Vacuum Electronics

Radiation detectors and low-noise electronics laboratory

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Outline

- The Vacuum Side
- Flange PCBs and Connectors
- Long Flex
- 47-Channel Module
- Development Roadmap
The Vacuum Side

47-pixel module and supporting structure for the KATRIN Monitor Spectrometer

Interface PCBs
1:1 connection between flex and Micro-D connectors

2x Flexible Printed Circuit (flex)
Carries 100 pins, organized in two layers, between module and feedthrough, both signal and power. 675 x 20 mm

47-CH ASIC Board
Hosts 4 Ettore ASIC preamplifiers, 12-ch each, LDOs, auxiliary electronics and filters

Rigid-flex-rigid Circuit Board
Cutting-edge PCB design to connect the SDD chip to the preamplifier board
The Vacuum Side

100-pin Micro-D Connector
AirBorn MK-452-100-335-620S

100-pin FPC Connector
Hirose FH29DJ-100S-0.2SHW(99)
The Vacuum Side

- 100-pin FPC Connector
  *Hirose FH29DJ-100S-0.2SHW(99)*

- 47-px SDD HLL Matrix

- Dual Compression 200-pin PCB-to-PCB Connector
  *Samtec ZA1-20-2-1.00-Z-10*
Flange PCB and Connectors

Components:

I. Micro-D Connectors
   Commercial product, we bought two, currently in KIT for outgassing measurements.

II. Interface PCBs
   Custom designed, currently in design phase. They offer 1:1 connection between the FPC connector and the Micro-D connector. The two PBCs, required in the 47-CH system, are identical. Typical PCB FR-4 material. Soldered with Sn96.5 Ag3.0 Cu0.5 alloy, no-clean flux.

III. FPC Connectors
   Commercial product, we have already a good number. Some are in KIT for outgassing measurements.
**Flange PCB and Connectors**

**47-CH (and half 166-CH) pin assignment:**

Micro-D pinout from datasheet [1]:

```
CONNECTOR MATING FACE*

76 (PGND) 77 (GNDS)
75 (CH27) 78 (GNDS)
74 (CH28) 79 (GNDS)
73 (CH29) 80 (CH41)
72 (CH30) 81 (GNDS)
71 (CH31) 82 (GNDS)
70 (CH32) 83 (GNDS)
69 (CH33) 84 (CH43)
68 (CH34) 85 (GNDS)
67 (CH35) 86 (GNDS)
66 (CH36) 87 (GNDS)
65 (CH37) 88 (GNDS)
64 (CH38) 89 (GNDS)
63 (CH39) 90 (CH9)
62 (CH40) 91 (GNDS)
61 (CH41) 92 (GNDS)
60 (CH42) 93 (GNDS)
59 (CH43) 94 (GNDS)
58 (CH44) 95 (GNDS)
57 (CH45) 96 (GNDS)
56 (CH46) 97 (GNDS)
55 (CH47) 98 (GNDS)
54 (CH48) 99 (GNDS)
53 (CH49) 100 (GNDS)

*** 100 POSITION***

*For pin (plug) connectors, the contact numbers are reversed left to right. Our case.

Options for the extra 2 micro-Ds required in the 166 module:

A. Reverse the two bottom feedthroughs in the flange. Best option (fully symmetrical), the 4 PCBs are identical, no development required.
B. Keep the same flange design and change the pinout on the micro-Ds. The 4 interface PCBs are still identical, air-side cables or bias system need to be adapted. The boards are not mechanically symmetrical.
C. Keep same flange design and same pinout on the micro-Ds. Since the ASIC board side is fixed, new interface PCBs must be developed for the bottom hemisphere (not a big issue). Their design can become unnecessarily complex (moderate issue but very bad for the signal integrity).
The Monitor Spectrometer requires 2x 100-pin Flexible Printed Circuits for the 47-CH module and 4x FPCs for the 166-CH module. The FPCs are identical.

Status: designed, manufacturer found (can produce FPCs up to 2 m long), purchase order started, production in September.
Components:

I. ASIC Board
   *Designed, produced, received, to be assembled.*

II. 47-CH planar design Detector Board
   *Designed, produced, received, to be assembled.*

III. Rigid-flex-rigid Detector Board
   *Designed, manufacturer selected, quote received, the purchase procedure is complex and will begin in September, delivery expected by the end of the year. This part is necessary in the three-dimensional 47-pixel and 166-pixel modules.*

IV. Microcontroller-based 47-CH ASIC Board tester
   *Ready. Diagnostic tool which can quickly check the functionality of Ettore’s channels before connecting an SDD matrix.*
47-Channel Module

ASIC Board:

Ready to be assembled, it will be tested with only one Ettore first. We have already developed two interface boards for connecting it directly to the Bias System without the vacuum feedthrough.
Planar design 47-pixel Detector Board:

The board is a 47-pixel extension of the current 12-pixel planar design Detector Board.
Microcontroller-based 47-CH ASIC Board tester:

- Automated Ettore basic functionality tests thanks to the ARM Cortex-M4 MPU with integrated 12-bit SAR ADC and on-board 47CH multiplexing network
- Measurement of detector’s voltages ($R_1$, $R_x$, IGR, BC, BF, and $V_{DRAIN}$)
- micro-USB port (bus powered)
## Development Roadmap

### 47 Channels
- ASIC Board 47 assembly
- Test with 12-px detector
- 47-px SDD bonding
- Test with 47-px planar
- Flange PCBs
- Long flex
- C-shape rigid-flex
- 47-px 3D tests

### 166 Channels
- ASIC board 83 CH

*Can be inherited or not depending on the future arrangement of the micro-Ds of the flange*