HIRSCHMANN

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Fieldbus in Basic Research.

Machinery

Fiber optic FIP field bus in gravitational wave antenna

One of the most demanding tasks in basic research is the detection of gravitational waves predicted by Albert Einstein. The detection of those waves is extremely difficult, because their interaction with masses is very weak. Thus huge detectors, mechanically very well insulated from earth generated noise are mandatory. Unfortunately those gravitational wave antennas must be extended over several kilometres. This makes the installations very expensive and therefore actually only five interferometers are operative worldwide with further detectors scheduled. A major project in Europe is named VIRGO. It is financed jointly by the French CNRS (Centre National de Recherche Scientifique) and the Italian INFN (Instituto Nazionale di Fisica Nucleare). The interferometer basically consists of two perpendicular arms, each of them three kilometres long. A plurality of research institutes contribute components to the detector situated in Cascina near Pisa in Italy, inaugurated Mai 2007. The University of Paris' Laboratoire de l'Accelerateur Lineaire worked on the ultra high vacuum system, where the large gate valves etc. are operated via FIP I/O networks using fiber optic communication made by Hirschmann™.

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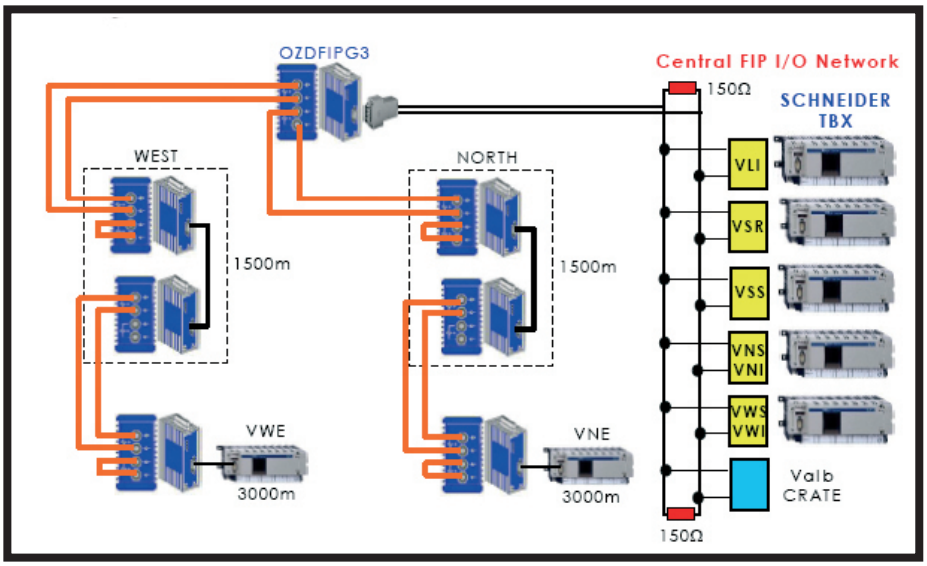

OZD FIP G3

Project details

The entire interferometer must be operated under ultra high vacuum; else the extremely small distance variations of the two masses could not be measured due to fluctuations in the density of the residual gas molecules. The expected distance variation is calculated to be far below one atom diameter! Thus extreme stability of all components of the interferometer becomes obvious. The 3 km long vacuum tubes have a diameter of 1.2 m. They are equipped at each end with large valve gates with an aperture of 1m to bring the components, e.g. the mirrors of the interferometer into the vacuum. Another extremely demanding task is the decoupling of the masses from any earth generated vibration. For the control system of the valves, pumping groups and vacuum gauges fiber optics is of course first choice in this extended high energy installation. Fibre optic cables are completely insusceptible to any electromagnetic influence. The communication protocol FIP I/O yields the necessary performance for isochronous real time communication.

Project parameters

- Mechanical dimensions:
  - Arm length 3km
  - Tube diameter 1.2m
- Vacuum performance:
  - Vacuum residual pressure <10mbar
- Laser system:
  - Laser frequency stability $<10^{-4}$ $Hz^{1/2}$
  - Stored laser power 50kW

Interferometer mirrors:
- Diameter 35mm
- Absorption <1ppm
- Micro roughness < 1 Ångstrom

Mechanical performance:
- Seismic attenuation 10^{-11}
- Thermal stabilisation 0.1 K

Requirements

- Control through high speed real time bus system
- Communication via fiber optics

Solution

- Control system based on FIP I/O
- Industry grade fiber optic converters from Hirschmann™
- Line topology alongside the ultra high vacuum tubes

Why Hirschmann™?

- Fiber optic repeater according to WorldFIP standard
- Availability of dual port repeaters for line topology
- Partner of PLC supplier Groupe Schneider