Author **Fin Bomholt** Date of origin **2012-09-04**
Change Date of change

Introduction

This document describes shortly how MIF values of specific RF waveforms have been determined and verified.

Reference Documents

[1] ANSI C63.19 draft 3.3 (final)
[2] ANSI C63.19-2011
[3] DASY52 manual

Definition and Setup

Field probes are calibrated with specified uncertainty according to ISO 17025 as described in their calibration certificate. Modulation calibration parameters (PMR, Probe Modulation Response) show the calibration for specific waveforms over the probe dynamic range, with a separate uncertainty.

The MIF according to the definition in [1] and [2] is specific for a modulation and can therefore be used as a constant value if the probe has been PMR calibrated. It is provided in the file "Communication Systems.xml" in the DASY52 system and is automatically applied if the modulation is chosen in the measurement procedure. See also [3].

The evaluation of the MIF is done numerically and has been verified by measurements.
All waveforms are generated by an Anritsu MG3700A in the probe calibration setup.

The evaluation of the MIF has been done by numerical means and has been verified by measurements with the generator connected via coaxial cable to the measurement device. Methods used are:

- Sampling of the waveform with DASY52 NEO PXI and numerical evaluation (digital filtering)
- Numerical evaluation (digital filtering) of the baseband waveform which was digitally available
- Measurement with an RMS detector, digitizer with 48 kHz and numerical evaluation (digital filtering)
- Measurement with the AIA (Audio Interference Analyzer) containing RMS detector, digitizer with 96 kHz and numerical evaluation (digital filtering). The AIA is supported in the latest DASY52 software (see [3] section 24.8).

The following section describes the digital filtering of the AIA and the verification results.

Audio Interference Analyzer (AIA)

Hardware involved:
Signal Generator Anritsu type MG3700A
AIA: SPEAG, type SE UMS 170 AA, pre-series, serial numbers 1000 - 1002

The modulated RF signal (698 MHz - 6 GHz) is connected to the AIA via an RF cable. The AIA contains an RMS detector, calibration circuits and a digital sampling unit (96 kHz) for the detected envelope and the choppered average envelope. According to the description in [3] section 24.8, the AIA first performs an internal calibration of the sampling unit (based on an internal generic baseband signal) and then measures the applied RF waveform until the filters are stable and the measurement noise reaches a minimum. The MIF is then calculated from the outputs of the digital filtering.
Before measuring the listed waveforms, the absolute MIF is adjusted with a calibration factor based on the reference signal (80% AM 1 kHz sinewave).

The digital filters consist of a spectral filtering and a temporal filtering:

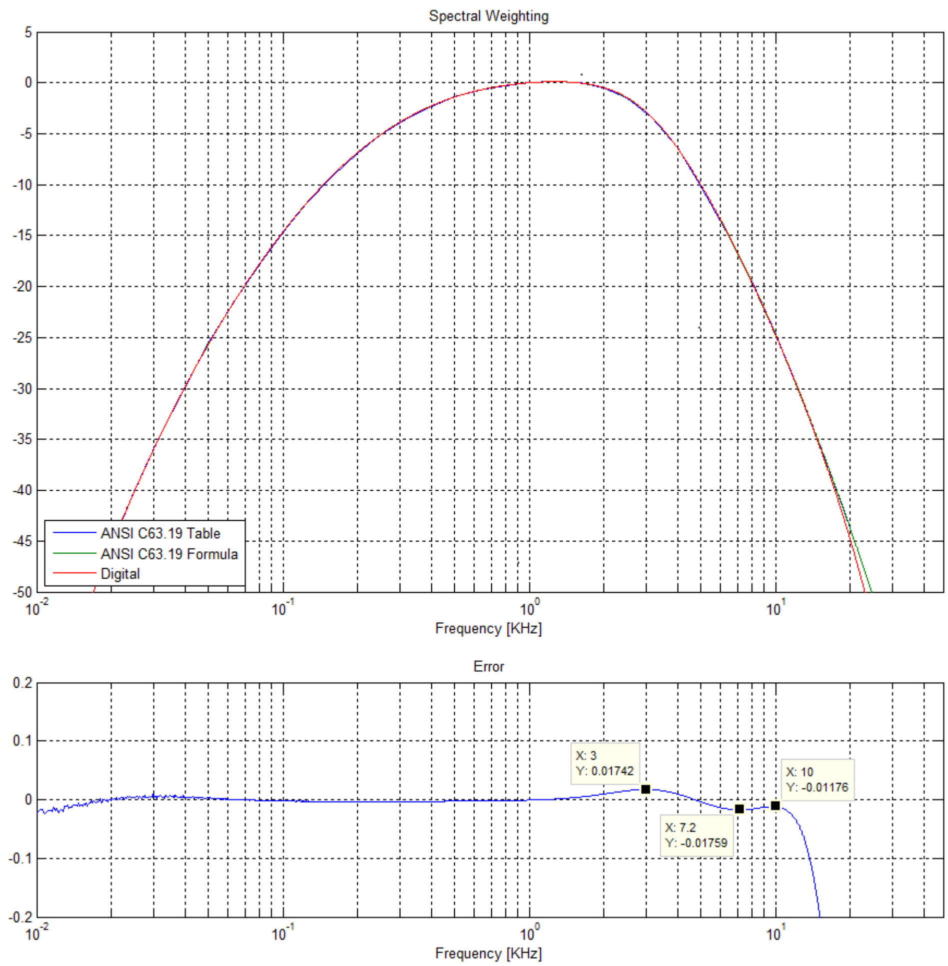

Fig. 1 Spectral filtering and deviation from the target defined in the standard [1]. Worst case deviation is < 0.02 dB in the frequency range from 100 Hz to 10 kHz.

The temporal filtering is straightforward in temporal implementation and therefore results in smaller errors than the spectral filtering.

The verification results are shown for two implementations of the numerical simulation and for measurements with the AIA at several levels for a 3 GHz signal (center of the frequency range).

Measurement results for generic waveforms

Table 1 Numerical and measurement results for pulse modulations according to [2] table D.3

	Pulse Modulation			
	1 KHz 50%	100 Hz 10%	100 Hz 1%	10 Hz 10%
ANSI C63.19	**-0.9 dB**	**3.9 dB**	**10.1 dB**	**1.6 dB**
MATLAB FFT	-0.85 dB	3.84 dB	9.84 dB	2.58 dB
MATLAB IIR	-0.83 dB	3.96 dB	9.68 dB	2.43 dB
3 GHz 0 dBm	-0.89 dB	3.86 dB	-	-
3 GHz -10 dBm			9.8 dB	-

Table 2 Numerical and measurement results for sine-wave modulations according to [2] table D.4

	Sinewave Modulation				
	1 KHz 80%	1 KHz 10%	1 KHz 1%	100 Hz 10%	10 KHz 10%
ANSI C63.19	**-1.2 dB**	**-9.1 dB**	**-19.1 dB**	**-16.1 dB**	**-21.5 dB**
MATLAB FFT	-1.15 dB	-9.10 dB	-19.08 dB	-15.99 dB	-21.49 dB
MATLAB IIR	-1.16 dB	-9.10 dB	-19.08 dB	-15.99 dB	-21.50 dB
3 GHz 0 dBm	-1.26 dB	-9.21 dB	-19.18 dB	-16.10 dB	-21.53 dB
3 GHz 6 dBm	-1.26 dB	-9.17 dB	-19.13 dB	-16.06 dB	-21.50 dB
3 GHz -10 dBm	-1.34 dB	-9.35 dB	-19.28 dB	-16.23 dB	-21.66 dB

Results

As expected, the deviations for MIF close to 0 dB and with modulation frequencies and their harmonics in the well-defined pass-band of the spectral filter are small.

The deviations for extreme waveforms have higher deviations as expected and allowed according to the standard requirements:

- Low AM frequencies (< 10 Hz)
- Narrow peaks limit the dynamic range

Conclusion

- PMR calibration of probes allows usage of numerically assessed MIF with constant value specific to the waveform.
- Calculated MIF can have some deviation from the values listed in the standard due to rounding (in the standard) and numerical implementation. Deviations can be larger outside the specified audio frequency band.
- MIF measured with the AIA shows very good agreement with the calculated values if the (audio) bandwidth and the dynamic range is observed.

