DBI version 002 User Manual

Free Balloon Flight Instrument

Safety

The manufacturer has designed this instrument to be safe when operated. Do not use this instrument for any other purpose than stated. Note - the DBITX1 is a secondary temperature indicator and shall only be used together with a melting fuse temperature flag (primary temperature indicator).

Operating restrictions

This instrument should ONLY be used in ships referred as *free balloons* carrying open fire or inert gas balloons.
Make sure the battery capacity is enough to ensure a safe flight.

Abbreviations

DBI	DigiTool Instruments free balloon flight instrument
DBITX1	DigiTool Instruments envelope temperature transmitter
LCD	Liquid Crystal Display
RTCA	Requirements & Technical Concepts for Aviation
m/s	Meter per second
ft/min	Feet per minute
InHg	Inch mercury, pressure unit
hPa	Hecto pascal, pressure unit, equals millibar
℉	Degrees fahrenheit, temperature unit
℃	Degrees celsius, temperature unit
V	Volt
VAC	Volt alternating current
mm	milli meter, length unit
gram	mass unit

Table of Contents

1. Introduction

1.1. Approvals

This device DBI version 001 is approved by the Swedish civil aviation following the documents TSO-C10b with subdocument AS8009 for pressure altimeter systems and TSO-C8d with subdocument AS8016 for vertical velocity instruments.

Swedish Civil Aviation Approval number is MSU 2/00.
German Approval: JTSO-C8d AND JTSO-C10b

1.2. Description

The DBI is a integrated flight instrument designed specifically for free balloons operation.

Flight data visually presented to the operator are:

- Altitude, rate of climb and barometric setting air data.
- Ambient temperature.
- Balloon envelope temperature.
- Elapsed flight time.

Flight data acoustically presented to the operator are:

- Rate of climb.
- Envelope temperature high warning.
- Altitude high warning.
- Altitude low warning.

Control of the DBI is done via three push buttons:

- Power On / Off.
- Barometric setting.
- Elapsed time timer clear.
- Altimeter unit toggle (Selectable).
- Flight recorder start (Selectable).
- Sound warning reset (Selectable).
- Altitude sound warning limits setup (Selectable).

Flight data recorded during flight are:

- Barometric setting
- Static pressure (altitude and rate of climb)
- Envelope and ambient temperatures
- Date and time

In non flight, an interface connects the DBI to standard PC computers :

- Configuration
- Internal battery charge.
- Flight recorder data upload.

1.3. Specification

Altimeter

Range feet x 1000	Total error +/- feet at 25 ℃	Total error +/- feet at -30 ℃	Total error +/- feet at 70 ℃
-1 to 6	30	52	43
6 to 8	40	70	58
8 to 10	45	78	65
10 to 12	50	87	72
12 to 14	55	96	79
14 to 16	60	105	87
16 to 18	65	113	94
18 to 20	70	122	101
20 to 22	75	131	108
22 to 25	85	148	123
25 to 30	100	175	145
30 to 35	120	210	174
35 to 40	135	236	195

Rate of climb (variometer)

Absolute error	< 0.1 meter per second
Scale error	< 0.15 % of reading
Time constant (configurable)	1.6 to 6.0 seconds

Barometric setting

Total error (900 to 100 hPa)	< 0.2 meter

Ambient thermometer

Range ℃	Total error +/- ℃
-50 to -25	3
-25 to 0	2
0 to 50	1
50 to 75	2
75 to 100	3
100 to 125	4

Envelope thermometer

Range ℃	Total error +/- ℃
-25 to 0	4
0 to 50	3
50 to 75	2
75 to 125	1
125 to 150	2
150 to 175	3
175 to 200	4

Physical dimensions

Item	Value	Unit
Length	131	mm
Height	110	mm
Depth	31	mm
Weight	480	gram

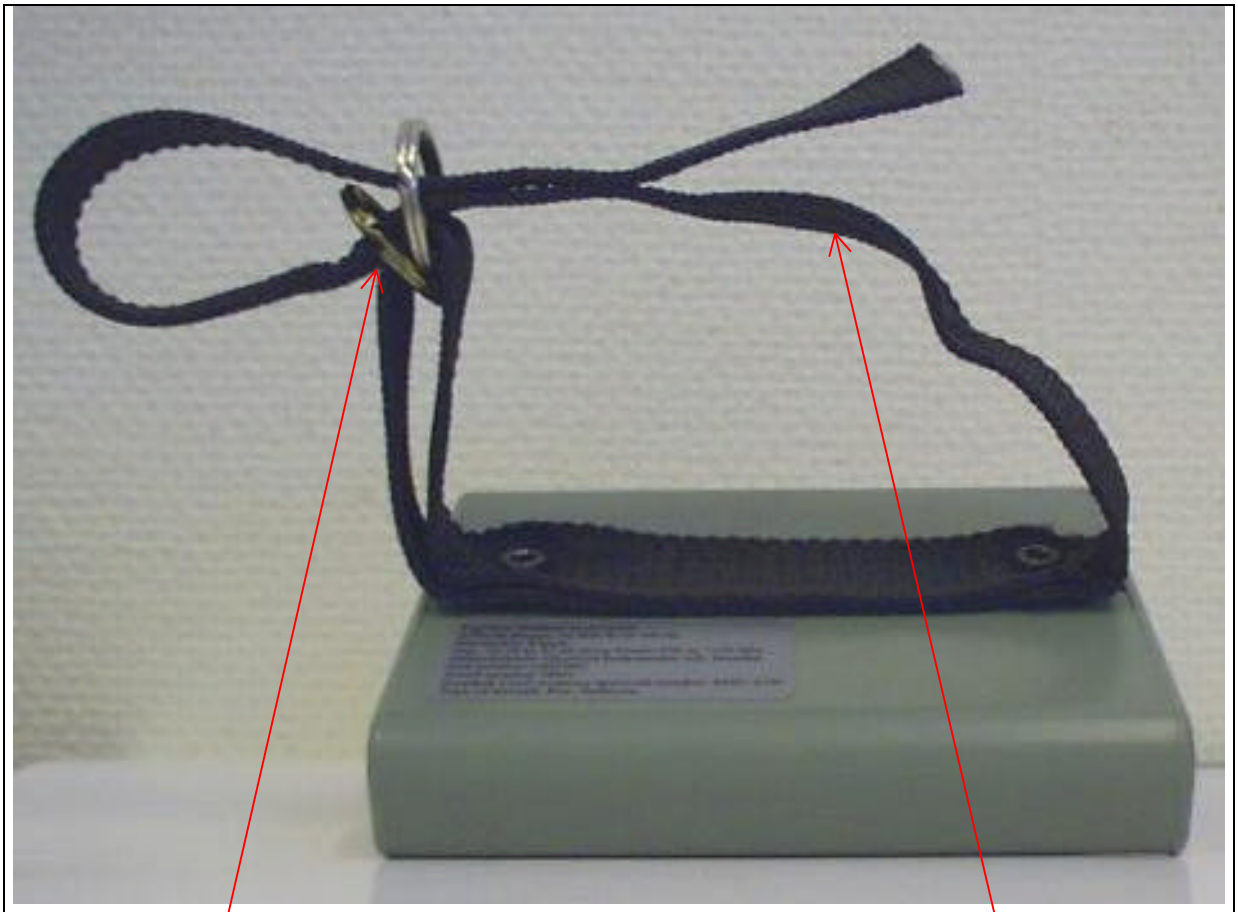
Environmental ratings

Item	Limitations
Vibration	RTCA/DO-160D section 8 Category M
Shock	RTCA/DO-160D section 7
Radio - Frequency Susceptibility	RTCA/DO-160D, (Change No 3) section 20.2 category Y. Test done to 1 GHz only
Radio - Frequency Emission	RTCA/DO-160D section 21.2 category H. Checks to 1 GHz only
Explosion	RTCA/DO-160D section 9 category X
Humidity	RTCA/DO-160D section 6 category A
Water	RTCA/DO-160D section 10 category W
Sand and Dust	RTCA/DO-160D section 12 category X
Salt Spray	RTCA/DO-160D section 14 category X
Fungus Resistance	RTCA/DO-160D section 13 category X
Magnetic Effect	RTCA/DO-160D section 15.3 category A
Operating temperature and ambient pressure	RTCA/DO-160D section 4, category paragraph 4.3, Section C4
Ambient Pressure storage	0 to 2000 hPa
Temperature High Operating	70 °C
Temperature Low Operating	-30 °C
Temperature High Storage	100 °C
Temperature Low Storage	-55 °C

2. Installation

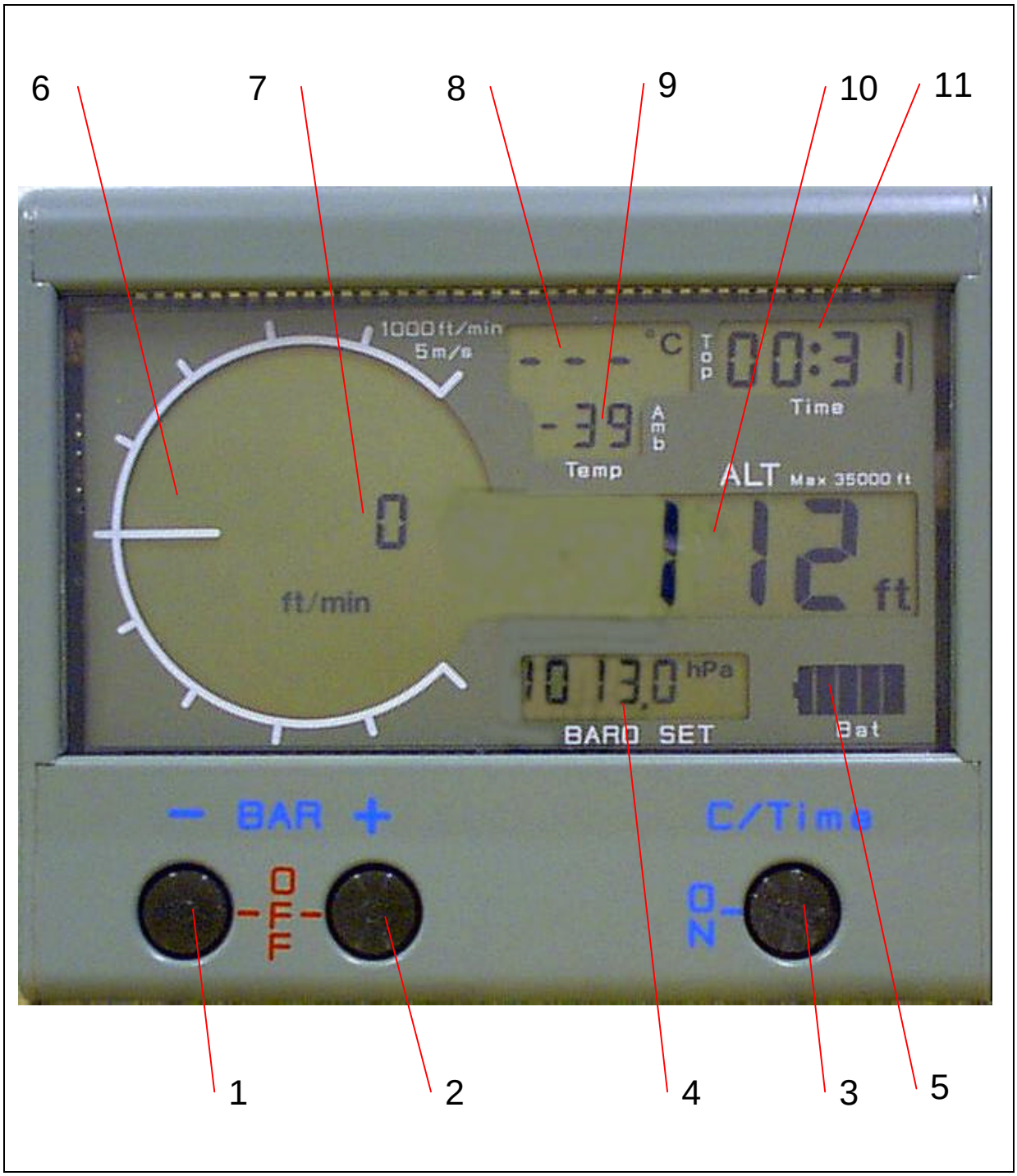
2.1. Attachment

- Use the cord to strap on a suitable item, for example a propane tank or the overhead frame support.
- Look the cord using the D-rings.



3. Operation

3.1. Display view



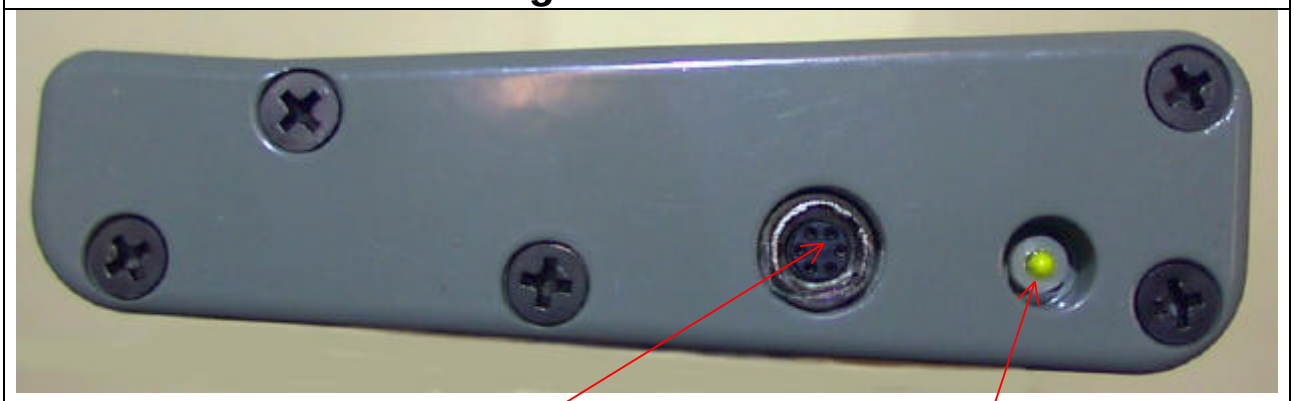
Display view list

Control push buttons function		
#	**Function**	**Action**
1	Decrement baro setting	Click
2	Increment baro setting	Click
1 + 2	Power OFF instrument	Hold 2 seconds
3	Power ON instrument	Click
3	Clear flight time	Hold 2 seconds
3	Start Flight recorder (Selectable)	Hold 2 seconds
3	Sound warning reset (Selectable)	Click
3	Toggle altimeter unit (Selectable)	Double click
2 + 3	Alt warning limits setup (Selectable)	Hold 2 seconds

Display items		
#	**Item**	**Unit**
4	QNH setting	hPa or InHg
5	Battery status	5 to 0 segments
6	Analog rate of climb	Scale fixed
7	Digital rate of climb	ft/min or m/s
8	Envelope temperature	°C or °F
9	Ambient temperature	
10	Altimeter	meter or feet
11	Flight time	hh:mm

3.2. Side views

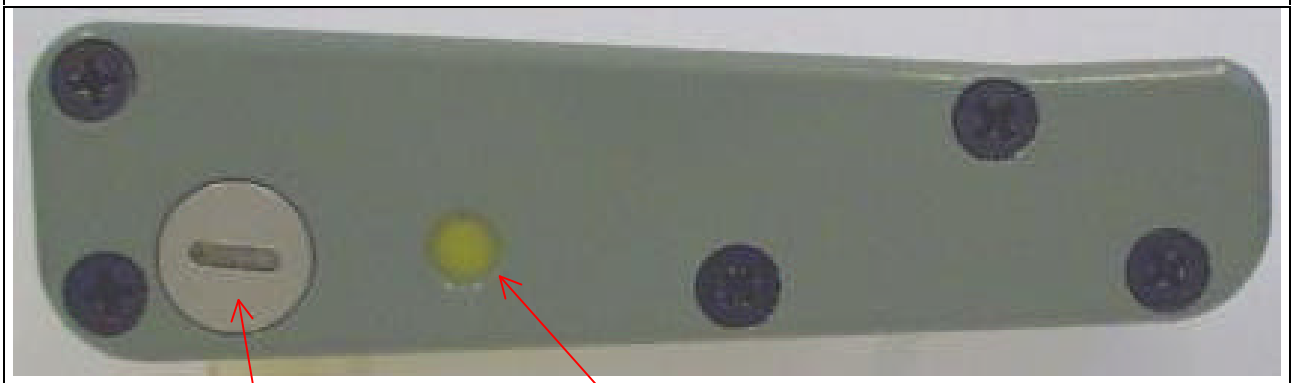
Right hand side



Interface connector

Ambient temperature sensor

Left hand side



Battery screw cap
Negative facing OUT

Acoustic rate of climb aperture

3.3. Back views

Type label

3.4. In flight operating functions

Power On / Off

- The DBI is powered **ON** by pressing the **C/Time** push button. This button is also marked **ON**.
- The DBI is powered **OFF** by pressing the two **BAR** buttons simultaneously for 2 seconds. These two buttons are also marked **OFF**.
- Auto power off enabled: The DBI powers off automatically when acquired static pressure has changed less than 0.5 hPa (4 meters altitude change at 1013 hPa) during 30 seconds during a 30 minutes time interval. Prior to the auto power off, the altitude display digits shows “OFF”.

Altimeter

- Altitude is displayed with 5 digits.
- Displayed Metric range is -9999 to 99999 meter. 1 meter resolution.
- Displayed Imperial range is -9999 to 99999 feet. 1 foot resolution.
- Unit static toggle enabled: Double clicking the **C/Time** push button toggles unit, [m or ft].
- Unit timeout toggle enabled: Double clicking the **C/Time** push button toggles unit, [m or ft] for 2 seconds.

Rate of climb (variometer)

- Rate of climb is displayed analog and digital.
- Response time can be configured between 1.2 to 6.0 seconds (fast to slow).

Analog rate of climb (variometer)

- An analog scale displays rate of climb.
- Zero indication is at 9 o'clock.
- Climb is indicated clockwise from 9 o'clock.
- Descend is indicated counter clockwise from 9 o'clock.
- Range is fixed at 5 meters per second ,1000 feet per minute). This range is fixed marked on display.
- Rate of climb or descend over 5 meters per second is indicated by a blinking analog variometer display.

Digital rate of climb (variometer)

- Rate of climb / descend is displayed with digits.
- **NOTE**: No sign is displayed.
- Metric range is 0 to 99.9 meter per second with one decimal place.
- Imperial range is 0 to 9900 feet per minute in 10:th increments.

Barometric setting

- Metric range is 900 to 1100 hPa with one decimal place. Adjustment fraction is 100 hPa (1mbar).
- Imperial range is 26.58 to 32.48 InHg with two decimal places. Adjustment fraction is 0.02 InHg.

Acoustic rate of climb (variometer)

- Sound signature is separately configured for climb and descend.
- Configurable signature: On/Off, Activation threshold, sound repetition interval scale factor.

Acoustic altitude high warning

- Warning signal is activated on climb transition passing configured altitude high warning limit.
- Warning signal is deactivated below altitude high warning limit.
- Warning signal is deactivated by pressing the **C/Time** pushbutton.

Acoustic altitude low warning

- Warning signal is activated on descend transition passing configured altitude low warning limit.
- Warning signal is deactivated above altitude low warning limit.
- Warning signal is deactivated by pressing the **C/Time** pushbutton.

Acoustic envelope temperature warning

- Warning signal is activated when exceeding configured temperature high warning limit.
- Warning signal is deactivated below temperature high warning limit.
- Warning signal is deactivated by pressing the **C/Time** pushbutton.

Flight time timer

- Elapsed time is displayed.
- Range is 00:00 to 99:59 [hour : min].
- Timer is CLEARED on power up.
- Timer is CLEARED by pressing the **C/Time** pushbutton for more than 2 seconds.

Ambient thermometer
Ambient temperature is displayed with 3 digits.

- Imperial range is -60 to 257 °F.
- Metric range is -50 to 125 °C.

Envelope thermometer
The DBI receives envelope temperature from the DBITX1 temperature transmitter (normally located at the top of the envelope). Envelope temperature is displayed with 3 digits.

- Imperial range is -13 to 392 °F.
- Metric range is -25 to 200 °C.
- Loss of data reception is displayed as "---".
- The DBI is configured with identification codes unique for each DBITX1. The DBI can be configured with up to 8 codes. NOTE: Only one DBITX1 shall be active during flight.

Battery monitor

- Battery charge status is displayed with a battery symbol containing 0 to 5 segments.

Segments	Continuing operation [hours]
5	50
4	40
3	30
2	20
1	10
0	>1

Flight data recorder

- During power on, flight data is recorded.
- Storage capacity is up to 170 hours and older data is overwritten.
- Start mode is configurable.

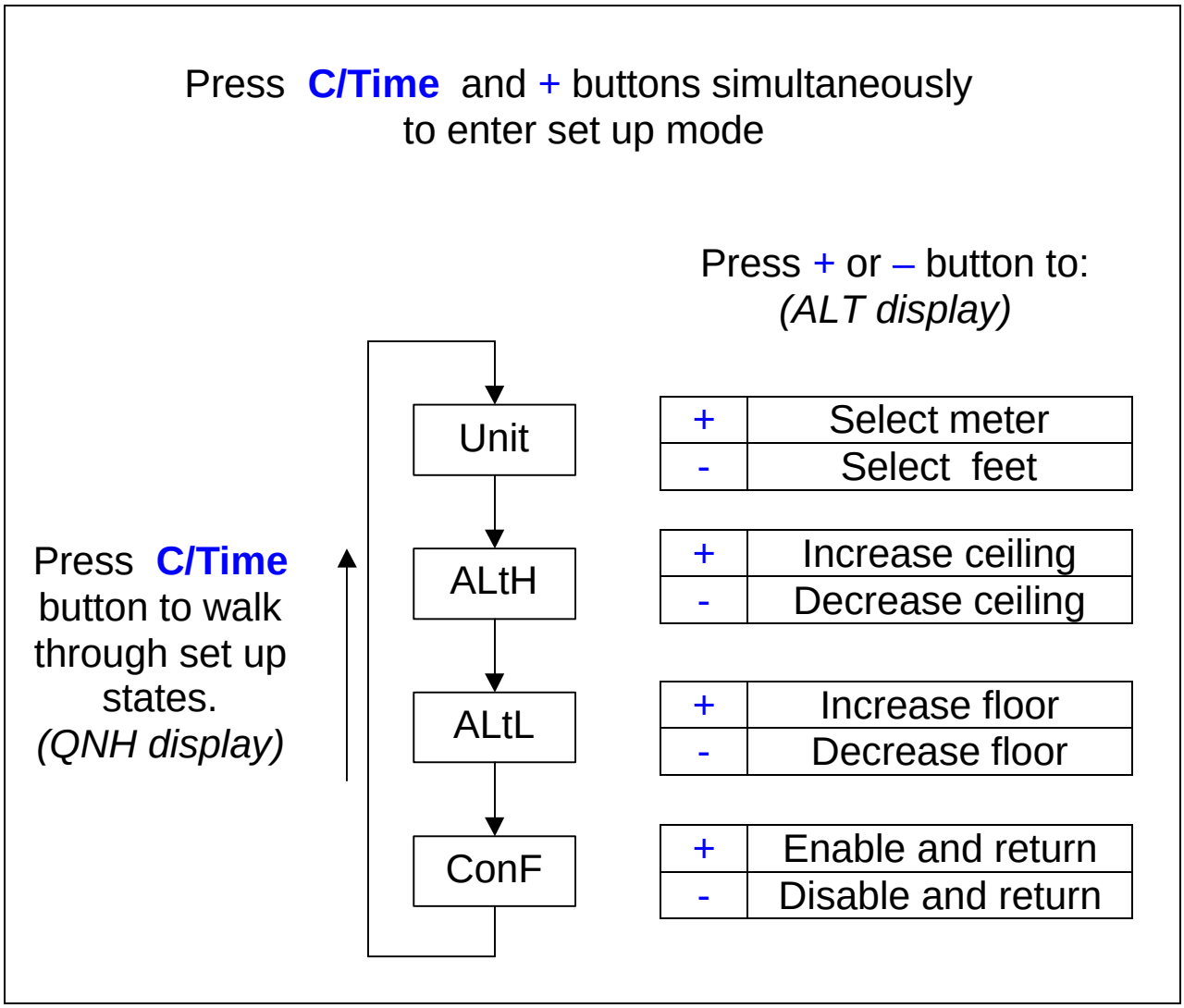
Flight recorder start modes	
Mode	Description
Off	Disabled.
Power on	Starts at DBI power ON.
Altitude takeoff	Starts at 1 hPa ambient static pressure decrease (approx 8 meters).
Altitude takeoff, clear lap	Starts at 1 hPa ambient static pressure decrease (approx 8 meters), also clears elapsed flight timer.
Start/Restart at manual lap clear	Starts at manual elapsed flight timer clear.

Flight recorder data	
Recorded raw data	**Derived data**
Barometric setting	Altitude
Acquired static pressure	
Ambient temperature	Ambient temperature
Envelope temperature	Envelope temperature
UTC time	UTC time and elapsed time

Altitude sound warning limits setup

- The altitude sound warning limits can be set up by the configuration procedure (see 3.6) or direct on the DBI.
- To use the direct set up method, it has to be enabled by the configuration procedure (see 3.6).

Direct set up method enabled:



3.5. Internal batteries / battery charge

Internal batteries

The DBI is powered by two rechargeable NiMH AAA batteries. These can be replaced via the battery access screw cap.

Charge

- The DBI is charged by connecting the DBI interface cable and the mains (230/110 VAC) charger.
- The charge process is fully automatic and takes approximately one hour from fully discharged condition. This is indicated by fast moving battery indicator.
- Completed charge phase is indicated by slow moving battery indicator.

Operational recommendations

See paragraph 4.2 Maintenance - batteries.

3.6. Configuration

Configuration of the DBI shall be done **only** in non flight mode. This is done by connecting the DBI to a standard PC type computers serial port with the DBI interface cable. The PC shall execute the DBI configuration program.

Air data unit selection
The DBI displays selectable units for flight data.
Programmable air data units are:

- Altitude unit **meter** or **feet.**
- Altitude unit toggle mode, **off** or **static** or **timeout.**
- Rate of climb **meter per second** or **feet per minute.**
- Barometric setting unit **hecto pascal** or **inch mercury**.
- Temperature unit **celsius** or **fahrenheit.**

NOTE !
Flight data units is displayed during DBI flight mode. Unit selection shall be fully understood by the operator prior to flight usage.

Acoustic rate of climb

- Acoustic indication threshold and signature.

Acoustic high and low altitude warning

- Acoustic indication thresholds and signature.

Acoustic envelope temperature warning

- Acoustic indication threshold and signature.

Flight recorder

- Date and time.
- Flight recorder start mode.

DBITX1 envelope temperature transmitter identification
The DBI is programmed with a 5 digit identification code labeled on the DBITX1 envelope temperature transmitter used. The DBI stores maximum 8 different codes.

Automatic power off
The automatic power off function enabled or disabled.

Flight recorder start mode
The flight recorder start mode (1 of 4) selected or disabled.

Altimeter unit toggle
Altitude unit toggling mode selected or disabled

Alt warning limits setup
Direct alt warning limit setup enabled or disabled.

4. Maintenance

4.1. General

The DBI contains NO internal serviceable parts. If subject to malfunction or other damage an approved service agent shall be used.
Operator maintenance is limited to cleaning and battery inspection.

4.2. Battery

- Inspect screw cap, battery support tube and inner contact for contamination. If contaminated, clean with soft cloth.
- Replace batteries if poor endurance is observed. Type is **NiMH size AAA**. Always replace both.
- Remove batteries prior to DBI long time storage.

4.3. Cleaning

- Use water and kitchen dish detergent to clean the DBI, dry with soft cloth.
- Be cautious not to scratch the transparent polycarbonate front cover with hard tools.

4.4. Calibration check

General
The DBI shall be checked for static pressure acquisition tolerances every 24 month or according to national regulations. This should be done ONLY by approved organizations to conform with national regulations.
Approved service station can obtain drawing and instructions for calibration from below stated service agents.

Control setup
Place the DBI in a pressure sealed chamber connected to a pressure calibrator. The chamber shall have a viewing window enabling reading of DBI display.

Control procedure
- Set th DBI barometric setting to 1013 hPa.
- Subject the DBI to pressure altitudes listed in paragraph *1.3 Specification - altimeter* column 1 by means of a pressure calibrator.
- Compare displayed altitude reading to be within column 2 max error tolerances.

Recalibration procedure
The DBI is recalibrated for offset error by using the DBI application program together with above control procedure data. This functionality shall ONLY be used by an national approved service station.

4.5. Approved service agents

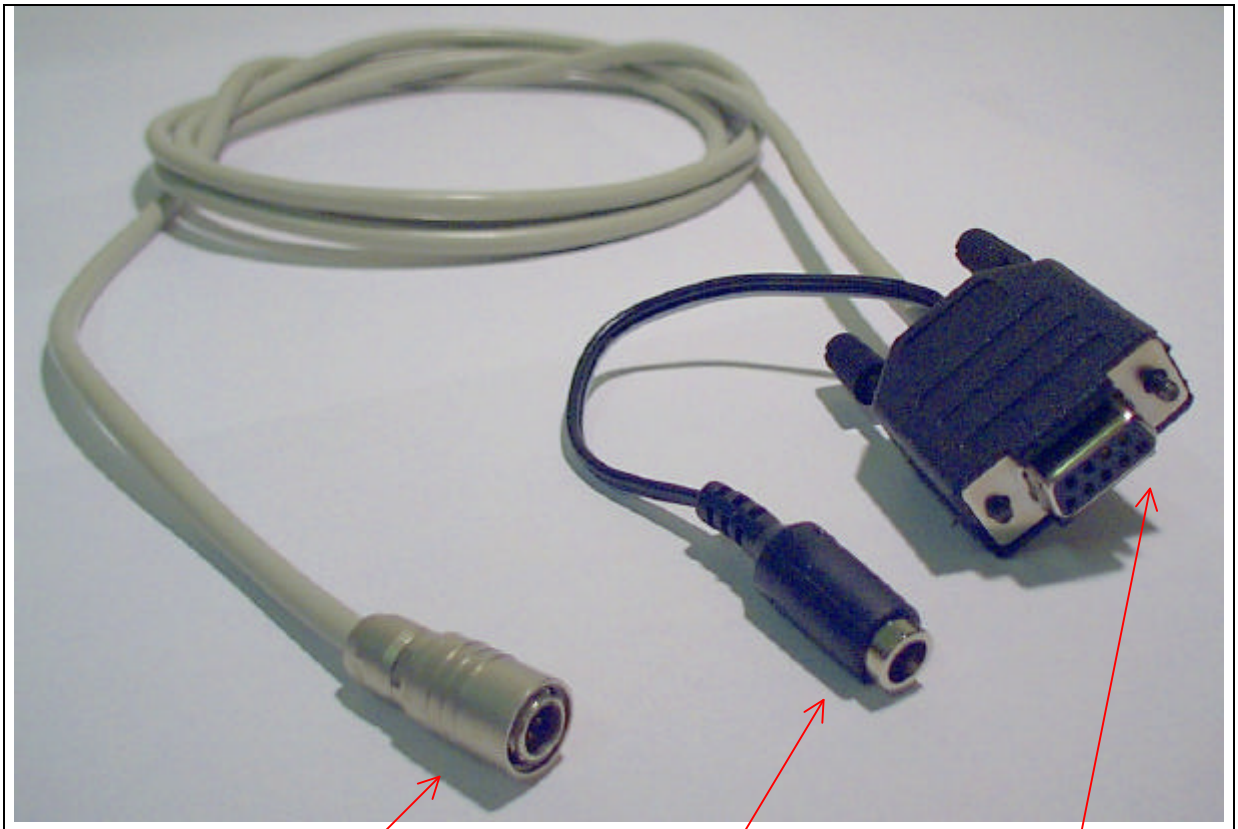
Name	Location	Contact
DigiTool AB	Sweden	tel +46 8 343410 Email service@digitool.se
Or any by national CAA listed	Worldwide	Check with your C.A.A.

5. Support apparatus

5.1. Mains battery charger

One charger is supplied with the DBI. It connect to the DBI via the interface cable. The mains charger input voltage range is market on the charger.

5.2. Interface cable



5.3. Mains charger

5.4. DBI PC application program

The application program enables configuration off and flight recorder access to the DBI. Functionality is described when running the application.

To use the application program, follow these steps:

- Install the application
- Connect the DBI to the PC:s serial port via the interface cable.
- Power on the DBI.
- Start the application

5.5. DBITX1 envelope temperature transmitter

The DBITX1 is described in **DBITX1 User Manual**.