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Beacon Decoding
May, 16th 20008

Technical Note

How to decode the beacon

COMPASS-1 sends periodically (every 3 minutes) a beacon in the form of CW Morse code on the frequency 437.275 MHz. In order to decode the content of the beacon, you should first record the signal as an audio file, such that you can do post-processing with it. We recommend the use of the free software 'audacity' (audacity.sourceforge.net). Of course, you can use your hearing to interpret the Morse code, but here we present a graphical method.

The first step is to remove the noise from the audio record. This can be found in the pull-down menu 'effect'. After that, display the file in 'pitch' format, which can be chosen from the pull-down menu as shown in the figure below (red circle). Then you should be able to identify the several groups of letters (as shown exemplary with the yellow boxes for the first three letters). Note that the gap between letters is about three times the gap between the beeps. Well, and then you need to decode each letter using a Morse code table (as is provided on the next page). Please also note that normal Morse code should be in the form of horizontal lines (a constant beep). COMPASS-1, however, is not beeping but whistling like a bird. Hence the letters look almost like musical notes as can be seen below.

The result of your decoding should then read '00compass' and 26 hexadecimal numbers (0 to F). The information on how to read that information is given on the next page.

Good luck and have fun with decoding!
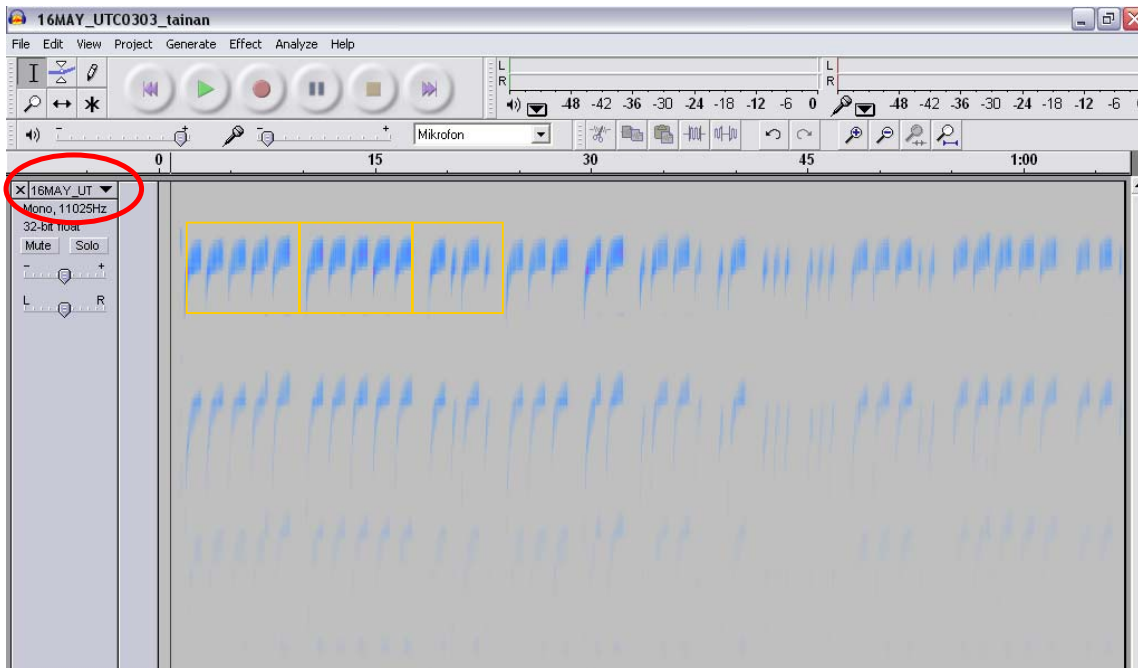
Morse Code Alphabet

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A . _        J . _ _ _      S . . .        2 . . _ _ _
B _ . . .    K _ . _        T _            3 . . . _ _
C _ . _ .    L . _ . .      U . . _         4 . . . . _
D _ . .      M _ _          V . . . _       5 . . . . .
E .          N _ .          W . _ _         6 _ . . . .
F . . _ .    O _ _ _        X _ . . _       7 _ _ . . .
G _ _ .      P . _ _ .      Y _ . _ _       8 _ _ _ . .
H . . . .    Q _ _ . _      Z _ _ . .       9 _ _ _ _ .
I . .        R . _ .        1 . _ _ _ _     0 _ _ _ _ _
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COMPASS-1 Beacon Information

The COMPASS-1 beacon is sent as CW Morse code about every 3 minutes (every 8 minutes in powersafe mode). The table below lists the information contained within the beacon. For details on how to interpret the data, please refer to the next page.

Information	Value	Bytes	Letters
Identification	COMPASS	7	7
Solar Cells Voltage	00..FF	1	2
Solar Panel 1..5 Current	00..FF	1 * 5	10
EPS reset counter	00..FF	1	2
Power Level	0..3	0.5 *	1
Heater Active	0..1	0.5 *	1
Powersafe Counter	00..FF	1	2
Emergency Mode Counter	00..FF	1	2
Battery Voltage and Current	00..FF	(1 + 1)	4
Battery Temperature	00..FF	1	2
			∑ 33

All values are in hex (except the identification header). As a first step, convert them all into the decimal system. Then obtain the information as follows:

- ➢ Voltage [V] = (value)*5/255

- ➢ Current [mA] = (value)*1.6/255*1000

- ➢ Temperature [°C] = (value)

If the (value) of temperature is greater than 127, then subtract 256 from it to obtain the correct temperature (which will be a result below 0°C)

For the Power Level information:
- o '0' means 'Battery Capacity OK'

- o '1' means 'Low Battery Capacity'

- o '2' means 'Critical Battery Capacity'

- o '3' means 'Battery Charging'

For the Battery Heater information:
- o '0' means 'Battery Heater is Off'

- o '1' means 'Battery Heater is On'

The other values are all simple counters.