

# RF/microwave DUT deembedding

Its excellent realtime baseband performance in combination with its ability to easily import the scattering parameters of an active/passive two-port interconnection network via s2p-files make the R&S®SMW200A vector signal generator ideal for high-precision RF and microwave tests requiring deembedding of the device under test (DUT).

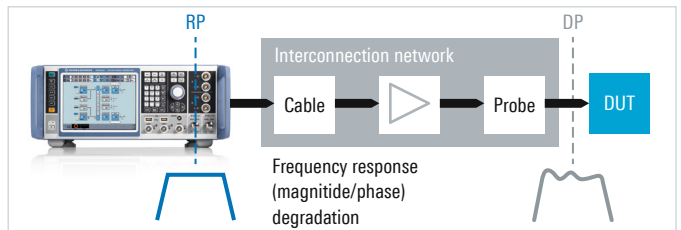


## Your task

Like most RF test instruments, an RF/microwave vector signal generator (VSG) is calibrated at its coaxial RF/microwave interface, which is defined as the reference plane (RP). This means all VSG performance parameters (e.g. level uncertainty, frequency response flatness, etc.) are specified for this interface.

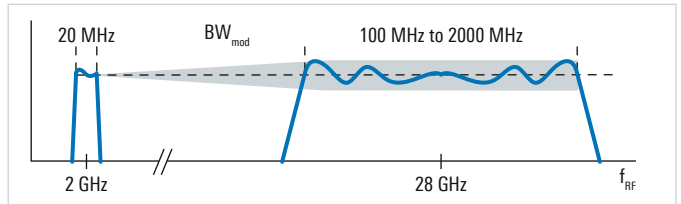
However, the device under test (DUT) is often not connected directly to this coaxial VSG interface but via an active/passive two-port interconnection network consisting of cables, attenuators, amplifiers, switches, test fixtures or even antennas.

Especially in the case of wideband microwave signals, a significant degradation of the frequency response flatness (magnitude/phase) can be observed at the DUT plane (DP) where the DUT is attached to the interconnection network.



Impact of interconnection network on frequency response.

This kind of impact is not new, but it is becoming increasingly important due to the higher modulation bandwidth  $BW_{mod}$  and RF/microwave frequency  $f_{RF}$  supported by many wireless applications and products.

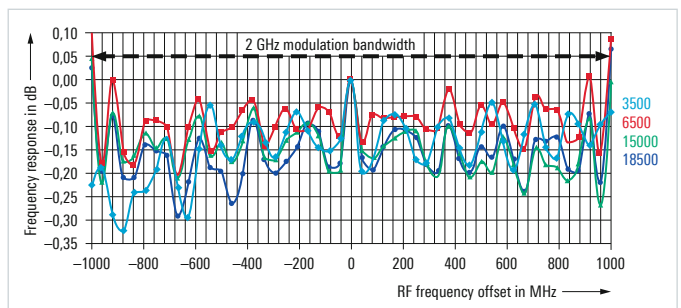


Increasing frequency response degradation,  $f (f_{RF} BW_{mod})$ .

For accurate DUT characterization, it is therefore essential to consider (remove) this undesired interconnection characteristic from the test signal at the DUT plane. This process, which shifts the reference plane from the VSG output port towards the input port of the DUT, is called deembedding.

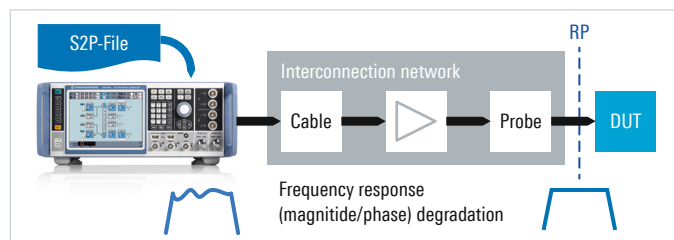
## T&M solution

The R&S®SMW200A vector signal generator offers an outstanding specified RF frequency response flatness (within a modulation bandwidth of up to 2 GHz) of <1 dB (meas. <0.4 dB) at the reference plane.



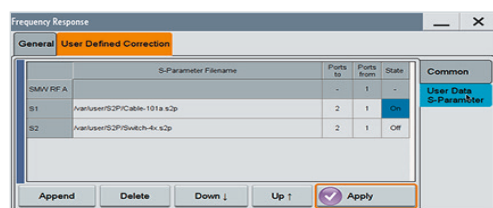
R&S®SMW200A frequency response flatness (meas.).

This high-end flatness performance makes the R&S®SMW the preferred signal source for all types of RF/microwave wideband test applications, e.g. LTE carrier aggregation, Wi-Fi/WLAN, pre-5G, 5G, radar signals and many others. The R&S®SMW-K544 user-defined frequency response correction (UDFRC) feature transfers this intrinsic R&S®SMW frequency response flatness towards the DUT plane by shifting the test signal reference plane to the input port of the DUT. This process of DUT deembedding is performed directly on the R&S®SMW in realtime by importing Touchstone® s2p files that describe the transmission and reflection performance of the two-port interconnection network by its scattering parameters  $S_{xy}$ .



R&S®SMW-K544 – DUT deembedding.

The enormous flexibility of the UDFRC means that up to 10 simultaneous s2p files characterizing different parts (cables, switches attenuators, amplifiers, antennas, etc.) of the interconnection network can be imported.



R&S®SMW-K544 – s2p file import.

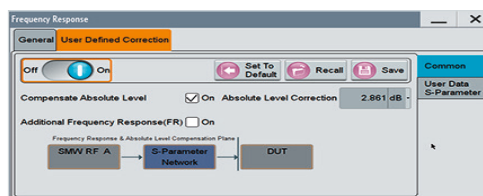
All imported s2p files can be individually activated/deactivated on the fly by the user. The R&S®SMW automatically concatenates all S-parameter matrices in the case of a cascaded interconnection network (multi s2p file scenarios). It is essential to know that the frequency response correction applies to:

- The entire frequency range covered by the imported s2p file(s) and not only a certain dedicated RF frequency
  - Any baseband signal and not only a dedicated waveform
- This high flexibility considerably simplifies the required deembedding process.

In addition to the frequency response correction within the modulation bandwidth, an absolute RF level correction based on the activated s2p file(s) is available.

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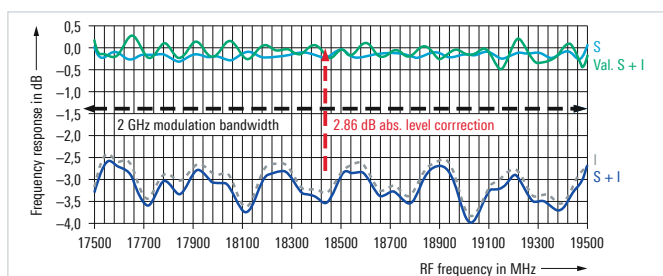


R&S®SMW-K544 – absolute RF level correction.

R&S®SMW-K544 deembedding steps:

- Characterize the interconnection by using either a
  - Vector network analyzer (VNA): phase/magnitude
  - Power sensor (e.g. R&S®NRP series): magnitude depends on the requirements of your test application
- Import the resulting scattering parameters  $S_{xy}$  to the R&S®SMW as s2p file(s)
- Activate UDFRC.

The following graph gives an impression of the UDFRC capabilities.



R&S®SMW-K544 capabilities.

The blue trace (S) describes the exceptional frequency response flatness over 2 GHz modulation bandwidth at the RP. The situation at the interconnection output (ripple  $\approx 1.5$  dB, insertion loss = 2.89 dB), at the DP, is highlighted by the dark-blue trace (S+I). With this frequency response mapped into a s2p file and activated in the R&S®SMW UDFRC (with applied absolute level correction), we end up in the green frequency response (Val. S+I) at the DUT input.

#### Key facts

The R&S®SMW200A vector signal generator equipped with the R&S®SMW-K544 option:

- Vector modulated (wideband) RF and microwave signals with outstanding frequency response flatness
- Import of s2p file(s) characterizing a two-port interconnection network
- Realtime DUT deembedding with optional absolute RF level correction

#### See also

[www.rohde-schwarz.com/product/SMW200A](http://www.rohde-schwarz.com/product/SMW200A)

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