Gautebøye - Specification

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Introduction

The Gautebuoy..

1 Overview

2 Concept

3 Hardware and analog system

4 Digital control system

5 Timing

The timing is based on the GPS unit time and date information as well as a pulse per second (PPS) signal which has an accuracy of up to 1 μs [1], this represents the limit on the timing. The PPS signal will only be present if the GPS has a sufficiently good enough signal (fix), which in the open air in the arctic should be no problem. If a PPS signal is present the status flag HAS_SYNC is set, if time and date is present the status flag HAS_TIME is set.

5.1 Time representation

The time is represented as seconds since UNIX epoch, 1970, the GPS time is used directly and **no** additional leap seconds are added.

When needed the time is represented as microseconds since UNIX epoch, i.e. for the batch reference. All operations thus require 64 bit wide unsigned integers.

5.2 Determining time

The current second is determined using the following steps (implemented in buoy/gps.cpp):

1. Received time and date telegram

   Disable PPS handler

   Determine seconds since UNIX epoch (1970)

   Enable PPS handler

2. Receive PPS signal

   Increment second

   Record output of micros(), the internal CPU time in microseconds, this is called the 'microdelta'.

To get a reference accurate to a microsecond, apart from the drift of the internal CPU clock since the last PPS append the delta of a new call to micros(), the CPU time in microseconds, and the recorded value of micros() at the time of the PPS signal, to the second determined at the time of the PPS signal.

Assumptions

1. When time and date is fixed the next PPS is for the next second, otherwise the time would already also be one second later.

2. There will be a good enough fix, under normal conditions, for the PPS signal often enough that micros() will not overflow and cause a backwards jump in time before a new reference has been set.

3. There cannot be PPS pulse without a valid time.

5.3 Determining a new reference

Every time there is a PPS signal a new reference is made available with a fresh 'microdelta'. The continuously refreshed reference is not used before a new batch is started. With a batch length of 1024 samples and a sample rate of 250 Hz it takes approximately 4 seconds before it is full. This is implemented in: buoy/ads1282.cpp and buoy/gps.cpp.

5.4 Drift

The drift of the CPU clock is bounded by the crystal accuracy, specified in ppm, as well as the number of CPU instructions around the causing any lag. The CPU instructions are in the order of 5-6 lines of C-code and given that the CPU runs at 72 MHz are ignored [1].

The crystal *TODO:* Figure out which crystal Olimexino is using and calculate drift over: a normal reference update cycle and a long cycle without PPS.

[1] TODO: Better ref: [2]

6 Protocol

7 Zero: Central logging point

References

[1] GlobalSat. *Product User Manual GPS Receiver Engine Board EM-406A.*

[2] STMicroelectronics. *STM32F10RBT6 Datasheet.*