

Minutes for AMiBA Engineering Telecon

Meeting Date: 16-Oct-2003

Participants:

Australia: Warwick Wilson

USA: M.T. Chen, F. Patt, T.H. Chiueh, C.J. Ma, Kyle Lin, P. Ho

Taiwan: Huei Wang, C.T. Li, H. Jiang, West Ho, Eugene Hwang, Johnson Han

USA Dial-in = 1-800-653-5390, 6668081#

Minutes Recorder: C.T. Li

[previous weeks comments](#)

I. New Action Items:

II. Previous Action Items (still open):

AI-25Sept03-2: Ming-Tang - Volunteered to review all the specs as much as we can, and collect them into one place so that we can look them up.

Ming-Tang - Found a place on AMiBA's web site that lists all the previous specs. Mike and Bob wrote some updates. When I gather more, I will ask various people to review that.

Ming-Tang - Started with Mike's original spec. Tried to work down the details. Things like collecting the interface in the individual work package so that I can make that a practical spec. Bob - suggested that as you go through, found where there is a gap or problem, send out an email right away to ask somebody to fill out the details.

AI-18Sept03-1: Bob - Re-visit the testing of phase shifter in a month.

Ming-Tang - We will see some results in this week or next week on the phase shifter test.

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

AI-25Sept03-1: Bob/Huei - Figure out our obligation to those residual MMIC Bob received. Are we supposed to get back to Todd Gaier or not? Are they residual extra, or we're supposed to send somebody to Todd to package them?

Huei - We can probably wait for 2nd run until next year since so far we haven't got the chips yet, probably can't test and re-design before next March. The suggestion for the budget on the phase one is to try to spend the money for something else. Hopefully we can allocate some money after we finish the design in the 2nd phase. The budget is about 180K USD for one run (Paul Shaw has the exact number). For the existing chips (S. Weinreb's design), certainly we should have enough chips to build all the amplifiers (even for 19 elements). For our own design, we try to get some improvement. In the very beginning, the purpose is set to that we have some existing design (S. Weinreb's). That's for insurance. In parallel, we're going to make our own design. Try to see whether we can get improvement or not. We did our own design in the first run. We will try to verify that, and see whether we need the 2nd run or not. For the current run, half of the mask is our own design, and the other half is Sander's design. Sander's design is for LNA, and our design includes all other chips. The other half is purely for development purpose. Todd Gaier just made this request - because he helped us so much without charging anything, if possible, he would like to have some of our chips. But He did not say how many. No matter what, we should have enough, and he would not ask a lot. Certainly we can mention to him. For now we can wait until his request. Those chips in Hawaii have been tested already by TRW. We have paid a little TRW to test them for gain. Gains of most of them look OK. But we don't test noise figure. Whenever we need them, we can

Minutes for AMiBA Engineering Telecon

have them packaged. If we start to have plans to build more LNAs, we may use our chips. Send them to JPL or the other vendor, and ask them to package them. It is probably more troublesome if we want to package them in Taiwan because we need the export license. It shouldn't be too much problem if we want to package them in US.

AI-14Aug03-1: Warwick - Become directly involved with offset issue

Kyle - No update on offset. Recently focus on the delay and frequency response of correlator. We measured the IF spectrum before and after the equalizers. After equalizers, there are still about 10 dB gain slope. At higher frequencies, the spectrum is below the noise floor of the spectrum analyzer. The spectra beyond 10 GHz start to drop very fast, at least 20 dB. After equalizers, the correlator only see maybe 2 to 10 GHz. Ming-Tang - will go up with them to check on the instrument. All 4 IF channels from receivers behave quite weird.

IV. Miscellaneous Discussions:

MMIC:

Huei - For the two, three weeks, we didn't hear anything from Northswab?, will send an email to follow up.

Receiver:

Ming-Tang - Working on testing prototype LO, DRO module. Found out the great temperature variation, and one of the LO box is mal-functioning. Tried to pin point the cause. Have been talking to Prof. Chu. In this week we should decide what to do with it. Also talking to Derek, Ferdinand and Prof. Chu about the big environmental temperature changes, day and night change by 20 degrees, and that has tremendous effect on receivers, and correlators too. How are we going to solve this problem? We may need some new devices to try out some new scheme, e.g. the automatic gain control, first mentioned by Jeff Peterson. Our 1st production receiver is still in Taipei. Haven't decided to have it shipped to Hilo because of this LO fluctuation problem. It doesn't look like there's anything wrong with the LO module there. The output power just changes with temperature. Before we see a clear path about how to tackle this problem, I prefer the receiver sitting there for few more weeks. About which part(s) are sensitive to temperature, I think I isolated to the PIN diode switch circuitry. Not sure whether it's the switch itself or the circuitry that turns it on and off. Need to figure that out. This may or may not be a problem. It depends on what kind of power you need for the observation. We can turn the power to the power you want during the observation. Because the power output is quite reproducible with temperature, if we want to observe at night, which has a much stable temperature, much preferable for astronomy observation. In that case, if the system doesn't work, just during the morning or afternoon time when the sun going up and down, the temperature drops so fast. That's our current situation.

Ming-Tang - Got two new developments going on last week. In email, Todd Gaier found that he had put in wrong resistors in the amplifiers we sent back to him. After the correction, they improved the amplifier noise temperature from 60 down to 40 K. We will send part of the amplifiers back to him for correction, while keeping some here. In about 6 weeks, after we receive the new batch, we can send back the other batch. The 2nd development is that last week Kyle and I went up the mountain to check on the prototype, want to investigate the problem of LO power variation. Found out we couldn't do much up there. Took the LO module (DRO) down to Hilo for testing. In the mean time, we're testing the production unit in Taipei. In general, we found in the production unit we got about 2dB variation over 10-degree change of temperature. For the prototype, we had about 2 dB power change when temperature changes about 20 degrees. This could be a problem for the prototype because in prototype, we're using 1st version mixer, which is quite sensitive to LO power. This can cause large variation in IF output. However, this is a drifting, slow change. We'd like to define the variation rate that we can tolerate. We'd like to work out this problem before we ship receiver to Hilo.

Minutes for AMiBA Engineering Telecon

LO/IF:

Correlator:

C.T. - We got 4 more PCBs done. Mark has put together one piece for each one. We're going to test whether the circuits work or not. And the turn-around time for each batch is about one week. It's pretty fast. Sent some data acquisition circuits to Warwick for him to review, then we can finish the last PCB soon. Also received correlator computer from vendor last week with a -48V DC power supply. Going to ask another spare computer to set up a test setup in Taipei, that will require the 2nd set of AT control boards.

Warwick - We should be able to get at least 2 of each control board to Taipei as soon as possible.

C.T. - For -48V DC power, I used the 48V DC power supply in lab, reverse the polarity, and it works. The power connection has 3 leads, and the ground is the one different from the other two outputs.

Ferdinand - We still can use a separate 48V power supply for the correlator PC.

C.T./Warwick - All I/Os, including into and out of AT's boards, are differential.

Derek - Haven't received the cover for the correlator modules. Should be here pretty soon (due yesterday). After we put the covers on, will send them to Taipei.

Tried to power up the 2nd section with Homin's DC-to-DC converter. We ran into some wiring problem. Is there any way we can get 12V out of 15V supply? Homin - You have to order the 12V module. Derek - Our plates are designed to accept 12V, instead of 15. I can regulate on the plate. It's only the switches that require 12V. Ming-Tang - At certain point, you probably want to get a power measurement, the gain measurement of the 1st section - gain vs. temperature.

Kyle - For the question whether our measurement of correlator in Hilo is under-driving the correlator, this week we put the noise source and CW signals together to drive the correlator with the noise source at -11dBm, and CW source still -23dBm, and the responsivity looks almost the same as previous one, and phase the same too. So the previous measurement is valid. Now we're interested frequency response below 2 GHz. We want to see whether our fringe problem is still due to low frequency contribution. But we haven't been able to measure the responsivity below 2 GHz. Derek has a suggestion that we can use the network analyzer as the CW source. We will do that later.

Kyle - Two days ago we tested two Marki production units we have been using on the prototype in the lab with two synthesizers to measure the amplitude and relative delay at different frequencies. The result is similar to what Derek and CT have measured before for Marki engineering module. Tried to understand whether the higher responsivity at low frequencies, combined with pretty flat IF spectrum, can produce the fringe delay problem we've seen before?

T.H. Chiueh - There is some subtle difference between two production type correlator modules. Kyle - Our measurement only has 1 GHz resolution. We increment the frequency 1GHz at a time. At 3 GHz, the two production modules have similar responsivity, and at 2 GHz, the #2 module has lower responsivity than at 3 GHz, but for #1 module, 2GHz responsivity is higher than at 3 GHz. So the #1 production module has more peaks (in responsivity) at low frequencies.

T.H. Chiueh - In other words, one has the tendency that the responsivity shoots up at lower frequency. The lowest frequency measurement that Kyle and CJ did is at 2 GHz. They can only see the tendency, not anything below 2 GHz. The suspicion is that at frequencies lower than 2 GHz, the power (responsivity?) is even larger (for production module #1?). The difference between these two production type correlators can at least qualitatively explain why the delay (phase difference?) in the production one is smaller than production two, because low frequency dominates. Bob - That emphasizes the reason for testing all the production units to characterize them. T.H. Chiueh - The main body of frequency spectrum of responsivity are pretty much the same, except at very low

Minutes for AMiBA Engineering Telecon

frequency. Bob - That is not surprising because that is where they put in the absorber material. That could depend on the handwork quality. Kyle - According to Derek, the spec on overall responsivity must be greater than 80 Vrms/Watts. In the measurements we've got for Marki modules, everyone has passed this specification. But the other spec is that amplitude variation should be within 3dB. Right now these two modules have more than 3-dB variation. We have tried other way to analyze the data. As Prof. Chiueh suggested, one way is to shift data from different lags by some amount, then add the data together. Shifting these data corresponds to some delay at different IF frequencies, also RF frequencies. This creates some frequency filter. However, this is not a very sharp filter - 10-GHz wide frequency filter. Our results showed that the 1st module has more peaks at low frequency. It's consistent with what we got from the synthesizer test (as well as the delay).

Kyle - We do have one problem - do we need to drive the correlator at like -10 dBm as with noise source, because right now we're using CW signals, the power is at -23 dBm. Are we under-driving the correlator? The concern is because higher (CW) power will saturate the DC amplifier, so we have to use the low power. CT - I think using low power is OK. It's better than saturating the correlator. Bob - You can kind of test by changing the power input by a factor 2 to see if you're in the linear region? CT - You can calculate the responsivity vs. input power to see whether you're saturating the device or not. You wanna operate below the saturation point. Kyle - In reality, our correlator is operated at -10dBm with noise, should we take it at that condition? CT - It's hard to convert from CW power to noise power, not sure how much power you wanna put in for CW? So I usually characterize them below the compression.

Jeff - The noise power are un-correlated, so don't tend to produce much DC output. Kyle - You mean driving the mixer at different modes? Jeff - I guess it's probably OK as long as -10dBm and -23dBm both in that linear region. The reason you get so much output, getting close to limiting of DC amplifier, is because your signals are fully correlated, while two noise signals you feed in are not very correlated, so they don't produce much output. That is the reason that you have to use lower level for the synthesizer test. I think you're stuck. You have to use low level, and I think it's OK. T.H. Chiueh - There is another way of doing that. You have a low level of CW, plus some certain amount of noise. Then you adjust the noise level to -10dBm, while the CW is still very small. The resulting signal coming out of correlator will be dominated by the CW.

Jeff - You could do that way. Seems to be a bit of work to set that up. That's a good way to simulate the performance of correlator because the correlator operates with tiny correlated input on top of large un-correlated noise. So testing in the lab with the simulation of that is a sensible thing to do. Remember when Derek is doing that, his two noises got coupled to each other a little bit. He did the lab test, which he fed un-correlated noise on both sides, then send one small correlated noise into the splitter, and to both sides, and he ended up with correlated noise passing from one side to another.

C.T. - It's weird that the LO power decreases, then the IF power increases, at the same time, the RMS also decreases. Is it possible that you're saturating the correlator so that as the IF power increases, you're into the compression that you got less RMS? Kyle - We have some data before, we changed the IF power to record the RMS. It's linear up to -6dBm. We're operating below -6dBm so far. C.T. - When I looked at the fringe of moon drift scan, I found within the beam envelop, the amplitude of 4 lag fringe doesn't change much. Is it possible that the pointing does not coincide with the zero-delay? Because when we measured the moon fringe early this year, within the beam pattern, we can see clearly some amplitude variation of fringe of each lag. Have you done anything to the IF path so that the zero-delay is off from the physical phase center of the platform? Kyle - I don't think we've changed that part. We're not sure about the absolute pointing. We used to check the relative pointing.

Platform/Mount:

Ferdinand - Talked with Phillipe yesterday. They worked on platform modifications. The plan is to put everything together, and test it today. Phillipe has some concern that they may not be able to finish this by Thursday (Germany time). They may need another day to put platform on the mount. Bob Romeo and his crew are there to do this. They will be on schedule, maybe going over on the weekend, maybe one more day or so. To my impression, they will finish it by next week.

Paul Ho - Get some update one way or the other so that we can keep track how things are. The most important is to get judgments, get some reading whether we're going to slip the schedule or not. Also asked Phillip's about whether VA is looking into shipping? That is one of the action whether the shipping can be done any faster, and optimized? Ferdinand - I think they reluctant to give us an answer on that one because they want to see everything working first, see if

Minutes for AMiBA Engineering Telecon

there is any problem they run into. They shipped the ring on a very low priority. That is OK. They have other ways of shipping to speed things up.

Calibration System:

Ferdinand - Have some good news. Got the polarization scrambler. Fired everything up. I can jingle the fiber cable and the output power doesn't change. I used the mixer we have, pumped with the GUNN oscillator, and I used the photonic detector, which goes up to 50 GHz, used coaxial to waveguide transition, V-type to WR-15, WR-15 to WR-10, then feed it right into the mixer, and I can see the signal. See my total power going up and down while I switching the LED on and off. Tried to cover the whole frequency band with the GUNN oscillator, that goes from 92 to 96 GHz, actually go down to 91 and 98 GHz. Pretty confident that we can cover most of our RF band. The LED is at 1550nm, and the photonic detector is designed from low frequency to 50 GHz, but it has the frequency response in W band. Between noise on and noise off, have a 1-dB change on the spectrum analyzer. Get something like 50 nW change in 2-GHz bandwidth. My guess of the mixer noise temperature may be 10,000 Kelvin. Estimated bandwidth (of mixer) is about 82 to 100 GHz. It's a double-sideband mixer. I may detect the lower sideband roll-off?

T.H. Chiueh - Like to urge people to think whether we need the phase calibration or not? So far it's all gain calibration. Ferdinand - John Payne and myself is thinking about that.

DC Power/ Distribution:

Enclosures:

Homin - Right now we have 4 boxes here. One is for the DRO. The other 3 are for receiver/correlator. Talked to Joshua to buy another 4. (one more for data acquisition)

Site:

Ferdinand - Picked up 99.9% of final drawing from Neil Harrison. Made some copies for Paul Shaw and Paul Ho. Tomorrow going up to the summit with the Taipei folks. Show them around. Maybe they have some idea, and come up with quote or bid. Talked to Mokey? last week, and had them up on the summit. He came up with the excavator and a general contractor. It's dragging on with the contractor. Don't get any number from them. They like the ride to the summit, but they don't like to give number. These are different from the last excavator I am talking to. Also investigating the possibility of hiring somebody and hiring the machine. The guy I have on my list as the operator is working on another job right now. He is not free to go in the next 4 weeks. Talked to John Motai?, about the electrical, asking him if he knows somebody will do the electrical, also the general contractor, excavator folks... He gave me a call back this morning, and he has an electrical guy, who probably will give me a call soon, also a contractor interested in doing something out there. Can pass the blue print to Luke-We to see when he is available?

Some information about the electrical - Helco? got back to us. Will send that out to RCUH to get signed over there. Still need to contact the local phone company because the power meter will be hooked up to one of the phone lines(not new phone line). Have to contact the local phone company to see what they have to say about it.

Minutes for AMiBA Engineering Telecon

Paul Ho - How long the job is to excavate? Ferdinand - When I talked to Lose-way?, he said that's done in a week.

Ferdinand - Talked to the person from Tai-sei? And we will have a visit to ML next Thursday. There is also visitor from Tai-sei Japan joining us - one of Tai-sei excavator folk. The big factor is the excavation. If we're able to sub-contract that out or have that done as quickly as possible. It's easier for other firms to give us the estimate. What I think the best approach is for Luke? to go ahead and do the excavation work. That also gives the other folks who would then do the concrete work, and casting and all that, give them a really good idea what they're actually dealing with. Luke is busy now (he got another contract). If we can go rent the equipment from Allies? and hire operator, just get started, in my estimate, I have excavator, the back-haul, and two operators, and that will cost us 12,000 dollars for one month. In the site development budget, Neil Harrison is supervising the main steps, make sure that the excavation is done right, make sure the casting, rebar work is done right, grounding system, then the next will be the concrete work. He will supervise these steps, not on the daily basis.

Paul Ho - We have the one option, which is Lusier. Let's develop the other option if we do hire our own equipment and our own operators. Use the scenario whether we can actually do this?

Dishes:

Ferdinand - For 60-cm dish test, will send the transmitter back to Taipei. After talking to Kyle, will put together components we have here, explain to him what I have done so far, then send it back to Taipei.

60-cm dish testing

Ferdinand - For the transmitter, receiver part, that seems to work. I have it all layout and tested in the lab, like both Gunns working together, slightly offset. I got the total power detector and the amplifier chain after the mixer. I got about 40dB dynamic range, which we may need. Nevertheless, I think to do this with antenna 8 is not feasible because you need to set the feed at the right focus position, and to use antenna 8 - the back of the shutter, the little compartment you can use there - and have the antenna mount there, and the feed, LO part, IF part of power detector will be in the shutter, we would have no access place. In order to do the focus adjustment, either we ought to motorize all the drives - x,y, and z, or we have to remove it each time. Considering the situation on MK, it may not be feasible. We need a multiple run, and motorize these stages. It will cost a lot of manpower to do this. We can set up something later if you want to test all the dishes. At the moment, you can't do it in the timely manner. Bob - Do you have any backup idea on astronomical source or something else? Ferdinand - Put it on the test mount, and have a drift scan on the planet to see the side lobe and have a good idea about the beam size. Could we do it on ML looking down to the road or visitor parking? Bob - Do you think you have enough power to do it all the way across the valley to HP?

2-Element Prototype Testing:

Kyle - We will have plenty to do after we put back the whole system. First thing we talked about is to use 1st section to cut off signal below 2 GHz, 2nd thing is that we can try to find the offset between the pointing center and phase center by inserting some adapters, the 3rd thing is to try to use the 60-cm dish to see if we can do the ground pickup test.

C.J. - Yesterday we just tested the optical telescope with aperture mostly covered by the cardboard. I think we can still use it for 60-cm dish for the prototype.

Schedule: