EUROTRAKKER
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REPAIR MANUAL
ELECTRIC/ELECTRONIC SYSTEM

IVECO

This publication describes the characteristics, the data, the correct methodology of the repairs that can be made on each individual component of the vehicle.

By complying with the instructions supplied and using the specific tools it is possible to perform any repair intervention correctly, within the specified time frames, while protecting the technicians against incidents.

Before starting any repair work, make sure that all accident prevention devices are ready at hand.

Check and wear the protective personal equipment provided for by the safety standards: goggles, helmet, gloves, shoes.

Check the efficiency of all processing, lifting and transport tools before using them.

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10156 Torino (Italy)

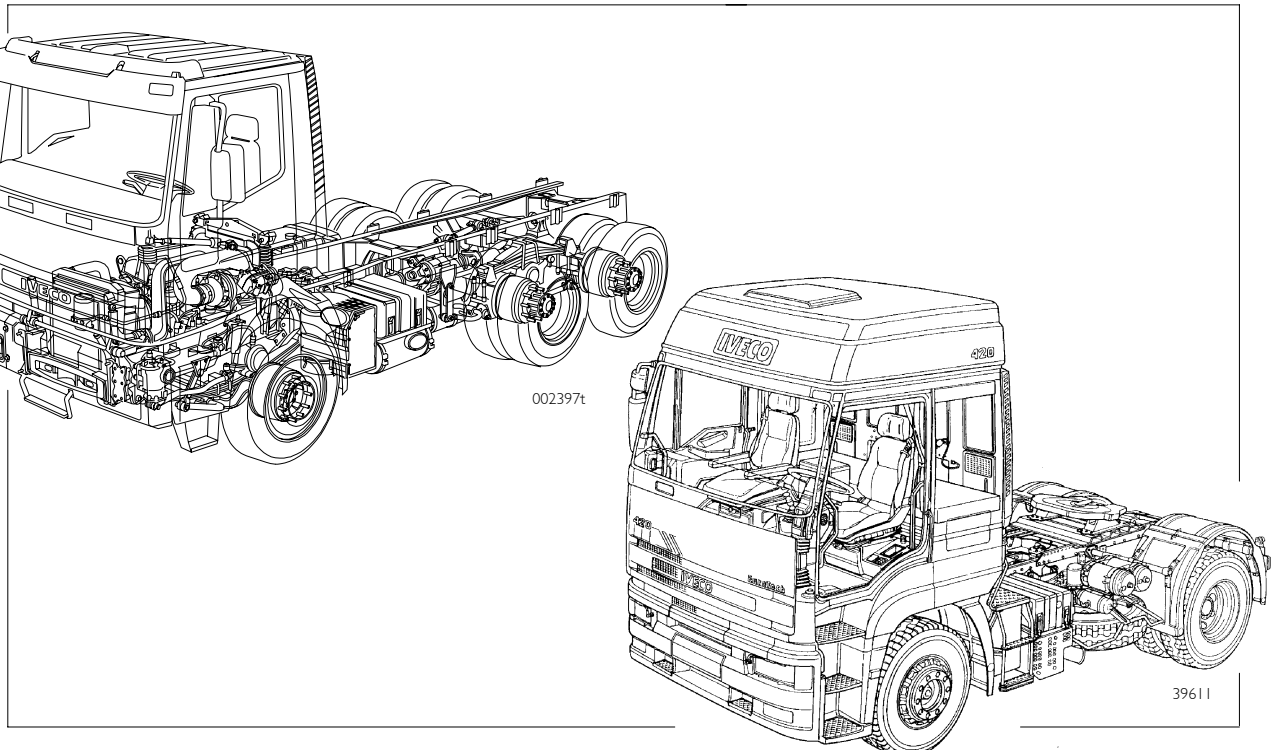
Printed **603.93.121** - 1st Ed. 2002

Produced by:

SATIZ msx
INTERNATIONAL
An MSX International Company

B.U. TECHNICAL PUBLISHING
C.so Svizzera, 185
10149 Torino (Italy)

FOREWORD



This manual is part of the aids that the Technical Publications sector makes available to workshop technicians to allow the correct performance of maintenance and/or repair operations and it is also a good way to familiarise with the IVECO product.

The experience acquired over many years in servicing and in editing technical publications has led us to devote a special volume to the electric system fitted on the models in question, considering the particularity and complexity of the subject.

This manual is intended for people with professional preparation in the "Vehicle Electrician" sector and at the same time avail of adequate and indispensable testing and/or measurement equipment for the main electrical ratings.

In drafting the texts and representing the graphics we have taken account of the particular necessities of the operator technician in some cases stating references or repeating certain diagrams in different places that may be obvious to a design engineer.

The completeness of the information given in the wiring diagrams, the size chosen and the ease with which they can be taken allow the repair operator to avail of all the information exactly where it is needed most, namely, on board the actual vehicle.

GENERAL LIST OF CONTENTS

CHAPTER

Introduction

INTRODUCTION

This manual comprises 5 chapters, identified by roman numerals:

Chapter I INTRODUCTION
Chapter II GENERAL DESCRIPTION
Chapter III SPECIFIC CIRCUITS
Chapter IV CIRCUIT CHARTS

The subjects dealt with are updated at the date of drafting of the manual which practically corresponds to the date of going to press.

Each chapter has its own progressive page number to simplify updating.

The numbering of the figures is double. The first digit refers to the chapter number and the second is a progressive number; this makes it easy to find figures if they are given as references elsewhere.

The possibility exists that the information given in this manual may not be up to date as a result of modifications adopted by the Manufacturer at any time for reasons of a technical or commercial nature or to adjust to the laws in force in the different Countries.

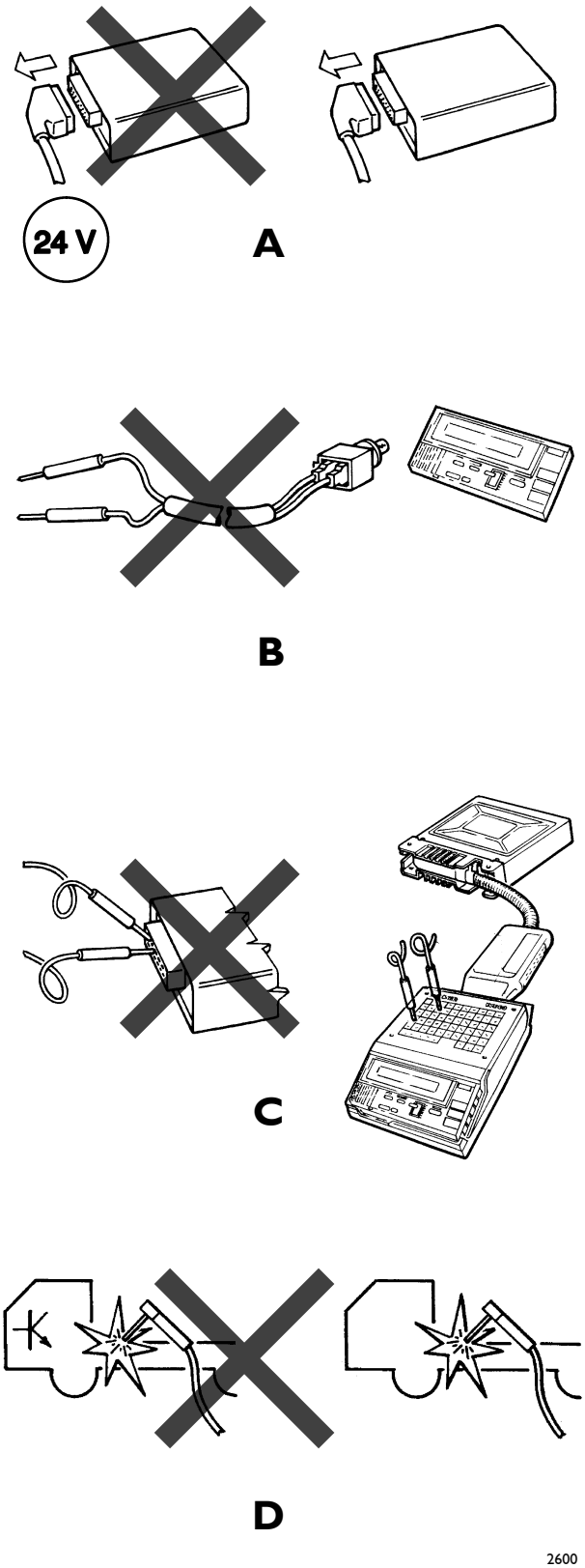
General cautions for electric/electronic components

NEVER DISCONNECT THE BATTERIES OF THE SYSTEM OR OPEN THE KNIFE SWITCH WITH THE ENGINE RUNNING.
DO NOT START THE ENGINE WITHOUT FIRSTLY CONNECTING THE BATTERIES PERMANENTLY.

- Before doing any work on the vehicle chock the wheels appropriately.
- Starting from the engine compartment may only be carried out when the cab is firmly fastened on its maximum opening position with the handbrake engaged, gearbox in neutral and wheels chocked.
- Do not use quick chargers to start the engine. Starting must only be carried out with separate batteries or with the special trolley.
- Make sure that the bias of the battery terminals is correct when starting from an auxiliary trolley.
- The incorrect polarisation of the power voltage of electronic control units (for example incorrect polarisation of the batteries) may lead to their destruction.
- When needing to disconnect the batteries from the system, firstly always disconnect the frame earth cable from the negative terminal of the batteries.
- Before connecting the batteries to the system, make sure that it is well insulated.
- The incorrect bias of the supply voltage of electronic control modules (foe example incorrect battery bias) may lead to their breakage.
- When seeking a circuit failure insert a wander fuse between the negative terminal of the battery and the frame earth cable (main current switch on).
- Before removing electric and/or electronic components disconnect the earth cable from the negative terminal of the battery.
- Electrical measurements on electronic components must only be carried out with appropriate measuring equipment.
- Disconnect the batteries from the system when charging them with external equipment.
- Disconnect the external charging equipment from the mains before removing its grippers from the terminals of the batteries.
- Do not insert or remove the connector of electronic control units with the power on.
- With temperatures above 80 °C (drying ovens) remove the electronic control units.
- During electric welding work, disconnect the connectors of electronic control units.
- During connection, tighten the nuts of the connectors (temperature, pressure sensors, etc.) only with the specified tightening torque.
- Carefully make sure that the battery terminal polarity is correct before starting from an auxiliary trolley.
- Do not direct jets of water on fuseboxes and electrical equipment.
- Do not direct jets of water on the batteries.

Measurements in electronic control units, plug connections and electric connections to components may be carried out only on appropriate testing lines, with special plugs and sockets. Never use improper means such as metal wires, screwdrivers, clips or the like. In addition to the danger of a short circuit, damage to the plug connectors may also result and this would subsequently cause contact problems.

- Before disconnecting the connector from an electronic control unit, isolate the system.(Figure opposite ref. A)
- Do not cause sparks to check whether a circuit is live.
- Do not touch the pins of the connectors of electronic control units with your fingers.
- Do not use a test bulb to check the continuity of a circuit. Only use the appropriate testing devices (ref. B)
- Do not directly power the components associated with electronic control units with the nominal power rating of the vehicle.
- Do not insert the prods of a measuring device in the pins of connectors of electronic control units. Any measurements are made using UNITESTER (ref. C).
- Make sure that the wirings of electronic devices (length, type of cable, location, grouping, connection of screen braiding, earthing, etc.) conform with the IVECO system and that they are carefully restored after repair or maintenance work. To avoid the possible malfunctioning of the electronic systems on board, the wirings of additional devices must follow a different path than that of the above-mentioned systems.
- Replace components only with original IVECO components.
- Do not install additional electrical and/or electronic equipment not provided for by IVECO or by local laws.
- Do not connect the negative terminals of additional systems to the negative terminals of electronic systems.
- In the event of electric welding on the vehicle, disconnect all the electronic control units and/or disconnect the power cable from the battery positive terminal and connect it to the frame earth (ref. D).



1.1 GENERAL WARNINGS FOR ELECTRONIC COMPONENTS

Concept of earth and electromagnetic compatibility

The electric system is traditionally a single-pole system. The body, the frame, the metal container of electromechanical components act as equipotential return conductor to the generator, as any point of their metal structure or any negative terminal not isolated is at the same reference potential or EARTH. This is why the earth has been chosen as reference to the whole system, conventionally giving it the value of zero.

Due to obvious reasons of construction, in the negative network of the system there are various earth points located on the vehicle in relation to the location of the components on the frame, engine or body.

On the other hand, ideally, all the equipment should be connected to only one earth point in order to provide them, particularly for electronic devices, a clearly defined earth reference.

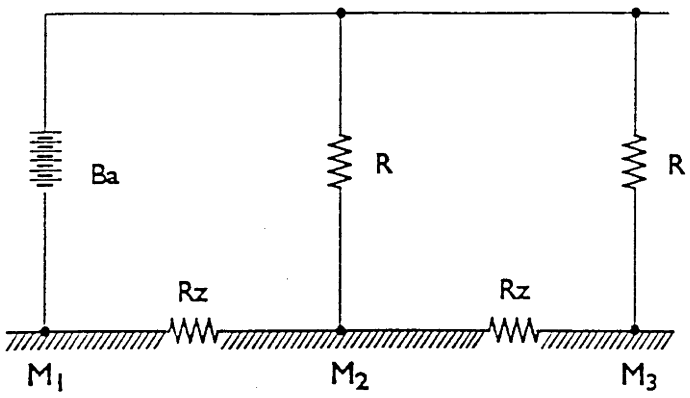
For the above-mentioned reasons it is necessary to distinguish the supply earth or system earth, characterised by strong direct current intensity (> 1 A for electromechanical components), from the analogue earth, characterised by wave shapes at determinate frequencies and very low current intensity (mA, μA) of electronic systems.

The definition of signal earth or analogue earth depends on the sensitivity of the electronic systems to EMC (electromagnetic compatibility), as parasite signals emitted by the systems on board or outside the vehicle, induce failures and/or deterioration of the systems themselves.

In order to minimise both continuous and transient disturbance or interference generated by parasite radiations, it is of the utmost importance to always bear in mind that the satisfactory efficiency of the reference plane or system earth depends on the excellent conductivity characteristics (contact resistance tending towards zero) in each of its connection points.

Briefly, we can say that the earth understood as equipotential electrical conductor, i.e. as potential reference for all the electric/electronic components on board, is subdivided into system earth and analogue earth.

The system earth points are those foreseen by the Manufacturer and must, of course, be free of paint, oxidation, grease, dust, etc.



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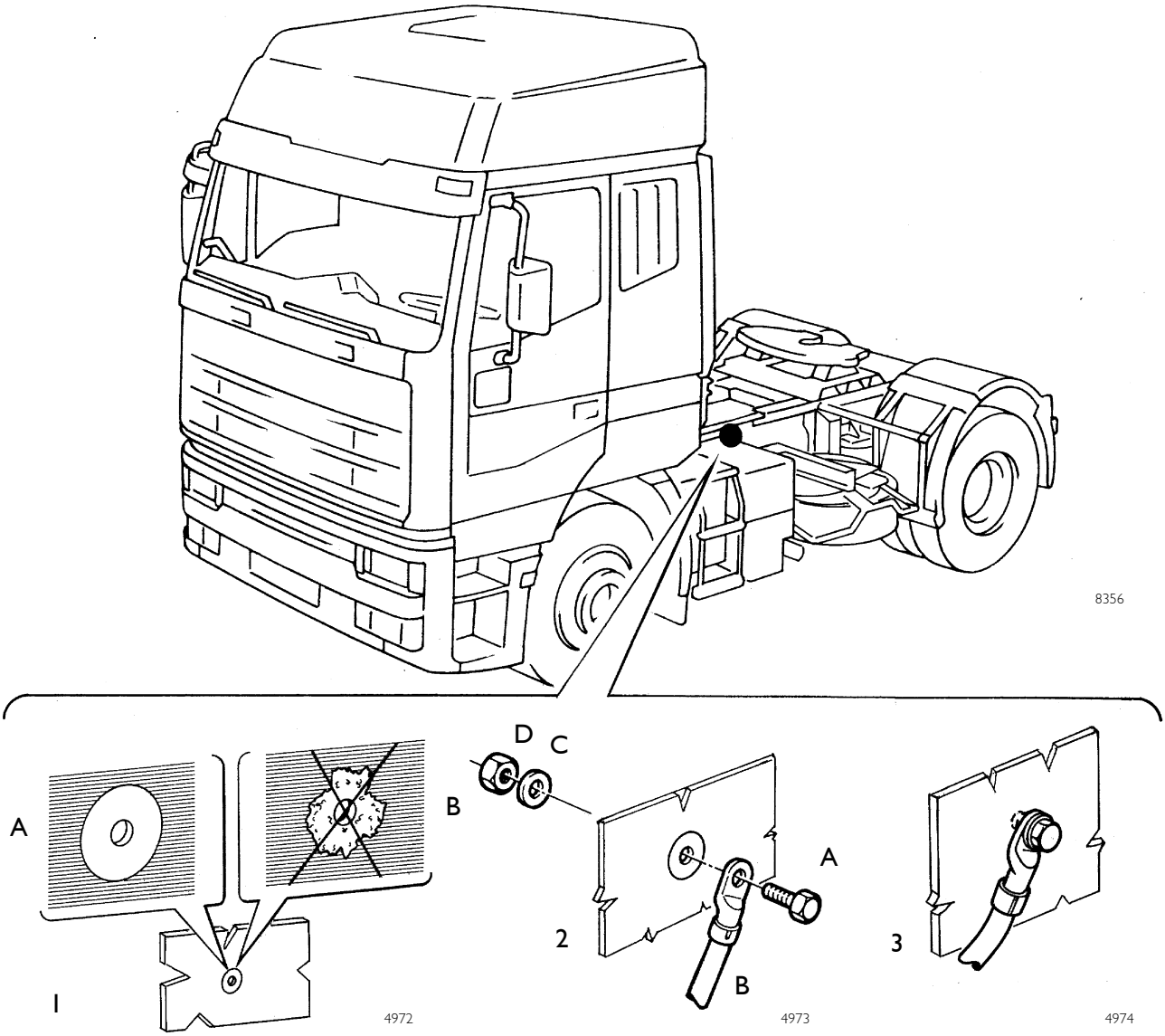
1.2 IDEAL EQUIPOTENTIAL EARTH NETWORK
Ba. BATTERY - **R.** LOADS - **Rz**. FRAME IMPEDANCE - **M.** EARTH

The system earth points are those foreseen by the manufacturer and must of course be free of paint, oxidation, grease, dust, etc.



I.3 **1** - EARTH CONNECTIONS: **A.** EFFICIENT EARTH POINT - **B.** INEFFICIENT EARTH POINT
2 - FASTENING SEQUENCE: **A.** SCREW - **B.** TERMINAL - **C.** WASHER - **D.** NUT
3 - CABLE CONNECTED TO EARTH

Should it be necessary to disconnect the earth cables from the frame, when restoring the connection it is necessary to completely remove the old conduction paint and coat with an even layer of paint BH44D which meets IVECO Standard 18-1705, proceeding as follows:

1° Remove the paint on both the frame and terminal side mechanically or using a suitable chemical product.

2° Brush on the paint, if in can, or spray.

3° Connect the earth cables within a maximum of 5 minutes from painting.

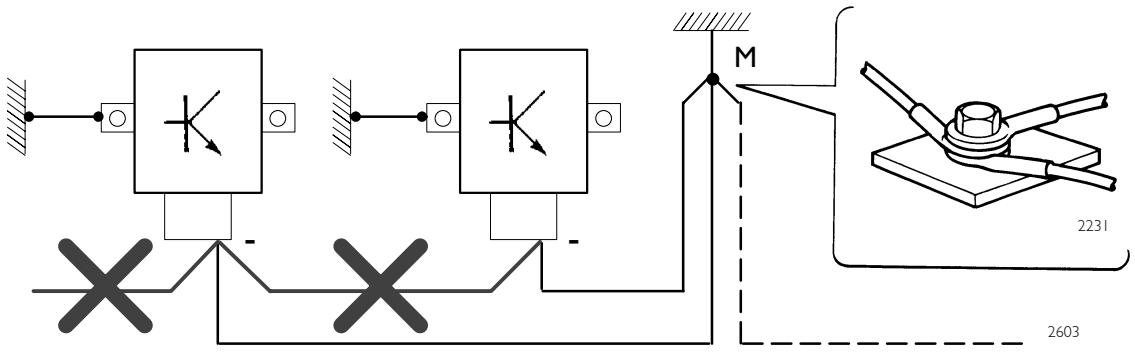
4° If a new earth contact is fitted, file around the terminal fastening hole to completely remove the anaphoretic paint of the frame creating a perfectly flat resting surface.

Practical advice

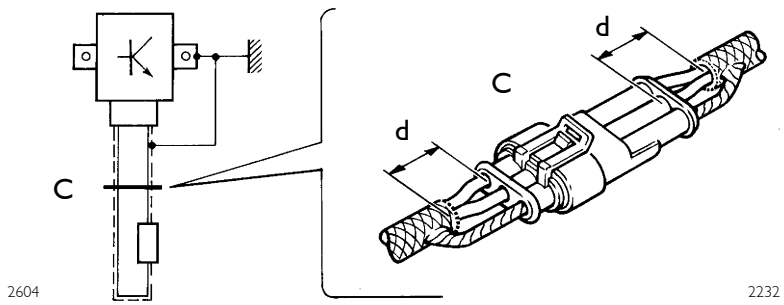
The negative cables connected to an earth point must be as short as possible and connected to one another in a "star" connection, trying to tighten them neatly and adequately (Fig. I.4 ref. M).

Additionally, for electronic components the following instructions should absolutely be followed:

- Electronic control units must be connected to the system earth when they have a metal container.
- The negative cables of control units must be connected to both a system earth point, for example the dashboard earth (avoiding "serial" or "chain" connections), and to the negative terminal of the battery/ies.
- Though they are not connected to the system earth/battery negative terminal, analogue earths (sensors) must be perfectly insulated. Therefore, particular care should be given to the parasite resistances of the terminals: oxidation, clinching defects, etc.
- The metal braiding of screened circuits must be in electrical contact in each of its ends with the components of the system.
- Only one end of the screening braid must be connected to the system earth.
- In the presence of connectors the unscreened section **d,** near them, should be as short as possible (Fig. I.5).
- The cables should be laid on parallel with the reference plane, i.e. as near as possible to the frame/body structure.
- Additional electromechanical systems should be carefully connected to the system earth and must not be set at the side of the cables of electronic components.



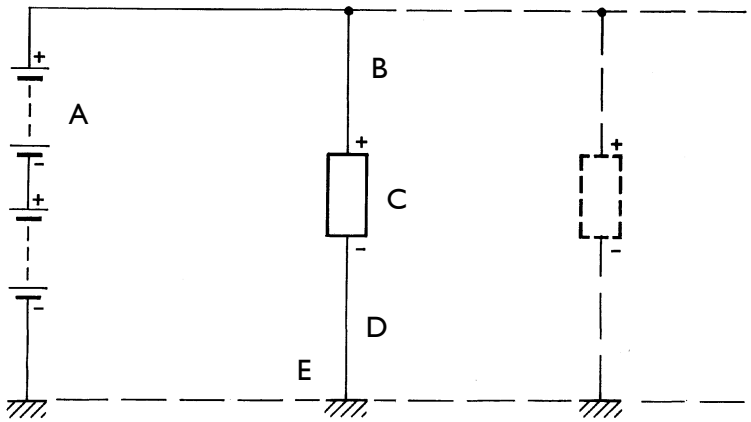
I.4 "STAR" CONNECTION OF NEGATIVE CABLES TO THE SYSTEM EARTH **M**



I.5 SCREENING BY METAL BRAID OF A CABLE TO AN ELECTRONIC COMPONENT - **C.** CONNECTOR - **d.** DISTANCE → 0

Structure of the electric network

— Unipolar system: current return from user to source via negative network and metallic structure of the vehicle (earth).



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I.6 **A.** SOURCE - **B.** POSITIVE NETWORK - **C.** LOAD - **D.** NEGATIVE NETWORK - **E.** METALLIC STRUCTURE

N.B. The circuit of the tachograph and auxiliary heater (optional) are always live

— Battery compartment (12 V x 2) located on the left sidemember

— System can be modulated through the main control box (UCI) located in the cab in the electric compartment and two wall connectors: one at the front and the other at the rear of the cab.
The main cables are:
power cable
cab cable
roof cable
exterior lighting cable
engine cable
ABS/EBS wheel anti-lock cable

— Tiltable cab with cab uncoupled indicator.

— Safety circuit for starting and stopping the engine from the engine compartment.

— Engine stopping (from cab) by resetting the ignition switch.

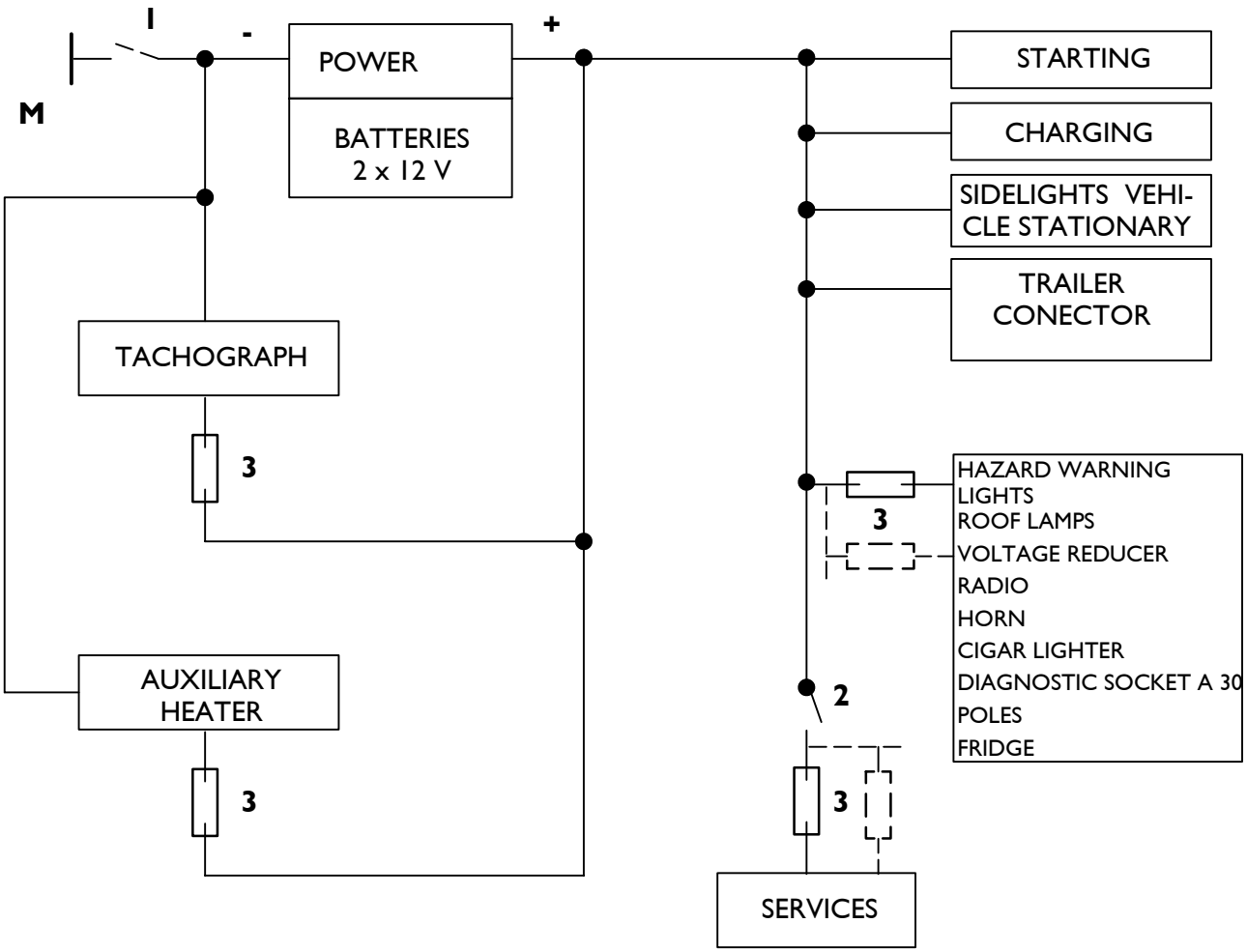
— BASE SYSTEM ELECTRONIC COMPONENTS
- Tachograph
- ABS/EBS anti wheel lock system
- Direction indicator flasher
- Injection control by electronic EDC MS6.5 system
- ECAS air suspensions
- Immobilizer.

Operating Synoptics

Briefly, we can say that the electric/electronic modularity comprises two main areas:

— AREA 1: commands, controls and protections
— AREA 2: power, batteries, starting, charging and system sectioning

The modularity of the two areas is ensured by 3 families of cables (cab, engine and frame) through the Main Interconnecting Control Box (UCI)



1.7 **1.** MANUAL BATTERY SECTIONER (OPTIONAL) - **2.** IGNITION SWITCH - **3.** PROTECTION AGAINST OVERLOADS - **M.** SYSTEM EARTH

Concept of CAN LINE

Over the past few years electronic systems on industrial vehicles have developed rapidly and they determine satisfactory operation of the vehicle.

What before was a complementary science has now become a key sector of technology. Currently electronic systems make the vehicle work and determine the effectiveness with which the single components interact with one another. Increasingly often we meet the term CAN used in this context.

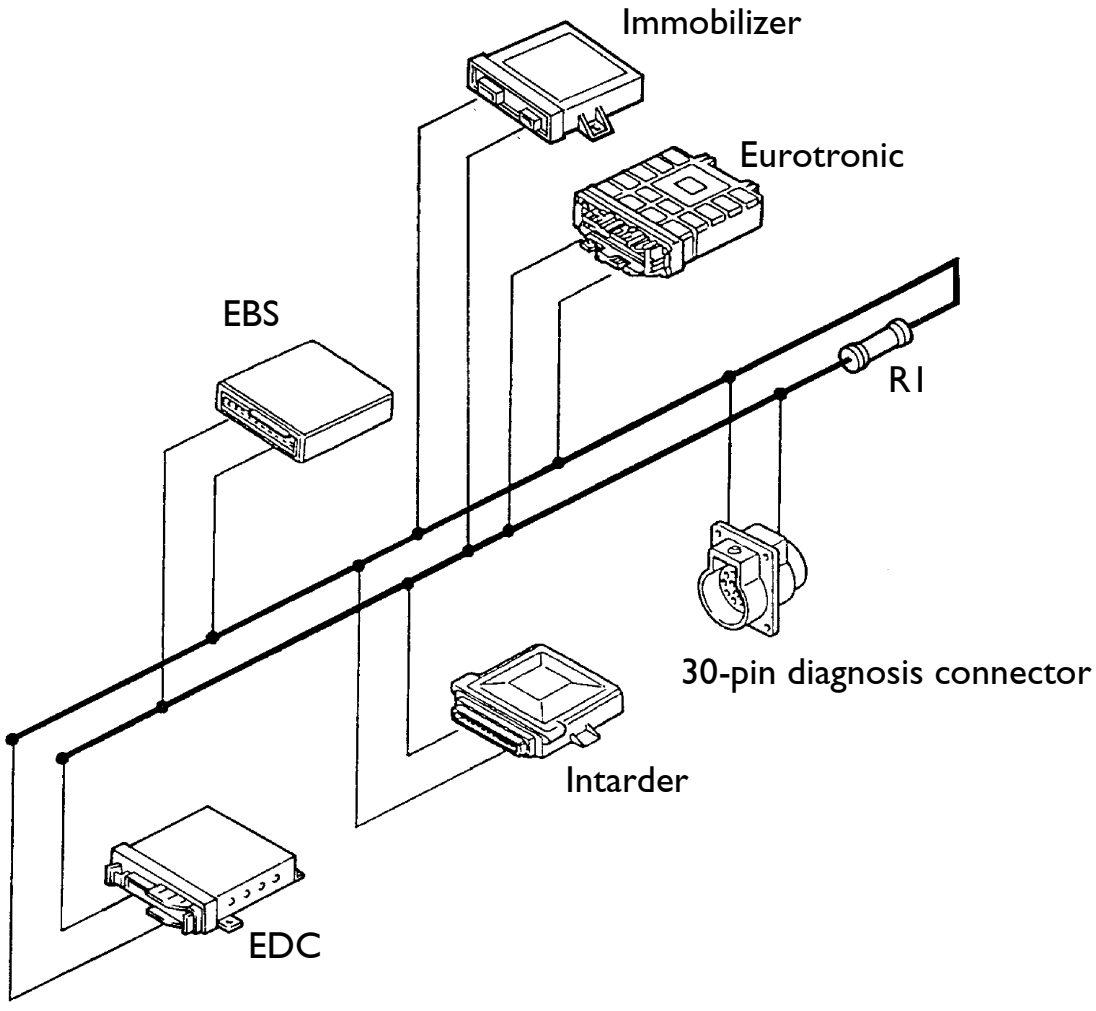
The term CAN means Controller Area Network. This is a dedicated wiring that connects the control units of a vehicle (ECU) to one another, thereby creating a structure similar to a nervous system.

This system enables the instantaneous exchange of large quantities of data between the various electronic systems on board the vehicle.

It is a TWO-WAY communication mode that is becoming increasingly widespread in the field of vehicles, owing to the reduction of the number of leads and interferences.

The information travels respecting a protocol which defines the conversation modes:

- Synchronisation of the information
- Call and answer mode between the various systems
- Identification and correction of any transmission errors
- Etc.



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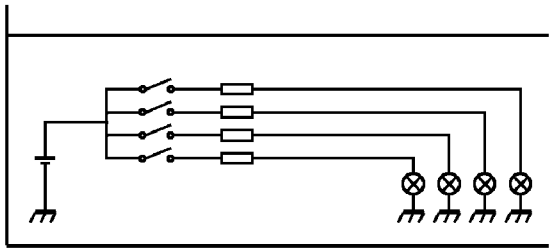
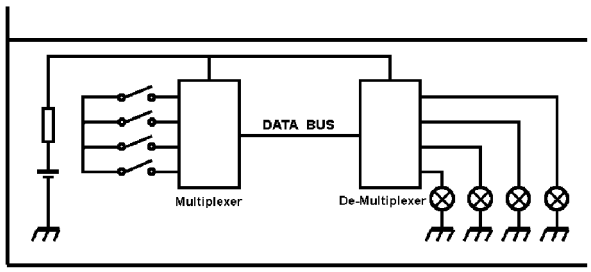
I.8 GRAPHIC REPRESENTATION OF THE CAN LINE



1.9 STANDARD CHECK



1.10 VIA MULTIPLEX CHECK

Operating features

To obtain new operating features it is important that the various electronic systems communicate with one another.

One of these operating features, for instance, is the reduction of torque during gearshifting, which is the result obtained from interaction of the engine and transmission control units.

The connection between the different control units may take place either grouping them in a single main unit (solution rejected due to the complexity of the management programme and because the system would be too rigid and expensive in the case of alterations and updates) or using a communication network capable of transferring the data quickly and reliably. Fast data transfer is fundamental for efficient management of vehicle driving, while reliability must be guaranteed for applications connected with safety (transmission, engine controls and control units) and there must not be any communication problems especially in the presence of electromagnetic influences.

About 60% of the problems concerning the electronics of a vehicle involve connection technology and can be identified in the corrosion of the contacts of a connector and in the connections of cables, wear of the insulating sheath or faulty assembly.

Another third of these problems is caused by operating faults in the sensors and actuators. Sing a lower quantity of cables and reducing the number of sensors, the stoppage time due to vehicles out of service will be minimised, resulting in lower operating costs. A wiring with less components will make it possible to diagnose the electronic system more easily.

The total length of the cables can reach several kilometres and, as mentioned previously, the higher number of components increases the risk of faults. The Multiplex systems offer better communication between the systems and simplify trouble-shooting.

The Multiplexer unit receives the information about the status of the switches. A coded value which is different for every switch, is transmitted to the Databus. The De-Multiplexer decodifies the values and activates the voltage to supply the appropriate lamp.

In Multiplexer systems various types of cables are used: the most cost-effective alternative is that of single cables. Further alternatives are: double or dual cable, twisted pair cables, optical fibres. The choice of the cable depends on the following requirements: signal speed, signal noise and interferences and this choice affects the overall cost of the system.

Different classes exist depending on the different data transmission speed on the Databus:

- class A: low speed (example: windscreen wiper and vehicle lights control).
- class B: medium speed (example: air conditioning and sound systems).
- class C: high speed (example: ABS and Traction Control systems).

All in all the advantages of a Multiplex system can be summarised in: lower costs due to the lower length of the cables, higher functionality, sharing of the signals of the sensors by the various systems and better diagnostic functions. Against this however, the overall number of connections increases, technical training requisites are higher, function reading is not possible through the wiring diagram and above all higher costs compared with a conventional system.

The different manufacturers use their own standards on their vehicles. In Germany BOSCH has developed the Bus CAN (Control Area Network).

All the nodes, i.e. electronic control units, are connected on the Databus.

The structure of the BusCAN is extremely flexible; one or more nodes may be added or removed easily and continue working in the event of a fault of one or more of them.

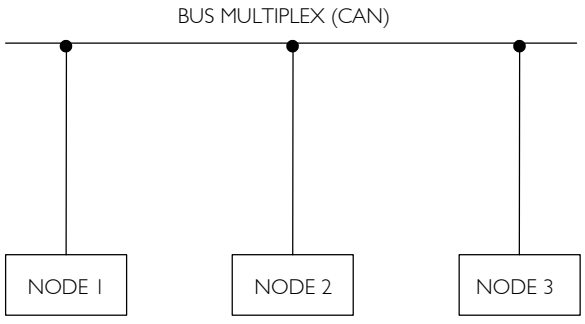
If node 2 sends a message, node 3 which is concerned accepts the message, while node 1 ignores it. It is important to know that the messages have been received correctly on the Databus; in the case of an error the message is sent again: the receiving node confirms reception of the message.

The units or nodes can share the information of many sensors.

As for any form of communication certain conditions must be met. CAN communication needs the right hardware, a task that was initially performed by a single microchip but which lately has been increasingly integrated in microcontrollers: the Can-Chip developed by Bosch makes the various control units communicate with one another with CAN protocol through the same "language" via bus; as transmitter it confers the messages to everyone and as receiver it is capable of identifying the messages addressed to it among many messages.

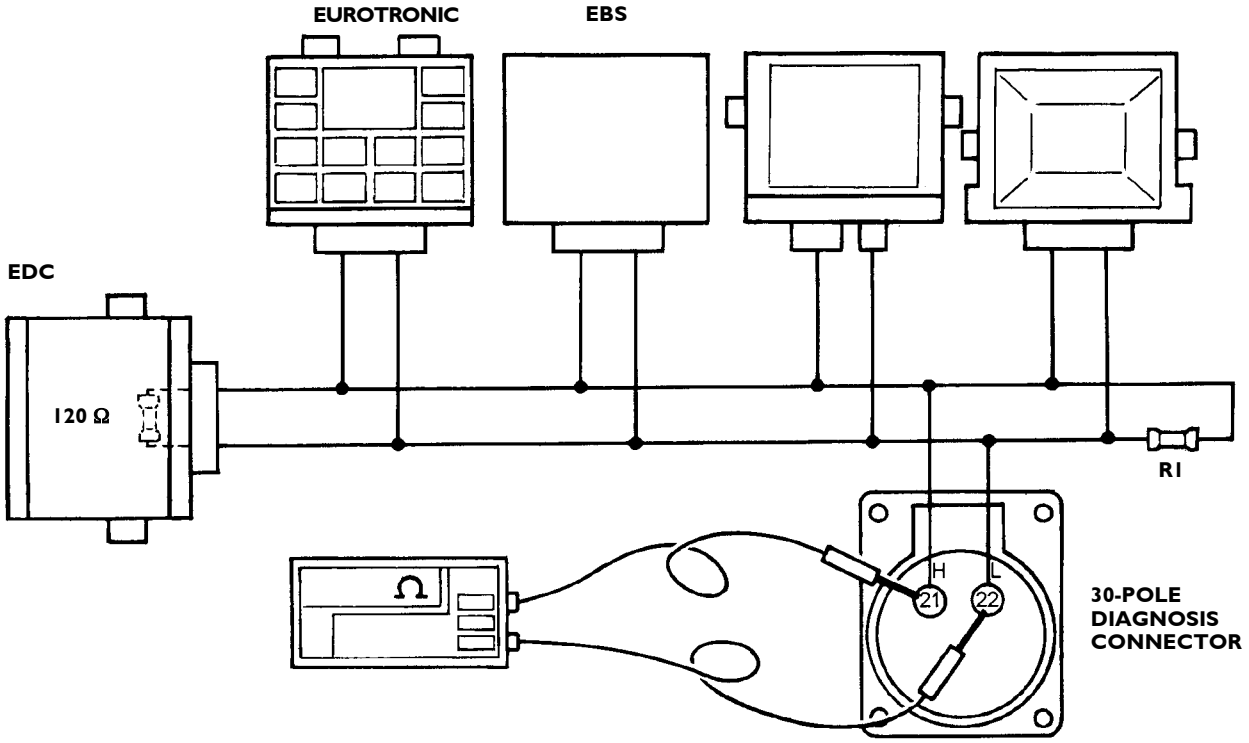
Since all the components that take part in communication can send messages simultaneously on the bus, the receiving component concerned will firstly receive the message with the highest priority while the others will return to the sender and be transmitted again: for example concerning vehicle driving are of primary importance and therefore the vehicle must react immediately to changes of the pedal position; it is also true that if important messages are transmitted constantly, the less important information will rarely or never reach its destination.

For this reason different buses are used.



I.11 CAN MULTIPLEX BUS

EFFICIENCY TEST ON CAN LINE



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0 Ω	~ 60 Ω	~ 120 Ω	o.L.
CAN line short circuit	CAN line OK	Resistance cut off	CAN line cut off

N.B.
Resistance RI by 120 Ω is used to close the CAN line circuit.
THEREFORE, THE RESISTANCE MISSING OR CUT OFF MAY CAUSE DATA TRANSMISSION FAILURE.