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## Система мониторинга CROP-PROTECTOR BinMaster



# CROP-PROTECTOR™



ADVANCED DIGITAL SOLUTIONS TO MONITOR  
AND CONTROL STORED GRAIN CONDITIONS



***BINMASTER®***

# Advanced Digital Solutions to Monitor and Control Stored Grain Conditions



The BinMaster Crop-Protector™ suite of products offers a complete solution for monitoring temperature, moisture, and spoilage prevention using advanced digital technology and automated controls to optimize the condition of grain stored in silos, flat storage warehouses, and piles. Crop-Protector™ technology was developed by iGrain of Denmark and has been proven to perform in Europe, Asia, and Africa since 2008. BinMaster brings this advanced technology and our grain industry expertise to the North and South American markets and will manufacture, sell, and service the Crop-Protector™ product line from its 75,000 square foot ISO

9001:2008 certified facility in Lincoln, Nebraska, USA.

## TEMPERATURE MONITORING



Crop-Protector™ temperature cables use advanced digital sensors encased in a rugged polymer cable equipped with fittings we machine in our Binmaster factory. This digital technology is proven to be highly accurate with a long service life, resulting in lower maintenance, higher reliability, and lower total cost of ownership than other types of temperature cables. Data from the temperature cables can be sent to a desktop or laptop PC or a wall-mounted touch PC loaded with Crop-Protector™

software. It is also possible to connect to a PLC or SCADA system, or a compact handheld reader. Temperature lances are another alternative for temperature monitoring using the same advanced digital sensor packaged in a compact spear. As they are highly portable, temperature lances can be used in flat storage warehouses or piles, or for checking smaller storage sites. The lances are simply inserted into the grain, and the temperature data is sent to a handheld reader. Up to 20 lances can be connected in one local network using just a single handheld reader for data collection from all sensors.



## MOISTURE MONITORING



Crop-Protector™ digital moisture sensing cables measure ambient relative humidity at several points in the grain bin and use the data to calculate grain moisture using the EMC curve (Equilibrium Moisture Concentration). In most silos, a single moisture cable is all that is needed to monitor grain moisture content. Accurate, digital moisture measurement helps control losses due to spoilage that can occur if excessive moisture is present, or shrinkage due to moisture loss caused by excessive aeration.

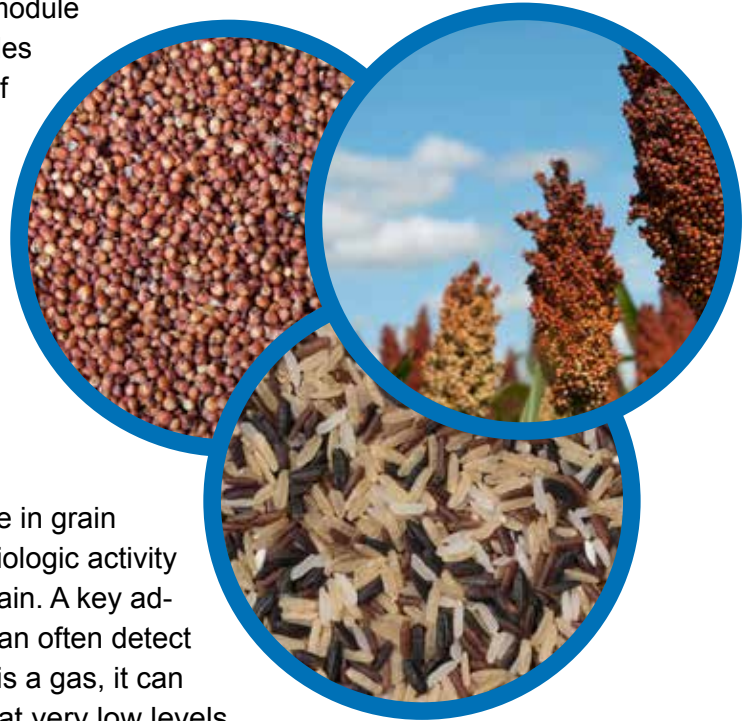




## AERATION CONTROL



Crop-Protector™ software offers an Aeration Control module that uses the data from temperature and moisture cables to determine when, and for how long, aeration and roof exhaust fans should be run to optimize grain moisture content. A weather station is integrated into the system to supply ambient temperature and relative humidity conditions, with that information used to determine when to stop or start the aeration or roof vent fans. (We don't sell the fans, just the controls!)



## SPOILAGE DETECTION



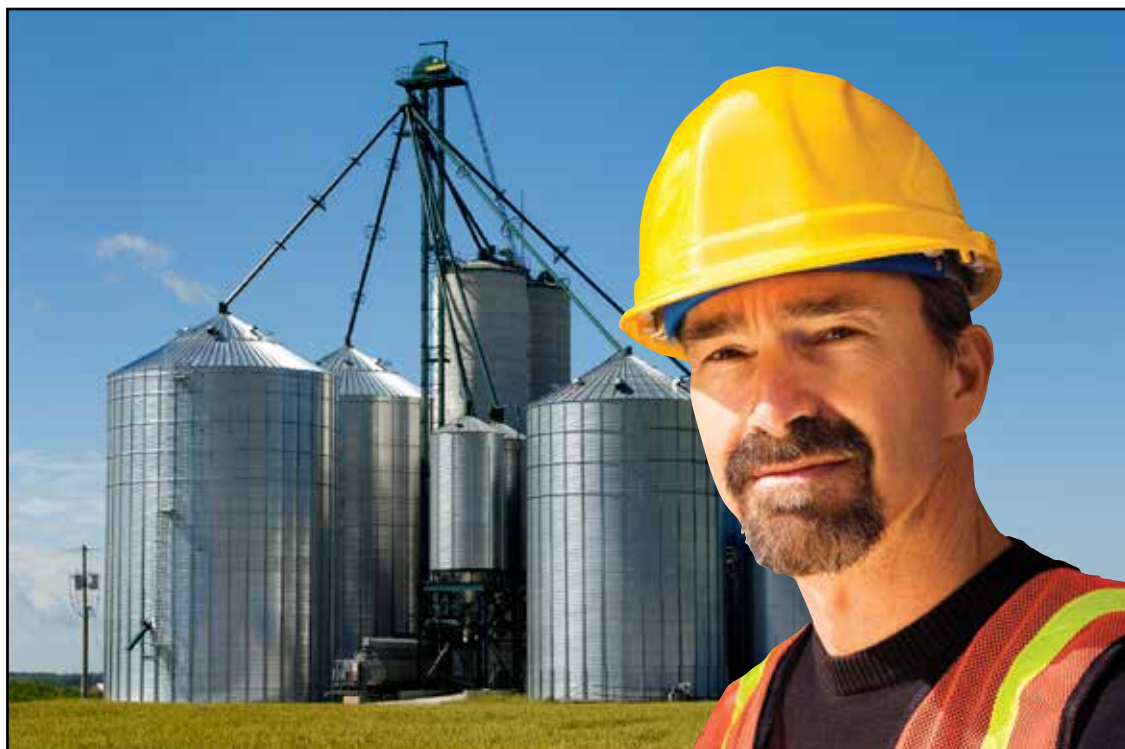
The Crop-Protector™ Grain Sniffer™ detects spoilage in grain by monitoring the level of CO<sub>2</sub> in the silo caused by biologic activity that is a result of insect infestation or fungus in the grain. A key advantage to the Grain Sniffer™ CO<sub>2</sub> monitor is that it can often detect spoilage faster than temperature monitoring. As CO<sub>2</sub> is a gas, it can travel through the grain mass, and can be detected at very low levels. Early detection of spoilage increases the operational options to prevent losses, such as reducing the need for blending or moving grain from one bin to the other, saving time, money, and protecting the value of the crop.

## COMPLETE SYSTEMS & CUSTOMER SERVICE

BinMaster will work with you to meet the requirements of each facility and recommend a custom solution using the modular components of the Crop-Protector™ system. At BinMaster, Crop-Protector™ isn't just a product line. It's a complete grain monitoring solution that is made, sold, and serviced by us right here in the Heartland of America.



Lincoln, NE  
USA



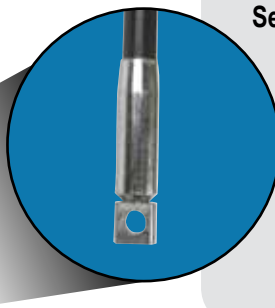
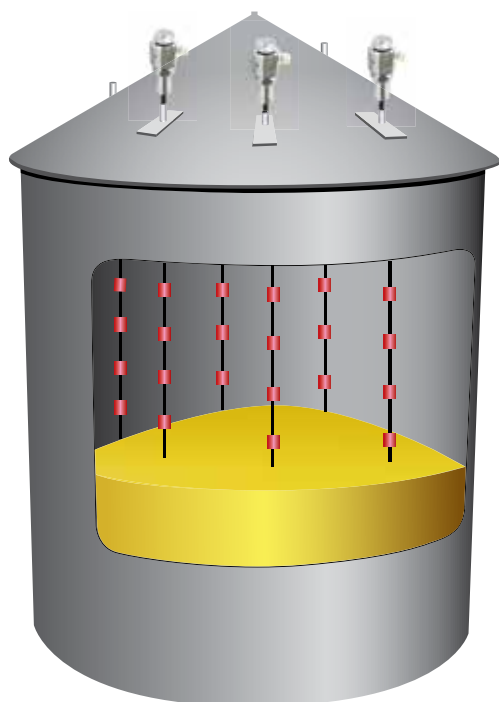
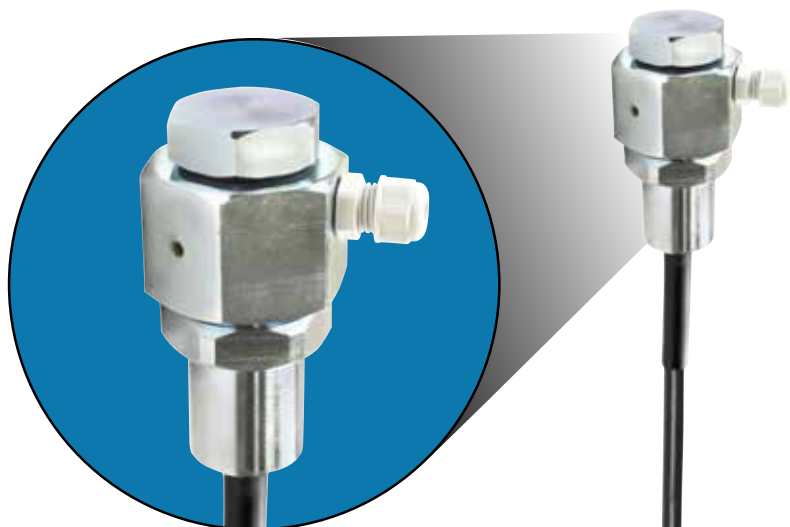


# Temperature Sensor Cable

## Advanced Digital Grain Temperature Monitoring



The Crop-Protector™ digital sensor cable offers precise temperature monitoring and long-lasting durability. Advanced digital sensors are encased in a rugged cable and suspended from the roof of steel or concrete grain silos. The cables are easily installed from inside the roof using a suspension hook or steel wires or from outside the roof using a mounting plate. Cable length is set so the cable clears the bin sweep auger. These temperature cables are designed to be maintenance-free and accurate over a long life of service.



### Features

- Superior, long-lasting, and precise digital technology
- Special “low-pull” polymer cable
- Reliable operation with no temperature drift
- Simple installation via a variety of suspension options
- Two-wire system reduces wiring costs and simplifies installation
- Long service life that reduces maintenance and total cost of ownership

### Specifications

**Temperature Sensor Cable Diameter:**

Ø.42 in. (10.8mm)

**Maximum Cable Length:** 98 ft. (30m)

**Tensile Strength:** 5,511 lb. (2,500 Kg)

Longer cables of larger diameter available for custom ordering

**Temperature Range:** -4°F to 158°F

(-20°C to +70°C)

**Resolution:** 0.5°F (0.3°C)

**Sensor Placement:** 6 ft. (1.8m) and 10 ft. (3.05m) standard

**Sensors per Cable:** Up to 99

**Silo Roof Mounting:** Hook, steel wire or mounting plate

**Silo Floor Attachment:** Hook eye for floor attachment

# **BINMASTER®**



# Sensor Cable Suspension Systems

## Mounting Systems for All Types of Applications



### Suspension Hooks

Suspension hooks are used when cables are mounted inside the silo and require access to the silo roof from inside the silo for installation. These heavy duty suspension hooks are designed for simple installation and long-lasting durability. Self-locking bolts secure the hook to the sensor to ensure that the bolts never loosen and the cable stays put. The hook can be mounted through an existing opening in the rafter. Several silo manufacturers provide a standard fitting for cable sensor mounting. Alternatively, a hole can be drilled through the rafter, if required.



#### Features

- Used for mounting cables from inside the silo
- Simple installation, long-lasting durability
- Self-locking bolt ensures permanent stability
- Install into an existing or drilled hole

### Roof Mounting Plates



Roof mounting plates allow rooftop access to the sensor cable, allowing it to be installed, wired, and serviced from outside the silo. The mounting plate kit comes complete with sealant, self-tapping screws, a template for cutting the hole, and mounting instructions. Nine mounting screws provide a strong attachment to the roof sheets and spread the pulling force of the roof plate to adjacent roof sheets for added strength and stability. Mounting plates may also be mounted near the overlap junction of two roof sheets, displacing the pulling force to both roof sheets. For very large or tall silos, the mounting plate may also be mounted in the middle of the sheet using a one or three-bar support system.



#### Features

- Allow installation, wiring and service from outside the silo
- Designed to spread pull force to adjacent roof plates
- Nine mounting bolts provide strength and stability
- Sealant, bolts, template, and instructions included in kit



# Temperature Sensor Lance



## Spot Checking or Permanent Pile and Flat Storage Monitoring

The sensor lance is a rugged spear used to monitor the temperature of grain in piles, flat storage warehouses, or is easily portable to any location where temperature readings are needed. Digital sensors are encased in a flexible fiberglass rod that has a super smooth surface for easy insertion into the grain. The lance has a rugged handle with a substantial grip for ease of use. The lance connects to a portable handheld reader where readings can be viewed for up to 20 lances. The data can be transferred to a PC where Crop-Protector™ Manager software can generate historical trend reports for each sensor.



### Features

- Precise portable or permanent digital temperature monitoring
- For piles, flat storage warehouses or remote locations
- Rugged handle and flexible fiberglass rod in a variety of lengths
- Outputs to handheld device with optional download to PC
- Up to 20 lances in a single network for large storage facilities

### Specifications

#### Sensor Lances

Lance Length	Number of Sensors
3 ft.	1
13 ft.	3
25 ft.	5

**Temperature Range:** -4°F to 158°F  
(-20°C to +70°C)

**Resolution:** 0.5°F (0.3°C)

**Sensors per Network:** Up to 20

**Lance-to-Lance Connection Cables:** 20 ft., 40 ft., 60 ft.

**Lance-to-Handheld Reader:** 3 ft. or 15 ft.

# ***BINMASTER***®





# Weather Station



## Quick Response Weather Monitoring for Aeration Control

The weather station provides fast, reliable information about the ambient temperature and air moisture conditions used for efficient aeration control. This information is integrated with the complex Automatic Aeration Control software that turns aeration fans on or off to optimize the moisture content of grain. Weather conditions such as rain starting or stopping, near freezing conditions, sunrise, and sunset, conditions are influential in determining when aeration should be applied. These conditions, along with ambient humidity relative to the moisture in stored grain, determine when and for how long aeration should be used to maximize the value of grain for market. The weather station is designed for long-lasting durability and is suitable for harsh conditions such as long, cold winters, hot tropical or desert-like conditions.



**Weather  
Station  
Pro**



**Weather  
Station  
LC**

### Weather Station AMBIENT AIR CONDITION

80°F

61.8 rH

### Last 24 Hours Hi/Lo

T Hi:	90°F	rH Hi:	80%
T Low:	46°F	rH Low:	36%

**Latest Reading:**  
15/07/2015 10:06:00

**Status:**  
OK

## Features

- Highly accurate, ambient weather information used for aeration control
- Connects to Automatic Aeration Control software to optimize grain moisture content
- Durable, long-lasting construction designed for minimal maintenance
- Suitable for cold winters, hot summers, and tropical or desert climates
- Remote access to weather conditions from Crop-Protector™ Manager software

## Specifications

**Power:** Via Master-Hub

**Communication:** Data-bus to Master Hub

**Relative Humidity Measurement Range:** 2% to 99% rH, non-condensing

**Temperature Measurement Range:** -22°F to 158°F (-30°C to +70°C)

**Weather Shields:** Sun, rain and snow protection

# **BINMASTER®**





# Moisture Sensor Cable

## Digital Grain and Air Moisture Monitoring



The moisture sensor cable is used to monitor the ambient relative humidity at two to four different sensor points in the grain bin. The relative humidity is used to calculate grain moisture content using the EMC curve (Equilibrium Moisture Concentration). The top sensor is located just under the silo roof to monitor the relative humidity in the head space. The data from this sensor is used in the Crop-Protector™ Manager software to control the operation of roof vent fans. Two other moisture sensors are located at high and low levels along the cable to detect the moisture level present in the grain. The data from these sensors is used to turn on the aeration fans only when needed to minimize shrinkage due to loss of moisture content. This Crop-Protector™ Aeration Control software also shows the moisture content of the grain over time and displays the information on a trend curve.



### Features

- Helps avoid shrinkage via reliable, digital moisture monitoring
- Control exhaust fan operation by monitoring humidity in head space
- Initiate aeration only when absolutely needed to prevent shrinkage
- Monitoring of grain and silo moisture conditions using easy-to-use PC software
- For use in all types of grain by simply changing software parameters

### Specifications

**Communication:** Sub-Hubs collect data from moisture cables. Master-Hubs collect data from Sub-Hubs and send it to the Crop-Protector™ Manager software on a PC.

**Moisture Sensor Cable Diameter:** Ø.42 in. (10.8mm)

**Maximum Cable Length:** 78 ft. (24m)

**Tensile Strength:** 4,409 lb. (2.000 Kg)

**Sensors per Cable:** 1 to 4

**Cable Anchoring:** Optional attachment eye available

**Grain Moisture Sensing Range:** 8% to 24%

**Head Space Moisture Sensing Range:** 2% to 99% rH

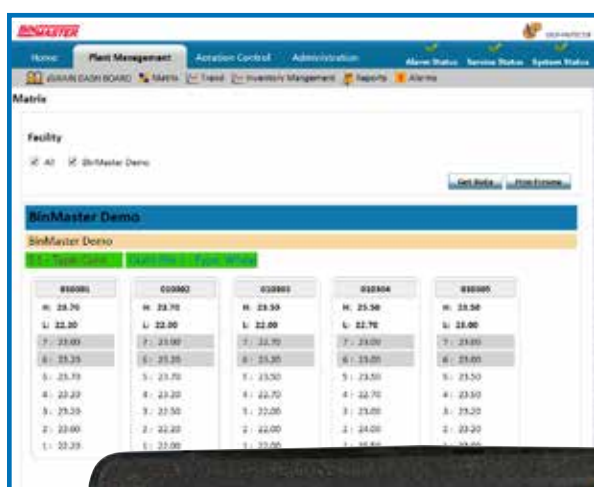


# Handheld Temperature Reader



## Portable Monitoring of Temperature Data with Logging

The handheld reader is a low cost, convenient device that allows you to read and collect data from temperature sensor cables or sensor lances. Each sensor cable or lance is connected in a sequential series and assigned a location number. Temperatures are read automatically, and displayed by simply scrolling through each sensor location and viewing the temperature data for each sensor. The handheld reader comes in a handy carrying case with accessories including a USB cable for charging the unit, a universal connector cable that works with either temperature cables or lances, and a flashlight. Data can be automatically transferred to a PC using the software on the memory stick included in the kit.



### Features

- Portable monitoring of data from temperature sensor cables or sensor lances
- Handy carrying case complete with USB charging cable, connector cable and flashlight
- Scroll with arrows between sensor cables/lances (LR arrow) and individual sensors (UD arrow)
- Includes memory stick for data transfer to PC software
- Matrix view with trend data can indicate development of hot spots

### Specifications

Model	2500-PC
Maximum # of Cables	20
Maximum # of Temperature Sensors	600
Memory Data Transfer to PC	Yes
Matrix View with Trend Data	Yes

# **BINMASTER®**



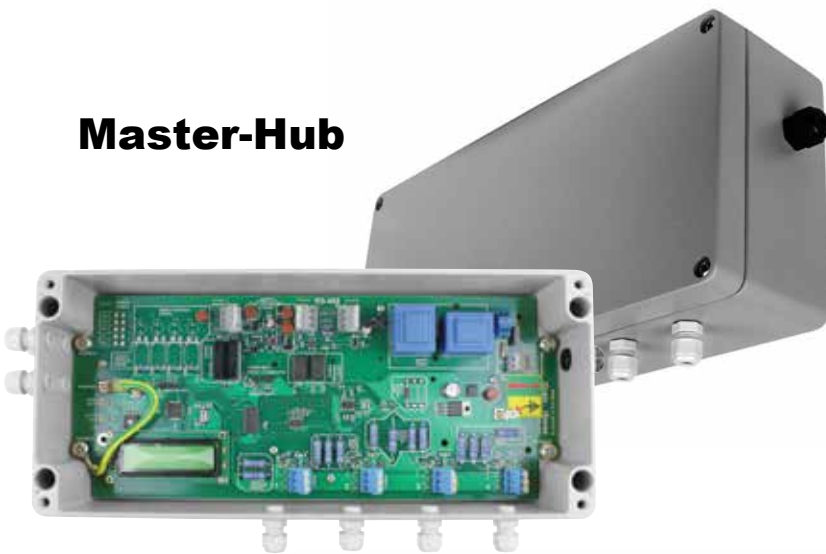
# Communications Boxes



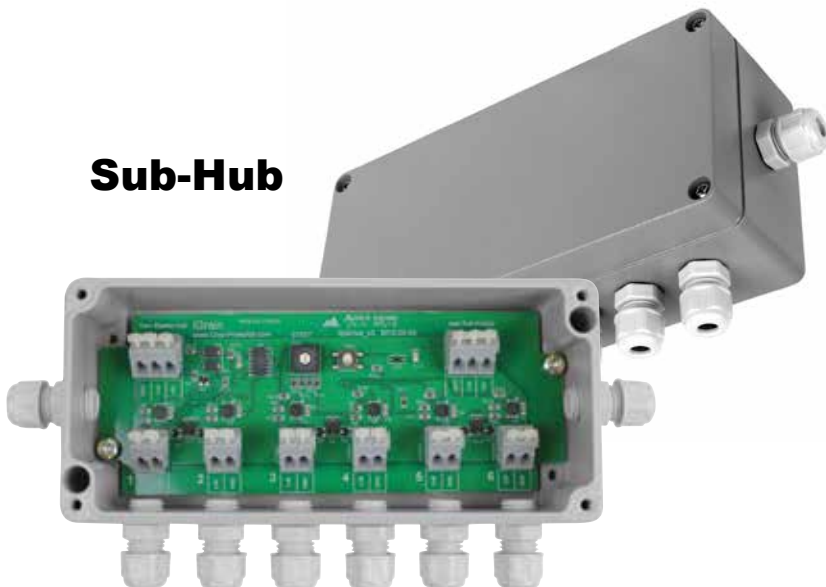
## Digital Data Transfer via Master-Hubs and Sub-Hubs

The Master-Hub and Sub-Hub are wiring boxes used to collect data from digital temperature or moisture cables and send it to the Crop-Protector™ software. Use of these rugged boxes enables modular system design that is scalable for both small and large grain storage operations. The Sub-Hub has 6 inputs for temperature or moisture cables, while the Master-Hub can connect to a maximum of 32 Sub-Hubs. The Master-Hub features a built-in display that continuously shows the numbers of Sub-Hubs, sensor cables, and sensors connected to it. The Master-Hub design allows the system to be commissioned, monitored, and serviced without connecting to a PC, if that is necessary. Most operations choose to interface their system with the Crop-Protector™ Dashboard Manager on a PC or in the Cloud.

### Master-Hub



### Sub-Hub



### Features

- Transfers data from temperature or moisture cables to Crop-Protector™ software
- Modular design is highly scalable for small and large grain storage operations
- Sub-Hub features 6 inputs for temperature or moisture cables
- System allows for up to 32 Sub-Hubs connected to each Master-Hub
- Master-Hub has digital display showing number of Sub-Hubs, sensor cables, and sensors
- System interfaces with Crop-Protector™ Dashboard Manager software on a PC or in the Cloud

### Specifications

#### Sub-Hub:

Up to 6 inputs from temperature or moisture sensor cables

Data sent to Master-Hub via Crop-Protector™ data-bus

Built-in power indicator for simple system check

#### Master-Hub:

4 input ports from up to 32 sub-Hubs (192 sensor cables)

Each Master-Hub can communicate with up to 4,000 sensors

Master-Hub can be used in series of up to 99 units RS-485 Modbus communication with PC or the Cloud



# Relay Output Unit



The relay output unit is a control device used for automated control of aeration fans in the Crop-Protector™ system. The units are controlled via the Aeration Control software that uses moisture sensor data to determine when and for how long an aeration fan should run to optimize grain moisture content. Each unit has 8 relays with the relay status of open or closed visible on the diodes. Every unit has an individual Modbus address and can be installed where the aeration fans have their power start/stop relays to minimize wiring. One relay will normally control all of the aeration fans for a single bin, allowing for up to eight bins to be controlled via a single relay box. The relay output unit can also be used to control head space ventilation fans, either directly or via a help-relay. Data output (via RS-485 Modbus) directly to a PLC is also available.



## Features

- Control device used for automated control of aeration fans and roof ventilation
- Unit has 8 relays with each relay's status visible on the diodes
- Crop-Protector™ Aeration Control software indicates need for aeration
- Manual or automated fan operation via RS-485 Modbus
- Status can be monitored via Aeration Control software on a PC or via the Cloud

## Specifications

**Communication:** Via RS-485 Modbus to Crop-Protector™ Dashboard

**Operation:** Automatic or semi-automatic mode as determined in Aeration Control software

**DIN Rail Unit:**

8 relays with normally open (NO) and normally closed (NC) contacts

Maximum switching power 12 – 24 VDC: 3A and 230 VAC: 10A

12 VDC, 600 mA power supply

Modbus protocol, addressed from 01 to 99 using Crop-Protector™ software

RS-485; up to 99 relay units in series, up to 3,937 ft. (1200m) on CAT-5e cable

**Cabinet Unit:**

Class IP-65 die-cast aluminum box 6.7 in. x 9.45 in. x 3.15 in. (170mm x 240mm x 80mm)

100 – 240 VAC power supply, maximum 10 w with power on indicator

# **BINMASTER®**





# Crop-Protector™ Dashboard Manager Software



## A Comprehensive Overview of Grain Storage and Monitoring Data

The Crop-Protector™ Dashboard Manager is the software platform that provides a comprehensive overview of all grain storage and monitoring data. The home page of the Dashboard provides an at-a-glance summary of stored grain conditions and control data. Dependent on the configuration of the system, the Dashboard will show grain temperature, grain moisture, weather data, approximate grain level, volume and weight, aeration fan and roof exhaust fan off or on status, and spoilage indication from the CO<sub>2</sub> sensor. More detail about each condition can be shown in detail by selecting from a sub-menu that includes options such as trend data, matrix view, inventory trend, alarm settings, fan status, and spoilage indication. The Crop-Protector™ Dashboard Manager is an easy-to-use tool that makes the lives of grain managers easy and safe.



### TREND DATA

The trend data chart displays the highest and lowest temperature reading in each silo and the average temperature from all sensors.



### MATRIX VIEW

The matrix view displays all of the temperatures for each sensor in each sensor cable, as well as a high (H) and low (L).

Facility and silo section



Grain level

Silo color indicates grain temp

CO<sub>2</sub> level

Temp/moisture cable

Weather station data

Aeration fan off/on status

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