

bip2x Software

Short Manual

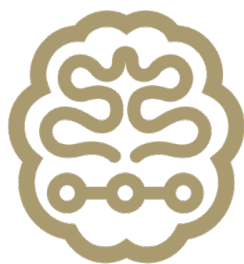
Brain Interchange System

Valid for research and clinical investigation:

EU: Exclusively for clinical investigation

USA: CAUTION – Investigational Device Limited by
Federal (or United States) law to investigational use.

EU&USA: Scientific research and development



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1. Information

Table 1: Information on Software Releases

Topic	Information
Software Releases:	Implant firmware: 1.0.238 / 1.1.260
	BIP2x: 1.0.238 / 1.1.260

2. File Conversion

The data of the CorTec Brain Interchange Application Software is stored in binary format. For Conversion, a python software tool called bip2x is provided with corresponding files as python application package.

Please install the bip2x python application package. Run the tool according to the instructions below. Make sure you use correct directory assignments.

3. Data Location

The data (neural data and system logs) is stored to files in a binary file format. The log files can be found in the Application Software's installation folder (e.g. C:\Program Files\CorTec\Brain Interchange Paralysis\Log). Every time the software is started, a new file with the current timestamp as file name and suffix *_bic_data.log will be generated.

4. Data Conversion

The conversion tool (bip2x) translates these binary files into CSV files, that can be read, e.g. by Microsoft Excel or Mathworks' Matlab.

Usage:

```
python -m bip2x -i <log filename> -c meas.json
```

where <log filename> is the name of the binary data output measured with the Application Software.

Example:

```
python -m bip2x -i 2020-12-03-08-42-32_bic_data.log -c meas.json
```

This call will generate a csv file with name 2020-12-03-08-42-32_bic_data_meas.csv

The columns of the csv are defined in meas.json (columns) the additional columns are appended after the "counter" column.

The result is a table which rows correspond to the packets transferred from the implant to the Communication Unit/Personal Computer; the columns of the table are described below.

Column 1: timestamp (μ s since start of the application software) The timestamp of packet arrival on the PC side, which is not a real-time system and data may be processed in chunks. For a more accurate time base the usage of the sampling rate of 1000 Hz and the counter variable is recommended.

Column 2 to 33: voltage (U_{DAC}) as digitized from channel 1 to 32 (see formula below)
 Column 34: measurement counter, increments with each measurement packet
 Column 35: trigger signal (1 if the voltage trigger input at the communication unit is electrical high, 0 if low)

Note: Every time a packet is lost, a row with 'nan' values is added for each column. It is up to the user to replace these 'nan' values, e.g. by interpolated values.

The digital analogue converted voltage U_{DAC} is converted to the voltage at the amplifier input according to the following equation:

$$U = -\frac{VPD_{AD}}{k} \left(U_{DAC} - \frac{Ref_{AD}}{2VPD_{AD}} \right),$$

VPD_{AD} : Voltage per digit
 Ref_{AD} : Reference voltage
 k : Amplification factor
 U_{DAC} : Digital analogue output voltage of a recording channel
 U : Signal amplitude at recording channel in V

with

$$Ref_{AD} = 3V$$

and

$$VPD_{AD} = \frac{Ref_{AD}}{2^{16}}.$$

Inserting these values leads to

$$U = -\frac{\left(\frac{3}{2^{16}}\right)}{k} (U_{DAC} - 2^{15}).$$

The amplification factor k depends on the amplification as shown in the following table:

Amplification in dB	Amplification factor
57,5	749.89
51,5	375.84
45,5	188.38
39,5	94.41

As a result, the calculations based on the constants and the equations above are the following (with U in μV):

57,5 dB:	$k = 749,89$	$U = -0.06104 \cdot (U_{DAC} - 2^{15})$
51,5 dB:	$k = 375,84$	$U = -0,1218 \cdot (U_{DAC} - 2^{15})$
45,5 dB:	$k = 188,38$	$U = -0,243 \cdot (U_{DAC} - 2^{15})$
39,5 dB:	$k = 94,41$	$U = -0,48487 \cdot (U_{DAC} - 2^{15})$



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