



VHF Ground Station

TG660-(XX)

Installation and Operation

Manual DV 17900.03

Issue 2 March 2016

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List of Abbreviations

AF	Audio Frequency
AUX	Auxiliary
ETSI	European Telecommunication Standards Institute
GND	Ground
HMI	Human Machinery Interface
ICAO	International Civil Aviation Organization
I&O	Installation & Operation
LCD	Liquid Crystal Display
M&R	Maintenance & Repair
PBIT	Power-On Built In Test
PTT	Push to Talk
RX	Receive
SPKR	Speaker (Loudspeaker)
SQL	Squelch
TX	Transmit
VHF	Very High Frequency
VSWR	Voltage Standing Wave Ratio

Units

V	Volt
V _{AC}	Volt Alternating Current
V _{DC}	Volts Direct Current
kHz	Kilohertz
MHz	Megahertz
dBm	Power ratio in decibels
dB	Decibel
Ohm(Ω)	Resistor
°C	Degree Celsius
mm	Millimeter
cm	Centimeter

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1 Section 1 GENERAL INFORMATION

1.1 Basic Operating Instructions

This manual DV17900.03 describes the VHF Ground Station TG660-(XX).

The manual DV17900.03 "Installation and Operation" contains the following sections:

	Section	Installation and Operation DV17900.03-BAI	Maintenance and Repair DV17900.04-BAI
1	General Information	X	X
2	Installation	X	X
3	Operation	X	X
4	Theory of Operation		X
5	Maintenance and Repair		X
6	Parts List		X
7	Modification and Changes		X
8	Circuit Diagrams		X

For safe operation of the VHF Ground Station TG660, follow the instructions below:

Stay always in a sufficient distance to the antenna avoiding been exposed to higher RF radiation during TX operation.

Perform a voice communication test before start-up. This test might be positive, if carried out close to the corresponding radio-station, even if the antenna cable is broken or short-circuited. It will not be possible to establish communication over a distance of 5 to 10 km in this case.

Speak loud to the microphone and keep it always close to the lips, otherwise ambient noise can be intrusive and make understanding difficult.

Use only microphones or headsets, which are suitable for ground-stations. Incoming radiation on the equipment antenna can affect the integrated amplifier of the microphone (feedback). This is noticeable in the station by whistling and/or heavy distortion. The described disturbances can occur in different ways on different transmit channels.

Transmit buttons can stick, or TX line is short circuited thus causing continuous carrier signal on the active channel. Therefore ensure that the display (sign "↑") disappeared when the "TX" button was released.

WARNING

- **The TG660 connects to High Voltage power supply!**
- **Only qualified personnel shall perform installation work.**
- **Always disconnect mains cable before gaining access to the inside of the TG660.**

1.2 Purpose of Equipment

The TG660 is a fixed station for voice communications in the VHF frequency range of 118.000 MHz to 136.990 MHz with 25 kHz / 8.33 kHz channel spacing in the standard version.

The transceiver TG660, designed for ATC operations, is useable on airports with different scale as a main transceiver, or as a standby unit, as well as for special tasks within the scope of air traffic control.

1.3 General System Description

The VHF transceiver TG660 specially designed for mounting in 19-inch rack systems, or in an ATC desk.

The unit operates in an AC supply voltage range from 100 V...230 V $\pm$ 10% / 50...60 Hz or with 24 V_{DC}, +20% - 10%.

The TG660 power supply logic is operating with AC-power by default. After AC-power failed, the logic automatically switches over to DC-power. The moment AC-power becomes available the logic returns back to AC-power source.

An optional internal 12 V_{DC} battery inside the TG660, if installed, provide power to continue operation over a certain time if AC and DC supply voltage fail at the same time.

Depending on the version, the TG660s are capable of delivering up to 6W, 10W, 25W or 50W RF power output (RF-carrier) to an external antenna via 50 Ω coaxial RF-cable.

The station has a simple user-friendly HMI; the main components on its front panel are the 2-line 16 character liquid-crystal display (LCD) and several control elements (rotating knob and buttons). The selected frequency and operating status of the equipment, displayed on the LCD, inform about the current operating mode. Control elements (knob, buttons) enable the user to change operating modes or operating frequency. Standby switch selected to "Standby" partially shuts down the TG660 internal power supply. Some circuitry of the power supply continue listening to the "Standby Switch" to repower the unit at any time. The "ON/OFF" switch, located on the rear panel, disconnects from AC supply completely.



Fig. 1 - 1 Front side

The VHF transceiver TG660 is available in a 6W, 10W, 25W or 50W transmit power version.

An antenna mismatch of $\geq 4:1$, detected on the transmitter output terminal, cause automatic output power reduction to 40 % of the declared nominal TX power.

The VHF transceiver is protected against jammed transmit button or short circuit on the PTT line. Factory setting of the time limit to release a "stuck PTT" is 2 minutes.

1.3.1 Microphone Inputs

Several microphone inputs are available for the following types:

- Standard microphone unbalanced, DC coupled and providing power supply for the mike,
- Dynamic mike input balanced and
- Symmetrical line input.

These microphone inputs connect to a dynamic volume compressor inside of the remote controlled transceiver, which keeps the modulation voltage constant $\geq 80\%$ over a wide mike-signal input voltage range.

1.3.2 Audio outputs

The TG660 has four different outputs:

- Headphone output
- Speaker output (speaker is switched off in transmit mode)
- Line out
- Voice recorder

The headphone output level provide 100mW @ 600Ω. The rated loudspeaker output power is $\geq 4W$ sin @ 4Ω. The LINE_OUT – AF output nominal output level is zero (0) dBm @ 600Ω. The levels on headphone and speaker output are adjustable by means of the volume potentiometer within the range -20...+10 dBm. The voice recorder output level is – 6 dBm @ 600Ω balanced.

1.3.3 Side tone output

In transmit mode, the side tone signal is routed to the line and phone output.

1.3.4 TG660 internal Sub Modules

The “Control Board”, located behind the front panel of the TG660, consists of the LC Display and all the Human Machine Interface (HMI) (e.g. Keypad, Function Switches and the Volume Control). All changes made from the “Control Board” are transferred to the “Interface Board” on which a microcontroller exchanges control information with the remote control transceiver like change of frequency, volume adjustment, “SQL” on/off and other parameters of the equipment. The microcontroller on the “Interface Board” handles the serial communication interfaces and by means of a Remote Control Unit which provide all settings of operating parameters on the VHF transceiver TG660. (Web Browser via IP)

The loudspeaker, located behind the front panel, switch off automatically during TX. This avoids acoustic coupling between loudspeaker and the microphone, which can cause acoustical feedback.

The RF power amplifier is located in the center of the chassis behind the front panel. The PA3-2AB-AIR-1 model is a mobile Air Band AM VHF RF power amplifier which can deliver 25 watts or 50 watt (depending on the TG660-(XX) version) of RF power when driven with 8/10 watts and it will cover the frequency range from 118 - 138 MHz. The amplifier's dimensions are: 7.5”L x 2.2”H x 3.7”W.

1.3.5 Rear panel

Following items are on the rear panel of the transceiver TG660 mounted.

- Equipment connectors for:
 - AC/DC power supply,
 - Voice Recorder,
 - IP Interface,
 - Record/DF,
 - Line Aux.
- Antenna socket.

1.3.6 Self-test

After the TG660 turned "ON" a system self-test is performing. Detected errors show up on the display otherwise the unit changes into the last used operation mode.

1.4 TG660 Variants and Options

Part-No.:	Description	Article-No.:
TG660-(05)	VHF-AM Transceiver, 118-137 MHz, 25/8.33 kHz, 6 W	0635.367.926
TG660-(10)	VHF-AM Transceiver, 118-137 MHz, 25/8.33 kHz, 10 W	0635.375.926
TG660-(25)	VHF-AM Transceiver, 118-137 MHz, 25/8.33 kHz, 25 W	0940.449.926
TG660-(50)	VHF-AM Transceiver, 118-137 MHz, 25/8.33 kHz, 50 W	0940.447.926
Option 1	Internal battery	0640.131-958
Option 2	Radio over IP "ROIP"	0640.141-958

Notes:

- 1) All TG660 models are combinable with Option 2.
- 2) The Option 1 only applies to the TG660-(05) and TG660-(10) models.

1.5 Technical Data

General data:

- Frequency range: 118.00-136.990 MHz
- Channel spacing: 25 kHz / 8.33 kHz,
automatically selected
- Modulation type: AM, 6K80A3EJN (25 kHz) & 5K00A3EJN (8,33 kHz)
- AC-Power: 90 V_{AC}....250 V_{AC},
45 Hz...65 Hz
- DC-Power external: Nominal: 24 V_{DC}
Range: 21 V_{DC} ...29.8 V_{DC}
- RF Antenna connection: N-Connector, female
- Warm up time: 5 sec.
- Duty cycle: RX/TX: 4 : 1
- Voice recorder output: -6 dBm, +3 / -12 dB @ 600 Ω, balanced

Environmental data:

- Temperature range: Operating -20°C....+55°C
Storage -55°C....+85°C
- Humidity: 48h, 50°C, 95% RH,
without condensation

Dimensions (W x D x H):

- Case: 428 x 280 x 86.5 mm
- 19 inch Unit: 482.6 x 280 x 88.1 mm

Weight:

4.5 kg without internal battery
 6.5 kg with internal battery
 5.6 kg with internal PA (25W & 50W versions)

Transmitter data:

- Carrier power: 6W, 10W, 25W or 50W, depending on transceiver model no.
- Frequency stability: ±1 ppm
- Protection of the transmitter: VSWR = 6 without any damage
- Modulation depth: 85% m 95%
- Modulation distortion: 10%
- AF-Response: 350 Hz....2500 Hz (8.33 kHz)
2 dB ≥ ripple ≥ -4 dB
- Adjacent channel power: 50 dB (8.33 kHz),
60 dB (25 kHz)
- AF-Line input level: -20 dBm to 10 dBm adjustable
- AF-Line input impedance: 600 Ω +/- 10%, balanced
- Local Mike sensitivity (dyn.): 2 mV to 10 mV @ 200 Ω, balanced

Receiver data:

- Sensitivity (Mod. Depth 30%): -101 dBm for 12 dB SINAD
- Effective bandwidth: ≥ 2.8 kHz, 8.33 kHz Channel
 ≥ 8.5 kHz for 25 kHz Channel
- AF-Response: 8.33kHz 350 Hz....2500 Hz
 2 dB $\geq$ ripple $\geq$ -4 dB,
 reference 0 dB @ 1kHz
 25 kHz 350 Hz....3400 Hz
 2 dB $\geq$ ripple $\geq$ - 4 dB,
 reference 0 dB @ 1kHz
- Adjacent channel rejection: ≥ 60 dB
- Spurious response rejection: ≥ 70 dB
- Inter-Modulation
 response rejection: ≥ 70 dB
- Blocking or desensitisation: ≥ 80 dB
- Cross modulation rejection: ≥ 80 dB
- Squelch operation: 6 dB S+N/N 12 dB,
 adjustable on front panel by software setting,
 override level -85 dBm
- Audio noise: ≥ 40 dB S+N/N @ -13 dBm
- RF-Input level range: -101 dBm RF level 10 dBm
- RF-Dynamic range: 6 dB AF variation for 100 dB
 RF variation
- AF-AGC for 30% m 90%: AF-Level variation 1.5 dB
- AF-Line output level: -20 dBm to 10 dBm,
 adjustable with internal potentiometer
- AF-Line output impedance: 600 Ω +/- 10%, balanced
- Local headphone output power: ≥ 1.5 V @ 600 Ohm,
 unbalanced, volume control
 located on front panel
- Ext./Int. speaker power: ≥ 4 W sinus @ 4 Ω , Volume
 control at the front panel

1.6 Accessories

Antenna connector for RG 213 / 214 coax-cable Article no.: 0716.502-277

Cable connector (soldering)

15 pin D-SUB (male) Article no.: 0726.303-277

9 pin D-SUB (male) Article no.: 0344.699-277

25 pin D-SUB (male) Article no.: 0584.940-954

Cable connector (crimp)

15 pin D-SUB (male) Article no.: 0812.803-227

9 pin D-SUB (male) Article no.: 0820.970-277

25 pin D-SUB (male) Article no.: 0584.983-954

Hand mike dynamic with cable Article no.: 0344.214-951
cable and 5-pole DIN connector 1PM012

1PH028 Headset, dynamic Mike, 200 Ω , Article no.: 0860.557-951
Headphone 300 Ω , 5-pin DIN connector

1PH030 Headset, dynamic Mike 200 Ω , Article no.: 0574.775-951
Headphone 600 Ω , 5-pin DIN connector

Lightning protection, overvoltage protection Article no.: 0600.891-277

Antenna 1A049 Article no.: 0812.064-952

Manuals

Installation and Operation DV17900.03 Article no.: 0639.583-071

Maintenance and Repair DV17900.04 Article no.: 0639.591-071

Operating Instructions Article no.: 0640.549-071

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2 Section 2 INSTALLATION

2.1 Installation in an ATC desk

2.1.1 General

Two version of TG660 are available, one without 19 inch housing for installation in an Air Traffic Control (ATC) desk and the other as stand-alone 19 inch VHF transceiver with an own desk cabinet. The following instructions thus apply only in a general way.

CAUTION

Only qualified and authorized personnel shall perform the installation the TG660.

2.1.2 Pre-installation check

When unpacking the goods inspect all deliveries in respect to be free from any damage that might occur during transport and check in accordance with the delivery note completeness of the whole ship-set.

2.2 Mechanical installation in a 19-inch equipment rack

The design of the TG660 is compliant to install requirements in standard 19-inch rack or in ATC desk.

2.3 Thermal considerations

When powered, the TG660 generates only limited heating, thus requiring no specific cooling system (e.g. forced cooling). However, consider sufficient space for convection at installations in a rack or a controller desk.

2.4 Electrical installation of the TG660

WARNING

115 or 230 V_{AC} is main supply voltage for the TG 660.

2.4.1 Grounding TG660 housing

The grounding terminal (M 4 screw with nut), which is clearly marked with the grounding symbol, is located on the rear side of the 19 inch rack. Connect this terminal directly to the next potential equalisation rail or grounding point of the building. Use an adequately dimensioned cable of 10 mm², coloured green/yellow.

NOTE

Observe the relevant national safety precautions.

2.4.2 Radio frequency radiation

The station shall be used only with antenna systems which are qualified for operation in ATC mobile communications service and for which the radio frequency radiation hazard awareness operations and maintenance personal is provided.

WARNING

The station may become a cause of radio frequency radiation hazard if installation incorrectly, not grounded, or if used with unapproved antenna systems.

2.4.3 Lightning protection

Install a lightning protection element in the antenna coaxial cabling to protect the station from lightning strike or static discharge at the antenna. Connect the grounding terminal of the lightning protection element to the potential equalisation rail of the building or any other low impedance ground via an adequately sized cable.

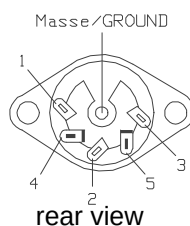
2.4.4 Installation of antenna system

For safety reasons the antenna system should be installed only by qualified personnel. The correct installation and grounding of the antenna system is an essential precondition for trouble free operation of the VHF ground station.

2.5 Pin connection front panel

2.5.1 Pin connection mike connector (MIC)

Pin	Signal	Description
1	GND	AF Signal Ground, Mike Shield and Return for PTT
2	MIKE HI	Microphone AF Signal HI
3	HEADPHONE	Headphones AF Signal HI
4	MIKE LO	Microphone AF Signal LO
5	PTT	PTT Switch Input



2.6 Pin connection rear panel

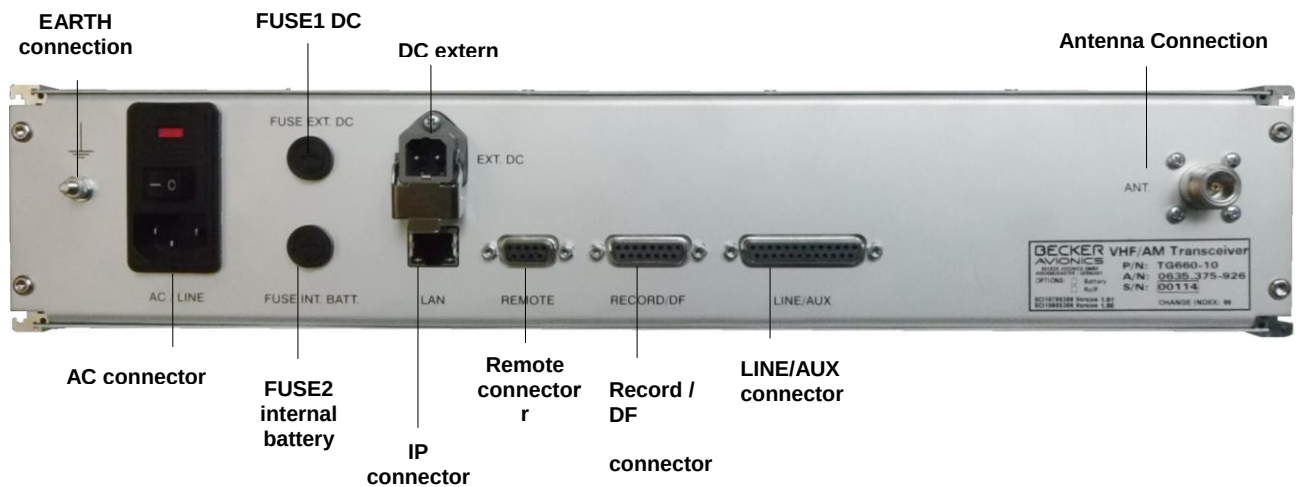
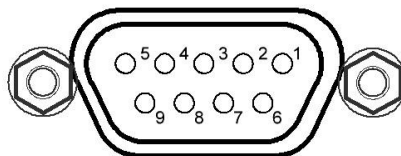


Fig. 2 - 1 Rear side

2.6.1 Remote control 9 PIN D-SUB connector (female)

Pin	Signal	Description
1	RX-	RS422 Data line
2	TX-	RS422 Data line
3	RX+	RS422 Data line
4	TX+	RS422 Data line
5	Shield	GND
6	NC	No Connection
7	NC	No Connection
8	NC	No Connection
9	NC	No Connection

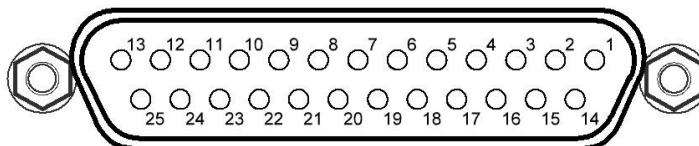


rear view

2.6.2 Line/AUX

25 PIN D-SUB connector (female)

Pin	Signal	Description
1	DC Out	Auxiliary voltage output 12 V, max 1A
2	DC GND	Auxiliary voltage ground
3	Line Out (HI)	AF output 0 dBm 600 Ohm
4	Line Out (LO)	AF output 0 dBm 600 Ohm
5	PTT Line (HI)	PTT activation
6	SQL Line (HI)	Squelch output HI
7	Line IN (HI)	AF input 0 dBm 600 Ohm
8	Line IN (LO)	AF input 0 dBm 600 Ohm
9	Line IN (M)	AF input transformers centre connection
10	RX_AGC	Receiver audio gain control output
11	Mike EXT (HI)	External microphone input Dyn/Electret
12	Mike EXT (LO)	External microphone input Dyn/Electret
13	Chassis	Chassis ground
14	PTT Line (LO)	PTT activation LO
15	SQL Line (LO)	Squelch output LO
16	Line Out (M)	Line Out transformer centre connection
17	PTT ext. (HI)	External PTT HI
18	PTT ext. (LO)	External PTT LO
19	NC	No connection
20	AF GND	AF ground
21	SPK (HI)	Loudspeaker signal
22	SPK GND	Loudspeaker ground
23	Error (HI)	Error detection, potential-free
24	Error (LO)	Error detection, potential-free
25	Chassis	Chassis ground

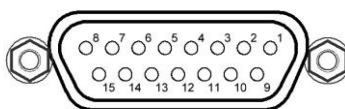


rear view

2.6.3 Record / DF

15 PIN D-SUB connector (female)

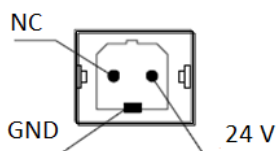
PIN	SIGNAL	DESCRIPTION
1	DF_BL (HI)	DF Blank (HI)
2	DF_BL (LO)	DF Blank (LO)
3	GND	Ground
4	VR_Out (HI)	Voice Recorder out (HI)
5	VR_Out (LO)	Voice Recorder out (LO)
6	GND	Ground
7	NC	Not connected
8	VR_Act (HI)	Voice recorder control active (HI)
9	VR_Act (LO)	Voice recorder control active (LO)
10	NC	Not connected
11	NC	Not connected
12	NC	Not connected
13	NC	Not connected
14	NC	Not connected
15	NC	Not connected



rear view

2.6.4 EXT. DC INPUT

2 PIN connector



front view

A 24 V_{DC} supply cable is connectable to the jack “DC extern” located on the rear panel of the TG660.

CAUTION

Ensure correct polarity of the DC leads!

An adequately dimensioned cable of 1.5 mm² or thicker shall be used for this purpose.

NOTE

24 V_{DC} input cannot be separated from external DC power supply by means of a dedicated switch. Disconnect the DC supply cable at “EXT.DC” input connector for this purpose.

2.6.5 AC / LINE power supply connector

The “AC / Line” power adapter on the rear side of the TG660 provides a socket to connect 220V/115V from the AC source via the cable IEC 60-320-1 and additionally an ON/OFF switch to disconnect AC power from all TG660 circuits.

NOTE

The TG660 power supply logic operates with AC-power by default. After AC-power failed, the logic automatically switches over to DC-power. The moment AC-power becomes available the logic returns back to AC-power source.

An **optional** internal 12 V_{DC} battery, installed inside the TG660, provide enough power to continue operation of the TG660 in case AC and DC supply voltage would fail the same time. During battery operation the TX power of a 10 W receiver will be reduced to 6 W (emergency operation).

2.7 LINE / AUX connection

PTT-LINE (HI)	Pin 5	PTT connection, HI
PTT-LINE (LO)	Pin 14	PTT connection, LO

NOTE

“PTT-LINE” (HI/LO) - (optically decoupled PTT input, active at 12 V ± 1 V). If 12 V_{DC} applied to this input, TX activates and TX modulation input of the transceiver switches internally to “LINE-IN” input.

2.7.1 Connection of an external speaker

The TG660 allow connection of an external loudspeaker. The external loudspeaker must be connected to pin 21 “SPK HI” (+) and pin 22 “SPK LO” (-) of the “LINE AUX” connector. The cable length between speaker and connector shall be ≤ 3 m.

The output is **not galvanically decoupled**. The “SPKR” (LO) lead connects internally to signal ground. The output “SPKR” (HI) has coupling capacitor, connected internally, in series. The max output power is 3 Watts at 4 Ω.

2.7.2 External speaker

Pressing “SPKR” key for approx. 2 sec enables / disables external loudspeaker, the display shows the status of the external and internal speaker for approx. 1 second.

2.7.3 Internal speaker

Pressing “SPKR” key shortly enables / disables the internal loudspeaker, the display shows status of the internal and external speaker for approx. 1 second.

2.7.4 Headphone connection

Connect only headphones with an impedance of 600 Ohm and a nominal output power of 100 mW to the headphone output on the front plate. This output **is not galvanically decoupled**.

A "VOLUME" knob on the front panel allow control of audio loudness.

Phone	Pin 3	Headphones AF signal
GND	Pin 1	Signal ground

2.7.5 Connection LINE IN / LINE OUT

The "LINE IN" input is a balanced AF input.

An AF transformer decouples galvanically from housing and internal signal ground. The AF transformer has centre tap connected to pin 9 "LINE_IN" (C). Nominal load resistance is 600Ω and nominal output level is 0 (zero) dBm @ 600Ω. PTT control and CALL indication provided by using the centre tap without additional control lines.

LINE_IN (HI)	Pin 7	AF Signal from Communication Equipment
LINE_IN (LO)	Pin 8	AF Signal from Communication Equipment
LINE_IN (C)	Pin 9	Centre Tap of "LINE_IN" input

The LINE OUT output is a balanced AF output

The "RX AF" signal from the station is present at this output. By an AF transformer "LINE OUT" signal galvanically decouples from housing and internal signal ground. Center tap of the AF transformer connects to pin 16 – "LINE_OUT" (C). Nominal load resistance 600Ω, nominal output level 0 (zero) dBm @ 600Ω.

LINE_OUT (HI)	Pin 3	AF Signal from Communication Equipment
LINE_OUT (LO)	Pin 4	AF Signal Communication Equipment
LINE_IN (C)	Pin 16	Centre Tap of "LINE OUT" output

2.7.6 Connection SQL - LINE

The "SQL-LINE" (HI/LO) is an optical-isolated switching control line. The signal HI/LO indicates the presence of received RF signal.

RX squelch is open if the switch is closed. This signal provides indication of a call on remote communication equipment. Maximum switching current is 20mA. Voltage drops at 20mA not more than 1V. Maximum switching voltage is 65V.

SQL_LINE (HI)	Pin 6	CALL Indicator
SQL_LINE (LO)	Pin 18	CALL Indicator

2.7.7 Output PTT LINE (HI/LO)

“TX_ACT LINE” (HI/LO) is an optical-isolated switching control line. The switch closes as long as TX is active. Maximum switching current is 20 mA. Voltage drop at 20 mA not more than 1V. Maximum switching voltage is 65V.

PTT LINE (HI)	Pin 5	TX ACTIVE Indicator
PTT LINE (LO)	Pin 15	TX ACTIVE Indicator

2.7.8 Input PTT_AUX LINE (HI/LO)

“PTT_AUX LINE” (HI/LO) is an optical-isolated switching control line. Maximum switching current is 20mA. Voltage drop at 20mA not more than 1V. Maximum switching voltage is 65V.

PTT ext. (HI)	Pin 17	PTT for Auxiliary TX
PTT ext. (LO)	Pin 18	PTT for Auxiliary TX

2.8 Microphone connection

2.8.1 Mike connector (MIC) front plate

The signals “MIKE (HI)” and “MIKE (LO)” are the balanced AF inputs of the TG660 (input impedance 200 Ω, nominal input voltage 10mV. The microphone connection on the front plate is foreseen connecting dynamic microphones by default, carbon microphone operation available from configuration only.

MIKE (HI)	Pin 2	Microphone AF signal
MIKE (LO)	Pin 4	Microphone AF signal

2.8.2 LINE/AUX connector (rear side of TG660)

The TG660 allows the connection of an external microphone. If respectively configured the microphone amplifier can operate with both, standard carbon- or dynamic mike.

Microphone selection

The microphone type can selected via the web browser connection. Adjustment of input levels and priority for connected microphones also provided.

Standard (carbon) microphone

For operation with standard microphone (carbon) the station has a balanced input with input resistance 150Ω and nominal sensitivity 250 mV. 12 volts DC power for standard microphones provided via a feed resistor 470 Ω.

Dynamic microphone

For operation with dynamic microphone, the station has a balanced input with an impedance of 200 Ohm input resistance and a nominal sensitivity of 2 mV.

2.9 Auxiliary Voltage output

The auxiliary voltage output is suitable for supply the optical isolated applications. The output voltage is 12 Volts @ 1A maximum.

DC out 12V/1A	Pin 1
DC GND	Pin 2

2.10 Record/DF connector

2.10.1 AF output to Voice Recorder

TX side tone and RX AF signals from the ground station are present at this output for recording the information. The output galvanically decoupled from housing and internal signal ground. Nominal load resistance is 600 Ω , nominal output level 547 mV @ 600 Ω .

VR_OUT (HI)	Pin 4	Audio to Voice Recorder
VR_OUT (LO)	Pin 5	Audio to Voice Recorder

2.10.2 Voice Recorder control

This signal provides control of the voice recorder. Maximum switching current is 20 mA. Voltage drops at 20 mA not more than 1V. Maximum switching voltage is 65V (optically-isolated contact).

The switch closes, either if TX is active or if RX squelch is open. This means, both transmit and receive signals are recorded if a voice recorder is connected.

VR_ACT (HI)	Pin 8	Voice Recorder Activation Control
VR_OUT (LO)	Pin 5	Voice Recorder Activation Control

2.10.3 Direction Finder blank-out

The switching output provides automatic control to blank-out during transmit the Direction Finder (blanks out Direction Finder during transmission).

The switch (Optically-isolated contact) is closed if TX is active. Maximum switching current is 20 mA. Voltage drop at 20 mA not more than 1V. Maximum switching voltage is 65V.

DF_BL (HI)	Pin 1	DF Blanking Signal
DF_BL (LO)	Pin 2	DF Blanking Signal

Blank

3 Section 3 OPERATION

3.1 Controls and Indicators of TG660



Fig. 3 - 1 Controls and indicators

3.2 Symbol Meaning on Controls and Indicators

Description	Function
STANDBY switch	Switches the station ON/OFF
SPKR key	The "SPKR" key provides switching "ON / OFF" of the internal and external loudspeaker. A short press on "SPKR" key enables/disables the internal loudspeaker and a longer press (approx. 2 sec.) enables/disables the external loudspeaker. Approximately 1 sec after each change process the display shows the actual status of both loudspeakers.
MODE key	Selection of modes: - Normal Operating mode (frequency selection via Key-pad) - Channel mode (selection of predefined channels) - Several long presses on the "MODE" key show the status of different supply voltages (e.g. Radio, DC-In and Optional Battery)
SPKR key LED	The LED lights up as long as the internal speaker enabled.
MODE key LED	The LED lights up as soon as the system self test detected an error.
SQL key LED	The LED lights up during receive of a signal. If the SQL is disabled the LED is continuously blinking.
PTT key LED	The LED lights up during the TG660 is in transmit mode. If the transmitter is continuously "ON" for more than 2 minutes, the transmitter shuts down automatically. The PTT LED is blinking until keying interrupts.
SQL key	Each short press on "SQL" key switches the squelch ON/OFF. A long press on squelch key activates the SQL threshold setting function. Another short press returns the TG660 into the previous mode.
Key (E)	Use Key (E) to acknowledge keypad re-entries.
Key (S)	Storage key
Keys 0 – 9	Numerical keypad
VOL knob	The "VOL" knob allows adjustment of loudspeaker volume.
AC/DC LED	The AC/DC LED's indicate which supply voltage is available.
MIC	The "MIC"-socket provide connection of a dynamic hand mike or a head set.

3.2.1 Power "ON"

Turn on the TG660 by means of the STANDBY switch on the front plate. The Logo "Becker Avionics" appear for 2 seconds on the LC display.

Depending on which power source is available, the associated indication at the front panel light up, (LED "AC" and/or "DC").

The TG660 power supply logic is operating with AC-power by default. After AC-power failed, the logic automatically switches over to DC-power. The moment AC-power becomes available the logic returns back to AC-power source.

An optional internal 24 V_{DC} battery inside the TG660, if installed, could provide power for continued operation over a certain time if AC and DC supply voltage would fail the same time.

If the station switches from AC to DC-power or vice-versa, the station is operable with the same functions and settings as before.

3.2.2 Power on Built In Test (PBIT)

Right after power is applied, the system performs a Display dimming test from minimum to maximum brightness and thereafter the LCD shows "Becker Avionics and TG 660" for approximately two (2) seconds.



PBIT thereafter starts in a 2 seconds interval to change from the 1st test-step to the next up to the last one.

1. Step The top line can show different information i, bottom line shows the last used frequency refer to 3.2.3.



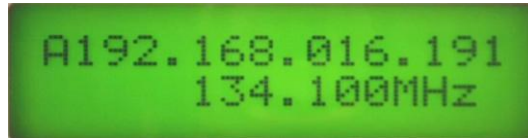
2. Step The 2nd picture shows the sample of an top line with the last used mode after a power cycle. Depending on customers last used mode different information can appear.

The following sample it shows the status of the optional internal battery, if installed.

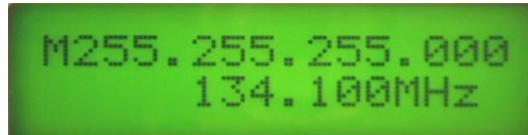
If not installed, the battery symbol on the right end of top line is crossed out and any actually stored voltage in a capacitor within the battery control circuit counts slowly downwards until 0 (zero) volts are reached.



3. Step The 3rd picture shows figures of the IP address in the top line.



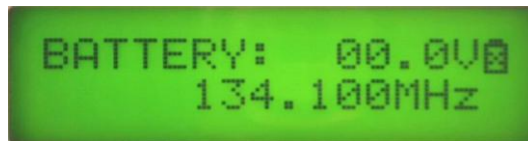
4. Step The 4th picture shows figures of the subnet mask in the top line.



5. Step The 5th picture shows the port number in the top line.



6. Step The 6th picture shows the display in last used mode which become active after the PBIT is completed successful.



Note: The display settings, selected before switch off, restore automatically after PBIT completion.

3.2.3 Possible Display Modes



The display shows the frequency and the status of the battery. The 'X' in the battery symbol indicates no battery option installed.



Press *MODE* key 1st time for approx. 2 seconds and the upper line of the display changes, the Radio Voltage become displayed.



Press *MODE* key 2nd time for approx. 2 seconds and the upper line of the display changes, the voltage of the internal battery become displayed. (optional battery)

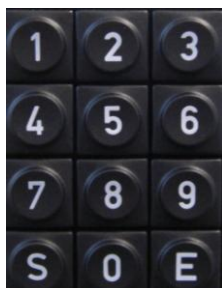


Press **MODE** key 3rd time for approx. 2 seconds and the upper line of the display changes, the Radio power supply voltage and the voltage of the internal battery become displayed.

The display shows the frequency and the status of the battery. The 'X' in the battery symbol indicates no battery option installed.

Description	Function
lower line	Indication of active transmit/receive frequency
upper line R: 24,0 V B: 00.0V	Indication of internal DC supply and opt. battery voltage (if a battery is installed, otherwise shows 00.0V)
upper line shows an arrow ↑	Indicating transmit mode (PTT active)
upper line shows an arrow ↓	Indicating receive signal detected
upper line battery symbol	Shows actual battery voltage status in most of the selectable operation modes, configuration pages excluded.

3.2.4 Keypad

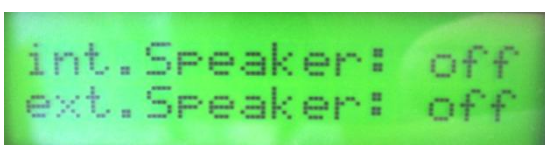


Use keypad for changing the actual frequency. Only 25/8.33 kHz frequencies are accepted. If the new frequency is not included in the 25/8.33 kHz channel spacing the upper line blinks.
 Type in all 6 digits of the desired frequency and use key "E" for activation.

3.2.5 SPKR Key



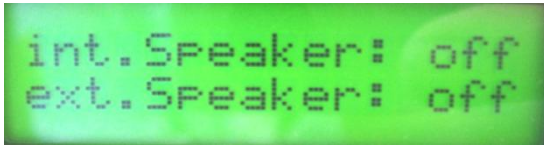
Press **SPKR** once - internal speaker is switched on. A red signal light at **SPKR** knob lights up.



Press **SPKR** again - internal speaker is switched off again. Red signal light will disappear.



Press SPKR approx. 2 seconds; the external speaker will be switched on.



Press SPKR again - external speaker is switched off again.

3.3 Storage procedure



Adjust the storage frequency in "Standard Mode", thereafter press the "S" button.



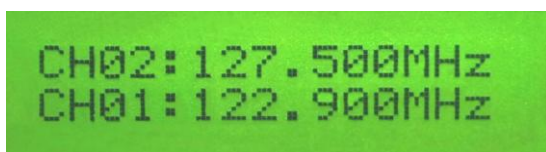
Select the desired channel number with the keyboard, key in "02" e.g.

! Engaged channels will be overwritten.

Press "E" button to store this frequency in CH02.



Vacant channels are displayed with "Chan. free"



Press the "E" button to save the frequency.

NOTE

The interdependence of the operating channel number and the real operating frequency of the transceiver is shown under section 3.4.

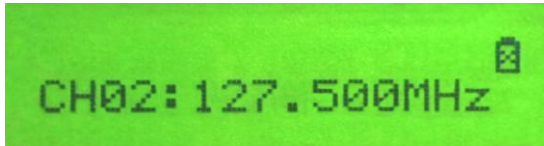
3.3.1 Channel mode



Make a short press on the MODE button
 The display shows a channel input field



Dial the desired channel number e.g. "02" and press the "E" button.



After pressing "E" button the display shows the dialled channel frequency.

Description	Function
top line	Indication the selected storage channel
top line	Indication of active transmission/reception frequency (active frequency)
line 24,0 V	Indication of DC supply voltage

3.3.2 MODE Key



Press MODE key 1st time for approx. 2 seconds and the upper line of the display changes, the Radio Voltage become displayed.



Press MODE key 2nd time for approx. 2 seconds and the upper line of the display changes, the voltage of the internal battery become displayed. (optional battery)



Press MODE key 3rd time for approx. 2 seconds and the upper line of the display changes, the Radio power supply voltage and the voltage of the internal battery become displayed.

3.4 Sample of Selectable Frequencies

The table below shows the relation between the real operating frequency and the selected frequency according to international standards. (refer to: ED-23D, chapter 1.3.2, or ICAO).

Channel Name	Channel Frequency	Channel Spacing
118.000	118.0000 MHz	25 kHz
118.005	118.0000 MHz	8.33 kHz
118.010	118.0083 MHz	8.33 kHz
118.015	118.0166 MHz	8.33 kHz
118.025	118.0250 MHz	25 kHz
118.030	118.0250 MHz	8.33 kHz
118.035	118.0333 MHz	8.33 kHz
118.040	118.0416 MHz	8.33 kHz
118.050	118.0500 MHz	25 kHz
118.055	118.0500 MHz	8.33 kHz
118.060	118.0583 MHz	8.33 kHz
118.065	118.0666 MHz	8.33 kHz
118.075	118.0750 MHz	25 kHz
118.080	118.0750 MHz	8.33 kHz
118.085	118.0833 MHz	8.33 kHz
118.090	118.0916 MHz	8.33 kHz
118.100	118.1000 MHz	25 kHz
...	...	...
136.975	136.9750 MHz	25 kHz
136.990	136.9916 MHz	8.33 kHz
