# Data Format of TDC on TRB3

In the data stream of the DAQ system, the TDC data starts with the word “0xXXXXf30X”, “0xf30X” indicating the address of the TDC in the system. The number of words sent by the TDC is marked in the upper 16 bits, e.g., “0x0006f30X” means, the next 6 words are from the TDC. The least 4 significant bits indicate the TDC number. It can alter between 0–3.

4 different kind of words are sent by the TDCs; header, data, debug and reserved.

## *1. HEADER*

The data format of the ***header*** word is shown below:

| “001” | reserved | error bits |
|---|---|---|

Table 1 – The data format of the HEADER word.

| | | |
|---|---|---|
| “001” | 3 bits | Header marker |
| reserved | 13 bits | Reserved for future use |
| error bits | 16 bits | Error might occur will be marked here. The user should be warned during the go4 analysis. |

## *2. TIME DATA*

The data format of the ***time data*** word is shown below:

| “1” | reserved | channel no | fine time | edge | coarse time |
|---|---|---|---|---|---|

Table 2 – The data format of the TIME DATA.

| | | |
|---|---|---|
| “1” | 1 bits | Time Data marker |
| reserved | 3 bits | Reserved for future use |
| Channel no | 6 bits | The channel number of the TDC – “000000” is the reference channel |
| fine time | 10 bits | The fine time value of the measurement |
| edge | 1 bit | The type of the measurement – '1' for rising edge, '0' for falling edge |
| coarse time | 11 bits | The coarse time value of the measurement (the user should be able to set as a parameter in go4 analysis) |

## 2.1 Analysis requirements

- Histograms for each channel of each TDC:
  - Fine time and coarse time histograms should be created for rising and falling edge measurements.
  - Bin widths should be calculated using the fine time histograms and bin width histograms should be created.
- Time interval calculations:
  - There will be two time interval analysis: time-of-flight (ToF) and time-over-threshold (ToT). This should be set by the user in the analysis parameters.
  - For ToF measurements the time information of the rising edge of a channel and the rising edge of the reference channel will be used.
  - For ToT measurements the time information of the rising edge and the falling edge of a channel will be used.
  - Raw time correlation graphs should be created. This should be relative to the active channels and the edges. (if the measurement is ToT, the correlation between the rising and falling edges should be plotted.)
  - Calibration table should be created and plotted.
  - Time difference (depending on the measurement type, relative to the falling edge or the reference channels) should be calculated with and without calibration table and plotted.

## *3. DEBUG*

The data format of the ***debug*** word is shown below:

| | | |
|---|---|---|
| “010” | debug mode | debug bits |

Table 3 – The data format of the HEADER word.

| | | |
|---|---|---|
| “010” | 3 bits | Debug marker |
| debug mode | 5 bits | Will be used define different debug values. |
| debug bits | 24 bits | Will be used to give debug information and statistics to the user. |

## *4. RESERVED*

The data format of the ***reserved*** word is shown below:

| | |
|---|---|
| “011” | reserved |

Table 4 – The data format of the RESERVED word.