TERAmeasure Non-contact millimeter and Terahertz frequency measurement paradigm for instrumentation and sensing applications unlocking metrology-grade results

D2.3:
Interconnection head assembly

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Dissemination level		
PU	**Public**	**X**
PP	**Restricted to other programme participants (including the Commission Services)**	
RE	**Restricted to a group specified by the consortium (including the Commission Services)**	
CO	**Confidential, only for members of the consortium (including the Commission Services)**	

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Document updates

Version	Date	Author	Organisation	Changes
1.0	27/04/2022	G. Carpintero	UC3M	First draft sent to partners
2.0	30/04/2022	G. Carpintero	UC3M	Updated draft

Abbreviations

DUT	Device-Under-Test		
DWS	Dielectric Waveguide Structure	**KoM**	Kick-Off Meeting
CPS	Coplanar Stripline	**LO**	Local Oscillator
CPW	Coplanar Waveguide	**MF**	Multiplication Factor
PIC	Photonic Integrated Circuit	**MMW**	Millimetre wave frequency
ER	Extinction Ratio	**MMIC**	
HDR	Harmonic Distortion Ratio	**THz**	Terahertz wave frequency
IF	Intermediate Frequency	**VNA**	Vector Network Analyser

Statement of independence

The work described in this document is genuinely a result of efforts pertaining to the TERAmeasure project. Any external source is properly referenced.

Confirmation by Authors:

Guillermo Carpintero, UC3M

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Executive Summary

This deliverable description is “Pictures of the assembled interconnection head, including photonic integrated photomixer chip onto the micromachined dielectric rod waveguide”

This deliverable, by means of photographic documentation, reports on the successful development of a photonic RF test probe with components from the first iteration (micromachined silicon rod waveguides from KTH and chip with photomixers for transmitter and receiver functionalities from HHI).

This is a novel interconnection head for the photonic-based vector network analyser (VNA).

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1. Introduction

The interconnection head is the element enabling the radically new measurement paradigm in the millimetre (MMW, 30 GHz–300 GHz) and Terahertz (THz, 300 GHz–3 THz) frequency bands, overcoming the current obstacles to better measurements by eliminating the frequency banded nature of rectangular waveguides. The initial vision in the project is shown in the following figure:

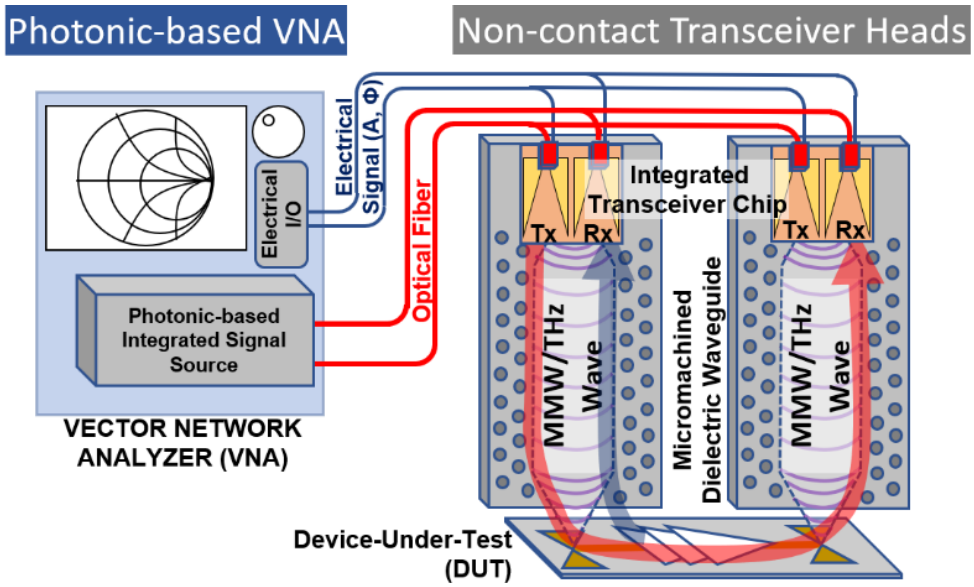

Figure 1. ***TERAmeasure*** *vision for non-contact transceiver head concept.*

One of the key element that we identified was the non-contact transceiver heads, which we identified had two main components:

1) Transceiver Chip (UC3M, HHI-THz), to unlock continuous-wave frequency generation and phase sensitive detection, including 1550 nm photomixing emitter (Tx) and receiver (Rx) with wideband antennas creating a point source to optimize the coupling of the generated signals to the dielectric waveguide over a wide frequency range.

2) Dielectric waveguide (UC3M, KTH), to unlock the ultrawideband non-contact interconnection between the interconnection head and the Device-Under-Test. This is a critical element which needs to provide low insertion losses, over an extremely wide frequency range. These are challenging aspects, as it is difficult to achieve impedance match over such a spectral range.

The successful fabrication of these devices was already reported in Deliverable 2.1, and the present one aims to demonstrate the successful assembly of these components into a Test Probe Head.

2. Assembled probe head

2.1 Test Probe Head sub-assembly

The assembly process was defined through several project meetings, mainly from discussions between FhG-HHI and UC3M, developing an assembly process.

The different elements in the probe head, mainly the carrier substrates and PCBs were designed by UC3M, ordering all these parts and connectors.

On September 2021, the first sub-assembly of the test probe was assembled at UC3M using Photoconductive InP chips from HHI.

The result, on the die bonder machine, is shown below:

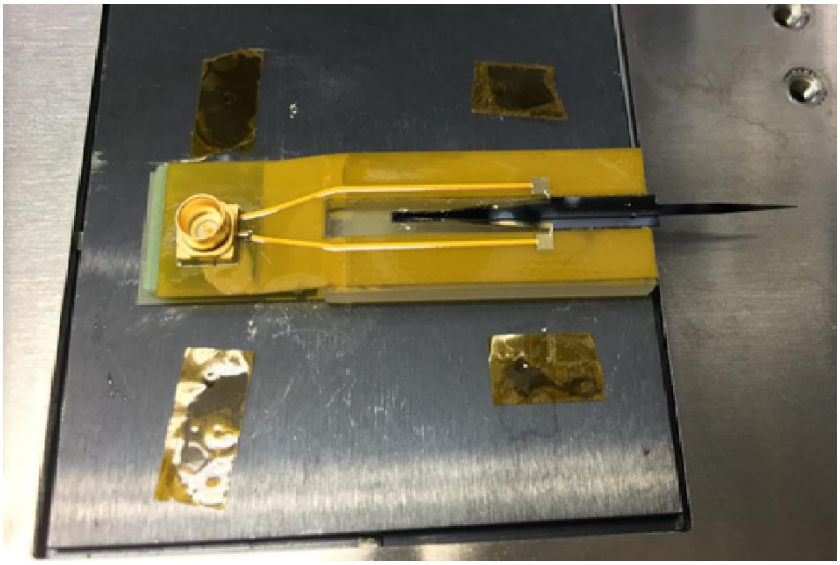

Figure 2. Picture of the assembled non-contact photoconductive-based head

2.2 Test Probe Head subassembly in experimental setup

The test probe sub-assembly has been introduced in the experimental setups to assess the performance of the element.

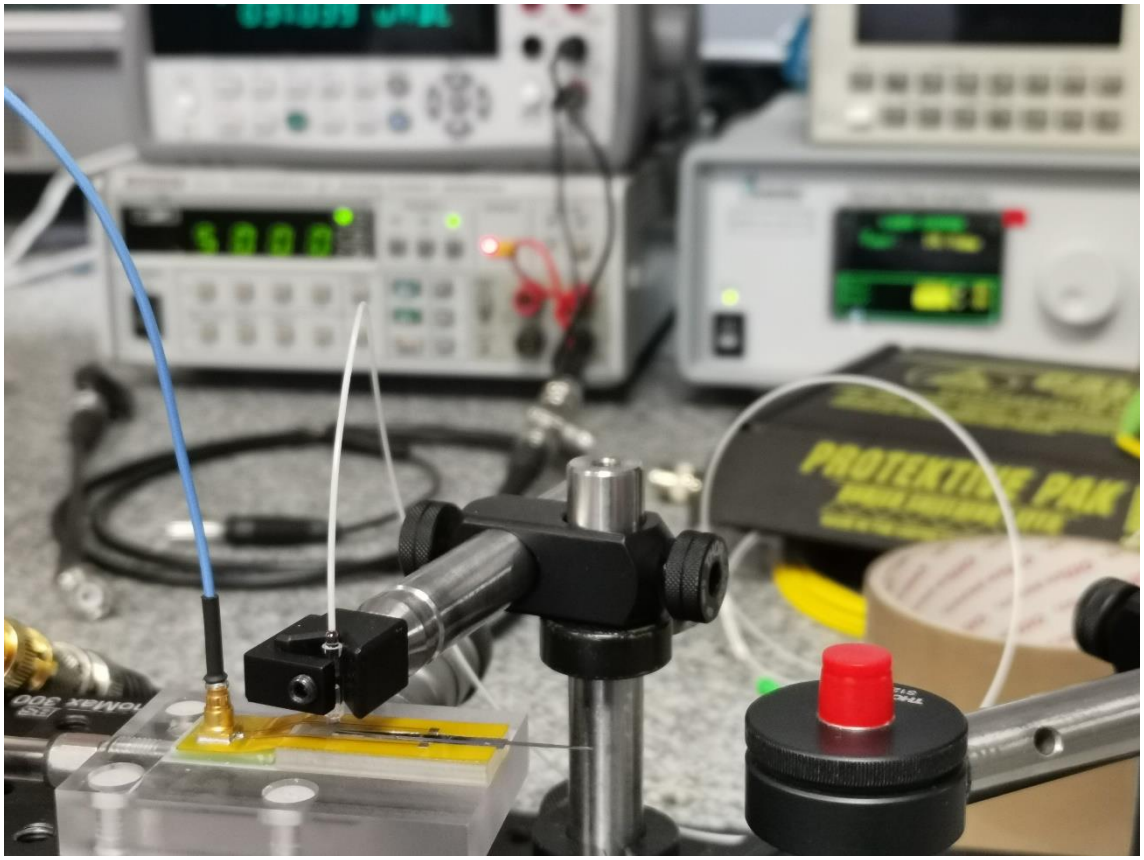

Figure 3. Picture of the experimental setup to characterize the photoconductive-based head.

2.3 Towards a Test Probe Head

We have already designed and fabricated the carrier platform, which is compatible with current probe positioners.

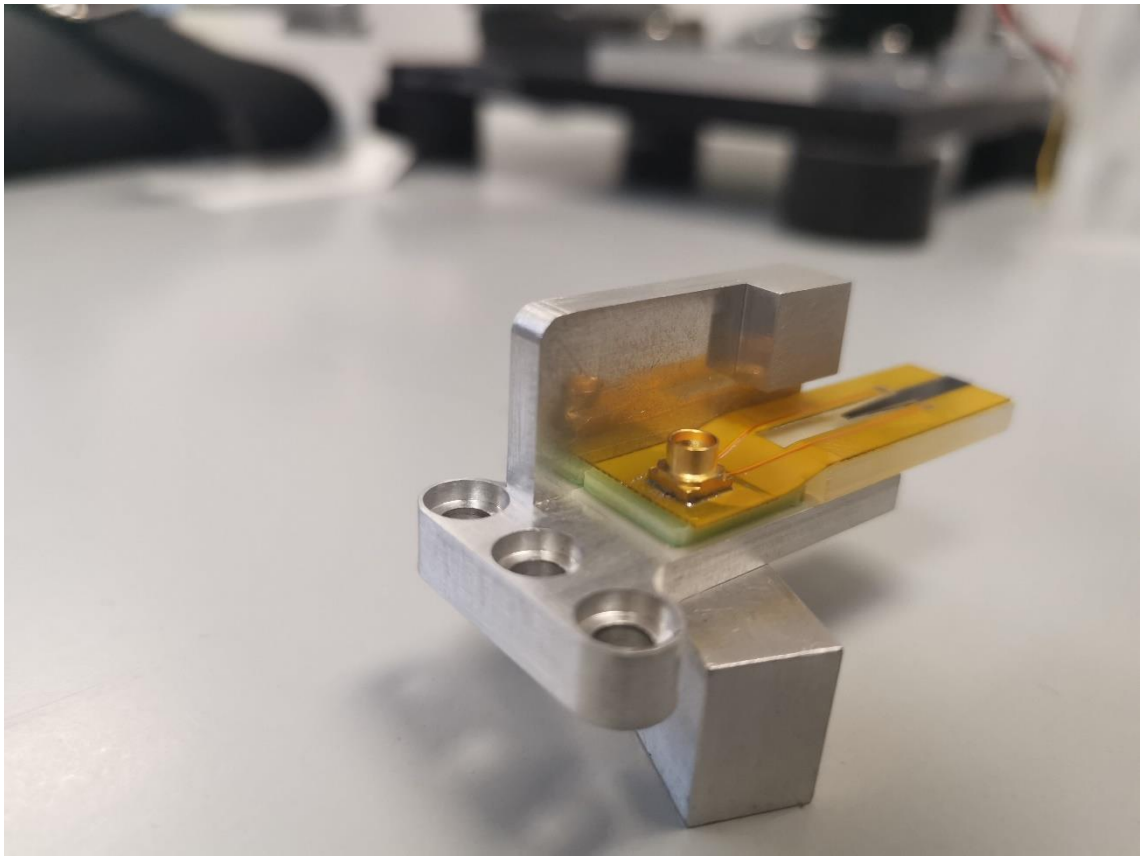

Figure 4. Picture of the planned assembly structure to place probe in positioner holder.

However, we have yet to determine which type of optical fiber (grin lensed, lensed fiber) is best suited, prior to attach the fiber in the carrier platform.