

# FSG 90 FSG 90-H1

## Dual Mode VHF/AM Airband-Transceiver

118.000 ... 136.975 MHz  
6 Watt / 10 Watt  
8.33kHz / 25 kHz channel spacing



ETSO:

FAA:

BAF:

FC FCC ID:

CE 0682 ⓘ

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D-0036/2014 (FSG90)

D-0037/2014 (FSG90-H1)

BVYFSG90

## Installation & Operation

applies for FSG 90 (6 W)

applies for FSG 90-H1 (10 W)

article no. F10185

article no. F10302

*Before installing and operating the transceiver, please read  
this manual thoroughly!*

*Please observe the Safety Information!*

*Keep for further use!*

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## Manual Revision History

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Retain this list in the front of the Installation & Operation  
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| <i>Revision<br/>Dittel</i> | <i>Reason for change</i>                                                                                                                                      | <i>Date</i>       |
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| <b>3.00</b>                | <b>Changes according to requirements by<br/>Bundesaufsichtsamt für Flugsicherung (BAF)</b>                                                                    | <b>19.12.2014</b> |

## Abbreviations

|       |                                                  |       |                                                                                                    |
|-------|--------------------------------------------------|-------|----------------------------------------------------------------------------------------------------|
| A/C   | Aircraft                                         | NM    | Nautical miles                                                                                     |
| A/N   | Article Number<br>(f.u.n.k.e. AVIONICS)          | nW    | Nanowatt ( $10^{-9}$ )                                                                             |
| AGC   | Automatic Gain Control                           | PEP   | Peak Envelope Power                                                                                |
| Ah    | Ampere hour                                      | PLL   | Phase-Locked Loop                                                                                  |
| AM    | Amplitude Modulation                             | ppm   | parts per million                                                                                  |
| ANT   | Antenna                                          | PTT   | Push-To-Talk                                                                                       |
| Ass'y | Assembly                                         | pW    | Picowatt ( $10^{-12}$ )                                                                            |
| AWG   | American Wire Gauge                              | PWR   | Power                                                                                              |
| ccw   | Counterclockwise (turn left ↺)                   | RF    | Radio Frequency                                                                                    |
| CH    | Channel                                          | rms   | Effective value (root mean square)                                                                 |
| CTS   | Ready-to-Transmit                                | RTS   | Invitation to send                                                                                 |
| cw    | Clockwise (turn right ↻)                         | RX    | Receive                                                                                            |
| dB    | Decibel                                          | RxD   | Receive data                                                                                       |
| dia.  | Diameter                                         | S+N/N | Signal-to-Noise Ratio                                                                              |
| EMF   | Electromotive Force (voltage of an open circuit) | SINAD | Ratio: $\frac{\text{Signal} + \text{noise} + \text{distortion}}{\text{noise} + \text{distortion}}$ |
| F/CH  | Frequency/Channel                                | SPKR  | Loudspeaker                                                                                        |
| FL    | Flight Level                                     | SQ    | Squelch                                                                                            |
| g     | Acceleration due to gravity                      | STBY  | Standby                                                                                            |
| GND   | Ground                                           | STO   | Store                                                                                              |
| HI    | High Power                                       | SWR   | Standing-Wave Ratio                                                                                |
| Hz    | Hertz                                            | TOT   | Time out timer                                                                                     |
| ICAO  | International Civil Aviation Organization        | TX    | Transmit                                                                                           |
| IF    | Intermediate Frequency                           | TxD   | Transmit data                                                                                      |
| kHz   | Kilohertz                                        | VCO   | Voltage-Controlled Oscillator                                                                      |
| LCD   | Liquid Crystal Display                           | Vdc   | Volts, direct current                                                                              |
| LED   | Light Emitting Diode                             | VHF   | Very-High Frequency                                                                                |
| LO    | Low Power                                        | VOL   | Volume                                                                                             |
| LOS   | Line-Of-Sight                                    | VSWR  | Voltage Standing-Wave Ratio                                                                        |
| m     | Modulation                                       | W     | Watt                                                                                               |
| mA    | Milliamperes                                     | Ω     | Ohm                                                                                                |
| MD    | Mode                                             | °C    | Degrees Centigrade                                                                                 |
| MHz   | Megahertz                                        | °F    | Degrees Fahrenheit                                                                                 |
| MIC   | Microphone                                       |       |                                                                                                    |
| mW    | Milliwatt                                        |       |                                                                                                    |

## 1 Safety Information

Every radio, when transmitting, radiates energy into the atmosphere that may, under certain conditions, cause the generation of sparks. All users of our radios should be aware of the following warning:

**Do not operate this radio in an explosive atmosphere (petroleum fuels, solvents, dust, etc.)!**

During normal use, the radio will subject you to radio energy substantially below the level where any kind of harm is reported.

### TO ENSURE PERSONAL SAFETY,

please observe the following simple rules:

- **DO NOT** transmit when the antenna is very close to, or touching, exposed parts of the body, especially the face and eyes.
- **DO NOT** transmit on a busy channel.
- **DO NOT** press the transmit (PTT) key when not actually desiring to transmit.
- **DO NOT** transmit in closed aircraft or vehicles with the antenna inside the cabin. This may cause malfunction of the avionics or trigger the airbag! Always operate the radio **FSG 90(X)** with a suitable outside / external antenna! Assure appropriate lightning protection where elevated outdoor antennas are used.
- **DO NOT** operate the radio whilst driving. Notice that the use of a hand held microphone while driving could constitute an offence under the Road Traffic Regulations in certain countries.
- **DO NOT** allow children to play with any radio equipment containing a transmitter.
- **DO NOT** call radio's SET-UP in flight or whilst driving a vehicle. Transmit and receive are partially disabled!
- After each SET-UP check all settings of the radio and cockpit instruments for correct function before the next flight or application!
- Always turn OFF the radio first (to turn OFF the radio rotate the **ON/OFF-VOL** knob fully counterclockwise to the dot position).
  - before switching on or switching off the power source
  - before installing the unit into vehicles, aircraft or carrier cases or when removing from it!
  - before starting an engine or vehicle!
- When operating the **FSG 90(X)** on a 24/28 Vdc source use a suitable Voltage Converter 24 Vdc/12 Vdc of at least 5 Amps!
- Use the **FSG 90(X)** exclusively for communication on the airband frequencies.

- Unauthorized modifications and changes of the system **are forbidden**.
- When replacing defective parts use only original spare parts or standard parts recommended by the manufacturer!
- In aircraft or vehicles, use a suitable noise cancelling microphone or headset for aircraft radios.
- Always carry a backup microphone during any flight. Even new microphones can fail.
- Volume is very important. Increasing speaking levels while the lips are facing the microphone, but not straining or pushing to yelling levels will increase clarity.
- Prior to any flight, verify proper **FSG 90(X)** functions by means of a short communications test. It has to be taken into account that with a faulty antenna or cable this COM test may absolutely turn out positive at the airfield or in short distance to the ground station. However, at a distance of 2 to 6 miles faulty antenna and/or cables will cause communication breakdown!
- Push-to-Talk keys may stick occasionally. Therefore, observe while transmitting the transmit (TX) symbol at the **FSG 90(X)** display. This TX symbol must disappear when releasing the PTT key. After 2 minutes continuous TX the built-in transmit time out timer disables the transmitter in order to avoid continuous channel blocking. Then, the whole display warns by continuous flashing. Refer to appropriate hints in this manual.
- Replace blown fuse only against correct type with specified nominal value. Investigate the cause.

In this manual the following symbols are used:



**DANGER!**

*describes an immediate threatening danger! Failing to observe the note may cause death or heaviest injuries.*



**CAUTION!**

*describes a special note for operation. Failing to observe the note may cause damage of the transceiver and/or stored data may be deleted!*



**IMPORTANT!**

*describes explanations and other useful hints. Failing to observe the note may cause degraded performance and/or unsatisfying operation!*

## **2 General Description**

### **2.1 Introduction**

This installation and operating manual IM 031.00 contains instructions and descriptions for application, installation, pre-setting operation and testing, as well as interconnecting diagrams of the multi-use **FSG 90 VHF/AM Transceiver System** of f.u.n.k.e. AVIONICS GmbH, 86807 Buchloe, Germany.

### **2.2 Models of the FSG 90 System**

This manual refers to 2 out of 8 models available up to now.

#### **A/N F10185, VHF/AM Dual Mode Airband Transceiver FSG 90**

Frequency range: 118.000 to 136.975 MHz, channel spacing 8.33 kHz/25 kHz, results in 2,278 channels, and 118.000 to 136.975 MHz, channel spacing 25 kHz, results in 760 channels. Ninety-nine (99) channel memories for combined 8.33/25 kHz mode, additional 99 memory channels for '25 kHz only' mode, **6 W RF carrier output power**, 10 - 16.5 Vdc supply. The radio will fit a standard 58 mm dia. / 2¼" dia. instrument panel.

**IDENT.: MODEL 90-25/8.33 (ED-23B CLASS C / CLASS E RECEIVER, CLASS 4 / CLASS 6 TRANSMITTER).**

#### **A/N F10302, VHF/AM Dual Mode Airband Transceiver FSG 90-H1**

Frequency range: 118.000 to 136.975 MHz, channel spacing 8.33 kHz/25 kHz, results in 2,278 channels, and 118.000 to 136.975 MHz, channel spacing 25 kHz, results in 760 channels. 99 channel memories for combined 8.33/25 kHz mode, additional 99 memory channels for '25 kHz only' mode, **10 W RF carrier output power**, 10 - 16.5 Vdc supply. The radio will fit a standard 58 mm dia. / 2¼" dia. instrument panel.

**IDENT.: MODEL 90-25/8.33-H1 (ED-23B CLASS C / CLASS E RECEIVER, CLASS 4 / CLASS 6 TRANSMITTER).**

### **2.3 Application**

The equipment is well suited for operation in powered aircraft and helicopter with reciprocating turboprop and turbojet engine.

Ultra low power consumption in conjunction with extremely wide DC supply voltage range, small dimensions and wide scope of accessories allow universal airborne applications in any powered aircraft, motor glider and Ultralight, and in glider and balloon, for primary or (also battery supplied) backup operation.

Universal use also in ground vehicle, as well as for compact portable cases and for desktop or rack mounted, local or remote controlled, fixed base primary, or (also battery supplied) backup operations, are further applications. Please always ensure suitable antenna solutions!

Retrofit installation is achieved against former panel mounted slide-in VHF COM transceivers **FSG 40A**, **FSG 40S**, **FSG 50**, **FSG 60M**, and panel mounted **FSG 70**, **FSG 71M** using adapters.

## 2.4 Brief Description

The two radios out of the **FSG 90 System** are miniaturized, lightweight, panel mounted single block VHF/AM transceivers operating in the airband frequency range 118.000 MHz ... 136.975 MHz. They provide either 2,278 channels with 8.33 kHz/25 kHz channel spacing, plus 760 channels with '25 kHz only' channel spacing, covering a standard communications distance of 100 NM (nautical miles) at FL 70.

Case dimensions of all models will fit into a standard 2¼ in. / 58 mm diameter opening of the instrument panel or console (behind panel installation), using four (4) screws. Depth including wiring is 230 mm.

All control and display elements are located on the front panel. Connections to the electrical environment are made through a 25-pole D-SUB connector and a BNC female connector at the rear panel of the units.

The ICAO channel name (8.33 kHz/25 kHz spacing) and operating frequency (25 kHz spacing), supply indicator, transmit indicator, channel memory number and SET-UP information are all indicated at a two-line Liquid Crystal Display (LCD, can be back-lit).

Three operating/display modes are user selectable:

- **Use/STBY Mode:** Active channel name or frequency, selectable standby channel name / frequency
- **Channel Mode:** Active channel name or frequency, associated pre-set channel memory number (1 ... 99)
- **Direct Tune Mode:** Active channel name or frequency only.

With the Dual Mode models **FSG 90(X)** up to 99 channel memories in 8.33 kHz / 25 kHz CH spacing (6-digit display), and another set of up to 99 channels in the '25 kHz only' CH spacing (5-digit display) can be pre-set. After change to the other operating mode (from 8.33/25 kHz to 25 kHz only, or from 25 kHz to 8.33/25 kHz), each stored set of up to 99 channel memories remains available.

Preset channel memories remain available also after manual or automatic power-off.

The non-volatile channel memories of all **FSG 90(X)** can easily be reprogrammed also during flight or ground operation.

Programming can be done in the actual mode. Deleting channel memories is possible in each mode (only during SET-UP mode).

For ground applications, limitation to use pre-set channel(s) only can be determined in (password protected) SET-UP.

Channel name / frequency, or pre-set channel memories are selected with the dual function **F/CH** switch.

Both Transmit and Receive use the same digital frequency synthesizer and one temperature calibrated reference crystal (accuracy 1 ppm in the temperature range from 0°C to +40°C/32°F to 104°F).

The dual superhet receiver offers very high immunity against in-band and out-of-band interference and intermodulation (Annex 10 FM immunity).

The automatic AM/FM Squelch (threshold adjustable in 4 levels, SET-UP) and the normally active transmitter blocking during Receive are disabled by pushing the **SQ** button, and enabled when the **SQ** button is pushed again.

An audio low pass filter for areas using Climax operation in 25 kHz spacing is incorporated.

Separate Audio amplifiers power the speaker (4 Watts / 4 Ohms or 8 Watts / 2 Ohms), and the headphones (100 mW / 600 Ohms).

The solid-state transmitter is wideband tuned from 118 to 137 MHz and delivers at least an RF carrier power of 6 Watts or 10 Watts for the **FSG 90-H1** model.

Transmit frequency / channel name is tuned simultaneously with Receive frequency / channel name (Simplex operation).

A keyed transmitter is indicated by a transmit symbol at the LC display.

Two independent microphone inputs (separate pins) allow universal accessory operation:

- For powered aircraft use Standard Carbon, amplified Dynamic or Electret microphones,
- For gliders, portable, vehicle mobile and fixed base operation use non-amplified Dynamic microphones.

The microphone inputs may also be continuously activated. This allows in Receive continuous intercommunication (no additional accessories needed) between pilot and crew (intercom wiring harness), using headsets.

A separate AF input allows interconnection of external audio source(s) especially in aircraft using other COM, VOR/LOC, DME, MKR and/or electric variometers. This allows signal monitoring during Receive by speaker and/or headphone.

30 mA current consumption saving can be achieved in standby mode (Squelch ON), when the **FSG 90(X)** is used e.g. in portable cases or installations, where no external audio is required for speaker output. However listening through the headphone remains possible. This external AF OFF function may be selected in SET-UP. This reduces the standby current consumption to only 85 mA and will extend battery supplied operating time significantly.

The transceiver can be supplied either directly from a 12 - 14 Vdc A/C bus, or through a suitable DC regulator from 28 Vdc-buses.

In aircraft (or portable cases) without on-board electric power generation system (UL, Glider etc.), operation from a 12 Vdc battery (min. 6 Ah) is suitable.

The DC supply voltage is monitored automatically. When supply drops below 11 Vdc, the Supply Indicator at the LC display starts blinking as a low supply warning.

Below 8.5 to 9.5 Vdc, the **FSG 90(X)** turns OFF itself automatically, and will resume operation with supply above 9.5 to 10 Vdc. The last used settings remain active.

A voice processor is incorporated to achieve identical acoustic voice quality during Transmit and Receive, as well as Audio Levelling in Receive, and in addition prevents overmodulation. Usual testing employs sinusoidal tone signals only; this feature especially considers the specific characteristic of the voice. It ensures also VERY HIGH

AVERAGE DEPTH OF MODULATION of some 80% AM, causing transmission signals sounding normal and very strong.

The radios are equipped with a time out timer. This avoids blocked channel after 2 minutes continuous TX (stuck button does no longer block a channel continuously) and is indicated by a continuously blinking display. Should the malfunction continue the **FSG 90(X)** is ready for another 2 minutes transmission period when turning OFF and ON again (e.g. for emergency transmissions).

The transmitter blocking feature avoids transmission on a busy channel. Transmitter blocking is usually active, but may be disabled permanently in SET-UP or manually by pushing the **SQ** button.

## 2.5 System and Type Approval Information

The Dual Mode VHF/AM Airband Transceivers **FSG 90** and **FSG 90-H1** comply for both, the combined 8.33 kHz/25 kHz as well as "25 kHz only" channel spacing, with all applicable National and International Type Approval requirements, for any airborne and ground operations.

- JTSO Authorization No. LBA.O.10.911/98 ETSO (LBA Luftfahrt-Bundesamt) based on \*EUROCAE ED-23B Airborne requirement is met besides 8.33 kHz requirements also for the 25 kHz ONLY channel spacing. This JTSO Authorization was replaced by ETSO Authorization EASA.210.1305 in July 2009.

This also includes Immunity according to ICAO ANNEX 10 against FM Broadcast Interference.

This also includes fulfilment of specific audio filtering required in areas with CLIMAX operation in 25 kHz channel spacing.

\* Associated EUROCAE ED-14C / RTCA DO-160C Environmental requirements.

\* Associated EUROCAE ED-12B Software requirements based on ED-23B.

- Compliant to BAF requirements according to German FSMusterZuIV, EU Regulations 552/2004 and 1079/2012.
- BZT No. B132705J, CE Conformity,
  - \* Associated with DIN/ISO 7637-1 DC supply in 12 Vdc vehicle.
- FCC Compliance with Part 15 (receiver) and Part 87 (transmitter)
- EC-Type-Approval of a type of component with regard to Directive 72/245/EEC, as last amended by Directive 2006/28/EG.



### **IMPORTANT!**

- ***For the first time after one year, then every 2<sup>nd</sup> year, ground applications using 8.33 kHz channel spacing require checking of the high precision reference frequency (tolerance less than  $\pm 1$  ppm) and recalibration, if necessary!***
- ***Every 4<sup>th</sup> year, airborne applications using 8.33 kHz channel spacing require checking of the high precision reference frequency (tolerance less than  $\pm 5$  ppm) and recalibration, if necessary!***
- ***All applications in the 25 kHz channel spacing require no recalibration (frequency accuracy tolerance less than  $\pm 20$  ppm).***
- ***All tolerances include the full operating temperature range of -20°C ... +55°C / -4°F ... +131°F.***
- ***Checking and recalibration must be performed by the equipment manufacturer or through authorized and approved avionics services. This requires use of specified test equipment as well as applicable test procedures (software) released by the manufacturer.***

## 2.6 Operating License



### **IMPORTANT!**

- *Depending on national regulations, VHF/AM airborne and VHF/AM ground operation may require an individual national operating license. Such license is usually granted by the responsible National Telecommunications Authority, using suitable application forms.*
- *Besides aircraft registration, operator's name, address and operating license payment details, state radio type, Serial number, ETSO number EASA.210.1305, and RegTP number A132937J, or when applicable, the FCC ID number BVYFSG90.*

## 2.7 Equipment supplied

| Description                                                                                                                                              | Article number |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Dual Mode 6 Watt VHF/AM Transceiver FSG 90</b> , Installation and Operation manual, Operating instructions, 4 screws M 4 x 12, Warranty 24 months     | <b>F10185</b>  |
| <b>Dual Mode 10 Watt VHF/AM Transceiver FSG 90-H1</b> , Installation and Operation manual, Operating instructions, 4 screws M 4 x 12, Warranty 24 months | <b>F10302</b>  |

## 2.8 Optional Accessories

Wide accessory scope allows **FSG 90(X)** installation and operation into aircraft, in ground systems; fixed, portable and mobile into vehicles.

Slide-in replacement adapters allow easy **FSG 90(X)** retrofit against former transceivers FSG 18, FSG 40S, FSG 50, FSG 60M, using existing installations.

| Description                                                                                                                                                                                      | Article no |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Retrofit adapter, ready mounted – to replace <b>FSG 70/71M</b>                                                                                                                                   | F10318     |
| Retrofit adapter, ready mounted – to fit into mounting tray of <b>FSG 50/60M/40S/18</b>                                                                                                          | F10315     |
| Retrofit adapter, ready mounted – to replace mounting tray of <b>FSG 50/60M/40S/18</b> , fixing holes left and right                                                                             | F10317     |
| Connector kit, D-SUB 25-pin, incl. mounting hardware                                                                                                                                             | F10212     |
| BNC antenna connector, solder type                                                                                                                                                               | E08980     |
| Wiring harness, 2.9 m/9.5 ft., complete with all connectors                                                                                                                                      | F10189     |
| Intercom wiring harness, 2.9 m/9.5 ft., complete with IC switch                                                                                                                                  | F10190     |
| Aircraft loudspeaker 4 $\Omega$ / 30 Watt, small, robust case, two 5-pole sockets to connect 2 microphones or headsets, terminal for PTT key, fits harness F10189 or F10190,                     | F10061     |
| Dynamic headset, noise cancelling, coiled cord, 4-pole plug U-174/U                                                                                                                              | W00048     |
| Adapter cable for headset W00048, to fit F10061 A/C speaker                                                                                                                                      | F10036     |
| Dynamic goose neck microphone 600 $\Omega$ , 3 m/9.8 ft. cable, 5-pole connector, especially for gliders and motor gliders                                                                       | F10039     |
| Dynamic microphone, for PC portable, and for car mobile use, coiled cord, PTT key, 5-pole plug                                                                                                   | F10041     |
| Retaining bracket, fits microphone F10041                                                                                                                                                        | E24907     |
| Dynamic fist microphone, 500 $\Omega$ , coiled cord, PTT key, 5-pole plug                                                                                                                        | F10346     |
| Microphone bracket, to keep microphone F10346                                                                                                                                                    | W00087     |
| Dynamic microphone-loudspeaker, coiled cord, PTT key, 5-pole plug, sealed                                                                                                                        | F10042     |
| PTT key, 3.5 m/11.5 ft. cable, permanent installation on the yoke                                                                                                                                | F10050     |
| Inline PTT key U-94A/U, coiled cord, 5-pole plug, mates A/C speaker F10061 or Portable Cases PC / PS and headset A/N W00048, clip allows attaching to clothing                                   | F10125     |
| Battery Box, 12 Vdc/7.2 Ah lead battery, sturdy steel/aluminium case, mounting plate for quick removal, 6.3 A circuit breaker, 5-LED battery test set, 3-pole DIN socket, mating 3-pole DIN plug | F10382     |
| Automatic battery charger DL-50A, 115/230 Vac. Output 13.8 Vdc / 600 mA. For all airborne and portable 12 V lead batteries                                                                       | F10385     |
| Car mounting bracket                                                                                                                                                                             | F10058     |

## **2.9 Equipment required but not supplied**

- a) VHF aircraft antenna with coax cable RG-58C/U and BNC connector (Male)
- b) Headphone (8 ... 600 Ohms, typical) and/or loudspeaker (2 ... 16 Ohms)
- c) Non-amplified dynamic microphone, (4 ... 600 Ohm),  
or amplified/carbon microphone (amplified dynamic or Electret mike), with or without PTT key (separate mike inputs amplified/non-amplified)
- d) Alternatively to b) and c) headsets with similar specifications
- e) Battery Box 12 Vdc, minimum 6 Ah, for aircraft without electrical system
- f) Push-to-talk key permanently installed on yoke (if microphone w/out PTT key is used)
- g) 25 pole D-SUB connector type DA-25 S and cover, if no pre-manufactured wiring harness exists.

## **2.10 Information on Equipment Reliability**

For use of the equipment as a ground-based radio station under normal operating conditions (0° - 40°C operating temperature), a Mean Time Between Failure (MTBF) of > 9,600 hours was calculated (according to MIL-HDBK-217F).

Mean Time to Repair (MTTR) will depend on shipment times. A standard turn-around time for factory repairs will be approx. 2 weeks.

## **2.11 Microphone hints**



### **IMPORTANT!**

- a) *Radio system reliability and performance significantly depends on quality acoustic accessories.*
- b) *Extremely high performance requirements - especially for 8.33 kHz Technology - demand after installation completion proper acoustics levelling through SET-UP in order to maintain best radio capability. Therefore, please do not use low performance acoustics accessories.*
- c) *Dynamic microphone requires shielded wiring. Essential requirement is consequent separation of microphone ground / shield from any other ground. This means, dynamic mike ground / shield must be separated from any other grounds for DC input and DC output, AF input and AF output like speaker, phone, PTT and external AF input. Other grounds for DC input and output, speaker, phone, PTT and external AF may be connected together with the amplified mike ground.*
- d) *Amplified microphones may contain dynamic or Electret acoustics transducers.*
- e) *Always ensure IDENTICAL microphones are used for parallel operation. Similar requirements are applicable for headphone characteristics.*
- f) *Always ensure that during SET-UP all of the many **FSG 90(X)** functions are adjusted to achieve optimized radio system performance.*
- g) *Operation of amplified microphone systems close to the radiating antenna (portable case or located right behind of the cockpit) may be influenced from strong antenna RF field strength and become unstable, oscillates, or causes modulation distortion. Verify this effects -possible caused by- by RF replacing the radiating antenna against artificial antenna / RF dummy load temporarily*

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## **3 Installation**

### **3.1 General**

This Section contains instructions and suggestions to be considered before installing the radio **FSG 90(X)** into an aircraft. Close adherence to these suggestions will assure more satisfactory performance from the equipment.

Information in this section is intended for certified avionics shops only. Work such as installation, wiring and testing should only be carried out by a qualified technician!



#### **IMPORTANT!**

- *If installation into an aircraft is made by other than a certified avionics shop, you have to consult your responsible Aircraft Avionics Airworthiness Inspector - before the installation – to get authorized certification of your completed installation.*
- *The conditions and tests required for **ETSO** and **FAA-TSO** approval of this article are minimum performance standards. It is the responsibility of those desiring to install this article either on or within a specific type or class of aircraft to determine that the aircraft installation conditions are within the **ETSO** or **FAA-TSO** Standards. If not within the **ETSO** or **FAA-TSO** standards, the article may be installed only if further evaluation by the applicant documents an acceptable installation and is approved by the Administrator.*

### **3.2 Unpacking and Inspecting Equipment**

Unpack the equipment carefully and inspect each item for evidence of damage incurred during shipment. **FSG 90** model number and serial number must comply with relevant details mentioned in Airworthiness Approval Tag and delivery note details attached to the shipment.

If a damage claim must be filed, save the shipping container and all packing materials to substantiate your claim. The claim should be filed with the transportation company as soon as possible.

If a damage is noted after the first test, notify the transportation company in writing with advance phone or fax advice about hidden transport damage.

A copy of such a claim including all information from the type label is to be forwarded immediately also to f.u.n.k.e. AVIONICS GmbH.

### **3.3 Pre-installation Test**

Before installing the radio into an aircraft, vehicle or portable carrying case, a short but comprehensive functional test by a certified avionics shop is recommended.

- a) Interconnect the radio with a test wiring harness (according to figure 3-1 or 3-2) to the test bench set-up. For **FSG 90** set supply to 13.8 Vdc at radio input terminals. For **FSG 90-H1** set supply to 14.0 Vdc at radio input terminals. Turn ON the radio with the **ON/OFF-VOL** switch on front panel. Switch OFF the Squelch (push **SQ** button).

- b) In Receive Mode set the VOL control to mid position. On all channels within 118 ... 136.975 MHz, almost identical, strong, continuous acoustic noise must be audible.
- c) Receiver sensitivity on all channels must comply with technical data (make sensitivity tests to cover the whole frequency range).
- d) Switch ON the Squelch (push **SQ** button again). The squelch threshold (depending on SET-UP pre-setting) shall be within 0.5  $\mu$ V and 5  $\mu$ V / 50 Ohms (vary signal generator output level).
- e) Connect a 50-Ohm Wattmeter and a 20 or 30 dB throughline RF attenuator pad. Key the transmitter and check RF output level (more than 6 W carrier or more than 10 W carrier for **FSG 90-H1** model).
- f) Adjust audio generator to 1,000 Hz (via attenuator for dynamic microphone or directly via decoupling capacitor) connected to  
**Amplified/Carbon Microphone Input**  
 With 100 mV rms input, the transmitter shall achieve more than 70% AM. Increase AF input to 1.0 V rms, observe modulation envelope, no overmodulation shall occur; depth of modulation must remain less than 95% AM.  
**Dynamic Microphone Input**  
 With some 1 mV rms input, the transmitter shall achieve more than 70% AM (depending on SET-UP pre-setting). Increase AF input to 10 mV rms and observe modulation envelope. No overmodulation shall occur; depth of modulation must remain less than 95% AM.

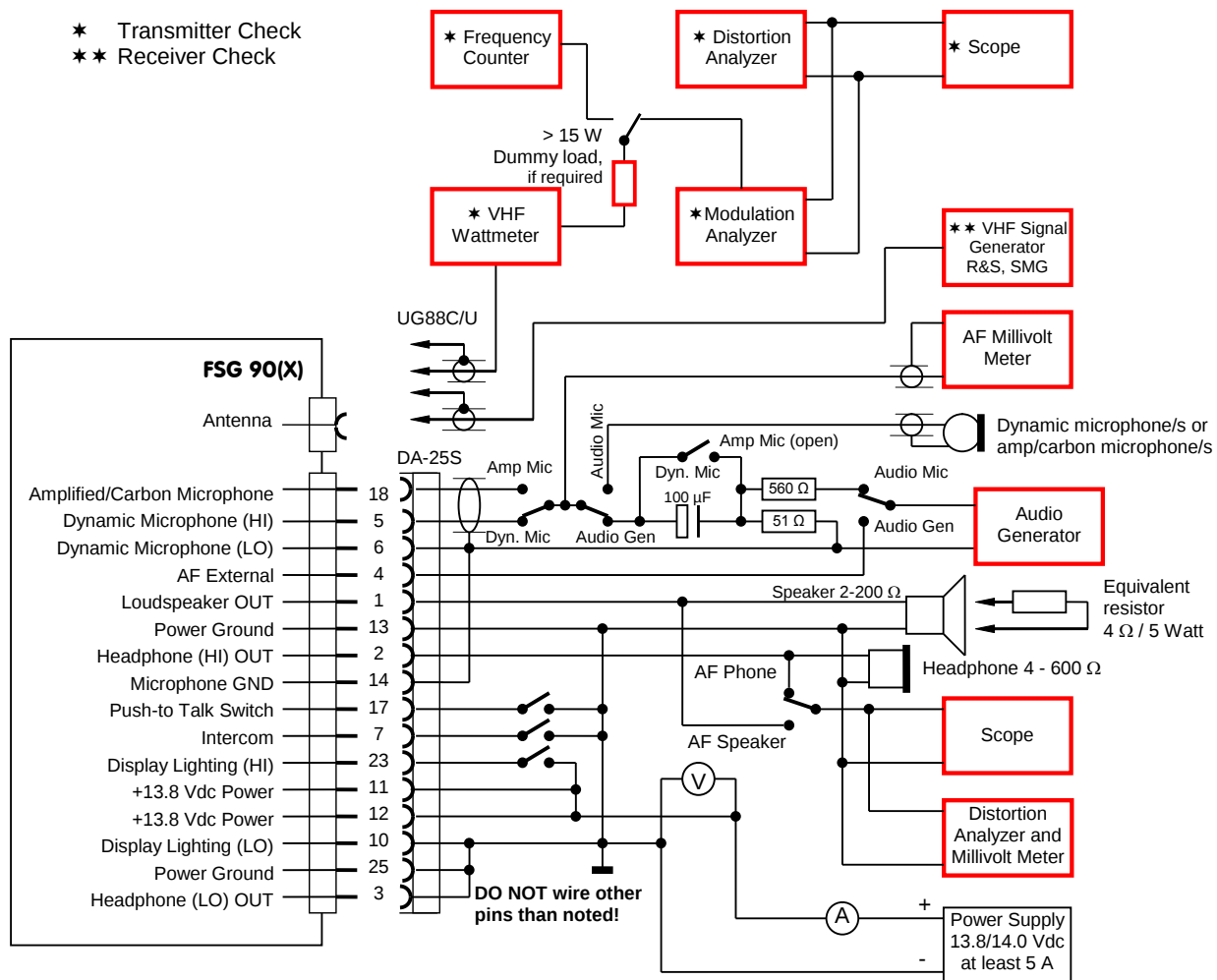
### 3.4 Particular Remarks to FSG 90(X) transmitter modulation

For the combined 8.33 kHz and 25 kHz channel spacing airband radio technology, highly demanding, and specific requirements shall be comprehensively considered as follows:

1. Voice modulation with its typical dynamic peaks (fast and large level changes) shall modulate the transmitter with peak AM depth of less than 85%.
2. Factory setting of the very specific **FSG 90(X)** voice processor results in a remarkable AVERAGE of approximately 80% AM depth (voice and Sine modulation!). Thus, optimized usage of the RF carrier is achieved.
3. Do not change this setting, otherwise the stringent Transmitter Spectrum Mask is no longer maintained.
4. The **FSG 90 System** incorporates a special VOICE PROCESSOR, which is matched best to meet the requirements of the particular environmental noise level situation.
  - a) This ensures a always loud and clear transmitter modulation, under consideration of specific test requirements.
  - b) Due to the voice processor voice signal transfer is IDENTICAL in both the 8.33 kHz and in the 25 kHz channel spacing mode.
  - c) Even under these very specific conditions, fulfilment of the critical, highly demanding Spectrum Mask is achieved.
5. Although due to the specific voice processor compression of modulation peaks, when tested with maximum sine wave modulation signal, a conventional testing of "standard modulation distortion measurements" is possible. This does however refer

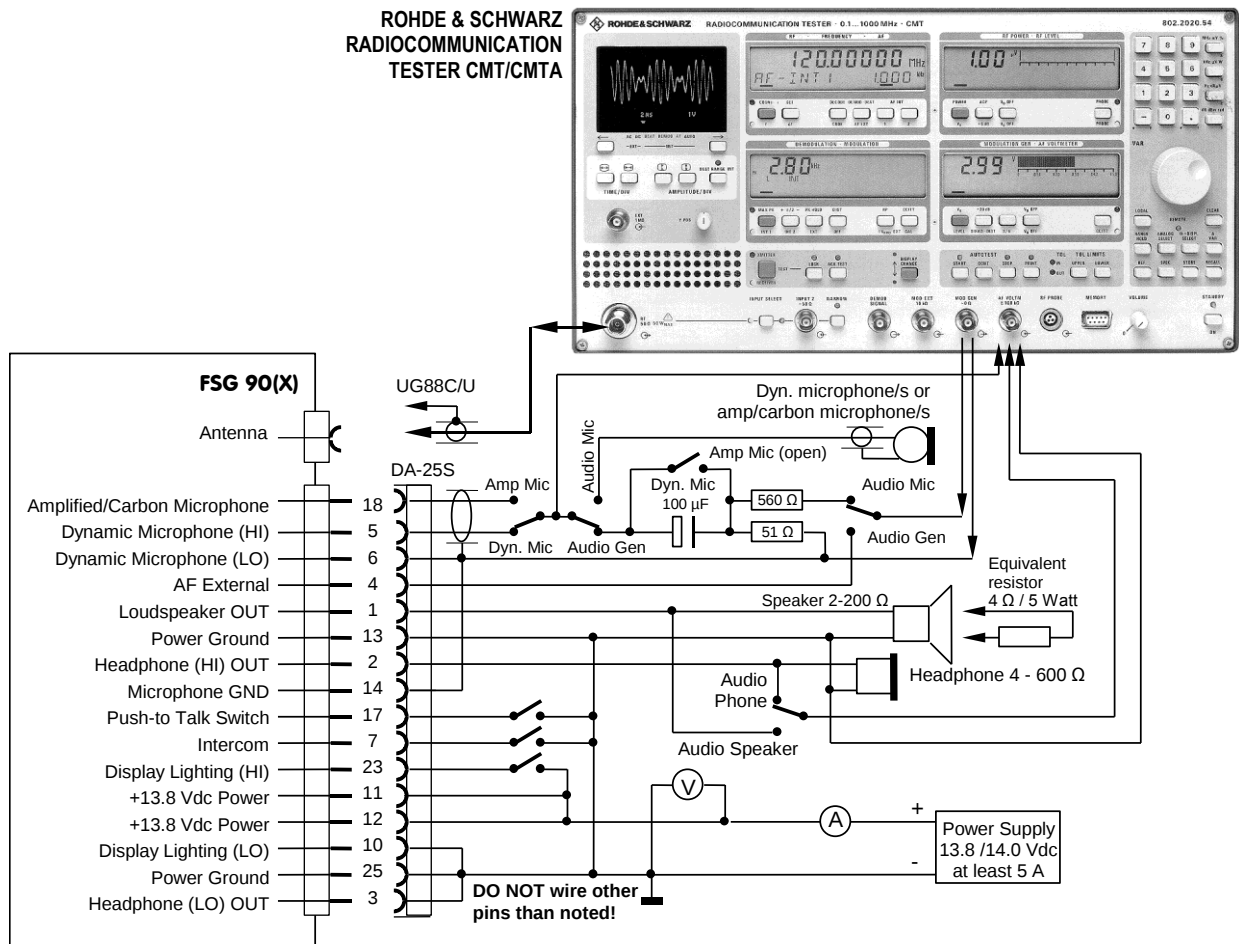
only to sine wave testing. It will be therefore higher than the usual 2% ... 10% sinus modulation distortion, but will stay far below the maximum allowed 25% modulation distortion factor with sinus modulation.

6. Therefore, evaluation of the effectively occupied total transmitter band width (spectrum mask) is the only true, real measurement method. Such measurements can be made only with specific test set-up.
7. For tests of the **FSG 90(X)** modulation capability, a sine modulation signal is useful only below some 70% AM depth, and is on the other hand helpful only in determining of possible overmodulation, but is not applicable to judge "voice distortion" anymore.



Always turn OFF the radio first before connecting or disconnecting the D-SUB connector

Fig. 3-1: **FSG 90 System**  
 Test Set-up



Always turn OFF the radio first before connecting or disconnecting the D-SUB connector

Fig. 3-2: **FSG 90 System**  
Test Set-up using CMT/CMTA

## 3.5 Mechanical Installation

### 3.5.1 Transceiver installation

Any radio installation into an aircraft shall be coordinated with both the licensed inspector who certifies the installation, and with the aircraft manufacturer's installation instructions.

Certifying the aircraft installation may be subject to specific National Regulations.

**FSG 90(X)** VHF/AM transceivers are designed to be installed into the instrument panel or operating console from its rear side into a standard 2¼ in. / 58 mm diameter panel opening. Dimensions and positioning of the 4 fixing holes refer to Figure 3-4.

Select a radio location distant to heat sources. All equipment controls shall be readily accessible from the pilot's normal seated position. The appropriate operator/crew member(s) shall have an unobstructed view of the display when in the normal seated position.

Leave sufficient room (at least 230 mm / 9 in.) behind the front panel for wiring accommodation. Fixing of the transceiver is achieved by use of four (4) cross recessed Pan head screws M 4 x 12 mm (supplied). These screws are sufficient for panel thickness between 2 mm and 5 mm (1/16 in. ...3/16 in.).

### 3.5.2 Compass deviation

Compass deviation caused by **FSG 90** is less than 30 cm for 1° deflection.

(Category Z in accordance with EUROCAE ED-14C / RTCA DO-160C environmental test conditions).

| Compass Deviation | Distance        |
|-------------------|-----------------|
| 0.5°              | 13 cm/5.1 in.   |
| 1.0°              | 10 cm/3.9 in.   |
| 1.5°              | 9.25 cm/3.7 in. |
| 2.0°              | 9.0 cm/3.6 in.  |
| 2.5°              | 8.25 cm/3.3 in. |
| 3.0°              | 7.5 cm/3 in.    |

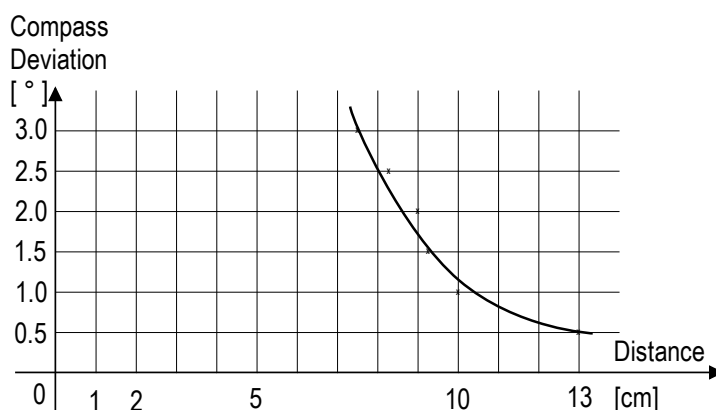


Fig. 3-3: Deviation of a compass by an operating **FSG 90**, depends on the distance between compass centre and contour of transceiver

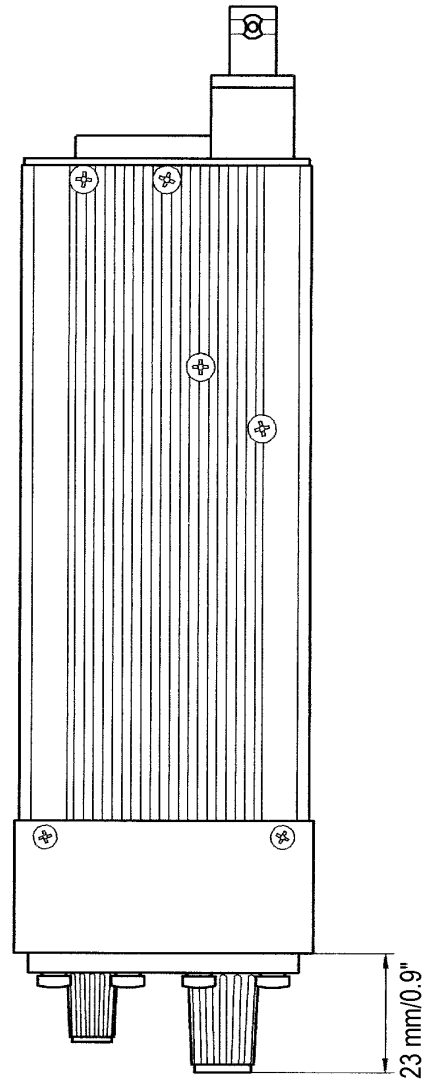
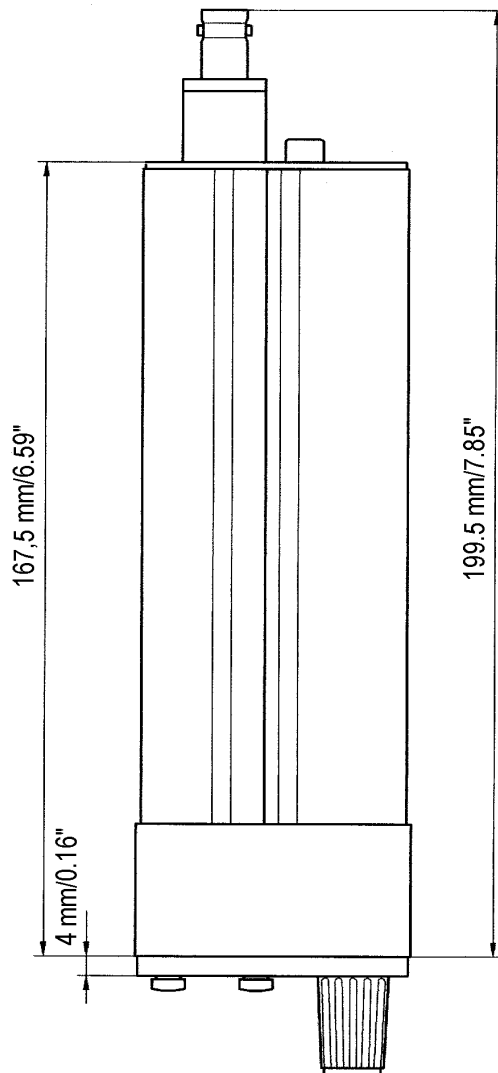
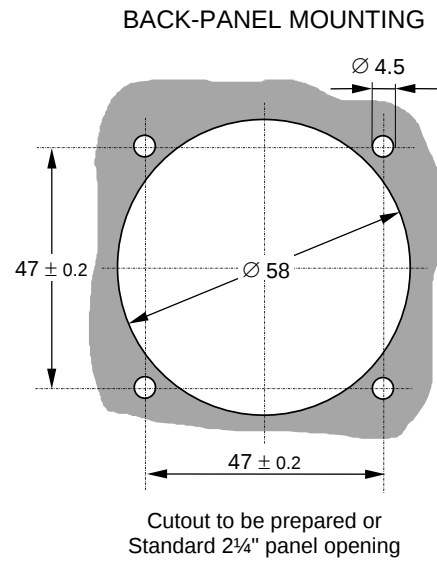
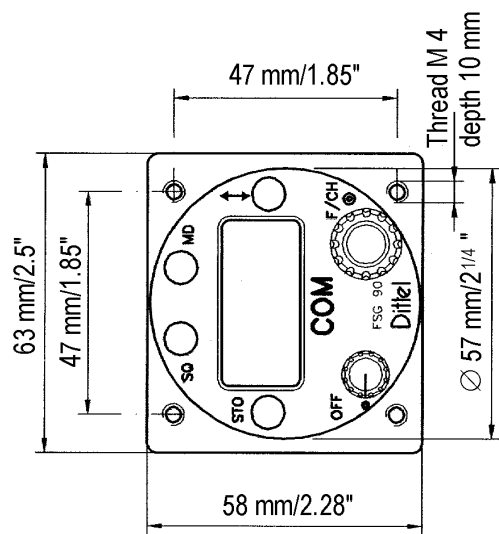


Fig. 3-4: **FSG 90(X)**  
Dimensions  
Installation Drawing

### **3.5.3 Antenna installation**

**Your radio FSG 90(X) is only as good as the antenna!**

For operation, a vertical polarized 50-Ohm broadband aircraft COM antenna is required. The antenna must be able to radiate RF energy evenly and omnidirectional:

- First of all, look up the aircraft's manual for antenna installation instructions.
- The antenna installation location must be carefully planned. It would be the best to consult the aircraft certifying inspector. In order to achieve best results into all directions, installation instructions must be fully complied with.
- For aircraft with metal fuselage, we recommend a rod antenna. The antenna is mounted vertically (as possible) on or under the fuselage. Location should be even away from horizontally screening metal parts like propeller, undercarriage, vertical metal fins etc., for maximum radio range into all (horizontal) directions.
- Distance to other aircraft antennas, like another COM, NAV antenna, should be at least 1.5 m/5 ft. When using two radios **FSG 90(X)**, a distance of 1 m/3.3 ft. between COM antennas is sufficient.
- The antenna mounting area should be as flat as possible.
- The metallic contact between aircraft surface/structure and the antenna cable outer conductor (shield) must be robust. The electrical contact shall remain continuously good safe against vibration.
- For wood and fiberglass (GRP) aircraft, 3 or 4 aluminium counter weight strips (ea. 60 cm/2 ft. long - 5 cm/2 in. wide) are recommended, but shall be placed (mostly) horizontally with a (if possible rectangular) shape as a star or cross.
- These as star or cross placed counter weights must be centrally screwed together with the antenna socket, with continuous, electrically good contact.
- Alternatively, for aircraft with non-metallic surface structure inside the fuselage, a metal foil (min. 60 x 60 cm/2 ft. x 2 ft.) can be stuck in. The antenna socket will then be placed in the foil centre, together with a metallic ground contact support plate.
- For aircraft with fuselage and/or tail-fin made of non-conductive material, a vertical folded top antenna is suitable. Installation is made preferably during manufacturing the tail-fin.

**IMPORTANT: Carbon fibre is conducting and may shield the antenna!**

- Careful sealing of all openings of the outer skin is mandatory. Make sure, that electrical contacts remain continuously good, even under bad environmental conditions.
- Use only high quality 50-Ω coax cable type RG-58C/U. Avoid any sharp cable bend (radius > 50 mm), and any excessive coax cable length.
- Place all wiring including antenna cable distant to other wiring which carries heavy AC currents, and distant to any aircraft controls.

- Any operating kinematics, trimming and all control handles must be absolutely free in all directions.
- Ensure the BNC antenna plug is not shortened between inner and outer connector (Ohmmeter). Resistance  $0.0\ \Omega$  indicates a short inside antenna connector, while some  $0.6$  to  $1\ \Omega$  indicates the antenna cable resistance, while an internally (static) protected antenna is used. A simple rod antenna is tested for low resistive contact between inner cable conductor and radiator, and outer conductor to counter weight.
- Check the antenna matching using  $50\text{-}\Omega$  SWR meter over the whole frequency range for  $\text{SWR} < 3:1$ . It may be helpful or necessary to change slightly the length of the middle radiator, or counter weight length for optimized antenna efficiency and matching.
- **REMEMBER: A good antenna is the best RF amplifier!**

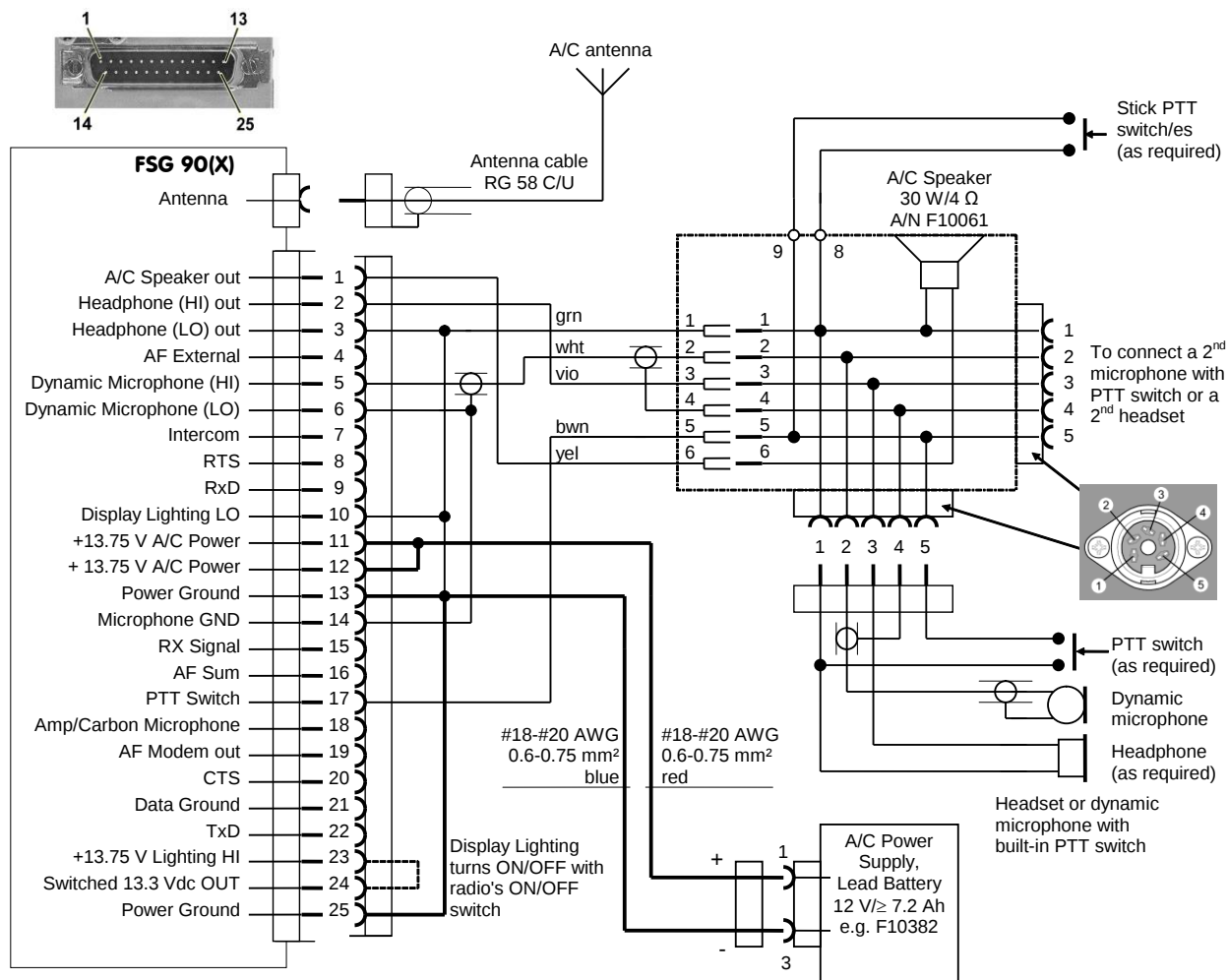
## **3.6 Airborne wiring**

Refer to Figures 3-5 to 3-7 of on-board wiring.

### **3.6.1 General recommendations**

- Always ensure continuously good, stable electrical contacts, and efficient RF interference suppression of all electrical systems like generator/alternator, ignition etc., especially consider vibration and corrosion effects. Consult the aircraft installation licensing inspector.
- Do not allow the harness to droop between clamps, especially if it is a heavy harness.
- Do not allow the wires in the harness to be exposed to sharp surfaces or ride against any movable surface.
- Do not install without allowing for service loops, this will help to prevent undue stress on the connectors and allow for easier repair of wire terminations.
- Do not allow harness to route through high heat areas without adequate thermo protection.
- Do not install harnesses in areas that are subject to chemical damage.
- Radio wiring shall be located most distant to other, high AC currents carrying leads. Route all wiring including antenna cable distant from aircraft control and handling components. Place DC power lines at least 15 cm away from compass.
- Use only aviation grade wiring material (LN 9251 resp. LN 9253) in self-extinguishing quality, and with > 500 Volt isolation.
- Prescribed cable diameters must be complied with.
- Ground loops must be avoided.
- Cables are soldered to the DA-25S connector. Solder joints shall be supported by shrinking or rubber sleeves. Cable connector case mounting shall not clamp or damage the wiring.
- The **FSG 90(X)** is protected against reversed polarity only when using a suitable DC supply protection fuse. For 6 Watt models, we suggest a 3.15 Amp quick acting fuse, or an automatic 3 Amp circuit breaker. For 10 W models (suffix "-H1"), we suggest a 5 Amp quick acting fuse, or an automatic 5 Amp circuit breaker. Without proper fuse protection, the radio unit may become severely damaged, warranty validity terminates.
- Power bus circuit breakers are to be mounted in the A/C breaker panel or instrument panel such that they will be accessible in flight and safe from physical damage.
- Before first connection to the **FSG 90(X)** radio is made, carefully cross-check all wiring details, especially DC supply polarity.
- Secure the connected accessory plug by the sliding lock to avoid unwanted connector loosening.
- For ease of installation, prefabricated wiring harnesses for all kind of aircraft are available from **FSG 90(X)** radio manufacturer.

- Electronic variometers seldom comply with airborne type approval requirements. All of the known models at printing time of this manual have to our knowledge a too high radiated RF interference emission. In transmit mode, the operator may even be faced with radio energy based functional variometer influence. Slight improvement may be achieved when the variometer wiring is both shielded and routed not in parallel but distant to the radio wiring. Eventually, short but bulky grounding contacts between all radio and variometer cases may improve this E-variometer RF susceptibility. Further measures to improve RF immunity may be obtained from variometer manufacturer.



### NOTES:

**DO NOT** wire other pins than noted!

Unless otherwise noted, all wires are #22 AWG (0.3 -0.4 mm<sup>2</sup>).

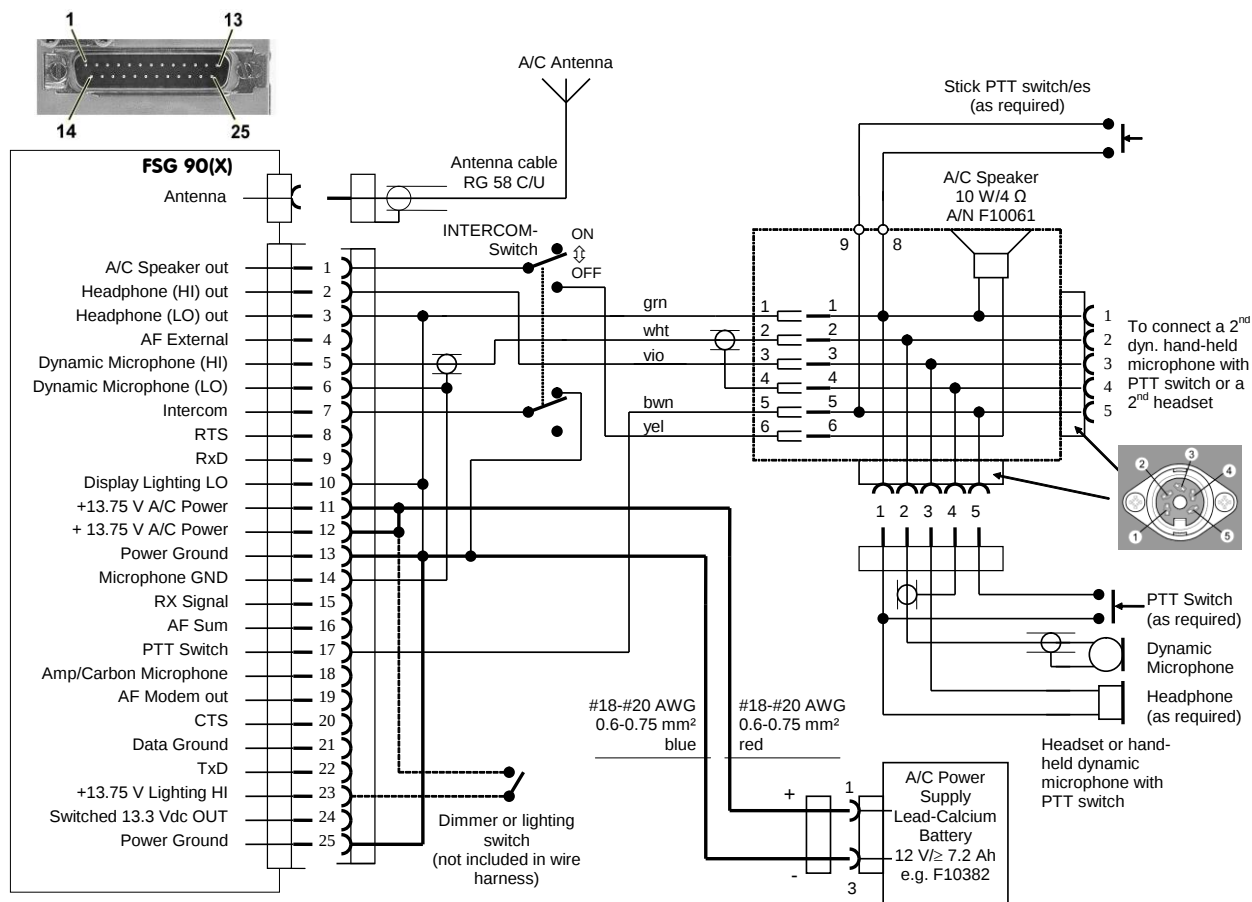
Built-in circuit breaker when using f.u.n.k.e. Battery A/C Power Supply, A/N F10382.

Length of pre-fabricated wire harness F10189: 2.9 m/ 9.5 ft.

----- and coax antenna cable are not included in wire harness F10189!

Always turn OFF the radio first before connecting or disconnecting the D-SUB connector

Fig. 3-5: **FSG 90 System**  
Hook-up Diagram using wire harness F10189  
1 - 2 Dynamic Microphone(s)



#### NOTES:

**DO NOT** wire other pins than noted!

Unless otherwise noted, all wires are #22 AWG (0.3 -0.4 mm<sup>2</sup>).

Intercom operation requires a microphone, which provides audio OUT with the PTT key de-energized (not keyed).

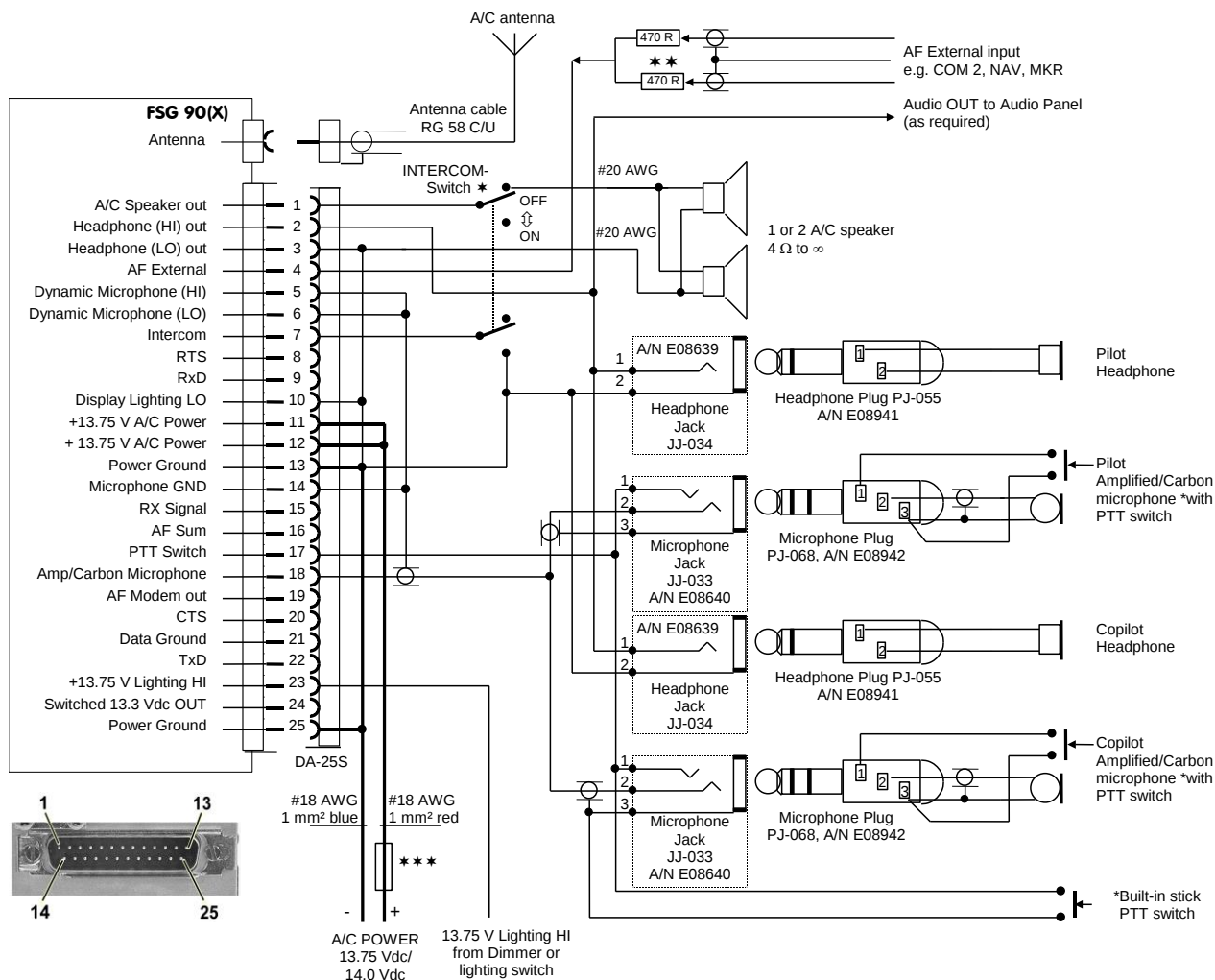
Built-in circuit breaker when using f.u.n.k.e. Battery A/C Power Supply, A/N F10382.

Length of pre-fabricated wire harness F10190: 2.9 m/ 9.5 ft.

----- and coax antenna cable are not included in wire harness F10190!

Always turn OFF the radio first before connecting or disconnecting the D-SUB connector

Fig. 3-6: **FSG 90 System**  
Hook-up Diagram using wire harness F10190  
1 - 2 Dynamic Microphone(s) and Intercom



### NOTES:

**DO NOT** wire other pins than noted!

Unless otherwise noted, all wires are #22 AWG (0.3 -0.4 mm²).

Unless otherwise noted, all Power Grounds are airframe grounds.

Intercom operation requires a microphone that provides audio OUT with the PTT key de-energized (not keyed).

Intercom operation requires a selector switch, double pole, double throw.

Terminate audio shields at one end only.

Mount the Power bus circuit breakers in the A/C breaker panel or instrument panel such that they will be accessible in flight and safe from physical damage.

\* PTT Key/s either at hand-held microphone/s or installed on the yoke.

\* Wiring without Intercom: connect A/C speaker direct to pins 1 and 3.

\*\* If more than one AF source isolation resistors 470 Ohm shall be installed.

\*\*\* 6 W model: Fuse 3.15 Amp quick acting, or circuit breaker 3 Amp.

10 W model: Fuse 5 Amp quick acting, or circuit breaker 5 Amp.

Always turn OFF the radio first before connecting or disconnecting the D-SUB connector

Fig. 3-7: **FSG 90 System**  
Hook-up Diagram  
2 Amplified/Carbon Microphones  
and Intercom

### 3.6.2 Microphone Connection

Independent of each other, almost any non-amplified dynamic microphone, or amplified Electret or amplified dynamic or carbon standard microphones can be connected to the **FSG 90 System**, without internal jumper setting or soldering.

A amplified/carbon microphone is connected to pin 18, a dynamic microphone is connected to pin 5 of the 25-pole D-SUB receptacle. Avoid any ground loop in microphone wiring (dynamic non-amplified mike shield shall not be connected to any other aircraft wiring, except directly at the assigned pin in the accessory connector).

Up to two IDENTICAL microphones for pilot and co-pilot can be operated in parallel simultaneously. Even two low impedance (4 Ohm) dynamic microphones may be connected in parallel as well. However, for microphones with less than 30 Ohms, it may be necessary to use a suitable microphone transformer.

The associated microphone ground (shield) for dynamic microphones must be consequently routed galvanically isolated, in order to avoid any ground loop.

This means, dynamic mike ground/shield must be separated from any other grounds for DC input or DC output, AF input and AF output like speaker, phone, PTT and external Audio).

In this context, due to the extremely wide mike input level adjustment range, it is mandatory to understand that correctly matched **FSG 90(X)** mike input sensitivity (SET-UP) will be good ONCE FOREVER for this configuration and to ensure stable operation without audio feedback.



#### **IMPORTANT!**

- *NEVER use the 3-pole mike connector type PJ-069 when using non-amplified dynamic microphones, because ground for mike and PTT is identical. This would create a ground loop and cause unstable / distorted modulation. This PJ-068 is allowed only for amplified/carbon mikes.*
- *However, the PJ-068/PJ-55 connector system must be regularly cleaned; contacts shall have sufficient spring-loaded force. This is especially mandatory under vibration operating conditions.*

### 3.6.3 Intercom (IC)

Intercom is suitable for twin seater aircraft with noisy cockpit. Intercom as well as radio operation should employ suitable aircraft headsets which must be matched properly to the transceiver (refer to SET-UP).

Hand-held microphones may be useful for intercom, if audio is not switched/keyed ON / OFF by the PTT function. Keying the mike audio may cause awful cracks, depending on mike technology.

To control the intercom capability, aircraft radio wiring must have a two-pole toggle switch (refer to figure 3-6 or 3-7). The intercom switch disconnects the loudspeaker during IC operation in the IC ON position. Simultaneously, pin 7 of the 25-pole connector is set to ground to select IC ON by continuously activating the microphone amplifier input signal.

With the IC switch in "ON" position it is possible anytime to perform normal transmitting (with the normal PTT key), it also allows continuous intercommunication during receive between pilot and co-pilot/crew (no PTT action is required for any IC operation).

During receiving, while IC is ON, both the IC loudness and external audio volume are temporarily reduced to improve receive intelligibility.

Receiving volume is set on the **FSG 90(X)** front panel (VOL), while intercom volume can be optimized by SET-UP adjustment.

### 3.6.4 Loudspeaker / Headset interconnection

Two separate AF output exist. The speaker output pin 1 can continuously supply up to two speakers each with 4 Ohms (load > 2 Ohms), while the headphone audio output pins 2 and 3 can accommodate up to 2 or more headphones each with some 600 Ohms, or all may be connected also simultaneously.

When no speaker is installed, Pin 1 may remain not connected, no spare load is required.



**CAUTION!**

- *The magnet compass is deflected by the speaker's magnetic field.*
- *Therefore, when using the f.u.n.k.e. compact speaker box F10061, a minimum distance of 1.3 m/4.3 ft. between compass and speaker is required.*

### 3.6.5 AF External Operation

The AF external input pin 4 may be connected to any external (selectable) audio output of any other audio source. 1 Volt rms is necessary to obtain maximum audio volume. Higher AF input may cause audio distortion. External AF will be audible only in Receive mode and in Standby mode, and may be heard in both speaker and headphones. During transmit, the external AF input is disabled.

Continuous interconnection of an external audio source(s) will be suitable especially in aircraft using just one COM and one NAV. The NAV headphone output may then be connected directly to the **FSG 90(X)** external AF input.

This allows in addition to the receiving and intercom function also the simultaneous listening of COM and NAV audio either by headphones or by speaker.

Interconnection of more than one external audio source requires additional external decoupling/isolation resistors (470 Ohms, refer to figure 3-7).

The individual audio volume is set directly at the particular external equipment.



#### **IMPORTANT!**

- *If external audio sources should be audible via A/C speaker, the external AF input must be enabled in the SET-UP. The 30 mA current saving in Standby Mode is then disabled.*

To achieve in External Audio operation the maximum **FSG 90(X)** audio output power, a minimum AF input level of 1 Volt rms is required (approx. 10 kOhm input impedance).

Interconnecting AF wiring must use shielded wires in order to avoid interference from strong electrical fields. An eventually magnetic interference coupling shall be especially regarded (distance from high current carrying wiring).

### 3.6.6 Lighting the Frequency Display



#### **IMPORTANT!**

- *Lighting is turned on or off via a separate input, but can be controlled by the radio, if desired.*
- *In order to save current while supplied from battery an external suitable illumination switch is suggested.*

The **FSG 90(X)** includes an LC display which can be back-lit. Pin 23 may be connected either directly to the 13.8 Vdc A/C power (perhaps via a suitable dimmer), or to the switched DC output Pin 24. For display lighting from a 28 Vdc A/C supply, insert a 680 Ohm resistor / 0.5 W, connected in series.



#### **CAUTION!**

- ***This way of matching to 28 Volt is only suitable for the lighting!***
- ***The FSG 90(X) always requires a 12 to 14 Volts DC supply.***

### 3.6.7 Connection to a 28 Vdc airborne system

Interconnection of the **FSG 90(X)** transceivers to a 28 Vdc supply requires a capable voltage converter. Interconnection wiring shall be according to instructions of the DC converter manufacturer. For lighting interconnection, refer to Section 3.5.6.

## **3.7 Post-installation Check**

### **3.7.1 Testing on the Ground with Engine Off**

Verification after installation completion

After installing the unit, check all aircraft control movements to be sure no electrical cable interfere with their operation. All aircraft and radio functions shall be tested after installation completion to identify, whether malfunctions caused by mechanical and/or electrical installation work occurs.

This must be performed by an authorized aircraft electronics inspector.

Testing of antenna matching between the **FSG 90(X)** antenna socket (BNC) and the BNC antenna cable connector is required, using a suitable 50 Ohm VHF Reflectometer (VSWR meter), or a directional Wattmeter.

The SWR must be less than 3 : 1 over the full frequency range, tested at least in 1 MHz steps (reflected power shall be less than 25% of the forward RF power output). If this limit is exceeded, this indicates a mismatched antenna and may be caused by wrong antenna radiator or counterweight length/dimensions, poor contacts, or damaged or unsuitable (no 50 Ohm) coaxial cable.

In order to optimize radio range, it is suggested to care for an SWR of less than 2 : 1 (reflected power shall be less than 11% of the forward RF power output).



#### **IMPORTANT!**

*If the antenna is belly mounted, perform antenna matching measurements if possible in flight, or at least while the fuselage is lifted upwards, using wood/non-metallic supporting material. This avoids antenna mismatch caused from ground proximity.*

Using known, but distant located fixed stations (VOLMET, ATIS) will also help in determining the radio range, especially in comparison with known, other radio range results of another aircraft at the same position on the ground at a known airfield location, or outside of the hangar or workshop.

### **3.7.2 Ground checks with engine running**

It must be ensured that the aircraft's electrical DC system voltage at the **FSG 90(X)** input terminals is within the tolerances permitted at 14 Vdc (or 28 V with DC converter).

Battery only supplied systems operate from 10 to 16.5 Vdc. Such testing requires normal RPM rated at cruising speed.

This testing evaluates both, the audio / noise influence and the RF radio range, at least from 10 to 30 km distance to the ground radio station. With cruising RPM, cabin noise background content shall almost not exist. Instead, loud and clear communications shall be achieved!

The microphone shall be in both Transmit and Intercom Mode placed right at the lips in order to obtain maximum voice level at lowest cabin noise content. Speak loud and clear. Verify proper microphone sensitivity setting during SET-UP adjustments prior to the first flight/on ground.

If possible, verify the communications capability also on both the low and high end of the VHF COM band.

If noise (both with Squelch On and Off) occurs only with the engine running, and if its frequency varies with the engine revolutions, it may be caused by an inadequate suppressed ignition system or alternator/voltage regulator equipment, or by poor stabilized on-board supply.

According to ED-14C / RTCA DO-160C requirements, the limits for ripple voltages at 14 Vdc supplies are  $0.79 V_{pp}$  at 0.2 ... 1 kHz, or  $1.98 V_{pp}$  at 1 ... 15 kHz. Double these limits for 28 V systems.

It is easier to determine in Receive Mode between RF and AF (interference carried on the lines) by temporary removing the antenna plug at the transceiver. RF interference, which usually comes from the ignition or generator/regulator will then disappear.

Ripple on the lines can be detected with an oscilloscope. Its source is usually the generator equipment in conjunction with a poor battery, or poor wiring (bad contacts, defective switches, inadequate wiring dimensions, ground loops (more than one ground connection to the airframe)).

RF interfering distortion is often caused by bad contacts in the antenna system, or other vibration depending on metal part contacts varying with the engine RPM. A noise attenuating headphone assists typical acoustic failure characteristics identification.

## 4 Functional Description

### 4.1 Introduction

This Section contains a functional description of each switch, push button, knob, indicator, display and socket located on the front or rear of the **FSG 90(X)** together with operating instructions.

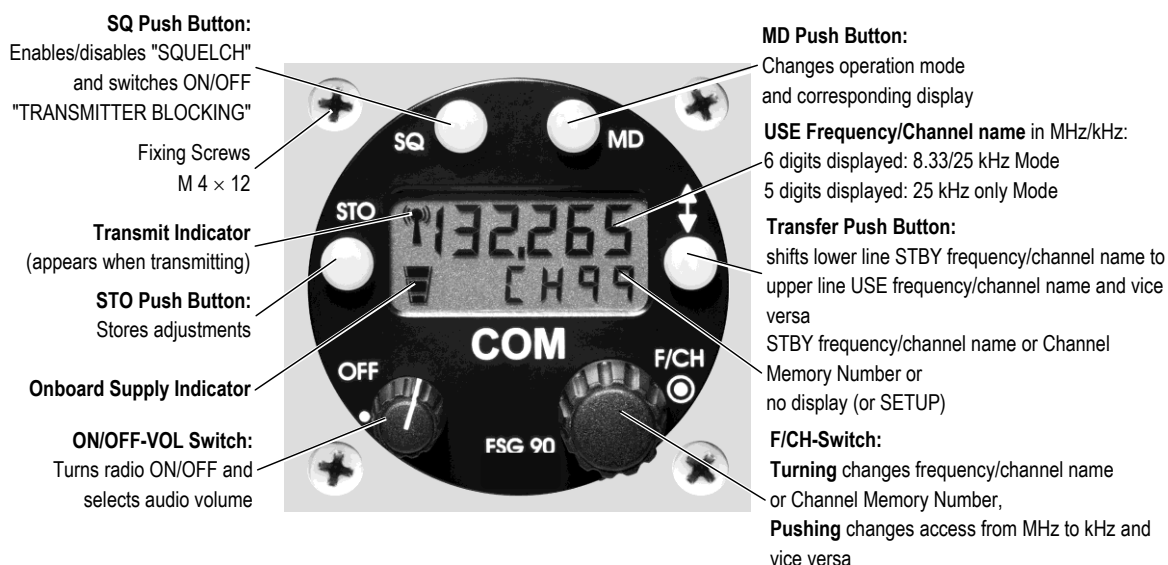
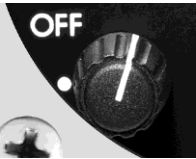
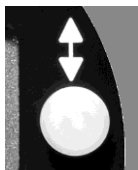


Fig. 4-1: Operator's Controls and Indicators

### 4.2 Operator's Controls

| Control                                                                                                  | Description/Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ON/OFF-VOL</b><br> | <p>Rotary step switch</p> <p>To turn ON the radio rotate the <b>ON/OFF-VOL</b> knob clockwise from the OFF position (dot).</p> <p><b>When power is activated</b></p> <ul style="list-style-type: none"> <li>all segments of the display are momentarily visible,</li> <li>the automatic squelch is activated,</li> <li>the display shows the frequency/ channel name in that Operating Mode, which was used before last turning OFF.</li> </ul> <p>Rotating the <b>ON/OFF-VOL</b> knob clockwise increases - turning counterclockwise decreases the audio volume audible in the a/c loudspeaker (Receive only) or connected headphone (TX Sidetone and Receive).</p> <p>To turn OFF the radio rotate the <b>ON/OFF-VOL</b> knob fully counterclockwise (ccw) to the OFF position (dot). Blank display.</p> |

|                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                       |            |               |  |            |                |                      |            |               |  |            |                       |                          |            |               |  |            |       |
|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------|---------------|--|------------|----------------|----------------------|------------|---------------|--|------------|-----------------------|--------------------------|------------|---------------|--|------------|-------|
| <div>SQ (SQUELCH)</div> <div></div> | <div>Push button</div> <div>After turning ON the radio <b>FSG 90(X)</b> the automatic squelch is always active.</div> <div>Momentarily pushing the <b>SQ</b>-Button</div> <div><ul style="list-style-type: none"><li>• puts the radio into the SQ-OFF mode (overrides the automatic squelch). Basic receiving noise is also audible during standby. Maximum receiving range. Increased current consumption.</li><li>• 'Transmitter Blocking' is inactive, i.e. transmitting is possible even if the channel is busy.</li></ul></div> <div>Momentarily pushing the <b>SQ</b>-Button once again</div> <div><ul style="list-style-type: none"><li>• puts the radio into the standard operating mode, automatic squelch is active. No receiving, noise during standby. Only reception of signals above SQ threshold to be heard.</li><li>• When the squelch is active 'Transmitter Blocking' is active, i.e. transmitting is only possible when the channel is not busy.</li></ul></div> <div><b>Note:</b> For certain purposes 'Transmitter Blocking' may be permanently switched OFF. Refer to SET-UP procedure, Section 5.</div> |                       |            |               |  |            |                |                      |            |               |  |            |                       |                          |            |               |  |            |       |
| <div>MD (mode)</div> <div></div>  | <div>Push button</div> <div>Repeatedly pushing the <b>MD</b> (mode)-button alters the display mode and display respectively:</div> <div><table><tr><td><b>Use/STBY Mode:</b></td><td>upper line</td><td>USE frequency</td></tr><tr><td></td><td>lower line</td><td>STBY frequency</td></tr><tr><td><b>Channel Mode:</b></td><td>upper line</td><td>USE frequency</td></tr><tr><td></td><td>lower line</td><td>channel memory number</td></tr><tr><td><b>Direct Tune Mode:</b></td><td>upper line</td><td>USE frequency</td></tr><tr><td></td><td>lower line</td><td>blank</td></tr></table></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Use/STBY Mode:</b> | upper line | USE frequency |  | lower line | STBY frequency | <b>Channel Mode:</b> | upper line | USE frequency |  | lower line | channel memory number | <b>Direct Tune Mode:</b> | upper line | USE frequency |  | lower line | blank |
| <b>Use/STBY Mode:</b>                                                                                                | upper line                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | USE frequency         |            |               |  |            |                |                      |            |               |  |            |                       |                          |            |               |  |            |       |
|                                                                                                                      | lower line                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | STBY frequency        |            |               |  |            |                |                      |            |               |  |            |                       |                          |            |               |  |            |       |
| <b>Channel Mode:</b>                                                                                                 | upper line                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | USE frequency         |            |               |  |            |                |                      |            |               |  |            |                       |                          |            |               |  |            |       |
|                                                                                                                      | lower line                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | channel memory number |            |               |  |            |                |                      |            |               |  |            |                       |                          |            |               |  |            |       |
| <b>Direct Tune Mode:</b>                                                                                             | upper line                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | USE frequency         |            |               |  |            |                |                      |            |               |  |            |                       |                          |            |               |  |            |       |
|                                                                                                                      | lower line                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | blank                 |            |               |  |            |                |                      |            |               |  |            |                       |                          |            |               |  |            |       |
| <div>TRANSFER</div> <div></div>   | <div>Push button</div> <div>Momentarily pushing the Transfer button</div> <div><ul style="list-style-type: none"><li>• while in CHANNEL or DIRECT TUNE mode will return the radio to USE/STBY mode, <b>or</b></li><li>• while in USE/STBY mode the last USE frequency will become the new STBY frequency and the last STBY frequency will become the new USE frequency, <b>or</b></li><li>• while in the SET-UP mode will return the radio to the display mode used before without power down. Only programmed settings stored previously by pushing the <b>STO</b>-button will be active.</li></ul></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                       |            |               |  |            |                |                      |            |               |  |            |                       |                          |            |               |  |            |       |

|                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>F/CH</b></p>           | <p>Rotary control <u>and</u> push button = dual function</p> <p><b>Momentarily pushing the F/CH knob</b></p> <ul style="list-style-type: none"> <li>• while in the USE/STBY or DIRECT TUNE mode changes the access from <b>kHz</b> to <b>MHz</b> or vice versa from <b>MHz</b> to <b>kHz</b>.</li> <li>• If there is no activity for 30 seconds the <b>F/CH</b> knob will return to the kHz access.</li> <li>• While in the CHANNEL mode pushing the <b>F/CH</b> knob is without function.</li> </ul> <p><b>Rotating the F/CH knob</b></p> <ul style="list-style-type: none"> <li>• while in the USE/STBY mode will increment or decrement the MHz or kHz portion of the STBY frequency with rollover at each band edge,</li> <li>• while in the CHANNEL mode changes the channel memory number and corresponding frequency. Only channel numbers which were programmed before will appear,</li> <li>• while in the DIRECT TUNE mode will increment or decrement the MHz or kHz portion of the USE frequency with rollover at each band edge.</li> </ul>                                                                                                                                                                                                                                                                                                                  |
| <p><b>STO (STORE)</b></p>  | <p>Push button</p> <p>Up to 99 frequencies/channel names in <u>each</u> Operating mode (combined 8.33/25 kHz mode <u>and</u> '25 kHz only' mode) may be stored in a non-volatile memory. The channel memory numbers (1 ... 99) are user programmable.</p> <p><b>Programming a frequency:</b></p> <ol style="list-style-type: none"> <li>1. Set the frequency or channel name to be stored in the upper line at the display!</li> <li>2. Initialize storing by pushing the <b>STO</b> button.</li> <li>3. The last used channel memory number is displayed in the lower line.</li> <li>4. A flashing "CH" shows "ready to store".</li> <li>5. Select appropriate (new) channel memory number (1 to 99) by rotating the <b>F/CH</b> knob.</li> <li>6. On a free channel memory an additional "<b>F</b>" (free) is displayed (CH 5 to 99).</li> <li>7. To enter the new frequency/channel name push the <b>STO</b>-button. The frequency/channel name will be stored under the adjusted channel memory number.</li> <li>8. A previously stored frequency/channel name will be overwritten.</li> <li>9. The last used Operating mode is displayed.</li> </ol> <p><b>Programming in the SET-UP mode:</b></p> <p>In the SET-UP mode all settings must individually be confirmed by pushing the <b>STO</b> button. Otherwise the settings are <b>not permanently</b> stored.</p> |

### 4.3 Frequency Display, 5-digit or 6-digit Liquid Crystal Display (LCD), two lines, can be back-lit.



#### **IMPORTANT!**

- *When the FSG 90 or FSG 90-H1 shows a 6-digit display, the radio is operating in the combined 8.33/25 kHz mode.*
- *When the FSG 90 or FSG 90-H1 shows a 5-digit display, the radio is operating in the '25 kHz only' mode.*
- *Frequency and channel name display complies with ICAO rules!*
- *The following displays are examples only!*



Transceiver operates in the **8.33/25 kHz mode (6-digit display)**

Upper line: USE channel name (display 135.090 = 135.0916 MHz transmit and receive frequency)

Lower line: STBY channel name (display 118.065 = 118.0666 MHz transmit and receive frequency)

Supply indicator: 3 segments:  $\geq 12.7$  Vdc, supply OK

TX indicator: OFF, radio receives.



Transceiver operates in the **'25 kHz only' mode (5-digit display)**

Upper line: USE frequency (display 135.87 = 135.875 MHz transmit and receive frequency)

Lower line: STBY frequency (display 118.02 = 118.025 MHz transmit and receive frequency)

Supply indicator: 3 segments:  $\geq 12.7$  Vdc, supply OK

TX indicator: OFF, radio receives.



Transceiver operates in the **8.33/25 kHz mode (6-digit display)**

Upper line: USE channel name (display 127.460 = 127.4583 MHz transmit and receive frequency)

Lower line: Channel memory number (19) associated with the above USE channel name

Supply indicator: 2 segments:  $\geq 12.0$  Vdc, battery  $\frac{1}{2}$  charged

TX indicator: **ON**, radio transmits.



Transceiver operates in the **'25 kHz only' mode (5-digit display)**

Upper line: USE frequency (display 124.77 = 124.775 MHz transmit and receive frequency)

Lower line: Channel memory number (75) associated with the above USE frequency

Supply indicator: 2 segments:  $\geq 12.0$  Vdc, battery  $\frac{1}{2}$  charged

TX indicator: **ON**, radio transmits.



**STO** button has been pushed (same function at 5-digit display).

Upper line: Channel name (6-digits) to be stored

Lower line: Free channel memory number **07** (**CH** is flashing)

After pushing the **STO** button once more the channel name 121.875 (= 121.875 MHz) will be stored in the channel memory **07**.

The last used Operating mode is displayed.



**STO** button has been pushed (same function at 5-digit display).

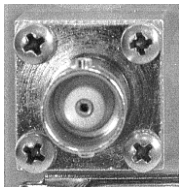
Upper line: Channel name (6-digits) to be stored

Lower line: Channel memory number **17** (**CH** is flashing)

After pushing the **STO** button once more the channel name 121.375 (= 121.375 MHz) will be stored in the channel memory **17**. A previously stored channel name will be overwritten.

The last used Operating mode is displayed.

#### **4.4 Connectors at the rear side**

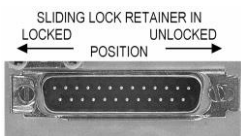


50  $\Omega$  BNC jack,

mating plug: BNC plug, UG 88/CU

Connects a suitable COM broad-band antenna with a frequency range of at least 118 - 137 MHz.

Refer to section 3.4.3 for Installation.



25-pole D-SUB receptacle, male, with sliding lock retainer

mating plug: 25-pole D-SUB, female, DA-25S, (A/N F10212: solder type, including shell and mounting hardware),

to connect the aircraft wiring. Refer to section 3.5 for wiring.

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## 5 SET-UP Procedure

This Section contains a description of the SET-UP procedure to be carried out by an **experienced avionics technician**. To carry out the SET-UP procedure the radio must be completely wired and ready to use.



### **DANGER!**

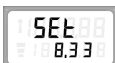
- ***During SET-UP procedure, the radio is partly unable to work. The radio can neither receive nor transmit!***
- ***NEVER carry out a SET-UP during flight or whilst driving a car! Perform SET-UP only whilst standing safely on the ground!***
- ***Before the next flight or application, check all settings of the radio and cockpit instruments for correct function!***



### **IMPORTANT!**

- The **FSG 90(X)** is factory pre-set for check and testing purposes. To achieve maximum performance it is therefore absolutely necessary to **optimize** the radio and to adapt the accessories used.
- To carry out the SET-UP the radio must be ready for operation (antenna connected, power supply OK, operational microphone/s, headset/s).
- If a headset is used, turn its volume control to maximum, if applicable.
- All frequencies, channel names, channel memory numbers etc., shown in the following illustrations, are **examples!**

The following settings can be selected or adjusted (in order):

1.  Adjusting the automatic squelch threshold
2.  Adjusting the microphone sensitivity
3.  Adjusting the Intercom volume (headset)
4.  Adjusting the Transmit Sidetone volume (headset)
5.  Adjusting the headset volume (during Receive, independent from speaker volume)
6.  Selecting '25 kHz only' channel spacing or combined 8.33 kHz / 25 kHz channel spacing. Confirmation with **STO** starts new mode at once!
7.  Deleting occupied channel memories (one after the other)
8.  Selecting AF External via A/C loudspeaker ON (1) or OFF (0).
9.  Selecting 'CHANNEL MODE' only (1) or 'FREE FREQUENCY SELECTION' (0)
10.  Selecting 'Transmitter Blocking' during receive ON (1) or OFF (0)

11.  Service, ON (1) or OFF (0)
12.  Optional module, ON (1) or OFF (0)
13.  Entering a password: protects against unauthorized changes of the radio parameters.

## 5.1 Calling SET-UP without password

Calling the SET-UP procedure without password is possible:

1. at ex works radios **FSG 90(X)**, or
  2. at radios which are reset to a factory basic setting (refer to chapter **RESET**), or
  3. at radios which are not protected by a password against unauthorized changes of the SET-UP adjustments.
- Turn OFF the radio (**ON/OFF-VOL** knob fully ccw).
  - **PUSH AND HOLD both MD and STO buttons**, then turn **ON** the radio (rotate **ON/OFF-VOL** knob clockwise, approximately mid position).
  - All segments of the display appear for a short moment then the display gets blank.
  - Release the buttons.



- After releasing the buttons the display shows in the upper line alternately »FSG90« and »SET-UP«.
- If there is no activity for 60 seconds the radio will return to the mode used before.
- Shortly pushing the **MD** button once will open the SET-UP menu to adjust the squelch threshold.
- Repeatedly pushing the **MD** button will open all other SET-UP menus in the order described before.

## 5.2 Calling SET-UP with password

Calling the SET-UP procedure with password must be carried out at radios, which are protected by a password against unauthorized changes of the SET-UP adjustments.

- Turn OFF the radio (**ON/OFF-VOL** knob fully ccw).
- **PUSH AND HOLD both MD and STO buttons**, then turn **ON** the radio (rotate **ON/OFF-VOL** knob clockwise, approximately mid position).
- All segments of the display appear for a short moment then the display gets blank.
- Release the buttons.



- After releasing the buttons the display shows in the upper line alternately »FSG90« and »SET-UP«, in the lower line **5 dashes**.
- If there is no activity for 60 seconds the radio returns to the mode used before.
- With the **F/CH** knob set the first digit of your password (the first dash changes to digit). Confirm the first digit by pushing the **F/CH** knob. The second digit is ready to be adjusted.
- With the **F/CH** knob set the second digit of your password (the second dash changes to digit). Confirm the second digit by pushing the **F/CH** knob.
- Continue until all five digits of your password are entered.
- Confirm the last digit input by pushing the **STO** button. This will open the SET-UP menu to adjust the squelch threshold. Repeatedly pushing the **MD** button will open all other set-up menus in the order described before.
- Entering a wrong password will return the SET-UP to the initial status (5 dashes).
- After the fourth attempt to open the SET-UP with a wrong password the radio returns to the operating mode used before trying to open the SET-UP. The **FSG 90(X)** is operational.

## 5.3 Interrupt the SET-UP procedure

The SET-UP procedure may be interrupted any time:

- Usually by turning OFF the power (**ON/OFF-VOL** knob fully ccw). All changed and individually stored adjustments (by pushing the **STO** button) are permanently stored and effective after turning ON the radio again.
- or by pushing the **Transfer button** (↕). The radio returns to the operating mode used before. All changed and individually stored adjustments up to now (by pushing the **STO** button) are permanently stored and effective.

## 5.4 SET-UP procedure



### **IMPORTANT!**

- The settings can be done in any order!
- Repeatedly pushing the **MD** button opens the menus step by step.
- Only settings confirmed by finally pushing the **STO** key are permanently stored and effective.
- When pushing the **STO** button the upper segment of the On-board supply indicator will light up to confirm storing visually.

### 5.4.1 Adjusting the automatic squelch threshold



The display shows in the upper line alternately »SET« and »SQUEL«, in the lower line »LO«, »MED1«, »MED2« or »HI«.

Adjust by rotating the **F/CH** knob the squelch threshold as required.

The lower line shows:

|             |                                                                                                                                                      |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>LO</b>   | ca. 1.0 $\mu$ V / -107 dBm (Standard setting)                                                                                                        |
| <b>MED1</b> | ca. 2.5 $\mu$ V / -99 dBm                                                                                                                            |
| <b>MED2</b> | ca. 5.0 $\mu$ V / -93 dBm                                                                                                                            |
| <b>HI</b>   | ca. 8.0 $\mu$ V / -89 dBm (this setting exceeds the required minimum sensitivity; adjust only for test purposes at very strong interference levels!) |

- Confirm your adjustment by pushing the **STO** button!
- If you want to carry on with the SET-UP procedure push once or repeatedly the **MD** button till the desired menu appears.

### 5.4.2 Adjusting the microphone sensitivity (Dynamic or amplified/carbon microphones)



### **IMPORTANT!**

- This adjustment is important particularly when **FSG 90(X)** is used in noisy environment like turboprop airplanes or vehicles:  
Turn your radio OFF (ON/OFF-VOL knob fully ccw).  
The **FSG 90(X)** should be turned ON only after engine start-up.  
Select a free frequency/channel name (no communication audible). Then call the SET-UP procedure.
- During this adjustment the transmitter is keyed. Carry out adjustment quickly!
- Up to two microphones of the same type may be connected parallel to the mic input (dynamic or amplified/carbon type).
- Parallel operated microphones must have the same specifications.
- This adjustment has to be repeated when changing microphones (brand, type or number)



The display shows in the upper line alternately »SET« and »MICRO«.

- **ONLY FOR ENGINE POWERED AIRPLANES AND VEHICLES: RUN THE ENGINE IN IDLE.**

Press and hold the PTT key. Talk in a loud, clear voice with the microphone one or two inches from your lips.

While talking the microphone level is measured. By turning the F/CH knob left or right set the upper dash line to three to four segments (the lower dash line shows only informative the actual range).

Release the PTT key and stop talking.

- **RUN THE ENGINE IN CRUISING SPEED.**

Press and hold the PTT key for at least 5 seconds, **do not talk!**

The upper dash line should show not more than one segment.

If the display shows more than one segment the mic input is too sensitive. Repeat adjustment with less sensitivity (only two to three segments visible when talking).

- Confirm your adjustment by pushing the **STO** button!
- If you want to carry on with the SET-UP procedure push once or repeatedly the **MD** button till the desired menu appears.

### 5.4.3 Adjusting the Intercom volume



#### **IMPORTANT!**

- *Intercom is only possible via headsets (microphones and headphones).*
- *The radio must be wired with an Intercom harness (IC switch) and two headsets connected.*



The display shows in the upper line alternately »SET« and »INTCO«.

Enable Intercom by switching ON the Intercom switch.

Talk in a loud, clear voice with one of the microphones one or two inches from your lips.

#### **DO NOT PRESS THE PTT KEY!**

While talking adjust with the F/CH knob a convenient headphone volume. The segments show the actual range. If more than four segments are shown overmodulation occurs.

- Confirm your adjustment by pushing the **STO** button!
- If you want to carry on with the SET-UP procedure push once or repeatedly the **MD** button till the desired menu appears.

#### 5.4.4 Adjusting the Sidetone volume



**IMPORTANT!**

- Sidetone audible during transmit is only possible via headphones (if applicable set maximum volume at the headset)
- During this adjustment the transmitter is active. Carry out adjustment quickly!
- The microphone(s) sensitivity has to be adjusted properly (refer to section 5.4.2)



The display shows in the upper line alternately »SET« and »SIDE«.

Press and hold PTT key. Talk in a loud, clear voice with the microphone one or two inches from your lips.

While talking adjust with the **F/CH** knob a convenient headphone volume. The segments show the actual range. If more than four segments are shown overmodulation occurs.

Release PTT key.

- Confirm your adjustment by pushing the **STO** button!
- If you want to carry on with the SET-UP procedure push once or repeatedly the **MD** button till the desired menu appears.

#### 5.4.5 Adjusting the headset volume



**IMPORTANT!**

- Receiving is possible via loudspeaker and headphone.
- First set with the **ON/OFF-VOL** knob loudspeaker volume to a convenient level, and then adjust with the SET-UP procedure a suitable headphone volume.



The display shows in the upper line alternately »SET« and »PHONE«.

With the speaker, noise or communication is audible.

With the **ON/OFF-VOL** knob set speaker output to a convenient level, leave **ON/OFF-VOL** knob as it is.

Put on headphone.

By rotating the **F/CH** knob adjust headphone level to a suitable volume. The dashes show the range.

If the adjustment range is not sufficient increase or decrease with the **ON/OFF-VOL** knob.

- Confirm your adjustment by pushing the **STO** button!
- If you want to carry on with the SET-UP procedure push once or repeatedly the **MD** button till the desired menu appears.

#### 5.4.6 Selecting '25 kHz only' or combined 8.33/25 kHz channel spacing



**IMPORTANT!**

- *Selecting either 8.33/25 kHz or '25 kHz only' may be necessary due to National Regulations.*



The display shows flashing in the upper line »SET«, in the lower line either »25« or »8.33«.

By rotating the F/CH knob select the required channel spacing:

»25« = '25 kHz only' channel spacing



»8.33« = combined 8.33 and 25 kHz channel spacing.



**IMPORTANT!**

- *Confirm the new channel spacing by pushing the **STO** button! The selected channel spacing becomes active and simultaneously SET-UP procedure will automatically closed down. The radio returns to the last used operating mode and the settings confirmed with the **STO** button became effective.*
- *If you want to carry on with the SET-UP procedure call again SET-UP. Push once or repeatedly the **MD** button till the required menu appears.*

#### 5.4.7 Deleting occupied channel memories



**IMPORTANT!**

- *Only channel memory numbers from 5 ... 99 can be deleted. Channel memories 1 to 4 can only be overwritten.*
- *On an occupied channel memory the channel memory number is displayed in the upper line, the associated frequency/channel name in the lower line.*
- *On a free channel memory the channel memory number is displayed in the upper line, the lower line shows »FREE«.*



**EXAMPLE:**

The display shows in the upper line alternately »CLR 05« and »CH 05« and in the lower line the associated frequency.



**EXAMPLE:** Channel memory number »39« (with the channel name 132.765) should be deleted.

By rotating the F/CH knob adjust the channel memory number »39« at the display.



If this channel memory should really be deleted, confirm by pushing the **STO** button. In the lower line the frequency/channel name disappears, it appears »FREE«.

- If further memory channels should be deleted adjust with the **F/CH** knob the channel memory number concerned and delete each by pushing the **STO** button.
- If you want to carry on with the SET-UP procedure push once or repeatedly the **MD** button till the desired menu appears.

#### 5.4.8 Selecting AF EXTERNAL via A/C speaker (ON/OFF)



##### **IMPORTANT!**

- Always switch OFF AF EXTERNAL ("0") when the radio **FSG 90(X)** is battery powered. It saves approximately 30 mAmps.



The display shows in the upper line alternately »SET« and »AF - E«, in the lower line »0« or »1«.

Adjust by rotating the **F/CH** knob the lower line to "0".

**0** = AF EXTERNAL OFF, AF external only audible via headphones

**1** = AF EXTERNAL audible via aircraft speaker

- Confirm the adjustment by pushing the **STO** button, if required!
- Carry on with the SET-UP procedure by pushing once or repeatedly the **MD** button till the desired menu appears.

#### 5.4.9 Selecting 'CHANNEL MODE ONLY' or 'NO RESTRICTION'



##### **IMPORTANT!**

- For certain applications (usually ground operation only) free selection of all frequencies by the operator may be restricted. Then transmitting and receiving is only possible in the **CHANNEL MODE**, pre-programmed before by authorized personnel.



The display shows in the upper line alternately »SET« and »FREQ«, in the lower line »0« or »1«.

Adjust by rotating the **F/CH** knob lower line to "0" or "1".

**0** = Standard operation, free frequency selection, no restriction.

**1** = **CHANNEL MODE only**, no other frequencies/channel names adjustable by operator.

- Confirm your adjustment by pushing the **STO** button!
- Carry on with the SET-UP procedure by pushing once or repeatedly the **MD** button until the desired menu appears.

#### 5.4.10 Selecting 'TRANSMITTER BLOCKING' during receive (ON/OFF)



**IMPORTANT!**

- Whenever 'Transmitter Blocking' is ON and squelch is ON, transmitting is disabled as long as the frequency/channel name is busy (communication audible). During that, no Sidetone is audible, even if PTT is pressed and one is talking into the microphone.
- Whenever the squelch is OFF 'Transmitter Blocking' is OFF and transmitting is possible even on a busy channel.



The display shows in the upper line alternately »SET« and »BLOC«, in the lower line »0« or »1«.

Adjust by rotating the F/CH knob the lower line to »0« or »1«.

- 0 = 'Transmitter Blocking' is OFF. Transmitting is always possible, even on a busy channel.
- 1 = 'Transmitter Blocking' is ON. With squelch ON transmitting is only possible on a free channel.
- Confirm your adjustment by pushing the **STO** button!
- Carry on with the SET-UP procedure by pushing once or repeatedly the **MD** button till the desired menu appears.

#### 5.4.11 Service (ON/OFF)



**IMPORTANT!**

- **For approved Avionics Shops only!**



The display shows in the upper line alternately »SET« and »SERV«, in the lower line »0«.

0 = STANDARD MODE, Service OFF.

- If required, confirm adjustment by pushing the **STO** button!
- Carry on with the SET-UP procedure by pushing the **MD** button.

#### 5.4.12 Optional module (ON/OFF)



**IMPORTANT!**

- **Not applicable with this radio.**



The display shows in the upper line alternately »SET« and »OPT«, in the lower line »0«.

0 = STANDARD MODE, Optional module OFF.

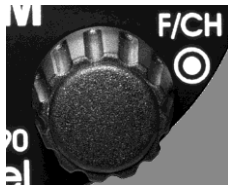
- Carry on with the SET-UP procedure by pushing the **MD** button.

### 5.4.13 Entering a password



**IMPORTANT!**

- *When the SET-UP of your radio is protected by a password it cannot be changed by any unauthorized persons without knowledge of the password.*
- *Your password consists of five digits!*



The display shows in the upper line alternately »SET« and »PASS«, in the lower line »00000«.

If you don't want to enter a password and your SET-UP procedure is finished leave the SET-UP menu by pushing the TRANSFER (⇧) button, or turn OFF the radio (ON/OFF-VOL knob).

If you want to enter a password proceed as follows:

- Rotate the **F/CH** knob. Adjust the first digit (0 .... 9). Confirm the first digit by pushing the **F/CH** knob.
- Adjust the second digit of your password by rotating the **F/CH** knob. Confirm again by pushing the **F/CH** knob.
- The third digit is ready now. Continue as described above for the third, fourth and fifth digit.
- Make sure the complete password corresponds to your idea.
- Confirm the password by pushing the **STO** button!
- **From now on a new SET-UP may be called only after entering the password first!**

#### 5.4.14 Reset



**CAUTION!**

**Every RESET to the factory setting**

- **deletes all your pre-set memory channels 5 to 99 (in both '8.33/25 kHz' and '25 kHz only' Mode)! Memory channels 1 - 4 get programmed with 118.00 or 118.005 respectively**
- **deletes your password!**
- **delete all your individual SET-UP adjustments!**

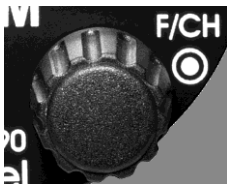
To reset all adjustments proceed as follows:

- Turn OFF the radio (ON/OFF-VOL knob fully ccw).
- **PUSH AND HOLD simultaneously the buttons MD, STO and SQ, then turn ON the radio** (rotate ON/OFF-VOL knob clockwise, approximately mid position).
- All segments of the display appear for a short moment then the display gets blank.
- Release the buttons.



After releasing the three buttons the display shows in the upper line alternately »SET« and »RESET«, in the lower line »0«.

If there is no activity for 60 seconds the radio will return to the mode used before.



With the F/CH knob set lower line to "1".



Confirm **RESET** by pushing the **STO** button.

The upper segment of the On-board Supply Indicator will light up shortly.

- The VHF radio **FSG 90(X)** is now operable in the factory setting.

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## 6 Operating Instruction

### 6.1 Introduction

This Section contains basic operating procedures for the **FSG 90(X)** transceivers. This instruction is only applicable for a radio which is

- correctly installed and wired by a certified avionics shop
- checked together with the a/c system, and
- optimized by the SET-UP procedure (refer to Section 5, **SET-UP PROCEDURE**).



**WARNING!**

**DO NOT OPERATE THIS RADIO IN AN EXPLOSIVE ATMOSPHERE (PETROLEUM FUELS, SOLVENTS, DUST, ETC.).**

### 6.2 Turning ON - Selecting Frequency/Channel Name - Volume



**CAUTION!**

**The FSG 90(X) should be turned ON**

- after installing the unit into vehicles, aircraft or carrier cases,
- after switching on the power source,
- after engine or vehicle start-up.

***This is a simple precaution which helps to protect the solid state circuitry and extends the operating life of your avionics equipment.***

**NOTICE: »Frequency« and »Channel Name« are ICAO terms!**

Turn the radio **FSG 90(X)** ON by rotating the **ON/OFF-VOL** knob clockwise. Momentarily all segments of the display are visible. Last used operating mode and frequency are displayed.

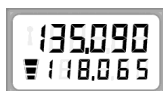
A warm-up period for the transmitter is not required. However, at temperatures of -20°C / -4°F, the LC display needs approximately one second until it is fully visible when the frequency or operating mode is changed.

To change the operating mode and therefore the display: Push once or twice the **MD** button.

Selecting the appropriate active frequency/channel name depends on operating mode:

EXAMPLE:

**STANDARD: USE/STBY (Standby) Mode**



At the lower line select appropriate **kHz** portion by **rotating F/CH** knob. A clockwise rotation will increment the previous frequency while a counter-clockwise rotation will decrement the previous frequency with rollover at each band edge.

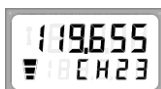
**Push F/CH** knob; this changes the access to MHz.

At the lower line select appropriate **MHz** portion by **rotating F/CH** knob. A clockwise rotation will increment the previous frequency while a counterclockwise rotation will decrement the previous frequency with rollover at each band edge.

**Push** the Transfer Button .

The last standby frequency/channel name (lower line) will become the new active frequency/channel name (upper line) and the last active frequency/ channel name will become the new STBY frequency/channel name (lower line).

EXAMPLE:

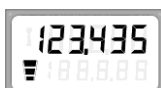


**Channel Mode:**

**Important:** *The appropriate operating frequency must be stored already in a memory channel (refer to **Storing a new Frequency/ Channel Name**).*

Select appropriate channel memory number together with the associated frequency/channel name by **rotating** the F/CH knob.

EXAMPLE:



**Direct tune Mode:**

Select appropriate kHz portion by **rotating** F/CH knob. A clockwise rotation will increment the previous frequency while a counterclockwise rotation will decrement the previous frequency with rollover at each band edge.

**Push** F/CH knob; this changes the access to MHz.

Select appropriate MHz portion by **rotating** F/CH knob. A clockwise rotation will increment the previous frequency while a counterclockwise rotation will decrement the previous frequency with rollover at each band edge.

The setting is the new active frequency/channel name.

- Rotate **ON/OFF-VOL** knob (1) clockwise, about half way.

**Continue with either Receive or Transmit Operation**

### **6.3 Receive (Listen) Operation**

- After turning ON the radio the automatic squelch is always ON.
- If the operating mode shall be changed: Push once or twice the **MD** button.
- If the active frequency shall be changed: refer to **6.2 Turning ON - Selecting Frequency/ Channel Name - Volume**
- **DO NOT** press the PTT (Push-To-Talk) key if you want to receive! Transmit Indicator at the display **must not** appear!
- Normal signals are received; weak signals and interfering pulses are disabled. Set the volume of the a/c loudspeaker or headphone to a comfortable level by rotating **ON/OFF-VOL** knob (in 15 steps).
- Weak signals can be received if the squelch circuit is switched OFF by pushing the **SQ** button. Then typical RX noise is heard during communication breaks.
- Pushing the **SQ** button again switches the squelch circuit ON again.



#### **IMPORTANT!**

- *Switching OFF the squelch only makes sense if long range reception shall take place. Thus, the radio is noisy during Standby operation, but no weak signals are suppressed and the full receiving range is available!*
- *Notice increased current consumption!*

## 6.4 Transmit (Talk) Operation



### **IMPORTANT!**

- *Please keep radio discipline!*
  - *Transmit only on a clear channel.*
  - *Since 'Transmit Blocking' is normally activated (refer to SET-UP) transmitting is not possible on a busy channel.*
  - *Care for an all-round obstacle free antenna location; the called station should be within "line-of-sight" distance.*
  - *Never place the radio such as the antenna gets very close to, or touching, exposed parts of the body, especially the face, shoulder or the eyes.*
  - *The radio is equipped with a transmit time out timer (2 minutes). This is used to limit the duration of calls and to guard against accidental PTT locking.*
- If the display mode shall be changed: Push once or twice the **MD** button.
  - If the USE frequency shall be changed: refer to **6.2 Turning ON - Selecting Frequency/Channel Name - Volume**.
  - Transmitting is normally only possible on a clear channel (no communication audible).
  - If you have to transmit (e.g. emergency case) although the channel is busy, the "Transmit Blocking" circuit may be turned OFF by pushing the **SQ** button.
  - Press and hold the PTT (Push-To-Talk) key. Talk in a loud, clear voice with the microphone opening 2 to 4 cm (1" - 2") from your lips. Make each transmission as brief as possible. As long as the PTT key is pressed the **Transmit Indicator** at the display appears!
  - Release the PTT key to end transmission and to clear the channel for reception; the Transmit Indicator must disappear. Switch Squelch ON again, if necessary.
  - The radio is equipped with a transmit TOT time out timer. This is used to limit the duration of transmissions to 2 minutes. When the transmitter is keyed continuously longer than 2 minutes the display of the **FSG 90(X)** starts flashing and transmission is disabled.
  - If you have to make calls longer than 2 minutes shortly release the PTT key and press again.
  - Should the TOT disable the transmitter accidentally (e.g. stuck PTT key) and you have to transmit **turn radio OFF and ON again**. This allows another 2 minutes to transmit.

## 6.5 Storing a new Frequency/Channel Name

In each active Operating Mode (combined 8.33/25 kHz mode or '25 kHz only' mode) up to 99 non-volatile channel memories can be user programmed. Channel memories of the non-active mode remain stored in the background. They are accessible after calling up the respective mode.



### **IMPORTANT!**

- *Free selection of frequencies and new storing may be disabled due to SET-UP adjustment (refer to Section 5.4.9)!*
- ***Channel memories 1 to 4 are always pre-set and may be used when called. They can only be changed but not deleted. Ex works and after Master Reset channel memories 1 to 4 are pre-set with either 118.00 MHz or 118.005 MHz!***
- ***Storing can be initialized in all three operating/display modes.***
- ***The USE frequency/channel name in the upper line of the display can be stored to any of the 99 channel memories.***

1. Set the frequency or channel name to be stored in the upper line at the display!
2. Initialize storing by pushing the **STO** button.
3. The last used channel memory number appears, "**CH**" flashes.
4. Select appropriate channel memory number (1 to 99) by turning the **F/CH** knob. On a free memory channel, an "**F**" appears before "**CH**" and the memory number.
5. To enter the new frequency/channel name push the **STO**-button. The frequency/channel name will be stored under the selected channel memory number. A previously stored frequency/ channel name will be overwritten.

## 6.6 Recall of stored Frequency/Channel Name

1. By pushing once or twice the **MD** button select the CHANNEL display mode.
2. By rotating the **F/CH** knob set appropriate channel memory number with its associated frequency/channel name at the display. Only channel numbers that have been programmed previously will appear.

## 6.7 Squelch (SQ) Operation

During standby (normal operation / no signal received), the squelch is active to disable continuous receiver noise; too weak signals are not heard. The squelch level (normally approx. 1  $\mu$ V) can be adjusted in the SET-UP menu by 4 thresholds (low, med1, med2, high) to meet best operational requirements.

Signals above the SQ threshold open audio amplifiers for speaker and phone audio output. If, however, very weak signals below the SQ threshold are to be heard (e.g. aircraft far from base) then the **SQ** button is pushed to open SQ. This permits noise during pauses, but weak signals are no longer suppressed, and the full Receiver range is available.

**SQ ON** also results in significantly lower standby current consumption and extends battery supplied operating time.

**DUAL FUNCTION** while the **SQ** is disabled allows, that Transmit is possible even during simultaneous receiving on this channel, in order to enable transmit whenever necessary. Normally, in **SET-UP** the "**BLOC**" function is activated (set to "1") to prevent overcrowded channels caused by simultaneous transmissions.

## 6.8 Intercom



### **IMPORTANT!**

- *To achieve best cabin noise suppression, especially during speech pauses, optimized microphone sensitivity adjustment must be performed during SET-UP-Procedure.*
  - *Intercom headset audio volume may be adjusted through SET-UP.*
1. Switch ON Intercom. This activates simultaneously the microphones, while the speaker is disabled.
  2. During Receive, through acoustic accessories (headphones with microphones), the **FSG 90(X)** allows intercommunications between pilot(s) and/or other crew members. Always speak loud and clear, while the microphone opening is located close to the lips.
  3. By pressing the PTT key the radio switches to transmit -without switching Off Intercom. The "true active" Sidetone is heard during transmit. This allows all intercom parties to monitor also actual cockpit radio communication.
  4. Releasing the PTT key turns the radio into Intercom mode again.
  5. In addition, both Receive as well as External Audio is audible while Intercom is ON. During Receive, all other audio inputs are reduced in volume. This allows safer listening to the radio signal.
  6. Audio volumes of external audio signals are adjusted only on the external units.

## 6.9 AF External

In Standby and Receive mode only, through the External Audio Input, the audio signals of additional units (another COM, VOR, Localizer, Marker, ADF, electric variometer, etc.) are audible simultaneously via A/C loudspeaker or headphone(s).

Such complex interfacing requires that audio volume is set directly on each unit individually.

The VOL control on the **FSG 90(X)** front panel is not affected by external audio sources, and vice versa.

The External AF Input is disabled during transmit.

## 6.10 Lighting

Depending on aircraft wiring, lighting the frequency display is either activated by turning ON the lighting switch or dimmer, or by turning ON the **FSG 90** radio.

## 6.11 Turning OFF

Turn OFF the radio by rotating the **ON/OFF-VOL** switch to the fully ccw position to prevent unnecessary discharge of the A/C battery.

## 6.12 Checking the A/C on-board supply

Transceivers of the **FSG 90 System** include an on-board supply level display with a 3-bar symbol. At dc levels below 11 V, those three bars start flashing as a warning!

### Radio supplied from a 13.8 V battery bus:

The following operating times may be obtained depending on battery's capacity and transmitter duty cycle:

|                                                                  |                                                                                                                                 |
|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Reference:                                                       | Approximately +20°C / +68°F, battery 7.2 Ah, only radio is supplied.                                                            |
| Duty cycle:                                                      | 10% Transmit, 20% Receive, 70% STBY                                                                                             |
| Flashing symbol only during Transmit:                            | ca. 4 hrs. left                                                                                                                 |
| Flashing symbol also during Receive:                             | ca. 45 min. left. Recommendation: Reduce utmost transmitting!                                                                   |
| Short-time flashing symbol during Standby (SQ ON, clear channel) | ca. 45 min. left. Cease transmitting!                                                                                           |
| Continuous flashing symbol during Standby (SQ ON, clear channel) | Radio will soon switch OFF itself!<br>Recharge battery as soon as possible (refer to <b>Section 6.14, Emergency Operation</b> ) |

**Remark:** These transitions are fluent. Recovery effect after load reduction may be possible.

### Radio supplied from a 13.8 Vdc generator bus (aircraft or vehicle):

|                  |                                                                                                               |
|------------------|---------------------------------------------------------------------------------------------------------------|
| Flashing symbol: | Urgently check aircraft's or vehicle's electrical system (generator, battery, regulator) and/or installation! |
|------------------|---------------------------------------------------------------------------------------------------------------|

### Radio supplied from a 28/14 V Regulator (28 Vdc aircraft or vehicle supply):

|                  |                                                                                                                               |
|------------------|-------------------------------------------------------------------------------------------------------------------------------|
| Flashing symbol: | Urgently check 28/14 V Regulator, aircraft's or vehicle's electrical system (generator, battery, regulator) and installation! |
|------------------|-------------------------------------------------------------------------------------------------------------------------------|

## 6.13 Operating times of an FSG 90 (6 Watt version) supplied from a 12 V battery only

The following duty cycle of Transmit (TX), Receive (RX) and Standby (STBY) results in available operating time (hours). Both the worst and the most favourable operation conditions are considered, e.g. maximum receiver volume combined with maximum speaker load (2 speakers, 4 Ohms each).

Higher current consumption will degrade the nominally available battery capability, as well as lower temperatures. The following tables show significant time differences depending on current consumption during Receive, and at temperatures.

### Prerequisite: Maximum RX audio volume, AF External ON

| Max. current drain                  | .11 A             | 2.5 A      | 1.0 A    | .11 A       | 2.5 A      | 1.0 A     | .11 A       | 2.5 A     | 1.0 A     | .11 A       |
|-------------------------------------|-------------------|------------|----------|-------------|------------|-----------|-------------|-----------|-----------|-------------|
| Lead Accumulator<br>12 Volts 7.2 Ah | STBY,<br>w/out RX | 5%<br>TX   | 5%<br>RX | 90%<br>STBY | 10%<br>TX  | 20%<br>RX | 70%<br>STBY | 20%<br>TX | 40%<br>RX | 40%<br>STBY |
| Temperature -20°C/-4°F              | 38 hrs.           | 12.30 hrs. |          |             | 6.00 hrs.  |           |             | 3.10 hrs. |           |             |
| Temperature +20°C/68°F              | 62 hrs.           | 20.10 hrs. |          |             | 10.00 hrs. |           |             | 5.20 hrs. |           |             |
| Temperature +50°C/122°F             | 66 hrs.           | 22.10 hrs. |          |             | 11.10 hrs. |           |             | 6.00 hrs. |           |             |

### Prerequisite: Minimum RX audio volume, AF External OFF (power saving)

| Max. current drain                  | .08 A             | 2.5 A      | .25 A    | .08 A       | 2.5 A      | .25 A     | .08 A       | 2.5 A     | .25 A     | .08 A       |
|-------------------------------------|-------------------|------------|----------|-------------|------------|-----------|-------------|-----------|-----------|-------------|
| Lead Accumulator<br>12 Volts 7.2 Ah | STBY,<br>w/out RX | 5%<br>TX   | 5%<br>RX | 90%<br>STBY | 10%<br>TX  | 20%<br>RX | 70%<br>STBY | 20%<br>TX | 40%<br>RX | 40%<br>STBY |
| Temperature -20°C/-4°F              | 57 hrs.           | 15.50 hrs. |          |             | 8.50 hrs.  |           |             | 4.40 hrs. |           |             |
| Temperature +20°C/68°F              | 85 hrs.           | 26.10 hrs. |          |             | 14.30 hrs. |           |             | 7.50 hrs. |           |             |
| Temperature +50°C/122°F             | 90 hrs.           | 28.40 hrs. |          |             | 16.20 hrs. |           |             | 8.40 hrs. |           |             |

## 6.14 Emergency Operation

Even under low / emergency supply conditions, the **FSG 90(X)** can be operated reliably from as low as 10 Volts supply. This however will reduce both the RF output level and audio output power.

Batteries must be recharged after discharge. However, the **FSG 90(X)** automatic switch-OFF feature at too low supply avoids battery damage, even if the radio is stored in switched ON condition! This is true for all types of 12 V batteries.

## Appendix A, Technical Summary

### A.1 General

|                             |                                                                                                                       |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------|
| Type:                       | <b>FSG 90</b> , A/N F10185                                                                                            |
| Frequency Range:            | 118.000 MHz to 136.975 MHz with 25 kHz spacing and<br>118.000 MHz to 136.975 MHz with 8.33/25 kHz spacing             |
| Number of Channels:         | 25 kHz spacing: 760<br>8.33/25 kHz spacing: 2,278, totally 3,038 Channels                                             |
| Number of Channel Memories: | 99 for Channel names with 8.33/25 kHz spacing. Additional<br>99 channel memories for frequencies with 25 kHz spacing. |
| Nominal Supply Voltage:     | 13.8 Vdc                                                                                                              |
| Nominal TX carrier output:  | ≥ 6 Watt                                                                                                              |
| Type:                       | <b>FSG 90-H1</b> , A/N F10302                                                                                         |
| Frequency Range:            | 118.000 MHz to 136.975 MHz with 25 kHz spacing and<br>118.000 MHz to 136.975 MHz with 8.33/25 kHz spacing             |
| Number of Channels:         | 25 kHz spacing: 760<br>8.33/25 kHz spacing: 2,278, totally 3,038 Channels                                             |
| Number of Channel Memories: | 99 for Channel names with 8.33/25 kHz spacing. Additional<br>99 channel memories for frequencies with 25 kHz spacing. |
| Nominal Supply Voltage:     | 14.0 Vdc                                                                                                              |
| Nominal TX carrier output:  | ≥ 10 Watt                                                                                                             |

|                                                                                                                                                                                                    |                                                                                                                                                                                                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Supply Voltage Range                                                                                                                                                                               | 11.0 - 16.5 Vdc, continuous                                                                                                                                                                                                             |
| Emergency Operation (below 11 Vdc)                                                                                                                                                                 | Good communication from 10 Vdc on                                                                                                                                                                                                       |
| Automatic Turn-Off                                                                                                                                                                                 | Approx. 8.5 ... 9.5 Vdc Supply                                                                                                                                                                                                          |
| Automatic Turn-On (reset)                                                                                                                                                                          | Approx. 9.5 ... 10 Vdc Supply                                                                                                                                                                                                           |
| Input Current at 13.8 Vdc:<br>Standby (Power Saving Mode)<br>Additionally Squelch, Intercom + AF Ext.<br>Receive Mode (70% AM voice)<br>Transmit Mode (carrier / 70% AM voice)<br>Display Lighting | <b>FSG 90:</b><br>≤ 85 mA (no volume, no AF External, no Intercom)<br>add 30 mA w/out AF volume, add 250 mA with max volume<br>≤ 1 A (into 2 Ohm speaker)<br>≤ 2.5 A / ≤ 3.0 A<br>≤ 30 mA additionally                                  |
| Input Current at 14.0 Vdc:<br>Standby (Power Saving Mode)<br>Additionally Squelch, Intercom + AF Ext.<br>Receive Mode (70% AM voice)<br>Transmit Mode (carrier / 70% AM voice)<br>Display Lighting | <b>FSG 90-H1:</b><br>≤ 85 mA (no volume, no AF External, no Intercom)<br>add 30 mA w/out AF volume, add 250 mA with max volume<br>≤ 1 Amp (into 2 Ohm speaker)<br>≤ 3.5 A / ≤ 4.5 A<br>≤ 30 mA additionally                             |
| DC Supply indicator                                                                                                                                                                                | 3 segments visible: ≥ 12.7 Vdc    Battery full<br>2 segments visible: ≥ 12.0 Vdc    Battery ca. ½ capacity<br>1 segment visible: ≥ 11.0 Vdc    Battery nearly<br>discharged<br>3 flashing segments: 11 V ... 10 Vdc Emergency operation |

## A.2 Dimensions, Weight, Fuses

|                                           |                                                                                                                                                                                            |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Front Panel                               | 57 mm dia / 2¼ in. dia, fits a standard panel opening                                                                                                                                      |
| Depth behind panel                        | 200 mm / 7.85 in. (allow 30 mm/1.2 in. for plugs and harness)                                                                                                                              |
| Overall Dimensions                        | Width = 63 mm/2.5 in., Height = 58 mm/2.28 in., Depth = 223 mm/8.78 in.                                                                                                                    |
| Weight <b>FSG 90</b>                      | 0.80 kg/1.77 lb. without harness and mating connectors                                                                                                                                     |
| Weight <b>FSG 90-H1</b>                   | 0.82 kg/1.81 lb. without harness and mating connectors                                                                                                                                     |
| External Fuse                             | <b>6 W model:</b> Cartridge fuse 3.15 Amp, quick acting, or automatic circuit breaker, 3 Amp<br><b>10 W model:</b> Cartridge fuse 5 Amp, quick acting, or automatic circuit breaker, 5 Amp |
| Inline Fuse, switched/regulated DC Output | 315 mAmp, medium time lag                                                                                                                                                                  |

## A.3 Approvals

|                                                                                        |                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Airborne Radio</b> (Regulatory Authority For Telecommunications and Posts)          | "EC Type-Examination Certificate" no. B132705J, and "TYPE-EXAMINATION CERTIFICATE" no. A132937J                                                                                                                                                                                                                                                            |
| <b>Airborne Radio</b> (Regulatory Authority For Telecommunications and Posts, and LBA) | Reg TP 321 ZV 034<br>EUROCAE ED-23B:<br>Receiver Class C 25 kHz spacing CLIMAX operation, and<br>Receiver Class E 8.33 kHz spacing<br>Transmitter Class 4 100 NM with 25 kHz spacing, and<br>Transmitter Class 6 100 NM with 8.33 kHz spacing<br>Environmental Requirements EUROCAE ED-14C / RTCA DO-160C:<br>Categories D1-AA(BMN)XXXXXXZBBBATZ(A3C2X)XXX |
| ETSO-Authorization (LBA, <b>airborne</b> )                                             | ETSO-2C37e and ETSO-2C38e<br>No. LBA.O.10.911/98 JTSO<br>replaced by EASA.21O.1305                                                                                                                                                                                                                                                                         |
| Software                                                                               | EUROCAE ED-12B / RTCA DO-178B, Level D                                                                                                                                                                                                                                                                                                                     |
| <b>Ground Operation</b> (BAF)                                                          | D-0036/2014 (FSG90)<br>D-0037/2014 (FSG90-H1)                                                                                                                                                                                                                                                                                                              |

## A.4 Receiver Characteristics

|                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Receiver Type                            | Dual Superhet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| IF Frequencies                           | First IF 10.0 MHz, second IF 455 kHz, high injection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Sensitivity (m = 30% / 1,000 Hz)         | $\leq 2 \mu\text{V EMF}$ ( $\leq -107 \text{ dBm}/50 \Omega$ ) for 6 dB S+N/N                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Selectivity                              | <p>SINAD decreased from 12 dB to 6 dB<br/>           Reference level m = 60%/1,000 Hz for 12 dB SINAD<br/>           Interference level m = 60%/400 Hz</p> <p> <math>\leq 6 \text{ dB}</math> for <math>\pm 8 \text{ kHz}</math> (25 kHz CH spacing)<br/> <math>\geq 60 \text{ dB}</math> for <math>\pm 17 \text{ kHz}</math> (25 kHz CH spacing)<br/> <math>\geq 70 \text{ dB}</math> for <math>\pm 25 \text{ kHz}</math> (25 kHz CH spacing)<br/> <math>\leq 6 \text{ dB}</math> for <math>\pm 3 \text{ kHz}</math> (8.33 kHz CH spacing)<br/> <math>\geq 50 \text{ dB}</math> for <math>\pm 7.37 \text{ kHz}</math> (8.33 kHz CH spacing)         </p> |
| Squelch Type                             | Automatic (FM/AM), adjustable (SET-UP); manual override.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| AGC Characteristic                       | $\leq 6 \text{ dB}$ , $2 \mu\text{V EMF}$ (-107 dBm) ... $2 \text{ V EMF}$ (+13 dBm/50 $\Omega$ ), m = 30%/1,000 Hz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| AGC Delay (RX)                           | $\leq 0.1 \text{ sec}$ , $200 \text{ mV EMF}$ (-1 dBm) ... $2 \mu\text{V EMF}$ (-107 dBm / 50 $\Omega$ ), m = 30%/1,000 Hz)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| AGC Recovery after TX                    | $\leq 0.1 \text{ sec}$ at $10 \mu\text{V EMF}$ (-93 dBm / 50 $\Omega$ ), after TX end                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Transfer time TX / RX                    | $\leq 50 \text{ msec}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Modulation distortion (AF Processor OFF) | $\leq 10\%$ , 350 ... 2,500 Hz (m = 85%)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Audio Frequency Response / AF Fidelity   | <p><math>\leq +2 \text{ dB}</math> and <math>-4 \text{ dB}</math>, 350 ... 2,500 Hz, 25 kHz and 8.33 kHz CH spacing<br/> <math>\geq -20 \text{ dB}</math>, 4,000 Hz, 25 kHz CH spacing (Climax Offset Operation)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Audio Frequency AGC                      | $\leq 1.5 \text{ dB}$ , m = 30% ... 90%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Nominal AF Output (Speaker)              | $\geq 4 \text{ Watt} / 4 \Omega$ , or $\geq 8 \text{ Watt} / 2 \Omega$ (at 13.8 Vdc)<br>$\geq 1.5 \text{ Watt} / 4 \Omega$ (at 10 Vdc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Nominal AF Output (Phone)                | $\geq 100 \text{ mW} / 600 \Omega$ (at 13.8 Vdc)<br>$\geq 50 \text{ mW} / 600 \Omega$ (at 10 Vdc)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| AF Noise Level                           | $\geq 40 \text{ dB}$ , m = 30%/1,000 Hz<br>$200 \mu\text{V EMF}$ (-67 dBm/50 $\Omega$ ) ... $10 \text{ mV EMF}$ (-33 dBm/50 $\Omega$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| AF External Input                        | $\leq 1 \text{ Volt}$ into 600 $\Omega$ for rated AF output (13.8 Vdc supply)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Spurious Response                        | $\geq 10 \text{ mV EMF}$ (-33 dBm), m = 30%/1 kHz, for S+N/N $\leq 6 \text{ dB}$<br>a) 108 - 156 MHz (of any Test Channel $\leq \pm 8 \text{ kHz}$ ), at other than the assigned channel and the adjacent channels<br>b) 50 kHz – 1,215 MHz (except 108 - 156 MHz)                                                                                                                                                                                                                                                                                                                                                                                        |
| Cross Modulation (AF Processor OFF)      | <p>Max. AF output level <math>\geq 10 \text{ dB}</math> <u>below</u> nominal AF output level:</p> <p>a) Wanted signal <math>20 \mu\text{V EMF}</math> (-87 dBm) ... <math>500 \mu\text{V EMF}</math> (-59 dBm/50 <math>\Omega</math>), unmodulated at RX frequency, additional<br/>           b) Unwanted signal <math>10 \text{ mV EMF}</math> (-33 dBm), m = 30%/1,000 Hz, frequency 100 - 156 MHz (frequency <math>\leq \pm 2 \text{ RX}</math> channels)</p>                                                                                                                                                                                          |
| Intermodulation (AF Processor OFF)       | $\leq 6 \text{ dB AF Quieting}$ (-5 dBm/50 $\Omega$ , 87.5 – 107.9 MHz), 2 signals                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

|                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Desensitization                   | <p>Wanted signal 20 <math>\mu</math>V EMF (-87 dBm), m = 30%/1,000 Hz, at RX frequency, for S+N/N <math>\geq</math> 6 dB, in the presence of</p> <p>Unwanted signal <b>A</b> 10 mV EMF (-33 dBm/50 <math>\Omega</math>), unmodulated, frequency 108 ... 156 MHz, except used CH, but includes <math>\geq</math> 1 RX CH, or</p> <p>Unwanted signal <b>B</b> 200 mV EMF (-7 dBm/50 <math>\Omega</math>); minimum 10 mV EMF (-87 dBm), unmodulated, frequency 50 kHz – 1,215 MHz, except 87.5 MHz ... 156 MHz, or</p> <p>Unwanted signal <b>C</b> 250 mV EMF (-5 dBm), unmodulated, frequency 87.5 ... 107.9 MHz</p> |
| Receiver Spurious Emission        | $\leq$ 400 pW / -64 dBm (50 kHz ... 1,215 MHz)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Channel Selection Time            | $\leq$ 0.4 sec, AF level within 3 dB, max. 99 Channel memories                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Receiver Muting, Squelch (CLIMAX) | <p>Simultaneous input at RX frequency:</p> <p>a) Wanted Signal <b>A</b>: 10 <math>\mu</math>V EMF (-93 dBm) +8 kHz (m = 30%/1,000 Hz), Squelch is open.</p> <p>b) Unwanted Signal <b>B</b>: More than 24 <math>\mu</math>V EMF (-85 dBm), m = 30% / 1,000 Hz, vary this frequency slowly from -8 kHz to +4 kHz. Squelch must remain open.</p>                                                                                                                                                                                                                                                                      |

## A.5 Transmitter Characteristics

|                                                                    |                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>FSG 90(X):</b> Nominal TX RF Output Power (normal operation)    | ≥ 6 Watt / 50 Ω (carrier), ≥ 20 Watt PEP, at 13.8 Vdc<br>-0.5 dB ... +1.5 dB                                                                                                                                                                                                                                                                           |
| <b>FSG 90-H1:</b> Nominal TX RF Output Power (normal operation)    | ≥ 10 Watt / 50 Ω (carrier), ≥ 30 Watt PEP, at 14.0 Vdc<br>-0.5 dB ... +1 dB                                                                                                                                                                                                                                                                            |
| <b>FSG 90:</b> Nominal TX RF Output Power (emergency operation)    | ≥ 1.5 Watt / 50 Ω (carrier) at 10 Vdc supply                                                                                                                                                                                                                                                                                                           |
| <b>FSG 90-H1:</b> Nominal TX RF Output Power (emergency operation) | ≥ 3.5 Watt / 50 Ω (carrier) at 10 Vdc supply                                                                                                                                                                                                                                                                                                           |
| TX Duty Cycle                                                      | 1 : 4 (1 minute TX / 4 minutes RX)                                                                                                                                                                                                                                                                                                                     |
| TX Time Out Timer                                                  | After 2 minutes continuous TX. Transmitter is unkeyed automatically and the radio display flashes as a warning.                                                                                                                                                                                                                                        |
| Modulation                                                         | Amplitude modulation, AM (A3E)                                                                                                                                                                                                                                                                                                                         |
| Depth of Modulation                                                | ≥ 75% (Voice processor with dynamic compression)                                                                                                                                                                                                                                                                                                       |
| Modulation Distortion                                              | ≤ 10% (m = 70% / 1,000 Hz)<br>≤ 15% (m = 70% / 350 ... 2,500 Hz)                                                                                                                                                                                                                                                                                       |
| Modulation Audio Frequency Response                                | ≤ +2 dB and -4 dB (350 ... 2,500 Hz)                                                                                                                                                                                                                                                                                                                   |
| Modulation AF Input for m = 70%                                    | Dynamic Microphone: ≤ 0.5 ... 10 mV symmetrical, sensitivity adjustable in SET-UP.<br>Amplified/Carbon Microphone: ≤ 80 ... 500 mV unsymmetrical, sensitivity adjustable in SET-UP.                                                                                                                                                                    |
| True Transmit Sidetone (derived from modulated TX RF signal)       | ≥ 100 mW / 600 Ω (at 13.8 Vdc supply),<br>≥ 50 mW / 600 Ω (at 10 Vdc), volume adjustable in SET-UP, independent from speaker volume                                                                                                                                                                                                                    |
| Carrier Noise Level                                                | ≥ 45 dB (m = 70%/1,000 Hz)                                                                                                                                                                                                                                                                                                                             |
| Emission of RF Energy (≤ 1000 MHz)                                 | ≤ 0,25 µW (-36 dBm) / 71 dB µV / 3.54 mV / 50 Ω<br>≤ 4 nW (-54 dBm) / 53 dB µV / 446 µV / 50 Ω, from 47 ... 68, 87.5 ... 137, 162 ... 244, 328 ... 336, 470 ... 862 MHz                                                                                                                                                                                |
| Emission of RF Energy (≥ 1000 MHz)                                 | ≪ 1 µW / ≪ -30 dBm / ≪ 77 dB µV / ≪ 7 mV / 50 Ω                                                                                                                                                                                                                                                                                                        |
| Transmitter Spectrum Mask                                          | Max. +2 / -4 dB at 350 ... 2,500 Hz modulation (8.33 kHz spacing)<br>≥ 45 dB at 3,200 Hz modulation (8.33 kHz spacing)<br>≥ 60 dB at ≥ 5,000 Hz modulation (8.33 kHz spacing)                                                                                                                                                                          |
| Channel Selection Time                                             | ≤ 0.5 sec                                                                                                                                                                                                                                                                                                                                              |
| Frequency Tolerance                                                | ≤ 1 ppm (0°C ... + 40°C / 32°F ... 104°F),<br>≤ 1.5 ppm (-20°C ... + 55°C / -4°F ... + 131°F)                                                                                                                                                                                                                                                          |
| Unwanted FM (Frequency modulation)                                 | ≤ 1.0 kHz at m = 70% / 1,000 Hz                                                                                                                                                                                                                                                                                                                        |
| TX Intermodulation                                                 | ≥ 45 dB                                                                                                                                                                                                                                                                                                                                                |
| Antenna Mismatching                                                | VSWR ≤ 3 : 1, normal operation<br>At VSWR 3 : 1 the requirements for modulation distortion, spurious and harmonics output as well as frequency stability are met. In addition, the RF output is ≥ 40 % /<br><b>FSG 90:</b> ≥ 2.4 Watt into 50 Ω at 13.8 Vdc.<br><b>FSG 90-H1:</b> ≥ 6 Watt into 50 Ω at 14.0 Vdc.<br>At VSWR ≤ 5 : 1 still functional. |

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## Appendix B, Environmental Performance Classification

Compliance measurements according to EUROCAE ED-14C / RTCA DO-160 C were performed and the following Environmental Categories fulfilled.

| Environmental Conditions         | ED-14C<br>DO-160C | Description of conducted tests                       | Category     |
|----------------------------------|-------------------|------------------------------------------------------|--------------|
| Temperature and Altitude         | 4.0               | Equipment tested to category                         | <b>D1</b>    |
| • Low Temperature                | 4.5.1             | Operation -20°C (-4°F)<br>Storage -55°C (-67°F)      |              |
| • High Temperature               | 4.5.2             | Operation +55°C (131°F)<br>Storage +85°C (185°F)     |              |
| • in-flight Loss of Cooling      | 4.5.3             | No auxiliary cooling required                        | -            |
| • Low Pressure (Altitude)        | 4.6.1             | 50,000 ft. /15,240 m                                 |              |
| • Decompression                  | 4.6.2             | No test required in category D1                      |              |
| • High Pressure                  | 4.6.3             | No test required in category D1                      |              |
| Temperature Variation            | 5.0               | 10°C/min (18°F/min),<br>Equipment tested to category | <b>A</b>     |
| Humidity                         | 6.0               | Equipment tested to category                         | <b>A</b>     |
| Shock                            | 7.0               | Equipment tested to                                  |              |
| • Operational shocks             | 7.2               | 6 g                                                  |              |
| • Crash safety                   | 7.3               | 15 g                                                 |              |
| Vibration                        | 8.0               | Equipment tested to category                         | <b>BMN</b>   |
| Explosion                        | 9.0               | No test required                                     | <b>X</b>     |
| Waterproofness                   | 10.0              | No test required                                     | <b>X</b>     |
| Fluids Susceptibility            | 11.0              | No test required                                     | <b>X</b>     |
| Sand and Dust                    | 12.0              | No test required                                     | <b>X</b>     |
| Fungus                           | 13.0              | No test required                                     | <b>X</b>     |
| Salt Spray                       | 14.0              | No test required                                     | <b>X</b>     |
| Magnetic Effect                  | 15.0              | ≤ 13 cm/1°, Equipment tested to category             | <b>Z</b>     |
| Power Input                      | 16.0              | Equipment tested to category                         | <b>B</b>     |
| Voltage Spike                    | 17.0              | Equipment tested to category                         | <b>B</b>     |
| Audio Frequency Susceptibility   | 18.0              | Equipment tested to category                         | <b>B</b>     |
| Induced Signal Susceptibility    | 19.0              | Equipment tested to category                         | <b>A</b>     |
| Radio Frequency Susceptibility   | 20.0              | Equipment tested to category                         | <b>T</b>     |
| Radio Frequency Emission         | 21.0              | Equipment tested to category                         | <b>Z</b>     |
| Lightning Induced Susceptibility | 22.0              | Equipment tested to category                         | <b>A3C2X</b> |
| Lightning effects                | 23.0              | No test required                                     | <b>X</b>     |
| Icing                            | 24.0              | No test required                                     | <b>X</b>     |
| Other Test                       | ---               | No test required                                     | <b>X</b>     |

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## Appendix c, ICAO Frequency-Channel Pairing

The table below shows TX and RX frequency, respective channel spacing and the corresponding channel name or frequency, which is shown at the display of the **FSG 90** in the range from 118.000 MHz to 118.1000 MHz.

In combined 8.33 kHz / 25 kHz channel spacing mode, the active Channel Name is displayed with 6 digits.

In "25 kHz only" channel spacing mode, frequencies are displayed with 5 digits.

This allows unique identification of the mode used.

Of course this frequency-channel pairing plan also applies to all other frequencies between 118.1000 MHz and 136.9750 MHz.

| Operating frequency<br>(MHz) | Channel Spacing<br>(kHz) | 8.33/25 kHz Mode<br>Channel Name =<br>Display at <b>FSG 90</b> | 25 kHz Mode<br>Frequency =<br>Display at <b>FSG 90</b> |
|------------------------------|--------------------------|----------------------------------------------------------------|--------------------------------------------------------|
| <b>118.0000</b>              | <b>25</b>                | <b>118.000</b>                                                 | <b>118.00</b>                                          |
| 118.0000                     | 8.33                     | 118.005                                                        |                                                        |
| 118.0083                     | 8.33                     | 118.010                                                        |                                                        |
| 118.0166                     | 8.33                     | 118.015                                                        |                                                        |
| <b>118.0250</b>              | <b>25</b>                | <b>118.025</b>                                                 | <b>118.02</b>                                          |
| 118.0250                     | 8.33                     | 118.030                                                        |                                                        |
| 118.0333                     | 8.33                     | 118.035                                                        |                                                        |
| 118.0416                     | 8.33                     | 118.040                                                        |                                                        |
| <b>118.0500</b>              | <b>25</b>                | <b>118.050</b>                                                 | <b>118.05</b>                                          |
| 118.0500                     | 8.33                     | 118.055                                                        |                                                        |
| 118.0583                     | 8.33                     | 118.060                                                        |                                                        |
| 118.0666                     | 8.33                     | 118.065                                                        |                                                        |
| <b>118.0750</b>              | <b>25</b>                | <b>118.075</b>                                                 | <b>118.07</b>                                          |
| 118.0750                     | 8.33                     | 118.080                                                        |                                                        |
| 118.0833                     | 8.33                     | 118.085                                                        |                                                        |
| 118.0916                     | 8.33                     | 118.090                                                        |                                                        |
| <b>118.1000</b>              | <b>25</b>                | <b>118.100</b>                                                 | <b>118.10</b>                                          |
| 118.1000                     | 8.33                     | 118.105                                                        |                                                        |
| etc.                         | etc.                     | etc.                                                           | etc.                                                   |

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## Appendix D, Certificates



**European Aviation Safety Agency**

### **EUROPEAN TECHNICAL STANDARD ORDER (ETSO) AUTHORISATION**

**EASA.21O.1305, REV. A**

This European Technical Standard Order (ETSO) Authorisation is issued by EASA, acting in accordance with Regulation (EC) No. 216/2008 on behalf of the European Community, its Member States and of the European third countries that participate in the activities of EASA under Article 66 of that Regulation, subject to conditions specified below, to

**FUNKWERK AVIONICS GmbH**  
HEINZ-STRACHOWITZ-STRASSE 4  
86807 BUCHLOE  
GERMANY

in accordance with Commission Regulation (EU) No. 748/2012, Part 21, Section A, Subpart O and JTSO-2C37E, JTSO-2C38E for

**FSG90(X) and FSG90(X)-H1 VHF Communication Transceiver Families**  
**P/N FSG90(X), FSG90(X)-H1**  
**DDP No. 031.00, or Subsequent Revisions**

**Remarks:**

This authorisation supersedes approval EASA.21O.1305 due to a name change of the approval holder.

**Conditions:**

1. The above ETSO Authorisation holder is only authorised to identify an Article with this ETSO marking whilst remaining in compliance with the conditions retained for the Issue of this Authorisation.
2. This ETSO Authorisation does not constitute an installation approval. It is the responsibility of those installing this article to determine that the aircraft installation conditions are within the ETSO standards.

This ETSO Authorisation shall remain valid until surrendered or revoked.

**For the European Aviation Safety Agency,**

**Date of issue: 30 August 2013**

  
**Markus GOERNEMANN**  
Certification Manager  
Parts & Appliances

EUROPEAN TECHNICAL STANDARD ORDER (ETSO) AUTHORISATION - 10025626, REV. A - FUNKWERK AVIONICS GmbH  
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|  <b>Bundesaufsichtsamt<br/>für Flugsicherung</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                   | <h1>Urkunde</h1> |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------|--|
| Ein(e)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | VHF-Sprechfunkgerät für Bodenfunkstellen des Flugfunkdienstes                     |                  |  |
| Typ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | FSG 90-II in dem im Anhang zur Zulassungsurkunde aufgeführten Konfigurationsstand |                  |  |
| Frequenzbereich                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 118 – 136,975 MHz                                                                 |                  |  |
| Kanalraster                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 8,33 kHz / 25 kHz                                                                 |                  |  |
| der Firma                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | f.a.n.k.e AVIONICS GmbH<br>Heinz-Strachowitz-Str. 4<br>86807 Buchloe              |                  |  |
| bestehend aus                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Rundgerät (Sende-/Empfangeinheit in 10W Ausführung)                               |                  |  |
| für die Betriebsart                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 6K80A3EJN (25 kHz) / 5K00A3EJN (8,33 kHz)                                         |                  |  |
| <p>ist auf Einhaltung der Anforderungen an Anlagen und Geräte für Zwecke der Flugsicherung gemäß § 4 Flugsicherungs-Anlagen- und Geräte-Musterzulassungs-Verordnung (FSMusterzulV) geprüft worden.</p> <p>Die Anlage oder das Gerät entspricht damit den Festlegungen des Bundesministeriums für Verkehr und digitale Infrastruktur hinsichtlich Art, Umfang und Beschaffenheit von flugsicherungstechnischen Einrichtungen gemäß § 32 Abs. 4 des Luftverkehrsgesetzes sowie der Richtlinien und Empfehlungen der Internationalen Zivilluftfahrt-Organisation (ICAO).</p> <p>Es wird daher als Muster mit den umseitig aufgeführten Auflagen in der Bundesrepublik Deutschland zugelassen.</p> <p>Der Gerätetyp hat die Zulassungsnummer <b>D-0037/2014</b> erhalten.</p> |                                                                                   |                  |  |
| <p>Bundesaufsichtsamt für Flugsicherung<br/>Langen, den 18.12.2014</p> <p>Im Auftrag </p> <p>Bodo Heinzl</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                   |                  |  |

|  <b>Bundesaufsichtsamt<br/>für Flugsicherung</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                | <h1>Urkunde</h1> |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|------------------|--|
| Ein(e)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | VHF-Sprechfunkgerät für Bodenfunkstellen des Flugfunkdienstes                  |                  |  |
| Typen                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | FSG 90 in dem im Anhang zur Zulassungsurkunde aufgeführten Konfigurationsstand |                  |  |
| Frequenzbereich                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 118 – 136,975 MHz                                                              |                  |  |
| Kanalraster                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 8,33 kHz / 25 kHz                                                              |                  |  |
| der Firma                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | f.a.n.k.e AVIONICS GmbH<br>Heinz-Strachowitz-Str. 4<br>86807 Buchloe           |                  |  |
| bestehend aus                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Rundgerät (Sende-/Empfangeinheit in 6W Ausführung)                             |                  |  |
| für die Betriebsart                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 6K80A3EJN (25 kHz) / 5K00A3EJN (8,33 kHz)                                      |                  |  |
| <p>ist auf Einhaltung der Anforderungen an Anlagen und Geräte für Zwecke der Flugsicherung gemäß § 4 Flugsicherungs-Anlagen- und Geräte-Musterzulassungs-Verordnung (FSMusterzulV) geprüft worden.</p> <p>Die Anlage oder das Gerät entspricht damit den Festlegungen des Bundesministeriums für Verkehr und digitale Infrastruktur hinsichtlich Art, Umfang und Beschaffenheit von flugsicherungstechnischen Einrichtungen gemäß § 32 Abs. 4 des Luftverkehrsgesetzes sowie der Richtlinien und Empfehlungen der Internationalen Zivilluftfahrt-Organisation (ICAO).</p> <p>Es wird daher als Muster mit den umseitig aufgeführten Auflagen in der Bundesrepublik Deutschland zugelassen.</p> <p>Der Gerätetyp hat die Zulassungsnummer <b>D-0036/2014</b> erhalten.</p> |                                                                                |                  |  |
| <p>Bundesaufsichtsamt für Flugsicherung<br/>Langen, den 18.12.2014</p> <p>Im Auftrag </p> <p>Bodo Heinzl</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                |                  |  |

CE-Déclaration de conformité à la directive 1999/5/CE  
CE-Déclaration d'aptitude à l'emploi de constituants d'interopérabilité suivant (CE) 552/2004

|                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Hersteller:<br/>Manufacture/fabricant:</p> <p>Anschrift:<br/>Adresse/adresse:</p> <p>Produktbezeichnung:<br/>Product description:</p> <p>Norm du produit:</p> <p>Types:<br/>Types/types:</p> | <p>f.u.n.k.e. AVIONICS GmbH</p> <p>Heinz-Strachowitz-Str. 4, D-86807 Buchloe, Germany</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <p>Produktbeschreibung:<br/>Product description:</p> <p>Description du produit:</p>                                                                                                             | <p>VHF Bodenfunkstelle, tragbar, stationär, mobil<br/>Ground-based VHF transceiver, portable, fixed, mobile<br/>Émetteur-récepteur VHF au sol, portable, fixe, mobile</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <p>Types:<br/>Types/types:</p>                                                                                                                                                                  | <p>FSG 90 / FSG 90-H1 / FSG 90E / FSG 90E-H1</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <p>Produktbeschreibung:<br/>Product description:</p> <p>Description du produit:</p>                                                                                                             | <p>VHF Flugfunkgerät bestehend aus Hardware und Software (Firmware) zur Verwendung als mobile oder stationäre Bodenfunkstelle<br/>VHF transceiver comprising hardware and software (firmware) to be used as a mobile or fixed ground radio station<br/>Appareil de communication radio fonctionnant à la fois en mode émission et en mode réception (microprogramme) utilisé comme une station de radio mobile ou fixe sol</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <p>Technische Daten:</p>                                                                                                                                                                        | <p>Technische Daten:</p> <ul style="list-style-type: none"> <li>• Gewicht: ca. 810 g</li> <li>• 25 KHz und 8.33 KHz Raster</li> <li>• Ausgangsleistung: typ. 6 Watt / 20 Watt PEP (FSG 90 und FSG 90E); 10 Watt / 30 Watt PEP (FSG 90-H1 und FSG 90E-H1)</li> <li>• Arbeits Temperaturbereich: -20 bis +55 °C</li> <li>• Abmessungen: 58 x 63 x 230 mm, inkl. Stecker</li> <li>• Frequenzbereich: 118.000 bis 136.975 MHz (FSG 90 und FSG 90-H1); 118.000 bis 149.975 MHz (FSG 90E und FSG 90E-H1)</li> </ul> <p>Technical Data:</p> <ul style="list-style-type: none"> <li>• Weight: approx. 810 g</li> <li>• 25 KHz and 8.33 KHz channel spacing</li> <li>• Output power: typ. 6 watts / 20 watts PEP (FSG 90 and FSG 90E); 10 watts / 30 watts PEP (FSG 90-H1 and FSG 90E-H1)</li> <li>• Operating temperature: -20 to +55 °C</li> <li>• Dimensions: 58 x 63 x 230 mm, incl. connectors</li> <li>• Frequency range: 118.000 to 136.975 MHz (FSG 90 and FSG 90-H1); 118.000 to 149.975 MHz (FSG 90E and FSG 90E-H1)</li> </ul> <p>Données techniques:</p> <ul style="list-style-type: none"> <li>• Poids: env. 810 g</li> <li>• Espacement de 25 KHz et 8,33 KHz</li> <li>• Puissance de sortie: typ. 6 watts / 20 watts PEP (FSG 90 et FSG 90E); 10 watts / 30 watts PEP (FSG 90-H1 et FSG 90E-H1)</li> <li>• Température de fonctionnement: -20 à +55 °C</li> <li>• Dimensions: 58 x 63 x 230 mm, incl. connecteurs</li> <li>• Gamme de fréquences: 118,000 à 136,975 MHz (FSG 90 et FSG 90-H1); 118,000 à 149,975 MHz (FSG 90E et FSG 90E-H1)</li> </ul> |

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Dr. Thomas Wittig  
Geschäftsführer  
Managing Director  
Directeur  
f.u.n.k.e. AVIONICS GmbH  
f.u.n.k.e. AVIONICS GmbH  
f.u.n.k.e. AVIONICS GmbH

Diese Erklärung bezieht sich auf die Betrachtung der Gebrauchstauglichkeit innerhalb des Flugverkehrsmanagementsfeldes zur VO (EG) Nr. 552/2004.  
 This statement refers to the consideration of the suitability for use within the air traffic management environment to regulation (EC) no. 552/2004.  
 Cette déclaration se réfère à l'examen de l'aptitude à l'usage au sein de l'environnement de gestion du trafic aérien au règlement (CE) no. 552/2004.

|                                                                                                                                        |                                                                                                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>f.u.n.k.e.</b><br/>AVIONICS GMBH</p> <p><i>f.u.n.k.e. means - fabrication - utilities - network - know-how - engineering</i></p> |                                                                                                                                                                        |
| <p>Maßnahmen zur effizienten Nutzung des Funkfrequenzspektrums<br/>means of the efficient use of the radio frequency spectrum</p>      | <p>Einhaltung der grundlegenden Anforderungen auf<br/>andere Art und Weise ...<br/>other means of demonstrating conformity with the essential<br/>requirements ...</p> |
| <p>Harmonisierte Normen ...<br/>Harmonised standards ...</p>                                                                           | <p>ETSI EN 300 676-1 V1.5.2 and<br/>ETSI EN 300 676-2 V1.5.1<br/>1-6011/13-01-03</p>                                                                                   |
| <p>Standards</p>                                                                                                                       |                                                                                                                                                                        |
| <p>Test Report No.</p>                                                                                                                 |                                                                                                                                                                        |
| <p>Ort, Datum<br/>Place &amp; date of issue</p>                                                                                        | <p>D-86807 Buchloe, 17. März 2014</p>                                                                                                                                  |
| <p>Name und Unterschrift<br/>Name and signature</p>                                                                                    | <p><br/>Dr. Thomas Wiling<br/>Accountable Manager</p>                               |

2(2)

|                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>f.u.n.k.e.</b><br/>AVIONICS GMBH</p> <p><i>f.u.n.k.e. means - fabrication - utilities - network - know-how - engineering</i></p>                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                          |
| <p><b>Konformitätserklärung</b><br/><b>Declaration of Conformity</b></p>                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                          |
| <p>gemäß dem Gesetz über Funkanlagen und Telekommunikationsendeinrichtungen (FTEG) und<br/>der Richtlinie 1999/5/EG (R&amp;TTE)</p>                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                          |
| <p>Declaration of Conformity appropriate to the law of radio and telecom terminal equipment</p>                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                          |
| <p><b>f.u.n.k.e. AVIONICS GmbH</b><br/>Heinz-Strachowitz-Str. 4<br/>D-86807 Buchloe</p>                                                                                                                                                                                                                 | <p><b>VHF/AM FLUGFUNKGERÄT</b><br/>VHF/AM Aeronautical Voice<br/>Communications Transceiver</p>                                                                                                                                                                                                          |
| <p>erklärt, dass das Produkt<br/>declares that the product</p>                                                                                                                                                                                                                                          | <p><b>FSG 90/FSG90E/FSG90E-HI/</b><br/><b>FSG90E-HI</b></p>                                                                                                                                                                                                                                              |
| <p>Typ (ggf. Anlagenkonfiguration mit Angabe der Module):<br/>Type (if applicable, configuration including the modules)</p>                                                                                                                                                                             | <p><input checked="" type="checkbox"/> Funkanlage<br/>radio equipment</p>                                                                                                                                                                                                                                |
| <p><input type="checkbox"/> Telekommunikations(Tk-)endeinrichtung<br/>telecommunications terminal equipment</p>                                                                                                                                                                                         | <p><b>II Geräteklasse, equipment class</b></p>                                                                                                                                                                                                                                                           |
| <p>VHF Bodenfunkstelle, tragbar, stationär, mobil;<br/>Ground-based VHF Transceiver, portable, fixed, mobile</p>                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                          |
| <p>Verwendungszweck, intended purpose</p>                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                          |
| <p>bei bestimmungsgemäßer Verwendung den grundlegenden Anforderungen des § 3 und den übrigen<br/>entschließlichen Bestimmungen des FTEG entspricht.<br/>complies with the appropriate essential requirements of the FTEG and the other relevant provisions, when used for its<br/>intended purpose.</p> |                                                                                                                                                                                                                                                                                                          |
| <p>Gesundheit und Sicherheit<br/>Health and Safety requirements</p>                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                          |
| <p>Harmonisierte Normen ...<br/>Harmonised standards ...</p>                                                                                                                                                                                                                                            | <p>Einhaltung der grundlegenden Anforderungen auf<br/>andere Art und Weise ...<br/>other means of demonstrating conformity with the essential<br/>requirements ...<br/>IEC 60950-1:2005 (2nd Edition)/A1:2009 and<br/>EN 60950-1:2006/A11:2009/A1:2010/A12:2011<br/>CE, AA WC 34<br/>1-6011/13-01-07</p> |
| <p>Standards</p>                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                          |
| <p>Test Procedure</p>                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                          |
| <p>Test Report No.</p>                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                          |
| <p>Schutzanforderungen in Bezug auf die elektromagnetische Verträglichkeit<br/>Protection requirements with respect to electromagnetic compatibility</p>                                                                                                                                                |                                                                                                                                                                                                                                                                                                          |
| <p>Harmonisierte Normen ...<br/>Harmonised standards ...</p>                                                                                                                                                                                                                                            | <p>Einhaltung der grundlegenden Anforderungen auf<br/>andere Art und Weise ...<br/>other means of demonstrating conformity with the essential<br/>requirements ...<br/>ETSI EN 301 489-1 V1.9.2 and<br/>ETSI EN 301 489-22 V1.3.1<br/>1-6011/13-01-05</p>                                                |
| <p>Standards</p>                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                          |
| <p>Test Report No.</p>                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                          |

1(2)

Annex 1 Expert Opinion – Registration No. E816847A-EO

Page 2 of 2

Product Characteristics:

Aeronautical ground-based VHF, mobile transceiver

Carrier Frequency

: 118.000-149.975 MHz

RF-Output (pulse power)

: FSG 90E: 37.8 dBm(6 W)  
FSG 90E-H1: 40.0 dBm (10 Watt)

Number of channels

: 3838 (8.33 kHz); 1280 (25 kHz)

Type of Modulation

: AM (8K00A3E)8.33 and 25kHz separation

Antenna

: BNC socket

Power supply

: 14V DC

Temperature range

: -20°C to +55°C

Conformity Details:

| Evaluated test reports | Standard, test report number, date & laboratory                                                                              |
|------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Requirement            | EN 60950-1:2006/A11:2009/A12:2010/A12:2011                                                                                   |
| Safety                 | No. : 1-6011/13-01-07 dated 2013-04-04 and issued by CETECOM ICT Services GmbH                                               |
| EMC                    | EN 301 489-1 V1.9.2<br>EN 301 489-22 V1.3.1                                                                                  |
| Radio spectrum         | No. : 1-6011/13-01-05 dated 2013-04-09 and issued by CETECOM ICT Services GmbH<br>EN 300 676-2 V1.5.1<br>EN 300 676-1 V1.5.2 |

Miscellaneous:

TCF according to the application

EXPERT OPINION

CETECOM

TM

CETECOM ICT Services GmbH  
EC Identification Number 0682

Industrie- und Handelskammer  
Saarbrücken

Industrie- und Handelskammer  
Saarbrücken

Certificate Holder:

Dittel Messtechnik GmbH  
Erpfinger Str. 36  
86889 Landsberg / Germany

Product Designation:

Aeronautical ground-based VHF, mobile transceiver

Model(s):

FSG 90 (X) (6 Watt) FSG 90(X)-H1 (10Watt)

Conformity Assessment:

| Essential requirements               | Examined documentation                        | Result  |
|--------------------------------------|-----------------------------------------------|---------|
| Health<br>R&TTE, Article 3.1a        | Technical documentation including test report | conform |
| Safety<br>R&TTE, Article 3.1a        | Technical documentation including test report | conform |
| EMC<br>R&TTE, Article 3.1b           | Technical documentation including test report | conform |
| Radio Spectrum<br>R&TTE, Article 3.2 | Technical documentation including test report | conform |

Expert Opinion:

Our opinion in accordance with Annex IV of Council Directive 1999/5/EC on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity is that the evaluation of the submitted documents related to the apparatus identified above complies with the requirement of that directive stated in the above scope.

Marking:

The product shall be marked with CE, our Notified Body Number and the Class II identifier (Alert sign) as shown in beside picture.

CE 0682

DEUTSCHE BERATUNGSGESAMTHEIT

DEUTSCHE BERATUNGSGESAMTHEIT

Annexes:

The scope of this evaluation relates to the submitted documents only.  
The certificate is only valid in conjunction with the following number of annexes: 1

Certificate Registration No.:

E816847A-EO

Place, Issue date

Saarbrücken, 2013-04-28

Authorized signature / title

Fabian Cöster

CETECOM ICT Services GmbH

2013.04.13 10:29:17 +02:00

Authorized signature / title

65117 Saarbrücken - Germany - www.cetecom.com

CETECOM ICT Services GmbH - Unterhühnenstr. 6-10

72

FAV\_D10024

December 2014

FCC - OET EAS Form 731 Grant of Equipment Authorization <https://apps.fcc.gov/oetcf/eas/reports/Eas731GrantForm.cfm?mod...>

**COPY**

FEDERAL COMMUNICATIONS  
COMMISSION  
WASHINGTON, D.C. 20554  
  
GRANT OF EQUIPMENT  
AUTHORIZATION  
Certification

**COPY**

f.u.n.k.e. AVIONICS GmbH  
Heinz-Strachowitz-Str. 4  
86807 Buchloe,  
Germany

Date of Grant: 11/27/2002  
Application Dated: 09/14/2001

Attention: Erik Wischmann

**NOT TRANSFERABLE**

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: BVYFSG90  
Name of Grantee: f.u.n.k.e. AVIONICS GmbH  
Equipment Class: Licensed Non-Broadcast Station Transmitter  
Notes: VHF/AM aviation analogue voice COMM transceiver  
Modular Type: Does not apply

| Grant Notes | FCC Rule Parts | Frequency Range (MHz) | Output Watts | Frequency Tolerance | Emission Designator |
|-------------|----------------|-----------------------|--------------|---------------------|---------------------|
|             | 87             | 118.0 - 136.975       | 6.0          | 1.5 PM              | 25K0A3E             |
|             | 87             | 118.0 - 136.975       | 10.0         | 1.5 PM              | 25K0A3E             |
|             | 87             | 118.0 - 136.975       | 6.0          | 1.5 PM              | 8K00A3E             |
|             | 87             | 118.0 - 136.975       | 10.0         | 1.5 PM              | 8K00A3E             |
|             | 87             | 118.0 - 149.975       | 6.0          | 1.5 PM              | 25K0A3E             |
|             | 87             | 118.0 - 149.975       | 10.0         | 1.5 PM              | 25K0A3E             |
|             | 87             | 118.0 - 149.975       | 6.0          | 1.5 PM              | 8K00A3E             |
|             | 87             | 118.0 - 149.975       | 10.0         | 1.5 PM              | 8K00A3E             |

Notes: Emission 8K00A3E is listed pursuant to waiver of Section 87.173(b)  
This application was originally granted on 06/04/2002.

Mail To:

EA102416



