BECKER
AVIONIC SYSTEMS

Control Unit

CU 5502 - ( )

Installation and Operation

Manual DV 60531.03
Issue 1 July 1997

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Section 1 General Information

1.1 Introduction

The CU 5502 - ( ) control unit is described in the “Installation and Operation” DV 60531.03 and “Maintenance and Repair” DV 60531.04 manuals.

The manuals DV 60531.03 “Installation and Operation” and DV 60531.04 “Maintenance and Repair” contain the following sections:

Section		DV 60531.03	DV 60531.04
1	General Information	X	X
2	Installation	X	X
3	Operation	X	X
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5	Maintenance and Repair		X
6	Illustrated Parts List		X
7	Modification and Changes		X
8	Circuit Diagrams		X

1.2 Purpose

The control unit is used to control and operate the RA 3502 - ( ) ADF receiver and is part of the ADF 3500 system. Both together form the automatic direction finding system which operates in the 190 kHz to 1799.5 kHz and 2182 kHz ± 5 kHz frequency range and was developed for use in aircraft.

The control unit was designed in accordance with RTCA Air Worthiness Requirements. RTCA DO-160C was used for the requirements under environmental influences. There is no restriction with regard to installation by rigid attachment to the fuselage of the aircraft or installation in the instrument panel, including in rotary wing aircraft, in the verified environmental categories.

A maximum operating ceiling of 50.000 ft. was verified for all system functions in the suitability test.

1.3 General description

1.3.1 Mechanical description

The control unit is designed for installation in the instrument panel of aircraft. The dimensions correspond to the ARINC standard for standard instruments of 60 mm (2 1/4") diameter. Installation is by means of four bolts (back panel mounting).

All the controls and indicators are located on the front panel. The equipment connectors are fitted on the back.

The control unit consists of the following circuit boards:

Display Board,
Switch Board,
Processor Board,
Power Supply Board.

Mechanically the control unit consists of a front section and rear section. The front section contains the display board and the switch board and these boards are connected to each other by a connector and held in place within the unit by four bolts. The processor board, which is also secured to the front section by two bolts, is mounted on a switch board. The power supply board is inserted into the rear section and secured from outside (back of rear section) by three bolts. After all the boards are assembled, the front and rear sections are joined together and secured to each other by four bolts inserted from the front section.

1.3.2 Electrical

After switch on, an initialization phase takes place between the control unit and the ADF receiver. During this period data transmission takes place from the remote ADF receiver to the control unit. This is necessary because data backup takes place in the remote ADF receiver. On completion of this phase, the mode which was set before switch off is automatically displayed on the control unit.

The frequencies are indicated by means of an LC display. The required active working frequency can be set using the frequency selector switches. The outer rotary switch engages at steps of 100 kHz/ 10 kHz and the inner rotary switch at steps of 2 kHz/500 kHz. In the frequency preselection mode, a faster frequency change between the set active frequency and the preset frequency is achieved by pressing the **(<->) exchange** key.

The control unit and ADF receiver are switched on using the mode switch with four detent positions, OFF, REC, ADF, BFO. In the REC position the ADF receiver operates as a receiver in the A2/A3 mode, in the ADF position as a radio direction finder and in the BFO position it operates in reception mode as an A1 beat frequency operator and radio direction finder.

The volume is set using the + and - keys. The **TMR** key operates a stopwatch.

Data transmission between the control unit and ADF receiver is via a bi-directional, serial RS 422 interface.

1.4 Technical data

Power supply	+ 27.5 V d.c. (22.0 V - 32.0 V)
Emergency power supply	+ 20 V d.c.
Power consumption (without panel lighting)	≤ 0.06 A at 27.5 V
Panel lighting	≤ 0.160 A at 13.75 V ≤ 0.080 A at 27.5 V
Operating temperature	- 20° C . . . + 55° C
Storage temperature	- 55° C . . . + 85° C
Operating ceiling	50.000 ft
Interface	RS 422
Vibration resistance in accordance with EUROCAE/RTCA ED-14C/DO-160C	Cat. NM
Humidity resistance in accordance with EUROCAE/RTCA ED-14C/DO-160C	Cat. A / + 50° C; 95%, 48 h
Environmental performance class	ED-14C/DO-160C
Env. Cat.	A1D1-BA(MN)XXXXXXZBABATAXXX
Dimensions	61.3 x 61.3 x 62 mm H x W x D
Weight	0.26 kg

1.5 Software

All data such as the set frequencies, selected mode etc. are stored in the remote ADF receiver. Any changes at the control elements result in an immediate data transmission to the remote ADF receiver. The frequency display is controlled by a microprocessor. The software was classified as level C in agreement with the EUROCAE/RTCA document ED12B/DO-178B.

1.6 Overview of variants

Table 1-1 shows the variants of the CU 5502 - ( ) control unit. There is no external difference between the different variants, i.e. dimensions, installation depth etc. are the same for all the series.

Article-No.	Part designation	Background lighting		Panel surface	
		red-orange	blue-white	Powder coated	Painted
0503.800-911	CU 5502 - (1) - X01	X			X
0508.500-911	CU 5502 - (1) - X11		X		X

1.7 Specification

LBA-No.:	10.921/53 JTSO
BAPT	A132 880 J
Specifications	
RTCA DO-179	JTSO - 2C41d
FTZ	17 TR 2010
Software	ED-12B/DO-178B Level C
Environmental categories	D1-BA(MN)XXXXXXZBABATAXXX EUROCAE/RTCA ED-14C/DO-160C

1.8 Environmental influences

The following resistances to environmental influences were verified in accordance with EUROCAE/RTCA ED-14C/DO-160C.

Environmental influence	ED-14C DO-160C	Environmental class	Influence variable
Temperature and altiude	4.0	A1 D1	
Low operating temperature	4.5.1		- 20° C
Low storage temperature			- 55° C
High short-duration temperature	4.5.2		+ 70° C
High operating temperature	4.5.3		+ 55° C
High storage temperature			+ 85° C
Negative pressure (altitude)	4.6.1		50,000 ft.
Pressure drop	4.6.2		from 5.000 ft. altitude to 50,000 ft.
Positive pressure	4.6.3		- 15.000 ft.
Temperature change	5.0	B	
Humidity	6.0	A	48 hrs at 50° C and ≥ 95% humidity
Impact under:	7.0		
Operating conditions	7.2		6 G/11 ms for the 3 axes
Crash landing conditions	7.3		Impact: 15 G/11 ms for the 3 axes
Vibration	8.0	MN	
Magnetic influence	15.0	Z	Deflection of a compass by 1° at a distance of ≥ 30 cm
Altered power supply	16.0	B	The functioning of the equipment on 20 V emergency power was verified
Voltage impulse on power supply	17.0	A	
Low frequency disturbing voltages	18.0	B	
Induced magnetic and electrical fields	19.0	A	
High frquency disturbing voltages and disturbing fields	20.0	T	
Unwanted radiation	21.0	A	

1.9 Scope of delivery

Control unit	Article-No.: refer to overview of variants
4 Phillips head screw	Article-No.: 0868.590-203
or	
4 countersunk screw	Article-No.: 0889.350-204
Operating instructions	Article-No.: 0511.757-071

1.10 Accessories (not included in scope of delivery)

Equipment cable socket 15-pole (crimped version)	Article-No.: 0774.030-277
Equipment cable socket 15-pole (soldered version)	Article-No.: 0344.801-277
Housing with push-in locking	Article-No.: 0774.049-277
Manuals	
Installation and Operation DV 60531.03	Article-No.: 0511.481-071
Maintenance and Repair DV 60531.04	Article-No.: 0511.498-071

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Section 2 Installation

2.1 General

The installation of the control unit depends on the type of aircraft and its equipment and therefore only general information can be given in this section.

2.2 Inspection before installation

Before installing the control unit in an aircraft, carry out a visual inspection for any transport damage, paying particular attention to the following.

1. Dirt, dents, scratches, corrosion, broken attaching parts on the housing and housing parts.
2. Dirt and scratches on the identification plate, front panel, LC display and marking.
3. Dirt, bent or broken pins, cracked connector inserts.
4. Dirt and mechanical damage to switches, keys and knobs.
5. Missing screws and bolts.

2.3 Mechanical installation

The control unit is designed for installation in the instrument panel of an aircraft. It is constructed for rear panel mounting. The circular cutout and the attaching holes are to be drilled to suit a small instrument size. The necessary dimensional details are given in Fig. 2-1. The unit is attached using four bolts which are included in the scope of delivery.

2.4 Aircraft wiring

2.4.1 General

The following points are to be observed for the wiring.

a.) Only cable fit for aviation (self-extinguishing) may be used. AWG 24 for power supply and AWG 24 for other cables.

b.) The interface lines TX-A/TX-B and RX-A/RX-B are each to be laid as 2-core twisted and screened (AWG 24) cables.

c.) Rubber sleeves are to be fitted over the soldering points on the equipment connector.

d.) A 1 A fuse or circuit breaker should be fitted in the power supply.

e.) No HF cable should be included in the cable harnesses. Laying connecting cables together with cables which carry AF power or impulses is also to be avoided.

f.) Check the wiring carefully before switching on the unit, particularly that (+ UB) and (GND) have not been mixed up.

2.4.2 Panel and display lighting

The control unit is fitted with panel and display lighting. It can also be connected via a dimmer system.

Connection panel and display lighting	13,75 V Power supply	27,5 V Power supply
P 31 - Pin 6 ILL.A	+ 13,75 V	Ground
P 31 - Pin 8 ILL.B	Ground	+ 27,5 V

NOTE

The panel and display lighting is not switched off when the unit is switched off ON/OFF switch).

2.4.3 Connector contact assignment for 15-pole P 31 connector

Pin	Connection	Description
1	TX-A	RS 422 interface
2	TX-B	RS 422 interface
3	Shield	Screen of RS 422 interface ground
4	RX-A	RS 422 interface
5	RX-B	RS 422 interface
6	ILL.A	Panel and display lighting A
7	Spare	Not wired
8	ILL.B	Panel and display lighting B
9	GND	Ground
10	GND	Ground
11	+UB	+ UB operating voltage
12	+UB	+ UB operating voltage
13	/ON	ON/OFF function
14	UBSW	Switched operating voltage
15	/X	Input special function low active

2.5 List of Abbreviations

The following abbreviations are used in this manual:

Abbreviations

Fig.	Figure
AC	Alternating current
AM	Amplituden modulation
ARINC	Aeronautical radio incorporation
ARINC 429 Line	ARINC 429 serial bus
ARINC 410 Line	ARINC 410 parallel bus
ATR	Avionics transport rack
Bite	Built in test equipment (Self test)
COM	Communication (Transceiver)
CU	Control Unit
dB	Dezibel
dBm	Dezibel refer to 1mW
DC	Direct current
D-GPS	Differential global positioning system
DME	Distance measuring equipment
EMK (EMF)	Electromotive force
EMV	Electrical magnetic interference
EEPROM	Electrical erasable programable read only memory
EXT	External
FTZ	Fernmelde-Technisches Zentralamt
ft	Feet
ICAO	Internationale civil aviation organization

ILL.A	Illumination.A
ILL.B	Illumination.B
I/O ports	Input/Output ports
GND	Ground
HSI	Horizontal situation indicator
Kbit/s	Data transfer rate
LBA	Luftfahrt-Bundesamt
LCD	Liquid crystal display
MAX	Maximum
MTBF	Mean time between failure
NAV	Navigation
N.C.	Not connected
NF-Signal	Audio signal
NOVRAM	Non volatile random acces memory
NVG	Night vision goggle
OUT	Output
/ON	ON/OFF function
PTT	Push-To-Talk
PRG	Program mode
PWR	Power
RAM	Random acces memory
RD	Read
RMI	Radio magnetic indicator
RX-A	RS 422 interface
RX-B	RS 422 interface
/SCK	Seriell clock display
SDA	Seriell data I2c-bus

SCL	Seriell clock I2c-bus
SPARE	Spare
SQL	Squelch
TR	Transceiver
TX-A	RS 422 interface
TX-B	RS 422 interface
UBSW	Operating voltage switched
V5	Internal operating voltage + 5 V
VOR	Very high frequency omnidirectional range
VOL	Volume
/X	Input special function, low activ
ZF	Intermediate frequency

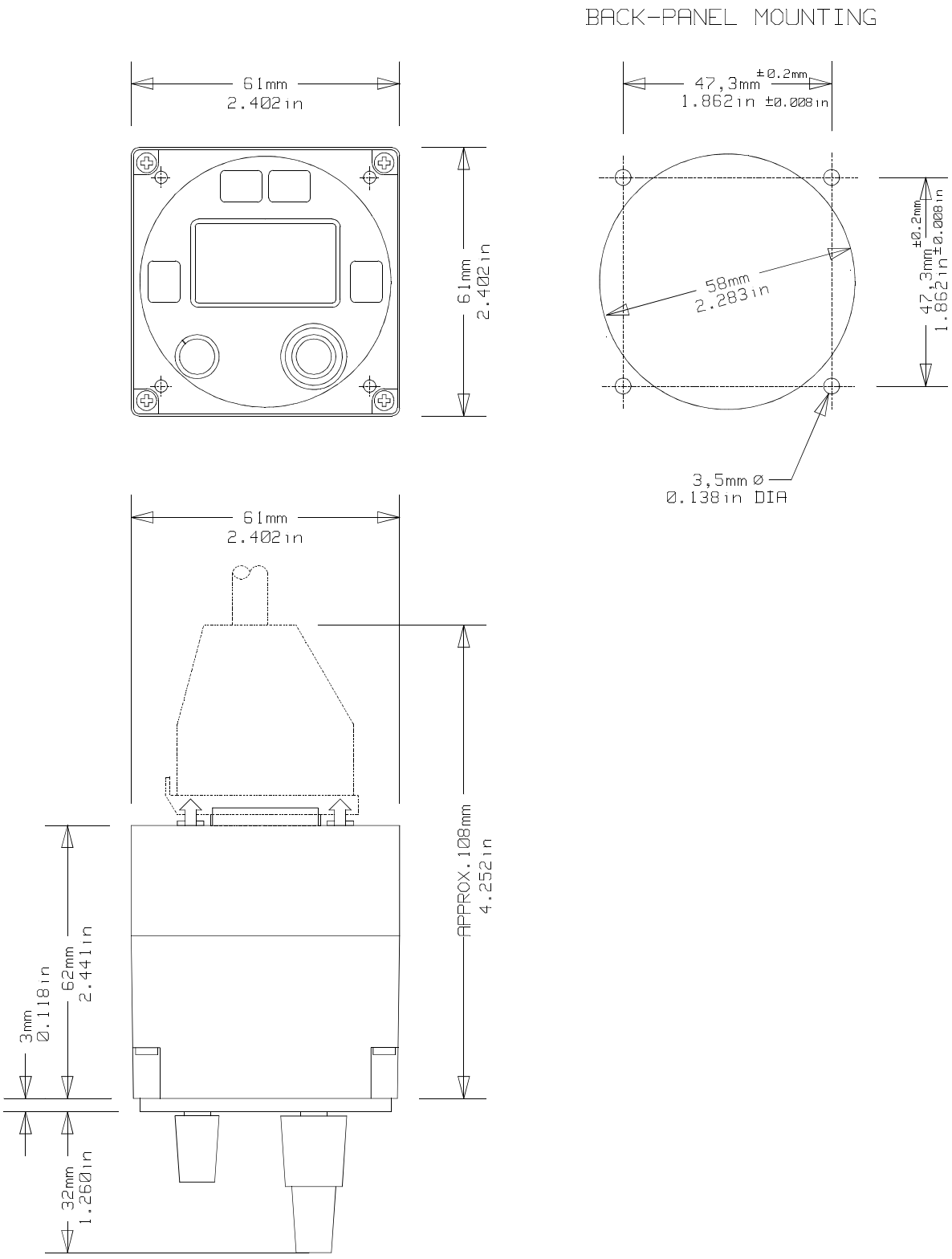

Fig. 2-1 Installation dimensions for the Control unit CU 5502 - ( )

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Section 3 Operation

3.1 Controls and indicators

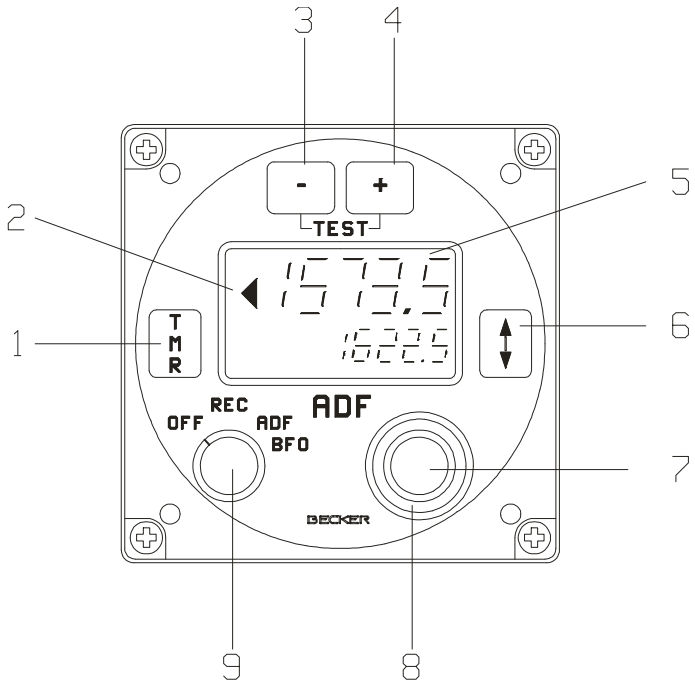
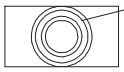
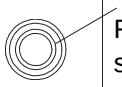


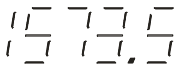
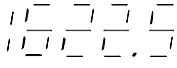
Fig. 3-1 Front panel of control unit

Meaning of symbols on the controls

	Symbol	Description	Function
1	**TMR**	Function key	Switching the stopwatch on and off
3	-	Minus key	Reducing the volume
4	+	Plus key	Increasing the volume
6	◄►	Exchange key	Press key and hold for more than 2 seconds Changeover between the frequency setting mode and frequency presetting mode Press key for less than 2 seconds Exchange of preset frequency and active frequency

	Symbol	Description	Function
	TEST		Pressing the - and + keys simultaneously activates the test function. The needle of the display unit moves to approximately 90° and all digits flash.
7		Frequency selector switch (outer rotary switch)	Switches the displayed frequency in steps of 10 kHz upwards or downwards. If rotated quickly the change takes place in steps of 100 kHz.
8		Frequency selector switch (inner rotary switch)	Switches the display frequency in steps of 500 Hz steps upwards or downwards. If rotated quickly the change takes place in steps of 2 kHz
9		Mode switch with four detent positions	OFF position Control unit and ADF receiver switched off REC position The system operates in reception mode ADF position The system operates in the ADF mode. the arrow is visible in the top line of the LC display. BFO position The system operates in the ADF/BFO mode

Liquid crystal display

	Symbol	Description	Function
5		(Top line) (active frequency)	Display of the active reception frequency
5		(Bottom line) (preset frequency)	Display of preset rececption frequency)
2		(Top line)	Arrow visible: ADF mode switched on Arrow not visible: ADF mode switched off
	T	(Bottom line)	Display of the stopwatch

Connector on back of unit

15-pole subminiature, male Push-in locking	Equipment connector for connecting the aircraft cabling

3.2 Operating instructions

3.2.1 Preparation

Switch on the aircraft power supply (check that the circuit breaker for the ADF system is set).

WARNING

Do not switch on the control unit if engines or motors are being started up or shut down.

3.2.2 Switching on the control unit

a. Set the mode switch to REC.

NOTE

System initialization takes place, i.e. data is transmitted between the control unit and the ADF receiver, for the first 5 to 10 seconds after power on. After completion of the initialization, the mode which was set before power off appears.

In all modes, disturbances of the ADF system are displayed in the form of fault messages.

- ❒ E2 synthesizer failed, lock detect error
- ❒ E5 interface fault

A comprehensive description of the various modes follows the general operating instructions.

3.2.3 REC/ADF/BFO mode

a. Press both **-** and **+** keys simultaneously (test modes). All the segments in the LC display shall flash and the needle of the connected display unit shall simultaneously deflect by approximately 90°.

b. Set the HDG setting on the display unit so that the 0° / 360° scale appears.

c. Using the frequency selector switches, set the required NDB station and monitor the identification signal. For A1 identification the BFO mode must be selected (set the mode switch to BFO).

d. After checking the identification signal, select the ADF mode (set the mode switch to ADF). The needle moves in the direction of the set NDB station.

e. Depending on the flight procedure, set the compass heading using the HDG setting.

3.2.4 Adjusting the volume

The volume is adjusted for monitoring received signals by using the “+” and “-” keys. The volume is shown in the bottom line by means of a numerical value between "0" (quiet) and “63" (loud). The symbol ”V" is placed before the numerical value. The indicated value remains visible for approximately 1 second after the key is released.

3.3 Operation of the various modes

The ADF system contains various functions which are performed under two modes. The modes are selected by pressing and holding the exchange key on the control unit for more than 2 seconds.

Frequency setting mode

Display of the active frequency in the top line. The bottom line is switched off. The active frequency can be directly changed using the frequency selector switches.

Frequency preselection mode

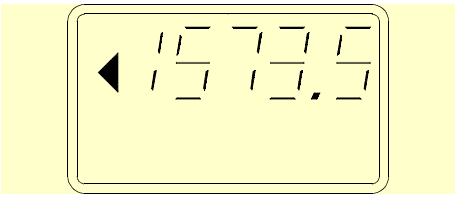
Display of the active and preset frequency. A new frequency can be preset using the frequency selector switches. Pressing the exchange key changes over between the active and preset frequencies.

NOTE

All mode or frequency changes are automatically stored after 2 seconds. This means that changes which are made immediately before switching off are not stored.

3.3.1 Frequency setting mode

The active frequency is shown in the top line and the bottom line is switched off.



The active frequency can be changed using the frequency selector switches.

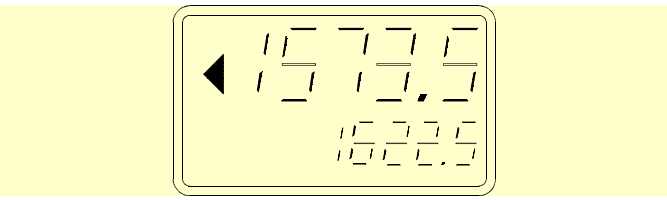
The set frequency remains stored even with the unit switched off.

Change of mode

To change the mode, press the exchange key and hold for at least 2 seconds.

3.3.2 Frequency preselection mode

The last active and preset frequencies appear in the top and bottom lines respectively.



The preset frequency (bottom line) is set using the frequency change switches.
Pressing the exchange key changes over between the active and preset frequencies.

NOTE

The ADF receiver is always ready to receive on the frequency shown in the top line.

Change of mode

To change the mode, press the exchange key and hold for at least 2 seconds.

3.3.3 Switching on the stopwatch

a. Pressing the **TMR** key starts the stopwatch. The frequency setting mode is immediately selected and the previously set mode is stored. The time is counted up 1 second at a time starting at 0 and displayed in the bottom line. The symbol “T” appears before the time.

b. Pressing the **TMR** key a second time stops the stopwatch. The elapsed time is shown in the bottom line and the “T” is shown flashing to the left of the time.

c. Pressing the **TMR** key a third time resets the stopwatch to 0. The symbol “T” is deleted from the bottom line. If the stopwatch is not re-started within 2 seconds, a changeover to the previously stored mode takes place.

3.3.4 Display the Software-Version

Press and hold the **+** key whilst the unit is being switched on and wait until the version number is displayed. As long as the **+** key is held pressed, the following is shown in the top line.

On the left, two positions of the version number of the ADF-Receiver.
Right two positions of the version number of the Control Unit.

Release the **+** key. The ADF receiver is always ready to receive on the frequency shown in the top line.

3.4 Safety precautions

- ❒ Switch off the unit when starting engines.
- ❒ The unit must be protected from the aircraft supply system by a separate circuit breaker.
- ❒ ADF equipment is sensitive to radio interference. Such interference includes the following:

Atmospheric disturbances caused by weather conditions (thunderstorms, thundery atmosphere).

Static charging of the aircraft airframe when flying through damp layers with ice particles.

In both cases this can cause uncontrolled deflection of the display unit. In the case of static charging, reception of an NDB station can fail completely for several minutes.

Disturbances caused by the aircraft supply system due to generators or ignition systems can substantially reduce the range to NDB stations. This can be checked as follows during the flight:

When receiving a disturbed NDB station

a. briefly switch off the generator and observe the effect,
b. set the ignition switch for piston engines to a magneto 1, magneto 2 and 0 in turn and observe the effect. If disturbance is detected, consult a repair facility!

- ❒ Dawn/dusk and night effect. Particularly during dawn/dusk, unusable bearings can arise if changes in the ionization layer influence the phases of ground and ionospheric waves. These influences are also possible at night.
- ❒ Shore errors. When flying over the sea, bearing errors can occur due to the reflection of electromagnetic waves on the coast. For this reason bearings are only correct which are taken at 90° to the coast.
- ❒ When overflying an NDB station the needle of the display unit should ideally move either through 90° (station to the right) or over 270° (station to the left) relative bearing until after overflying it stabilizes in the 180° direction.

Because of a cone of uncertainty of æ 45° which is unavoidable for physical reasons, it must be taken into account that an unstable indication is obtained when flying through this cone of uncertainty and a multiple needle deflections are possible. After departure from the cone, the indication then stabilizes at a value of about 180°. This can vary from NDB to NDB.

- ❒ Approaches to radio transmitters can then only be correctly made if these are expressly listed in the AIP as navigational aids.

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