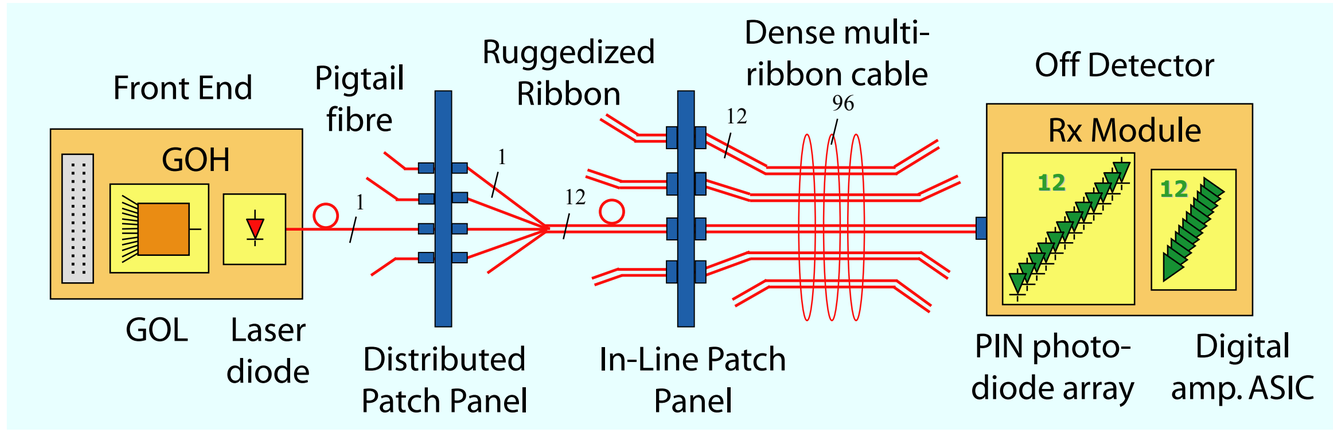
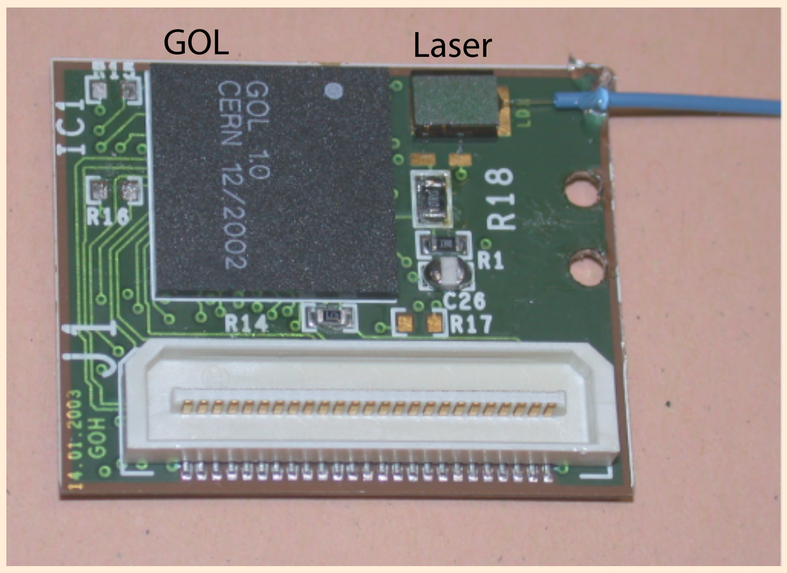
CMS ECAL Optical Data Links

Approximately 9,000 data links will be used to transfer trigger and event data from the front end of the CMS Electromagnetic Calorimeter (ECAL) to the off detector electronics. The link must operate at 800Mbit/s and achieve a bit error rate < 10^{-12}.

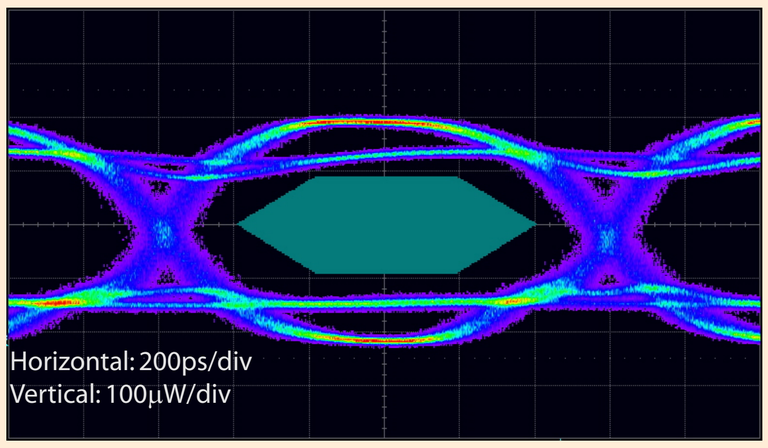




The GOH

GOL

The GOL was developed by the CERN microelectronics group as a combined serialiser and laser driver. It has been developed in 0.25μm CMOS technology using radiation tolerant layout techniques. It takes 16 or 32 channels of data at 40Mbit/s and combines them into one 0.8 or 1.6Gbit/s data stream using either 8/10 Bit or GLink protocols. In the ECAL links the GOL operates at 800Mbit/s using either protocol.



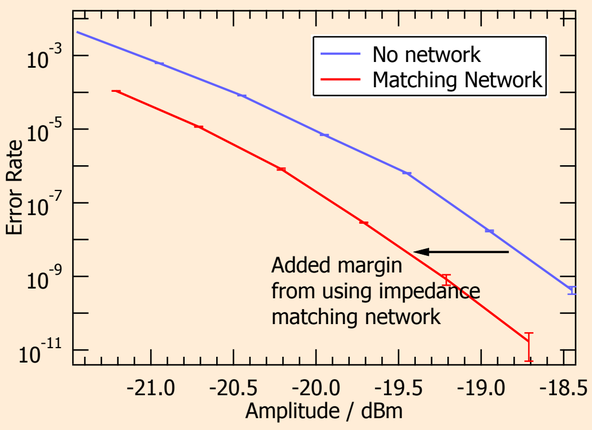
An eye diagram of the optical signal transmitted by the GOH with a mask test applied

GOL Optohybrid (GOH)

The GOH will be mounted on the front end electronics of the ECAL. It is composed of a connector, a Gigabit Optical Link (GOL) transmitter, a laser diode and passive components all mounted on a FR4 substrate.

Laser Diode

The optical transmitter was originally developed for use in the CMS Tracker analogue optical links. In order to avoid repeating the qualification process the same technology has been applied to the ECAL links. It consists of an edge-emmitting laser diode producing light at a wavelength of 1310nm. It has an optical fibre pigtail terminated with a MU connector. An impedance matching network has been developed to couple the laser to the GOL, opening the eye and increasing the margin in the link.

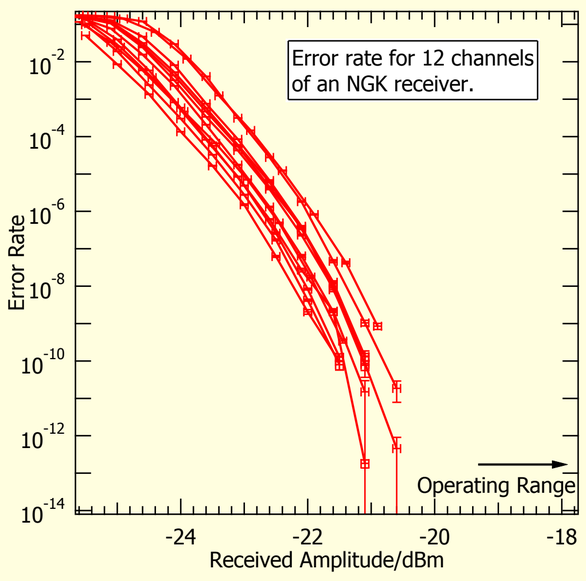


GOH Testing

The GOH must be tested by the manufacturer in under 1 minute to meet production requirements. A mask test is a fast solution for verifying the optical quality of the signal. The traces of the signal are overlaid on a scope to produce an eye diagram. If all the sweeps remain outside a shape or mask the GOH passes. The mask can determine the maximum jitter and rise and fall times as well as the minimum amplitude of the signal.

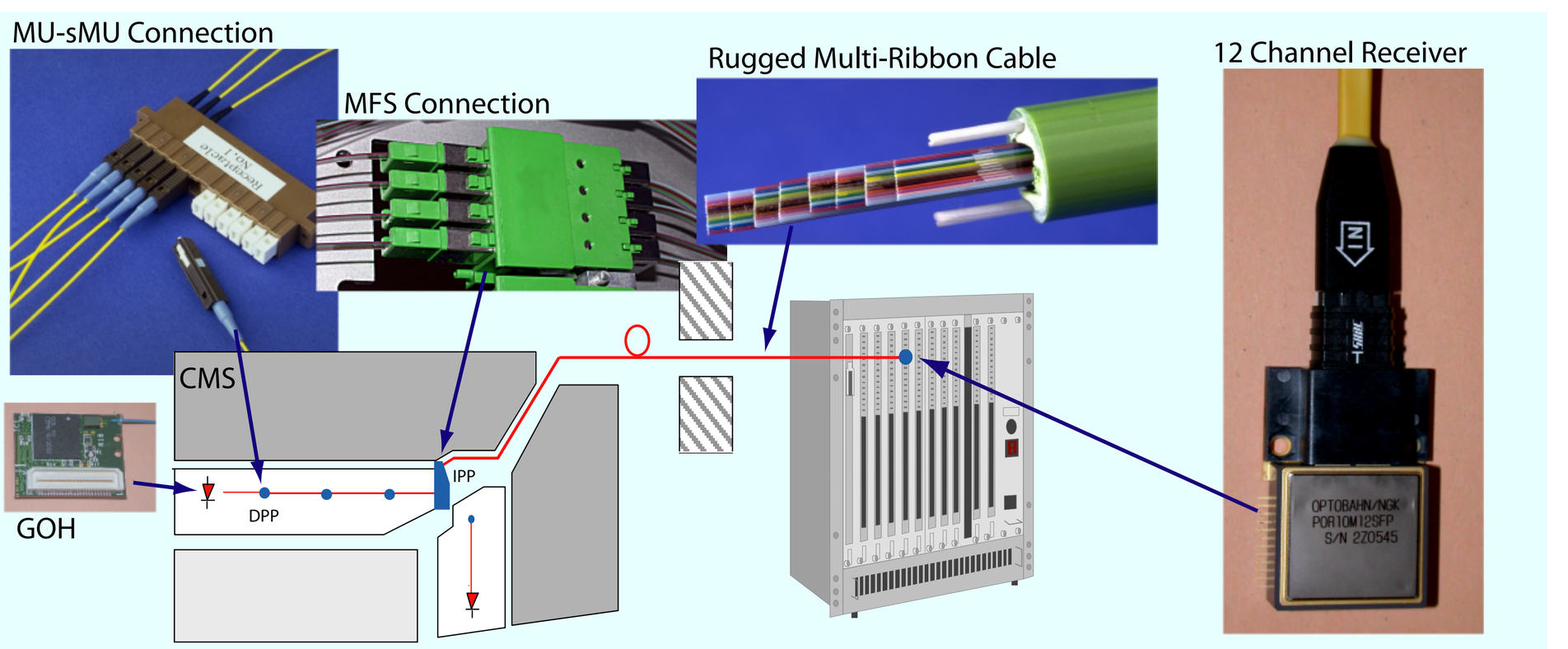
12 Channel Receiver

The 12 channel receiver module is a commercial product made by NGK. It converts the optical signal from 12 GOH to electrical differential signals to be passed on to a deserialiser. The signal entering the receiver can be attenuated down to amplitudes ~-18dBm before the error rate becomes significant. Given that the GOH produces an optical signal of about -5dBm (320μW) there is a good margin for attenuation or losses in the links. It can also tolerate up to ~-2.5dBm of average optical power before the receiver saturates.



Fibres and Connectors

The technology for the cabling has all been taken from the Tracker optical links. The single mode fibres from the laser go to a distributed patch panel (DPP) where they are connected to a fanout, combining 12 fibres into one ribbon. The ribbons are then combined via the in-line patch panel (IPP) to dense multi-ribbon cable containing 8 ribbons (96 fibres). Each ribbon is fed to a receiver on the off detector electronics.



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