

# Product datasheet of Audi DDA Gen2 MLB BM roof antenna with LTE, GNSS, FFB and active Bluetooth

## History

| Date       | Version | Description of modification |
|------------|---------|-----------------------------|
| 21.09.2023 | 1.0     | Initial version             |
|            |         |                             |
|            |         |                             |
|            |         |                             |

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# 1 General description

## 1.1 Features

The DDA MLB Gen2 is a compact roof antenna series applied to the MLBevo platform vehicles.

This Audi DDA roof antenna comprises the services:

- active Bluetooth transceiver as gateway for “remote parking”, “light control” and “user recognition” to be used in combination with the branded mobile phone apps.
- cellular phone,
- navigation,
- remote control (FFB)

This version is “SFD2” (UNECE cybersecurity) compliant with K-Matrix V8.18.

This roof antenna is designed to be screwed to a metal roof at the rear end of the vehicle.

## 1.2 Bluetooth

The Bluetooth transceiver supports application specific Bluetooth low energy (BLE) characteristics only.

It is configured as a strictly restricted gateway to prevent unauthorized access, as it is allowed to wake up the vehicle's CAN bus while parked. User recognition is done while passing the vehicle with the mobile. Thus, this may happen several times while parked user recognition does not wake up the car. The latest IDs are kept in the gateway waiting for a wake up of the CAN bus triggered by other events. The sleep current limits are allowed to be slightly increased due to the BLE activities while parked.

The cryptographic keys to use the BLE features are exchanged via the brand specific backend. This exchange is done over cellular protocols. The cellular transfer of these keys is no feature of this device it is done between the rest of the vehicle and the backend as well the backend and the mobile. The keys are exchanged via the CAN bus with the vehicles remaining infrastructure. There is no direct exchange of private keys towards the mobile. The gateway expects the mobiles to connect with valid keys.

Connect trials with standard BLE characteristics are rejected without any action. Connection requests with correct keys but no valid user actions afterwards are counted to prevent the battery from discharging. This feature is called “play protection”. Triggering the play protection limit shuts down the BLE transceiver until the CAN bus was woken by another event.

The BLE transceiver is shut down in drive cycles not classified as remote parking action - it is active in stand still scenarios only.

After the connection procedure with the mobile the device is just a logical transparent wireless modem. The control of the park and light scenarios are handled via this transparent logical channel between the users mobile and the vehicles remaining infrastructure. IDs kept by user recognition are announced towards the vehicles remaining infrastructure, only.

The Bluetooth transceiver is powered as contact 30 device with logical contact 15 via the connection to the vehicle's infotainment CAN. The closed-circuit current is allowed to be increased.

## 1.3 Cellular phone

The cellular phone is a passive circuit which covers the frequency ranges 3G LTE and 4G LTE.

## **1.4 Navigation**

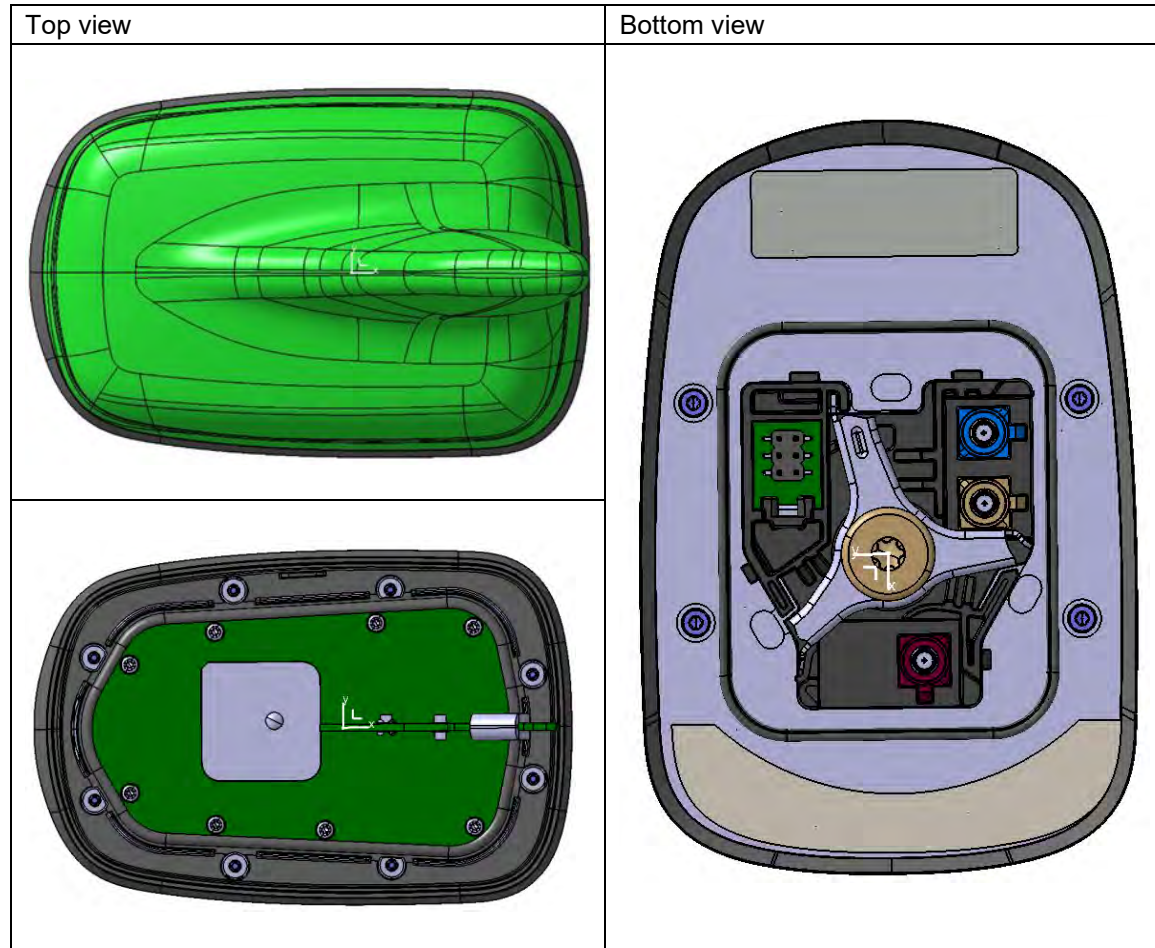
A ceramic patch and a two-stage low noise amplifier (LNA) build up the GNSS antenna providing reception for the upper L-band signals GPS L1, GLONASS G1, Beidou B1 and Galileo G1 as well as associated augmentation signals like WAAS, EGNOS and MSAS (1559 ...1606 MHz).

The GNSS circuit must be supplied with power via phantom feed.

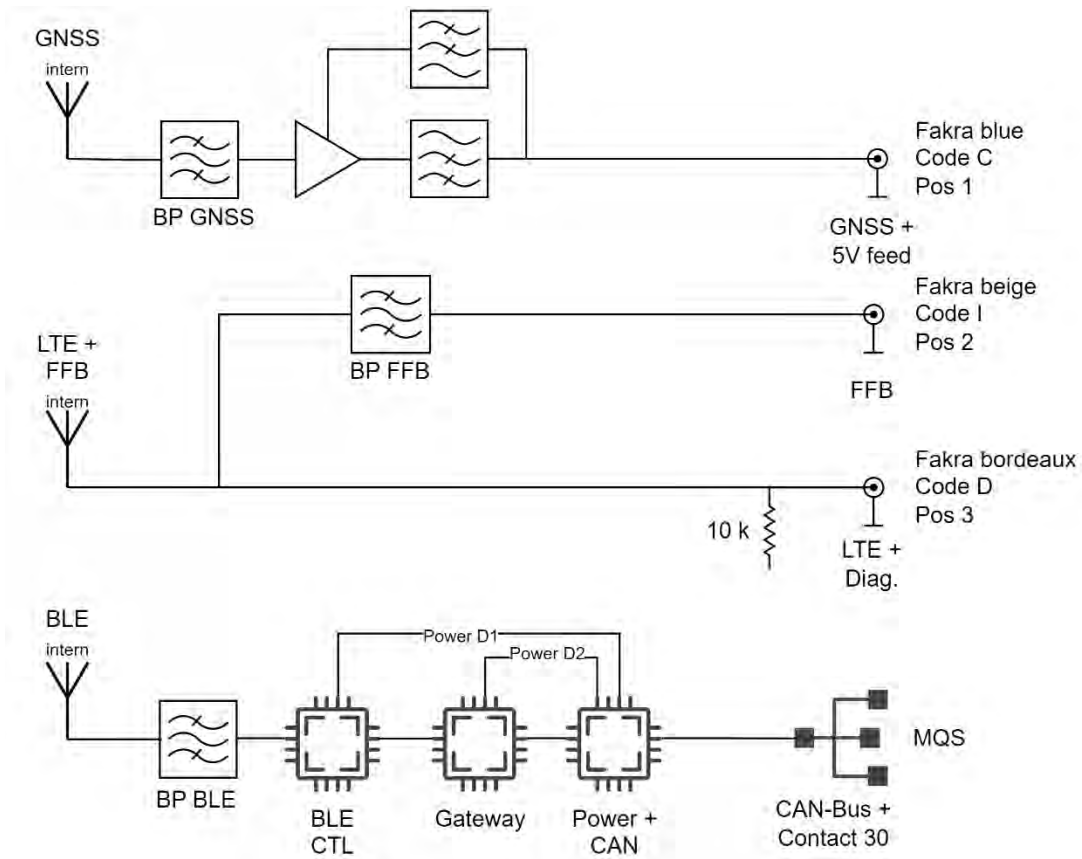
## **1.5 Remote control**

The remote control circuit is a passive circuit which covers the ISM Band at 868 MHz (FFB). It is used for applications like remote climate control e.g.

## 1.6 Views



## 1.7 Block diagram



## 1.8 Pin configuration

| Pos | Connector          | Pin acc. to drawing | Description      | Potential in car         |
|-----|--------------------|---------------------|------------------|--------------------------|
| 1   | Fakra blue (C)     | Inner contact       | GNSS (RF / UB+)  | +5V                      |
|     |                    | Outer contact       | Ground (RF / DC) | 0V                       |
| 2   | Fakra beige (I)    | Inner contact       | FFB (RF)         |                          |
|     |                    | Outer contact       | Ground (RF)      |                          |
| 3   | Fakra bordeaux (D) | Inner contact       | LTE (RF)         |                          |
|     |                    | Outer contact       | Ground (RF)      |                          |
| 4   | Not used           |                     |                  |                          |
|     |                    |                     |                  |                          |
| MQS | MQS                | 1                   | Contact 30       | +U <sub>BAT</sub> (+12V) |
|     |                    | 2                   | Contact 31       | 0V                       |
|     |                    | 3                   | CAN_H            |                          |
|     |                    | 4                   | CAN_L            |                          |
|     |                    | 5                   | N.C.             |                          |
|     |                    | 6                   | N.C.             |                          |

## 2 Model numbering

|                      |                |
|----------------------|----------------|
| OEM part number      | 4N0.035.503.BM |
| Supplier part number | 52521495       |

| Further supplier part numbers: |          |          |          |          |          |          |
|--------------------------------|----------|----------|----------|----------|----------|----------|
| 52521496                       | 52521497 | 52521498 | 52521499 | 52521500 | 52521501 | 52521502 |
| 52521503                       | 52521504 | 52521505 | 52521506 | 52521507 | 52521508 | 52521509 |
| 52521510                       | 52521511 | 52521512 | 52521513 | 52521514 | 52521515 | 52521516 |
| 52521517                       | 52521518 | 52521519 | 52521520 | 52521521 | 52521522 | 52521523 |
| 52521524                       | 52521525 | 52521526 | 52521527 | 52521528 | 52521529 | 52521530 |
| 52521531                       | 52521532 | 52521533 | 52521534 | 52521535 | 52521536 | 52521537 |
| 52521538                       | 52521539 | 52521540 | 52521541 | 52521542 | 52521543 | 52521544 |
| 52521545                       | 52521546 | 52521547 | 52521548 | 52521549 | 52521550 | 52521551 |
| 52521552                       | 52521553 | 52521554 | 52521555 | 52521556 | 52521557 | 52521558 |
| 52523112                       | 52523113 | 52523114 | 52523115 | 52523190 | 52523191 | 52523192 |
| 52523220                       | 52523221 | 52523242 | 52524031 | 52524127 | 52524128 |          |

## 3 Specification

### 3.1 General specification

|                       |                                                 |
|-----------------------|-------------------------------------------------|
| Operating temperature | -40 °C ... +95 °C                               |
| Storage temperature   | -40 °C ... +95 °C                               |
| Validation tests      | compliant to VW80000, VW80101 and LAH 4M0.035.G |
| EMC tests             | compliant to VW81000 and EMV-LAH-Module 2.4     |

### 3.2 GNSS specification

#### 3.2.1 Antenna performance

Table 3-1: Typical electrical properties of the passive GNSS adapter

| Parameter           | Condition                                   | Value                      |
|---------------------|---------------------------------------------|----------------------------|
| Patch dimensions    | Width x Length x Height                     | 25 mm x 25 mm x 4 mm       |
| Frequency ranges    | Beidou                                      | 1559,052 ... 1563,144 MHz  |
|                     | GPS/Galileo                                 | 1571,42 ... 1579,4 MHz     |
|                     | Glionass                                    | 1598,0625 ... 1605,375 MHz |
| Return loss         | GPS/Galileo                                 | min. 10 dB                 |
| Linear Average Gain | Zenith, on 1 m ground plane,<br>GPS/Galileo | typ. 2,9 dBic              |
| Axial ratio         | GPS/Galileo                                 | typ. 4,1 dB                |
| Peak gain           |                                             | 3,9 dBic                   |
| Impedance           |                                             | 50 $\Omega$                |
| Polarization        |                                             | RHCP                       |

Radiated measurement has been performed in the center of the turntable on conducting ground.

### 3.2.2 LNA performance

Table 3-2: RF LNA performance (GNSS)

| Parameter                    | Condition                         | Value          |
|------------------------------|-----------------------------------|----------------|
| Supply voltage               |                                   | 4,5 ... 5,5 V  |
| Current consumption          | 4,5 V / -40 °C                    | 20,3 mA (min)  |
|                              | 5,0 V / +30 °C                    | 24,1 mA (typ)  |
|                              | 5,5 V / +100 °C                   | 27,5 mA (max)  |
| Noise figure                 | 5,0 V / 1559 ... 1605 MHz         | max. 2,4 dB    |
| Gain                         |                                   | typ. 29,6 dB   |
| Output return loss           |                                   | min. 13,7 dB   |
| Gain ripple                  |                                   | max. 1,8 dB    |
| Input 1dB Compression Point  | 5,0 V / 1575 MHz                  | typ. -21,6 dBm |
| Output Third Order Intercept | f1 / f2 = 1574,9 MHz / 1575,1 MHz | typ. 18,1 dBm  |
| Selectivity                  | 800 ... 1000 MHz                  | min. 54,1 dB   |
|                              | 1700 ... 2700 MHz                 | min. 35 dB     |
|                              | 100 ... 1450 MHz                  | min. 42,1 dB   |
|                              | 1450 ... 1525 MHz                 | min. 37,1 dB   |
|                              | 1650 ... 2100 MHz                 | min. 27,3 dB   |
|                              | 2100 ... 2400 MHz                 | min. 48,6 dB   |
|                              | 2400 ... 2700 MHz                 | min. 63,5 dB   |

### 3.2.3 Overall performance

Table 3-3: Typical electrical properties of the active GNSS antenna

| Parameter           | Condition                                | Value          |
|---------------------|------------------------------------------|----------------|
| Return loss         | GPS/Galileo                              | min. 9,8 dB    |
| Linear Average Gain | Zenith, on 1 m ground plane, GPS/Galileo | typ. 32,5 dBic |
| Axial ratio         | Zenith, GPS/Galileo                      | typ. 5,4 dB    |
| Peak gain           |                                          | 33,5 dBic      |
| Impedance           |                                          | 50 $\Omega$    |
| Polarization        |                                          | RHCP           |

Radiated measurement has been performed in the center of the turntable on conducting ground.

Table 3-4: Isolation (GNSS) to other services of the active antenna

| Parameter                         | Condition         | Value        |
|-----------------------------------|-------------------|--------------|
| GNSS (Rx) and cellular phone (Tx) | 698 ... 894 MHz   | min. 51,9 dB |
|                                   | 1710 ... 1990 MHz | min. 15,8 dB |
|                                   | 2110 ... 2155 MHz | min. 31,1 dB |
|                                   | 2400 ... 2484 MHz | min. 40,2 dB |
|                                   | 2496 ... 2690 MHz | min. 41,3 dB |
| GNSS (Rx) and Bluetooth (Tx)      | 2400 ... 2484 MHz | min. 36,4 dB |

### 3.3 Cellular phone specification

Table 3-5: Typical electrical properties (cellular phone)

| Parameter            | Condition                              |                                                                                                    | Value                    |
|----------------------|----------------------------------------|----------------------------------------------------------------------------------------------------|--------------------------|
| Frequency ranges     | Low-band (LB)                          |                                                                                                    | 698 ... 960 MHz          |
|                      | Mid-band (MB)                          |                                                                                                    | 1710 ... 2170 MHz        |
|                      | High-band (HB)                         |                                                                                                    | 2400 ... 2700 MHz        |
| Return loss          | 698 ... 960 MHz                        |                                                                                                    | min. 7,3 dB <sup>1</sup> |
|                      | 1710 ... 2170 MHz                      |                                                                                                    | typ. 10 dB               |
|                      | 2400 ... 2700 MHz                      |                                                                                                    | typ. 10 dB <sup>1</sup>  |
| Linear Average Gain  | 698 ... 960 MHz                        | on 1 m ground plane;<br>$\Delta\Phi = 0 \dots 359^\circ$ and<br>$\Delta\theta = 60 \dots 90^\circ$ | typ. 2,8 dBi             |
|                      | 1710 ... 2170 MHz                      |                                                                                                    | typ. 1,7 dBi             |
|                      | 2400 ... 2700 MHz                      |                                                                                                    | typ. -1 dBi              |
| Peak gain            |                                        |                                                                                                    | max. 8 dBi               |
| Impedance            |                                        |                                                                                                    | 50 $\Omega$              |
| Polarization         | Combination of vertical and horizontal |                                                                                                    | Linear H + V             |
| Diagnosis resistance |                                        |                                                                                                    | typ. 10 k $\Omega$       |

Radiated measurement has been performed in the center of the turntable on conducting ground.

### 3.4 Remote control specification

Table 3-6: Typical electrical properties (remote control)

| Parameter            | Condition                              |  | Value                    |
|----------------------|----------------------------------------|--|--------------------------|
| Frequency ranges     | Low-band (LB)                          |  | 698 ... 960 MHz          |
| Return loss          | 867,5 ... 869,5 MHz                    |  | min. 7,3 dB <sup>2</sup> |
| Linear Average Gain  | 867,5 ... 869,5 MHz                    |  | typ. -6,5 dBi            |
| Peak gain            |                                        |  | max. -3 dBi              |
| Impedance            |                                        |  | 50 $\Omega$              |
| Polarization         | Combination of vertical and horizontal |  | Linear H + V             |
| Diagnosis resistance |                                        |  | none                     |

<sup>1</sup> including 5 m long RTK031 RF cable

<sup>2</sup> including 5 m long RTK031 RF cable

### 3.5 Bluetooth specification

#### 3.5.1 Antenna performance

Table 3-7: Typical electrical properties (Bluetooth) passive

| Parameter           | Condition                                                                                       | Value               |
|---------------------|-------------------------------------------------------------------------------------------------|---------------------|
| Frequency range     |                                                                                                 | 2400 ... 2483,5 MHz |
| Linear Average Gain | on 1 m ground plane,<br>$\Delta\Phi = 0 \dots 359^\circ$ and $\Delta\theta = 60 \dots 90^\circ$ | typ. 1,1 dBi        |
| Peak gain           |                                                                                                 | max. 6,4 dBi        |
| Polarization        | Combination of vertical and horizontal                                                          | Linear H + V        |

Radiated measurement has been performed in the center of the turntable on conducting ground.

#### 3.5.2 Transceiver performance

Table 3-8: Typical electrical properties (Bluetooth) active

| Parameter                  | Condition                                                         | Value                                                                    |
|----------------------------|-------------------------------------------------------------------|--------------------------------------------------------------------------|
| Frequency range            |                                                                   | 2400 ... 2483,5 MHz                                                      |
| Channel width              |                                                                   | 2 MHz                                                                    |
| Output-Power               | at antenna feed point                                             | +1 dBm (+- 1dB)                                                          |
| Modulation                 |                                                                   | GFSK                                                                     |
| Nominal supply voltage     |                                                                   | 12 V                                                                     |
| Operating voltage range    |                                                                   | 7 V ... 18 V                                                             |
| Max. current (transceiver) |                                                                   | 100 mA                                                                   |
| Sleep current              | Depending on advertisement status                                 | 80 $\mu$ A ... 168 $\mu$ A                                               |
| Bluetooth low energy       | VW group specific Bluetooth low energy (BLE) characteristics only |                                                                          |
| Data bus                   | CAN                                                               | High speed at 500 kBit/s                                                 |
|                            | Termination                                                       | high impedance<br>RT1 + RT2 = 9,28 k $\Omega$<br>(= 2 x 4,64k $\Omega$ ) |

#### 3.5.3 Overall performance

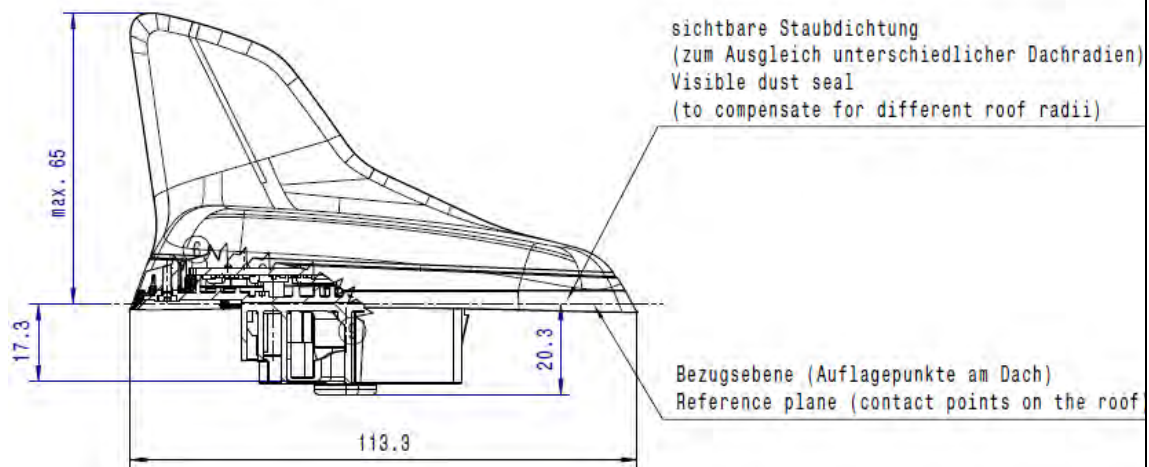
| Parameter             | Condition           | Value        |
|-----------------------|---------------------|--------------|
| Radiated power (EIRP) | 2400 ... 2483,5 MHz | max. 8,4 dBm |

Table 3-9: Isolation (Bluetooth) to other services

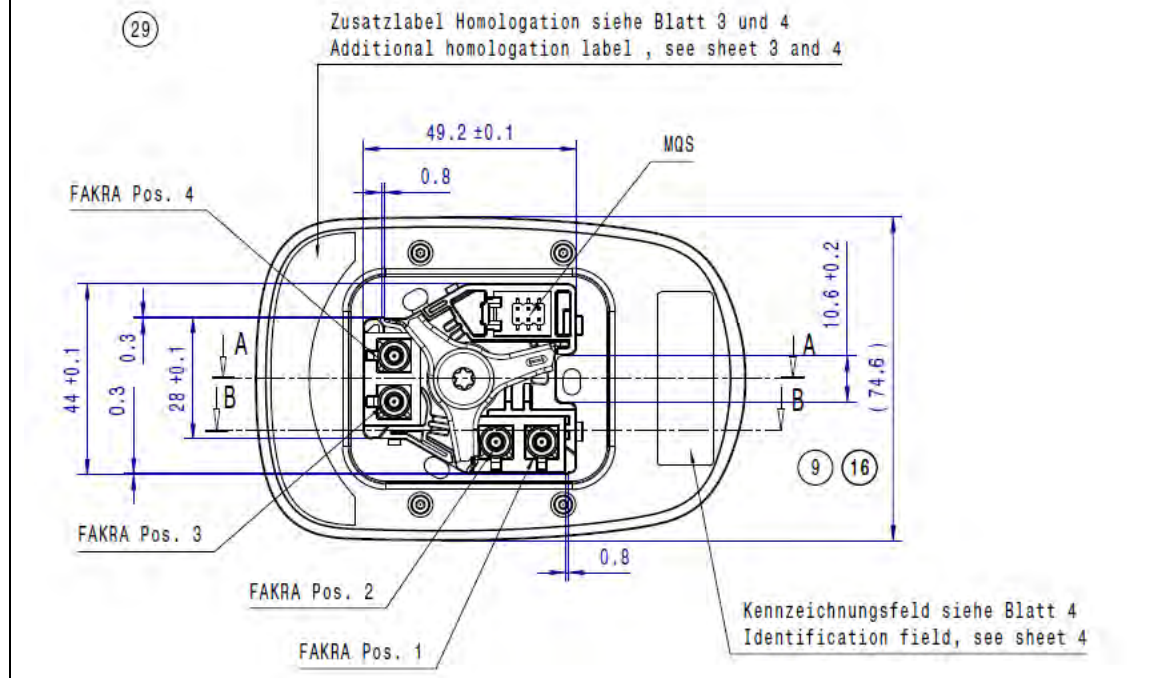
| Parameter                              | Condition         | Value        |
|----------------------------------------|-------------------|--------------|
| Bluetooth (Rx) and cellular phone (Tx) | 698 ... 894 MHz   | min. 49,5 dB |
|                                        | 1710 ... 1990 MHz | min. 40,2 dB |
|                                        | 2110 ... 2155 MHz | min. 37,7 dB |
|                                        | 2400 ... 2484 MHz | min. 13 dB   |
|                                        | 2496 ... 2690 MHz | min. 45,4 dB |

## 4 Dimensions

As-received condition



Bottom view



## Roof hole

Dachloch, Ansicht von oben  
Roof hole, view from above

2:1

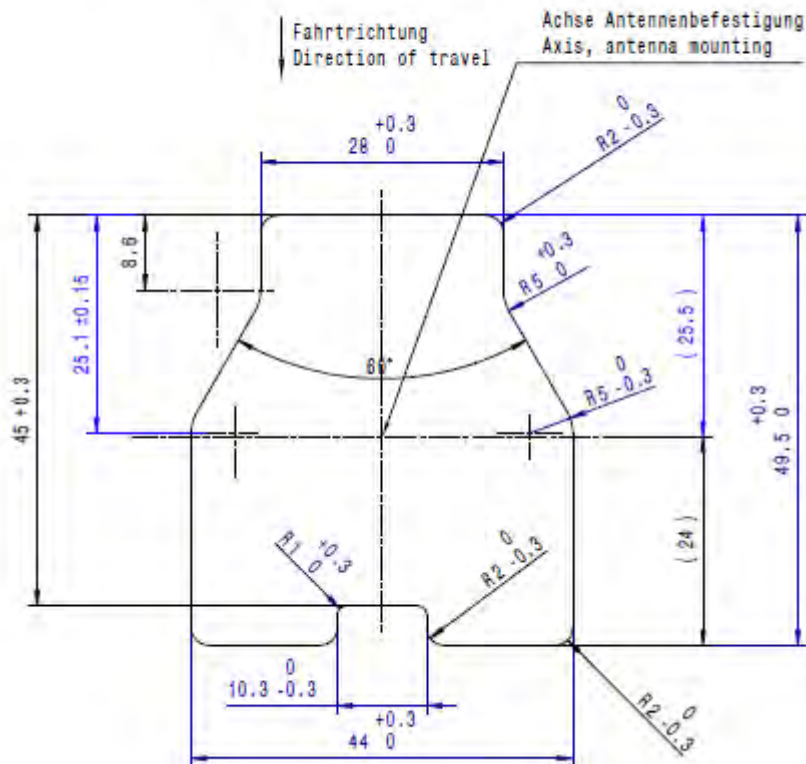


Figure 4-1: Mechanical drawing

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# Messbericht Komponenten DDA2\_perso

**4N0 035 503 DC**

|                     |                                                       |       |              |       |
|---------------------|-------------------------------------------------------|-------|--------------|-------|
| Datei               | MESSBERICHT_KOMPONENTENMESSUNG_4N0 035 503 DC V01.DOC |       |              |       |
| Autor               | Thomas.Schano@continental.com                         |       |              |       |
| Version             | V01                                                   |       |              |       |
| Status              | C sample                                              |       |              |       |
| Datum               | 07.09.2023                                            |       |              |       |
| Projekt             | 4N0 035 503 DC                                        |       |              |       |
| Fahrzeug / Bauteile |                                                       |       |              |       |
| Freigabe            | Version                                               | _____ | Datum        | _____ |
|                     | Name                                                  | _____ | Unterschrift | _____ |

Die Komponente

**4N0 035 503 DC**

ist hardwareseitig identisch mit der Variante

**4N0 035 503 AP.**

Die Varianten unterscheiden sich nur in Der SW des Maincontollers.  
Diese SW Update hat keinen Einfluss auf die Ergebnisse aus diesem Messbericht.

Vorlagenname: EE\_Vorlage\_Word\_V03, Vorlagenversion: V03

# Messbericht Komponenten DDA2\_perso

## 4N0 035 503 AP

|                     |                                                       |
|---------------------|-------------------------------------------------------|
| Datei               | MESSBERICHT_KOMPONENTENMESSUNG_4N0 035 503 AP V01.DOC |
| Autor               | Klaus.Jaeger@kathreinautomotive.com                   |
| Version             | V01                                                   |
| Status              | C sample                                              |
| Datum               | 26.07.2019                                            |
| Projekt             | 4N0 035 503 AP                                        |
| Fahrzeug / Bauteile |                                                       |

|                 |         |       |              |       |
|-----------------|---------|-------|--------------|-------|
| <b>Freigabe</b> | Version | _____ | Datum        | _____ |
|                 | Name    | _____ | Unterschrift | _____ |

Vorlagenname: EE\_Vorlage\_Word\_V03, Vorlagenversion: V03

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# 1 Einleitung

## 1.1 Lieferantenangaben

**Tabelle 1: Lieferantenangaben.**

|                                        |                                       |
|----------------------------------------|---------------------------------------|
| Firma                                  | Continental Advanced Antenna GmbH     |
| Adresse                                | Römerring 1,<br>31137 Hildesheim / DE |
| Lieferanten Code (auf Bauteil Etikett) | BN2                                   |
| Produktionsort (Adresse, Land)         | Vila Real, Portugal                   |
| Produktionsdatum                       | KW28/2019                             |
| DUNS-Nummer                            | 341229368                             |

**Tabelle 2: Übersicht und Status der vermessenen Komponenten.**

| VW/AudiTeile-<br>nummer | Funktion              | HW-<br>stand | Leiterplattenstand | Muster-<br>ter-<br>stand | Abweichungen |
|-------------------------|-----------------------|--------------|--------------------|--------------------------|--------------|
| 4N0 035 503 AP          | LTE/GNSS/BT/FFB<br>BD | 01S          | 13612260B02P01V01  | C                        |              |

## 2 Zusammenfassung

### GNSS03

|                      | Limit     | DUT           | Result |
|----------------------|-----------|---------------|--------|
| Ubat (V)             | 4,5...5,5 |               | pass   |
| Is (mA)              | 18...30   | 24            | pass   |
| Gain (dB)            | 27...33   | 29            | pass   |
| NF (dB)              | 2 (2,6)   | 1.8...2.7     | pass   |
| BW(3dB)              | 50...70   |               | pass   |
| Fmin (MHz)           | 1571,42   |               | pass   |
| Fmax(MHz)            | 1605,37   |               | pass   |
| IP3(out) (dBm)       | 11        | 17            | pass   |
| Entkopplung LTE (dB) | >45       | 0,8...1GHz    | pass   |
|                      | >40       | 1,7...2.7GHz  | pass   |
| Ripple (dB)pp        | 1,5 (2)   | pass band     | pass   |
| Selektion            | 40        | 0,1...1,3G    | pass   |
|                      | 30        | 1,3...1,49G   | pass   |
|                      | 23        | 1,49...1,525G | pass   |
|                      | 15        | 1,645...1,65G | pass   |
|                      | 30        | 1,65...1,84G  | pass   |
|                      | 37        | 1,84...2G     | pass   |
|                      | 28        | 2,4...2,7G    | pass   |

### FFB

| Parameter                                              |                 | Erfüllt J/N | Bemerkung |
|--------------------------------------------------------|-----------------|-------------|-----------|
| Inband: Durchlassbereich Telestart                     |                 |             |           |
| Einfügedämpfung Antenneneingang->Mobilfunk (Inband)    | IS21I           | J           |           |
| Einfügedämpfung Antenneneingang->Telestart (Inband)    | IS31I           | N           | 11dB      |
| Entkopplung Mobilfunk-Telestart (Inband)               | IS32I           | N           | 11dB      |
| Anpassung (Inband)                                     | IS33I           | J           |           |
|                                                        |                 |             |           |
| Ausserband Durchlassbereich TEL(4G), TEL(3G)           |                 |             |           |
| Einfügedämpfung Antenneneingang-Mobilfunk (Ausserband) | IS21I           | J (*)       | Max 2dB   |
| Entkopplung Mobilfunk-Telestart (Ausserband)           | IS31I           | J           |           |
| Entkopplung Mobilfunk-Telestart (Ausserband)           | IS32I           | J           |           |
| Anpassung (Ausserband)                                 | IS11I,<br>IS22I | J           |           |

### LTE

Erfüllt nicht durchgängig die RL>10dB Anforderung.

### BT2 (aktiv)

TBD

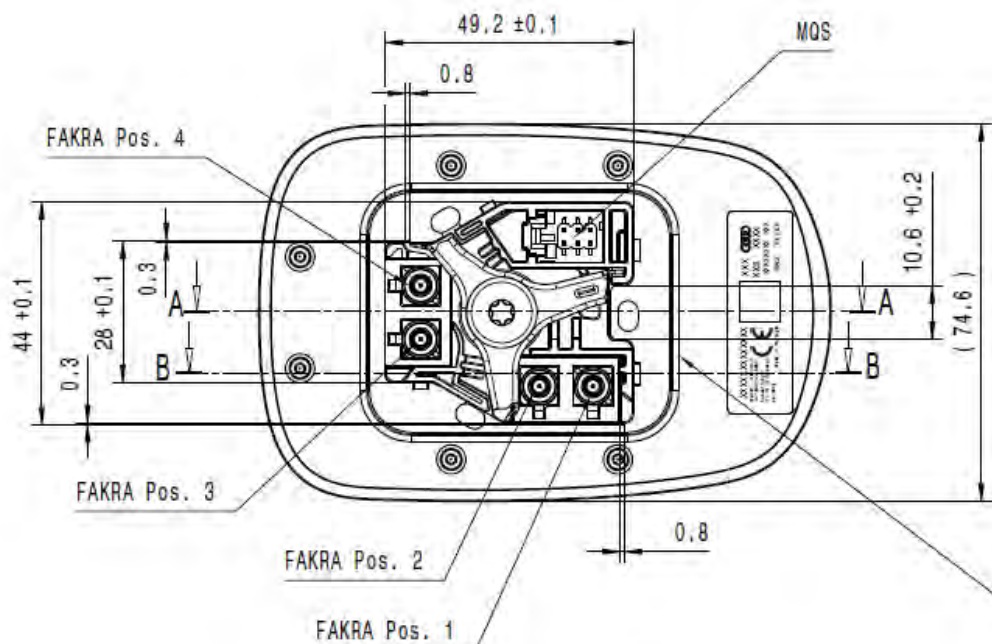
### 3 Allgemeine Angaben

#### 3.1 Temperatur und sonstige Angaben

Raumtemperatur 23°C

Anpassungsmessungen auf Metall-GND-Platte (Durchmesser 600mm)

#### 3.2 Steckerbelegung



| Variante                 | AUDI-Nr.       | Einbauart | Fakra-Pos.1 | Fakra-Pos.2 | Fakra-Pos.3     | Fakra-Pos.4  |
|--------------------------|----------------|-----------|-------------|-------------|-----------------|--------------|
|                          |                |           |             |             |                 |              |
| DDA: TEL+GNSS+FFB+BT(V2) | 4N0.035.503.AP | Volldach  | blue Code C | -           | bordeaux Code D | beige Code I |

GNSS      Fakra blue  
LTE        Fakra bordeaux  
FFB        Fakra beige

## 4 Angaben zur Mechanik

### 4.1 Zeichnungsstand und KVS-Stand

TAB\_010\_425\_BE\_DRW\_TZ\_\_015\_001\_ANTENNE\_VOLLDACH\_\_\_\_\_20190528

### 4.2 Mechanische Abweichungen

n.a.

## 5 Messungen

### 5.1 GNSS-Messungen (ohne Antenne)

#### 5.1.1 Stromaufnahme über Ub

| Ub (V) | Ib (mA) |
|--------|---------|
| 4.5    | 21      |
| 5.0    | 24      |
| 5.5    | 26      |

#### 5.1.2 S-Parameter

##### 5.1.2.1 Messaufbau

Entspr. TL82133

##### 5.1.2.2 Messergebnisse

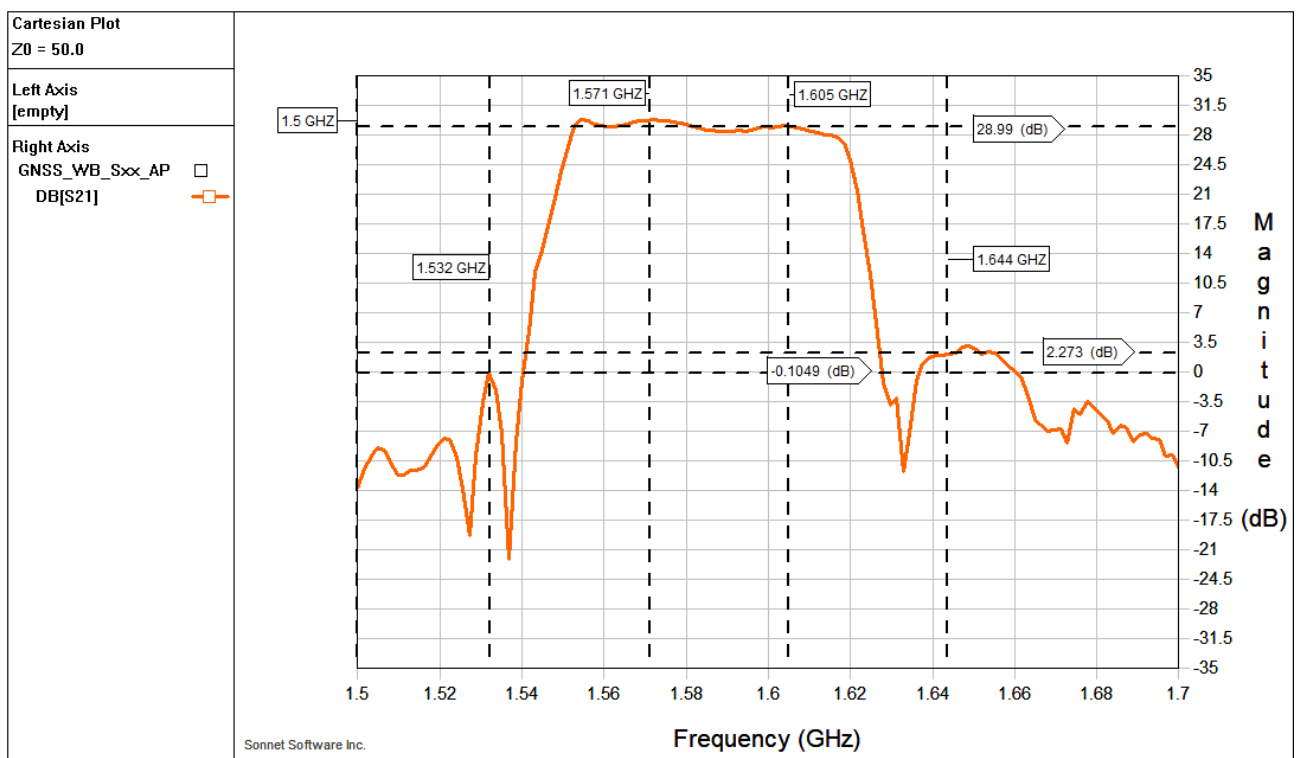


Abbildung 1 GNSS Selektion (NB)

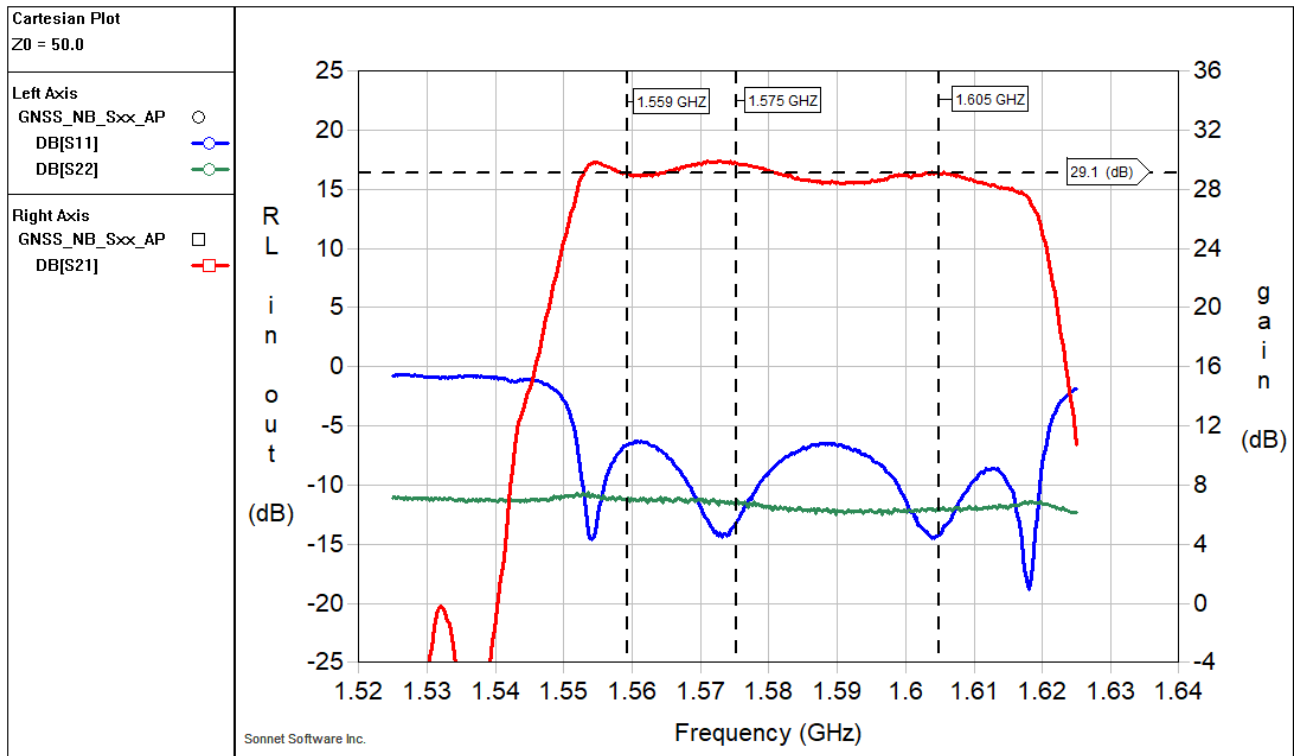


Abbildung 2 GNSS (NB) S-parameter

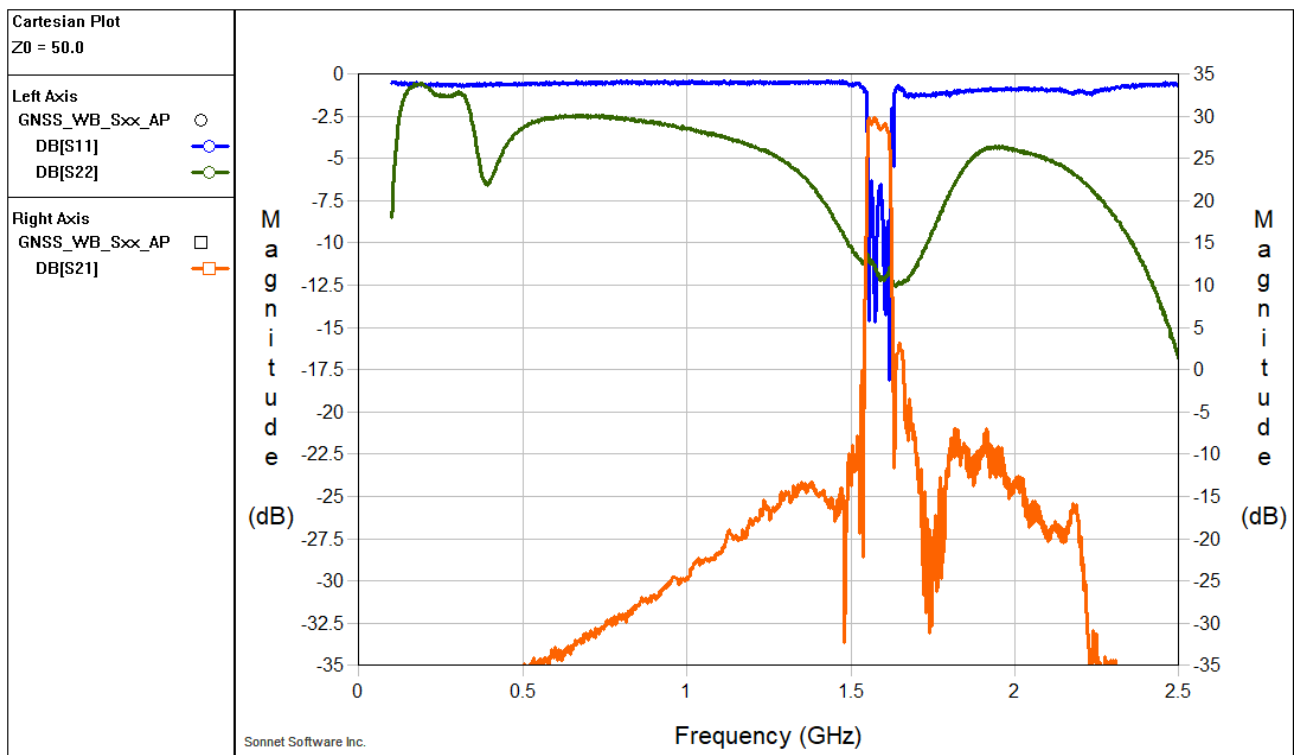


Abbildung 3 GNSS S-Parameter (WB)

### 5.1.2.3 Stabilitätsnachweis

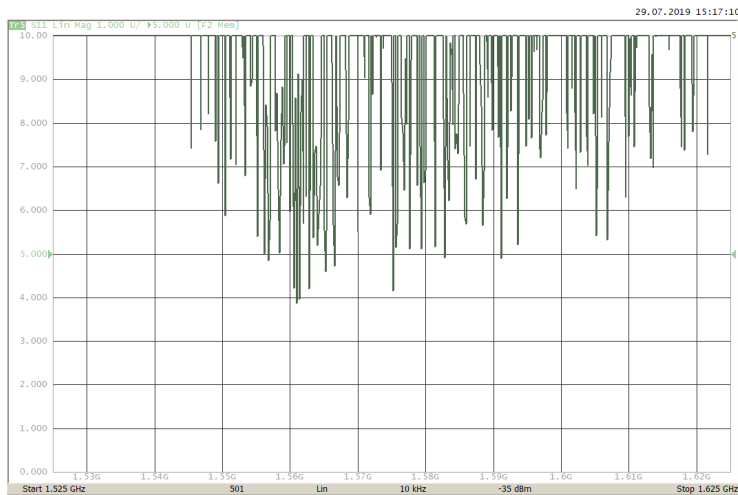


Abbildung 4 GNSS K-Faktor (NB)

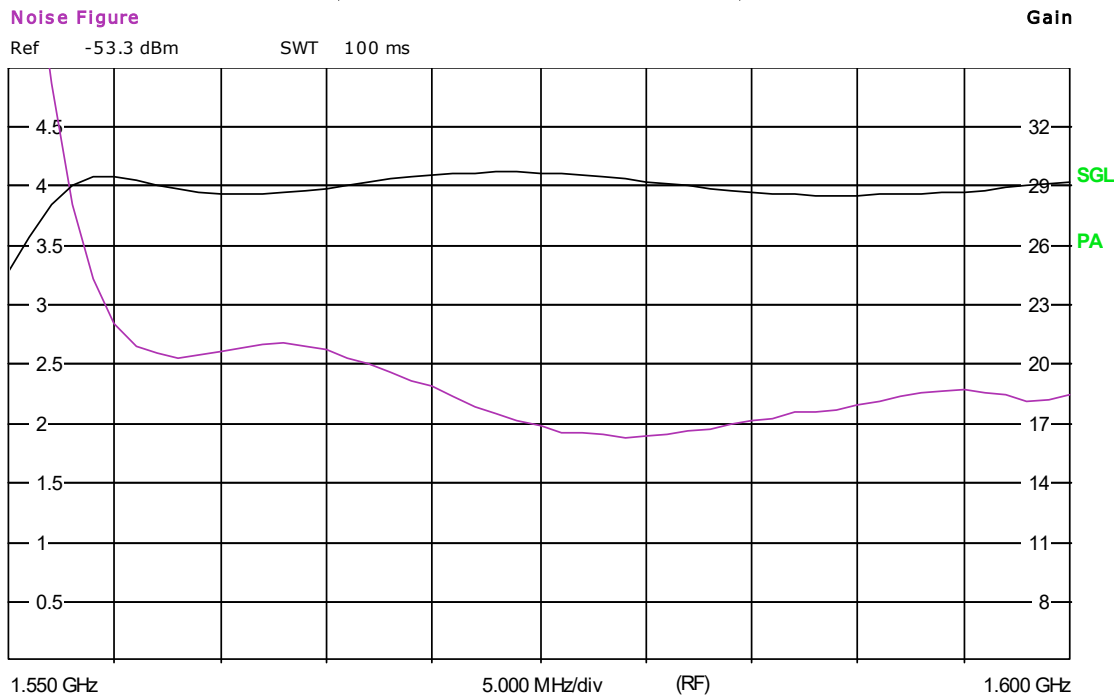


Abbildung 5 GNSS K-Faktor (WB)

### 5.1.3 Rauschzahl

#### 5.1.3.1 Messergebnisse

| Direct        |         | NOISE & GAIN   |          | CALIBRATED      |          |
|---------------|---------|----------------|----------|-----------------|----------|
| RBW:          | 1 MHz   | RF Atten.      | 0 dB     | 2nd Stage Corr. | On       |
| Average:      | 4       | Auto Ref Level | On       | Image Rejection | ...      |
| Current Value |         |                |          |                 |          |
| RF:           | 1.6 GHz | ENR            | 15.45 dB | NF.             | 2.23 dB  |
| LO:           | ...     | Loss In        | 0 dB     | Noise Temp.     | 194.89 K |
| IF:           | ...     | Loss Out       | 0 dB     | Gain            | 29.18 dB |



Measurement Complete

Date: 29.JUL.2019 14:29:00

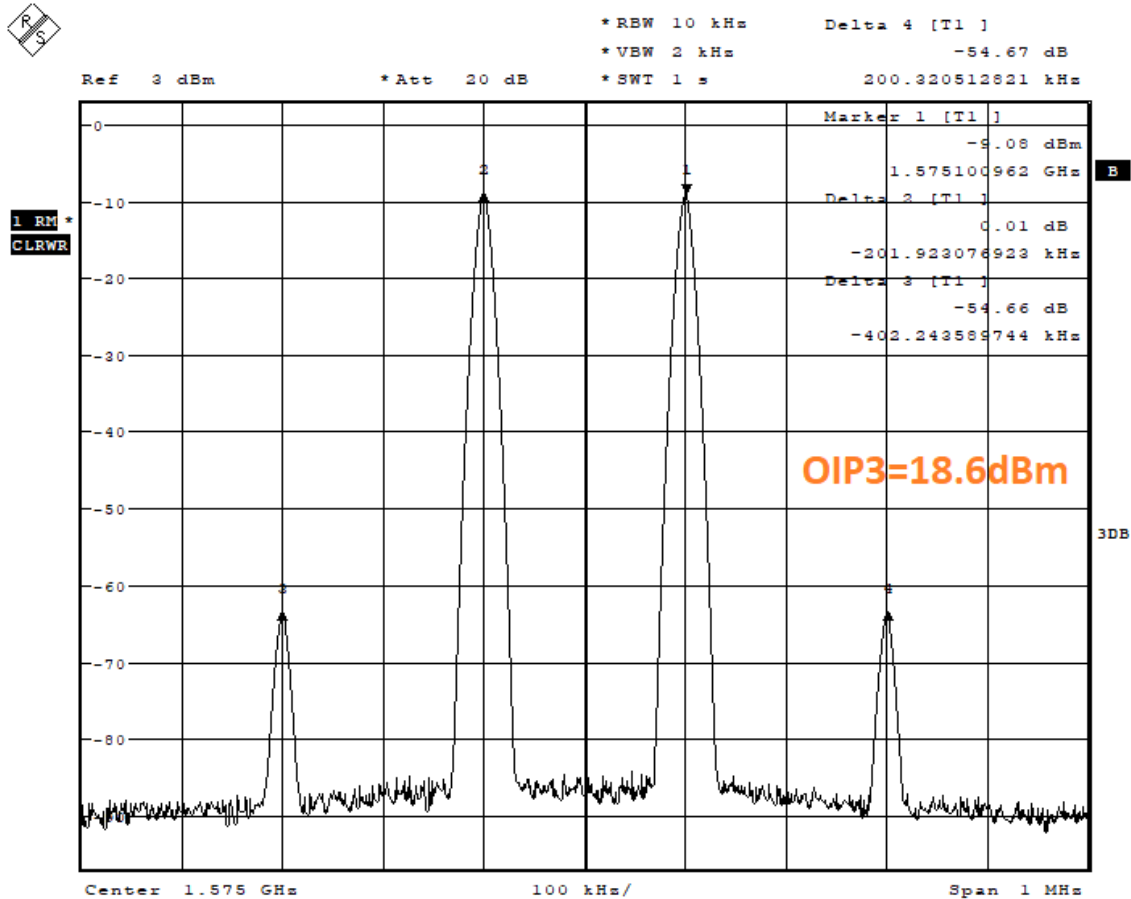
Abbildung 6 GNSS NF & Gain

## 5.1.4 Intermodulation / Kompression

### 5.1.4.1 Messaufbau

Entspr. TL82133

### 5.1.4.2 Messergebnisse OIP3



Date: 29.JUL.2019 14:22:11

Abbildung 7 GNSS IM3

### 5.1.4.3 Messergebnisse P1dB

19.07.2019 10:59:21



Abbildung 8 GNSS P1dB Kompression

## 5.2 Telefon-Messungen

### 5.2.1 Stromaufnahme über Ub

#### 5.2.1.1 Messergebnisse

12V      1.2mA      ( $R_{\text{sense}}=10\text{k}\Omega$ )

### 5.2.2 S-Parameter

#### 5.2.2.1 Messaufbau

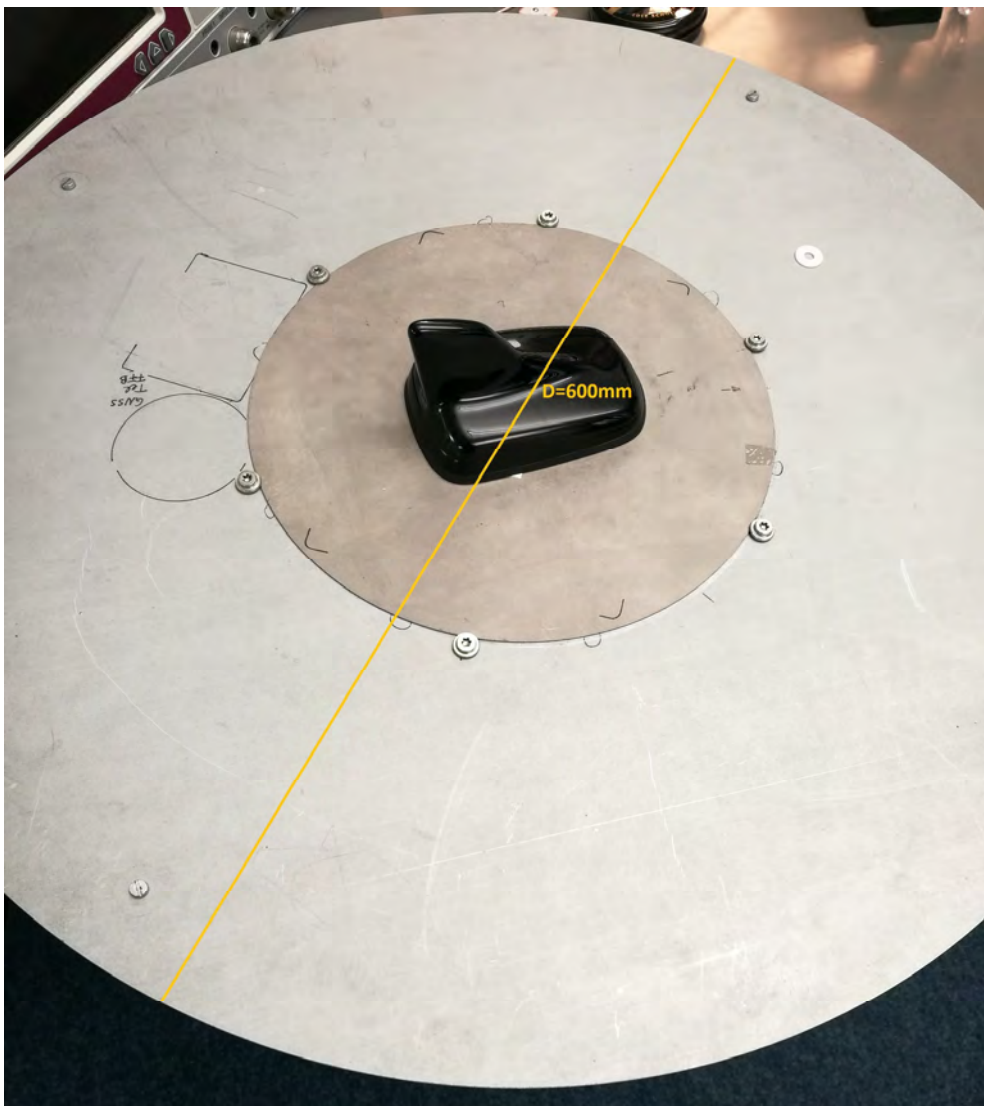


Abbildung 9 Messung RL auf Metallplatte D=0.6m

### 5.2.2.2 Messergebnisse

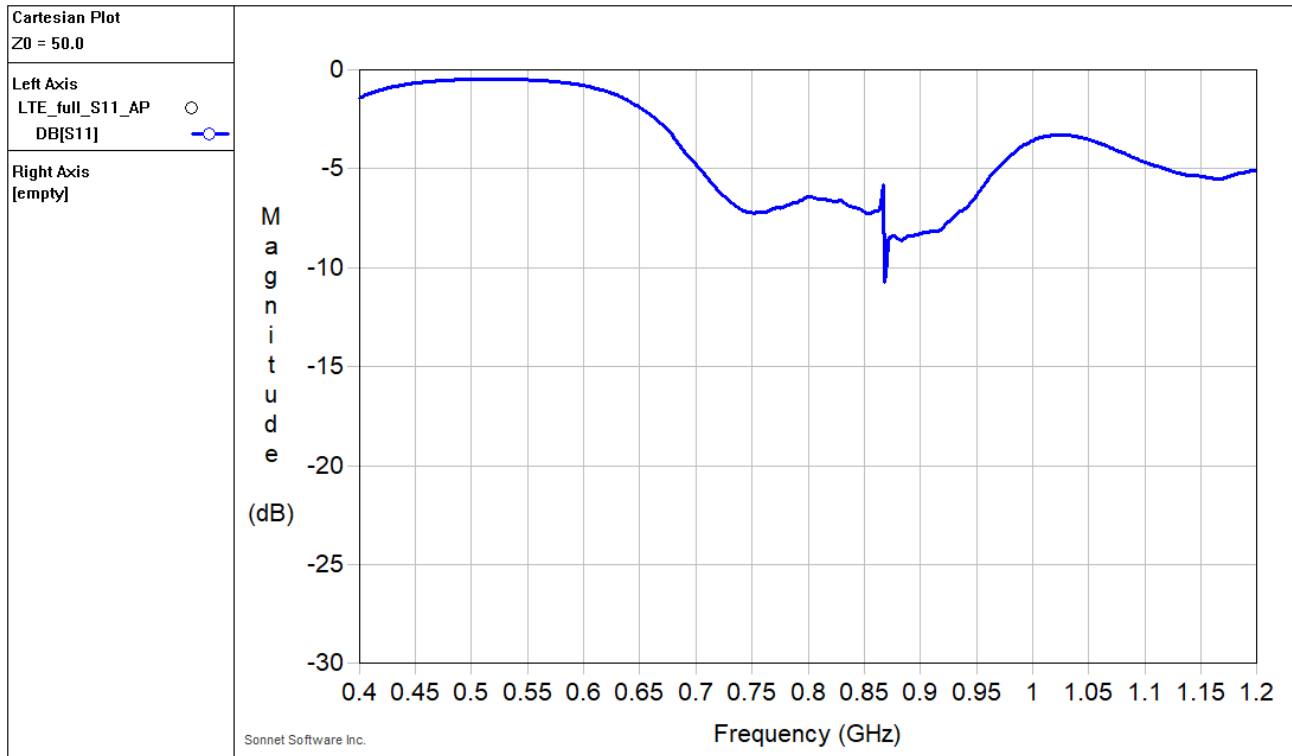


Abbildung 10 RL GSM900

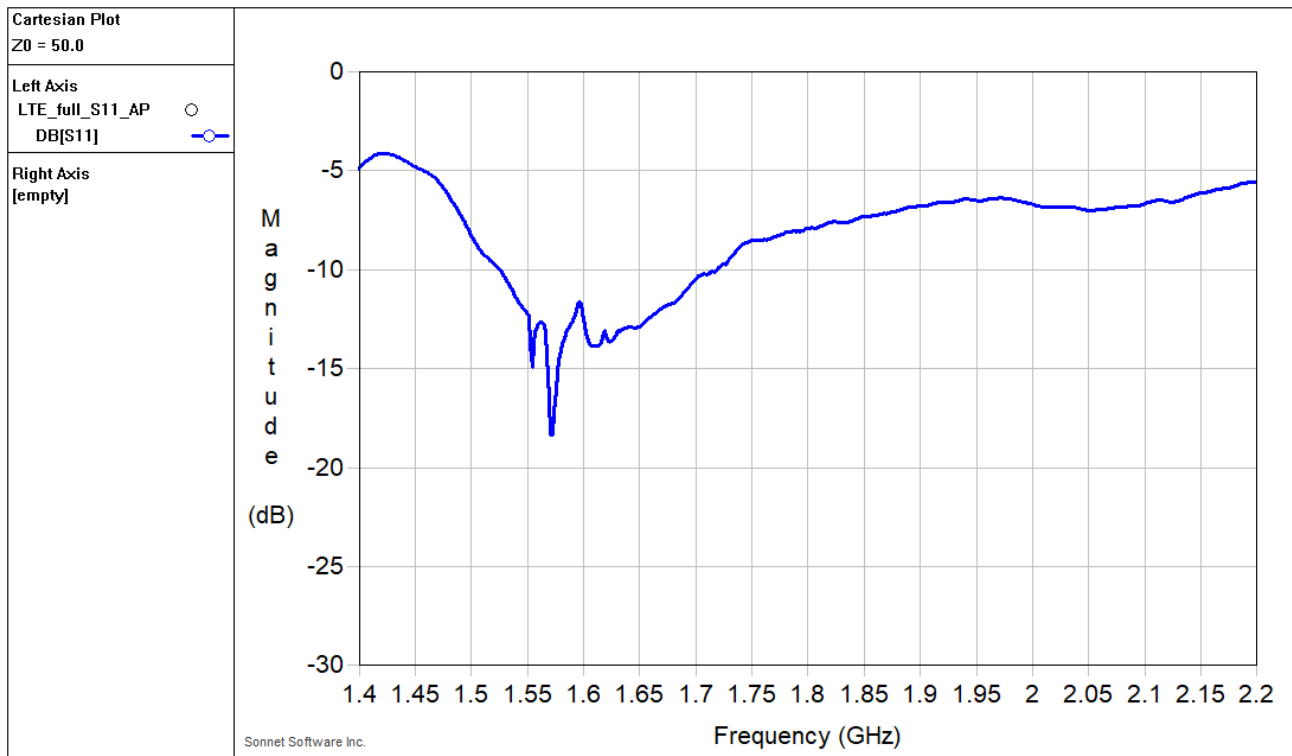


Abbildung 11 LTE RL GSM1800

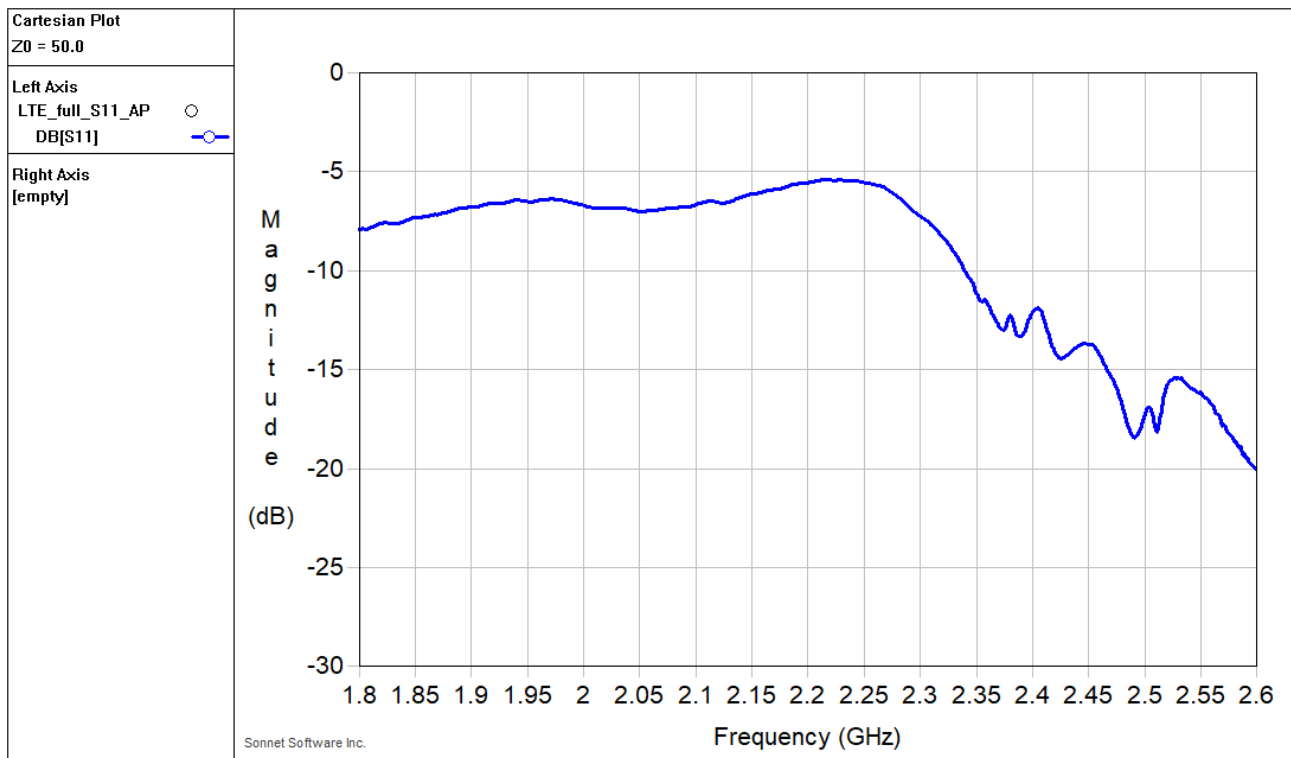


Abbildung 12 LTE RL UMTS

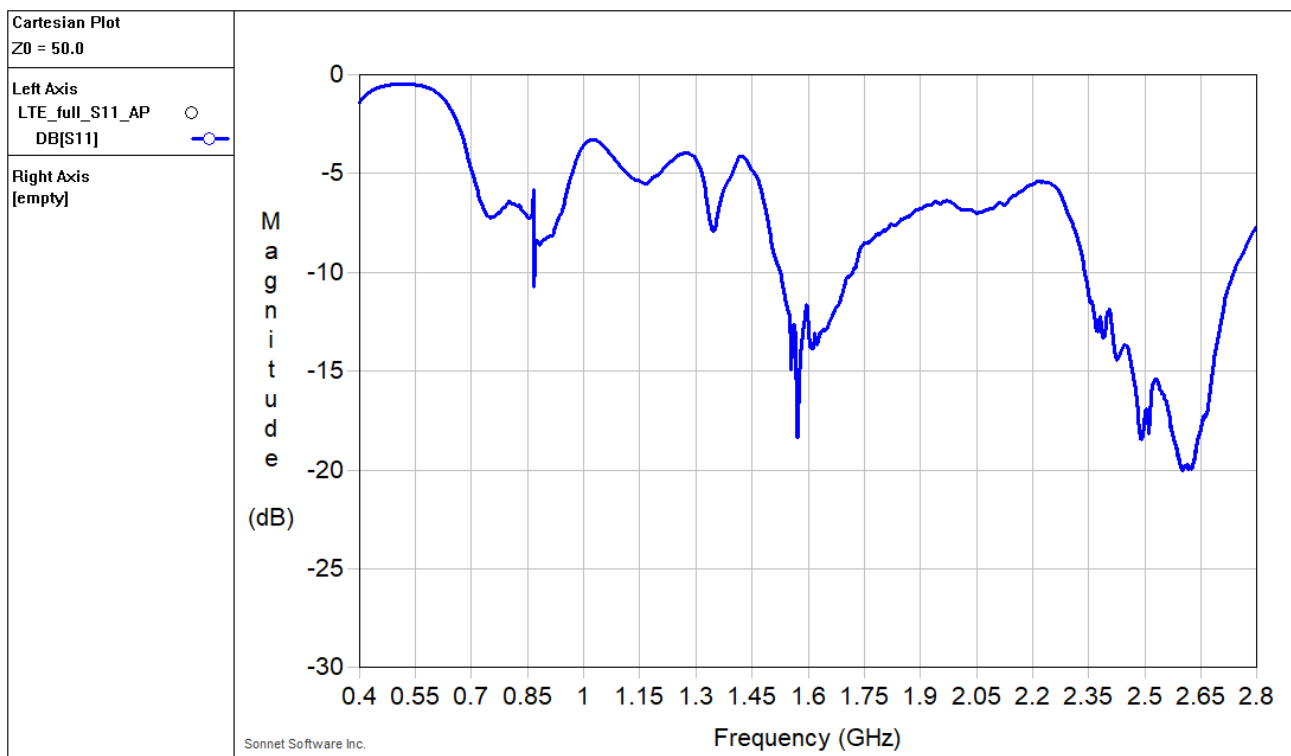


Abbildung 13 LTE RL Gesamt

## 5.3 FFB-Messungen

### 5.3.1 Anpassung mit Antenne

#### 5.3.1.1 Messaufbau

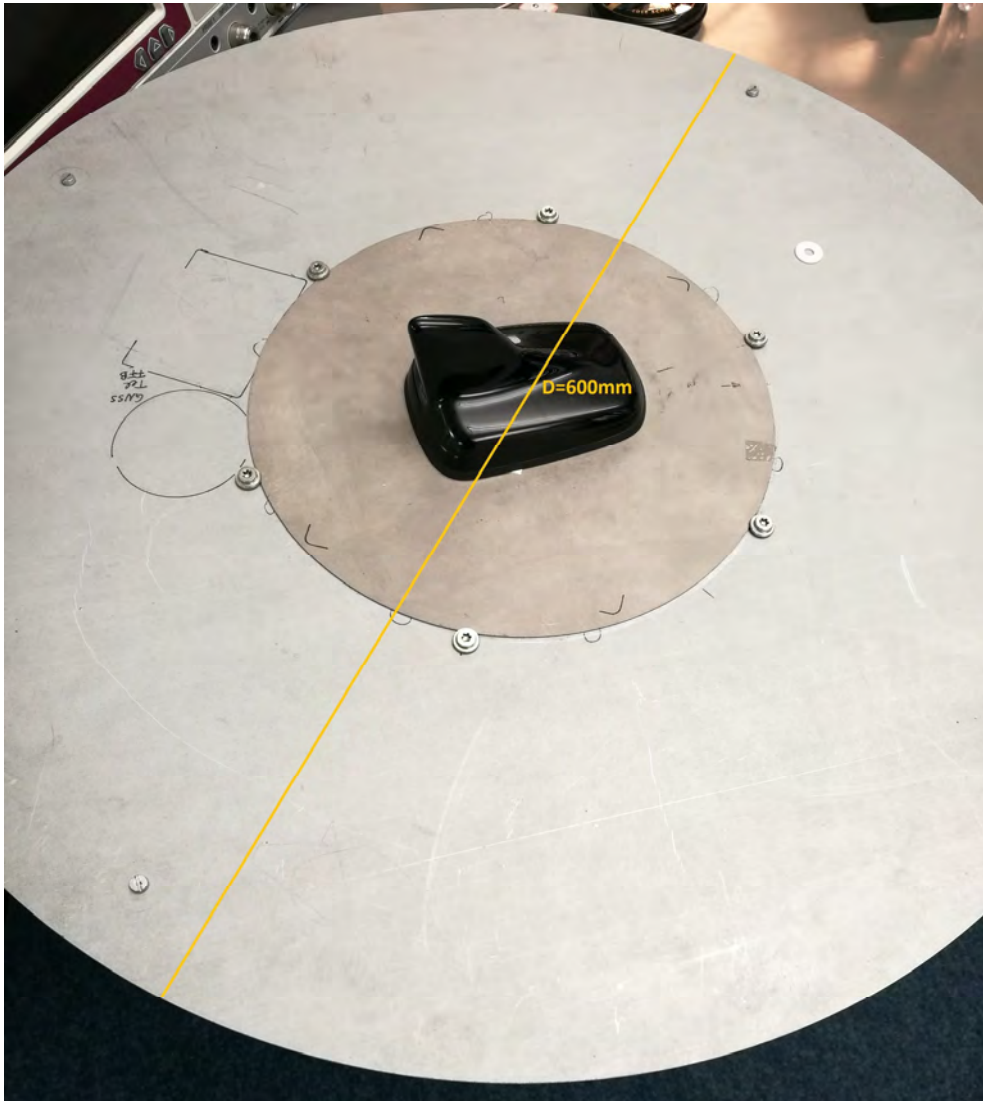


Figure 1 Messung RL auf Metallplatte D=0.6m

### 5.3.1.2 Messergebnisse

#### 5.3.1.2.1 FFB Narrow Band

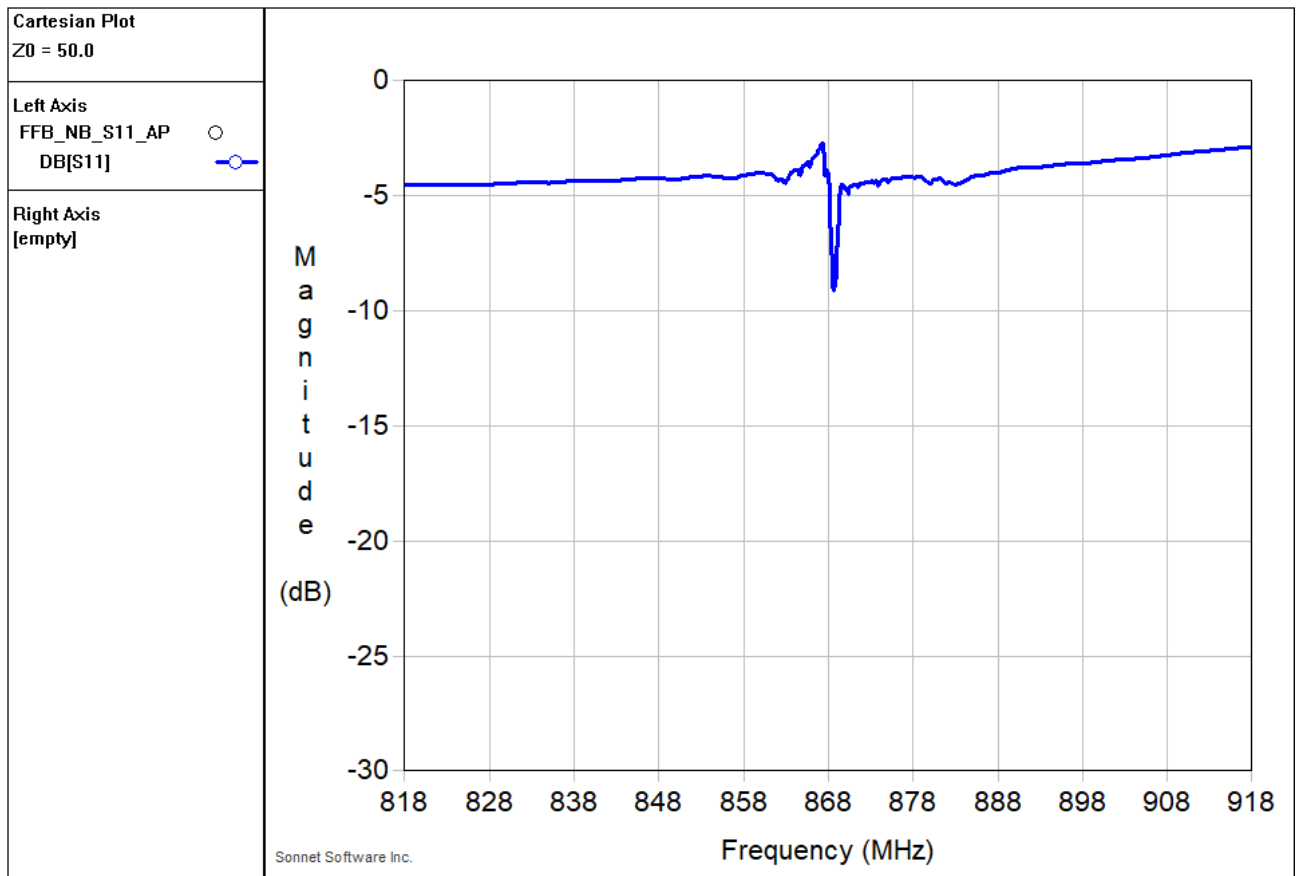


Abbildung 14 FFB NB RL (mit Antenne auf GND)

### 5.3.1.2.2 FFB Wide Band

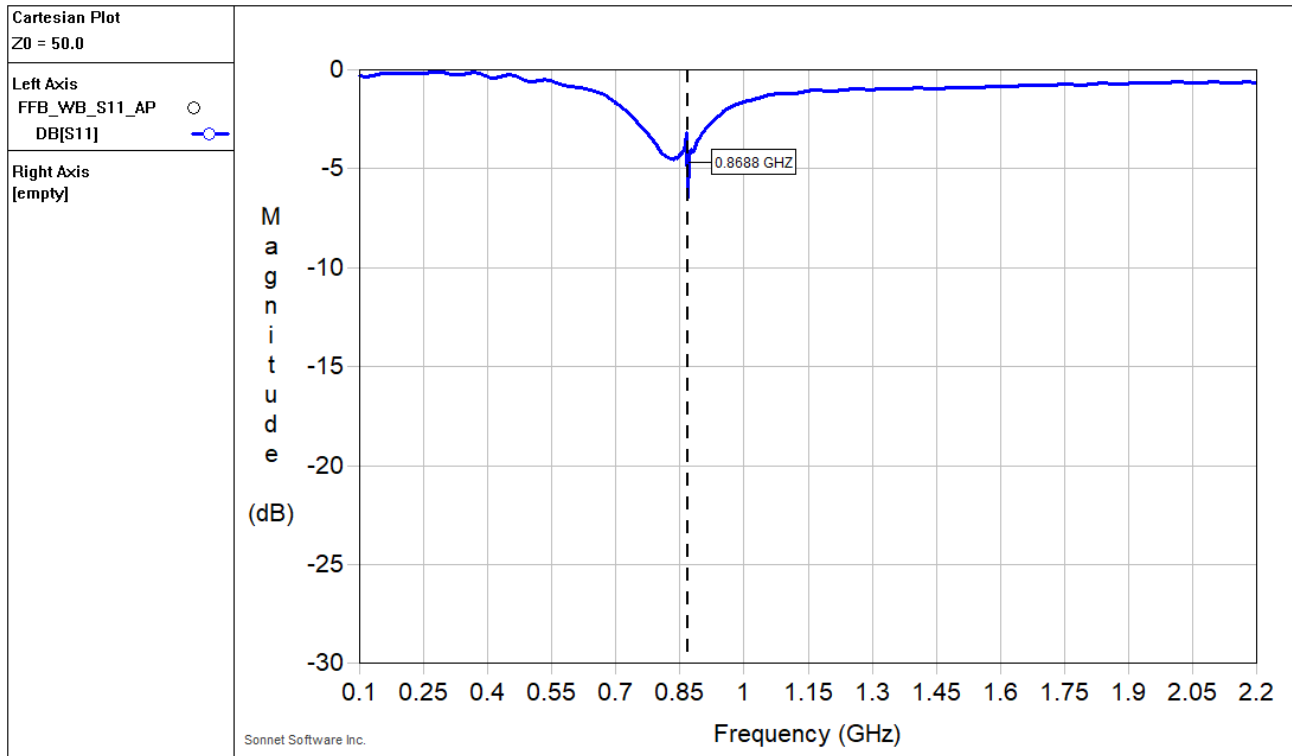
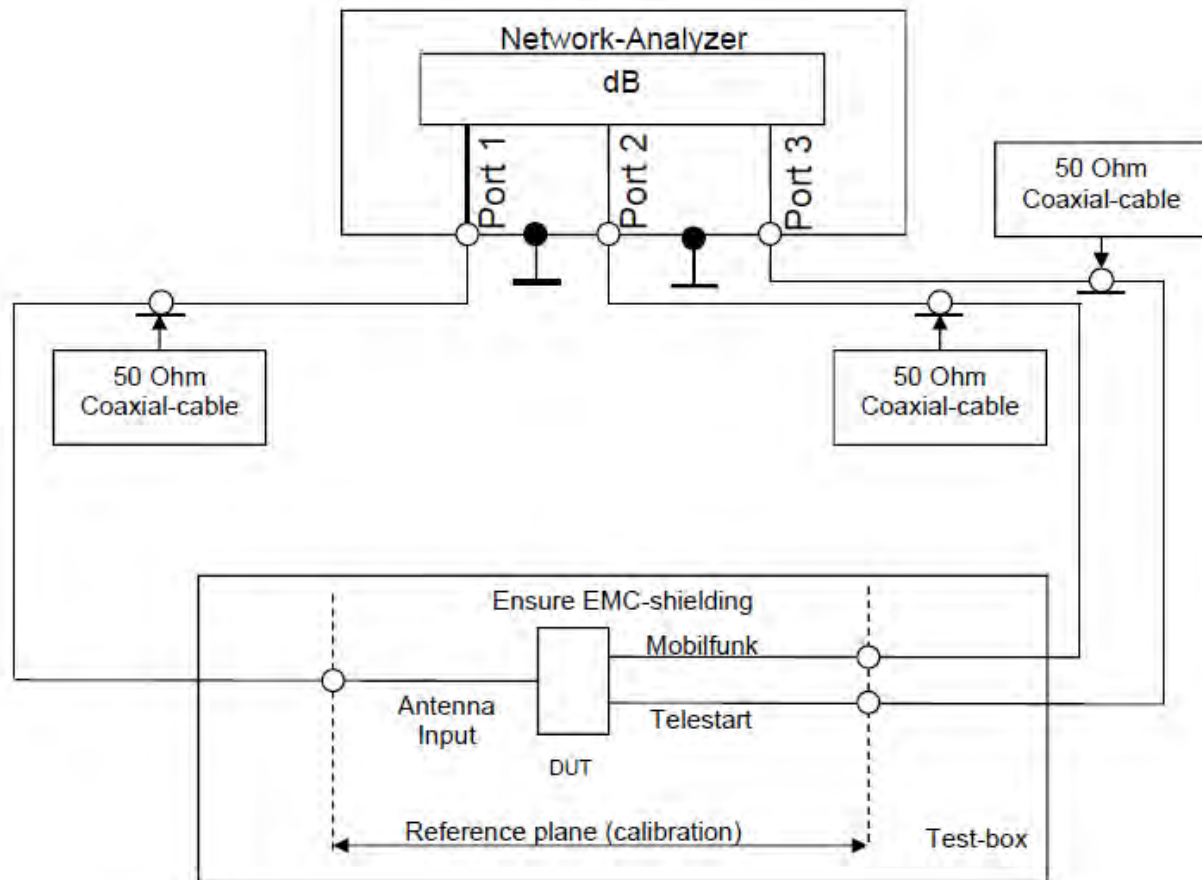
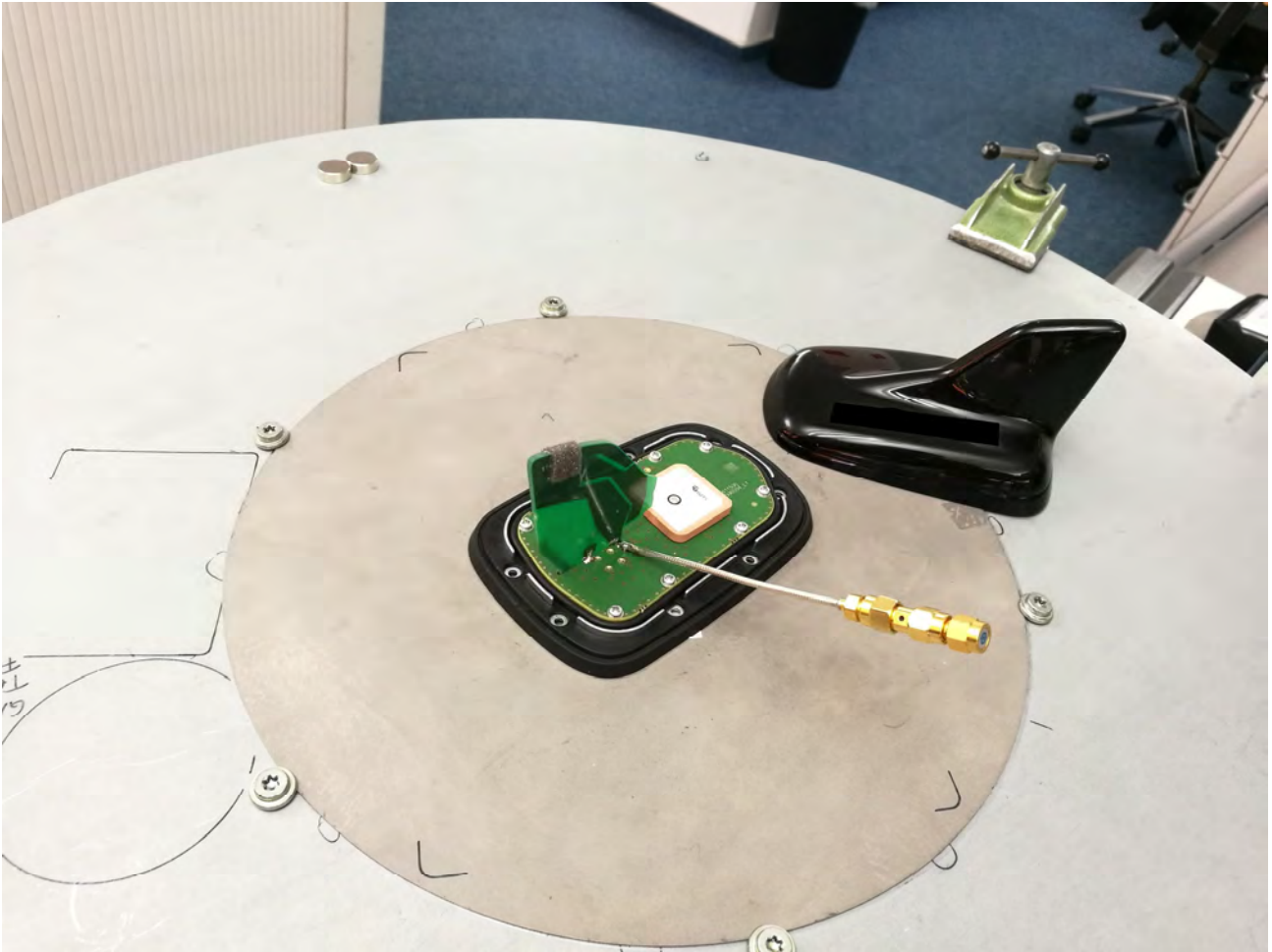


Abbildung 15 FFB WB RL (mit Antenne auf GND)

## 5.3.2 S-Parameter PCB

### 5.3.2.1 Messaufbau





**Abbildung 16 FFB Messaufbau S-parameter**

### 5.3.2.2 Entkopplung

#### 5.3.2.2.1 Antenne – FFB

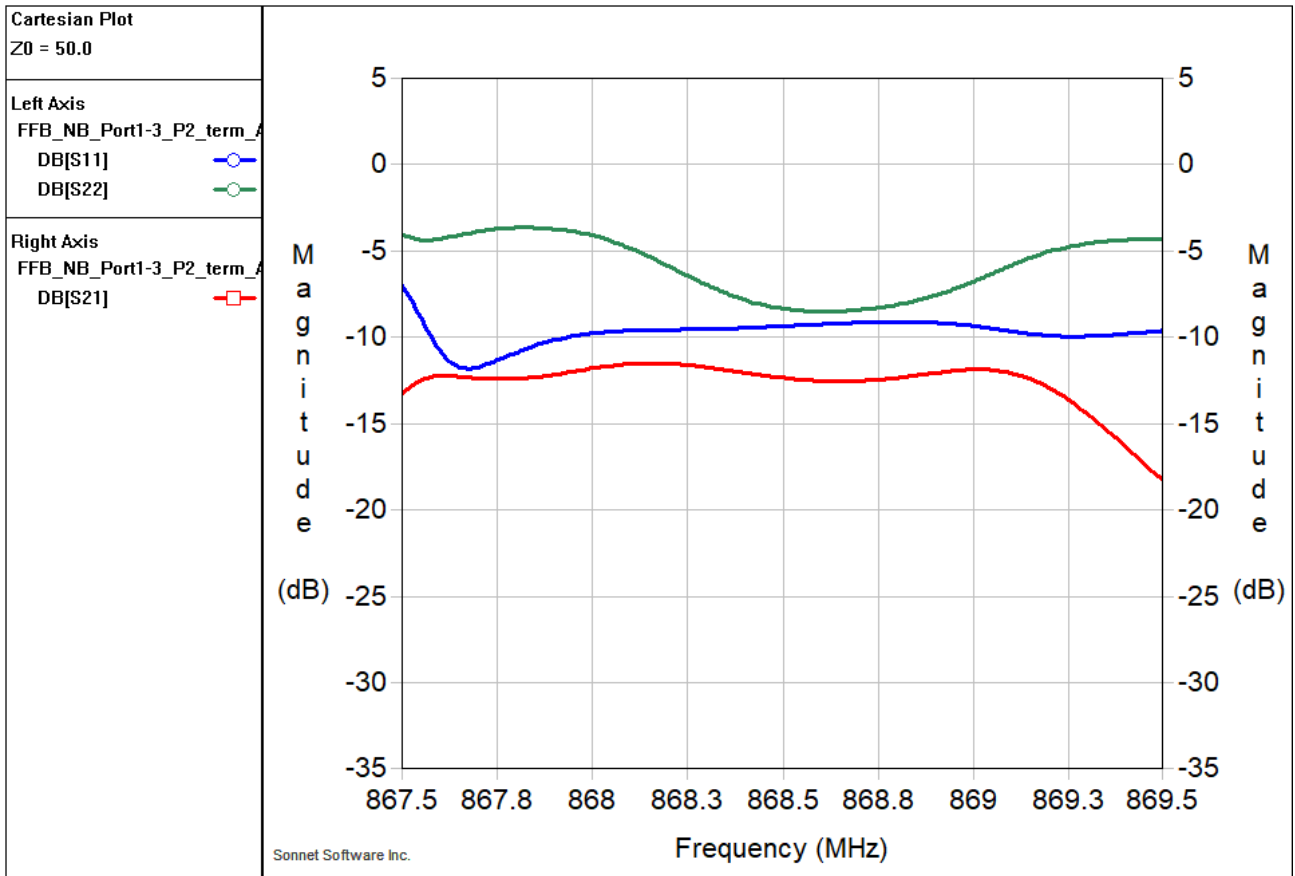


Abbildung 17 Antenne (P1)-FFB (P3)

### 5.3.2.2.2 Antenne –Telefon

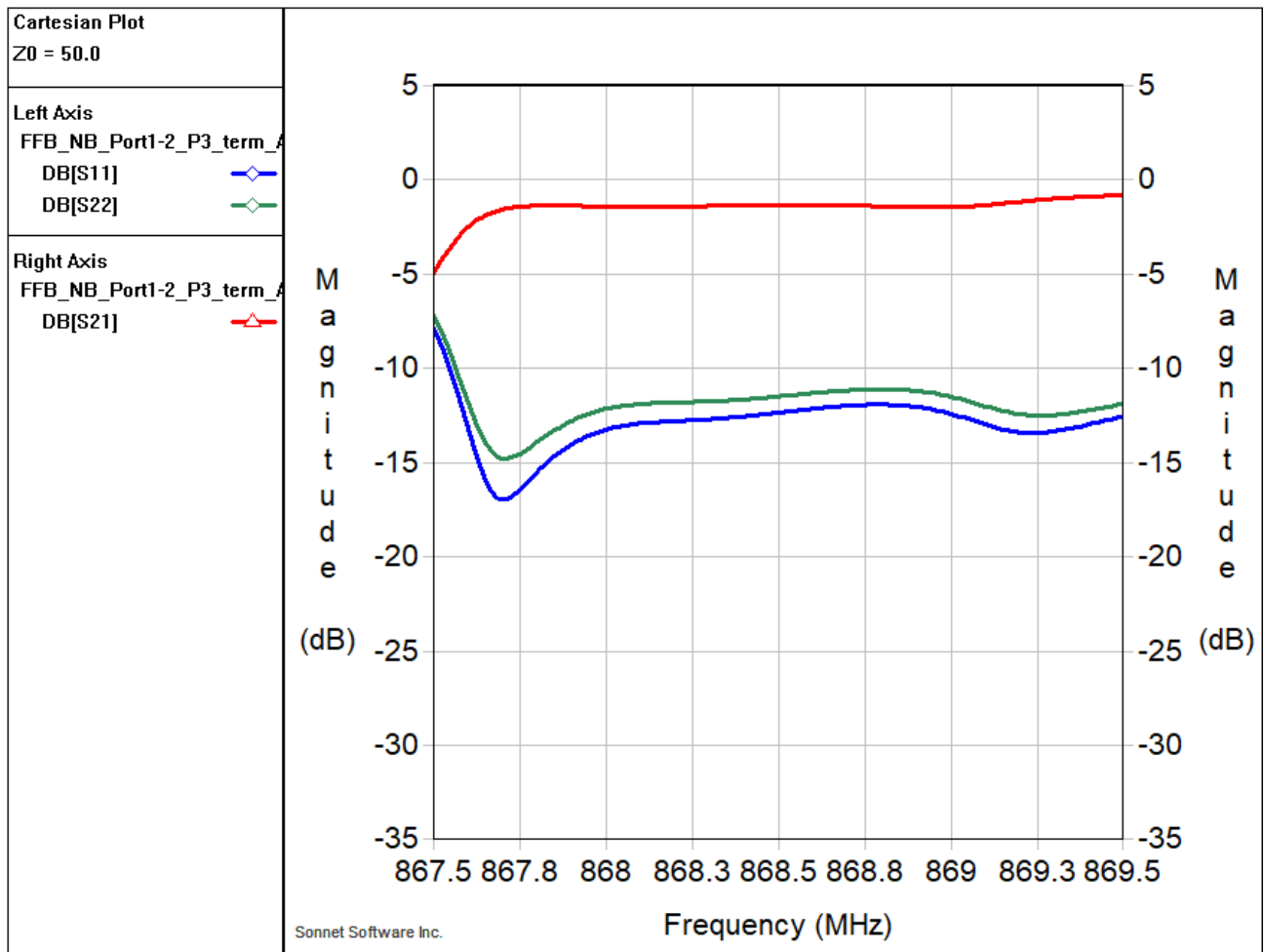


Abbildung 18 Antenne (P1)-LTE (P2)

### 5.3.2.2.3 Telefon – FFB

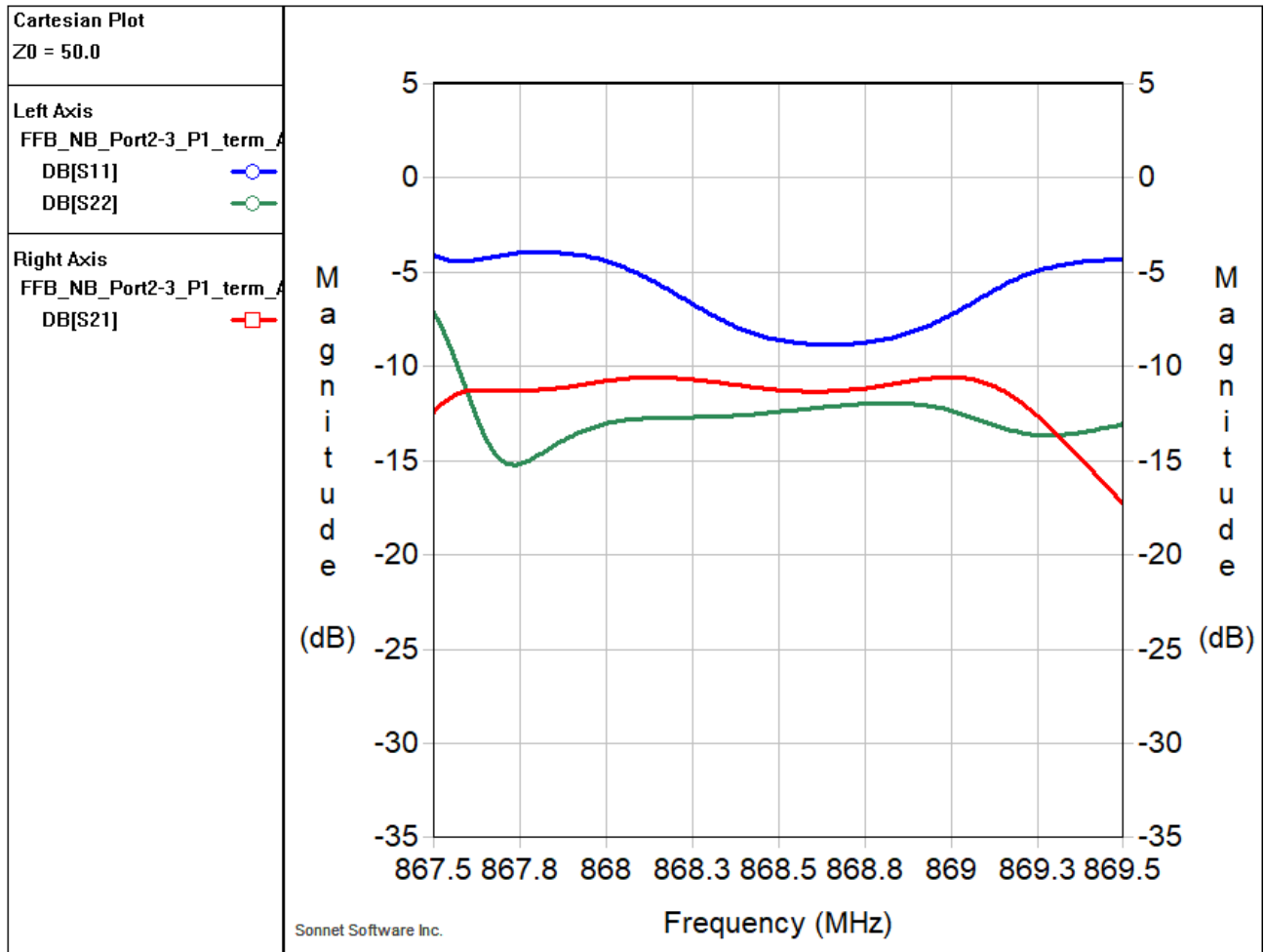


Abbildung 19 FFB (P3)-LTE (P2)

## 5.4 Bluetooth v2 (aktiv) Messungen

### 5.4.1 Messaufbau

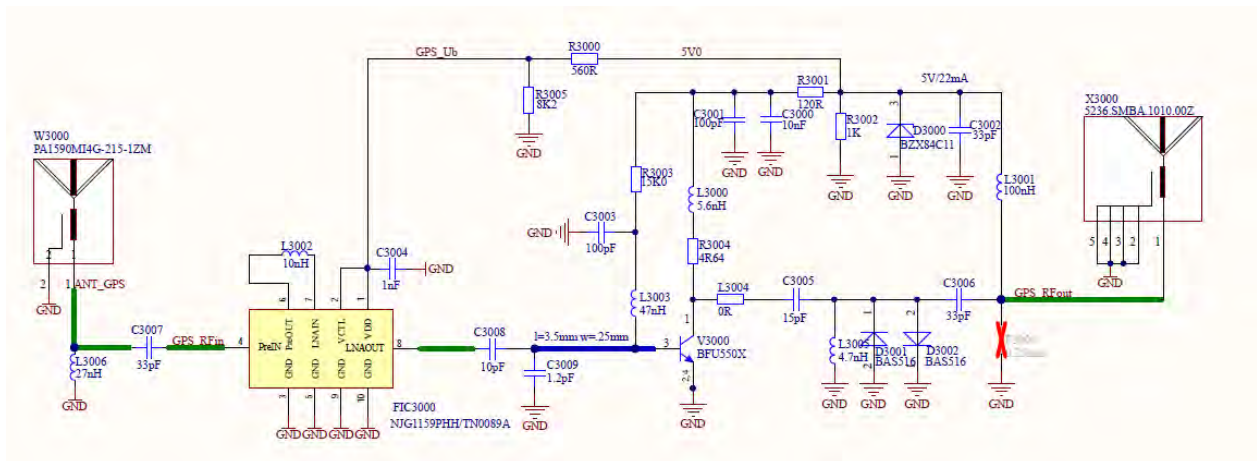
### 5.4.2 Messergebnisse

## 6 Detaillierter Schaltplan

Tabelle 3: Zuordnung der Komponenten zu den Schaltplänen.

| Komponente     | Schaltplanversion |
|----------------|-------------------|
| 4N0 035 503 AP | C-sample          |

### 6.1 GNSS\_LNA



## 6.2 LTE / FFB

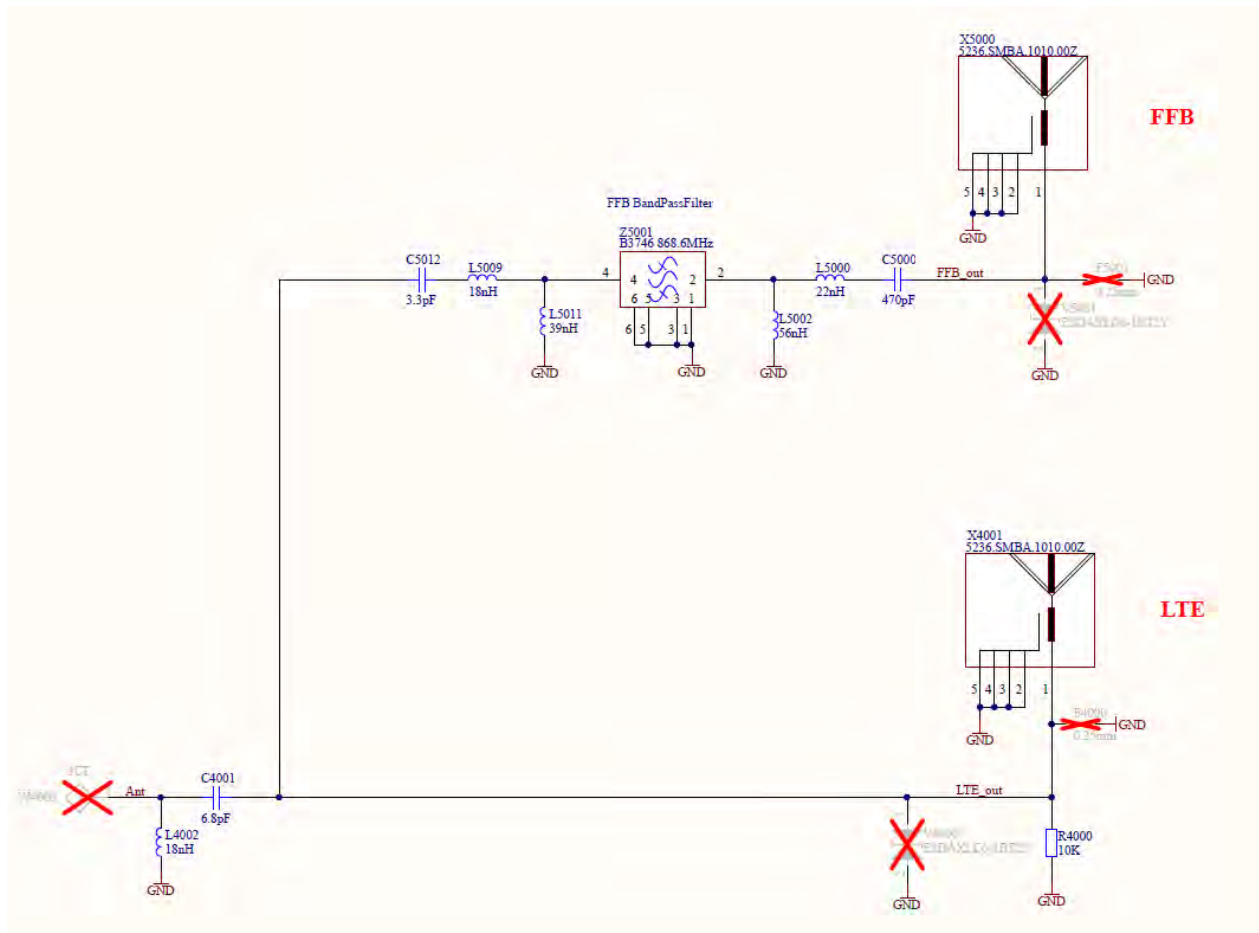
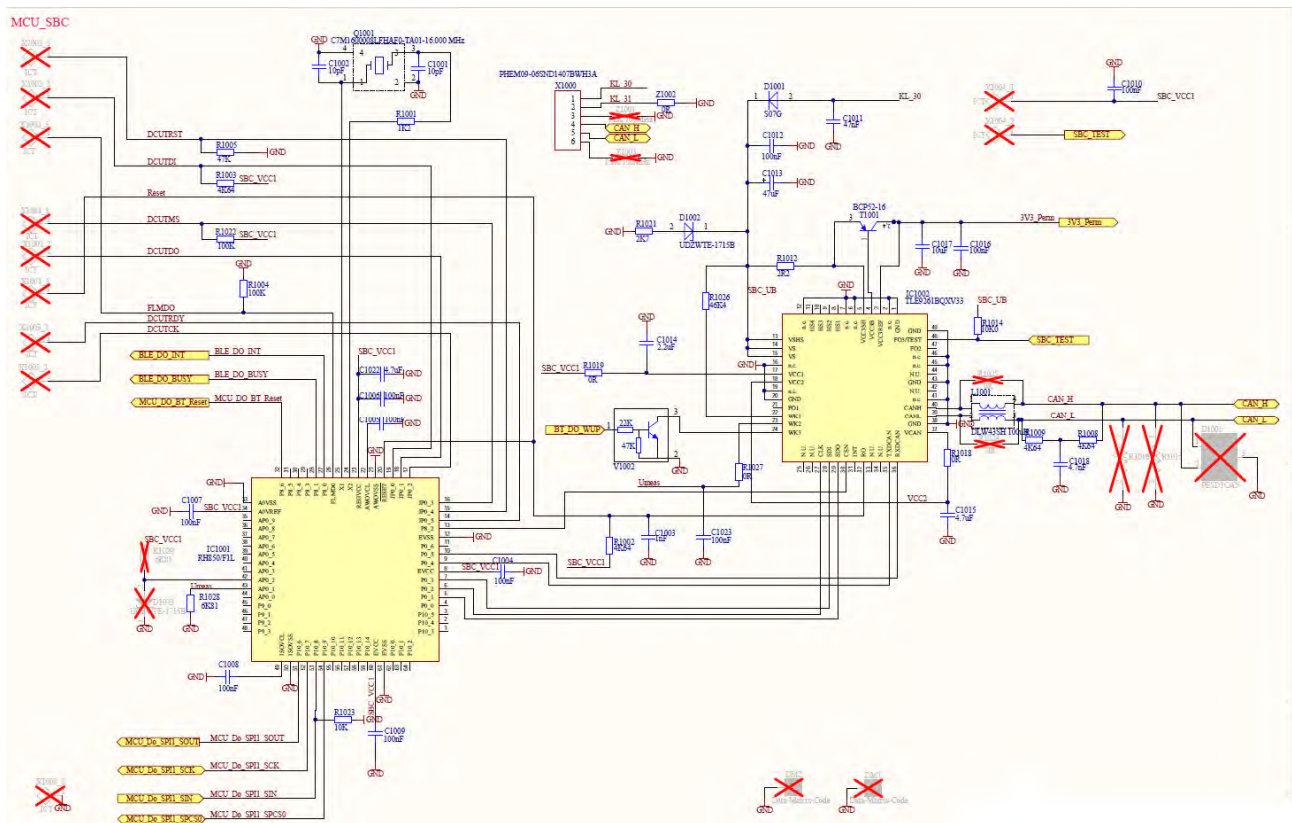
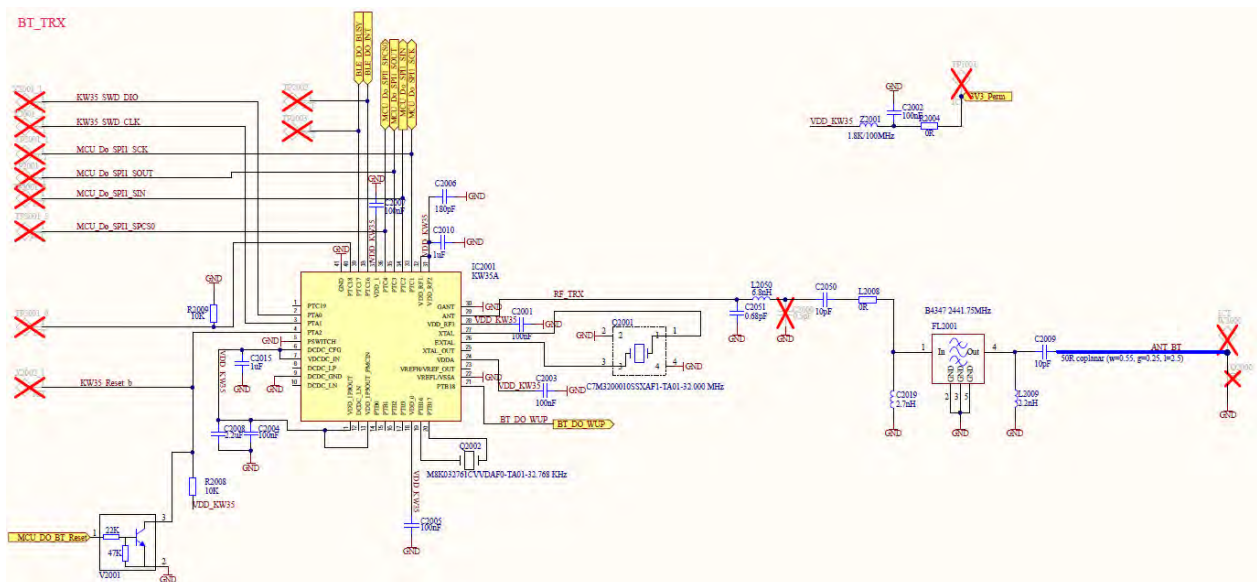


Abbildung 20 LTE / FFB DDA2\_AP

### 6.3 Bluetooth v2 (aktiv)



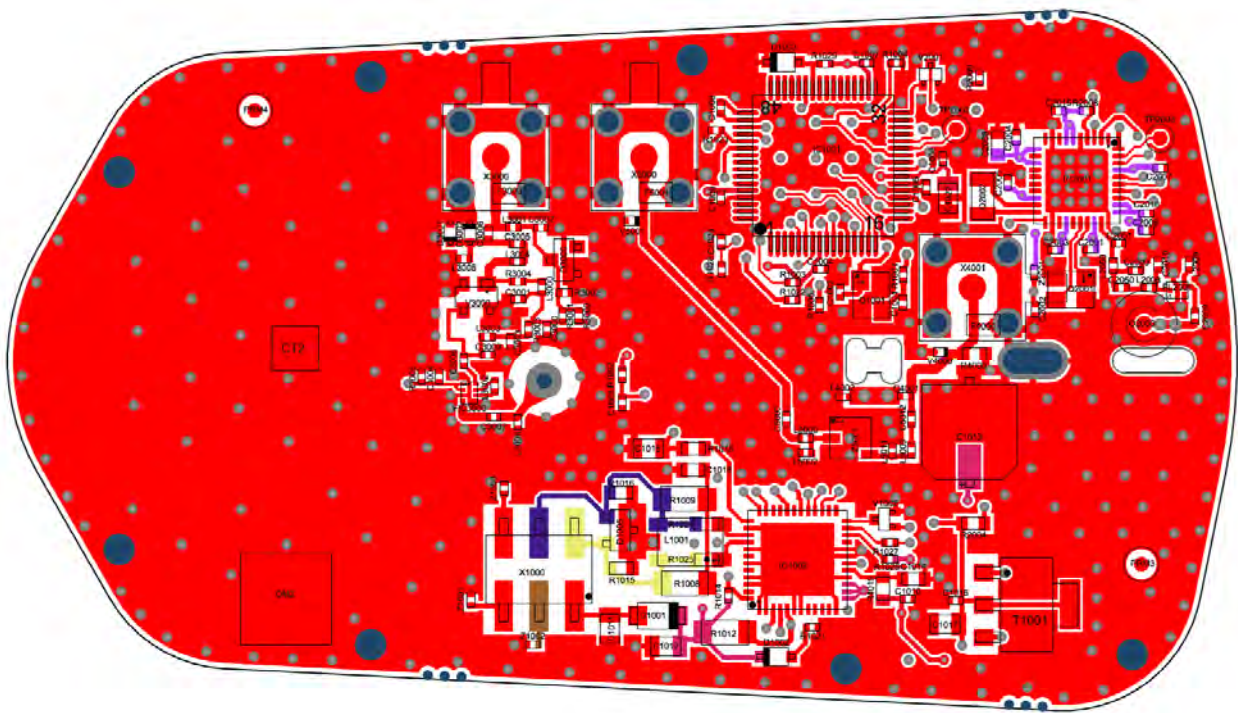
### Abbildung 21 BTv2\_Controller



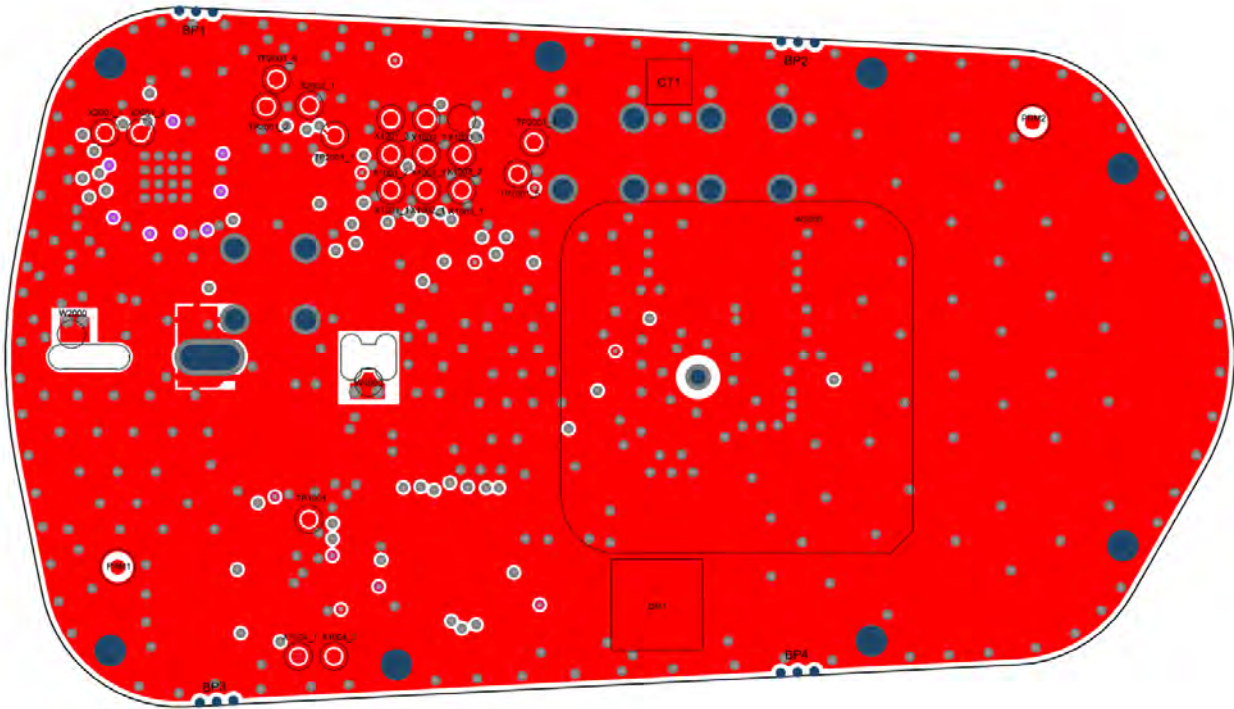
### Abbildung 22 BTv2\_RX/TX

## 7 Layout mit Bestückungsplan

## 7.1 Bottom



## 7.2 Top



## 7.3 Stückliste

| Item | Level | LibRef  | Description                                | Quantity | Designator                                                                                              |
|------|-------|---------|--------------------------------------------|----------|---------------------------------------------------------------------------------------------------------|
| 1    | 1     | 9009618 | SMD, Capacitor, Chip 0402                  | 5        | C1001, C1002, C2009, C2050, C3008                                                                       |
| 2    | 1     | 9009735 | SMD, Capacitor, Chip 0402                  | 2        | C1003, C3004                                                                                            |
| 3    | 1     | 9009867 | SMD, Capacitor, Chip 0402                  | 15       | C1004, C1005, C1006, C1007, C1008, C1009, C1010, C1016, C1023, C2001, C2002, C2003, C2004, C2005, C2007 |
| 4    | 1     | 9009913 | SMD, Capacitor, Chip 0805, Fail save       | 1        | C1011                                                                                                   |
| 5    | 1     | 9009914 | SMD, Capacitor, Chip 0805, Fail save       | 1        | C1012                                                                                                   |
| 6    | 1     | 9009915 | Electrolytic Capacitors, Chip EEEFP1V470AP | 1        | C1013                                                                                                   |
| 7    | 1     | 9009909 | SMD, Capacitor, Chip 0603                  | 2        | C1014, C2008                                                                                            |
| 8    | 1     | 9009911 | SMD, Capacitor, Chip 0805                  | 2        | C1015, C1022                                                                                            |
| 9    | 1     | 9009912 | SMD, Capacitor, Chip 0805                  | 1        | C1017                                                                                                   |
| 10   | 1     | 9009675 | SMD, Capacitor, Chip 0603                  | 1        | C1018                                                                                                   |
| 11   | 1     | 9009694 | SMD, Capacitor, Chip 0402                  | 1        | C2006                                                                                                   |
| 12   | 1     | 9009910 | SMD, Capacitor, Chip 0402                  | 2        | C2010, C2015                                                                                            |
| 13   | 1     | 0951745 | SMD, Inductor, Chip 0402                   | 1        | C2019                                                                                                   |
| 14   | 1     | 9009418 | SMD, Capacitor, Chip 0402                  | 1        | C2051                                                                                                   |

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|    |   |          |                                                                                |   |                     |
|----|---|----------|--------------------------------------------------------------------------------|---|---------------------|
| 15 | 1 | 9009697  | SMD, Capacitor, Chip 0402                                                      | 1 | C3000               |
| 16 | 1 | 9009619  | SMD, Capacitor, Chip 0402                                                      | 2 | C3001, C3003        |
| 17 | 1 | 9009626  | SMD, Capacitor, Chip 0402                                                      | 3 | C3002, C3006, C3007 |
| 18 | 1 | 9009622  | SMD, Capacitor, Chip 0402                                                      | 1 | C3005               |
| 19 | 1 | 9009605  | SMD, Capacitor, Chip 0402                                                      | 1 | C3009               |
| 20 | 1 | 9009615  | SMD, Capacitor, Chip 0402                                                      | 1 | C4001               |
| 21 | 1 | 9009696  | SMD, Capacitor, Chip 0402                                                      | 1 | C5000               |
| 22 | 1 | 9009611  | SMD, Capacitor, Chip 0402                                                      | 1 | C5012               |
| 23 | 1 | 9053889  | SMD, DO-219AB,Standard Recovery Rectifier High Voltage Surface Mount           | 1 | D1001               |
| 24 | 1 | 9053467  | SMD, UMD2, 15V Z-Diode, UDZW B Series                                          | 1 | D1002               |
| 25 | 1 | 9053486  | SMD, SOT23, BZX84/C11, 11V Z-Diode                                             | 1 | D3000               |
| 26 | 1 | 9053489  | SMD, High-Speed Si-Diode, SC79, SCD80                                          | 2 | D3001, D3002        |
| 27 | 1 | 9053853  | GPS, GLONASS, Beidou and Galileo Front-End Module.NJG1159PHH/TN0089A           | 1 | FIC3000             |
| 28 | 1 | 0993650  | SMD,1.4X1.1mm,2441.75MHz SAW RF filter                                         | 1 | FL2001              |
| 29 | 1 | 9053852  | SMD, QFP64,Body 10x10mm, Pitch 0.5mm,High-end MCU with a 32-bit RH850G3K core. | 1 | IC1001              |
| 30 | 1 | 90510012 | SMD, VQFN48, power package with LTI feature                                    | 1 | IC1002              |
| 31 | 1 | 9054116  | SMD,HVQFN40,Automotive and Industrial Qualified Wireless MCUs                  | 1 | IC2001              |
| 32 | 1 | 0951842  | SMD,DLW43SH101XK2, Common Mode Filter                                          | 1 | L1001               |
| 33 | 1 | 9036102  | SMD, Resistor, Chip 0402                                                       | 2 | L2008, R1027        |
| 34 | 1 | 0951648  | SMD, Inductor, Chip 0402                                                       | 1 | L2009               |
| 35 | 1 | 0951652  | SMD, Inductor, Chip 0402                                                       | 1 | L2050               |
| 36 | 1 | 0951703  | SMD, Inductor, Chip 0402                                                       | 1 | L3000               |
| 37 | 1 | 0951662  | SMD, Inductor, Chip 0402                                                       | 1 | L3001               |
| 38 | 1 | 0951654  | SMD, Inductor, Chip 0402                                                       | 1 | L3002               |
| 39 | 1 | 0951660  | SMD, Inductor, Chip 0402                                                       | 1 | L3003               |
| 40 | 1 | 9036597  | SMD, Resistor, Chip 0402                                                       | 2 | L3004, Z1002        |
| 41 | 1 | 0951651  | SMD, Inductor, Chip 0402                                                       | 1 | L3005               |
| 42 | 1 | 0951657  | SMD, Inductor, Chip 0402                                                       | 1 | L3006               |
| 43 | 1 | 0951791  | SMD, Inductor, Chip 0402                                                       | 2 | L4002, L5009        |
| 44 | 1 | 0951746  | SMD, Inductor, Chip 0402                                                       | 1 | L5000               |
| 45 | 1 | 0951661  | SMD, Inductor, Chip 0402                                                       | 1 | L5002               |
| 46 | 1 | 0951659  | SMD, Inductor, Chip 0402                                                       | 1 | L5011               |
| 47 | 1 | 9073365  | SMD,3.2X2.5MM 4 PADS TYPE,Frequency 16.000MHz,CERAMIC SMD CRYSTAL              | 1 | Q1001               |

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|    |   |              |                                                                |   |                     |
|----|---|--------------|----------------------------------------------------------------|---|---------------------|
| 48 | 1 | 9073363      | SMD,3.2X2.5MM typ,Frequency 32.000MHz,CERAMIC SMD CRYSTAL      | 1 | Q2001               |
| 49 | 1 | 9073364      | SMD,3.2X1.5MM typ,Frequency 32.768 KHz,TUNING FORK SMD CRYSTAL | 1 | Q2002               |
| 50 | 1 | 9036530      | SMD, Resistor, Chip 0402                                       | 1 | R1001               |
| 51 | 1 | 9036279      | SMD, Resistor, Chip 0402                                       | 2 | R1002, R1003        |
| 52 | 1 | 9036294      | SMD, Resistor, Chip 0402                                       | 2 | R1004, R1022        |
| 53 | 1 | 9036578      | SMD, Resistor, Chip 0402                                       | 1 | R1005               |
| 54 | 1 | P9035376     | SMD, Resistor, Chip 1206                                       | 2 | R1008, R1009        |
| 55 | 1 | 9036501      | SMD, Resistor, Chip 1206                                       | 1 | R1012               |
| 56 | 1 | 9036286      | SMD, Resistor, Chip 0402                                       | 1 | R1014               |
| 57 | 1 | 9036469      | SMD, Resistor, Chip 0603                                       | 3 | R1018, R1019, R2004 |
| 58 | 1 | 9036534      | SMD, Resistor, Chip 0402                                       | 1 | R1021               |
| 59 | 1 | 9036571      | SMD, Resistor, Chip 0402                                       | 3 | R1023, R2008, R2009 |
| 60 | 1 | 9036292      | SMD, Resistor, Chip 0402                                       | 1 | R1026               |
| 61 | 1 | 9036283      | SMD, Resistor, Chip 0402                                       | 1 | R1028               |
| 62 | 1 | 9036568      | SMD, Resistor, Chip 0402                                       | 1 | R3000               |
| 63 | 1 | 9036560      | SMD, Resistor, Chip 0402                                       | 1 | R3001               |
| 64 | 1 | 9036595      | SMD, Resistor, Chip 0402                                       | 1 | R3002               |
| 65 | 1 | 9036287      | SMD, Resistor, Chip 0402                                       | 1 | R3003               |
| 66 | 1 | 9036223      | SMD, Resistor, Chip 0402                                       | 1 | R3004               |
| 67 | 1 | 9036540      | SMD, Resistor, Chip 0402                                       | 1 | R3005               |
| 68 | 1 | 9032053      | SMD, Resistor, Chip 0603                                       | 1 | R4000               |
| 69 | 1 | 9053855      | SMD, SOT223,PNP Silicon AF Transistors                         | 1 | T1001               |
| 70 | 1 | 9053476      | SMD, SC75, NPN-Transistor mit Widerstand 22k/47k               | 2 | V1002, V2001        |
| 71 | 1 | 9053871      | SMD, SOT143B, NPN wideband silicon RF transistor               | 1 | V3000               |
| 72 | 1 | 0993515      | SMD,2.54mm Pin Header Dual Row SMT Type, PHEM09-06SND1407BWH3A | 1 | X1000               |
| 73 | 1 | 0923335      | Fakra Insert Pin in Paste                                      | 3 | X3000, X4001, X5000 |
| 74 | 1 | 0951397      | SMD, CHIP 0402, 1k8/100MHz EMI-Filter                          | 1 | Z2001               |
| 75 | 1 | 0993656      | SMD, SAW RF Filter B3746 868.6MHz                              | 1 | Z5001               |
| 76 | 1 | 03611921 b02 | raw PCB                                                        | 1 | PCB                 |

## 8 Änderungshistorie

| Version | Datum    | Autor  | Änderungen |
|---------|----------|--------|------------|
| V01     | 06.08.19 | Jaeger |            |
|         |          |        |            |
|         |          |        |            |
|         |          |        |            |
|         |          |        |            |
|         |          |        |            |

## Anhang A Referenzen und Begriffe

### A.1 Referenzen

| Referenz | Dokument                 |
|----------|--------------------------|
| [1]      | TL82133, Ausgabe 2008-06 |
|          |                          |

### A.2 Verwendete Begriffe

| Begriff | Erklärung |
|---------|-----------|
|         |           |
|         |           |
|         |           |

### A.3 Verwendete Abkürzungen

| Abk. | Definition |
|------|------------|
|      |            |
|      |            |

## Anhang B Verzeichnis der Abbildungen und Tabellen

|                                                                    |    |
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| ABBILDUNG 5 GNSS K-FAKTOR (WB).....                                | 10 |
| ABBILDUNG 6 GNSS NF & GAIN .....                                   | 11 |
| ABBILDUNG 7 GNSS IM3 .....                                         | 12 |
| ABBILDUNG 8 GNSS P1DB KOMPRESSIION .....                           | 13 |
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