



Receiver Clock Synchronizing

Configuration Example

Version 1.0

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HOW TO SYNCHRONIZE RECEIVER CLOCK

1.1. How to synchronize the receiver clock with an external event generator

Connect the external event signal generator to one of the receiver's event inputs (A or B). For definiteness assume that Event Input A will be used.

Enable the selected event input.

```
set,/par/dev/event/a/in,on
```

Select the effective edge for the event signal. In this example, select the rising edge.

```
set,/par/dev/event/a/edge,rise
```

Select a reference time system for the event. Bear in mind that the external event generator that we are eventually going to synchronize the receiver clock with is supposed to be associated with this very time scale.

Let us choose GPS time for definiteness.

```
set,/par/dev/event/a/time,gps
```

Ensure that external events are NOT tied up with the selected reference time.

```
set,/par/dev/event/a/tied,off
```

Enable the synchronization mechanism:

```
set,/par/dev/event/a/lock,on
```

The receiver's internal time counter will become synchronized with the effective edge of the external event signal arrived immediately after issuing this command.

or

```
set,/par/dev/event/a/lock,always
```

How to Synchronize Receiver Clock

How to coherently synchronize the receiver frequency/clock with an external generator frequency/clock

Each time external event signal arrived, receiver's internal time counter will be resynchronized with the effective edge of this event signal.

Note: It is allowed to run "set,/par/dev/event/a/lock,on" command repeatedly. Every time this command is sent, the receiver clock will be re-synchronized with the event signal generator.

Note: The potential accuracy of synchronizing a JAVAD GNSS receiver clock with an external event generator usually is 10 ns (± 5 ns). This is due to a hardware limitation (recall that the DSP usually has a 50 MHz sampling frequency and event logic works at twice DSP frequency). In firmware version 3.2.x and later versions sampling frequency is programmable (see "asic/frq" command).

Note: 1 pps of external clock should be rather close to selected time scale (not worse than 1 millisecond). Otherwise synchronization logic may work incorrectly.

1.2. How to coherently synchronize the receiver frequency/clock with an external generator frequency/clock

Due to hardware design, this possibility is available for receivers with DSP sampling frequency equal to 80 MHz. If firmware version 3.2.x or later is used, change DSP frequency. Receiver reset is required then.

```
set,/par/asic/frq,80
set,/par/reset,y
```

For earlier firmware versions, please ask JAVAD GNSS support for special 80 MHz sampling rate firmware.

Assume that it is required to synchronize your receiver with an external high-quality generator (clock) that has two outputs:

10 MHz frequency, and one pulse per second signal, which is coherent with the 10 MHz frequency.

Our objectives are as follows.

First, we want to make the receiver oscillator signal coherent with the external 10 MHz frequency.

Second, we want the receiver time grid to be precisely synchronized with the external one-pulse-per-second event signals.

Get the receiver ready for using an external frequency.

```
set,/par/frq/mode,use
```

Specify the nominal value of the external frequency used (recall that in our example it is 10 MHz)

```
set,/par/frq/in/frq,10
```

Connect the 10MHz frequency source to the receiver's frequency input.

Finally, follow the steps described above in “How to synchronize the receiver clock with an external event generator” .

Note: Although, strictly speaking, we cannot measure external events with an accuracy higher than several ns in a receiver, however, the receiver and an external event generator can be synchronized with a sub-nanosecond accuracy. The following explains why it is feasible:

It is possible to input a 1 pulse per second (PPS) into one of the event marker connectors, and have the receiver's oscillator synchronize to the next input frequency cycle at its zero-crossing (or a fixed offset from that).

This means that it is possible to feed the JAVAD GNSS receiver reference 1 pps and 10 MHz, and have the receiver restart with a known offset from our reference clock after every power cycle. This is much usable for time users.

A 10 MHz reference frequency has a cycle length of 100 ns, so several ns resolution detection of the event input will be enough to pinpoint a single cycle of the reference frequency, and thus give a unique relationship between the reference 1pps and frequency.

A JAVAD GNSS receiver disciplines its internal oscillator to the external frequency reference according to detection of zero-crossings. So, the detection of the 1 pps input pinpoints a unique zero-crossing, and the internal oscillator/clock is synchronized with that unique zero-crossing. The synchronization then is immune to noise on the input 1 pps at the level of 1 ns, whilst following the input frequency precisely at the sub-ns level, giving a start-up synchronization repeatable to the sub-ns level.

Note: Because of possible different delay of 1 pps signal and external frequency, it may happen that 1 pps comes a little bit earlier than corresponding zero-crossing of input reference frequency. In this case wrong resolution may happen. Increasing a while of 1 pps cable length should help. Or, alternatively,

```
set,/par/dev/event/a/offs/ns,1
```

command may be issued, which instructs receiver to delay received event on specified number of nanoseconds.



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