**When**: 1st March

**Where**: Satellite – Mt. Takato

GS – BIRS GS, 8F

**Who**:

Mt. Takato

Yudai, Rintaro, Jorge, Tasuku

Kyutech GS

Sirash, Souta, Javier

**To bring**:

Mt.Takato

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| --- | --- | --- |
| □ BIRDS-X FM Satellite | □ Pelican Case | □ Soldering iron and lead |
| □ Spectrum Analyzer (Portable) | □ Power Supply | □ PC |
| □ Styro foam (Big and Small) | □ Multimeter | □ Pen |
| □ Satellite pad, bubble wrap | □ Adapters (e.g. SMA adapters) | □ Phone Charger |
| □ RF Cables | □ Capton tape | □ Gloves (box) |
| □ UART cable (debug) | □ Duct tape | □ Alcohol |
| □ charging cable | □ Measuring tape | □ Tissue (box) |
| □ PICKit 3 programmer | □ Scissors | □ Umbrella |
| □ programming board | □ Cutter | □ Tharindu’s TRX and antenna and micro mini usb cable |
| □ RTL-SDR and antenna | □ Screw box |  |

Kyutech GS

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| □ RF cables | □ Attenuator set | □ YAESU FT-2D |
| □ Adapters | □ Multimeter | □ Signal Generator |
| □ Spectrum Analyzer | □ PC | □ BIRDS-GS UHF Antenna |
| □ iCOM-9100 | □ Pen | □ BIRDS-GS PC |
| □ RF Amplifier | □ Signal Generator | □ Horyu-4 GS (UHF and VHF) |
| □ TNC for BIRDS-X |  |  |

Outline

0. Preparation

0.1 Measure and confirm the following output power

1. UHF Test (Addnics\_-Y)

1.1 Calibration

1.1.1 Pointing the BIRDS GS UHF Antenna towards Mt.Takato

1.1.2 Measure the Effective Uplink Attenuation from GS to Mt. Takato

1.2 Uplink Success Rate using ICOM-9100 GS setup

1.3 Uplink Success Rate using Tharindu GS setup

2. UHF Test (New\_+Y)

2.1 Calibration

2.1.1 Pointing the BIRDS GS UHF Antenna towards Mt.Takato

2.1.2 Measure the Effective Uplink Attenuation from GS to Mt. Takato

2.2 Uplink Success Rate using ICOM-9100 GS setup

2.3 Uplink Success Rate using Tharindu GS setup

3. VHF Test (APRS REF #1\_-Y)

3.1 Calibration

3.1.1 Pointing the Horyu-4 VHF antenna towards Mt. Takato

3.1.2 Measure the Effective Uplink Attenuation from GS to Mt. Takato

3.2 Uplink Success Rate using Handy TRX with Horyu-4 GS setup

4. VHF Test (APRS REF #2\_+Y)

4.1 Calibration

4.1.1 Pointing the Horyu-4 VHF antenna towards Mt. Takato

4.1.2 Measure the Effective Uplink Attenuation from GS to Mt. Takato

4.2 Uplink Success Rate using Handy TRX with Horyu-4 GS setup

5. VHF Test (APRS REF #3\_+Y)

6. VHF Test (APRS Sri Lanka #2\_+Y)

7. VHF Test (APRS Paraguay\_+Y)

8. VHF Test (APRS Sri Lanka #1\_+Y)

9. VHF Test (APRS Canada\_+Y)

**0 Preparation**

Before going to Mt. Takato, make sure the following have been done.

0.1 Measure and confirm the following output power.

|  |  |
| --- | --- |
| Parameter | Measured Value (dBm) |
| BIRDS-X FM (Addnics) CW Output (see if it’s 20 dBm) |  |
| BIRDS-X FM (New) CW Output |  |
| IC-9100 Output (for UHF at 8F, set to 45 dBm) |  |
| SG-RF Amp configuration Output (for UHF at 8F, set to 45 dBm, SG = -8 dBm) |  |
| APRS REF #1 Pwr Output | 28.04 dBm |
| APRS REF #2 Pwr Output | 26.08 dBm |
| APRS REF #3 Pwr Output | 27.50 dBm |
| APRS Sri Lanka #2 Pwr Output | 27.50 dBm |
| APRS Paraguay Pwr Output | 24.63 dBm |
| APRS Sri Lanka #1 Pwr Output | 27.40 dBm |
| APRS Canada Pwr Output | 24.58 dBm |
| YAESU FT-2D Output |  |
| Measure Each Attenuator : |  |
| 40 dB |  |
| 10 dB etc.. |  |
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1. **UHF Test (Addnics\_-Y)**
   1. **Calibration**
      1. **Pointing the BIRDS GS antenna towards Mt. Takato**

In this test, BIRDS-X FM satellite will transmit continuous beacon signal (20dBm) and BIRDS GS antenna will try to capture maximum power from Mt. Takato side.

* + - * Position BIRDS-X FM satellite such that the UHF antenna is　horizontal and facing towards the GS (Note: this will be BIRDS-X FM satellite position all throughout this test).
      * Set the BIRDS-X FM satellite to enable CW beacon by Tharindu’s TRX.
      * Point the BIRDS GS antenna in the nominal direction (EL = 0°, AZ = 220°).
      * Measure the received power at the BIRDS GS antenna. Set channel power bandwidth of spectrum analyzer to 500Hz and center frequency 437.375MHz. Record in the table below.
      * Adjust the BIRDS GS antenna direction about the nominal direction to find the direction with the maximum received power. Record in the table below.

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| --- | --- |
| BIRDS GS Antenna AZ | Received Signal Power (dBm) |
| 220 |  |
| 217 |  |
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* + - * + Fix the BIRDS GS antenna in this direction.

AZ direction: \_\_\_\_\_\_\_\_\_\_

Received Signal Power: \_\_\_\_\_\_\_\_\_\_

Note: when the maximum power is received, and antenna direction should be fixed and it should be kept throughout the test.

* + 1. **Measuring Effective Uplink Attenuation from GS to Mt. Takato**
       - BIRDS-X FM satellite will transmit continuous CW beacon ( dBm). Carefully take note of this position.
       - Measure the received power by the BIRDS GS antenna and record in the table below.

Using BIRDS GS UHF Antenna

|  |  |
| --- | --- |
| Received Power (dBm) | Effective Downlink Attenuation (dB) ( dBm – Received Power) |
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* 1. **Uplink Success Rate using ICOM-9100 GS Setup**

In this test, we do the same test as in 1.2 but use IC-9100 setup. BIRDS GS antenna will be connected to IC-9100 to transmit command signal (45 dBm) and receive ACK, as shown below. This is because some BIRDS GS have only this configuration.

A close-up of a paper

Description automatically generated

Send the uplink commands to BIRDS-X FM satellite for a given attenuation value. If satellite sends back ACK, it is taken as success. Repeat this procedure 10 times (not finalized) for a given attenuation value and record the success rate.

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| --- | --- | --- | --- |
| TX Power (dB) | Total Attenuation (dB) | Received Power (dBm) at Mt.Takato | Success Rate (/10) |
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\* Total Attenuation = Effective Attenuation + Variable Attenuator Value

* 1. **Uplink Success Rate using Tharindu GS Setup**

In this test, we do the same test as in 1.2 and 1.3 but use Tharindu’s setup. Send the uplink commands to BIRDS-X FM satellite for a given attenuation value. If satellite sends back ACK, it is taken as success. Repeat this procedure 10 times (not finalized) for a given attenuation value and record the success rate.

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| TX Power (dB) | Total Attenuation (dB) | Received Power (dBm) at Mt.Takato | Success Rate (/10) |
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1. **UHF Test (New\_+Y)**

Do same as in 1 but for Tharindu’s TRX.

* 1. **Calibration**
     1. **Pointing the BIRDS GS antenna towards Mt. Takato**

In this test, BIRDS-X FM satellite (New TRX) will transmit continuous beacon signal ( dBm) and BIRDS GS antenna will try to capture maximum power from Mt. Takato side.

* + - * Position BIRDS-X FM satellite such that the UHF antenna is　horizontal and facing towards the GS (Note: this will be BIRDS-X EM satellite position all throughout this test).
      * Set the BIRDS-X FM satellite to enable CW beacon by Tharindu’s TRX.
      * Point the BIRDS GS antenna in the nominal direction (EL = 0°, AZ = 220°).
      * Measure the received power at the BIRDS GS antenna. Set channel power bandwidth of spectrum analyzer to 500Hz and center frequency 437.375MHz. Record in the table below.
      * Adjust the BIRDS GS antenna direction about the nominal direction to find the direction with the maximum received power. Record in the table below.

|  |  |
| --- | --- |
| BIRDS GS Antenna AZ | Received Signal Power (dBm) |
| 220 |  |
| 217 |  |
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* + - * + Fix the BIRDS GS antenna in this direction.

AZ direction: \_\_\_\_\_\_\_\_\_\_

Received Signal Power: \_\_\_\_\_\_\_\_\_\_

Note: when the maximum power is received, and antenna direction should be fixed and it should be kept throughout the test.

**2.2.1 Measuring Effective Uplink Attenuation from GS to Mt. Takato**

Using BIRDS GS UHF Antenna

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| --- | --- |
| Received Power (dBm) | Effective Downlink Attenuation (dB) ( dBm – Received Power) |
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**2.2 Uplink Success Rate using ICOM-9100 GS Setup**

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| --- | --- | --- | --- |
| TX Power (dB) | Total Attenuation (dB) | Received Power (dBm) at Mt.Takato | Success Rate (/10) |
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**2.3** **Uplink Success Rate using Tharindu GS Setup**

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| --- | --- | --- | --- |
| TX Power (dB) | Total Attenuation (dB) | Received Power (dBm) at Mt.Takato | Success Rate (/10) |
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1. **VHF Test (APRS REF #1\_-Y)**
   1. **Calibration**
      1. **Pointing the Horyu-4 VHF antenna towards Mt.Takato**

In this test, BIRDS-X FM satellite (APRS REF #1) will transmit beacon signal ( 28.04 dBm) and BIRDS GS antenna will try to capture maximum power from Mt. Takato side.

* + - * Position BIRDS-X EM satellite such that the VHF antenna is　horizontal and facing towards the GS (Note: this will be BIRDS-X FM satellite position all throughout this test).
      * Set the BIRDS-X FM satellite to enable APRS REF #1 beacon mode by Tharindu’s TRX.
      * Point the Horyu-4 VHF antenna in the nominal direction (EL = 0°, AZ = 220°).
      * Measure the received power at the Horyu-4 VHF antenna. Set channel power bandwidth of spectrum analyzer to 500Hz and center frequency 145.825MHz. Record in the table below.
      * Adjust the Horyu-4 VHF antenna direction about the nominal direction to find the direction with the maximum received power. Record in the table below.

|  |  |
| --- | --- |
| BIRDS GS Antenna AZ | Received Signal Power (dBm) |
| 220 |  |
| 217 |  |
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* + - * + Fix the Horyu-4 VHF antenna in this direction.

AZ direction: \_\_\_\_\_\_\_\_\_\_

Received Signal Power: \_\_\_\_\_\_\_\_\_\_

Note: when the maximum power is received, and antenna direction should be fixed and it should be kept throughout the test.

* + 1. **Measuring the Effective Uplink Attenuation from GS to Mt.Takato**
       - APRS REF#1 will transmit beacon ( 28.04 dBm). Carefully take note of this position.
       - Measure the received power by the BIRDS GS antenna and record in the table below.

Using Horyu-4 GS VHF Antenna

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| Received Power (dBm) | Effective Downlink Attenuation (dB) (27.70 dBm – Received Power) |
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* 1. **Uplink Success Rate using Handy TRX with Horyu-4 GS Setup**

Horyu-4 VHF antenna will be used for sending uplink signal. It will be connected to YAESU FT-2D handy transceiver. (5W(maximum), 2.5W, 1W, 0.1W ) This configuration is also used for receiving ACK. First, BIRDS-X EM uplink success rate will be determined by finding the maximum attenuation connected to the handy TRX wherein ACK can still be received (~75% success rate). Use simplified EM software but remove beacon.

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| TX Power (dB) | Total Attenuation (dB) | Received Power (dBm) at Mt.Takato | Success Rate (/10) |
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**4. VHF Test (APRS REF #2\_+Y)**

**4.1 Calibration**

**4.1.1 Pointing the Horyu-4 VHF antenna towards Mt.Takato**

In this test, BIRDS-X FM satellite (APRS REF #2) will transmit beacon signal ( 26.08 dBm) and BIRDS GS antenna will try to capture maximum power from Mt. Takato side.

* + - * Position BIRDS-X FM satellite such that the VHF antenna is　horizontal and facing towards the GS (Note: this will be BIRDS-X FM satellite position all throughout this test).
      * Set the BIRDS-X FM satellite to enable APRS REF #2 beacon mode by Tharindu’s TRX.
      * Point the Horyu-4 VHF antenna in the nominal direction (EL = 0°, AZ = 220°).
      * Measure the received power at the Horyu-4 VHF antenna. Set channel power bandwidth of spectrum analyzer to 500Hz and center frequency 145.825MHz. Record in the table below.
      * Adjust the Horyu-4 VHF antenna direction about the nominal direction to find the direction with the maximum received power. Record in the table below.

|  |  |
| --- | --- |
| BIRDS GS Antenna AZ | Received Signal Power (dBm) |
| 220 |  |
| 217 |  |
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* + - * + Fix the Horyu-4 VHF antenna in this direction.

AZ direction: \_\_\_\_\_\_\_\_\_\_

Received Signal Power: \_\_\_\_\_\_\_\_\_\_

Note: when the maximum power is received, and antenna direction should be fixed and it should be kept throughout the test.

**4.1.2 Measuring the Effective Uplink attenuation from GS to Mt.Takato**

* + - * APRS REF#2 will transmit beacon ( 26.08 dBm). Carefully take note of this position.
      * Measure the received power by the BIRDS GS antenna and record in the table below.

Using Horyu-4 GS VHF Antenna

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| Received Power (dBm) | Effective Downlink Attenuation (dB) (26.08 dBm – Received Power) |
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**4.2 Uplink Success Rate using Handy TRX with Horyu-4 GS Setup**

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| TX Power (dB) | Total Attenuation (dB) | Received Power (dBm) at Mt.Takato | Success Rate (/10) |
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**5. VHF Test (APRS REF#3\_+Y)**

**5.1 Uplink Success Rate using Handy TRX with Horyu-4 GS Setup**

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| TX Power (dB) | Total Attenuation (dB) | Received Power (dBm) at Mt.Takato | Success Rate (/10) |
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**6. VHF Test (APRS Sri Lanka #2\_+Y)**

**6.1 Uplink Success Rate using Handy TRX with Horyu-4 GS Setup**

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| TX Power (dB) | Total Attenuation (dB) | Received Power (dBm) at Mt.Takato | Success Rate (/10) |
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**7. VHF Test (APRS Paraguay\_+Y)**

**7.1 Uplink Success Rate using Handy TRX with Horyu-4 GS Setup**

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| TX Power (dB) | Total Attenuation (dB) | Received Power (dBm) at Mt.Takato | Success Rate (/10) |
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**8. VHF Test (APRS Sri Lanka #1\_+Y)**

**8.1 Uplink Success Rate using Handy TRX with Horyu-4 GS Setup**

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| TX Power (dB) | Total Attenuation (dB) | Received Power (dBm) at Mt.Takato | Success Rate (/10) |
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**9. VHF Test (APRS Canada\_+Y)**

**9.1 Uplink Success Rate using Handy TRX with Horyu-4 GS Setup**

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| --- | --- | --- | --- |
| TX Power (dB) | Total Attenuation (dB) | Received Power (dBm) at Mt.Takato | Success Rate (/10) |
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