

Calibration of an Ashtech Z12-T using the traveling BIPM Z12-T receiver Guidelines and operational procedures

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1. Description of the equipment

Equipment supplied:

- Ashtech Z12-T serial number LP02944
- Antenna Ashtech choke ring serial number CR15373
- Frequency doubler (if 20 MHz is to be generated from 10 MHz)
- Frequency quadrupler (if 20 MHz is to be generated from 5 MHz), temporarily not available (september 2003)
- DC Power supply, TTI EX752M, serial number 185180 (to be set to 13 or 24 Volts)
- Antenna cable
- Antenna splitter
- Portable PC TOSHIBA Satellite

Other non-supplied necessary equipment:

- Oscilloscope

2. Set-up of the Z12-T receiver

Hardware

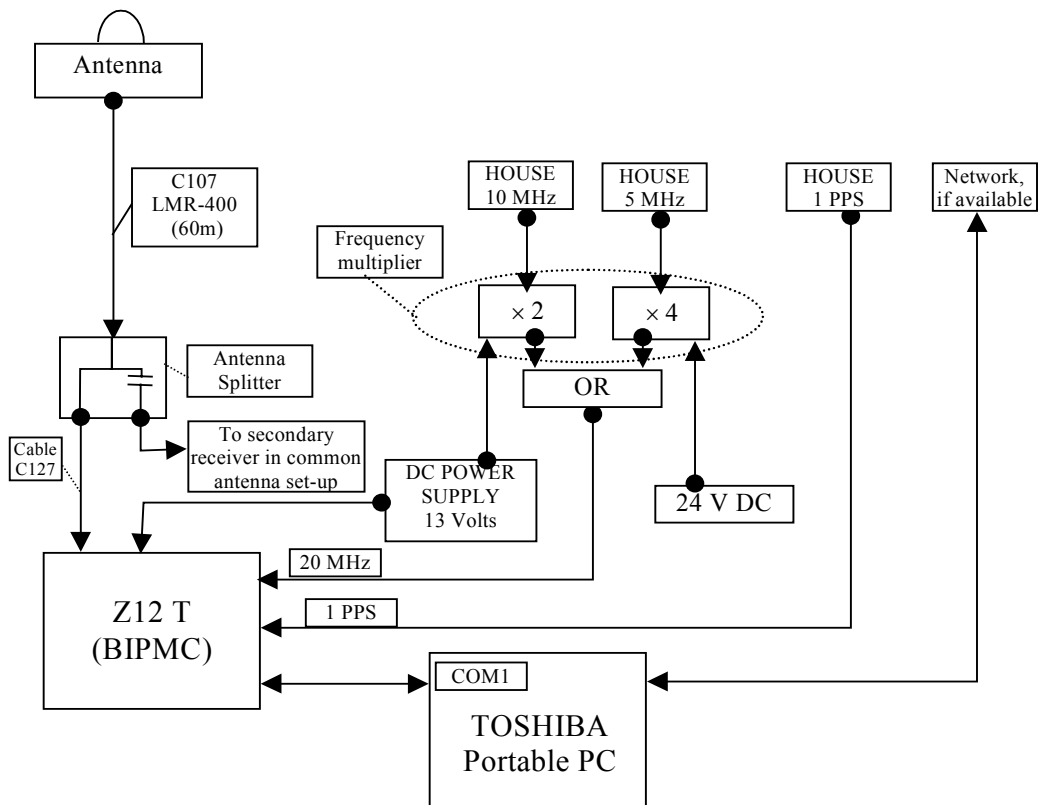


Figure 1: General set-up

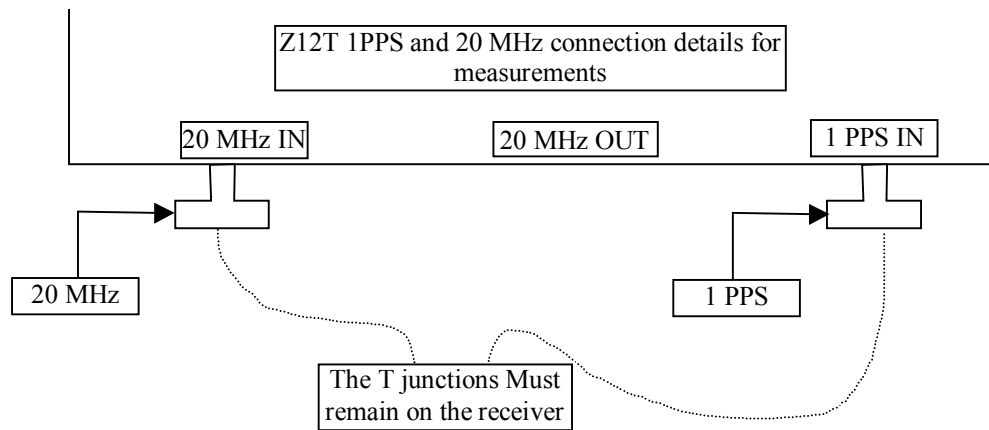


Figure 2: 1PPS and 20 MHz input and output close up.

Software for data acquisition:

The GBSS version 3.0 is used for the acquisition.

Please check the annex 1 to properly configure GBSS before starting the acquisitions.

Coordinates:

Coordinates for the phase centers of the two antennas should be provided. The relative positions should be known with an uncertainty of one cm [a few cm].

3. Relating the internal reference to the laboratory reference

The procedure to relate the Z12-T internal reference to the laboratory reference is presented below and a detailed description is given in annex 2. The procedure should be carried out at the beginning and the end of the experiment (to check for stability and possible mistake), for the two Z12-T systems.

3-0) Check the oscilloscope: one should obtain the same results when measuring a delay with different ranges (1V or 20 mV). Also when reversing channels.

3-1) Measure the delay between the laboratory reference 1PPS @ 1V and the 20 MHz in (inverted, positive zero crossing) (oscilloscope range 1V)

3-2) Measure the delay between the laboratory reference 1PPS @ 1V vs. 20 MHz out (positive zero crossing) (oscilloscope range 20 mV)
[20 MHz out should trail inverted 20 MHz in by 18.2 ns]

3.3) Provide a plot of the oscilloscope screen (for both measurements for the two Z12-T systems).

4. Measurements for differential calibration of total (internal + antenna) delay

The two Z12-T systems are set-up independently (2 antennas). The 20 MHz in and 1 PPS in for the two systems are derived from the same reference.

One week of measurements are taken with a 30s data interval and stored in daily files (see annex 1).

5. Measurements for differential calibration of internal delay and antenna delay

The Z12-T receiver under calibration is fed by the BIPM antenna using the splitter. No change should be made to the set-up of the 1 PPS/20 MHz in. Cable delay that are different from the initial set-up should be measured and reported. One week of measurements are taken with a 30s data interval and stored in daily files (see annex 1).

6. Data report

Figure describing the actual set-up with indication of all measured delays.

Measurements of the 1 PPS /20 MHz set-up (at the beginning and end of the experiment).

Coordinates

Log of events

The BIPM Z12-T data are stored on the traveling PC.

The Laboratory Z12-T data are provided in daily RINEX files. They may also be stored on the traveling PC.

For safety reasons, all files should be recorded on an independent storage medium and kept by the laboratory until the end of the calibration trip. They should also be sent electronically to the BIPM (or made available on a server).

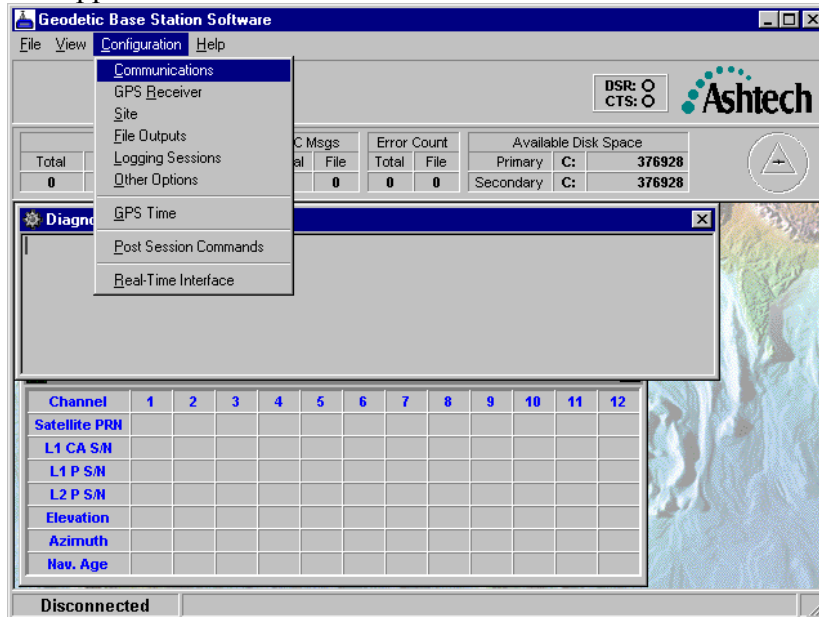
ANNEX 1

GBSS configuration

Launch the GBSS software by double-clicking on this icon situated on the desktop of the Toshiba.

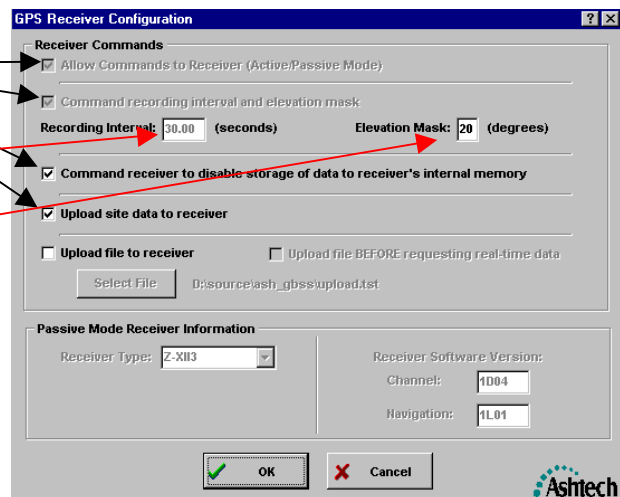


This screen should appear on the screen.



In the configuration Menu, start by checking the “GPS Receiver”.
On this screen, make sure :

1. The 4 four first check box are ticked.
2. The recording interval is 30 seconds
3. The elevation mask is 20 degrees



Press OK.

Then go to the Site configuration screen

1. Leave BIPC as site name.
2. Update the coordinates with the ones corresponding to your site

Press OK

Then go to the File Outputs screen

- On the data files page:
1. Update the primary and secondary output path names. Choose in D:\BIPMC the directory named after your laboratory and affect it to both primary and secondary path.
 2. Make sure these three check box are ticked.
 3. Make sure the file duration is 24 hours.
 4. It is best to leave a 60 seconds re-open rate and to disable epoch filtering
 5. Do not use the ashtech subdirectory structure

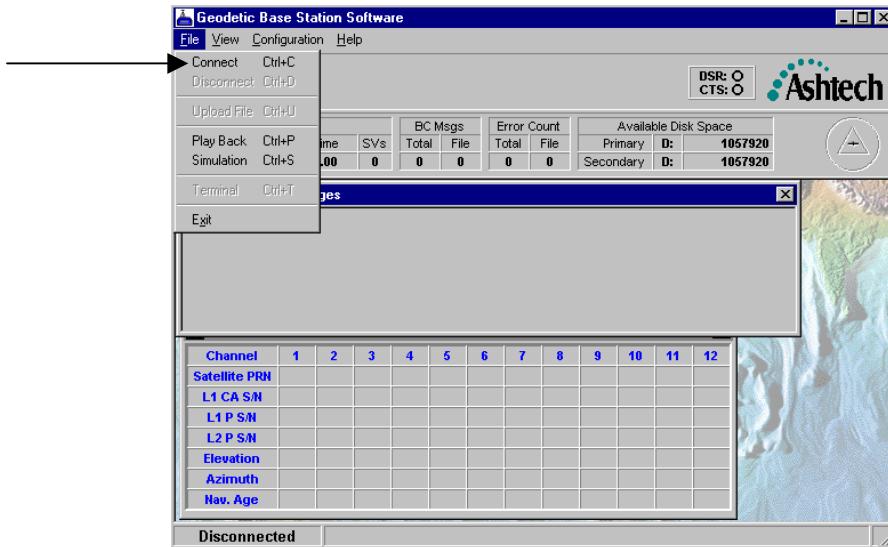
Then on this screen click on the Configure RINEX command button.

You should get this screen:

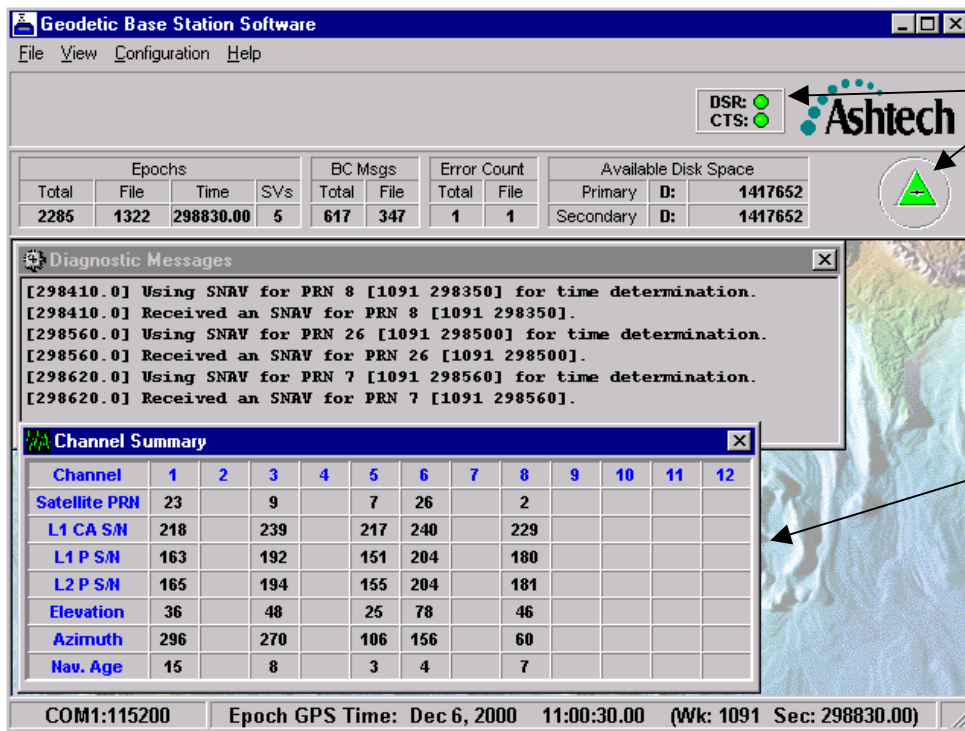
1. Update these three fields
2. Add any comments you think necessary
3. Do not change these three options

Press OK

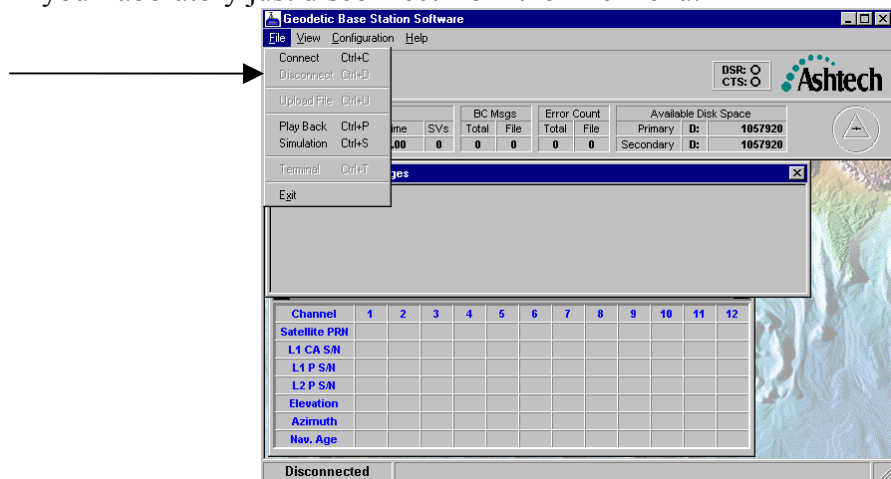
Then go to the File menu and click on Connect



You should then get something like this screen:



At the end of the stay in your laboratory just disconnect from the File menu.



At all times files except the one of the current day are accessible and transferable from the directory selected in the File outputs configuration screen.

ANNEX 2 Measurement detailed procedure

These measurements do not affect the receiver operation.
 Please note the use of two phase matched external cables (cable A and cable B).
 They are provided but, if for any reason you are using other cables, please make sure they are phase matched at the level of 0.1 ns.

MEASUREMENT 3-1:

Set-up your oscilloscope as stated on the following figure. The trigger level is not critical.
 Use a time base of 10ns/div, the signals will then be easier to identify.

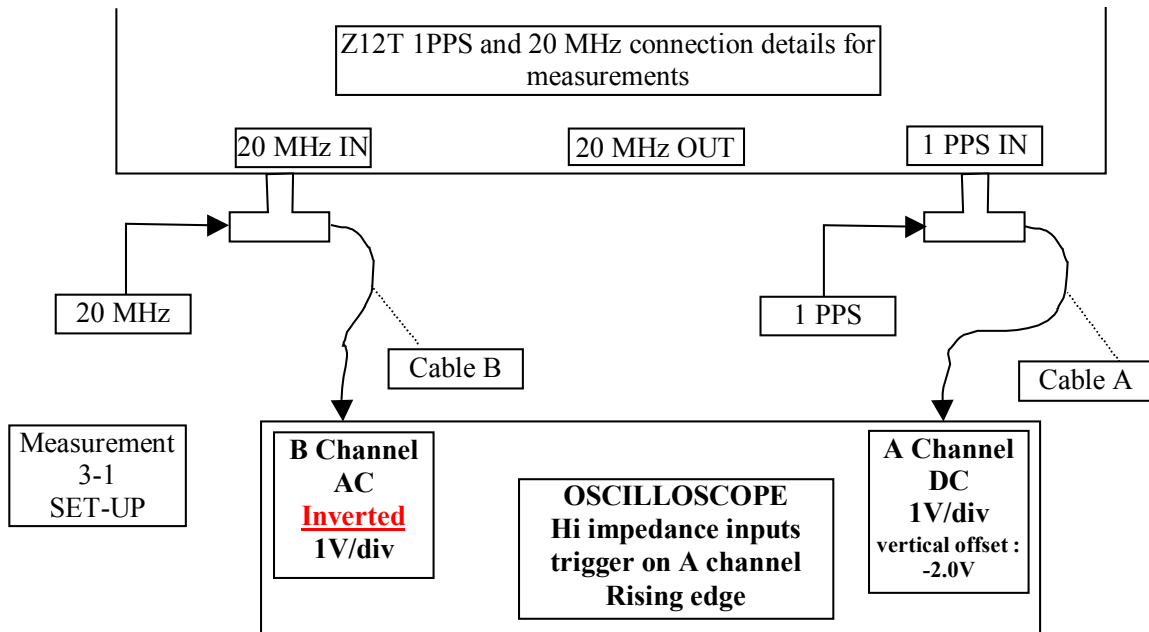


Figure 1: measurement (3-1) set-up

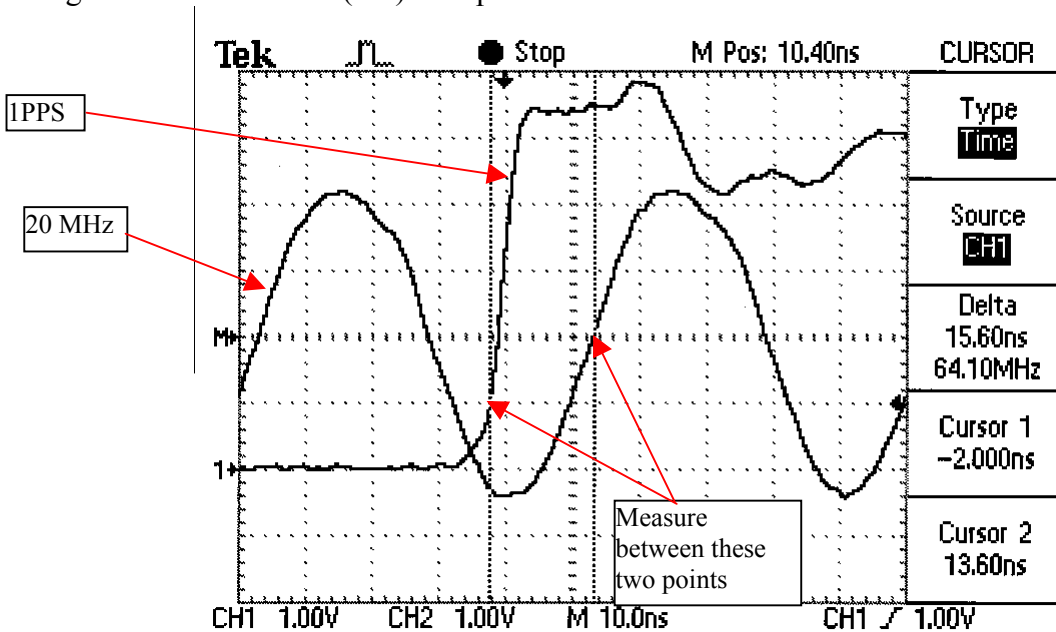


figure 2 example of oscilloscope display using this set-up

Measure the phase difference between the 1PPS 1V crossing and the following inverted 20 MHz RISING EDGE ZERO crossing as shown on figure 2.

This first measurement is important because you can check if the configuration correspond to the receiver setup.

For a receiver in “rising edge sampling”, the measurement value should be between 5 and 20 ns. For a receiver in “falling edge sampling”, the measurement value should be between 30 and 45 ns. If the measurement value is not in the indicate range, add a delay line in the 20Mhz line to force this first measurement in this range.

Examples below are for “rising edge sampling”, which is the usual setup of a receiver.

Use this configuration to check your oscilloscope measurement:

Change the range of both channels to 20mV

Make sure to apply a vertical offset of -1.0 V on channel A (the PPS channel) This will put the 1.0V level in the middle of the screen. Use the cursors to check where the 1.0V level is. You should get a display like this one:

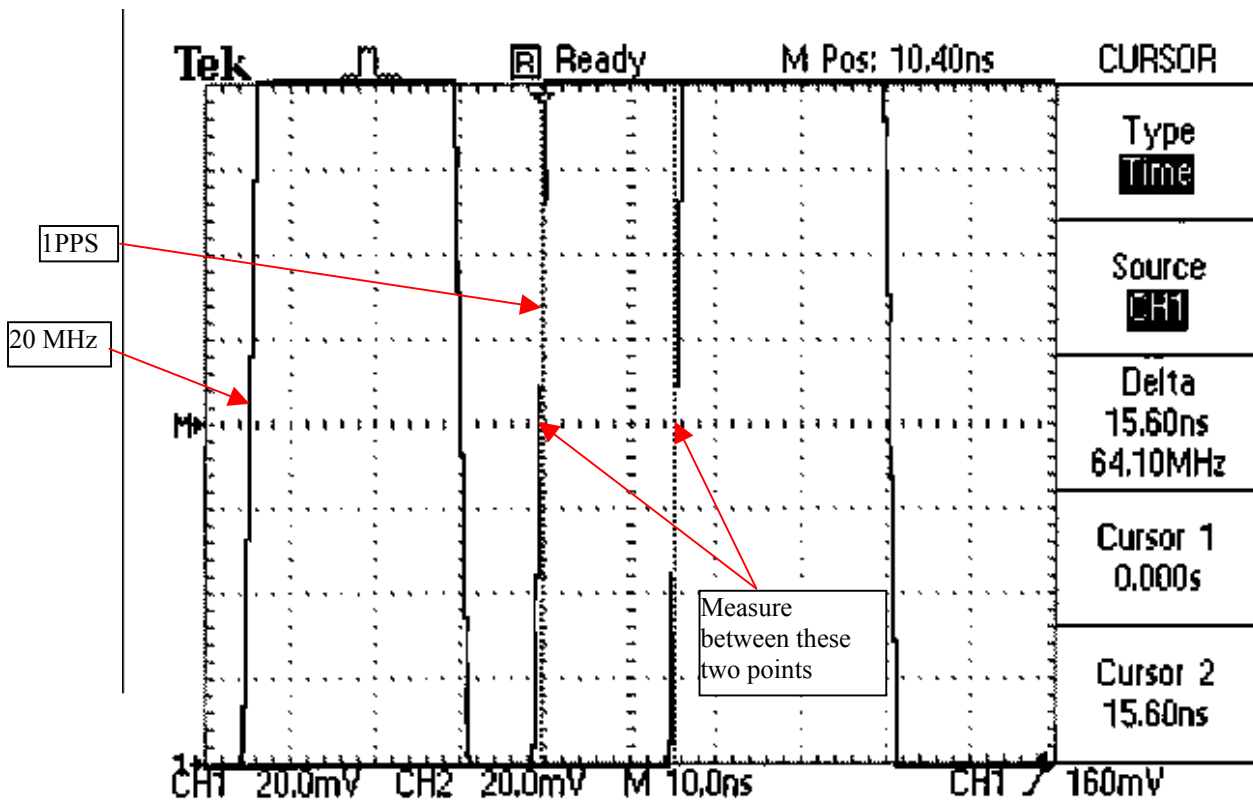


Figure 3 example of oscilloscope display using 20 mV range

Measure the same delay, The result should be the same (within the cursor uncertainty) as the one using the 1V/div range. If you don't measure the same value try to use another oscilloscope.

There is still a set-up to try to validate the oscilloscope measurements.
 Set the vertical range back to 1V/div. remove vertical offset values
 Interchange the channels and measure again

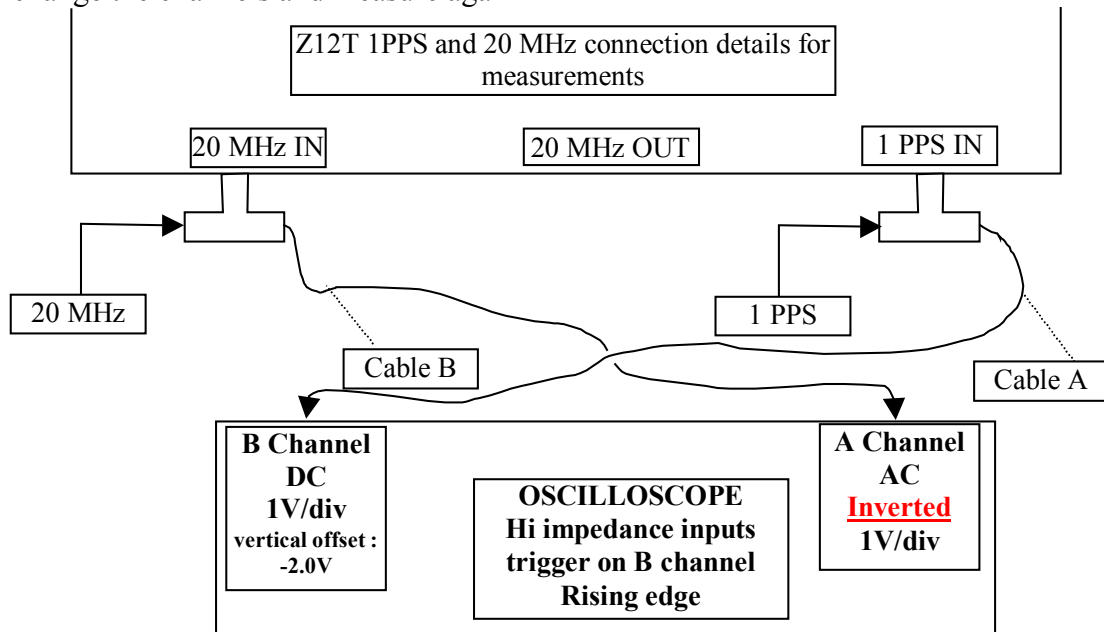


figure 4 exchanged channel set-up

With this setup, you should get a plot equivalent to the figure 2
 The measurement should give the same value as the others (within cursor uncertainty).
 If not, take the average between this value and the one measured at the same range before
 exchanging channels.

MEASUREMENT 3-2:

Set-up your oscilloscope as stated on the following figure. The trigger level is not critical.
 Use a time base of 10ns/div, the signals will then be easier to identify.

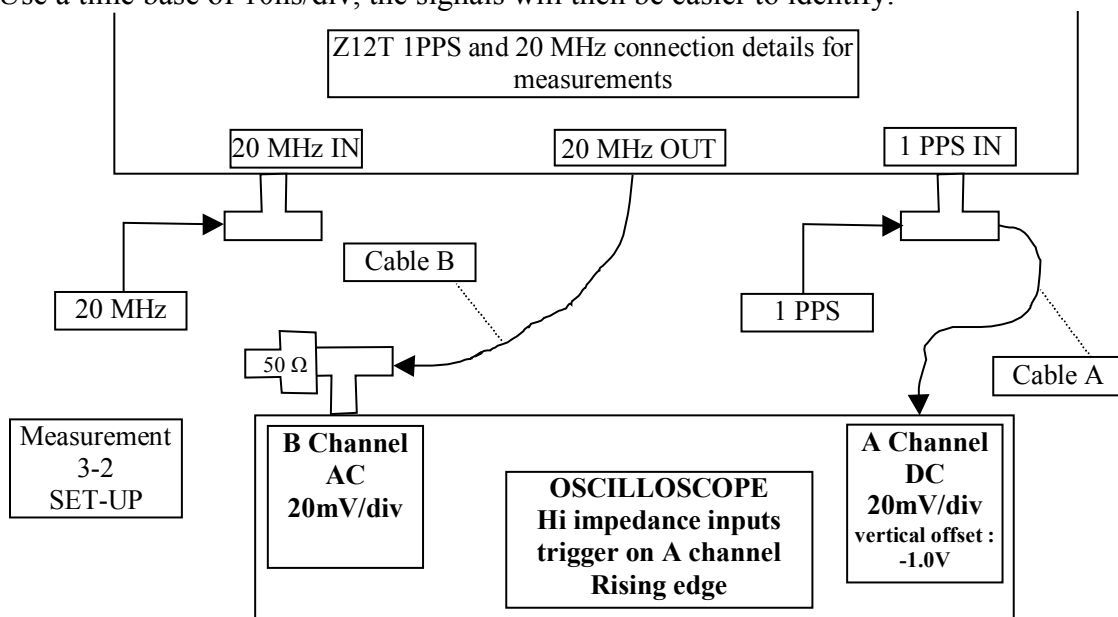


figure 5: measurement (3-2) set-up

You should obtain a result like the figure 6.

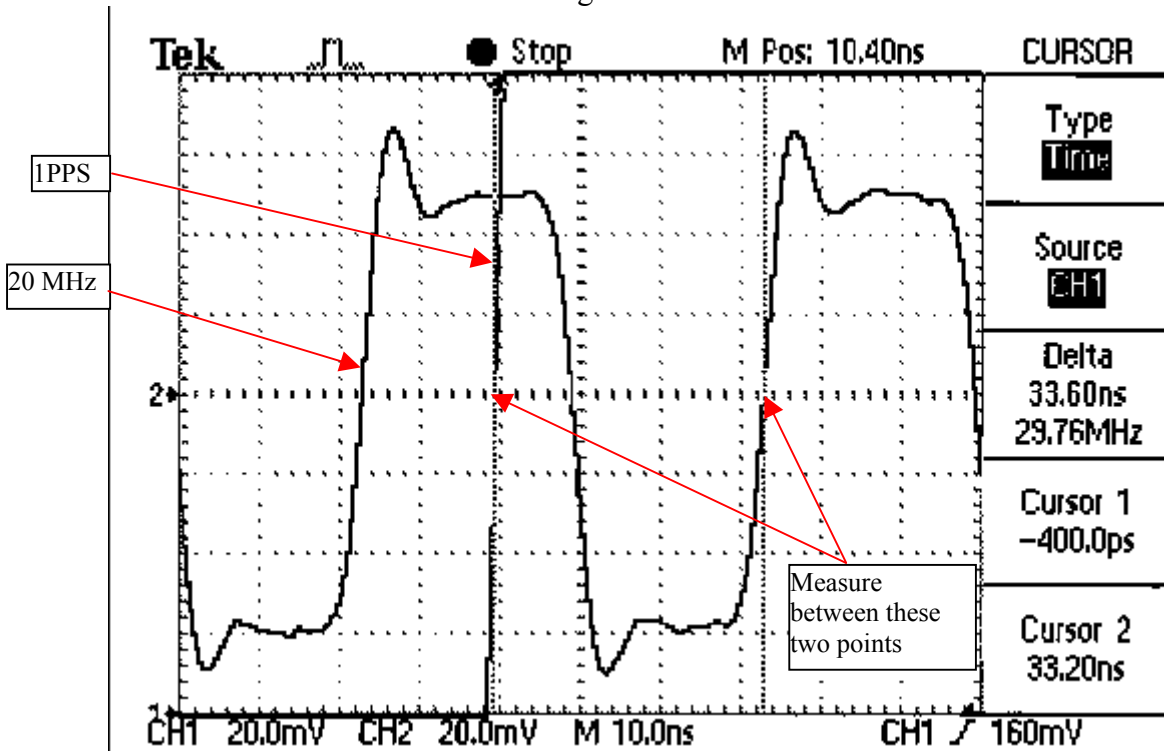


Figure 6: example of oscilloscope display

Measure the phase difference between the 1PPS 1V crossing and the following 20 MHz RISING EDGE ZERO crossing as shown on figure 2.

Do a measurement with exchanged channels if necessary.

The difference between measurement (3-1) and (3-2) should be 18.2 ns (within combined cursor measurement uncertainties).