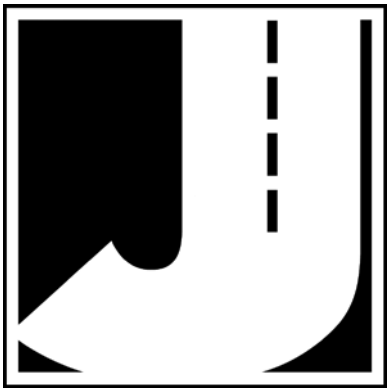


WARNING

Use of the RAC Plus III while driving could cause an accident, resulting in serious injury or death. As with any in-vehicle instrumentation, the information provided by the RAC Plus III should be observed as part of the normal operation of the vehicle. Changes to the RAC Plus III should only be done in a safe manner.

Installation of the RAC Plus III and distance sensor should be done with caution so it does not cause unsafe conditions.
DO NOT mount the RAC Plus III where it will obstruct the driver's view.
DO NOT mount the RAC Plus III over or near an air bag.
DO NOT route cables in a manner that would interfere with operation of the vehicle.

LIMITED WARRANTY

JAMAR Technologies, Inc. warrants the RAC Plus series instruments for a period of five (5) years limited warranty against defects in material and workmanship as follows: first year, parts and labor; years two through five, parts only, flat labor charge. Sensors, cables, connectors, brackets and other hardware are warranted for ninety (90) days.

JAMAR Technologies, Inc. warrants each new instrument manufactured by the company to be free from defective material and workmanship and agrees to remedy any such defect. At its option, it may furnish a new part in exchange for any part of any instrument of its manufacture which, under normal installation, use and service discloses such defect. The instrument must be returned to the JAMAR factory or authorized service agent intact, for examination, with all transportation charges prepaid.

This warranty does not extend to any products which have been subject to misuse, neglect, accident, incorrect wiring not our own, improper installation or use in disregard of instructions furnished by JAMAR. This warranty does not extend to products which have been repaired or altered outside the JAMAR factory or authorized service agent.

In no event shall JAMAR Technologies, Inc. be liable for any damages arising from the use of this product including damages arising from the loss of information.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for JAMAR Technologies, Inc. any other liability in connection with the sale or use of JAMAR products.

JAMAR Technologies, Inc. reserves the right to make improvements on the product and/or specifications at any time without notice. Questions concerning this warranty or any JAMAR Technologies, Inc. product should be directed by e-mail, mail or telephone to:

JAMAR Technologies, Inc.
1500 Industry Road, Suite C, Hatfield, PA 19440
215-361-2244 • sales@jamartech.com

We are pleased that you have chosen the RAC Plus III for your distance measuring needs. We have strived to develop a unit that is easy to use and has the options that our customers require. The RAC Plus III has undergone extensive testing to verify the accuracy of its operations, and each unit is tested before it leaves our facility. However, just like other complex electronic devices, problems can occur. We always suggest that users verify the continuing accuracy of any device they use. Should you detect any problems with any of our products, please notify JAMAR Technologies immediately and discontinue use of the unit until we have verified its operation.

If you have any questions about the use of the RAC Plus III, please call the following number:

1-215-361-2244

Monday — Friday, 8:00 AM to 5:00 PM Eastern time

You may also contact us by e-mail at:

sales@jamartech.com

For more information on our products, or for the latest news in product development, visit our web site at:

www.jamartech.com

For support information specific to the RAC Plus devices, go to:

www.jamartech.com/RACPlusSupport.html

Address any correspondence to:

JAMAR Technologies, Inc.
1500 Industry Road, Suite C
Hatfield, PA 19440

Table of Contents

Chapter 1

Quick Start Guide & Introduction to the RAC Plus III\GPS

Quick Start Guide

The RAC Plus III will allow you to accurately measure distance quickly and easily. However, before you can do this a few basic steps must be taken to ensure that you get the optimum performance from your instrument.

Step 1

Install your RAC and its distance sensor. Refer to Chapter 2 for detailed instructions on this. If you would like to have the equipment professionally installed, contact a garage or speedometer shop in your area.

Step 2

Install your GPS receiver and connect it to your RAC. Refer to Chapter 2 for detailed instructions on this.

Step 3

Calibrate your instrument. Refer to Chapter 3 for detailed instructions on how this is done. **Your RAC will not accurately measure distance unless it is properly calibrated.**

Step 4

Perform a test measurement with your vehicle. Once your RAC has been calibrated, you should perform a test measurement over a known distance. This will ensure that the instrument has been calibrated correctly.

To do a test measurement, drive to your starting point and stop. Turn on the RAC and wait until zero is shown on the larger, upper display and CH is shown on the smaller, lower display. Next, press the CH (count hold) button to release the instrument from count hold and then drive the distance to be measured. Stop and/or press the CH button once you reach the end of the distance to be measured.

Step 5

Familiarize yourself with the features and options of the RAC Plus III. Refer to Chapter 4 for more detailed instructions on the functions and procedures of the unit.

Step 6

Practice. Before attempting to use the instrument on a job, be sure you are comfortable with how to operate it.

What is the RAC Plus III\GPS?

The JAMAR Technologies Road Analysis Computer (RAC) Plus III\GPS is an accurate, easy-to-use distance measuring instruments (DMI) that incorporates GPS technology.

Fig. 1.1 — RAC Plus III\GPS Distance Measuring Instrument

The RAC Plus III has been designed with features to provide you with a versatile and functional instrument that can be learned in a very short time.

This cost-effective unit saves time & money by allowing personnel to measure distance, accurate to 1 foot per mile, while recording GPS coordinates of roadway features.

How does it work?

The RAC Plus III is installed in your car along with a **distance sensor**.

Distance sensors do the behind-the-scenes work of the RAC Plus distance measuring instruments. Connected between your vehicle and the RAC Plus head unit, these sensors read and modify the data coming from your vehicle and send a signal to the RAC telling it when to count distance.

There are currently three types of distance sensors that are used with the RAC Plus III – the AutoLink OBD sensor, the modular sensor and the magnetic sensor.

Why are there three types? Because distance measuring instruments are used by a wide variety of customers who often have different needs and in a wide variety of vehicles that don't all work the same.

The simple breakdown of the three is that the AutoLink sensor is the newest and easiest to install (plug and play, no tools required), but that ease of install trades a degree of accuracy. The magnetic sensor is the most precise, but much more intensive to install than the AutoLink, while the modular sensor has accuracy similar to that of the magnetic sensor and is somewhat easier to install, but is not compatible with all vehicles.

While the RAC Plus III is using the distance sensor to record distance, it also has the unique ability to track and store GPS coordinates. This is made possible through a connection to a GPS receiver. The GPS coordinates of road features (intersections, bridges, signs, guardrails, etc.) can then either be internally stored for download to the RACPro software, or read directly off the RAC's display.

The next chapter details how to install the various distance sensors into your vehicle. If your already have a sensor installed, you may skip to Chapter 3 for information on calibrating your RAC.

Chapter 2

Installation

Before You Begin

The JAMAR RAC Plus III distance measuring instruments are very reliable. However, there can be some external variables that could affect proper operation and the ability to accurately measure distance traveled. By observing a few simple precautions you will be able to eliminate potential problems.

• **Do not** install wires near any object that could cause stray pulses to be picked up, such as the alternator, spark plugs or engine coil.

• **Do not** install the wires or sensor near any objects that will get hot, such as the manifold. The installation wires or sensor can melt if they are too close to a heat source.

• **Do not** install wires near any objects that could vibrate and cut the wires.

• Tire pressure should be the maximum suggested by the tire manufacturer, typically 32-35 PSI cold. The tire should have ample tread depth. Steel belted radial tires are highly recommended.

• Drive the vehicle 3 to 5 miles (depending on climate) to warm the tires up to normal operating temperatures prior to calibrating your RAC. Refer to Chapter 3, Calibration for more detailed instructions.

Installing the OBD Distance Sensor

These instructions are for installing a RAC Plus III with an OBD Distance Sensor. If you are installing a different type of sensor, skip this section.

The AutoLink allows connection between the On-Board Diagnostics (OBD) connector in your vehicle and the RAC Plus Distance Measuring Instrument.

Note: Your RAC and vehicle should be turned off while plugging in the AutoLink cables.

Step 1

Plug the large OBD cable attached to the AutoLink II into the vehicle OBD connector. The OBD connector is typically found under your dash near your steering wheel column.

Fig. 2.1 – Plugging in to the OBD Port

Step 2

Connect the grey telephone-style cable from the AutoLink II to the RAC Plus Power (PWR) port.

Fig. 2.2 – Connecting the OBD Sensor to the RAC Plus III

IMPORTANT: Note that the supplied grey telephone-style cable is the ONLY cable that should be used. **DO NOT** use any other cables that may have been provided with your RAC as you may damage your RAC or the Auto-Link.

Step 3

Now that the AutoLink II and the RAC are connected, start your vehicle. Next, turn on the RAC and the AutoLink II LED lights will begin flashing.

At this point, the **Lock** green LED will stay on and remain steady. A steady green Lock LED indicates the AutoLink II is communicating with, and is locked onto, the OBD signals coming from the vehicle computer.

The yellow "OBD Tx and Rx" LED lights confirm the transfer of information between the OBD and the AutoLink II. Note that on 2010 and newer vehicles the LEDs will flash very rapidly and may appear to be on constantly; this is normal.

The self-adhesive mounting tabs and the tie wraps included can be used to secure the OBD and the telephone-style cable as desired.

Step 4

Calibrate the RAC as described in Chapter 3. You are then ready to start collecting data.

For Best Results

• OBD speed signals are generally not available below 1 MPH. As such, the AutoLink II is not recommended for use where the vehicle may be traveling at 'creeping' speed for any length of time. Recording short distance nodes within a longer course using a stop and go method can result in less accurate data. This is a function of extreme low speeds introduced during starting and stopping. In these cases we recommend you use an alternative sensor type, like a magnetic sensor, for higher accuracy.

• Note that while the vehicle is in motion the RAC and the AutoLink II will have a small time lag while recording distances into memory. Also note there will be a final buffered distance on the RAC once the vehicle is fully stopped.

• After using your RAC, you should turn off the RAC while your vehicle is not being used. Power consumption of the RAC display, although minimal, may drain your battery if the vehicle is idle for an extended time with the RAC connected and turned on. This is particularly true if your battery is in poor condition.

• The AutoLink II is turned on and off by the RAC's power switch and as such can be left connected to the OBD port while not in use. Note that this was not the case with the original AutoLink I. The AutoLink I should always be disconnected from the OBD when not in use.

Installing the Modular Distance Sensor

Note: These instructions are for installing a RAC Plus III with a Modular Distance Sensor. If you are installing a different sensor, skip this section.

1. Find a location under the vehicle dashboard that will allow fairly easy access to the MDS. **Do Not** mount the MDS on the heater ducts or where the heater vents will blow directly onto it. Attach the MDS using the nylon ties or Velcro provided, as shown in Fig. 2.3.

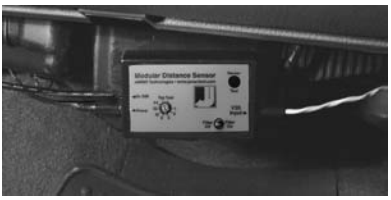


Fig. 2.3
MDS Mounted Under Dash

2. Locate the 2 wires coming from the Vehicle's Speed Sensor (VSS).

- On most Ford and Chrysler pick-up trucks, the best place is on the rear end differential housing using the rear ABS signal.

- On GM pick-up trucks, the best place is the VSS at the transmission.

- On many vehicles (both trucks and autos) you can go to the cruise control signal or to the vehicle ECU which is often located under the dashboard.

(**Note:** Vehicle wiring changes from year to year and model to model. For technical support in locating the vehicle speed signal wire call JAMAR at 215-361-2244. Your local Auto/Truck dealer can also usually tell you where the VSS can be located on your vehicle.)

All wires and the MDS itself should be kept away from heat sources that could cause melting.

3. Route the red and black end of the 20' grey VSS cable through the firewall. This can usually be done by using an existing rubber grommet where other wires pass through the firewall. If you cannot locate an existing hole, **CAREFULLY** drill a small hole large enough for both the VSS cable and the +12Volt/Ground wires. **EXTREME CAUTION** must be taken to insure you do not drill into anything mounted on the opposite side of the firewall or cut any existing wiring.

Use the cable ties provided while routing the cable to the location for getting the speed signal that you previously identified. Attach the **red** wire of the VSS cable to the *high-speed signal wire* of the vehicle's speed sensor using the tap splice connectors provided. The **black** wire is for optional use with vehicles made before 2002. In these vehicles, it should be connected to the *low speed signal wire* of the vehicle's speed sensor or chassis ground. If you are unsure which wire from the VSS is the high-speed signal and which is the low-speed signal, pick one and connect the red wire to it. If the RAC counts when the vehicle moves, you are good to go. If not, connect the red wire to the other wire from the VSS.

NOTE: The tap splice connectors are supplied for convenience for initial installation. However, we recommend that once the installation is completed and you have verified the instrument is working properly, remove the tap splice connectors and solder the connections. Insulate using electrical tape or silicone.

4. Plug the connector of the VSS cable into the hole labeled *VSS Input* located on the right side of the MDS, as shown in Figure 2.4.

Fig. 2.4 –VSS Plug-in

5. Route the black DMI cable from the MDS to the desired instrument location. This will usually be routed between the doorpost and the dashboard. Make sure the cable will not be pinched when closing the door. If the instrument is going to be mounted to the front of the dashboard, you may want to bring the cable straight up the front of the dash. There is adequate cable length to allow mounting the DMI in any desired location inside the vehicle. Plug the cable into the MDS jack labeled *To DMI*, as shown in Figure 2.5. It does not matter which end of the cable is plugged into the MDS or DMI.

Fig. 2.5 – DMI Plug-in

6. Route the Red (+12 Volts) and Black (Ground) power cables directly to the vehicle's battery. This can be done using the same feed through location that was used for the VSS Cable. If, out of convenience, you elect to obtain the +12VDC and ground from a fuse panel or other location under the dashboard, **make sure it is a constant 12 volt source** and **not** one that

is switched off with the ignition key. We also recommend the circuit should have as few devices as possible to avoid voltage fluctuations from Turn Signals, Brake Lights, etc. Plug the power cable into the hole labeled *Power* on the MDS, as shown in Figure 2.6.

Fig. 2.6 – Power Plug-in

Adjusting the Vehicle Speed Sensor Pulse Rate

The signal pulses coming from the vehicle speed sensor are generated for use by the vehicle's computer, engine/transmission control, fuel management, ABS brakes, etc. The pulse rate can vary from 4,000 to in excess of 100,000 pulses per mile. The MDS will condition and amplify these pulses for use by the RAC. Since the higher pulse rates are not required for accurate distance measurements, the MDS incorporates a divider circuit to reduce the pulse rate. This is done by adjusting the **rotary switch** on the front of the MDS, as shown in Figure 2.7.

Fig. 2.7
Rotary Switch Adjustment

The adjustments go from 1 to 1 (1 pulse into the sensor, 1 pulse out) through 64 to 1 (64 pulses into the sensor, 1 pulse out). Although your particular vehicle may vary, generally Chrysler and Ford vehicles use a 4 to 1 ratio (position 4 on the switch) while General Motors vehicles use a 16 to 1 ratio (position 16 on the switch).

To adjust the ratio, use a small screwdriver to turn the switch to align it with the number you want. Note that the switch is at the '1' position when switch is turned fully counterclockwise. It is at the 'Test' position when the switch is turned fully clockwise.

The Tap Test positions are explained in the troubleshooting section on page 3-4. You may need to adjust the ratio again based on the results of the calibration procedure described in Chapter 3. Any time you change the pulse ratio, you will need to re-calibrate the RAC.

Once you have installed the MDS, install your RAC Plus using the instructions on page 2-15.

Filter Toggle

As a default, the Filter toggle should be set to 'Filter Off'. However, on some vehicles there is 'noise' on the speed sensor line that causes the RAC to count up while the vehicle is not moving. The filter toggle should be flipped to 'Filter On' in these cases.

**Fig. 2.8 –
Filter Toggle**

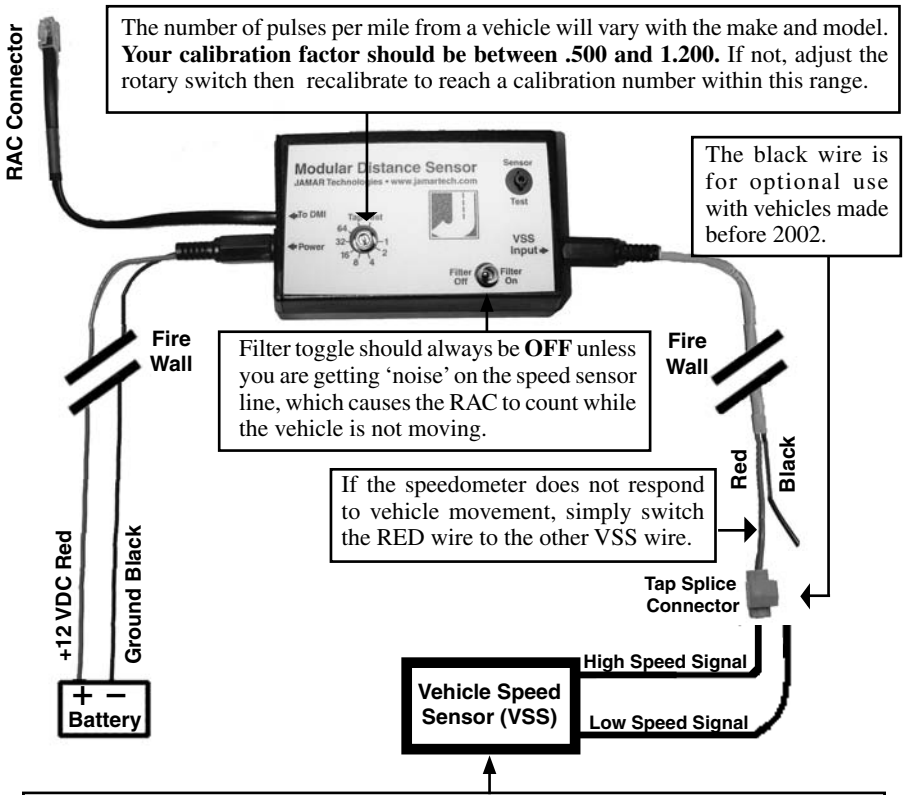


Fig. 2.9 –MDS Installation Diagram

Installing the Magnetic Distance Sensor

Note: These instructions are for installing a RAC Plus III with a Magnetic Distance Sensor. If you are installing a different sensor, skip this section.

For the installation you will need the Magnetic Sensor Kit shown below.

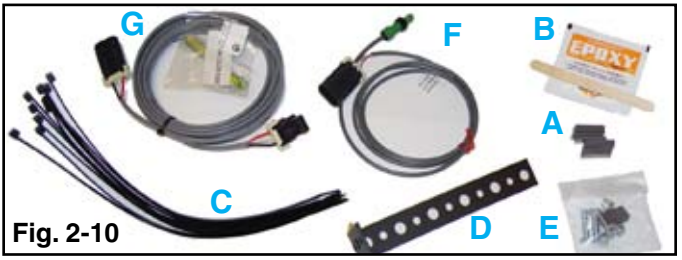


Fig. 2-10

A – Magnets
B – Epoxy
C – Zip Ties
D – Mounting Bracket
E – Hardware Kit
F – Magnetic Sensor
G – Extension Cable

and the Vehicle Installation Kit shown below.

H – Terminal Block
I – Power Cable
J – Ground Cable
K – DMI Connector Cable
L – Velcro
M – Zip Ties

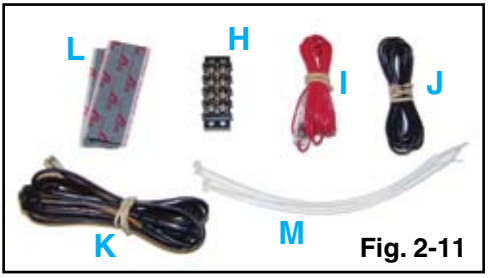
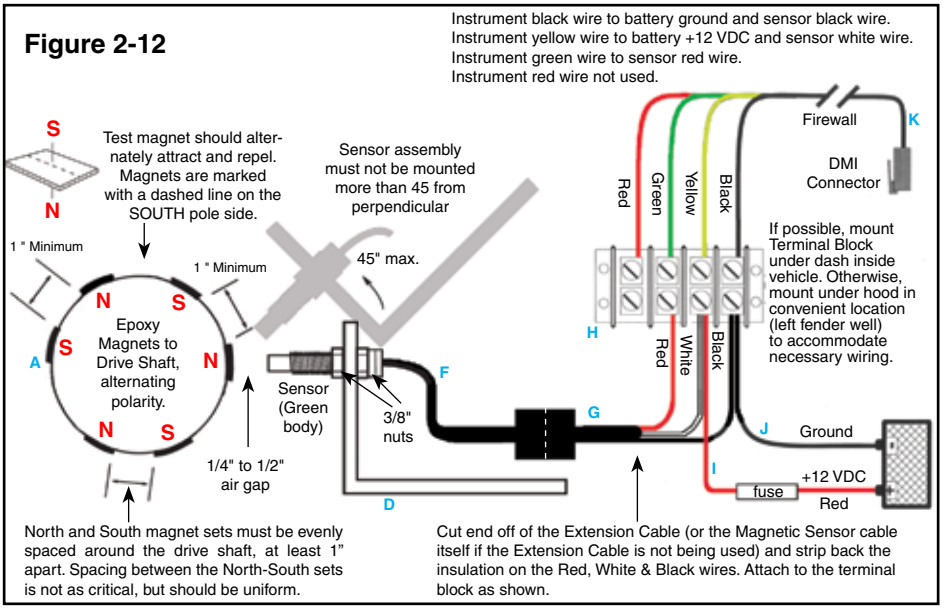


Fig. 2-11

Once you have finished the following steps, your installation should look similar to Figure 2-12 below.

Figure 2-12



Step 1 - Installing the Magnets

The number of magnets that must be used depends on the size of your tire and where you mount the sensor. Most all installations on automobiles or trucks will require at least six magnets (3 North/South Sets) to be installed. This will provide 3 pulses per revolution of the wheel or drive shaft to be sent to the Distance Measuring Instrument (DMI).

On tractor or implement wheels the general rule of thumb is one magnet for each wheel bolt (minimum of two, and always an even number). For drive shafts of small wheels (ATVs), two magnets are usually adequate.

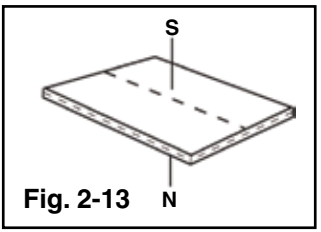


Fig. 2-13

The magnets provided are marked with a dashed line on the SOUTH pole side of the magnet, as shown in Figure 2-13.

Always use an even number of magnets, and always alternate the polarities of the magnets as you go around the wheel hub or drive shaft.

To install the magnets (part A in figure 1) on the drive shaft, use the Epoxy (B). Spare magnets are provided in the Hardware Kit (E) should they be needed.

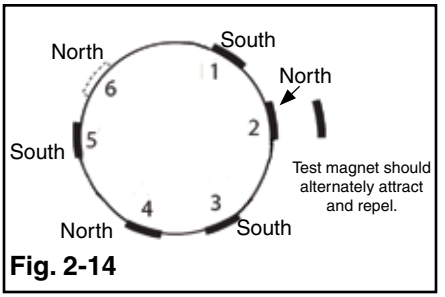


Fig. 2-14

(For **front wheel drive** vehicles, the magnetic targets should be attached to the inner CV joint, on the larger section between the rubber boot and the transmission.)

Note that the epoxy provided needs 6-8 hours to cure properly before the vehicle should be driven. The magnets can come loose and be lost if the vehicle is driven before the epoxy has a chance to cure. A quicker setting epoxy can be used if you need to cut down on curing time. Also, the zip ties (C) can be used to tie the magnets in place after the epoxy dries to make sure they stay in place.

Mount the first magnet with the SOUTH pole side (dashed line) facing toward the hub or shaft. Mount the second magnet with the NORTH pole side facing toward the hub or shaft, as shown in Figure 2-14. A test magnet should be used after installation to ensure the magnets have been placed correctly. Pass the test magnet over the installed magnets and it should alternately attract and repel.

For proper operation, the North and South magnet sets must be evenly spaced around the wheel or drive shaft, at least 1" apart, as shown in Figure 2-15. Spacing from one North-South magnet set to the next set is not as critical, but should be uniform.

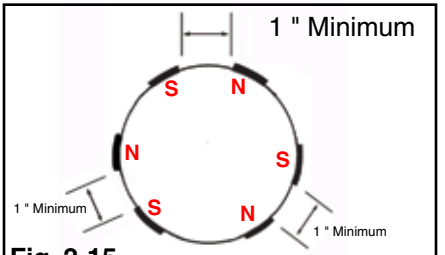


Fig. 2-15

Step 2 – Attaching the Magnetic Sensor

The Magnetic Sensor (F) is mounted directly over the magnets as shown in figure 3. When the wheel or drive shaft begins turning, a speed impulse is sent to the DMI every time a magnet passes by the tip of the speed sensor. For the speed sensor to operate properly, the spacing between the magnets and the tip of the sensor must always remain constant. Before permanently mounting any parts, be sure that the location you have selected will meet the requirements shown in Figure 7. NOTE: Observe magnet polarities (see previous section).

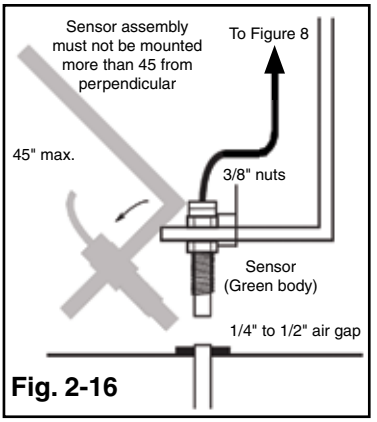


Fig. 2-16

Using the Sensor Bracket (D) provided, locate a nut or bolt on the side of the transmission, close to the magnets. Attach the bracket to the transmission using the hardware . (You may have to drill a larger hole in the sensor bracket to allow proper fitting over the selected bolt/stud.) Bend the bracket as required so that the Sensor is scanning the targets with a spacing of about ¼ to ½ inch. The cable coming from the Magnetic Sensor will be used as part of the next step.

Step 3 - Installing and Wiring the Terminal Block

Mount the Terminal Block (H) provided with the Vehicle Installation Kit under the dash inside the vehicle, if possible. If it is not possible to mount it inside the vehicle, mount on the driver's side fender well or other convenient location. The terminal block can be mounted using the Velcro provided.

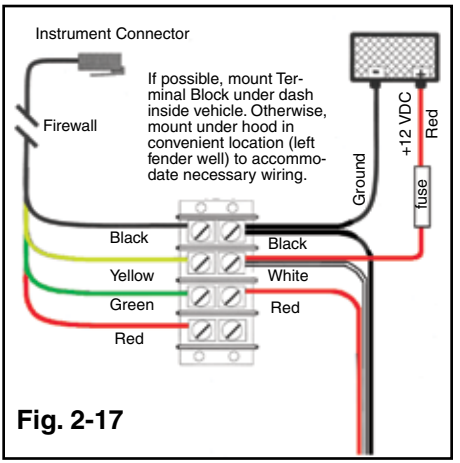


Fig. 2-17

Instrument black wire to battery ground and sensor black wire.
Instrument yellow wire to battery +12 VDC and sensor white wire.
Instrument green wire to sensor red wire.
Instrument red wire not used.

The Magnetic Sensor cable has 5 feet of a jacketed 3 wire cable

with a water tight plug on the end. There is also a heaver wire Extension Cable (G) 10 feet in length. This will allow you to use up to 15 feet of wire for the installation from the magnetic sensor location to the terminal block. Depending on where you have attached the magnetic sensor (Front Wheel CV Joint or Rear Wheel Drive Shaft) and the location of the terminal block, you may or may not need the extension cable.

If the extension cable is needed, plug the extension cable into the magnetic sensor cable using the water tight connector, then cut the extension cable to the required length, strip back the insulation on the Red, White & Black wires and attach to the terminal block as shown in Figure 2-17. Each wire should be connected to a separate terminal on the block.

If the extension cable is not needed, cut the plug off the end of the smaller magnetic sensor cable, strip the wires and attach to the terminal block as shown in Figure 2-17.

Once the magnetic sensor has been properly connected to the terminal block, connect the terminal block to the vehicle's battery using the black and red cables provided.

The RED wire with the in-line fuse (+12VDC) should be connected to the POSITIVE terminal on the battery and to the same location on the terminal block as the red wire from the magnetic sensor. The BLACK wire (Ground) should be connected to the NEGATIVE terminal on the battery and to the same location on the terminal block as the black wire from the magnetic sensor.

Finally, connect the DMI Connector Cable (K) to the terminal block as follows:
- Connect the black wire to the battery ground and sensor black wire.
- Connect the yellow wire to the battery +12 VDC and sensor white wire.
- Connect the green wire to sensor red wire.

The red wire from the DMI connector cable is not used.

Once these steps are complete, you may connect the RAC itself.

Installing the RAC Instrument

The compact case design of the RAC Plus allows mounting of it in a number of convenient locations. Popular locations include on the front of the dashboard, above or below the dashboard, or on the windshield using the optional windshield mounting bracket. Wherever you decide to mount the instrument, remember it should be within easy reach and the display should be visible without obstructions.

It is most common to mount the RAC to the front of the dashboard using the Velcro provided. Two plastic 'L' brackets are also provided to facilitate mounting to the top of the dashboard if that is your preferred location. For best results, attach the 'L' bracket so that the bottom of the 'L' is facing away from the RAC as shown in figure 2.18.

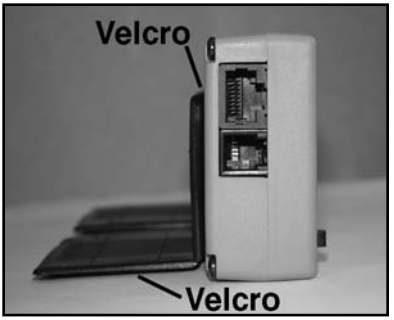


Fig. 2.18 - 'L' Bracket Side View

Using the two 'L' brackets allows you to compensate for curved dashboards even if it requires the RAC to be mounted on a left or right slope.

Fig. 2.19 - 'L' Bracket on Curved Dashboard

After mounting the RAC, plug the power cable from your distance sensor into the RAC. You may want to consider allowing enough slack in the cable to permit a passenger to hold/operate the RAC if necessary. Regardless of the mounting location, Velcro strips are provided for quick, easy mounting & removal of your RAC.

Note: While the RAC Plus III is designed to withstand very high temperatures, we recommend disconnecting the RAC and storing it in the glove box or below the dash if the vehicle will be left for long periods of time in direct sunlight and high temperatures.

Installing the GPS Receiver

The RAC Plus III is able to store and display GPS coordinates through a connection to an external GPS receiver.

Fig. 2.20 - GPS Receiver on Roof

The receiver can be placed on the dash, but for best results, we recommend that the receiver be mounted on the roof of your vehicle, as shown in figure 2.20. The base of the receiver contains a magnetic mount that makes installation easy.

The wiring for the receiver can be run into the vehicle and connected to the *GPS* port on the GPS Receiver Data Interface box, as shown in figure 2.21. The interface box comes with a stick-on pad that allows it to be mounted at any convenient location in the vehicle.

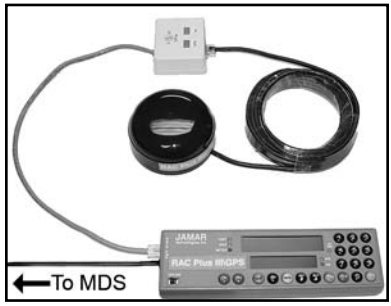


Fig. 2.21 - GPS Receiver connected to Interface Box

IMPORTANT: Do not plug the GPS receiver directly into the RAC Plus III as this could damage the RAC Plus III. The Data Interface Box must be used, as shown in figure 2.21.

When selecting a GPS menu function (menus 9, 10 & 11), the RAC checks for the proper GPS data. If the GPS receiver is properly connected, and has a signal, the GPS LED will be lit and will not be blinking. **For best results, have the RAC III powered on with the GPS Receiver connected for at least 1 minute before trying to access GPS features.**

If the GPS receiver is not properly connected, or does not have a signal, the GPS LED will be blinking and the upper display will show an error message. The message is usually 'no-PPS', which means that the RAC is not receiving a signal from the GPS Receiver. In most cases, if you have just connected the RAC to the receiver, the receiver may still be locating the GPS satellites. Wait up to 5 minutes to see if a signal is acquired. If the error message persists, refer to Chapter 5, Troubleshooting, for assistance.

Chapter 3

Calibration

Automatic Calibration Procedure

In order to accurately measure distance, your RAC Plus must know the exact distance that the vehicle will travel based on pulses from the vehicle's speed sensor. The calibration number is the automatic calculation that represents the number of pulses received over a set distance. This number, once calculated, will remain accurate until a change to the vehicle occurs, such as different size tires are put on the vehicle, tire wear, tire pressure change, etc. Such changes will require a re-calibration in order to maintain proper accuracy.

Your RAC Plus must be calibrated in order to accurately measure distance.

The RAC Plus has the ability to store four (4) separate vehicle calibration numbers in memory. This simplifies sharing one instrument between up to four different vehicles.

In order to calculate the calibration number for your particular vehicle, you must first establish a **calibration course**. The length of the course can be any known distance more than 500 feet. One thousand feet is ideal, but the course can be any distance over 500 feet (for example, 623 feet from pole to tree). Your course should be **straight** and **accurate**, so take the time to measure the course using a 100' tape or hand wheel. Mark the beginning and ending points so they can be seen from inside your vehicle. Remember, the course length can be any **accurate** distance over 500 feet, so for convenience you could use a telephone pole or other marker as reference point.

Note: If you are using the Metric unit of measuring, laying out the calibration course in feet is required to obtain the most accurate calibration number.

Step 1

Slide the ON/OFF switch to ON. Your RAC will perform a brief Self Test. The current calibration number will be shown in the larger, upper display (D-1) and CF U(vehicle 1, 2, 3 or 4) in the smaller, lower display (D-2). This is displayed for 3-4 seconds while a tone sounds, then **0** is shown in D-1 (0.000 if the mile or meter unit of measurements is selected) while **CH** is shown in D-2.

Fig. 3.1
Calibration Display on Start-up

Step 2

Press the **Menu** key, the **# 1** key and **Enter**. At this point, the unit of measurement will automatically change to feet. You can then select the vehicle number that this calibration will be for by using the 1 through 4 numeric keys.

Fig. 3.2
Vehicle Number Selection

Step 3

Once the vehicle number has been selected, press **Enter**. Key in the course length (in feet) to be used for the calibration using the number keys, then press **Enter** again.

Fig. 3.3 - Enter Course Length

Step 4

Using a reference point on your vehicle (i.e. the window post, door handle, your shoulder, etc.), align your vehicle to the beginning course marker.

Step 5

Press the **CH** key and drive away. As you drive, the pulses received from the vehicle are being shown in D-1. This is not the distance being traveled, so don't panic when the display doesn't equal the actual length of your calibration course. When you reach the end of the course, stop your vehicle so you are exactly aligned (using the same reference point in the vehicle) with the end course marker.

If your RAC does not count during the calibration procedure, refer to the troubleshooting section on the next page.

Step 6

Press the **CH** key. The calibration factor will then be shown in D-1. You should record the calibration number, vehicle number and date in the Appendix of this manual on page A-4. It is also recommended that you put this same information on a piece of tape attached to the inside of the vehicle's glove box.

Fig. 3.4
Calibration Number Displayed

Step 7

Press **Enter** and the unit of measurement will return to your desired unit of feet, mile or meter. Press **Enter** again to exit the menu function and return to normal operation. Your calibration number for the vehicle selected is now stored in the RAC's nonvolatile (permanent) memory. The calibration number will stay in memory for more than 50 years, or until you re-calibrate or manually change the data. You are able to view the calibration number and unit (vehicle) number every time you power up the RAC.

You should rerun the calibration course, in the normal mode, to verify the calibration for your vehicle. Press the CH key prior to measuring. If this is the first time you have calibrated a DMI, you may want to run the course a couple of times to practice being properly aligned when starting and stopping at the course markers.

Important: Ideally, the calibration number used should be between .500 and 1.200. If your calibration number is below this range, you need to use a higher division factor such as 16 on the Modular Distance Sensor (MDS). Of course, if your calibration number is too high, you can lower the number by using a lower number such as 1 on your MDS. This is done by adjusting the rotary switch on the MDS so it points to 1, 2, 8, 16, 32 or 64.

Your calibration number should be between .500 and 1.200. If not, you need to adjust the rotary switch on your MDS.

Any time you adjust the rotary switch setting, **you must re-calibrate** to get the correct calibration number. Changing the switch setting **will not** change the calibration number, only the number of pulses being received by the RAC.

Refer to the *Adjusting the Vehicle Speed Sensor Pulse Rate* section in Chapter 2 for more information on this. Several calibration runs may be necessary to determine which division factor is best for your vehicle.

If Your RAC Fails to Calibrate

If your RAC fails to count during calibration, perform the following operational checks:

Step 1

Locate the Sensor Test button on the front upper right of the MDS, shown in Figure 3.5. When pressed, this will generate an internal low-level signal that is fed directly into the VSS Input circuit. First, unplug the VSS Input connector from the right side of the MDS. Second, turn on the RAC and press the CH key just like you would prior to starting a measurement. Next, using a small pointed object (pen, pencil, screwdriver, etc.) or your finger press the Sensor Test button for a few seconds. The RAC should count when the button is pushed. What number it counted doesn't matter as long as it did count.

Fig. 3.5 – Sensor Test

If the RAC did count, everything from the MDS up to the RAC is okay and the problem is most likely either a poor connection at the vehicle's speed sensor or the connection is not at the correct location to get the vehicle speed signal. The speed sensor output is generally at the transmission or the rear differential. If you are unsure about being attached to the correct output, disconnect the plug and move the vehicle. If the speedometer does not function, you have chosen the correct plug wires.

If you are at the correct location, make sure you have a good electrical connection at the tap in point. Once you are sure you tapped into the correct location, it is always better to wire solder the connection.

After checking the connection, plug the VSS Input connector back into the MDS and try the RAC again. If the RAC counts, you can proceed with calibration. If the RAC still does not count, go to Step 2.

Step 2

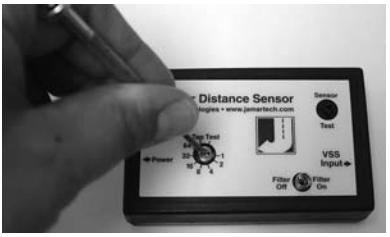


Fig. 3.6 - Tap Test

The Tap Test will determine if the distance pulses being sent from the MDS are getting to, and being processed by, the RAC. The Tap Test is performed using the rotary switch shown in figure 3.6. First make sure you note the current position of the rotary switch (1, 2, 4, 8,16, 32 or 64), as you will have to return the slot back to this same position after the test is completed.

Next, turn on the RAC. Press the CH key just like you were beginning to measure. Using a small screwdriver, rotate the switch between the Tap and Test positions four or five times. (Note that when the switch is turned clockwise until it stops, it is at the Test position.) The RAC should register. The count shown does not matter, just as long as the RAC did register a count. If it did count, the cable from the MDS to the RAC and the instrument itself are OK. If the RAC did not count, the problem is most likely a bad cable to the RAC or the RAC itself is bad. If available, try another RAC and repeat the Tap Test. If the second RAC doesn't count, the problem has to be the cable between the MDS and the RAC.

Once the test is complete, return the Rotary Switch to the previous position.

If the previous steps do not correct the problem, contact us using the information on page iii.

Manual Calibration Procedure

It is very common to share one RAC on a plug-in basis between a number of different vehicles that have been equipped to accept the instrument. Installing additional vehicle kits on other vehicles is an inexpensive and cost effective means to greatly expand your measuring capabilities. Obviously, each vehicle so equipped would have to be calibrated and the number recorded.

The RAC Plus has the unique ability to store in memory four (4) different vehicle numbers and their associated calibration numbers. If you are moving the RAC from vehicle to vehicle you will need to enter the correct vehicle (unit) number prior to measuring with that vehicle. The following procedure assumes the calibration number for a particular vehicle has already been determined and is stored in memory.

Step 1

Slide the ON/OFF switch to ON. The RAC Plus will complete a brief Self Test during which a tone will sound and the active calibration number will be displayed in D-1 while the vehicle number is displayed in D-2. After the self test, **0** is shown in D-1 (0.000 if the mile or meter unit of measurements is selected) while **CH** is shown in D-2.

Fig. 3.7
Calibration Display on Start-up

Step 2

Press the **Menu** key, the **#2** key and **Enter**. You can then select the vehicle number for the calibration that you wish to change by using the 1 through 4 numeric keys. If all you want to do is change the **active vehicle number**, press **Enter** and go to Step 5. If you want to change the calibration factor, proceed to Step 3.

Fig. 3.8
Vehicle Number Selection

Step 3

Press the **Enter** key and the current calibration number for the vehicle selected will be displayed. Press the Clear key (CLR) to clear the current number.

Fig. 3.9
Calibration Number Cleared

Step 4

Using the numeric keys, key in the desired calibration number for the vehicle selected.

Fig. 3.10
New Calibration Number Entered

Step 5

Press **Enter** to return to the initial menu screen, then press **Enter** again to exit the menu function. The new vehicle number and/or calibration number is stored in memory and the RAC is back to normal measuring mode.

Once your DMI is properly installed and calibrated, you are ready to begin accurately measuring distance.

Chapter 4

Key Functions & Operating Procedures

RAC Plus Key Functions

Fig. 4.1 — RAC Plus Key Layout

Your RAC Plus series DMI has been designed for simple operation, using large individual keys which provide a click and tone feedback.

The two 6-digit high-intensity LED display windows (exclusive to the RAC Plus series) allow flexibility in displaying data to you. The upper, larger display window (referred to as D-1) is primarily used to display distance. It is also used to indicate menu locations, time and GPS coordinates. The lower, smaller display window (referred to as D-2) is used to display count status, speed, interval distance, menu descriptions, event codes, GPS co-ordinates, etc.

OFF/ON

This is the slide switch which provides power to the RAC Plus. When turned on, the RAC will do the following:

1. Initiate internal Self Test sequence.
2. Display calibration number in D-1 and vehicle number in D-2, along with a 3 second tone.
3. Set itself in Count Hold with **CH** displayed in D-2.
4. Set the unit of measuring (feet, mile, meter) and the vehicle number to be the last one used when the RAC was turned off.
5. Set itself to count up.
6. Set the Distance Pulse Output interval to zero.

Count Hold

The Count Hold key will start or stop the computation of distance pulses. When in Count Hold, **CH** will be displayed in D-2 and the RAC will not accumulate any distance. If speed is also being displayed, it will continue as CH **does not** stop the computation of vehicle speed. When released, CH in D-2 will go out and distance computation will resume.

Display Hold

Display Hold will stop the display from updating while the RAC will continue to accumulate distance internally. When in Display Hold, **DH** will be displayed in D-2. If speed is also being displayed, it will continue as DH **does not** freeze the speed display. **Note:** You cannot put the RAC in both Count Hold and Display Hold at the same time. Count Hold will take precedence over Display Hold.

Unit

The Unit key allows you to select the desired unit of measurement. This can be selected/changed while moving or at rest. When pressed, the distance will cycle from total feet to miles to kilometers/meters. The LEDs to the left of D-1 indicate which unit is currently being used.

Speed

The Speed key allows you to turn on or off the display of speed (mph or kph) in D-2. The display of speed is not interrupted by either the Count Hold or Display Hold keys.

Menu

The Menu key allows you to select from a variety of functions. After pressing the Menu button, the Add and Sub keys can be used to scroll through the options, which are displayed in D-2. To select an option, press the ENT (Enter) key. The options are:

Menu 1 - Auto Calibration (A-CAL)
Menu 2 - Manual Calibration (E-CAL)
Menu 3 - Pre-Distance (P-diS)
Menu 4 - Clock Set (CLoSEt)
Menu 5 - Distance Pulse Output (dPO)
Menu 6 - Memory Store (StorE)
Menu 7 - Memory Status (StAtUS)
Menu 8 - Memory Erase (ErASE)
Menu 9 - Store GPS (Str-g)
Menu 10 - Track GPS (Str-t)
Menu 11 - Display GPS (gPS-n)
Menu 12 - Format GPS (gPS-Fo)
Menu 0 - Return to Normal Operation (rEturn)

See pages 4-5 to 4-23 for specific menu instructions.

Add

The Add key instructs the RAC to count **up**. It is also used in the Menu function to scroll up through the various options, and is used in the Pre-Distance function.

Subtract

The Sub key instructs the RAC to count **down**. When in this mode, the LED indicator for the active unit of measurement will flash to indicate that you are subtracting distance. Should you count down to zero (0), the RAC will provide a tone and automatically begin counting up.

The Sub key is also used in the Menu function to scroll down through the various options, and is used in the Pre-Distance function to subtract a desired distance from the displayed distance.

Dim

The Dim key allows you to select from four (4) levels of display brightness to best suit the ambient light conditions. Full bright is best for daylight conditions while full dim may best suit night conditions. Each time the Dim key is pressed, the brightness will drop one level until the lowest level is reached. It will then jump back to the high brightness level. Both D-1 and D-2, as well as the LED indicators, are controlled by the Dim key.

Clear

The Clear key is normally used to clear the D-1 distance display as well as the Interval Distance in D-2 if that function has been selected. Clear can be used on the run (while measuring), which allows you to establish a zero starting point without having to stop your vehicle in traffic or the center of a busy intersection. Clear will not reset the Time Counter in normal mode.

Enter

The Enter key instructs the RAC to accept the previously keyed value currently on the display. It is also used in the Menu function and Interval Distance application.

Numbers 0 - 9

The numeric keys are used to identify menu options and select numbers desired for calibration, pre-distance, distance pulse output, clock set, etc.

RAC Plus Menu Functions

The Menu key of the RAC allows you to select from a variety of functions. After pressing the Menu button, the Add and Sub keys can be used to scroll through the options, which are displayed in D-2. To select an option, press the ENT (Enter) key.

Menu 1 & 2 - Calibration Procedures

Refer to Chapter 3, *Calibration*, for full details on calibration procedures.

Menu 3 - Pre-Distance

The Pre-distance feature will allow you to enter a known distance starting point other than zero. It could be where you left off before lunch, or just beginning at a known station. This feature also allows you to Add or to subtract off a distance currently on display in D-1.

Note: The RAC must be in **Count Hold** to use Pre-Distance.

Step 1

Press the **Menu** key, the **#3** key then the **Enter** key. At this point, the unit is ready to have a distance entered.

Fig. 4.2 — Enter Pre-Distance

Step 2

Using the numeric keys, key in the desired distance (up to 6 digits), then press **Enter.**

Fig. 4.3 — Distance Entered

Step 3

Press **Enter** to return to the initial menu screen, then press **Enter** again to exit the menu function. You are now back in the normal mode with the distance set to the value you entered.

Fig. 4.4
Normal mode w/ Pre-distance set

Note: If you just want to **add** to the distance already on display in D-1, in Step 2, rather than pressing Enter, press the Add key. To **subtract** from the current distance, press the Sub key.

Menu 4 - Clock Set

The RAC Plus will compute & display time as either **elapsed time** from when the instrument was powered up, or **real time** if the timer has been set. The timer starts automatically at zero when the RAC is powered-up. Time is displayed in D-1 as hh.mm.ss.

To View Elapsed Time:

Press the **Menu** key, then the **#4** key, then the **Enter** key. D-1 shows the elapsed time since the RAC was powered on. At this time you can stop and reset the timer with the CLR (clear) key or just let it continue to run. To return to normal mode, press the **Menu** key then the **Enter** key.

Fig. 4.5 — Elapsed Time

To Set Timer to Real-Time:

Step 1

Press the **Menu** key, then the **#4** key, then the **Enter** key. D-1 shows the elapsed time since the RAC was powered on, as shown in Figure 4.6 above.

Step 2

Press the **Clear** key. Using the number keys, key in the time you wish to display (hh.mm.ss format). This can be either 12 or 24 hour format (i.e 1 PM = 13 hrs).

Fig. 4.6 — Clock Time Entered

Step 3

Wait until the keyed in time is reached and press the **Enter** key to begin the clock counting.

Fig. 4.7
Counting from Entered Time

Step 4

To return to normal mode, press the **Menu** key then the **Enter** key.

Note: To view the Clock/Timer while in the normal measuring mode (not as a Menu function), press the #1 key. D-1 will then display the clock/timer in hh.mm.ss format. Press the #1 key again to toggle back to distance. This function does not interrupt the distance count.

IMPORTANT: Once the RAC is turned off, the clock/timer shuts off and will reset to zero on the next power up. Also note that the Count Hold **does not** stop the clock/timer.

Menu 5 - Distance Pulse Output (DPO)

Note: Use of the Distance Pulse Output feature with a Modular Distance Sensor (MDS) requires a factory modification to the MDS. Contact us using the information on page iii if you need to use this feature with an MDS.

When activated, the distance pulse output (DPO) will provide a +5 VDC (TTL level) output pulse at a pre-selected distance interval and signal duration. This low level signal is provided on the red wire in the power/signal cable. The +5 VDC signal can be used to send distance pulsed to a computer or other device that can accommodate low voltage, low current signals. Should you wish to control a +12 VDC high current device, you will need our optional DPO Amplifier.

In addition to creating a DPO pulse at the pulse interval, one byte of data is sent out on the RS-232 communications port. This byte contains an ASCII 'S' at 9600 baud. This capability allows the RAC to effectively signal a PC or other type of unit at the leading edge of the DPO pulse.

CAUTION: The DPO signal can be used to control potentially hazardous equipment. When activated, the DPO could cycle this equipment at any time. If you are working with this type of equipment, TURN OFF the RAC, which will deactivate the DPO signal.

To activate the DPO signal:

Step 1

Press the **Menu** key, the **#5** key, then the **Enter** key. At this point, the RAC is ready to have an interval distance entered.

Fig. 4.8 — Enter DPO Distance

Step 2

Using the numeric keys, enter the interval distance that you want the DPO signal generated, based on your selected unit of measurement (feet, mile, meter).

Fig. 4.9 — DPO Distance Entered

Step 3

Press the **Enter** key and you will be prompted to enter how long the DPO signal should last. You can key in a desired signal duration from 10 milliseconds (key in 1) to 2.55 seconds (key in 255). Keep in mind that if you select a long output duration your signals may run together at high speeds. A 10 millisecond pulse duration is usually adequate for sending pulses to a laptop computer and will not overlap at normal highway speeds.

Fig. 4.10 — Enter DPO Duration

Step 4

Press **Enter** and you will be prompted to select whether or not you want an audible tone to sound when the DPO signal is triggered. The 1 in D-1 signifies that the tone is **on**. If you want a tone with each output pulse, leave 1 in D-1. If you **do not** want a tone, enter zero (0) or press the Clear key.

Fig. 4.11 — DPO Tone On

Step 5

Once you have selected whether you want a tone or not, press **Enter**. D-2 will then indicate that the DPO signal has been activated.

Fig. 4.12 — DPO Activated

Step 6

Press **Enter** to return to the initial menu screen, then press **Enter** again to exit the menu function. You are now back in the normal mode with the DPO signal set.

To turn off the DPO signal:

Step 1

Press the **Menu** key, the **#5** key then **Enter**. The current DPO interval distance is then displayed in D-1.

Fig. 4.13 — Current DPO Distance

Step 2

Press the **CLR** (clear) key and the DPO distance is removed.

Fig. 4.14 — DPO Distance Cleared

Step 3

Press the **Enter** key and D-2 will then indicate that the DPO signal has been deactivated.

Fig. 4.15 — DPO Deactivated

Step 4

Press **Enter** to return to the initial menu screen, then press **Enter** again to exit the menu function. You are now back in the normal mode with the DPO signal turned off.

Note: When the RAC is turned off, the DPO distance interval duration resets to zero (0), thereby deactivating the output. If you turn the RAC off, you must reset this if you want the DPO to be activated again.

Menu 6 - Memory Store

The RAC Plus III has the capability to store up to 400,000 events in its internal memory in this mode. Using this feature, you can manually key in numeric codes to identify various events, such as intersections, signs, culverts, bridges, pavement markings, telephone/power poles, etc. The numeric code can be up to four (4) digits in length. This feature makes the RAC Plus III ideal for road inventories, outside plant inventories, asset management and engineering.

Note: Data collected in this mode must be downloaded using the RACPro software, or other interface software.

Note: This option is for storing the distance of events only. To store distance in combination with GPS data, refer to the instructions for Menus 9 and 10 later in this chapter.

Step 1

Press the **Menu** key, then the **#6** key. D-2 then indicates that you are in the Memory Store function.

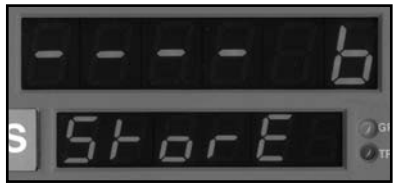


Fig. 4.16 — Memory Store

Step 2

Press **Enter**. D-1 displays the last date that was used in the memory store function. Note: There is no check to ensure that a valid date is entered or correct. If you want to enter a new date, press the **CLR** (clear) key, then, using the numeric keys, enter the date you wish to use (mm.dd.yy).

Fig. 4.17 — Enter Date

Step 3

Once you have keyed in a date, press **Enter**. D-2 will then display 'Other'. At this point, you have the option of entering a number, up to six digits, that can be associated with the stored data. This could be the inventory route number, an operator identifier number, etc. It is not mandatory to key in a number. If you do not want one, leave the value set to zero.

Fig. 4.18 — Enter Optional Identifier

Step 4

Once you have selected the identifier you want, press **Enter**. At this time, if you wish to start at a distance other then zero, you can enter a starting distance using the numeric keys.

Fig. 4.19 — Enter Starting Distance

Step 5

Press **Enter** and the RAC will be ready to begin at the starting distance you entered.

Fig. 4.20 — Ready to begin survey

Step 6

Align your vehicle with the starting point of the survey. We recommend that you enter a starting code number of up to four digits (such as 1111) and press the Enter key. This stores the starting reference code and distance in memory.

Fig. 4.21 — Enter Starting Reference Code

Step 7

Press the CH key to release the Count Hold. The distance in D-1 will begin to count once the vehicle begins to move.

The four digits in D-2 display the numeric code numbers as they are keyed in. Using a numeric code (0-9999) you are able to identify up to 10,000 separate events for inventory purposes. For example, an intersection to the right might be a 1, to the left a 2, a bridge a 6, a telephone pole a 7, a power pole an 8, a culvert a 22, a 45 mph speed limit sign a 45, a municipal boundary line a 500, etc.

As you see the event ahead of you, key in the code number using the numeric keys. The number will appear in D-2. When you reach the event (using a reference point on the vehicle), press

Fig. 4.22 — Enter Event Codes

Enter. The event code, distance, speed and time (elapsed or real) are stored in memory.

There is a short delay (1/2 second) when you press Enter before you can key in another event code. However, the code you entered is written to memory at the instant you press Enter.

Should you key in an incorrect code number, you can overwrite that number by simply keying in the correct number. This must be done prior to pressing the Enter key. Once you hit the Enter key, the code that was in D-2 is stored in memory.

Step 8

When the inventory route is completed, press the **CH** key. Key in an ending reference code (such as 9999) to mark the end of the survey, then press **Enter**. Note that you can store up to 400,000 events in the RAC Plus III's memory.

Fig. 4.23 —
Enter Ending Reference Code

Step 9

To exit the memory store function, the RAC must be in Count Hold. Press the **Menu** key, then press **Enter**. You are now back in normal mode.

Note: To begin another survey, go back to **Step 1**.

Menu 7 - Memory Status

If you are conducting numerous field surveys before downloading the data to a computer, you may want to check the status of the RAC's memory from time to time to make sure you have enough memory left for a new survey.

Step 1

Press the **Menu** key, then the **#7** key to access the Memory Status function.

Fig. 4.24 — Memory Status

Step 2

Press **Enter** and the RAC will change to show the amount of memory remaining and the number of surveys stored. D-1 shows the percentage of remaining internal memory (i.e. Str 95 means 95% of memory is still available). D-2 shows the number of surveys stored in memory (i.e. Sur 2 means there are currently 2 surveys stored in memory.

Fig. 4.25 — Memory Percentage and Surveys Stored

Step 3

Press **Enter** to return to the initial menu screen, then press **Enter** again to exit the menu function. You are now back in the normal mode.

Menu 8 - Memory Erase

This feature allows you to clear **all** memory locations that have been stored in the RAC Plus III. Note that when doing this **ALL** memory locations are cleared. You are not able to clear partial memory or selected surveys.

Step 1

Press **Menu**, the **#8** key and then **Enter** to access the Memory Erase function. *Erase* will be listed in both D-1 and D-2.

Fig. 4.26 — Memory Erase

Step 2

Press **Enter** and D-1 will begin flashing to alert you that you are about to clear **ALL** surveys in memory.

Step 3

Press **Enter** again and D-1 will change to *Done*, indicating that the memory has been erased.

Fig. 4.27 — Memory has been erased

Step 4

Press **Enter** to return to the initial menu screen, then press **Enter** again to exit the menu function. You are now back in the normal mode.

Note: If at any point prior to Step 3 you change your mind about erasing the memory, just press the **Menu** key then **Enter**. You will be returned to the normal mode without erasing the memory.

Menu 9 - Store GPS & Menu 10 - Track GPS

For best results, have the RAC III powered on with the GPS Receiver connected for at least 1 minute before trying to access GPS features.

These options are the same as Menu 6 - Store Memory, but with the addition of storing GPS data. The Store GPS and Track GPS options are set up the same way. However, with Store GPS, GPS coordinates are only saved to memory when you enter an event. With Track GPS, GPS coordinates are saved to memory every second, along with events you manually record. Up to 50,000 events can be stored in Store GPS mode. Up to 100,000 events, or up to 30 hours of data, can be stored when using Track GPS.

Note: Data collected in either of these modes must be downloaded using the RACPro software, or other interface software.

Step 1

Press the **Menu** key, then the **#9** key for Store GPS mode or the **Menu** key, then the **#1** and **#0** keys for Track GPS mode. D-2 indicates the function you have selected function.

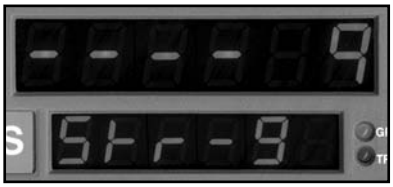


Fig. 4.28 — Store GPS

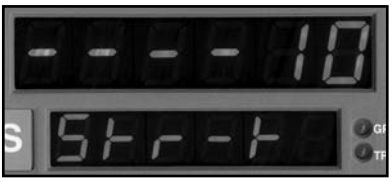


Fig. 4.29 — Track GPS

Step 2

Press **Enter**. The RAC checks for the presence of the proper GPS data. If the GPS receiver is properly connected, and has a signal, the GPS LED will be lit and will not be blinking. (When using Track mode, the TRK LED will also be lit.)

D-1 will display the last date that was used in the Store or Track function. Note: There is no check to ensure that a valid date is entered or correct. If you want to enter a new date, press the **CLR** (clear) key, then, using the numeric keys, enter the date you wish to use (mm.dd.yy).

Fig. 4.30 — Enter Date

Fig. 4.31 — No GPS Signal

If the GPS receiver is not properly connected, or does not have a signal, the GPS LED will be blinking and D-1 will display an error message. The message is usually 'no-PPS', which means that the RAC is not receiving a signal from the GPS Receiver. In most cases, if you have just connected the RAC to the receiver, the receiver may still be locating the GPS satellites. Wait up to 5 minutes to see if a signal is acquired. If the error message persists, refer to Chapter 5, Troubleshooting, for assistance.

Step 3

Once you have keyed in a date, press **Enter**. D-2 will then display 'Other'. At this point, you have the option of entering a number, up to six digits, that can be associated with the stored data. This could be the inventory route number, an operator identifier number, etc. It is not mandatory to key in a number. If you do not want one, leave the value set to zero.

Fig. 4.32 —
Enter Optional Identifier

Step 4

Once you have selected the identifier you want, press **Enter**. At this time, if you wish to start at a distance other then zero, you can enter a starting distance using the numeric keys.

Fig. 4.33 —
Enter Starting Distance

Step 5

Press **Enter** and the RAC will be ready to begin at the starting distance you entered.

Fig. 4.34 — Ready to begin survey

Step 6

Align your vehicle with the starting point of the survey. We recommend that you enter a starting code number of up to four digits (such as 1111) and press the Enter key. This stores the starting reference code and distance in memory.

Fig. 4.35 — Enter Starting Reference Code

Step 7

Press the CH key to release the Count Hold. The distance in D-1 will begin to count once the vehicle begins to move.

The four digits in D-2 display the numeric code numbers as they are keyed in. Using a numeric code (0-9999) you are able to identify up to 10,000 separate events for inventory purposes. For example, an intersection to the right might be a 1, to the left a 2, a bridge a 6, a telephone pole a 7, a power pole an 8, a culvert a 22, a 45 mph speed limit sign a 45, a municipal boundary line a 500, etc.

As you see the event ahead of you, key in the code number using the numeric keys. The number will appear in D-2. When you reach the event (using a reference point on the vehicle), press **Enter**. The event code, GPS coordinates, distance, speed and time (elapsed or real) are stored in memory.

Fig. 4.36 — Enter Event Codes

There is a short delay (1/2 second) when you press Enter before you can key in another event code. However, the code you entered is written to memory at the instant you press Enter.

Should you key in an incorrect code number, you can overwrite that number by simply keying in the correct number. This must be done prior to pressing the Enter key. Once you hit the Enter key, the code that was in D-2 is stored in memory.

Step 8

When the inventory route is completed, press the **CH** key. Key in an ending reference code (such as 9999) to mark the end of the survey, then press **Enter**. Note that you can store up to 50,000 events in memory when in Store GPS mode. You can store up to 100,000 events, or up to 30 hours of data, in memory when in Track GPS mode.

Fig. 4.37 —
Enter Ending Reference Code

Step 9

To exit the memory store function, the RAC must be in Count Hold. Press the **Menu** key, then press **Enter**. You are now back in normal mode.

To begin another survey, go back to **Step 1**.

Note: *If the GPS LED begins blinking during the course of the survey, it means the GPS signal has been lost. Wait up to 5 minute to see if a signal is reacquired. You may also want to move the vehicle to be sure the receiver is not blocked by tree branches, buildings, etc. If the error message persists, refer to Chapter 5, Troubleshooting, for assistance.*

Menu 11 - Display GPS

This feature allows you to record and view GPS information directly on the display of the RAC Plus III, along with distance information. With this feature you do not have to download your data to a computer.

Step 1

Press the **Menu** key, then the **#1** and **#1** key. D-2 indicates that you are in the Display GPS function.

Fig. 4.38 — Display GPS

Step 2

Press **Enter**. The RAC checks for the presence of the proper GPS data. If the GPS receiver is properly connected, and has a signal, the GPS LED will be lit and will not be blinking. The unit will then go into Count Hold mode and wait for you to begin.

Fig. 4.39 —
Count Hold, Ready to Begin

If the GPS receiver is not properly connected, or does not have a signal, the GPS LED will be blinking and D-1 will display an error message. The message is usually 'no-PPS', which means that the RAC is not receiving a signal from the GPS Receiver. In most cases, if you have just connected the RAC to the receiver, the receiver may still be locating the GPS satellites. Wait up to 5 minutes to see if a signal is acquired. If the error message persists, refer to Chapter 5, Troubleshooting, for assistance.

Step 3

When you are ready to begin the data collection, we recommend that you first check the quality of the GPS signal you are receiving and, if you want, record the starting location.

To do this, press the #9 key and the GPS Accuracy screen will be displayed.

Fig. 4.40 —
GPS Accuracy Displayed

The first two digits on D-1 will display the 'Fix Value' of the GPS information as either F0, F1 or F2. F0 means the fix is not valid and the GPS coordinates

should not be used. F1 means there is a valid fix and F2 means there is a valid fix with Wide Area Augmentation System (WAAS) in use. WAAS improves the accuracy of GPS signals by using a correction signal created by a collection of 25 land-based stations spread out across North America.

When doing your data collection, ideally you want an F2 displayed. However, this is not always possible depending on your location on the Earth and the position of the GPS satellites. At a minimum, you need to have at least an F1 to record usable data.

The last three digits of D-1 give the estimated accuracy of the GPS coordinates in measurable values. When the RAC's units are set to either Feet or miles, the estimated accuracy is shown in feet. When the RAC's units are set to meters, the estimated accuracy is shown in meters in a mm.m format.

Note that if the first digit of the estimated accuracy is zero, the display will show an 'A' to represent zero. For example, in figure 4.40, the estimated accuracy shown is 8 feet (A 8).

D-2 shows the number of satellites that are being used to calculate the current position. In general, the more satellites the receiver can see, the better the data will be. The number can vary from 3 to 8 or more.

Press **#9** again and the latitude of your location will be shown, with the first three digits of the coordinates shown in D-1 and the last six shown in D-2. In figure 4.41, this would be read as 40.215497 degrees North.

Fig. 4.41 — Latitude Displayed

Press **#9** again and the longitude of your location will be shown, again with the first three digits of the coordinates shown in D-1 and the last six shown in D-2. In figure 4.42, this would be read as 75.159008 degrees West.

Fig. 4.42 — Longitude Displayed

North/South and East/West are determined by a '-' before the first three GPS digits. If the latitude is North, just the coordinates are shown. If it is South,

the coordinates are preceded by '-'. Likewise, if the longitude is East, just the coordinates are shown. If it is West, the coordinates are preceded by '-'.

Note that there are three different formats for showing the GPS coordinates, represented by a '0', '1' or '2' shown at the far left of D-1 when viewing either latitude or longitude. The formats are:

0 – Degrees, Decimal Minutes (40° 12.9474')
1 – Degrees, Minutes, Seconds (40° 12' 56.844")
2 – Decimal Degrees (40.215790°)

Setting the format is done with Menu 12, described later in this chapter.

Press **#9** again and you will be returned to the distance screen.

Step 4

Once you have checked your GPS accuracy, and noted any initial recordings, you are ready to collect data. Release the Count Hold and begin driving. When you reach an event you want to mark, press the **Display Hold** key (DH). The display will freeze and a *calculated GPS position* (see side box) will be recorded and available for viewing using the #9 keys as described earlier.

Calculated GPS Positions
The GPS receiver transmits position information to the RAC every second. When you record an event with DH, it is possible it could occur between two seconds. To allow for this, the RAC uses two separate GPS positions (one before the event and one after) to determine the *calculated GPS position* that gets recorded for review, providing greater accuracy in your GPS data.

Once the GPS and distance information has been recorded, press **DH** to release display hold. You can then record subsequent events using the same procedures described above.

Note: *If the GPS LED begins blinking during the course of the survey, it means the GPS signal has been lost. Wait up to 5 minute to see if a signal is reacquired. You may also want to move the vehicle to be sure the receiver is not blocked by tree branches, buildings, etc. If the error message persists, refer to Chapter 5, Troubleshooting, for assistance.*

Also note that if you want to monitor the status of the incoming GPS information as you drive, you can do so by pressing the #7 key. This will show the GPS accuracy information and GPS coordinates as they are coming in on a second by second basis from the GPS receiver.

Menu 12 - Format GPS

This feature allows you to select the format for showing GPS information.

Step 1

Press the **Menu** key, then the **#1** and **#2** key. D-2 indicates that you are in the Format GPS function.

Fig. 4.43 — Format GPS

Step 2

Press **Enter**. D-2 changes to prompt you to enter the format you want to use. There are three formats that can be selected, by pressing either the #0, #1 or #2 key. The formats are:

Fig. 4.44 — Enter GPS Format

0 – Degrees, Decimal Minutes (40° 12.9474')
1 – Degrees, Minutes, Seconds (40° 12' 56.844")
2 – Decimal Degrees (40.215790°)

Once you have select either 0, 1 or 2, press **Enter** and the format you selected will be set in the RAC. Press **Enter** again to exit the menu function.

RAC Plus Additional Features

Interval Distance

This feature allows you to determine distance between points of interest, such as telephone poles, signs, pavement markings, etc. You can activate Interval Distance at any time as long as you are in the normal measuring mode and not using the menu functions.

Step 1

To activate the Interval Distance feature, press the **#4** key. The INT DIST LED indicator will then light. D-1 will be used to show the actual travel distance, while D-2 will be used to show the Interval Distance.

Fig. 4.45 —
Interval Distance Activated

Step 2

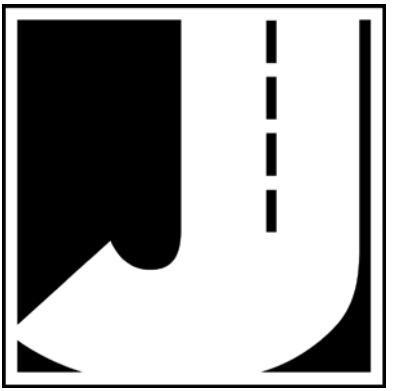
As you pass each reference point, press the **Enter** key. D-1 continues to show overall distance travelled, while D-2 will lock on the current interval distance. Each time the Enter key is pressed, D-2 will update to the most recent interval distance. There is no limit to the number of times you can use the Enter key to update the interval distance display.

Fig. 4.46 —
Interval Distance Displayed

Step 3

To exit the Interval Distance feature, press the **#4** key.

Note: If speed is already being displayed in D-2, Interval Distance will take precedence over speed until the Interval Distance feature is ended.



Chapter 5

Troubleshooting

Frequently Asked Questions

Q. My RAC will not count. What's wrong?

A. In most cases, when a RAC Plus won't count, it is not the unit itself that has the problem. It is usually a problem with the interface sensor or wiring. Check the following:

1. Ensure the RAC has a calibration number in memory. The RAC will not count if there is not a number in memory. As you switch on the RAC, the calibration number will be displayed for about three seconds. The factory uses .900 as the test number. If no number is listed, refer to the Manual Calibration Procedure on page 3-7 for information on how to enter a number.

2. Ensure that you are attached to the speed sensor output. It is generally at the transmission or the rear differential. If you are unsure about being attached to the correct output, disconnect the plug and move the vehicle. If the speedometer does not function, you have chosen the correct plug wires.

3. Perform a Sensor Test. Locate the Sensor Test button on the front upper right of the Modular Distance Sensor. When pressed, this will generate an internal low-level signal that is fed directly into the VSS Input circuit. First, unplug the VSS Input connector from the right side of the MDS. Second, turn on the RAC and press the CH key just like you would prior to starting a measurement. Next, using a small pointed object (pen, pencil, screwdriver, etc.) or your finger press the Sensor Test button for a few seconds. The RAC should count when the button is pushed. What number it counted doesn't matter as long as it did count.

If the RAC did count, everything from the MDS up to the RAC is okay and the problem is most likely a poor connection at the vehicle's speed sensor. Make sure you have a good electrical connection at the tap in point. Once you are sure you tapped into the correct location, it is always better to wire solder the connection.

After checking the connection, plug the VSS Input connector back into the MDS and try the RAC again.

4. Perform a Tap Test. The Tap Test will determine if the distance pulses being sent from the MDS are getting to, and being processed by, the RAC. The Tap Test is performed using the rotary switch on the MDS. First make sure you note the current position of the rotary switch (1, 2, 4, 8,16, 32 or 64), as you will have to return it back to this same position after the test is completed.

Next, turn on the RAC. Press the CH key just like you were beginning to measure. Rotate the switch between the Tap and Test positions four or five times. (Note that when the switch is turned clockwise until it stops, it is at the Test position.) The RAC should register. The count shown does not matter, just as long as the RAC did register a count. If it did count, the cable from the MDS to the RAC and the instrument itself are OK. If the RAC did not count, the problem is most likely a bad cable to the RAC or the RAC itself is bad. If available, try another RAC and repeat the Tap Test. If the second RAC doesn't count, the problem has to be the cable between the MDS and the RAC.

Once the test is complete, return the Rotary Switch to the previous position.

5. If after checking these items the RAC still does not count, contact us using the information on page iii.

Q. My RAC counts while the vehicle is not moving. What's wrong?
A. There are three possible causes for this.

1. Your wiring may be picking up stray pulses from the vehicle. This can occur if the wiring is too close to the alternator, spark plugs, distributor cap or engine coil. To eliminate this noise, turn the filter toggle on the modular distance sensor to ON.

2. Your ground wire may not be connected properly. Double check its connections.

3. Your Modular Distance Sensor may not be working correctly. Contact JAMAR using the information on page iii for information on getting replacement parts.

Q. My RAC will not turn on. What's wrong?
A. There are several possible causes for this.

1. You may have a loose connection. Double check all connections at the distance sensor and RAC to make sure they are tight and at the correct locations.

2. There may be a problem with the telephone jack on the power/ signal cable. Check to make sure the contacts are not bent.

Q. My RAC counts in increments of 2, 5, 10, etc. What's wrong?
A. Your calibration number is too high. The calibration number should be between .500 and 1.200. You can lower the calibration number by adjusting the rotary switch on your modular distance sensor. Refer to Chapter 2 for more detailed information.

Q. My RAC is not receiving a signal from the GPS Receiver. What's wrong?
For best results, have the RAC III powered on with the GPS Receiver connected for at least 1 minute before trying to access GPS features.

If the GPS receiver is not properly connected, or does not have a signal, the GPS LED will be blinking and D-1 will display an error message. The message is usually 'no-PPS', which means that the RAC is not receiving a signal from the GPS Receiver.

In most cases, if you have just connected the RAC to the receiver, the receiver may still be locating the GPS satellites. Wait up to 5 minutes to see if a signal is acquired.

If the error persists, try re-initializing the RAC by turning it off, then turning it back on and selecting the GPS menu you are trying to use. Note that the GPS signal is only used with menu options 9, 10 and 11 of the RAC.

If the error message persists, next check that the GPS Receiver has been properly connected to the RAC and that the connections are tight. The GPS Receiver should be plugged into the 'GPS' port on the interface box. The

output cable from the interface box should be connected to the 'Data' port on the RAC, as shown in figure 5.1.

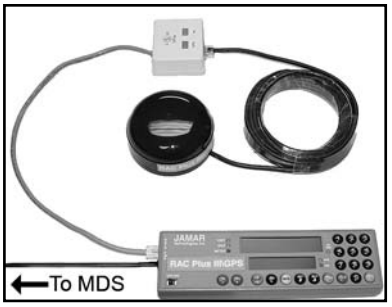


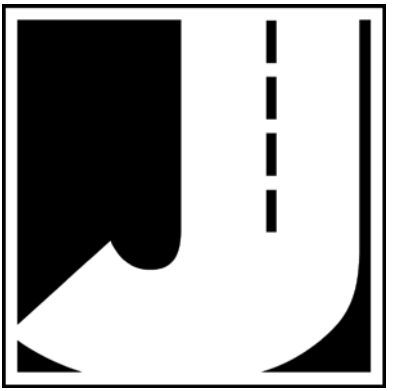
Fig. 5.1 — GPS & RAC Connections

Note that the PC connection of the interface box is optional. It is not required that you have something plugged into this port for the GPS Receiver to communicate and work with the RAC.

If the connections are good, next check the physical location of the GPS receiver. We recommend that it be placed on the roof of the vehicle, as shown in figure 5.2.

Fig. 5.2 - GPS Receiver on Roof

If there is still no signal being received, check that there is nothing that could be blocking the receiver, like tree branches or buildings. Try moving the vehicle to another location to see if a signal is received.



Appendix

Connection and Output Formats

Power Connector

Pin 1 (Yellow) +12 VDC
Pin 2 (Green) Sensor Input
Pin 3 (Red) DPO
Pin 4 (Black) Signal Ground

Memory/Serial (RS-232) Output

Since the RAC Plus III has a large internal memory, it is usually not practical to try to view the data on the display on an event by event basis. It is necessary to download this data to a computer for processing.

The output format of the RAC Plus III is a binary format, which means it cannot be read with standard text capturing software (as could be done with earlier RAC models).

The JAMAR **RACPro** software is designed to retrieve the data from the RAC Plus III and generate a report showing the data collected in the field. You can also save the data in a variety of standard formats (Excel spreadsheet, Access database, comma-delimited text file) so that you can work with the data using your own software.

The software is Windows based and is compatible with Windows versions XP, Vista and 7. You need a custom cable (available from JAMAR) to interface the RAC Plus III to your computer.

The RACPro software has the following features:

- Reads directly from the RAC Plus III
- Converts event codes to plain language text (You can edit and store different schemes that translate an event code to a text phrase.)
- Capable of merging multiple surveys together
- Insert/delete events from existing surveys
- Export data in a variety of formats

Refer to the RACPro manual for specific information on how to retrieve and process data from the RAC Plus III.

RAC Plus III Specifications

Power: 9 to 16 VDC, negative ground. **Data Output**: Serial RS-232
Display: Dual 6 digit window, high intensity LED. Separate LED indicators for unit or measurement and interval distance. Four brightness levels.
Accuracy: +/- 1 foot per mile. **Resolution**: 1 foot.
Keyboard: 20 sealed keys, 5 million operation with click & tone feedback. ON/OFF slide switch.
Speed Display: Three digit 0-999 (mph & kph) displayed with distance.
Time: Elapsed/Real Time (hh,mm,ss). **Count**: Bi-Directional (Up/Down).
Calibration: Automatic & manual with four vehicle calibration and vehicle number ability. Non-Volatile EEPROM Memory.
Test: System check on power up w/display of calibration & vehicle number.
Automatic Distance Conversion: Miles (thousandths) to Total Feet to Meters (kilometers).
Count Hold: Stops accumulation of distance.
Display Hold: Freezes display without loss of distance.
Pre-distance: Capability of starting at known distance or Add/Subtract desired distance value from current distance display.
Interval Distance: Display of distance between selected events & total distance.
Distance Pulse Output:0-5 VDC, low going hi, selectable interval & duration.
Sensor Error Detection: Checks for error due to vehicle's dynamic motion.
Memory Retention: Non-Volatile EEPROM for calibration & vehicle numbers — 50+ years retention.
Memory: In Memory Store mode (menu 6), up to 400,000 event locations. In Store GPS mode (menu 9), up to 50,000 event location. In Track GPS mode (menu 10), up to 100,000 event locations or 30 hours of data.
0-9999 Event code identifiers, Distance, Time & Speed.
Memory Retention: Non-volatile EEPROM, calibration & vehicle numbers.
Circuitry: Solid state, surface mount, modular, EEPROM, micro-computer.
Case: ABS non-warping plastic.
Dimensions: 7.8"W x 2.3"H x 1.2" D **Weight**: 6.5 oz.
Operating Temperature: 0°C to 75°C **Warranty**: 5-year instrument warranty.
Example: JAMAR Technologies RAC Plus III

Vehicle Calibration Record

Date: ________________________

Veh. No: _____________________

Cal. Factor: __________________

Veh. Odometer: _______________

User Initials: _________________

Date: ________________________

Veh. No: _____________________

Cal. Factor: __________________

Veh. Odometer: _______________

User Initials: _________________

Date: ________________________

Veh. No: _____________________

Cal. Factor: __________________

Veh. Odometer: _______________

User Initials: _________________

Date: ________________________

Veh. No: _____________________

Cal. Factor: __________________

Veh. Odometer: _______________

User Initials: _________________

Date: ________________________

Veh. No: _____________________

Cal. Factor: __________________

Veh. Odometer: _______________

User Initials: _________________

Date: ________________________

Veh. No: _____________________

Cal. Factor: __________________

Veh. Odometer: _______________

User Initials: _________________

Date: ________________________

Veh. No: _____________________

Cal. Factor: __________________

Veh. Odometer: _______________

User Initials: _________________

Date: ________________________

Veh. No: _____________________

Cal. Factor: __________________

Veh. Odometer: _______________

User Initials: _________________

We are pleased that you have chosen the RAC Plus III for your distance measuring needs. We have strived to develop a unit that is easy to use and has the options that our customers require. The RAC Plus III has undergone extensive testing to verify the accuracy of its operations, and each unit is tested before it leaves our facility. However, just like other complex electronic devices, problems can occur. We always suggest that users verify the continuing accuracy of any device they use. Should you detect any problems with any of our products, please notify JAMAR Technologies immediately and discontinue use of the unit until we have verified its operation.