Changes in Power Distribution for the LHCb OT Upgrade
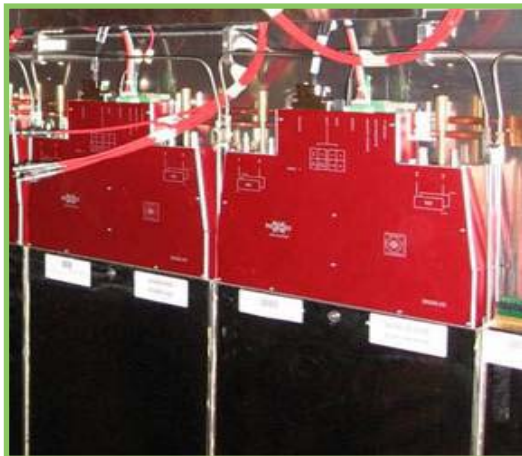
Questions:

1. New FE with Linear Regulators or DC-DC converters ?

2. Power Supplies: Any change in Tunnel-Wiener LV-supplies?

3. Any Change in Power Cabling?
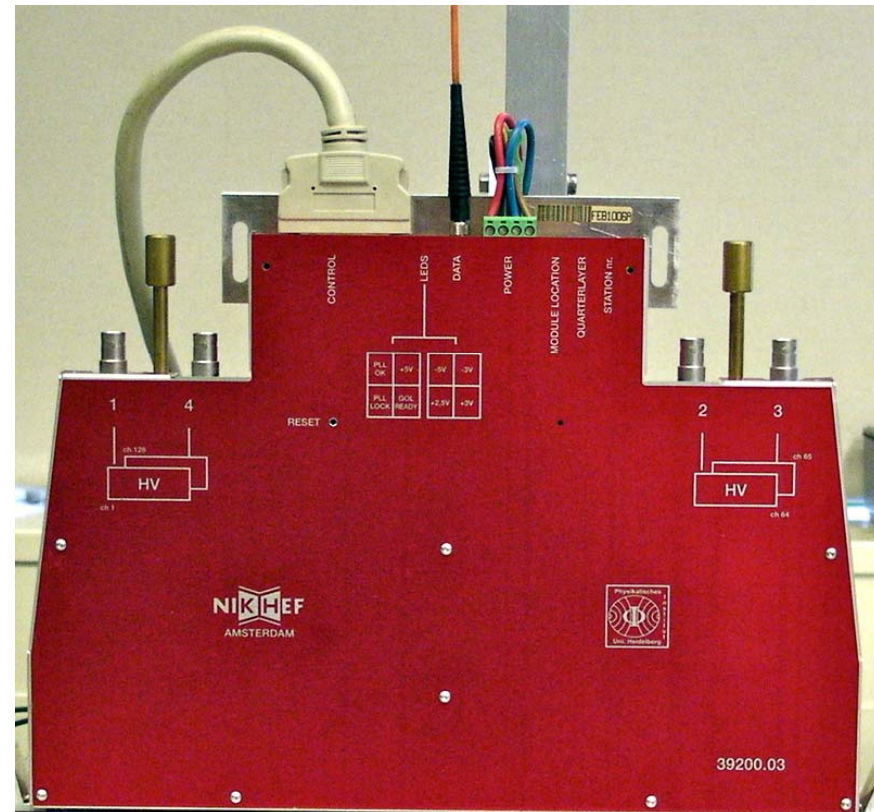
Remark: Actel-TDC's assumed

Changes in Power Distribution for the LHCb OT Upgrade

Remarks:
Electronics has to fit in the same housing
Housing should stay the same thickness
(no touching of Cframes)

FE on frame without HV cabling

FE with Linear Regulators or DC-DC converters ?

REGULATORS PREFERED !

***Regulators** (2500 needed.) **pros and cons**

+ Regulators preferred because of **small size** when build in same FE

+ Regulators **low noise** compared to normal switching supplies

- Efficiency problem using 9 GBTx with GBLD in FE (1.5V/8A)
  Wiener for 9 FE must give 63A with lin regulators,or
  better we need additional DC-DC converters 1.5V/8A -> 6V /2 or 2.5A (75%)
 **Combi needed** = also 2 dc-dc converters

***DC-DC converter pros and cons**

+ DC-DC converters **high efficiency** (>75%)

+ DC-DC converters low output noise !?

- **Too large to build a few in FE**

- Outside FE, on frame gives variable cable drop on critical 1.5V
   +75mV/-75mV allowed

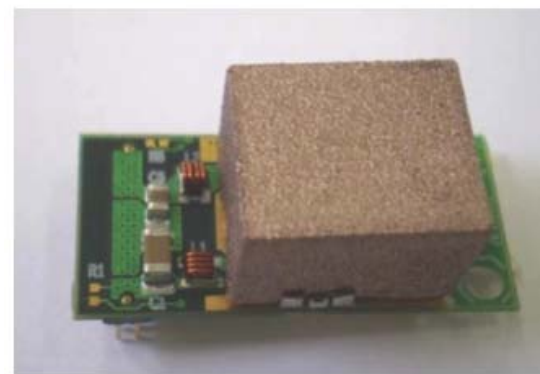- **No negative voltage version available**

FE with Lin Regulators or DC-DC converters ?

This is what they look like

Figure 5: GOL-auxiliary board IF13-0 prototype, bottom side. Mind the changed pin out for the negative power regulator L7913
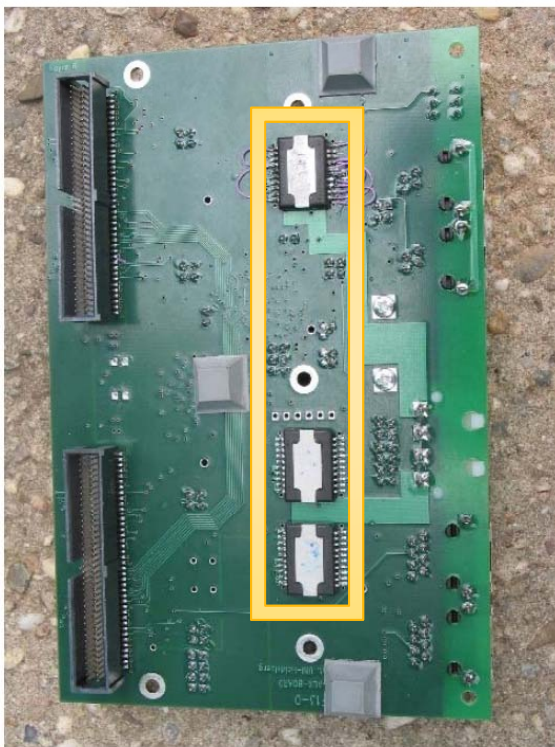
GOL board proto with 3 regulators
Very flat on a 10*16cm card

Matchbox DC-DC converter
12V in 2.5V/5A out
- Rad hard,
- Low noise
- Non Magnetic
! connector on cooling side

FE with Lin Regulators or DC-DC converters ?

Ken said remaining ~10K regulators are bought from ST ?

Frederico Faccio says only 2k left for all.

We need ~2500 regs :

+3.0V/1.5A , -3.0V/1A , **1.5V/7.2+1.2=8.4A (2 reg's)** , 2.5V/ 1A?

Meaning 5 regulators per FE, total = ~1900 pos, ~500 neg ,
  with 24 for control boxes, and a number for development and
    spares

Power : 4.5+ 3+ 12.6+2.5 Watt= 20.8W@ 100% efficiency

LHCb OT possibly 'other' regulators?

ST still sells 'our' Radiation tolerant regulators through AVNET
*different housing * price unknown yet

RHFL4913A

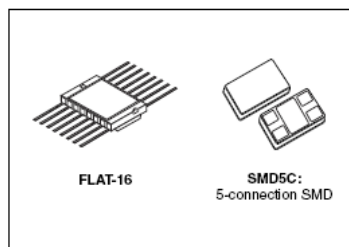**Rad-hard adjustable positive voltage regulator**

Features

- 3 A low dropout voltage
- Embedded overtemperature and overcurrent protection
- Adjustable overcurrent limitation
- Output overload monitoring/signalling
- Adjustable output voltage
- Inhibit (ON/OFF) TTL-compatible control
- Programmable output short-circuit current
- Remote sensing operation
- Rad-hard: guaranteed up to 300 krad Mil Std 883E Method 1019.6 high dose rate and 0.01 rad/s in ELDRS conditions
- Heavy ion, SEL immune

FLAT-16   SMD5C: 5-connection SMD

Description

The RHFL4913A high-performance adjustable positive voltage regulator provides exceptional radiation performance. It is tested in accordance with Mil Std 883E Method 1019.6, in ELDRS conditions. The device is available in the FLAT-16 and the new SMD5C hermetic ceramic package, and the QML-V die is specifically designed for space and harsh radiation environments. It operates with an input supply of up to 12 volts. The RHFL4913A is QML-V qualified, DSCC SMD #5962F02524.

Input 3-12V
Output 1.23 to 9V/2-3A <15W
**Drop 950mV @ 2A**

RHFL7913A

Rad-hard adjustable negative voltage regulator

Features

- 3 A low dropout voltage
- Optional overtemperature and overcurrent protection
- Adjustable overcurrent limitation
- Load short circuit monitoring
- Adjustable output voltage
- Inhibit (ON/OFF) TTL-compatible control
- Programmable output short-circuit current limitation
- Remote sensing operation
- Rad-hard: sustains 300 krad in Mil-1019.7 at High & ELDRS low dose rate conditions
- Heavy ions, SEL immune at 68 MeV/cm²/mg LET ions

FLAT-16   SMD5C: 5-connection SMD
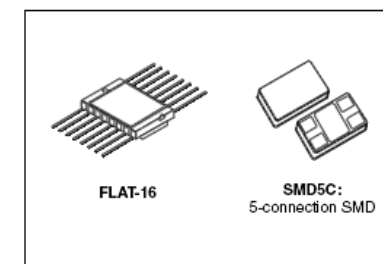
Description

The RHFL7913A adjustable is a high performance Rad hard negative voltage regulator. Available in FLAT-16 and new SMD5C hermetic ceramic packages, it is specifically intended for space and harsh radiation environments. It provides exceptional electrical performances, high speed and low dropout voltage. Input supply ranges from - 3 V to - 12 V. It also provide logical control / monitor functions (inhibit, output monitor, short-circuit control) from/to external positive voltage signals, while the entire RHFL7913A adjustable analog functions are biased at negative voltages with respect of ground pin. The device is QML-V qualified with SMD 5962-02532.

Input -3-12V
Output -1.20 to -9V/2-3A <15W
Drop 800mV @ 1A

Upgrade FE power explained

- 8 ASDBLR boards +3.0V /1.5A , -3.0V/1A

- 4 Actel 1.5V/0.3A*4 ACTEL= 1.2A

- **9 GBT chipset** 2W/set estimated =18W
  =**1.5V / ~0.8A *9 GBT** = 7.2A + 1.2A for 4*Actel core 1.5V
  9*GBTx. , 1*TIA, 9*LDA (+ SCA)

- Details currents GBT set atlas/cms mini workshop 2010:

- Gbtx 1.5V!/728mA*9=6.55A ,
  TIA 2.5V/0.1A*1=0.1A ,
  LDA 1.5V/0.115A*9=1A and 2.5V/0.119A*9=1A

Same nr of Wieners?

1 FE uses:
- 8 ASDBLR boards +3.0V /**1.5A** , -3.0V/1A
- 4 Actel 0.3A*4=1.5V/1.2A (add to gbt)
- 9 GBT chipset 2W/set estimated =18W

  =1.5V / 0.8A *9 = 7.2A (tot 8.4A =12W=6V /2-**2.5A**) so ~2.5A with converter <<

  GBTx. , TIA*1, LDA*9 (+ SCA) **2.5V/1A**

  Total **pos**: 1.5+2.5+1= **5 Amp** per FE =5*9= **45 A**

WE CAN INCREASE THE SAME OUTPUT FROM 27A TO 45A
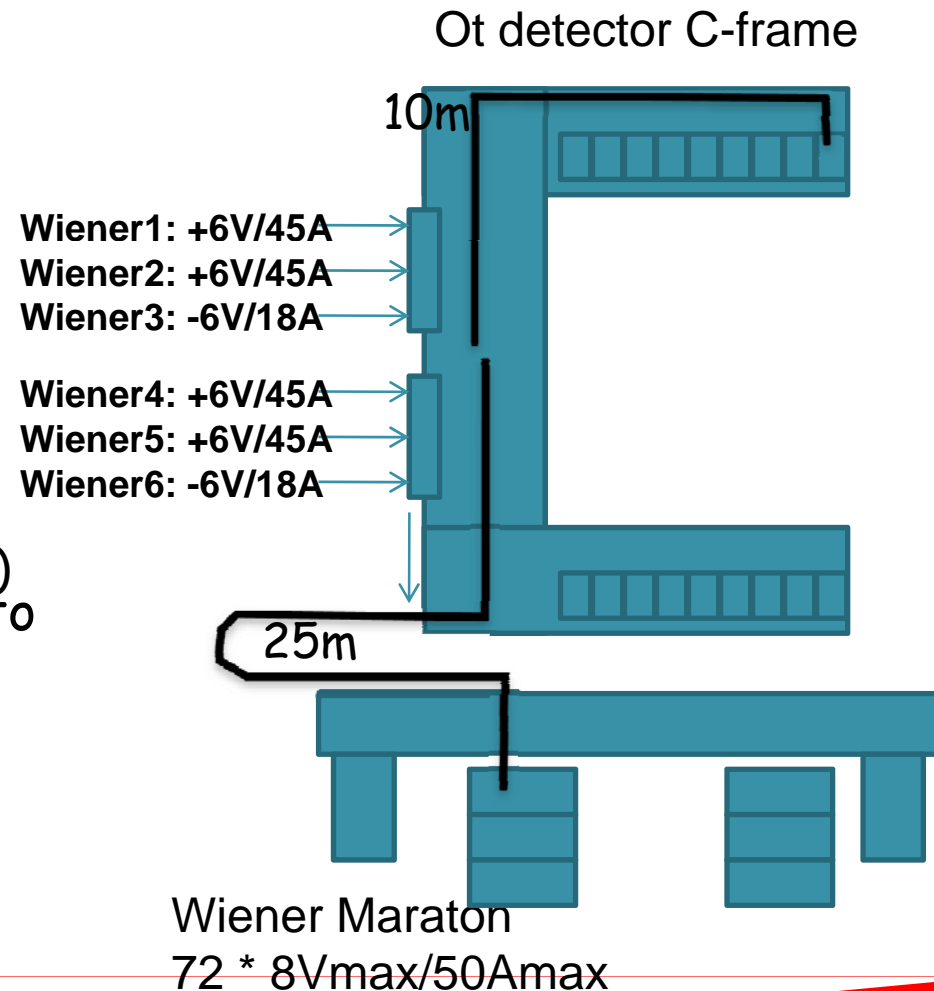**This is just within max for Wiener 8V/50A**

  Negative supply stays the same

Concl we can just live with the same nr of wieners
Even though we have 9 GBT's
Detector Cooling system needs increase from 11 to ~16 kW

- Details of currents GBT set atlas/cms mini workshop 2010:
- Gbtx 1.5Vl/728mA TIA 2.5V/0.1A ,
  LDA 1.5V/0.115A and 2.5V/0.119A ,
- 5 switching supplies 75% eff

Same Supply Cabling ?

- Thick cables to detector, 25m 35mm2 for 27A later 45A

  Thin to each FE 2.5mm2 for 2.7A later 5.5A

  No danger of heating

- Drop over 2*35m **now 1V** later 1.5V but **enough margin**, we have 8V max
  Also common mode range(0.75V) problems of ground drop have to be checked, should be ok.

- **Conclusion** :
  Power cable can stay the same

Ot detector C-frame

10m

Wiener1: +6V/45A
Wiener2: +6V/45A
Wiener3: -6V/18A

Wiener4: +6V/45A
Wiener5: +6V/45A
Wiener6: -6V/18A

25m

Wiener Maraton
72 * 8Vmax/50Amax

Tom Sluijk, Albert Zwart, Wilco Vink

Conclusion

- Q: Regulators or DC-DC converters?

  A: Combi

- Q: Same nr of Wieners?

  A: Yes, but on the edge of current capacity 45A of 50A

- Q: Same Detector Power cabling?

  A: Yes.

- 11/16 KW Water Cooling machine has to be checked for capacity increase.
- Tell 40 not considered here.

Tom Sluijk, Albert Zwart, Wilco Vink