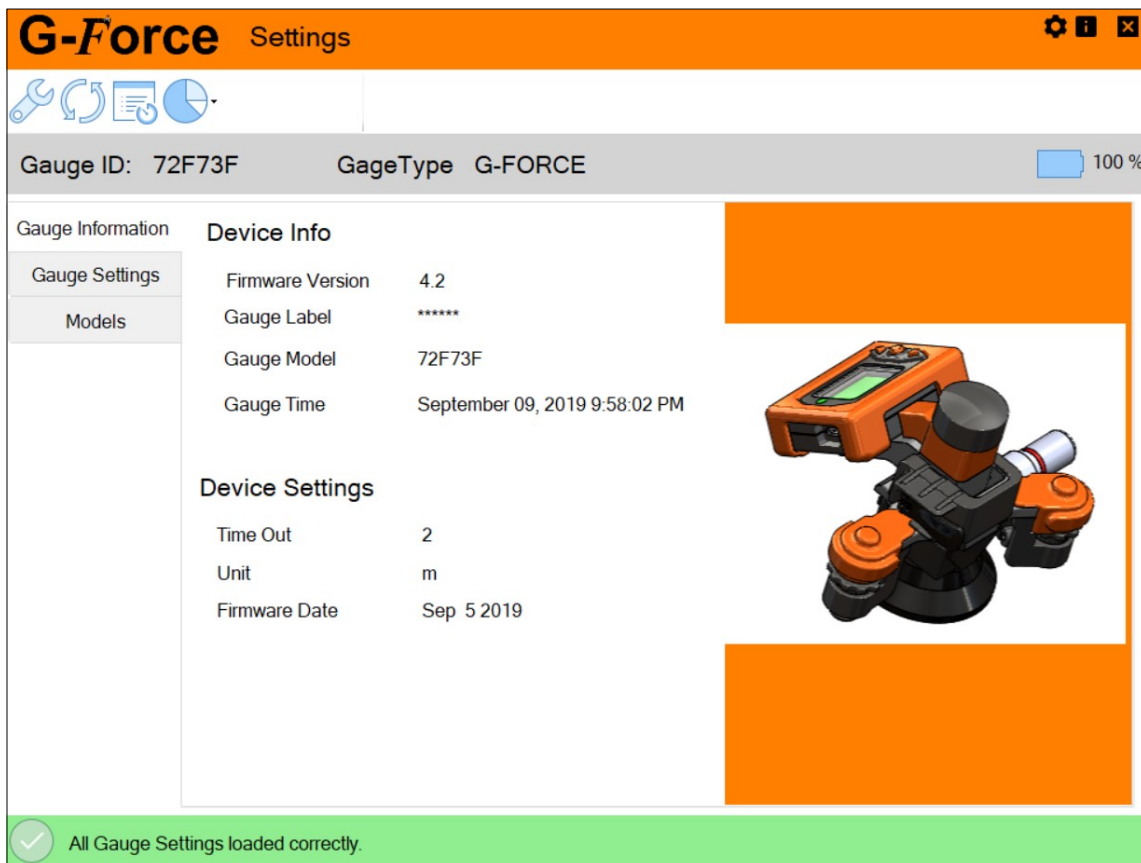


4.9 G-Force Settings



Clicking on Settings button will open up the G-Force Settings. Icons for gauge information, resetting the gauge information, syncing the system clock to the G-Force, and charting are at the top of the window. Tabs for Gauge information, Gauge Settings, and Models are on the left side of the window.

Gauge Information displays information about the currently connected G-Force:



Gauge Settings allows the user to select global settings for the G-Force.

The screenshot shows the 'G-Force Settings' application window. At the top, there's an orange header with the 'G-Force' logo and 'Settings' text. Below the header, a status bar shows 'Gauge Type: G-FORCE', 'Measure Mode: Metric', 'Mode: Data mode <OFF>', and 'Battery Status: Full'. The main content area is divided into a left sidebar with 'Gauge Information', 'Gauge Settings', 'Models', and 'Options'. The 'Gauge Settings' section is active, showing 'Device Settings' with various dropdown menus: 'Parameters' (Velocity), 'Velocity Units' (m/sec), 'Time Out' (5), 'Gauge Mode' (AUDIT), 'Work Label' (J (Joules)), and 'Range' (0.1). Below these is a checkbox for 'Velocity Only' which is checked. At the bottom, there's a 'Device Display' section with three columns: 'Description' (unchecked), 'Gauge ID' (checked), and 'Gauge COM' (unchecked) in the first column; 'Velocity' (checked), 'Work' (unchecked), and 'Force' (unchecked) in the second column; and 'Velocity' (checked), 'Work' (unchecked), and 'Force' (unchecked) in the third column. A green status bar at the bottom of the window displays a checkmark icon and the text 'All G-Force Gauge Parameters loaded correctly.'

Parameters: Applies Upper Spec and Lower Specs to the chosen parameter. This will determine which algorithm the green/red (pass/fail) LED is applied to after a measurement is completed.

Velocity Units: Choose between meters per second or feet per second.

Time Out: Sets the amount of time before the G-Force will shut off if not used.

Gauge Mode: Allows the user to choose between one of four gauge modes within the G-Force. This can also be toggled from the G-Force menu screen.

Work Label: Chose between Joules (J) or Newton meters (Nm).

Range: Threshold for successful test when in Auditor Mode. See Appendix A for more information.

Velocity Only: Toggles the velocity only feature on or off. See Section 3.1.

Description: Chose whether or not to send the Door Description (DF, DR, etc.) before the measurement value(s).

Gauge ID: Chose whether or not to send the Gauge ID after the measurement value(s).

Gauge COM: Used in Inline mode for two way communication between a line system and UGI software. Contact sales@lmicorporation.com for more information about inline mode.

Send: Chose one or more values that will be transmitted when the user presses the SEND button at the end of a test.

Display: Chose one or more values to display at the end of a test. All three are displayed by default.

Gauge Mode: Allows the user to choose between AUDIT mode or LINE_ mode. LINE_ mode is for use on a moving assembly line.

Description: Selects whether or not the door description is sent with the reading.

The desired settings can then be uploaded to the gauge by press the up arrow icon. To restore the default G-Force settings, click on the gear icon.

The **Models** section allows users to rename, reconfigure, and set spec limits for the G-Force.

Model	Description	Active	Velocity	LSL	USL	Start Angle
MD1	DF	☒	100 Peak Velocity	0	1.22	30
MD1	DR	☐	100 Peak Velocity	0	1.44	30
MD1	PF	☐	100 Peak Velocity	0	1.22	30
MD1	PR	☐	100 Peak Velocity	0	1.44	30
MD1	LG	☐	100 Peak Velocity	0	1.5	30
MD2	DF	☒	200 Peak Velocity	0	1.22	30
MD2	DR	☐	100 Peak Velocity	0	1.44	30
MD2	PF	☐	100 Peak Velocity	0	1.22	30
MD2	PR	☐	100 Peak Velocity	0	1.44	30
MD2	LG	☐	100 Peak Velocity	0	1.5	30
MD3	DF	☒	400 Peak Velocity	0	1.22	30
MD3	DR	☐	100 Peak Velocity	0	1.44	30
MD3	PF	☐	100 Peak Velocity	0	1.22	30
MD3	PR	☐	100 Peak Velocity	0	1.44	30

Records: 10
Download Attempts: 1

Model: Allows the user to change the model name (up to six characters) for any (or all) of the ten models within the G-Force.

Description: Four-character door name. To place the door in slider mode (used for sliding doors on vans), the door needs to be named SLDR. To set up a door as a liftgate, the door description must begin with the characters LG.

Active: Selects whether or not a door is included in the model. By default, the first door of each model must be activated.

Velocity: Provides choices between 100Hz, 200Hz, or 400Hz sampling rates for both peak and closing velocity. Peak reports the peak velocity achieved when performing the test. Closing velocity reports the velocity at a distance from closed set in the Distance to Close column.

LSL/USL: Sets the spec limits for each door. Any reading that falls between the upper and lower spec limits will trigger a solid green LED at the end of the test. Any reading falling outside the spec limits will trigger a solid red LED at the end of the test.

Start Angle: Sets the angle at which liftgate test will automatically start. Only used in liftgate or decklid tests. If manual start of the test is desired, set the angle to 180. The test will then begin when the user presses the start button.

Velocity @ Distance: When using a closing velocity algorithm, this reports the velocity at a distance from the full door closure to report the measurement. For example, if this field is set to 50, the G-Force will report the velocity when the gauge was 50mm from the fully closed position of the door.

Distance to Hinge: Input for the distance from the hinge to the G-Force.

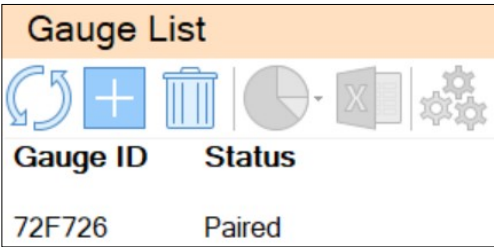
The **Options** tab allows user name configuration when in Data Collection Mode. See Appendix B for details.

Section 5: Wireless BLE Connection to G-Force Utility

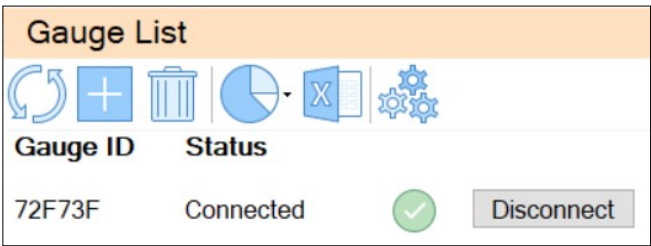
While LMI recommends using the wired USB connection for settings and data transfer between the G-Force and G-Force Utility software, there are a few things the user can do when connected via the BLE dongle.

Please note that whenever using the BLE dongle to communicate wirelessly to the G-Force, G-Force should not be connected to the PC via the USB cable at the same time. Doing so can create communication issues between the software and G-Force. Begin by plugging the included LMI BLE dongle into a USB port on the PC and double-click the G-Force Utility icon to start the software.

The G-Force comes pre-paired to the BLE dongle, which should automatically appear under the Gauge List.



Once the G-Force appears in the list, it needs to be connected in order to update models and settings. To connect the G-Force, place the gauge in Setup Mode by pressing down the center button for three seconds (the LED will briefly go out) and then press the down arrow. From the menu, press the center button again to get into Setup Mode. The LED will begin flashing blue. The software should now indicate the gauge as Connected instead of Paired, as shown below:



The G-Force should still be in Setup Mode with a flashing blue LED. Press and hold the center button to exit from Setup Mode. From here, the user can download chart data and view the charts themselves.

5.1: Gauge Icon Menu for BLE Connection



Refresh the Whitelist: Used only with BLE Wireless Connection. Queries the Whitelist to find newly added devices.



Add G-Force to Whitelist: Used only with BLE Wireless Connection. Adds a G-Force to the list of available devices.



Refresh the Whitelist: Used only with BLE Wireless Connection. Updates the list of available devices.



Chart Download: One-button download of a chart for velocity, force, distance, or acceleration.



Data Download: Download raw numerical data for charting use inside Excel or SPC software.

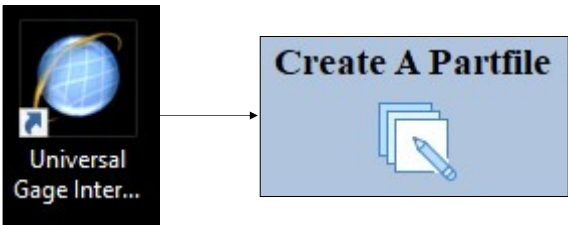


G-Force Settings: Allows the user to view the information from the connected G-Force. **Note:** The user cannot up-load global parameters or update models via the wireless connection.

Section 6: Data Collection with Universal Gauge Interface

Preface: This section only covers the most basic partfile a user can create in UGI. If trace fields, a customized export, two-way communication, etc. are required, please consult the UGI Manual that shipped with the UGI software.

There are five required steps that must be completed to create a partfile for use with the G-Force. Begin by double-clicking on the UGI icon and then click the **Create a Partfile** button.



Step 1: Partfile Name and Save:

Navigation

Required Steps:

Partfile Name and Save

Partfile Gauges

Partfile Graphics

Partfile Inputs

Partfile Exports

Optional Steps:

Reasonable Limits

Rate Of Change

Summary Screen

Sequence Editor

Partfile Name:

G-Force Demo

Partfile Description:

Creation Date:

12/15/2019

Modify Date:

12/15/2019

Partfile Location:

C:\ProgramData\LMI Corporation\Partfiles

☐ Associate Part File Work Instruction:

[Show Advance Options >>](#)

Browse

Browse

In this screen, the user must give the partfile a name under the **Partfile Name** field and choose a location for the partfile to be stored by clicking the Browse button to the side of the **Partfile Location** field. A new window will open up asking the user to select a location for the partfile. To store the partfile in the default location, simply click OK on the browse window. While the user has the choice to store the partfile anywhere on the PC or network location, LMI strongly recommends leaving it in the default folder. Press the Next button in the upper left hand corner of the window to move to Partfile Gauges.

Step 2: Partfile Gauges

Note: The fields shown in the columns below are specific to the G-Force. The additional columns to the right of the COM Port column will need to be set up as well. Please reference the UGI manual for additional information and setup of the USL/LSL, UCL/LCL, HR/LR, and active columns. Mux Port, Span, Invert, and Frequency columns do not apply to the setup of a G-Force partfile.

Note 2: The number of outputs chosen in UGI **MUST** match the number of outputs on the G-Force. For example, if the user wants to see only force and energy, but the G-Force is set to transmit velocity, force, and energy, it will not work.

In this step, the user sets up how many doors will be measured per vehicle and how many of the three outputs will be collected. For example, if the user only wants to capture Work (energy) for one door, the setup would look like the following:

Number of Gage Points: 1									
	Characteristic	Description	Component	Gauge Type	Association	Calculation	Mux Port	COM Port	
1	DS	72F726		G-Force-1			N/A	5	

If collecting both Velocity and Work on the driver's side front door, the setup would look like the following:

Number of Gage Points: 2									
	Characteristic	WGID	Component	Gauge Type	Association	Calculation	Mux Port	COM Port	
1	DS V	72F726		G-Force-1	Row 2		N/A	5	
2	DS W	72F726		G-Force-2	Row 1		N/A	5	

Note that if collecting two output types from the G-Force, the first row will use the **G-Force-1** Gauge Type and the second row will use the **G-Force-2** Gauge Type. The Association column must also be filled out, connecting the first output row (velocity) with the second output row (work).

If collecting velocity, force, and work, then all three rows must use the **G-Force-All** Gauge Type. Note that the order of transmission will be velocity, force, and work if sending over all three readings. The Association column will be left blank:

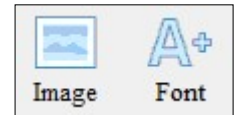
Number of Gage Points: 3									
	Characteristic	Description	Component	Gauge Type	Association	Calculation	Mux Port	COM Port	
1	DS V	72F726		G-Force-All			N/A	5	
2	DS F	72F726		G-Force-All			N/A	5	
3	DS W	72F726		G-Force-All			N/A	5	

Additional doors should be added in the order in which the operator will collect the data (e.g., DF, DR, LG, PR, PF). Press the Next button in the upper left hand corner of the window to move to Partfile Graphics. Below is an example of a coupe routine, where DS denotes *driver side* and PS denotes *passenger side*:

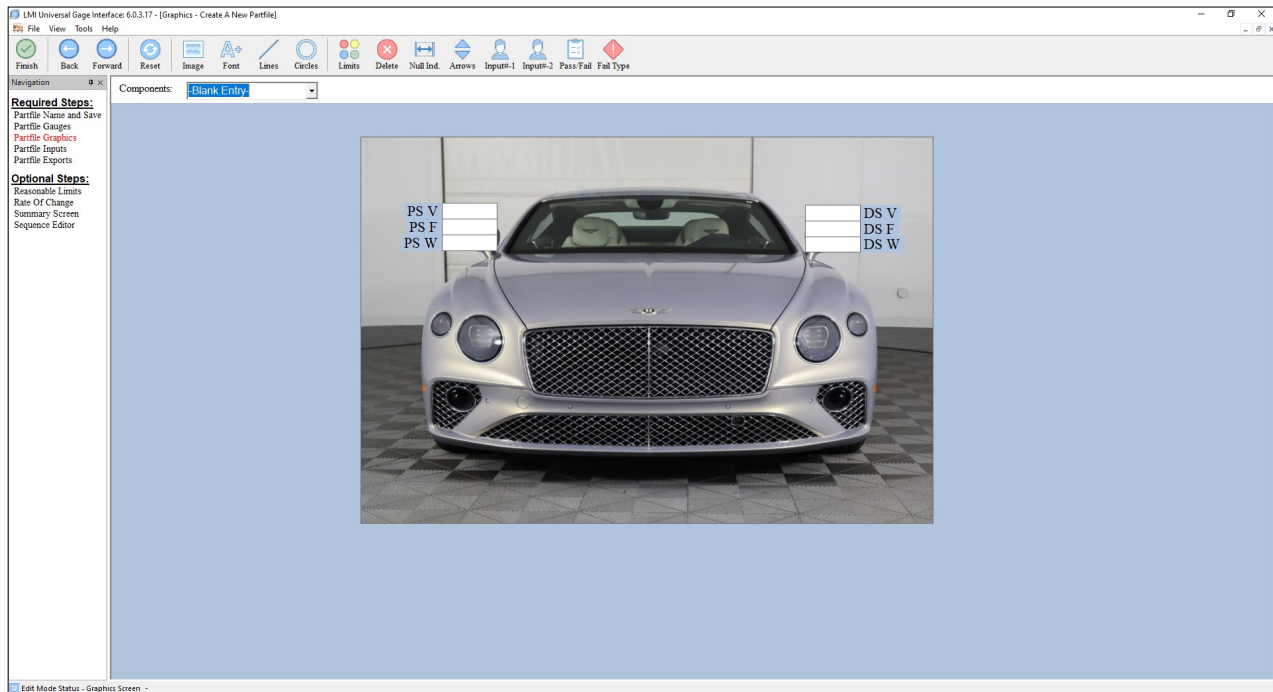
Number of Gage Points: 6									
	Characteristic	Description	Component	Gauge Type	Association	Calculation	Mux Port	COM Port	
1	DS V	72F726		G-Force-All			N/A	5	
2	DS F	72F726		G-Force-All			N/A	5	
3	DS W	72F726		G-Force-All			N/A	5	
4	PS V	72F726		G-Force-All			N/A	5	
5	PS F	72F726		G-Force-All			N/A	5	
6	PS W	72F726		G-Force-All			N/A	5	

Step 3: Partfile Graphics

Place the graphic(s) that best represent the vehicle to be measured in the **C:\Program Data\LMI Corporation\Graphics** folder. Click on the Image Icon in the menu bar and then select the graphic to use in the routine. The font size can also be increased for ease of viewing by clicking on the Font Icon in the menu bar.



Click and drag the white boxes onto the image. To switch the places of the box and characteristic name, double-click on the box. Below is an example of a coupe that will have velocity, force, and work collected for the driver and passenger doors.



Click on the Next icon in the upper left hand corner to continue to Partfile Inputs.

Step 4: Partfile Inputs:

The Partfile Inputs page is where trace inputs (non-measurement data such as operator name and shift) can be added to the partfile. This routine will not have any trace inputs, but full instructions for adding inputs can be found in the UGI manual that shipped with the software. Click on the Next icon in the upper left hand corner to continue to Partfile Export.

Step 5: Partfile Export:

The Partfile Export page is where the user configures the data export format for all trace and measurement data. For the purpose of this example, a pre-configured .txt output will be selected. Additional information for customizing an export can be found in the UGI manual that shipped with the software.

Choose a location on the PC where the data file will be written by clicking on the ellipsis (...) to the right of the Export Location field. Next, enter a name for the data export in the Export Name box (e.g., Coupe Closure Data). After that, click on the drop down to the right of the Export Name box and choose .TXT as the export format.

Export Location...	Export Name...	Export Extension...
C:\ProgramData\LMI Corporation\Partfiles	Coupe Closure Data	TXT
Clear Current Export		

Continued on next page...

Step 5: Partfile Export: (...continued)

If a separate export is needed for each vehicle, a checkmark can be placed in the Export Unique File box; otherwise, newly collected data will append to the same export file.

To complete the partfile, click on the Add Export button in the lower right hand corner of the partfile and then click on the Finish button in the upper left hand corner of the window. Choose Yes to Save the partfile.



Running the Partfile

Check to make sure the LMI BLE dongle is plugged into the COM Port selected in Step 3. If it is not, close down UGI, plug in the dongle, and then restart UGI.

From the main menu, choose **Run A Partfile**. Click on the Browse button to navigate to the location where you saved the partfile in Step 1. Double-click on the partfile to select it, then click the Run button at the bottom of the page.

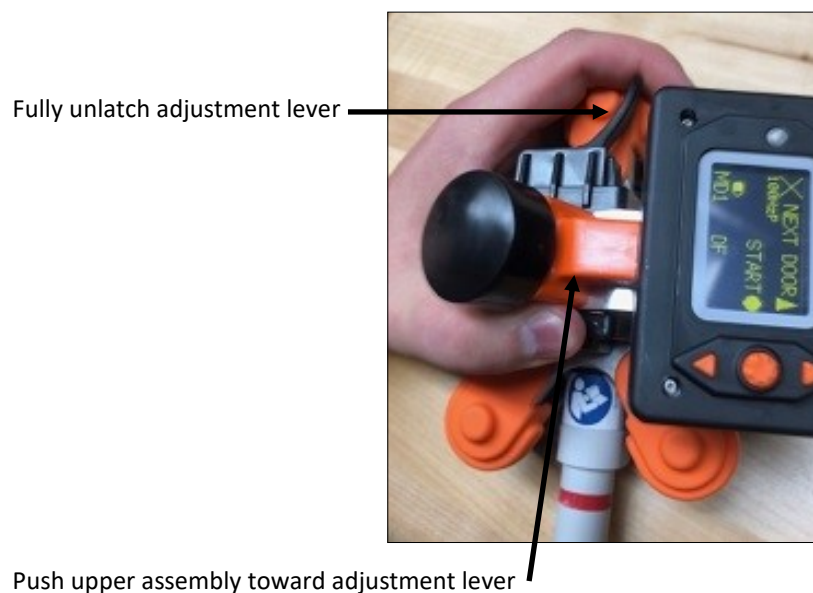
Place the G-Force in Setup mode by pushing and holding the center button on the G-Force down for four seconds, then push the down arrow. From the SETUP MODE in the Selction Menu, push the center button. The green flashing LED should now be flashing blue. Press and hold down the center button to exit setup mode.

Note: If Setup Mode is not entered before the first measurement is taken, the G-Force will connect when the up arrow is pressed to send the first reading. The first reading, however, will not populate the box in UGI and must be retested.

Place the G-Force on the vehicle door, open the door, and press the center button (labeled onscreen as START) then push the center load button to take the test. Press the up arrow to send the reading(s) to UGI.

Section 7: Troubleshooting

- 1. The G-Force Utility isn't showing the G-Force is connected to USB:** Make sure that USB is displayed on the screen of the G-Force. If it is not, unplug the G-Force from the cable and then plug it back in, making sure it is firmly inserted in the jack.
- 2. The G-Force Utility has become unresponsive:** Unplug the USB cable from the G-Force if in a wired connection. Unplug the BLE dongle if in a wireless connection. In either case, close out the G-Force Utility, reconnect the G-Force (if cabled) and restart the software.
- 3. Angle of display cannot be adjusted:** Make sure the angle adjustment lever is fully unlatched. Hold the G-Force in the orientation shown below and push the upper assembly towards the adjustment lever. After doing this, rock the display back and forth to the desired angle and then fully close the adjustment lever.



Appendix A: Auditor Mode Setup

Auditor Mode is designed to allow a user to take a G-Force out to a lot or down the line without a PC and perform lowest closing velocity tests on a vehicle without the need for the user to remember the highest non-latch closure and the lowest latched closure. The G-Force will retain both of these in a temporary memory file until the user chooses to SEND the data after the measurements fall within a pre-determined threshold setup using the G-Force Utility.

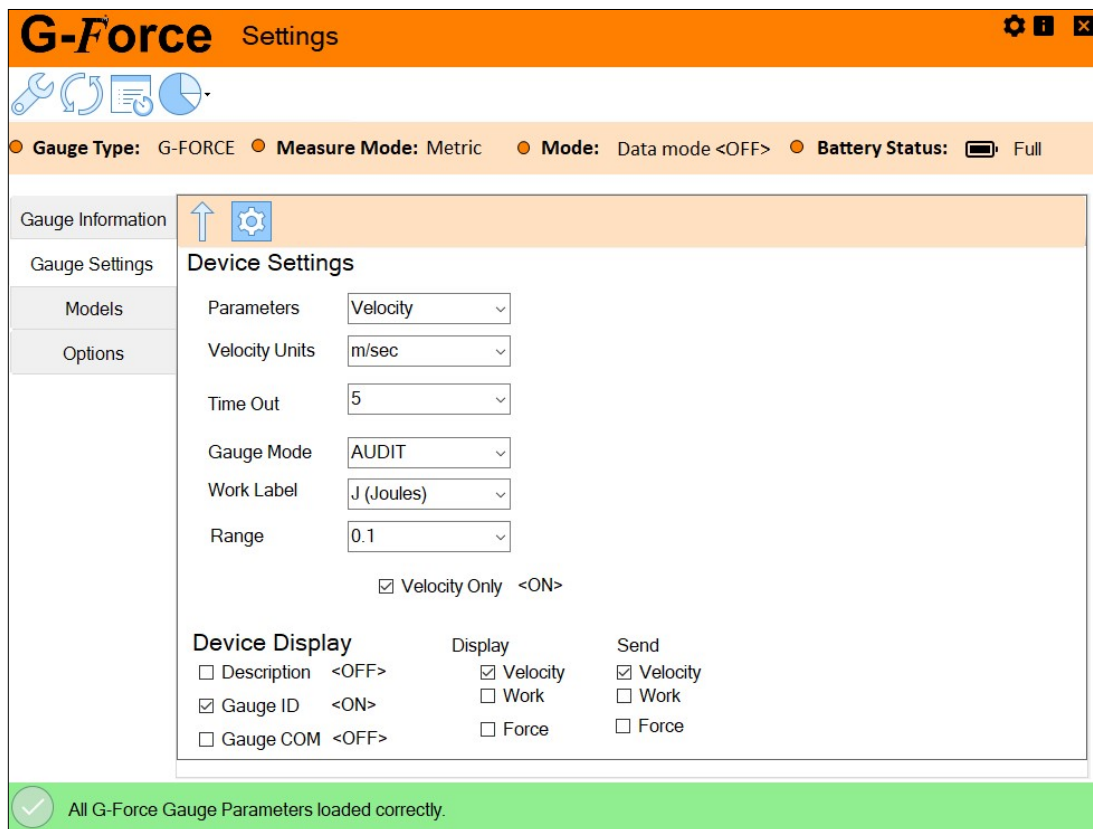
To set the threshold, connect the G-Force to the PC using the included USB Type-C cable and double-click the G-Force Utility icon to start the program.



Once the program has found the G-Force, click on the Gauge Settings icon:



Click on the Gauge Settings tab and choose an acceptable threshold range between a latched and no-latched closure.

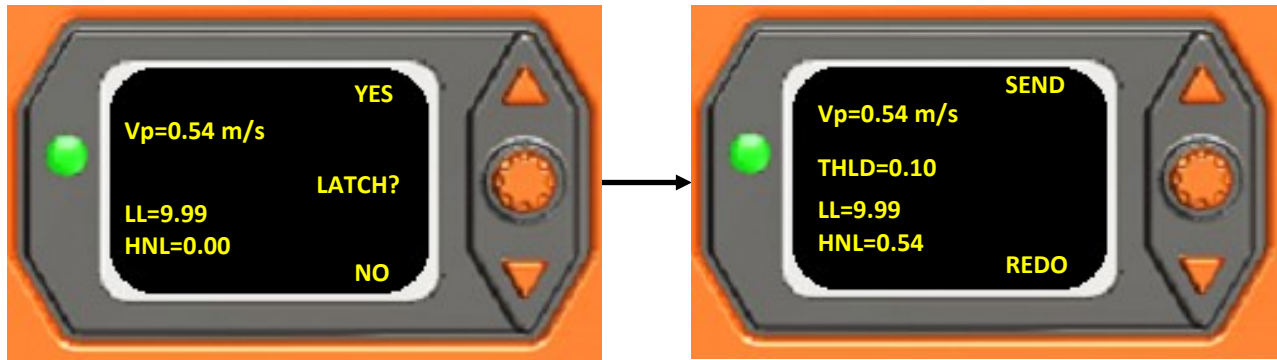


In this example, the threshold is set to 0.1 m, meaning that when the lowest latched push is within 0.1 m of the highest non-latched push, the LED will flash green to let the user know they have reached the threshold and the test is complete. The screen of the G-Force will display both the lowest latched and highest unlatched and the user can then choose to REDO the test or SEND the data to a data collection program or simply write the values down using paper and pen.

To upload these settings to the G-Force, press the upload arrow icon and then close down G-Force Utility, unplug the G-Force, and begin closing doors.

Again, the purpose of this mode is to find the lowest *latched* closing velocity. Here's an example of how it works:

The user takes a test and gets a no-latch value of 0.54 m/s. The left image below shows the display of the G-Force.

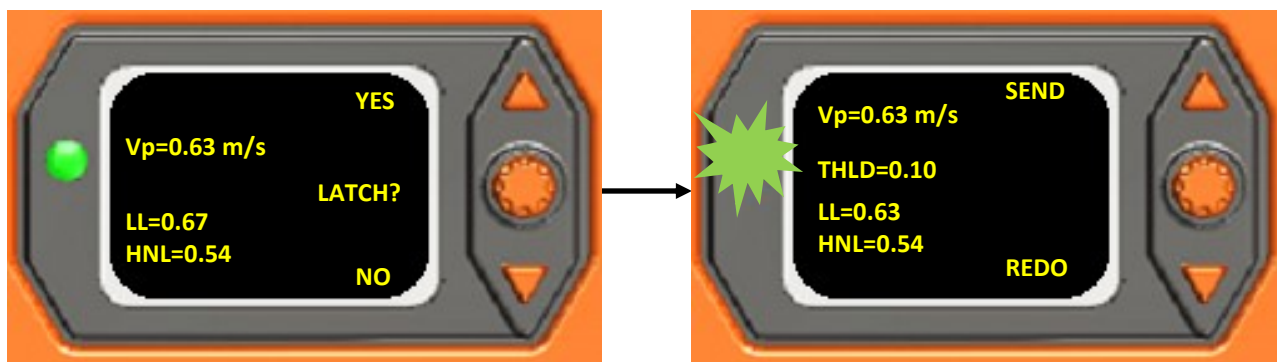


The user answers the question **LATCH?** with **NO** by pressing the down arrow. The user presses the down arrow again to **REDO** the test, as shown in the right image, above.

The user closes the door again, and this time gets a latched value of 0.67 m/s. The G-Force screen will display the following:



The user answers the question **LATCH?** with **YES** by pressing on the up arrow. The Lowest Latched (**LL**) reading changes from the default 9.99 to 0.67 (above right). As the 0.1 m/s threshold has not been met, the user presses the down arrow to **REDO** the test.

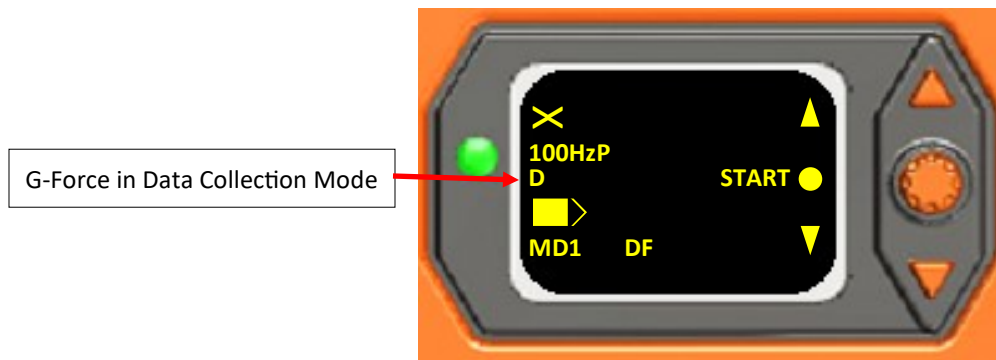


The user closes the door again, this time getting a latched value of .0.63. The user answers the question **YES** and then the green LED begins to flash, indicating that the threshold has been met. The user can now choose to **REDO** the test again using the down arrow or end the test by pressing the up arrow (labeled **SEND**).

Appendix B: Data Collection Mode Setup

Data Collection Mode allows the G-Force to act as a simple data collection device capable of holding up to 500 records that can then be downloaded to a text or Excel file via the G-Force Utility.

To set up Data Collection mode, press and hold down the center button on the G-Force until the red LED stops flashing, then press the down arrow to enter the Selection Menu. Use the down arrow to scroll down to USER MODES, then press the center button. Use the down arrow again to select DATA COLLECT then press the center button. Press the up arrow to turn on the Data Collect mode, then press the center button again. The screen of the G-Force will now display a D on the left hand side of the screen to denote Data Collection Mode has been turned on and data will be saved to the internal memory of the G-Force.



Before data collection begins, the user will press and hold the center button down again until the red LED quits flashing, and then press the center button on the G-Force. Using the down arrow to select USER, the user will be prompted to select:

User number (or name if configured): User 1 / User 2 / User3 / User 4

Shift: First / Second / Third

Line: 1 / 2 / 3 / A / B / C

This information will be tagged along with the readings captured by the user. When the shift is over or another user begins testing with the same G-Force, they will need to select their user number, shift, and line.

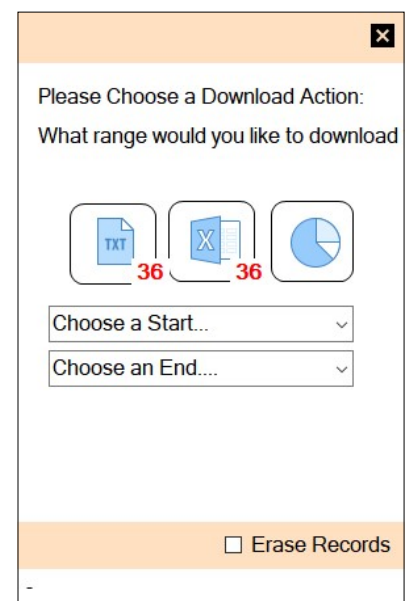
Once the data has been collected, connect the G-Force to the PC using the included USB Type-C cable. Open the G-Force Utility Software. The software should automatically find the G-Force. When it does, click on the Download Data icon shown to the right.



The Download Action window will open and the user then has the choice between downloading the data as a .txt file or an Excel file. The red number in the lower right hand corner of each icon displays how many records are on the G-Force. Click either of the icons and then select the start and end rows for downloading the data. In the example to the left, the user would start at 1 and end at 36 to download all the data files.

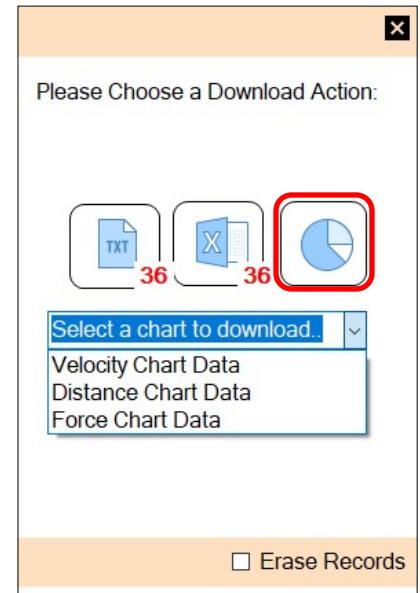
If the Erase Records button is checked, the records will be erased from the G-Force after they have been downloaded. LMI recommends that the user check this box so that there will always be room for additional data.

When the data has finished downloading, the respective file will open in Notepad or Excel. From here you can save the data as you normally would a .txt or .csv/.xlsx file.



In addition to download collected data, the rightmost icon will allow the user to download chart data for the last test taken with the G-Force. When the user clicks on the Download Chart Data icon, they will be presented with a choice to download either the velocity, distance, or force chart data. This data will open in an Excel which can then be easily plotted or saved for future use.

Note: Each chart data download will open in a separate excel file.

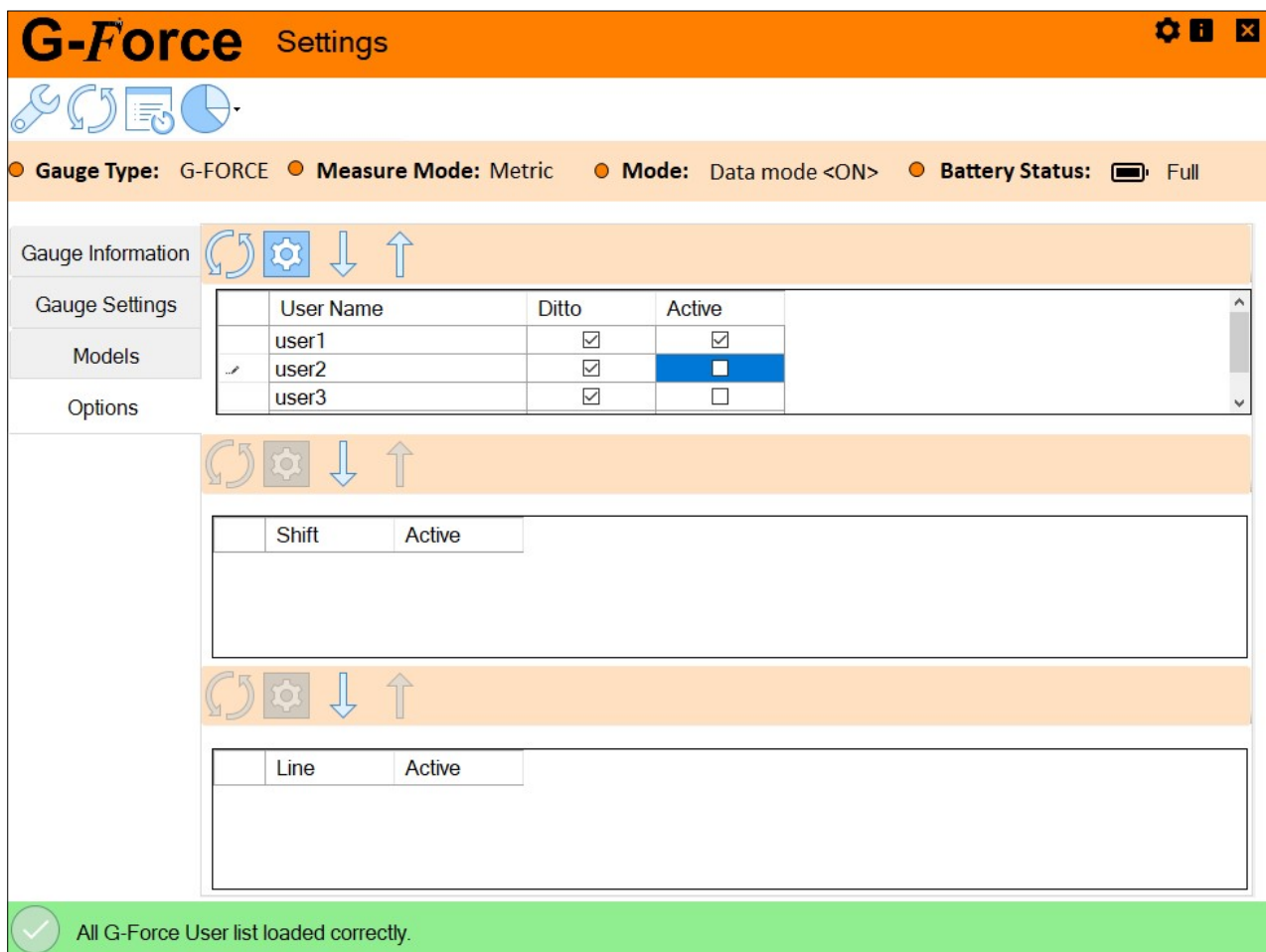


Configuring User Names

Username 1-4 can be replaced with operator names through the Options tab of the G-Force Utility. Connect the G-Force to the PC through the USB Cable, then click on the Options tab. Click the downward arrow icon to recall the user names from the G-Force. The user can replace the default user names with the names of the auditors, with a five character limit for each name. When finished, click on the upward arrow to load the names into the G-Force.



Note: Shift and Line will be configurable in a future update to be released in mid-2020.



User Notes