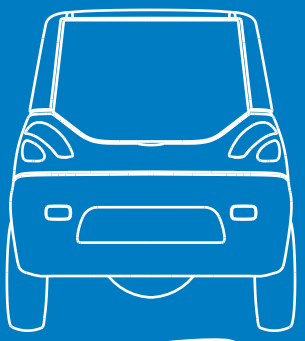
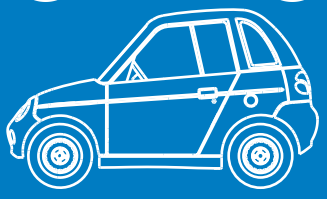
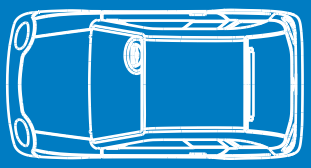
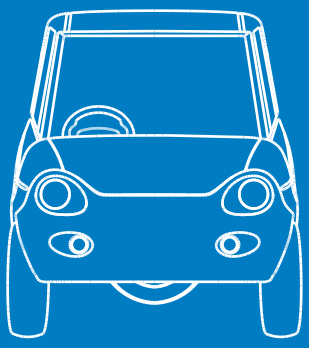




REVA i

Service manual





maini

REVA

ISSUED TO:

DEALER NAME - .....

ADDRESS - .....

.....

.....

LOCATION - .....

DATE - .....

Copy No. - **SM** .....

Revision No. - **REV -2** .....

FOREWORD

This manual contains procedures for diagnosis, maintenance, adjustments, minor service operations, replacement of components (Service) and for disassembly and assembly of major components (Unit Repair - Overhaul).

Applicable model: REVA

The contents are classified into sections each of which is given a section number as indicated in the Table of Contents on next page. First page of each individual section has an index of that section.

This manual should be kept in a handy place for ready reference of the service work. Strict observance of the specified service will enable one to obtain the full performance of the vehicle.

When replacing parts or servicing by disassembling, it is recommended to use REVA genuine parts, tools and service materials (lubricants, sealants, etc.) as specified in each description.

All information, illustrations and specifications contained in this literature are based on the latest product information available at the time of publication and used as the main subject of description for the vehicle of standard specifications. Therefore, note that illustrations may differ from the vehicle being actually serviced.
The company reserves the right to make changes at any time without notice.

technical specifications 00.0

GENERAL	
Type	2 door hatch back, right hand drive
Seating Capacity	2 Adults + 2 children
Overall length	2638 mm
Overall width	1324 mm
Overall height	1510 mm
Wheelbase	1710 mm
Track	Front - 1166 mm Rear - 1171 mm
Ground Clearance	118 mm
Curb weight	670 Kgs
Gross axle weight	Front - 371 Kgs Rear - 596 Kgs
Gross vehicle weight	970 Kgs
Turning radius	3800 mm
Steering gear box	Rack & Pinion
Toe-in dimension	1 mm/side
Fixed Caster Angle	10 deg
Camber angle (adjustable)	+ 0.5 deg (30 minutes)
Fixed Kingpin angle	14.1 deg
Frame type	Welded tubular steel space frame
Tyre size (front & rear)	145 / 70 R13
Tyre pressure	Front 35 Psi Rear 40 Psi

SUSPENSION	
Front	MacPherson struts
Rear	Single pivot trailing arm and anti roll bar with Strut assisted by shock absorbers.

BRAKING SYSTEM	
Type	Foot operated Hydraulic internal expanding drum brake at rear and disc at front
Parking brake	Mechanically actuated on the rear wheels
Wheel cylinder	Front - 215mm disc brakes Rear - 15.87 mm

MOTOR	
Three Phase Squirrel cage AC Induction Motor	
Nominal Power	6KW
Maximum power	12KW@2400 rpm
Maximum Speed	8000 rpm

MOTOR CONTROLLER	
Description	3 Phase AC Induction Motor Controller
Voltage	48V
Maximum Rating	350A
Speed control is built within the controller.	
Reversal is possible within the controller.	
Also controller can operate in Forward, Reverse & Boost (Forward) modes.	

ELECTRICALS	
The car uses 12V electrical for the lighting system	
Headlights	55/60W -Halogen bulbs/4w
Turn indicators	Front: 21W -BAY15d Rear: 21 W- BAY15s
Parking light	5 W
Brake light	21W -BAY15d
The rear combination bulb, parking and brake lights.	
Reverse light	10W -BAY15s
Room light	5W
Wiper motor	12V
Audio system (optional)	12V - Connected to the system
INSTRUMENT CLUSTER HAS THE FOLLOWING:	
Speedometer	0-100 kmph / 0-60 mph
Odometer in Kms / miles	Digital
Fuel (SOC) Gauge	0-100%
Indications Low Battery/C harge LED/Turn Indicators/Service/Hi-beams/over temperature/ battery water level low/parking brake ON/brake fluid level low warning lights/ Neutral Light/ Power Indicator/ Encoder Fault Light.	
The car also has a chime to give audio alarms in the event of system malfunctioning.	
A key switch with contactor controls application of power to the controller and to the motor.	

INTERIORS	
Body Panels	High impact ABS
Interior paneling	Acrylonitrile Butadiene Styrene (ABS)

BUMPERS
R- Rotomolded bumper
RA- Vacuum formed and textured coated with mat clear
RAD- Vacuum formed painted

POWER PACK	
Battery type / location	Lead acid tubular type with single point watering system packaged under the front seats.
Pack voltage	Uses eight 6-volt batteries connected in series to build up the 48 V DC system.
Package Capacity	200 AH @ C5 rate.
The pack has bolted interconnects to give reliability and trouble free operation. The pack has a single point watering system with auto filling and leveling of electrolyte in all the cells. It also has a water-level sensor to monitor the water level in the battery and a temperature sensor.	

PERFORMANCE	
Range (with full payload)	80 Kms @ 50 - 60 Km/hr
Top speed	70 Km/hr in 'F' mode 80 Km/hr in 'B' mode
Maximum gradeability	18% with full payload
Charge time	80% SOC in less than 3 hours 100% SOC in less than 9 hours

CHARGER	
Input Typical value	 160 - 260 V, 50 - 60 H, AC and 16 Amps.
Output Voltage Current	 42 - 65 V DC 40 Amps (maximum)
Circuit type Switch mode High frequency transformer type. The charger is controlled by the EMS.	
DC - DC CONVERTER:	
Input	35 - 65 V DC
Output	13.5 V DC +/- 2%
Power	400 W

MAIN SHUNT	
Application	Used to measure the battery current.
Location	Mounted in rear electronics tub, inside passenger compartment.
Current Sensing Range	-400 A to 400 A
Maximum Current	+/- 400 A
Voltage Range	75 mV @ 400 A -75 mV @ -400 A
Thermal Rating	150 A continuous

MAIN CONTACTOR	
Location	Rear tub of the car along with other electronic parts.
COIL DATA	
Nominal Voltage	48V DC
Voltage Range	36V - 64 V DC
Coil Current / Coil resistance)	2 A (Max) / 336Ω
CONTACT DATA	
Continuous Current	200 A
Maximum Current	450 A for 2 min.

EMS	
Input	13.5 V DC ±2%
Current	150 mA
Location	Rear tub of the car.
Applications	Controls the charge profile.
	Controls the SOC Guage & IP Cluster lamps
	Communicates with motor controller
	Vehicle diagnostics

special tools + service materials 01.0

LOCATION OF VEHICLE IDENTIFICATION NUMBER PLATE
The vehicle identification is riveted on the chassis strut cross member near jack mounting area / near windshield wiper washer unit under the hood.

LOCATION OF CHASSIS NUMBER
Chassis number is punched on the chassis strut cross member, near the jack mounting.

Export cars

Domestic cars

LOCATION OF MOTOR NUMBER
Motor number is punched on the Plate on the body of motor.

STANDARD WORKSHOP PRACTICES

CHARGER 12V AND BATTERY POSITIVE (+VE) CABLE - DISCONNECTING

NOTE

Charger 12V and Battery positive (+ve) cable to be removed, before any electrical or mechanical maintenance is carried out.

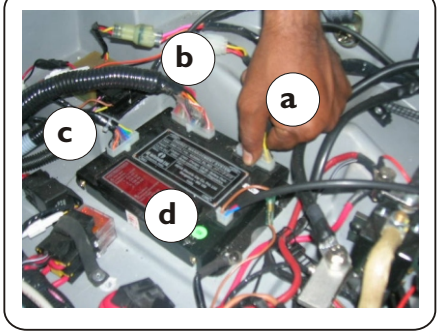
2. Remove the rear seat.

3. Connect the PET (Palm) to the Diagnostic port 9 pin EMS connector Located behind the front RH seat.
4. Note down the actual SOC. (eg. 700)
5. Download the Error Data. (Type <**$RER**> command to download Error Data)
6. Save these Errors in a File.

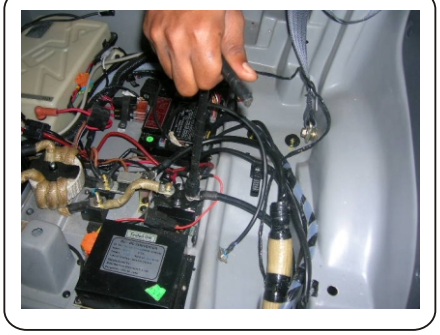
NOTE

EMS connectors should be removed first, before Charger 12V and Battery positive (+ve) is removed.

5. Remove EMS connectors in the order given below:
   a. Remove Battery Pack Sense Connector (CN66).
   b. Remove Main Harness Connector(CN 64).
   c. Remove Charger to EMS Connector(CN 63).
   d. Remove Diagnostic harness (Cn67).



6. Remove Charger 12V cable and Battery Positive (+ve).



CAUTION

As soon as the Charger 12V cable and battery positive (+ve) cable is removed, insulate them with insulation tape.

Be extremely careful not to short (touch) the negative (-ve) to the positive (+ve) terminal.

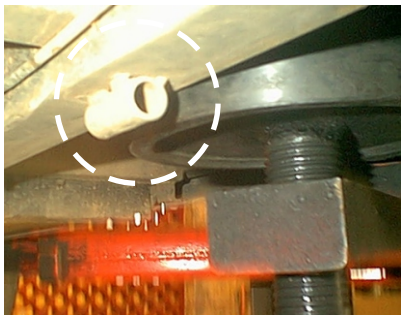
BATTERY POSITIVE (+VE) CABLE - RECONNECTING

1. Connect Battery Positive (+ve) and connect the Charger 12V cable.

CAUTION

Always connect the Battery positive (+ve) cable and charger 12V cable before connecting EMS connectors to prevent EMS from damage.

2. Connect EMS Connectors in the following order:
   - > Connect CN67.
   - > Connect Charger to EMS Connector(CN 63).
   - > Connect Main Harness Connector(CN 64).
   - > Connect Battery Pack Sense Connector(CN66).
3. Set SOC to previous noted SOC value.
   (eg. If previous noted SOC is 700 then, <**$SOC 700**>)
4. Reset Service Light. (Type <**$RSL**> to Reset Service Light)
5. Clear Error Data. (Type <**$CER**> to clear Error Data)



SERVICING WITH HOIST

- Ensure that the hoist contacts are at the respective front and rear jacking points.

CAUTION

The hoist contact should be as shown below (right and left at the same position). Raise the car up till all tyres are off the ground.

The car should be balanced throughout the service period, depending on the parts to be removed.

Make sure to lock hoist after car is hoisted up.

SERVICING WITHOUT HOIST

- In the absense of a hoist, jack up the car at a point on the chassis other than the jacki ng points.
- Now secure the car by placing safety stands (axle stands) at the jacking points. Only then remove the jack.

CAUTION

Place chocks (stopper) against both right and left wheels on the ground at front and rear.

Do not short 48v negative and positive cables.

All insulated tools to be used while working on electrical systems.

NOTE

A tightening torque table is provided for reference. Please ensure that all nuts and bolts adhere to this table. Use torque wrenches for these bolts.

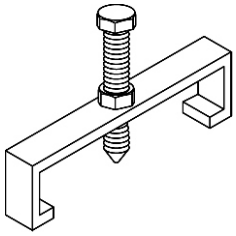
Genuine REVA spares only must be used. Use of other spurious parts may have a detrimental effect on the performance of REVA.

Special tools must be used to save time and to achieve good quality workmanship. These are available from RECC.

SPECIAL TOOLS

Special tools assure three things:
1) Improved workman ship.
2) Speedy execution of jobs.
3) Protection of parts and components against damage.

Here are the special tools prescribed for this model.



0100-3001: Transmission Casing Remover

0100-7002: Bearing Remover -6208

0100-7004: Bearing Installer 6208

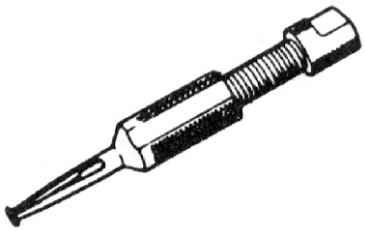
0100-7001: Transmission Oil Seal Remover

0100-5001: M-6 Motor Mounting Bolt Tool

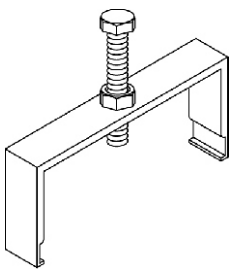
0100-7006: Bearing Installer 6204

0100-3002: Sliding Hammer

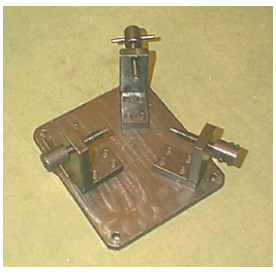
0100-7005: Bearing Installer 6205



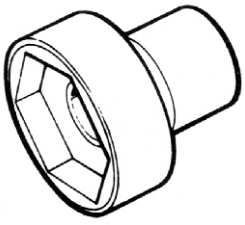
0100-6007: Pinion Bearing Remover



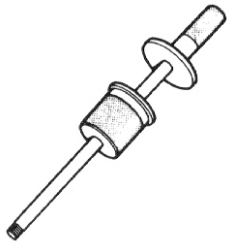
0100-3003: Rear Brake Drum Puller



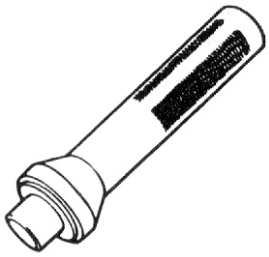
0100-7003: Differential Housing Holder



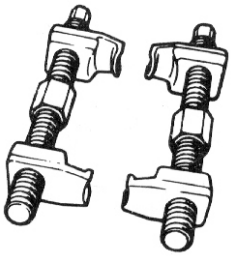
0100-6009: Pinion Bearing Plug Remover



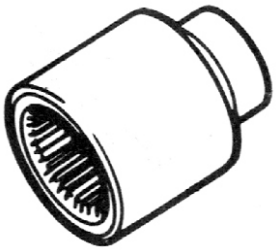
0100-6008: Steering Sliding Shaft



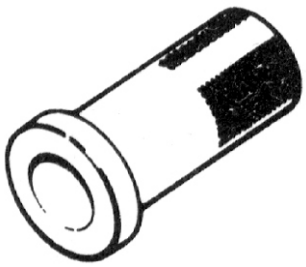
0100-6004: Rack Bush Installer



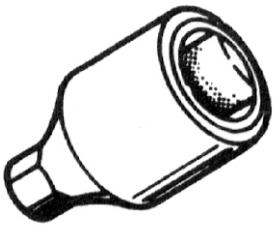
0100-9001: Strut Coil Spring Removing Fixture



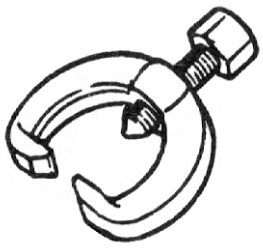
0100-6010: Pinion Torque Checking Socket



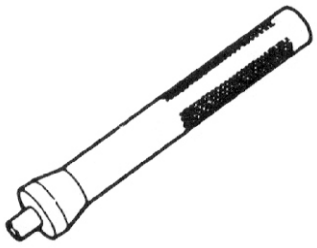
0100-3004: Rear Wheel Hub Installer



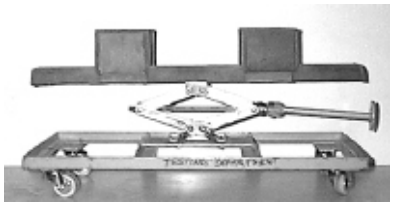
TABDZ012 : Heaxgon Socket - 10 mm



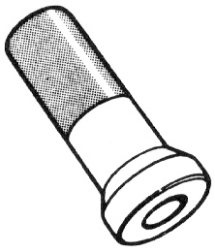
0100-6003: Tie Rod End Remover



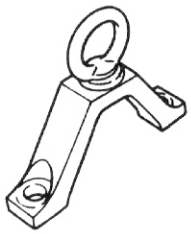
0100-6006: Pinion Bearing Installer



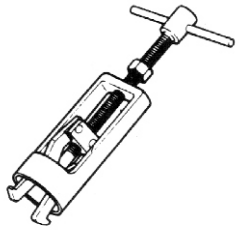
0100-12001: Door Removing / Fixing Fixture



0100-8001: Rear Axle Bearing Installer



0100-8002: Wheel Hub Remover



0100-6005: Rack Bush Remover

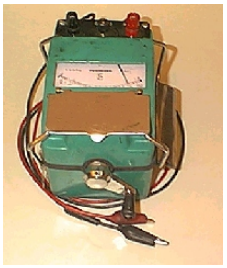
0100-7007: Transmission Oil Seal Installer

TABDZ011 : Windshield Glass Lifter

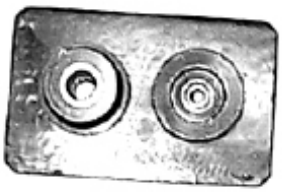
0100-4001: Battery Pack Lift Fixture

0100-5003: Motor Terminal Nut Spanner

0100-7010: Transmission LH Casing Fixture



0100-13003: Megger



0100-7000: Input & Intermediate Shaft Holder

0100-12004: Sealant Gun

0100-13002: Controller Hand Held

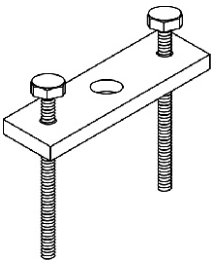
0100-12002: Pop Rivet Gun

0100-7009: Intermediate Gear Pressing

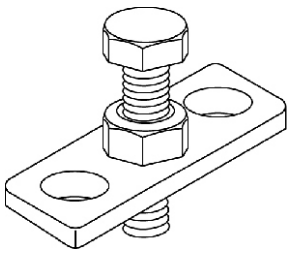
0100-13001: Palm Pilot

0100-12003: Double Face Rivet Gun

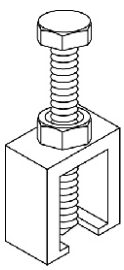
0100-7011: Transmission RH Casing Fixture



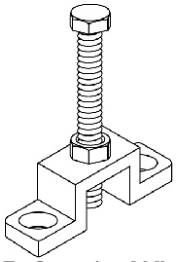
TABAA013 : Axle Shaft Remover



TABDZ006 : Motor Fan Puller



TABAA012 : Steering Arm - Ball Joint Remover



TABDZ007 : Steering Wheel Puller

FJAZZ120 HUB REMOVING FIXTURE

FJAZZ119 HUB HOLDING FIXTURE

7MM L-HANDLE

BEARING REMOVING FIXTURE

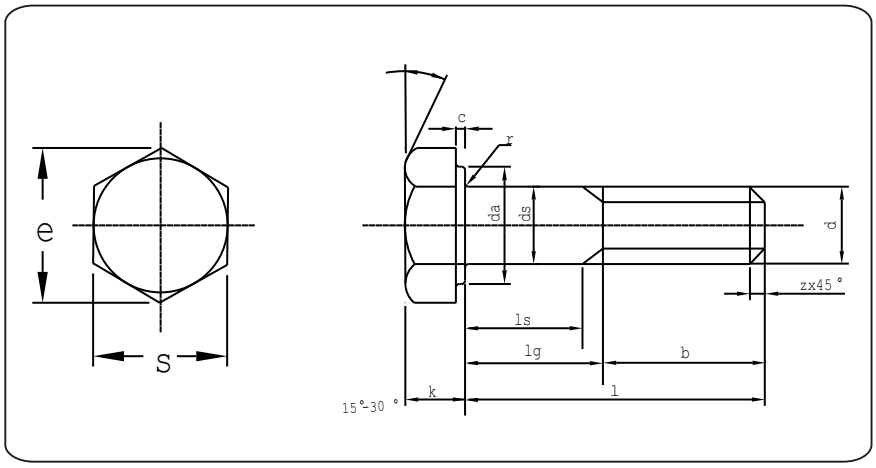
ENCODER BEARING REMOVING FIXTURE

SERVICE MATERIALS

SERVICE MATERIALS		
NO.	**MATERIAL**	**USE**
1	BRAKE FLUID **DOT 3** **Indian Oil :** Servo brake fluid super HD **Hindustan Petroleum :** HP Super duty brake fluid **Indrol :** Castrol brake fluid crimson.	To fill master cylinder reservoir Clean and apply to inner parts of master cylinder, wheel cylinder whenever they are dismantled.
2	THREAD LOCK CEMENT "1342" (99000-32050)	Steering pinion bearing plug thread.
3	GEAR OIL SAE 80 and 90	Transmission gear bearing and differential case (0.6 litres).
4	SERVOGEM-2	To apply to steering (rack and pinion) gear case inner parts.
5	SERVOGEM-3	Transmission oil seal Differential oil seal Wheel bearings. Transmission input shaft splines.
7	Mini combi	Puncture sealant.
8	Loctite 510	Transmission casing sealant.
9	Terostat 8590	Glass bonding sealant..
10	Silicon walker Grey	Rubber seal sealant.
11	Silicon walker black	Plastic to metal sealant.
12	Silicon walker white	Plastic to plastic panel sealant.

STANDARD TIGHTENING TORQUES

Each fastener should be tightened to the specified values mentioned in each section of this manual. If no description or specification is provided, refer to the following tightening torque chart for the applicable torque for each fastener. However when a fastener of greater strength than the original one is used, use the torque specified for the original fastener.



NOTE

WF - with washer face.

Dimensions with * mark must be inspected; other ones are for reference only.

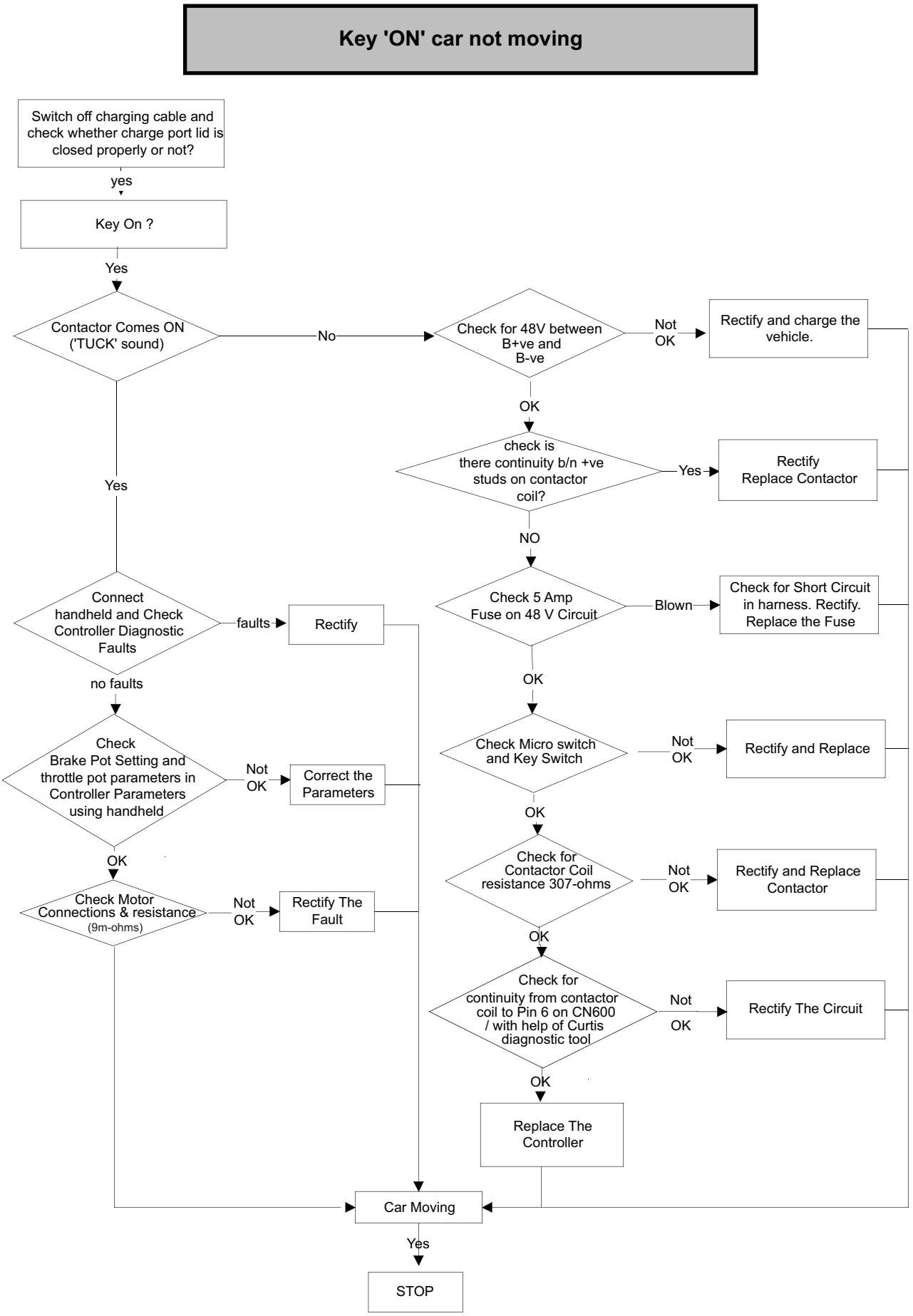
Part No. 015-01-80 & 016-01-00 must be self centering type bolt.

Hardness as per IS - 1367 (Part 3): 1991.

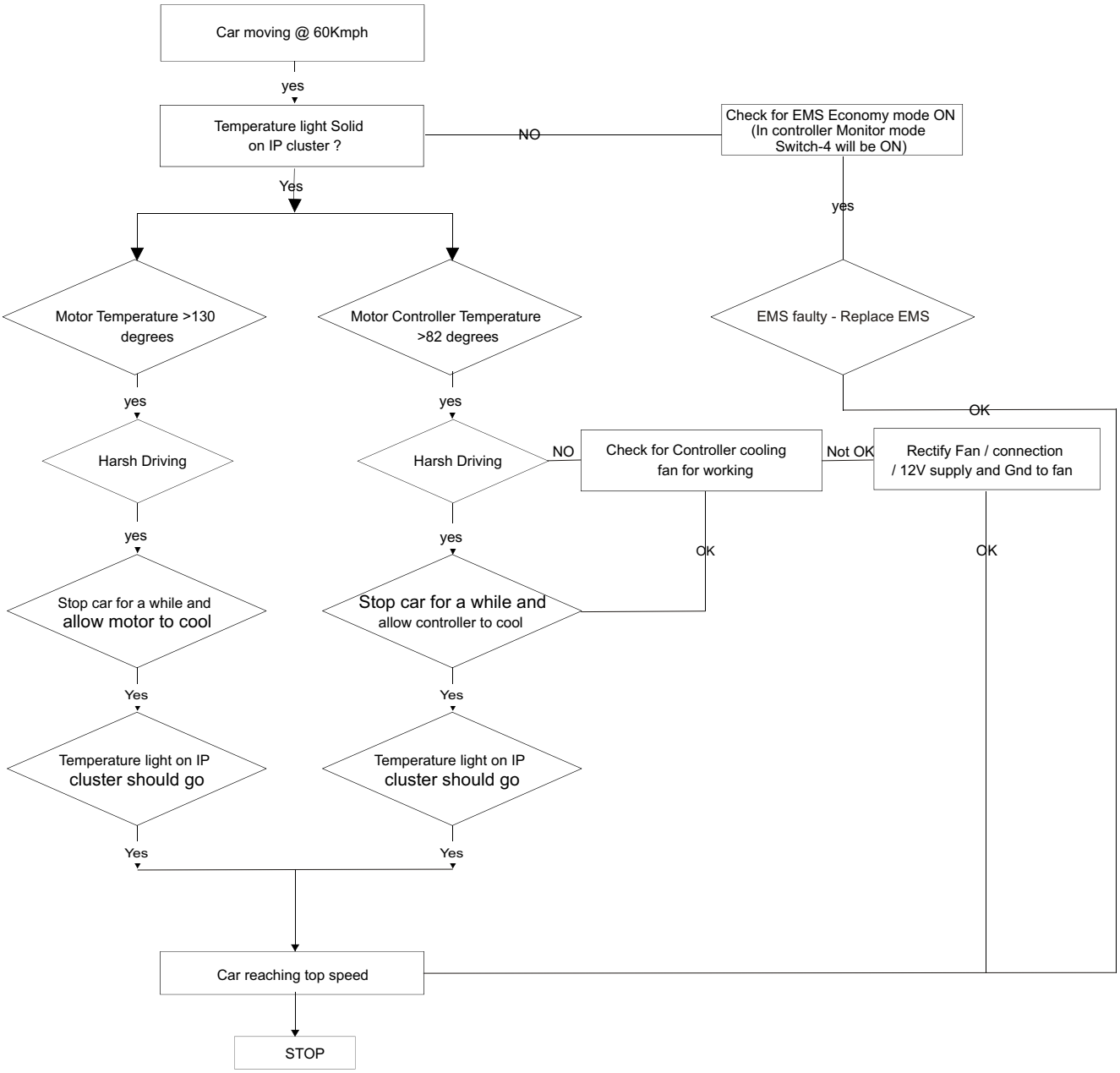
Part No. 014-01-31 to be coated with rust preventive oil in supply and storage condition.

Sl. No.	Part No.	Description	l *	b *	Property Class	Form Features IS-1367	Tightening Torque
1	010-01-25	Bolt, Hex, M5x0.8x25	25	25	8.8	WF	6.5 Nm
2	012-01-12	Bolt, Hex, M4x0.7x12	12	12	8.8	WF	3 Nm
3	012-01-25	Bolt, Hex, M4x0.7x25	25	14	8.8	WF	3 Nm
4	013-01-15	Bolt, Hex, M6x1x15	15	15	8.8	WF	8 Nm
5	013-01-16	Bolt, Hex, M6x1x16	16	16	8.8	WF	11 Nm
6	013-01-20	Bolt, Hex, M6x1x20	20	20	8.8	WF	11 Nm
7	013-01-25	Bolt, Hex, M6x1x25	25	25	8.8	WF	11 Nm
8	013-01-35	Bolt, Hex, M6x1x35	35	35	8.8	WF	11 Nm
9	013-01-45	Bolt, Hex, M6x1x45	45	18	8.8	WF	11 Nm
10	014-01-12	Bolt, Hex, M8x1.25x12	12	12	8.8	WF	26 Nm
11	014-01-16	Bolt, Hex, M8x1.25x16	16	16	8.8	WF	26 Nm
12	014-01-20	Bolt, Hex, M8x1.25x20	20	20	8.8	WF	26 Nm
13	014-01-24	Bolt, Hex, M8x1.25x25	25	25	8.8	WF	22 Nm
14	014-01-25	Bolt, Hex, M8x1.25x25	25	25	8.8	WF	26 Nm
15	014-01-30	Bolt, Hex, M8x1.25x30	30	22	8.8	WF	26 Nm
16	014-01-31	Bolt, Hex, M8x1.25x30	30	22	10.9	WF	26 Nm
17	014-01-35	Bolt, Hex, M8x1.25x35	35	35	8.8	WF	26 Nm
18	014-01-45	Bolt, Hex, M8x1.25x45	45	22	8.8	WF	26 Nm
19	014-01-51	Bolt, Hex, M8x1.25x55	55	22	10.9	WF	26 Nm
20	015-01-16	Bolt, Hex, M10x1.5x16	16	16	8.8	WF	55 Nm
21	015-01-25	Bolt, Hex, M10x1.5x25	25	25	8.8	WF	55 Nm
22	015-01-30	Bolt, Hex, M10x1.5x30	30	30	8.8	WF	55 Nm
23	015-01-35	Bolt, Hex, M10x1.5x35	35	26	8.8	WF	55 Nm
24	015-01-36	Bolt, Hex, M10x1.25x35	35	14	8.8	WF	55 Nm
25	015-01-40	Bolt, Hex, M10x1.5x40	40	26	8.8	WF	55 Nm
26	015-01-45	Bolt, Hex, M10x1.5x45	45	26	8.8	WF	55 Nm
27	015-01-50	Bolt, Hex, M10x1.5x50	50	50	8.8	WF	55 Nm
28	015-01-55	Bolt, Hex, M10x1.5x55	55	26	8.8	WF	55 Nm
29	015-01-60	Bolt, Hex, M10x1.5x60	60	26	8.8	WF	55 Nm
30	015-01-70	Bolt, Hex, M10x1.5x70	70	26	8.8	WF	55 Nm
31	015-01-80	Bolt, Hex, M10x1.5x80	80	26	8.8	WF *	55 Nm
32	015-01-90	Bolt, Hex, M10x1.5x90	90	26	8.8	WF	55 Nm
33	016-01-00	Bolt, Hex, M12x1.75x100	100	30	8.8	WF *	91 Nm
34	016-01-60	Bolt, Hex, M12x1.75x60	60	30	8.8	WF	91 Nm
35	017-01-99	Bolt, Hex, M12x1.75x190	190	38	8.8	WF	91 Nm

troubleshooting 02.0

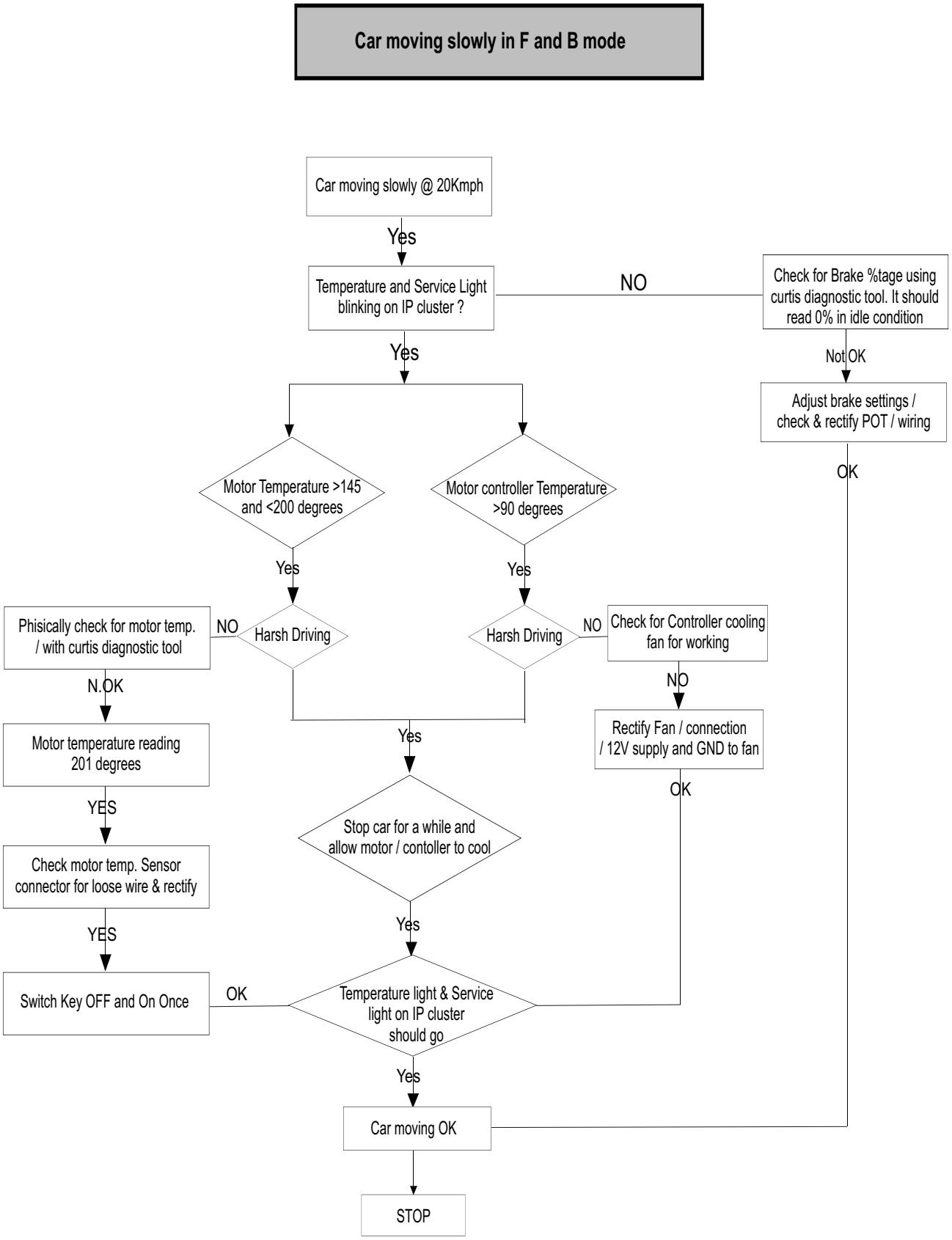

Key 'ON' car not moving
Switch off charging cable and check whether charge port lid is closed properly or not?
yes
Key On ?
Yes
Contactor Comes ON ('TUCK' sound)
No
Check for 48V between B+ve and B-ve
Not OK
Rectify and charge the vehicle.
OK
check is there continuity b/n +ve studs on contactor coil?
Yes
Rectify Replace Contactor
NO
Check 5 Amp Fuse on 48 V Circuit
Blown
Check for Short Circuit in harness. Rectify. Replace the Fuse
OK
Check Micro switch and Key Switch
Not OK
Rectify and Replace
OK
Check for Contactor Coil resistance 307-ohms
Not OK
Rectify and Replace Contactor
OK
Check for continuity from contactor coil to Pin 6 on CN600 / with help of Curtis diagnostic tool
Not OK
Rectify The Circuit
OK
Replace The Controller
Yes
Connect handheld and Check Controller Diagnostic Faults
faults
Rectify
no faults
Check Brake Pot Setting and throttle pot parameters in Controller Parameters using handheld
Not OK
Correct the Parameters
OK
Check Motor Connections & resistance (9m-ohms)
Not OK
Rectify The Fault
Car Moving
Yes
STOP

Car not reaching top speed in F and B mode

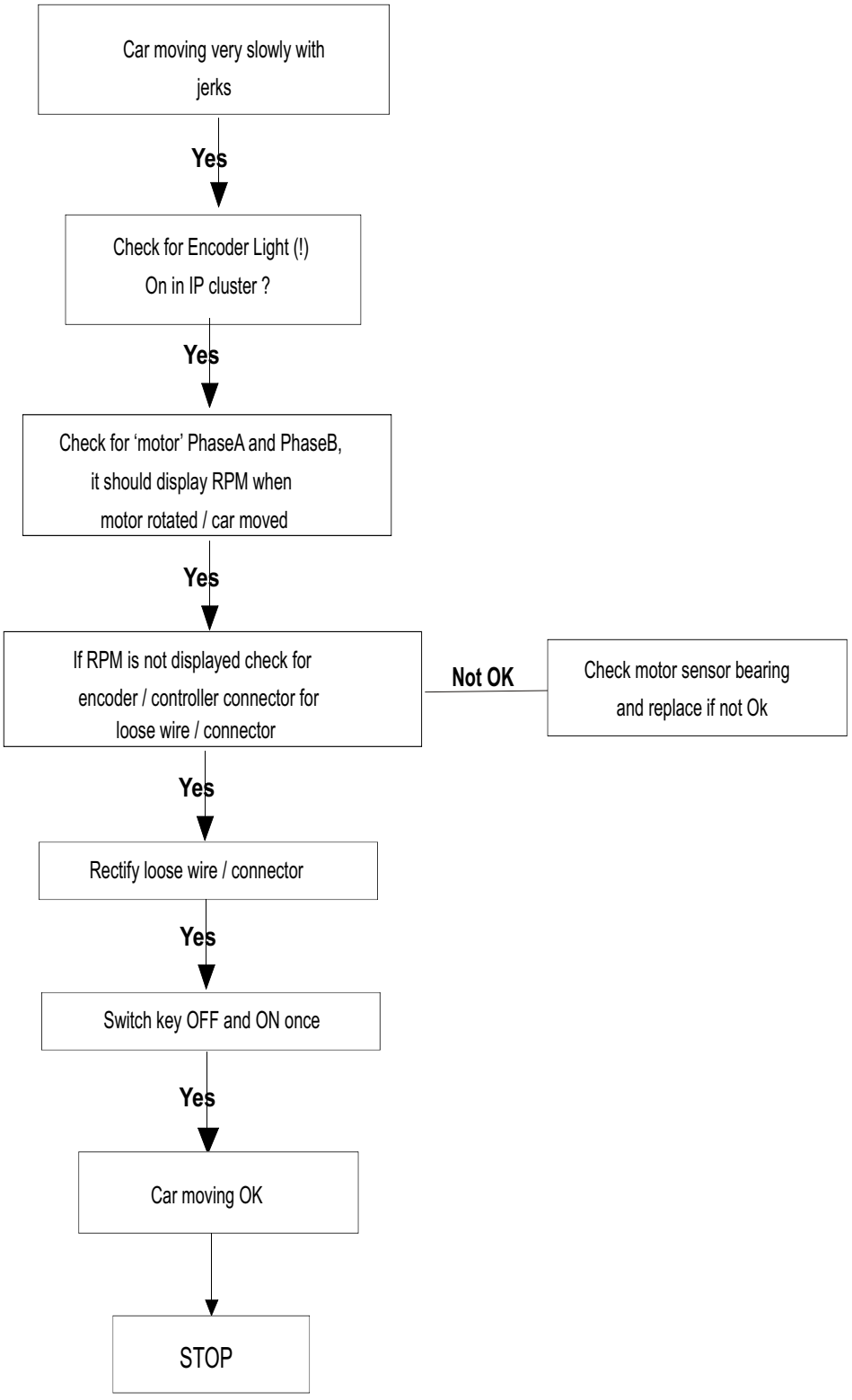


Check for Motor controller speed setting

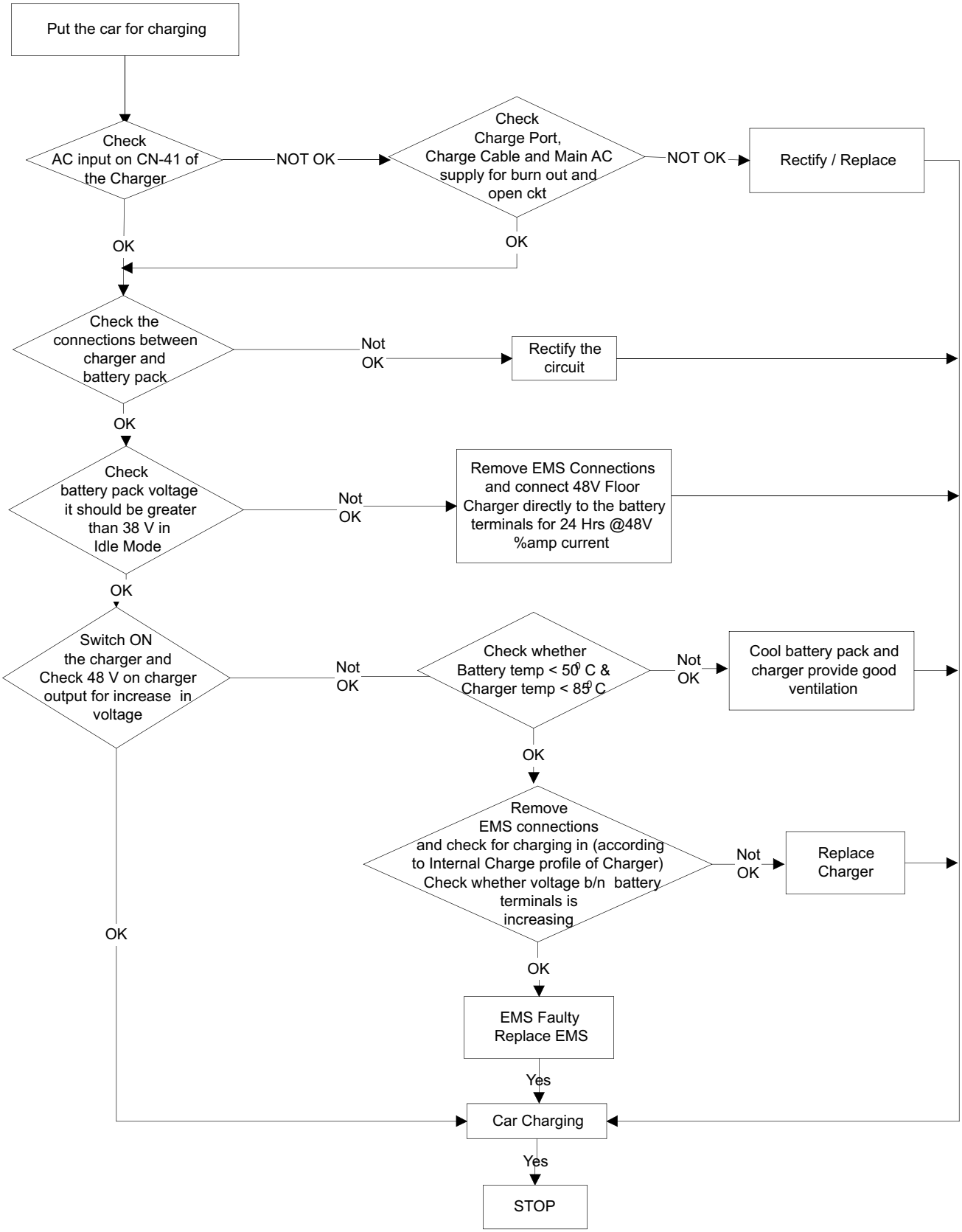
1. Check for Max speed set to 100% in Program mode->Foward parameters
2. Check for Throttle 100% reading in monitor-> mode inputs->Throttle, if not set the Throttle deadbands in Program mode->Throttle->"Forward deadband" and "Forward max" (If forward parameters changed make sure you set same value for "Reverse deadband" and "Reverse max".
3. Checks after selecting B mode- 2-Torque control mode->speed limiter->Max speed value is 7240 rpm
   In current limiting map->Power limiting Map-> Base speed=2000 rpm
   Delta speed=550 rpm
   All factors in Drive limiting map = 100 %
4. Checks after selecting F mode- 2-Torque control mode->speed limiter->Max speed value is 7240 rpm
   In current limiting map->Power limiting Map-> Base speed=1760 rpm
   Delta speed=600 rpm
   In Drive limiting map
   Nominal=86%, Base plus delta=59%, Base plus 2xdelta=59%
   Base plus 4xdelta=46%, Base plus 8xdelta=34%


Car moving slowly in F and B mode
Car moving slowly @ 20Kmph
Yes
Temperature and Service Light blinking on IP cluster ?
NO
Check for Brake %tage using curtis diagnostic tool. It should read 0% in idle condition
Not OK
Adjust brake settings / check & rectify POT / wiring
OK
Yes
Motor Temperature >145 and <200 degrees
Motor controller Temperature >90 degrees
Yes
Yes
Phisically check for motor temp. / with curtis diagnostic tool
NO
Harsh Driving
Harsh Driving
NO
Check for Controller cooling fan for working
N.OK
NO
Motor temperature reading 201 degrees
Yes
Rectify Fan / connection / 12V supply and GND to fan
OK
YES
Stop car for a while and allow motor / contoller to cool
Check motor temp. Sensor connector for loose wire & rectify
Yes
YES
Switch Key OFF and On Once
OK
Temperature light & Service light on IP cluster should go
Yes
Car moving OK
STOP

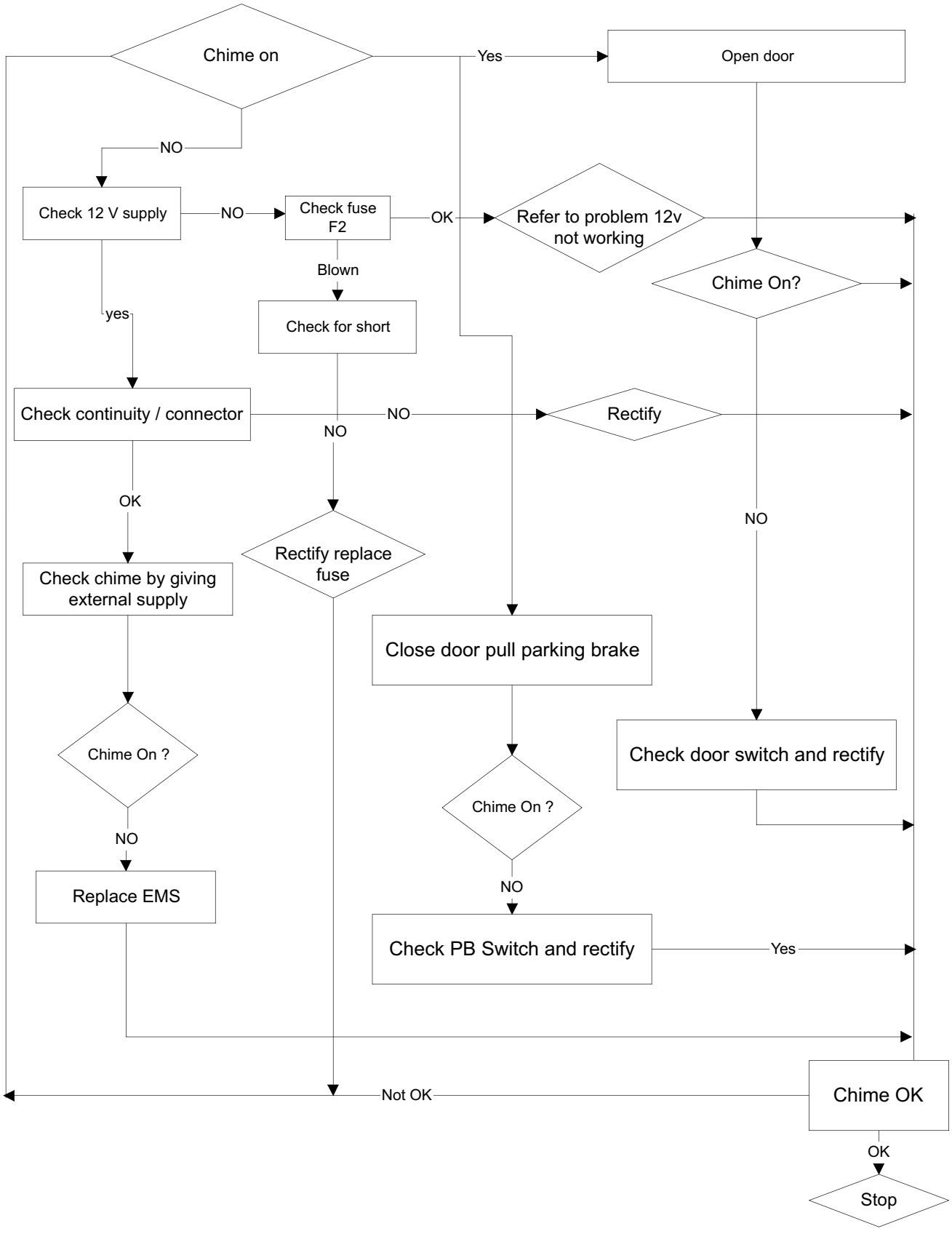
Car moving slowly in all modes

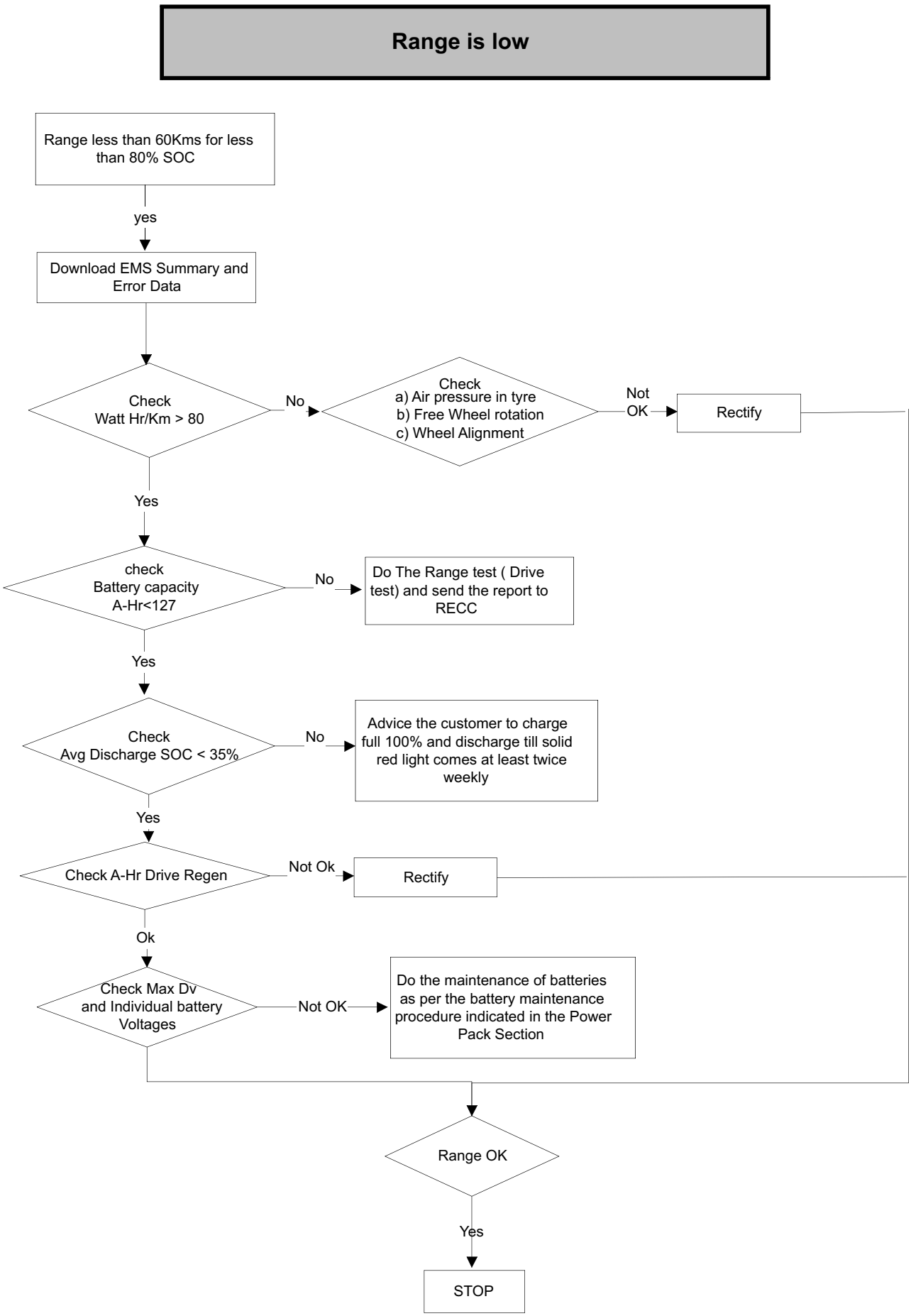


Vehicle does not charge

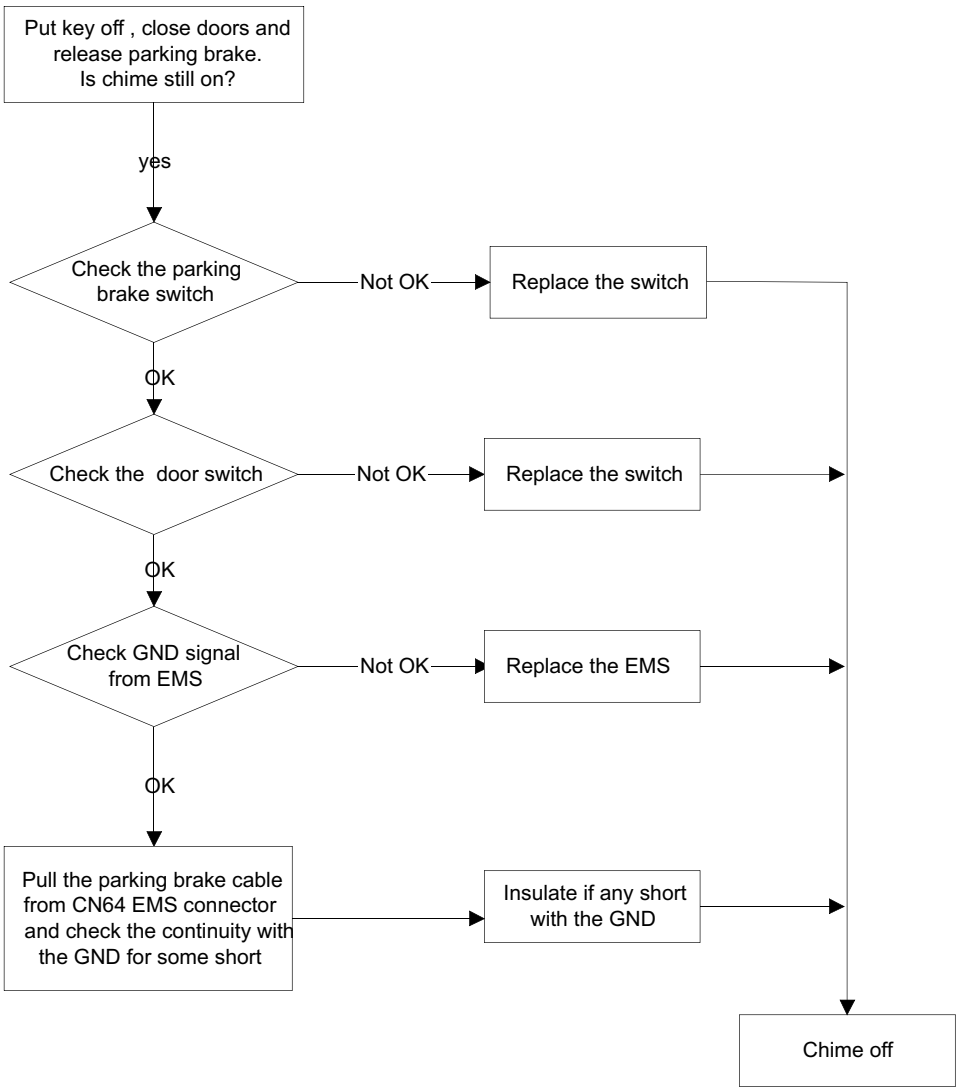


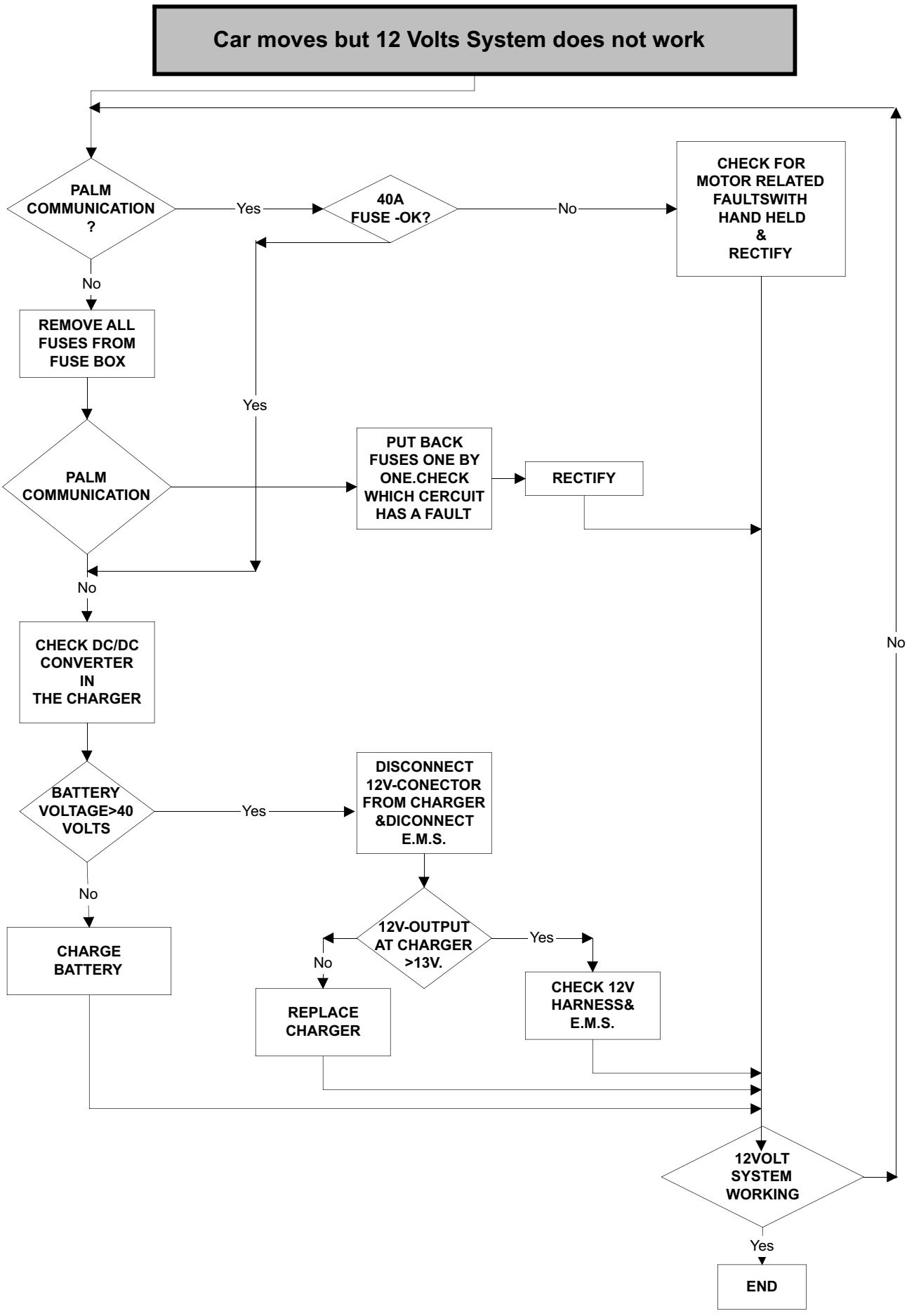
Chime malfunctioning / not working

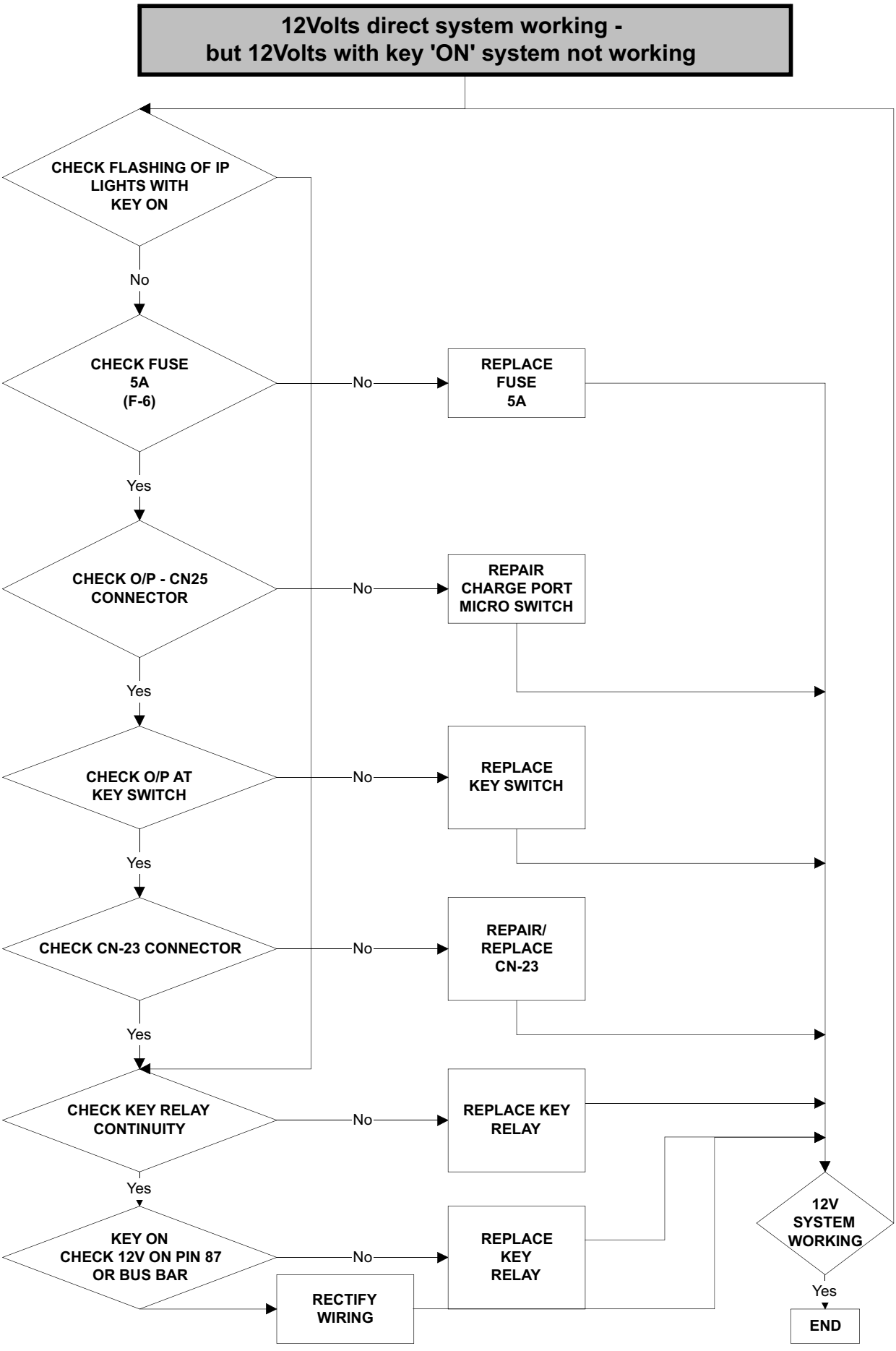



Range is low
Range less than 60Kms for less than 80% SOC
yes
Download EMS Summary and Error Data
Check Watt Hr/Km > 80
No
Check a) Air pressure in tyre b) Free Wheel rotation c) Wheel Alignment
Not OK
Rectify
Yes
check Battery capacity A-Hr<127
No
Do The Range test (Drive test) and send the report to RECC
Yes
Check Avg Discharge SOC < 35%
No
Advice the customer to charge full 100% and discharge till solid red light comes at least twice weekly
Yes
Check A-Hr Drive Regen
Not Ok
Rectify
Ok
Check Max Dv and Individual battery Voltages
Not OK
Do the maintenance of batteries as per the battery maintenance procedure indicated in the Power Pack Section
Range OK
Yes
STOP

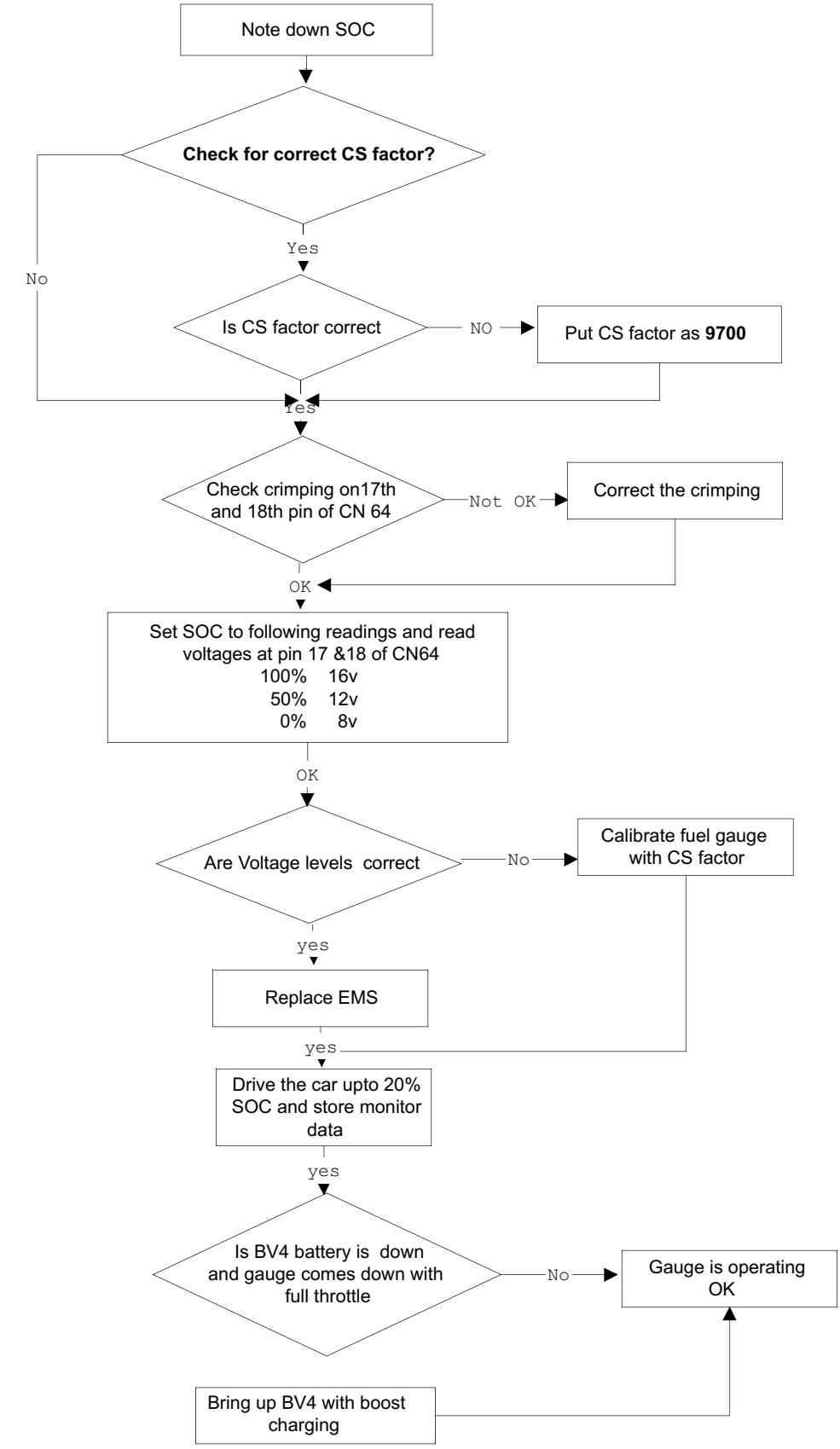
Chime continuously ON




Car moves but 12 Volts System does not work
PALM COMMUNICATION ?
Yes
40A FUSE -OK?
No
CHECK FOR MOTOR RELATED FAULTSWITH HAND HELD & RECTIFY
No
REMOVE ALL FUSES FROM FUSE BOX
Yes
PALM COMMUNICATION
PUT BACK FUSES ONE BY ONE.CHECK WHICH CERCUIT HAS A FAULT
RECTIFY
No
CHECK DC/DC CONVERTER IN THE CHARGER
BATTERY VOLTAGE>40 VOLTS
Yes
DISCONNECT 12V-CONECTOR FROM CHARGER &DICONNECT E.M.S.
No
CHARGE BATTERY
12V-OUTPUT AT CHARGER >13V.
Yes
No
REPLACE CHARGER
CHECK 12V HARNESS& E.M.S.
12VOLT SYSTEM WORKING
No
Yes
END

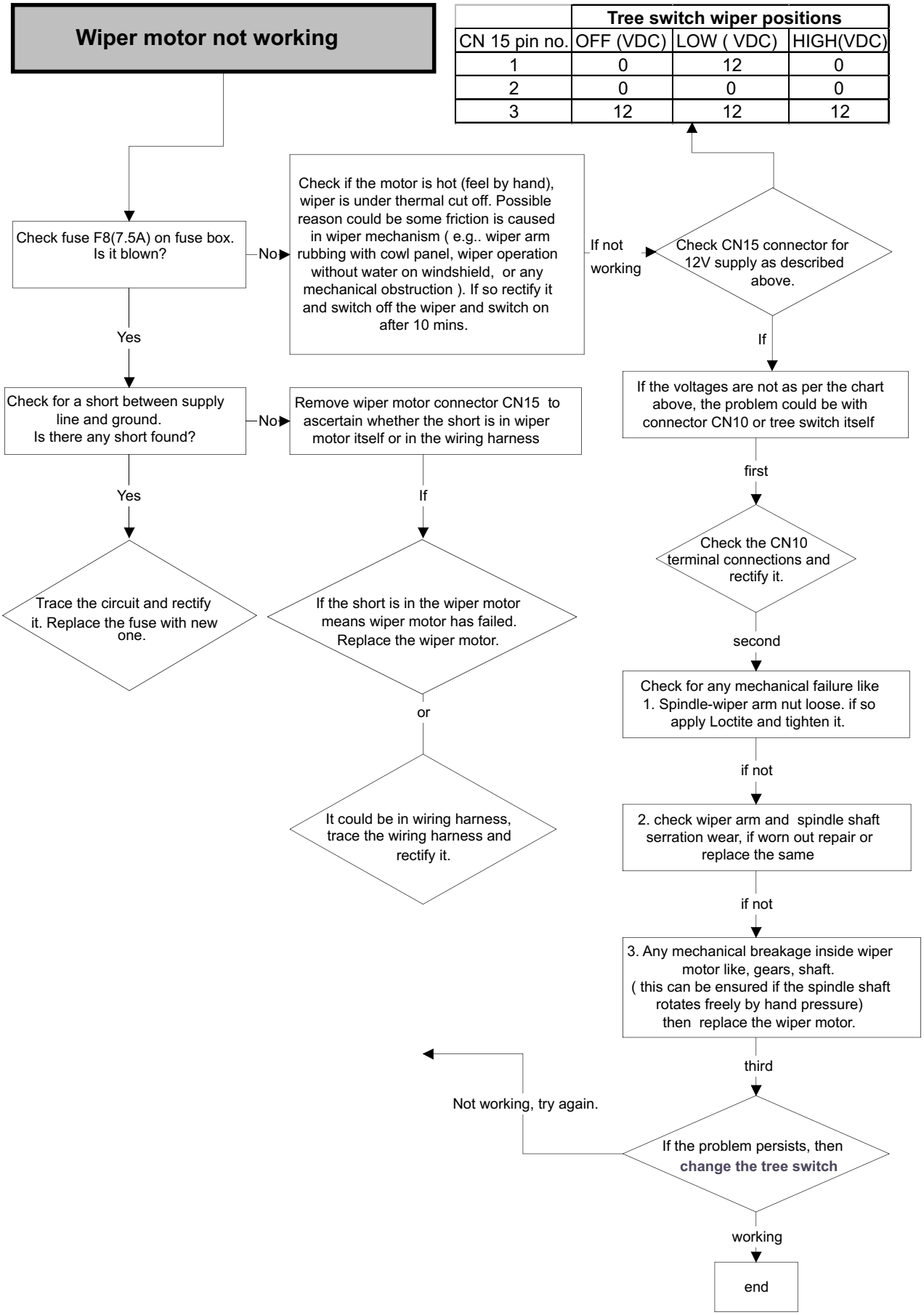

12Volts direct system working -
but 12Volts with key 'ON' system not working
CHECK FLASHING OF IP LIGHTS WITH KEY ON
No
CHECK FUSE 5A (F-6)
No
REPLACE FUSE 5A
Yes
CHECK O/P - CN25 CONNECTOR
No
REPAIR CHARGE PORT MICRO SWITCH
Yes
CHECK O/P AT KEY SWITCH
No
REPLACE KEY SWITCH
Yes
CHECK CN-23 CONNECTOR
No
REPAIR/ REPLACE CN-23
Yes
CHECK KEY RELAY CONTINUITY
No
REPLACE KEY RELAY
Yes
KEY ON CHECK 12V ON PIN 87 OR BUS BAR
No
REPLACE KEY RELAY
RECTIFY WIRING
12V SYSTEM WORKING
Yes
END

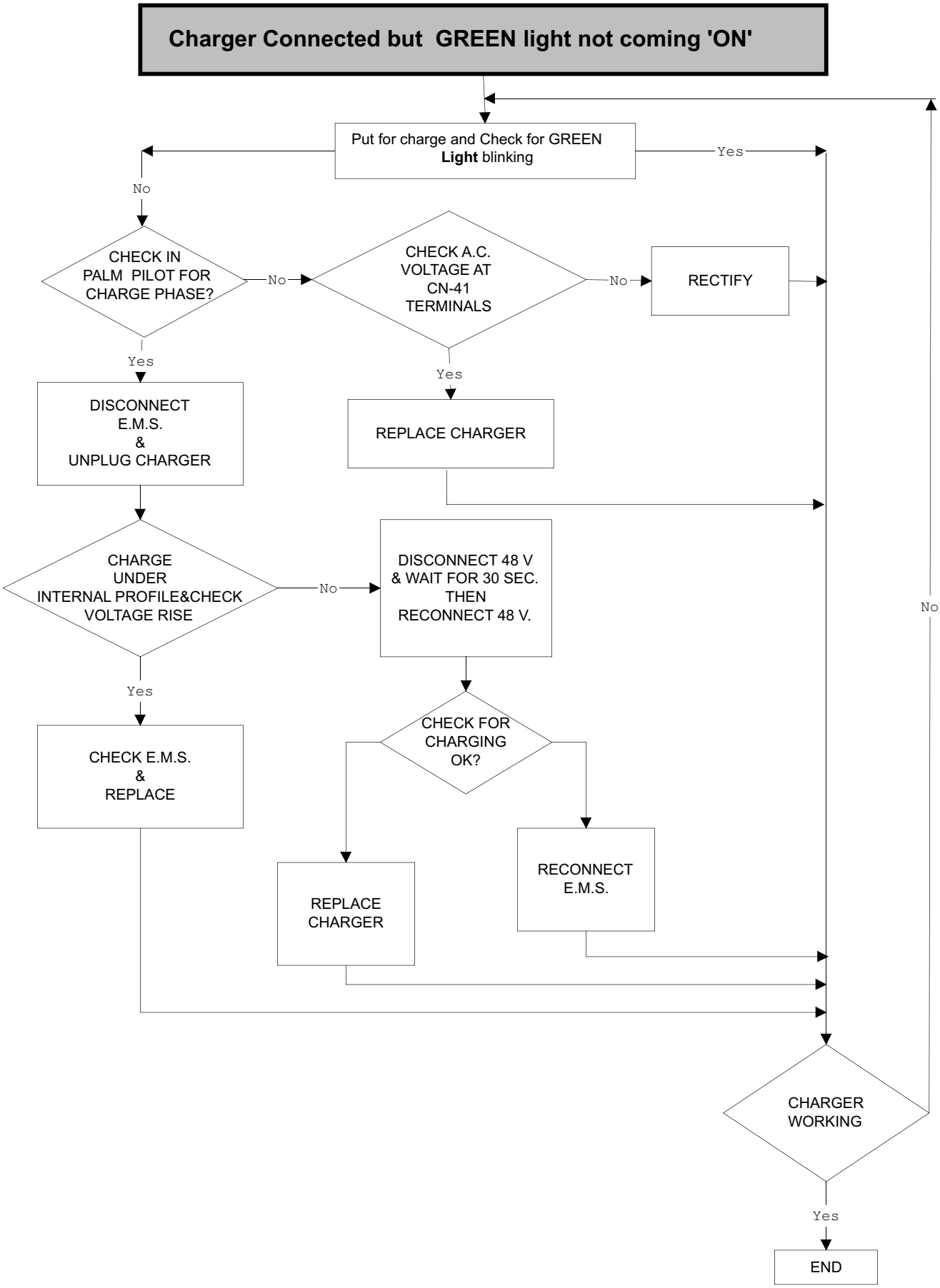
SOC Gauge shows erratic readings

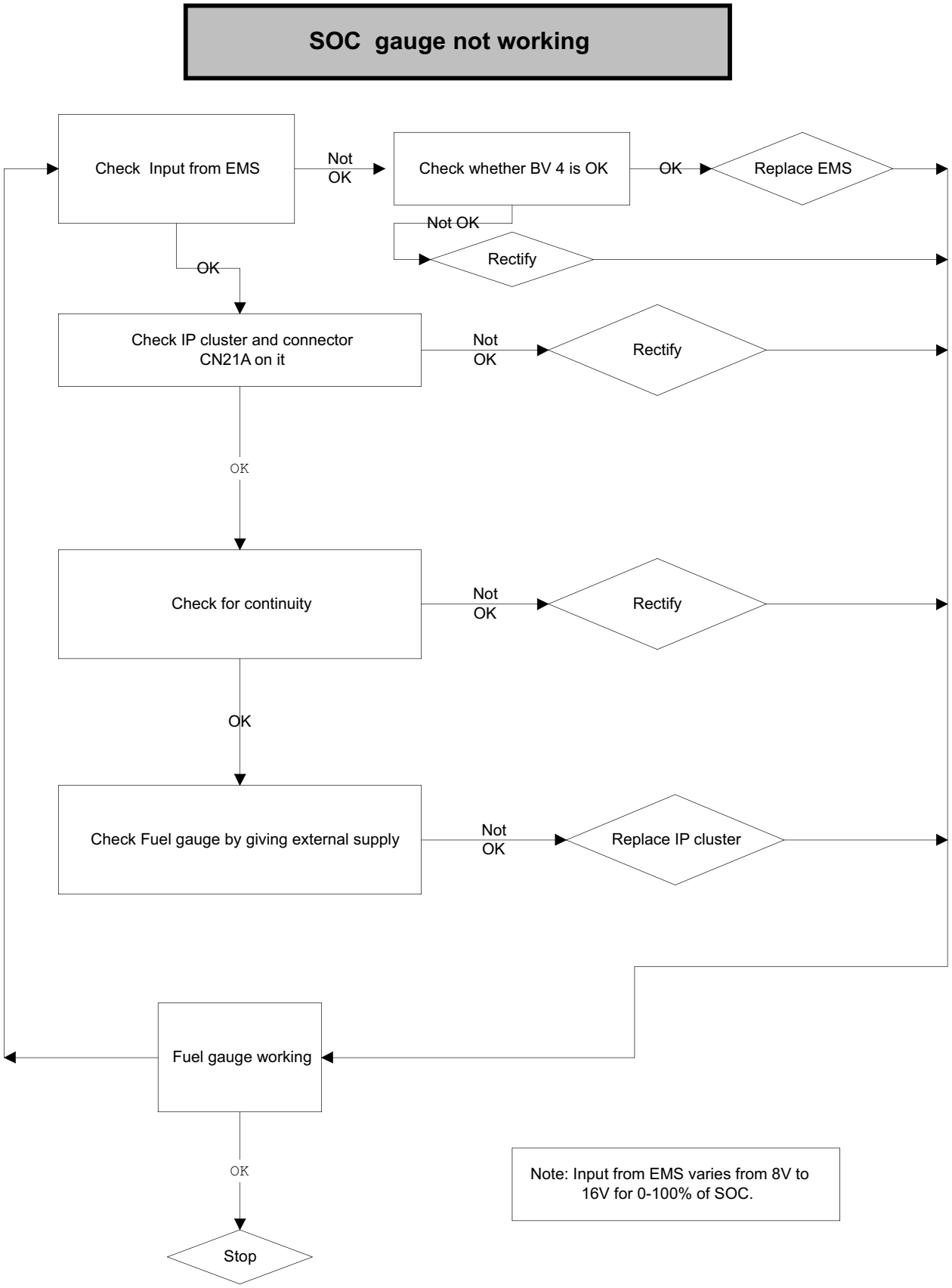


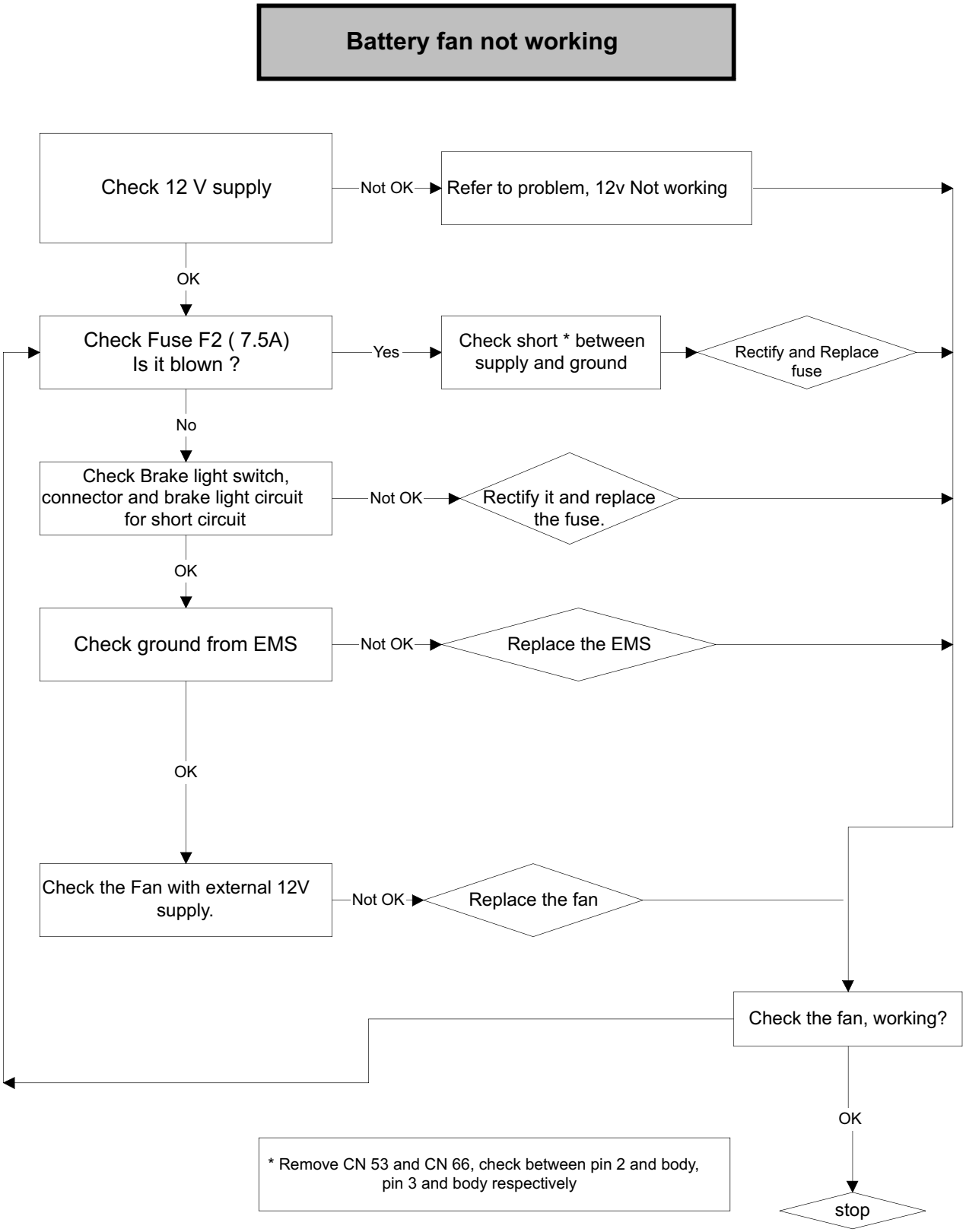
Wiper motor not working

	Tree switch wiper positions		
CN 15 pin no.	OFF (VDC)	LOW (VDC)	HIGH(VDC)
1	0	12	0
2	0	0	0
3	12	12	12

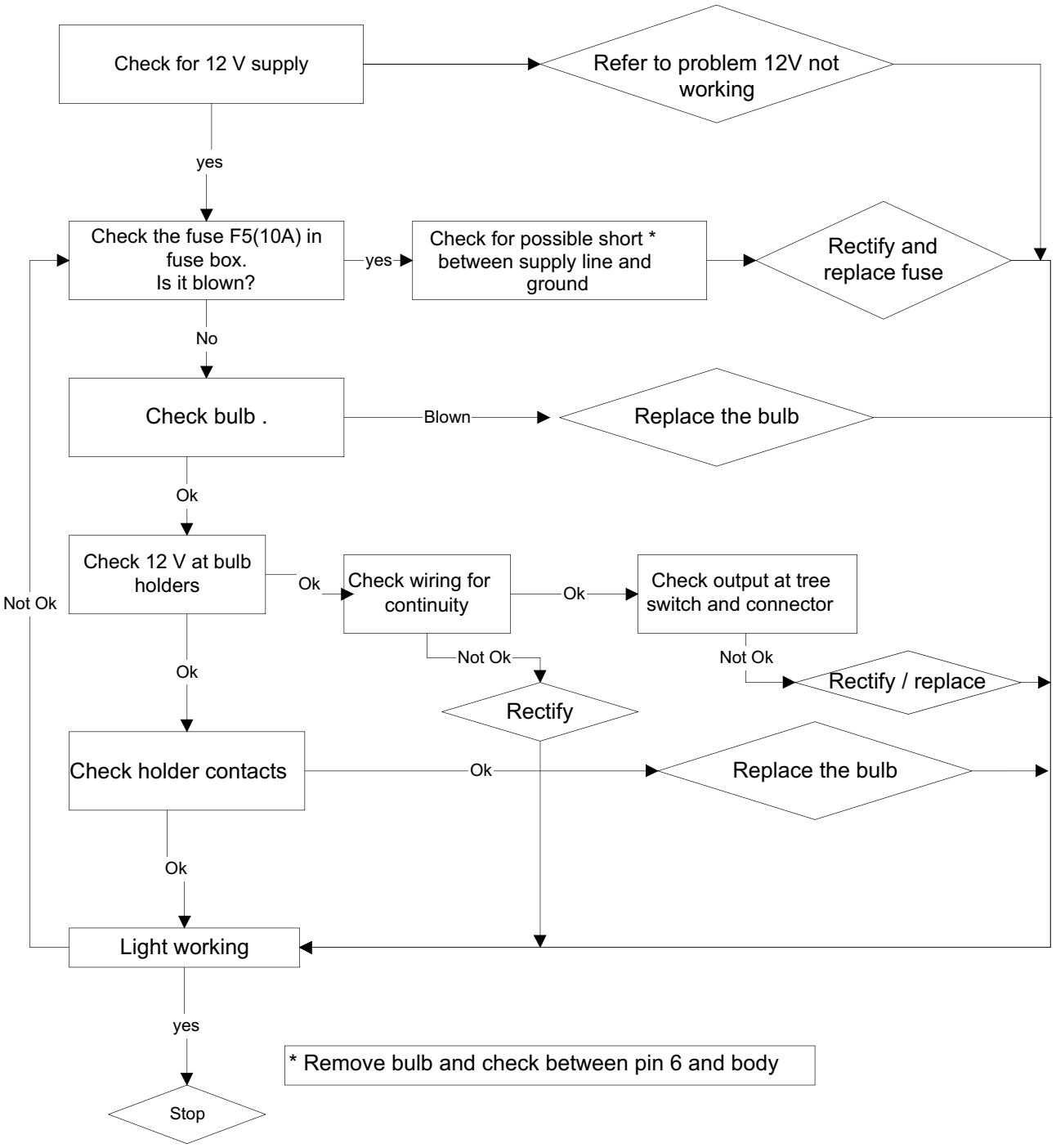



Charger Connected but GREEN light not coming 'ON'
Put for charge and Check for GREEN Light blinking
Yes
No
CHECK IN PALM PILOT FOR CHARGE PHASE?
No
CHECK A.C. VOLTAGE AT CN-41 TERMINALS
No
RECTIFY
Yes
DISCONNECT E.M.S. & UNPLUG CHARGER
Yes
REPLACE CHARGER
CHARGE UNDER INTERNAL PROFILE&CHECK VOLTAGE RISE
No
DISCONNECT 48 V & WAIT FOR 30 SEC. THEN RECONNECT 48 V.
Yes
CHECK E.M.S. & REPLACE
CHECK FOR CHARGING OK?
REPLACE CHARGER
RECONNECT E.M.S.
No
CHARGER WORKING
Yes
END

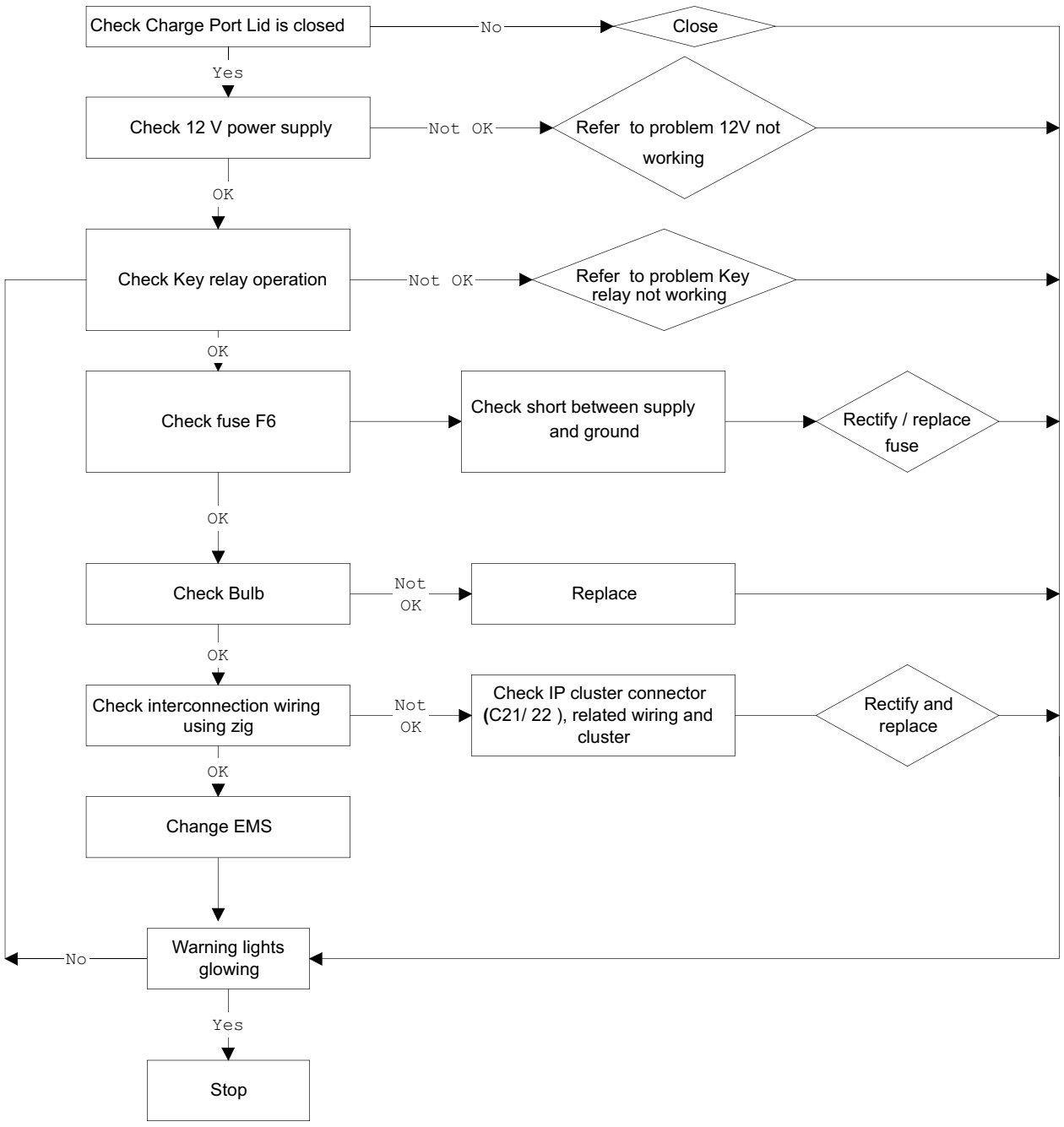

SOC gauge not working
Check Input from EMS
Not OK
Check whether BV 4 is OK
OK
Replace EMS
Not OK
Rectify
OK
Check IP cluster and connector CN21A on it
Not OK
Rectify
OK
Check for continuity
Not OK
Rectify
OK
Check Fuel gauge by giving external supply
Not OK
Replace IP cluster
Fuel gauge working
OK
Stop
Note: Input from EMS varies from 8V to 16V for 0-100% of SOC.


Battery fan not working
Check 12 V supply
Not OK
Refer to problem, 12v Not working
OK
Check Fuse F2 (7.5A)
Is it blown ?
Yes
Check short * between supply and ground
Rectify and Replace fuse
No
Check Brake light switch, connector and brake light circuit for short circuit
Not OK
Rectify it and replace the fuse.
OK
Check ground from EMS
Not OK
Replace the EMS
OK
Check the Fan with external 12V supply.
Not OK
Replace the fan
Check the fan, working?
OK
stop
* Remove CN 53 and CN 66, check between pin 2 and body, pin 3 and body respectively

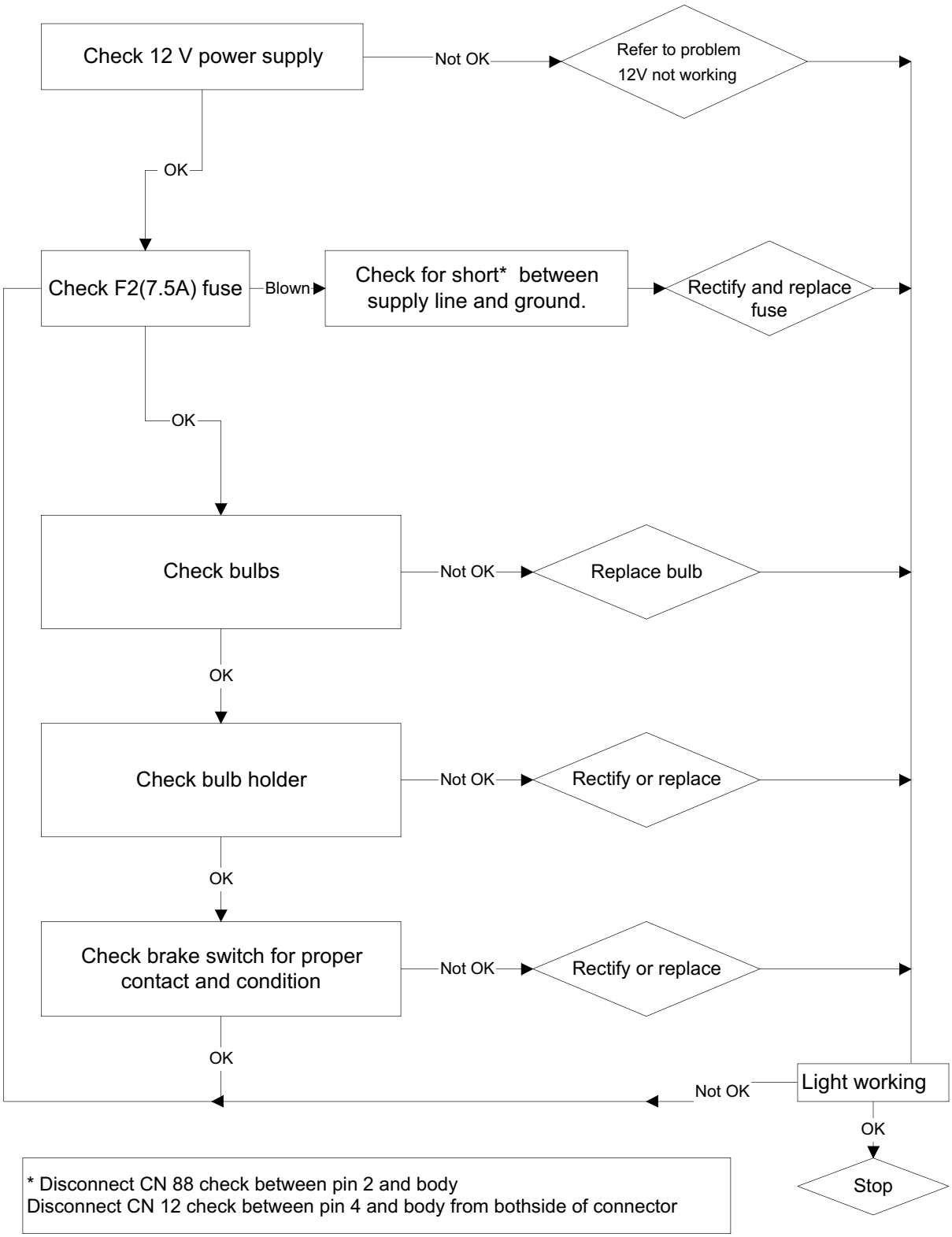
License plate light not working



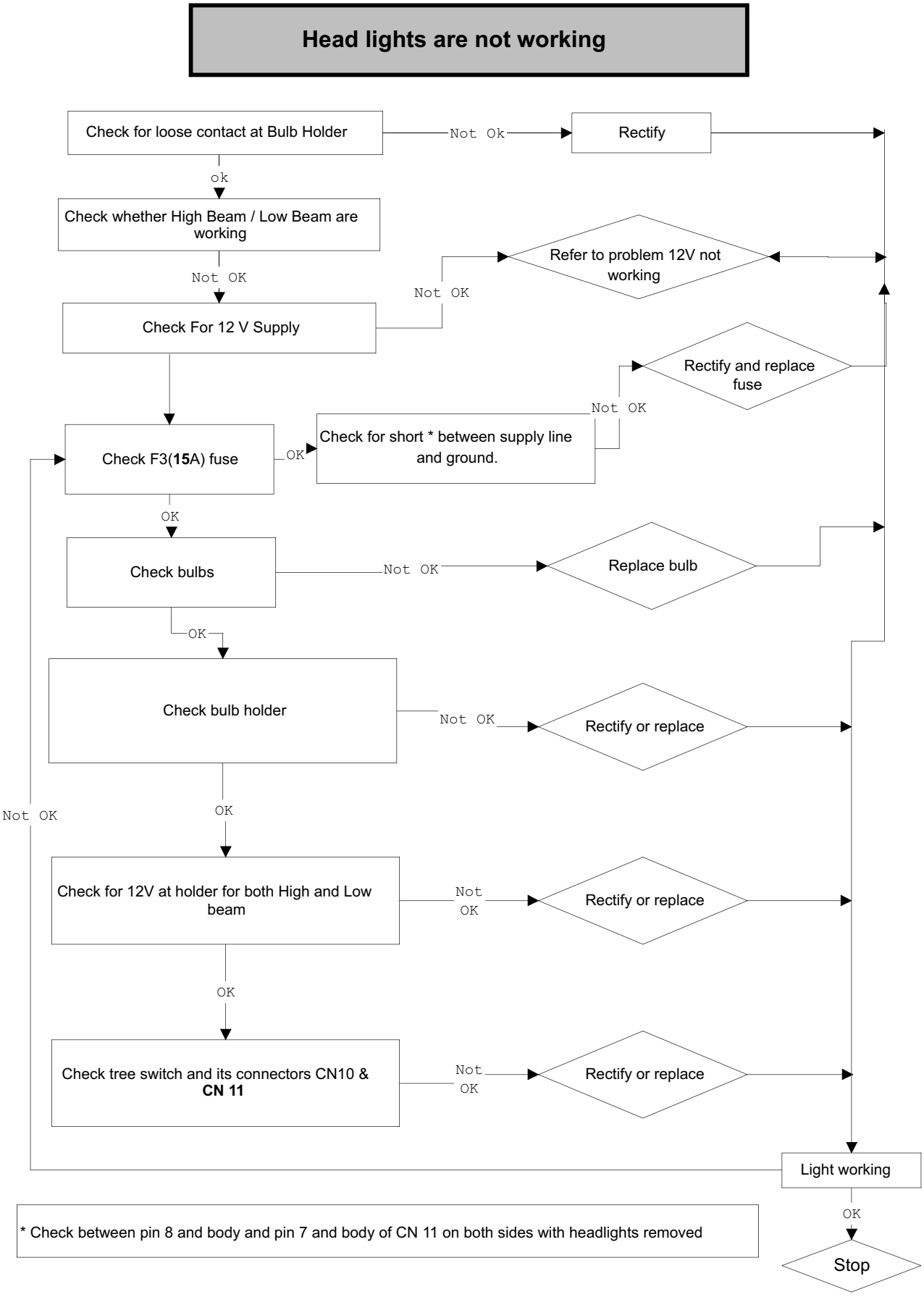
IP Cluster Warning Light / Lights are not working



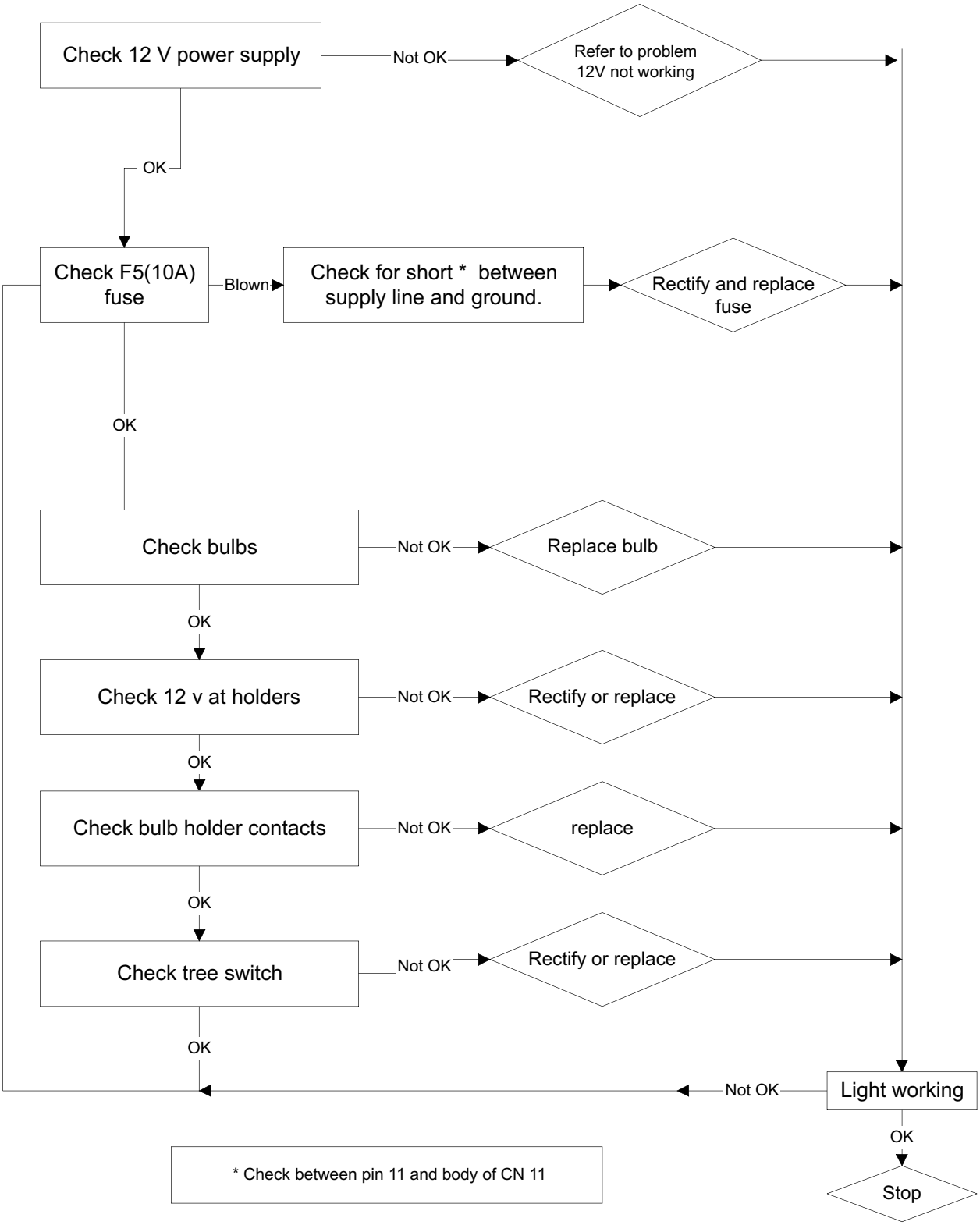
Brake lights are not working



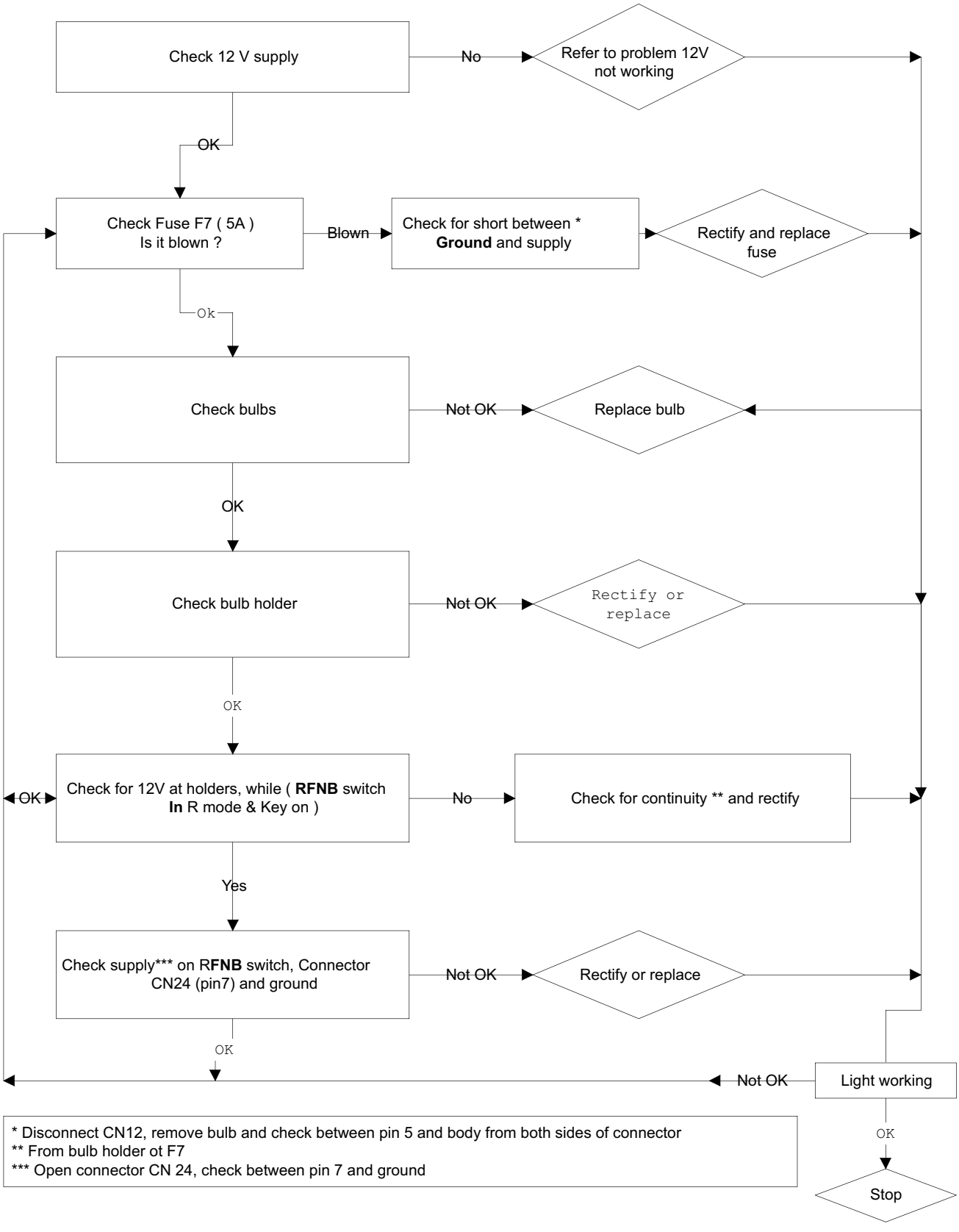
* Disconnect CN 88 check between pin 2 and body
Disconnect CN 12 check between pin 4 and body from bothside of connector


Head lights are not working
Check for loose contact at Bulb Holder
Not Ok
Rectify
ok
Check whether High Beam / Low Beam are working
Not OK
Refer to problem 12V not working
Not OK
Check For 12 V Supply
Rectify and replace fuse
Not OK
Check F3(15A) fuse
OK
Check for short * between supply line and ground.
OK
Check bulbs
Not OK
Replace bulb
OK
Check bulb holder
Not OK
Rectify or replace
Not OK
OK
Check for 12V at holder for both High and Low beam
Not OK
Rectify or replace
OK
Check tree switch and its connectors CN10 & CN 11
Not OK
Rectify or replace
Light working
OK
Stop
* Check between pin 8 and body and pin 7 and body of CN 11 on both sides with headlights removed

Parking Lights are not working

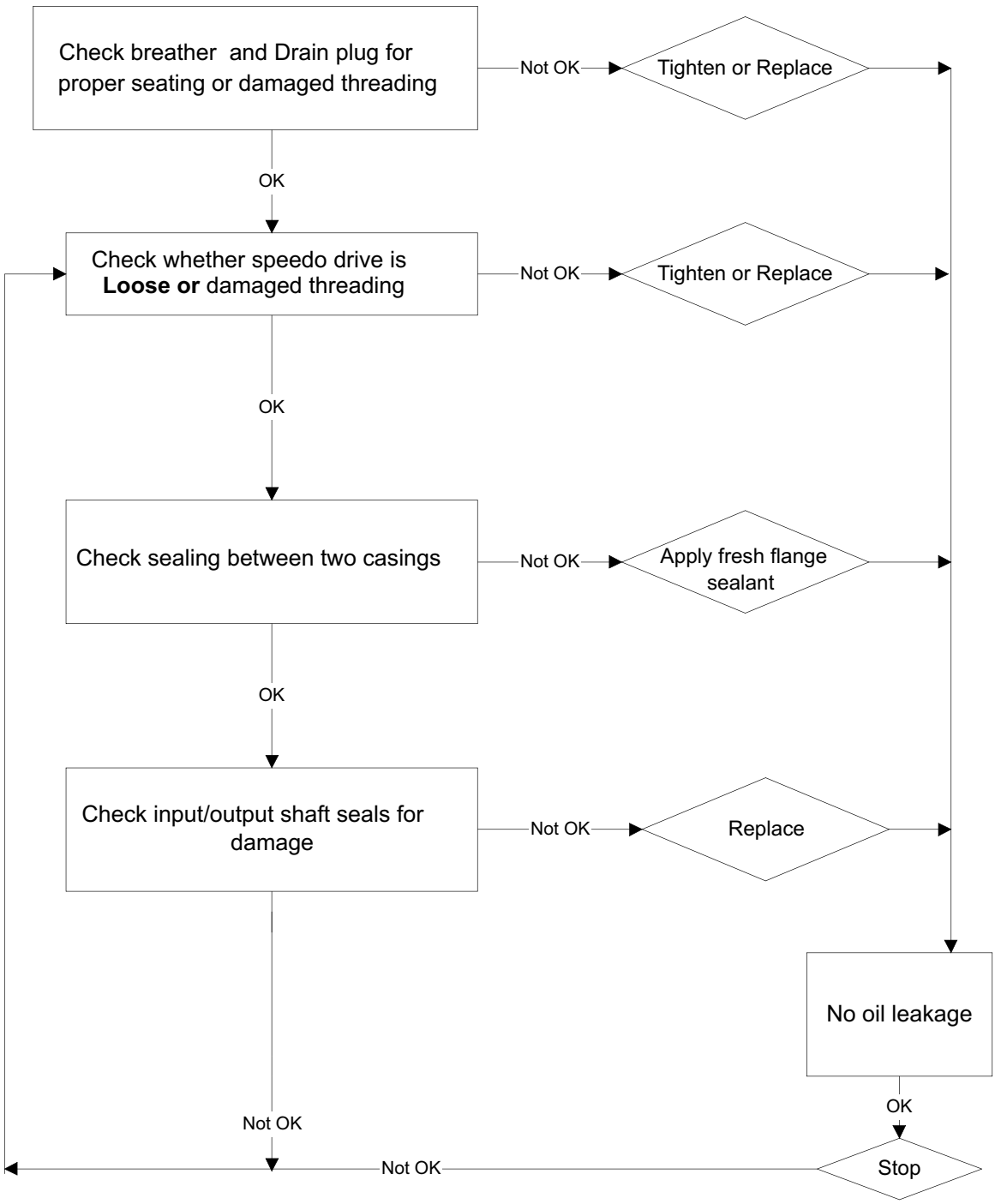


Reverse lights are not working



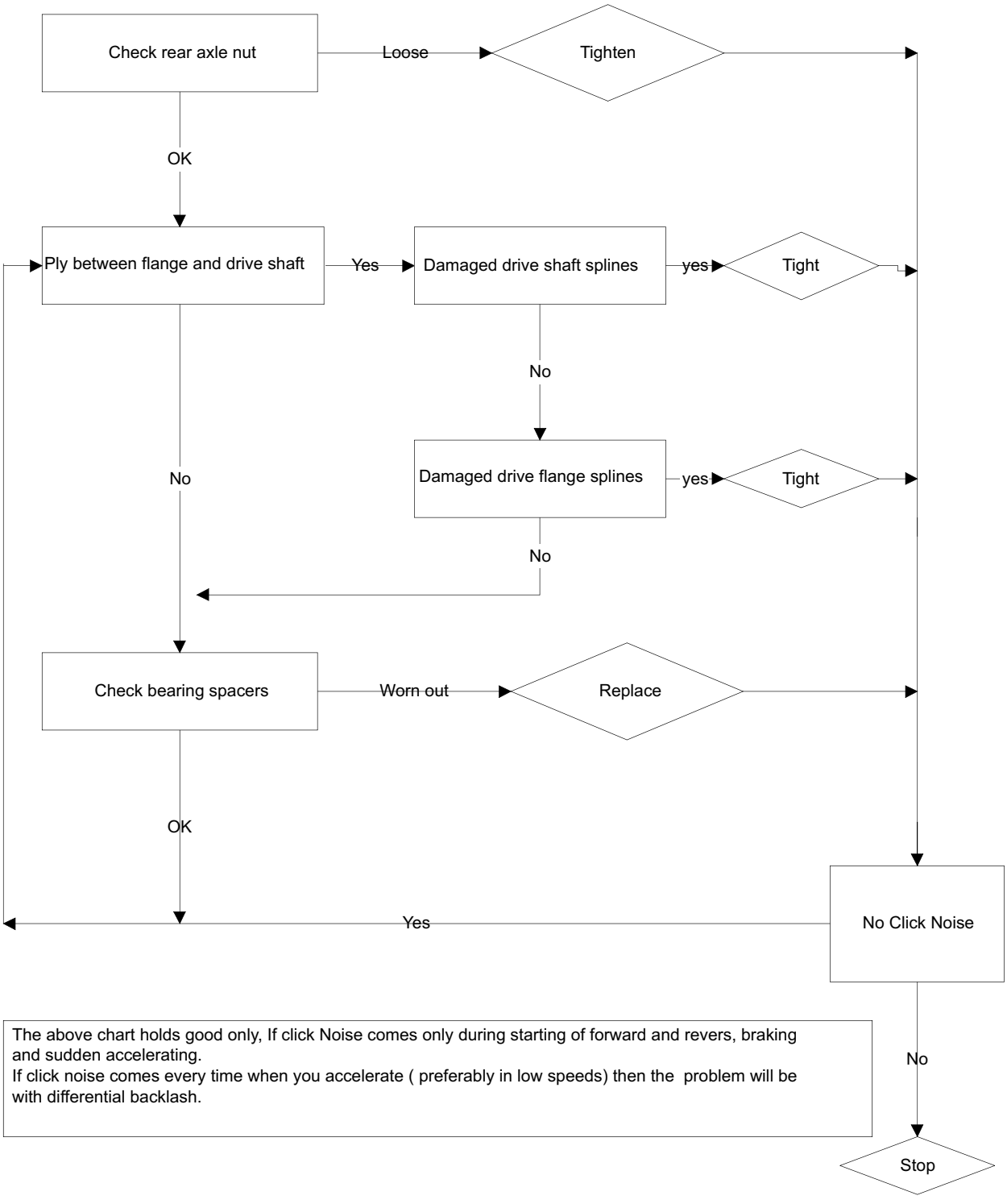
* Disconnect CN12, remove bulb and check between pin 5 and body from both sides of connector
** From bulb holder ot F7
*** Open connector CN 24, check between pin 7 and ground

Oil leakage from transmission

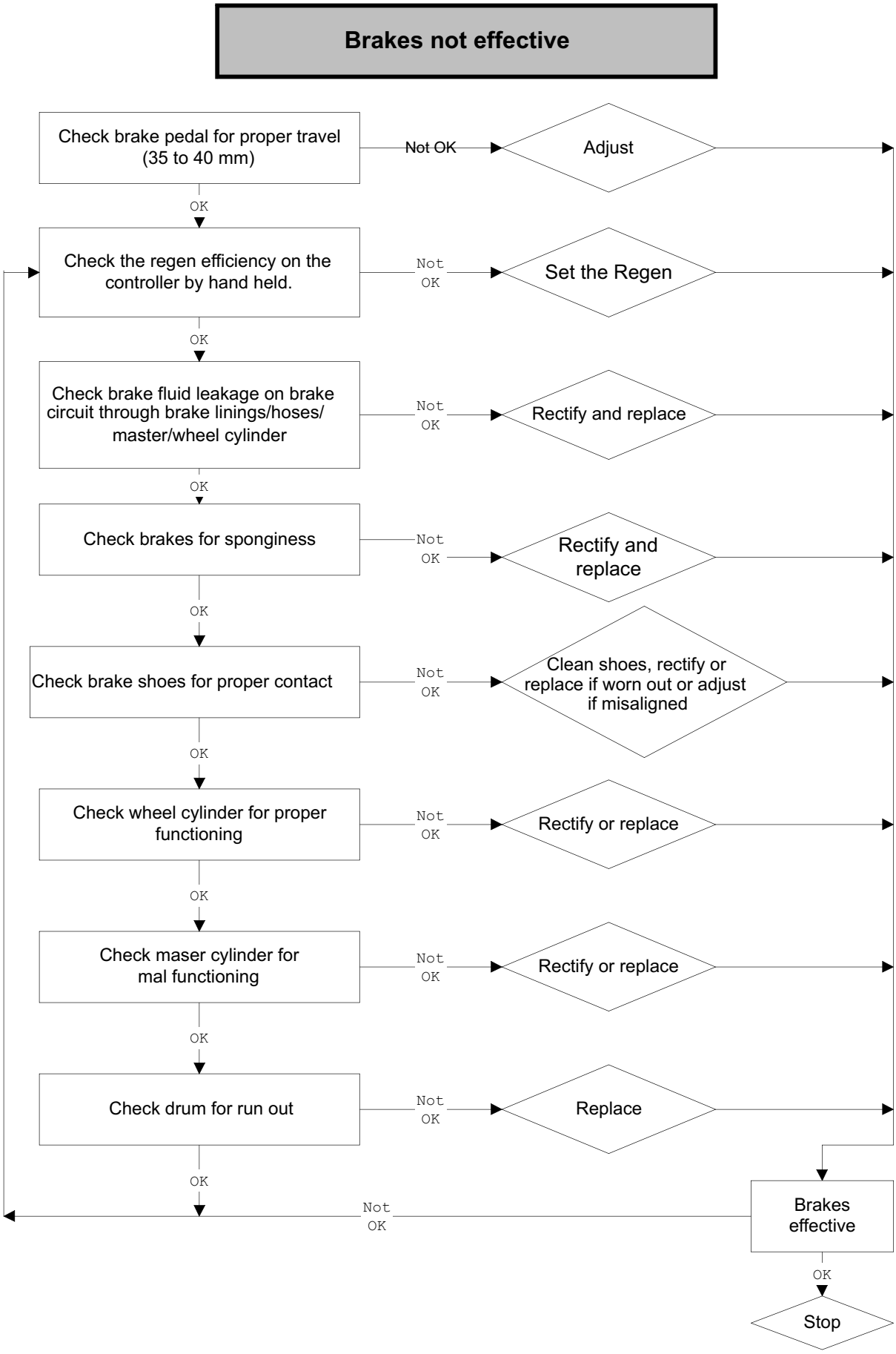



Front Wheel Wobbling
Check tyre pressure
Low / high
Inflate / Deflate
OK
Check for rim damage/alignment
Not OK
Wheel alignment
OK
Check steering arm mounting bolts
Loose / Broken
Tight / Replace
OK
Check strut mounting bush
Not OK
Replace
OK
Check front strut
Not OK
Replace
OK
Check upright mounting bolts
Broken / Loose
Tight / Replace
OK
Check Front wheel axial play
Yes
Check Ball Joint
No
Check Brake drum bearing
No
Check Brake drum bore
Yes
Replace
Yes
Replace
yes
Replace
OK
Wheel not wobbling
Not OK
Stop

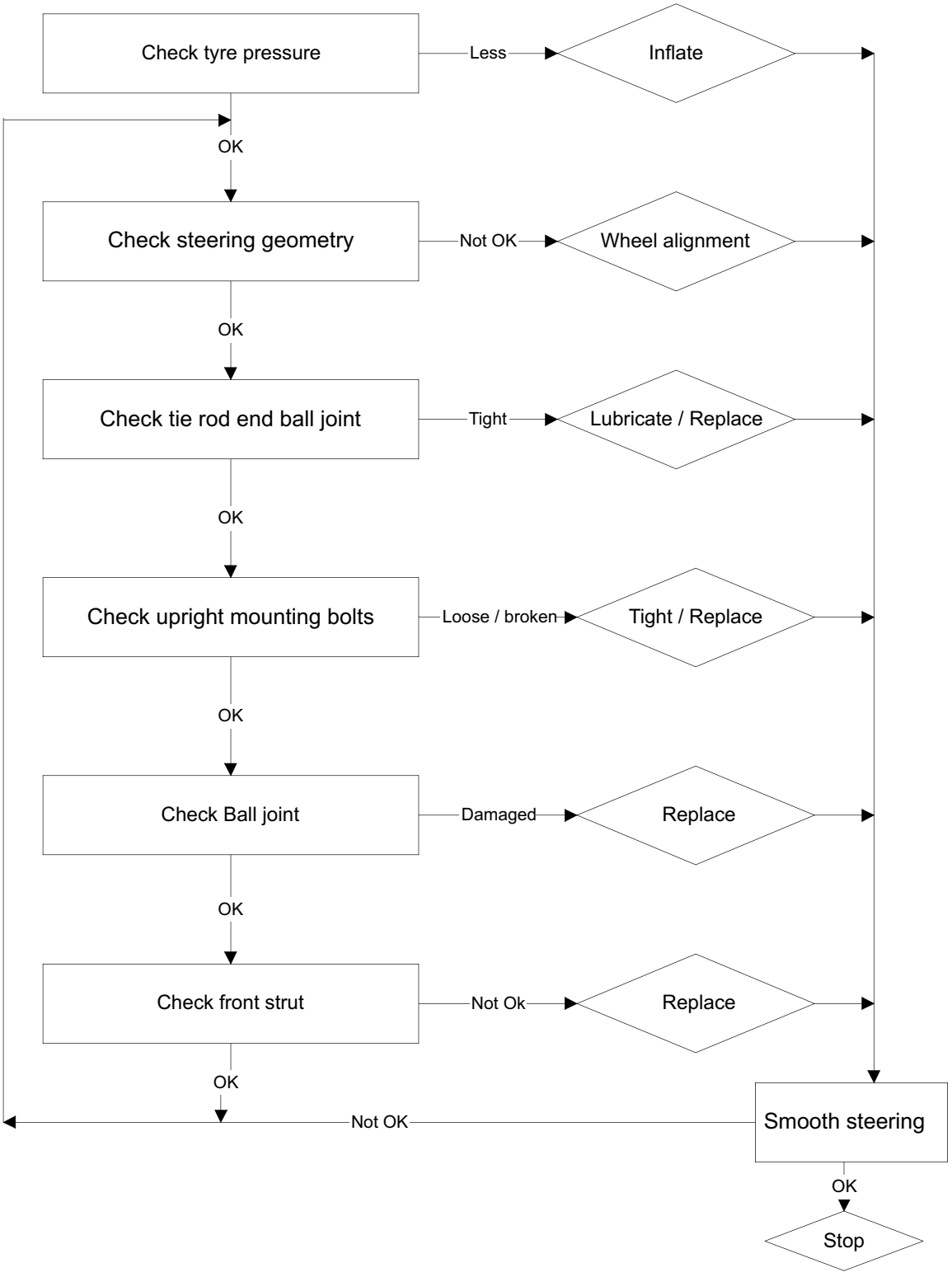
Noise from rear axle

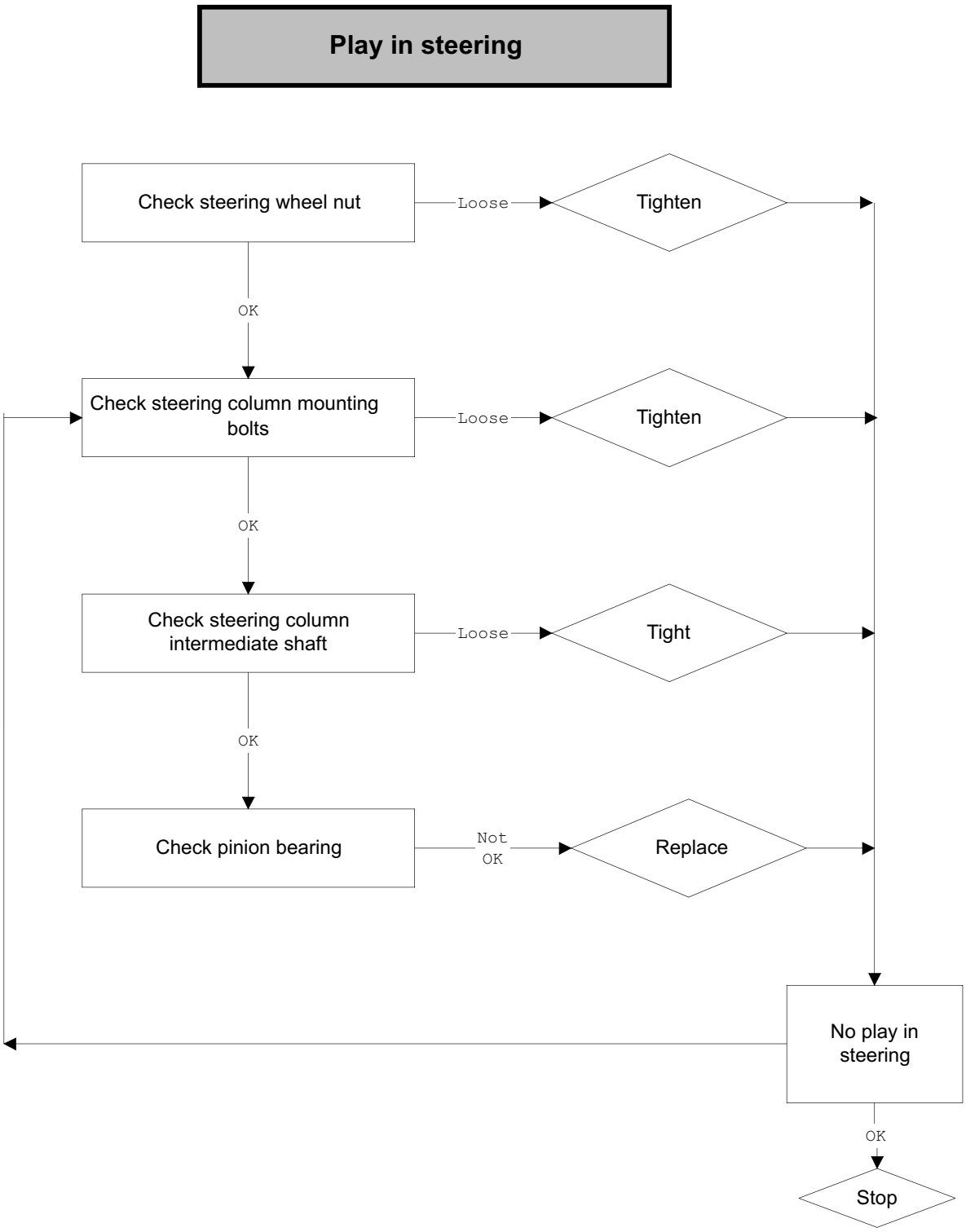


The above chart holds good only, If click Noise comes only during starting of forward and revers, braking and sudden accelerating.
If click noise comes every time when you accelerate (preferably in low speeds) then the problem will be with differential backlash.

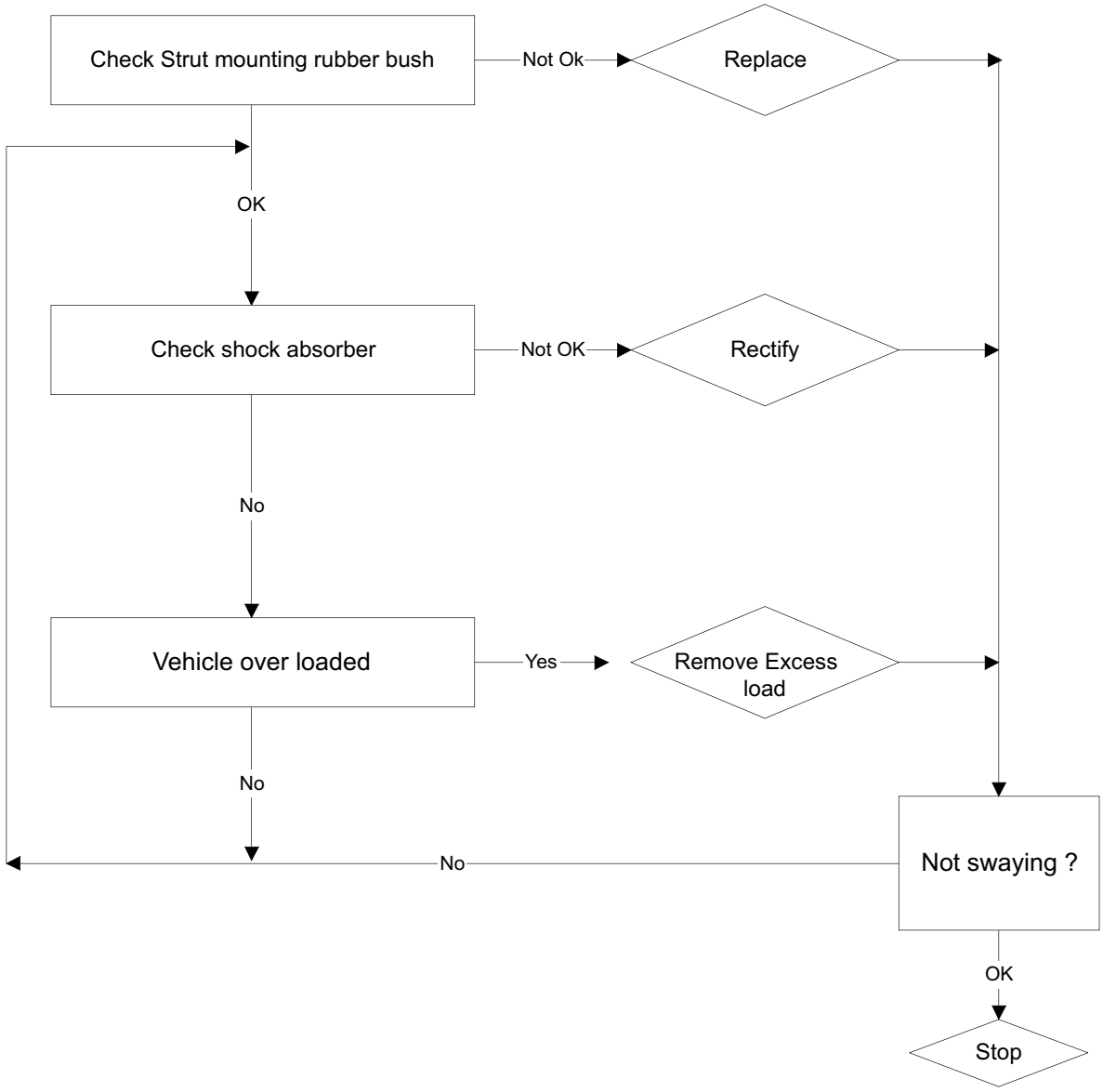

Brakes not effective
Check brake pedal for proper travel (35 to 40 mm)
Not OK
Adjust
OK
Check the regen efficiency on the controller by hand held.
Not OK
Set the Regen
OK
Check brake fluid leakage on brake circuit through brake linings/hoses/ master/wheel cylinder
Not OK
Rectify and replace
OK
Check brakes for sponginess
Not OK
Rectify and replace
OK
Check brake shoes for proper contact
Not OK
Clean shoes, rectify or replace if worn out or adjust if misaligned
OK
Check wheel cylinder for proper functioning
Not OK
Rectify or replace
OK
Check maser cylinder for mal functioning
Not OK
Rectify or replace
OK
Check drum for run out
Not OK
Replace
OK
Not OK
Brakes effective
OK
Stop

Hard steering

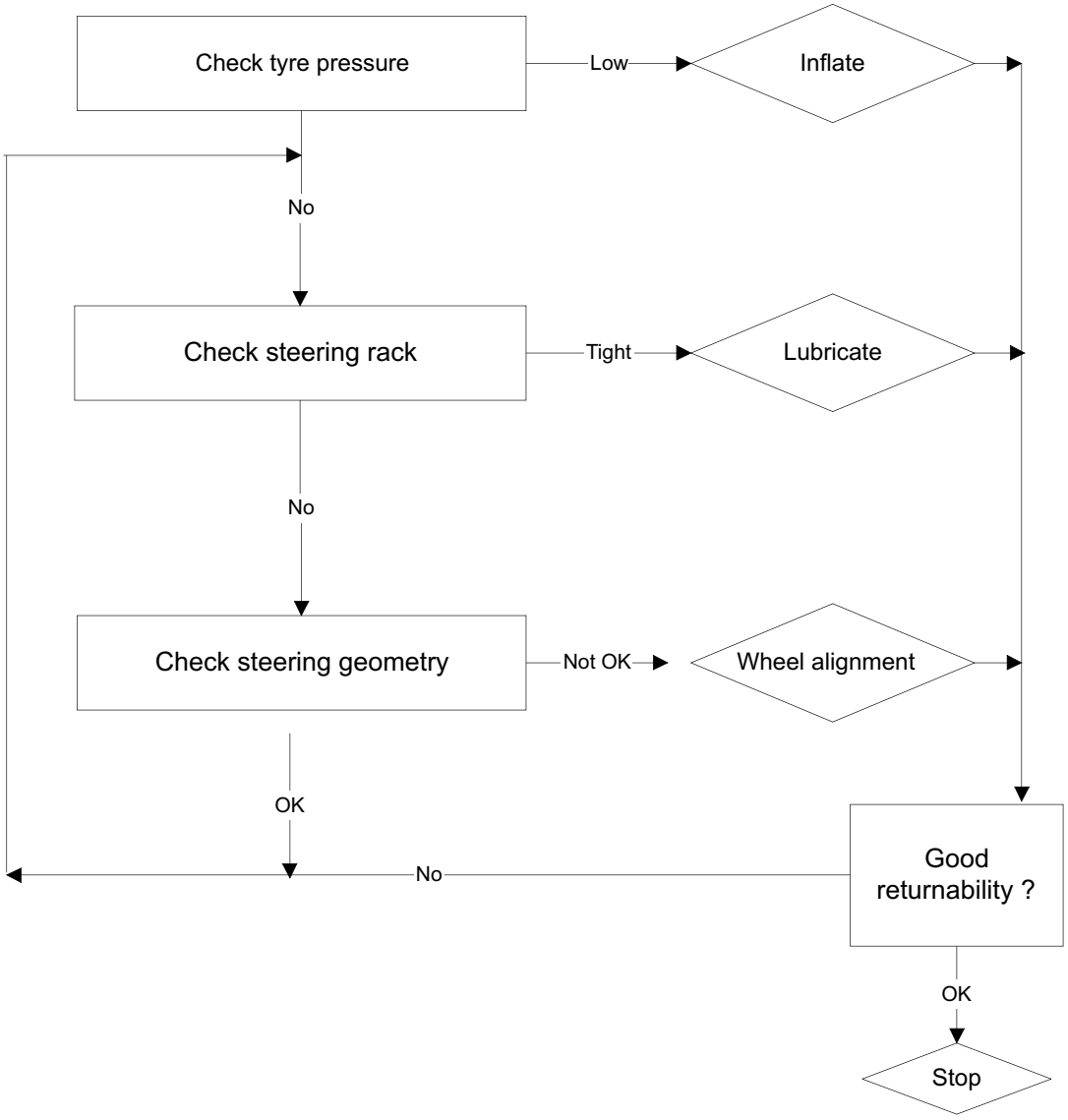



Play in steering
Check steering wheel nut
Loose
Tighten
OK
Check steering column mounting bolts
Loose
Tighten
OK
Check steering column intermediate shaft
Loose
Tight
OK
Check pinion bearing
Not OK
Replace
No play in steering
OK
Stop

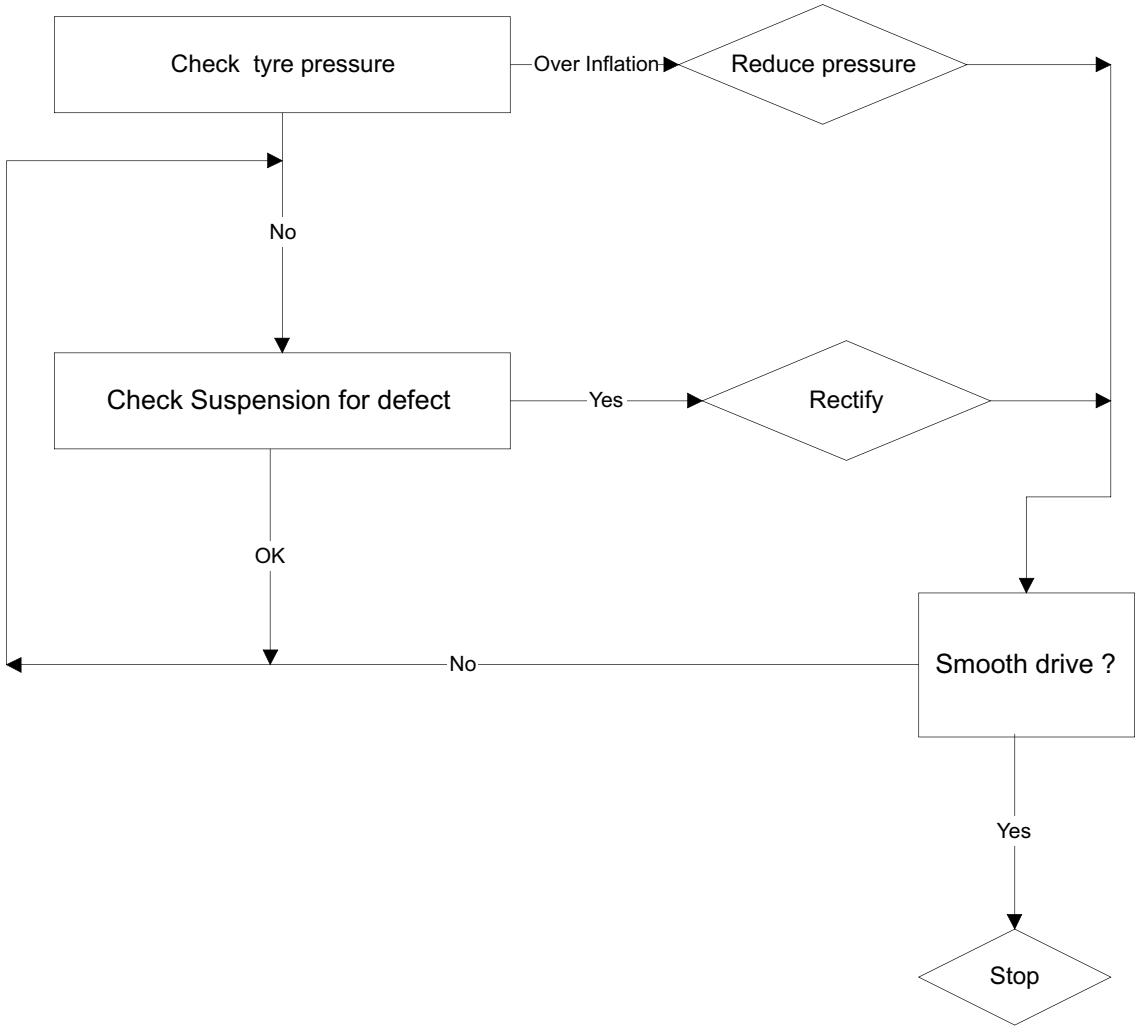
Body sways on corners



Poor Returnability



Hard / Rough Drive



MECHANICALS

transmission 03.0

GENERAL DESCRIPTION

The transmission is a two stage single reduction gear box with helical gears and a gear ratio of 9.4 :1. The differential unit is an integral part of the transmission.

There are two reduction stages from input speed.

There are three sections inside the transmission are,

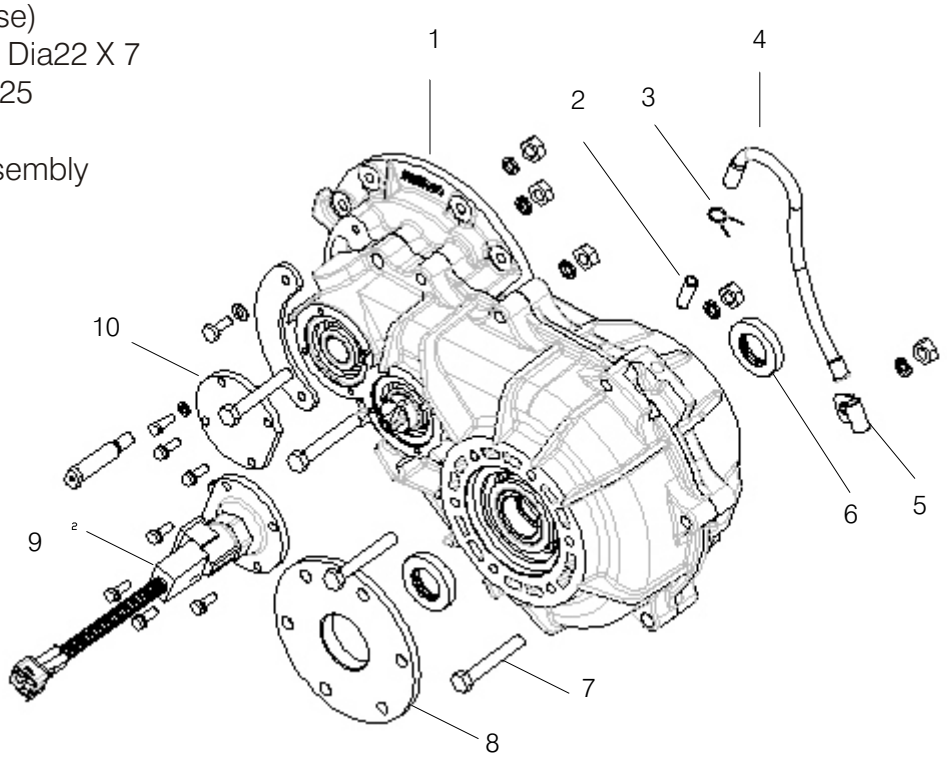
1. Input Shaft
2. Intermediate Gear
3. Final/ differential Drive

The top portion of the transmission, input shaft is coupled to motor shaft and the bottom portion of the transmission final drive gear is coupled to the rear wheels through intermediary drive shaft.

TRANSMISSION - OPERATION

The motor shaft rotates the input shaft of transmission, which intern rotates the intermediate and final drive gear. Finally the motion is transmitted to wheels through axle shafts. The forward and reverse operation is selected through the RNFB switch and by the polarity change to motor. The forward speed is limited to 65Km/hr of the vehicle and reverse speed is limited to 20km/hr through motor controller.

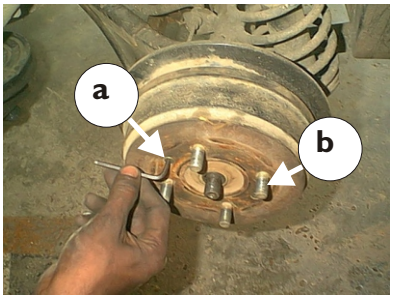
1.Transmission Assembly
2.Union (Breather hose)
3.Clip(Breather hose)
4.Breather hose
5.Plug(Breather hose)
6.Oil seal - Dia40 X Dia22 X 7
7.Bolt, Hex M8 X 1.25
8.Spacer plate
9.Speedo drive Assembly
10.Input cover



TRANSMISSION - REMOVAL FROM VEHICLE

- Remove battery positive (+ve).
- *Follow **Standard Workshop Procedure - I** (Pg. 13 / Sec. 1.0)*
- Jack up the vehicle on hoist or Axle stand
- Remove LH & RH rear wheels.
- *Follow **Standard Workshop Procedure - II** (Pg. 14 / Sec. 1.0)*

- Remove the 2 allen screws (**a**) and the axle nuts (**b**) from both LH & RH wheel drums.



- Now remove both LH & RH wheel drums using drum puller (Sp. tool No. 0100-3003)

- Using drive flange puller (Sp. tool No. TABDZ009) take out the drive flange.

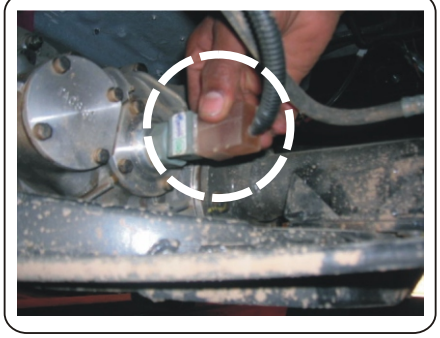
- Remove the bearing circlip using circlip plier.

- Remove the LH & RH axle shafts with the help of the puller (Sp. tool No. TABAA013)

- Position the rear trailing arm on the safety stand.

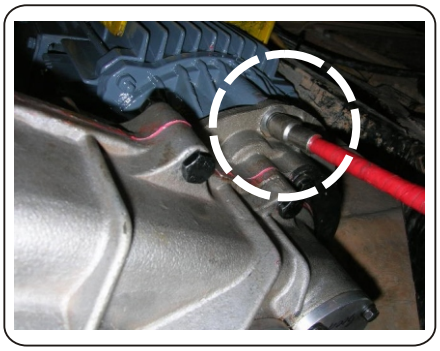
- Open the drain plug on the transmission with the help of 6mm allen key.
- Drain the transmission oil and measure it.

- Disconnect the Speedo Meter connector.

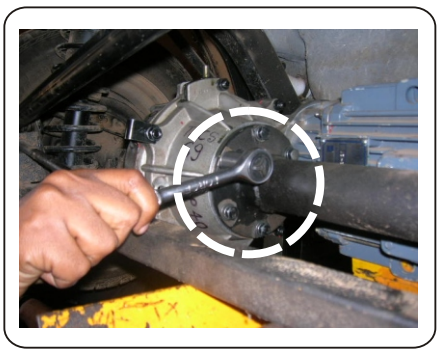


- Loosen and unscrew the Speedo meter drive assembly from transmission assembly.

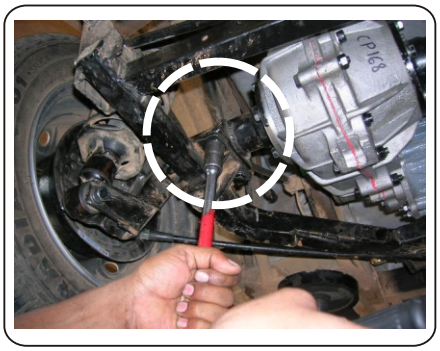
- Loosen and remove the motor mounting nuts (M6 X 6 Nos).



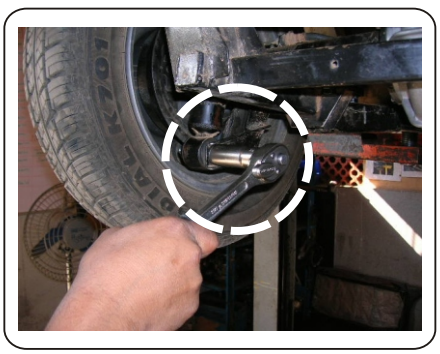
- Remove the transmission housing nuts (M8 X 6 Nos. LH X 6 Nos. RH) from the axle housing weldment.



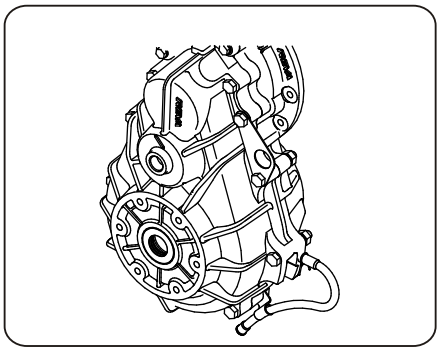
- Remove the trailing arm mounting bolts (M10 X 4 Nos. LH X 4 Nos. RH) from the axle housing weldment.



- Support the transmission by hand and remove the lower mounting bolts of both LH & RH shock absorbers.



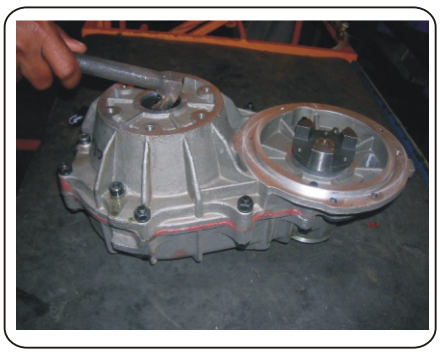
- Support transmission and slide out both the side axle weldments.



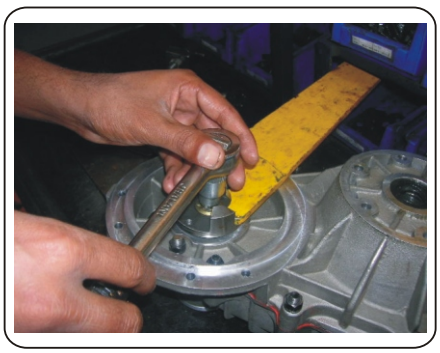
TRANSMISSION - DISMANTLING & INSPECTION

- Remove the speedo drive from the LH casing of the transmission.
- Check for any damage to -
  1. I/P shaft oil seal
  2. Final drive O/P shaft oil seals (both LH & RH)

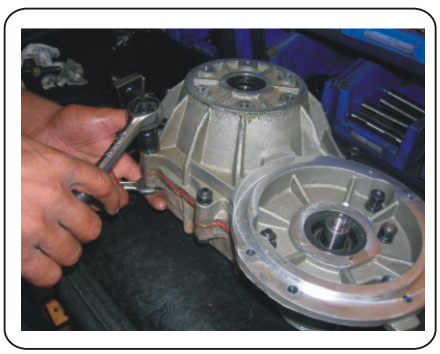
  If found damaged, replace with only the double lip recommended



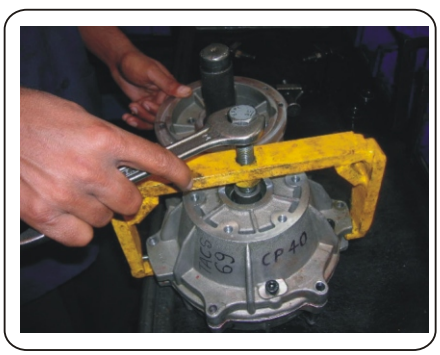
- Remove the LH and RH casing oil seals with the help of the oil seal puller (Sp. tool No. 0100-7010)



- Loosen and remove the Flexi coupling Hub with the help of hub removing Fixture(FJAZZ121)

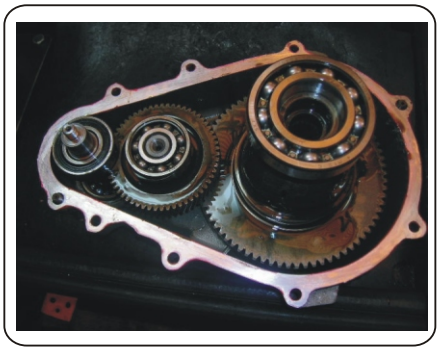


- Remove the casing mounting bolts (M8 X 9 Nos.)



- Separate the RH casing from the LH casing with the help of a pair of pullers (Sp. tool Nos. 0100-3001)

- Check for any visual damage or metal particles inside the housing.
- Inspect the transmission casings for any damage (cracks, etc.)



- Now remove -
    1. Input shaft flexible coupling (19 teeth)
    2. Intermediate shaft (24 and 58 teeth)
    3. Differential housing (74 teeth)

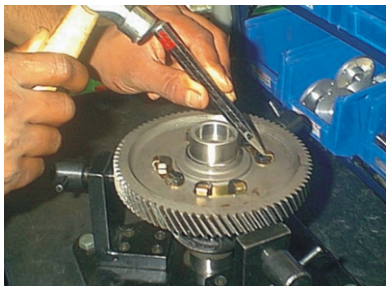
  one by one in this order, by holding each shaft and hammering the LH casing with a mallet.
- Inspect for gear teeth damage and for play in the bearings of all the gears.
- Check spline wear on input shaft.

- Remove the 6208 bearing from the differential housing with the help of a 3 jaw puller(Sp. tool No. 0100-7002)

CHECKING BACKLASH

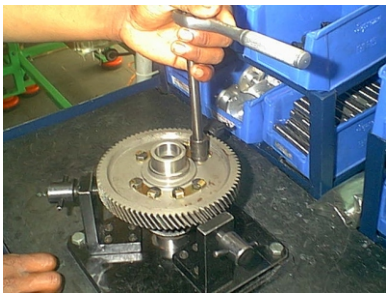
- Keep the differential housing on the surface plate.
- With the help of height dial gauge check the backlash of LH & RH bevel gears. (The backlash should be less than 0.25mm)
- If it is less than 0.05 mm or more than 0.25 mm then the shimming procedure to be carried out.

Sl. No.	Spacer No.	Play Min	Play Max
1	17.6	0.05	0.25
2	17.7		
3	17.8	0.05	0.25
4	17.9		
5	18.0	0.05	0.25



SHIMMING PROCEDURE FOR DIFFERENTIAL PLAY

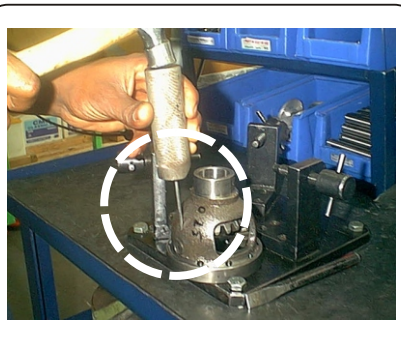
- Place the transmission differential housing on the holding fixture (Sp. Tool No. 0100-7003)
- Unlock the tab washers/locking plates (4 Nos.) of the differential housing gear with a screwdriver or chisel.



- Remove the bolts (M8 X 8 Nos.) from the differential housing gear along with the tab washers.

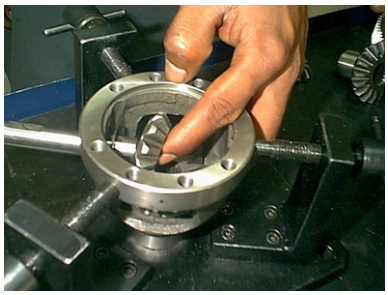
- Remove the final drive (74 teeth) gear from the housing.
- Check for any gear damage. Replace if found damaged.

- Remove the bevel gear from 74 teeth gear side (LH casing side) and mark it with a permanent marker so that LH & RH are not mixed up during assembly.
- Check for any gear damage. Replace if found damaged.

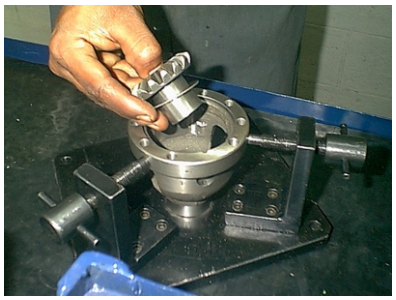


- Remove the lock pin of the bevel pinion gear shaft with the help of pin remover (Sp. tool No. 0100-6007)
- Mark the bevel pinion gear shaft end and the respective side of the housing from which it is removed, with a permanent marker while it is still in the housing.

- Slide the bevel pinion gear shaft out of the housing and remove the bevel pinion gears (LH & RH) and mark them along with their respective shims.
- Check for any gear damage. Replace if found damaged.



- Now remove the RH casing side bevel gear from the housing .
- Check for any gear damage. Replace if found damaged.
- Shims to be added on both the sides as per the requirement of the Backlash.

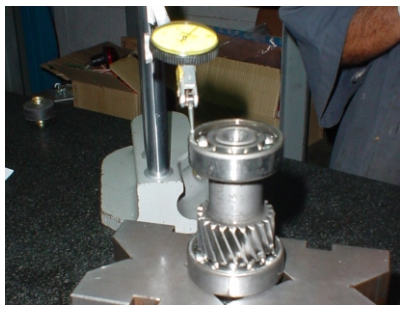


NOTE

When adding new shims use only recommended shims.

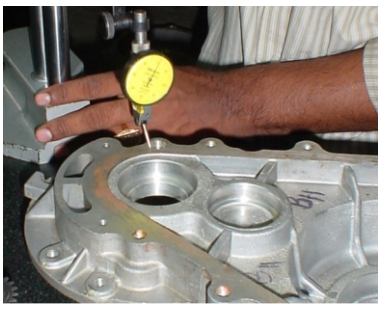
SHIMMING PROCEDURE FOR AXIAL PLAY

- Measure the height of the input-gear, intermediate -gear and the output -gear.
- Add all the gear heights to get Total Gear Height.

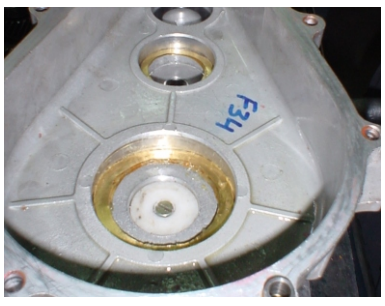


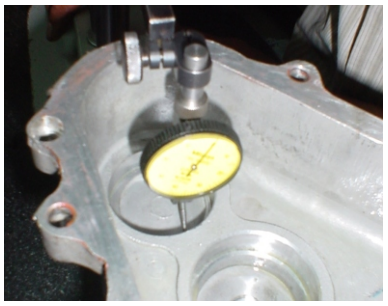
- Measure the central distance of the casing both LH and RH
- Add the casing heights to get the Total Casing height.

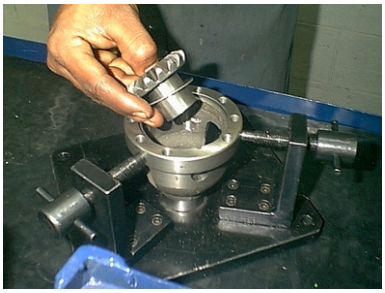
- Find the difference between total casing height and total gear height.



- Add appropriate shim corresponding to the calculated difference so that play is between 0.1 mm and 0.2 mm



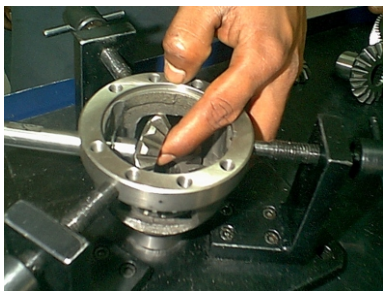




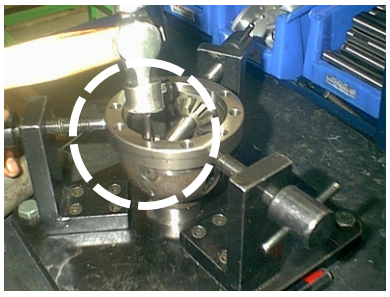
TRANSMISSION - ASSEMBLY

DIFFERENTIAL HOUSING ASSEMBLY

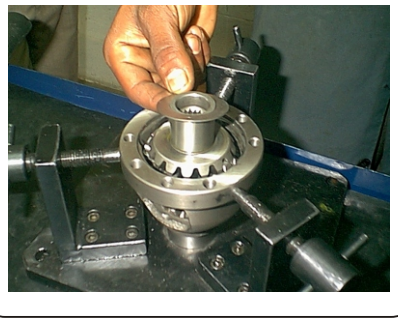
- Fix the RH casing side bevel gear along with the shims to the RH side of differential housing.



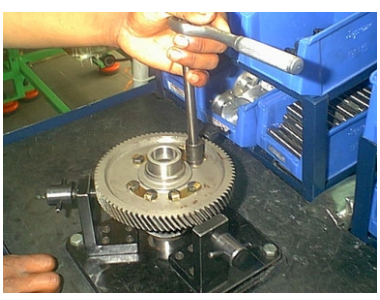
- Fix the bevel pinion gears along with the shims in the same marked position by sliding the shaft into the housing.



- Lock the bevel pinion gear shaft by inserting the lock pin by slightly hammering it in.



- Now, fix the LH casing side bevel gear along with the shims to the LH side of differential housing.



- Fix the differential final drive gear (74 teeth) on the housing with the M8 bolts and tab washers and torque to 20 Nm.

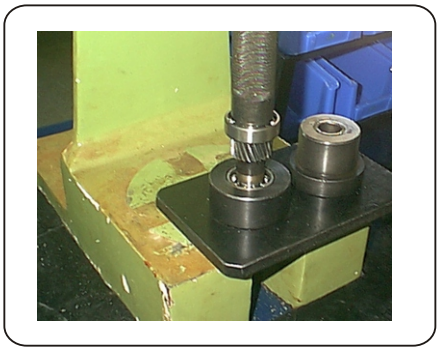
- Check the backlash with the help of the height dial gauge.
- If found within the limit, lock the tab washers with the help of a screwdriver or chisel.

NOTE

Backlash Limits

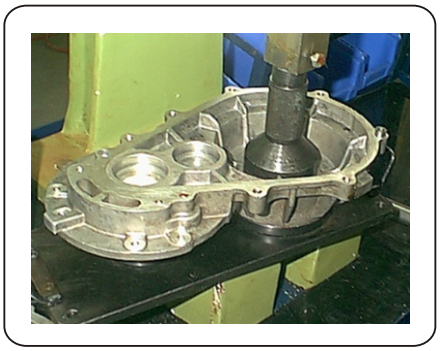
Std Limit:	0.25mm
Wear Limit:	0.3mm

- Now, clean all the gears and the housing with a cleaning agent (diesel, etc.)
- Press the bearings 6204 & 6205 (if they have been removed and replaced if found damaged) to the input shaft using drift (Sp. tool No.0100-7006) and harbor press keeping the casing in the holding fixture (Sp.



- Assemble the intermediate gear (only in case it had been dismantled) using drift and press, holding it on the intermediate fixture (Sp. Tool No.0100-7009)

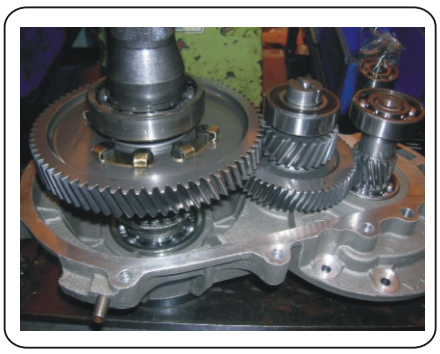
- Press both the 6208 bearings to the Differential housing using drift and press keeping the housing on the holding fixtures (Sp. tool No.0100-7010 and 0100-7011) respectively.

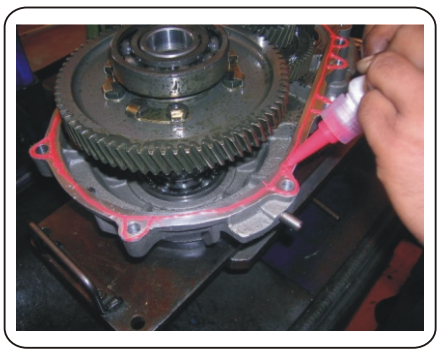


- Keeping on RH casing fixture press the Input shaft to the RH casing.
- Take care not to damage the gear surface or teeth while pressing.

- Press the intermediate gear assembly to the RH casing by matching the teeth to the input drive gear.
- Take care not to damage the gear surface or teeth while pressing.

- Finally, press the Differential housing/final drive to the RH casing by matching the teeth to the intermediate gear.
- Take care not to damage the gear surface or teeth while pressing.
- Rotate the gears manually and check for any abnormal noise.

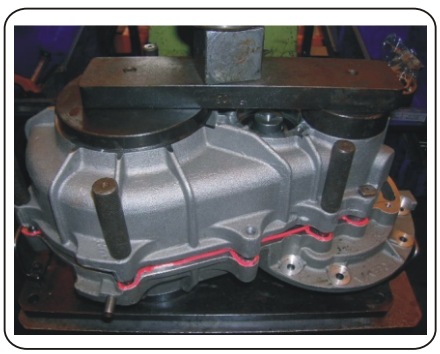




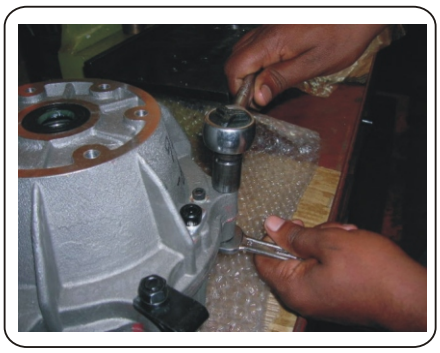
- Apply sealant LOCTITE 510 on the RH casing's matching surface.

NOTE

Clean the LH & RH casing matching surfaces with (CTC) Carbon Tetra Chloride before applying the sealant (LOCTITE 510) on the RH casing.

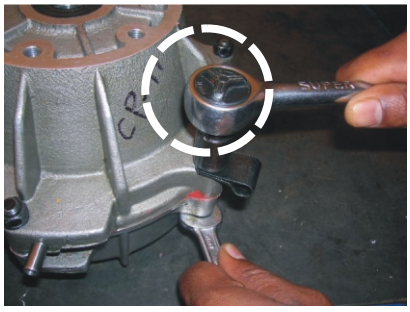


- Press the LH casing to the RH casing with the help of press using aligning bolts for correct positioning, continuously rotating the input shaft till the mating systems are in contact.

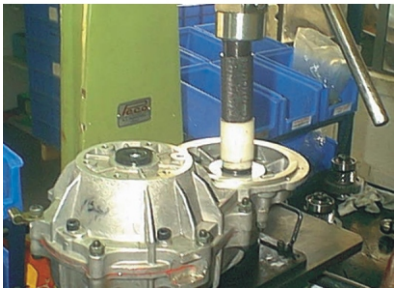


- Start fixing the transmission mounting bolts (M8 X 9 Nos.) in the diagonally opposite sequence.

- Attach the Breather Hose Clamp with its respective bolt.
- Tighten all bolts to their specified torque.

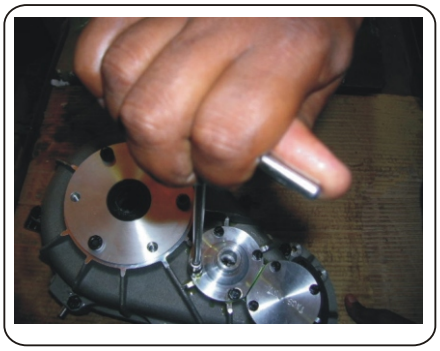


- Apply Servo Gem RR3 grease to the input shaft.
- Insert the oil seal on to the input shaft using drift (Sp. tool No. 0100-7007) by slight hammering.

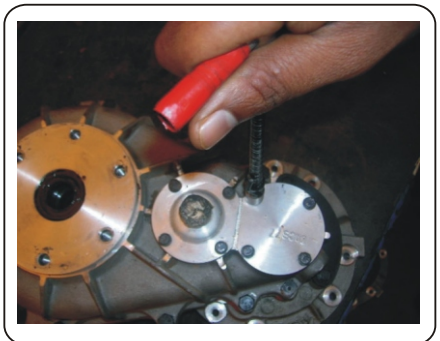


- Insert the oil seal on both the RH & LH casing of drive (output) gear using drift (Sp. tool No. 0100-7007) by slight hammering or using press.
- Rotate the input shaft manually to check for its free movement.

• Fix the Speedo meter intermediate cover and tighten the bolts.(M6 X 4 Nos).

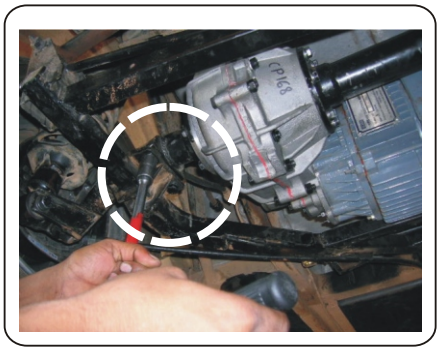


- Fix the Input cover and tighten the bolts.(M6 X 4 Nos)

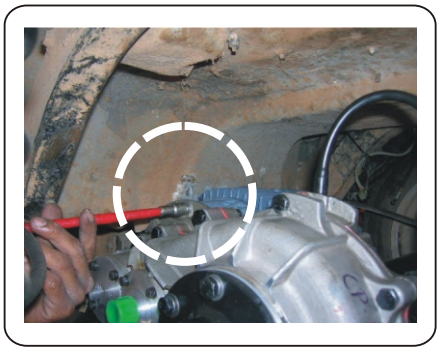


TRANSMISSION - ASSEMBLY TO VEHICLE

- Slide the transmission aligning with Motor coupling hub and supporting it, fix both the side axle weldment's to the transmission flange by tightening the bolts (M8 X 6 LH X 6 RH) .

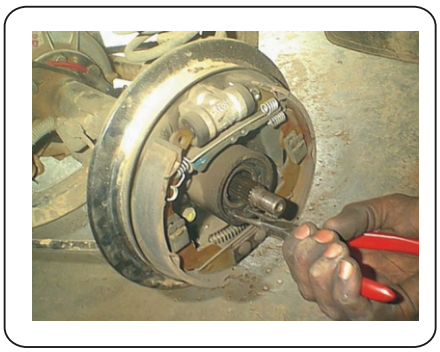


- Align the axle weldment to the trailing arm and fix the mounting bolts (M10 X 4 LH X 4 RH) to the trailing arm.



- Fix the motor mounting nuts (M6 X 6 Nos.) to the transmission.
- Now, tighten all the nuts and torque them.

- Fix the LH & RH axle drive shaft along with the spacers and bearings.



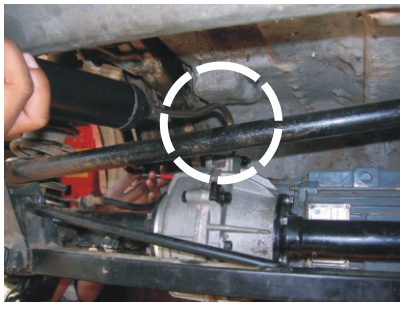
- Put the circlips to the LH & RH drive shaft bearing housing.

- Fix the LH & RH drive flanges by slightly hammering with the drift.

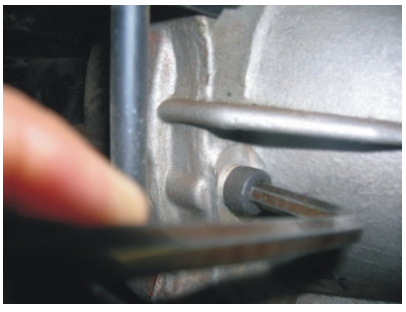
- Fix the LH & RH wheel drums and tighten with allen screws.

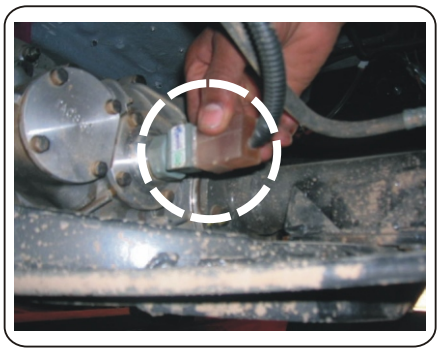
- Fix the LH & RH axle nuts and tighten t0 specified torque.

- Fill (SAE 90 grade) oil in the transmission upto the level/filling plug (approx. 500 ml.) using oil gun (Spl. tool No TABDZ002).

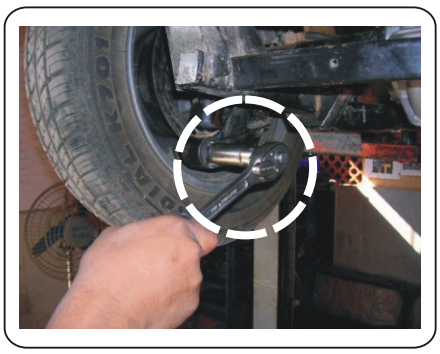


- Tighten the filler plug with the help of 6mm allen key.





- Fix the speedo drive to the transmission and connect the connector in harness.

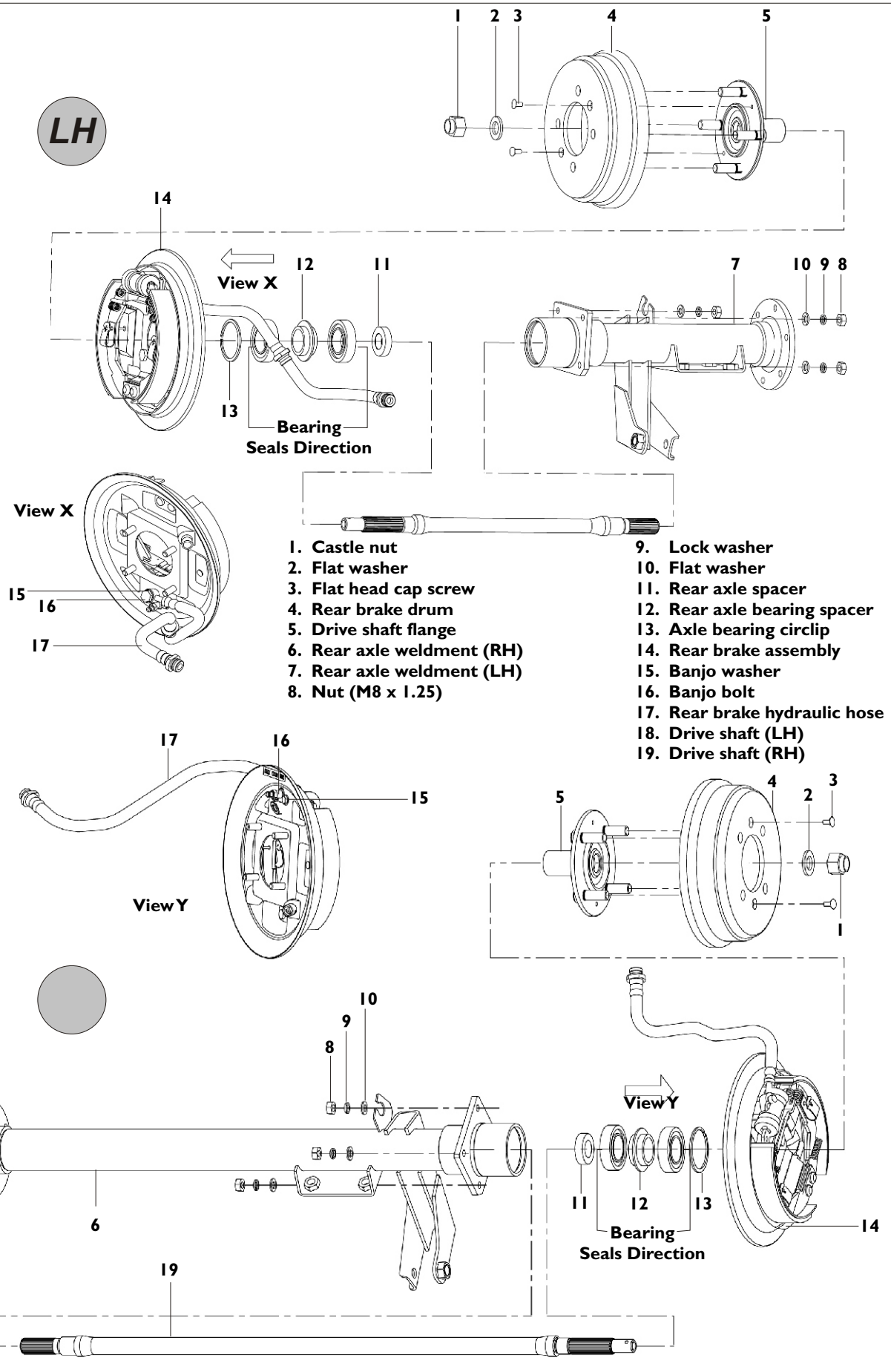


- Fix both shock absorber lower mounting bolts.
- Cross-check all the fasteners for proper torque.
- Fix both the rear wheels and torque its bolts to 70 Nm.
- Connect the battery *positive* (+ve). *(Refer Sec. 1.0, Pg. 15)*
- Before removing vehicle from the hoist or jack run it once to check for proper functioning.

TORQUE SPECIFICATION

DIFFERENTIAL GEAR ASSEMBLY	M8 X 1.25 X 35	20NM
CASING OUTER BOLT	M8 X 1.25 X 5.5	18 NM
MOTOR MOUNTING	M6 X 1.0 X 25	12NM
AXLE HOUSING	M8 X 1.25 X 25	25NM

rear axle assembly 04.0


LH
1
2
3
4
5
14
View X
12
11
7
10
9
8
13
Bearing
Seals Direction
View X
15
16
17
1. Castle nut
2. Flat washer
3. Flat head cap screw
4. Rear brake drum
5. Drive shaft flange
6. Rear axle weldment (RH)
7. Rear axle weldment (LH)
8. Nut (M8 x 1.25)
9. Lock washer
10. Flat washer
11. Rear axle spacer
12. Rear axle bearing spacer
13. Axle bearing circlip
14. Rear brake assembly
15. Banjo washer
16. Banjo bolt
17. Rear brake hydraulic hose
18. Drive shaft (LH)
19. Drive shaft (RH)
17
16
15
View Y
5
4
2
3
1
10
9
8
View Y
6
11
12
13
14
Bearing
Seals Direction
19

REAR AXLE WELDMENT

REAR AXLE HOUSING - REMOVAL

- Remove the rear axle housing.
  (*Refer* ***Transmission*** *- Pg. 57 / Sec. 3.0*)
- After removing the bolts connecting the transmission to the rear axle weldment, slide out the axle weldment from the transmission.

REAR AXLE HOUSING - INSPECTION

- Clean the housing thoroughly.
- See for any cracks in the welding of strut mounting .
- Replace the axle housing if found damaged.
- Clean the shaft thoroughly.
- Check for any damages in and splines.
- Replace the shaft if found damage.

NOTE

If any damage in axle housing & shaft is found, don't repair or rework. Replace the entire assembly.

REAR AXLE HOUSING - ASSEMBLY

- Fix the rear axle housing to the transmission by using bolts.
- Fix the trailing arm mounting & axle housing mounting bolts.
- Fix the axle shaft , spacer and bearing & circlip.
- Fix the axle flange and tighten the centre nut.
- Check for the free rotation of flange.

NOTE

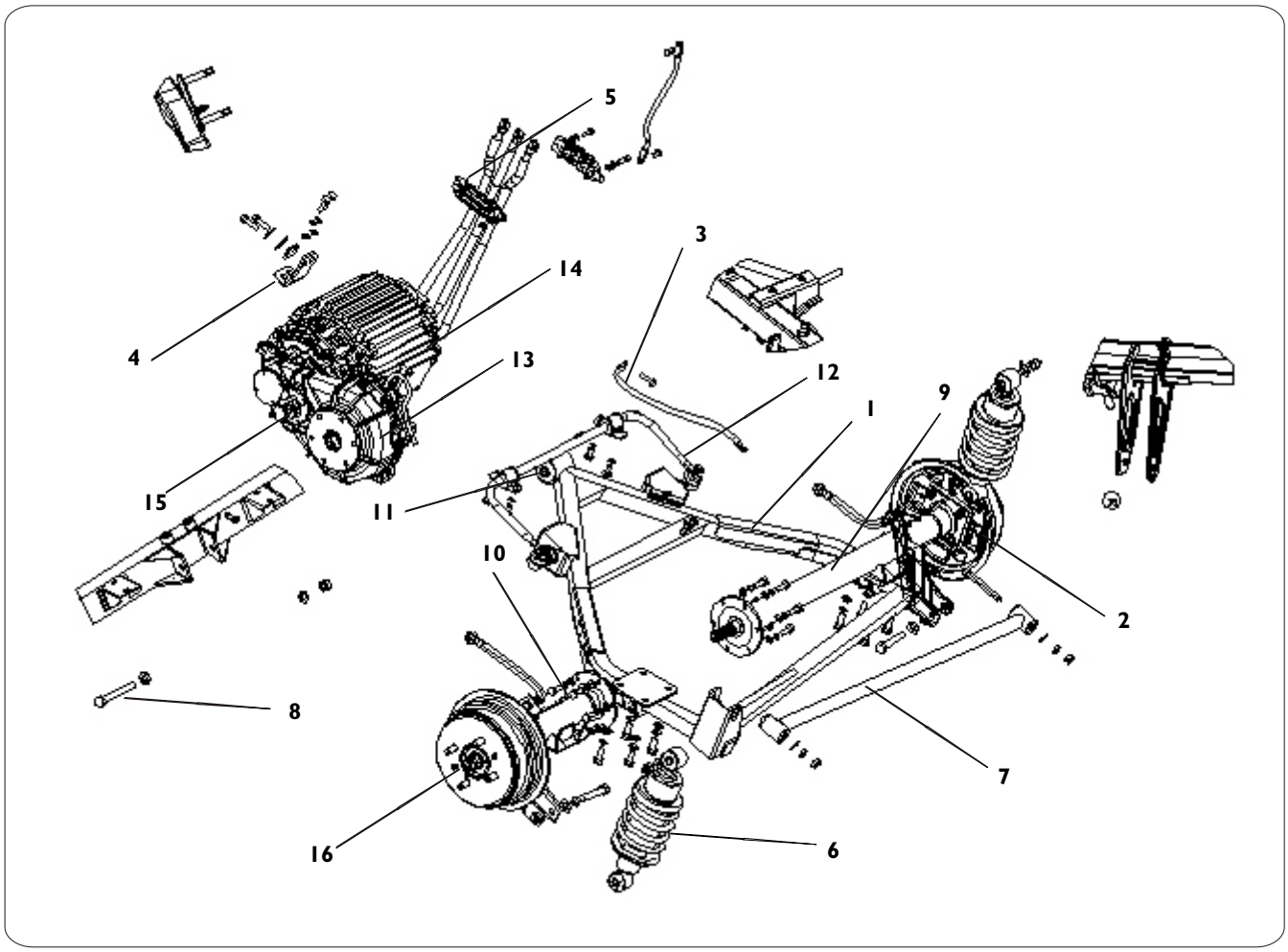
Smear the axle splines with grease (Servo Gem RR3) before assembly.

Pack bearings with grease (Servo Gem RR3) (lithium based).

Bearing seals should face towards the outer side as shown.

Sl. No.	Spacer No.	Play
1	17.6	0.05 0.25
2	17.7	
3	17.8	0.05 0.25
4	17.9	
5	18.0	0.05 0.25

TRAILING ARM



1. Trailing arm
2. Brake back plate assembly
3. Ground cable
4. Motor mounting bracket
5. Strain relief -motor cables
6. Rear Shock Absorber
7. Pan hard rod
8. Trailing arm mounting bolt
9. Rear axle housing (RH)
10. Rear axle housing (LH)
11. Centre arm bush
12. Anti roll bar
13. Transmission
14. Motor
15. Speedo drive
16. Castle nut

TRAILING ARM - REMOVAL

- Jack up the vehicle on hoist or axle stands.
- Support the rear axle by axle stands.

- Remove the trailing arm mounting bolts (Size M10X1.25X25 Part No 015-01-25) (4 Nos. LH + 4 Nos. RH) from the rear axle weldment.
- Remove the pan-hard rod mounting bolt (Size M10X1.5X80 Part No 015-01-80) connected to the trailing arm.
- Remove the motor mounting bracket.
- Support the transmission by placing a safety stand under it.

NOTE

Make sure that transmission is supported, otherwise it may tilt and get damaged.

- Finally, remove the centre arm bush bolt and slide down the trailing arm.

TRAILING ARM - INSPECTION

- Remove the centre arm bush with the help of harbor press. Check for any damage and wear-tear in the bush. Replace if necessary.
- Check for any damage and dents in the trailing arm. Replace if necessary.
- Check for damage in pan hard rod mounting & its rubber bush. Replace the pan hard rod & bush if necessary.

TRAILING ARM - ASSEMBLY

- Apply soap solution to the rubber bush.
- Fit the new centre arm rubber bush (in case it is to be replaced) to trailing arm by using harbor press.

NOTE

Care to be taken while pressing the bush to trailing arm. Do not use any petroleum lubricant as it would damage the rubber bush.

- Fit the trailing arm centre arm bush to the chassis.
- Tighten the centre arm bush bolt to specified torque.
- Fit the LH & RH trailing arm mounting to respective axle housing weldment.
- Fit the pan hard rod and tighten bolt to specified torque.

TORQUE SPECIFICATIONS

Pan hard rod	M10 x 1.5 x 80	50 -55 Nm
Trailing arm bolt	M12 x 1.75 x 100	90-100Nm
Trailing arm to axle hsg. mtg .	M10 x 1.5 x 25	160 Nm
Nuts	M8 x 1.25	16 Nm
Banjo bolt	M10 x 1.0	35 Nm
Nylock nut	M16 x 1.5	100 Nm

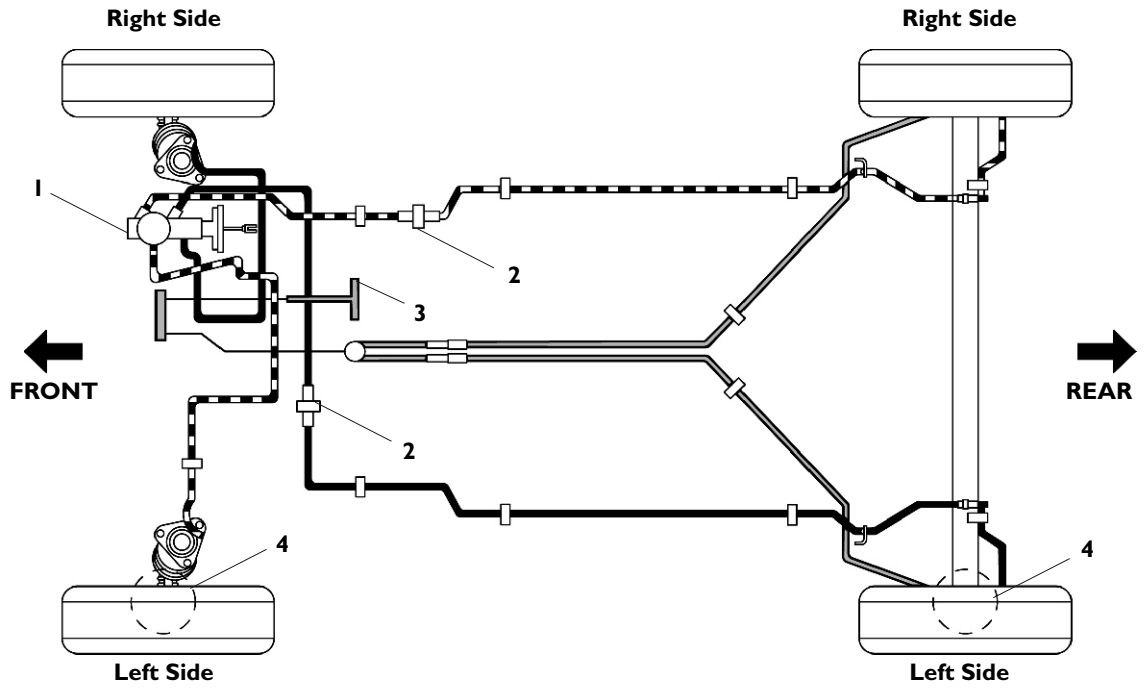
brakes 05.0

GENERAL DESCRIPTION

The system is operated by hydraulic pressure from the master cylinder, when the brake pedal is depressed.

It is a tandem master cylinder, which is connected to four brake pipes of two independent circuits which is connected to the front right and rear left and the other: front left to rear right. It includes a proportioning valve in between the master cylinder and rear brake lines, where front is disc brakes and rear wheels are drum brake type.

The parking brake is of mechanical type. It consists of a cable and mechanical linkage system, which is connected to the rear brake shoes, commonly used for both foot and parking brakes.

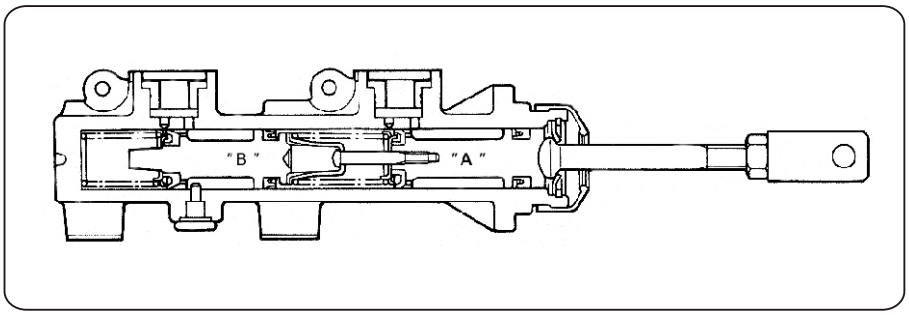


1. **Master cylinder**
2. **Proportioning valve**
3. **Parking brake lever**
4. **Drum brake**

MASTER CYLINDER

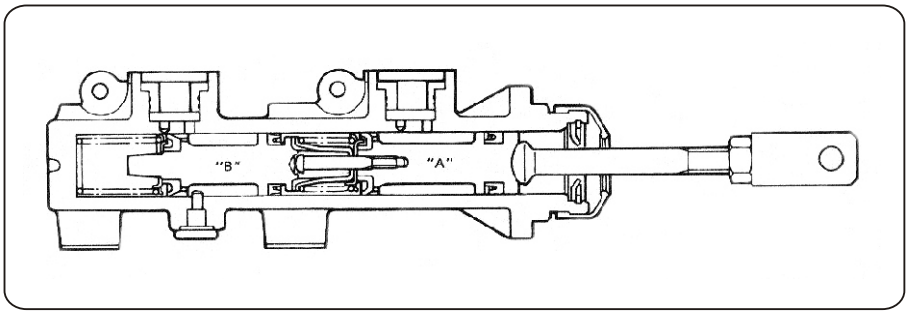
GENERAL DESCRIPTION OF MASTER CYLINDER ASSEMBLY

- It is a tandem master cylinder whose construction is similar to a normal master cylinder, which has two pistons where hydraulic pressure is developed in the chamber, which is distributed to the front and rear brake lines circuit.



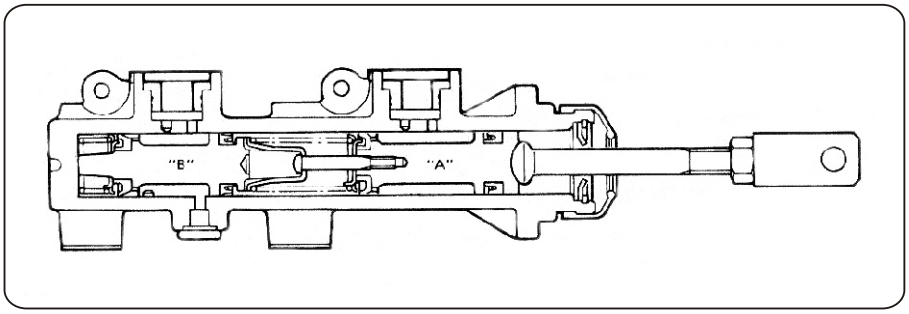
FRONT LEFT AND REAR RIGHT BRAKES CIRCUIT FAILURE

- When the brake pedal is depressed, it causes the primary piston 'A' to move. If the front left and rear right brake line circuit cannot hold the pressure; the fluid in the cylinder containing piston 'A' cannot be pressurized and keeps compressing the spring of piston 'B' retainer. Now, Piston 'B' starts moving from this point and pressurizes the fluid and this actuates the front right and rear left.



FRONT RIGHT AND REAR LEFT BRAKES CIRCUIT FAILURE

- In this condition the piston "A" has little effect in pressurising the fluid for F-LH and R-RH. Due to the initial rise in fluid pressure which causes piston "B" to yield and move leftward. The forward end of piston "B" stops and bears against the head of the cylinder. From this, the piston "A" becomes effective in pressurising the fluid ahead of F-LH and R-RH brakes. Shown below is the secondary piston "B" at halt.

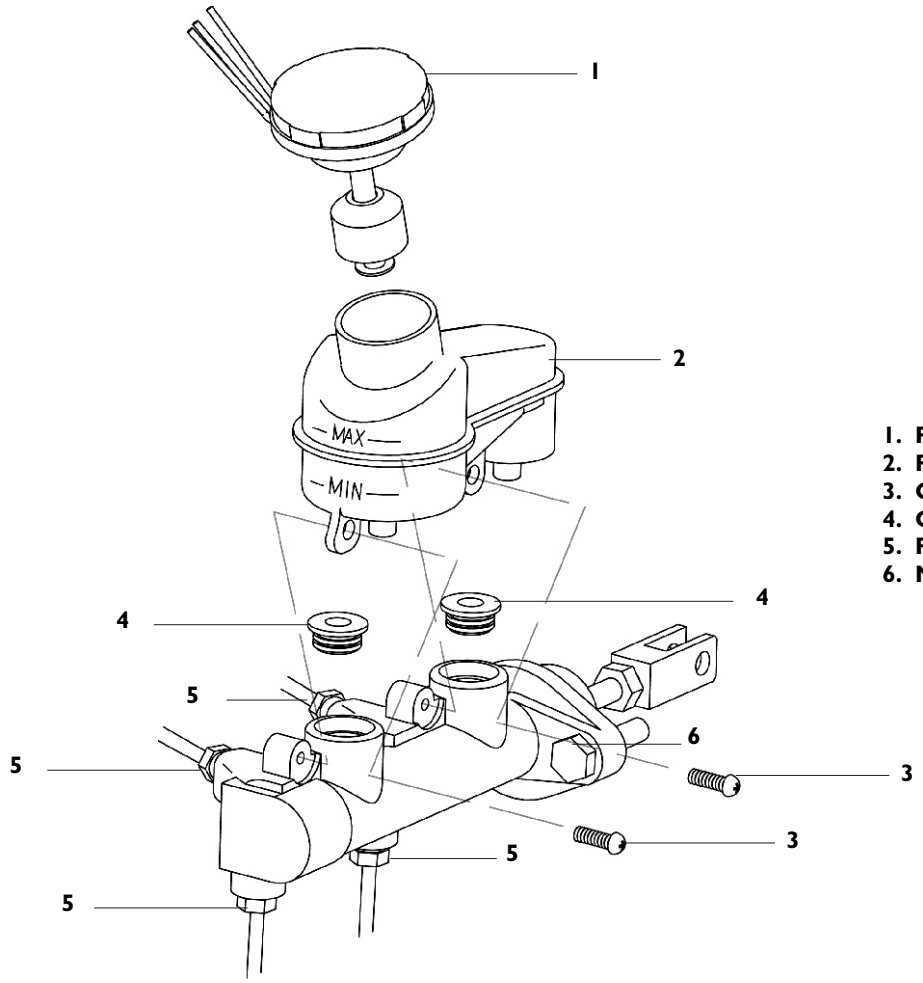


MASTER CYLINDER - REMOVAL FROM VEHICLE

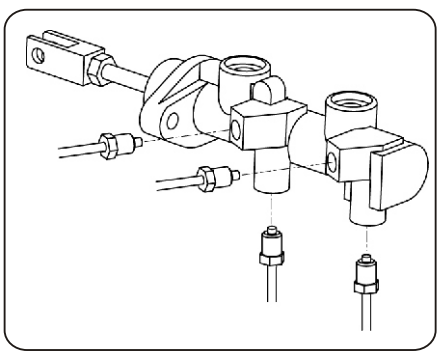
- Clean outside of reservoir
- Drain fluid from the reservoir
- Remove reservoir connector screw
- Remove reservoir

NOTE

Do not spill brake fluid on painted surfaces, cowl and fire wall.

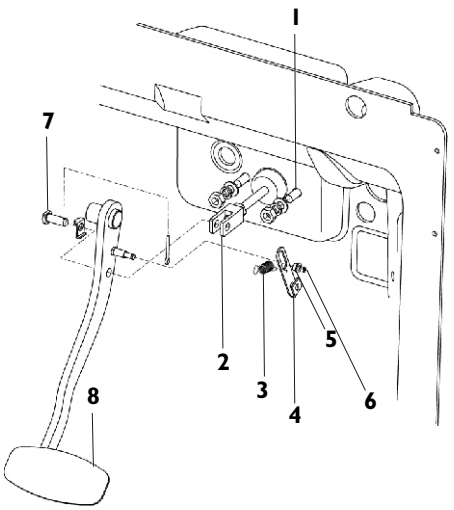


1. **Reservoir cap**
2. **Reservoir**
3. **Connector Screw**
4. **Grommets**
5. **Flare nuts**
6. **Mounting bolts**



- Disconnect four brake pipes from the master cylinder

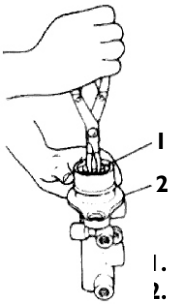
- Dismantle master cylinder push rod clevis pin and cotter pin from the brake pedal arm.
- Disassemble two mounting nuts of master cylinder from firewall mounting.
- Remove the master cylinder from the vehicle.



1. **Master cylinder mounting bolts**
2. **Clevis**
3. **Brake pot lever spring**
4. **Brake pot lever**
5. **Bush**
6. **Circlip**
7. **Cotter pin**
8. **Brake pedal**

MASTER CYLINDER - DISMANTLING

- Remove circlip from push rod

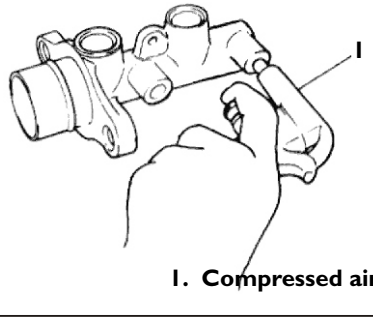


1. **Circlip**
2. **Master cylinder**

NOTE

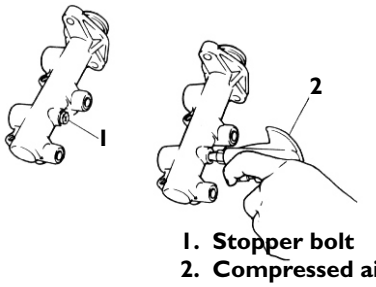
Be cautious during removal, as primary piston will jump out.

- Remove primary piston by using compressed air.



1. **Compressed air**

- Remove piston stopper bolt.
- Then remove secondary piston by blowing compressed air into hole from which piston stopper bolt was removed.



1. **Stopper bolt**
2. **Compressed air**

MASTER CYLINDER - INSPECTION OF COMPONENTS

- Inspect all disassembled parts for wear and damage, and replace parts if necessary.

NOTE

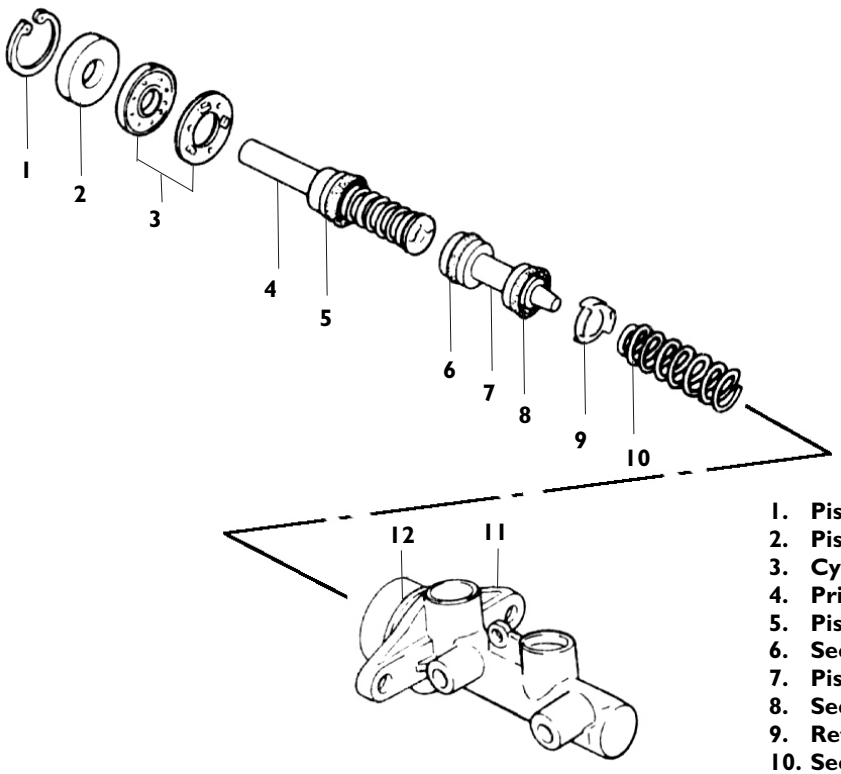
Wash disassembled parts with brake fluid.

Do not re-use piston cups.

Inspect master cylinder bore for scoring or corrosion.

Polishing bore of the master cylinder with cast aluminum body with anything abrasive is prohibited, as damage to cylinder bore may occur.

Rinse cylinder in clean brake fluid. Shake excess rinsing fluid from cylinder. Do not use a cloth to dry cylinder, as lint from cloth will remain on the cylinder bore surfaces.



1. **Piston stopper circlip**
2. **Piston stopper**
3. **Cylinder cup & plate**
4. **Primary piston**
5. **Piston cup**
6. **Secondary piston pressure cup**
7. **Piston cup**
8. **Secondary piston**
9. **Return spring secondary seat**
10. **Secondary piston return spring**
11. **Master cylinder body**
12. **Sealing**

MASTER CYLINDER - ASSEMBLY

NOTE

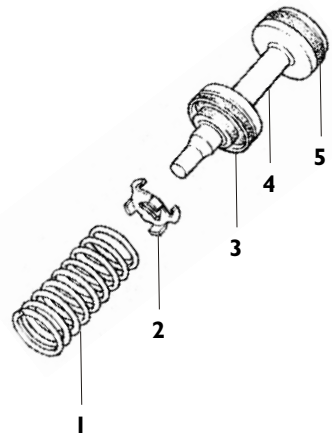
Before assembling, wash each part in fluid recommended to use for the car.

- Assemble secondary piston and primary piston as shown here.
- Assemble master cylinder and tighten nuts to torque specification.
- Assemble secondary piston assembly into cylinder.
- Assemble primary piston in the cylinder.

NOTE

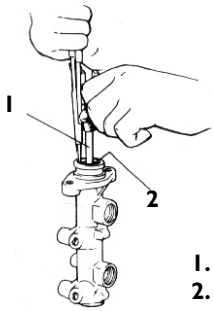
Do not use shock absorber fluid or any fluid other than the REVA specified fluids.

Keep all fluid containers capped to prevent contamination.



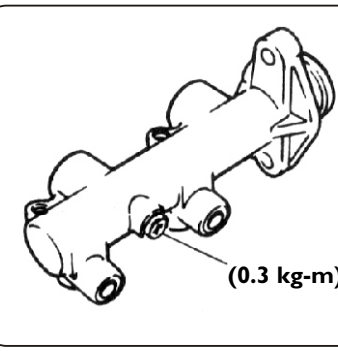
1. **Secondary Piston - Return Spring**
2. **Return Spring Seat**
3. **Piston Cup**
4. **Secondary Piston**
5. **Piston Pressure Cap**

- Depress and install circlip.



1. **Circlip**
2. **Master cylinder**

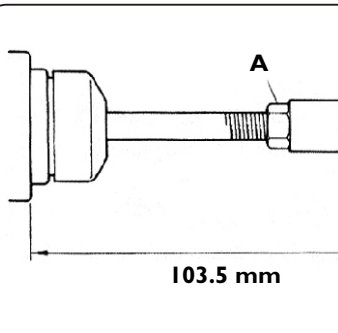
- Install piston stopper bolt with pistons pushed in all the way and tighten it to the specified torque.



- Be sure to adjust and secure lock nut at the position within the measurement given below. Data in figure does not include gasket thickness.

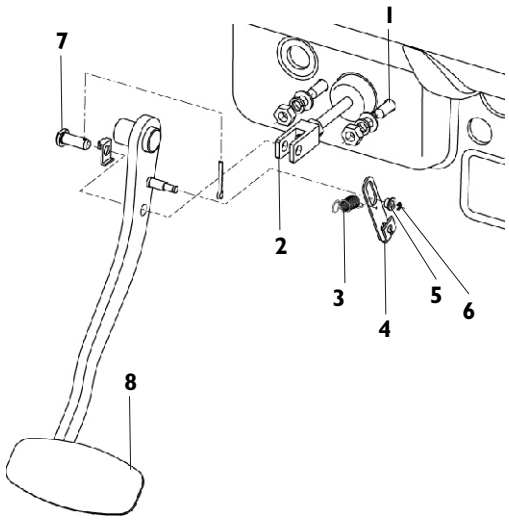
NOTE

Do not loosen locknut "A" of the push rod, only clevis should be loosened.



MASTER CYLINDER - INSTALLATION TO VEHICLE

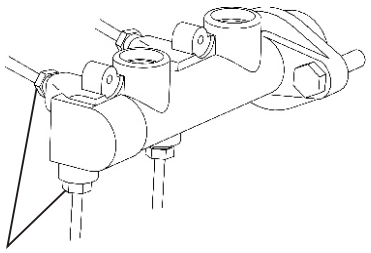
- Fix the master cylinder to the vehicle by tightening the mounting bolts.
- Install master cylinder push rod to brake pedal by clevis pin and bend split pin securely.
- Check the clevis pin freeness after master cylinder is fitted to brake pedal



1. **Master cylinder - mounting bolts**
2. **Clevis**
3. **Brake pot lever spring**
4. **Brake pot lever**
5. **Bush**
6. **Circlip**
7. **Cotter pin**
8. **Brake pedal**

NOTE

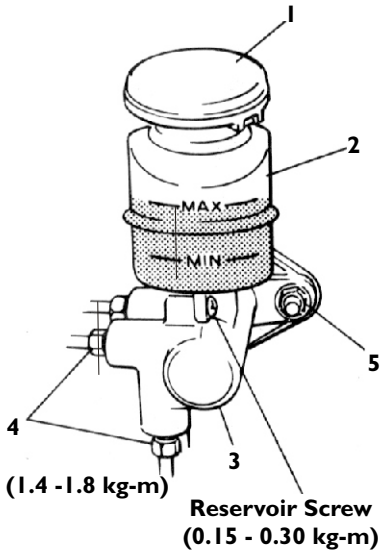
If any variation found on the above condition, the master cylinder push rod may be pre-loaded and could lead to drag on wheels.



Flare nuts (1.4 - 1.8 Kg-m)

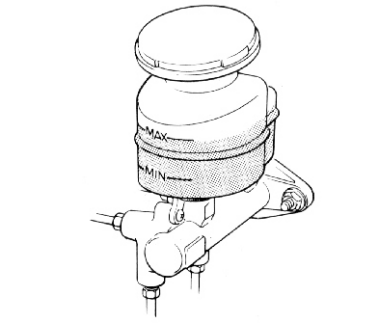
- Connect four hydraulic lines and torque flare nuts to specified value.

- Fill reservoir with specified fluid.
- When using new grommets, lubricate them with the same fluid.
- Then press fit grommets to the master cylinder.
- Install reservoir and tighten screws to specified torque.

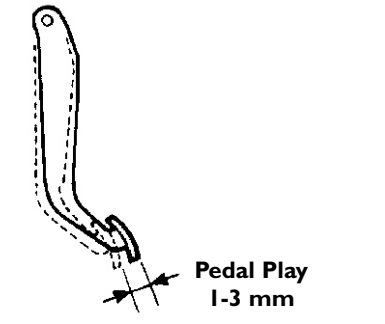


1. Reservoir cap
2. Reservoir
3. Master cylinder
4. Flare nuts
5. Attaching nuts

- Fluid to be filled to the MAX line marked on the reservoir.

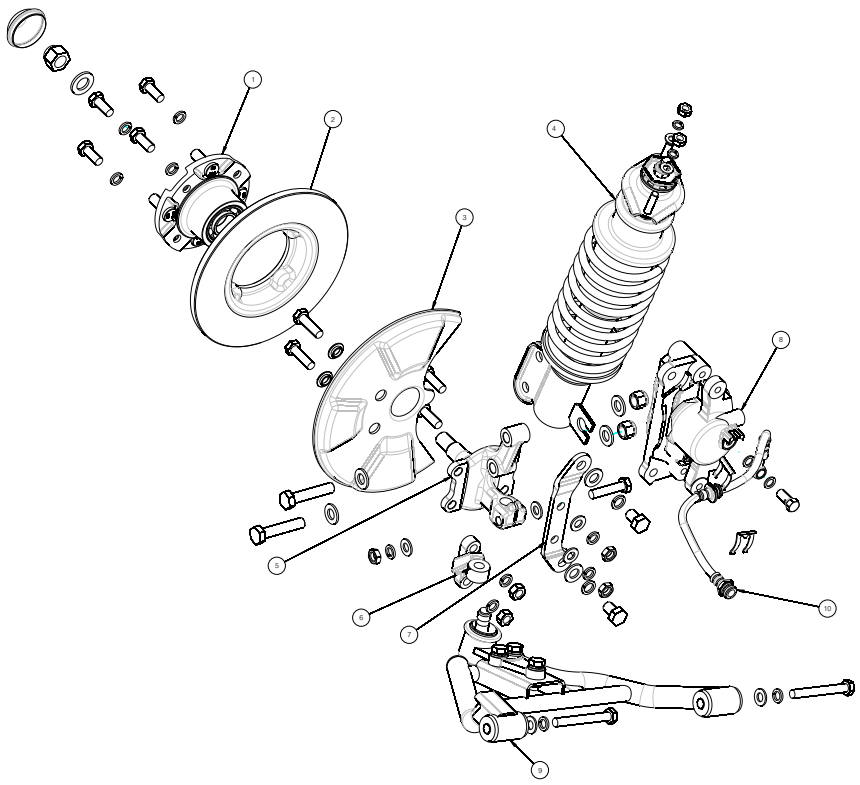


- After installing, check brake pedal height.
- Check for the pedal free play about 1-3 mm.



FRONT DISC BRAKES

This assembly has self-adjusting brake pad clearance system so that disc-to-brake pad clearance is maintained appropriately at all times.



1. **Hub assembly**
2. **Disc- front brake**
3. **Dust cover**
4. **Front strut assembly**
5. **Upright**
6. **Steering arm**
7. **Mounting Bracket- caliper assy**
8. **Caliper assembly**
9. **A-arm**
10. **Flexible hose- front disc brake**

CAUTION

During service do not polish or sand the brake linings as the hard particles of sand paper will be deposited in lining and may damage the disc. When pad lining requires correction, replace with new one.

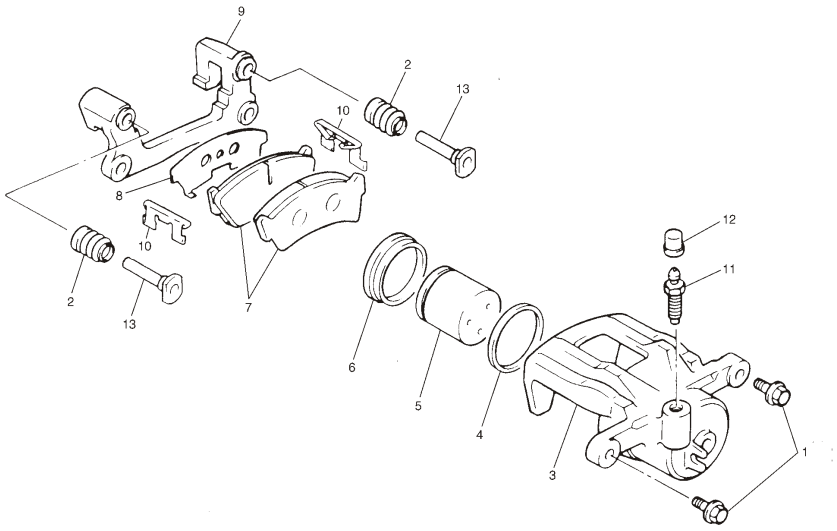
NOTE

Use genuine Reva repair kits for service of this disc brake system.
Lubricate parts as specified.
If any hydraulic component is removed or brake line disconnected, bleed the brake system. The torque values specified are for dry, unlubricated fasteners.

BRAKE OPERATION

The caliper is mounted to the caliper carrier with two caliper pin bolts and has a single bore. When the brake pedal is pressed the hydraulic force acts equally against the piston and the bottom of the caliper bore to move the piston outward and to move inward resulting in a clamping action on the disc.

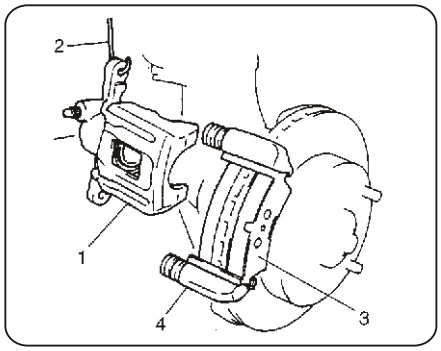
This clamping action forces the pads against the disc creating to stop the vehicle.



1. Caliper pin bolt
2. Dust boot
3. Disc brake caliper
4. Piston seal
5. Disc brake piston
6. Piston boot
7. Disc brake pad
8. Anti nose shim
9. Brake caliper carrier
10. Pad spring
11. Bleeder plug
12. Bleeder plug cap
13. Cylinder slide guide pin

FRONT BRAKE DISC - DISMANTLING

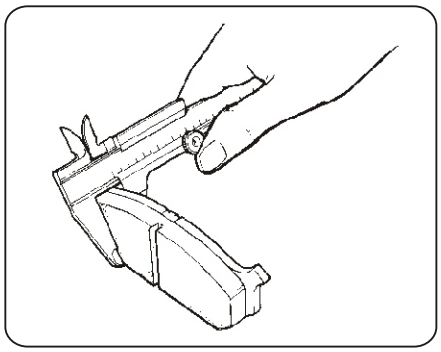
- Hoist or jack up the vehicle and remove the wheel.
- Remove the caliper pin bolt from the caliper carrier.
- Remove brake pads.



INSPECTION:

- Check pad lining for wear. When wear exceeds limit, replace with new set.

Pad thickness(lining+pad rim)
Standard: 15 mm
Limit : 7 mm

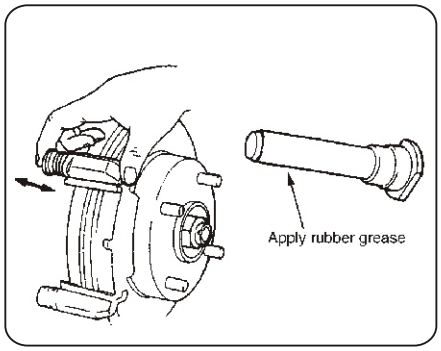


Cylinder slide guide pin

- Check guide pin for smooth movement as shown.(if found faulty correct or replace)
- Apply rubber grease to guide pin outer surface.

Dust boot

- Check boot for breakage, crack and damage. If defective replace with new one.

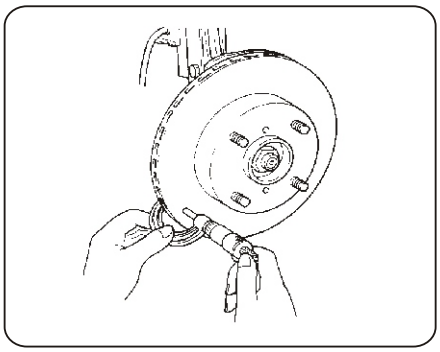


NOTE

Replace pads in axle sets only. The torque values specified are for dry, unlubricated fasteners.

Hang removed caliper with a wire hook or the like so as to prevent brake flexible hose from twisting excessively or pulled.

Do not operate brake pedal with pads removed.



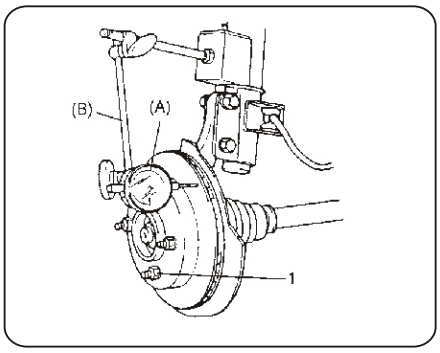
FRONT BRAKE HUB & DISC - ASSEMBLY

- Install wheel bearings 6204 & 6205 by using bearing installer (special tool No. 0100-7005) and hammer.
- Fix the brake disc to the hub assembly.

- Check disc surface for scratches in wearing parts.
- Inspect for deep scratches or scratches all over the disc surface ,replace it.
- when only one side is scratched , polish and correct that side.

Disc thickness

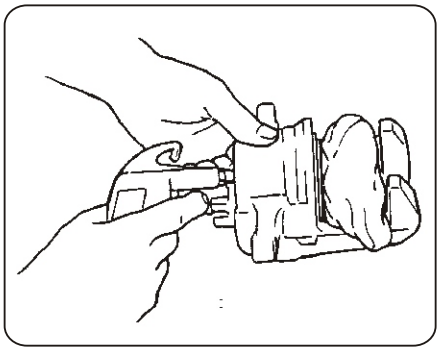
Standard : 10 mm
Limit : 8 mm



Use wheel nuts to hold the disc securely against the hub and mount a dial gauge as shown. To measure the deflection of disc, take measurement at 2 points on its periphery and center with dial gauge while rotating it.

Limit on disc deflection : 0.15 mm

• NOTE: Check front wheel bearing for looseness before measurement.



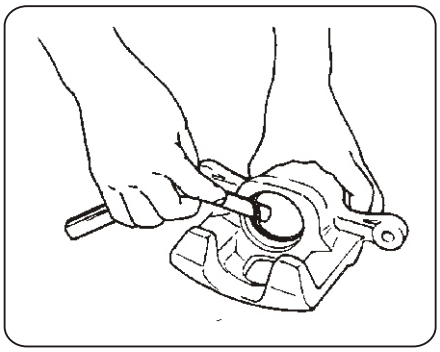
DISASSEMBLY OF CALIPER

- Before disassembly, clean all around caliper with brake fluid.
- Blow air into the cylinder through bolt hole where flexible hose is fitted. With air pressure , piston can be pushed out of cylinder.

NOTE

Do not apply too highly compressed air which will cause piston jump out of the cylinder.

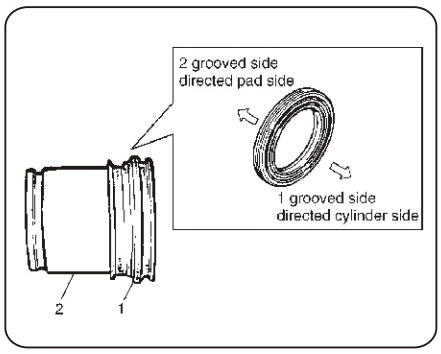
Do not place your fingers in front of piston when using compressed air.



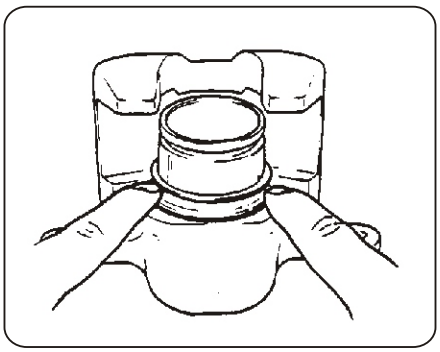
- Remove piston seal using a thin blade like a thickness gauge. etc
- Check boots for breakage, crack and damage. If defective, replace.
- Excessive or uneven wear of pad lining may indicate unsmooth return of the piston and in such case replace the rubber seal.

CALIPER PISTON - REMOVAL & INSTALLATION

- Before inserting piston(2) into cylinder, install boot (1) onto piston as shown.



- Fit the boot as it is in figure into boot groove in cylinder with fingers.
- Insert piston into the cylinder by hand and fix the boot in the groove in the piston.
- To confirm that boot is fitted in its groove in cylinder properly, pull out the piston cylinder a little but do not take it out.

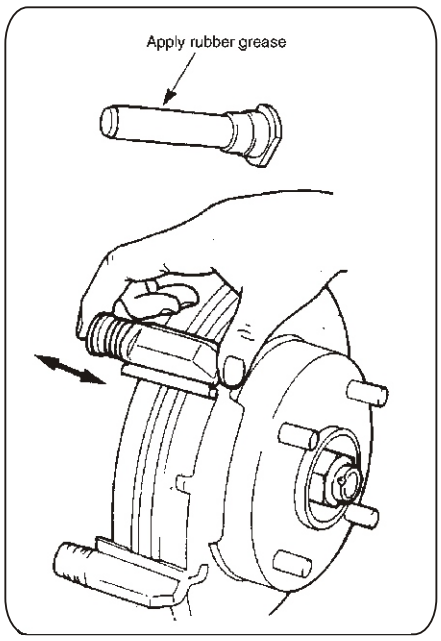


NOTE

Boot's face should be at the same level from cylinder's face all around.

CALIPER

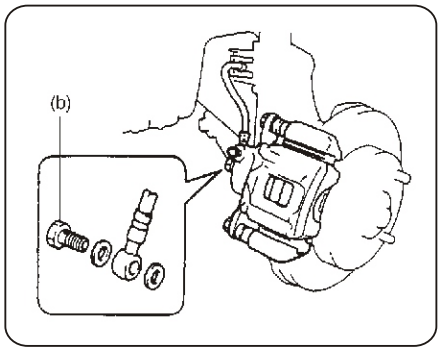
- Before installing caliper (cylinder body) to carrier, ensure that pin can be moved smoothly in thrust direction.
- Apply rubber grease to caliper pin, then install caliper to caliper carrier.
- Tighten caliper pin bolts to specified torque.
  Tightening Torque:27 N-m
- Tighten flexible hose to specified torque.
  Tightening torque: 23 N-m



NOTE

Make sure that flexible hose is not twisted when tightening hose bolt. If it is twisted, reconnect it using care not to twist the hose.

Tighten the wheel nuts to specified torque (70 N-m)



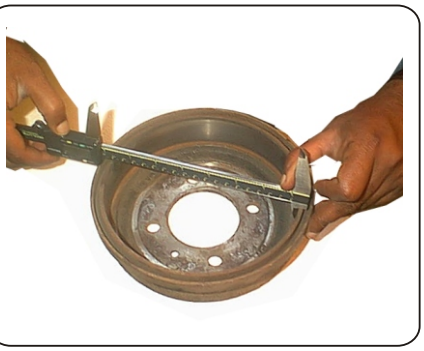
REAR DRUM BRAKES - DISMANTLING

- Remove the rear wheel.
- *Follow* ***Standard Workshop Procedure - II*** *(Pg. 14 / Sec. 1.0)*
- Remove the 2 allen screws and the axle nuts from both LH & RH wheel drums.

- Remove wheel drum using drum puller (Sp. tool No. 0100-3003).

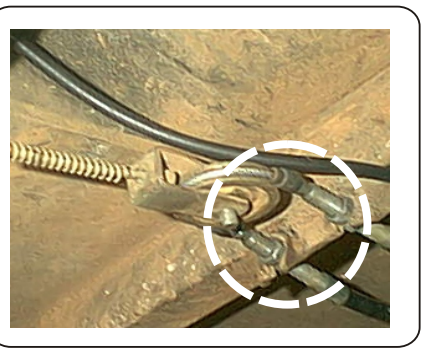
NOTE

Assembly in all cases, if not mentioned, is the reverse procedure of disassembly.



- Measure the internal diameter of the rear drum. It should be within the service limit.

  Standard : **180 mm**

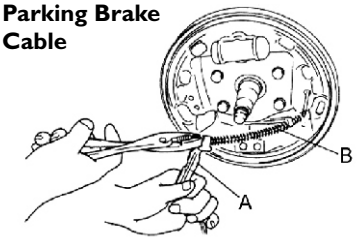


NOTE

Check to ensure that parking brake lever is not pulled.

- Loosen the parking brake cable nuts.

1. **Parking Brake Shoe Lever**
2. **Parking Brake Cable**



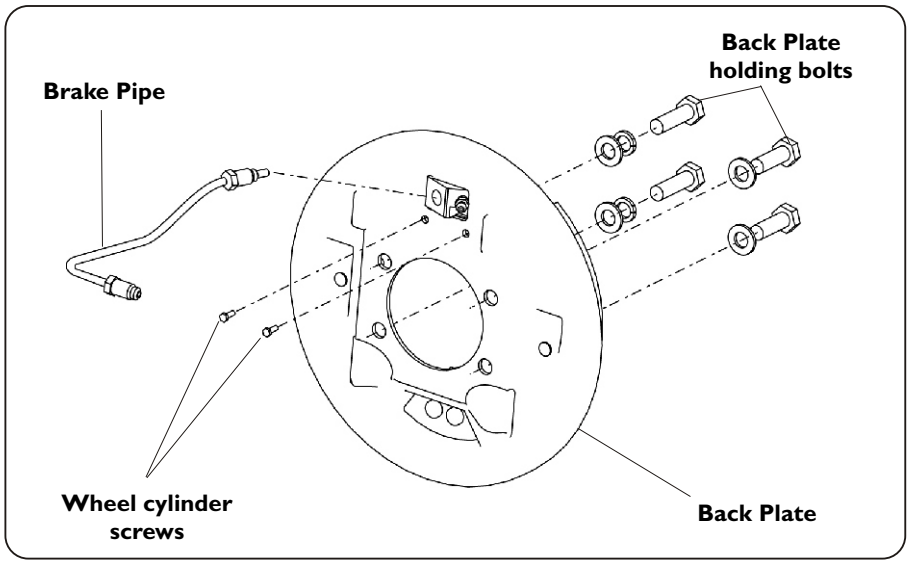
- Check for any crack or damage in the brake shoe.
- Disconnect parking shoe levers.
- Inspect parking shoe lever free movement against shoe web. If defective, replace it.
- Remove parking brake cable from brake drum.
- Pull the cable as shown in the figure and disconnect the cable from the parking brake shoe lever.
- Inspect ratchet strut for wear or damage.

REAR BRAKE SHOES & BACK PLATE - REMOVAL & INSTALLATION

- Inspect for any corrosion on the brake shoes.
- Replace shoe if worn out beyond the service limit
  Standard: **6.0 mm**
  Service Limit: **2.6 mm**

- Even if one brake lining is worn to service limit, then all the linings must be replaced.
- Disconnect the brake hose from the wheel cylinder.
- Loosen the four bolts on the back plate, which is connected, to the upright.
- Finally remove the wheel cylinder by loosening the two screws on the back plate, to release the brake shoes.

- *Refer **'Front & Rear wheel cylinder and springs - inspection'** (Pg. 92) for further procedure regarding wheel cylinder.*



NOTE

Assembly in all cases, if not mentioned, is the reverse procedure of disassembly.

NOTE

When installing shoe, don't cause damage to wheel cylinder boots.

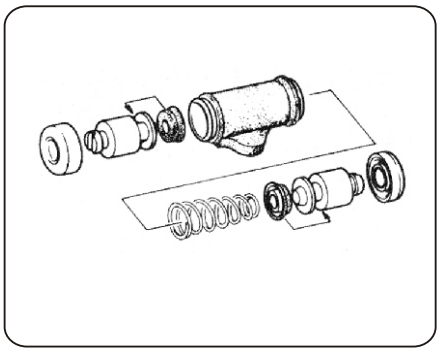
NOTE

If brake-backing plate was removed from wheel cylinder or brake pipe was disconnected from wheel cylinder, then bleed air from the brake system.

Upon completion of all jobs, depress brake pedal with about 30 Kg load four to five times so as to obtain proper drum-to-shoe clearance.

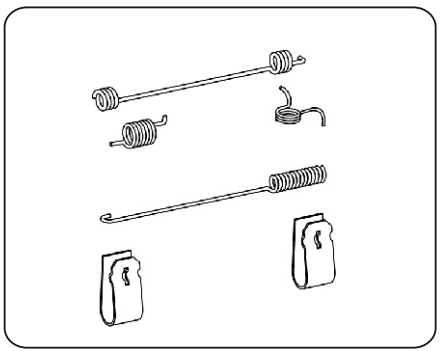
Adjust parking brake cable.

Check to ensure that brake drum is free from dragging and proper braking is obtained. Then remove car from hoist and perform the brake test.



WHEEL CYLINDER + SPRINGS - INSPECTION (REAR)

- Dismantle the wheel cylinder.
- Inspect all the parts in the assembly for wear, cracks, corrosion or damage.
- Check ratchet for any damage.



- Inspect for defective or weakening springs. Replace if damaged.

NOTE

Precautions on installations -

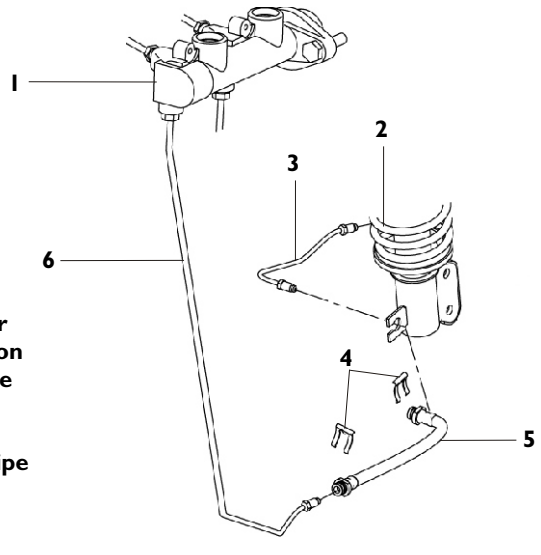
If wheel cylinder is damaged, corroded, replace it.

Tighten wheel cylinder to brake back plate to specified torque.

Assemble parts as shown in the reverse order of removal.

BRAKE PIPES AND HOSES - INSPECTION

- Take out all the brake fluid.
- Clean dirt and foreign material from either hose end or pipe end fittings. Remove brake hose or pipe.
- Reverse removal procedure for brake hose or pipe installation. When installing hose, make sure that it has no twists or kinks. Inspect to see that hose doesn't make contact with any part of the suspension. Check in extreme right and left turn conditions for front brakes.
- Check the maximum travel up and down movement for rear brake hoses. If hose makes any contact, remove and correct.
- Fill and maintain brake fluid level in the reservoir.
- Check for tighten of the brake hose end nut and flare nut of brake pipe



1. **Master cylinder**
2. **Front suspension**
3. **Brake pipe/hose**
4. **E - ring**
5. **Brake hose**
6. **Brake bundy pipe**

NOTE

Be sure to install brake flexible hose E-ring into hose groove.

Upon completion of installation, check each joint for fluid leakage with brake pedal depressed.

BRAKES - MAINTENANCE & SERVICE

ROAD TESTING OF BRAKES

- Brakes should be tested on dry, clean, smooth and reasonably level roadway,
- Road test brakes by adjusting regen brake % by using controller hand held. *(Refer to 'Adjusting regen braking' - Pg 98)*
- Check for effectiveness of brake pedal.
- After road test ensure if any wheel brake gets jammed
- Check for any dragging of vehicle , when brakes is applied
- check the tyre pressure, front & rear before test drive.

BRAKE FLUID LEAKS

- Check master cylinder fluid levels.
- Check for leakage in hose end joint and flaring nut end. Tighten it.

BRAKE FLUID LEVEL INSPECTION

- Use brake fluid recommended by REVA genuine materials
- Use of local fluid is strictly prohibited.
- Fluid level should be between MIN and MAX lines marked on reservoir.
- When warning light comes on during driving, replenish fluid to MAX line
- When fluid decreases quickly, inspect brake system for leakage. Correct leaky points and then refill to specified level.

FILL RESERVOIR

- Add brake fluid upto MAX line.

BRAKE HOSE AND PIPE - INSPECTION

HOSE

- The flexible hydraulic brake hose, which transmits hydraulic pressure from bundy brake line on the body to front and rear cylinders should be inspected.
- The brake hose assembly should be checked for road hazard damage, for cracks or chafing of outer layer, for leaks and blisters.
- If brake hoses are damaged, replace it.

BRAKE BUNDY PIPE

- Inspect the tube for damage, cracks, and dents and corrosion. If any defect is found, rectify it by replacement.

BRAKE SHOE AND LINING INSPECTION

- Inspect brake shoe and lining according to the maintenance schedule.

BRAKE DRUM INSPECTION

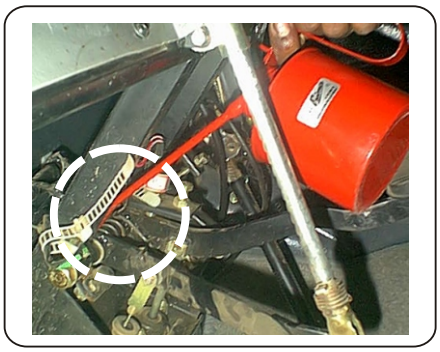
- Inspect brake drum according to maintenance schedule.

BRAKE PEDAL PLAY ADJUSTMENT

- Pedal play should be within below specification.
- Check stoplight switch for proper installation position and adjust if necessary.
- Also, check pedal shaft bolt and master cylinder pin installation for looseness and replace if defective.
- Check brake drum for dragging after adjustment.

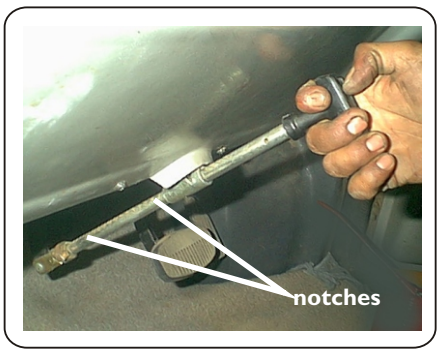
NOTE

Do not use shock fluid or any other fluid than REVA specified fluid.



PARKING BRAKE - INSPECTION & ADJUSTMENT

- Pull up the parking brake lever all the way and check for it's smooth operation.
- Lubricate the parking brake lever bottom spring area to release the lever smoothly.

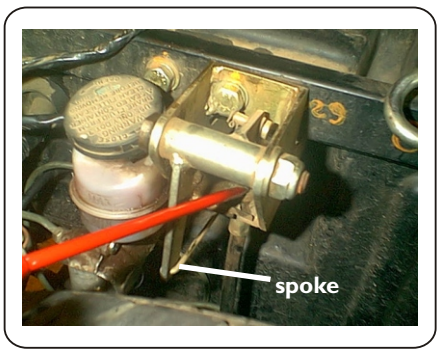


- Parking brake should be pulled with a maximum force of 20-40 Kg, which is equivalent to 4-5 notches.

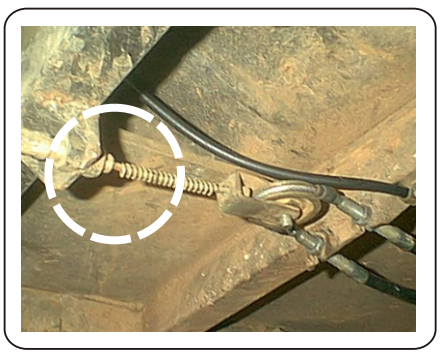
NOTE

Check the parking lever tooth tip of each notch for damage or wear. If any damage or wear is found, replace the parking lever.

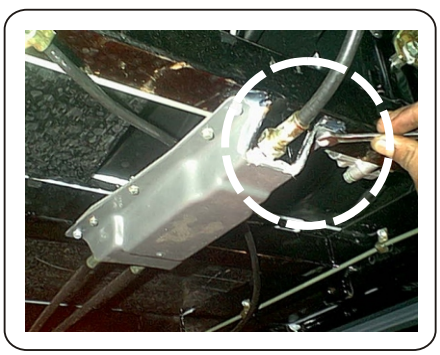
Make sure for following conditions before parking cable adjustment.



- Check for smooth operation of the parking brake linkage mechanism.
- Check for the full stroke operation of spoke , such that it doesn't touch the spare wheel.
- Adjust the clevis by maintaining the correct length of spoke from

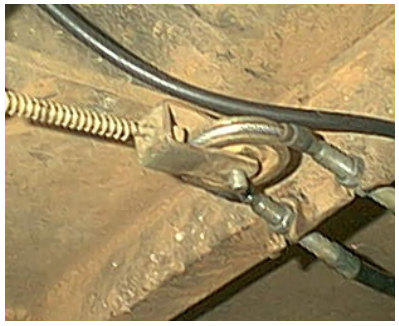


- Remove the primary cable and check for the damage in the outer sleeve.
- Check for its smooth operation.
- Lubricate cable and replace if damaged.

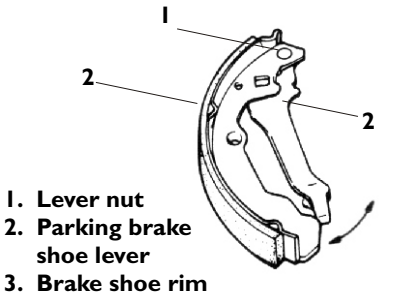


- Remove the bottom pulley cover of parking brake and check for any damage in pulley.

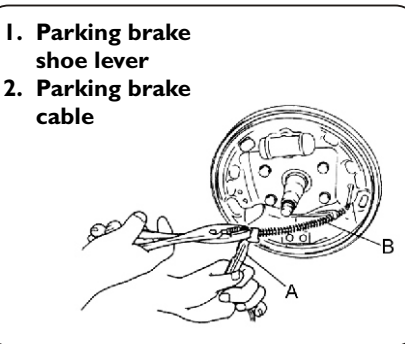
- Clean the pulley and adjustment area and check for the smooth operation.



- Remove the rear brake drum *(Refer to '**Rear Drum Brake removal** - Pg. No. 90)* and check for the function of parking shoe lever.
- Inspect brake shoe lever for free movement against brake shoe web. If



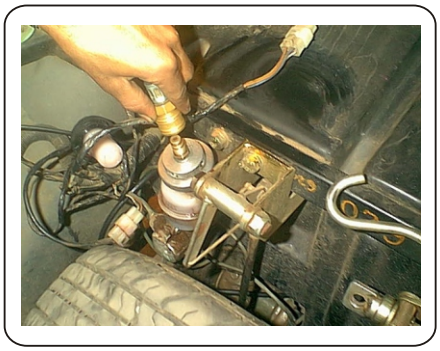
- Right and left outer cables should be adjusted equally.



BRAKE BLEEDING - PROCEDURE

- Hoist up the vehicle to an operator-comfortable height and confirm that the hoist ratchet system is properly locked.
- Fill the master cylinder reservoir to the top edge with brake fluid.

- Connect the pressurized-brake-bleeding unit to the master cylinder reservoir with the appropriate bleeder adaptor.

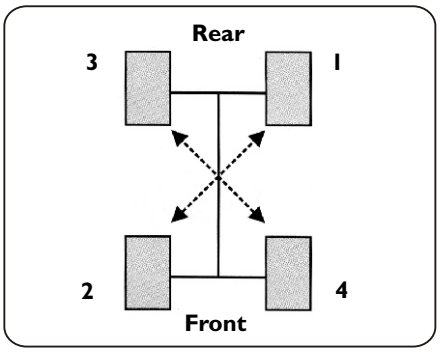


- Connect the filling hose to the adaptor.

- Ensure that all bleeder valves in the vehicle's system must be closed.
- Turn unit ON; the brake system is now under working pressure. (2 Kgs)
- Close the regulator by rotating the hand wheel counter clockwise until no more resistance is felt.
- The pressure regulator is now closed and the pressure on the gauge should not fall over a period of 5 minutes.
- If the pressure falls during the period, the system is leaking.
- Rectify the defect for leaks and correct it.
- Once it is confirmed that there are no more leaks, the bleeding process can begin.

- Fix the recovery measuring bottle hose to the rear left wheel bleeder valve and loosen the nipple until clear brake fluid, free from air bubbles, flows out.
- Immediately tighten the bleeder valve.

- Repeat for the front right wheel, rear right wheel and front left wheel



NOTE

Bleeding should start with the longest brake line from the master cylinder i.e. Rear left wheel and then proceed in a diagonal manner.

- After brake bleeding rear wheel cylinders & front caliper, check for leaks in the circuit. If any, then find the fault and sort it out.
- Turn unit OFF and release the pressure by rotating the regulator hand wheel in anti-clockwise direction.
- Remove the master cylinder reservoir adaptor and keep the bleeder machine aside.
- Put back the original master cylinder reservoir cap and check the fluid in the reservoir for MAX level.

- Recheck all bleeder valves and brake lines for tightness to prevent leaks.
- Replace all plastic caps of the bleeder valves.

NOTE

If brake fluid has accidentally touched the paint of the car, wipe it immediately as it might damage the paint on the plastic panels.

BRAKE SPONGINESS

- After the brake bleeding check for "sponginess" in brake pedal.
- If "sponginess" is found repeat the entire bleeding process till the air is out of the brake line.

BRAKE PEDAL - FREE PLAY ADJUSTMENT

- To ensure trouble free operation of the brakes it is necessary to have a pedal free play.
- The pedal free play corresponds to the clearance between the pedal link and pressure pin. This is adjusted with the help of threaded end of pressure pin.

IMPORTANT

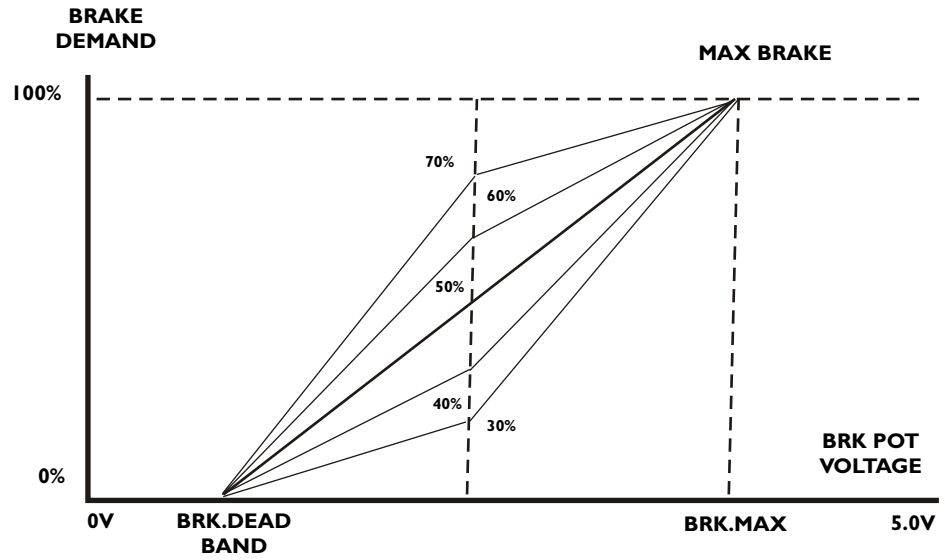
Check the wheel freeness by rotating front and rear wheels while operating the brake pedal several times.

IMPORTANT

Confirm the freeness of the rear wheel, when hand brake lever is in fully released condition before road test.

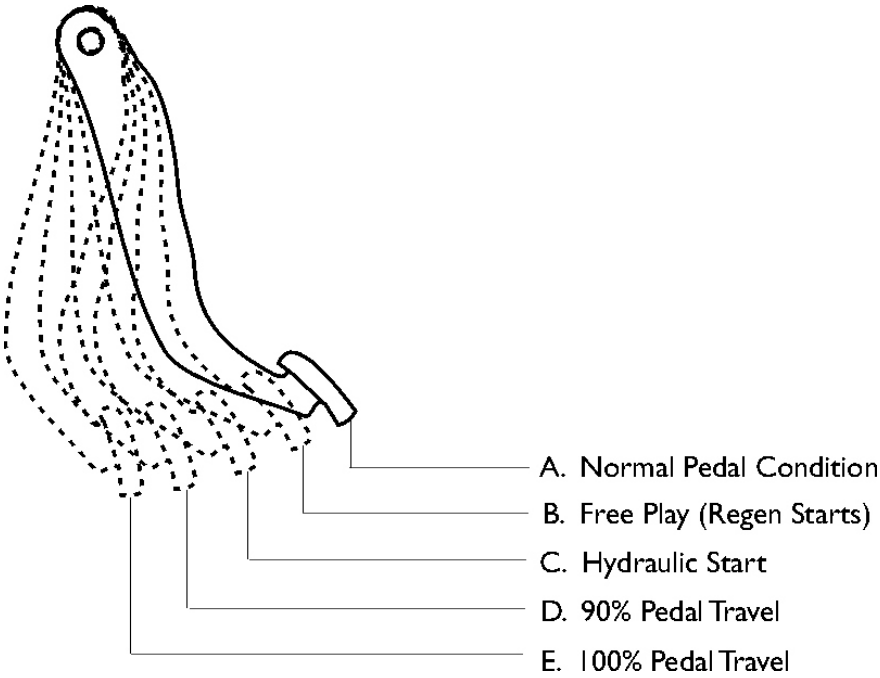
REGEN BRAKING & HYDRAULIC BRAKE - ADJUSTING

BRAKE MAP WITH REGENERATION BRAKING

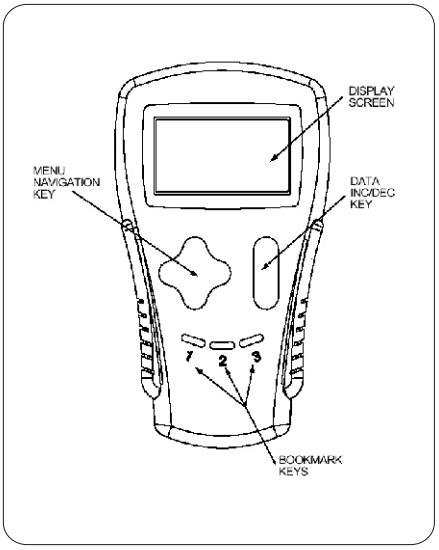


(BRK.MAX-BRK. DEAD BAND) / 2 = Brake Map% :That determines the Brake

PEDAL MOVEMENT



- Hook up hand held to the controller unit at the 4 pin connector.
- Put the key switch in on and check for the main menu display in the handheld.
- Go to Monitor Mode and press enter.
- Press the down button in handheld and position the display for the brake voltage.
- Depress the brake pedal fully and check for the minimum & maximum brake pedal voltage.
- Normal depression of brake shows 100% and further towards full depression - the % starts falling.
- Note down the min & max brake voltage reading.
- Press the programme mode in the hand held.



PROBLEM SOLVING

- After stopping the vehicle does not move.
  Check brake pedal free play " B " and increase its value by 0.1 point.

- Rear wheel locking.
  Check the brake locking at 50Kms/Hr speed and decrease the " E " value till the brakes are not locking.

- Initial brake feel poor.
  Decrease the " C " value by few points till initial brake feel is good.

- Initial brake abrupt.
  Increase the " C " value till the Braking is in normal condition.

- For hard braking, brakes not effective.
  Increase the " E " value till the brakes are effective.

NOTE

The above Brake Pot adjustment should be within the Max and Min Brake pedal Travel Values shown in the hand held.

PART		TIGHTENING TORQUE
Master cylinder mounting nuts	M8 x 1.25 x 35	15 -18 Nm
Master cylinder: brake bundy pipes flaring nuts		14 - 18 Nm
Wheel cylinder bleeding nipple		8 -10 Nm
Brake back plate mounting		20 - 24 Nm
Rear axle nylock nuts		150 Nm
Proportionating valve bundy pipe flaring nut		10 - 16 Nm
Wheel nut		70 - 80 Nm
Rear flange lock nut	M16 x 1.5	160 Nm
Front brake disc lock nut	M16 x 1.5	130 Nm
Proportionating valve to chassis mounting	M6 x 1 x 45	8 - 12 Nm
Brake pipe flair nuts		1.4 - 1.8 Kg-m
Brake flexible hose		2.0 - 2.5 Kg-m
Proportionating valve bolt		0.8 - 1.2 Kg-m

pedal box 06.0

GENERAL DESCRIPTION

- Pedal box is mounted on the front part, inside the fire wall near the leg room area for operating the hand brake, brakes and accelerator pedal assembly.

PEDAL BOX - REMOVAL FROM THE VEHICLE

- Remove battery positive (+ve) and charger 12V cable.
- *Follow **Standard Workshop Procedure - I** (Pg. 13 / Sec. 1.0)*

- Remove the IP.
- *Refer **Steering wheel removal** (Pg. 110 / Sec. 7.0)*

- Disconnect the electric connectors which are connected from front wiring harness to brake pot, accelerator pot & hand brake switch.

- Disconnect the master cylinder push-rod which is connected to brake pedal with yoke and clevis pin.

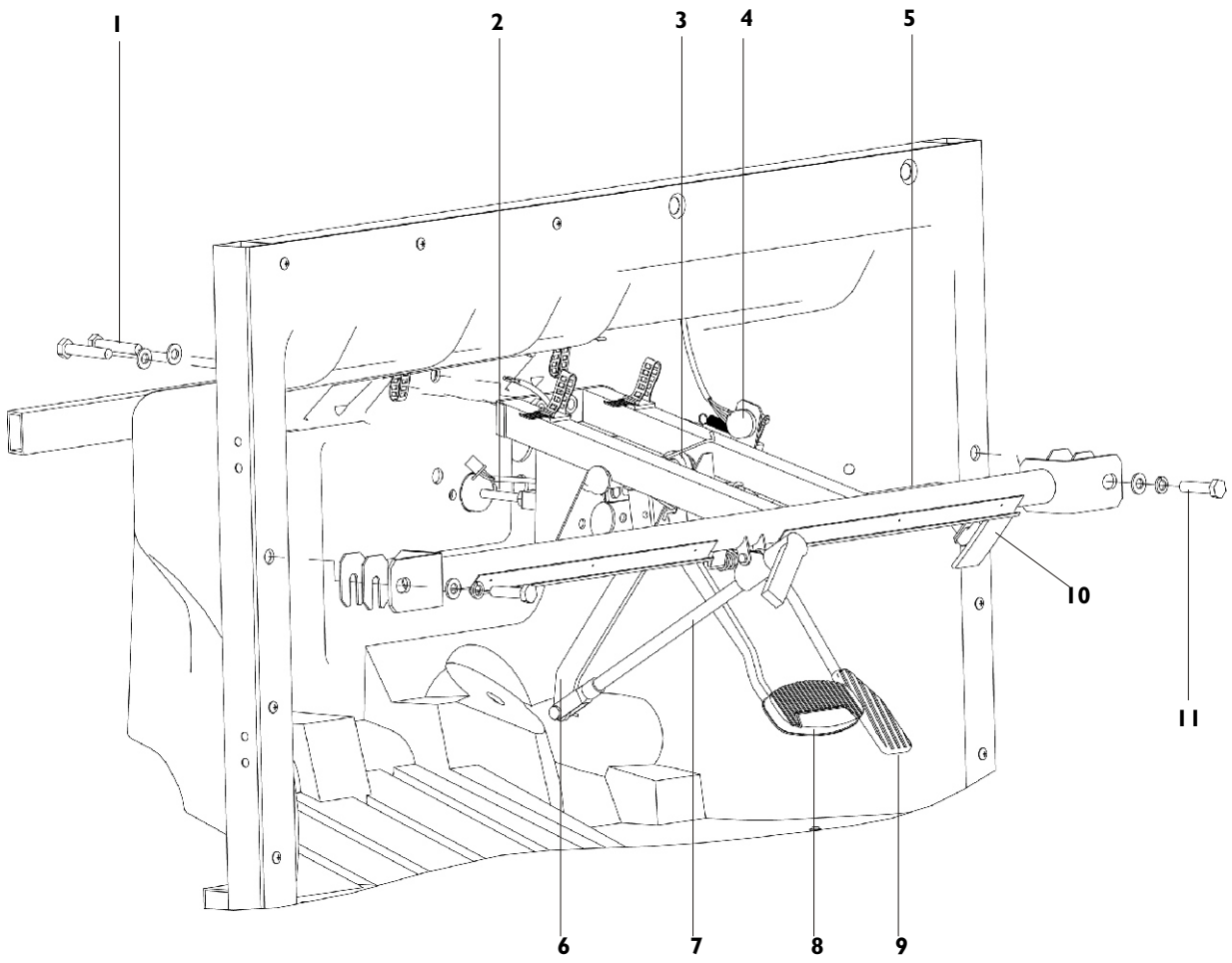
- Disconnect the front hood release lever from the pedal box weldment.

- Loosen the mounting bolts from LH & RH side, which are assembled on 'A' pillar in the chassis.

- Loosen the bolts which are connected inside front hood knee bolster to pedal box in firewall tubular channel in the chassis.

- Loosen the hand brake weldment bracket which is fixed in lower side of parking brake weldment inside the hood in the pedal box.

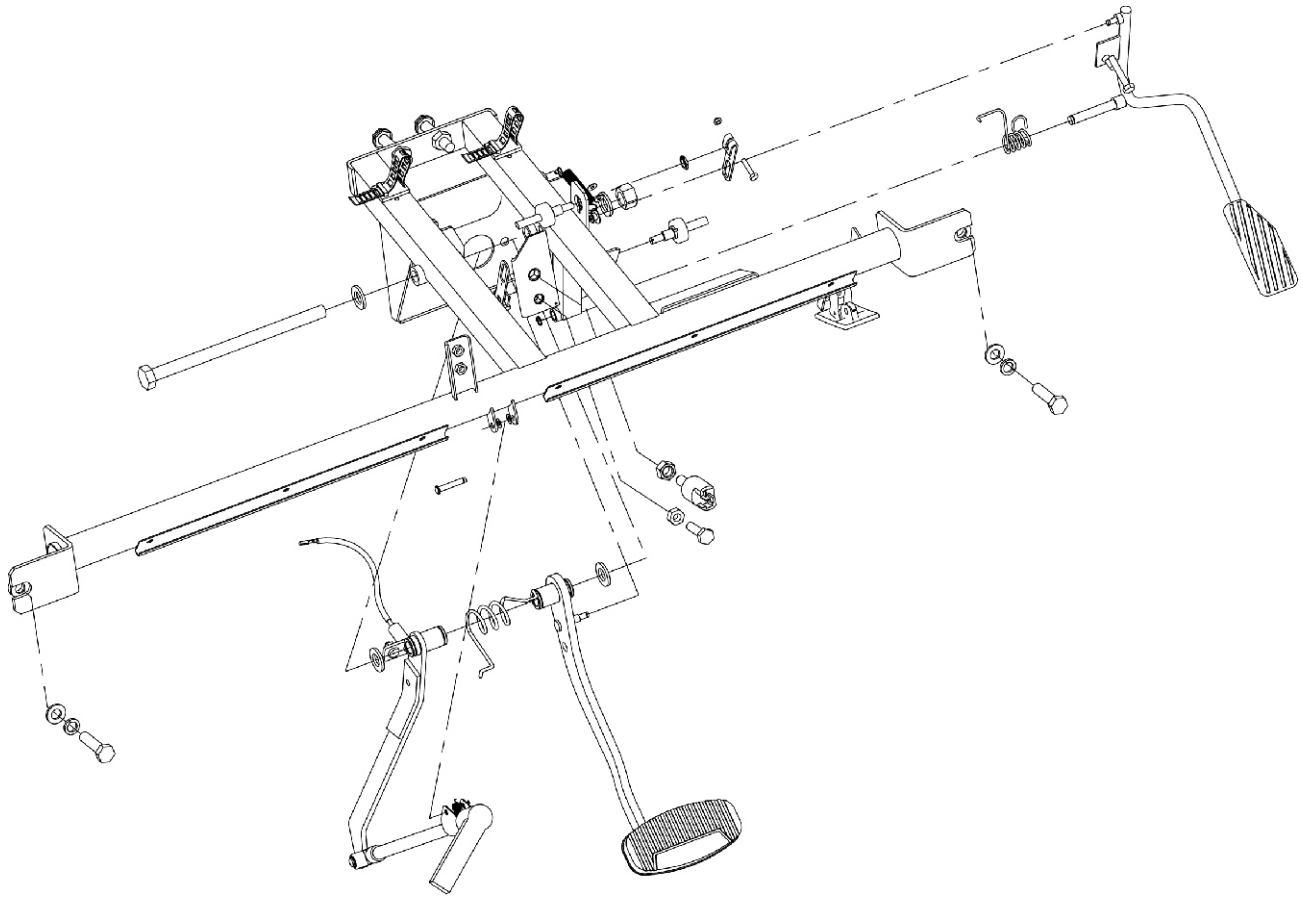
- Disconnect the hand brake yoke connected from the hand brake lever to hand brake weldment as shown in the figure.



1. **Pedal box-firewall tubular channel bolts**
2. **Master cylinder push rod**
3. **Brake pot**
4. **Accelerator pot**
5. **Fire wall**
6. **Hand brake yoke**
7. **Hand brake lever**
8. **Brake pedal**
9. **Accelerator pedal**
10. **Hood release lever**
11. **Pedal weldment mounting bolts**

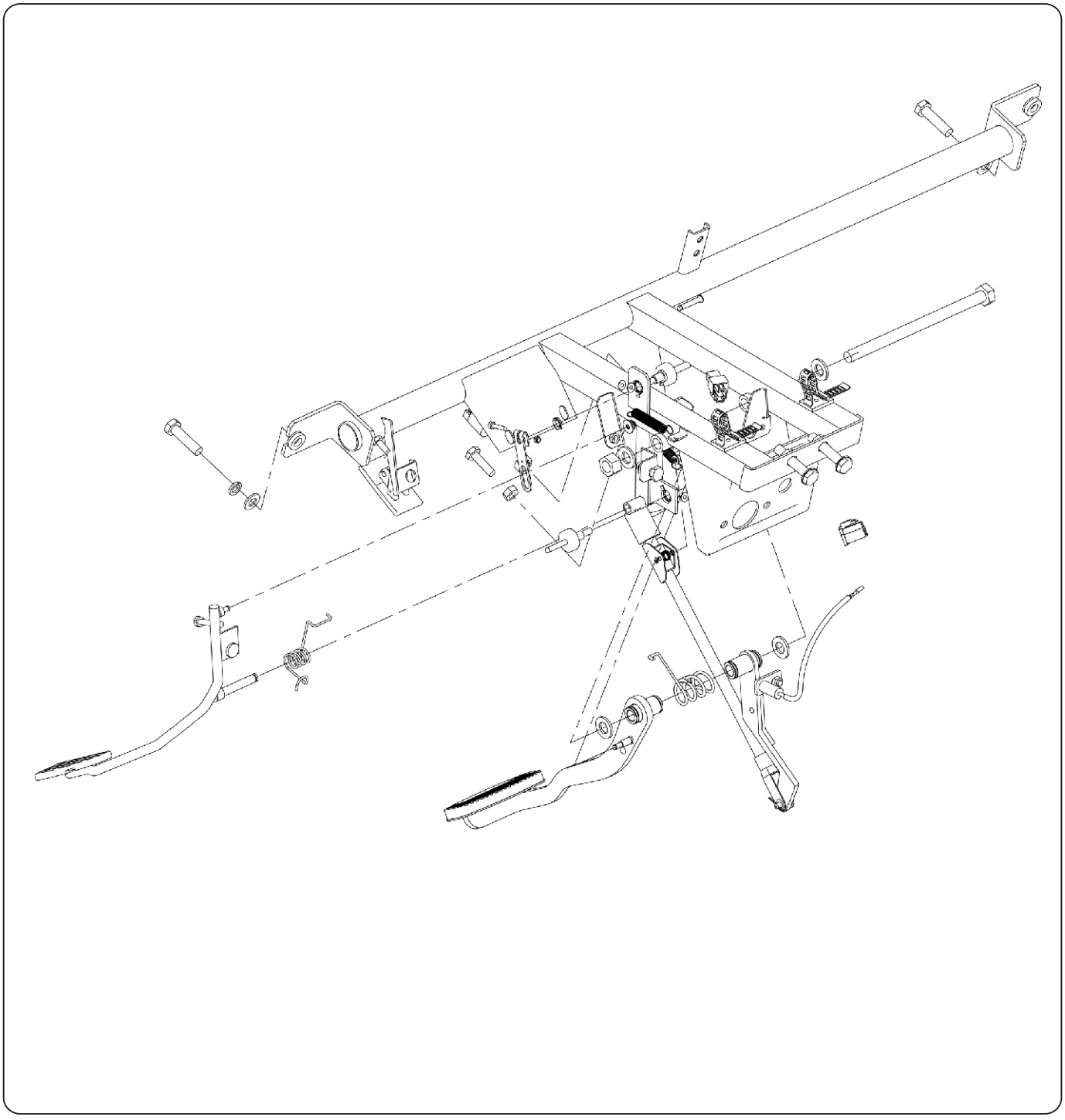
PEDAL BOX - DISMANTLING

- Loosen the centre nut M12 x 1.75 from the pedal box assembly.
- Loosen the brake pot & linkage which is mounted on pot bracket in pedal box weldment and disconnect the linkage spring.
- Loosen the M4 screw in accelerator pot & linkage which is mounted on the pot mounting bracket in pedal box weldment and disconnect the linkage spring.
- Remove the circlip from the accelerator mounting pin and disconnect the accelerator pedal from the pedal box weldment.
- Remove the M12 X 1.75 90 bolt and remove the brake and hand brake



PEDAL BOX - INSPECTION

- Check for the bracket weldment of potentiometer in the pedal box.
- If any crack is found in bracket weldment, re-weld the bracket or replace.
- Check the brake pedal damage or bent & replace if found damaged.
- Check for the nylon bushing in the brake arm weldment & replace if found damaged.
- Check for the rubber pad on brake pedal and replace if found damaged.
- Check for the correct function of potentiometer meter by using multimeter to show the maximum and minimum resistance.
- Check the brake and accelerator potentiometer knob for its correct



PEDAL BOX - ASSEMBLY

- Fix the pedal box weldment firmly in a fixture as shown.
- Insert the nylon bush to brake arm weldment and parking brake pedal arm weldment and apply Erato-32 oil on nylon bush.
- Insert potentiometer lever into the brake arm weldment and lock with M5 large washer and insert the circlip.
- Insert the parking brake switch and fix with bolt M6 X1X16 with flat & lock washer.
- Align the parking brake and brake pedal arm with the spring in between the assembly and insert the bolt to pedal box M12 x x1.75 X 90 with lock with the flat washer and nylock nut.
- Lock the spring at both ends with one end connected to parking brake lever and other end to brake arm weldment.

FIXING ACCELERATOR ROD WELDMENT TO PEDAL BOX

- Insert the nylon bush to the accelerator pedal weldment and apply Erato-32 oil on the nylon bushing link.
- Insert washer M5 pot meter linkage mounting rod and fix the linkage by locking it with circlip.
- Apply grease to the accelerator pin in the weldment.
- Insert the rubber stopper on the accelerator pedal in the tab accelerator and pull the rubber stopper till it sits inside the hole.
- Insert the main accelerator spring to the accelerator pedal weldment and lock the spring at two ends lock the accelerator pedal with circlip.
- Insert the stopper adjustment bolt of acceleration by moving the pedal upward and down ward.
- Install the stopper bolt in the pedal box to adjust the brake lever pedal adjustment.
- Fix the brake switch on the pedal box weldment with the bracket provided.

INSTALLATION OF BRAKE AND ACCELERATOR POTENTIOMETER

- Fix the brake and accelerator potentiometer to the brackets in the pedal box weldment.
- Initial adjustment is necessary for all the brake and potentiometer.
- The device used to check the potentiometer is a multimeter.
- Set the multimeter knob to 2000 ohms, and connect the red probe of the multimeter to the red colour wire of the accelerator potentiometer male connector and the black probe of multimeter to the black colour wire of the accelerator male connector.
- Tighten the linkage assembly to the potentiometer with M4 nut .
- Set the multimeter knob to the 20k and check the resistance from potentiometer by connecting one probe of multimeter to red and the other to black colour wire in potentiometer.
- The resistance should vary from 4.8k to 5k when the accelerator is pressed and released for several times.
- Repeat the same accelerator potentiometer procedure for adjusting the brake potentiometer.
- Tighten all the linkages by M4 nut and check for the smooth function of the pedals.
- Installation of the pedal box assembly to the vehicle is reverse procedure of the removal.
- Assemble the hand brake lever on the pedal box weldment.
- Fix the hand brake arm to the hand brake lever and check for its operation.

NOTE

After assembly of pedal box to the vehicle check for the correct operation of the brake & accelerator and check the function of hand brake assembly

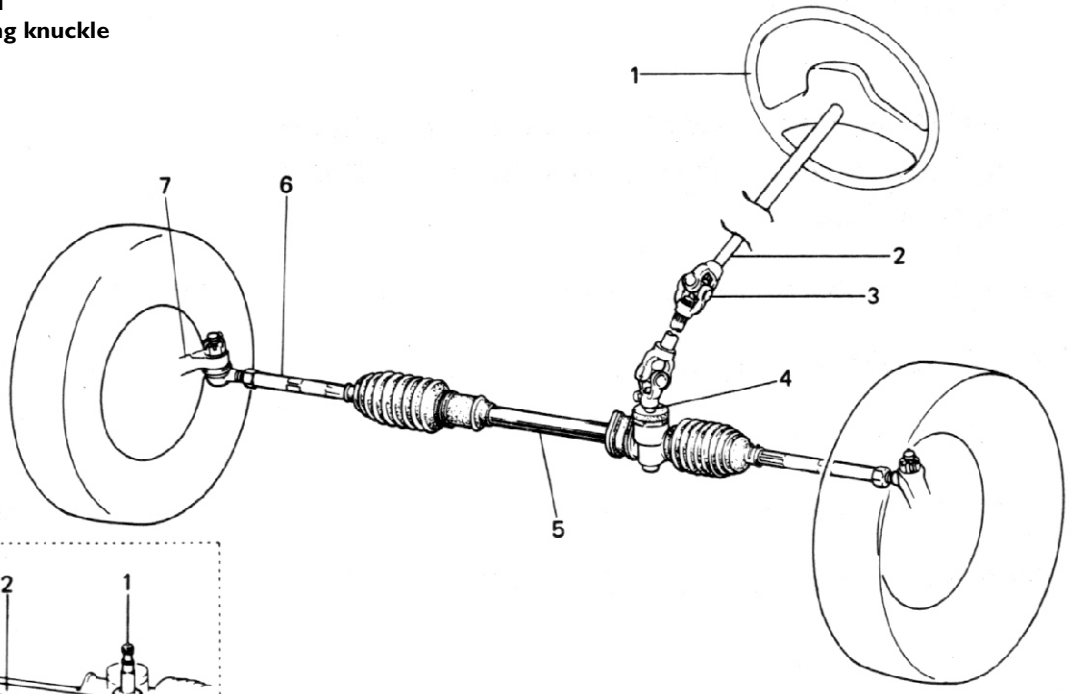
Adjust the parameter of the brake and accelerator potentiometer by hooking up the hand held to the controller as explained in section 3 of brakes

steering system 07.0

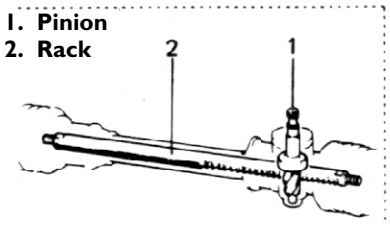
GENERAL DESCRIPTION

- The steering system consists of two main components, the rack and the pinion.
- Turning of the steering wheel provides the motion, which is transmitted to the steering shaft, and joints and then to the pinion. The pinion teeth mesh with teeth on rack, and the motion is further transferred to the rack, changed to linear motion. Then the force is transmitted through the tie rods to the steering arm, which turns the front wheels.

1. **Steering wheel**
2. **Steering shaft**
3. **Steering shaft joint**
4. **Steering pinion**
5. **Steering gear case**
6. **Tie rod**
7. **Steering knuckle**



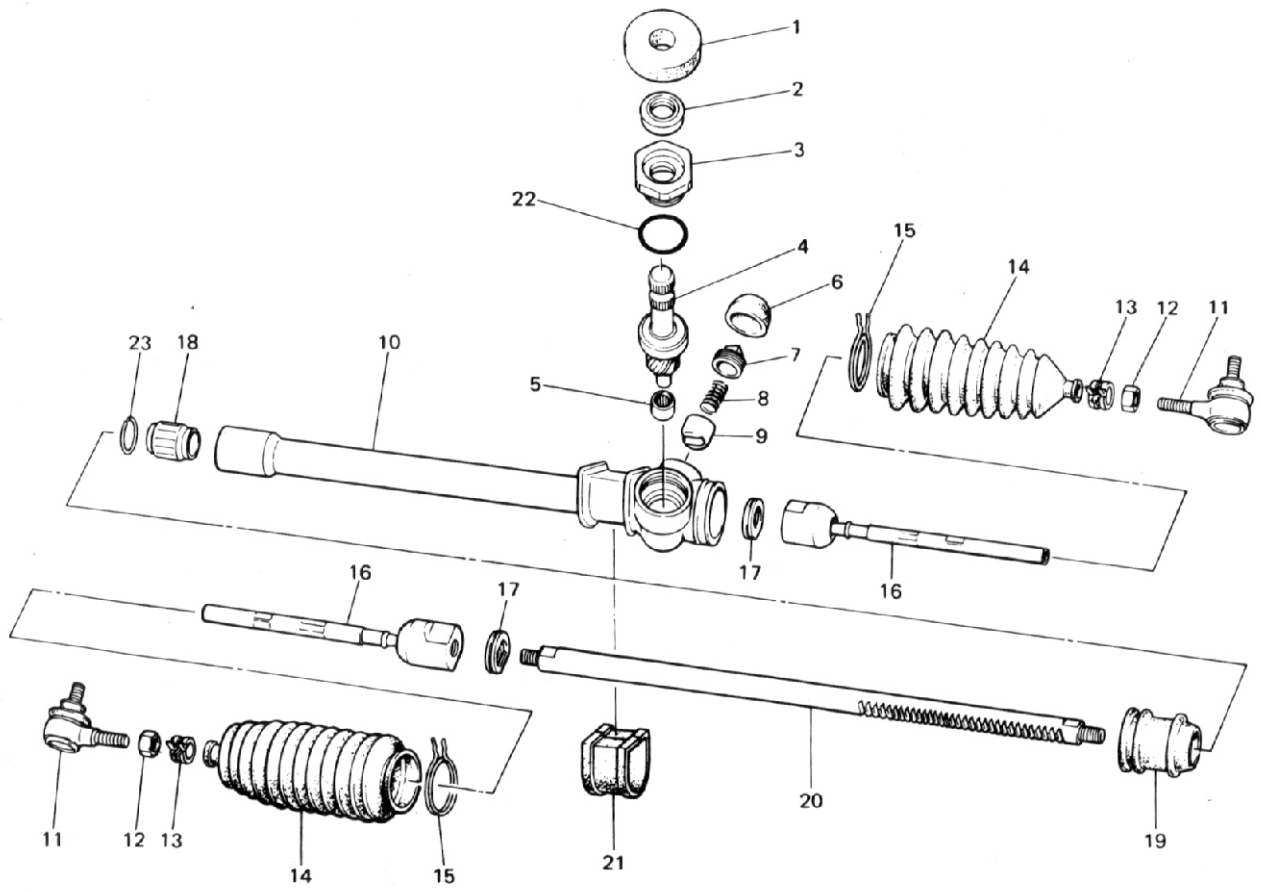
1. **Pinion**
2. **Rack**



Rack and Pinion

STEERING - RACK AND PINION

EXPLODED VIEW



1. Steering gear case packing
2. Steering gear case oil seal
3. Pinion bearing plug
4. Steering pinion
5. Steering pinion needle bearing
6. Rack damper screw cap
7. Rack damper screw
8. Rack plunger spring
9. Steering rack plunger
10. Steering rack housing & gear case
11. Tie-rod end
12. Tie-rod end lock nut
13. Rack boot clip
14. Boot
15. Wire
16. Steering tie-rod
17. Tie-rod lock washer
18. Steering rack bushing
19. Steering rack side mount
20. Steering rack
21. Steering pinion side mount
22. Gear case seat
23. Snap ring

STEERING SYSTEM - DISMANTLING

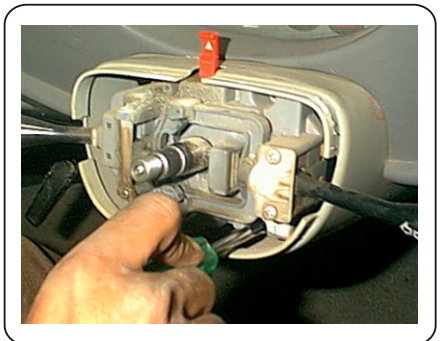
STEERING WHEEL - REMOVAL

- Hold horn cover on steering wheel and lift upward to remove.

- Use 19-mm box spanner with a small extension to loosen the centre lock nut provided in the steering wheel.

- Gently tap the steering wheel upward to remove or use steering wheel removing tool. (Part No TABDZ007)

- Uncap the tree switch by removing the 2 screws holding the cover.

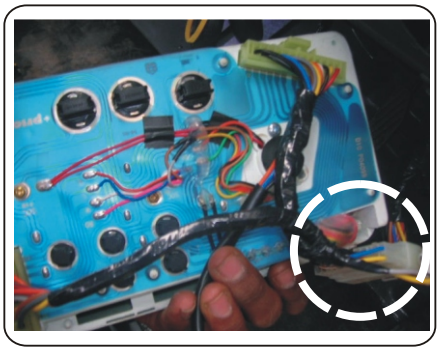


- Unscrew tree switch mounting screw 3 Nos. and remove the connections of the connector CN-10 and CN-11 from tree switch to wiring harness below the IP.

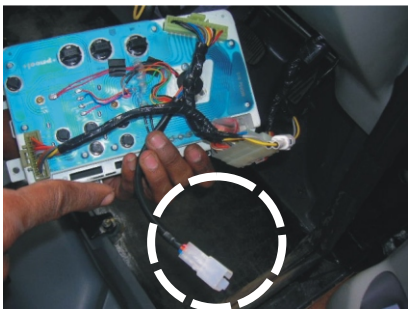
INSTRUMENT PANEL (IP) - REMOVAL

- Remove the screws of IP, which are in LH and RH side on the chassis.

- Offset the IP from the steering column.
- Remove the connector connecting to cluster unit.



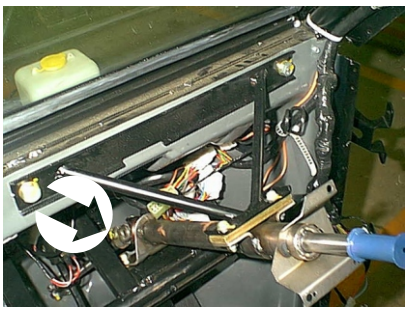
- Disconnect the Speedo cable connector from the cluster.
- Lift the IP and take it out of the car.

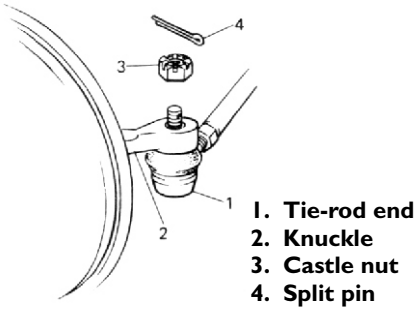


STEERING COLUMN - REMOVAL

- Follow step one to dismantle steering wheel.
- Follow step 2 to dismantle tree switch.
- After following the above, remove the IP cluster.
- Loosen the bottom steering pinion connection from the steering column joint.

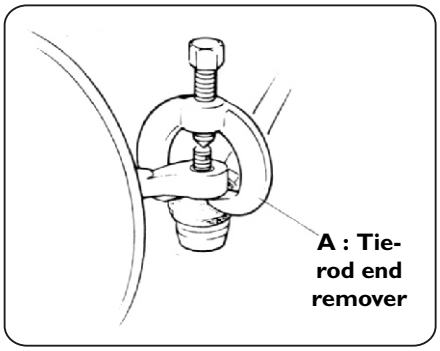
- Loosen the clamp bolts M8 from the centre mounting of the steering column, which is fixed to brake pedal.
- Loosen M6 screws from steering column top mounting to U-Clamp.
- Remove steering column from the vehicle.





STEERING RACK - REMOVAL

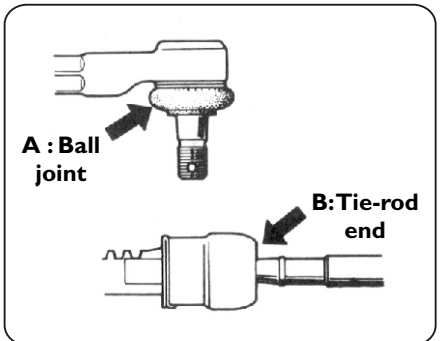
- Raise front side of the vehicle on safety stand.
- Remove front LH/ RH wheels from vehicle.
- Remove split pins from the steering arm, tie-rod, ball joint & castle nut.
- Unscrew castle nut.



- Disconnect ball joint by using special tools (0100 - 6003) from LH & RH side.

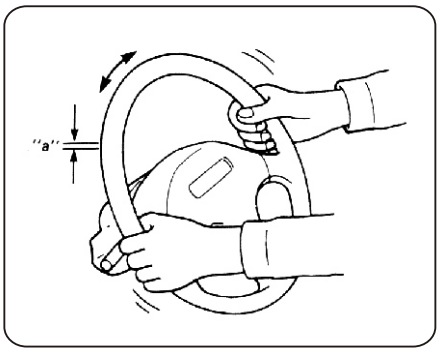
- Disconnect the other side in a similar way.
- Remove 'C' clamp mounting bolt M8 of LH & RH holding the steering rack housing in the chassis, located behind the stepney.

- Remove the M8 bolt of the bottom steering pinion connection release the steering rack and lift it out of the vehicle.



- Check for the tie-rod end and ball joint play.
- The play must be within the specified limit. If found defective, replace it.
- Check for within specification, inspect for the following. If found defective, replace.
- Wear of tie-rod end ball stud (ball stud should move when more than 2

STEERING SYSTEM - INSPECTION



STEERING WHEEL - INSPECTION

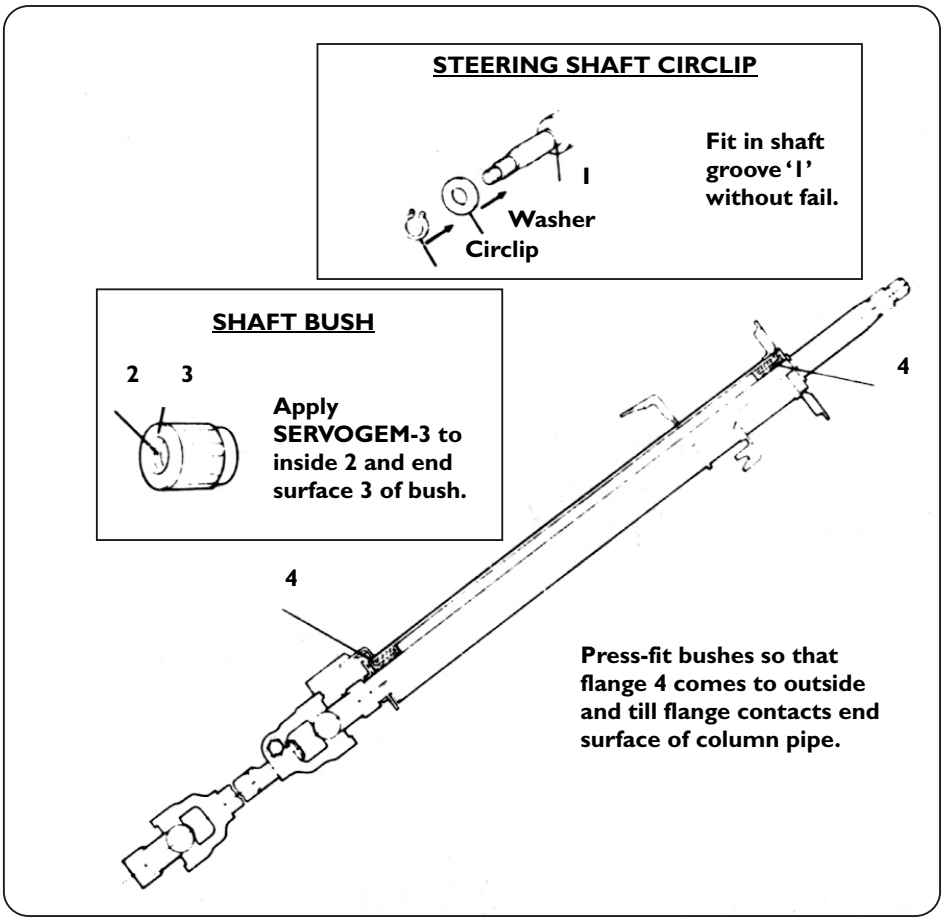
- Check the steering wheel play and rattling, when the vehicle is straight and in forward condition.
- Check for the play within the specified limit.
- If found incorrect, check and replace the following :
  1. Worn out 'A' arm ball joint & bushes.
  2. Worn out steering lower and upper ball joint serration.

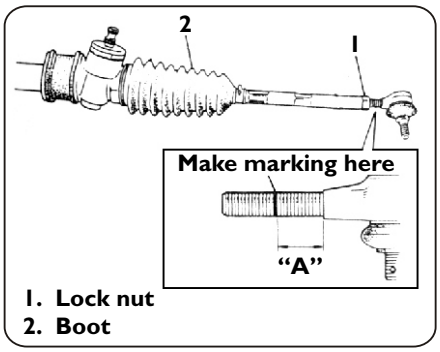
STEERING COLUMN - INSPECTION

- Check for the lower joint shaft play.
- Check for any damage in lower joint serration.
- Check for upper joint play.
- Check for the bent of centre mounting bracket.
- Remove the rack housing from the vehicle, fix it on a bench vice.
- If any part is defective replace it.
- If shaft is removed ensure to check the column bushes and replace if

NOTE

This steering column assembly can be made separate from shaft and column.





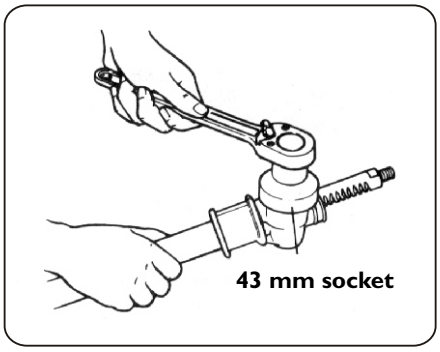
1. Lock nut
2. Boot

INSPECTION OF PINION & STEERING RACK

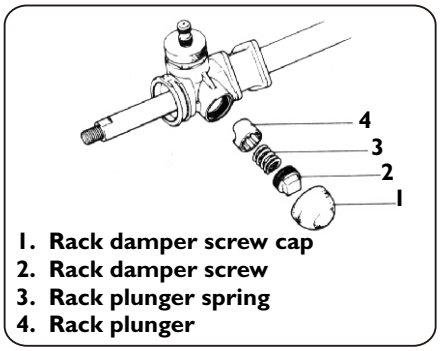
- Dismantle the rack & pinion for inspection, only if a play is found.
- Loosen the tie rod end lock nut and loosen the tie rod as shown below.

NOTE

Mark the tie rod end thread length, This doesn't disturb the wheel alignment after assembly.

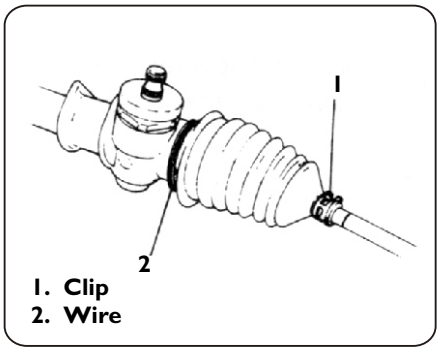


- Remove the rack plunger as shown below.



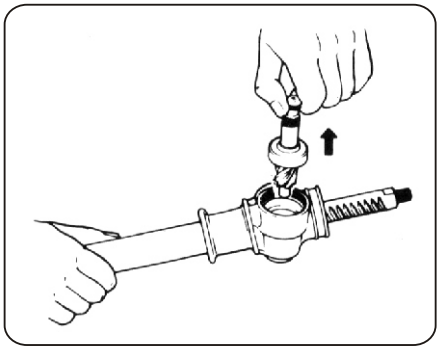
1. Rack damper screw cap
2. Rack damper screw
3. Rack plunger spring
4. Rack plunger

- Remove gear case packing and bearing as shown below.



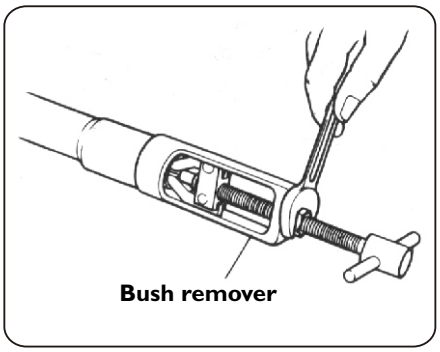
1. Clip
2. Wire

- Remove the rubber boot from tie.

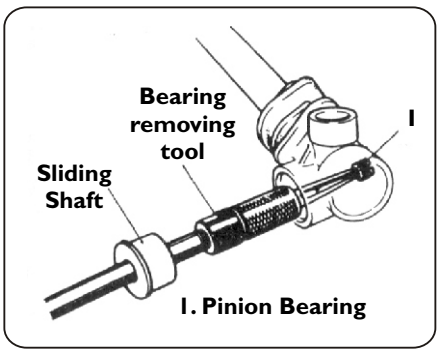


- Pull out pinion shaft as shown below.

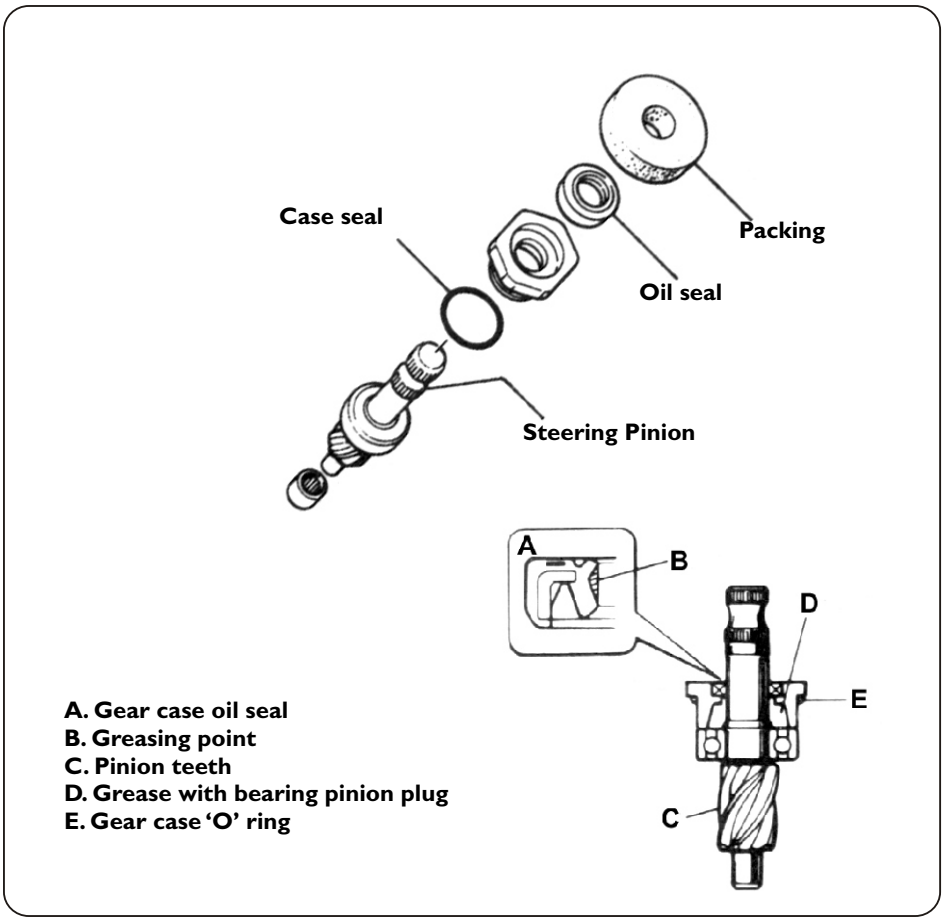
- Remove snap ring , and pull out bushing from rack housing with special tool (0100 - 6005).

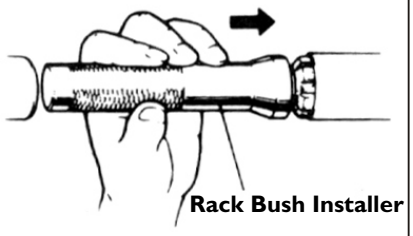


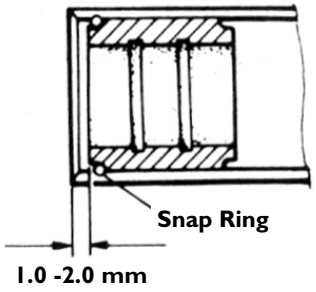
- Remove bearing assembly by using special tool (0100 - 60070).



- Check for teeth damage in pinion.
- Check for oil seal damage and replace it.
- Inspect gear case housing. If found damaged replace it.
- Check for rotation of bearing , replace if found defective.







STEERING GEAR CASE - INSTALLATION

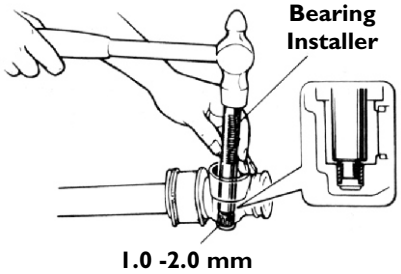
- While fitting the bush to rack housing, apply grease on inner surface area.
- Use special tool (0100 - 6004) as shown to fit the bush.

NOTE

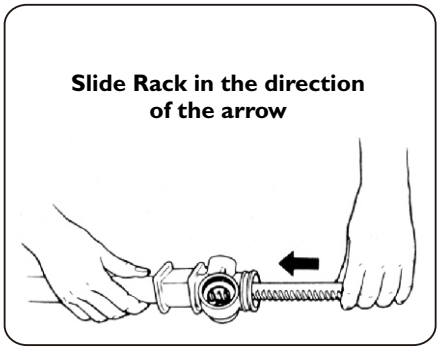
Assembly in all cases if not mentioned should be carried out in the reverse order of disassembly.

NOTE

After completion of steering system assembly, carry out wheel alignment, take a test drive, and check for steering wheel centre alignment.



- After installation of rack bush lock with the snap ring.
- Press fit pinion bearing into rack case as shown with special tool (0100 - 6006).



- Fit rack into steering housing from the direction shown below
- Assemble the rack & pinion to car and test drive the vehicle for steering stability.

TORQUE SPECIFICATION

• Steering rack mount bracket	M8 x 1.25 x 35	25 - 30 Nm
• Castle nut of steering rack	M12 x 1.25	35 - 50 Nm
• Steering column & steering rack clamp	M8X 1.25 x 30	25 - 30 Nm
• Upper bracket of steering column	M6 x 1 x 25	10 - 12 Nm
• Steering arm cont support bracket & pedal box	M8 x 1.25 x 25	18 - 20 Nm
• Steering column top support fixing bracket	M10 x 1.5 x 25	25-30 Nm
• Steering Ball joint	M8X1.25x35	25-30 Nm

front suspension 08.0

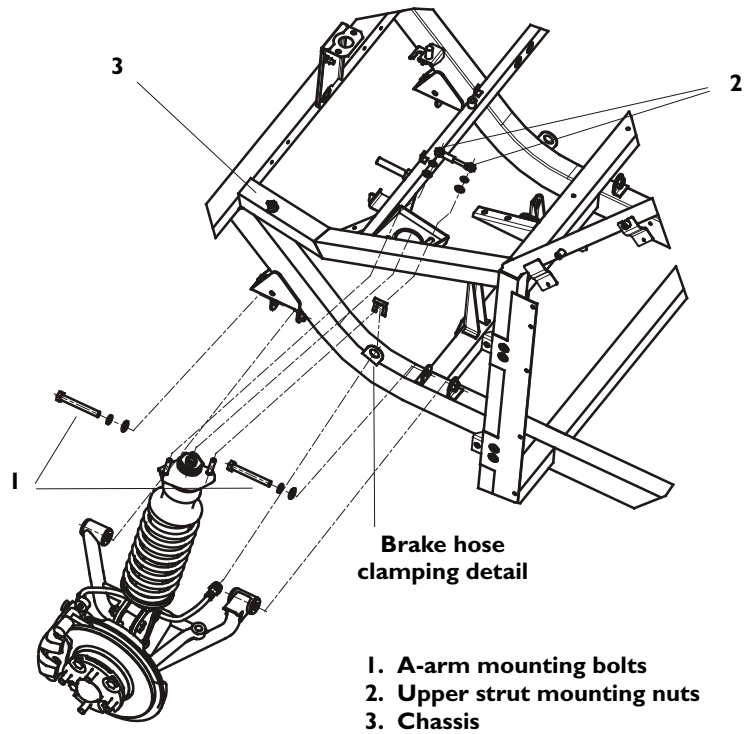
GENERAL DESCRIPTION

The front suspension is MacPherson strut type independent suspension, where the upper end of the strut is mounted to the chassis and the lower end is connected to the upright . A rubber mounting on chassis isolates the strut support. The front suspension consists of 'A ' arm ,upright struts & steering arm. The lower end of a strut is connected to the upper end of the upright, which is supported by strut combined with the coil spring.

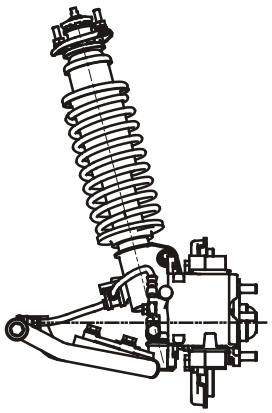
The steering arm is mounted on the upright which is connected to the tie rod end of the steering . The steering wheel movement is transmitted from tie rod to the upright that moves the tire and wheel to move .The wheel turning movement with the help of ball joint provided in ' A ' arm.

FRONT SUSPENSION - REMOVAL FROM VEHICLE

- Remove front wheel.
- *Follow* ***Standard Workshop Procedure - II*** *(Pg. 14 / Sec. 1.0)*
- To remove the front suspension assembly from the vehicle disconnect the 2 'A' arm mounting bolts, along with the 2 upper strut mounting nuts which are connected to the chassis bracket .



Brake hose clamping detail



Front suspension assembly

1. **A-arm mounting bolts**
2. **Upper strut mounting nuts**
3. **Chassis**

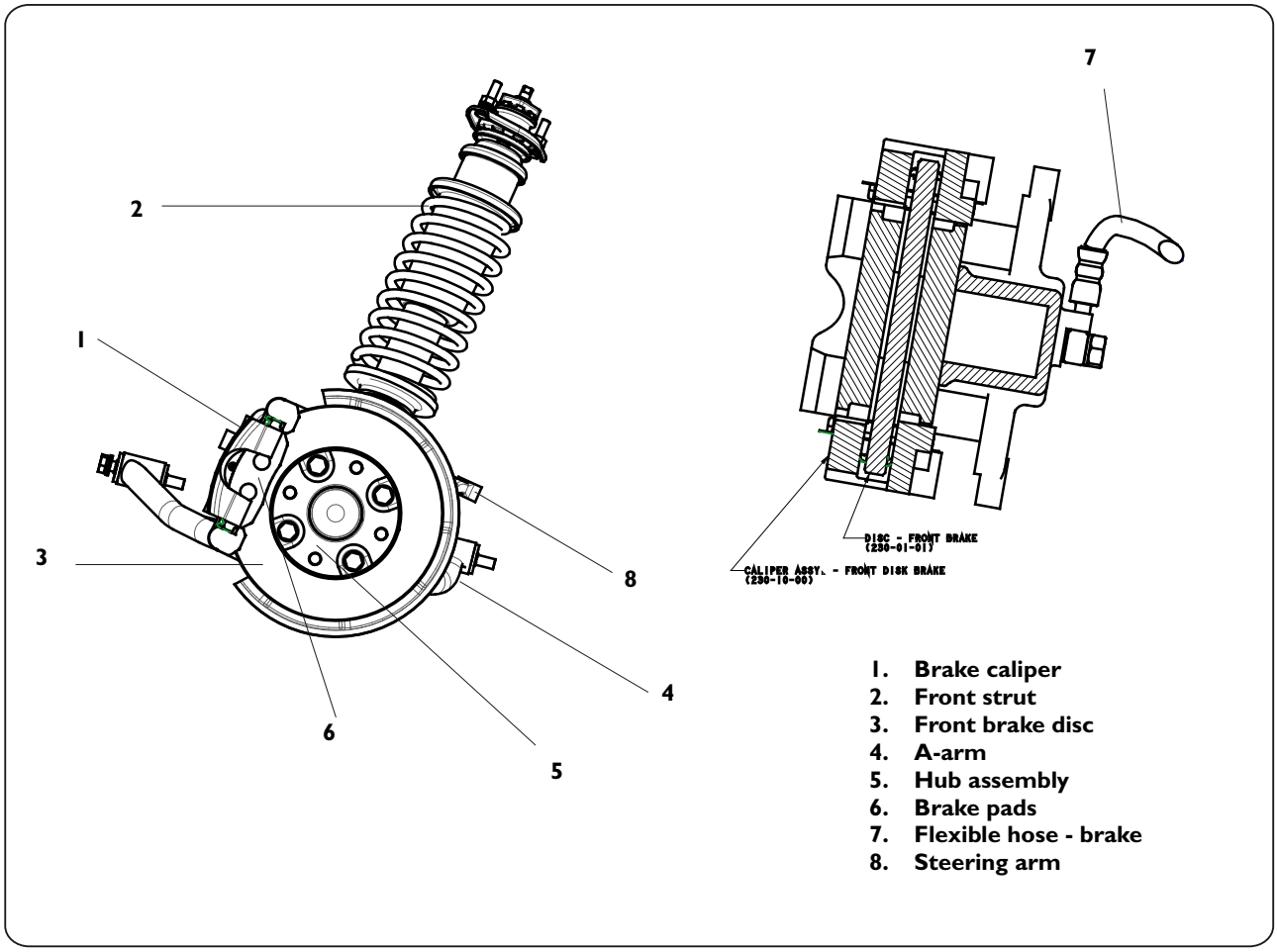
FRONT SUSPENSION - ‘A’ ARM

‘A’ ARM -DISMANTLING

- Remove the two mounting upper strut mounting bolts of ‘ A’ arm which are connected to the chassis bracket. *(Refer Pg. 124)*
- Disconnect the bolt, which is connected to ‘ A ‘ arm ball joint and upright.
- Loosen the lower strut bottom mounting bolt from the upright.

‘A’ ARM - INSPECTION

- Loosen the ‘ A’ arm ball joint by removing the 3 bolts.
- Check for any damages in the tube of ‘A’ arm.
- Check for the damage in ‘ A’ arm mounting bushes.
- Check for the ball joint rubber seal and damage of ball joint.
- Replace any part if found damaged.



1. **Brake caliper**
2. **Front strut**
3. **Front brake disc**
4. **A-arm**
5. **Hub assembly**
6. **Brake pads**
7. **Flexible hose - brake**
8. **Steering arm**

FRONT SUSPENSION - UPRIGHT

UPRIGHT - DISMANTLING

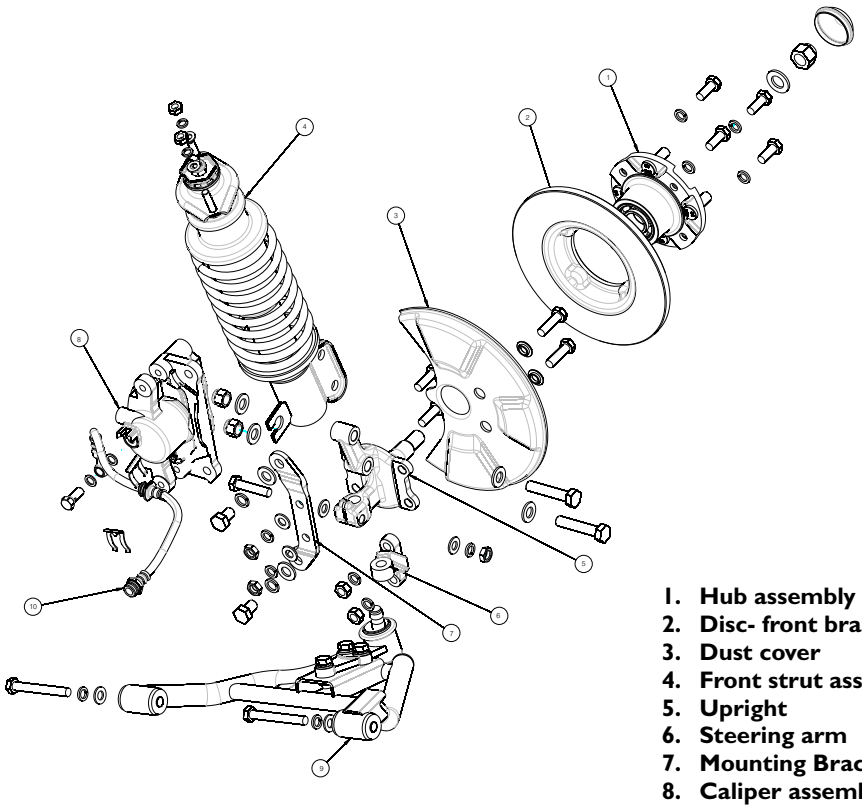
- Disconnect the 'A' arm as explained on the previous page.
- Disconnect the steering tie rod end ball joint from the steering arm which is fixed to upright.
- Loosen the centre nut of the brake disc and remove the brake disc.
- Loosen the four bolts on the back plate which are attached to the upright.
- Remove the 'E ' ring securing brake flexible hose from the bracket and remove the flexible hose and bundy tube.
- Loosen the bottom mounting of the strut and remove the upright from the vehicle.

UPRIGHT - INSPECTION

- Check for any cracks & damage in the forging of upright.
- Replace if found damaged.

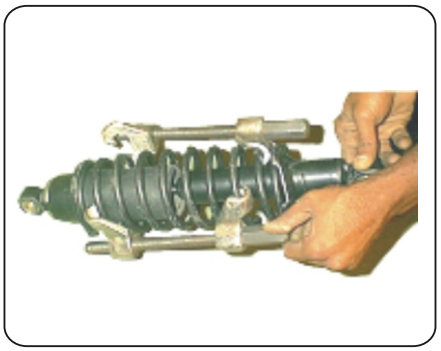
NOTE

If the overhaul of suspension is done on car avoid removing the brake bundy pipe from the back plate. If brake bundy pipe is removed brake bleeding is to be carried out.



1. **Hub assembly**
2. **Disc- front brake**
3. **Dust cover**
4. **Front strut assembly**
5. **Upright**
6. **Steering arm**
7. **Mounting Bracket- caliper assy**
8. **Caliper assembly**
9. **A-arm**
10. **Flexible hose- front disc brake**

FRONT SUSPENSION - STRUT



STRUT - DISMANTLING

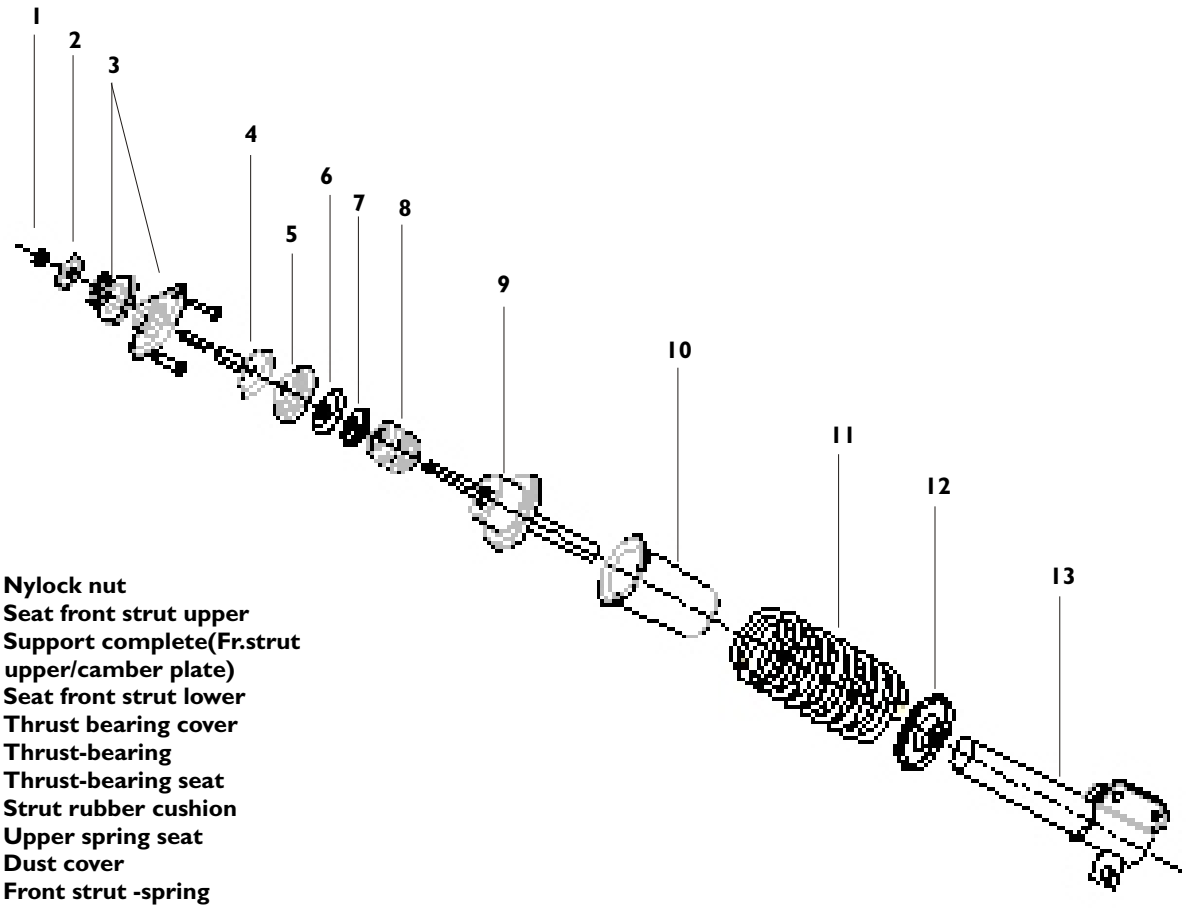
- Remove the bottom mounting of strut from upright.
- Remove the two top mounting bolts from the strut which is connected to the chassis.
- Place the strut on special tool and compress the spring as shown.
- Compress the spring and remove the lock in the top.
- Disassemble all the parts, check for the correct wear of rubber bush & washer.
- Replace if found damaged.

STRUT - INSTALLATION

- Fix the spring to the stepped part of the lower strut as shown.
- Install spring seat and upper mating part and compress with the special tool.
- Lock the upper cover after the spring is compressed.
- Install the mount seat strut mount stopper and inner support as shown.
- Tighten the strut to the specified torque.

NOTE

Assembly in all cases is the reverse of disassembly.



1. **Nylock nut**
2. **Seat front strut upper**
3. **Support complete(Fr.strut upper/camber plate)**
4. **Seat front strut lower**
5. **Thrust bearing cover**
6. **Thrust-bearing**
7. **Thrust-bearing seat**
8. **Strut rubber cushion**
9. **Upper spring seat**
10. **Dust cover**
11. **Front strut -spring**
12. **Spring seat-lower**
13. **Strut element**

TORQUE SPECIFICATIONS

Strut top mounting	50 - 55 NM
'A' arm mounting bolts	M10 x 1.5 x 45

rear suspension 09.0

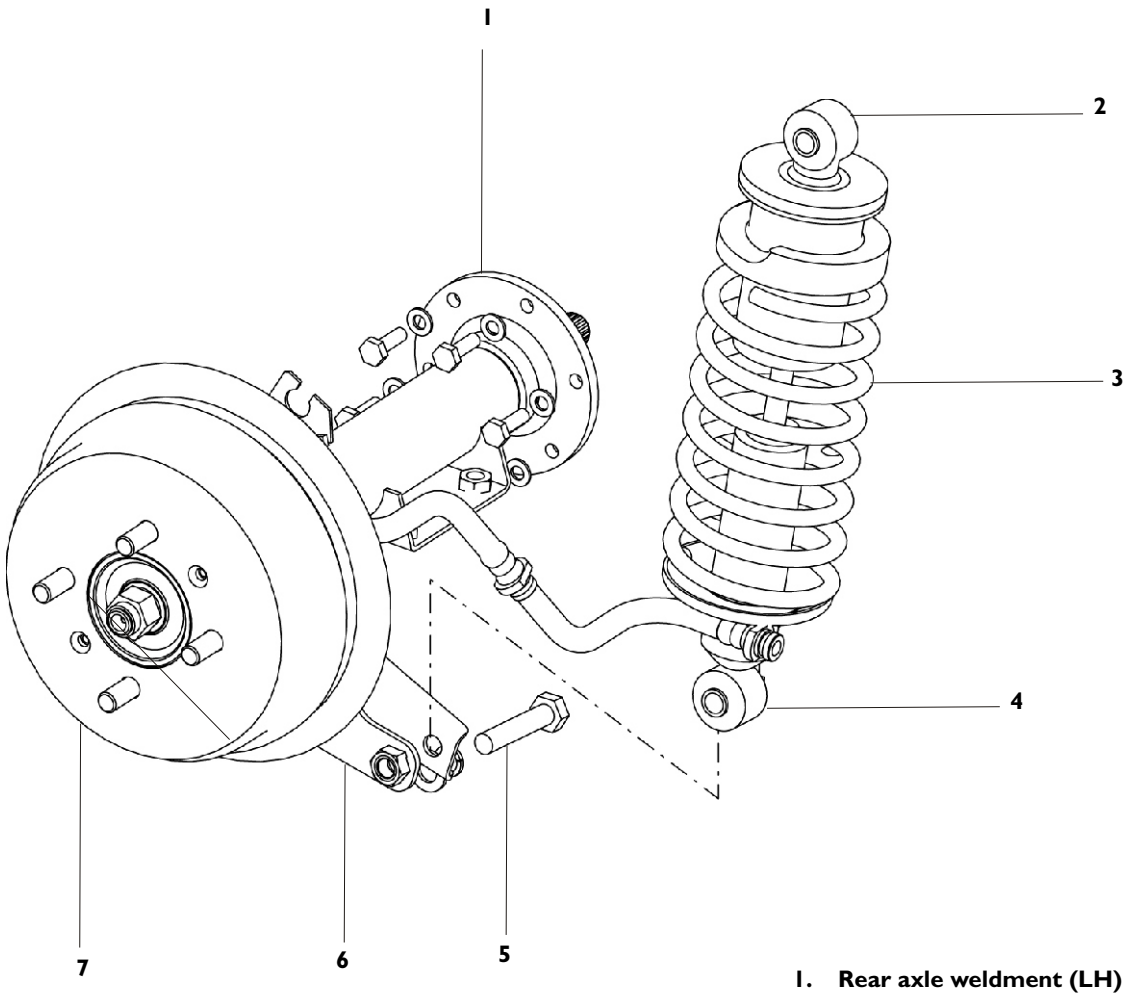
GENERAL DESCRIPTION

The rear suspension consists of a strut supported by coil springs, where as the upper end is connected to the chassis and the lower end is supported by the drive axle housing assembled to a trailing arm with a centre pivot point mounted on to chassis with a support of pan hard rod.

REAR SUSPENSION - REMOVAL FROM VEHICLE

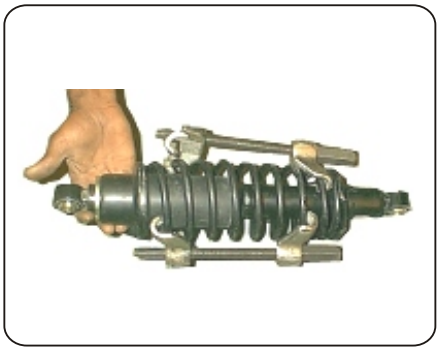
- Remove rear wheels.
- *Follow **Standard Workshop Procedure - II** (Pg. 14 / Sec. 1.0)*

- Loosen the top mounting bracket of the strut from the chassis.
- Remove the bottom mounting bolt of strut, which is fitted on the welded bracket to the axle housing.



1. **Rear axle weldment (LH)**
2. **Upper strut mounting point**
3. **Rear strut**
4. **Lower strut mounting point**
5. **Lower strut mounting bolt**
6. **Lower strut mounting bracket**
7. **Rear drum brake**

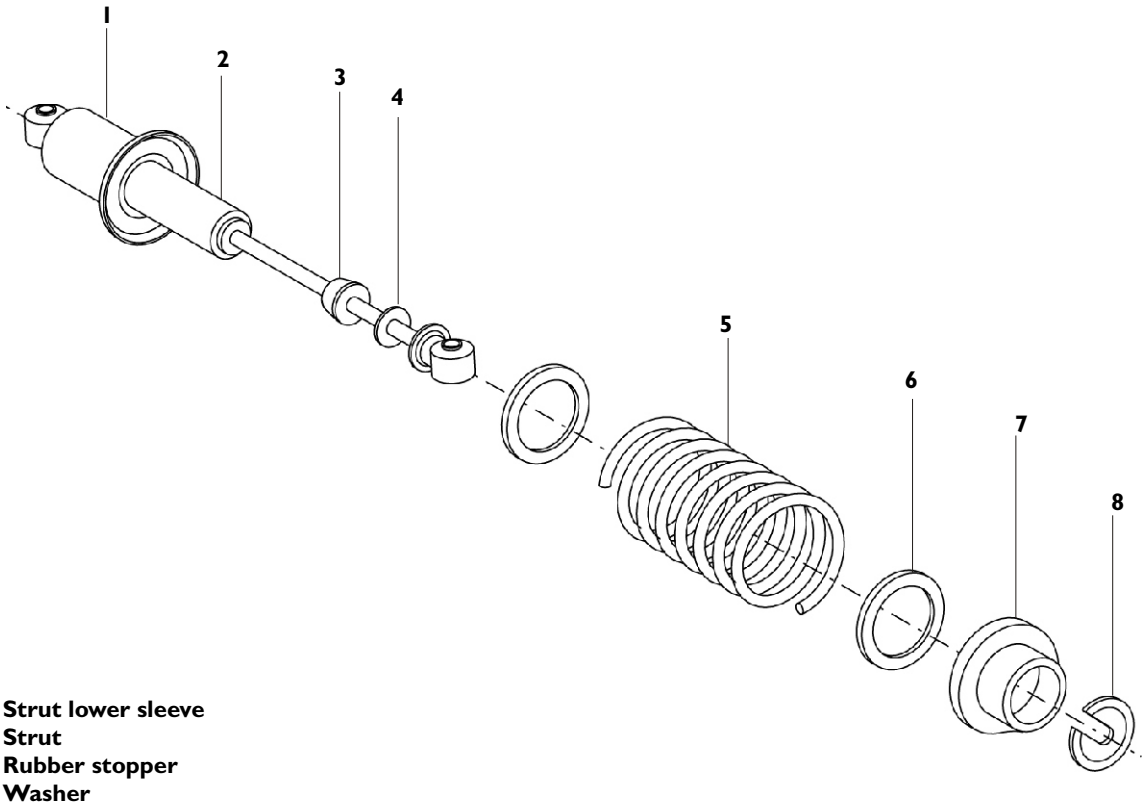
REAR SUSPENSION - INSPECTION



- Check for any oil leakage in the strut.
- Check for any damage in spring and strut assembly.
- Fix the Special tool for removing the spring as shown in the figure and remove the spring by tightening the special tool.
- Remove the coil spring from the strut.
- Check for the damage in rubber bushes and sleeve from top & bottom mounting of strut.
- Check for the function of strut by compressing and releasing the strut.
- See for any damage in the strut & oil leakage.
- Check for the rubber stopper for any damage.

REAR STRUT - ASSEMBLY

- Fix the coil spring by using the special tool as shown.
- Fix the rubber dust cover over the coil spring.
- Fix the coil spring top mounting cup which should be locked in-between the spring.
- Lock the strut assembly by a split washer.
- Replace the mounting bush if worn out.
- Install the strut to the body by mounting the lower and upper mounting
- Test drive the vehicle for comfort handling.



1. **Strut lower sleeve**
2. **Strut**
3. **Rubber stopper**
4. **Washer**
5. **Coil spring**
6. **Bush**
7. **Strut upper sleeve**
8. **Locking split washer**

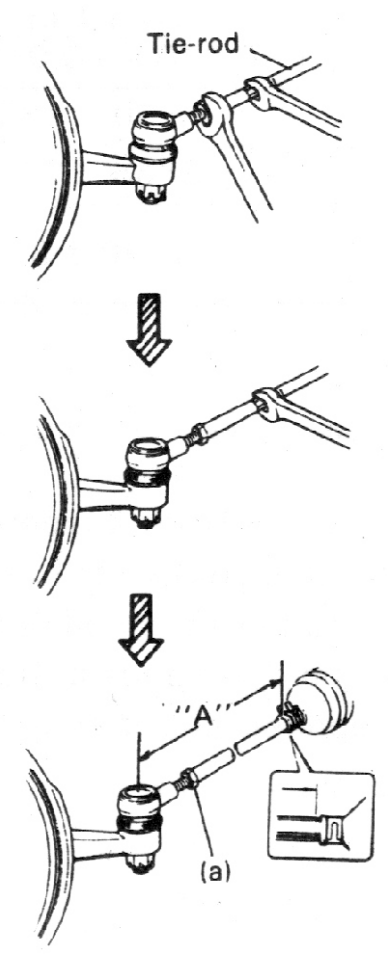
TORQUE SPECIFICATIONS

Upper strut mounting	M12 x 1.75	50 -55 Nm
Lower strut mounting	M12 x 1.75 x 60	50 - 55 Nm

wheel alignment 10.0

GENERAL DESCRIPTION

- Alignment refers to the angular relationship between the front wheels, and front suspension attached parts to the ground.
- The alignment is done for excessive wear and tear of tyres and smooth handling of the vehicle
- The caster angle is fixed in a car,
- The camber angle to be adjusted as per the vehicle manufacturer's specification
- Due to the damage caused by hazardous road conditions or collision, whether the damage is in the suspension should be determined and repair or replace.



TOE

- Toe is the turning in or out of the front wheels. The purpose of a toe specification is to ensure parallel rolling of the front wheels (excessive toe-in or toe-out may increase tyre wear)
- Amount of toe can be obtained by subtracting A form B as shown in the figure and is given in mm.

TOE ADJUSTMENT

- Check the no. of rotation of the steering wheel from left to right and center the steering wheel in equal rotation.
- Toe is adjusted by changing tie rod length. Loosen right and left tie rod ends lock nuts first and then rotates right and left tie rods by the same amount to align toe-in to specification. In this adjustment, right and left tie rods should become equal in length.
- Before rotating tie rods, apply grease between tie rods and rack boots so that boots won't be twisted. After adjustment, tighten lock nuts to specified torque and make sure that rack boots are not twisted.

CAMBER

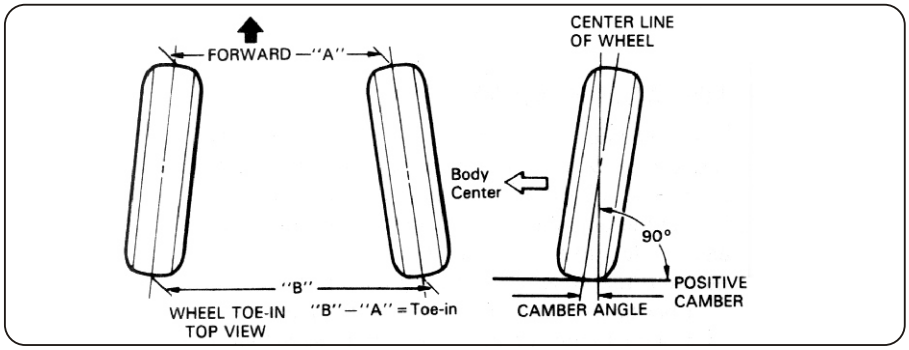
- Camber is the tilting of the front wheels from the vertical, as viewed from the front of the car.
- When the wheels tilt outward at the top, the camber is positive. When the wheels tilt inward, negative camber is said to exist. The amount of tilt is measured in degrees.

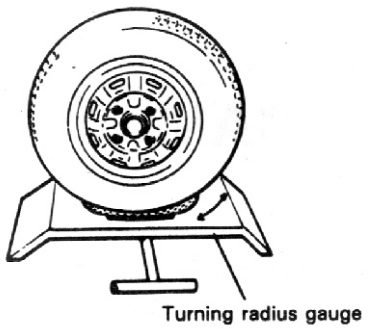
PRELIMINARY CHECKS PRIOR TO ADJUSTING FRONT ALIGNMENT

- Steering and vibration complaints are not always the result of proper alignment. An additional item to be checked is the possibility of tyre lead due to worn out or improperly manufactured tyres. “Lead” is the deviation of the car from a straight path on a level road without hand pressure on the steering wheel.
- Before making any adjustment affecting toe setting, the following checks and inspections should be made to insure correctness of alignment readings and alignment adjustments:
- Check all tyres for proper inflation pressures and approximately the same tread wear.
- Check for loose ball joints. Check tie rod ends; if excessive looseness is noted, it must be corrected before adjusting.
- Right-to-left trim height difference should be within 15 mm with curb weight.
- Check for loose control arms
- Consideration must be given to excess loads, such as toolboxes. If this excess load is normally carried in the car, it should remain in the car during alignment checks.
- Consider the condition of the equipment being used to check alignment and follow the manufacturer instructions.
- Regardless of equipment used to check alignment, the car must be on a level surface.

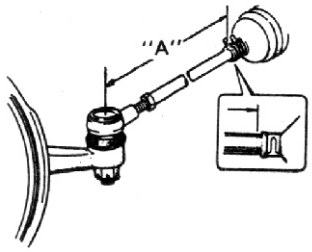
CAMBER ADJUSTMENT

- Should camber or caster be found out of specifications upon inspection,
- If it is in damaged, loose, bent, dented or worn suspension parts, they should be replaced.
- If it is in car body, repair it to attain specifications.
- To prevent possible incorrect reading of camber and caster, car front end must be moved up and down a few times before inspection.





Turning radius gauge



STEERING ANGLE

- When tie rod or tie rod end is replaced, check toe and then also steering angle with turning radius gauges.
- If steering angle is not correct, check if right and left tie rods are equal in length.

NOTE

If tie rod length were changed to adjust steering angle, re-inspect toe-in.

ALIGNMENT SERVICE DATA

FRONT WHEEL ALIGNMENT

Parameters	Specifications	TOLERABLE RANGE	
		MIN	MAX
Total Toe	+2.0mm	+1.5	+2.5
Partial Toe	+1.0mm	+0.75	+1.25
Set - Back	+0° 0'	+-0 ° 36'	+0 ° 36'
Camber	+0° 30'	0 ° 20'	+ 0 ° 40'
Steering Angle	+0° 0'	-0 ° 36'	+0 ° 36'
Caster	+10° 0'	+9° 30'	100 30'
King - Pin	+0° 0'		
Included Angle	------	------	-----

REAR WHEEL ALIGNMENT

Parameters	Specifications	Tolerable Range	
		min	max
Total Toe	+0° 0'	---------	-------
Partial Toe	+0° 0'	--------	--------
Camber		------	-----
Thrust Angle	+0° 0'	-0 ° 15'	+00 ,5'

tyres + wheels 11.0

TYRES

- This vehicle is equipped with tubeless tyres
  145/70R13 - HANKOOK
- This is designed to operate loads upto the full rated load capacity satisfactorily . When tyres are inflated to the recommended inflation pressure
- The tyre is designed to Lower Rolling Resistance, which enhances your driving range.
- Better road grip in wet conditions.

CONDITIONS OF REPLACEMENT

- Use original tubeless tyres when tyre is being replaced.
- The wear indicators are seen at three or more places around the tyre.
- The tread or sidewall is cracked, cut, or snagged deep enough to show cord or fabric.
- If the tyre has a bump, bulge or split.
- If the tyre has a huge damage, puncture or cut, depending on the size

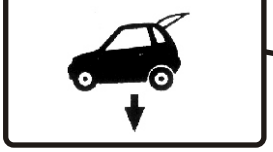
NOTE

While replacing the tyre, please refer the original tyre placard.

TYRE PLACARD

- The tyre placard is located on the right door rear hatch opening and should be referred to for tyre information. The placard lists the maximum load, tyre size and cold tyre pressure when applicable.

TYRE	145/70R13(TUBELESS)	
RIM	4B X 13	
TYRE PRESSURE (COLD)	kg/cm²	Psi
FRONT	2.5	35
REAR	2.8	40



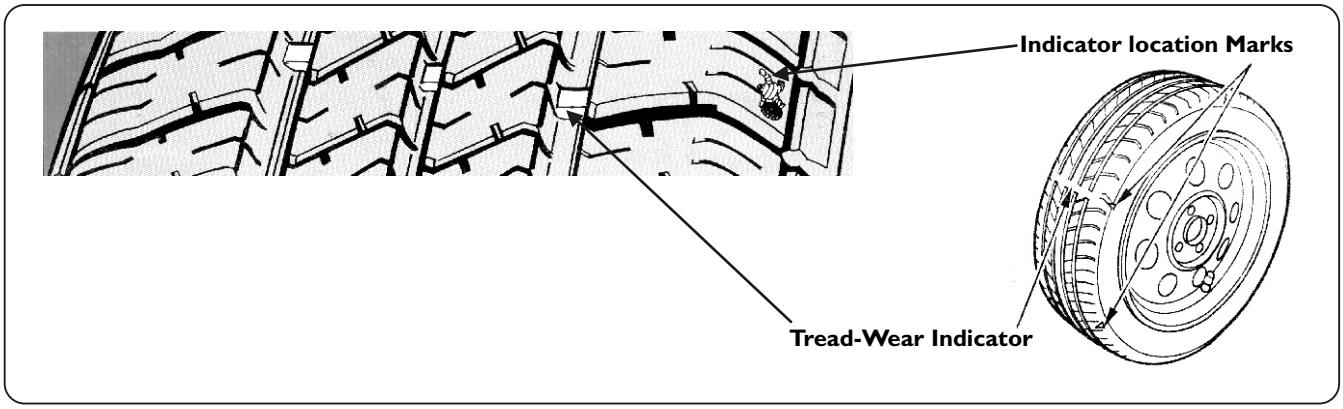
NOTE

The tyre that is replaced should be of same size and same load range as per the original specifications of the vehicle.

The use of other tyre and wheel rim may affect the ride, handling vehicle, ground clearance and calibration of speedometer/odometer and range.

WEAR INDICATORS

- Tyres carry tread depth indicators, which show whether a tyre is reaching its wear limit. When the indicators appears 3 or more grooves at 6 locations, tyre replacement is recommended.



SPARE WHEEL

- Except in particular cases such as the use of a temporary spare tyre, it is not recommended to fit bias-belted or cross-ply tyres to the rear of the

NOTE

Mixing different types of tyre such as radial, bias and bias belted tyres in the vehicle may cause serious handling problem and may cause loss of control.

TYRES - INFLATION

- The pressure recommended for Reva is carefully calculated to give a comfort handling, tread wear and tyre life.
- It is normal for tyre pressure to increase, when the tyres get hot due to driving.
- Do not bleed or reduce tyre pressure after driving. Bleeding reduces the "cold inflation pressure.
- Tyre pressure with tyre cold (less than one km drive) should be checked monthly.

COLD PRESSURE	Kg/cm ^{2}	Psi
Front	2.5	35
Rear	2.8	40

HIGHER THAN RECOMMENDED PRESSURE CAN CAUSE :

1. Hard drive
2. Tyre bruising
3. Rapid tread wear at center of tyre.

LOWER THAN RECOMMENDED PRESSURE CAN CAUSE :

1. Tyre squeal on turns
2. Hard steering
3. Rapid and uneven wear on the edges.
4. Tyre rim rupture
5. Tyre corde breakage.
6. High tyre temp.
7. Reduced handling
8. High power consumption

UNEQUAL PRESSURE ON SAME AXLE CAN CAUSE:

1. Uneven braking
2. Reduced handling
3. Swerve on acceleration.

TYRES - FIXING AND REMOVING

- The tyre changing should be done using a tyre changer machine to mount or de-mount the tyres.

NOTE

Hand tools or tyre removing irons to change tyres may cause the tyre breads or rims to damage.

Follow the manufacturer's instruction before removing or installing tyres.

CAUTION

While inflating do not stand or hammer the tyre if the tyre does not sit correctly on the corner of rims, release the pressure and re-inflate

Over inflation can cause damage or break leading to personal serious injury.

- After mounting, inflate to specified pressure and check that beads are completely seated.

TYRES - REPAIR

- The tubeless tyre should be repaired by an authorised person.

WHEELS

- The standard wheels used in the REVA are the steel wheels **4B X 13.**

WHEELS - REPLACEMENT

- Wheels must be replaced if they are bent, dented, have excessive lateral or radial run-out, leak air through welds, have elongated bolt holes, or heavily rusted.
- Wheels with run-out greater than shown below may cause vibrations. Replacement wheels must be equivalent to the original equipment wheels in load capacity, diameter, rim width, offset and mounting configuration.
- A wheel of improper size or type may affect wheel and bearing life, brake cooling, speedometer/odometer calibration, car ground clearance and tire clearance to the body and chassis.
- A wheel of improper size or type may affect wheel bearing life, brake cooling, Speedometer / Odometer calibration, car ground clearance and tyre clearance to the body and chassis.
- Higher tyre pressure can cause steering hard & rapid tyre wear in centre of the tyre.
- lower tyre pressure can cause the vehicle to squeal on turns , Rapid and uneven tyre weariness on edges and reduce comfortless in handling
- Unequal tyre pressure on the same axle can cause uneven brake skidding, steering lead, high consumption & reduced handling.

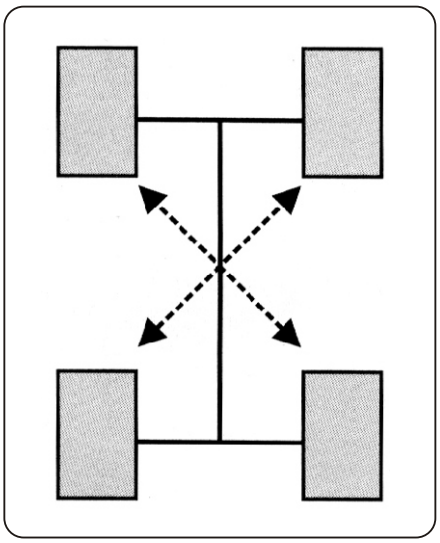
NOTE

The valve caps should always be on the valve to avoid dust and water.

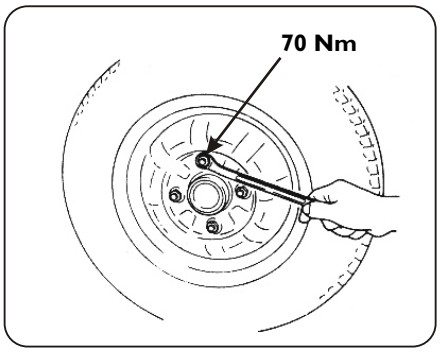
WHEELS - MAINTENANCE

- The welding and heating of wheel rim and repairing is not recommended.
- Damaged wheels must be replaced.

WHEELS & TYRES - ROTATION



- To equalize the wear of tyres the tyres on the vehicle must be rotated periodically. After tyre rotation the front wheels should be balanced and check for the wheel alignment.
- Check for damaged tyres and wheels.
- The purpose of regular rotation at specified intervals is to achieve more uniform wear on the vehicle.
- The rotation of tyres is most important .The rotation pattern is as shown below.
- After the tyres have been rotated, adjust the front and rear inflation pressures as indicated on the right hand door near the rear hatch opening.
- The tyre specification should be the same as recommended by the vehicle manufacturer.
- If the customer uses the spare wheel, ensure that the spare wheel, which is the tubed tyre, goes back to the original place. If the spare wheel is used for long period of running, the ride quality is hampered and the range of drive could be reduced.
- Make sure that the wheel nuts are tightened to the specifications.



WHEELS - REMOVAL

- Loosen the wheel nuts by 180 degree by using wheel spanner or pneumatic gun
- Jack the car and place the axle stands or hoist the car.
- Remove the wheel from the vehicle
- When the wheel is assembled to the vehicle, the nuts must be tightened in a diagonal pattern to avoid bending of wheel rim.
- Tightening torque of wheel nut for front & rear is 70 N-m.

NOTE

Before installing wheels, remove any build up of corrosion on the wheel mounting surface and brake drum by scraping and wire brushing. Installing wheels without good metal-to-metal contact at the mounting surfaces can cause the wheel nuts to loosen, which can later allow a wheel to come off when the car is moving.

NOTE

Never use heat to loosen up a tight wheel because the application of heat to the wheel can damage the bearings and shorten the life of the wheel.

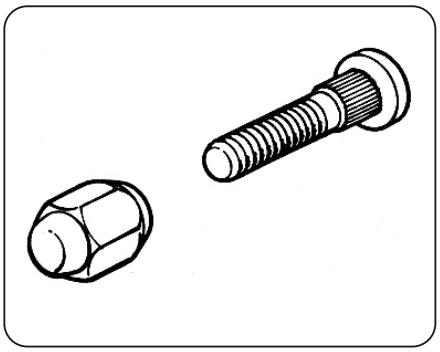
WHEELS - BALANCING

- Dynamic balance is the equal distribution of weight on each side of the wheel centerline so that when the tyre spins there is no tendency for the assembly to move from side to side.
- Wheel rim must be clean and free from deposit of mud etc.
- The wheel balancing tyres should be checked for damage and then balanced according to the equipment manufacturers.

NOTE

Stones should be removed from the tread in order to avoid operator injury during spin balancing and to obtain a good balance.

WHEELS AND WHEEL NUTS - REPLACEMENT

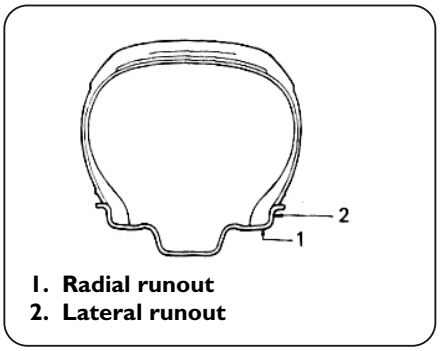


- Replace the wheel rims which are badly cracked, corroded and bent .
- If the wheel nut tightening area in the rim is found to have increased.
- If the air gets leaked from wheel rims , replace the rim.
- New wheel rim should have the same load-carrying capacity, diameter, width, offset and be mounted the same way as manufacturer's.

NOTE

Using the wrong replacement wheels, wheel bolts, or wheel nuts on your vehicle can be dangerous. It could affect the braking and handling of your car, make your tyres loss in air, and make the driver to lose the control.

GENERAL TYRE CARE – HANKOOK



1. Radial runout
2. Lateral runout

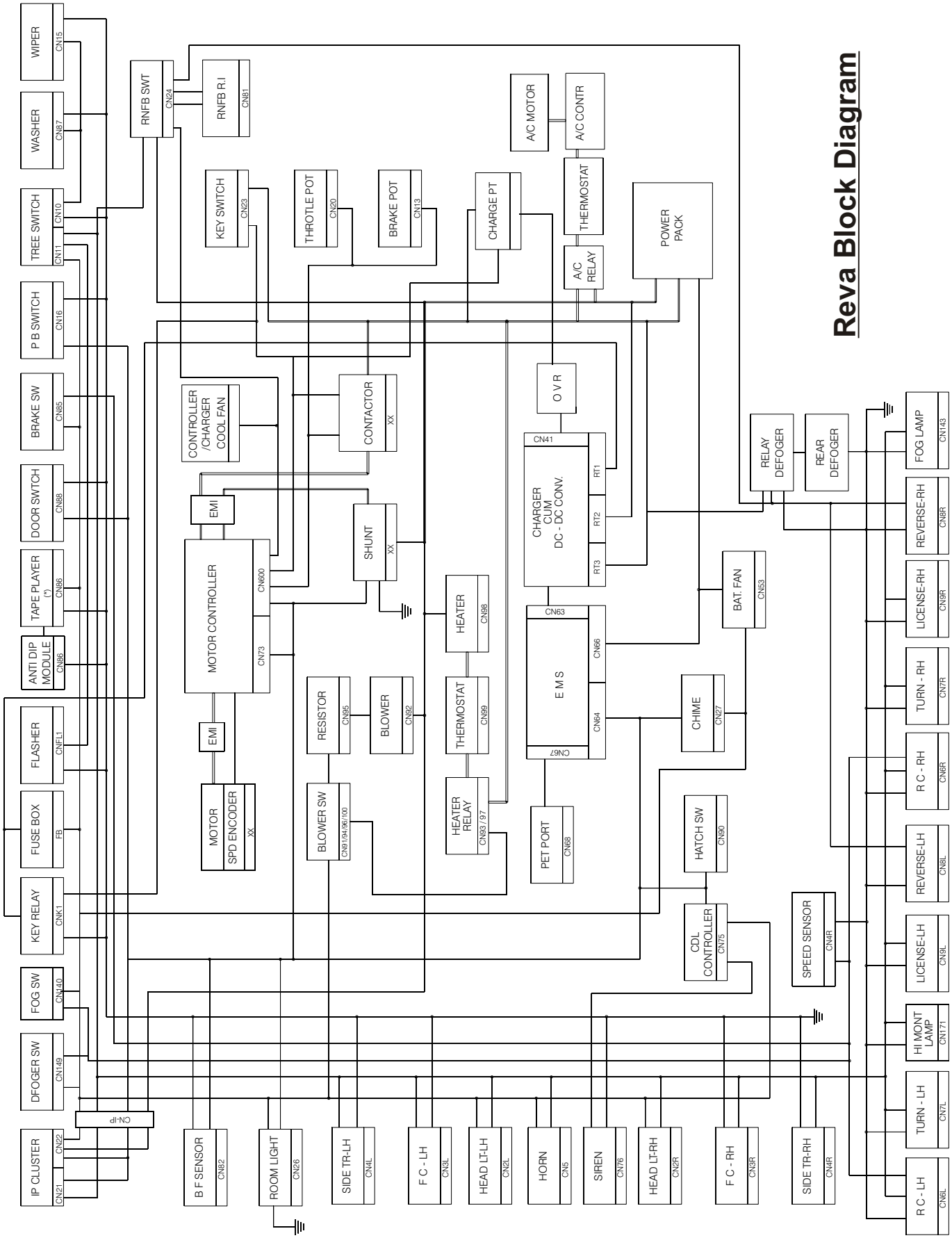
- Maintain air pressure as recommended by the vehicle manufacturer (to be checked cold).
- Periodic wheel balancing and alignment should be ensured.
- Tyres should be changed when the Tread Wear Indicator (TWI) is reached
- New tyres should be the same as OE – any change in the specifications must be made after consulting the vehicle manufacturer or a tyre expert
- Mixing of tyres must be avoided – bias / radial, different sizes / LI / SI / Aspect ratio
- New tyres should be fitted on the rear as far as possible
- Remove embedded stones / nails from the tyres regularly.

TYRES MUST BE EXAMINED REGULARLY WITH PARTICULAR ATTENTION PAID TO THE FOLLOWING:

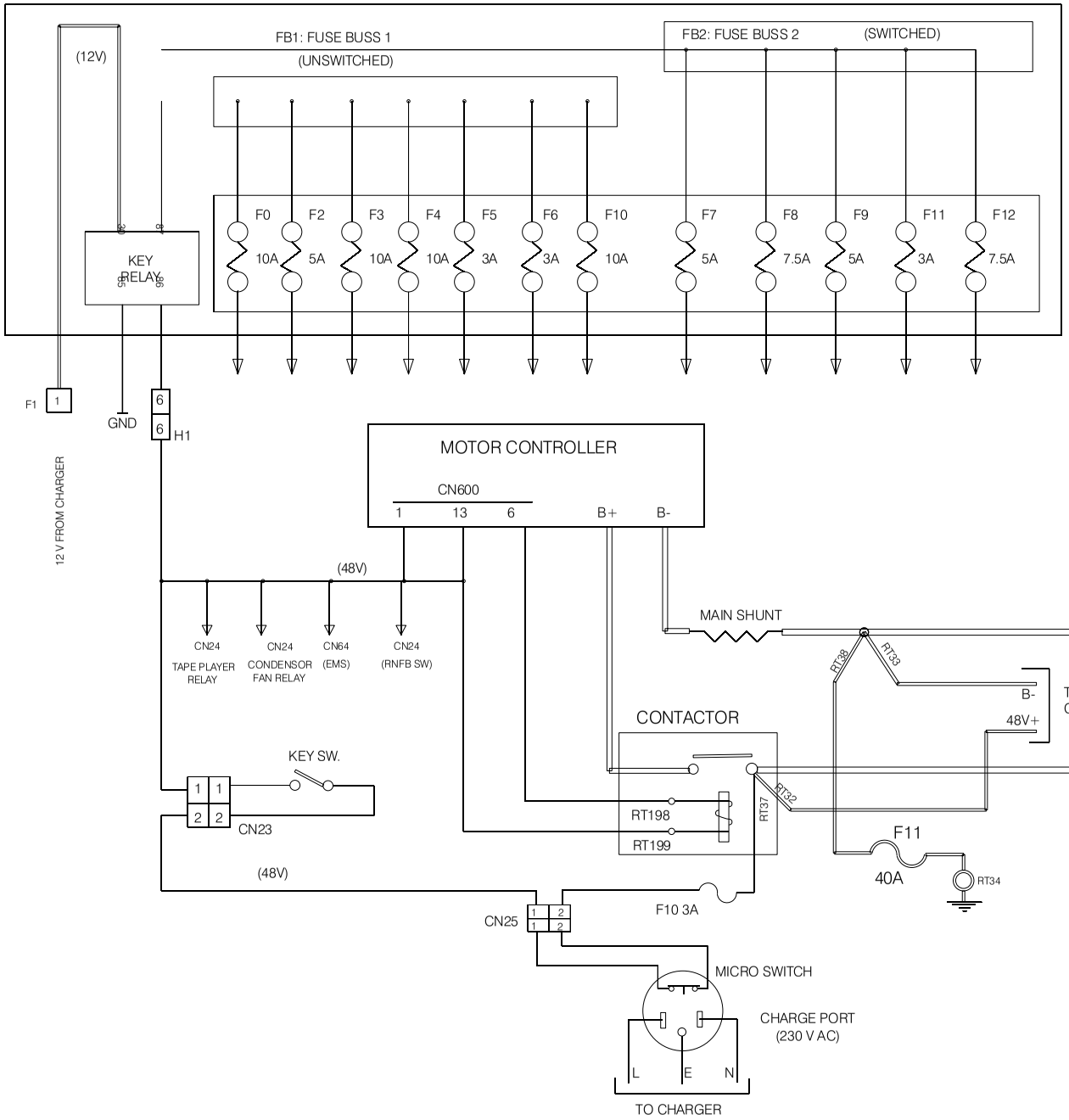
- The tread area:
  Check for abnormal wear, cuts, localised deformations and foreign bodies (nails, stones, etc.)
- Sidewalls:
  Check for cuts, cracks, shock ruptures (from curbing, pot holes, etc.), rubbing and abnormal deformations
- The tyre should be removed and checked to find the reason for the loss of pressure.
- Any abnormality should be shown to a professional who can decide whether a repair is feasible and necessary.
- A specialist should only carry out repairs on the tubeless tyres.
- It is recommended that the inside of the tyre be examined for damage before proceeding to refit.

ELECTRICALS

electrical system 12.0


Reva Block Diagram
WIPER
CN15
WASHER
CN87
TREE SWITCH
CN10
CN11
P B SWITCH
CN16
BRAKE SW
CN85
DOOR SWTCH
CN88
TAPE PLAYER
(*)
CN86
ANTI DIP
MODULE
CN86
FLASHER
CNFL1
FUSE BOX
FB
KEY RELAY
CNK1
FOG SW
CN140
DFOGER SW
CN149
CN-IP
IP CLUSTER
CN21
CN22
RNFB SWT
CN24
RNFB R.I
CN81
KEY SWITCH
CN23
THROTLE POT
CN20
BRAKE POT
CN13
CHARGE PT
A/C MOTOR
A/C CONTR
THERMOSTAT
A/C
RELAY
POWER
PACK
CONTROLLER
/CHARGER
COOL FAN
CONTACTOR
XX
EMI
MOTOR CONTROLLER
CN600
CN73
EMI
MOTOR
SPD ENCODER
XX
SHUNT
XX
O V R
CN41
CHARGER
CUM
DC - DC CONV.
RT1
RT2
RT3
RELAY
DEFOGER
REAR
DEFOGER
FOG LAMP
CN143
REVERSE-RH
CN8R
LICENSE-RH
CN9R
TURN - RH
CN7R
R C - RH
CN6R
REVERSE-LH
CN8L
LICENSE-LH
CN9L
HI MONT
LAMP
CN171
TURN - LH
CN7L
R C - LH
CN6L
HEATER
CN98
THERMOSTAT
CN99
HEATER
RELAY
CN93 / 97
RESISTOR
CN95
BLOWER
CN92
BLOWER SW
CN9 /94/96/100
CN63
E M S
CN66
CN64
CN67
BAT. FAN
CN53
CHIME
CN27
HATCH SW
CN90
PET PORT
CN68
CDL
CONTROLLER
CN75
SPEED SENSOR
CN4R
B F SENSOR
CN82
ROOM LIGHT
CN26
SIDE TR-LH
CN4L
F C - LH
CN3L
HEAD LT-LH
CN2L
HORN
CN5
SIREN
CN76
HEAD LT-RH
CN2R
F C - RH
CN3R
SIDE TR-RH
CN4R

FUSE BOX ASSEMBLY



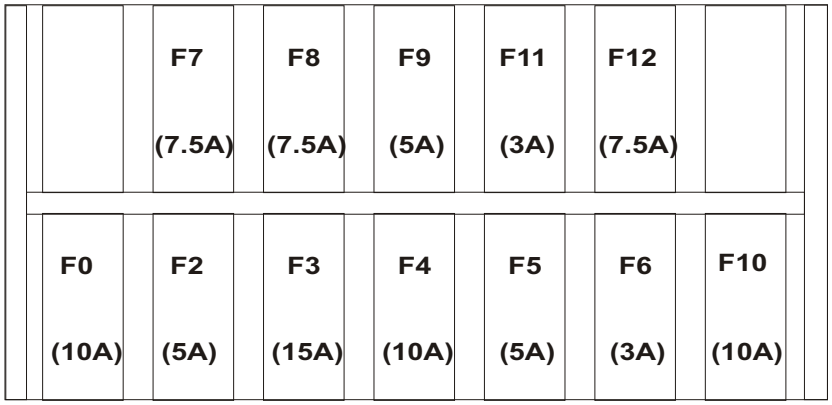
UUNSWITCHED

F2 : BRAKE SW, BATTERY FAN, CHIME
F3 : HEAD LIGHTS
F4 : HORN, HAZARDS LIGHTS
F5 : HB+, DOME LIGHT, DRIVE LIGHTS
F6 : IP CLUSTER (WARNING LIGHTS)
F10 : CDL - HAZARD LIGHTS

USWITCHED

F7 : TURN SIGNALS, REVERSE LIGHTS
F8 : WIPER, WASHER
F9 : TAPE PLAYER
F11 : CDL (CONTROLS)
F12 : BLOWER

FUSES & FUSE LOCATIONS



UN SWITCHED

F0 : Un switched Blower, 12V Adapter
F2 : Brake Switch, Battery Fan, Chime, Cooling Fans And Heater pad controller
F3 : Head Lights
F4 : Horn, Hazard Lights
F5 : Roof light, Parking lights, High beam, RNFB Back illumination, Licence plate lights.
F6 : IP Cluster, Warning lights, Tape player, Clock, Chime Relay
F10 : CDL Lighting

SWITCHED

F7 : Turn Signals, Reverse Lights, Odometer display
F8 : Wiper and Washer
F9 : Fog Lamps
F11: CDL Controls
F12: Blower, Relay, Rear Defogger
F16: Condenser Fan

POWER PACK :

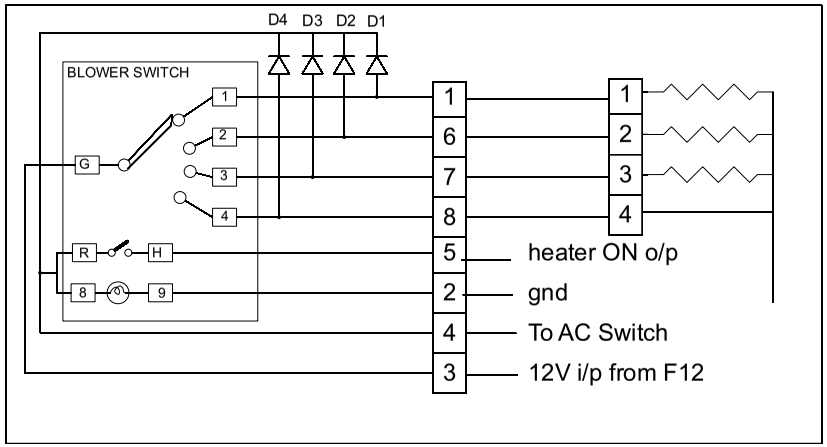
1. 250A - MAIN FUSE
2. 3A (8NO'S) & 5A (1NO) FUSES IN PACK SENSE WIRES

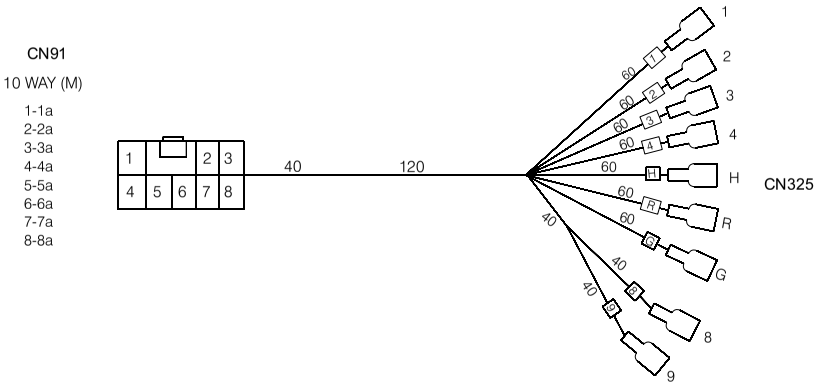
OTHERS :

1. 5A FUSE ON 48V CIRCUIT (REAR TUB)
2. 40A FUSE ON GROUND WIRE (REAR TUB)
3. 40A FUSE ON 48V CIRCUIT FOR AC & HEATER (REAR TUB)
4. 5A FUSE ON CCS DC-DC CONVERTOR INPUT (REAR TUB)

BULB RATINGS

SL NO	DESCRIPTION	VOLTS	WATTS	AMPS
1	Head Light	12	55/60	5.5/4.5A
2	Front Combination	12	21/05	1.75/0.5A
3	Rear Combination	12	21/05	1.75/0.5A
4	Rear Turn Light	12	21	1.75A
5	Reverse Light	12	10	0.8A
6	License Light	12	5	0.5A
7	Dome Light	12	5	0.5A
8	RNFB Back Light & Cluster Illumination	12	LED*	0.3A
9	Warning Lights in Cluster	12	1.5	
10	Blower/CCS back illumination	12	1.5	
11	I/P cluster turn indicator	12	3	
* In case of LED failure, IP cluster / RNFB back illumination needs to be changed				



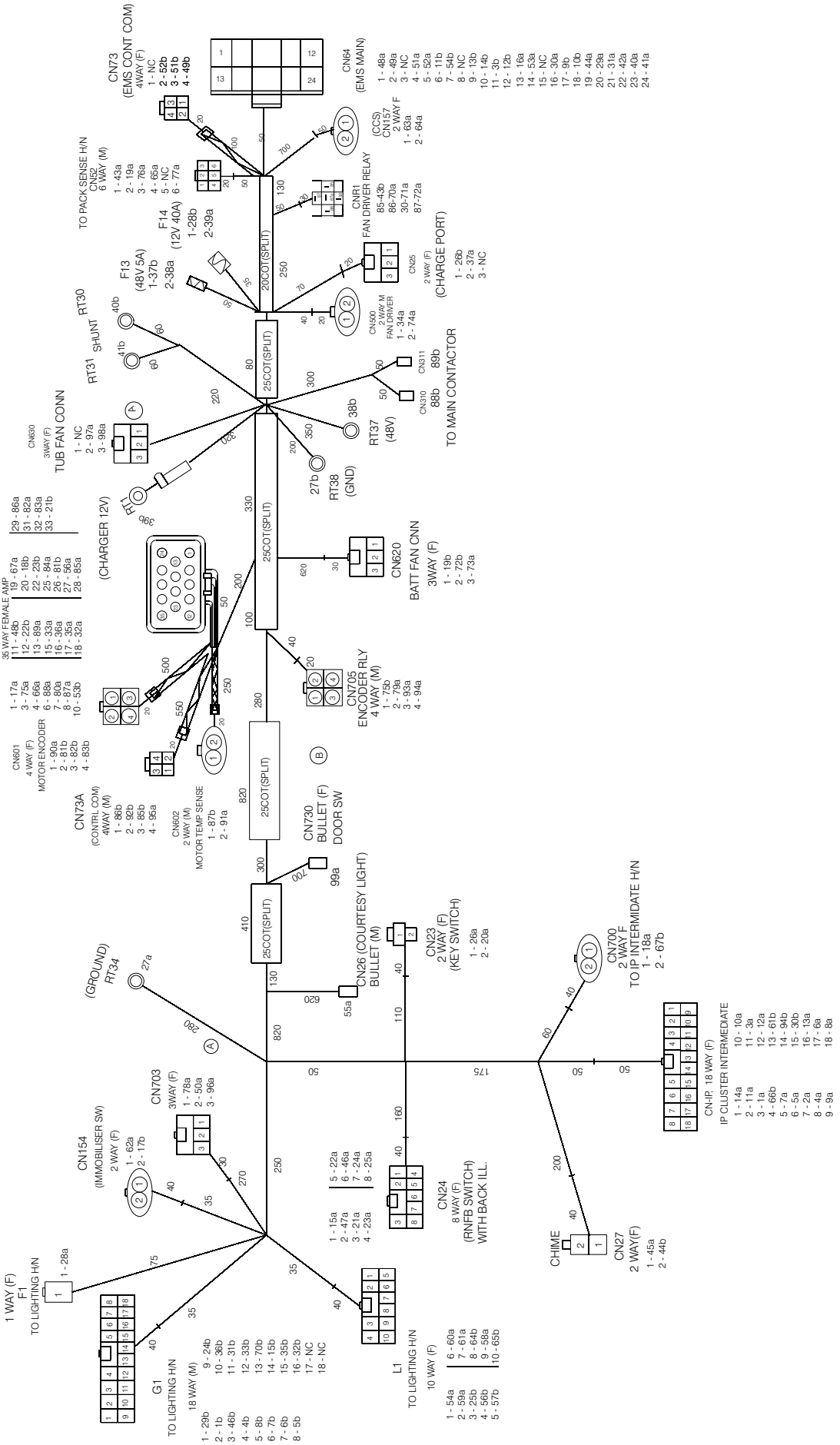


WIRE LEGEND DETAILS

WIRE No.	WIRE SIZE	CONNECTR PIN	TERMINAL At A	CIRCUIT FROM	CIRCUIT TO	CONNECTOR PIN	TERMINAL At B	WIRE COLOUR
1	11/.3	CN91-1	90 SER M	SPEED-1	--	CN325-1	6.3MM F WINDOW	ORG
2	7/.3	CN91-2	90 SER M	LAMP GND	--	CN325-9	6.3MM F WINDOW	BRN
3	15/.3	CN91-3	90 SER M	12V SUPPLY	--	CN325-G	6.3MM F WINDOW	WHT/GRN
4	7/.3	CN91-4	90 SER M	12V O/P AC SWITCH	--	MID JNT	MJ 9	YEL/GRN
5	7/.3	CN91-5	90 SER M	HTR RLY 12V OUT	--	CN325-H	6.3MM F WINDOW	ORG/BLK
6	15/.3	CN91-6	90 SER M	SPEED-2	--	CN325-2	6.3MM F WINDOW	BLU
7	15/.3	CN91-7	90 SER M	SPEED-3	--	CN325-3	6.3MM F WINDOW	YEL/RED
8	15/.3	CN91-8	90 SER M	SPEED-4	--	CN325-4	6.3MM F WINDOW	GRN/BLK
9	7/.3	CN325-R	6.3mm F	HTR RLY 12V I/P	--	MID JNT	MJ 15-18	YEL/GRN
10	7/.3	CN325-8	6.3mmF WINDW	LAMP SUPPLY	--	MID JNT	MJ 9	YEL/GRN
11	7/.3	D1-1	SLDER JNT	SPEED-1	--	MJ 1	MID JOINT	ORG
12	7/.3	D2-1	SLDER JNT	SPEED-2	--	MJ 6	MID JOINT	BLU
13	7/.3	D3-1	SLDER JNT	SPEED-3	--	MJ 7	MID JOINT	YEL/RED
14	7/.3	D4-1	SLDER JNT	SPEED-4	--	MJ 8	MID JOINT	GRN/BLK
15	7/.3	D1-2	SLDER JNT	SPEED-1	--	MJ 9	MID JOINT	YEL/GRN
16	7/.3	D2-2	SLDER JNT	SPEED-2	--	MJ 9	MID JOINT	YEL/GRN
17	7/.3	D3-2	SLDER JNT	SPEED-3	--	MJ 9	MID JOINT	YEL/GRN
18	7/.3	D4-2	SLDER JNT	SPEED-4	--	MJ 9	MID JOINT	YEL/GRN

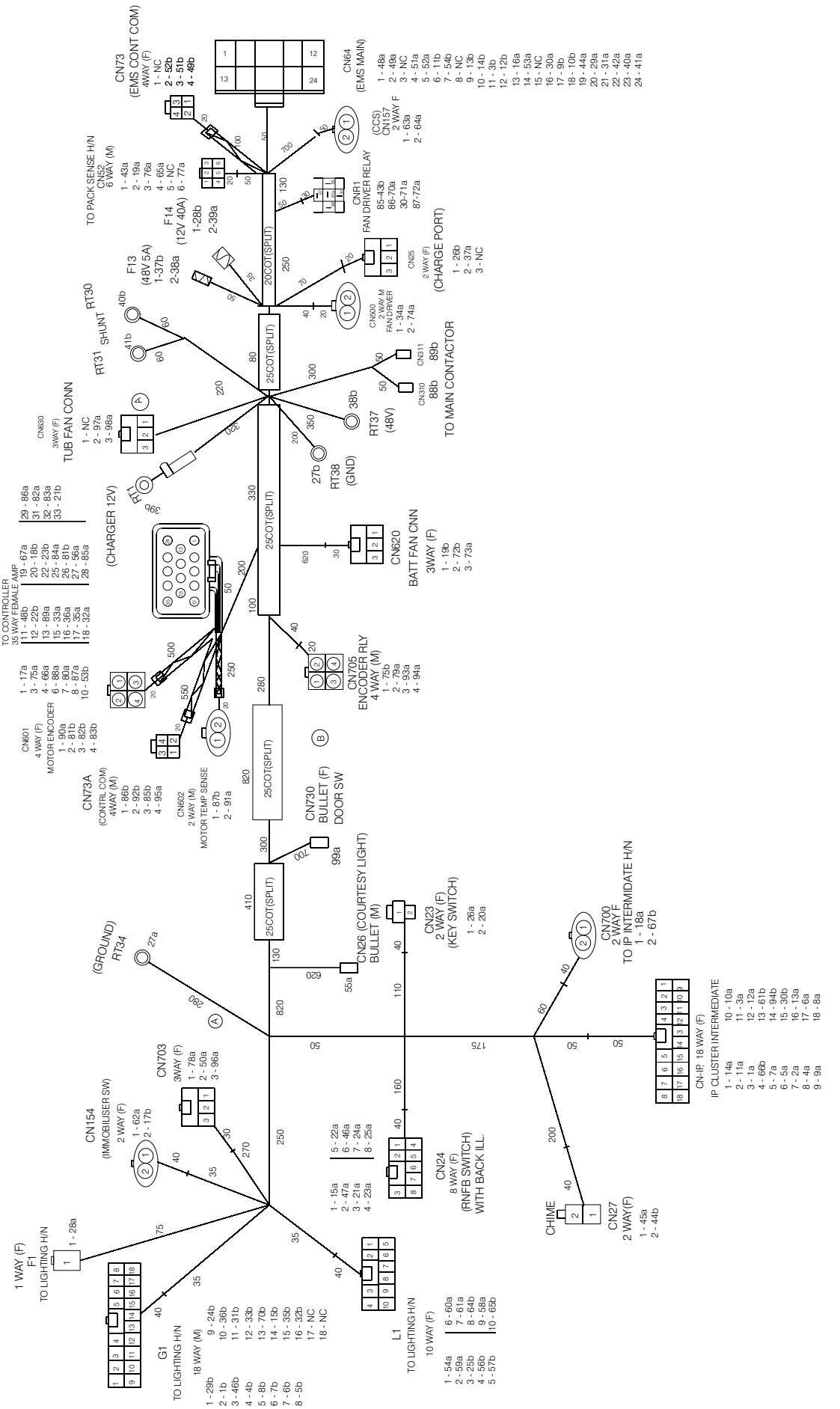
CONNECTORS USED

SL	CON.NO.	DESCRIPTION	MF PART NO	MAKE	COMPONENT /PURPOSE
01	CN 91	90 SERIES 8 WAY MALE	8M 090 FHCL	BESMAK	TO LIGHTING HARNESS


MAIN HARNESS
CN73 (EMS CONT COM) 4WAY (F) 1 - NC 2 - 52b 3 - 51b 4 - 49b
CN64 (EMS MAIN) 1 - 48a 2 - 49a 3 - NC 4 - 51a 5 - 52a 6 - 11b 7 - 54b 8 - NC 9 - 13b 10 - 14b 11 - 3b 12 - 12b 13 - 16a 14 - 53a 15 - NC 16 - 30a 17 - 9b 18 - 10b 19 - 44a 20 - 29a 21 - 31a 22 - 42a 23 - 40a 24 - 41a
CN57 (CCS) 2 WAY F 1 - 69a 2 - 64a
TO PACK SENSE H/N CN52 6 WAY (M) 1 - 43a 2 - 19a 3 - 76a 4 - 65a 5 - NC 6 - 77a
F14 (12V 40A) 1-28b 2-39a
CNR1 FAN DRIVER RELAY 85-43b 86-70a 30-71a 87-72a
F13 (48V 5A) 1-37b 2-38a
CN25 2 WAY (F) (CHARGE PORT) 1 - 28b 2 - 37a 3 - NC
CN500 2 WAY M FAN DRIVER 1 - 34a 2 - 74a
RT30 SHUNT
RT31
CN311 89b
CN310 88b
TO MAIN CONTACTOR
RT37 (48V)
38b
RT38 (GND)
27b
CN630 3WAY (F) TUB FAN CONN 1 - NC 2 - 97a 3 - 98a
RT1 (CHARGER 12V)
39b
CN620 BATT FAN CNN 3WAY (F) 1 - 19b 2 - 72b 3 - 73a
CN600 TO CONTROLLER 35 WAY FEMALE AMP 11 - 48b 12 - 22b 13 - 89a 15 - 33a 16 - 36a 17 - 35a 18 - 32a 19 - 67a 20 - 18b 22 - 23b 25 - 84a 26 - 81b 27 - 56a 28 - 85a 29 - 86a 31 - 82a 32 - 83a 33 - 21b
CN601 4 WAY (F) MOTOR ENCODER 1 - 17a 3 - 75a 4 - 66a 6 - 88a 7 - 80a 8 - 87a 10 - 53b 1 - 90a 2 - 91b 3 - 92b 4 - 83b
CN705 ENCODER RLY 4 WAY (M) 1 - 75b 2 - 79a 3 - 93a 4 - 94a
CN73A (CONTRL COM) 4WAY (M) 1 - 86b 2 - 92b 3 - 85b 4 - 95a
CN602 2 WAY (M) MOTOR TEMP SENSE 1 - 87b 2 - 91a
CN730 BULLET (F) DOOR SW
99a
CN26 (COURTESY LIGHT) BULLET (M)
55a
CN23 2 WAY (F) (KEY SWITCH) 1 - 26a 2 - 20a
(GROUND) RT34
27a
CN700 2 WAY F TO IP INTERMIDIATE H/N 1 - 18a 2 - 67b
CN-IP. 18 WAY (F) IP CLUSTER INTERMEDIATE 1 - 14a 2 - 11a 3 - 1a 4 - 66b 5 - 7a 6 - 5a 7 - 2a 8 - 4a 9 - 9a 10 - 10a 11 - 3a 12 - 12a 13 - 61b 14 - 94b 15 - 30b 16 - 13a 17 - 6a 18 - 8a
CHIME
CN27 2 WAY(F) 1 - 45a 2 - 44b
CN703 3WAY (F) 1 - 78a 2 - 50a 3 - 96a
CN154 (IMMOBILISER SW) 2 WAY (F) 1 - 62a 2 - 17b
CN24 8 WAY (F) (RNFB SWITCH) WITH BACK ILL. 1 - 15a 2 - 47a 3 - 21a 4 - 23a 5 - 22a 6 - 46a 7 - 24a 8 - 25a
L1 TO LIGHTING H/N 10 WAY (F) 1 - 54a 2 - 59a 3 - 25b 4 - 56b 5 - 57b 6 - 60a 7 - 61a 8 - 64b 9 - 58a 10 - 65b
G1 TO LIGHTING H/N 18 WAY (M) 1 - 29b 2 - 1b 3 - 46b 4 - 4b 5 - 8b 6 - 7b 7 - 6b 8 - 5b 9 - 24b 10 - 36b 11 - 31b 12 - 33b 13 - 70b 14 - 15b 15 - 35b 16 - 32b 17 - NC 18 - NC
1 WAY (F) F1 TO LIGHTING H/N 1 - 28a
25COT(SPLIT)

MAIN HARNESS LEGEND DETAILS

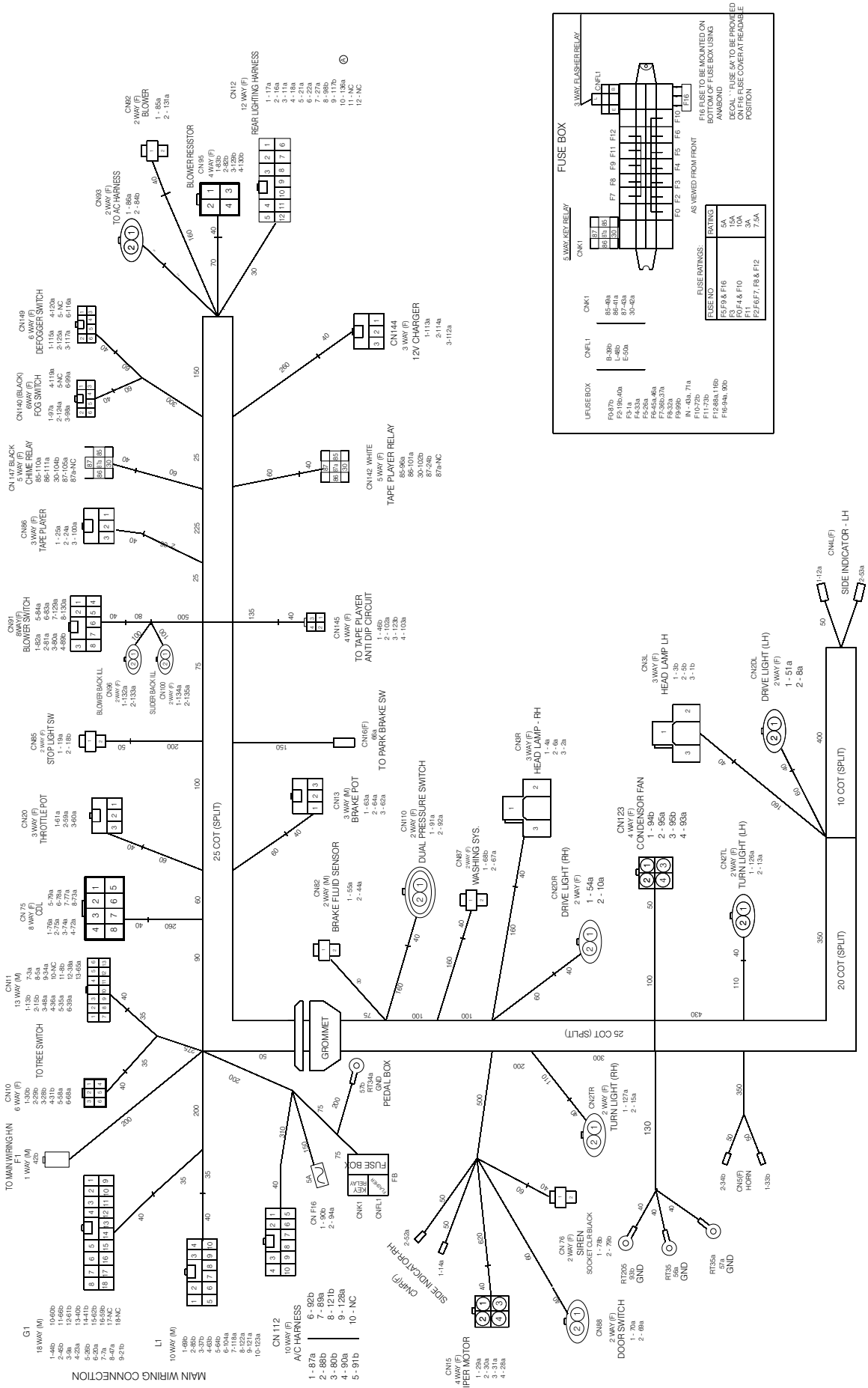
WIRE		CONNECTOR	TERMINAL	CIRCUIT		CONNECTOR	TERMINAL	COLOR
No.	SIZE	PIN	AT A	FROM	TO	PIN	AT B	
01	7/.3	CNIP-3	90 SERIES FEMALE	IPCLUST.+12V	INTERMEDIATE CONN	CNG1-2	MALE 90 SERIES	ORN
02	11/.3	CNIP-7	90 SERIES FEMALE	IPCLUST.GND	MAIN GND LINE	MJ WIRE 27	MID JOINT	BRN
03	7/.3	CNIP-11	90 SERIES FEMALE	IPCLUST.LO BATT	EMS:LO BATT	CN64-11	FEMALE ALEX	YEL/WHT
04	7/.3	CNIP-8	90 SERIES FEMALE	IPCLUST. ILL	INTERMEDIATE CONN	CNG1-4	MALE 90 SERIES	BLU
05	7/.3	CNIP-6	90 SERIES FEMALE	IPCLUST.TL	INTERMEDIATE CONN	CNG1-8	MALE 90 SERIES	BLK/WHT
06	7/.3	CNIP.17	90 SERIES FEMALE	IPCLUST.HB-	INTERMEDIATE CONN	CNG1-7	MALE 90 SERIES	YEL
07	7/.3	CNIP-5	90 SERIES FEMALE	IPCLUST.TR	INTERMEDIATE CONN	CNG1-6	MALE 90 SERIES	BLK/GRN
08	7/.3	CNIP-18	90 SERIES FEMALE	IPCLUST.HB+	INTERMEDIATE CONN	CNG1-5	MALE 90 SERIES	RED/BLU
09	7/.3	CNIP-9	90 SERIES FEMALE	IPCLUST.F+	EMS:FUEL Gg ANA OUT	CN64-17	FEMALE ALEX	GREY
10	7/.3	CNIP.10	90 SERIES FEMALE	IPCLUST.F-	INTERMEDIATE CONN	CN64-18	FEMALE ALEX	BRN/BLK
11	7/.3	CNIP-2	90 SERIES FEMALE	IPCLUST. BRK	EMS:PARKING/BRK FLD	CN64-6	FEMALE ALEX	RED/GRN
12	7/.3	CNIP.12	90 SERIES FEMALE		EMS:CHARGE IND	CN64-12	FEMALE ALEX	ORN/GRY
13	7/.3	CNIP.16	90 SERIES FEMALE	IPCLUST. HI TEMP	EMS:MOTOR OVR TMP	CN64-9	FEMALE ALEX	BLK/YEL
14	7/.3	CNIP.1	90 SERIES FEMALE	IPCLUST. SERVICE	EMS:SERVICE WARN LITE	CN64-10	FEMALE ALEX	BRN/GRN
15	11/.3	CN24-1	90 SERIES FEMALE	RNFB 48V IN	INTERMEDIATE CONN	CNG1-14	FEMALE 90 SERIES	RED/BLK
16	7/.3	CN64-13	FEMALE ALEX	EMS:KEY ON SIGNAL	MID JOINT	MJ WIRE 15	MID JOINT	RED/BLK
17	7/.3	CN600-1	AMP FEMALE	CONTROLLER: KEY ON	IMMOBILISER SW	CN 154-2	FEMALE 90 SERIES	RED/GRY
18	7/.3	CN700-1	MALE90 SER	IP CLUSTER HI POWER	CNTR DRIVE O/P	CN600-20	AMP FEMALE	YEL/RED
19	7/.3	CN52-2	90 SERIES MALE	TTLSIGNAL EMS	FAN TTL	CN620-1	MALE 90 SERIES	YEL
20	15/.3	CN23-2	FEMALE 250 SERIES	KEY SW:48V O/P	MID JOINT	MJ WIRE 15	MID JOINT	RED/BLK
21	7/.3	CN24-3	90 SERIES FEMALE	RNFB REVERSE	CONTR: REVERSE	CN600-33	AMP FEMALE	YEL/GRN
22	7/.3	CN24-5	90 SERIES FEMALE	RNFB ECONOMY MODE	CONTR: ECONOMY MODE	CN600-12	AMP FEMALE	GRY/WHT
23	7/.3	CN24-4	90 SERIES FEMALE	RNFB FORWARD	CONTR:FORWARD MODE	CN600-22	90 SERIES FEMALE	ORN/RED
24	11/.3	CN24-7	90 SERIES FEMALE	RNFB 12V FOR REV LIGHT	INTERMEDIATE CONN	CNG1-9	MALE 90 SERIES	ORN/GRN
25	11/.3	CN24-8	90 SERIES FEMALE	RNFB 12V IN	INTERMEDIATE CONN	CNL1-3	FEMALE 90 SERIES	ORN/BLU
26	15/.3	CN23-1	FEMALE 250 SERIES	KEY SW:48V I/P	CHRG PORT MICRO SW	CN25-1	FEMALE 90 SERIES	WHT/BLK
27	57/.3	RT34	EYELET 6.5mm ID	CHASSIS GND:BRK PEDAL	GROUND ON BAT -VE	RT38	ELELET 8MM ID	BRN
28	85/.3	CNF1-1	8 mm MALE	CHRGR 12V O/P	FUSE F14 END 1	F14	FEMALE 8mm L	RED/YEL
29	7/.3	CN64-20	FEMALE ALEX	EMS:BRK FLD SENSOR	INTERMEDIATE CONN	CNG1-1	MALE 90 SERIES	WHT/BLU
30	7/.3	CN64-16	FEMALE ALEX	EMS:LO WATER	IP CLUST: LO WATER	CNIP-15	FEMALE (MOLEX)	WHT
31	7/.3	CN64-21	FEMALE ALEX	EMS:PARK BRK SENSOR	INTERMEDIATE CONN	CNG1-11	MALE 90 SERIES	GRY/GRN
32	7/.3	CN600-18	AMP FEMALE	CONTR:THROTTLE POT LO	INTERMEDIATE CONN	CNG1-16	MALE 90 SERIES	BLK/YEL
33	7/.3	CN600-15	AMP FEMALE	CONTR:THROTTLE POT HI	INTERMEDIATE CONN	CNG1-12	MALE 90 SERIES	RED/YEL
34	7/.3	CN500-1	90 SERIES MALE	COOLING FAN 12V SUPPLY	MID JOINT	MJ70		YELL/BLK
35	7/.3	CN600-17	AMP FEMALE	CONTR:BRK POT WIPER	INTERMEDIATE CONN	CNG1-15	MALE 90 SERIES	WHT/RED
36	7/.3	CN600-16	AMP FEMALE	CONTR:THRT POT WIPER	INTERMEDIATE CONN	CNG1-10	MALE 90 SERIES	WHT/GRN
37	15/.3	CN25-2	FEMALE 90 SERIES	CHRG PORT MICRO SW	FUSE F13 END 1	F13	IN-LINE FUSE HOLD	BLK/WHT
38	15/.3	F13	IN-LINE FUSE	FUSE F13 END 2	RING TERMNL ON CNTCTR	RT37	EYELET 8 mm ID	BLK/WHT
39	85/.3	F14	FEMALE 8MM L	FUSE F14 END 2	M5X4Sq.mm.CHAR 12V O/P	RT1	EYELET 5 mm ID	RED/YEL
40	7/.3	CN64-23	FEMALE ALEX	EMS:BATT SHUNT HI	SHUNT:VOLTAGE SENSE	RT30	EYELET 4 mm ID	RED
41	7/.3	CN64-24	FEMALE ALEX	EMS:BATT SHUNT LO	SHUNT:VOLTAGE SENSE	RT31	EYELET 4 mm ID	BLK
42	7/.3	CN64-22	FEMALE ALEX	EMS:BATT SHUNT SHIELD				
43	7/.3	CN52-1	MALE 90 SERIES	FAN DRIVER	RLY COIL GND 85	CNR1-85	FEMALE 250	BLK
44	7/.3	CN64-19	FEMALE ALEX	EMS:CHIME OUTPUT	CHIME RETURN PATH	CN27-2	FEMALE ALEX	BLU/WHT
45	7/.3	CN27-1	FEMALE ALEX	CHIME SUPPLY	MID JOINT	MJ WIRE 70	MID JOINT	YEL/BLK
46	7/.3	CN24-6	90 SERIES FEMALE	RNFB BACK ILL +VE	INTERMEDIATE CONN	CNG1 -3	MALE 90 SERIES	GREY/RED
47	7/.3	CN24-2	90 SERIES FEMALE	RNFB BACK ILL GND	MID JOINT	MJ WIRE 27	MIDJOINT	BRN
48	7/.3	CN64-1	FEMALE ALEX	LIMP HOME O/P	LIMP HOME I/P TO CONTR	CN600-11	AMP FEMALE	ORG/BLK
49	7/.2	CN64-2	FEMALE ALEX	+15V SUPPLY FROM CONTROLLER	+15V SUPPLY TO EMS	CN73-4	FEMALE ALEX	RED
50	7/.3	CN703-2	90 SER FEMALE	12V SUPPLY	MID JOINT	MJ 84		RED/YEL
51	7/.2	CN64-4	FEMALE ALEX	RECEIVE DATA FROM CONTROLLER	TRANSMIT DATA TO EMS	CN73-3	FEMALE ALEX	YEL
52	7/.2	CN64-5	FEMALE ALEX	GROUND FROM CONTROLLER	GROUND TO EMS	CN73-2	FEMALE ALEX	BLK
53	7/.3	CN64-14	FEMALE ALEX	ECONOMY OUT FROM EMS	CONTROLLER ECONOMY INPUT	CN600-10	AMP FEMALE	ORG/GRN
54	7/.3	CNL1-1	FEMALE 90 SERIES	DOOR SWITCH INPUT TO EMS	EMS - DOOR SWITCH INPUT	CN64-7	FEMALE ALEX	RED/WHT
55	7/.3	CN26	BULLET MALE	DOME LIGHT GROUND	MID JOINT	MJ WIRE 54	MID JOINT	RED/WHT
56	7/.3	CN600-27	90 SERIES FEMALE	BRAKE POT MAX	INTERMEDIATE CONN.	CNL1-4	FEMALE 90 SERIES	GRN/BLK
57	7/.3	CNL1-5	90SERIES FEMALE	BRAKE POT MIN	INTERMEDIATE CONN.	MJ 32	MIDJOINT	BLK/YEL
58	7/.3	CNL1-9	FEMALE 90 SERIES	LOW BATTERY SIGNAL	MID JOINT	MJ WIRE 3	MID JOINT	YEL/WHT
59	36/.3	CNL1-2	FEMALE 90 SERIES	GND FOR BLOWER	MID JOINT	MJ-27		BRN
60	7/.3	CNL1-6	FEMALE 90 SERIES	INTERMEDIATE CONN.	MID JOINT	MJ 44	MID JOINT	BLU/WHT
61	7/.3	CNL1-7	FEMALE 90 SERIES	INTERMEDIATE CONN.	LO BEAM INPUT	CN1P-13	FEMALE (Molex)	RED
62	7/.3	CN154-1	FEMALE 90 SERIES	IMMOBILISER SW	MID JOINT	MJ 15	MJ	RED/BLK
63	7/.3	CN157-1	FEMALE 90 SERIES	CCS SW BACK ILL	MID JOINT	MJ 46	MJ	GREY/RED
64	7/.3	CN157-2	FEMALE 90 SERIES	SW +12V FOR CCS	INTERMEDIATE CONN.	CNL1-8	FEMALE 90 SERIES	BLK
65	11/.3	CN52-4	MALE 90 SERIES	BV3 SUPPLY	INTERMEDIATE CONN.	CNL1-10	FEMALE 90 SERIES	ORN/BLK
66	7/.3	CN600-4	AMP FEMALE	CONTR NUTRAL O/P	IP CLUSTER DISPLAY	CNIP-4	FEMALE 90 SERIES	GRY/RED
67	7/.3	CN600-19	AMP FEMALE	REGION IND	IP CLUSTER DISPLAY	CN700-2	FEMALE 90 SERIES	GRY
68	7/.3	D1-1	SOLDER JOINT	FAN DRIVER SIGNAL	MID JOINT	MJ43		BLK
69	7/.3	D1-2	SOLDER JOINT	COIL SUPPLY	MID JOINT	MJ70		YEL/BLK
70	7/.3	CNR1-86	FEMALE 250SERIES	COIL12V SUPPLY 86	INTERMIDATE CONN	CNG1-13	MALE 90 SERIES	YEL/BLK
71	7/.3	CNR1-30	FEMALE 250SERIES	I/P TO RLY	MID JOINT	MJ27		BRN
72	7/.3	CNR1-87	FEMALE 250 SER	O/P OF RLY	BATT FAN	CN620-2	MALE 90 SERIES	BRN/BLK
73	7/.3	CN620-3	MALE90SER	12V UNSW SUPPLY	MID JOINT	MJ70		RED/GRN
74	7/.3	CN500-2	MALE90 SER	GND FOR COOLING FAN	MID JOINT	MJ72		BRN/BLK
75	7/.3	CN600-3	AMP FEMALE	CONTR O/P ENCODER FAIL DRIVE	ENCODER RLY COIL I/P	CN705-1	MALE 90 SERIES	GRY/BLK
76	7/.3	CN52-3	MALE90 SER	12V UN SW SUPPLY	MID JOINT	MJ70		YEL/BLK
77	7/.3	CN52-6	MALE 90 SER	GND FOR HEATER PAD CONT	MID JOINT	MJ71		BRN
78	7/.3	CN703-1	FEMALE 110 SER	SWITCHED 12V FOR IP CLUSTER	MID JOINT	MJ25		ORG/BLU
79	7/.3	CN705-2	MALE 90 SERIES	12V SUPPLY	MID JOINT	MJ 84		RED
80	7/.3	CN600-7	AMP FEMALE	GROUND O/P	MID JOINT	MJ 90,91,92,96		BLK
81	16/.18	CN600-26	AMP FEMALE	5V SUPPLY O/P	ENCODER 5V	CN601-2	FEMALE 90 SERIES	WHT
82	16/.18	CN600-31	AMP FEMALE	PHASEA	ENCODER FHASE A	CN601-3	FEMALE 90 SERIES	YEL
83	16/.18	CN600-32	AMP FEMALE	PHASE B	ENCODER FHASE B	CN601-4	FEMALE 90 SERIES	GRN
84	7/.3	CN600-25	AMP FEMALE	12V SUPPLY O/P	MID JOINT	MJ 79,50,95		RED
85	16/.18	CN600-28	AMP FEMALE	SERIAL TX	SERIAL TX	CN73A-3	MOLEX FEMALE	YEL
86	16/.18	CN600-29	AMP FEMALE	SERIAL RX	SERIAL RX	CN73A-1	MOLEX FEMALE	GRN
87	16/.18	CN600-8	AMP FEMALE	MOTOR TEMP SENSE	MOTOR TEMP	CN602-1	MALE 90 SERIES	RED
88	11/.3	CN600-6	AMP FEMALE	MAIN CONT DRIVE	MAIN CONT COIL	CN310	6.3MM F +VE LOCK	BRN/GRN
89	11/.3	CN600-13	AMP FEMALE	MAIN CONT RETURN	MAIN CONT COIL	CN311	6.3MM F +VE LOCK	RED/WHT
90	7/.2	CN601-1	90SERIES FEMALE	GROUND	MIDJOINT	MJ 80		BLK
91	7/.2	CN602-2	90SERIES FEMALE	GROUND	MIDJOINT	MJ 80		BLK
92	7/.3	CN73A-2	MOLEX MALE	GROUND	MIDJOINT	MJ80		BLK
93	7/.3	CN705-3	MALE 90 SER	INPUT GND	MIDJOINT	MJ27		BRN
94	7/.3	CN705-4	MALE 90 SERIES	O/P RLY GND	IP CLUSTER	CNIP -14	MALE 90 SERIES	GRY/RED
95	16/.18	CN73A-4	MOLEX MALE	12V SUPPLY	MID JOINT	MJ 84		WHT
96	7/.3	CN703-3	90 SERIES FEMALE	CONTR GND O/P	MID JOINT	MJ 80		BRN
97	7/.3	CN630-2	90SER FEMALE	REAR TUB FAN GND	MID JOINT	MJ 71		BLK
98	7/.3	CN630-3	90 SER FEMALE	12 VSUPPLY	MID JOINT	MJ 64		RED
99	7/.3	CN730	BULLET FEMALE	DOOR SW O/P	MID JOINT	MJ 54		RED/WHT


MAIN HARNESS
CN73 (EMS CONT COM) 4WAY (F) 1 - NC 2 - 52b 3 - 51b 4 - 49b
CN64 (EMS MAIN) 1 - 48a 2 - 49a 3 - NC 4 - 51a 5 - 52a 6 - 11b 7 - 54b 8 - NC 9 - 13b 10 - 14b 11 - 3b 12 - 12b 13 - 16a 14 - 53a 15 - NC 16 - 30a 17 - 9b 18 - 10b 19 - 44a 20 - 29a 21 - 31a 22 - 42a 23 - 40a 24 - 41a
TO PACK SENSE H/N CN52 6 WAY (M) 1 - 43a 2 - 19a 3 - 76a 4 - 65a 5 - NC 6 - 77a
(CCS) CN157 2 WAY F 1 - 63a 2 - 64a
CNR1 FAN DRIVER RELAY 85-43b 86-70a 30-71a 87-72a
CN25 2 WAY (F) (CHARGE PORT) 1 - 26b 2 - 37a 3 - NC
CN600 2 WAY M FAN DRIVER 1 - 34a 2 - 74a
F14 (12V 40A) 1-28b 2-39a
F13 (48V 5A) 1-37b 2-38a
RT30 SHUNT
RT31
CN630 3WAY (F) TUB FAN CONN 1 - NC 2 - 97a 3 - 98a
RT1 (CHARGER 12V)
RT37 (48V)
RT38 (GND)
CN310 88b
CN311 89b
TO MAIN CONTACTOR
CN620 BATT FAN CNN 3WAY (F) 1 - 19b 2 - 72b 3 - 73a
CN600 TO CONTROLLER 35 WAY FEMALE AMP 11 - 48b 12 - 22b 13 - 89a 15 - 33a 16 - 36a 17 - 35a 18 - 32a | 19 - 67a 20 - 18b 22 - 23b 25 - 84a 26 - 81b 27 - 56a 28 - 85a | 29 - 86a 31 - 82a 32 - 83a 33 - 21b
CN601 4 WAY (F) MOTOR ENCODER 1 - 17a 3 - 75a 4 - 66a 6 - 88a 7 - 80a 8 - 87a 10 - 53b | 1 - 90a 2 - 81b 3 - 82b 4 - 83b
CN602 2 WAY (M) MOTOR TEMP SENSE 1 - 87b 2 - 91a
CN73A. (CONTRL COM) 4WAY (M) 1 - 86b 2 - 92b 3 - 85b 4 - 95a
CN705 ENCODER RLY 4 WAY (M) 1 - 75b 2 - 79a 3 - 93a 4 - 94a
CN730 BULLET (F) DOOR SW
99a
CN26 (COURTESY LIGHT) BULLET (M)
55a
CN23 2 WAY (F) (KEY SWITCH) 1 - 26a 2 - 20a
CN700 2 WAY F TO IP INTERMIDATE H/N 1 - 18a 2 - 67b
CN-IP. 18 WAY (F) IP CLUSTER INTERMEDIATE 1 - 14a 2 - 11a 3 - 1a 4 - 66b 5 - 7a 6 - 5a 7 - 2a 8 - 4a 9 - 9a | 10 - 10a 11 - 3a 12 - 12a 13 - 61b 14 - 94b 15 - 30b 16 - 13a 17 - 6a 18 - 8a
CHIME
CN27 2 WAY(F) 1 - 45a 2 - 44b
CN24 8 WAY (F) (RNFB SWITCH) WITH BACK ILL. 1 - 15a 2 - 47a 3 - 21a 4 - 23a | 5 - 22a 6 - 46a 7 - 24a 8 - 25a | 6 - 60a 7 - 61a 8 - 64b 9 - 58a 10 - 65b
CN703 3WAY (F) 1 - 78a 2 - 50a 3 - 96a
CN154 (IMMOBILISER SW) 2 WAY (F) 1 - 62a 2 - 17b
(GROUND) RT34
27a
L1 TO LIGHTING H/N 10 WAY (F) 1 - 54a 2 - 59a 3 - 25b 4 - 56b 5 - 57b | 6 - 60a 7 - 61a 8 - 64b 9 - 58a 10 - 65b
G1 TO LIGHTING H/N 18 WAY (M) 1 - 29b 2 - 1b 3 - 46b 4 - 4b 5 - 8b 6 - 7b 7 - 6b 8 - 5b | 9 - 24b 10 - 36b 11 - 31b 12 - 33b 13 - 70b 14 - 15b 15 - 35b 16 - 32b 17 - NC 18 - NC
1 WAY (F) F1 TO LIGHTING H/N 1 - 28a
20COT(SPLIT)
25COT(SPLIT)

CONNECTORS USED IN MAIN HARNESS

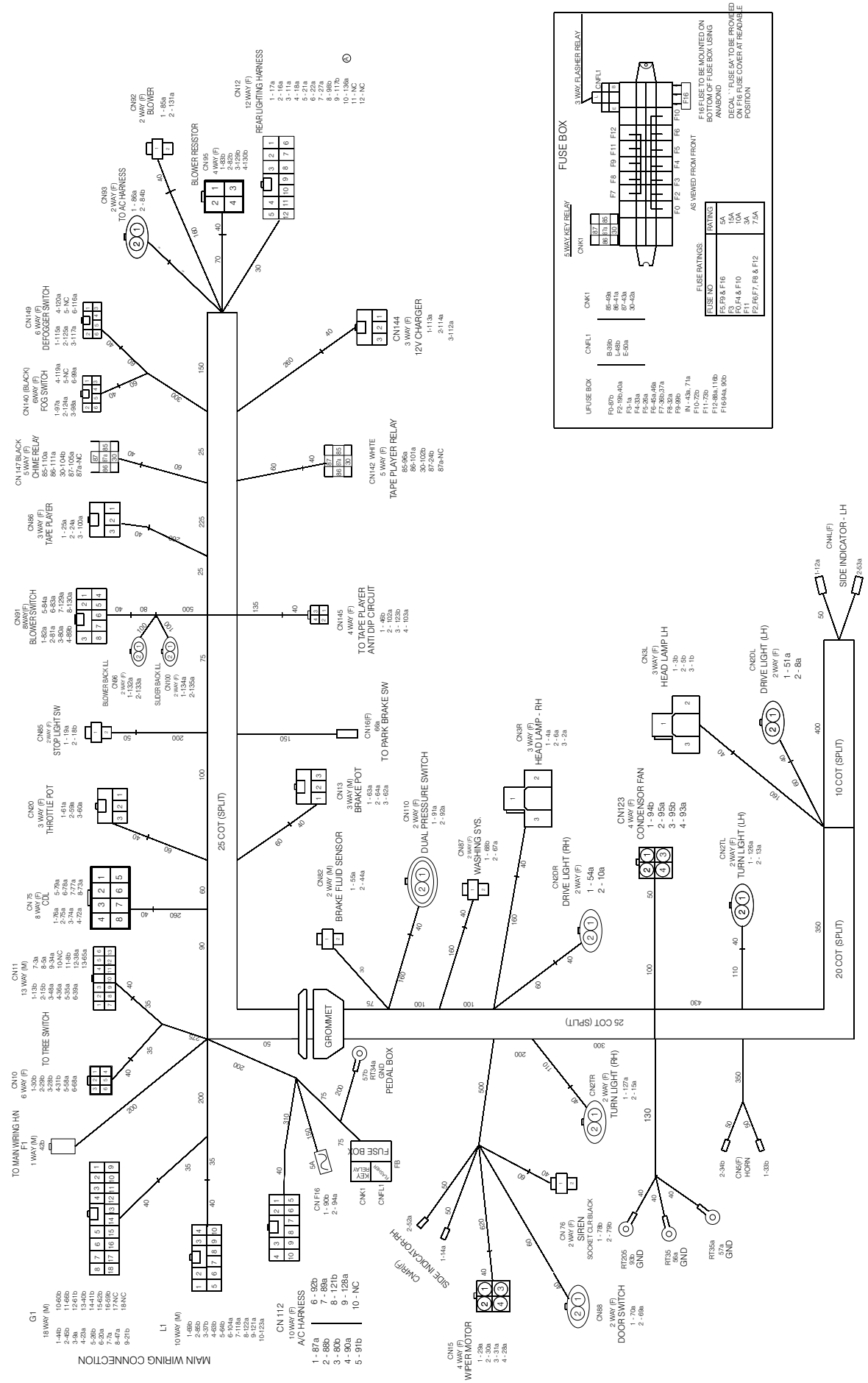
SL	CON NO.	DESCRIPTION	MF PART NO	MAKE	COMPONENT /PURPOSE
1	CNIP	90 SERIES 18 WAY (F)	MG 610062	KET	INTERMEDIATE - IP CLUSTER
2	CN23	250 SERIES 2 WAY (F)	TTP-22FN	TT	KEY SWITCH
3	CN24	90 SERIES 8 WAY (F)	3F 090 FHCL	KET	RNFB SWITCH & REAR ILLUMINATION
4	CN25	90 SERIES 3 WAY(F) - WP *		BESMAK	CHARGE PORT MICRO SWITCH
5	CN26	BULLET TERMINAL (M)	TT-1708	TT	COURTESY LIGHT VIA DOOR SWITCH
6	CN27	2 WAY FEMALE ALEX		MOLEX	CHIME SUPPLY
7	CN52	90 SERIES 2 WAY (M) - WP *	2MW 090 FHCL	BESMAK	BATTERY FAN BV3 SUPPLY
8	CN64	2x12 (F) MOLEX		MOLEX	EMS (MAIN)
9	CN71	18WAY (F) 90 SER	MG 620061	KET	MOTOR CONTROLLER MAIN
10	CN73	2x2 (F) MOLEX		MOLEX	MOTOR CONTROLLER (COMMN)
11	CN 154	90 SERIES 2 WAY (F) - WP *	2FW 090 FHCL	BESMAK	CDL IMMOBILISER
12	CN 157	90 SERIES 2 WAY (F) - WP *	2FW 090 FHCL	BESMAK	CCS I/M
13	CN 251	90 SERIES 6 WAY (F)	6F 090 FHCL	BESMAK	MOTOR MONITORING MODULE
14	G1	90 SERIES 18 WAY (M)	MG 620061	KET	INTERMEDIATE TO LIGHTING H/N
15	L1	90 SERIES 10 WAY (F)		KET	INTRERMEDIATE TO LIGHTING H/N
16	F1	350 SERIES 1 WAY (8mm F)	TTP-31FN	TT	12V SUPPLY TO FUSE BOX
17	F13	IN-LINE FUSE HOLDER WITH COVER	TTP-1868	TT	FUSE HOLDER(48V, 5A)
18	F14	FUSE HOLDER WITH 6.3mm (F) (I)	TTP-1868	TT	FUSE HOLDER 40A WITH COVER
19	RT1	EYELET 5mm	TT-1949	TT	CHARGER 12V OUTPUT
20	RT30	EYELET 4mm	TT-1944	TT	SHUNT (SENSE +VE)
21	RT31	EYELET 4mm	TT-1944	TT	SHUNT (SENSE -VE)
22	RT34	EYELET 6mm	TT-1851	TT	CHASSIS GROUND (MAIN)
23	RT37	EYELET 8mm	TT-1849	TT	48 V SUPPLY ON CONTACTOR
24	RT38	EYELET 8mm	TT-1849	TT	GROUND POINT ON SHUNT
25	CN500	90 SER FEMALE	2FW 090 FHCL	TT	48 V SUPPLY - CONTACTOR COIL
26	CN311	6.3mm WINDOW (F) +VE LOCKING	TT-1872	TT	GND CONTACTOR COIL
27	CN620	90 SER 3WAY FEMALE	3FW 090 FHCL	KET	BATTERY FAN
28	CN700	90 SER 2 WAY FEMALE	2FW 090 FHCL	BESMAK	IP CLUSTER
29	CNR1	250 SER 5 WAY RELAY HOLDER	TTP-RB1	TT	FAN DRIVER RELAY
30	CN703	3 WAY MALE 90 SER			TO LIGHTING HARNESS
31	CN600	35 WAY AMP FEMALE	--	AMP	TO CONTROLLER
32	CN601	4 WAY FEMALE WP	4FW 090 FHCL	BESMAK	ENCODER
33	CN602	2 WAY 90 SER MALE WP	2MW 090 FHCL	BESMAK	TEMPRATURSENSOR
34	CN73A	4 WAY MOLEX MALE		MOLEX	CONTROLLER COMMUNICATION
35	CN310	6.3MM FEMALE +VE LOCKING	2MW 090 FHCL	TT	MAIN CONTACTOR COIL
36	CN311	6.3MM FEMALE +VE LOCKING	2MW 090 FHCL	TT	MAIN CONTACTOR COIL
37	CN705	90SER 4WAY MALE WF	4MW 090 FHCL	BESMAK	TO ENCODER RELAY
38	CN730	BULLET FEMALE	TT-1780	TT	DOOR SWITCH

* WP -WATER PROOF CONNECTOR


LIGHTING HARNESS
MAIN WIRING CONNECTION
FUSE BOX
FUSE RATINGS
AS VIEWED FROM FRONT
F16 FUSE TO BE MOUNTED ON BOTTOM OF FUSE BOX USING ADHESIVE
DECAL ON FUSE COVER AT REARABLE POSITION
5 WAY KEY RELAY
3 WAY FLASHER RELAY
UFUSE BOX
CN FL1
CN K1
CN 112 A/C HARNESS
CN 147 BLACK 5 WAY (F) CHIME RELAY
CN 140 (BLACK) 6WAY (F) FOG SWITCH
CN 149 6 WAY (F) DEFOGGER SWITCH
CN 91 6WAY (F) BLOWER SWITCH
CN 86 3 WAY (F) TAPE PLAYER
CN 85 2 WAY (F) STOP LIGHT SW
CN 20 3 WAY (F) THROTTLE POT
CN 75 8 WAY (F) CDL
CN 11 13 WAY (M)
CN 10 6 WAY (F)
CN 82 2 WAY (M) BRAKE FLUID SENSOR
CN 13 3 WAY (M) BRAKE POT
CN 96 2WAY (F) BLOWER BACK LL
CN 100 2WAY (F) SLIDER BACK LL
CN 16(F) TO PARK BRAKE SW
CN 145 4 WAY (F) TO TAPE PLAYER ANTI DIP CIRCUIT
CN 142 WHITE 5 WAY (F) TAPE PLAYER RELAY
CN 144 3 WAY (F) 12V CHARGER
CN 92 2 WAY (F) BLOWER
CN 95 4 WAY (F) BLOWER RESISTOR
CN 93 2 WAY (F) TO AC HARNESS
CN 12 12 WAY (F) REAR LIGHTING HARNESS
CN 110 2 WAY (F) DUAL PRESSURE SWITCH
CN 97 2WAY (F) WASHING SYS.
CN 3R 3 WAY (F) HEAD LAMP - RH
CN 2DR DRIVE LIGHT (RH) 2 WAY (F)
CN 123 4 WAY (F) CONDENSOR FAN
CN 2TR 2 WAY (F) TURN LIGHT (RH)
CN 3L 3 WAY (F) HEAD LAMP LH
CN 2DL DRIVE LIGHT (LH) 2 WAY (F)
CN 2TL 2 WAY (F) TURN LIGHT (LH)
CN 4L(F) SIDE INDICATOR - LH
CN 88 2 WAY (F) DOOR SWITCH
CN 15 4WAY (F) WIPER MOTOR
CN 76 2 WAY (F) SIREN SOCKET CLR BLACK
CN 5(F) HORN
CN 16 1-90b 2-94a
RT 205 93b GND
RT 35 58 GND
RT 35a 57a GND
RT34a GND
TO MAIN WIRING HN
TO TREE SWITCH
PEDAL BOX
GROMMET
25 COT (SPLIT)
10 COT (SPLIT)
20 COT (SPLIT)
SIDE INDICATOR RH
G1 18 WAY (M)
L1 10 WAY (M)

LIGHTING HARNESS LEGEND

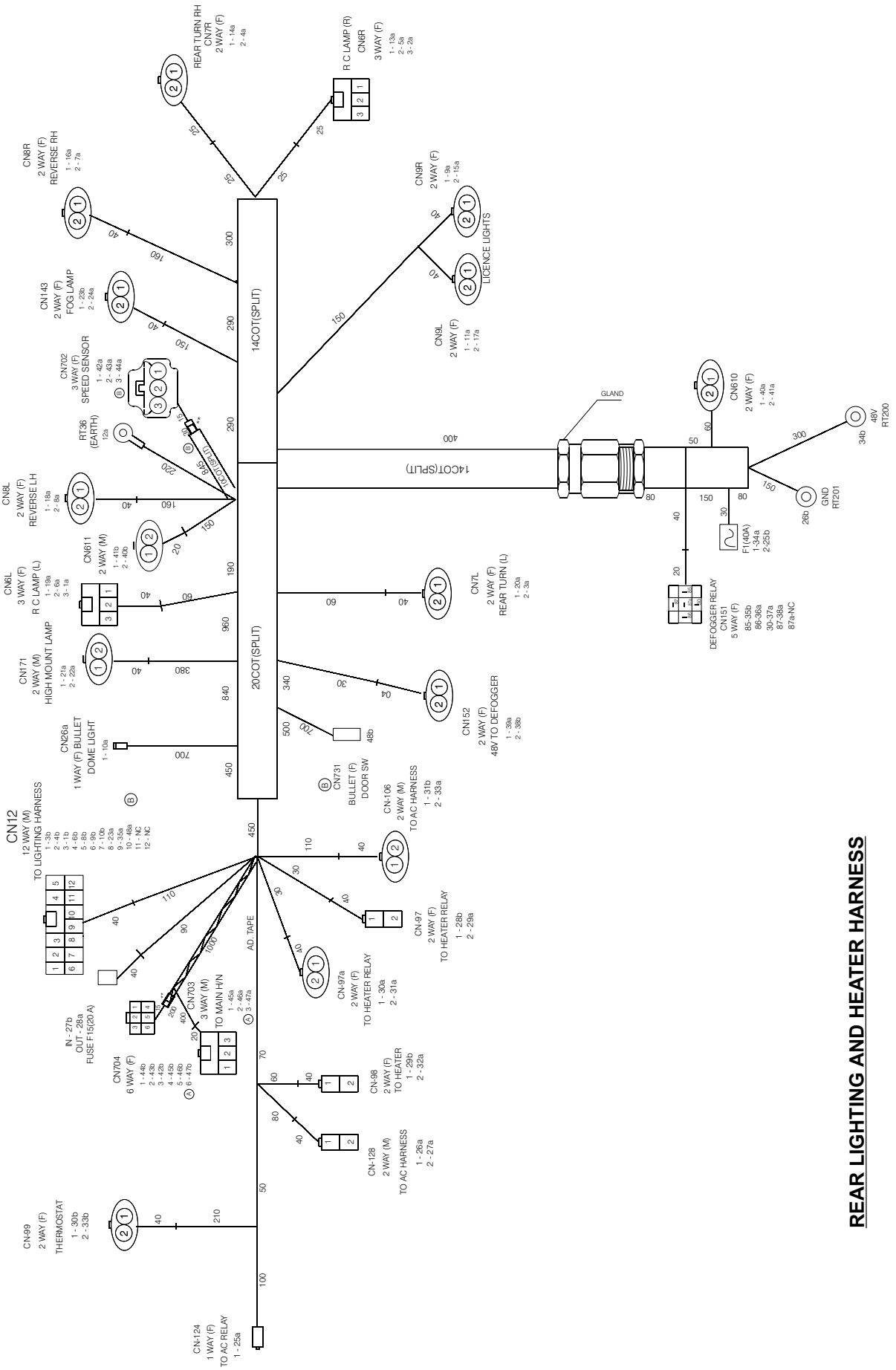
WIRE NO	WIRE SIZE	CONNECTOR PIN	TERMINAL AT A	CIRCUIT FROM	CIRCUIT TO	CONNECTOR PIN	TERMINAL AT B	WIRE COLOUR
1	22/.3	F3	FUSE FEMALE	F3 (FUSE BOX)	HEADLITE(LH) SUPPLY	CN3L-3	FEMALE 8 mm	GRN
2	22/.3	CN3R-3	8 mm FEMALE	HEADLIGHT (RH) SUPPLY	MID JOINT	MJ WIRE 1	MID JOINT	GRN
3	22/.3	CN11-7	MALE 90 SERIES	TREE SW LO BEAM O/P	HEAD LITE(LH)LO	CN3L-1	FEMALE 8 mm	RED
4	22/.3	CN3R-1	8 mm FEMALE	HEAD LITE(RH) LO	MID JOINT	MJ WIRE 3	MID JOINT	RED
5	22/.3	CN11-8	MALE 90 SERIES	TREE SW HI BEAM O/P	HEAD LITE(LH)HI	CN3L-2	FEMALE 8 mm	YEL
6	22/.3	CN3R-2	8 mm FEMALE	HEAD LIGHT (RH) HI	MID JOINT	MJ WIRE 5	MID JOINT	YEL
7	7/.3	CNG1-7	FEMALE 90 SERIES	TO IP HB-	MID JOINT	MJ WIRE 5	MID JOINT	YEL
8	7/.3	CN2DL-2	FEMALE 90 SERIES	FR.COMB LITE (LH)DRIVE	TR.SW DRV LITE O/P	CN11-11	MALE 90 SERIES	GRY/RED
9	7/.3	CNG1-3	FEMALE 90 SERIES	RNFB BACK ILL +VE	MID JOINT	MJ WIRE 8	MID JOINT	GRY/RED
10	7/.3	CN2DR-2	FEMALE 90 SERIES	FR.COMB LITE (RH) DRIVE	MID JOINT	MJ WIRE 8	MID JOINT	GRY/RED
11	7/.3	CN12-3	FEMALE 90 SERIES	RC LIGHT INPUT	MID JOINT	MJ WIRE 8	MID JOINT	GRY/RED
12	7/.3	CN4L-1	FEMALE LU	SIDE TURN IND (LH)+VE	MID JOINT	MJ WIRE 13	MID JOINT	BLK/WHT
13	7/.3	CN2TL-2	FEMALE 90 SERIES	FR.COMB (LH) TURN	TR.SW LEFT TURN O/P	CN11-1	MALE 90 SERIES	BLK/WHT
14	7/.3	CN4R-1	FEMALE LU	SIDE TURN IND(RH)+VE	MID JOINT	MJ WIRE 15	MID JOINT	BLK/GRN
15	7/.3	CN2TR-2	FEMALE 90 SERIES	FR.COMB(RH) TURN	TR.SW RIGHTTURNO/P	CN11-2	MALE 90 SERIES	BLK/GRN
16	7/.3	CN12-2	FEMALE 90 SERIES	REAR TURN RIGHT	MID JOINT	MJ WIRE 15	MID JOINT	BLK/GRN
17	7/.3	CN12-1	FEMALE 90 SERIES	REAR TURN LEFT	MID JOINT	MJ WIRE 13	MID JOINT	BLK/WHT
18	15/.3	CN12-4	FEMALE 90 SERIES	BRAKE LIGHT	BRAKE LIGHT	CN85-2	FEMALE 250 SERIES	RED/WHT
19	15/.3	CN85-1	FEMALE 250 SERIS	BRAKE LITE SW I/P	FUSE BOX FUSE	F2	FEMALE	BLUE
20	7/.3	CNG1-6	FEMALE 90 SERIES	TO IP TR	MID JOINT	MJ WIRE 15	MID JOINT	BLK/GRN
21	11/.3	CN12-5	FEMALE 90 SERIES	REVERSE LIGHTS	INTERMEDIATE CONN	G1-9	FEMALE 90 SERIES	ORG/GRN
22	7/.3	CN12-6	FEMALE 90 SERIES	LICENCE LITE(LH) I/P	MID JOINT	MJ WIRE 38	MID JOINT	BLU
23	7/.3	CNG1-4	FEMALE 90 SERIES	LICENCE LITE(LH) I/P	MID JOINT	MJ WIRE 22	MID JOINT	BLU
24	11/.3	CN86-2	FEMALE 90 SERIES	TAPE PLAYER I/P (Switched)	O/P OF TAPE PLAYER RELAY	CN142-87	FEMALE 6.3 mm	RED
25	11/.3	CN86-1	FEMALE 90 SERIES	TAPE PLAYER GND	MID JOINT	MJ WIRE 58	MID JOINT	BRN
26	15/.3	F5	FEMALE LU 6.3 mm	FUSE BOX FUSE	INTERMEDIATE CONN	CNG1-5	FEMALE 90 SERIES	RED/BLU
27	7/.3	CN12-7	FEMALE 90 SERIES	DOME LIGHT SUPPLY	MID JOINT	MJ WIRE 26	MID JOINT	RED/BLU
28	11/.3	CN15-4	FEMALE 90 SERIES	WIPER MOTOR 12V	Tr. Sw Conn for Wiper 12V	CN10-3	FEMALE 250 SERIES	YEL
29	11/.3	CN15-1	FEMALE 90 SERIES	WIPER MOTOR LO	Tr. Sw Conn for Wiper Lo	CN10-2	FEMALE 250 SERIES	WHT
30	11/.3	CN15-2	FEMALE 90 SERIES	WIPER MOTOR HI	Tree Switch Conn for Wiper Hi	CN10-1	FEMALE 250 SERIES	BLU/RED
31	11/.3	CN15-3	FEMALE 90 SERIES	WIPER MOTOR RESET	Tr. Sw Conn for Wiper Off	CN10-4	FEMALE 250 SERIES	BLU/WHT
32	11/.3	F8	FUSE FEMALE	FUSE BOX FUSE	MID JOINT	MJ WIRE 28	MID JOINT	YEL
33	15/.3	F4	FUSE FEMALE	FUSE BOX FUSE	HORN SUPPLY	CN5-1	FEMALE (+VE LOCK)	BLK/YEL
34	15/.3	CN11-9	MALE 90 SERIES	TR.SW HORN GND O/P	HORN GND	CN5-2	FEMALE(+VE LOCK)	BRN/YEL
35	15/.3	CN11-5	MALE 90 SERIES	HAZARD LITES SUPPLY I/P	MID JOINT	MJ WIRE 33	MID JOINT	BLK/YEL
36	15/.3	CN11-4	MALE 90 SERIES	TURN IND SUPPLY I/P	FUSE BOX FUSE	F7	FEMALE	BLK/RED
37	11/.3	F7	FEMALE LU	FUSE BOX FUSE	INTERMEDIATE CONN	CNL1-3	MALE 90 SERIES	ORG/BLU
38	7/.3	CN11-12	MALE 90 SERIES	TR.SW O/P FOR LIC LITES	MID JOINT	MJ WIRE 22	MID JOINT	BLU
39	15/.3	CN11-6	MALE 90 SERIES	TR.SW FLASHER B O/P	FLASHER B I/P	FLASHER B	FEMALE LU 6.3mm	RED/BLK
40	11/.3	F2	MALE LU	FUSE BOX FUSE	INTERMEDIATE CONN	CNG1-13	FEMALE 90 SERIES	YEL/BLK
41	7/.3	KEY REL 86	FEMALE LU 6.3 mm	48V COIL VOLTAGE IN	INTERMEDIATE CONN	CNG1-14	FEMALE 90 SERIES	RED/BLK
42	85/.3	KEY REL 30	FEMALE LU 6.3 mm	12V I/P TO RELAY CONTACT	INTERMEDIATE CONN	CNF1	MALE 350 SERIES	RED/YEL
43	36/.3	KEY REL 87	FEMALE LU 6.3 mm	SWITCHED 12V OUT	FUSE BOX FUSES	F7,F8,F9,F11,F12	FEMALE LU 6.3mm	YEL
44	7/.3	CN82-2	MALE 250 SERIES	BRK FLD SENSOR I/P	INTERMEDIATE CONN	CNG1-1	FEMALE 90 SERIES	WHT/BLU
45	11/.3	F6	FEMALE LU	FUSE BOX FUSE	INTERMEDIATE CONN	CNG1-2	FEMALE 90 SERIES	ORN
46	11/.3	F6	FEMALE LU	FUSE BOX FUSE	UniSW 12V I/P to Anti Dip ckt	CN145-1	FEMALE ALEX	RED
47	7/.3	CNG1-8	FEMALE 90 SERIES	INTERMEDIATE CONN	MID JOINT	MJ WIRE 13	MID JOINT	BLK/WHT
48	15/.3	CN11-3	MALE 90 SERIES	TR.SW FLASHER L I/P	FLASHER L O/P	FLASHER L	FEMALE LU 6.3mm	RED/GRN
49	7/.3	KEY REL 85	FEMALE LU 6.3 mm	KEY RELAY GND	MID JOINT	MJ WIRE 56	MID JOINT	BRN
50	7/.3	FLASHER E	FEMALE LU 6.3 mm	FLASHER GND	MID JOINT	MJ WIRE 58	MID JOINT	BRN
51	11/.3	CN2DL-1	FEMALE 90 SERIES	FR.COMBI(RH) GND	MID JOINT	MJ WIRE 56	MID JOINT	BRN
52	7/.3	CN4R-2	FEMALE LU	SIDE TURN(RH) GND	MID JOINT	MJ WIRE 56	MID JOINT	BRN
53	7/.3	CN4L-2	FEMALE LU	SIDE TURN IND(LH)GND	MID JOINT	MJ WIRE 56	MID JOINT	BRN
54	11/.3	CN2DR-1	FEMALE 90 SERIES	FR.COMBI(RH) GND	MID JOINT	MJ WIRE 56	MID JOINT	BRN
55	7/.3	CN82-1	MALE 250 SERIES	BRK FLD SENSOR GND	MID JOINT	MJ WIRE 56	MID JOINT	BRN
56	22/.3	RT35	EYELET 6 mm ID	CHASSIS GND FRONT	MID JOINT	MJ WIRE 49	MID JOINT	BRN
57	36/.3	RT35a	EYELET 6 mm ID	CHASSIS GND FRONT	CHASSIS GND Pedal Box	EYELET 6 mm ID	RT34a	BRN
58	36/.3	CN10-5	FEMALE 250 SERIES	GND LINE FOR TR.SW	MID JOINT	MJ WIRE 57	MID JOINT	BRN
59	7/.3	CN20-2	FEMALE 90 SERIES	THROTTLE POT MIN	INTERMEDIATE CONN	CNG1-16	FEMALE 90 SERIES	BLK/YEL
60	7/.3	CN20-3	FEMALE 90 SERIES	THROTTLE POT WIPER	INTERMEDIATE CONN	CNG1-10	FEMALE 90 SERIES	WHT/GRN
61	7/.3	CN20-1	FEMALE 90 SERIES	THROTTLE POT MAX	INTERMEDIATE CONN	CNG1-12	FEMALE 90 SERIES	RED/YEL
62	7/.3	CN13-3	MALE 90 SERIES	BRAKE POT WIPER	INTERMEDIATE CONN	CNG1-15	FEMALE 90 SERIES	WHT/RED
63	7/.3	CN13-1	MALE 90 SERIES	BRAKE POT MAX	INTERMEDIATE CONN	CNL1-4	MALE 90 SERIES	BLK/RED
64	7/.3	CN13-2	MALE 90 SERIES	BRAKE POT Min	INTERMEDIATE CONN	CNL1-5	MALE 90 SERIES	GRN/BLK
65	36/.3	CN11-13	MALE 90 SERIES	TR.SW DRIVE LITE I/P F5	MID JOINT	MJ WIRE 26	MID JOINT	RED/BLU
66	7/.3	CN16-1	FEMALE BULLET	PARK BRAKE SWITCH	INTERMEDIATE CONN	G1 - 11	FEMALE 90 SERIES	GRY/GRN
67	11/.3	CN87-2	FEMALE 250 SERIES	WASHING MOTOR - GND	MID JOINT	MJ WIRE 58	MID JOINT	BRN
68	11/.3	CN10-6	FEMALE 250 SERIES	TR. SW WASHING OUTPUT	WASHING MOTOR - 12V	CN87-1	FEMALE 250 SERIES	RED
69	7/.3	CN88-2	FEMALE 90 SERIES	DOOR SWITCH OUTPUT	INTERMEDIATE CONN	L1-1	MALE 90 SERIES	RED/WHT
70	7/.3	CN88-1	FEMALE 90 SERIES	DOOR SWITCH I/P (GND)	MIDJOINT	MJ-58		BRN
71	85/.3	F0,F2-F6,F10	FEMALE 6.3 mm Lu	FUSE BOX FUSES	MID JOINT	MJ WIRE 42	MID JOINT	RED/YEL
72	11/.3	CN75-4	FEMALE 250 SERIES	12V SUPPLY	FUSE BOX	FUSE F10	FUSE FEMALE	WHT
73	11/.3	CN75-8	FEMALE 250 SERIES	12V SWITCHED SUPPLY FOR CDL	FUSE BOX	FUSE F11	FUSE FEMALE	BLK
74	11/.3	CN75-3	FEMALE 250 SERIES	SUPPLY GND FOR CDL	MID JOINT	MJ WIRE 58	MID JOINT	BRN
75	11/.3	CN75-2	FEMALE 250 SERIES	TAPPING FOR TURN LIGHT - L	MID JOINT	MJ WIRE 13	MID JOINT	BLK/WHT
76	11/.3	CN75-1	FEMALE 250 SERIES	TAPPING FOR TURN LIGHT - R	MID JOINT	MJ WIRE 15	MID JOINT	BLK/Grn
77	7/.3	CN75-7	FEMALE 250 SERIES	DOOR SWITCH INPUT TO CDL	MID JOINT	MJ WIRE 69	MID JOINT	RD/WHT
78	7/.3	CN75-6	FEMALE 250 SERIES	SIREN OUTPUT FROM CDL	SIREN- 12V	CN76-1	FEMALE 6.3MM	YEL/GRN
79	7/.3	CN75-5	FEMALE 250 SERIES	SIREN OUTPUT FROM CDL	SIREN- GND	CN76-2	FEMALE 6.3MM	GREY/GRN
80	15/.3	CN91-3	FEMALE 90 SERIES	12V SUPPLY FOR BLOWER	FUSE BOX CONNECTOR	CN 112-3	FEMALE 90 SERIES	WHT/GRN
81	7/.3	CN91-2	FEMALE 90 SERIES	GND FOR LAMPS	MID JOINT	MJ WIRE 25	MID JOINT	BRN
82	7/.3	CN91-1	FEMALE 90 SERIES	BLOWER SPEED-1	BLOWER RESISTOR	CN95-2	FEMALE 6.3MM	ORG
83	15/.3	CN91-6	FEMALE 90 SERIES	BLOWER SPEED-2	BLOWER RESISTOR	CN95-1	FEMALE 6.3MM	BLU
84	7/.3	CN91-5	FEMALE 90 SERIES	OUTPUT FOR HEATER RELAY	HEATER RELAY-12V	CN 93-2	FEMALE 90 SERIES	ORG/BLK
85	36/.3	CN92-1	FEMALE 6.3MM	GND FOR BLOWER	GND FOR BLOWER	L1-2	MALE 90 SERIES	BRN
86	7/.3	CN93-1	FEMALE 90 SERIES	GND FOR HEATER RELAY	MID JOINT	MJ 81	MID JOINT	BRN
87	7/.3	CN112-1	FEMALE 90 SERIES	UN SW 12V INTO FBC	FUSE BOX	FUSE F0	FEMALE 6.3 mm	RED/YEL
88	15/.3	FUSE F12	FEMALE 6.3 MM	FUSE BOX	SW 12V INTO FBC	CN112-2	FEMALE 90 SERIES	ORG/BLK
89	7/.3	CN112-7	FEMALE 90 SERIES	12V SUPPLY FOR AC SWITCH	OUTPUT FOR AC SWITCH	CN91-4	FEMALE 90 SERIES	YEL/GRN
90	15/.3	CN112-4	FEMALE 90 SERIES	48V SUPPLY TO COND FAN FUSE(5A)	NEAR FUSE BOX FUSE	F16	FEM (TONGUE) 6.3 mm	YEL
91	7/.3	CN110-1	FEMALE 90 SERIES	12V SUPPLY IN TO DPS	12V SUPPLY IN TO DPS	CN112-5	FEMALE 90 SERIES	BLU
92	7/.3	CN110-2	FEMALE 90 SERIES	12V SUPPLY OUT FROM DPS	12V SUPPLY OUT FROM DPS	CN112-6	FEMALE 90 SERIES	ORG
93	15/.3	CN 123-4	FEMALE 90 SERIES	GND FOR CONDENSER FAN	———	RT 205	EYELET 6 MM ID	BRN
94	15/.3	CN F16	FEM (TONGUE) 6.3 mm	FUSE OUT	48V SUPPLY TO COND FAN	CN123-1	FEMALE 90 SERIES	YEL
95	15/.3	CN 123-2	FEMALE 90 SERIES	SHORTING LINK	SHORTING LINK	CN123-3	FEMALE 90 SERIES	BLU/BLK
96	7/.3	CN142-85	FEMALE 6.3 mm	48V I/P TO TAPE RLY COIL	MID JOINT	MJ 41	MID JOINT	RED/BLK
97	7/.3	CN 140-1	FEMALE 90 SERIES	GND FOR FOG LAMP SW BACK ILL	MID JOINT	MJ 85	MID JOINT	BRN


FRONT LIGHTING HARNESS
FUSE BOX
5 WAY KEY RELAY
3 WAY FLASHER RELAY
AS VIEWED FROM FRONT
FUSE RATINGS
F16 FUSE TO BE MOUNTED ON BOTTOM OF FUSE BOX USING ANABOND
DECAL ' ' FUSE 5A TO BE PROVIDED ON F16 FUSE COVER AT READABLE POSITION
MAIN WIRING CONNECTION
G1
L1
CN112 A/C HARNESS
CN15 WIPER MOTOR
CN88 DOOR SWITCH
CN76 SIREN
CN6(F) HORN
CN4L(F) SIDE INDICATOR - LH
CN4R(F) SIDE INDICATOR RH
CN2DL DRIVE LIGHT (LH)
CN2DR DRIVE LIGHT (RH)
CN3L HEAD LAMP LH
CN3R HEAD LAMP - RH
CN2TL TURN LIGHT (LH)
CN2TR TURN LIGHT (RH)
CN123 CONDENSOR FAN
CN87 WASHING SYS.
CN110 DUAL PRESSURE SWITCH
CN82 BRAKE FLUID SENSOR
CN13 BRAKE POT
CN16(F) TO PARK BRAKE SW
CN145 TO TAPE PLAYER ANTI DIF CIRCUIT
CN142 WHITE TAPE PLAYER RELAY
CN144 12V CHARGER
CN12 REAR LIGHTING HARNESS
CN92 BLOWER
CN95 BLOWER RESISTOR
CN93 TO AC HARNESS
CN149 DEFOGGER SWITCH
CN140 (BLACK) FOG SWITCH
CN147 BLACK CHIME RELAY
CN86 TAPE PLAYER
CN91 BLOWER SWITCH
CN100 SLIDER BACK LL
CN66 BLOWER BACK LL
CN85 STOP LIGHT SW
CN00 THROTTLE POT
CN 75 CDL
CN11
CN10 TO TREE SWITCH
TO MAIN WIRING H/N F1
25 COT (SPLIT)
20 COT (SPLIT)
GROMMET
PEDAL BOX
FUSE BOX
CN1K1
CN1FL1
CN F16
SIDE INDICATOR RH
RT205 93b GND
RT35 56a GND
RT35a 57a GND

	WIRE NO	WIRE SIZE	CONNECTOR PIN	TERMINAL AT A	CIRCUIT FROM	CIRCUIT TO	CONNECTOR PIN	TERMINAL AT B	WIRE COLOUR
	98	7/.3	CN 140-3	FEMALE 90 SERIES	12V O/P FROM FOG LAMP SW	INTERMED CONNECTOR	CN12-8	FEMALE 90 SERIES	RED
	99	7/.3	CN 140-6	FEMALE 90 SERIES	12V I/P TO FOG LAMP SW	FUSE BOX FUSE	F9	FUSE TERMINAL	YLW/WHT
	100	7/.3	CN 86-3	FEMALE 90 SERIES	UN SW 12V I/P TO TAPE PLAYER	MID JOINT	MJ 102	MID JOINT	BLUE
	101	7/.3	CN142-86	FEMALE 6.3 mm	GND FOR TAPE RELAY COIL (48V)	MID JOINT	MJ 85	MID JOINT	BRN
	102	11/.3	CN145-2	FEMALE ALEX	12V BY TAPE PLAYER ANTI DIP CKT.	SW 12V I/P TO TAPE PLAYER RELAY	CN142-30	FEMALE 6.3 mm	BLUE
	103	11/.3	CN145-4	FEMALE ALEX	GND FOR TAPE PLAYER ANTI DIP CKT	MID JOINT	MJ 85	MID JOINT	BRN
	104	7/.3	CN L1-6	MALE 90 SERIES	BYPASS GND FOR CHIME THRO' RLY	CHIME RELAY CONT THRO' DIODE	CN147-30	FEMALE 6.3 mm	BLU/WHT
	105	7/.3	CN147-87	FEMALE 6.3 mm	12V O/P BY CHIME RLY CONT NO	MID JOINT	MJs 106 &107	SOLDER JOINT	GRY/RED
	106	7/.3	D3-1	SOLDER JOINT	12V O/P BY CHIME RLY CONT NO	MID JOINT	MJ 105	SOLDER JOINT	GRY/RED
	107	7/.3	D4-1	SOLDER JOINT	12V O/P BY CHIME RLY CONT NO	MID JOINT	MJ 105	SOLDER JOINT	GRY/RED
	108	7/.3	D3-2	SOLDER JOINT	CHIME GND THRO' LO BEAM SW	MID JOINT	MJ 3	MID JOINT	RED
	109	7/.3	D4-2	SOLDER JOINT	CHIME GND THRO' HI BEAM SW	MID JOINT	MJ 5	MID JOINT	YEL
	110	7/.3	CN147-85	FEMALE 6.3 mm	12V I/P TO CHIME RLY COIL	MID JOINT	MJ 46	MID JOINT	RED
	111	7/.3	CN147-86	FEMALE 6.3 mm	GND CHIME RLY COIL THRO' DS	MID JOINT	MJ 69	MID JOINT	RED/WHT
	112	7/.3	CN144-3	FEMALE 90 SERIES	12V FOR BACK ILL OF ADAPTER	MID JOINT	MJ 8	MID JOINT	GRY/RED
	113	7/.3	CN144-1	FEMALE 90 SERIES	GND FOR ADAPTER	MID JOINT	MJ 85	MID JOINT	BRN
	114	7/.3	CN144-2	FEMALE 90 SERIES	12V SUPPLY FOR ADAPTER	MID JOINT	MJ 87	MID JOINT	RED/YEL
	115	7/.3	CN149-1	FEMALE 90 SERIES	GND FOR DEFOGER SW BACK ILL	MID JOINT	MJ 85	MID JOINT	BRN
	116	7/.3	CN149-6	FEMALE 90 SERIES	12V I/P TO DEFOGGER SW	FUSE BOX FUSE	F12	FUSE TERMINAL	PINK
	117	7/.3	CN149-3	FEMALE 90 SERIES	12V O/P BY DEFOGGER SW	12V FOR DEFOGGER RELAY COIL	CN12 -9	FEMALE 90 SERIES	ORG
	118	7/.3	CNL1-7	MALE 90 SERIES	LOW BEAM INPUT	MID JOINT	MJ 3	MID JOINT	RED
	119	7/.3	CN140-4	FEMALE 90 SERIES	12V DEFOGGER SW BK ILL (CONT GLOW)	MID JOINT	MJ 8	MID JOINT	GRY/RED
	120	7/.3	CN149-4	FEMALE 90 SERIES	12V FOG SW BK ILL (CONT GLOW)	MID JOINT	MJ 8	MID JOINT	GRY/RED
	121	7/.3	CNL1-9	MALE 90 SERIES	LOW BAT. SIGNAL	SOC SIGNAL TO A/C H/N	CN112-8	FEMALE 90 SERIES	YEL/WHT
	122	7/.3	CNL1-8	MALE 90 SERIES	SW 12V FOR CCS	MID JOINT	MJ 73	MID JOINT	BLK
	123	11/.3	CNL1-10	MALE 90 SERIES	BV3 SUPPLY	BV3 IN TO TP ANTI DIP CKT	CN145-3	FEMALE ALEX	ORG/BLK
	124	7/.3	CN140-2	FEMALE 90 SERIES	SW 12V TO ON STATUS LED FOG SW	MID JOINT	MJ 98	MID JOINT	RED
	125	7/.3	CN149-2	FEMALE 90 SERIES	SW 12V TO ON STATUS LED DEFOG SW	MID JOINT	MJ 117	MID JOINT	ORG
	126	11/.3	CN2TL-1	FEMALE 90 SERIES	FRT TURN (LH) GND	MID JOINT	MJ 56	MID JOINT	BRN
	127	11/.3	CN2TR-1	FEMALE 90 SERIES	FRT TURN (RH) GND	MID JOINT	MJ 56	MID JOINT	BRN
	128	7/.3	CN112-9	FEMALE 90 SERIES	12V TO BLOWER HI SPEED	MID JOINT	MJ 130	MID JOINT	GRN/BLK
	129	7/.3	CN91-7	FEMALE 90 SERIES	BLOWER SPEED-3	RESISTOR 3	CN95-3	FEMALE 6.3MM	YEL/RED
	130	7/.3	CN91-8	FEMALE 90 SERIES	BLOWER SPEED-4	RESISTOR 4	CN95-4	FEMALE 6.3MM	GRN/BLK
	131	15/.3	CN92-2	FEMALE 6.3MM	BLOWER 12V SUPPLY	MIJ JOINT	MJ 130	MID JOINT	GRN/BLK
	132	7/.3	CN96-1	FEMALE 90 SERIES	BLOWER BACK ILL SUPPLY	MID JOINT	MJ 8	MID JOINT	GRY/RED
	133	7/.3	CN96-2	FEMALE 90 SERIES	BLOWER BACK ILL GND	MID JOINT	MJ 81	MID JOINT	BRN
	134	7/.3	CN100-1	FEMALE 90 SERIES	BLOWER BACK ILL SUPPLY	MID JOINT	MJ 132	MID JOINT	GRY/RED
	135	7/.3	CN100-2	FEMALE 90 SERIES	BLOWER BACK ILL GND	MID JOINT	MJ 133	MID JOINT	BRN
Ⓐ	136	7/.3	CN12-10	FEMALE 90 SERIES	DOOR SW O/P	MID JOINT	MJ 69	MID JOINT	RED/WHT

CONNECTORS USED IN LIGHTING HARNESS

SL	NUMBER	DESCRIPTION	PARTNUMBER	MAKE	USED FOR
1	CN2DL /CN2DR	90 SERIES 2 WAY FEMALE WATER PROOF	2FW 090 FHCL	BESMAK	FRONT COMBINATION DRIVE LIGHTS (LH/RH)
2	CN2TL/CN2TR	90 SERIES 2 WAY FEMALE WATER PROOF	2FW 090 FHCL	BESMAK	FRONT COMBINATION TURN LIGHTS (LH/RH)
3	CN3L	3 WAY (F) SOCKET	TTP-1855(C)	TT	HEAD LIGHT (LH)
4	CN3R	3 WAY (F) SOCKET	TTP-1855(C)	TT	HEAD LIGHT (RH)
5	CN4L	6.3mm WINDOW TYPE (F) LUCAR W SLEEVE		TT	SIDE TURN INDICTATOR (LH)
6	CN4R	6.3mm WINDOW TYPE (F) LUCAR W SLEEVE		TT	SIDE TURN INDICTATOR (RH)
7	CN5	6.3mm WINDOW TYPE (F) LUCAR W SLEEVE +VE LOCKING	TT-1904	TT	HORN
8	CN10	250 SERIES 6 WAY FEMALE (6.3mm F TERMINALS)	TTP-26FN	TT	COMBINATION SWITCH
9	CN11	90 SERIES 13 WAY MALE (LIGHTS & HORN)	MG 620217	KET	COMBINATION SWITCH
10	CN12	90 SERIES 12 WAY FEMALE		KET	REAR HARNESS SUPPLY
11	CN13	90 SERIES 3 WAY MALE	3M 090 FHCL	BESMAK	BRAKE POT
12	CN15	90 SERIES 4 WAY FEMALE WATER PROOF	4FW 090 FHCL	BESMAK	WIPER MOTOR
13	CN16	4.5mm F BULLET WITH SLEEVE	TT-1809	TT	HAND BRAKE SWITCH
14	CN20	90 SERIES 3 WAY FEMALE	3F 090 FHCL	BESMAK	THROTTLE POT
15	CN75	250 SERIES 8 WAY FEMALE,	TTP-28FN	TT	CENTRAL DOOR LOCKING SYSTEM
16	CN76	250 SERIES 2 WAY FEMALE (6.3mm F TERMINALS)	TTP-22FN	TT	SIREN
17	CN82	250 SERIES 2 WAY MALE	TTP-22MN	TT	BRAKE FLUID SENSOR
18	CN85	250 SERIES 2 WAY FEMALE	TTP-22FN	TT	STOP LIGHT SWITCH
19	CN86	90 SERIES 3 WAY FEMALE	3F 090 FHCL	BESMAK	TAPE PLAYER
20	CN87	250 SERIES 2 WAY (6.3mm F TERMINALS)	TTP-22FN	TT	WASHING SYSTEM
21	CN88	90 SERIES 2 WAY FEMALE WATER PROOF	2MW 090 FHCL	BESMAK	DOOR SWITCH
22	CN91	90 SERIES 8 WAY FEMALE	8F 090 FHCL	BESMAK	BLOWER SWITCH
23	CN92	250 SERIES 2 WAY FEMALE (6.3mm F TERMINALS)	TTP-22FN	TT	BLOWER MOTOR
24	CN93	90 SERIES 2 WAY FEMALE WATER PROOF	2FW 090 FHCL	BESMAK	HEATER RELAY
25	CN95	250 SERIES 4 WAY FEMALE (6.3mm F TERMINALS)	TTP-24FN	TT	BLOWER RESISTER
26	CN96	90 SERIES 2 WAY FEMALE WATER PROOF	2FW 090 FHCL	BESMAK	BLOWER BACK ILL
27	CN100	90 SERIES 2 WAY FEMALE WATER PROOF	2FW 090 FHCL	BESMAK	SLIDER BACK ILL
28	CN110	2 WAY FEMALE - MSSL PNo:61890094	61890094	MSSL	DPS SWITCH
29	CN112	90 SERIES 10 WAY FEMALE		KET	TO A/C HARNESS
30	CN123	90 SERIES 4WAY FEMALE WATER PROOF	4FW 090 FHCL	BESMAK	CONDENSOR FAN
31	CN140	90 SERIES 6 WAY FEMALE		KET	FOG LAMP SW
32	CN142	250 SERIES 5 WAY (6.3mm FEM TERMINALS)	TTP-RB1	TT	TAPE PLAYER RELAY
33	CN144	90 SERIES 3 WAY FEMALE	3F 090 FHCL	BESMAK	12V CHARGER
34	CN145	ALEX 2 X 2 WAY FEMALE		MOLEX	TAPE PLAYER ANTI DIP CIRCUIT
35	CN147	250 SERIES 5 WAY (6.3mm FEM TERMINALS)	TTP-RB1	TT	CHIME RELAY
36	CN149	90 SERIES 6 WAY FEMALE		KET	DEFOGGER SW
37	CN 250	250 SERIES 5 WAY (6.3mm F), SPACER	TTP-RB1 , TTP-SP1	TT	POT RELAY
38	CNG1	90 SERIES 18 WAY FEMALE	MG 620061	KET	TO MAIN HARNESS
39	CNL1	90 SERIES 10 WAY MALE		KET	TO MAIN HARNESS
40	FB	FUSE BOX WITH 2X7 WAYS	TTP-14FB	TT	BLADE FUSE
41	CNF1	350 SERIES 1 WAY (8mm MALE TERMINALS)	TTP-31MN	TT	12 V SUPPLY TO FUSE BOX
42	CNK1	250 SERIES 5 WAY(F)	TTP-RB1	TT	KEY RRELAY
43	CNFL1	250 SERIES 3 WAY(F)	TTP-RB5	TT	FLASHER RELAY
44	RT34a	EYELET 6 mm	TT-1851	TT	CHASSIS GROUND NEAR PEDAL BOX
45	RT35	EYELET 6 mm	TT-1851	TT	CHASSIS GROUND ON HORN MTG.
46	RT35a	EYELET 6 mm	TT-1851	TT	CHASSIS GROUND ON HORN MTG.
47	RT205	EYELET 6 mm	TT-1851	TT	CHASSIS GROUND ON HORN MTG.
48	F 16	IN-LINE FUSE HOLDER WITH COVER	TTP-1868	TT	FUSE HOLDER (48V, 5 A)



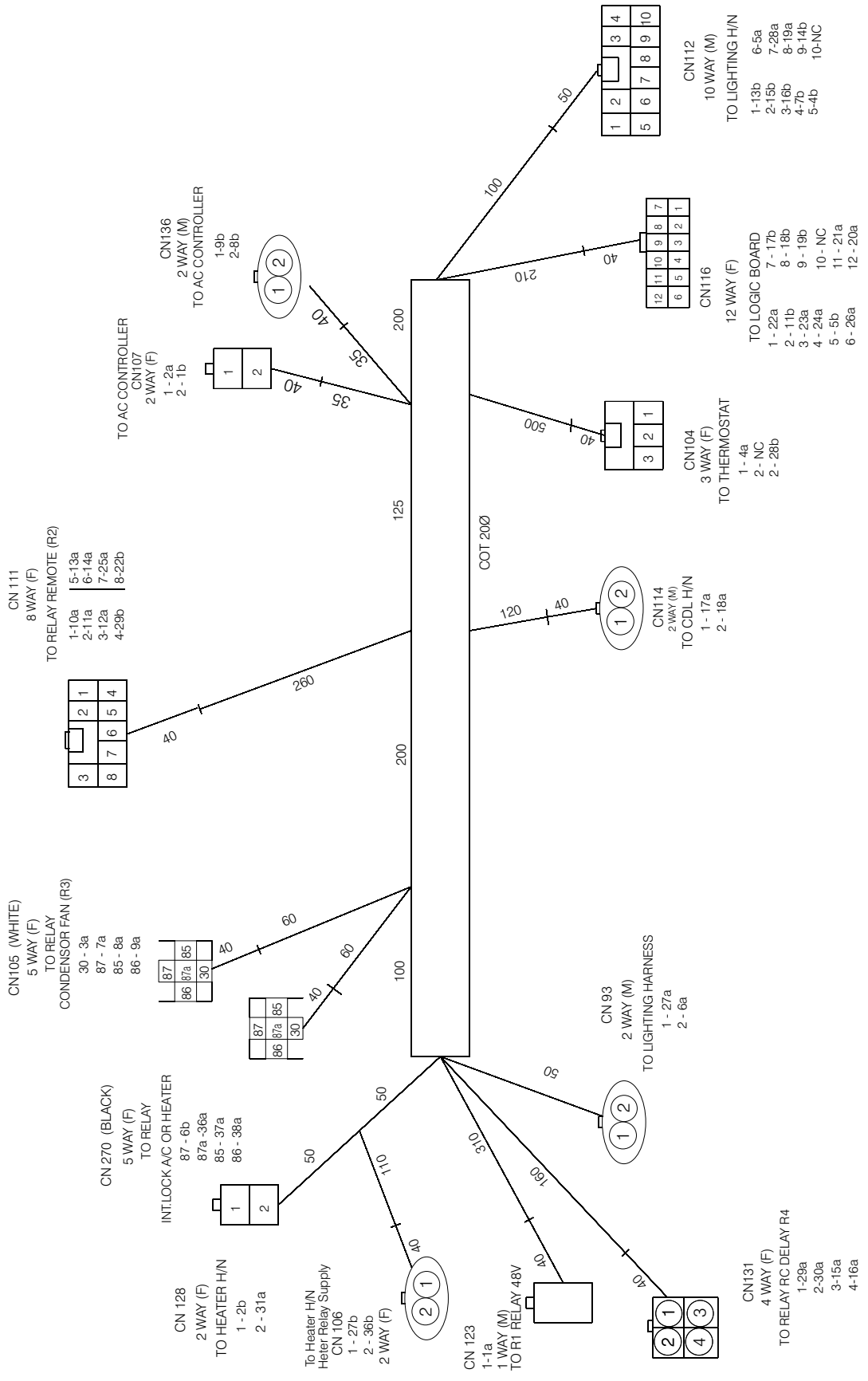
REAR LIGHTING AND HEATER HARNESS

CONNECTORS USED IN REAR LIGHTING HARNESS

WIRE		CONNECTOR	TERMINAL	CIRCUIT		TERMINAL	CONNECOTR	WIRE
No.	SIZE	PIN	AT "A"	FROM	TO	AT "A"	PIN	COLOR
1	7/0.3	CN6L-3	FEMALE 90 SERIES	RC LAMP(L) DR	RC LAMP(L) DR INPUT	MALE 90 SERIES	CN12-3	GRY/RED
2	7/0.3	CN6R-3	FEMALE 90 SERIES	RC LAMP(R) DR	MID JOINT	Mid Joint	MJ WIRE 1	GRY/RED
3	7/0.3	CN7L-2	FEMALE 90 SERIES	REAR TURN (L)	REAR TURN (L) INPUT	MALE 90 SERIES	CN12-1	BLK/WHT
4	7/0.3	CN7R-2	FEMALE 90 SERIES	REAR TURN (R)	REAR TURN (R) INPUT	MALE 90 SERIES	CN12-2	BLK/GRN
5	15/0.3	CN6R-2	FEMALE 90 SERIES	RC LAMP(L) BRK	MID JOINT	Mid Joint	MJ WIRE 6	RED/WHT
6	15/0.3	CN6L-2	FEMALE 90 SERIES	RC LAMP(R) BRK	RC LAMP(R) BRK INPUT	MALE 90 SERIES	CN12-4	RED/WHT
7	11/0.3	CN8R-2	FEMALE 90 SERIES	REVERSE (R)	MID JOINT	Mid Joint	MJ WIRE 8	ORN/GRN
8	11/0.3	CN8L-2	FEMALE 90 SERIES	REVERSE (L)	REVERSE INPUT	MALE 90 SERIES	CN12-5	ORN/GRN
9	7/0.3	CN9R-1	FEMALE 90 SERIES	LICENCE (R)	LICENCE INPUT	MALE 90 SERIES	CN12-6	BLUE
10	7/0.3	CN26a	FEMALE BULLET	DOME LIGHT	DOME LIGHT INPUT	MALE 90 SERIES	CN12-7	RED/BLU
11	7/0.3	CN9L-1	FEMALE 90 SERIES	LICENCE (L)	MID JOINT	MID JOINT	MJ WIRE 9	BLUE
12	22/0.3	RT36	EYELET 6mm ID	REAR GROUND	MID JOINT	MID JOINT	MJ WIRE-12	BROWN
13	15/0.3	CN6R-1	FEMALE 90 SERIES	RC LAMP(R) G	MID JOINT	MID JOINT	MJ WIRE-12	BROWN
14	15/0.3	CN7R-1	FEMALE 90 SERIES	REAR TURN(R) G	MID JOINT	MID JOINT	MJ WIRE-12	BROWN
15	7/0.3	CN9R-2	FEMALE 90 SERIES	LICENCE (R) G	MID JOINT	MID JOINT	MJ WIRE-12	BROWN
16	15/0.3	CN8R-1	FEMALE 90 SERIES	REVERSE (R) G	MID JOINT	MID JOINT	MJ WIRE-12	BROWN
17	7/0.3	CN9L-2	FEMALE 90 SERIES	LICENCE (L) G	MID JOINT	MID JOINT	MJ WIRE-12	BROWN
18	15/0.3	CN8L-1	FEMALE 90 SERIES	REVERSE (L) G	MID JOINT	MID JOINT	MJ WIRE-12	BROWN
19	15/0.3	CN6L-1	FEMALE 90 SERIES	RC LAMP(L) G	MID JOINT	MID JOINT	MJ WIRE-12	BROWN
20	15/0.3	CN7L-1	FEMALE 90 SERIES	REAR TURN(L) G	MID JOINT	MID JOINT	MJ WIRE-12	BROWN
21	15/0.3	CN171-1	MALE 90 SERIES	Hi mt stop Lamp	MID JOINT	MID JOINT	MJ WIRE 6	RED/WHT
22	15/0.3	CN171-2	MALE 90 SERIES	Gnd Stop Lamp	MID JOINT	MID JOINT	MJ WIRE 12	BROWN
23	7/0.3	CN12-8	FEMALE 90 SERIES	INT CONNECTOR	12V I/P TO FOG LAMP	FEMALE 90 SERIES	CN 143-1	RED
24	7/0.3	CN143-2	FEMALE 90 SERIES	Gndfor FOG Lamp	MID JOINT	MID JOINT	MJ 12	BRN
25	85/.3	CN124-1	FEMALE 350 SERIES	INT.MEDIATE CONN.	48V FUSE OUT	FUSE TERMINAL	F1 OUT	RED
26	85/.3	CN128-1	MALE 350 SERIES	GND A/C CONTR.	GND ON CONTR.	EYELET 8mm ID	RT201	BRN
27	57/.3	CN128-2	MALE 350 SERIES	48V FOR HEATER	48V FUSE IN	FUSE TERMINAL	F15 IN	RED
28	57/.3	F15 OUT	FUSE TERMINAL	F15 OUT	INT.MEDIATE CONN.	FEMALE 350 SERIES	CN97-1	RED
29	57/.3	CN97-2	FEMALE 350 SERIES	INT.MEDIATE CONN.	TO HEATER	FEMALE 350 SERIES	CN98-1	YEL
30	7/.3	CN97a-1	FEMALE 90 SERIES	INT.MEDIATE CONN.	12V O/P BY THERMOSTAT	FEMALE 90 SERIES	CN99-1	RED/WHT
31	7/.3	CN97a-2	FEMALE 90 SERIES	INT.MEDIATE CONN.	GND I/P RLY	MALE 90 SERIES	CN106-1	BRN
32	57/.3	CN98-2	FEMALE 350 SERIES	GND I/P TO HEATER	MID JOINT	MID JOINT	MJ - 26	BRN
33	7/.3	CN106-2	MALE 90 SERIES	12V I/P	12V I/P TO THERMOSTAT	FEMALE 90 SERIES	CN99-2	WHT/RED
34	85/.3	F1 IN	FUSE TERMINAL	48V SUPPLY IN	UN S/W 48V SUPPLY	EYELET 8mm ID	RT200	RED
35	7/.3	CN12-9	MALE 90 SERIES	12V I/P DEFOG RLY	12V FOR DEFOG RLY	FEMALE 6.3mm	CN151-85	ORG
36	7/.3	CN151-86	FEMALE 6.3 MM	GND FOR DEFOG RLY	MID JOINT	MID JOINT	MJ-12	BRN
37	15/.3	CN151-30	FEMALE 6.3 MM	48V I/P DEFOG RLY	MID JOINT	MID JOINT	MJ-25	RED
38	15/.3	CN151-87	FEMALE 6.3 MM	48V RLY NO' OUT	48V FOR DEFFOGER	FEMALE 90 SERIES	CN152-2	PINK
39	15/.3	CN152-1	FEMALE 90 SERIES	GND FOR DEFOG	48V FUSE OUT	MID JOINT	MJ-26	BRN
40	7/.3	CN610-1	FEMALE 90 SERIES	FAN SUPPLY	UNSW 12V SUPPLY	MALE 90 SERIES	CN611-2	YELL/BLK
	7/.3	CN610-2	FEMALE 90 SERIES	FAN GROUND	FAN DRIVE	MALE 90 SERIES	CN611-1	BRN/BLK
42	16/.18	CN702-1	FEMALE SUMITOMO	SENSER +VE	SENSER +VE I/P	FEMALE 90 SERIES	CN704-3	WHT
43	16/.18	CN702-2	FEMALE SUMITOMO	SENSER -VE	SENSER -VE I/P	FEMALE 90 SERIES	CN704-2	BRN
44	16/.18	CN702-3	FEMALE SUMITOMO	SPEED SIGNAL	SIGNAL O/P	FEMALE 90 SERIES	CN704-1	GRN
45	7/.3	CN703-1	MALE 90 SER	12V SUPPLY	I/P SUPPLY	FEMALE 90 SERIES	CN704-4	ORG/BLU
46	7/.3	CN703-2	MALE 90 SER	CONTR 12V SUPPLY	I/P SUPPLY	FEMALE 90 SERIES	CN704-5	RED
47	7/.3	CN703-3	MALE 90 SER	CONTR GND	I/P GND	FEMALE 90 SERIES	CN704-6	BRN
48	7/.3	CN12-10	MALE 90 SER	DOOR SW O/P	DOOR SWI/P	BULLET FEMALE	CN731	WHT/RED

CONNECTORS USED IN REAR LIGHTING HARNESS

SL	CON.NO	DESCRIPTION	MF PART NO	MAKE	COMPONENT/PURPOSE
01	CN-6L/6R	90 SERIES 3 WAY FEMALE	3F 090 FHCL	BESMAK	REAR COMB. LAMP
02	CN-7L/7R	90 SERIES 2 WAY FEMALE WATER PROOF	2FW 090 FHCL	BESMAK	REAR TURN LAMP
03	CN-8L/8R	90 SERIES 2 WAY FEMALE WATER PROOF	2FW 090 FHCL	BESMAK	REVERSE LAMP
04	CN 9L/9R	90 SERIES 2 WAY FEMALE WATER PROOF	2FW 090 FHCL	BESMAK	LICENCE LIGHTS
05	CN-12	90 SERIES 12 WAY MALE		KET	TO LIGHTING HARNESS
06	CN-26a	1 WAY FEMALE BULLET	TT-1809	TT	DOME LIGHT
07	CN-97	350 SERIES 2 WAY FEMALE	TTP-32FN	TT	TO HEATER RELAY
08	CN-97a	90 SERIES 2 WAY FEMALE-WATER PROOF	2FW 090 FHCL	BESMAK	TO HEATER RELAY
09	CN-98	350 SERIES 2 WAY FEMALE	TTP-32FN	TT	TO HEATER
10	CN-99	90 SERIES 2 WAY FEMALE-WATER PROOF	2FW 090 FHCL	BESMAK	TO THERMOSTAT
11	CN-106	90 SERIES 2 WAY MALE	2MW 090 FHCL	BESMAK	TO A/C HARNESS
12	CN-124	350 SERIES 1 WAY FEMALE	TTP-31FN	TT	TO A/C RELAY
13	CN-128	350 SERIES 2 WAY MALE	TTP-32MN	TT	TO A/C HARNESS
14	CN-143	90 SERIES 2 WAY FEMALE WATER PROOF	2FW 090 FHCL	BESMAK	FOG LAMP
15	CN-151	250 SERIES 5 WAY FEMALE	TTP-RB1	TT	DEFOGGER RELAY
16	CN-152	90 SERIES 2 WAY FEMALE WATER PROOF	2FW 090 FHCL	BESMAK	TO DEFOGGER
17	CN-171	90 SERIES 2 WAY MALE WATER PROOF	2MW 090 FHCL	BESMAK	HI MOUNT LAMP
18	F1	FUSE 40 A	MTA	MTA	BLADE FUSE
19	F-15	FUSE 20A	TT-1868	TT	BLADE FUSE
20	RT36	EYELET 6mm ID	TT-1851	TT	GND
21	RT200	EYELET 8mm ID	TT-1849	TT	UNSWITCHED 48V
22	RT201	EYELET 8mm ID	TT-1849	TT	GND
23	CN610	90 SERIES 2 WAY FEMALE-WATER PROOF	2FW 090 FHCL	BESMAK	TO FAN DRIVE I/P
24	CN611	90 SERIES 2 WAY MALE-WATER PROOF	2MW 090 FHCL	BESMAK	TO CONTR/CHARG COOLING FAN
25	CN702	3WAY FEMALE SUMITOMO WF	624854317	SUMITOMO	SPEEDO SENSER
26	CN704	90 SERIES 6 WAY FEMALE	6FW 090 FHCL	KET	TO IP SPEEDO METER
27	CN703	3WAY 90 SERIES FEMALE	3FW 090 FHCL	KET	12VSUPPLY FOR IP
28	CN731	BULLET FEMALE	TT1809	TT	DOOR SWITCH

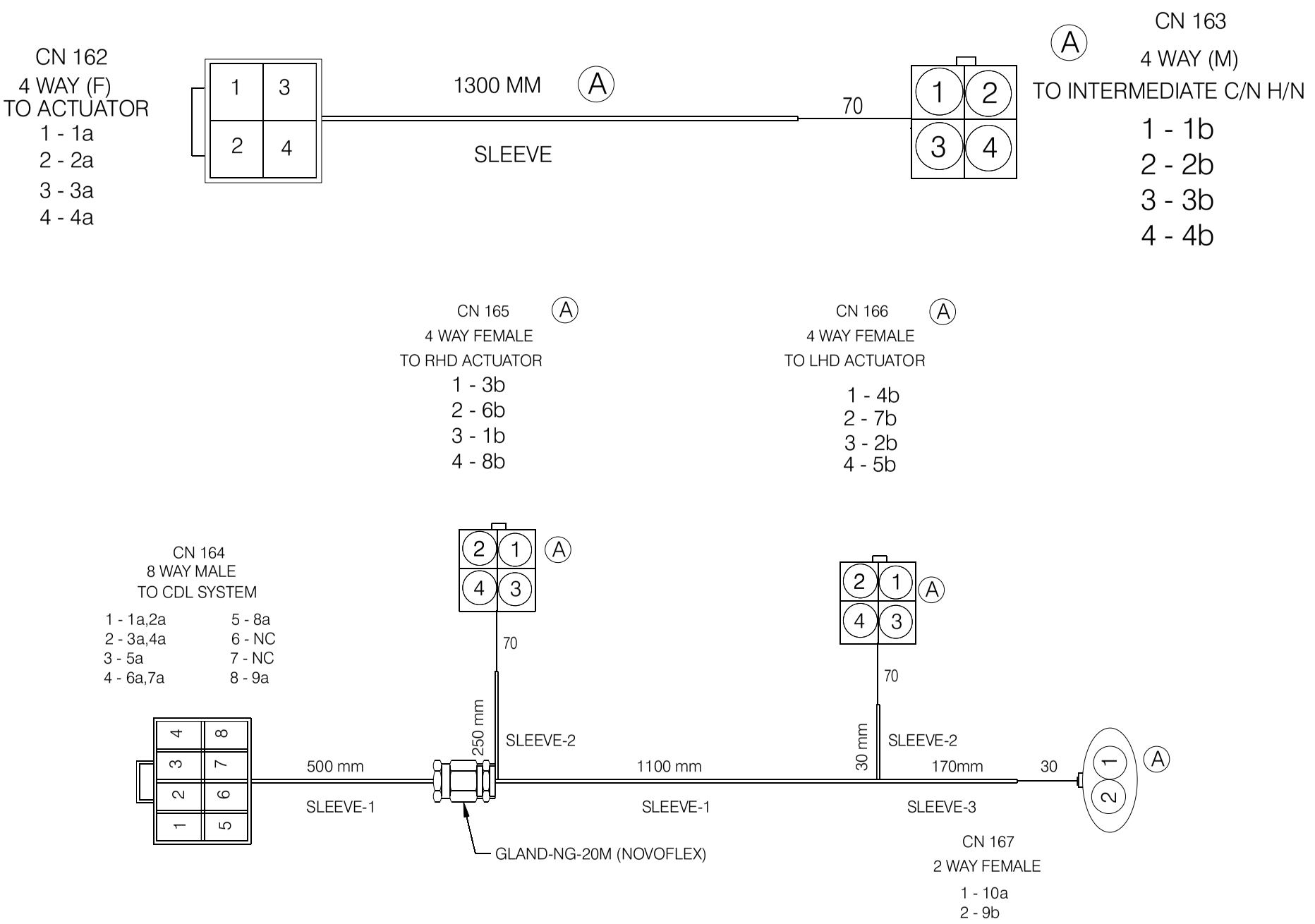

AC HARNESS
COT 200
CN 128
2 WAY (F)
TO HEATER H/N
1 - 2b
2 - 31a
CN 270 (BLACK)
5 WAY (F)
TO RELAY
INT.LOCK A/C OR HEATER
87 - 6b
87a -36a
85 - 37a
86 - 38a
CN105 (WHITE)
5 WAY (F)
TO RELAY
CONDENSOR FAN (R3)
30 - 3a
87 - 7a
85 - 8a
86 - 9a
CN 111
8 WAY (F)
TO RELAY REMOTE (R2)
1-10a
2-11a
3-12a
4-29b
5-13a
6-14a
7-25a
8-22b
TO AC CONTROLLER
CN107
2 WAY (F)
1 - 2a
2 - 1b
CN136
2 WAY (M)
TO AC CONTROLLER
1-9b
2-8b
CN112
10 WAY (M)
TO LIGHTING H/N
1-13b 6-5a
2-15b 7-28a
3-16b 8-19a
4-7b 9-14b
5-4b 10-NC
CN116
12 WAY (F)
TO LOGIC BOARD
1 - 22a 7 - 17b
2 - 11b 8 - 18b
3 - 23a 9 - 19b
4 - 24a 10 - NC
5 - 5b 11 - 21a
6 - 26a 12 - 20a
CN104
3 WAY (F)
TO THERMOSTAT
1 - 4a
2 - NC
2 - 28b
CN114
2 WAY (M)
TO CDL H/N
1 - 17a
2 - 18a
CN 93
2 WAY (M)
TO LIGHTING HARNESS
1 - 27a
2 - 6a
To Heater H/N
Heter Relay Supply
CN 106
1 - 27b
2 - 36b
2 WAY (F)
CN 123
1-1a
1 WAY (M)
TO R1 RELAY 48V
CN131
4 WAY (F)
TO RELAY RC DELAY R4
1-29a
2-30a
3-15a
4-16a

WIRE LEGEND DETAILS FOR AC HARNESS (AC + HEATER WITH

WIRE NO	WIRE SIZE	CONNECTOR PIN	TERMINAL AT A	CIRCUIT FROM	CIRCUIT TO	CONNECTOR PIN	TERMINAL AT B	WIRE COLOUR
1	85/.3	CN123-1	MALE 8 MM	UNSWITCHED 48 V INPUT	48 V INPUT TO ACC	CN 107-2	FEMALE 8 MM	RED
2	85/.3	CN107-1	FEMALE 8 MM	GND FOR ACC	GND FOR ACC	CN 128-1	FEMALE 8 MM	BRN
3	15/.3	CN105-30	FEMALE 6.3 MM	48V INPUT TO R3 RELAY CONT	MID JOINT	MID JON T 1	MIDJOINT	RED
4	7/.3	CN104-1	90 SERIES FEMALE	12 V O/P FROM THERMOSTAT	12V INPUT TO DPS	CN112-5	MALE 90 SERIES	BLU
5	7/.3	CN112-6	MALE 90 SERIES	12 V O/P BY DPS	12V I/P TO ACC	CN116-5	FEMALE ALEX	ORG
6	7/.3	CN93-2	MALE 90 SERIES	12V I/P TO HTR FROM L H/N	12 V I/P TO RELAY NC CONT	CN270-30	FEMALE 250 SERIES	ORG/BLK
7	15/.3	CN105-87	FEMALE 6.3 MM	48V O/P BY R3 RLY NO CONT	48V I/P TO CONDENSER FAN	CN112-4	MALE 90 SERIES	YLW
8	7/.3	CN105-85	FEMALE 6.3 MM	48V INPUT TO R3 RELAY COIL	48V I/P FROM AC MOTOR	CN136-2	MALE 90 SERIES	ORG
9	7/.3	CN105-86	MALE 6.3 MM	GND FOR R3 RELAY COIL	AC MOTOR GND	CN136-1	MALE 90 SERIES	GRY
10	7/.3	CN111-1	90 SERIES FEMALE	UNSW 12V I/P TO R2 RELAY COIL	MID JOINT WIRE	MID JOINT 13	MID JOINT	RED/YEL
11	7/.3	CN111-2	90 SERIES FEMALE	GND FOR R2 RELAY COIL	R2 RLY GND I/P TO LOGIC CKT	CN 116 - 2	FEMALE ALEX	BLK/WHT
12	7/.3	CN111-3	90 SERIES FEMALE	UNSE 12V I/P TO R2 RLY CONTACT	MID JOINT WIRE	MID JOINT 13	MID JON T	RED/YEL
13	15/.3	CN111-5	90 SERIES FEMALE	UNSW 12V I/P TO R2 RLY CONTACT	INTERMEDIATE	CN112-1	MALE 90 SERIES	RED/YEL
14	7/.3	CN111-6	90 SERIES FEMALE	12V O/P BY R2 RLY CONTACT	12V I/P TO BLOWER HI SPEED	CN112-9	MALE 90 SERIES	GRN/BLK
15	15/.3	CN131-3	90 SERIES FEMALE	SW 12V I/P TO R2 RLY NC CONT	SW 12 V (F12) fromF BC	CN 112- 2	MALE 90 SERIES	ORN/BLK
16	15/.3	CN131-4	90 SERIES FEMALE	12V O/P by R2 Rly NC contact	12V I/P TOB LOWER	CN 112 - 3	MALE 90 SERIES	WHT/GRN
17	7/.3	CN114-1	MALE 90 SERIES	REMOTE 'FIND'SIGNAL FROM CDL H/N	REMOTE FIND SIGNAL I/P TO LB	CN 116-7	FEMALE ALEX	GRY
18	7/.3	CN114-2	MALE 90 SERIES	LOCK SIGNAL FROM CDL H/N	REMOTE LOCK SIGNAL I/P TO LB	CN 116-8	FEMALE ALEX	RED/BLK
19	7/.3	CN112-8	MALE 90 SERIES	SOC SIGNAL FROM MAIN H/N	SOC SIGNAL TO ACC	CN116-9	FEMALE ALEX	YEL/WHT
20	7/.3	CN116-12	FEMALE ALEX	AC & HEATER SWITCH SIGNAL FOR LB	MID JON T	MJ 34 & 35	SOLDER JOINT	GRY/RED
21	7/.3	CN116-11	FEMALE ALEX	SWITCHED 12V I/P TO LB	MID JOINT WIRE	MID JOINT 15	MID JOINT	ORN/BLK
22	7/.3	CN116-1	FEMALE ALEX	GND FOR R1 COIL IN LB	GND FOR R1 RELAY COL	CN 111-8	FEMALE 90 SERIES	BRN
23	7/.3	CN116-3	FEMALE ALEX	UNSWITCHED 12V I/P TO LB	MID JOINT WIRE	MID JOINT 13	MID JON T	RED/YEL
24	7/.3	CN116-4	FEMALE ALEX	GND FOR LOGIC BOARD	MID JOINT	MID JOINT 27	MID JON T	BRN
25	7/.3	CN111-7	FEMALE 90 SERIES	UNSW 12V I/P TO R1 RELAY COIL	MID JOINT	MID JOINT 13	MID JON T	RED/YEL
26	7/.3	CN116-6	FEMALE ALEX	HIGH SPEED SIGNAL I/P TO LB	MID JOINT	MID JOINT 14	FEMALE Lu	GRN/BLK
27	7/.3	CN93-1	MALE 90 SERIES	GND FOR HEATER RELAY	GND FOR HEATER RELAY	CN 106-1	FEMALE 90 SERIES	BRN
28	7/.3	CN112-7	MALE 90 SERIES	12V I/P FROM L H/N	12V I/P TO AC THERMOSTAT	CN 104-2	FEMALE 90 SERIES	YEL/GRN
29	7/.3	CN131-1	FEMALE 90 SERIES	12V I/P FOR RC DELAY RELAY COIL	12V O/P BY R2 RELAY CONCT	CN 111-4	90 SERIES FEMALE	RED/WHT
30	7/.3	CN131-2	FEMALE 90 SERIES	12V GND FOR RC DELAY RELAY COIL	MID JOINT	MID JON T 27	MID JOINT	BRN
31	85/.3	CN128-2	FEMALE 8 MM	48V FOR HEATER	MID JOINT	MID JON T 1	MID JOINT	RED
32	7/.3	D1- 1	SOLDER JOINT	AC SW SIGNAL(REMOTE)	MID JON T	MID JOINT 4	MID JOINT	ORN/BLU
33	7/.3	D2- 1	SOLDER JOINT	HEATER SW ON SIGNAL(REMOTE)	MID JON T	MID JOINT 6	MID JOINT	RED/WHT
34	7/.3	D1- 2	SOLDER JOINT	AC SW SIGNAL(REMOTE)	MID JON T	MID JOINT 20	MID JOINT	GREY/RED
35	7/.3	D2- 2	SOLDER JOINT	HEATER SW ON SIGNAL (REMOTE)	MID JON T	MID JOINT 20	MID JOINT	GREY/RED
36	7/.3	CN270-87a	FEMALE 6.3MM	12V OUTPUT THRO RLY CONT (NC)	12V I/P HEATER COIL	CN106-2	FEMALE 90 SERIES	RED/WHT
37	7/.3	CN270-85	FEMALE 6.3MM	GND FOR RLY	MID JON T	MID JOINT 27	MID JOINT	BRN
38	7/.3	CN270-86	FEMALE 6.3MM	12V SUPPLY FOR RLY COIL	MID JON T	MID JOINT 4	MID JOINT	ORN/BLU

CONNECTORS USED IN AC & HEATER HARNESS

SL	CON NO.	DESCRIPTION	MF PART NO.	MAKE	COMPONENT/PURPOSE
1	CN 93	90 SERIES 2 Way (M) WATER PROOF	2MW 090 FHCL	BESMAK	FROM LIGHTING H/N TO HEQATER RLY
2	CN 104	90 SERIES 3 WAY FEMALE	3F 090 FHCL	KET	THERMOSTAT
3	CN 105	250 SERIES 5 WAY RELAY HOLDER	TTP-RB1	TT	R3 - RELAY COND. FAN
4	CN 106	90 SERIES 2 Way (F) WATER PROOF	2FW 090 FHCL	BESMAK	TO HEATER RELAY
5	CN 107	350 SERIES 2 WAY (F)	TTP-32FN	TT	48V I/P TO AC CONTROLLER
6	CN 111	90 SERIES 8 WAY(F)		KET	R2 - REMOTE RELAY
7	CN 112	90 SERIES 10 WAY (M)		KET	INTERMEDIATE CONN.
8	CN 114	90 SERIES 2 WAY (M)-WATER PROOF	2MW 090 FHCL	BESMAK	CDL I/P
9	CN 116	MOLEX 6X2 WAY FEMALE		MOLEX	LOGIC BOARD
10	CN 123	350 SERIES 1 WAY (8MM M)	TTP-31MN	TT	48V INPUT TO AC HARNESS
11	CN 128	350 SERIES 2 WAY (8MM F)	TTP-32FN	TT	LOGIC BOARD
12	CN 131	90 SERIES 4 WAY (F)-WATER PROOF	4FW 090 FHCL	BESMAK	RELAY RC DELAY CONNECTOR
13	CN 136	90 SERIES 2 WAY (F) WATER PROOF	2FW 090 FHCL	BESMAK	AC CONTROLLER
14	CN 270	250 SERIES 5 WAY (F) RELAY HOLDER	TTP-RB1	TT	RELAY CONDENCER FAN


CN 162
4 WAY (F)
TO ACTUATOR
1 - 1a
2 - 2a
3 - 3a
4 - 4a
1
3
2
4
1300 MM
A
SLEEVE
70
1
2
3
4
A
CN 163
4 WAY (M)
TO INTERMEDIATE C/N H/N
1 - 1b
2 - 2b
3 - 3b
4 - 4b
CN 165
A
4 WAY FEMALE
TO RHD ACTUATOR
1 - 3b
2 - 6b
3 - 1b
4 - 8b
CN 166
A
4 WAY FEMALE
TO LHD ACTUATOR
1 - 4b
2 - 7b
3 - 2b
4 - 5b
CN 164
8 WAY MALE
TO CDL SYSTEM
1 - 1a,2a
2 - 3a,4a
3 - 5a
4 - 6a,7a
5 - 8a
6 - NC
7 - NC
8 - 9a
2
1
4
3
A
70
250 mm
SLEEVE-2
2
1
4
3
A
70
30 mm
SLEEVE-2
4
3
2
1
8
7
6
5
500 mm
SLEEVE-1
1100 mm
SLEEVE-1
170mm
SLEEVE-3
30
2
1
A
GLAND-NG-20M (NOVOFLEX)
CN 167
2 WAY FEMALE
1 - 10a
2 - 9b

Ⓐ WIRE LEGEND DETAILS

WIRE		CONNECTOR PIN	TERMINAL AT A	CIRCUIT		CONNECTOR PIN	TERMINAL AT A	WIRE COLOUR
No	SIZE			FROM	TO			
1	7/.3	CN162-1	FEMALE 250 SERIES	LOCK	LOCK	CN 163-1	90 SR MALE	GRN
2	7/.3	CN162-2	FEMALE 250 SERIES	MASTER	MASTER	CN 163-2	90 SR MALE	WHT
3	7/.3	CN162-3	FEMALE 250 SERIES	UNLOCK	UNLOCK	CN 163-3	90 SR MALE	BLU
4	7/.3	CN162-4	FEMALE 250 SERIES	MASTER	MASTER	CN 163-4	90 SR MALE	BRN

Ⓐ CONNECTORS USED IN CDL H/N - DOOR

S.NO	CONNECTOR	DESCIPTION	MF PART NO	MAKE	COMPONENTS/PURPUS
01	CN162	250 SERIES 4 WAY MALE	TTP-24 FN	TT	ACTUATOR
02	CN163	90 SR 4 WAY MALE -WP	4MW 090 FHCL	BESMAK	CDL H/N INTERMEDIATE

Ⓐ WIRE LEGEND DETAILS

WIRE		CONNECTOR PIN	TERMINAL AT A	CIRCUIT		CONNECTOR PIN	TERMINAL AT A	WIRE COLOUR
No.	SIZE			FROM	TO			
1	7/.3	CN164-1	MALE 6.3mm	UNLOCK	UNLOCK (RHD)	CN 165-3	90 SR FEMALE	BLU
2	7/.3	CN164-1	MALE 6.3mm	UNLOCK	UNLOCK (LHD)	CN 166-3	90 SR FEMALE	BLU
3	7/.3	CN164-2	MALE 6.3mm	LOCK	LOCK (RHD)	CN 165-1	90 SR FEMALE	GRN
4	7/.3	CN164-2	MALE 6.3mm	LOCK	LOCK (LHD)	CN 166-1	90 SR FEMALE	GRN
5	7/.3	CN164-3	MALE 6.3mm	MASTER	MASTER	CN 166-4	90 SR FEMALE	BRN/WHT
6	7/.3	CN164-4	MALE 6.3mm	MASTER	MASTER (RHD)	CN 165-2	90 SR FEMALE	WHT
7	7/.3	CN164-4	MALE 6.3mm	MASTER	MASTER (LHD)	CN 166-2	90 SR FEMALE	WHT
8	7/.3	CN164-5	MALE 6.3mm	MASTER	MASTER	CN 165-4	90 SR FEMALE	BRN/WHT
9	7/.3	CN164-8	MALE 6.3mm	DOOR SW	DOOR SW	CN 167-2	90 SR FEMALE	GREY
10	7/.3	CN167-1	90 SR FEMALE	MASTER	MID JOINT	MJ WIRE 6	MIDJOINT	WHT

Ⓐ CONNECTORS USED IN CDL-H/N INTERMEDIATE

SL	CON.NO.	DESCRIPTION	MF PART NO	MAKE	COMPONENT /PURPOSE
01	CN 164	250 SERIES 8 WAY (M)	TTP-28 MN	TT	CDL SYSTEM
02	CN 165	90 SR 4 WAY FEMALE-WP	4FW 090 FHCL	BESMAK	RHD ACTUATOR H/N
03	CN 166	90 SR 4 WAY FEMALE-WP	4FW 090 FHCL	BESMAK	LHD ACTUATOR H/N
04	CN 167	90 SR 2 WAY FEMALE-WP	2FW 090 FHCL	BESMAK	DOOR SWITCH

SL NO	CONN NO	COMPONENT USING THIS CONNECTOR	CONNECTOR TYPE	LOCATION
1	CN2DL	FRONT COMB. DRIVE LIGHT, LEFT	90SERIES, (F)	FRONT (BELOW HOOD)
2	CN2DR	FRONT COMB. DRIVE LIGHT, RIGHT	90SERIES, (F)	FRONT (BELOW HOOD)
3	CN2TL	FRONT COMB. TURN LIGHT, LEFT	90SERIES, (F)	FRONT (BELOW HOOD)
4	CN2TR	FRONT COMB. TURN LIGHT, RIGHT	90SERIES, (F)	FRONT (BELOW HOOD)
5	CN31	HEADLIGHT, LEFT	SOCKET FEMALE	FRONT (BELOW HOOD)
6	CN3R	HEADLIGHT, RIGHT	SOCKET FEMALE	FRONT (BELOW HOOD)
7	CN4L	SIDE TURN INDICATOR, LEFT	6.3MM LUCAR WITH SL. (F)	FRONT (BELOW HOOD)
8	CN4R	SIDE TURN INDICATOR, RIGHT	6.3MM LUCAR WITH SL. (F)	FRONT (BELOW HOOD)
9	CN5	HORN	6.3MM LUCAR WITH SL. (F)	FRONT (BELOW HOOD)
10	CN10	COMBINATION SWITCH	250SERIES, 6WAY (F)	IP
11	CN11	COMBINATION SWITCH	90SERIES, 13WAY (M)	IP
12	CN12	REAR HARNESS SUPPLY	90SERIES, 12WAY (F)	PEDALBOX / IP
13	CN13	BRAKE POT	90SERIES, 3WAY (M)	PEDALBOX / IP
14	CN15	WIPER MOTOR	90SERIES, 4WAY (F)	FRONT (BELOW HOOD)
15	CN16	HAND BRAKE SWITCH	4.5MM BULLET (F)	PEDALBOX / IP
16	CN20	THROTTLE POT	90SERIES 3WAY (F)	PEDALBOX / IP
17	CN75	CENTRAL DOOR LOCKING SYSTEM	250SERIES, 8WAY (F)	PEDALBOX
18	CN76	SIREN	250SERIES, 2WAY (F)	FRONT (BELOW HOOD)
19	CN82	BRAKE FLUID SENSOR	250SERIES, 2WAY(M)	FRONT (BELOW HOOD)
20	CN85	STOP LIGHT SWITCH	250SERIES, 2WAY (F)	PEDALBOX
21	CN86	TAPE PLAYER	90SERIES, 3WAY (F)	IP
22	CN87	WASHING SYSYEM	250SERIES, 2WAY (F)	FRONT (BELOW HOOD)
23	CN88	DOOR SWITCH	90SERIES, 2WAY (F)	FRONT (INSIDE FENDER)
24	CN91	BLOWER SWITCH	90SERIES, 6WAY (F)	IP
25	CN92	BLOWER MOTOR	250SERIES, 2WAY (F)	PEDALBOX / IP
26	CN93	HEATER RELAY	90SERIES, 2WAY (F)	PEDALBOX / IP
27	CN110	DPS SWITCH	MSSL, 2WAY (F)	FRONT (BELOW HOOD)
28	CN112	TO AC HARNESS	90SERIES, 10WAY (F)	IP
29	CN123	CONDENSOR FAN	90SERIES, 4WAY (F)	IP
30	CN140	FOG LAMP SWITCH	90SERIES, 6WAY (F)	IP
31	CN142	TAPE PLAYER RELAY	250SERIES, 5WAY (F)	IP
32	CN144	12V CHARGER	90SERIES, 3WAY (F)	IP
33	CN145	TAPE PLAYER ANTIDIP CKT.	ALEX, 2X2WAY (F)	IP
34	CN147	CHIME RELAY	250SERIES, 5WAY (F)	IP
35	CN149	DEFOGGER SWITCH	90SERIES 6WAY (F)	IP
36	CN250	POT RELAY	250SERIES 5WAY (F)	PEDALBOX / IP
37	CNG1	TO MAIN HARNESS	90SERIES, 18WAY (F)	PEDALBOX / IP
38	CNL1	TO MAIN HARNESS	90SERIES, 10WAY (M)	PEDALBOX / IP
39	CNF1	12V SUPPLY TO FUSEBOX	350SERIES, 1WAY (F)	PEDALBOX / IP
40	CNK1	KEY RELAY	250SERIES, 5WAY (F)	PEDALBOX / IP
41	CNFL1	FLASHER RELAY	250SERIES, 3WAY (F)	PEDALBOX / IP
42	CNIP	INTER. IP CLUSTER	90SERIES, 18WAY (F)	IP
43	CN23	KEY SWITCH	250SERIES, 2WAY (F)	IP
44	CN24	RNFB SWITCH & REAR ILLU.	90SERIES, 8WAY (F)	IP
45	CN25	CHARGEPORT MICROSWITCH	90SERIES, 2WAY (F)	REAR TUB
46	CN26	COURTESY LIGHT VIA DOOR SWITCH	BULLET TERMINAL (M)	ROOF (INSIDE)
47	CN27	CHIME SUPPLY	ALEX, 2WAY (F)	IP
48	CN52	BATTERY FAN, BV3 SUPPLY	90SERIES, 2WAY (M)	REAR TUB
49	CN64	EMS (MAIN)	MOLEX 2X12 (F)	REAR TUB
50	CN71	MOTOR CONTROLLER (MAIN)	MOLEX 2X12 (F)	REAR TUB
51	CN73	MOTOR CONTROLLER (COMM.)	ALEX, 2X2WAY (F)	REAR TUB
52	CN154	CDL IMMOBILISER	90SERIES, 2WAY (F)	IP
53	CN157	CCS INTERMEDIATE	90SERIES, 2WAY (F)	FRONT SEAT

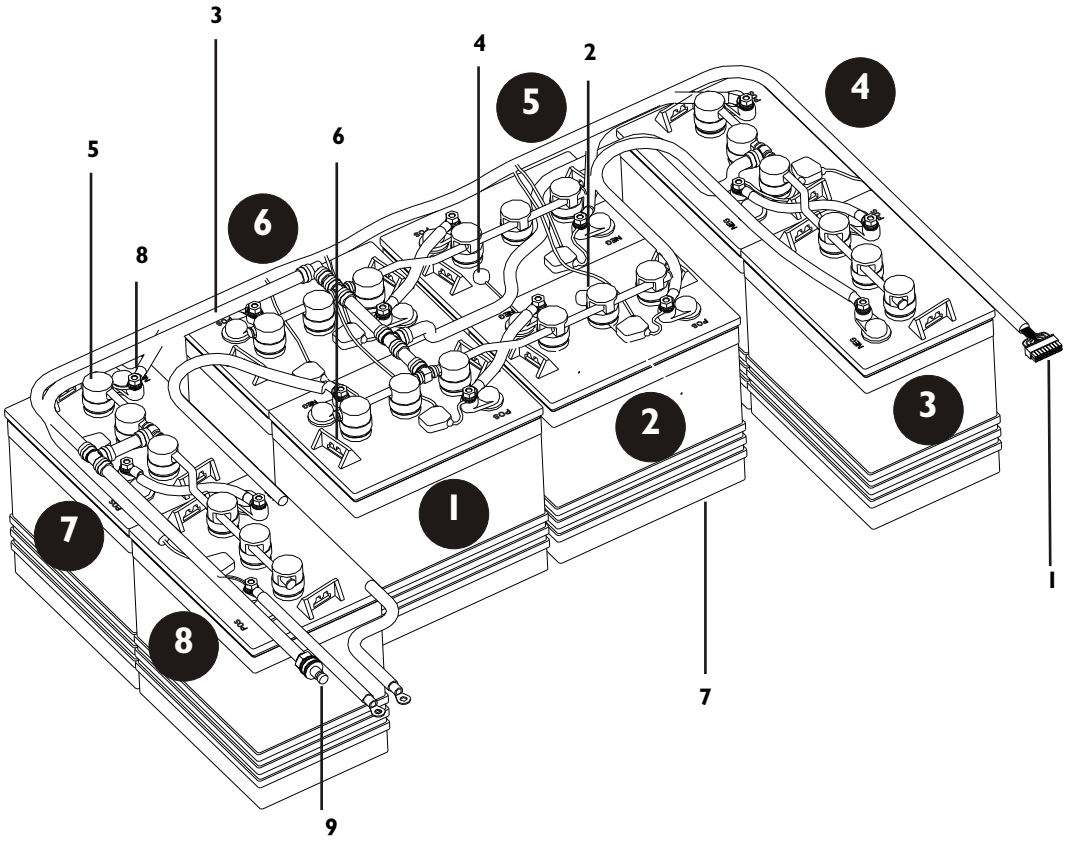
SL NO	CONN NO	COMPONENT USING THIS CONNECTOR	CONNECTOR TYPE	LOCATION
54	CN251	MOTOR MONITORING MODULE	90SERIES, 6WAY (F)	REAR TUB
55	CN104	THERMOSTAT	6.3MM LUCAR WITH SL. (F)	PEDALBOX / IP
56	CN105	R-3 RELAY CONDENSOR FAN	250SERIES, 2WAY (F)	IP
57	CN106	TO HEATER RELAY	90SERIES, 2WAY (F)	IP
58	CN107	48V I/P TO AC CONTROLLER	350SERIES, 2WAY (F)	IP
59	CN111	R-2 REMOTE RELAY	90SERIES, 8WAY (F)	IP
60	CN114	CDL I/P	90SERIES, 2WAY (M)	IP
61	CN116	LOGIC BOARD	MOLEX, 12WAY (F)	IP
62	CN123	48V I/P TO AC HARNESS	350SERIES, 1WAY (M)	IP
63	CN126	AC SWITCH	250SERIES, 3WAY (F)	IP
64	CN128	LOGIC BOARD	350SERIES, 2WAY (F)	IP
65	CN131	RELAY RC DELAY CONNECTOR	90SERIES, 4WAY (F)	IP
66	CN136	AC CONTROLLER	90SERIES, 2WAY (F)	IP
67	CN270	RELAY CONDENSOR FAN	250SERIES, 5WAY (F)	IP
68	CN6L	REAR COMBIATION LAMP, LEFT	90SERIES , 3WAY (F)	REAR (T/L PANEL)
69	CN6R	REAR COMBIATION LAMP, RIGHT	90SERIES , 3WAY (F)	REAR (T/L PANEL)
70	CN7L	REAR TURN LIGHT, LEFT	90SERIES, 2WAY (F)	REAR (T/L PANEL)
71	CN7R	REAR TURN LIGHT, RIGHT	90SERIES, 2WAY (F)	REAR (T/L PANEL)
72	CN8L	REVERSE LAMP, LEFT	90SERIES, 2WAY (F)	REAR (T/L PANEL)
73	CN8R	REVERSE LAMP, RIGHT	90SERIES, 2WAY (F)	REAR (T/L PANEL)
74	CN9L	LICENCE LIGHT, LEFT	90SERIES, 2WAY (F)	REAR (T/L PANEL)
75	CN9R	LICENCE LIGHT, RIGHT	90SERIES, 2WAY (F)	REAR (T/L PANEL)
76	CN26a	DOME LIGHT	BULLET, 1WAY (F)	ROOF (INSIDE)
77	CN97	TO HEATER RELAY	350SERIES, 2WAY (F)	IP
78	CN97a	TO HEATER RELAY	90SERIES, 2WAY (F)	IP
79	CN98	TO HEATER	350SERIES, 2WAY (F)	IP
80	CN99	TO THERMOSTAT	90SERIES, 2WAY (F)	IP
81	CN124	TO AC RELAY	350SERIES, 1WAY (F)	IP
82	CN143	FOG LAMP SWITCH	90SERIES, 2WAY (F)	IP
83	CN151	DEFOGGER RELAY	250SERIES, 5WAY (F)	REAR TUB
84	CN152	TO DEFOGGER	90SERIES, 2WAY (F)	REAR TUB
85	CN171	HI MOUNT LAMP	90SERIES, 2WAY (M)	
86	CN94	BLOWER SWITCH	DELPHI, 9WAY (F)	IP
87	CN95	BLOWER RESISTOR	250SERIES, 4WAY (F)	PEDALBOX / IP
88	CN96	BACK ILLU. SLIDING LEVER	90SERIES, 2WAY (F)	IP
89	CN100	BACK ILLU. BLOWER	90SERIES, 2WAY (F)	IP
90	CN161	BATTERY FAN	90SERIES, 3WAY (F)	REAR TUB
91	MS1	MICRO SWITCH	4.5MM SLEEVED (F)	REAR (Q/P LEFT INSIDE)
92	CNCP	CHARGEPORT	RINGLUG, M3/2.5 SQ-MM	REAR (Q/P LEFT INSIDE)
93	CN159	TCU	90SERIES, 2WAY (F)	REAR TUB
94	CN260	HEATERPAD	90SERIES, 2WAY (F)	REAR TUB
95	CN134	R1 RELAY	250SERIES LUCAR SLEEVE (F)	IP
96	CN133	R1 RELAY	250SERIES LUCAR SLEEVE (F)	IP
97	CN148	ADAPTOR 12V	6.3MM LUCAR SLEEVE (F)	IP
98	CN137	RELAY TERMINALS	6.3MM LUCAR SLEEVE (F)	IP
99	CN178	RELAY MATE CONNECTOR	RLY MATE, 6WAY (F)	IP
100	CN179	DELPHY S/W ADAPTOR	DELPHI, 9WAY (F)	FRONT SEAT
101	CN258	BATTERY PACK TEMP SENSE	90SERIES, 4WAY (F)	REAR TUB
102	CN259	GROUND BATT TEMP SENSE	BULLET TERMINAL (M)	REAR TUB
103	CN162	ACTUATOR DOOR	250SERIES, 4WAY (M)	HOOD INSIDE
104	CN163	CDL HARNESS INTERMEDIATE	90SERIES, 4WAY (M)	IP
105	CN157a	GND DEFOGGER	LUCAR WITH SLEEVE (F)	REAR HATCH
106	CN157b	48V DEFOGGER	LUCAR WITH SLEEVE (F)	REAR HATCH

SL NO	CONN NO	COMPONENT USING THIS CONNECTOR	CONNECTOR TYPE	LOCATION
107	CN21	IP CLUSTER	1X12WAY (M)	IP
108	CN22	IP CLUSTER	1X8WAY (M)	IP
109	CN129a	GND FR R1 RELAY COIL	6.3MM LUCAR WITH SLEEVE (F)	IP
110	CN129b	12V I/P TO R1 RELAY COIL	6.3MM LUCAR WITH SLEEVE (F)	IP
111	CN141	HEATER THERMOSTAT	90SERIES, 2WAY (M)	IP
112	CN132	RC RELAY	250SERIES, 5WAY (F)	IP
113	CN67	EMS DIAGNOSTIC	ALEX, 2X2WAY (F)	REAR TUB
114	CN68	DIAGNOSTIC PORT	DB9, 9PIN (M)	REAR TUB
115	CN69	CHARGER GND	BULLET TERMINAL (M)	REAR TUB
116	CN176	SWITCH BACK ILLU.	90SERIES, 2WAY (M)	FRONT SEAT
117	CN170	INT. CCS HARNESS	350SERIES, 2WAY (M)	FRONT SEAT
118	CN171	INT. CCS HARNESS	90SERIES, 2WAY (M)	FRONT SEAT
119	CN172	TED ASSY	1X4WAY (F)	FRONT SEAT
120	CN173	CCS BLOWER	1X4WAY (F)	FRONT SEAT
121	CN174	CCS BLOWER	1X4WAY (M)	FRONT SEAT

power pack 13.0

GENERAL DESCRIPTION

- The power pack mounted in each vehicle is a series connection of eight batteries of 6-volts, lead-acid tubular type.
- 48 Volts DC system having a total capacity of 200 AH (C5).
- The power pack is mounted under the front seats on battery box lower and covered by ABS panel(battery box upper).
- Electrolyte per battery is 6 litres & 48 litres per power pack.
- The net weight of this power pack is 260 Kgs.
- The pack has bolt on terminals that interconnects to give reliability and trouble free operation.
- The pack has a single point watering system with auto filling and leveling of electrolyte in all the cells.
- It also has a water-level sensor to monitor the water level in the battery.
- A temperature sensor in the power pack allows the service personnel to



1. **Power pack to EMS harness**
2. **Water level sensor**
3. **Water line**
4. **Battery temperature sensor**
5. **Water level indicator - float unit**
6. **Battery handle fixing point**
7. **Battery**
8. **Battery terminals**
9. **Watering inlet**

MAINTENANCE OF BATTERY

The Power pack is a very reliable component, but it needs periodical attention.

- Always use demineralized water from the reliable source.
- Clean and apply petroleum jelly on the battery terminals and the fuse holders at every service.
- Fill the distill water when water indication comes on or at 700-800 kms intervals or 4 weeks whichever occurs earlier.
- Try and avoid driving the car when the fuel gauge is in the red zone.

TIPS ON CHARGING

- Keep your REVA on charge when ever possible.
- Allow the Power pack to charge completely when ever possible.
- Never leave the car unplugged for more than 7 days.
- Do not charge when the ambient temperature is high or REVA is parked under the sun.
- Charge the vehicle in ventilated area.
- Please allow the vehicle for equalising charge to complete when automatically the same takes place. (Both Charge and Low battery LED's flashing).

THERE ARE SEVERAL WAYS IN WHICH THE POWER PACK WILL LOWER ITS CAPACITY:

1. **Loss of electrolyte or fall in electrolyte level:**

When this happens, the battery cannot hold so much Charge as it originally could.

- Handle the battery with care when you take it out. Barring the loss of electrolyte by careless spilling or otherwise, the electrolyte level goes down gradually in the battery at work, because the water content of it evaporates during charging.
- Periodically refill distilled water to each battery, so that the electrolyte is always up to the specified level. Never allow its level to fall so much as to expose the cell plates.
- Refill the power pack as soon as the low water level is ON in the dashboard.
- If the voltage is allowed to drop below 38Volt DC due to non charging.

2. Always make sure to know the SOC (state of charge) of the battery.

- The simplest way of knowing the SOC is to carry out the hydrometer test. The hydrometer is an inexpensive instrument for measuring the specific Gravity of the battery electrolyte.

CAUTION

Please ensure charge port handle is completely inserted during charging to avoid arcing and damage.

CAUTION

Please always ensure that the batteries are fully charged before watering them with demineralised water .

CAUTION

When handling a battery, the following safety precautions should be followed:

- Do not short positive and negative cables.
- Power pack produces hydrogen gas during charging. A flame or spark near the battery may cause the gas to ignite.
- Battery fluid is highly acidic. Avoid spilling on clothing or other fabric. Any spilled electrolyte should be flushed with large quantity of water and cleaned immediately.
- To remove or replace a pack, disconnect the cables and insulate them with insulation tape.
- Avoid skin contact with the electrolyte. In case of accidental contact with sensitive skin or eyes, wash immediately with profuse quantities of clean water and see your doctor.
- It is also recommended to use protective goggles while working with batteries.

FLOOR CHARGING OF POWER PACK

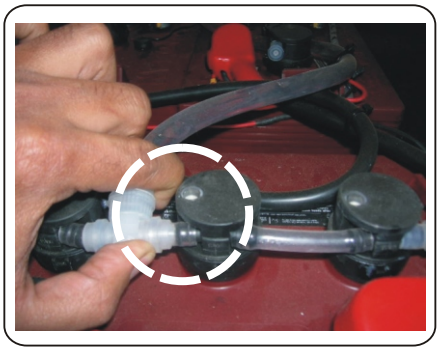
- Check up the water level in each of the 6V battery block.
- If the water level is below the separators /plates, connect the watering system and allow the battery to be watered.
- You need a power supply or charger which can give a current of 0-15A at 0-50 V to connect to the power pack to slowly build up the voltage. Preferred charger 12V/15A.
- Disconnect the cables from the car and connect it to the external source. Charge the batteries with a constant current of 3-5Amp. Once the voltage reaches about 42-44Volts (Open Circuit) the on board charger can takeover.
- If 50V/5A power supply is not available a 6V/12V and 5A/15A charger can also be used.
- If 6V charger is used individual battery needs to be charged for an hour or more to build the voltages. Once the pack voltage reaches 40V or more the onboard charger can be switched on. In this case the battery cables need not be disconnected from the car.

PROCEDURE FOR CLEANING AND COMPENSATING ACCIDENTAL SPILLAGE OF ELECTROLYTE

1. In case of accidental spillage of electrolyte, immediately neutralize it with Sodium Carbonate, Sodium Bicarbonate.
2. Then wash the floor and effected area with plenty of water.
3. If acid is spilled on the clothes wash as soon as possible.
4. In order to compensate the electrolyte loss, first identify the monoblock from which acid has spilled out.
5. Remove the vent plugs (BFS) by properly removing the connections.
6. Fill the individual cells with required amount of battery grade Sulphuric acid of 1.280 specific gravity.
7. Charge the pack fully.
8. Adjust the final specific gravity to 1.280 +/- 0.005
9. Check the float indicator to make sure that cells are neither over-filled nor under filled.
10. Clean the surface of the battery with demineralised water and dry with dry compressed air.

PROCEDURE TO REPLACE DEFECTIVE MONOBLOCK IN PACK

- Identify the defective block (with help of EMS data, multimeter & drive Data
- Charge the power pack fully
- Remove the power pack from the car and keep in free spacious area



- Remove the connection of BFS from the defective block to other blocks

- Remove the floats and replace with dummy vent plugs
- Remove the protective boots on the terminals of the defective Mono block (One at a time)

NOTE

This is a highly skilled operation. Only authorised personnel should attempt this procedure.

- Remove the interconnecting cable along with the lower power harness With the help of insulated 14mm spanner and insulate the terminal .leads.

During this operation utmost care should be taken that no tools or harness touch the other terminal.
Short circuit of battery should be avoided under any circumstances.

- Select the replacement block and remove the electrolyte upto the plate Level in all 3 cells

NOTE

To avoid the problem of mismatch,
- Use a block which has run for similar range.
- After replacing the block charge and discharge the pack completely for two to three cycles.
- Fully charge the pack and put it for equalization so that Max Dv error is within one volt

- Place the block and connect battery cable back to the terminals and tighten the nut of terminal leads to 11-12 n-mts using Torque Wrench.

NOTE

Clean the area, takeout the block and clean the threads on terminal lead.

- Re fix the Floats and harness and check for any water leaks from joints.

- Reconnect the BFS system as earlier and position the protective terminal boots after applying vaseline jelly.

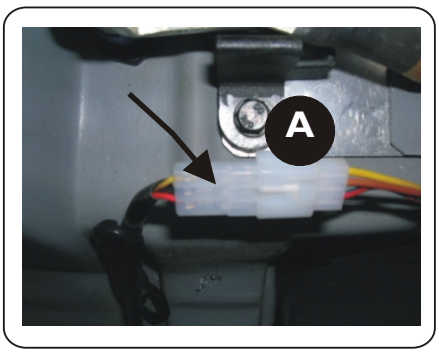
- Fix back the pack in car and do drive test / pack capacity test

POWER PACK - REMOVAL

- Remove RH side door by unscrewing the M8 x 25 bolts (4 Nos.) from the door hinges, supporting it all the time with the door holding fixture.

- Now carry out the battery positive (+ve) removal procedure.
  Follow Standard Workshop Procedure - I (Pg. 15 / Sec. 1.0)

- *Remove Trim seat bottom and n*ext remove the battery positive (+ve).



- Free the battery-to-EMS harness (A) by undoing the tie holding it.
- Disconnect the battery-ventilation-fan connector (B).

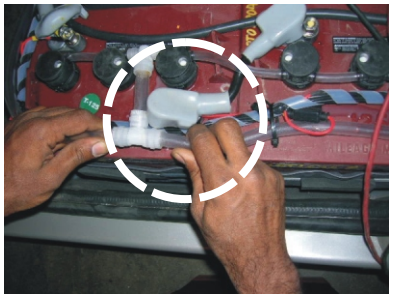
NOTE

Make sure that the EMS is disconnected before disconnecting the batteries.

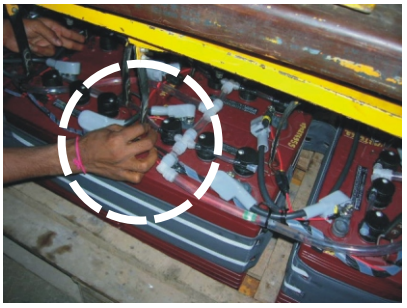
- Remove the front seats by removing the seat holding bolts (6 Nos.) using a ratchet spanner.

- Remove the steering wheel by detaching the snap fit horn cover and undoing the central bolt using a ratchet spanner.

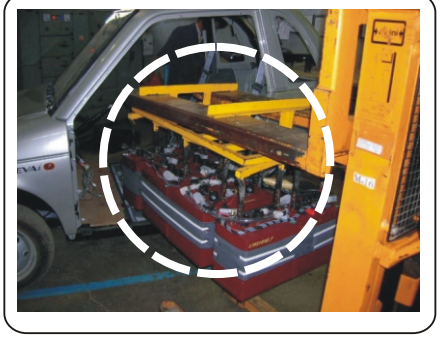
- Disconnect watering tube.
- Fix battery handles to all the batteries.



- Attach the battery mounting fixture (Part No 0100-4001) to the battery by clamping the straps provided with the fixture.



- Taking care not to damage the car body fix the battery removal fixture to battery and mount the fixture on to the Stacker.
- Move stacker (Spl. Tool No TABEZ003) back till the pack is out of car again taking care not to damage the corners of the car body.



- Lower the battery pack and place on the wooden pallet.

POWER PACK - INSPECTION

- Clean the dust on the power pack top.

CAUTION

Do no blow air on the vent caps as this may spray the acid and cause personal injury.

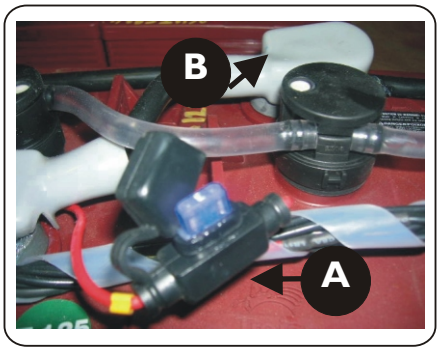
Wear safety glasses and hand gloves before starting any inspection.

GENERAL CHECKS ON POWER PACK

- Inspect for any burnt cables and replace, if necessary.
- Inspect for any individual cracks in the battery pack.
- Check water leakage on the pipe connections.
- Check for any acid leak in the top cover joints.
- Check for full charging data profile. *(Refer separate manual on data analysis)*
- The fully charged pack should have specific gravity of 1.27 to 1.29 depending upon ambient temperature.
- Power Pack temperature should be not more than 40C.

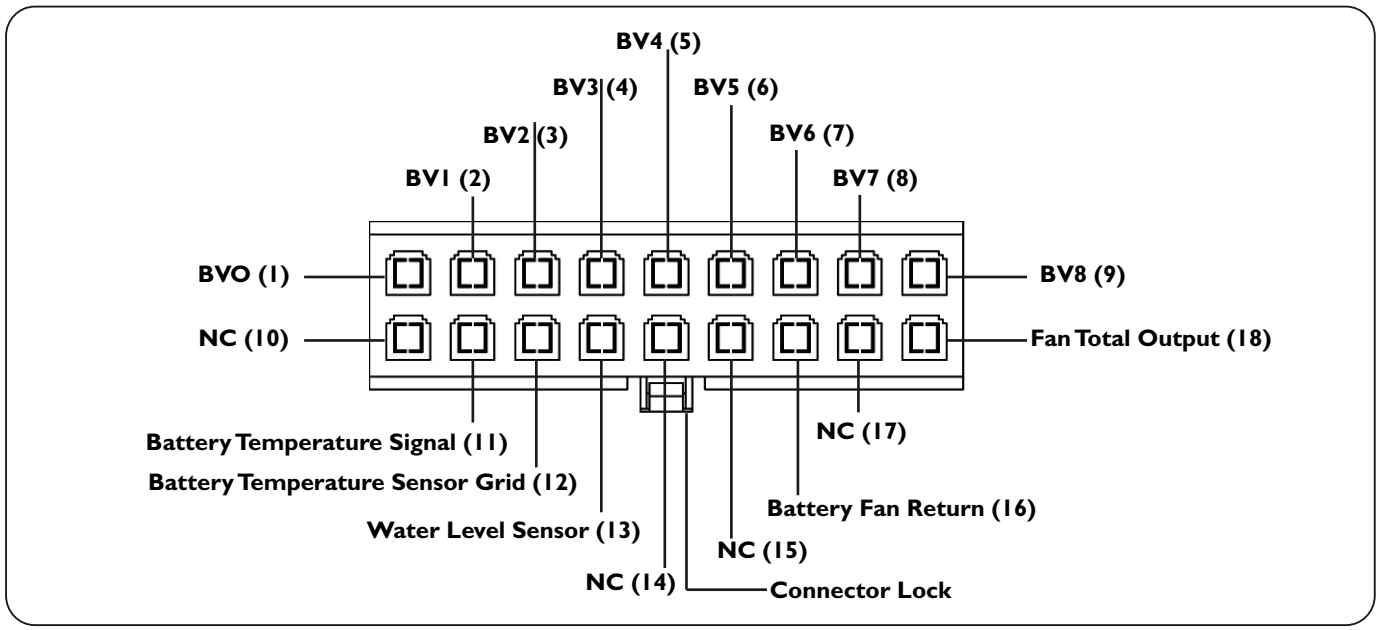
TERMINALS AND FUSES

- Check for any corrosion or loose connection at each of the battery terminals (b).
- Check all the battery fuses (a) for sulphation - seen as a green deposition.
- Clean with an anti-corrosive spray (WD40) and emery.
- Apply petroleum jelly to the battery terminals and the fuses before fixing again.



POWER PACK SENSE CONNECTOR (CN66) (18 PIN)

- Signal locations on the battery pack sense connector are as shown below.



Sl. No.	Ambient Temp	Volts
1	15	2.88
2	16	2.89
3	17	2.90
4	18	2.91
5	19	2.92
6	20	2.93
7	21	2.94
8	22	2.95
9	23	2.96
10	24	2.97
11	25	2.98
12	26	2.99
13	27	3.00
14	28	3.01
15	29	3.02
16	30	3.03
17	31	3.04
18	32	3.05
19	33	3.06
20	34	3.07
21	35	3.08
22	36	3.09
23	37	4.00
24	38	4.01
25	39	4.02
26	40	4.03
27	41	4.04
28	42	4.05
29	43	4.06
30	44	4.07
31	45	4.08
32	46	4.09
33	47	5.00
34	48	5.01
35	49	5.02
36	50	5.03

CHECKING INDIVIDUAL VOLTAGE

- The voltages at these points can be measured with a standard digital multimeter. (*Refer the separate* ***EMS manual chapter 17*** *for further details)*.
- To check voltage of first battery place the multimeter probes between the connector's first and second pin. For second battery place probes between second and third pins and so on and so forth.
- Voltages should be around 6V.

CHECKING PACK VOLTAGE

- To check voltage of entire power pack place the multimeter probes between the connector's first and ninth pin.

BATTERY WATER LEVEL SENSOR

- Battery level water sensor is fixed in battery # 2 in the Power Pack.
- Check for pin # 13 in connector of EMS wiring harness, for correct functioning of water level sensor.
- If the voltage output between pin # 13 and Gnd is less than 8 Volts, replace the sensor.

BATTERY TEMPERATURE SENSOR

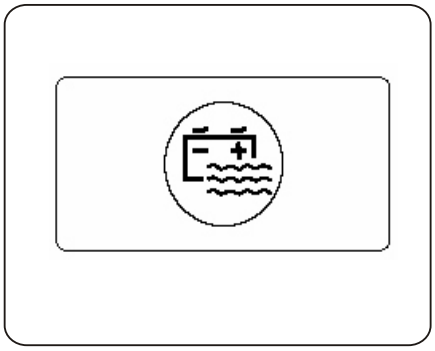
- Battery temperature sensor is fixed in battery # 5 in Power Pack.
- Check for pin # 11 and 12 in connector of wiring harness for correct functioning of temperature sensing.
- If the voltage of temperature sensor from pin # 11 and 12 is not matching the readings of the table shown, replace the sensor.

POWER PACK INSTALLATION

NOTE

Assembly in all cases, if not mentioned, is the reverse procedure of disassembly.

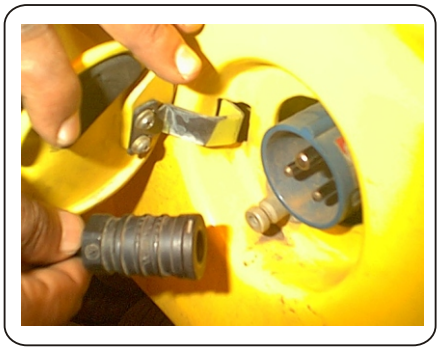
POWER PACK - WATERING



- Water the batteries in the power pack as soon as possible after the 'Battery water level lamp' lights up in red colour OR after 700-800 Kms OR 4 weeks whichever occurs earlier.

NOTE

The vehicle should be fully charged before watering.



- Open the charge port lid on the rear quarter panel.
- Plug the watering container nozzle in the socket provided for watering.

- Check for free rotation of the indicator wheel in the pipeline provided with the container.
- Check any water leakage in the pipeline.
- When the wheel comes to rest, unplug the nozzle.

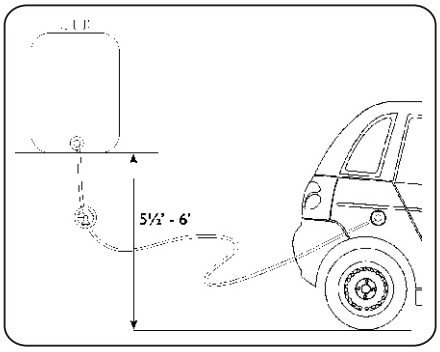
- Note down the water consumed by graduations on the calibrated container.
- Watering is complete when the flow indicator wheel stops.

CAUTION

Never top the power pack with water while charging is in process.

Top the power pack within 3 charging cycles after the battery water light comes on. Not doing so will affect the REVA's performance and also your power pack warranty.

Ensure that battery water for the power pack is always from an authorised REVA Service Centre.



NOTE

Ensure that battery watering system is 5.5 - 6 feet above ground.

- If overflowing takes place from any of the batteries during watering, check the water level indicator - float unit -check interconnects and rectify/replace as necessary.

MEASURING SPECIFIC GRAVITY

- Specific gravity indicates the condition of electrolyte in the power pack.
- It should be measured at every service by using hydrometer.Fully charged battery should show between 1.279 to 1.299 specific gravity.

SPECIFIC GRAVITY CORRECTION

- Charge the car fully and put for equalization
- Remove the front seat of the car by unscrewing the 6 mounting bolts
- Disconnect the CCS seat controller connections, CCS switch cover & connector cover (Applicable to selected models) and remove the seat out from the car.
- Unscrew the mounting screws of battery box top and take out the battery top from the car
- Open both the doors and Rear hatch for proper ventilation
- Cover the I.P, Rear seat, Rocker panels, LH & RH inner door panels and Front carpet area with plastic sheet to protect from acid spillage and damage to car interiors
- Remove all battery cell float lids to measure the specific gravity and cell temperature
- Keep the table fan air flow into the car cabin to exhaust the acid fumes while doing the acid correction
- Measure Battery block No.1, Cell1 Sp. Gravity and cell temperature and note down
- Measure Sp. Gravity and temp for all the block cells and note down
- Remove Acid from the cell and add battery DM water to reduce the Sp. Gravity and vice versa.

CALCULATION

SG@30C = Sp.Gravity Measured+0.0007(correction factor) (Temp Measured -30C)
SG@15C = Sp.Gravity Measured+0.0007(correction factor) (Temp Measured -15C)
E.g.: If Sp.Gravity measured=1.34
Temp Measured=34C
Then@15C Sp.Gravity correction = 1.34+0.0007(34-15)
= 1.34+0.0007(19)
= 1.34+0.0133
= 1.3533

Approximately 80ml Electrolyte removed from the cells = 0.01 less gravity
If 160ml electrolyte removed 160= 0.02 less gravity
If 240ml electrolyte removed 160= 0.03 less gravity

Then calculation = Sp.Gravity@15C Qty Electrolyte Removed from cell(240ml)
= 1.3533-0.03
= 1.3233
The minimum and maximum for correction value is
Min=1.285@30C
Max=1.295@30C

Repeat the same procedure for all the cells and after completing the process for all battery cells, Charge the batteries for 5-6Hrs in Equalization mode, let the battery be cooled for 15min and again measure the cell Sp.Gravity and Temperature.
Do calculations and continue the process until the gravity level reaches the above Min & Max Specified values.

EQUALISING CHARGE ON POWER PACK

- Equalisation charge is carried out automatically at specific intervals of approximately 800 Kms (equivalent to a months usage under normal city driving conditions).
- While equalisation charge is under process the dashboard Charge LED and Low battery light will be blinking alternatively.
- The total equalisation charge duration will be 10 hrs after the required 6 to 9 hrs to achieve 100% charging. This charge is not to be interrupted.
- If the equalisation charge is terminated more than five times, then an error will be recorded in error data.
- After equalisation the LED indication will turn to solid green.
- Equalising charge can be done in 3 successive charge cycles. I.e within three charging cycles the equalisation should be completed.

HOW TO DO EQUALISATION CHARGE (MANUALLY)

- Before plugging in for charge, turn the key ON and OFF 3 times, make Sure the dash lights come ON each time. You will hear a 2 sec's chime when you switch on for fourth time.
- Plug in the car and equalisation will start once the car has reached full charge. The process is complete when a solid Green charge light glows continuously.

HOW TO DO EQUALISATION CHARGE (USING PALM)

- Charge the power pack to 100% SoC by normal charging.
- Connect the palm to the EMS port.
- Click Petsoft button
- Go to 'Service Information'.
- Select the information button, you will get 3 options as below
  1. Start Battery equalisation,
  2. Reset SRL
  3. SOC

  Choose option 1.

REPLACEMENT OF POWER PACK

- For any replacement of the power pack The REVA Electric Car Co. will have to be contacted.

Heater pad

In cold climate, the temperature light will flash during charge or drive, if the battery temperature is less than 10°C. This indicates that the range of the car likely to be low due to battery characteristics. Keeping the car plugged in to the utility supply under this condition will activate the battery heaters and warm up the batteries.

Following are the components required for battery heating system

- Heater controller (potted)
- Wrap type heater pad (240V with resistance 300 +/- 10 ohms)
- Controller to battery pack temp. Sensing harness
- Charger input to chargeport harness

Installation

- Controller is fixed with Velcro next to charger
- Heater pad will be wrapped around the battery with starting point between BV1 and BV6 with ending point BV3
- After wrapping, tie the pack with strips and crimp with clips
- Inputs to the controller are: -
    1) 12V - mid joint of auxiliary pack sense female pin No.3 (Bat fan connector)
    2) Ground - mid joint of pin 1 of CN 66
    3) O/P from relay contact of controller to the heater pad
    4) Temp. Signal from pin 11 of CN 66

Operation of the controller

- Once the temperature of the electrolyte goes below 20 degree centigrade, the controller will turn ON the heater pad and when it goes above 25 degree centigrade, the controller will turn off the heater pad

Troubleshooting

- During charge check heater pad heating manually in the Car if there is no heat, check the battery temperature-using Palm at EMS serial port.
- If the temperature is within the above mentioned range, but the heater pad is not switched ON, check the Fuse near the battery heater controller and check 230 V AC at the heater pad connector
- Check 12V input in Cn258, pin2 and pin4, if no then check F2 fuse.
- Check temperature signal in Cn258, pin1 and pin4, if no- check battery temperature sensor, if ok- check EMS, **if not ok or sensor reading erratic replace EMS**
- If output for heater pad is Ok, replace Heater pad and check for functioning

NOTE

Thermostat is (NC) Normally Closed

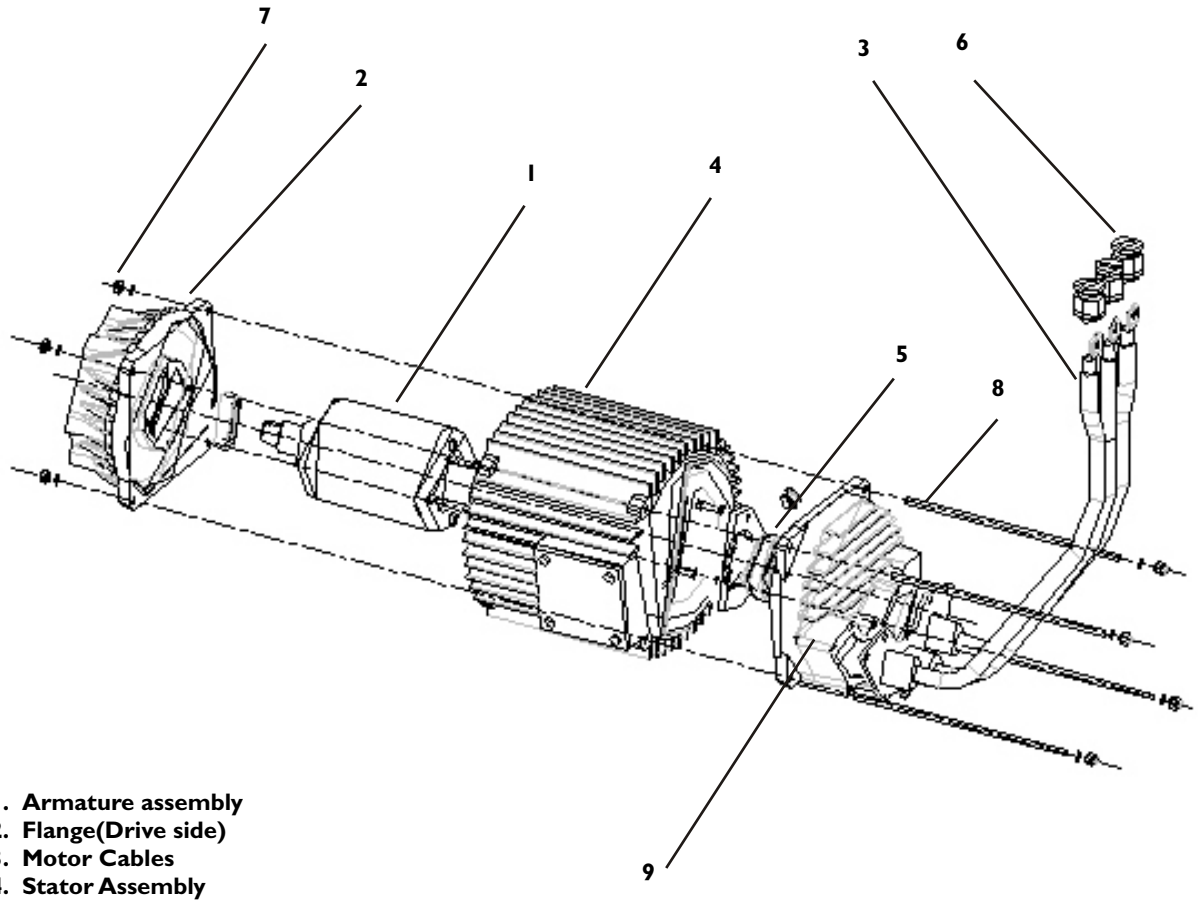
A - Heaterpad strap
B - Heaterpad

motor 14.0

MOTOR

GENERAL DESCRIPTION

- The motor is a 3 Phase Squirrel cage Induction Type.
- It has Field and Armature windings.
- A picture depicts a view of the motor with three cables of stator windings.
- It is having Speed sensor bearing to know the exact speed of motor.



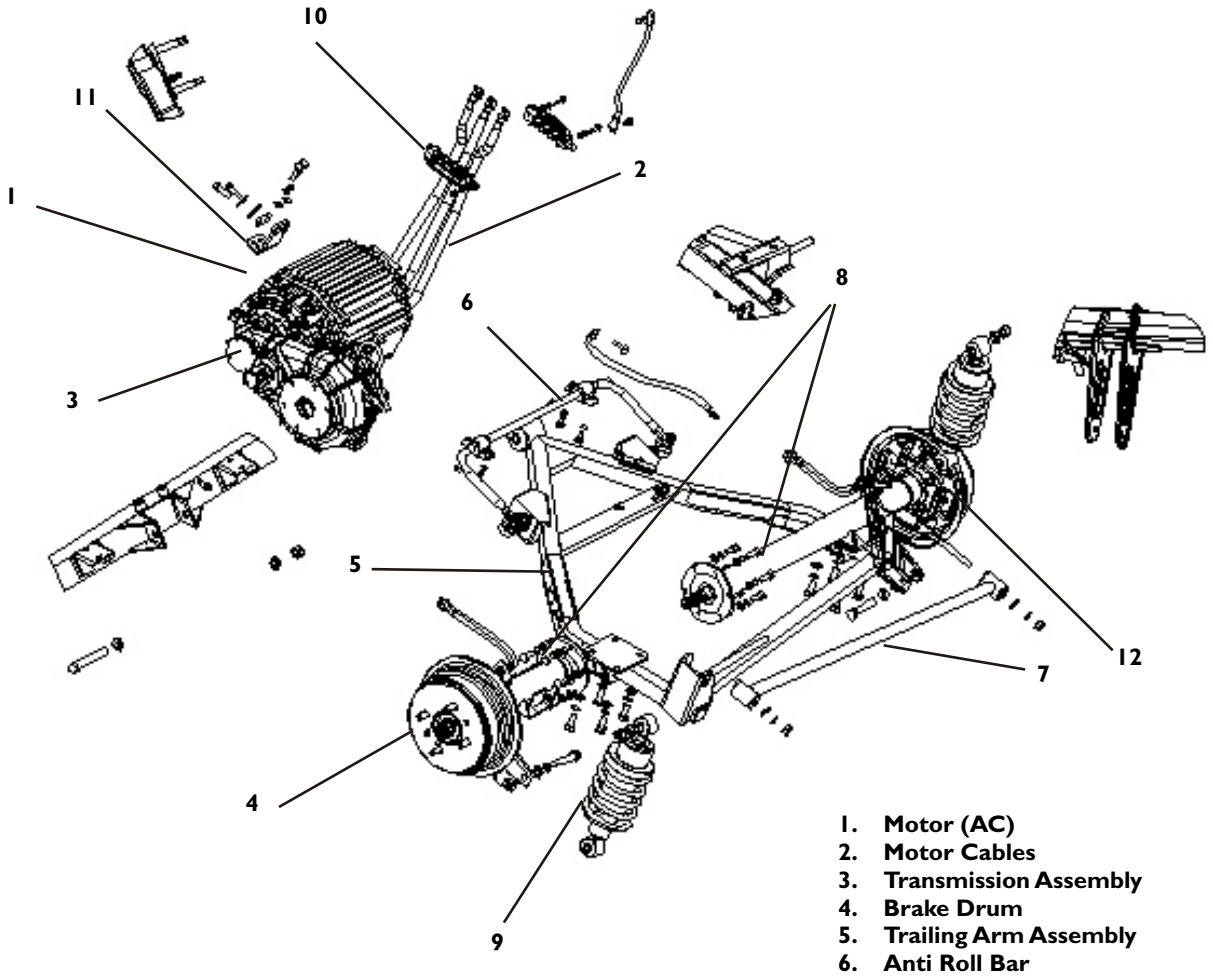
1. **Armature assembly**
2. **Flange(Drive side)**
3. **Motor Cables**
4. **Stator Assembly**
5. **Speed sensor bearing**
6. **Gland(Motor cables)**
7. **Nut-motor stud**
8. **Studs-motor**
9. **Flange(Motor cable**

MOTOR - REMOVAL FROM VEHICLE

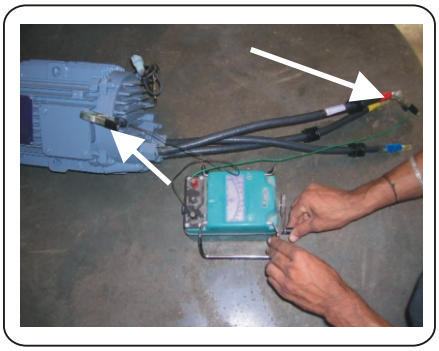
- Remove Charger 12V and battery positive (+ve).
- *Follow **Standard Workshop Procedure - I** (Pg. 14 / Sec. 1.0)*
- Remove LH rear wheel.
- *Follow **Standard Workshop Procedure - II** (Pg. 15 / Sec. 1.0)*
- Now disconnect the motor cables:
  ie, motor U, V and W cables and unscrew the stain relief bracket
- Now disconnect the temperature sensor and Speed sensor bearing connector.
- Remove the M6 motor mounting bolts (6 Nos.) (Size. No M6X25 Part. No. 013-01-25) which connect the motor to the transmission.
- Loosen the bolts (4 Nos.) on the motor mounting bracket
- Loosen the M10 RH shock absorber bolt (1 No.).
- Lower the car; give support to the trailing arm and remove all bolts.
- Slightly lift the motor using jack and slide it in the direction of the RH wheel.

IMPORTANT

Be very careful not to damage the sensor connectors, while sliding out the motor.



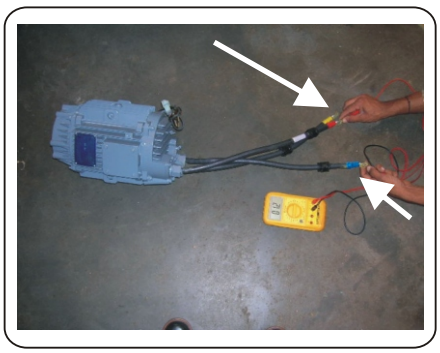
1. **Motor (AC)**
2. **Motor Cables**
3. **Transmission Assembly**
4. **Brake Drum**
5. **Trailing Arm Assembly**
6. **Anti Roll Bar**
7. **Pan Hard Rod**
8. **Drive Shaft Housing Assembly**
9. **Rear Shock Absorber**
10. **Strain Relief(Motor cables)**
11. **Motor Mounting Bracket**
12. **Brake Back Plate Assembly**



MOTOR - TESTING

CHECKING INSULATION RESISTANCE WITH MEGGER

- Connect the Megger cable terminals one end to U or V or W cable and other to the Rotor or Motor body.
- Rotate the megger handle
- The Megger should show minimum 20mega ohm and if <20 mega-ohm, dismantle the motor and Check for proper insulation.

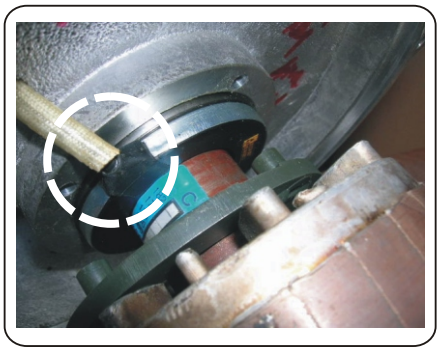


CHECKING WITH MULTI METER

- Check continuity between U, V and w cables.
- Check for no continuity of cables with motor body.

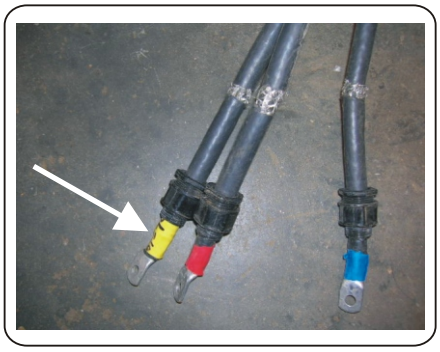
NOTE

If the Megger shows less than 20 mega ohm, dismantle the motor and check for any damage to the insulation.



SPEED SENSOR BEARING, TEMPERATURE SENSOR AND MOTOR CABLES CHECKING

- Check Speed sensor bearing cable for any open sleeve .
- Check for Temperature sensor cable for damages.
- Check for motor cables shielding mesh for not fouling with motor cables.



CHECK

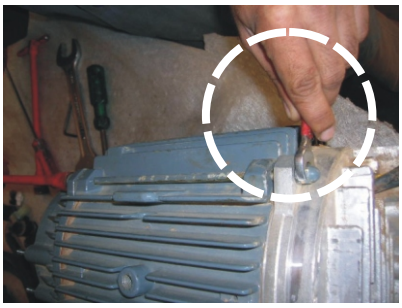
Always check bolts of motor mounting bracket for tightness and Strain relief for proper movement of speed sensor and temperature sensor cables.

MOTOR - DISASSEMBLY & ASSEMBLY

- Remove the motor hub mounting bolt(M8X20).
- Remove the coupling hub using special tool FJAZZ120.

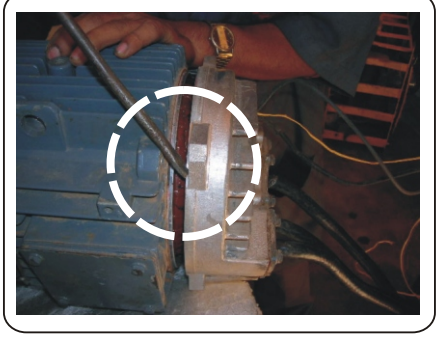
- Remove the nuts on the flange(Non drive end) using open end spanner 27 size.

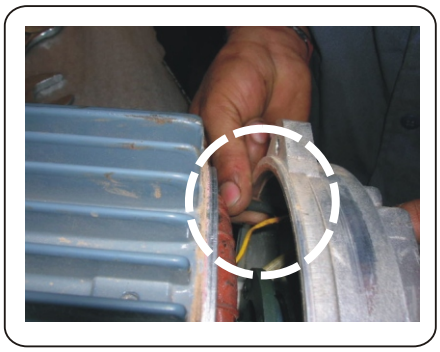
- Remove the studs with M6 bolt X4 No's by using tubular spanner No.10



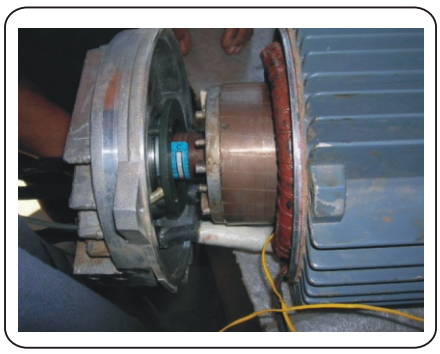
- Using the Flat screw drivers and mallet remove the drive side end flange.

- Using mallet and Flat screw driver remove the non drive end flange.
- Take care not to damage the wires of sensors and the Motor cables.



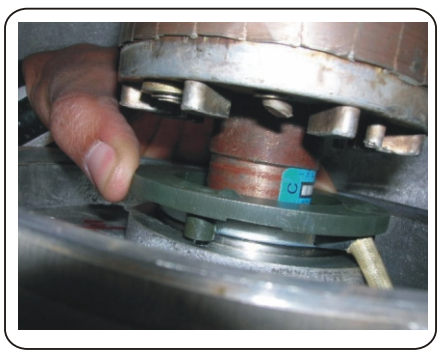


- Slide the Flange out of the motor cables same time pull out the sensor wires from the flange .



- Slide out the Flange from the stator and remove it with the rotor.

- Using 4 mm allen key remove the bolts holding the bearing retainer Plate(3 No's).



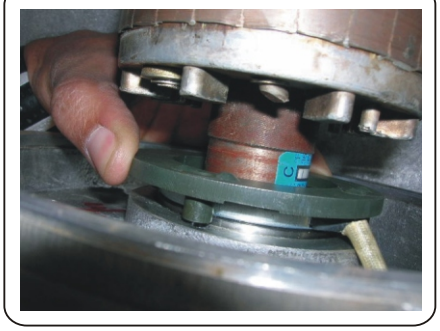
- Check for bearing play and proper mounting.

NOTE

After checking of motor and sensors, follow the reverse process for assembly.

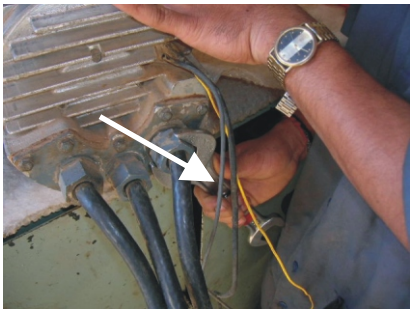
SENSOR BEARING FAILURE

- In case of bearing sensor failure the car goes into LOS mode.(ie,car goes with very low speed and jerks with {!}sign on the IP).
- In the above case check for cut/loose wire connections and bearing failure.



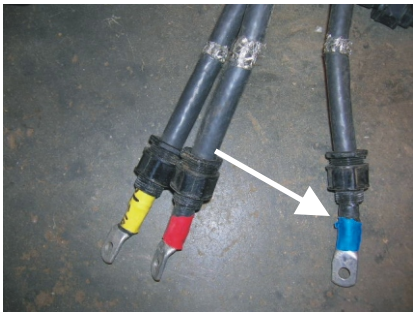
TEMPERATURE SENSOR FAILURE

- During the temperature sensor failure the car goes in Economy mode(50kmph) and temperature light will be on in the IP.
- Check for loose connection/cut in wires for the sensor.



CONTROLLER OVER VOLTAGE

- This state will switch off the contactor.
- check for any shield mesh is fouling with the Motor cables.
- Check for proper grounding of cables.



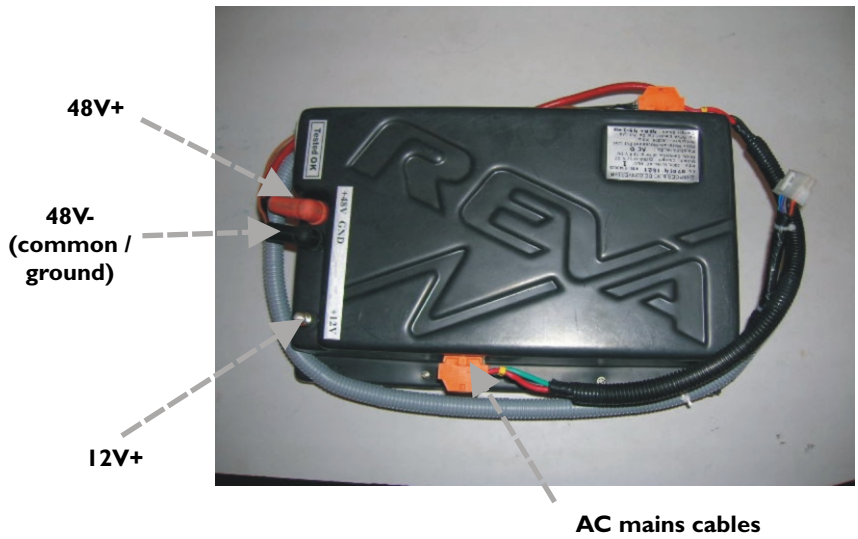
ENCODER BEARING REMOVAL

- Remove the rotor assy from the stator
- Fix the 3-jaw puller onto the bearing retainer plate as shown in the picture
- Using the ring spanner tighten the bolt of the puller to remove the bearing from the rotor.
- Use hydraulic press to fix the bearing to the rotor assembly.

charger 15.0

DESCRIPTION

- The charger is fitted below the rear seat on the tub.
- Source of power in the Reva the battery power pack .
- Power pack consists of batteries of 6 volts in series to give an output of 48volts.
- When these batteries get discharged it needs to be charged to bring up the specific gravity and voltage.
- Charger provides the feedback supply to charge the batteries.
- Other purpose of charger is to provide 12V DC supply for the accessories of the car like, head lights, combination lights, reverse lights, parking lights, cabin lights, fan, wiper, IP cluster, horn, turn signals and radio.



(For specifications refer page 10)

INSPECTION OF CHARGER

- Check that the +12 V cable to be connected to +12V terminal of the charger terminal is completely isolated from ground terminal or the 48V (there should not be any short between the cables).
- Do not connect the EMS harness cable No. CN 63 to charger.
- Connect the + and – terminals of the battery terminal cables to the +48V and ground terminals of the charger output as marked.
- Check with a multimeter the voltage at the + 12V with respect to the ground terminal. It should read 13.23V to 13.77 V DC.
- Connect the harness cable + 12V to the output terminal of the charger. Check the voltage at the terminal. It should be 13.23V to 13.77 V DC.
- The charger mains cable has Red wire connected to Line, Black wire connected to neutral and Green – yellow to the earth. Ensure that the wires from the car harness are according to the charger wires mentioned above.

- Connect the input cable to the mains input of the charger after ensuring above step.
- Switch ON the AC Mains. Measure the output voltage of the charger, which will be around 51-52 V DC depending on the initial battery voltage.
- Measure the voltage across the shunt, which gives the charger / charging current.
- When EMS is not connected to the charger the internal profile will take over and the current will be steady at 40 Amps till charger output voltage reaches around 53-54V DC and decreases slowly to 5 Amps.
- Measure the signal voltages coming from charger at the EMS terminal.
- When EMS has to be connected, ensure that the connector end at the EMS end is open and the Mains to charger is switched OFF.
- After connecting the connector CN63 to the charger, measure all the signal voltages as described above.
- Connect the connector to the EMS.
- Switch ON the Mains.
- The EMS will now control the output voltage and the current to the battery.

INDICATIONS OF A FAULTY CHARGER

LOOSE OR BURNT CONNECTION

- Check the I/P and O/P side of connectors. If the contacts were burnt or loose- then rectify.
- Switch off the main and then check at battery +ve and –ve. It should read 48V or more by at least 2 volts.
- Check for 12V supply on RT-1 and RT-2 on charger terminals after disconnecting +12V from charger. If 12 volt is not available then the charger needs to be checked by the authorised technician for further servicing.
- If 12 volts supply is available and still the charging is not taking place then there is problem with the charger.

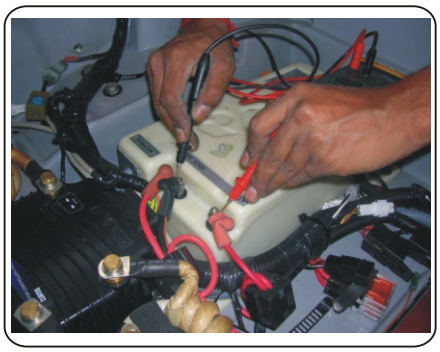
TEMPERATURE OF HEAT SINK

- If due to some reason the temperature has shot up to 70°C - 75°C the charger will stop functioning. There is no fault with the charger. If allowed to cool up to 65°C, it will once again start working.

NOTE

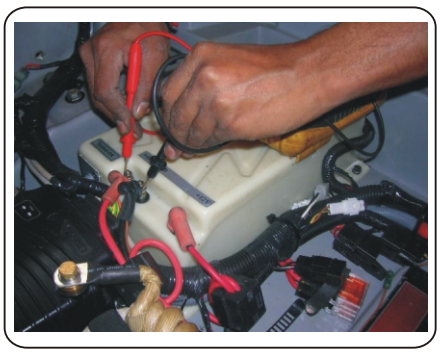
Please check the reason which is causing the temperature to rise higher than the preset value. The following can be the reasons -

- Ventilation fan not working.
- Duct has holes, cracks or leakage.
- Fan works at low speed.



FOLLOWING CHECKS TO BE CARRIED OUT BEFORE REMOVAL

- Check with a multimeter on Terminals 12V and GND. It should read 13.23V -–13.77V.



- Check voltage at 48V terminal and GND. It should read min. 42 volts if the voltage is low charger will not charge.

- When key switch is ON, hear for a click sound, if not working then charger is faulty.
- Check with a multimeter on Battery +ve and –ve terminals, while the AC main cable is connected. It should show clear sign of voltage rise every two seconds.

NOTE

Charger will not respond to programming signals below these values.

While disconnecting Battery +ve terminal, use insulated tool and ensure that cable does not touch any other line. Insulate the end terminal with tape.

Then only disconnect the AC main connector, CN63, 48V, Ground and +12V connections.

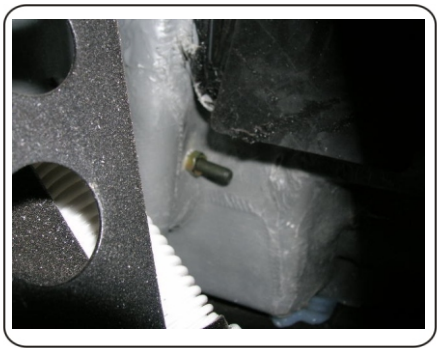
Before touching AC main connector, make sure that the charge port disconnected.

CAUTION

Charger is not a serviceable part. If for any reason, it is found defective or malfunctioning it is to be returned to RECC for necessary service or replacement.

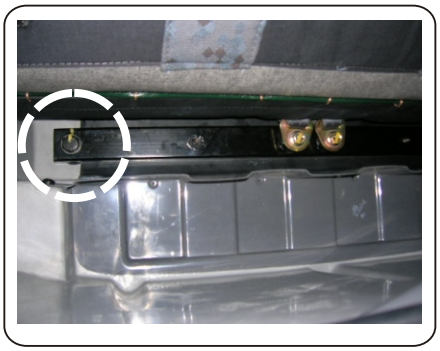
REMOVAL OF CHARGER FROM THE VEHICLE

- Disconnect the charging cable from the vehicle if it is kept for charging.
- Remove the EMS. *(Refer Sec. 17.0 on EMS removal)*
- Remove the battery positive (+ve) cable with the help of insulated tool. *(Refer Sec. 1.2, Pg. 15 on Battery positive removal)*

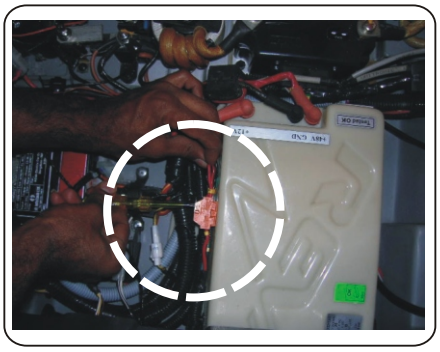


- Remove the rear seat rest by unscrewing M8 X 2 no's nuts from rear bottom side of the car.

- Remove the Tommy bar by unscrewing mounting bolts M10 X 2 no's

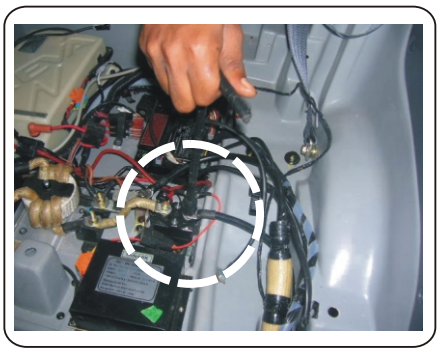


- Remove the charger 3 pin connector which is connected to AC mains CN 63.

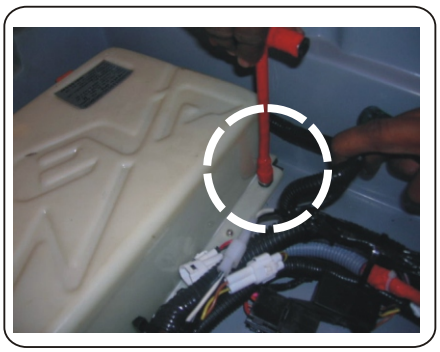


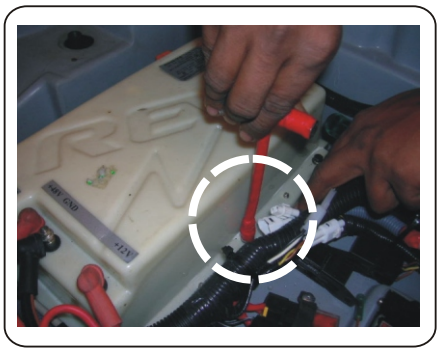
- Remove +12 V at charger end.

- Remove +48V (Red) and -48V(Black) at contactor and EMI core end.



- Remove the mounting screws (M6 X 6 Nos.) of the charger.





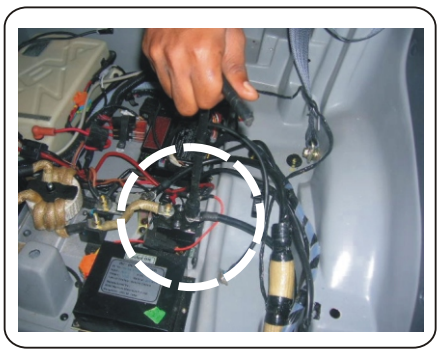
CHARGER - INSTALLATION

- Ensure that the dust around the charger is cleaned.
- Keep the charger in position.

NOTE

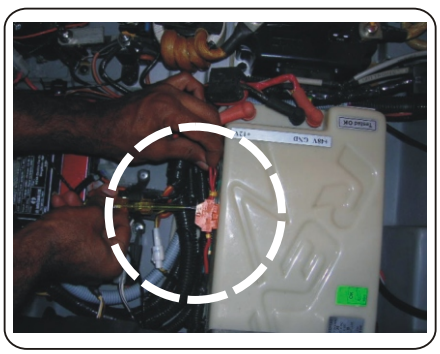
Place the charger gently in place for installation. It should seat flat.

- Mount the charger with screws (M6 X 6 Nos.) onto the tub electronics.



- Check the connections coming from the batteries viz. +ve and -ve 48 V.
- Ensure that the polarities of the battery cables are identified and noted properly.
- Check that the +12 V cable to be connected to the +12 V terminal of the charger terminal is completely isolated from the ground terminal or the 48 V (there should not be any short between the cables).
- Connect the +ve and -ve terminals of the battery cables to the + 48 V and GND terminals of the charger as marked.

- Check with a multimeter the voltage at the + 12 V and GND terminal. It should read 13.23 V to 13.77 V DC.
- Connect the harness cable + 12 V to the O/P terminal of the charger. Check the voltage at the terminal. It should be 13.23 V to 13.77 V DC.
- Connect the Charger harness CN 63 to the EMS assy and other connectors



- Ensure that the wires from the car harness to charger are according to the charger wires mentioned in the box.
- Now connect the I/P cable to the mains I/P of the charger after ensuring proper cable goes to proper terminal.

NOTE

The charger mains cable has RED wire connected to Line.

BLACK wire connected to neutral.

GREEN - YELLOW to earth.

- Check the battery voltage before AC main switch ON.
- Switch ON the AC mains.
- Measure the O/P voltage of the charger. It should show clean sign of voltage increase every 2 seconds.
- Measure the voltage across the shunt, which gives the charger/ charging current.
- When EMS is not connected to the charger the internal profile will take over and the current will be steady at 40 Amp till charger O/P voltage reaches around 53 - 54 V DC and decreases slowly to 5 Amp.
- Measure the signal voltages coming from charger at the EMS terminal.
- When EMS has to be connected, ensure that the connector end at the EMS end is open and the Mains to charger is switched OFF.
- After connecting the connector CN63 to the charger, measure all the signal voltages as described above.
- Connect the connector to the EMS.
- Switch ON the Mains.
- The O/P voltage and the current to the battery will now be controlled by the EMS.

NOTE

Ensure all screws (M6) are tightened properly.

Connect +ve cable (48V) to terminal marked 48V, -ve cable to COM. terminal, and 12V+ve terminal to 12V terminal only.

Connect CN63 terminal connector.

Connect AC cable but ensure that the line, return and earthling cables are connected to the respective terminals.

Lastly after connecting terminal cables, check and ensure proper tightness.

Be careful - sparks may be generated while connecting Battery +ve.

NOTE

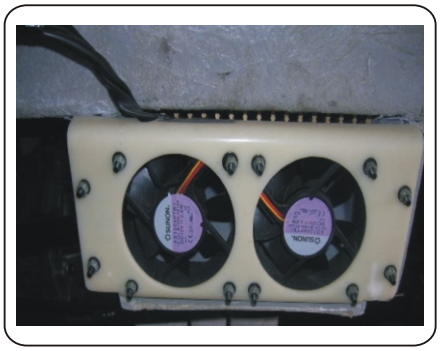
Only the drive motor operates on 48 V DC but the other accessories like - the lightening systems, wiper, radio system, horn, dash board indicators etc. work on 12V DC.

OVR - (OVER VOLTAGE RELAY)

- OVR is the protection device for charger against over voltage.
- OVR is mounted in the rear tub next to charger.
- OVR unit has MOV protection against high voltage surges
- Cut-off voltage =265V AC
- Cut-in voltage = 250V±2% AC
- Range max = 300V AC

NOTE

OVR is only used in Domestic Cars only.



CHARGER - COOLING SYSTEM

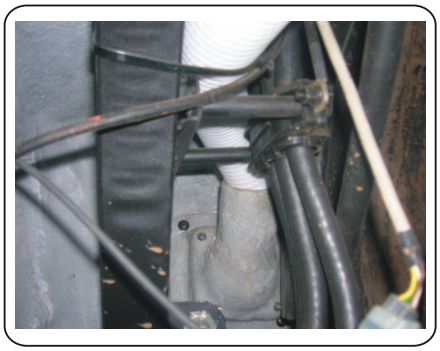
- The charger is having a heat sink which is fitted below the charger.
- The heat sink is cooled with the help of ventilation fan.
- The fan blows the air through the duct to the heat sink.
- The fan works at the time of charging the batteries to keep the charger and controller temperature to keep cool.

WHEN THE CHARGING TAKE PLACE ENSURE -

- That the fan must be in working condition.
- If fan is not in working condition, the temperature of the charger goes higher and over temperature occurs shutting of the charging.
- If fan working is stopped remove the fan from the ventilation duct and check for its function.
- Replace if found burnt or damaged.

NOTE

If due to some reason the temperature has shot-up to 70°C-75°C the charger will stop functioning. There is no fault with the charger. If allowed to cool up to 65°C, it will once again start working.



CHECKING BATTERY FAN FAILURE

- First check with physical feeling at the left side bottom end duct for air coming out during charging.
- Connect computer/Palm. Check for TTL connection for finding working of fan.
- If TTL is not working then fan is not running. Check for TTL connection O/P yellow wire of fan connection to ground for 4.0V approx.
- If voltage comes of around 4.0V check for wire continuity from fan connector to EMS pin CN connector CN 66. Pin 18 to yellow wire of fan connector.
- If no TTL, no Voltage, replace fan.
- If fan is not working, check voltage from Red wire of fan connector to ground for +12V.
- If +12V not available at Red wire check harness.
- If +12V to ground OK, check for black wire of fan connection to EMS Cn66 - pin 16.
- If OK suspect EMS for no return from EMS.
- If +12V available at fan continuity Red & Black wire to be available. If not replace fan.

REPLACING PROCEDURE

- Remove fan connector.
- Remove RH wheel and wheel upper wheel well panel (screws mounted)
- Remove the 8 bolts used for mounting the fan and the duct.
- Take out fan. Fix new one. Check for working and TTL O/P with charging connected. Found OK fix back in reverse order.

NOTE

Some time if fan connecting lead not coming smoothly, remove front seat and battery cover. Remove if any sealant fixed at cooling duct end.

controller 16.0

CONTROLLER

- It is an electronic control unit which is fixed on the rear tub of the vehicle near the charger with M10 bolts on heat sink.
- It is specially made for the AC Induction Motors, which are used on electric vehicles.
- The function of controller is to control the speed and torque of the vehicle.
- It does not require any additional relays and contactors.
- It controls regenerative braking .
- The controller is programmable by means of an handheld programming device which is used for monitoring and editing the various parameters namely current limits, mode controls,, acceleration and brake parameters etc.

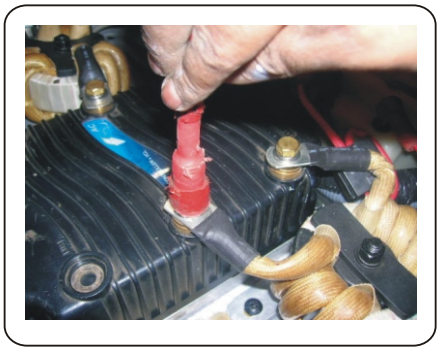
- The Hand held programming device has got a fault diagnosis mode which helps in analysing and rectifying the faults which have occurred in the controller.

NOTE

Precautions to be taken while working on transmission and motor. The start-up key should be OFF and removed from key slot to safe guard the controller against damage.

CONTROLLER - REMOVAL FROM THE VEHICLE

- Hook up the hand held to the CN73 connector point and check for the fault shown in the Diagnosis Mode.
- If the display appears on the hand held, down load and save all the parameters displayed in the hand held according to the format.



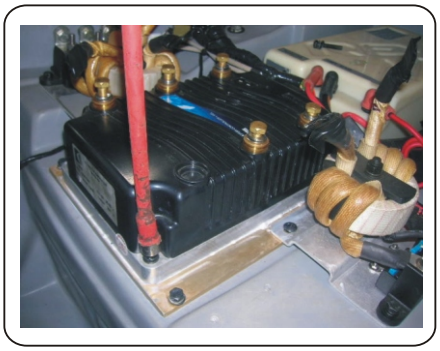
- First, remove charger 12 V cable and the battery positive (+ve) at the contactor end.
  (Refer Sec 1.2, Pg. 15)
- Now, using a 13mm insulated tubular spanner remove the bolts of the battery negative (-ve), motor Phase U, V and W cables on the Controller.

- Loosen the controller mounting bolts on the top of the controller heat sink.
- Disconnect the CN 600 Controller connector, slide and remove the controller out from the rear tub.

NOTE

Use proper insulated tools for removal and tightening of the controller.

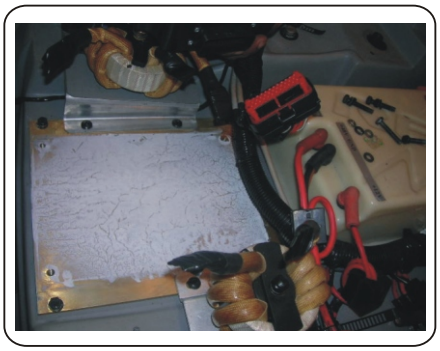
Ensure proper cable routing and tension of the terminal.



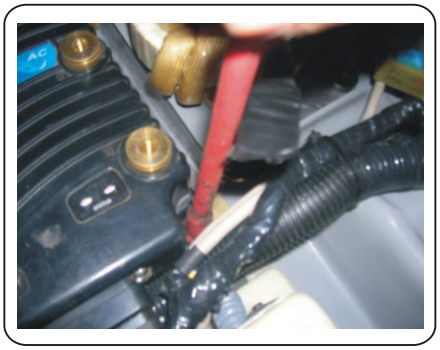
CONTROLLER - INSTALLATION TO THE VEHICLE

- Clean the controller mounting area with air to make it dust free.
- Apply heat sink compound on the controller base and the heat sink.

- Remove the Cn600 controller connectors located at the rear of the controller.



- Place controller on the heat sink and tighten the bolts to the specified torque.
- Connect the controller terminals in the reverse order of the removal.
- Check the original parameters taken before removing and upload the same to the new controller.
- Test drive and fine tune the parameters.

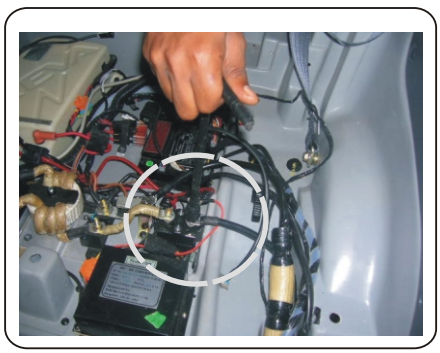


EMI - Introduction

All electrical / electronic devices generate a certain amount of 'electromagnetic radiation' which could affect other electronic devices in the vicinity.
International regulations prescribe the amount of such radiation 'a car can generate - so as not to affect other devices' and 'a car must tolerate from other sources'.
EMI filtering components are used in Reva to meet these regulations
The following procedure details the method of removal and reassembly of these components during service. Two types ferrites are used they are,

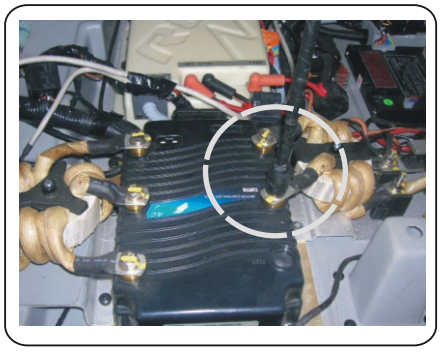
1. Split tube in plastic clip-on housing

2. EMI core assembly for input and output cables.



EMI - Removal from Vehicle

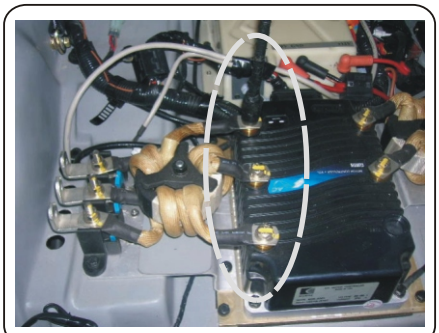
- Remove EMS connection,12V and battery +ve, insulate with the tape.



- Loosen and unscrew the M8 X 2 No's bolts at the controller end, M6 X 2 No's, screws and bolt at the battery -ve.

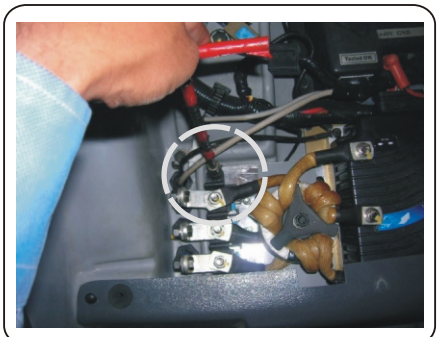
- Now, using 10mm insulated tubular spanner remove the M6 X 2 No's bolts and screws used for mounting EMI Core assembly plate.

- Now, using 13mm insulated tubular spanner remove the mounting bolts M8 X 3 no's on the Controller.



- Now, using 13mm insulated open end spanners remove the M8 X 3 No's bolts and nuts of the Motor cables.

- Now, using 10mm insulated tubular spanner remove the M6 X 2 No's bolts and screws used for mounting EMI Core assembly plate.



EMI - Installation to the Vehicle

- Follow reverse procedure of removal from vehicle

TROUBLESHOOTING CHART

CODE	PROGRAMMER LCD DISPLAY *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
12	Controller Overcurrent *Motor stops;* *main contactor opens.*	1. External short of phase U,V, or W motor connections. 2. Motor parameters are mis-tuned. 3. Controller defective.	*Set:* Phase current exceeded the current measurement limit. *Clear:* Cycle KSI.
13	Current Sensor Fault *Motor stops;* *main contactor opens.*	1. Leakage to vehicle frame from phase U, V, or W (short in motor stator). 2. Controller defective.	*Set:* Controller current sensors have invalid offset reading. *Clear:* Cycle KSI.
14	Precharge Failed *Motor stops;* *main contactor opens.*	1. External load on capacitor bank (B+ connection stud) that prevents the capacitor bank from charging. 2. See 1311 menu Monitor/Battery: Capacitor Voltage.	*Set:* Precharge failed to charge the capacitor bank to the KSI voltage. *Clear:* Cycle Interlock input or use VCL function ***Precharge().***
15	Controller Severe Undertemp *Motor stops;* *main contactor opens.*	1. Controller is operating in an extreme environment. 2. See 1311 menu Monitor/Controller: Temperature.	*Set:* Heatsink temperature below -40°C. *Clear:* Bring heatsink temperature above -40 °C, and cycle interlock or KSI.
16	Controller Severe Overtemp *Motor stops;* *main contactor opens.*	1. Controller is operating in an extreme environment. 2. Excessive load on vehicle. 3. Improper mounting of controller. 4. See 1311 menu Monitor/Controller: Temperature.	*Set:* Heatsink temperature above +95°C. *Clear:* Bring heatsink temperature below +95°C, and cycle interlock or KSI.
17	Severe Undervoltage *Motor stops.*	1. Battery Menu parameters are misadjusted. 2. Non-controller system drain on battery. 3. Battery resistance too high. 4. Battery disconnected while driving. 5. See 1311 menu Monitor/Battery: Capacitor Voltage.	*Set:* Capacitor bank voltage dropped below the Severe Battery Undervoltage limit (see page 37) with FET bridge enabled. *Clear:* Bring capacitor voltage above Severe Battery Undervoltage limit.
18	Severe Overvoltage *Motor stops;* *main contactor opens.*	1. Battery Menu parameters are misadjusted. 2. Battery resistance too high for given regen current. 3. Battery disconnected while regen braking. 4. See 1311 menu Monitor/Battery: Capacitor Voltage.	*Set:* Capacitor bank voltage exceeded the Severe Battery Overvoltage limit (see page 37) with FET bridge enabled. *Clear:* Bring capacitor voltage below Severe Battery Overvoltage limit, and then cycle KSI.
19	Nominal Voltage Parameter Out of Range *Motor stops;* *main contactor opens.*	1. Nominal Voltage parameter needs to be adjusted.	*Set:* Nominal Voltage parameter (Battery Menu) not within the rated controller voltage limits (see page 37) . *Clear:* Set the Nominal Voltage within the rated limits, and then cycle KSI.
21	Controller Undertemp Cutback *Reduced drive and brake torque.*	1. Controller is performance-limited at this temperature. 2. Controller is operating in an extreme environment. 3. See 1311 menu Monitor/Controller: Temperature.	*Set:* Heatsink temperature dropped below -25°C. *Clear:* Bring heatsink temperature above -25°C.

TROUBLESHOOTING CHART, *continued*

CODE	PROGRAMMER LCD DISPLAY *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
22	Controller Overtemp Cutback *Reduced drive and brake torque.*	1. Controller is performance-limited at this temperature. 2. Controller is operating in an extreme environment. 3. Excessive load on vehicle. 4. Improper mounting of controller. 5. See 1311 menu Monitor/Controller: Temperature.	*Set:* Heatsink temperature exceeded 85°C. *Clear:* Bring heatsink temperature below 85 °C.
23	Undervoltage Cutback *Reduced drive torque.*	1. Normal operation. Fault shows that the batteries need recharging. Controller is performance limited at this voltage. 2. Battery parameters are misadjusted. 3. Non-controller system drain on battery. 4. Battery resistance too high. 5. Battery disconnected while driving. 6. See 1311 menu Monitor/Battery: Capacitor Voltage.	*Set:* Capacitor bank voltage dropped below the Battery Undervoltage limit (see p. 37) with the FET bridge enabled. *Clear:* Bring capacitor voltage above the Undervoltage limit.
24	Overvoltage Cutback *Reduced brake torque.*	1. Normal operation. Fault shows that regen braking currents elevated the battery voltage during regen braking. Controller is performance limited at this voltage. 2. Battery parameters are misadjusted. 3. Battery resistance too high for given regen current. 4. Battery disconnected while regen braking. 5. See 1311 menu Monitor/Battery: Capacitor Voltage.	*Set:* Capacitor bank voltage exceeded the Battery Overvoltage limit (see page 37) with the FET bridge enabled. *Clear:* Bring capacitor voltage below the Overvoltage limit.
25	+5V Supply Failure *None, unless a fault action is programmed in VCL.*	1. External load impedance on the +5V supply (pin 26) is too low. 2. See 1311 menu Monitor/outputs: 5 Volts and Ext Supply Current.	*Set:* +5V supply (pin 26) outside the +5V±10% range. *Clear:* Bring voltage within range.
26	Digital Out 1 Overcurrent *Digital Output 1 driver will not turn on.*	1. External load impedance on Digital Output 1 driver (pin 19) is too low.	*Set:* Digital Output 1 (pin 19) current exceeded 15 mA. *Clear:* Remedy the overcurrent cause and use the VCL function ***Set_DigOut()*** to turn the driver on again.
27	Digital Out 2 Overcurrent *Digital Output 2 driver will not turn on.*	1. External load impedance on Digital Output 2 driver (pin 20) is too low.	*Set:* Digital Output 2 (pin 20) current exceeded 15 mA. *Clear:* Remedy the overcurrent cause and use the VCL function ***Set_DigOut()*** to turn the driver on again.

TROUBLESHOOTING CHART, *continued*

CODE	PROGRAMMER LCD DISPLAY / *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
28	Motor Temp Hot Cutback *Reduced drive torque.*	1. Motor temperature is at or above the programmed Temperature Hot setting, and the requested current is being cut back. 2. Motor Temperature Control Menu parameters are mis-tuned. 3. See 1311 menus Monitor/Motor: Temperature and Monitor/Inputs: Analog2.	*Set:* Motor temperature is at or above the Temperature Hot parameter setting. *Clear:* Bring the motor temperature within range.
29	Motor Temp Sensor Fault *Throttle request = 0%.*	1. Motor thermistor is not connected properly. 2. Motor Temperature Control Menu parameters are mis-tuned. 3. Motor temperature is at or above the programmed Temperature Max setting. 4. If the application doesn't use a motor thermistor, Temp Compensation and Temp Cutback should be programmed Off. 5. See 1311 menus Monitor/Motor: Temperature and Monitor/Inputs: Analog2.	*Set:* Motor thermistor input (pin 8) is outside the setup temperature range. *Clear:* Bring the motor thermistor input within range.
31	Coil1 Driver Open/Short *Driver1 will not turn on.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Driver 1 (pin 6) is either open or shorted. *Clear:* Correct the open or short and cycle driver.
31	Main Open/Short *Main contactor driver will not turn on; motor stops.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Main contactor driver (pin 6) is either open or shorted. *Clear:* Correct the open or short and cycle driver.
32	Coil2 Driver Open/Short *Driver2 will not turn on.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Driver 2 (pin 5) is either open or shorted. *Clear:* Correct the open or short and cycle driver.
32	EM Brake Open/Short *EM brake driver will not turn on; motor stops.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Electromagnetic brake driver (pin 5) is either open or shorted. *Clear:* Correct the open or short and cycle driver.
33	Coil3 Driver Open/Short *Driver3 will not turn on.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Driver 3 (pin 4) is either open or shorted. *Clear:* Correct the open or short and cycle driver.
34	Coil4 Driver Open/Short *Driver4 will not turn on.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Driver 4 (pin 3) is either open or shorted. *Clear:* Correct the open or short and cycle driver.

TROUBLESHOOTING CHART, *continued*

CODE	PROGRAMMER LCD DISPLAY *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
35	PD Open/Short *Proportional driver will not turn on.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Proportional driver (pin 2) is either open or shorted. *Clear:* Correct the open or short and cycle driver.
38	Main Contactor Welded *Motor stops; main contactor opens.*	1. Main contactor tips are welded closed. 2. Motor phase U is disconnected or open. 3. An alternate voltage path (such as an external precharge resistor) is providing a current to the capacitor bank (B+ connection stud).	*Set:* With the main contactor commanded open, the capacitor bank voltage (B+ connection stud) did not discharge. *Clear:* Cycle KSI.
39	Main Contactor Did Not Close *Motor stops; main contactor opens.*	1. Main contactor did not close. 2. Main contactor tips are oxidized, burned, or not making good contact. 3. External load on capacitor bank (B+ connection stud) that prevents capacitor bank from charging.	*Set:* With the main contactor commanded closed, the capacitor bank voltage (B+ connection stud) did not charge to B+. *Clear:* Cycle KSI.
41	Throttle Wiper High *Throttle request = 0%.*	1. Throttle pot wiper voltage too high. 2. See 1311 menu Monitor/Inputs: Throttle Pot.	*Set:* Throttle pot wiper (pin 16) voltage is higher than the high fault threshold (default value 5.5V, but can be changed with the VCL function ***Setup_Pot_Faults()***. *Clear:* Bring throttle pot wiper voltage below the fault threshold.
42	Throttle Wiper Low *Throttle request = 0%.*	1. Throttle pot wiper voltage too low. 2. See 1311 menu Monitor/Inputs: Throttle Pot.	*Set:* Throttle pot wiper (pin 16) voltage is lower than the low fault threshold (default value 0.1V, but can be changed with the VCL function ***Setup_Pot_Faults()***. *Clear:* Bring throttle pot wiper voltage above the fault threshold.
43	Brake Wiper High *Throttle request = 0%; brake request = 100%.*	1. Brake pot wiper voltage too high. 2. See 1311 menu Monitor/Inputs: Brake Pot.	*Set:* Brake pot wiper (pin 17) voltage is higher than the high fault threshold (default value 5.5V, but can be changed with the VCL function ***Setup_Pot_Faults()***. *Clear:* Bring brake pot wiper voltage below the fault threshold.
44	Brake Wiper Low *Throttle request = 0%; brake request = 100%.*	1. Brake pot wiper voltage too low. 2. See 1311 menu Monitor/Inputs: Brake Pot.	*Set:* Brake pot wiper (pin 17) voltage is lower than the low fault threshold (default value 0.1V, but can be changed with the VCL function ***Setup_Pot_Faults()***. *Clear:* Bring brake pot wiper voltage above the fault threshold.
45	Pot Low Overcurrent *Throttle request = 0%; brake request = 100%.*	1. Combined pot resistance connected to pot low is too low. 2. See 1311 menu Monitor/Outputs: Pot Low.	*Set:* Pot low (pin 18) current exceeds 10mA. *Clear:* Clear pot low overcurrent condition and cycle KSI.

TROUBLESHOOTING CHART, ***continued***

CODE	PROGRAMMER LCD DISPLAY / *EFFECT OF FAULT*	POSSIBLE CAUSE	SET/CLEAR CONDITIONS
46	**Default Params Not Loaded** *Motor stops; main contactor opens; all driver outputs turn off.*	1. Mismatch between the software loaded into the controller and the default values in the controller's parameter block.	*Set:* The software loaded into the controller does not match the parameter default values in the controller's parameter block. *Clear:* Download the correct software (OS) and matching parameter default settings into the controller and cycle KSI.
47	**HPD/Sequencing Fault** *Throttle request = 0%.*	1. KSI, interlock, direction, and throttle inputs applied in incorrect sequence. 2. Faulty wiring, crimps, or switches at KSI, interlock, direction, or throttle inputs. 3. See 1311 menu Monitor/Inputs.	*Set:* HPD (High Pedal Disable) or sequencing fault caused by incorrect sequence of KSI, interlock, direction, and throttle inputs. *Clear:* Reapply inputs in correct sequence.
49	**Parameter Change Fault** *Motor stops; main contactor opens.*	1. This is a safety fault caused by a change in certain 1311 parameter settings so that the vehicle will not operate until KSI is cycled. For example, if a user changes the Throttle Type this fault will appear and require cycling KSI before the vehicle can operate.	*Set:* Adjustment of a parameter setting that requires cycling of KSI. *Clear:* Cycle KSI.
51–67	**OEM Faults** *(See OEM documentation.)*	1. These faults can be defined by the OEM and are implemented in the application-specific VCL code. See OEM documentation.	*Set:* See OEM documentation. *Clear:* See OEM documentation.
68	**VCL Runtime Error** *Motor stops; main contactor opens; all driver outputs turn off.*	1. VCL code encountered a runtime VCL error. 2. See 1311 menu Monitor/Controller: VCL Error Module and VCL Error. . (This error can then be compared to the runtime VCL module ID and error code meanings found in the specific OS system information file.	*Set:* Runtime VCL code error condition. *Clear:* Edit VCL application software to fix this error condition; flash the new compiled software and matching parameter defaults; cycle KSI.
69	**External Supply Out of Range** *None, unless a fault action is programmed in VCL.*	1. External load on the 5V and 12V supplies draws either too much or too little current. 2. Fault Checking Menu parameters Ext Supply Max and Ext Supply Min are mis-tuned. 3. See 1311 menu Monitor/Outputs: Ext Supply Current.	*Set:* The external supply current (combined current used by the 5V supply [pin 26] and 12V supply [pin 25]) is either greater than the upper current threshold or lower than the lower current threshold. The two thresholds are defined by the Ext Supply Max and Ext Supply Min parameter settings (page 36). *Clear:* Bring the external supply current within range.

CURTIS PMC PROGRAMMER

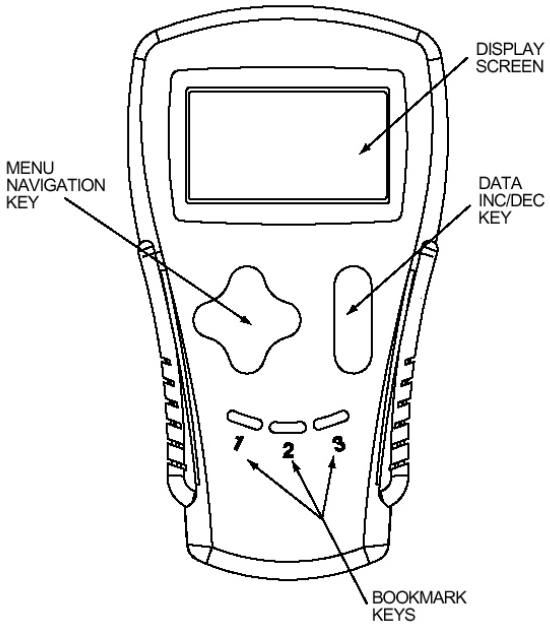
MODEL 1311

OPERATION

- The 1311 Curtis PMC Handheld Programmer simplifies programming, testing and diagnosing Curtis PMC Controllers. The Programmer is powered by the host controller via the 4 pin Molex Mini-Fit Jr. connector located on the top of the controller.

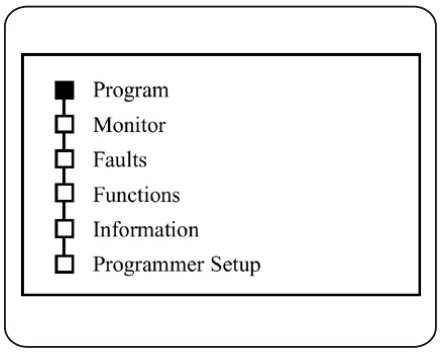
- When the Programmer is first plugged into the controller, the programmer displays the controller's model number, date of manufacture, and software revision code. Following this initial display, the programmer displays a prompt for further instructions.

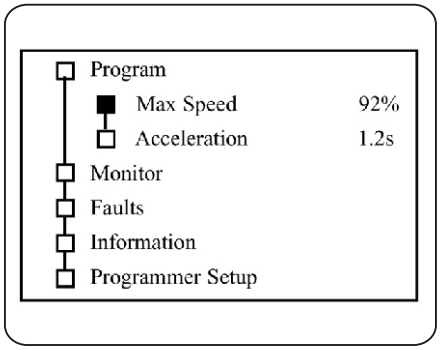
- The programmer is operated using the buttons shown on the



- The Menu Navigation Key moves the screen cursor up or down through Menu list (top or bottom arrow), and opens or closes Sub Menus (right and left arrows).
- The Data Inc/Dec Key changes the value of the parameter indicated by the cursor.
- The Three Book mark Keys allow you to quickly go back to your favourite selections without having to navigate back through menu.

- To set a position in the menu, hold a Bookmark Key down for three seconds, until the Bookmark set screen will be displayed. To jump to a selected Bookmark position, press the appropriate Bookmark Key.
- After the data is uploaded from the controller the main menu appears.
- A blinking square on the left edge indicates the position of the cursor.
- Entering a Main Menu (right arrow on the Menu navigation Key) brings up Sub Menu displayed in Second column and indented right.
- The Program Menu contains several Sub Menus of parameters.
- The Monitor contains a list of all variables that can be read and displayed.
- The Faults Menu provides the present status and access to past fault history.
- The Functions Menu provides access to copy data between units, reset data etc.
- The Information Menu provides overview of information such as software , hardware versions etc
- The Programmer Setup Menu provides access to set up options.





CHANGING A PARAMETER

- When the programmer is connected to the controller a parameter list is uploaded to the programmer
- To change a parameter use Menu Navigation Key to select " Program "
- Scroll through the list and press the right arrow on the Menu Navigation Key to enter the Sub-Menu. Use the Data Inc/Dec Key to increase or decrease the value of the parameter.

READING FAULTS AND DIAGNOSTIC HISTORY FILE

- The programmer runs continuous self-diagnostics and will record and log an error event in the memory when connected to the controller.
- To see the present errors use Menu Navigation Key to select " Faults -> System faults"
- To access this log, use the Menu Navigation Key to select " Faults -> Fault History"
- The faults are shown as a code and descriptive text. If there are multiple faults, scroll through the list using Up and Down Keys.
- After reading the Fault History it is useful to clear it. To clear the fault history select , " Faults -> Clear History"
- To confirm use Increment Arrow (+) for yes and decrement arrow (-) for

NOTE

Incase the handheld does not communicate check the cable for loose connection and check crimping in connectors. Change or alter the parameters only when required.

POTENTIO METERS PARAMETER SETTINGS FOR CONTROLLER

PARAMETERS FOR ACCELERATOR AND BRAKE SETTINGS					
THROTTLE					
	THROTTLE TYPE	2	1	5	
	FORWARD DEAD BAND	0.6	0	5	VOLT
	FORWARD MAP	50	0	100	%
	FORWARD MAX	3.5	0	5	VOLT
	FORWARD OFFSET	0	0	100	%
	REVERSE DEAD BAND	0.6	0	5	VOLT
	REVERSE MAP	50	0	100	%
	REVERSE MAX	3.5	0	5	VOLT
	REVERSE OFF SET	0	0	100	%
	HPD/SRO ENABLE	1	0	1	
	SEQUENCING DELAY	0.1	0	5	SECONDS
BRAKE					
	BRAKE PEDAL ENABLE	1	0	1	
	BRAKE TYPE	2	1	5	
	BRAKE DEAD BAND	0.5	0	5	VOLT
	BRAKE MAP	50	0	100	%
	BRAKE MAX	1.01	0	5	VOLT
	BRAKE OFF SET	0	0	100	%

NOTE

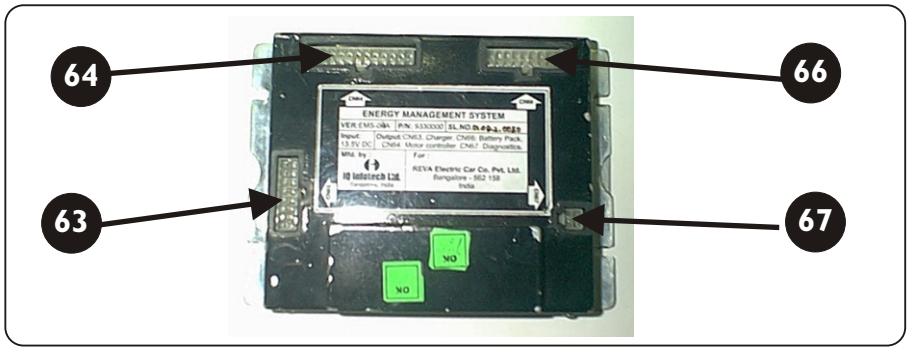
Do not change or alter any parameters unless specified by RECC. Some changes in parameters may result in reduced performance or failures.

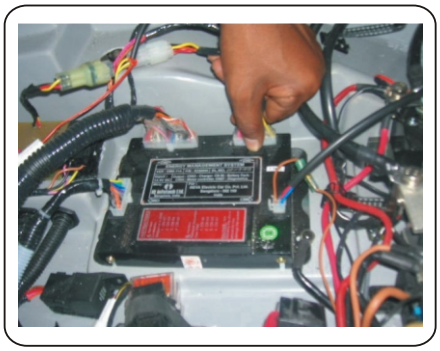
ems 17.0

DESCRIPTION

The REVA Energy Management System (EMS) provides the following features critical to maximizing battery performance and life of EV's for a consumer.

- Longer Battery Life
- Greater effective pack range.
- Improved State of Charge estimation
- Reduced Charging Time





EMS - REMOVAL FROM THE VEHICLE

- Ensure that the car is in idle mode i.e. no charging ,no discharging .
- Ensure that all the summary and error data are down loaded according to the procedure *(Refer Section 18.3)* before disconnecting the EMS from the vehicle.
- Down load both Summary Data and Error Data.
- Note down the actual SOC in PET's Monitor System.
- Loosen the four mounting screws on EMS.
- Remove Harness from the EMS as shown below:
    - CN66 Battery Pack Harness
    - CN64 Main Harness to EMS
    - CN63 Charger to EMS Harness
    - CN67 Diagnostic Harness

EMS - CONNECTING TO THE VEHICLE

- Ensure that the car is in idle mode i.e. no charging ,no discharging .
- Place EMS in the correct position.
- Tighten the four mounting screws on EMS.
- Connect the Harness to the EMS as shown below.
    - CN67 Diagnostic Harness
    - CN63 Charger to EMS Harness
    - CN64 Main Harness to the EMS.
    - CN66 Battery Pack Harness.
- Set SOC to the previous noted SOC.
- Reset Service Light. *(Refer Procedure 18.4)*

WHAT TO DO BEFORE REMOVING THE BATTERY NEGATIVE

- Note down the actual SOC in PET's Monitor System. *(Refer Procedure 18.3)*
- Download Error Data in PET's Service Information Menu. *(Refer Procedure 18.3)*
- Remove Harness from the EMS as shown below.
    - CN66 Battery Pack Harness
    - CN64 Main Harness to EMS
    - CN63 Charger to EMS Harness
    - CN67 Diagnostic Harness

- Remove Battery positive after removal of 12V charger cable.
- Connect Battery positive in the reversal order of removal.

WHAT TO DO AFTER CONNECTING THE BATTERY POSITIVE

- Connect the battery positive .
- Connect Harness to the EMS in the order given below.
    - CN67 Diagnostic Harness
    - CN63 Charger to EMS Harness
    - CN64 Main Harness to the EMS.
    - CN66 Battery Pack Harness.
- Set SOC to previous noted SOC value.
- Reset Service Light.*(Refer Procedure 18.4)*
- Clear Error Data.*(Refer Procedure 18.4)*

NOTE

Procedure to calibrate I_PROG:

1. If the battery current is more than the Programming current then Iprog has to be calibrated. e.g., if battery current is - 8.3A and Iprog is 7A then the Iprog has to be calibrated.

2. The difference current has to be found out
   i.e. |Ibatt| - Iprog = modulus (battery current) - Iprog is 8.3 - 7 = 1.3A.
   To decrease the current from 8.3A to 7A i.e. to reduce by 1.3A we have to decrease the I_PROG factor by the same amount.
   e.g., if 8.3 — 1.3A
   10000 — ?
   then, (10000*1.3 / 8.3) = 1566.
   i.e., I_Prog factor has to be decreased by 1566 to reduce the battery current from 8.3A to 7A. Therefore, the New I_prog factor is 10000 - 1566 = 8434

3. Now check for the matching of battery current and I_prog.

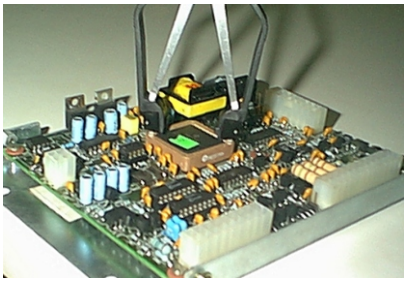
EMS BOARDS - CHANGING

EMS boards have to be changed due to:

- If there is a problem in the board.

PROCEDURE TO REPLACE EMS

- Check the car is in idle mode (i.e. no charging and no discharge). Note down the SOC. Download Summary & Error Data. *(Refer Procedure 18.3)*
- Remove Harness from the EMS which is to be replaced. Refer Removal of EMS Procedure. *(Refer Procedure 17.2)*
- Place new EMS Board over old EMS.
- Connect the Harness to the new EMS. *(Refer Procedure 17.2)*
- Download Calibration Parameters in PET from New EMS. *(Refer Procedure 18.3)*
- Remove Harness from the new EMS. Refer Removal of EMS Procedure. *(Procedure 17.2)*
- Loosen the four mounting screws on the EMS, which is to be replaced.
- Open EMS enclosure. Remove EEPROM from the removed EMS as shown in the Fig. (A eight pin chip).
- Place this EEPROM in the new EMS Board.
- Place new EMS in the correct position. Tight the four mounting screws.
- Connect the Harness to the EMS. Refer Connection of EMS Procedure. *(Procedure 17.2)*
- Set the noted SOC and remove Service Light (Service Light is because of SOC < 5% error).
- Upload Calibration Parameters to the new EMS.



EMS SOFTWARE - UPDATING

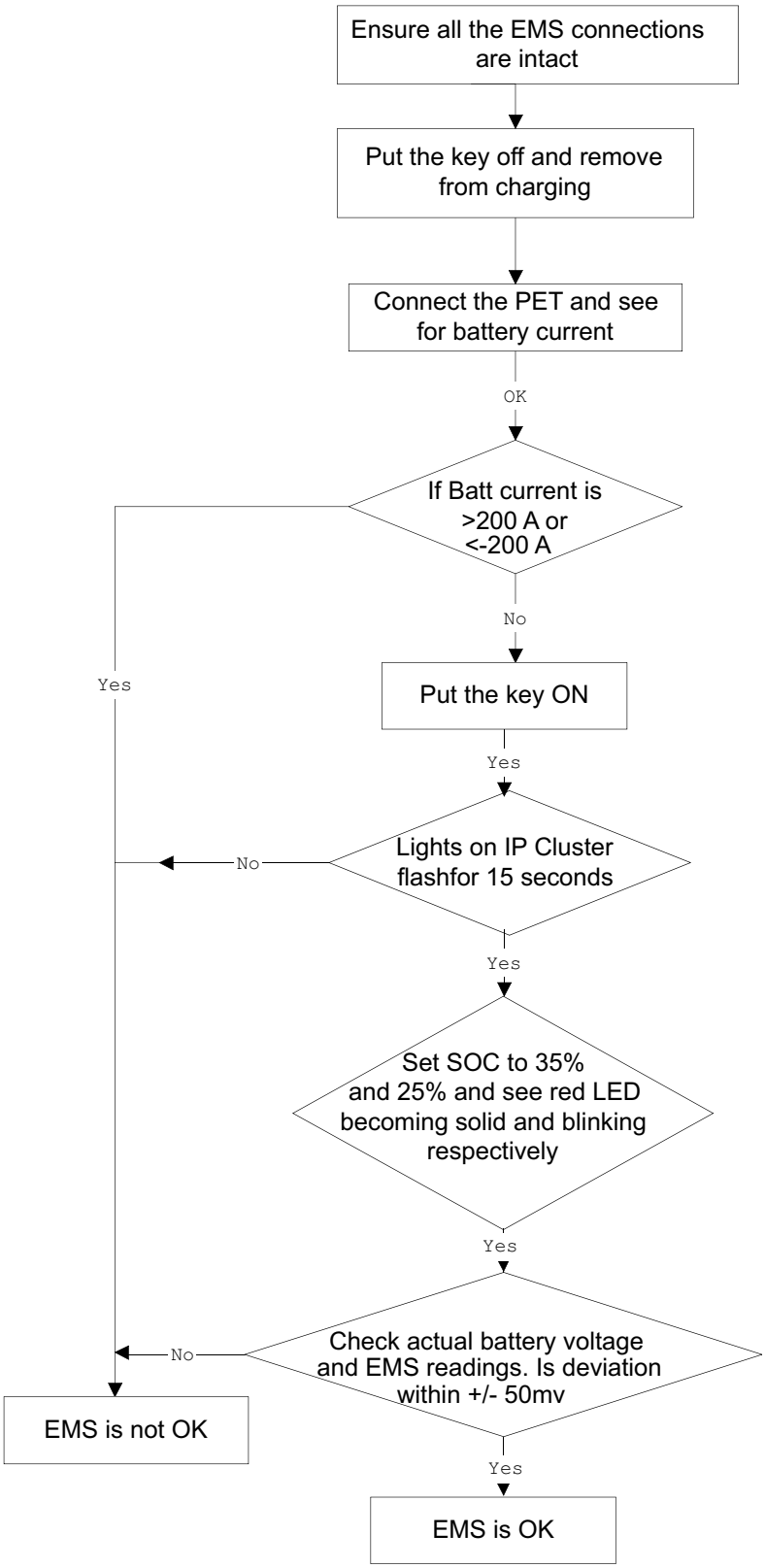
- Remove the rear seat.
- Check the car is in idle mode (i.e. no charge or no discharge).
- Connect PET.
- Note down the SOC. *(Refer Procedure 18.3)*
- Remove EMS Harness. Refer EMS Removal procedure. *(Procedure 17.2)*
- Open the EMS enclosure, replace old micro-controller chip with new one and close the EMS enclosure. Ensure that you use proper tools for removing the chip.
- Connect the Harness to the EMS. Refer Connection of EMS procedure. *(Refer Procedure 17.2)*
- Set SOC to the previous noted SOC in PET. *(Refer Procedure 18.4)*
- Reset Service Light *(Refer Procedure 18.4)* & Clear Error Data in PET. *(Refer Procedure)*

EMS - CHECKING WORKING OR NOT

(PROVIDED ALL OTHER ASSOCIATED SYSTEMS WORKING CORRECTLY)

- Ensure that all the EMS connectors are intact .
- Put the key ON
- The indicators (LED in both colour, over temperature light, service light, water light, brake light) on the IP cluster should glow for few seconds
- Switch off key and connect the PET and check data records . *(Refer Procedure 18.3)*
- Down load summary and error data .*(Refer Procedure 18.3)*
- Put the car for charge. After three minutes check for the correspondence between the I_prog and battery current. And they should match each other .
  Check all the battery voltage and pack voltage readings in the PET .
- Put the KEY ON. Note down the SOC reading. Set the SOC at 35% and at 25% to see the LED becoming solid red and flashing respectively.
  After observing the function of red light SET back the original SOC.
- If all the above steps are working fine EMS is working correctly .

To check EMS is working or not.



EMS HARNESS (CONNECTOR) DETAILS

CHARGER TO EMS HARNESS (CN63)

PIN No.	PIN NAME DESCRIPTION	DESCRIPTION
1	EMS Supply	This is the Supply Voltage of 12V from Charger to operate EMS.
2	EMS Supply Return	This is the GND signal
3	Charger Over Temperature	This pin indicates that Charger Temperature is high. This is a voltage signal between 5V to 48V.
4	Charger Status	This pin indicates Charger status. This is a voltage signal between 5V to 48V.
5	Low AC Line/ Low Mains	The charger under voltage is a signal from charger to EMS indicates that the car is put for charge i.e. 230V AC mains is connected and it is 0V w.r.t GND When the car is not put for charge i.e. when no 230V are connected it gives 5V-w.r.t GND
6	Charge Control Enable	The charger control enable is a signal from EMS to charger indicates that the EMS takes the charge control. It is 0V-w.r.t GND. When the car is put for charge.
7	Charge Control Ground	It is a GND signal from the EMS to Charger.
8	Charge Voltage Control, Vprog	Programming voltage from the EMS (Vprog) to charger. It is a 0 to 5V signal to charge the battery from 42V to 66.5V.
9	Charge Current Control, Iprog	Programming voltage from the EMS (Iprog) to charger. It is a 0 to 5V signal to charge the battery from 0 to 40A.
10	Charger Shunt Low	The charger shunt voltage is the differential voltage from the charger and is equivalent t0the charging current.
11	Charger Shunt High	The rating of the shunt is 40A/40mV. The EMS displays the mili volt equivalent of charging current from the charger to the terminal.
12	Charger Temperature Sensor Low	The differential voltage from the charger is equivalent of the charger temperature.
14	Charger Temperature Sensor High	The voltage equivalent of temperature will be 3V @ 27 ÿC and increases by 0.01V for every 1 ÿC rise thereafter For e.g.: At 40 ÿC the voltage is equal to 3.13V
13	No Connection	
15	No Connection	
16	No Connection	

BATTERY PACK SENSE HARNESS (CN66)

PIN No.	PIN NAME DESCRIPTION	DESCRIPTION
1	Battery Pack Voltage 0	Reference voltage for all Battery voltage measurements. The voltage measured will be 0 to 0.2V w.r.t ground.
2	Battery Pack Voltage 1	Battery voltage 1 Measured w.r.t BV0 will be 5 to 8V.
3	Battery Pack Voltage 2	Battery voltage 2-Measured w.r.t BV1 will be 5 to 8V.
4	Battery Pack Voltage 3	Battery voltage 3-Measured w.r.t BV2 will be 5 to 8V.
5	Battery Pack Voltage 4	Battery voltage 4-Measured w.r.t BV3 will be 5 to 8V.
6	Battery Pack Voltage 5	Battery voltage 5-Measured w.r.t BV4 will be 5 to 8V.
7	Battery Pack Voltage 6	Battery voltage 6-Measured w.r.t BV5 will be 5 to 8V.
8	Battery Pack Voltage 7	Battery voltage 7-Measured w.r.t BV6 will be 5 to 8V.
9	Battery Pack Voltage 8	Battery voltage 8-Measured w.r.t BV7 will be 5 to 8V.
10	No Connection	
11	Battery Temperature Sensor Signal	The differential voltage from the battery is equivalent of the battery temperature.
12	Battery Temperature Sensor GND	The voltage equivalent of temperature will be 3V @ 27 ÿC and increases by 0.01V for every one degree centigrade rise thereafter. For e.g.: At 40 ÿC the voltage is equal to 3.13V.
13	Water Level Sensor	The water level signal from water level sensor indicates to the EMS that the battery water level is low or high. The voltage measured w.r.t ground is around at 8.6V when the batteries are watered.
14	No Connection	
15	No Connection	
16	Battery Fan Return	This is the GND signal given by the EMS to run the fan.
17	No Connection	
18	Fan TTL Output	The Signal from the fan indicating that it is rotating .The voltage measured w.r.t GND will be 2.5V to 3V. The counts will be around 20 to 30000 counts

FAN OPERATION

STATE	FAN ON	TIME DELAY AFTER CHARGE /DRIVE IS FINISHED
Charge	Always	20 minutes
Drive	Battery Temperature > 38 °C OFF < 35 °C	10 minutes

MAIN HARNESS CONNECTOR (Cn64)

PIN NO.	PIN NAME DESCRIPTION	DESCRIPTION
1	Motor Controller Limp Home Mode Select	Limp home mode signal given by the EMS to the motor controller to run the car in limp home mode When the SOC becomes 15% and less. This signal operates at pack voltage at that time.
2	From Motor Controller for Power	This voltage is +15V irom the motor controller to EMS.
3	NC	
4	Motor Controller Receiver	Receives data from Controller.
5	Ground from Motor Controller	This is the GND signal from the motor controller to EMS
6	Brake Light	The parking brake light gets ON by the EMS when the parking brake is pulled. The same light flashes indicating the brake fluid is low. It is the GND signal from EMS.
7	Tachometer Pulses	It is a GND signal (0V) from the door switch to the EMS when the door is open i.e. when door switch is not pressed.
8	Tachometer Return	It is a GND signal.
9	Over Temperature Light	The temperature Light gets on by the EMS for various temperatures such as battery temperature, Charger temp, Controller temp and motor temperature. It may glow either as blinking or solid depending on the temperature range. It is a ground signal given by EMS to switch ON the light. (Table II)
10	Service Warning Light	The EMS puts on the service light when there is an error in the car. It may temporary or permanent depending on type of error. It is a GND signal given by the EMS to switch on the light. For more information on errors see the ERROR LIST in Chapter 4.10
11	Low Battery Light	The low battery light is a LED on the IP cluster becomes red in color put on by the EMS when the SOC becomes 35% in drive. The same light flashes when the SOC becomes 25%. The voltage measured w.r.t GND will be between 4 to 12V w.r.t ground.

continued

PIN NO.	PIN NAME DESCRIPTION	DESCRIPTION
12	Charge Indicator Light	Charging light is a LED on the IP cluster is green in color put on by the EMS when the charging is ON. It blinks during charging and becomes solid at the end of charge. The voltage measured w.r.t ground will be between 4 to 12V.
13	KEY on Signal Via F2	It is the battery pack voltage signal to the EMS indicating that the car is put on drive.
14	Motor Controller Economy Mode Select	When the SOC is equal to or less than 25%, Economy mode signal given by the EMS to the motor controller to run the car in economy mode. This signal operates at pack voltage at that time.
15	No Connection	
16	Water Level Low Light	Water level light gets on by the EMS whenever it detects that water is low in the battery through water level sensor. It is a ground signal given by the EMS to switch on the light.
17	Fuel Gauge Analog Out	Fuel Gauge Signal is given by EMS as 8V to 16V signal to control the gauge from 0% SOC to 100% SOC. The voltage is measured between FG+ and FG-.
18	Fuel Gauge Analog Return	It is a GND signal from EMS.
19	Chime Output	It is a buzzer gets on by the EMS whenever there is an error and remains for only two seconds. And gets on for the fllowing conditions. This is a GND signal given by the EMS to switch on the Chime.
20	Brake Fluid Sensor	The brake fluid sensor is the signal indicating the level of the brake fluid to the EMS. When the brake fluid is full the voltage is 5V-w.r.t ground. When the brake fluid is low it is a ground signal.
21	Parking Brake Sensor	The parking brake sensor is the signal to the EMS indicating whether the parking brake is pulled or not. When the parking brake is not pulled the voltage is 0V-w.r.t GND. When the parking brake is pulled it is a ground signal.
22		
23	Battery Shunt High	The battery shunt voltage is the differential voltage measured across the shunt which is equivalent of the battery current.
24	Battery Shunt Low	The rating of the shunt is 400A/75mV. The EMS displays the battery current equivalent of millivolt measured across the shunt to the terminal.

DIAGNOSTIC HARNESS (CN67) **TABLE I**

PIN NO.	PIN NAME	PIN NAME DESCRIPTION	DESCRIPTION
1	STX	RS232 Transmit	The EMS sends Data to the Palm / Terminal.
2	RTX	RS232 Receive	The EMS receives the data from Palm / Terminal.
3	GND	Ground	Ground Signal for the Communication.
4	GND	Charge Ground Signal	This is the ground signal from the charger. Before any harness connections are given to the EMS, the diagnostic port is first connected to EMS to give the ground first and then the supply. So also during the removal of harnesses this diagnostic harness will be last one to remove ensuring the EMS is always grounded for any other harness removal.

OVER TEMPERATURE LIGHT STATE DURING CHARGE **TABLE II**

BATT TEMP	CHARGER TEMP	OVER TEMP LIGHT	BATTERY CURRENT (-VE) CHARGER CURRENT
> 45 °C & < 50 °C		Solid	Derated between 40 °C and 50 °C
> 50 °C& < 10 °C		Flashing	
	> 73.5 °C & < 77 °C	Solid	Derated between 73.5 °C and 77 °C
	> 77 °C	Flashing	

OVER TEMPERATURE LIGHT STATE DURING DRIVE **TABLE III**

BATTERY TEMP	CONTROLLER TEMP	MOTOR TEMP	OVER TEMP LIGHT	BATTERY CURRENT
> 50 °C & <10 °C			Flashing	
	>82 °C & <90 °C		Solid	Current is limited by Controller
	> 90 °C		Flashing	Vehicle Halts, wait for 15 Minutes.
		> 130 °C & < 145 °C	Solid	Current is limited by Controller
		> 145 °C	Flashing	Vehicle Halts, wait for 15 Minutes.

DRIVE LIGHT CONDITIONS **TABLE IV**

SOC	LOW BATTERY LIGHT	BATTERY CURRENT
<= 35 %	Flashing	
<= 25 %	Solid	Motor controller put in Economy Mode, Top speed and battery current limited
<= 15 %	Solid	Motor controller put in Limp Home Mode, Top speed and battery current further limited.

DESCRIPTION OF DATA RECORDS

DESCRIPTION OF CHARGE AND DRIVE DATA

PARAMETERS	DESCRIPTION
State	The Present State of Car.
Time	The total time completed in the charge or drive at that moment. In Palm, it is displayed in minutes.
Cycle	One completion of Charge & discharge is called a cycle.
Charger Current	The EMS displays the charging current in Ampere equivalent of charger shunt voltage. The rating of the charger shunt is 40A/40mV.
Battery Current	The EMS displays the battery current in amperes equivalent of battery shunt voltage. The rating of the battery shunt is 400A/75mV.
BV1 to BV8	These are the eight individual battery voltages in volts.
Vpack	This is the sum of all individual voltages. The total pack voltage is in volts.
Battery Temp	The Battery Temperature is in deg C.
Charger Temp	The Charger Temperature is in deg C.
Ampere Hour	It gives the capacity of the battery during charging or drive. KiloIt is the calculation based on the amount of current flown in the battery in one hour. The capacity is measured with the unit ahr.
Kilowatt Hour	It gives the power of the battery during charging or drive . It is the product of current and voltage. It is the calculation based on the Amount of power given /consumed in the battery in one hour in the Charge/discharge. The power is measured as Kwhr.
SOC	It gives the percentage amount of charge in the battery.
Max Dv	It is the difference between maximum and minimum of the eight individual battery voltages. Normally it should be within 1V both in charge and discharge.
Fault	It gives the present error in the Car.
Iprog/Est SOC	Iprog is the programming current from the EMS to charge the battery . The Est SOC is estimated State of Charge calculated on the basis of battery current and battery voltage during drive.
Vprog/ No Data	Vprog is the programming voltage from the EMS to charge the battery . There is no data in Drive.
Eq.Count/No Data	It shows Eq.count in Charge. There is no data in Drive.
No Data	There is no data in Charge and Drive .
No Data	There is no data in Charge and Drive.
Fan TTL/Speed	The counts displayed indicates that the fan is running .The count varies As 170Hz in old cars and 115Hz in new cars. This is Speed in which the car is running measured in Kilometer per hour.
No Data/Motor Temp	There is no data in Charge. This is temperature of the motor measured in degree centigrade.
No Data/Controller Temp	There is no data in Charge. This is temperature of the controller heat sink measured in degree centigrade.
No Data/%Throttle	There is no data in Charge.
No Data/Motor Power	There is no data in Charge.

DESCRIPTION OF SUMMARY DATA

PARAMETERS	DESCRIPTION
Type	eoc - Indicates End of Charge eod - Indicates End of Drive
Cycle	One completion of Charge and Discharge is called a Cycle
Time	It is the total time taken to charge or discharge in one cycle during charging / drive.
Tbatt_Avg	It is the average of the battery temperature during charge or drive.
Tbatt_Max	It is the maximum temperature of the battery occurred in the charge or drive.
Ahr	It gives the capacity of the battery during charging or drive .It is the calculation based on the amount of current flown in the battery in one hour.The capacity is measured with the unit ahr.
Ahr_Regen	It is the ampere-hour regenerated back to the battery during drive on braking. It gives the capacity of the battery charged during drive because of the braking.
Kwhr	It gives the power of the battery during charging or drive .It is the product of current and voltage. It is the calculation based on the amount of power in the battery in one hour. The power is measured with the unit Kwhr.
SOC	It gives the percentage amount of charge in the battery at the end of charge (eoc) or at the end discharge (eod).
Watering Faults	Watering faults (0-5) shows, '0' as no fault,'1' as temp.fault '4' as permanent fault and '5' as both faults.
Max Dv	It is the difference between maximum and minimum of the eight individual battery voltages. The maximum limit of the MAX DV set is 1 V.
@V_batt	This is the battery pack voltage at which Max Dv has occurred in the charge or drive.
@I_batt	This is the battery current at which the maximum deviation (MAX DV) has occurred in the charge or drive.
@SOC/Kms	In eoc, it is SOC at which Max Dv occurred. In eod, it gives total kilometers driven.
Tcont	In eod, it gives the maximum temperature of the controller Occurred during drive.
Tchg/Tmot	In eoc, it gives the maximum temperature of the charger occurred during charge. In eod, it gives the maximum temperature of the motor occurred during drive.

NOTE

Different States

c1 - Charge Phase 1
c2 - Charge Phase 2
c3 - Charge Phase 3
cf - Final Phase
ci - Idle mode after Regular Charge.
ce - Equalize Charge
cq - Idle mode after Equalize Charge.
ct - Idle mode after Time out Shut down.
co - Idle mode after Over Voltage Shut down.
cp - Idle mode after Over Temp Shut down.
dd - Drive (Key ON)
im - Idle Mode (No Charge/ No Drive)

DESCRIPTION OF ERROR DATA

PARAMETERS	DESCRIPTION
Error Code	This is error number which is recorded by the EMS for the particular error.
Cycle	Cycle no in which the error code is recorded.
State	This indicates the state in which the error has occurred.
Time	This indicates the time at which the EMS records the error.
Vpack	This indicates the pack voltage at which the error recorded by the EMS.
Battery Current	This indicates the battery current at which the error was recorded by the EMS
Tbatt	This indicates the battery temperature at which the error was recorded by the EMS.
Tchg	This indicates the charger temperature at which the error was recorded by the EMS.
Tcont	This indicates the controller temperature at which the error was recorded by the EMS.
Tmot	This indicates the motor temperature at which the error was recorded by the EMS

TROUBLESHOOTING OF EMS

KEY POINTS IN SOLVING PROBLEMS RELATED TO EMS

- The service person should ensure for the harness connections with the EMS. And he should make sure that all the lights on the IP cluster should glow when the key is put ON.
- Order should be followed to connect and remove the harnesses from EMS.
- Data should be checked with the PET. If there is a problem with the EMS and can not be solved at that instant of time then EMS has to be replaced. *(Refer 17.4)*
- Before removing the EMS supply SOC has to be noted down. *(Refer 18.3)*
- Once we remove EMS supply and put back, the state of charge has to set to the previous value and the error code 513 has to be removed. *(Refer 18.4)*.
- All the EMS connections and removal has to be done in idle mode (neither charging nor discharging) only after taking eoc and eod of 2 ahrs.
- We have to give importance to eoc and eod .For the eocs or eods to be recorded in the EMS, the car has to be charged or discharged for atleast 2 ahr.
- PET has to be operated only when there is no reset of the EMS is going on i.e. when no lights on the IP cluster is flashing.
- When communication error occurs in Palm, the car has to be put for charge if it is in drive and vice –versa.

PROBLEM ANALYSIS FOR MOST LIKELY PROBLEMS

- Improper charging.
- Low range.
- Over temperature.
- When to equalize.
- Gauge dropping fast.
- Charging not ending for even six hours.
- Fuel gauge always struck at 100% SOC.
- Erasing of calibration parameters.

IMPROPER CHARGING

1. HIGH BATTERY TEMPERATURE

It occurs during Charge, when the temperature of the Battery is more than 50 °C.

SL No.	CAUSES	ACTION TO BE TAKEN
1	Due to erratic readings of the Sensor.	Check for Battery Sensor with Multimeter. The voltage equivalent of temperature will be 3V @ 27 °C and increases by 0.01V for every 1 °C rise thereafter, e.g. at 40 °C the voltage is equal to 3.13V
2	After Drive, if the car is put for Charge immediately.	
3	If actual temperature of the Battery is more than 50 °C.	Allow Battery for Cooling.

2. IF THERE IS A FAN FAILURE

During Charge, Fan is not working (0 Counts) and v_prog reading is 54.50V.

SL NO.	CAUSES	ACTION TO BE TAKEN
1	If 12Volts to the Fan is disconnected.	Check for Fan connections.
2	If EMS is not giving GND to the Fan.	Check for continuity between Fan GND & Battery Shunt GND. If the EMS is not giving the GND the EMS has to be replaced.
3	If no TTL is coming from Fan.	Check the voltage between Pin 18 of CN66 & GND and it should read between 2 to 2.5V. If the required voltage is not coming, fan has to be replaced.

3. HIGH CHARGER TEMPERATURE

During Charge, the temperature of the Charger is more than 77 °C

SL NO.	CAUSES	ACTION TO BE TAKEN
1	If Fan is not working.	Check for the fan failure
2	If the actual temperature of charger is more than 77 °C.	Allow charger for Cooling.

4. IF THE CUV SIGNAL IS NOT COMING FROM THE CHARGER

SL NO.	CAUSES	ACTION TO BE TAKEN
1	If the charger is failed in sending the CUV (Charger under voltage) signal, then the charging won't take place.	The CUV signal should be checked. When the car is put on charge it should read 0V. Other wise it is 5V .If the CUV reads 5V even when the AC is on, the charger has to be replaced.
2	If the actual temperature of charger is more than 77 °C.	Allow Charger for Cooling

3. OVER TEMPERATURE

There are two types of Over Temperature

- High Battery Temperature
- High Charger Temperature

(Refer Tables for High Battery Temperature & Charger Temperature in the previous page.)

WHEN TO EQUALIZE

If the Equalization of Batteries is not completed in 5 consecutive cycles.

SL NO.	CAUSES	ACTION TO BE TAKEN
1	Stopping of charging, when it is equalizing. (Indication of equalizing, with low Battery light & Charge light Blinking)	Checking for the alternate blinking of both lights alternatively whenever the cable is removed from the charge port. Leaving for equalization charge in installments for 10 hours in 5 consecutive cycles.
2	No clear instructions about the start of equalization to customers.	The customer should be clearly instructed about the next start of equalization charge.
3	If the Avg. DV is greater Than the limit specified	Equalize for the remaining period till we get 'cq' on the terminal and solid green Charge light appears on the IP.

SOC GAUGE DROPPING FAST

Initially if the gauge drops fast from 100% SOC, as the estimated SOC will be low at the beginning as battery is self-discharged and trickle charge didn't happen.

SL NO.	CAUSES	ACTION TO BE TAKEN
1	If the car is kept idle for Many days.	Drive the car for few kilometers and Then put the car on charge.
2	If the car is not put for charge when it is not used for more than one day.	Customer should be told clearly to put the car on charge when it is not used for more than one day.

CHARGING NOT ENDING FOR EVEN SIX HOURS

While Charging, if Charge Time is more than 12hrs, then there will be Time Out Shutdown.

SL NO.	CAUSES	ACTION TO BE TAKEN
1	If Battery Current is not read by EMS correctly.	Check Battery Shunt Readings & check EMS for Calibration of battery current.
2	If there is a Fan Failure	Check Fan for it's working. The 12V supply for the FAN ,GND from EMS to run the fan and fan TTL output (2 .5 to 3V)
3	If Temperature sensor is reading erratically more than 50 °C.	Check for Sensor with Multimeter.
4	If there is high battery and/or charger temperature	Allow Battery and/or Charger for cooling.

FUEL GAUGE ALWAYS STRUCK AT 100% SOC

SL NO.	CAUSES	ACTION TO BE TAKEN
1	If Battery Current is not read by EMS correctly. i.e. when the crimping of battery shunt wires Pin No.23 and Pin 24	No.24 of the Main harness connector (CN 64) is damaged. When the current reading in drive will always be negative leading the SOC gauge not to go down.
2	Previously if there is a motor failure. The TIMER circuit of the EMS will be damaged causing the battery current to be always negative even in idle mode.	If higher charger and battery currents are observed even in idle mode then the EMS board has to be replaced as the cause of the problem is due to the motor short.

ERASING OF CALIBRATION PARAMETERS

SL NO.	CAUSES	ACTION TO BE TAKEN
1	Removal and connecting of battery positive with all EMS connections intact .i e without removing the EMS connection when the battery positive is removed and put back there are chances of disturbing the calibration parameters	The connection and removal of battery positive should be done only after the EMS connections are removed.
2	Not following the order of connections of harnesses to EMS may disturb the calibration parameters.	Refer Removal of EMS & Connection of EMS Procedures for order of connection & removal of Harness. (Refer 17.2)

NOTE

If the car is left Idle for many days and battery pack voltage goes down less than 12volts, the EMS calibration data can get erased. In that case the pack has to be charged and parameters has to be reloaded to EMS.

LIST OF ERRORS					
ERR NO.	**ERROR**	**ERROR DESCRIPTION**	**ROOT CAUSES**	**ACTION TO BE TAKEN**	**INDICATION**
1	Battery Over Temperat-ure (Charge)	It occurs during charge, when temperature of the Battery is more than 50 °C.	1. Due to erratic readings of the sensor. 2. After drive, if the car is put for charge Immediately. 3. If actual temperature of the Battery is more than 50 °C.	1. See Error Log & Monitor Data for Battery Temperature Sensor. Also verify with the Multimeter. If it is not working, replace it. 2. Allow Battery for cooling.	Auto SRL
2	Fan Failure	During Charge, Fan is not working (0 Counts).	1. If 12Volts to the Fan is disconnected. 2. If EMS is not giving Gnd to the Fan. 3. If no TTL is coming from Fan.	1. See Error Log & Monitor Data for Fan failure. 2. Check for Fan connections. 3. Check for continuity between Fan GND & Battery Shunt GND 4. Check with Multimeter (Pin 18 of CN66 & GND = 2 to 2.5V)	Auto SRL
4	Battery Pack Under Voltage	During Charge or Drive, Battery Pack Voltage is less than 38 Volts.	1. If CN66 is removed from the EMS.	1. Check for proper connection of the Harness.	Auto SRL
			1. If Batteries is discharged in the drive. 2. If BV8 reading from EMS is zero.	1. Car to be driven 5 to 6 Kms after flashing Light comes ON. 2. Compare BV8 EMS reading with actual Battery reading.	
8	Ch Over Temp	During Charge, the temp of the Charger is more than 78 °C.	1. If Fan is not working.	1. See Instructions given in Err No.2 for Fan.	Auto SRL
32	Time Out Shutdown	During Charge, if Charging time is more than 30000 sec.	1. If Battery Current is not read by EMS correctly. 2. If there is a Fan Failure. 3. If Temperature sensor is reading erratically more than 50 °C. 4. Charger Latching.	1. Check Battery Shunt Readings & check EMS for Calibration. 2. Check Fan according to Err No. 2. 3. Check for Sensor with Multimeter. 4. Replace software with version 1.84 for EMS ver 7 board and with version 1.85 for EMS ver 8 board.	Auto SRL
128	Trickle Charge		1. If car is not put for Charging for continuos 5 days.	1. Put it for charge always, if car is not used for more than 1 day.	Auto SRL

SRL = service light

LIST OF ERRORS					
ERR NO	**ERROR**	**ERROR DESCRIPTION**	**ROOT CAUSE**	**ACTION TO BE TAKEN**	**INDICATION**
257	BV1	Battery Voltage 1 is Out of Range	1. If BV1 < 0 V. 2. If BV1 > 8.7V. 3. If fuse is not Ok. 4. If crimping is not Ok.	1. Compare EMS & Multimeter Readings. 2. Check for continuity in Fuse. (battery harness fuse 3Amp) 3. Check for EMS Battery Calibration Parameters. 4. Check crimping of respective pin in CN66 connector.	Auto SRL
258	BV2	Battery Voltage 2 is Out of Range	1. BV2 < 0 V. 2. If BV2 > 8.7V. 3. If fuse is not Ok. 4. If crimping is not Ok.	1. Compare EMS & Multimeter Readings. 2. Check for continuity in Fuse. (battery harness fuse 3Amp) 3. Check for EMS Battery Calibration Parameters. 4. Check crimping of respective pin in CN66 connector.	Auto SRL
260	BV3	Battery Voltage 3 is Out of Range	1. BV3 < 0 V. 2. If BV3 > 8.7V. 3. If fuse is not Ok. 4. If crimping is not Ok.	1. Compare EMS & Multimeter Readings. 2. Check for continuity in Fuse. (battery harness fuse 3Amp) 3. Check for EMS Battery Calibration Parameters. 4. Check crimping of respective pin in CN66 connector.	Auto SRL
264	BV4	Battery Voltage 4 is Out of Range	1. If BV4 < 0 V. 2. If BV4 > 8.7V. 3. If fuse is not Ok. 4. If crimping is not Ok.	1. Compare EMS & Multimeter Readings. 2. Check for continuity in Fuse. (battery harness fuse 3Amp) 3. Check for EMS Battery Calibration Parameters. 4. Check crimping of respective pin in CN66 connector.	Auto SRL
272	BV5	Battery Voltage 5 is Out of Range	1. BV5 < 0 V. 2. If BV5 > 8.7V. 3. If fuse is not Ok. 4. If crimping is not Ok.	1. Compare EMS & Multimeter Readings. 2. Check for continuity in Fuse. (battery harness fuse 3Amp) 3. Check for EMS Battery Calibration Parameters. 4. Check crimping of respective pin in CN66 connector.	Auto SRL
288	BV6	Battery Voltage 6 is Out of Range	1. If BV6 < 0 V. 2. If BV6 > 8.7V. 3. If fuse is not Ok. 4. If crimping is not Ok.	1. Compare EMS & Multimeter Readings. 2. Check for continuity in Fuse. (battery harness fuse 3Amp) 3. Check for EMS Battery Calibration Parameters. 4. Check crimping of respective pin in CN66 connector.	Auto SRL
320	BV7	Battery Voltage 7 Out of Range	1. If BV7 < 0 V. 2. If BV7 > 8.7V. 3. If fuse is not Ok. 4. If crimping is not Ok.	1. Compare EMS & Multimeter Readings. 2. Check for continuity in Fuse. (battery harness fuse 3Amp) 3. Check for EMS Battery Calibration Parameters. 4. Check crimping of respective pin in CN66 connector.	Auto SRL
					SRL = service light

LIST OF ERRORS					
ERR NO	**ERROR**	**ERROR DESCRIPTION**	**ROOT CAUSE**	**ACTION TO BE TAKEN**	**INDICATION**
384	BV8	Battery Voltage 8 Out of Range	1. If Bv8< 0 V. 2. If BV8 > 8.7V. 3. If fuse is not Ok. 4. If crimping is not Ok.	1. Compare EMS & Multimeter Readings. 2. Check for continuity in Fuse. 3. Check for EMS Battery Calibration Parameters. 4. Check crimping of respective pin in CN66 connector.	Auto SRL
513	SOC < 5%	Indicates the batteries are discharged completely. Battery Voltage 3 is Out of Range	If EMS supply is removed When 1. The battery negative is removed. 2. EMS CN63 connector is removed.	1. Note down SOC before Battery Negative is removed. 2. Note down SOC, before CN63 is removed. 3. Set SOC to previous noted SOC, after putting back the supply. 4. Only after clearing the root causes of the problem, reset Service light.	Permanent SRL
			1. Battery is discharged too much even after the flashing red light comes ON.	1. Check Summary & Error Data. 2. Check for frequent low Soc's. 3. Check for excessive Whr/Kms if Ahr/Percentage SOC is out of range (too low). 4. Do full charge. 5. Do capacity test 6. Instruct Customer to drive the car only 5 to 6 Kms after flashing Light comes ON. 7. Only after clearing the root causes of the problem, reset Service light.	
516	No Watering	No Watering of Batteries.	1. If Batteries were not watered after Low Battery Light comes for 3 consecutive cycles, then Service Light come.	1. Instruct Customer to check low level water light. 2. Watering of Batteries should be done. 3. Only after clearing the root causes of the problem, reset Service light.	No SRL
520	Battery Over Temperature (Dr)	During Drive, If the temperature of the Battery is more than 50 °C.	1. If Battery Temperature Sensor shows wrong reading even if actual temperature is correct.	1. See Error Log & Monitor Data for Battery Temperature Sensor Failure. 2. Verify Sensor with the Multimeter, if Sensor is failed, replace sensor. 3. Only after clearing the root causes of the problem, reset Service light.	Permanent SRL
			1. If temperature of the Battery >50 °C in last 10 Cycles.	1. Instruct Customer to charge at a cool place and do only one drive/day. 2. Only after clearing the root causes of the problem, reset Service light.	

SRL = service light

LIST OF ERRORS					
ERR NO	**ERROR**	**ERROR DESCRIPTION**	**ROOT CAUSE**	**ACTION TO BE TAKEN**	**INDICATION**
528	Battery Sensor Failure	During Charge / Drive, If the Temperature of the Battery is equal to 30 °C.	1. Temperature Sensor is not working.	1. See Error Log & Monitor Data for Battery Temperature Sensor Failure. 2. Verify Battery Temperature Sensor with the Multimeter. 3. If it is not working, then replace.	Auto SRL
544	Charger Sensor Failure	During Charge, if the Temperature of the Charger is 30 °C.	1. Charger Temperature Sensor is not working.	1. See Error Log & Monitor data for Charger Temperature Sensor Failure. 2. Verify the same with Multimeter. 3. If it is not working, then change it.	Auto SRL
576	Avg. Dv	During Charge or Discharge, if average deviation between battery voltages is more Than 20% or 15%.	1. If batteries were deviated.	1. Check deviations between Individual Battery Voltages 2. Put for Equalization. 3. Only after clearing the root causes of the problem, reset Service light.	Permanent SRL
			1. If CN66 is removed during Charge or Drive. 2. Due to EMS erratic readings	1. Check for the connection of the connectors to the EMS. 2. Check for EMS Calibration. 3. Only after clearing the root causes of the problem, reset Service light.	
640	No Equalize	If Equalization of Batteries is not completed in 5 consecutive cycles.	1. The equalization of 10 hrs is not finished in 5 consecutive cycles. Stopping of charging, when it is equalizing. (Indication of equalizing, with charge & low Battery light blinking). 2. No clear instructions about the start of equalization.	1. Customer to check for the alternate blinking of charge & low battery Light customer should do equalization charge in installments for 10 hours In 5 consecutive cycles. 2. The customer should be clearly instructed about the next start of equalization charge. 3. Only after clearing the root causes of the problem, reset Service light.	No SRL
769	Charger Over Temperature	During Charge, the Temperature of Charger is more than 80 °C for 3 consecutive cycles.	1. If Charger Temperature Sensor is failed. 2. If the Fan is not working.	1. Check Error Log and also in Monitor Data for Sensor failure. Verify with the Multimeter. 2. Check Error Log also in Monitor Data for the Fan failure. For further details on Fan Failure, see Inst. given in Err. No. 2. 3. Only after clearing the root causes of the problem, reset Service light.	Permanent SRL
770	Motor Over Temperature	During Drive, the temperature of the Motor is more than 150 °C for 3 consecutive cycles	1. Due to high ambient temperature. 2. If Parking Brake is pulled during drive. 3. Driving habits. 4. If ventilation is not OK. 5. Due to Vehicle related problem	1. Stop Driving & allow for cooling. 2. Ensure that Parking Brake is not pulled during drive. 3. Instruct Customer. 4. Check for ventilation. 5. Check for Vehicle related problem. 6. Only after clearing the root causes of the problem, reset Service light.	Permanent SRL
					SRL = service light

LIST OF ERRORS					
ERR NO	**ERROR**	**ERROR DESCRIPTION**	**ROOT CAUSE**	**ACTION TO BE TAKEN**	**INDICATION**
772	Controller Over Temperature	Thermal Fault coming for more than consecutive 3 Cycles.	1. Due to high ambient temperature. 2. If Parking Brake is pulled during drive. 3. Driving habits. 4. If ventilation is not OK.	1. Stop driving & allow for cooling. 2. Ensure that parking brake is not pulled during drive. 3. Check for ventilation of controller. 4. Instruct customer. 6. Only after clearing the root causes of the problem, reset Service light.	Permanent SRL
1025	HPD / Sequence Fault.	When Key is switched On the RNFB knob Not in neutral position.	1. RNFB knob not in neutral position prior to key on. 2. Accelerator pedal pressed prior to key on.	1. Set the RNFB knob to Neutral position. 2. Check for any Accelerator percentage, if so reset the Potentiometer or remove the foot off the pedal.	No SRL
1028	Controller Communica-tion	There is no connection between EMS & Controller.	1. Controller to EMS (CN73) is removed for 3 consecutive cycles. 2. If crimping of 3 Pins in CN73 is not correct.	1. Check for connector (CN64) Pin no 1 for 15V-w.r.t GND. 2. Check for Controller connector's CN73 pins. 3. Check for wiring.	Auto SRL
1281	Encoder / Stall detect Fault.	Bearing failure/ LOS	1. Sensor bearing failure. 2.Loose connection / wires cut 3. Controller faulty.	1. Replace the sensor bearing. 2.Replace or rectify the connections. 3. Replace or rectify the controller.	Flash SRL
1282	Main open / Short	Main contactor Driver will not turn on Motor stops	1. Due to open or short on driver load. 2. Dirty connections/ bad crimp/ faulty wiring.	1. Replace or rectify . 2. Clean / re crimp or rectify.	No SRL No Chime
1284	Over voltage Cut back	Reduced brake torque	1. Regen braking current increased the battery voltage. 2. Battery parameters mis adjusted or battery disconnected during regen braking.	1. Check and adjust the battery / regen parameters	No SRL No Chime
1288	Controller Over current	Motor stops Main contactor opens	1. External short of phase U, V and W motor cable connections. 2. Motor parameters mis-tuned. 3. Controller defective.	1. Rectify the short in motor phase cables. 2. Adjust the motor parameters. 3. Rectify or replace the controller	Auto SRL
1296	Controller over Temperature Cut back	Reduced drive and Brake torque.	1.Controller operating in extreme temperature. 2.Excessive load on vehicle.. 3. Improper mounting of controller.	1. Check for ambient temperature, if more allow controller for cooling. 2. Avoid driving with excessive load. 3. Apply adequate heat sink compound and mount the controller properly.	No SRL No Chime
					SRL=service light

LIST OF ERRORS					
ERR NO	**ERROR**	**ERROR DESCRIPTION**	**ROOT CAUSE**	**ACTION TO BE TAKEN**	**INDICATION**
1312	Precharge failed.	Motor stops. Main contactor opens	Problem in Vehicle wiring.	1. Check vehicle wiring and rectify.	Auto SRL
1344	Motor temperature hot cut back	Reduced drive torque.	1. Motor temperature is at or above the programmed parameter setting. 2. Motor temperature parameters mis tuned.	1.Stop driving the car and allow the motor to cool. 2. Adjust and tune the parameters in the controller.	No SRL
1408	Motor temperature sensor fault.	Throttle request=0%	1. Motor temperature sensor failure. 2. Parameters mis tuned. 3. Motor temperature more than the programmed setting.	1. Replace motor temperature sensor. 2. Adjust the parameters in controller. 3. Allow the motor to cool.	Auto SRL
1793	Water level	Indicates low water level in batteries	1.Low water level. 2. Due to problem in water level sensor.	1. Check water level in batteries. If it is low, refill it. 2. If water level is not low, check water level sensor (check pin no.13 of CN 66 & GND = 8 to 10V)	No SRL
1794	Brake fluid.	Indicates low brake fluid level.	1. Brake fluid low. 2. Wiring problem. 3. Brake fluid sensor problem.	1. Check brake fluid level, refill if it is low. 2. Check wiring. 3. Check the sensor (check for continuity when sensor is dipped in fluid)	Auto SRL
1794	Brake Fluid	Indicates low fluid level	1. Brake Fluid is Low. 2. Wiring problem. 3. Brake Fluid Sensor problem.	1. Check Brake Fluid Level, if it is low the refill. 2. Check Wiring. 3. Check Brake Fluid Sensor (Check for continuity when sensor is dipped in fluid).	No SRL/ Chime
1796	Tbatt > 45 °C	During Charge or Drive, the temperature of the battery is >45deg C	1. Due to erratic readings of the sensor. 2. If the actual Battery Temperature is more than 45 deg C.	1. Check Battery Sensor with Multimeter. 2. Allow Battery for cooling.	No SRL
1800	Tchg > 77 °C	During Charge, the Temperature of the Charger more than 77 °C	1. If charger and controller cooling Fan is not working.	1. See instruction given in Serial No. 2 for Fan failure.	No SRL
1808	Tmot > 130 °C	During Drive, Motor Temperature is more than 130 °C.	1. Due to high ambient temperature. 2. Driving habits. 3. If parking brake is pulled during drive. 4. If ventilation not OK. 5. Vehicle problem (related to drive train)	1. Stop Driving & allow for cooling. 2. Instruct customer. 3. Ensure that parking brake is not pulled during drive. 4. Check for ventilation. 5. Check for Vehicle related problem.	No SRL
					SRL=service light

LIST OF ERRORS					
ERR NO	**ERROR**	**ERROR DESCRIPTION**	**ROOT CAUSE**	**ACTION TO BE TAKEN**	**INDICATION**
1824	Tcont > 82 °C	During Drive, Controller Temperature is more than 82 °C.	1. Due to high ambient temperature. 2. If parking brake is pulled during drive. 3. Driving habits. 4. If ventilation not OK.	1. Stop driving & allow for cooling. 2. Ensure that parking brake is not pulled during drive. 3. Instruct customer. 4. Check for ventilation.	No SRL
1856	Tbat< 10 °C	Batt temp reading less than 10 degrees	1. Due to low ambient temperature.	1. During winter and cold weather, keep the car always on charge	Temp light blinking No SRL
1920	Charge over voltage shut down(Ch)	Battery voltage is more than 63.5V	1.This is configurable.	1. This is adjusted by setting the parameters.	No SRL
SRL = service light					

Ccs 18.0

Climate control seats (CCS) in REVA provide the first level of passenger comfort enhancement by allowing the occupant to independently adjust the temperature of the seats by a selector switch. The CCS Uses semiconductor thermoelectric devices (TED's) known as Peltier Junctions. Small, light, reliable and requiring a little power, a CCS can deliver noticeably cool or warm air to the passengers in less than 30 seconds after activation. Unlike conventional heated seats, CCS can also cool the seat. An 'in seat' air circulation system comprising a compact, efficient, low resistant, high capacity blower through a specialised fabric help achieve uniform temperature across the seat area. A 'CCS Electronic controller' is used to select and control the amount of ventilation, heating or cooling. The electronic controller is powered by a separate DCDC Converter of the vehicle's 48V system.

The CCS™ is extremely efficient and typically uses 50-70 watts per seat resulting in less than 3% decrease in range

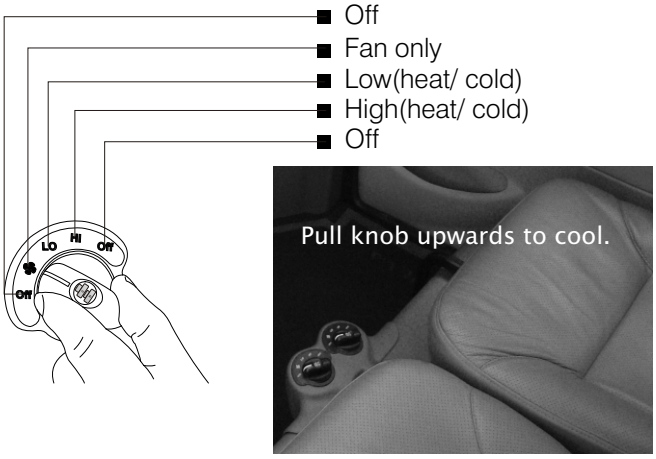
CLIMATIC CONTROL SEATS (CCS)*

The CCS is a unique feature to enhance driver and co-passenger comfort by allowing adjustment of the temperatures of the Front Seats independently.
If your car is fitted with a CCS option, switches as shown will be available between the driver seat and co-passenger seat.

The two switches can be used to independently control the temperatures of the two seats. To select 'cool' mode, pull the switches 'UP'. To select heat mode, keep the switches 'pushed' in.
In both the cool and heat modes, the following levels can be selected based on your individual comfort requirements.

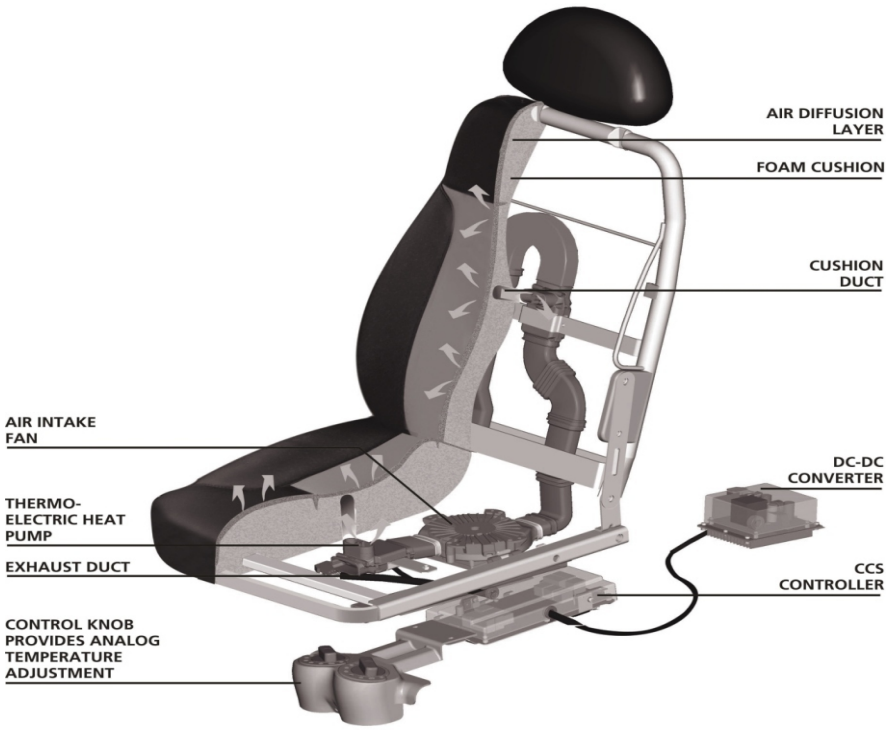
***** optional

Ccs Operation



To extend your driving range use more of CCS and less of Heater, Defroster, Defogger for climate conditioning.

CLIMATE CONTROL SEATS IN REVA

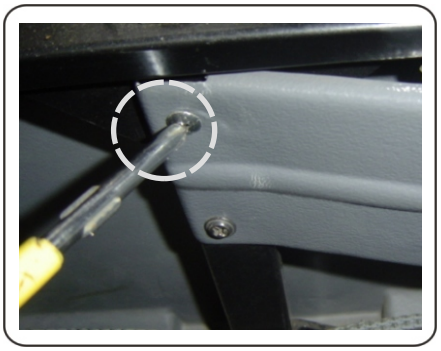


Different parts in ccs are :

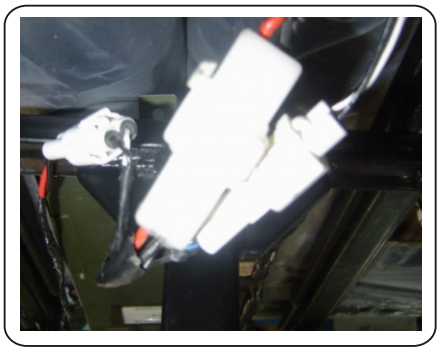
a) ccs controller
b) ccs fan
c) TED - Thermo Electric Device
d) ccs - Dc-Dc Converter
e) Control knob

Ccs controller - Removal from vehicle

- Remove the connector cap by loosening the screws using screw driver which is located behind the front seat

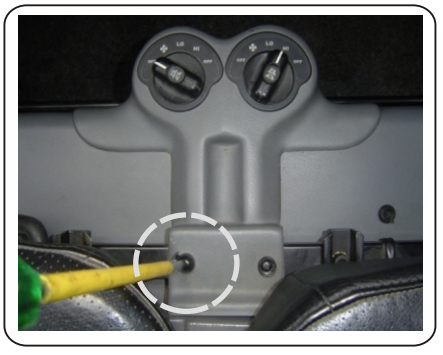


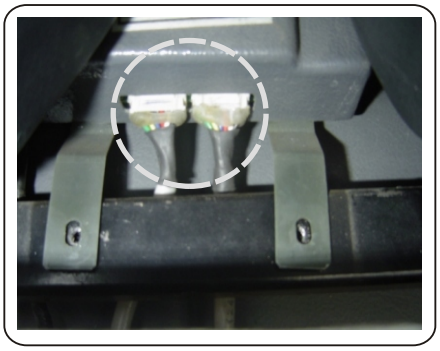
- Disconnect the wire connectors CN170(350series) and CN171 (90 series connector)



- Loosen the front seat mounting bolts using 16mm box spanner and take out the seat assembly and keep it on working table

- Open the cap screw and loosen the mounting screws using screw driver





- Disconnect the control knob connectors(CN178) which is connected at the front side of controller

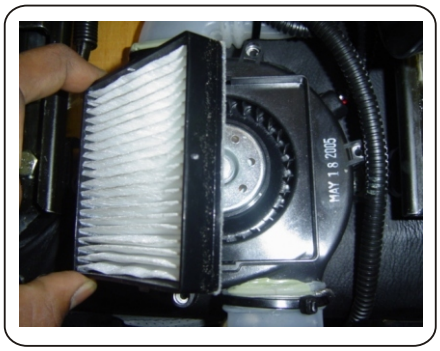
- Takeout the controller form the seat assembly

Ccs controller - Installation to the Vehicle

- Follow reverse procedure of removal from vehicle

Ccs fan - Removal from vehicle

- Disconnect the ccs fan connector CN174
- Loosen three mounting screws using screw driver



NOTE

Ccs fan air filter to be cleaned every 3 months or in every scheduled service using compressed air

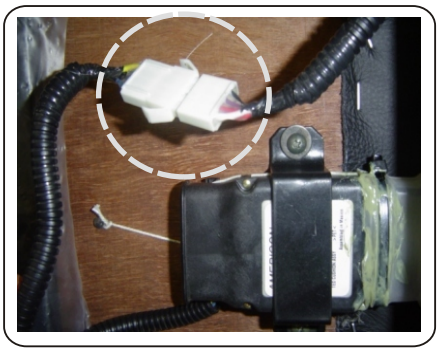
- Remove the duct which is connected by cutting the cable tie

Ccs fan - Installation to the Vehicle

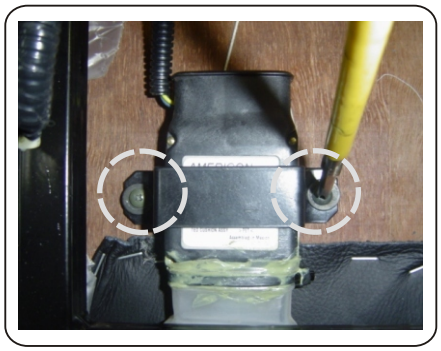
- Follow reverse procedure of removal from vehicle

Ccs TED - Removal from vehicle

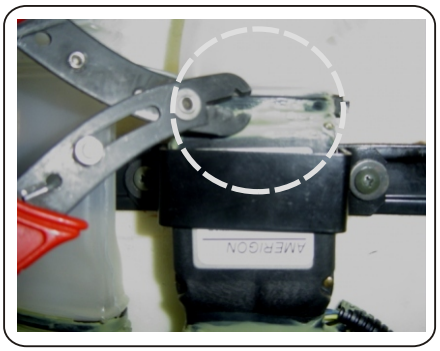
- Disconnect the ccs TED connector CN172



- Loosen two mounting screws which are fastened on to TED bracket Using a screw driver



- Remove the duct which is connected by cutting the cable tie

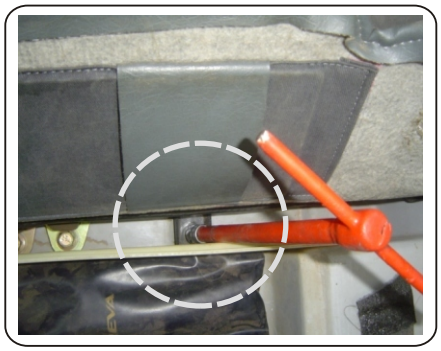


Ccs TED - Installation to the Vehicle

- Follow reverse procedure of removal from vehicle

Ccs DC-DC converter - Removal from vehicle

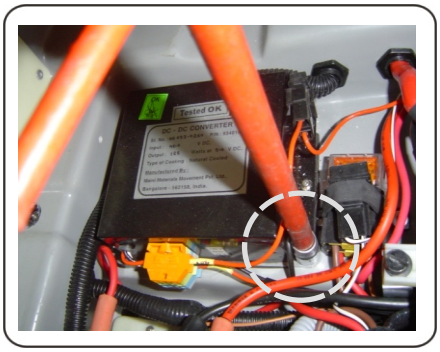
- Remove the rear bottom seat by loosening the mounting bolts using 13mm tubular spanner



- Disconnect 3 wires, 48V input(Red wire), GND (Black wire) and 9V output (Red wire) from wago connector by pressing connector pins with a sharp tool

NOTE

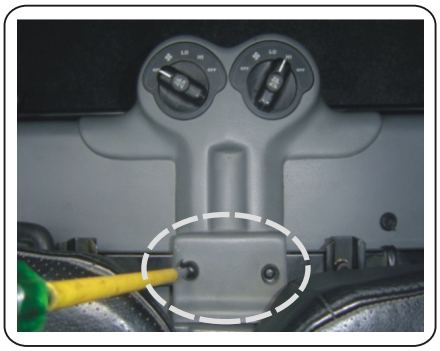
Secure 48V+ wire with insulation tape



- Now, using 7mm tubular remove 4 mounting bolts

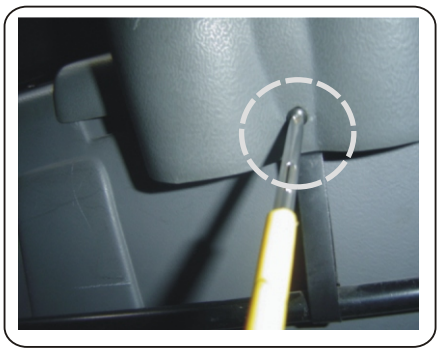
Ccs DC-DC Converter - Installation to the Vehicle

- Follow reverse procedure of removal from vehicle

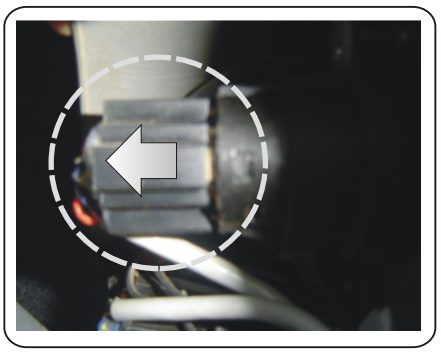


Control knob - Removal from vehicle

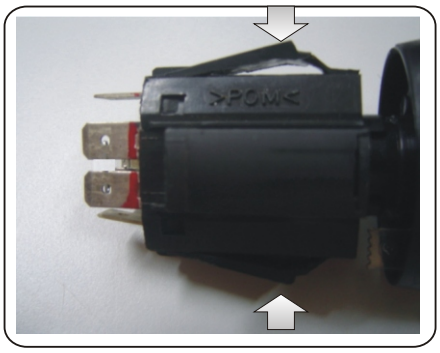
- Remove cap screw and unscrew the screws using screw driver



- Remove screw which is located at the front of control knob using a screw driver



- Disconnect the Delphi connector from control knob



- Press the locking clips of switch from behind and pull out the knob

Ccs - Trouble shooting

1. Control knob not working
2. Ccs fan not working
3. TED not working
4. Ccs controller not working
5. Dc-Dc converter not working

1. Control knob not working

a) If Ccs fan not working in any one mode

- Remove the control knob and check for continuity between
  Pin G+ and Pin 1 - continuity should be there, if not **replace switch**
  Pin G+ and Pin 2 - continuity should be there, if not **replace switch**
  Pin G+ and Pin 3 - continuity should be there, if not **replace switch**
  Pin G+ and Pin 4 - continuity should be there, if not **replace switch**

b) If Ccs Cold mode not working

- Remove the control knob and check for continuity between
  Pin R and Pin H+ - continuity should be there when switch in pulled condition, if not **replace switch**

c) If control knob back illumination not working

- Remove the control knob and check for the illumination bulb
  - If not ok **Replace bulb**
- Disconnect CN176 Ccs back illumination connector and check for unswitched 12V supply in pin 1 (white wire)
  - If not ok **check connector and F5 fuse**

2. Ccs fan not working

a) If Ccs fan not working

- Check VCC(7.5V, 9V, 12V) in fan connector pin Cn174 pin2(Red) and pin4(black) - If not ok **check Fuse F**11, if ok check control knob, **-** if ok **replace ccs controller**
- Check 12V enable signal in Pin3 (purple) - If not Ok **replace ccs controller**
- Check fan TTL (4.5-5.5V) in pin1 and GND - If not ok **replace Fan**

3. TED not working

a) If Ccs TED not working in cold / hot mode

- Check pin 1(Blue) and pin4(Yellow) in CN 172(TED1) and Cn174(TED2) for 4.5V in *Lo* and 9V in *Hi*
  - Polarity changes in Cold and hot mode as selected by Control knob
  - If Voltage available - **replace TED** and if no Voltage
  - **replace controller**

NOTE

Simple method to check which TED has failed

Put Ccs ON in Hi-speed and check for Heat/cool, which side TED has no effect that is failed

4. Ccs controller not working

a) If Ccs fan not working

- Check ccs fan out put from controller(If control knob is ok) - If no **replace controller**

b) If Ccs TED not working

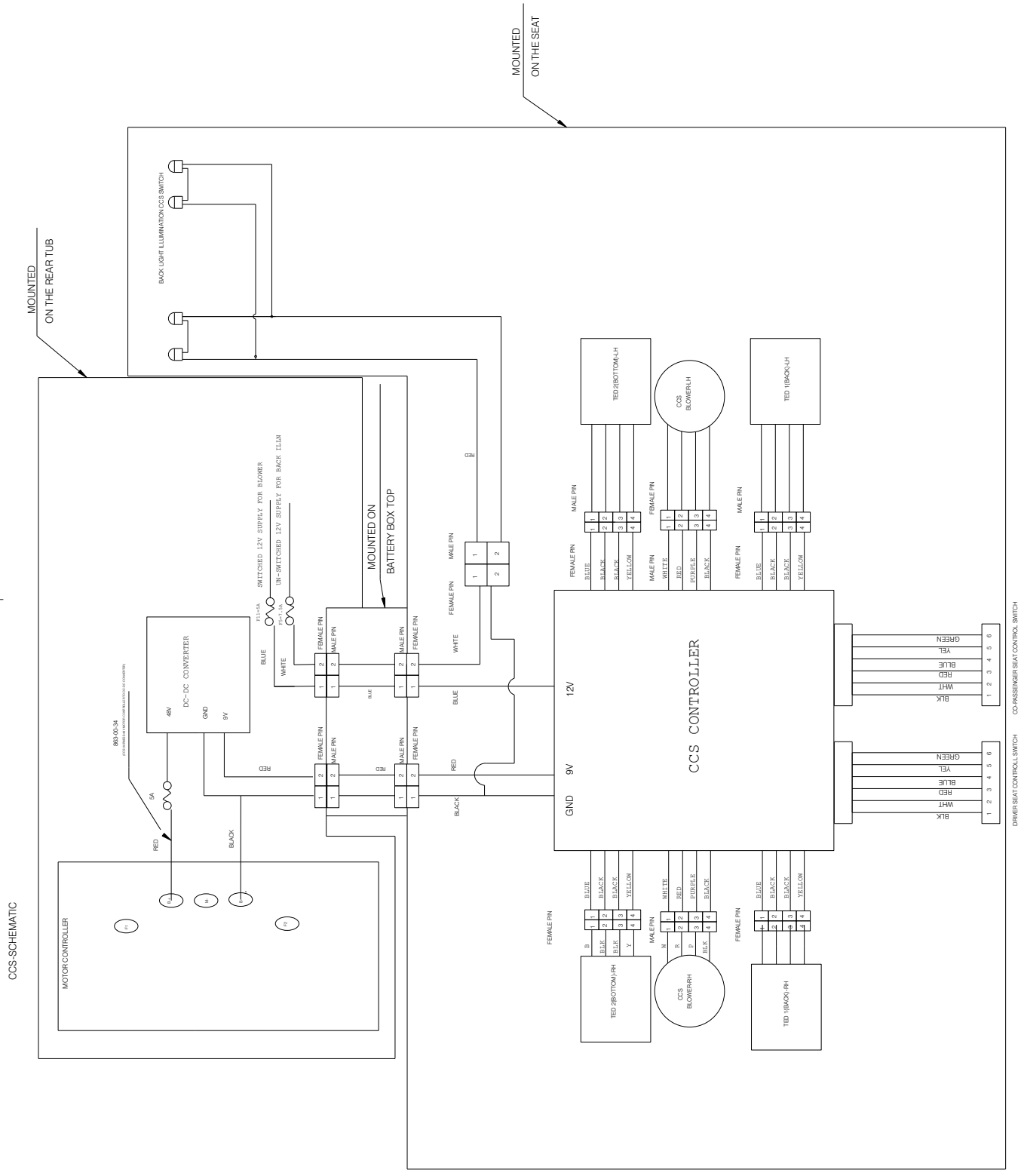
- Check ccs TED out put from controller(If control knob is ok) - If no **replace controller**

5. Dc-Dc converter not working

a) If Ccs Dc-Dc converter not working

- Check ccs input 48V - If no, check 5A fuse inline- If ok, check **battery Pack voltage and rectify**
- Check ccs output 9V - If no **replace Dc Dc converter**

Ccs schematic diagram



CCS-SCHEMATIC

petsoft 19.0

INTRODUCTION

The handheld Portable Electronic Tool (PET) is a small lightweight, self-powered; LCD display/keypad device designed to fit in one hand. It has a serial interface to the EMS and a serial interface to a PC for data storage and retrieval.

PetSoft is highly "intelligent" software (running on PET) will control all the Diagnostic activity of the car based on detailed knowledge of Energy Management System of the car.

PALM USAGES

- It is used to download Summary & Error when Service Light comes.
- At Customer place to put for equalization, set SOC. Check & upload Calibration parameters during EMS replacement. To reset Service Light.
- Analysis of data can be done, using PET.
- PET is extensively used when there is no PC access.
- PET is used in drive, because of its lightweight, self-powered, and easy to fit in one hand, it can be used in drive to collect drive data.

FEATURES

- PetSoft allows the dealer/repair shop to access Error Log and Vehicle history, logs data and prompts system tests.
- Through a serial connection to the EMS, PetSoft provides a "window" into the Battery System, Charger, Motor & Controller.
- PetSoft can be used as an on-board data logging system to record real time events while operating the vehicle to further aid problem diagnosis.
- Runs on internal power (AAA Batteries), and thereby allows the viewing/ manipulation of data while disconnected.

COMMUNICATION

- Upon activating the program (PetSoft), a "Welcome Screen" will pop up for 10 seconds, with "**RECC REVA PORTABLE ELECTRONIC TOOL…**" and a pixel image of REVA Car.
- If at anytime communication to the vehicle is lost or can not be started, an information screen will be displayed stating "Communication to the Vehicle is lost. Press Reset and try again or Press Enter to work offline".
- While downloading data, if communication error occurs, do resetting of EMS i.e. if car is in drive, put car for charge or if car is in charge, then put car for drive.

NOTE

Replace one battery at a time and replace within 30 seconds. Delay would cause the software getting erased.

It is advisable to keep a back up of the software

NAVIGATION

- For Navigation, the keys at the bottom of the device will be used i.e., "UP" and "DOWN" and the two keys left of them as "Back" and "Enter".

KEY	DESCRIPTION
ENTER KEY	Accept the selected value in vehicle information screen, add setup screen and go to offline mode in case of communication failure
BACK Key	Move backward in the menu structure, this is also the escape key.
UP KEY	Increment data or scroll up the menu list.
DOWN KEY	Decrement or scroll down the menu list.
LOG KEY	Used in Monitor System to log data at the rate of 2 sec

HELP FILES

- A Help File is available for every menu and sub-menu. It is quickly accessed by pressing the "!" icon at the top right corner of each menu/ sub-menu title block. Pressing the Back or Enter key will return the user back to the actual menu. The Up and Down buttons scroll the help file if it is longer than one screen. An Arrow will appear at the top or bottom if more text can be found in the indicated direction.

HOTSYNC PROCESS

HotSync is the process of automatically synchronizing data between the Palm and Palm Desktop. Changes you make on the Palm or Palm Desktop will be reflected on both platforms after a HotSync. After taking Summary Data, Error Data or any other Data in Palm, HotSync must be done to transfer Data from Palm to PC.

- Connect Palm's cable into the communications port you selected during software installation.
- Launch Palm Desktop.
- From HotSync menu, choose Setup. When Setup Dialog appears, click Local tab to display settings.
- Check the selected Serial Port and make sure it corresponds to the port number that is connected to the Palm.
- Choose a Speed. The default is As Fast As Possible, which will allow to Palm & Palm Desktop to find and use the fastest speed.
- Click OK to close Setup Dialog and activate your settings.

TO USE HOTSYNC FOR THE FIRST TIME

- If HotSync Manager is not running, launch it.
- Choose Local from HotSync Manager. Selecting Local tells the Palm Desktop to use cradle for synchronization.
- Press HotSync Button on the front of the Palm cradle
- After HotSync process is done, a directory will be created under Palm (Where Palm Desktop software is installed) with a user name. For e.g. if Palm user id is Service1 then all files are stored under C\Palm\Ser1\Backup\files
- Summary Data is stored in SummaryDB.pdb file
- Error Data is stored in ErrorDB.pdb file
- Monitor Data (includes Charge, Drive & Equalize Data) stored in MonitorDataDB.pdb
- Vehicle Information Data is stored in C:\Palm\Ser1\memopad\memopad.bak or memopad.dat files.

NOTE

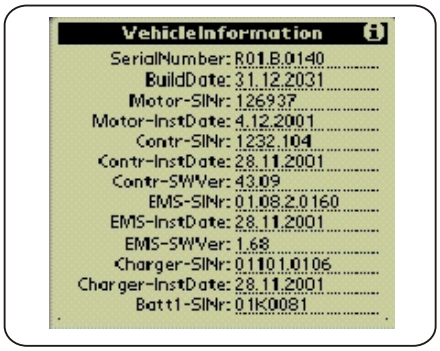
During the course of the first HotSync, you will be asked for the user name that will correspond to the Palm.

Every Palm should have a unique name.

Never try to synchronize more than one Palm to the same user name.

DATA DOWNLOADING

To analyze the data (i.e. Charge data, Drive data, Summary, Error and Vehicle Information data), it can be downloaded through Terminal software in PC or using PetSoft software in Palm device.



VEHICLE INFORMATION DATA

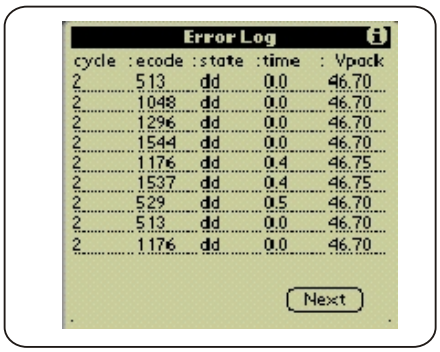
The Vehicle Information is used to display data on the vehicle manufacture and subsystem revision level. This information is also stored in the memopad along with Vehicle Id, Date & Time.

- Connect Palm Cable to the EMS diagnostic port.
- Select the ***PetSoft*** icon from the main screen of the Palm.
- Upon activating the PetSoft, a Welcome screen is pop up for about 10 seconds, with "RECC REVA PORTABLE ELECTRONIC TOOL…" and a pixel image of REVA CAR.
- Main Menu screen is displayed, after the Welcome screen pops up.
- Select Vehicle Information menu from the list of menus in Main Menu screen.
- After selecting Vehicle Information menu, it takes some time (2 to 3 secs) to display the data. Once the data is downloaded, the screen looks as shown in figure (left).

ERROR DATA

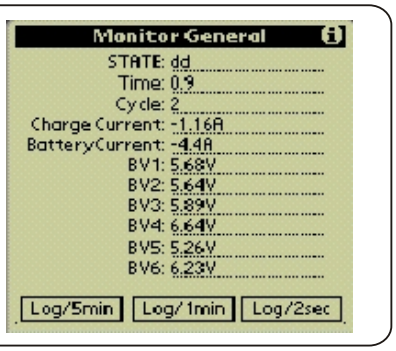
To download Error Log Data in Palm device, follow the instructions in the order given below.

- Select Service Information from the list of menus in the Main menu. The Service Information sub-menu is used to display the present error on the system and provide an access to the error.
- After selecting Service Information menu from Main menu, an information "Please Wait! Downloading…" is displayed at the bottom in the Service Information screen.
- The time taken to download the Error data is around 2 to 3 minutes.
- If there is no present fault, then Present Error line will print "None" instead of error Code ##.
- The number of Errors logged in the file is listed. The error log data is also stored in a database - ErrorDB.pdb.
- Selecting the Present Error line will bring up a brief description of the error.
- Selecting the Error Log will bring up the complete history since the last time the error log has been cleared.
- After selecting Error Log item, the data will be displayed on the screen in the tabular column.



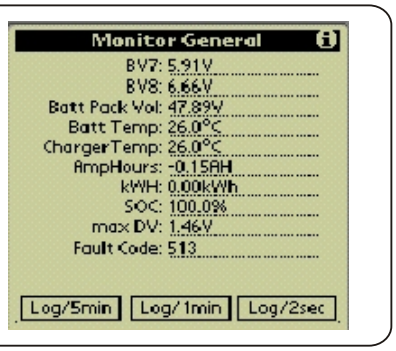
CHARGE DATA

- Select Monitor System from the list of menus in the Main menu. The Monitor System allows the user to view the states and values. The monitored data will be sent from the EMS to the PET at an update rate of once every 2 secs. The Monitor System allows the user to log the data with different log rates.
- A header consisting of date, time and vehicle identification will automatically be inserted in the log file each time the log option is selected. The log file is MonitorDataDB.pdb.



DRIVE DATA

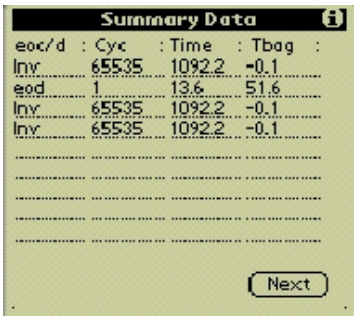
- Switch OFF the power supply, disconnect the charging cable from external power source (15 Amps, 220-240V).
- Check and ensure that the Control Knob is in Neutral [N] mode.
- Connect Palm Cable to the EMS diagnostic port.
- Select the PetSoft icon from the main screen of the Palm.
- Main Menu screen is displayed, after the Welcome screen is pop up.
- Insert the startup key and turn ON. Check to see that all lights on the Instrument Cluster lights up. Press log/2 sec button to log data.
- A header consisting of date, time and vehicle identification will automatically be inserted in the log file each time the log option is selected. The log file is MonitorDataDB.pdb.

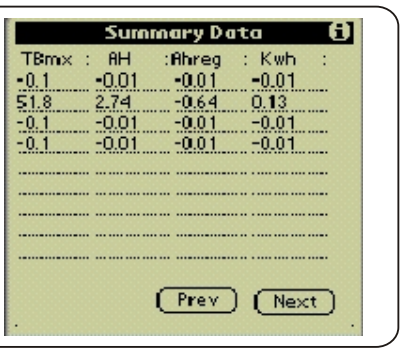


SUMMARY DATA

It summarizes the necessary parameters, which are important in the Charge & Drive as eoc and eod respectively.
("eoc" – end of charge "eod "– end of drive.)

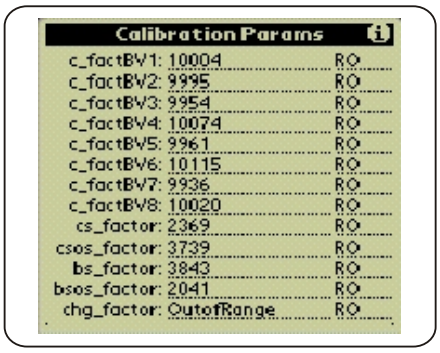
- Connect Palm Cable to the EMS diagnostic port.
- Select the ***PetSoft*** icon from the main screen of the Palm.
- Upon activating the PetSoft, a Welcome screen is pop up for about 10 seconds, with "RECC REVA PORTABLE ELECTRONIC TOOL…" and a pixel image of REVA CAR.
- Main Menu screen is displayed, after the Welcome screen pops up.
- Select DownLoad Data menu from the list of menus in the Main menu.
- Click DownLoad SummaryData button to download Summary from DownLoad Data menu. A message "Please Wait! Downloading…" is displayed at the bottom of the DownLoad Data menu.
- After selecting DownLoad SummaryData item, the data will be downloaded and displayed on the screen in the tabular column. The downloading time depends upon the number of cycles in EMS EEPROM. For e.g. for 100 cycles (eoc/eod) it takes around 3 to 4 minutes.
- The summary data is stored in the database SummaryDB.pdb. A header Vehicle id Date and Time is added before storing the log data.
- To run a macro on summary data, which is stored in the Palm, then select the path C:\Palm\Palm user name (e.g. -EE4)\Backup\SummaryDB.pdb

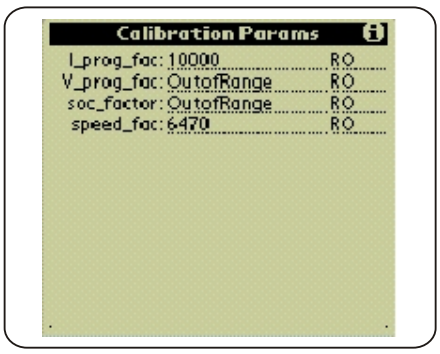




NOTE

The Palm or PET cannot download the data if the number of cycles ie, eoc or eod's are more than 200 cycles. In such cases Terminal software has to be used to download the summary data.





CALIBRATION DATA

The Setup System allows the PET user to change the settings and Calibration parameters of the vehicle electronic systems, i.e the EMS.

If an item is Read-Write accessible, selecting the item pops opens a change setting screen and allows adjustment. If the access rights are read-only, then selection of the item does nothing, but a short is sounded to indicate access denied. A RO or RW is displayed after the parameter setting to inform the user of his or her access rights.

(For petsoft login Refer 18.3)

- Select Setup System from the list of menus in the Main menu. The Setup System allows the user to view, change the calibration parameters of the EMS.
- A RO or RW is displayed after the parameter setting informs the user of his or her access rights.
- On selecting a RW access rights item, the Change Parameter screen is displayed. Press ENTER key to accept the changes made by the user.

SERVICE INFORMATION MENU

- Select **Service Information** from the list of menus in the Main menu.
- After selecting Service Information menu from Main menu, an information "Please Wait! Downloading…" is displayed at the bottom in the Service Information screen.
- If communication to the vehicle is lost or cannot be started, an Information screen is displayed with the message "Communication to the Vehicle is lost. Press Reset and try again or press Enter to work offline". Palm will reset, after pressing the Reset button.
- Click Menu Button, after downloading the Service Information.

The Service Information Screen's pull down menu consists of the following:

START BATTERY EQUALIZATION

- Make sure parking brake is engaged.
- Ensure control knob is in Neutral [N] mode.
- Turn startup key to OFF position and remove it from key slot.
- After downloading the Service Information, click Menu button.
- After selecting **Start Battery Equalization**, the car will be in equalizing mode. It takes 10 hours to complete equalization. If you want to verify that it is in equalize mode, select Monitor System from the Main Menu. In Monitor System screen check if Iprog is 5A and "ce" is displayed in phase column.

RESET SERVICE LIGHT *(This menu is to remove servce light)*

- Selecting this menu, will send command $RSL or $rsl command to the EMS.

SET SOC

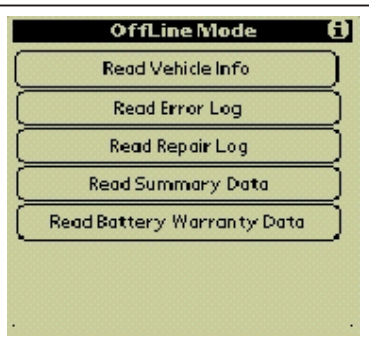
- Selecting this menu item will take the user to another screen in which he/she has to enter SOC value between 0 and 999. After entering the value, selecting "Enter SOC" button will send $SOC followed by the SOC value to the EMS. If SOC value is out of range, then selecting "Enter SOC" button will display an alert message to the user.
  (0 to 999 is equal to 0% to 99.9% for eg 453 is equal to 45.3%)

PETSOFT LOGIN

The **PET setup** sub-menu can be used to set different access levels. The different access levels are - Engineer, Factory, Dealer and Technician.

- Select **PET Setup** from the list of menus in the Main menu. The PET Setup sub-menu is used to set different access levels.
- If he/she wants to change the Password, then click **Change Password** Button in the PET Setup Dialog Box.
- To change the password, old password must be known; otherwise password cannot be changed.

OFFLINE MODE

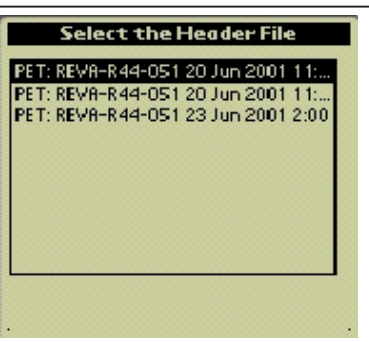


Offline Mode is used to view the following data stored in the PetSoft databases:

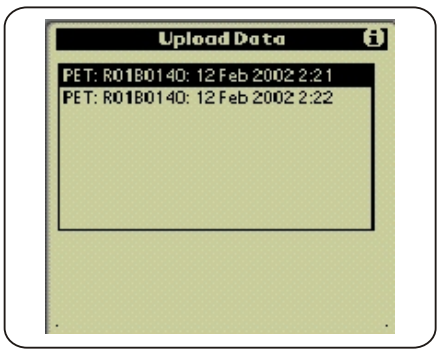
VEHICLE INFORMATION DATA
The Vehicle Information Data is stored in memopad.

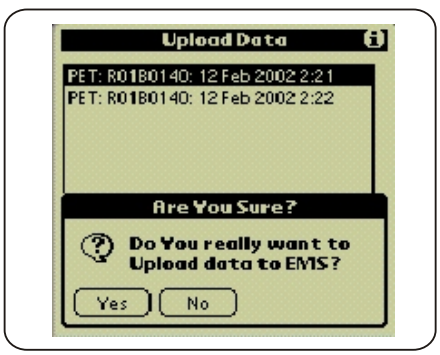
ERROR LOG
The Error Data is stored in ErrorDB.pdb file.

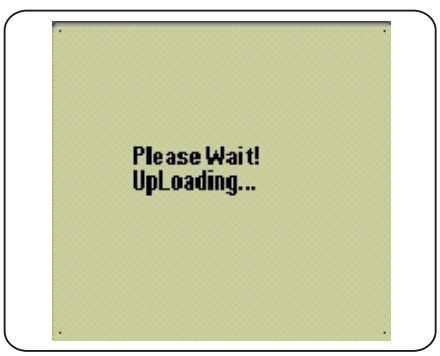
SUMMARY DATA
The Summary Data is stored in SummaryDB.pdb file.



- Connect Palm Cable to the EMS diagnostic port.
- Select the **PetSoft** icon from the main screen of the Palm.
- Upon activating the PetSoft, a Welcome screen is pop up for about 10 seconds, with “RECC REVA PORTABLE ELECTRONIC TOOL…” and a pixel image of REVA CAR.
- Main Menu screen is displayed, after the Welcome screen is pop up.
- Select any one of the following menus, which includes Vehicle Information, Service Information or Download Data.
- Press Enter key. The Offline Mode Dialog Box is displayed.
- The **Offline Mode** consists of 5 buttons mentioned above. Selecting any of them will take the user to another screen, where a list of headers (Vehicle ID, Date & Time) are displayed. Selecting any of them will display the data for that particular Vehicle, logged on date & time displayed in the header.







UPLOAD DATA

The Upload System Data Sub-menu is used to upload calibration parameters, Vehicle Information Data to the memory.

The available files are provided in a list, which can be scrolled through (these files are loaded from the PC to the PET previously or downloaded previously from other EMS).

- Select **Upload Data** from the list of menus in the Main menu. The Upload Data allows the user to upload data to the EMS's memory.
- After selecting Upload Data menu, an Upload screen is displayed which consists of Upload Calibration Data, Upload VehicleInfo, and Upload ErrorLogData…. Etc.
- After selecting any of the following menus, the Upload Data Screen is displayed. A list of available files is provided in a list, which can be scrolled through.
- Selecting any file for uploading from Upload Data Dialog Box will pop up an information box asking for second confirmation.
- After pressing Yes Button, an information "Please Wait! Uploading" is displayed on the screen.
- After uploading is confirmed for the second time, the results "Upload Successful" or "Upload Failed" are displayed on the screen.
- Each File to be uploaded is identifiable by Vehicle ID, Date & Time.

DATA ANALYSIS USING PALM

MONITOR SYSTEM

- In Monitor System, if temperature of the Battery or Charger is 30°C, indicates that there is a problem with the Battery or Charger Sensor.
- During Charge, in Monitor System, if fan is showing 0 counts & Vprog is 54.50V, indicates fan related failure.
- If any one of the Individual Battery Voltages (BV1 to BV8) is showing Out of Range, indicates those Individual Battery Voltages is less than 3.5 V in drive or more than 8.7 V in charge or the corroded battery fuse.
- If user selects the Fault code in Monitor General, a brief description of the error code is displayed.
- During charging, check Iprog & Battery Current for Shunt Mismatch (Offset) problem. Check if (Iprog – Ibatt) is less than 10A, indicates Shunt Mismatch.
- If Charger is latched, then Battery Current & Charger Current will be zero, but Iprog will be 40A.
- During Drive, the ampere-hours will be around 14 to 16 for 10% SOC decrease (for around 8 Kms). User can verify total ampere-hour & distance covered based on SOC discharge.
- During Drive, if Controller parameters (includes Current parameters, Mot Temp, Controller Temp, Field Voltage, Arm Cur. Etc.) Is 0 or erroneous readings, then there is a problem with controller communication.
- Monitor System has different set of pull down menu, from which we can be able to see the behavior of different parameters related to Battery, Charger, and Motor. Current/ speed can be seen in Monitor VI mode.

SERVICE INFORMATION

- After downloading error data, in Service Information screen, selecting the Present Error Line will bring up a brief description of the Error. From this, user comes to know the present fault in the vehicle.
- Selecting the Error Log will bring up the complete history, since the last time the log has been cleared. Selecting error code in Error Log will bring up a brief description of the Error. Based on these errors, we can go to Monitor System, start-analyzing parameters and corrective action can be taken. See Error List Table for root causes and action to be taken based on different types of errors. *(Refer 17.10)*
- Error Data also consists of Pack voltage, Battery Current, Battery Temperature, Charger Temperature, Controller Temperature & Motor Temperature at which particular error has arise. From this we can see the actual value of the parameters, when error occurs.
  e.g. If Vpack<38V error comes, we can see the corresponding Pack Voltage in Error Data.
- If Battery Pack under voltage appears – user can see corresponding Pack Voltage is less than 38V.
- If Battery Sensor Failure or Charger Sensor Failure appears – user can see the corresponding Battery & Charger temperature is 30 °C.
- If errors related to temperature appears – user can see the corresponding Battery, Charger, Controller & Motor Temperature.

SUMMARY DATA

After downloading Summary Data, we can have a look at the parameters in respective eoc's & eod's, if any parameter is Out of Range in respective Charge or Discharge cycles.

- In eod's, if Motor Temperature or Controller Temperature is showing 0, indicates there is a problem in Controller Communication.
- If Motor Temperature > 135 °C, Controller Temperature > 90 °C, Battery Temperature > 45 °C or Charger Temperature > 78 °C, indicates that temperature's are showing out of range.
- Check Pack Voltage in the range 65V < Vpack < 45V in eoc & 57V < Vpack < 38V in eod.
- Check Battery Current in the range Abs (Ibatt) > 400A in eod and Ibatt > 0 or Ibatt < -4.2A in eoc.
- Check If TBmx & Tch is 30 °C, then there is problem with the sensors.
- Check, if DV_max > 1V in drive and in charge.
- Check, if DV_av is greater than 0.7V in charge and drive.

- Ahr_Regen is not displayed in the summary data. To calculate Ahr_Regen use formula Total Ahr = Ahr_Regen + Ahr_Drive. Calculate Ahr_Regen, since we know Total Ahr & Ahr_Drive from Summary Data. Check whether Ahr_Regen is more than zero.

CALIBRATION PARAMETERS

- In EMS, if there is a problem related to individual Battery Voltages, deviations in Battery Voltages, Charger shunt, Battery shunt problem, Iprog and Over Voltage then check calibration parameters in the Palm.
- Compare the downloaded calibration parameters & actual calibration parameters of the Vehicle database. Contact RECC for the same.
- If the parameters are not matching, then make changes & upload the calibration parameters to the EMS through palm.
- Verify calibration parameters.

data analysis 20.0

INTRODUCTION

After downloading data in PET, the downloaded data has to be analysed.

- For analysing the data, if data is collected in PET then HotSync should be done to transfer data from PET to PC.
- Once the data is available for analysing, run Macros on data to plot different type of plots for Charge, Drive and Equalize.
- Run Macros on Summary Data to calculate different parameters, to print out of Range values from Summary Data.
- Similarly run Macros on Error Data to give Error description, to print out of Range values, to add root causes & Action to be taken for each error.

Hardware & Software Requirements:

- Personal P III Computer with Microsoft Excel.
- Reva Automation Software.

NOTE

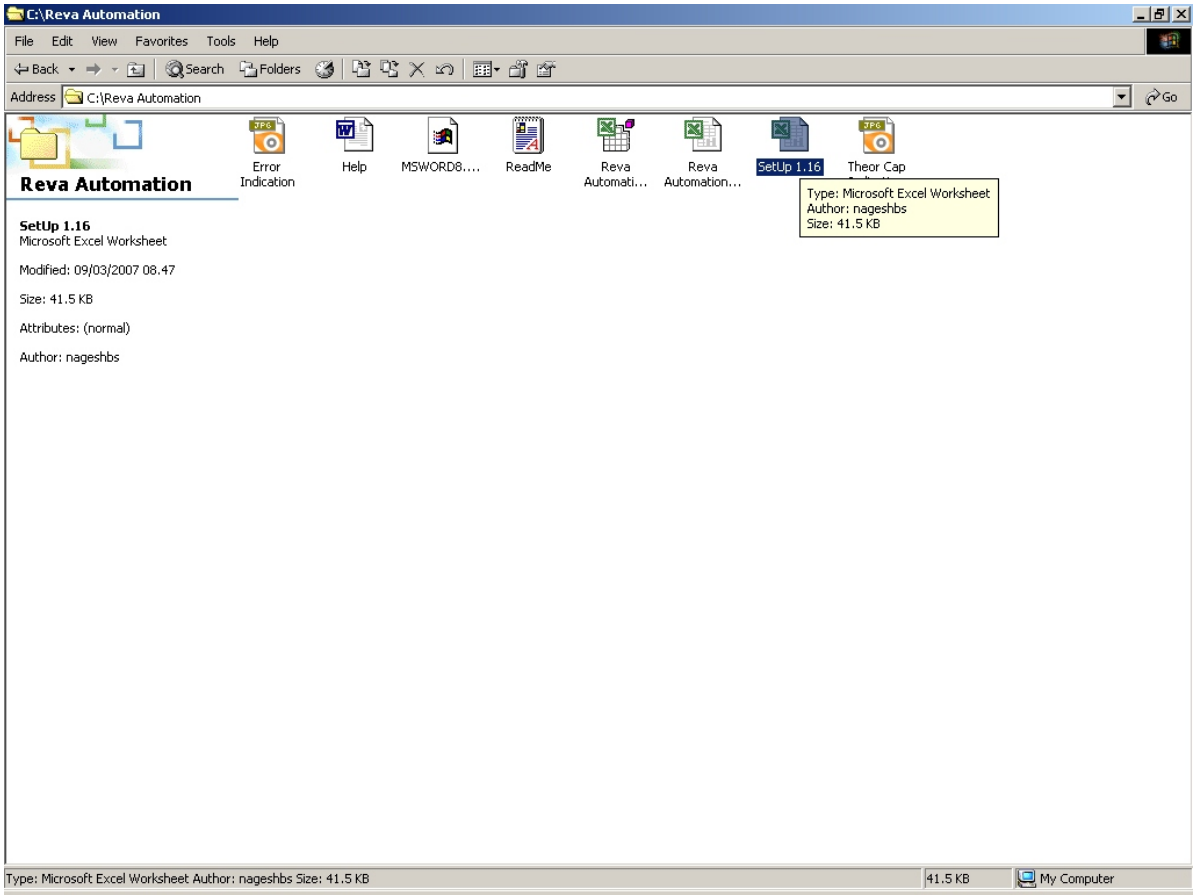
It is not possible to collect entire Charge or Equalize data in PET, because of less memory.

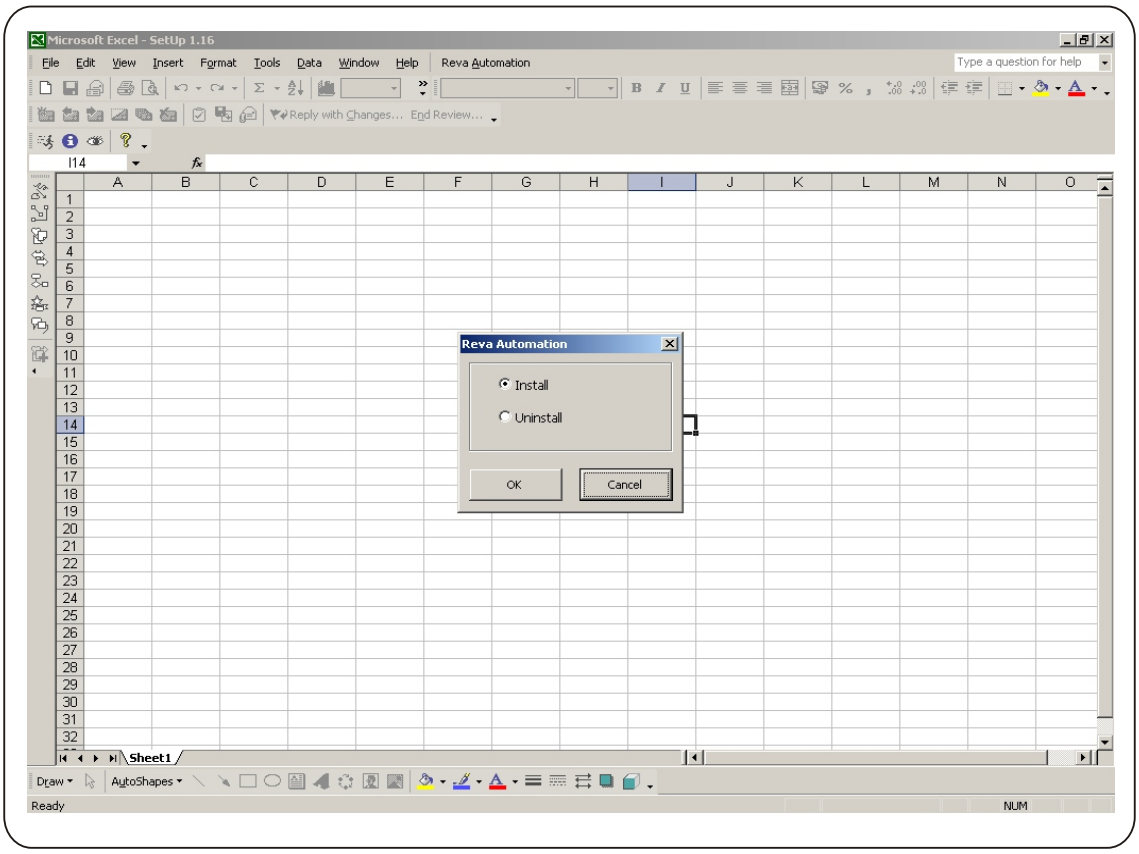
Collect Charge or Equalize Data in PC using Terminal Software.

Shaded - Permanent SRL
Regular - Auto SRL
Italic - No SRL/Chime
Bold - No SRL/No Chime

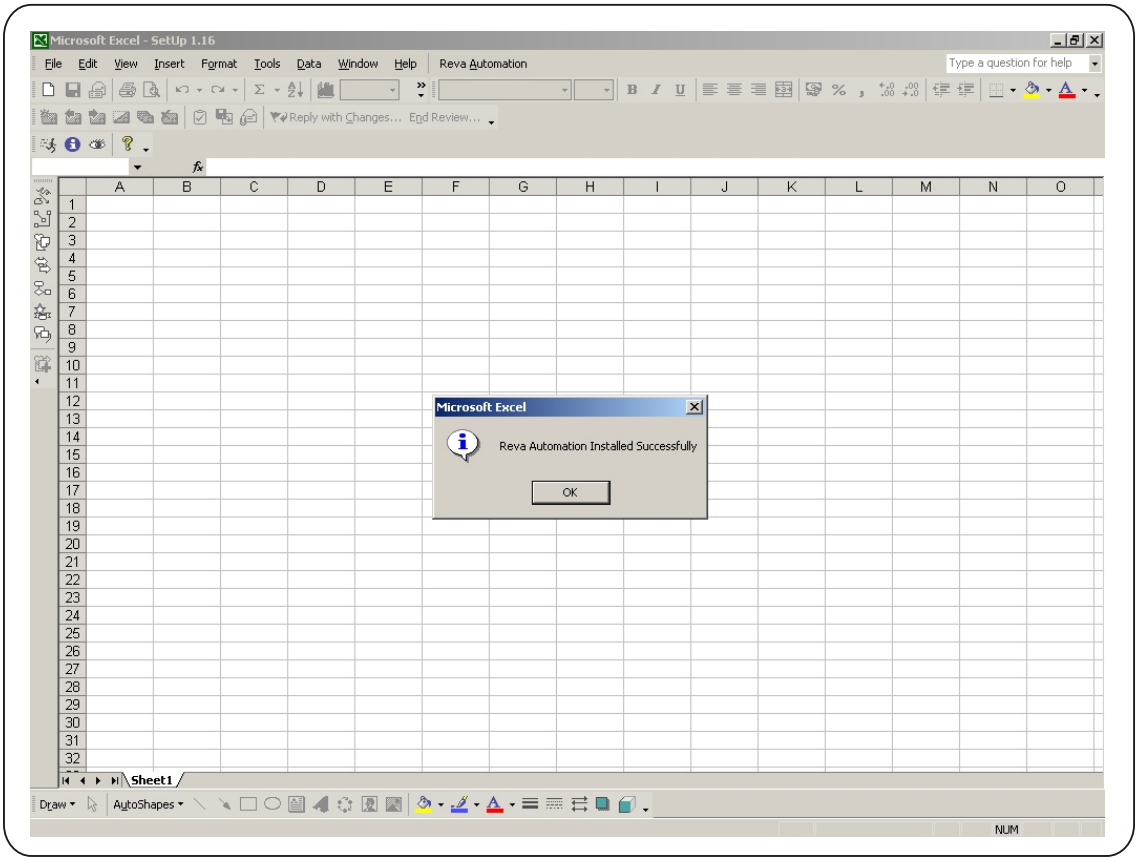
INSTALLATION OF REVA AUTOMATION

- Copy the automation folder and paste in "C" drive folder.
- Open the folder and click on the SET UP.
- As dialogue box opens and displays install / uninstall button, click on install button.

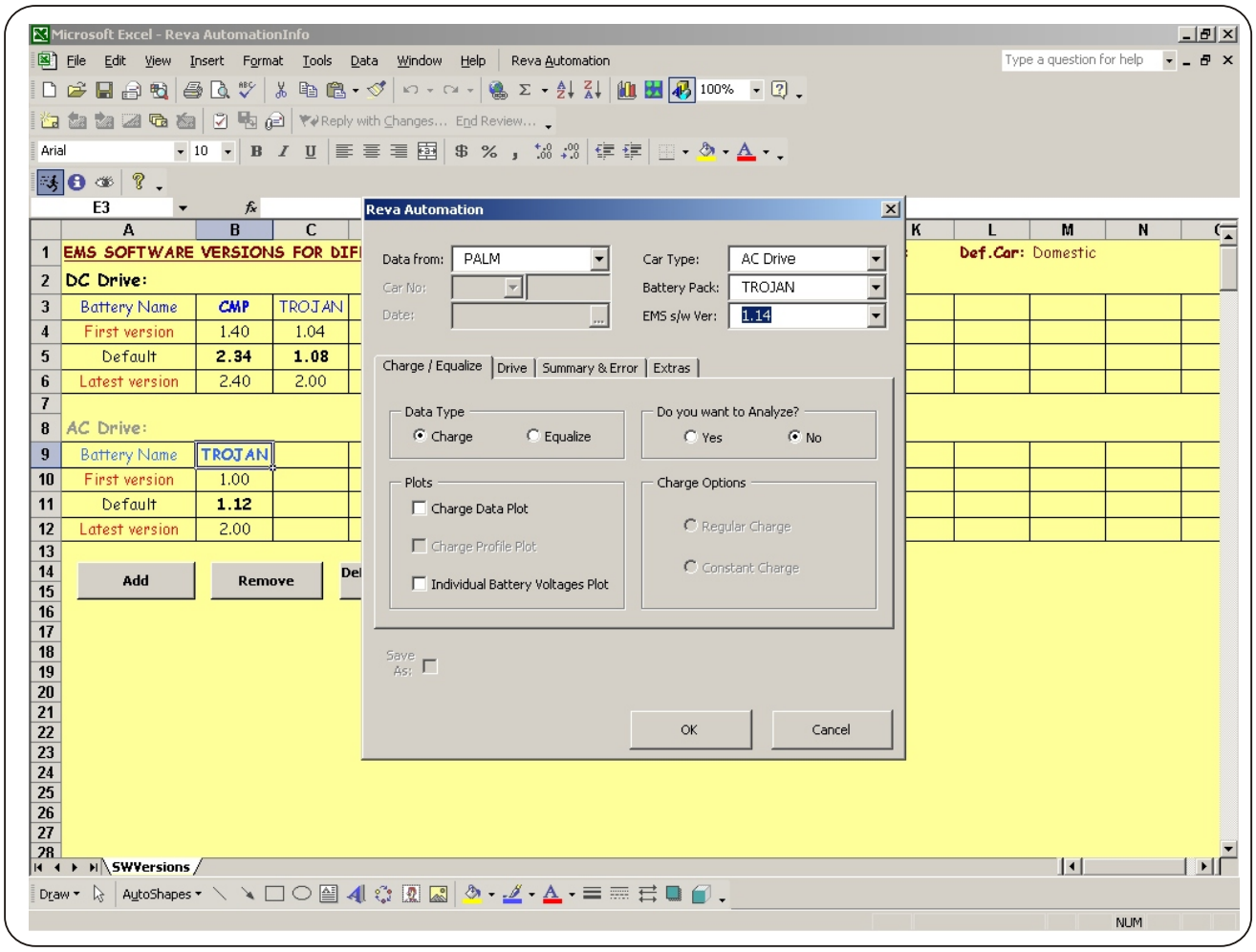




Once the Automation is installed, it displays automation installed successfully.



- Click on Reva Automation and click on run to analyse data by Macro



•After clicking *Reva Automation*, the following *Macros Main Form* dialog box is displayed.
•This form contains options to select the different macros like Charge/Equalise, Drive, Summary& Error, Extra for Battery Warranty Verification Data and Vehicle Information Data to be run on different kinds of data and an option to cancel.

Charge Data/Equalise data

If you want to plot different types plot based on charge */equalise*, select *Charge Data/equalise data* button from *Macros Main Form.*

Drive Data

To run a macro on the drive data, select *Drive Data* button from *Macros Main Form*

Vehicle Information Data

To run a macro on the Vehicle Information data for different vehicles stored in palm, then select *Extra* button from *Macros Main Form.*

Summary & Error Data

To run a macro on Summary data, Error data, updating master files for Summary & Error Data. Select *Summary & Error Data* button from *Macros Main Form.*

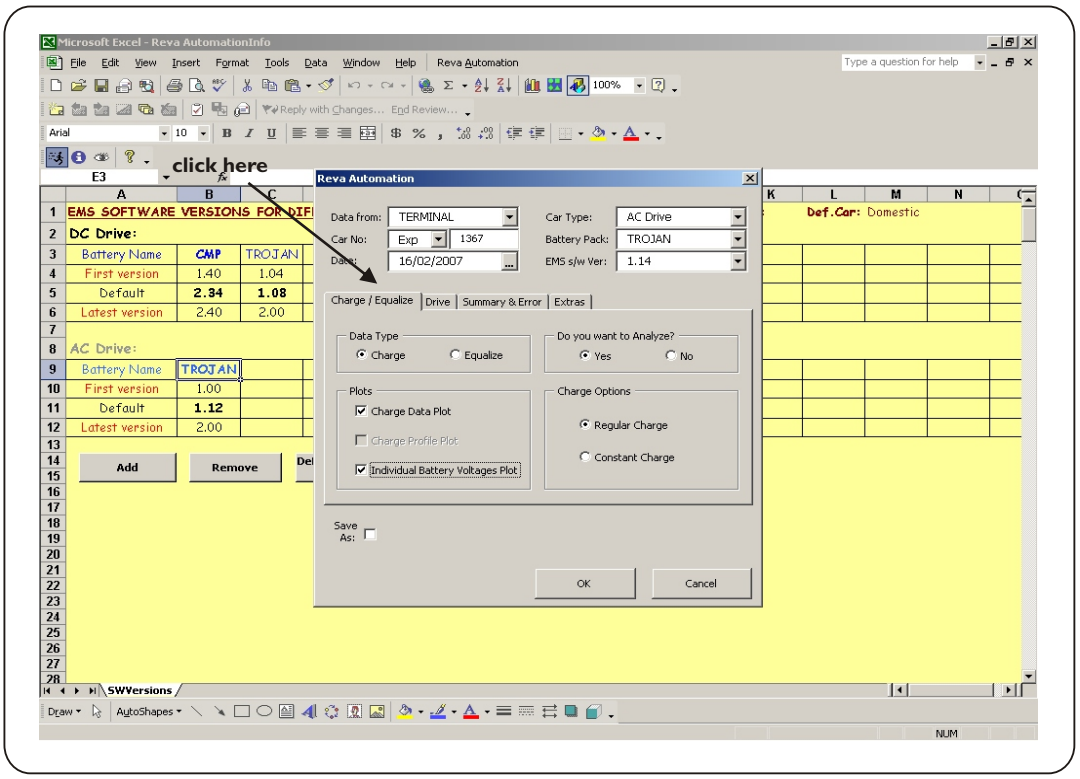
Quit From Program

To quit from running the macros, select *cancel From Program* from *Macros Main Form.*

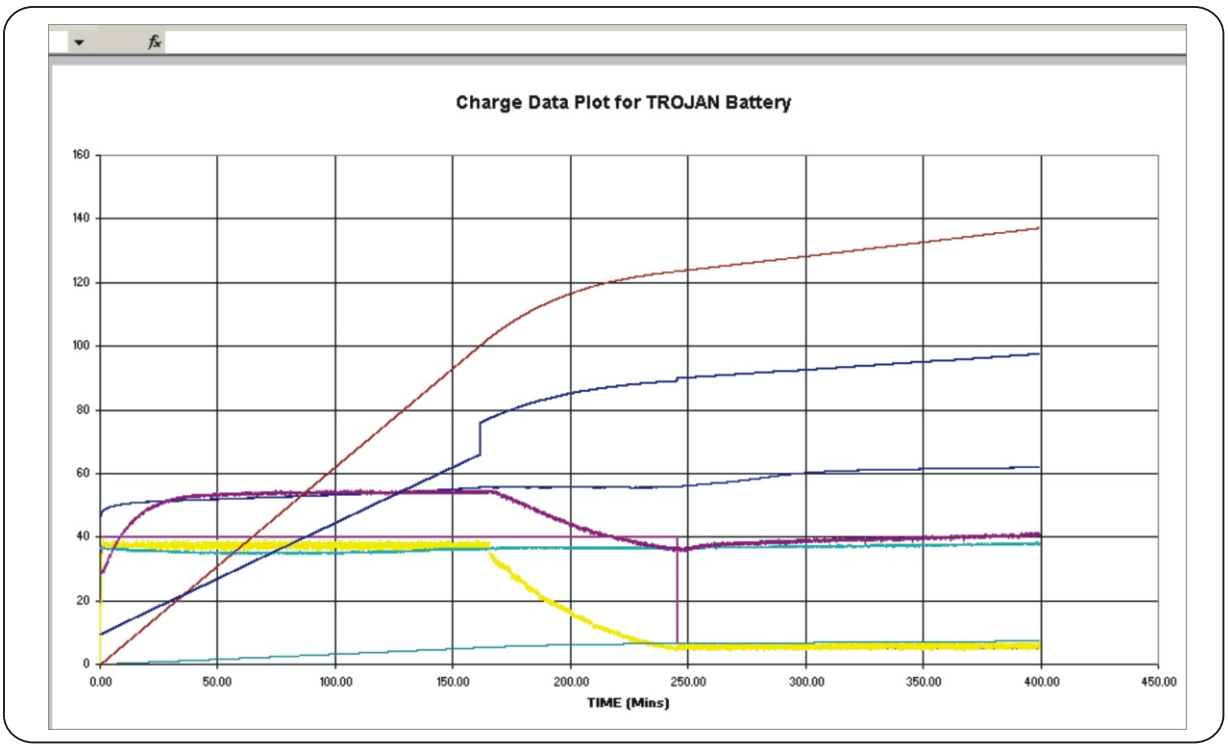
- Select *Main_Entry* macro and press *OK* button.

TO RUN CHARGE/EQUALISE DATA

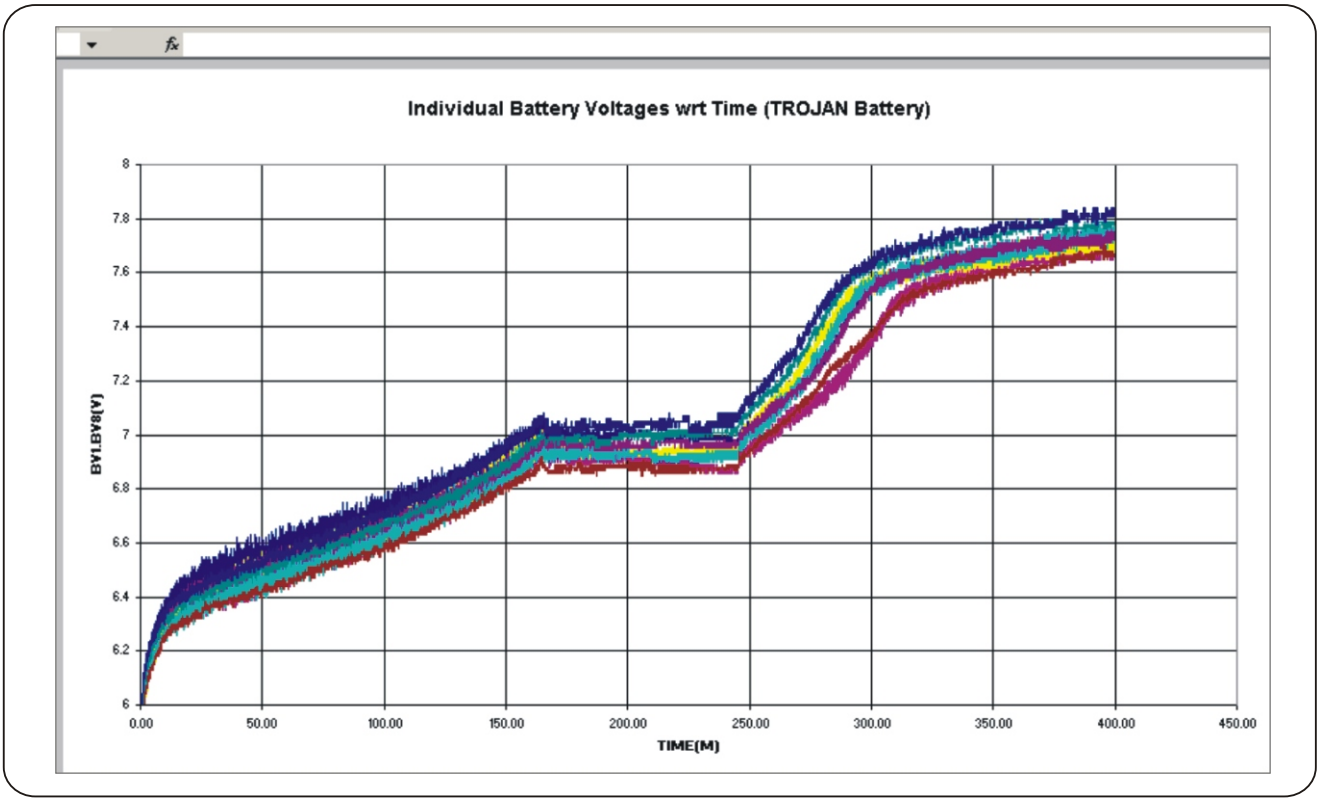
- On the Menu bar, Select charge/equalise data and click on plots, analysis, charge or equalise and click OK .
- Select the source file either text file(.txt) or palm file(C Drive/program files/palm/back up/monitor data db.pdb file).Then select the car VIN no for running of macros.



- After the macro is run on charge data, the **Charge Data Plot** looks like as shown below.



- In charge data plot, Time versus Battery current, Programmable Current (Iprog), Battery Temp, Charger Temp, State of Charge, Ampere-Hour, Kilowatt-hour, and Pack voltage is plotted.
- In Charge Profile plot, Pack Voltage versus charger current, Battery Current, Iprog is plotted.



- The individual battery voltages with respect to time is as shown above.

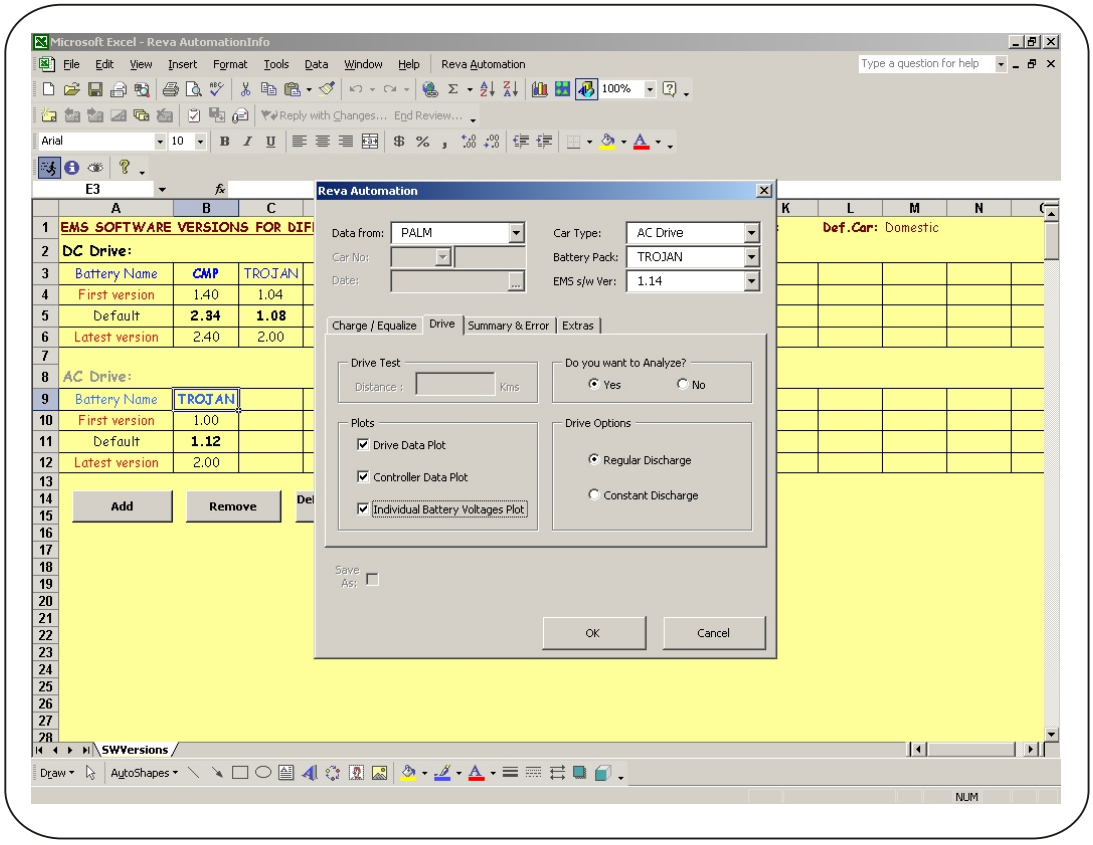
CHARGE DATA

- Once the Charge data is run and the analysis is done the file is saved in corresponding car files.
- Also the files can be updated in Master files.

EMS DRIVE DATA

- Select *Drive Data* Button from *Macros Main Form*.

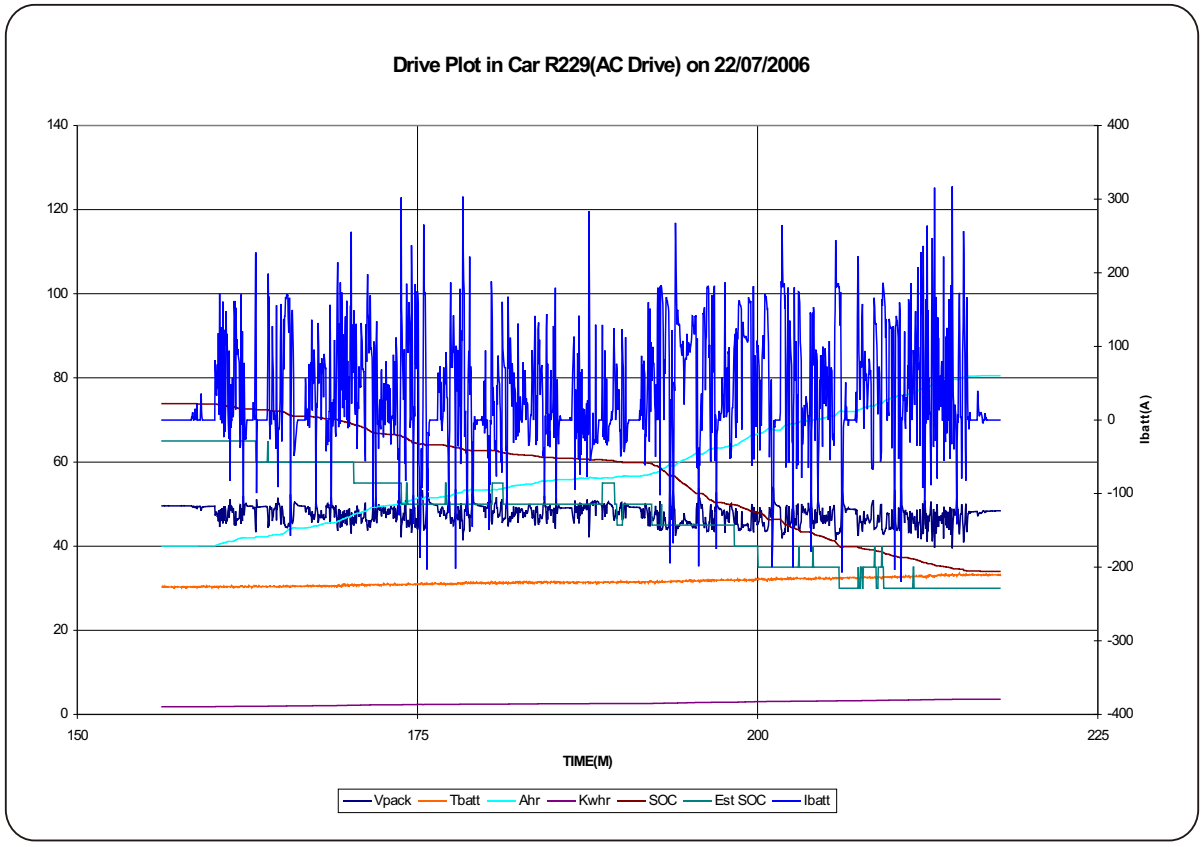
- The Drive form consists of Car Number, Date when drive was done, total Distance, type of drive, Battery type, software Version options to select the plots to be plotted like Drive Plot, Controller Plot, Individual Battery Voltages w.r.t. Time based on selecting terminal or palm.



- After selecting the type of data, press **TAB** or **ENTER** key. Then select the required plots to be plotted. Without selecting any plots, if you press **OK** button, again a message **"Select Plots!"** is displayed.
- If you want save the file, **before source file is selected for Drive** data plot, click **Save As,** the **Save As** dialog box is displayed with the default file name.
- If you want to stop macros, press **Cancel**.
- Once the required information is entered in the **Drive DATA** form, press **OK** button**, then select source file**.
- Once the source file is selected, the Drive data is plotted and based on requirement the scaling can be done for analysis and saved in the corresponding car files.

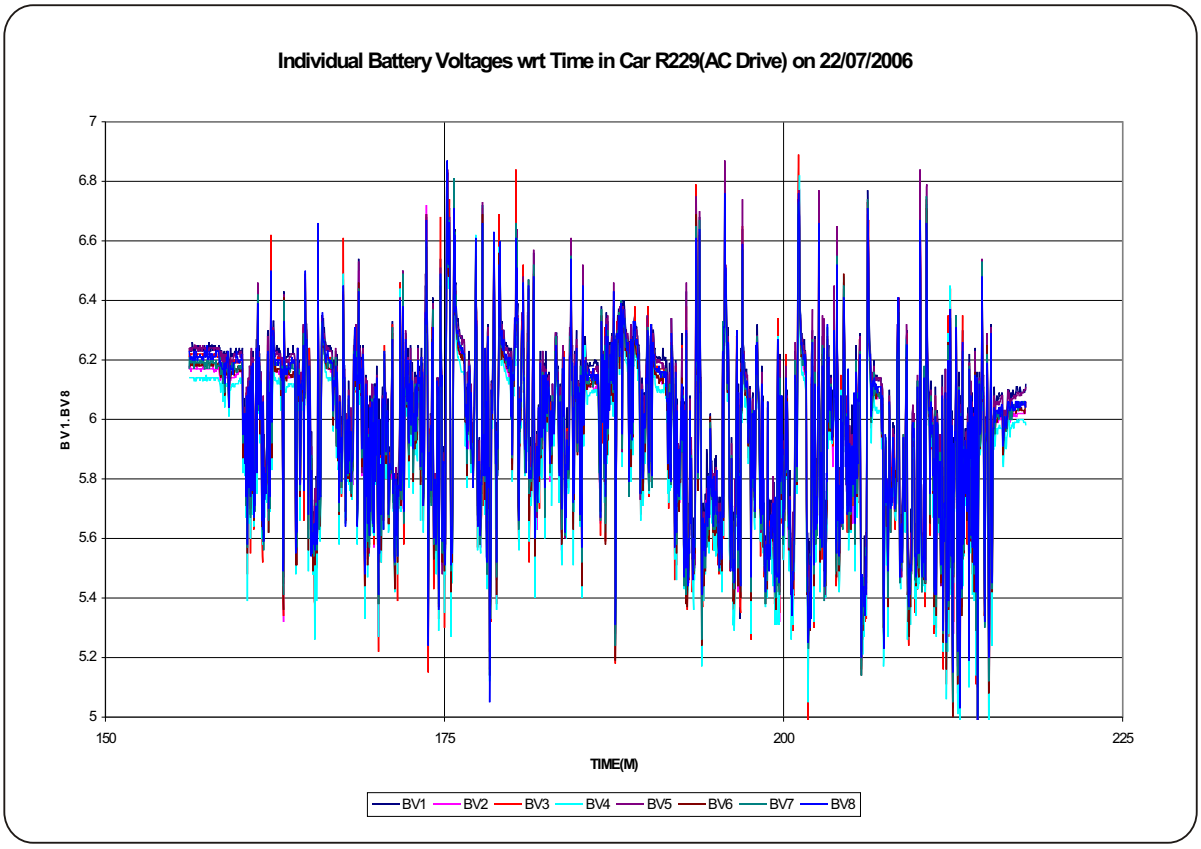
DRIVE DATA PLOT

- In Drive plot, Time versus Battery current, Battery Temperature, Estimated SOC, State of Charge, Ampere-Hour, kilowatt-hour, and Pack voltage is plotted. Battery Current will be on secondary axis.



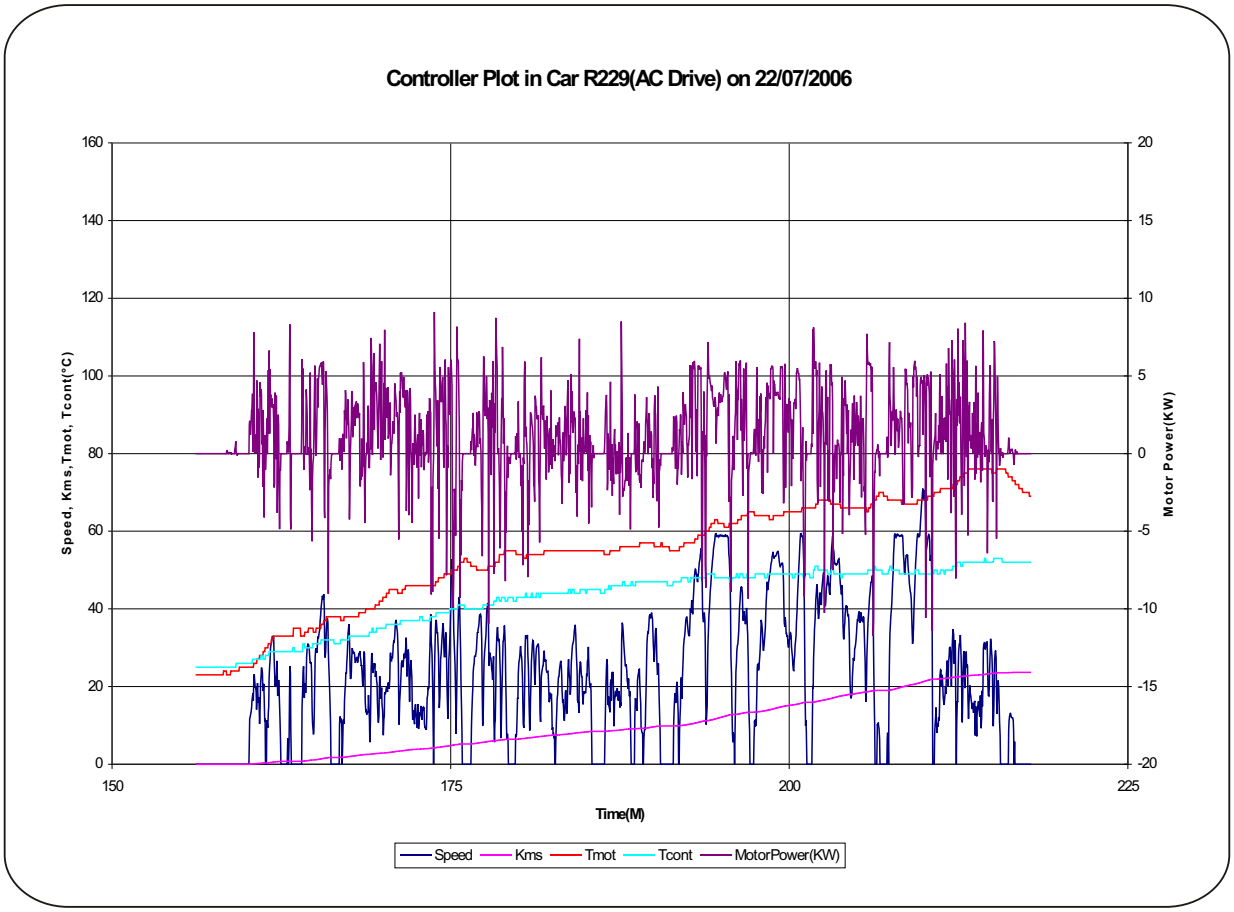
INDIVIDUAL BATTERY VOLTAGES PLOT

- In this plot, Time versus all eight individual battery voltages is plotted.



CONTROLLER PLOT

- In this plot, Time versus Speed, Kilometers, Motor Temperature, Controller Temperature and Motor Power is plotted.



- After the **Drive** plot is plotted, the file is saved with the filename given by user. If **Save As:** is not clicked, a message **"File is not saved!"** is displayed.

- The file can still be saved using Excel menu.

VEHICLE INFORMATION DATA

Vehicle Information consists of Vehicle manufacture and subsystem revision level. The details like Car Serial No., Build Date (i.e. Date when car was build), Motor Serial No., Motor Installation Date, Controller Serial No., Controller Installation Date, Controller Software Version, EMS Serial No., EMS Installation Date, EMS Software Version, Charger Serial No., Charger Installation Date, BV1...BV4 Serial No., BV1..BV4 Installation Date, BV1...BV4 Kms, Last Service Date, and Last Service Kms.

- Select the **EXTRA** button from *Macros Main Form*. After pressing *EXTRA* button *select the Vehicle information and press OK* , then *selecting source file the VEHICLE DATA DETAILS* form is displayed.

- If you want save the file, after the macro is run on Vehicle Information data, then click **Save As** in the form . The **Save As** dialog box is displayed with the default file name. Press Save Button.

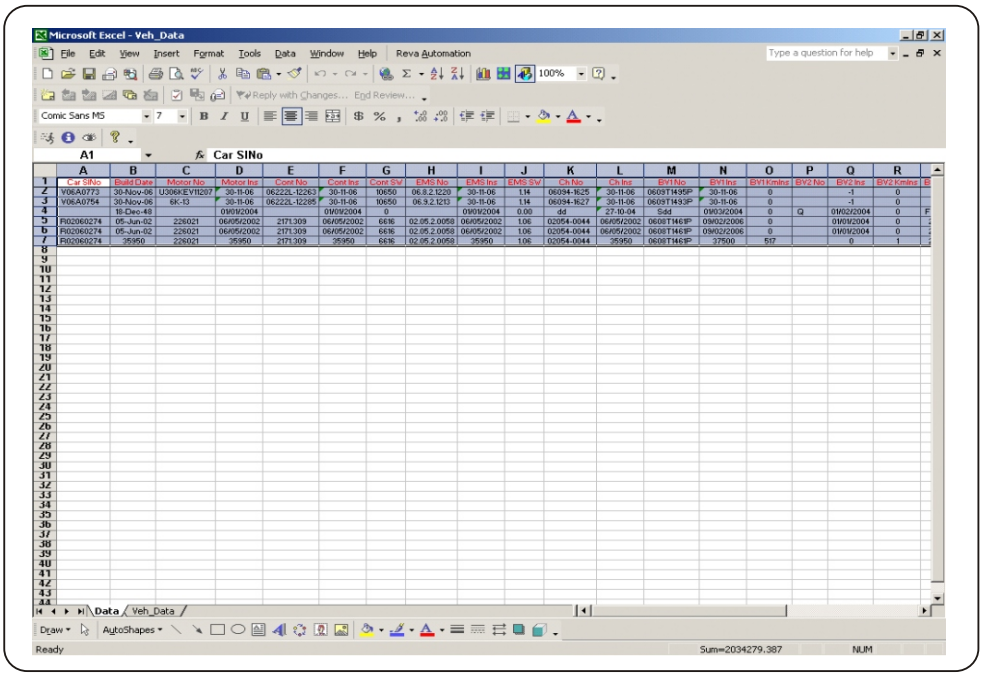
- If filename has to be changed, then change the filename, select the required folder for file, and press **Save** button.

- If you press **Cancel** button , then it stops macros from running.

NOTE

Vehicle Information Data for all cars will be stored in memopad.dat file, different palm will have different memopad.dat files. For running macro on Vehicle Information Data, select memopad.dat file. For selecting memopad.dat file goto C:\Palm\palm name(Eg - Ee4r) \memopad \memopad.dat

- Once the macro is run on Vehicle Information Data, the sheet looks as shown below.



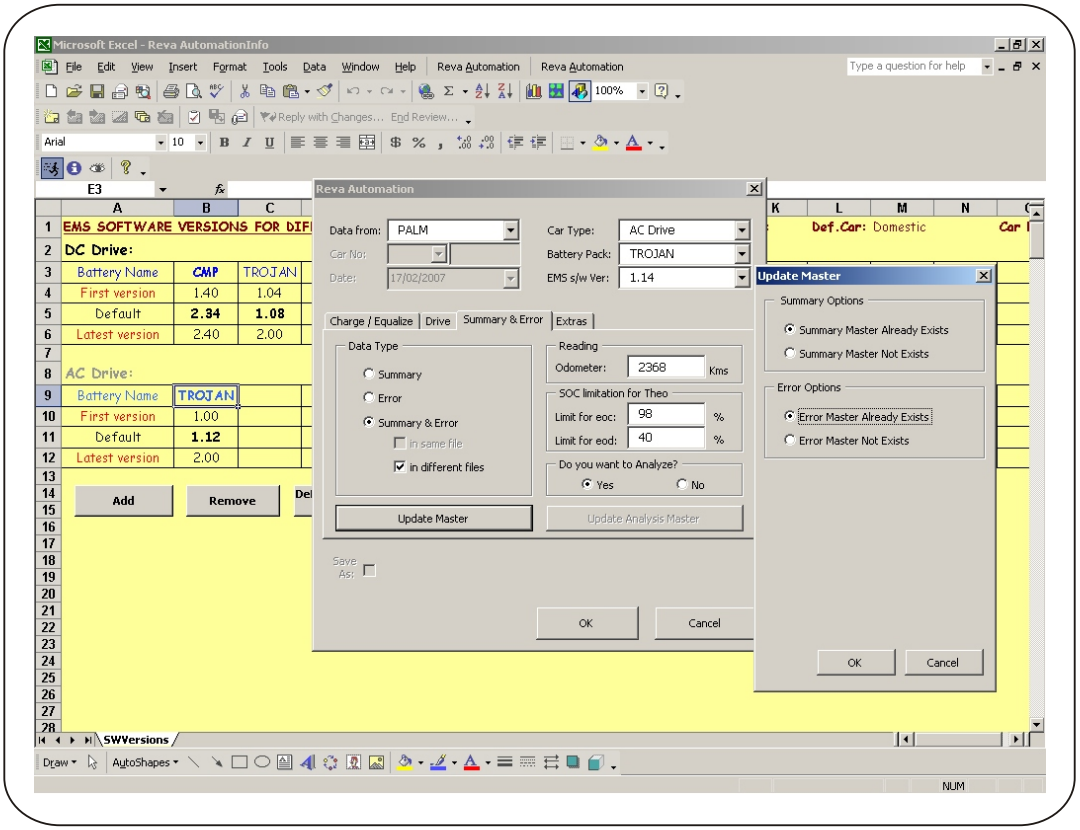
- If **Save As** is not clicked in *VEHICLE DATA DETAILS* form, the message **"File is not saved!"** is displayed at the end.
- Still the file can be saved using Excel menu.

SUMMARY & ERROR DATA

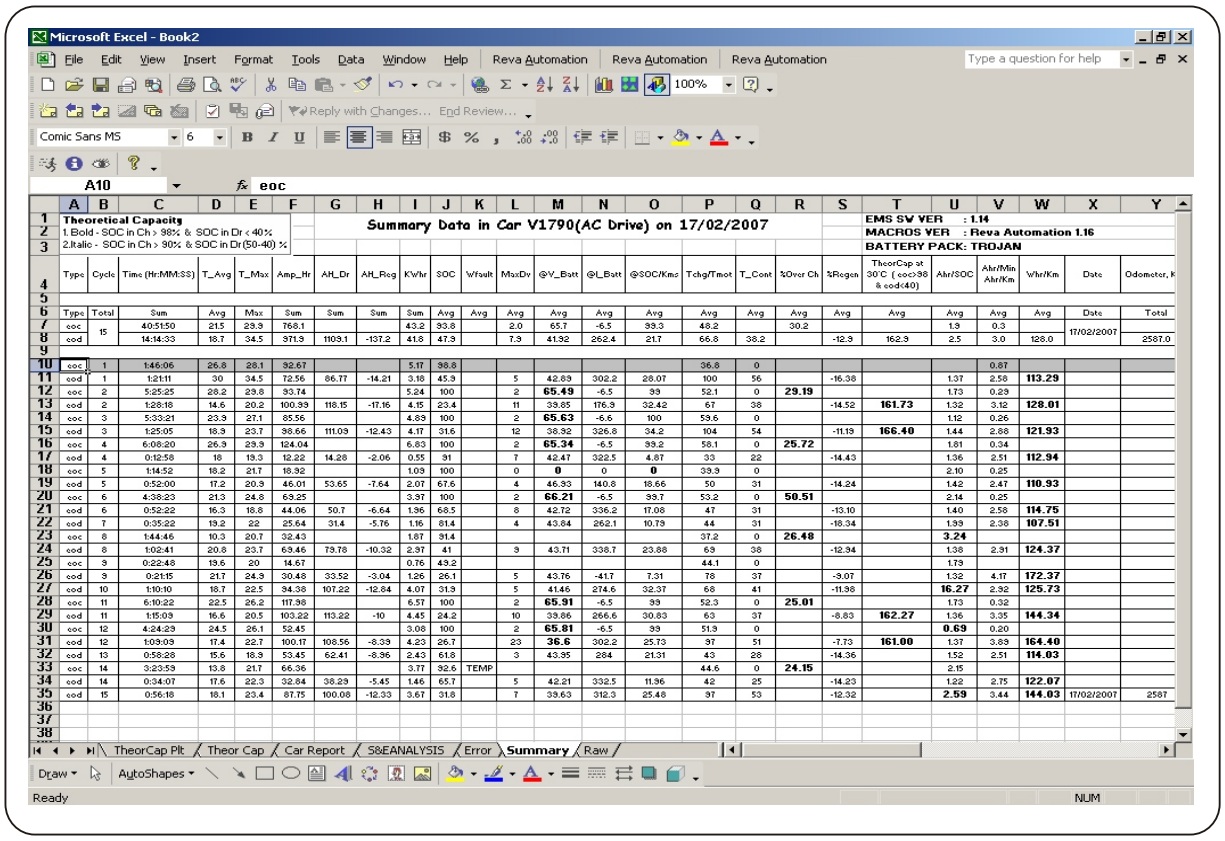
- Select *Summary & Error Data* button from *Macros Main Form*.

- This form contains details like Data from palm or terminal, car type, Battery pack, EMS software version, Odometer readings, Limits for EOC and EOD, need for analysis.File Options i.e. Summary and Error data contained in same file or different files. It also contains options to select Summary Data, Error Data, or Summary & Error Data . An option to save the file. An option to update or create Master Files for Summary & Error Data.

- The **SUMMARY AND ERROR DETAILS** form is as shown:



- **File Options**: Indicates whether Summary and Error Data are in same file or different files.
  1. Summary & Error in Different Files -
  It indicates that Summary and Error data are contained in two different files.
  2. Summary & Error in Single Files -
  This indicates Summary and Error data are contained in the same file.
- Select any one of the **File Options**. If you press **OK** button, without selecting any one of the **File Options**, the message **"Select any one of the File options!"** is displayed.
- **Options**: These Options are used based on the kind of data on which macro has to be run.
  1. Summary Data: This option is selected, if macro has to be run only on Summary Data.
  2. Error Data: This option is selected, if macro has to be run only on Error Data.
  3. Summary & Error Data: If macro has to be run on both Summary and Error Data, then this option must be selected.
- If you click **Save As**: or press **OK** button, without selected any **Options**, the message **"Select any of the Options!"** is displayed.



Microsoft Excel - Book2

File Edit View Insert Format Tools Data Window Help Reva Automation Reva Automation Reva Automation

Type a question for help

Comic Sans MS 6

A10 eoc

Theoretical Capacity
1.Bold - SOC in Ch > 98% & SOC in Dr < 40%
2.Italic - SOC in Ch > 90% & SOC in Dr(50-40) %

Summary Data in Car V1790(AC Drive) on 17/02/2007

EMS SW VER : 1.14
MACROS VER : Reva Automation 1.16
BATTERY PACK: TROJAN

Type	Cycle	Time (Hr:MM:SS)	T_Avg	T_Max	Amp_Hr	AH_Dr	AH_Reg	KWhr	SOC	Wfault	MaxDv	@V_Batt	@I_Batt	@SOC/Kms	Tchg/Tmot	T_Cont	%Over Ch	%Regen	TheorCap at 30'C (eoc>98 & eod<40)	Ahr/SOC	Ahr/Min Ahr/Km	Whr/Km	Date	Odometer, K
Type	Total	Sum	Avg	Max	Sum	Sum	Sum	Sum	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Avg	Date	Total
eoc	15	40:51:50	21.5	29.9	768.1			43.2	33.8		2.0	65.7	-6.5	99.3	48.2		30.2			1.9	0.3		17/02/2007	
eod		14:14:33	18.7	34.5	371.9	1103.1	-137.2	41.8	47.9		7.9	41.92	262.4	21.7	66.8	38.2		-12.9	162.9	2.5	3.0	128.0		2587.0
eoc	1	1:46:06	26.8	28.1	32.67			5.17	98.8						36.8	0					0.87			
eod	1	1:21:11	30	34.5	72.56	86.77	-14.21	3.18	45.9		5	42.89	302.2	28.07	100	56		-16.38		1.37	2.58	**113.29**		
eoc	2	5:25:25	28.2	29.8	93.74			5.24	100		2	**65.49**	-6.5	99	52.1	0	**29.19**			1.73	0.29			
eod	2	1:28:18	14.6	20.2	100.99	118.15	-17.16	4.15	23.4		11	39.85	176.9	32.42	67	38		-14.52	**161.73**	1.32	3.12	**128.01**		
eoc	3	5:33:21	23.9	27.1	85.56			4.89	100		2	**65.63**	-6.6	100	53.6	0				1.12	0.26			
eod	3	1:25:05	18.9	23.7	38.66	111.09	-12.43	4.17	31.6		12	38.92	326.8	34.2	104	54		-11.19	**166.40**	1.44	2.88	**121.93**		
eoc	4	6:08:20	26.9	29.9	124.04			6.83	100		2	**65.34**	-6.5	99.2	58.1	0	**25.72**			1.81	0.34			
eod	4	0:12:58	18	19.3	12.22	14.28	-2.06	0.55	91		7	42.47	322.5	4.67	33	22		-14.43		1.36	2.51	**112.94**		
eoc	5	1:14:52	18.2	21.7	18.92			1.09	100		0	**0**	0	**0**	33.9	0				2.10	0.25			
eod	5	0:52:00	17.2	20.9	46.01	53.65	-7.64	2.07	67.6		4	46.33	140.8	18.66	50	31		-14.24		1.42	2.47	**110.93**		
eoc	6	4:38:23	21.3	24.8	63.25			3.37	100		2	**66.21**	-6.5	99.7	53.2	0	**50.51**			2.14	0.25			
eod	6	0:52:22	16.3	18.8	44.06	50.7	-6.64	1.96	68.5		8	42.72	336.2	17.08	47	31		-13.10		1.40	2.58	**114.75**		
eoc	7	0:35:22	19.2	22	25.64	31.4	-5.76	1.16	81.4		4	43.84	262.1	10.79	44	31		-18.34		1.39	2.38	**107.51**		
eod	8	1:44:46	10.3	20.7	32.43			1.67	91.4						37.2	0	**26.48**			**3.24**				
eoc	8	1:02:41	20.8	23.7	69.46	79.78	-10.32	2.97	41		9	43.71	338.7	23.88	69	38		-12.94		1.38	2.91	**124.37**		
eoc	9	0:22:48	19.6	20	14.67			0.76	49.2						44.1	0				1.79				
eod	9	0:21:15	21.7	24.9	30.48	33.52	-3.04	1.26	26.1		5	43.76	-41.7	7.31	78	37		-9.07		1.32	4.17	**172.37**		
eod	10	1:10:10	18.7	22.5	34.38	107.22	-12.84	4.07	31.9		5	41.46	274.6	32.37	68	41		-11.98		**16.27**	2.32	**125.73**		
eoc	11	6:10:22	22.5	26.2	117.98			6.57	100		2	**65.91**	-6.5	99	52.3	0	**25.01**			1.73	0.32			
eoc	11	1:15:09	16.6	20.5	103.22	113.22	-10	4.45	24.2		10	39.86	266.6	30.83	63	37		-8.83	**162.27**	1.36	3.35	**144.34**		
eod	12	4:24:29	24.5	26.1	52.45			3.08	100		2	**65.81**	-6.5	99	51.9	0				1.26	0.20			
eoc	12	1:09:09	17.4	22.7	100.17	108.56	-8.39	4.23	26.7		23	**36.6**	302.2	25.73	97	51		-7.73	**161.00**	1.37	3.89	**164.40**		
eod	13	0:58:28	15.6	18.9	53.45	62.41	-8.96	2.43	61.8		3	43.95	284	21.31	43	28		-14.36		1.52	2.51	**114.03**		
eoc	14	3:23:59	13.8	21.7	66.36			3.77	92.6	TEMP					44.6	0	**24.15**			2.15				
eod	14	0:34:07	17.6	22.3	32.84	38.29	-5.45	1.46	65.7		5	42.21	332.5	11.96	42	25		-14.23		1.22	2.75	**122.07**		
eod	15	0:56:18	18.1	23.4	87.75	100.08	-12.33	3.67	31.8		7	39.63	312.3	25.48	97	53		-12.32		**2.59**	3.44	**144.03**	17/02/2007	2587

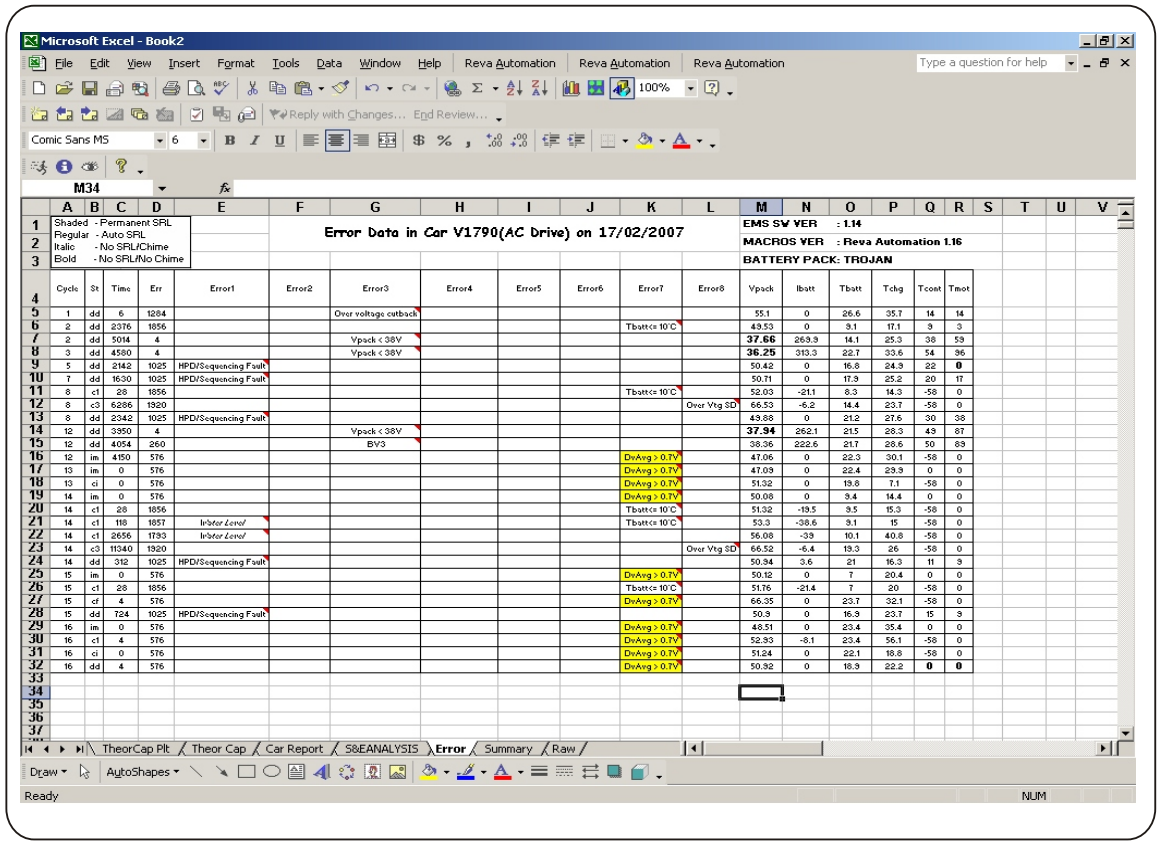
TheorCap Plt | Theor Cap | Car Report | S&EANALYSIS | Error | **Summary** | Raw

Draw AutoShapes

Ready NUM

- The Summary sheet looks like as shown in the figure above.

- Similarly the Error sheet looks like as shown in the figure below.



Microsoft Excel - Book2

File Edit View Insert Format Tools Data Window Help Reva Automation Reva Automation Reva Automation

Type a question for help

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M34

Shaded - Permanent SRL
Regular - Auto SRL
Italic - No SRL/Chime
Bold - No SRL/No Chime

Error Data in Car V1790(AC Drive) on 17/02/2007

EMS SW VER : 1.14
MACROS VER : Reva Automation 1.16
BATTERY PACK: TROJAN

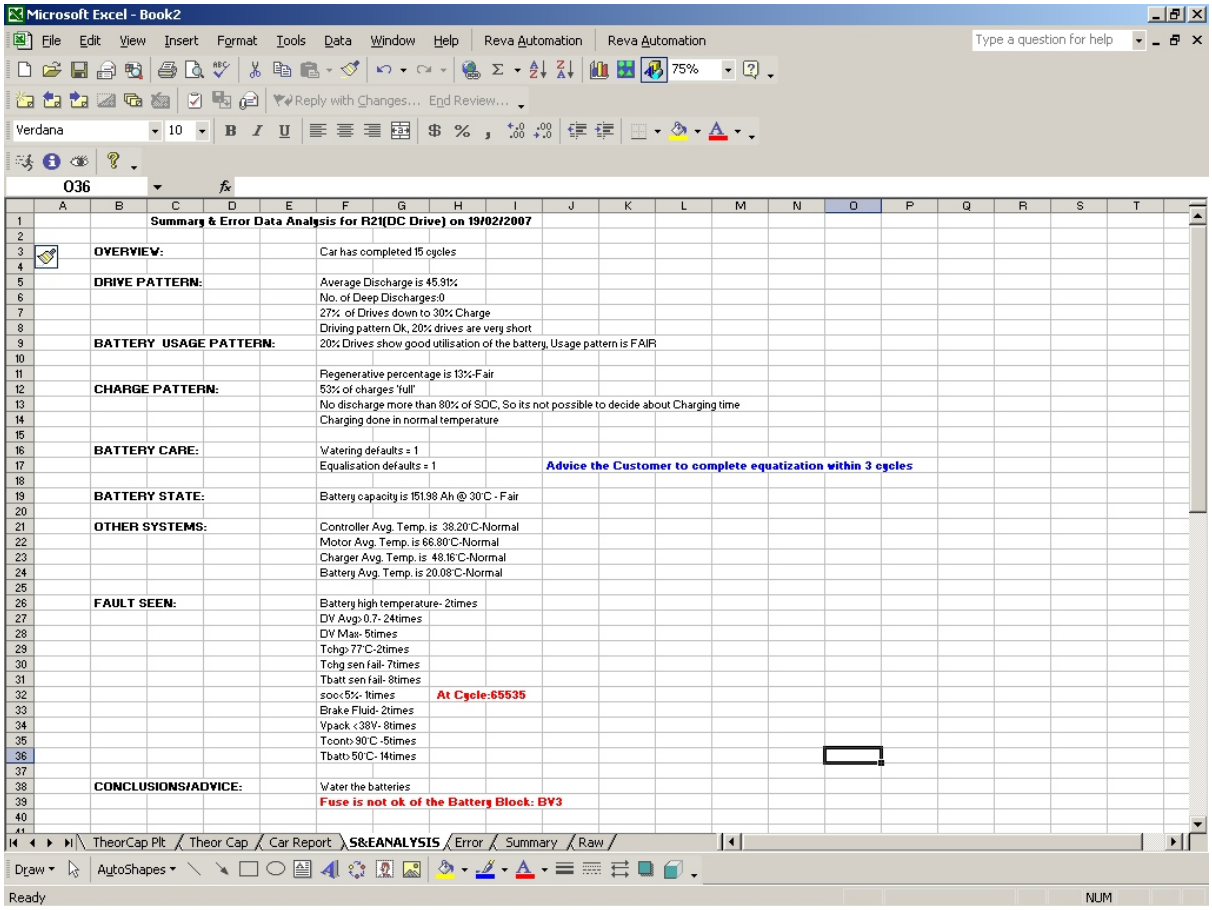
Cycle	St	Time	Err	Error1	Error2	Error3	Error4	Error5	Error6	Error7	Error8	Vpack	Ibatt	Tbatt	Tchg	Tcont	Tmot
1	dd	6	1284			Over voltage cutback						55.1	0	26.6	35.7	14	14
2	dd	2376	1856							Tbatt<= 10'C		49.53	0	9.1	17.1	3	3
2	dd	5014	4			Vpack < 38V						**37.66**	269.9	14.1	25.3	38	59
3	dd	4580	4			Vpack < 38V						**36.25**	313.3	22.7	33.6	54	96
5	dd	2142	1025	HPD/Sequencing Fault								50.42	0	16.8	24.9	22	**0**
7	dd	1630	1025	HPD/Sequencing Fault								50.71	0	17.9	25.2	20	17
8	c1	28	1856							Tbatt<= 10'C		52.03	-21.1	8.3	14.3	-58	0
8	c3	6286	1920								Over Vtg SD	66.53	-6.2	14.4	23.7	-58	0
8	dd	2342	1025	HPD/Sequencing Fault								49.88	0	21.2	27.6	30	38
12	dd	3950	4			Vpack < 38V						**37.94**	262.1	21.5	28.3	49	87
12	dd	4054	260			BVS						38.36	222.6	21.7	28.6	50	83
12	im	4150	576							DvAvg > 0.1V		47.06	0	22.3	30.1	-58	0
13	im	0	576							DvAvg > 0.1V		47.09	0	22.4	29.9	0	0
13	c1	0	576							DvAvg > 0.1V		51.32	0	19.8	7.1	-58	0
14	im	0	576							DvAvg > 0.1V		50.08	0	3.4	14.4	0	0
14	c1	28	1856							Tbatt<= 10'C		51.32	-19.5	9.5	15.3	-58	0
14	c1	118	1857	Inrtor Level						Tbatt<= 10'C		53.3	-38.6	9.1	15	-58	0
14	c1	2656	1793	Inrtor Level								56.08	-39	10.1	40.8	-58	0
14	c3	11340	1920								Over Vtg SD	66.52	-6.4	19.3	26	-58	0
14	dd	312	1025	HPD/Sequencing Fault								50.94	3.6	21	16.3	11	3
15	im	0	576							DvAvg > 0.1V		50.12	0	7	20.4	0	0
15	c1	28	1856							Tbatt<= 10'C		51.76	-21.4	7	20	-58	0
15	c1	4	576							DvAvg > 0.1V		66.35	0	23.7	32.1	-58	0
15	dd	724	1025	HPD/Sequencing Fault								50.3	0	16.9	23.7	15	3
16	im	0	576							DvAvg > 0.1V		48.51	0	23.4	35.4	0	0
16	c1	4	576							DvAvg > 0.1V		52.93	-8.1	23.4	56.1	-58	0
16	c1	0	576							DvAvg > 0.1V		51.24	0	22.1	16.8	-58	0
16	dd	4	576							DvAvg > 0.1V		50.32	0	18.9	22.2	**0**	**0**

TheorCap Plt | Theor Cap | Car Report | S&EANALYSIS | **Error** | Summary | Raw

Draw AutoShapes

Ready NUM

- The Analysis of Summary and Error data looks like as shown in the figure below.



BATTERY WARRANTY VERIFICATION DATA

- For getting Battery Warranty details about a particular car, Master Files for Summary and Error should be exists and selected for running a macro.
- Battery Warranty Verification Data sheet is shown below.

Battery Warranty Verification Data In Car R42 on 21/06/02

Name	Type	Description	EOC	EOD
Tot_Km	Int	Total kilometers in drive		11731
Cum_Charge_Ahr	Float	Cumulative Amp-hours in charge	19364.12	
Cum_Charge_Kwhr	Float	Cumulative Kilo Watt-hours in charge	1082.87	
Cum_charge_time	Hr:MM:SS	Total time spent in active charge	777:139:15	
Cum_num_cycles	Int	Cumulative number of charge/discharge cycles	307	
Cum_num_cycles	Int	Cumulative number of discharge cycles		303
Cum_num_cycles	Int	Cumulative number of charge cycles	294	
DOD_hist[0]	Int	# of discharge cycles DOD < 40%		110
DOD_hist[1]	Int	# of discharge cycles 40% < DOD < 60%		135
DOD_hist[2]	Int	# of discharge cycles 60% < DOD < 80%		42
DOD_hist[3]	Int	# of discharge cycles 80% < DOD <= 100%		16
DOD_hist[4]	Int	# of discharge cycles > 100%		0
Ave_DOD	Float	Average DOD of all cycles		43.80
Temp_hist[0]	Int	# of cycles avrg T < 15 C in charge	0	
Temp_hist[1]	Int	# of cycles 15 C < avrg T < 30 C	77	
Temp_hist[2]	Int	# of cycles 30 C < avrg T < 35 C	71	

ANALYSIS OF DATA

CHARGE DATA

The data collected during Charge. In Charge Data, we are plotting 2 types of plots namely

1. Charge Data Plot
2. Individual Battery Voltages Plot

CHARGE DATA PLOT

In charge data plot, Time versus Battery current, Programmable Current (Iprog), Batter Temp, Charger Temp, State of Charge, Ampere-Hour, kilowatt-hour, and Pack voltage plotted.

After charge data plot is plotted, check the following parameters:

- During Charge, Battery current should follow Iprog. If there is an offset between Battery Current & Iprog check for any Shunt Mismatch (error no. 514) in Fault code. For root causes & action to be taken for Shunt Mismatch, refer Error List table.
- Check whether Charger Temperature and Battery Temperature is working. If they are constant at 30 Deg C in Charge plot, then there may be problem with Battery or Charger Sensor. See Battery Sensor Failure or Charger Temperature Sensor Failure error (Error No. 528 or 544). For root causes & action to be taken for Battery Sensor failure or Charger Sensor failure, refer Error List table.
- Check whether Battery Temp is more than 45 Deg C. If Battery Temp > 45eg C, then Iprog is limited. Check corresponding Iprog current.
- Check whether Charger Temp is more than 73.5 Deg C. If Charger Temp > 73.5 Deg C, then Iprog is limited.
- If Charger Temp is more than 77 Deg C, check whether fan is working (i.e. Fan count is zero).
- Check whether Battery Pack Voltage less than 38 V. Check BV8 reading is zero.
- Check SOC value in different phases based on Vpack.

Phase	Vpack at 30 ^{O}C	SOC
C1 to C2	56 V	76%
C2 to C3	57.6 V	90%
C3 to Cf	>58V	99%

- Check for the type of shut down.
  - **co** - Over Voltage Shut down (when Vpack – **66**.**5V**)
  - **ct -** Time Out Shut down (when Time – **720**M)
  - **cf** - Final phase in charge (Regular shut down, 25 minutes after dv/dt criteria met**.**
  - **cp** - Over Temperature Shut down (When Tbatt > 50 deg C)
  - **ci** - idle mode after regular dv/dt shutdown.
- Check total ampere-hour consumed to be between 170 to 180.
- Check whether Fan is working. (0 Counts in Data Sheet)

- Check Iprog in different phases based on Vpack.

Phase	Vpack at 30 °C	Iprog
Upto C1	Upto 56 V	40 A
C1 to C2	56 V - 57.6 V	40 A to 5 A
C2 to C3	57.6 V - 60 V	5 A
C3 to Cf	Above 60 V	5 A

- Check whether Battery Current & Charger Current follows Iprog.
- Compare Iprog, Battery Current & Charger Current with Ideal graphs.

INDIVIDUAL BATTERY VOLTAGES PLOT

The Individual Battery Voltages (BV1…. BV8) is plotted w.r.t time. From this plot, we can see the behavior of individual Batteries through out the Charge.

- Check deviation between individual battery voltages should not be greater than 300mv.
- Check for any Max Dv or Avg Dv errors.
- Check whether individual battery voltages (BV1…BV8) is out of range (i.e. > 8.7V).

DRIVE DATA

The data collected during Drive. In Drive Data, we are plotting 3 types of plots namely

1. Drive Plot
2. Individual Battery Voltages Plot
3. Controller Data Plot.

DRIVE PLOT

In drive plot, Time versus Battery current, Battery Temp, State of Charge, Ampere-Hour, kilowatt-hour, and Pack voltage & estimated SOC is plotted.

- Check for Battery Current between – 350A & + 350A.
- Check for Battery Pack Voltage between 38V to 57V. If Pack Voltages is less than 38V. Check Battery Voltage 8 (BV8) reading is zero.
- Check Ampere-Hour is 130 for SOC 80Che% discharge.
- Check Battery Temp between 25 Deg C to 45 Deg C.
- For 10% SOC discharge, check ampere-hour is 16.

NOTE

- If Dv Avg > 20% in Charge, check corresponding Dv Avg in Summary Data and verify it.
- If Dv Max > 15% in Drive, check the corresponding Dv Max in Summary Data.
- If Battery Temperature > 45°C, Charger Temperature > 77 °C, Controller Temperature > 82 °C & Motor Temperature > 130°C error occurs, then corresponding temperatures value is displayed in error sheet, you can verify it.
- If Vpack < 38V error occurs, see the corresponding Pack Voltage in the error sheet. Verify whether Vpack is actually < 38V.
- If any one of the Individual Battery Voltages (BV1 … BV8) is out of range error occurs, see the corresponding Pack Voltage in the error sheet.
- If Battery Sensor Failure or Charger Sensor Failure, then Battery Temperature & Charger Temperature Sensor will 30 °C in Error sheet

INDIVIDUAL BATTERY VOLTAGES PLOT

- Check deviation between individual battery voltages should not be greater than 300mv.
- Check for any Max Dv or Avg. Dv errors.
- Check whether individual battery voltages (BV1…BV8) is out of range (i.e. >15% of Deviation).

CONTROLLER DATA PLOT

- Check Motor Speed <80kms.
- Check Motor Power.
- Check Controller Temp less than 82 Deg C.
- Check Motor Temp.

SUMMARY DATA

In Summary Data, the fault (Out of Range) values are printed in bold letters. It is easy to find the out of range values.

- If @Vbatt in eod, is less than 38V then check *Battery Pack Under Voltage* error & actual Pack Voltage in corresponding error data. 57V and in eoc 45…65V.
- Ibatt > 350A in eod and Ibatt > 0 or Ibatt < -42A in eoc.
- Check in eod @Vbatt > 52V and @Ibatt > 0 or @Vbatt < 46V and @Ibatt < -100A
- If T_Avg is greater than 45 degree in charge and drive.
- If T_max is greater than 45 degree or Tmax equals 30 degree in charge or drive
- If Tchg is greater than 77 degree in charge or Tchg equals 30 degree in Charge.
- If Tmot is greater than 130 degree C in drive.
- If Tcont is greater than 82 degree C in drive.
- If DV_max > 15% in drive.
- DV_av is greater than20% in charge.
- % Over Charge is negative or greater than 15 %
- % Regen more than –5 % and less than –20 %.
- If Ahr < 0 or Ahr > 200.
- If Ahr_Dr < 0 or Ahr_Dr > 200.
- If Ahr_Regen > 0.
- If Kwhr < 0 or Kwhr > 20.
- If SOC < 0 or SOC > 100.
- If @SOC < 0 or @SOC > 100.
- If Kms < 0 or Kms > 100.

ERROR DATA

After downloading errors in Palm or Terminal software, analyze errors. For root causes of errors and action to be taken, please refer Chapter 4.10.

ANALYSIS OF SUMMARY DATA

In Summary Data, the fault (Out of Range) values are printed in bold letters. It is easy to find the out of range values.

- If @Vbatt in eod, is less than 38V then check Battery Pack Under Voltage error & actual Pack Voltage reading in corresponding error data.

- Check whether @Vbatt is more than 57V in eod, then check Over Voltage error & actual Pack Voltage reading in corresponding error data. Check in Error Data, whether it happened at time < 10 Min after begining of drive. It happens because of Regen Braking during Drive just after full Charge.

- Check if Ibatt > 350A in eod and Ibatt > 0 or Ibatt < -42A in eoc.

- Check in eod @Vbatt > 52V and @Ibatt > 0 or @Vbatt < 46V and @Ibatt < -100A.

- If Tchg_Max is greater than 77 degree in charge. Check for Charger Over Temperature error & the corresponding Charger Temperature in error data. It may be due to Fan failure. See whether Fan is working or not. To check whether Fan is working, see Monitor Data (Charge) for Zero Fan Counts.

- If Tchg_Max is 30 degree Centigrade, then it indicates that there is a problem in Charger Temperature Sensor. For verification, see Charger Temperature Sensor Failure error and Charger Temperature readings in Error Data. Check whether Charger Temperature is 30 degree in Monitor Data (Charge).

- If Tbatt_Max is greater than 45 degree in charge.
  Check for Tbatt_Max > 45 deg C error and corresponding Tbatt_Max reading in Error Data. It may be due to erratic readings of Battery Temperature Sensor. Check Battery Temperature Sensor. Cool Battery Pack.

- If Tbatt_Max is 30 degree Centigrade, then it indicates that there is a problem in Battery Temperature Sensor. For verification, see Battery Temperature Sensor Failure error and Battery Temperature readings in Error Data. Check whether Battery Temperature is 30 degree in Monitor Data (Charge).

- If Tbatt_Max is more than 50 degree Centigrade in eod, see in consecutive cycles whether Tbatt_Max is > 50 deg C. If Tbatt_Max > 50 °C for 10 consecutive cycles, then check whether Tbatt > 50°C error is occured in Error Data. It may be due to erratic readings of Battery Temperature Sensor. Check for Battery Temperature Sensor failure in Error & Monitor Data.

- If Tmot is greater than 130 degree Centigrade in drive. Check for Tmot > 130 deg C error & corresponding Motor Temperature reading in Error Data. Motor Temperature may be high due to high ambient temperature, if ventillation is not good, if Parking Brake is pulled during drive and due to Vehicle related problem.

- If Tmot is greater than 145 degree Centigrade in drive. Check for Tmot > 145 deg C error & corresponding Motor Temperature reading in Error Data. If Tmot > 145 deg C, then it is a permanent error. It may be due to same reasons mentioned in the above steps.

- If Tcont is greater than 82 degree C in drive. Check for Tcont > 82°C error & corresponding Controller Temperature reading in Error Data. Controller Temperature is high due to high ambient Temperature, if Ventillation is not OK and if Parking Brake is pulled during Drive. If Tcont > 90°C, then it is a permanent error.

- Check whether Dv Max is more than 15%. If Dv Max > 15%, then check deviation between individual Battery Voltages. Check EMS Calibration. See BV1..BV8 plots for deviation.

- Check whether Dv Avg is greater than 20% in charge . If DvAvg > 20%, then check deviation between battery voltages, check EMS Calibration. Check for the corresponding error in Error Data. It is a permanent error.

- Check whether % Over Charge is negative or greater than 15 %. If %Over Charge is negative, it indicates that Battery is not Charged and if %Over Charge > 15%, then it indicates that Battery is fully Charged.

- Check whether if % Regen more than –5 % and less than –20 %. If %Regen i > -5%, it indicates that Regen Braking is not effective and if %Regen is <15%, it indicates that Regen Braking is more.

- Check whether Whr/Kms is less than 65 or more than 85. If Whr/Kms is more than 85, it indicates power consumption from Battery for Kms is high and if Whr/Kms < 65 then power consumption from Battery per Kms is low. Same is >137 or <105 in case of Whr /miles.

ANALYSIS OF ERROR DATA

After downloading errors in Palm analyze errors. For root causes of errors and action to be taken, please refer Error List Table.
(Refer 17.10)

- If Dv Avg >20%, check corresponding Dv Avg in Summary Data and verify it.

- If Dv Max > 15%, check the corresponding Dv Max in Summary Data. Charger Temperature > 78 °C, Controller Temperature > 82 °C & Motor Temperature > 130 °C error occurs, then corresponding temperatures value is displayed in error sheet, you can verify it.

- If Vpack < 38 V error occurs, see the corresponding Pack Voltage in the error sheet. Verify whether Vpack is actually < 38V.

- If any one of the Individual Battery Voltages (BV1 … BV8) is out of range error occurs, see the corresponding Pack Voltage in the error sheet.

- If Battery Sensor Failure or Charger Sensor Failure, then Battery Temperature & Charger Temperature Sensor will 30 °C in Error sheet.

ANALYSIS OF CALIBRATION PARAMETERS

In EMS, if there is a problem related to individual Battery Voltages, deviations in Battery Voltages, Charger shunt, Battery shunt problem, Iprog and Over Voltage, Motor Temperature. Then check calibration parameters in the Palm. Compare the downloaded calibration parameters & actual calibration parameters of the Vehicle database. If it is not matching, then make changes & upload the calibration parameters to the EMS through palm. Verify calibration parameters.*(Refer 18.7)*

FREQUENTLY OCCURING ISSUES THAT CAN BE IDENTIFIED USING SUMMARY AND ERROR DATA

1. High Battery Temperature

Identification

- We get Tbatt > 50 °C error in error data.
- In error data, check the corresponding Tbatt is greater 50 °C.
- In Summary, check Tmax is greater than 50 °C in the corresponding cycle.

Causes

- Erratic readings of the Sensor.
- Actual temperature of the Battery is more than 50 °C.

Action to be taken

- Check Battery Sensor with Multimeter (CN 66, PIN 11 & 12 with EMS connected). The voltage equivalent of temperature will be 3V @ 27 °C and increases by 0.01V for every 1 °C rise thereafter. For e.g., at 40 °C the voltage is equal to 3.13V
- Allow Battery for Cooling.

2. Fan Failure

Identification

- During Charge mode, check Fan TTL is 0 counts.
- Check Vprog is 54.50V in charge.

Causes(EMS VER 11A & below)

- 12Volts to the Fan is disconnected.
- EMS not giving GND signal to the Fan.
- No TTL signal from Fan.

Causes(EMS VER 12 & above)

- Ground to the Fan is disconnected.
- EMS not giving 12V to the Fan.
- No TTL signal from Fan.

Actions to be taken

- Check Fan connections.
  Check F2 in fuse box.
- Check for continuity between Fan Gnd & Battery Shunt Gnd. If the EMS is not giving the GND in old EMS versions and 12V in ver12 & above EMS, then EMS has to be replaced.
- Check the voltage between Pin 18 of CN66 & GND with EMS connected

3. High Charger Temperature

Identification
- In error data, we get Tchg > 77 °C.
- In error data, check the corresponding Tchg is greater 77 °C.
- In Summary, check Tchg is greater than 77 °C in the corresponding cycle.

Causes
- Fan is not working.
- Actual temperature of charger is more than 77 °C.

Action to be taken
- Check for the fan failure.
- Allow charger for Cooling.

4. Average Deviation (AvgDv)

Identification
- If Dv Avg > 20%, check corresponding Dv Avg in Summary Data and verify it.

Causes
- Batteries voltage deviation.
- CN66 is removed during Charge or Drive.
- EMS erratic readings
- Specific Gravity

Action to be taken
- Check deviations between Individual Battery Voltages
- Carry out Equalization Charge.
- Check for the connection of the connectors to the EMS.
- Check for EMS Calibration.
- Only after clearing the root causes of the problem, reset Service light.
- Check all the Power Pack Fuses (3 Amp.)

5. Maximum Deviation (MaxDv)

Identification
- Check Dvmax is greater than 15% in summary data.

Causes
- Battery voltage deviation.
- CN66 is removed during Charge or Drive.
- EMS erratic readings.
- Failure of individual Battery fuses in the Power Pack.
- Loose connections in CN66.
- Battery discharged >95%.

Action to be taken
- Check deviation between Individual Battery Voltages.
- Check for the connection of the connectors to the EMS.
- Check for EMS Calibration.
- Put the Key ON if car is in charge or vice versa to reset Service Light.

6. No Water

Causes

- If Batteries were not watered after Low Water Light comes for 3 consecutive cycles, then error 516 is recorded in Error Data.

Action to be taken

- Instruct Customer to check low level water light.
- Watering of Batteries should be done after full charge.
- Only after clearing the root causes of the problem, clear error data.

7. Battery Voltages Drift

If Battery Voltages (BV1 … BV8) are showing out of range. That is getting errors as BV1… BV8.

Causes

- Battery Voltages (BV1..BV8) < 0 V or 20%deviation
- Battery Voltages (BV1..BV8) > 8.7V.
- Fuse is not Ok.
- Crimping is not Ok.

Action to be taken

- Compare EMS & Multi meter Readings.
- Check for continuity in Fuse.
- Check for EMS Battery Calibration Parameters.
- Check crimping of respective pin in CN66 connector.

8. Battery Temperature Sensor Failure

Identification

- We get Tbatt Sen Fail error in Error Data.
- Check the corresponding battery temp is 30 °C in the error data.
- Also verify in summary data by checking whether Tmax is 30°C.

Causes

- Temperature Sensor is not working.

Action to be taken

- See Error Log & Monitor Data for Battery Temperature Sensor Failure.
- Verify Battery Temperature Sensor with the Multi meter.
- Disconnect CN 66 and check resistance between Pin 11 & 12. There should not be continuity.
- Check battery temperature sensor, by checking voltage on Pin 11 & 12 of CN 66. It should read 3 volts.

9. Over Temperature in Controller

Identification

- We get Tcont > 90 °C error in error data.
- Check in summary data and verify.

Causes

- High ambient temperature.
- Parking Brake is pulled during drive.
- Harsh driving habits.
- Ventilation is not OK.
- Improper mounting of Controller.
- Poor controller - heat sink compound.
- Loose connections on Controller.

Action to be taken

- Stop driving & allow for cooling.
- Ensure that parking brake is not pulled during drive.
- Check for ventilation of controller.
- Check for Controller heat sink compound.

10. Over Temperature in Motor

Identification

- We get Tmot > 130 °C error in error data.
- Check in summary and verify it.

Causes

- High ambient temperature.
- Parking Brake is pulled during drive.
- Harsh driving habits.
- Ventilation is not OK.
- Loose connections of motor U, V and W cables.
- Bearing problem.
- Poor field winding insulation.

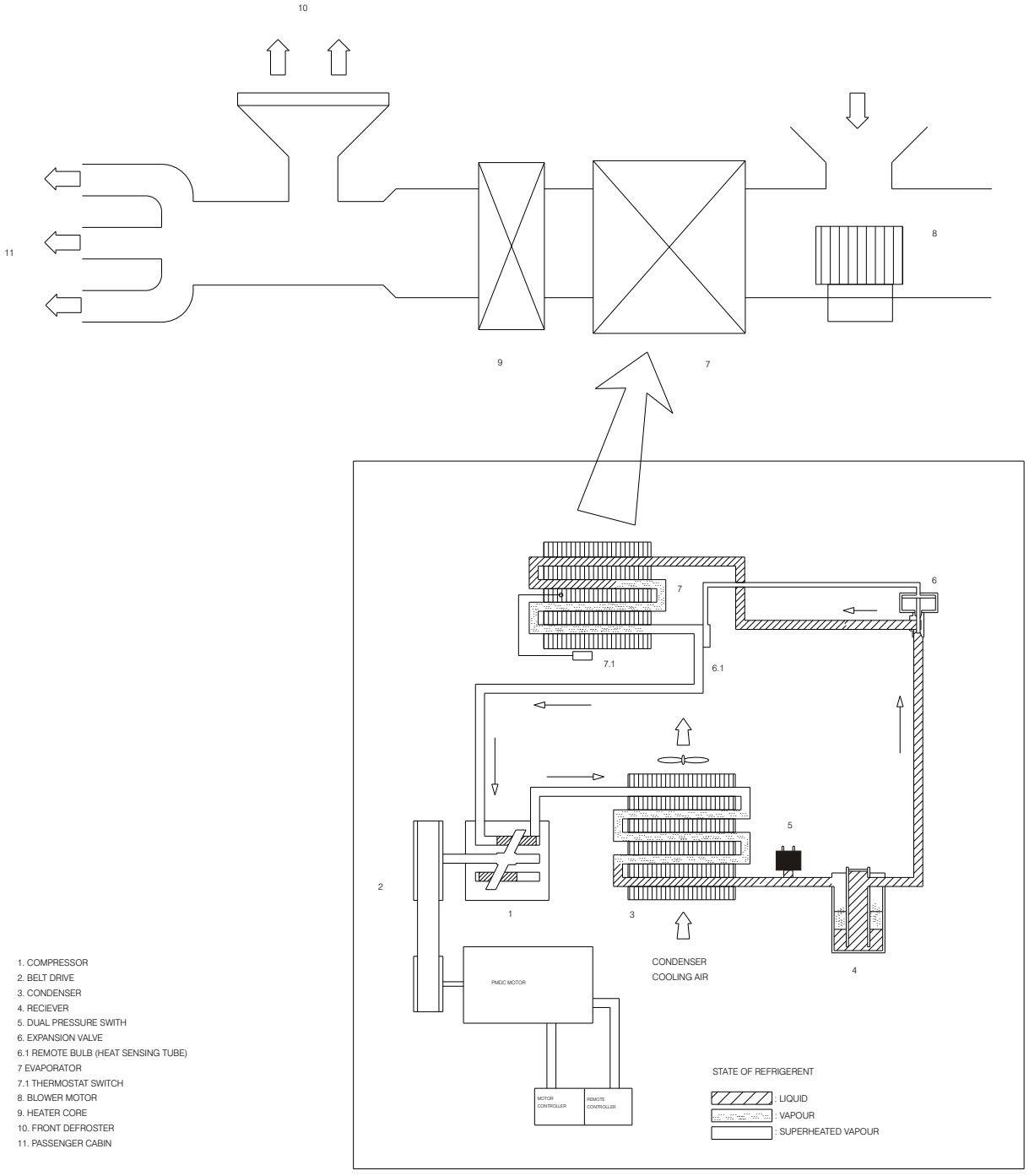
Action to be taken

- Stop Driving & allow for cooling.
- Ensure that Parking Brake is not pulled during drive.
- Customer Education to be done on Driving Habits.
- Check for ventilation.
- Check connections of Motor.
- Check for Bearing play.
- Check insulation resistance of field windings.
- Check temperature limitation parameters of controller using handheld.

air conditioning 21.0

GENERAL DISCRIPTION

MAJOR COMPONENTS AND REFRIGERANT FLOW OF AIR CONDITIONING SYSTEM



1. COMPRESSOR
2. BELT DRIVE
3. CONDENSER
4. RECIEVER
5. DUAL PRESSURE SWITH
6. EXPANSION VALVE
6.1 REMOTE BULB (HEAT SENSING TUBE)
7 EVAPORATOR
7.1 THERMOSTAT SWITCH
8. BLOWER MOTOR
9. HEATER CORE
10. FRONT DEFROSTER
11. PASSENGER CABIN

INTRODUCTION

Vehicles today are expected to provide a high level of comfort to the occupants. Cabin temperature being an important factor attracts attention which is addressed through air conditioning system.

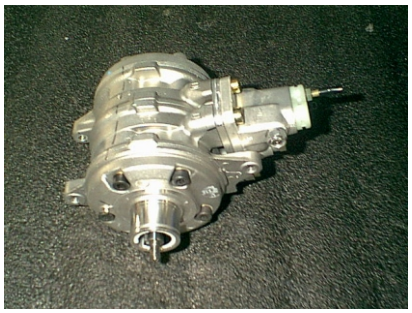
Compressed AC gas is cooled to ambient temperature and is then made to evaporate the heat from the passenger compartment. The latter's temperature gets lowered in the process.

WORKING OF AC

- **Compressor** draws off gaseous refrigerant from the evaporator and compresses it.The process of compression, however raises the temperature of the refrigerant also.
- **Condenser** helps in bringing down the temperature of the compressed refrigerant which comes to the liquid state.
- **Receiver** removes any traces of moisture and filters out dirt in the system and It also serves as a reservoir for excessive refrigerant.
- **Expansion valve** controls liquid refrigerant into the evaporator cores, causing a drop in pressure and consequently drop in temperature as well.
- **Evaporator** Here**,** the released refrigerant expands and flows through the
- evaporator tubes. This removes heat from the air blowing across the fins and tubes and evaporates, causing the temperature inside the vehicle to
- gradually lower.

A/C IN IC ENGINE VEHICLE Vs A/C IN REVA

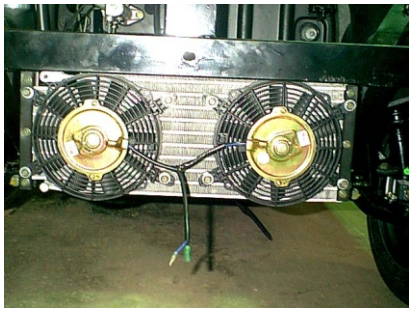
- In IC engine vehicle the A/C compressor is driven by the main power unit i.e; the engine but Reva employs a separate motor to drive the compressor.
- A/C motor has got a separate controller. This avoids the usage of clutch
- assembly magnet as essential in IC engine vehicles.
- Performance of Reva A/C remains unaffected by the speed of the engine , as the compressor is driven at constant speed at all vehicle speeds, even at rest.



BASIC COMPONENTS

COMPRESSOR

It is critical that only gas be drawn into the compressor. If liquid enters, it will cause a hydrostatic lock in the compressor and stall it. The gas drawn in is compressed,which causes it to get very hot.

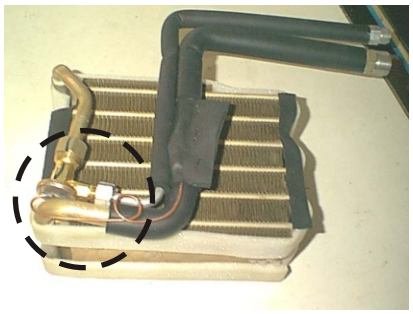


CONDENSER

The condenser mounted at the front of the vehicle acts as radiator , drawing off some of the heat of compression, and changes the high temperature gas into a liquid under high pressure. When operating normally, the inlet of the condenser is full of hot gas and the outlet is full of hot liquid.

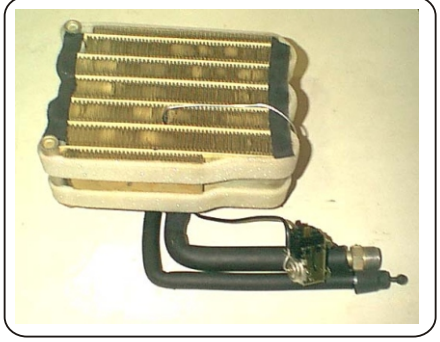
RECEIVER /DRYER

This component acts as a storage device for liquid refrigerant. It also contains a filter and a desiccant, which is a material that absorbs moisture from the A/C system. Usually, the receiver / Dryer also contains a sight glass at the outlet which allows us to see the refrigerant flowing out of it to the expansion valve.



EXPANSION VALVE

This small valve controls the flow of refrigerant into the evaporator. It is controlled by a temperature sensor at the evaporator outlet .If the outlet temperature is too high, it means not enough refrigerant is flowing into the evaporator and poor passenger cooling will result.
If the out let temperature is too cool, it means too much refrigerant is flowing and the evaporator fins will probably load up with ice. In either case, the feed back temperature sensor opens or closes the expansion valve opening to achieve the

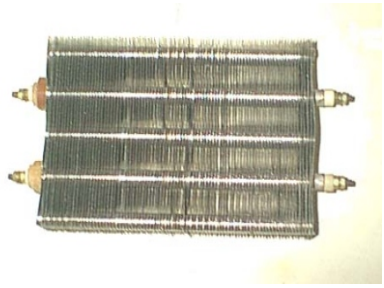


EVAPORATOR

The last component in the cycle and where we finally get around to cooling air. As the foggy mist of refrigerant enters, the air passing over the evaporator fins gives up its heat to evaporating refrigerant .At the inlet the refrigerant is liquid at the outlet is has changed into gas.

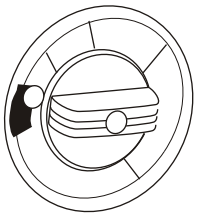
HEATER CORE

The heater core heats the air before it enters the car.



VERO KNOB

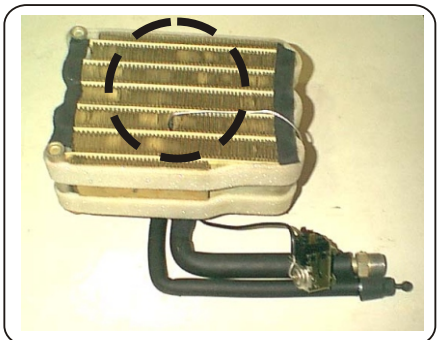
To operate the air conditioner, turn on the Blower and rotate the Varo Knob for desired cooling effect. Cool air will be Blown through the main vents gradually.



CONTROL COMPONENTS

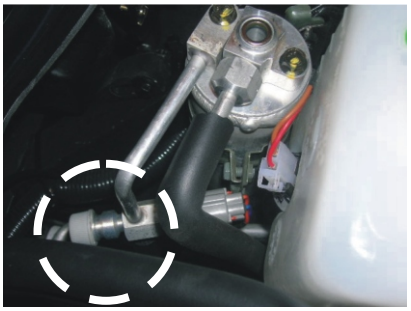
THERMOSTAT SWITCH

Thermostat is the temperature-sensing device, which is also known as anti frost device. it is installed on cooling unit and its senses the temperature of the air discharge from evaporator.
Thermostat maintains the evaporator temperature within a specified range, cutting off when the temperature goes below, the lower limit while it cuts in when the temperature rises above the upper limit.



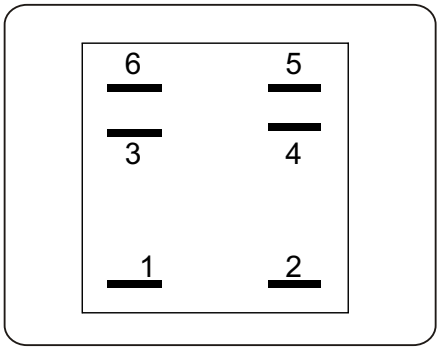
DUAL PRESSURE SWITCH

Dual Pressure switch is installed in the liquid line between tank receiver and Condenser. This switch detects abnormally high pressure of the refrigerant due to its leakage, lack of refrigerant or has reached too high a level in this system and turns the motor off. This will avoid bursting of any component /hoses of refrigeration system, due to excessive pressure.



ROTOMAG MOTOR

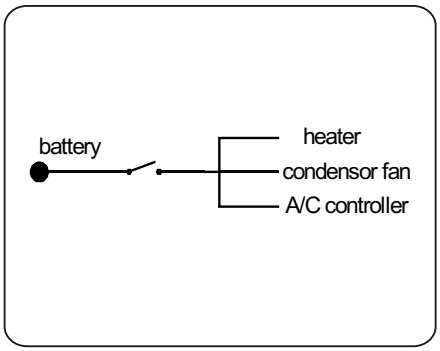
The motor is capable of running the compressor by drawing the power from the battery source. Permanent Magnet Motor are fit for use where response time is the critical factor. This has conventional armature and uses permanent magnets in place of the winding in the field. DC Power is supplied only to the armature .Since the field is constant at all times the performance curve is linear and current drawn varies linearly with the torque.



RELAY DESCRIPTION

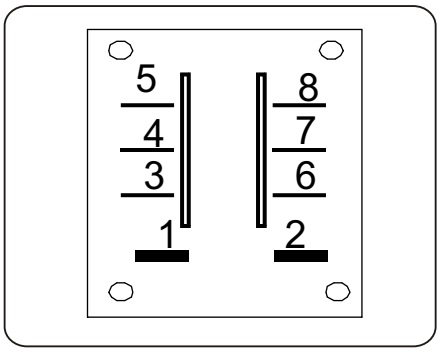
To interface the power components (blower, PMDC motor, heater, condenser fan) relays have been introduced. Low power input signal will be given to the coil winding, and high power supply is given in the contactor load side.

A/C RELAY (R1):
48 V supplies from the battery to the A/C controller, condenser fan, heater goes through the A/C relay contact. This relay avoids continuos operation of the A/C controller under any conditions. This relay gets open when the SOC is less than 25%.



Coil winding (1, 2):
UN switched 12-V supply is connected to this relay one end. Other end will be connected to switch in A/C controller. When the A/C is selected with remote or with manually, the switch will be closed and this relay coil gets ground.

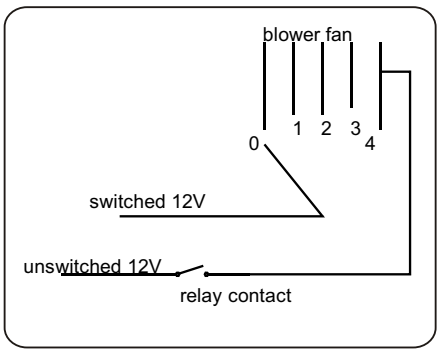
Normally opened contact (3, 4):
48-V supply is comes from the battery positive terminal. Other end is connected to the A/C motor, condenser fan relay and heater. When ever the A/C system is selected, this contact gets closed and 48V is applied across the A/C controller,



REMOTE RELAY (R2):
This relay functions when the A/C system is selected with remote operation. This relay turns on the blower for fourth speed when A/C selected in remote mode. In addition, it gives 12 V supply to the RC- Delay relay. The connection diagram is shown.

Coil winding (1-2):
UN switched 12-V supply is connected to this relay one end. Other end will be connected to the switch in A/C controller. When the A/C is selected with remote, the switch will be closed. This relay gets excite.

Normally open contact (6-7):
UN-switched 12-V supply is connected to one end of connector. Another end contact is connected to the 4th position of blower speed. When ever the relay gets excite this contact becomes close, and blower starts running for 4th speed.



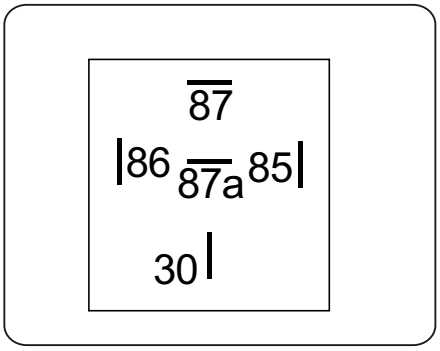
Normally open contact (3-4):
UN-switched 12-V supply is connected to one end of connector. Another end. Another end contact is connected to the RC-Delay Relay coil through a delay circuit.

CONDENSER FAN RELAY (R3):
This relay functions whenever the A/C system is selected. This relay connects 48 V supplies to the condenser fan. This relay operates in both remote and manual modes of operation.

Coil winding: 48-V supply is comes from the output terminal of the A/C controller (to contact No 1). Contact No 2 goes to the A/C controller. When ever the A/C system is selected, 48 V supplies comes to this coil contact through a delay circuit.

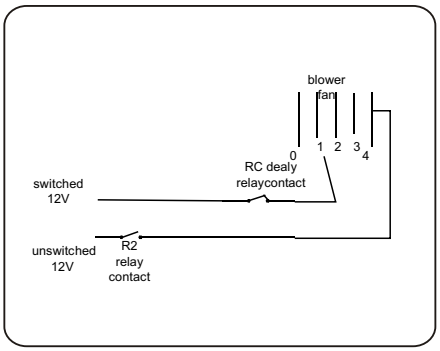
48 V contact: UN-switched 48V supply is connected to one end of contact

RC DELAY RELAY:
This relay using for a normally closed contact to the blower fan from the key switch input. In manual operation of A/C this contact will be closed. When the A/C is selected for remote operation, this relay coil gets 12V supply through remote relay (R2) contact. The contact becomes open. This relay is included to avoid circulating currents.



Coil winding (85-86):
UN switched 12 supply to this comes through the remote relay contact (3-4). Whenever the A/C is selected for remote operation, remote relay gets excite, and contact gets opened. UN switched 12V supply is applied to the RC delay relay coil through a delay circuit.

Normally closed contact (30-87a):
Switched 12V supply to the blower is given through a normally closed contact of this relay. When the A/C is turned off this contacts become close, with a delay of 1 sec. This delay is to avoid circulating currents.



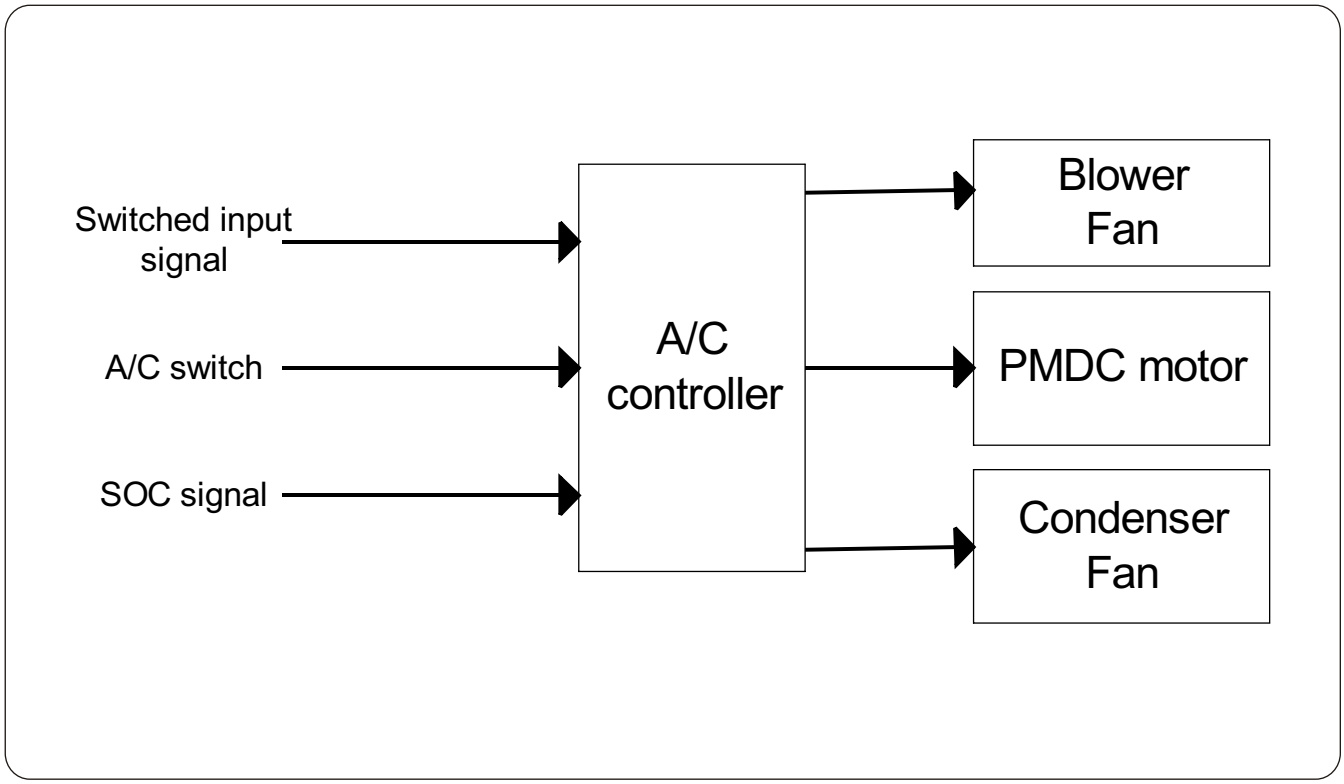
AIR CONDITIONING IN REVA

Air conditioning in REVA contains a compressor, driven by a Permanent magnet DC motor. The supply to the motor is given through an A/C motor controller. The air conditioning system in the car is having different modes of operation. To interface the PMDC motor , blower and condenser fan, and heater through Relays , in all modes of operation, an A/C controller is incorporated.

A/C system in REVA contains two versions:
1. **Standard A/C:** Provides manual operation in driving mode.
2. **Reva Classe:** Provides Air Conditioning in manual and remote operations.

FUNCTIONAL BOCK DIAGRAM AND BRIEF DESCRIPTION:

Standard A/C:

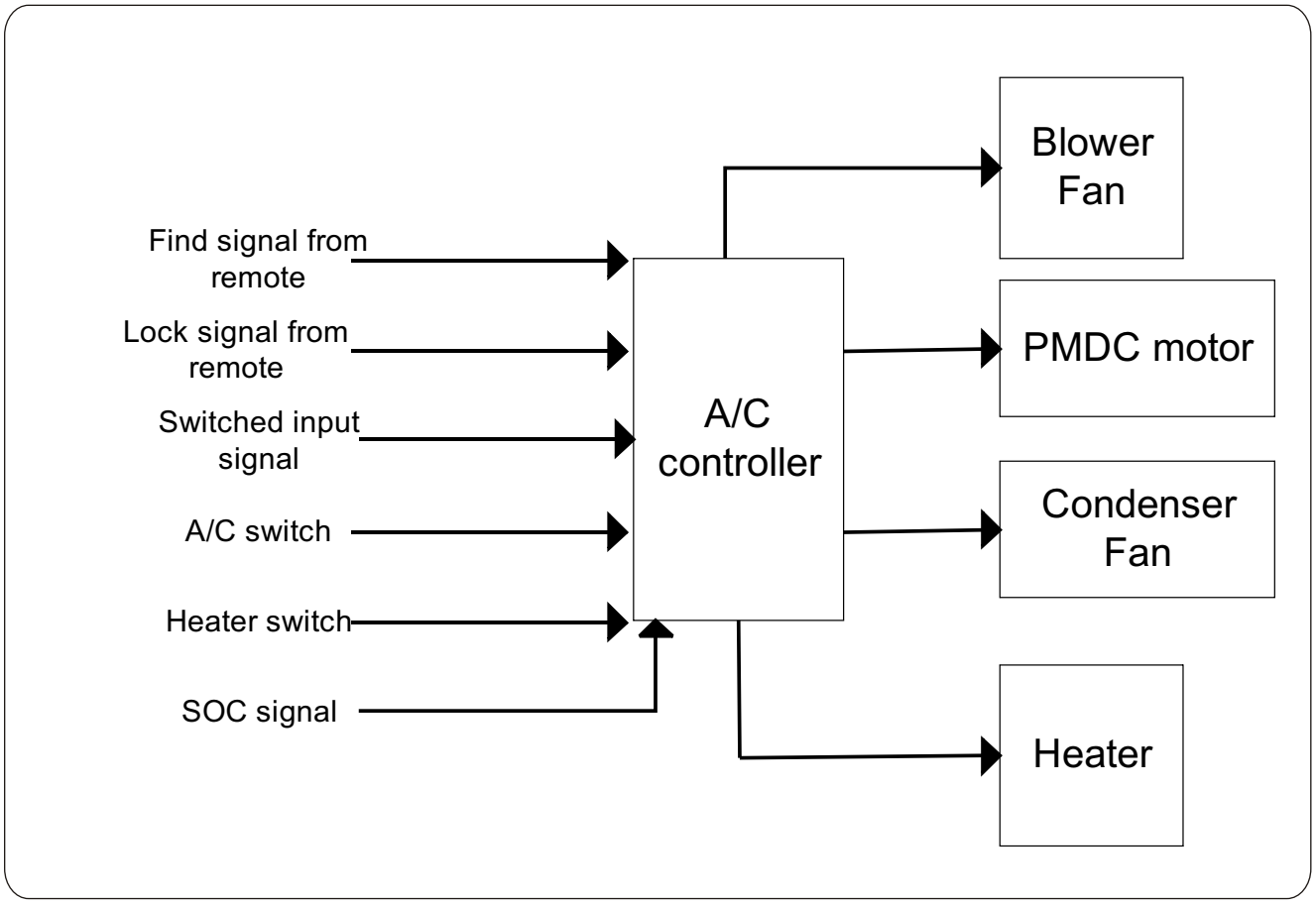


Block diagram description:
An electric motor driven compressor is used in this system. PMDC motor is selected for driving this compressor. A 48 V condenser fan is used for reducing the temperature of the compressed gas coming out from compressor. Blower fan will pump the airflow in to the cabin through the evaporator grill.

Operation: A/C can be selected by selecting key switch, blower switch, and **Vero Knob** turned. The switching sequence may be in random. A/C system shuts down, if any of the switches is turned off.

SOC: A low battery signal is given to the A/C controller. If the SOC is less than 25% or in equalization charge, the A/C system will not function.

REVA Classe



The Air Conditioning system in REVA Classe provides following features,

- A/C with cooling
- A/C with heating
- A/C with cooling and heating

BLOCK DIAGRAM DESCRIPTION:

A/C with cooling: An electric motor driven compressor is used in this system. PMDC motor is selected for driving this compressor. A 48 V condenser fan is used for reducing the temperature of the compressed gas coming out from compressor. Blower fan pumps the airflow in to the cabin through the evaporator grill.

A/C with heating: A 48 V volts heater coil is placed in the blower fan assembly, provides warm air in to the cabin. Heater comes on when blower switch pulled and selects the speed.

A/C with heating and cooling: Provides both cooling and heating at a time by running motor, condenser fan and heater.
The above features of the system can be selected manually or with remote by pre selecting the Vero knob or heater switch or both ON.

Manual operation: A/C (either cooling or heating or both) can be selected by selecting key switch, blower switch, and Vero knob (or heater) . These should be ON. Both cooling and heating is available by choosing both Vero knob and heater switch. If any of the switch gets off, the A/C system shuts down.

With remote: A/C (either cooling or heating or both) functions with the help of remote, designed for CDL system. This remote contains 3 buttons.
"L" for locking the door and turn off the A/C system.
"C" for switching on the A/C system
"U" to UN-lock the door.

A/C system with remote can energize in following ways,

The Vero knob has to be in desired position for air-cooling.
The blower has to be pulled out (heater switch) for heating.
Both vero knob turned on and blower has to be pulled out, for cooling and heating.

Blower runs for high-speed operation, independent of it's position.

SOC:
A low battery signal is given to the A/C controller. If the SOC is less than 25% then the A/C System (both cooling and heating) will not function.
A/C System shuts down, during equalization charge.

ELECTRICAL SPECIFICATION

MOTOR CONTROLLER:
Input characteristics:

Input voltage	Min	42 volts
	Max	65 volts
Input current	Nominal	31.5±1 Amps

Output characteristics:

Output voltage	Min	42 volts (±1 volts)
	Max	65 volts (±1 volts)
Output current	Nominal	31.5±1 Amps

TROUBLESHOOTING

Before the hot season starts, do a systematic check on each functional part in the refrigeration cycle. This will make it possible to find those troubles which customers are seldom aware of. The early discovery and prompt repair of troubles will contribute to the longer service life of each device.

VISUAL AND ACOUSTIC CHECKS

- **Is V-Belt too loose?**
  If a V Belt is too loose , it will be torn off because of slippage. To prevent such trouble , keep the belt tight. Replace a torn belt with a new one.

- **Noise around the compressor .**
  Check the compressor mounting bolts and the bracket mounting bolts for looseness and tighten it if necessary. Check that the mounting brackets should not come in contact with the body of the car. (Note: It should be isolated from the body.)

- **Noise from inside the compressor .**
  This may indicate that either a delivery or suction valve has been damaged or the connecting rod has become loose. In such a case ,dismount the compressor and replace it.

- **Mud and dirt on the condenser and fins.**
  If the condenser and fins are fouled with mud or dust , the cooling effect of the condenser will decline to a marked degree and the room cooling capacity to the air conditioner will also be reduced .Be sure to wash the mud and dust off the condenser . If the condenser fins are washed with hard hair brush, they will be scratched or bent. Therefore, clean them carefully.

- **Dirty connection and portions with oil -**
  The presence of oil indicates that the refrigerant is leaking. The compressor oil contained in the refrigerating gas escapes from the cycle together with the leak refrigerant. Consequently, the gas leaking portions get fouled with oil. If any place has become dirty with oil ,re-tighten the fastener or replace the related parts to prevent gas leakage. Oil stains are frequently found in the compressor gaskets and piping connections, so check these portions carefully.

- **Noise around the blower.**
  Run the blower at low, medium, and high speeds. If you notice any abnormal operating noise or unsatisfactory rotation, replace the blower motor .But before replacing the blower motor , see if the noise is caused by foreign matter stuck in the motor or if the motor is running unsatisfactorily because of loose parts.

- **Checking the quantity of refrigerant through the sight glass.**
  When many air bubbles are seen through the sight glass, it indicates a lack of refrigerant. Therefore, add refrigerant up to its proper level. In case, there are any oils stains , confirm that the refrigerant is not leaking from any point. If no air bubbles are seen through the sight glass even when the condenser is cooled with water, it indicates that too much refrigerant has been charged into the condenser. In this case, carefully drain the refrigerant through a low pressure service valve . Other wise, too much refrigerant will drain out or the compressor oil will spurt out.

TROUBLESHOOTING OF A/C SYSTEM

Problem 01 (continuos function of A/C system):

Once the 12 pin connector (CN-116) is tested as per the instructions given in checking of A/C harness, connected to the A/C controller, A/C may start running by default. Switch it off with "L" button. If the system not getting shutdown follow these steps.

- Remove the F_0 fuse, the system will shutdown.
- Check 8^{th} pin of 12-pin connector (CN-116). It should give 12 V pulse at this pin.
- The problem could be in the A/C controller. Replace the old A/C controller by new piece.

Problem 02: (A/C system not working in manual mode)

- Check the SOC status. If the SOC is less than 25%, A/C will not run.
- Check the F_0 fuse.
- Check the 40Amps fuse (F-14) at the rare tub. And check the voltage across the A/C motor terminals. It should be more than 42 V. if motor not running then problem would be in motor. Refer the Problem No: 9
- If still problem persist then Remove the IP.
- Check intactness of the RC delay relay harness connections or in blower harness connections.
- If blower still is not working refer Problem No:8.
- If blower is started working then check the voltage (when blower is working with VERO KNOB on) at the ends of DPS switch with respect to chassis ground. Both sides should get voltage of 12 V. then Check the 5th pin of 12-pin connector (CN-116). It should give 12 V.
- 48V are available at the A/C controller input and 12 V signal is coming at the 5th pin of 12 pin connector. If the A/C controller were not giving the out voltage more than 42 V then problem would be in the A/C controller.
- If out put is available at the A/C controller and motor not running please refer Problem No:7
- If the A/C controller not getting 48V input, check the 48V at the R1 relay input and output terminals. If the output contact is not giving the voltage then check the voltage across the relay coils. It should be 12 V.
- Otherwise then Check 11th pin of CN-116. When key switch is ON this pin should give 12 V dc signal. Check 12th pin of CN-116. When the Vero knob
- is ON, this pin should give 12 V signal. Other wise refer A/C harness drawing for connections.
- Problem could be in A/C controller if the above-specified voltages are existing and the R1 relay is not getting closed

Problem 03 (system not working in remote mode):

- The A/C system can be selected with the help of remote. Select the Vero Knob on and press the "C" button A/C system will come with in 8-10 sec's. If the system is not getting responding follow the below steps for rectification.
  A/C motor, condenser fan and blower fan are not running.
- Check the SOC status. If the SOC is less than 25%, A/C will not run.
- If the car is getting charging in equalization mode then A/C not functions.
- Check the F_0 fuse.
- Remove the IP. With out removing the 12 pin connector from the controller,
- Check the 7th pin of 12-pin connector (CN-116), by selecting the "C" button, it has to give 12 V continuos signals. If these are not coming, check pin No 1 of the 2 way male pin connector (CN-114). It should be connected to CDL harness.
- Check the R1, R2 relays are getting closed or not. If not check the continuity of the 1st, 2nd pins of 12-pin connector (CN-116) with respect to the chassis ground. If the continuity is not available problem could be in controller.
- If A/C working with only blower and motor and condenser fan are not running, then check the DPS switch explained in previous section.

Problem 04: A/C or heater in remote operation is not continuously ON.

This problem will be observed if blower is left for any speed operation, and select the A/C with remote, system will not run continuously more than 2min. This problem occurs if there is any problem in the RC delay circuit. This may cause some other mal functions.

Lock the doors with remote, and press the "C" button and the system will starts after 8 sec's, with the hooter.

- Key switch ON, and blower, Vero knob (Blower or both) switch on, system continues to run with hunting.

This will be a problem in the RC delay circuit. May be failure in the circuit or in loose connections

Problem 05: SOC < 25%

If the SOC is less than 25%, than the system should be shut down. Some mal functions may appear in the system in following way,

System may shut down for 35%.

! System may not shut down even for 25%, or it may be hunting.

Follow these steps to find the problem,

! Remove the IP and check the input signal voltage level at the 9th pin of 12 pin connector. It should be 12 V with out IP cluster. This is 12 V signal coming from the EMS.

! Connect the IP cluster. If the voltage will drop less than 6Vat the same pin , problem in IP cluster. Because of loading of red LED, voltage is dropping down. Change the intermediate IP harness.

! With out IP cluster, the voltage at the input pin to the A/C controller is 12V. For this voltage system gives mal operation when the SOC is less than 25%.

Problem 06: (condenser fan not working)

! Check the condenser fan fuse (F-16)

! Check the R_3 relay connection. Refer relay description for R3 relay.

Problem 07: (motor not working)

When the A/C system is selected for manual operation Check the SOC, if SOC $<$ 25% A/C both condenser fan and motor will not run. Refer the **Problem No 02.**

If the problem in the motor, remove the motor connections and clean the carbon dust in the motor an check the IR value. If IR value is less than 2 Mega Ohm, then refer the problem to RECC.

If the IR value is more than 2 Mega Ohm, run the motor in no load condition. Also check the brush wear of the motor.

Problem No 8: (blower not working)

In manual mode operation blower not working with key switch ON. That could be problem in the RC delay circuit and blower harness connections. Check the intactness of the both the connections.

Problem 9: (less cooling)

This situation may arise when the A/C motor runs with low speed under over load . Reasons for this case.

! If the refrigerant charge is less due to leakage.

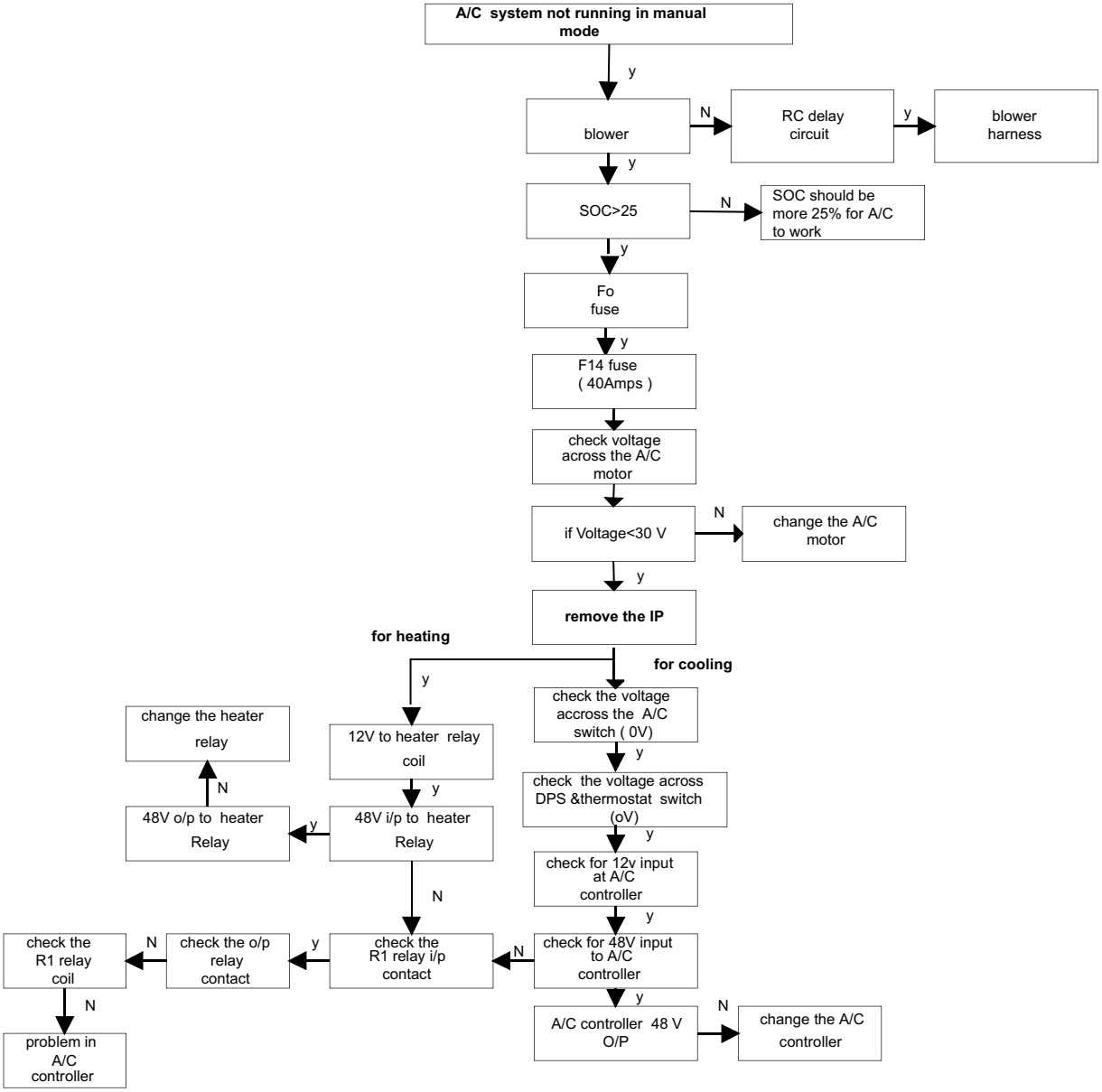
! If the refrigerant charge is more, motor runs with low speed.

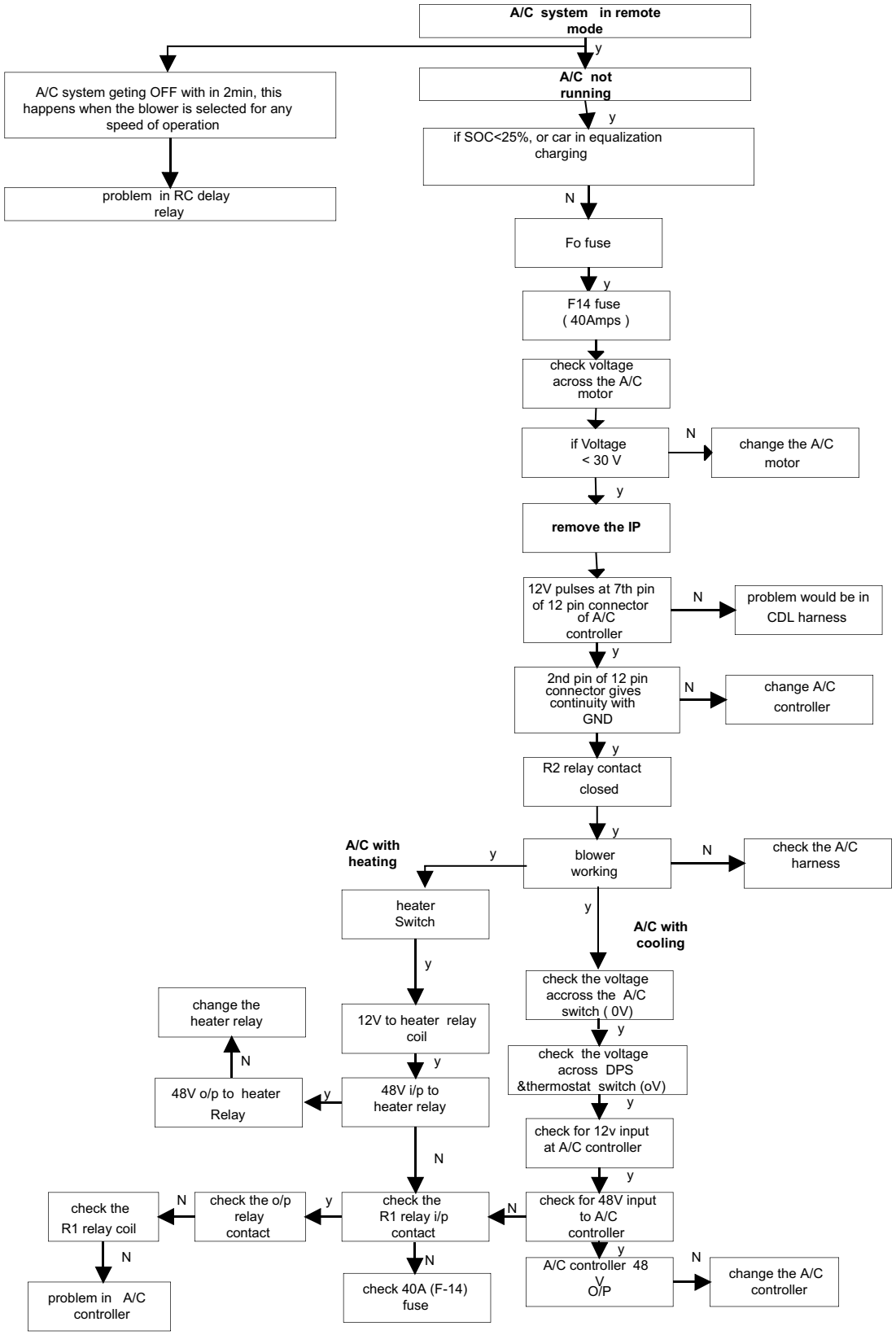
! If any over loading due to compressor mechanical failure.

! During condenser fan failure.

For above points 1,2,3, Refer check sheet for charged state of refrigerant.
During condenser fan failure refer problem No : 6.

Problem may rise form A/C controller. Measure the current at the input terminals of the motor. It should be in 18-24 Amps limit. If the voltage at the motor terminals is less than 42 volts, and current is less than 18 Amps then problem would be in A/C controller. Replace the A/C controller.


A/C system not running in manual mode
y
blower
N
RC delay circuit
y
blower harness
y
SOC>25
N
SOC should be more 25% for A/C to work
y
Fo fuse
y
F14 fuse (40Amps)
check voltage across the A/C motor
if Voltage<30 V
N
change the A/C motor
y
remove the IP
for heating
for cooling
y
12V to heater relay coil
y
48V i/p to heater Relay
y
48V o/p to heater Relay
N
change the heater relay
N
check the R1 relay i/p contact
y
check the o/p relay contact
N
check the R1 relay coil
N
problem in A/C controller
check the voltage accross the A/C switch (0V)
y
check the voltage across DPS &thermostat switch (oV)
y
check for 12v input at A/C controller
y
check for 48V input to A/C controller
N
y
A/C controller 48 V O/P
N
change the A/C controller


A/C system in remote mode
y
A/C not running
y
if SOC<25%, or car in equalization charging
N
Fo fuse
y
F14 fuse (40Amps)
check voltage across the A/C motor
if Voltage < 30 V
N
change the A/C motor
y
remove the IP
12V pulses at 7th pin of 12 pin connector of A/C controller
N
problem would be in CDL harness
y
2nd pin of 12 pin connector gives continuity with GND
N
change A/C controller
y
R2 relay contact closed
y
blower working
N
check the A/C harness
y
A/C with heating
y
heater Switch
y
12V to heater relay coil
y
48V i/p to heater relay
y
48V o/p to heater Relay
N
change the heater relay
N
check the R1 relay i/p contact
y
check the o/p relay contact
N
check the R1 relay coil
N
problem in A/C controller
N
check 40A (F-14) fuse
A/C with cooling
y
check the voltage accross the A/C switch (0V)
y
check the voltage across DPS &thermostat switch (oV)
y
check for 12v input at A/C controller
y
check for 48V input to A/C controller
N
y
A/C controller 48 V O/P
N
change the A/C controller

Electrical Functioning of the A/C system:

		Steps to be carried out			Effect on system
Manual operation	A/C ON	Key switch ON	Blower switch ON	Vero knob ON	A/C motor, blower and condenser fan will ON
	A/C OFF	Key switch ON	Blower ON	Vero knob OFF	A/C motor and condenser fan OFF. Blower ON
		Key switch ON	Blower OFF	Vero knob ON	A/C motor & Blower and condenser OFF.
		Key switch OFF	Blower ON	Vero knob ON	A/C motor, Blower and condenser fan are OFF
Remote operation	A/C ON	Select the Vero knob and Press the find button "C", wait for 8 sec.			A/C motor runs with condenser fan and blower (4th speed)
	A/C OFF	Press the lock button "L".			Lock the car door
		System will be switched off automatically after 20 min.			Functions with remote only

Functioning of Heater system :

		Steps to be carried out			Effect on system
Manual operation	Heater ON	Key switch ON	Blower switch ON	Heater switch ON	Heater and blower will be ON
	Heater OFF	Key switch ON	Blower ON	Heater switch OFF	Heater is OFF. Blower ON
		Key switch ON	Blower switch OFF	Heater switch ON	Heater & Blower OFF
		Key switch OFF	Blower ON	Heater switch ON	Heater & Blower OFF
Remote operation	Heater ON	Pull the blower switch and Press the find button "C", wait for 8 sec.			Can't get the hazard light
	Heater OFF	Press the lock button "L".			Lock the car door
		System will be switched off automatically after 20 min.			Functions with remote only

NOTE

The A/C system will be switched off automatically when the SOC is less than 25% OR in equalization mode.

CHECKING CHARGED STATE OF REFRIGERANT

The following procedure can be used for quickly checking whether the A/C system has a proper charge of refrigerant or not.
Operate A/C at its max. cooling capacity for a few minutes. Then lock at the sight glass on receiver/dryer to check charge of refrigerant.
Use the following table when checking charged state of refrigerant and correct it as necessary.

Item no.	Symptom	Charge of refrigerant	Remedy
1.	Bubbles observed in sight glass	Insufficient charge of refrigerant in system	Check system for leaks with a leak tester or soap solution
2.	No bubbles observed in sight glass	No or insufficient charge of refrigerant in system	Refer to the items 3 and 4
3.	No temperature difference between compressor inlet and outlet	Empty or nearly empty system	Evacuate and charge system and then check it for leaks with a leak tester or soap solution.
4.	Noticeable temperature difference between compressor inlet and outlet	Proper or too much charge of refrigerant in system	Refer to the items 5 and 6
5.	When A/C is turned OFF , refrigerant in sight glass clears immediately and remains clear.	Too much charge of refrigerant in system	Recover refrigerant, evacuate air and charge proper amount of refrigerant.
6.	When A/C is turned OFF, refrigerant in sight glass once produces bubbles and then clears	Proper charge of refrigerant in system	No Correction needed because charge of refrigerant is normal.

AC PERFORMANCE CHECK-UP PROCEDURE

Step1:
- Open the doors
- Check & adjust position of:
  - Grill direction
  - Select the blower switch position.

Step2 :
- Open the hood
- Check:
  - Conditions of condenser surface. Clean condenser with low pressure water, if required.
  - Belt Tension by the belt tension checking gauge.(Refer Page 30)

Step3:
- Switch on blower to maximum speed
- Turn on Vero knob

Step 4:
- Check sight glass on receiver drier if refrigerant is adequate , the glass will be clear , if refrigerant is less the glass will show excessive bubbles.

Step 5:
- If refrigerant level is low
  - Stop the A/C
  - Check refrigerant leakage by using leak detector/ using soap water

Step 6:
- Release all refrigerant.
- Repair leakage and check again
- Vacuum system by using vacuum pump
- Recharge refrigerant.

Step 7:
- Check A/C Performance by the thermometer
- Sit in the vehicle.
- Close all the doors and windows
- Switch on the blower to maximum speed.
- Install the thermometer in center grill

AIR CONDITIONING MOTOR CURRENT CONSUMPTION CHART IN DIFFERENT AMBIENT TEMPERATURES

The current consumption of AC motor differs on climatic ambient temperature. The current consumption increases in higher ambient temperature and decreases in lower ambient temp. Normally the AC motor has to consume 18 -28 Amperes depending on Ambient temperature. If it exceeds 31.5A the AC controller will trip the power supply to

Ambient Temp	AC Motor Current Consumption
20 - 30 C	16 - 20A
30 - 35 C	20 - 25A
35 - 45 C	25 - 30A

DO'S & DON'TS For A/C System:

Sl. No	DO'S	Reason
1	Clean condenser during regular service of the vehicle	Dirty & Clogged Condenser results in A/C Tripping and less cooling.
2	Maintain proper refrigerant Level	Less refrigerant results in less cooling. Excessive refrigerant results in A/C tripping and less cooling.
3	Add recommended Oil & quantity in the compressor during refrigerant charging	Adequate quantity of compressor oil prevents poor pumping and premature wearing of internal components.
4	Clean evaporator periodically to remove Dust and foreign particles.	Clogged Evaporator results in less airflow and reduced cooling.
5	Educate Customer on Proper Usage of A/C controls (Refer Owner's Manual)	Proper usage of A/C Control will give optimum cooling
6	Check Proper Belt Tension	Loose belts will slip and over tight belt will result in noise.

Sl.No	DON'T'S	Reason
1	Do not operate A/C without refrigerant in the system	This will result in premature failure of Compressor.
2	Do not check the A/C System with more than 20-kg/cm2 pressure.	Higher pressure may result in damage to A/C Components.
3	Do not leave A/C joints open	Moisture tends to enter the A/C system if the joints remain open for long time.
4	Do not charge refrigerant in the A/C system m without carrying out proper vacuum	Improper or No vacuuming of the A/C system results in less cooling conditions.

NECESSARY STEPS TO BE CARRIED OUT TO RUN THE A/C

- A/C switch (heater switch or both) should be activated to run the A/C (cooling or heating or both) with remote.
- Before selecting with remote, lock the door with "L".
- If A/C comes ON unwontedly, terminate by "L" button.

FOLLOWING THESE STEPS WILL CAUSE MAL-FUNCTION OF A/C

- If the car is locked with remote, A/C will come with hooter, in the following cases.
- Pull out the door knob and open the door.
- Open the door with door lock.
- Key switch ON.
- Pressing the "L" button can terminate hooter and A/C.

Brush Replacement chart for PMDC Motors in REVA

Brush readings @ Odo (Kms)	Expected remaining length of brush	Expected Wear	Minimum Brush reading found	Action to be taken
60 Hrs OR 4800kms	19.45 mm	1.05 mm	Less than 17.35 mm	Replace the brush
			Between 19.45 mm to 17.35 mm	Check brush wear out @ 16000Kms
			More than 19.45 mm	
200 Hrs OR 16000Kms	17 mm	3.5 mm	Less than 15.25 mm	Replace the brush
			Between 15.25 mm to 17.0 mm	Check brush wear out @ 32000Kms
			More than 17.00 mm	
400 Hrs OR 32000Kms	13.5 mm	7 mm	Less than 13.5 mm	Replace the brush
			More than 13.5 mm	Check brush wear out @ 48000Kms
600 Hrs OR 48000Kms **	10 mm	10.5 mm	Less than 12.6 mm	Replace the brush

Notes :
1. Expected brush life : 48000 Kms.
2. Initial brush length : 20.5 mm
2. Maximum wear allowed: 10.5 mm i,e, remaining brush length 10mm minimum.
3. Reading of all 4 brushes to be taken before arriving at the minimum length.
4. Brush wear out need to be checked at every service.
5. ** Car to be called for brush replacement

Total Life : 600Hrs

- Considering normal drive as 2Hr/Day and 1Hr of AC usage/day – 600days
- 600days x 65kms upto 35% soc = 39000kms
- 600days x 15kms from 35% - 20% soc = 9000kms

Brush life is 600Hrs of usage of AC or 48000kms (39000+9000) drive with AC ON

ON VEHICLE SERVICE

When servicing air conditioning system , the following rules must be observed:

REFRIGERANT RECOVERY

When discharging refrigerant out of A/c system, always recover it by using refrigerant recovery and recycling equipment.

NOTE

When handling recovery and recycling equipment, be sure to follow the instruction manual for the equipment.

WIRING

- Remove F0 and F14 (40A) Fuse before removing -ve and +ve cable.
- Connect wire connectors securely.
- When routing a wire harness through a panel hole, first insert a rubber bushing into the hole for its protection.
- Use vinyl tape or original clamp to connect air conditioning wire harness to main wire harness.
- If original harness has been disconnected or removed while servicing , return it to a proper position .
- During their installation , be careful not to pinch original clamps and A/C wire harness.
- When soldering , use those lead wires which share the same diameter and tape each connection.
- Keep wire harness away from any moving components as these may be subjected to high temperature .
- Make sure that wire harness makes no contact to a sharp edge or corner.
- Standard routing as per drawing should be followed.

REFRIGERANT LINES:

- Never use heat for bending pipes .When bending a pipe , try to make a bend as little as possible.
- Keep internal parts of A/C free from moisture and dust. When disconnecting any line from system , install a blind plug or cap to such line immediately.
- When connecting hoses and pipes to each other respectively, apply a few drops of refrigerating oil to seats of coupling nuts and o ring.
- When tightening or loosening a fitting, use two wrenches , one to turn and the other for support.
- Receiver /dryer inlet fitting must be connected to the pipe from condenser outlet fitting.
- Route drain hose so that drained water does not make any contact to car components.

HANDLING REFRIGERANT - R134a

- When handling refrigerant , always wear goggles to protect your eyes.
- Avoid your direct contact to liquid refrigerant.
- Do not heat refrigerant container higher than 40C
- Do not discharge refrigerant into atmosphere.
- Do not allow liquid refrigerant to touch bright metals. Refrigerant combined with moisture is corrosive and will tarnish surfaces of bright metals including chrome.

WARNING

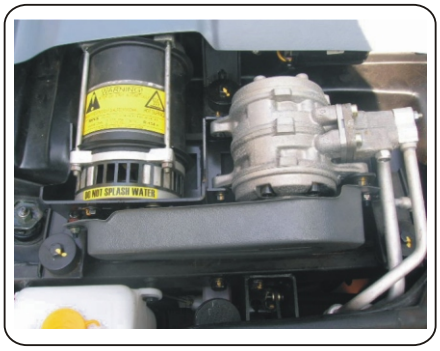
! In case if Refrigerant 134a strike your eye(s):

DO NOT USE YOUR HAND TO RUB AFFECTED EYES(S)

..Instead , use quantities of fresh cold water to splash it over affected area .

! Obtain proper treatment as soon as possible from a doctor or eye specialist.

! Should liquid R134a get on your skin , such affected part should be treated in the same manner as when skin is frostbitten or frozen.



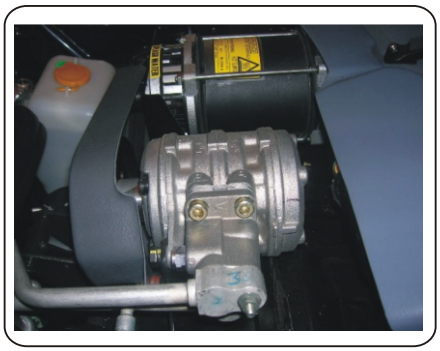
COMPRESSOR

REMOVAL

- ! Recover refrigerant from refrigeration system using recovery and recycling equipment.
- ! Disconnect suction and discharge flexible hoses from compressor

NOTE

As soon as the above hose and pipe disconnected, cap the open fittings so that moisture and dust do not enter condenser.



- ! Remove the pulley belt cover.
- ! Motor bolts to be removed and push the motor to RH side so that pulley belt can be loosen and belt can be removed.
- ! Remove the compressor from its mounts.

INSTALLATION

- ! Reverse removal procedure to install compressor.
- ! When installing new compressor, take out extra amount of oil which is 40 cc from new compressor.
- ! After installing check the tension of the belt, it should be for 8kg 7mm deflection.
- ! Evacuate air from A/C system, charge A/C system with refrigerant and check for gas leakage.

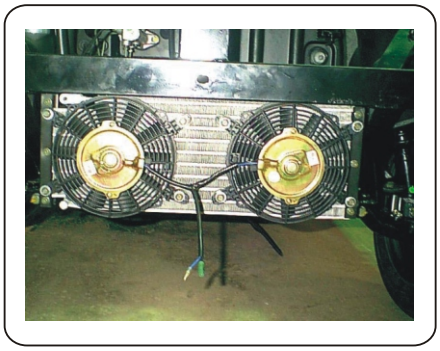
NOTE

Cap the open fittings immediately to keep moisture out of system.

CONDENSER

INSPECTION

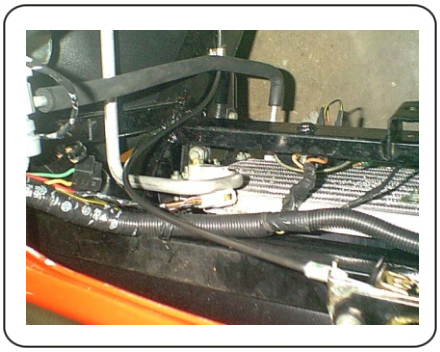
Check a) condenser fins for blockage b) condenser fittings for leakage and c) condenser fins for damage. Clogged condenser fins should be washed with water, and should be dried with compressed air.



NOTE

Be careful not to damage condenser fins. If any condenser fins are bent, straighten then using a screwdriver or pair of pliers. If any leakage is found from fitting or tube, repair or replace condenser.

- ! Recover refrigerant from refrigeration system using recovery and recycling equipment.
- ! Remove the bumper.
- ! Disconnect condenser fan lead wire at coupler.
- ! Remove compressor delivery hose from condenser inlet fittings.



- ! Remove the condenser two top mounting bolts and two bottom mounting bolts.

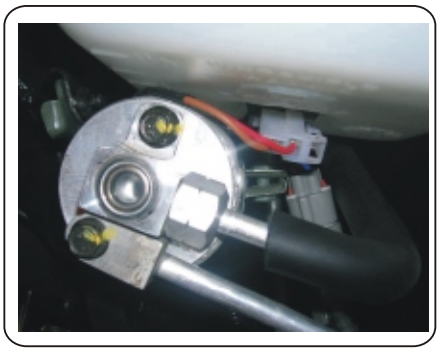
NOTE

As soon as the above hose and pipe disconnected, be sure to cap the opened fittings so that moisture and dust do not enter condenser.

INSTALLATION
Reverse removal procedure to install condenser .when replacing condenser , add 10 20 cc of refrigerant oil from the compressor suction-side.
Evacuate air from A/C system , charge A/C system with refrigerant and check gas leakage.
Torque: 10-12 Nm

Amount of refrigerant : 530 g

RECEIVER DRYER



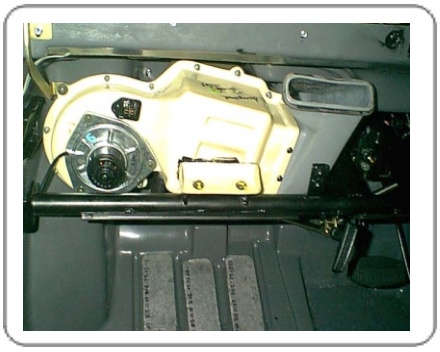
! Use a leak tester (or soap foam/water) to check for leakage around sight glass, fusible plug and fittings.

REMOVAL
! Recover refrigerant from refrigeration system using recovery and recycling equipment.
! Disconnect liquid pipes from receiver dryer inlet and outlet fittings.
! Remove the receiver dryer after removing the holder bolts.

INSTALLATION
! Reverse removal procedure to install receiver dryer , add 10 cc of refrigerating oil from compressor suction-side. Blind plugs of the receiver dryer should not be removed until just before receiver dryer is installed.
! Evacuate air from A/C system, charge A/C system with refrigerant and check gas leakage.

! Torque : 10-12 Nm
! **Amount of refrigerant : 530 g**

EVAPORATOR (COOLING UNIT)



REMOVAL
! Recover refrigerant from refrigeration system using recovery and recycling equipment.
! Remove the following parts
! Steering wheel,
! Tree switch
! Disconnect connector from Instrument Panel.
! Remove the bumper .
! Remove the spare wheel.
! Remove the Master cylinder and parking brake-mounting bolts.
! Loosen or remove the steering column mounting bolts.
! Then remove the pedal box weldment.
! Disconnect all the wiring harness (heater harness & blower harness) connected to the evaporator unit.
! Disconnect compressor suction hose and receiver dryer outlet pipe from the evaporator unit.

NOTE

As soon as the above hose and pipe disconnected, be sure to cap the opened fittings so that moisture and dust do not enter cooling unit.

! Remove its attaching bolts and clamp mounting to remove evaporator unit.

DISASSEMBLY

! Separate the evaporator unit in upper and lower cases from each other.
! Pull out thermister of evaporator thermal switch from between evaporator fins.
! Take out the evaporator from the upper and lower cases.
! Detach the following from the evaporator.
! Pipe
! Expansion valve

INSPECTION

! Check evaporator fins for blockage. If found clogged , use compressed air to clean fins.

NOTE

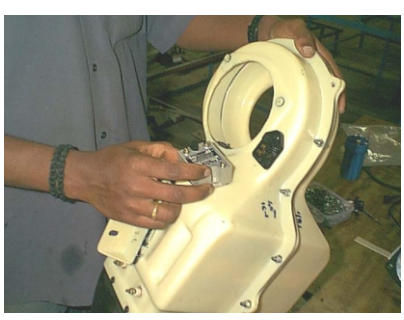
Do not use water for cleaning evaporator.

! Check inlet and outlet fittings for crack or scratches. Repair as required.

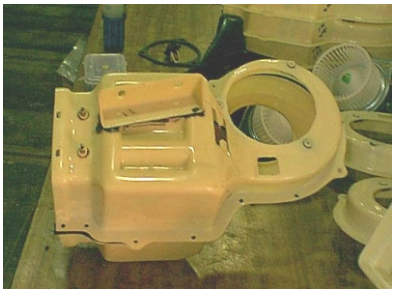
INSTALLATION

! Reverse removal and disassembly procedure to install evaporator , add 20cc of refrigerant oil from compressor suction side.
! Evacuate air from the A/C system , charge A/C system with refrigerant and check gas leakage.

! Torque : 10-12 Nm



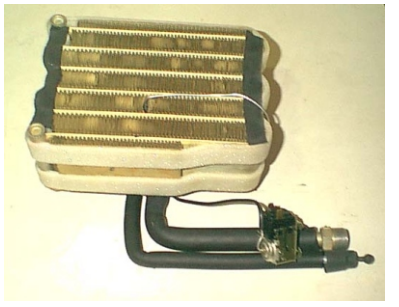
EXPANSION VALVE



REMOVAL
Refer to removal and disassembly of evaporator described previously.

INSTALLATION
Reverse removal procedure to install expansion valve.
Evacuate air from A/C system, charge A/C system with refrigerant and check for gas leakage.

Amount of refrigerant: 530 g



REFRIGERANT LINE

INSPECTION

- Use leaker tester /soap foam solution to check hoses and pipes for any gas leakage.
- Check to see if each hose or pipe has any loose clamps. Re tighten or replace loosened clamp as required.

REMOVAL

- Recover refrigerant from refrigeration system using recovery and recycling equipment. Be sure to follow the instruction manual for the equipment .The amount of compressor oil removed must be measured and the same amount added to the system.

NOTE

When tightening or loosening a fitting, use two wrenches, one to turn and the other for support.

NOTE

As soon as hose or pipe is disconnected . be sure to cap the opened fitting from which it is disconnected to prevent moisture and dust from entry.

INSTALLATION

- Reverse removal procedure to install refrigerant line.
- Be sure to tighten flare nuts and connecting bolts to specified torque.
- Evacuate air from A/C system , charge A/C system with refrigerant and check for gas leakage.

- **Amount of refrigerant: 530 g**

A/C MOTOR (PMDC)

REMOVAL

- Remove Wiper arm, hood and cowl panel
- Remove the pulley belt cover.
- Remove bolts of the motor
- Remove the belt.
- Disconnect the coupler from the wire and remove the motor.

INSTALLATION

- Reverse removal procedure to install motor.
- After installing check the tension in the belt.

DRIVE BELT

INSPECTION

- Check for motor and compressor pulley wobbling.
- Check the alignment of both compressor and motor pulley faces.
- Check belt for wear and crack , and replace it as required.
- Using belt tension gauge check belt tension by measuring how much it deflects when pushed at intermediate point between A/C compressor pulley and motor pulley with about 8 kg Deflection of A/C belt
- "a" : 7 mm.

AC CONTROLLER

REMOVAL

- Remove the Steering Wheel
- Tree switch
- Remove the IP.
- After Removing follow the below Procedure for connection

Sequence of steps to followed while removing the A/C controller from car -

- Remove the 12 Pin connector (CN-116) to the controller
- Remove the 48 V 2pin connector to the A/C controller.
- Remove two single pin 48 V connectors from the A/C controller to the PMDC motor.

INSTALLATION

- Reverse removal procedure to install A/C controller.

Sequence of steps to followed while assembling the A/C controller in the car

- Connect the two single pin 48 V connectors from the A/C controller to the PMDC motor.
- Connect the 48 V 2pin connector to the A/C controller.

CONTROLLER ASSEMBLY

TESTING OF A/C HARNESS AT THE A/C CONTROLLER END FOR STANDARD A/C CAR

Sequence of steps to followed while assembling the A/C controller in the car:

- Connect the two single pin 48 V connectors from the A/C controller to the PMDC motor.
- Connect the 48 V 2pin connector to the A/C controller.
- Connect the 12 Pin connector (CN-116) to the controller.

Sequence of steps to followed while removing the A/C controller from car:

- Remove the 12 Pin connector (CN-116) to the controller
- Remove the 48 V 2pin connector to the A/C controller.
- Remove two single pin 48 V connectors from the A/C controller to the PMDC motor.

Checking of A/C harness connections:

- Before assembling the A/C controller in the car, respective voltage levels or GND connections at all pins has to check as specified below.
- Check the 48V-supply line of two-pin connector (CN-107) of A/C controller, i t should be zero volts. And the black wire continuity with chassis should give.
- Check the continuity of other two single pin connectors coming from A/C motor (PMDC motor), with the chassis. Continuity should not be available.
- Checking of 12-pin connector (CN-116) for A/C controller.

Pin No 1:
Active GND signal connected to the R1 relay. It has to give 12 V (1.5) signal.

Pin No 3:
12V (1.5) UN switched supply

Pin No 4:
Ground connection.

Pin No 5:
12V (1.5) signal coming through thermostat. It gives active high when A/C starts functioning.

Pin No 6:
Blower 4th speed voltage signal.

Pin No 9:
This is a SOC signal tapped from SOC signal indicator. It gives three different voltage signals depending on SOC.

SOC > 35%	GND signal
25< SOC>35 %	7 V (1.0) continuos signal
SOC < 25 %	pulsating 7 V (1.0) signal

Pin No 11:
A signal coming from switched 12 V (1.5) supplies.

Pin No 12:
A 12 V (1.5) signal from key switch.

NOTE

Remaining pins should not give any voltage signals.

CHECKING OF A/C HARNESS CONNECTIONS FOR REVA CLASSE CAR:

Before assembling the A/C controller in the car, respective voltage levels or GND connections at all pins has to check as specified below:

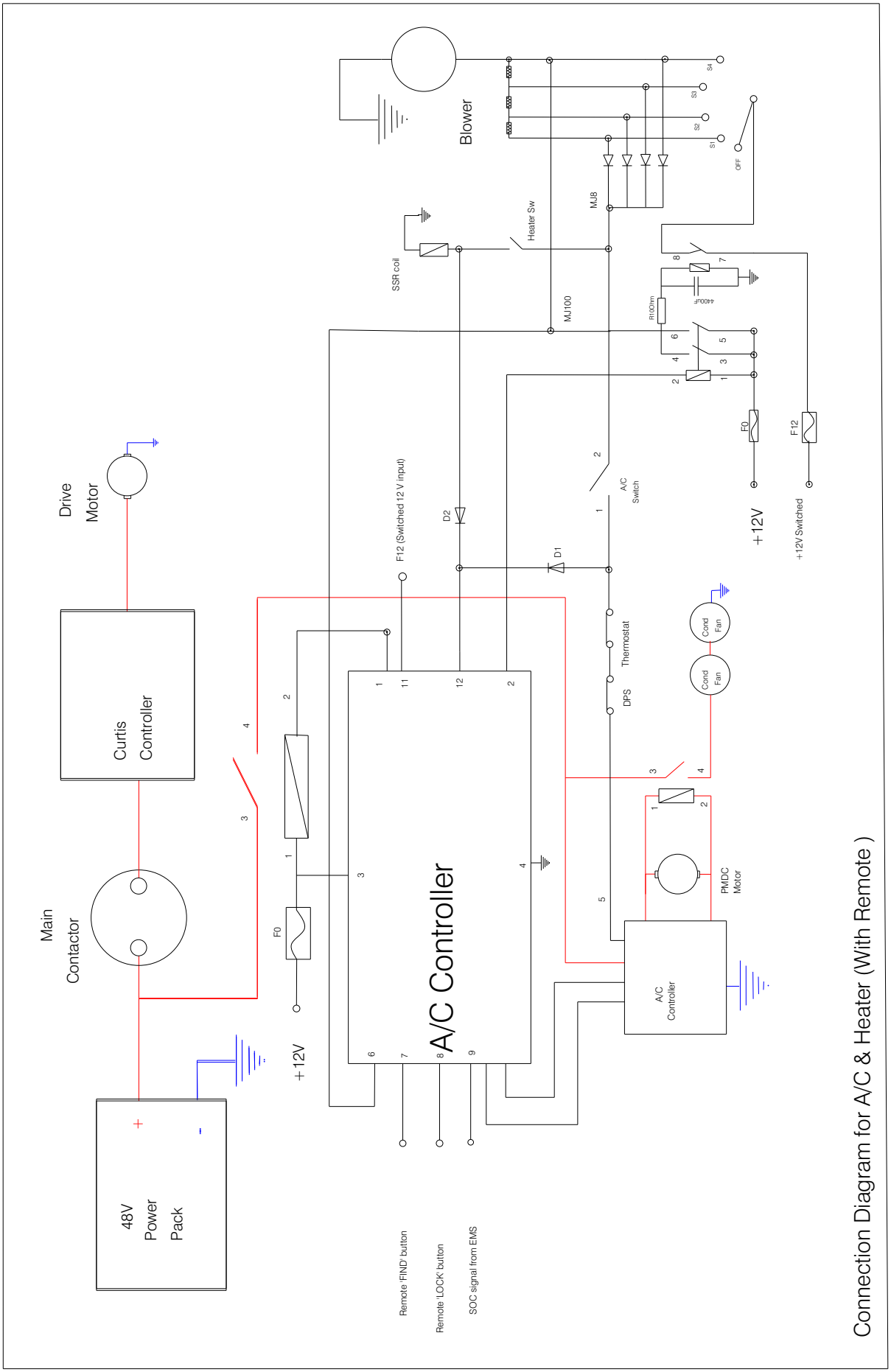
- Check the 48V-supply line of two-pin connector(CN-107)of A/C controller, it should be zero volts. And the black wire continuity with chassis should give.
- Check the continuity of other two single pin connectors coming from A/C motor (PMDC motor), with the chassis. Continuity should not be available.
- Checking of 12-pin connector (CN-116) for A/C controller.

Pin No 1:
Active GND signal connected to the R1 relay. It has to give 12 V signal.
Pin No 2:
Active GND signal connected to the R2 relay. It has to give 12 V signal.
Pin No 3:
12V UN switched supply
Pin No 4:
ground connection.
Pin No 5:
12V signal coming through thermostat. It gives active high when A/C starts functioning.
Pin No 7:
Signal coming from CDL unit. When "C" is selected, this pin has to give continuos pulses 12V DC pulses.
Pin No 8:
A door signal coming from CDL unit by pressing "L" button on remote. This is a 12 V pulse for duration of less than 1 sec's.
Pin No 9:
This is a SOC signal tapped from SOC signal indicator. It gives three different voltage signals depending on SOC.

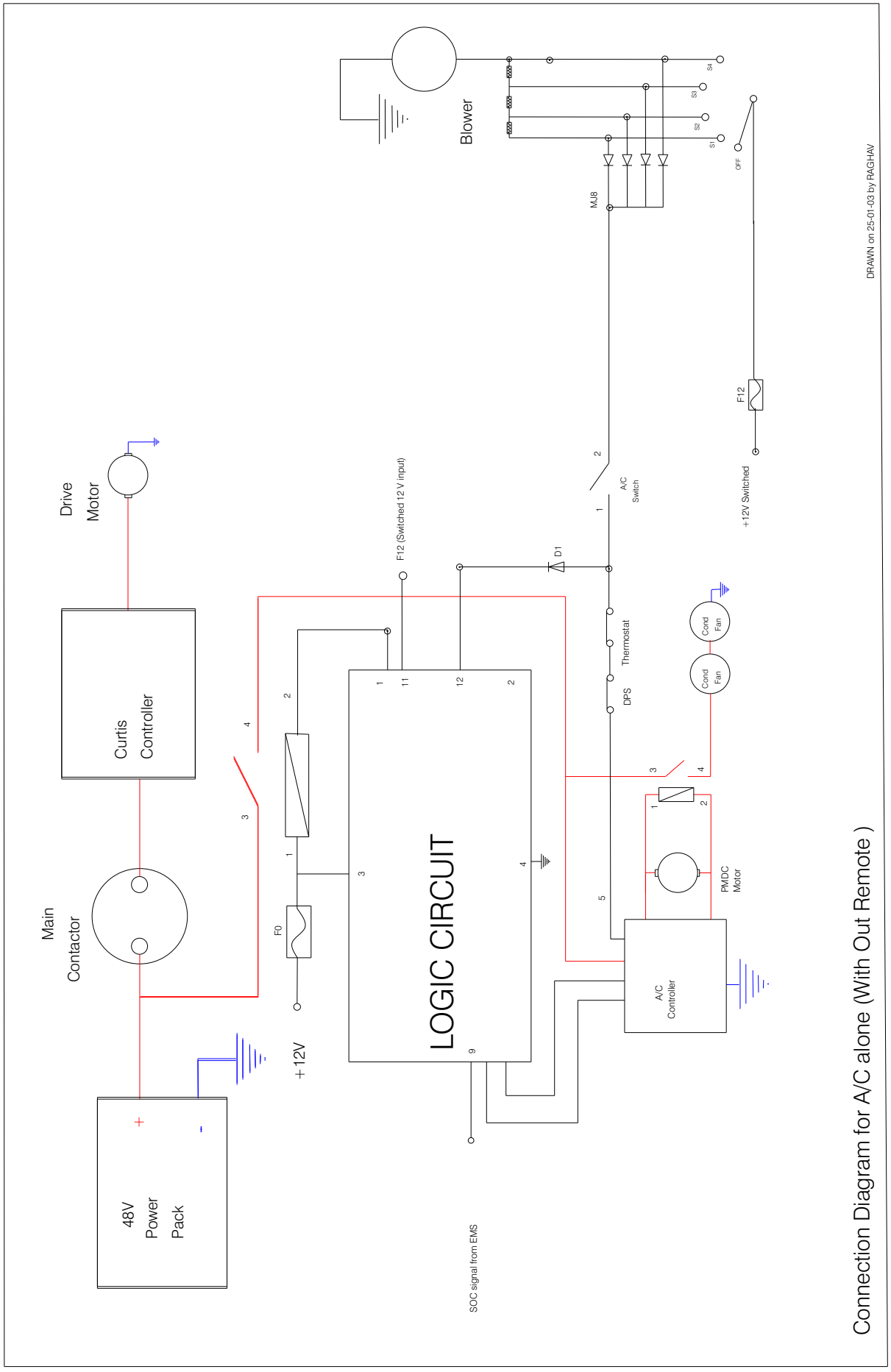
SOC > 35%	GND signal
25< SOC>35 %	12 V continuos signal
SOC < 25 %	pulsating 12 V signal

Pin No 10:
Is left free.
Pin No 11:
A signal coming from switched 12 V supply.
Pin No 12:
A 12 V signal from key switch.
While disconnecting of battery negative or positive cable, the following steps have to be carried out:
- Remove all the EMS connections as per the sequence indicated on the EMS board.
- Then remove 40 Amps A/C fuse F1 from the rear tub.
- Then remove F0 fuse from the main fuse box (near the Accelerator pedal.)
- Then remove the battery +ve cable.

While connecting the battery positive cable, the following steps have to be taken in a given sequence.
- First connect the battery +ve cable.
- Then connect the F0 fuse in the main fuse box.
- Connect 40 Amps F1 A/C fuse in the rear tub.
- Then connect all the EMS connections as per sequence indicated on the EMS Board.



Connection Diagram for A/C & Heater (With Remote)


Blower
S4
S3
S2
S1
OFF
MJ8
F12
+12V Switched
F12 (Switched 12 V input)
D1
A/C
Switch
Thermostat
DPS
Cond
Fan
Cond
Fan
Drive
Motor
Curtis
Controller
Main
Contactor
LOGIC CIRCUIT
F0
+12V
PMDC
Motor
A/C
Controller
48V
Power
Pack
SOC signal from EMS
DRAWN on 25-01-03 by RAGHAV
Connection Diagram for A/C alone (With Out Remote)