REV 1.0

Using 1PPS

iSuite 3 application note

This document describes the usage of the 1PPS functionality with the iSuite 3 firmware based GPS receivers.

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CHANGE LOG

0.1	01-01-2007 / KH	Initial revision
1.0	05-01-2007 / KH	Minor corrections. Added PPS message example.

CONTENTS

1 DEFAULT 1PPS BEHAVIOUR

The 1PPS function is by default enabled in the iSuite 3 software, meaning that as soon as the GPS receiver has acquired a fix it will start to toggle the 1PPS line to indicate even time of week (TOW) seconds. The NMEA PPS message is not output by default, and has to be enabled by modifying the NMEA message mask - see below or in the on-line NMEA protocol documentation at http://isuite.fastrax.fi/sdk/331/Protocols/PRO_NMEA.html.

```
$PFST,PPS,wwww,ssssss,mmm,utcvalid,hhmmss.ss,ddmmyy,ppsnum*hh<CR><LF>
```

wwww	week number
ssssss	number of seconds since start of week
mmm	milliseconds
utcvalid	validity of UTC time, 1 if valid, 0 if not
hhmmss.ss	UTC time
ddmmyy	UTC date
ppsnum	number of SV's used to calculate the PPS fix. Empty field or 0 means that the PPS pulse will be predicted

Example:

```
$PFST,PPS,1375,113664,493,1,073410.82,150506,10,*45
```

The PPS message is output after the navigation result has been calculated. The PPS message refers to the next 1PPS pulse that generated after the navigation result has been calculated. As the sampling time is by default not synchronized to the GPS time the relationship between the PPS message and the 1PPS pulse is random and can also change over time. Figure 1 and Figure 2 show examples of possible relationships between sampling, PPS message and 1PPS pulse times.

The GPS time given in the PPS message refers to the sampling time of the measurements used for calculating the navigation result. This is the same time as in the GGA, GLL and RMC messages and indicates the actual time instant the navigation fix refers to.

The UTC time in the PPS message indicates the time when the PPS message output starts. Rounding this time up to the next even second

gives the approximate UTC time of the next 1PPS pulse. This UTC time is approximate since in addition to the leap seconds there is a difference of a few microseconds between the GPS and UTC even seconds given by the UTC model. This difference may change over time.

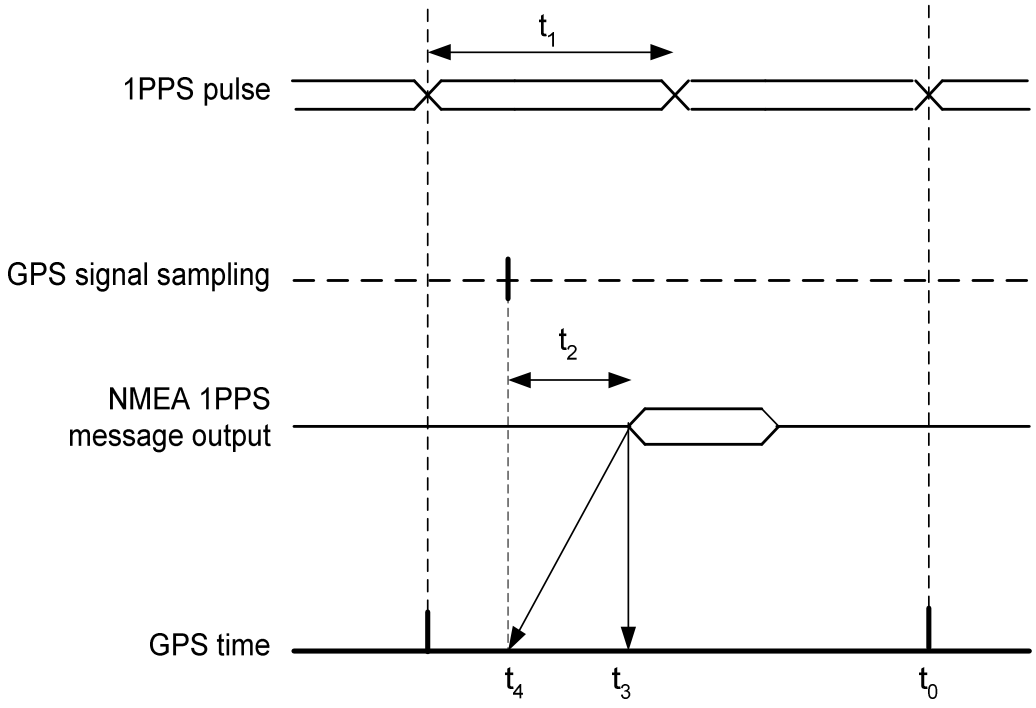

Figure 1 shows a scenario where the sampling of the GPS signals occurs right after the even GPS TOW: t_0 = TOW the PPS message refers to, t_1 = 1PPS pulse duty cycle, t2 = delay from sampling to PPS message output caused by calculation of the navigation result, t_3 = UTC time in the PPS message, t_4 = GPS time in the PPS message.

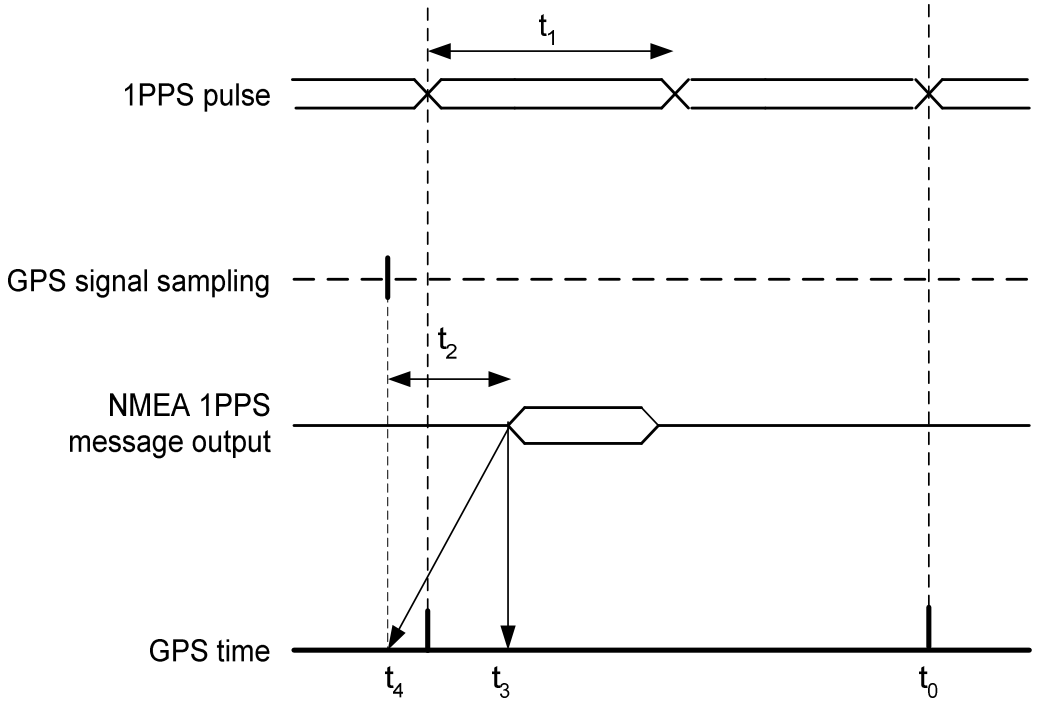

Figure 2 shows a scenario where the sampling of the GPS signals occurs just before the even GPS TOW: t_0 = TOW the PPS message refers to, t_1 = 1PPS pulse duty cycle, t2 = delay from sampling to PPS message output caused by calculation of the navigation result, t_3 = UTC time in the PPS message, t_4 = GPS time in the PPS message.

2 SETTING 1PPS PARAMETERS

As can be seen from Figure 1 and Figure 2, getting the actual GPS time of the 1PPS pulse from the PPS message is not straight forward with the default parameter settings. This can be resolved by configuring the PPS parameters as follows.

To force the sampling to take place at the even GPS TOW set the PPS_SYNC_TRACK parameter to TRUE. This causes the sampling time to be adjusted as close to the even TOW as possible. This is however accurate only to ±1ms with Sony based HW and ±4ms with uNav based HW so the sampling could occur just before, at or just after the even TOW. To make sure sampling takes place after the even TOW use PPS_MEAS_MS parameter to offset the sampling time from the even TOW by at least 4 ms. Figure 3 illustrates the use of these parameters. With these settings the next even TOW second can always be obtained by rounding the GPS time in the PPS message up to the next even second.

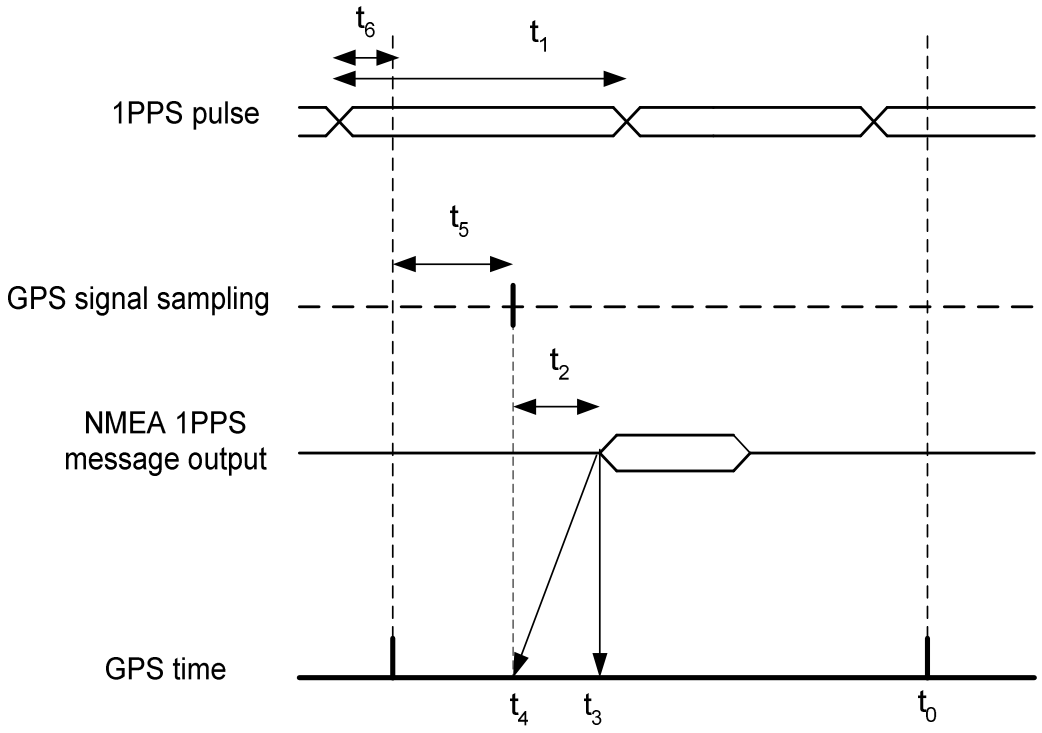

Figure 3 illustrates the 1PPS parameters. t_0 = TOW the PPS message refers to, t_1 = 1PPS pulse duty cycle, t2 = delay from sampling to PPS message output caused by calculation of the navigation result, t_3 = UTC time in the PPS message, t_4 = GPS time in the PPS message, t_5 = samping time fixed in relation to the TOW using the PPS_SYNC_TRACK and PPS_MEAS_MS parameters, t_6 = 1PPS pulse offset (cable delay) set using the PPS_DELAY parameter.

3 CONFIGURING STATIC 1PPS MODE

By default the 1PPS operates in a roving mode, where the coordinates are allowed to change, and a valid navigation result is needed to provide an accurate 1PPS output. Without a valid navigation result, for example in situation where less than three satellites are available, the 1PPS pulse is predicted and the accuracy of this prediction will deteriorate over time unless a valid navigation result can be obtained again.

If the GPS receiver is in a fixed location then the accuracy and robustness of the 1PPS can be improved by setting the GPS receiver in a static mode. The procedure is as follows:

1. Change the value of parameter KLM_MODE from D60Fh to D60Bh, in other words turn off the kalman velocity flags (KALMAN_VEL) from the kalman mode mask.

2. Reset the receiver.

3. Start navigation unless it is started automatically and wait until a stable location has been obtained. The longer you wait the more accurate this location will be. Usually a 24 hours is used as the “survey period” to get the location accurately.

4. Set the parameter KLM_NUM_OBS_LIMIT to 1. This allows 1PPS pulses to be accurately generated even with only 1 satellite in track using the location obtained in step 3 as reference.

If the location of the receiver changes than you need to set KLM_NUM_OBS_LIMIT back to it’s default value and return to step 2.