Redundant and remote manageable power supply concept developed and deployed at the European XFEL.

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Abstract

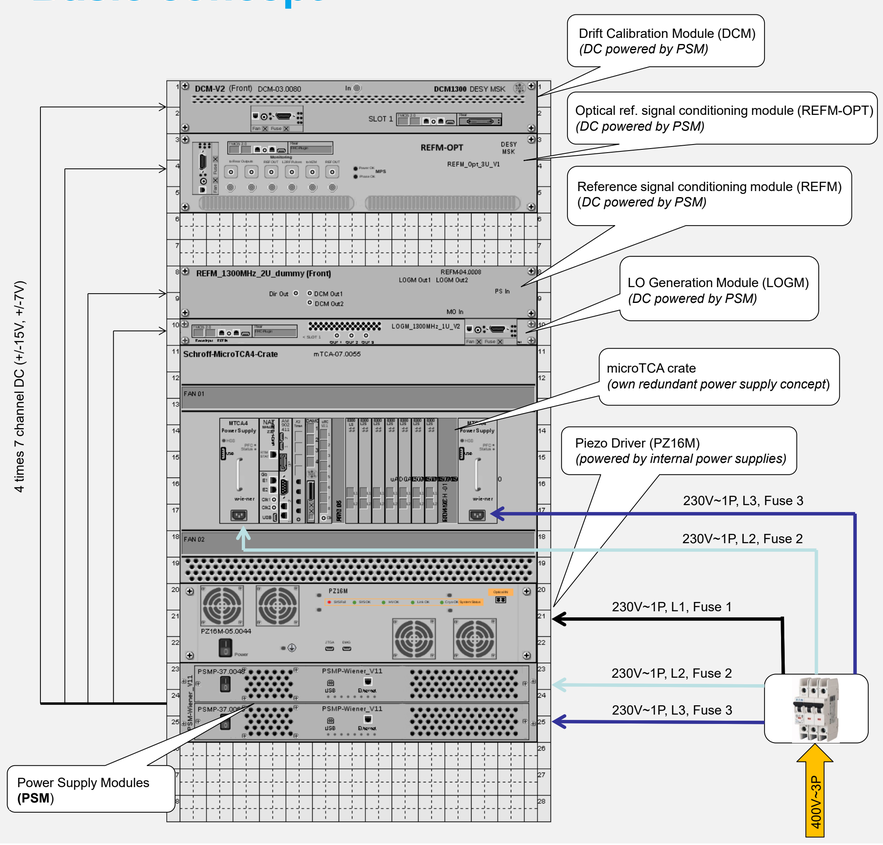
In complex electronic systems such as LLRF systems one of the main weak points regarding reliability are often the power supplies. To reduce downtime it is necessary to have a power supply which guaranties very high reliability.

Monitoring all voltages and currents of the supplied modules allows preventive maintenance and early detection of problems that may occur during operation of the modules. Having remote control of every single voltage channel also allows switching off or restarting particular modules during operation avoiding in-situ interventions.

To achieve these requirements, a special power supply concept was developed for the LLRF system of the EuXFEL. It consists of a central redundant power supply module (19") for every RF station in the accelerator. This module supplies, depending on the configuration, up to four 19" modules in the same rack. It provides seven output channels for each module. For EMI reasons these channels are divided into groups of bipolar voltages for digital and analog purposes. Every supplied module has its own power entry unit called FRED (Fuse Relay boarD). This internal unit controls up to eight voltage channels and is fully remote manageable. Furthermore, it monitors and controls the cooling fans of the 19" module and manages various hot-plug scenarios automatically.

The power supply concept realized at the EuXFEL is presented in this poster. In particular how the different hardware components are integrated and problems like voltage drops during submodule hot swap are solved. How firmware and software components of the whole power supply management system work together, from a finite-state machine on the power entry module to the GUI for the Operators in the control room is also presented.

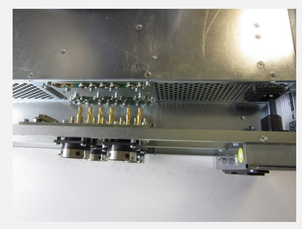
Basic concept



Power Supply Module (PSM)

Designed and produced by W-Ie-Ne-R Plein & Baus GmbH
for the EuXFEL
Wiener Type PL8-F8

Features
- > two equal modules for full redundancy
- > hot swappable
- > Ethernet for remote management
- > no active components on backplane
- > independent mains inputs for each module

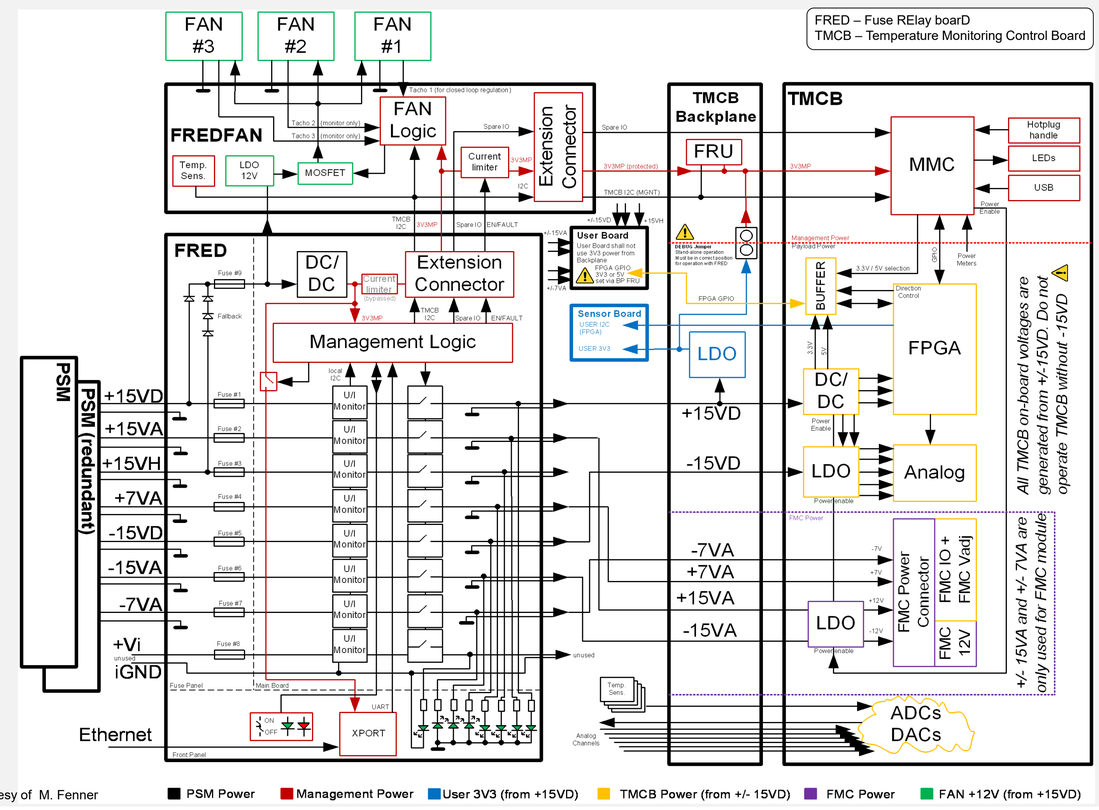


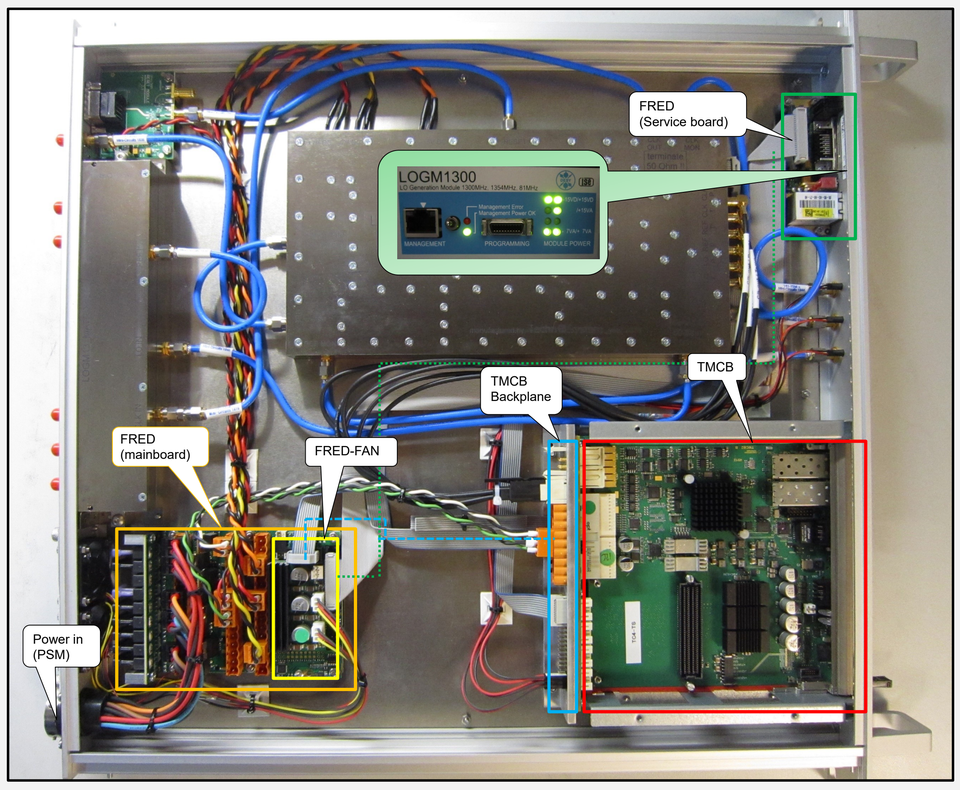
Output channels

CH	output voltage	max. current *	purpose / application
U0	+15 V	5 A	digital circuits (FPGAs, µC, …)
U1	-15 V	5 A	digital circuits (FPGAs, µC, …)
U2	+7 V	6 A	analog circuits (RF amplifiers, VCOs, …)
U3	-7 V	6 A	analog circuits (RF amplifiers, VCOs, …)
U4	+15 V	5 A	analog circuits (RF amplifiers, VCOs, …)
U5	-15 V	5 A	analog circuits (RF amplifiers, VCOs, …)
U6	+15 V	8 A	high current (Peltier modules, DRO heating, …)
U7	0 V	0 A	spare

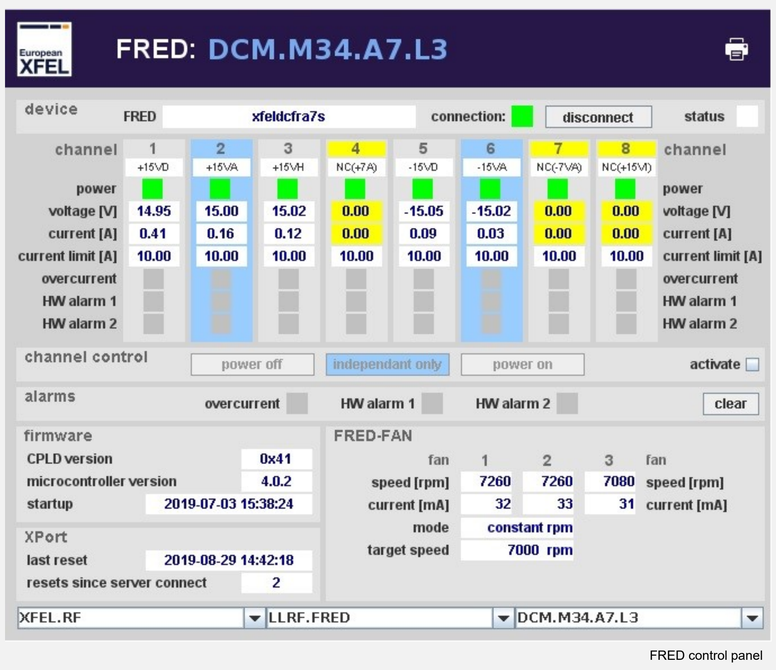
* When both modules are in operation, the possible maximum current is double as high (but no redundancy)

19“ module internal power distribution scheme (LOGM / DCM / REFM)

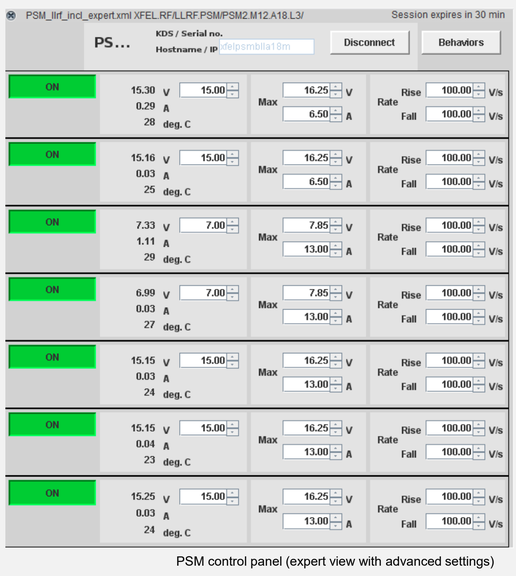




Control panels for the operator



FRED control panel



PSM control panel (expert view with advanced settings)

PSM control panel for master and slave station

Benefits

- > monitoring the voltages and currents allows remote diagnostics
- > remote power cycling for particular sub circuits is possible at any time
- > the condition of the fans and power supplies can be monitored which helps planning preventive maintenance and reduces downtime
- > One PSM cassette can be hot swapped (exchange without interruption of the supplied voltages). Therefore no time consuming recalibration of the LLRF system caused by phase loss of the RF occurs.

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