BITPACKING FORMAT FOR NTLAB DATA

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1. Multi-Channel Bitpacking Format

The NTLAB front end has four channels, let us name these 0, 1, 2, 3. At a given sampling instant, all four channels generate one sample each. Each sample is 2 bit quantized. So the NTLAB generates 8 bit (1 B) of data at each sampling instant.

To read data from the NTLAB binary file, it is most convenient to read 1 B at a time. This byte of data has one sample from each of the four channels. As one might expect, these are all samples from the same time instant. Let $M_i^{t_k}$ and $S_i^{t_k}$ denote the magnitude and sign bit for the i^{th} channel at sample time t_k. The byte of data is arranged as (left-most bit is most-significant)

$$\left[M_0^{t_k}\ S_0^{t_k} \mid M_1^{t_k}\ S_1^{t_k} \mid M_2^{t_k}\ S_2^{t_k} \mid M_3^{t_k}\ S_3^{t_k}\right]$$

The sign and magnitude bits may be converted to sample values per the following table:

S	M	value
0	0	-1
0	1	-3
1	0	$+1$
1	1	$+3$

When read correctly, the first 16 samples of ntlab.bin must be as follows.

Channel 0: $+1, +1, -1, -1, -3, +1, -1, -1, +1, +1, +3, +1, -1, +1, -1, +1$

Channel 1: $+1, +1, +1, +1, +3, +3, +3, +3, +3, +3, +3, +3, +1, -1, -1, -1$

Channel 2: $+1, +1, +1, +1, +1, +1, -1, +3, +1, -1, +3, +1, -1, -1, -1, +1$

Channel 3: $+3, +3, +3, +1, +3, +1, +3, +3, -3, -1, -1, -1, +3, +3, -1, +1$

2. Channel Definitions for TEX-CUP

The NTLAB front-end performs single stage downconversion to intermediate frequency (IF). The list of IF in Tables 1, 2, 3, 4 are not exhaustive, and are only provided for easy reference. The IF for any signal type may be computed from the provided RF mixer frequency.

Table 1. Channel 0 specifications

Antenna	Port
Sampling frequency	79.5 MHz
RF mixer frequency	1590 MHz
Spectral inversion	True
Passband	1559 MHz – 1590 MHz
GPS L1 C/A IF	14.58 MHz
GPS L1C IF	14.58 MHz
SBAS L1 IF	14.58 MHz
Galileo E1 IF	14.58 MHz
BeiDou B1C IF	14.58 MHz

Table 2. Channel 1 specifications

Antenna	Port
Sampling frequency	79.5 MHz
RF mixer frequency	1590 MHz
Spectral inversion	False
Passband	1590 MHz – 1610 MHz

Table 3. Channel 2 specifications

Antenna	Port
Sampling frequency	79.5 MHz
RF mixer frequency	1200 MHz
Spectral inversion	True
Passband	1163 MHz – 1200 MHz
GPS L5C IF	23.55 MHz
Galileo E5a IF	23.55 MHz
BeiDou B2a IF	23.55 MHz

TABLE 4. Channel 3 specifications

Antenna	Port
Sampling frequency	79.5 MHz
RF mixer frequency	1200 MHz
Spectral inversion	False
Passband	1200 MHz – 1237 MHz
GPS L2C IF	27.6 MHz