An assembly concept for modules of the CBM Silicon Tracking System*

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The functional building block in the layout of the CBM experiment's Silicon Tracking System (STS) is a detector module, definded as the assembly of a single double-sided silicon microstrip sensor or several daisy-chained sensors, micro cables and two front-end electronics boards, one for each sensor side. Various module types will be applied, differing in the sensor arrangement and the length of the read-out cables to the front-end electronics at the top and bottom periphery of the STS. A module is a non-reworkable unit, which in case of failure will need to be replaced as a whole. Due to the thin micro cables it is a very delicate device that can be mounted onto and dismounted from the ladder structure only by means of specialized assembly tools and procedures.

Components

The components of a module as shown in Fig. 1 are:

- Sensor: Double-sided silicon strip sensor with 7.5° stereo angle and 1024 strips of 58 μm pitch per side. One or several daisy-chained sensors of 6.2 cm width and either 6.2, 4.2 or 2.2 cm length are used.
- Microcables: Single-layer Aluminum cables on polyimide carrier, 64 leads at a pitch of 116 μm. Two staggered layers at twice the pitch will be used to connect all sensor channels. Eight doubly-layered cables read out the 1024 channels per sensor side. The total number of cable stacks per module is 16.
- Readout ASIC: The dedicated STS-XYTER chip comprises 128 readout channels.
- Front-end board: A FEB receives eight read-out ASICs and serves 1024 input channels. The digital data from the chips are channeled by the data aggregator HUB chip into four high-speed serial links. Two FEBs are applied per module.

Assembly

The following sequence of assembly steps has been worked out from an analysis of ladder manufacturing options taking into account risk and yield evaluation [1, 2]. The scheme aims to minimize the overall risk, to maximize complete assembly yield and to minimize production costs while avoiding the shift of crucial challenges to later assembly steps. Current work is focused on a detailed refinement of the technological steps and the demonstration of their feasibility.

1. FEB is fully populated with parts including the HUB chip. STS-XYTER chips not yet installed.
2. Tab bonding of first 64-channel micro cable onto the STS-XYTER chip in a dedicated tool followed by a connectivity test.
3. Tab bonding of second 64-channel micro cable onto the STS-XYTER chip; connectivity test.
4. Tab bonding of micro cables with attached read-out chips to the p-side of a sensor; connectivity test.
5. Tab bonding of micro cables with read-out chips to the n-side of a sensor; connectivity test.
6. Installation of first row of four chips to FEB.
7. Wedge-wedge wire bonding of chips to FEB; successive application of glob top.
8. Installation of second row of four chips to FEB.
9. Wedge-wedge wire bonding of chips to FEB; application of glob top.
10. Flipping upside down of module. Repetition of the installation of read-out chips into the second FEB.
11. Functional test of FEBs with connectivity test of the sensor through the micro cables.

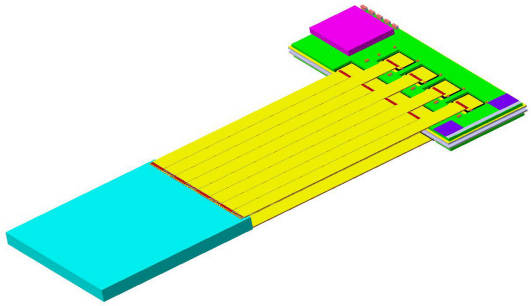

Figure 1: Schematical view of an assembled STS module.

References

[1] Workshop on quality assurance for the CBM Silicon Tracking System, Univ. Tübingen, 14-15 June 2012, https://indico.gsi.de/conferenceDisplay.py?confId=1621

[2] Workshop on Module Assembly for the CBM Silicon Tracking System, GSI Darmstadt, 3-7 December 2012, https://indico.gsi.de/conferenceDisplay.py?confId=2021

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