CARMA I.F. system – preliminary block diagram

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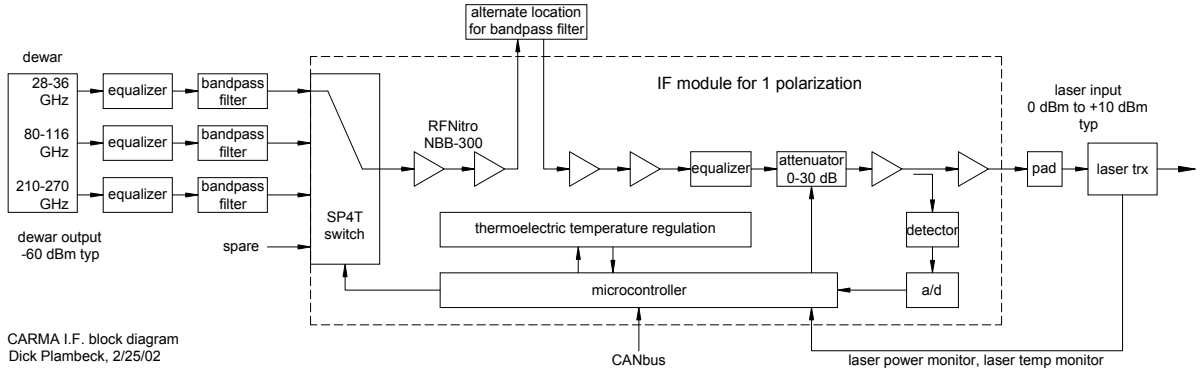

key assumptions/specifications:

- each I.F. module/laser link handles 1-10 GHz (500 MHz – 10 GHz?)
- a separate I.F. module/laser link is used for each polarization
- passband filters precede the I.F. module; if all bands have the same width (true now at BIMA), a filter may be inserted in the alternate location following the selector switch
- input level to module should be at least -60 dBm
- max amplitude variation across input passband should be < 6 dB
- freq response of module + link is flat within 2 dB; equalizer required inside module
- laser link is driven 3 to 5 dB below its 1 dB gain compression point; expected power to laser is 0 dBm to +10 dBm, depending on laser chosen
- attenuator following final amplifier guarantees that input level to laser is safe
- noise temperature of I.F. module and fiber link < 1000 K
- gain of I.F. module (and link?) should be stable to 1 part in 1000 over periods of an hour

component choices:

- *input switch:* mechanical, PIN diode, or transistor? possible choice is Hittite HMC 344LP3: SP4T, nominal range 0-8 GHz, 2 dB insertion loss, surface mount package; need to precede switch with single stage amplifiers to reduce input noise temp
- *amplifier:* RF Nitro NBB-300 is possible choice for the ATA: 0-10 GHz, 12 dB gain, 5 dB noise figure, P1dB +14 dBm; 3.9 V, 50 mA; approx $7 each
- *attenuator:* possible choice is Hittite HMC 424LP3: 0-31.5 dB in 0.5 dB steps, 4 dB insertion loss, 10 picosec delay change over atten range, surface mount package
- *detector:* packaged device used by OVRO is Herotek zero bias Schottky diode, DZR124AA

fiberoptic link choices:

- existing links at BIMA are mixture of Ortel lasers (3510A, 3510B, 3530A), mostly with bandwidths of 3 or 6 GHz; OVRO uses Ortel 3530A lasers with bandwidth of 10 GHz; all of these operate at 1310 nm
- Agere (formerly Ortel) 3541 is the only off-the-shelf analog link available today
  - $12.4 K (laser + photodiode)
  - specified noise figure is 49 dB, 1-6 GHz; 59 dB, 6-9 GHz; P1dB is +13 dBm
  - operates at 1310 nm
- the Allen Telescope array plans to use Fujitsu FLD5F10NP laser with integrated electro-absorption modulator and thermoelectric cooler + Discovery photodetector
  - *projected* price is ~ $3K in quantities of several hundred; temperature regulation circuit must be added
  - link gain rolls off by 3 dB at 10 GHz
  - measured noise figure is 40 dB, P1dB is +5 dBm
  - operates at 1550 nm

other questions:

- I.F. module has 60-80 dB gain; gain lumps must be divided into compartments to prevent oscillation
- how much integration is desirable? switch + amps + atten + equalizer + detector + microcontroller in 1 box? include laser too? build double modules to handle 2 polarizations?
- present fiber linelength system works at 1310 nm; how accurately can it predict delay for the I.F. if we send it back at 1550 nm?