



Andhra Pradesh State Road Transport Corporation
Office of the Managing Director, Bus Bhavan, Hyderabad - 500 624.

No: OP3/462/ALJnNURM2/2015-MED

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Sub: MAINTENANCE - Introduction of **Ashok Leyland Low floor BS-III Buses (under JnNURM-2 scheme) in Corporation** - Salient features and maintenance aspects communicated - Reg.

Corporation has introduced **Ashok Leyland-6000 mm Wheel Base fully built buses of 900 mm floor height (ALFBV2/118) and 650 mm floor height buses (JAN Bus-ALBFV8/5) during the year 2015** under JnNURM-II scheme.

The following are the depot wise allotment details of 900 mm & 650 mm buses.

900 mm Buses			650 mm Buses		
S.No	Depot	Fleet held	S.No	Depot	Fleet held
GUNTUR Region			KRISHNA Region		
1	Guntur-1	13	1	Autonagar	1
2	Guntur-2	13	2	Gannavaram	5
3	Tenali	4	3	Vuyyuru	4
4	Managalagiri	8	VISAKHAPATNAM Region		
5	Ponnuru	5	1	Visakha Steel City	10
6	Narasaraopet	2			
7	Chilakaluripet	8			
8	Sattenapalli	5			
9	Vinukonda	1			
CHITTOOR Region			TOTAL		
10	Chittoor-1	13			10
11	Chittoor-2	14			
12	Pileru	4			
Total		91			

The salient technical specifications, features & maintenance systems of these buses are furnished hereunder.

1. The Ashok Leyland-6000 mm Wheel base fully built buses are provided with "H" Series BSIII CRS Engines with dry type air cleaner, fully forced pressure circulation lubrication system and with Automated Manual Transmission. The Unit wise technical specifications are at **Annexure-I**.

2. Recommended coolants, Lubricants and periodicities for Oil, grease and filter changes are furnished at **Annexure-II**.
3. The system wise preventive maintenance schedules are similar to the existing periodicities furnished at **Annexure- III**.

4. ADVANCED SYSTEMS PROVIDED IN SLF & JAN Bus of JnNURM-2 BUSES

These buses meet the JnNURM Urban Bus Specifications-2 and salient features of these buses are hereunder:

- i. Engine Management system By M/s BOSCH
- ii. Automated manual transmission by M/s WABCO
- iii. Multiplexing System By M/s Ashok Leyland
- iv. Pneumatic doors by M/s Mitech & M/s Janatics
- v. Intelligent Transport System (ITS) by M/s KPIT

The system wise description, procedures and troubleshooting are furnished at **Annexure-IV** & **Annexure-V**.

5. ADDITIONAL TOOLS REQUIRED FOR MAINTENANCE

S.NO	PART NAME	PART NO
1	Engine Diagnostic tool	FN201100
2	OBD cable for coupler	
3	Multiplex wiring Diagnostic tool	

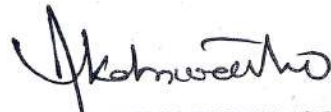
6. ESSENTIAL SPARES REQUIREED FOR MAINTENANCE:

The list of essential spare parts required at Depots for maintenance of these buses is given at **Annexure-VI**.

The Dy.CMEs are advised to educate the staff on operation and maintenance of AL JnNURM-2 buses at the depots duly providing necessary tools required for day to day maintenance. They are also advised to monitor the performance of these buses and furnish the feedback on HSD KMPL, BDs, problems in preventive maintenance etc. to CME(O), Head Office regularly.

The Controllers of Stores and WMs are advised to supply required spare parts and units to the Depots basing on the requirements furnished by DMs & Dy.CMEs.

The Depot Managers and Maintenance incharges are advised to ensure proper maintenance to the vehicles and see that the vehicles are utilized without any breakdown and obtain optimum performance.



EXECUTIVE DIRECTOR (E&IT)

To

All Depot Managers

Copy to: Personal Secretary to VC&MD for information

Copy to: Dir (V&S), ED (O&MIS), ED(A,P&Med), FA&CAO for information.

Copy to: ED (NLR), ED(VJA), ED(VZM) & ED(KDP) for information.

Copy to: CME(O), CCOS, CM(F&A), CME(C&B), CE(IT), CPM for infn. & n/action.

Copy to: All RMs for information & necessary action.

Copy to: All DyCMEs, WM, COS & DyCAOs for necessary action.

Copy to: All Principals of ZSTCs & TA/VJA for information.

Copy to: Resident Audit Officer, Bus Bhavan, Hyd for information.

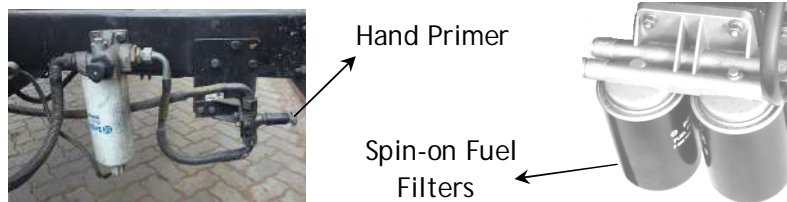
Copy to: In-charge, Manual Section for record.

1. Engine

- Engine Model: " H " SERIES HA57L165 BSIII CRS
 - 4 stroke, 6 cylinder front mounted diesel engine, water cooled, Direct injection, inline over head valve
- Max. Power: 225 hp (165 kw) @2500 rpm
- Max. Torque: 800 Nm @1400 -1800 rpm
- Cylinder Bore x Stroke: 104 x 113 mm
- Capacity: 5759 cc
- Cylinder Liners: Dry type : Mild interference fit liner (MIL)
- Compression Ratio: 17.5:1
- Firing order: 1-4-2-6-3-5
- Valve clearance: Intake - 0.30 mm (0.012"), Exhaust - 0.45 mm(0.018")

2. Fuel System

- Common Rail Direct Injection system of BOSCH (EDC17)
- High pressure Pump: Inline type with two plungers (CB-28) lubricated with engine oil
- Governor: Electronic Control Unit for Fuel Injection Equipment (There are no control lever and mechanical linkages in FIE)
- Injector: Solenoid type injector - timing controlled by electrical signals to the injector solenoid.
- Common Rail: 1400 bar working pressure & a mechanical Pressure Relief Valve which opens at 1800 bar
- Hand primer: Mounted on chassis bracket near Fuel filter cum water Separator



- Fuel Filters: Two stage Fuel filtration, one Fuel filter cum water separator fitted on chassis and twin micro fuel filters (spin-on) mounted near engine fitted at the low pressure side before HP Pump.
- Plastic (Polyurethane) Fuel tank capacity: 165 Lts

3. Air Intake System

- Air cleaner: Dry type paper filter with service Indicator
- Intercooler: Aluminum core with fins located in front of radiator
- Turbocharger(TC): Radial flow type with Waste gate arrangement

4. Lubrication system:

- Full forced pressure circulation by gear pump driven by timing gear
- The total system capacity is 18 lts.
- Piston cooling nozzles are provided directly on main oil gallery and are set for operation at 1.5 kg/cm²
- Multi plate Oil cooler of 8 plates is provided for better heat dissipation from engine oil
- Oil pump relief pressure is 4 kg/cm²
- Engine oil warning lamp activation pressure is 1 kg/cm²
- Positive crank case ventilation

5. Cooling system:

- The total cooling system capacity is 22 lts.
- Fan is with integral ring for strength and is coupled with viscous fan to engine.
- The engine fan belt is of Poly-V groove type.
- Maximum water pump output is 240 lpm at 1.5 kg/cm²
- Cooling system pressure is 0.9 bar
- Thermostat opens at a temperature of 82°C and fully opens at 95°C, Check & Ensure the maximum lift of thermostat (7.5 mm at 95°C) with the help of thermostat checking apparatus.
- Coolant supplied to water cooled AC Head for cooling the air supplied for Brake system.

6. Clutch

- Pneumatic clutch actuation system with Single plate dry type 15" Axial Spring clutch four Finger type (Non - Asbestos)

7. Transmission

- Model: ZF-6S 850 OD with Automated Manual Transmission
- Type: Synchromesh on all forward gears and reverse gear
- No. of speeds: 6 forward and 1 reverse
- Gear Ratio: 1st - 6.72, 2nd - 3.68, 3rd - 2.15, 4th - 1.41, 5th - 1.0, 6th - 0.79 & Reverse - 6.03

8. Front Axle



- **Model: FA 99, 6 ton capacity (for 900mm)**
- Type: Forged I - Section Reverse Elliot Type with an Axle weight of 84 kg
- King pin size - 44.138 mm (STD) with Grease lubrication, double cotter type

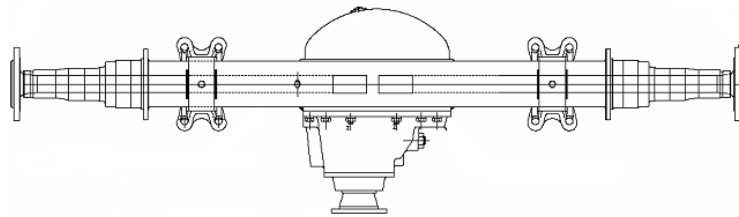


- **Model: FA 99, Double Drop 6 ton capacity (for JAN Bus 650mm)**
- Type: Forged I - Section Reverse Elliot Type with an Axle weight of 130 kg
- Mainly introduced to achieve the low ground clearance of 650mm
- King pin size - 44.138 mm (STD) with Grease lubrication, double cotter type

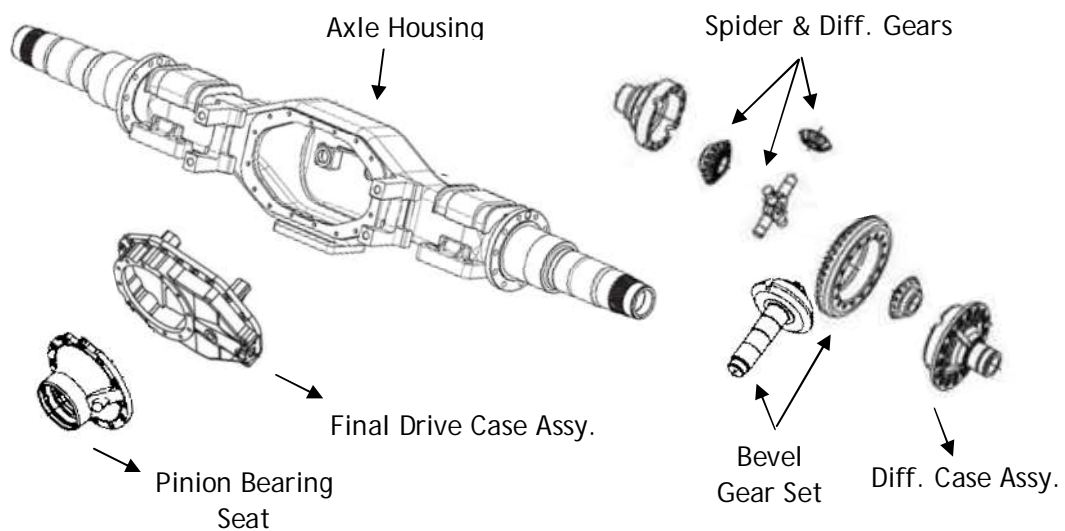
9. Rear Axle

- Dana make, Single reduction, hypoid gears with fully floating axle shafts, 60SHO drive head with axle ratio of 6.17:1.

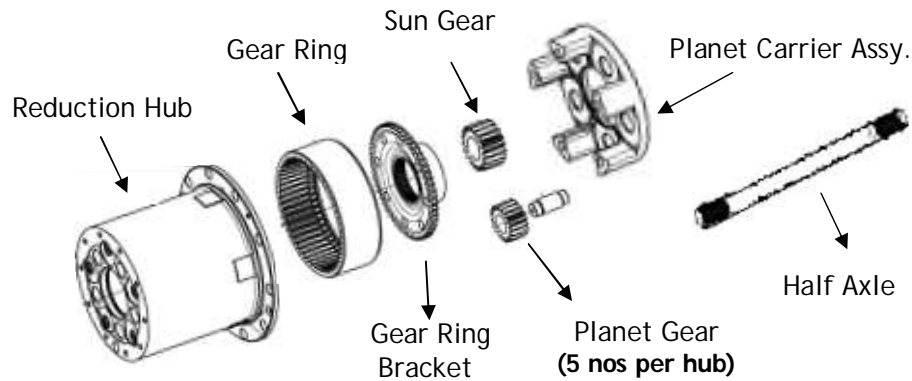
EXISTING 60SHO REAR AXLE HOUSING - (For 900mm Bus)



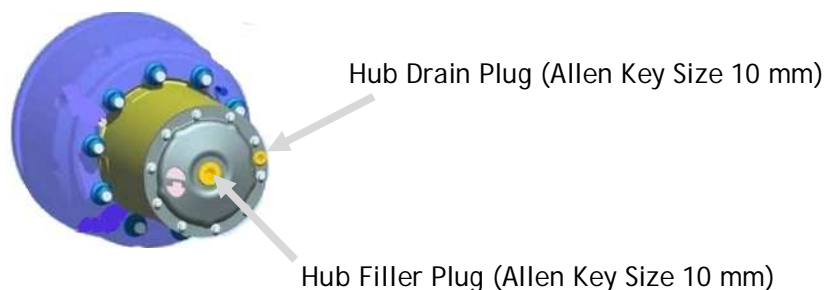
HUB REDUCTION REAR AXLE HOUSING & PARTS - (For 650mm Bus)



REDUCTION HUB INTERNAL PARTS



- Shaanxi Hande Axle Co. Ltd. make, Fully floating with hub reduction (for 650 mm JAN bus) introduced to achieve low floor height of 650mm.
- Reduction drive axles have a single reduction axle combined with wheel reduction hubs. They are designed to provide with superior traction and towing capabilities. This is accomplished through a planetary gear systems contained in the wheel hubs by reducing the wheel rpm and increasing torque.
- Power from the vehicle driveline is transmitted to the differential through the primary drive pinion, crown gear (Hypoid gears) and differential unit. The differential then transmits torque to the axle shafts which drives a planetary gear system within the wheel hub. The planetary carrier rotates against a fixed gear and drives the wheel hub.
- Crown/pinion ratio is 1.5:1 and Hub reduction ratio is 3.95:1 with a final drive ratio is 5.92:1.
- The differential and reduction hubs are lubricated with recommended multi grade gear oil with a periodicity of 50,000 kms.
- Oil filling capacities: Rear axle housing - 9 Its; Each Hub-3.5 Its; Total capacity -16 Its



10. Steering

- ZF Make power Steering
- Vane pump gear driven
- Steering gear ratio - 23.6:1

11. Suspension

- Front - Weveller parabolic suspension (for 900mm SLF)
- Front - Air suspension (for 650mm JAN bus)
- Rear - Air suspension for both 650 & 900 mm buses

12. Brakes

- Service brake in Front and Rear
- Type: Dual circuit full Air 'S' cam brake system with DDU
- **Air compressor** : Twin cylinder 230 cc belt driven water Cooled
- **System Pressure** : Cutout- 8.1 +/- 0.2 kg/cm² ; Cut in-7.1 kg/cm²
- Slack adjuster : Automatic (MEI make)

13. Exhaust System

- Normal silencer muffler provided

14. Wheel & Tyre

- Size: 295/80 R22.5 - 16PR
- Wheel rim: 8.25 X 22.5

15. Electrical system

- Battery: 2 x 12v - 150 AH
- Alternator model & capacity: 100 A
- Starter model: 24V/ Pre-engaged with thermal cutout
- **There are mainly three types of wiring harness**
 - 1) **Multiplex wiring in Black colour**
 - 2) **AMT wiring in yellow colour**
 - 3) **EDC wiring in blue colour**

16. Performance

- Max Speed: 99 (12M FESLF) / 90 (JAN Bus) kmph
- Gradeability:29 %

RECOMMENDED LUBRICANTS AND COOLANT

Description	Specification	Brand of Lubricants & Coolants		
		Gulf Oil India	IOCL	Capacity
Engine Oil	SAE15W40 API CI-4 (Plus)	Gulf Superleat LE Dura Max 15W-40	Servo pride ALT plus 15W-40	18 Its
Gear Box oil	SAE 80W90	Gulf Gear XP Dura Max 80W-90	Servo Gear ALT 80W-90 (LL)	6.5 Its
Differential Oil	SAE 85W140	Gulf Gear DB Dura Max 85W-140	Servo Gear Axle ALT 85W-140	14 Its - SLF 900 mm 16 Its - JAN BUS 650 mm
Power Steering oil	DEXTRON II D	Gulf Power Steering Dura Max	Servo Transdex II	4.5 Its
Wheel Bearing Grease	IS 12203	Gulf Crown Dura Max NLGI 3	Servo Grease Super 3	1.6 kg - 900mm Bus 0.9 kg - 650mm JAN Bus
Chassis Grease	Lithium MP	Gulf MP Grease Max NLGI 2	Servo Grease ALT	--
Coolant	Non Amino Base 50% water + 50% Ethylene Glycol	Eurocool LL Max 50	Servo Kool ALT 50	21.5 ± 0.5 approx. (Pre-mixed)

OIL, GREASE & FILTER CHANGES PERIODICITIES:

The specific maintenance activities applicable for BS-III buses (other than those stipulated in the regular Sch-I/II, III/IV and FC) are furnished hereunder.

LUBRICANTS, COOLANT & FILTERS CHANGE PERIODICITIES		
1	Engine Oil & Filter	80,000 kms
2	Fuel Pre-filter Element (Chassis)	40,000 kms
3	Twin fuel Filters (Spin-on-engine mounted)	40,000 kms
4	Gear Box oil	1,20,000 kms
5	Differential Gear oil (SLF 900mm)	80,000 kms
6	Differential Gear oil (Housing including two hubs- at 3 points - for JAN bus 650mm)	50,000 kms
7	Power Steering Oil & filter	1,60,000 kms
8	Wheel Bearing Grease	80,000 kms
9	Primary air filter element	Whenever the vacuum indicator shows red band
10	Secondary air filter element	At the time of every third replacement of primary filter element
11	Coolant	2,00,000 kms

Schedule of Maintenance Activities

Annexure - III

Description of Activity	Sch-I	Sch-II	Sch-III	Sch-IV
	Daily	Weekly	9,000 kms	27,000 kms
ENGINE				
Check Engine oil level & arrest leakage if necessary	✓	✓	✓	✓
Check & adjust Valve clearance				✓
Check and tighten front and rear engine mounting / other peripheral bolts			✓	✓
Check Damper Pulley and attend if necessary			✓	✓
Drain water from Water separator	Daily			
Clean Fuel tank inside & Tank strainer				✓
Check Fan belts for damage/looseness	✓	✓	✓	✓
Check Exhaust pipes and mounting			✓	✓
Check Radiator coolant level	✓	✓	✓	✓
ELECTRONIC DIESEL CONTROL				
Check for engine full acceleration (Throttle response	✓	✓	✓	✓
Check tightness of all mating connectors and ensure they are connected properly			✓	✓
Check and secure wiring harness away from temperature zones on the engine/vehicle			✓	✓
Check functioning of EDC and sensors with diagnostic tool				✓
Check tightness of engine speed sensors and clean the sensor tip for any dirt/dust deposits			✓	✓
Check functioning of warning EDC light	✓	✓	✓	✓
TURBOCHARGER & INTERCOOLER				
Check Air duct connections, hoses and gaskets			✓	✓
Check charge air cooler for any blockage of fins and clean the cooler if necessary (2.5 kg/cm ²)				✓
CLUTCH				
Check function of clutch system		✓	✓	✓
Lubricate clutch withdrawal lever		✓	✓	✓
Check Clutch pedal free play and pedal stroke		✓	✓	✓
Check clutch lever stroke and oil in breather, if traces of oil found overhaul the PCA with repair kit.				✓
Pneumatic clutch actuator	Check at every 80,000 kms			
AMT GEAR BOX				
Check for tightening torque of shift select actuator to adaptor plate			✓	✓
Check for tightening torque of Input / Output sensor and proper clamping			✓	✓
Check for tightening torque of Gear shifter unit to bonnet			✓	✓
Clean the Input / Output sensor tip				✓
Check for oil in X-Y Actuator breather; if oil found in solenoid, replace actuator				✓
Check SLU modes performance whether selected mode displays in screen (E/P , M/A and C)				✓
Check for clutch wear indication through scan tool			✓	✓
Check for AMT Tank air pressure and air leak in vehicle		✓	✓	✓
Check Gear box oil level	✓	✓	✓	✓

Description of Activity	Sch I	Sch II	Sch III	Sch IV
	Daily	Weekly	9,000 kms	27,000 kms
SUSPENSION				
Check Suspension U-bolt / Beds/ nuts tightness		✓	✓	✓
Check Air Bellow for damage/leakage	✓	✓	✓	✓
Check Mountings for looseness and damage	✓	✓	✓	✓
Check Shock absorbers for leaks and damage	✓	✓	✓	✓
Check Shock absorbers for looseness in mounting	✓	✓	✓	✓
Check Air spring static height			✓	✓
Check Anti roll bar bushes (Replace if necessary)			✓	✓
Clean the leveling valve brass filter & check its operation				✓
Check Spherilastic bushes, Split bushes etc.				✓
Check rubber element (for weveller spring) & replace			✓	✓
PROPELLER SHAFT				
Check Propeller shaft nuts tightness	✓	✓	✓	✓
Check Universal joint and splines for wear		✓	✓	✓
Universal joint and splines Greasing		✓	✓	✓
Lubricate centre joint bearing (other than sealed bearing)		✓	✓	✓
REAR AXLE				
Check Differential gear oil level	✓	✓	✓	✓
Check leakages of oil if any	✓	✓	✓	✓
FRONT AXLE				
Lubricate King Pins		✓	✓	✓
Lubricate track rod / drag link ball joints		✓	✓	✓
STEERING				
Check Power steering fluid level (When engine is in idle i.e. 500-600 rpm)	✓	✓	✓	✓
Check Power steering fluid tank strainer			✓	✓
Check Looseness in mounting			✓	✓
Check for Steering linkage for damage, looseness and excessive play		✓	✓	✓
SERVICE BRAKE				
Check Brake Lining wear		✓	✓	✓
Check Brake drum for wear and damage			✓	✓
Check Air hoses and pipes for leakage, damage and loose connections	✓	✓	✓	✓
Replace all brake units i.e., DB valve, SP valve, Brake Chambers, Relay valve etc.	At 160000 km or two years whichever is earlier			
Replace Air Compressor	Overhaul at 100000 km or One year whichever			
Overhaul Air dryer	First at 240000 km or three years whichever is earlier and there after every 160000 km or 2 years whichever is earlier.			

ADVANCED SYSTEMS PROVIDED IN SLF & JAN Bus of JnNURM-2 BUSES

These buses meet the JnNURM Urban Bus Specifications-2 and salient features are given under.

- i. Engine Management system By M/s BOSCH
- ii. Automated manual transmission by M/s WABCO
- iii. Multiplexing System By M/s Ashok Leyland
- iv. Pneumatic doors by M/s Mitech & M/s Janatics
- v. Intelligent Transport System (ITS) by M/s KPIT

1) Engine Management System by M/s BOSCH --Electronic Diesel Control EDC17 (CRS H Series Engine)

The EDC (Electronic diesel control) system is capable of meeting the following demands.

1. High fuel injection pressure
2. Fuel injection independent of pressure generation and engine speed.
3. Multiple injections (BSIII - Main, Pilot & Post Injection)
4. Flexible in fuel quantity, injection timing and fuel injection pressure independent of engine speed.
5. Environmental (Ambient, Coolant temperature etc.,) / Altitude dependent fuel quantity adjustment.
6. Integration with other vehicle systems (Automatic transmission, ABS etc.,)

In EDC system, the driver has no direct control over the injected fuel quantity through the accelerator pedal.

The injected fuel quantity is based on

- i. The vehicle response desired by the driver communicated through the accelerator pedal sensor with the help of ECU.
- ii. The engine operating conditions.
- iii. The engine operating coolant temperature.
- iv. Boost pressure
- v. Engine speed

EDC system is also capable of data exchange with other electronic systems such as Automatic transmission through CAN (Control Area Network).

Major **components of EDC system** (Electronic Diesel Control system) comprises of the following:

- Electronic Control Unit (ECU)
- Common rail CRS (CB28) pump Fuel injection pump.
- Solenoid type Injector for all cylinders.
- Coolant temperature sensor
- Boost pressure & temperature sensor.

- Camshaft speed sensor
- Crank shaft speed sensor
- Rail pressure sensor
- Water in fuel sensor
- Oil pressure and temperature sensor.
- Accelerator pedal position sensor
- Brake switch
- Clutch pedal switch
- Vehicle speed sensor
- Wiring harness.

In EDC system, the injected fuel quantity is based on the following:

- The vehicle response desired by the driver, communicated through the accelerator pedal position sensor.
- The engine operating temperature
- Boost pressure and temperature
- Engine speed, Atmospheric pressure, Proper functionality of EDC components.

EDC system is subdivided into

1. Sensors

Detect the engine operating conditions and the driver's demand. They convert physical variables into electrical signals.

2. Electronic Control Unit (ECU)

Processes the information received from the sensors. It controls the actuators through electrical output signals. It also provides interfaces with other systems like diagnostic tool, ABS etc.

3. Actuators

Convert the electrical signal from the ECU into physical variable.

Controls

Open and Closed Loop Electronic Control

Open Loop control:

The actuators are operated by the ECU output signals which the ECU has calculated using the input variables, stipulated data, characteristic maps, and algorithms. The final results are not checked.

Close Loop Control:

The actual value at the output is continually monitored against the desired value and as soon as a deviation is detected this is corrected by a change in the actuator control. The advantage of close loop control lies in the fact that disturbances from outside are detected and taken into account. In our system close loop control is used for rail pressure governing through activating metering unit.

Fuel - Injection Control:

In order that the engine can run with optimum combustion under all operating conditions, the ECU calculates exactly the right injected fuel quantity at right time in different conditions. Here the values of various parameters are considered.

Starting Torque Requirement:

The injected fuel quantity is calculated as a function of coolant temperature and cranking speed. This will generate from the moment the starting switch turned and until minimum engine speed is realized.

Drive Mode:

When the vehicle is being driven normally, the driving torque is a function of the accelerator pedal position and engine speed and boost pressure. Calculation depends upon maps, which also consider high fuel temperature. This permits best possible alignment of the engine's output to the driver's wishes and also protect FIP parts.

Engine Idle Speed Control:

When the accelerator pedal is not pressed, it is the job of the idle speed control to ensure that a determined idle speed is maintained. For instance, with the engine being cold, the idle speed is maintained by adjusting to the desired torque in reference to water temperature and the set speed is maintained similarly at increased water temperature.

Engine Maximum Speed Control

This control ensures that the engine shall not to be rotated at excessive speeds. To avoid damage to the engine, the engine manufacturer stipulates a Permissible maximum rotational speed that may only be exceeded for a very brief period. In our case Engine rated speed is 2300 rpm and Fuel Cut off speed is 2550 rpm. Maximum engine speed or vehicle speed can be controlled through ECU.

Sensors, Actuators and ECU (Electronic Control Unit):

The ECU is the brain of the system that process the requirements through sensors and the accelerator pedal movement with the fuel mappings already calibrated in the ECU and decides on the fuel delivery thru injectors. It operates on 24V DC.

Common rail CRS CB28 Fuel injection pump:

This pump is mechanically driven and electronically controlled by ECU. Output signals from ECU triggers the governor there by controls the fuel quantity of fuel injected and the start of injection.

Solenoid Type Injector

Solenoid injector will deliver the calculated fuel & pressure into the engine with respect to engine operating range based on electrical input from ECU.

Accelerator Pedal Position Sensor

The Sensor serves to measure demand from the driver and communicates to the ECU. It detects the pedal position by means of potentiometer and transfers this information to the ECU in terms of Voltage. It consists of two potentiometers for measuring the position of accelerator pedal module from 0% travel position to 100% travel position.

Engine Coolant Temperature Sensor

It is a thermistor, mounted on coolant return line from cylinder block. It measures the engine coolant outlet temperature.

Engine Speed Crank Sensor

The Crank shaft speed sensor is mounted on the cylinder block. The sensor works on Magnetic induction principle. The tooth space on the crankshaft trigger wheel causes a change in magnetic flux thereby generating output pulses, the frequency of which determines the speed.

Engine Speed Cam Sensor

The Cam shaft sensor is mounted on the cylinder head. The sensor works on Magnetic induction principle. The tooth space on the camshaft trigger wheel causes a change in magnetic flux thereby generating output pulses, the frequency of which determines the position.

The crankshaft position signal combined with camshaft position signal indicates the cylinder that is on compression and the ECU can determine from its programming the engine firing order. Cam sensor is used to synchronize with crank speed sensor while starting the engine & back up for crank sensor while engine is running.

Back up for Crank Sensor

The crankshaft position signal combined with camshaft position signal indicates the cylinder that is on compression and the ECU can determine from its programming the engine firing order. If either crank or cam sensor malfunction, the cam or crank sensor will aid to start the engine.

Engine Boost Pressure & Temperature Sensor

Engine Boost Pressure sensor is mounted on the intake manifold to measure the absolute intake manifold pressure & temperature.

Rail pressure sensor

The rail pressure sensor senses the pressure in common rail and sends the signal to ECU and ECU in turn sends the signal to metering unit to regulate volume of fuel in common rail. Stainless steel sensing element with metal thin film strain gauges Digital circuit concept with analogue output signal.

Metering Unit

Metering unit function is controlled on electro magnet principle of having solenoid, present inside. Metering unit regulate fuel flow on receiving the signals from ECU. The Rail pressure sensor and Metering unit are inter related to maintain the fuel pressure in Common rail.

Injectors

Injector functions are controlled on electro magnet principle of having solenoid situated at top side. When the solenoid coil is energized, it lifts the

plunger and allows the high pressure fuel from high pressure connector to injector inlet and the fuel fills inside the stem of injector and finally it delivers to the combustion chamber.

Water in Fuel Sensor

Water in fuel sensor located at the Bottom of Pre-filter. When the water in fuel got settled at bowl, the sensing lead senses the presence of water and sends the alarm signals to the Dashboard. As per this alarm we have to drain the water from the bowl by turning the cork Anti Clockwise.

Oil Pressure & Temperature Sensor

This sensor is mounted on the Oil Cooler Module and used to measure the absolute Oil pressure. On the version with integral temperature sensor, the temperature of the oil is also measured. The piezo-resistive pressure sensor element and a suitable circuitry for signal amplification and temperature compensation are integrated on a silicon chip. The active surface of the silicon chip is exposed to a reference vacuum, that is formed by an evacuated kind of a TO-housing. The pressure is lead up by a pressure nozzle to the back side of the diaphragm, which is resistant to the measured medium. The temperature sensor element is a NTC-resistor.

Vehicle Speed Sensor

Working on proximity principle, produces 6 or 8 pulses per revolution, pulse output is used for calculating the distance travel and speed of the vehicle. Vehicle speed sensor is mounted on the gearbox at speedo drive output shaft for Manual transmission. In Automated Manual Transmission (AMT), Vehicle speed signal will be sent to Engine ECU through CAN by AMT ECU.

Engine Start / STOP Procedure

Before starting, ensure that the gear is in neutral position and the parking brake is applied.

Engine Start Procedure

- 1.The ignition switch is provided in the steering column. Insert the ignition key in the ignition switch, turn clockwise for 24 V supply to vehicle electricals & EDC system. Leave 15 - 20 sec before cranking the engine.

- 2.Turning this key further will crank the engine. After starting the engine release the key immediately to avoid any starter motor damage.

Engine Stop Procedure

To stop the engine, turn the ignition key anticlockwise. Wait for 10 seconds to completely switch off the engine.

Limp Home and EDC Failure Reaction Functions:

The table shown indicates the details of sensor failure and its effect on the vehicle.

Accelerator Pedal sensor failure	Limp home - Engine speed limited to 1450 rpm and accelerator pedal no response
Crank or Cam Speed sensor or oil temperature sensor failure	Engine speed limited to 1750 rpm for 6 cylinder and 1580 rpm for 4 cylinder engines
One Injector failure or Open load and short circuit between injectors	Engine speed limited to 1750 rpm and drop in pick-up.
Rail Pressure sensor or Metering Unit failure	40% Torque reduction and Pressure Relief Valve (PRV) open
Oil pressure sensor failure or water in fuel sensor detects water in fuel	40% Torque reduction and engine speed limited to 1750 rpm
Low oil Pressure in system or Both coolant and oil temperature sensor failure	80% Torque reduction
Engine coolant sensor failure	30% torque reduction and engine over heat
ECU failure or Rail pressure exceeds 1890 bar	Engine shutoff
Both crank and cam sensor failure	Engine will not start
Improper connectivity or malfunction of starter relay	Engine will not start (ECU controlled start function)
Vehicle speed sensor failure	Engine speed limited to specific rpm (as per legislation)

2) Automated Manual Transmission:

This vehicle is provided with Automated Manual Transmission System (AMT). In this system, the basic gear box is built with Add-ON pneumatic actuators for automatic gear shift, selection and clutch actuation. That means, in AMT the clutch pedal and gear shift linkages are excluded and control unit & actuators added to the Manual transmission.

AMT SYSTEM COMPONENTS:

1. SLU
2. XY ACTUATOR
3. PCA
4. INPUT SENSOR
5. OUTPUT SENSOR

Communicates with Dash board, Engine ECU and Retarder ECU.

Shift Lever Unit (SLU):

The Shift Lever Unit is the control of the automated gearbox. It transmits the gear shift request of the driver to the Electronic Control Unit (ECU) which is inside the Shift Lever Unit. The Shift Lever Unit contains the following operation devices:

- Shift Lever: It is used for up and down shifting of Gears.
- Neutral Button: It is used to shift into neutral gear.
- Function Button: It activates functions of AMT.
SLU contains the following Drive Mode Buttons:
- M/A: This button is used to switch between manual and automated drive mode.
- E/P: This button is used to switch between economic and power drive mode
- C : Crawler Mode

XY ACTUATOR:

It will replace the existing tower assembly of the manual transmission and is mounted on the top of the Gearbox. X-Y actuators are used to select and shift the gear position. It is controlled by the Electronic Control Unit (ECU). It carries Electrical and Pneumatic signals.

Terms Used:

DSG: Distance sensor Gear

VG1: Valve Gear No 1

VG3: Valve Gear No 3

VSE1: Valve sensor selection No 1

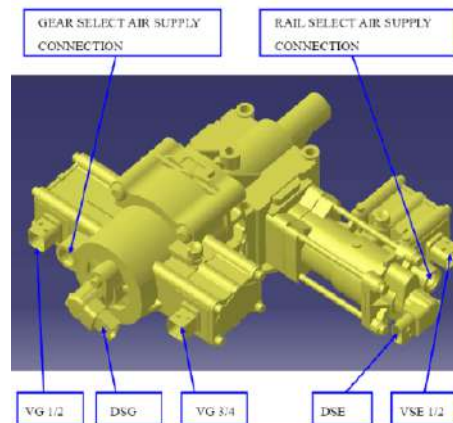
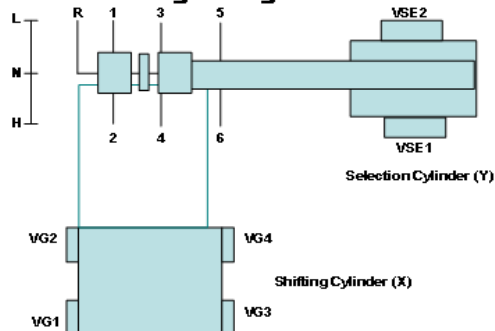
DSSE: Distance Sensor Selection

VG2: Valve Gear No 2

VG4: Valve Gear No 4

VSE2: Valve sensor selection No 2

XY Actuator Logic Diagram

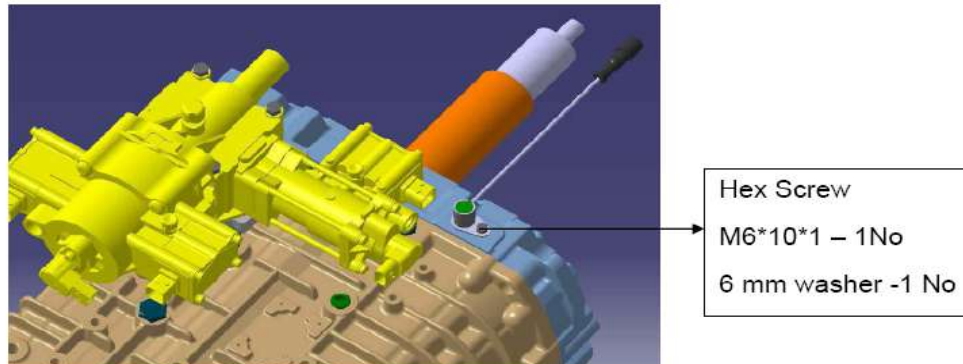


Pneumatic Clutch Actuator (PCA):

In this Clutch Actuator, four valves are available for the clutch control. One pair of valves is required to open and one pair to close the clutch. The valves are incorporated inside the Clutch Actuator. The clutch actuator is an air unit which actuates the clutch fork with travel control. The clutch actuator is used to apply the clutch via the linkage. The Clutch Actuator are connected by pneumatic pipes. The compressed-air system of the vehicle stores a certain amount of compressed-air for the transmission shifting system.

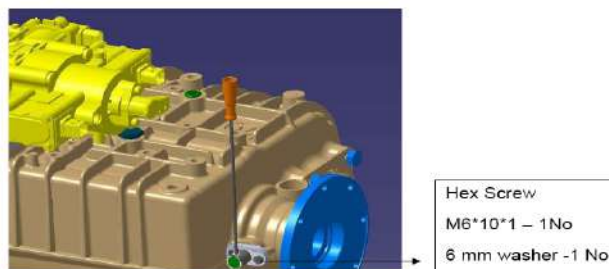
Pneumatic connection is to be given to the input port from auxiliary air tank. Electrical connection is given to the Distance Sensor Connector (DSC) and Solenoid Connector (CLUTCH).

Input Sensor:



Use M6*10*1 (CP) and 6 mm washer to mount the sensor

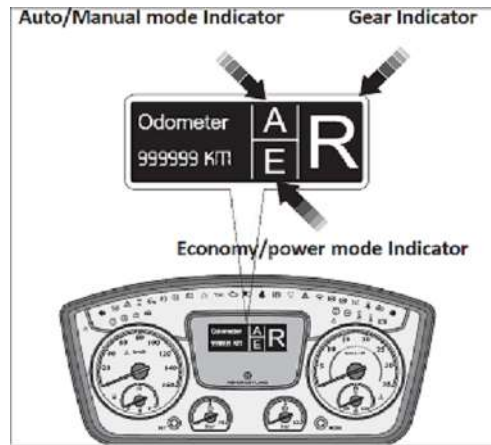
The Input Speed Sensor affects the contact less measurement of the state of motion of the counter shaft and/or main shaft rotating.



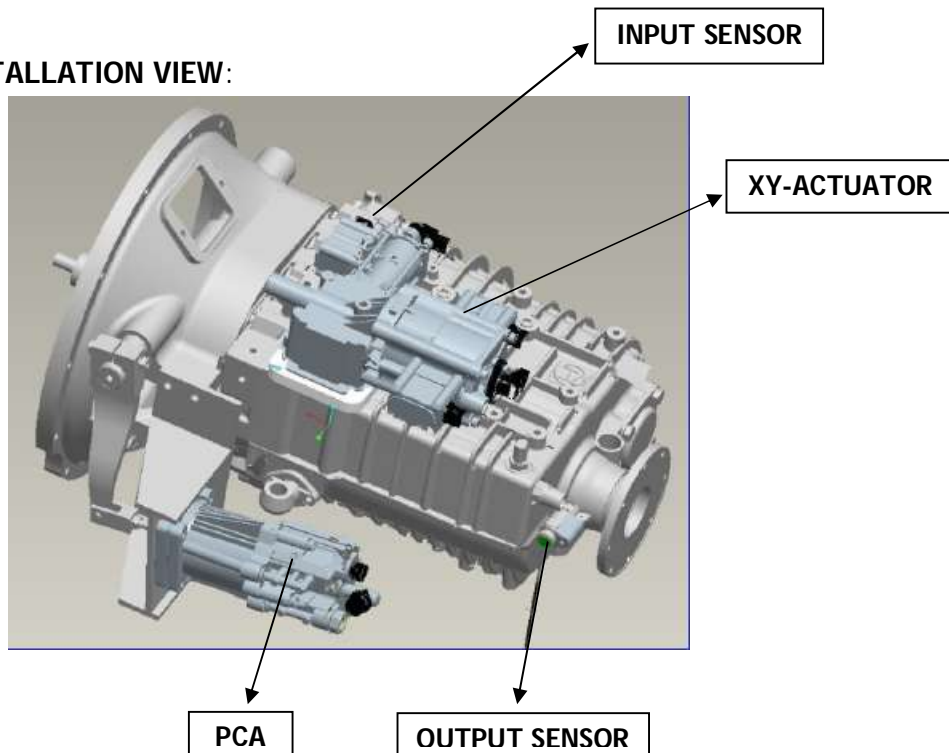
OUTPUT SENSOR:

The Output Speed Sensor affects the contactless measurement of state of motion of the output shaft rotating. Alternate voltages are produced in the Sensor in an inductive way. Their frequency is proportional to the corresponding rotational speed.

Communication with Dashboard:



AMT INSTALLATION VIEW:



PNEUMATIC INTERFACE:

- Working medium : Compressed Air
- Working pressure : 8.0 bar
- Nominal working pressure : 6.5 bar
- Minimum working pressure: 5.5 bar
- Operating voltage : 22 to 32V
- Reverse polarity protection : Max. 32V

Electrical Connections Required for AMT:

- a) Gearbox Connections: VG $\frac{1}{2}$, VG $\frac{3}{4}$, DSG, DSSE, INPUT SENSOR & OUTPUT SENSOR
- b) PCA Connections : Clutch Valve and DSG.

- c) AMT-Vehicle CAN connection
- d) AMT-Vehicle Harness Interface Connections, specifically: Parking Brake Switch, Brake Switch and Ignition Key
- e) POWER SUPPLY: Positive to Isolator Switch and Ground to Battery
- f) SLU Connection

Pneumatic Connections:

The following Pneumatic connections are to be ensured for proper functioning of AMT:

- a) Inlet of Gear Cylinder
- b) Inlet of selection / rail cylinder
- c) Inlet of PCA

Ensure that availability of recommended air pressure of 8 Bar for AMT system.

LEARNING PROCEDURE:

Learning Procedure is a system level self check and self calibration for AMT system. AMT system will be operational only after a successful completion of the learning. It is necessary to perform the learning procedure in the following conditions:

- a) First Installing of AMT system on a vehicle
- b) While changing any of the following AMT related components in the existing system - XY Actuator, PCA, Gearbox & Clutch
- c) Replacement of New SLU.

Manual Learning Process:

Step - 1: Initiating Learning Procedure.

- Switch OFF the Ignition Key
- Switch OFF the Isolator (Power Supply) for AMT system
- Switch ON the Parking brake
- Switch ON the Isolator (Power Supply)

Step - 2:

- Hold "F" button and "N" buttons on the SLU.
- Switch ON the Ignition Key
- Keep holding the two buttons till learning is complete.

Step - 3:

Clutch Learning:

- Learning Procedure Initiated in Step - 1 is indirectly indicated by "ABSENCE" of Gear number in the cluster.
- Clutch Learning will start automatically.
- Clutch learning is observed by actuation of PCA
- Twice, the PCA will dis-engage and engage the clutch. (Observed by a pushrod movement with a stroke of 20 mm)

Gearbox Learning:

- Completion of Clutch learning is indicated by blinking of Neutral in the cluster.
- Switch ON the Engine at this point to initiate the Gearbox learning.
- Gearbox learning is observed by actuations in the X-Y actuator.
- The display will no longer continue to show neutral blinking.

Step - 4: Completion of Learning Procedure

- Completion of the Gearbox learning and thereby the complete learning procedure is indicated by display of Neutral in the Cluster.
- Check for parameter "Learning Procedure Status" to be in "Learning Completed Successfully" state.
- In case "Learning Procedure Status" is in "Learning Failed" state, check for the learning error number and troubleshoot the failure.

Launching the vehicle:

MANUAL MODE

- Press function button and move the lever upward for first forward gear.
- For selecting 2nd, 3rd, 4th, 5th or 6th gears, without function button pressing, move the lever upward for next gear or high gear.
- For selecting the down gear, without function button pressing, move the lever downward for down gear.
- For selecting the higher gear or next gear in manual mode without function button pressing, the gear will be selected only if the desired KMPH is reached even if the Driver is requesting the gear change.
- If it is required to shift to higher gear even if the desired KMPH is not reached, then request the gear with pressing the function button.

AUTO MODE:

- In Auto mode the driver has to select only the starting gear (First gear) i.e., forward or reverse.
- During driving, the AMT system selects appropriate gears and controls the clutch automatically.
- For launching the vehicle in Auto Mode - Press Function button and move the lever upward for launching the vehicle. (First forward gear)
- For 2nd, 3rd, 4th, 5th and 6th gears, it will sense the vehicle speed and shift automatically.
- Manual intervention of Driver in Auto mode is possible (Up shift) depending on the requirement of driving condition. In such a case, without pressing function button, move the lever upward for higher gear or next gear.

KICK DOWN:

- Kick down is the special function which can be used for climbing the vehicle in gradient.

- For climbing the vehicle in gradient, shift the first gear and then press the accelerator pedal fully, then vehicle will slowly climb the gradient.
- If the vehicle is to be stopped in gradient due to traffic, apply the brake and hold it. If the vehicle is to be moved again, immediately release the brake pedal and press accelerator pedal very quickly.

CRAWLER MODE (Steep Gradient):

- Engage the parking brake.
- Press the C button.
- Engage the first forward gear.
- Press the accelerator pedal if the engine RPM is reached at 1200 RPM, release the parking brake and then vehicle will climb the gradient.

REVERSE GEAR:

- Reverse gear can only be engaged from the neutral position and when the vehicle is stationary.
- For selecting the reverse gear, press Function button and move lever downward.
- Select reverse gear only from Neutral.

PARKING:

- Before carrying out power down of the vehicle by switching Ignition key Off, follow the below steps.
- Engage the parking brake.
- Press Neutral button. Shift to neutral is completed and 'N' will be displayed on the cluster.
- Switch OFF the Engine.

IMPORTANT INSTRUCTIONS:

- In AMT, it will automatically shift to neutral after 120 seconds in Idling. To avoid this in traffic, slightly press accelerator pedal once.
- Don't switch OFF the vehicle in Gear. Don't switch OFF Isolator immediately after Ignition key - OFF. Wait for 30 - 45 sec for the system to shut down.
- In case of any malfunction or Error in the system, Switch OFF the Ignition and wait for a minute before starting again.

3) ELECTRICAL ELECTRONIC ARCHITECTURE (EEA):

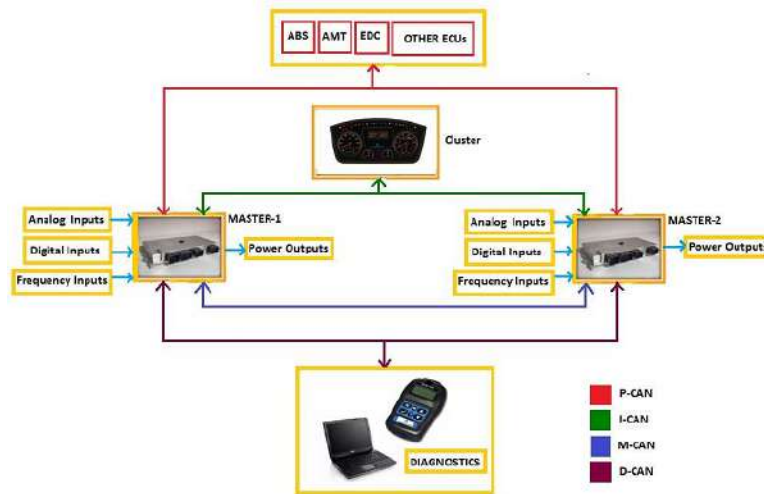
These vehicles are provided with Ashok Leyland Vehicle Electrical/Electronic Distributed Architecture called as ALVEDA™.

EEA System processes information & assures the reliable delivery of power, signals, & data across the network. It defines interaction between components such as wiring, electrical components, connectors, switches,

actuators, controllers, sensors and data networks. EEA provides efficient diagnostics and functionality.

For Master& Master configuration, main ALVEDA™ Components are:

- MASTER 1 Body Control Unit (MASTER 1 BCU)
- MASTER 2 Body Control Unit (MASTER 2 BCU)
- Electronic Cluster



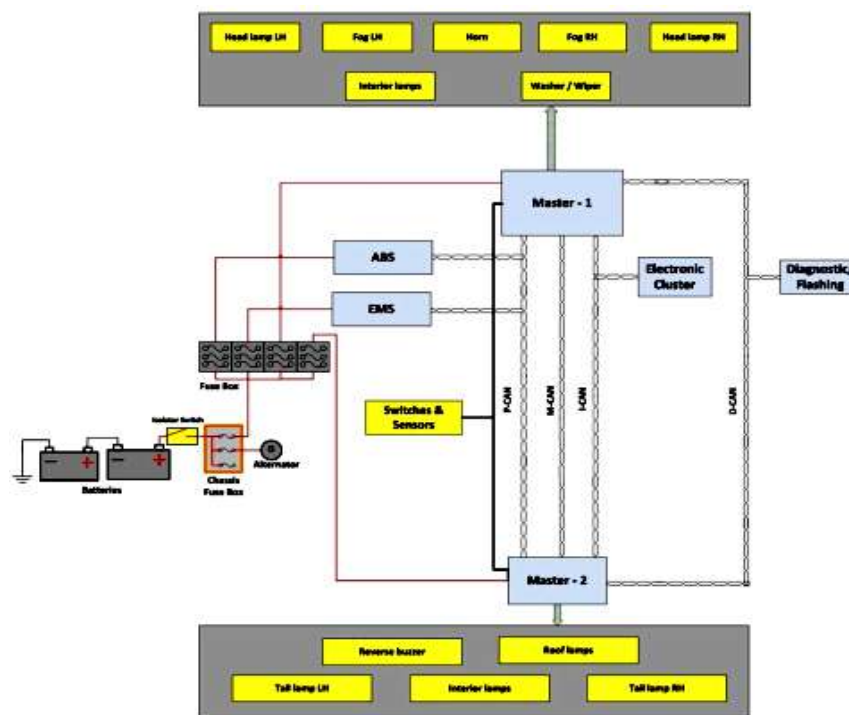
Master 1 and Master 2 processes both input and sensor information and will communicate with other ECUs to drive loads. They not only drive loads, but also detect the electrical diagnostics like short to battery, short to ground and open load errors. When Master 1 fails, Master 2 takes control of the redundant front loads and displays Master 1 failure message. When Master 2 fails, Master 1 takes control of the redundant rear loads and displays Master 2 failure message.

Cluster acts as **Human-Machine Interface (HMI)**. This is a complete CAN based Electronic Instrument Cluster that replaces all the mechanical gauges with Stepper Motor Driven Gauges which improves the reliability. The Instrument Cluster has 34 Telltales and pictograms on the LCD screen. Trip Information (Distance, fuel Economy) and Diagnostics Information of all ECUs connected in the network is displayed. Cluster has a flash memory to store the trip and diagnostics data that can be downloaded using PEN DRIVE. The HMI is through the 2 Push Buttons (SET & Mode) on the Instrument Cluster (used for resetting the trip meter, date & Time settings, LCD Brightness settings & Scrolling to different pages of LCD). In Cluster Gear Shift Advisory System is also available for better Driving assistances.

Master 1, Master 2, Cluster, Others ECUs and Diagnostic Tool communicate with each other via Controlled Area Network (CAN) channels.

CAN Networks:

1. **P-CAN:** Power Train CAN - ECUs like EDC ECU, ABS ECU, and AMT ECU are connected to BCU via power train CAN. These ECUs are responsible for power train of the vehicle.
2. **I-CAN:** Infotainment CAN - Instrument Cluster and Telematics unit are connected to BCU via Infotainment CAN. These ECUs display to the driver and stores it in server.
3. **M-CAN:** CAN for Rear Nodes -Master 1 transmits & Receives CAN information from Master 2 via CAN-3. This CAN interface connects to Master 2 Nodes.
4. **D-CAN:** Diagnostics CAN - This CAN is used for lashing the ECUs and for connecting diagnostic tool to get diagnostic data.



DO'S AND DON'T'S IN EEA SYSTEM:

- Never remove the connectors from the BCUs and cluster when the power is on - Turn off the isolator switch when the ECU connectors are removed.
- After ignition is turned off, allow 40 secs after run before removing the power from the battery (i.e.) switching off Isolator switch.
- Avoid tapping of the wires during service for additional load fitment
- Never increase the fuse rating than the specified rating provided in the vehicle.
- Never do any welding with BCU and cluster connected.

4) ELECTRO PNEUMATIC DOORS:

The AL JnNURM-2 buses are equipped with two Electro - Pneumatic Door control Mechanisms one in Front and another in rear portion provided by M/s Mitech & M/s Janatics India (P) Ltd. The Pneumatic Door mechanism actuates the open / close movements of bus doors through double acting cylinders (One in front & two in rear) with suitable linkages.

To prevent people from being clamped, the door system adopts electro pneumatic sensor, PE converter, flow control valve so that the door will retract automatically when any obstruction occurs. All the units are mounted above the door.

Technical Data:

- | | |
|------------------------|---|
| a) Operating Pressure: | > 6.0 kg/cm ² |
| b) Rated Voltage: | 24 V DC |
| c) Open / close time: | depends upon flow control valve setting |

Description of the Product:

- Single door Assembly is provided at front where as twin door assemblies (LHS & RHS) are provided at rear
- The double acting cylinders used are of 63 mm Bore X 100 mm stroke with ball joint fitted at cylinder end.
- 5/2 Electrical operated valve (Operation control valve) is provided which is used for opening / closing of the cylinder.
- One 3/2 pilot operated valve (System Control valve) is also provided for emergency operation.
- 3/2 Electrical operated valve (Emergency Reset valve) is provided which is used for electrical reset after emergency.
- 3/2 Push - Pull valve (Main Cut Off valve) is provided which is used for main air supply cut off at the dash board end.
- One Non return valve is provided for compensation of air in the pilot/ emergency line.

Oiling and greasing shall be done on Mechanical Parts, once in a week for smooth functioning and long life of the system. The trouble shooting guide is enclosed at **Annexure-V**.

5) ON BUS INTELLIGENT TRANSPORT SYSTEM (OBITS)

OBITS is an Integrated hardware and software wireless solution designed to track and monitor buses. OBITS enables tracking of vehicles and store, represent and display data of moving buses which is then transmitted to the vehicle tracking server via GPRS.

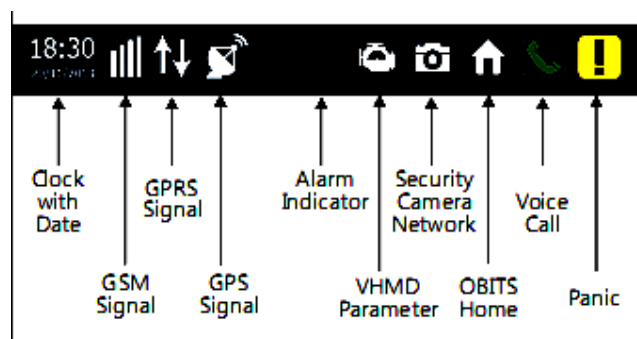
The Driver of the bus has to use touch screen of Bus Driver Console (BDC) to operate OBITS.

The BDC has the following buttons:

1. Auto
2. Menu
3. Brightness control
4. Screen ON/OFF button

After OBITS is switched ON, the BDC displays Home screen which is divided into three parts i.e., Header, Content and Machine ID.

HEADER: The below Image shows the Header part of Home screen, which is self explanatory.



The **CONTENT** part of OBITS home screen contains the following buttons:

- Pre Recorded Messages - Used to play the pre recorded messages
- Routes - Used to select and display the available routes for a Bus
- Security Camera - Used to view live streaming of cameras
- More - Used for further navigation of OBITS features & functions

When the '**More**' Button is pressed on Home screen, the following buttons are displayed:

- Data Transfer - Used to transfer the recorded files and to upgrade the OBITS
- Settings - Used to adjust the volume of PIS speakers
- VHMD parameters - Used to view VHMD parameters
- Duty Information - Used to view the duty information

Driver has to check for GSM, GPRS and GPS connectivity prior to start the bus. Initially details all the routes / services in a particular depot shall be fed into the system. By way of operating the 'Routes' Button, one can select a route, start a route. Driver has to select a route in order to start the passenger Information system (PIS). Pre-recorded messages can be played and volume can be adjusted in PIS.

After selecting and confirming the route, the information gets displayed on the LED boards.

Security Camera Network: OBITS has surveillance cameras to record the activities inside the bus which record all the activities till OBITS is ON.

Vehicle Health Monitoring and Diagnostics (VHMD):

VHMD parameters can be viewed by pressing "VHMD PARAMETERS BUTTON" on the 'MORE' screen. VHMD parameters can also be viewed by pressing "VHMD button" on the header.

VHMD parameter screen contains parameter group buttons and parameters table. Vehicle health parameters are arranged in various groups. Select a group to view parameters in tabulated form. Table contains pre-configured parameters of that specific group providing information about parameter name, its value at that specific time and its unit. OBITS creates Log files for VHMD parameters and PIS sign data and communicates it to the control centre at the end of the day.

The Driver can communicate with the 'Central Control Center' in case of panic viz., accident, caught fire, drowning in water etc., by sending a panic message. For this, driver has to select PANIC button in the header, and press the relevant pre-defined message.

The Driver can also make a call to the 'Central Control Center' and receive a call from BDC where numbers are pre configured in the system.

DATA TRANSFER: The data can be transferred from OBITS to Central Call Center via wi-fi or USB. In order to transfer the data via 'wi-fi', press the "via wi-fi" button on data transfer screen. System displays a pop-up when synchronization between OBITS and CCC is in progress, successful and also when synchronization fails. The pop-up disappears automatically after three seconds and system displays home screen.

In order to transfer the data via 'USB', press the "via USB" button on data transfer screen. The operations 'copy data to USB' and 'upgrade from USB' can be performed in this function by selecting appropriate buttons.

Do's:

- ITS Switch (On bus Dash board) should be in OFF Mode prior to start of Vehicle's Ignition switch (Cranking of Engine). Please turn 'ON' ITS switch post ignition key is turned on.
- Similarly while switching OFF ignition, first turn 'OFF' OBITS Switch and then turn OFF the ignition key to increase OBITS system life.
- Wait for 2-3 minutes after ITS switch 'ON' to start BDC. Check power 'ON' LED status of BDC.
- Ensure clear visibility of camera before starting a route.
- Check GPS/GPRS/GSM signal status prior to start off route.
- Check all LED boards display message immediately after start of OBITS.
- Do take the backup of daily recorded files from Black Box as delay may cause loss of surveillance data, if the disk gets full.
- Always ensure storage device (like USB) is free from viruses before initiating the daily back up of black box, else it may cause loss of surveillance data.

Don'ts:

- Do not place any object in front of BDC, it may block the view for navigation and control.
- Do not place any object on/in front of combi-antenna as it may impact GPS/GSM Connectivity.
- Do not use battery of SCU for any other purpose like charging of mobile or running of infotainment system and so on.
- Do not install any unauthorized electrical accessories as it may damage the OBITS, making the manufacturer warranty null and void.
- Do not disconnect or lose any wiring connections as it may lead to non-performance.
- Do not drive the vehicle with micro pedal switch in the ON condition mode.
- Do not switch off the BDC screen during the route in progress.
- Do not attempt to disturb the standard setting of BDC.

Annexure-V

S. No	Trouble	Causes	Action To be Taken
1	Continued Air leak through filter regulator on/off knob	Wrong Port Connection	Change Port Connection
2	Dashboard Switch not working	No Air supply	Air supply to be given from Bus
		Air leak from Main Line. Front & Rear tube connections	Air leak To be arrested
		Main Air line cutoff Not Reset	Turn ON main air line from FRC, Reset the Door system
3	Door not Opening / Closing	No Air supply	Connect Air Pressure
		PU Tubes are removed	Plug the tubes firmly
		Blocked Tube connection	Remove Blockade in PU tube
		Wrong Connection of electrical wires & pneumatic tubing	Connect wires to respective components, Use color coding of wires for proper connection before testing.
		No (+ve) / (-ve) to solenoid coil, Loose connection on coil terminals	Check power in harness. And connect the terminals properly.
		Solenoid coil failure	Replace solenoid coil
		Shelf plate Harness cable failure	Replace shelf plate harness cable assy, Release air block and connect
		Solenoid valve spool struck due to low air pressure	Maintain air pressure above 4.5 bar
4	Door not closing	No air supply/ no electrical power supply	Air supply & electrical supply to be given
		Double solenoid valve spool struck due to low air pressure	Maintain air pressure above 4.5 bar
		Flow control valve fully closed	Open the flow control valve to close the door and set required Speed
		Electro pneumatic sensor is getting activated automatically even when there is no entrant.	Sensitivity screw to be tightened
		Electro pneumatic sensor is getting activated automatically even when there is no entrant. due to friction in the roller rail.	Clean the rail and service and apply grease on the roller for friction free movement
		Electro pneumatic sensor was activated as the sensitivity screw was loose condition	Screw to be tightened
5	Door Opens automatically after fully closing	No power supply for EPS	Check EPS
		PE converter	To align properly
		Loose connection	Connect firmly
6	Improper / Erratic Operation of Door	Flow control valve screw high throttling	To be adjust flow control valve repaired Speed by using screw driver for both Open /Close
		Cylinder mounting in loose connection	To be tightened
		Flow control valve pot failure	To be replace flow control valve
7	Safety not working	Electro pneumatic sensor (EPS) failure	Replace EPS sensor
		EPS sensor not working due to connectors are removed / Loose connection	Fit the connectors firmly
		EPS sensor not working due to harness wires are interchanged.	Check whether the connection to the harness are interchanged (refer color coding of the wires.)
8	Door Trouble rattling noise secondary leaf came out struck during Open or close	False complaint	Necessary action to be taken to avoid registration of false complaint
		Due to fouling external component. Due to dust accumulation at door travelling area & pivot locations	Remove all external components such as scrap. dust particles etc..
		Hinge mounting bolt loose and hinge came outside from door flap. Bottom Bracket mounting bolt loose	Clean door travelling area. Hinge bolt to be tightened Lubricate on shelf plate guide Bottom bracket Mounting bolt to be tightened

Annexure-VI

Essential Spares - COMMON PARTS FOR 900mm Buses & 650mm JAN Buses

S. No.	Part No	Description	System	Qty / Bus
1	X5V00100	750 MM WIPER ARM DRIVER SIDE	BODY	1
2	X5V00200	750 MM WIPER ARM CO-DRIVER SIDE	BODY	1
3	X5X00200	24V,115NM WIPER MOTOR	BODY	1
4	X5W00100	1000MM WIPER BLADE	BODY	2
5	F3V05800	DUAL BRAKE VALVE TREADLE TYPE	BRAKES	1
6	F8836400	HAND BRAKE VALVE	BRAKES	1
7	P1023951	REPAIR KIT - HAND BRAKE VALVE	BRAKES	1
8	P1024351	REPAIR KIT-RELAY VALVE	BRAKES	1
9	FL402300	RELAY VALVE WITH INLET AND SIGNAL PTFE DELIVERY PORTS	BRAKES	1
10	F3V05900	PRESSURE PROTECTION VALVE 6.7 BAR	BRAKES	1
11	F8000400	LOW PRESSURE INDICATOR SWITCH - 6.5 bar	BRAKES	1
12	F1990150	ELBOW HOSE- COMPRESSOR INLET	BRAKES	1
13	F1902800	HOSE ASSY FOR AIR RESTRICTION	BRAKES	1
14	F7B01800	PRIMARY FILTER	BRAKES	1
15	FN700300	BRAKE HOSE M18X1.5	BRAKES	2
16	F1925950	L-HOSE	COOLING	1
17	P2652939	Cap-Dat	COOLING	1
18	F8K01345	ASSY OF CAC	COOLING	1
19	F0530150	RUBBER BUSH	COOLING	4
20	F8P16358	CAC INLET HOSE - ENGINE SIDE	COOLING	1
21	F8P01958	RADIATOR HOSE	COOLING	1
22	F8P02358	CAC-INLET HOSE	COOLING	1
23	F8P04958	CAC OUTLET PIPE HOSE - CAC SIDE	COOLING	1
24	F8P02058	RADIATOR HOSE	COOLING	1
25	F8P02258	CAC-OUTLET HOSE	COOLING	1
26	F8600958	HOSE-RAD BOTTOM TO ENGINE	COOLING	2
27	X0806710	CLIP,TC COMPRESSOR OUTLET PIPE	COOLING	1
28	F1926350	L-HOSE	COOLING	1
29	PD600178	AMT REPAIR KIT	CLUTCH	1
30	B1391805	15 INCH RDC COVER ASSY WITH TEKTONIX PRESSURE PLATE	CLUTCH	1
31	B1306303	380 DIA CLUTCH DISC 14MM THK - SETCO MAKE	CLUTCH	1
32	P5104073	380 DIA F510MCC FACING REP KIT	CLUTCH	1
33	X7200122	FACEPLATE, 15 RDC, WITH DOWEL HOLES	CLUTCH	1
34	F3032622	CLUTCH BACK PLATE	CLUTCH	1
35	P0941751	CLUTCH REPAIR KIT - MINOR	CLUTCH	1
36	P0958151	CLUTCH BUSH PIN KIT	CLUTCH	1
37	F0P00700	CLUTCH RELEASE BEARING	CLUTCH	1
38	PF400007	PRESSURE SENSOR	ENGINE	1
39	B2W00306	LUBE OIL PIPE FROM FIP HOUSING TO CB28 PUMP	ENGINE	1
40	F7A01500	OIL FILTER - Fleetguard part no - LF16238	ENGINE	1
41	X2009500	SENSOR OIL, PRESSURE & TEMPERATURE DS-K-TF	ENGINE	1
42	X7478300	BOOST PRESSURE SENSOR	ENGINE	1
43	X0301650	BELT, 8PK 1250 (FENNER)	ENGINE	1
44	B8763401	COOLANT PUMP ASSY	ENGINE	1
45	X2706700	OIL SEAL, FRONT (PTFE)	ENGINE	1
46	X7472800	SENSOR, COOLANT TEMPERATURE	ENGINE	1
47	B9706401	DIPSTICK AND GUIDE AS A PAIR.	ENGINE	1
48	X7472700	ENGINE SPEED SENSOR DG6	ENGINE	1
49	X7488700	Engine Mounted Fuel Filter for CRS Engines	ENGINE	1
50	P1302040	MAIN FILTER INSERT - CRS	ENGINE	1
51	B2W00307	FUEL HOSE, FROM FILTER TO CB28 PUMP	ENGINE	1
52	B3740301	FLOOR MTD TYPE ELECTRONIC APM	ENGINE	1
53	F7A04700	PRE-FILTER WITH WATER SEPERATOR	ENGINE	1

S. No.	Part No	Description	System	Qty / Bus
54	FF406500	FUEL LEVEL SENSOR	ENGINE	1
55	F1115000	FUEL TANK CAP - ADEEP MAKE	ENGINE	1
56	F9E05000	HEAD LAMP WITH PARKING	ELECTRICAL	2
57	F8172300	DOUBLE POLE ELECTRICAL ISOLATOR SWITCH	ELECTRICAL	1
58	X8841200	PRESSURE SENSOR	ELECTRICAL	2
59	FJ106300	DOUBLE LEVER COMBINATION SWITCH CANCELLATION	ELECTRICAL	1
60	PB600001	S/W ASSLY WIPER -G45/90/91	ELECTRICAL	1
61	PB600002	S/W ASSLY LIGHT -G45	ELECTRICAL	1
62	PB600004	S/W ASSLY LIGHT -G45	ELECTRICAL	1
63	F6H19900	REAR MASTER ASSEMBLY SET	ELECTRICAL	1
64	F6H03099	INSTRUMENT CLUSTER ASSY.	ELECTRICAL	1
65	F6H10500	FRONT MASTER ASSMEBLY SET	ELECTRICAL	1
66	X7826200	CURRENT SENSOR	ELECTRICAL	1
67	F8844600	RELAY	ELECTRICAL	9
68	B2H17908	IGNITION SWITCH ASSY WITH DUMMY CAP	ELECTRICAL	1
69	F8825200	MICRO RELAY	ELECTRICAL	7
70	FV605300	MICRO RELAY	ELECTRICAL	1
71	FN200900	MICRO RELAY	ELECTRICAL	3
72	PHW00011	Slow blow FUSE 120 AMPS Male - White	ELECTRICAL	1
73	PHW00008	Slow blow FUSE 40A Female - Green	ELECTRICAL	1
74	PHW00002	Slow blow FUSE 60A Female - Yellow	ELECTRICAL	2
75	F0P02610	FRONT AXLE OUTER BEARING	F.AXLE	2
76	F0P02710	FRONT AXLE INNER BEARING	F.AXLE	2
77	F0991215	King Pin - FA99	F.AXLE	2
78	F0268310	Thrust Bearing	F.AXLE	2
79	F0501042	KING PIN BUSH	F.AXLE	2
80	F2725900	Oil seal for king pin	F.AXLE	2
81	X8823300	AUTOMATIC SLACK ADJUSTER-LH (38MM OFFSET-MEI)	F.AXLE	1
82	PD600303	BRAKE LINING KIT - FRONT RD2619	F.AXLE	1
83	X8823400	AUTOMATIC SLACK ADJUSTER-RH (MEI)	F.AXLE	1
84	P2665239	TIE ROD END RH	F.AXLE	1
85	P2665139	TIE ROD END LH	F.AXLE	1
86	F3569310	WHEEL BOLT	F.AXLE	20
87	F2754200	OIL SEAL - HUB - FENNER	F.AXLE	2
88	P3126251	King pin kit	F.AXLE	1
89	FA600180	GEARBOX INPUT SHAFT OIL SEAL FOR ZF6S-850 GEAR BOX	G.BOX	1
90	FA600250	OIL SEAL - MAIN SHAFT REAR	G.BOX	1
91	FF402200	AMT INPUT SENSOR -WABCO	G.BOX	1
92	FF402300	AMT OUTPUT SENSOR - WABCO	G.BOX	1
93	P4502451	UJ KIT	PP. SHAFT	1
94	F0257010	CENTER BEARING KIT	PP. SHAFT	1
95	P4501939	BEARING WITH RETAINER	PP. SHAFT	1
96	F2730200	OIL SEAL SUPER 4B 1621	R.AXLE	2
97	F0233010	HUB BEARING INNER	R.AXLE	2
98	F2701400	OIL SEAL	R.AXLE	2
99	F1879622	Brake Drum-TO SUIT 8 INCH BRAKES	R.AXLE	2
100	F3R00114	SPRING BRAKE ACTUATOR TY24/24 LH WABCO VE	R.AXLE	1
101	F3R00214	SPRING BRAKE ACTUATOR TY24/24 RH WABCO VE	R.AXLE	1
102	FP600500	AUTOMATIC SLACK ADJUSTER 28.5MM OFFSET - LH	R.AXLE	1
103	FP600600	AUTOMATIC SLACK ADJUSTER 28.5MM OFFSET - RH	R.AXLE	1
104	P2616251	MAJOR REPAIR KIT	R.AXLE	1
105	P2616151	MINOR REPAIR KIT	R.AXLE	1
106	P4200340	FILTER ELEMENT	STEERING	1
107	F0130150	RUBBER ELEMENT	SUSPENSION	8

ESSENTIAL SPARES - EXCLUSIVE PARTS FOR 900 MM BUSES

S. No.	Part No	Description	System	Qty per bus
1	FN700200	BRAKE HOSE M22X1.5 FEMALE RUNNING NUT ON BOTH SIDE	BRAKES	2
2	F8P21858	EPDM HOSE - RADIATOR PIPING	COOLING	1
3	FD003945	RADIATOR ASSY	COOLING	1
4	B5J28302	SUCTION LINE FUEL FILTER TO FIP	ENGINE	1
5	B5J28303	RETURN LINE ENGINE TO FUEL TANK	ENGINE	1
6	B5J28301	SUCTION LINE FUEL TANK TO LINE PRIMER	ENGINE	1
7	B5J28304	SUCTION LINE HAND PRIMER TO FILTER	ENGINE	1
8	FEN02500	EDC WIRING HARNESS	ELECTRICAL	2
9	FN308700	165KW EDC 17 ENGINE WIRING HARNESS	ELECTRICAL	2
10	FAG07800	FRAME WIRING HARNESS FOR 12MFESF JNNURM II	ELECTRICAL	1
11	PM800059	Pre-fuse Pigtail harness	ELECTRICAL	1
12	F1P00500	AMT WIRING HARNESS FOR 12M FESLF JNNURM II	ELECTRICAL	2
13	FMX03300	MAIN WIRING HARNESS	ELECTRICAL	1
14	FD900411	SYNCHRO RING (3/4)	G.BOX	1
15	FD900511	SYNCHRO RING (5/6)	G.BOX	1
16	F0P00810	NEEDLE CAGE - CRAWLER GEAR (NRB)	G.BOX	1
17	FJ400116	SYNCHRO BODY - 3RD/4TH	G.BOX	1
18	FKY00511	INPUT SHAFT - MODIFIED	G.BOX	1
19	FKZ00322	IPS COVER	G.BOX	1
20	F8R02542	CONNECTION HOUSING FOR AMT 6S-36/2 GB	G.BOX	1
21	F1719100	GASKET - SELECTOR HOUSING	G.BOX	1
22	F7Y03600	GASKET FOR SHIFT SELECT ACTUATOR	G.BOX	1
23	FF702811	MAIN SHAFT - MODIFIED	G.BOX	1
24	PD600299	BRAKE LINING KIT - REAR RD2619	R.AXLE	1
25	F0230110	HUB BEARING OUTER	R.AXLE	
26	P4301936	RETURN SPRING-BRAKE SHOE	R.AXLE	4
27	P4300936	SPRING -BRK SHOE RETAINING	R.AXLE	4
28	B2281401	SUCTION HOSE ASSY AT RESERVOIR END	STEERING	1
29	B2281410	PRESSURE HOSE ASSEMBLY AT PUMP END	STEERING	1
30	B2281409	SUCTION HOSE ASSEMBLY AT PUMP END	STEERING	1

ESSENTIAL SPARES - EXCLUSIVE PARTS FOR 650 MM JAN BUSES

S. No.	PART NO	Description	Qty per bus
1	FJ122500	24V 5A ISOLATOR SWITCH FORM MARQUARDT LTD	1
2	F3V06000	AIR DRYER 9 BAR PTFC	1
3	FT000200	SYSTEM PROTECTION VALVE NEW GEN.PARALLEL CHARGING	1
4	PD600213	REPAIR KIT	1
5	B2C02401	MAIN DRAG LINK ASSY	1
6	PE700047	SOCKET END-ASSLY-RH	1
7	B2C02301	RELAY DRAG LINK ASSY	1
8	PE700047	SOCKET END-ASSLY-RH	1
9	FD004445	RADIATOR ASSEMBLY	1
10	B5J13404	S/A OF HOSE - PREFILTER TO FIP	1
11	B5J22202	S/A OF RETURN HOSE	1
12	B5J22201	S/A OF SUCTION HOSE	1
13	P5104306	RD2619M BRLINING KIT/JANBUS RR-STD with Rivets	1
14	PA600022	OIL SEAL	1
15	PA600023	OIL SEAL	1
16	PA600025	OIL SEAL-R	1
17	PP600007	AUTO SLACK ADJ-RIGHT	1
18	PP600006	AUTO SLACK ADJ-LEFT	1
19	X5X00300	1760MM WIPER LINKAGE	1
20	P5104305	Front RD2619 brake lining kit with rivets	1
21	F7B02900	Pre filter Spin on	1
22	FN700600	BRAKE HOSE M22X1.5 - 600MM	2
23	FN700500	BRAKE HOSE M18X1.5 - 600MM	2
24	FSJ00100	PRESSURE REDUCTION VALVE 8 BAR (TANK MOUNTED)	2
25	P3S00002	BRAKE DRUM	2
26	P0P00057	TAPERED ROLLER BEARING	2
27	P0P00058	TAPERED ROLLER BEARING	2
28	FZ601600	SPRING BRAKE ACTUATOR TYPE 24/24	2
29	P4A00031	BUSH OF S-CAM SHFT	4
30	P3P00004	BRAKE SHOE	4
31	PL800084	WASHER	4
32	P4A00032	BUSH	4
33	PB300030	PIN	4
34	PE200006	ROLLER	4
35	P4P00009	CIRCLIP FOR SHAFT	4
36	PB300028	BRAKE SHOE PIN	4
37	P4A00030	BUSH	4
38	P4X00012	RETURN SPRING	4
39	PB300029	RETURN SPRING PIN	4
40	PD900023	SEAL RING	4
41	PC200022	SCREWED PLUG	4
42	PD900019	PACKING RING	4
43	FC200161	NYLON PLUG	4
44	PM300003	WHEEL BOLT	20