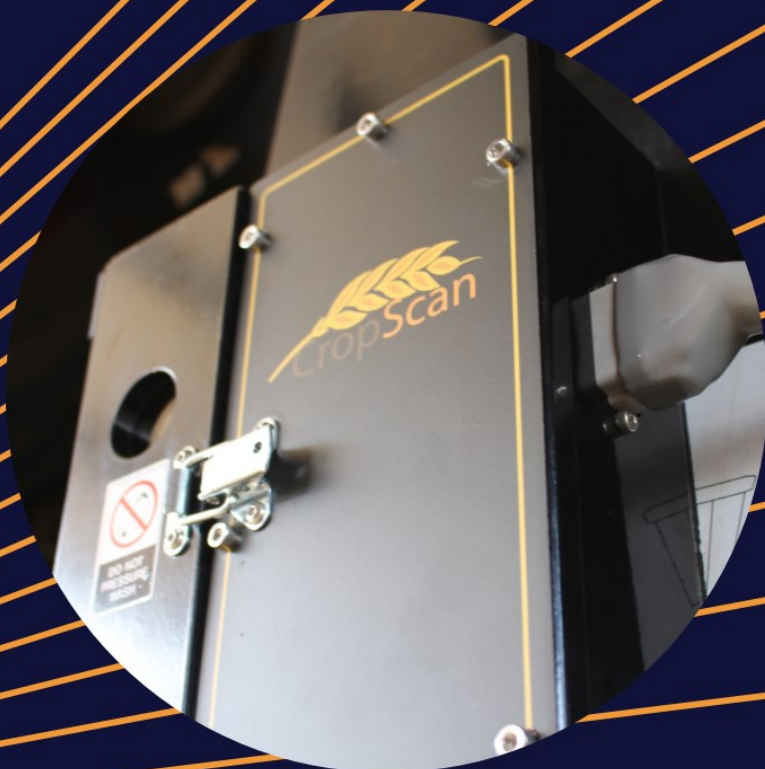




4000VT

ISOBUS Integration



ON COMBINE GRAIN ANALYSER USER GUIDE

www.cropscanag.com

CropScan 4000VT On Combine Grain Analyzer: Users Guide

REVISION HISTORY

Initial Prototype	November	2022
Rev. I	May	2023
Rev II	October	2023
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CropScan 4000VT On Combine Grain Analyzer: Users Guide

Table of Contents

Revision History	2
1.0 <u>Product Description</u>	
1.1 Overview	5
1.2 Description	5
1.3 Technology	6
1.4 Virtual Terminal	6
1.5 N-GAUGE Description	7
1.6 N-GAUGE Harvest Manager	7
1.7 N-GAUGE Nutrient Manager	7
2.0 <u>Operation</u>	
2.1 Overview	8
2.2 Daily Checks	8
2.3 Power On	8
2.4 Start Analysis	9
2.5 Stop Analysis	10
2.6 Shut Down	10
3.0 <u>Run Screen Descriptions</u>	
3.1 Overview	11
3.2 Field Data	11
3.3 Field Map	11
3.4 Grain Tank Data	11
4.0 <u>Option Menu's</u>	
4.1 Overview	12
4.2 Temperature Unit	12
4.3. Volume Unit	12
4.4 Seeding Month	12
4.5 Outlier Detection	12
4.6 Harvest ID	12
4.7 N-GUAGE Setuo	12
4.8 WiFi Setup	13
4.9 Field IDS	13
5.0 <u>Calibration</u>	
5.1 Overview	14
5.2 Slope and Bias Description	14
5.3 Accuracy	15
5.4 Precision	15
5.5 Calibration Adjustment	16
5.6 Auto-Calibration	17
5.7 Delete Calibration	18

CropScan 4000VT On Combine Grain Analyzer: Users Guide

Table of Contents Cont.

6.0	<u>Data Transfer Menu</u>	
6.1	Overview	19
6.2	Export Data	19
6.3	Import Calibration	19
6.4	Update Virtual terminal	20
6.5	Import INI	21
6.6	Import GFF (USB) or (Cloud)	21
7.0	<u>Diagnostics Menu</u>	
7.1	Overview	22
7.2	100% Lamp Signal Test	22
7.3	Noise Hardware Test	22
7.4	Temperature Test	22
7.5	Sample Photo Sensor Test	22
7.6	Outlet Flap Test	22
7.7	Lamp ON/OFF	22
7.8	Auger Sensor Test	22
7.9	Configuration Settings	23
7.10	Ref Scan	23
7.11	Temperature Modelling	23
7.12	About	23
8.0	<u>Error Codes</u>	
8.1	Overview	24
8.2	Implement Error	24
8.3	NIR ECU Not Detected	24
8.4	NIR ECU Error	24
8.5	Sample Sensor Error	25
8.6	Lamp Low Signal	25
8.7	Outlet Flap Error	25
8.8	Low Signal	26
8.9	Outlet Error	26
8.10	No Sample Detected	27
8.11	Error Code Log	27
8.12	About Window	27
9.0	<u>Warranty</u>	28
10.0	<u>Disclaimer</u>	28

CropScan 4000VT On Combine Grain Analyzer: Users Guide

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. 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.

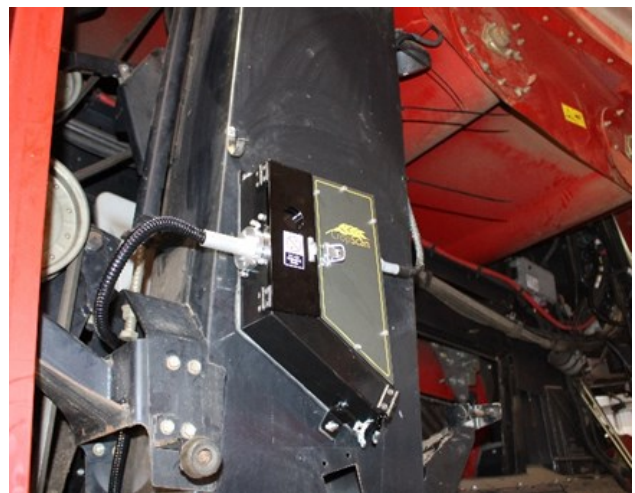


Figure 1.2 CropScan 4000VT Sample Head.



Figure 1.3 CropScan 4000VT NIR Spectrometer..

CropScan 4000VT On Combine Grain Analyzer: Users Guide

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 runs a Virtual Terminal (figure 1.4) on the Pro 700 or Intelliview IV displays. Protein, Oil, Moisture, Starch 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.

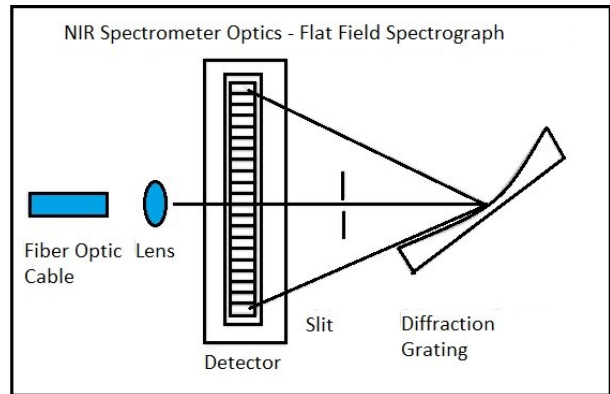


Figure 1.3 Schematic of the NIR Spectrometer Optics Layout.



Figure 1.4 Pro 700 CropScan VT



Figure 1.5 Pro 700 CropScan VT Field Data screen



Figure 1.6 Pro 700 CropScan VT Tank Data screen

CropScan 4000VT On Combine Grain Analyzer: Users Guide

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 their 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 included in all CropScan 4000VT On Combine Grain Analyzer 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. Users can create an On Farm virtual storage site to view the recorded in loading and unloading of grain to the grower's bins or silos. 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 automatically when the Auger is cycled or when the Combine Rotor is disengaged.

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

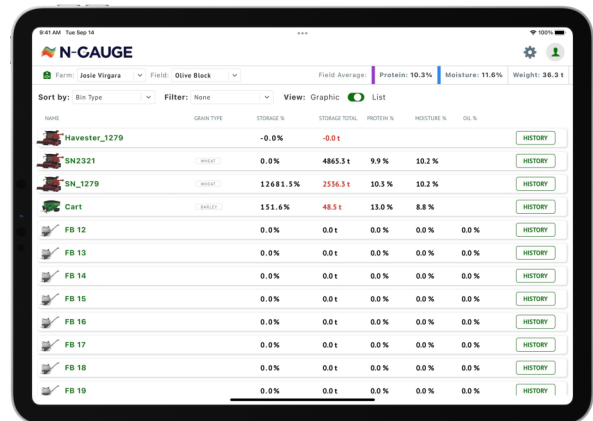


Figure 1.8 CropScanAg N-GAUGE Harvest Manager App



Figure 1.9 CropScanAg N-GAUGE Nutrient Manager App

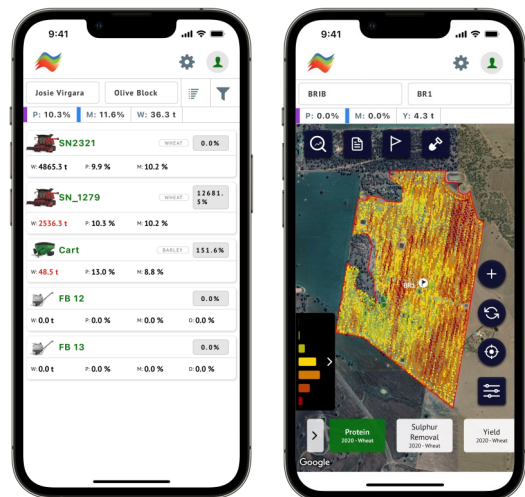


Figure 1.10 CropScanAg N-GAUGE App on iPhones

CropScan 4000VT On Combine Grain Analyzer: Users Guide

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 Apps Software connects growers with their 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 Probe for correct Crop Type position. 7mm for Canola, 15mm for Wheat and Barley, 24mm for Soybean, Corn, Peas and Beans.
- v. Allow the NIR Spectrometer to warm up for 5-10 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's 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 fails, the VT will bring up a warning to notifying the user (figure 2.3). 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.

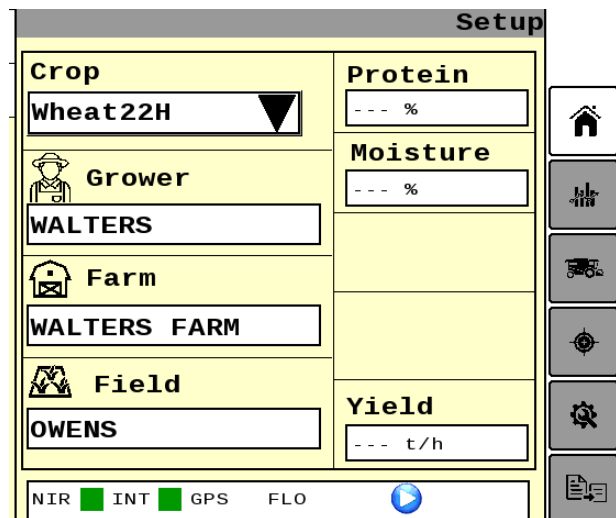


Figure 2.2 CropScan Virtual Terminal Setup screen.

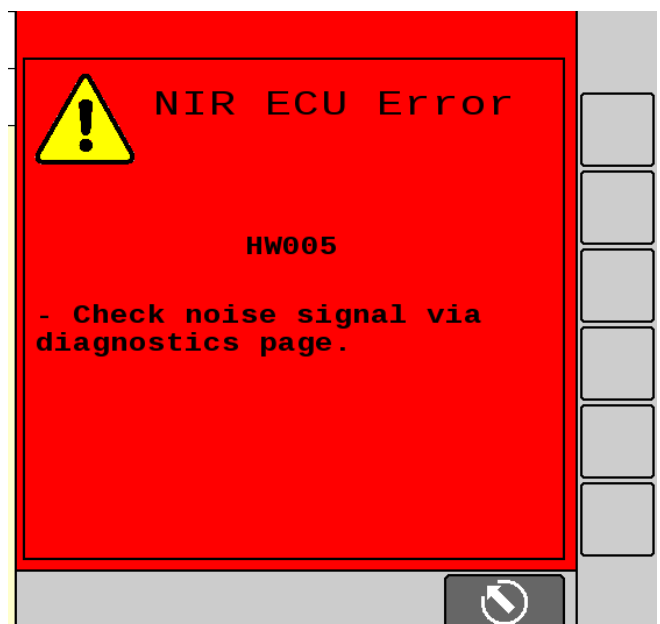


Figure 2.3 CropScan 4000VT Error Screen

CropScan 4000VT On Combine Grain Analyzer: Users Guide

2.4 Start 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's main run screen 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 the below file naming structure:

Grower Farm Field Serial No Year-Map.csv

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

iv. Press and Confirm the Fibre Optic Probe is in the correct Crop Type GFF 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, e.g, 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 position will cause erratic results. Use the supplied Pathlength Test Block Assembly to check probe 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 passed through the Fibre Optic Cable to the NIR Spectrometer. The ECU generates the NIR spectrum, applies the calibration models for Protein, Moisture, Oil and Starch, then sends the along with Yield and GPS coordinates to the VT screen (figure 2.7). The system cycles the outlet flap to the open position and empties the chamber. The outlet flap then cycles to the closed position to fill the sample chamber so that the next sample can be analyzed. The cycle time is approximately 3-4 secs.

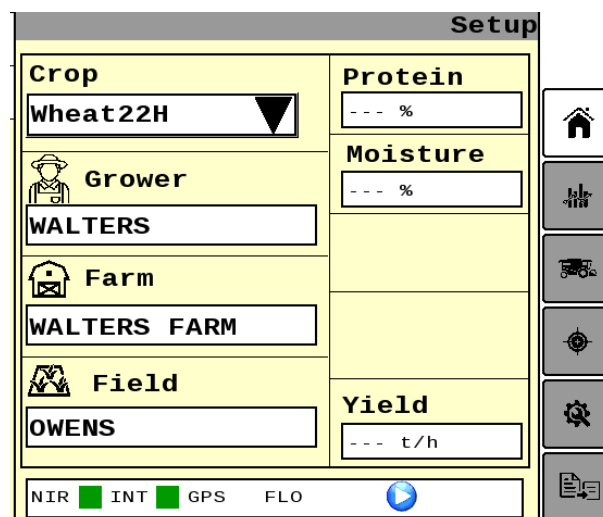


Figure 2.4 Crop Type and Grower Farm Field inputs.



Figure 2.5 Fibre Optic Probe position warning.

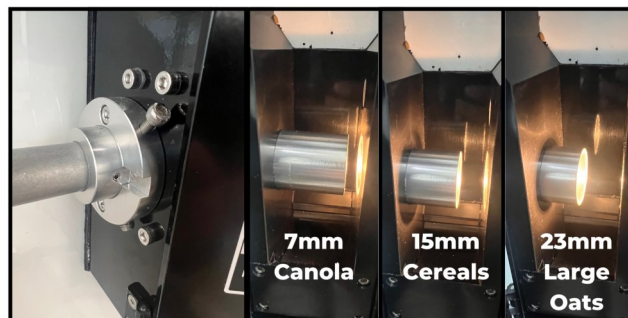


Figure 2.6 Fibre Optic Probe positions.

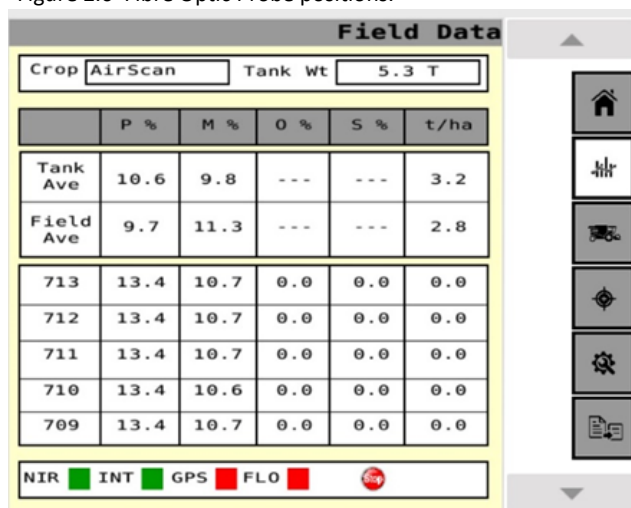


Figure 2.7 Field Data screen

CropScan 4000VT On Combine Grain Analyzer: Users Guide

2.5 Stop 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.

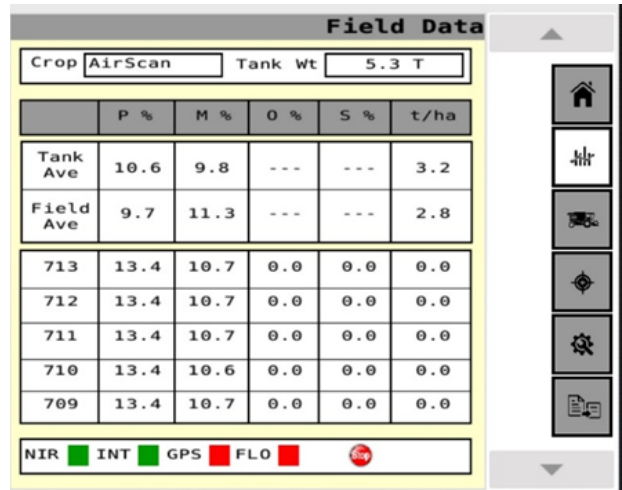
Note: if the Crop Type or Field Name is changed while the Rotor is Engaged, the Crop Type and Field name is not sent. These messages are only published when the Rotor is disengaged.

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 after 20 seconds.

Note: If the Ignition key is switched ON while the ECU is powering down, a connection failure will likely occur and connection to the Virtual Terminal will not be successful. If a Connection Failure is displayed, 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.



The screenshot shows the 'Field Data' screen with a table of crop analysis results. At the top, 'Crop' is set to 'AirScan' and 'Tank Wt' is '5.3 T'. The table has columns for 'P %', 'M %', 'O %', 'S %', and 't/ha'. Below the table are status indicators for NIR, INT, GPS, FLO, and a red stop button.

	P %	M %	O %	S %	t/ha
Tank Ave	10.6	9.8	---	---	3.2
Field Ave	9.7	11.3	---	---	2.8
713	13.4	10.7	0.0	0.0	0.0
712	13.4	10.7	0.0	0.0	0.0
711	13.4	10.7	0.0	0.0	0.0
710	13.4	10.6	0.0	0.0	0.0
709	13.4	10.7	0.0	0.0	0.0

At the bottom, there are status indicators: NIR (green), INT (green), GPS (green), FLO (red), and a red stop button.

Figure 2.8 Combine VT Run Screen



Figure 2.9 Combine Pro 700 Monitor and Rotor Switch



Figure 2.10 Combine Ignition Switch.

3.0 Virtual Terminal Run Screens

3.1 Overview

The data can be viewed in three different Run Screens, i.e., Home Setup, Field Data and Grain Tank Data. Click on the Tab to display each screen format. The Crop Type and current Tank Average are displayed at the top of each Run Screen.

3.2 Home Setup Screen

The Home Screen displays 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 twenty five 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 displays the tank averages for Protein, Moisture, Oil, Starch, Fiber and the Weight for each tank load that has been harvested and outloaded to a grain cart or truck. Each time the outloading auger is extended, the CropScan 4000VT ECU registers an auger cycle and triggers the Grain Tank Run screen to record and reset the new Grain Tank average. Use the Up and Down arrows to scroll back to previous tank loads.



This data is stored in a single storage file called:

Grower Storage SN1234 2022.csv.

This storage file allows operators to monitor grain tank loads and the running stack average of stored grain using the N-GAUGE App on a smart device. The N-GAUGE Grain Logistics module is a simple tool to record the Weight, Protein, Moisture, Oil and Starch of grain stored in each storage unit, i.e., grain cart, field bin, truck, silo etc. N-GAUGE Grain Logistics module enables the user to transfer grain, split grain loads and blend grain in order to maximise crop payments.

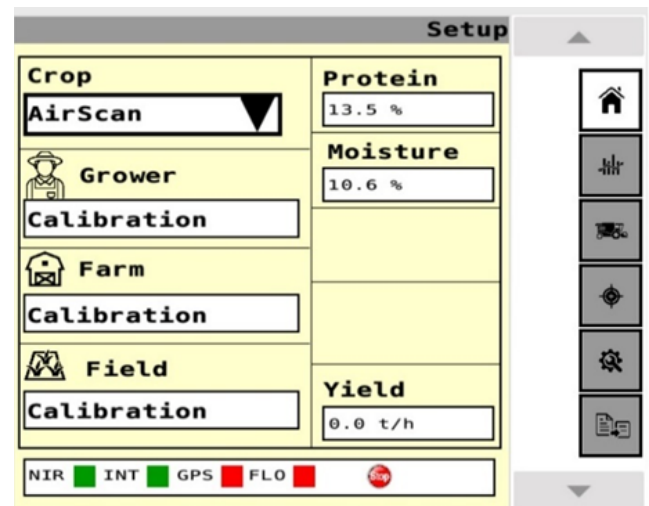


Figure 3.1 CropScan Virtual Terminal Setup screen

	P %	M %	O %	S %	t/ha
Tank Ave	10.6	9.8	---	---	3.2
Field Ave	9.7	11.3	---	---	2.8
713	13.4	10.7	0.0	0.0	0.0
712	13.4	10.7	0.0	0.0	0.0
711	13.4	10.7	0.0	0.0	0.0
710	13.4	10.6	0.0	0.0	0.0
709	13.4	10.7	0.0	0.0	0.0

Figure 3.2 CropScan Virtual Terminal Field Data screen

	P %	M %	O %	Tons
Tank Ave	10.8	9.9	---	5.3 T
Field Ave	9.7	11.3	---	---
10	10.5	10.9	0.0	2.3
9	9.6	11.8	0.0	0.6
8	6.3	14.6	5.9	0.6
7	8.8	12.4	0.0	0.6
6	10.4	10.9	0.0	0.4

Figure 3.3 CropScan Virtual Terminal Tank Data screen

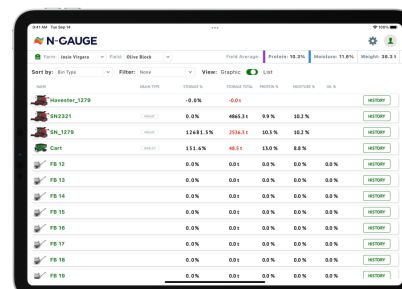


Figure 3.4 CropScanAg N-GAUGE Grain Logistics Module

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, Kilograms 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".

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

- Press the **N-GAUGE Setup** button to access the User Credential setup window.
- Enter the User email address used to create the CropScanAg Cloud account.
- Enter the User Password used to create the CropScanAg Cloud account.
- 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 connectivity will be available.

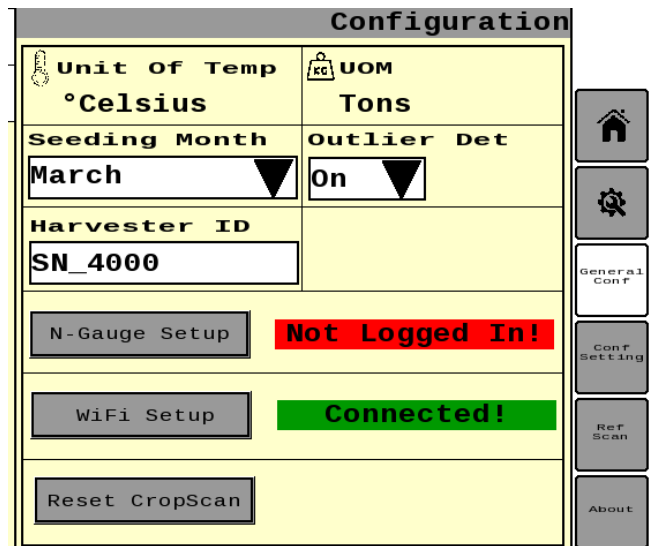


Figure 4.1 CropScan Virtual Terminal General Configuration screen

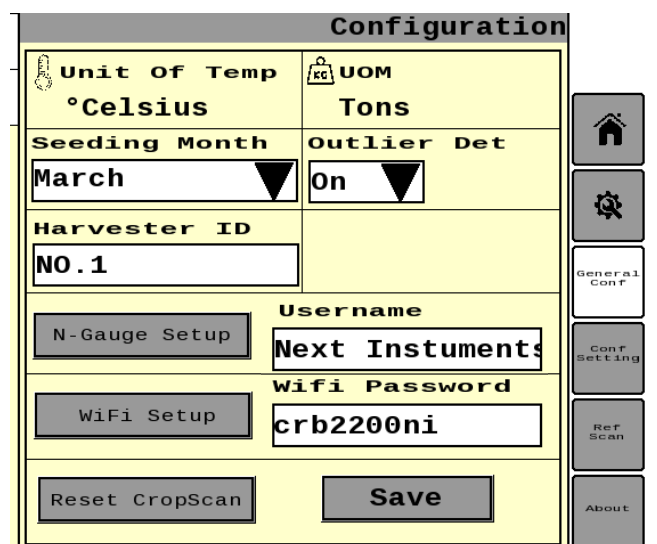


Figure 4.2 CropScan Virtual Terminal Unit of measure selector screen.

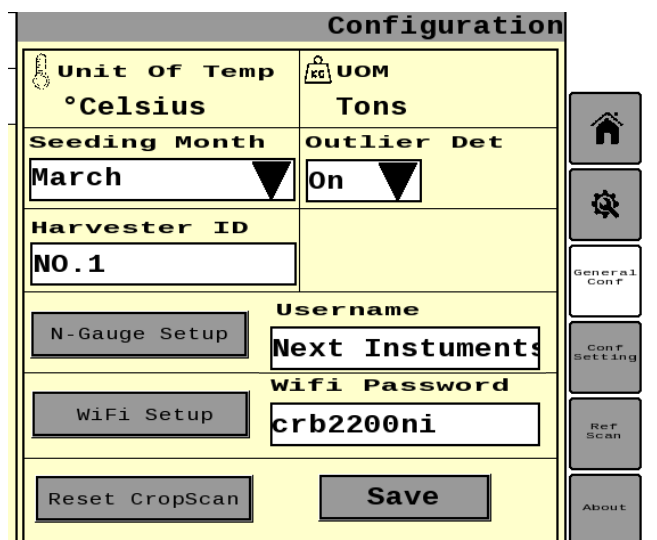


Figure 4.2 N-GAUGE Setup screen

CropScan 4000VT On Combine Grain Analyzer: Users Guide

4.8 WiFi Setup

NOTE: Make sure a phone Hotspot is ON or with 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 IDs

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

Grower-Farm-Field Import

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

- i. Save a CN1 Folder to the route directory of a USB memory device.
- ii. Insert the USB device into the CropScan 4000VT NIR Spectrometer's USB port on the lower side of the box located outside of the cabin as shown in figure 4.5.
- iii. Select the **Data Transfer** Menu to access the data transfer options.
- iv. Press the Grower Farm Field (GFF) 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.

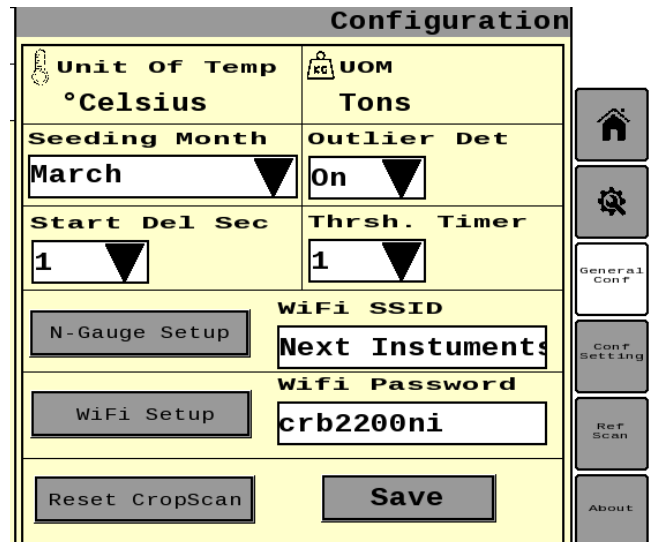


Figure 4.4 CropScan Virtual Terminal General Configuration



Figure 4.5 CropScan NIR Spectrometer USB Port

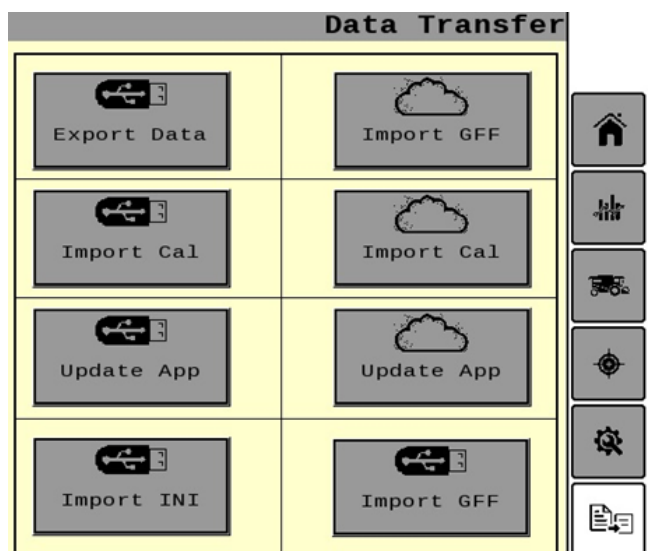


Figure 4.6 CropScan Virtual Terminal Data Export screen

5.0 Calibration

5.1 Overview

The CropScan 4000VT CropScan ECU 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 in order to correct the calibration to some external reference method of analysis for each component, i.e. Kjeldahl for protein, Oven Drying for moisture and Soxhlet Extraction for oil.

5.2 Slope and Bias Description

The CropScan 4000VT Analyzer predicts Protein, Moisture, Oil, Starch and Fiber in a range of cereal grains, oilseeds and pulses. A linear plot between the CropScan predicted values and the reference values should be achieved using the master calibration files installed in the analyzer. (Figure 5.2)

To align the CropScan predicted results to an external reference source, the system has Slope (Skew) and Bias (Intercept) adjustments for each constituent. The Slope and Bias are 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 line of best fit across the sample set and compute the Slope and Bias values.

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 5-2 shows the X Y equation as:

$$\% \text{Protein (Corrected)} = \text{Slope} \times \% \text{P (Original)} + \text{Bias}$$

$$\begin{aligned} \text{Slope} &= 1.385 \\ \text{Bias} &= -4.6 \end{aligned}$$

By applying the new Slope and Bias, the corrected values for Protein % can be calculated. Figure 5.3 shows the new prediction values.

Applying the new Slope and Bias (S & B) reduces the Standard Error of Prediction (SEP) from 0.5 to 0.2.

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

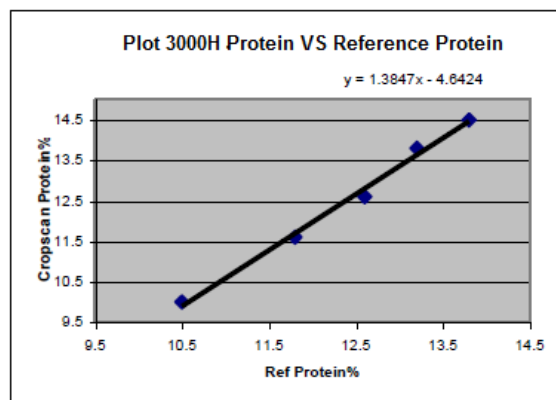


Figure 5.2 CropScan VS Reference X Y Plot

	CropScan	Lab Ref	Difference
Sample ID	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

CropScan 4000VT On Combine Grain Analyzer: Users Guide

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

Moisture +/- 0.2%

Canola

Oil

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	9.9	10	-0.1
2	11.7	11.6	0.1
3	12.9	12.6	0
4	13.7	14	0.3
5	14.5	14.5	0.3

SEP = Accuracy	0.22
-----------------------	-------------

Figure 5.4 Example of Accuracy Calculation (SEP)

	CropScan	Lab Ref	Difference
Sample ID	Protein	Protein	Protein
1	9.9	9.9	0.0
2	11.7	11.8	0.1
3	12.9	12.9	0.0
4	13.7	13.9	0.2
5	14.5	14.4	-0.1

SDD = Accuracy	0.12
-----------------------	-------------

Figure 5.6 Example of Precision Calculation = SDD)

Calibration Cont.

5.5 Calibration Adjustment

Calibration Adjustment enables operators to align the CropScan results to a grain buyers NIR or laboratory method. Users can increase or decrease the BIAS settings for each constituent in order to align the CropScan with local elevator sites. Operators can manually adjust the bias settings or use the Auto Calibration Bias adjustment function.

The following steps explain how to manually change the Bias values in the 4000VT.

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



ii. Select the Crop Type from the list. A screen will appear showing the existing Slope and Bias values for each constituent.

iii. Use the Up and Down arrows to adjust the Bias for each constituent.

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

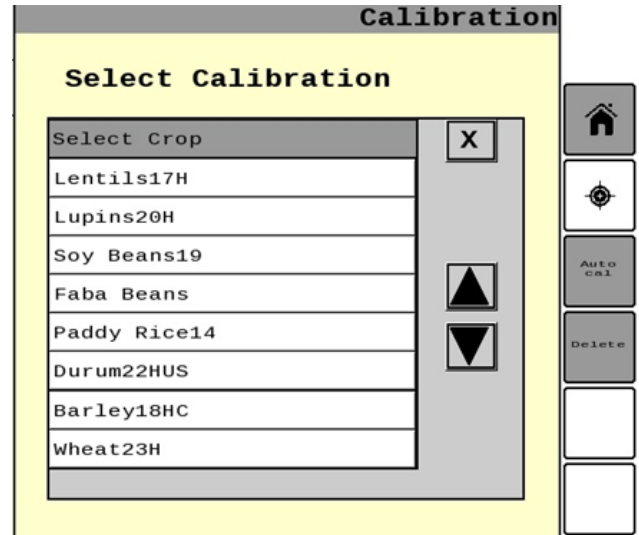


Figure 5.7 List of Crop types.

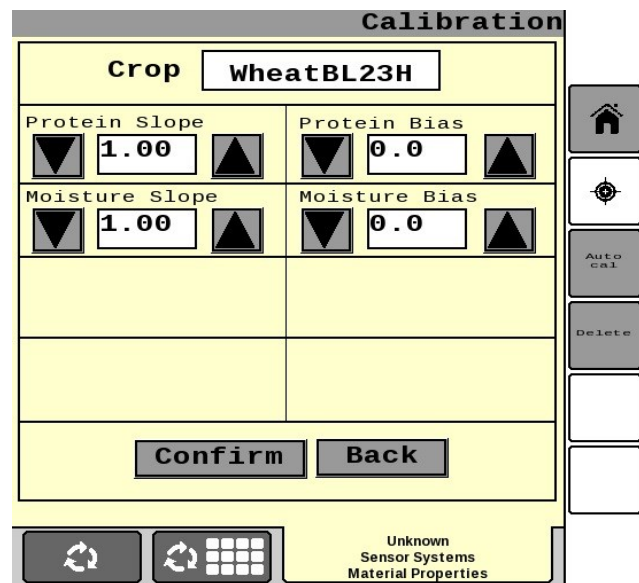


Figure 5.8 CropScan Virtual Terminal Bias Adjustment

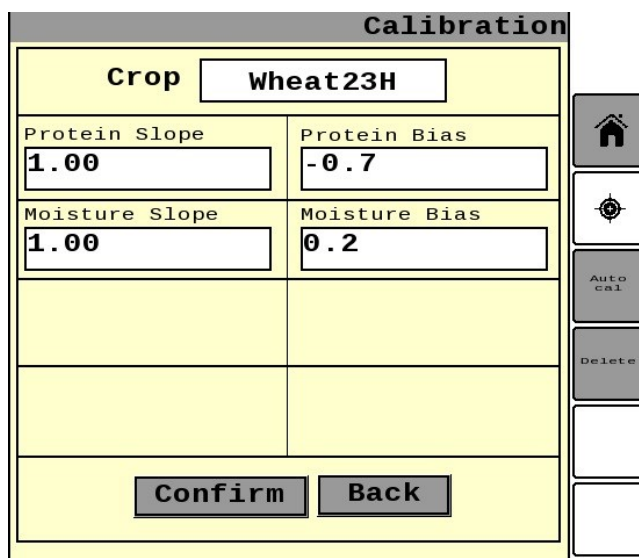


Figure 5.9 CropScan Virtual Terminal Bias Adjustment

CropScan 4000VT On Combine Grain Analyzer: Users Guide

5.6 Auto-Calibration

The AutoCalibration 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 AutoCalibration routine saves the data so that it can be easily exported after the AutoCalibration routine is completed.

The CropScan 4000VT is pre-calibrated with 3 Crop Types: Wheat, Barley and Canola. Other crop calibrations are included however no Slope and Bias adjustments have been made to these calibrations.

Once the system is installed a set of 5 reference calibration samples should be tested using the AutoCalibration function in order to align the CropScan to the 5 reference samples.

As well, prior to each harvest, a set of 3 to 5 validation samples should be run through the CropScan 4000VT to check and fine tune the calibrations.

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:

- Press the Autocal button
- Select the Crop type from the pull down menu.
- Select the number of samples to be used. i.e., 1- 5.
- Press Start to confirm Crop Type and number of samples..

The operator needs to go to the CropScan Sample Head located on the clean grain elevator. Remove the inlet cap 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 scan 10 sub samples to be analyzed 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.

When all the reference samples have been run through the CropScan Sample Head, return to the screen inside the cabin.

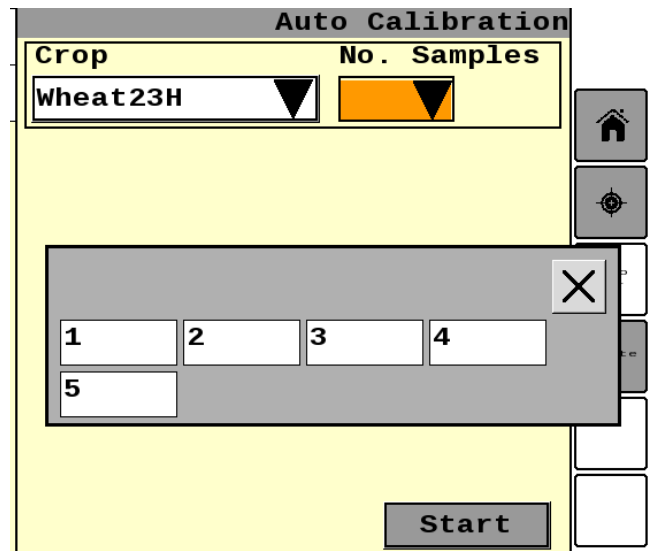


Figure 5.10 CropScan Virtual Terminal Auto Cal screen



Figure 5.11 Certified Reference Samples



Figure 5.12 Auto Calibration Sample pouring

Calibration Cont.

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

A window will appear showing the Old Bias and the New Bias.

If the SEP for each constituent is 0.3% or less than the Old Bias values are considered to be within acceptable error range. As such, press Cancel.

If the SEP for 1 or any constituent is greater than 0.3% then press Next to save the New Bias values.

5.7 Delete Calibration

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

Crop	No. Samples	P %	M %	---	---
Wheat23H	5				
1 Act		16.9	12.5	---	---
1 Ref		15.1	12.0		
2 Act		11.4	11.1	---	---
2 Ref		9.8	10.4		
3 Act		11.9	11.6	---	---
3 Ref		10.3	11.0		
4 Act		9.3	11.3	---	---
4 Ref		7.5	11.0		
5 Act		11.0	10.9	---	---
5 Ref		9.2	10.5		

Figure 5.13 Auto Calibration Results Screen

Constituent	Old Bias	New Bias	SEP
Protein	---	---	---
Moisture	---	---	---
Oil	---	---	---
Starch	---	---	---

Figure 5.14 Auto Calibration new Bias Factor screen

Figure 5.15 Calibration Delete Menu

6.0 Data Transfer

6.1 Data Transfer Overview

The Protein, Moisture, Oil and Yield data are stored in 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.

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 files can imported to the ECU hard drive:

- Import Cal files from a USB
- Update N-GAUGE Apps from a USB
- Import INI files from a USB
- Import Cal files from the Cloud
- Import GFF (Grower-Farm-Field) files from a USB
- Update N-GAUGE Apps from the Cloud
- Import GFF files from the Cloud

The following data file 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

Select the Data Transfer icon.

- Insert USB Stick into CropScan 4000VT NIR Spectrometer USB port
- Press the Export Data icon
- Select CropScan Data or Log Data
- Select the Log Data to export Logs and reference scans.

6.3 Import Calibration

Note: Create a Folder named Calibration on the root drive of the USB

- Copy the new Calibration Bin files onto the Calibration folder on the USB device.
- Insert USB Stick into CropScan 4000VT NIR Spectrometer USB port .
- Press "Import Cal" (USB) or (Cloud) icon.
- Click on the Calibration you wish to import from the USB or Cloud.
- Wait for the Import to be completed.

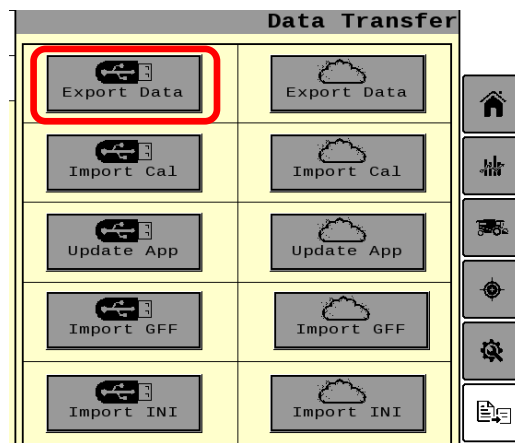


Figure 6.1 CropScan Virtual Terminal Data Transfer menu.

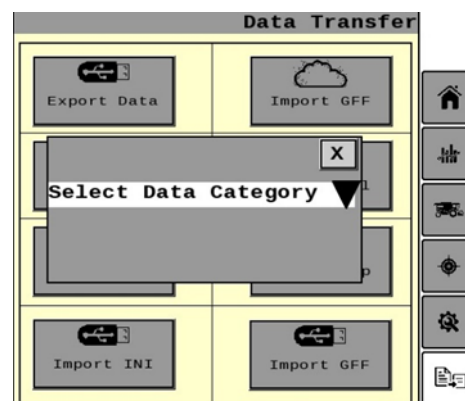


Figure 6.2 CropScan Virtual Terminal Export Data

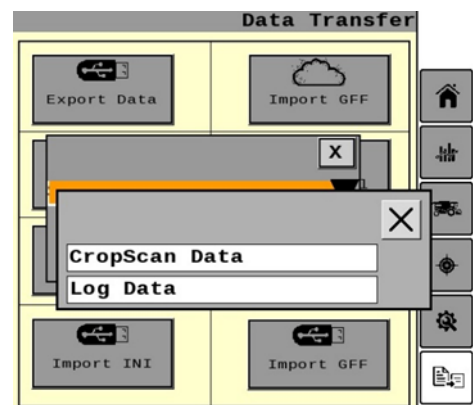


Figure 6.3 CropScan Virtual Terminal Export Data

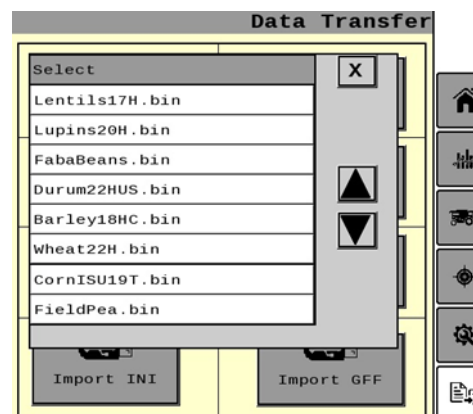


Figure 6.4 CropScan Virtual Terminal Import Calibration

CropScan 4000VT On Combine Grain Analyzer: Users Guide

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.

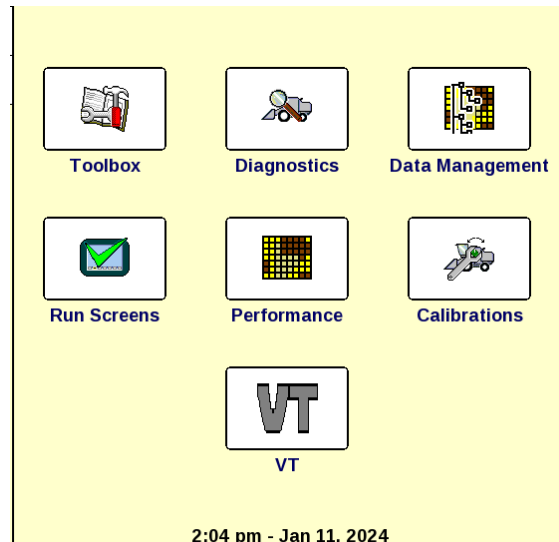


Figure 6.5 Combine Monitor Menu Screen



Figure 6.6 NVM Browser Screen

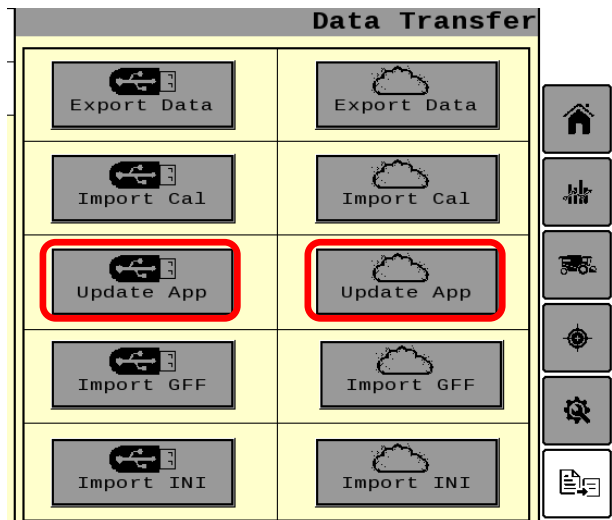


Figure 6.7 CropScan Virtual Terminal Data Transfer Screen

CropScan 4000VT On Combine Grain Analyzer: Users Guide

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.

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.

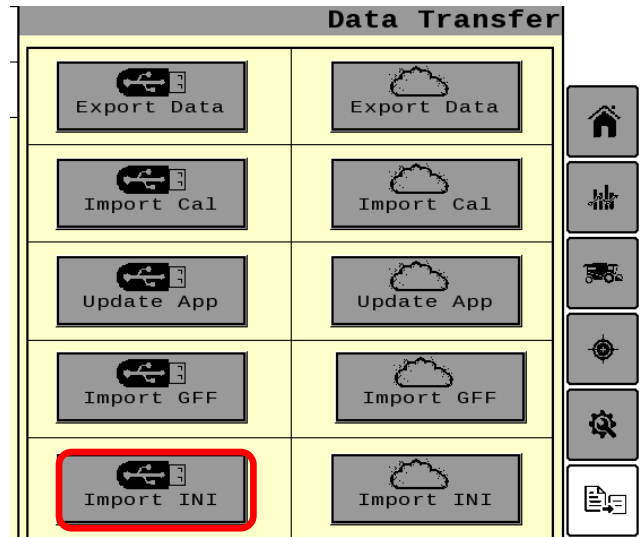


Figure 6.8 CropScan Virtual Terminal Import INI

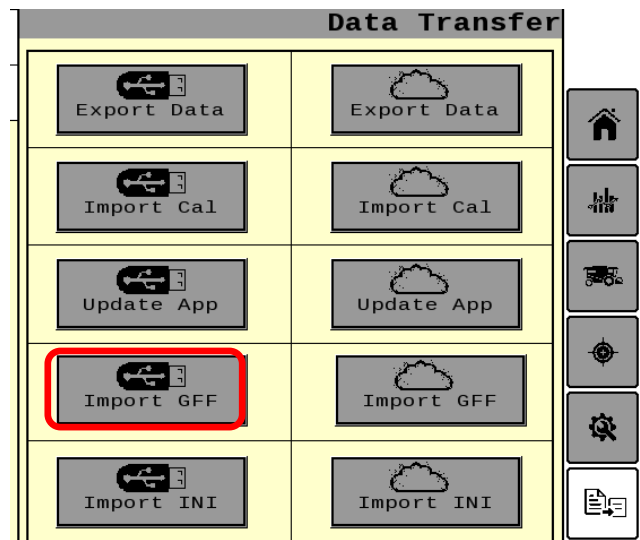


Figure 6.9 CropScan Virtual Terminal Import GFF

7.0 Diagnostics

7.1 Overview

The Diagnostics screen provides a trouble shooting tool used to test the operation of the CropScan 4000VT sensors, lamp, electronics 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

Select the Diagnostics icon.

Press the 100% button to collect a 100% signal scan as shown in figure 7.2.

The Max should be between 2000 and 3500 pAmps. The Min should be greater than 50 pAmps.



7.3 Noise Hardware Test

Press the Noise button to collect a signal scan with the Lamp Off as shown in figure 7.3.

The Noise level with the Lamp Off should be low i.e. ± 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. Allow the spectrometer box to heat up to 35 degrees.

7.5 Sample Photo Sensor Test

Press the Sensor button to test whether the chamber is full or empty. Hold a piece of paper over the photo sensor to test the Full status.

7.6 Outlet Flap Test

Press the FLAP button to show if the flap is open or closed.

7.7 Lamp ON/OFF

Press the LAMP button to turn ON and OFF.

7.8 Auger Sensor Test

With the Outloading Auger retracted, the Auger Sensor status box should turn **GREEN** when the Test Auger button is pressed. With the Outloading Auger extended away from the yellow sensor, the Test Auger Sensor status box should turn **RED** when the Test Auger Button is pressed.

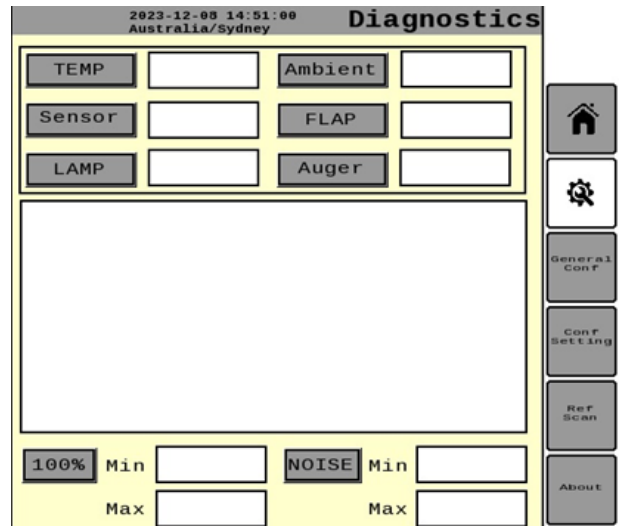


Figure 7.1 CropScan Virtual Terminal Diagnostics screen

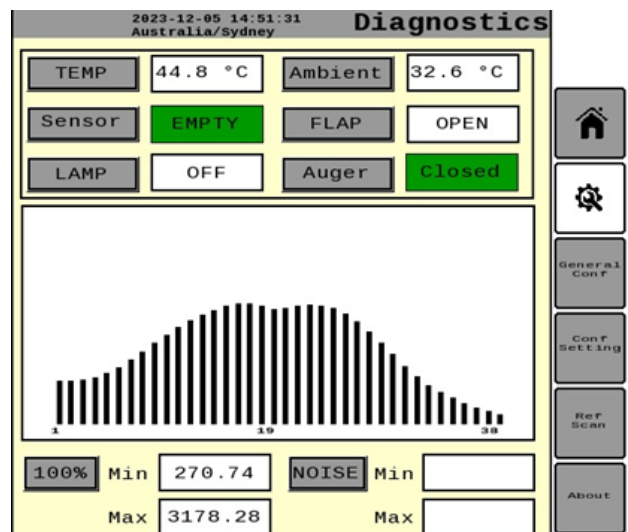


Figure 7.2 CropScan Diagnostics Lamp 100% test scan

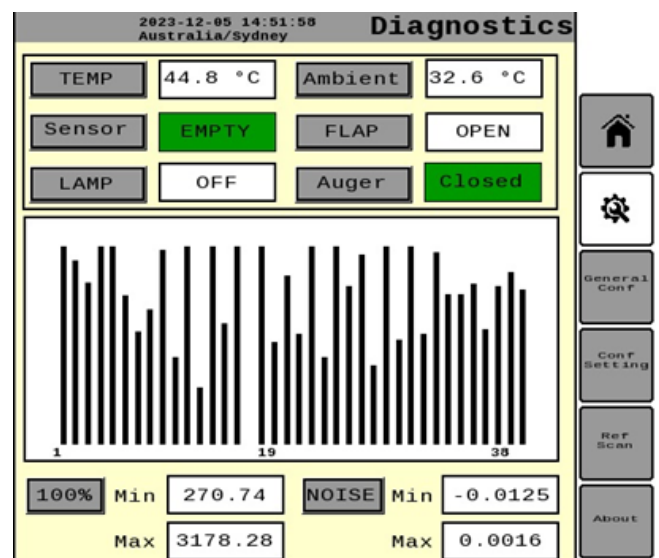


Figure 7.3 CropScan Virtual Terminal Diagnostics Noise scan

CropScan 4000VT On Combine Grain Analyzer: Users Guide

7.9 General Configuration

The General Configuration screen shows the settings used by the Cr4000VT. These settings should not be changed unless guided by CropScanAg directly.

- Out Angle refers to the Flap Angle. The larger the value the more grain that falls through each cycle.
- Pck Delay refers to the time in seconds used as a delay to ensure that the sample has packed correctly.
- Sample Sensor Enable should be ticked however if unticked will result in the software performing an analysis after a set period of time rather than waiting for the cell to fill up.
- Samp Sens Pck Delay is used to define the time in seconds after the Photo Sensor is activated before a scan is commenced.
- The Auger Sens is not included in the Cr4000VT.
- The GPS is read form the CANBUS in the Cr4000VT. If n alternate GPS transponder is used then this box is ticked.



Pressing the SAVE button results in these settings being downloaded to the ECU. To initiate these new settings, the Cr4000VT has to be re-booted.

7.10 Ref Scan

The Reference Scan is stored in the ECU and is used to correct to linearize the transmission data from the sample scan. Whenever there are changes to the optics, i.e., Fibre Optics, Lenses, Lamp, Spectrograph, Detector etc, then Reference Scan must be collected and saved. Open the Sample Head and clean the windows. Place the Fibre Optic Probe in the 15mm slot. Close the Sample Head.

Select the Ref Scan icon.



Press the Reference Scan button. Wait for a new 100% scan to appear. It should resemble the plot shown in figure 7.5 and the MAX value should be between 2000 and 3500 and the Min should be greater than 100. If so, then press SAVE.

7.11 Temperature Modelling

The temperature of the detector is important. To correct for temperature variations due to the environment, then a Temperature Modelling routine is available. This is strictly to be used by CropScanAg technicians.

7.12 About

The About screen provide a record of the software version number, the instrument serial number and the firmware version number.

The two Q images can be sued to open the User Manual on a smart phone or tablet.

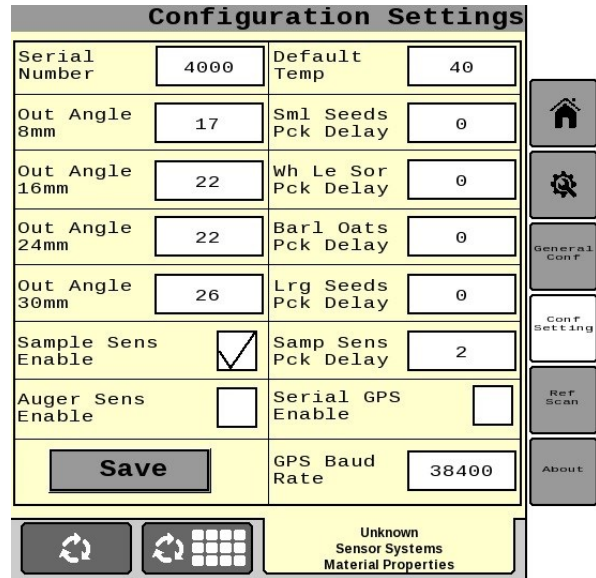


Figure 7.4 CropScan 4000VT Configuration Settings

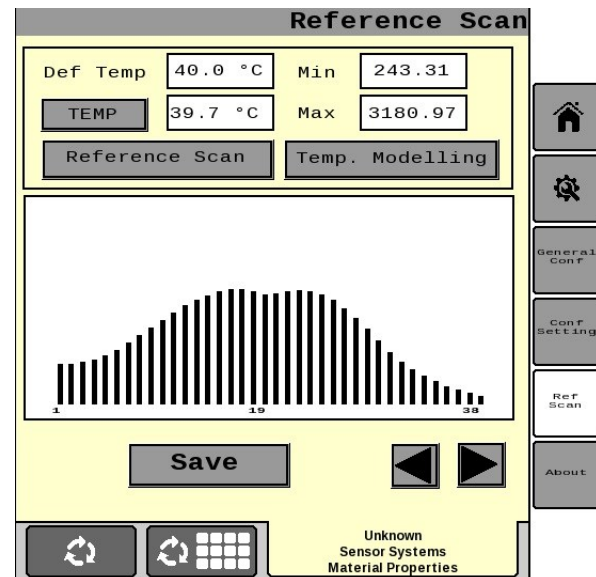


Figure 7.5 CropScan 4000VT Ref Scan

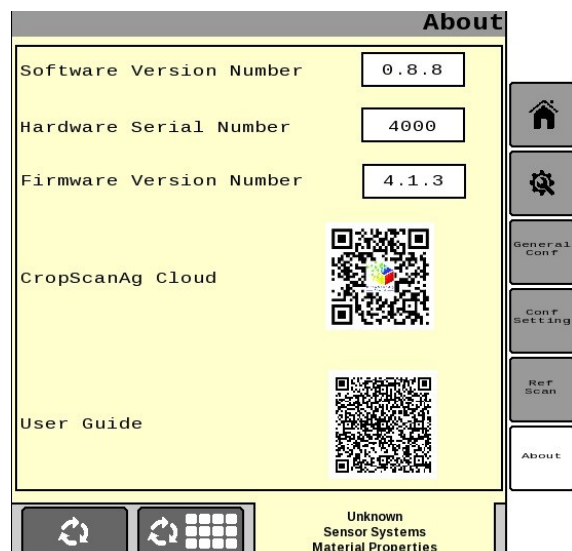


Figure 7.3 CropScan Virtual Terminal Diagnostics Noise scan

8.0 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 may 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 programming 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 Noise test as explained in Ch 7.3.
- ii. If the Noise Diagnostic Check passes and is within the operation limits -0.01 to $+0.000$ units continue with operation.

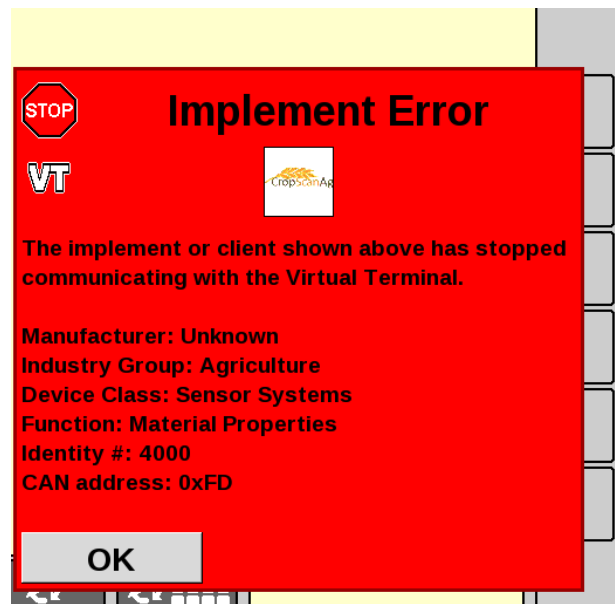


Figure 8.1 CropScan Virtual Terminal Implement Error Code.



Figure 8.2 CropScan Virtual Terminal NIR Error Code.

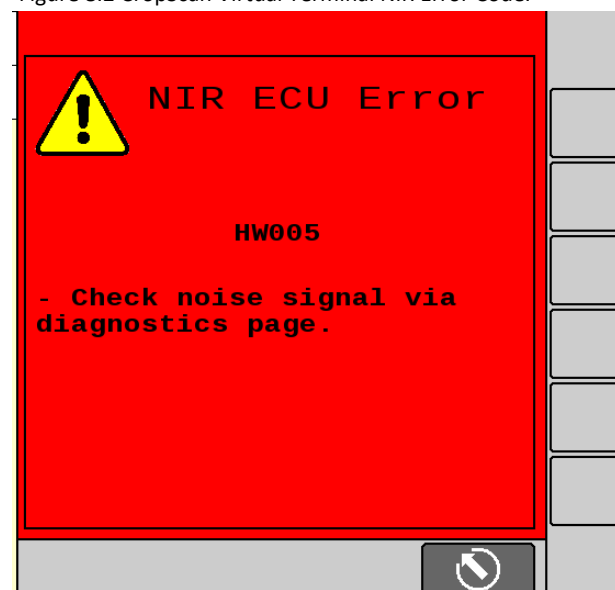


Figure 8.3 CropScan Virtual Terminal NIR Error Code.

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.

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.
- lii. 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.

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.

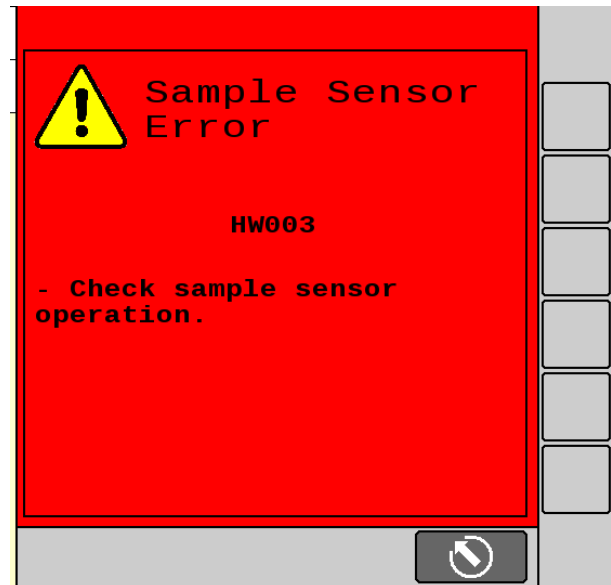


Figure 8.4 CropScan Virtual Terminal NIR Error Code.

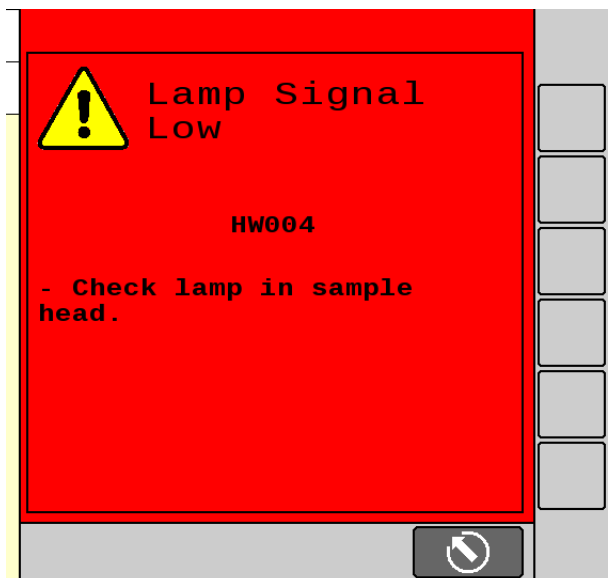


Figure 8.5 CropScan Virtual Terminal NIR Error Code.

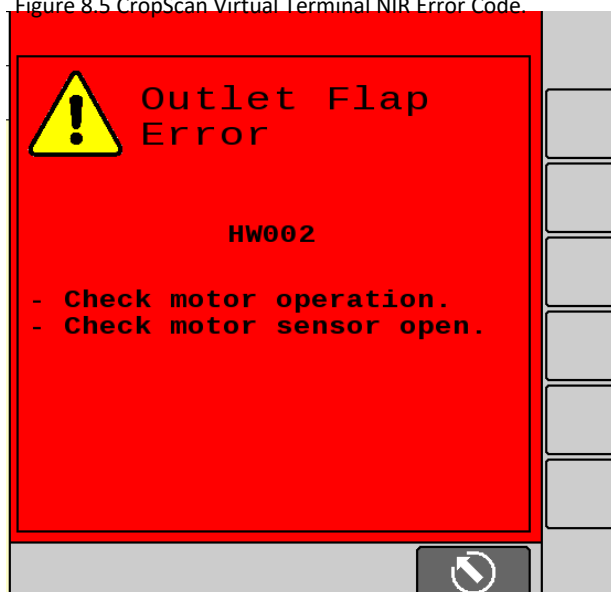


Figure 8.6 CropScan Virtual Terminal NIR Error Code.

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

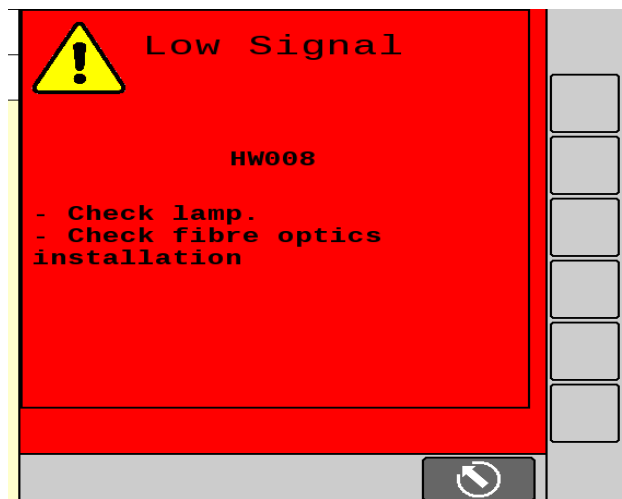


Figure 8.7 CropScan Virtual Terminal NIR Error Code.

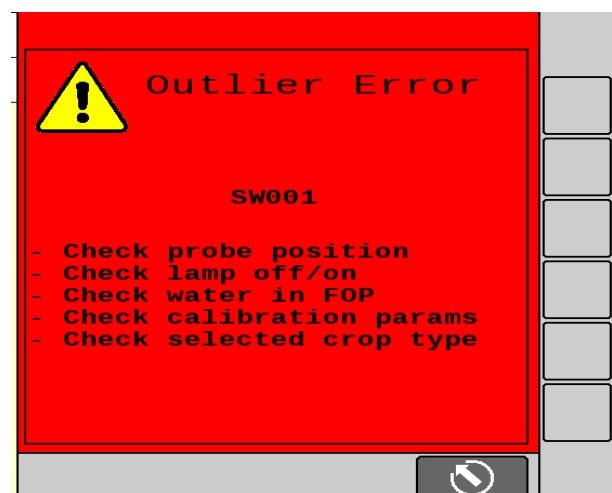


Figure 8.8 CropScan Virtual Terminal NIR Error Code.

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.

8.11 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.

8.12 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

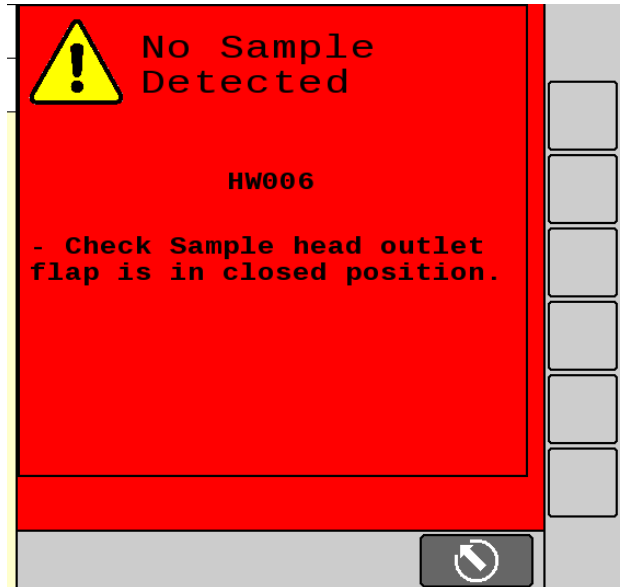


Figure 8.9 CropScan Virtual Terminal NIR Error Code.

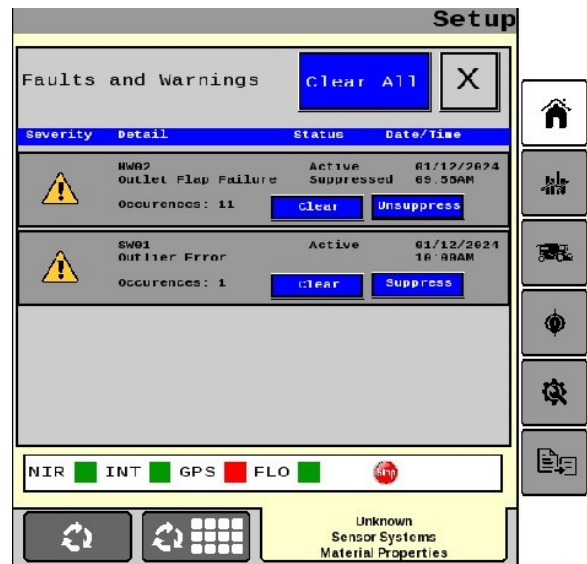


Figure 8.10 CropScan Virtual Terminal Faults and Warning.

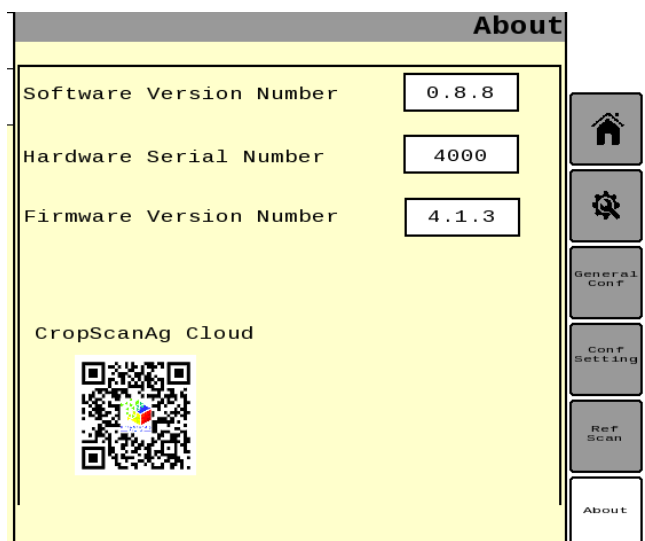


Figure 8.11 CropScan Virtual Terminal About window.

CropScan 4000VT On Combine Grain Analyzer: Users Guide

9.0 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.

10.0 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.