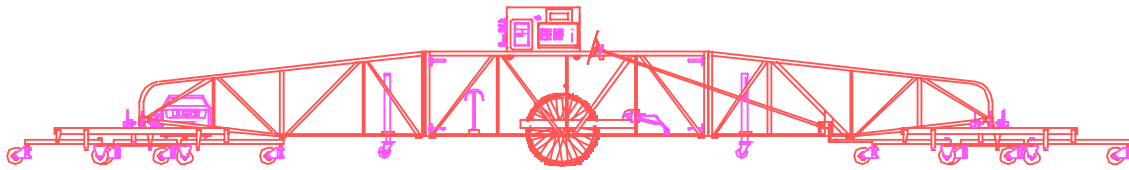


**JAMES COX & SON, INC.**

**CS8200 COMPUTERIZED PROFILOGRAPH**

**OPERATOR'S MANUAL**



**MAY 1998  
Version 3.01**

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**DISCLAIMER**

The current software shipped with the CS8200 includes the original programmable single pole data filter plus a new programmable third order Butterworth data filter. This flexibility will allow a state or federal agency to select the amount of data filtering allowable on their projects.

For a further discussion of these filters and their settings refer to DATA FILTER and LOW PASS FILTER sections of the manual.

---

**CAUTION**

*The contractor should obtain certification, from the agency involved, for the use of this type of profilograph. The filter setting selected for use will automatically be printed on each report for future verification. Care must be taken to avoid OVER-FILTERING of the data. The filter should only remove spikes from the data caused by debris, pavement texture, and frame vibration.*

---

## **CALIBRATION**

### **VERTICAL**

Due to rough or possible mishandling of the profilograph, the vertical calibration may be altered causing inaccurate vertical measurements. Periodic checking of the vertical calibration **MUST** be practiced by the user. The inspection procedure is very simple and is accomplished by using a calibration kit which is provided (see VERTICAL INSPECTION under DIAGNOSTICS for a full discussion of the inspection procedure).

### **ODOMETER**

Due to routine measurement wheel tire wear it is recommended that the calibration procedure be repeated periodically, once a week, as described in the DIAGNOSTICS section under ODOMETER CALIBRATION. James Cox & Sons also recommends that the measurement wheel tire pressure, to be determined by state D.O.T., be checked DAILY. Small variations in measurement wheel circumference caused by improper tire pressure or wear will produce inaccurate results.

## GETTING STARTED

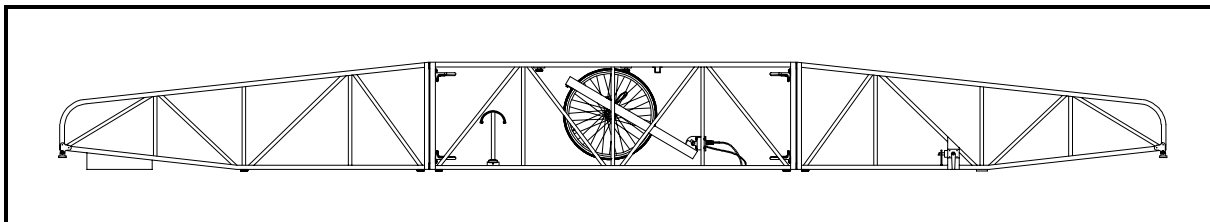
The purpose of this section is to get the user rapidly acquainted with the basic operations of the CS 8200. It is an overview and is not meant to be complete or comprehensive. Read the rest of the manual before you do any serious measuring. There are, however, a few **IMPORTANT** rules that must be observed; they are as follows:

### IMPORTANT

- **NEVER** - You must never start the generator with any of the computer's power switches in the **ON** position. These switches are located on the left side of the computer when viewed from the front (refer to figure 3).
- **NEVER** - The generator must never be turned off while any of the computer's power switches are in the **ON** position. This could result in damage to the computer.
- **NEVER** - Do **NOT** turn the computer **OFF** unless the bottom line of the LCD display reads **STOPPED**. Failure to do so may cause problems retrieving data from the FLASH memory.
- **NEVER** - The generator must never be allowed to run out of gas while the computer is on. A good rule of thumb would be to fill the generator first thing in the morning and then at noon.
- **NEVER** - The **CS 8200** computer must never be transported unless it is in its padded shipping box. It will not survive even a short ride in the back of a pickup without adequate padding. Care must also be taken when transporting and storing the center frame section. Transducer life will be prolonged by protecting the center section from excessive vibration and high humidity.
- **NEVER** - The **CS 8200** must not be run in the rain. Although we have tried to make the computer's case as waterproof as possible there is a risk of electrical shock.
- **IMPORTANT** - Once the generator has been started, allow it to run, with the computer's power switches in the **OFF** position for one to two minutes. This will allow the generator to warm up and stabilize. At least once a week check the voltage output of the generator. It needs to be **120 VAC**. Output above 125 VAC can cause damage to the computer. Output below 110 VAC will cause the computer to reset itself.
- **CAUTION** - The measurement wheel (bicycle wheel) should only be replaced by **James Cox & Sons**. The measurement wheel has been ground round as to not induce artificial bumps.
- **CAUTION** - The measurement wheel (bicycle wheel) should only be in the down position when making measurements. You must **never roll the CS 8200 backwards** for more than a few feet with the measurement wheel down. This can cause an error message to appear on the LCD and lock-up the computer. Refer to page 56 to fix this.
- 
- **ALWAYS** - The **tire pressure** of the measurement wheel must be checked daily, **25 psi** is a good starting point, but check your pavement specification for an exact number.

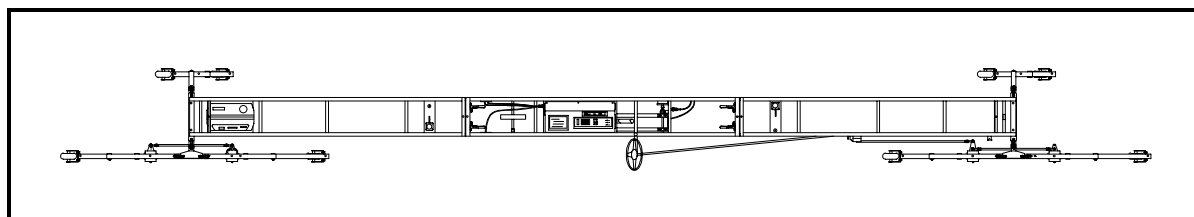
**ASSEMBLING THE FRAME**

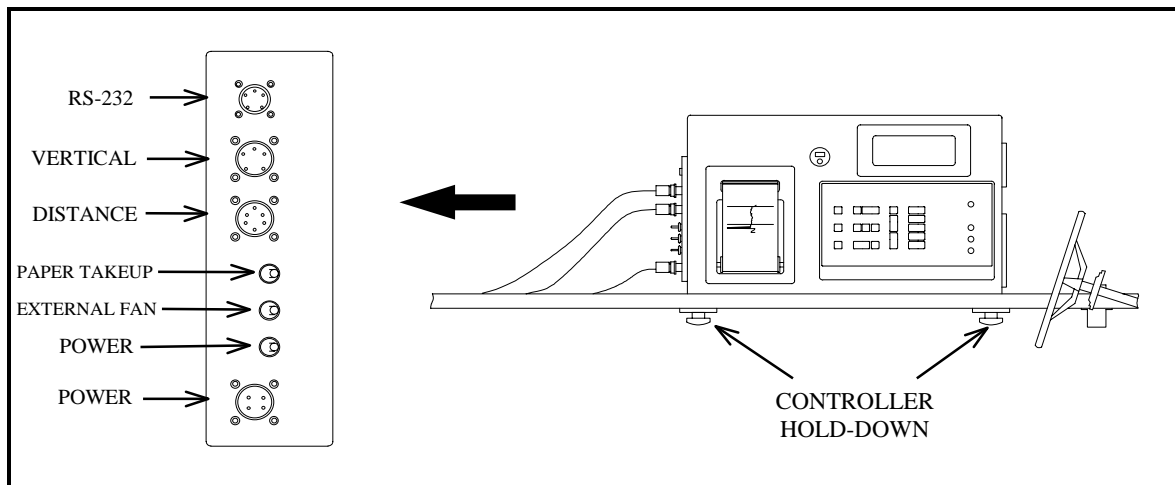
- 1 The CS 8200 frame is color coded for ease of assembly. Sections with similarly colored dots should be mated together. Typically the three frame sections are assembled first (refer to figure 1). Once you have slid the three sections together making sure that the colored dots match, clamp the sections together.

**Figure 2 - Frame Sections**

- 2 The next step in assembling the CS 8200 is to assemble the support wheels. Once again, these are color coded so you can't go wrong. Once assembled, clamp the wheel assemblies together. The front wheel assembly will be color coded to the front of the frame. Install the front wheel assembly first, making sure the longer side is on the same side of the frame as the steering box (refer to figure 2). The easiest way to get the wheel assemblies under the frame is for one person to stand inside the frame near the end and lift while another attaches the wheel carriages. The steering arm, from the steering box to the front wheel assembly, may now be attached.
- 3 Now that the front wheel assembly has been installed you may attach the rear wheel assembly, making sure that the long section of the assembly is on the same side as the front wheel assembly. Note the lock on the rear wheel carriage, this is normally set so that the rear wheels are in line with the frame. The wheels may be temporarily turned to aid in maneuvering.
- 4 The generator is then lowered onto its platform at the rear of the frame, then its power cord is plugged into the adjacent receptacle.

The frame should now look something like the following figure:

**Figure 3 - Frame Top View**



**Figure 4 - Controller Connections**

- 5 Next, the controller is placed in the center span and the controller hold downs must be fastened to the controller. Now you may connect the cables. Note that each cable has a unique number of pins to discourage incorrect cabling.
- 6 The steering wheel may now be attached; make sure to place the pin through the aluminum tubing at the steering wheel end of the assembly.
- 7 There are two trailer lifts, one located on the front section of the frame and the other located on the rear section. These must be installed to permit the CS 8200 frame to be turned on narrow sections of roadway.

**STARTING THE GENERATOR**

Check that the system has been assembled correctly, no parts are left, and all cables are plugged in. **It is very IMPORTANT that all the power switches, located on the left side of the computer, are in their OFF position.** Starting the generator with the power switches ON could cause serious damage to the computer.

Read the generator manual. Check that the generator has fuel and oil and is plugged in. Start it using the choke and the pull start cable. Allow at least one minute for it to warm up and stabilize.

To ensure power is getting to the electronic controller, turn the external cooling fan switch ON. This switch is located above the power switch. The fan that this switch controls is located on the opposite side of the controller. If power is getting to the controller then you should be able to hear this fan. If the fan is not operating, check all cable connections. The internal fan should only be left on if the thermometer indicates that it is above 100 degrees F.

Use the dial thermometer, located on the front of the control box, to check that the temperature inside the controller box is well above freezing. **The CS 8200 should not be operated at temperatures below freezing.** It may fail to work at low temperatures and attempting to operate it at these temperatures could cause damage.

**MAKING YOUR FIRST MEASUREMENT**

This section will describe how to use the CS 8200 in its **SIMPLE MODE** of operation. The CS 8200 can operate in other modes, but this section will be limited to the SIMPLE MODE. In the SIMPLE MODE of operation there are only a two things to set, BEGIN and DIRECTION. BEGIN tells the computer where you are on the pavement. DIRECTION tells the computer whether you will be going up or down station. To set the BEGIN parameter, first make sure the CS 8200 is in the STOPPED mode. You can determine this by looking at the bottom line of the LCD display; it should read STOPPED.

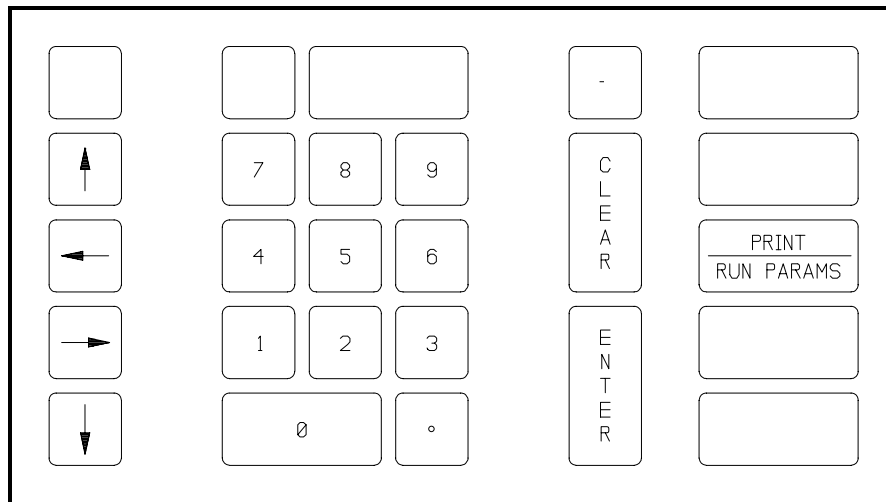
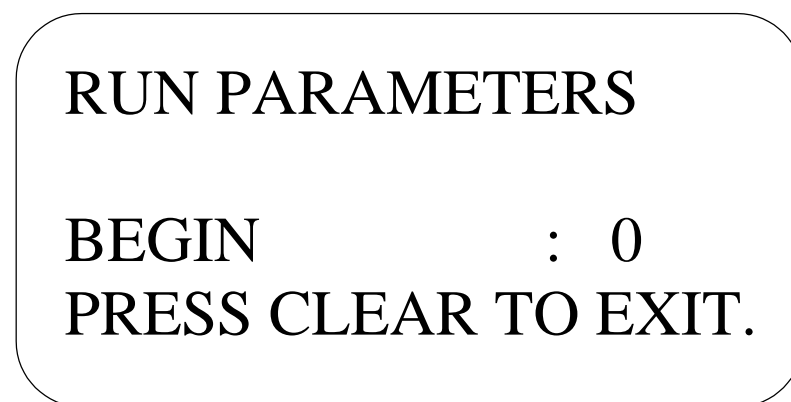


Figure 5 - Modify *RUN* keys

Now press the **PRINT/RUN PARAMS** key located on the front panel keypad of the computer described above, and the following screen should appear on the LCD display :



Now simply enter the begin station at the begin prompt; the begin prompt is the third line of the LCD. The new begin information will be entered after the colon on this line. Let us say that we wish to begin measuring at station 57 + 00 on the pavement surface. Well the CS 8200 does not accept the (+) sign for station information so we must convert this to feet.

---

This is as simple as removing the (+) sign from the station, so the station would be, in CS 8200 terms, 5700 feet. You should notice a flashing box located after the colon on the third line of the LCD. This is called a cursor and will be referenced as such from here on. At the cursor, type in the number 5700 followed by the pressing the ENTER key located just to the right of the number keys. If you do not press the ENTER key, this new value will not be accepted.

You have now successfully entered the begin station. Now press the CLEAR key to return to the main screen which should look something like the following :

5700.0	0.25
BEGIN	5700
PASS#	1 DOC#
STOPPED.	

Now that you have told the computer where you are on the pavement, notice that the second line of the LCD now reads "BEGIN 5700", which is what you entered. You must also inform the CS 8200 which direction you will be traveling on the pavement. This is done by flipping the DIRECTION switch to either (+) or (-). The (+) sign indicates you will be going up station, meaning station numbers will be getting bigger as you push, while the (-) setting indicates you will be traveling down station, which has the opposite effect.

You are now ready to start measuring a section, but first we must define a reference point from which all measurements will be referenced to. We like to define this point as the axle of the measurement wheel. The measurement wheel (bicycle wheel) is located in the center section of the frame. From this point on, all measurements will be with respect to this reference point.

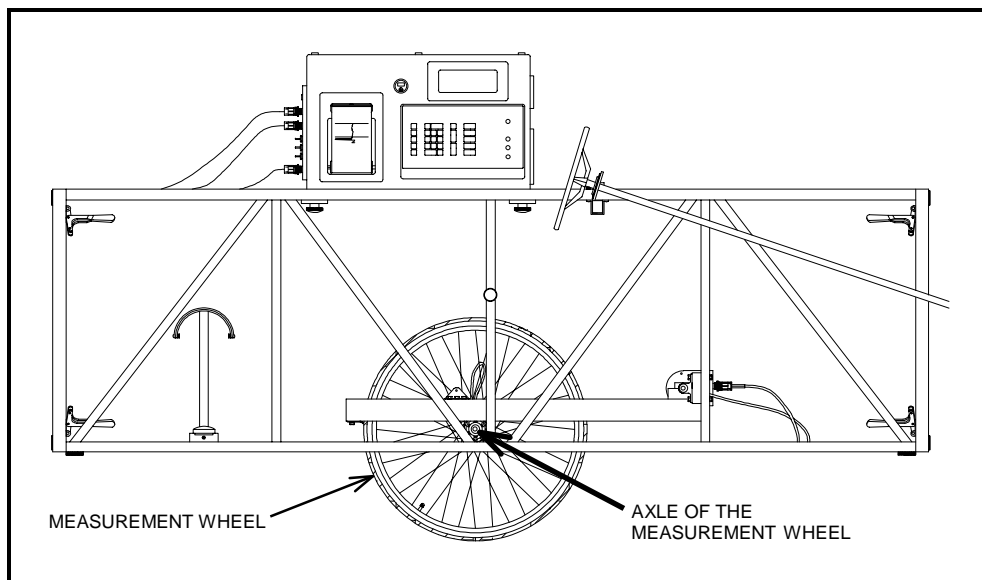
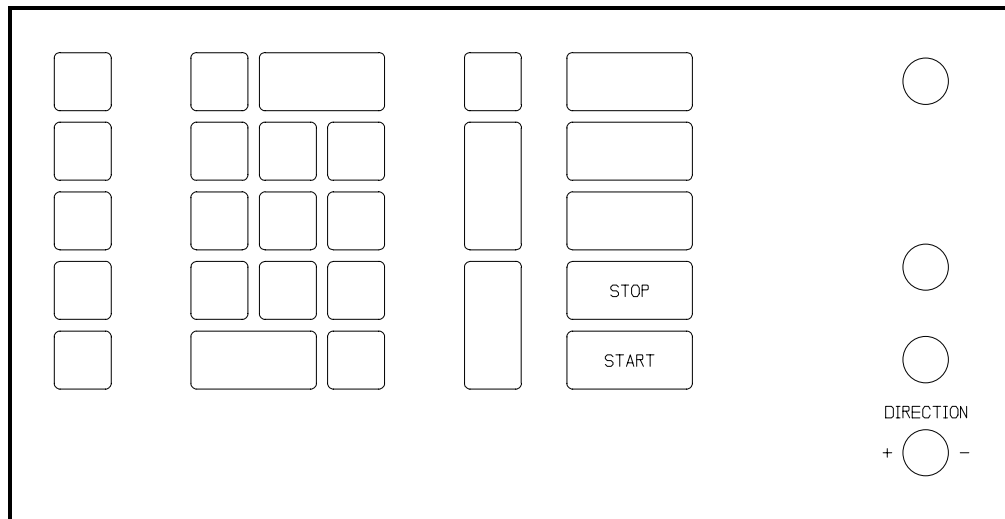


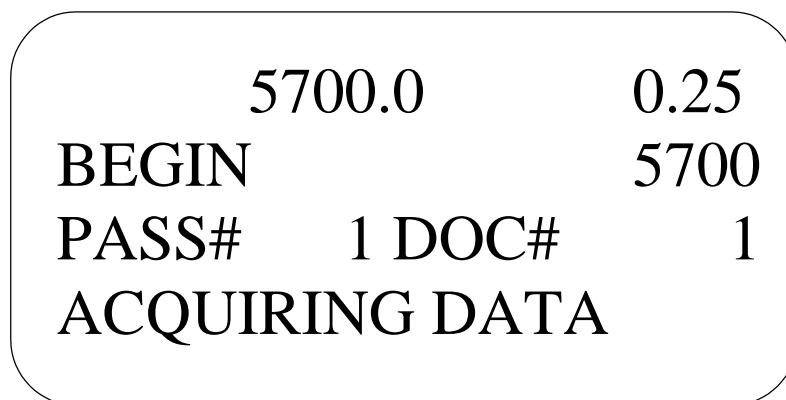
Figure 7 - Reference point



**Figure 8 - Start Keys**

Now that we have defined a reference point we can start measuring a section. To measure a section perform the following steps:

- 1 With the measurement wheel down, roll the machine up to the start of the section to be measured and align the axle of the measurement wheel up with the begin station on the pavement. This location should be the same as the location you entered for BEGIN.
- 2 **Make sure the DIRECTION switch is set properly, to the (+) position if stations will be increasing and the (-) position if stations will be decreasing.**
- 3 With the axle of the measurement wheel aligned with the start of the measurement section, press the START key located on the lower right section of the front panel of the computer and the LCD should appear as follows:



Notice that the ODOMETER has been set to 5700, which is what you set the BEGIN parameter to. If you had set BEGIN to 2000 the ODOMETER would now read 2000. The ODOMETER will be set to whatever BEGIN holds every time the START key is pressed.

- 4 Now look at the printer and ensure the following header is being printed. If it is not, you have done something wrong; start from the top making sure you follow all the steps as described exactly.

```

AUTOPROF VERSION          3.01
FNAME                     5C031409
MARCH 03, 1998           14:09
JOB NUMBER                6734
PASS                      0
PAVEMENT                  8
ROUTE                    66
DISTRICT                  18
WHEEL PATH                RR
DIRECTION                 NORTH

ODOMETER(COUNTS/528 FT)  15840
NULL BAND WIDTH(IN)      0.20
BUMP HEIGHT(IN)          0.30
BUMP WIDTH(FT)           25.0
BUMP BOTTOM                OFF
DATA FILTER HI(CYC/FT)   0.00
DATA FILTER LO(CYC/FT)   2.00

```

```
*****START REPORT*****
```

If you make it to this point, you are acquiring data. The bottom line of the LCD display should now read **"ACQUIRING DATA"**. The computer will now continue to acquire and reduce data until you press the STOP key, which is located above the START key on the front panel. The interval at which the computer prints reports is defined by REDUC LEN and is initially set at 528 feet, but this can be changed. For a description of how to change the REDUC LEN (see REDUCTION PARAMETERS).

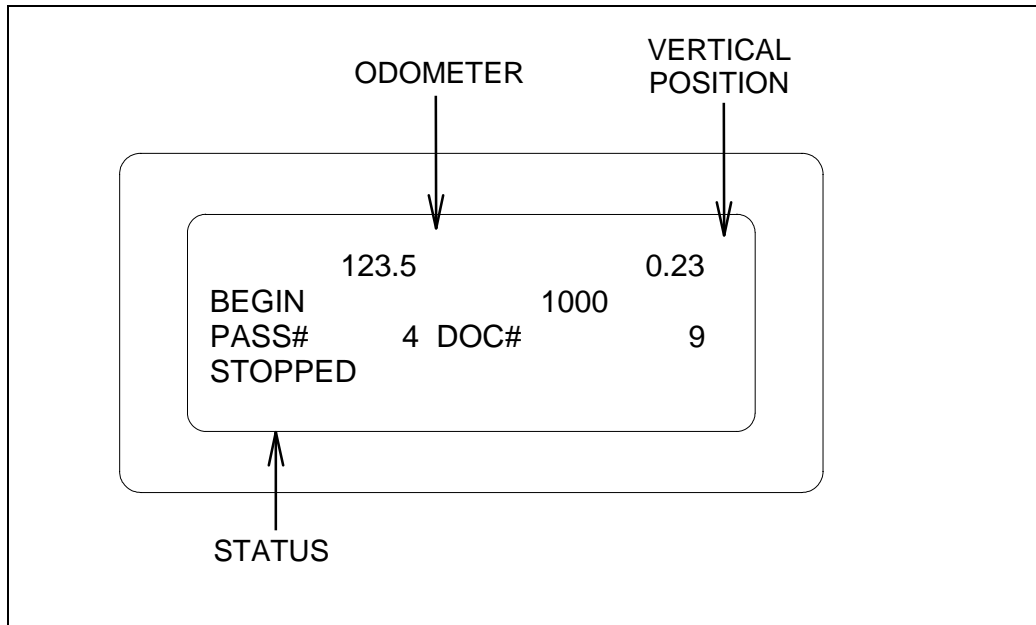
- 5 When you have completed pushing the machine through the measurement interval making sure to align the axle of the measurement wheel up with the end of the measurement section press the STOP key and the final report shall be printed, followed by summary information.

### **READ THE REST OF THE MANUAL**

This section is designed as an overview of one method of operation. The CS 8200 has additional capabilities than were discussed above. Understanding these additional capabilities are absolutely necessary for the operation of this equipment. Read the rest of the manual.

**FRONT PANEL DISPLAY**

The front panel display, located on the front panel of the computer, is a four line by twenty character Liquid Crystal Display (LCD), which is also back-lighted for use at night, with the following format:



**Figure - LCD Display**

The top line gives the vertical position of the measurement wheel and the odometer, which tells you where you are on the pavement. The second line indicates the current setting of the BEGIN parameter, which is one of the two things that must be set for SIMPLE MODE operation. The third line gives the DOC# and PASS# which are printed on each report every time the start button is pressed. The fourth line is the status line which will be described later.

**ODOMETER**

The odometer field of the LCD display indicated current position on the pavement. This number shall be incremented if the DIRECTION switch is (+) and decremented if the DIRECTION switch is (-). This number is automatically set, with the contents of BEGIN, each time the START key is pressed.

**VERTICAL POSITION**

The vertical position indicates the vertical position of the measurement wheel. This number can be useful for finding the exact location of must grinds.

**BEGIN STATION**

The second display line gives the begin station (BEGIN). This is what the odometer will be set to when you press the START button at the beginning of a test. This parameter may be changed by pressing the DOCUMENT POINT button on the front panel, (see GETTING STARTED).

**DOCUMENT NUMBER**

The first number in the third line is the document number. This number is incremented each time the DOCUMENT POINT key is pressed and this new number will be shown on the report with a hash mark showing the exact location where the key was pressed. This feature allows the user to precisely locate, on the report, objects of interest on the pavement.

**PASS NUMBER**

The second number on the third line is the pass number. It is used to keep track of the lane being measured. It may be incremented by pressing the (+) key or decremented by pressing the (-) key located on the front panel key pad. A description of how to set this number to an initial value can be found in the RUN PARAMETERS section of the manual.

**STATUS LINE**

The fourth line indicates various states of the CS 8200; they are as follows:

**STOPPED**

This indicates that the system is not recording data.

**ACQUIRING DATA**

This indicates that the system is recording data.

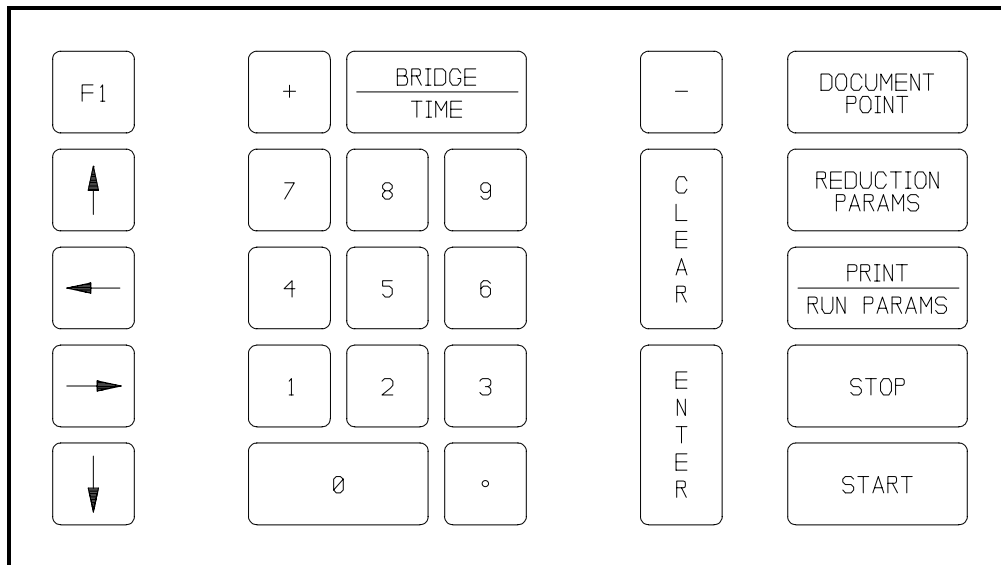
**IGNORING BRIDGE**

This indicates that a section is being ignored. This is normally used to ignore bridge sections (see IGNORING BRIDGES section).

**FRONT PANEL KEYPAD AND SWITCHES**

The front panel has a series of test control switches and keys. There is a membrane type keypad, and four toggle switches. The following is a description of these keys and switches :

**KEYPAD**



**Figure - CS 8200 Keypad**

**START -**

When this key is pressed, the CS 8200 starts acquiring data, (see SIMPLE MODE). This key is also used in the odometer calibration mode, (see ODOMETER CALIBRATION).

**STOP -**

When this key is pressed, the CS 8200 stops acquiring data, (see SIMPLE MODE). This key is also used in the odometer calibration mode, (see ODOMETER CALIBRATION).

**NUMERIC KEYPAD (0-9) -**

These keys are used to modify parameters. The parameter to be modified is first selected by entering a parameter entry mode; for example, pressing the PRINT/RUN PARAMS key, for setting the RUN parameters or pressing the REDUCTIONS PARAMS key to alter the REDUCTION parameters. An accessed character will flash showing the presence of the cursor; the cursor is a flashing box that appears over the character to be modified. The accessed character may then be modified by keypad entry. If the ENTER key is pressed, the value visible at that instant will be stored and become effective. For a complete discussion of setting the parameters, refer to the GETTING STARTED section of the manual.

**ARROW KEYS (UP & DOWN) -**

The UP ARROW and DOWN ARROW keys are used to scroll through (select) a parameter. Once a parameter entry mode has been selected either by pressing PRINT/RUN PARAMS to change a RUN parameter or by pressing REDUCTION PARAMS to change a REDUCTION parameter, you may then use the DOWN ARROW key or the ENTER key to scroll through the parameters. For example, to change the DOCUMENT# which is a RUN parameter you would first press the PRINT/RUN PARAMS key to enter the RUN entry mode. Then you would press the DOWN ARROW key once. This will take you to the DOCUMENT# parameter which may now be changed by entering the new value followed by pressing the ENTER key.

**ARROW KEYS (LEFT & RIGHT) -**

The LEFT ARROW and RIGHT ARROW keys are used to access and move the cursor within the parameter being modified. These are discussed in more detail under the KEYPAD DATA ENTRY section.

**ENTER -**

This key will update the appropriate value within the controller.

**CLEAR -**

This key will return you to the main screen. This key is used once the user has finished entering new parameters.

**F1 - This key has two functions.**

If the F1 key is held down as the system is powered up or reset, it will set the CS 8200 into diagnostic mode (see DIAGNOSTICS MODE for a full description).

If F1 key is pressed after the system is stable and the CS 8200 is STOPPED, it will cause the parameter report to be printed.

**(+) and (-) -**

These keys increment (+) or decrement (-) the pass number. The pass number may also be modified as a parameter; this would be necessary to set to an initial value.

**BRIDGE/TIME- This key has two functions.**

If the CS 8200 is in the STOPPED mode, pressing this key allows you to set the time.

If the CS 8200 is in the ACQUIRING DATA mode, its function is to ignore a section which is discussed under the IGNORING BRIDGES section of the manual.

DOCUMENT POINT - This Key has two functions.

If the CS 8200 is the STOPPED mode, pressing this key brings up the FLASH OPTIONS menu, (see FLASH MEMORY).

If the CS 8200 is in the ACQUIRING DATA mode, this key documents roadway features. One major use is to mark recognizable features such as drop inlets, culvert markers, etc. When this key is pressed, the DOC# on the LCD display is incremented. This new number with a locating hash mark is then included on the profilogram. The operator may either take written notes describing the document points or may use a tape recorder for this purpose.

REDUCTION PARAMS-

When the CS 8200 is in STOPPED mode, the bottom line of the LCD reads STOPPED. This key, when pressed, will allow you to set the REDUCTION parameters. For example, you would use this to change the REDUC LEN parameter, but not the BEGIN parameter, (see REDUCTION PARAMETERS).

PRINT/RUN PARAMS-

This key, when pressed in the STOPPED mode, allows the user to modify the RUN parameters, (see RUN PARAMETERS).

## SWITCHES

DIRECTION-

This switch determines whether the odometer will increment or decrement with forward motion of the CS 8200. The positive position is used when running up station and the negative direction is used for running down station.

PAPER ADVANCE-

This switch is used to advance the paper on the printer.

RESET-

This switch causes a hardware reset of the system. Essentially, this performs the same function as turning the system off and then turning it back on. It is used to enter the DIAGNOSTICS MODE and to UPLOAD new software to the CS 8200.

NULL BAND-

This switch currently has no function.

## PROFILOGRAPH PARAMETERS

The CS 8200 has a series of 15 parameters which can be modified by the user. The following list of the 15 parameters may be printed to the thermal printer by pressing the F1 key located on the front panel. These parameters may only be changed by the user when the CS 8200 is in the STOPPED mode.

### PROFILOGRAPH PARAMETERS

#### RUN PARAMETERS

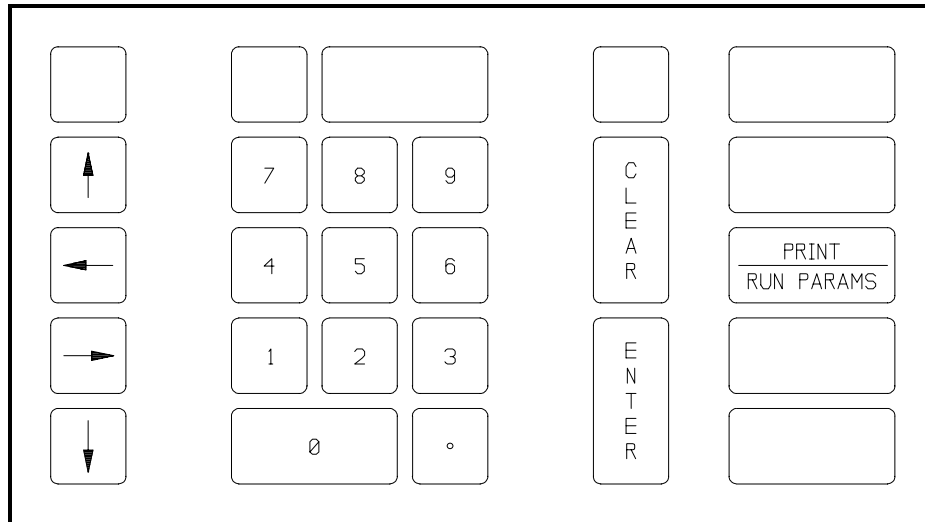
MAY 24, 1998	01:35
JOB NUMBER	6437
BEGIN	1000
PASS #	3
DOCUMENT #	22
ROUTE	66
PAVEMENT	8
DISTRICT	18
WHEEL PATH	RR
DIRECTION	NORTH

#### REDUCTION PARAMETERS(ENGLISH)

ODOM FACT(COUNTS/528 FT)	3956
DATA FILTER LO(CYC/FT)	2.00
DATA FILTER HI(CYC/FT)	0.00
REDUCT LEN(FT)	528
BUMP HEIGHT(IN)	0.30
BUMP WIDTH(FT)	25.0
BUMP BOTTOM	OFF
NULL BAND WIDTH(IN)	0.20
ROUND SCALLOPS TO(IN)	0.01
BUMP LOCATOR	ON
FLASH STORAGE	ON

The parameters are broken into two groups. The first group is referred to as the RUN parameters because they effect the running of the machine. These parameters may be accessed by pressing the PRINT/RUN PARAMS key. These are the parameters you will most likely be modifying. The second group will be referred to as the REDUCTION parameters. This group is used by the computer to determine how the data shall be reduced. Once set, these should rarely be changed.

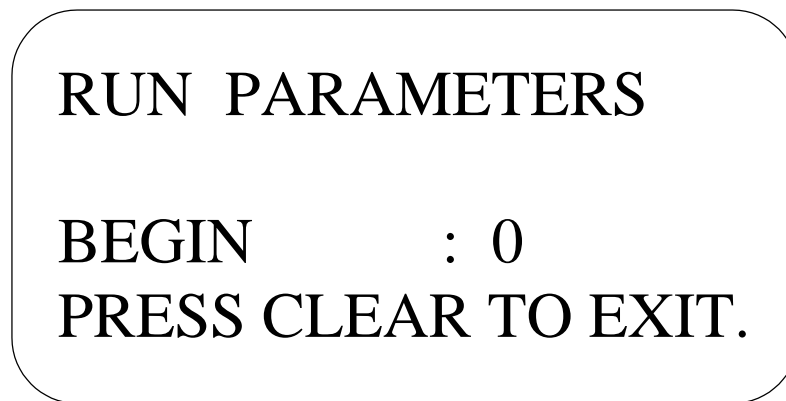
**Figure 11 - Keys for setting RUN parameters**



### **RUN PARAMETERS**

The run parameters can be modified by observing the following steps:

- 1 Making sure you are in the STOPPED mode, press the PRINT/RUN PARAMS key located on the front panel of the computer. The LCD display should now look like this:



- 2 You may now select one of the RUN parameters by using the UP and DOWN arrow keys located on the left side of the key pad.
- 3 Once a parameter has been selected, type in the desired value followed by the ENTER key to accept the change. Note, you may use the LEFT arrow key to delete the character you just entered. The WHEEL PATH and DIRECTION parameters are set differently from the rest please refer to their specific descriptions for a information on how to set these parameters.
- 4 You may repeat this process indefinitely; when finished press the CLEAR key to return the main view which should look something like the following:

346.5	0.25
BEGIN	5700
PASS#      1	DOC#      1
STOPPED	

**BEGIN** - This parameter is the number which will be loaded into the odometer when the START key is pressed.

**DOCUMENT#** - This parameter is a number from 0 to 999, which can be used to mark the location of ground features on the profilogram. (See DOCUMENT POINT under FRONT PANEL KEYPAD AND SWITCHES).

**JOB NUMBER**- This parameter indicates the current job number. This value will be printed at the beginning and end of each test interval.

**PASS#**- This number indicates which pass you are making, it is up to the operator to determine appropriate values for this parameter. This value will be printed at the beginning and end of each test interval.

**TIME**- This parameter should only have to be entered occasionally. The CS 8200 has a battery powered clock that keeps track of the time and date. The time is printed at the beginning and end of each test interval, every time START key is pressed.

**DATE**- This parameter is kept by a battery powered clock within the CS 8200. The date is printed at the beginning and end of each test interval, every time the START key is pressed.

**ROUTE**- This parameter may be used to hold route information, which will be printed at the beginning and end of each test interval.

**PAVEMENT**- This parameter may be used to store pavement information, which will be printed at the beginning and end of each report.

**DISTRICT**- This parameter may be used to store identifying numbers up to nine digits long. This value will be printed at the beginning and end of each test interval.

**WHEEL PATH**- This parameter was recently added to allow the user to indicate which wheel path is being profiled. The choices are RR(right rut), LR(left rut), CNTR(center). To select one of these values press either the left or right <ARROW> keys.

**DIRECTION**- This parameters was recently added to allow the user to indicate which direction the CS8200 is being pushed. The choices are NORTH, SOUTH, EAST, and WEST. To select one of these values press either the left or right <ARROW> keys.

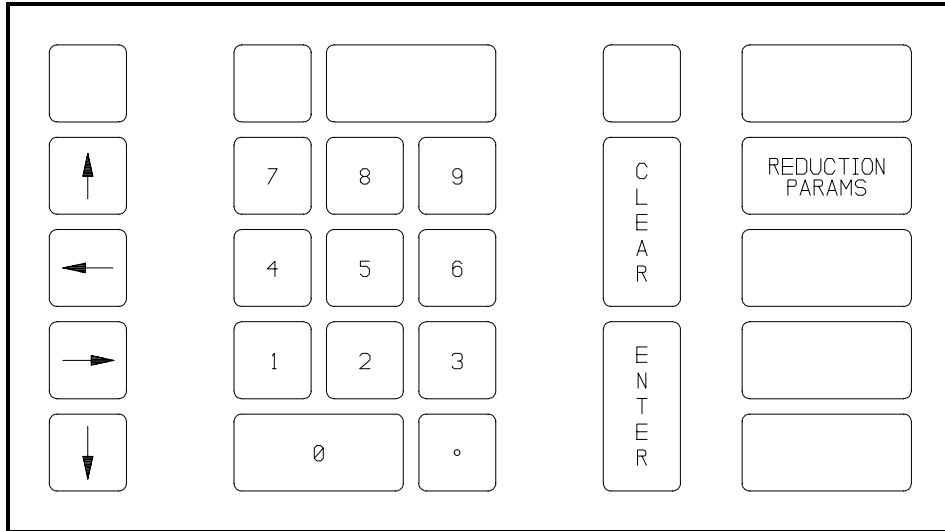


Figure 12 - Keys to set *REDUCTION* parameters

## REDUCTION PARAMETERS

The reduction parameters are changed in the same way as the RUN parameters, but with one exception; you press the REDUCTION PARAMS key instead of the PRINT/RUN PARAMS key to change them.

### REPORT LENGTH

**REDUCT LEN** - This specifies the reduction interval. The reduction interval can be defined as the interval at which the computer will automatically print a report. Normally, REDUC LEN is set to 528.0 feet in English units or 100.0 when working in metrics.

### BLANKING BAND (NULL BAND)

**BLANK WID** - This specifies the width of the blanking band (null band). This is usually .20 inches or 5.0 mm.

### DATA FILTERING

**DATA FILTER(LO)** - In simple terms, this filter is used to remove trace chatter. Chatter is caused by a number of things such as dirt, rocks, and pavement texture. The data is filtered with respect to traveled distance, so that moving very slowly will not cause over-filtering of the input data. (Refer to the DATA FILTER section for more details on the use of the filter, and refer to the LOW PASS FILTERS section for an explanation of how the filter works.)

**DATA FILTER(HI)** - See HIGH PASS FILTER for a description of this filter.

## **SCALLOP ROUNDING**

**0.05 ROUND** - This feature allows scallop counts to be rounded to 0.05, by setting 0.05 ROUND to a 1, or to 0.01 if 0.05 ROUND is set to a 0. Note this feature is only available with the English software.

## **MUST GRINDS**

**BUMP HT** - This is the height used for the bump cutting template. It is usually .30 inches or 7.52 mm.

**BUMP WID** - This determines the width of the bump template. This is normally 25.0 feet or 7.6 meters.

**BUMP LOC** - This is used to enable (set to 1) or disable (set to 0) the bump processor.

**BUMP BOTTOM** - This is used to enable( set to 1 ) or disable( set to 0 ) the bottom bump processor.

Refer to the BUMP LOCATOR section of the manual for a description of these features.

## **FLASH STORAGE**

**FLASH STOR** - This function is only available if your machine is equipped with flash memory. This is used to enable (set to 1) or disable (set to 0) the storage of data to the flash memory device.

## CONTROLLING THE RUN

### SIMPLE MODE

The CS 8200 can be set up to run in the SIMPLE MODE. The CS 8200 is in the simple mode if the REDUCTION LEN is greater than 10 ft. In this mode, the controller prints reports at an interval described by the REDUCTION LEN. To run a test in the SIMPLE MODE, follow these steps:

- 1 Key the desired beginning station number into **BEGIN**.
- 2 Select an incrementing or decrementing odometer with the **DIRECTION** switch.
- 3 Align the axle of the measurement wheel with the BEGIN station number on the pavement.
- 4 **Press START**; at this point, the report header should be printing on the printer.
- 5 When you have reached the end of the measurement interval **press the STOP key** and the final report will be printed.

In SIMPLE MODE, the controller will generate reports at the interval specified in REDUCT LEN. These reports, however, will not be printed until the reduction interval has been completed. Once completed, the report shall then be printed. The printing of the report will not interfere with the accumulation of data for the next report.

There is normally one shortened segment run because the distance between the beginning station and the ending station is seldom an even multiple of the reduction length. This shortened segment will be placed at the end unless it is less than 10 feet in which case it will be omitted.

Specifying a reduction length of 10 feet or less will cause unpredictable and undesirable results.

When the START button is pushed, the starting station will be transferred to the ODOMETER and a header will be printed. Data collection and reporting shall continue until the STOP button is pushed. Pressing the STOP key causes any remaining data to be reduced and summary information to be printed.

## REPORT FORMAT

Each test interval includes at least three sections, a report header, report(s) every REDUCTION LEN, and summary information.

### REPORT HEADER

The following is the report header which is printed every time the start key is pressed. This report records the state of the CS 8200 at the beginning of a test. Note, parameters cannot be changed after the start key is pressed. Parameters may only be changed when the CS 8200 is in the STOPPED mode.

AUTOPROF VERSION	3.00
FILE NAME : 5C031409	
MARCH 03, 1998	14:09
JOB NUMBER	6437
PASS	1
PAVEMENT	8
ROUTE	66
DISTRICT	18
WHEEL PATH	RR
DIRECTION	NORTH
ODOMETER(COUNTS/528 FT)	15840
NULL BAND WIDTH(IN)	0.20
BUMP HEIGHT(IN)	0.30
BUMP WIDTH(FT)	25.0
BUMP BOTTOM	OFF
DATA FILTER HI(CYC/FT)	0.00
DATA FILTER LO(CYC/FT)	2.00

\*\*\*\*\*START REPORT\*\*\*\*\*

---

### NOTE

*Due to variations in printer platen size, the horizontal(longitudinal) scaling, which should be 1 inch(on the trace) equals 25 feet of pavement traveled, may vary depending on the actual amount of platen diameter variation.*

---

## REPORT(S)

An annotated profilogram will be printed when the CS 8200 has finished measuring a reduction interval as described by the REDUC LEN parameter. Each time the CS 8200 has traveled through a reduction interval an annotated profilogram of that interval will be printed. The vertical scaling of this report is 1(inch) to 1(inch), while the horizontal scaling of this report is 1(inch) on paper to 25(feet) of pavement.

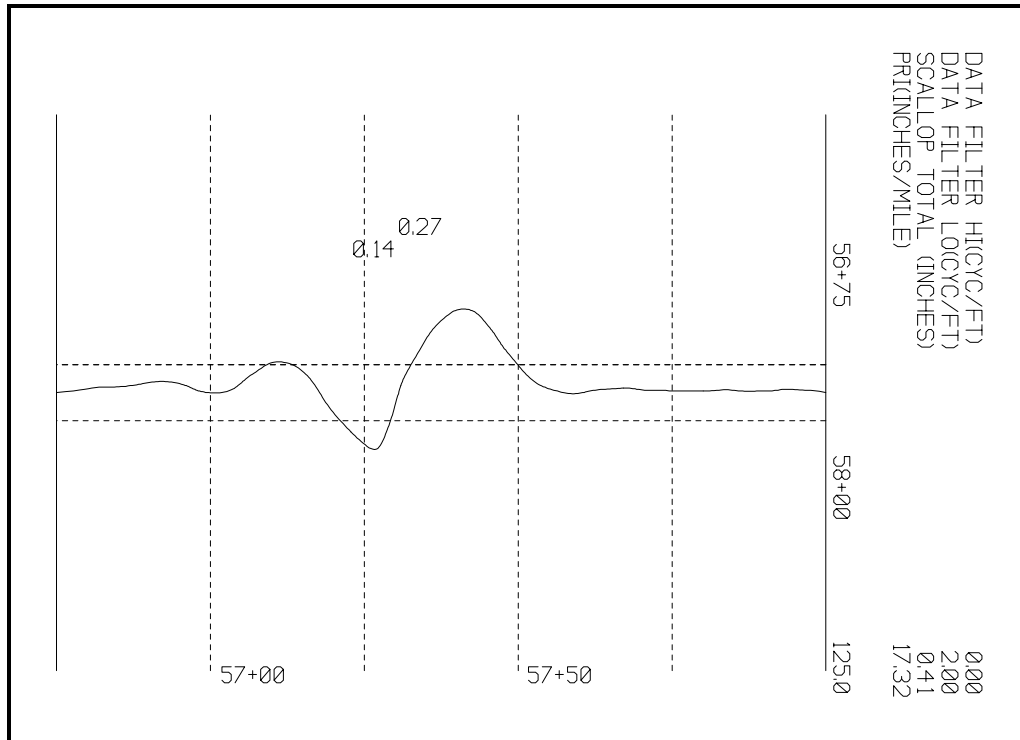


Figure 13 Annotated Report

The two parallel dashed horizontal lines are referred to as the null band. Scallop(bump) height is determined with respect to these lines. This report indicates two scallops. The first scallop height has been recorded as 0.14 and has been placed above the trace. All scallop counts are placed above the trace. The second scallop has been measured as 0.27 and is also printed above the trace. There is a third area which is located before the 0.14 scallop that has not been counted. This is because all scallops must meet a minimum length and height requirement.

The vertical dashed lines indicate stationing. They are printed every 1 inch on the paper which would be every 25 feet on the pavement. Every 50 feet an actual station number is printed at the bottom of the report. In this case the station numbers 57+00, 57+50 are printed.

## TEST INTERVAL SUMMARY

When the STOP key is pressed any remaining data will be printed; this final report will often be less than REDUCTION LEN(528'). This last report will be followed by a summary report. This report lists approximate must grind locations, report begin, report end, report distance, report total of scallop counts(IN), and the PRI of each report. For example, the first report started at 15+65, ended at 10+37, the distance traveled was 528 feet, the total scallop counts were 0.35, and the PRI was 3.50. The next two lines describe the following two reports. Finally, the CS 8200 has totaled the distance and the scallop counts. This information is used for the calculation of an overall PRI number.

\*\*\*\*\*END REPORT\*\*\*\*\*

AUTOPROF VERSION 3.01

FILE NAME : 5C031409

MARCH 03, 1998 14:09

JOB NUMBER 6437

PASS 1  
PAVEMENT 8  
ROUTE 66  
DISTRICT 18  
WHEEL PATH RR  
DIRECTION NORTH

ODOMETER(COUNTS/528 FT) 15840  
NULL BAND WIDTH(IN) 0.20  
BUMP HEIGHT(IN) 0.30  
BUMP WIDTH(FT) 25.0  
BUMP BOTTOM OFF  
DATA FILTER HI(CYC/FT) 0.00  
DATA FILTER LO(CYC/FT) 2.00

\*\*\*\*\*APPROX MUST GRIND LOCATIONS\*\*\*\*\*

FROM	TO
15+05	14+91

\*\*\*\*\*REPORT HEADER SUMMARY\*\*\*\*\*

FROM	TO	DIST	COUNTS	PRI
15+65	10+37	528.0	0.35	3.50
10+37	5+09	528.0	0.47	4.70
5+09	0+45	464.0	0.29	3.30
		-----	-----	
		1520.0	1.11	

OVERALL PRI (INCHES/MILE) = 3.86

The above OVERALL PRI calculation was performed in the following manner :

$$( 5280 / \text{distance}(1520) ) * \text{counts}(1.11) = \text{PRI}(3.86)$$

## IGNORING BRIDGES

Note: This function has been temporarily disabled in software.

The CS 8200 has a special feature, which can be used to ignore bridges or other non-measurement sections. The following steps are necessary to use this feature:

- 1 Stop the CS 8200 and align the measurement wheel up with the beginning of the section to be ignored.
- 2 Wait for the printer to stop printing; a report may be in progress. The BRIDGE feature will not function until the report is finished.
- 3 Push the BRIDGE/TIME key. This will cause a report to be printed, ACQUIRING DATA on the bottom line of the LCD will be replaced by IGNORING BRIDGE.
- 4 Move the profilograph across the section to be ignored. Do **NOT** pick up the measurement wheel.
- 5 Wait for the printer to stop printing if necessary.
- 6 Push the START key. This will cause IGNORING BRIDGE to be replaced by ACQUIRING DATA and measuring will continue. No header report will be written.

The IGNORE BRIDGE feature results in a profilogram without the ignored section. For example, the following is a summary report which was produced using the ignore bridge function:

FROM	TO	DIST
758 + 00	763 + 28	528
763 + 28	766 + 53	325
768 + 50	773 + 84	520
773 + 84	779 + 12	528

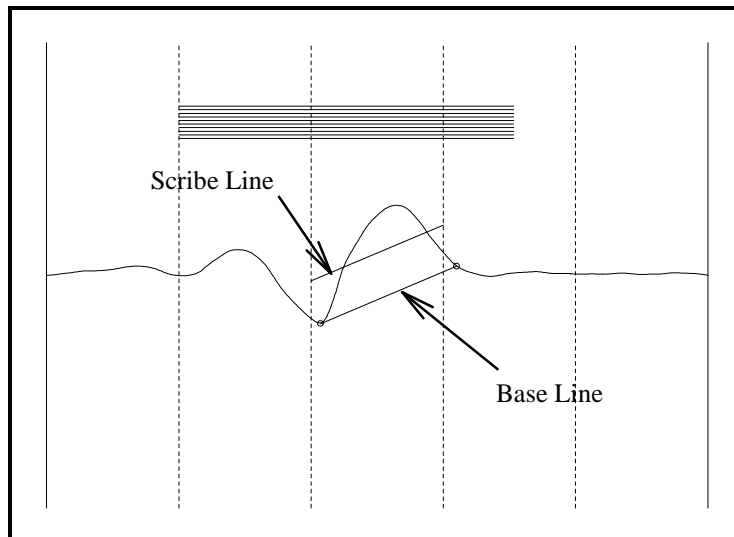
The operator started the CS 8200 at 758+00 and continued to the start of the bridge at 766+53 at which point the operator pressed the BRIDGE button. The operator then pushed the CS 8200 to 768+50, with the measurement wheel down, at which point the START key was pressed again. The road profile from 766+53 to 768+50 has been ignored. The operator then pushed the machine from 768+50 to 779+12 which caused two reports to be printed.

## BUMP LOCATOR

The CS 8200 has the ability to detect bumps with a template of user selected length and height (see REDUCTION PARAMETERS). Normally the template is set at 25 feet (7.6 meters) in length and 0.30 inches (0.75 cm) in height. This template is moved through the data as the CS 8200 is pushed. The template consists of two parallel lines separated by BUMP HT. A must grind condition occurs if the trace extends above the parallel line defined by BUMP HT, scribe line. At this point the CS 8200 alerts the user that the pavement is out of spec by sounding the internal beeper, and by displaying BUMP OUT on the bottom line of the LCD display. The pavement will remain out of spec until the trace does not extend beyond the parallel line defined by BUMP HT, scribe line. **The calculation of the must grind has nothing to do with the null band or the scallop counts recorded at the top of the trace. These two test are performed independently.**

The BUMP BOTTOM parameter allows the user to check for dips. If enabled, the CS 8200 will apply the must grind template to the data upside down.

The must grind information is also recorded so it may later be printed to the thermal printer. The report format is as follows:



In the above figure the must grind is indicated by the dark horizontal lines appearing above the trace. These lines indicate the area where the trace is out of spec. Due to multiple template placements for any given must grind the final grinding areas are not marked by the CS 8200. This is best left to a human.

---

### WARNING

*The shaded area is APPROXIMATE; by no means should the user assume that the entire area must be ground. The shaded area simply indicates a region of pavement that is out of specification. The exact locations which must be ground must be located on the pavement preferably with a straight edge.*

The CS 8200 also records the approximate start and stop location of the must grind(s) found, up to five hundred, and these are printed at the end of the test interval, (see REPORT FORMATS).

```

**APPROX MUST GRIND LOCATIONS**

FROM          TO
-----
20+52         20+84
37+53         99999999+99
```

Above is an example of two grind areas the first starting at 20+52 and ending at 20+84. The second starts at 37+53 and appears to never end. This is because the grind area continued beyond the point where the STOP key was press.

---

## WARNING

*These are approximate locations. The actual location of the grind may vary slightly from the indicated area. It is our opinion that exact bump location is best done with a straight edge.*

---

## NULL BAND

The null band width is controlled by the NULL BAND WIDTH parameter. This is usually set to 0.20 inches but may be change to whatever values your local authority determines. The null band may also be set to 0.00 which in effect makes the band a line. This was done to allow the CS 8200 to be operated in those states that require a zero blanking band.

The null band is established by a **best fit** line through all the points within the section being reduced. This method does not work, however, when short radius curves are present. In this case, a digital filter may be used to filter out any long wavelengths from the data. This filter is the DATA FILT HI. This filter will be enabled if the DATA FILT(HI) parameter is set to any number greater than 50.

---

## CAUTION

***DATA FILT(HI) This filter should only be used if short radius curves are being measured. This is almost never the case. James Cox & Sons has not studied the use of this filter and has included it for qualified state or federal agencies to evaluate, (see HIGH PASS FILTER).***

---

**DATA FILTER**

The CS 8200 profilograph uses a low pass digital filter to smooth the incoming data before analyzing it. It does this because its data reduction program tests for maximum excursions from the null band. Manual data reducers estimate the center of the data traces generated on mechanical profilographs. This is necessary because mechanical recorders are affected by vibration and play in the linkages plus the fact that "high frequency" roughness caused by pavement texture is not a pavement flaw. **The goal of the DATA FILTER is to smooth the curve adequately so that it corresponds to the center of the trace that would be generated by a mechanical profilograph but not so much that it smooths out pavement profile flaws.**

A recommended data filter factor was determined by running a manual profilograph and a CS 8200 repeatedly over the same pavement and overlaying the two traces. In our tests, a DATA FILTER settings of 2.0 to 2.2 produced a curve on the CS 8200 that closely approximated the center of the trace of the manual profilograph. This does not guarantee, of course, that any given data reducer would get identical results when reducing the two profilograms or that either would exactly match the computer's interpretation. The computer may be more or less forgiving in its interpretation of the data than a human data reducer would be. The computer interpretation, however, will almost certainly be more consistent from unit to unit than manual reduction will be from reducer to reducer.

**It is up to the responsible authority to determine if alternative filter factors and acceptable counts per mile are appropriate for the prevailing conditions. It is important to understand that the test results are heavily affected by the selected filter factor.** The filter factor is specified in the header report at the start of each test. It may not then be modified until the test has been terminated.

James Cox & Sons, Inc. recommends DATA FILTER settings from 2.0 or 2.2 as a starting point. We recommend that any consistent difference between human and computer interpretations be resolved by modifying the acceptable counts per mile (kilometer) instead of negotiating filter factors.

For those states that have adopted the 8000 data filter setting this filter is selected by entering 8000 for the DATA FILT LO parameter. In fact, any numbers greater than 1000 will select the old filter while numbers less than 1000 will select the new third order filter. If the data filter is set to 0 no filtering will be performed.

**LOW PASS FILTER**

The CS 8200 profilograph has two digital data filters. The original is a first order low pass filter; the new filter is a 3 pole Butterworth. We recommend using the Butterworth with a filter setting of 2. The original, first order, filter has been kept for those states which have already written specifications around the first order filter.

**CAUTION**

*The contractor should obtain certification, from the agency involved, for the use of this type of profilograph. The filter setting selected for use will automatically be printed on each report for future verification.*

*Care must be taken to avoid OVER-FILTERING of the data. The filter should only remove spikes from the data caused by debris, pavement texture, and frame vibration.*

FIRST ORDER (original filter) is of the equation :

$$Y(k) = AY(k-1) + BX(k)$$

where:  $A + B = 1$ .

B times 65536 is used as the filter factor  
k has a ground resolution of 1.2 in (3.0 cm)

Filter factors vary from 1000 to 65535. A factor of 1000 gives an unreasonable heavy filter and a factor of 65535 results in virtually no filter at all. Let's look at how they work.

Assume that the current value is 1.43 and the filter factor is 8000. A reading is taken every 1.2 inches or 3.0 cm. The next reading shows that the test wheel has hit a rock and suddenly jumped to 2.00. The new data is multiplied by the filter factor over 65536:

$$2.00 (8000/65536) = .24$$

The last reading is multiplied by 65536 minus the filter factor and then is divided by 65536:

$$1.43 (65536/65536) = 1.26$$

These two values are added together and form the next point on the data line:

$$.24 + 1.26 = 1.50$$

The new data point affected the data line. It brought the data line from 1.43 to 1.50, but the data line would have gone to 2.00 had the data filter not been operating.

Larger filter factors will give more weight to each new data point and will result in a rougher data line. Lower filter factors will make the data line progressively smoother.

**GENERIC THIRD ORDER BUTTERWORTH AS DESCRIBED BY JON W. REINCKE OF M.D.O.T. (new filter)**

```
FUNCTION FIL(X)
DATA W1, W2, WW1/3*0/
W3=X*Q-B1*W2-B2*W1
FIL=W3+A1*W2+W1
W1=W2
W2=W3
WW2=FIL=BB1*WW1
FIL=WW2+AA1*WW1
WW1=WW2
RETURN
END
```

**CALCULATION OF THE LOW PASS CONSTANTS**

```
C=1.0/TAN(3.141592654*WC/SR)
Q=1.0/(1.0+C)*1.0/(1.0+C+C**2)
A1=2.0
B1=(2.0-2.0*C**2)/(1.0+C+C**2)
B2=(1.0-C+C**2)/(1.0+C+C**2)
AA1=1.0
BB1=(1.0-C)/(1.0+C)
```

WC = Filter breakpoint in cycles per foot (e.g. a 2 ft wave is 1/2 cycles per foot).

SR = Samples per foot (10.0 for the CS8200).

Filter settings for the Butterworth filter vary from 0.1 to 50 feet.

For example, a filter setting of 2.0 indicates that a wavelength of 2.0 ft will be attenuated by 3db, and shorter wavelengths will be attenuated even more.

## HIGH PASS FILTER

### CALCULATION OF THE HIGH PASS CONSTANTS

$$\begin{aligned}C &= \text{TAN}(3.141592654 * \text{WC} / \text{SR}) \\Q &= 1.0 / (1.0 + C) * 1.0 / (1.0 + C + C^{**2}) \\A1 &= -2.0 \\B1 &= (2.0 * C^{**2} - 2.0) / (1.0 + C + C^{**2}) \\B2 &= (1.0 - C + C^{**2}) / (1.0 + C + C^{**2}) \\AA1 &= -1.0 \\BB1 &= (C - 1.0) / (1.0 + C)\end{aligned}$$

WC = Filter breakpoint in cycles per foot (e.g. a 200 ft wave is 1/200 cycles per foot).

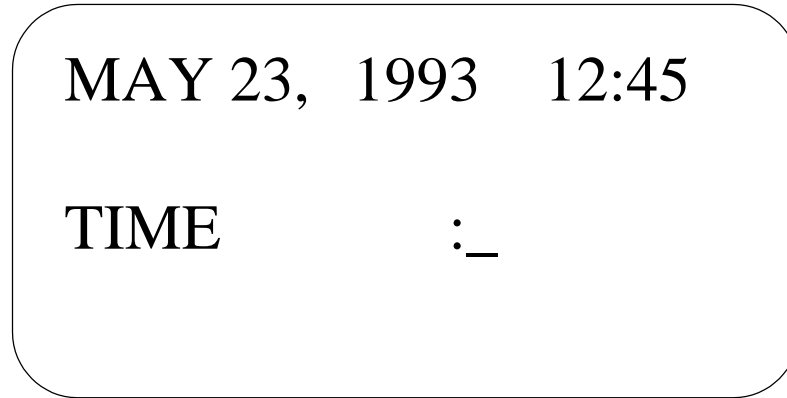
SR = Samples per foot (10.0 for the CS8200).

Filter settings for the Butterworth filter vary from 50.0 to 500.0 feet.

For example, a filter setting of 75.0 indicates that a wavelength of 75.0 feet will be attenuated by 3db, and longer wavelengths will be attenuated even more.

## SETTING THE TIME AND DATE

To set the time you must first be in the STOPPED mode. Now press the BRIDGE/TIME key and the following screen should appear:



To change the time simply enter the new time at the time prompt in the following format HOUR.MIN and then press the ENTER key (Note, 24 hour time is used). For example, if it was 2:53 p.m. you would enter 14.53 followed by pressing the ENTER key. At this point the CS 8200 asks you to enter a new date. If you wish only to change the time then press the CLEAR key to exit or enter a new date at the date prompt.

To change the date you enter the date in the following format MONTH.DAY.YEAR and then press the ENTER key. For example, if you wished to set the date to June 1, 1993 you would enter 6.1.93 and then press the ENTER key.

If for some reason you should accidentally enter the date/time editing mode you may exit by pressing the CLEAR key. This will take you back to the main view.

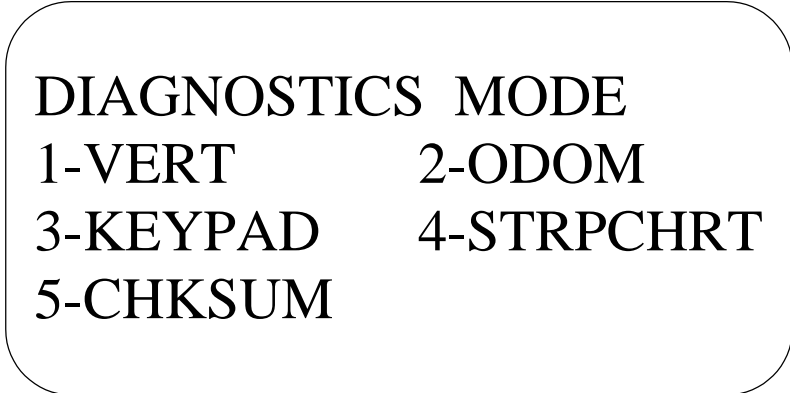
### NOTE:

**If the time and date change by themselves, this means that you need to replace the two AA batteries located on the top right side of the computer.**

## **DIAGNOSTICS**

The CS 8200 Profilograph has a set of diagnostic routines to aid the operator in trouble shooting and calibration. You may enter the DIAGNOSTICS mode by executing the following steps :

- 1       Reset the computer by holding the RESET switch located on the front panel.
- 2       While holding the RESET switch press the F1 key located in the upper left hand corner of the front panel keypad.
- 3       Now release the RESET switch while still holding the F1 key down until the following screen appears on the LCD display.



**DIAGNOSTICS MODE**  
1-VERT           2-ODOM  
3-KEYPAD       4-STRPCHRT  
5-CHKSUM

- 4       To exit the diagnostics mode simply hold the reset switch and release.

The following diagnostics and calibration procedures can then be performed:

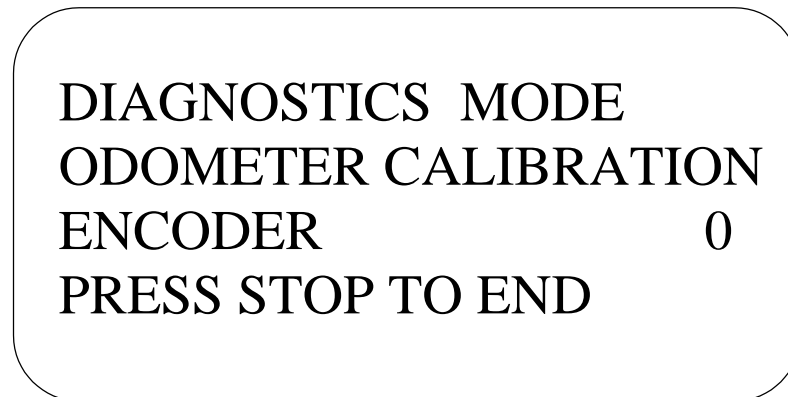
- ODOMETER CALIBRATION**
- VERTICAL INSPECTION**
- KEYPAD & SWITCH DIAGNOSTICS**
- STRIP CHART MODE**
- CHECKSUM**

The following sections will describe how to use each of these functions in detail.

## ODOMETER CALIBRATION

Odometer calibration is accomplished by pushing the CS 8200 through a 528 foot interval. The calibration procedure requires that the CS 8200 need only traverse the 528 foot interval once, unlike its mechanical predecessors. The odometer is calibrated by following the procedure described below, but first you must measure off 528 feet as accurately as possible, the more accurate this is the better the calibration of the machine. The odometer is calibrated by the sequence detailed below:

- 1 Enter DIAGNOSTICS mode as described above.
- 2 Push the profilograph to the start of the measured distance (528 feet), being careful to align the axle of the measurement wheel up with the start of the 528 foot section.
- 3 Press the START button, located in the lower right hand corner of the keypad, and the following screen should appear.



- 4 Push the profilograph, in as straight of a line as possible, to the end of the measured distance, also being careful to align the axle of the measurement wheel up with the end mark on the pavement.
- 5 Press the STOP key located on the front panel keypad. In the event of a malfunction, an error message will be printed to the LCD display.
- 6 If you wish to use this calibration run press the ENTER key, if not, press the CLEAR key. If the ENTER key is pressed, a report shall be printed to the thermal printer documenting the date, time and the old and new factors. It is a good idea to keep these documents as proof of frequent calibrations. If the CLEAR key is pressed, you will be returned to the main diagnostics screen.

---

### NOTE


***Due to routine measurement wheel tire wear it is recommended that the calibration procedure be repeated periodically. James Cox & Sons also recommends that the measurement wheel tire pressure, to be determined by state D.O.T., be checked daily. Small variations in measurement wheel circumference caused by improper tire pressure or wear will produce inaccurate results.***

---

## VERTICAL INSPECTION

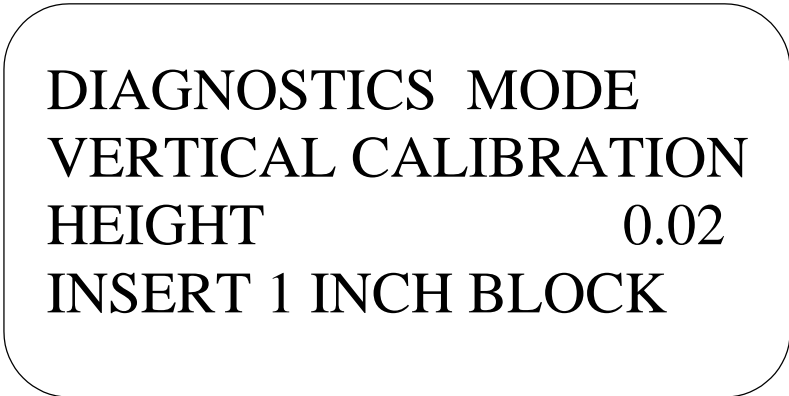
Due to rough or possible mishandling of the profilograph, the vertical calibration may be altered, causing inaccurate vertical measurements. **Periodic checking of the vertical displacement MUST be practiced by the user.** The inspection procedure is very simple and is accomplished by using a calibration kit which is provided. The following steps explain this procedure.

- 1 Assemble the CS 8200 (Refer to the ASSEMBLY section).
- 2 Move the CS8200 to a relatively flat area and turn on the electronic control unit and enter the DIAGNOSTICS mode (see DIAGNOSTICS above). Once in the DIAGNOSTICS mode press the 1 key and the following screen should appear on the LCD:



DIAGNOSTICS MODE  
VERTICAL CALIBRATION  
  
INSERT BASE PLATE

- 3 Place the base plate under the measurement wheel and then press the ENTER key. Once the ENTER key has been pressed **DO NOT** lean on or touch the CS 8200 until the following screen appears:



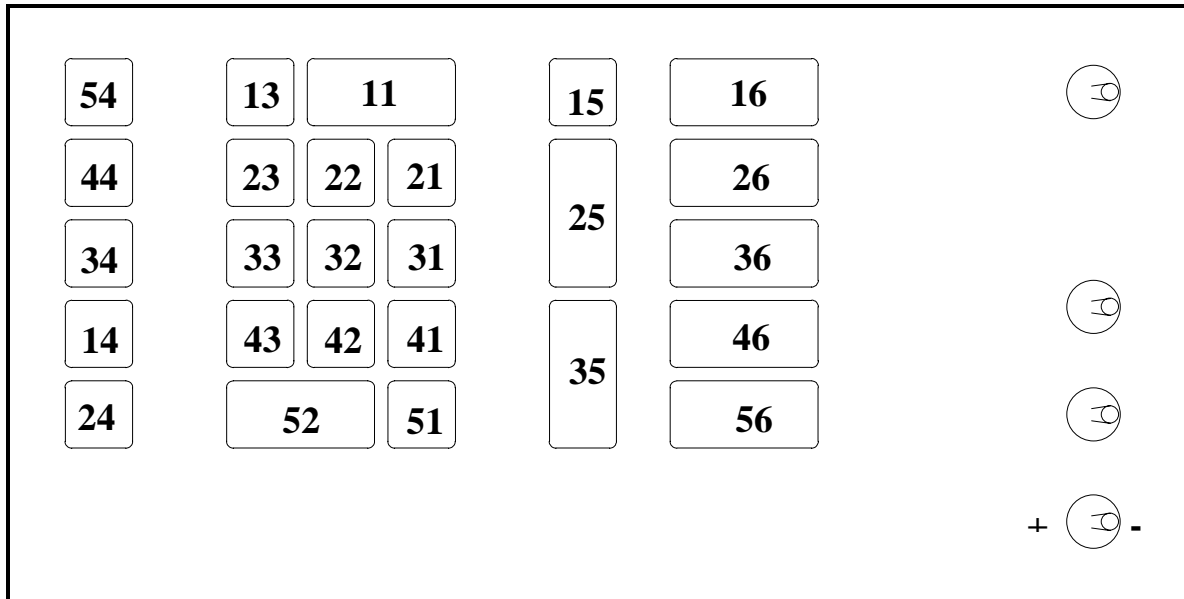
DIAGNOSTICS MODE  
VERTICAL CALIBRATION  
HEIGHT 0.02  
INSERT 1 INCH BLOCK

- 4 Gently lift the wheel off the base plate, being careful not to disturb the base plate, and place the stepped measuring block so that the wheel rests on the 1 inch section. Press the ENTER key again, following the guidelines described above (no leaning or touching), and the following screen should appear:

DIAGNOSTICS MODE  
VERTICAL CALIBRATION  
HEIGHT 0.02  
INSERT 2 INCH BLOCK

- 5 Gently move the stepped measuring block so the wheel now rests on the 2 inch section. Press the ENTER key again, observing the no-touch warning, and once a few seconds have passed and the calibration check was successful a message will be printed to the LCD display indicating the CS 8200 passed. If the CS 8200 failed an error message will be printed on the LCD display and a report will be printed to the thermal printer. If this should happen, call James Cox & Sons immediately.

## KEYPAD & SWITCH DIAGNOSTICS



**Figure 15 - Key Codes**

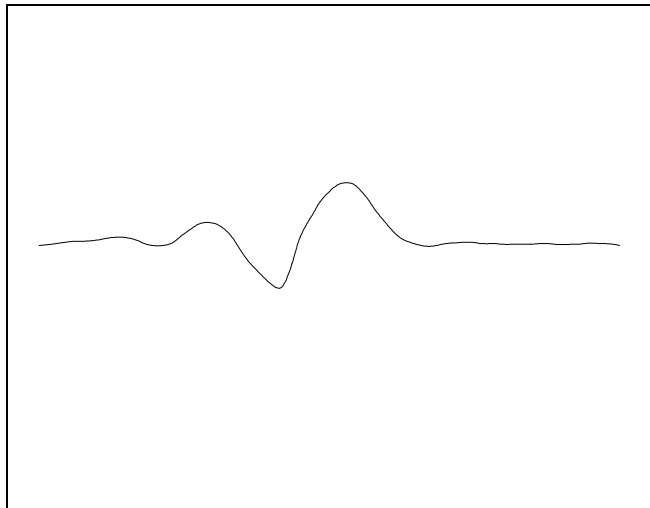
The figure above indicates the key code that should appear on the LCD in the lower right hand corner when the associated key has been pressed. The keypad and switches can be checked with this diagnostic by performing the following steps:

- 1 Enter DIAGNOSTICS (see DIAGNOSTICS).
- 2 Press the 3 key to enter keypad diagnostics.

In response to this, the bottom line of the display should display two fields. The first will be either (-) or (+) depending upon the position of the DIRECTION switch. The second field will be a zero until a key pad is pressed. When a key is pressed, its number will be displayed in this second field. See Figure 8 for the numeric codes of the keys.

## **STRIP CHART MODE**

The CS 8200 is also capable of operating in a STRIP CHART mode. This is called by entering the diagnostics mode and then pressing the 4 key (see DIAGNOSTICS for a discussion of the STRIP CHART mode). Strip Chart Mode generates a single trace without null band, bump shading, or stationing. It does not reduce scallops or report "counts". It is intended mainly as a diagnostic tool and may be used to exactly locate pavement features. It is slower than the normal report printing but works in real time.



**Figure 16 - Strip Chart Mode**

## CHECKSUM

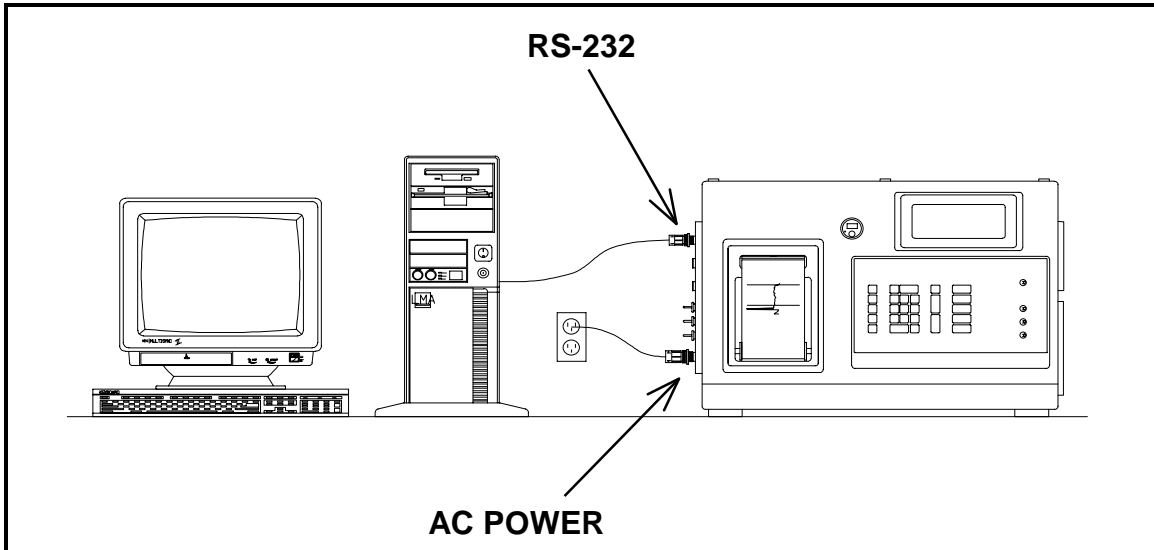
A checksum of the program memory can be obtained in DIAGNOSTICS mode by pressing the 4 key. After a few seconds the checksum is displayed on the bottom line of the display. This number should be recorded. If the checksum ever changes, it indicates a problem with the program memory. Loss of a program bit is rare and usually results in complete system failure. A lost program bit may, however, cause some very puzzling symptoms. When a malfunction occurs, this test can assure you that the problem is not caused by program failure. If the diagnostic runs and the proper numbers are displayed, the computer and its program are probably fully functional. The problem is most likely outside of the computer and can be troubleshot with standard electronic tools. Note, the checksum number will change every time the software is updated.

RECORD CHECKSUMS HERE:

Version	Checksum
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

## PROGRAM UPDATE

The CS 8200 has the capability of having its software updated in the field. This requires the user to have either a IBM PC compatible laptop or IBM PC compatible with a RS-232C serial port. Software updates will come on either 5.25 inch or 3.25 inch IBM compatible floppy diskettes.



---

## WARNING

*Data stored in the FLASH memory may be damaged by updating the control software. If the FLASH memory contains data either print it or save it. Once the data has been saved or printed FLASH memory must be erased, (see ERASING FLASH MEMORY).*

---

The software update process is described in the following steps:

- 1 Bring the CS 8200 controller into your office and place it beside your IBM compatible PC. Connect the AC power adapter cable to the CS 8200 controller and turn it on.
- 2 Connect the RS-232C cable between your PC and the CS 8200 controller. You may need to refer to your PC's operators manual for instructions on how to connect to your particular PC.
- 3 Procedure for PC running DOS or Windows version 3.10:  
Now reboot your PC with a bootable floppy in drive A: if you have MS-DOS version 5.0 or earlier. If you have MS-DOS version 6.0 or later then reboot your computer by pressing <CTRL> <ALT> <DEL>. A short time later a message will appear STARTING MS-DOS..., at this point hold down the <F5> key. The above two procedures describe how to clean boot your computer so that no TSR's or device drivers are loaded. These programs, if present, may conflict with the CS 8200 program update software.

**Procedure for a PC running Windows 95 :**

Boot computer by cycling the power. When the display reads "STARTING WINDOWS 95" press the <F8> key. You will then be prompted to select the boot method. Chose the option which reads "**Safe mode command prompt only**".

- 4 Now place the supplied program update disk into drive A: of your computer.
- 5 With the program update disk in drive A: of your computer, you must change the drive letter to A:. To accomplish this type the following command at the DOS prompt :

A:<ENTER>

A: is now the current drive. Now type ENG or ENG /2 at the DOS prompt; note, the /2 indicates that you have connected the CS 8200 to COM2 of your computer. If you had connected the CS 8200 to COM1 then you would simply type ENG. The following is an example of how to install the software from drive A: via COM2.

A:>ENG /2<ENTER>

If the installation program was executed properly the following message should appear on your computers display.

CS8200 Program Updater, Ver 1.50  
Copyright (C) 1993-96 James Cox & Sons, Inc.

Waiting for connection on COM2.

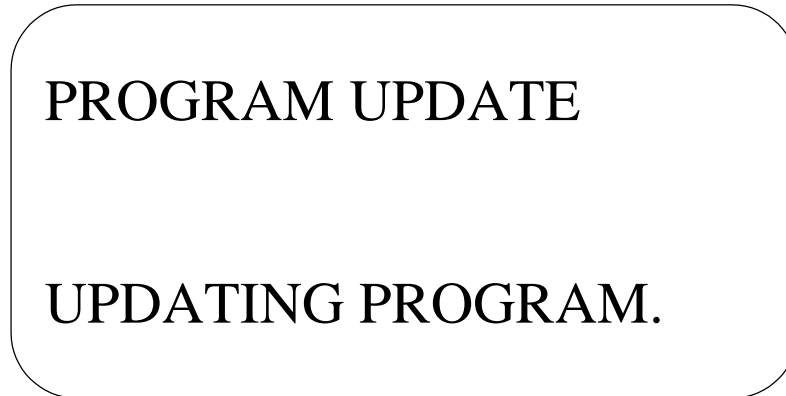
If you wanted to use COM1 to communicate then you would type the following command at the A: prompt :

A:>ENG<ENTER>

At this point your PC is waiting to establish a communication link with the CS 8200.

If you wished to install the SI (Metric) version of the CS 8200 control program, simply replace the ENG command with the SI command, and the SI version of the software will be loaded.

6 You may now reset the CS 8200 making sure to hold down the UP ARROW key until the following screen appears:



7 Now your PC display should read as follows:

CS8200 Program Updater, Ver 1.50  
Copyright (C) 1993-96 James Cox & Sons, Inc.

Sending record # : xxx

If for some reason this is not the case call James Cox & Sons for assistance. The programming process can take a few minutes, so kick back and wait for the CS 8200 to tell you how things went. If the programming process was successful the CS 8200 software is automatically run. If something went wrong an error message will be printed to the LCD informing you that there was a problem. If this is the case call James Cox & Sons for assistance.

If the process went well the following will appear on your computer's display:

CS8200 Program Updater, Ver 1.50  
Copyright (C) 1993-96 James Cox & Sons, Inc.

Program update successful.

If the process was not successful the following will appear on your computer's display:

CS8200 Program Updater, Ver 1.50  
Copyright (C) 1993-96 James Cox & Sons, Inc.

Program update failed, call James Cox & Sons for assistance.

- 8** Once the CS 8200 control software has been successfully loaded you **MUST** re-initialize the parameter storage area. This procedure will re-initialize the parameters to their default values. For a record of the current parameter settings, press the <F1> key while the CS 8200 is in the stopped mode, and a report will be printed. You may now re-initialize the parameters by performing the following steps :

Enter diagnostics mode, (see DIAGNOSTICS).

Press the BRIDGE key.

Wait for the bottom line of the LCD to read "Flash Init Done, Reset to Exit".

Reset the CS 8200 for normal operation.

Now press the <F1> key again to determine which parameters have been changed by this process. Now, would be a good time to set any parameters that have been altered. The ODOM FACT parameter is always set back to its default value. You **MUST** re-calibrate the CS 8200 after updating the control software, (see ODOMETER CALIBRATION under DIAGNOSTICS).

Remember to erase the flash memory, (see ERASING FLASH MEMORY). James Cox & Sons does not guarantee that the data storage format from one version to another will stay the same.

- 9** Now record the new checksum in the CHECKSUM section of the manual by performing the following steps :

Generate new checksum, (see CHECKSUM under DIAGNOSTICS).

Record this number in the CHECKSUM section of the manual.

## FLASH MEMORY

The CS 8200 has the ability to store 51 miles of data on a non-volatile solid state FLASH memory device. To select the FLASH OPTIONS menu press the DOCUMENT POINT key while the CS 8200 is in the STOPPED mode. The following menu should appear.

### FLASH OPTIONS

1 - ERASE	2 - DWNLOAD
3 - PRINT	4 - STATUS

The following FLASH functions may then be performed :

- ERASE FLASH
- DOWNLOAD DATA FROM FLASH
- PRINT DUPLICATE REPORT FROM FLASH
- STATUS OF FLASH

---

### WARNING

*The CS 8200 must not be allowed to run out of gas, be turned off, or be reset, unless the bottom line of the LCD display reads STOPPED. Failure to observe this precaution could result in the loss of FLASH data.*

---

## **ERASING FLASH MEMORY**

**It is recommended that you erase the Flash Memory frequently. If you allow it to fill up it will cause an error message to appear on the LCD that will not allow you to continue to acquire data.**

Once you have selected the ERASE option from the FLASH OPTIONS menu the following screen should appear :

**WARNING ALL DATA  
WILL BE DESTROYED !  
PRESS F1 TO ERASE**

At this point the user must press the F1 key to confirm the erase operation, pressing any other key will return the user to the FLASH OPTIONS menu.

---

### **WARNING**

***This will destroy all data contained in the FLASH memory.***

---

The erase procedure can take a few minutes depending on the amount of data stored. When complete the main FLASH OPTIONS menu will reappear.

You may then check to see if the card has been erased by selecting the STATUS option from the FLASH OPTIONS menu, (see FLASH STATUS).

## **PRINTING DUPLICATE TRACES**

This function allows the user to print reports from the FLASH memory. The user may make as many copies as necessary.

Once you have selected the PRINT option from the FLASH OPTIONS menu, the following screen should appear :

### **PRINT OPTIONS**

1 - ALL                      2 - DATE  
3 - ID

You have the option of printing all the reports contained in flash memory, just the test intervals generated on a specific day, or the test interval identified by a user supplied ID.

- ALL -                      If you select the ALL option, then all the reports currently stored in flash memory will be printed to the printer. Since there may be more than 30 reports( 3 miles ), this function will pause after printing 30 reports, so that you may insert a new roll of paper. You must also insert a new roll of paper before starting this procedure.
- DATE -                      If you select the DATE option, you will then be prompted to enter the date that the test intervals were recorded. The format is the same as changing the date, mm.dd.yy<ENTER>, (see SETTING THE TIME AND DATE for a full description). If however you wish to print the reports that have been generated on the current date then simply press the ENTER key and the current date will be used to select the test intervals to be printed.
- ID -                              If you select the ID option, you will then be prompted to enter an ID number. To determine the ID number of the test interval stored in FLASH memory that you are interested in, you must first print the FLASH status, (see FLASH STATUS). Once you have printed the FLASH status, you will notice that ID numbers are printed directly above the filename.

## **ADJUSTING THE NULL BAND**

The duplicate trace function allows the null band width to be changed from its original setting. All other parameters are not alterable. To change the null band width for a duplicate trace you simply change the null band width parameter, (see REDUCTION PARAMETERS).

## FLASH STATUS

You may look to see which reports have been saved by selecting the STATUS option from the FLASH OPTIONS menu. A report similar to the following will be printed if the flash memory is not blank :

```
*****FLASH STATUS*****  
  
MILES REMAINING -> 50.7  
  
ID #      1  PASS #      1  
FNAME 4D171739  
      20+00                25+28  528.0  
      25+28                30+56  528.0  
      30+56                34+99  443.0
```

The report is started with the FLASH STATUS header which is followed by the MILES REMAINING line. MILES REMAINING indicates how many miles of data can be stored in flash memory.

This is followed by a ID number and the PASS number. These two numbers may be matched to the original trace as a further means of identifying reports. The ID number may also be used to indicate which duplicate traces you would like to print, (see DUPLICATE TRACES).

This is followed by a filename, FNAME, indicating the name of the test interval. A test interval is defined as all the reports printed from the time the user pressed the START key until the user pressed the STOP key. The example above indicates there are three reports which define a test interval. The first report started at 20+00, ends at 25+28 and the total distance measured is 528.0 feet. The following two lines indicate the begin, end and distance of the remaining reports.

The filename may look confusing, but it is really a date and time code. The reason it is coded to eight digits is so that it may be used as a filename on a PC. The filename may be decoded as follows :

The first digit, 4, represents the last digit of the year in this case it indicates 1994.

The second digit, D, indicates the month where A is January, B is February and so on. Therefore the D represents April.

The following two digits, 17, represent the date.

The final four digits, 1739, represent the time in 24 hour time, 17:39 or 5:39pm.

For cross referencing a filename, like the one above, is printed on the report when the START key is pressed. This filename is also used when the data is downloaded to a PC.

## DATA DOWNLOADING

The CS 8200 has the ability to download the data stored in the FLASH memory. The only current use for this data is research projects, and keeping an electronic copy the traces. There is no current way to re-print the data from the PC because of concerns about tampering with the data. This however may be resolved someday, so it may be a wise idea to save the data for future reference.

To download data from the CS 8200 it must first be connected to an IBM compatible PC or laptop computer, (see PROGRAM UPDATE for connection details), and you must have installed the Utility Software on your PC, (see LOADING UTILITY SOFTWARE).

Now reboot your PC with a bootable floppy in drive A: if you have MS-DOS version 5.0 or earlier. If you have MS-DOS version 6.0 or later then reboot your computer by pressing <CTRL> <ALT> <DEL>. A short time later a message will appear STARTING MS-DOS..., at this point hold down the <F5> key. The above two procedures describe how to clean boot your computer so that no TSR's or device drivers are loaded. These programs, if present, may conflict with the CS 8200 download software.

The CS 8200 has the ability to download data via a RS232 connector located on the left side of the controller. Once the CS 8200 has been connected to a PC you must run the Capture utility program. First, change directories to the CS 8200 sub-directory created when the Utility Software was installed.

```
C:\>cd \CS8200<ENTER>
```

If you have connected the serial cable to COM1 then simply type Capture followed by pressing the ENTER key on your computers keyboard at the DOS prompt.

```
C:\CS8200>Capture<ENTER>
```

If you installed the serial cable on COM2 you would then type Capture /2 followed by the enter key at the dos prompt. Note, data records will be stored in the current directory. Once the program has been executed the following screen should appear:

```
CS 8200 Data Capture, Ver 3.0  
Copyright (C) 1993-96 James Cox & Sons Inc.
```

```
Waiting for data. COM1
```

---

## WARNING

***Any TSR's or device drivers using the serial ports or disk caching programs may cause the download utility to function improperly.***

---

## **DATA CONVERSION**

The downloaded data is stored in a compressed format which is not of any use for analysis. The data files may be expanded into an ASCII format by the COXTOASC utility program.

This utility may be used in the following manner :

```
coxtoasc <FILENAME>
```

For example if you have a file named 3J220628.cox that you wished to expand you would type the following command at the DOS prompt :

```
C:\CS8200>coxtoasc 3j220628<ENTER>
```

Note the extension is assumed.

If you wished to convert multiple files with the cox extension you could type the following command :

```
C:\CS8200>coxtoasc *.cox<ENTER>
```

The information captured is stored in the following format :

### **START STATE -**

This is how the CS 8200 was setup when the start button was pressed. This information is also printed at the beginning of a report. There is only one of these per run. A run being defined as the interval between the pressing of the START button and the STOP button.

### **DATA HEADER -**

A data header contains where this report started, where it ended, the PRI and the number of data points contained. There will be one of these for each report section. A report section is the defined by the REDUCTION LEN parameter.

### **DATA SECTION -**

The data section is the actual data which was recorded.

For a full description of this format contact James Cox & Sons Inc.

## **SOURCE FOR PRINTER PAPER**

Distributor:

**B G Instruments, Inc.**

13607 E. Trent Ave.  
Spokane, Wa. 99216

**(888) 244-4004 Toll Free**

(509) 893-9881 Phone

(509) 893-9803 Fax

**Use type TP-4 Thermal Paper**

You must use this paper in the thermal printer. The use of any other paper may result in inaccurate printout and shortened printer life. We do not stock this paper, so it should be ordered directly from the distributor.

## **MAINTENANCE**

### **CLEANING THE PRINT HEAD**

The printer/plotter print head should be cleaned about once a week during heavy use. Use a cotton tipped swab with completely denatured alcohol which can normally be obtained from a pharmacist. **DO NOT USE RUBBING ALCOHOL.** Alternatively, use a good grade of cassette head cleaner. The steel print bar that touches the paper as the printed chart emerges has a row of 416 heaters. These should be scrubbed with the alcohol soaked swab and then dried.

### **PROTECTION FROM THE ELEMENTS**

If you are caught in a rainstorm, turn off the cooling fan, install the tonneau, and turn off the generator. Page 4 of the generator manual warns against running it in the rain. The fan will tend to pull rain into the controller cabinet.

The CS 8200 controller box should be fairly well protected from light showers if the tonneau cover is installed. If heavy showers are expected, covers should be carried for both the controller cabinet and the generator.

### **TRANSPORTATION AND STORAGE**

The CS 8200 controller box is sensitive to temperature extremes, moisture, shock and vibration. It should always be transported in its foam lined transit box, and it should be stored in an office environment. The generator should also be stored in a protected environment but not in the office. The frame can be stored in an unheated shed.

### **SERVICE THE GENERATOR**

The generator is the component that requires the most service. It should be carefully maintained as per the owner's manual. Pay particular attention to the air filter and the oil level. Use only the recommended fuel. When the generator goes out of specification, the CS 8200 may develop some strange symptoms. It will most likely start resetting itself. This will cause the beeper to give a short beep and the controller will cancel whatever it was doing.

### **DATA RETENTION BATTERIES**

Two AA alkaline cells are located on the side of the controller above a cover located above the main power switch. These maintain power to the clock/calendar when the system is not powered. Replace these if the clock/calendar stops retaining the correct time and date when the system is powered down. It is also a good idea to replace them every year at the beginning of the season.

### **REPLACING THE GENERATOR**

If for some reason the generator should disappear, the replacement generator's AC output voltage **MUST be adjusted to 120VAC.** We have found that the out of the box voltage is around **130VAC which is not acceptable.**

**REPLACING MEASUREMENT WHEEL**

It may be necessary to replace the measurement wheel due to tire wear. We recommend that you order a new factory replacement. This is because of the cost involved with shipping the old one back to us. Once the new tire has been installed on the CS8200 the user must perform the odometer calibration procedure described in the calibration section of the manual.

**WARRANTY AND ASSISTANCE**

This warranty covers Custom Equipment manufactured by us to customer specifications.

We warrant all goods manufactured by James Cox & Sons, Inc. to be free of defects in materials and workmanship for a period of one year from the date of acceptance by the purchaser. If the date of acceptance is unduly prolonged, the warranty period will automatically commence thirty days from the date of delivery at the customer's site.

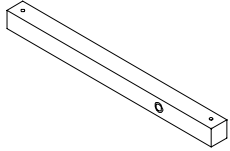
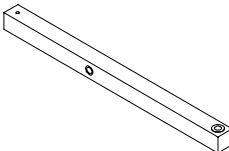
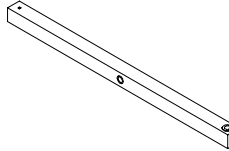
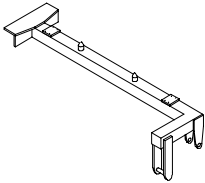
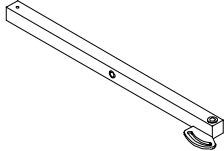
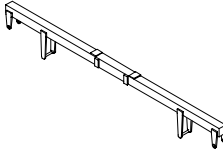
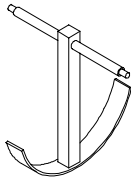
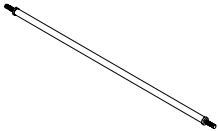
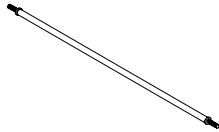
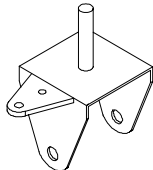
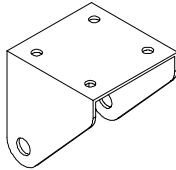
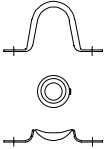
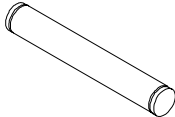
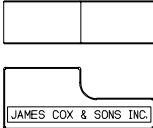
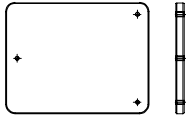
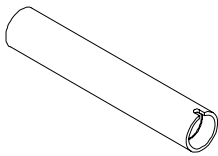
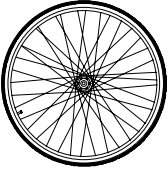
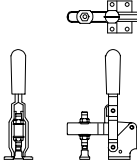
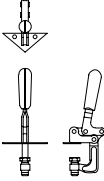
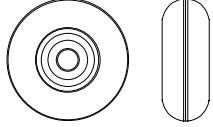
We will replace free of charge, but not including transportation costs, installation or any other service charges, components or assemblies that are manufactured by us which our inspection shows to be defected, providing they are returned to our plant within the warranty period. The warranty extends only to those machines that have been properly assembled and properly installed by the end user. On major separable items which are not manufactured by us, warranties of the original manufacturer are transferred to the purchaser with whatever warranty that remains.

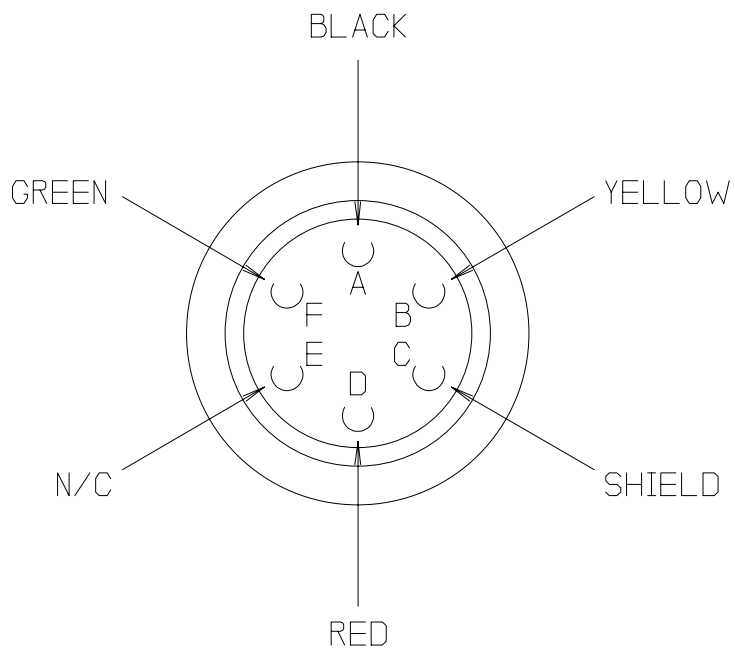
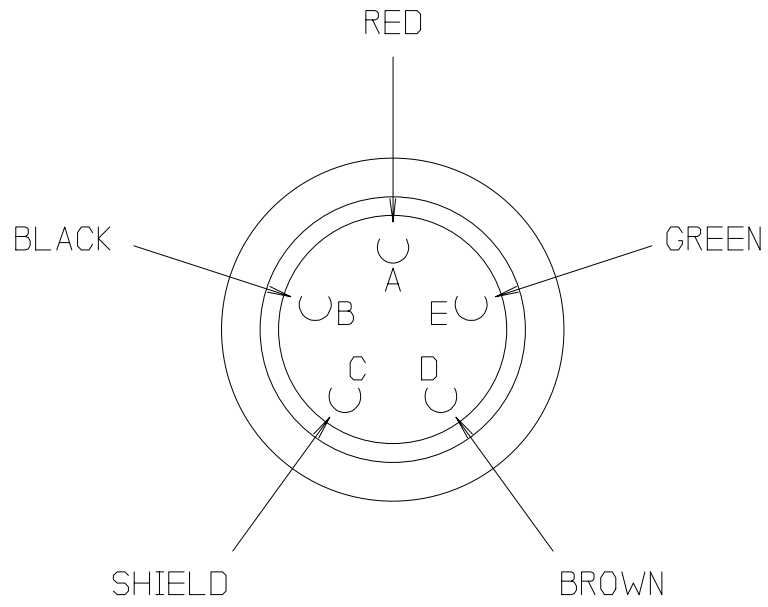
The terms of the warranty are automatically revoked in any case where a part or assembly has been physically modified in any manner whatsoever by the customer or an agency other than ours without written permission.

We are not liable for consequential damages arising from use, misuse, servicing or repair of our equipment, nor do we accept any product liability.

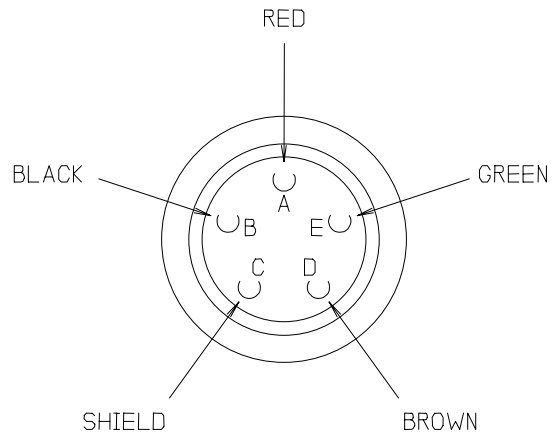
Assistance agreements are available for our products that require repair on-site.

Assistance agreements provide emergency service when deemed necessary by the customer. Tourist class round trip airline transportation will be charged at cost along with current daily rates for field service personnel.

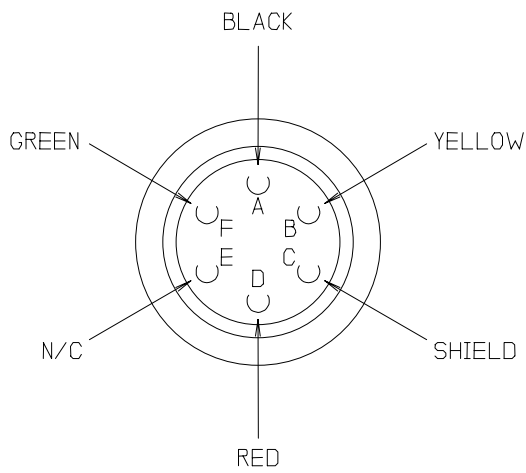
 <p>WHEEL PIVOT BAR ( 21.75 LONG ) PART NO.: PRO-118</p>	 <p>WHEEL PIVOT BAR ( 27.375 LONG ) PART NO.: PRO-119</p>	 <p>WHEEL PIVOT BAR ( 36.125 LONG ) PART NO.: PRO-120</p>	 <p>WHEEL PIVOT CROSS SUPPORT WELDMENT ASSEMBLY PART NO.: PRO-121</p>
 <p>STEERING WHEEL PIVOT BAR ASSEMBLY ( 36.0 LONG ) PART NO.: PRO-122</p>	 <p>MAIN WHEEL PIVOT BAR ASSEMBLY ( 62.0 LONG ) PART NO.: PRO-123</p>	 <p>BRAKE ASSEMBLY PART NO.: PRO-131</p>	 <p>28" TIE ROD PART NO.: PRO-132</p>
 <p>41" TIE ROD PART NO.: PRO-133</p>	 <p>STEERING WHEEL HOUSING ASSEMBLY PART NO.: PRO-141</p>	 <p>WHEEL HOUSING PIVOT BRACKET PART NO.: PRO-142</p>	 <p>BEARING HOUSING SET PART NO.: PRO-146</p>
 <p>WHEEL AXLE PART NO.: PRO-179</p>	 <p>VERTICAL MEASUREMENT BLOCK PART NO.: PRO-228</p>	 <p>MEASUREMENT BLOCK PLATE PART NO.: PRO-229</p>	 <p>PAPER TAKE UP TUBE PART NO.: PRO-161</p>
 <p>MEASUREMENT WHEEL PART NO.: 8200-004</p>	 <p>WHEEL CLAMP PART NO.: 8200-010</p>	 <p>FRAME CLAMP PART NO.: 8200-009</p>	 <p>BALLOON CUSHION WHEEL PART NO.: 8200-008</p>



SIGNAL CABLES FROM FRAME TO COMPUTER  
CONNECTOR PIN LAYOUT  
SOLDER SIDE SHOWN



VERTICAL  
MEASUREMENT  
5 PIN MALE



DISTANCE  
MEASUREMENT  
6 PIN FEMALE

**Troubleshooting**

1. **Any error message that appears on the LCD.** To fix this you must **enter the Diagnostics Mode and push the Bridge/Time Key**. This will re-initialize the operating software. The display will tell you to “Reset to exit”. You will have to recalibrate the odometer counts for distance. Also the rounding of the count will change to .01. You can change this back to .05 by pushing the reduction param key and cursuring down to 0.05 round: and entering a 1. At this point you should also make whatever duplicates you want then erase the flash memory.
2. **Vertical displacement quits working (flat road).** Begin by visually inspecting the signal cable coming out of the frame that plugs into the computer (5 pin male) page 57. If you forget to unplug the cables when you take the computer off the center section they can be easily broken.
3. **Distance readings quit working.** Inspect the signal cable coming out of the frame that plugs into the computer (6 pin female) page 57.
4. **While acquiring data the computer beeps and changes to Stopped Mode.** Use a voltmeter to check the generator output. If it is around 110vac, this will cause the computer to reset. You need to speed the generator up so the output is around 120vac. Generator output should be checked weekly.
5. **“OK”** appears top left of display. To fix this you need to replace the “AA” batteries located at the top right side of the computer.
6. **Small counts appear about every 5 feet on the profilogram.** Inspect the measurement wheel for roundness. If you don't have the measurement wheel in the up position while turning the machine around, you will rub a flat spot on the tire.