***BRO-LNA Assembly Checkout Test***

IFS No: 1060321

| Rev | Date | Description |
| --- | --- | --- |
| 1.0 | 13-03-2023 | Initial |
|  |  |  |

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# Introduction

The LNA assembly consist of four separate LNA’s which need to phase matched to each other.

Each LNA have one input port label the X# and an output port Y#, where the # could be 1,2,3,4 representing the LNA1, LNA2, LNA3 and LNA4. All four units are to be tested and measured separately.

The temperature is measured using TMP100 sensor and interfaced by the connector P110. Each LNA is supply by 5V by the connector P100. The RF input signal is applied on the P300 and the output on P310 connector.

|  |  |
| --- | --- |
|  |  |
| LNA assembly , 4x1 LNA. | LNA, picture, bottom view |

## Pin connections

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  | | --- | --- | | P100 connector | | | Pin | **Description** | | 1 | 5V | | 2 | GND | | |  |  | | --- | --- | | P110 connector | | | Pin | **Description** | | 1 | Vt | | 2 | SCL | | 3 | SDA | | 4 | GND | |  |  | |

# Requirements

|  |  |  |  |
| --- | --- | --- | --- |
|  | Frequency | Limits | Comments |
| RF frequency [MHz] | 3000-3100MHz |  |  |
| Maximum Input RF power | 3000-3100MHz | <-20dBm | Characterization outside this freq. range 2600-3600 MHz |
| Noise Figure@25C | 3000-3100MHz | <1.4dB | Characterization outside this freq. range 2600-3600 MHz |
| Gain@25C | 3000-3100MHz | >18dB | Characterization outside this freq. range 2600-3600 MHz |
| DC Power consumption |  | <55mA |  |
| Limiter Threshold |  | 4dBm |  |
| Phase difference | 3000-3100MHz | +/- <10deg difference | ∠Sx21- ∠S121<10deg, where x=2,3,4  Characterization outside this freq. range 2600-3600 MHz |
| Spurious signals | 1 to 26GHz | -50dBm |  |
| Temperature addresses  LNA #1: 1001001  LNA #2: 1001010  LNA #3: 1001011  LNA #4: 1001100 |  | Connection  Connection  Connection  Connection |  |

# Equipment

The following equipment have been used and calibrated according to Gomspace calibration program.

|  |  |  |  |
| --- | --- | --- | --- |
| Instrument Used | Manufacture ID | Gomspace ID | Valid  Calibration date |
| Noise source | Keysight N4000A. ENR 6dB, 10MHz-18GHz. | GS-0071 | 15-12-2024 |
| Spectrum analyzer | Keysight N9000A. 26GHz | GS-0043 | 06-08-2024 |
| Power supply | R&S HMC8143 | GS-0720 | Not calibrated |
| RF generator | R&S SMF100A. 20GHz | GS-0042 | Not calibrated |
| Network analyzer | R&S ZN8. 8.5GHz | GS-0028 | Not calibrated |

# Check out test

The aim of the check-out is to check the functionally and the performance of the unit before sent to the customer. This will include a visual inspection and an electrical test.

## Inspection

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Test/Inspection | Unit | Check | PASS/FAIL |
| 5.1 | Visual inspection LNA #1 |  |  | Pass |
| Visual inspection LNA #2 |  |  | Pass |
| Visual inspection LNA #3 |  |  | Pass |
| Visual inspection LNA #4 |  |  | Pass |

## Power consumption

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. | Test/Inspection | Min. | Max. | Unit | Measured | PASS/FAIL |
| 5.2 | Current consumption LNA #1 | 45 | 55 | mA | 51 | Pass |
| Current consumption LNA #2 | 45 | 55 | mA | 52 | Pass |
| Current consumption LNA #3 | 45 | 55 | mA | 52 | Pass |
| Current consumption LNA #4 | 45 | 55 | mA | 53 | Pass |

## Communication ports

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. | Test/Inspection | Min. | Max. | Unit | Check | PASS/FAIL |
| 5.3.1 | Check Addresses  **LNA #1:** 1001001  **LNA #2:** 1001010  **LNA #3:** 1001011  **LNA #4:** 1001100 | - | - | - | pass | Pass  Pass  Pass  Pass |
| 5.3.2\* | Temperature readings LNA #1 | 20 | 30 | C | 25.2 | Pass |
| Temperature readings LNA #2 | 20 | 30 | C | 26.1 | Pass |
| Temperature readings LNA #3 | 20 | 30 | C | 24.9 | Pass |
| Temperature readings LNA #4 | 20 | 30 | C | 25.7 | Pass |
| 5.3.3\*\* | Check temperature LNA #1 | - | - | - | Pass | Pass |
| Check temperature LNA #2 | - | - | - | Pass | Pass |
| Check temperature LNA #3 | - | - | - | Pass | Pass |
| Check temperature LNA #4 | - | - | - | pass | Pass |

\*) measured a room temperature.

\*\*) apply heat to sensor and check if it increases.

## Transmission

### Setup

|  |
| --- |
|  |

|  |  |  |
| --- | --- | --- |
| Instrument Used | Manufacture ID | Gomspace ID |
| Power supply | R&S HMC8143 | GS-0731 |
| Network analyzer | R&S ZN20. 20GHz | GS-0050 |

|  |  |
| --- | --- |
| Network analyzer settings | |
| Frequency | 2600-3600MHz |
| IF BW | 300Hz |
| Power Level | -20dBm |
| Points | 1001 |

### Gain vs Frequency Test

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. | Test/Inspection | Min. | Max. | Unit | Measured | PASS/FAIL |
| 5.4.2 | Gain delta between LNA’s, Pin=-20dBm. | -1 | 1 | dB | 0.2/-0.2 | Pass |

\*) see graph below.

|  |
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### S21, Phase Test

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. | Test/Inspection | Min. | Max. | Unit | Measured | PASS/FAIL |
| 5.4.3 | Delta Delta between LNA’s  Pin=-20dBm. Frequency 3000-3100MHz. | -10 | 10 | deg | +5.2/-6.7 | Pass |

\*) see graph below.

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## Gain & Noise Figure

### Setup

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|  |

|  |  |  |
| --- | --- | --- |
| Instrument Used | Manufacture ID | Gomspace ID |
| Noise source | Keysight N4000A. ENR 6dB, 10MHz-18GHz. | GS-0071 |
| Spectrum analyzer | Keysight N9000A. 26GHz | GS-0043 |
| Power supply | R&S HMC8143 | GS-0731 |

|  |  |
| --- | --- |
| Spectrum analyzer settings | |
| Frequency | 3002-3100MHz |
| IF BW | 2MHz |
| Points | 40 |
| ENR | 6dB |

### Test

Include RF cables on DUT

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. | Test/Inspection | Min. | Max. | Unit | Measured | PASS/FAIL |
| 5.5.2 | Noise figure, LNA #1\* |  | 1.4 | dB | 1.2 | Pass |
| Noise figure, LNA #2\* |  | 1.4 | dB | 1.3 | Pass |
| Noise figure, LNA #3\* |  | 1.4 | dB | 1.3 | Pass |
| Noise figure, LNA #4\* |  | 1.4 | dB | 1.3 | Pass |
| 5.5.3 | Gain, LNA 1\* | 18.0 | 22.0 | dB | 18.4/18.9 | Pass |
| Gain, LNA 2\* | 18.0 | 22.0 | dB | 18.0/18.6 | Pass |
| Gain, LNA 3\* | 18.0 | 22.0 | dB | 18.0/18.6 | Pass |
| Gain, LNA 4\* | 18.0 | 22.0 | dB | 18.0/18.8 | Pass |

\*) see graph below, include 0.15dB loss compensation of connector. Gain is measured more accurately using the s-parameters.

|  |  |
| --- | --- |
| LNA-X1 |  |
| LNA-X2 |  |
| LNA-X3 |  |
| LNA-X4 |  |

## Spurious signals (RF frequency 3050MHz)

### Test setup

|  |
| --- |
|  |

|  |  |  |
| --- | --- | --- |
| Instrument Used | Manufacture ID | Gomspace ID |
| Power supply | R&S HMC8143 | GS-0731 |
| Spectrum analyzer | Keysight N9000A | GS-0071 |
| RF generator | R&S SMF100A | GS-0042 |

### Spurious test

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No. | Test | Condition | Limit | Measured | PASS/FAIL |
| 5.6.2 | Spurious level | Spectrum in frequency range 0 to 26GHz | -50dBm | Pass | pass |

The signal from the RF generator is -40dBm@3050MHz.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Spur frequencies | Spur magnitude [dBm] | | | | PASS/FAIL |
| Req  [dBm] | [MHz] | **LNA-1**  **[dBm]** | **LNA-2**  **[dBm]** | **LNA-3**  **[dBm]** | **LNA-4**  **[dBm]** |  |
| -50 | 2660 | -79.5 | -81.2 | -81.1 | -78.3 | Pass |
| -17 | 3055 | -21.1 | -21.2 | -21.1 | -21.1 | Pass |
| -50 | 3905 | -83.1 |  |  | -82.7 | Pass |
| -50 | 6100 | -62.6 | -63.1 | -62.9 | -63.1 | Pass |
| -50 | 7555 | -79.4 | -79.4 | -79.2 | -79.2 | Pass |
| -50 | 12590 | -76.7 | -76.4 | -76.6 |  | pass |

\*) Harmonics and frequency above 6GHz are beyond the range of the SDR.

|  |  |
| --- | --- |
| LNA-X1 |  |
| LNA-X2 |  |
| LNA-X3 |  |
| LNA-X4 |  |

# Statement of conformity

It is hereby certified that apart from the deviations or waivers noted in the Remarks box below, the whole of the items detailed, conform I all respects to the specification(s), drawings(s) and conditions(s) or requirement(s) respect to the specification(s), drawings(s) and conditions(s) of the contract.

|  |
| --- |
| Remarks:  Three used instruments have not been calibrated- the vector analyzer (uncalibrated) and spectrum analyzer (calibrated) is providing the same results. The output power of generator is already affect by the cable used- and the spurious are relative to the carrier.  It is therefore concluded that LNA assembly is passing the checkout test. |

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| Product Name: BRO3-9 LNA Assembly  Template Document No: 1049805 rev 2.0  Part no: 108340 Eng. Revision: 1  LNA#1: 107022-89, LNA#2:107022-90, LNA#3: 107022-91 LNA4: 107022-92  Shop order 11782  Serial no: 17  Tested by: max  Approved by: max Date: 28-06-2024 |

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