# Detroit Hoist Lidar Travel Limit System

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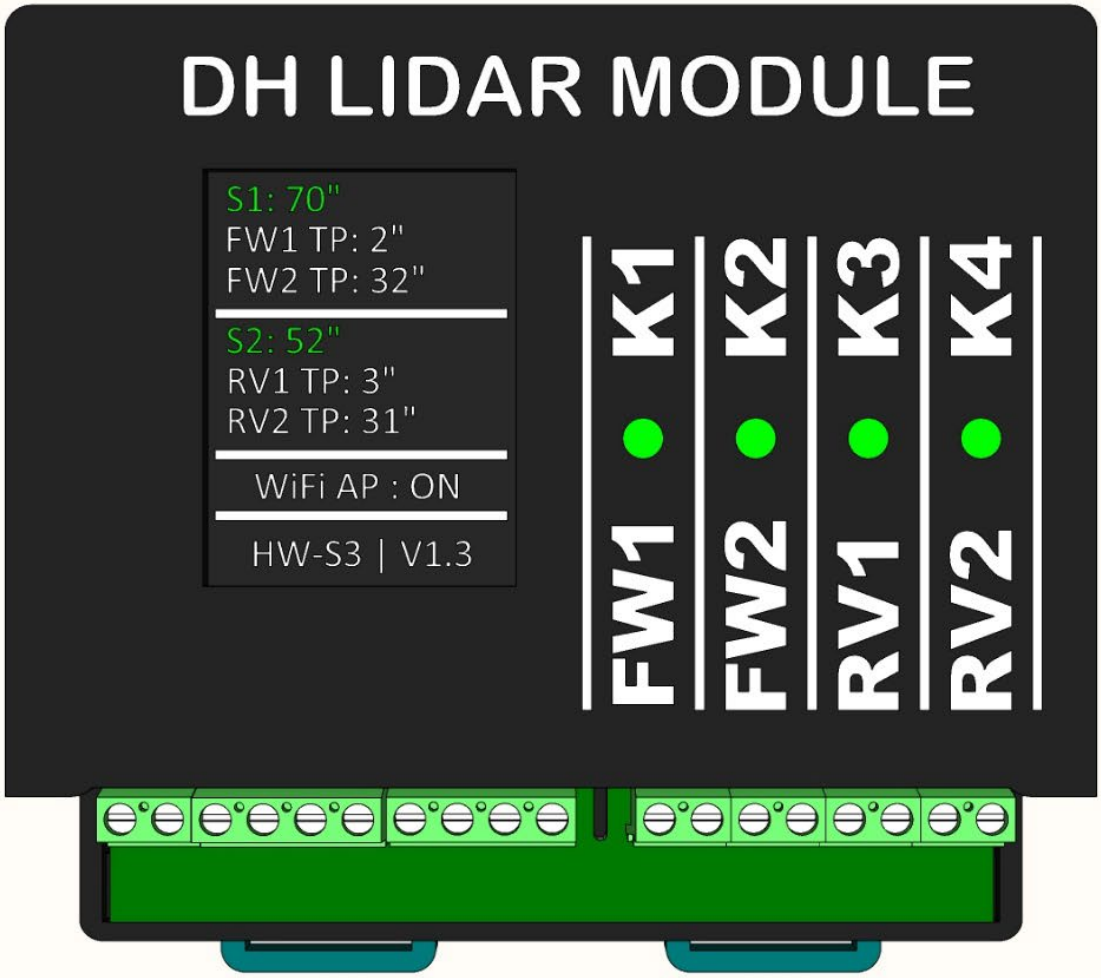

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## BASIC SPECIFICATIONS

For specifications that are not listed please contact Detroit Hoist for further information.

- Class 2 low voltage limited energy circuit 7-24vdc (24vdc typical) input power supply 350mA max, diode reverse polarity protected.
- (4) relays using N.O contacts. (2) relays for each direction slow and stop trip points.
- LED indicators for each status relay.
- ESP32 based microcontroller using self-hosted webserver (no application or internet required).
- 2.0” 320x240 IPS TFT display for module read out.
- WPA2 password protected Wi-Fi access point to securely allow wireless programming and adjustments to the system. No app to download, just connect to the Wi-Fi access point of the module and view the data and program the trip points from your browser.
- Wi-Fi toggle switch to allow disabling of the Wi-Fi radio and access point after initial programming.
- DIN rail mounted 3D printed PETG enclosure.
- (2) LiDAR sensors IP65 rated sensing range 40m max. (spot size dependent)
- Class 1 (IEC60825) 850nm wavelength, VCSEL light source.
- LiDAR sensor distance accuracy +/- 1% (5m-40m) | +/- 5cm (0.1m – 5m) based on 90% reflectivity surface (white object).
- Ambient light immunity 100Klux, FOV 3°, frame rate 100Hz.
- Modbus RS485 communication protocol between sensor and controller to provide highly robust, standard industrial communication protocol designed for harsh environments, offering noise immunity through differential signaling and supporting long distances up to 1200 meters.

## GENERAL OVERVIEW

The LiDAR travel limit system was created to provide a cost effective non mechanical travel limit system that can be programmed and adjusted wirelessly based on the LiDAR concept. LiDAR stands for light detection and ranging. The sensor works by using laser pulses to measure distance by calculating the time light takes to reflect back to the sensor also known as time-of-flight. This concept is unique because it does not require any welding of trip brackets to trip switches and serves as slow down and stop limits in each direction. Inherently by design since the LiDAR sensors are measuring distance of objects in front of the sensor it can also act as anti-collision.

Mechanical limit switches can provide a cost-effective solution for a single hoist or bridge crane but come with some downfalls, whereas the LiDAR based systems can accommodate those downfalls without additional cost.

**Mechanical limit switches downfalls**

- If deceleration times in the VFD are increased or decreased, then the trip point arms must be physically moved to accommodate for the changes in deceleration time.
  With the LiDAR based system you can use the wireless system to adjust the trip points from the ground with a phone, tablet, or computer. The module serves as a webserver and does not require any app to download, simply connect to the Wi-Fi access point and uses your web browser.

- If additional cranes are added to a runway, then anti-collision systems are typically required.
  With the LiDAR based system make sure the LiDAR sensor has a white surface to range off from the additional crane and wirelessly adjust the trip points if needed.

- If additional hoists are added to a bridge, then anti-collision systems are typically required.
  With the LiDAR based system make sure the LiDAR sensor has a white surface to range off from the additional hoist and wirelessly adjust the trip points if needed.

## SPOT SIZE REQUIREMENTS

The detection angle of TF02-i is 3°. At different distances, the size of light spot, namely the edge length of the detection range, is different. Side length of the detection range at different distances (the detection range is a square), as shown below.

| **Ranging Distance (m)** | 1 | 2 | 3 | 5 | 7 | 10 | 20 | 30 | 40 |
|---|---|---|---|---|---|---|---|---|---|
| **Spot Size (cm)** | 5 | 10 | 16 | 26 | 37 | 52 | 105 | 156 | 208 |

## LIDAR SENSOR SAFETY / WARNINGS

The Benewake TF02 is rated as a Class 1 eye-safe laser product under IEC/EN 60825 standards. Warnings on such sensors are standard legal and safety precautions, but normal operation poses no risk to human eyes. Avoid Magnification: Never look directly into the operational lens through magnifying glasses, microscopes, or camera lenses.

## LIDAR SENSOR MAINTENANCE

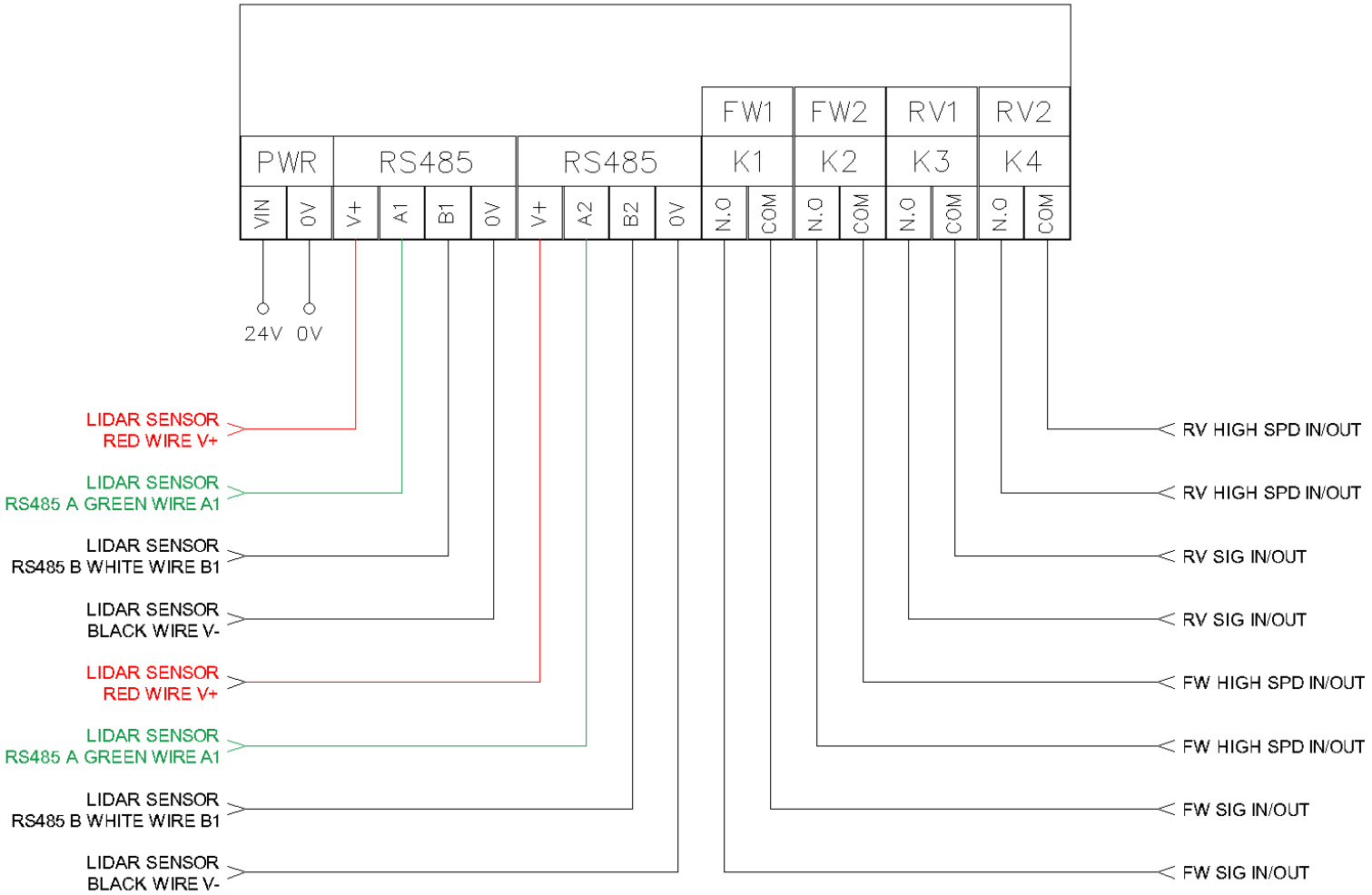
To provide the best accuracy from the sensors it is recommended to periodically clean the sensors lens and the white plate that the sensor range off from. Use a damp cloth to wipe the sensors lens. **DO NOT USE any solvents or alcohol to clean the lens of the sensor.**

## LIDAR SENSOR INSTALLATION

**DO NOT align the opposing sensors directly with each other.** The sensors must not be aligned with reflective surfaces like mirrors, windows, or reflectors. The proper surface should be white in color and be a matte finish.

## MODULE WIRING

The module relays are set up to use the N.O contacts of the relays. This is intended to prevent motion until the system is ready and the sensors are reading properly. The system uses 24vdc as the input power supply for the module and sensors. A isolated class 2 power supply is required.



## Wi-Fi SWITCH

To use the self-hosted webserver access point the Wi-Fi switch must be in the ON position. The device does not require the Wi-Fi to be on for normal operation only for configuration. The Wi-Fi switch is located on the top right of the module enclosure. The status of the switch will be display on the 2.0” color display. The Wi-Fi switch is shown below highlighted in orange.

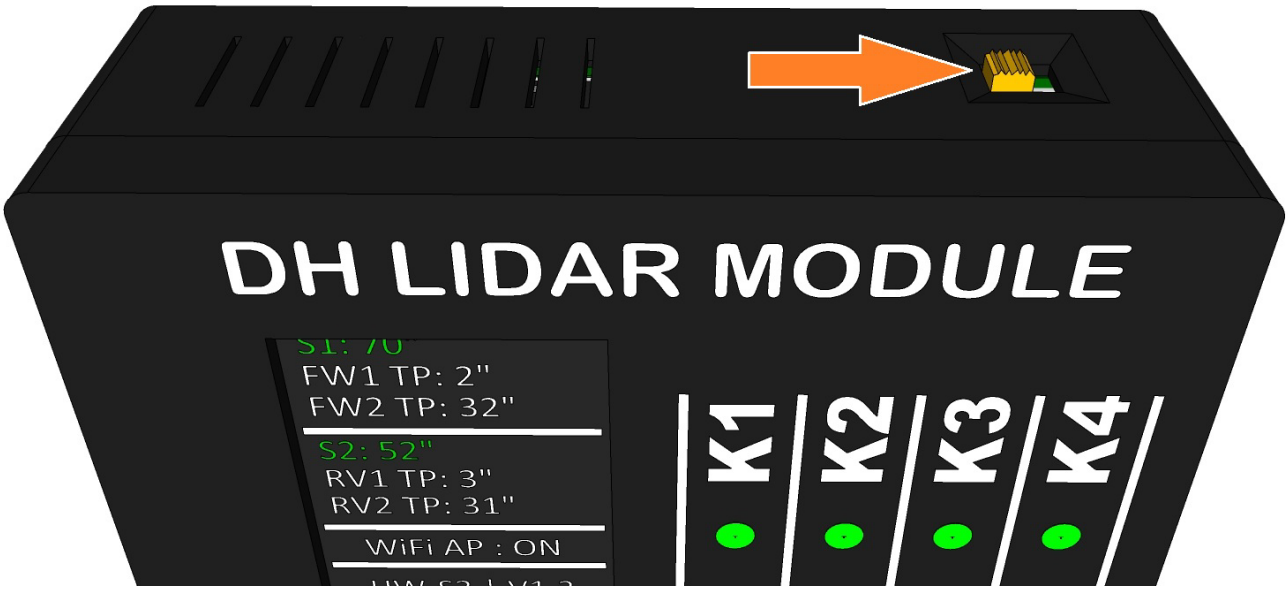



*Figure 1 - Hardware HW-S3 Wi-Fi Switch*

## MODULE DISPLAY

The module has a 2.0” TFT color display that provides real time information about the sensor’s status, distance readings, trip points, Wi-Fi switch status, hardware version, and firmware version.

| | |
|---|---|
| **S1 : 69”**<br>**FW1 TP: 2”**<br>**FW2 TP: 32”** | <- Sensor 1 reading<br><- Sensor 1 stop trip point distance<br><- Sensor 1 slow trip point distance |
| **S2 : 84”**<br>**RV1 TP: 2”**<br>**RV2 TP: 30”** | <- Sensor 2 reading<br><- Sensor 2 stop trip point distance<br><- Sensor 2 slow trip point distance |
| **WiFi AP: ON** | <- Wi-Fi switch status |
| **HW-S3 \| V1.3** | <- Hardware (S3) \| Firmware V1.3 |

*Figure 2 - Module Display*

## CONNECTING TO MODULES WEBPAGE

The module has a built-in webserver that doesn't require any outside internet connection. Using a phone, tablet, or computer you can connect directly to the modules Wi-Fi network to configure the modules settings and update the firmware.

Search for available Wi-Fi networks using your device and select the lidar modules network name and enter the password. The default Wi-Fi network name and password will be as shown below. Once connected the captive portal will open at the main tab of the webpage interface. If your mobile device does not support captive portals, then once connected open a browser tab and in the URL type 192.168.4.1 and enter.

| Default Wi-Fi Network Name | Default Password |
|---|---|
| DH-Lidar-Module | Xcal@!!187 |

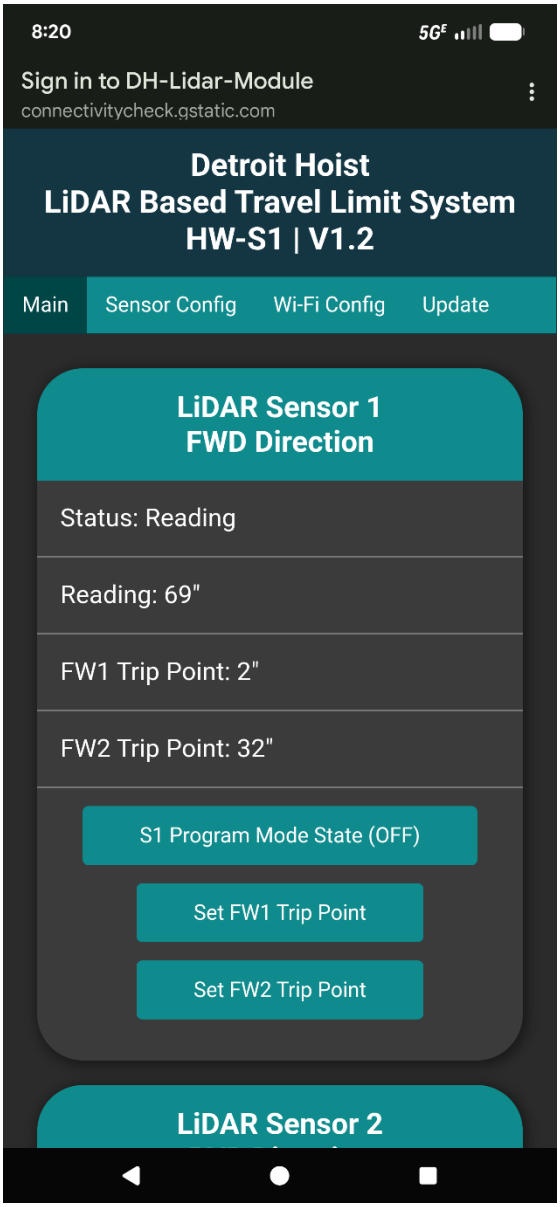



*Figure 3 - Captive Portal*

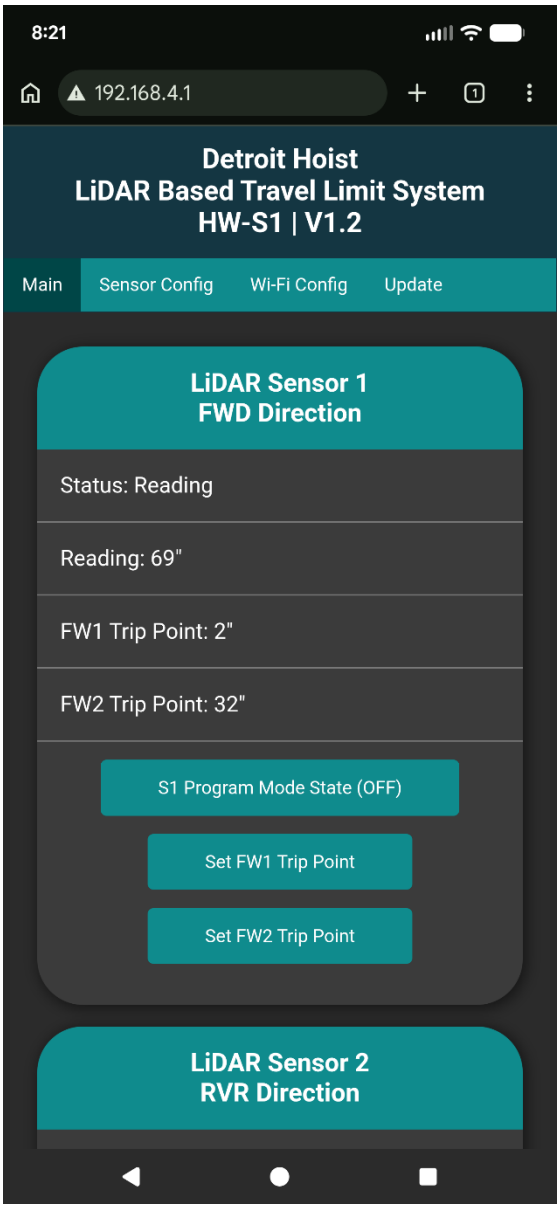



*Figure 4 - URL Page*

## PROGRAMMING THE LIMITS

In order to connect to the module's web interface, the Wi-Fi switch must be on, and the display reads **WiFi AP : ON**. Follow the process below to set the forward and reverse trip points.

| | |
|---|---|
| **Step 1** | Connect to the modules Wi-Fi network using a mobile device or PC. Once on the webpage interface navigate to the "**Main**" tab if not already there. |
| **Step 2** | Press the "**(S1) Program Mode State**" button if setting the FW1 & FW2 limits.<br>Press the "**(S2) Program Mode State**" button if setting the RV1 & RV2 limits.<br>It will show (ON) indicating program mode is on. |
| **Step 3** | In the direction that is being programmed run the trolley or bridge to the desired distance in which to start slowing down. |
| **Step 4** | Press the "**Set (FW2) Trip Point**" button to store the slow down distance if setting the FW2 limits.<br>Press the "**Set (RV2) Trip Point**" button to store the slow down distance if setting the RV2 limits. |
| **Step 5** | In the direction that is being programmed run the trolley or bridge to the desired distance at which to stop. |
| **Step 6** | Press the "**Set (FW1) Trip Point**" button to store the stop distance if setting the FW1 limits.<br>Press the "**Set (RV1) Trip Point**" button to store the stop distance if setting the RV1 limits. |
| **Step 7** | Press the "**(S1) Program Mode State**" button if setting the FW1 & FW2 limits.<br>Press the "**(S2) Program Mode State**" button if setting the RV1 & RV2 limits.<br>It will show (OFF) indicating program mode is off. |
| **Step 8** | In the direction that is being programmed verify the limits are working correctly and adjust if needed. |

## SENSOR BYPASS

If a sensor is not working correctly, damaged, or not performing within the environment you can bypass the specific sensor. The bypass status is stored in memory, so it is not required to bypass the sensor each time it is used. To bypass a sensor, you must use the modules web interface and navigate to the “Sensor Config” tab. The modules display will indicate if the sensor is in bypass mode.

To bypass sensor 1, press the “S1 Bypass Mode State” button. The state of the sensor is shown in the button (OFF) / (ON).

To bypass sensor 2, press the “S2 Bypass Mode State” button. The state of the sensor is shown in the button (OFF) / (ON).

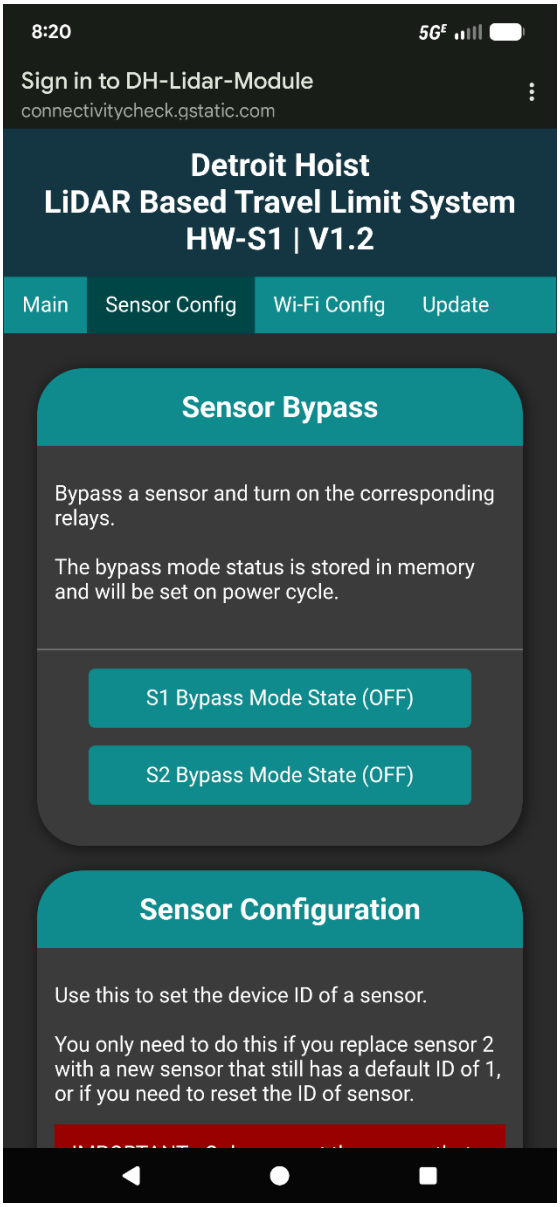



*Figure 5 - Sensor Bypass Mode*

## SENSOR ID CONFIGURATION

Each sensor must have a separate device id. Sensor 1 will have a device id of 1 and sensor 2 will have a device id of 2. In the case of replacing sensor 1 nothing is required since the default device id is 1. If replacing sensor 2 you would need to set the device id to 2. You can use the modules web interface to set the device id to 2, be sure to only have the sensor connected that needs to have the device id changed.

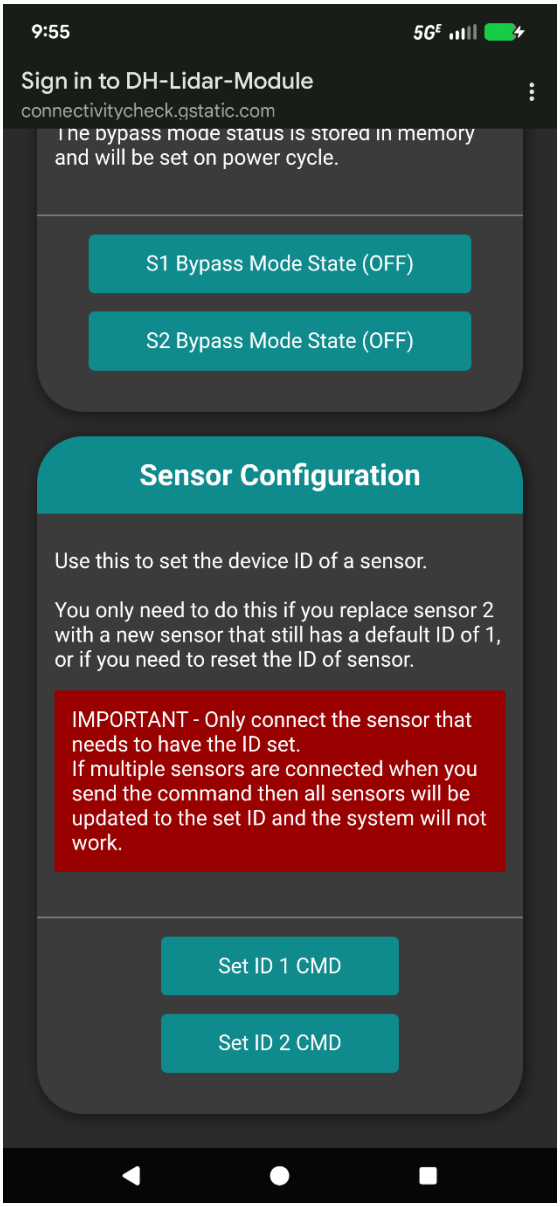



*Figure 6 - Set Device ID*

## Wi-Fi CONFIGURATION

You can rename the Wi-Fi network and change the password. If multiple systems are installed changing the Wi-Fi name to a unique name that helps identify the system to the specific hoist or crane is suggested. The Wi-Fi channel number can be changed if multiple systems are nearby or other wireless networks are on the same channel.

After making any changes to the network name, password, or channel the module will reboot to apply the changes.

| Default Wi-Fi Network Name | Default Password |
|---|---|
| DH-Lidar-Module | Xcal@!!187 |

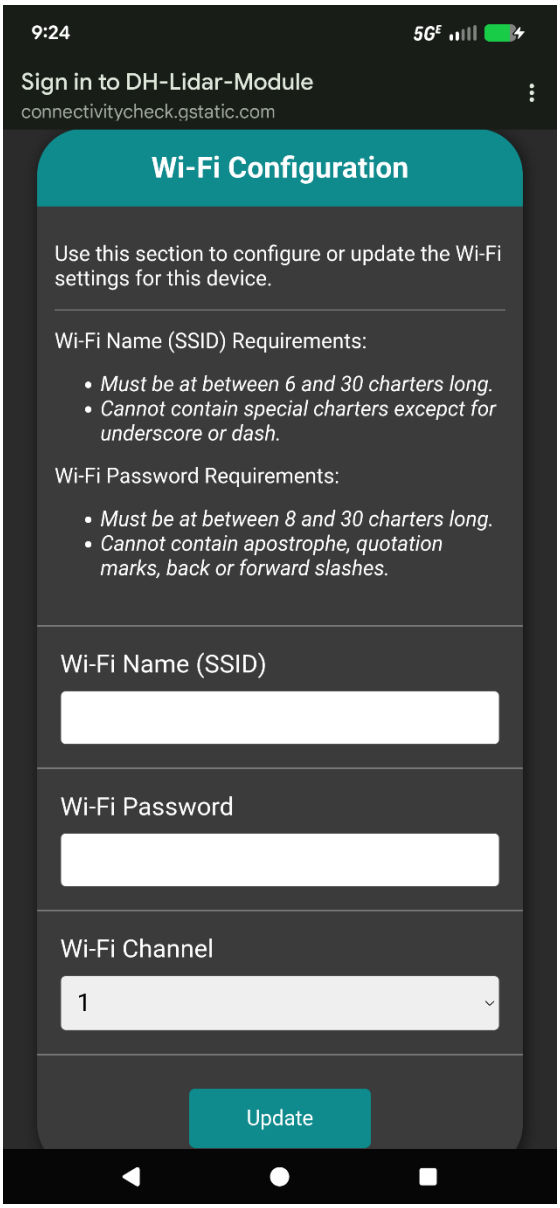



*Figure 7 - Wi-Fi Config*

## RESTORE DEFAULT Wi-Fi CONFIGURATION

To restore the factory Wi-Fi network name, password, and channel press and hold the factory default button for 10 seconds and the device will reboot. The Wi-Fi default button is highlighted in the image below for reference. The hole is next to the Wi-Fi switch.

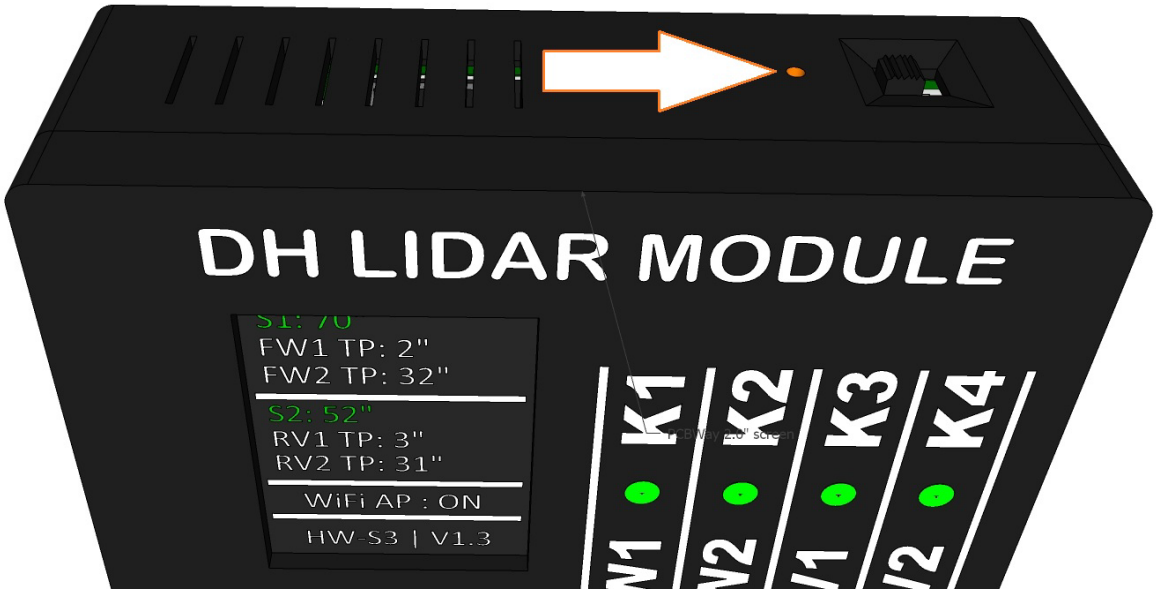
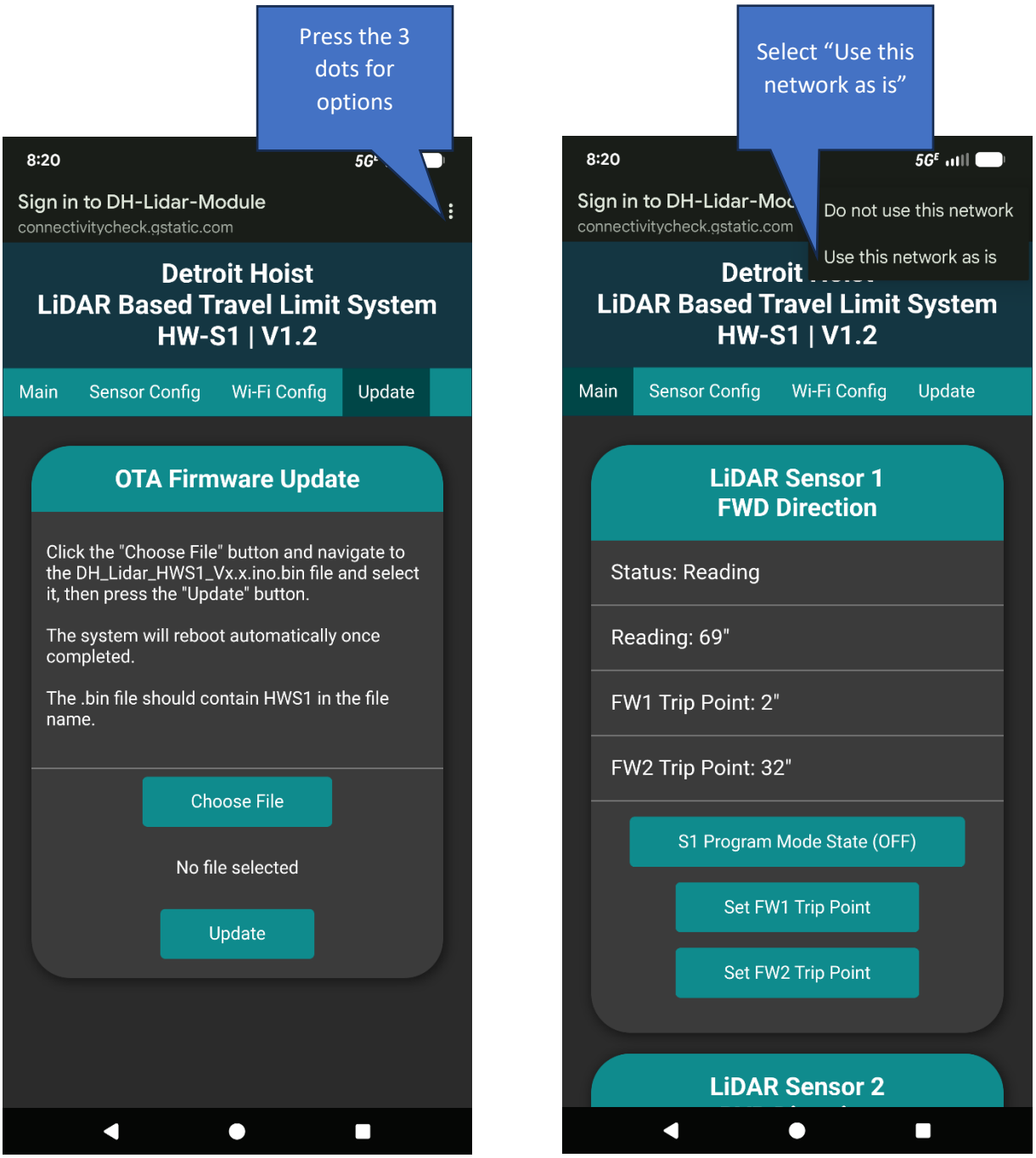


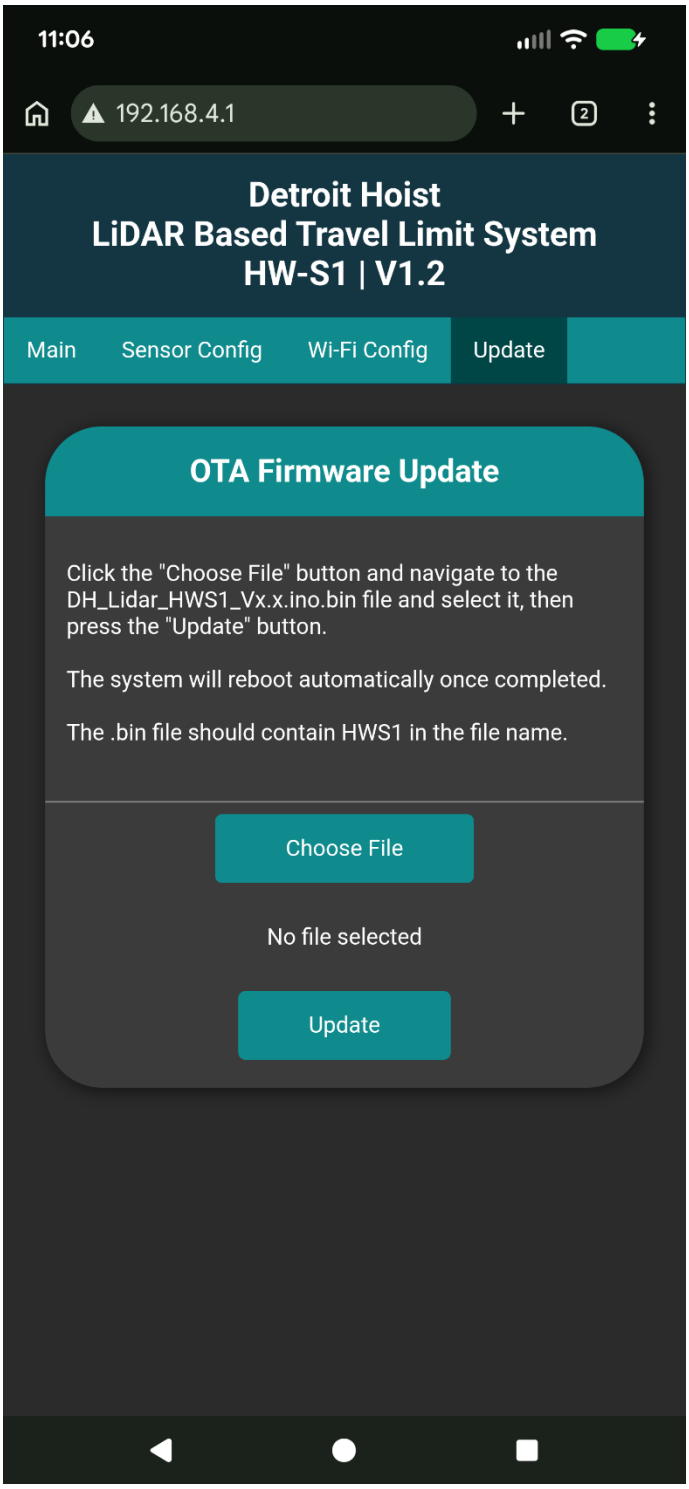

*Figure 8 - Wi-Fi Restore Default Button*

## FIRMWARE UPDATE (OTA)

If a firmware update is available, you can update the firmware through the web interface. Navigate to the “Update” tab and click the choose file and locate the firmware file for the hardware version you have (HWS1 or HWS3) and then press the “Update” button. Once the update is complete the device will reboot. The hardware version is shown at the top of the web interface as well as on the modules display.

NOTE – The “Choose File” may not work while connected in captive mode on Android devices. Select “Use this network as is” and then open your web browser and in the URL bar type in 192.168.4.1 and press enter. Then go to the “Update” tab and “Choose File” then press the “Update” button.




11:06
192.168.4.1
Detroit Hoist
LiDAR Based Travel Limit System
HW-S1 | V1.2
Main
Sensor Config
Wi-Fi Config
Update
OTA Firmware Update
Click the "Choose File" button and navigate to the DH_Lidar_HWS1_Vx.x.ino.bin file and select it, then press the "Update" button.
The system will reboot automatically once completed.
The .bin file should contain HWS1 in the file name.
Choose File
No file selected
Update