

DBI3 version 01 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.

Operating restrictions

This instrument should ONLY be used in ships referred as *free balloons* carrying open fire or inert gas balloons. On the backside of the instrument is the marking “for use onboard manned free balloons only”. See photo 3.3 back view. Make sure the battery capacity is enough to ensure a safe flight.

Abbreviations

DBI3	DigiTool Instruments free balloon flight instrument
DBITX3	DigiTool Instruments envelope temperature transmitter
LCD	Liquid Crystal Display
RTCA	Requirements & Technical Concepts for Aviation
knot	knots
mps	meter per second
fpm	feet per minute
kmh	kilometers per hour
mph	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
mm	milli meter, length unit
in	Inch, length unit
gram	mass unit
sog	speed over ground
cog	course over ground

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1. Introduction

1.1. Document change log

Issue	Change	Date
C1	Initial version	2016-05-14
C1	Clause 1.2 Approvals. Added ref to subdocument AS8009 for pressure altimeter systems	2016-05-23
C1	numerous	2017-01-21

1.2. Approvals

This device DBI3 version 01 is approved by <**TBD** by Dave :)> with subdocument AS8009 for pressure altimeter systems and subdocument AS8016 for vertical velocity instruments.

1.3. Description

The DBI3 is an 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.
- 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 connects the DBI to standard PC computers :

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

1.4. Specification

Altimeter

Range feet	Total error +/- feet at 25 °C / 77 °F	Total error +/- feet at -30 °C / -22 °F	Total error +/- feet at 70 °C / 158 °F
-1000	20	30	25
0	20	30	25
500	20	30	25
1000	20	30	25
1500	25	37	31
2000	30	45	37
3000	35	52	43
4000	40	60	50
6000	60	90	75
8000	80	120	100
10000	90	135	112
12000	100	150	125
16000	110	165	137
18000	120	180	150
20000	130	195	162
22000	140	210	175
25000	155	232	193
30000	180	270	225
35000	205	307	256
40000	230	345	287
45000	255	382	318
50000	280	420	350

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
175 to 200	347 to 392	4	7

Physical dimensions

Item	Value metric	Value Imperial
Length	82 mm	3.23 inch
Height	74 mm	2.91 inch
Height /w antennas	83 mm	3.27 inch
Depth	20 mm	0.79 inch

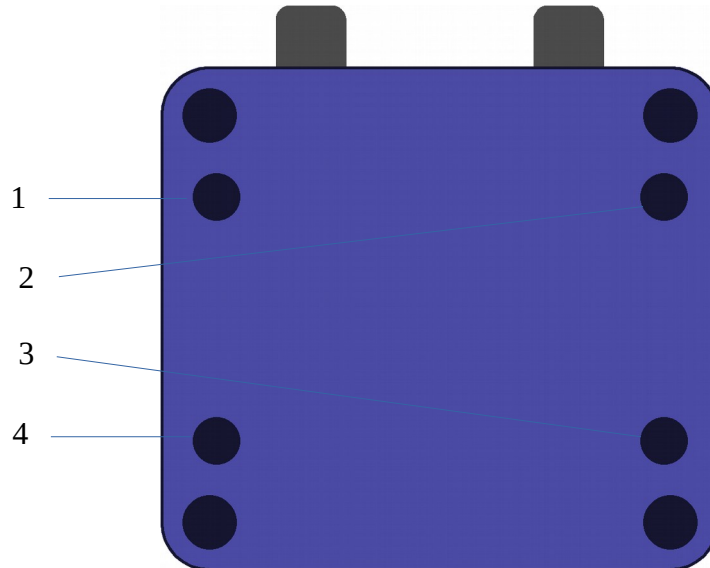
Weight	185 gram	6.52 ounce
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Environmental ratings

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

2. 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. Operation

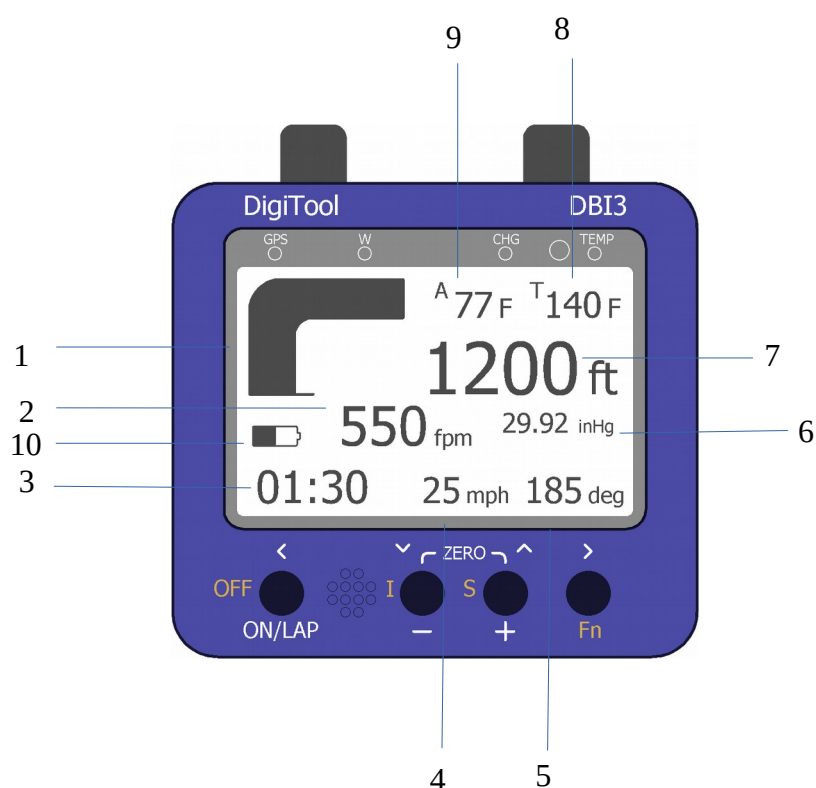
3.1. Push Buttons / Audio Output Aperture



Push Buttons Controls / Audio

#	Function	Mode	Action
1	Turn instrument ON	OP1, OP2, LOCK (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
4 and 2	Show INFO Display	OP1	press simultaneously
4 and 3	Show SETUP Display	OP1	press simultaneously
4 and 1	Turn instrument OFF	OP1, OP2, LOCK (from ON state)	press simultaneously > 2 seconds
1	Move Left	SETUP	press
2	Move Down	SETUP	press
3	Move Up	SETUP	press
4	Move Right	SETUP	press
5	Silence alarm	OP1, OP2, LOCK	touch
6	Audio output aperture	OP1, OP2, LOCK	NA

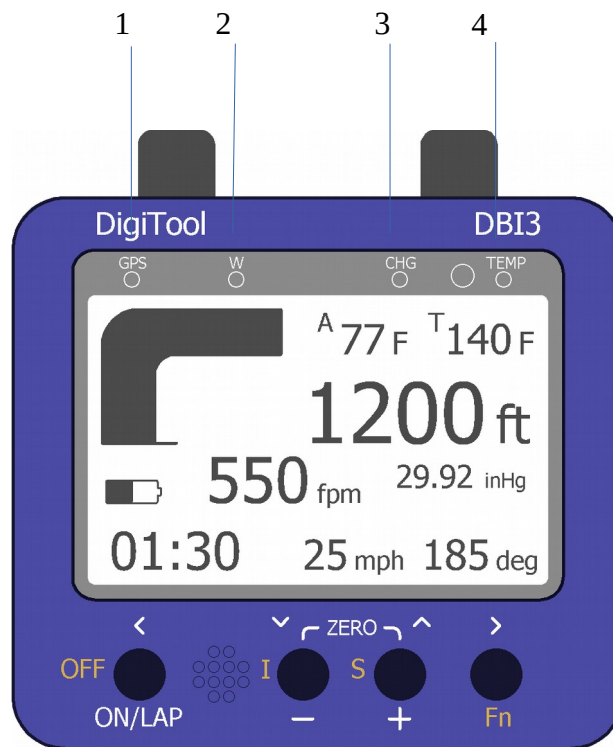
3.2. LCD Display



LCD Display View

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

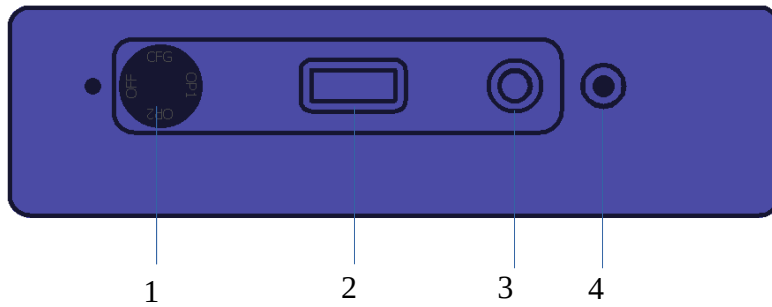
3.3. LED Indicators



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

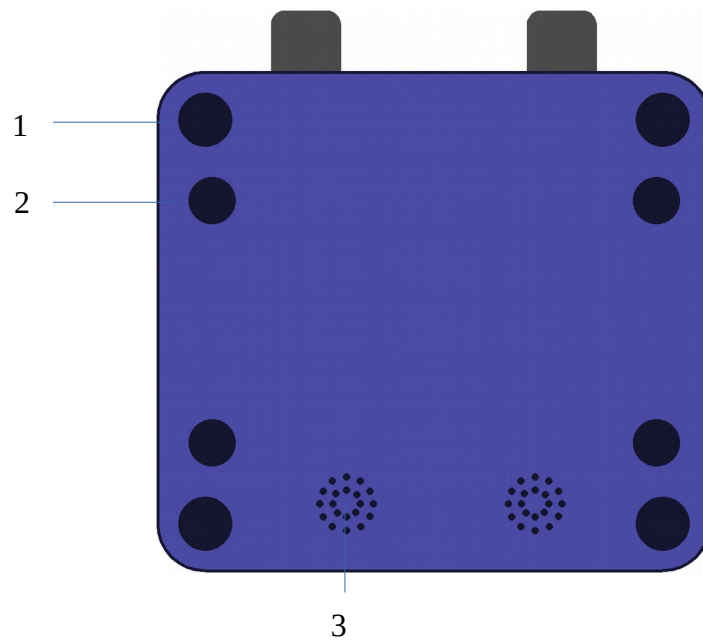
3.4. Connectors & Mode Select switch



Mode Select, USB and Ambient temp connectors/sensor

#	Item	Function
1	Rotary Mode Select Switch	Select instrument mode: OFF – Instrument is hard off LOCK – Locked mode OP1 – Operating mode1 OP2 – Operating mode2
2	USB micro AB connector	Charge and Data connection. Use standard USB micro B 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 DBI 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 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 (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).
- 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: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.

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 touching the touch button OR by pressing Fn push-button.

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 touching the touch button OR by pressing Fn push-button.

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 touching the touch button OR by pressing Fn push-button.

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 4 codes.

Battery monitor

Battery monitor is composed of five segments indicating 20 to 100 percent remaining battery capacity. 100 percent capacity equals more than 30 hours of operation.

Flight data recorder

- During power on, flight data is recorded.
- Storage capacity is up to 10000 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 (X,Y,Z)	GPS position

3.7. Internal battery / battery charge

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 is 1000 mAh thus charging time from a fully discharged condition is 2 hours.

Battery precautions

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

Charge

- The DBI is charged by connecting one micro USB type B cable and one USB Battery Charging Specification Revision 1.2 compliant charger.
- The charge process is fully automated and takes approximately two hours from a fully discharged condition. This is indicated by RED LED indicator.
- Completed charge phase is indicated by flashing RED LED indicator.

3.8. Setup

Setup is performed directly from DBI3 setup mode display. Setup is organized from six rows and three columns by navigating a selection box. Selection in table below is indicated with bold face text. First column selects category, second column selects quantity and third column selects actual unit or number. Move 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..)		

3.9. Setup reference

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			
	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
	TOPT	238 to 112 F 150 to 80 C	Top temperature warning value
FUNCS			
	AUT	off static	Altimeter unit toggle mode

Category	Quantity	Unit/Number	description
		timeout	
	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			
	RESP	6.0 to 1.2 sec	Response time value
	AUDIO	off on	Variometer audio mode
TOPT			
	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

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.

4.2. 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.

4.3. Calibration check

General

The DBI3 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 DBI3 in a pressure sealed chamber connected to a pressure calibrator. The chamber shall have a viewing window enabling reading of DBI3 display.

Control procedure

- Set the DBI3 barometric setting to 1013 hPa.
- Subject the DBI3 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 DBI3 is recalibrated for offset error by using DBI3 PC application program together with above control procedure data. This functionality shall ONLY be used by an national approved service station.

4.4. Approved service agents

Name	Location	Contact

5. Support apparatus

5.1. Interface cable and data interface

- Connect DBI3 to a host with one USB 2.0 micro B connector at DBI3 end.
- Use DBI3 PC application program for setup and download av log data.

5.2. DBI-TX3 envelope temperature transmitter

The DBITX3 is described in DBI-TX3 User Manual.