



Morehouse
THE FORCE IN CALIBRATION SINCE 1925

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Morehouse Calibration Software

Instruction Manual

Data acquisition software using polynomial equations



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1. Software Summary

The Morehouse Calibration Software (**the software**) is provided by Morehouse Instrument Company (**Morehouse**) and is designed to be used with indicators and calibration coefficients. The software is capable of supporting an unlimited number of devices, simultaneously. Each device connected via the software will have its mV/V value read from it, converted into a reading using the user supplied coefficients, and displayed on the screen. The software is also capable of reading from multiple devices simultaneously and adding their calculated values together.

1.1. Hardware Devices

The software is designed to initiate communication with hardware devices over a Virtual Communication Port (**VCP**). Most devices will require a third party driver to be installed on the computer to turn the USB connection into a VCP. These drivers are included in the ZIP archive to install for the specified models. Some devices may also require a custom RS232 cable as well as a customer supplied RS232 to USB adapter. The adapter may have its own driver the customer may need to install.

Currently, the only known limitation on the number of simultaneously connected devices is determined by the computer they're connected to. Most computers are limited to a maximum of 255 Serial Ports. Theoretically, the software would be able to simultaneously read from all 255 ports. Using more ports than necessary will cause the hardware discovery process to take longer, so it is recommended to limit the number of connected devices to about 10-15. Leaving more connected should not cause an issue with the program, but it will significantly increase the chance of a user (**technician**) making a mistake.

1.2. Hardware Communication

The software is designed to communicate with various devices utilizing a Serial Port object. This behavior can also be reproduced using an RS232 terminal or even via PowerShell. As each device is different, a collection of baud rates and other configurations are tried to establish a connection with a device. Unfortunately, some serial port devices are sensitive to unknown commands being sent to them. This may cause unexpected behavior, including displaying an error message on the screen. To prevent this issue from happening, it is recommended to disconnect these devices from the computer first.

The software is also designed to gracefully ignore serial devices that don't respond well to attempted communications. This may include a Bluetooth device, the computer manufacturer's enabled serial device, or other devices. These devices may be left connected to the computer, but if an issue arises, it is recommended to disconnect them to ensure they aren't the reason for the issue.

For devices that a successful communication has been established, the software can communicate with the device using a handful of commands. Devices that require remote operation, like the HBM DMP40, the software is able to enter/exit remote operation mode by itself. For some devices, this generally locks out the front panel, preventing human interaction without restarting the device. The software is designed to enter remote mode when attempting to communicate with the device, but will automatically exit remote mode when communication has been finished. The software will also exit the device from remote mode if the technician requests that live readings are turned off.



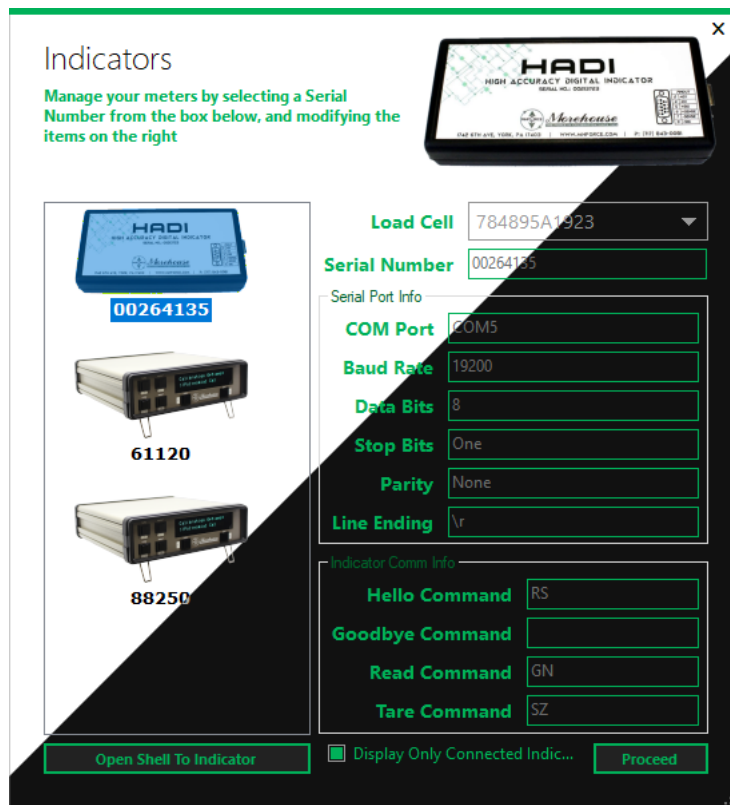
The software is also capable of requesting the device’s serial number (used to verify the manufacturer and model), tare the meter, and obtain the current reading from the device. The serial number is only requested during the discovery phase to look for a response. Once a response has been received, the software will request the serial number again to verify. The software will only tare the meter upon the technician’s request, either via individual device taring or by requesting a tare of all devices.

It has been reported that some devices do not always tare when prompted. This may be due to the current reading of the device being higher than the manufacturer's programmed threshold. This may also indicate possible damage to the equipment. Please contact Morehouse for further assistance.

When the software attempts to retrieve a reading from the device, it will typically request the mV/V reading of the device. Not every device has a mV/V reading, like the Morehouse G501F, so the software will opt to read what is currently displayed on the device. This means that if the calibration was done in LBF, the G501F will need to be set to the LBF units to get accurate readings. If a different unit is required than what the device was calibrated for (KGF instead of LBF), use the software’s built in unit conversion.

The software also has a built-in terminal for communicating with a device. This allows messages to be sent and received from devices from within the program without requiring a different application.

1.3. Software Appearance





The software is designed using the Metro theme based on the Windows 8 operating system. This theme utilizes a green style to closely match the colors of Morehouse. The software's user interface (**UI**) is tailored towards smaller resolutions. Currently, the software supports resolutions of 720p (100% UI scaling) and greater and 1080p (150% UI scaling) and greater. Due to the target resolutions, the UI may not appear optimally on better resolutions. To alleviate this, it's recommended to manually set the size to provide a pleasant appearance.

The software is also equipped with a dark mode. The ability to change the software between light and dark mode gives the technician the flexibility to determine the correct contrast to best observe the readings. The current light/dark mode is set in the main window and is applied to all other windows of the software. Dark mode can be toggled directly within the software. Dark mode will also be enabled when the software starts if the computer's color personalization is set to Dark or the default app mode is set to Dark.

Internationalization has been implemented within the software. This feature is limited to numbers that are displayed throughout the software. The numbers will be displayed with the thousands and decimal separator according to the computer's locale.

1.4. Software Releases

To better manage the software's releases, all releases are now hosted on GitHub. Morehouse's GitHub organization is located at <https://github.com/mhforce> but only the releases are available to the public. This provides Morehouse more flexibility with uploading new versions and updating information for previous versions.

For customers that are unable to access <https://github.com> from work and can't get an exception for Morehouse's GitHub organization, please contact Morehouse for a copy of the latest release.

1.5. Data Storage

The software is designed to store all data in a JSON file in the software's program data directory (`%ProgramData%/Morehouse Calibration Software/data.json`). This is a plain text file format and can be edited by any text editor program. Manual modifications to this file may cause unexpected behavior. It is recommended to only modify this file if instructed by Morehouse.

If a version before 1.2.0 of the software was used, the program used a SQL database file. Version 1.2.0 is able to migrate the data from the SQL database to the JSON file. If the software is unable to migrate the data, an error will be presented and the program will exit. In the event the migration fails, the database file can either be deleted and start fresh, or Morehouse can be contacted for assistance.



2. Installation and Setup

2.1. Download

To download the latest version of the software, visit https://github.com/mhforce/MorehouseCalibrationSoftware-Releases/releases/latest/download/Morehouse_Calibration_Software.zip. A ZIP archive containing the latest versions of the installer, this instruction manual, and meter drivers will be downloaded. Unzip the archive and follow the next steps to get the software installed.

2.2. Install Morehouse Software Calibration

The software is installed using an offline installer and is named **Morehouse Calibration Software.msi**. Follow the instructions in the installer. The installer may request elevated permissions or ask to approve the installation. Failure to complete this step will prevent the software from being installed. If admin privileges are not available, choose to install the software for **Just me** instead of for **Everyone** and change the installation directory to a location that the user has access to. **Program Files** and **Program Files (x86)** are generally restricted to admin access only. A recommended location to install software just for the user is in **%LocalAppData%\Programs** (e.g. **C:\Users\CalTech\AppData\Local\Programs\Morehouse Calibration Software**).

2.3 Windows Defender SmartScreen

Previous versions of the software were unsigned and would trigger Windows Defender SmartScreen. This is no longer the case. The software is now signed with an Extended Validation (EV) code signing certificate.

2.4. Necessary Components

Previous versions of the software required Microsoft SQL Server Compact 4.0 SP1 to be installed. This is no longer required. The software now utilizes a JSON file to store the data and will migrate an existing database to the JSON file. .NET Framework 4.8 is still required, but is included on modern Windows PCs. If .NET Framework 4.8 is not installed, please contact the company's IT department.

2.4.1. Microsoft Excel

The software requires that a version of **Microsoft Excel** is installed to use the Excel interoperability functionality. Due to the widespread use of Excel, no installer is provided with the software. If a copy of Excel is needed, please contact the company's IT department.



2.5. Indicator Drivers

To communicate with an indicator, the devices need to be detected by the computer as a **Serial Port** in the **Device Manager**. If a device is not visible under the **Serial Port** section or if the device isn't being detected by the software, the corresponding driver may need to be installed. The drivers included with the installer are USB to VCP drivers and should allow the device to appear under the **Serial Port** section. Also see [Missing Indicator §5.3](#), [Missing HADI Indicator §5.4](#), and [Resetting COM Ports §5.5](#) for more troubleshooting steps.

All the device drivers are located in the **Drivers** directory. Each device model supported by the software has its own directory listed. Within each directory is the USB to VCP driver for the specific model. If a needed model isn't listed, the device likely doesn't include a USB connection port and offers an RS232 port instead.

If the device utilizes an RS232 port, a custom RS232 cable and 3rd party RS232 to USB adapter will be required to establish communications. The chosen RS232 adapter will offer its own driver to enable communication with the device. For more information, please contact the manufacturer or check the User's Manual of the device.

3. Operating the Software

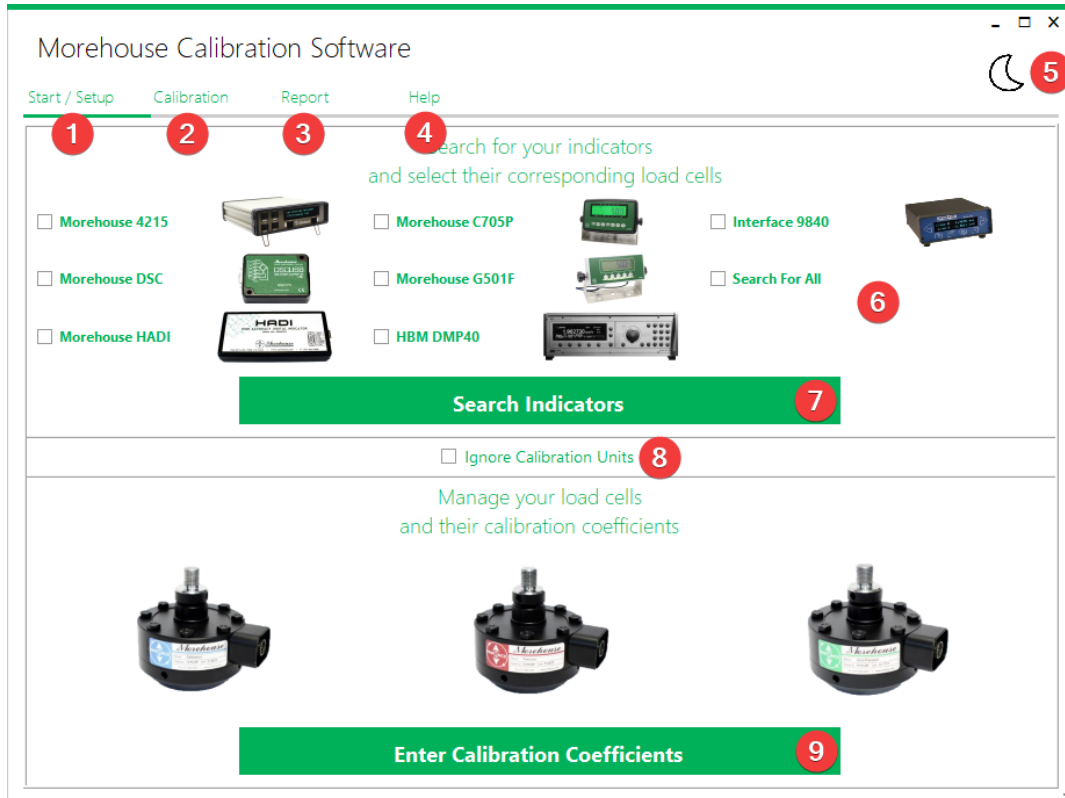
3.1. Launching the Software

By default, the software is installed at **C:\Program Files (x86)\Morehouse Calibration Software\Morehouse Calibration Software**. Double-click the **Morehouse Calibration Software** file to run the program. Alternatively, a shortcut to the software is available on the desktop and start menu.



3.2. Interacting with the Software

3.2.1. Start/Setup Tab





1. The software starts with the **Main Screen** visible and the **Start/Setup** tab selected. This is the landing screen of the software. To return to this screen at any time, select **Start/Setup** at the top of the screen.
2. Selecting **Calibration** will switch to the **Calibration Tab §3.2.2** and allow a technician to read from any discovered indicators and capture data.
3. Selecting **Report** will switch to the **Report Tab §3.2.4** and will allow a technician to review the captured data from each indicator and compare the percent error. Captured data can also be modified here.
4. Selecting **Help** will switch to the **Help Tab §3.2.5** and will present contact information, relevant links, and software information to the technician.
5. Clicking on the **moon/sun** in the upper right will toggle between light and dark modes **§1.3**. If the moon is visible, it will toggle to dark mode and change to a sun. If the sun is visible, it will toggle to light mode and switch to a moon. This toggle is always available on the **Main Screen**, regardless of which tab is being shown.
6. Before being able to search for connected devices (**7**), the checkbox corresponding to the manufacturer and model (**6**) of the meter must first be checked. Alternatively, the **Search For All** option can be checked to discover all supported, connected devices. The software will not experience any issues if models are selected that are not currently connected to the computer.
7. Once the model(s) are selected, clicking on **Search Indicators** will cause the software to begin searching for connected devices. While the software is searching, a loading screen will be displayed. Once finished, the **Indicator Screen §3.2.6** will be displayed.
8. Toggling **Ignore Calibration Units** prevents units from being shown throughout the software. Additionally, unit conversions are disabled.
9. Selecting **Enter Calibration Coefficients** will allow a technician to create, delete, or modify coefficients for a load cell. This will open the **Instrument Screen**.



3.2.2. Calibration Tab

The screenshot shows the 'Morehouse Calibration Software' interface with the 'Calibration' tab selected. The interface is divided into several sections:

- Readings:** A digital display (1) shows '0.0000 LBF' (2). To the right are 'Peak' (3) and 'Valley' (4) input fields. Below the display are 'Live Readings' (5) with an 'Off' indicator, a settings gear (6), 'Tare All' (7), 'Reset Values' (8), and 'Capture Data' (9) buttons.
- Settings:** Includes 'Convert To Mass' (10) with an 'Off' indicator, 'Local Gravity (m/s^2)' (11) set to 9.80665, 'Reading Interval' (12) set to 100ms, 'Interval' (13) set to LBF, and a dropdown (14) set to 1. A red 'X' (15) is next to the LBF unit.
- Indicators:** A section for adding indicators (16) with a red 'X' (17) and the instruction 'Click an indicator below to add it to the read configuration.' An image of an HAD1 indicator (16) with ID 784895A1923 is shown.
- Active Indicators:** A section (18) with a red 'X' (19) and a '+' sign.
- Data Logging:** A table with columns for Target Value, Run 1, Run 2, and Run 3. Below the table are 'Clear Data' and 'Export to Excel' buttons.



1. **Main Reading** - Displays the sum of the most recent reading of each device that is included in the summation.
2. **Reading Units** - The units (13) shown by the main reading.
3. **Peak Reading** - Shows the highest value the main reading (1) reached since the values were last reset (8), captured (9), or a meter was tared (7).
4. **Valley Reading** - Shows the lowest value the main reading (1) reached since the values were last reset (8), captured (9), or a meter was tared (7).
5. **Enable Readings** - Enables/disables actively reading from the activated indicators (18).
6. **Settings Toggle** - Shows/hides the **Settings** pane.
7. **Tare All** - Will attempt to tare all actively read devices simultaneously and reset values (8).
8. **Reset Values** - Reset the peak (3) and valley (4) readings to the current reading.
9. **Capture Data** - Resets values (8) and captures data. More information in the [Capturing Data §3.2.3](#) section.
10. **Mass Conversion** - Enables/disables mass conversion calculations. Changes force units to mass units. Enables gravity controls (11).
11. **Local Gravity** - If converting to mass (10), the local gravity needs to be entered for an accurate conversion.
12. **Reading Interval** - Determines how fast readings should be updated for each active device.
13. **Engineering Units** - Shows either force or mass units. Changes the calculated value to account for the unit conversion, if applicable.
14. **Reading Resolution** - The resolution to calculate readings to as a power of 10.
15. **Close Settings** - Closes the **Settings** pane.
16. **Inactive Indicators** - Inactive, connected devices are shown here. Clicking on one will move it to **Active Indicators** (18).
17. **Close Indicators** - Closes the **Indicators** pane.
18. **Active Indicators** - Shows connected devices that will be read from when live readings (5) is enabled.
19. **Indicators Toggle** - Shows/hides the **Indicators** pane.



3.2.3. Capturing Data

The screenshot shows the 'Morehouse Calibration Software' interface. At the top, there are menu options: Start / Setup, Calibration, Report, and Help. The main display area is divided into several sections:

- Readings:** A large digital display shows '873.04 LBF'. To the right, 'Peak' is 920.86 and 'Valley' is 857.10. Below the display are buttons for 'Live Readings On', 'Tare All', 'Reset Values', and 'Capture Data' (11).
- Active Indicators:** This section contains two indicator cards. The top card shows '137.6%' and '1.20089' with a 'Load' button (3) and 'Add to Force Sum' checkbox (4). The bottom card shows '-37.6%' and '-0.00010' with a 'mV/V' button (9) and 'Add to Force Sum' checkbox. Below these are 'Tension' (7) and 'Compression' buttons, and a 'Tare' button (8).
- Data Logging:** A table on the right shows data for three runs. The table has columns for Target Value, Run 1, Run 2, and Run 3. Below the table are 'Clear Data' (15) and 'Export to Excel' (16) buttons.
- Bottom Status:** A status bar at the bottom left shows 'Max Individual Load - Min Individual Load: 1,528.74' (10).

Numbered callouts (1-16) point to specific UI elements: 1 (Live Readings On), 2 (Percentage), 3 (Load button), 4 (Add to Force Sum checkbox), 5 (HADI device), 6 (Load cell), 7 (Tension button), 8 (Tare button), 9 (mV/V button), 10 (Max/Min Load status), 11 (Capture Data button), 12 (Data Logging table), 13 (Run 3 dropdown), 14 (Data Logging text), 15 (Clear Data button), and 16 (Export to Excel button).



- 1. Contribution Percentage** - Displays the percentage this instrument contributes to the summation.
- 2. Instrument Reading** - Instrument's calculated value or raw reading.
- 3. Displayed Value** - Click to toggle.
 - **Load** is the calculated value.
 - **mV/V** is the raw reading from the instrument.
- 4. Add to Summation** - Toggle to include this instrument in the total.
- 5. Indicator** - Image of the indicator with its serial number underneath.
- 6. Instrument** - Load cell image with the instrument's serial number underneath.
- 7. Loading Mode** - Click to toggle. Switches between the compression and tension coefficients.
- 8. Tare** - Requests the indicator to tare and reset the peak and valley values.
- 9. Remove indicator** - Click to remove. Moves the indicator to the **Indicator** pane and stops reading from the indicator.
- 10. Reading Range** - Calculates the difference between the largest and smallest reading. Visible with 2 or more active indicators.
- 11. Capture Data** - Captures the current raw reading of each active instrument as well as the coefficients and if the instrument is included in the summation. The data is recorded into a data cell **(13)** and is recalculated whenever any **Setting** is modified.
- 12. Target Cells** - Enter the target value for each data point here. Used to calculate % error on the **Report Tab §3.2.4** or when data is exported **(16)**.
- 13. Data Cells** - Select the cell to capture data to it. When capturing data **(11)**, the selected cell's information will be updated.
- 14. Captured Data** - Contains indicator/instrument serial numbers and the raw reading with the calculated value.
- 15. Clear Data** - Clears the **Target Cells** and **Data Cells**.
- 16. Excel Export** - Exports the captured data to **Excel [§3.3.4]**.

See **Configuring Active Indicator Reading Panes §3.3.2** for more information.

See **Understanding the Data Grid §3.3.3** for more information about **Target Cells (12)**, **Data Cells (13)**, and **Captured Data (14)**.



3.2.4. Report Tab

Morehouse Calibration Software

Start / Setup Calibration **Report** Help

Load Cell: 355760A1923 (1) mV/V: -0.00003 (8) Tension
 Resolution: .1 (2) Value: 272.1 LBF (9) B₀ = 2.750702E+02 (10)
 Units: LBF (3) B₁ = 9.858617E+04
 Mass: (4) Gravity: 9.80665 (5)
 272.1126149 = 2.750702E+02 × -0.00003 + 9.858617E+04 × -0.00003 (6)
 272.1 LBF = RoundUp(272.1126149 / 0.1, 0) * 0.1 (7)

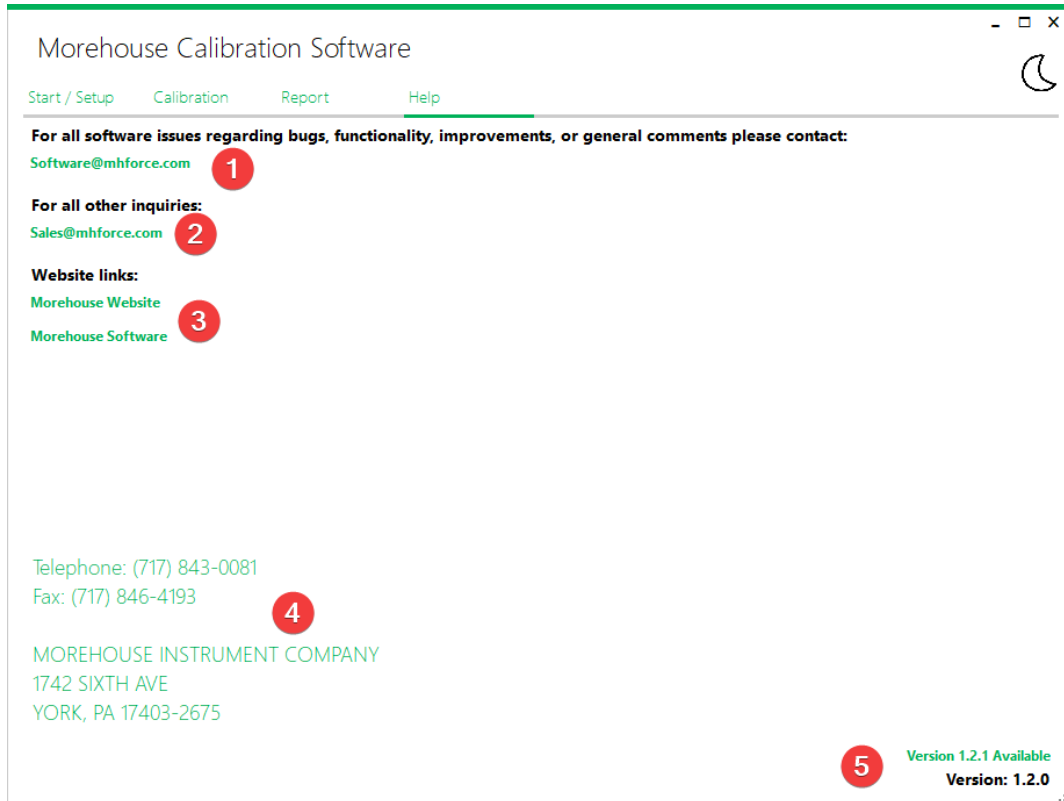
Target Value	Run 1	% Error	Run 2	% Error	Run 3	% Error	Run 4	% Error	Run 5
271.1	272.1	0.37%	271.1	0.00%	273.1	0.74%			
272.1	272.1	0.00%	271.1	0.37%	273.1	0.37%			
273.1	272.1	0.37%	271.1	0.73%	273.1	0.00%			

(11)

1. **Load Cell Serial Number** - Review captured data from the selected load cell.
2. **Resolution** - Performs the same as (14) in [Calibration Tab §3.2.2](#).
3. **Units** - Performs the same as (13) in [Calibration Tab §3.2.2](#).
4. **Mass Conversion** - Performs the same as (10) in [Calibration Tab §3.2.2](#).
5. **Local Gravity** - Performs the same as (11) in [Calibration Tab §3.2.2](#).
6. **Coefficient Calculation** - Shows the calculation used to turn a raw reading into the calibrated engineering unit. Updates when selecting a cell in the table (11). Copy button on the left will copy an Excel friendly version of the equation to the clipboard.
7. **Unit & Resolution Calculation** - Shows the calculation for resolution and unit conversion (including mass if applicable). Updates when selecting a data or % error cell in the table. Copy button on the left will copy and Excel friendly version of the equation to the clipboard.
8. **Captured mV/V** - Allows adjusting the raw reading if necessary. Updates when selecting a cell in the table (11). Forces all calculations to update when changing the value.
9. **Final Value** - The final calculated value with the units displayed (if applicable). Useful for viewing how modifying the raw reading affects the calculated value.
10. **Coefficient List** - Shows all coefficients for the selected load cell (Compression & Tension).
11. **Data Grid** - Shows the target and calculated values as well as the % error, using the reading resolution to improve accuracy. Can show NaN (not a number) or infinity. % error cell is yellow if the error less than 1%. An error over 1% turns red.



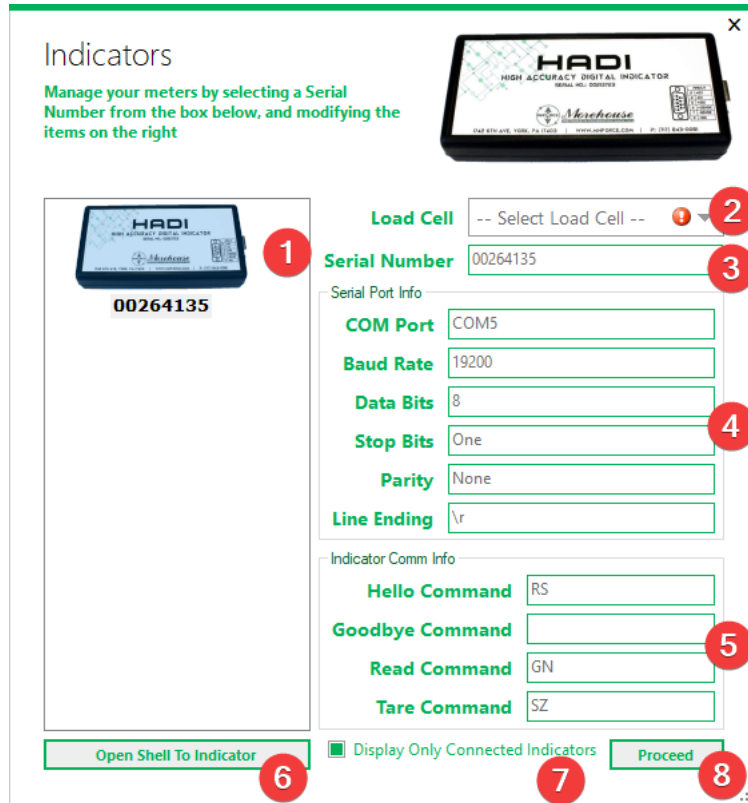
3.2.5. Help Tab



- 1. Email Software** - Creates a new email draft and populates the **To** and **Subject** fields to submit feedback to the software team.
- 2. Email Sales** - Creates a new email draft and populates the **To** and **Subject** fields to contact the Morehouse sales team.
- 3. Website Links** - Opens the Morehouse website. The **Software** link will open directly to the software page on the website.
- 4. Non-Digital Communications** - Morehouse contact information for users that prefer non-digital correspondence.
- 5. Version Number** - Displays the current version of the program. Additionally, the program will attempt to check for updates when the software is opened.
 - **Version x.x.x Available** - An update is available that will be downloaded when clicked. The update will still need to be installed manually.
 - **Up to Date** - The latest version is currently being used.
 - **Update Check Failed** - The software was unable to locate the latest version.



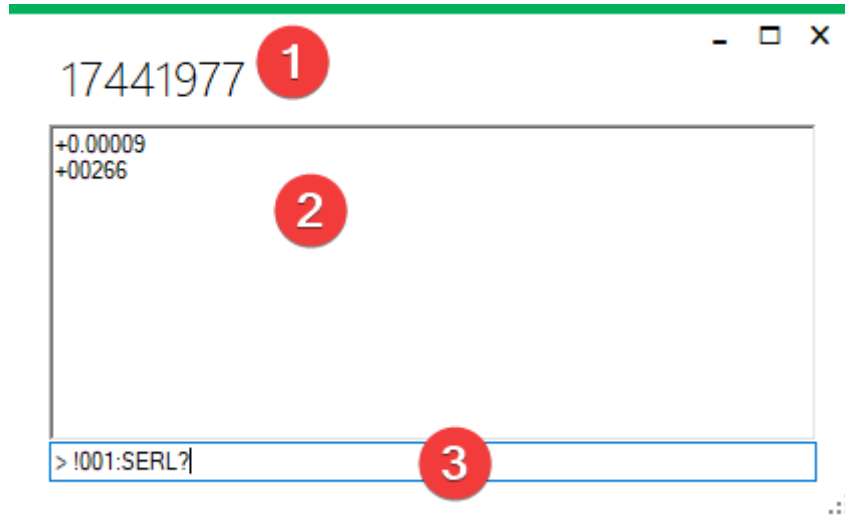
3.2.6. Indicator Screen



1. **Indicator Pane** - Shows connected/all indicators. Can be toggled (7).
2. **Load Cell** - The load cell's coefficients to use. Warns if a load cell isn't selected.
3. **Serial Number** - The meter's serial number.
4. **Serial Port Info** - Various configurations to establish a connection with the device.
5. **Communication Commands** - The commands the software uses to communicate with the device.
6. **Indicator Shell** - Opens a communication terminal to the device to send/receive messages.
7. **Connected Only** - Toggles between hiding/showing disconnected meters. Disconnected meter models are unknown so (4) and (5) are empty.
8. **Proceed Button** - Closes this window. If a connected device doesn't have a selected load cell (2), a prompt will appear before closing.



3.2.7. Shell Screen



- 1. Serial Number** - Indicator's serial number for easy reference.
- 2. Command History** - Shows all responses from the device.
- 3. Command Input** - Text entered here will be sent to the device once the **Enter** key has been pressed.



3.2.8. Instrument Screen

Instruments
x

Manage your instrument coefficients by selecting from the box below, or add a new instrument if empty.

1956855A1923
L785522BA1323
1191686A1923
P-9936A1823
1121595A1923
355760A1923
P-8560A1923
A0212016A0623
70387554A1723
Q13394-2A1823
1956855A2023
P-10597A2023
P-10596A1823
9701-2343A2023
134149A1823
1622313A2023
1845958A1923
U-8648A2023

Add
Delete

Instrument Name

Serial Number

Compression

Units

B₀

B₁

B₂

B₃

B₄

B₅

Tension

Units

B₀

B₁

B₂

B₃

B₄

B₅

DRAG & DROP CERTIFICATES TO IMPORT THE COEFFICIENTS.

Proceed



- 1. Instruments** - Collection of all instruments currently saved in the database by serial number. Selecting one will update the other fields.
- 2. Add Instrument** - Creates a new instrument. A new instrument can only be created if the previously created instrument has been assigned a name.
- 3. Delete Instrument** - Deletes the currently selected instrument.
- 4. Instrument Name** - Allows the currently selected instrument's name to be updated. An error will appear if the name is not unique or is blank/contains only spaces.
- 5. Serial Number** - Allows the currently selected instrument's serial number to be updated. An error will appear if the serial number is not unique, is blank, or contains only spaces.
- 6. Compression Units** - Compression force units the instrument was calibrated for. For non-force instruments, leave the units as **LBF** and be sure to enable **Ignore Units (8)** on the **Start/Setup Tab §3.2.1**.
- 7. Compression Coefficients** - Coefficients for the compression mode found on the certificate. For non-force instruments, this would be one mode, like clockwise, vacuum, etc.
- 8. Tension Units** - Tension force units the instrument was calibrated for. For non-force instruments, leave the units as **LBF**.
- 9. Tension Coefficients** - Coefficients for the tension mode found on the certificate. For non-force instruments, this would be the other mode (if applicable), like counter-clockwise, pressure, etc.
- 10. Import Certificates** - Drag & Drop Morehouse calibration certificates to automatically import their information. See **Importing Certificates §3.3.1** for more information.
- 11. Proceed Button** - Closes the window. If there are any errors on an instrument, the user will be prompted before exiting.

3.3. Detailed Operation

3.3.1. Importing Certificates

Only digital calibration certificates generated by Morehouse for Single Run or E74 calibrations are supported at this time. Other certificate formats must be entered manually.

To import a calibration certificate, drag and drop the certificate file(s) (from **File Explorer**) onto the **Instrument Screen §3.2.8**. If importing a single file, the calibration **report number** from the certificate is matched against the currently selected instrument. The comparison made is **<serialNumber><DateCode>** and **<serialNumber>**. In the event of a match, the current instrument's data is updated with the information contained in the certificate. If the comparison doesn't match, other existing instruments are checked for a match. If one is found, the user is asked to update the existing one or the currently selected one. When there is no match to any existing instrument, the user will be asked to either update the currently selected instrument or create a new one.



When importing multiple certificates at once, there are no prompts. A status bar is displayed to show the progress of the import. During the import process, each certificate report number is compared against all existing instruments in the software using the above-mentioned comparison method. If an existing instrument matches, its information is updated with the information in the certificate. If no existing instrument matches, a new instrument is created in the software with the information from the certificate.

When bulk importing, the process will continue silently until complete. Upon completion, the user will be notified of any certificates that failed to import and the file's name. If importing a single certificate, and it isn't recognized, the user is notified it doesn't match a supported format.

3.3.1.1. Importing a Single Certificate Example

If the report number of the certificate is **S-12345B2023**, the software will look to see if an instrument with the name or serial number of **S-12345B2023** exists. If it doesn't, it checks to see if an instrument with the name or serial number of **S-12345** exists. The software extracts the instrument's serial number as **S-12345** and the date code as **B2023** (2/20/2023).

- The currently selected instrument is **S-11111** and there were no matches
 - The user is asked to create **S-12345B2023** or update **S-11111**
- The currently selected instrument is **S-11111** and **S-12345B2023** exists
 - The user is asked to update **S-12345B2023** or update **S-11111**
- The currently selected instrument is **S-12345**
 - The instrument **S-12345** is updated silently

3.3.1.2. Importing Multiple Certificates Example

During the import process, no prompts are provided. Like in **Importing a Single Certificate Example §3.3.1.1**, a match with the report number or just the serial number is looked for. If there is a match to an existing instrument, it is updated silently. Otherwise, a new instrument is created.

- Importing **S-12345B2023** and **S-12345** exists
 - **S-12345** is updated silently
- Importing **S-12345B2023** and there were no matches
 - **S-12345B2023** is created silently

3.3.2. Configuring Active Indicator Reading Panes

Active indicators have several settings that can be changed independently of other indicators. Clicking on **Load** to show the **mV/V** (raw) reading is beneficial for troubleshooting if the software is not operating as expected. Otherwise, the **Load** mode is generally used.

Toggling between loading modes (**Compression/Tension**) switches between the two sets of calibration coefficients.



Including an indicator in the summation of readings will add its force value to other indicators that are included in the summation. The sum is shown on the **Main Display (1) §3.2.2**. Some use cases may require standard(s) and unit(s) under test (UUT). To support this operating mode, the UUT(s) can be removed from the summation as their readings are still captured for data export. Any combination of standard(s) and UUT(s) are supported.

Loading mode and summation inclusion settings must be configured before capturing any data. If they were misconfigured during data capture, the data must be recaptured.

3.3.3. Understanding the Data Grid

If a technician is targeting a predetermined set of values (for example 10% points), the target values **(12) §3.2.3** can be entered before capturing any data. Alternatively, if target values are unknown ahead of time or not needed, they can be left blank. Regardless, a data cell **(13) §3.2.3** must be selected to record data. Once the data has been captured, the cell below the current one is selected, adding a new row to the table if necessary. Focus is returned to the **Capture Data** button for quick, repeated data capture.

When the **Capture Data** button is pressed while a target value **(12) §3.2.3** is selected, the technician will be asked if they want to capture data in the adjacent data cell. If the technician chooses no, nothing is done. A technician can also overwrite existing data by selecting a data cell that already contains data and press **Capture Data** again. Previous data will be lost.

When capturing data, only the raw reading, loading mode (compression/tension) coefficients, and summation inclusion state are recorded. This allows existing data to be recalculated if the units or resolution of the software are changed. It also allows a technician to modify captured data.



3.3.4. Exporting Captured Data

Negative Coefficients			Captured				Calculated			
	B0		Target	Run 1	Run 2	Run 3	Target	Run 1	Run 2	Run 3
	B0	3.798979E+01	30000	0.03182	0.03179	0.03176	30000	10026	10017	10007
	B1	3.138716E+05	90000	0.09541	0.09542	0.09544	90000	29988	29991	29997
	B2	3.171438E+02	150000	0.15915	0.15913	0.15909	150000	49999	49993	49981
	B3	5.063792E+01	300000	0.31840	0.31840	0.31834	300000	100009	100009	99990
			450000	0.47749	0.47756	0.47750	450000	149987	150009	149990
			600000	0.63660	0.63667	0.63660	600000	199991	200013	199991
			900000	0.95467	0.95467	0.95456	900000	300015	300015	299981
			1200000	1.27235	1.27244	1.27226	1200000	400011	400039	399982
			1350000	1.43104	1.43109	1.43098	1350000	449999	450015	449980
			1500000	1.58971	1.58974	1.58963	1500000	500008	500018	499983
			1800000	1.90664	1.90676	1.90663	1800000	599983	600020	599979
			2100000	2.22334	2.22333	2.22325	2100000	700006	700003	699978
			2400000	2.53958	2.53958	2.53948	2400000	800015	800015	799984

The software is capable of exporting the captured data either to a new or existing Excel workbook. After selecting to either create a new workbook or open an existing one, the software will work through the workbook over a few different phases. Additionally, several Excel named ranges will be used by the software. If a named range already exists in the workbook, the contents of that range are updated (beneficial for template workbooks). If the range doesn't exist, it is created. The following ranges are used by the software:

NOTE: The <serial number> is sanitized for use as a named range. This replaces every character that isn't a letter, number, or period with an underscore (_).

NOTE: The <serial number> is sanitized for use as a worksheet name. This replaces the characters : \ / * [] with an underscore (_).

- **RAW_<serial number>** - Captured data from the instrument.
- **CALC_<serial number>** - Calculated values after polynomial, unit conversion, mass conversion, and resolution.
- **NEG_<serial number>** - Negative (compression) coefficients.
- **POS_<serial number>** - Positive (tension) coefficients.
- **LocalGravity** - The local gravity in m/s². Only used if doing mass conversion.
- **StandardGravity** - The average gravity value in m/s². Only used if doing mass conversion.
- **Resolution** - The precision to round the values to and/or the number of decimals to show (if significant).
- **TargetValues** - The values the totals should add up to.
- **<unit name>** - First letter capitalized. Values are per pound.



Named ranges can be managed via the **Name Manager** in Excel. The Name Manager can be found under the **Formulas** tab. Existing named ranges can have its location changed or be deleted. While a named range tutorial is beyond the scope of this manual, the **INDEX** function can be used to access the contents of a named range. For example, **=INDEX(RAW_S_12345,2,1)** will return the value in the second row of the first column of the **RAW_S_12345** named range. For an example, check the formulas in the calculated tables of an instrument or the overview worksheet.

3.3.4.1. Phase 1: Creating the Overview Worksheet

If the spreadsheet **MCS Calculated** exists, its contents are cleared, otherwise the software will create that spreadsheet. Unit conversion rates and the software's configured resolution are written. If mass conversion was used, the configured local gravity and average gravity values are written as well.

The named ranges **LocalGravity** and **StandardGravity** are used to store the local gravity and average gravity values. The named range **Resolution** is used to store the software's configured resolution. The named ranges **<unit name>** are used to store the unit conversion rates. If these named ranges already exist, their contents are updated. Otherwise, they are created in their respective locations on this sheet.

Additionally, the software will create the overview run tables. These tables are named **Run<run number>Table** and are used to store the summation of the chosen captured data for a given run. The named range **TargetValues** is used to store the target values. If the named range doesn't already exist elsewhere in the workbook, it is applied to the left most column of the first run table. The tables will include the aforementioned Target column, as well as a total column and a column for each instrument.

3.3.4.2. Phase 2: Creating the Instrument Worksheets

NOTE: The <serial number> is sanitized for use as a named range and table names. This replaces every character that isn't a letter, number, or period with an underscore (_).

NOTE: The <serial number> is sanitized for use as a worksheet name. This replaces the characters : \ / * [] with an underscore (_).

For each instrument's serial number, the software will create a new worksheet named **Data <serial number>**, following the above note. If the worksheet already exists, its contents are cleared first. The coefficients for the instrument (both positive and negative coefficients) are written to the worksheet. The named ranges **NEG_<serial number>** and **POS_<serial number>** are used to store the negative (compression) and positive (tension) coefficients respectively. If these named ranges already exist, their contents are updated. Otherwise, they are created in their respective locations on this sheet.



Additionally, the software will create the captured data table and the calculated data table. These tables are named **Captured<serial number>Table** and **Calculated<serial number>Table** respectively. The named ranges **RAW_<serial number>** and **CALC_<serial number>** are used to store the captured and calculated data respectively. If these named ranges already exist, their contents are updated. Otherwise, they are created in their respective locations on this sheet.

To provide transparency, the software will create Excel formulas to calculate the values the same way it does. If there is no captured data for a specified point, the calculated value will be blank.

3.3.4.3. Phase 3: Filling the Run Overview Tables

Back on the **MCS Calculated** spreadsheet, the run data tables are filled in with references to the captured and calculated data named ranges for each instrument. If a reading was omitted from summation, the value will be turned gray to help distinguish from the included values. The total column is also filled in with the sum of the included values.

4. Quick Start Guide

4.1. Checklist

1. Verify the instrument's coefficients are set and correct.
2. Verify indicators are connected to the computer and not in use in another program.
3. Search for indicators to read from.
4. On each indicator, select the connected instrument from the drop-down.
5. Navigate to the Calibration tab and activate indicators to read from.
6. Configure indicator settings.
 - Tension/Compression
 - Summation
7. Configure reading settings.
 - Reading Interval
 - Resolution
 - Units
 - Mass/Gravity
8. If necessary, pre-enter target values in the first column of the data grid.
9. Enable live readings.
10. Choose the cell in the data grid where desired to capture the first reading.
11. Press the capture data button to capture a reading.
12. Review captured data, if desired.
13. Repeat steps 10 - 12 until enough data has been collected.
14. Export to Excel.



4.2. Detailed Guide

Opening the **Instrument Screen §3.2.8** allows a technician to view all configured instruments. Selecting any of them will allow both sets of coefficients to be displayed. If necessary, modify the coefficients to match the current ones for the instrument. Once all instruments are properly configured, exit the **Instrument Screen §3.2.8**. If necessary, **Ignore Calibration Units** can be enabled here to hide the units throughout the software. See **Removing Force Units §5.1** for more information.

To discover indicators, ensure all devices are connected to the computer, their drivers have already been installed, and none of the devices are currently in use by another program or the system. If necessary, verify the indicator is plugged in and turned on. Choose the indicator models on the **Start/Setup Tab §3.2.1** and press **Search Indicators**. Once indicators have been found, verify that each indicator on the **Indicator Screen §3.2.6** is paired with the correct instrument and close the screen. If 1 or more connected indicators isn't found, refer to **Missing Indicator §5.4** for more information.

Switch to the **Calibration Tab §3.2.2** to obtain readings from the newly discovered indicators. Select whichever indicators to use from the inactive indicators' pane. If all inactive indicators are activated, the pane will automatically close, otherwise, the red **X** will close the pane manually. If the pane needs to be reopened, press the green plus at the bottom right of the active indicators' pane. Each active indicator can be configured independently for tension/compression and to include the indicator's value into the summation shown on the **Main Display**. Additionally, the reading can be changed from the calculated value (**Load**) to show the raw reading (**mV/V**).

Reading settings can also be modified. The system's resolution can be configured in powers of 10, rounding accordingly. The resolution can be changed at any time, even during live readings or after data has been captured. Engineering units, mass, and gravity can also be set now, during live readings, or after data has been captured. When enabling mass readings, the engineering units options will change from force units to mass units. All of these settings will cause the readings to be recalculated. Additionally, the **Reading Interval** at which a new reading is displayed for the software can be configured. A longer interval could allow the readings to be more stable.

The **Settings Pane** can be closed with the red **X** or by pressing the gear icon next to the **Live Reading** toggle. To open the settings again, simply press the gear icon next to the live reading toggle. If target values are known prior to starting the calibration, they should be entered into the first column of the **Data Logging** data grid. Just select the first data cell and type the target value in. Pressing **Enter** after the value has been entered, the next cell down will be selected, making it easy to enter all the values quickly. If necessary, a new row will be automatically added once the last row is reached.

Before **Capturing Data §3.2.3**, the **Live Readings** toggle must be enabled. This will begin communication with each of the active indicators, causing their displays to update within their corresponding panels. This update always occurs after the reading interval has elapsed. If necessary at this time, an indicator can be tared using the button on its panel or all indicators can be tared simultaneously via the **Tare All** button. Taring can also be performed at any time the software is actively reading from 1 or more indicators.



Choose a cell in the **Data Logging** data grid. The chosen cell will have data entered into it once the **Capture Data** button is pressed. After the data has been entered into the chosen cell, the next cell down will automatically be selected, creating a new row if that cell was in the last row. Repeat this step as many times as necessary until all desired data has been captured. If additional runs are required, select a cell in the next run's column and repeat this entire step as necessary.

While **Capturing Data §3.2.3**, the **Report Tab §3.2.4** can be chosen at any point to review collected data. The tab provides the calculated % error for the reading from the target value. For convenience, coefficients are shown for the selected instrument. Readings and settings can also be modified on this screen as necessary.

If no more data is to be collected, live readings can be disabled without losing data. Optionally, an active indicator can be removed by pressing the red **X** in the top right of an active indicators' panel. The data can also be exported to an Excel spreadsheet **§3.3.4**.

5. FAQ - Frequently Asked Questions

5.1. Removing Force Units

Question: Our company does more than just force and mass calibration/measurements. Is there a way to remove the unit label to help remove confusion for our technicians?

Answer: Yes. Enabling the **Ignore Calibration Units (8)** checkbox on the **Start/Setup Tab §3.2.1**, all unit labels are removed from the program. Due to a technical limitation though, the **Instrument Screen §3.2.8** still requires a unit to be selected.

Please note that when this feature is enabled, the unit of Force/Mass dropdown is disabled and simply displays "As Calibrated". Additionally, the Mass toggle and Gravity text box are also disabled. Finally, any points captured while this feature is enabled will not record any unit of measurement data.

5.2. Force Summation

Question: Can I use multiple indicators and load cells to calculate force?

Answer: Yes. Force summation is supported.

1. Ensure all load cell coefficients and indicators are set up. See **Instrument Screen §3.2.8** and **Indicator Screen §3.2.6** for instructions.
2. Select the indicators to be used in the calculation. See **Capturing Data §3.2.3** for instructions.
 - Each selected indicator/instrument will have its own region for control and display purposes
3. An indicator can be ignored temporarily by unchecking the Add to Force Sum checkbox for the indicator.
4. Set the Force/Mass toggle.
5. Capture data and export as before.
6. The exported data will contain all devices.



5.3. Missing Indicator

Question: Why isn't my indicator showing up?

Answer:

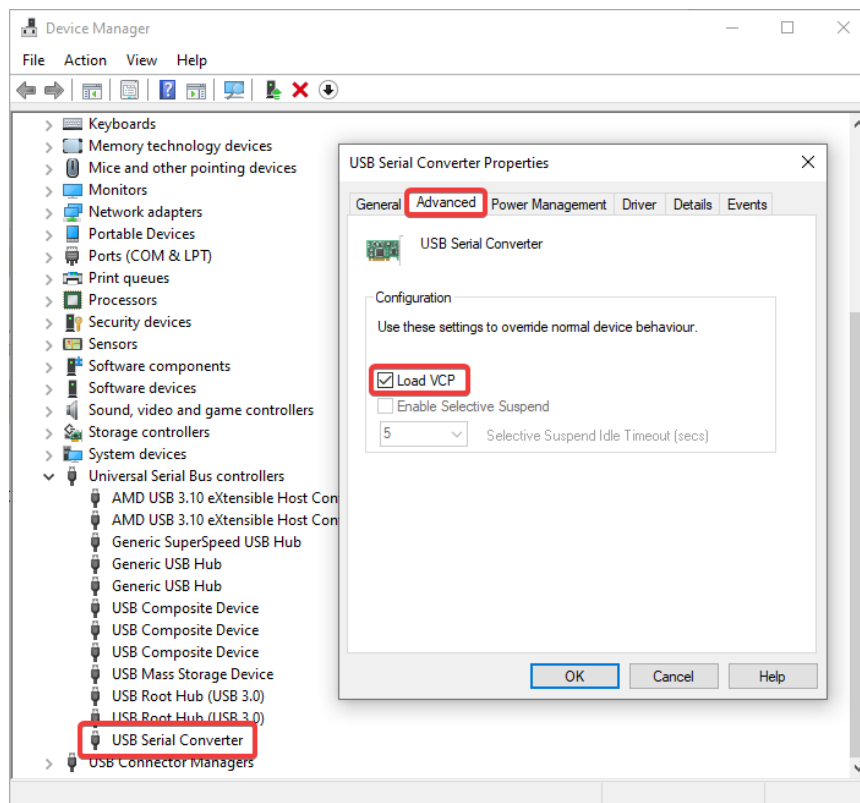
1. If using a Morehouse 4215 indicator, ensure that the "Add Line Feeds" option is enabled via the front panel controls.
2. The indicator may not be properly connected. Please ensure the connection to the computer is good.
3. The indicator's driver may not have been installed. Please refer to **Indicator Drivers §2.5** in this document for further instructions.
4. The indicator may be in use by another program. Please stop any other programs that may be using the indicator or restart the PC.
5. As a last attempt, please see **Resetting COM Ports §5.5**.

5.4. Missing HADI Indicator

Question: Why isn't my HADI indicator being detected?

Answer:

1. Complete the steps in the **Missing Indicator §5.3** first
2. Open the computer's Device Manager via Control Panel or right-clicking on the start menu and selecting Device Manager
3. Find the **Universal Serial Bus controllers** device category and expand to view all devices
4. Locate the **USB Serial Converter** device and right click on it and select **Properties**.
5. Navigate to the **Advanced** tab and enable **Load VCP**



5.5. Resetting COM Ports

Question: I am having unexplained indicator issues, how do I reset my COM ports?

Answer: Follow the instructions below, but be aware of the warning.

WARNING: These steps will also remove any other COM devices. Use with caution!

1. Open the computer's Device Manager via Control Panel or right-clicking on the start menu and selecting Device Manager
2. Find the **Ports (COM & LPT)** device category and expand to view all devices
 - USB Serial Port (HADI), USB COM Port (4215), or USB DSC Port (DSC) may be listed
3. Select each listed device from the Ports (COM & LPT) category and right click and select **Uninstall Device**
4. Disconnect the indicator's USB cable from the PC and then reconnect it. If it is not automatically detected, click on the Scan for hardware changes button at the top of the device manager