

## Minutes for AMiBA Engineering Telecon

Meeting Date: 23-Oct-2003

Participants:

Australia: Mike Kesteven

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

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Minutes Recorder: C.T. Li

[previous weeks comments](#)

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### I. New Action Items:

**AI-23Oct03-1:** Paul Ho - Discuss with Sun Kwok about whether to keep AMiBA stuffs in new SMA building?

**AI-23Oct03-2:** T.H. Chiueh and Bob - Sort out what to do next, and Summarize what has been done so far (for prototype testing).

Paul Ho - For the prototype testing leader, to inform us as how things are going, whether there are concrete conclusions, whether we're proceeding in the right way, whether the information derived has to be sent back to the engineers? I think that's all we need is some indication of how things are going in terms of testing. That is why I asked you and Bob a week ago to discuss this because Bob raised the concern that he thought the testing was not productive enough. That's why I thought you two can discuss this and come to conclusion. Any revision we just revise if it needs to be revised.

### 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 - Continue collecting more info.

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.

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

Ming-Tang - Johnson has finished the measurement of a dumpy phase shifter in cold test dewar (around 15K) as a reference. Will continue testing the phase shifter.

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

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

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### IV. Miscellaneous Discussions:

MMIC:

Huei - The export license for chips of our own designs, plus 20 Sander Weinreb's design, has been approved. Will follow up the required documentation.

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

Receiver:

Ming-Tang - We are ready to ship receiver #1, depends on where we are going to ship it to, haven't had a shipping address yet. Basically the testing in Taipei is pretty

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much there, we'd like to ship it here for further testing, while receiver #2 will stay in Taipei for electronic test. Paul Ho - Lab will take some time to set up since you're moving. Ming-Tang - Sometime ago when we're talking about this, we're told that we (AMiBA) will move together into the new SMA building. In that sense, the environment should have been set up already. We will take less time to set it up. But if that turns out to be not feasible, it will take longer time to prepare because we need to get the CSO building cryogenic lines and compressor, etc. Paul Ho - What is the current situation? Ming-Tang - Up to this morning, we don't know whether we're going to move our AMiBA stuff. Paul Ho - There is some issue between SAO people whether they want to keep the building only for SMA stuff or not. We need to address this issue with Sun Kwok quickly, how Sun intends to deal with it? I'll take an action item to talk to Sun about it.

Ming-Tang - We had a new version of the noise coupler made. West Ho has done the dimension measurements. It looks encouraging. We're going to send it back to gold plating. However, we do have a simulation, and it looks the current design should work. Ferdinand - if the noise injection behind the sub-reflector works, that could save us money on the receiver components.

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 1<sup>st</sup> 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 re-producible 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.

LO/IF:

Correlator:

Derek - Re-visit the issue about the gain and phase stability with respect to temperature. Ran a test on the Celeriteck amplifier in 1<sup>st</sup> section, measured the gain variation about -0.5dB across 10-degree C change in temperature. Anticipate about 1.5 dB increase in power to the correlator module during the evening time. For phase, we've seen -2.2 degree per 10-degree C change. The other aspect about phase is the cable. We do have some long cables - 6-meter Andrew Helix cables, and another 3-meter segments between the 2<sup>nd</sup> section and 3<sup>rd</sup> section. We calculated the opposite slope is about 5 degrees at 10 GHz in phase per 10-degree rise.

C.T. - Besides the readout board, also checked out the other 4 PCB boards (TP, XY, Readout2Acq, and TP2Acq) we got. Waiting for the electronic parts for them (ordered from Digi-key). Then we can put them together. Have got some comment from Warwick about the circuit of the data acquisition board. Hope to finalize the design in next week.

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 2<sup>nd</sup> 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.

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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 2<sup>nd</sup> 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 1<sup>st</sup> 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.

### Platform/Mount:

Ferdinand - Talked to Phillipe two days ago, got some email from Paul Ho, and report from Comrade? about the installation in Germany, if the platform has some major problem. Talked to Bob about that this morning. I think we should have a telecon meeting. I propose a written report from Phillipe, Ted, Bob Romeo. We already got something from Comrade. We understand Comrade's concern about the whole mount could collapse if the mount has some major problem and break apart. That will damage the Jack-screws and the drives. That would be a major disaster. He has to play safe on his side to protect Vertex's investment so far. By looking at the picture, I would be rather cautious. I don't know what to do yet. Paul Ho - Sounds like the stand? plates were under-designed according to Phillipe. There are supposed to be L-shape anchors that were not in place. I don't know how that happened. Ferdinand - That is strange. If this is CMA's problem, then they have to fix it as soon as possible. I also see a lot of missing bolts, thread off... That needs to be fixed. Each bolt is part of the structure, and has to be in place. If we want to attach receiver, correlator, and all the electronics, and the thread comes off, we will have flying parts all over the place in a couple of weeks after mounting it. I would recommend that We rather have a very firm approach, then come to CMA that they get this up to specs.

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 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 - Got a working amplifier from summit. I fired everything up and I will show it to Kyle after this meeting. It's working and it has 45-dB dynamic range without any amplification. I should a report written soon. Like to talk to John Payne before sending anything official out. It looks very promising. We like to have receivers up to ML to do some further test. Some good news - I talked to Adward? Tom this morning, he has some good suggestion about the photo-diode to WR-10 transition. Actually he developed with Wisewave? a V-type connector to WR-10 transition, instead of going from V to WR-15, WR-15 to WR-10. This is one component. He did some test

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with that. With that we should have no problem up to 115 GHz. I'll look into the improvement on it. Maybe buy one or two V-to-WR10 transition from Wisewave.

C.T. - How wide is the bandwidth of the mixer? Ferdinand - I tuned from 91 to 98 GHz, and I got a response at both ends of frequency range. At 91 GHz, the response is strong like 1dB, at 98 GHz, it rolls off at the upper band, which I think it's the roll-off of my V-to-WR15 transition. It's a double-sideband mixer so I can not tell where I'm actually at because I don't inject the line. The actually bandwidth I can't tell. But with the new V-type to WR10 transition, as Tom told me, I am pretty confident that we can cover the whole band. There may be some roll-off. The test on AMiBA receiver will tell us. C.T. - How do you select between frequencies? by changing the LO frequency? Ferdinand - Yes. C.T. - Is it possible that you're picking up lower sideband around 60 GHz? Ferdinand - No, that is below the cut-off frequency of the WR10. At 91 GHz (LO) of double-sideband mixer, I would say I detect noise change at 87 GHz, and at 89 GHz LO, I would say that I detect something at 102 GHz. But the amount of upper-lower sideband ratio, I can't tell because it's a combination of both. Looking at this number, I am pretty confident to say that we cover with current noise diode from 80 up to 105 GHz. I am missing that measurement. We have to do it up in the summit. We also calculate the noise power that we inject - a rough guess, without knowing the noise temperature of mixer we have, is on the order of 500 to 1000 K. It looks like a 10,000 or 5,000 K mixer, and the amount of change we see is about 500 to 1000 K, way much than we need.

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 - I was up at the site with 4,5 construction folks. We walked about the ML for few hours. They looked at every detail, asked lots of questions. I handed out copies of site design, electrical... They made very good comment on how to do these, and what kind of equipment they need. But I guess Tai-sei will come up around a million dollar quote on this one, which is way too much that we can't afford. Few days before I was up on the mountain with Mo-key and related construction company. However, he came up with un-reasonable numbers. Luke looks still the best one (for excavation). I had a quote based on the new version of drawing. Mo-key put in numbers for electrical. I contact thru Taisei another electrical company. They will give me a quote, Hopefully. I do not have time to contact the rental company again. (I was up at MK, and now the move is coming) Paul Ho - It looks to me there is enough information. There are lots of people who bid at very high price, either we live with one of these guys or to rent the equipment and our own operators. We should come to a decision and just do it. Set the budget to be around 50,000 - the budget for the excavation. Ferdinand - The site actually becomes a full-time

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occupation for one person. We need more help, maybe one more person to actually push on this much harder.

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 Taisei 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.

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

### Dishes:

Ferdinand - I will go over with Kyle after this meeting. Identify everything that needs to be sent back to Taipei.

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.

### 2-Element Prototype Testing:

Kyle - Yesterday we went to install LO back to the system. It looks like it go back to the original status that we took some fringe from the sun. We will check whether the detail has changed, but there's no obvious change. We tried to use 1<sup>st</sup> section to suppress the power below 2 GHz, but on the spectrum it doesn't roll off, maybe because IF originally has too much power below 2 GHz. Our plan now is to find out phase center and pointing center difference. We will do that tomorrow. Another thing we have done is that we have measured the production type correlator responsivity below 2 GHz. Below 2 GHz, we measured at 200 MHz difference, there's some oscillation. At very low frequency, there is almost no response, begins to rise and have a peak around 1 GHz, go down and rise again at about 1.8 GHz. This is maybe related to the 3 GHz peak in the measurement before. For the IF spectrum from Ming-Tang, it looks like new receiver will not have much power below 2 GHz. We probably don't have to worry too much about the responsivity below 2 GHz.

Ming-Tang - We have been doing the prototype test for quite sometime. Do we have a conclusion of issues of hardware that is going to be related to our future observation? The issue should be raised, things that should not happen on the production? Can anyone come up with a list about it?

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

### Schedule: