Altimeter INDU 80 — Manual

Kanardia d.o.o.

March 2016

Manual Revision 1.3

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Revision History

The following table shows the revision history of this document.

Rev.	Date	Description
1.0	Feb 2015	Initial release
1.1	Oct 2015	Altitude model is extended up to 20000 m.
1.2	Dec 2015	Procedures for QNH toggle and IAS auto zero.
1.3	Mar 2016	Procedure for Illumination wheel activation.

Contents

1 Introduction

First of all, we would like to thank you for purchasing our device. Indu altimeter is an electronic device, which mimics classical altimeter construction and combines it with the state of the art electronics. This results in the best of both worlds; a perfect and intuitive analogue reading combined with high precision of modern electronics.

This manual describes the technical description of the unit, installation and operation.

1.1 General Description

The altimeter is an electromechanical device. It consist of high precision electronic barometric sensor, which provides static pressure information in digital form. The electronics reads the sensor and drives two coaxial stepper motors turning one needle each. The pressure information is also shown on a colour LCD display. A rotating knob is used to adjust the barometric offset (aka QNH value). When connected to a CAN bus the altimeter outputs the pressure information. An optional dim knob can be connected to the device and it is used to adjust the brightness of the screen.

Display is divided linearly in 360°scale. The large pointer is working in 1000 m (feet) per revolution with the 20 m markings (20 feet). The small pointer is working in 10000 m (feet) per revolution with 200 m markings (200 feet).

1.2 Technical Specification

Table 1 shows some basic technical specification of Indu altimeter.

Description	Value
Altitude range	-500 – 16000 m, (-1500 – 50000 feet)
Sensor calibration	standard: -500 – 6000 m, extended: -500 – 16000 m
Weight	245 g
Size	82 x 82 x 54 (73 with connectors) mm
Operational voltage	6–32 V
Power consumption	1.44 W
Current	120 mA at 12 V 60 mA at 24 V
Operating temperature	-30 °C to +85 °C
Humidity	30 % -90 %, non condensing
Panel hole	80 mm (3.15 inch) diameter, standard fit
Barometric sensor	24 bit, 10-1200 hPa, 20 cm resolution
QNH range	590 – 1080 hPa, (17.42 – 31.89 inHg)
Internal logger storage	cca. 208 hours before overlapping, 1 sec interval
Communication	CAN bus, 29 bit header, 500 kbit, Kanardia protocol

Table 1: Basic technical specifications.

1.3 Options

The instrument can be delivered with two different scales. One scale is in feet and the other scale is in meter.

The QNH (baro-correction) units are optional. You can choose between:

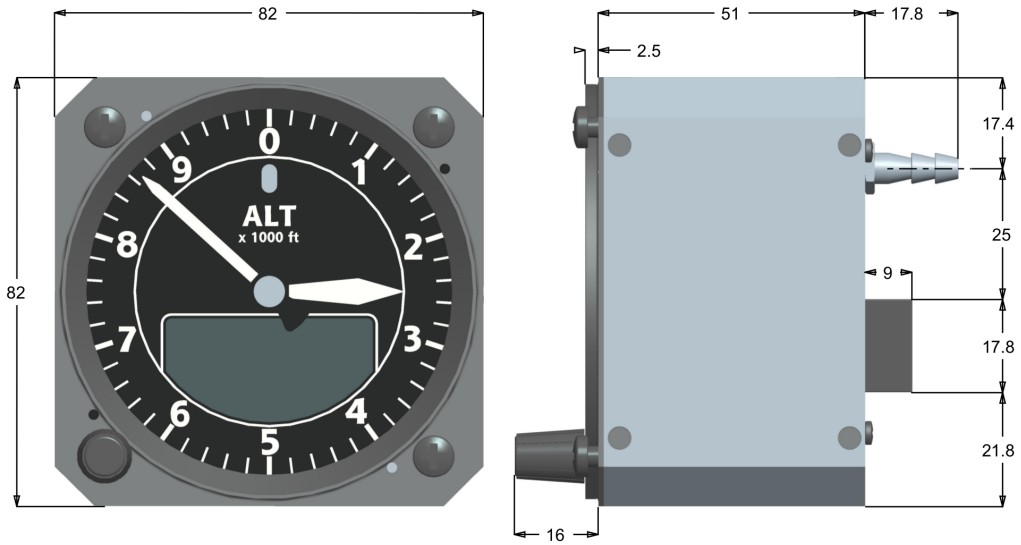

Figure 1: Front and side view of the altimeter with its principal dimensions.

- hPa in the range of (590 – 1080) with one hPa step.
- inHg in the range of (17.42 – 31.89) with 0.01 inHg step.

Both options, the scale and the QNH (baro-correction) units, must be specified at the time of order.

2 Installation & Maintenance

The Indu altimeter requires a standard size 80 mm hole in the instrument panel. The position of the hole must ensure good access to the instrument for the QNH adjustments and it must be always visible from the pilot's perspective.

2.1 Mounting Dimensions

The mounting screw holes are located on a circle of 89 mm diameter. The instrument is mounted using three screws type M4. To prevent internal stresses, please make sure that the instrument panel is flat. It is highly recommended that the instrument panel is mounted using rubber shocks, which reduce the vibrations. Figure 2 illustrates the mounting hole.

2.2 Connections

Figure 3 illustrates all connections at the back side of the instrument.

2.2.1 Static Connection

The altimeter must be connected to the static pressure source. The static source is usually obtained from pressure sources located on the fuselage side surfaces or from the static port on the pitot tube.

It is highly recommended to keep the static tubing as short as possible. The tubing must avoid sharp bends and twists. The tubing must be airtight. Water must not be allowed to enter the tubing.

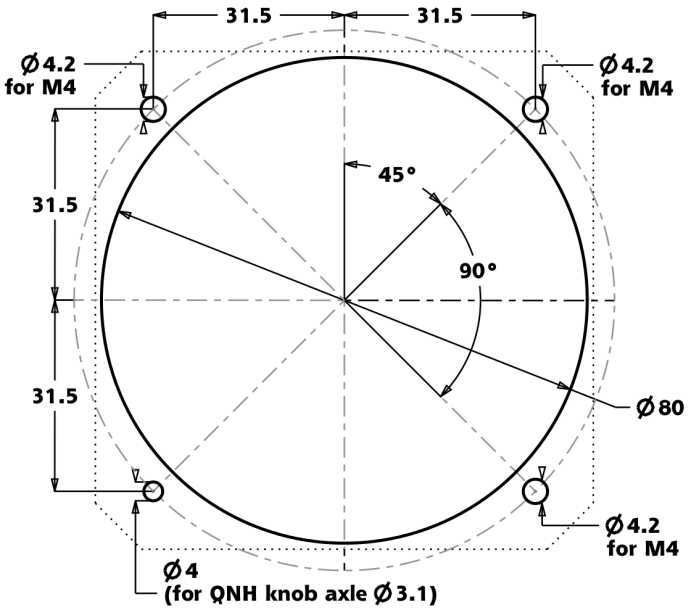

Figure 2: Instrument panel cutout and mounting hole. Note: Figure is not in scale.

Figure 3: Back view of the instrument with connections.

2.2.2 CAN Bus Connection

Connection to the CAN bus is optional and is not required for the normal operation. When connected to the bus, altimeter will transmit altitude, QNH and vario to other units connected to the bus. At the same time it will serve as a data logger - it will log most of relevant information provided on the bus.

Use standard RJ45 ethernet cable to connect it with other Kanardia equipment.

2.2.3 Illumination

Optional illumination knob can be connected to the back of the instrument. The knob is used to change the brightness of the LCD display.

When altimeter is connected to the CAN bus, the knob adjusts brightness of all instruments connected to the bus.

Illumination knob part number is I-ALT-ILLUM and it must be ordered separatelly. Please refer also to section 2.9 on page 7 for the activation procedure.

2.3 Power Connection

Connect supplied connector at the back of the altimeter. The connector has a notch on one side, which protects from wrong orientation.

Connect blue lead to negative (ground) terminal and red lead to positive (+12-24 V) terminal.

2.4 Maintenance

No special maintenance is required. A static leak test should be performed annually and calibration check biannually. In the case of small deviation, use the procedure described in section 2.6.

2.5 Repair

The Indu altimeter has no serviceable parts inside. In the case of malfunction, it must be sent to factory for a repair.

2.6 Static Sensor Offset

1020 → 999 → 1013 for hPa or 30.12 → 29.50 → 29.91 for inHg.

A minor sensor offset may be required in order to adjust the instrument to some reference. Please, follow the steps given below in order to make an adjustment. A precise reference instrument is needed in this procedure.

1. Set both the reference instrument and Indu altimeter to 1013 hPa and compare the readings. Write down the altitude shown by the reference.
2. Turn the knob on altimeter to indicate 1020 hPa (30.12 inHg) and wait for about 3 seconds for a short cyan line to appear on the top of LCD display.
3. Quickly turn the knob to indicate 999 hPa (29.50 inHg) and wait about three seconds. A longer cyan line shall appear on the top. You must reach 999 hPa before cyan line disappears.
4. Turn the knob to select 1013 hPa (29.91 inHg) and wait for about three seconds. Again, you have to reach this value before cyan line disappears.
5. Now a full cyan line appears and the LCD display is slightly altered. It shows the offset and the altitude. Turn the knob until the altimeter shows the same altitude as the reference. Wait for cyan line to disappear.

   This completes the sensor offset procedure.

2.7 Toggle QNH hPa – inHg

1020 → 1025 → 1013 for hPa or 30.12 → 30.27 → 29.91 for inHg.

Part of the LCD display is also a QNH value. This value can be shown in hPa or in inHg units. If current unit does not suit you, you can change it by following procedure:

1. Turn QNH until it shows 1020 hPa (30.12 inHg) and wait for about three seconds for a short cyan line to appear on top of LCD display.
2. Quickly turn the knob to indicate 1025 hPa (30.27 inHg). After about three seconds a longer cyan line appears.
3. Turn the knob to 1013 hPa (29.91 inHg) to complete the procedure. Observe the units and values next to QNH. They changed from hPa to inHg and vice versa.

2.8 Airspeed Indicator Auto Zero

1020 → 1030 → 1013 for hPa or 30.12 → 30.42 → 29.91 for inHg.

In special situations, when altimeter and airspeed indicator are connected with the CAN bus, you can use altimeter to issue zero calibration command on the airspeed indicator. Normaly, this is not needed. You should issue this command only, if airspeed indicator shows significant offset during pitostatic test.

When airspeed indicator receives such command, it changes offset of the internal pressure sensor so that it shows true zero afterwards.

Important: Please make sure that aeroplane is either inside hangar or there is absolutely no wind and that pitot tube is not covered. Failing to do so may result in wrong offset and it may worsen airspeed precision.

The procedure is as follows:

1. Turn QNH until it shows 1020 hPa (30.12 inHg) and wait for about three seconds for a short cyan line to appear on top of LCD display.
2. Quickly turn the knob to indicate 1030 hPa (30.42 inHg). After about three seconds a longer cyan line appears.
3. Turn the knob to 1013 hPa (29.91 inHg) to complete the procedure. Cyan line disappears and no other visual feedback is shown on either indicator.

2.9 Toggle Illumination Knob

1020 → 1035 → 1013 for hPa or 30.12 → 30.56 → 29.91 for inHg.

If the illumination knob does not work – screen does not react on the knob change, try the following procedure. This procedure enables remote illumination knob if it was not enabled or disables illumination knob, if it was enabled.

1. Turn QNH until it shows 1020 hPa (30.12 inHg) and wait for about three seconds for a short cyan line to appear on top of LCD display.
2. Quickly turn the knob to indicate 1035 hPa (30.56 inHg). After about three seconds a longer cyan line appears.
3. Turn the knob to 1013 hPa (29.91 inHg) to complete the procedure.
4. Finally, you need to turn off the instrument and then back on in order to activate the change.

3 Calibration And Pressure Altitude

3.1 Calibration

Each unit is factory calibrated against reference barometer at different pressure points. These measurements are then repeated at different temperatures.

Eleven pressure points are used to cover pressure range 1100 – 100 hPa. First pressure is decreased in steps 1100, 900, 700, 500, 300, 100 and from this point the pressure is increased again to 200, 400, 600, 800 and 1000 hPa.

These measurements are then repeated at different temperatures ranging from -5 to 55 °C. Typical steps are: -5, 10, 25, 40, 55 °C.

Please note that FAA Part 43, Appendix E does not require calibration/verification at different temperatures. But temperature calibration is essential for any electronic sensor.

This means that each altimeter is calibrated against 55 different temperature - pressure pairs. The least squares method is then applied on this results in order to obtain corrections coefficients. A two dimensional, second degree polynomial is used for the correction model.

3.2 Pressure Altitude

Pressure altitude is calculated according to the ISA 1976 model of athmosphere. First two athmosphere layers are used; throposphere and thropopause. The throposphere is modeled by equation (1) up to 11000 meters of geopotential altitude. The thropopause layer is modeled by equation (2) up to 20000 meters of geopotential altitude.

As the pressure sensor is calibrated down to 100 hPa (about 16000 meters) altitudes above 16000 meters are not reliable.

$$p = p_0 \left[\frac{T_0 + T_0' \cdot z}{T_0} \right]^{\frac{-g_0}{RT_0'}} \tag{1}$$

$$p = p_1 \exp\left[-\frac{g_0 (z - z_1)}{R T_1} \right] \tag{2}$$

The equations converts geopotential altitude into pressure. Here z means geopotential altitude, $g_0 = 9.806645$ m/s^2 is gravity constant, $R = 287.0528$ N $\cdot$ m/kg $\cdot$ K. is gas constant for dry air, $p_0 = 1013.25$ hPa is standard pressure at sea level, $p_1 = 226.321$ hPa is standard pressure at throposphere/thropopause limit, $z1 = 11000$ m is geopotential altitude of the limit, $T_0 = 288.15$ K is temperature at sea level, $T_1 = 216.65$ K is temperature at limit and $T_0' = -0.0065$ K/m is temperature gradient in throposphere.

Besides the equations given below, their inverse and derivatives of inverse are also used.

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Although a great care was taken during the design, production, storage and handling, it may happen that the Product will be defective in some way. Please read the following sections about the warranty and the limited operation to get more information about the subject.

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