



Selex ES

A Finmeccanica Company

**VS4000
UHF Vehicle Radio
Equipment**

Technical Handbook



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Rev. 01

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Safety rules



Before using the equipment, read all the instructions contained in the manual and with special care those relative to safety.



Lue käyttöohjeet ja erityisesti turvallisuuteen liittyvät ohjeet ennen laitteen käyttöä.



Alvorens over te gaan tot het gebruik van het apparaat lees met aandacht al de instructies van het handboek en let vooral op die die de veiligheid betreffen.



Alvorens het apparaat in gebruik te nemen lees alle instructies van het handboek en vooral de voorschriften betreffende de veiligheid.



Avant toute utilisation de l'appareil, lire toutes les indications contenues dans le Manuel et avec une attention particulière celles relatives à la sécurité.



Läs alla instruktioner i denna manual innan ni använder apparaten och då särskilt noggrant de anvisningar som gäller säkerheten.



Læs alle de vejledninger, der er indeholdt i manualen med særlig opmærksomhed på de vejledninger, der vedrører sikkerheden, før apparatet tages i brug.



Vor Gebrauch des Geräts alle in dieser Bedienungsanleitung enthaltenen Anweisungen und Vorschriften lesen.

Den Sicherheitsbestimmungen ist dabei besondere Aufmerksamkeit zu widmen.



Πριν χρησιμοποιήσετε τη συσκευή διαβάστε όλες τις οδηγίες που περιέχονται στο εγχειρίδιο και δώστε ιδιαίτερη προσοχή στις οδηγίες ασφαλείας.



Prima di utilizzare l'apparecchiatura leggere tutte le indicazioni contenute nel manuale e con particolare attenzione quelle relative alla sicurezza.



Antes de utilizar el equipo leer todas las instrucciones contenidas en el manual, poniendo particular atención a las de seguridad.



Antes de utilizar o aparelho, leia todas as instruções que constam no manual e com muita atenção as instruções relativas à segurança.



Перед эксплуатацией оборудования внимательно прочитайте инструкции данного руководства, в частности, относящиеся к правилам безопасности.

تحذير



قبل استخدام الأجهزة إنتبه لقراءة جميع الارشادات المحتوية في الكتيب وخاصةً بالمعلومات الأمنية.

警告



在使用之前，请你一定要阅读说明手册全文，并请特别注意阅读“有关安全之重要说明”。

This equipment is marked



According to the requirements specified in the R&TTE directive 1999/5/EC and the Commission Decision 6th April 2000, the EC marking is accompanied by the Class II equipment class identifier.

This equipment is intended for sell and use in AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB.

This equipment requires authorization or license for use.

This equipment operates on frequency bands non-harmonised in the EU.

This equipment can also be used worldwide where the equipment is approved for use

Selex ES S.p.A. tímto prohlašuje, že tento VS4000 je ve shodě se základními požadavky a dalšími příslušnými ustanoveními směrnice 1999/5/ES.

Undertegnede Selex ES S.p.A. erklærer herved, at følgende udstyr VS4000 overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF.

Hiermit erklärt Selex ES S.p.A., dass sich das Gerät VS4000 in Übereinstimmung mit den grundlegenden Anforderungen und den übrigen einschlägigen Bestimmungen der Richtlinie 1999/5/EG befindet.

Käesolevaga kinnitab Selex ES S.p.A. seadme VS4000 vastavust direktiivi 1999/5/EÜ põhinõuetele ja nimetatud direktiivist tulenevatele teistele asjakohastele sätetele.

Hereby, Selex ES S.p.A., declares that this VS4000 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

Por medio de la presente Selex ES S.p.A. declara que el VS4000 cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE.

ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ Selex ES S.p.A. ΔΗΛΩΝΕΙ ΟΤΙ VS4000 ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 1999/5/EK.

Par la présente Selex ES S.p.A. déclare que l'appareil VS4000 est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 1999/5/CE.

Hér með lýsir Selex ES S.p.A. yfir því að VS4000 er í samræmi við grunnkröfur og aðrar kröfur, sem gerðar eru í tilskipun 1999/5/EC

Con la presente Selex ES S.p.A. dichiara che questo VS4000 è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.

Ar šo Selex ES S.p.A. deklarē, ka VS4000 atbilst Direktīvas 1999/5/EK būtiskajām prasībām un citiem ar to saistītajiem noteikumiem.

Šiuo Selex ES S.p.A. deklaruoja, kad šis VS4000 atitinka esminius reikalavimus ir kitas 1999/5/EB Direktyvos nuostatas.

Hawnhekk, Selex ES S.p.A., jiddikjara li dan VS4000 jikkonforma mal-ħtiġijiet essenzjali u ma provvedimenti oħrajn relevanti li hemm fid-Dirrettiva 1999/5/EC.

Alulírott, Selex ES S.p.A. nyilatkozom, hogy a VS4000 megfelel a vonatkozó alapvető követelményeknek és az 1999/5/EC irányelv egyéb előírásainak.

Hierbij verklaart Selex ES S.p.A. dat het toestel VS4000 in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 1999/5/EG.

Selex ES S.p.A. erklærer herved at utstyret VS4000 er i samsvar med de grunnleggende krav og øvrige relevante krav i direktiv 1999/5/EF.

Niniejszym Selex ES S.p.A. oświadcza, że VS4000 jest zgodny z zasadniczymi wymogami oraz pozostałymi stosownymi postanowieniami Dyrektywy 1999/5/EC

Selex ES S.p.A. declara que este VS4000 está conforme com os requisitos essenciais e outras disposições da Directiva 1999/5/CE.

Selex ES S.p.A. izjavlja, da je ta VS4000 v skladu z bistvenimi zahtevami in ostalimi relevantnimi določili direktive 1999/5/ES.

Selex ES S.p.A. týmto vyhlasuje, že VS4000 spĺňa základné požiadavky a všetky príslušné ustanovenia Smernice 1999/5/ES.

Selex ES S.p.A. vakuuttaa täten että VS4000 tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.

Härmed intygar Selex ES S.p.A. att denna VS4000 står i överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.

The full declaration of conformity may be requested to Selex ES S.p.A., Quality Function, via A. Einstein 35 – 50013 – Campi Bisenzio Firenze ITALY.

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REFERENCE STANDARD

- **EN 303 035-1** “Terrestrial Trunked Radio (TETRA)
Harmonized EN for TETRA equipment
covering essential requirements under article
3.2 of the R&TTE Directive; Part 1: Voice plus
Data (V+D)”

- **EN 303 035-2** “Terrestrial Trunked Radio (TETRA)
Harmonized EN for TETRA equipment
covering essential requirements under article
3.2 of the R&TTE Directive; Part 2: Direct
Mode Operation (DMO)”

- **ETSI EN 301 489-1** Electromagnetic compatibility and Radio
spectrum Matters (ERM); ElectroMagnetic
Compatibility (EMC) standard for radio
equipment and services; Part 1: Common
technical requirements

- **ETSI EN 301 489-18** Electromagnetic Compatibility (ECM)
standards for radio equipment and services –
Part 18: Specific conditions for TETRA
equipment

- **CENELEC EN 60950-1** Information Technology Equipment – Safety
- **Directive 72/245/EEC** (EMC Automotive) on the approximation of the
laws of the Member States relating to the
suppression of radio interference produced by
spark-ignition engines fitted to motor vehicles

- **ETSI EN 300 394-1** TETRA Conformal Testing Specification –
Part 1: Radio

- **ETSI EN 302 561** Electromagnetic compatibility and Radio
spectrum Matters (ERM); Land Mobile
Service; Radio equipment using constant or
non-constant envelope modulation operating
in a channel bandwidth of 25 kHz, 50 kHz, 100
kHz or 150 kHz; Harmonized EN covering
essential requirements of article 3.2 of the
R&TTE Directive

- **ETSI EN 300 392-2** Terrestrial Trunked Radio (TETRA);Voice plus
Data (V+D);Part 2: Air Interface (AI)

- **ETSI EN 300 396-2** Terrestrial Trunked Radio (TETRA) -
Technical Requirements for Direct Mode
Operation (DMO) - Part 2: Radio Aspects

- **ETSI EN 300 396-4** Terrestrial Trunked Radio (TETRA) -

- **ETSI EN 300 396-5** Technical Requirements for Direct Mode Operation (DMO) - Part 4: Type 1 repeater air interface
Terrestrial Trunked Radio (TETRA) - Technical Requirements for Direct Mode Operation (DMO) - Part 5: Gateway air interface

FCC APPROVAL

FCC approval

VS4000 806-870 vehicular equipment complies with Part 15 of the FCC/Federal Communication Commission regulations.

Operation is governed by the following:

FCC ID: X5YVS4000-806-870

These devices comply with part 15 of the FCC Rules.

Operation is subject to the following two conditions:

- these devices may not cause harmful interference, and
- these devices must accept any interference received, including interference that may cause undesired operation.

Any unauthorized modifications or changes to these devices could void the user's authority to operate these devices.

Note:

FCC ID X5YVS4000-806-870 apply to VS4000 806-870 model.

RF Exposure Compliance

The described product is intended for use in occupational/controlled conditions, where users have full knowledge of their exposure and can exercise control over their exposure to meet R&TTE and FCC/IC limits. This apparatus is NOT authorized for any other use.

Using an omnidirectional antenna with gain of 6,13 dB, the following values of Power density were measured:

Position	Maximum measured Power Density (mW/cm ²)	FCC limit (mW/cm ²)
Internal positions (driver and passengers seats)	0,006	0,549
External by stander (at a minimum distance of 72 cm from antenna)	0,004	0,579

1. GENERAL INFORMATION

1.1 INTRODUCTION

This technical manual contains the description of the VS4000 vehicular radio, a mobile form of radio communication equipment operating in 806÷870 MHz band.

The VS4000 transceiver is a frequency synthesized equipment controlled by a microprocessor and designed for voice and data reception/transmission according to TETRA communication system.

The information and descriptions given in this manual are related to product development. Therefore they may change according to the product release.

The manual is divided into the following sections:

Section 1: General information

The equipment's purpose, structure, functions, main technical data and safety recommendations are described in this section.

Section 2: Technical description

The functional description of each assembly present in the equipment is contained in this section.

Section 3: Setting Up

The procedures for inspection and setting up of the equipment are described in this section.

Section 4: Disposal

Information on the disposal of equipment parts is given in this section.

Section 5: Preventive maintenance

The preventive maintenance procedures of the equipment are described in this section.

Section 6: Troubleshooting

Information on troubleshooting procedures of the equipment are described in this section.

Section 7: Corrective maintenance

Information on corrective maintenance procedures of the equipment are described in this section.

Appendix A: Accessories

Contains information on accessories of the equipment.

For the VS4000 use see the relative User Guide, for the VS4000 installation see the relative Installation Guide.

1.2 GENERAL CHARACTERISTICS

The VS4000 equipment is a digital vehicular radio terminal designed in compliance with the TETRA standard.

The equipment comprises two main modules: the Radio Unit transceiver and the Front Panel.

The Radio Unit consists of a single piece, die-cast aluminium container that contains the boards with the circuitry for signal processing both in transmission and reception phase.

The Front Panel acts as an interface between the operator and the transceiver.

The VS4000 equipment is shown in Fig. 1.1. The Front Panel is installed on the dashboard. The transceiver is installed in the boot (trunk) of the vehicle, up to 6 metres from the Front Panel.

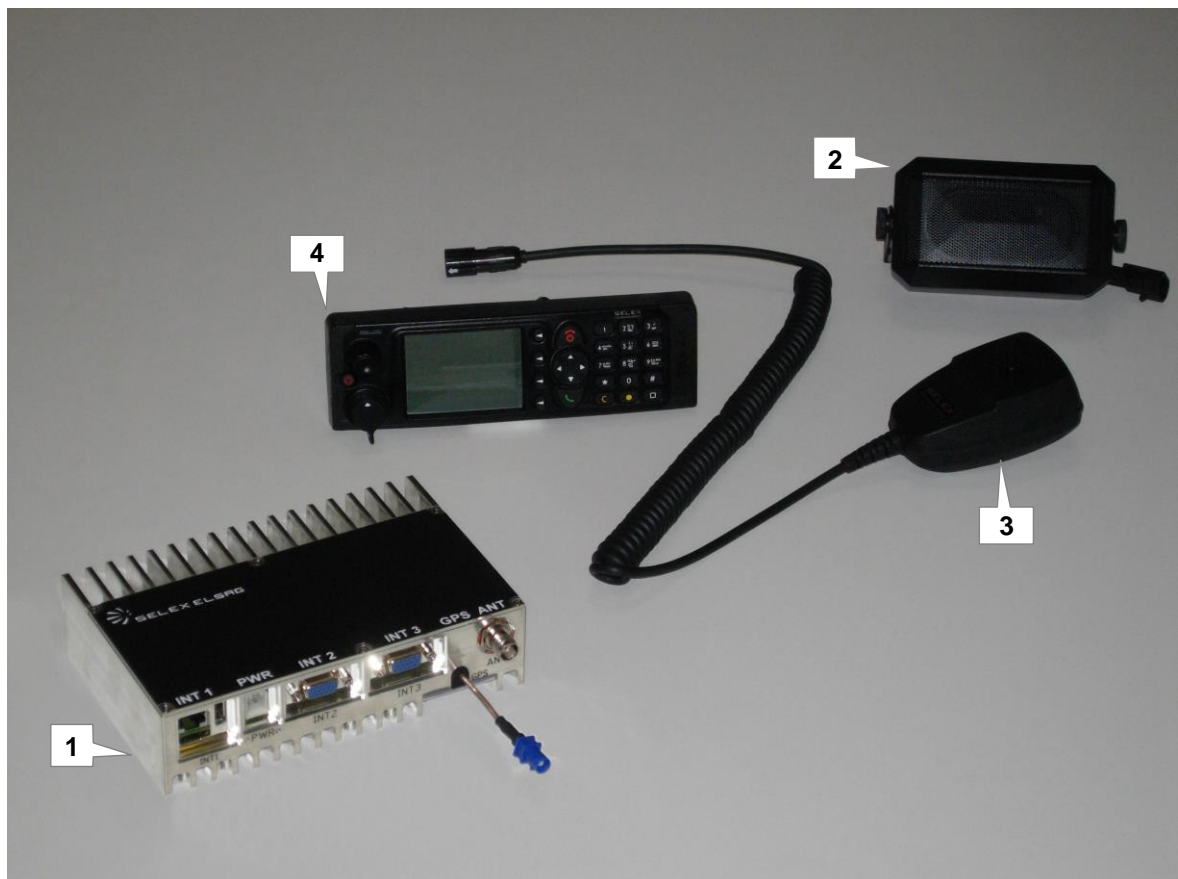


Fig. 1.1: VS4000 equipment overview

- 1 VS4000 radio unit
- 2 Loudspeaker
- 3 Microphone
- 4 FPG3 universal front panel

1.3 TECHNICAL CHARACTERISTICS

The VS4000 equipment main technical characteristics in Tab. 1.1 are shown.

Tab. 1.1: Technical characteristics

Parameters	Type/Value
VS4000 Radio body	
Mechanical characteristics	
Dimensions	47.3x134x178 mm (DIN compliant)
Weight	1.15 Kg
Protection to dust and water	IP54
Shock and vibrations	MIL STD-810 F ETSI EN 300 019-2-1 ETSI EN 300 019-2-2
Electrical characteristics	
RF Power	10 W (Class 2 Tetra) ¹ 3 W (Class 3 Tetra) ¹
Frequency Band	806-870 MHz
AF Power	8 W (with 4 Ohm load)
DC Power Supply	13.2 V (10.8 V ÷ 15.6 V in extreme conditions)
Modulation	$\pi/4$ DQPSK (Tetra Standard)
Carrier Spacing	25 KHz
Frequency offset	Tetra Standard with 0, 6.25, 12.5 kHz
RF Performance Compliance	ETSI EN 300 392-2
Operative Temperature	-25°C / +55°C
Storage Temperature	-40°C / +85°C
Functional characteristics	
Standard	TETRA
Tetra mods	TMO DMO + Idle Dual Watch DMO Repeter 1A / 1B DMO Gateway
Internal options	E2E Encryption module GPS RX module

¹ The multislots TX for TETRA, foresee a time/temperature limit.

Parameters	Type/Value
Special boards (to be developed)	
External options	SIM card
External interfaces	RS232 serial PEI TNC main antenna GPS Antenna Remoted Front Panel Connector Power Supply Connector Auxiliary Connector
Reference STANDARD	
TETRA standard Reference	ETSI EN 300 392-2 ETSI EN 300 396-2 ETSI EN 300 396-4 ETSI EN 300 396-5
Parameters	Type/Value
FPG3 Front Panel (vehicular)	
Operative temperature range	-20°C ÷ +60°C
Storage temperature range	-40°C ÷ +85°C
Voltage range	+9 ÷ +15.6 V
Nominal voltage	+13.2 V
Polarity	Negative To GND
Over voltage protection	By transorb
Voltage fall protection	By reset
Polarity inversion protection	By diode
Current absorption	< 180 mA
Connectors	12 pins; USB-A (only for vehicular); 26 pins female (J1); 26 pins male (P1)
Protection from dust and water	IP54
Dimensions (without connectors and knob)	T.B.D.
Weight	< 460 g

1.4 MAINTENANCE

Maintenance concerns all the actions aimed to maintain or restore the equipment operativity.

Maintenance can be preventive (scheduled maintenance) and corrective (unscheduled maintenance).

In order to schedule maintenance interventions it is necessary to divide maintenance into levels according to the operations to be carried out.

The maintenance levels define the actions and the personnel allowed to carry out the maintenance operations.

Three maintenance levels are thus defined:

- I: Equipment Maintenance Level.
- II: Module Maintenance Level.
- III: Component Maintenance Level.

For example in a TETRA system we can define:

- Equipment: any radio terminal (Hand-held, vehicular or fixed).
- Module: a Base Band of TTU400 of the Base Station BS400.
- Component: any part of a module (e.g. an IC).

A description of the maintenance levels is shown in Tab. 1.2.

Tab. 1.2: Maintenance levels

Maintenance level	Action	Personnel
I	Replacement of an equipment	Operator
II	Replacement of a module of an equipment	Maintenance technician
III	Replacement of a component of a module or equipment	Selex ES technician

1.5 MAIN COMPONENTS

The VS4000 main components are listed in Tab. 1.3.

Tab. 1.3: VS4000 main components

Description	P/N
Main elemets	
Radio unit	<p>MODEL VS4000 806-870</p> <p>VS4000 806-870MHz WITH E2E ENCRYPTION AND GPS TEA1 STD.VERS.</p> <p>774-1052/01</p> <p>VS4000 806-870MHz WITH E2E ENCRYPTION AND GPS TEA2 STD.VERS.</p> <p>774-1053/01</p> <p>VS4000 806-870MHz WITH E2E ENCRYPTION AND GPS TEA3 ST.VERS.</p> <p>774-1054/01</p> <p>VS4000 806-870MHz WITH ONLY GPS BOARD TEA2</p> <p>774-1055/01</p> <p>VS4000 806-870MHz WITH ONLY GPS BOARD TEA1</p> <p>774-1056/01</p> <p>VS4000 806-870MHz WITH ONLY GPS BOARD TEA3</p> <p>774-1057/01</p> <p>VS4000 806-870MHz WITH ONLY GPS BOARD NO TEA</p> <p>774-1067/01.01</p>
Control Panel (FPG3)	<p>972-0562/03.01 (vehicular)</p> <p>972-0562/04.01 (vehicular-arabian keyboard)</p> <p>972-0562/05.01 (vehicular-cyrillic keyboard)</p>
Installation	
Installation kit for FPG3 (vehicular and motorcycle)	971-0536/01
Bracket installation kit VS4000	771-2359/01
Bracket quick lock/release VS4000	970-4929/01

Cable FPG3-VS4000	976-1539/01.01
Cable mains kit VS4000	771-2229/01
Loudspeaker cable VS4000	976-1542/01.01

Description	P/N
Accessories	
Antenna	(806÷870): 68720-42/023
Loudspeaker	774-0139/02
Loudspeaker extension cable (6 mt.) LF	976-0099/02
Loudspeaker cable (2,5 mt.) LF	976-1431/01
Microphone	HPI-0103/01
Magnetic Hook Handset	HPI-0244/01
Hands free kit	771-2058/01
Key downloading Kit	771-2390/01
FPG3 Programming cable	HPI-0158/01
Main elemets	
FPG3 Data cable	HPI-0157/01
GPS magnetic antenna	2100045MO295
Hanger to install the GPS antenna (if a metal surface is not available)	970-3614/01
Documentation	
Technical manual	MAN-0974/01

1.6 SAFETY RECOMMENDATIONS

Carefully read all of the cautions and warnings before using the vehicular radio:



Do not use the radio equipment for uses different than those indicated in the manual.



For a correct use of the radio equipment, read what is listed in the user's guide.



Protect the radio from sprinklings of water and/or other liquids and from dust.



Be careful not to damage the vehicular radio when cleaning the vehicle.



Do not place the audio accessories above the airbags or in their area of action. If the airbag is activated, it may not swell correctly and/or hurl the audio accessory, with great force, inside the passenger compartment where the vehicle occupants are located.



Do not use the vehicular radio if the antenna and/or the antenna cable are damaged.



The electronic devices are sensitive to electromagnetic interference (EMI) if not adequately shielded, designed or configured differently for electromagnetic fields immunity. If electromedical equipment (ex. pace-makers, acoustical equipment, etc.) is used together with the vehicular radio, make sure that it is adequately shielded from external electromagnetic fields.



Do not take the radio into environments that have a potentially explosive atmosphere (ex. fuel storage sites, filling stations, etc.).



Install the vehicular radio following the instructions given in the installation guide. The mounting screws can damage cables and wires that run under some mounting surfaces in the vehicle. Be careful to avoid mounting the bracket above these locations. The equipment must be installed in such a way that it complies with the national regulations in effect.



Carry out the maintenance interventions on the vehicular radio following the instructions given in this technical handbooks.



Follow all accident prevention standards when carrying out maintenance interventions on the vehicular equipment and use the proper tools (spanners, screwdrivers,.....).



First and second maintenance level interventions on the equipment are to be carried out by authorized technicians only.
Third maintenance level interventions are to be carried out by Selex technicians only. The maintenance levels are defined in this technical manual.



Use only original accessories and spare parts, or approved by the manufacturer, suitable for the vehicular radio. The use of different accessories and/or spare parts (earphone, antenna, etc.) makes the safety and electromagnetic compatibility certifications to be valid no more and it could lower the user safety level and/or generate electromagnetic fields that exceed the accepted limits.



After the radio has been trasmitting for a long period, it may reach high temperatures: in such a case avoid touching the radio shell.



The emergency call is a priority type call.

The vehicular radio, like all mobile telephony equipment, operates with radio frequency signals, therefore, the forwarding of the call depends on the network coverage at the moment of the call.

If you need send an emergency call, keep pressed the emergency button for at least 2 seconds, when the radio is switched on. Relating on the radio setting (from PRP), two cases may occur if the trasmission is inhibit:



- a) the emergency call is not sent; it is necessary to disable the Tx Inhibit founction from radio menu to foward a call (even if the call is an emergency call).
- b) the emergency call is sent and automatically the Tx Inhibit function is disabled; from radio menu it is possible to recover the Tx Inhibit function again

The radio complies with all product specifications and great care is taken by the manufacturer so that user safety, as far as the effects of electromagnetic waves on health are concerned, is guaranteed within the limits established by the international specifications.

1.7 ESD PRECAUTIONS

No ESD precautions have to be taken by the operator. The VS4000 vehicular radio and its ancillary parts are designed and manufactured in such a way to not be sensible to electrostatic discharges according to what referred in the EN 301 489-18.

2. TECHNICAL DESCRIPTION

2.1 INTRODUCTION

This section contains the functional description of the VS4000 vehicular equipment in order to give the maintenance technician a good knowledge of the equipment operating principles.

2.2 GENERAL DESCRIPTION

The VS4000 equipment is made up of two main modules:

- VS4000 Radio Unit;
- Front Panel (FPG3).

The Front Panel provides the user with the controls interface, the audio accessory connector, and the USB-A socket (only for mass storage devices)..

2.2.1 VS4000 connectors overview

In this paragraph the equipment connectors are described.

External connectors on the FPG3 Front Panel

The 12 pins connector provides the connection of audio accessories.

The USB-A, (available only for the FPG3 vehicular) provides the connection of the mass storage devices.

The 12 pins connector and the USB-A port are located on the front side of the FPG3.

The J1 (26 pins female) connector provides the connection of external accessories.

The P1 (26 pins male) connector provides the connection of the Radio Unit.

The connectors J1 and P1 on the rear side of the FPG3 are located.

Radio Unit external connectors

There is one interface side: on the rear side of the Radio Unit (IFP).

The IFP interface in Fig. 2.1 is reported.

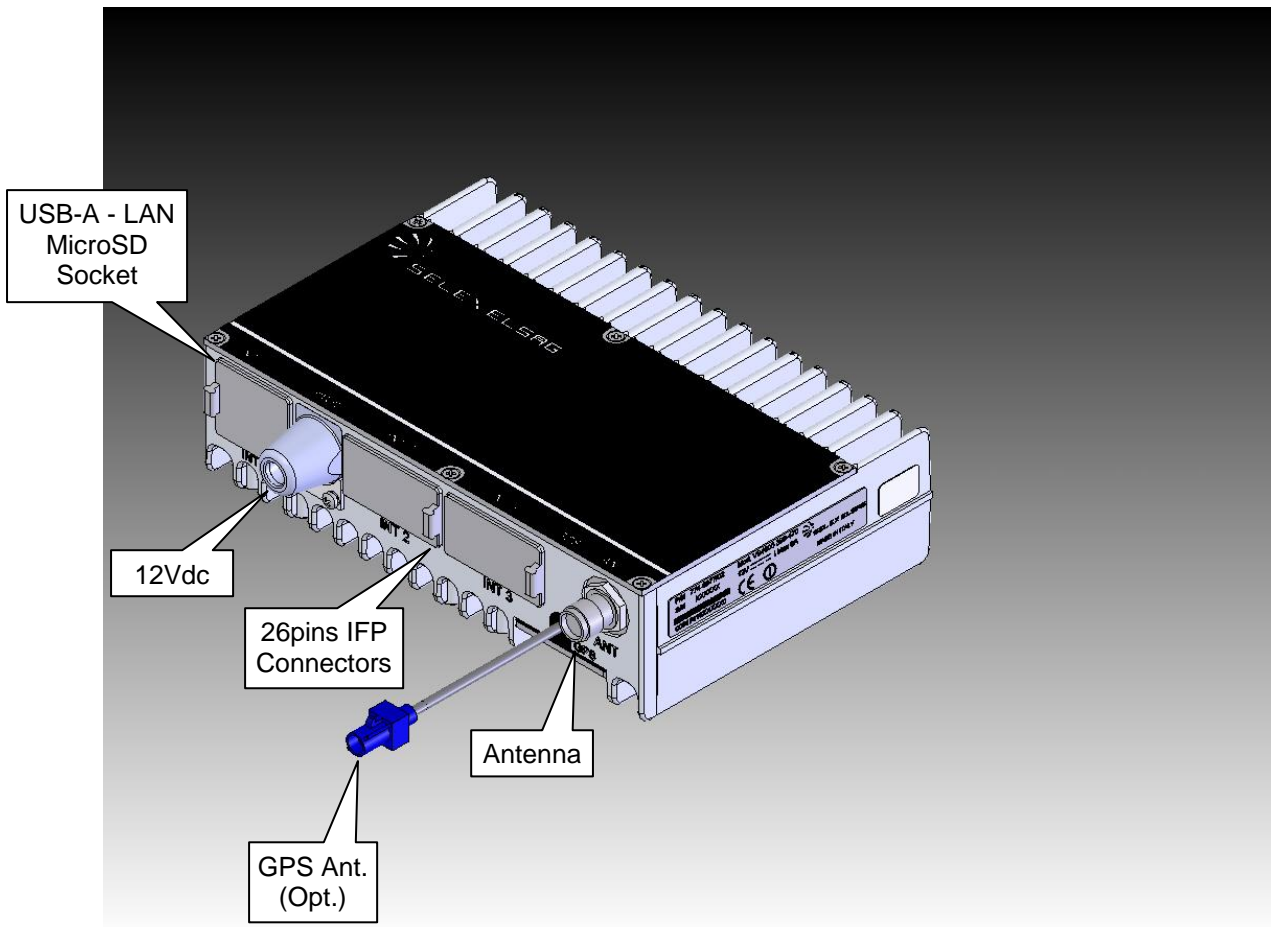


Fig. 2.1: IFP Interface

The installation with the remoted Front Panel in Fig. 2.2 is reported.

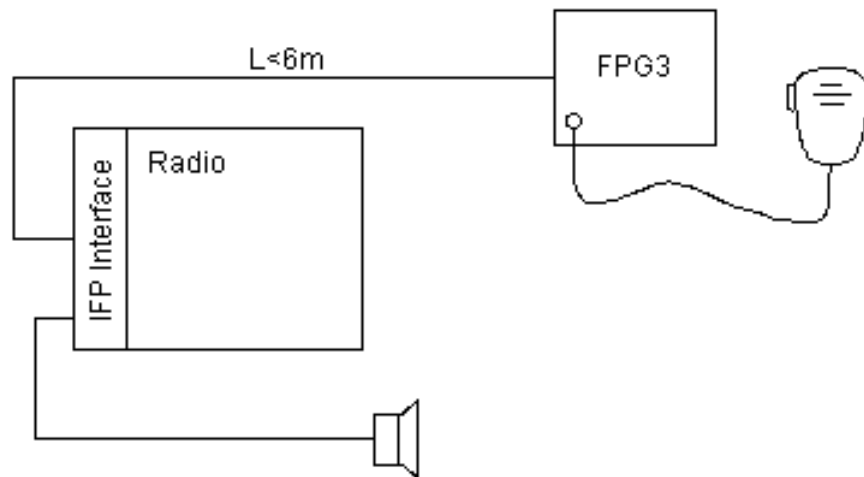


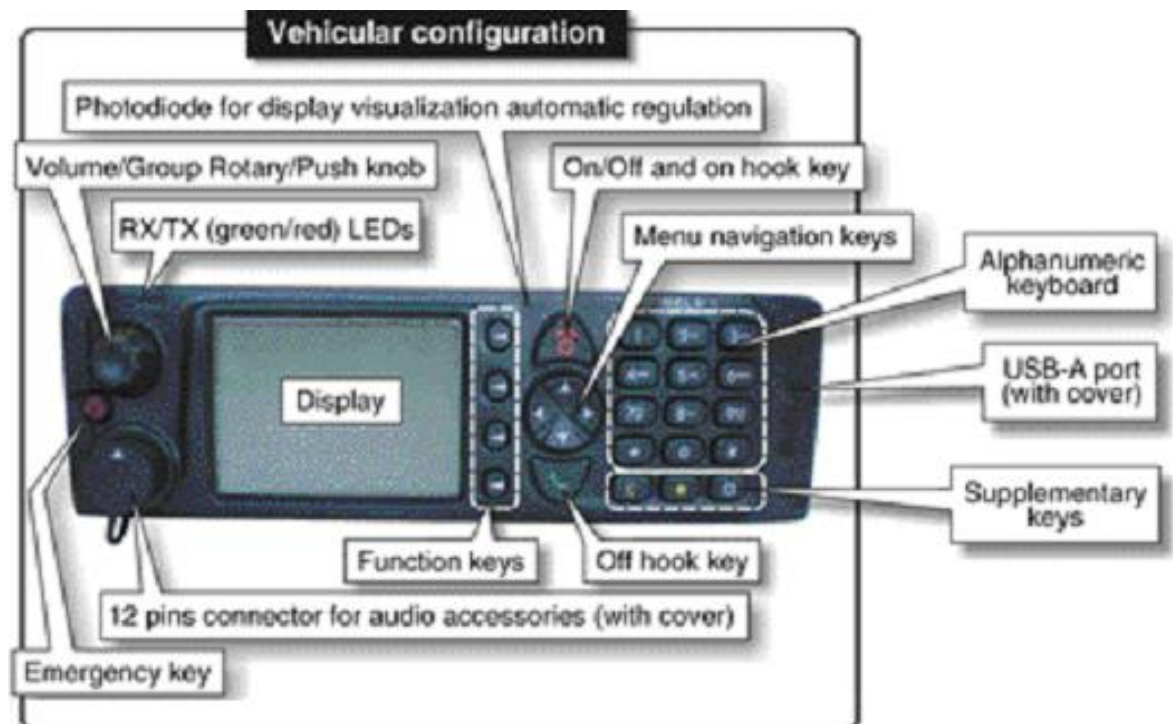
Fig. 2.2: Remoted Front Panel installation

2.3 FPG3 FRONT PANEL

The Front Panel is composed of two die-cast half-bearings and it includes.

- electronic board;
- display (LCD 128x81 FSTN Technology);
- backlight diffuser for keyboard and rotary knob;
- keyboard (silicone rubber keys).

In the following picture, the FPG3 is shown.



2.4 RADIO UNIT

The Radio Unit module comprises a die-cast structure closed the four screws/washer fasten the container by means of a cover (see Fig. 2.3).

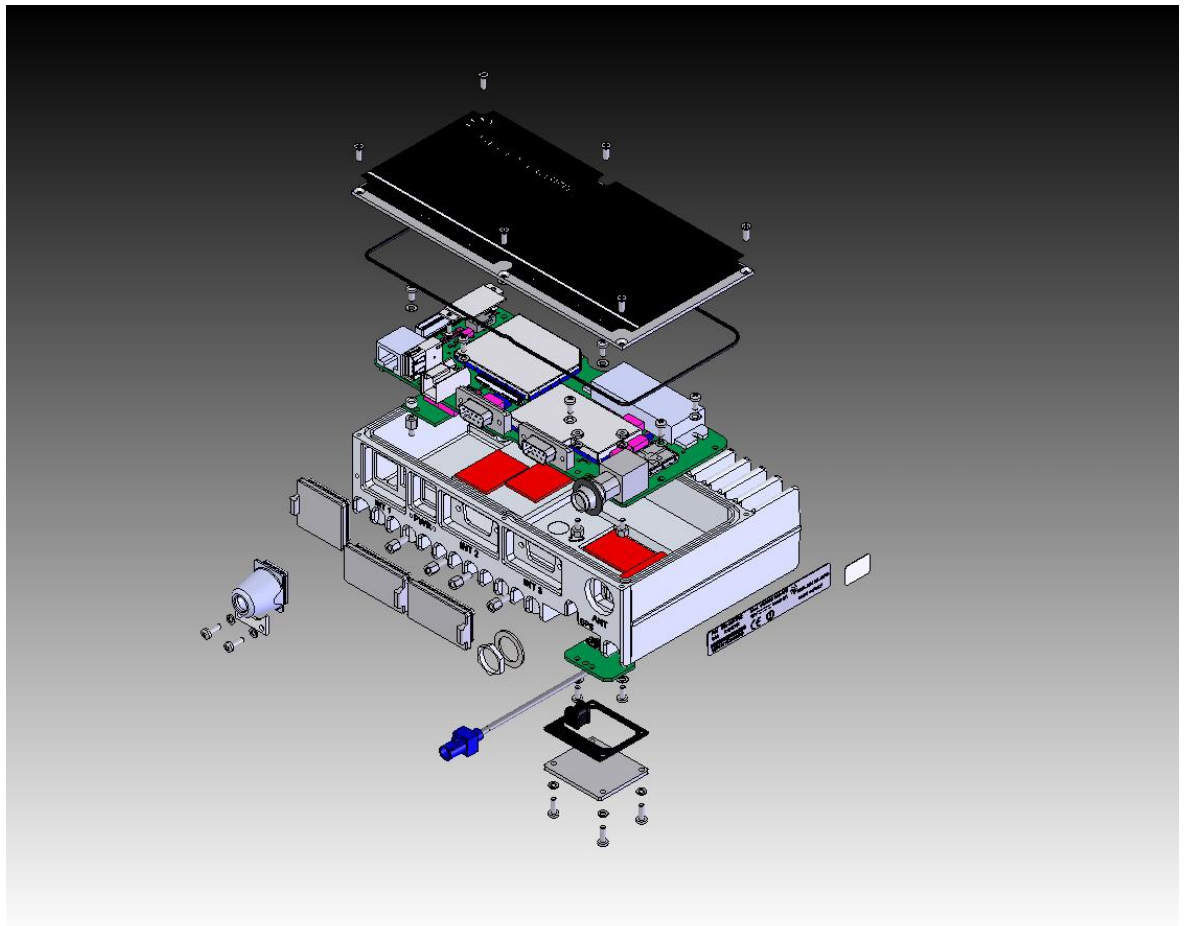


Fig. 2.3: Equipment structure

The Radio Unit container provides finned surfaces to dissipate heat (heat-sink).

The Radio Unit electronic circuits are distributed on a card.

The VS4000 equipment functional block diagram in Fig. 2.4 is reported.

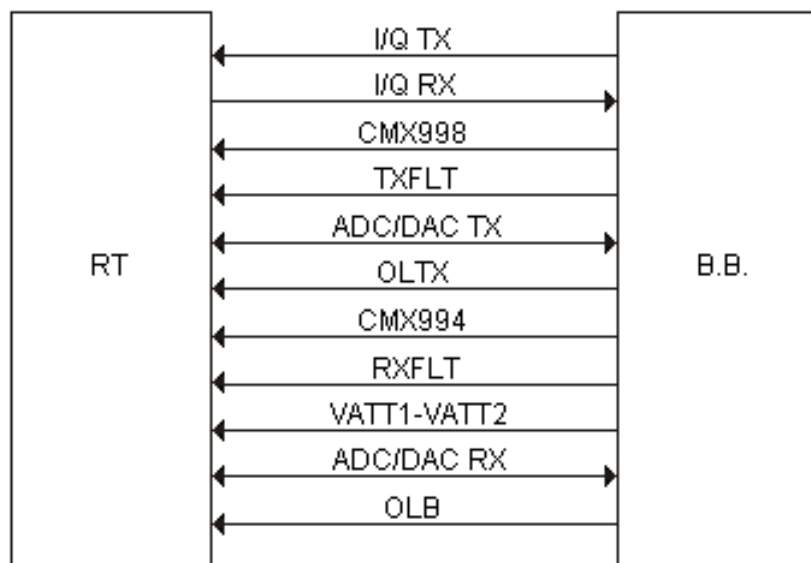


Fig. 2.4: Block diagram

2.5 FUNCTIONAL DESCRIPTION

The radio functional block diagram in Fig. 2.4 is reported.

2.5.1 Power Supply

The VS4000 radio power supply is 13.2 V with range 10.8÷15.6 V.

The power supply block diagram in Fig. 2.5 is shown.

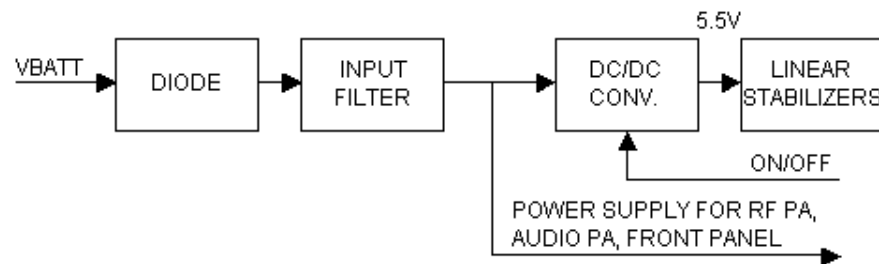


Fig. 2.5: Power supply scheme

The diode (CR16) protects against the polarity inversions; the input filter is a low pass filter.

VBATTINT is the output of the ON/OFF block and directly supplies:

- the RF power Amplifier;
- the Audio Power Amplifier;
- the Front Panel.

The DC/DC converter ($\eta \simeq 90\%$) provides 5.5 V; the linear stabilizers provide all the necessary voltage values.

2.5.1.1 ON/OFF Circuit

The VS4000 ON/OFF management by means of FPG3 or remote switch in this paragraph is described.

The ON/OFF circuit in Fig. 2.6 is reported.

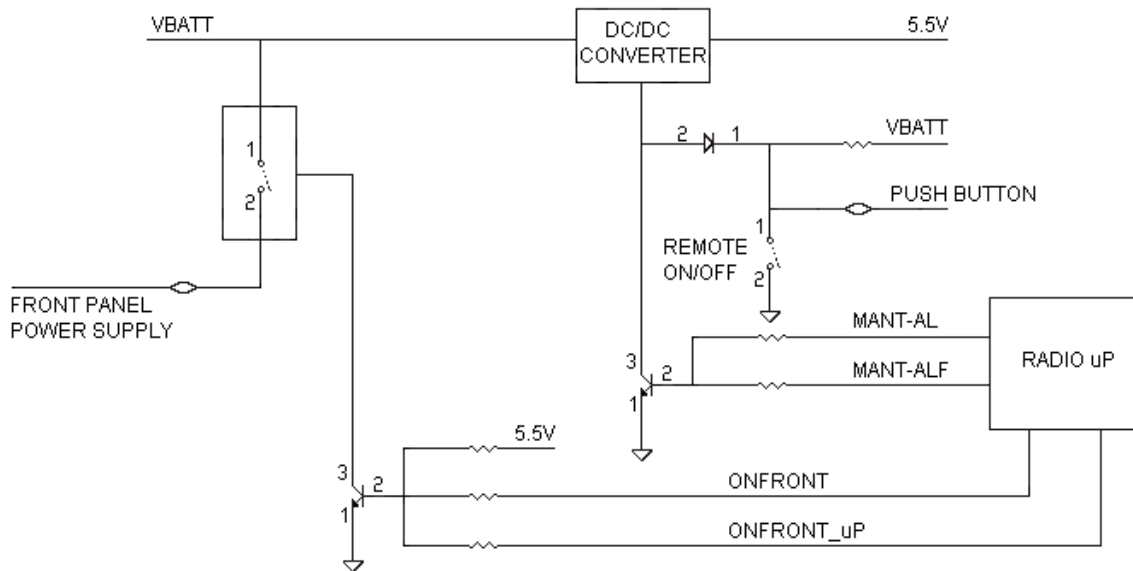


Fig. 2.6: ON/OFF Circuit

2.5.2 PLL

The DMO gateway functionality is supported by VS4000 equipment. The synthesizer ADF4351 has two differential outputs for the RX and TX chains that can be selected according to the operation mode.

The PLL architecture in Fig. 2.7 is explained.

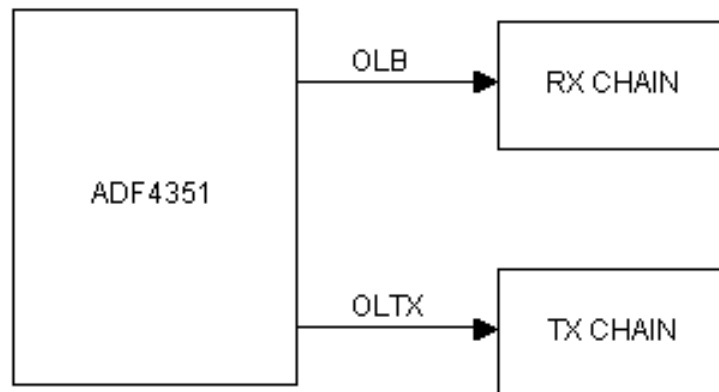


Fig. 2.7: PLL Architecture

2.5.3 Receiver

The receiver block scheme in Fig. 2.8 is shown.

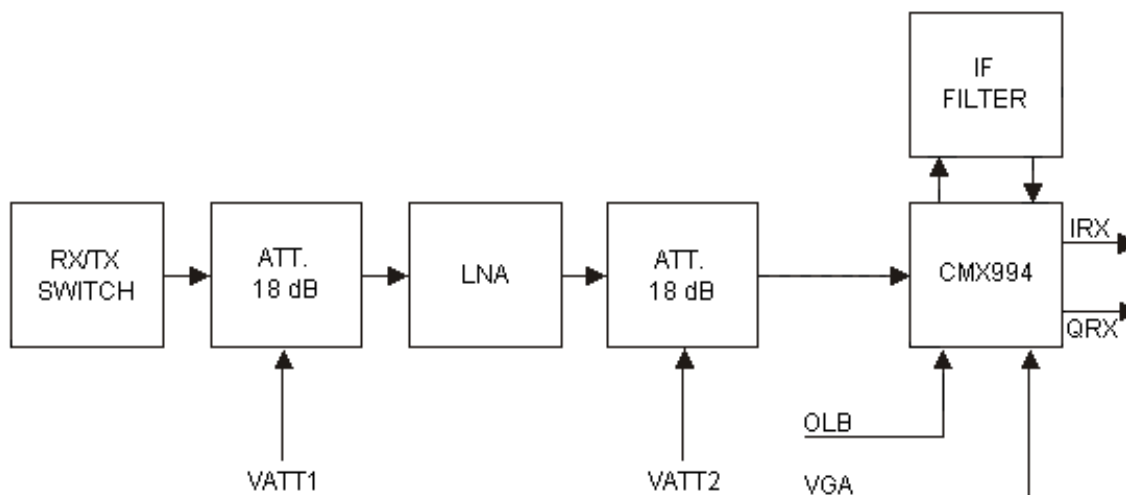


Fig. 2.8: Receiver block scheme

The receiving chain is composed of:

- RX/TX switch, that allows to insulate the receiving and transmitting chains;
- The 36 dB attenuator is inserted by the VATT1 – VATT2 commands; in particular:
 - VATT1 = insert 6dB step attenuation at input LNA;
 - VATT2 = insert 6dB step attenuation at output LNA.

The attenuator assures a good linearity also in DMO Gateway Repeater operative modalities.

- LNA, which is the low noise amplifier.
- CMX 994 integrated receiving module, which convert directly to the intermediate frequency and produces the analogic base band signals I/Q_{RX} which are the inputs, once digitally converted, of the DSP. The internal mixer is driven by OLB, and VGA manages the variable gain stages.

2.5.4 Transmitter

The transmitter block scheme in Fig. 2.9 is shown.

The transmitting chain is composed of the following components:

- CMX 998 module, which converts to radio frequency the input signal, these input signals are the DSP outputs I/Q_{TX} in the BB section.
- MGA 62563 module, which amplifies the RF signal of a fixed amount of 20 dB.
- RA45H7687M1 module, which is the power amplifier for 806-870 MHz
- Directional coupler.
- RX/TX SWITCH module, which is the switch between receiver block and transmitter block.
- L.P. Filter, which is a low pass filter before the transmitting antenna.

The output power of this transmitter is +40 dBm.

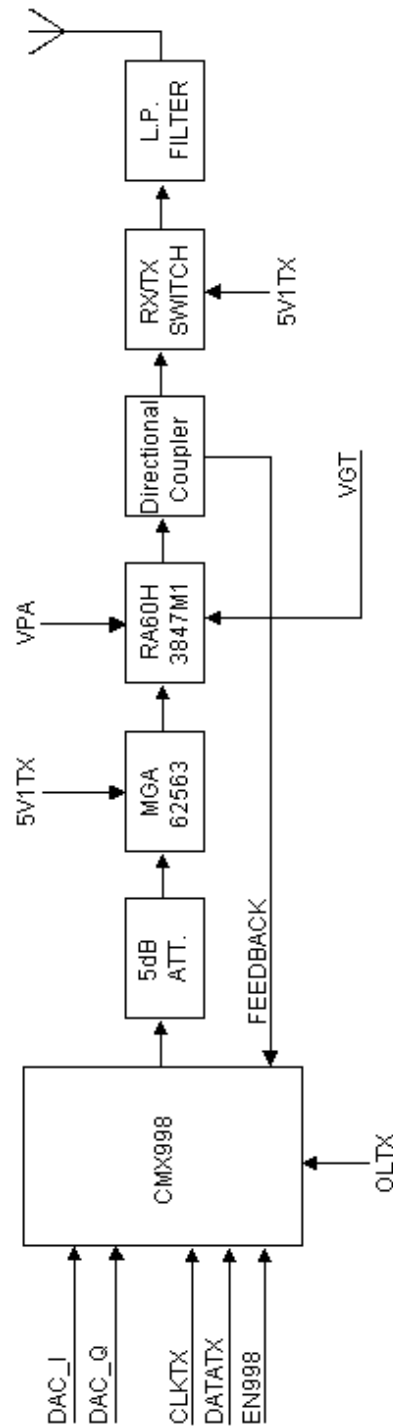


Fig. 2.9: Transmitter block scheme

2.5.5 Base Band Section

In Fig. 2.10 the Base Band section block scheme is shown.

The μP + DSP + Flash 4MB RAM, and FPGA (TIME BASE and AIE) are connected one another by means of the Data Bus.

The TIME BASE FPGA and AIE FPGA are of programmable type.

The front panel is connected by means of a serial line to the μP .

By means of the TIME BASE FPGA two serial lines are generated for TX and RX sections.

The serial TX line drives:

- CMX998
- TXFLT
- ADC/DAC TX

The serial RX line drives:

- CMX994
- RXFLT
- VATT1-VATT2
- ADC/DAC RX

The interface signals to the R/T section and PLL ADF4351 are all managed by the TIME BASE FPGA.

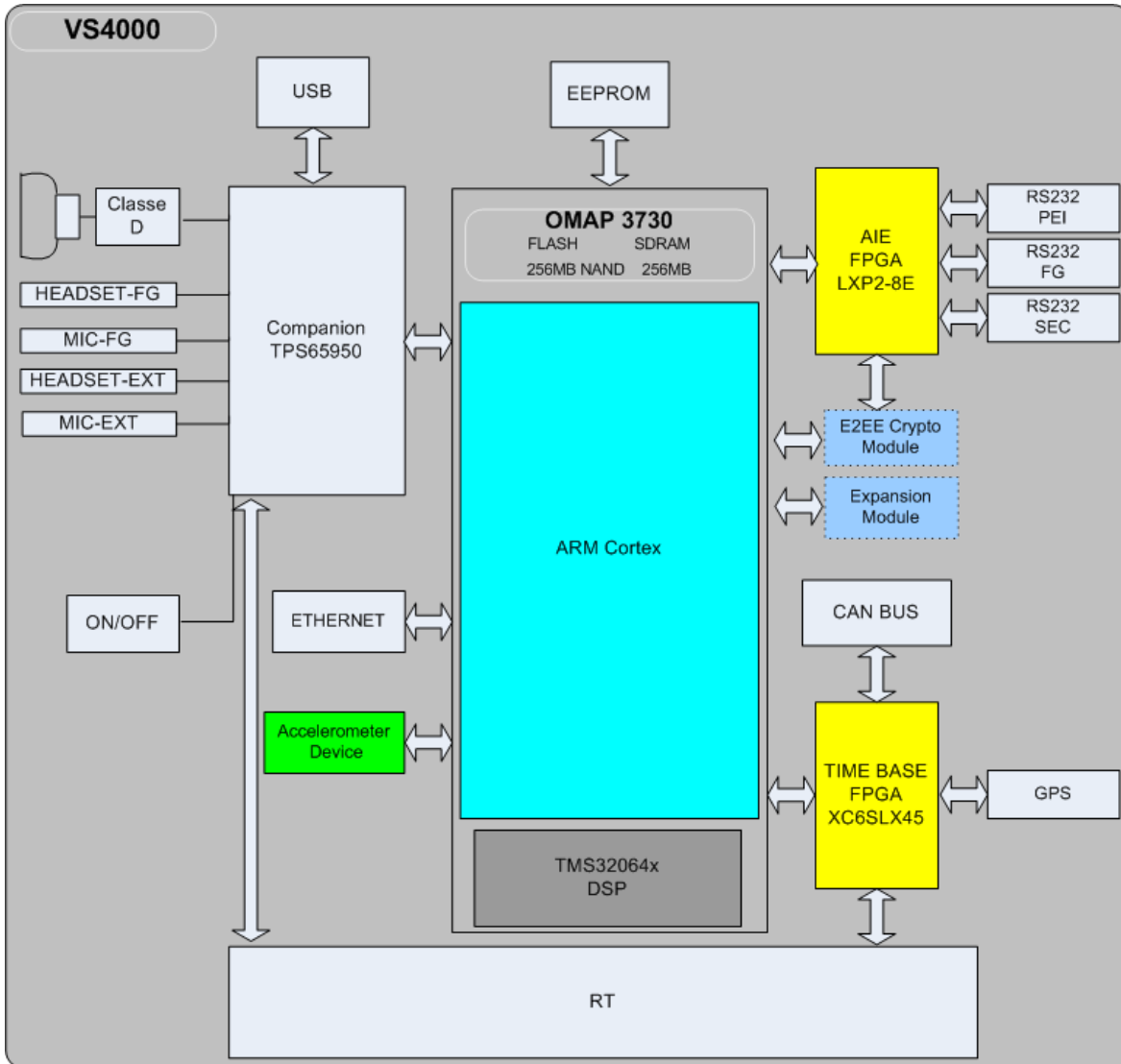


Fig. 2.10: Base Band section block scheme

2.5.5.1 *Microphone Lines management*

The audio codec TPS65950 has two independent balanced microphone inputs:

- MIC-FG, front panel microphone
- MIC-EXT, external microphone

MIC-FG pins are available on rear 26 pin connector (J5)

MIC-EXT pins are available on 64pin expansion connector (P3).

in Fig. 2.11 the microphone lines management scheme is shown.

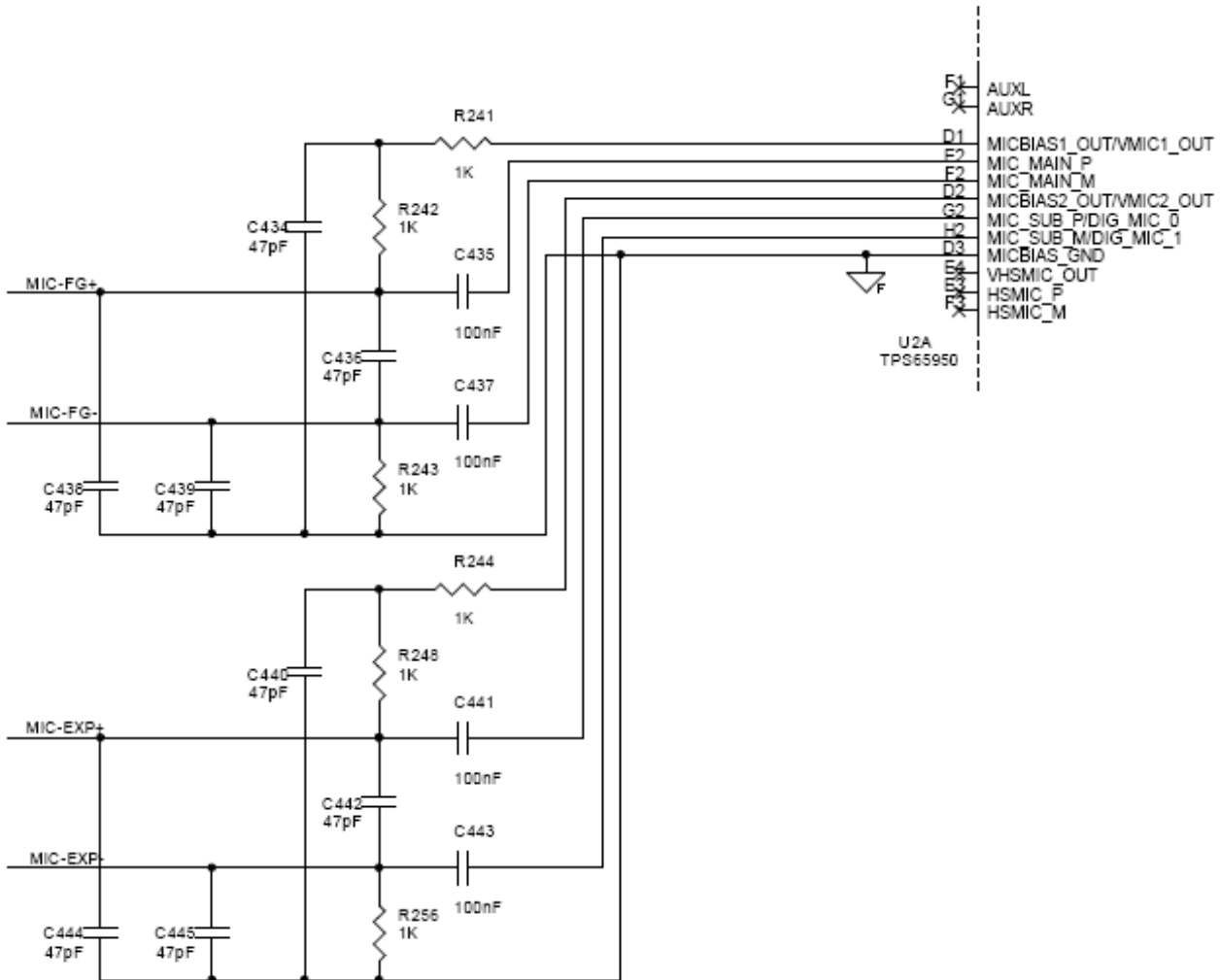


Fig. 2.11: Microphone lines management

2.5.5.2 PTT line management

On the rear J5 connector PTT-EXT is available.

PTT line is connected as in Fig. 2.12 is shown.

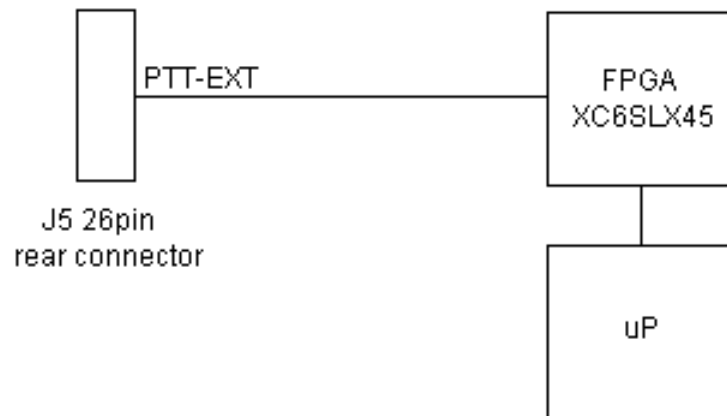


Fig. 2.12: PTT line

2.5.5.3 *AF Output Power*

The VS4000 equipment is provided of an audio power amplifier final stage of class D ($\eta = 90\%$).

Audio performances of the radio are:

8 W @ 4 Ohm

3. SETTING UP

3.1 INTRODUCTION

This chapter describes the way to configure a TETRA vehicle equipment by using a suitable tool installed in a PC. This tool, the Programming Package, will be referred to as PRP, in the following description.

For further details about PRP see the relevant user guide.

3.2 SETTINGS

3.2.1 HW/SW Configurations

The PC where the PRP is installed must have the following minimum configuration:

- 128 Mb RAM
- One or more serial ports
- Minimum graphic resolution: 640 x 480 pixels
- Operating system: Windows (95, 98, NT, XP, Win7)

The PRP installation is carried out from the PC control Panel or, simply, by executing the file "Setup.exe", and is completely driven by operating system. A de-compression .zip file is not required.

3.2.2 Connecting the equipment and the computer

The connection between the radio and the computer is carried out via Ethernet line by means of the relevant programming.

3.3 GENERAL DESCRIPTION

The PRP is mainly composed of:

1. an application, resident on the PC, able to manage and carry out the complete configuration of a set of radios;
2. a communication protocol to transfer the information from the PC to the radio terminals;
3. a Boot software to be installed on the equipment to enable communication with the PC.

The main functions, allowed by the MMI of the PRP, are the following:

- downloading of the Boot software into the radio terminal;
- downloading of the code of the equipment;
- downloading of the firmware of the equipment;
- downloading of the equipment data configuration;

Therefore the MMI provides the interface for managing the database and the users.

3.4 PRP PROGRAMMING PACKAGE SERVICE GUIDE

Detailed information about PRP use are available on PRP Programming Package service guide.

4. DISPOSAL

4.1 INTRODUCTION

General instructions for the disposal of hazardous materials are contained in this chapter.

4.2 DISMANTLING AND DISPOSAL

When the equipment described in this technical manual comes to the end of its life cycle and is removed from service, special precautions must be taken during the dismantling and disposal phases.

National legislation and/or local regulations in effect regarding health, safety and the environment must be carefully followed.

The owner is responsible for the dismantling of the equipment being compelled to safely disconnect it from supplies, cables and services before entrusting it to an authorized disposal and placement company.

It is furthermore necessary that the disposal company is aware that the equipment is destined for disposal and NOT for re-use.

The nature of any hazard or any hazardous material contained in the equipment must be notified to the disposal company.

These hazards may include:

- Heavy weight of the equipment;
- Flammable materials;
- Potentially harmful, corrosive or toxic substances and materials.

4.3 PROVISIONS FOR RE-USE

Whenever the equipment is destined for sale in order to be re-used, the new owner of the equipment must comply with the laws and regulations in effect in the new country of use, and assume the responsibility for the health and safety of the personnel and the environment as well.

It is essential for the owner to supply the potential purchaser with a copy of this technical manual, containing the instructions for safe operation and the procedures to identify potential hazards. In any case, the owner must inform the potential purchaser, in writing, of these hazards.

Selex ES disclaims all responsibility for the equipment once it is scrapped or re-sold.

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5. PREVENTIVE MAINTENANCE

In this section the information necessary to carry out the preventive maintenance operations on the radio equipment VS4000 is gathered.

5.1 INTRODUCTION

The preventive maintenance operations required by the equipment taken into consideration are substantially limited to a regular control of their efficiency, a visual inspection and cleaning.

The tools and the consumable materials needed to carry out the maintenance activities are listed, when required, together with the procedures to be followed to carry out the operations. Moreover operations periodicity and maintenance levels are also described.

All the information is gathered in the proper preventive maintenance (PM) forms.

5.2 COLLECTION OF PREVENTIVE MAINTENANCE FORMS

In this chapter all the PM forms describing the relative preventive maintenance operations to be carried out on the radio terminal VS4000 are gathered. All the forms are sequentially numbered.

The operations to be carried out are summarised in Tab. 5.1.

Tab. 5.1: Summary of the preventive maintenance operations

Description	Equipment	Periodicity	Form N°
Visual inspection and cleaning	Radio terminal VS4000	1 Month	PM-01
Functional test	Radio terminal VS4000	1 Month	PM-02
Check of car battery system efficiency and assembly tightness	Radio terminal VS4000	1 Month	PM-03

Equipment Radio Terminal VS4000	Form number PM-01
	Page 1/2

Operation Visual inspection and cleaning	
Required tools - Soft cloth - Brush	Consumable materials - Deoxidizing spray

Periodicity	Maintenance level
1 Month	I

PROCEDURE



Read all the safety recommendations before proceeding.



Do not use solvents for the cleaning operation.

- Visually check the general condition of the equipment.
- Make sure that all the connectors are in good repair; when required operate with a deoxidizing spray on the connector's contacts.
- Make sure that all the external connection cables are in good repair. When required replace the cable.
- Make sure that the upper cover is correctly closed.
- Carefully clean the unit's external parts. Remove dust with a soft brush and remove stains with a soft, dry or slightly dampened cloth.
- Check the condition of the antenna and of its connector.

Form number PM-01	Equipment Radio Terminal VS4000
Page 2/2	

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Equipment Radio Terminal VS4000	Form number PM-02
	Page 1/2

Operation Functional test	
Required tools - None	Consumable materials - None

Periodicity	Maintenance level
1 Month	I

PROCEDURE



Read all the safety recommendations before proceeding.

- With the equipment turned on, make sure that the keyboard and PTT push-buttons operate correctly.
- Check the equipment's operation in all possible operating modes.

Form number PM-02	Equipment Radio Terminal VS4000
Page 2/2	

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Equipment Radio Terminal VS4000	Form number PM-03
	Page 1/2

Operation Check of car battery system efficiency and assembly tightness	
Required tools - None	Consumable materials - Deoxidizing spray

Periodicity	Maintenance level
1 Month	I

PROCEDURE



Read all the safety recommendations before proceeding.

- Check the correct working of the equipment, when the car engine is off and the radio is transmitting.
- Check the condition of the power supply connector's contacts and, in particular, the state of oxidation. If necessary clean the contacts with a deoxidizing spray.
- Check the efficiency of the fuses for protection of the unit.
- Make sure that all the equipment's connectors are properly tightened.
- Make sure that the transceiver bracket's fastening nuts are properly tightened in order to avoid the transceiver vibrating.
- Check the tightness of the nut that locks the antenna cable.

Form number PM-03	Equipment Radio Terminal VS4000
Page 2/2	

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6. TROUBLESHOOTING

The radio terminal VS4000 troubleshooting techniques are described in this section. These techniques are meant to find out failures that cause a bad functioning of the equipment.

The information given in this manual takes into consideration the fact that all the III level maintenance operations will be done only by the Selex ES assistance technicians.

The descriptions of the replacement procedures which can be done by the purchaser are detailed in section 7 of this technical manual.

6.1 INTRODUCTION

The troubleshooting procedures are shown in flow diagrams (see par. 6.3.1). The tests to be carried out by the use of the Radio Test Set on the radio terminal VS4000 are described in chapter 6.2. These tests are aimed to find out whether or not the equipment works correctly, under a radio point of view. If not, it must be sent to the Selex ES assistance centre.

6.2 RADIO TESTS WITH THE RADIO TEST SET

6.2.1 Tests with Radio Test Set

To carry out the Power Test and the Sensitivity Test on the radio terminal, you need a TETRA RADIO TEST SET (IFR) with the power supply cable and a TNC cable, as well as the radio terminal to be tested.

Note

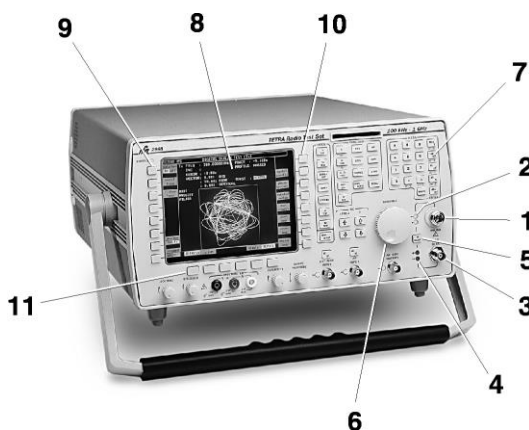
Several functions can be active on the TETRA TEST SET, depending on the release.

To carry out the test:

- turn off the RADIO;
- disconnect the antenna from the RADIO and replace it with the TNC cable;
- connect the other end of the TNC cable to the TETRA RADIO TEST SET; turn on the TETRA RADIO TEST SET (see Fig. 6.1).

Note

If the radio terminal to be tested is a portable one (Puma T2/T3), connect to the test set on the most sensitive RF connector (1W); to select this connector, press the "RF select" button; the two leds next to the connection selected will light up. By default, the Tetra Radio Test Set sets itself on the least sensitive RF connection (150 W), signaling it with the lighting up of the relative leds; this connection should be used in all cases in which the radio to be tested supplies a maximum power greater than 1 Watt.



- 1 RF connection 150 W
- 2 Led signaling RF connection, 150 W
- 3 RF connection 1 W
- 4 Led signaling RF connection, 1 W
- 5 "RF select" button
- 6 Adjustment knob
- 7 "Enter" keys
- 8 Display
- 9 Keys to the left of screen
- 10 Keys to the right of screen
- 11 Keys under screen

Fig. 6.1: Tetra Radio Test Set

When the TETRA RADIO TEST SET is turned on, a screen appears on the display with the initials IFR; the test set saves the data relative to the last test carried out in the memory.

By default, the TETRA RADIO TEST SET sets itself in analog mode; to select digital mode, press the "SYSTEMS" key (see Fig. 6.2) to load the TETRA protocol.



Fig. 6.2: SYSTEMS key

Before carrying out the test, it is necessary to know which channels are set on the terminal (setting from PRP). Even if there is more than one channel set, it is sufficient to consider just one of them for the purposes of the test.

When the "TETRA MOBILE" key is pressed from among the keys to the right of the display (see Fig. 6.3) and, subsequently, when the key in correspondence to "SET-UP" is pressed (from among the keys to the left of the display), a screen appears on the display that allows visualizing "SYSTEM PARAMETERS"; press the "CHANNEL PLAN" key to carry out the search for the reference frequency of the terminal being tested (see Fig. 6.4).

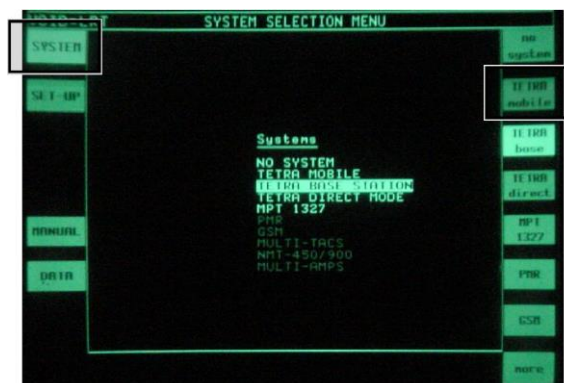


Fig. 6.3: System selection



Fig. 6.4: Channel selection

Once the frequency has been found, confirm it by pressing the key that corresponds to the operating frequency of the terminal from among those located to the right of the display; the test set finds the frequency band and, when the “CONTROL CHANNEL” button is pressed, shows all of the available parameters. Enter the value of the parameters using the numeric pad (see Fig. 6.5).



Fig. 6.5: DATA keys

For example:

- Control Channel: 2496;
- Traffic Channel: 2496;
- Time slot: 3 (select from 1 to 4);
- Mobile Country Code: 420 (that of the terminal);
- Mobile Network Code: 00005 (that of the terminal);
- Base Color Code: (Not useful for carrying out the test).

Note

If the frequency band of the terminal under test does not appear among those available to the test set, proceed by creating a personal "SET UP" to insert it (see IFR manual relative to the TETRA TEST SET).

Press any one of the red "ENTER" keys to confirm data entry (see Fig. 6.6)

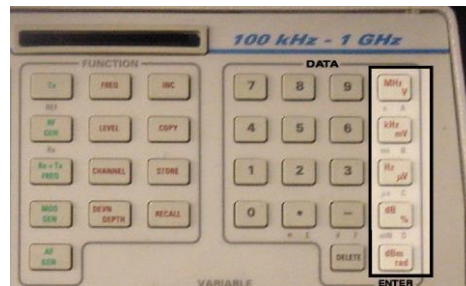


Fig. 6.6: Red "ENTER" keys

Note

It is possible to obtain confirmation (ENTER) by pressing any one of the red keys only when you are not required to press a specific key (ENTER) relative to the required measurement unit.

Note

It is possible to reduce the frequency search time through the "BASE COLOUR CODE" item only when several groups of cells are found under the same area.

Once the values relative to the first group of essential parameters have been entered (which are highlighted on the display), press the "MORE" key to highlight the second group of parameters, in order to be able to enter the values relative to these also.

- min Rx level for access: -110 dBm (indicates the minimum signal level coming from the BS in order that it be considered by the radio terminal);
- max Tx level: 30 dBm (corresponds to the maximum signal level transmitted by the terminal: 1 W for portable terminals; 10 W for vehicular/fixed terminals);
- access parameters: -39 dBm (this value is given by a relation involving two parameters, C1 and C2, to determine passage from cell to cell);
- the other parameters in this second group are not useful for carrying out the test in question.

Press the “MORE” key again to access the parameters of the third and last group; none of these are useful for carrying out the test.

Note

If the parameters of the first group are not entered, the test set remains in “wait mode”; if, instead, the parameters of the second group are not entered, the test set operates anomalously; finally, the parameters of the third group do not influence the test in any way.

A screen divided into two parts (see Fig. 6.7) appears on the RADIO TETRA TEST SET display:

- MANUAL TEST: groups all of the settings given previously
- MODE : groups all test values

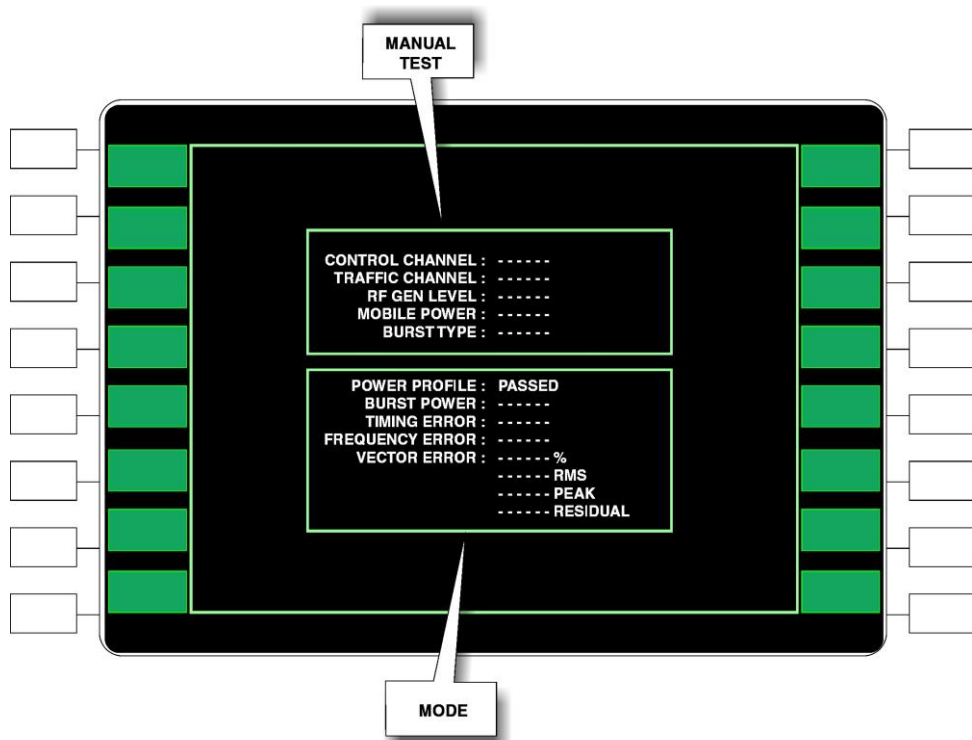


Fig. 6.7: “Manual Test” and “Mode”

Now turn on the terminal to be tested; it begins to search and then registers itself with its identifier (ITSI), which will appear on the display.

When “CALL MOBILE” is pressed, the test set sends a call to the terminal under test; when the terminal accepts the call, it is possible to check the “MODE” data on the test set.

- Power Profile: (“Passed” must appear).
- Other parameters are (see Tab. 6.1) “Burst Power” (it can be expressed in dBm or mW), “Timing Error” (indicates the number of symbols read erroneously), “Frequency Error” (frequency error) and “Vector Error” (referred to the vector (symbol) transmitted; the mean error (RMS), the peak error (PEAK and the residual error (RESIDUAL) are specified).

Even if only one of the parameters does not comply with the ETSI standard (see Tab. 6.1), “Passed” does not appear next to “Power Profile”.

Tab. 6.1: Parameters

Phase	Action	Expected result
1	After the antenna has been disconnected, connect the terminal to the Tetra Test Set as explained in this chapter of the manual.	None.
2	Carry out the necessary settings on the Tetra Test Set (selection of the TETRA environment, selection of transmission mode, operating frequency, etc.) to pick up the carrier.	If the Tetra Test Set settings are correct, it receives and demodulates the radio terminal carrier. Depending on the test set options, various screens appear (constellation diagram, vector modulation diagram, etc.).
3	Check the following on the Tetra Test Set: RF power Frequency error Vector error, mean value (RMS) Vector error, peak value Vector error, residual value SYS INFO (correct decoding of system data)	RF power ⁽¹⁾ : 10 dBm/±1,5 dBm (up to 470 MHz) 10 dBm/±2 dBm (in the 870 MHz band) Frequency error ⁽²⁾ : <0.1 ppm Vector error, mean value (RMS) ⁽³⁾ : ≤10% Vector error, peak value ⁽⁴⁾ : ≤30% Vector error, residual value: ≤5% SYS INFO: correctly decoded
4	Drawing up of Test Report.	None.
<p><i>Notes:</i></p> <p>(1): In compliance with ETSI 300 392-2 article 6.4.1.1, as recommended in ETSI 300 394-1 article 7.1.1.2</p> <p>(2): The TETRA RF test set will have a precision in frequency greater than 0.1 ppm (BS diagram) or will be tied to a higher external reference precision. If similar conditions are not complied with, this measurement is not reliable and should only be considered approximate.</p> <p>(3): In compliance with ETSI 300 392-2 article 6.6.1.2.</p> <p>(4): In compliance with ETSI 300 392-2 article 6.6.1.2.</p>		

In these tests, the TETRA TEST SET simulates the TETRA network.

Power Test

When the “CALL MOBILE” button is pressed on the test set, a call is forwarded to the terminal being tested.

After having pressed the “RF GEN” button, vary the field using the adjustment knob (see Fig. 6.8), weakening it and thus forcing the terminal to increase the transmitted power until reaching its MAX power (1 W for portable terminals, 10 W for vehicular/fixed terminals). The change in the fluctuating values (in dBm) will be noted in correspondence to “RX GEN LEVEL”.

Sensitivity Test

The DYNAMIC SENSITIVITY tests are not carried out in the lab; for this reason, we refer here to STATIC SENSITIVITY.

When the “CALL MOBILE” button is pressed on the test set, a call is forwarded to the terminal under test.

After having pressed the “RF GEN” button, use the adjustment knob (see Fig. 6.8) to bring the signal to -112 dBm, starting from a higher value (for example, -90 dBm).

The call, previously forwarded to the terminal, must remain active up to the value of -112 dBm; to guarantee this, the terminal under test will bring itself to the MAX power value transmitted (1 W for portable terminals and 10 W for vehicular/fixed terminals).

At the end of the test, the operator, besides having carried out the POWER and SENSITIVITY TESTS, also verifies the accuracy of all of the radio terminal parameters.

Note

The POWER and SENSITIVITY TESTS are closely correlated; in fact, the power is controlled by varying the sensitivity and vice versa.



Fig. 6.8: Adjustment knob

6.3 TROUBLESHOOTING FLOW DIAGRAMS

The troubleshooting flow diagrams are gathered in this chapter. These diagrams are meant only for maintenance technical personnel.

By starting from a bad functioning symptom we arrive to the corrective operation to be carried out in order to remove the failure; the corrective action can be a simple maintenance operation (III level excluded) or it can end in sending the equipment to the Selex ES assistance centre.

The troubleshooting flow diagrams relative to the radio terminal VS4000 are gathered in par. 6.3.1.

6.3.1 VS4000: troubleshooting flow diagrams

A summary of the VS4000 radio equipment troubleshooting is shown in Tab. 6.2.

In particular:

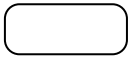
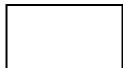
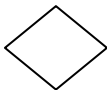
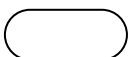
- N:** stands for the procedure position in the prospectus;
- Description:** stands for the symptom and thus the beginning of the fault seeking procedure;
- Fig. Ref.:** stands for the figure containing the flow chart relating to the appropriate procedure.

Tab. 6.2: Radio terminal VS4000 troubleshooting

N.	Description	Fig. Ref.
1	It's not possible to control the volume of the loudspeaker	6.9
2	The equipment doesn't turn on	6.10
3	It's not possible to exchange data with an external equipment	6.11
4	Failure in the selection of the standard operative functions and/or in the selection of the digits from the keyboard	6.12
5	The green and/or red LED are not lit when they should	6.13
6	The FPG3 display is out of order or it shows wrong symbols	6.14
7	The radio link, within the normal coverage area, is impossible, intermittent or faint	6.15

The troubleshooting procedures are shown in the flow diagrams whose symbols are described in Tab. 6.3.

Tab. 6.3: Description of the symbols used in the troubleshooting flow diagrams

Symbol	Meaning
	Stands for the beginning or the end of the flow diagram. The symptom of the possible fault is described inside the symbol.
	Stands for the action to be carried out. This action is described inside the symbol itself.
	Stands for a decision to be made. The question that must be answered is shown inside the symbol.
	Stands for the term of the search.

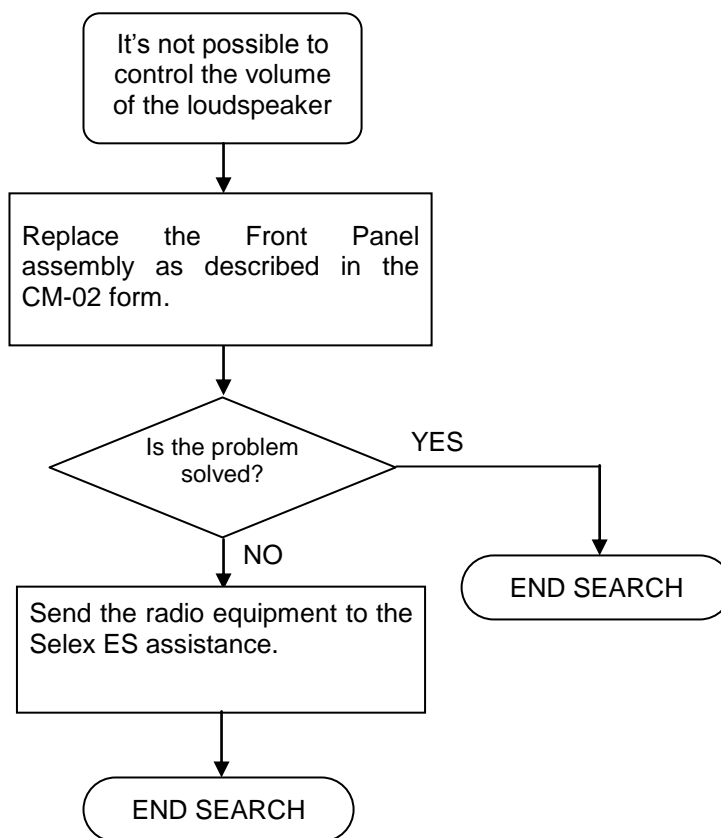


Fig. 6.9: It's not possible to control the volume of the loudspeaker

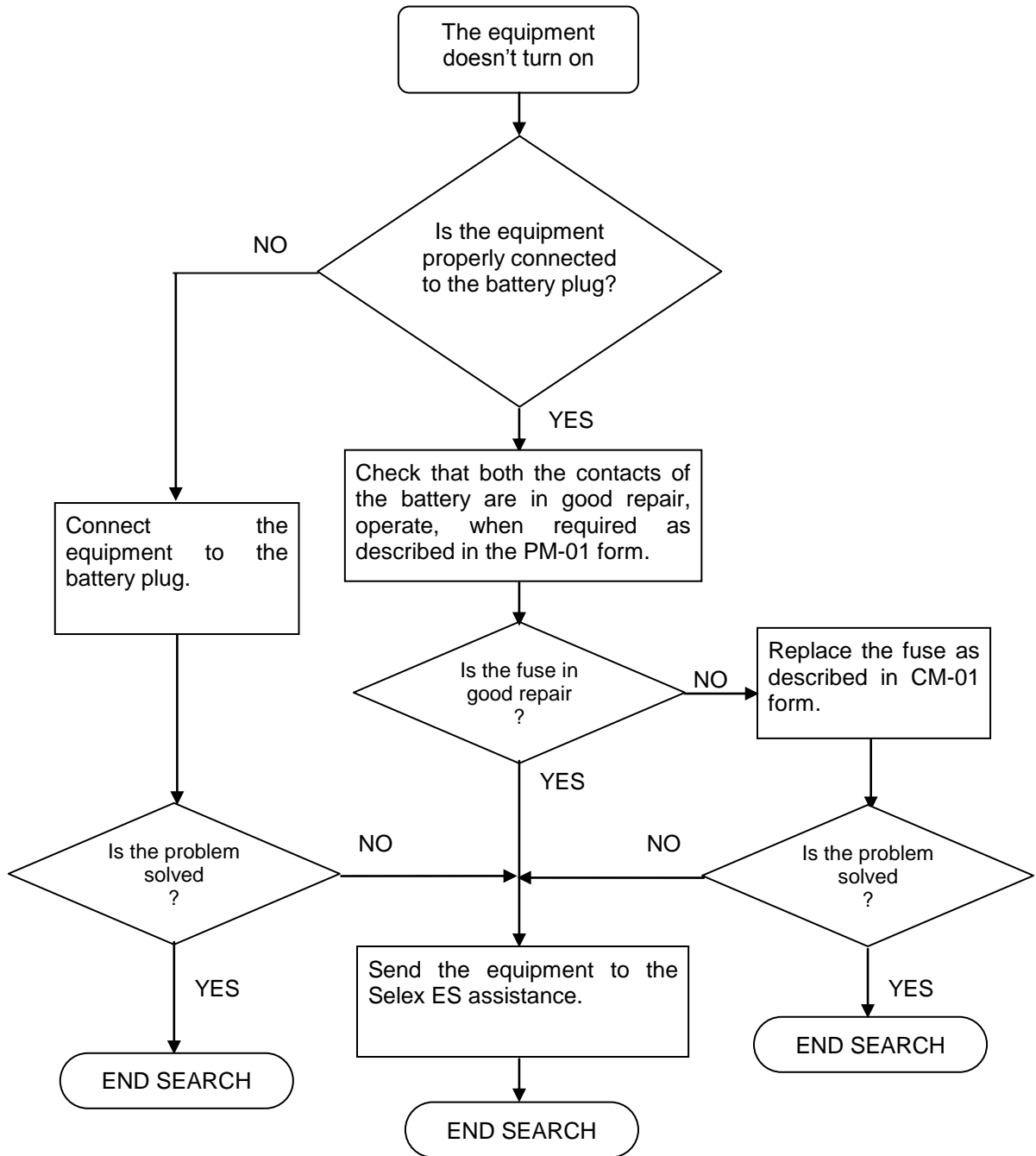


Fig. 6.10: The equipment doesn't turn on

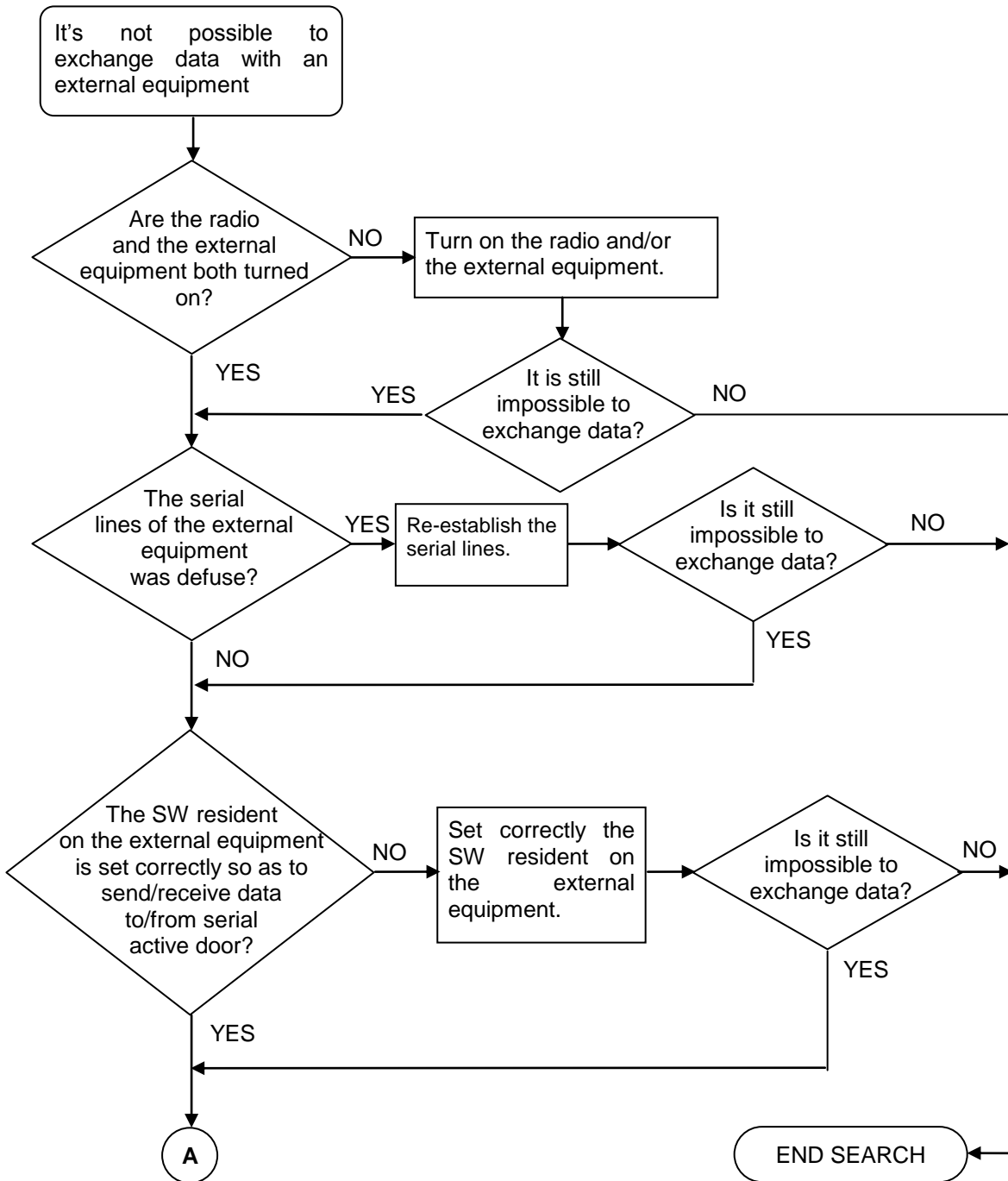


Fig. 6.11: It's not possible to exchange data with an external equipment (sheet 1 of 2)

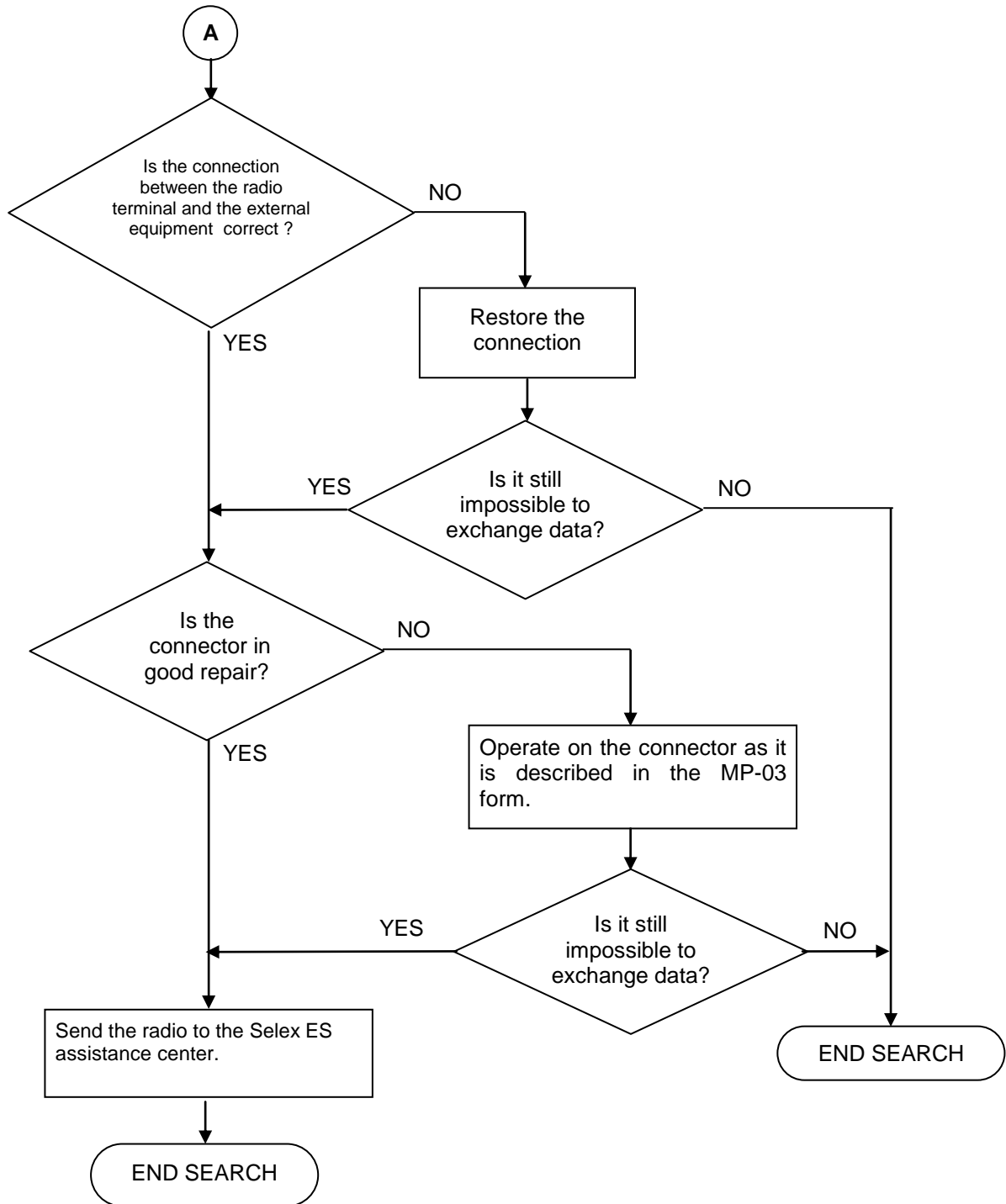


Fig. 6.11: It's not possible to exchange data with an external equipment (sheet 2 of 2)

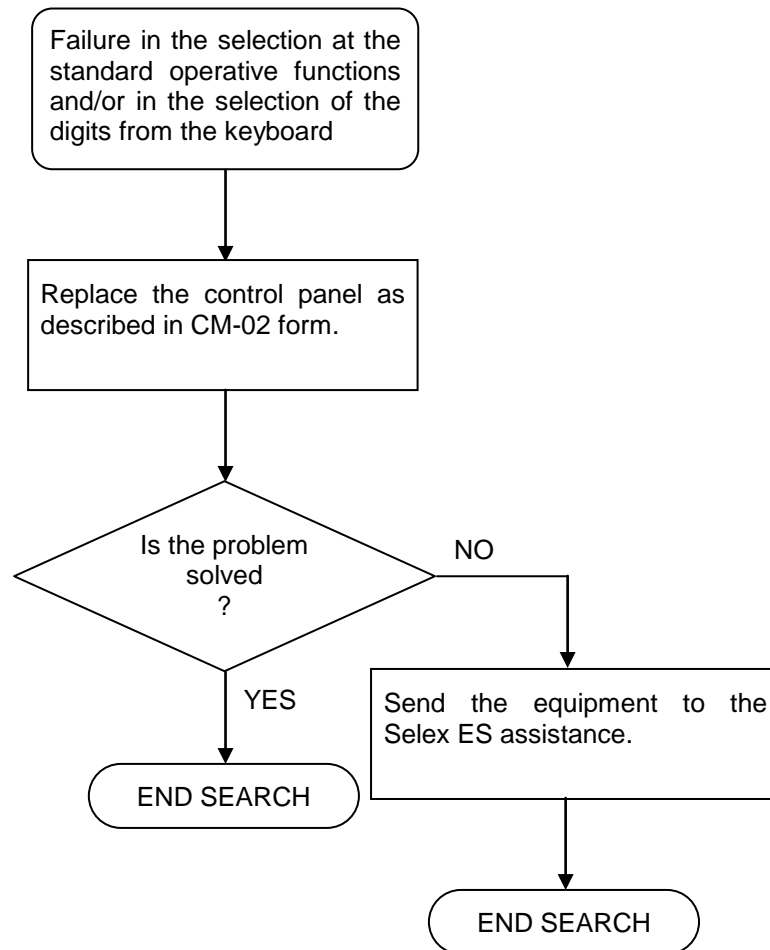


Fig. 6.12: Failure in the selection of the standard operative functions and/or in the selection of the digits from the keyboard

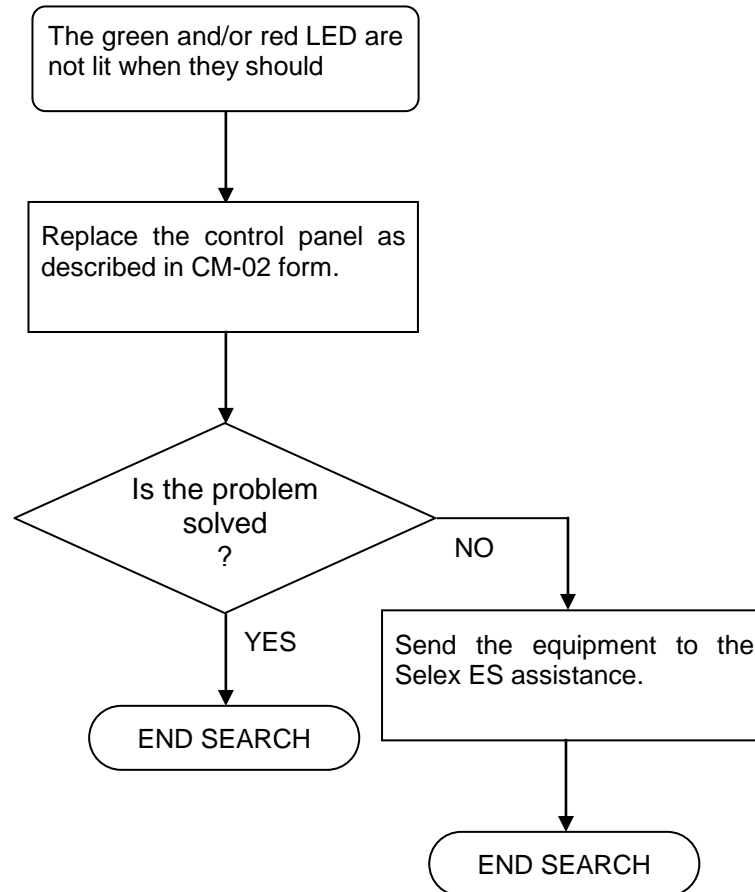


Fig. 6.13: The green and/or red LED are not lit when they should

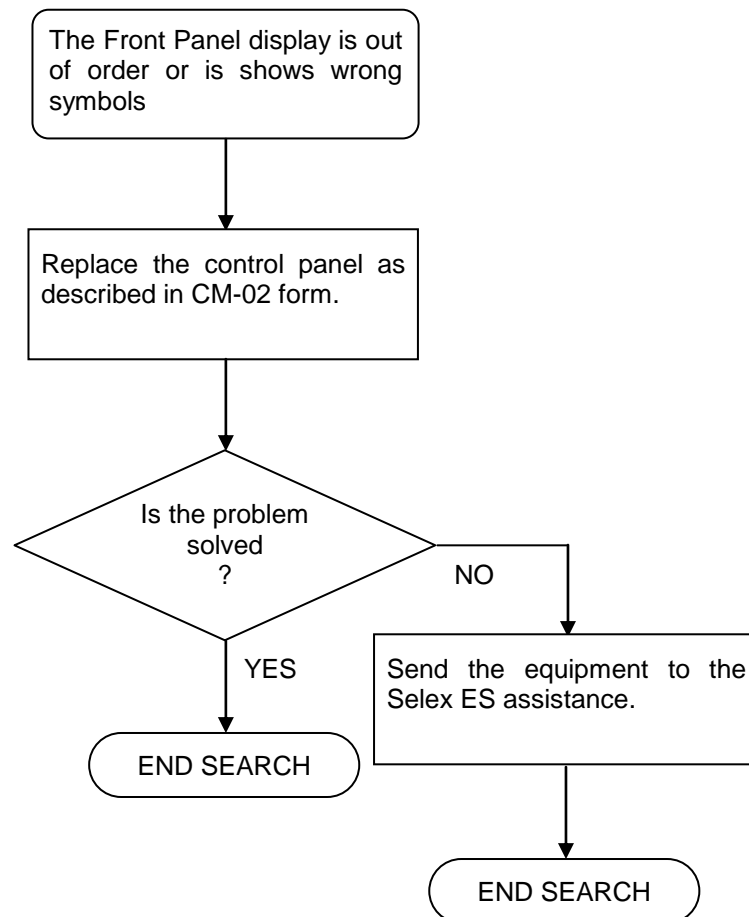
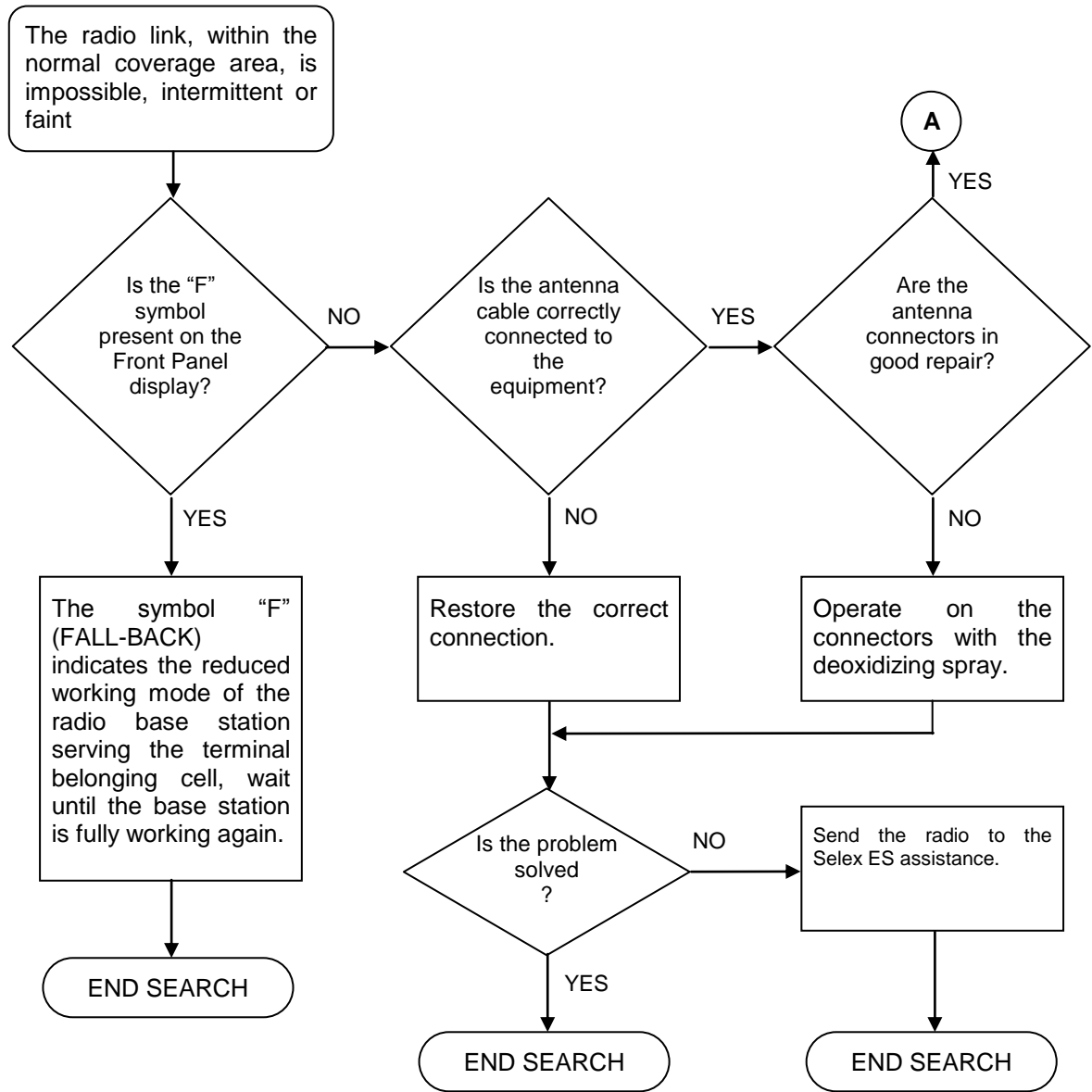


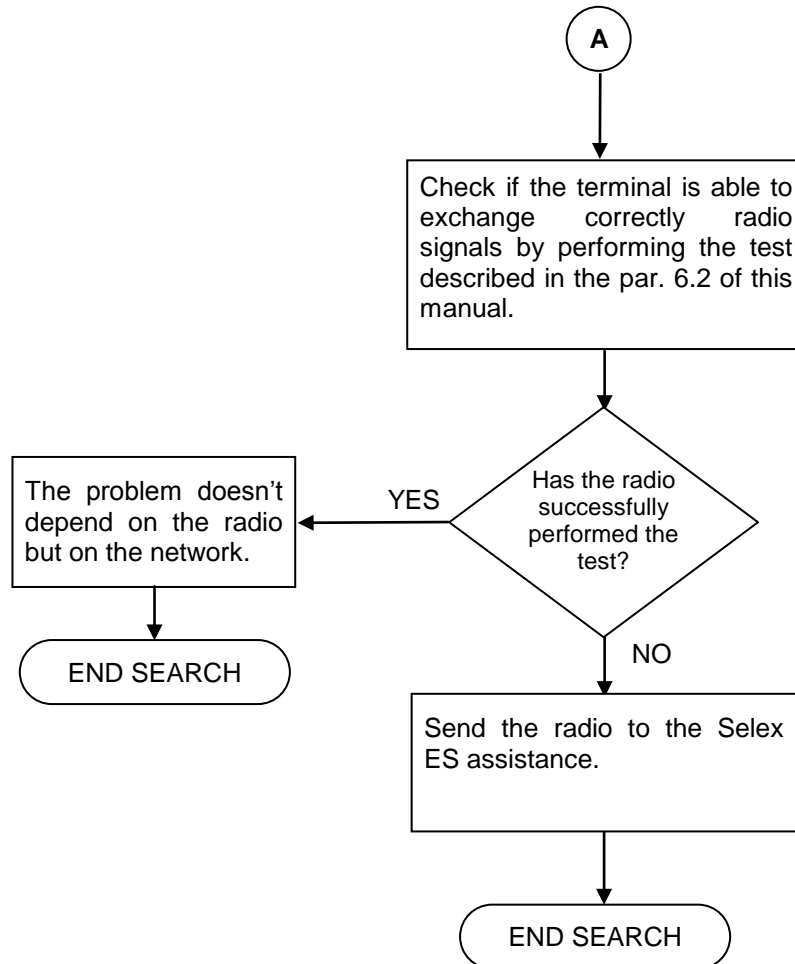
Fig. 6.14: The FPG3 display is out of order or it shows wrong symbols



Note

In this flowchart the antenna system is considered in good repair.

Fig. 6.15: The radio link, within the normal coverage area, is impossible, intermittent or faint (sheet 1 of 2)



Note

In this flowchart the antenna system is considered in good repair.

Fig. 6.15: The radio link, within the normal coverage area, is impossible, intermittent or faint (sheet 2 of 2)

6.4 FUNCTIONAL TEST

A suitable test bench must be prepared in order to carry out the test procedures. The list of required items, except the terminal to be tested, is given below.

- Reference auxiliary hand-held equipment PUMA TETRA or any other TETRA terminal.
- Reference microphone.
- Reference loudspeaker.
- Reference TETRA Base Station. This base station must be located in a suitable area in order to guarantee the radio link with the above equipment. It must be configured to have in its database an identifier number for a dummy (test) radio that can be configured each time a radio is tested in order to verify its operation.
- PC installed with the software to configure the equipment to be tested and with the parameters of the radio base station.
- Cable for the equipment downloading.

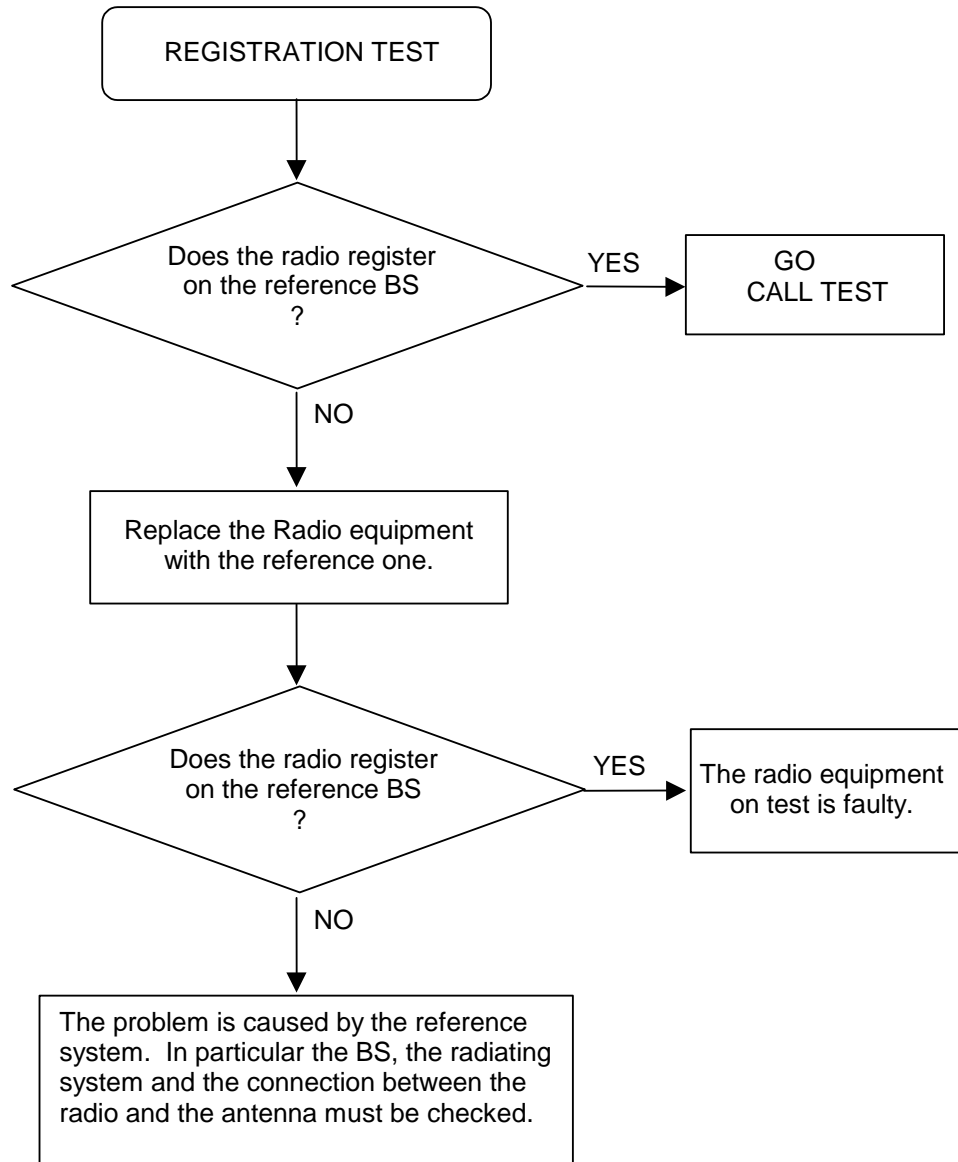


Fig. 6.16: Registration test

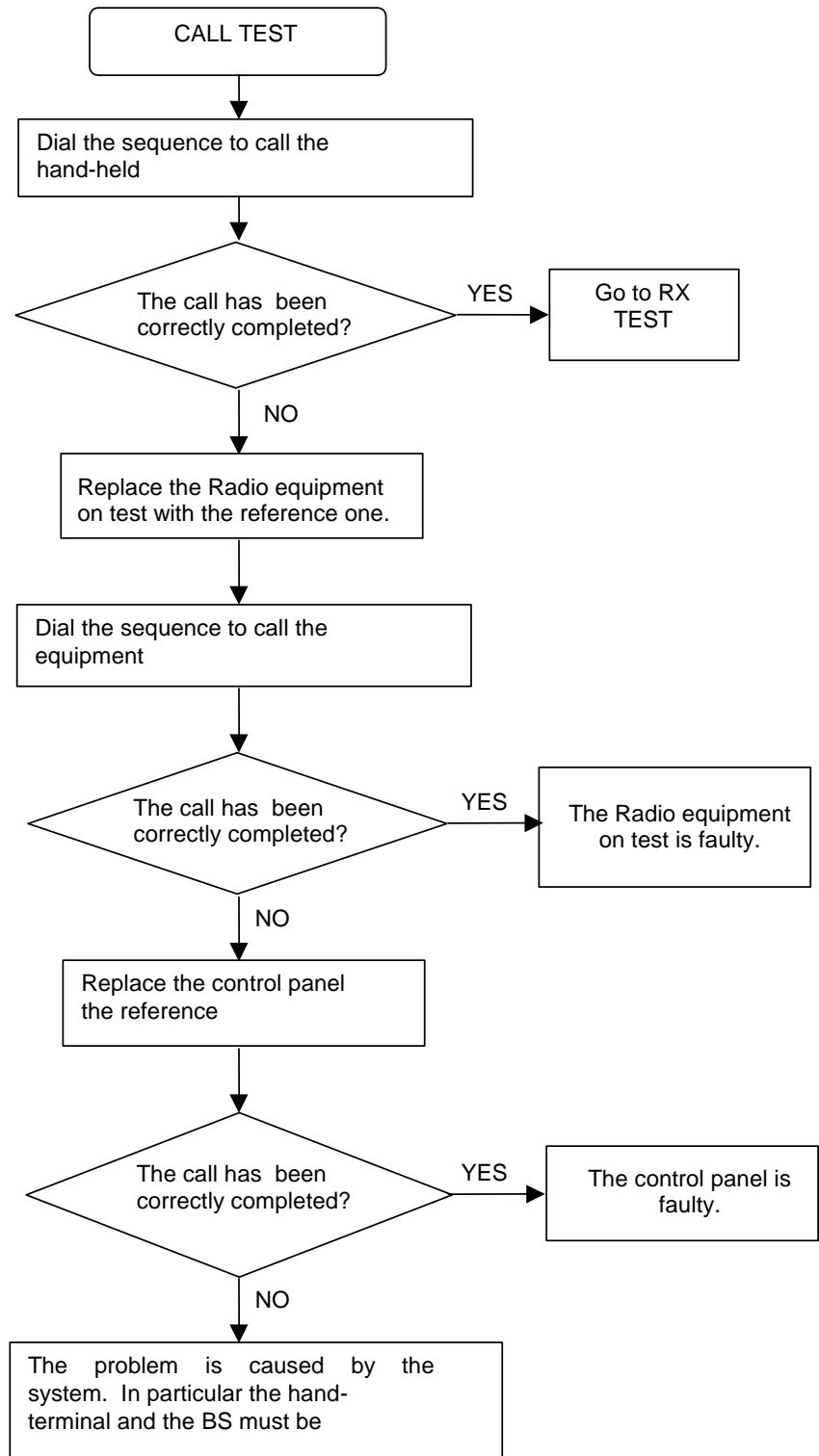


Fig. 6.17: Call test

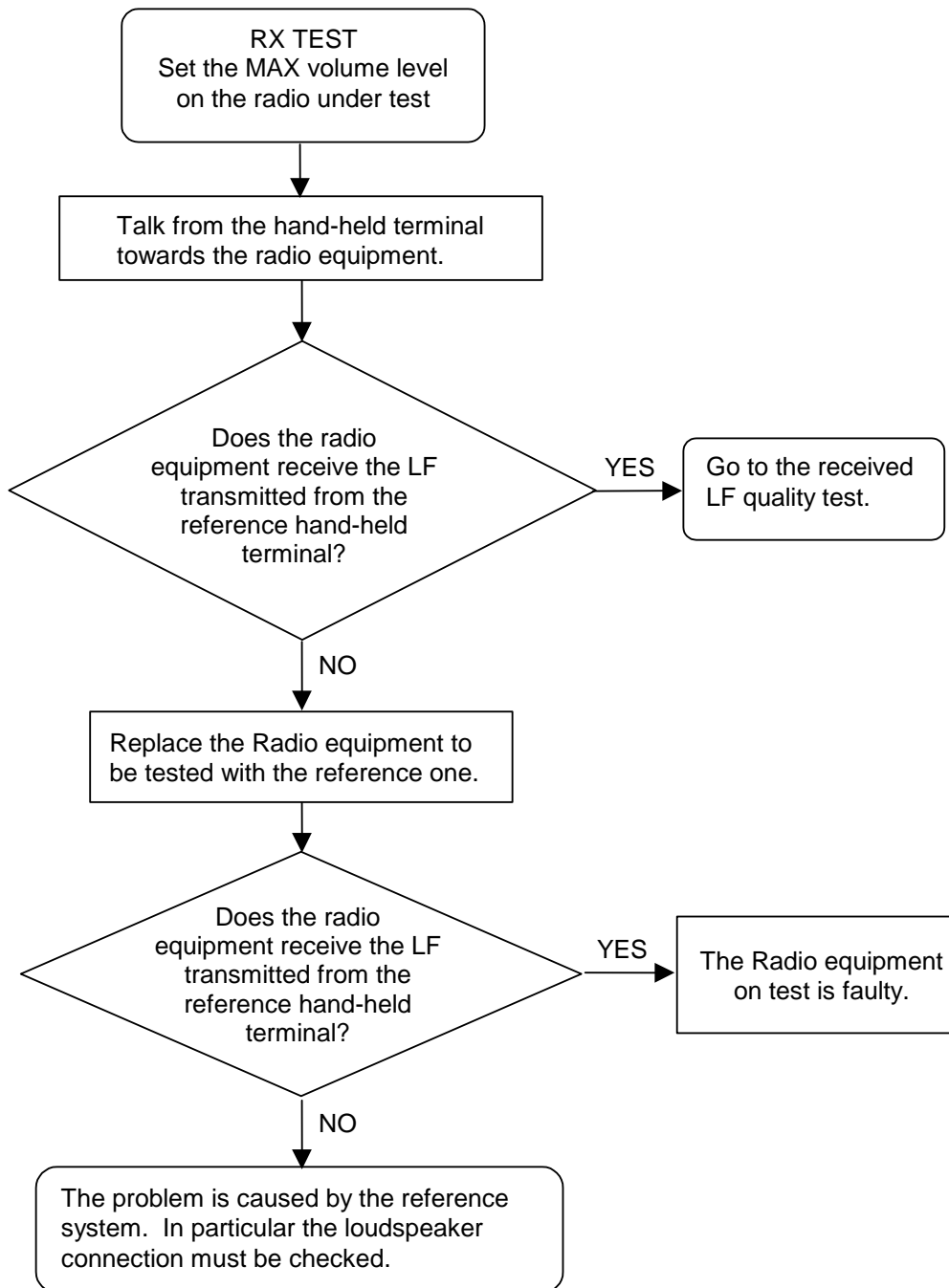


Fig. 6.18: RX test

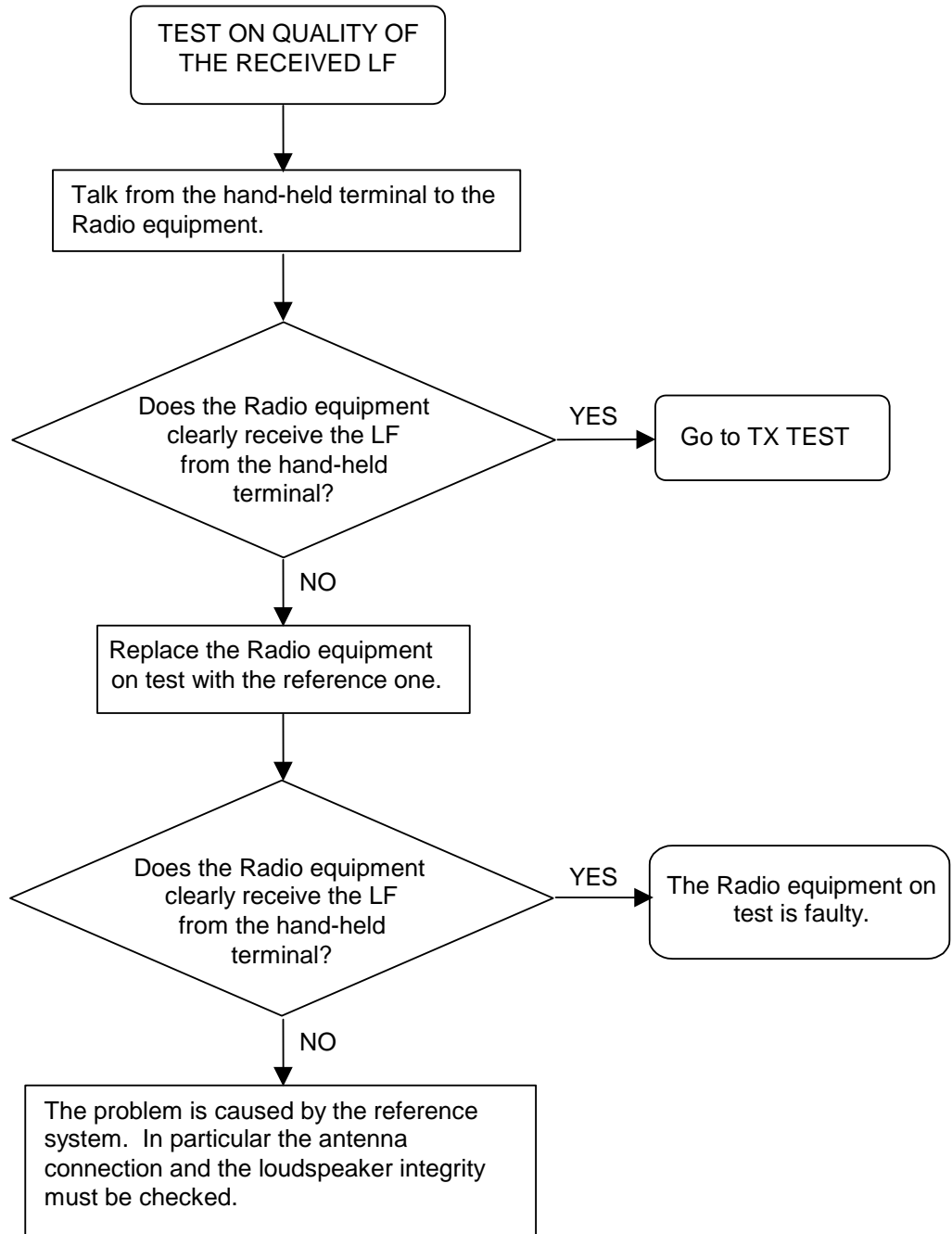


Fig. 6.19: Test on quality of the received LF

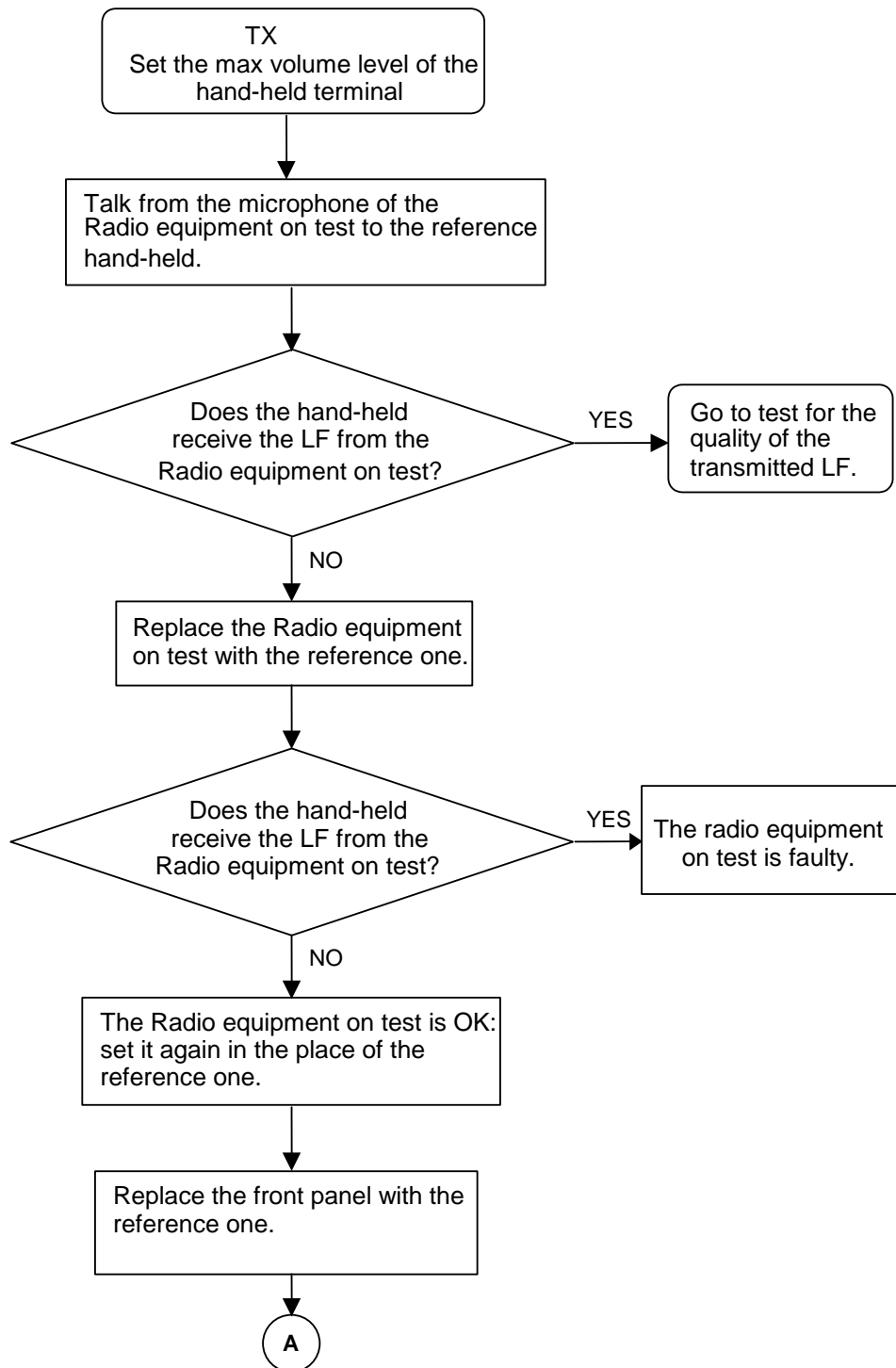


Fig. 6.20: TX test (sheet 1 of 2)

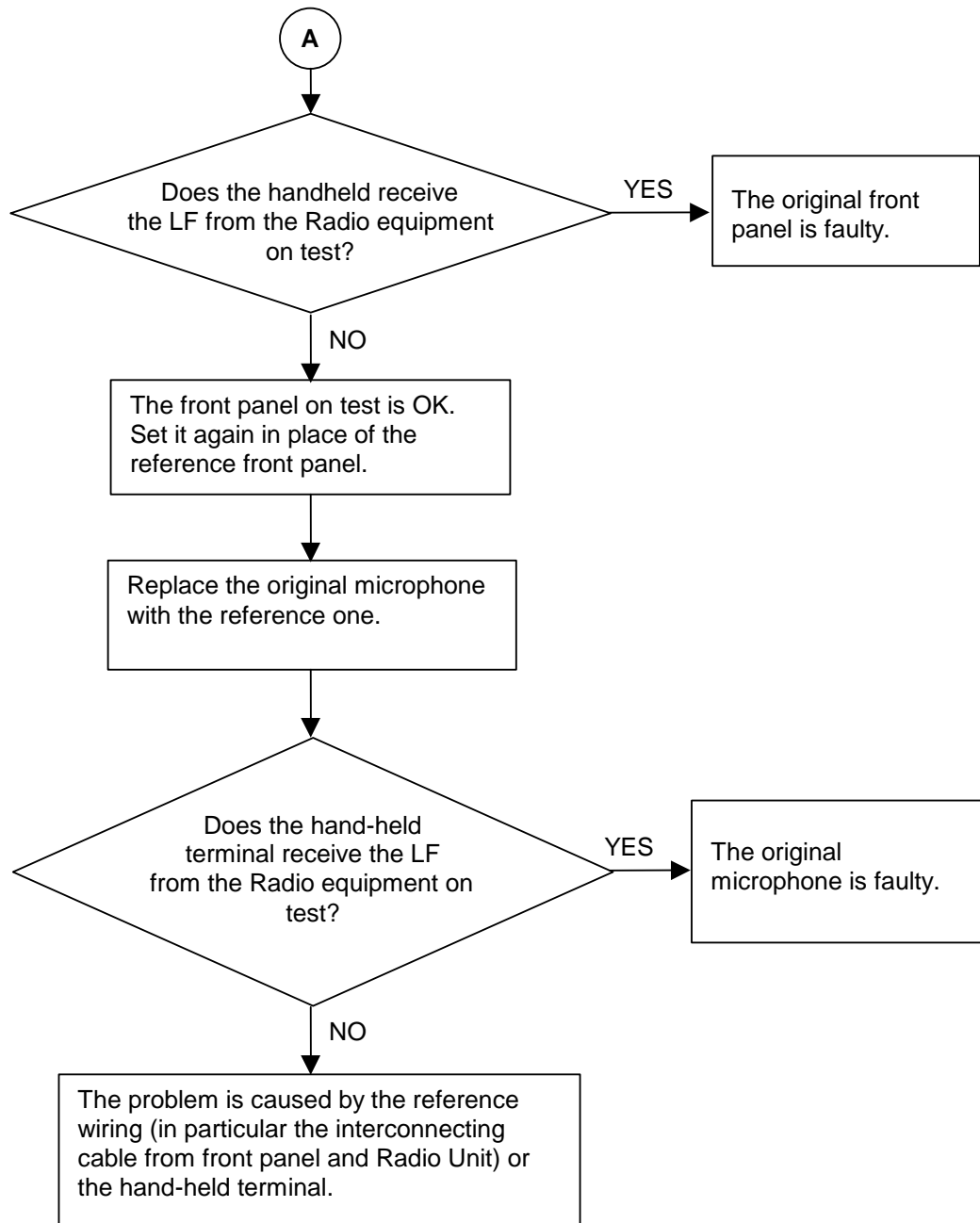


Fig. 6.20: TX test (sheet 2 of 2)

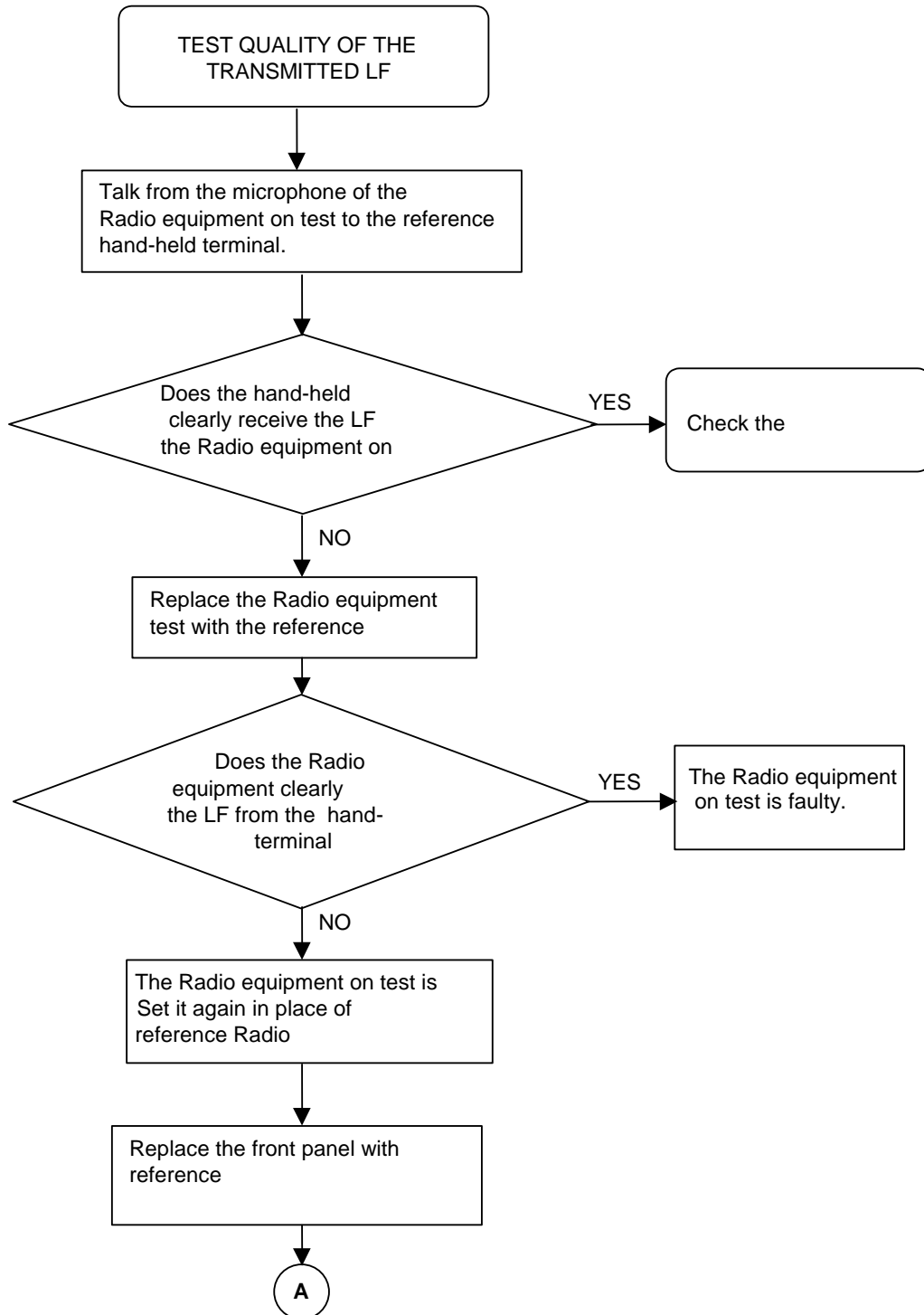


Fig. 6.21: Test on quality of the transmitted LF (sheet 1 of 2)

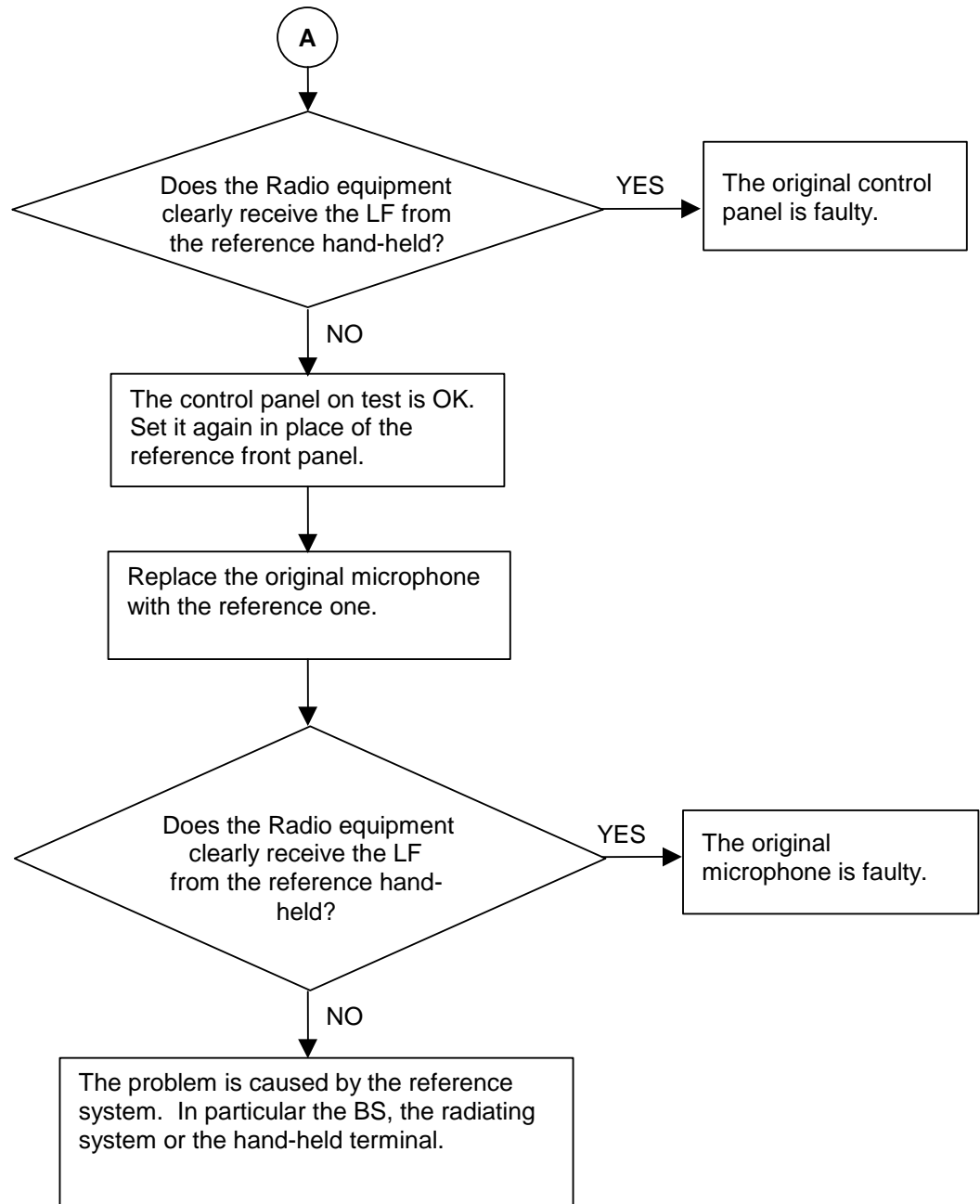


Fig. 6.21: Test on quality of the transmitted LF (sheet 2 of 2)

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7. CORRECTIVE MAINTENANCE

The information necessary to carry out the replacement operations relatively to the corrective maintenance on the VS4000 radio equipment is gathered in this section.

7.1 INTRODUCTION

The corrective maintenance operations required by the equipment taken into consideration are substantially limited to the replacement of replaceable parts.

The tools and the consumable materials needed to carry out the maintenance activities are listed, when required, together with the procedures to be followed to carry out the operations. All the information is gathered in the proper corrective maintenance (CM) forms.

7.2 COLLECTION OF CORRECTIVE MAINTENANCE FORMS

In this chapter all the CM forms describing the relative corrective maintenance operations to be carried out on the VS4000 radio terminal are gathered. All the forms are sequentially numbered.

The operations which can be carried out at the I and II maintenance level, without the intervention of the Selex ES assistance centre, are summarised in Tab. 7.1.

Tab. 7.1: Summary of the corrective maintenance operations

Frontal panel replacement	VS4000	CM-01
VS4000 antenna replacement	VS4000	CM-02
VS4000 radio module replacement	VS4000	CM-03

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Equipment VS4000 Radio System (vehicle configuration)	Form number CM-01
	Page 1/2

Operation Front panel replacement	
Required tools - Screw-driver	Consumable materials - Front panel

Periodicity	Maintenance level
Not applicable	I

PROCEDURE

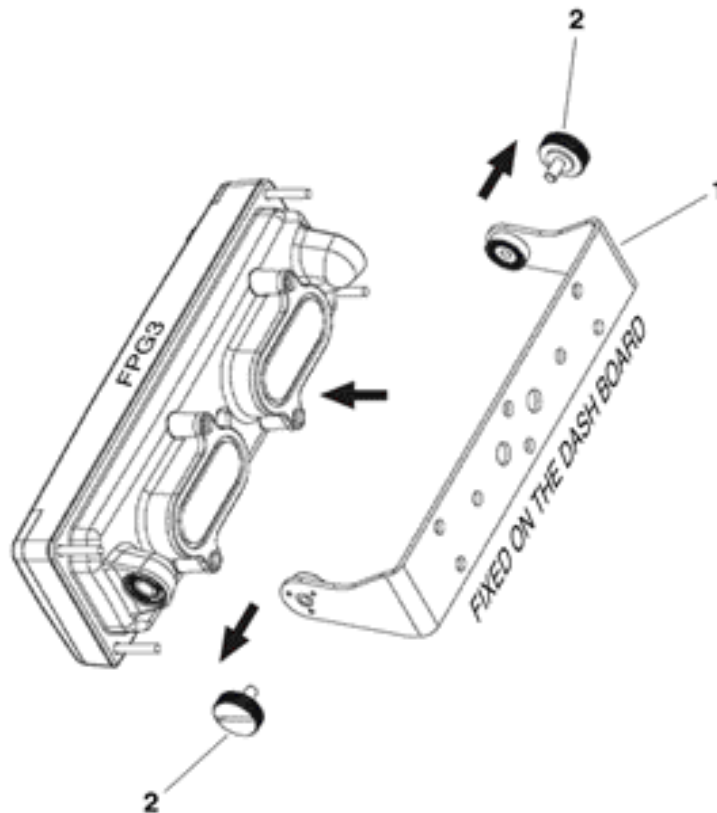


Read all the safety recommendations before proceeding.

- When the car engine is off, switch OFF the radio system by means the proper button of the front panel.
- Disconnect the positive terminal of the power supply cable from the car battery.
- Unscrew the four fixing screws (1, Fig. 1) of the control panel and disconnect it from the bracket.

Form number CM-01	Equipment VS4000 Radio System (vehicle configuration)
Page 2/2	

Fig. 1 FPG3 removal



- 1 Bracket (fixed on the dash board)
- 2 Knobs

VS4000 Radio System	Form number CM-02
	Page 1/2

Operation VS4000 antenna replacement
--

Required tools - None	Consumable materials - Antenna - De-oxidizing spray
--------------------------	---

Periodicity	Maintenance level
Not applicable	I

PROCEDURE



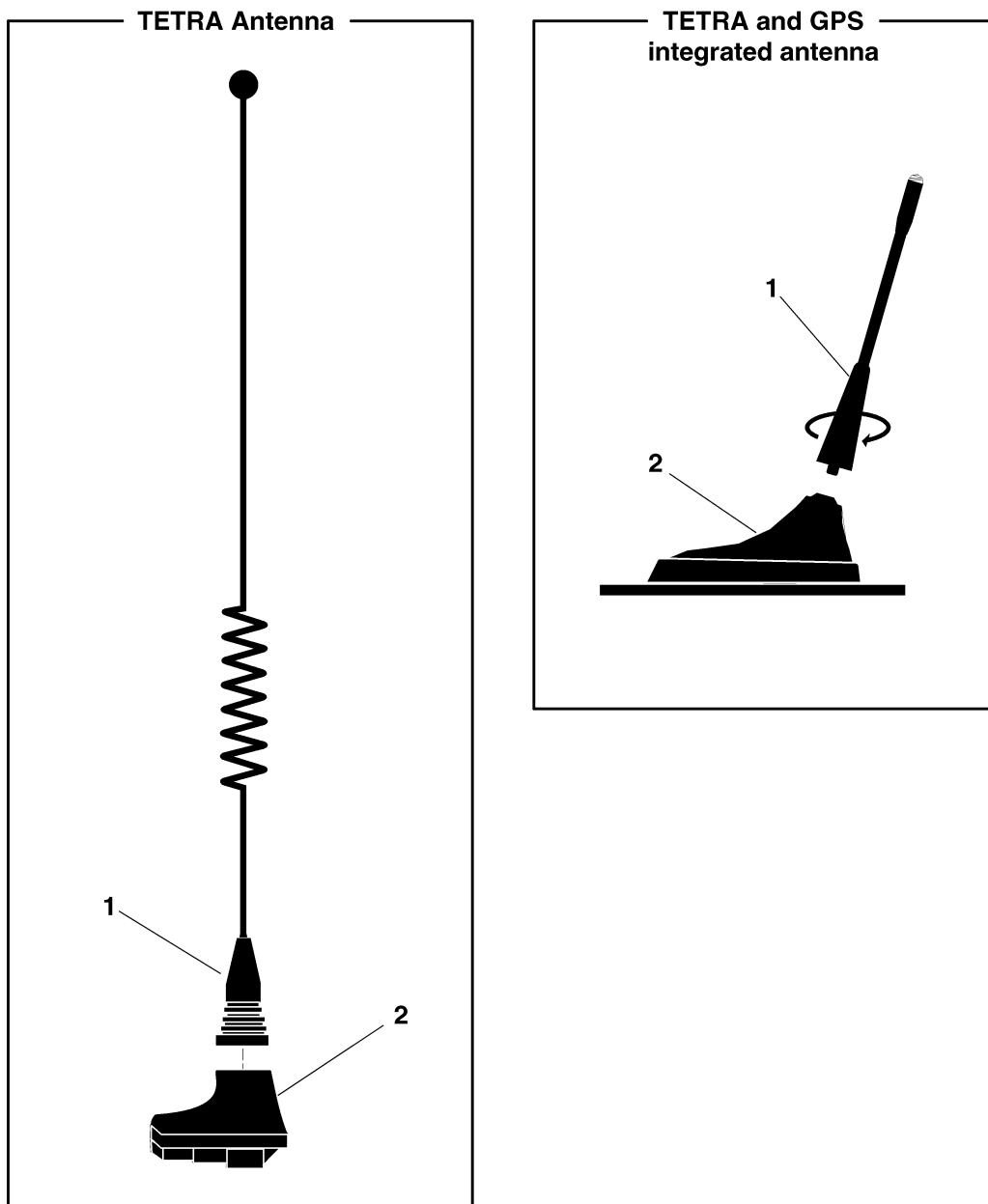
Read all the safety recommendations before proceeding.

- Unscrew the antenna (1, Fig. 1) from the TNC connector (2).
- Check the condition of the connector and, when required, proceed as explained in the preventive maintenance PM-01 form.
- Screw the new antenna on the TNC connector.

NOTE: the GPS antenna is of magnetic anchoring type.

Form number CM-02	Equipment VS4000 Radio System
Page 2/2	

Fig. 1 Antenna replacement



Equipment VS4000 Radio System	Form number CM-03
	Page 1/2

Operation VS4000 radio module replacement	
Required tools - Screw-driver	Consumable materials - Radio module

Periodicity	Maintenance level
Not applicable	I

PROCEDURE



Read all the safety recommendations before proceeding.

- When the car engine is off, switch off the radio system by means the proper button of the front panel.
- Disconnect the positive terminal of the power supply cable from the vehicle battery.
- Disconnect all the cable from the connectors of VS4000 radio module.
- Unscrew the fixing screws of the bracket for VS4000 radio module and remove it from the bracket.

Form number CM-03	Equipment VS4000 Radio System
Page 2/2	

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APPENDIX A: ACCESSORIES

A.1 SUBJECTS TREATED

The characteristics of the vehicular equipment's accessories in this section are given.

A.2 MICROPHONE

The microphone for the VS4000 with PTT is shown in Fig. A.1; its characteristics are reported in Tab. A.1.



Fig. A.1: Microphone MK1B

Tab. A.1: Microphone characteristics

Characteristic	Type/Value
Frequency range	20 to 16000 Hz
Sensitivity	-45 dB \pm 4 dB at 1 kHz
Impedance	< 2.2 K Ω
Operating temperature range	-25 to +55 °C

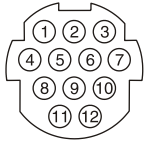
In next figure the microphone connector with waterproof protection plug, is shown.



Fig. A.2: Microphone connector

The connector pinout is referred in next table.

Tab. A.2: Microphone connector pin out

			
Pin	Description	Pin	Description
1	MIC-FG+_CONN	7	ID1_CONN
2	MIC-FG-_CONN	8	RXD-PEI-FG(FRONT)_CONN
3	GND	9	TXD-PEI-FG(FRONT)_CONN
4	PTT-FG_CONN	10	ID2_CONN
5	HOOK_CONN	11	VDC_CONN
6	HEADPHONE_OUT_CONN	12	GND

A.3 LOUDSPEAKER

The loudspeaker, connected to the VS4000 through the Control Panel, is capable of assuring high performance even in very noisy environments, such as a car.



Fig. A.3: Loudspeaker

Tab. A.3: Loudspeaker characteristics

Parameter	Value
Audio power	9 W
Impedance	4 Ω

A.4 VS4000 ANTENNA

The VS4000 system has an omnidirectional antenna.

For the connection between the antenna and VS4000 radio module is used a coaxial cable.

Kind of antenna models are available for the VS4000 Radio System:

- omnidirectional TETRA antenna:

In Fig. A.4 the antennas are shown.

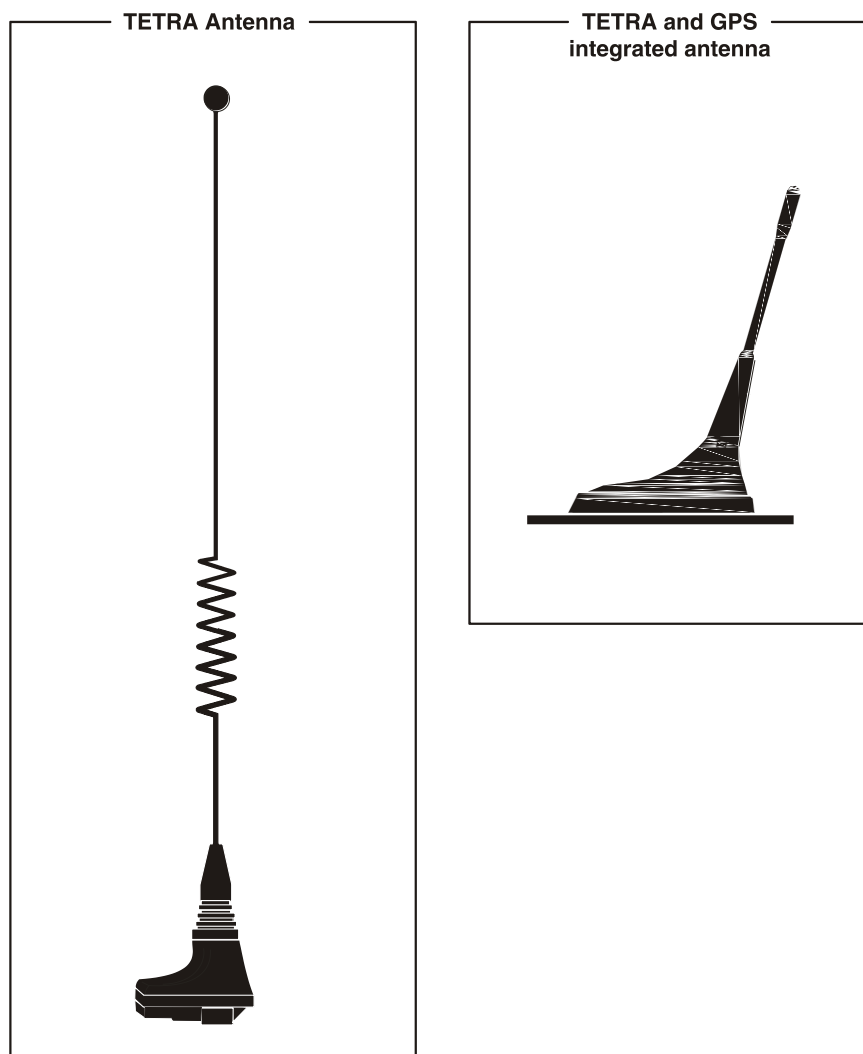


Fig. A.4: Antennas

A.5 MAGNETIC HOOK HANDSET

This accessory is shown in the following figure:

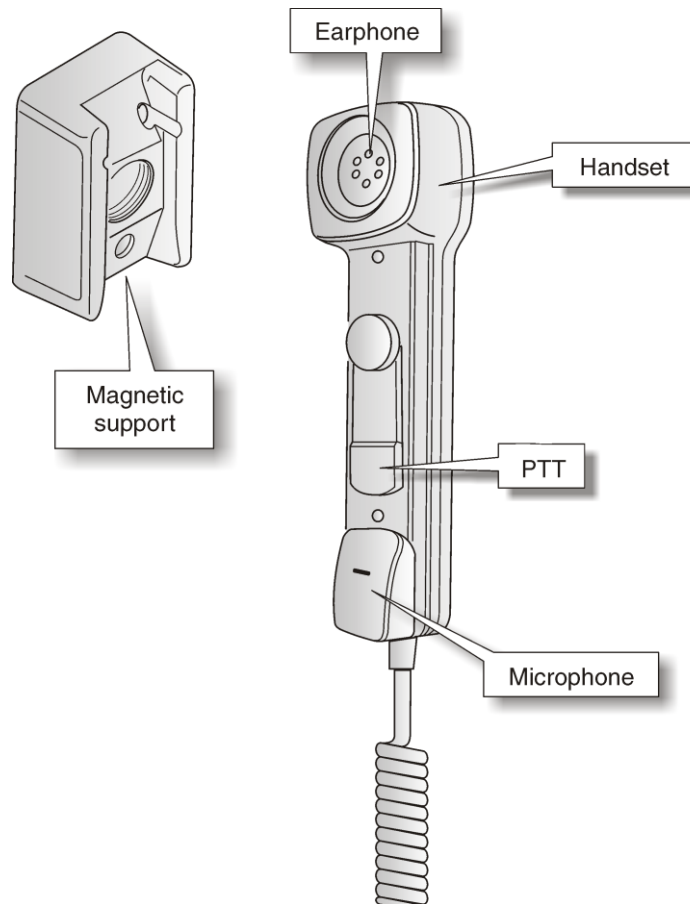


Fig. A.5: Handset

The magnetic support dimensions are reduced and the efficiency is high. It allows to insert the handset from any direction and with the high magnetic attraction force it is suitable to be used in environmental condition compliant with ETS 300 019-2-5 class IEC 5M3 standard.

The water and dust protection is IP54.

The microphone and earphone characteristics are reported on the following tables:

Tab. A.4: Handset characteristics

Microphone Characteristic	Type/Value
Type	Electret, water resistance
Frequency range	200 to 8000 Hz
Power supply	1 ÷ 10V
Current consumption	300 μ A max
Sensitivity	-62 dB \pm 2 dB @ 1 KHz
Impedance	3 K Ω \pm 30% @ 1KHz
Operating temperature range	-30°C +60°C
Earphone Characteristic	Type/Value
Frequency range	500 to 3000 Hz
Sensitivity	-91 dB S.P.L. \pm 2dB @ 1KHz Re: 20 μ Pa
Impedance	200 Ohm \pm 40 Ohm
Operating temperature range	-30 to +65 °C

The connector used is the same showed in Fig. A.2.

A.6 GPS ANTENNA

This is a compact, active, micropatch GPS antenna and it has a magnetic mounting for quick, convenient placement on any suitable Metal surface.

If a metal surface is not available, use the suitable hanger (see Fig A.5) to install the GPS magnetic antenna.

Tab. A.5: GPS antenna characteristics

Parameter	Type/Value
Dimensions	50,5x42x13,8 mm
Weight	115 g (without cable)
Power consumption	15 mA (max)
Mounting	Magnetic
Environment	-40° to +85° with high humidity

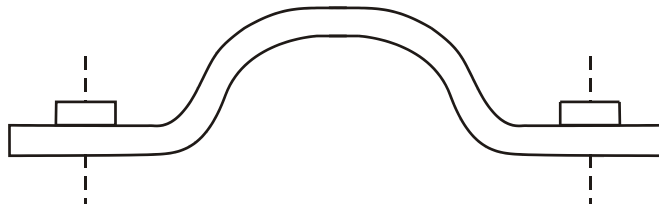


Fig. A.6: Hanger to install the GPS magnetic antenna

A.7 DOWNLOADING KEY ASSEMBLY

The downloading key assemble is a tool for downloading encryption keys.

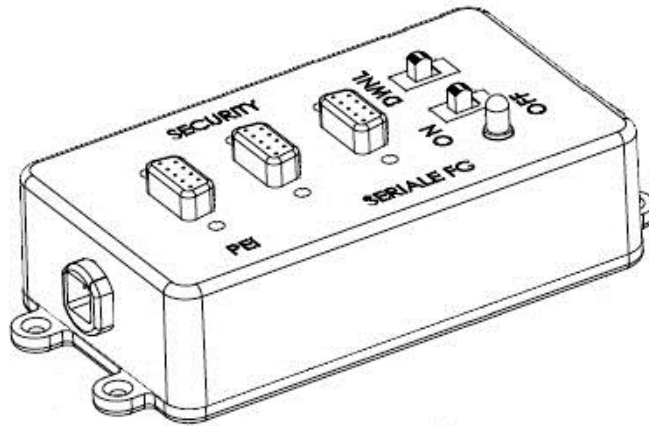


Fig. A.7: Downloading Key Assembly

A.8 HANDSFREE KIT

The handsfree kit includes:

- Cable assembly
- Microphone on the wind screen
- PTT on the wheel

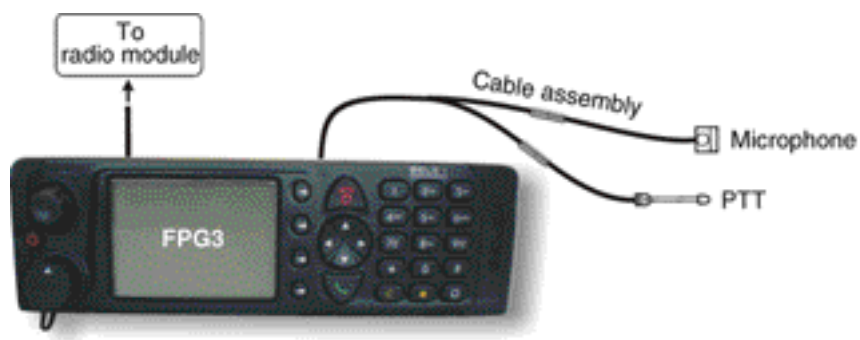


Fig. A.8: Handsfree kit connection scheme

WORDBOOK

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Summary

LIST OF ACRONYMS V

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LIST OF ACRONYMS

4w-E&M	4 wires – Ear & Mouth
A/D	Analogue to Digital
AACH	Access Assignment Channel
AC	Alternate Current
ACCH	Associated Control Channel
ADU	Alarm Display Unit
AGC	Automatic Gain Control
AGP	Accelerated Graphics Port
AMI	Alternate Mark Inversion
AP	Access Priority
API	Application Programming Interface
ARFA	Allied Radio Frequency Agency
ASM	Assembler
ASSI	Alias Short Subscriber Identity
ATA	Advanced Technology Attachment
ATSI	Alias TETRA Subscriber Identity
AUI	Attachment Unit Interface
AVL	Automatic Vehicle Location
AWGN	Additive White Gaussian Noise
B channel	ISDN signalling channel
BB	BaseBand
BBK	Broadcast block
BCCH	Broadcast Control Channel
BER	Bit Error Rate
BLE	Base Link Entity
BNC	Bayonet Neill-Concelman
BNCH	Broadcast Network Channel
BRI	Basic Rate Interface
BS	Base Station
BSCH	Broadcast Synchronisation Channel
BU	Bad Urban
CB	Control (uplink) Burst
CC	Call Control
CCITT	Comité Consultatif International Télégraphique et Téléphonique
CCK	Common Cipher Key
CDB	Configuration Database containing updated information on the status of

	TETRA specific network elements
CENELEC	European Committee for Electrotechnical Standardisation
CEPT	European Conference of Postal and Telecommunications Administrations
CFM	Cubic Feet per Minute
CLCH	Common Linearisation Channel
CLNP	Connectionless Network Protocol
CLR	Central Location Register
CM	Cluster Manager
CMCE	Circuit Mode Control Entity
CO	Central Office
Codec	Coder/Decoder
CONP	Connection Oriented Network Protocol
CoU	Class of Usage – priority levels for scanning lists defined by MS
CPE	Customer Premises Equipment
CPU	Central Processor Unit
CS	Cartographic Server
CTbus	Computer Telephone bus
CTI	Computer Telephony Integration
D channel	ISDN traffic channel
D/A	Digital to Analogue
DAC	Dispatcher Audio Console
DC	Dispatch Console (also Direct Current)
DCE	Data Communication Equipment
DCK	Derived Cipher Key
DGNA	Dynamic Group Number Assignment
DGPS	Differential Global Positioning System (Differential Station)
DID	Direct Inward Dialling
DM	Direct Mode
DMO	Direct Mode Operation
DQPSK	Differential Quadrature Phase Shift Keying
DRAM	Dual Random Access Memory
DS0	Digital Signal level 0 – a 64K/bit digital channel
DSP	Digital Signal Processor
DTE	Data Terminal Equipment
DTMF	Dual Tone Multi Frequency
E&M	Ear & Mouth
e.m.f.	Electro-motive force
ECCH	Extended Control Channel
EEPROM	Electrically Erasable Programmable Read Only Memory
EIDE	Enhanced Intelligent Drive Electronics
EIU	Elementary Interface Unit
EMC	Electro-Magnetic Compatibility

EMI	Electro-Magnetic Interference
ENIA	Enhanced Network Interface ASIC
ERM	Event Reporting Module
ESD	Electro-Static discharge
ESI	Encrypted Short Identity
ETS	European Telecommunication Standard
ETSI	European Telecommunications Standards Institute
EX/CPU	Communications and Control Card
EXS	Expandable Switching System
F/W	Firmware
FACCH	Fast Associated Control Channel
FCC	Federal Communication Commission
FEC	Forward Error Correction
FFS	Flash File System
FIFO	First In First Out (buffer)
FIR	Finite Impulse Response
FM	Frequency Modulation
FPGA	Field Programmable Gate Array
GAL	Gate Array Logic
GB	Guard Band
GCK	Group Cipher Key
GND	Ground
GPS	Global Positioning System
GPSIS	Localization device using the GPSIS (Global Positioning System Information Service)
GPU	Gateway Processing Unit
GSM	Global System for Mobile communications
GSSI	Group Short Subscriber Identity
GTSI	Group TETRA Subscriber Identity
GUI	Graphical User Interface
GW	Gateway
H/W	Hardware
HD	High Density
HDD	Hard Disk Device
HDLC	High Level Data Link Control
HLR	Home Location Register
HPI	Host Port Interface
HPR	Hand-Portable Radio
HSCN	Home Switching and Control Node
I/F	Interface
I/O	Input/Output
IC	Integrated Circuit

IDE	Intelligent Drive Electronics
IEC	International Electrotechnical Committee
IEEE	Institute of Electrical and Electronics Engineers
IPMI	Intelligence Platform Management Interface
ISA	Industry Standard Architecture
ISDN	Integrated Services Digital Network
ISI	Inter-System Interface
ISSI	Individual Short Subscriber Identity
ITSI	Individual TETRA Subscriber Identity
IUSP	Internal Unified Signalling Protocol
K	Authentication Key
LA	Location Address
LAN	Local Area Network
LAPD	Link Access Procedure for the D Channel
LB	Linearisation Burst
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LIP	Localization device using the ETSI-LIP (Location Information Protocol)
LLC	Logical Link Control
LLH	LAPD Link Handler
LMN	Land Mobile Network
LNA	Low Noise Amplifier
LNM	Local Network Management
LRS	Logging Recorder System
LS	Line Station
lsb	Least significant bit
LSC	Local Switching Centre
LSI	Line Station Interface
LTR	Line Transformer Unit
LVD	Low Voltage Differential
MAC	Medium Access Control
MCC	Mobile Country Code
MCCH	Main Control Channel
MER	Message Erasure Rate
MIB	Management Information Base
MLE	Mobile Link Entity
MM	Mobility Manager
MMI	Man Machine Interface
MNC	Mobile Network Code
MPU	Multi-Processor Unit
MRU	Mobile Radio Unit
MS	Mobile Station
msb	most significant bit

MSC	Main Switching Centre
MSCS	Microsoft Cluster Server
MSDB	Mobile Subscriber Database
MT	Mobile Termination
MTBF	Mean Time Between Failures
MTU	Mobile Termination Unit
MUX	Multiplexer
NDB	Normal Downlink Burst
NEIP	Network Element Interface Protocol
NMC	Network Management Centre
NMI	Network Management Interface
NMS	Network Management System
NC	Normally Closed
NO	Normally Open
NRZ	Non Return to Zero
NSAP	Network Service Access Point
NT	Network Termination
NUB	Normal Uplink Burst
NVRAM	Non-Volatile Random Access Memory
O&M	Operations and Maintenance
ODEC	Oil Dispatch Emergency Communications system
OSI	Open System Interconnect
OSPF	Open Shortest Path First
OTAP	Over The Air Programming
p.w.	psophometric weighted
P/N	Part Number
PA	Power Amplifier
PABX	Private Automatic Branch Exchange
PAIP	PSOS Application IP
PAMR	Public Access Mobile Radio
PC	Personal Computer
PC	Protocol Control (also Personal Computer)
PCB	Printed Circuit Board
PCI	Peripheral Component Interconnect
PCM	Pulse Code Modulation
PD	Packet Data
PDN	Packet Data Network
PDO	Packet Data Optimised
PDU	Power Distribution Unit
PDU	Protocol Data Unit (also Power Distribution Unit)
PEB	PCM Expansion Bus
PEI	Peripheral Equipment Interface

PGS	Priority Group Scanning - a mechanism by which an MS simultaneously attaches to a list of MS groups
PICMG	PCI Industrial Computer Manufactured Group
PIN	Personal Identification Number
PLL	Phase Locked Loop
PMR	Private Mobile Radio
PPC	Pre-emptive Priority Call
PPM	Pulse Per Million
PRC	Primary Reference Clock
PRI	Primary Rate Interface
PRP	Programming Package
PSC	Power Supply Card
PSOS+	pS real time operating system
PSTN	Public Switched Telephone Network
PSU	Power Supply Unit
PTN	Private Telephone Network
PTT	Press To Talk
PUK	PIN Unblocking Key
PWR	Power
QS	Quasi Synchronous
R2	Register Trunk Signalling
RA	Rural Area
RAID	Redundant Array of Inexpensive Disks
RAM	Random Access Memory
RD	Read
RF	Radio Frequency
RFDT	Radio Frequency Dispatch Terminal
RM	Resource Manager
RPS	Replay Station or LAN switch Redundant Power System
RPS S/A	Stand Alone Replay Station
RSCN	Regional SCN
RSSI	Radio Signal Strength Indication
RU	Radio Unit (equivalent to MS)
RX	Receive/Receiver
SACCH	Slow Association Control Channel
SAF-TE	SCSI Accessed Fault – Tolerant Enclosures
SAGE	Security Algorithms Group of Experts
SAP	Service Access Point
SB	Synchronisation Burst
SC	Site Controller
SCbus	Signal Computing Bus
SCCH	Secondary Control Channel

SCH	Signalling Channel
SCK	Static Cipher key
SCLNP	Specific Connectionless Network Protocol
SCN	Switching and Control Node
SCSA	Signal Computing System Architecture
SCSI	Small Computer System Interface
SDB	Subscriber Database
SDH	Synchronous Digital Hierarchy
SDM	Short Data Message
SDRAM	Synchronous Dynamic RAM
SDS	Short Data Service
SES	SCSI Enclosure Services
SF	Stealing Flag
SIM	Subscriber Identity Module
SINAD	Signal to Noise Ratio
SNAF	Sub-Network Access Function
SNMP	Simple Network Management Protocol
SRC	Sub-rate Switching Card
SS	Supplementary Service
SSDB	Static Subscriber Database
SSI	Short Subscriber Identity
STCH	Stealing Channel
SVE	SCSI Video Ethernet
SW	Software
SwMI	Switching and Management Infrastructure
SWR	Standing Wave Ratio
SYSINFO	System Information broadcast PDU
TAA1	TETRA Authentication Algorithm 1
TCH	Traffic Channel
TCP/IP	Transmission Control Protocol / Internet Protocol
TDM	Time Division Multiplexing
TDMA	Time Division Multiple Access
TE	Terminal Equipment
TEA1	TETRA Encryption Algorithm 1
TEA2	TETRA Encryption Algorithm 2
TEI	TETRA Equipment Identifier
TETRA	TErrestrial Trunked RAdio
TIA	Telecommunication Industry Association
TIU	TETRA Interface Unit
TMN	Telecommunications Management Network
TMO	Trunked Mode Operation
TMV-SAP	Tetra MAC virtual SAP
TRX	Transmitter/Receiver

TSI	TETRA Subscriber Identity
TSU	TETRA Switching Unit
TTL	Transistor Transistor Logic
TU	Typical Urban
TX	Transmitter
UART	Universal Asynchronous Receiver Transmitter
UDP	User Datagram Protocol
UPS	Un-interrupted Power Supply
V+D	Voice plus Data
VAD	Voice Activity Detection
VASSI	Visitor ASSI
VATSI	Visitor ATSI
VC	Virtual Call
VGA	Video Graphics Array
VGSS	Visitor GSSI
VGTSI	Visitor GTSI
VHDC	Very High Density Connector
VLR	Visitors Location Register
VMR	Vehicle Mounted Radio
VP	Voice Processing
VPN	Virtual Private Network
VR	Vehicle Radio
VSSI	Visitor Short Subscriber Identity
VSWR	Voltage Standing Wave Ratio
WAN	Wide Area Network
WDS	WAN Dispatcher Station for DC
WDT	Watch Dog Timer
WFQ	Weighted Fair Queuing
WPS	Working Profile Subset – a collection of group identities stored in the Mobile Station (MS-DB)
WR	Write
wrt	with respect to

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