iMet-1-RSB Radiosonde Protocol

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Jim Wendell, Allen Jordan (allen.jordan@gmail.com)

National Oceanic and Atmospheric Administration

This document describes the packet protocol for iMet-1-RSB radiosondes (and attached instruments) when decoding received packets through a modem.

PTU Packet:

The main radiosonde data packet containing information on pressure, temperature, humidity, and various internal conditions of the iMet.

This table shows the packet format. The first row is the byte index (offset). The second row identifies fields in the packet (with ~ showing the byte span of the field). The third row shows the value of constants and/or defaults, if they exist.

Fields in this packet are stored **LSB-first**

0	1	2	3	4	5	6	7	8	9	10	11	12	13
SOH	PKT ID	PKT	~	P	~	~	T	~	U	~	VBAT	CRC	~
0x01	0x01												

Fields and Calculations:

- SOH is the "start of heading" character in ASCII (0x01)
- PKT ID is the packet identifier, set to 0x01 for PTU
- PKT is the packet number (not used)
- Pressure = P/100 [mb]
- Temperature = T/100 [deg C]
- Humidity = U/100 [% RH]
- Battery Voltage = VBAT/10 [V]

Note that the **2-byte CRC is a 16-bit CCITT using 0x1021 as the polynomial**. All packets should be verified using the CRC for validity.

PTUX Packet:

Fields in this packet are stored **LSB-first**

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
SOH	PKT ID	PKT	~	P	~	~	T	~	U	~	VBAT	TI	~	PT	~	UT	~	CRC	~
0x01	0x04																		

Fields and Calculations:

- Pressure, temperature, humidity, and battery voltage are the same as the PTU packet
- Internal Temperature = TI/100 [deg C]
- Pressure Sensor Temperature = PT/100 [deg C]
- Humidity Sensor Temperature = UT/100 [deg C]

GPS Packet:

Fields in this packet are stored **LSB-first**

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
SOH	PKT ID	LAT	~	~	~	LON	~	~	~	ALT	~	SATS	H	M	S	CRC	~
0x01	0x02																

Fields and Calculations:

- Latitude = conversion of the four LSB-first bytes in the LAT field to a single floating point number
- Longitude = conversion of the four LSB-first bytes in the LON field to a single floating point number
- Altitude = ALT-5000 [m]
- SATS is the number of locked GPS satellites (at least 3 are needed for good coordinates)
- H is the hours field of GPS time [GMT]
- M is the minutes field of GPS time [GMT]
- S is the seconds field of GPS time [GMT]

GPSX Packet:

Fields in this packet are stored **LSB-first**

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SOH	PKT ID	LAT	~	~	~	LON	~	~	~	ALT	~	SATS	E VEL	~
0x01	0x05													

Continued below...

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
~	~	N VEL	~	~	~	UP VEL	~	~	~	H	M	S	CRC	~

Fields and Calculations:

- Latitude, longitude, altitude, and number of satellites are the same as the GPS packet
- East Velocity = conversion of the four LSB-first bytes in the E VEL field to a single floating point number
- North Velocity = conversion of the four LSB-first bytes in the N VEL field to a single floating point number
- H is the hours field of GPS time [GMT]
- M is the minutes field of GPS time [GMT]
- S is the seconds field of GPS time [GMT]

XDATA Packet:

XDATA packets represent data from extra instruments attached to the iMet radiosondes.

Fields in this packet are stored **MSB-first (note the byte-order difference from previous packet types)**

0	1	2	3 … (N + 2)	(N + 3)	(N + 4)
SOH	PKT ID	N	...	CRC	~
0x01	0x03				

Fields and Calculations:

-      N is the number of data bytes to follow before (but not including) the CRC
◦   Note that a typical XDATA packet starts the data section with two bytes. The first byte is an instrument identifier (0x01 for an ozonesonde, 0x10 for a hygrometer, etc), the second byte represents the packet's daisy chain index*.

*If more than one extra instrument is attached, packets are "daisy chained" to the iMet. When an extra instrument receives a packet from another instrument higher up the chain (further from the iMet), the daisy chain index is incremented by one before the packet is forwarded down the chain. In this way, several of the same instrument may be attached and properly identified.

Ozonesonde XDATA Packet:

Fields in this packet are stored **MSB-first**

0	1	2	3	4	5	6	7	8	9	10	11	12
SOH	PKT ID	N	INST ID	DC IND	IC	~	TP	~	IP	VBAT	CRC	~
0x01	0x03	8	0x01									

Fields and Calculations:

-      INST ID is the instrument identifier, which is 0x01 for an ozonesonde
-      DC IND is the daisy chain index, indicating how many times the packet has been forwarded by instruments further down the chain
-      Cell Current = IC/1000 [uA]
-      Pump Temperature = TP/100 [deg C]
-      Pump Current = IP [mA]
-      Battery Voltage = VBAT/10 [V]

Hygrometer XDATA Packet:

This is the packet format for the NOAA digital frostpoint hygrometer. The frostpoint temperature and mixing ratio calculations are not listed, as they are quite complex. There are also frost "clearing" regions and gain changes that need to be taken into account before using the resulting water vapor data. Contact Emrys Hall (emrys.hall@noaa.gov), Allen Jordan (allen.jordan@gmail.com), or Dale Hurst (dale.hurst@noaa.gov) for more information.

Fields in this packet are stored **MSB-first**

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SOH	PKT ID	N	INST ID	DC IND	HYG TYPE	FRST	~	FILT FRST	~	SUN	~	LOW SUN	~	FPT ADC
0x01	0x03	25	0x10		0x00									

Continued below...

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
~	OPT	~	OPT HEAT	~	MIRR HEAT	~	PRES	~	PRES TEMP	~	AVG FPT	VBAT	CRC	~

Fields and Calculations:

•	HYG TYPE represents the type of hygrometer packet, 0x00 for normal and 0x01 for a hygrometer thermistor calibration packet (documented in the next section)
•	FRST is the frost coverage of the chilled mirror, represented as an ADC value from 0 (frosty) to 65535 (max clear, though usually only gets to around 41000)
◦	The setpoint for frost control is at 32767
•	FILT FRST is the frost coverage after sunlight removal filtering is applied (and possibly other filters, such as a median filter to eliminate outliers).
•	SUN is the ambient sunlight measured in the sensor housing.
•	LOW SUN is the lowest sunlight measured over a short timespan.
•	FPT ADC is the ADC measurement of the frostpoint thermistor, with a 49.9k ohm resistor making the 5v divider.
•	OPT is the optics block temperature, controlled to a stable level above room temperature at surface.
•	OPT HEAT is the PWM value used to heat the optics block. The higher the value, the more heat is applied.
•	MIRR HEAT is the PWM value used to heat the chilled mirror.
•	Pressure = PRES/10 [mb]
•	Pressure Sensor Temperature = (PRES TEMP)/10 [deg C]
•	AVG FPT is a long exponential moving average of the frostpoint temperature calculated on-board the hygrometer. This slow-moving value is used for gain changes.
•	Battery Voltage = VBAT/10 [V]

Hygrometer Thermistor Calibration XDATA Packet:

This packet is used in conjunction with the previously described hygrometer packet. It gives calibration values used to calculate frostpoint temperature. Contact Emrys Hall (emrys.hall@noaa.gov), Allen Jordan (allen.jordan@gmail.com), or Dale Hurst (dale.hurst@noaa.gov) for more information.

Fields in this packet are stored **MSB-first**

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
SOH	PKT ID	N	INST ID	DC IND	HYG TYPE	MIR NUM	~	CAL 0	~	CAL 45	~	CAL 79	~	~	~	CRC	~
0x01	0x03	13	0x10		0x01												

Fields and Calculations:

•	MIR NUM is the identifying number of the hygrometer's mirror/thermistor
•	CAL 0 is the thermistor resistance at 0 degrees C
•	CAL 45 is the thermistor resistance at -45 degrees C
•	CAL 79 is the thermistor resistance at -79 degrees C