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Power consumption of the Outer Tracker Front-End Electronics

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The active front-end and readout electronics of the Outer Tracker straw tube chambers consist of the ASD-BLR pre-amplifier boards, the OTIS TDCs for the time digitization and the GOL serialiser chip. Additonally there are low-voltage regulators for the power supply and a card to receive and to distribute the TTC signals (LVDS) as well as the Slow Control signals (I2C). All the above components are mounted directly at the end of the modules and are enclosed in an metal box for shielding. In the following the heat dissipation for the the elctronics mounted in such an electronics box is estimated:

Component	Number / Box	Power / Comp	Heat / Box
ASD-BLR	16	420 mW	6.7 W
pull-up resistor network	128	15mW	1.9 W
OTIS	4	550 mW	2.2 W
GOL	1	390 mW	0.4
Others			1 W
L4913ADJ L7913ADJ	3 1		10 W
Total			22 W

<u>Comments:</u>

- <u>ASD-BLR:</u> Power consumption: 2×70mA at $\pm$ 3V
- <u>OTIS</u> Power consumption: 1×220mA at $\pm$ 2.5V
- <u>Pull-up:</u> A pull-up resistor network is needed to change the differential ASD output level to the LVDS level required by the OTIS. Per channeL: $2 \times (750 + 470)\Omega$ at 3V $= 2 \times 2.5$mA $\rightarrow 15mW$

- <u>GOL:</u> Power consumption: 400 mW. The value includes the VCSEL current.
- <u>Other</u> e.g. the QPLL chip
- <u>LV Reg</u> For the low-voltage regulators it is for simplicity assumed that all the power (12.2 W) is supplied at 3V equivalent to a total current of 4.1 A. Assuming that the regulators are operated at an input voltage of 5.5 they produce an additional heat of 2.5V $\times$ 4.1A $= 10W$

Conclusion:

The total heat dissipation of the front-end electronics is thus 22 W per electronics box or $450 \times 22\ W = 10$ kW for the total Outer Tracker. This heat is generated locally and if not transported away will lead to a significant warm-up of the electronics as well as of the chambers. Considering the dense packing of modules inside a station it is clear that active cooling is mandatory. Further more pure air cooling is likely not to be sufficient, particularly since we will not be allowed to dump this amount of heat into the hall.