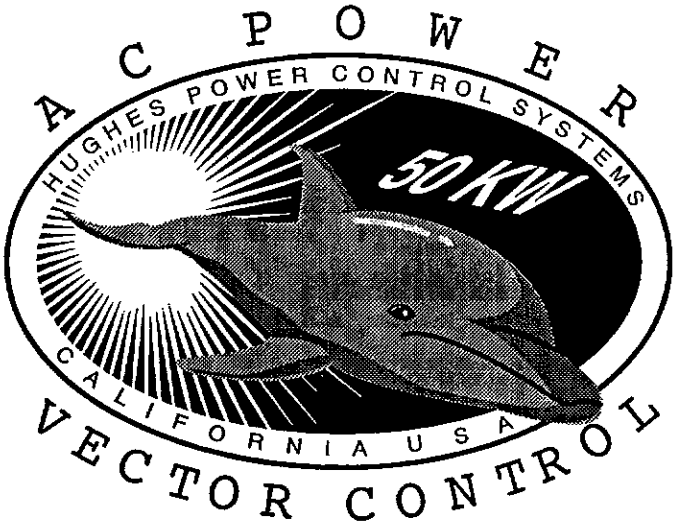
PRELIMINARY COPY



DOLPHIN PROPULSION SYSTEM

SERVICE MANUAL

PRELIMINARY

LIST OF ILLUSTRATIONS

LIST OF TABLES

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SECTION I

INTRODUCTION

This manual covers the Dolphin propulsion system (Figure 1-1) which consists of a power control unit (PCU) (Figure 1-2) and an ac induction traction motor (Figure 1-3). The Dolphin system possesses important features such as performance, efficiency, safety, low maintenance and ease of conversion, in addition to the environmental considerations of zero emission transportation. The electronic matching of the PCU and motor as well as the off–throttle regeneration and regenerative braking all contribute to the high efficiency of the Dolphin propulsion system. The Dolphin propulsion system includes safety features such as, built-in interlocks as well as circuitry to monitor battery isolation for high voltage protection. The dolphin propulsion system itself requires no regular maintenance. In addition, the Dolphin propulsion system reduces brake wear (due to the off–throttle regeneration) and also extends the life of the accessory battery by keeping a slow trickle charge on the battery. This propulsion system is adaptable to a variety of internal combustion engine automobiles using the existing cooling and +12 Vdc electrical systems as well as the transmission. The conversion would also require propulsion battery packs and a 110/220 Vac chassis assembly for charging.

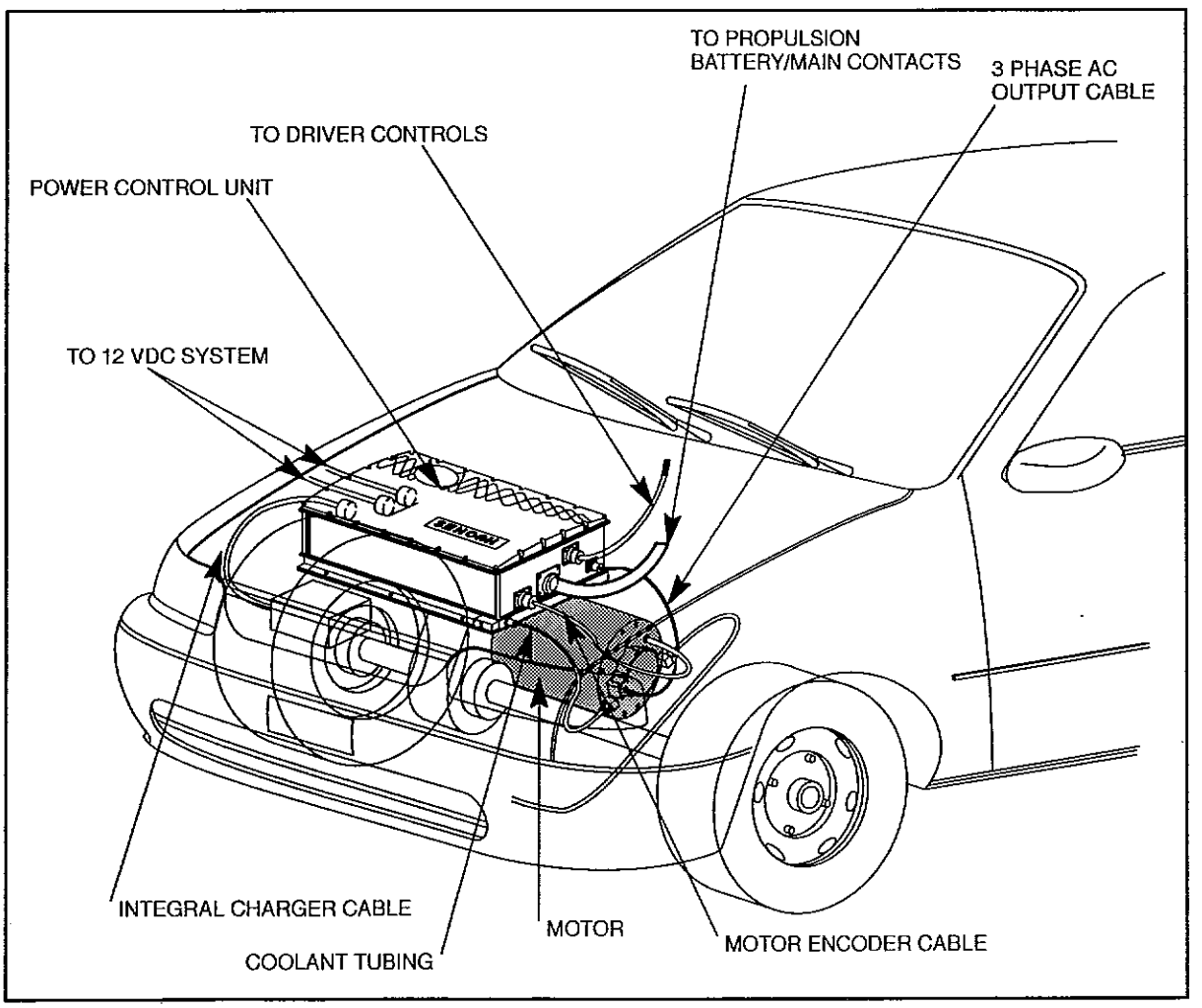

Figure 1-1. Dolphin Propulsion System and Interfaces

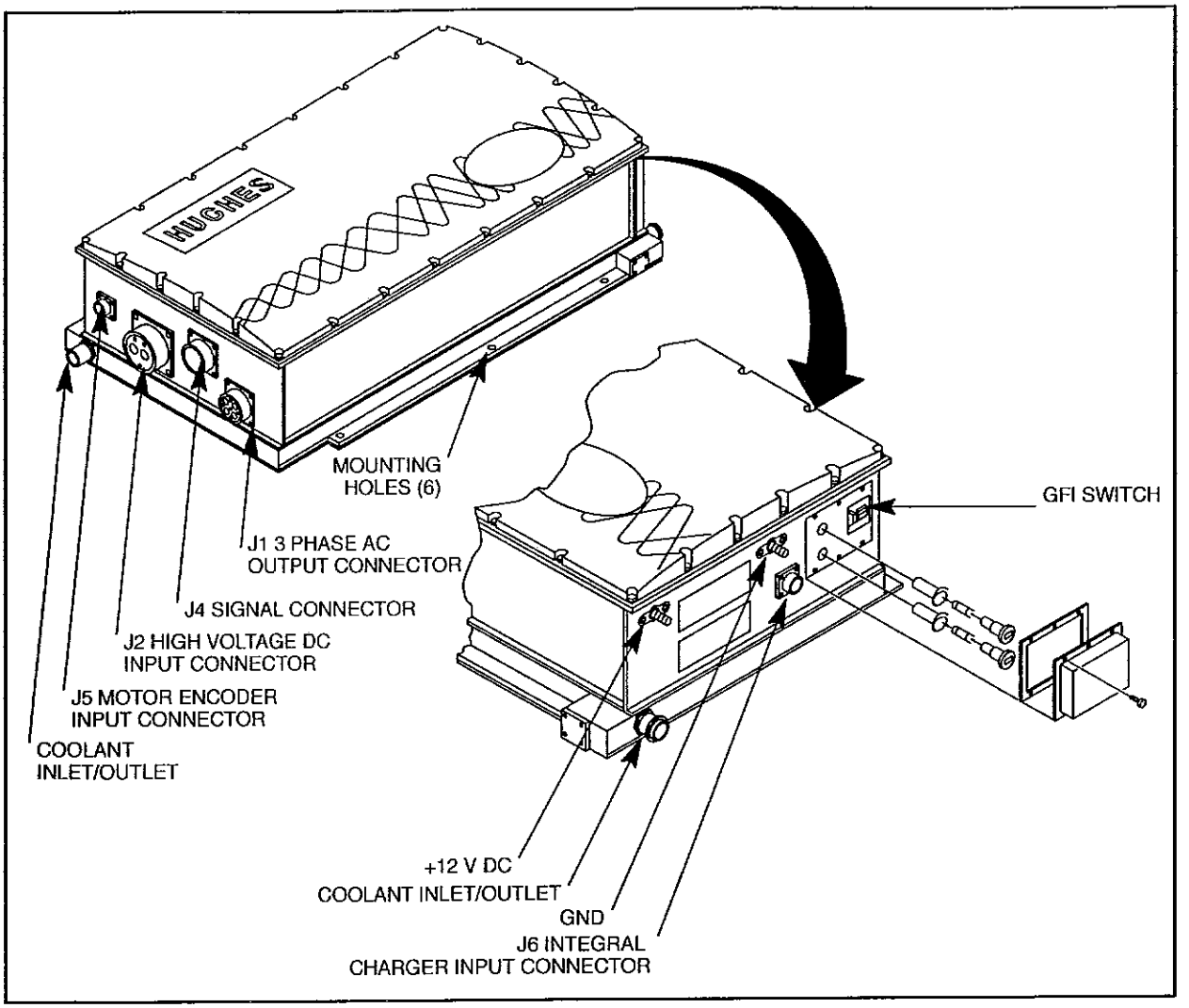

Figure 1-2. Dolphin Power Control Unit (PCU)

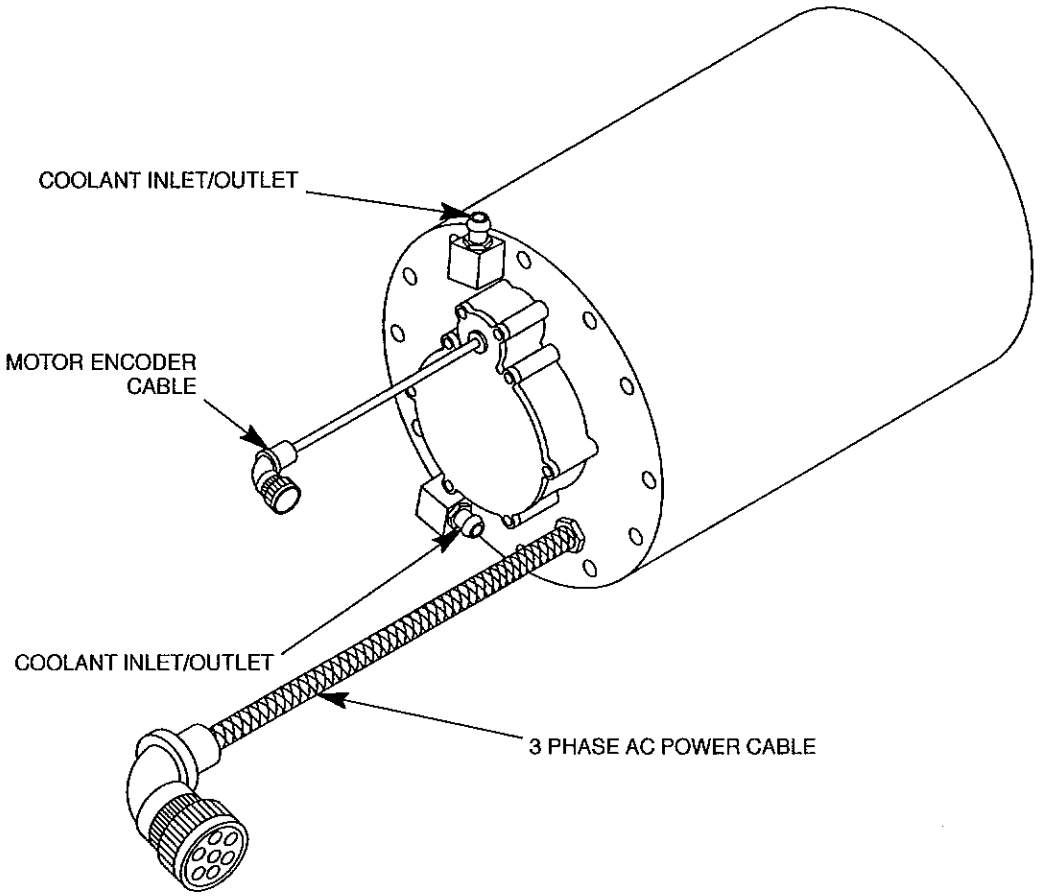

Figure 1-3. Dolphin AC Induction Traction Motor

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SECTION II

OPERATION

NORMAL MOTORING OPERATION

Normal operating procedure is as follows:

1. Insert car key into start switch.
2. Turn key to on position.
3. Fault indicator blinks for approximately 2 seconds and then turns off.
4. The ready indicator will then be lit.
5. Car is now ready for normal operation.

NORMAL CHARGING OPERATION

Normal charging procedure is as follows:

1. Turn main battery switch on.
2. Ensure start switch is in off position.
3. Insert 110/220 V ac single-phase line into charger receptacle.
4. Charger indicator blinks during charge cycle.
5. When charging is complete, charge indicator is continuously lit.
6. Disconnect 110/220 V ac single-phase line from charger receptacle.

NORMAL OPERATING TEMPERATURE RANGES

It is normal for the temperature to fluctuate from minimum to maximum temperature depending upon the load and ambient temperature conditions to which the Dolphin propulsion system is subjected.

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SECTION III
MAINTENANCE

SCHEDULED MAINTENANCE PHILOSOPHY

The Dolphin propulsion system requires no scheduled maintenance; however, to maintain peak operating efficiency, the coolant and interface cables should be checked regularly. These items interface with the Dolphin propulsion system and can directly degrade the system's efficiency. It is highly recommended that the scheduled maintenance for these items be followed (table 3-1).

CORRECTIVE MAINTENANCE PHILOSOPHY

The Dolphin propulsion system corrective maintenance procedures can be used to troubleshoot down to the field replaceable unit (FRU). The FRUs are the power control unit (PCU), traction control motor, motor encoder cable or other system within the vehicle (i.e. battery, cooling or +12 Vdc electrical system etc.). All FRU failures should be removed and replaced by a qualified technician. Fuses are serviceable on–site and do not require the removal of an FRU. The troubleshooting procedures are written for manual or computer-assisted troubleshooting, however it is strongly advised that a diagnostic computer be used for troubleshooting the Dolphin propulsion system. Figure 3-1 is the system electrical interface diagram.

CORRECTIVE MAINTENANCE GENERAL DESCRIPTION

POWER CONTROL UNIT

The PCU integrates a three-phase ac power inverter, dc/dc converter and an integral charger into one main assembly. The PCU power inverter converts high voltage dc into three-phase ac power for the motor. The dc/dc converter provides a trickle charge for the +12 Vdc auxiliary battery. The integral charger is compatible with 110/220 Vac single phase 15 amp service.

MOTOR

The Dolphin propulsion system uses an ac induction traction motor with an environmentally sealed housing. The traction motor can be coupled to a standard transmission that is fixed in first or second gear. The traction motor is electronically matched (tuned) to the output of the power inverter of the power control unit (PCU), increasing the power transfer to the road.

MOTOR ENCODER CABLE

The motor encoder cable carries +5 volts, motor encoder signals and temperature signals. The +5 volt signal powers the motor encoder circuitry housed within the motor housing. The motor encoder signals relay motor speed information to the PCU. The temperature signal is a voltage between 0 and 5 volts that is analogous to the temperature of the motor.

REQUIRED TOOLS AND TEST EQUIPMENT

DIAGNOSTIC COMPUTER

The diagnostic computer is a 486 microprocessor-based PC computer (preferably a laptop style) that is compatible with the Hughes Power Systems diagnostic software. The diagnostic computer must also have the capability to communicate with the PCU via RS–232 or SAE J1850 serial interface.

DIAGNOSTIC SOFTWARE

The only software that shall be used to troubleshoot the Dolphin propulsion system is the diagnostic software written by Hughes Power Control Systems.

COMPUTER CABLING

- 9-pin RS–232 cable

TEST EQUIPMENT

- Digital Multi--meter, Beckman 310 or equivalent (Required)
- A 80486 class PC compatible computer loaded with Hughes Power Control Systems diagnostic software with a RS–232 cable. (Optional)

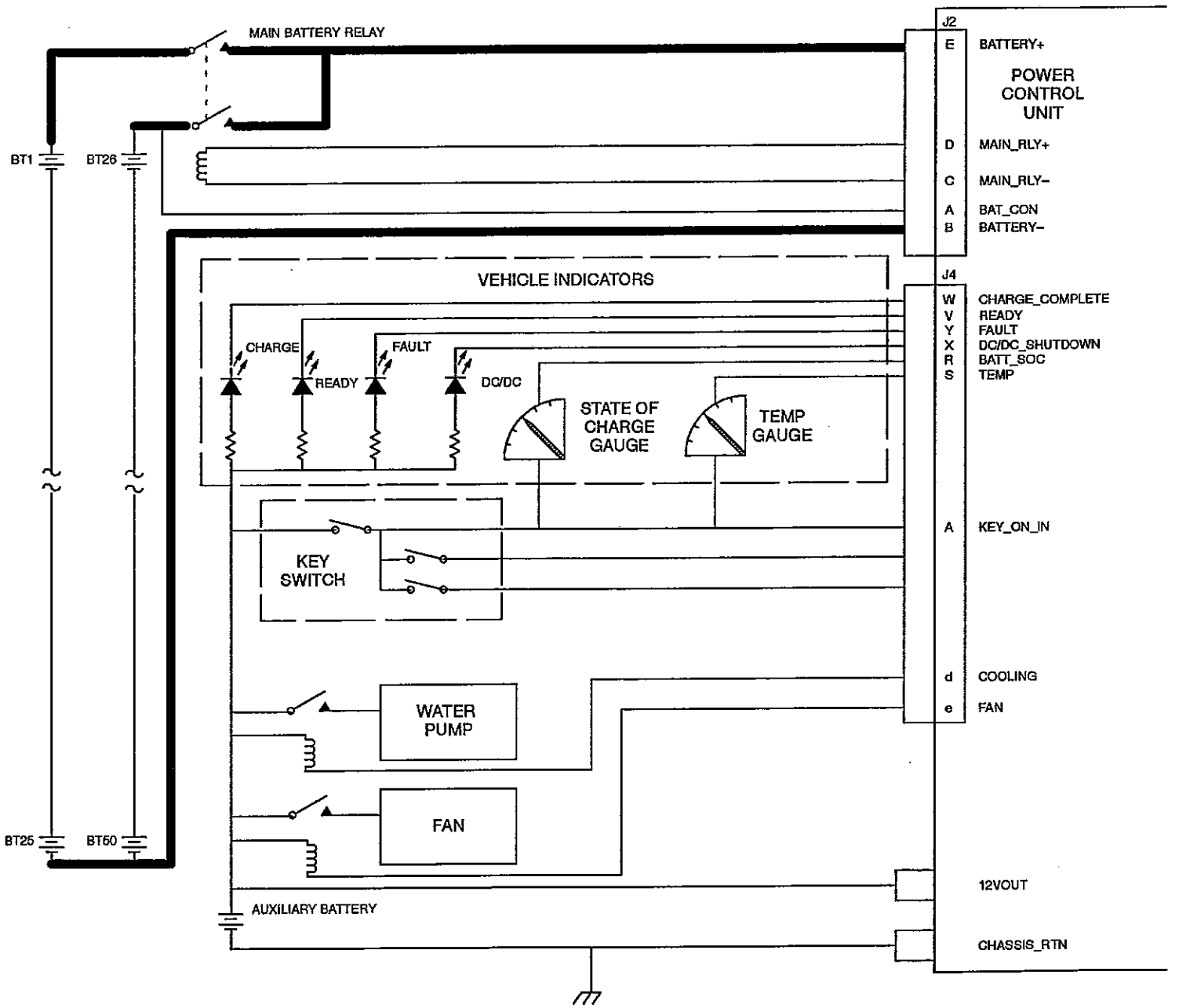

Figure 3-1. Dolphin Propulsion System Block Diagram (Sheet 1 of 2)

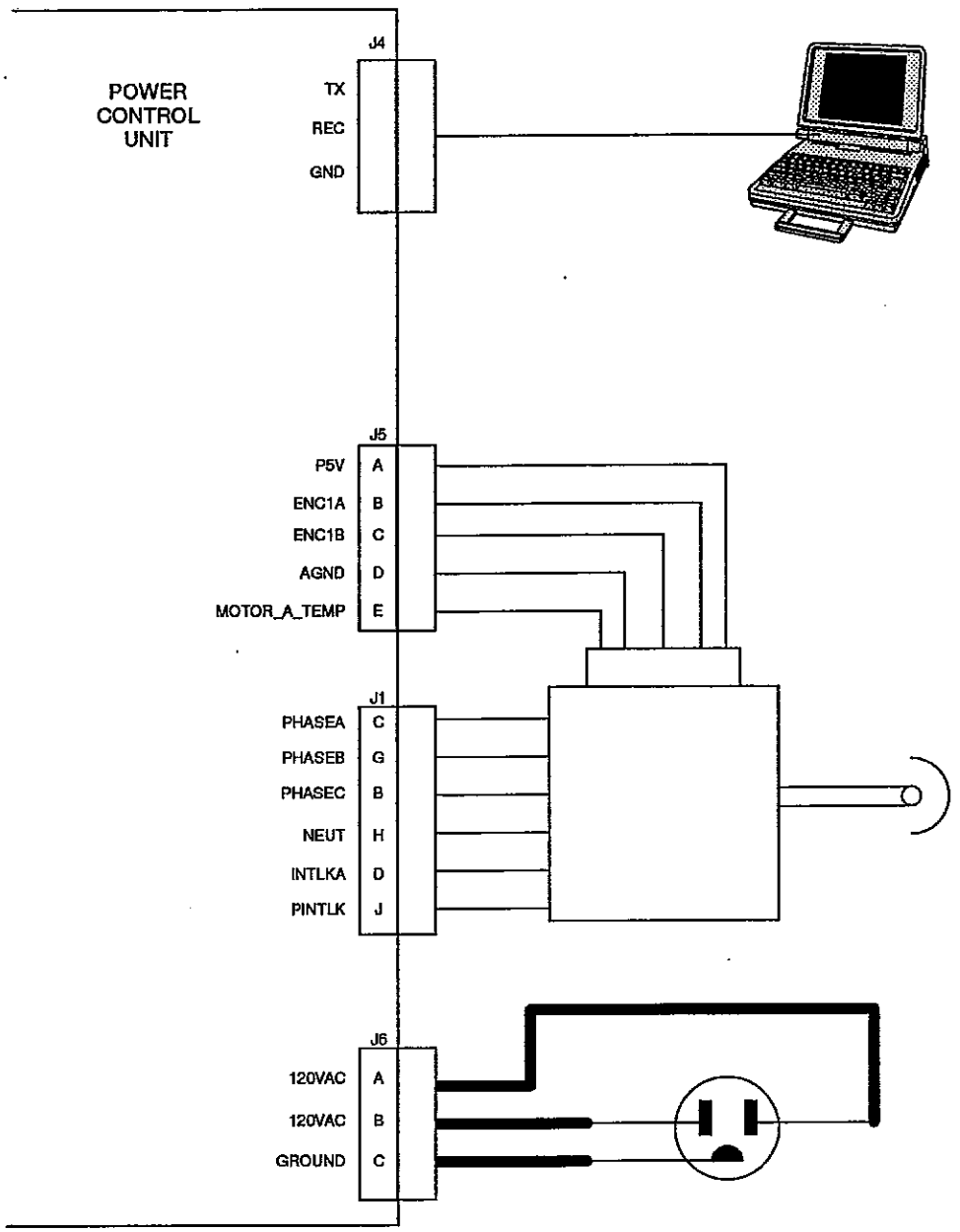

Figure 3-1. Dolphin Propulsion System Block Diagram (Sheet 2 of 2)

Table 3-1. Scheduled Maintenance

ITEM	SERVICE INTERVAL	RECOMMENDED ACTION
Coolant		
• Check Coolant Level	Every 2 Weeks	Top off with 50/50 ethylene glycol or water with a corrosion inhibitor
• Replace Coolant	Every 12 Months	Replace with 50/50 ethylene glycol or water with a corrosion inhibitor
Cables		
• Check Cable Connectors	Every Week	Visual inspection of cable connectors
• Check for Cable Chaffing	Every 2 Months	Visual inspection of cables

SERVICE SAFETY

CAUTION: Before removing or installing any electrical unit or when a tool or equipment could easily come in contact with "live" exposed electrical terminals, disconnect the negative auxiliary battery cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the key switch and the main battery pack external on/off switch shall be in the "off" position.

HANDLING ELECTROSTATIC DISCHARGE (ESD) SENSITIVE PARTS

Many solid state electrical components can be damaged by electrostatic discharge (ESD). Some will display a label as shown in figure 3-2, but many will not.

NOTICE: Before any servicing is performed on the Dolphin Propulsion system, proper ESD precautions should be taken. The following are some of the precautions that should be taken:

1. Always wear an anti–static wrist strap that is attached to a secure ground.
2. Do not touch exposed electrical terminals on components or connectors with your finger or any tools.
3. Never jumper, ground or use test equipment probes on any components or connectors unless specified in diagnostics.
4. Do not remove the solid state component from its protective packaging until you are ready to install the part.

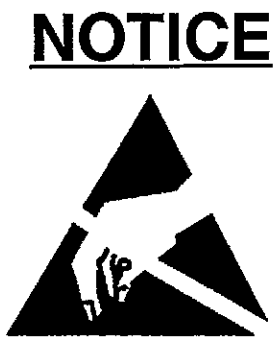

Figure 3-2. Electrostatic Discharge Sensitive Parts Label

DIAGNOSIS OF DOLPHIN PROPULSION SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
Start-up Fault – No Indicator Lights (Reference no indicator lights diagnostic procedure (part 1 of 2) Figure 3-10)	1. Cables to PCU are loose or disconnected. 2. US Electricar auxiliary power system fault. 3. 12 Vdc line fuse blown. 4. PCU fault.	1. Disconnect and reconnect all cables to PCU. 2. Refer to US Electricar auxiliary power system diagnostic procedure. 3. Replace blown fuse. 4. Refer to computer diagnostic program. Replace PCU if necessary.
Start-up Fault – Fault Indicator Remains On (Reference fault indicator remains on diagnostic procedure (part 1 of 2) Figure 3-13)	1. Cables to PCU are loose or disconnected. 2. Main battery pack external on/off switch is off. 3. Accelerator pedal not in fully off position. 4. Low auxiliary battery. 5. Fuse inside PCU integral charger is blown. 6. US Electricar auxiliary power system fault. 7. PCU fault.	1. Disconnect and reconnect all cables to PCU. 2. Turn switch to on position. 3. Reposition accelerator pedal to off position. 4. Check auxiliary battery voltage with volt meter or diagnostic computer; charge battery if necessary. 5. Check fuse, replace if necessary. 6. Refer to US Electricar auxiliary power system diagnostic procedure. 7. Refer to diagnostic computer. Replace PCU if necessary.
Start-up Fault – No Ready Indicator (Reference no ready indicator diagnostic procedure Figure 3-15)	1. Cables to PCU are loose or disconnected. 2. US Electricar auxiliary power system fault. 3. Accelerator is not fully off. 4. Main power relay may not be engaging. 5. PCU fault.	1. Disconnect and reconnect all cables to PCU. 2. Refer to US Electricar auxiliary power system diagnostic procedure. 3. Reposition accelerator to off position. 4. Refer to US Electricar main power diagnostic procedure. 5. Refer to computer diagnostic program. Replace PCU if necessary.

DIAGNOSIS OF DOLPHIN PROPULSION SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Motoring Fault – Car Will Not Move	1. Cables to PCU are loose or disconnected. 2. Main power relay may not be engaging. 3. Motor interlock is open or motor fault. 4. PCU fault. 5. Transmission fault.	1. Disconnect and reconnect all cables to PCU. 2. Refer to US Electricar main power diagnostic procedure. 3. Refer to the motor diagnostic procedure Figure 3-18. 4. Refer to computer diagnostic program. Refer to PCU remove and replacement procedure if PCU replacement is necessary. 5. Refer to US Electricar transmission diagnostic procedure.
Motoring Fault – Miles Per Charge Has Degraded	1. Low air pressure in tires. 2. Main batteries pack not fully charged. 3. State of charge meter fault. 4. High impedance in the power circuit causing voltage drop. 5. Integral charger within PCU is not fully charging the batteries. 6. Main batteries fault. 7. Motor fault.	1. Inflate tires to proper pressure level. 2. Charge main battery pack. 3. Refer to US Electricar indicator diagnostic procedure. 4. Refer to US Electricar main power diagnostic procedure. 5. Refer to integral charger diagnostic procedure Figure 3-16. 6. Refer to US Electricar main power diagnostic procedure. 7. Refer to motor diagnostics procedure Figure 3-18.
Motoring Fault – Vehicle Slips Into Charge Mode While Motoring	1. PCU fault.	1. Replace PCU. Refer to PCU removal and replacement procedure.
Motoring Fault – Vehicle Indicators Will Not Turn Off When Key Is In Off Position	1. Fused main power relay.	1. Refer to US Electricar main power diagnostic procedure.
Motoring Fault – Vehicle Powers Down Unexpectedly	1. Loose connector. 2. Thermal shutdown. 3. Motor fault. 4. PCU fault.	1. Disconnect and reconnect all PCU cables. 2. Refer to the temperature problems diagnostic procedure (part 1 of 2) Figure 3-5. 3. Refer to the motor diagnostic procedure Figure 3-18. 4. Refer to the computer diagnostic procedure. Replace PCU if necessary.

DIAGNOSIS OF DOLPHIN PROPULSION SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Motoring Fault – Temperature Problems	1. Low coolant.	1. Refill coolant reservoir with proper coolant mixture.
	2. Water pump fault.	2. Refer to US Electricar water pump diagnostic procedure.
	3. Fan fault.	3. Refer to US Electricar fan diagnostic procedure.
	4. PCU fault.	4. Refer to the temperature problems diagnostic procedure (part 1 of 2) Figure 3-5. Replace PCU if necessary.
Motoring Fault – Unusual Noise During Motoring	1. Motor noise –	1. Repair as necessary.
	a. Loose motor mounting bolts.	a. Tighten motor mounting bolts. See motor replacement procedure for specifics.
	b. Motor fault.	b. Refer to motor removal and replacement procedure.
	2. PCU noise –	2. Repair as necessary.
	a. Loose PCU mounting bolts.	a. Tighten PCU mounting bolts. See PCU replacement procedure for specifics.
	b. PCU fault.	b. Refer to PCU removal and replacement procedure.
	3. Other car noise	3. Refer to US Electricar noise diagnostic procedure.
Motoring Fault – Vehicle movements Are Not Normal	1. Cables to PCU are loose or disconnected.	1. Disconnect and reconnect all cables to PCU.
	2. Main battery pack not fully charged.	2. Charge main battery pack.
	3. Main battery pack fault.	3. Refer to US Electricar main power diagnostic procedure.
	4. Integral charger is not fully charging main battery pack.	4. Refer to integral charger diagnostic procedure Figure 3-16.
	5. High impedance in the power circuit causing voltage drop.	5. Refer to US Electricar main power diagnostic procedure.
	6. Motor encoder fault.	6. Refer to motor encoder diagnostic procedure Figure 3-7.
	7. Motor fault.	7. Refer to motor diagnostic procedure Figure 3-18.
	8. PCU fault	8. Refer to computer diagnostic procedure. Replace PCU if necessary.

DIAGNOSIS OF DOLPHIN PROPULSION SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Charging Fault – Charge Indicator Never Lights	1. Cables to PCU are loose or disconnected.	1. Disconnect and reconnect all cables to PCU.
	2. Indicator is burned out.	2. Refer to US Electricar indicator diagnostic procedure.
	3. Fuse within integral charger is blown.	3. Replace fuse.
	4. GFI switch has been tripped.	4. Reset GFI switch.
	5. Integral charger fault.	5. Replace PCU.
Charging Fault – Charge Indicator Does Not Blink During Charge Mode	1. Cables to PCU are loose or disconnected.	1. Disconnect and reconnect all cables to PCU.
	2. Indicator is burned out.	2. Refer to US Electricar indicator diagnostic procedure.
	3. Fuse within integral charger is blown.	3. Replace fuse.
	4. GFI switch has been tripped.	4. Reset GFI switch.
	5. Integral charger is faulty.	5. Replace PCU.
Charging Fault – Main Battery Pack Not Fully Charging (Reference integral charger diagnostic procedure Figure 3-16)	1. Charge cable from power source is not fully connected.	1. Disconnect and reconnect charge cable plug.
	2. Loose connectors to PCU.	2. Disconnect and reconnect all connectors to PCU.
	3. High impedance in the power circuit causing voltage drop.	3. Refer to US Electricar main power diagnostic procedure.
	4. Integral charger is not producing enough current.	4. Use diagnostic computer or current probe to measure output current of the integral charger. Replace PCU if necessary. Refer to PCU removal and replacement procedure.
	5. Main battery pack fault.	5. Refer to US Electricar main power diagnostic procedure.
Charging Fault – 12 Volt Auxiliary Battery Loses Its Charge (Reference PCU 12 vdc auxiliary charger diagnostic procedure Figure 3-17)	1. Cable connection between auxiliary battery and PCU is loose.	1. Tighten connections at PCU and auxiliary battery.
	2. Bad power cable between PCU and auxiliary battery.	2. Refer to US Electricar auxiliary power system diagnostic procedure. Replace cable if necessary.
	3. 12 volt auxiliary battery fault.	3. Refer to US Electricar auxiliary power system diagnostic procedure. Replace battery if necessary.
	4. DC/DC converter is faulty.	4. Refer to PCU 12 vdc auxiliary charger diagnostics procedure Figure 3-17. Replace PCU if necessary.

DOLPHIN PROPULSION SYSTEM DIAGNOSTICS

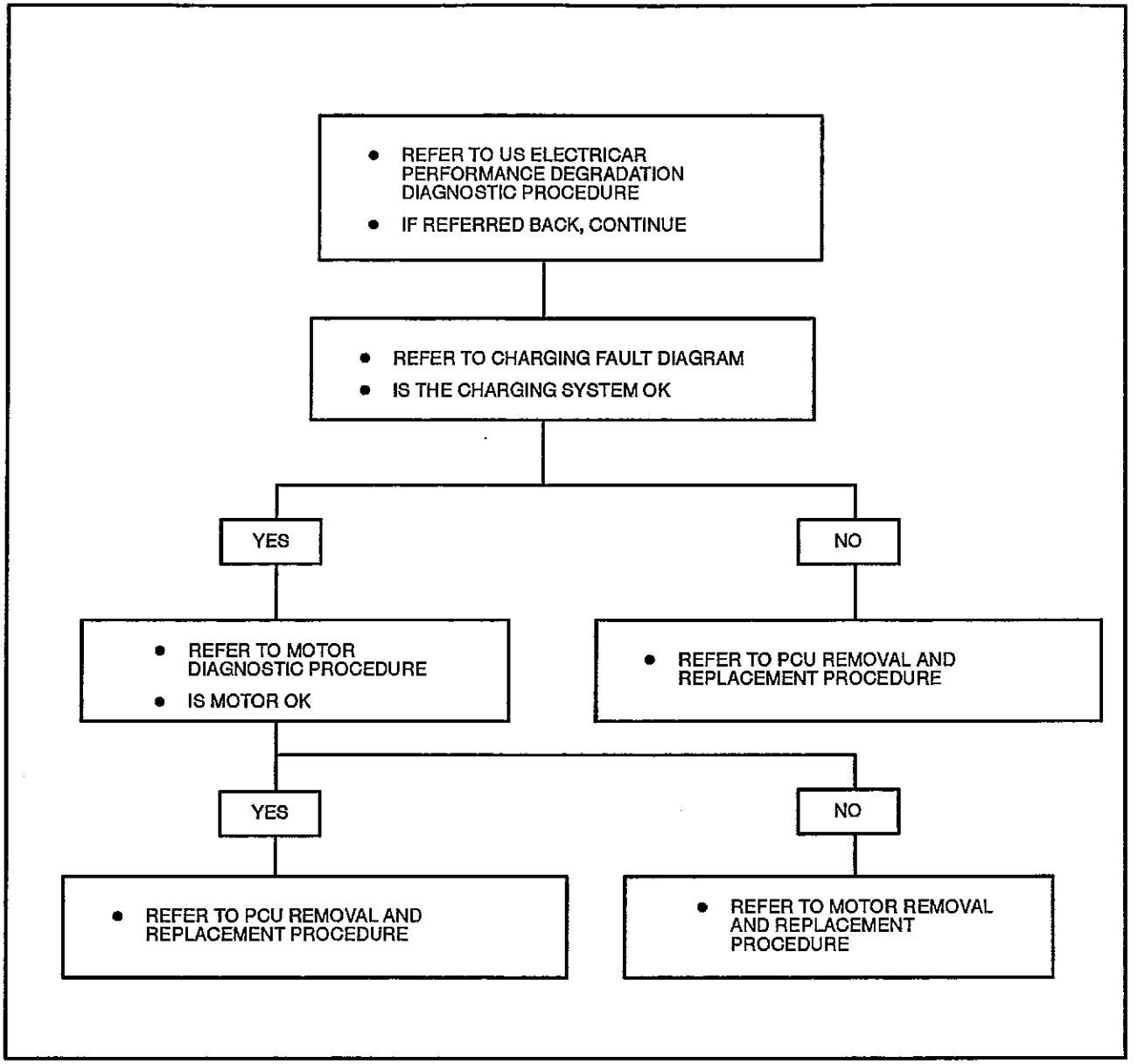

Figure 3-3. Miles Per Charge Has Degraded Diagnostic Procedure

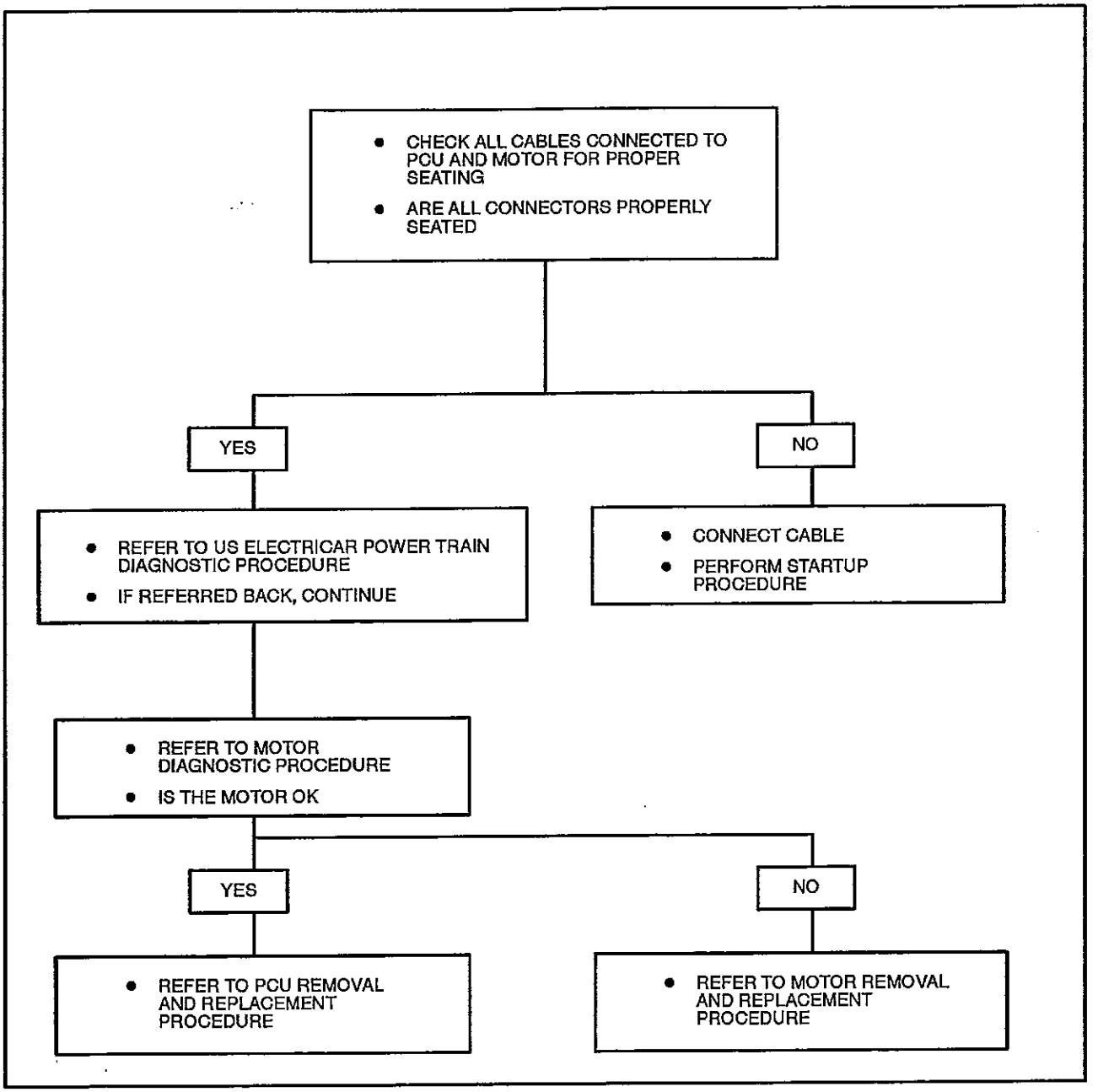

Figure 3-4. Vehicle Powers Down Unexpectedly Diagnostic Procedure

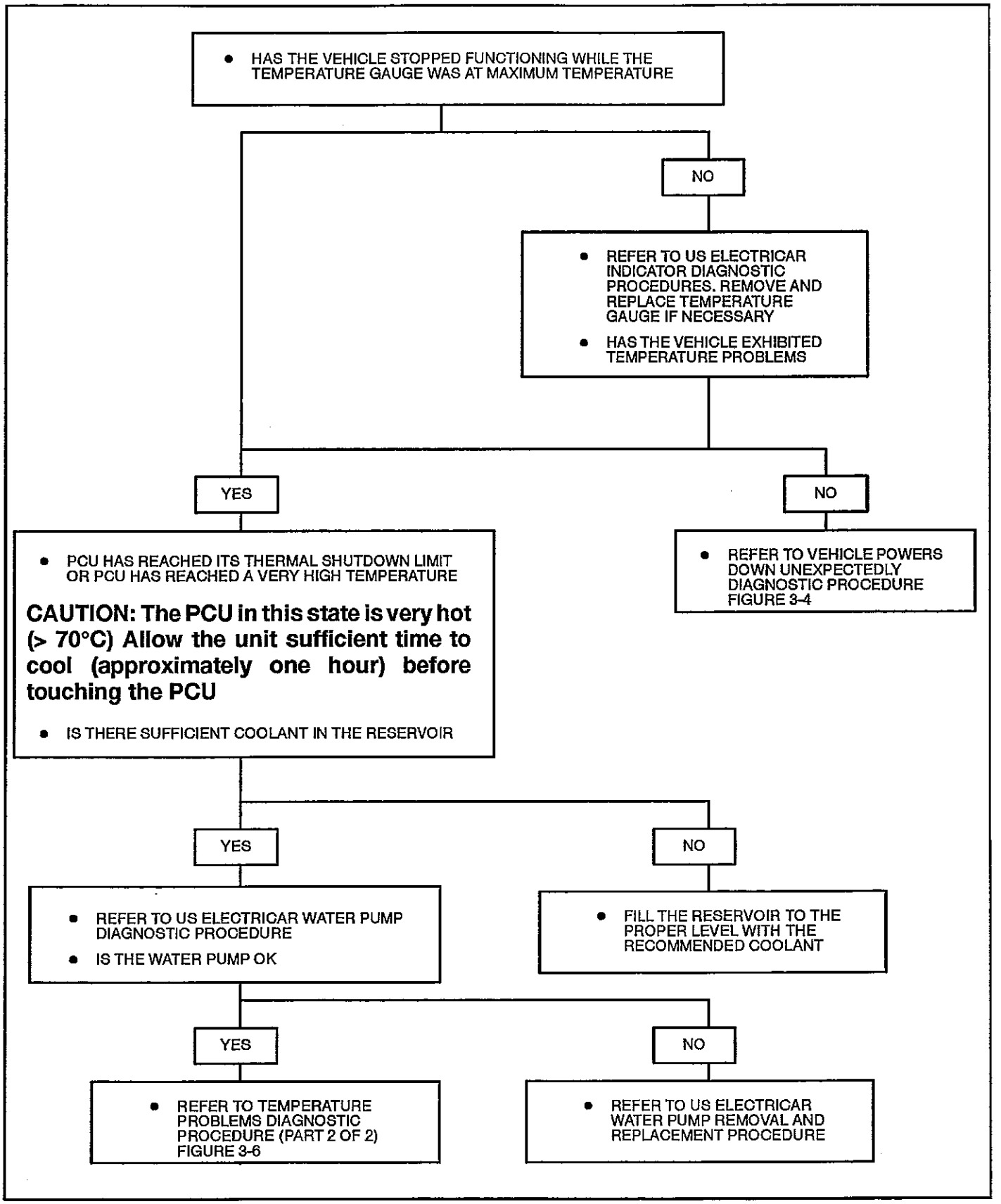

Figure 3-5. Temperature Problems Diagnostic Procedure (Part 1 of 2)

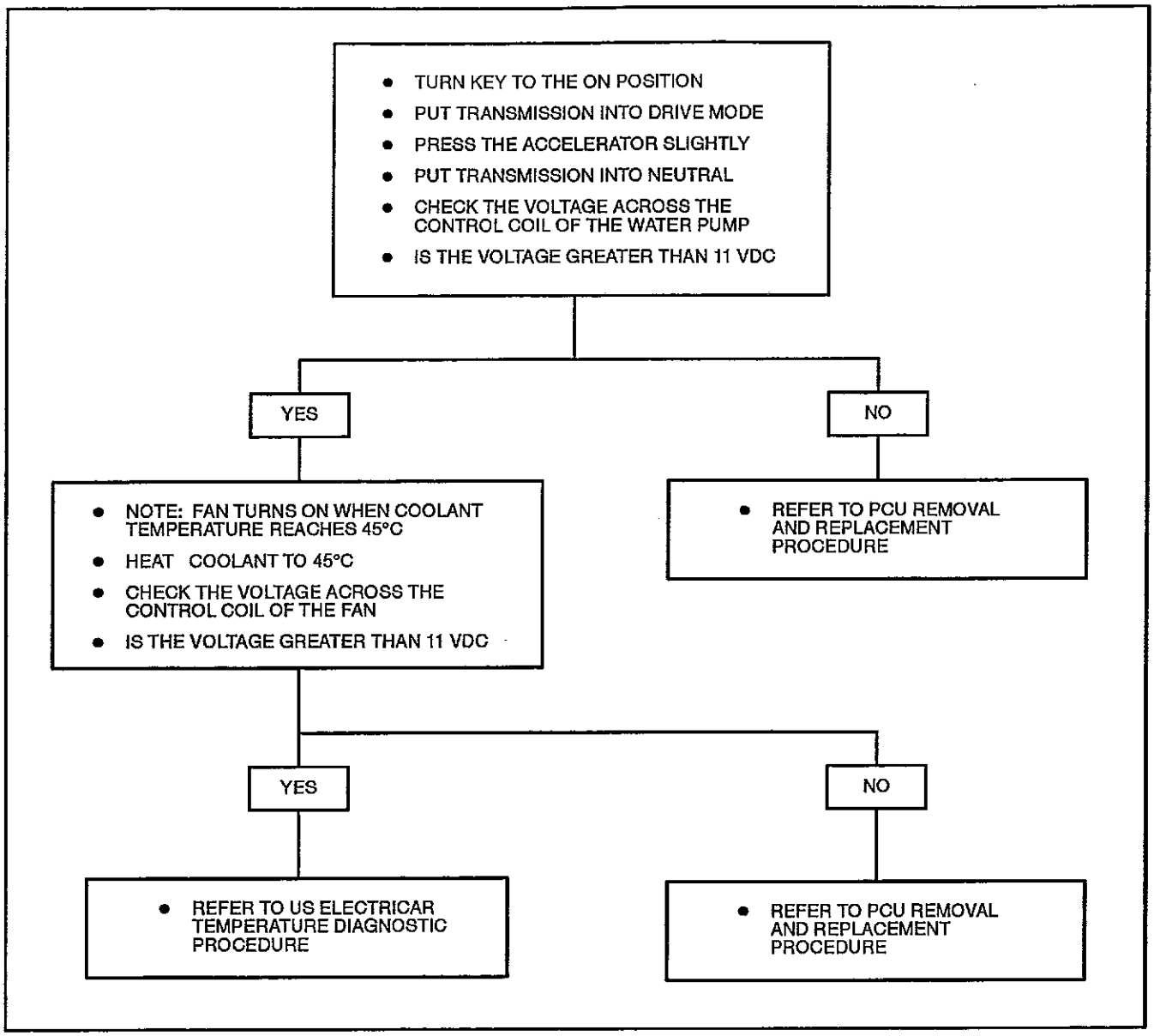

Figure 3-6. Temperature Problems Diagnostic Procedure (Part 2 of 2)

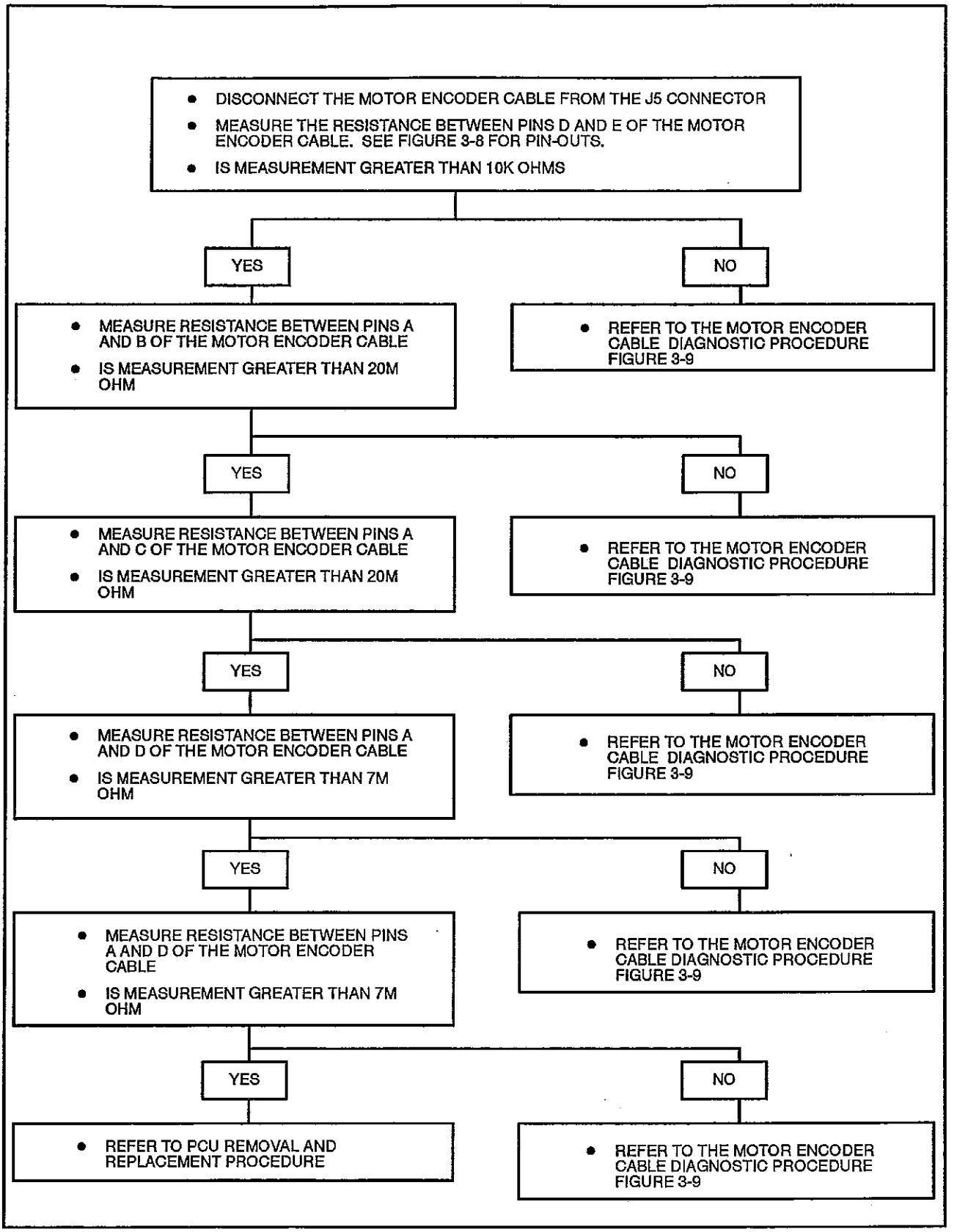

Figure 3-7. Motor Encoder Diagnostic Procedure

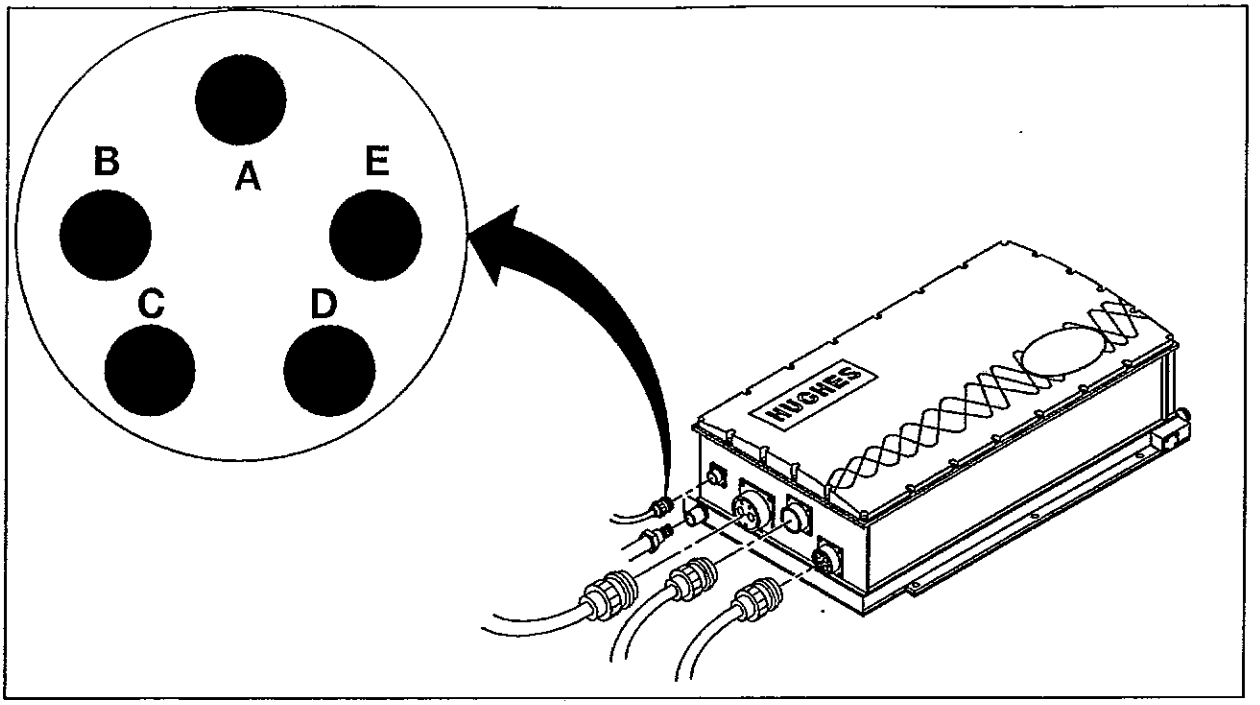

Figure 3-8. Motor Encoder Cable Pin-Out

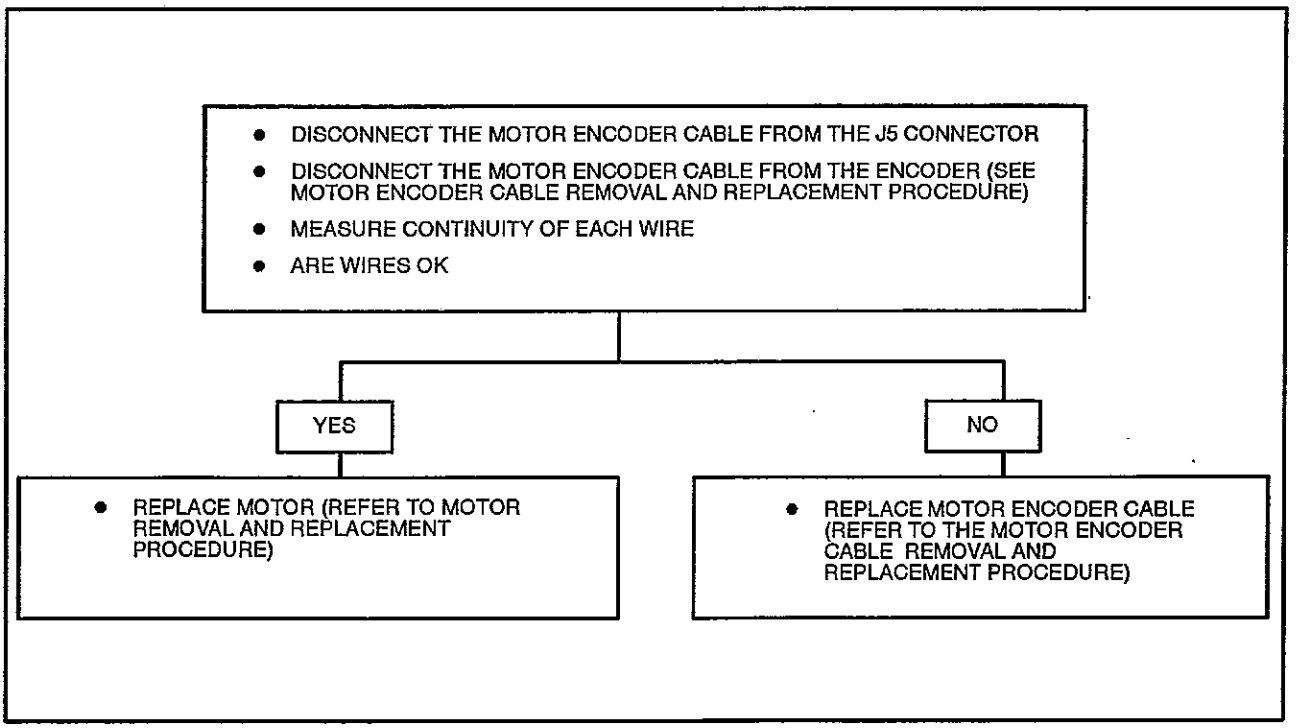

Figure 3-9. Motor Encoder Cable Diagnostic Procedure

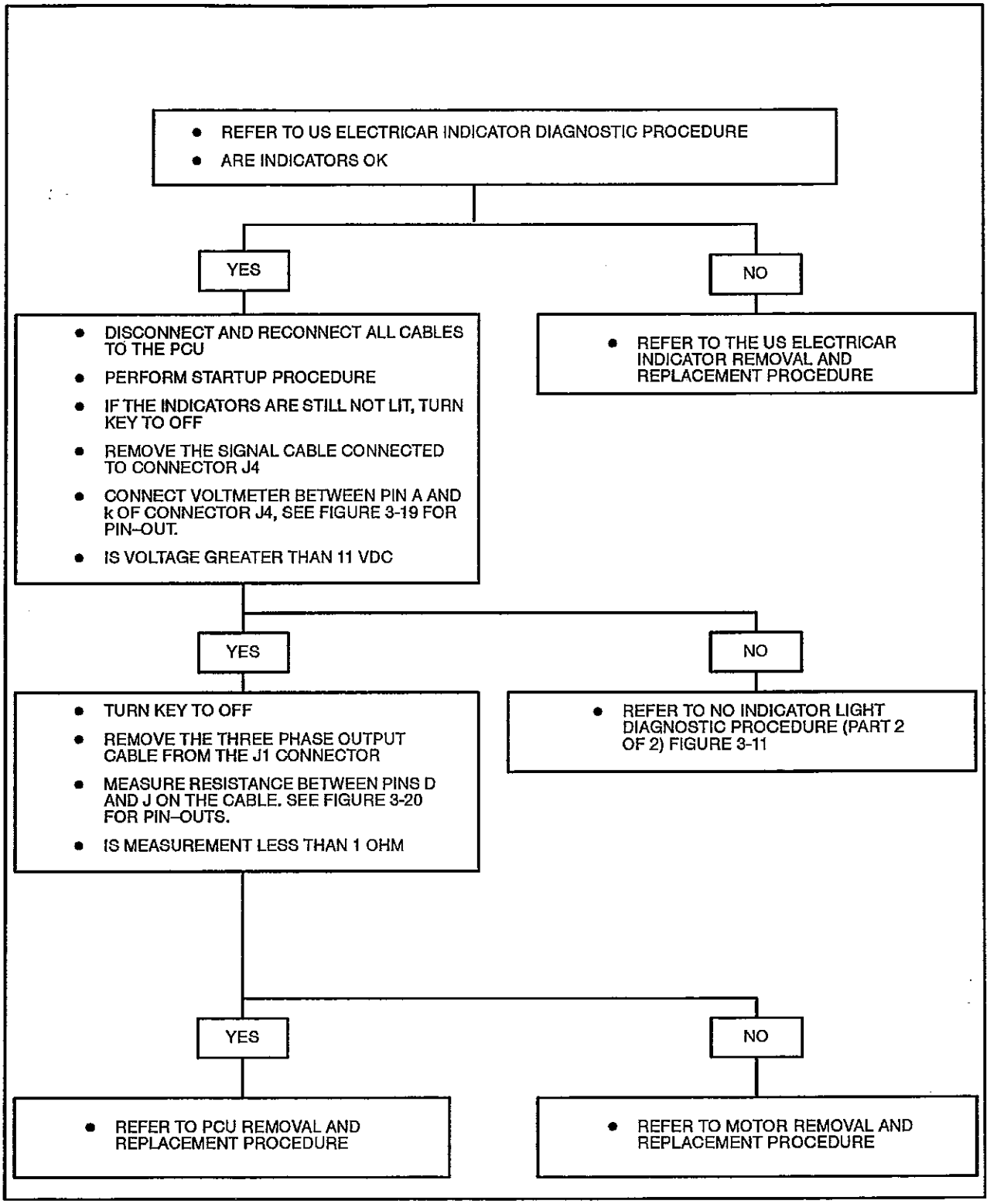

Figure 3-10. No Indicator Lights Diagnostic Procedure (Part 1 of 2)

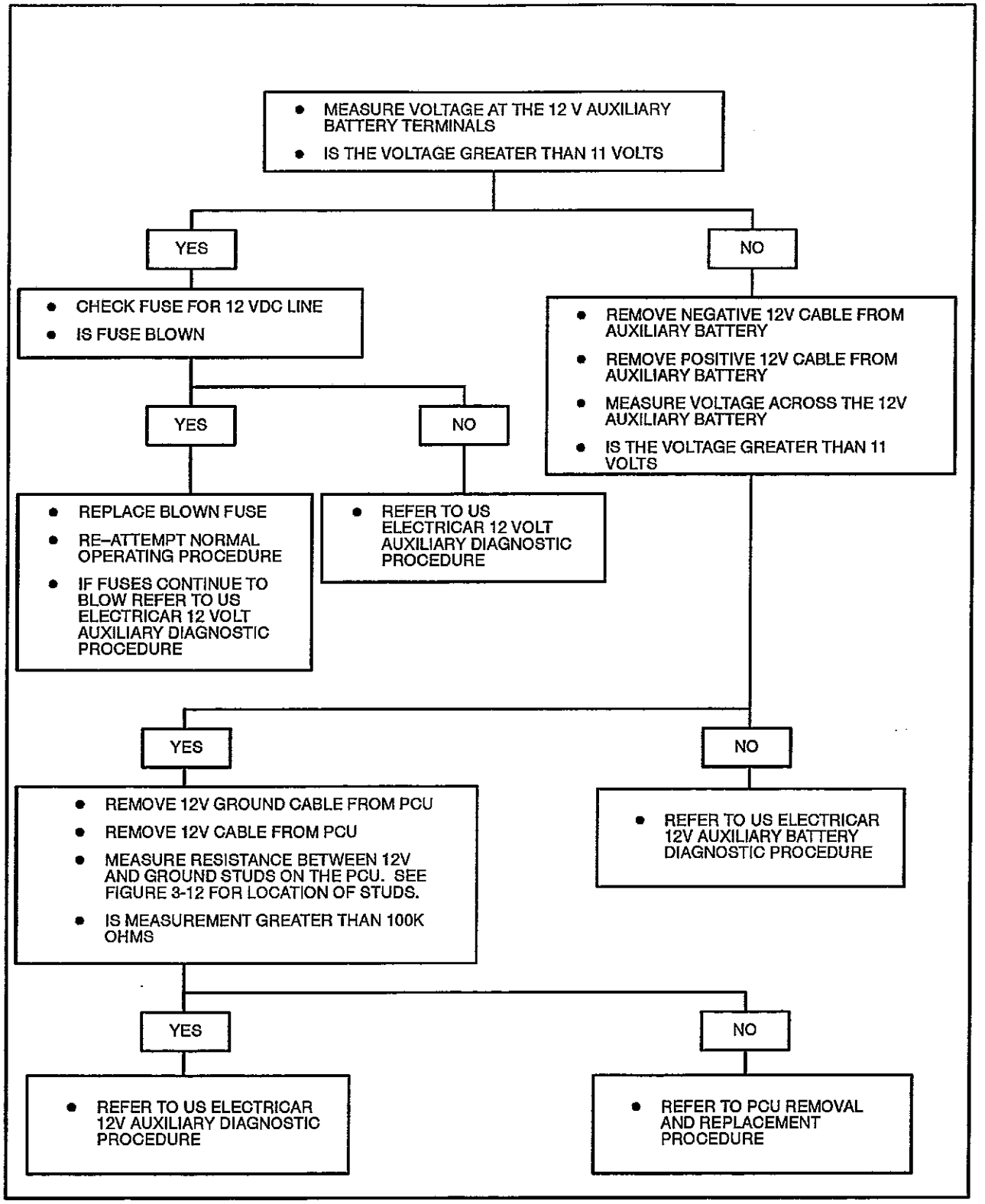

Figure 3-11. No Indicator Lights Diagnostic Procedure (Part 2 of 2)

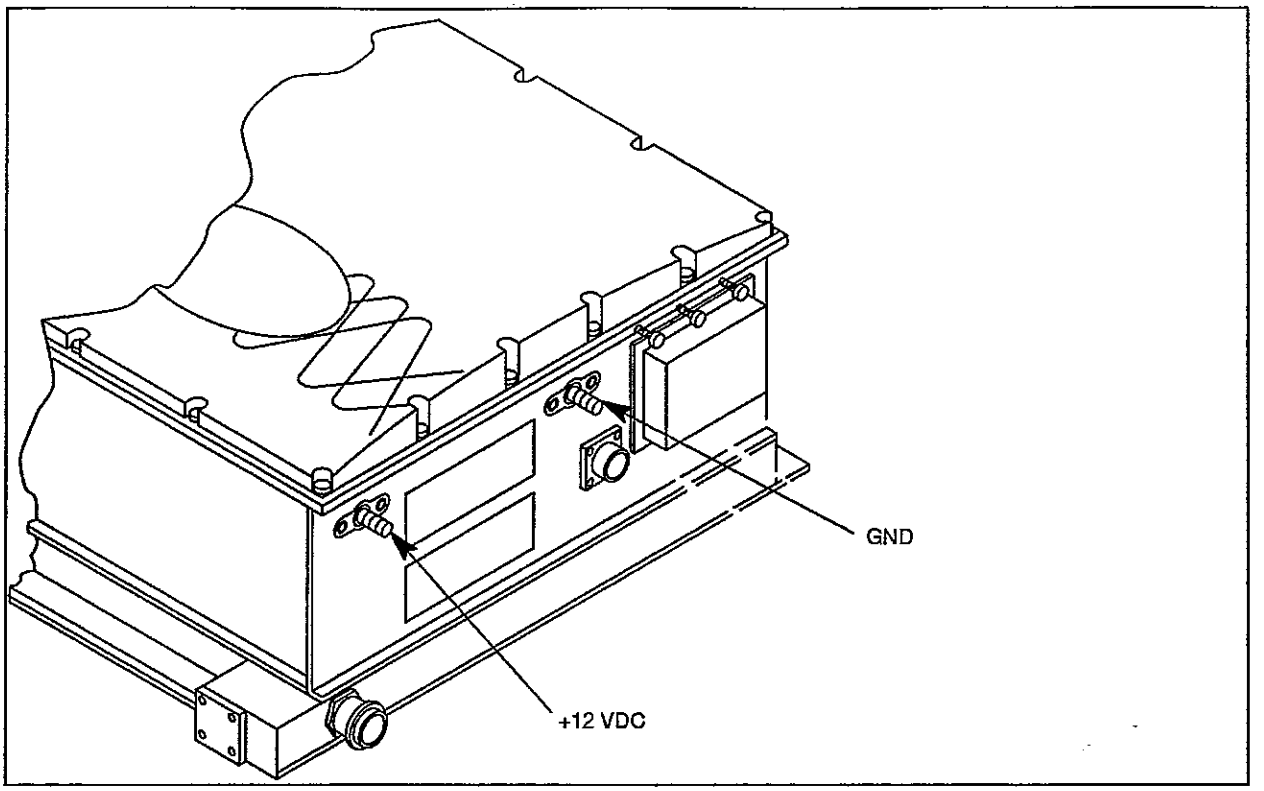

Figure 3-12. 12 VDC Power Location

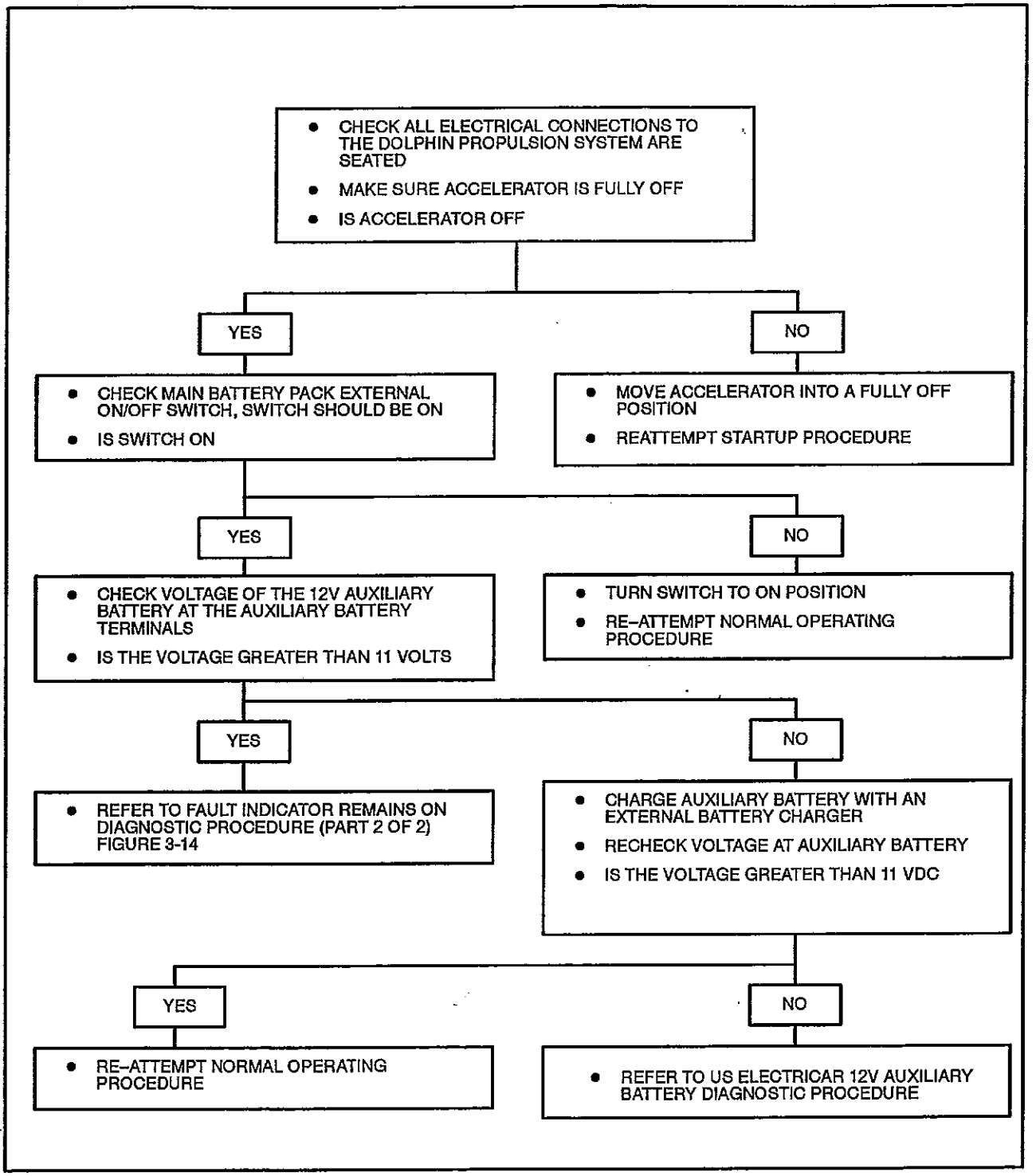

Figure 3-13. Fault Indicator Remains On Diagnostic Procedure (Part 1 of 2)

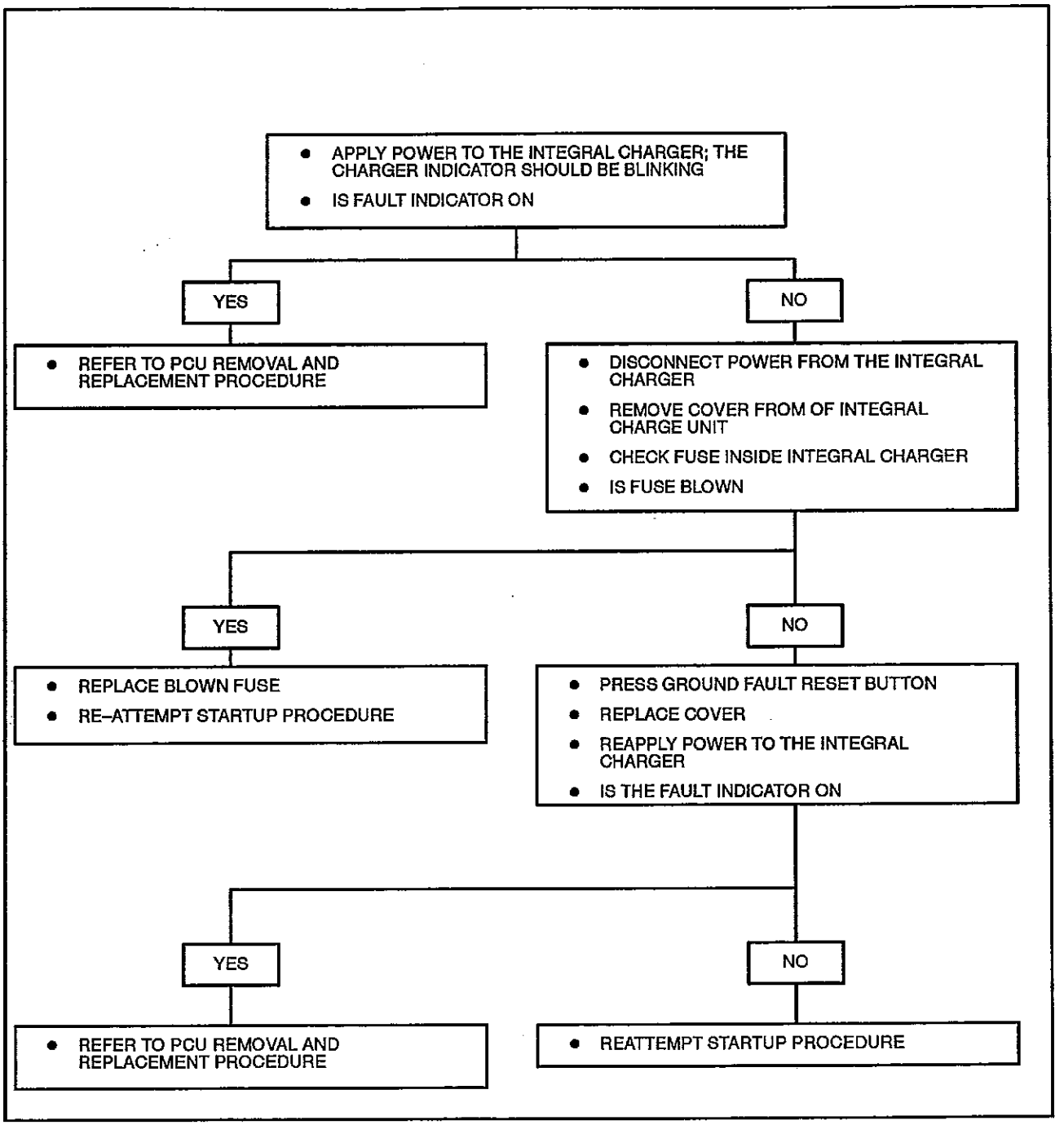

Figure 3-14.. Fault Indicator Remains On Diagnostic Procedure (Part 2 of 2)

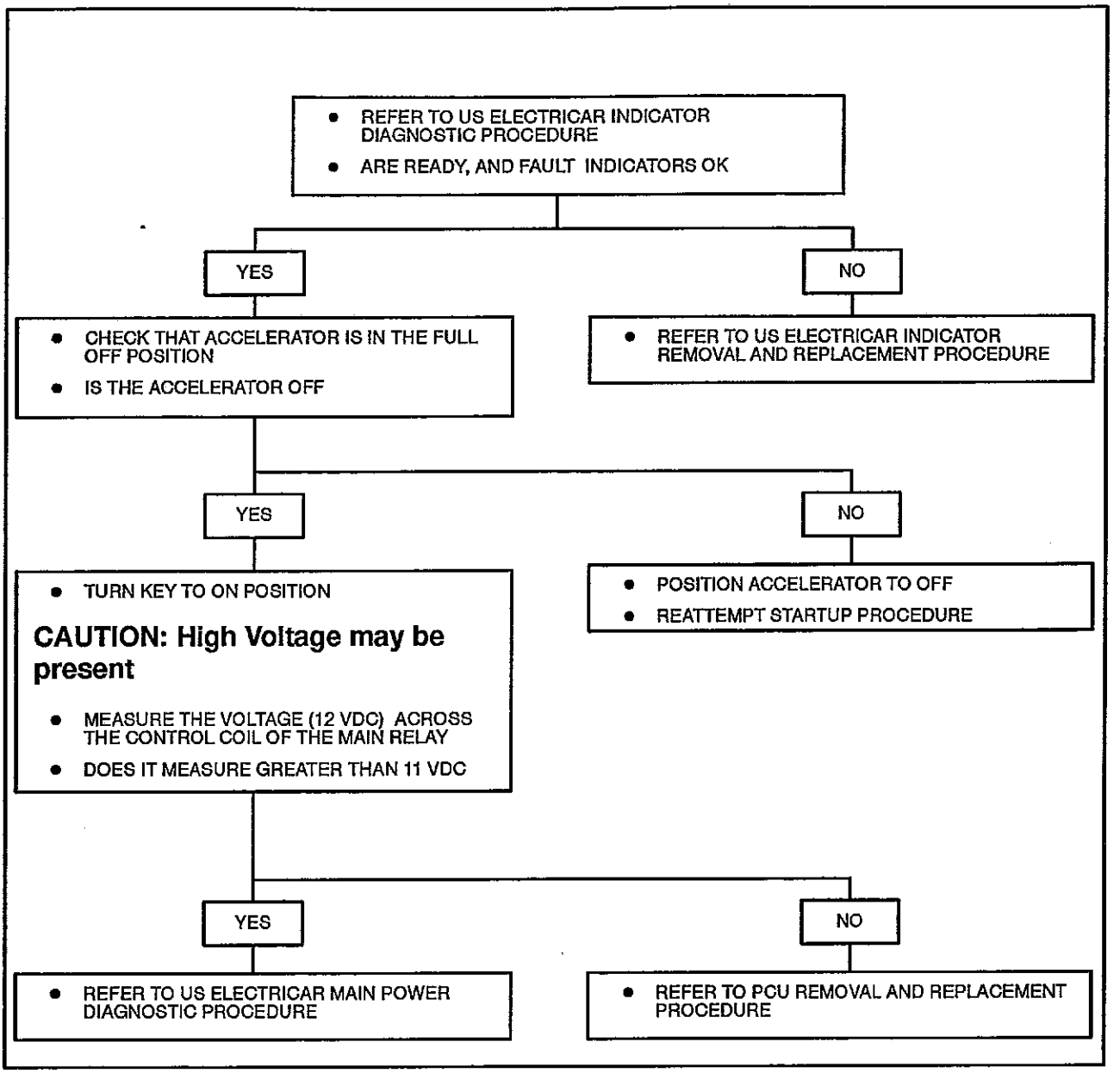

Figure 3-15. No Ready Indicator Diagnostic Procedure

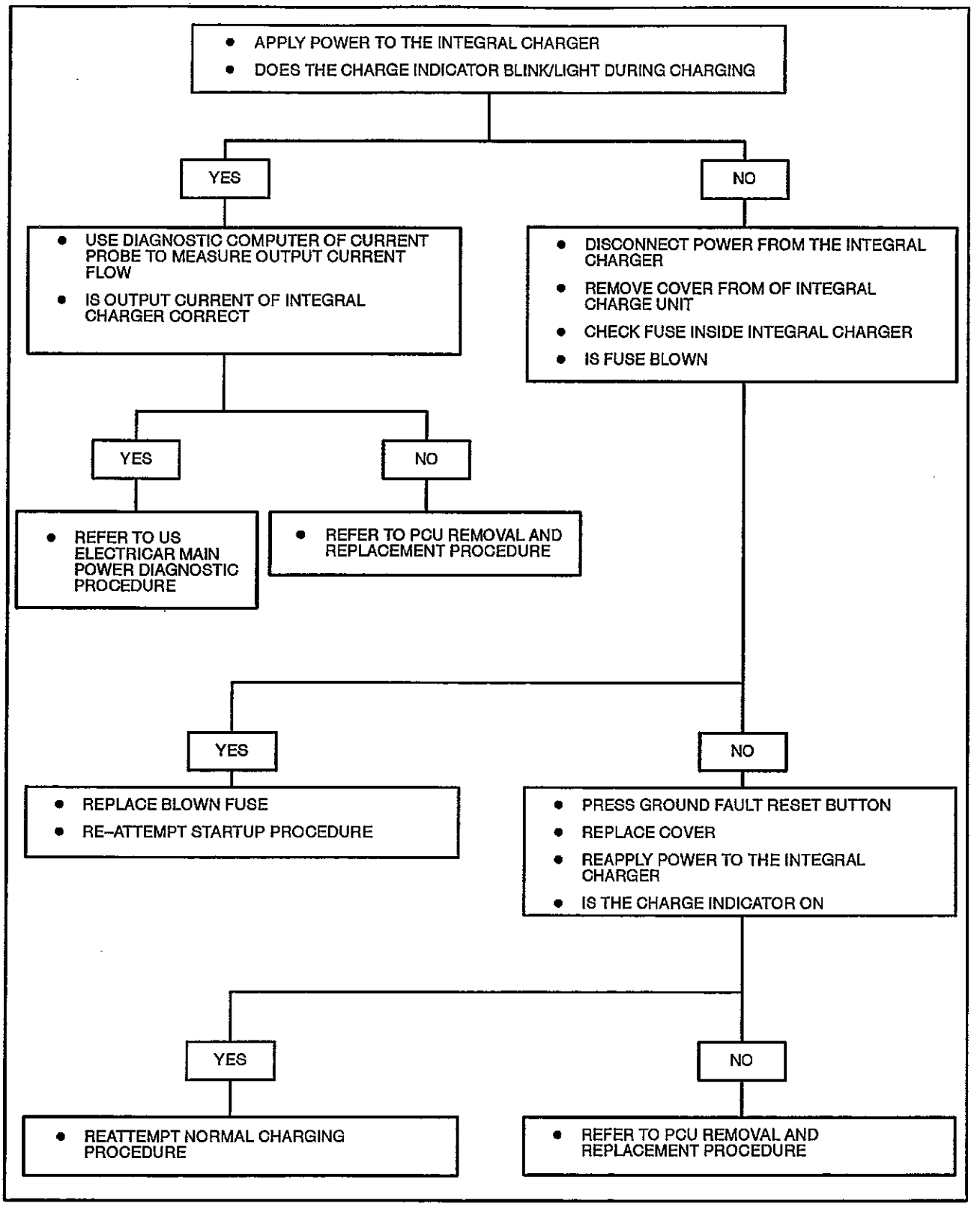

Figure 3-16. Integral Charger Diagnostic Procedure

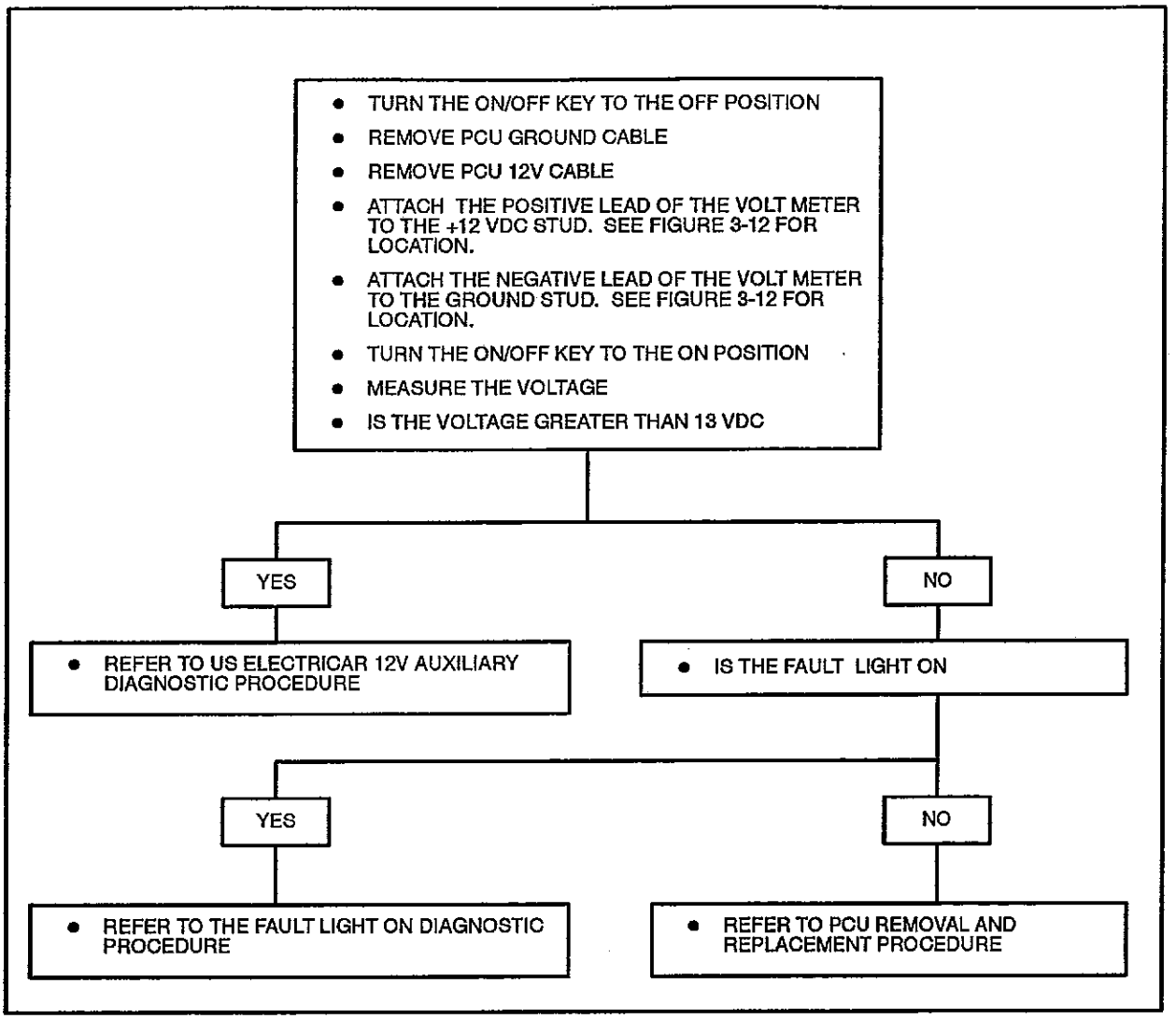

Figure 3-17. PCU 12 VDC Auxiliary Charger Diagnostic Procedure

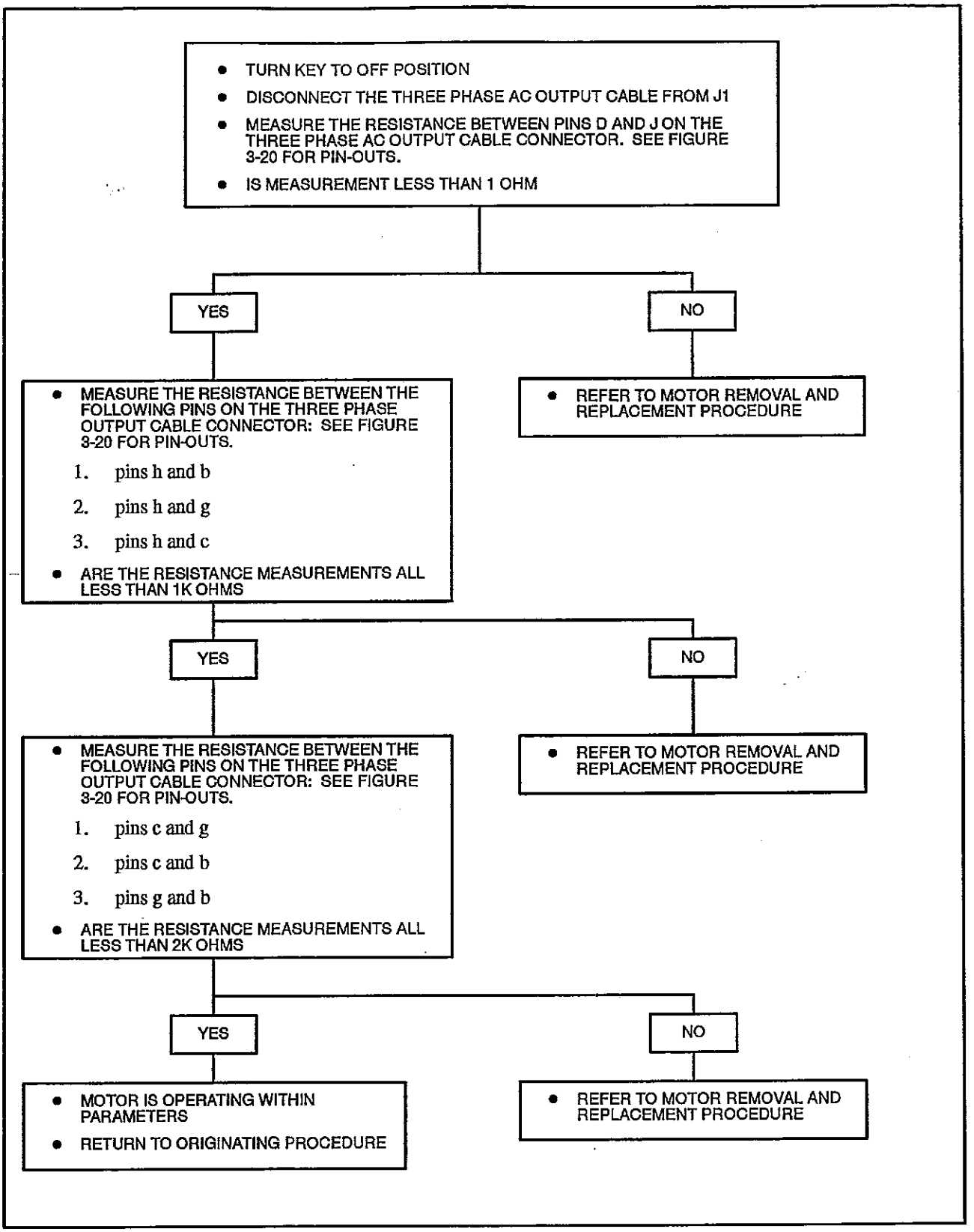

Figure 3-18. Motor Diagnostic Procedure

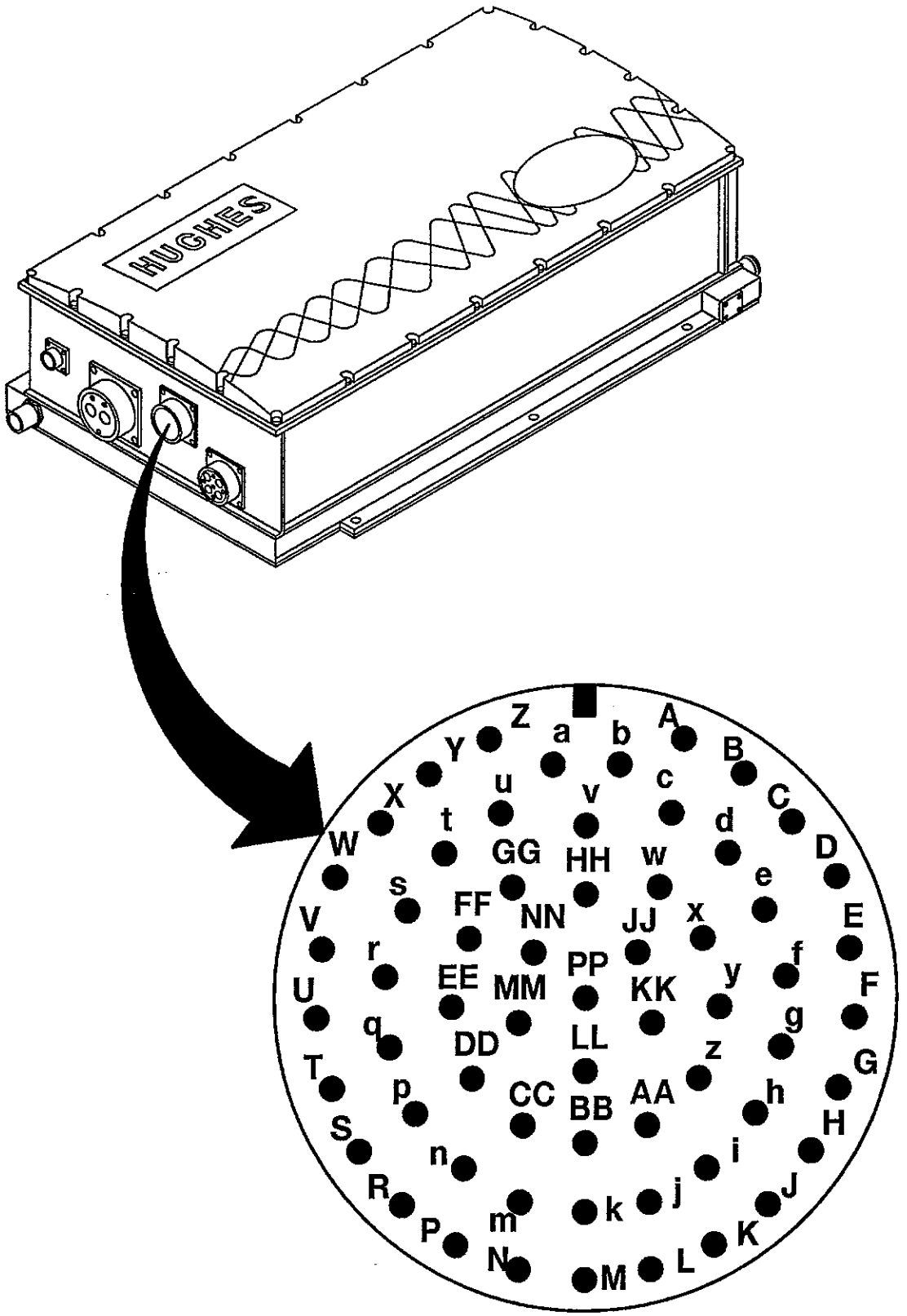

Figure 3-19. Connector J4 Pin–Out

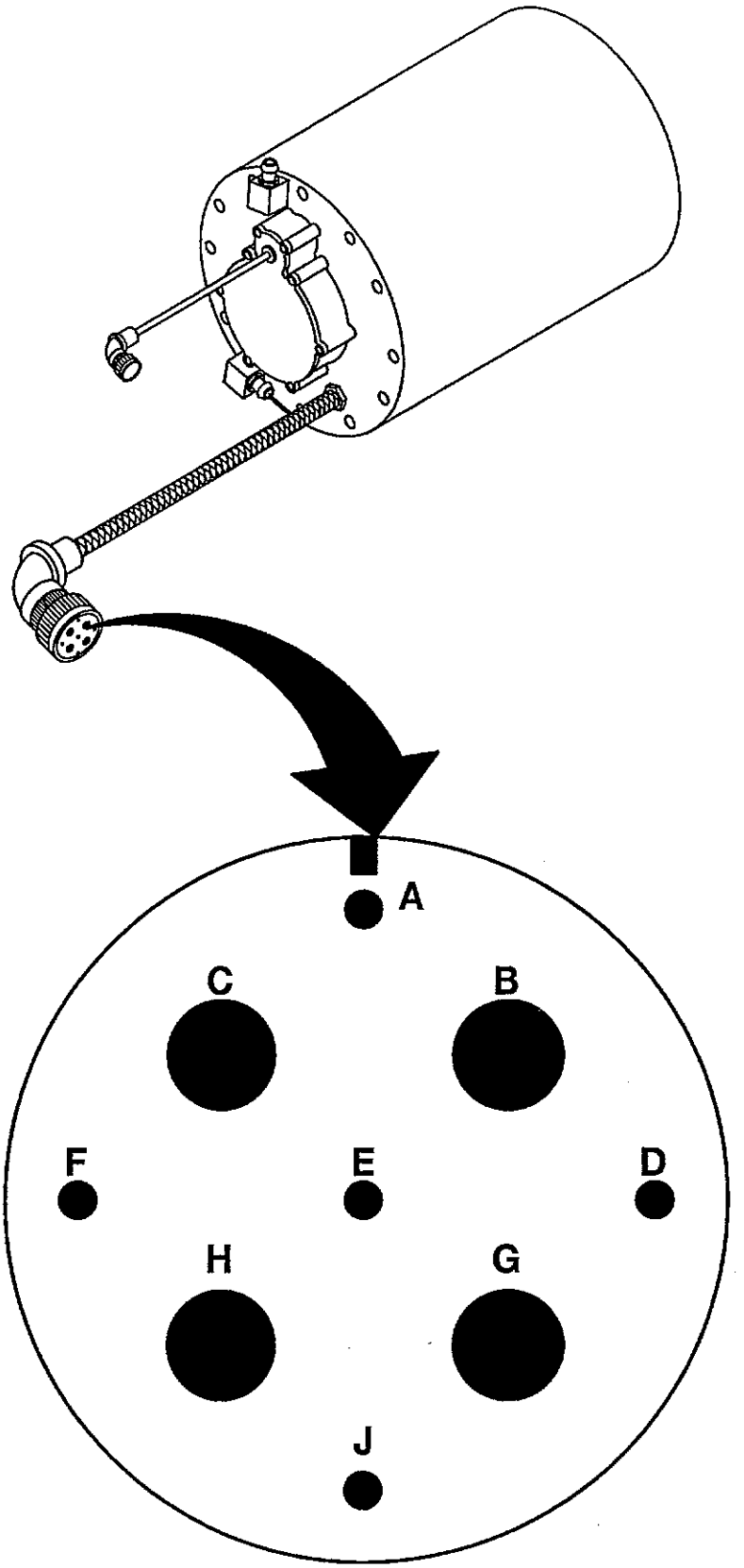

Figure 3-20. Three Phase AC Output Cable Pin-Out

TROUBLESHOOTING WITH DIAGNOSTIC COMPUTER PROCEDURE

- Note that the term drive A is only a reference. Depending on the set–up of the computer used substitute the drive and directory (if applicable) of the location where the Dolphin diagnostic program is located. Furthermore, the procedure will assume that there is a pointing device such as a mouse or trackball, keyboard equivalents will be given in parenthesis. To select an item the pointing device must be clicked once. The keyboard equivalents are usually two key combination that are selected simultaneously ie. Alt–D requires the user to press the ALTERNATE key and the D key simultaneously. Full explanation of each field in the motoring or charging display begins on page .

The diagnostic procedure is as follows:

1. Plug–in the RS–232 cable into the RS–232 port of the Dolphin PCU and computer.
2. Initiate and run the diagnostic program on the computer.
   a. Put the Dolphin test software disk into the A drive of the laptop.
   b. Log–onto drive A. The screen should look similar to Figure 3-21.
   c. Initiate the diagnostic program by typing DOLCOM. The screen should look similar to Figure 3-22.
   d. The initial diagnostic screen will look similar to Figure 3-23.
   e. Move the pointing device to the DATA menu and selected it (Alt–D). The screen should look similar to Figure 3-25.
   f. Select DISPLAY (D) and the screen should look similar to Figure 3-26 (motoring mode) or Figure 3-27 (charge mode). This is the diagnostics display.
3. Read the fault description and DSP status words and match the bits to the bits listed in table 3-2 or refer to the specific troubleshooting diagram for use with the laptop.
4. To exit the diagnostics program press 0 to return to the initial screen. See Figure 3-28.
5. To exit the program entirely, move the pointing device to the FILE menu and select it (ALT–F). The select EXIT (X). See Figure 3-29.

Figure 3-21. DOS Prompt

Figure 3-22. Computer Diagnostics Executable Program

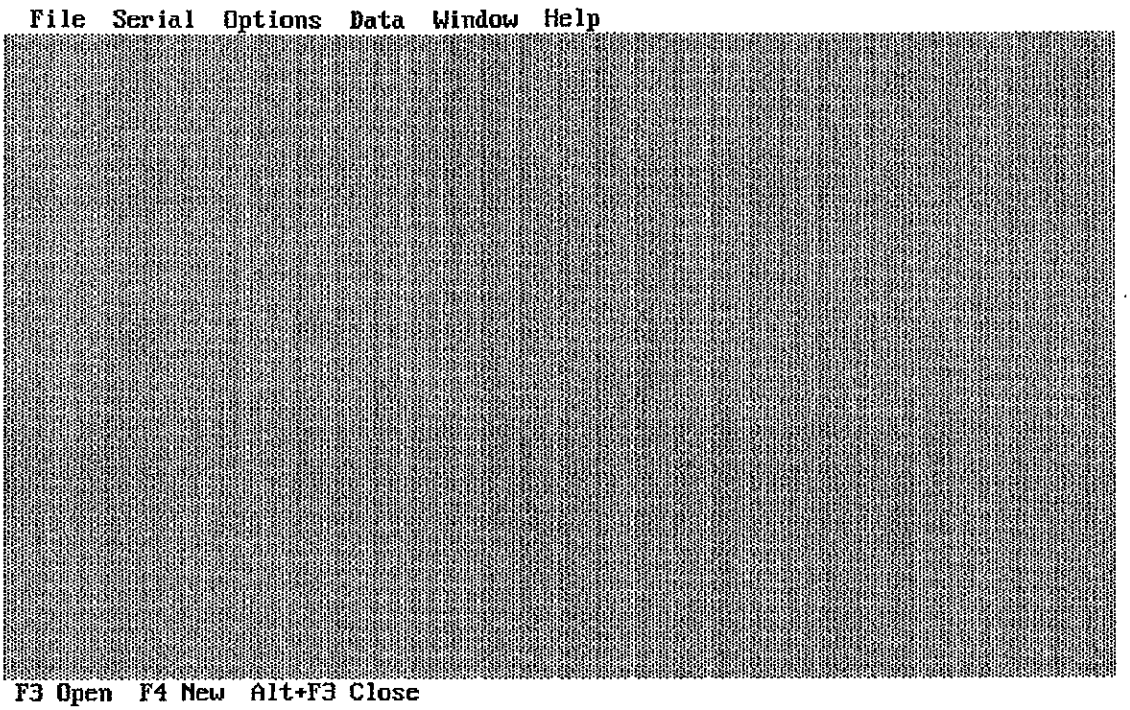

Figure 3-23. Computer Diagnostic Program Opening Screen

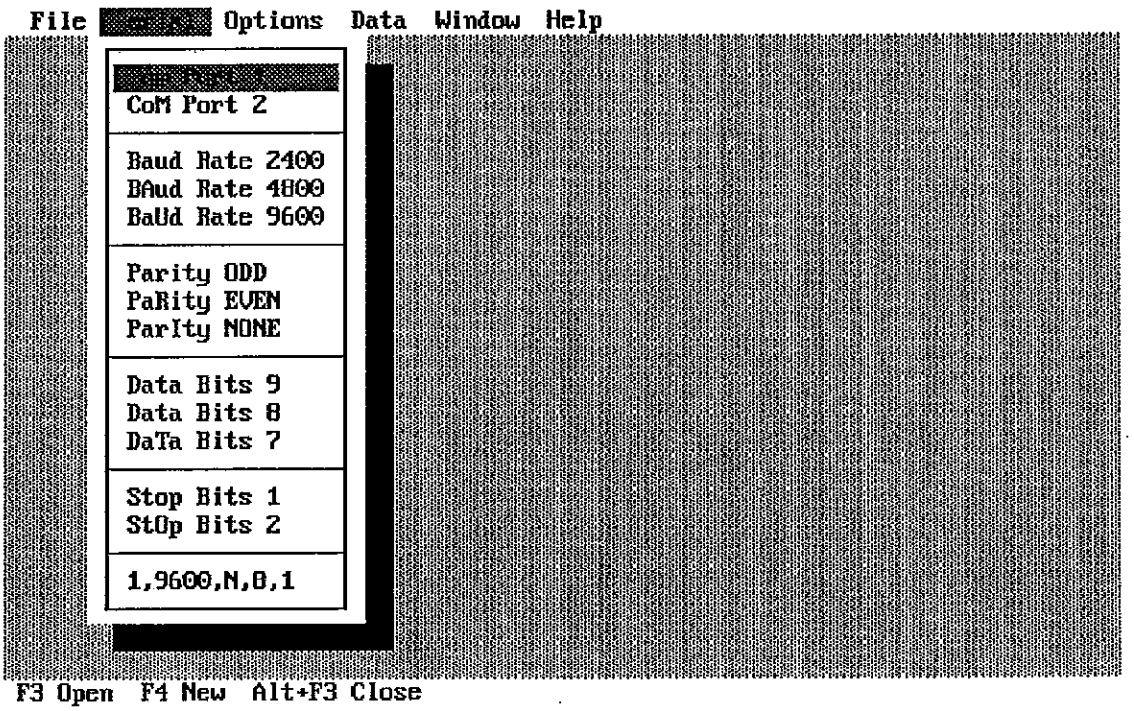

Figure 3-24. Serial Communication Set-up Screen

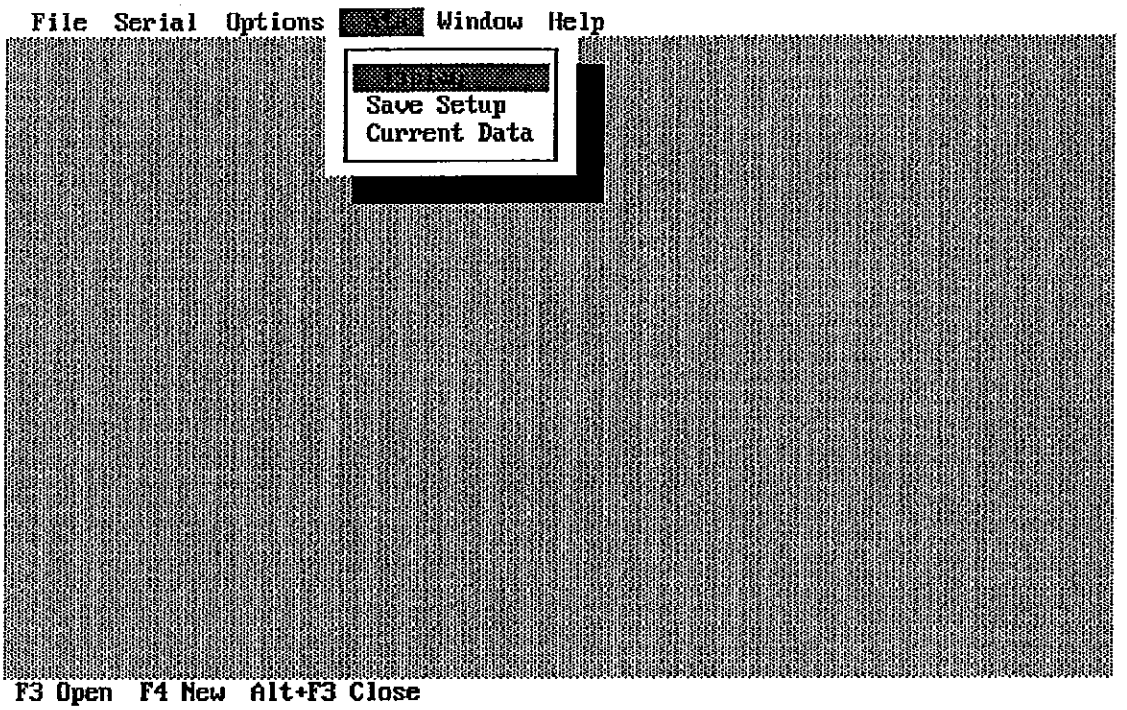

Figure 3-25. Diagnostic Display Initiate

*** DATA RAM EDIT SCREEN		MOTORING MODE ***		
STATUS	–>	0 = Fault	31 = Accell	
Fault	–>	1 = Status	32 = Accell1	
Veh Inf	–>	2 = an0 (VBatt)	33 = Vregen	
Velocity (RPM)	–>	3 = an1 (IBatt)	34 = id	
Velocity (MPH)	–>	4 = an2 (Acc 0)	35 = iq	
Battery V	–>	5 = an3 (Acc 1)	48 = batI	
Command Direction	–>	–>	6 = an4 (Acc 2)	52 = Power
MOTOR Direction	–>	7 = an5 (Brake)	64 = Vel Cmd	
12V Bias	–>	8 = an6 (Regen)	132 = Anminflt	
User Defined	–>	9 = an7 (Isolation)	133 = Anmaxflt	
Battery Current	–>	10 = an8 (P12V)	134 = Anmin Offset	
Power In	–>	11 = an9 (Line Vac)	135 = isov	
Current Command %	–>	12 = anA (Line Iac)	137 = Vmin	
Address User	–>	14 = iop	145 = fwdlim	
		15 = Regen Gain	147 = batonmin	
		19 = position	151 = Slip < Base	
Cold Plate Temp	–>	22 = Fault Delay	182 = Regen Drive	
		24 = vel1	183 = Regen Low	
Time Seconds	–>	28 = BatI Offset	184 = Regen Two	
0: Exit		29 = vmul	206 = Slip	
1: Dolphin Unit Memory Read		30 = Brake	224 = SOC Out	
2: Vehicle Interface Memory Read		Enter Choice –>		

Figure 3-26. Motoring Mode Diagnostics Display

```
*** DATA RAM EDIT SCREEN  CHARGE MODE ***
STATUS          ->      0 = Fault           147 = Bat On Min
FAULT           ->      1 = Status          160 = Vchrgslope
Veh Inf         ->      2 = Battery V       161 = Vchrgoff
                        3 = Battery I       162 = Vchrgstart
Vac Peak        ->      9 = Isolation       163 = Vmulmax
Iac Peak        ->      11 = Line Vac       164 = Vchrgmx
VBat            ->      12 = Line Iac       165 = IREF Offset
IBat            ->      14 = IOP(dsp in)    166 = VAC min off
Vac * Iac       ->      15 = Regen Gain     167 = Bat min On
User Defined    ->      22 = Delay          168 = Max Current
P12V            ->      28 = BatI offset    169 = VAC Min
Dolphin Unit Temp ->    29 = vmul           170 = VBATMx
                        48 = BatI           171 = IAC Min       Address User
->              52= Power 173 = Trickle Ref
                        54 = Chrg Scale     174 = 120VAC Ref
                        55 = vacmax         175 = 220VAC Ref
Charge Mode     ->      56 = iref           176 = chrsclmx
AC Relay        ->      58 = iacmax         177 = Vmode Delay
Time Seconds    ->      135 = Isov          178 = Imode Delay
0: Exit                 138 = Bat Off Min
1: Dolphin Unit Memory Read
2: Vehicle Interface Read       Enter Choice ->
```

Figure 3-27. Charge Mode Diagnostics Display

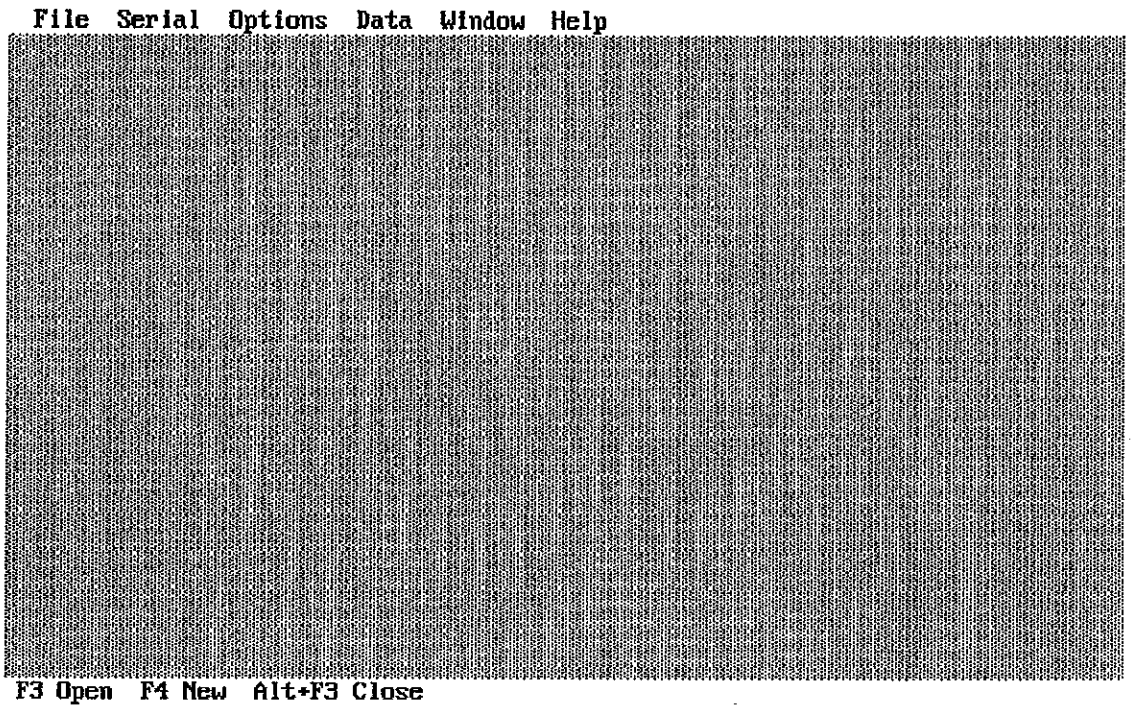

Figure 3-28. Computer Diagnostic Opening Screen

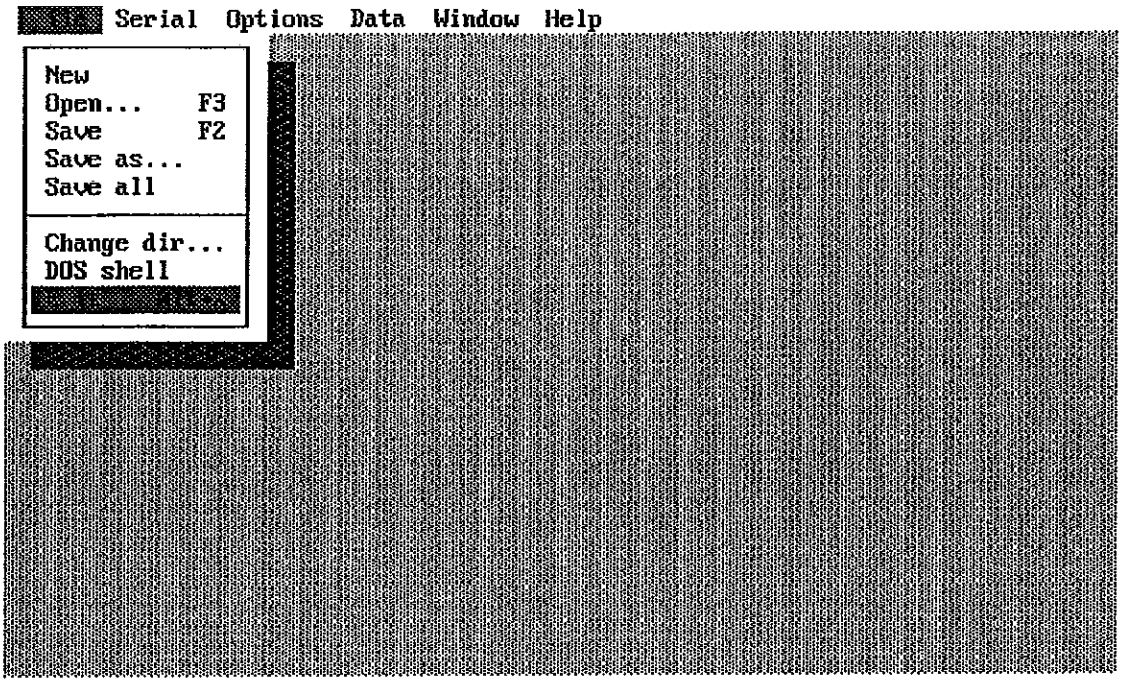

Figure 3-29. Computer Diagnostics Exit Screen

Table 3-2. DOLPHIN SYSTEM FAULT/STATUS DEFINITIONS

		FAULT DESCRIPTION														RAN ADD 0				
BIT LOC		F	E	D	C		B	A	9	8		7	6	5	4		3	2	1	0
		X	X	X	X		X	X	X	X		X	X	X	X		X	X	X	X
MOTORING		Encoder	Isolation	Battery High	Battery Low		IGBT	P12V	Power Down	Enable		Speed Limit	HC11	Interlock	Charge Port		Key On	Correlation	Brake	Accelerator
CHARGING		TBD	Isolation	Battery High	Battery Low		IGBT	P12V	Power Down	TBD		TBD	VAC Low	Interlock	Charge Port		Key On	TBD	TBD	TBD
									DSP STATUS							RAM ADD 1				

DOLPHIN SYSTEM FAULT/STATUS DEFINITIONS

BIT LOC		F	E	D	C		B	A	9	8		7	6	5	4		3	2	1	0
MOTORING		Internal	Internal	TBD	Charge (1)		Main On (1)	Low (1)	TWO (1)	TBD		Pre Charge (1)	Reverse (1)	Drive (1)	Motor Dir (1 = FWD)		Park (1)	Internal	Stable (1)	Enable (1)
CHARGING		TBD	AC Low	TBD	Charge (1)		Main On (1)	AC Relay (1)	TBD	TBD		Pre Charge (1)	TBD	TBD	Normal (1)		220/110 VAC	Vmode (1)	Stable (1)	Charge Port

EXPLANATION OF MOTORING MODE DISPLAY FIELDS

Turn Key to ON position, the "DATA RAM EDIT SCREEN MOTORING MODE" screen will show up with data filled in as follow;

*** DATA RAM EDIT SCREEN		MOTORING MODE ***		
STATUS	->	0000 1000 1011 0110	0 = Fault	31 = Accell
Fault	->	0000 0000 0000 0101	1 = Status	32 = Accell1
Veh Inf	->	1000 0000 0000 1011	2 = an0 (VBatt)	33 = Vregen
Velocity (RPM)	->	0.00	3 = an1 (IBatt)	34 = id
Velocity (MPH)	->	0.00	4 = an2 (Acc 0)	35 = iq
Battery V	->	335.40	5 = an3 (Acc 1)	48 = batI
Command Direction	->	DRIVE	6 = an4 (Acc 2)	52 = Power
MOTOR Direction	->	FORWARD	7 = an5 (Brake)	64 = Vel Cmd
12V Bias	->	11.32	8 = an6 (Regen)	132 = Anminflt
User Defined	->		9 = an7 (Isolation)	133 = Anmaxflt
Battery Current	->		10 = an8 (P12V)	134 = Anmin Offset
Power In	->	0.00	11 = an9 (Line Vac)	135 = isov
Current Command %	->	0.00	12 = anA (Line Iac)	137 = Vmin
Address User	->		14 = iop 145 = fwdlim	
		15 = Regen Gain	147 = batonmin	
		19 = position	151 = Slip < Base	
Dolphin Unit Temp	->	35	22 = Fault Delay	182 = Regen Drive
		24 = vel1	183 = Regen Low	
Time Seconds	->	1.5	28 = BatI Offset	184 = Regen Two
0: Exit		29 = vmul	206 = Slip	
1: Dolphin Unit Memory Read		30 = Brake	224 = SOC Out	
2: Vehicle Interface Memory Read		Enter Choice ->		
Accel Correl				

STATUS FIELD

The *STATUS* field consists of 16 bits in combination of 0s or 1s. Each 0 or 1 represents different status of vehicle. The left most bit represents the most significant bit (MSB); the right most bit represents the least significant bit (LSB). The following table explains each status bit:

Bit F (bit 15)	–	Not implemented yet
Bit E (bit 14)	–	Test (Used in testing Dolphin Unit)
	1	Test mode
	0	Regular motoring mode
Bit D (bit 13)	–	Not implemented yet
Bit C (bit 12)	–	Charge Mode
	1	Charge mode
	0	Motoring mode
Bit B (bit 11)	–	Main Relay Status
	1	Main Relay Closed
	0	Main Relay Opened
Bit A (bit 10)	–	PRNDL in LOW Mode Status
	1	PRNDL in LOW
	0	PRNDL not in LOW
Bit 9	–	PRNDL in TWO Mode Status
	1	PRNDL in TWO
	0	PRNDL not in TWO
Bit 8	–	Not implemented
Bit 7	–	PreCharge Relay Status
	1	PreCharge Relay Closed
	0	PreCharge Relay Opened
Bit 6	–	PRNDL in REVERSE Mode Status
	1	PRNDL in REVERSE
	0	PRNDL not in REVERSE
Bit 5	–	PRNDL in DRIVE Mode Status
	1	PRNDL in DRIVE
	0	PRNDL not in DRIVE
Bit 4	–	Motor Direction Status
	1	Motor direction is in FORWARD
	0	Motor direction is in REVERSE
Bit 3	–	PRNDL in PARK Mode Status
	1	PRNDL in PARK
	0	PRNDL not in PARK
Bit 2	–	Not implemented yet
Bit 1	–	Dolphin system status
	1	Stable
	0	Not stable (Vehicle will not move)
Bit 0	–	Motor Enable Status
	1	Motor is enabled
	0	Motor is not enabled

FAULT FIELD

The *Fault* field consists of 16 bits in combination of 0s or 1s. Each 0 or 1 represents different fault status of vehicle. The left most bit represents the most significant bit (MSB); the right most bit represents the least significant bit (LSB). The following table explains each status bit:

Bit F (bit 15)	–	Encoder fault status
	1	Encoder fault exist
	0	No encoder fault
Bit E (bit 14)	–	Isolation fault status
	1	Isolation fault exist
	0	No isolation fault
Bit D (bit 13)	–	Battery High fault status
	1	Battery voltage is too high (higher than 370 Volts)
	0	No battery high fault
Bit C (bit 12)	–	Battery Low fault status
	1	Battery voltage is too low (lower than 270 Volts)
	0	No battery low fault
Bit B (bit 11)	–	IGBT fault status
	1	IGBT fault exist
	0	No IGBT fault
Bit A (bit 10)	–	P12V fault
	1	12 volts bias supply is too low (lower than 10 Volts)
	0	12 volts bias supply is fine
Bit 9	–	Power Down Status bit
	1	Power down sequence has been activated in the Dolphin Unit
	0	No power down sequence activated
Bit 8	–	Enable fault status
	1	Motor enable fault exist
	0	No motor enable fault
Bit 7	–	Speed Limit fault status
	1	Vehicle speed reached maximum speed
	0	Vehicle speed is under maximum speed
Bit 6	–	Overheat
	1	Dolphin Unit or/and Motor is overheated
	0	No overheat condition
Bit 5	–	Interlock fault status
	1	Interlock fault exist (interlock is opened)
	0	No interlock fault (interlock is closed)
Bit 4	–	Charge Port status
	1	Charge port is being utilized
	0	Charge port is not being used
Bit 3	–	Key ON status
	1	Key is ON position
	0	Key is OFF
Bit 2	–	Correlation fault status
	1	Accelerator has correlation fault
	0	No correlation fault
Bit 1	–	Brake fault status
	1	Brake has fault condition
	0	Brake is fine
Bit 0	–	Accelerator fault status
	1	Accelerator has fault condition
	0	Accelerator is fine

VEH INF FIELD

The *Veh Inf* field consists of 16 bits in combination of 0s or 1s. Each 0 or 1 represents different vehicle interface status. The left most bit represents the most significant bit (MSB); the right most bit represents the least significant bit (LSB). The following table explains each status bit:

Bit F (bit 15)	–	Dolphin Unit fault status
	1	Dolphin unit has fault
	0	Dolphin unit is fine
Bit E (bit 14)	–	Overheat status
	1	Dolphin unit or/and motor is overheated
	0	Dolphin unit or/and motor is not overheated
Bit D (bit 13)	–	Not implemented yet
Bit C (bit 12)	–	Not implemented yet
Bit B (bit 11)	–	Not implemented yet
Bit A (bit 10)	–	Not implemented yet
Bit 9	–	Charge port status
	1	Charge port is being used
	0	Charge port is not being used
Bit 8	–	Not implemented yet
Bit 7	–	Park Brake Status
	1	Parking brake is on
	0	Parking brake is off
Bit 6	–	Brake High Switch Status (If installed)
	1	High limit brake switch on by pressing on the brake
	0	No high limit brake switch on
Bit 5	–	Brake Low Switch Status (If installed)
	1	Low limit brake switch on by pressing on the brake
	0	No low limit brake switch on
Bit 4	–	*PRNDLP Switch Status
	1	PRNDLP switch on
	0	PRNDLP switch off
Bit 3	–	*PRNDLC Switch Status
	1	PRNDLC switch on
	0	PRNDLC switch off
Bit 2	–	*PRNDLB Switch Status
	1	PRNDLB switch on
	0	PRNDLB switch off
Bit 1	–	*PRNDLA Switch Status
	1	PRNDLA switch on
	0	PRNDLA switch off
Bit 0	–	Key on Status
	1	Key is ON position
	0	Key is OFF

* *Combination of PRNDLP, PRNDLC, PRNDLB, and PRNDLA switches determines the transmission selection*

VELOCITY (RPM) FIELD

The *Velocity (RPM)* field represents the motor speed in revolutions per minutes while the vehicle is in motion.

VELOCITY (MPH) FIELD

The *Velocity (MPH)* field represents the vehicle speed in miles per hour while the vehicle is in motion.

BATTERY V FIELD

The *Battery V* field represents the battery voltage in Volts.

COMMAND DIRECTION FIELD

The *Command Direction* field represents the transmission selection.

MOTOR DIRECTION FIELD

The *MOTOR Direction* field represents the state of the motor direction.

12V BIAS FIELD

The *12V Bias* field represents the 12V bias supply voltage in Volts.

USER DEFINED FIELD

The *User Defined* field prints out the value of the Dolphin Unit processor memory location that user specified. Following is how to read the memory location:

1. Type **1** or **2** **(DO NOT HIT RETURN)**

   1 – To read the Dolphin Unit controller memory location (Memory location and its usage is already on the screen, also refer to RAM description table)

   2 – To read the vehicle interface controller memory location (None on screen, refer to RAM description table)

2. Type memory location address and return
3. The value will show up in the *User Defined* field

BATTERY CURRENT FIELD

The *Battery Current* field represents the battery current in Ampere.

POWER IN FIELD

The *Power In* field represents the power going into the motor while the accelerator pedal is depressed and the vehicle is moving.

CURRENT COMMAND % FIELD

The *Current Command %* field represents current command in use.

ADDRESS USER <UNIT|VEH> FIELD

The *Address User <UNIT|VEH>* field prints out the memory address that the user specified. Either *UNIT* or *VEH* prints out depends on the user selection.

DOLPHIN UNIT TEMP FIELD

The *Dolphin Unit Temp* field represents the temperature of the Dolphin Unit in Celsius.

TIME SECONDS FIELD

The *Time Seconds* field represents how long the communication between the PC and the Dolphin Unit been up. This field does not updates unless communication link is connected, therefore, if this field is not updating, then the communication link is not connected.

MOTOR TEMP FIELD

The *Motor Temp* field is a hidden field. To read the motor temperature:

1. Type **1 (DO NOT HIT RETURN)**
2. Type **238** and **RETURN**
3. The *Motor Temp* field shows up with the motor temperature in Celsius line after the Dolphin Unit Temp

To hide the *Motor Temp* field:

1. Type **1 (DO NOT HIT RETURN)**
2. Type **any memory address** and **RETURN**
3. The *Motor Temp* field will hide

FAULT DESCRIPTION FIELD

In the very last line, all the fault description prints out, if any fault occurs. In the example screen above, the **Accel** and **Correl** faults shows.

EXPLANATION OF EACH FIELD ON SCREEN IN CHARGING MODE

Plug in the INDUCTIVE CHARGE Paddle to the charge port, or connect the AC plug to the power outlet, the following screen will show up:

```
*** DATA RAM EDIT SCREEN  CHARGE MODE ***
STATUS   ->   0001 1100 1001 0010        0 = Fault          147 = Bat On Min
FAULT    ->   0000 0000 0000 0000        1 = Status         160 = Vchrgslope
Veh Inf  ->   0000 0000 0000 0000        2 = Battery V      161 = Vchrgoff
                                         3 = Battery I      162 = Vchrgstart
Vac Peak          ->   155.56            9 = Isolation      163 = Vmulmax
Iac Peak          ->   3.02              11 = Line Vac      164 = Vchrgmx
VBat              ->   329.24            12 = Line Iac      165 = IREF Offset
IBat              ->   -1.05             14 = IOP(dsp in)   166 = VAC min off
Vac * Iac         ->   234.90            15 = Regen Gain    167 = Bat min On
User Defined      ->                     22 = Delay         168 = Max Current
P12V              ->   11.45             28 = BatI offset   169 = VAC Min
Dolphin Unit Temp ->   38                29 = vmul          170 = VBATMx LtchOff
                                         48 = BatI          171 = IAC Min LtchOFF
Address User      ->                     52 = Power         173 = Trickle Ref
                                         54 = Chrg Scale    174 = 120VAC Ref
                                         55 = vacmax        175 = 220VAC Ref
Charge Mode       ->   NORMAL            56 = iref 176 = chrsclmx
AC Relay          ->   CLOSED            58 = iacmax        177 = Vmode Delay
Time Seconds      ->   3.2               135 = Isov         178 = Imode Delay
0: Exit                  138 = Bat Off Min
1: Dolphin Unit Memory Read
2: Vehicle Interface Read    Enter Choice ->
```

STATUS FIELD

The *STATUS* field consists of 16 bits in combination of 0s or 1s. Each 0 or 1 represents different status of vehicle. The left most bit represents the most significant bit (MSB); the right most bit represents the least significant bit (LSB). The following table explains each status bit:

Bit F (bit 15)	–	Not implemented yet
Bit E (bit 14)	–	Test (Used in testing Dolphin Unit)
	1	Test mode
	0	Regular motoring mode
Bit D (bit 13)	–	Charge Complete Status
	1	Charge complete
	0	Charge in process
Bit C (bit 12)	–	Charge Mode
	1	Charge mode
	0	Motoring mode
Bit B (bit 11)	–	Main Relay Status
	1	Main Relay Closed
	0	Main Relay Opened
Bit A (bit 10)	–	AC Relay Status
	1	AC Relay Closed
	0	AC Relay Opened
Bit 9	–	Not implemented yet
Bit 8	–	Not implemented
Bit 7	–	PreCharge Relay Status
	1	PreCharge Relay Closed
	0	PreCharge Relay Opened
Bit 6	–	Not implemented yet
Bit 5	–	Not implemented yet
Bit 4	–	NORMAL Charge Mode Status
	1	Normal charge mode
	0	Trickle charge mode
Bit 3	–	220/110 VAC Selection Status
	1	220 Selected
	0	110 Selected
Bit 2	–	Not implemented yet
Bit 1	–	Dolphin system status
	1	Stable
	0	Not stable (Vehicle will not move)
Bit 0	–	Charge Port Selection Status
	1	Charge port is being used
	0	Charge port is not being used

FAULT FIELD

The *Fault* field consists of 16 bits in combination of 0s or 1s. Each 0 or 1 represents different fault status of vehicle. The left most bit represents the most significant bit (MSB); the right most bit represents the least significant bit (LSB). The following table explains each status bit:

Bit F (bit 15)	–	Not implemented yet
Bit E (bit 14)	–	Isolation fault status
	1	Isolation fault exist
	0	No isolation fault
Bit D (bit 13)	–	Battery High fault status
	1	Battery voltage is too high (higher than 370 Volts)
	0	No battery high fault
Bit C (bit 12)	–	Battery Low fault status
	1	Battery voltage is too low (lower than 270 Volts)
	0	No battery low fault
Bit B (bit 11)	–	IGBT fault status
	1	IGBT fault exist
	0	No IGBT fault
Bit A (bit 10)	–	P12V fault
	1	12 volts bias supply is too low (lower than 10 Volts)
	0	12 volts bias supply is fine
Bit 9	–	Power Down Status bit
	1	Power down sequence has been activated in the Dolphin Unit
	0	No power down sequence activated
Bit 8	–	Not implemented yet
Bit 7	–	AC Voltage Low Status
	1	AC in voltage is low
	0	AC in voltage is O.K.
Bit 6	–	Overheat
	1	Dolphin Unit or/and Motor is overheated
	0	No overheat condition
Bit 5	–	Interlock fault status
	1	Interlock fault exist (interlock is opened)
	0	No interlock fault (interlock is closed)
Bit 4	–	Charge Port status
	1	Charge port is being utilized
	0	Charge port is not being used
Bit 3	–	Key ON status
	1	Key is ON position
	0	Key is OFF
Bit 2	–	Not implemented yet
Bit 1	–	Not implemented yet
Bit 0	–	Not implemented yet

VEH INF FIELD

The *Veh Inf* field consists of 16 bits in combination of 0s or 1s. Each 0 or 1 represents different vehicle interface status. The left most bit represents the most significant bit (MSB); the right most bit represents the least significant bit (LSB). The following table explains each status bit:

Bit F (bit 15)	–	Dolphin Unit fault status
	1	Dolphin unit has fault
	0	Dolphin unit is fine
Bit E (bit 14)	–	Overheat status
	1	Dolphin unit or/and motor is overheated
	0	Dolphin unit or/and motor is not overheated
Bit D (bit 13)	–	Not implemented yet
Bit C (bit 12)	–	Not implemented yet
Bit B (bit 11)	–	Not implemented yet
Bit A (bit 10)	–	Not implemented yet
Bit 9	–	Charge port status
	1	Charge port is being used
	0	Charge port is not being used
Bit 8	–	Not implemented yet
Bit 7	–	Park Brake Status
	1	Parking brake is on
	0	Parking brake is off
Bit 6	–	Brake High Switch Status (If installed)
	1	High limit brake switch on by pressing on the brake
	0	No high limit brake switch on
Bit 5	–	Brake Low Switch Status (If installed)
	1	Low limit brake switch on by pressing on the brake
	0	No low limit brake switch on
Bit 4	–	*PRNDLP Switch Status
	1	PRNDLP switch on
	0	PRNDLP switch off
Bit 3	–	*PRNDLC Switch Status
	1	PRNDLC switch on
	0	PRNDLC switch off
Bit 2	–	*PRNDLB Switch Status
	1	PRNDLB switch on
	0	PRNDLB switch off
Bit 1	–	*PRNDLA Switch Status
	1	PRNDLA switch on
	0	PRNDLA switch off
Bit 0	–	Key on Status
	1	Key is ON position
	0	Key is OFF

* *Combination of PRNDLP, PRNDLC, PRNDLB, and PRNDLA switches determines the transmission selection*

VAC PEAK FIELD

The *Vac Peak* field represents the peak voltage of the AC line in.

IAC PEAK FIELD

The *Iac Peak* field represents the peak current of the AC line in.

VBAT FIELD

The *VBat* field represents the battery voltage in Volts.

IBAT FIELD

The *IBat* field represents the battery current in Ampere.

VAC * IAC FIELD

The *Vac * Iac* field represents the calculated charging power.

USER DEFINED FIELD

The *User Defined* field prints out the value of the Dolphin Unit processor memory location that user specified. Following is how to read the memory location:

1. Type **1** or **2 (DO NOT HIT RETURN)**

   1–To read the Dolphin Unit controller memory location (Memory location and its usage is already on the screen, also refer to RAM description table)

   2–To read the vehicle interface controller memory location (None on screen, refer to RAM description table)

2. Type memory location address and return
3. The value will show up in the *User Defined* field

12V BIAS FIELD

The *12V Bias* field represents the 12V bias supply voltage in Volts.

DOLPHIN UNIT TEMP FIELD

The *Dolphin Unit Temp* field represents the temperature of the Dolphin Unit in Celsius.

ADDRESS USER <UNIT|VEH> FIELD

The *Address User <UNIT|VEH>* field prints out the memory address that the user specified. Either *UNIT* or *VEH* prints out depends on the user selection.

CHARGE MODE FIELD

The *Charge Mode* field represents the charge mode, either NORMAL mode or TRICKLE mode.

AC RELAY FIELD

The *AC Relay* field represents the status of the AC Relay, either CLOSED or OPEN.

TIME SECONDS FIELD

The *Time Seconds* field represents how long the communication between the PC and the Dolphin Unit been up. This field does not updates unless communication link is connected, therefore, if this field is not updating, then the communication link is not connected.

MOTOR TEMP FIELD

The *Motor Temp* field is a hidden field. To read the motor temperature

1. Type **1 (DO NOT HIT RETURN)**
2. Type **238** and **RETURN**
3. The *Motor Temp* field shows up with the motor temperature in Celsius line after the Dolphin Unit Temp

To hide the *Motor Temp* field,

1. Type **1 (DO NOT HIT RETURN)**
2. Type **any memory address** and **RETURN**
3. The *Motor Temp* field will hide

FAULT DESCRIPTION FIELD

In the very last line, all the fault description prints out, if any fault occurs.

VEHICLE INTERFACE MEMORY DESCRIPTION

Table 3-3. Variables

Address	Name	Comment
128	FAULT1	MSB of 16 bits fault variable Motoring: 0: 1: 2: 3: IGBT _ 4: 5: 6: Isolation 7: Charging: 0: 1: 2: 3: IGBT_ 4: 5: 6: Isolation 7:
129	FAULT0	LSB of 16 bits fault variable Motoring: 0:Cold TMP 1: Motor TMP 2: 3: _ 4: 5: 6: 7: Charging: 0:Vbat < 100 1: 2: 3: _ 4: 5: 6: 7:
130	STSH1	MSB of 16 bits status variable Motoring: 0: 1: 2: 3: _ 4: 5: Chrg Cmp 6: AC Relay(1) 7: Charging: 0: 1: 2: 3: _ 4: 5: Chrg Cmp 6: AC Relay(1) 7:
131	STSH0	LSB of 16 bits status variable Motoring: 0: Key On 1: P12V DSP 2: 3: _ 4: 5: 6: 7: RTI Charging: 0: Key On 1: P12V DSP 2: 3: _ 4: 5: 6: 7: RTI
132	xx84	DSP fault register MSB (NOT USED)
133	xx83	DSP fault register LSB (NOT USED)
134	STS1	DSP Status Register MSB (NOT USED)
135	STS0	DSP Status Register LSB (NOT USED)
136	hcan0	A/D input 0; Cold plate temperature
137	hcan1	A/D input1; Motor Temperature A sensor
138	hcan2	A/D input2; Motor Temperature B sensor (NOT IMPLEMENTED)
139	hcan3	A/D input3; (NOT IMPLEMENTED)
140	hcan4	A/D input4; (NOT IMPLEMENTED)
141	hcan5	A/D input5; (NOT IMPLEMENTED)
142	hcan6	A/D input6; Battery voltage sensor (P12V)
143	hcan7	A/D input7; (NOT IMPLEMENTED)
144	rxdadd	Next receiving byte address pointer from DSP
145	s0	Receiving byte location for synchronizing value 1
146	s1	Receiving byte location for synchronizing value 2
147	s2	Receiving byte location for synchronizing value 3
148	temp0	Temporary variable 1
149	temp1	Temporary variable 2
150	temp2	Temporary variable 3
151	txdadd	Next transmitting byte pointer (NOT USED)
152	txdb1	Part of transmitting package that contains DSP Address to read
153	txdb2	Part of transmitting package that contains DSP Address to write
154	txdb3	Part of transmitting package that contains MSB data to write
155	txdb4	Part of transmitting package that contains LSB data to write
156	txdb5	Part of transmitting package that contains dummy byte
157	txaddr	Pointer for next transmitting package
158	hcinp1	HC11 LSB input port infomation to be send to DSP

Table 3-3. Variables (Cont.)

Address	Name	Comment
		0: Login 8 1: CP 2: 3: _4: 5: TEST 6: HC11 Fault 7: DSP Fault
159	hcinp0	HC11 MSB input port infomation to be send to DSP 0: Key on 1: PRNDLA 2: PRNDLB 3: PRNDLC_4: PRNDLP 5: Brk Low 6: Brk High 7: Park Brake
160	serflt1	DSP fault; MSB
161	serflt0	DSP fault; LSB
162	seriq1	DSP current command; MSB
163	seriq0	DSP current command; LSB
164	servel1	DSP velocity; MSB
165	servel0	DSP velocity; LSB
166	serbtv1	DSP battery voltage; MSB_3 bits of MSB are control bits for PC communication_101 – PC commnucation_001 – HC11 write request from PC_010 – HC11 read request from PC
167	serbtv0	DSP battery voltage; LSB
168	sersts1	DSP status; MSB
169	sersts0	DSP status; LSB
170	serinp1	DSP resending HC11 input port information; MSB
171	serinp0	DSP resending HC11 input port information; LSB
172	serusr1	DSP user defined value; MSB_When HC11 READ or WRITE from PC, MSB HC11 address
173	serusr0	DSP user defined value; LSB_When HC11 READ or WRITE from PC, LSB HC11 address
174	serbti1	DSP battery current; MSB
175	serbti0	DSP battery current; LSB
176	sertbd1	DSP resending cold plate temperature, so, PC can read
177	sertbd0	Data to be written to HC11 variable location pointed in serusr1 and serusr0 when HC11 write request
178	seraddr	PC user defined memory address in DSP
179	serhc1	DSP HC11 user defined MSB
180	serhc0	DSP HC11 user defined LSB
181	BLNK	Blinking flag
182	CHBLNK	Flag for blinking mode in charge mode
183	BLNKTMR	Blink timer
184	CHTMR	Blink timer for charge light
185	BLNKMOD	Flag for blinking mode
186	FLSHMOD	Flag for flashing FAULT and READY light
187	DAC-OUT	DAC voltage to be sent to DSP
188	DACFLG	Flag bit to set DAC depends on range of cold plate temperature
189	SLIPIND	Slip index, depends on motor temperature, to be sent to DSP
190	PC_COM	Flag for PC communcation
191	USR_ADR	User defined address to be sent to DSP
192	PRECED	Flag for precedence to send hcinp packet when any hcinp changes, so it will send hcinp packet in next transmitting package
193	PRTXPK	Pointer for next transmitting packet before hcinp packet took the precedence

Table 3-3. Variables (Cont.)

Address	Name	Comment
194	PC_PRTX	Pointer for next transmitting packet before PC read request
195	MEMPTR	Memory location pointer from PC read request
197	DATAWR	Data to be written to HC11 memory location pointed by MEMPTR
Address	Name	Comment
198	REQ-WREE	Flag for EEPROM write request
199	CHRGCMP	Flag for Charge complete
200	NEWPKG	Flag for NEW package to be sent been ready
201	PREVFLT	Previous hcinp fault bit before new hcinp input read in
202	RAMRDRQ	Flag for HC11 read request from PC
203	MACHRST	Flag for MACH been resetted
204	AMPVAL	AMP HR VALUE READ FROM DSP
206	MSBUPT	Inverter up time, MSB
207	UPTIME	Invert up time, LSW
209	OLDUPT	Previous up to date inverter up time
211	PWRDNFG	Flag for power down
212	CLREE	EEPROM clear flag bit
213	PRE-VUSR	Previous user defined address to read (Not used)
214	AMP-GET	Flag for reading AMP HR from DSP ($FF: reading AMPHR; $00: reading uptime)
215	TMR1SEC	1 second timer counter (Using it for .5 sec)

Table 3-4. Constants

Address	Name	Value (Comments)
768	CLDPMX	38 (Overheat Cold plate temperature condition; 70 C)
769	MOTTMX	38 (Overheat motor temperature condition; 70 C)
770	CLDFNMX	60 (Cold plate temperature to turn fan on, motoring mode; 55 C)
771	CLDFNMN	67 (Cold plate temperature to turn fan off, motoring mode; 50 C)
772	MFANTMX	45 (Motor temperature to turn fan on, motoring mode ; 65 C)
773	MFANTMN	60 (Motor temperature to turn fan off, motoring mode; 55 C)
774	CFANTMX	79 (Cold plate tempterature to turn fan (and pump in trickle mode) on, charging mode; 45 C
775	CFANTMN	89 (Cold plate temperature to turn fan (and pump in trickle mode) off, charging mode; 40 C
776	P12V_MN	182 (Minimum P12V; 10 volts)
777	P12V_TL	14 (Maximum differece between HC11 and DSP reading for P12V; 0.2 volt)
778	VBAT_MN	213 (Minimum battery voltage; 100 volts)
779		
780		

Table 3-4. Constants (Cont.)

Address	Name	Value (Comments)
781		
782		
783		
784	TVAL0	154 (3 volt DAC out to DSP)
785	TVAL1	117 (2.3 volts DAC out to DSP)
786	DACT0	79 (Upper limit cold plate temperature (45 C) for sending 0 volts DAC to DSP)
787	DACT1	51 (Upper limit cold plate temperature (60 C) for sending 2.3 volts DAC to DSP)
788	DACT2	45 (Upper limit cold plate temperature (65 C) for sending 3 volts DAC to DSP)
789	DACT0MN	103 (Lower limit cold plate temperature (35 C) for sending 2.3 volts DAC to DSP, after start sending 2.3 volts)
790	DACT1MN	68 (Upper limit cold plate temperature (50 C) for sending 3 volts DAC to DSP, after start sending 3 volts)
791	DACT2MN	62 (Lower limit cold plate temperature (62 C) for sending 5 volts DAC to DSP, after start sending 5 volts)
792		
793		
794		
795		
796		
797		
798		
799		

Table 3-5. EEPROM

Address	Name	Comments
3456	LTFAULT	LATCHED FAULT INFORMATION 0: Isolation 1: 2: 3:_4: 5: 6: 7:
3457		
3458		
3459		
3460		
3461		
3462		
3463		
3464		
3465		
3466		
3467		
3468		
3469		
3470		
3471		
3472	AMPHR1	AMP HR value saved in EEPROM, MSB
3473	AMPHR2	AMP HR value saved in EEPROM, LSB
3474	MSBUPTE	Inverter up time, MSB

Table 3-5. EEPROM (Cont.)

Address	Name	Comments
3475	LSWUPTM	Inverter up time, LSW (MSB)
3476	LSWUPTL	Inverter up time, LSW (LSB)
3477		
3478		
3479		
3480		
3481		
3482		
3483		
3484		
3485		
3486		
3487	SAVFLG	Flag for EEPROM row $0D90 has been written

DRIVER CONTROLS

DRIVER CONTROLS DIAGNOSTICS

See drive controls section of the US Electricar Manual.

COOLING SYSTEM

COOLING SYSTEM DIAGNOSTICS

See cooling system section of the US Electricar manual.

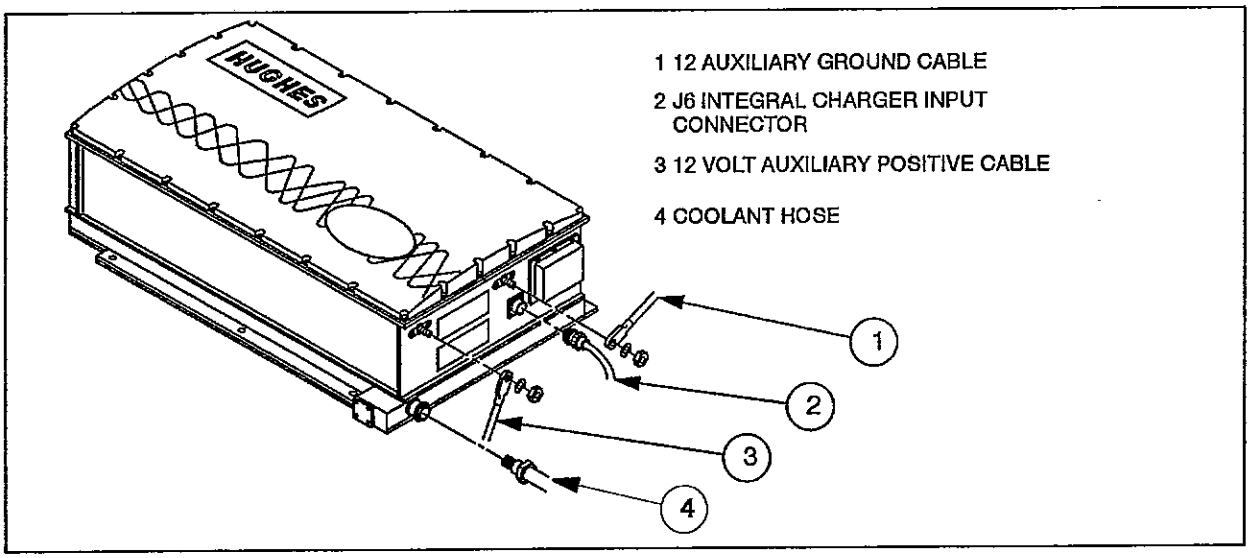

Figure 3-30. PCU Connections

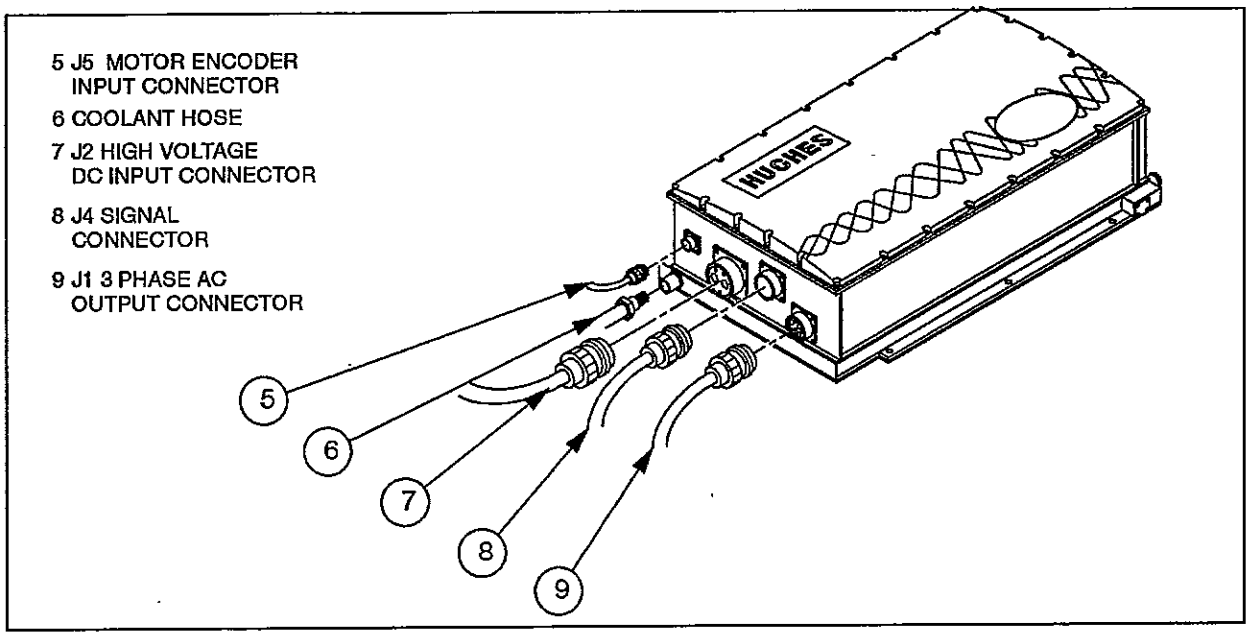

Figure 3-31. PCU Connections

PCU REMOVAL AND REPLACEMENT

PCU REMOVAL PROCEDURE

Figures 3-30, 3-31 ,and 3-32

1. Turn the main battery switch to the off position.

Remove or Disconnect

2. 12 volt auxiliary ground cable (1).

Remove or Disconnect

3. 12 volt auxiliary battery cable (3).
4. J6 (2).
5. J2 (7).
6. J1 (9).
7. J5 (5).
8. J4 (8).
9. Coolant hoses (4,6).
10. Six nuts or bolts (depending upon the configuration of the mounting bracket).

Install or Connect

11. Coolant caps to hoses.
12. Coolant caps to inlet/outlet.

Remove or Disconnect

13. PCU.

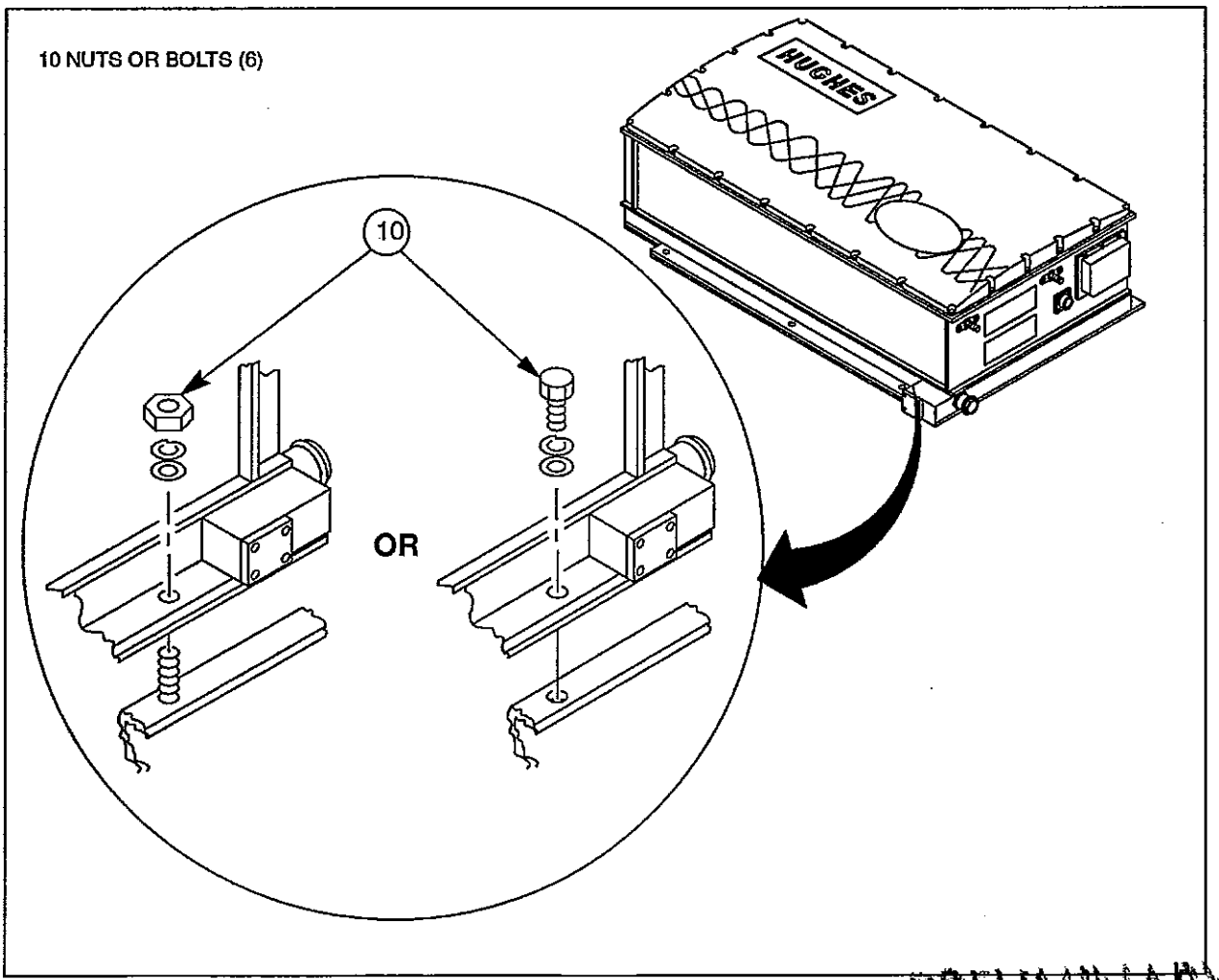

Figure 3-32. PCU Mounting

COOLANT REMOVAL PROCEDURE

1. Move PCU to an appropriate location for coolant disposal.

Remove or Disconnect

2. Coolant caps.
3. Coolant.

PCU REPLACEMENT PROCEDURE

Figures 3-30, 3-31, and 3-32

1. Turn main battery switch to the off position.

Install or Connect

2. Inverter on the bracket.

Tighten

- Six mounting nuts/bolts to 32 Nm (24 lb–ft.).

3. Mounting nuts or bolts (10).

Remove or Disconnect

4. Coolant caps from PCU.
5. Coolant caps from coolant hose (if applicable).

Install or Connect

6. Coolant hoses (4, 6).
7. High voltage cable to J2 (7).
8. Signal cable to J4 (8).
9. 3 phase output cable to J1 (9).
10. Motor encoder cable to J5 (5).
11. Integral charge input cable to J6 (2).
12. 12 volt auxiliary battery positive cable (3).
13. 12 volt auxiliary battery ground cable (1).

MOTOR REMOVAL AND REPLACEMENT

MOTOR REMOVAL PROCEDURE

Remove or Disconnect

Refer to US Electricar motor removal procedure.

MOTOR REPLACEMENT PROCEDURE

Install or Connect

Refer to US Electricar motor replacement procedure.

MOTOR ENCODER CABLE REMOVAL AND REPLACEMENT

MOTOR ENCODER CABLE REMOVAL PROCEDURE

Remove or Disconnect

1. Motor.

Disassemble

2. Motor encoder lid from motor.
   a. Eight mounting screws.

Remove or Disconnect

3. Motor encoder cable from encoder module.
4. Grommet in encoder lid cutout.
5. Slide motor encoder cable and connector through cutout of encoder lid.

MOTOR ENCODER CABLE REPLACEMENT PROCEDURE

Assemble

1. Motor encoder cable and connector through cutout of encoder lid.

Install or Connect

2. Grommet in encoder lid cutout.

MOTOR ENCODER CABLE REPLACEMENT PROCEDURE (CONT.)

3. Motor encoder cable to encoder.

Install or Connect

4. Motor encoder lid to motor housing.

Assemble

5. Strain relief onto screw.

Tighten

6. Eight screws.

Table 3-6. Part Identification and Information

NAME	REFERENCE DESIGNATOR	MANUFACTURE'S PART NUMBER
PCU	...	A04600AAO
Motor Assembly	.....	A04730AAO

RE–SHIPPING FAILED MODULES FOR REPAIR

See warranty information and shipping instructions in section IV.

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SECTION IV

WARRANTY INFORMATION

FER Form Instructions

Please follow these instructions completely to speed service

Return Authorization:	Call the PCS service number (800) 482–6644 for telephone assistance before filling out the form. We may be able to solve your problem over the phone. If we are not able to solve your problem, you will need to have a valid Return Authorization to receive prompt service.
Initiator:	Please enter your name and a phone number where you can be reached during normal business hours.
Driver / Owner Contact:	Please enter the name of the driver or owner contact who may be able to provide additional detail about the event in case we need that information.
Vehicle Description:	Please enter the make and model of the vehicle, e.g., Geo Prizm.
Identification #:	Please enter the Vehicle Identification number – found under the windshield on the driver's side.
Odometer Mileage:	Please enter the mileage from the vehicle's odometer at the time of the event.
Location:	Where did the event occur? City and state.
Part Name:	What's the name of the suspected part? (e.g., Power Control Unit)
Part #:	Please enter the part number of the suspect unit from the nameplate.
Serial #:	Enter the serial number from the nameplate.
"Briefly describe the event . . ."	What happened or didn't happen that caused you or the driver to think there was a problem? Please include as much detail as possible.
"What was happening just before the event occurred?"	Please describe the situation that led up to the event. What was the vehicle doing? Provide as much detail as possible.
"Any other comments?"	This is your opportunity to provide us with any other comments you would like to offer about the event, the Dolphin system, our service or anything you would like to say to PCS.

Dolphin™	Field Event Report (FER)	GMH / POWER CONTROL SYSTEMS / Delco Electronics

Note: A completed FER form, with a valid Return Authorization MUST accompany any item sent back to PCS for repair, replacement, credit, or other service.

Call 1(800) 482–6644 for Telephone Service Assistance and Return Authorization.

Return Authorization: _____ Initiator Name: _____ Phone: _____

Driver/Owner Contact: _____ Phone: _____

Vehicle Description: _____ Identification #: _____

Odometer Mileage: _____ Location: _____

Part Name: _____ Part #: _____ Serial #: _____

Briefly describe the event / incident / problem. (What happened or didn't happen?)

What was happening just before the event occurred? (For example, driving up hill at 35 mph, or vehicle at battery charger overnight)

Any other comments?

PCS Tracking #:

WARRANTY INSTRUCTIONS and INFORMATION

Power Control Systems (PCS) warrants this product to be free from defects in material and workmanship.

If the vehicle technician / mechanic suspects a Dolphin™ Propulsion System fault, he or she should call the PCS service number (800) 482–6644. We will attempt to solve the problem over the phone. If the problem can't be solved over the phone, you will be assigned a Return Authorization and asked to fill out a Field Event Report (FER) form. A FER form was packed with this unit at the time it was shipped from the factory. You may also copy the form from the vehicle service manual or ask that one be mailed or faxed to you.

A completed FER Form and a valid Return Authorization are required to process all warranty service requests.

A return shipping label was also packed with this unit when it left the factory. Please place the Return Authorization on the shipping label, attach the label to the original shipping container, and pack the warranted unit in the original shipping container. Your PCS service representative will repeat these instructions when you call.

Your PCS service representative can arrange to ship the unit to our factory. Please be ready to provide information that will help the delivery service to quickly find your location. We will need your address, any gate or dock number that may apply, the nearest cross streets, and the name and phone number of someone to contact in case all else fails.

Do not attempt to diagnose or repair problems inside the power control unit (PCU). Do not remove the cover, since the warranty will be void if the seals are broken.

THIS WARRANTY SHALL APPLY ONLY TO DEFECTS THAT APPEAR WITHIN ONE (1) YEAR FROM THE DATE THE PRODUCTS ARE DELIVERED TO US ELECTRICAR (USE) CUSTOMERS OR PUT INTO SERVICE BY SEE AS A DEMONSTRATION VEHICLE BUT IN NO EVENT SHALL THIS WARRANTY PERIOD EXCEED EIGHTEEN (18) MONTHS FROM THE DATE THE PRODUCTS ARE DELIVERED TO USE. USE must notify PCS of any such defects within fifteen (15) days after discovery of the defect, but in any event not more than fifteen (15) days after the end of the warranty period.

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