# Disko-Kraken
# Circuit Board

- DK board design specifics and status
- Some questions and points
- DK board testing

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# DK Board Design Specifics and Status

- 12 layer stackup - details on the next page

- 5 Sets of Design Rules:

  Default, e.g. low speed CMOS, power & ground

  Input Power (+- 50 V wrt the sea) use 500 V IPC Class 2 rules
  The same rules are used for the Isolated RS-485 Bus
  Input Power and RS-485 both use 500 V Overvoltage Clamps

  1 GHz Differentail Signals, e.g. Ethernet and Clocks
  These signals are run as Microstrip and Strip Line.

  13 GHz Differential Signals  PMT ADC Data  JESD204B
  Both the PMT ADC and the FPGA proved top layer access
  Suffering the "dispersion" of the short top layer microstrip
  is cleaner than making transitions to and from inner layer
  strip line.  Velocity is about 17 cm/nsec  Length about 5 cm
  This implies that at 13 GHz there are 3 or 4 bits on the line.
  About 1.3 cm/bit    $\frac{1}{4}$ of the 3rd harmonic is about 1.1 mm.

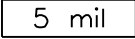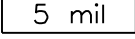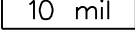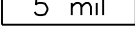  DDR4 Data Buses and Address Command Buses
  Running at the maximum speed of the DDR4 Controllers.
  Using two adjacent layers per byte wide data bus.
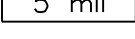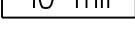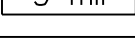
# DK PCB Stackup

**Physical Layer** | **Copper Weight & Function**

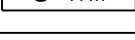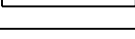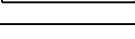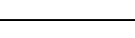| Layer | Laminate Thickness | Copper Weight | Function |
|---|---|---|---|
| L1 | | 0.5 oz | Top Traces and Pads |
| | 5 mil | | |
| L2 | | 0.5 oz | Upper Ground Plane |
| | 5 mil | | |
| L3 | | 0.5 oz | Traces |
| | 10 mil | | |
| L4 | | 0.5 oz | Traces and Power Fills |
| | 5 mil | | |
| L5 | | 0.5 oz | Middle Ground Plane |
| | 5 mil | | |
| L6 | | 1 oz | Power Fills |
| | 10 mil | | |
| L7 | | 1 oz | Power Fills |
| | 5 mil | | |
| L8 | | 0.5 oz | Middle Ground Plane |
| | 5 mil | | |
| L9 | | 0.5 oz | Traces |
| | 10 mil | | |
| L10 | | 0.5 oz | Traces |
| | 5 mil | | |
| L11 | | 0.5 oz | Lower Ground Plane |
| | 5 mil | | |
| L12 | | 0.5 oz | Bottom Traces and Pads |

Laminate Thickness

Note: There is no Ground Plane between L3 - L4 or between L9 - L10.

- Total Thickness about 2 mm

- Minimum:
  Clearance 0.13 mm
  Trace Width 0.13 mm
  Drill Dia. 0.20 mm

- Aspect Ratio 10:1 max

- Via Plugs Top Side Only

- Back Drills None

- Controlled Zo
  L1, L3, L4, L9, L10, L12

- Laminate: Isola 408HR

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# DK Board Current Status

- The drawing set is now essentially stable.
  Only 7 drawing edits so far in May.

- Essentially all components and nets are in the CAD design.
  Currently 1346 components and 3322 net connections.

- Most components are at final known routable locations - exceptions:
  tight in bypass caps, some Interposer I/F comps, DCDC Converters
  2 & 3 must change shape, FPGA & all associated comps must
  move Southh.

- Known design / routing issues:
  DDR4 Data Buses - have 2 possible solutions - still studying

- Anticipate what you would call routing to start week of the May 20th.

- Will pause at about the 50% point to release a data set for bids:
  Estimate 3 weeks of work to complete 50% of the routing.
  A 50% complete design is OK for accurate bids.
  Get the business side of this purchase started - Bus & Tech in parallel.
  Get feedback on any assembly issues and on the bare pcb, e.g. stackup.
  Get the scripts written for the data release so that we are not
  doing that when focusing on final checks before the production release.

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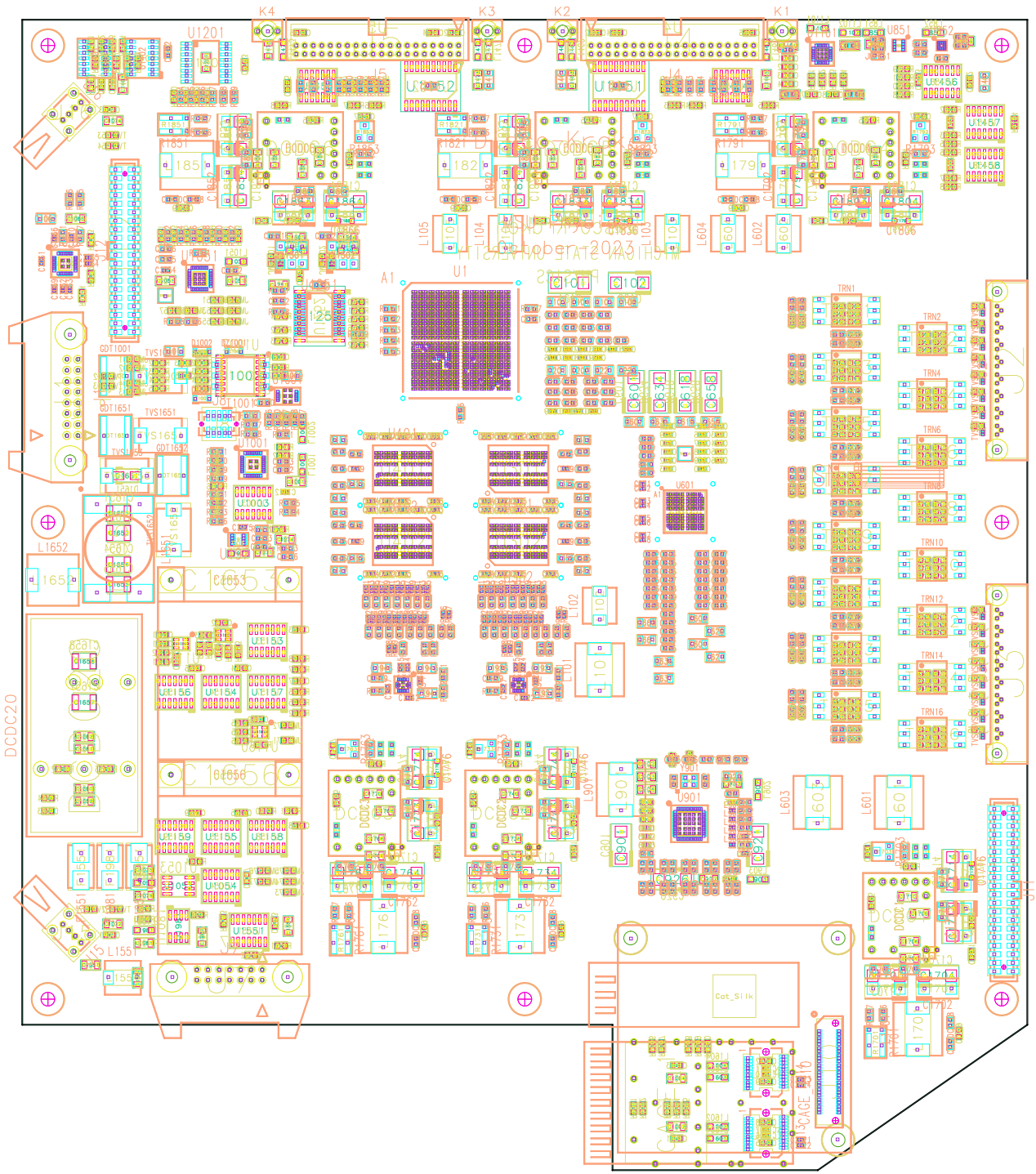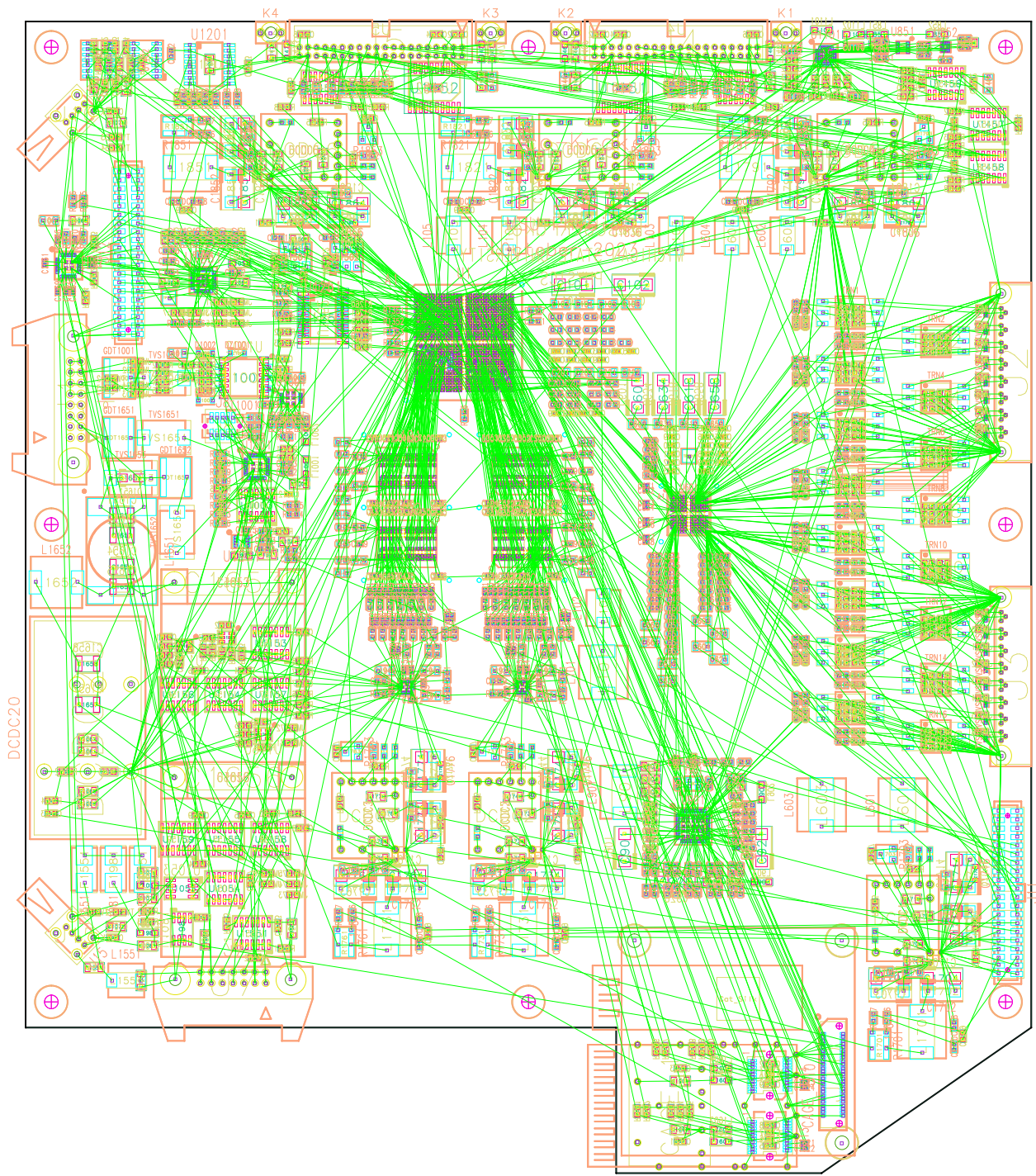
# Some Points and Questions

- Screws for Module Assembly: Thread Locking and Captive
  Thread Locking because in may applications we can not
  forcibly thghten a screw but also can not risk that a screw
  can rattle loose and fall out. Don't want to use "Loctite"
  for a couple of reasons, e.g. ease of disassembly and out gas.
  Captive so that a screw can not slip out of your fingers during
  final assembly and fall down into the module.

- DK Input Power Supply is 20 Watts - this implies:
  Continuous base line load must be < 12 Watts
  Rare momentary peak load must be < 18 Watts
  The power consumpsion of the DK board itself is 6 Watts.
  Are we fully signed off on this ?     This ship has sailed.

- DK is being designed to have a metal shield above its PMT
  analog input section  (within its 30 mm  allowed height)
  and I'm  counting on the metal mounting plate being at the
  DK  Signal Ground potential.

- I've moved the Barnacle Connecter 1 or 2 cm West.
  This give better clearance for the TOMcat FO cable. Is this OK ?

# Some Points and Questions

- The Bosch Temperature Pressure Humidity Sensor requires
  a "reconditioning procedure" after reflow soldering, see its
  datasheet page 46.  Have you done that in the past ?
  Interesting note at end of the datasheet - don't use in
  "deep sea" applications  (and is light sensitive).

- Will  the Module include  any  desiccant ?
  I'm  concerned about  the  lifetime of epoxy  packaged ICs  with
  aluminum  bond wires.  Filling with dry gas is good but I expect
  that most of the water trapped inside the module has been absorbed
  into various materials.  What does ONC do ?  Old deep sea
  (and hermitically sealed)  coaxal cable repeaters included desiccant.

- Steel Mounting Plate - what is needed from  me for its design ?
  Cable Slot locations ?   Cable protection from  the steel edges ?
  Ground wire mounting screw  for the DK's signal ground connection ?

- Points &  questions from  others ?

# DK Card Testing - 3 types of Test Setups

- Bench Tests - to verify that the Design works as expected
  One time tests, mostly on just one card, to verify the Design.
  No need for automation or to preserve the test setups.
  Special test setups may need to be soldered to the card under test,
  e.g. transient load box or added static loads to test power supplies.
  Margin tests to verify the correct operation of various card
  functions over a range of power supply voltages and termperature.
  Final characterize of the ADCs to verify that they match the values
  seen in the prototypes: SFDR, cross-talk, frequency response, gain.

- Production Card Test Station - for testing 1400 production DK cards.
  Needs to be mostly automated. Needs to last for the life of the
  exteriment.  Needed to test production cards and to retest any
  repaired cards.  Needs to have test signals that are very stable
  over 20 years time.  Many questions, e.g. test PMT ADC Channels
  with sine wave or with pulse signals ?    Students must be able
  correctly use the Production Card Test Station. This Test Station
  must throughly test each DK booard because these cards will
  receive only limited additional testing  (durning Module and String
  assembly)  before deployment.

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# DK Card Testing - 3rd type of Test Setup

- Slice Test or in our case String Test
  This test should be the full "length" of the DAQ system but is only
  one string in "width". Need a permanent home for this String Test
  for the life of the experiment. The hardware of the String Test
  is the definitive location to test software and firmware for the
  modules. Need a permanent realistic setup for the power supplies.
  Must understand what test signals are needed, e.g. PMT, muon,
  hydrophone, ... What can and can't we test in the triggering with
  this kind of one String width test setup. What is needed to verify
  special things, e.g. that the Flashers fire when they should.

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