6-24-99

MTTSym99.nt2

Notes from the 1999 MTT Symposium

Unexpurgated version -- please do not circulate.

Photomixer LO generation

Paper MO2C-2: The Lincoln Lab photomixer work started by Elliott Brown is now following the UCLA velocity matched distributed approach, but they plan to radiate the beat frequency from a dipole on a substrate lens.

I had discussions with Itoh, Qian, and Kaneda: There is a materials problem with the latest batch of e-beam devices which have substantial leakage current. I asked about the reported finding that the first diode does all the work: they say that is because the coupling to the optical w/g was much too strong – needs tapered coupling. They will need a no-cost extension. If we continue the UCLA work into another contract, we should make sure they do a simulation of the whole N-port (2 CPW ports and (N-2) diode ports). Then it should be possible to simulate the mm-wave part of the circuit accurately.

Sandy wants to look at matching to a single photodiode, but I think that is impractical for two reasons: (i) It would be impossible to get enough of the laser photons absorbed in the thin depletion layer needed for a high speed photo-Schottky diode -- the rest of he photons would heat up the surrounding substrate (cf. the SAO/Lincoln Lab melt-down limitation). And (ii) the bandwidth would be too restricted by the fairly high-Q matching circuit. I am pretty sure we are on the right track with the distributed photomixer, but we need to (a) improve the distribution of optical power between the photodiodes, and (b) do a proper EM analysis of the N-port photomixer circuit and get the design right.

Inductively coupled plasma etching of Si

Paper TU3C-4 reported via holes etched in Si wafers using ICP. Holes 60 µm diameter and 150 µm deep were very uniform. The ICP etcher was made by STS in UK (http://www.stsystems.com). Its selectivity on Si is 75:1 using photoresist and 150:1 using a metal mask. After etching the holes, they were plated through by sputtering 100 nm TiW and 1500 nm Au, then electroplated with an additional 3-5 µm Au.

IF preamps for SIS mixers

Sandy Weinreb inadvertently omitted our grounded gate MMIC's from his latest wafer run. He said they didn't look very good on paper as 50-Ω amplifiers (not surprising) and he has instead designed a GS stage with resistive feedback to lower Zin. I don't think that will work as well with an SIS mixer, but he will send me his MMICAD file and I can test it with a mixer in MMICAD.

Herbert Zirath has some 2-stage GaAs MMIC amplifiers with a grounded gate input stage, intended for 1-13 GHz, and we can have some to test after he has tested them.

MMA conventional LO development

Neal Erickson can not understand why NRAO is not involved in FIRST LO development so we can have access to JPL's MMIC technology. He says FIRST and JPL are desperate to get more people involved to do the many different parts of the work. Amongst other things, they have a lot of MMIC power amplifiers and no one to test them or field test them in a real system to see if they have any unexpected vices. He suggests that we could use them on the 12-m telescope during real observations. Once involved in FIRST work, it would be easy to get other things we need for MMA development, he says.

Weinreb/TRW power amplifiers: 71-80 GHz, 90-102 GHz 102-110 GHz, 100 mW over a 12 GHz band, 200 mW peak. There is an agreement between TRW and JPL that these amplifiers *can* be supplied to other groups for use in ground-based astronomy. They will be available when fully tested -- about mid-September.

Receiver optics

Neal Erickson says that circular grooves on lenses cause a lot of cross polarization. Should groove both sides linearly on a CNC machine. This observation is consistent with the high cross-polar power measured by Bill Shillue on the 12-m receivers (which use lenses with circular grooves). We should therefore re-design the lenses for the 12-m receivers.

QuickWave

QuickWave has introduced skin depth and will add surface inductance and resistance (per square) which are necessary for simulating superconductors, in the near future. An optimizer is now available for QW for $2000. I gave Wojciech Gwarek my list of suggested QuickWave improvements.

Odds & ends

Conductive Epoxy: Neal Erickson uses AbelStik pre mixed conductive epoxy – one of the AbelBond series –which keeps *indefinitely* in a deep freeze (-40 deg (Cor F?)) http://www.ablestik.com/97_004.html.

Glass beads: Thunderline, Hampstead, NH (http://www.thunderlinez.com) makes glass beads. Could be appropriate for thermal isolation of IF preamp in SIS mixer.

Microwave wafer probers: Cascade Microtech -- basic dual probe station to 12 or 20 GHz is ~$25k.
RPC(?) in AZ makes a cryogenic probing station for ~$100k, according to SW. Jose Fernandez at JPL (high level technician) knows a lot about wafer probers.

BWO's/Carcinotrons: According to Fred Labaar (in charge of instrument calibration at TRW Space & Electronics Group) Denis (Xavier) LeGolvan at NIST has had a lot of experience with Russian BWO's which they use with 6-port VNA's -- (303) 497-3210, legolvan@boulder.nist.govFor the Russian BWO's: www.nnz.ru/elva-1/Index.htm

George Ponchack at NASA Lewis (now Glen Research Center) is working on transmission lines on Si. He likes microstrip with the ground-plane on the same side and a polyimide dielectric (~20 μm thick, I think he said).

Met Chuck Oleson -- maker of VNA extenders to 330 GHz (http://www.olesonmicrowave.com). He gets his mixers and harmonic generators from Pacific Millimeter. SW says his WR-5 8510 extender has plenty of dynamic range.

Quartz filled SS semirigid coax: Kaman has semirigid SS coax with powdered quartz filling (http://www.gigatron.com/kaman.html) -- good for cryogenics?

ARK 24 June 1999