**3GPP TSG-RAN WG4 Meeting #95-e DRAFT R4-2008857**

Online, 25 May - 5 Jun 2020

**Source:** Huawei

**Title:** [OTA TR] TP to TR 37.941 EIRP MU budget procedure update

**Agenda Item:** 6.19.5

**Document for:** Approval

# Introduction

It was agreed that the OTA budgets already agreed in the donor TR’s would be implemented in the new external TR. In the last few meetings the MU budgets have been updated and many corrections made using pre agreed excel MU budgets, the tables have then been copied into the new TR.

There has been some discussion however about the existing TYR sections where the MU budget and the MU calculation are captured in 2 tables, which contain almost the same information. As the new TR contains many such tables the approach has been taken to combine the tables into a single one. This has the advantage that many pages are saved in the TR.

However it has been argued that this method of recording the results is not directly in line with the agreed procedure.

As a compromise between the procedure and saving space in the document it is proposed that a single requirement (EIRP) is captured with the 2 table method and the procedure is updated to explain that the tables are combined into a single table in the rest of the document to save space, but the assessment procedure is the same.

This TP capture the updates to the EIRP section so that both tables are captured for each chamber type.

# TP to TR 37.941 v0.2.0

**--- Start of changes ---**

#### 9.2.2.3 MU value derivation, FR1

Table 9.2.2.3-1 captures uncertainty budget contributors and Table 9.2.2.3-2 captures the derivation of the expanded measurement uncertainty values for EIRP accuracy measurements in Indoor Anechoic Chamber (Normal test conditions, FR1).

Table 9.2.2.3-1: Indoor Anechoic Chamber measurement uncertainty contributors for EIRP accuracy measurements, Normal test conditions, FR1

|  |  |  |
| --- | --- | --- |
| **UID / Details in annex** | **Uncertainty source** |  |
| **Stage 2: BS measurement** | | |
| A1-1 | Positioning misalignment between the AAS BS and the reference antenna |  |
| A1-2 | Pointing misalignment between the AAS BS and the receiving antenna |  |
| A1-3 | Quality of quiet zone |  |
| A1-4a | Polarization mismatch between the AAS BS and the receiving antenna |  |
| A1-5 | Mutual coupling between the AAS BS and the receiving antenna |  |
| A1-6 | Phase curvature |  |
| C1-1 | RF power measurement equipment (e.g. spectrum analyzer, power meter) |  |
| A1-7 | Impedance mismatch in the receiving chain |  |
| A1-8 | Random uncertainty |  |
| **Stage 1: Calibration measurement** | | |
| A1-9 | Impedance mismatch between the receiving antenna and the network analyzer |  |
| A1-10 | Positioning and pointing misalignment between the reference antenna and the receiving antenna |  |
| A1-11 | Impedance mismatch between the reference antenna and the network analyzer. |  |
| A1-3 | Quality of quiet zone |  |
| A1-4b | Polarization mismatch between the reference antenna and the receiving antenna |  |
| A1-5 | Mutual coupling between the reference antenna and the receiving antenna |  |
| A1-6 | Phase curvature |  |
| C1-3 | Uncertainty of the network analyzer |  |
| A1-12 | Influence of the reference antenna feed cable |  |
| A1-13 | Reference antenna feed cable loss measurement uncertainty |  |
| A1-14 | Influence of the receiving antenna feed cable |  |
| C1-4 | Uncertainty of the absolute gain of the reference antenna |  |
| A1-15 | Uncertainty of the absolute gain of the receiving antenna |  |

NOTE: In the legacy BS testability technical reports, the MU/TT derivation tables were using UID as a counting numbers across multiple test chambers and requirement’s clauses. In this TR a modified approach was taken with the UID’s being the annex number of the measurement uncertainty source description.

Table 9.2.2.3-2: Indoor Anechoic Chamber measurement uncertainty value derivation for EIRP accuracy measurements, Normal test conditions, FR1

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| UID | Uncertainty source | Uncertainty value (dB) | | | **Distribution of the probability** | **Divisor based on distribution shape** | ***ci*** | **Standard uncertainty *ui* (dB)** | | |
| f<3 GHz | **3<f<4.2 GHz** | **4.2<f<6 GHz** | **f<3 GHz** | **3<f<4.2 GHz** | **4.2<f<6 GHz** |
| Stage 2: BS measurement | | | | | | | | | |  |
| A1-1 | Positioning misalignment between the AAS BS and the reference antenna | 0.03 | 0.03 | 0.03 | Rectangular | 1.73 | 1 | 0.02 | 0.02 | 0.02 |
| A1-2 | Pointing misalignment between the AAS BS and the receiving antenna | 0.3 | 0.3 | 0.3 | Rectangular | 1.73 | 1 | 0.17 | 0.17 | 0.17 |
| A1-3 | Quality of quiet zone | 0.1 | 0.1 | 0.1 | Gaussian | 1.00 | 1 | 0.10 | 0.10 | 0.10 |
| A1-4a | Polarization mismatch between the AAS BS and the receiving antenna | 0.01 | 0.01 | 0.01 | Rectangular | 1.73 | 1 | 0.01 | 0.01 | 0.01 |
| A1-5 | Mutual coupling between the AAS BS and the receiving antenna | 0 | 0 | 0 | Rectangular | 1.73 | 1 | 0.00 | 0.00 | 0.00 |
| A1-6 | Phase curvature | 0.05 | 0.05 | 0.05 | Gaussian | 1.00 | 1 | 0.05 | 0.05 | 0.05 |
| C1-1 | RF power measurement equipment (e.g. spectrum analyzer, power meter) | 0.14 | 0.26 | 0.26 | Gaussian | 1.00 | 1 | 0.14 | 0.26 | 0.26 |
| A1-7 | Impedance mismatch in the receiving chain | 0.14 | 0.33 | 0.33 | U-shaped | 1.41 | 1 | 0.10 | 0.23 | 0.23 |
| A1-8 | Random uncertainty | 0.1 | 0.1 | 0.1 | Rectangular | 1.73 | 1 | 0.06 | 0.06 | 0.06 |
| Stage 1: Calibration measurement | | | | | | | | | |  |
| A1-9 | Impedance mismatch between the receiving antenna and the network analyzer | 0.05 | 0.05 | 0.05 | U-shaped | 1.41 | 1 | 0.04 | 0.04 | 0.04 |
| A1-10 | Positioning and pointing misalignment between the reference antenna and the receiving antenna | 0.01 | 0.01 | 0.01 | Rectangular | 1.73 | 1 | 0.01 | 0.01 | 0.01 |
| A1-11 | Impedance mismatch between the reference antenna and the network analyzer. | 0.05 | 0.05 | 0.05 | U-shaped | 1.41 | 1 | 0.04 | 0.04 | 0.04 |
| A1-3 | Quality of quiet zone | 0.1 | 0.1 | 0.1 | Gaussian | 1.00 | 1 | 0.10 | 0.10 | 0.10 |
| A1-4b | Polarization mismatch between the reference antenna and the receiving antenna | 0.01 | 0.01 | 0.01 | Rectangular | 1.73 | 1 | 0.01 | 0.01 | 0.01 |
| A1-5 | Mutual coupling between the reference antenna and the receiving antenna | 0 | 0 | 0 | Rectangular | 1.73 | 1 | 0.00 | 0.00 | 0.00 |
| A1-6 | Phase curvature | 0.05 | 0.05 | 0.05 | Gaussian | 1.00 | 1 | 0.05 | 0.05 | 0.05 |
| C1-3 | Uncertainty of the network analyzer | 0.13 | 0.2 | 0.2 | Gaussian | 1.00 | 1 | 0.13 | 0.20 | 0.20 |
| A1-12 | Influence of the reference antenna feed cable | 0.05 | 0.05 | 0.05 | Rectangular | 1.73 | 1 | 0.03 | 0.03 | 0.03 |
| A1-13 | Reference antenna feed cable loss measurement uncertainty | 0.06 | 0.06 | 0.06 | Gaussian | 1.00 | 1 | 0.06 | 0.06 | 0.06 |
| A1-14 | Influence of the receiving antenna feed cable | 0.05 | 0.05 | 0.05 | Rectangular | 1.73 | 1 | 0.03 | 0.03 | 0.03 |
| C1-4 | Uncertainty of the absolute gain of the reference antenna | 0.50 | 0.43 | 0.43 | Rectangular | 1.73 | 1 | 0.29 | 0.25 | 0.25 |
| A1-15 | Uncertainty of the absolute gain of the receiving antenna | 0 | 0 | 0 | Rectangular | 1.73 | 1 | 0.00 | 0.00 | 0.00 |
| **Combined standard uncertainty (1σ) (dB)** | | | | | | | | 0.44 | 0.54 | 0.54 |
| **Expanded uncertainty (1.96σ - confidence interval of 95 %) (dB)** | | | | | | | | 0.87 | 1.06 | 1.06 |

**--- Next change ---**

#### 9.2.3.3 MU value derivation, FR1

Table 9.2.3.3-1 captures uncertainty budget contributors and Table 9.2.3.3-2 captures the derivation of the expanded measurement uncertainty values for EIRP accuracy measurements in CATR (Normal test conditions, FR1).

Table 9.2.3.3-1: CATR measurement uncertainty contributors for EIRP accuracy measurements, Normal test conditions, FR1

|  |  |  |
| --- | --- | --- |
| **UID / Details in annex** | **Uncertainty source** |  |
| **Stage 2: BSBS measurement** | | |
| A2-1a | Misalignment BS & pointing error for EIRP |  |
| C1-1 | RF power measurement equipment (e.g. spectrum analyzer, power meter) |  |
| A2-2a | Standing wave between BS and test range antenna |  |
| A2-3 | RF leakage (SGH connector terminated & test range antenna connector cable terminated) |  |
| A2-4a | QZ ripple BS |  |
| A2-12 | Frequency flatness |  |
| **Stage 1: Calibration measurement** | | |
| C1-3 | Uncertainty of the network analyzer |  |
| A2-6 | Mismatch of receiver chain |  |
| A2-3 | Insertion loss variation of receiver chain |  |
| A2-3 | RF leakage (SGH connector terminated & test range antenna connector cable terminated) |  |
| C1-4 | Influence of the calibration antenna feed cable: |  |
| C1-4 | Uncertainty of the absolute gain of the reference antenna |  |
| A2-1b | Misalignment positioning system |  |
| A2-9 | Misalignment of calibration antenna and test range antenna |  |
| A2-2b | Rotary Joints |  |
| A2-4b | Standing wave between calibration antenna and test range antenna |  |
| A2-11 | QZ ripple calibration antenna |  |
| A2-13 | Switching uncertainty |  |

NOTE: In the legacy BS testability technical reports, the MU/TT derivation tables were using UID as a counting numbers across multiple test chambers and requirement’s clauses. In this TR a modified approach was taken with the UID’s being the annex number of the measurement uncertainty source description.

Table 9.2.3.3-2: CATR MU value derivation for EIRP accuracy measurements, Normal test conditions, FR1

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| UID | Uncertainty source | Uncertainty value (dB) | | | Distribution of the probability | Divisor based on distribution shape | *ci* | Standard uncertainty *ui* (dB) | | |
| f≤3 GHz | 3<f≤4.2 GHz | 4.2<f≤6 GHz | f≤3 GHz | 3<f≤4.2 GHz | 4.2<f≤6 GHz |
| Stage 2: BS measurement | | | | | | | | | |  |
| A2-1a | Misalignment BS & pointing error for EIRP | 0.00 | 0.00 | 0.00 | Exp. normal | 2.00 | 1 | 0.00 | 0.00 | 0.00 |
| C1-1 | RF power measurement equipment (e.g. spectrum analyzer, power meter) | 0.14 | 0.26 | 0.26 | Gaussian | 1.00 | 1 | 0.14 | 0.26 | 0.26 |
| A2-2a | Standing wave between BS and test range antenna | 0.21 | 0.21 | 0.21 | U-shaped | 1.41 | 1 | 0.15 | 0.15 | 0.15 |
| A2-3 | RF leakage (SGH connector terminated & test range antenna connector cable terminated) | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A2-4a | QZ ripple BS | 0.09 | 0.09 | 0.09 | Gaussian | 1.00 | 1 | 0.09 | 0.09 | 0.09 |
| A2-12 | Frequency flatness | 0.25 | 0.25 | 0.25 | Gaussian | 1.00 | 1 | 0.25 | 0.25 | 0.25 |
| Stage 1: Calibration measurement | | | | | | | | | |  |
| C1-3 | Uncertainty of the network analyzer | 0.13 | 0.20 | 0.20 | Gaussian | 1.00 | 1 | 0.13 | 0.20 | 0.20 |
| A2-6 | Mismatch of receiver chain | 0.13 | 0.33 | 0.33 | U-shaped | 1.41 | 1 | 0.09 | 0.23 | 0.23 |
| A2-3 | Insertion loss variation of receiver chain | 0.18 | 0.18 | 0.18 | Rectangular | 1.73 | 1 | 0.10 | 0.10 | 0.10 |
| A2-3 | RF leakage (SGH connector terminated & test range antenna connector cable terminated) | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| C1-4 | Influence of the calibration antenna feed cable: | 0.02 | 0.02 | 0.02 | U-shaped | 1.41 | 1 | 0.02 | 0.02 | 0.02 |
| C1-4 | Uncertainty of the absolute gain of the reference antenna | 0.50 | 0.43 | 0.43 | Rectangular | 1.73 | 1 | 0.29 | 0.25 | 0.25 |
| A2-1b | Misalignment positioning system | 0.00 | 0.00 | 0.00 | Exp. normal | 2.00 | 1 | 0.00 | 0.00 | 0.00 |
| A2-9 | Misalignment of calibration antenna and test range antenna | 0.50 | 0.50 | 0.50 | Exp. normal | 2.00 | 1 | 0.25 | 0.25 | 0.25 |
| A2-2b | Rotary Joints | 0.05 | 0.05 | 0.05 | U-shaped | 1.41 | 1 | 0.03 | 0.03 | 0.03 |
| A2-4b | Standing wave between calibration antenna and test range antenna | 0.09 | 0.09 | 0.09 | U-shaped | 1.41 | 1 | 0.06 | 0.06 | 0.06 |
| A2-11 | QZ ripple calibration antenna | 0.01 | 0.01 | 0.01 | Gaussian | 1.00 | 1 | 0.01 | 0.01 | 0.01 |
| A2-13 | Switching uncertainty | 0.26 | 0.26 | 0.26 | Rectangular | 1.73 | 1 | 0.15 | 0.15 | 0.15 |
| Combined standard uncertainty (1σ) (dB) | | | | | | | | 0.57 | 0.65 | 0.65 |
| Expanded uncertainty (1.96σ - confidence interval of 95 %) (dB) | | | | | | | | 1.11 | 1.27 | 1.27 |

#### 9.2.3.4 MU value derivation, FR2

The MU assessment was carried out using a CATR chamber only however other chamber types are not precluded if suitable MU assessment is done.

A CATR MU budget was assessed in order to determine acceptable MU for the EIRP accuracy measurement in FR2. The CATR test setup and calibration and measurement procedures for FR2 are expected to be similar to those of FR1, although the test chamber dimensions and associated MU values will scale due to the shorter wavelengths and larger relative array apertures.

Table 9.2.3.4-1 captures the uncertainty budget contributors and Table 9.2.3.4-2 captures the derivation of the expanded measurement uncertainty values for EIRP accuracy measurements in CATR (Normal test conditions, FR2).

Table 9.2.3.4-1: CATR measurement uncertainty contributors for EIRP accuracy measurements, Normal test conditions, FR2

|  |  |  |
| --- | --- | --- |
| **UID / Details in annex** | **Uncertainty source** |  |
| **Stage 2: BS measurement** | | |
| A2-1a | Misalignment BS & pointing error (EIRP) |  |
| C1-7 | RF power measurement equipment (e.g. spectrum analyzer, power meter) - High power |  |
| A2-2a | Standing wave between BS and test range antenna |  |
| A2-3 | RF leakage, test range antenna cable connector terminated. |  |
| A2-4a | QZ ripple with BS |  |
| A2-12 | Frequency flatness |  |
| **Stage 1: Calibration measurement** | | |
| C1-3 | Network Analyzer |  |
| A2-5a | Mismatch of receiver chain |  |
| A2-6 | Insertion loss variation in receiver chain |  |
| A2-3 | RF leakage, (SGH connector terminated & test range antenna connector cable terminated) |  |
| A2-7 | Influence of the calibration antenna feed cable |  |
| C1-4 | SGH Calibration uncertainty |  |
| A2-8 | Misalignment positioning system |  |
| A2-1b | Misalignment of calibration antenna and test range antenna |  |
| A2-9 | Rotary joints |  |
| A2-2b | Standing wave between calibration antenna and test range antenna |  |
| A2-4b | QZ ripple calibration antenna |  |
| A2-11 | Switching uncertainty |  |

NOTE: In the legacy BS testability technical reports, the MU/TT derivation tables were using UID as a counting numbers across multiple test chambers and requirement’s clauses. In this TR a modified approach was taken with the UID’s being the annex number of the measurement uncertainty source description.

Table 9.2.3.4-2: CATR MU value derivation for EIRP accuracy measurements, Normal test conditions, FR2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| UID | Uncertainty source | Uncertainty value (dB) | | Distribution of the probability | Divisor based on distribution shape | *ci* | Standard uncertainty *ui* (dB) | |
| 24.25<f <29.5GHz | 37<f <40GHz | 24.25<f <29.5GHz | 37<f <40GHz |
| **Stage 2: BS measurement** | | | | | | | | |
| A2-1a | Misalignment BS & pointing error (EIRP) | 0.20 | 0.20 | Exp. normal | 2.00 | 1 | 0.10 | 0.10 |
| C1-7 | RF power measurement equipment (e.g. spectrum analyzer, power meter) -High power | 0.50 | 0.70 | Normal | 1.00 | 1 | 0.50 | 0.70 |
| A2-2a | Standing wave between BS and test range antenna | 0.03 | 0.03 | U-shaped | 1.41 | 1 | 0.02 | 0.02 |
| A2-3 | RF leakage, test range antenna cable connector terminated. | 0.01 | 0.01 | Normal | 1.00 | 1 | 0.01 | 0.01 |
| A2-4a | QZ ripple with BS | 0.40 | 0.40 | Normal | 1.00 | 1 | 0.40 | 0.40 |
| A2-12 | Frequency flatness | 0.25 | 0.25 | Normal | 1.00 | 1 | 0.25 | 0.25 |
| **Stage 1: Calibration measurement** | | | | | | | | |
| C1-3 | Network Analyzer | 0.30 | 0.30 | Normal | 1.00 | 1 | 0.30 | 0.30 |
| A2-5a | Mismatch of receiver chain | 0.43 | 0.57 | U-shaped | 1.41 | 1 | 0.30 | 0.40 |
| A2-6 | Insertion loss variation in receiver chain | 0.00 | 0.00 | Rectangular | 1.73 | 1 | 0.00 | 0.00 |
| A2-3 | RF leakage, (SGH connector terminated & test range antenna connector cable terminated) | 0.01 | 0.01 | Normal | 1.00 | 1 | 0.01 | 0.01 |
| A2-7 | Influence of the calibration antenna feed cable | 0.21 | 0.29 | U-shaped | 1.41 | 1 | 0.15 | 0.21 |
| C1-4 | SGH Calibration uncertainty | 0.52 | 0.52 | Rectangular | 1.73 | 1 | 0.30 | 0.30 |
| A2-8 | Misalignment positioning system | 0.00 | 0.00 | Exp. normal | 2.00 | 1 | 0.00 | 0.00 |
| A2-1b | Misalignment of calibration antenna and test range antenna | 0.00 | 0.00 | Exp. normal | 2.00 | 1 | 0.00 | 0.00 |
| A2-9 | Rotary joints | 0.00 | 0.00 | U-shaped | 1.41 | 1 | 0.00 | 0.00 |
| A2-2b | Standing wave between calibration antenna and test range antenna | 0.09 | 0.09 | U-shaped | 1.41 | 1 | 0.06 | 0.06 |
| A2-4b | QZ ripple calibration antenna | 0.01 | 0.01 | Normal | 1.00 | 1 | 0.01 | 0.01 |
| A2-11 | Switching uncertainty | 0.10 | 0.10 | Rectangular | 1.73 | 1 | 0.06 | 0.06 |
| **Combined standard uncertainty (1σ) (dB)** | | | | | | | 0.89 | 1.06 |
| **Expanded uncertainty (1.96σ - confidence interval of 95 %) (dB)** | | | | | | | 1.74 | 2.07 |

**--- Next change ---**

#### 9.2.4.3 MU value derivation, FR1

Table 9.2.4.3-1 captures the uncertainty budget contributors and Table 9.2.4.3-2 captures the derivation of the expanded measurement uncertainty values for EIRP accuracy measurements in One Dimensional Compact Range.

Table 9.2.4.3-1: One Dimensional Compact Range measurement accuracy contributors for EIRP accuracy measurements, FR1

|  |  |  |
| --- | --- | --- |
| **UID / Details in annex** | **Uncertainty source** |  |
| **Stage 2: BS measurement** | | |
| A4-1 | Misalignment BS and pointing error |  |
| A4-2a | Standing wave between BS and test range antenna |  |
| A4-3a | Quiet zone ripple BS |  |
| A4-4a | Phase curvature AAS |  |
| A4-5a | Polarization mismatch between BS and receiving antenna |  |
| A4-6a | Mutual coupling between BS and receiving antenna |  |
| C1-1 | RF power measurement equipment (e.g. spectrum analyzer, power meter) |  |
| A4-7 | Impedance mismatch in receiving chain |  |
| A4-8a | RF leakage (BS connector terminated and test range antenna connector cable terminated) |  |
| **Stage 1: Calibration measurement** | | |
| A4-9 | Misalignment positioning system | A4-9 |
| A4-10 | Pointing error between reference antenna and test range antenna | A4-10 |
| A4-11 | Impedance mismatch in path to reference antenna | A4-11 |
| A4-12 | Impedance mismatch in path to compact probe | A4-12 |
| A4-2b | Standing wave between reference antenna and receiving antenna | A4-2b |
| A4-3b | Quiet zone ripple reference antenna | A4-3b |
| A4-4b | Phase curvature refernce antenna | A4-4b |
| A4-5b | Polarization mismatch between reference antenna and receiving antenna | A4-5b |
| A4-6a | Mutual coupling between reference antenna and receiving antenna | A4-6a |
| C1-1 | RF power measurement equipment (e.g. spectrum analyzer, power meter) | C1-1 |
| A4-13 | Influence of the reference antenna feed cable (flexing cables, adapters, attenuators, connector repeatability) | A4-13 |
| A4-14 | Mismatch of receiver chain | A4-14 |
| A4-15 | Insertion loss of receiver chain | A4-15 |
| C1-4 | Uncertainty of the absolute gain of the reference antenna | C1-4 |
| A4-8b | RF leakage (SGH connector terminated and test range antenna connector cable terminated. | A4-8b |

NOTE: In the legacy BS testability technical reports, the MU/TT derivation tables were using UID as a counting numbers across multiple test chambers and requirement’s clauses. In this TR a modified approach was taken with the UID’s being the annex number of the measurement uncertainty source description.

Table 9.2.4.3-2: One Dimensional Compact Range MU value derivation for EIRP accuracy measurements, FR1

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UID** | **Uncertainty source** | **Uncertainty value (dB)** | | | **Distribution of the probability** | **Divisor based on distribution shape** | ***ci*** | **Standard uncertainty *ui* (dB)** | | |
| **f<3 GHz** | **3<f<4.2 GHz** | **4.2<f<6 GHz** | **f<3 GHz** | **3<f<4.2 GHz** | **4.2<f<6 GHz** |
| **Stage 2: BS measurement** | | | | | | | | | | |
| A4-1 | Misalignment BS and pointing error | 0.00 | 0.00 | 0.00 | Exp. normal | 2.00 | 1 | 0.00 | 0.00 | 0.00 |
| A4-2a | Standing wave between BS and test range antenna | 0.18 | 0.18 | 0.18 | U-shaped | 1.41 | 1 | 0.13 | 0.13 | 0.13 |
| A4-3a | Quiet zone ripple BS | 0.03 | 0.03 | 0.03 | Gaussian | 1.00 | 1 | 0.03 | 0.03 | 0.03 |
| A4-4a | Phase curvature AAS | 0.01 | 0.01 | 0.01 | Gaussian | 1.00 | 1 | 0.01 | 0.01 | 0.01 |
| A4-5a | Polarization mismatch between BS and receiving antenna | 0.05 | 0.05 | 0.05 | Rectangular | 1.73 | 1 | 0.03 | 0.03 | 0.03 |
| A4-6a | Mutual coupling between BS and receiving antenna | 0.00 | 0.00 | 0.00 | Rectangular | 1.73 | 1 | 0.00 | 0.00 | 0.00 |
| C1-1 | RF power measurement equipment (e.g. spectrum analyzer, power meter) | 0.14 | 0.26 | 0.26 | Gaussian | 1.00 | 1 | 0.14 | 0.26 | 0.26 |
| A4-7 | Impedance mismatch in receiving chain | 0.01 | 0.01 | 0.01 | U-shaped | 1.41 | 1 | 0.00 | 0.01 | 0.01 |
| A4-8a | RF leakage (BS connector terminated and test range antenna connector cable terminated) | **0.00** | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| **Stage 1: Calibration measurement** | | | | | | | | | | |
| A4-9 | Misalignment positioning system | 0.00 | 0.00 | 0.00 | Exp. normal | 2.00 | 1 | 0.00 | 0.00 | 0.00 |
| A4-10 | Pointing error between reference antenna and test range antenna | 0.00 | 0.00 | 0.00 | Rectangular | 1.73 | 1 | 0.00 | 0.00 | 0.00 |
| A4-11 | Impedance mismatch in path to reference antenna | 0.05 | 0.05 | 0.05 | U-shaped | 1.41 | 1 | 0.04 | 0.04 | 0.04 |
| A4-12 | Impedance mismatch in path to compact probe | 0.03 | 0.03 | 0.03 | U-shaped | 1.41 | 1 | 0.02 | 0.02 | 0.02 |
| A4-2b | Standing wave between reference antenna and receiving antenna | 0.09 | 0.09 | 0.09 | U-shaped | 1.41 | 1 | 0.06 | 0.06 | 0.06 |
| A4-3b | Quiet zone ripple reference antenna | 0.18 | 0.18 | 0.18 | Gaussian | 1.00 | 1 | 0.18 | 0.18 | 0.18 |
| A4-4b | Phase curvature refernce antenna | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A4-5b | Polarization mismatch between reference antenna and receiving antenna | 0.05 | 0.05 | 0.05 | Rectangular | 1.73 | 1 | 0.03 | 0.03 | 0.03 |
| A4-6a | Mutual coupling between reference antenna and receiving antenna | 0.00 | 0.00 | 0.00 | Rectangular | 1.73 | 1 | 0.00 | 0.00 | 0.00 |
| C1-1 | RF power measurement equipment (e.g. spectrum analyzer, power meter) | 0.14 | 0.26 | 0.26 | Gaussian | 1.00 | 1 | 0.14 | 0.26 | 0.26 |
| A4-13 | Influence of the reference antenna feed cable (flexing cables, adapters, attenuators, connector repeatability) | 0.08 | 0.08 | 0.08 | Rectangular | 1.73 | 1 | 0.05 | 0.05 | 0.05 |
| A4-14 | Mismatch of receiver chain | 0.20 | 0.30 | 0.30 | U-shaped | 1.41 | 1 | 0.14 | 0.21 | 0.21 |
| A4-15 | Insertion loss of receiver chain | 0.18 | 0.18 | 0.18 | Rectangular | 1.73 | 1 | 0.10 | 0.10 | 0.10 |
| C1-4 | Uncertainty of the absolute gain of the reference antenna | 0.50 | 0.43 | 0.43 | Rectangular | 1.73 | 1 | 0.29 | 0.25 | 0.25 |
| A4-8b | RF leakage (SGH connector terminated and test range antenna connector cable terminated. | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| **Combined standard uncertainty (1σ) (dB)** | | | | | | | | **0.46** | **0.56** | **0.56** |
| **Expanded uncertainty (1.96σ - confidence interval of 95 %) (dB)** | | | | | | | | **0.90** | **1.10** | **1.10** |

**--- Next change ---**

#### 9.2.5.3 MU value derivation, FR1

Table 9.2.5.3-1 captures the uncertainty budget contributors and Table 9.2.5.3-2 captures the derivation of the expanded measurement uncertainty values for EIRP accuracy measurements in Near Field Test Range.

Standard uncertainty values for the signal generator, network analyzer and reference antenna are according to the test equipment uncertainty values, as captured in annex C.

Table 9.2.5.3-1: NFTR measurement accuracy contributors for EIRP accuracy measurements, FR1

|  |  |  |
| --- | --- | --- |
| **UID / Details in annex** | **Uncertainty source** |  |
| **Stage 2: BS measurement** | | |
| A3-1 | Axes Intersection |  |
| A3-2 | Axes Orthogonality |  |
| A3-3 | Horizontal Pointing |  |
| A3-4 | Probe Vertical Position |  |
| A3-5 | Probe H/V pointing |  |
| A3-6 | Measurement Distance |  |
| A3-7 | Amplitude and Phase Drift |  |
| A3-8 | Amplitude and Phase Noise |  |
| A3-9 | Leakage and Crosstalk |  |
| A3-10 | Amplitude Non-Linearity |  |
| A3-11 | Amplitude and Phase Shift in rotary joints |  |
| A3-12 | Channel Balance Amplitude and Phase |  |
| A3-13 | Probe Polarization Amplitude and Phase |  |
| A3-14 | Probe Pattern Knowledge |  |
| A3-15 | Multiple Reflections |  |
| A3-16 | Room Scattering |  |
| A3-17 | BS support Scattering |  |
| A3-18 | Scan Area Truncation |  |
| A3-19 | Sampling Point Offset |  |
| A3-20 | Spherical Mode Truncation |  |
| A3-21 | Positioning |  |
| A3-22 | Probe Array Uniformity |  |
| A3-23 | Mismatch of receiver chain |  |
| A3-24 | Insertion loss of receiver chain |  |
| A3-25 | Uncertainty of the absolute gain of the probe antenna |  |
| C1-1 | RF power measurement equipment (e.g. spectrum analyzer, power meter) |  |
| A3-26 | Measurement repeatability - positioning repeatability |  |
| A3-33 | Test system frequency flatness |  |
| **Stage 1: Calibration measurement** | | |
| C1-3 | Uncertainty of the network analyzer |  |
| A3-27 | Mismatch of receiver chain |  |
| A3-28 | Insertion loss of receiver chain |  |
| A3-29 | Mismatch in the connection of the calibration antenna |  |
| A3-30 | Influence of the calibration antenna feed cable |  |
| A3-31 | Influence of the probe antenna cable |  |
| C1-4 | Uncertainty of the absolute gain of the reference antenna |  |
| A3-32 | Short term repeatability |  |

NOTE: In the legacy BS testability technical reports, the MU/TT derivation tables were using UID as a counting numbers across multiple test chambers and requirement’s clauses. In this TR a modified approach was taken with the UID’s being the annex number of the measurement uncertainty source description.

Table 9.2.5.3-2: NFTR measurement uncertainty value derivation for EIRP accuracy measurements, FR1

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UID** | **Uncertainty source** | **Uncertainty value (dB)** | | | **Distribution of the probability** | **Divisor based on distribution shape** | ***ci*** | **Standard uncertainty *ui* (dB)** | | |
| **f<3 GHz** | **3<f<4.2 GHz** | **4.2<f<6 GHz** | **f<3 GHz** | **3<f<4.2 GHz** | **4.2<f<6 GHz** |
| **Stage 2: BS measurement** | | | | | | | | | |  |
| A3-1 | Axes Intersection | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-2 | Axes Orthogonality | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-3 | Horizontal Pointing | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-4 | Probe Vertical Position | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-5 | Probe H/V pointing | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-6 | Measurement Distance | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-7 | Amplitude and Phase Drift | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-8 | Amplitude and Phase Noise | 0.02 | 0.02 | 0.02 | Gaussian | 1.00 | 1 | 0.02 | 0.02 | 0.02 |
| A3-9 | Leakage and Crosstalk | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-10 | Amplitude Non-Linearity | 0.04 | 0.04 | 0.04 | Gaussian | 1.00 | 1 | 0.04 | 0.04 | 0.04 |
| A3-11 | Amplitude and Phase Shift in rotary joints | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-12 | Channel Balance Amplitude and Phase | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-13 | Probe Polarization Amplitude and Phase | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-14 | Probe Pattern Knowledge | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-15 | Multiple Reflections | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-16 | Room Scattering | 0.09 | 0.09 | 0.09 | Gaussian | 1.00 | 1 | 0.09 | 0.09 | 0.09 |
| A3-17 | BS support Scattering | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-18 | Scan Area Truncation | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-19 | Sampling Point Offset | 0.01 | 0.01 | 0.01 | Gaussian | 1.00 | 1 | 0.01 | 0.01 | 0.01 |
| A3-20 | Spherical Mode Truncation | 0.02 | 0.02 | 0.02 | Gaussian | 1.00 | 1 | 0.02 | 0.02 | 0.02 |
| A3-21 | Positioning | 0.03 | 0.03 | 0.03 | Rectangular | 1.73 | 1 | 0.02 | 0.02 | 0.02 |
| A3-22 | Probe Array Uniformity | 0.06 | 0.06 | 0.06 | Gaussian | 1.00 | 1 | 0.06 | 0.06 | 0.06 |
| A3-23 | Mismatch of receiver chain | 0.28 | 0.28 | 0.28 | U-Shaped | 1.41 | 1 | 0.20 | 0.20 | 0.20 |
| A3-24 | Insertion loss of receiver chain | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-25 | Uncertainty of the absolute gain of the probe antenna | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| C1-1 | RF power measurement equipment (e.g. spectrum analyzer, power meter) | 0.14 | 0.26 | 0.26 | Gaussian | 1.00 | 1 | 0.14 | 0.26 | 0.26 |
| A3-26 | Measurement repeatability - positioning repeatability | 0.15 | 0.15 | 0.15 | Gaussian | 1.00 | 1 | 0.15 | 0.15 | 0.15 |
| A3-33 | Test system frequency flatness | 0.25 | 0.25 | 0.25 | Normal | 1.00 | 1 | 0.25 | 0.25 | 0.25 |
| **Stage 1: Calibration measurement** | | | | | | | | | |  |
| C1-3 | Uncertainty of the network analyzer | 0.13 | 0.20 | 0.20 | Gaussian | 1.00 | 1 | 0.13 | 0.20 | 0.20 |
| A3-27 | Mismatch of receiver chain | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-28 | Insertion loss of receiver chain | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-29 | Mismatch in the connection of the calibration antenna | 0.02 | 0.02 | 0.02 | U-Shaped | 1.41 | 1 | 0.01 | 0.01 | 0.01 |
| A3-30 | Influence of the calibration antenna feed cable | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A3-31 | Influence of the probe antenna cable | 0.00 | 0.00 | 0.00 | Gaussian | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| C1-4 | Uncertainty of the absolute gain of the reference antenna | 0.50 | 0.43 | 0.43 | Rectangular | 1.73 | 1 | 0.29 | 0.25 | 0.25 |
| A3-32 | Short term repeatability | 0.09 | 0.09 | 0.09 | Gaussian | 1.00 | 1 | 0.09 | 0.09 | 0.09 |
| **Combined standard uncertainty (1σ) (dB)** | | | | | | | | **0.52** | **0.56** | **0.56** |
| **Expanded uncertainty (1.96σ - confidence interval of 95 %) (dB)** | | | | | | | | **1.01** | **1.10** | **1.10** |

**--- Next change ---**

#### 9.2.6.3 MU value derivation, FR1

Table 9.2.6.3-1 captures the uncertainty budget contributors and Table 9.2.6.3-2 captures the derivation of the expanded measurement uncertainty values for EIRP accuracy measurements in PWS.

Table 9.2.6.3-1: PWS measurement accuracy contributors for EIRP accuracy measurements, FR1

|  |  |  |
| --- | --- | --- |
| **UID / Details in annex** | **Uncertainty source** |  |
| **Stage 2: BS measurement** | | |
| A7-1a | Misalignment BS & pointing error |  |
| C1-1 | RF power measurement equipment (e.g. spectrum analyzer, power meter) |  |
| A7-2a | Longitudinal position uncertainty (i.e. standing wave and imperfect field synthesis) for BS antenna |  |
| A7-3 | RF leakage (calibration antenna connector terminated) |  |
| A7-4a | QZ ripple with BS |  |
| A7-5 | Miscellaneous Uncertainty |  |
| A7-14 | System non-linearity |  |
| A7-13 | Frequency Flatness |  |
| **Stage 1: Calibration measurement** | | |
| C1-3 | Uncertainty of the network analyzer |  |
| A7-6 | Mismatch (i.e. reference antenna, network analyser and reference cable) |  |
| A7-7 | Insertion loss variation |  |
| A7-3 | RF leakage (calibration antenna connector terminated) |  |
| A7-8 | Influence of the calibration antenna feed cable |  |
| C1-4 | Uncertainty of the absolute gain of the reference antenna |  |
| A7-9 | Misalignment of positioning system |  |
| A7-1b | Misalignment of calibration antenna & pointing error |  |
| A7-10 | Rotary joints |  |
| A7-2b | Longitudinal position uncertainty (i.e. standing wave and imperfect field synthesis) for calibration antenna |  |
| A7-4a | QZ ripple with calibration antenna |  |
| A7-11 | Switching uncertainty |  |
| A7-12 | Field repeatability |  |

NOTE: In the legacy BS testability technical reports, the MU/TT derivation tables were using UID as a counting numbers across multiple test chambers and requirement’s clauses. In this TR a modified approach was taken with the UID’s being the annex number of the measurement uncertainty source description.

Table 9.2.6.3-2: PWS measurement uncertainty value derivation for EIRP accuracy measurements, FR1

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UID** | **Uncertainty source** | **Uncertainty value (dB)** | | | **Distribution of the probability** | **Divisor based on distribution shape** | ***ci*** | **Standard uncertainty *ui* (dB)** | | |
| **f<3 GHz** | **3<f<4.2 GHz** | **4.2<f<6 GHz** | **f<3 GHz** | **3<f<4.2 GHz** | **4.2<f<6 GHz** |
| **Stage 2: BS measurement** | | | | | | | | | | |
| A7-1a | Misalignment BS & pointing error | 0.10 | 0.10 | 0.10 | Rectangular | 1.73 | 1 | 0.06 | 0.06 | 0.06 |
| C1-1 | RF power measurement equipment (e.g. spectrum analyzer, power meter) | 0.14 | 0.26 | 0.26 | Gaussian | 1.00 | 1 | 0.14 | 0.26 | 0.26 |
| A7-2a | Longitudinal position uncertainty (i.e. standing wave and imperfect field synthesis) for BS antenna | 0.05 | 0.14 | [0.14] | Rectangular | 1.73 | 1 | 0.03 | 0.08 | [0.08] |
| A7-3 | RF leakage (calibration antenna connector terminated) | 0.09 | 0.09 | 0.09 | Normal | 1.00 | 1 | 0.09 | 0.09 | 0.09 |
| A7-4a | QZ ripple with BS | 0.42 | 0.43 | [0.43] | Rectangular | 1.73 | 1 | 0.24 | 0.25 | [0.25] |
| A7-5 | Miscellaneous Uncertainty | 0.00 | 0.00 | 0.00 | Normal | 1.00 | 1 | 0.00 | 0.00 | 0.00 |
| A7-14 | System non-linearity | [0.06] | [0.06] | [0.06] | Rectangular | 1.73 | 1 | [0.04] | [0.04] | [0.04] |
| A7-13 | Frequency Flatness | 0.13 | 0.13 | 0.13 | Rectangular | 1.73 | 1 | 0.08 | 0.08 | 0.08 |
| **Stage 1: Calibration measurement** | | | | | | | | | | |
| C1-3 | Uncertainty of the network analyzer | 0.13 | 0.20 | 0.20 | Gaussian | 1.00 | 1 | 0.13 | 0.20 | 0.20 |
| A7-6 | Mismatch (i.e. reference antenna, network analyzer and reference cable) | 0.13 | 0.33 | 0.33 | U-shaped | 1.41 | 1 | 0.09 | 0.23 | 0.23 |
| A7-7 | Insertion loss variation | 0.18 | 0.18 | 0.18 | Rectangular | 1.73 | 1 | 0.10 | 0.10 | 0.10 |
| A7-3 | RF leakage (calibration antenna connector terminated) | 0.09 | 0.09 | 0.09 | Normal | 1.00 | 1 | 0.09 | 0.09 | 0.09 |
| A7-8 | Influence of the calibration antenna feed cable | 0.10 | 0.10 | 0.10 | Rectangular | 1.73 | 1 | 0.06 | 0.06 | 0.06 |
| C1-4 | Uncertainty of the absolute gain of the reference antenna | 0.50 | 0.43 | 0.43 | Rectangular | 1.73 | 1 | 0.29 | 0.25 | 0.25 |
| A7-9 | Misalignment of positioning system | 0.00 | 0.00 | 0.00 | Exp. normal | 2.00 | 1 | 0.00 | 0.00 | 0.00 |
| A7-1b | Misalignment of calibration antenna & pointing error | 0.05 | 0.05 | 0.05 | Rectangular | 1.73 | 1 | 0.03 | 0.03 | 0.03 |
| A7-10 | Rotary joints | 0.00 | 0.00 | 0.00 | U-shaped | 1.73 | 1 | 0.00 | 0.00 | 0.00 |
| A7-2b | Longitudinal position uncertainty (i.e. standing wave and imperfect field synthesis) for calibration antenna | 0.12 | 0.12 | [0.12] | Rectangular | 1.73 | 1 | 0.07 | 0.07 | [0.07] |
| A7-4a | QZ ripple with calibration antenna | 0.20 | 0.20 | 0.20 | Rectangular | 1.73 | 1 | 0.12 | 0.12 | 0.12 |
| A7-11 | Switching uncertainty | 0.02 | 0.02 | 0.02 | Rectangular | 1.73 | 1 | 0.01 | 0.01 | 0.01 |
| A7-12 | Field repeatability | 0.06 | 0.12 | [0.12] | Normal | 1.00 | 1 | 0.06 | 0.12 | [0.12] |
| **Combined standard uncertainty (1σ) (dB)** | | | | | | | | **[0.50]** | **[0.60]** | **[0.60]** |
| **Expanded uncertainty (1.96σ - confidence interval of 95 %) (dB)** | | | | | | | | **[0.98]** | **[1.18]** | **[1.18]** |

**--- End of changes ---**