



# HarvestMaster™

*Field Data Collection Tools*

1740 North Research Park Way  
Logan, Utah 84341-1977  
Tel: 435-753-1881 • Fax: 435-753-1896  
E-mail: [hm@harvestmaster.com](mailto:hm@harvestmaster.com)  
Web Site: [www.harvestmaster.com](http://www.harvestmaster.com)

Document #	10262-04
Release Date	January 2001
Editor:	Chris Muffoletto Jan Jardine

© Copyright 1996, HarvestMaster, Inc. Any reproduction of this manual, in part or in full, by any means, mechanical, electronic, or otherwise, is strictly prohibited without express written consent of HarvestMaster, Inc.

™ HarvestMaster, the HarvestMaster logo, HM-500 Yield Mapping System, and HM-500 Yield Monitor are recognized trademarks of HarvestMaster, Inc.



---

## Warranty and Repair Information

---

### Twelve Month Warranty

HarvestMaster, Inc. warrants that all *HM-500 Yield Mapping System* hardware components shall be free from defects in materials and workmanship for a period of 12 months from the date of shipment when properly installed, calibrated, and operated in accordance with instruction manuals accompanying said hardware and used for the purpose for which said hardware was designed. In the event of a defect in materials or workmanship is discovered and reported to HarvestMaster, Inc. within said 12 month period, HarvestMaster, Inc. will, at its option, repair the defect or replace the defective product. This warranty does not apply where the product has been operating outside of the specifications of the product or where cables, sensors, or other components of the system have been subject to abuse. HarvestMaster's obligation hereunder will be limited to such repair or replacement. Customer shall have the responsibility to ship the defective equipment to HarvestMaster, Inc. at customer's expense, with all cost of shipment prepaid. After repair or replacement, HarvestMaster, Inc. will ship the replacement or repaired item at its cost by the same type of carrier as the item was shipped to us.

### Disclaimer of Warranties

The warranties set forth above are in lieu of all other warranties of HarvestMaster, Inc., whether written, oral, or implied. HarvestMaster, Inc. makes no warranties regarding its products (hardware or software), including, without limitation, warranties as to merchantability, fitness for a particular purpose, any warranty arising from course of performance, course of dealing or usage of trade whether any of the foregoing warranties are either expressed or implied. HarvestMaster, Inc. specifically makes no warranties as to the suitability of its products for any particular application. HarvestMaster, Inc. shall in no event be liable for special, incidental, or consequential damages in connection with or arising out of the furnishing, performance, or use of any product covered by this disclaimer whether such claim is based upon warranty (express or implied) contract, strict liability, negligence, or otherwise. Any responsibility and / or liability of HarvestMaster, Inc. shall, in connection with a warranted product, be limited in maximum amount to the original purchase price of that product.

## ***Removal of Serial Number***

Removal of the serial number label from an instrument will void any warranty on said instrument. HarvestMaster, Inc. will not repair or update an instrument and return it to an individual if the instrument is without said serial number label.

## ***Factory Sealed Unit***

The *HM-500 SCCU* is a factory sealed unit. There are no internal user serviceable parts. If the *HM-500 SCCU* is opened or in any other way tampered with, all warranties are null and void.

## ***Updates or Modifications***

HarvestMaster, Inc. shall be under no obligation to update or modify its products except as herein noted to correct defects or errors. Furthermore, the customer agrees that all representations and warranties contained herein shall be immediately null and void in the event of any modification, alteration, or change in or to any product effected by or on behalf of customer except for a change made by HarvestMaster or other direct supervision thereof.

---

## **Customer Service**

---

HarvestMaster is dedicated to insuring that your yield monitoring equipment provides high quality performance. If repair becomes necessary, a simple process has been developed to get your system up and running again. Simply call one of our customer service representatives to receive an RMA (Return Material Authorization) number and the process will be under way. Please have the following information ready when you call:

- *HM-500* serial numbers (electronic unit)
- Your name
- Name of company / university / agency
- Phone and Fax number
- Clear description of the problem encountered

For equipment that is not under warranty or extended warranty, a purchase order number as well as the billing and shipping address will also be needed.

# Table of Contents

---

## **Section I: Hardware Installation**

<b>Hardware Installation .....</b>	<b>1-1</b>
System Overview .....	1-1
Installation Time .....	1-2
Required Tools and Materials .....	1-2
Components .....	1-2
Preparation for Installation .....	1-3
Installation Step #1: Mounting the Idler Wheel Load Cells .....	1-4
Optional Installation Step: Mounting a Tilt Sensor .....	1-6
Installation Step #2: Mounting the Belt Speed Sensor .....	1-6
Installation Step #3: Mounting the Ground Speed Sensor .....	1-7
Optional Installation Step: Mounting a Hold/Run Sensor .....	1-7
Installation Step #4: Mounting the HM-500 SCCU .....	1-8
Installation Step #5: Mounting the Field Computer .....	1-8
Installation Step #6: Connecting the Components .....	1-8
<i>Load Cell Connection .....</i>	<i>1-8</i>
<i>Belt/Ground Speed Sensor Connection .....</i>	<i>1-9</i>
<i>Field Computer to SCCU Connection .....</i>	<i>1-11</i>
<i>Power Cable Connection .....</i>	<i>1-11</i>
Interfacing GPS with the HM-500 .....	1-12
<i>Mounting the GPS Antenna &amp; Receiver .....</i>	<i>1-12</i>
<i>Connecting the GPS Components to the HM-500 .....</i>	<i>1-13</i>

## **Section II: System Operation**

<b>Menu Structure .....</b>	<b>2-1</b>
Sign-On Screen .....	2-2
<b>Main Menu .....</b>	<b>2-2</b>
<b>Help .....</b>	<b>2-3</b>
<b>System (Sys) .....</b>	<b>2-3</b>
Select/Name a Field (Fld) .....	2-4
Calibrate & Setup (Cal) .....	2-4
Sensor Readings (Sens) .....	2-6
GPS Information .....	2-7
<b>Load (Load) .....</b>	<b>2-8</b>
Load Summary .....	2-8
Load Setup .....	2-9
Automatic Calibration .....	2-9
<b>Row+ /- .....</b>	<b>2-10</b>
<b>Data Storage and File Formats .....</b>	<b>2-11</b>
Data Files from the HM-500 Yield Monitor Program .....	2-11
Transferring Data from your Field Computer .....	2-13

## ***Section III: Troubleshooting***

<b>Preliminary Troubleshooting Tips.....</b>	<b>3-1</b>
<b>Symptoms and Possible Solutions.....</b>	<b>3-1</b>
HM-500 Power Failure (No Power LED) .....	3-2
Communication Failure between the Mobile Computer and the HM-500 System .....	3-2
GPS Receiver Status is "OFF" .....	3-3
GPS Receiver Status "No Fix" .....	3-3
Receiver Status "GPS" .....	3-4
Weight Readings are Zero .....	3-4
Weight Readings Fluctuate or Are Not Accurate .....	3-5
Both Load Cells Do Not Respond .....	3-5
One Load Cell will not Respond .....	3-6
Belt Speed Reading is Zero ( Red "Belt" LED Blinks) .....	3-8
Belt Speed Reading is Zero ( Red "Belt" LED does not blink) .....	3-8
<b>HM-500 Operating System Update Procedures .....</b>	<b>3-10</b>
Checking your FOS software version .....	3-10
Updating the FOS .....	3-10
Injecting a New IOS .....	3-11

## ***Appendix A: Wiring Diagrams***

Host Cable .....	A-1
Power Cable .....	A-2
Belt Speed Connector Cable (4 lead) .....	A-2
Belt Speed Connector Cable (6 lead) .....	A-3
Loadcell Cable .....	A-4
GPS Communication Cable .....	A-4
COM A Pin-Out Diagram .....	A-5
Belt Speed Pin-Out Diagram .....	A-5

# Section I

## Hardware Installation

### Hardware Installation

#### System Overview

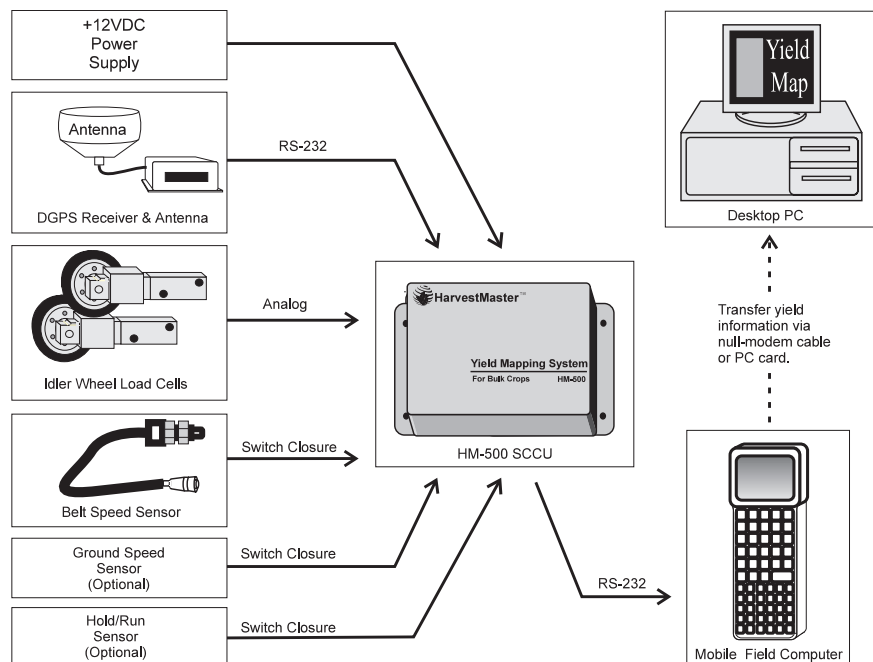
This section explains how to install your HM-500 hardware. It is important that you follow the installation procedures in the order they are presented.

The Yield Mapping System operates as a group of functional modules:

- Mobile Field Computer\*
- HM-500 Signal Conditioning and Control Unit
- Position Measurement Unit (DGPS Receiver)
- Weight Measurement
- Belt Speed Measurement

\* In some systems the mobile computer and position measurement system are configured together as a "mobile GPS computer."

*HM-500 Functional System Diagram*



## Installation Time

Typically the installation takes approximately 4 to 6 hours. This varies based on your particular application and harvester.

## Required Tools and Materials

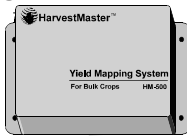
Have the following tools on hand:

- A Phillips-head screwdriver
- A flat-blade screwdriver
- Wrench set, 7/16" to 1" (sizes depend on existing rollers)
- Socket set, 7/16" to 1" (sizes depend on existing rollers)
- A power drill with 13/32" and 9/32" drill bits
- Straight edge or 1" square tubing (3'-4' in length)
- Hardware for mounting GPS and radio antennas (varies according to your equipment)
- Connectors and crimping tool for electrical connections
- Come-a-long to lift chain off of rollers
- 1" Hole Saw
- Center Punch
- Hammer

The HM-500 Basic Yield Mapping System includes the following components (depending upon the harvester and application, additional components may be necessary):

## Components

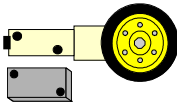
HM-501 SCCU



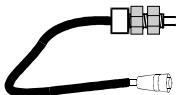
Mobile Computer



HM-505  
Idler Wheel  
Assembly



Speed Sensor



- HM-501 Signal Control and Conditioning Unit (SCCU)
- Mobile Field Computer (Allegro Field PC, Pro4000 FieldBook or other mobile computer device)
- CA-PW-H5: 20 foot HM-500 Power Cable with 4 pin Trident connector (plugs into the SCCU) to red and black pigtail (black = ground; red = +12V DC).
- CA-MC-H5: 40 foot RS-232 Serial Communication Cable (goes from SCCU to the field computer) 8 pin Trident connector to 9 pin sub-D female connector.
- HM-505: (2) 500 pound full scale load cells (includes one 5" idler wheel assembly, two 1/2" mounting spacers, and mounting bolts with each load cell)
- CA-BS4-H5: 6 foot Belt/Ground Speed Adaptor Cable
- HM-BS-H5: Belt and Ground Speed Sensors (includes magnets and mounting bracket)
- HM-510-H5: Installation Kit (includes load cell drill template, cable ties, etc.)
- HM-522: Mounting Bracket for HM-500 SCCU (optional)



- DGPS receiver & antenna such as: Trimble's Ag GPS 122 or 132 receiver and antenna, the Rockwell Vision System, Satloc's receiver and antenna)
- Type I or II PC memory cards for data storage on the mobile computer (optional)

To prepare for installation of the HM-500 Yield Mapping System determine the mounting location of the following components:

## **Preparation for Installation**

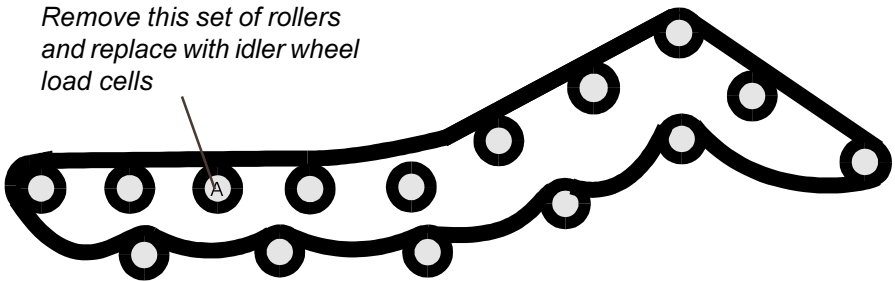
- HM-500 SCCU (on the harvester): The mounting of the HM-500 SCCU, load cells, speed sensors and GPS cables must be positioned so they can be connected easily without interfering with any moving parts on the harvester (chains, sprockets, etc.)
- Field Computer: Plan the mounting location of the field computer console so it is in easy view and reach of the operator.
- Belt Speed Sensor: Determine the mounting location of the belt speed sensor. It will need to be on the drive shaft of the chain that the idler wheel load cells are mounted on.
- Ground Speed Sensor: The ground speed sensor should be located on a "pulled" wheel (rather than a powered wheel) to minimize speed error due to slippage.

# Installation Step #1: Mounting the Idler Wheel Load Cells

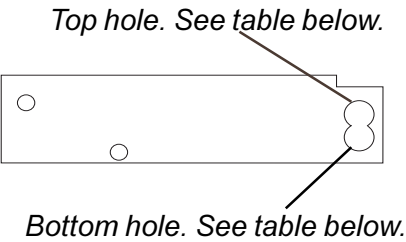
Important:

Proper mounting of the load cells is critical to the accuracy of the weight measurement. Care should be taken to ensure that this part of the installation is done as accurately as possible

The load cells should be mounted as far downstream on the picking table as possible. Be sure that when the loading boom is raised that the chain doesn't lift from the rollers. This can be determined by having the operator raise the boom to the maximum harvesting height while someone is observing the rollers on the picking table. Locate the furthest pair of rollers downstream that the chain doesn't lift from. Move one pair of rollers upstream. That should be the pair selected for removal and subsequent mounting of the weighing rollers (see illustration on below).

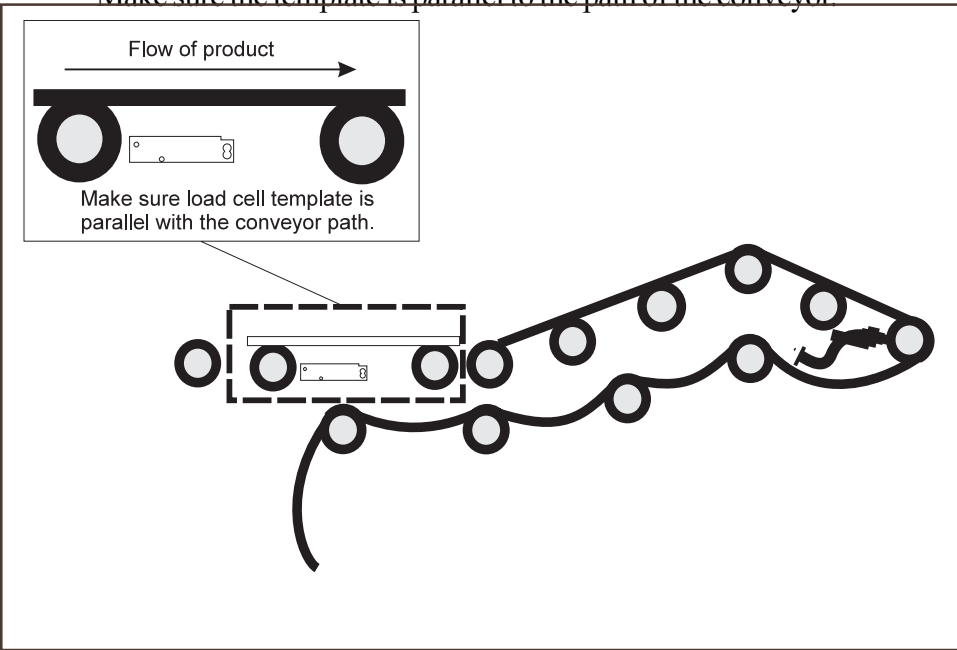


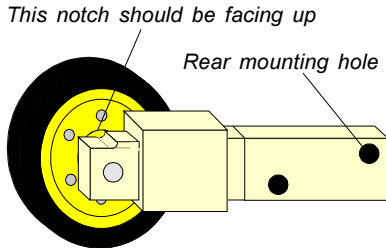
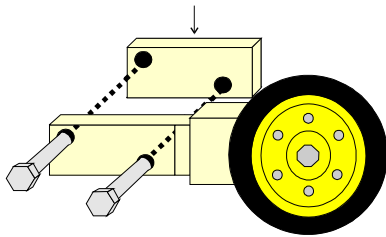
- Either undo or lift the picking table chain so you can access and remove the old roller and mount the weighing roller. If you choose not to undo the chain, use a come-a-long to lift the chain up.
- Remove the existing rollers. The rollers should be directly across from each other.
- Use the idler wheel load cell drill template to drill the mounting holes for the idler wheel load cells. The placement holes are designed to line up with the hole in the harvester frame where the idler wheel was removed. The placement hole you use depends upon the existing idler wheel size (see table at left). Put a bolt through the appropriate placement hole in the template and the harvester frame. Gently tighten template in place. Make sure the template is parallel to the path of the conveyor



Conveyor Wheel Size (in inches)	Load Cell Wheel Size (in inches)	Hole Used
3"	4"	Top
3"	3"	Bottom
4"	5"	Top
4"	4"	Bottom
5"	5"	Top
5"	4"	Bottom
6"	6"	Top
6"	5"	Bottom

Load Cell Template Mounting Diagram

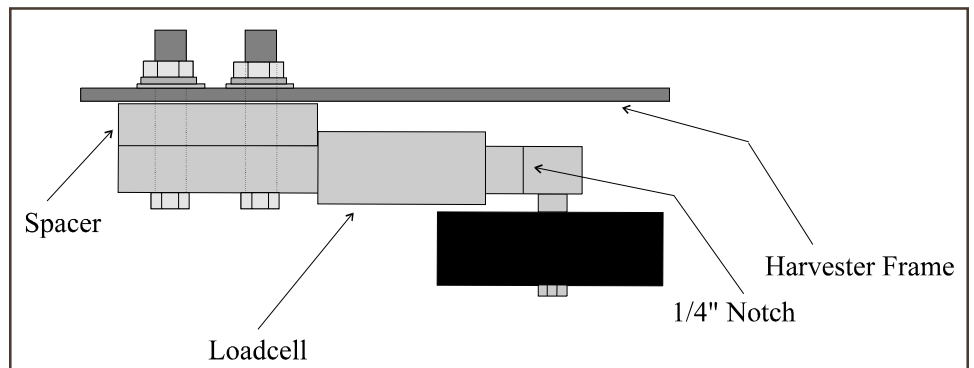




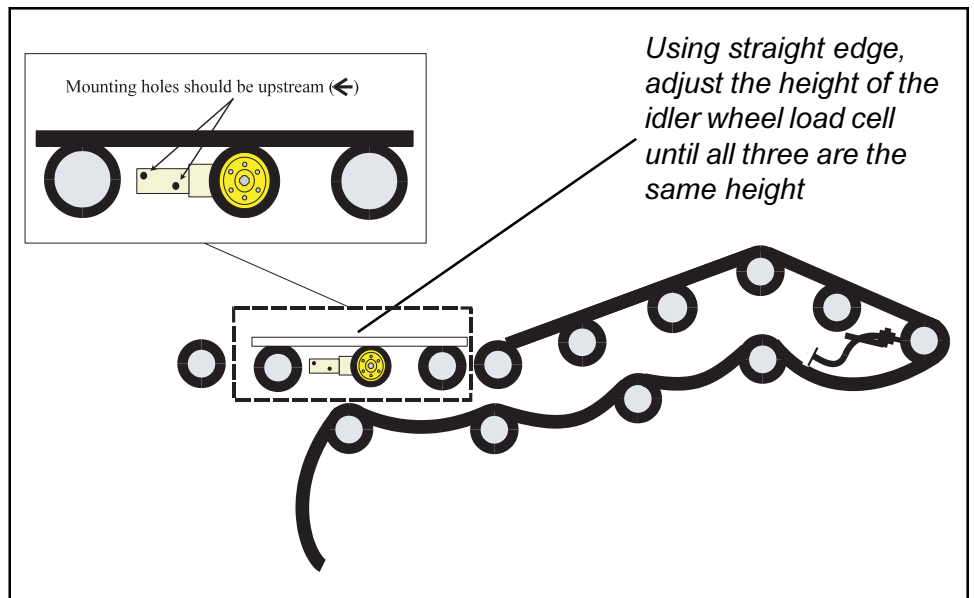
Load Cell: Top View

- d. Once the idler wheel load cell mounting template is bolted firmly in place, drill the idler wheel load cell mounting holes using a 13/32" drill bit.
- e. Repeat steps (c) and (d) to drill holes on the other side of the conveyor.
- f. Gently bolt the idler wheel load cells in place. You will notice on the roller end of the weighbar that there is a 1/4" recession. This recession should face upward with the mounting holes upstream from the roller.

ⓘ Note: 150 pound load cells have no notch. Make sure the load cell is facing the correct direction, with the wheel downstream and inside. The rear mounting hole should be up.



- g. With the roller bolted in place, put the straight edge across the weighbar, resting on the upstream and downstream roller. Adjust the height of the roller until all three rollers are the same height (see diagram below). The weighbar should be as close to level as possible.



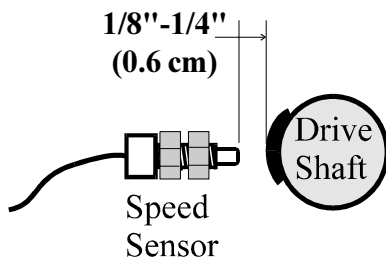
- h. Route the load cell cables back to the nearest cross-bar using wire ties.
- i. Using the 1" hole saw, drill a hole in the frame of the harvester on the side nearest the HM-500 SCCU.
- j. Run the cable on the far side of the conveyor across the cross-bar using the wire ties. Then run both load cell cables through the 1" hole, along the harvester frame, and to the SCCU.

## Optional Installation Step: Mounting a Tilt Sensor

If your system requires a tilt sensor, install it at the same time as the Load Cells since it will be mounted in the same area. Position the conveyor as close to horizontal as possible. Mount the tilt sensor near the load cells so that it will measure the correct angle of that portion of the conveyor. Make sure the arrow on the tilt sensor points upward. The tilt sensor uses an eyelet to position the tilt multiplier correctly for calibration (see page 2-5 for information about calibrating the tilt sensor).

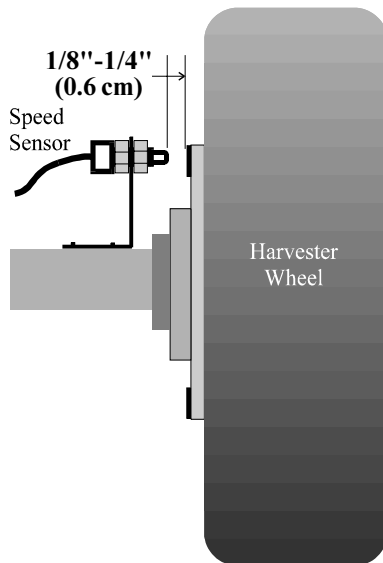
## Installation Step #2: Mounting the Belt Speed Sensor

The belt speed sensor will need to be mounted so that it is pointing directly at the drive shaft on the conveyor that the load cells are mounted to. There will need to be approximately 1/8"-1/4" (0.6 cm) of clearance between the magnet that will be mounted on the shaft and the end of the speed sensor. The barrel of the speed sensor is threaded for adjustment.



- a. Use a drill to make a hole for the sensor approximately 7/16" (1 cm) in diameter. The hole may be slotted to allow for adjustment if desired. The mounting bracket may either be welded or bolted to the frame. If you weld the bracket, remove the speed sensor before welding.
- b. Mount the magnet to the drive shaft. We recommend bonding the magnet to the shaft using epoxy and securing it with cable ties. Electrical tape can also be used.
- c. Mount the speed sensor so the tip is approximately 1/8"-1/4" (0.6 cm) away from the magnet and secure the sensor in place with the jam nut.

### Installation Step #3: Mounting the Ground Speed Sensor



Two types of ground speed sensors may be used with the HM-570: a magnetic ground speed sensor or a Dickey-John radar speed sensor. The magnetic ground speed sensor is essentially the same as the belt speed sensor, only it is mounted on a "pulled" wheel rather than a conveyor drive shaft.

To mount the magnetic ground speed sensor, follow the instructions given below:

- Mount the ground speed sensor so it is pointing directly at the magnet located on the inner side of a "pulled" wheel.
- Use a drill to make a hole for the sensor approximately 7/16" (1 cm) in diameter. The hole may be slotted to allow for adjustment if desired. The mounting bracket may either be welded or bolted to the frame. If you weld the bracket, remove the speed sensor before welding.
- Use an epoxy resin to mount the magnet to the wheel.
- Mount the speed sensor so the tip is approximately 1/8"-1/4" (0.6 cm) away from the magnet and secure the sensor in place with the jam nut.

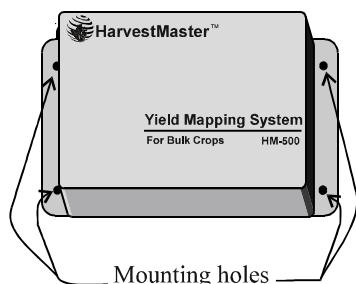
If you are using a Dickey-John radar speed sensor, mount it no higher than 4 feet (1.2 m) off the ground, and at an angle of 35°, following steps a-d above.

Optionally, you can select to use the speed of the GPS receiver to measure ground speed. Note that there may be some sacrifice of speed measurement accuracy depending on the GPS receiver used.

### Optional Installation Step: Mounting a Hold/Run Sensor

A Hold/Run sensor may be necessary if the chain on your harvester is running even when you are not harvesting. The Hold/Run sensor is necessary for some sugarbeet harvesters. Normally, the Hold/Run sensor is not used with potato harvesters because the chains are usually only in operation during harvest. Since the belt speed sensor picks up this chain operation, the Hold/Run sensor is typically not required. Installation of this sensor varies depending on the harvester being used. If you have questions as to whether or not you need a Hold/Run sensor, call our Customer Service department for information and further installation instructions.

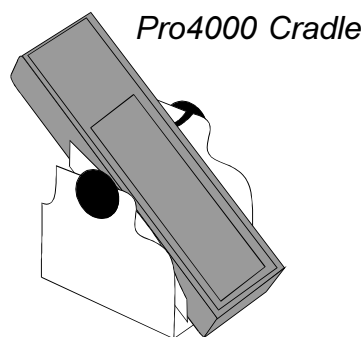
## Installation Step #4: Mounting the HM-500 SCCU



The HM-500 SCCU has four mounting holes. Using the HM-500 mounting template and a center punch, mark the location on the harvester of each hole to be drilled.

- Using the 9/32" drill bit, drill each of the four holes in the harvester.
- Bolt the SCCU into place using the 1/4" x 1" cap screws and locking nuts.

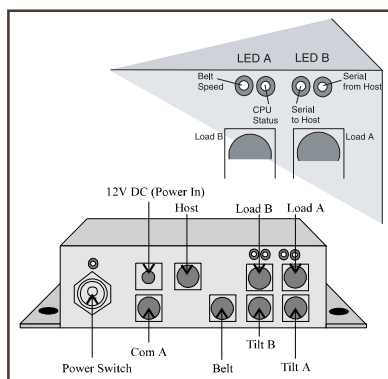
## Installation Step #5: Mounting the Mobile Computer



The Allegro Field PC and Pro4000 FieldBook from HarvestMaster come with a mounting cradle that should be mounted in the tractor near the operator. The cradle base is adjustable and can be mounted to either a horizontal or vertical surface. The operator can adjust the angle of the base for ease of viewing.

Other field computers (i.e. Ashtech Ag Navigator™, Rockwell VCD, or Satloc Excalibur) are compatible with the HM-500 Yield Mapping System. If your system is configured with one of these mobile field computers, see the mobile field computer manual for mounting instructions.

## Installation Step #6: Connecting the Components



On the front panel of the HM-500 is a diagram of the SCCU connectors. You will need to refer to this diagram to make proper connections.

### HM-570 SCCU Port

### Connects To...

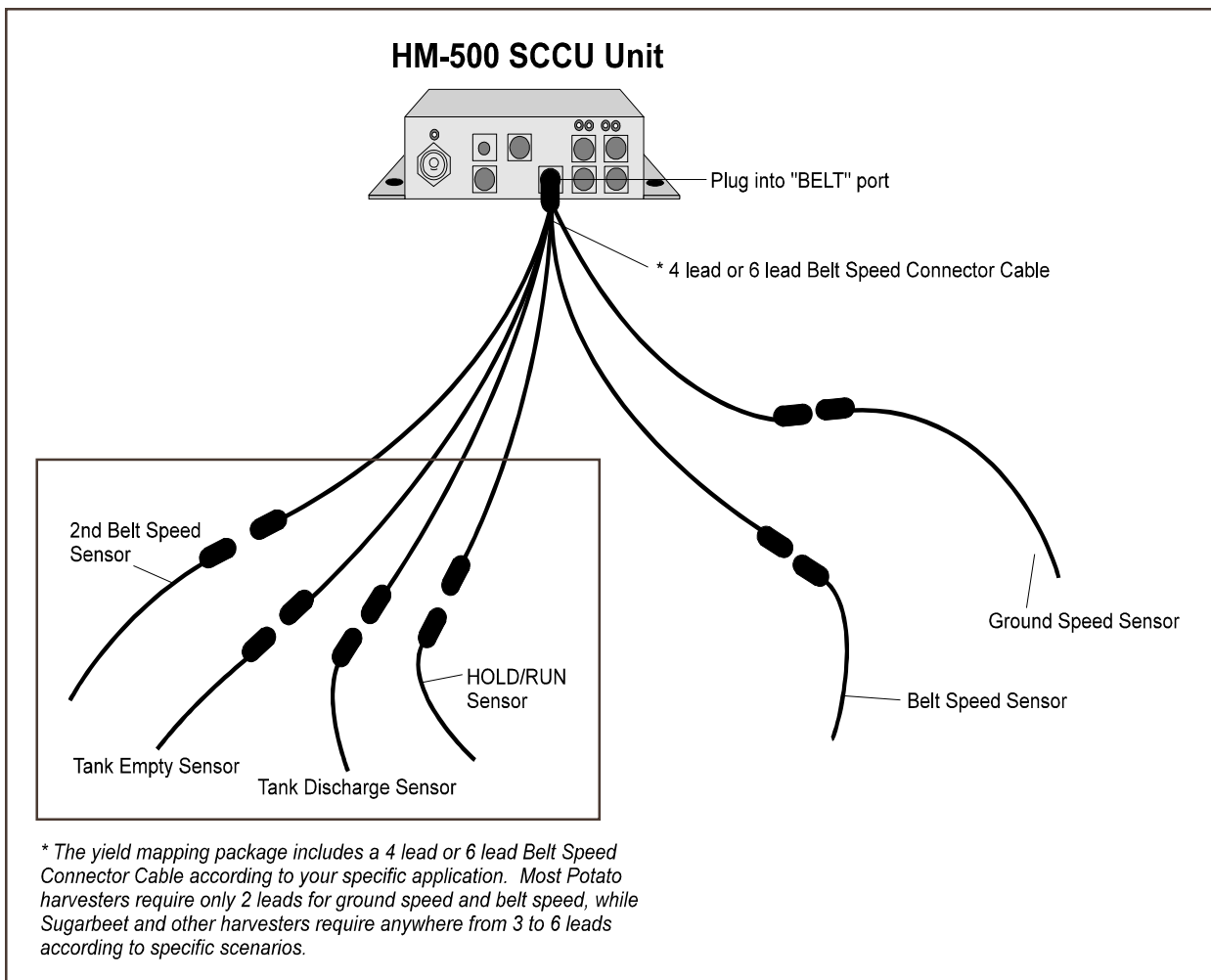
12 V .....	Power Source
BELT .....	Speed Sensor
HOST .....	Field Computer
COM A .....	GPS Receiver*
TILT B .....	Main Profile Sensor
TILT A .....	Secondary Profile Sensor

\*GPS may also be connected directly to the mobile field computer

### **Load Cell Connections**

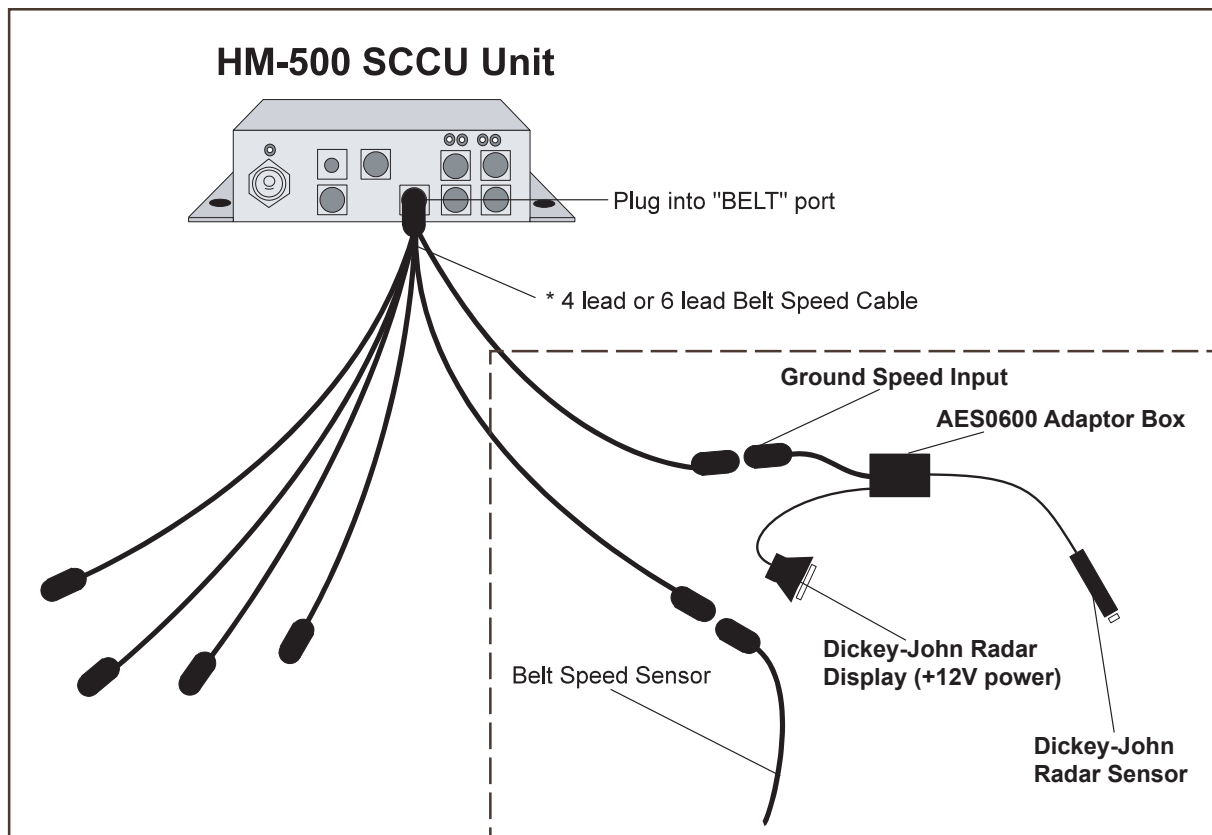
- Locate the two cables coming from the load cells and plug them into the Load A and Load B ports on the HM-500. Twist the connector locking ring into place to secure the connector.
- Once the connection is made, firmly attach the load cell cables to the frame of the harvester to ensure that the cables will not be caught in any moving parts. Heavy duty tape or plastic cable ties work well.

## Belt/Ground Speed Sensor Connection



If you are using the magnetic ground speed sensor:

- a. Connect the 4 or 6 lead Belt Speed Connector Cable (CA-BS4-H5) to the HM-500 SCCU, as shown above.
- b. Connect the Speed Sensor (model #: HM-BS-H5) used for the belt speed into its corresponding lead on the Belt Speed Connector Cable. Repeat this process for the Speed Sensor used for ground speed measurement (model #: HM-BS-H5) along with any other sensors required for your specific application.



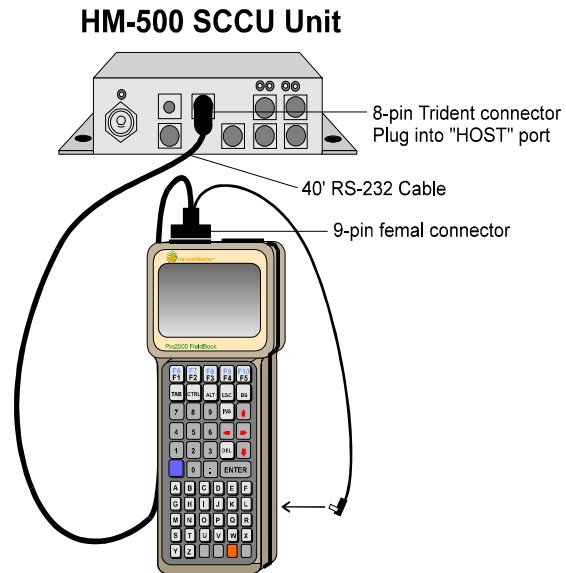
If you are using the Dickey-John ground speed sensor:

- a. Connect the belt speed connector cable (CA-BS4-H5) to the HM-500 SCCU, as shown above.
- b. Connect the Speed Sensor (model #: HM-BS-H5) used for the belt speed into the corresponding belt speed sensor lead on the belt speed connector cable.
- c. Connect the Dickey-John Radar Adaptor AES0060 to:
  - 1) The corresponding ground speed sensor lead on the belt speed connector cable (CA-BS4-H5)
  - 2) The tractor electronics (or +12VDC power supply)
- d. Connect the Dickey-John ground speed sensor into the Dickey-John Adaptor Box (see above).



## Field Computer to SCCU Connection

- Locate the 40 foot RS-232 cable and plug the 8-pin Trident connector into the port labeled "Host." Twist the connector locking ring to lock the plug in place.
- Run the cable from the SCCU to the field computer in the cab and connect the 9-pin female connector into the 9-pin male connector on the field computer (COM 1 on the Pro4000). See the pin-out diagram in *Appendix A* to ensure proper host cable connection.
- Plug the 12V pigtail into the back of your field computer.
- Secure the cable in place so that it does not interfere with any moving parts of the harvester.

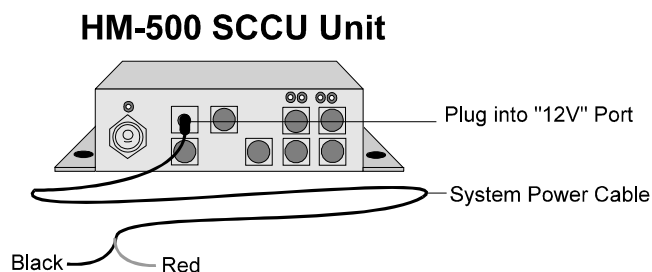


## Power Cable Connection

### Warning:

Be certain the power cable is wired correctly before applying power to the HM-500 SCCU.

- Locate the HM-500 System Power Cable. On the pigtail end, connect the red wire to a positive 12V DC supply and connect the black wire to ground (either chassis ground or negative battery terminal). You may wish to connect the +12VDC (red) to a switched 12 Volt on the harvester to allow monitor to power off when equipment is not running.
- Connect the power cable to the HM-500 SCCU in the port labeled "12V" and secure into place.



## Interfacing GPS with the HM-500

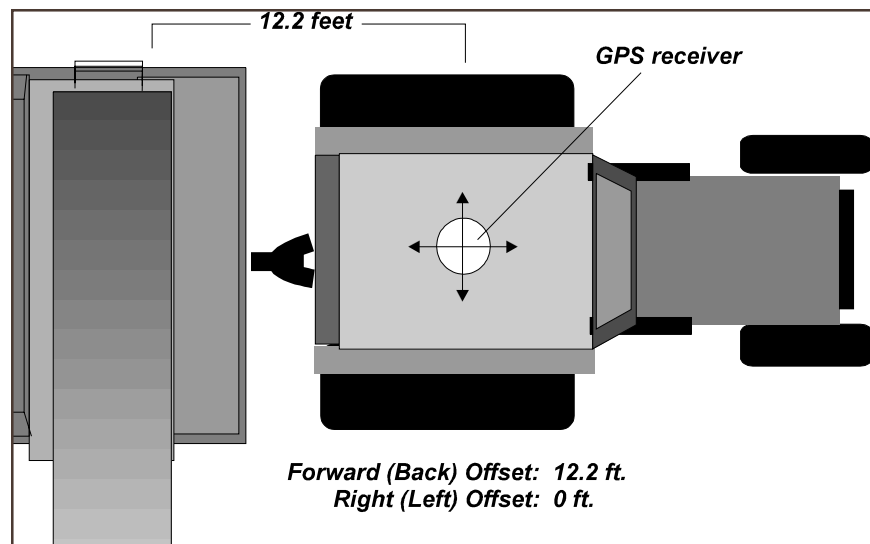
### Mounting the GPS Antenna & Receiver

Proper mounting of the GPS antenna is critical to accurate positioning. Location is measured at the site of the antenna. The antenna should be centered over the digging blade as accurately as possible. The antenna should be positioned higher than the tractor cab in order to have a clear view of the sky and to avoid multi-path signals. Methods for mounting the GPS hardware will vary depending on the type of harvester. The receiver box component can be mounted wherever you desire (preferably in the cab).

#### Antenna Mounting Checklist:

- ☐ Mount the GPS antenna in open view of the sky (360 degrees)
- ☐ Mount it where vehicle noise (alternator, etc.) will not interfere with a Coast Guard differential signal.

⇒ Note: The HM-500 software allows for position correction when the receiver cannot be mounted directly over the harvest point.



*Figure shows hypothetical software correction input*

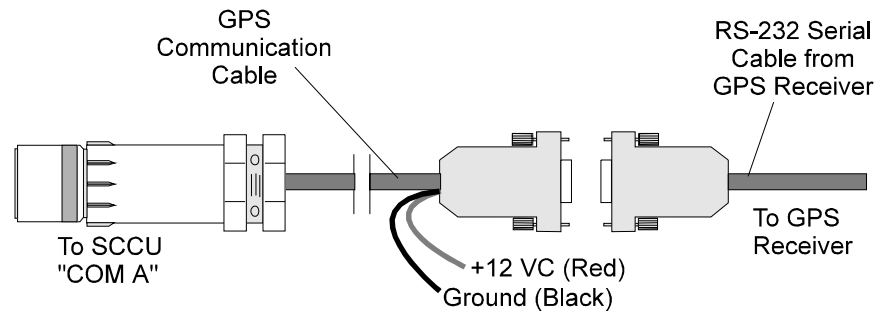
## **Connecting the GPS Components to the HM-500**

- ⇒ Note: Skip this section if your GPS receiver connects directly to your mobile GPS computer (e.g. Pro4000, Rockwell VCD, AshTech AgNavigator, etc.)

The HM-500 is designed to work with a variety of GPS equipment. The HM-500 connects to GPS receivers via the GPS communication cable as shown below:

*Appendix A* shows the signals on Com A (the port used for communication with the GPS receiver). This is a standard DTE, 9-pin, RS-232 connection like the serial communication ports on a PC without the hardware flow controls (CTS, RTS).

The 12 volt power connections allow for automatic power-up when connected to the GPS receiver



Contact HarvestMaster if you need specific cables or if you have questions regarding your specific GPS equipment.

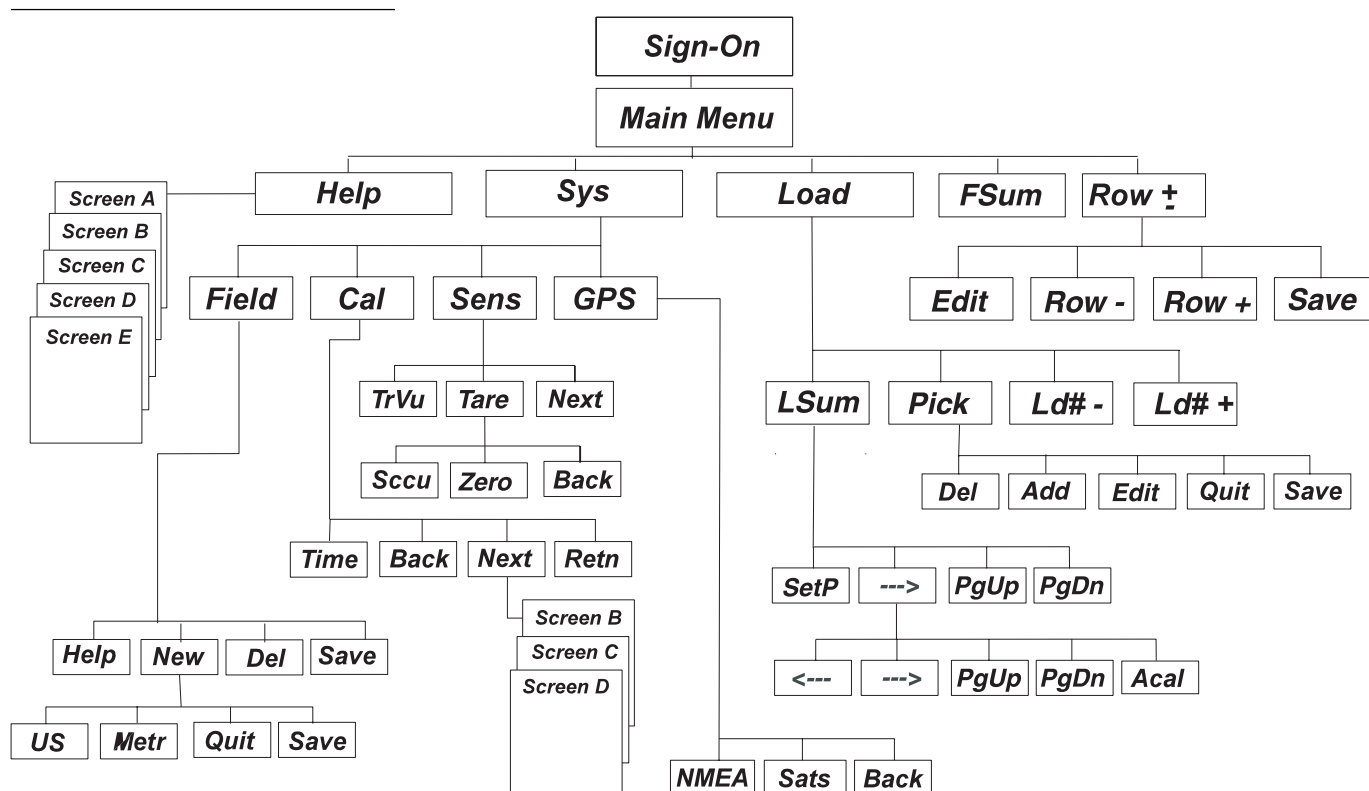
Please note that other pins on Com A also serve as a printer port and external "Enter" button port for system expansion.



# Section II

## System Operation

### Menu Structure



The HM-500 program runs on the field computer. The structure of the program is shown in the diagram above. Menu items appear at the bottom of each screen and are activated by the corresponding function keys (F1 through F5) on the field computer's key pad. As a new menu item is selected, this "Action Key" legend changes to allow other user options. The [Retn] selection always returns you to the Main Menu. [Up], [Down], [Back], and [Next] selections are toggle keys for movement within and among screens. Arrow keys are also used for movement within the various screens. While in any screen, press <ESC> to back up one level on the menu structure. Pressing <ESC> from the Main Menu brings up the program shutdown screen.

## Sign-On Screen

The sign-on screen is displayed until the field computer has established communication with both the SCCU and the GPS unit. If the field computer is not connected to SCCU or GPS, the program begins blinking and displays a message that the HM-500 is not responding. Press <ESC> or <F4> to display the Main Menu without connecting the field computer. Refer to *Section III, Troubleshooting* if you have problems once the proper connections are made.

## Main Menu

```
Fld: NORTH 40   Rows: 12
DGPS   Yld(tn/ac): 22.1
Hold   Avg Yield: 24.7
Ac: 55.129     MPH: 3.22
Ld#: 45       Lb: 17,170
TrkID           %: 60.4
Marks:<1><2><3><4><5><6>
Help Sys Load FSum Row±
```

The Main Menu is the starting point for all operations. To return to the Main Menu at any time, press the <ESC> key or select [Retn] from the “Action Key” legend where available.

The Main Menu provides the following information:

- [Fld] Displays user-defined field name for field being harvested
- [Rows] The total number of rows currently being harvested. This includes rows being windrowed in.
- [Yield] Displays the instantaneous yield in tons/acre or cwt/acre.
- [Average Yield] shows average running yield, in tons/acre or cwt/acre, for the current field.
- [Ac] and [MPH] display acreage covered and current speed.
- [Ld #], [Lb], [Trk ID], and [%] are statistics referring to the current truck. [%] flashes when it reaches 95% of the load value.
- <1><2>... Indicates the active marks. Marks are used to indicate areas in the field with a specific problem such as weeds or rocks and target them for future treatment. Numbers that appear in this section indicate the marks that are active. To turn a mark on or off, press the number which corresponds to it.
- [DGPS] shows the status of the GPS signal. When the signal is not sufficient for yield data to be recorded, GPS error messages will appear here. For accurate yield maps, this should always read “DGPS.”

### Active Keys for the Main Yield Monitor Screen

Tab: Increment Load#  
SHF-Tab: Decrement Load#  
ESC: Brings up the “Quit” Yes/No screen for the user  
F1 - F5: Access sub-menus  
1 - 6: Toggle user marks on and off

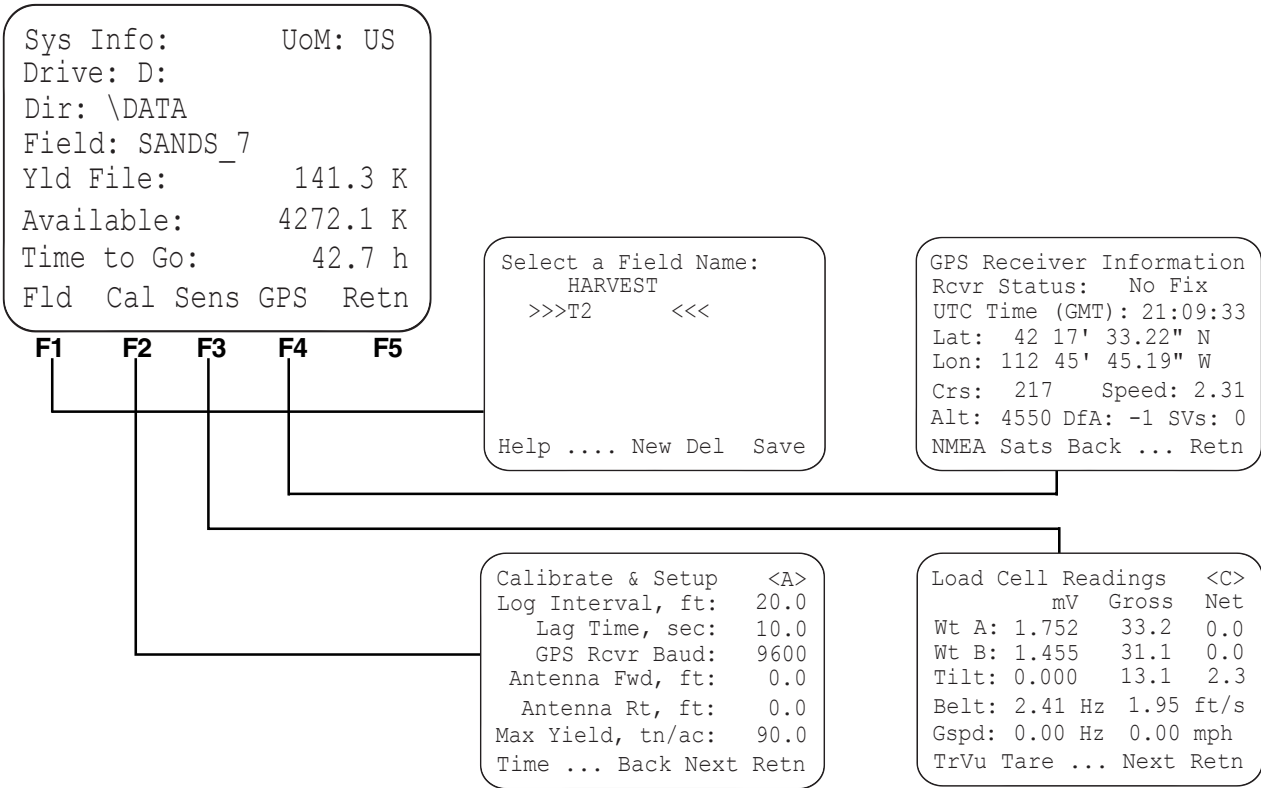
The bottom line of the screen shows the “Active Key” legend for this screen. These five menu options are activated by pressing the corresponding function key on the field computer (F1 through F5). These five sub-menus are described in detail on the pages that follow.

# Help

Pressing the <F1> key at the bottom of the Main Menu accesses the user help screens for assistance in software operation. Use the [Next] and [Back] selections (F1 and F2) to toggle between screens. Context-sensitive help is available for other screens, such as the Select a Field Name Screen: [Sys], then [Fld]. Look for the [Help] Action Key as you navigate through the software.

# System [Sys]

Pressing the <F2> key while on the main screen will access the System Screen (labeled [Sys] on the bottom line of the main screen). The System Screen is the gateway to view sensor values, change yield monitor calibration, view GPS status and incoming position data, and to set up other operating parameters. Keys <F1> through <F4> access corresponding user screens as depicted below.



## Select/Name a Field [Fld]

```
Select a Field Name:
  HARVEST
>>>T2      <<<

Help .... New Del  Save
```

This function of the System Screen allows you to select, name or change a field. Pressing <F1> allows you to enter a new field. Use the up and down arrow keys to toggle up and down among previously entered field names. Use <F3> to enter new field names and <F4> to delete field names. Use <F5> to save newly entered field names to the list. The [Quit] option <F4> cancels any entry and returns you to the List Screen.

```
Key in a new field name:
(8 char. max, no spaces,
must be alphas/numeric.)

Field Name: SANDS_7 <--
Measure: US

.... US METR Quit Save
```

## Calibrate & Setup [Cal]

```
Calibrate & Setup  <A>
Log Interval, ft:  20.0
  Lag Time, sec:   10.0
  GPS Rcvr Baud:   9600
  Antenna Fwd, ft:  0.0
  Antenna Rt, ft:  0.0
Max Yield, tn/ac:  90.0
Time ... Back Next Retn
```

Calibrate & Setup is accessed from the System Screen by selecting [Cal] with the <F2> key. These screens allow for calibration and setup of various parameters for calculating yield:

**Log Interval:** Interval per reading of yield measurement. Normally between 10 and 50 feet (3 and 15 meters).

**Lag Time:** Time required, in seconds, for produce to flow from the ground (harvest point) to the load cells.

**GPS Rcvr Baud:** Baud rate from the GPS receiver. Typically either 9600 or 4800. Change the setting with the right arrow key.

**Antenna Fwd and Antenna Rt:** GPS antenna position correction relative to the digging or picking point.

**Max Yield:** Parameter set to avoid logging poor or misleading data. Should be set above the expected maximum yield in the field.

```
Calibrate & Setup  <B>
  Belt Length, ft: 32.00
  Belt Mult, ft/hz: 1.20
Grnd Speed Sensor: GPS
  Gspd Mult, ft/hz: 1.22
  Hold/Run Sensor: No
  Flow Cutoff lb/s: 0.0
... .. Back Next Retn
```

**Belt Length:** Total length of the conveyer chain (belt). This provides a tare averaging time equal to one belt revolution.

**Belt Multiplier:** Pulses per foot of belt travel detected by the speed sensor. Each pulse is generated by the magnet (located on the drive shaft) passing the speed sensor. To find the belt multiplier, multiply the diameter of the drive shaft sprocket by pi.

$$\text{Belt Multiplier} = \text{Sprocket Diameter (ft. or m)} \times 3.14$$

Measure the diameter of the sprocket from the low points where the chain rests, not from the tops or ends of the sprocket cogs.

**Gspd Sensor:** Normally, select “Pulse” and use a ground speed sensor on a wheel of the harvester or a radar ground speed sensor and a “Y” cable adaptor. Alternatively, select “GPS” for ground speed data provided by the GPS receiver. Note that many GPS receivers give ground speed accuracies insufficient for yield data accuracy. Speed data from sub-meter DGPS receivers is typically sufficient. Change the setting with the right-arrow key.



**Gspd Multiplier:** Feet or meters of travel per sensor pulse.

$$\text{Gspd Multiplier} = \frac{\text{Tire Diameter (ft. or m)} \times 3.14}{\text{No. of magnets}}$$

The diameter is taken from the outside edges of the tire. Ideally, the installation will provide for a pulse at least each 2 to 3 feet of travel. It is common to put 4 magnets equally spaced on the wheel.

**Hold/Run Sensor:** Indicates whether or not a Hold/Run sensor is being used during harvest.

**Flow Cut-Off:** Minimum threshold for recording data.

```
Load Cell Setup      <D>
Yield Mult LdCel: 1.000
Ld A Mult, lb/mv: 27.2
Ld B Mult, lb/mv: 27.2
Ld A Offset, lb: 0.0
Ld B Offset, lb: 0.0
```

... .. Back Next Retn

**Yield Multiplier:** Method of manually adjusting yield monitor accumulation to match scale net weights of the truck. Divide the truck scale weight by the yield monitor recorded weight to find a percentage difference. (For better accuracy, do this several times and find an average difference of several loads.) Multiply this average by the Yield Multiplier and use the resulting number as the new Yield Multiplier. Automatic Calibration [Acal] adjusts this automatically.

**Ld A Mult and Ld B Mult:** The weight of product required per millivolt. Typically set at 91 lbs. when using 500# load cells and 27.3 when using 150# load cells.

**Ld A Offset and Ld B Offset:** This is only needed when using a tilt sensor. Place the conveyor in a vertical position with the load cells pointing down and the weight of the chain is off the idler wheel load cell. Go to the Sensors screen and find the number showing in the “gross” reading for the A and B load cells. These numbers should be used in the Elect Offset for each load cell.

```
Tilt Sensor Setup    <E>
Tilt Multiplier: 0.0
Tilt Offset, Deg: 0.0
```

... .. Back Next Retn

**Tilt Multiplier:** Degrees of Tilt per volt of signal from the tilt sensor. Default value is 67. Using a hand-held angle finder, place the portion of the conveyor with the load cells perfectly level. Adjust the position of the tilt sensor until the tilt sensor reading in the software is 0. Using the hand-held angle finder, change the conveyor to a known angle (such as 30 degrees). Check the gross sensor reading again. If it does not match the known angle, divide the known angle by the sensor reading. Multiply the result by the current Tilt Multiplier. This will be the new Tilt Multiplier. **Note: If your application does not use a tilt sensor, set Tilt Multiplier to zero.**

**Tilt Offset (deg):** If you are using a tilt sensor, enter a Tilt Offset only if the tilt sensor cannot be adjusted to read “0” when the conveyor is horizontal. This should be set to zero if your application does not use a tilt sensor.

**Harvester ID:** Labels data with a harvester identification.

```
Calibrate & Setup    <F>
Harvester ID: JENNY
Yield Snr Type: LdCells
Data Drive:
Dir:
Sync Clk to GPS: No
```

... .. Back ... Retn

**Yield Sensor Type:** Select which type of sensor is being used (load cells or profile sensor or both).

**Data Drive and Dir:** Storage locations of the yield data. Key in the letter of the drive and name of the directory where you want your data to be stored. To log the data program’s location, leave both settings blank.

**Sync Clk to GPS:** synchronizes minutes and seconds with GPS time.

## Time/Date Setting

To set up the time and date, select [Time] from the Calibrate and Setup screen <A> by pressing <F1>.

## Sensor Readings [Sens]

From the System Information Screen press <F3> to view two diagnostic screens for verifying operation and correct connection of the load cells and other sensors used in your HM-500 system.

```
Load Cell Readings  <C>
      mV  Gross  Net
Wt A: 1.752   33.2  0.0
Wt B: 1.455   31.1  0.0
Tilt: 0.000   13.1  2.3
Belt: 2.41 Hz  1.95 ft/s
Gspd: 0.00 Hz  0.00 mph
TrVu Tare ... Next Retn
```

Screen <C> shows the weight placed on the load cells in millivolts, gross pounds (weight placed on the conveyor chain plus chain and load cell weight), and net pounds (weight placed on conveyor chain). These weights should fluctuate as more or less weight is placed on the load cells. Gross and net tilt are also shown for the optional tilt sensor.

The Belt and Gspd lines show belt and ground speed as measured by their respective sensors. Readings are given in both Hz (cycles per second) and MPH and should fluctuate with an increase or decrease in speed.

Selecting the [Tare] option on screen <C> sets net weights to zero, storing a new tare weight in the HM-500. Some error in load weights will occur if the conveyor chain where the load cells are mounted is carrying trash or mud. Make sure the conveyor is running empty when you press [Tare]. The tare value gets averaged over the belt length, thus it takes several seconds (one complete belt revolution) to complete the tare operation. In many operations, you might initiate a tare operation only once per day, or even once every few days. In muddy operations, it is advisable to tare the system right after completing a load.

```
Load Cell Readings  <D>
Belt: 2.41 Hz  1.95 ft/s
Gspd: 0.00 Hz  0.00 mph
Hold/Run: Hold

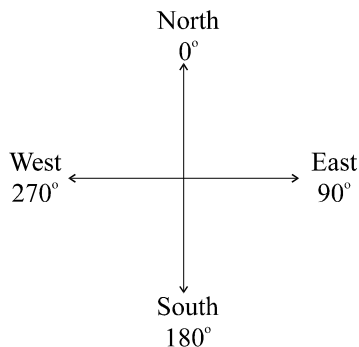
Ld Cell Flow:  2.7 lb/s
Ld Cell Wt:    5 lb
SCCU Zero Back ... Retn
```

Selecting [Next] on screen <C> brings up Load Cell Readings screen <D>. This screen gives current status of various system inputs. Selecting <F1> [SCCU] from this screen allows you to view raw data. Selecting <F2> [Zero] resets the weight sum to zero. This is useful when first doing calibrations if a known weight of material can be run across the conveyor (e.g. 50 lb. bag of sand).

⇒ Note: Selecting the [Retn] option from any screen automatically returns you to the Main Screen.

## GPS Information

```
GPS Receiver Information
Rcvr Status: No Fix
UTC Time (GMT): 21:09:33
Lat: 42 17' 33.22" N
Lon: 112 45' 45.19" W
Crs: 217 Speed: 2.31
Alt: 4550 DfA: -1 SVs: 0
NMEA Sats Back ... Retn
```



⇒ **Note:** *The HM-500 requires NMEA format from the DGPS receiver; GGA and VTG packets are required. Additionally, GSV and GSA packets are recommended.*

## Satellite Constellation Screen

```
Satellite Constellation
SV Az El Sig Used
07 217 43 20.2 Yes
12 328 22 14.1 Yes
15 27 88 22.9 Yes
16 135 64 24.8 Yes
17 223 14 9.3 No
PgUp PgDn Back ... Retn
```

⇒ **Note:** *This data will only be complete if both the GSV and GSA NMEA data packets are being transmitted by the DGPS receiver.*

Selecting <F4> [GPS] from the System Information Screen is the gateway to the GPS information screens. These screens display GPS time, latitude, longitude, course, speed, altitude, satellites in view, and the age of the differential correction. You can also verify that the GPS is communicating with the HM-500 and the field computer. If you are receiving information from the receiver, it will be displayed here.

- *RCVR Status* verifies whether or not the GPS receiver is on or connected properly.
- *UTC time (GMT)* displays the UTC (Universal Time Coordinated) time transmitted from the satellite. If the time is 00:00:00, the GPS is not connected or not configured properly.
- *Lat* and *Lon* display latitude and longitude values respectively. If no GPS signals are available, the last computed position will be shown.
- *Crs* displays the current course heading in degrees based on the degree values chart shown at the right.
- *Speed* refers to ground speed (GPS speed only) in miles per hour.
- *Alt* refers to altitude and will show the last computed value if no GPS signal is being received.
- *DfA* is the age in seconds of the differential correction. The older the correction, the less accurate the position data will be.

Selecting <F2> [Sats] brings up the Satellite Constellation screen. This screen displays satellite position data for each of the satellites being used to track ground position.

- *SV* is the space vehicle identification number.
- *Az* displays the respective azimuth for each satellite. Azimuth is the horizontal angle from true North to the object (in this case, a satellite) in degrees. A satellite with an azimuth of 270 would be due West of the GPS ground position, while a satellite due South of the of the GPS ground position would have an azimuth of 180.
- *El* displays the elevation of the satellite in degrees above the horizon. A satellite at an elevation angle of 90 degrees would be directly overhead.
- *Sig* is the strength of the satellite signal. This ranges from 0 (no signal) to around 35 (very strong signal). The stronger your signals, the more reliable your positioning data will be. A signal strength below 5 might be unusable.

## Incoming NMEA Strings Screen

```
Incoming NMEA Strings
$GPGGA,004430,4143.316,N
,11158,740,W,1,5,001.9,1
362,M,-017,M,,*A
$GPVTG,357,T,343,M,14.9
N,27.7,K*45
```

```
...    ...    Back ... Retn
```

## Load [Load]

```
Enter Truck ID . . .
```

```
Truck Ident: LD 41
Load #: 41
Pct Loaded: 0.0
```

```
Key in Truck ID or Pick
LSum Pick Ld#- Ld#+ Retn
```

Selecting <F1> [NMEA] from the GPS screen opens up the Incoming NMEA Strings Screen. Incoming data verifies receipt of data from the GPS receiver.

Pressing <F3> on the Main Menu will activate the [Load] option. This section of the software is reserved for all truck and load information and displays important data from the current load. This screen allows you to monitor current load weight (in lbs), percent loaded, start time, and load time for a particular load and truck.

Selecting <F2> [Pick] from the Load Screen brings up the Select Truck Identification Screen which allows easy scrolling among previously entered truck names using the arrow keys on your field computer. Selecting [Add] or [Edit] from this screen allows you to enter new truck names and capacities, or edit existing ones. On-screen instructions give directions for data entry and deletion on each of these screens. Arrow keys are used to toggle among options, the key pad is used for data entry, and the enter key completes a given entry. Selecting <F5> [Save] completes your request and saves any changes.

## Load Summary [LSum]

The Load Summary is accessed by selecting <F1> [LSum] from the Load Screen and allows the user to see information about each load. The data is displayed across several screens, and the [--->] and [<---] selections allow you to move among the screens. The database of truck load information created by the software looks like the example below when printed. It can be imported to a spread sheet program for further summaries by the user. The file is named <fieldname>.TRK.

```
Ld#  Fld_Wt  Scl_Wt  Cal
1    1146    0        *
2    8,301    8,791    Y
3    2,013    0        *
4    774      0        *
5    5,049    5,570    Y
6    5,111    0        *
<--- ---> PgUp PgDn Acal
```

```
Ld#  Trk_ID  Fld_Wt  Scl_Wt  Yr  Mo  Da  Hr  Mn  Sc  Ld_Tm  Cal
---  ---  ---  ---  --  --  --  --  --  --  ---  ---
107  000051  29,127  29,235  98  08  13  09:13:27  11:23  Y
108  000054  30,225  30,325  98  08  13  09:24:33  10:01  N
109  000017  28,777          98  08  13  09:38:14  07:12  N
110  000010  28,785          98  08  13  09:47:54  08:54  N
111  000051  29,002  29,100  98  08  13  09:55:44  09:32  Y
112  000054  28,010          98  08  13  10:14:11  10:47  N
```

## Load Setup [SetP]

```
Set up load defaults....
Tab Key = Ld+ Only
Load Screen:   Brief
Save New TkID: No
Dflt Weight:   30,000 lb
Auto Incrmt:   110%
US Yld Unit:   tn/ac
... .. Back ... Retn
```

Select <F1> [SetP] from the Load Summary Screen to set the following parameters:

**TAB Key:** Customize the task the TAB key will perform.

**Load Screen:** Select either brief (abbreviated) or full screen.

**Save New TkID:** Select Yes or No.

**Dflt Weight:** Default truck weight for maximum load weight.

**Auto Incrmt:** % over truck weight for auto increment.

**US Yld Unit:** Either ton/acre or cwt/acre.

## Automatic Calibration [Acal]

Ld#	Fld Wt	Scl Wt	Cal
1	1146	0	*
2	8,301	8,791	Y
3	2,013	0	*
4	774	0	*
5	5,049	5,570	Y
6	5,111	0	*

<--- ---> PgUp PgDn Acal

The Automatic Calibration function <F5> [Acal] gives a comparison of field and scale weight for each load and allows you to choose which loads to use for calibration. After you have the scale weight back from one or more loads harvested in a field, you can key these into the program, as explained above, and have the program automatically calculate a new calibration factor, and update the current load and yield files in the active field.

Select [Load] [LSum], then press <F2> [--->] to move you to the screen showing load weights as measured by the yield monitor and scale weights as entered by the user. Key in the known scale weights next to the yield monitor measured scale weight, followed by <Enter>. Use the arrow keys to navigate within the screen. Under the "Cal" label, enter "Y" if you wish to include a given scale weight in the calibration adjustment.

```
Calibration Adjustment
Cal Load Count:    1
Old Cal Factor:     1.000
New Cal Factor:     1.103
Change:             10.3%

Key 'DoIt' to invoke the
change, 'Back' = Cancel
DoIt .... Back ....
```

Use three or four loads to a calibration. It is recommended that you tare the conveyor before each load being used for calibration. There is no harm in calibrating with one load only, then calibrating again a few loads later when more data is available.

After entering the scale weights, and changing the "Cal" indicator to "Y" for those loads you wish to use, press <F5> [Acal]. This will bring up a screen which gives a summary of the calibration adjustment to be made. Selecting <F1> [DoIt] will update and adjust the current field files (load and yield) by the amount shown.

⇒ Note: We recommend that you practice the steps above on an empty file by pressing <Tab> a few times to increment load numbers, then going to the second Load Summary screen and keying in both weight and scale values (use the left arrow to move back to the "Weight" column).

---

## Row+/-

---

Change Row Count .....

Row Setting: 4  
Min Row Cnt: 4  
Max Row Cnt: 8  
Total Swath: 12.00 ft

... Edit Row- Row+ Save

Edit Working Swath ...

Row Spacing: 120.0 in  
Min Row Cnt: 1  
Max Row Cnt: 1  
Norm Row Cnt: 1  
Chg Multiple: 1

edit: keys, Up, Dn, Entr  
.... .... Back ... Retn

The final option on the Main Menu is [Row+/-]. This allows you to select or adjust the number of rows currently being harvested. This number appears in the upper right hand corner associated with the “Row:” title. Press <F5> to enter [Row+/-]. Adjust the number of rows being harvested by pressing <F3> [Row+] or <F4> [Row-]. Edit the displayed information with the <F2> [Edit] function.

The settings in the Edit Working Swath Screen are as follows:

**Row Spacing:** Width between row centers.

**Min Row Cnt:** Fewest number of rows harvested at one time.

**Max Row Cnt:** Maximum number of rows harvested at one time.

**Norm Row Cnt:** Number of rows most commonly harvested at one time.

**Chg Multiple:** Number by which row count changes by pressing [Row+] or [Row-].

---

## Data Storage and File Formats

---

### Data Files from the HM-500 Yield Monitor Program

If you are using a mobile field computer other than a HarvestMaster field computer or a Windows computer running the HarvestMaster HM5 software, the data formats will be specific to the mobile computer, and you need to consult the operations guide for your particular machine (e.g. WAG Vision System, Ag Leader PF-3000, AgNavigator, etc.).

If you are reading beyond this point, it is assumed that you are logging yield data using HarvestMaster HM5 software. This section would not be complete without some discussion of the data collected by the HM-500 Yield Monitor Program since, to a great extent, the goal of the yield monitor system is to generate data from which yield maps can be produced. The other objective is to generate information which can be used by the harvester operator to properly load trucks, and to give truck and acreage statistics throughout the day.

It is normally recommended that you use a PC ATA Flash Card (available from HarvestMaster or through a mail order computer supplies house) to store your data. We recommend the SanDisk brand, but many other brands will work fine just make sure it is an “ATA Flash” card. We recommend a card size of 10 or 20 megabytes. In a 10 hour day of harvest, you will use a half to one megabyte of data storage depending on the data recording interval.

To ensure quality and security of data, it is recommended that data be transferred to “high ground” (i.e. to your PC) as often as every day or two and at the longest interval of once per week. When you first start, you should transfer your first few hours of data to the PC and make a map, to ensure that all the systems are operating correctly. Remember the old adage, “Garbage in, Garbage out!”

The HM5 software creates the following four files for each field from which crop material is harvested and from which data is logged into the system:

<b>&lt;field_name&gt;.YLD</b>	Contains the actual yield data.
<b>&lt;field_name&gt;.TRK</b>	Contains truck data.*
<b>&lt;field_name&gt;.LOG</b>	Contains event information, such as calibration data when calibrations are changed, or time/date of exception messages.
<b>&lt;field_name&gt;.ERR</b>	Yield data is stored here when the GPS receiver information is less than DGPS, or missing.

\*The .TRK file contains binary data that must be converted to .txt format before being used. To do this, run the file LDCON.EXE on the field computer. Additional instructions are found in the README.TXT file.

All of these files are comma delimited ASCII files, which may be easily imported into a spreadsheet for analysis if desired by the user. The .YLD file format is standard on some farm GIS software packages (e.g. SS Toolbox). Normally, after acquiring data, you would use a text editor such as Microsoft's NotePad to review the .LOG file. If a .ERR file exists at all, or is of size larger than a few hundred bytes, it is cause for alarm; the problems need to be found and rectified. In general practice, the .LOG file should be reviewed for any exception messages indicating a sub normal level of system performance.

Here is the format of the <field\_name>.YLD file (spring, 1998):

Date	Time	Latitude	Longitude	Alt	Yld	—Marks—						QP	Spd	Flow	Swth	Dist
yrmoda	hrmns	Deg_WGS84	Deg_WGS84	ft	T/A	6	5	4	3	2	1		MPH	Lb/S	ft	ft
980813	124131	42.351123	-112.123456	4222	23.2	0	1	0	0	0	0	2	3.2	45.2	12.8	35.1
980813	124136	42.351123	-112.123476	4223	23.1	0	1	0	0	1	0	2	3.2	45.0	12.8	34.7
980813	124141	42.351123	-112.123496	4224	23.0	0	1	0	0	1	0	2	3.2	44.8	12.8	35.3

The first four columns give you information about when and where the information was gathered. The next three columns provide the following information:

**Yld** refers to yield units in Tons per acre.

**Marks** identify areas where certain traits are present. There are 6 marks available; a 0 implies the corresponding trait is not present, 1 implies that a trait is present.

**QP** means quality of position: 0 => position invalid, 1 => position is autonomous GPS, 2 => position is DGPS (Any data values with QP not equal to 2 (DGPS) will be stored in a second file with a type suffix .ERX.

The last four columns are for quality checking of data, and normally not used for mapping purposes.

**Spd** is harvester speed in miles per hour.

**Flow** is harvested product flow in lbs/second

**Swth** is the currently entered harvester swath. The operator has console control of this value, in increments of row width. In case it might be found that the operator overlooked properly setting this value, the yields would be artificially high, or low, and could be corrected in a spread sheet after the fact, if necessary.

**Dist** is distance traveled for the yield value mapped in each record.



## **Transferring Data from Your Field Computer to Your PC**

Data can be moved from the HarvestMaster Allegro Field PC or Pro4000 FieldBook to your desktop PC in two ways:

1) Remove the PC card, and read it via your laptop computer's PC card slot, or a PC card reader attached to your desktop PC. Use Windows Explorer to transfer your files.

2) The HarvestMaster Allegro Field PC and Pro4000 FieldBook have accompanying utilities programs that support transfer of multiple files at a time from the field computer to the PC. Details on transferring files are found in the operator's manual that came with your field computer.

If using a field computer not manufactured by HarvestMaster, consult the operator's manual that came with your computer for information about transferring files to your desktop PC.



# Section III

## Troubleshooting

---

---

### Preliminary Troubleshooting Tips

---

This section contains suggestions and tips for troubleshooting problems you may encounter when using your HM-500 system.

If you are experiencing problems with your system, first refer to *Section I, Installation* and make sure everything is installed correctly.

If everything appears to be installed correctly, but your system is still not functioning, your next step is to isolate the component(s) that is malfunctioning. The procedures outlined in this section will help you check the following components:

- Sensors
- Interconnecting cables
- HM-500 electronics
- Mobile computer

The easiest way to find a problem is by replacing the existing component with a known working one. If you do not have any extra components, the procedures outlined in this section will aid you in determining which component is malfunctioning.

You will need to have the following tools on hand to complete the troubleshooting steps in this section:

- Digital volt meter
- 24 AWG jumper wires stripped and tinned (paper clips will work also)
- Notebook PC

If your system is still having problems after trying the suggestions in this troubleshooting section, contact our customer service department for more suggestions. If it is apparent that your equipment needs to be returned to the factory for repair, an RMA (Return Material Authorization) number will need to be authorized. To receive your RMA number call our customer service department at (435) 753-1881 (8 am - 5 pm MST, Monday - Friday).

---

## Symptoms and Possible Solutions

---

### HM-500 Power Failure (No Power LED)

The following section outlines the symptoms of several possible problems that you may be experiencing with your HM-500 system along with troubleshooting solutions for each.

- Check the power cord connection to see that it is plugged into the SCCU correctly.
- Check the power cord connections and polarity to the power source.
- With a voltmeter, check the voltage on the HM-500 Console at the end of the power cable that connects into the system. Make sure this voltage is at least a positive 11VDC (desired 14.8VDC with the implement running).

### Communication Failure between Mobile Computer and HM-500 System

- Check to make sure the power of the HM-500 is turned on and running properly. The red power LED by the HM-500 power switch should be on continuously, and the green LED labeled “CPU” should blink approximately once every 1.5 seconds.

If these two LED indicators are not displaying as described above, turn the power off and then on again to reset the HM-500 system. If green LED is still not blinking, check to make sure that you have proper power to the HM-500 electronics.

If the LED is blinking in any other sequence than described above, the Injected Operating System (IOS) may not have been loaded properly. Check the IOS and Fixed Operating System (FOS) version numbers by viewing them on your sign-on screen as the software powers up. If the software version numbers are absent, the IOS and FOS needs to be reloaded (Please refer to the FOS and IOS update procedures later in this section).

- Check to make sure that the green LED labeled “CPU” is blinking approximately once every 1.5 seconds. This tells you that the HM-500 is sending a string of information to the mobile computer every time the LED blinks. The same procedures as outlined above should be used to troubleshoot this LED.
- Check the cable to see that it is plugged into the COM1 port on your mobile computer.
- Check the cable to make sure that it is not damaged in any way.

- Unplug the communications cable from the HM-500 system and inspect the pins in the ITT Cannon Trident connector to assure that all of the pins are locked into place, and not damaged. Refer to the “Host Cable” wiring diagram in *Appendix A* for pin placement. If you suspect the cable, you can ohm the cable from pin to pin according to the wiring diagram.
- Connect the cable to a notebook PC and run a terminal program such as Window’s Hyper Terminal. Make sure that the HM-500 system is sending information to the PC. Send the command “\$qu,ii,fi” to see if the system responds by giving you the Injected Operating System (IOS) and Fixed Operating System (FOS) version numbers.

## GPS Receiver Status is “OFF”

- Make sure the receiver is getting power.
- Make sure that you have the correct cable attached between the “COM A” port of the HM-500 and GPS Receiver. A wiring diagram of a standard GPS communication cable is supplied with this manual in *Appendix A*. Using the ohm meter, check the communications wiring (RXD, TXD, and GND) from pin to pin for possible cable faults.
- From the Main Menu of the HM-500 Yield Monitor software, select [SYS], [SENS], [GPS], and [NMEA] to get to the screen that will allow you to view the information that is being sent from the receiver. An NMEA string should look similar to the example below:

*“\$GPGGA,004430,4143.316,N,11158.740,W,1,5,  
001.9,1362,M,-017,M, ,\*4a”*

The “Host” communications cable can be attached to a notebook PC and the communication string can be viewed by running a terminal program such as Window’s Hyper Terminal, or any NMEA GPS utility program.

- Refer to the manual that came with your GPS receiver for more troubleshooting tips.

## GPS Receiver Status “No Fix”

- Check to see if you have enough satellites being used by entering [SATS] in the [GPS] menu of the HM-500 Yield Monitor Program. Four satellites must be “used” to receive latitude, longitude, and altitude.
- If you are receiving differential corrections from radiobeacon reference stations, make sure your GPS antenna is mounted in a location with an open view of the sky (360 degrees) and that it is not mounted where vehicle noise (alternator etc.) can interfere with the Coast Guard differential signals.
- Check the GPS antenna cable for nicks, scratches, severs, or other types of damage. The signal will be lost if the cable is damaged in any way.
- Refer to the manual that came with your GPS receiver for more troubleshooting tips.

## Receiver Status “GPS”

- If you have subscribed to a satellite subscription service, make sure it has not expired.
- Make sure the GPS receiver is configured properly.
- Refer to the manual that came with your GPS receiver for more troubleshooting tips.

## Weight Readings are Zero

- Check to make sure the power of the HM-500 is turned on and running properly. The red power LED by the HM-500 power switch should be on continuously, and the green LED labeled “CPU” should blink approximately once every 1.5 seconds.

If these two LED indicators are not displaying as described above, turn the power off and then on again to reset the HM-500 system. If green LED is still not blinking, check to make sure that you have proper power to the HM-500 electronics.

If the LED is blinking in any other sequence than described above, the Injected Operating System (IOS) may not have been loaded properly. Check the IOS and Fixed Operating System (FOS) version numbers by viewing them on your sign-on screen as the software powers up. If the software version numbers are absent, the IOS and FOS needs to be reloaded (Please refer to the FOS and IOS update procedures later in this section).

```
Load Cell Setup      <D>
Yield Mult LdCel: 1.000
Ld A Mult, lb/mv: 27.2
Ld B Mult, lb/mv: 27.2
Ld A Offset, lb: 0.0
Ld B Offset, lb: 0.0
```

... .. Back Next Retn

```
Load Cell Readings  <C>
      mV  Gross  Net
Wt A: 1.752   33.2  0.0
Wt B: 1.455   31.1  0.0
Tilt: 0.000   13.1  2.3
Belt: 2.41 Hz  1.95 ft/s
Gspd: 0.00 Hz  0.00 mph
TrVu Tare ... Next Retn
```

- Check the calibration constants “Ld Multipliers” in the Calibration & Setup screen <D> by selecting <F2> [Sys] from the Main Menu, then <F2>[CAL], <F4> [Next]and <F4> [Next]. The lb/mV reading for Ld A and Ld B Multipliers should be around 91 if you are using 500 pound load cells and 27.3 if you are using 150 pound load cells and will typically be the same for both load cells.
  - If you deviate from the 27.3 or 91 lb/mV setting, check your sensor readings by going back to the System Information Screen and selecting <F3>[Sens]. From the Load Cell Readings screen <C>, select <F2> [Tare] to bring the weight readings to zero. Then suspend a known weight of 50 lbs or greater from the load cell idler wheel and verify the resulting weight reading on your display.
- ⇒ Note: A lb/mV value of zero for Ld A and Ld B Multipliers will always produce a weight value of zero in the Load Cell Readings screen <C> no matter what the mV reading is doing.
- Refer to load cell troubleshooting procedures outlined later in this section for more troubleshooting tips.

## **Weight Readings Fluctuate or Are Not Accurate (Cannot Calibrate)**

- Refer to *Section II, System Operation* to ensure that the proper weight calibration procedures have been followed.
- Refer to “Mounting the Idler Wheel Load Cells” in *Section I, Hardware Installation* to make sure the installation was performed correctly.
- View the millivolt (mV) readings of the load cells by selecting [SENS] from the main menu of the HM-500 Yield Monitor Program. With the harvester very still and the tractor not running, check the stability of the mV readings of both load cells. Make sure that they are very stable (not changing).
- If the millivolt readings are fluctuating for one load and the other one is stable, switch the load cells to see if the problem follows the load cell. If it does, the load cell will need to be replaced; if it does not, the problem could be in the HM-500 electronics and the system may need to be sent in for repair. Contact our Customer Service Department for details.
- Refer to load cell troubleshooting procedures outlined later in this section for more troubleshooting tips.

## **Both Load Cells Do Not Respond**

- Check to make sure the power of the HM-500 is turned on and running properly. The red power LED by the HM-500 power switch should be on continuously, and the green LED labeled “CPU” should blink approximately once every 1.5 seconds.

If these two LED indicators are not displaying as described above, turn the power off and then on again to reset the HM-500 system. If green LED is still not blinking, check to make sure that you have proper power to the HM-500 electronics.

If the LED is blinking in any other sequence than described above, the Injected Operating System (IOS) may not have been loaded properly. Check the IOS and Fixed Operating System (FOS) version numbers by viewing them on your sign-on screen as the software powers up. If the software version numbers are absent, the IOS and FOS needs to be reloaded (Please refer to the FOS and IOS update procedures later in this section).

- View the millivolt (mV) readings of the load cells by selecting [SENS] from the Main Menu of the HM-500 Yield Monitor Program.

With the load cells plugged into the HM-500 system (not loaded) and powered on, the mV value should be close to zero ( $\pm .1$  mV). Remember that the load cell idler wheel cannot have any weight on it at all. Pressing down or pulling up on the mounted idler wheel should result in a respective positive or negative reading of the “mV” value on each of the load cells.

- Check the cable connecting the load cells to the HM-500 system for damage (nicks, cuts, or other types of damage).
- If there still is not a response, unplug each load cell from the HM-500 system and inspect the pins in the ITT Cannon Trident connector to assure that all of the pins are locked into place, and not damaged. Refer to the load cell cable wiring diagram in *Appendix A* for pin placement.
- Check to ensure that the load cells are securely plugged into "Load A" and "Load B" connector ports on the HM-500 system and make sure the metal locking ring is turned to lock the connector securely into place.
- The following test can also be used to help determine whether the load cell or the HM-500 system is responsible for a "no-reading" problem.
  1. Disconnect the load cells from the HM-500
  2. With a short jumper wire, short A to C and D to E. You should see the reading move to approximately +8.23 mV.
  3. Shorting A to D and C to E should send the reading equally negative
  4. Shorting C, D, and E together should yield a mV reading very close to zero

#### **HM-500 Load Cell Wiring**

<u>Pins</u>	<u>Signal</u>
A	+ 5 Volt Excitation
C	Signal (+)
D	Signal (-)
E	Excitation Ground

Passing the above test tells you that the HM-500 console is working properly and your problem is the load cells.

### **One Load Cell Does Not Respond**

- View the millivolt (mV) readings of the load cells by selecting [Sens] from the main menu of the HM-500 Yield Monitor Program.

With the load cells plugged into the HM-500 system (not loaded) and powered on, the mV value should be close to zero ( $\pm .1$  mV). Remember that the load cell idler wheel cannot have any weight on it at all. Pressing down or pulling up on the mounted idler wheel should result in a respective positive or negative reading of the "mV" value on each of the load cells.

- Check the cable connecting the load cells to the HM-500 system for damage (nicks, cuts, or other types of damage).

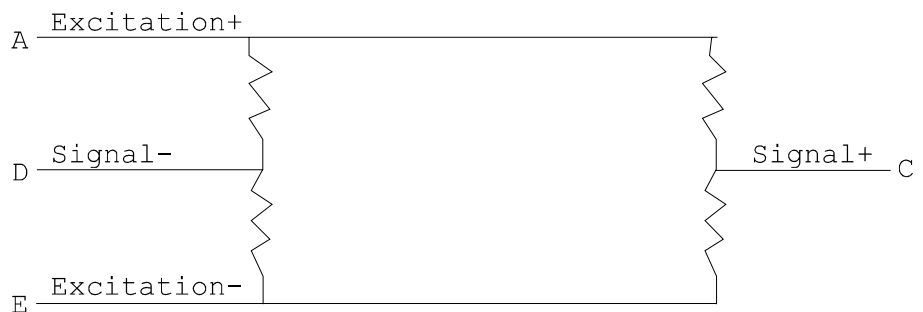


- If there still is not a response, unplug the load cell that is malfunctioning and inspect the pins in the ITT Cannon Trident connector to assure that all of the pins are locked into place, and not damaged. Refer to the load cell cable wiring diagram in *Appendix A* for pin placement.
- Check to ensure that the defective load cell is securely plugged into "Load A" or "Load B" connector port on the HM-500 system and make sure the metal locking ring is turned to lock the connector securely into place.
- Swap the faulty load cell with the good one and visa versa to see if the problem follows the load cell. If it does, the problem is the load cell. If it does not, the problem could be in the HM-500 console and may need to be sent in for repair. Contact our Customer Service Department for more details.
- With an ohm meter, check the pins on the load cell. You should see approximately the following resistances between the pins on the load cells:

<u>Pins</u>	<u>Ohms</u>
A to C	280 $\Omega$
A to D	280 $\Omega$
A to E	380 $\Omega$
C to D	350 $\Omega$
C to E	280 $\Omega$
D to E	280 $\Omega$

- ☞ Note: Readings varying from these by more than 15 W to 20 W are indicative of a faulty load cell. If any of these are open (infinite ohms) you know you have a bad load cell or a broken lead wire inside the cable and these items need to be replaced.

### *Load Cell Schematic*



## **Belt Speed Reading is Zero (Red “Belt” LED Blinks)**

- In the HM-500 software program Main Menu, select [SYS], [CAL], and [NEXT] until you come to the "Calibrate & Setup <B>" screen. Check to see if there is a belt multiplier entered. Refer to the “Verifying System Operation & System Calibration” section in this manual.

The belt speed multiplier must be the length of the belt travel per pulse from the sensor. A zero multiplier in the calibrations will cause the belt speed to be zero. It can be calculated by taking the diameter of the drive gear and multiplying it by PI. If you used any units other than feet, you will need to convert them to feet.

$$\begin{aligned} \text{*For Example: } 5'' \text{ diameter drive gear} \times 3.1416 (\text{PI}) &= 15.73'' \\ 15.73'' / 12'' &= 1.3108 \text{ ft/sec} \end{aligned}$$

## **Belt Speed Reading is Zero (Red “Belt” LED does not blink)**

- Check to make sure the power of the HM-500 is turned on and running properly. The red power LED by the HM-500 power switch should be on continuously, and the green LED labeled “CPU” should blink approximately once ever 1.5 seconds.

If these two LED indicators are not displaying as described above, turn the power off and then on again to reset the HM-500 system. If green LED is still not blinking, check to make sure that you have proper power to the HM-500 electronics.

If the LED is blinking in any other sequence than described above, the Injected Operating System (IOS) may not have been loaded properly. Check the IOS and Fixed Operating System (FOS) version numbers by viewing them on your sign-on screen as the software powers up. If the software version numbers are absent, the IOS and FOS needs to be reloaded (Please refer to the FOS and IOS update procedures later in this section).

- Check to make sure the magnet is on the shaft and it is turning past the belt speed sensor.
- Check the speed sensor distance from the magnet to make sure that it is approximately 1/4" and that the speed sensor lock nut is securely tightened.

⇒ Note: We recommend that you use the magnet that comes with the sensor (HM Part #: 9483). The magnet should pass no greater than 3/8"(1 cm) from the end of the belt speed sensor and should cause a “closed” circuit, which turns on the Red "Belt" LED.

- To check the integrity of the HM-500 electronics, disconnect the belt speed sensor and use a small wire to short from pin L to pin M of the socket. Refer to the “Belt Speed Cable” wiring diagram in *Appendix A*. If shorting these two sockets together does not turn the red "Belt" LED on, then the HM-500 electronics are likely causing the problem.
- If the electronics check out, then inspect the speed sensor cable for damage. You may want to check the pin to pin wiring as compared with the belt speed cable as outlined in *Appendix A*.

---

# HM-500

## Operating System Update Procedures

---

### Checking your FOS software version:

Sometimes it is necessary to reload the Fixed Operating System (FOS) and the Injected Operating System (IOS) in order to get your system to run properly.

Follow the steps below to check your FOS version:

- Plug the communications cable that is attached to the "Host" port on your HM-500 box is plugged into a notebook or desktop PC.
- Restart your computer in DOS mode or shell out to a DOS prompt.
- Place the FOS Update Diskette into the A:\ drive of your PC and change to the A:\ drive by typing A: at the DOS prompt and pressing <ENTER>.

**▲ CAUTION: Be sure the connection is on COM1 or COM2 of the PC NOT the parallel port. Connecting the HM-500 communications cable to your PC's parallel port will cause your PC irreparable damage!**

```
FOS Loading Program
Version 2.0 23APR97
-----
Select an Activity.....
1. Display Helps
2. Chg Com Port <COM1>
3. Display FOS Ver #
4. Burn NEW FOS
5. Reset HM-500
6/ESC. Exit/End Pgm
7. Soft HM-400 Reset
8. Set FOS name, now is
   f570.tsk
MAKE SELECTION:
```

- Type "FOSUP," and wait for the program menu. If you need to use COM2, press "2" to make that menu selection at this time.
- With the serial cable connected between your PC and the HM-500 "Host" port, turn the power to the HM-500 system "ON". Select menu item #3, to view the version of FOS currently installed, and to ensure that your PC is communicating properly with the HM-500 system. Do not try to update until you have successfully viewed the information from menu item #3.

### Updating the FOS:

After completing the steps above to check the FOS version and to ensure that your PC is communicating properly with the HM-500 system, you are now ready to update the FOS.

- Select menu item #5, to "Reset HM-500".
- Once you have seen the version identification string on the display of your PC and the HM-500 system is reset, go to the main menu and select menu item #4 (Burn New FOS). You should see a string of dots move across the display as the new FOS is being loaded. The process is completely automatic, and takes about one minute.

**▲ CAUTION: DO NOT interrupt the transfer process. Doing so may corrupt the program in the FLASH PROM. This would require you to send it back to the factory for updating.**

- The activities taking place will be updated from your PC screen. The last of which is “Waiting for new FOS Identification.” It takes about 20 seconds.

☞ Note: If the new software version is not displayed, use the “ESC” key to get out of the program, turn the SCCU off and then on again, and then re-enter the program. By pressing option #3 “Display FOS Version”, you should see the updated FOS displayed as “FOS Version x.x”.

## Injecting a New IOS:

After loading the new FOS, an IOS must be injected in order for the system to operate correctly, follow the procedures below to inject a new IOS.

```
IOS Loading Program
Version 2.0 23APR97
-----
Select an Activity.....
1. Display Helps
2. Chg Com Port <COM1>
3. Display FOS Ver #
4. Inject NEW IOS
5. Reset HM-500
6/ESC. Exit/End Pgm
7. Soft HM-400 Reset
8. Set IOS name, now is
   i570.tsk
MAKE SELECTION:
```

- It is assumed that you have just completed the FOS update and you still have the cable attached to the HM-500 system.
- At the DOS prompt and with the IOS upgrade diskette inserted into drive A:\, type “IOSUP,” and wait for the program menu. If you need to use COM2, press "2" to make that menu selection at this time.
- With the serial cable connected between your PC and the HM-500 “Host” port, turn the power to the HM-500 system “ON”. Select menu item #3, to view the version of FOS currently installed, and to ensure that your PC is communicating properly with the HM-500 system. Do not try to update until you have successfully viewed the information from menu item #3.
- Select menu item #5, to “Reset HM-500”.
- Once you have seen the version identification string on the display and the HM-500 system is reset, go to the main menu and select menu item #4 (Inject New IOS). You should see a string of dots move across the display as the new IOS is being loaded. The process is completely automatic, and takes about one minute.

**▲ CAUTION: DO NOT interrupt the transfer process. Doing so may corrupt the program in the FLASH PROM. This would require you to send it back to the factory for updating.**

- The activities taking place will be updated from your PC screen. The last of which is “Waiting for new IOS Identification.” It takes about 20 seconds.



# Appendix A

## Wiring Diagrams

### Host Cable

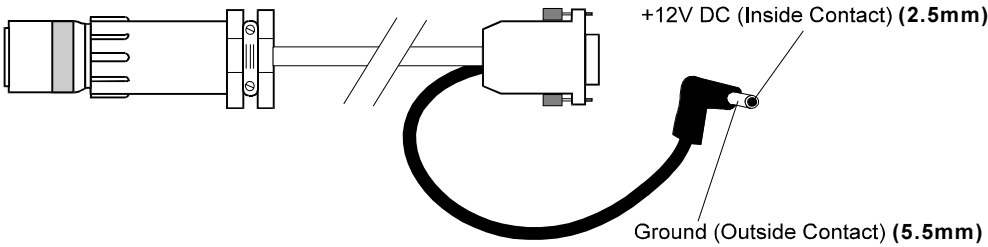
Model #: CA-MC-H5

8-Pin Trident  
Host Port

9-Pin Sub "D"  
Female Connector

Pin	Description
A	No Connect
B	Transmit Data (TXD) to SCCU (Green)
C	Receive Data (RXD) from SCCU (White)
D	Ground
E	No Connect
F	Shield
G	Host Ring from SCCU (Red)
H	Host Charge +12VM (Brown)

Pin	Description
1	No Connect
2	RXD to Handheld (White)
3	TXD from Handheld (Green)
4	No Connect
5	Ground
6	No Connect
7	No Connect
8	No Connect
9	Host Ring from SCCU (Red)
	Ground
	+12 V DC



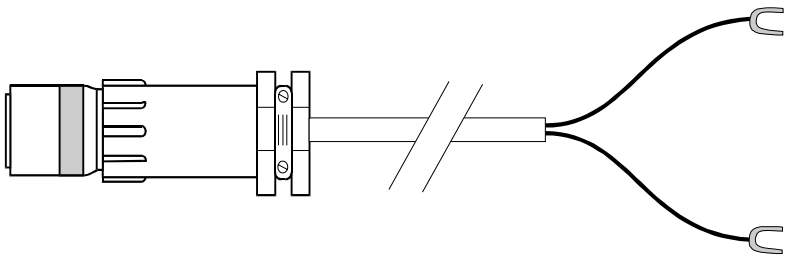
# Power Cable

M-odel #: CA-PW-H5

4-Pin Trident  
+12 V Main Power Port

Black & Red Pigtail

Pin	Description
A:	+12VBS (Red)
B:	No Connect
C:	No Connect
D:	Ground #2 (Black)



# Belt Speed Connector Cable (4 lead)

Model #: CA-BS4

12 Pin Trident  
Connector

3 Pin Cannon Sure-Seal

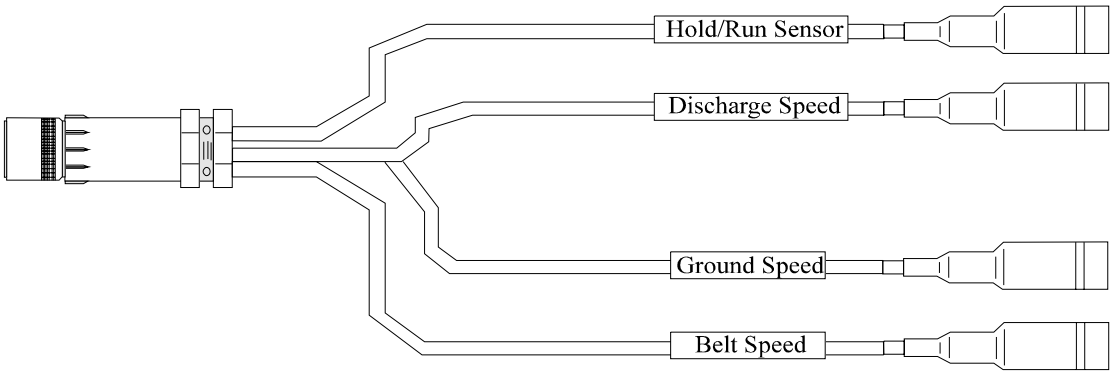
Pin	Description
A:	Hold/Run
B:	No Connect
C:	Ground
D:	No Connect
E:	Discharge Spd
F:	Ground
G:	No Connect
H:	No Connect
J:	Ground
K:	Ground Spd
L:	Belt Spd
M:	Ground

1: Pin
2: Socket
3: Socket

1: Pin
2: Socket
3: Socket

1: Pin
2: Socket
3: Socket

1: Pin
2: Socket
3: Socket



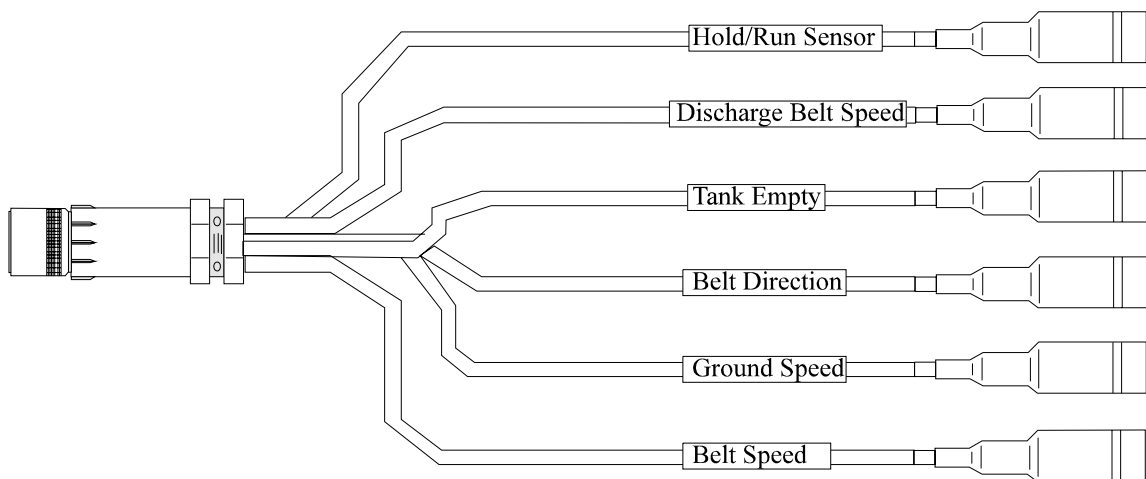
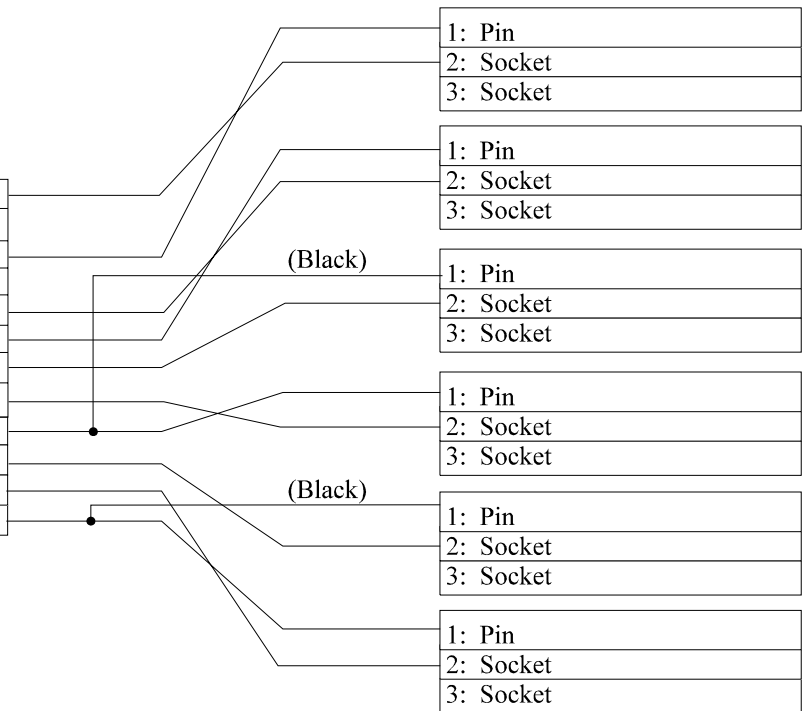


3 Pin Cannon Sure-Seal

## 12 Pin Trident Connector

Pin Description

A:	Hold/Run
B:	No Connect
C:	Ground
D:	No Connect
E:	Discharge Spd
F:	Ground
G:	Tank Empty
H:	Belt Direction
J:	Ground
K:	Ground Spd
L:	Belt Spd
M:	Ground



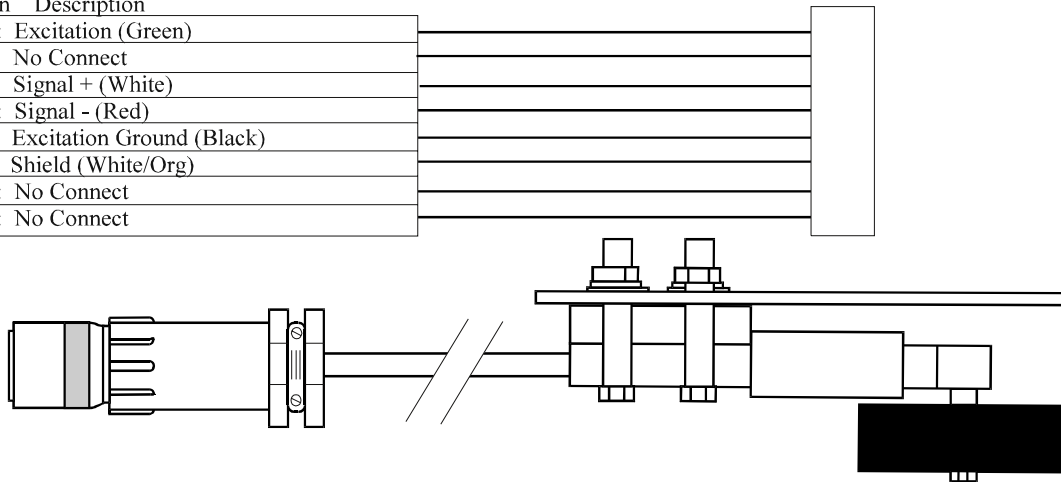
# Loadcell Cable

8-Pin Trident  
Load Cell Port

Load Cell  
HM-505

Pin Description

A: Excitation (Green)
B: No Connect
C: Signal + (White)
D: Signal - (Red)
E: Excitation Ground (Black)
F: Shield (White/Org)
G: No Connect
H: No Connect



# GPS Communication Cable

Model #: CA-GPS-H5

12 Pin Trident Connector  
(connects to COM A)

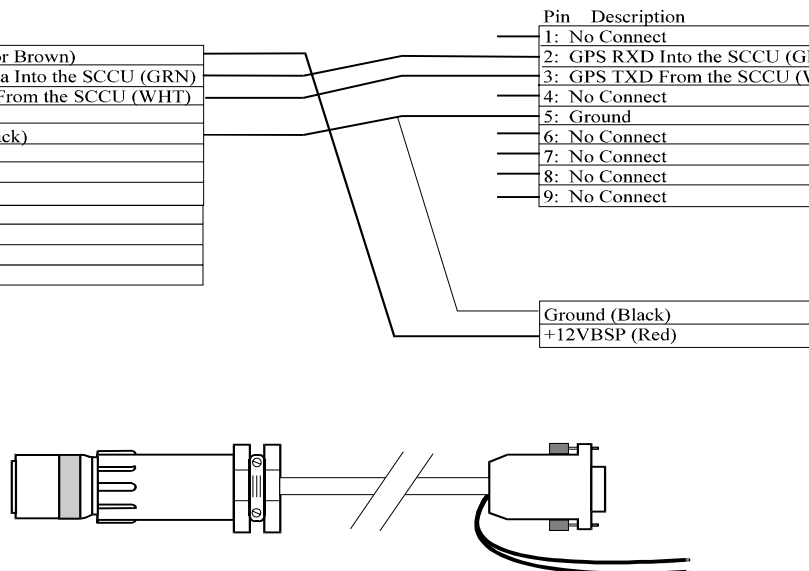
9-Pin Sub "D"  
Male

Pin Description

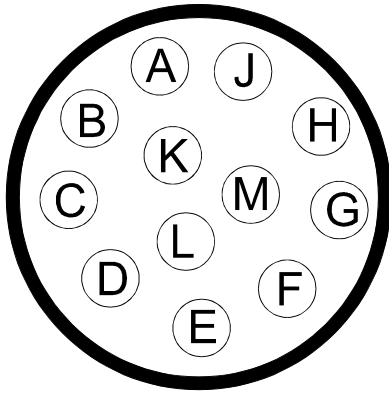
A: +12VBSP (Red or Brown)
B: GPS Receive Data Into the SCCU (GRN)
C: GPS Trans Data From the SCCU (WHT)
D: No Connect
E: GPS Ground (Black)
F: No Connect
G: No Connect
H: No Connect
I: No Connect
J: No Connect
K: No Connect
L: No Connect

Pin Description

1: No Connect
2: GPS RXD Into the SCCU (GRN)
3: GPS TXD From the SCCU (WHT)
4: No Connect
5: Ground
6: No Connect
7: No Connect
8: No Connect
9: No Connect

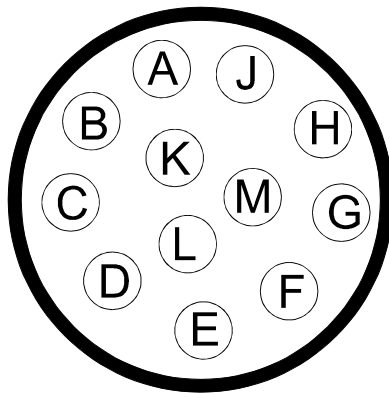


## COM A Pin-Out Diagram



Pin	Signal
A .....	+12V Excitation
B .....	GPS Receive Data (RXD) to SCCU
C .....	GPS Transmit Data (TXD) From SCCU
D .....	Paper Take-Up
E .....	Ground
F .....	External "Enter" Switch
G .....	+5VDC Excitation
H .....	Printer Receive Data (RXD) to SCCU
J .....	Printer Transmit Data (TXD) from SCCU
K .....	Printer RTS
L .....	Ground
M .....	Printer CTS

## Belt Speed Pin-Out Diagram



Pin	Signal
A .....	Hold / Run
B .....	Status Condition
C .....	Signal Ground
E .....	Head RPM
D .....	Discharge Speed
F .....	Signal Ground
G .....	Tank Empty
H .....	Belt Direction
J .....	Signal Ground
K .....	Ground Speed
L .....	Belt Speed
M .....	Signal Ground



## A

Active Keys for the Main Yield Monitor Screen 2-2  
Auxillary Setting 2-5

## B

Belt Length 2-5  
Belt Multiplier 2-4  
Belt Speed Cable A-2, A-3  
Belt Speed Connector Cable (4 lead) A-2  
Belt Speed Connector Cable (6 lead) A-3  
Belt Speed Pin-Out Diagram A-5  
Belt Speed Reading 3-8  
Belt Speed Sensor 1-3

## C

Calibrate & Setup (Cal) 2-4  
COM A Pin-Out Diagram A-5  
Communication Failure 3-2  
Components 1-2  
Connecting the Components 1-8  
Connecting the GPS Components to the HM-500 1-13  
Customer Service iv

## D

Data files from the HM-500 Yield monitor Program 2-9, 2-11  
Data Logging Path 2-5  
Data Storage and File Formats 2-11  
Disclaimer of Warranties iii  
Dist 2-12  
Dschg Delay (sec) 2-5

## F

Factory Sealed Unit iv  
Field Computer 1-3  
Field Computer to SCCU Connection 1-11  
Flow 2-12

## G

GPS Antenna & Receiver 1-12  
GPS Communication Cable A-4  
GPS Components 1-13  
GPS Forwd 2-4  
GPS Information 2-7  
Ground Speed Sensor 1-3  
Gspd Multiplier 2-5

## H

HardwareInstallation 1-1  
Help 2-3  
HM-500 Functional System Diagram 1-1  
Hold/Run Sensor 2-5  
Host Cable A-1

## I

Idler Wheel Load Cells 1-4  
Incoming NMEA Strings Screen 2-8  
Installation Time 1-2  
Interfacing GPS with the HM-500 1-12

## L

Ld A Multiplier 2-5  
Ld B Multiplier 2-5  
LED Red 3-8  
Load (Load) 2-8  
Load Cell Connections 1-8  
Load Info 2-8  
Loadcell Cable A-4

## M

Main Screen 2-2  
Marks: 2-12  
Materials 1-2  
Menu Tree 2-1  
Mounting the GPS Antenna& Receiver 1-12  
Mounting the Idler Wheel Load Cells 1-4

## P

Power Cable A-2  
Power Cable Connection 1-11  
Power Failure 3-1  
Preparation for Installation 1-3  
Problems 3-1

## Q

QP 2-12

## **R**

Required Tools and Materials 1-2  
RMA (Return Material Authorization) iv

## **S**

Satellite Constellation Screen 2-7  
SCCU iv, 1-3  
SCCU Mounting 1-8  
Select/Name a Field (Fld) 2-4  
Sensor Readings (Sens) 2-6  
Serial Number iv  
Spd 2-12  
Speed Sensor Mounting 1-6  
Startup Screen 2-2  
Swth 2-12  
System (Sys ) 2-3  
System Overview 1-1

## **T**

Tilt Multiplier 2-5  
Tilt offset (deg) 2-5  
Time/Date Setting and Automatic Calibration 2-6  
Tools 1-2  
Troubleshooting 3-1

## **U**

Updates or Modifications iv

## **W**

Warranties iii  
Warranty and Repair Information iii  
Wiring Diagrams A-1

## **Y**

Yld 2-12

## **Index**