Digitool Instruments AB
DBI3 US User Manual
Free Balloon Flight Instrument

Balloonacy, LLC d/b/a *DigitoolUSA* 125 REDWOOD CIRCLE FAYETTEVILLE, GA 30214	DRAWN: DWS	3/3/17	REVISIONS				
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Not Used

Safety

Digitool AB has designed this flight instrument to enable the user to comply with the requirements of 14 CFR §31.85, Required Basic Equipment, as well as the equivalent requirements of other national aviation authorities. The DBI3 provides the necessary data to conduct safe flight operation across a wide spectrum of lighter-than-air operations, and should not be used for any purpose other than that for which it is designed.

Notes, Cautions, and Warnings

NOTE

A NOTE denotes information which is of special interest and importance to the reader.

CAUTION

A CAUTION includes information or instructions which, if not adhered to, may result in damage to the balloon or possible injury to passengers or crew.

WARNING

A WARNING alerts the reader to information and instructions which are imperative for the safe operation of the balloon system. Failure to adhere to these warnings may result in severe damage, injury or death.

Operating Restrictions

This instrument should ONLY be used in aircraft referred to as manned free balloons. On the reverse of the instrument is the marking “For use on board Manned Free Balloons only”. See Figure 3.5, Back View.

Document Change Log

Issue	Change	Date
IR	Initial version	3 March 2017
A	Editorial Changes	15 July 2017
B	Battery power indicator; added Setup instructions as Appendix III	11 Aug 2017

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Not Used

1.0 Introduction

1.1 Approvals

This device DBI3 version 01 is approved by the U.S. Federal Aviation Administration under the provisions of STC XXXXXXXX, using criteria derived from AS8009 for pressure altimeter systems, AS8016 for vertical velocity instruments, and AS8005 for temperature instruments

1.2 Description

The DBI3 is an integrated flight instrument designed specifically for manned free balloon operation, and meeting the requirements specified under 14 CFR Part 31.85.

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.
- Course over ground
- Speed over ground

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 four push buttons:

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

- Configuration.

Flight data recorded during flight are:

- Barometric setting
- Static pressure (altitude and rate of climb)
- Envelope and ambient temperatures
- Speed and course over ground
- GPS Position date and time

In non flight, an interface cable connects the DBI III to a standard PC computer/USB Port:

- Configuration
- Internal battery charge
- Flight Recorder data upload

1.3 Airworthiness Limitations per 14 CFR §31:

None

1.4 Operations Limitations

- Minimum voltage required for flight: 20% battery, as shown by battery power indicator.

2.0 Installation

2.1 Attachment screw fittings

Attach bracket e.g. belt-loop part to instrument using the four mounted pan-head M4 screws, 1 thru 4. Screw head is TORX T8.

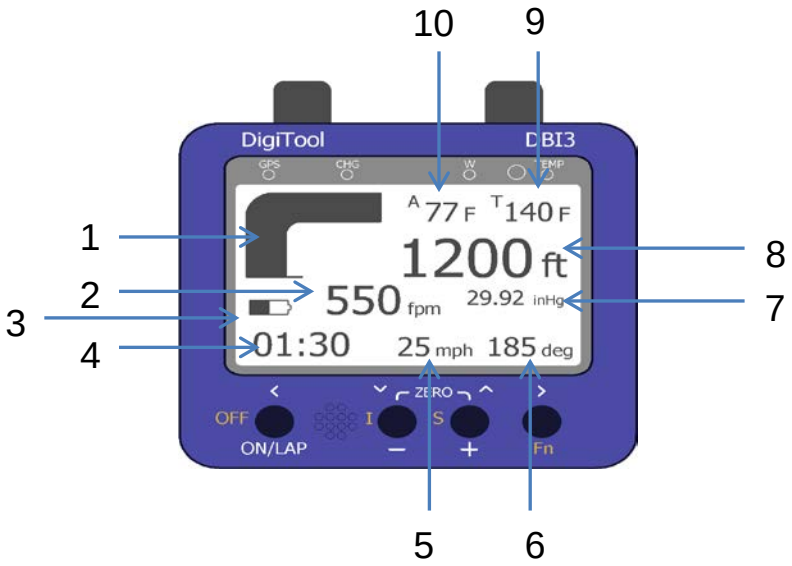
3.0 Operation

3.1 Push Buttons/Audio Output Aperture

Push Button Controls

#	Function	Mode	Action
1	Turn instrument ON	OP1, OP2, SET (from OFF state)	press
1	Start/Stop/Clear elapsed timer	OP1, OP2	press
2	Decrease BAR setting	OP1, OP2	press
3	Increase BAR setting	OP1, OP2	press
2 and 3	Set BAR to zero ALTITUDE	OP1, OP2	press simultaneously
2 and 4	Show INFO Display	OP1	press simultaneously
3 and 4	Show SETUP Display	OP1	press simultaneously
1 and 4	Turn instrument OFF	OP1, OP2, SET (from ON state)	press simultaneously > 2 seconds
1	Move Left	CONFIG	press
2	Move Down	CONFIG	press
3	Move Up	CONFIG	press
4	Move Right	CONFIG	press

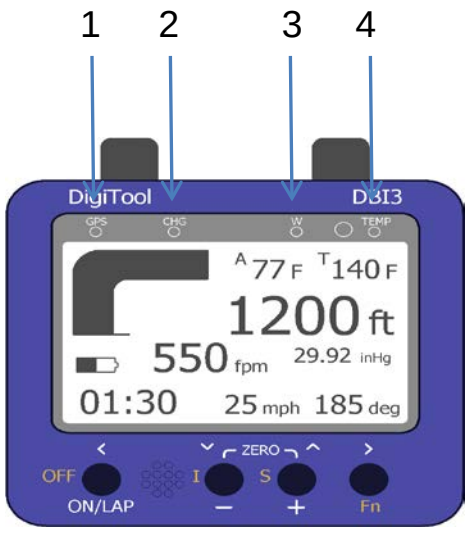
3.2 LCD Display



LCD Display View

#	item	unit
1	Analog rate of climb	Scale fixed
2	Digital rate of climb	ft/min or m/s
3	Battery Status	Zero to five segments
4	Flight time	hh:mm
5	Speed over ground	mi/h or km/h or m/s
6	Course over ground	Degrees
7	QNH setting	inHg or hPa
8	Altitude	feet or meter
9	Top (envelope) temperature	°F or °C
10	Ambient temperature	°F or °C

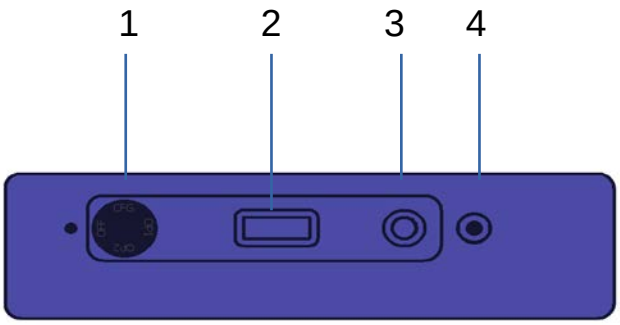
3.3 LED Indicators



LED Indicators function

#	Marking / Color	Function
1	GPS / Yellow	Flash at 1Hz rate indicating GPS OK
2	W / Orange	Flash at 1Hz rate for any alarm warning
3	CHG / Red	On when charge. Flash at 1Hz rate when fully charge
4	TEMP / Blue	Flash at 1Hz rate indicating wireless link OK

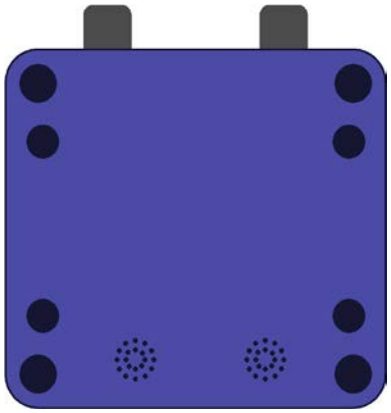
3.4 Connectors & Mode Select Switch



Mode Select, USB and Ambient temp connectors/sensor

#	Item	Function
1	Rotary Mode Select Switch	Select instrument mode: OFF – Instrument is hard off CONFIG – Config mode OP1 – Operating mode1 OP2 – Operating mode2
2	USB micro A connector	Charge and Data connection. Use standard USB micro AB cable
3	External ambient temperature connector	Connection for external ambient temperature sensor cable
4	Ambient temperature sensor	Ambient temperature sensor aperture

3.5 Back views



#	Item
1	Enclosure mounting screws (4 places)
2	Instrument bracket mounting screws (4 places)
3	Instrument pressure equalization vents (2 places)

3.6 In flight Operating Functions

Power On / Off

- The DBI3 is powered **ON** by pressing the ON/LAP push button.
- The DBI3 is powered **OFF** by pressing Fn and OFF buttons simultaneously for >2 seconds. OFF button is also marked ON/LAP.
- Auto power off enabled: The DBI3 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 ON/LAP push button toggles unit, [m or ft].
- Unit timeout toggle enabled: Double clicking the ON/LAP push button toggles unit, [m or ft] for 2 seconds.

Rate of Climb

- 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).
- 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.
- 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 ft 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 descent.
- Configurable signature, On/Off, Activation threshold.

Acoustic altitude high warning

- Warning signal is activated on climb when passing thru altitude high warning limit.
- Warning signal is deactivated below altitude high warning limit.
- Warning signal is deactivated by pressing the Fn pushbutton.

Acoustic altitude low warning

- Warning signal is activated on descent when passing thru altitude low warning limit.
- Warning signal is deactivated above altitude low warning limit.
- Warning signal is deactivated by pressing the Fn 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 Fn 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 ON/LAP 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 DBI3 receives envelope temperature from the DBITX3 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 “NoSig“.
- The DBI is configured with identification codes unique for each DBITX3. The DBI3 can be configured with up to 8 codes.

Battery monitor

Battery monitor is composed of five segments indicating 20 to 100 percent remaining battery capacity. At 100 percent capacity, the DBI3 is capable of more than 30 hours of continuous operation.

NOTE

At 20% battery capacity (one segment of the battery indicator, approximately 3.9 volts), user may expect approximately 1.5 hours of continuous operation

Flight data recorder

- During power on, flight data is recorded.
- Storage capacity is up to 10,000 hours
- Start mode is configurable.

Flight recorder start modes	
Mode	**Description**
Off	Disabled.
Power on	Starts at DBI3 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
Speed over ground	GPS speed over ground
Course over ground	GPS course over ground
Position	GPS position

3.7 Internal Battery / Battery Charging

CAUTION: LiPo Battery Charging

Never charge batteries unattended. When charging LiPo/Li-ion batteries you should always remain in constant observation to monitor the charging process and react to potential problems that may occur.

Never store or charge battery pack inside your car in extreme temperatures, since extreme temperature could cause a fire.

Note: Battery precautions

Never expose the DBI3 to open fire or other excessive heat sources.

Internal battery

The DBI3 is powered by one rechargeable Lithium Polymer battery. The charging process is fully controlled by the DBI3 itself and protected from input voltage polarity reversal, over/under voltage, over temperature and over current conditions. Charge current is 500 mA DC. Battery capacity is1000 mAh thus charging time from a fully discharged condition is 2 hours.

Charge

- The DBI is charged by connecting one USB to micro B cable and one **10 watt USB power adapter** charger.
- The charge process is fully automatic and takes approximately one hour from fully discharged condition. This is indicated by RED LED indicator.

- Completed charge phase is indicated by flashing RED LED indicator.

3.8 Pre-flight Check

1. Power instrument on.
2. Check available power; must be minimum 20% battery power / one battery segment (approximately 3.9v)
3. Set barometric pressure (buttons 2 and 3)

3.9 Flight Recorder Data Download Procedures

Information on download procedures TBD

4.0 Maintenance

4.1 General

The DBI3 contains NO user serviceable parts. Operator maintenance is limited to cleaning and battery inspection. If subject to malfunction or other damage an approved service agent shall be used.

4.2 Cleaning

- Use water and kitchen dish detergent to clean the DBI3, dry with soft cloth.
- Be cautious not to scratch the transparent polycarbonate front cover with hard tools.

4.3 Approved service agents

Name	Location	Contact
Balloonacy, ltd, LLC FAA CRS SU9R747J	US	770-719-9492 info@balloonacyltd.com

5.0 Support Apparatus

5.1 Interface Cable and Main Charger

- Connect DBI3 to the host PC using a USB cable with a micro B connector.
- Use the DBI3 PC application program for setup and data download of Av Log data.

5.2 DBITX3 Envelope Temperature Transmitter

- The DBI-TX3 is described in the DBI-TX3 User Manual.

Appendix I - Abbreviations

DBI3	DigiTool Instruments free balloon flight instrument
DBITX3	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
km/h	kilometers per hour
mi/h	miles per hour
InHg	inch mercury, pressure unit
hPa	hecto pascal, pressure unit, equals millibar
°F	degrees fahrenheit, temperature unit
°C	degrees celsius, temperature unit
V	Volt
VAC	Volt alternating current
mm	millimeter, unit of length
in	Inch, length unit
gram	mass unit
sog	speed over ground
cog	course over ground

Appendix II - Specifications

Altimeter

Range feet x 1000	Total error +/- feet at 25 °C / 77 °F	Total error +/- feet at -30 °C / -22 °F	Total error +/- feet at 70 °C / 158 °F
-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

Rate of climb (variometer)

Absolute error	< 0.1 m/s , 20 ft/min
Scale error	< 0.15 % of reading
Time constant (configurable)	1.6 to 6.0 seconds

Barometric Setting

Total error (900 to 1200 hPa)	< 0.2 meter
Total error (26.6 to 36.5 inHg)	< 1 ft

Ambient Thermometer

Range °C		Total error +/-	
°C	°F	°C	°F
-50 to -25	-58 to -13	3	6
-25 to 0	-13 to 32	2	4
0 to 50	32 to 122	1	2
50 to 75	122 to 167	2	4
75 to 100	167 to 212	3	6
100 to 125	212 to 257	4	7

Envelope thermometer

Range °C	Total error +/-

°C	°F	°C	°F
-25 to 0	-13 to 32	4	7
0 to 50	32 to 122	3	6
50 to 75	122 to 167	2	4
75 to 125	167 to 257	1	2
125 to 150	257 to 302	2	4
150 to 175	302 to 347	3	6

Physical dimensions

Item	Value metric	Value Imperial
Length	82 mm	3.23 inch
Height	74 mm	2.91 inch
Depth	20 mm	0.79 inch
Weight	187.1 grams	6.6 ounces

Environmental Ratings

Item	Limitations
Vibration	RTCA/DO-160G section 8 Category X
Shock	RTCA/DO-160G section 7 Category X
Radio - Frequency Susceptibility	RTCA/DO-160G, (Change No 3) section 20.2 category Y
Radio - Frequency Emission	RTCA/DO-160G section 21.2 category H
Explosion	RTCA/DO-160G section 9 category X
Humidity	RTCA/DO-160G section 6 category A
Water	RTCA/DO-160G section 10 category W
Sand and Dust	RTCA/DO-160G section 12 category X
Salt Spray	RTCA/DO-160G section 14 category X
Fungus Resistance	RTCA/DO-160G section 13 category X
Magnetic Effect	RTCA/DO-160G section 15.3 category A
Operating temperature and ambient pressure	RTCA/DO-160G section 4, category paragraph 4.3, Section C4
Ambient Pressure storage	0 to 2000 hPa / 0 to 59 inHg
Temperature High Operating	70 °C / 158 °F
Temperature Low Operating	-30 °C / -22 °F
Temperature High Storage	100 °C / 212 °F
Temperature Low Storage	-55 °C / -67 °F

Appendix III – Instrument Setup

The rotary switch (see Paragraph 3.4) allows the user to configure the instrument to their personal preferences. The switch has four positions, OFF, CONFIG, OP1 and OP2. The CONFIG setting is used at the factory for initial configuration only. The OFF setting is a “hard” off, where the instrument cannot be powered up. There is also a LOCK mode, where no settings can be change. The instrument is typically used while in the LOCK mode.

The user may configure OP1 and OP2 to different settings. To access these modes, turn the rotary switch COUNTER-CLOCKWISE, using a small screwdriver, until reaching the desired mode. Setup is performed directly from DBI3 setup mode display. Setup is organized from six rows and three columns by navigating a selection box. Selections as shown in the tables below are indicated with bold face text. The first column selects category, second column selects quantity and the third column selects actual unit or number. Move the selection up, down, left, right by pressing push-buttons.

Setup first column, UNIT selected

UNITS	ALT	feet
ALARM	ROC	fpm
FUNCS	BAR	inHg
VARIO	TEMP	F
TOPT	SOG	knot
(exit..)		

Setup first column, ALARM selected

UNITS	ALTH	3000 ft
ALARM	ALTL	1000 ft
FUNCS	CLMB	500 fpm
VARIO	DESC	400 fpm
TOPT	TOPT	214 F
(exit..)		

Setup first column, FUNCS selected

UNITS	AUT	timeout
ALARM	FRS	pon
FUNCS	AOF	off
VARIO		
TOPT		
(exit..)		

Setup first column, VARIO selected

UNITS	RESP	2.8 sec
ALARM	AUDIO	off
FUNCS		
VARIO		
TOPT		
(exit..)		

Setup first column, TOPT selected

UNITS	TOP1	10400
ALARM	TOP2	off
FUNCS	TOP3	off
VARIO	TOP4	off
TOPT		
(exit..)		

Setup references

Category	Quantity	Unit/Number	Description
UNITS			
	ALT	**feet** **meter**	Altitude unit
	ROC	**fpm** **mps**	Rate Of Climb unit
	BAR	**InHg** **hPa**	Barometric setting
	TEMP	**F** **C**	Temperature unit
	SOG	**knot** **mps** **kmh** **mph**	Speed over ground unit

ALARM	Quantity	Unit/Number	Description
	ALTH	**3000** to **-400** ft **1000** to **-125** m	Altitude hi warning value
	ALTL	**3000** to **-400** ft **1000** to **-125** m	Altitude lo warning value
	CLMB	**2000** to **0** fpm 10 to 0 mps	Climb warning value
	DESC	**2000** to **0** fpm **10** to **0** mps	Descend warning value

Category	Quantity	Unit/Number	Description
	TOPT	**238** to **112** F **150** to **80** C	Top temperature warning value

FUNCS	Quantity	Unit/Number	Description
	AUT	**off** **static** **timeout**	Altimeter unit toggle mode
	FRS	**off** **pon** (power on) **toff** (takeoff) **toff/C** (takeoff with lap clear) **lap/C** (lap timer start with lap clear)	Flight recorder start mode
	AOF	**off** **on**	Instrument auto turn off mode

VARIO	Quantity	Unit/Number	Description
	RESP	**6.0** to **1.2** sec	Response time value
	AUDIO	**off** **on**	Variometer audio mode

TOPT	Quantity	Unit/Number	Description
	TOP1	**12000** to **100**	Top temp1 code
	TOP2	**12000** to **100**	Top temp2 code
	TOP3	**12000** to **100**	Top temp3 code
	TOP4	**12 000** to **100**	Top temp4 code

NOTES