

## Introduction

The following waveforms measure 'insertion loss' and 'isolation' on a standard (randomly chosen) 'headend quality' 1 GHz DC-9 directional coupler. All measurements were taken with a Rohde & Schwarz FSH818 Spectrum analyzer & tracking generator, with test lead and adaptor losses 'normalized' to the 0 dB reference line, therefore the *loss values* shown on the diagrams are the precise (accuracy better than .1 dB) insertion loss and/or isolation values. The horizontal (frequency) axis is from 0 to 2 GHz.

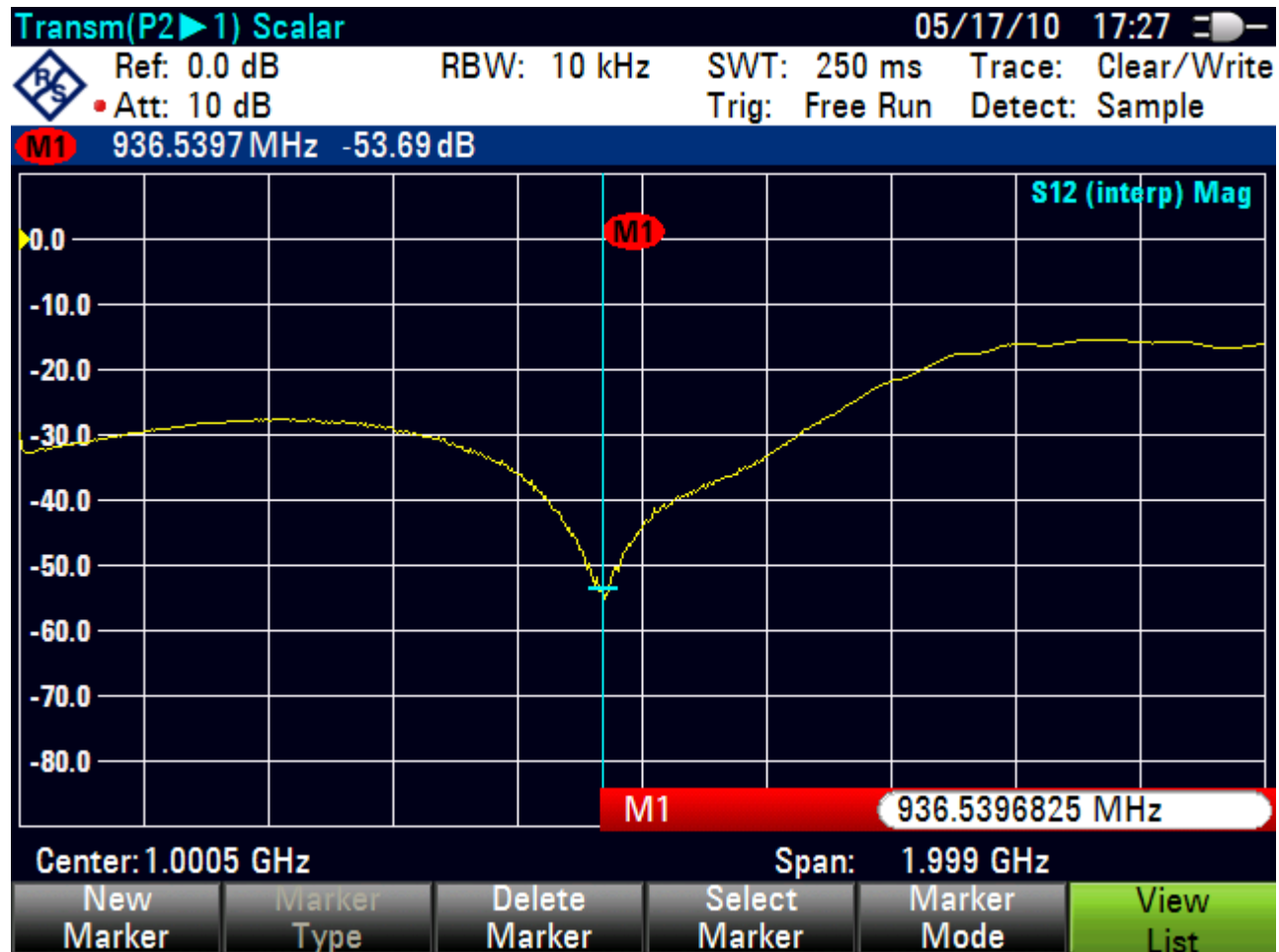
The 'isolation' series of waveforms demonstrate why distributed padding is vitally important in FDM (combiner) networks, where small pad values, evenly distributed throughout the combining circuitry, 'force' a good 75 ohm match on the input and output of all passive components and keep isolation values high.



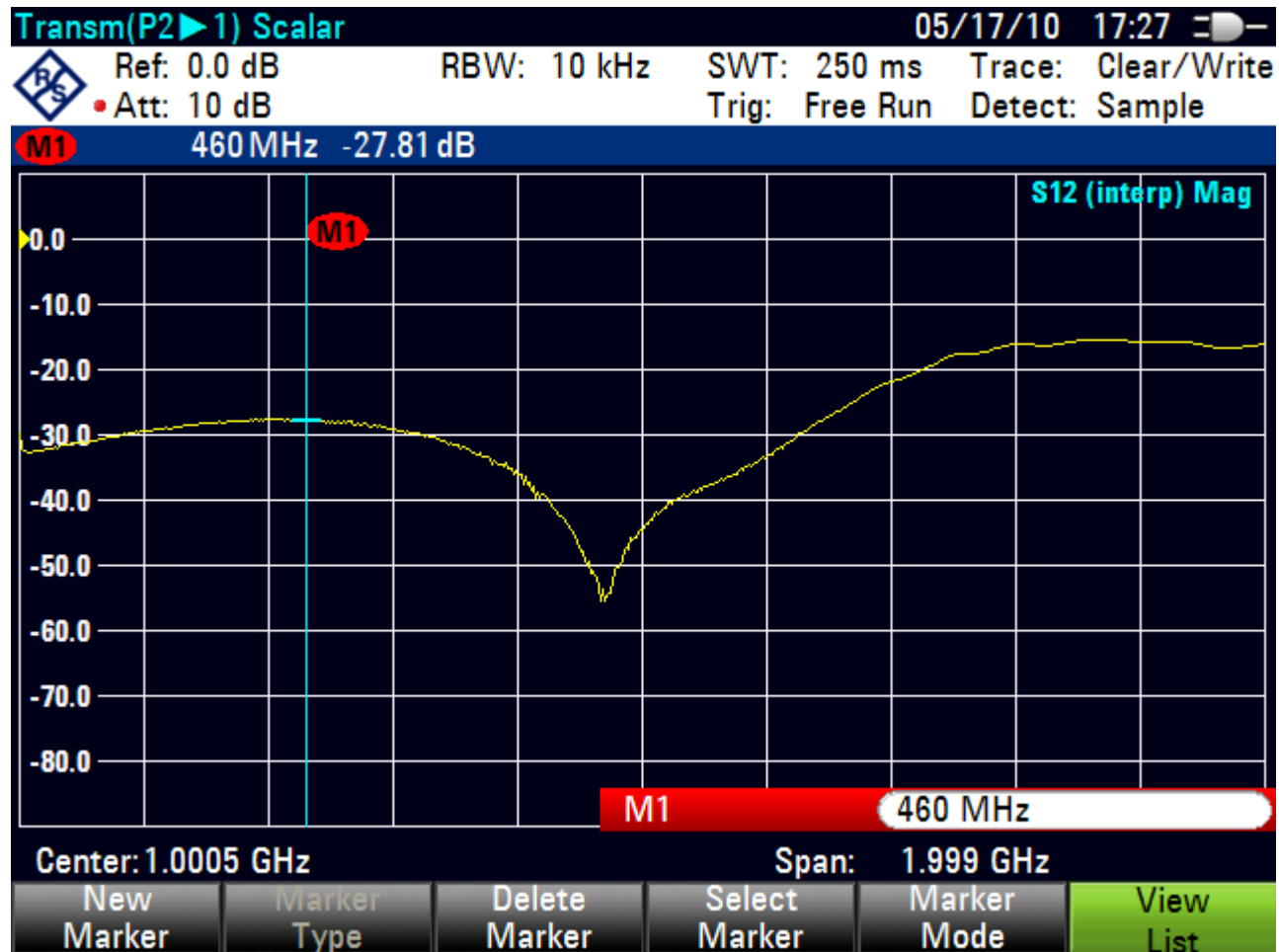
Insertion loss from coupler input to 'through' output leg. The tap leg is terminated. Insertion loss at 1 GHz is 1.9 dB.



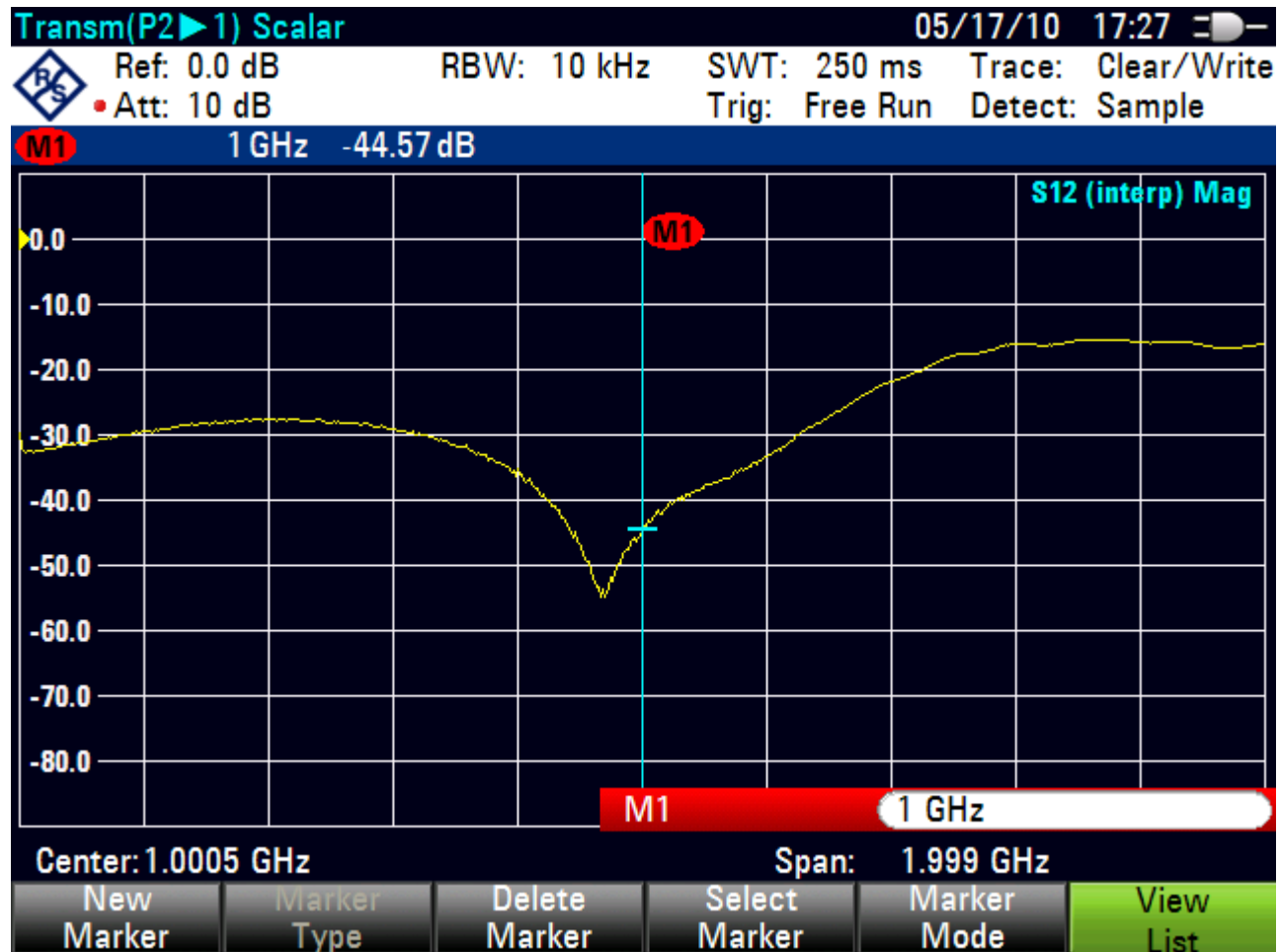
Insertion loss from coupler input to 'tap' output leg. The 'through' leg is terminated. Insertion loss at 1 GHz is 9.6 dB.



Isolation is now measured from the 'tap' to the 'output' port (TG signal injection at tap leg), with the input port terminated. The best-case isolation value is a whopping 53.7 dB, measured at approx. 936.5 Mhz.



**Isolation** is now measured from the 'tap' to the 'output' port (signal injection at tap leg), with the input port terminated. The worst-case isolation value is 27.8 dB, measured at 460 Mhz. *This is 25.9 dB worse than the isolation at 936 MHz!*



'Tap port' to 'output port' isolation at 1 GHz is 44.6 dB.



**Isolation** is now measured from the 'tap' to the 'output' port (signal injection at tap leg), with a **poor impedance** match on the input port. The isolation at 1 GHz is only 11.8 dB.



Isolation is now measured from the 'tap' to the 'output' port (signal injection at tap leg), with a **poor impedance** match on the input port. The isolation value at 600 MHz is only 8.8 dB.

With a poor impedance match value on the input port, isolation drops from 44.6 dB to 11.8 dB at 1GHz! Since coupler ports are typically are not at a true 75 ohm impedance (Z), the use of small value (distributed) pads is vital, so that a good impedance is seen on the input port, and isolation values are kept at their best-case values.