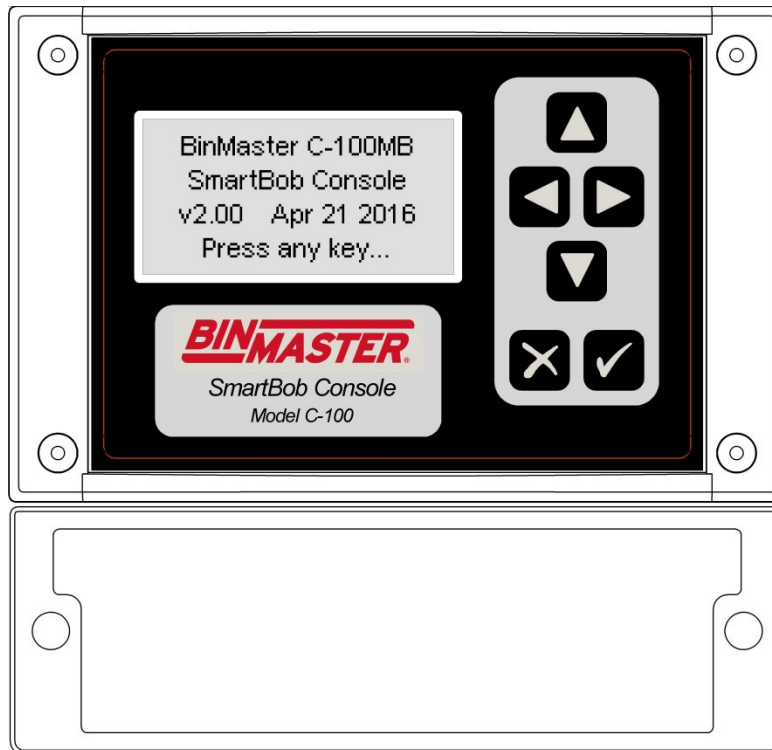




Model C-100MB  
SmartBob Console with Modbus Interface



**OPERATORS MANUAL**

Please read thoroughly before installation and operation.



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## Safety Summary

Review the following safety precautions to avoid injury and prevent damage to the equipment.

The product should be installed, commissioned, and maintained by qualified and authorized personnel only.

Install according to installation instructions and comply with all national and local codes.

Use electrical wire that is sized and rated for the maximum voltage and current of the application.

Insure that the enclosure cover is in place and secured tightly during normal operation.

In potentially wet environments thoroughly seal all conduit entries.

If this product is used in a manner not specified by the manufacturer the safety protection could be compromised.

## Safety Terms and Symbols



**WARNING:** Warning statements identify conditions or practices that could result in injury or loss of life. Risk of electrical shock.

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**CAUTION:** Caution statements identify conditions or practices that could result in damage to this product or other property.

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## FCC Compliance

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

## 1.0 Introduction

This version of the operator's manual is intended for C-100MB consoles with firmware v2.00 or newer.

The BinMaster Model C-100MB is a compact control console for a network of BinMaster SmartBob sensors. It can control from 1 to 120 SmartBob sensors with a few keystrokes or automatically by use of an interval timer or external start input signal. It has a 4-20mA current output that, in conjunction with the external start input, provides for a traditional interface to a PLC (programmable logic controller) or DCS (distributed control system) system. The console was designed with a NEMA 4X rating, thus if it is properly installed it will be protected from windblown dust and rain. Vessel configuration is quick and easy with a simple and intuitive user-interface, configurable in either the English or Spanish languages. Measurement formats can be displayed as headroom percentage, headroom height, headroom weight, product percentage, product height and product weight. Vessel configuration and user settings are stored in non-volatile memory and will be retained during a power failure.

The Model C-100MB can be remotely accessed via a Modbus slave interface. Through the Modbus interface, a Modbus master can initiate measurements, monitor measurement progress and retrieve results for any or all SmartBobs enabled in the C-100MB console.

## 2.0 Specifications

### Power Requirements

Isolated 24VDC source with 2W (0.085A) minimum output.

A quality earth connection is also required on the power terminal. Although this is not needed for power or normal operations, it is required for proper protection from lightning and other electrical surges.

### SB-485 Port

RS-485 at 2400 bps using BinMaster's proprietary half duplex protocol A or B and supporting 1 to 120 SmartBob sensors on up to 4,000 feet of a quality twisted-pair shielded cable.

### EX-485 Port

RS-485 at 2400, 4800, 9600, 19,200, 38,400 or 57,600 bps using either Modbus/RTU (8E1, 8O1, 8N2) or Modbus/ASCII (7E1, 7O1, 7N2).

### External Start Input

Continuous monitoring for a dry contact closure to initiate a measurement with a response time of less than 1 sec.

### 4-20mA Current Output

Continuous 4 – 20mA current output with 16 bits of resolution into a maximum loop resistance of 700Ω. If weight calculations are DISABLED, the output level is relative to the last measurement of a user-assigned vessel and its entered height. If weight calculations are ENABLED, the output level is relative to the calculated weight of a user-assigned vessel and all its entered parameters.

An error condition (did not drop, bob stuck or communications error) can also be presented at this output with a user-selectable value of either 2mA or 22mA.

#### Interval Timer for Automatic Measurements

Any number of SmartBobs on the network can be configured for an automatic measurement with a time between measurements ranging from 0 minutes (continuous) to 49 hours and 59 minutes in 1 minute increments.

#### Vessel Parameters

Vessel Height in feet:	1.00 to 299.99 in 0.01 increments
Vessel Height in meters:	0.30 to 89.99 in 0.01 increments
Body Height in feet:	1.00 to 299.99 in 0.01 increments
Body Height in meters:	0.30 to 89.99 in 0.01 increments
Body Radius/Width in feet:	0.10 to 59.99 in 0.01 increments
Body Radius/Width in meters:	0.10 to 19.99 in 0.01 increments
Hopper Height in feet:	0.10 to 29.99 in 0.01 increments
Hopper Height in meters:	0.10 to 8.99 in 0.01 increments
Outlet Radius/Width in feet:	0.10 to 8.99 in 0.01 increments
Outlet Radius/Width in meters:	0.10 to 2.99 in 0.01 increments
Sensor Offset in feet:	-99.99 to 99.99 in 0.01 increments
Sensor Offset in meters:	-29.99 to 29.99 in 0.01 increments
Product Density in lbs/cu ft:	1.00 to 199.99 in 0.01 increments
Product Density in kg/cu m:	16.00 to 3,999.99 in 0.01 increments

#### Displayed Measurement Accuracy

Headroom Height:	+/-0.01 of reading plus the accuracy of the SmartBob sensor.
Product Height:	+/-0.01 of reading plus the accuracy of the SmartBob sensor plus the accuracy of the entered vessel's height.
Volume / Weight:	+/-0.01 of reading plus the accuracy of the SmartBob sensor plus the accuracy of all entered vessel parameters.

#### 4-20mA Output Accuracy

Headroom Height:	+/-0.16% plus the accuracy of the SmartBob sensor.
Product Height:	+/-0.16% plus the accuracy of the SmartBob sensor plus the accuracy of the entered vessel's height.
Volume / Weight:	+/-0.16% plus the accuracy of the SmartBob sensor plus the accuracy of all entered vessel parameters.

#### Ambient Temperature

Storage:	-4° to 158° Fahrenheit (-20° to 70° Celsius)
Operating:	-4° to 158° Fahrenheit (-20° to 70° Celsius)

## Physical

Dimensions:	6.5 x 6.3 x 3.5 inches (166 x 160 x 89 mm)
Weight:	1.5 lbs (0.7 kg)
Enclosure:	Polycarbonate, light industrial gray.

Ingress Protection Rating                      NEMA Type 4x

## 3.0 Installation

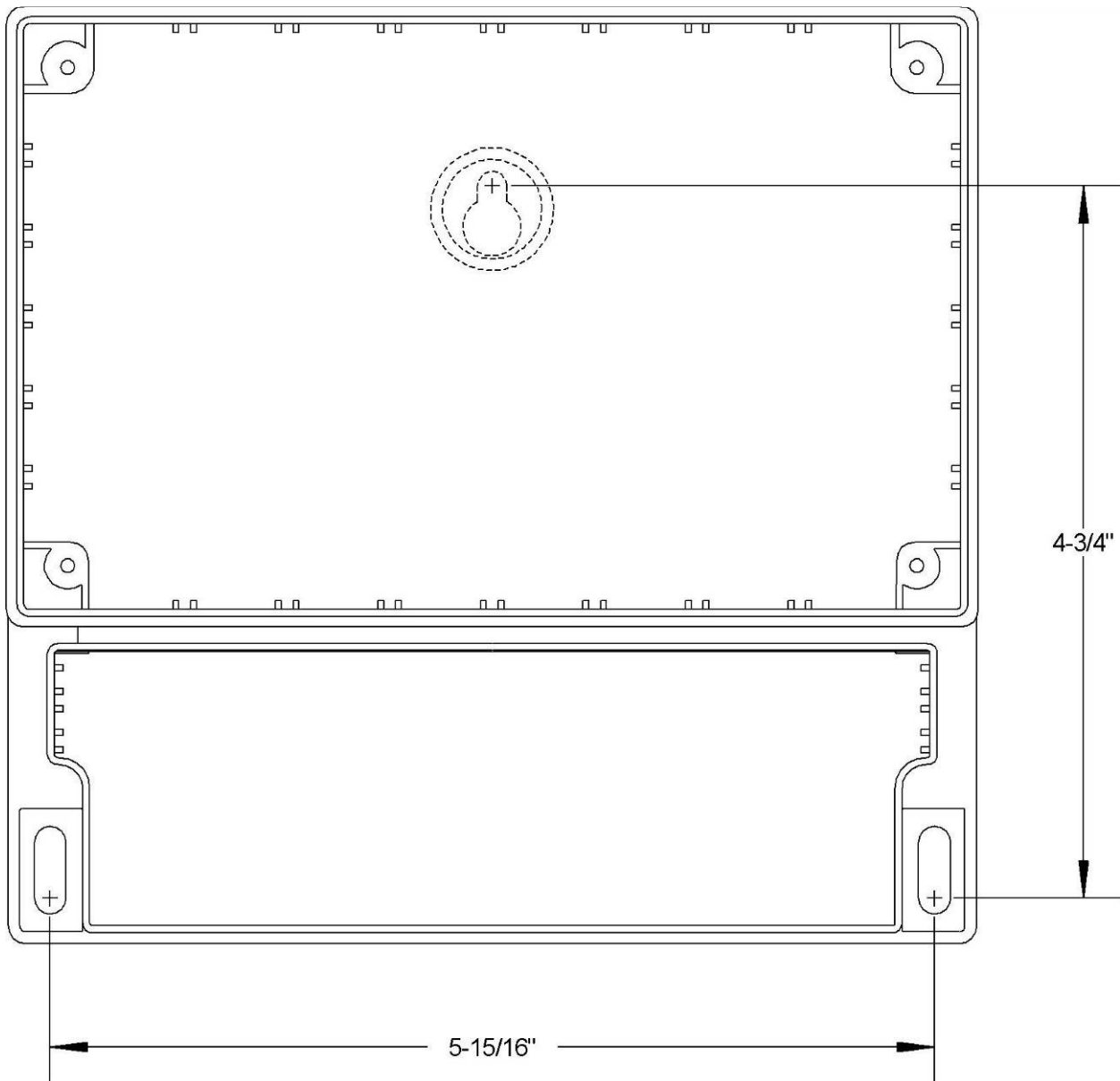
### 3.1 Mounting

When locating a position to mount the C-100MB SmartBob control console, make sure to allow for adequate air flow around the unit and don't place it near any equipment that produces excessive heat. If the ambient temperature of the C-100MB is going to exceed 122°F (50°C), consider using a fan of some type to circulate the air. Allowing for good air flow around the C-100MB will prolong the life of the unit. Also, to prolong the life of the unit's enclosure and front panel, avoid a location that would place it in direct and constant sunlight.

### 3.1.1 Screw Mount

There are three screw holes that can be used for mounting the C-100MB SmartBob control console as shown in the diagram below. You will need one #8 wood screw at least 3/8" long and two #8 wood screws at least 5/8" long.

1. Locate, drill a hole for and screw the 3/8" long screw into the mounting board/plate, leaving the head of the screw out about 1/8".
2. Hang the console with the one screw by the center mounting tab.
3. Remove the lower wiring cabinet cover and mark the locations for the two lower mounting screws with a pencil or awl.
4. Remove the console and drill holes for the two lower mounting screws.
5. Hang the console again by the center mounting tab and fasten in place with the two lower mounting screws.





## 3.2 Connections and Wiring

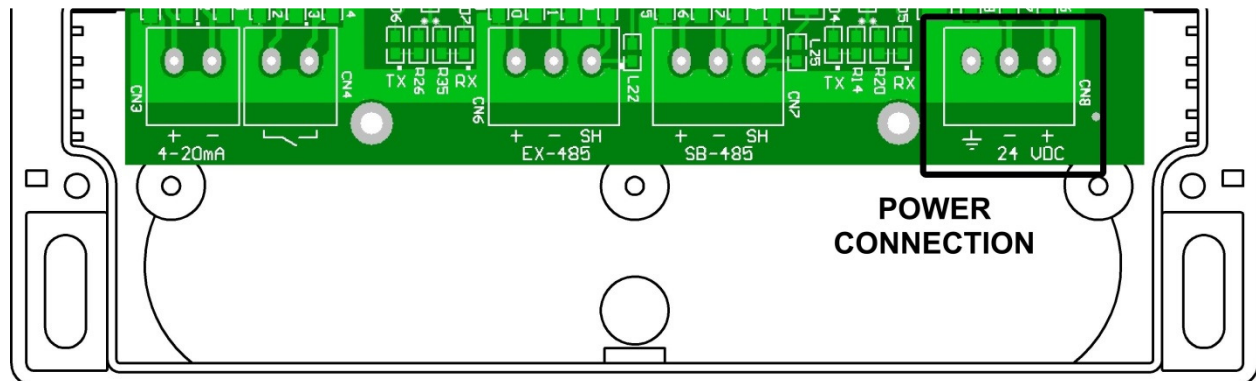
A minimum configuration will require a three-wire power connection and a three-wire RS-485 connection to the SmartBob network. Optionally, there may be a two-wire 4-20mA connection, a two-wire external start connection and another three-wire RS-485 connection for the Expansion network.

All wiring is fed through water-tight cordgrips and connected inside the lower wiring cabinet to pluggable terminal blocks mounted on the printed circuit board. Remove the two screws on the lower wiring cabinet cover to gain access to the terminal blocks. When wiring is complete, be sure that the lid is properly fastened down for a water and dust-tight seal. Never remove or unscrew the nameplate lid with the keypad and LCD window.

There are a total of five terminal blocks but only four cordgrip/entry points inside the wiring cabinet. It is recommended that if all terminal blocks are being used, that the 4-20mA Output (CN3) and the External Start Input (CN4) share the same cordgrip/entry point.

All five terminal blocks are capable of supporting 22 to 12 AWG size wires. Be sure to use the appropriate wire gauge/size for the connections and follow all national and local codes concerning this installation.

### 3.2.1 Power Connection



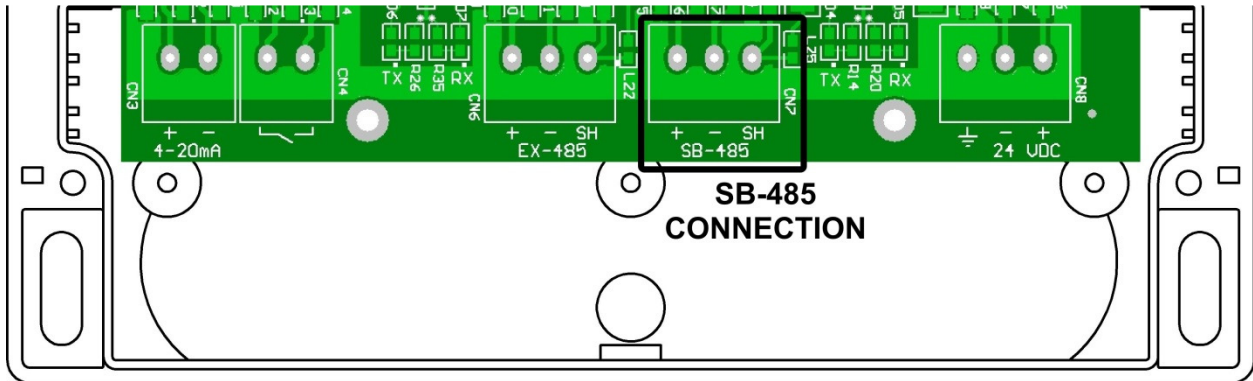
The power connection (CN8) is a three wire terminal block located on the far right. Two terminal screws marked + and – are for connecting to a 24VDC source, isolated from earth ground. See section 2.0 Specifications for power source requirements. Due to the low power requirements of this console, a 16 or 18 AWG wire would be sufficient for these two power connections.

The terminal screw marked with the  $\text{⏏}$  symbol should be connected to a quality earth for proper protection from lightning and other electrical surges induced in an industrial environment. It is recommended to use a 16 AWG wire or larger for the earth connection and connect it to the closest possible source to earth.

It is recommended to use a separate isolated power source for every device on a SmartBob system. This will provide additional protection from lightning and other electrical surges.

All three connections at CN8 are required for proper operation and protection of the console.

### 3.2.2 SB-485 for SmartBob Network



The SB-485 connection (CN7) is a three wire terminal block located near the center of the printed circuit board and is for connection to the SmartBob RS-485 network. Two terminal screws marked + and – should be connected to the positive and negative wires of the SmartBob network cable. The third terminal screw marked SH should be connected to the shield of the SmartBob network cable. Do NOT connect the shield to earth.

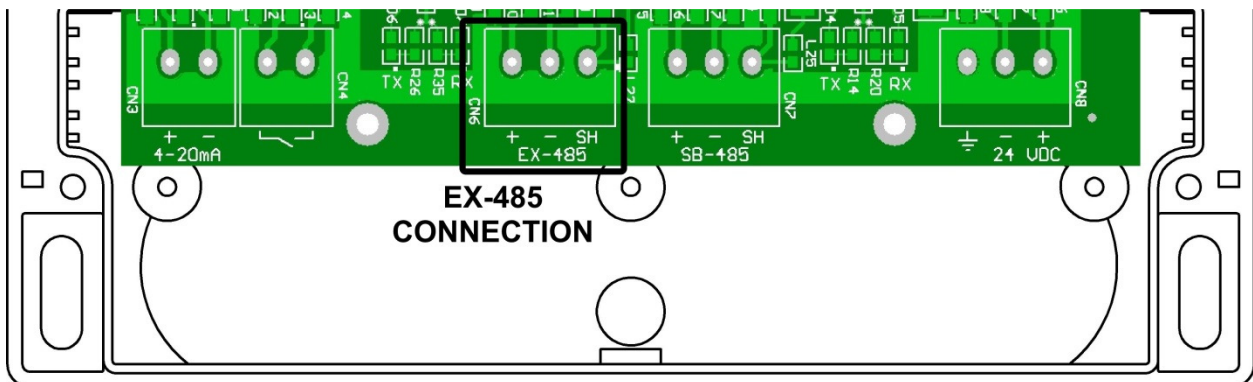
All three connections at this terminal block are required in order to properly communicate to any SmartBob sensors.

A good quality twisted-pair shielded cable should be used for the SmartBob network. The cable should connect to each device on the SmartBob network in a daisy-chain fashion. Branch lines or splits are not recommended. The maximum length of the cable should be 4,000 feet or 1,220 meters.

The C-100MB SmartBob control console has permanent biasing resistors for the SmartBob network, so remove or un-switch any other bias resistors on all other devices connected to this network.

Devices located at the ends of the SmartBob network must be properly terminated. For the two devices located at the ends, switch in their NTR or termination resistor. The C-100MB SmartBob control console can be located anywhere along the SmartBob network and has a software menu for switching its termination in or out of circuit.

### 3.2.3 EX-485 for Expansion



The EX-485 connection (CN6) is a three wire terminal block located near the center of the printed circuit board and is to be used for connection to a Modbus master. Two terminal screws marked + and – should be connected to the positive and negative wires of the RS-485 network cable. The third terminal screw

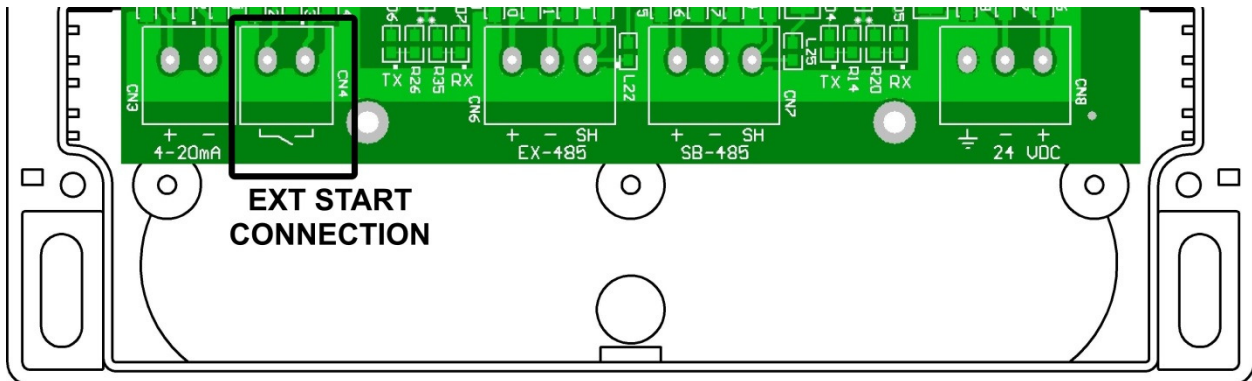
marked SH should be connected to the shield of the RS-485 network cable. Do NOT connect the shield to earth.

These three connections at this terminal block are optional and only needed when remotely accessing the C-100MB through Modbus.

A good quality twisted-pair shielded cable should be used for the RS-485 network. The cable should connect to each device on the network in a daisy-chain fashion. Branch lines or splits are not recommended. The maximum length of the cable should be 4,000 feet or 1,220 meters.

This port has built-in line biasing and termination.

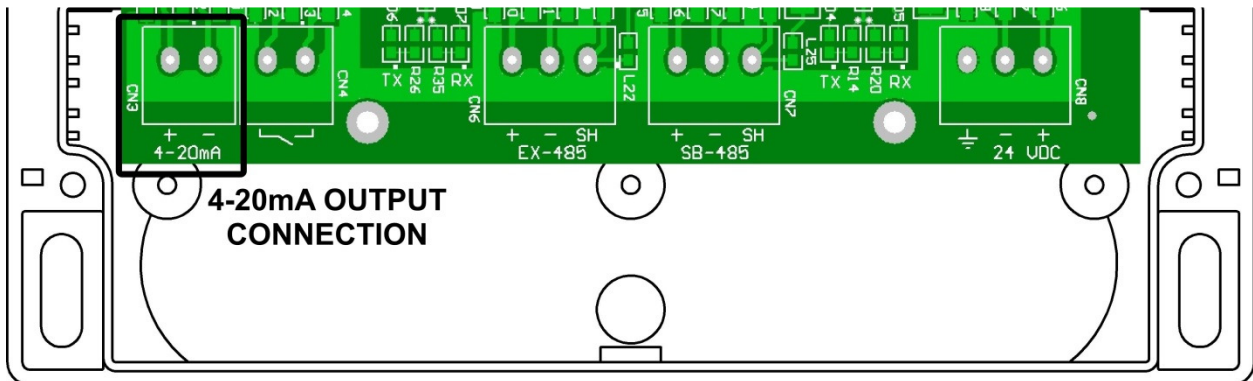
### 3.2.4 External Start Input



The External Start connection (CN4) is a two wire terminal block located towards the left of the printed circuit board. It is identified with CN4 and an open switch symbol. These two terminal screws are polarity independent and are intended only for a dry contact closure, such as a relay output from a PLC or a pushbutton switch. This connection does not source or sink any negligible amount of current so a quality twisted-pair cable of 20 to 22 AWG wiring is sufficient. A shielded cable is not required; however, if one is used leave the shield un-connected at the console.

The External Start connection is optional and only needed when a PLC/DCS or remote pushbutton switch is needed to initiate a measurement. This input can only trigger one SmartBob sensor but can be assigned to any one on the network. This input is negative edge-triggered, meaning the dry contact must be cycled open and then closed again to initiate a new measurement.

### 3.2.5 4-20mA Output



The 4-20mA Output connection (CN3) is a two wire terminal block located on the far left of the printed circuit board. It is identified with CN3 and labeled with 4-20. The two terminal screws marked + and – should be connected to the proper positive and negative wires of the load. This output is powered and capable of driving up to a 700Ω loop. Depending on the distance this wiring must go, a quality twisted-pair cable of 18 to 22 AWG wiring is sufficient. A shielded cable is not required; however, if one is used leave it un-connected at the console.

The 4-20mA Output connection is optional and only needed when a 4-20mA output is needed to feed a PLC or DCS system of the last measurement taken. This output can only represent one SmartBob measurement but can be assigned to any SmartBob sensor on the network.

### 3.3 RS-485 Network Requirements

Both the SmartBob network (SB-485) and the Expansion network (EX-485) use RS-485 wiring and data signaling techniques and must meet certain criteria for reliable operation. If these criteria are not met, communications errors will most likely occur and result in failed measurements. Troubleshooting communications errors can be expensive and time consuming, so BinMaster strongly encourages you to take adequate time in understanding and installing the RS-485 networks and to use quality cabling and connection techniques.

Summary of RS-485 requirements for BinMaster products:

- All devices must be wired or connected in a daisy-chain fashion.
- Use a quality twisted-pair cable with shield.
- Maintain correct polarity between all devices wired to the network cable.
- The two ends of the network cable must be terminated.
- Biasing must be applied in only one place anywhere along the cable or network.
- All devices on the network must support and be configured for the same protocol.

## Wiring

All devices on an RS-485 network must be connected directly to the network cable with no splits, taps or branch lines. The overall length of the cable must not exceed 4,000 feet or about 1,220 meters. Use a quality twisted-pair cable with shield and connect as per the wiring diagram in section 3.5. Observe the polarity of the wiring between all devices on the network, making sure that the wire connected to the + terminal at the C-100MB SmartBob control console is also connected to the + terminal on all other devices. Likewise, make sure that the wires connected to the – and SH terminals at the C-100MB SmartBob control console are also connected to the – and SH terminals, respectively, on all other devices. Do not connect the wires or shield to anything other than that specified.

## Termination

All BinMaster RS-485 networks must be terminated at both ends with a 120Ω resistor for proper operation and reliability. Normally this is done by the two devices connected at the very ends of the network cable. On some devices the termination is set ON or OFF by a slide switch labeled “NTR” and on other devices this may be set IN or OUT of circuit through a software menu.

The C-100MB console uses a software menu titled “SB-485 Termination” for switching the termination resistor IN or OUT on the SB-485 port. For the EX-485 port, the C-100MB console has the termination resistor permanently switched in and therefore the C-100MB console must be located at one end of the network. Refer to the manual of the other devices for instructions on how to switch their termination.

## Bias Resistors

All BinMaster RS-485 networks must have bias resistors installed or switched in for proper operation and reliability. This must be done at only one device but anywhere along the network cable.

The C-100MB SmartBob control console has bias resistors permanently switched in for both the SB-485 port and the EX-485 port, so for all other devices connected to either of these networks make sure that the bias resistors are turned OFF or switched OUT of circuit. Refer to the manual of these other devices for instructions on how to do so.

## Protocol

All devices on an RS-485 network must be configured to use the same protocol. BinMaster supports two protocols for the SmartBob network. Protocol A is newer, more reliable and more efficient while protocol B is older and supported for legacy products. It is recommended to use protocol A if all the devices on the SmartBob network support it; otherwise use protocol B.

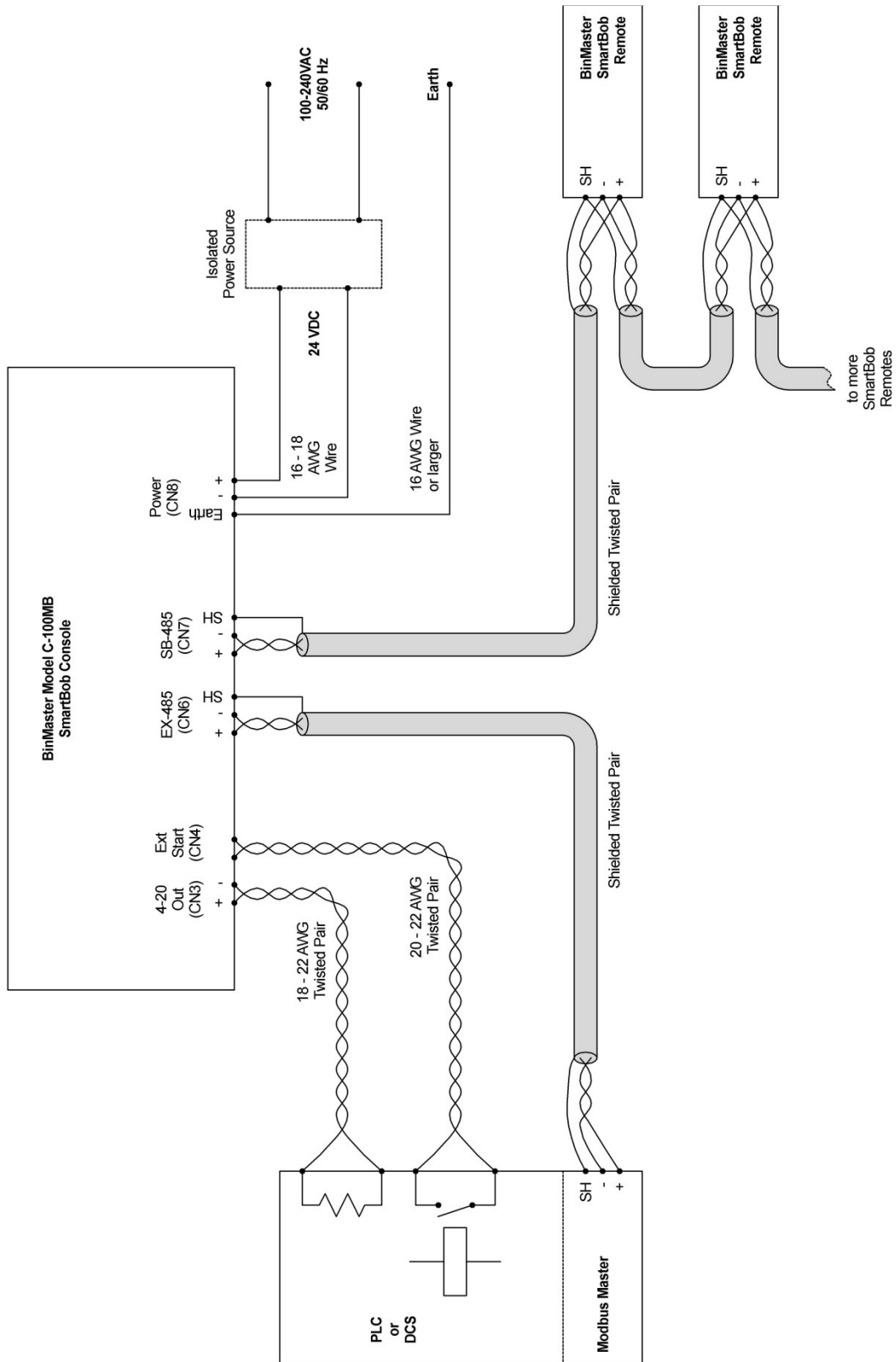
Depending on the device, selecting the SmartBob protocol may be done with a switch, a jumper position or a software menu. The C-100MB SmartBob control console uses a software menu titled “SB-485 Protocol” for configuration between SmartBobs protocol A or B. Refer to the manual of the other devices for instructions on how to set or configure their SmartBob protocol.

### 3.4 Lightning/Surge Protection

All electronic devices connected to a large wired network are susceptible to damage from lightning and other sources of electrical surges. Both the power source and an RS-485 network are a means for electrical surges to enter the C-100MB SmartBob control console and do damage. Although some level of protection from electrical surges is built into the C-100MB SmartBob control console, there are options to further protecting your investment.

1. As recommended for the power connection at CN8, use an isolated power source and verify that the output is NOT grounded or referenced to earth. Make sure that all devices connected to either the SmartBob network or Expansion network uses a separate power source.
2. Be sure to connect the terminal at CN8 marked  $\perp$  to a good quality earth using a 16 AWG size wire or larger. This wire should be as short as possible to earth with no sharp bends or loops in the wiring.
3. Use additional external lightning/surge arrestors on the RS-485 networks. This is very critical of large outdoor networks that are high off the ground. Place 1 to 3 surge arrestors on the RS-485 network evenly spaced apart, following the manufacturer's installation instructions and using a good quality connection to earth.
4. Consider using BinMaster wireless solutions that not only greatly protect your investment from lightning but can reduce installation time and eliminate the need for running long lengths of RS-485 cable. Call BinMaster and speak with one of our applications specialist for more information on our wireless solutions.

### 3.5 Wiring Diagram



## 4.0 Operation and Setup

The C-100MB SmartBob control console is controlled and operated through the use of a 6-button icon-based keypad and a simple intuitive text-based menu system. The menu system is user-selectable in either the English or Spanish languages.

### 4.1 Keypad

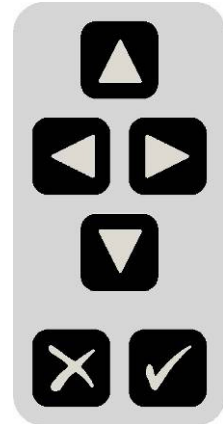
The keypad consists of 6 membrane style keys appearing as shown to the right.

Four of them are labeled with left, right, up and down arrow keys and are used for navigating menu selection bars and character cursors.

Another key is labeled with a ✕ (cross out) for cancel or escape and is generally used to stop an action or to exit a screen without taking action.

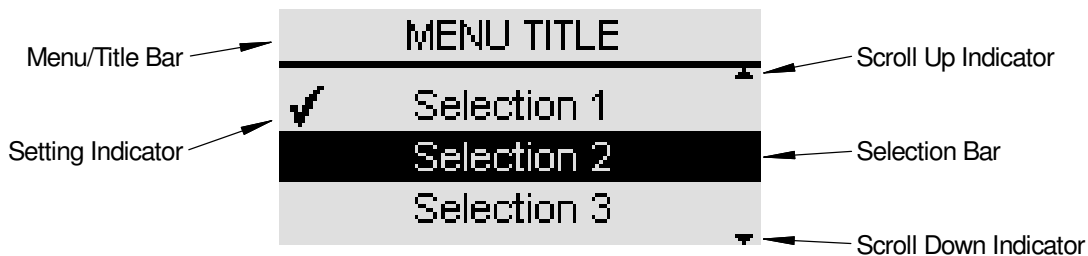
The final key is labeled with a ✓ (check mark) for Ok and is generally used to accept the current selection and/or to advance to the next screen.

Most operations will simply require a single press and release of a key; however some operations may benefit from a key being held. For instance, holding the up or down arrow keys will allow the user to continuously scroll through long lists of vessel measurements. In some menus, the left and right arrow keys serve as a page up and page down key for faster navigation through long lists. Also, in some menus with long lists, you can press the left and up arrow keys simultaneously for a jump to the top of the list and pressing the right and down arrow keys simultaneously for a jump to the bottom of the list.



### 4.2 Menu System

Each menu and/or screen maintains a common format for ease of understanding and use. The example screen below shows a few of the common items found on most screens.



The Menu/Title Bar will always be present at the top and identify the current menu or screen to the user. Below that will be up to three lines of text or selection items, depending on the current menu or screen.

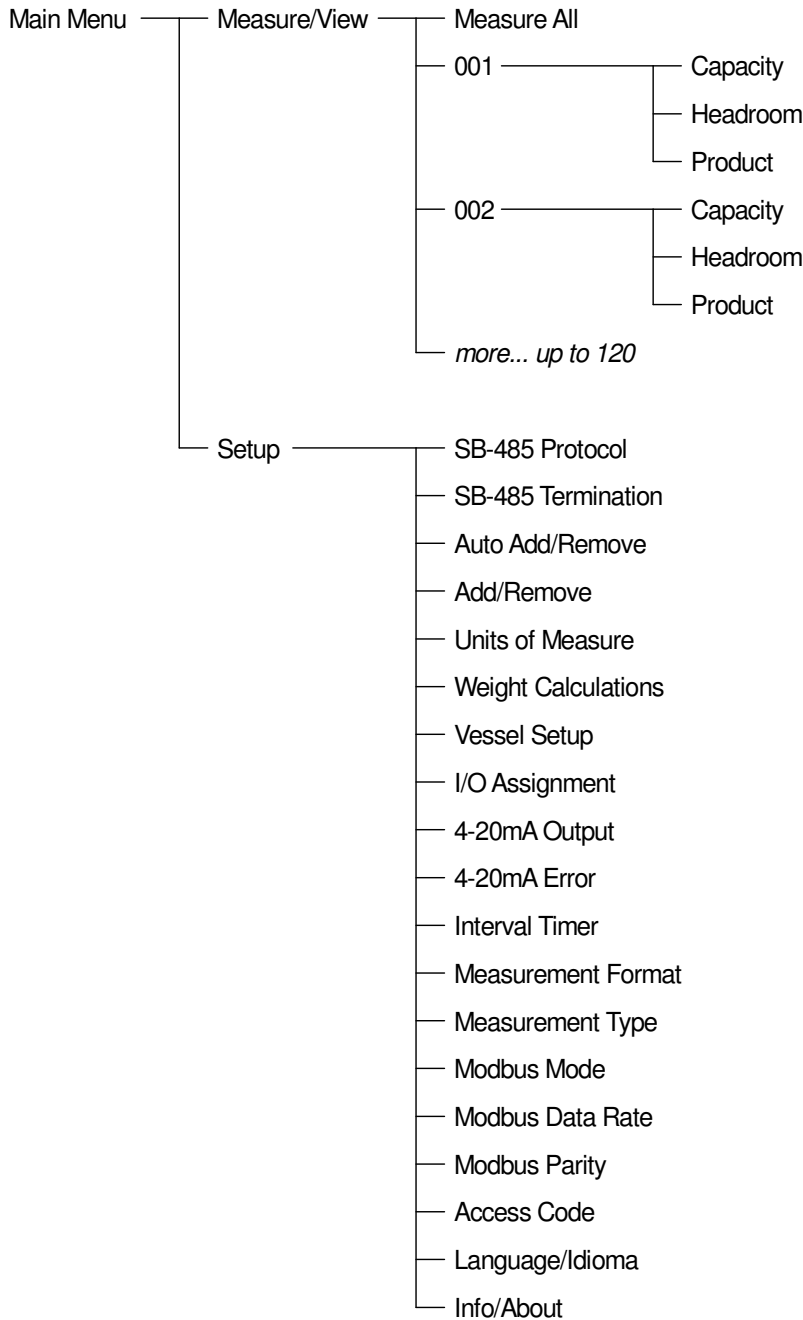
The Selection Bar is repositioned vertically with the ▲/▼ keys and is used for making a selection in a menu. Normally a selection isn't accepted until the ✓ key is pressed.

The Setting Indicator, displayed as a check mark towards the left of the screen, is used in various places under the Setup Menu to indicate current or active settings.



The Scroll Up and Down Indicators, displayed as little up and down arrows towards the right of the screen, will be present when more selections or information is available off screen. The Scroll Up Indicator will be present when the user can scroll up to obtain more selections or information and the Scroll Down Indicator will be present when the user can scroll down to obtain more selections or information.

Navigating through the menu system is straight-forward, position the selection bar on the desired menu or selection item and press the ✓ key. To go back a menu or escape from the current screen, press the ✕ key. The menu system is structured as shown in the following diagram.

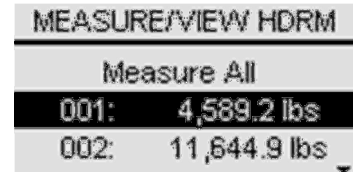


### 4.2.1 Main Menu

The Main menu has two selections: Measure/View and Setup. Select Measure/View if you want to take an immediate measurement or view the results of the last measurement. Select Setup if you need to change user display preferences, setup vessel parameters, SmartBob network settings or configure the Expansion network. The main menu is at the top of the menu system, so pressing the **X** key here will have no effect.

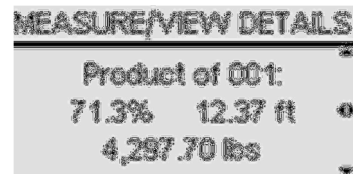
### 4.2.2 Measure/View

The Measure/View menu provides a full listing of all the last measurement results and a means to initiate a measurement. It will always have at least two selections. The first selection will always be Measure All and selecting it will immediately start a measurement process on all configured SmartBob sensors. The second selection and any following selections will contain the last measurement data next to its associated SmartBob address. Note that SmartBob sensors are identified by their address and are always displayed with three digits ranging from 001 to 120. Selecting any of the measurement data will bring up the details screen for that SmartBob. If there is only one SmartBob sensor configured on the network then there will only be two selections in this menu. If you have multiple SmartBob sensors configured, then you can scroll through this menu to see them all. The title bar will also indicate whether the measurement data is of the headroom (Hdrm) or of the product (Prod), as set under Measurement Format. Note that 'headroom' refers to the upper empty space in the tank and 'product' refers to the lower filled space.



MEASURE/VIEW HDRM	
Measure All	
001:	4,589.2 lbs
002:	11,644.9 lbs

The details screen displays additional data for a particular SmartBob and provides a means to take a measurement with that particular SmartBob by pressing the **✓** key. Use the **◀/▶** keys to cycle through all the data (capacity, headroom and product) for the selected vessel and SmartBob. In each mode, the percentage and height are displayed, as is volume or weight if weight calculations are enabled. If the vertical scroll indicators are present, the operator can scroll to other SmartBob measurement results.



MEASURE/VIEW DETAILS	
Product of 001:	
71.3%	12.37 ft
4,297.70 lbs	

The accuracy of these readings is dependent on both the SmartBob reading and the vessel parameters entered into Vessel Setup.

### 4.2.3 Setup

The Setup menu has selections for setting user preferences, configuring the SmartBob network, the Expansion network and defining SmartBobs and associated vessels. All settings and configurations made will be retained during a loss of power.

#### SB-485 Protocol

This is a menu for setting which communications protocol to use on the SmartBob network, the operator can choose A or B. The default setting is A.

All devices on the SmartBob network must be configured to use the same protocol. Protocol A is newer, more reliable and more efficient while protocol B is older and supported for legacy products. It is recommended to use protocol A if all the devices on the SmartBob network support it; otherwise use protocol B. The protocol must be configured prior to running Auto Add/Remove or any measurement process. See the SBR11 or SB-TS1 manual for their protocol jumper settings.

## SB-485 Termination

This is a menu for setting whether the SmartBob network termination is switched In or Out. If the console is the final device connected at either end of the SmartBob network choose In, otherwise choose Out. The default setting is In. The termination must be set prior to running Auto Add/Remove or any measurement process.

## Auto Add/Remove

This is a process the operator can choose to let the console automatically scan and detect any SmartBob sensors on the network. After selecting Auto Add/Remove, it will begin searching for SmartBob sensors currently connected to the network and adding them to the working list. If there are existing SmartBobs enabled, a confirmation screen will appear to make sure you want to re-scan for new and removed SmartBob sensors. Press **X** to cancel or **✓** to confirm. The operator can choose to let it scan all the way to 120 or stop it once the process has found all known SmartBob sensors.

Since this process uses SB-485 communications, make sure that SB-485 Protocol and SB-485 Termination have previously been set.

## Add/Remove

This is a menu that allows the operator to manually add or remove SmartBob sensors to the console's working list. Use the **▲**, **▼** and **✓** keys to select and accept one or more SmartBob addresses from the list to be configured for use. After all desired addresses are assigned, use the **X** key to exit.

## Units of Measure

This is a menu for selecting the units used for entering vessel dimensions and product density in Vessel Setup. It also determines the units used for readings when Measurement Format is set for Height or Cubic Units. If weight calculations are enabled, your two choices are English (ft, lbs) or Metric (m, kg) with the default being English (ft, lbs). If weight calculations are disabled, your two choices are Feet (ft) or Meters (m) with the default being Feet (ft).

Changing this setting will convert all stored vessel parameters from one system to the other.

## Weight Calculations

This is a menu for enabling or disabling volume and weight calculations. The default is disabled. By enabling weight calculations, the operator will be able to view measurement results as a volume or weight in various units. The option to disable this feature is provided due to the complexity of entering vessel parameters that may not be needed on some systems.

This setting will have an effect on the following:

1. The amount of data to be entered under Setup > Vessel Setup.
2. Selections available under Setup > Measurement Format.
3. Data presented under Measure/View.
4. Data represented by the 4-20mA output.

## Vessel Setup

This is a menu for entering the vessel parameters associated with the SmartBob addresses previously configured in Add/Remove or Auto Add/Remove. Defining vessels accurately is critical in obtaining accurate measurement data of weight or product height.

If weight calculations are disabled, this is simply for setting the overall height of the vessel, sensor offset and maximum drop. The first screen is for selecting the vessel(s) to be configured, the second screen is for entering the vessel height of the selected vessel(s), the third screen is for setting a headroom offset and the fourth for setting maximum drop distance.

Vessel Selection – This is for selecting which vessel or vessels to configure parameters for, choose either Set All or one particular vessel. If all vessels are to be the same or similar use Set All, otherwise configure one at a time.

Vessel Height – For setting the overall height of the vessel.

Sensor Offset – For setting the offset or distance between the sensor and the full mark. A positive value places the sensor below the full mark or down in the tank. A negative value places the sensor above the full mark or up outside the tank.

SmartBob Max Drop – For setting the maximum drop distance the SmartBob will drop its probe. If set to some value less than the height of the vessel, it would prevent the SmartBob from dropping its probe down through the hopper outlet and into an auger. **Note:** This feature is only available when configured for protocol A and will not function properly unless the SmartBob contains firmware v2.8 or newer. Due to detection time within the SmartBob itself, it may actually drop up to 1.5 inches more than this setting.

If weight calculations are enabled, this is a multi-page menu for entering vessel parameters and product density required in calculating weight. Following is a listing of the different Vessel Setup pages and a process flowchart.

Vessel Selection – See description above.

Vessel Shape – For setting the shape of the previously selected vessel(s), choose between circular or rectangular.

Body Height – For setting the height of the vessel's body. Note that this is just the main body of the vessel and not the overall height.

Body Radius – For setting the radius of a circular vessel's body.

Body Width 1 & Body Width 2 – For setting the two widths of a rectangular vessel's body.

Hopper Present – Choose between Yes or No on whether a hopper is present.

Hopper Height – For setting the height of the hopper, if it exists.

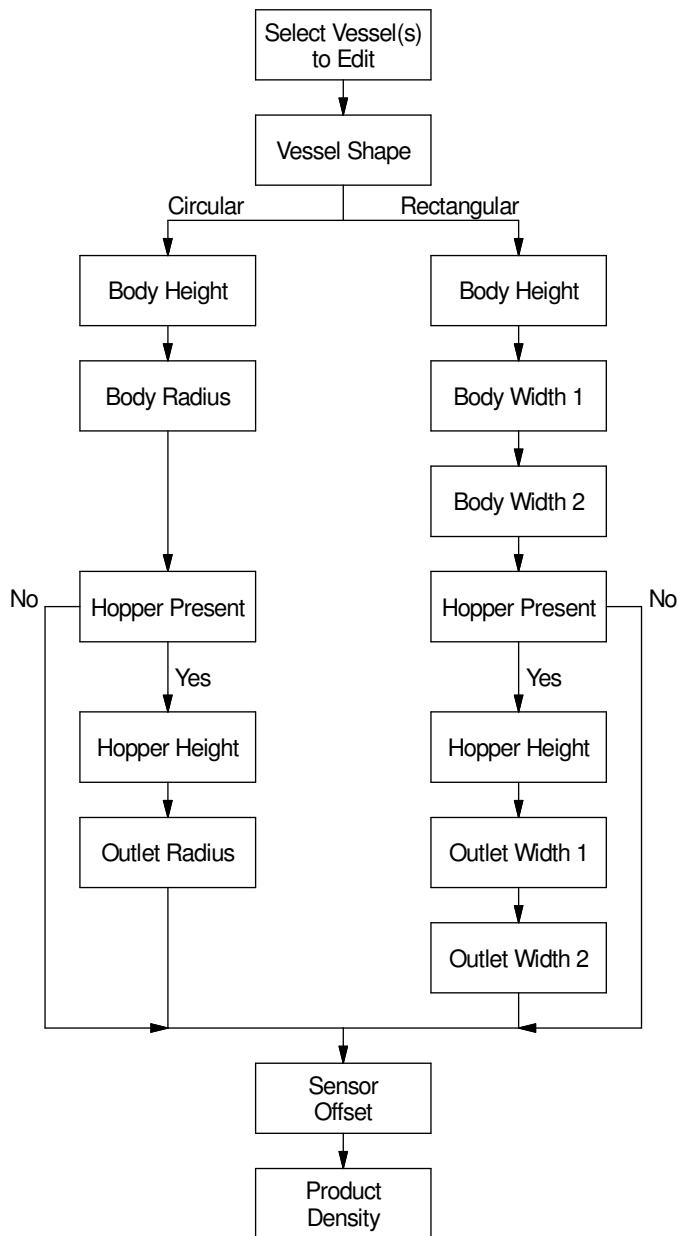
Outlet Radius – For setting the radius of a circular hopper's outlet, if a hopper exists.

Outlet Width 1 & Outlet Width 2 – For setting the two widths of a rectangular hopper's outlet, if a hopper exists.

Sensor Offset – See description above.

Product Density – For setting the weight density of the product or contents of the vessel.

SmartBob Max Drop – See description above.



### I/O Assignment

This is a menu for assigning SmartBob sensors to the onboard I/O port. The operator must use Add/Remove or Auto Add/Remove prior to making this selection. With this menu, the operator simply selects the address of any single SmartBob to assign to the onboard I/O (external start input and 4-20mA output). It will default to the first address available in the list.

### 4-20mA Output

This is a menu for setting what the 4-20mA Output will represent; the operator can choose between Product and Headroom. The default setting is Product.

When weight calculations are disabled, this output is a percentage of the headroom height or product height. When weight calculations are enabled, this output is a percentage of the headroom weight or product weight.

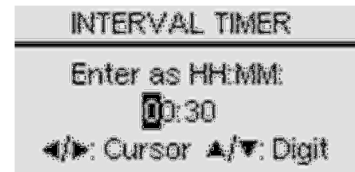
#### 4-20mA Error

This is a menu for setting what the 4-20mA output error level will be, the operator can choose between 2mA and 22mA. This error level will be programmed to the output whenever the last measurement produced an error condition such as a communications error or Bob is stuck. The default setting is 22mA.

#### Interval Timer

The interval timer allows the operator to enable and configure the console to take multiple automatic timed measurements. The selections are On/Set and Off. The default setting is Off.

After selection of On/Set, a setup screen appears for entering the timer value in hours and minutes. Enter any amount of time from 0 minutes (continuous) to 49 hours and 59 minutes in the format: HH:MM. One minute would be 00:01 and 24 hours would be 24:00. The timer is adjusted one digit at a time. Use the ◀/▶ keys to select a digit by repositioning the cursor and the ▲/▼ keys to adjust the selected digit. Once all four digits have been entered, press the ✓ key.



After the interval time has been set, a menu appears for assigning SmartBobs to the automatic measurement process. At least one must be assigned and up to all SmartBob sensors configured may be assigned. Use the ▲, ▼ and ✓ keys to select and accept one or more SmartBob address' from the list to the interval timer. After all desired SmartBob sensors are assigned, press the ✕ key to exit.



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**CAUTION:** Setting the interval timer value to 00:00 (continuous) may decrease the life cycle of the SmartBob sensors assigned to the interval timer.

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#### Measurement Format

This is a menu for selecting the measurement format displayed under the Measure/View menu. When weight calculations are disabled, only Percent and Height are available. When weight calculations are enabled, the operator can select between the following:

- Percent
- Height
- Cubic Units
- U.S. Gallons
- U.S. Bushel
- Liters
- Pounds
- Tons
- Kilograms
- Metric Tons

Height and Cubic Units will be dependent on the setting in Units of Measure, with units in either feet (ft) or meters (m).

Note that this setting effects what is displayed in Measure/View and Measure/View Details.

## Modbus Mode

This menu is for setting the Modbus mode of transmission. The operator can select between RTU and ASCII, with a default of RTU. As per the Modbus specification, the character size is 8 data bits for RTU and 7 data bits for ASCII.

## Modbus Data Rate

This menu is for setting the data or baud rate for the Modbus interface. The operator can select between 2400, 4800, 9600, 19,200, 38,400 or 57,600 bits per second. The default is 19,200 bps.

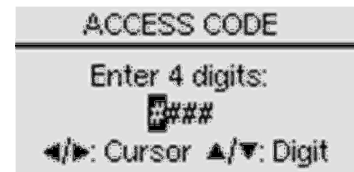
## Modbus Parity

This menu is for setting the parity for the EX-485 port when configured as a Modbus slave. The operator can select between Even, Odd or None. The default is Even. As per the Modbus specification, there is 1 stop bit used with even and odd parity and 2 stop bits with no parity.

## Access Code

This menu allows the operator to enable and set a 4-digit code for access to the Setup menu. The selections are On/Set and Off. The default setting is Off.

After selection of On/Set, a setup screen appears for entering a 4-digit number. Enter any 4-digit number between 0000 and 9999, one digit at a time. Use the ◀/▶ keys to re-position the cursor and the ▲/▼ keys to adjust the selected digit. After all four digits have been entered, write the number down in a safe place and press the ✓ key. Next time the Setup menu is accessed, this same screen is presented for entering the access code. Entry to the Setup menu is not permitted until the correct 4-digit code is entered. With an access code set, if the console is left unattended in the Setup menu it will automatically exit to the Main menu after 20 seconds of no keypad activity.



**CAUTION:** If you lose or forget the access code you will have to clear ALL nonvolatile memory to regain access to the Setup menu. Doing so will also erase all user settings, vessel parameters and measurement data.

To clear all nonvolatile memory, press and hold both the ✕ and ✓ keys while either pressing S1 inside the wiring cabinet or power cycling the console.

## Language/Idioma

This is a menu that allows the operator to select either the English or Spanish language for displaying the text-based menu system. The default is English.

This menu is also presented to the user when the C-100MB SmartBob control console is powered up for the very first time.

## Info/About

This screen simply displays company, product and firmware version information. Knowing the firmware version may be needed when working with BinMaster's service department. This information is also displayed momentarily when powering up.

## 5.0 Modbus Slave Interface

The section specifies how the Model C-100MB SmartBob console is implemented as a Modbus slave at the EX-485 port and how to use Modbus to interface to it.

For Modbus specifications, refer to the following documents online at [www.modbus.org](http://www.modbus.org):

- Modbus Application Protocol Specification, v1.1b
- Modbus over Serial Line Specification and Implementation Guide, v1.02

### 5.1 Implementation

Communications flow is per the Modbus Serial Line specification. Following are specifics to the implementation on the C-100MB:

- The following character formats are supported:
  - RTU mode
    - 8 data bits, Even parity, 1 stop bit (default)
    - 8 data bits, Odd parity, 1 stop bit
    - 8 data bits, No parity, 2 stop bits
  - ASCII mode
    - 7 data bits, Even parity, 1 stop bit
    - 7 data bits, Odd parity, 1 stop bit
    - 7 data bits, No parity, 2 stop bits
- The master should not send another request until a Modbus frame is detected or a response timeout expires.
- If a response timeout expires, the request may be transmitted again and as many times as necessary for the controlling application. Generally, three attempts should be sufficient.
- The length of a response timeout should vary with the controlling application based on the data rate and the maximum frame size expected. Following is a guideline:
  - 3.0 sec minimum at 2400 bps
  - 1.5 sec minimum at 4800 bps
  - 1.0 sec minimum at 9600 bps and faster data rates
- The Modbus slave will respond with an exception code if any of the following are requested:
  - An unsupported or illegal function code
  - An unsupported or illegal data value
  - An unsupported or illegal address value
- Broadcast mode is not supported. All requests must be addressed to a C-100MB and a response is to be expected.
- As per the Modbus specification, only one master is supported on the network.
- The registers should be formatted and sent zero-based. This means that holding register 4x0001 would be sent as 0 and holding register 4x0100 would be sent as 99.



Two Modbus function codes are supported for accessing the summary registers and the SmartBob registers.

- Read Holding Registers (03) – Valid addresses in a request to Modbus address 247 must be in the range 4x0001 to 4x0490 (0000h to 01E9h), with a maximum of 120 registers per request. Valid addresses in a request to Modbus addresses 001 to 120 must be in the range 4x0001 to 4x0005 (0000h to 0004h), with a maximum of 5 registers per request.
- Write Single Register (06) – Only summary register 4x0009 and SmartBob register 4x0001 can be written too. See details in register tables.

## 5.2 Summary Register List

The summary registers are accessible at Modbus address 247 and consists of 490 holding registers (4x). They are as follows:

Register	Access	Name and Description
4x0001	RO	Firmware Version – Indicates the firmware version of the console. The high byte contains the version major and the low byte contains the version minor. The version minor is always 2-digit decimal, meaning a value of 0101h is v1.01 not v1.1.
4x0002	RO	Hardware Level – Indicates the PCB hardware level of the console. 0 = 353-0084 1 = 353-0084 rev A 2 = 353-0084 rev B to F 3 = 530-0573 rev G or newer
4x0003 to 4x0007	RO	Reserved – These five registers should read as 65,535 (FFFFh).
4x0008	RO	Number of Enabled SmartBobs – Will provide the number of SmartBobs enabled on the console. Will read from 0 to 120 (0000h to 0078h).
4x0009	R/W	Initiate Measurements – Write the address of any enabled SmartBob to this register to initiate a measurement on that SmartBob. Write any value greater than 120 to initiate measurements on all enabled SmartBobs. No action will be taken when 0 is written to this register, but will always read as 0.
4x0010	RO	Number of Idle SmartBobs – Will provide the number of SmartBobs not taking a measurement, including those not enabled. This register will read 120 (0078h) when no measurements are being performed and can be monitored to determine when all measurements are completed. Subtract this value from 120 to determine the number of SmartBobs currently taking a measurement.

Register	Access	Name and Description
4x0011 to 4x0130	RO	<p>Measurement Status – One hundred twenty registers, each one containing the measurement status for a SmartBob. Any value other than 0 (idle) indicates a measurement is in progress.</p> <p>Use the following to determine the register address corresponding to a known SmartBob address:  <math>register\_addr = 4x0010 + smartbob\_addr</math></p> <p>Measurement Status values are as follows:  0 = Idle (ready for measurement)  1 = Pending (waiting for SB-485 traffic to clear)  2 = Pending (initiating or waiting to initiate a measurement)  3 = Pending (waiting for status)  4 = Dropping (measuring)  5 = Retracting (measuring)  6 = Retrieving Results  7 = Pending (setting SmartBob maximum drop)</p>
4x0131 to 4x0250	RO	<p>Results/SmartBob Status – One hundred twenty registers, each one representing a SmartBob. The high byte provides the status of the results from the last measurement and the low byte defines whether the SmartBob is enabled.</p> <p>Use the following to determine the register address corresponding to a known SmartBob address:  <math>register\_addr = 4x0130 + smartbob\_addr</math></p> <p>Results Status (high byte):  100 (64h) = No Data or Invalid  101 (65h) = Valid Data  102 (66h) = Override  103 (67h) = Comm Error  104 (68h) = Bob Stuck  105 (69h) = Did Not Drop  106 (6Ah) = Measurement Error  Any other value should be considered an unknown error.</p> <p>SmartBob Status (low byte):  0 = Disabled (will NOT respond to measurement requests)  1 = Enabled</p>
4x0251 to 4x0370	RO	<p>Drop Measurement – One hundred twenty registers, each containing the drop distance from its last successful measurement. This should only be considered valid when the Results Status for the corresponding SmartBob reads 101 (65h). This is the raw measurement value taken from the SmartBob with a resolution of 0.0125 foot (0.15 inch) per count. Divide this value by 80 for a distance in feet.</p> <p>Use the following to determine the register address corresponding to a known SmartBob address:  <math>register\_addr = 4x0250 + smartbob\_addr</math></p>

Register	Access	Name and Description
4x0371 to 4x0490	RO	<p>Product Percentage – One hundred twenty registers, each containing the percentage of the vessel that is full with product. This value is calculated based on the SmartBob drop measurement, the vessel parameters and the product density configured in the console. See the C-100MB operator’s manual for details on what settings can affect this value. Divide this value by 100 to obtain a percentage. For example, if it reads 6421, then the corresponding vessel is 64.21% full of product.</p> <p>Use the following to determine the register address corresponding to a known SmartBob address:</p> $register\_addr = 4x0370 + smartbob\_addr$

### 5.3 SmartBob Register List

The SmartBob registers are accessible at Modbus addresses 001 to 120, each consisting of 5 holding registers (4x). They are as follows:

Register	Access	Name and Description
4x0001	R/W	Initiate Measurement – Write any value greater than zero to this register to initiate a measurement with this SmartBob. No action will be taken when 0 is written and will always read as 0.
4x0002	RO	Measurement Status – Any value other than 0 (idle) indicates a measurement is in progress.  Measurement Status values are as follows: 0 = Idle (ready for measurement) 1 = Pending (waiting for SB-485 traffic to clear) 2 = Pending (initiating or waiting to initiate a measurement) 3 = Pending (waiting for status) 4 = Dropping (measuring) 5 = Retracting (measuring) 6 = Retrieving Results 7 = Pending (setting SmartBob maximum drop)
4x0003	RO	Results/SmartBob Status – The high byte provides the status of the results from the last measurement and the low byte defines whether the SmartBob is enabled.  Results Status (high byte): 100 (64h) = No Data or Invalid 101 (65h) = Valid Data 102 (66h) = Override 103 (67h) = Comm Error 104 (68h) = Bob Stuck 105 (69h) = Did Not Drop 106 (6Ah) = Measurement Error Any other value should be considered an unknown error.  SmartBob Status (low byte): 0 = Disabled (will NOT respond to measurement requests) 1 = Enabled
4x0004	RO	Drop Measurement – Contains the drop distance from the last successful measurement. This should only be considered valid when the results status for the corresponding SmartBob reads 101 (65h). This is the raw measurement value taken from the SmartBob with a resolution of 0.0125 foot (0.15 inch) per count. Divide this value by 80 for a distance in feet.
4x0005	RO	Product Percentage – Contains the percentage of the vessel that is full with product. This value is calculated based on the SmartBob drop measurement, the vessel parameters and the product density configured in the console. See the C-100MB operator's manual for details on what settings can affect this value. Divide this value by 100 to obtain a percentage. For example, if it reads 6421, then the corresponding vessel is 64.21% full of product.

## 5.4 Measurement Process Examples

The following is one example of how to take a measurement on all enabled SmartBobs using the summary registers:

1. Initiate measurements. Write a value of FFFFh to register 4x0009 at Modbus address 247 and go to step 2.
2. Monitor progress. Continue to read register 4x0010 at Modbus address 247 until the value is 120. When the value read is 120, go to step 3.
3. Check if results available. Cycle through registers 4x0131 – 4x0250 at Modbus address 247, checking the results of all enabled SmartBobs. If the low byte is 0, this SmartBob is disabled so increment to the next register. If the low byte is 1 and the high byte is 65h (valid data), go to step 4. Any other value for the results status should be handled as needed for your application.
4. Retrieve results. Depending upon your application, retrieve either the drop measurement in registers 4x0251 – 4x0370 at Modbus address 247 or the product percentage in registers 4x0371 – 4x0490. If there are more measurement results to retrieve, go back to step 3.

Following is one example of how to take a measurement on the SmartBob at address 5 using its register list:

1. Initiate measurement. Write a value of 0001h to register 4x0001 at Modbus address 005 and go to step 2.
2. Monitor progress. Continue to read register 4x0002 at Modbus address 005 until the measurement is complete. When the value is 0 (idle), go to step 3.
3. Check results status. Read register 4x0003 at Modbus address 005. If the high byte is 65h (valid data) then go to step 4, any other value can be used to determine the reason for no data.
4. Process measurement results. At Modbus address 005, read register 4x0004 for the drop measurement or read register 4x0005 for the product percentage.

## **6.0 Warranty and Service**

### **6.1 Limited Warranty**

BinMaster warrants this product against defects in material and workmanship for two (2) years according to the following terms:

- 1.) This warranty extends to the original purchaser only and commences on the date of original purchase.
- 2.) BinMaster's sole obligation under said warranty is to repair, or at its option replace the defective parts. The buyer shall have no other remedy. All special, incidental and consequential damages are excluded. The buyer must deliver the product under warranty prepaid to the factory. BinMaster's obligation is limited to the cost of material and labor to repair or replace, and does not include transportation expenses.
- 3.) This warranty shall be voided, in our sole judgment, by alterations of equipment except by BinMaster, or tampering with, improper installation or maintenance, accident or misuse, or act of God. This warranty expressly excludes all damage to the product resulting from careless or neglectful packaging or transportation. The warranty does not extend to repairs made necessary by normal wear.
- 4.) This warranty is in lieu of all other warranties, expressed or implied including any implied warranties or merchantability or fitness for particular purpose. No employee, agent, franchise dealer or other person is authorized to give any warranties of any nature on behalf of BinMaster.
- 5) BinMaster shall in no event be responsible for any warranty work done without first obtaining BinMaster's written consent.
- 6) Except as provided herein, BinMaster shall have no liability, loss or damage caused or alleged to be caused directly or indirectly by this equipment.
- 7) This warranty gives the buyer specific legal rights, and you may also have other rights which vary from state to state.
- 8) For service, please call 402-434-9102.

### **6.2 Technical Support, Customer Service and Repair**

If you are in need of an updated operator's manual, specification drawing or parts replacement list, please visit our online documentation at [www.binmaster.com](http://www.binmaster.com).

Prior to shipping your Model C-100 back for repair, please call our service department for an RMA number. Along with the RMA number, you will also be provided with shipping instructions and address.

You may call the customer service department for technical support, application assistance and to receive an RMA Monday through Friday from 8:00 am to 5:00 pm Central Time.

BinMaster, a division of Garner Industries, offers a toll-free telephone number (800) 278-4241 to our customer service department. International customers can call us at (402) 434-9102 or reach us via fax at (402) 434-9133.

## **7.0 Disposal**

This product consists of materials that may be recycled by certain recycling companies. It uses recyclable materials and is designed to be easily separated. Consult local authorities for proper disposal locations.

# Declaration of Conformity

BinMaster Level Controls  
7201 North 98th Street  
Lincoln, NE 68507-9741  
Phone: 402-434-9100, Fax: 402-434-9133

BinMaster declares that all models of the SBR II level control devices as listed below comply with the following directives and harmonized standards. This product if installed, operated and maintained as described in this manual will provide a safe and reliable level measurement device for a variety of materials.

EMC Directive 2004/108/EC  
Standard EN 61326-1:2006

**Product:** Industrial console for a network of SmartBob sensors.  
**Models:** C-100MB

All test reports and documentation are held and can be obtained from BinMaster.

**Manufacturing Location:** Lincoln, Nebraska, USA



Scott McLain  
President  
4/8/2010

***BINMASTER***

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