Minutes for AMiBA Engineering Telecon

Meeting Date: 08-Jan-2004

Participants:
Australia:
USA: Paul Ho, Ming-Tang, Paul Shaw, T.H. Chiueh, C.J. Ma, Kyle, Jeff Peterson
Taiwan: Huei Wang, C.T. Li, Homin, Eugene Huang, Johnson, West

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Minutes Recorder: C.T. Li
previous weeks comments

I. New Action Items:

II. Previous Action Items (still open):

III. Closed Action Items (as of this meeting):

IV. Miscellaneous Discussions:

MMIC:

Ming-Tang – We just had a meeting to go over the current MMIC situation. Huei and Paul Ho will contact Paul Clenworld to follow up.

Huei/Paul Shaw – Will remind Sun Kwok to check with RCUH about whether or not to re-do the administration.

Receiver:

Ming-Tang – We shipped out the 1st production receiver to Hilo. It has been cleared of the custom. We will set it up in AMiBA's lab in CSO building. Plan to ship the 2nd one once we have the 3rd one set up in Taipei.

Homin – We're preparing 1st production receiver for shipping to Hawaii and accessories, like long Helium lines, for Hilo lab. 2nd receiver is also ready. The parts for the rest of 5 receivers are in the lab now. It will take about 6 to 8 weeks to assemble another 2 receivers, and do the cold test in Taipei. The LNAs have to be installed and tested in Hawaii.

Ming-Tang – Will take a look at the receiver next week. Have received some repaired amplifiers from Todd.

LO/IF:

Ming-Tang – Prof. Chu and his student have been working on the 2nd IF/LO module by modifying bias voltage to eliminate spurious in the doubler. Just suggested Kyle ordering the commercial cavity filter for the future use.

T.H. Chiueh - The commercial one can guarantee the insertion loss less than 1 dB. It's been proved that most of the DC offsets were coming from the LO. Besides its spurious, there is also the power imbalance between phase switching. In Kyle's report, it showed that by using adjustable attenuators, the remaining DC offset can be eliminated as well. However, as the temperature changes, the compensation will drift away. Also the attenuators cost a lot. We will need 14 of them for 7-element.

Jeff – There would be 3 levels to adjust LO power of 2 states – the first one is to use mechanical adjustment, like putting Mylar sheets. That may be sufficient. The next level is to put in the electronic adjustment, e.g. the attenuator driven with

the switching signal. Then you can adjust the pots to finer dB. The next level after that is that you actually measure the power levels in two states with power detectors, and provide a feedback voltage that adjust electronically the power levels to be the same. Then that will compensate the temperature change.

Derek – The overall LO power has a very large swing in temperature. If we optimize the drive level to the sub-harmonic mixer during the day time, in the evening, the power goes up. That will cause more conversion loss.

Ming-Tang – Prof. Chu mentioned few weeks ago that he is considering putting in thermal insulation or heater for IF/LO boxes.

Homin – Mr. Tseng is coming after Chinese new year to take care of production of remaining 5 LO/IF modules. Prof. Chu and his students were fixing the 2nd unit.

Paul Shaw – Will talk to Prof. Chu about this issue.

Correlator:

C.T. – We circulated the test results of 30 correlator modules last week. They seem to have maybe twice responses around 3 GHz than at higher frequencies. Their responses look quite similar. Need to figure out how much effective bandwidth we'll get.

Derek – The responses of 30 modules look similar to that of Marki's engineering model – having two bumps, the left bumps from 2 to 5 GHz were quite large, and about 100 V/W for the minimum response at about 5 GHz, then a minor hump, maybe 14 or 15 GHz, not as big as the left bump. Since they look similar, I am wondering if you can make or I can order some amplitude equalization circuit that basically compensate for the average. Then they're going to be the same for every antenna. We put them at the R/L polarization outputs.

C.T. – We need to find out the final frequency response of the system that we can start thinking how to balance it to get a larger bandwidth.

Jeff – If you start to get complicated, what will happen is that the filter will have complicated phase response. Phase is just as important as amplitude because we're doing the complex correlation. In some level you're introducing as much structure in the phase function as you're getting rid of the amplitude function as you start building this complicated equalizing filter. But generally if there is one large feature at 3 GHz, a filter with a broad notch around it compensates for it.

T.H. Chiueh – We found out that the noise from 4 lags are correlated. Correlated noise from different lags is not a good news. Because eventually one wants to do the linear combination of the 4 lags, if the noise are correlated, then linear combination will give you coherent sum. You don't improve S/N ratio by doing this. In the past we didn't trust the RMS data too much because of the DC offset. Then we're afraid that the correlation is coming from DC offset. Right now the DC offset is mostly eliminated, we trust the RMS data more. This correlation is about 50% correlation if you look the time stream data of noise, you display the 4 traces on the same screen, then you see each trace goes up and down quite coherently. If IF spectrum is flat from 0 to 20 GHz, with center frequency of 10 GHz, and delay is 90 degrees for 10 GHz, then the noise should not have any correlation. Because now the spectrum shape changes, with the low frequency having higher power, such correlation will appear.

Jeff – Is that just a reflection that the effective bandwidth is not really 20 GHz?

T.H. Chiueh – and the center frequency is not 10 GHz, because the delay is designed to be 90 degrees at 10 GHz. If the two humps have equal power, and average of them is still 10 GHz, I think the noise can still remain un-correlated. The 4 lags take the noise from the same input, intuitively one would expect that because each lag take the same noise, so each noise should be the same. By using the different delay in different lag, you want to try to scramble the phase relation between each lag. If the delay length is not long enough, then the noise are correlated because you don't scramble them well enough.

C.T. – West and I were testing the correlator modules. Since one of the synthesizers is degrading, we can only test up to 16.5 GHz, starting from 1.5 GHz, frequency spacing 0.5 GHz. Will circulate the results later on. Mark and I were modifying the phase switch and data acquisition circuits. Will have them fabricated soon.

Platform/Mount:

Ted – This week we had some email exchange. We will have a meeting tonight. During this meeting we will finalize all the issues, including the schedule, agreement for the modification parts. At the moment, Philippe and I tried to finalize all the modification parts, to make sure that we didn't anything. On Feb 1st, we plan to be in Germany for 2 weeks to do the modification.

Paul Shaw – According the last projection, the platform modification will start in the beginning of Feb. Afterward, we will continue to do the test together with the mount. If that's the case, then we should hopefully finish all the integration, in-plant test in the beginning of March, get ready to ship by end of April. We hope to get platform and mount delivered to Hilo in middle of June. Then we follow up to do more modifications, add more L-brackets on the platform. That happens around July, hopefully to finish all the modification before end of July, and assemble the whole thing, installed on site.

Ted – Bob Romeo had agreed with us on the 2nd modification of platform, scheduled in early February, should be done in 2~3 weeks. We're still working on the final details. Philippe and I plan to do this part of modification (platform re-enforcement) in Hilo due to the time constraint. We haven't decided which company will execute this modification.

Calibration System:

Ming-Tang – Ferdinand has the calibration system packed in CSO.

Kyle – Ferdinand gave us some equipment to inject CW signal into the receivers for testing. We used a synthesizer to generate signals at 16 GHz, used a multiplier to get signals at 96 GHz, injected thru the secondary of dish into the receivers. We didn't see any signal. We used a W-band power sensor to measure the output power of the multiplier. Since the power sensor can only measure down to –30 dBm, we didn't see anything there. By injecting the signal into both receivers, we didn't see any correlated signal either. After Ferdinand comes back, we will start to work on photonic noise injection system.

Dish:

Ted – About the burnt-out 60-cm dish, Along are still working on rebuilding it. It will take one or two weeks, including the measurement, to make sure all the dimensions and alignment are correct. About the Gortex material for the dish cover, I found the supplier in Taiwan. In the same time, I tried to design the fixture to fix the Gortex material on the dish.

T.H. Chiueh – For 60-cm dish beam pattern measurement, the angular scale of dish pointing is not accurate enough. Instead of moving the dish, you make the dish fixed, then move the source. Another question is the distance from the dish to the source, which is on the order of 100 meters. One has to determine it more or less accurately. Proty has asked people from NTU civil engineering to help do the measurement of distance. That has been done. Perhaps in next weeks, they can have two runs of measurements.

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Ted – After discussing with Eugene, we decided to use Gortex for covering the dishes. At the moment, I will design some fixture to hold the film. The transmission loss of Gortex is about 0.1 dB.

Site:

Paul Shaw – We had a short discussion yesterday afternoon. Basically we will review all the documents, including the drawings, specifications, to make sure everything is what we want. Then we will issue the updated documents to 3 potential bidders.

Paul Shaw – We got one preliminary quote. The price is much lower than the other two companies. Now tried to figure out all the details. Have asked him to break down each item.

2-Element Prototype Testing:

T.H. Chiueh – In the past two weeks, what we have done is to get rid of DC offset, by first having the cavity filter, secondly having the PIN diode attenuators, trying to compensate the power difference in the phase switch of LO. There are still some DC offsets of 10 to 20 counts for RMS about 400, because the PIN diode attenuators start to drift away after we adjust them. C.J. has done preliminary analysis of the RMS data. It looks quite white. In the past when the DC offset is present, there is still reasonable 1/f noise in the spectrum. When DC offset is gone, that 1/f noise is also mostly gone.

Kyle – We have tried to design and make a 21-GHz cavity filter. We tested the filter, and the result is not bad. Q factor is 350, which gave us about 50 MHz bandwidth around 21 GHz. That will suppress the spurious by we saw in LO by 17 dB. The spurious is about 300 MHz away from 21 GHz. However the insertion loss is about 4 dB. Then the LO power is not sufficient for receiver 2. We're checking the relation between DC offset with delay right now.

T.H. Chiueh – We can try putting the filter along the LO path to receiver 1 that receiver 2 will still have enough LO power.

C.J. Ma – We got one quotation from K&L for the cavity filter.

T.H. Chiueh – In the 2nd iteration, we should be able to make it. The Q value of 350 is about right, because if the Q value is too large, then the bandwidth is too sharp, any temperature variation may shift the response, then you miss the 21 GHz. Right now the bandwidth is about 50 MHz, which is good enough. Even in current iteration, there is a room to improve the Q value by a factor of 2. In other words, to reach Q value of 1000 is probably not difficult. The way to couple signal in and out of cavity is not optimized.