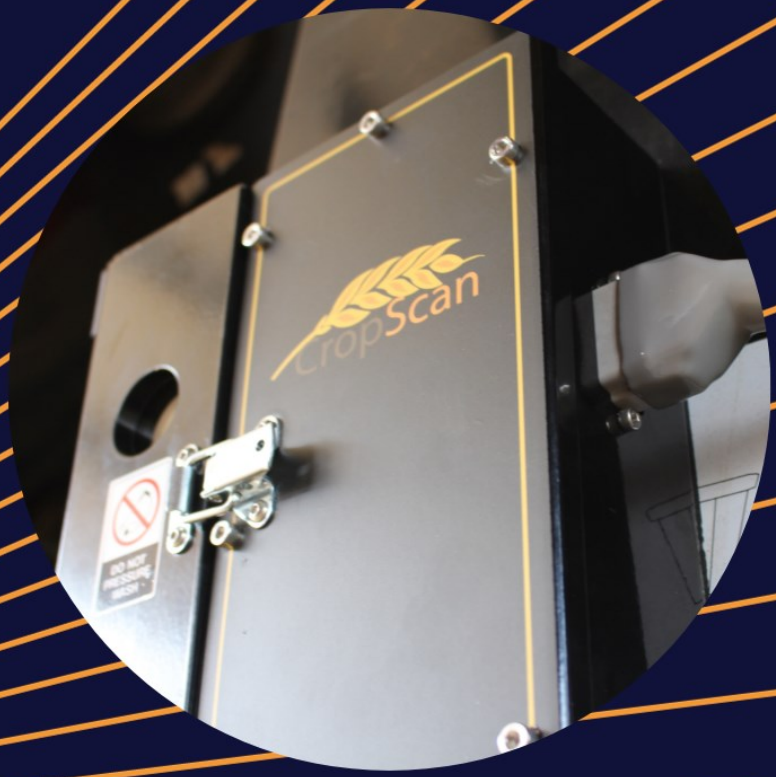
CropScan

# 4000VT

ISOBUS Integration




# ON COMBINE GRAIN ANALYSER

## USER GUIDE

www.cropscanag.com

**REVISION HISTORY**

| | | |
|---|---|---|
| Initial Prototype | November | 2022 |
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# 1.0 Product Description

## 1.1 Overview

This chapter gives you an overview of the CropScan 4000VT On Combine Grain Analyzer's features and a description of the operation.

## 1.2 Description

The CropScan 4000VT On Combine Grain Analyzer has been developed and tested worldwide for use in measuring Protein, Oil, Moisture, Starch and Fiber in grains, oilseeds and pulses sampled from the clean grain elevator of a combine harvester.

The CropScan 4000VT comprises a Sampling Head, a Fibre Optic cable and an NIR Spectrometer.

The Sample Head is mounted onto the clean grain elevator. A hole is cut into the upside and the downside of the elevator to allow grain to be sub sampled in the Sample Head chamber where the NIR scans are collected every 3-4 seconds or 4-6 meters (12-18 feet) as the combine travels down the field.

The NIR Spectrometer is mounted to the wall of the combine and houses the ECU (Electronic Control Unit) which is connected to CAN 1 and 2 of the Combine. The ECU reads the CANBUS messages for Crop Type, Grower-Farm-Field, GPS and Rotor Engage status which initiates the work mode to begin collecting data.

With the Outlet Steel Flap in the closed position, grain falls through Sample Head inlet hole, fills the chamber. When the chamber is full, a Sample Sensor is triggered and the grain is trapped in the chamber. The Lamp Probe transmits light through the sample of grain which is collected by a Fibre Optic Probe and Cable that connects the Sample Head to the NIR Spectrometer located on the outside of the cabin. The NIR Spectrometer generates the NIR spectrum for the trapped grain sample and computes the results for Protein, Oil, Moisture, Starch and Fiber. The is data is displayed in the CropScan Virtual Terminal screens on the combine harvester monitor. The data is synced to the CropScanAg Cloud Server for viewing remotely on a smart device using the N-GAUGE App software.

After the NIR scan is computed, the outlet flap opens and the grain drops out and returns to the downside of the elevator and a new sample is collected and the next NIR scan is collected.


Figure 1.1 CropScan 4000VT Virtual Terminal, Setup screen.

Figure 1.2 CropScan 4000VT Sample Head.

Figure 1.3 CropScan 4000VT NIR Spectrometer..

## 1.3 Technology

The CropScan 4000VT is a full spectrum NIR Spectrophotometer which uses a linear diode array detector and a spectrograph to provide the NIR transmittance spectrum from 720-1100 nm. Within this region of the electromagnetic spectrum, compounds such as Protein (1020nm), Moisture (970nm), Oil, (910nm) sugars (830nm), and other organic compounds absorb infrared energy. By measuring the intensity of the infrared energy that passes through a sample of grain, Protein, Oil, Moisture, Starch and Fiber can be measured.
The NIR Spectrometer is based on a flat field spectrograph and a silicon photodiode array detector as shown in figure 1-3.

The advantage of the diode array spectrometer lies in that there are no moving parts. The spectrometer is robust enough to work in the harsh environment of a combine harvester, compact enough to fit inside or outside the cabin of the combine and powerful enough to provide data as good, if not better, than a bench top NIR Analyzer used in a laboratory. The Fibre Optic Cable allows the NIR spectra to be collected remotely thus removing the NIR Spectrometer from the Sampling Head.

## 1.4 Virtual Terminal

The CropScan NIR Spectrometer controls the entire system. The CropScan 4000VT Virtual Terminal displays the Protein, Oil, Moisture, Starch, Fiber and Yield data for each sample and the results are presented to the combine harvester operator via the Field Data and Tank Data run screens. The 4000VT allows users to configure, calibrate, transfer data and run diagnostic functions from the Virtual Terminal.

The CropScan NIR Spectrometer includes a solid-state hard drive for storing large amounts of field data. The CropScan ECU has an internal SIM Card and Wi-Fi antenna to connect to a supported network or Wi-Fi Hotspot where available in the field. This device allows data to be transmitted to the CropScanAg Cloud Server and viewed in the N-GAUGE Harvest Manager and Nutrient Manager App's.

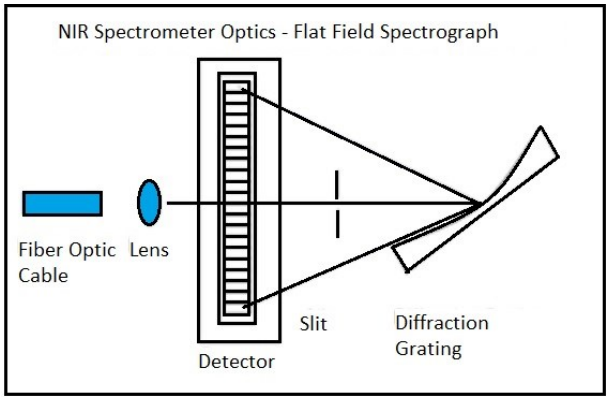


Figure 1.3 Schematic of the NIR Spectrometer Optics Layout.


Figure 1.4 Pro 700 CropScan VT Home Setup screen


Figure 1.5 Pro 700 CropScan VT Field Data screen


Figure 1.6 Pro 700 CropScan VT Tank Data screen

## 1.5 N-GAUGE Description

The CropScanAg N-GAUGE App has been developed to customize, present and share your Harvest Data via a smart phone or tablet. Added partners can also view the data via there own login to aid in managing the Grain Logistics or connect your data to your advisors and agronomist's in making better informed nutrient management planning decisions for the coming seasons.

## 1.6 N-GAUGE Harvest Manager (5 Year Subscription included)

The N-GAUGE Harvest Manager is include in all CropScan 4000VT On Combine Grain Analyser kits. The Harvest Manager enhances and presents the Protein, Moisture, Oil and Yield Data giving growers the ability to view tank by tank load data, storage grain site load averages in the Grain Logistics Module. User's can create an On Farm virtual storage site to view the recorded in loading and outloading of grain to the growers bins or silo's. Grain delivery contacts can be created and log the delivered grain to the grain buyer. The agronomic field data for protein, moisture oil and yield layers are viewable in the Nutrient Manager module by selecting a field boundary and using the layer picker to select a layer type. The data is synced and sent to the CropScanAg Cloud automictically when the Auger is cycled or when the Combine Rotor is dis engaged.

## 1.7 N-GAUGE Nutrient Manager (Optional Subscription)

View and validate high density field maps with N-GAUGE Nutrient Manager. Generate insightful field performance maps and reports. Design soil testing locations with GPS waypoints. Create and export machine-ready prescriptions from your smart phone or tablet to your AFS/PLM Connect or John Deere Operations Centre Platform.

The N-GAUGE Nutrient Manager is an optional subscription to enhance the functionality of the Harvest Manager. When the Nutrient Manager license is activated additional features are available from the Nutrient Manager Module to enable users to create and send Rx prescriptions from the N-GAUGE App to the users Machinery Platform:

- Application Creator—send Rx prescriptions
- Generate Nutrient Removal Layers
- Create Reports
- Drop Notes pins
- Drop Soil Testing sites pins

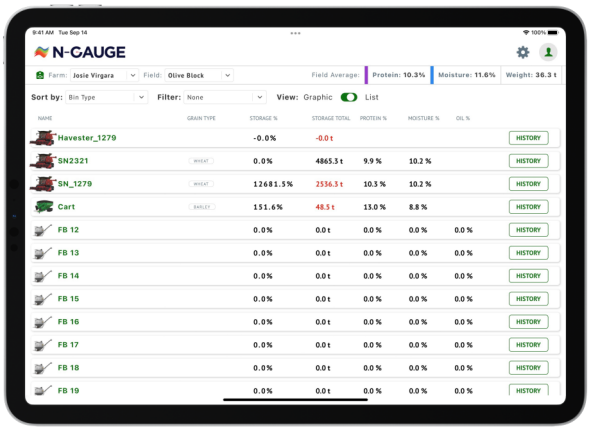


Figure 1.5 CropScanAg N-GAUGE Harvest Manager App


Figure 1.6 CropScanAg N-GAUGE Tablet Layout.

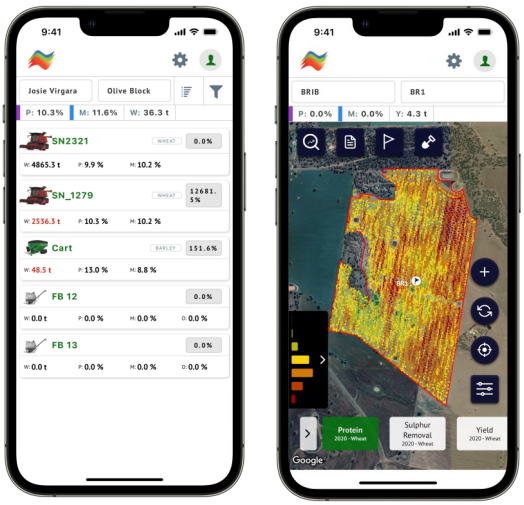


Figure 1.7 CropScanAg N-GAUGE Phone Layour.

# 2.0 Operation

## 2.1 Overview

The operation of the CropScan 4000VT On Combine Grain Analyzer has been specifically designed for the CNHi Combines. The integrated VT software allows operators to quickly understand the logic and functions of the system and the ability to use the advanced N-GAUGE App's Software connects growers with the harvest data. This operator guide explains in detail each run screen operation and function.

## 2.2 Daily Checks

Prior to using the CropScan 4000VT On Combine Grain Analyzer, the following daily checks are recommended to achieve optimal results.

i. Open Sample Head hinged cover door and clean the sample chamber using a brush, rag or air hose.

ii. Remove any buildup of dust and debris.

iii. Wipe the 2 x lens windows inside the Sample Head with a clean cloth if they are dirty. If clean leave the windows.

Iv. Check the Fibre Optic Prove for correct Crop Type position as shown in figure 2.5 and 2.6.

v. Allow the NIR Spectrometer to warm for 10 minutes or until the NIR Spectrometer reaches a minimum temp of 30 deg C or 77 deg F.

## 2.3 Power On

The CropScan 4000VT On Combine Analyzer runs off the combine's 12VDC battery supply. Follow the below steps to power on the CropScan 4000VT.

i. Turn ON the Combine Ignition key to power on the NIR Spectrometer.

ii. Wait for the Pro 700 to power ON and access the VT pages to operate the CropScan if required.

The Virtual Terminal will connect to the NIR Spectrometer ECU on key power. The NIR, Internet, GPS and Crop Flow will indicate the work status with a green or red indicator box. When the NIR Spectrometer is connected the NIR indicator will be Green as shown in Figure 2-2. If any component hardware failures, the VT will bring up a warning to notifying the user. This alert provides the operator feedback on the operation of the Motor and Motor Sensor, Sample Sensor Sensors, Lamp, Spectrometer Temperature, Spectrometer Hardware, and GPS status.

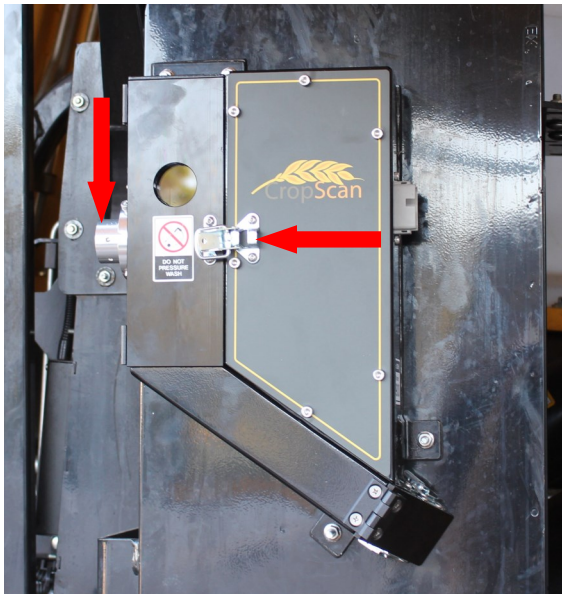


Figure 2.1 Sample Head Daily inspection points.

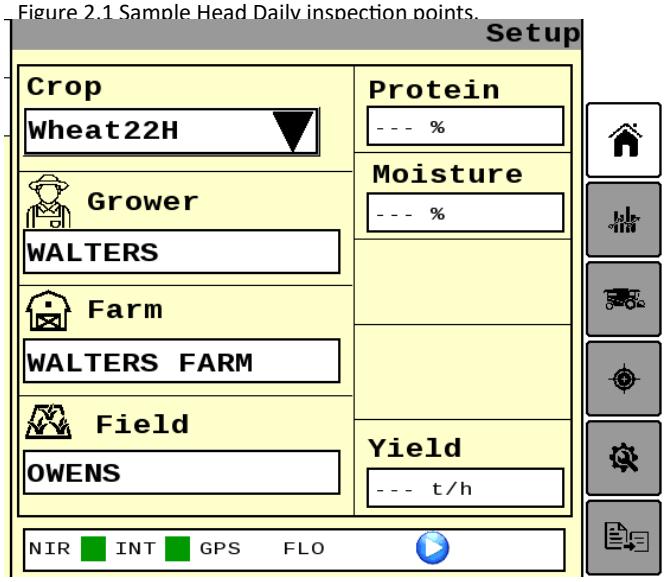


Figure 2.2 CropScan Virtual Terminal Setup screen.

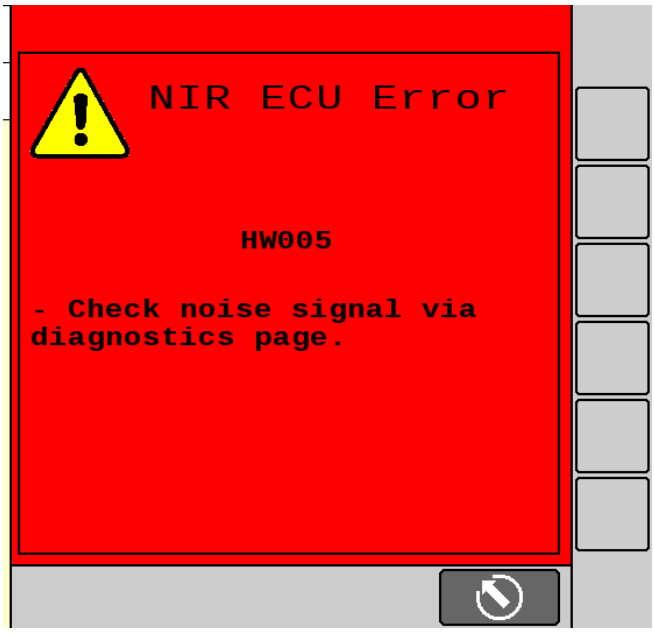


Figure 2.3 CropScanAg N-AUGE Harvest Manager App

## 2.4 Start Field Analysis

i. Select the Crop Type from the combine monitor and the CropScan ECU will sync the Crop Type selected and display in the VT Setup screen.

ii. Select Grower-Farm-Field from the combine monitor and the CropScan will sync the GFF ID's selected and display in the CropScan VT Setup screen. The data will be saved and recorded on the NIR ECU. The data file for each field file will be automatically named and recorded as per te below file naming structure:

**Grower_Farm_Field_Serial No_Year-Map.csv**

iii. Engage the Combine Rotor to start the CropScan 4000VT into the work mode. The Sample Head Outlet Flap will close once the Rotor is engaged and the first sample is collected and scanned.

iv. Press and Confirm the Fibre Optic Probe is in the correct Crop Type position as shown in Figure 2.5 and 2.6.

v. Adjust the Probe Position if required by loosening the M5 locking screw and moving the Probe in or out to the correct Crop Type position as shown in Figure 2.6. Tighten the locking screw to secure. This warning will appear each time a new calibration has been selected with a different FOP Probe position. Ie, switching from Canola to Wheat will bring up the Alert but no Alert will be displayed for changing from Wheat to Barley as the same Fibre Optic Probe position of 15mm is used for both these Crop Types.

***Warning: Incorrect probe portion will cause erratic results. Use the supplied Pathlength Test Block Assembly to check probe gap position.***

### Sample Head Probe Positions

**Canola = 7mm**

**Wheat, Barley, Sorghum, Lentils = 15mm**

**Corn, Soy, Beans, Lupins, Oats, Beans, Peas, = 23mm**

Once the chamber is filled with grain and the Sample Sensor is covered, the transmitted light is collected by the NIR Spectrometer which sends the scan data with GPS position to the VT screen. The calibration models will be applied to the scan data and the results will be displayed on the CropScan 4000VT Run Screens. The system will cycle the outlet flap to the open position and empty the chamber. The outlet flap will cycle to the closed position again to fill the sample chamber so that the next scan can be taken. The cycle time is approximately 3-4 secs.

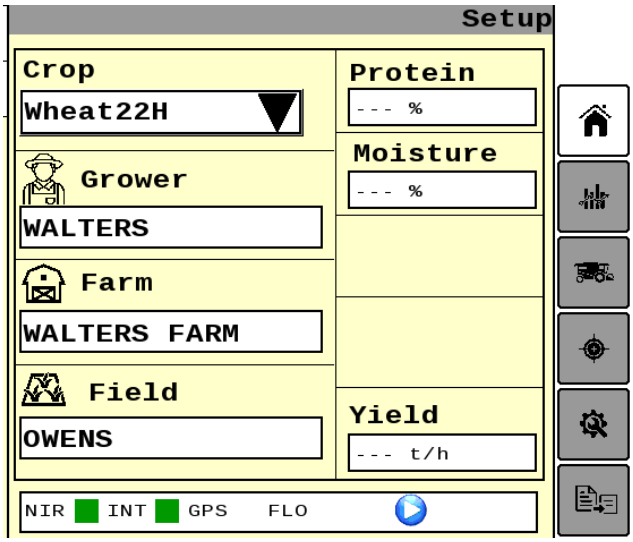


Figure 2.4 Crop Type and Grower Farm Field inputs.


Figure 2.5 Fibre Optic Probe.

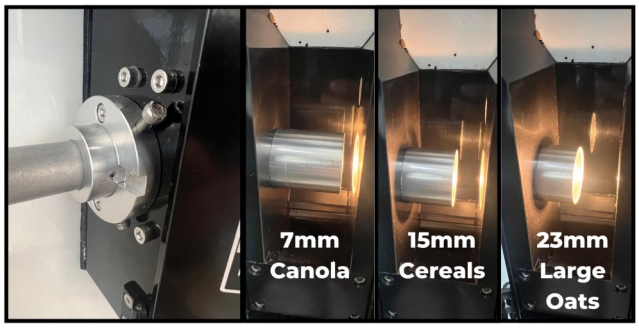


Figure 2.6 Fibre Optic Probe positions (7mm, 15mm and 23mm.

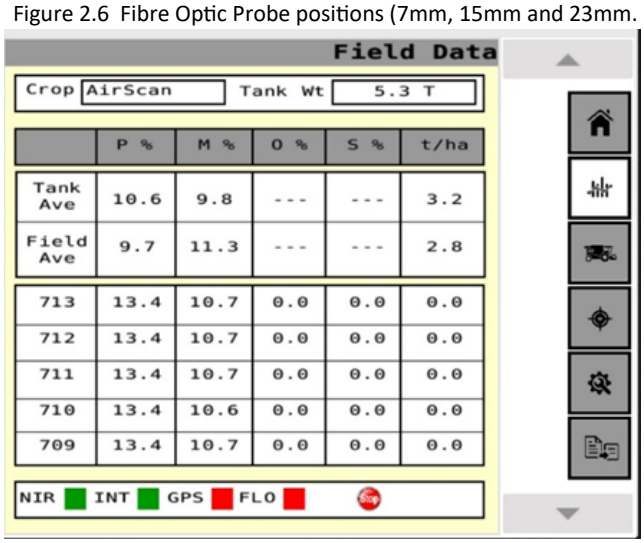


Figure 2.7 Field Data screen

## 2.5 Stop Field Analysis

i. Disengaging the Rotor will place the CropScan 4000VT in the idle mode. In the idle mode, the CropScan 4000VT is scanning for Crop Type and Field Name Changes from the Pro 700 monitor.

Note: if the Crop Type or Field Name is changed while the Rotor is Engaged the Crop Type and Field name is not sent. These messages are only published when the Rotor is disengaged.

ii. Once the Rotor is disengaged, the CropScan 4000VT will finish scanning the sample in the sample chamber.

## 2.6 Shut Down

i. Turn OFF the Combine Ignition Switch and the CropScan 4000VT ECU will be placed into shutdown mode. Once the key is off for greater than 20 seconds the CropScan ECU will go into a 30 second shutdown.

Note: If the Ignition key is switched ON while the ECU is powering down, a connection failure will likely occur and a connection to the Virtual Terminal will not be successful. If a Connection Failure is noted, then power down the Ignition Key for 60 seconds and then switch key back to the ON position. This will guarantee complete power down from the CropScan 4000VT ECU.

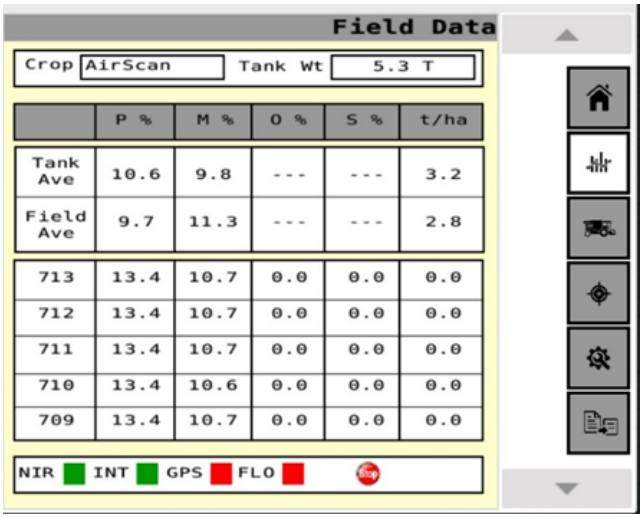


Figure 1.8 CropScan Virtual Terminal.

Figure 1.9 Combine Pro 700 Monitor and Rotor Swtich

Figure 110 Combine Rotor Key Switch

# 3.0 Virtual Terminal Run Screens

## 3.1 Overview

The data can be viewed in three different Run Screens, i.e., Home Setup Screen, Field Data and Grain Tank Data. Click on the Tab to display each display format. The Field and current Tank average is formatted consistently at the top of each Run Screen to make data interpretation quick and easy.

## 3.2 Home Setup Screen

Display's the selected Crop Type, Grower Farm Field ID and the real-time Protein, Moisture, Oil, Starch and Fibre results along with the Yield. This screen is updated every scan cycle.

## 3.3 Field Data

The results are displayed in the **Field Data** Screen and present the Field average and current Tank average and the last fifteen averaged results are displayed in the scrollable table. This data is stored in a field files called on the NIR ECU Hard drive and CropScanAg Cloud servers:

**Grower_Farm_Field_SN1234_Year-Map.csv.**

## 3.4 Grain Tank Data

The **Grain Tank** Run Screen display's the accumulated tank averages for Protein, Moisture, Oil, Starch, Fiber and the weight for each tank load. Each time the outloading auger is extended, the CropScan ECU will register an auger cycle and trigger the Grain Tank Run Screen to record and reset the new Grain Tank average. This data is stored in a single storage file called:

**Grower_Storage_SN1234_Year.csv.**

This allows operators to monitor grain tank loads and the running stack average of store grain. The advanced N-GAUGE App software allows used to then further manage the in loading and out loading of grain from the Bin or Silo's. The Grain Logistics module is a simple tool to help visualise the stored grain and activity simulate grain blending to meet the grain buyers contract.

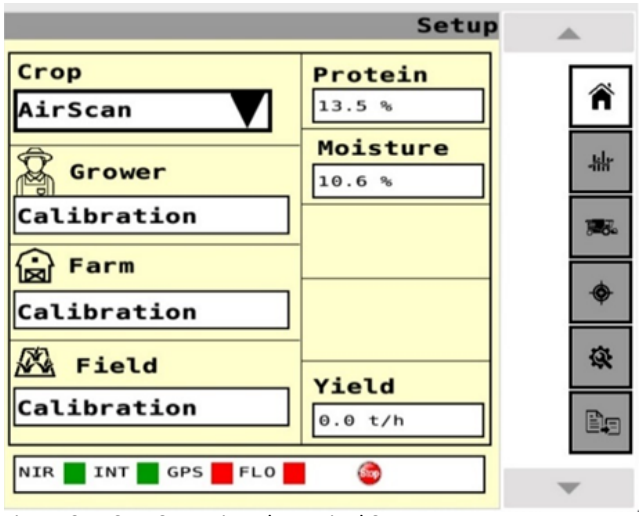


Figure 3.1 CropScan Virtual Terminal Setup screen

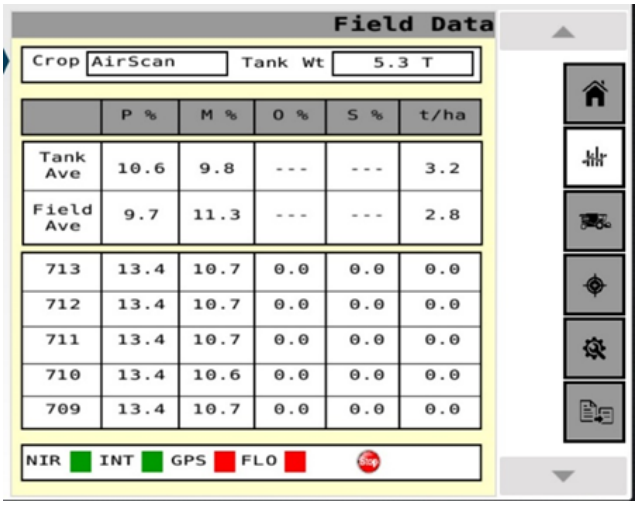


Figure 3.2 CropScan Virtual Terminal Field Data screen

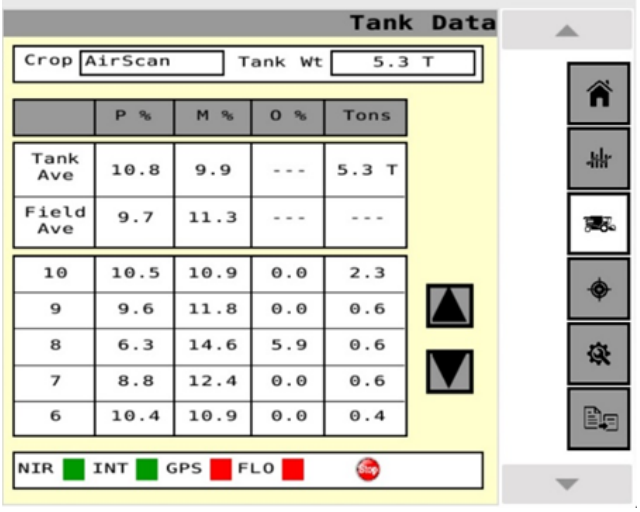


Figure 3.3 CropScan Virtual Terminal Tank Data screen

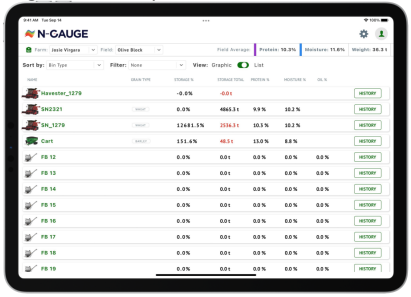


Figure 3.4 CropScanAg N-GAUGE Grain Logistics Module

# 4.0 Configuration Menu

## 4.1 Overview

The **Configuration Menu** allows operators to set up the CropScan ECU to suit the user's farming operation. The user can set up an API connection to their CropScanAg Cloud account, set Seeding Month, set up the Wi-Fi connection, manage Data Storage, activate Outlier Detector and set the unit of measure for temperature and weight.

## 4.2 Temperature Unit

Select displayed Temperature units (C or F) .

## 4.3 Volume Unit

Select Crop Weight units (Tonnes, Kg's or Bushels) .

## 4.4 Seeding Month

Select the month the seeding applications begin. The CropScan 4000VT Analysis Software will manage the harvest data in a 12 month period from this selected month.

***Note: Select January for Northern Hemisphere users and June for Southern Hemisphere users.***

## 4.5 Outlier Detection

(Recommended) The Outlier Detection option applies a filtering method to reject any samples where the result are below or above the Crop Type minimum or maximum range. E.g., Wheat (5- 20%) .

## 4.6 Harvester ID

The Harvester ID parameter allows the renaming of the CropScan serial number displayed on the N-GAUGE Grain Logistic module. This allows the user to rename the CropScan to a Combine number ie "Combine 1" or the name of the operator "Tom".

i. Press on the Harvester ID white box and enter the new name using the pop up keyboard.

ii. Press Enter to confirm and check the name change on the N-GAUGE App Grain Logistics Module.

## 4.7 N-GAUGE Setup

***NOTE: Sign up at*** *app.cropscanag.com*

i. Press the **N-GAUGE Setup** button to access the User Credential setup window.

ii. Enter the User email address used to create the CropScanAg Cloud account.

iii. Enter the User Password used to create an CropScanAg Cloud account.

iv. Press the SAVE button to connect the API between the CropScan ECU and the CropScanAg Cloud.

***Note: If there is no internet connection to the CropScan ECU, then no access to any connectively will be available.***

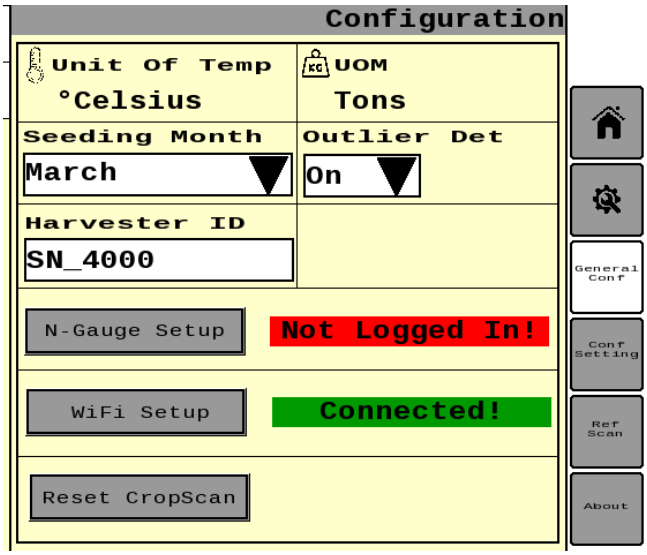


Figure 4.1 CropScan Virtual Terminal General Configuration screen

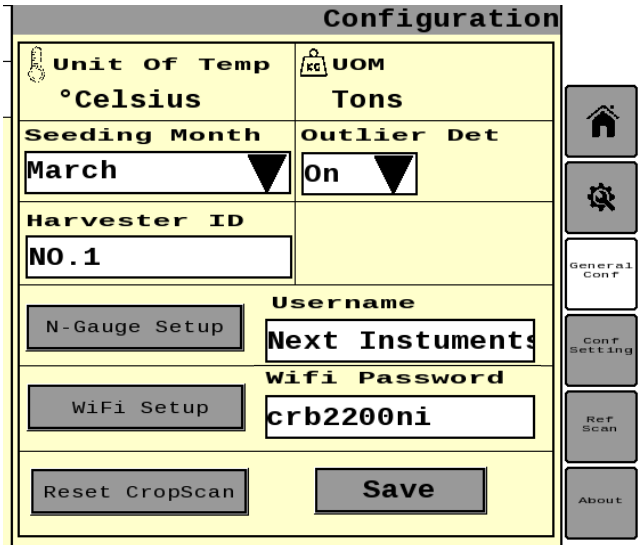


Figure 4.2 CropScan Virtual Terminal Unit of measure selector screen.

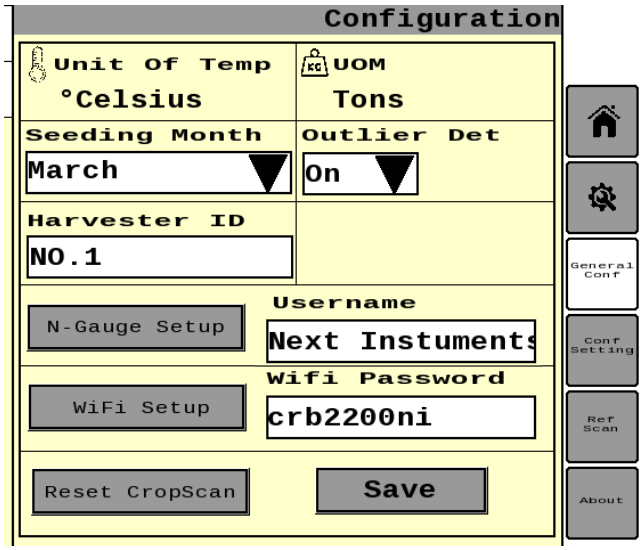


Figure 4.3 CropScan Virtual Terminal General Configuration

## 4.8 WiFi Setup

***NOTE: Make sure a phone HotSpot is ON or within Wifi range to add a Wifi Profile.***

i. Press the **Wifi Setup** button to access the User Credential setup window.

ii. Enter the Wifi SSID (Wifi name)

iii. Enter the Wifi Password.

iv. Press the SAVE button to add the Wifi HotSpot Profile. The CropScan ECU will auto connect each time the added Wifi Hotspot is within range.

## 4.9 Field ID's

The CropScan VT can import a CN1 Setup file with the Grower-Farm- Field ID's. Loading a Grower Farm Field list to the CropScan ECU helps with syncing GFF's from the main combine run screen.

The Grower-Farm-Field files can be uploaded from a USB device or from the Cloud.

## 4.10 Grower-Farm-Field Import

***Note: Copy and paste a CN1 folder with Setup data to the root drive of a USB memory device for USB import.***

i. Save a CN1 Folder to a folder to the rout drive of a USB.

ii. Insert the USB memory device. into the CropScan NIR Spectrometer's USB port located on the lower side of the box located outside of the cabin as shown in figure 4.5.

iii. Press the **Data Transfer** Menu to access the data transfer options.

iv. Press the Grower Farm Field Import option to read and import the Grower Farm Field list from the CN1 folder loaded onto the USB.

v. Remove the USB from the NIR Spectrometer USB port.

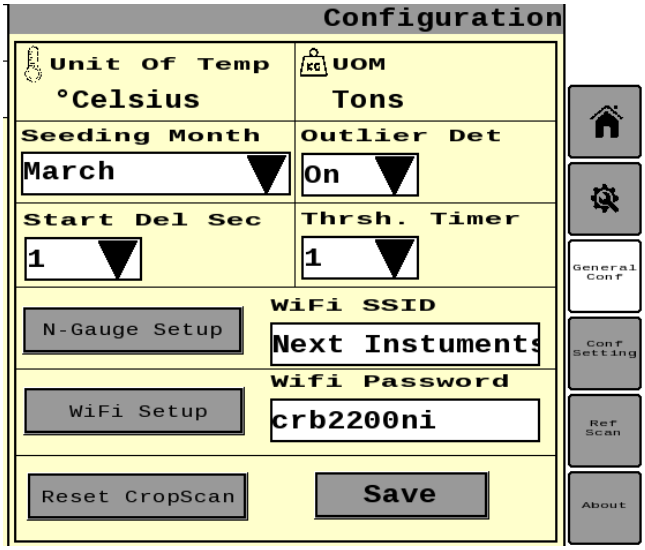


Figure 4.4 CropScan Virtual Terminal General Configuration


Figure 4.5 CropScan NIR Spectrometer USB Port

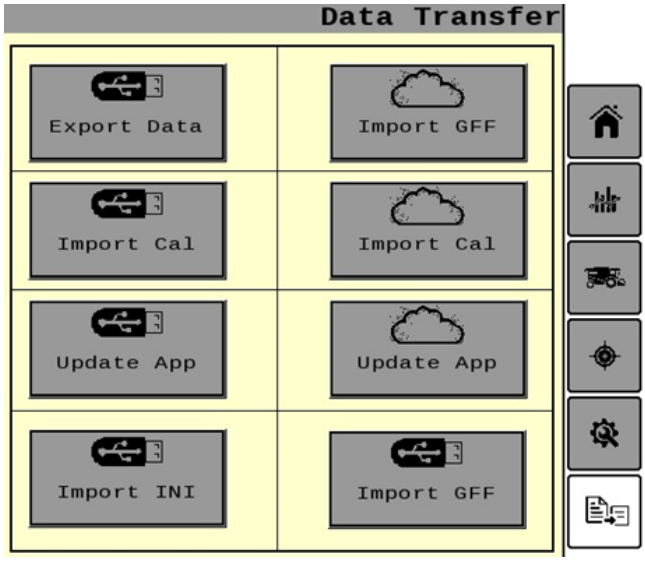


Figure 4.6 CropScan Virtual Terminal Data Export screen

# 5.0 Calibration

## 5.1 Overview

The CropScan 3300H CropScan Display stores the calibration models for each grain type. The models contain one or several components, e.g., protein, moisture and oil. Each of these calibration models have a Bias and Slope adjustment facility. The bias and slope can be adjusted in order to correct the calibration to some traditional reference method of analysis for each component, i.e. Kjeldalh for protein, Oven Drying for moisture and Soxhlet Extraction for oil.

## 5.2 Slope and Bias Description

Slope and Bias adjustment is used when all sample readings lie on a straight line but some samples read high and some read low as compared with the reference readings. The Slope and Bias is calculated by plotting the CropScan readings VS the reference readings in a Slope and Bias Calculator software. The Slope and Bias Calculator will calculate the best line of fit across the sample set, creating an equation = Slope and Bias.

Note: Slope and Bias adjustments require 5 samples with a range from low to high (9% - 15%). Slope and Bias adjustments should only be done by a trained technician.

The Slope and Bias is taken from the X and Y plot equation. Figure 5-5 shows the X Y equation as:

**$\%Protein_{orrected} = Slope \times \%P_{orig} + Bias$**

**Slope = 1.385**
**Bias = -4.6**

Using this equation the corrected prediction values for Protein % can be calculated. Figure 5.3 shows the new prediction values.
Applying the new Slope and Bias (S & B) we can decrease the standard error of prediction (SEP) or accuracy. The SEP shown in figure 5-4 to figure 5-6 improves protein error from 0.5 to 0.2 by apply the Slope and Bias equation.

The Slope and Bias Adjustment setting for each Crop Type can be accessed through the Calibration Adjustment Tab.

| | 3300H | Lab Ref | Difference |
|---|---|---|---|
| Sample ID | Protein | Protein | Protein |
| 1 | 10.5 | 10 | -0.5 |
| 2 | 11.8 | 11.6 | -0.2 |
| 3 | 12.6 | 12.6 | 0 |
| 4 | 13.2 | 14 | 0.8 |
| 5 | 13.8 | 14.5 | 0.7 |

| SEP = Accuracy | 0.5 |
|---|---|

Figure 5.1 3300H VS Reference Protein Table

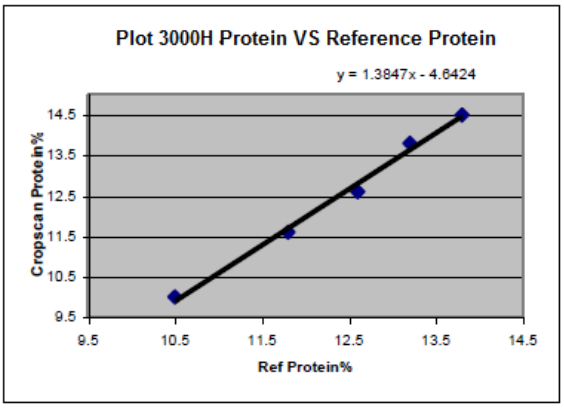


Figure 5.2 CropScan VS Reference X Y Plot

| | CropScan | Lab Ref | Difference |
|---|---|---|---|
| Sample | Protein | Protein | Protein |
| 1 | 9.9 | 10 | 0.1 |
| 2 | 11.7 | 11.6 | -0.1 |
| 3 | 12.9 | 12.6 | -0.3 |
| 4 | 13.7 | 14 | 0.3 |
| 5 | 14.5 | 14.5 | 0.0 |

| SEP = Accuracy | 0.2 |
|---|---|

Figure 5.3 New predicted protein vales

## 5.3 Accuracy

Accuracy is defined as the difference between a reference method and the CropScan predicted results. Typically, 50 samples of grain are analyzed in duplicate by the reference method and then by the CropScan. The Standard Deviation of Differences between the
reference method and the CropScan are referred to as the Standard Error of Prediction (SEP). The following values represent 95% confidence levels or 2 X SEP.

| | |
|---|---|
| **Wheat** | |
| Protein | +/- 0.5% |
| Moisture | +/- 0.4% |
| **Barley** | |
| Protein | +/- 0.6% |
| Moisture | +/- 0.5% |
| **Canola** | |
| Oil | +/- 1.0% |
| Moisture | +/- 0.5% |

## 5.4 Precision:

Precision is defined as the ability of an analyzer to measure the same sample twice. Typically, 10 samples of grain are analyzed in duplicate on the CropScan. The Standard Deviation of Differences between the duplicate readings is referred to the Standard Deviation of Differences (SDD). The following values represent 95% confidence levels or 2 X SDD.

| | |
|---|---|
| **Wheat** | |
| Protein | +/- 0.3% |
| Moisture | +/- 0.2% |
| **Barley** Protein | +/- 0.3% |
| Moisture | +/- 0.2% |
| **Canola** Oil | +/- 0.5% |
| Moisture | +/- 0.4% |

These values are intended as a guide only. Under laboratory conditions, using clean grain samples that are of good quality, then you should be able to achieve similar results. However, temperature variations of the sample and the instrument have big effects on SEP and SDD. Weather damaged grain or dirty grain will give rise to larger errors. Poor mixing of sample can result in excessive errors. Excess chaff, straw, dirt, leaves etc will also negatively affect the Accuracy and Precision.

| | CropScan | Reference | Difference |
|---|---|---|---|
| **Sample ID** | **Protein** | **Protein** | **Protein** |
| **1** | 10.5 | 10 | -0.5 |
| **2** | 11.8 | 11.6 | -0.2 |
| **3** | 12.6 | 12.6 | 0 |
| **4** | 13.2 | 14 | 0.8 |
| **5** | 13.8 | 14.5 | 0.7 |

| | |
|---|---|
| **SEP = Accuracy** | **0.5** |

Figure 5.4 CropScan VS Reference Protein Table

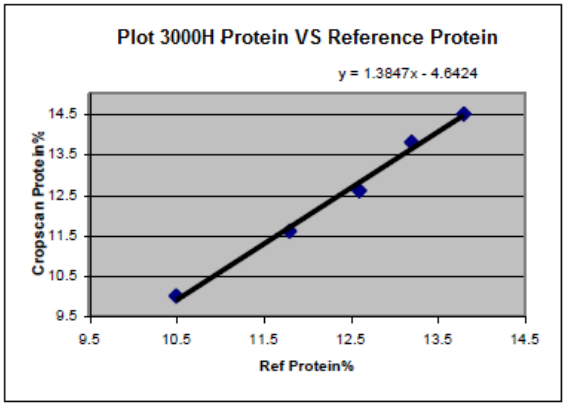


Figure 5.5 CropScan VS Reference X Y Plot

| | CropScan | Lab Ref | Difference |
|---|---|---|---|
| **Sample** | **Protein** | **Protein** | **Protein** |
| **1** | 9.9 | 10 | 0.1 |
| **2** | 11.7 | 11.6 | -0.1 |
| **3** | 12.9 | 12.6 | -0.3 |
| **4** | 13.7 | 14 | 0.3 |
| **5** | 14.5 | 14.5 | 0.0 |

| | |
|---|---|
| **SDD = Accuracy** | **0.2** |

Figure 5.6 CropScan VS Reference X Y Plot

# Calibration Cont.

## 5.5 Calibration Adjustment

Calibration Adjustment enables operators align there CropScan results to a grain buyers NIR or Laboratory method. Users can increase or decrease the calibration factor Bias settings to align the CropScan with local elevator sites. Operators can toggle the protein bias settings up or down to align or carry out a 5 sample Auto Calibration Bias Adjustment. The follow steps explain how to change the Crop Type Calibration factor Bias values in the 4000VT.

i. Select the **Calibration** icon button as shown in figure 5.7.

ii. Select the Crop Type to adjust the calibration bias factor.

iii. Press on the Bias factor you want to adjust. Type in the new Bias factor using the pop up keyboard as shown in figure 5.9.

iv. Press the Confirm button to save the new calibration Bias factor.

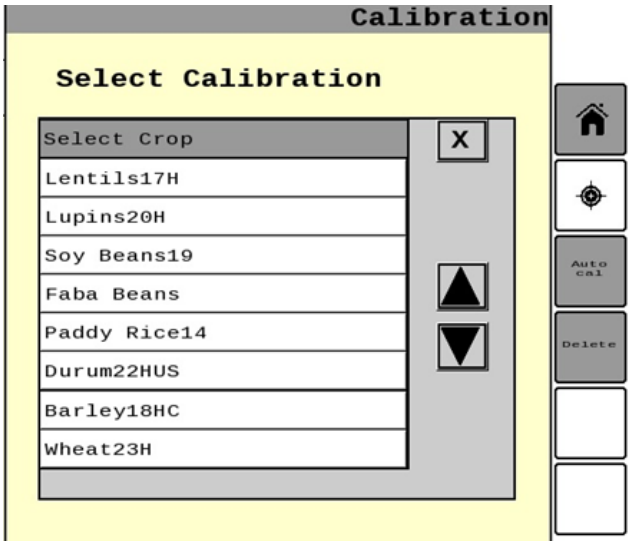


Figure 5.7 CropScan Virtual Terminal Calibration screen

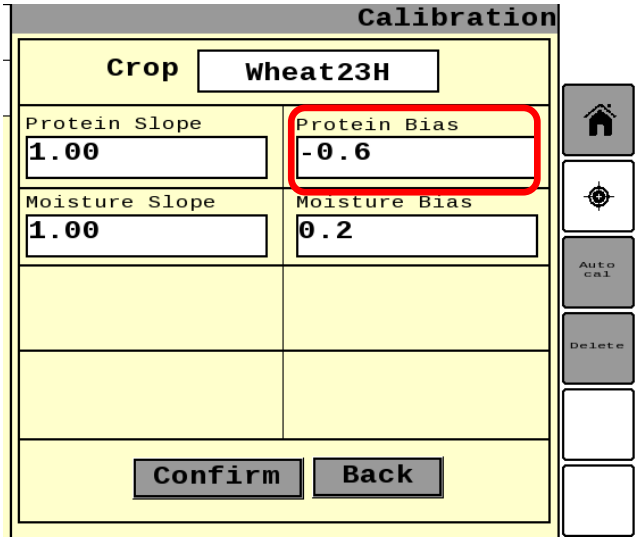


Figure 5.8 CropScan Virtual Terminal Bias Adjustment screen

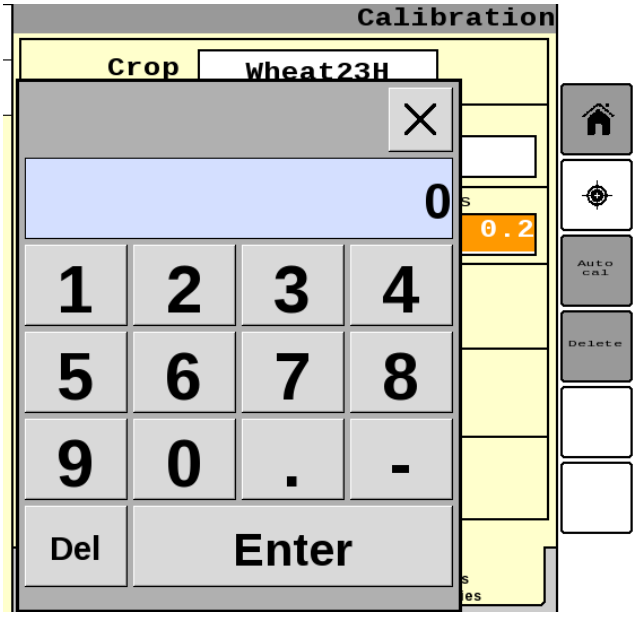


Figure 5.9 CropScan Virtual Terminal Bias Adjustment keyboard.

# Calibration Cont.

## 5.6 Auto-Calibration

The CropScan 4000VT is pre calibrated with 3 Crop Types: Wheat, Barley and Canola. Once the system is installed a calibration validation/adjustment should be performed using the Auto-Calibration function.

A pre-harvest CropScan validation is recommended to check and fine tune the CropScan 4000VT using a set of 5 grain samples, much the same way as a NIR benchtop analyzer is checked at installation or annually.

The Auto-Calibration function is a simple way of analyzing 5 samples in a row and entering the samples actual values after all the samples have been analyzed. The Auto-Calibration routine saves the data so that it can be easily exported after the Auto-Calibration routine is completed. The Raw Data results are saved in a file called **Calibration_Serial Number** of the CropScan. These files can be exported to a USB memory device.

**Tools Required:**
5 x Wheat Samples,
5 x Barley Samples,
5 x Canola Samples,
1 x Bottom Sample Shute (supplied in the kit)
1 x Funnel, 2 x 1 Litre plus sized containers

### Operation:

i. Press the Autocal button .

ii. Select the Crop type form the pull down menu.

iii. Select the number of samples to be used. i.e., 1- 5.

iv. Press Start to confirm Crop Type and number of samples to be analysed in the Auto-Calibration routine.

The operator needs to go down to the CropScan Sample Head on the clean grain elevator. Loosen the circular plate at the top of the Sample Head and fit a funnel. Release the Outlet Door and install the Outlet Port Shute.
Pour the first grain sample into the funnel and use the 2 litre container to collect the grain at the Outlet Shute. The system will require 10 sub samples to be analysed for each sample. After each sample of grain is completed, the flap will open and the grain will flow out of the Sample Head. The lamp inside the Sample Head will flash four times to instruct the operator to pour in the next grain sample. Return to the cabin once the last sample is scanned.

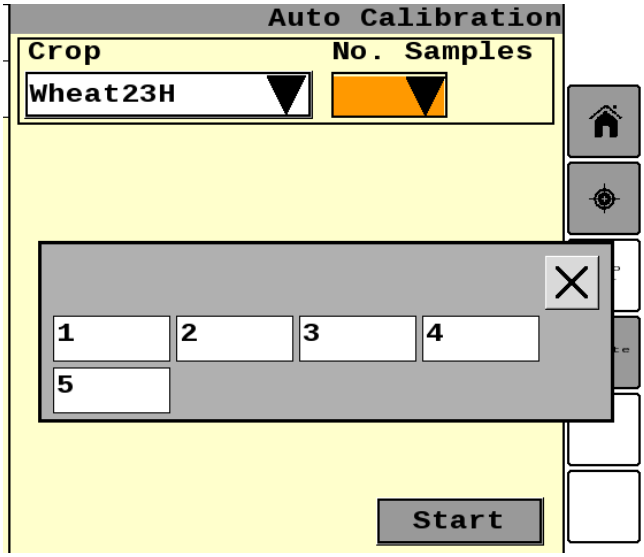


Figure 5.10 CropScan Virtual Terminal Auto Cal screen

Figure 5.11 Certified Reference Samples

Figure 5.12 Auto Calibration Sample pouring

## Calibration Cont.

The 4000VT Auto-Calibration results screen will display the predicted Protein, Moisture, Oil etc for each sample as shown in figure 5.13. Below each Actual Reading there is a box to type in the Reference Values. Enter the reference values for each constituent and press Next.

The new Bias window will appear showing the Old Bias and the new suggested Bias.

If the Bias difference between the old and new bias for each constituent is 0.3% or less the values are considered w=to be within acceptable error range. As such press **CANCEL** and use the old bias factor.

If the new Bias factor is greater than 0.3% Press **NEXT** to save the new bias factors.

### 5.7 Delete

To remove a calibration from the CropScan ECU and listed in the CropScan VT.

i. Press the Delete button.

ii. Select the Calibration/s to be deleted. A tick will appear alongside the Crop type.

iii. Press Confirm to delete the calibration.

***Note that the Deletion operation is final. It cannot be reversed. The original calibration can be reloaded. If a Calibration is deleted incorrectly, import a new calibration from the supplied***

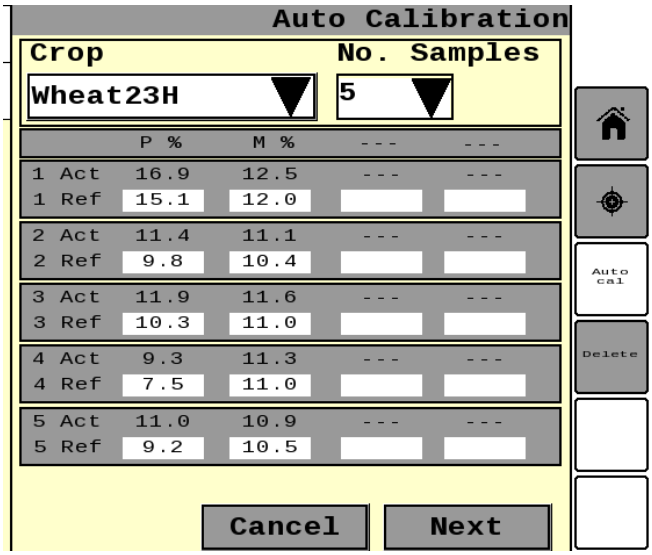


Figure 5.13 Auto Calibration results screen

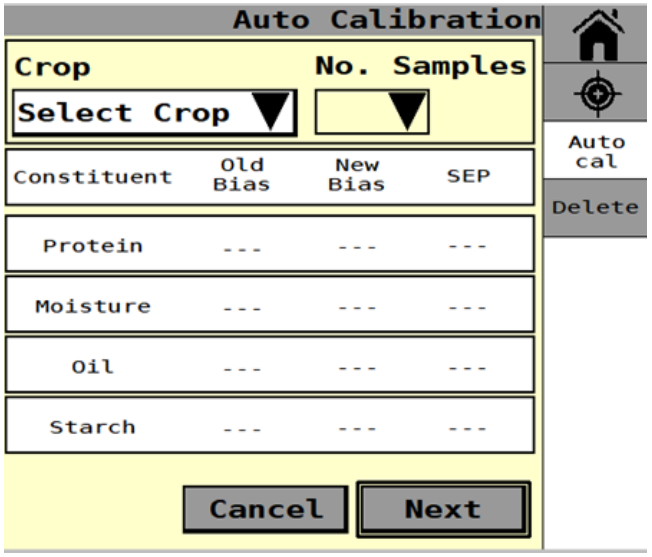


Figure 5.14 Auto Calibration new Bias Factor screen

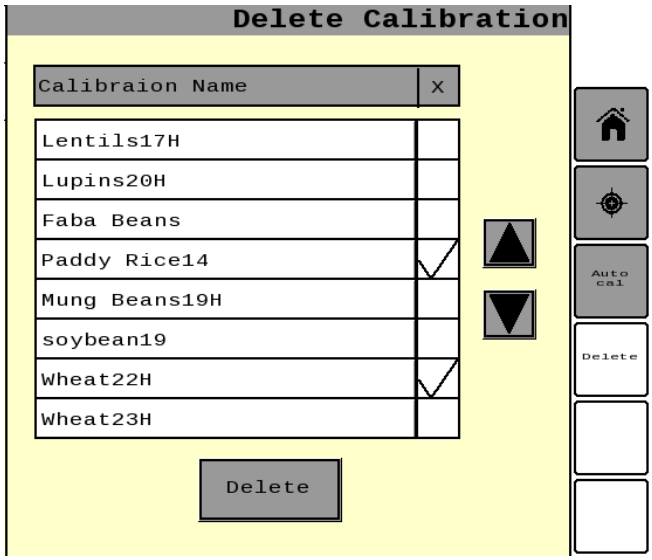


Figure 5.15 Calibration Delete Menu

# 6.0 Data Transfer

## 6.1 Overview

The Protein, Moisture, Oil and Yield data are stored to the CropScan ECU internal hard drive. The data files can be transferred to and from a USB memory device or the CropScanAg Cloud Server. The user is required to set up a CropScanAg Cloud Server account at app.cropscanag.com for Cloud data transfer.

The **Data Transfer** menu is designed to allow operators to Export and Import data or files to and from CropScan ECU or to the CropScanAg Cloud.

The following data can be imported to the ECU hard drive:

- Export Data to a USB or Cloud sync
- Import Cal files from a USB or Cloud sync
- Update N-GAUGE Apps from a USB or Cloud sync
- Import Grower Farm Field from a USB or Cloud sync
- Import INI files from a USB or Cloud sync
-

The following data can be exported from the ECU hard drive

- Export Data to a USB

***Note: The CropScan ECU will read and write to a USB storage device. The USB is required to have pre loaded folders to read and write to:***

- ***Calibration***
- ***Software***

## 6.2 Export Data

i. Insert USB memory device. into CropScan 4000VT NIR Spectrometer USB port

ii. Press the Export Data icon

iii. Select CropScan Data to export the CropScan Data.

iv. Select the Log Data to export Logs and Reference Scans .

## 6.3 Import Calibration

***Note: Create a folder called "Calibration'.***

i. Copy a Calibration Bin File onto USB memory device. Calibration folder.

ii. Insert USB memory device. into CropScan 4000VT NIR Spectrometer USB port

iii. Press the Data Transfer icon on the 4000VT screen.

iv. Select "Import Cal" (USB) option to import the new calibration.

v. Select on the Calibration from the list to import.

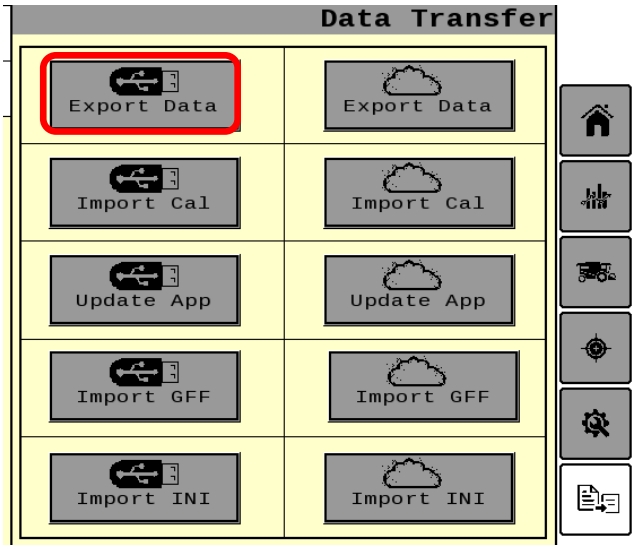


Figure 6.1 CropScan Virtual Termina Data Transfer menu.

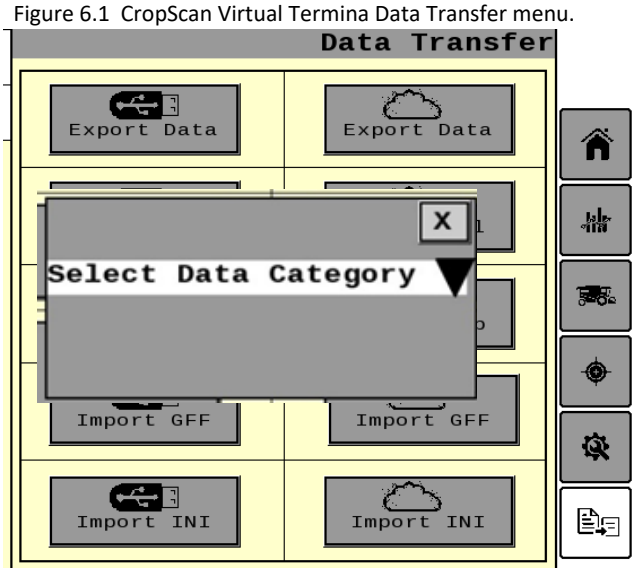


Figure 6.2 CropScan Virtual Termina Export Data

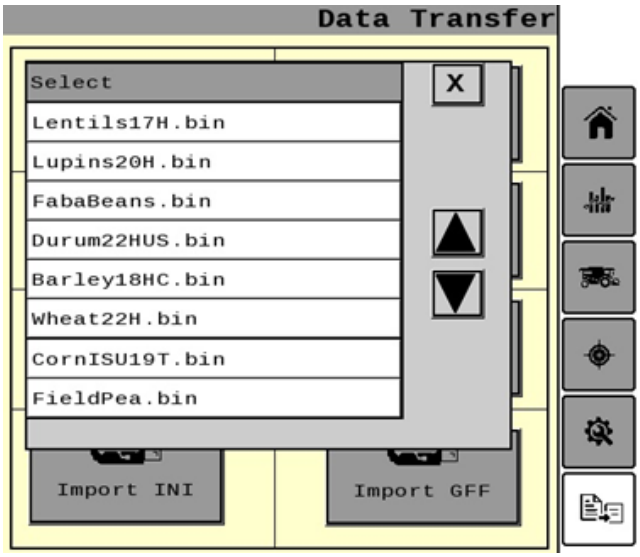


Figure 6.3 CropScan Virtual Termina Import Calibration

## 6.4 Update Virtual Terminal App

***Note: Copy and paste the CropScanAg App file to the Software Folder of a USB memory device for USB import.***

i. Copy and paste the CropScanAg App file onto USB memory device Software folder.

ii. Insert USB memory device into CropScan 4000VT NIR Spectrometer USB port.

iii. Delete the VT Object pool before updating the CropScan 4000VT App. Access the Diagnostic's menu from the combine monitor. Select the VT option NVM browser and delete the CropScan object pool as shown in figure 6.6.

iii. Return to the CropScan VT Data Transfer icon on the 4000VT screen.

iii. Press the Import App Update (USB) icon for USB Update or App Update (Cloud) icon for cloud sync on the 4000VT screen.

iv. The system will automatically upload the CropScan VT App from the Software Folder or cloud to the CropScan 4000VT ECU.

v. Wait for the CropScan VT complete reading the CropScanAg App file and auto re boot process.

.

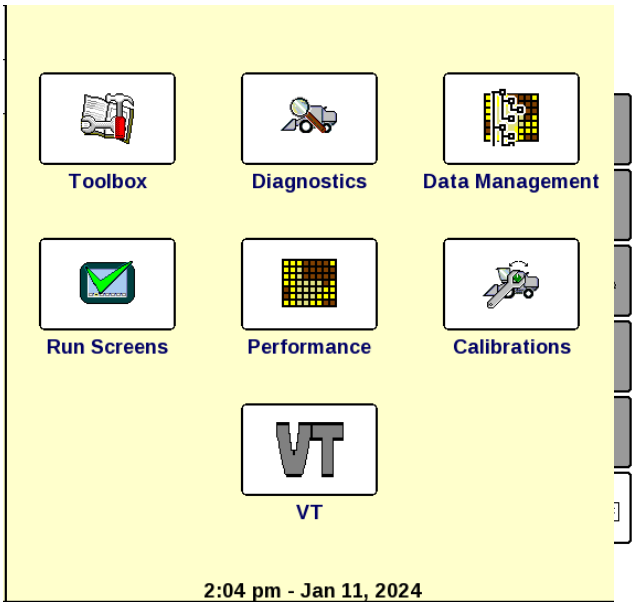


Figure 6.5 Combine monitor menu screen.

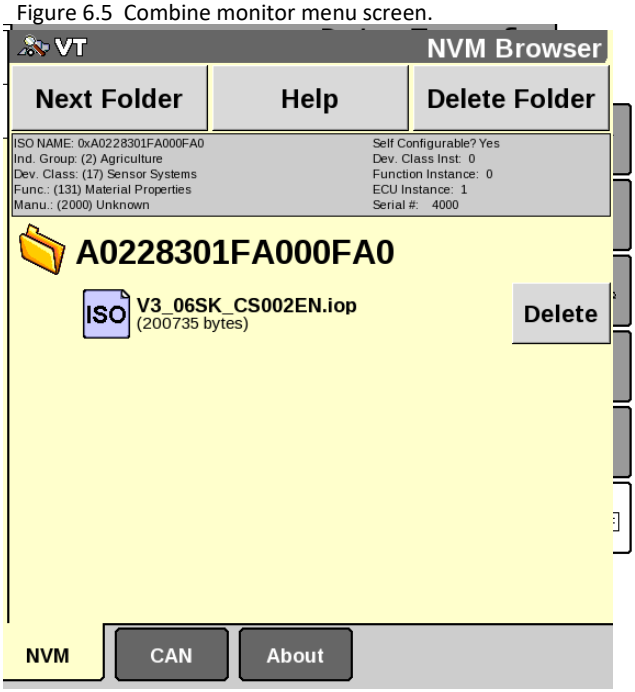


Figure 6.6 NVM Browser screen.

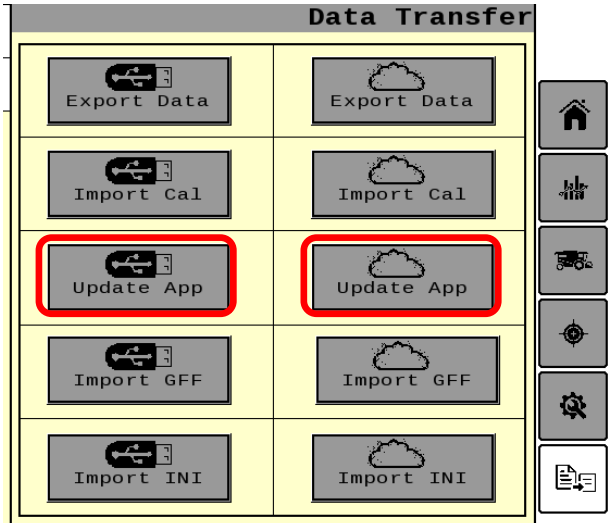


Figure 6.7 CropScan Virtual Termina Data Transfer menu.

## 6.5 Import INI

***Note: Copy and paste a Default.ini file to the Configuration Folder of a USB memory device for USB import.***

i. Copy and paste a Default.ini file to the Configuration Folder of a USB memory device.

ii. Insert USB memory device into CropScan 4000VT NIR Spectrometer USB port.

iii. Press the Import INI (USB) icon for USB import or INI (Cloud) icon for cloud sync on the 4000VT screen.

iv. The system will automatically upload the Default.ini file from the USB or cloud to the CropScan 4000VT ECU.

v. Wait for the CropScan VT complete reading the CN1 folder or cloud sync process.

vi. Wait for the CropScan VT to re boot.

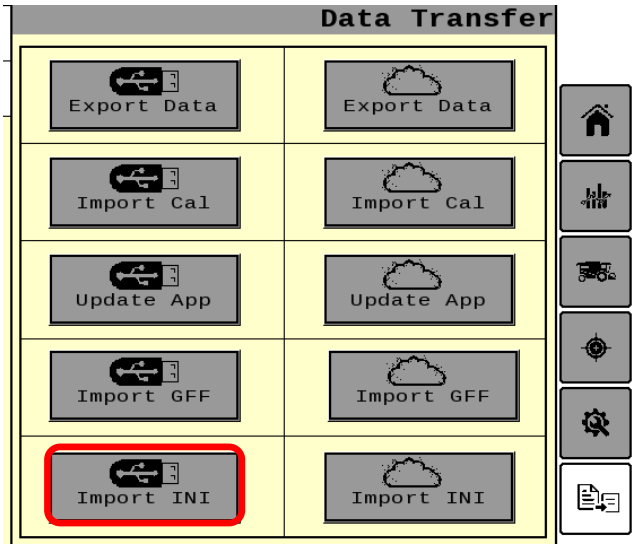


Figure 6.8 CropScan Virtual Termina Import INI

## 6.6 Import GFF (USB) or (Cloud)

***Note: Copy and paste a CN1 folder with Setup data to the root drive of a USB memory device for USB import.***

i. Copy and paste the CN1 file onto root directory of the USB memory device.

ii. Insert USB memory device into CropScan 4000VT NIR Spectrometer USB port.

iii. Press the Import GFF (USB) icon for USB import or GFF (Cloud) icon for cloud sync on the 4000VT screen.

iv. The system will automatically upload the SetUp Data from the CN1 file or cloud to the CropScan 4000VT ECU.

v. Wait for the CropScan VT complete reading the CN1 folder or cloud sync process.

.

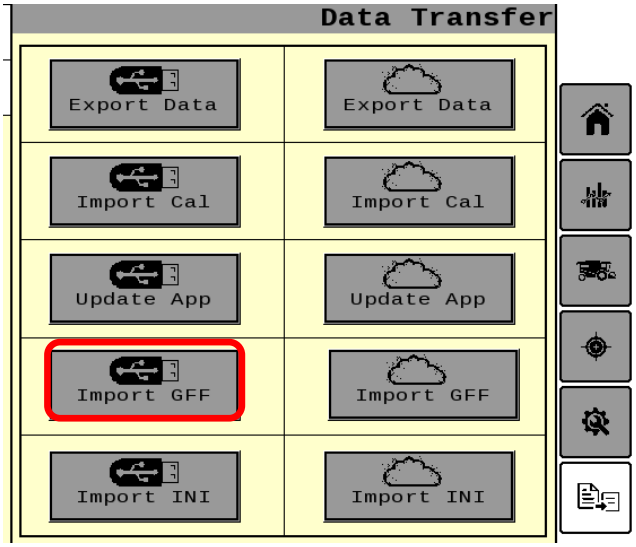


Figure 6.9 CropScan Virtual Termina Import GFF

# 7.0 Diagnostics

## 7.1 Overview

Diagnostics is a troubleshooting tool used to test the operation of the CropScan 4000VT sensors and motors. These tools provide a service person with a means of diagnosing problems within the system. Unless instructed by your Technical Support agent, these tools should not be used by the operator.

## 7.2 Lamp 100% Test

Press the **Diagnostic** icon button to open the Diagnostics screen. Press the 100% button to scan the lamp 100% signal as shown in figure 7.2. The Max should be between 2000 and 3000 pAmps. The Min should be greater than 100 pAmps.

## 7.3 Noise Hardware Test

Press the Noise button to collect a signal s can with the Lamp Off as shown in figure 7.2. The Noise level with the Lamp Off should be low ie <+/- 0.0100 units. If the panel door is open when the test is taken, sunlight may also be detected. Make sure the side panel door is closed when doing this test.

## 7.4 Temperature Test

Press the TEMP button to read the detector temperature. The temperature should be 40C. Press the AMBIENT button to read the internal temperature of the NIR Spectrometer.

## 7.5 Sample Sensor

The Sample Sensor is the trigger to indicate the Sample Chamber is full.

i. Press the Sample Sensor button to test whether the Chamber Full or Empty. Place a non ferrous object like a finger or clothing front of the sample sensor to test the Full status.

## 7.6 Outlet Flap Test

The Outlet Flap is controlled by a 12 Volt Direct Drive Motor, the Stainless Steel Flap is coupled to the Motor Gear Box. A micro switch sends a feedback for the closed position.

i. Press the FLAP button to cycle the flap to the open or closed position.

## 7.7 Lamp ON/OFF

The Lamp Assembly consists of a 12 Volt 10 Watt Bi Pin Lamp.

i. Press the FLAP button to cycle the flap to the open or closed position.

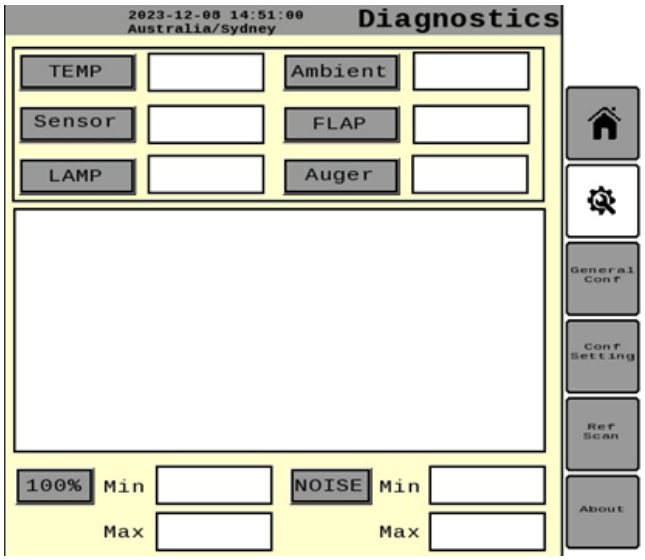


Figure 7.1 CropScan Virtual Terminal Diagnostics screen

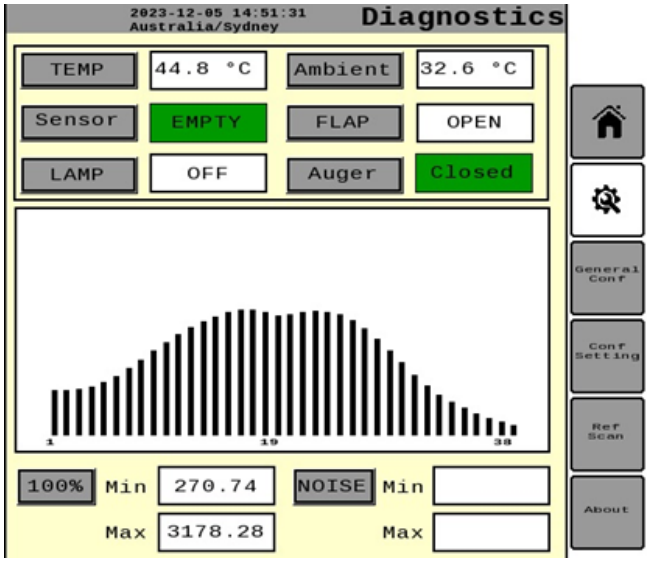


Figure 7.2 CropScan Virtual Terminal Diagnostics Lamp scan

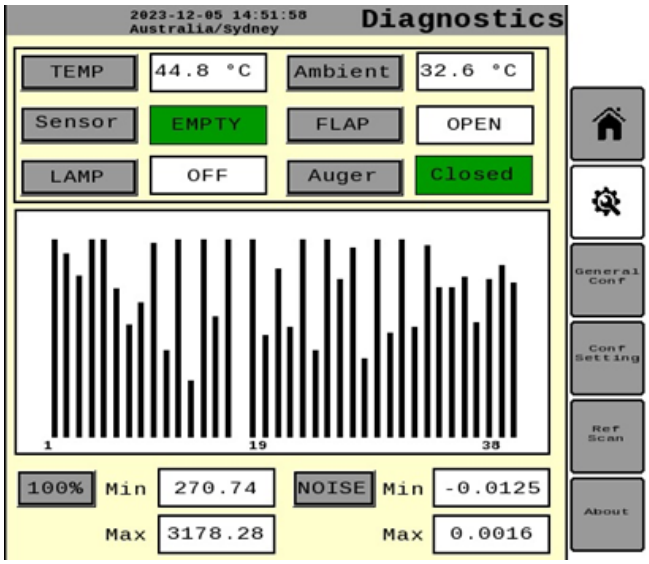


Figure 7.3 CropScan Virtual Terminal Diagnostics Noise scan

## Diagnostic Cont.

### 7.8 Auger Sensor Test

The Augur position status CANBUS message is checked each sample cycle and will record a Grain Tank reset when cycled. The Auger must remain open for 30 seconds to register a Auger cycle and Grain Tank.

i. When the Outloading Auger is retracted, the Test Auger Sensor status box should turn **GREEN** when pressed as shown in figure 7.3.

ii. When the Outloading Auger is extended away from the yellow sensor, the Test Auger Sensor status box should turn **RED** when pressed.

### 7.9 Configuration Settings

The Configuration Setting Menu contains the follow:

1. **Serial Number**
1. **Outlet Flap Angle 8mm - Small Seeds = 17**
2. **Outlet Flap Angle 16mm - Wheat = 22**
3. **Outlet Flap Angle 16mm - Barley = 22**
4. **Outlet Flap Angle 30mm - Large Seeds = 26**
5. **Sample Packing Delays - Barley = 0**
6. **Sample Sensor Enable = TICK**
7. **Auger Sensor Enable = UN TICKED**
8. **Default Temp = 40**
9. **Small Seeds Packing Delay = 0**
10. **Wheat Seeds Packing Delay = 0**
11. **Barley Seeds Packing Delay = 0**
12. **Large Seeds Packing Delay = 0**
13. **Sample Sens Packing Delay = 0**
14. **Serial GPS Enables = UN TICKED**
15. **GPS BUAD Rate = Blank**

***Note: These settings should be only changed when instructed by CropScanAg or a trained dealer.***

i. Press the Configuration Menu and wait for the parameter page to load.

ii. Select the parameter you want to change and use the popup keyboard as shown in figure 7.4 to adjust setting.

iii. Press **SAVE** to confirm new Configuration Settings.

***NOTE: the Spectrograph takes around 45-60 seconds to reboot, let the CropScan Virtual Terminal reboot.***

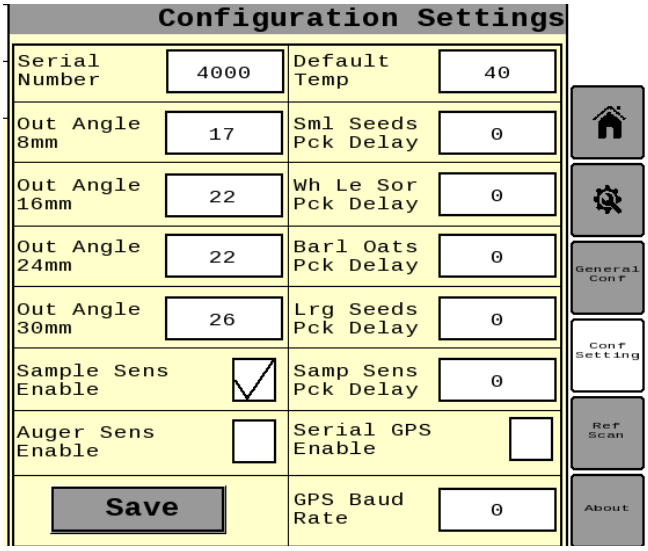


Figure 7.4 CropScan Virtual Terminal Configuration Setting Menu

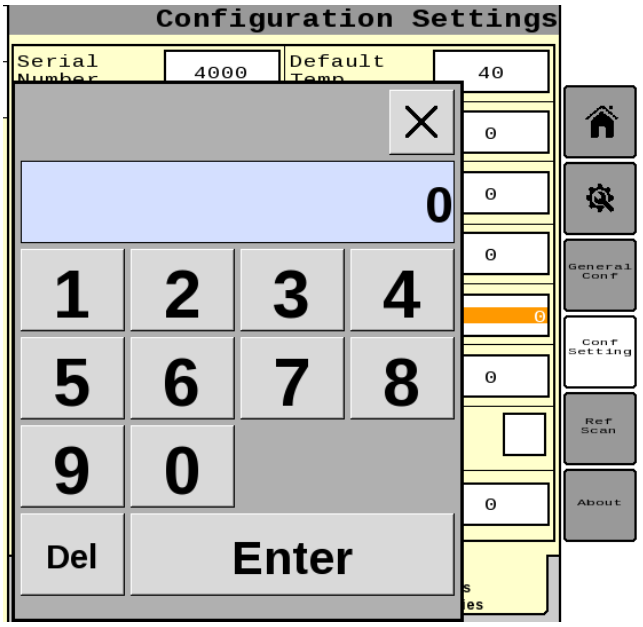


Figure 7.4 CropScan Virtual Terminal Configuration Keyboard.

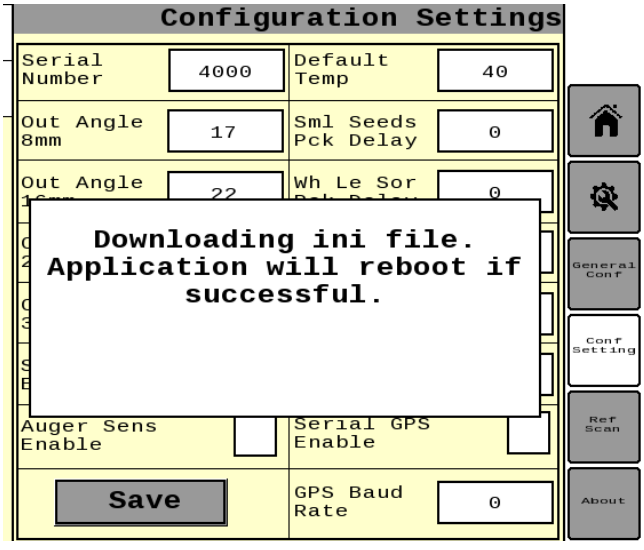


Figure 7.4 CropScan Virtual Terminal downloading INI file.

# Er8.0 Error Codes

## 8.1 Overview

The CropScan VT Error Codes are designed to provide operator feedback when a hardware or software fault is detected. There are 8 fault codes:

**Hardware Code Error List**

1. Implement Error
2. NIR ECU Not Detected
3. NIR ECU Error
4. Sample Sensor Error
5. Lamp Signal Low
6. Outlet Flap Error
7. Low Signal
8. Outlier Error
9. No Sample Detected

## 8.2 Implement Error

Error Code Implement Error indicates the NIR Spectrometer ECU is detecting an application error. This maybe be related to a Hardware or Software fault.

i. Check Error Code Logs but pressing on the status bar yellow triangle warning to display fault codes.

ii. Export Log Files via the Data Transfer menu as described in Ch 6.2 of the User Guide.

iii. Contact technical support via dealer or email support@nextinstruments.net

## 8.3 NIR ECU Not Detected

Error Code HW001 indicates the NIR Spectrometer is not communicating with the ECU.

i. Check Sample Head Lamp condition, Lamp On indicates the NIR Spectrometer is powered and ready to communicate.

ii. Lamp Off indicated the NIR Spectrometer is not powering on due to program status. Re programing of the NIR Spectrometer is recommended by a training technician.

## 8.4 NIR ECU Error

Error Code HW005 indicates the NIR Spectrometer Noise signal boot up checks have failed.

i. Check Diagnostics Nosie test as explained in Ch 7.3.

ii. If the Nosie Diagnostic Check passes and is within the operation limits –0.01 to +0.000 units continue with operation.

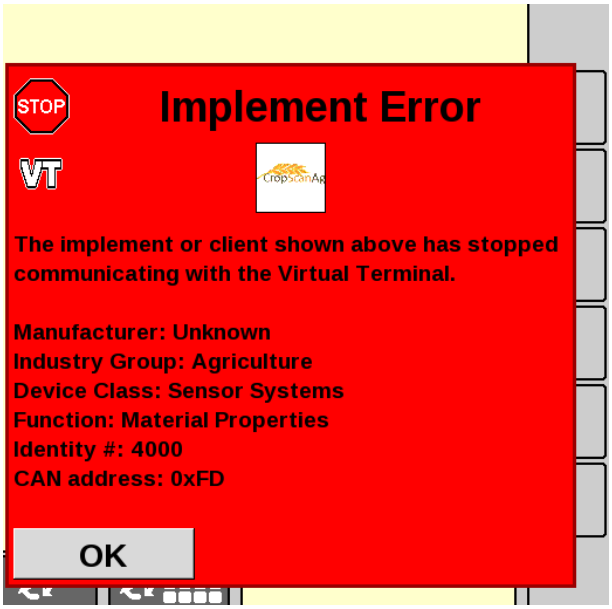


Figure 8.1 CropScan Virtual Terminal Implement Error Code.

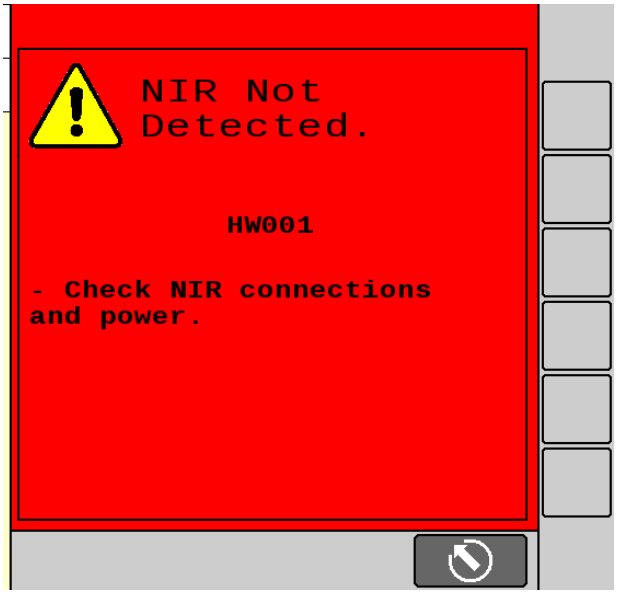


Figure 8.2 CropScan Virtual Terminal NIR Error Code.

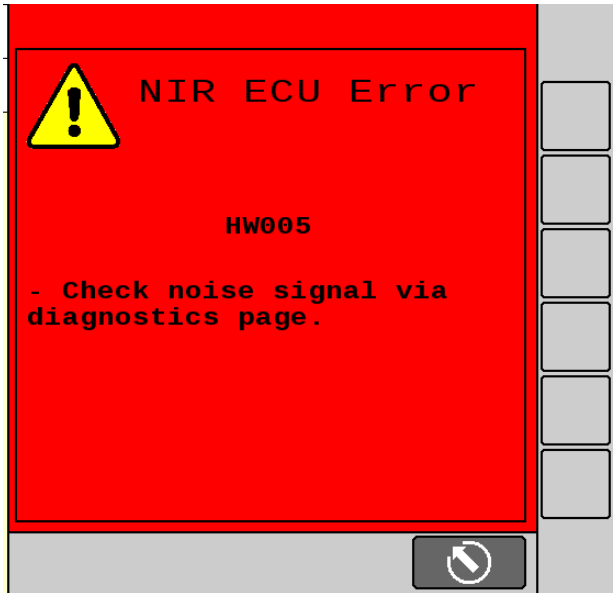


Figure 8.3 CropScan Virtual Terminal NIR Error Code.

## Error Codes Cont.

### 8.5 Sample Sensor Error

Error Code HW003 indicates the Sample Head Sample Sensor is not supplying a 0-5 Volt feedback to the NIR Spectrometer.

i. Remove the Sample Head Electrical cover for inspection.

ii. Test the Sample Sensor trigger LED located on the aft side of the sensor. Manually place a non ferrous material in front of the sensor. When the LED is ON the Sensor is triggered and indicating the sample chamber is full. When the LED is OFF the Sample is indicating a the sample chamber is empty.

iii. Test the Sample Sensor Diagnostic Check via the CropScan VT Diagnostics screen as per Ch 7.5.

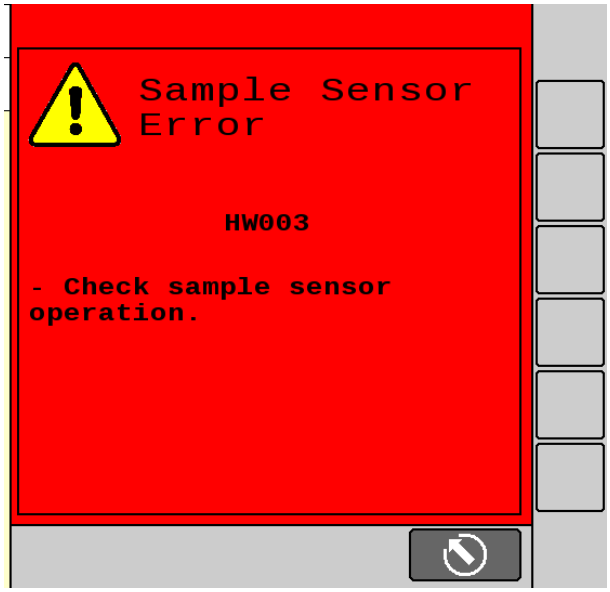


Figure 8.4 CropScan Virtual Terminal NIR Error Code.

### 8.6 Lamp Signal Low

Error Code HW004 indicates the Sample Head Sample Lamp energy output is low and signal to the NIR Spectrometer below limits. The lamp signal low level could indicate a sample chamber blockage. Check the Sample Head condition before any troubleshooting.

i. Check Diagnostics Nosie test as explained in Ch 7.2.

ii. If the 100% Lamp Diagnostic Check passes and is within the operation limits 2000-3000 units continue with operation.

Iii. If the error code HW004 continues a new Master Reference Scan Temp Modelling Procedure is required.

iv. Contact technical support via dealer or email **support@nextinstruments.**net for Temp Modelling Procedure and support.

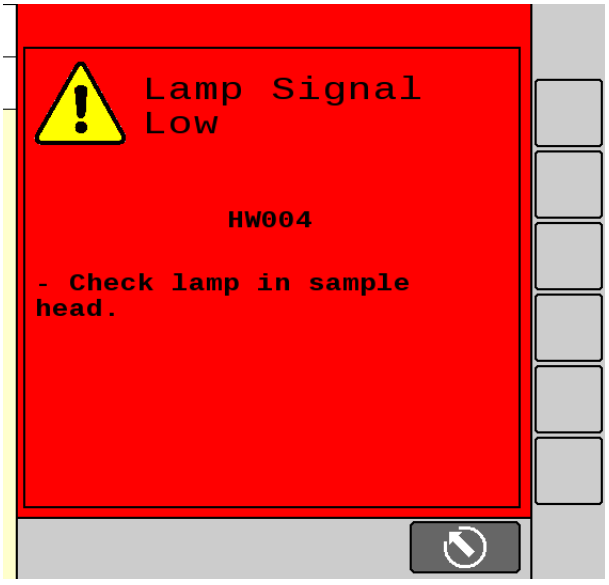


Figure 8.5 CropScan Virtual Terminal NIR Error Code.

### 8.7 Outlet Flap Error

The Outlet Flap is controlled by a 12 Volt Direct Drive Motor, the Stainless Steel Flap is coupled to the Motor Gear Box. A micro switch sends a feedback for the closed position.

i. Check the Flap Cycle Test as explained in Ch 7.6.

ii. Press the FLAP button to cycle the flap to the open or closed position.

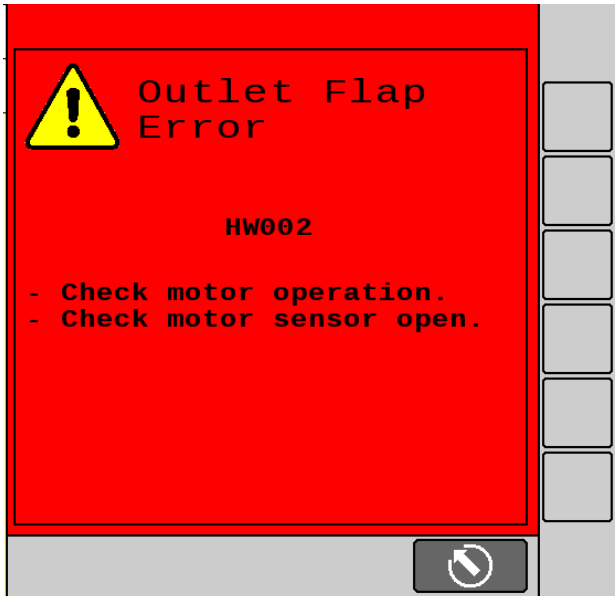


Figure 8.6 CropScan Virtual Terminal NIR Error Code.

## Error Codes Cont.

iii. Remove power to the Sample Head by disconnecting the Sample Head cable and manually cycle the Stainless Steel Flap. If the Flap moves the motor and gear box are satisfactory.

iii. Check Sample Head Cable Pin Wiring for power across the Blue and White Motor Wires inside the sample head. When the Flap Open Button is pressing via the Diagnostics page 12 VDC will be applied to the Blue and White Motor wires inside the sample head. If the 12 VDC is present at the Blue and White Motor wires the wiring to the motor is satisfactory.

iv. The Microswitch provides the switching feedback to the NIR Spectrometer. If the Micro switch is not trigger on the close cycle the Outlet Sensor Faut code is generates and displayed on the CropScan VT.

v. Check the Microswitch positioning to Flap Bar bolt is triggering the microswitch as the Stainless Steel Flap touches the sample chamber rubber bumper. If the Stainless Steel Flap pushes to hard against the rubber bumper it would indicate the Microswitch needs adjusting.

## 8.8 Low Signal

Error Code SW008 indicates signal to the NIR Spectrometer below limits.

i. Check Sample Head Lamp is ON.

ii. Check Fibre Optic Probe position is correct for Crop Type selection. Ref Ch 2.4 for Fibre Optic Probe positions.

## 8.9 Outlier Error

Error Code SW001 indicates CropScan results are below or above the expected sample range.

i. Check the Sample Head for:

- Probe Position
- Cleanliness
- Lamp Lens Condition & Lamp is powered ON
- Moisture inside the Fibre Optic Probe

ii. Check the correct Crop Type is selected in the VT.

i. Check the CropScan Calibration Bias Factor value. Ref Ch 5.5 for instructions to access the Calibration Bias factors. If the Bias factors have been changed during a recent Auto Calibration or manual Calibration Adjustment it is recommended a new Auto Calibration routine.

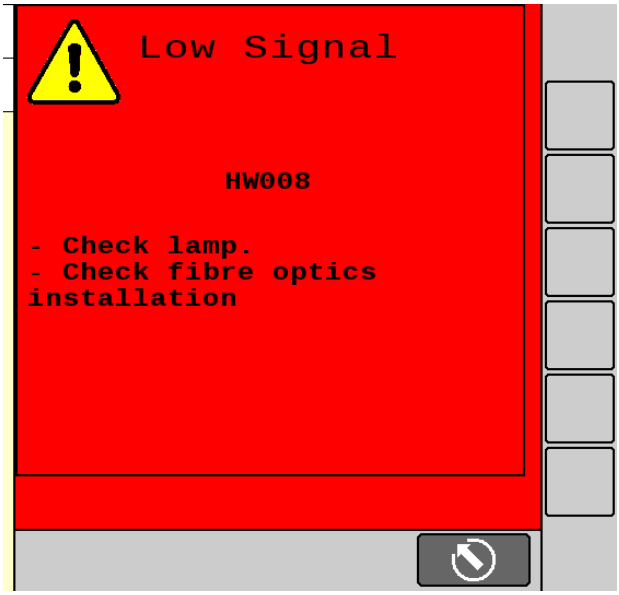


Figure 8.7 CropScan Virtual Terminal NIR Error Code.

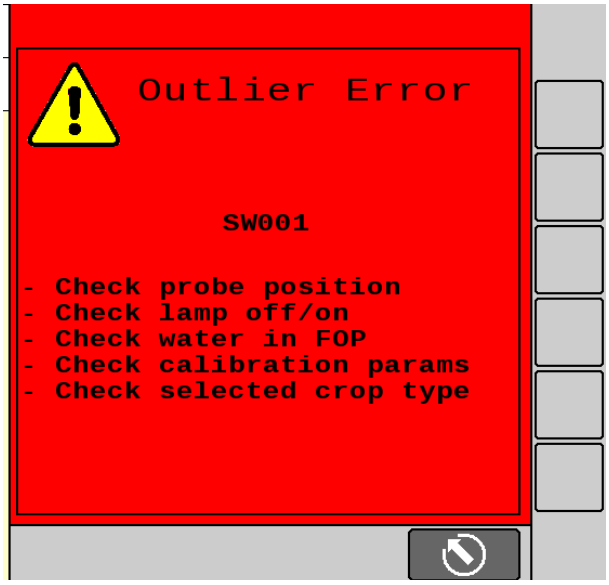


Figure 8.8 CropScan Virtual Terminal NIR Error Code.

## Error Codes Cont.

### 8.10 No Sample Detected

Error Code SW006 indicates no sample has been collected.

i. Check Sample Head Stainless Steel Flap is in the Closed position.

ii. Adjust Motor Microswitch position to reduce the Flap to rubber bumper gap.

### 8.10 Error Code Log

The CropScan Virtual Terminal logs and records Hardware and Software error codes.

The Codes will be displayed as pop up warnings and logged in the Fault Warning window as shown in figure 8.7.

Error logs can be exported from the Data Transfer Menu.

i. Ref to the Data Transfer Ch 6.2 for explanation and steps to export the log data.

ii. Fault Code Logs will be listed in the Fault Warning windows and can be cleared individually or Clear All.

### 8.11 About Window

The CropScan Virtual Terminal About windows provides:

- CropScan Virtual Terminal Software Version
- CropScan Serial Number
- Spectrometer Firmware Version
- CropScanAg Cloud Web Portal QR Code
- CropScan 4000VT User Guide QR Code

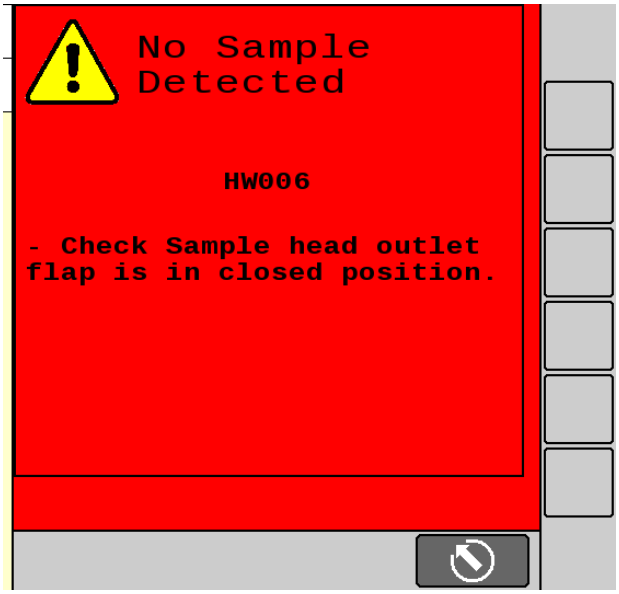


Figure 8.9 CropScan Virtual Terminal NIR Error Code.

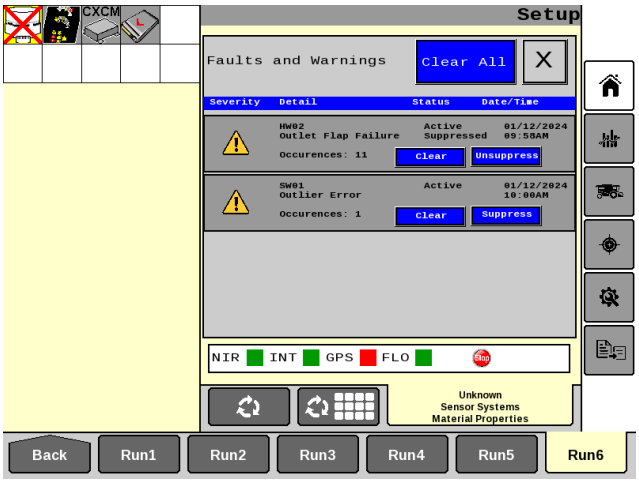


Figure 8.10 CropScan Virtual Terminal Faults and Warning.

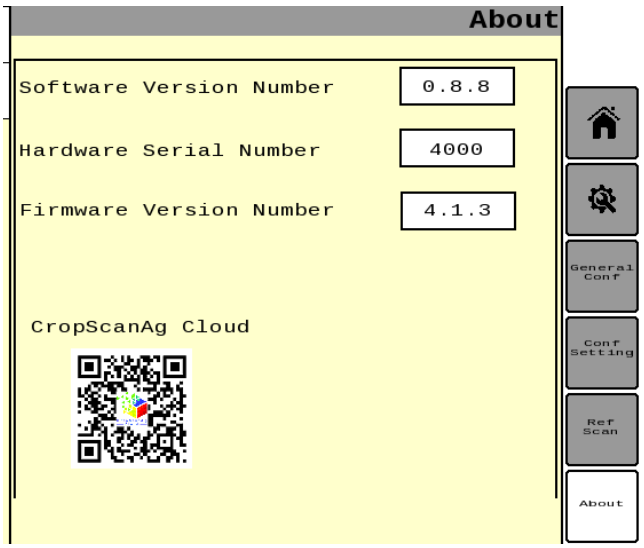


Figure 8.11 CropScan Virtual Terminal About window.

## 13.0 Warranty

The CropScan 4000VT On Combine Analyzer is warranted for 12 months. The warranty includes all parts and labour for the repair of any component that has failed to be within the recommended operating conditions. If there is damage to the instrument due to inappropriate handling, then the warranty will be voided.

## 14.0 Disclaimer

The CropScan 4000VT On Combine Analyzer is designed to function as a Near Infrared Spectrophotometer. The instrument measures the amount of light absorbed by the sample and the computer applies a calibration model for a specific product and thereby calculates the constituent values. Calibrations supplied with the instrument are not guaranteed to perform to any standard or specification. Owners are responsible for evaluating the calibrations used within the instrument. Owners are responsible for interpreting and using the information provided by these instruments at their discretion. The manufacturer takes no responsibility for any damages or costs incurred by the user based on the information provided by the instrument.