# Hardware review

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**Locosys AC-1513 Rev 0.5? (December 2006)**

## Measurement Setup

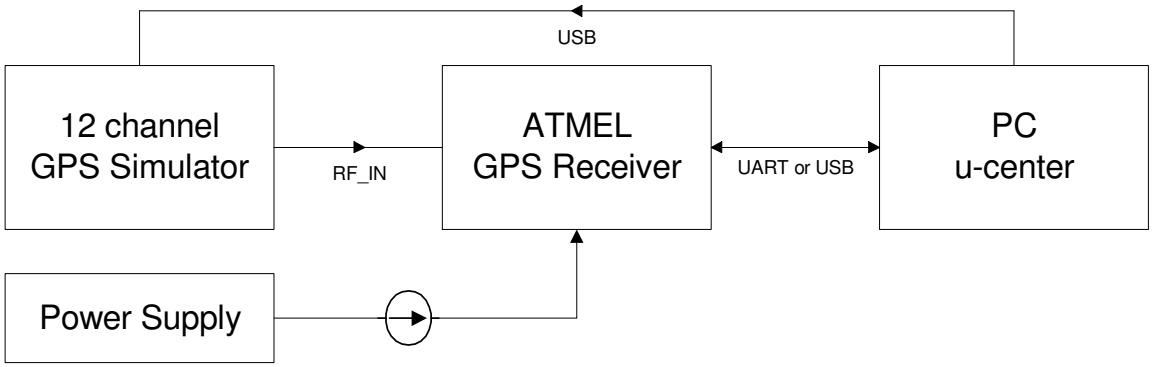


***Figure 1: Measurement Setup***

You already provided the modules with a RF cable rather than a patch antenna. This is perfect as testing it with a simulator gives us a comparable result. Our Spirent Simulator STR4500 is equipped with an external 10dB attenuator, so a slider value of +10 is equivalent to a power level of -130dBm. The attenuator shifts the output level range of the STR4500 down to -125dBm ≥ $P_{Out}$ ≥ -160dBm. Please note that we use the same power level of each satellite, our standard scenario is static_taipeh_no_errors_V2.sim. This measurement setup simulates a passive antenna, for an active antenna performance we add an extra LNA right behind the attenuator.

## System Performance

Most important parameters are TTFF, acquisition sensitivity and tracking sensitivity. However, there are some additional numbers that back that key figures.

| Parameter | C/N | Noise Level | AGC Monitor | SigH / L | TCXO Clock drift | RTC clock drift |
|---|---|---|---|---|---|---|
| **DUT 1** | 39 | 104 | 58.3 | 17 / 30 | -0.47 | -17.7 |
| **DUT 2** | 39 | 109 | 57.9 | 22.5 / 25 | -0.77 | -18.5 |

**Table 1: System Measurements at an input level of -130dBm**

The signal to noise ratio is very good with 39dB with an input level of -130dBm. This is the result of the a small denominator “noise” which can be measured via the ubx-message ubx-mon-hw Noise Level. Basically this is a sum of the total signal available in front of the correlators, such as thermal noise, jammers, spreaded signal… . This also explains the “low C/N at the beginning” issue as right after cold start the receiver has to find out this number and delivers a higher noise value during that time.

The second number out of this ubx-message is the AGC monitor, it shows how the AGC works. In an optimal design this value is very smooth, which can be seen easily in a chart view window in u-center 4.02.

As You know the ATR0635 internally has a 1.5bit ADC. On its output signals SigH and SigL we can measure the distribution. This is best when its about equally distributed on both lines as it is the case on Your modules, i.e. a ratio of 17 / 30 is also all right.

| Test | # 1 | # 2 | # 3 | # 4 | # 5 | # 6 | # 7 | # 8 | # 9 | # 10 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **DUT 1** | 36 | 35 | 35 | 47 | 52 | 47 | 43 | 52 | - | - | 43.4 |
| **DUT 2** | 53 | 38 | 44 | 39 | 43 | 45 | 36 | 54 | 48 | 32 | 43.2 |

**Table 2: TTFF Coldstart Measurements at an input level of -130dBm**

| Test | # 1 | # 2 | # 3 | # 4 | # 5 | Average |
|---|---|---|---|---|---|---|
| **DUT 1** | 3.2 | 1.5 | 1.9 | 1.6 | 1.6 | 1.96 |
| **DUT 2** | 1.8 | 3.4 | 3.0 | 2.3 | 1.6 | 2.42 |

**Table 3: TTFF Hotstart Measurements at an input level of -130dBm**

The time to first fix measurements show a very good performance, so no coldstart takes longer than a minute.

| Test | Acquisition Sensitivity | Tracking Sensitivity |
|---|---|---|
| **DUT 1** | -137.5 dBm | -157 dBm |
| **DUT 2** | -137.5 dBm | -157.5 dBm |

**Table 4: Sensitivity measurements using Auto Mode**

For a quick orientation on behalf of the sensitivity performance we are using the quality indicator QI in the message ubx – nav – svinfo. This indicator is described in more detail in the ANTARIS4 Protocol Specification. **Acquisition Sensitivity** corresponds to the level when there is at least one SV left with a QI = 7 for over 30 seconds after reducing the power level (QI = 7 stands for Code and Carrier locked, receiving 50bps data).

For the **Tracking Sensitivity** this is the case when one satellite remains with a QI = 4 (Code Lock on Signal) some time. For our design we got an Acquisition Sensitivity of -138dBm and a Tracking Sensitivity of -158dBm. One might argue that this values are not as good as the ones in the data sheet. This is mainly due to the different test setup. You can get these values under lab conditions by setting the input power level and waiting for 30 minutes with an optimal design, i.e. a another LNA.

Table 4 shows the results of the sensitivity measurements. These values are as good as they are on our modules.

**Resume**

You have done a very good design, having comparable performance as on our designs. We are very proud having You as partner.