REFLECTOMETER SYSTEM FOR ACTIVE PHASE DRIFT COMPENSATION IN COAXIAL CABLES

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Introduction
The performance of the RF phase reference distribution system suffers from phase drifts in coaxial cables. Drifts caused mainly by temperature changes must be reduced to fulfill the system performance requirements. Reflectometer scheme for active phase drift compensation has been developed to actively reduce phase drifts in coaxial cables.

Design and first measurement results from a prototype reflectometer system are presented. The main goal of the reflectometer was to achieve phase drift compensation at the level of 0.1 ps p-p over 1 hour in 200m long coax cable link.

Requirements
- Compensate phase drift with a speed greater than 2kHz
- Operation at frequencies of 216 MHz or 1300 MHz
- Maximum cable attenuation: ≤10dB
- Required phase stability: <100 fs rms

Operational Principles
- The reference signal (forward) is compared by a phase detector with the reflected signal (backward).
- Changes of the backward signal are double in relation to forward phase changes in the cable.

System Diagram
- Board with RF components and microcontroller circuit was designed to process measured signal, calculate calibration and correction coefficients and to close the feedback loop.
- PID regulator was used

Problems
- System component drifts with temperature and humidity changes
- Humidity change cause a large phase drift almost equal to requirements
- Device and test setup have to be inserted into climate chamber to prevent from error caused by humidity and temperature changes

Reflection of JSPHS-1000 changes from -7dB to -30dB during the change of control voltage. So huge changes eliminate simple analog solutions.

The main signal is the smallest unfortunately
- The reflection of JSPHS-100 Phase Shifter have to be measured in control voltage domain and used as a correction values

Practical Realization
- Waterproof metal case
- Thermal isolation
- Internal temperature stabilization
- High speed ARM microcontroller
- Precision ADC and DAC

Measurement Results
- The test setup included 12m SS420 cable which was cooled or heated
- Large temperature changes showed less phase compensate error then long work in stable temperature
- Influence of external effects occurs

Conclusions and Potential System Improvements
Conclusions
- System is working but still it has to be improved
- There are many problem which have to be solved especially the isolation from influence from outside temperature and humidity and improvement precision of calibration

Potential system improvements
- Build a smaller device and improve EMC and noise protection
- Use a faster ADC
- AutoDetect of RF signal power level
- Upgrade used temperature and humidity stabilization methods

References