

IcePAP: An Advanced Motor Controller for Scientific Applications in Large User Facilities

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Large synchrotron radiation facilities like the ESRF are equipped with thousands of motorized position actuators, and the choice of the motor controllers is a strategic matter. In this poster we present IcePAP, a motor controller designed at the ESRF, based on the experience acquired in motion control during the first 15 years of operation of the facility, with the aim to optimise simultaneously functionality, performance, ease of deployment, level of standardisation and cost.

Design Goals

A High performance controller

- Specialised in motion and motor control
- Versatile, adaptable to various requirements
- Flexible, easy to interface with other devices

A Standard controller

- Low cost, also for simple applications
- Easy to install and support
- Reliable

IcePAP
 In-house development
 High quality components
 Direct outsourcing to manufacturing suppliers
 Optimised reliability and performance

Architecture

The IcePAP system

- Three main components: Rack, Controller board, and Driver board.
- Up to 16 linked racks (128 axis drivers) per system
- One single interface with the host control computer per system
- A field bus and synchronisation signals are shared by all the boards in the system

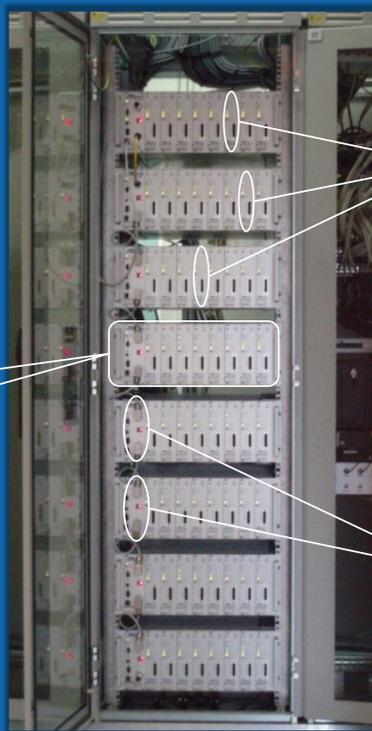
IcePAP rack

In each rack:

- one controller board
- up to eight driver boards
- Mechanical support to boards
- 1 kW power supply with power factor correction



EMC-shielded connectors for motor and encoders



IcePAP driver

- High performance single axis driver
- Flexible power driver
- Encoder readout electronics
- Synchronisation resources



IcePAP Controller

- Slave board
 - rack specific functions
- Master board
 - System functions
 - Ethernet interface to control system



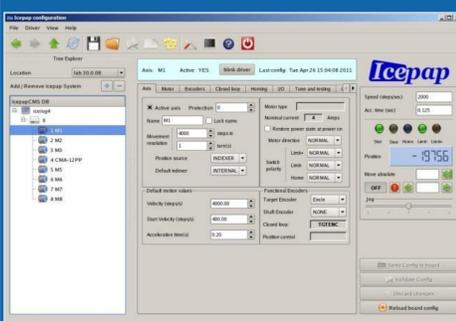
Characteristics

General

- 2-phase steppers (50mA to 7A)
- Motor voltage and current configurable per axis
- Internal resolution: 64bits
- 30Msteps/s step generators
- Up to 2 encoders per axis (incremental or SSI absolute)
- Trajectory generation
 - linear, jog, updated move
- IN/OUT synchronisation signals in each driver
- Very reliable hardware
 - <5 breakdowns/yr in 7 years (with 2700 axes in continuous operation)
- Low cost: ~500€/axis

System

- On-line reprogramming:
 - Full system firmware upgrade in a few minutes
- Detailed diagnostics
- Software axis configuration (no jumpers, no hardware options)
- A specific axis configuration tool IcePAP CMS:



Advanced functionalities

Presently available

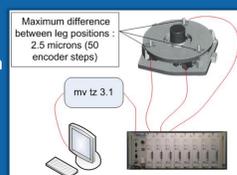
- Advanced homing
- Position closed loop
- Interface with external drivers
 - brushless, piezo-motors
- Multiaxes synchronised motion



ID20 Raman spectrometer analysers: 6 groups of 3x12 axes (216 in total). All axes in a group can be moved simultaneously for fast alignment

- Linked axes support
 - One degree of freedom with several axes

ID01 vertical translation with extremely low axial error (the three legs must move simultaneously)



Under development

- Parametric N-dimensional trajectories
- Additional motor types
 - 3-phase, DC, brushless
- Advanced tracking mode
 - Regulation over an external measure (a force, a beam intensity...)
- Advanced motion diagnostics tool
 - Use of the recording capabilities of the drivers
- Motion triggered by external hardware signals
- Electronic cam
 - A synchronisation output signal at specified positions