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COBALD Operating Instructions – iMet Configuration –

Table of contents

1. General Considerations.....	2
2. Launch Preparation.....	2
3. Telemetry.....	4
4. Standby.....	4
5. Links	5

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1. General Considerations

CAUTION: COBALD emits collimated beams from visible and infrared high power LED sources. Direct eye exposure to the beams should be avoided.

These instructions refer to COBALD sondes with serial numbers beyond 270 using the XDATA instrument ID 0x19. Hosting by an iMet radiosonde and data recording through the NOAA ESRL SkySonde software is assumed.

The sonde is designed for nighttime operation only. Sun elevation of at least 10° below the horizon is required during the balloon sounding. At mid-latitudes, a sounding should not be started before approximately one hour after sunset. For deployment at high latitude, the IDL tool solar-horizonangle.pro may be used to calculate solar elevation angle as function of time and location, including balloon altitude. Alternatively, a calendar for local nautical dawn can be consulted.

To mitigate influence of stray light over large cities with bright surface illumination, COBALD may be tilted pointing the optics upwards at an angle between 20° and 40° with respect to the horizon. The optics field of view should not be obscured by any other part of the payload. Front edges of the optical elements need checking for cleanliness before launch to make sure they are free of dust particles, hairs, or lint.

The sonde is accessed from the back during payload assembly – it should not be removed from its Styrofoam housing. The power supply inside the Styrofoam package consists of eight size AA L9 Lithium cells for the LEDs and logic circuitry, and of two 9V alkaline 6LR-61 blocks for the analog electronics. Under typical operation conditions the batteries last for approximately four hours. The instrument main electronics is connected permanently to the battery pack through a flexible printed circuit (FPC). It is turned on by the power switch on the battery pack circuit board. To facilitate payload checkout, two different standby modes can be selected through a dedicated switch as described below. Before launch the sonde should run at least 15 minutes to warm up. Data connection to the radiosonde and further instruments in the iMet daisy chain is accomplished through two four-pin connectors on the battery pack. The data cable(s) should be fixed on the payload to minimize the effect of electromagnetic interference.

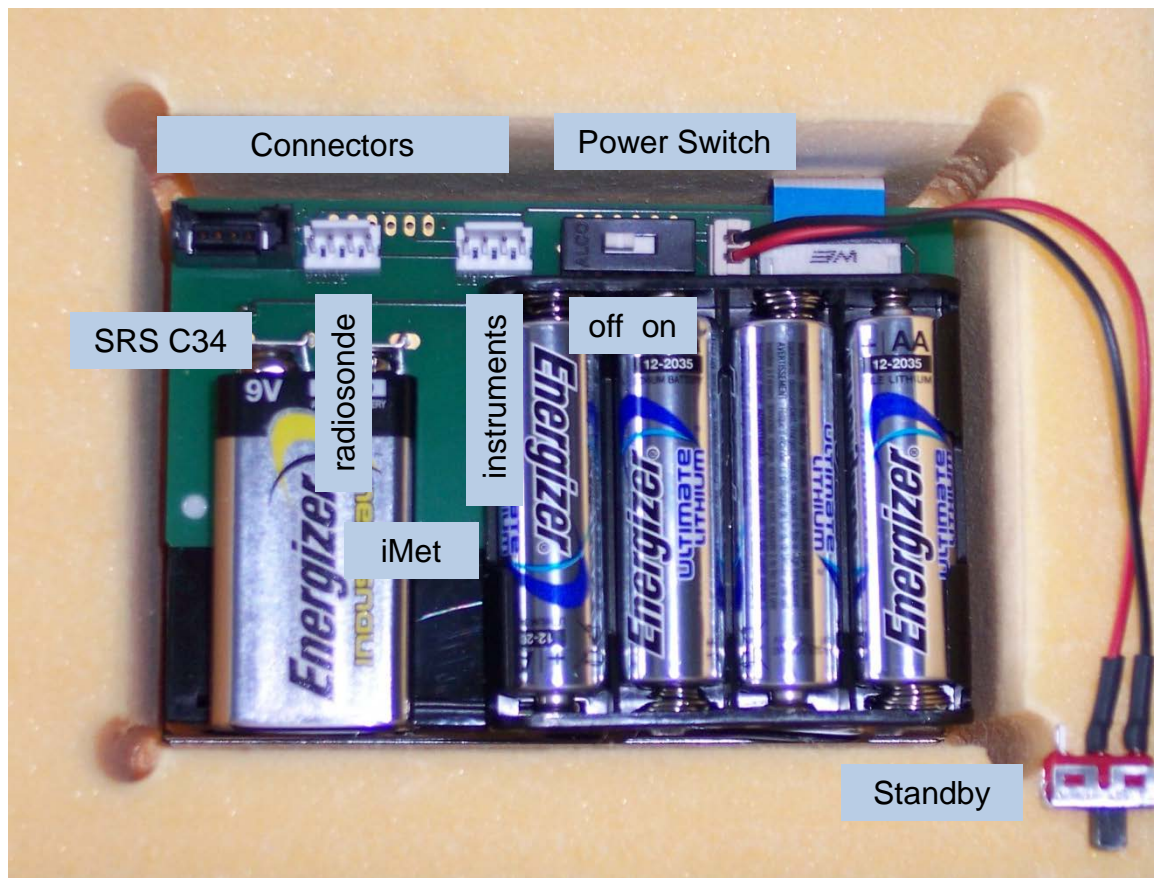
2. Launch Preparation

1. Establish the mechanical payload arrangement.
2. Connect the broadband receiver to the recording computer via an adequate audio cable. Activate the data monitoring and recording software, e.g. [NOAA ESRL SkySonde](http://NOAA-ESRL-SkySonde) by Allen Jordan. The telemetry of the Cryogenic Frostpoint Hygrometer, if present on the same payload, can be decoded with the CFH-SkyPlugin.
3. Power on the iMet radiosonde first: connecting the unpowered iMet sonde to powered instruments may damage the radiosonde. Ensure the broadband receiver receives the radio signal, and that the recording software registers the radiosonde data correctly.

COBALD Operating Instructions
– iMet Configuration –

4. Connect the radiosonde serial XDATA cable to the connector labeled 'radiosonde' on the battery pack. The connector labelled 'instrument' establishes connection to additional sensors if needed. Turn on the sonde using the power switch on the battery pack circuit board. The LEDs should light up. Locate the standby switch, connected to the battery pack by a two-wire cable, at an accessible position outside the assembled payload. To save battery power during payload preparation it selects two standby modes turning off the LEDs and potentially data transmission as described below. Remember to activate the LEDs at least 15 minutes before launch.
5. The additional COBALD data in the telemetry should be noticeable in the broadband receiver's audio frequency signal. Check the COBALD data received: sonde type, chain number and sonde number should be displayed correctly, the sonde temperature should be plausible while the instrument heats up, and the LED monitor readouts should be within 15% of the values supplied with shipment. Note that the monitor readings change during warm-up and are affected by nearby illuminated surfaces. The signal values are not significant due to uncontrolled backscatter at ground before launch.
6. Close the Styrofoam housing, check cleanliness of the optic's front edges, and launch the payload.

Instrument Back View



3. Telemetry

The XDATA interface of the iMet radiosonde allows adding one or more external instruments to the radiosonde telemetry. To support this interface each external instrument has to supply two full duplex (RxD and TxD) serial ports: one directed “downstream” to the radiosonde and the other “upstream” towards the next external instrument, simulating the radiosonde there.

The COBALD iMet configuration supports this requirement providing two connectors on the battery pack. The *‘radiosonde’* connector leads – possibly through additional instruments – downstream towards the radiosonde. The *‘instrument’* connector provides means to add further instruments upstream in the chain. Pin-out is identical for all interface connectors with ground lines outside (i. e. pin 1 and 4) and signal lines inside (i. e. pin 2 and 3). The XDATA cable attached to the radiosonde connects directly to the first instrument. Cables in between instruments have to maintain the outside ground pin assignment while crossing the inside lines: an instrument interconnection cable should connect pins [1234] to pins [1324]. Further details are provided in the [XDATA Protocol & Daisy Chaining](#) document.

Each instrument is assigned a chain number increasing with position away from the radiosonde, and an instrument type identifier. Data is transmitted at 9600 baud (1start bit, 1 stop bit, no parity) over this interface using readable ASCII character byte encoding (e. g. by sending the characters ‘4a’ to identify the hexadecimal byte value 4a). Each packet is initiated by ‘xdata=’ followed by the instrument identifier and the chain number. To establish the increasing chain number order, the chain position fields of forwarded packages are incremented by each instrument.

The COBALD data is organized as follows: `xdata=1901nnnTTTbbbbbbrrrrrrBBBBRRRR`

1901	iMet protocol COBALD identifier 19 and chain number 01
nnn	sonde number (1.5 bytes)
TTT	internal temperature as 12 bit 2’s complement, $T \text{ in } ^\circ\text{C} = \text{TTT} / 8$
bbbbbb	blue backscatter signal, 24 bit 2’s complement
rrrrrr	red backscatter signal, 24 bit 2’s complement
BBBB	blue monitor signal, 16 bit 2’s complement
RRRR	red monitor signal, 16 bit 2’s complement

4. Standby

The standby switch selects normal operation in “on” position, shorting the instrument “nEnable” line to ground (negative logic). Opening this contact turns off the LEDs to reduce power consumption while preparing the payload. Similar to the iMet radiosonde, certain sensors on the data chain require a passive data input line when powered on. Therefor two standby modes have been realized:

- If standby is activated later than one second after powering on the sonde (or after selecting normal operation) the outgoing telemetry line is set to high impedance: For the downstream instrument COBALD behaves as switched off via the main power switch – or as if it was dis-

connected. A single blink of the blue LED in intervals of five seconds indicates this mode, recommended to switch on the radiosonde and one instrument after the other in upstream direction right before launch.

- In contrast, selecting standby mode within one second after going operative leaves the outgoing telemetry active. A double blink of the blue LED indicates this state, provided to test the entire daisy chain telemetry during payload ground check.

5. Links

solarhorizonangle.pro

ftp://iacftp.ethz.ch/pub_read/frank/Soft/solarhorizonangle.pro

NOAA ESRL SkySonde

<https://www.esrl.noaa.gov/gmd/ozwv/wvap/sw.html>

CFH-Sky Plugin

ftp://iacftp.ethz.ch/pub_read/frank/SkySonde/

XDATA Protocol & Daisy Chaining

[ftp://aftp.cmdl.noaa.gov/user/jordan/iMet-1-RSB Radiosonde XDATA Daisy Chaining.pdf](ftp://aftp.cmdl.noaa.gov/user/jordan/iMet-1-RSB%20Radiosonde%20XDATA%20Daisy%20Chaining.pdf)