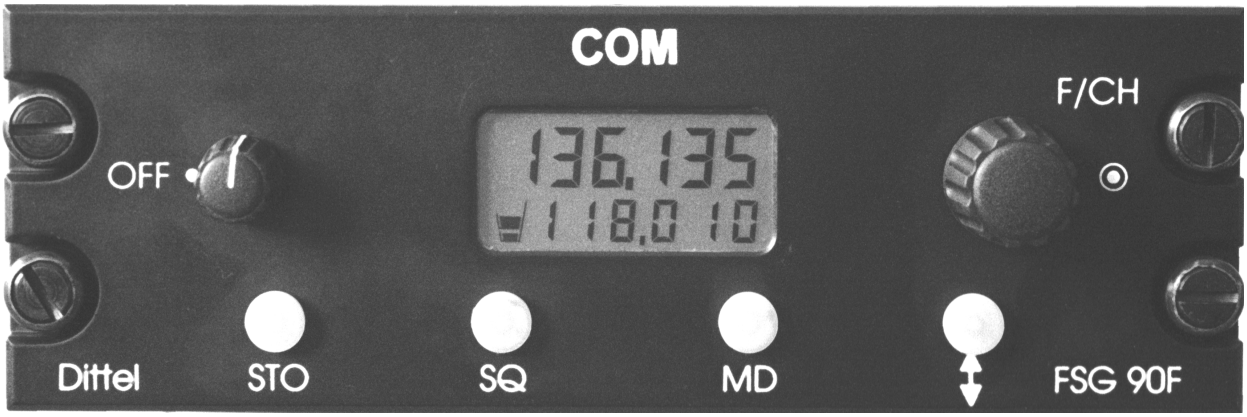
6 Watt FSG 90F

10 Watt FSG 90F-H1



CE

B A132
Z
T 937J

No. LBA.O.10.911/98 JTSO
DFS-No.: B-7850/97

6 Watt – 10 Watt Dual Mode VHF/AM AIRBAND TRANSCEIVERS

118.000 ... 136.975 MHz

8.33 kHz/25 kHz or '25 kHz only' channel spacing

Installation & Operation

applies for FSG 90F article no. F10194
applies for FSG 90F-H1 article no. F10306

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

Please observe the Safety Information!

Keep for further use!

Document No.:	IM 034.00
Article-No.:	D10033
Date of Issue	November 2000

Walter DITTEL GmbH
Luftfahrtgerätebau

Avionics Division
Erpftinger Strasse 36 ★ D-86899 Landsberg ★ GERMANY
Telephone +49 8191/ 3351-0 ★ Fax +49 8191/ 3351-49
e-mail: firma@dittel.com ★ **Internet:** http://www.dittel.com

Warranty - Copyright - Service

Warranty

The details and data in this operator's manual correspond to the respective state of technology on the day of printing. We reserve our right to change without prior notice due to new technological design or corresponding new production technology.

Walter Dittel GmbH takes no guarantee for these documents with respect to application and interpretation.

Walter Dittel GmbH ("Warrantor") warrants to the purchaser of new radio equipment of the warrantor's manufacture that such equipment shall be free from defects in material and workmanship for a period of 24 month from the date of delivery. Equipment and accessory items not manufactured by the Warrantor carry the standard warranty (12 month) of the manufacturer thereof.

This warranty does not cover equipment which has been

1. **damaged or not maintained as reasonable and necessary,**
2. **modified in any way,**
3. **improperly installed,**
4. **repaired by someone other than the warrantor or an authorized warranty avionics shop, or**
5. **used in a manner or purpose for which the equipment was not intended.**

This warranty shall not extend to incidental or consequential damages arising from operation of the equipment or from any claimed breach of this warranty.

Service

The information in this Operator's Manual does not profess to include all the details of design, production, or variation of the equipment, or to cover all the possible contingencies which may arise during operation or maintenance.

Should any unusual problem arise or further information be desired, please contact the Walter Dittel GmbH Service Department, Erpftinger Strasse 36, D-86899 Landsberg am Lech, Germany.

Subject to technical changes Printed in Germany 14.09.01

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Abbreviations

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

Section 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 frequency 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 (or part of it) inside the cabin. This may cause malfunction of the avionics or trigger the airbag! Always operate the radio **FSG 90F(X)** with a suitable outside / external antenna! Assure appropriate lightning protection where elevated outdoor antennas are used.
- **DO NOT** operate the radio whilst driving. It should also be noticed 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 switch OFF the radio first when installing the unit into vehicles or aircraft when removing from it!
- Always switch OFF the radio first when starting an engine or vehicle!
- When operating the **FSG 90F(X)** on a 24 Vdc source a suitable Voltage Converter 24 Vdc/12 Vdc of at least 4 Amps must be used!
- The **FSG 90F(X)** may be used 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 a suitable noise canceling microphone or headset for aircraft radios shall be used.
- A backup microphone should always be carried 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 90F(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. But at distances of 2 to 6 miles a faulty antenna and/or cable will cause communication breakdown!
- Push-to-Talk keys may stick occasionally. Therefore, observe while transmitting the transmit (TX) symbol at the **FSG 90F(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.

1.1 Used Symbols

In this manual the following symbols are used:

DANGER!
describes an immediate threatening danger! Failing to observe the note may cause death or heavy 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 (SET-UP or user programmed memory)!

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

Section 2 General Description

2.1 Introduction

This installation and operating manual IM 034.00 contains instructions and descriptions for application, installation, presetting operation and testing, as well as interconnecting diagrams of the multi-use **FSG 90F / FSG 90F-H1 VHF/AM Transceiver System** of Walter Dittel GmbH, Luftfahrtgeraetebau, D-86899 Landsberg, Germany.

The maintenance manual MRM 034.00 contains detailed circuit description, repair instructions, alignment procedures, testing instructions, and an illustrated parts list.

2.2 Models of the FSG 90F System

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

F10194, VHF/AM Dual Mode Airband Transceiver FSG 90F

Frequency range: 118.000 to 136.975 MHz, channel spacing 8.33 kHz/25 kHz, results in 2,278 channels, or 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, **6 Watt RF output power**, 10 - 16.5 Vdc supply. The radio fits a standard ARINC NORM rectangular opening.

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

F10306, VHF/AM Dual Mode Mode Airband Transceiver FSG 90F-H1

Frequency range: 118.000 to 136.975 MHz, channel spacing 8.33 kHz/25 kHz, results in 2,278 channels, or 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 Watt RF output power**, 10 - 16.5 Vdc supply. The radio fits a standard ARINC NORM rectangular opening.

IDENT.: MODEL 90F-H1-25/8.33 (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 **FSG 90F(X)** airborne applications in any powered aircraft, motor glider and Ultralight, and in glider and balloon, for primary or (also battery supplied) backup operation.

2.4 Brief Description

Both radios out of the **FSG 90F System** are miniaturized, lightweight, panel-mounted 1.8" high flat-pack VHF/AM transceivers operating in the airband frequency range 118.000 MHz ... 136.975 MHz, thus providing either 2,278 channels with 8.33 kHz/ 25 kHz channel spacing, or 760 channels only with 25 kHz 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 ARINC NORM rectangular opening of the instrument panel or console, fixing is done by 4 DZUS fasteners. Depth including wiring is 215 mm.
All control and display elements are located on the front panel. Connections to the electrical environment are made through a 25-pole SUB-D connector and a BNC female connector at the rear panel of the units.
The ICAO channel name (8.33 kHz/25 kHz spacing) and / or 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 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 preset channel memory number (1 … 99)
- **Direct Tune Mode:** Active channel name or frequency only.

With the Dual Mode models **FSG 90F** and **FSG 90F-H1**, 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 preset. After change to the other operating mode (from 8.33/25 kHz to 25 kHz only, or from 25 kHz only 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 the **FSG 90F(X)** can easily reprogrammed also during flight or ground operation.
Programming can be done in the actual (8.33/25 kHz or 25 kHz only) mode.
Deleting channel memories is only possible during SET-UP.
For ground applications, limitation to use preset channel(s) only can be determined in (password protected) SET-UP.
Channel name / frequency, or preset 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).
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 90F-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 during 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 90F(X)** is used in installations, where no external audio is required for speaker output. Listening through headphone remains however possible. This external AF OFF function may be selected in SET-UP. This reduces the standby current consumption to only 80 mA and will extend battery supplied operating time significantly.
The transceiver can be supplied either directly from a 12 to 14 Vdc A/C bus, or through a suitable DC regulator from 28 Vdc-buses.
In aircraft without onboard electric power generation system (UL, Glider etc.), operation from a rechargeable 12 Vdc battery (min. 6 Ah) is suitable.
The DC supply voltage is monitored continuously while the radio is ON. 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 90F(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 Leveling in Receive, and in addition prevents overmodulation in both Single and Dual channel spacing Mode. 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 90F(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 VHF/AM Airband Transceivers **FSG 90F(X)** 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.

2.5.1 JTSO Authorization LBA.O.10.911/98 JTSO (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 also includes Immunity according to ICAO ANNEX 10 against FM Broadcast Interference.

This also includes fulfillment 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.

2.5.2 Reg TP No. A132937J, stringent German Type Approval requirements Reg TP 321 ZV 034 (airborne) and Reg TP 321 ZV 039 (ground).

2.5.3 DFS (Deutsche Flugsicherung) No. B-7850/97 (ground) German Type Approval requirements.

2.5.4 BZT No. B132705J, CE Conformity,
* Associated with DIN/ISO 7637-1 DC supply in 12 V vehicle.

IMPORTANT!

- ***For the first time after one year, then every 2nd year, ground applications using 8.33 kHz channel spacing require checking of the high precision reference frequency (tolerance less than ± 1.5 ppm) and recalibration, if necessary!***
- ***Every 4th year, airborne applications using 8.33 kHz channel spacing require checking of the high precision reference frequency (tolerance less than ± 5 ppm) and recalibration, if necessary!***
- ***All applications in the 25 kHz channel spacing require no recalibration (frequency accuracy tolerance less than ± 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!

- ***Both VHF/AM airborne and ground operation always requires an individual operating license. Depending on national regulations, such license must be applied for at appropriate National Authorities, using suitable application forms.***
- ***Besides aircraft registration, operator's name, address and operating license payment details, state radio type, Serial number, JTSO number LBA.O.10.911/98 JTSO, and Reg TP number A132937J.***

2.7 Equipment supplied

Description	Walter Dittel Article number
Dual Mode 6 Watt VHF/AM Transceiver **FSG 90F**, Installation and Operation manual, Operating instructions, Warranty card to cover 24 months	F10194
Dual Mode 10 Watt VHF/AM Transceiver **FSG 90F-H1**, Installation and Operation manual, Operating instructions, Warranty card to cover 24 months	F10306

2.8 Optional Accessories

Description	Article no
Connector kit, SUB-D 25-pin, incl. mounting hardware	F10212
Folded-top antenna, for gliders, antistatic, 118-137 MHz, 9 m/29.5 ft cable RG-58C/U, BNC connector. Applies for wood or GRP tail-fin, not metal or carbon fiber tail-fin!	F10057
Aircraft whip antenna, swivel type, 5 m/16.5 ft cable, w/out RF plug	W00066
BNC antenna connector, male, 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 10 Watt / 4 ? , small, robust case, two 5-pole sockets to connect 2 microphones or headsets, terminal for PTT key, mates harness F10189 or F10190,	F10061
Dynamic headset, noise cancelling, coiled cord, 4-pole plug U-174/U	W00048
Adapter cable for headset W00048, to mate F10061 A/C speaker	F10036
Dynamic goose neck microphone 600 ? , 3 m/9.8 ft cable, 5-pole connector, specially for gliders and motor gliders	F10039
Dynamic microphone, for PC portable, and for car mobile use, coiled cord, PTT key, 5-pole plug	F10041
Holding clamp device for microphone F10041	E24907
Dynamic fist microphone, 600 ? , coiled cord, PTT key, 5-pole plug	F10043
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, mate A/C speaker A/N F10061, and noise canceling Headset, A/N W00048, clip allows attaching to clothing	F10125
Aircraft Power Supply, 12 Vdc/6.5 Ah lead calcium battery, complete with rugged steel/aluminum case, circuit breaker, 5-LED test set, 2-pole socket, mounting bracket	F10023
Automatic battery charger DL-50, 115/230 Vac. Output 13.8 Vdc / 600 mA. For all airborne and portable 12 V lead batteries	F10130

2.9 Accessories 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 power supply unit 12 Vdc, minimum 6 Ah, for aircraft without electrical system
f) Push-to-talk key permanently installed on yoke (if a microphone w/out PTT key is used)
g) 25 pole SUB-D connector type DA-25 S and cover, if no pre-manufactured wiring harness exists.

2.10 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 leveling 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 90F(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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Section 3 Installation

3.1 General

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

Information in this section are 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 inspector - before the installation – to get authorized certification of your completed installation.*
- *The conditions and tests required for **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 **FAA-TSO** standards. If not within the **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 90F** 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 without delay also to Walter Dittel GmbH.

3.3 Pre-installation Test

Before installing the radio into an aircraft or vehicle, 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) to the test bench setup. For **FSG 90F** set supply to 13.8 Vdc at radio input terminals. For **FSG 90F-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 presetting) shall be within 0.5 µV and 5 µV / 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 Watts carrier, or more than 10 Watts carrier for **FSG 90F-H1** model).

f) Adjust audio generator to 1,000 Hz (via attenuator for dynamic microphone or directly via decoupling capacitor) connected to

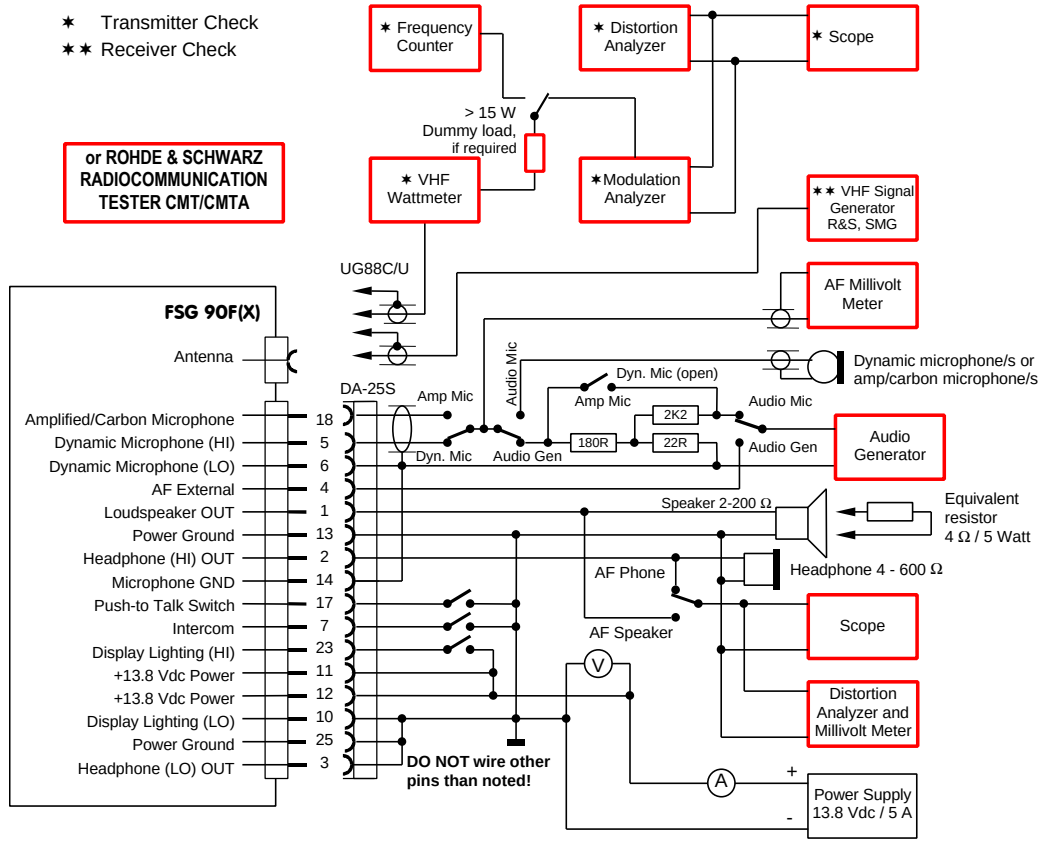
Amplified/Carbon Microphone Input
With 100 mV rms input, the transmitter shall achieve more than 70% AM. Increase AF input to 1.0 V rms, observe modulation envelope, no overmodulation shall occur; depth of modulation must remain less than 95% AM.

Dynamic Microphone Input
With some 1 mV rms input, the transmitter shall achieve more than 70% AM (depending on SET-UP presetting). Increase AF input to 10 mV rms and observe modulation envelope. No overmodulation shall occur; depth of modulation must remain less than 95% AM.

3.3.1 Particular Remarks to FSG 90F(X) transmitter modulation

For the combined 8.33 kHz and 25 kHz channel spacing airband radio technology, highly demanding, 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 90F(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 Walter Dittel GmbH **FSG 90F System** incorporates a special Dittel VOICE PROCESSOR, which is matched best to meet the requirements of the particular environmental noise level situation.
    a) This ensures 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, fulfillment 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% sine modulation distortion, but will stay far below the maximum allowed 25% modulation distortion factor with sine modulation.
6. Therefore, judgement 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 setup.
7. For tests of the **FSG 90F(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.



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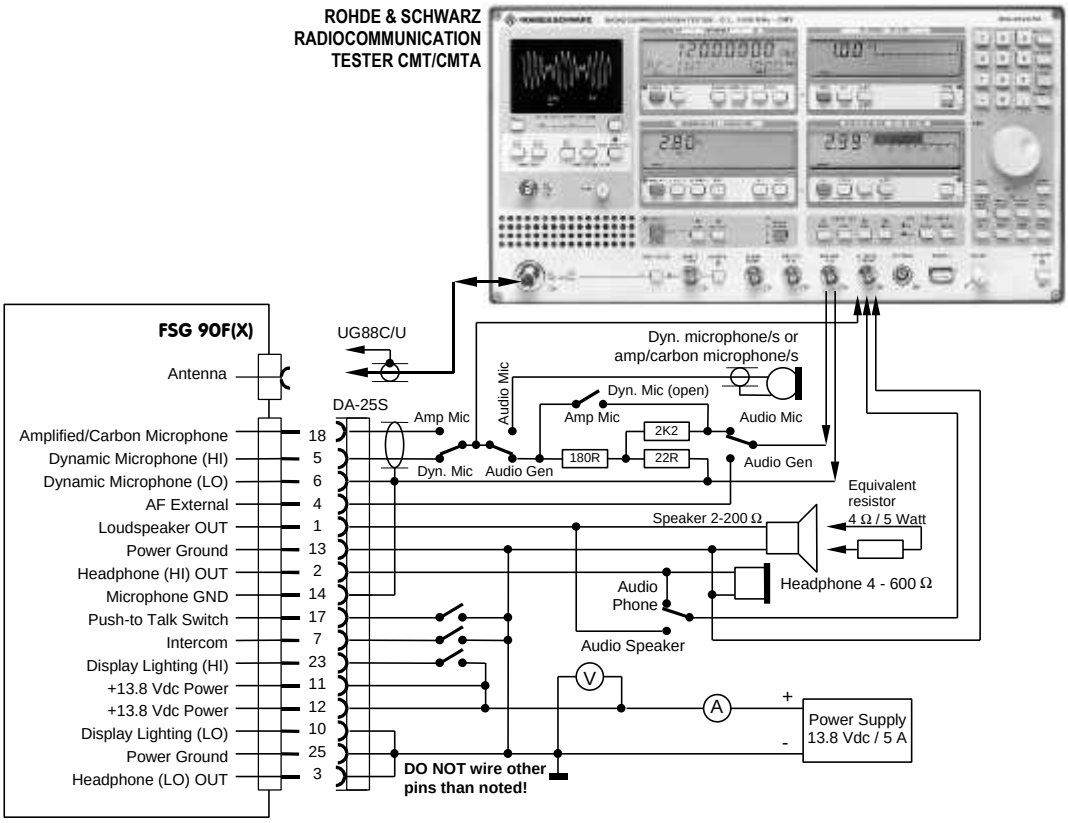


Fig. 3-1: **FSG 90F System** Test Setup

3.4 Mechanical Installation

3.4.1 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 90F(X) VHF/AM transceivers are designed to be installed into the instrument panel or operating console from its front side. Fixing is made by four DZUS fasteners (ARINC NORM SIZE). All dimensions to install the **FSG 90F(X)** refer to Figure 3-3. For installation of the fastener strips refer to Figure 3-4.

If there is no suitable cutout, one can be made following the dimensions given in Figure 3-4. Using flat fastener strips (type PR 35-1) is recommended.

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.

Sufficient room (at least 230 mm / 9 in.) behind front panel must be left for wiring accommodation.

3.4.2 Compass deviation

Compass deviation caused by **FSG 90F(X)** 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.

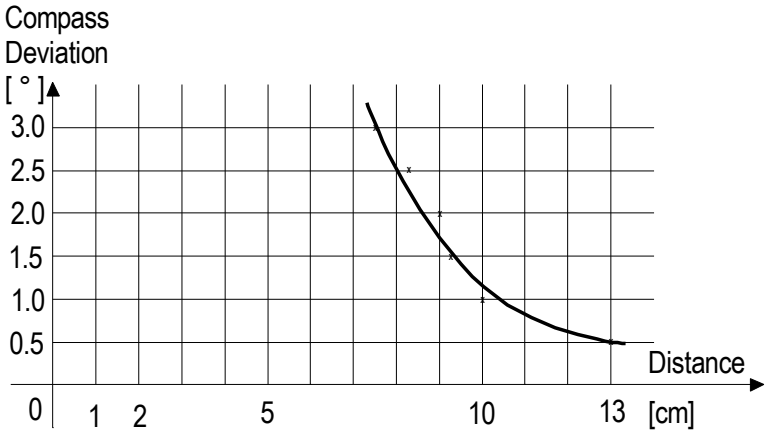


FIG. 3 - 2: DEVIATION OF A COMPASS BY AN OPERATING **FSG 90F(X)**, DEPENDS ON THE DISTANCE BETWEEN COMPASS CENTER AND CONTOUR OF TRANSCEIVER

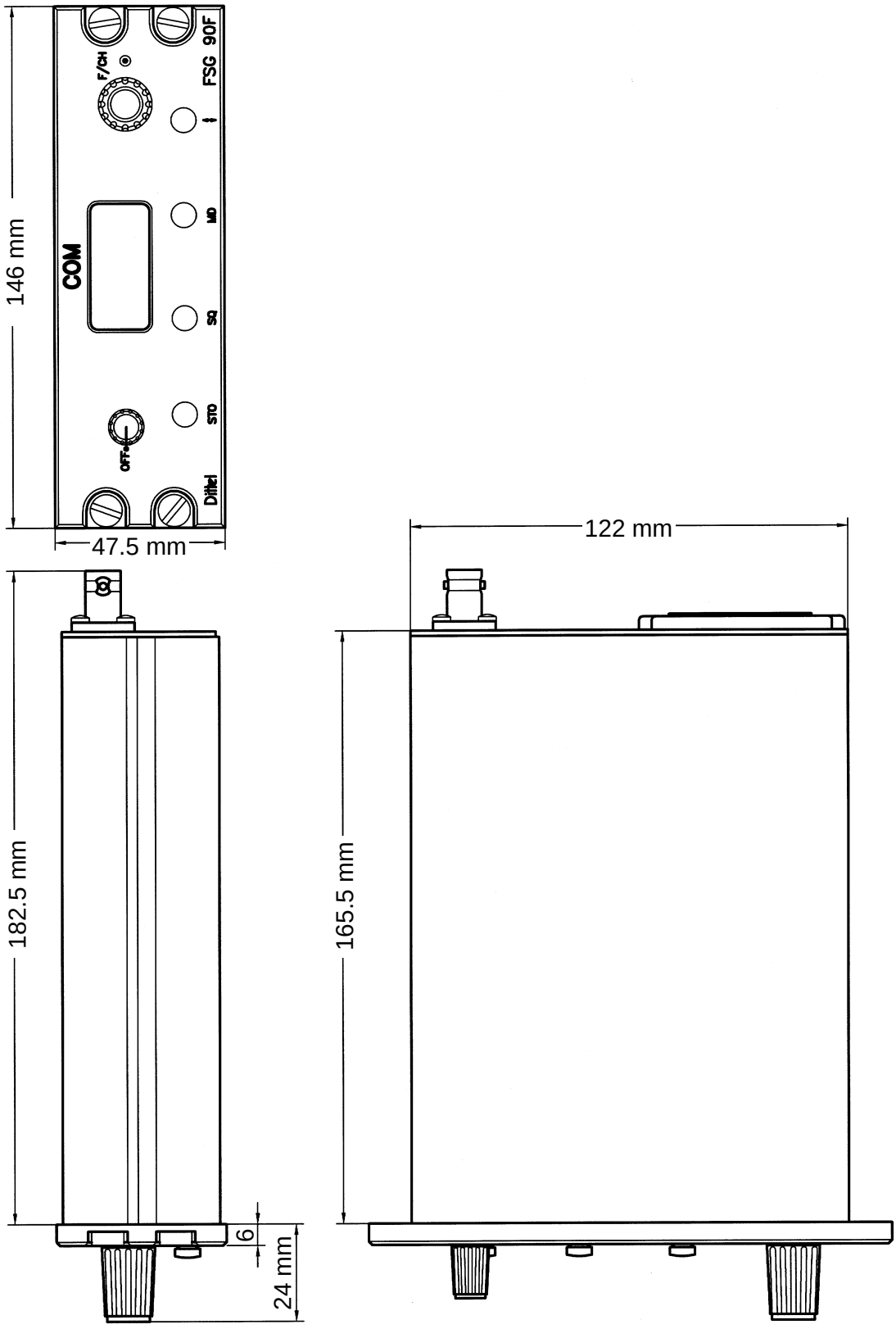


FIG. 3-3: **FSG 90F(X)**
DIMENSIONS
INSTALLATION DRAWING

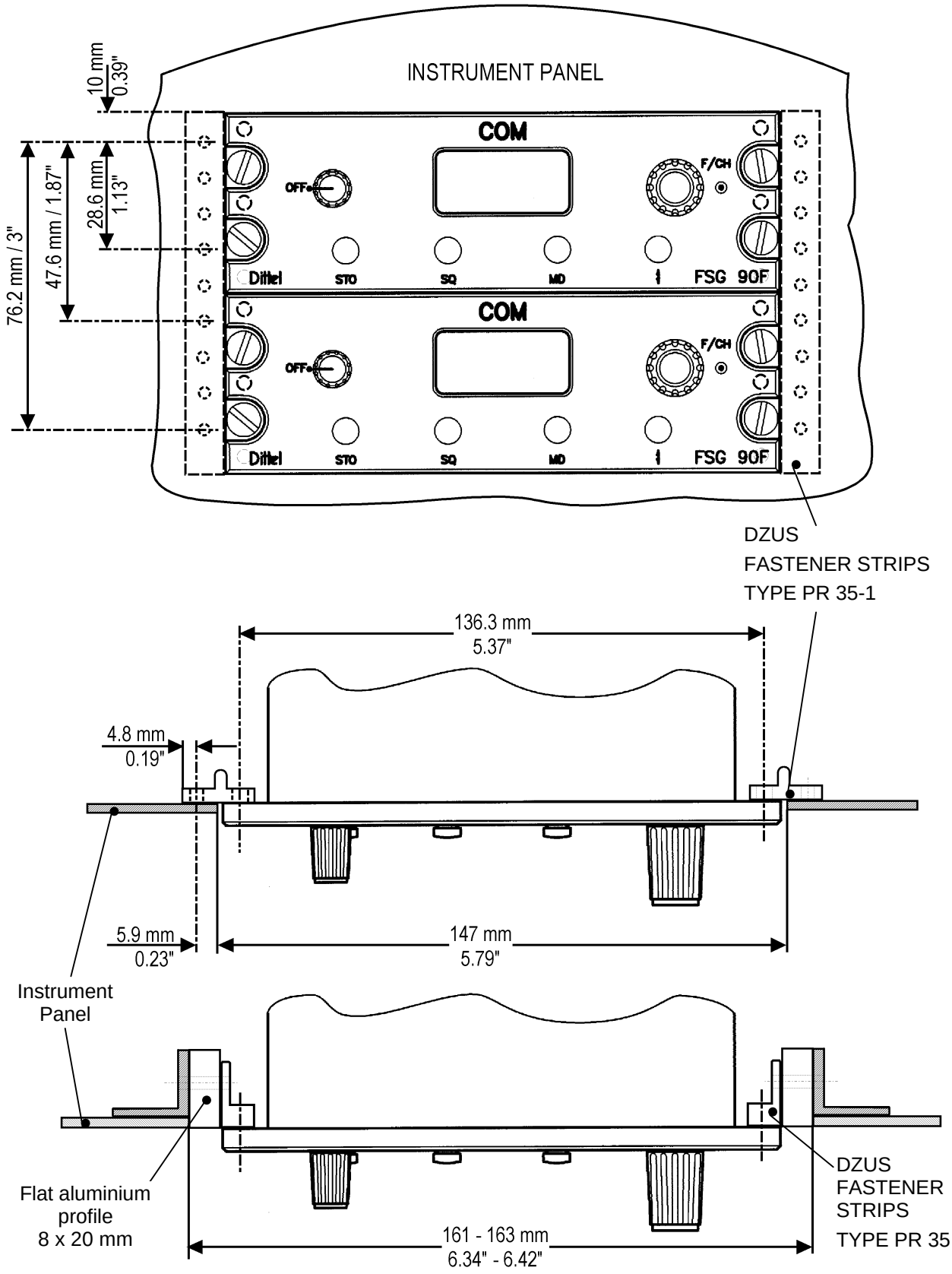


Fig. 3-4: **FSG 90F(X)**
Installation of the Fastener Strip

3.4.3 Antenna installation

Your radio FSG 90F(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:

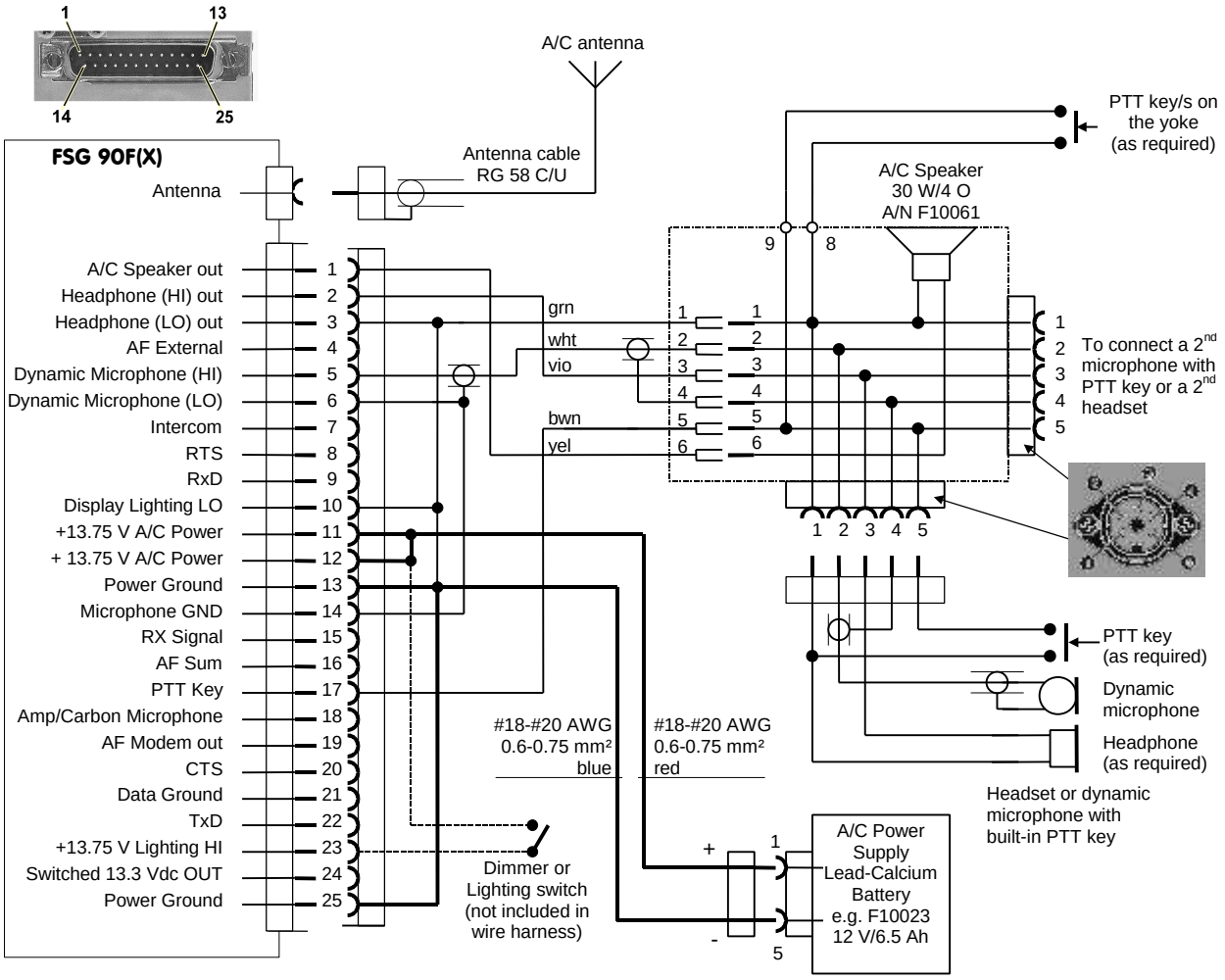
- First of all, look-up the aircraft's manual for antenna installation instructions.
- The antenna installation location must be carefully planned. It would be the best to consult the aircraft certifying inspector. In order to achieve best results into all directions, installation instructions must be fully complied with.
- For aircraft with metal fuselage, we recommend our antenna, article No. W00066. 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 90F(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 aluminum 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 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 glued in. The antenna socket will then be placed in the foil center, together with a metallic ground contact support plate.
- For aircraft with fuselage and/or tail-fin made of non conductive material our vertical folded top antenna, article no. F10057, is suitable. Installation is made best during manufacturing the tail-fin. A installation drawing is available on request.
  IMPORTANT: Carbon fiber 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 Ohm 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 Ohms indicates a short inside antenna connector, while some 0.6 to 1 Ohm indicates the antenna cable resistance, while an internally (static) protected antenna is used. A whip 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 Ohm SWR meter over the whole frequency range for SWR < 3:1. It may be helpful/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!**

3.5 Airborne wiring

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

3.5.1 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 come in contact with 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 90F(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 Watt 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 90F(X)** radio is made, carefully cross-check all wiring details, especially DC supply polarity.
- Secure the plugged SUB-D connector by the sliding lock retainer to avoid unwanted loosening.
- For easy installation, prefabricated wiring harnesses for all kind of aircraft are available from Walter Dittel GmbH.
- Electronic variometer 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. Perhaps, 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!

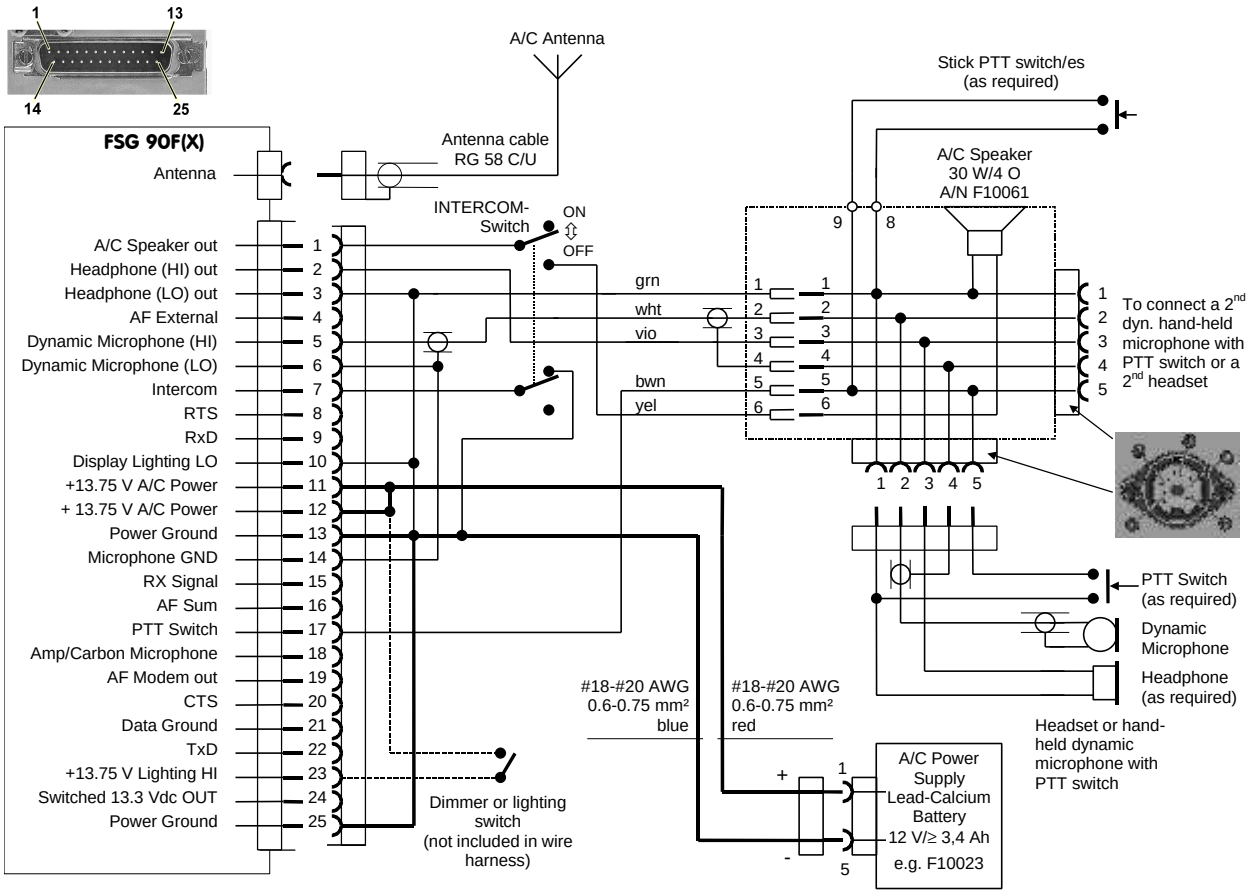
Unless otherwise noted, all wires are #22 AWG (0.3 -0.4 sq. mm).

Built-in circuit breaker when using **Walter Dittel** Battery A/C Power Supply, A/N F10023.

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

--------- and coax antenna cable are <u>not</u> included in wire harness F10189!

FIG. 3-5: **FSG 90F System**
HOOK-UP DIAGRAM USING WIRE HARNESS F10189
1 - 2 DYNAMIC MICROPHONES



NOTES:

DO NOT wire other pins than noted!

All wires #22 AWG (0.3 -0.4 sq. mm) unless otherwise noted.

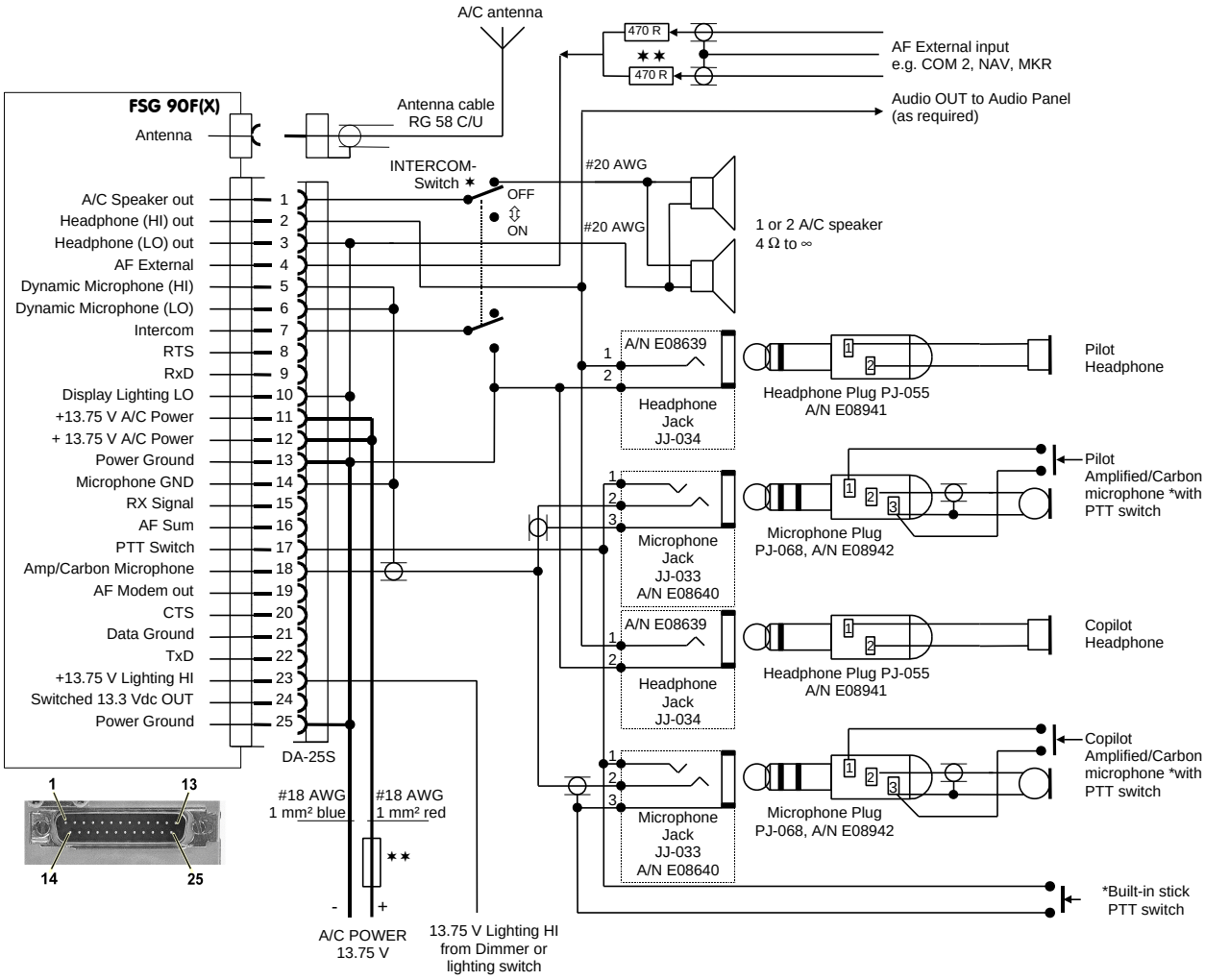
Intercom operation requires a microphone which provides audio OUT with the PTT key de-energized (not keyed).

Built-in circuit breaker when using **Walter Dittel GmbH** Battery A/C Power Supply, A/N F10023

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

--------- and coax antenna cable are <u>not</u> included in wire harness F10190!

FIG. 3-6: **FSG 90F System**
HOOK-UP DIAGRAM USING WIRE HARNESS F10190
1 - 2 DYNAMIC MICROPHONES AND INTERCOM



NOTES:

DO NOT wire other pins than noted!

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

Unless otherwise noted all Power Grounds are airframe grounds.

Intercom operation requires a microphone which 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.

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.

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

✶ Wiring without Intercom: connect A/C speaker direct to pins 11 and 15.

✶✶ If more than one AF source, isolation resistors 470 Ohm shall be installed.

✶✶✶ Fuse 3.15 Amp, quick acting, or circuit breaker 3 Amp.

FIG. 3-7: **FSG 90F System**
HOOK-UP DIAGRAM
2 AMPLIFIED/CARBON MICROPHONES
AND INTERCOM

3.5.2 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 90F 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 SUB-D 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 copilot 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 90F(X)** mike input sensitivity (SET-UP) will be good ONCE FOREVER for this configuration and to ensure stable operation without audio feedback.

IMPORTANT!

*The 3-pole mike connector type PJ-069 **MUST NEVER** be used 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.

3.5.3 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 copilot/crew (no PTT action is required for any IC operation).

During receive, 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 90F(X)** front panel (VOL), while intercom volume can be optimized with a SET-UP adjustment.

3.5.4 Loudspeaker / Headset interconnection

Two separate audio outputs are provided. 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, this Pin 1 may remain not connected, no spare load is required.

CAUTION!

- ***The magnet compass will be deflected by the speaker's magnetic field. Therefore, when using the*** Walter Dittel ***compact speaker box F10061, a minimum distance of 1.3 m/4.3 ft. between compass and speaker is required.***

3.5.5 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. Then the NAV headphone output may be connected directly to the **FSG 90F(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 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 90F(X)** AF 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. A possible magnetic interference coupling shall be especially regarded (distance from high current carrying wiring).

3.5.6 Lighting the Frequency Display

IMPORTANT!

- *Lighting operates separately and will not be controlled by the radio.*
- *In order to save current while supplied from battery an external suitable illumination switch is suggested.*

The **FSG 90F(X)** includes a display which can be back-lit. Pin 23 may be connected either directly to 14 Volt or to the switched 13.3 Vdc output Pin 24 (perhaps via a suitable dimmer). For dimmer operation from 28 Vdc 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 90F(X) *always requires a 12 to 14 Volts DC supply.***

3.5.7 Connection to a 28 Vdc airborne system

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

3.6 Post-installation Check

3.6.1 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 90F(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 VSWR 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 wrong (no 50 Ohm) coaxial cable.

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

After completion of the antenna matching measurements, perform the following test sequence:

- All audio level settings (microphone(s), phone(s), speaker, intercom through the SET-UP (refer to Section 5).
- Check radio with a known base station, as well as with distant airborne station(s).

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.*

3.6.2 Ground checks with engine running

It must be ensured that the aircraft's electrical DC system voltage at the **FSG 90F(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 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