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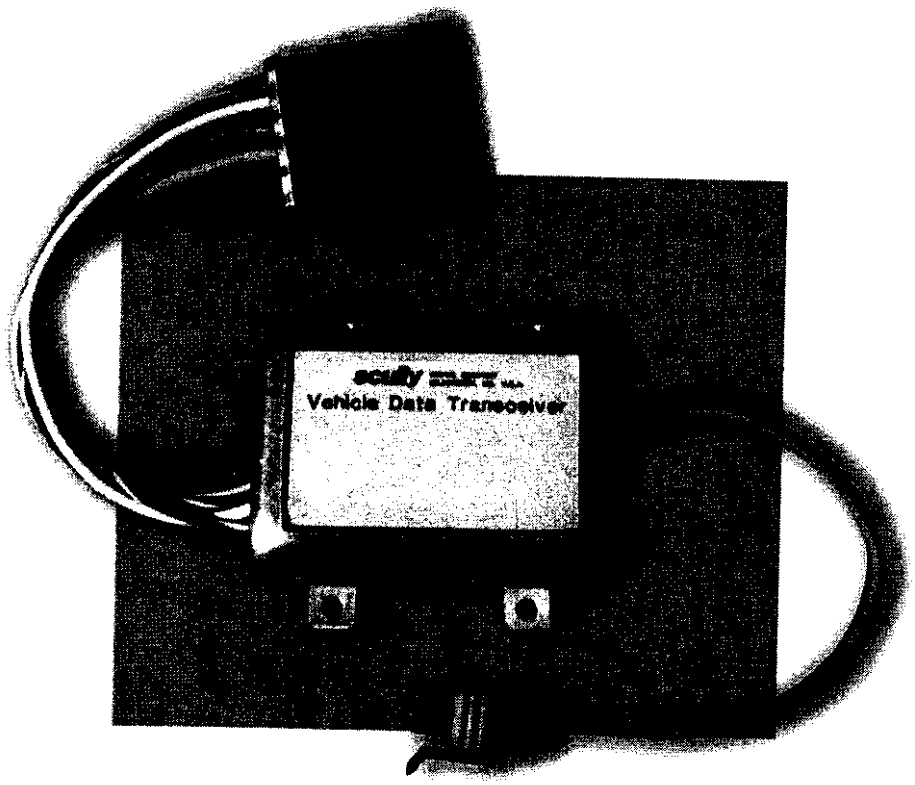
SAFS™ Automated Fueling System

Vehicle Data Computer Installation and Programming Manual



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Section 1 Description

Please read this manual carefully before beginning installation and programming of the Vehicle Data Computer (VDC). It is strongly recommended that an installation plan be developed for each specific vehicle. The VDC must be installed as described in this manual to ensure the reliability and proper operation of the system. Scully Signal Company provides a toll-free number for customers and installers having any question pertaining to the installation. Please call SAFS™ Technical Support at 1-800-272-8559.

This document is provided to assist in installation, programming, service and maintenance of the Scully Automated Fueling System (SAFS™), VDC and associated equipment. SAFS™ allows the secure unattended refueling of a fleet of vehicles from a land based or mobile station and records vehicle transaction information for use in managing the fleet. Vehicles in the fleet are authorized to pump by transmitting authorizing information from a VDC. The authorizing information or Vehicle Communications (VCOMM) contains the Vehicle ID, Fleet ID, Engine Hours, Odometer Mileage, and CHECKSUM for error detection. The Vehicle Communications packets are sent electromagnetically from the VDC through a transmitter coil (T-Ring) on the vehicle's fuel tank inlet, to a receiving coil on the refueling nozzle (N-Ring). The VCOMM packets are then transmitted electronically to the System Controller, which validates the packets, controls pumping, and keeps track of transaction information.

VDC installation must be done in accordance with federal, state and local codes, and the National Fire Protection Association code NFPA-30, "Flammable and Combustible Liquids Code". The VDC complies with Part 15 of the FCC rules. Operation is subject to the two following conditions:

1. The device may not cause harmful interference.
2. The device must accept any interference received, including interference that may cause undesired operation.

CAUTION

Changes or modifications to this equipment not expressly approved by the party responsible for FCC part 15 compliance could void the users authority to operate the equipment. Failure to receive authorization violates the warranty conditions of the equipment.

Section 2 Installation

CAUTION

Before performing any of the following procedures be sure the engine is turned off. Insure that the engine cannot be started while work is in progress. When installing the VDC, do not tamper with the brake or steering systems or attach wires or cables to the steering column, brake system cable or any moving mechanical parts.

2.1 Defining the Installation Layout

When considering the installation layout for the VDC, four basic areas must be considered:

1. The National Fire Protection Agency (NFPA) code.
2. Practical considerations within the jurisdiction of this code

Flammable and Combustible Liquids Code

Location	NEC Class 1, Group D Division	Extent of Classified Area
Tank Vehicle and Tank Car* Loading through open dome	1	Within 3 feet of edge of dome, extending in all directions.
	2	Area between 3 feet and 15 feet from edge of dome, extending in all directions.
Loading through bottom connections with atmospheric venting	1	Within 3 feet of point of venting to atmosphere extending in all directions.
	2	Area between 3 feet and 15 feet from point of venting to atmosphere, extending in all directions. Also up to 18 inches above grade within a horizontal radius of 10 feet from point of loading connection.

Flammable and Combustible Liquids Code *(continued)*

Location	NEC Class 1, Group D Division	Extent of Classified Area
Loading through closed dome with atmospheric venting	1	Within 3 feet of open end of vent, extending in all directions.
	2	Area between 3 feet and 15 feet from open end of vent, extending in all directions. Also within 3 feet of edge of dome, extending in all directions.
Loading through closed dome with vapor control	2	Within 3 feet of point of connec tion of both fill and vapor lines, extending in all directions.
Bottom loading with vapor control. Any bottom unloading	2	Within 3 feet of point of connections extending in all directions. Also up to 18 inches above grade within horizontal radius of 10 feet from point of connection.

*When classifying extent of area, consideration shall be given to fact that tank cars or tank vehicles may be spotted at varying points. Therefore, the extremities of the loading or unloading positions shall be used.

3. Locate the VDC in a non-hazardous area **at least 3 feet from the fuel tank,** protected from excessive electrical interference within the vehicle.
4. The odometer transducer types
   - Vehicles with electromechanical odometer/speedometers
   - Vehicles with an electronic odometer/speedometer
5. The Engine "ON" Hours connection
6. The transmitter coil (T-Ring) and it's cable routing

2.2 Tools & Parts Required

Installation of the VDC requires the following tools and parts:

Electric Drill	Rubber grommet assortment*
Crimp tool	Ring terminal assortment*
Screwdriver	Butt connector assortment*
Pliers	Heat Shrink Tube*
Heat gun or mini-butane torch	Self-drilling screws*
2 Conductor shielded Cable*	Convoluted Tube*

* These parts are supplied with the VDC installation kit. All terminals and connectors contain corrosion protection gel. One tube (2 oz.) of corrosion preventive compound for electrical contacts is provided with the kit for all connections that do not have protection gel.

2.3 VDC Mounting Location

Select a suitable location for the VDC, preferably where wiring connections are protected from excessive heat, water, oil, or other agents which could be harmful to electronic components. Sufficient room should be left around the installation area to connect wires to the VDC. Prepare the surface by cleaning away all dirt and oil where the unit is to be mounted, **make sure it is at least 3 feet from the fuel tank inlet**. Mount the VDC using self-drilling screws at two diagonal outer holes. VDC installation kit is supplied with self-drilling screws, however, drilling pilot holes might be required on some installation.

Good power and ground connections are critical for proper VDC operation. If extra wire is needed to reach the battery post, use the 2 conductor shielded cable. The VDC black wire must be grounded to the negative battery post. The VDC case is isolated from its electronic circuit, therefore the chassis does not provide a reference ground. Cut the drain wire on battery connection end and ground the drain wire at the VDC end. The VDC red wire is connected to constant HOT (battery voltage) and must be from a constant power source. For negative ground vehicles, you can use one of the existing VDC mounting holes as the drain wire ground point, as long as it is mounted on a metal surface with a good chassis ground.

2.4 Odometer Transducer Location

2.4.1 Electronic Odometer/Speedometer

The optional odometer/speedometer transducer is a device that converts mechanical rotation to electronic pulses so that the VDC can calculate mileage. Vehicles with an electronic odometer/speedometer or an electronic dashboard already have electronic sensor. This sensor is usually found where the transmission or transaxle connects to the drive shaft. For such vehicles, connect the two wires from the VDC harness (white and black/white) to the odometer/speedometer cable. The vehicle speed sensor should be wired to the VDC with correct polarity to guarantee that the high to low transition occurs on the "clean" side of the sine wave (see **Figure 1**). If the connection is made with wrong polarity, reverse the connection.

Starting from the VDC, run the white and black/white harness wires to where the electronic sensor is located. Crimp harness wires to sensor wires by using one of the following recommended methods.

CAUTION

When routing wires or cables, it is important to keep away from any moving parts, and any parts that generate excessive heat, or areas that may impede safety. Keep away from drive shafts, fan blades, belts, adjustable steering column, foot pedals, radiator, and exhaust system.

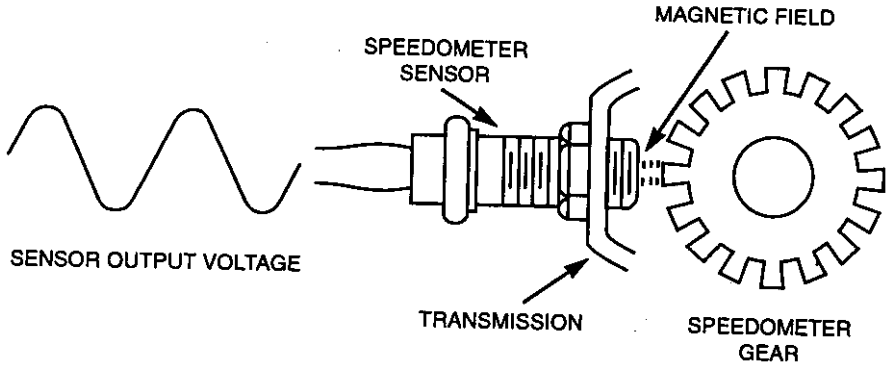


Figure 1 – Speed Sensor

Method A: **Using MOISTURE-RESISTANT Tap Connector.**

1. Open hinged side wall. Place unstripped sensor wire inside run channel and close hinge sidewall to 90° position to keep the sensor wire in place. The connector is gel-filled for corrosion protection.
2. Insert unstripped VDC white wire completely into tap port.
3. Hold pliers perpendicular to the wire and make the connection by crimping the u-contact down flush with the top of the insulator.
4. Close cover until securely latched.

> ☞ *Important*
>
> *It is strongly recommended to cover all connections with moisture resistant tape.*

Using the above procedure crimp the VDC black/white wires to the other sensor wire (Stagger the connection point).

Cover connections with 6 inches of convoluted tubing.

Recommended Connector: 3M® Scotchlok® 804 MOISTURE-RESISTANT Tap Connector.

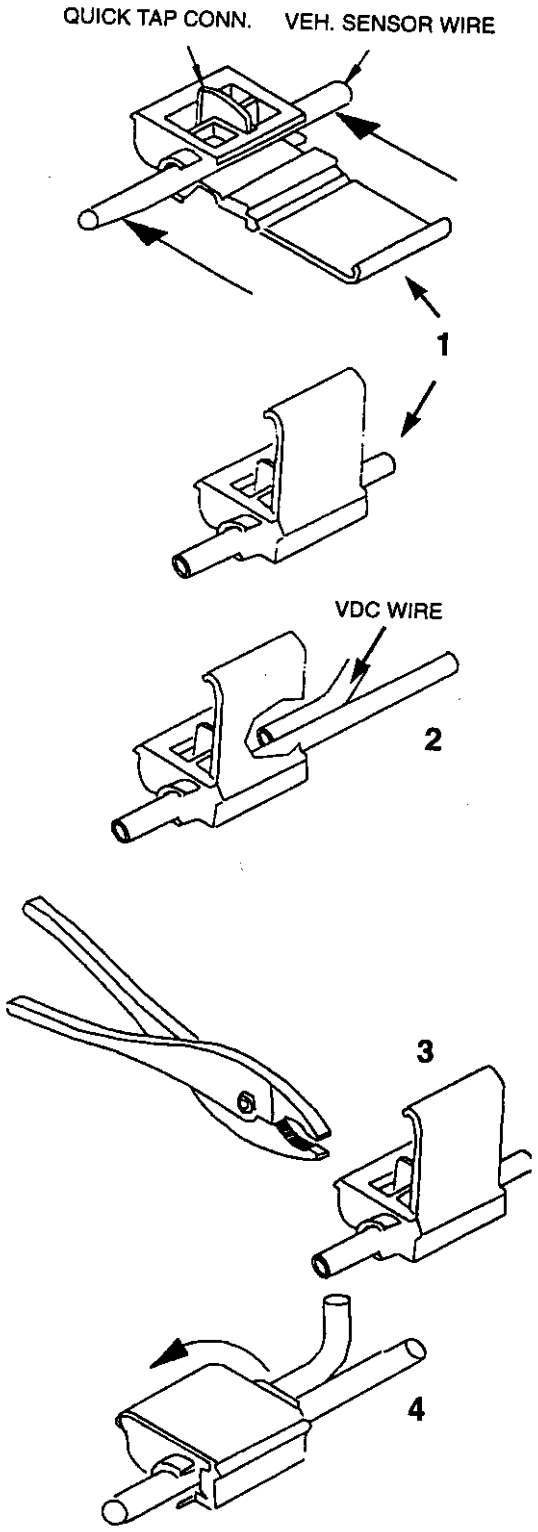


Figure 2 – Method A

Method B: **Using MOISTURE-RESISTANT Butt Connector.**

1. Cut the sensor wire and strip off about 1/4" of insulation from each end.
2. Cut and place 1.5" of self sealing heat shrink tube over one end of sensor wire.
3. Strip off 1/4" of insulation from the VDC white wire. Twist the stripped VDC wire together with one of the sensor wire.
4. Crimp a butt splice connector onto the twisted wires. Crimp the other side of the connector onto the other stripped sensor wire.
5. Place the heat shrink tube over the butt connector.
6. Use a heat gun, or mini-butane torch to shrink and seal the tubing. Shrink the tubing to form a moisture-tight seal around the wire when heated.
7. Use the above procedure to crimp the VDC black/white wires to the other sensor wire (stagger the connection).

WARNING

When heating the shrink connector, make sure it is positioned at least 3 feet from fuel lines or batteries, in order to avoid an explosion.

Cover harness wires with 6 inches of convoluted tubing. Using cable ties, secure the harness wires to the chassis supports. Be sure to leave some slack and provide sufficient clearance from any moving parts, brake or steering components. Leave at least 4 inches of clearance from any ignition system wiring or hot surfaces. Do not attach the wires to any moving parts, pneumatic or hydraulic lines or to clutch to brake cables. If the wires must be run along the chassis, it must be routed away from exhaust pipes, and it must be protected from any object which could strike it.

Recommended Connector: 3M Scotchlok MNG18CMX MOISTURE-RESISTANT Butt Connector.

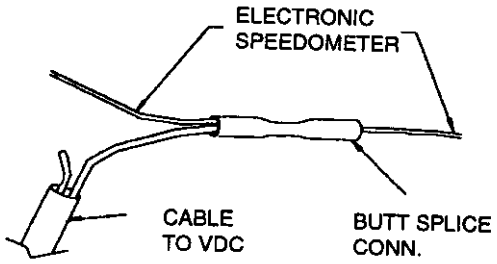


Figure 3 – Method B

2.4.2 Electro-Mechanical Odometer/Speedometer

The optional odometer transducer is connected to the VDC via a three-wire cable which is supplied in 12 foot length. The transducer is installed on the vehicle odometer shaft, or directly to a gear box odometer output.

To install the odometer transducer remove the existing odometer/speedometer drive cable. Select the proper odometer key or keys for the vehicle being installed. Attach the appropriate end of the odometer/speedometer cable back onto the odometer transducer per the manufacturer instructions. Insure the flexible cable does not have excessive slack or kinks. Periodically grease any fittings per manufacturer's instructions. The transducer cable runs from the transmission gearbox to the VDC. Connect Transducer red to VDC red/white, white to white and black to black/white wires using Method B. Secure the cable to the chassis supports. Cover any exposed cables with convoluted tubing provided in the installation kit. Be sure to leave some slack and provide sufficient clearance from any ignition system wiring or hot surfaces. Do not attach the cable to any moving parts, pneumatic or hydraulic lines or to clutch or brake cables. If the cable must be run along the chassis, it must be routed away from exhaust pipes, and it must be protected from any object which could strike it. Use rubber grommets to secure and protect the cable.

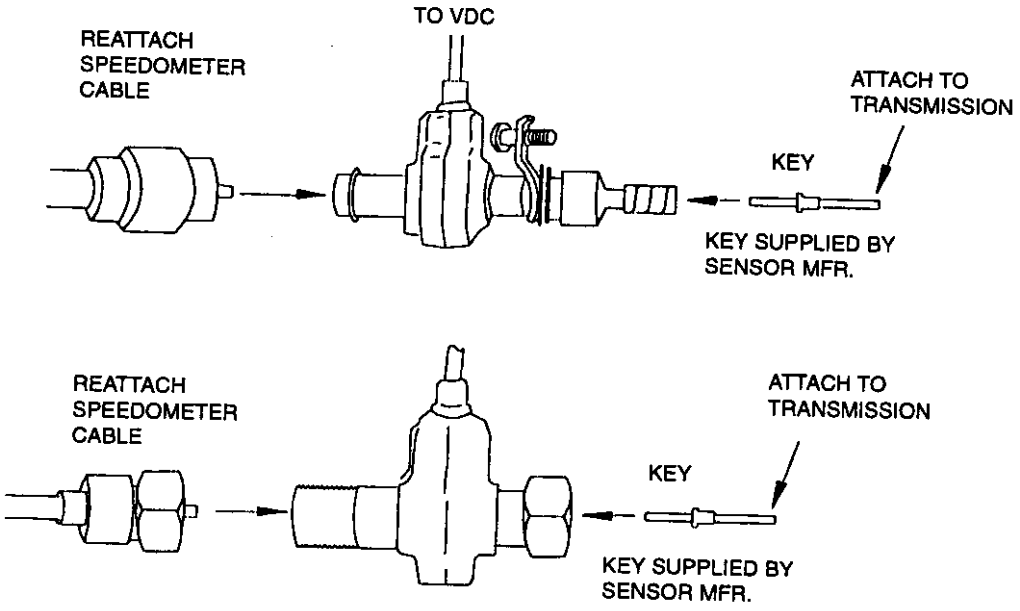


Figure 4 – After Market Transducer

2.5 Engine Hours Connection

For the VDC to record engine hours, VDC's yellow wire must be connected to a point in the vehicle that provides HOT (battery voltage) signal while the engine is ON or running, and OFF (zero voltage) when the engine is off. Check the vehicle's wiring diagram to determine the best connection point. Suggested connection points are an existing hour meter, the positive side of the oil pressure switch, or the switched side of ignition key. Verify that the connection point is one where the battery voltage is present when the ignition switch is on, and is open or grounded when the switch is off. Follow one of the recommended Methods A or B, to make your connections.

2.6 Transmitter Coil (T-Ring) Mounting

WARNING

When performing any work around the fuel tank inlet be sure to comply with all applicable federal, state, local and other applicable codes and regulations as well as the requirements of NFPA-30 "Flammable and Combustible Liquids Code". Do not smoke or perform any metal work with the fuel tank cover removed, or when fuel vapor is present. Do not perform any operation which may impair the fuel tank or fuel pipe safety. Use only pneumatic tools for metal work.

The VCOMM packets are sent electromagnetically from the VDC through a transmitter coil (T-Ring) on the fuel tank inlet, to a receiving coil on the refueling nozzle (N-Ring). One T-Ring should be installed around each fuel tank inlet with the mounting ears down (two T-Rings per VDC maximum). The T-Ring should be positioned as close to the fuel tank opening as possible, preferably within four inches due to Nozzle Ring (N-Ring) sensitivity. Two sizes of T-Rings are available; 2.7" ID and 4.7" ID. The 2.7" ID T-Ring fits most passenger cars, light trucks, and buses with 2-1/2" fill pipe. The 4.7" ID T-Ring fits truck saddle tanks with 4-1/2" fill pipe. T-Rings have a thin flexible flange inside a rigid outer ring that keeps them in place on the fuel tank. They are supplied with approximately 12 inches of wire and must be extended using the coil harness and/or two conductor shield cable Scully part number 000766. Use Method B - Using MOISTURE-RESISTANT Butt Connectors to make your connections.

CAUTION

When routing the T-Ring wires, be sure to keep it at least 2 inches from any other wires in order to preserve the intrinsic wiring requirements.

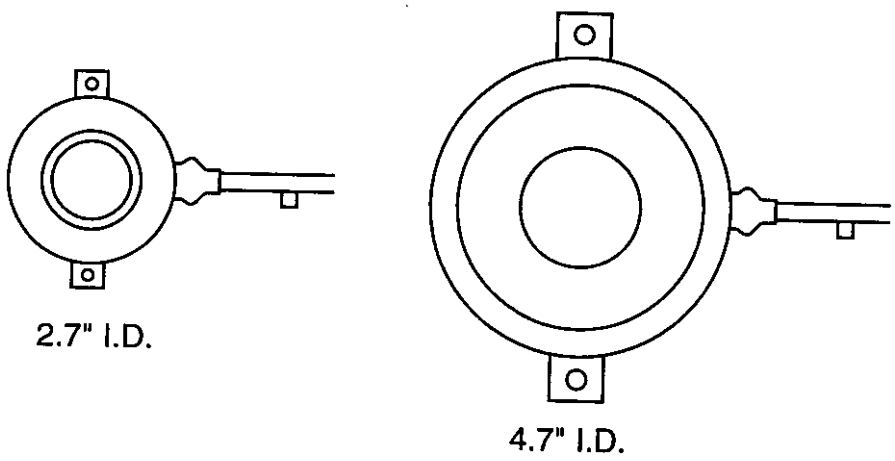


Figure 5 – T-Rings

Before beginning the installation, have the fuel pipe repaired or replaced if it shows any signs of leakage or excessive wear. Check to make sure that the fuel inlet cover fits tightly. Position the T-Ring around the fuel tank inlet and check to make sure that there is sufficient room to remove and replace the fuel inlet cover. The T-Rings are designed to be held in place by fitting the diaphragm over the fuel tank inlet neck. In cases where the coil mounting ears are unused, and interfere with proper fit, the ears may be removed. Be careful not to cut into any wires within the coil.

The mounting ears provide an alternate method of attachment. External threaded adhesive studs (Click Bond CS series) should be positioned to accept the mounting ears. Since power tools can not be used in a Class I, Division I location, use of studs is strongly recommended. Please consult Click Bond (702) 885-8000 for your specific application. If drilling a hole is absolutely needed, you must remove the shroud and take it to a safe place to drill hole, then re-attach the shroud.

Cover the T-ring wires and connections with a 12 inch piece of convoluted tubing. Add a cable tie at the neck of the T-Ring to keep tubing in place.

2.7 Optional Harness Assembly

The optional harness assembly is provided to reduce the installation time. The harness contains weatherproof connectors with suitable length of wires for a typical vehicle installation. VDC T-Ring wiring is provided via a short harness and must be extended using the coil harness and two conductor shield cable Scully part number 000766. T-Ring wiring should run along the vehicle side on which the fuel tank inlet is located. T-Ring harness should have a minimum clearance of 2" from all other wires and the harnesses.

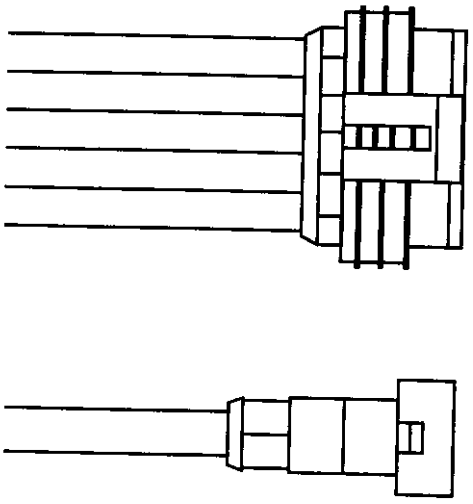


Figure 5 – VDC harness assembly

2.8 Final Inspection

Verify that all work has been completed according to your installation plan, and is in agreement with the National Fire Protection Association NFPA-30 "Flammable and Combustible Liquids Code", federal, state and local and any other applicable codes and regulations. Conduct a visual inspection to make sure all wires are secure and well protected. Do not attach any VDC cable to any moving parts, pneumatic or hydraulic lines or to clutch or brake cables.

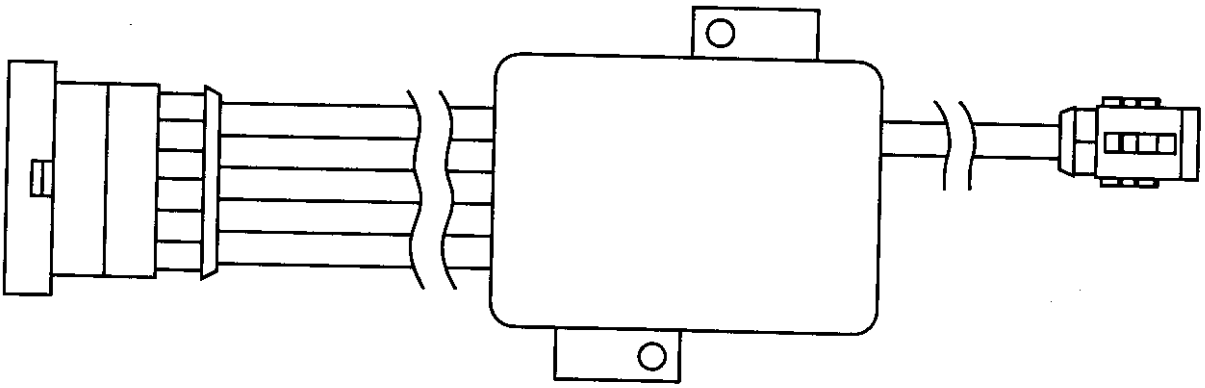


Figure 6 – VDC with weatherproof connectors

Section 3 Configuration

A Hand Held Programmer (HHP) is used to interface to the Scully Automated Fueling System (SAFS™). The HHP has three operating modes:

Programmer - At the time of VDC installation, the HHP programs the VDC with the desired information to identify the vehicle and keep track of important vehicle parameters.

Calculate Pulse Factor - This is used initially to automatically calculate the odometer ratio also referred to as Pulse Factor. This may also be used periodically to adjust for slight variation between the dashboard odometer and the VDC odometer readings.

Manual Authorizer - Manually Authorizes the pump for a single transaction on equipment which may not be registered as part of the fleet, and does not have a VDC installed.

☞ *Important*

It is strongly recommended that users of the HHP be limited to the administrative service attendants and installation technicians.

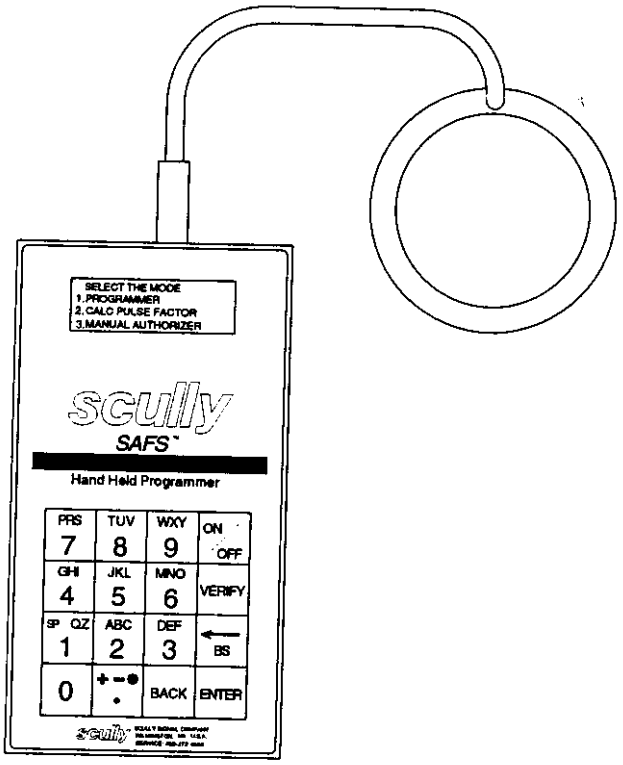


Figure 7 – Handheld Programmer

3.1 Battery Replacement

The HHP uses a 9 volt alkaline battery. Replace the battery as needed.

3.2 Keypad Operation

This section describes the keypad operating style of the HHP common to all operating modes.

ON

To turn the HHP on, press the **ON/OFF** key once. The display first goes through a power-on self-test and then displays the main menu.

OFF

Press **ON/OFF** key once while HHP is **ON** to turn it **OFF**. To conserve battery power, the HHP will also shut itself off when there is no key activity within 3 minutes.

VERIFY

Pressing **VERIFY** key while holding the HHP coil near the vehicle T-Ring displays the VDC's programmed parameters. Once the VDC has been programmed, the data should be verified to make sure VDC is sending the correct information to the System Controller. This will not only verify that the VDC has been correctly programmed, but also that the VDC's transmitter coils work properly.

BS (back space)

Press **BS** key to set the cursor back one space. Each subsequent press of the **BS** key sets the cursor back another space.

ENTER

Pressing **ENTER** key will advance to the next field. After all data has been entered into a field, press **ENTER** to advance to the next field. If no data entry is required, press **ENTER** key to skip to the next field.

BACK

Press **BACK** to go back to the previous field. Each subsequent press of the **BACK** key sets back one field.

Entering Numeric Data

On the keypad, press the number that you want entered into the field. The cursor will automatically advance to the next position. After all digits have been entered, press **ENTER** key to advance to the next field.

Entering Alphanumeric Data

On the keypad the **keys 1** through **9** have letters above the numbers. Pressing and holding the number key will scroll through all characters every 1.5 seconds. When entering data into an alphanumeric field, if you press and hold a number, it shows that character, but the cursor doesn't advance to the next position. Continuing to hold the number for 1.5 seconds shows the first letter marked above the number, continuing to hold the number shows the second letter marked above the number followed by third letter. For example, to enter the string PBF96:

Press and hold **key 7** until P is displayed. Release the key, letter P is registered and cursor automatically advances to the next position.

Press and hold **key 2** until B is displayed. Release the key, letter B is registered and cursor automatically advances to the next position.

Press and hold **key 3** until F is displayed. Release the key, letter F is registered and cursor automatically advances to the next position.

Press and release **key 9**. Number 9 is registered and cursor automatically advances to the next position.

Press and release **key 6**. Number 6 is registered and cursor automatically advances to the next position.

Entering Spaces and Special Characters

If you need to enter space, press and hold **key 1** until space is placed. Release the key, space is registered and cursor automatically advances to the next position.

Special characters available are: **+**, **-**, and *****. Scroll through **(Decimal Point)** key to select one of the special characters.

Editing Within a Field

To edit data within a field, press the **BS** key to set the cursor back one space. It has now erased the data previously entered in that position. Each subsequent press of the **BS** key sets the cursor back another space. Once you get to the position you want, start entering the correct data.

3.3 HHP Operating Modes

Programmer
Once the VDC installation is completed, the HHP is used to program the VDC with the desired data in order to authorize it for refueling and enable it to keep track of important vehicle information. The VDC can be re-programmed with new data at any time. Turn the HHP on and from the main menu select **mode 1-PROGRAMMER**. You need to hold HHP Ring near the VDC T-Ring to establish communication for programming. If the vehicle is equipped with two T-Rings, perform the programming at one Ring, and then use the second Ring during the Testing the Programmed VDC. When communication with the VDC is established, the factory default parameters are read. Press **ENTER** and program new data specific for the vehicle as prompted on the HHP display. Remember, you do not need to maintain communication with the VDC T-Ring while entering new data. If at any time you make a mistake typing the data, you can press the **BS** key to back up one space at a time to the beginning of the current field, then type the correct data. Once all data is entered, hold the HHP Ring near the VDC T-Ring to transfer new parameters to the VDC.

☞ *Important*

Do not program a VDC when the vehicle's engine is running. Make sure the vehicle is shut off during programming.

VDC Program Data Sheet
As you will see, there are many fields that may be programmed into a VDC. It is helpful to write all of the data into a chart as you program a VDC. At the end of this manual, there is a sample chart that you can use to tailor your system.

Following is the information recorded in the VDC:

Vehicle ID
Twelve characters alphanumeric string identifying the specific vehicle.

☞ *Important*

Every VDC must have a unique Vehicle ID because SAFS™ uses Vehicle ID as well as Fleet ID to monitor on-going transactions to tell if the nozzle is still inserted into the same vehicle/equipment.

Fleet ID
A maximum Five digit numeric string (1 to 65534) will identify the fleet or department the vehicle is assigned to.

☞ *Important*

Every VDC must have a Fleet ID because SAFS™ uses Vehicle ID as well as Fleet ID to monitor on-going transactions to tell if the nozzle is still inserted into the same vehicle/equipment.

Engine Hours
This field is 7 whole digits and 2 decimal places indicating the amount of time the vehicle's engine has been running. For vehicle's equipped with an hour meter, use the meter reading for Engine Hours, otherwise select a default value. The VDC counts time in increments of approximately 4 seconds once this signal is at +12 or +24 volts.

Odometer
This field is 7 whole digits and 2 decimal places indicating the current vehicle mileage. Use the reading from the vehicles dashboard odometer with any rollover factored in. The VDC receives odometer data as a series of pulses and counts in 1/100 of a mile.

Pulse Factor
The Conversion factor to interpret the number of pulses from the odometer to the number of miles traveled. The maximum value of the Pulse Factor is 131070. If the vehicle specification is not known, use CALC PULSE FACTOR feature to narrow down to the correct Pulse Factor.

Install Odometer
This field is 7 whole digits and 2 decimal places indicating the vehicle mileage at the time of VDC initial installation. Enter the reading from the vehicles dashboard odometer with any rollover factored in.

TX Interval
VCOMM broadcast cutoff time after the engine is turned off is TX Interval. This feature reduces VDC's vehicle battery consumption from 40 milli amp during normal operation to 20 milli amp during NO VCOMM (also referred as sleep mode). The default time for this post engine shutdown sleep time is 256 minutes (approximately 4 hours); maximum interval time is 45 days. TX interval is reset every time Engine Hour signal is set to +12 volt or +24 volt OR when Odometer pulses are received.

☞ *Important*

If there is no Engine Hour signal or no Odometer pulses, the VDC will remain in NO VCOMM (sleep) and ueling is not permitted.

TX With Engine On (Y/N)
Allows VDC VCOMM broadcast with engine ON. Default is **N** (no), fueling permitted only when engine is off. If it is desired to fuel while the engine is running, this field should be set to **Y** (yes).

After completion of programming you will be prompted with the following three screens before going back to the main menu. Verify the data shown is correct; otherwise go back to the PROGRAMMING mode and change the data from main menu.

3.4 Odometer Pulse Factor

The VDC receives odometer data as a series of pulses. These pulses may come from sensors mounted to the transmission, transaxle, transaxle, or drive shaft. The number of pulses of the odometer transducer required to register one mile is called Pulse Factor. The Pulse Factor is affected by several factors such as, tire size, axle ratio, and transmission specifications.

3.4.1 Mechanical Odometer Cable

Older vehicles use a mechanical cable to deliver odometer pulses to the dashboard. To allow the VDC to record these pulses, a transducer should have been purchased and installed according to the VDC Installation section. The formula for mechanical odometer Pulse Factor is:

Cable revaluations per mile multiplied by *sensor pulses per revolution*

Cable revaluations per mile is the number of revolutions the mechanical cable turns for each mile. This can be found in the transmission specification. For domestic vehicles the typical value is 1000 revs/mile and for foreign vehicles is 900 revs/mile.

Sensor pulses per revolution is the number of electronic pulses generated for each revolution of the sensor input. This is determined by the sensor manufacturer and may be stamped on the sensor. A typical value is 8 pulses per revolution. Therefore, the typical Pulse Factor for a domestic vehicle is 8000 and for a foreign vehicle it is 7200.

3.4.2 Electronic Odometer

On newer vehicles, the odometer signal to the VDC is tapped off an existing sensor. There are several ways to determine the electronic odometer Pulse Factor:

Match Working Vehicle. If a previously equipped vehicle is keeping accurate odometer data in the VDC, use that same Pulse Factor for all other similar vehicles in the fleet.

Use Engine Computer Ratio. Over-the-road trucks have smart engines allowing you to view many parameters through the diagnostic port. If the VDC odometer input is tapped off of the same signal source as the dashboard speedometer, you can use the speedometer ratio stored in the engine computer for the VDC Pulse Factor.

Calculate From Vehicle Specs. If the VDC odometer input is directly from the speedometer sensor mounted in the transmission, you may be able to calculate the correct ratio using specs from the vehicle manufacturer. Although there are variations among manufacturers and vehicle types, a typical speedometer system on a rear-drive-axle vehicle is described here. There is a gear, usually called the speedometer signal gear, mounted to the output shaft of the transmission. The speedometer sensor is mounted to the transmission so that its tip is in close proximity to the signal gear's teeth. A permanent magnet located in the speedometer sensor establishes a magnetic field at the tip. The magnetic field is repeatedly cut by the teeth on the signal gear,

creating alternating current voltage impulses that are transmitted to the speedometer. The frequency and amplitude of the signal is directly proportional to the speed of the signal gear. The speed of the signal gear is determined by the rotation of the drive shaft, which is determined by the drive axle ratio and tire size. Therefore, the number of pulses-per-mile from the speedometer sensor is calculated from the following formula:

Number of teeth on signal gear multiplied by *tire revolution per mile* multiplied by *drive axle ratio*

Number of teeth on signal gear is found in the transmission specifications. A typical number of teeth is 16.

Tire revolution per mile can be found in the tire manufacturer's spec sheet. These figures are standard throughout the tire industry. For example, a new Michelin® 275/80R22.5 tire turns 514 revolutions per mile.

Drive axle ratio can be found in the manufacturer's line setting tickets, and also on a tag attached to the differential assembly on rear wheel drive vehicles.

If you do not know the vehicle specification, CALC PULSE FACTOR will help you to determine the Pulse Factor. This feature is also used when you are required to narrow down or re-calibrate to the correct Pulse Factor after a vehicle has traveled for a few weeks.

3.5 CALC Pulse Factor

At the time of initial VDC programming, enter 4000 as default Pulse Factor and drive the vehicle for a minimum of 10 miles. Make a note of the vehicle odometer reading turn the vehicle HHP on and:

- Select CALC PULSE FACTOR mode and hold HHP coil near the vehicle transmitter coil to establish and maintain communication during calculation process.
- Press **ENTER** key and enter the data as prompted on the HHP display.
- HHP automatically calculates the new Pulse Factor and updates both VDC Odometer and Install Odometer based on the data entered.

3.6 Testing the Programmed VDC

The HHP VERIFY function reads and displays data from a programmed VDC. It is the easiest way to confirm that the VDC is transmitting information. To test, turn on the HHP and hold its ring over a VDC T-Ring. Press the VERIFY key and immediately the display fills with data. Check that parameters are correct. If there is no display, replace programmer battery and check programmer operation on another VDC:

- Compare displayed vehicle identity to its nameplate.
- Check displayed fleet identification against prescribed parameters.

- When the odometer monitoring option is used, check displayed value against vehicle mileage.
- When the odometer monitoring option is used, compare displayed Pulse Factor value with prescribed parameter.
- When the engine ON monitoring option is used, compare displayed value against vehicle's hour meter. If the vehicle is not equipped with hour meter, compare with prescribed parameters.
- For vehicles with two T-Rings, repeat the above. Parameters should be identical to those of the first T-Ring.

3.7 Manual Authorizer

The Manual Authorizer mode is used to authorize (turn on) a pump for one transaction. This allows vehicles or other non-VDC equipped vessels to receive fuel and transmits important fleet management information to the System Controller, which keeps track of refueling transactions.

To operate the Manual Authorizer:

- Place the pump nozzle into the fuel inlet of the vehicle.
- Turn **ON** the HHP.
- Select mode 3. MANUAL AUTHORIZER.
- Enter the data as prompted on the HHP display.
- Hold HHP Coil within a few inches of the pump's Nozzle Ring (N-Ring) for 10 seconds.

WARNING

Ensure nozzle handle is not engaged.

- The pump is now authorized for one transaction.

☞ *Important*

VEHICLE ID and FLEET ID data must be entered to authorize the pump. It is strongly recommended to enter MILEAGE and ENGINE HOURS data, however, they are not required to authorize the pump.

Section 4 Maintenance

The VDC requires no maintenance other than a re-calibration of the mileage for tire wear, tire change, or any change to the power train. Before attempting to perform re-calibration, consider the tolerance of mileage discrepancy due to tire wear and odometer accuracy. During vehicle preventive maintenance inspection, check and verify:

- That the VDC is securely installed to the mounting surface.
- Inspect all connections for corrosion.
- Make sure all connectors are well mated.
- Harness routing and fastening.
- The T-Ring wiring has a minimum of 2 inches clearance from any other wiring.
- Wiring connections for correct wiring (according to wiring diagram).
- Make sure the VDC wiring and harness is not attached to the steering column, brake cables, hydraulic or pneumatic conduits.
- When a transducer is included in the installation, make sure there is a tight connection between the harness and transducer.

4.1 Troubleshooting

If the VDC fails to program, using a voltmeter, check the red and black power lines for 12 or 24 volts. The switched 12V or 24V input (yellow wire) for monitoring engine hours must also be off (zero volts). Check these points with a voltmeter. If the voltage is out of range, troubleshoot the vehicle's electrical installation. Check harness wires for exposed conductors that could cause a short circuit. Inspect the connector pin of the harness for damage and possible short. Check wiring for loose connections. Measure the resistance for 2 to 4 ohms of the T-Ring and check the polarity of the T-Ring wiring. Connect another good T-Ring or else replace the unit if the unit won't program. Once the VDC is programmed, it is ready to receive fuel. If the vehicle cannot be refueled, check the following:

- Incorrect programming of the vehicle identity (ID)
- Incorrect programming of the fleet identity (ID)
- Vehicle ID is not in the system's computer authorized vehicle list
- Fleet ID is not in the system's computer authorized fleet list

4.2 Battery Life Conservation Setting (Sleep Mode)

The VDC unit typically draws 40 mA with one T-Ring operating and 60 mA with two T-Rings operating. A sleep mode feature has been incorporated into the VDC, which when activated, reduces power draw on the vehicle's battery when the vehicle is not in operation. While in sleep mode the draw on the battery is reduced to 20 mA. When sleep mode is in effect the vehicle cannot communicate as an authorized vehicle to receive fuel.

Vehicles such as police cars with constant power drawing accessories and vehicles not used over a long period of time (example 2 weeks) should be programmed with a short activating sleep mode to conserve battery draw.

The self-discharge rate for a typical automotive battery is 10% per month. This is equivalent to 8.3 mA constant draw. For a brand new battery with 425 CCA (cold cranking amps) it would take approximately 10 weeks to self-discharge to 350 CCA, a worst-case starter requirement.

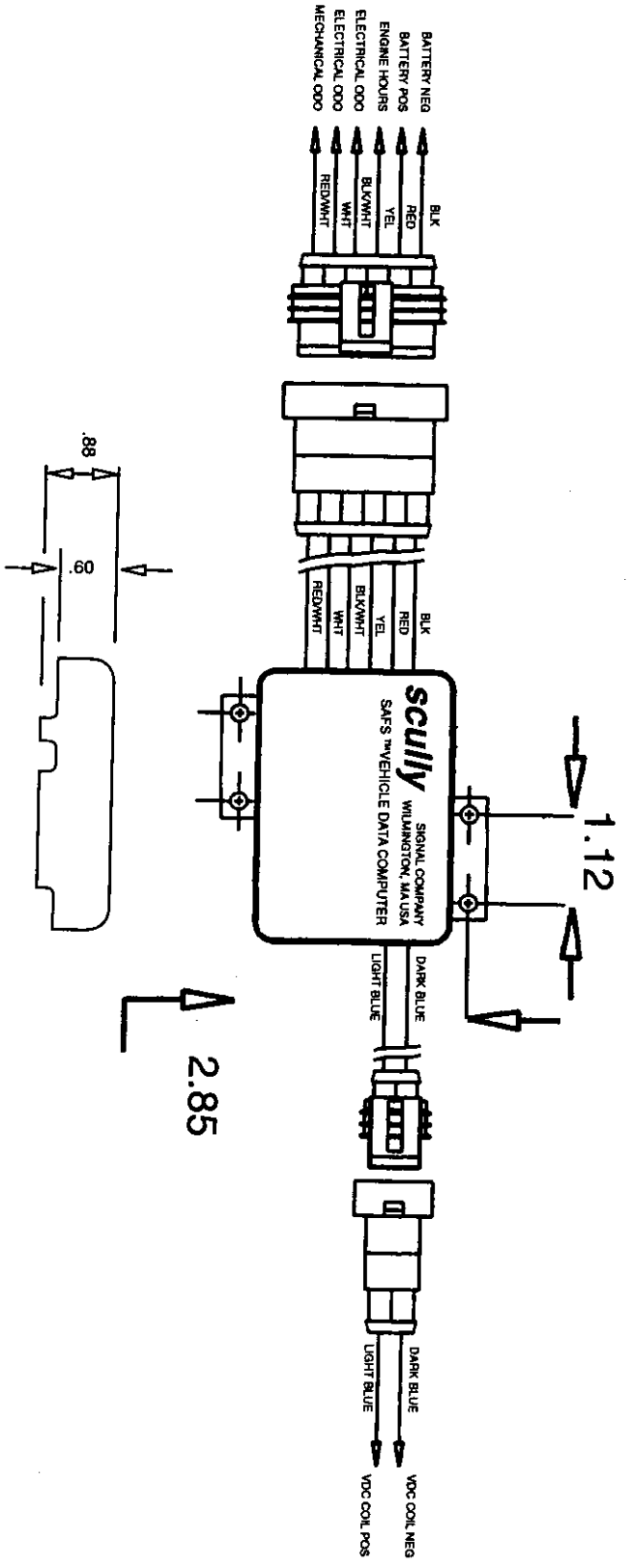
4.3 T-Ring Maintenance

The T-Rings require no specific maintenance; however, for safety reasons no fuel should be allowed to accumulate on the T-Rings. Any T-Ring whose outer case has been damaged by impact or excessive wear should be replaced. The cause of such wear should be addressed by repositioning the T-Ring for protection of its wires.

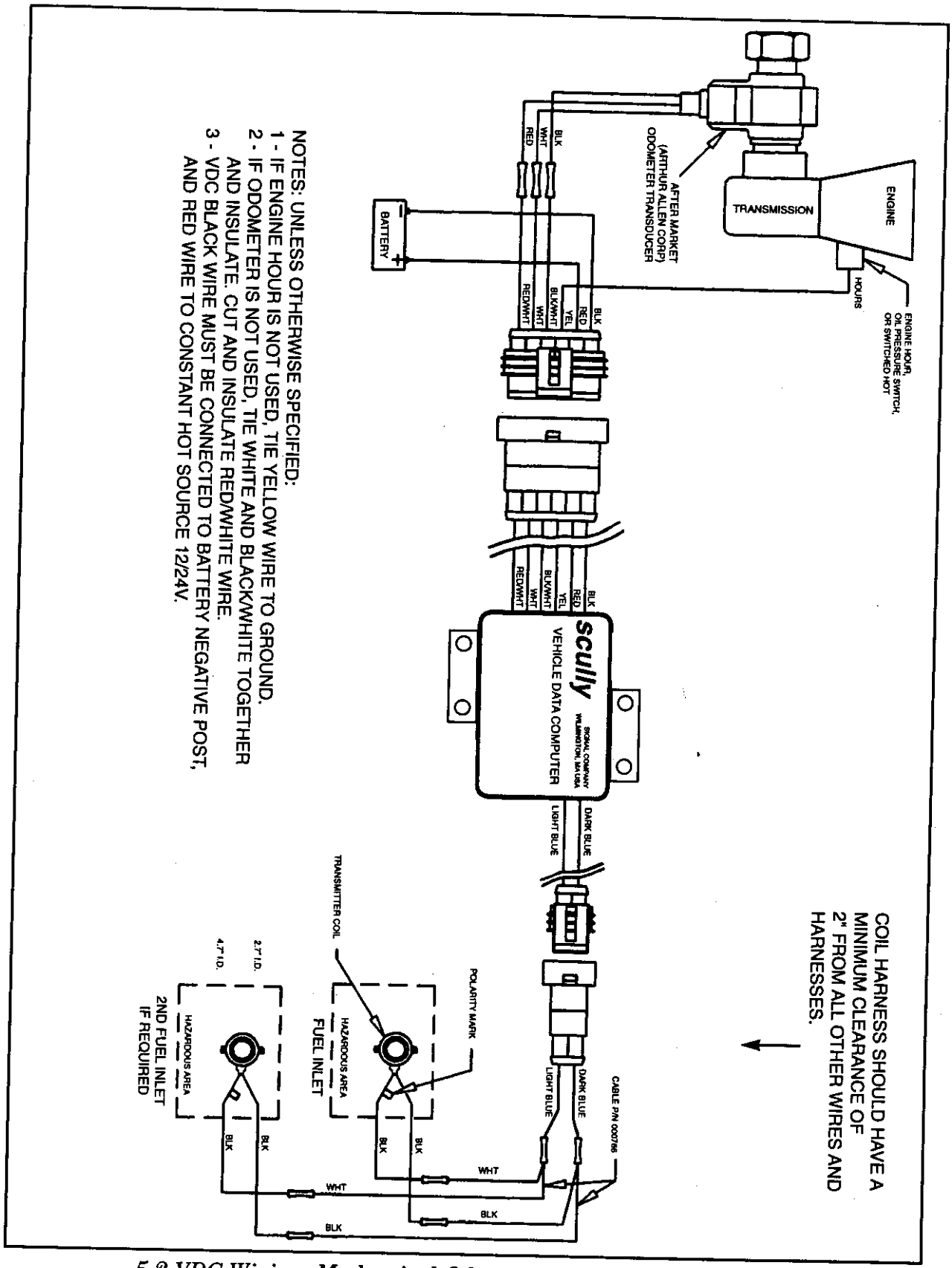
4.4 Odometer Transducer Maintenance

Some odometer transducers require periodic greasing. Follow the manufacturer's instructions to avoid accelerated wear. The pulse factor to be programmed for each vehicle is a function of the gearing, the tire size and the number of poles per shaft rotation.

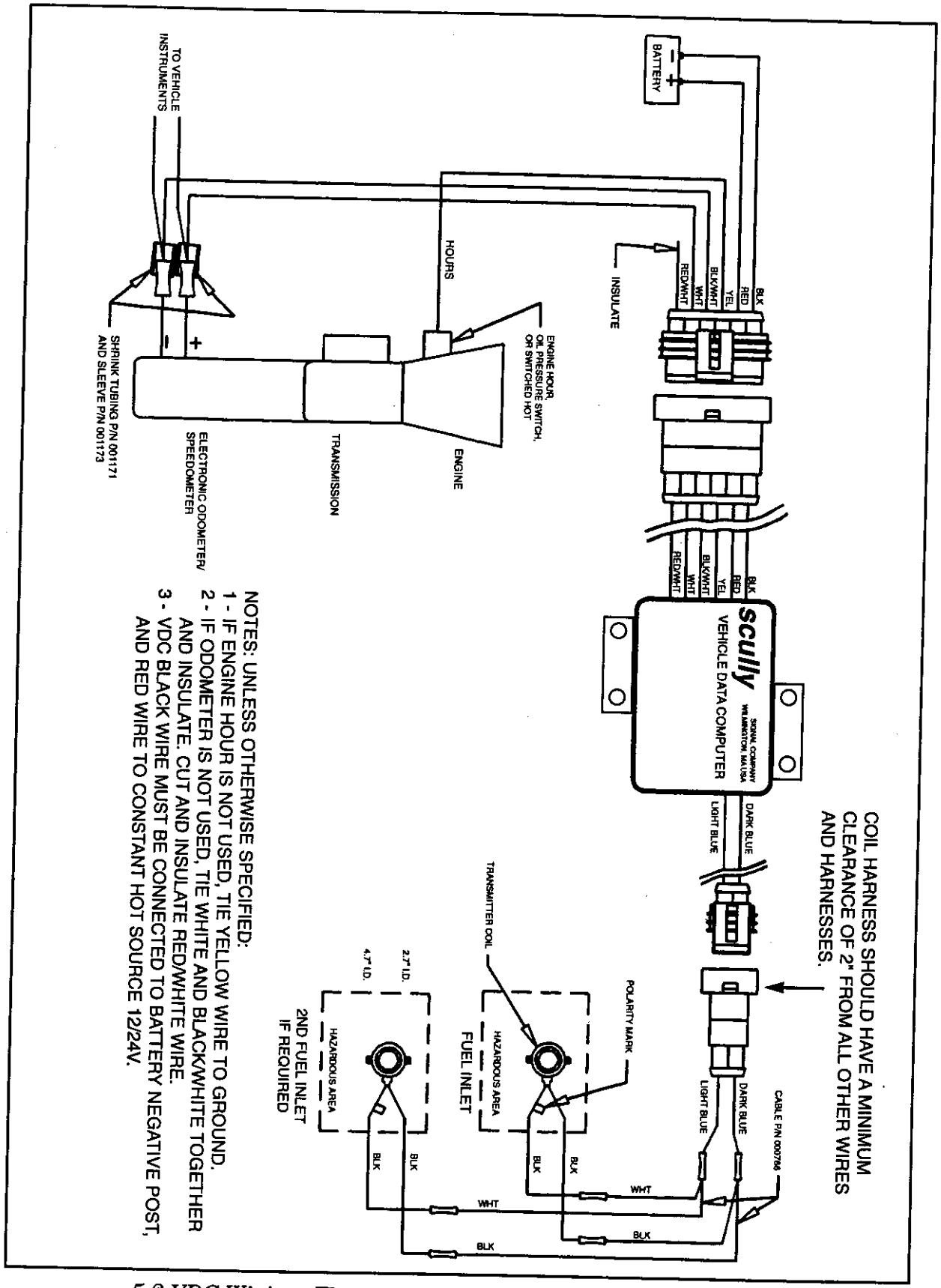
Section 5 Installation Drawings



5.1 VDC Dimension



5.2 VDC Wiring: Mechanical Odometer - shown with optional harness



5.3 VDC Wiring: Electronic Odometer - Shown with optional harness

VDC PROGRAM DATA SHEET

DATE:

VEHICLE ID No.	FLEET ID No.	MODEL & YEAR	TANK CAP	FUEL TYPE	INSTALL HOURS	INSTALL MILES	PULSE FACTOR	INSTALL LOCATION

VEHICLE CALIBRATION FACTOR DATA SHEET

DATE:

VEHICLE MANUFACTURER	VEHICLE MODEL	YEAR	TRANSDUCER TYPE	PULSE FACTOR