

# Silo Manager: CL Analog Silo Controllers For up to 12 Silos



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Instruction Manual CL IM 8 FEB 2018



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NOTES:

Please record the following information, which is specific to this piece of equipment, in the space provided. Our Parts/Service Department will need these numbers to properly respond to any of your requests.

Instruction Manual: <u>CL IM 8 FEB 2018</u>
Model #: _____
Serial # _____

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## 1.0 OVERVIEW

A Siemens LOGO! PLC monitors the fill levels of between four and twelve aggregate-filled silos using BinMaster ultrasonic sensors which properly calculate angles of repose and drainage. These values are graphically shown on a 4" color HMI mounted on the control box for the plant operators' use. High and low level alarm set points can be entered (provided the operator is properly logged in) from the HMI on a global basis (i.e., all silos are subject to the same alarm levels). Optionally, there may be a lamp and/or audible alarm mounted on the control box to alert nearby personnel of any issues.

## 2.0 HARDWARE

### 2.1 PLC(s)

A Siemens LOGO! BM12/24RCE controller (PLC) receives and conditions signals from as many as twelve BinMaster 3DLS ultrasonic sensors. It also communicates with the local Siemens KTP400 Basic Panel HMI. The PLC also holds several configuration parameters set by the end user (alarm set points, etc.) via the HMI. These values are retentive, i.e., not lost if there is a power interruption. For twelve silo systems, a second PLC will be installed and configured as a "Slave". It will only pass its four analog inputs to the Master PLC.

### 2.1 HMI

A Siemens KTP400 Basic Panel color (4" color touchscreen) is used for the operator interface. It allows the operator to see graphic depictions of silo levels, and provides alerts for any high or low alarm conditions. The operator also has the ability to look into alarm history to see any alarms that occurred in the past. The operator (with proper security credentials) can also do the following:

- Choose how many silos are being monitored (up to twelve depending on the model).
- Adjust high and low alarm level set points which affect all silos (IOW, global).
- Tell the system whether or not a local audible alarm is in use. An optional alarm lamp, if it's wired in, will automatically light when an alarm is present.

### 2.3 Power Supply

A 24VDC, 2.5A Siemens "LOGO! Power" power supply is included.

### 2.4 Level Sensors

Four-wire BinMaster CDLS ultrasonic sensors mounted on top of the silos send a 4-20mA current signal to our PLC to indicate the percentage of fill for each silo. These are also powered by LOGO! Power. The LOGO! PLC(s) in use only "understand" DC voltage inputs, so to convert the sensors' output to a voltage input that the LOGO! understands, a 250 ohm resistor is wired across each silo input to the PLC. This renders an effective 1 - 5VDC input at the PLC which gets scaled to a 0-100% signal. Any value less than 1VDC is treated as a wire break and alarmed as such.

### 3.0 PLC SOFTWARE

#### 3.1 Inputs

The silo sensors' raw input signals are first seen by the logic as analog integers from 0 to 500. This represents -25% to 100% of silo fill. We scale this to end up being -250 to 1000 which represents our silo full percentage x10. As long as we have good continuity from the sensor to the PLC (and no malfunctions), we should never see less than 0.0% after scaling. If we do, it probably means that we have a broken wire in the signal current loop between the sensor and PLC. This is annunciated on the HMI as a wire break.

The PLC also receives inputs from the HMI to manage its alarm set points, silo visibility status, and whether this application will be using an audible alarm. All these data are retentive i.e., they will be remembered through a power interruption. This will be discussed in the HMI Software section of this manual.

#### 3.2 Main Logic

Here, we scale the analog sensor inputs and compare them against high, and low alarm level set points received from the HMI. Any alarm conditions are output to our HMI.

#### 3.3 Utilities

##### 3.3.1 Klaxon Logic

It is optional, for this machine to include an audible alarm (AKA klaxon) where the end user might desire it. The Klaxon Logic manages the siren so that it will sound whenever there are any alarms present. The HMI allows the operator to silence the klaxon. This logic manages the klaxon so that, even if it has been silenced by the operator, it will again sound if other alarms become active. This helps because an operator does not have to remember to re-activate the alarm.

##### 3.3.2 Backlighting

The LOGO! controller can be set to show the LCD screen backlit as either white, amber, or red. Logic in this section will turn on the white backlight whenever any of the LOGO! directional keys are pressed while holding down the "ESC" key. The white backlight will remain on for 30 seconds after the key combination is pressed. The red backlight will come on and flash whenever there are silo alarms present (regardless of what's going on with the optional alarm klaxon).

##### 3.3.3 Message Display

The LOGO! LCD screen (inside the box) will display the fill levels of up to twelve silos while running. You may notice, that in our screenshot at right, silos 2, 3, and 4 read negative values and the bar graphs are 100% filled. This indicates that those silos are not receiving signals from the silo sensors. Silo 1 is showing 37.3% filled. Each message display screen shows four silos; 1 – 4, 5 – 8, and 9 – 12. To move between the screens, hold the ESC key on the front of the LOGO! and press either the right or left arrow key.

S	i	l	o	1	-	4	L	e	v	e	l	s	
E						F				%			
1	[Bar graph: 37.3% filled]						+ 37.3						
2	[Bar graph: 100% filled]						- 24.7						
3	[Bar graph: 100% filled]						- 24.7						
4	[Bar graph: 100% filled]						- 24.7						

### **3.4 Outputs**

In the logic area, we distribute outputs to both the local LOGO! outputs for the optional klaxon and alarm beacon lamp, and all the “network” outputs to the HMI.

### **3.5 Twelve Silo Notes**

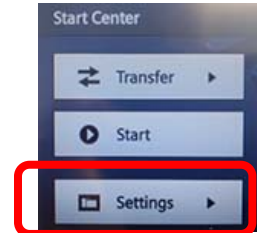
Twelve silo systems will have two LOGO! PLCs installed. The one that handles silos #9-12 will be configured (online configuration, not downloadable!) as a Slave whose Master is the silo #1-8 LOGO! (192.168.1.191). No logic runs in the slave LOGO!.

## 4.0 HMI SOFTWARE

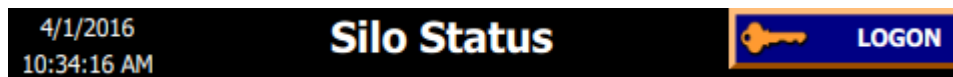
The HMI allows the user to see the current fill status of all silos, allows tweaking the points at which the silos will give high and low alarms, and whether an audible alarm is being used. The user also has the ability to change usernames and passwords in the security mechanism. The operator does not need to login to see silo status, but will need to login with proper credentials to change set points, and edit user credentials.

### 4.1 HMI System Settings

To change settings like time and date, etc., or to backup or restore the HMI, cycle power to the HMI and when the startup screen is shown, click on “Settings” which will allow various system changes to the HMI. The HMI allows five seconds at startup time to do this after which it will start the Silo application.



### 4.2 Global Settings



The date and time, screen name, and the logon button are shown at the top of every screen. If no one is currently logged in (as shown above), clicking on this button will pop up a screen that prompts the user to log in, for instance, to change an alarm set point. Once properly logged in, the button will show the username that’s logged in and the key icon will be overlaid with a red circle which means that if the button is clicked again, the user will be logged out. Default users are discussed along with the User Name screen description (see 4.5)



At the bottom of all screens there are four buttons. Left to right they mean:

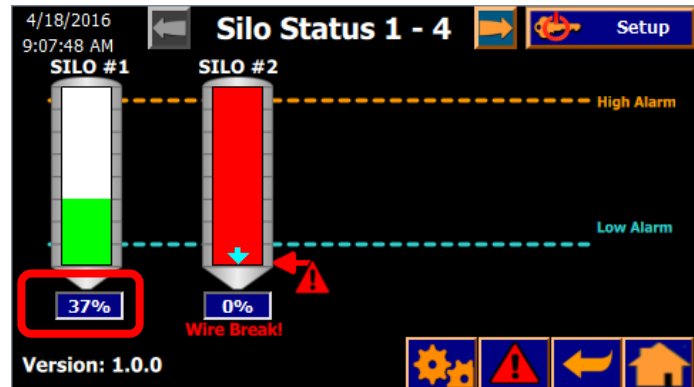
- Show Setup screen (if it’s grayed-out, you’ll need to log in to use it)
- Show Alarm screen
- Go back to last screen
- Show Home screen



The KTP400 HMI in use here has four “real” buttons labeled F1 through F4 located below the touchscreen. These buttons serve the same functions as the four touchscreen buttons just discussed above in the same left to right order.

### 4.3 Silo Status

The Silo Status, or home, screen is normally what will be displayed on the HMI. It offers a graphic look at status of the silos. Here, we have two silos in the system (AKA visible). The material level in silo#1 is between the dashed low and high alarm lines shown on our screen. Those lines indicate where our low and high alarm levels are currently set and can be changed from the System Setup screen. The amount of material in the silo is shown graphically by the green bar and the analog percentage is shown in the blue box just beneath the silo.

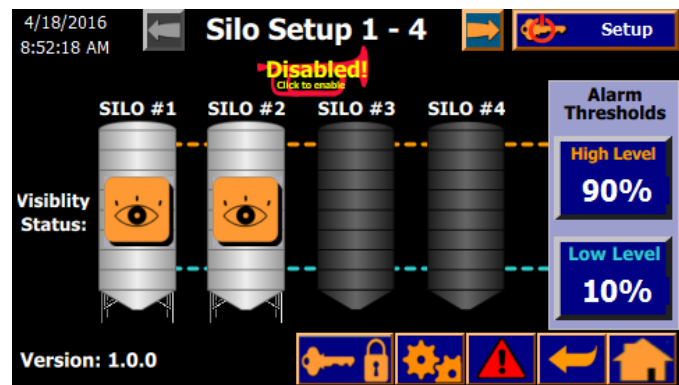


The color of the “material” in silo #1 is green, because it is not in either a low or high alarm state. If the material was greater than the orange high alarm level line, the material indication would be colored orange (same as the high alarm line). If the silo material level was below the low alarm threshold (blue dashed line), the material would also be colored the same as that line. A silo in alarm will also display an arrow and alarm triangle (see silo #2) either at the top or bottom of the silo. Silo #2 in our screenshot has a value internal to the LOGO! PLC that is less than zero. That indicates that our sensor’s level signal is not making it to the PLC’s input terminal. Normally, this indicates either a faulty sensor, or more likely, a broken signal wire between the sensor and the input to the PLC. We indicate this condition by showing the silo filled 100% red, and flash “Wire Break!” below the silo.

#### 4.4 Silo Setup

The operator needs to log in (upper right button) to access the Silo Setup screen. Use “Level3” with password”3333” at which point the gears button will be orange on a blue background), and then click the “gears” button at the bottom of any screen.

The operator should now be looking at the System Setup



screen to setup the parameters for the application. In the screenshot at right, silos 1 and 2 are visible (indicated by the eye), and #3 and 4 are shown in a darker color which means they are not visible, meaning they do not exist.

Click on a silo icon to toggle its visibility status ON or OFF. If the system has more than four silos, there will be two arrow buttons on either side of the screen title (“Silo Setup 1 – 4” in the screenshot above). Pressing these arrows allows navigation to the other silos available. In the screenshot above, the left arrow button is grayed out because there are no silos less than one, and that the right arrow is orange (enabled) which means in this particular system there are more than four silos available.

The alarm threshold buttons are on the right hand side of the screen. Click them to change the thresholds to whatever makes sense in in this plant. Note that there is no logic in place to keep from setting the low level higher than the high, so be sure that the High Level value is higher than the Low Level value. NOTE: If the silo system is connected to an FX2 system, the thresholds can also be changed from there. See [Appendix 6.0](#) for the details on how this mechanism works.

Above the silos, is an icon resembling a bugle which represents an audible alarm that may be present in your system. It’s shown here red, or disabled, which means that there is no alarm horn, or it has been purposely disabled. Just click the bugle and it will turn green and if a horn is wired in, the alarm will sound whenever a new alarm shows up.

Across the bottom of the screen, to the left of our four navigational buttons is a button with a key and lock icon shown. Click this to get to the User View screen where you can change usernames and passwords.

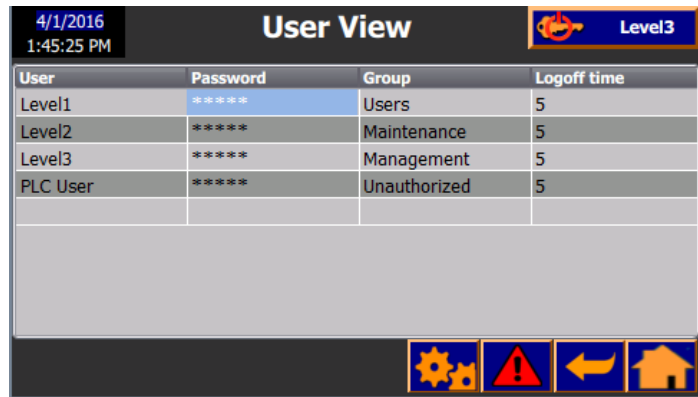


**NOTE: Be sure to keep a list of the usernames and passwords as there is no way to recover forgotten information.**

#### 4.5 User View

The User View screen will allow changing users' parameters. The columns break down like this:

- User: This is the text the user would enter after pressing the Logon button in the upper right corner of every screen. User names are NOT case sensitive.
- Password: The password needed to be able to get this user properly logged in.
  - Level1, password: 1111...Member of Users group. No practical use here.
  - Level2, password: 2222...Member of Maintenance group. No practical use here.
  - Level3, password 3333...Member of Management group. Only the Management group members can change silo parameters in this application.
- Logoff Time: The numbers seen here indicate minutes of inactivity after which the user will be automatically logged off. Putting a zero here will keep the user logged in until the Logon button is pressed which will log out whomever is currently logged in. It is recommended to keep the time short for the Level3 user so if parameter changes are made, and then Level3 forgets to log off, the system parameters won't be left vulnerable to unauthorized changes.



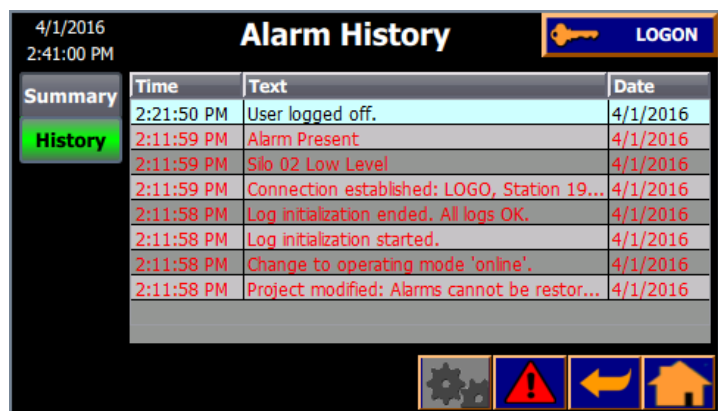
User	Password	Group	Logoff time
Level1	*****	Users	5
Level2	*****	Maintenance	5
Level3	*****	Management	5
PLC User	*****	Unauthorized	5

**Remember to keep a list of usernames and passwords if you change them.**

#### 4.6 Alarm Summary/History

The Alarm screen displays either the alarms currently active (summary), or those currently active *and* those that have come and gone (history as shown in the screenshot). Click the buttons at the left side of the screen to switch between views. See the appendix for a description of alarms that may be seen in this application.

New alarms are shown at the top of the list.



Summary	Time	Text	Date
History	2:21:50 PM	User logged off.	4/1/2016
	2:11:59 PM	Alarm Present	4/1/2016
	2:11:59 PM	Silo 02 Low Level	4/1/2016
	2:11:59 PM	Connection established: LOGO, Station 19...	4/1/2016
	2:11:58 PM	Log initialization ended. All logs OK.	4/1/2016
	2:11:58 PM	Log initialization started.	4/1/2016
	2:11:58 PM	Change to operating mode 'online'.	4/1/2016
	2:11:58 PM	Project modified: Alarms cannot be restor...	4/1/2016

#### 4.7 Sm@rtServer

The V14 Portal HMI project allows the HMI to act as a Sm@rtServer (VNC server). This capability requires that the customer purchase a license or the HMI will constantly send reminders about the lack of it. The master project has this ability disabled. If the customer has bought a license, this ability must be enabled in the project and then downloaded to it. Without doing that, it is impossible to use Sm@rtServer on the HMI.

## 5.0 STARTUP

### 5.1 Prior to Power Up

- Wire up all silo sensors.
- Wire up incoming power, but do not put main breaker in.
- Check that there are no dead shorts between L1 and the frame of the machine.
- Check that there are no dead shorts between +24V and machine frame.
- Check that the machine frame to 0V is shorted.
- Check that your building's ground is shorted to the system cabinet's ground stud.
- Perform a visual inspection to ensure there are no loose wires and that nothing else has come loose during transport.

### 5.2 Power Up

- Before putting in the main breaker, check incoming power to make sure it's correct (110VAC on L1 to N and GND).
- Put main breaker in and measure voltage between some metal part in your building to the ground stud in the system cabinet. It should be 0V +/- 100mV. If not, shut down immediately and fix it.
- Check for the presence of +24VDC at any "+24V" terminal.
- Look to see if LOGO! started up OK. There should now be a graphic depiction of silos 1 through 4 fill level (although it may not be correct right now). The LOGO! backlight may be flashing red. That's OK because the sensors still need to be set up and high and low alarm values set.

### 5.3 Sensor Setup

Wire up the sensor as shown in the silo controller schematics.

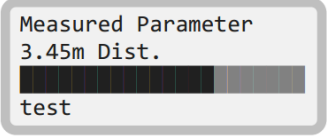
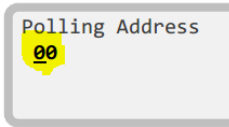
- Blue: +24V to "PWR IN +".
- White/blue tracer: 0VDC: "PWR IN -" and "4...20mA -". (In the field, BinMaster recommends that 0VDC and negative loop connection be separate wires.)
- Yellow: Sensor output to LOGO: "4...20mA +".
- RS485+ (Not shown and can be any color): Terminates in box at the proper silos "SnS+" terminal where "n" represents the silo number.
- RS485- (Not shown and can be any color): Terminates in box at the proper silos "SnS-" terminal where "n" represents the silo number.



NOTE: The RS485 wiring will allow the technician to communicate to the sensors without climbing on top of the silos. The RS485 wiring terminates in the silo control box.

Set up the High/Low parameters for each silo (Section 4.4). With the parameters setup the transducer can be turned on (see BinMaster manual).

```
Init. Please wait...
3DLEVELSCANNER <MV>
FW Ver: 03.00.00
HW Ver: 020
```

- Open up the cover to the sensor (thumbscrew) exposing the programming interface and put the power to it. Up to 30 seconds of a blank LCD screen will be followed by a brief display of the hardware and software version numbers. Lastly, the basic measurement screen should appear. 
- Press the “E” button to get to the main menu. (Press and hold the “ESC” key for 3 seconds to get back to the basic measurement screen)
- Press – to get to the Polling Address item. Press E which will show the current polling address. It should be 00. If it’s not, use the + and – keys to get it to 00. Press ESC to get back to the main setup menu. 
- Click the – key until the arrow is pointing to “Current Settings” and press E. That should be set to “Standard 4-20 mA. The other settings must be done by using the BinMaster software and an RS485 connection to the sensor. See Section 6.5.

## 6.0 APPENDIX

### 6.1 IP Addresses

Analog silo controllers may be networked to other systems (FX2 as an example). The IP addresses assigned are as follows:

- LOGO! #1 (all controllers): 192.168.1.191/24
- LOGO! #2 (12 silo controllers only): 192.168.1.192/24
- HMI: 192.168.1.190.

### 6.2 Alarms

- Silo nn High Level: The level of material in silo #nn is greater than the high level alarm set point.
- Silo nn Low Level: The level of material in silo #nn is less than the low level alarm set point.
- Alarm Present: At least one silo alarm is present in the system. If using a visible alarm beacon, this alarm is what turns it on.
- Alarm Horn Sounding: If an optional alarm horn is present, enabled, and active, this alarm will be true.

Other system alarms related to the LOGO! PLC may show up here and should be diagnosed by looking through the Siemens LOGO! documentation.

### 6.3 FX2 Integration Notes

These silo controllers may be networked to an FX2 system. The FX2 should be able to read silo levels, alarm conditions, etc. FX2 can write the global silo high and low alarm threshold levels.

#### 6.3.1 Alarm Threshold Logic

- Setting from local HMI: See Section 4.4 for details.
- Setting from FX2: The FX2 system will make a change to either “HighLevelOnThresholdSetpointFX2” or “LowLevelOnThresholdSetpointFX2” alarm FX2 threshold set point tags in the communication DB (DB215 currently) which is read by the LOGO!. The LOGO! does nothing with these values but make them available to the local HMI. When the local HMI sees a change of this value, it will pass the value to the appropriate “local” threshold via tag

scripting. Whenever the local threshold sees a change (either from the FX2 tag or our operator making a change at the local HMI), it passes the value (AKA the set point) to the LOGO!. The LOGO! logic takes the set point received and runs it through an averaging block effectively making it retentive. The output of the averaging block is called the actual threshold and is distributed to the LOGO! logic and also sent back to the HMI. When the HMI sees a change in the actual threshold value, it writes it to its "local" threshold. This completes the comm exchange and the HMI sits and waits for the next set point change from either the local HMI or the FX2. If there is no FX2 present, the HMI will see zeroes for the set point values coming from the FX2. Whenever it sees a zero on either FX2 set point, it will effectively ignore it by passing the actual threshold to the local threshold. At the FX2 end, the logic should push the LOGO's actual threshold value to the FX2 set point value whenever a change comes from the LOGO.

## 6.4 Sensor Setup Via RS485 and 3D Vision Software

### 6.4.1 RS232 to RS485 Laptop Setup

Use adapter similar to GearMo USB RS485 which uses FTDI UART chip. PC must have FTDI driver to communicate with USB adapter AND MUST ALSO HAVE VCP (Virtual Comm Port) DRIVER LOADED so Windows will assign a comm port to the USB serial adapter.

- FTDI USB to serial driver for Windows 10:  
<http://www.gearmo.com/downloads/>
- VCP Driver for FDTI adapter: <http://www.ftdichip.com/Drivers/VCP.htm>

Once this is done, plug in the RS485 output to the DB9f connector in the cabinet (DR9FTB) and then put the proper jumpers in to talk to the desired sensor (see next section).

### 6.4.2 Jumper Wiring

For comm to a specific sensor, put jumpers on as follows:

Sensor 1:

- TB2-SxP+ to TB2-S1P+
- TB2-SxP- to TB2-S1P-

Sensor 2:

- TB2-SxP+ to TB2-S2P+
- TB2-SxP- to TB2-S2P-

Sensor 3:

- TB2-SxP+ to TB2-S3P+
- TB2-SxP- to TB2-S3P-

And so on for the rest of the sensors.

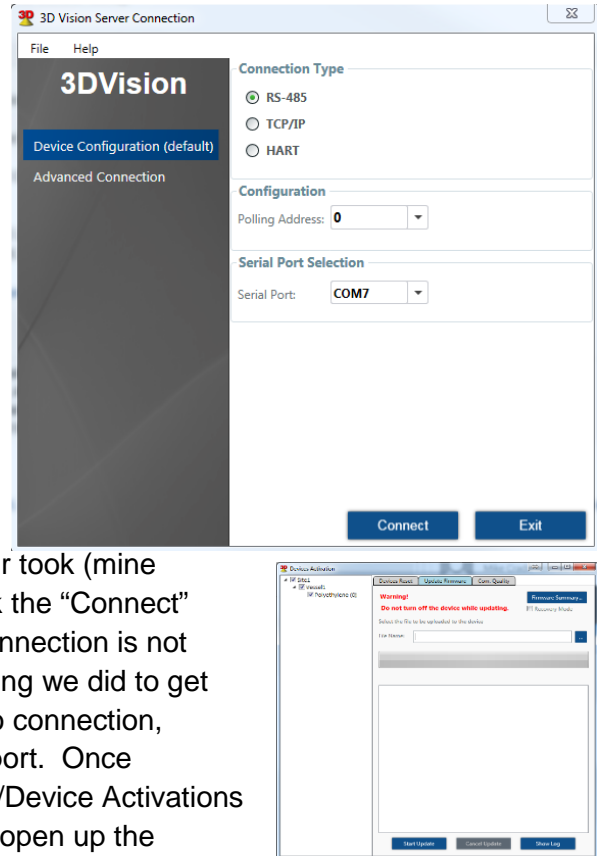
### 6.4.3 3DVision Software

Contact the BinMaster tech support and get the latest 3D MultiVision software and sensor firmware.

Install the software on your laptop and fire it (3DVision) up. Connect up everything as mentioned above, and power up the sensor. On your laptop, 3DVision should be showing the connection screen.

Choose RS-485, polling address 0 and the com port that your RS485 adapter took (mine happens to be Com7). Click the “Connect” button at the bottom. If a connection is not made, go back over everything we did to get this far, and if there is still no connection, contact BinMaster tech support. Once connected, go to the Device/Device Activations menu choices which should open up the “Devices Activation” window. Choose the “Update firmware” tab and browse to find the latest firmware file that should have been gotten from BinMaster. Once that’s found, click the “Start Update” button to load the firmware to the sensor. After that’s done, start configuring the 3D sensor to work in your application. Close this window now.

To get started with the configuration, click the “Wizard” button in the blue menu bar. This opens the basic configuration where specs for your silos should be entered. Help for setting up these parameters can be found in the BinMaster software manual which can be found at <http://www.binmaster.com/resources/dyn/files/1110583z49e1a461/fn/3DLevelManager+Software+Manual+V02002+BINMASTER.pdf>. Once done, the new parameters will be loaded into the sensor. There are also some Advanced parameters that can be tweaked from the Device/Advanced Parameters menu. Once all data is entered, from the Edit menu, you can save the settings as an XML file.





## 7.0 WARRANTY - Effective Date 7 FEB 2018

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Please note that we always strive to satisfy our customers in whatever manner is deemed most expedient to overcome any issues in connection with our equipment.

### **Warranty Periods:**

Note: All warranty periods commence with the shipment of the equipment to the customer.

### **5-Year (Except 1-Year on Non-Novatec Buy-Out Items)**

#### **Resin Drying to Include**

NovaWheel™ Dryers \*  
Dual Bed Dryers  
NovaDrier \*  
NDM-5 Membrane Dryer  
Gas-Fired Process Heaters  
Gas-Fired Regeneration Heaters  
Drying Hoppers  
Central Drying Hopper Assemblies  
Heater/Blower Units and Hot-Air Dryer  
Silo Dehumidifiers  
NovaVac Dryers \*  
Nitrogen NovaDriers (Nitro)  
DryTemp Plus

#### **Central System Controls to Include**

FlexTouch™ Series Controls  
FlexXpand™ Series Controls  
OptiFlex™ Series Controls  
PLC Communications Modules  
Greenboard Communications Modules  
LOGO! Mini PLC  
MCS-600 Series Controls – (Distributed I/O)  
MCS-400 Series Controls  
CL Silo Manager

#### **Moisture Measurement Equipment to Include**

MoistureMaster®

#### **PET Resin Crystallizers**

#### **Resin Blending and Feeding to Include**

WSB Blenders, MaxiBatch & Feeders \*  
Gaylord Sweeper Systems

#### **Downstream Extrusion Equipment to Include**

C and NC Bessemer Series Cutters  
NPS Bessemer Series Pullers  
NPC Mini Puller/Cutter  
All NS Series Servo Saws  
All Cooling and Vacuum Tanks Manufactured

#### **Resin Conveying and Systems Components to Include**

GSL Series Vacuum Loaders  
GlassVu Loaders, Receivers and Hoppers  
VL/VLP Series Loaders  
VRH, VR, VR-FL & VRP Series Receivers  
Compressed Air Loaders  
AL-B Barrel Loader  
Cyclone Dust Collectors  
Conveying System Accessories  
Surge Bins  
Valves and Accessories  
Electronic Metal Separators  
Quick Select Manifolds  
Tilt Tables  
Filter Dust Collectors  
Drawer Magnets  
Velocity Control Valves

### **3-Year**

#### **Resin Conveying System Components to Include**

\*\* VPDB Vacuum Positive Displacement Pumps  
\*\* SVP Vacuum Pumps  
\*\* MVP Vacuum Pumps  
\*\* Railcar Unloading Systems

**\*\*5-Year Extended Warranty** - When a MachineSense® data plan is activated for products with \*\*, Novatec automatically extends the warranty to 5 years. The data plan must be activated within 60 days after product shipment, and remain active through the warranty period to maintain extended warranty eligibility. The first 6-months of data plan usage is free from Novatec.

### **1-Year**

**Infrared Dryers**  
**UltraVac Vacuum Pumps**

**Vacuum Regenerative Blower Pumps**  
**Custom Equipment of any kind unless otherwise specified**

**Exclusions:**

Routine maintenance/replacement parts are excluded from the warranty. These include, but are not limited to: hoses, desiccant, filters, filter elements, wiper seals, gaskets, dew point sensors, infrared lamps, motors, internal solenoids, fuses and motor brushes. Use with abrasive materials will void the warranty of any standard product. Wear resistant options may be available to extend usable service life with abrasive materials. Novatec reserves the right to limit the warranty if the customer installs replacement parts that do not meet the specifications of the original parts supplied by Novatec.

**\*Specific Exclusions:**

1. NovaDrier and NovaDrier-Nitro warranty is void if coalescing filters are not replaced on a 6-month or yearly basis (per instruction manual) and/or membrane has been exposed to ozone.
2. NovaVac Dryer -The ability of the canisters to hold vacuum will be compromised if the vacuum seal edge is damaged from mishandling. We do not warranty canisters damaged from improper handling. We do, however, warranty the seals.
3. LOAD CELLS on our WSB's are covered by Novatec standard warranty as long as they have not been damaged from improper handling.
4. Desiccant Wheel Warranty will be void if the wheel has been exposed to plasticizer, dust or other contaminants as a result of negligence on the part of the processor.

**This warranty shall not apply to equipment:**

1. Repaired or altered without written approval of NOVATEC unless such repair or alteration was, in our judgment, not responsible for the failure
2. Which has been subject to misuse, negligence, accident or incorrect wiring by others
3. Warranty is void if processing rates exceed manufacturer-recommended levels or if damage is caused by ineffective power isolation and/or power spikes/sags or incorrect installation.

NOTE: All conditions and content of this warranty are subject to changes without notice.

