FSG 2T

118.000 ... 136.975 MHz
25 kHz channel spacing

CE 0682 ⓘ
LBA.O.10.911/103 JTSO
DFS-No.: B-XXXX

FC FCC ID:
BVYXXXXXX

5 Watt VHF / AM AVIATION TRANSCEIVER

Installation & Operation

applies for FSG 2T (5 W) **article no. F10350**

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

Please observe the Safety Information!

Keep for further use!

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Serial #

Certified ISO 9001 Zertifiziert

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Manual Revision History

MANUAL IM 035.00
REVISION -

Retain these instructions in the front of the Installation & Operation Manual as a RECORD OF REVISIONS.

PAGE	REASON FOR CHANGE

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Abbreviations and Acronyms

A/C	Aircraft
A/N	Article Number (Walter Dittel GmbH)
AGC	Automatic Gain Control
Ah	Ampere hour
AM	Amplitude Modulation
ANT	Antenna
Ass'y	Assembly
AWG	American Wire Gauge
ccw	Counter-clockwise (turn left ↺)
CH	Channel
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	Milliampere
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)
RX	Receive
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
VCO	Voltage-Controlled Oscillator
Vac	Volts, alternating current
Vdc	Volts, direct current
VFO	Variable-frequency oscillator
VHF	Very-High Frequency
VOL	Volume
VSWR	Voltage Standing-Wave Ratio
W	Watt
Ω	Ohm
°C	Degrees Centigrade
°F	Degrees Fahrenheit

Section 1 For Your Safety

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:

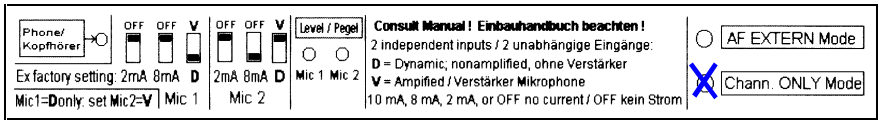
Do not operate this radio in an explosive atmosphere (petroleum fuels, solvents, dust, etc.)!

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

There are no user replaceable parts inside the FSG 2T! If the radio fails it must be returned to a WALTER DITTEL GMBH approved repair facility!

The licensee of a radio station is responsible at all times for the proper operation of the station. Radio operators should use the following guidelines to make this radio a useful tool for safe and efficient flight:

- **DO NOT** transmit when the antenna is very close to, or touching, exposed parts of the body, especially the face and eyes. Persons with pacemakers should be aware that proper functioning may be affected when in the vicinity of the antenna!
- **DO NOT** transmit without antenna connected.
- **DO NOT** operate the radio on an unprotected power supply. Replace a blown fuse only against correct type with specified nominal value. Investigate the cause.
- **DO NOT** transmit on a busy channel.
- **DO NOT** press the transmit (PTT) key when not actually desiring to transmit.
- **DO NOT** transmit with the antenna inside aircraft or vehicle. This may cause malfunction of onboard avionics, trigger the vehicle airbag or interfere onboard instruments! Always operate the radio **FSG 2T** with a suitable outdoor / external antenna! Assure appropriate lightning protection / grounding where (elevated) outdoor antennas are used.
- **DO NOT** operate the radio whilst driving. It should also be noticed that even 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** use a radio **FSG 2T** for airborne operation which is marked as "CHANNEL ONLY Mode":



- Always switch OFF the radio first when installing the unit into vehicles, aircraft or carrying cases, or when removing from it!
- Always switch OFF the radio before starting an aircraft or vehicle engine!
- When operating the **FSG 2T** on a 24 Vdc / 28 Vdc source a suitable Voltage Converter 24 Vdc / 12 Vdc of at least 3 Amps must be used!
- The **FSG 2T** should be used exclusively for aviation related communication purposes.
- Unauthorized modifications and changes of the system are **forbidden**.
- Sufficient speech volume is very important. While the lips are very close and facing the microphone, speak loud and clear. Proper speech level is indicated by the yellow flickering LED on the **FSG 2T** front panel.
- In aircraft / vehicles a suitable noise canceling microphone or headset shall be used.

- A backup microphone should always be carried during any flight. Even new microphones can fail!
- Prior to any flight verify proper **FSG 2T** functions by means of a short radio check. It has however to be taken into account that with a faulty antenna or its cable this COM test may absolutely turn out positive at the airfield or in short distance to the ground station. But at a distance of 2 to 6 miles, a faulty antenna and / or cables will cause communication breakdown!
- Push-to-Talk keys may stick occasionally.
  The transmission signaling RED or flickering YELLOW LED shall be turn to CLEAR or GREEN when releasing the PTT key.
  However, after more than two minutes continuous transmitting (by stuck button or operator caused), the built-in transmit time-out-timer disables the transmitter in order to avoid continuous channel blocking. A continuously flashing display warns the user. Refer to appropriate hints in this manual.

1.1 Used Symbols

In this manual the following symbols are used:

WARNING!
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!

Section 2 General Description

2.1 About this document

This installation and operation manual IM 035.00 refers to a **FSG 2T**, Article Number F10350, and contains instructions and descriptions for application, installation, presetting, operation and testing, as well as hook-up diagrams for the universal / multi-use **FSG 2T** VHF/AM Transceiver of **WALTER DITTEL GMBH**, Luftfahrt-geraetebau, D-86899 Landsberg, Germany.

Additionally, the Maintenance Manual MRM 035.00 contains Circuit Description, Over-haul and Maintenance Instructions, Alignment Procedures, Testing Instructions, and an Illustrated Parts List.

2.2 General Description

The **FSG 2T** VHF/AM COM is a miniaturized, lightweight, panel mounted, single block transceiver operating in the VHF/AM airband radio frequency range 118.000 MHz ... 136.975 MHz, thus providing 760 channels with 25 kHz channel spacing, covering a standard communications distance of 100 NM (nautical miles) at FL 70.

2.2.1 Application

The equipment is approved for airborne operation as COM 1, COM 2, COM 3 in Fixed Wing and Helicopter aircraft, and for ground use in any Portable, Fixed Based or Mobile operation.

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 in ground vehicle, as well as for compact portable cases and for desk-top 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!

2.2.2 Operation Description

The transceiver fits into a standard 2¼ in. / 58 mm diameter instrument hole and is fixed by four (4) screws M4. Installation depth behind the front panel including connectors and wiring is 240 mm.

Connections at the rear panel to the electrical environment are achieved via a Standard DB-15 male connector using a wiring harness, and a BNC antenna connector.

All operational control and display elements are located on the night-design front panel:

Transmit / Receive Mode, modulation level or Intercom is indicated by a 3-color signaling LED on the front panel.

The back-lit Liquid Crystal Display (LCD) shows the active frequency, onboard supply or memory channel number as well as ERROR codes (if applicable). During switch-on the firmware version is shown and a display check is performed.

Two display modes are user selectable:

FREQUENCY MODE: **Active Frequency and actual onboard voltage** are shown at the display. Turning / pushing the **F/CH** knob changes Frequency.

CHANNEL MODE: **Active Channel Number (1 … 20) and associated Frequency** are shown at the display. Turning the **F/CH** knob changes preset Channel Number and associated Frequency. Reprogramming without restriction.

Optionally – only for ground based operation – a particular mode can be set where the operation is limited to use only preset channels. To set this mode the radio has to be opened. **This may only be performed by an approved repair facility!**

20 preset memory channels and the last operating setting remain all stored in a non-volatile memory. Switching OFF or power failure does not result in loss of memory information.

Turning the left inner knob adjusts loudspeaker or headset audio level. Full ccw position turns the radio OFF.

The continuously variable SQ-knob (left, outer ring) adjusts the Squelch threshold. Full ccw position turns the SQ circuit OFF (full Receiver sensitivity, continuous RX noise is audible during RX Mode).

On the rear panel a 15-pin SUB-D connector for the aircraft wiring is located. It contains two independent microphone inputs which can be set individually by DIL switches suitable either for

- Dynamic non-amplified microphones,
- Amplified Dynamic / Electret / Standard Carbon Microphones, with or without DC supply, or
- one input for a Dynamic non-amplified microphone and the other input for an Amplified Dynamic / Electret / Standard Carbon Microphone.

For each MIC input, the microphone signal can be adjusted by potentiometer #1 and #2 to modulate the transceiver properly. Additionally, supply current for amplified or Standard carbon microphones for each MIC input can be set by DIL switches to 2 mA, 8 mA, 10 mA, or none.

Phone audio output is adjustable by potentiometer #3 at the rear panel.

For two seat aircraft and noisy environment, the voice activated (VOX) Intercom is a long expected feature. It eliminates constant background noise since it is only active when you talk.

2.3 Technical Description

Both Transmitter and Receiver use the same digital frequency synthesizer and an accurate reference crystal. The transmit frequency is tuned simultaneously with the Receive frequency (Simplex operation).

The single superhet Receiver offers high immunity against in-band and out-of-band RF interference, intermodulation and cross modulation, including ICAO Annex 10 FM immunity / intermodulation.

The automatic Receiver AM / FM noise Squelch threshold is continuously adjustable on the front panel by the SQ knob. Full cw position of the SQ knob requires maximum -93 dBm / 5 µV / 50 Ω to open the Squelch. Full ccw position of the SQ knob offers maximum Receiver gain, the Squelch is always open and RX noise is continuously audible while in RX Mode.

The transceiver can be supplied directly from any properly fused 9 – 16.1 Vdc power source (aircraft, vehicle, etc.) with sufficient current supply capability.

As a specific **FSG 2T** feature, integral controls enable full transceiver operation without any degradation even during Emergency Supply Condition between 9 Vdc and 11 Vdc,.

A suitable DC regulator is required for supply from 28 Vdc-buses.

In Ultralights, Gliders, Balloons or Portables without onboard electric power generation system, long-term operation from a 12 Vdc battery (min. 6 Ah) is appropriate.

The onboard voltage is monitored continuously. When supply voltage drops below 11 Vdc, the Supply Indication on the LC display starts flashing as a low supply warning.

Below 8.5 to 9.5 Vdc, the **FSG 2T** turns OFF itself, but will come back into operation when the supply voltages increases / returns to more than some 10.5 Vdc. The last used settings remain however active.

An audio low pass filter for areas using CLIMAX operation with 25 kHz channel spacing is incorporated in the **FSG 2T**, to suppress multi-carrier beat audio tones.

The audio amplifier provides AF power to the speaker (4 Watts into 4 Ohms and 50 mW into 300 Ohms for headphones).

The solid state temperature-controlled transmitter is wideband tuned from 118 to 137 MHz and delivers some 5 Watts transmitter RF carrier power.

A keyed transmitter, without or with too low microphone modulation input voltage, is indicated RED by the status LED at the **FSG 2T** front panel. Detailed information regarding TX modulation, monitoring and setting is given in § 4.2, Microphone Set-up.

In Receive Mode for Intercom purposes (Intercom selector switch), the microphone input level enables voice activated (VOX) pilot / crew intercommunication. This allows in Receive Mode a voice activated intercommunication (no additional accessories needed) between pilot and crew when using the Intercom wiring harness, headsets, proper mike input setting and sufficient speech volume.

Intercom phone audio volume can be adjusted individually by the **VOL** knob on the front panel. In addition, VOX ON is optically indicated by the GREEN **TX/RX** Status LED on the front panel.

During Intercom, as long as a Receive signal exists, the Intercom audio level is reduced by 6 dB / half level, and the Receiver audio dominates therefore.

The **FSG 2T** is equipped also with a transmit time-out timer. This avoids blocked channel after 2 minutes continuous TX (stuck button does not block a channel continuously) and is indicated by a continuously blinking display. Should such stuck button malfunction continue, the **FSG 2T** is ready for another 2 minute transmission period when turning OFF and ON the unit again (e.g. for emergency or blind transmission).

OPTION: The external AF input allows interconnection of 1 Volt / 600 Ω audio source(s) especially in aircraft using other COM, VOR / LOC, DME, MKR and / or electric variometers. This allows signal monitoring during Receive Mode by speaker, and / or headphone in Intercom Mode. This option can only be enabled by an internal solder bridge (performed by an approved Avionics Service Shop, marked on the information label). This increases the Standby current consumption up to 200 mA. In addition the VOX Intercom Function is then disabled.

External AF input, Receive and Intercom audio listening through headphone(s) is simultaneously possible in Receive / Standby Mode.

2.4 System and Type Approval Information

The Dual Mode VHF/AM Airband Transceiver **FSG 2T** complies with ICAO 25 kHz channel spacing and also meets applicable National and International Type Approval requirements, for any airborne and ground operation:

- JTSO Authorization LBA.O.10.911/103 JTSO (LBA Luftfahrt-Bundesamt) is based on EUROCAE ED-23B Airborne requirement (25 kHz ONLY CH spacing).
- FM Immunity requirements according to ICAO ANNEX 10 against FM Broadcast RF Interference.

- Audio filtering required in areas with CLIMAX operation in 25 kHz channel spacing.
- Associated EUROCAE ED-14D / RTCA DO-160D Environmental requirements for Fixed Wing and Helicopter aircraft.
- Associated EUROCAE ED-12B Software requirements based on ED-12B, Level C.
- Type Approval requirements for ground operation, meeting ETSI EN 300 676.
- CE Conformity requirements for ground operation, meeting ETSI EN 301 489-1 and -22.
- DFS (Deutsche Flugsicherung) No. D-0001-2002 German (ground) Type Approval.
- DIN / ISO 7637-1 Dc supply in 12 Vdc vehicle.
- FCC Compliance with Part 15 (receiver) and Part 87 (transmitter) (pending).
- FAA / TSO Authorization (pending)

2.5 Re-calibration Information

IMPORTANT!

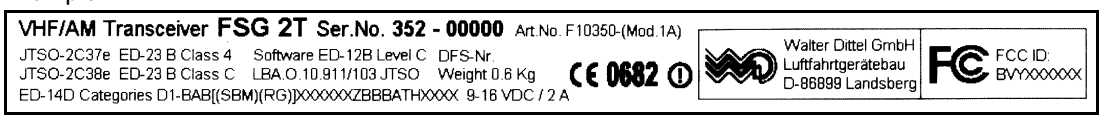
- ***For airborne applications, no frequency re-calibration is necessary, since applications in the 25 kHz channel spacing require a frequency accuracy tolerance of less than ± 20 ppm.***
- ***For the first time after three years, FSG 2T equipment for ground applications require checking and re-calibration of the high precision reference frequency (tolerance better than ±10 ppm).***
- ***All tolerances include the full operating temperature range of -20°C ... +55°C / -4°F ... +131°F.***
- ***Checking and re-calibration must be performed by the equipment manufacturer or through authorized and approved avionics services!***

2.6 Operating License

IMPORTANT!

- ***Depending on national regulations, VHF/AM airborne and / or VHF/AM ground operation may require an individual national operating license. Such license is usually granted by the responsible National Telecommunications Authority, through suitable application forms.***
- ***Aircraft registration, operator's name, address and operating license payment details, radio type / model, Serial number, JTSO number LBA.O.10.911/103 JTSO, and DFS number DXXXXX, or, when applicable, the FCC ID number BVYXXXX.***

Example:



2.7 Equipment supplied

Description	A/N
5-Watt VHF/AM Transceiver FSG 2T, Installation and Operation Manual, Operating Instructions, 4 screws M 4 x 12, Warranty card to cover 24 months	F10350

2.8 Optional Accessories

Wide accessory scope allows **FSG 2T** installation and operation in aircraft, in ground systems; fixed, portable and mobile into vehicles.

Description	A/N
Connector kit, SUB-D 15-pin, incl. mounting hardware	W00009
Folded-top antenna, for gliders, anti-static, 118-137 MHz, 9 m / 29.5 ft cable RG-58 C/U, BNC connector. Applies for wood or GRP tail-fin, not for metal or carbon fiber tail-fin!	F10057
Rod antenna, swivel type, 5 m / 16.5 ft cable, w/out RF plug	W00066
BNC antenna connector, solder type	E08980
Cable Harness Set, 3.2 m / 10.5 ft, numbered and color-coded cables, polarized connectors, for use with Loudspeaker / Junction Box	F10028
Intercom Cable Harness Set, 3.2 m / 10.5 ft, numbered and color-coded cables, polarized connectors, for use with Loudspeaker / Junction Box, comes with panel mount Intercom Switch	F10029
Loudspeaker / Junction Box, 4 Ω / 30 Watt, small, sturdy housing, two 5-pole DIN jacks to connect 2 dynamic microphones or headsets in parallel, terminal for PTT key, fits harness F10028 or F10029,	F10061
Dynamic headset, noise canceling, coiled cord, 4-pole plug U-174/U	W00048
Adapter cable for headset W00048, to fit 5-pole DIN jack	F10036
Dynamic gooseneck (boom) microphone 600 Ω, 3 m / 9.8 ft cable, 5-pole DIN connector, especially for gliders and motor gliders	F10039
Dynamic microphone, for PC portable and car mobile use, metal housing, coiled cord, PTT key, 5-pole DIN plug	F10041
Retaining bracket, fits microphone F10041	E24907
Dynamic hand microphone, 500 Ω, coiled cord, PTT key, 5-pole DIN plug	F10346
Microphone bracket, to keep microphone F10346	W00087
Dynamic microphone-loudspeaker, coiled cord, PTT key, 5-pole DIN plug, sealed	F10042
PTT key, 3.5 m / 11.5 ft cable, permanent installation on the control stick	F10050
Inline PTT key U-94A/U, coiled cord, 5-pole DIN plug, connects directly to Loudspeaker / Junction Box or Portables and headset A/N W00048, clip allows attaching to clothing	F10125
Battery Box, 12 Vdc / 7.2 Ah lead battery, sturdy steel / aluminum case, mount plate for quick removal, 6.3 A circuit breaker, 5-LED battery test set, 2-pole DIN socket, 2-pole DIN plug	F10023
Automatic battery charger DL-50, 115 / 230 Vac. Output 13.8 Vdc / 600 mA. For all airborne and portable 12 Vdc lead batteries	F10130
Vehicle mount bracket, permits the **FSG 2T** to be mounted under or above the dash of a vehicle / aircraft	F10058

2.9 Equipment required, but not supplied

a) VHF aircraft antenna with coax cable RG-58 C/U and BNC connector (Male)
b) Headphone (8 ... 600 Ohms, typical) and / or loudspeaker (4 ... 16 Ohms)
c) Non-amplified dynamic microphone, (4 ... 600 Ohm),
or amplified / Electret / Standard carbon microphone,
with or without PTT key (separate MIC 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, e.g. stick mounted (if microphone without PTT key is used)
g) 15 pole SUB-D connector type DB-15 S and cover, if no pre-wired cable harness is used.

2.10 Some words about Microphones

IMPORTANT

a) Radio performance and system reliability significantly depend on quality acoustic accessories, and their proper audio leveling adjustments. Please avoid use of low quality / low performance accessories.

b) After installation completion, optimized acoustics performance requires proper mike audio system selection and its appropriate level adjustment (non-amplified dynamic, or Standard carbon microphone(s) system.

*c) Since the radio **FSG 2T** has got two (2) separate microphone inputs, it is possible to connect and adjust different microphone types / techniques on separate MIC inputs.*
Furthermore two microphones can be connected in parallel to one input, but then

- *make sure that only microphones of identical type / characteristics may be interconnected in parallel and appropriately together adjusted / matched.*

d) Dynamic microphones require shielded wiring and galvanic separation of mike grounds from any other signal ground (e.g. DC input / DC output, Dimmer, Speaker, Phone, PTT, and external AF input ground).

e) Standard Carbon / compatible amplified microphones may employ Dynamic or Electret acoustics transducers. Amplified microphone ground may be connected together with other grounds, e.g. for DC input / switched output, speaker, phone, PTT, dimmer, external audio input.

f) Operation of amplified microphone systems close to the RF radiating antenna (on portable case or located close to the cockpit) may be heavily interfered from own radiated, strong antenna RF field strength and become unstable, oscillates or causes modulation distortion. Verify such effects, which are possibly caused by RF, by replacing the radiating antenna against an artificial antenna / RF dummy load temporarily.

Section 3 Installation

3.1 General

This section contains instructions and suggestions to be considered before installing the radio **FSG 2T** 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 Airworthiness Inspector - before the installation – to get authorized certification of your completed installation.*
- *The conditions and tests required for **JTSO** 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 **JTSO** or **FAA-TSO** standards. If not within these standards, the article **FSG 2T** 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 2T** 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 e-mail, 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, vehicle or portable carrying case, a short but comprehensive functional bench test through 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 2T** set supply to 13.8 Vdc at radio input terminals. Turn ON the radio with the **VOL** switch on front panel. Switch OFF the Squelch by rotating the **SQ** knob to fully counter-clockwise position.
Verify, whether on all channels within 118 ... 136.975 MHz almost identical, strong, continuous Receiver acoustic noise without strange or rhythmic characteristic is audible.

b) In Receive Mode, cw (clockwise) rotate / adjust the dot marking of the **SQ** knob on the dot marked on front panel.
Verify, whether Receiver sensitivity on all channels complies with technical data (make sensitivity tests covering the whole frequency range).
At almost full ccw and full cw position, the Squelch threshold shall be within 0.5 µV / -113 dBm and 5 µV/ -93 dBm / 50 Ohms (vary signal generator output level).

c) Connect a 50 Ohm Wattmeter and a 20 dB or 30 dB throughline RF attenuator pad. Key the transmitter and check RF output level (approximately 5 W carrier).

d) For **Amplified / Standard Carbon Microphone(s)** adjust the audio generator to 1,000 Hz and apply signal via decoupling capacitor to the Standard Carbon MIC input. With 30 mV to 100 mV rms input, the transmitter shall achieve more than 70% AM (depends on MIC sensitivity setting). Increase AF input to 500 mV rms, observe modulation envelope, no overmodulation shall occur, depth of modulation must remain less than 95%.

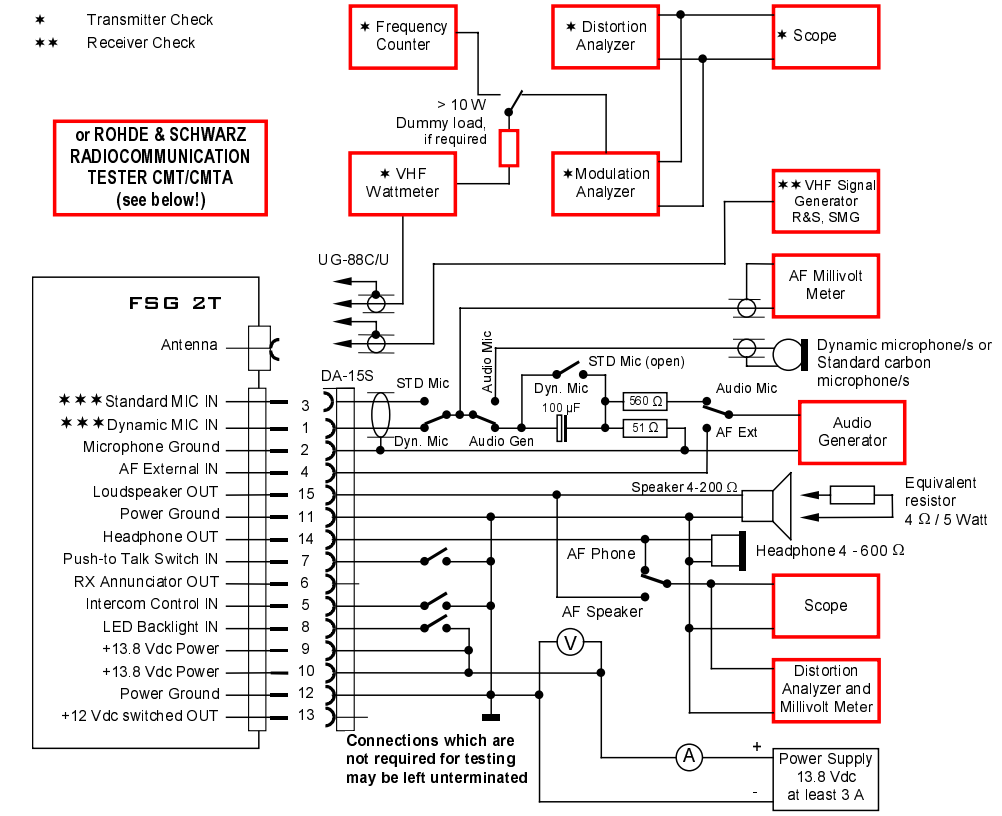
e) For **Dynamic Microphone(s)** adjust the audio generator to 1,000 Hz and apply signal via attenuator to the Dynamic MIC input. With some 0.5 mV to 3 mV rms input, the transmitter shall achieve more than 70% AM (depends on MIC sensitivity setting). Increase AF input to 15 mV rms and observe modulation envelope. No over-modulation shall occur, depth of modulation must remain less than 95% AM.

NOTE Proper modulation input level setting is indicated, when the (time delayed) control LED on the front panel just changes from red (too low modulation level) to yellow (appropriate modulation level setting).

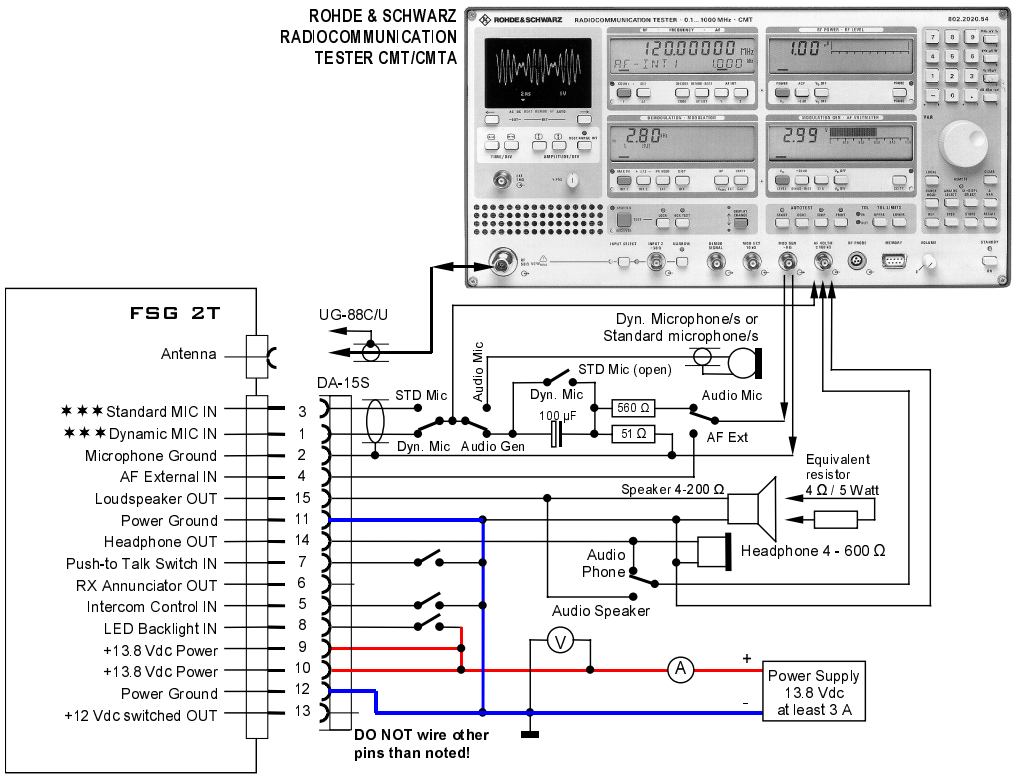
3.3.1 Particular Remarks to FSG 2T Transmitter Modulation

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 not more than some 85%.
2. Factory setting of the very specific **FSG 2T** 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 (25 kHz) Transmitter RF Emission Spectrum Mask is no longer maintained.
4. The **FSG 2T** incorporates a special **DITTEL** VOICE PROCESSOR, which is matched best to meet the requirements of the particular environmental noise level situation.
   a) This ensures an always loud and clear transmitter modulation, under consideration of specific test requirements.
   b) Even under these very specific conditions, fulfillment of the critical, highly demanding RF Emission Spectrum Mask is achieved.
   c) The correct microphone level setting is achieved when – slightly time delayed – the front signaling LED changes from RED to flickering YELLOW, while speaking in Transmit Mode loud, clear and close to the microphone transducer element.
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 waveform testing. It will be therefore result in 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, 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. However, the front LED assists optically.
7. For tests of the **FSG 2T** modulation capability, a sine modulation signal is useful only at or 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.



OR



✶✶✶ for MIC setting, refer to § 3.5.2.1

Fig. 3 - 1 **FSG 2T**
Pre-Installation Test set-up

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.
The **FSG 2T** VHF/AM transceiver is designed to be installed rigid into the instrument panel or operating console from its rear side into a standard 2¼ inch / 58 mm diameter instrument hole. Shock-mounts are not required, even not for helicopter installation. For dimensions and positioning of the 4 fixing holes refer to Figure 3 - 3.
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 and access to the control knobs when in the normal seated position.
Sufficient room (at least 220 mm / 9 inches) behind front panel must be left for wiring accommodation. Fixing of the transceiver is achieved by use of 4 cross recessed Pan head screws M4 x 12 mm (supplied). These screws are sufficient for panel thickness between 2 mm and 5 mm (1/16 …3/16 inch).

3.4.2 Compass deviation

Compass deviation caused by **FSG 2T** is less than 30 cm for 1° deflection.
(Category Z in accordance with EUROCAE ED-14D / RTCA DO-160D environmental test conditions).

Compass Deviation	Distance
0.5°	12 cm / 4.73 in.
1.0°	7 cm / 2.76 in.
1.5°	< 7 cm / 2.76 in.
2.0°	< 7 cm / 2.76 in.
2.5°	< 7 cm / 2.76 in.
3.0°	< 7 cm / 2.76 in.

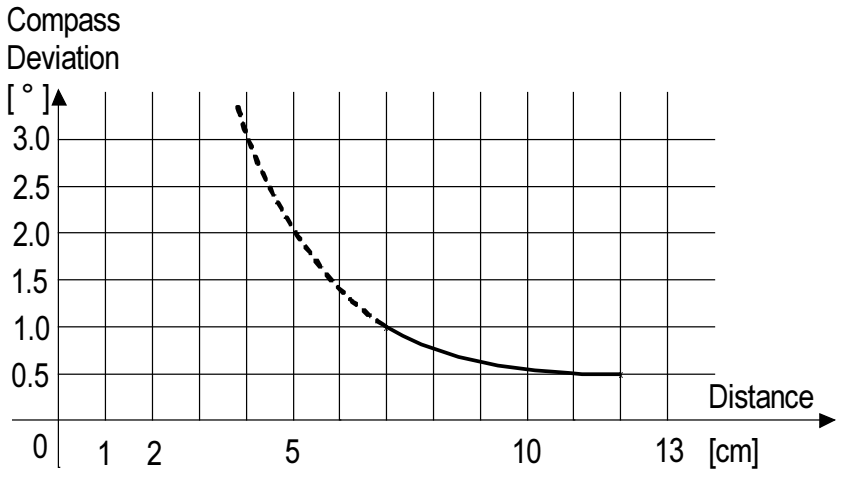
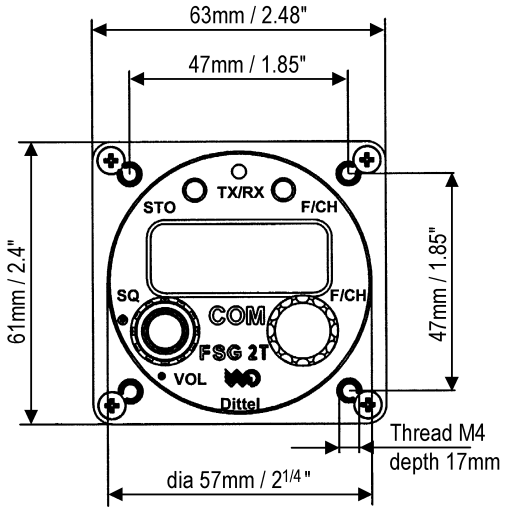
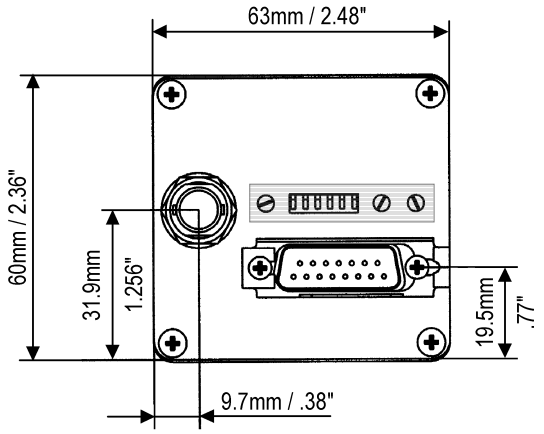
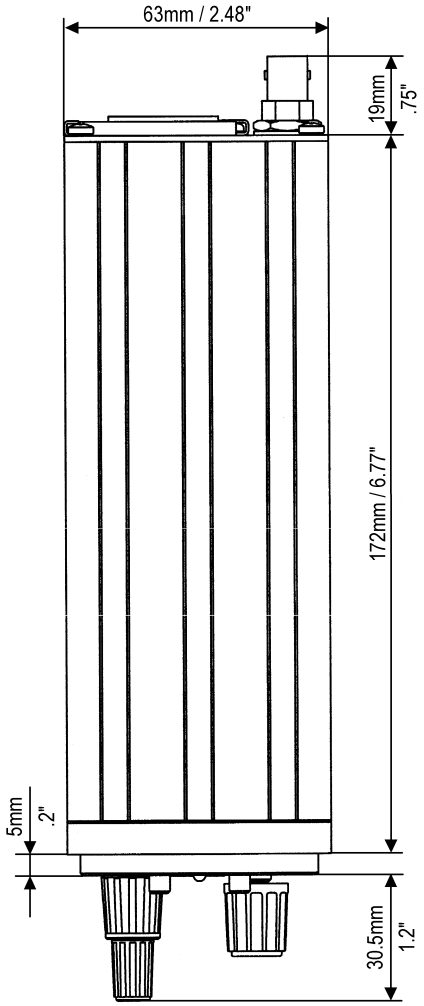


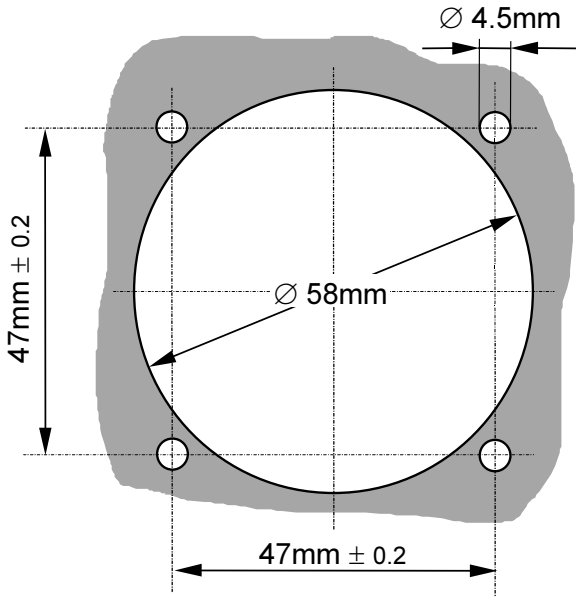
Fig. 3 - 2: Deviation of a compass by a transmitting **FSG 2T**; depends on the distance between compass center and contour of transceiver







BACK-PANEL MOUNTING



Cutout to be prepared or
Standard 2¼" Instrument Hole

Fig. 3 - 3 **FSG 2T**
Dimensions
Installation Drawing

3.4.3 Antenna installation

Your radio FSG 2T 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 omni-directional:

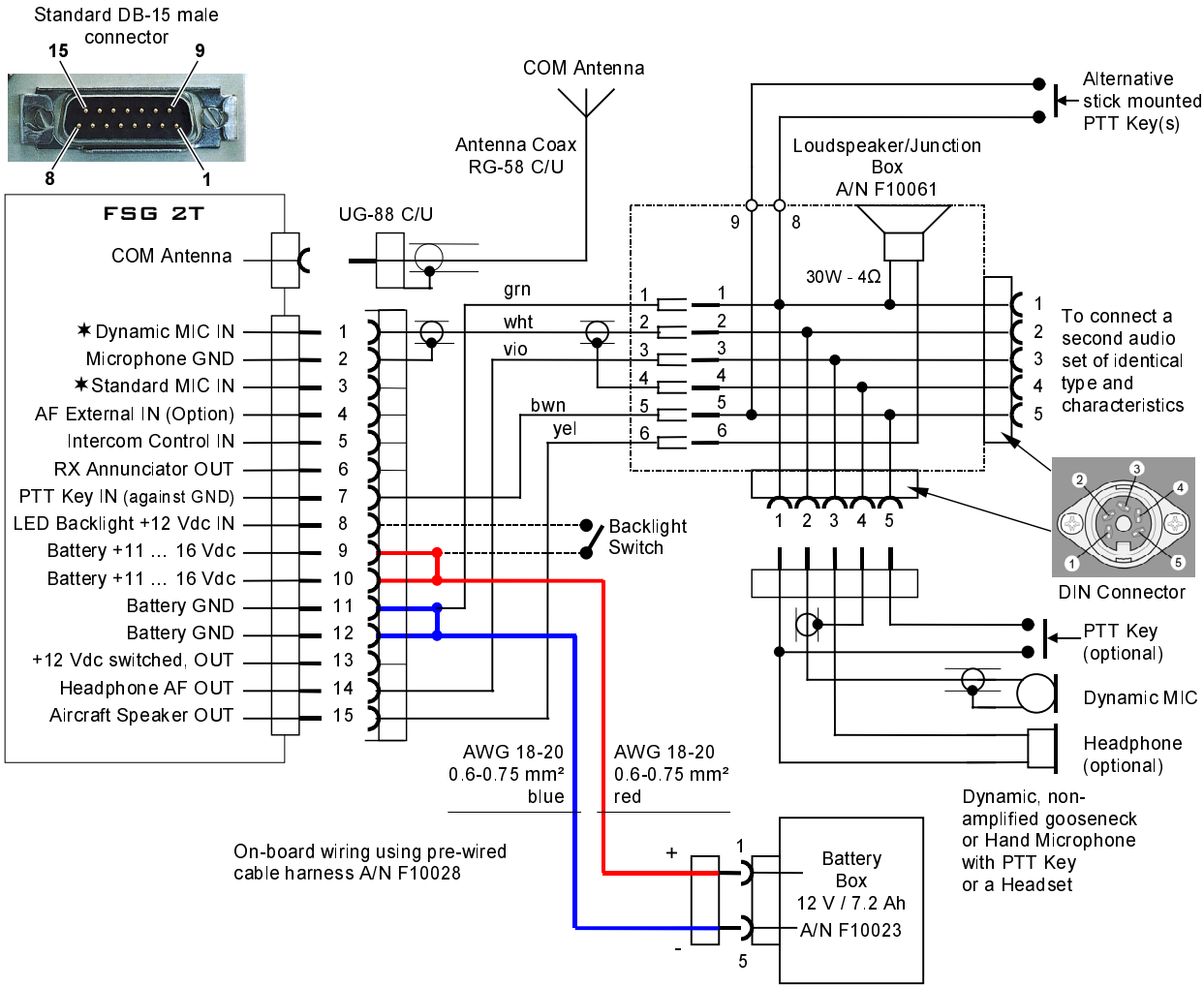
- First of all, look up the aircraft's manual for antenna installation instructions.
- The antenna installation location must be carefully planned. It would be the best to consult the Aircraft Certifying Inspector. In order to achieve best results into all directions, installation instructions must be 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 or NAV antenna should be at least 1.5 m / 5 feet. When using two radios **FSG 2T**, a distance of 1 m / 3.3 feet 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 durable and robust. The electrical contact shall remain continuously good safe against vibration and corrosion.
- For wood and fiberglass (GRP) aircraft, 3 or 4 aluminum counter weight strips (ea. 60 cm / 2 feet long - 5 cm / 2 inches wide) are recommended, but shall be placed (mostly) horizontally in the shape of a star.
- These stellate counter weights must be centrally screwed together with the antenna socket. Care for a permanent good electrical contact.
- Alternatively, for aircraft with non metallic surface structure inside the fuselage, a metal foil (min. 60 x 60 cm / 2 x 2 feet) can be stuck in. The antenna socket will then be placed in the foil center, together with a metallic ground contact support plate. Consult aircraft manufacturer's instructions to verify proper antenna location.
- 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 preferably during manufacturing the tail-fin. An 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 permanent good, even under bad environmental conditions.
- Use only high quality 50-Ω coax cable type RG-58 C/U. Avoid any sharp cable bend (radius > 50 mm), mounting pressure, strain, 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 conductor (Ohmmeter). Resistance 0.0Ω indicates a short inside the antenna connector, while some 0.6 to 1Ω 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.
- **You should possess a reasonable knowledge of antenna installations and the importance of ground planes before attempting the following:** Check the antenna matching using 50-Ω VSWR meter over the whole frequency range for VSWR less than 3:1. It may be helpful / necessary to cut slightly the length of the 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 - 4 to 3 - 8 of on-board wiring.

3.5.1 General recommendations

- Always ensure permanent good, stable electrical contacts, and efficient RF interference suppression of all electrical systems like generator / alternator, ignition, electronic variometer, etc., especially consider vibration and corrosion effects. Consult the aircraft installation licensing inspector.
- Connect the positive (+12 Vdc) power wire (normally red) to pins 9 and 10. Because of current requirements it is essential that the connection is made to both pins, otherwise problems may arise. The positive wire must be connected to the aircraft power via a circuit breaker (inline fuse 3.15 amps or automatic circuit breaker 3 amp) and through a radio master switch, not direct to the battery. Do not connect to power until installation is complete and cross-checked.
- Connect the negative (-12 Vdc) ground wire (normally blue) to pins 11 and 12. Because of current requirements it is essential that the connection is made to both pins, otherwise problems may arise. The ground wire must be connected to a good clean contact that provides a durable path to the aircraft ground. Prefer a ground wire direct to the battery's negative terminal.
- 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.
- 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 part.
- Do not install without allowing for service loops / strain relief, 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 (6 inches) 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 Standard DB-15 female connector. Solder joints shall be supported by shrinking or rubber sleeves. Connector back shell must not clamp or damage the cables.
- Secure the radio connector by the sliding lock to avoid unwanted connector loosening.
- Pre-wired cable harness assemblies are color coded for simple plug-in installations when used with optional loudspeaker / junction boxes and dynamic microphones for all kind of aircraft.
- Electronic variometer seldom comply with airborne RF environmental type approval requirements. All of the known models at printing time of this manual have to our knowledge a (some even far) too high radiated RF interference emission. In **FSG 2T** 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 capability. Further measures to improve RF immunity may be obtained from the variometer manufacturer, and in some cases also from the aircraft manufacturer.



NOTES:

DO NOT wire other pins than noted! Connections which are not required for your installation may be left unterminated!

All wires are #22 AWG (0.3 - 0.4 mm²) unless otherwise noted

✶ **For MIC setting, refer to § 3.5.2.1**

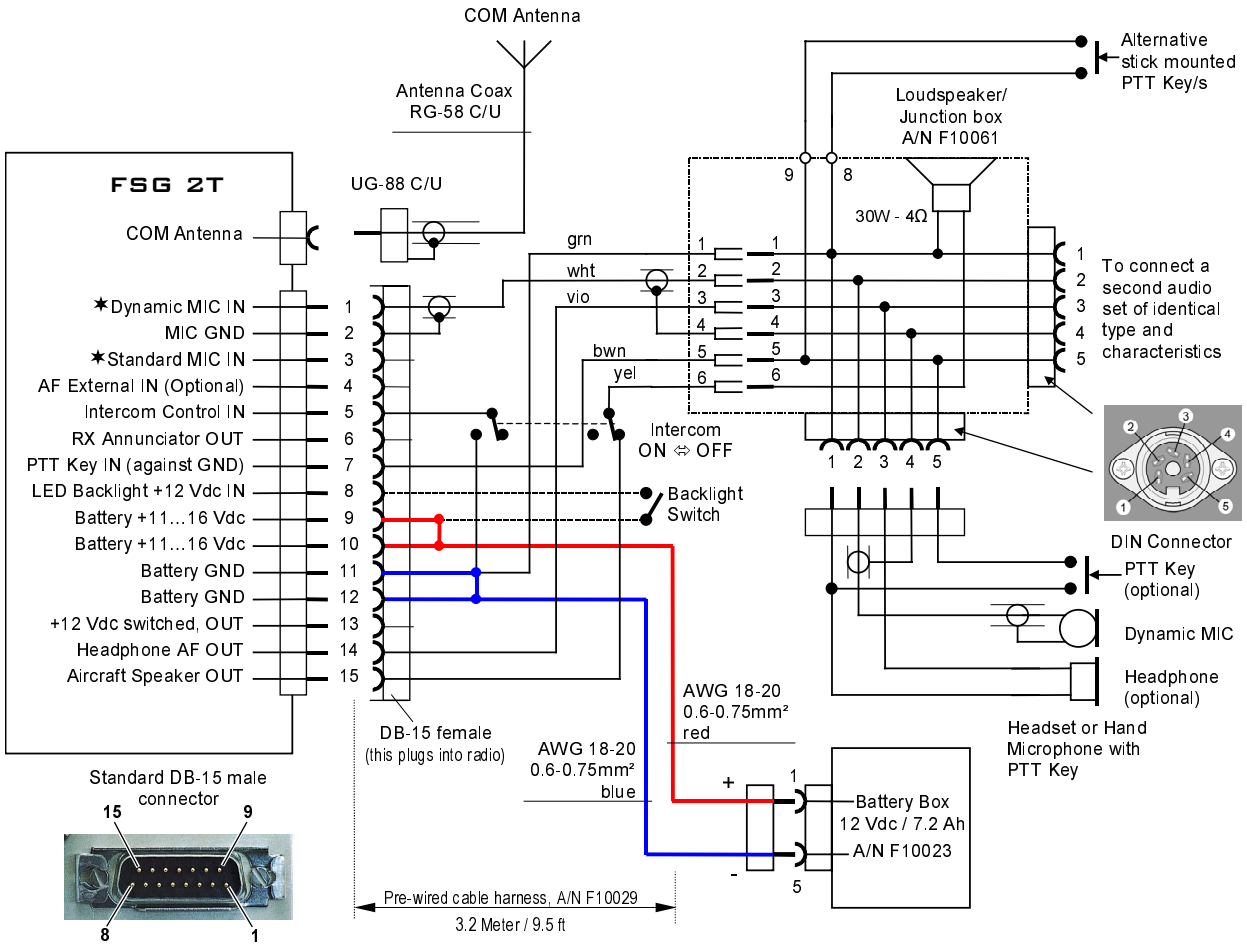
Built-in Automatic Circuit Breaker provided when using Battery Box A/N F10023

Length of pre-wired cable harness F10028: 3.2m / 9.5ft

\- - - - - - - and coax antenna cable are **not** included in pre-wired cable harness A/N F10028

Fig. 3 - 4 **FSG 2T**
Standard Hook-up Diagram using pre-wired cable harness A/N F10028

- one MIC input, for
- one non-amplified Dynamic Microphone, or
- two non-amplified Dynamic Microphones (identical) in parallel



NOTES:

DO NOT wire other pins than noted! Connections which are not required for your installation may be left unterminated!

All wires #22 AWG (0.3 - 0.4 mm²) unless otherwise noted

✶ **For MIC setting, refer to § 3.5.2.1**

Intercom operation requires microphones which provide audio OUT with the PTT key de-energized (not keyed)

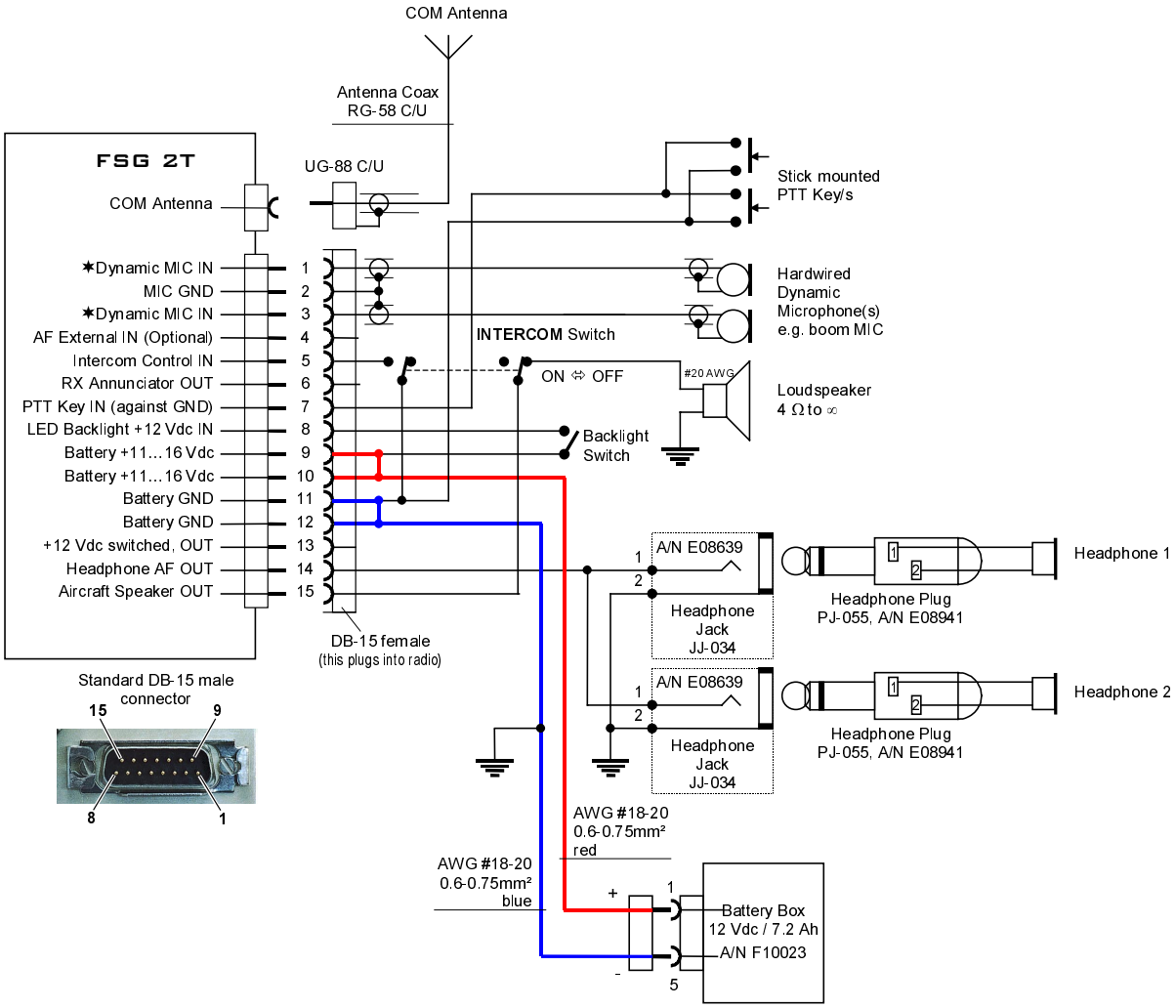
Built-in Automatic Circuit Breaker provided when using Battery Power Supply A/N F10023

Length of pre-wired cable harness F10029: 3.2m / 9.5ft

- - - - - - - and coax antenna cable are **not** included in pre-wired cable harness A/N F10029

Fig. 3 - 5 **FSG 2T** with INTERCOM
Hook-up Diagram for two seat application using pre-wired cable harness A/N F10029

- one MIC input, for
- two non-amplified Dynamic Microphones (identical) in parallel



NOTES:

DO NOT wire other pins than noted! Connections which are not required for your installation may be left unterminated!

All wires #22 AWG (0.3 - 0.4 mm²) unless otherwise noted

✶ **For MIC setting, refer to § 3.5.2.1**

Microphone shielding should only be connected to MIC ground at the radio end and insulated against common ground at the MIC end.

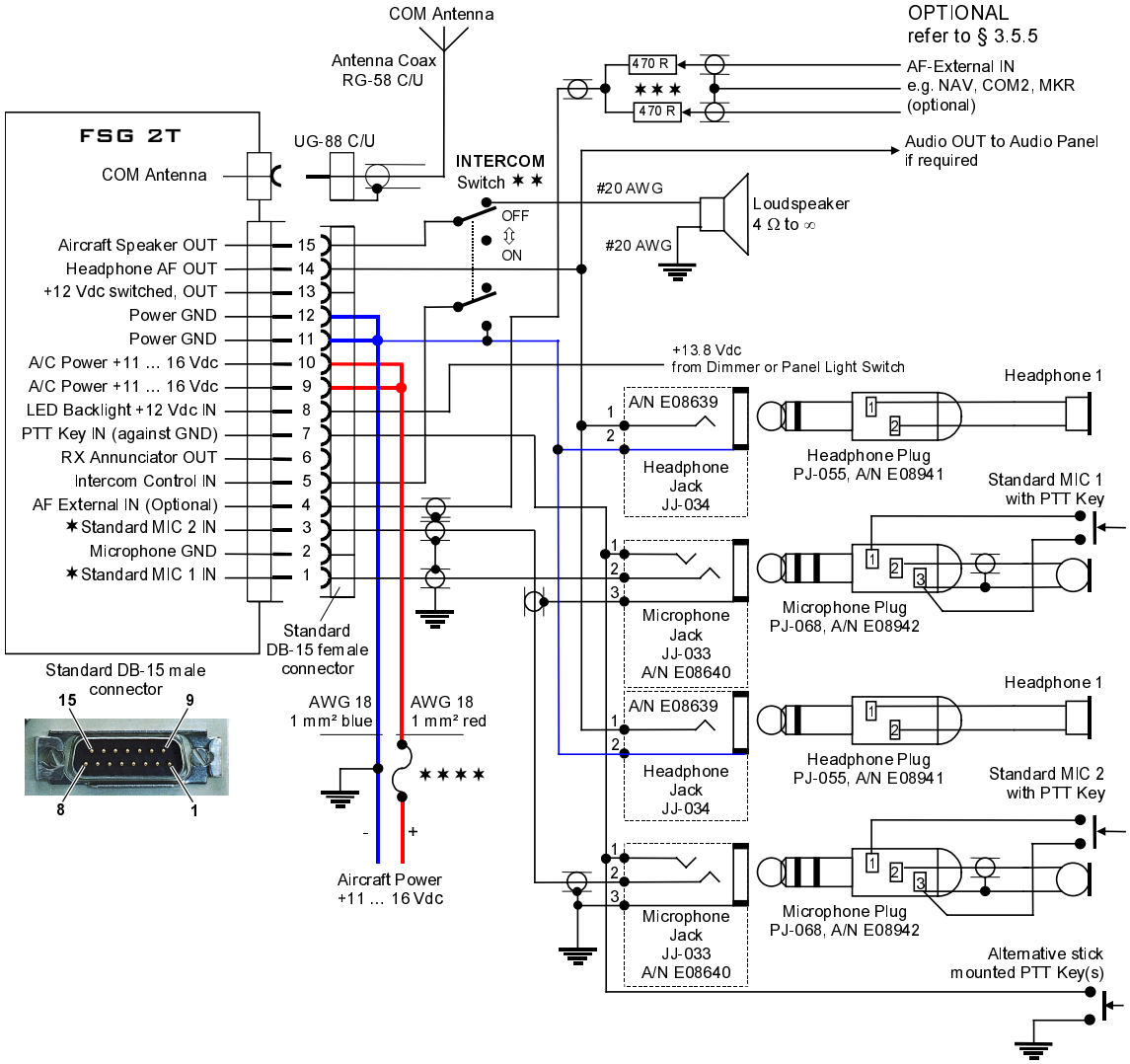
INTERCOM operation requires a selector switch, double pole, double throw

Wiring without **INTERCOM**: connect loudspeaker direct to pin 15.

Built-in Automatic Circuit Breaker 6.3 A provided when using Battery Box A/N F10023

Fig. 3 - 6 **FSG 2T** with INTERCOM
Hook-up Diagram for two seat application, using

- two MIC inputs, for
- two separate (different, hardwired) non-amplified Dynamic Microphones



NOTES:

- **DO NOT** wire other pins than noted! Connections which are not required for your installation may be left unterminated!
- 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
- 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.

✶ **For MIC setting, refer to § 3.5.2.1**

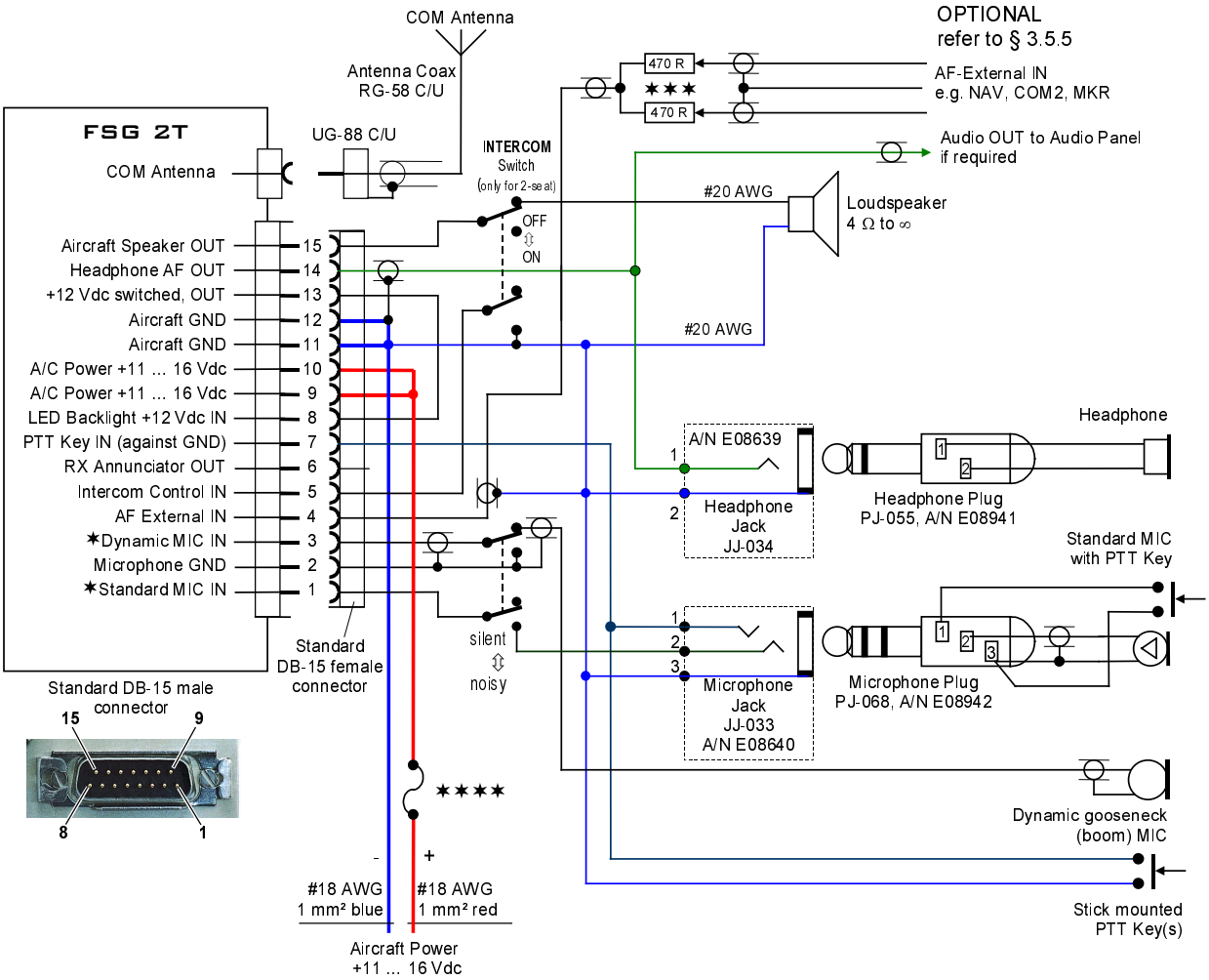
✶✶ Wiring without Intercom: connect A/C speaker direct to pins 11 and 15.

✶✶✶ 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 2T** with INTERCOM
Hook-up Diagram for two seat application, using

- two MIC inputs, for
- two separate (even different) Amplified / Standard Carbon Microphones



- **DO NOT** wire other pins than noted! Connections which are not required for your installation may be left unterminated!
- All wires #22 AWG (0.3 - 0.4 mm²) unless otherwise noted
- All power Grounds are airframe grounds
- For two-seat application connect second audio set (headphone, Standard MIC, boom MIC) and PTT key in parallel to the first one. Both audio sets must be of the same type.
- Intercom operation requires microphones which provide audio OUT with the PTT key de-energized (not keyed)
- Intercom operation requires a selector switch, double pole, double throw
- Terminate audio shields at radio 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.

✶ **For MIC setting, refer to § 3.5.2.1**

✶✶ 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 - 8 **FSG 2T** with MIC Selector Switch and INTERCOM
Hook-up Diagram for single or two seat application, using

- Amplified / Standard Carbon Microphone(s) during self launching (noisy) and
- non-amplified Dynamic Gooseneck Microphone(s) during soaring (silent)

3.5.2 Wiring the Microphone(s)

IMPORTANT!

- *Radio performance and system reliability significantly depend on quality acoustic accessories, and their proper audio leveling adjustments.*
- *After installation completion, optimized acoustics performance requires proper mike audio system selection and its appropriate initial level adjustment (non-amplified dynamic, or Standard carbon microphone(s) system).*
- *It is possible to connect two microphones in parallel, but:*
  make sure that only microphones of identical type / characteristics may be interconnected in parallel and appropriately together adjusted / matched.
  Please avoid use of low quality / low performance accessories.
- *Dynamic microphones require shielded wiring and galvanic separation of mike grounds from any other signal ground (e.g. DC input / DC output, Speaker, phone, PTT, and external AF input ground). The MIC GND should only be connected at the radio's end!*
- *Standard Carbon / compatible Amplified microphones may employ Dynamic or Electret acoustics transducers. Amplified microphone ground may be connected together with other grounds, e.g. for DC input / switched output, speaker, phone, PTT, dimmer, external audio input.*
- *Operation of amplified microphone systems close to the RF radiating antenna (on portable case or located close to the cockpit) may be heavily interfered from own radiated, strong antenna RF field strength and become unstable, oscillates or causes modulation distortion. Verify such effects, which are possibly caused by RF, by replacing the radiating antenna against a temporarily connected artificial antenna / RF dummy load.*

3.5.2.1 Microphone setting

IMPORTANT!

- ***Both microphone inputs must either be terminated with appropriate microphone(s), or the not used MIC input must be set for Amplified Microphone (position V).***

The **FSG 2T** offers two separate selectable and adjustable MIC inputs. You have the choice of connecting one or two dynamic (non-amplified) microphones and/or one or two Standard Carbon (amplified) microphones to the radio. The MIC inputs pin 1 and 3 are selectable by DIL switches at the rear. Use a suitable tool to set the switches. The pin no. refers to the Standard DB-15 connector.

When using Dynamic Microphone(s) on input pin 1 set DIL switch 3 to **D** (default)

When using Dynamic Microphone(s) on input pin 3 set DIL switch 6 to **D**

When using Amplified Microphone(s) on input pin 1 set DIL switch 3 to **V**

When using Amplified Microphone(s) on input pin 3 set DIL switch 6 to **V** (default)