

FutureCom Training Course Agenda DRAFT

PTB Braunschweig and ONLINE

Wednesday 29th November, 14:00 – 17:05

Course title: Harsh Environmental Testing of RF and Microwave Circuits for Future Communications Technologies

Course Abstract: This course explores testing methods to assess the performance of RF and microwave circuits in real world and harsh environments such as above and below ambient temperatures (including at cryogenic temperatures) and at different levels of relative humidity. This assessment will aid future communication technology design by offering a better understanding of where the limit of operation is when using certain materials thus leading to better optimisation in cost and time to produce.

The course begins with an overview of the different types of environmental testing that are commonly performed for the evaluation of electrical circuits including printed circuit boards (PCBs). Following this will be a look at the design of the evaluation PCBs used for environmental testing in the FutureCom project. There then follows a discussion on the importance of end-launch RF connectors for use with high frequency PCBs. Moving onto on-wafer electrical circuits, a comparison of measurements before and after thermal cycling of an impedance substrate standard (ISS) is examined for any degradation resulting from the environmental conditioning. Finally, the course concludes with a discussion of proposed EM modelling for wafers and Si-based components that will be subject to cryogenic temperatures to investigate how these conditions will impact their RF performance.

Talk #1: 14:00 – 14:30

Speaker: Ana Robador, National Physical Laboratory (NPL)

Title: PCB Reliability Testing Methods

Abstract: In-field reliability and lifetimes of product are dependent on individual component or material reliability or the effects of combining materials. In this presentation, we will explore common failure modes in electronics systems, in particular those that may affect high frequency performance in substrates. We will look at the role of the substrate, an introduction to the measurement techniques and degradation conditioning which can be utilised and what they can tell us about performance in the field.

Talk #2: 14:35 – 15:05

Speaker: Lewis Manning, National Physical Laboratory (NPL)

Title: Design and testing of an FR4 based reference PCB for environmental testing of RF & Microwave circuits

Abstract: A 4-layer reference Printed Circuit Board (PCB) is designed that features simple RF and microwave printed structures and standards that will be used to evaluate the performance of the reference PCB before, during and after harsh environmental testing. This talk explores some of the design principles and techniques associated with general microwave PCB design as well as how they have been considered during the design of this reference PCB. The PCB stackup itself aims to emulate the operating environment of a sub-6 GHz PCB used in industry and uses a typical FR4 substrate throughout the PCB's stack up (Isola 370 HR). To evaluate the performance of the PCB, S parameter measurements are performed and compared against simulation data to determine how effective the design implementation is and are shown in the latter part of the talk.

Talk #3: 15:10 – 15:40

Speaker: Bill Rosas, Signal Microwave

Title: PCB Connector Launch Design

Abstract: Critical in many new projects is a transparent interface to the board - one you do not even notice is there. This connector to board interface is referred to as the board “launch”, where the RF energy transitions from the connector to the board. Use of a high-quality connector and proper PCB design and fabrication all need to be addressed for a “transparent” connection to the board.

BREAK (15:40 – 16:00)

Talk #4: 16:00 – 16:30

Speaker: Devika Poduval, VSL

Title: VSL Results for On-Wafer Environmental Age Testing

Abstract: The behaviour and performance of on-wafer planar calibration circuits change throughout their lifetime. To understand the limits of operation and how the environment affects performance, accelerated ageing tests are conducted to simulate real-world and harsh conditions. This includes age testing, where the circuits are electrically tested before and after various environmental tests. In this talk, we present the first results for the on-wafer planar circuits, electrically tested, before and afterwards under ambient environmental conditions to determine any degradation in the performance due to the thermal cycling.

Talk #5: 16:35 – 17:05

Speaker: Ehsan Shokrolahzade, Delft University of Technology (TUDelft)

Title: Impedance Standard Substrate Characterization and EM model definition for Cryogenic and Quantum-Computing Applications”

Abstract: This talk describes the proposed modelling approach and the characterization procedures used to develop accurate standard models for cryogenic, probe-level, calibrations substrates. Key electrical and mechanical parameters of the impedance terminations and the lines used in commercially available impedance standard substrates are characterized versus temperature. Usage of 2.5D EM commercial solvers is shown to provide numerically derived models at cryogenic temperatures. Measurement result of different calibrations at cryogenic temperatures is evaluated on CPW lines on the calibration substrates and also on state of the art passive components integrated in Si-based technology.