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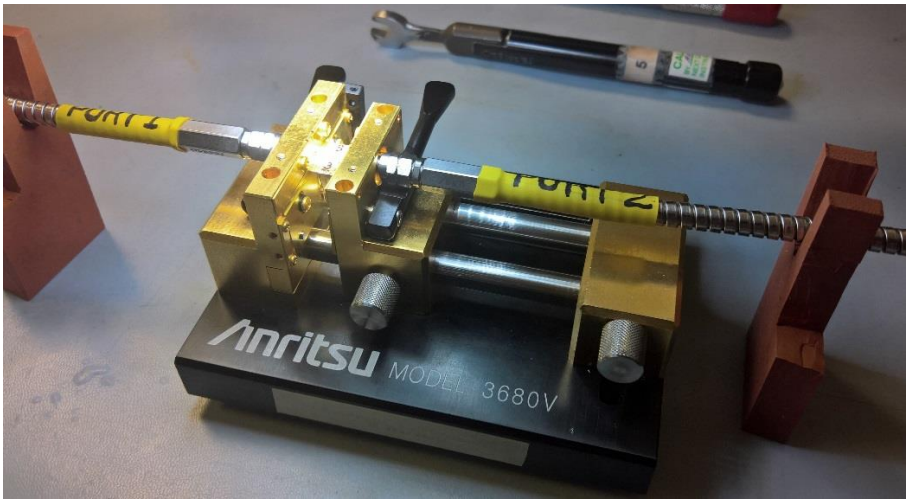
# RF Performance Test Report

## TT9 Series Attenuators
## RF Response Measurements Comparison: Universal Test Fixture (UTF) vs. Evaluation Test Board (EVB)

Juan Ayala, 08/10/2018



## 1. Scope:

In order to achieve the best RF response measurements that mimic actual device use, SMT devices should be soldered and measured in a de-embedded test fixture, usually small in size, with an LRL calibration, and using the best coax-to-DUT PCB transition launch possible. Evaluation Test boards are physically larger, use non-metrology quality transitions (solder-on, end launch connectors), and will be used to verify the product with traditional SOLT (Short-Open-Load-Thru) calibrations since SOLT standards are widely available and easy to use and repeat. This document shows the difference in RF response between the Reference (UTF) and Evaluation Test Board (EVB) fixture types designed for the TT9XX.0SMT Attenuators.

## 2. Test Description:

The first group of parts tested were TT9XX.0SMT 0dB through 10dB Attenuators soldered with Sn62 to the REF4720 Test Boards that were modified to .454" long (1cm Ref distance plus the DUT length) to fit the Anritsu 3780C Universal Test Fixture (UTF) and measured on Anritsu 37297C VNA (see figure 5 & cover photo). The metrology grade coax-to-microstrip line DUT transitions of the fixture combined with the LRL calibration, which de-embeds fixture effects essentially up to the DUT itself provides the best opportunity to obtain the best performance and truest results of the DUT (Device Under Test). The UTF measurements are considered to be the Reference measurements and are used for customer requested S-parameters which are used in circuit simulations.

The second group tested for comparison were TT9XX.0SMT 0dB through 10dB Attenuators from the same lots as the first (Reference) group, but not the same parts. The parts were tested on EVB-TT9 (TT9XX.0SMT Evaluation Test Board, see figure 6) which was modified to make a Production-type non-solder contact (push-on) RF Test Fixture by tinning the contact, attaching to a base, and adding a Kapton tape nest (see figure 7). The parts were measured on an Agilent E8363B VNA. The EVB-TT9 Thruline performance is respectable, but not as good as the UTF thruline. The higher VSWR effects of the EVB fixturing transfer to the DUT measurements.

## 3. Notes and Observations:

- Due to the attenuation effect previously described, the data presented, on both test groups, includes the test fixture loss. Normalization of the line loss would cause the Attenuation results to fall outside of the specification limits in both test groups. S-Parameter files always record the raw (loss included) data, making the data given to the customer for simulation, the same as what is presented in this document, which shows spec compliance.

- Both Measurement groups showed some values (8, 9 & 10dB) exhibiting a loss in attenuation at higher frequencies. This effect could be caused by internal signal coupling within the device's resistors, but these measurements cannot detect that possible effect.

- The largest source of The UTF measurement error is slight, and it comes from the difference in loss between the UTF Cal standard (10mil thick Alumina) & the DUT EVB (13.3 mil thick RO4350B)which is negligible below 10GHz and increases to ~.4dB @ 20GHz (see figure 8), this loss is ignored as not significat per Anritsu UTFR Operation Manual and the fact that Loss measurements are relative.

- The largest source of the EVB measurement error is in Reflection (VSWR) and is due to the increased PCB length and also the connector quality and match to the transmission line. Also the loss of the EVB fixture is ~3X  than that of the UTF (see figure 9), but it is due to its' physical size.  Thruline is normally used to remove this error. But again, the fact that Loss measurements are relative, it makes the attenuation response curves very similar to the reference (UTF) attenuation response curves.

- All devices met specification on both fixtures (discounting the fixture loss normalization). The worst performance being the 0 dB device measured the highest reflection at 10GHz, but it still meet the 1.7:1 max VSWR spec (figure 2).

## 4. Conclusion:

Based on the measurements shown, the TT9XX.0SMT design meets the VSWR & Attenuation specifications on the Reference fixture: the Anritsu UTF, and also meets these specifications, albeit to a lesser degree, on the TT9-EVB Evaluation Test board which will be used as a component in the TT9XX.0SMT Evaluation Kit. The EVB can also be modified to be used as a production, non-solder contact RF Test Fixture used for product validation.

## 5. Test Results:

VSWR and Attenuation plots of UTF (Reference) and EVB push-on fixtures are shown in figures 1 – 4 below:

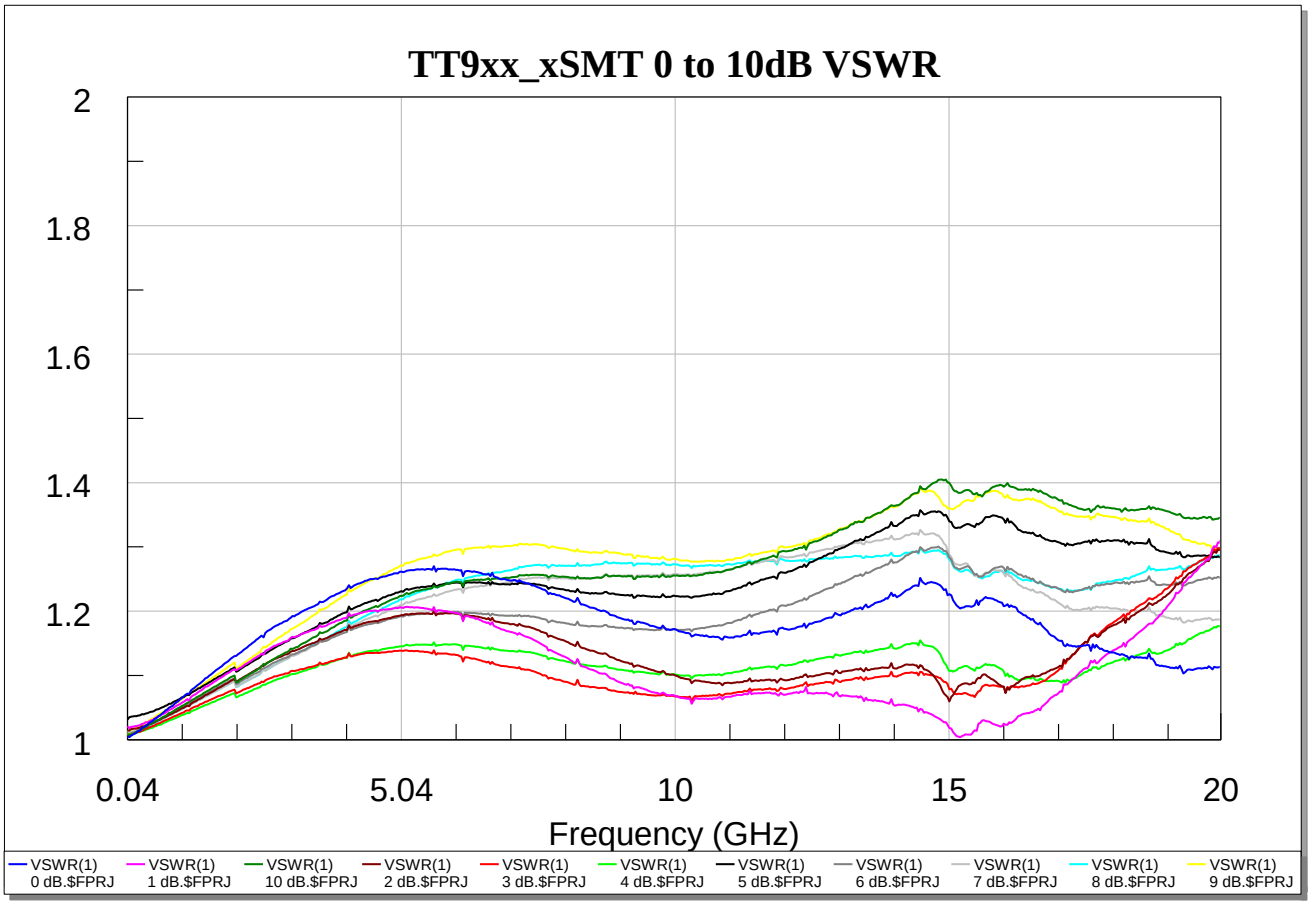



*Figure 1:TS09xx.xSMT 0dB to 10dB VSWR soldered devices on UTF fixture.*

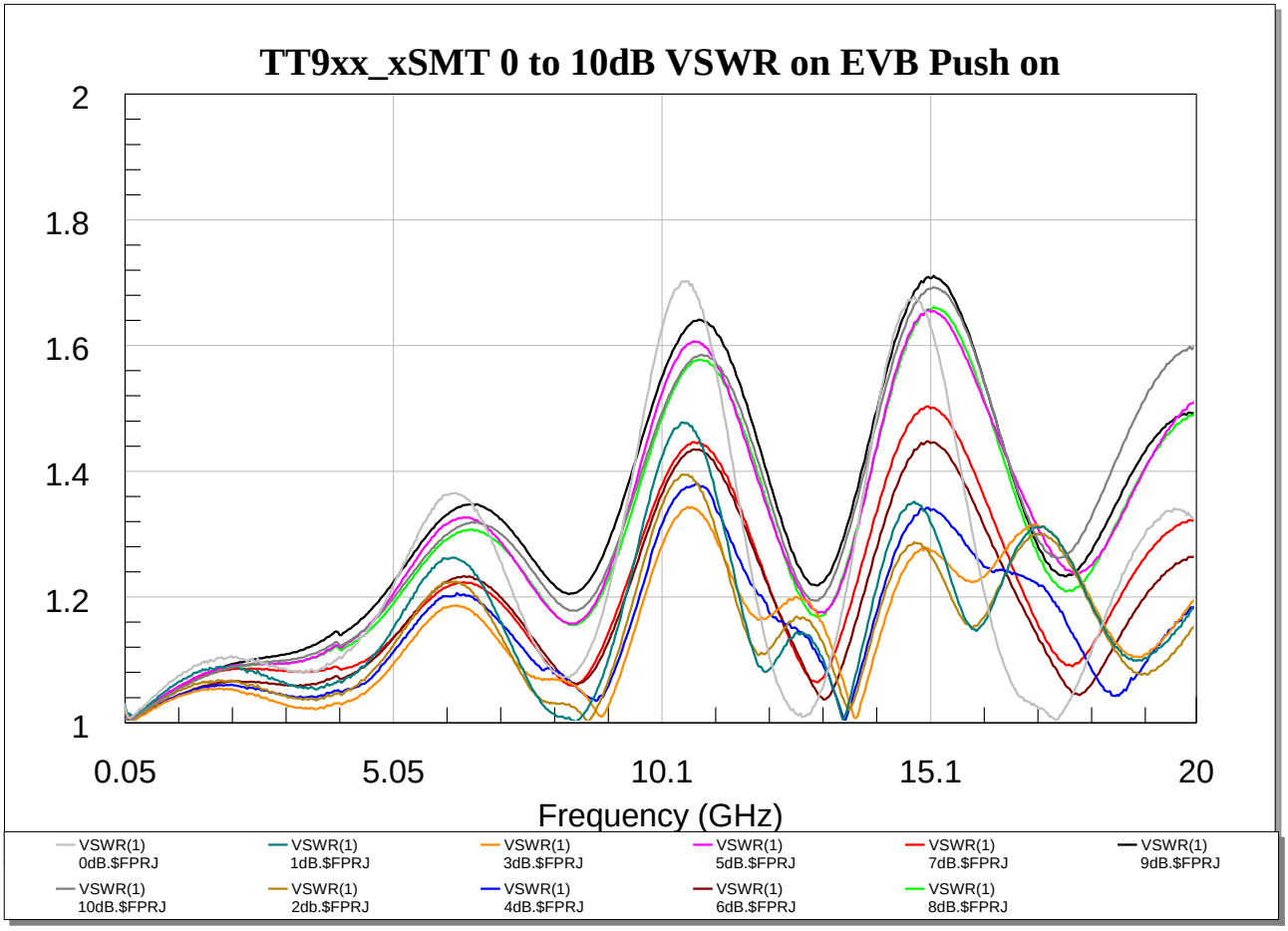



*Figure 2: TS09xx.xSMT 0dB to 10dB VSWR on EVB push-on fixture.*

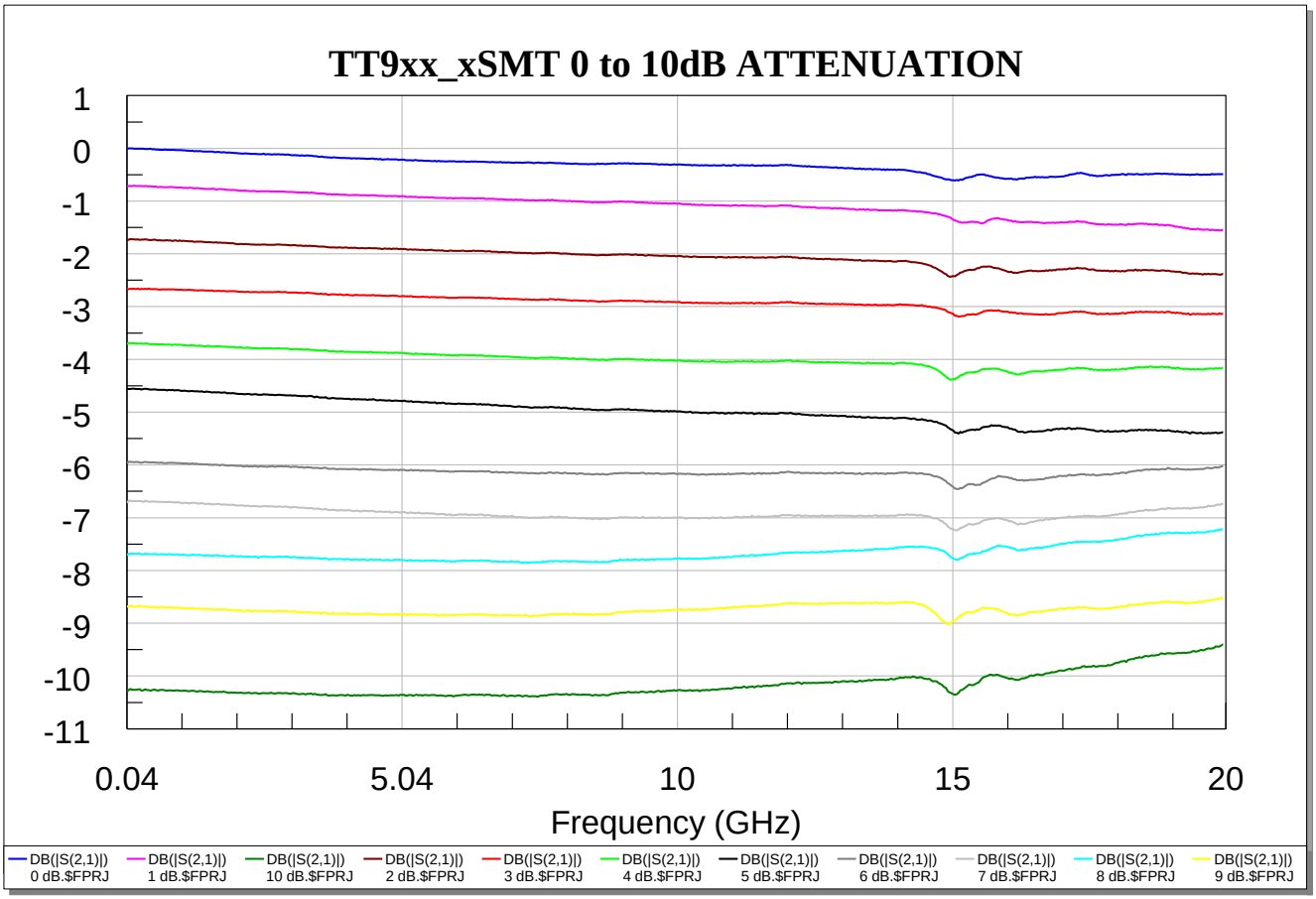



*Figure 3: TS09xx.xSMT 0dB to 10dB Attenuation soldered devices on UTF fixture.*

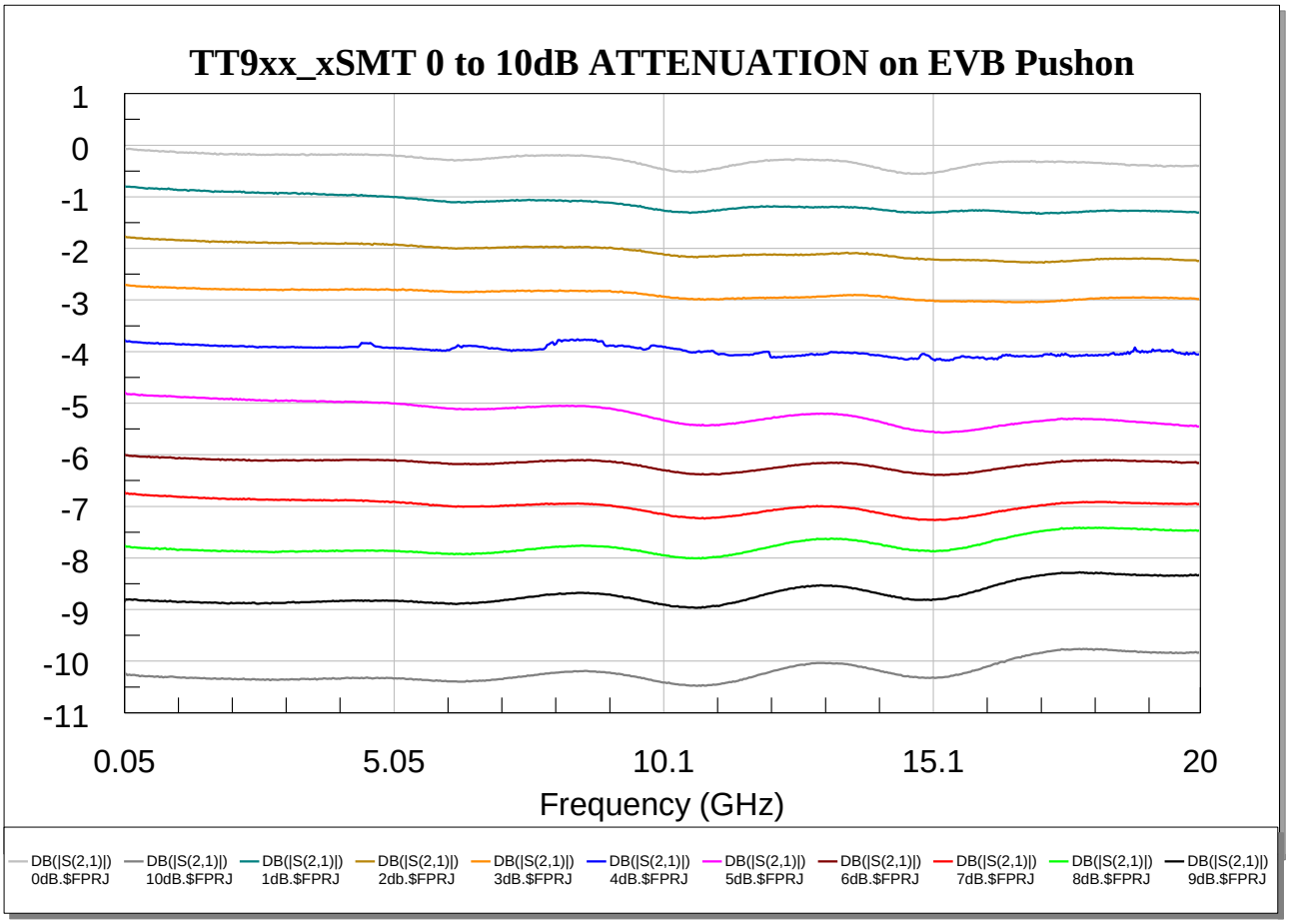



*Figure 4: TS09xx.xSMT 0dB to 10dB Attenuation on EVB push-on fixture.*

## 6. Exhibits:

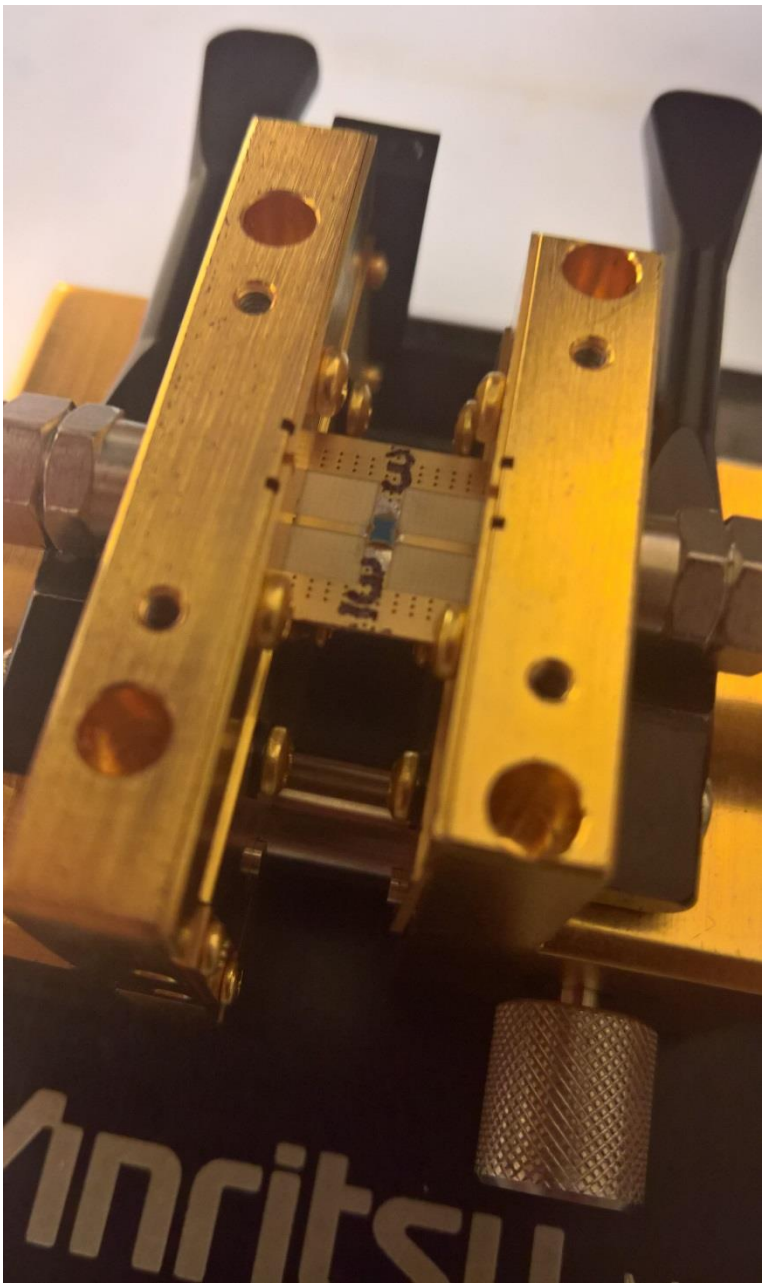



*Figure 5: TT903.0SMT soldered to REF4720 mod Test Board being measured on the Anritsu 3780 UTF.*

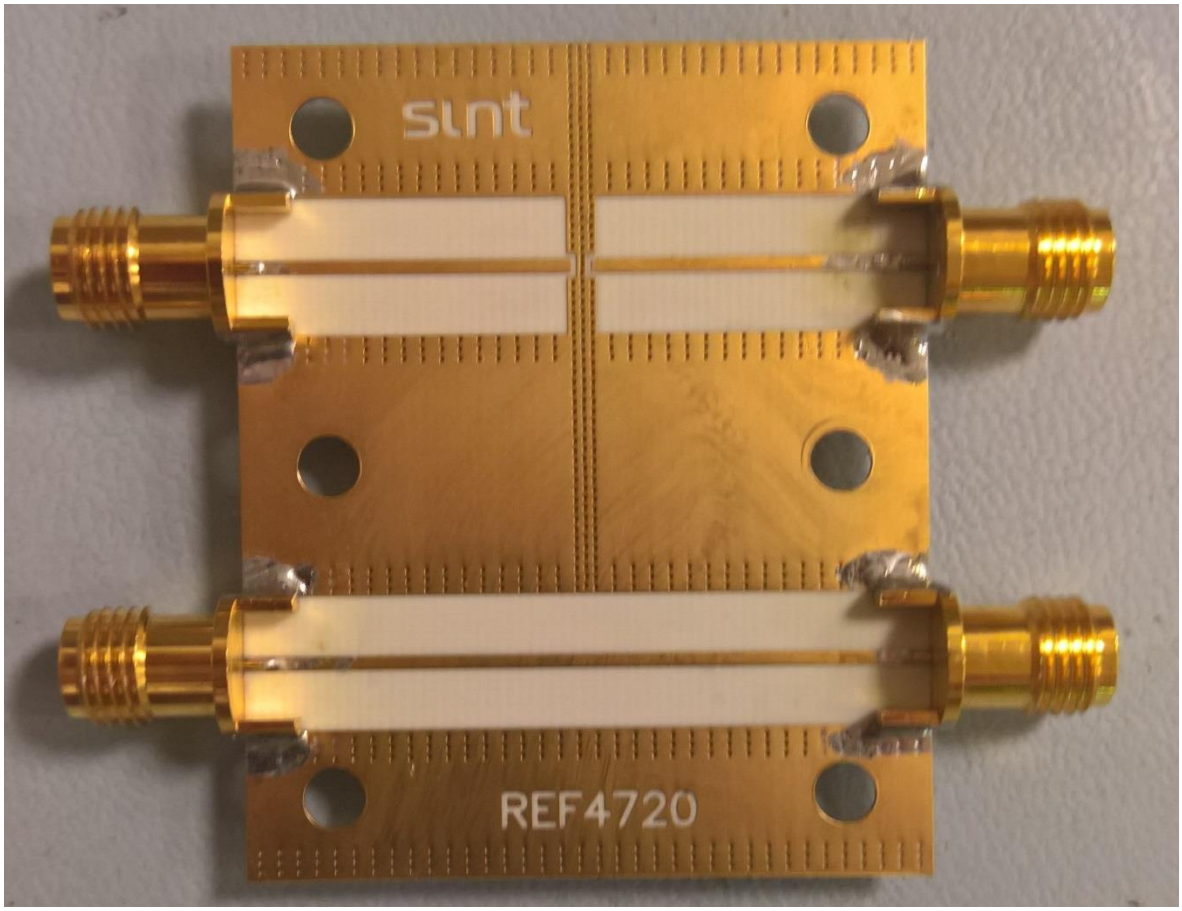



*Figure 6: TT9-EVB is the TT9XX.XSMT attenuator family Customer Evaluation Test Board, which consists of the REF4720 Test board and the 009-01-078 Edge launch connectors.*

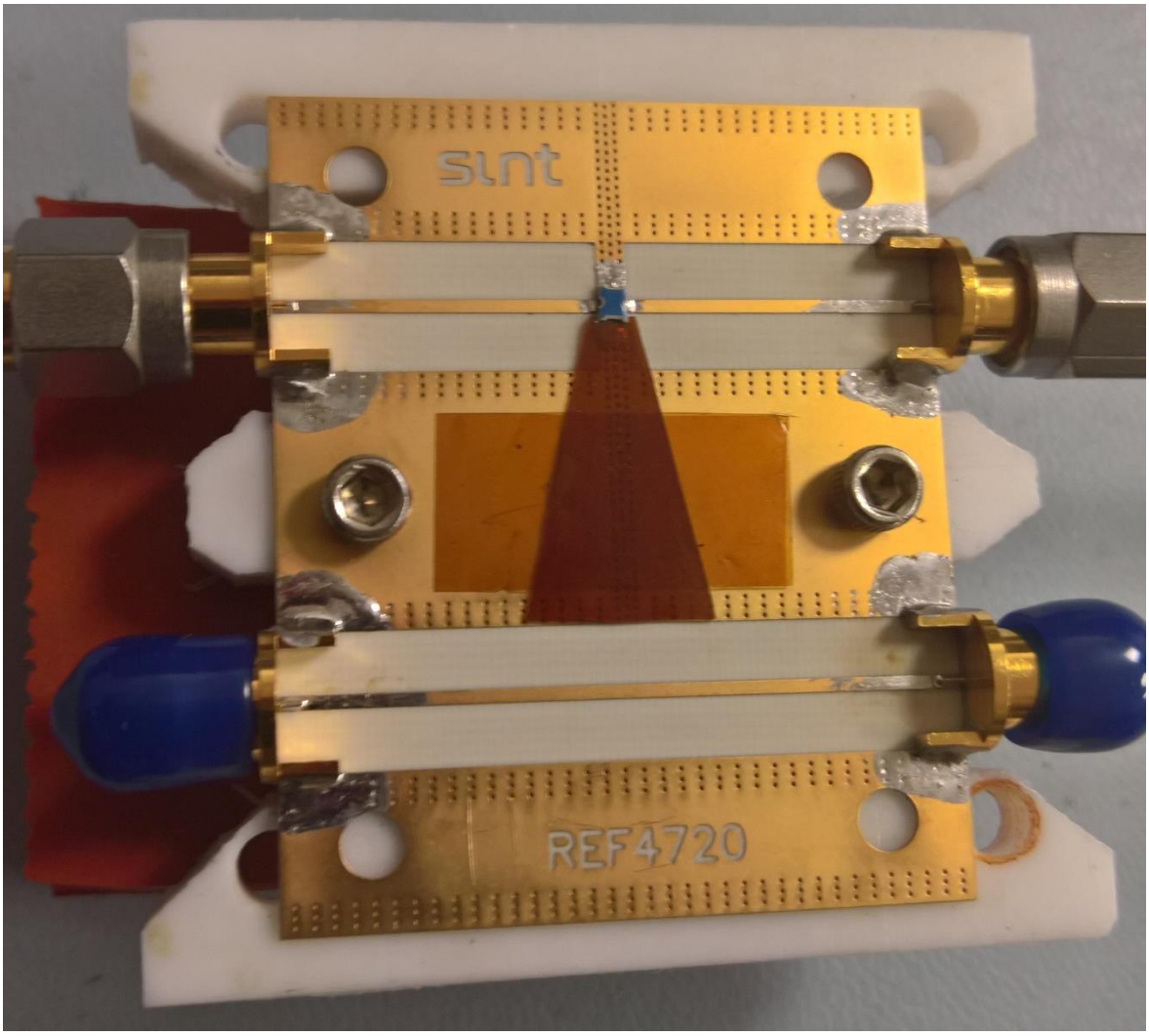



*Figure 7: TT910.0SMT attenuator in the TT9-EVB modified to be a push-on RF Test Fixture.*

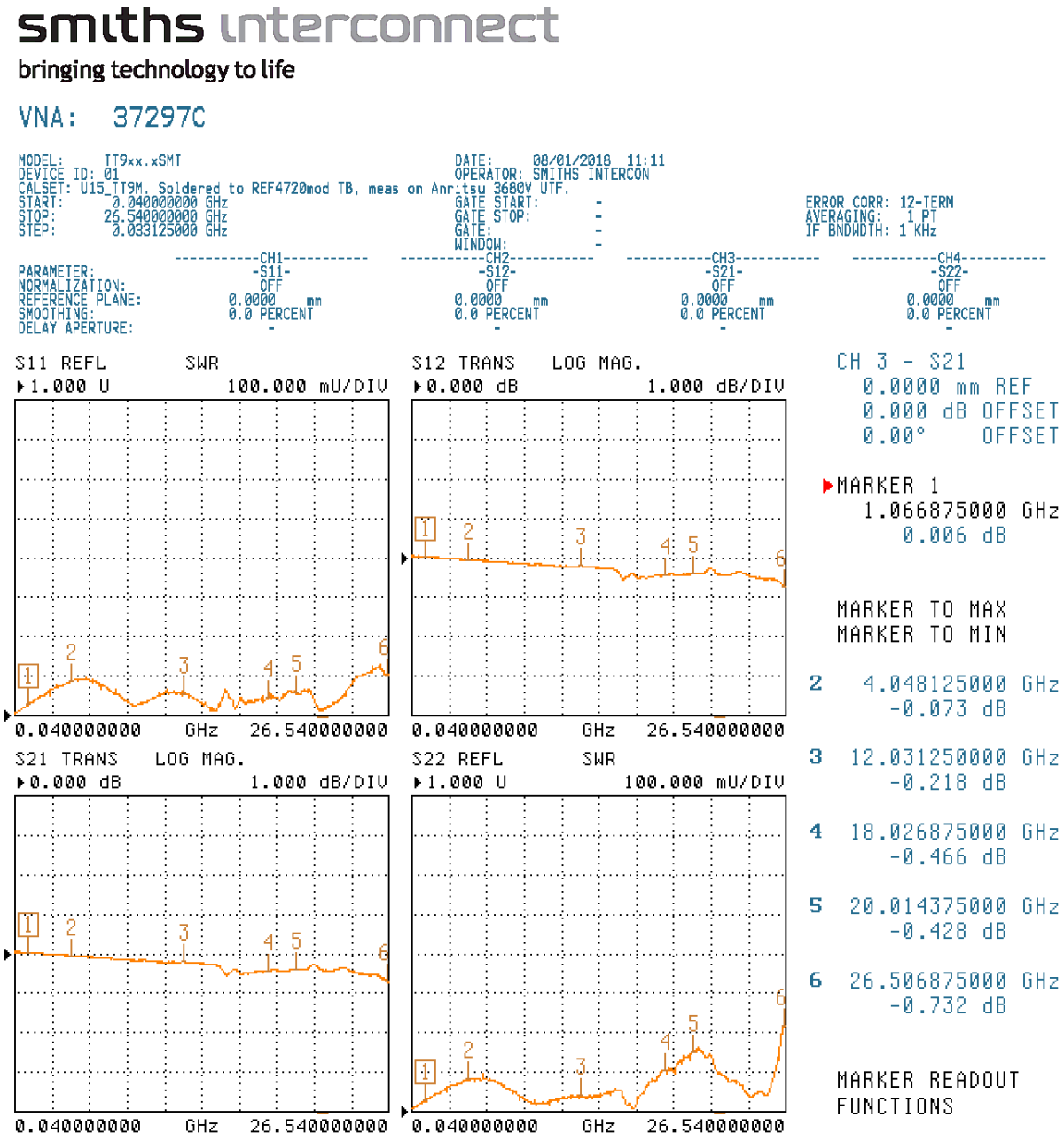



*Figure 8: REF4720mod Test Board Thruline measured on the Anritsu UTF.*

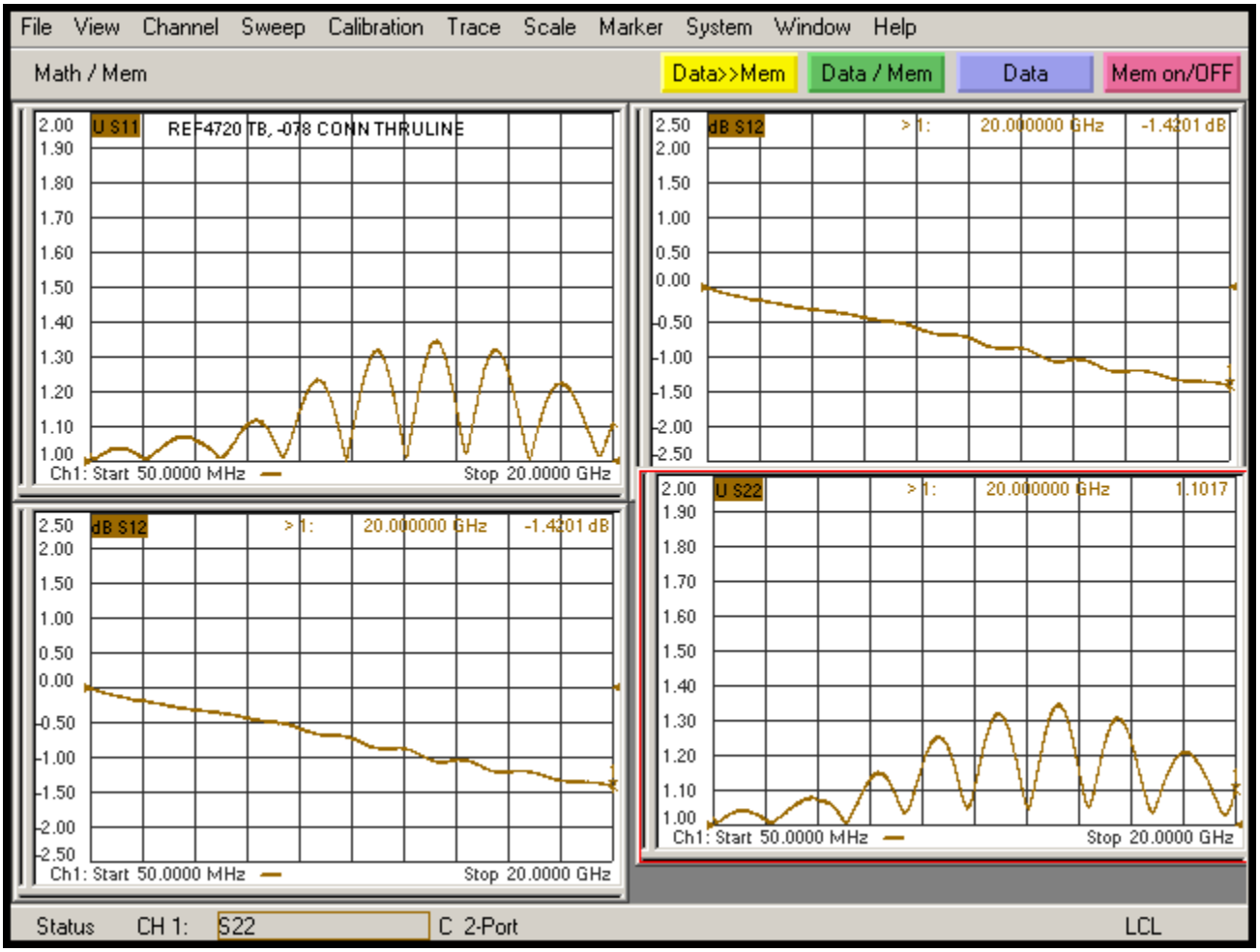



*Figure 9: TT9-EVB Test Fixture Thruline.*