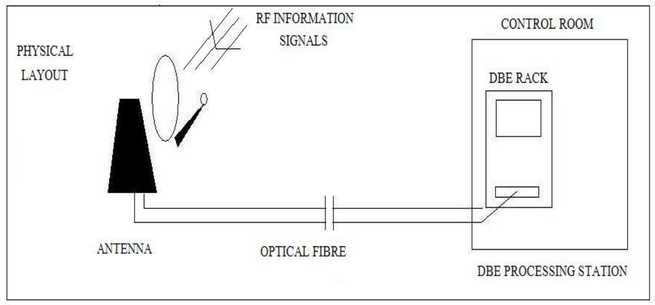
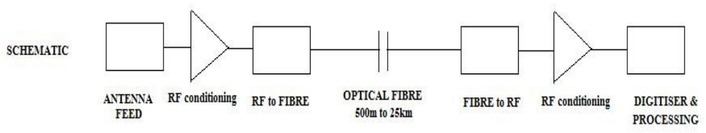
Phase Calibrator for meerKAT

by Roufurd Julie - MSc 2007

Physical Layout of 1 meerKAT Antenna-Receiver



Electrical Schematic of the RF chain of a meerKAT antenna



Some References

Temperature Sensitivity of a Fibre Optic link
Otokar Buzek,
European Frequency and Time Forum,1996, Pg471-474

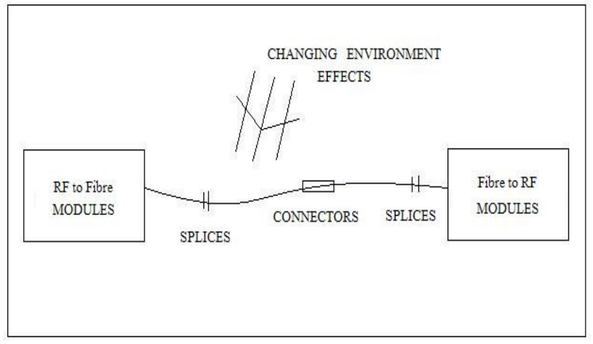
Predicted Optical Fibre length variations due to temperature variations
Terry Cotter,
EVLA Memo 10, September 2000

Methods of measurement of optical fibre properties
K.I. White,
J. Phys. E: Sci. Instrum., Vol. 18, 1985.

Background

In order to minimise the amount of Radio Frequency Interference (RFI), generated by the Digital Back-End (DBE), being picked up by the antenna, the Antenna and Signal Processing systems are physically separated. Optical Fibre is used to transport the information signal from the antenna to the DBE for processing, due to its wide bandwidth, and low attenuation properties. The optical fibre however, has a time varying influence on the phase and amplitude of the information signal. My project attempts to produce an instrument/methodology that measures and reports on these amplitude and phase changes in near real time.

Environmental Effects on Optical Fibre



Objectives

Measure the long term phase stability of the fibre optic link and report on these changes

Determine the variation in power gain over the life of the fibre optic link and report on these changes

Methodology

Investigate the requirements to which the phase and magnitude properties are to be known. This involves speaking to the Imaging team at meerKAT.

Understand why the phase and magnitude changes in the optical fibre circuit. This would consist of theoretical and experimental investigations.

Evaluate different solutions to the measuring and reporting problem.

Design and implement the chosen measuring and reporting system, to fulfil the objectives.

Test the performance of the solution.

Solution

A fibre, forming part of the main fibre bundle, will be looped back at the point where the information signal is optically modulated onto the fibre. This fibre is in the same environment as the information carrying fibre, and thus will represent the status of all the fibres in that bundle.

An sinusoidal signal, at 2 different frequencies, representing the content of the information signal, will be sent down the fibre mentioned above.

The phase and amplitude changes of this representative signal will be measured and reported upon, in a method TBD.

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