

|                                                                                   |                                                   |                                    |                                              |                             |
|-----------------------------------------------------------------------------------|---------------------------------------------------|------------------------------------|----------------------------------------------|-----------------------------|
|  | <h1>NGT-2500 FCC COMPLIANCE PLAN AND RESULTS</h1> |                                    |                                              |                             |
| <b>CAGE Code</b><br><b>1WYD3</b>                                                  | <b>Initial Release Date</b><br><b>01-Oct-2014</b> | <b>Revision Date</b><br><b>N/A</b> | <b>Document Number</b><br><b>8021005-001</b> | <b>Revision</b><br><b>-</b> |

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## Record of Revisions

| Rev | Date        | Authorization | Description of Change |
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|                                |                                               |               |
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## 1 INTRODUCTION

The NGT-2500 is an Automatic Dependent Surveillance-Broadcast (ADSB) transceiver with a built-in GPS receiver. The equipment provides ADSB out functionality over Universal Access Transceiver (UAT) link, Enhanced Visual Acquisition (EVAcq) using traffic information from ADS-B In received via a UAT link, Flight Information Service – Broadcast (FIS-B) using received data via UAT link and Wireless interception of the Mode A squawk Code from the aircraft's existing Air Traffic Control Radar Beacon System (ATCRBS) transponder or through a dedicated MODE A control panel interface.

The GPS-UAT equipment is designed to operate with +14V or +28V VDC power supply

### 1.1 Purpose

The purpose is to provide the FCC compliance plan and test results for the NGT-2500 equipment

### 1.2 Scope

This test results document establishes the FCC compliance plan and procedures for NGT-2500, Part Number 9022500-10000

### 1.3 References

**Table 1-1 Referenced ACSS Documents**

| Document No.  | Revision | Description                       |
|---------------|----------|-----------------------------------|
| 9022500-10    | F        | Hardware Assembly Drawing         |
| 9022500-10000 | B        | Assembly, Hardware End item       |
| 9022010-002   | B        | CCA Drawing (GPS-UAT CCA)         |
| 9021030-001   | E        | CCA Drawing (Power Supply CCA)    |
| 9021020-001   | F        | CCA Drawing (Power Amplifier CCA) |
| 9022501-001   | B        | Outline and Installation Drawing  |
| 0040-17011-01 | -        | Installation Manual               |

**Table 1-2 Referenced Industry Documents**

| Source | Document No. | Revision   | Description                                                                                |
|--------|--------------|------------|--------------------------------------------------------------------------------------------|
| FAA    | AC-20-172A   | 03/23/2012 | Airworthiness Approval for ADS-B In Systems and Applications                               |
| FAA    | AC 20-165A   | 11/07/2012 | Airworthiness Approval of Automatic Dependent Surveillance – Broadcast (ADS-B) Out Systems |

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**Table 1-2 Referenced Industry Documents**

| Source | Document No.               | Revision                 | Description                                                                                                                                |
|--------|----------------------------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| FAA    | TSO-C145c                  | 05/02/2008               | Airborne Navigation Sensors Using The Global Positioning System Augmented By The Satellite Based Augmentation System                       |
| FAA    | TSO-C154c                  | 12/02/2009               | Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast (ADS-B) Equipment Operating on Frequency of 978 MHz          |
| FAA    | TSO-C157a                  | 09/09/2011               | Aircraft Flight Information Services – Broadcast (FIS-B) Data Link Systems and Equipment                                                   |
| FAA    | TSO-C195a                  | 02/29/2012               | Avionics Supporting Automatic Dependent Surveillance – Broadcast (ADS-B) Aircraft Surveillance Applications (ASA)                          |
| RTCA   | DO-160G                    | 12/08/2010               | Environmental Conditions and Test Procedures For Airborne Equipment                                                                        |
| RTCA   | DO-229D with Change 1      | 12/13/2006<br>02/01/2013 | Minimum Operational Performance Standards for Global Positioning System/Satellite-Based Augmentation System Airborne Equipment             |
| RTCA   | DO-267A                    | 04/29/2004               | Minimum Aviation System Performance Standards (MASPS) for Flight Information Services-Broadcast (FIS-B) Data Link                          |
| RTCA   | DO-282B with Corrigendum 1 | 12/02/2009<br>12/13/2011 | Minimum Operational Performance Standards (MOPS) for Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast (ADS-B) |
| RTCA   | DO-317A                    | 12/13/2011               | Minimum Operational Performance Standards (MOPS) for Aircraft Surveillance Applications (ASA) System                                       |

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**Table 1-3: Referenced FCC Documents**

| Document No.                                      | Description                                                                                                                                                                                                                                |
|---------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CFR Title 47<br>Chapter 1<br>Part 2<br>Subpart J  | Code of Federal Regulations – Telecommunications<br>Federal Communications Commission<br>Frequency Allocations and Radio Treaty Matters; General Rules and Regulations<br>Equipment Authorization Procedures Revised as of October 1, 2001 |
| CFR Title 47<br>Chapter 1<br>Part 15<br>Subpart A | Code of Federal Regulations – Telecommunications<br>Federal Communications Commission<br>Radio Frequency Devices<br>General<br>Revised as of October 1, 2001                                                                               |
| CFR Title 47<br>Chapter 1<br>Part 87              | Code of Federal Regulations, Telecommunication. Part 87 – Aviation Services<br>Revised as of 10/01/1989                                                                                                                                    |
| PART 87                                           | Code of Federal Regulations, Telecommunication. Part 87 – Aviation Services                                                                                                                                                                |

## 1.4 Acronyms and Abbreviations

**Table 1-4: Acronyms and Abbreviations**

| Acronym | Definition                                      |
|---------|-------------------------------------------------|
| ACSS    | Aviation Communication and Surveillance Systems |
| ADSB    | Automatic Dependent Surveillance – Broadcast    |
| ASA     | Aircraft Surveillance Applications              |
| ATCRBS  | Air Traffic Control Radar Beacon System         |
| ATE     | Automated Test Equipment                        |
| CCA     | Circuit Card Assembly                           |
| CFR     | Code of Federal Regulations                     |
| CPFSK   | Continuous Phase Frequency Shift Keying         |
| CRC     | Cyclic Redundancy Check                         |
| dB      | decibel                                         |
| EVAcq   | Enhanced Visual Acquisition                     |
| FAA     | Federal Aviation Administration                 |
| FCC     | Federal Communications Commission               |
| FET     | Field Effect Transistor                         |
| FIS-B   | Flight Information Service - Broadcast          |
| FPGA    | Field Programmable Gate Array                   |
| FSK     | Frequency Shift Keying                          |
| GHz     | Giga Hertz                                      |
| GPS     | Global Positioning System                       |
| IF      | Intermediate Frequency                          |
| kHz     | kilo Hertz                                      |
| LDMOS   | Laterally Diffused Metal Oxide Semiconductor    |
| LNA     | Low Noise amplifier                             |
| LO      | Local Oscillator                                |
| LRU     | Line Replaceable Unit                           |

|                     |                                                                                                               |        |
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| Acronym | Definition                                    |
|---------|-----------------------------------------------|
| MASPS   | Minimum Aviation System Performance Standards |
| Mbps    | Mega bits per second                          |
| MHz     | Mega Hertz                                    |
| MOPS    | Minimum Operational Performance Standards     |
| ns      | nanosecond                                    |
| PC      | Personal Computer                             |
| PLL     | Phase Locked Loop                             |
| PPM     | Parts Per Million                             |
| RF      | Radio Frequency                               |
| rms     | root mean square                              |
| RTCA    | Radio Technical Commission for Aeronautics    |
| TCXO    | Temperature Compensated Crystal Oscillator    |
| TSO     | Technical Standard Order                      |
| UAT     | Universal Access Transceiver                  |
| us      | microsecond                                   |
| UUT     | Unit Under Test                               |
| VCO     | Voltage Controlled Oscillator                 |
| VDC     | Volts Direct Current                          |

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## 2 GENERAL INFORMATION

### 2.1 Type Designation

The equipment has been designated by ACSS as NGT-2500, P/N 9022500-10000.

### 2.2 Service and Rule for Intended Operation

Air Traffic Control  
Part 87, Subpart A

### 2.3 Description of Equipment

#### 2.3.1 NGT-2500 Functionality

The NGT-2500 is an Automatic Dependent Surveillance-Broadcast (ADSB) transceiver with a built-in GPS receiver. The equipment provides ADSB out functionality over Universal Access Transceiver (UAT) link, Enhanced Visual Acquisition (EVAcq) using traffic information from ADS-B In received via a UAT link, Flight Information Service – Broadcast (FIS-B) using received data via UAT link and Wireless interception of the Mode A squawk Code from the aircraft's existing Air Traffic Control Radar Beacon System (ATCRBS) transponder or through a dedicated MODE A control panel interface. The NGT-2500 will be compliant to the following TSO's:

- TSO-C145c: Airborne Navigation Sensors Using The Global Positioning System Augmented By The Satellite Based Augmentation System
- TSO-C154c: Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast (ADS-B) Equipment Operating on Frequency of 978 MHz
- TSO-C157a: Aircraft Flight Information Services – Broadcast (FIS-B) Data Link Systems and Equipment
- TSO-C195a: Avionics Supporting Automatic Dependent Surveillance - Broadcast (ADS-B) Aircraft Surveillance Applications (ASA)

##### 2.3.1.1 Type of Emission

UAT Transmission: 1M30F1D  
Mode A Interrogation: 18M0P1D

##### 2.3.1.2 Frequency Range

UAT Transmission: 978 MHz  $\pm$  19.56 kHz  
Mode A Interrogation: 1030 MHz  $\pm$  0.1 MHz

##### 2.3.1.3 Power Rating

UAT Transmission: 40 Watts Peak Effective Radiated Power (Pulsed)  
Mode A Interrogation: 0.00032 Watts Peak Effective Radiated Power (Pulsed)

##### 2.3.1.4 Final Power Amplifier

The final power amplifier is a 60W LDMOS FET with approximately 14dB of gain.

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### 2.3.1.5 Active Device Functions

**Table 2-1: UAT Active Devices**

| Function        | Device Type                                       | Part           | Manufacturer       |
|-----------------|---------------------------------------------------|----------------|--------------------|
| Oscillator      | Temperature Compensated Crystal Oscillator (TCXO) | FOX924B-27.000 | Fox Electronics    |
|                 | RF Synthesizer/VCO with integrated RF Mixer       | RFFC2071SQ     | RFMD               |
|                 | Integrated Synthesizer and VCO                    | ADF4360-7BCPZ  | Analog Devices     |
| Transmitter     | Gain Block, Id = 35mA, 22.4 dB Gain               | GALI-3+        | Mini Circuits      |
|                 | Gain Block, Id = 48mA, 19 dB Gain                 | BL051          | BeRex              |
|                 | High-Linearity LNA Gain Block                     | TQP3M9035      | TriQuint           |
|                 | 2 Watt High Linearity Amplifier                   | TQP7M9106      | TriQuint           |
|                 | 60W LDMOS Amplifier                               | LET9060        | STMicroelectronics |
| CPFSK Modulator | Digital Data Synthesizer                          | AD9953YSVZ     | Analog Devices     |

### 2.3.2 Circuit Diagram

A block diagram and schematics will be provided with the FCC Form 731 when the application for certification is filed with the FCC.

### 2.3.3 Instruction Book

An ACSS document, Installation Manual (0040-17011-01) provides instructions for the proper installation of the NGT-2500 on a given aircraft.

### 2.3.4 Tune-up Procedure

No field tuning is required.

### 2.3.5 Oscillator Circuit

The NGT-2500 uses 907.4 MHz as LO signal for up-conversion and down-conversion of UAT signal. The LO utilizes a TCXO of frequency 27 MHz. Another LO driven by the same 27 MHz TCXO, generates 1030MHz for Mode A Interrogation. A FPGA is used to program both these LO's to produce the required frequencies.

### 2.3.6 LO Source Circuitry

The LO signal (907.4 MHz) for UAT signal up-conversion and down-conversion is generated in a RF Synthesizer with an integrated VCO and mixer. The generated LO signal is internally buffered and routed to the transmitter mixer and receiver mixer. The VCO core consists of three VCO's and each VCO has 128 overlapping bands, which are used to achieve low VCO gain and optimal phase noise performance across the whole tuning range. The chip automatically selects the correct VCO (VCO auto-select) and VCO band (VCO coarse tuning) to generate the desired LO frequency based on the values programmed

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into the PLL1 and PLL2 registers banks. The lock detect flag indicates if the LO is locked to the correct frequency. All on-chip are programmed using a proprietary 3-wire serial bus, which supports both write and read operations. Synthesizer programming, device configuration, and control are achieved through a mixture of hardware and software controls.

Another RF synthesizer with integrated VCO generates 1030 MHz for Mode A Interrogation. The center frequency of the RF synthesizer is set by external inductors. All the on-chip registers are controlled by FPGA through a simple 3-wire interface.

### 2.3.7 Frequency Stabilization

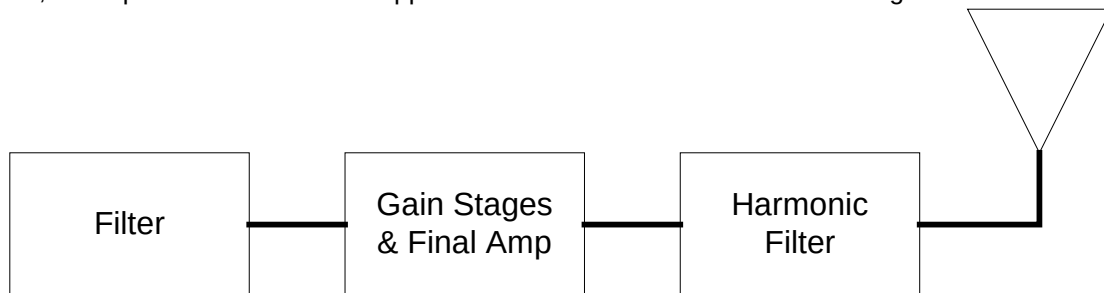
TCXO with stability of  $\pm 2.5$ PPM

### 2.3.8 Modulation Limiting

Not Applicable

### 2.3.9 Radiated Interference Suppression

The In-band transmission spectrum of the pulsed signal (978 MHz) is controlled by using an IF filter and by affecting the rise and fall times of the pulsed output of the modulator. Band pass filters are used in between amplifiers to suppress the LO leakage and the harmonic of the transmitted signal. After the final amplifier, a low pass filter is used to suppress the harmonics of the transmitted signal further down.



The spectral output for 978 MHz transmissions will be limited to the following schedule:

**Table 2-2 Transmitter Spectral Mask**

| Frequency difference<br>(MHz from carrier) | Maximum Relative power<br>(dB below maximum) |
|--------------------------------------------|----------------------------------------------|
| $\pm 0.5$                                  | 0dBc                                         |
| $\pm 1$                                    | 18dBc                                        |
| $\pm 2.25$                                 | 50dBc                                        |
| $\pm 3.25$                                 | 60dBc                                        |

|                                |                                               |               |
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### 3 MODULATION DETAILS

#### 3.1 UAT Transmission

The nominal modulation rate is 1.041667 megabits per second. The data is modulated onto the carrier using binary Continuous Phase Frequency Shift Keying with a modulation index of 0.6. A binary 1 is indicated by a shift up in frequency from the nominal carrier frequency of  $\Delta f/2$  (+312.5 kHz) and a binary 0 by a shift of  $-\Delta f/2$  (-312.5 kHz). These frequency deviations apply at the optimum sampling points for the bit interval.

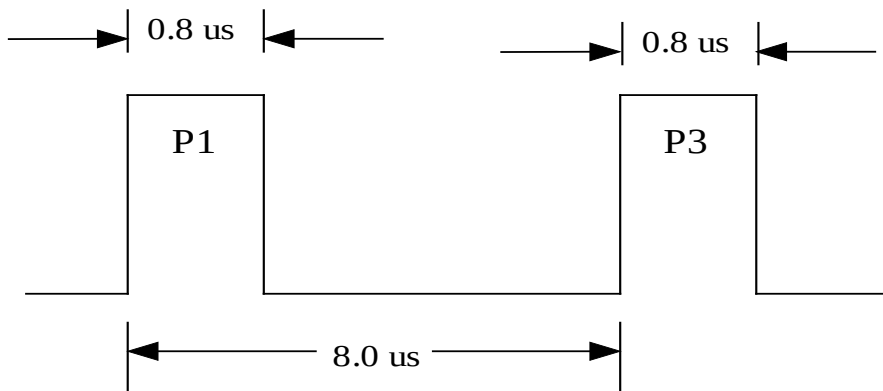
#### 3.2 Mode A Interrogation

Mode A interrogation takes place once in a second after every UAT transmission. Mode A interrogations are pulse amplitude modulated signals (PAM) and consist of P1 and P3 pulses. The pulse characteristics of P1 and P3 pulses are tabulated in Table 3-1

**Table 3-1: P1 and P3 Pulse Characteristics**

| Parameter               | Specification             |
|-------------------------|---------------------------|
| Pulse Duration          | $0.8 \pm 0.05 \text{ us}$ |
| Rise Time               | 0.1 us maximum            |
| Fall Time               | 0.2 us maximum            |
| Pulse Spacing, P1 to P3 | $8.0 \pm 0.1 \text{ us}$  |

Mode A interrogation pulse waveform is as shown in Figure 3-1



**Figure 3-1: Mode A Interrogation Pulse Waveform**

|                                |                                               |               |
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## 4 EQUIPMENT AND SETUP

### 4.1 Test Equipment

The test equipment used, are listed in each test results section below.

#### 4.1.1 Setup Block Diagram

Setup block diagrams are shown in each test results section below.

### 4.2 LRU Setup



Figure 4-1: Test Equipment Setup

|                                |                                               |               |
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**Figure 4-2: Test Equipment Setup and Temperature Chamber**

|                                |                                               |               |
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**Figure 4-3: NGT-2500 inside the Temperature Chamber**

#### **4.2.1 Hardware Configuration**

Testing was conducted on a single NGT-2500 LRU P/N 9022500-10000, S/N Q10020

#### **4.2.2 Software Configuration**

The part number and CRC of the software, which was used for testing, are shown in Figure 4-4

|                                           |                                      |
|-------------------------------------------|--------------------------------------|
| ..... BOOT Loader Software Part Number    | RL980002-021                         |
| ..... BOOT Loader Software Version Number | 01                                   |
| ..... BOOT Loader Software CRC            | 46,45,34,39,41,43,38,37(0xFE49AC87)  |
| ..... Operational Software Part Number    | RL98005-021RL980001-021              |
| ..... Operational Software Version Number | 21                                   |
| ..... Operational Software CRC            | 45,43,38,30,33,45,43,42(0xEC803ECB)  |
| ..... Firmware Part Number                | RL98005-021RL9021120-021             |
| ..... Firmware Version Number             | 18                                   |
| ..... Firmware CRC                        | 42,30,34,43,42,38,30,42,(0xB04CB80B) |

**Figure 4-4: Software Details**

|                     |                                                                                                               |         |
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## 5 DRAWINGS AND PHOTOGRAPHS

### 5.1 Drawings

Refer to Table 1-1 for a list of ACSS drawings that will be furnished with the application.

### 5.2 Photographs

Photographs of the NGT-2500 unit illustrating the assembly drawings are found in Figure 5-1 through Figure 5-12.



**Figure 5-1: NGT-2500 Front View**

|                                |                                               |               |
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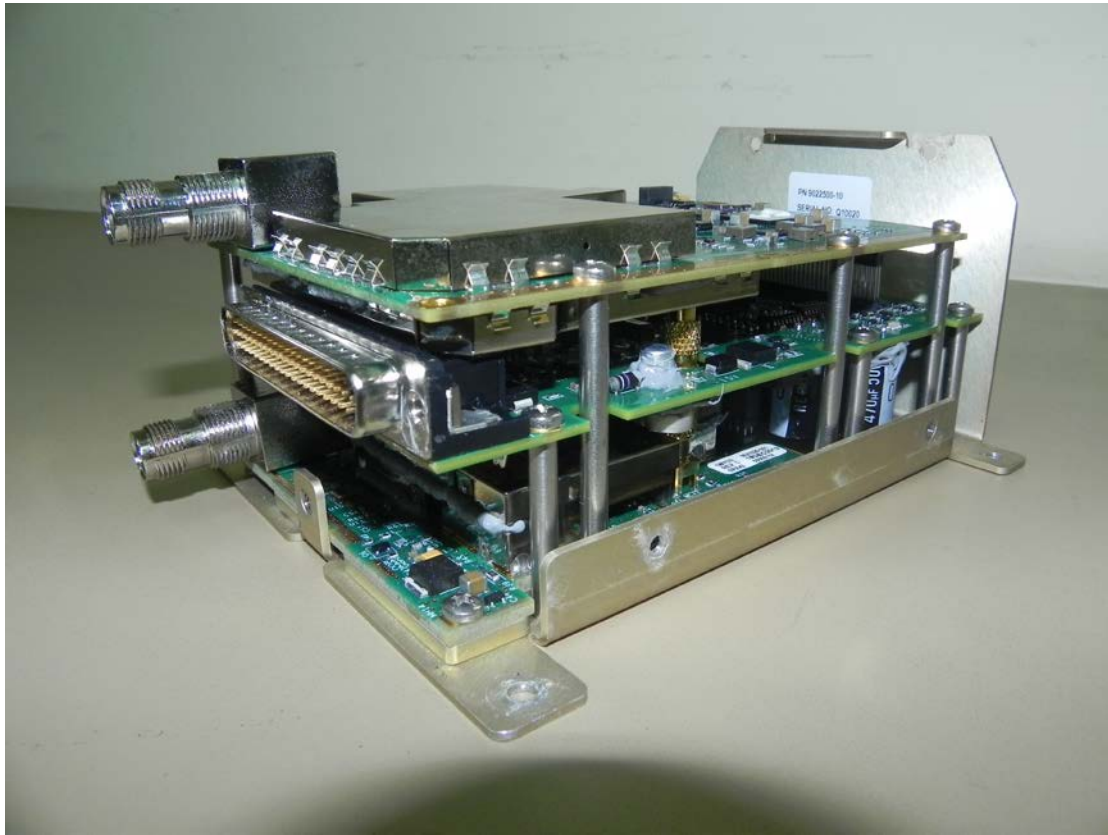
Figure 5-2: NGT-2500 Rear View

|                                |                                               |               |
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**Figure 5-3: NGT-2500 Top View With Top Cover Removed**

|                                |                                               |               |
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**Figure 5-4: NGT-2500 Side View With Top Cover Removed**

|                                |                                               |               |
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**Figure 5-5: NGT-2500 with GPS-UAT CCA Removed**

|                                |                                               |               |
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**Figure 5-6: GPS-UAT CCA Top Side**

|                                |                                               |               |
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**Figure 5-7: GPS-UAT CCA Bottom Side**

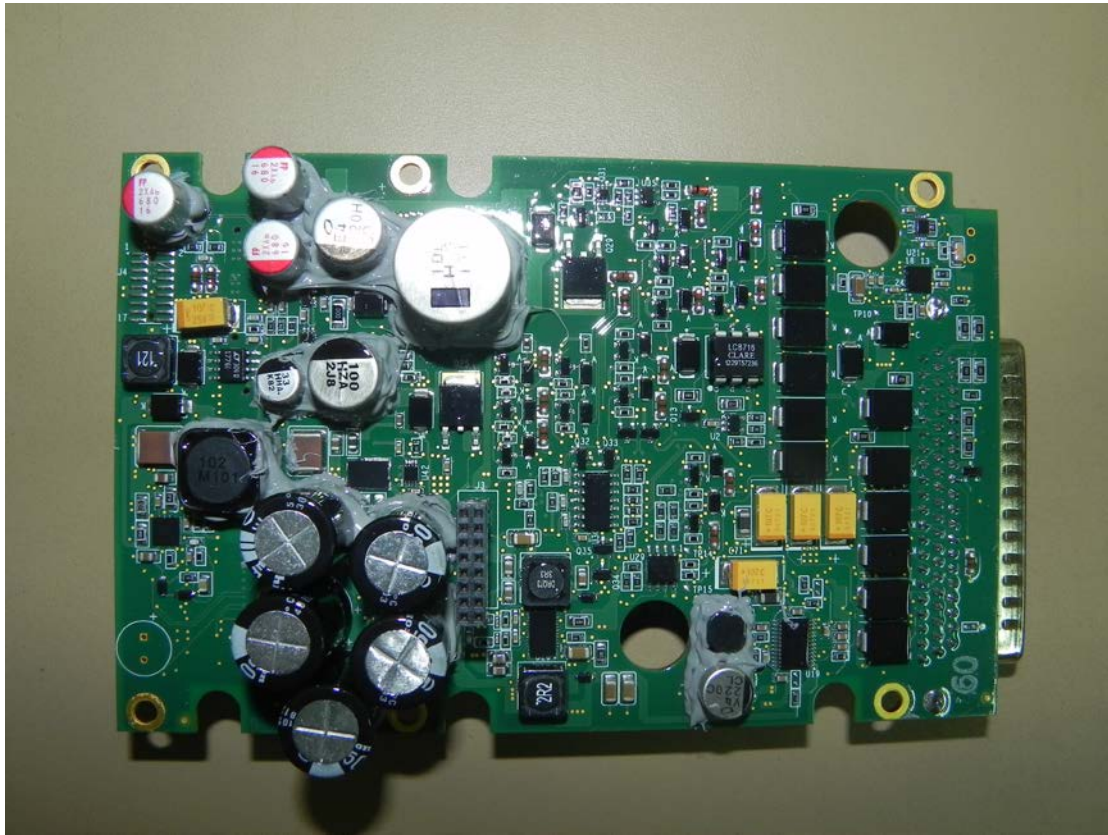
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**Figure 5-8: NGT-2500 with GPS-UAT CCA and Power Supply CCA Removed**



|                                |                                               |               |
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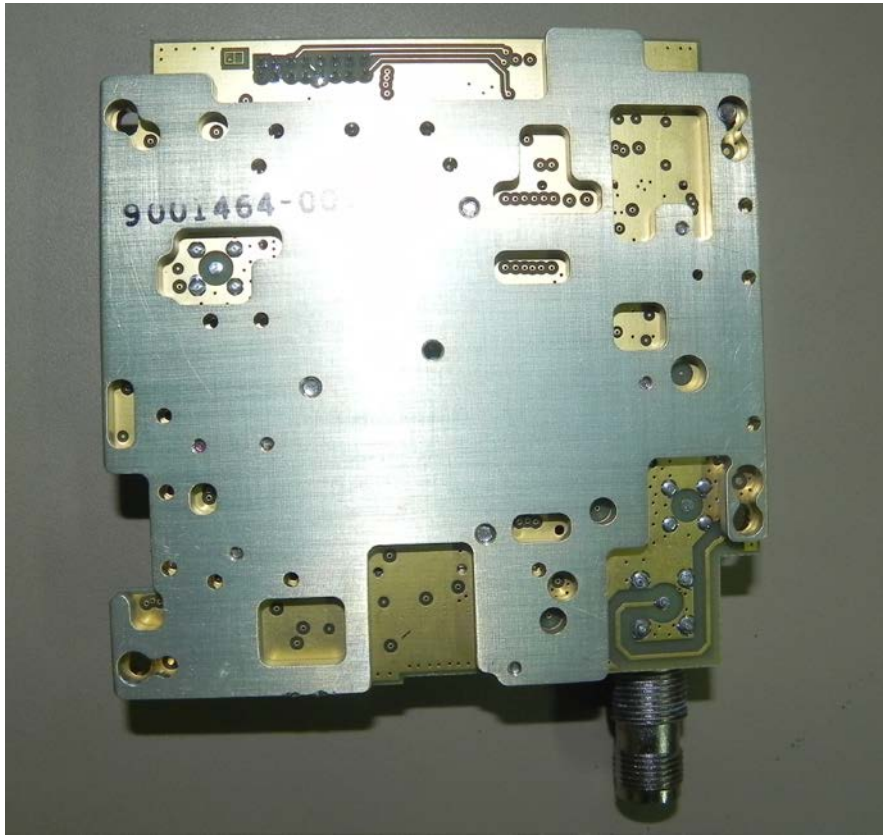
**Figure 5-10: Power Supply CCA Bottom Side**

|                                |                                               |               |
|--------------------------------|-----------------------------------------------|---------------|
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**Figure 5-11: Power Amplifier CCA Top Side**

|                                |                                               |               |
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**Figure 5-12: Power Amplifier CCA Bottom Side**

|                                |                                               |               |
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## **6 FCC COMPLIANCE TEST PLAN**

### **6.1 FCC Compliance Overview**

The Code of Federal Regulations, Title 47, Volume 1, Part 2, Subpart J (47CFR2.xxxx) provides procedures for radio frequency equipment to be authorized by the FCC. Certification is an equipment authorization issued by the commission, based on representations and test data submitted by the applicant. Certification attaches to all units subsequently marketed by the grantee which are identical to the sample tested except for permissive changes or other variations authorized by the commission.

#### **6.1.1 FCC Identifier**

47CFR2.924 states that equipment, which has been authorized by the FCC, bears an FCC Identifier. Equipment, which has been authorized, may be marketed under different model/type numbers or trade names without additional authorization from the commission, provided that such devices are electrically identical and the equipment bears an FCC Identifier validated by a grant of equipment authorization.

### **6.2 NGT-2500 to be subjected to FCC Compliance Testing**

The NGT-2500 unit (9022500-10000) will be subjected to the full suite of FCC compliance tests with the resulting data submitted to the FCC for certification. All results will be compiled in the report that follows.

|                                |                                               |               |
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## 7 TEST FACILITIES

FCC Testing performed at the following FCC Listed and Certified facilities:

DNB Engineering, Inc  
Utah Test Facility  
1100 Chalk Creek Road  
Coalville, UT 84017  
United States

|                                |                                               |               |
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## 8 TEST SCHEDULE

FCC testing will commence in September of 2014.

|                                |                                               |               |
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## 9 FCC COMPLIANCE TEST PROCEDURES

47CFR2.1041 states that for equipment operating under parts 15 & 18, the measurement procedures are specified in the rules governing the particular device for which certification is requested. For equipment operating in the authorized radio services, measurements are required as specified in sections 2.1046 (RF Power Output), 2.1047 (Modulation Characteristics), 2.1049 (Occupied Bandwidth), 2.1051 (Spurious Emissions at Antenna Terminals), 2.1053 (Field Strength of Spurious Radiation), 2.1055 (Frequency Stability) and 2.1057 (Frequency Spectrum to be Investigated).

### 9.1 RF Power Output

47CFR Reference:  
2.1046, RF Power Output  
87.131, Bandwidth of Emission

#### 9.1.1 UAT Transmission

Given that the power output of the UAT transmitter located inside the NGT-2500 unit ranges from 25 W to 63 W at the UAT antenna port of the unit, the UAT transmitter's peak power output in dBm is calculated as follows:

$$P_{\text{peak\_Max}} \text{ (dBm)} = 10\text{Log}_{10} (1000 \times P_{\text{peak\_Max}} \text{ (W)} / 1\text{W})$$

$$P_{\text{peak\_Max}} \text{ (dBm)} = 10\text{Log}_{10}(1000 \times 63 / 1\text{W})$$

$$P_{\text{peak\_Max}} \text{ (dBm)} = +48 \text{ dBm}$$

$$P_{\text{peak\_Min}} \text{ (dBm)} = 10\text{Log}_{10} (1000 \times P_{\text{peak\_Min}} \text{ (W)} / 1\text{W})$$

$$P_{\text{peak\_Min}} \text{ (dBm)} = 10\text{Log}_{10}(1000 \times 25 / 1\text{W})$$

$$P_{\text{peak\_Min}} \text{ (dBm)} = +44 \text{ dBm}$$

The UAT transmitter's measured peak power output should be within +44dBm and +48dBm at the UAT antenna port, considering manufacturing tolerances, measurement equipment tolerances and losses in any cables/connectors.

*Comment: In this report, the LRU's output power may be referenced in two separate locations, at the antenna or at the UAT antenna port of the unit. Maximum installation cable loss considered is 2dB.*

##### 9.1.1.1 RF Power Output Test Equipment Required

**Table 9-1: RF Power Output Test Equipment Required**

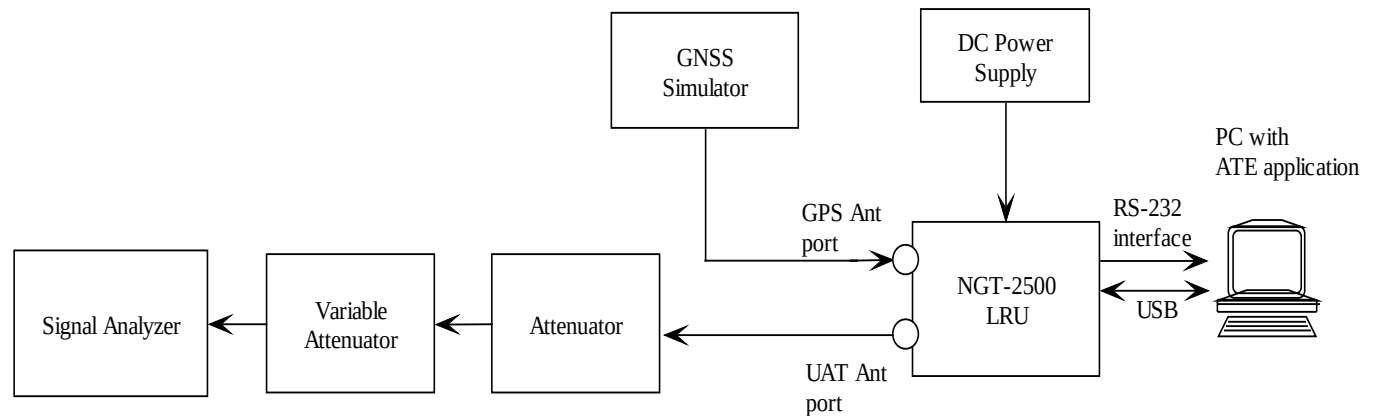
| Equipment/Application               | Manufacturer       | Model         |
|-------------------------------------|--------------------|---------------|
| NGT-2500 LRU                        | ACSS               | 9022500-10000 |
| Attenuator (or Equivalent)          | Mini Circuits      | BW-S20W20+    |
| Variable Attenuator (or Equivalent) | Fairview Microwave | SA35110       |
| Signal Analyzer                     | Agilent            | N9020A        |
| GNSS Simulator                      | Accord             | ACC_SIM_04    |
| DC Power Supply                     | Aplab              | L6403         |
| ATE Application                     | Accord             | ATE-APP-2.20  |

*Comment: Equivalent equipment may be used.*

|                     |                                                                                                               |         |
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#### 9.1.1.2 RF Power Output Test Setup



**Figure 9-1: RF Power Output Test Setup for UAT transmission**

#### 9.1.1.3 RF Power Output Test Procedure

1. Connect the equipment as shown in Figure 9-1 above.
2. Adjust the variable attenuator such that 978MHz signal power level at the input of Signal Analyzer is  $-6 \pm 1\text{dBm}$  (Total attenuation required between UAT antenna port of UUT and Signal Analyzer input: 53dB approx.)
3. Configure the Signal Analyzer as per below settings
  - Center frequency: 978MHz
  - Span: 0Hz
  - Resolution bandwidth: 2MHz
  - Video bandwidth: 6MHz
  - Sweep time: 1ms
  - Trigger type: Video
  - Trigger delay: -250us
  - Trace/Max hold: ON
  - Continuous peak search: ON
  - Reference level offset: Total attenuation between the unit and Signal Analyzer
  - Reference level: +55dBm
4. Configure the NGT-2500 unit to transmit one long message per second with valid payload data using ATE application and control panel.
5. Record the measured output power on Signal Analyzer.

#### 9.1.1.4 Test Result Data

The peak power measured is mentioned in Table 9-2.

**Table 9-2: NGT-2500 Peak power output**

| NGT-2500 UAT Peak power output |                  | Limit            |
|--------------------------------|------------------|------------------|
| Measurement                    | UAT antenna port |                  |
| Power Output (dBm)             | +47.57           | +44dBm to +48dBm |

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### 9.1.2 Mode A Interrogation

The peak power output calculation in dBm for Mode A Interrogation is as follows:

$$P_{\text{peak\_Max}} \text{ (dBm)} = 10\text{Log}_{10} (1000 \times P_{\text{peak\_Max}} \text{ (W)} / 1\text{W})$$

$$P_{\text{peak\_Max}} \text{ (dBm)} = 10\text{Log}_{10}(1000 \times 0.0005 / 1\text{W})$$

$$P_{\text{peak\_Max}} \text{ (dBm)} = -3 \text{ dBm}$$

$$P_{\text{peak\_Min}} \text{ (dBm)} = 10\text{Log}_{10} (1000 \times P_{\text{peak\_Min}} \text{ (W)} / 1\text{W})$$

$$P_{\text{peak\_Min}} \text{ (dBm)} = 10\text{Log}_{10}(1000 \times 0.0000158 / 1\text{W})$$

$$P_{\text{peak\_Min}} \text{ (dBm)} = -18 \text{ dBm}$$

#### 9.1.2.1 RF Power Output Test Equipment Required

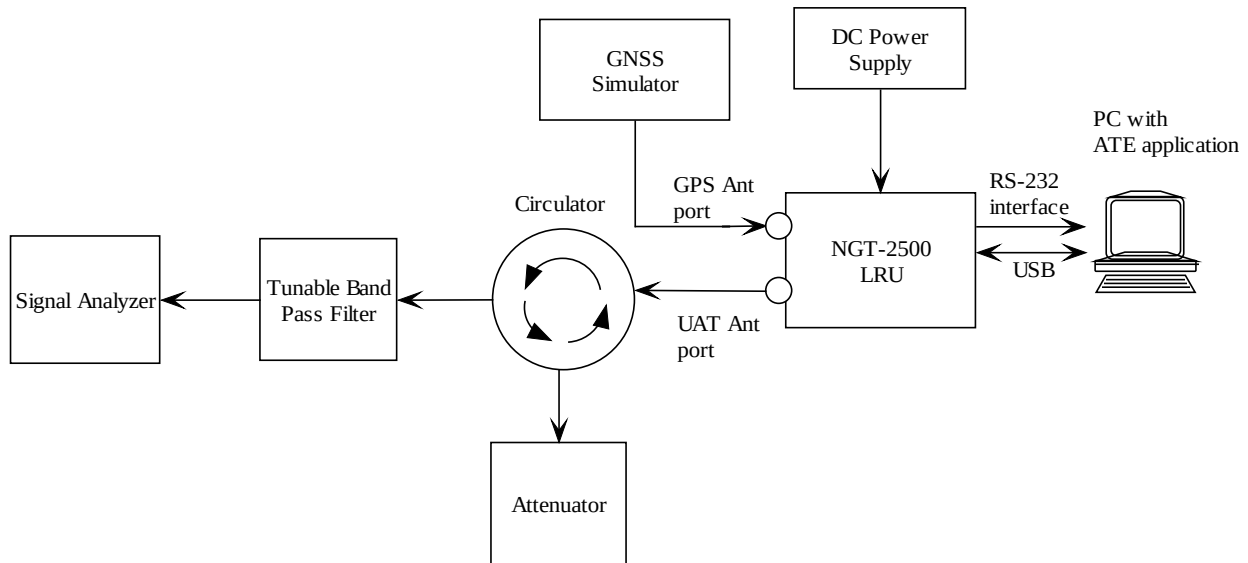
**Table 9-3: RF Power Output Test Equipment Required**

| Equipment/Application                       | Manufacturer                               | Model         |
|---------------------------------------------|--------------------------------------------|---------------|
| NGT-2500 LRU                                | ACSS                                       | 9022500-10000 |
| Circulator                                  | Renaissance Communications Private Limited | A2NN          |
| Attenuator (or Equivalent)                  | Mini Circuits                              | BW-S20W20+    |
| Tunable Band Pass Filter (Tuned to 1030MHz) | Telonic Berkeley Inc.                      | TTF 1000      |
| Signal Analyzer                             | Agilent                                    | N9020A        |
| GNSS Simulator                              | Accord                                     | ACC_SIM_04    |
| DC Power Supply                             | Aplab                                      | L6403         |
| ATE Application                             | Accord                                     | ATE-APP-2.20  |

*Comment: Equivalent equipment may be used.*

|                                |                                               |               |
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### 9.1.2.2 RF Power Output Test Setup



**Figure 9-2: RF Power Output Test Setup for Mode A Interrogation**

### 9.1.2.3 RF Power Output Test Procedure

1. Connect the equipment as shown in Figure 9-2.
2. Configure the Signal Analyzer as per below settings
  - Center frequency: 1030MHz
  - Span: 0Hz
  - Resolution bandwidth: 8MHz
  - Video bandwidth: 50MHz
  - Sweep time: 20us
  - Trigger type: Video
  - Trigger delay: -5us
  - Trace/Max hold: ON
  - Continuous peak search: ON
  - Reference level offset: Total attenuation between the unit and Signal Analyzer
3. Configure the NGT-2500 unit to transmit one long message per second with valid payload data using ATE application and control panel.
4. Record the measured output power on Signal Analyzer.

### 9.1.2.4 Test Result Data

The peak power measured is mentioned in Table 9-4

**Table 9-4: NGT-2500 Peak power output**

| NGT-2500 Mode A Interrogation Peak power output |                  | Limit           |
|-------------------------------------------------|------------------|-----------------|
| Measurement                                     | UAT antenna port |                 |
| Power Output                                    | -15.029 dBm      | -3dBm to -18dBm |

|                     |                                                                                                               |         |
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## 9.2 Modulation Characteristics

47CFR Reference:  
2.1047, Modulation Characteristics  
87.141c, Modulation Requirements

### 9.2.1 UAT Transmission

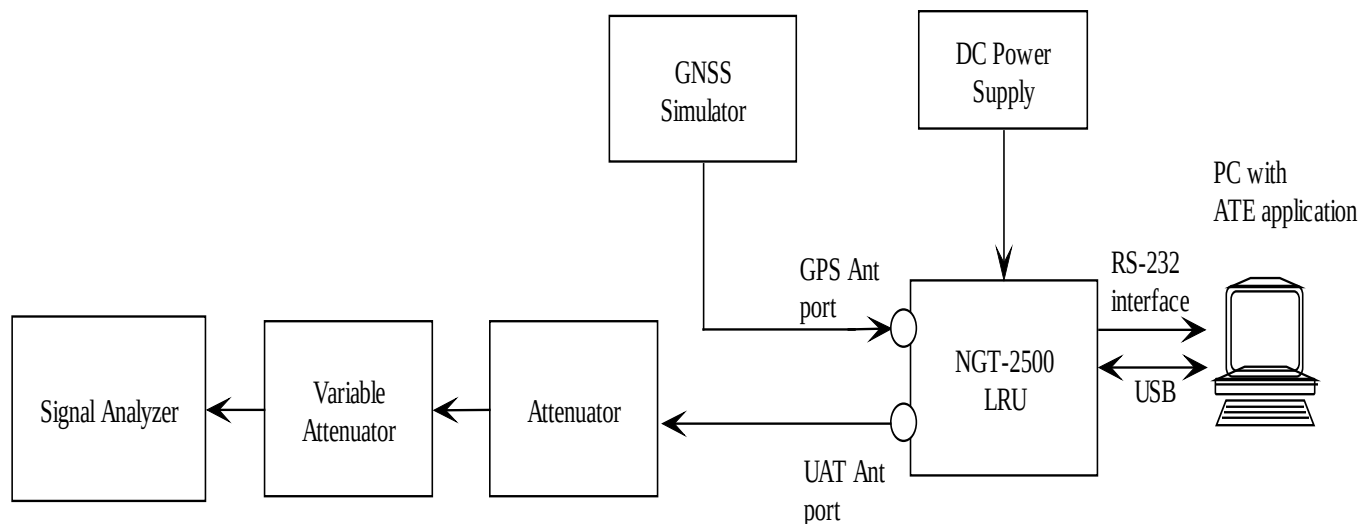
#### 9.2.1.1 Modulation Characteristics Test Equipment Required

**Table 9-5: Modulation Characteristics Test Equipment Required**

| Equipment/Application               | Manufacturer       | Model         |
|-------------------------------------|--------------------|---------------|
| NGT-2500 LRU                        | ACSS               | 9022500-10000 |
| Attenuator (or Equivalent)          | Mini Circuits      | BW-S20W20+    |
| Variable Attenuator (or Equivalent) | Fairview Microwave | SA35110       |
| Signal Analyzer                     | Agilent            | N9020A        |
| GNSS Simulator                      | Accord             | ACC_SIM_04    |
| DC Power Supply                     | Aplab              | L6403         |
| ATE Application                     | Accord             | ATE-APP-2.20  |

*Comment: Equivalent equipment may be used.*

#### 9.2.1.2 Modulation Characteristics Test Setup



**Figure 9-3: Modulation Characteristics Test Setup for UAT Transmission**

|                                |                                               |               |
|--------------------------------|-----------------------------------------------|---------------|
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### 9.2.1.3 Modulation Characteristics Test Procedure

1. Connect the equipment as shown in Figure 9-3
2. Adjust the variable attenuator such that 978MHz signal power level at the input of Signal Analyzer is  $-40 \pm 1\text{dBm}$  (Total attenuation required between UAT antenna port of UUT and Signal Analyzer input: 87dB approx.)
3. Configure the Signal Analyzer as per the settings given in Table 9-6
4. Configure the NGT-2500 unit to transmit one long message per second with payload data containing alternate one's and zero's using ATE application and control panel.
5. Record the frequency deviation values for bit '1' and bit '0' on Trace-1 and collect the screen shots
6. Record the carrier offset value and frequency deviation displayed on Trace-4 and collect the screen shot
7. Override the NGT-2500 to transmit long messages with pseudo-random payload data
8. Collect the screen shot of eye diagram on Trace-3

**Table 9-6: Signal Analyzer settings for carrier-offset measurement for UAT transmission**

| Parameter Item/Function                                        | Parameter Setting Value    |
|----------------------------------------------------------------|----------------------------|
| Instrument Mode                                                | Digital Demodulation       |
| Instrument Mode / demodulation setup / demodulation format     | 2-FSK                      |
| Instrument Mode / demodulation setup / symbol rate             | 1.041667 Mbps              |
| Instrument Mode / demodulation setup / result [message] length | 420 symbols                |
| Instrument Mode / demodulation setup / measurement filter      | off                        |
| Instrument Mode / demodulation setup / reference filter        | raised cosine              |
| Instrument Mode / demodulation setup / [filter] alpha          | 0.5                        |
| Instrument Mode / demodulation setup / normalize               | off                        |
| Frequency / center frequency                                   | 978 MHz                    |
| Frequency / frequency span                                     | 3.255 MHz                  |
| Range / channel 1 [signal] range                               | -40dBm                     |
| Time / result [message] length                                 | 420 symbols                |
| Time / points/symbol                                           | 4                          |
| Average / average                                              | on                         |
| Average / number of averages                                   | 10                         |
| Average / average type                                         | rms exponential            |
| Trigger / trigger type                                         | External (Negative)        |
| Trace 1 - Measurement Data                                     | FSK measured time          |
| Trace 1 - Data Format                                          | part real (I)              |
| Trace 1 - RefLvl/Scale / Y per division                        | 78.125 kHz                 |
| Trace 3 - Measurement Data                                     | FSK measure                |
| Trace 3 - Data Format                                          | eye diagram                |
| Trace 3 - Data Format / more format setup / eye length         | 1                          |
| Trace 3 - RefLvl/Scale / Y per division                        | 70 kHz                     |
| Trace 4 - Measurement Data                                     | symbol table/error summary |

### 9.2.1.4 Modulation Characteristics Test Results

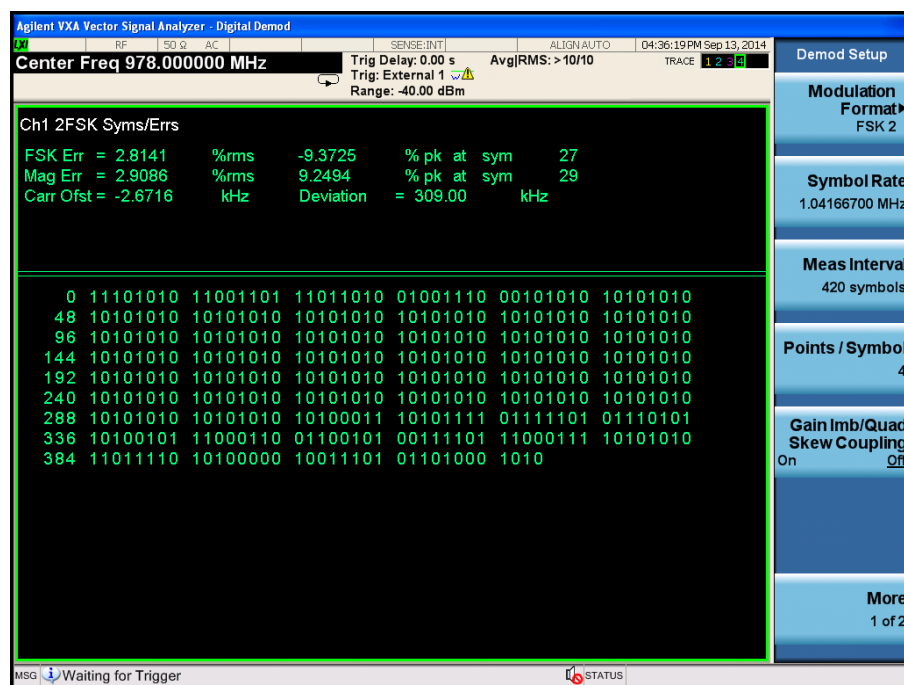
The measured modulation related parameters are mentioned in Table 9-7

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**Table 9-7: NGT-2500 Modulation related parameter measurement**

| NGT-2500 Modulation Characteristics of UAT Transmission |                  | Limits           |
|---------------------------------------------------------|------------------|------------------|
| Measurement                                             | UAT antenna port |                  |
| Carrier Offset                                          | -2.6716 kHz      | ±19.56 kHz       |
| Frequency Deviation                                     | 309 kHz          | Minimum 280 kHz  |
| Frequency Deviation for bit '1'                         | +307.0813 kHz    | Minimum +280 kHz |
| Frequency Deviation for bit '0'                         | -308.9458 kHz    | Maximum -280 kHz |
| Minimum Horizontal Eye Opening                          | 0.86 us          | Minimum 0.624 us |
| Minimum Vertical Eye Opening                            | 580 kHz          | Minimum 560 kHz  |



**Figure 9-4: Carrier offset measurement of UAT transmission**

|                                |                                               |               |
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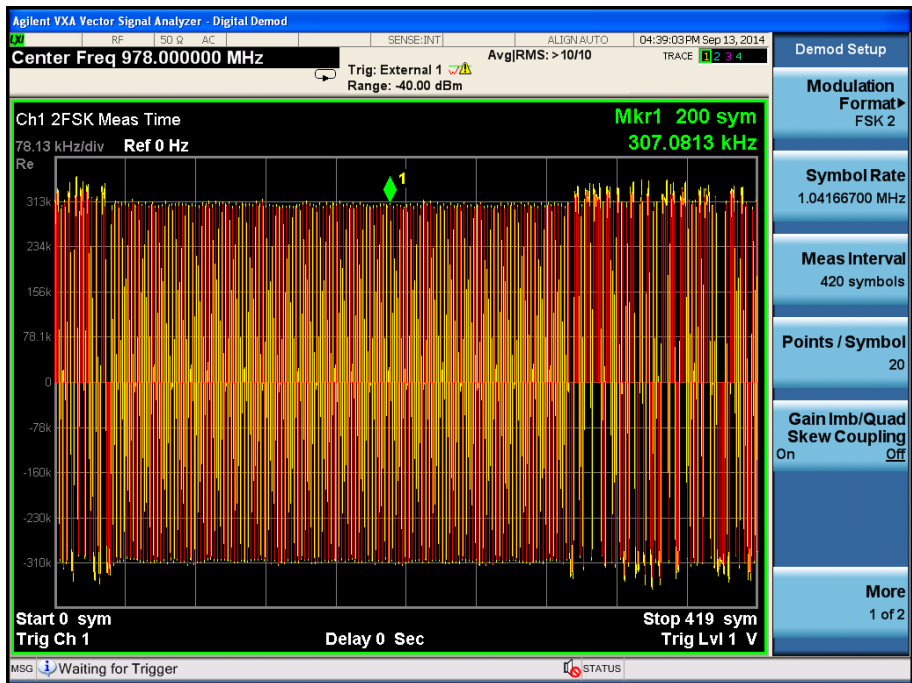


Figure 9-5: Frequency deviation for bit '1'

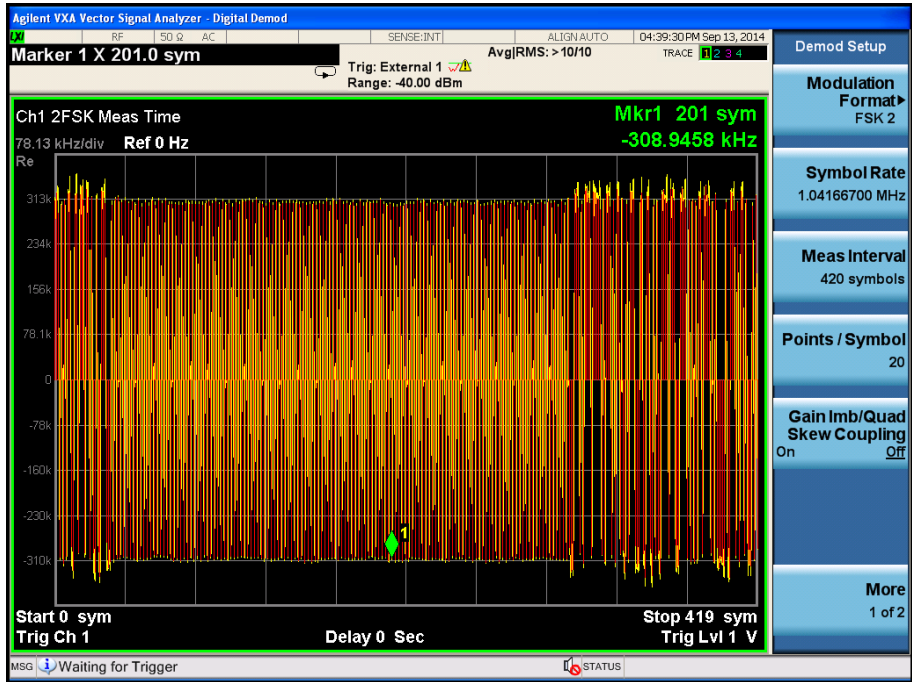


Figure 9-6: Frequency deviation for bit '0'

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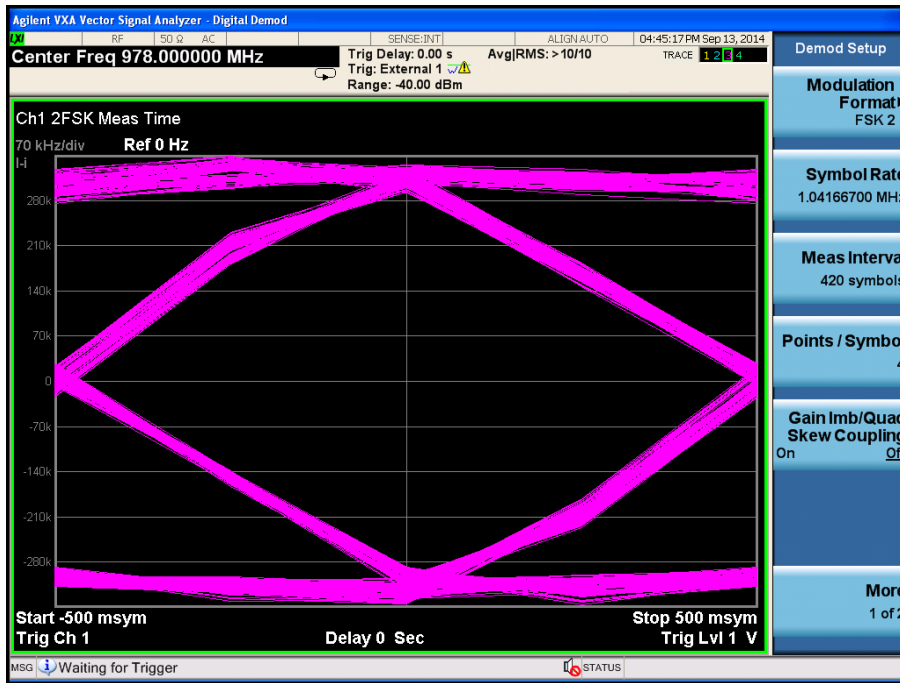


Figure 9-7: Eye diagram of UAT transmission

## 9.2.2 Mode A Interrogation

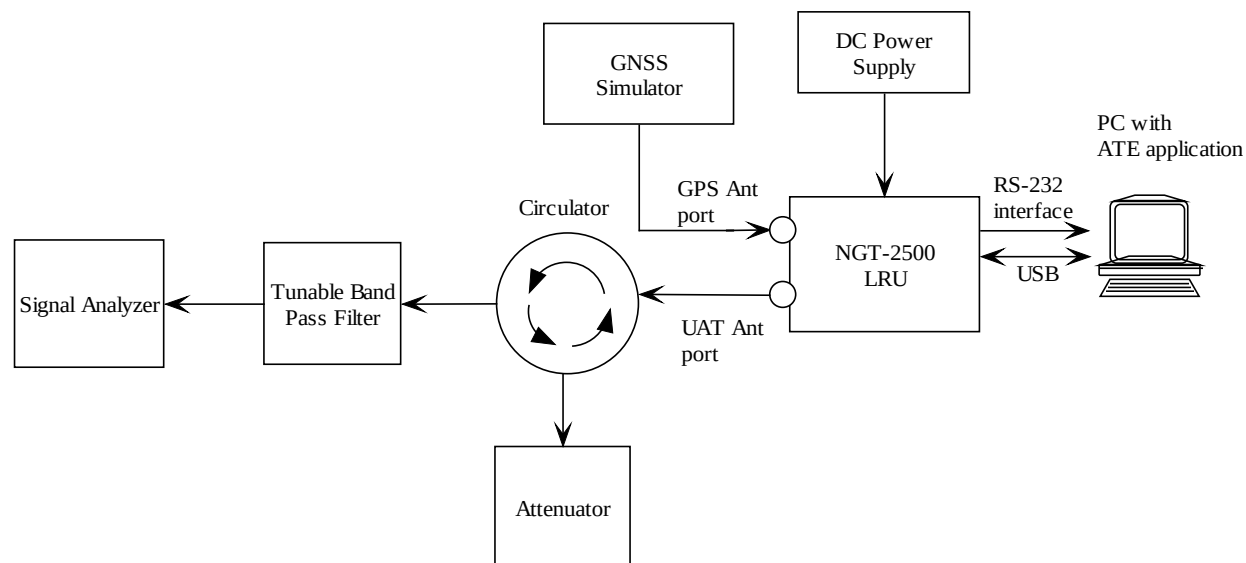
Table 9-8: Modulation Characteristics Test Equipment Required

| Equipment/Application                       | Manufacturer                               | Model         |
|---------------------------------------------|--------------------------------------------|---------------|
| NGT-2500 LRU                                | ACSS                                       | 9022500-10000 |
| Circulator                                  | Renaissance Communications Private Limited | A2NN          |
| Attenuator (or Equivalent)                  | Mini Circuits                              | BW-S20W20+    |
| Tunable Band Pass Filter (Tuned to 1030MHz) | Telonic Berkeley Inc.                      | TTF 1000      |
| Signal Analyzer                             | Agilent                                    | N9020A        |
| GNSS Simulator                              | Accord                                     | ACC_SIM_04    |
| DC Power Supply                             | Aplab                                      | L6403         |
| ATE Application                             | Accord                                     | ATE-APP-2.20  |

Comment: Equivalent equipment may be used.

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### 9.2.2.1 Modulation Characteristics Test Setup



**Figure 9-8: Modulation Characteristics Test Setup for Mode A Interrogation**

### 9.2.2.2 Modulation Characteristics Test Procedure

1. Connect the equipment as shown in Figure 9-8 above.
2. Configure the Signal Analyzer as per below settings
  - Center frequency: 1030 MHz
  - Span: 0 Hz
  - Resolution bandwidth: 8 MHz
  - Video bandwidth: 50 MHz
  - Sweep time: 1 us
  - Trigger type: Video
  - Trigger delay: -500 ns
  - Amplitude/ mode: Linear
  - Reference level offset: Total attenuation between the unit and Signal Analyzer
3. Configure the NGT-2500 unit to transmit one long message per second with valid payload data using ATE application and control panel.
4. Adjust the trigger delay and measure the following parameters of P1 and P3 pulses
  - Rise time
  - Fall time
  - Pulse width
5. Change the sweep time to 10us and trigger delay to -1 us. Measure the spacing between P1 pulse and P3 pulse.

### 9.2.2.3 Modulation Characteristics Test Results

The measured modulation related parameters are mentioned in Table 9-9

|                                |                                               |               |
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**Table 9-9: NGT-2500 Modulation related parameter measurement**

| NGT-2500 Modulation Characteristics of Mode A Interrogation |                  | Limit              |
|-------------------------------------------------------------|------------------|--------------------|
| Measurement                                                 | UAT antenna port |                    |
| Rise time of P1 pulse                                       | 88.8 ns          | Maximum 100 ns     |
| Rise time of P3 pulse                                       | 79.8 ns          | Maximum 100 ns     |
| Fall time of P1 pulse                                       | 87.7 ns          | Maximum 200 ns     |
| Fall time of P3 pulse                                       | 126.7 ns         | Maximum 200 ns     |
| Pulse width of P1 pulse                                     | 780 ns           | 800 ns $\pm$ 50 ns |
| Pulse width of P3 pulse                                     | 790.5 ns         | 800 ns $\pm$ 50 ns |
| Pulse spacing between P1 pulse and P3 pulse                 | 8 us             | 8.0 $\pm$ 0.1 us   |

- Rise time measurement:**

The rise time was measured using 8MHz resolution bandwidth. Considering the rise time of a cascaded network, the measured rise time can be related to the rise time of the pulse and rise time of Signal Analyzer as,

$$\text{Measured rise time} = \sqrt{(\text{Rise time of the pulse})^2 + (\text{Rise time of Signal Analyzer})^2}$$

Measured rise time for P1 pulse: 99 ns

Rise time introduced by signal Analyzer: 43.75 ns

$$\text{Rise time of P1 pulse} = \sqrt{(\text{Measured rise time})^2 - (\text{Rise time of Signal Analyzer})^2}$$

$$\text{Rise time of P1 pulse} = \sqrt{99^2 - 43.75^2}$$

$$\text{Rise time of P1 pulse} = 88.8 \text{ ns}$$

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**Figure 9-9: Rise time measurement of P1 pulse**

Measured rise time for P3 pulse: 91 ns  
Rise time introduced by signal Analyzer: 43.75 ns  
Rise time of P3 pulse =  $\sqrt{((\text{Measured rise time})^2 - (\text{Rise time of Signal Analyzer})^2)}$   
Rise time of P1 pulse =  $\sqrt{(91^2 - 43.75^2)}$   
Rise time of P1 pulse = 79.8 ns

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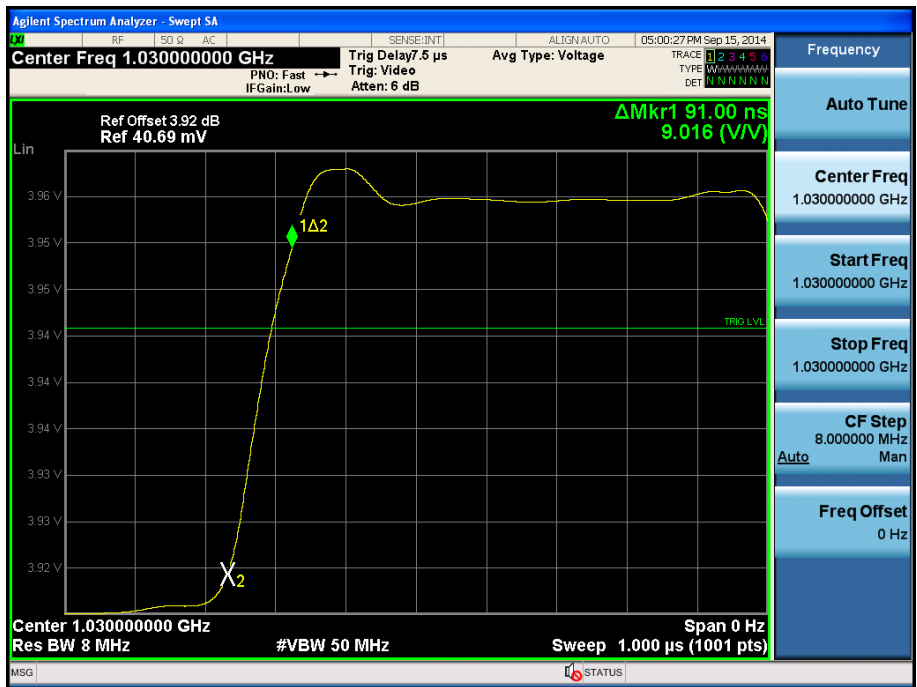


Figure 9-10: Rise time measurement of P3 pulse

- Fall time measurement:**

The fall time was measured using 8MHz resolution bandwidth. Considering the fall time of a cascaded network, the measured fall time can be related to the fall time of the pulse and fall time of Signal Analyzer as,

$$\text{Measured fall time} = \sqrt{(\text{Fall time of the pulse})^2 + (\text{Fall time of Signal Analyzer})^2}$$

Measured fall time for P1 pulse: 98 ns

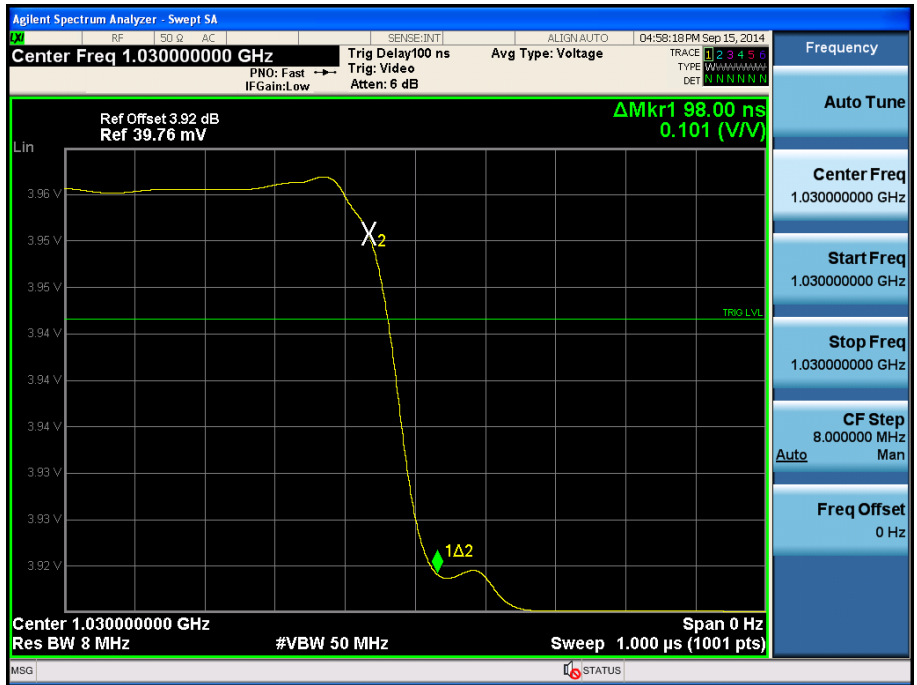
Fall time introduced by signal Analyzer: 43.75 ns

$$\text{Fall time of P1 pulse} = \sqrt{(\text{Measured fall time})^2 - (\text{Fall time of Signal Analyzer})^2}$$

$$\text{Fall time of P1 pulse} = \sqrt{(99^2 - 43.75^2)}$$

$$\text{Fall time of P1 pulse} = 87.7 \text{ ns}$$

|                                |                                               |               |
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**Figure 9-11: Fall time measurement of P1 pulse**

Measured fall time for P3 pulse: 134 ns  
 Fall time introduced by signal Analyzer: 43.75 ns  
 $\text{Fall time of P3 pulse} = \sqrt{((\text{Measured fall time})^2 - (\text{Fall time of Signal Analyzer})^2)}$   
 $\text{Fall time of P3 pulse} = \sqrt{(134^2 - 43.75^2)}$   
 Fall time of P3 pulse = 126.7 ns



Figure 9-12: Fall time measurement of P3 pulse

- Pulse width measurement

Measured pulse width of P1 pulse: 780 ns

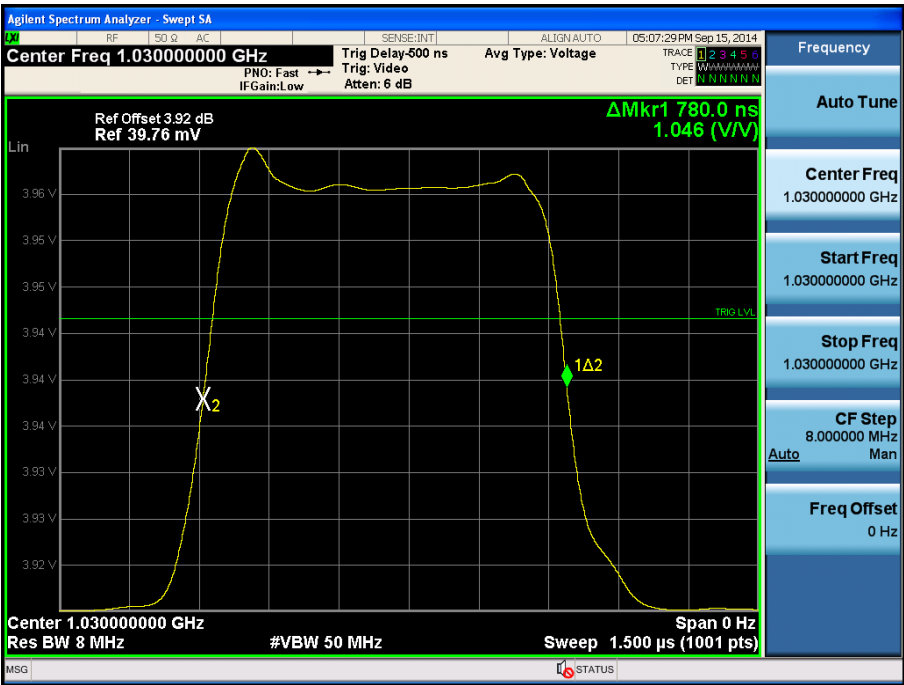


Figure 9-13: Pulse width measurement of P1 pulse

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Measured pulse width of P3 pulse: 790.5 ns

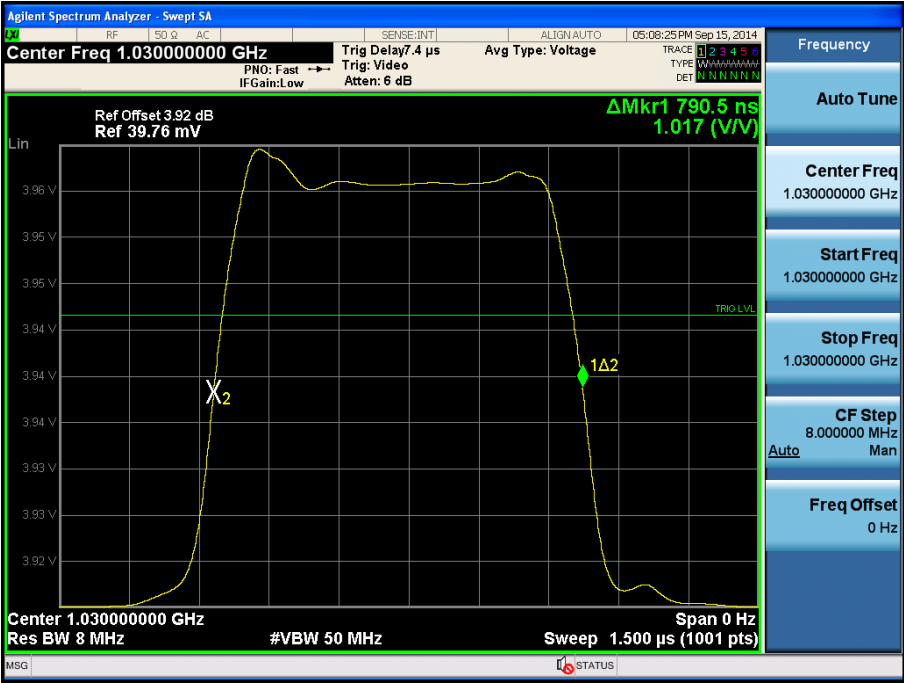


Figure 9-14: Pulse width measurement of P3 pulse

- Pulse spacing**

Measured pulse spacing between P1 pulse and P3 pulse: 8 us

|                                |                                               |               |
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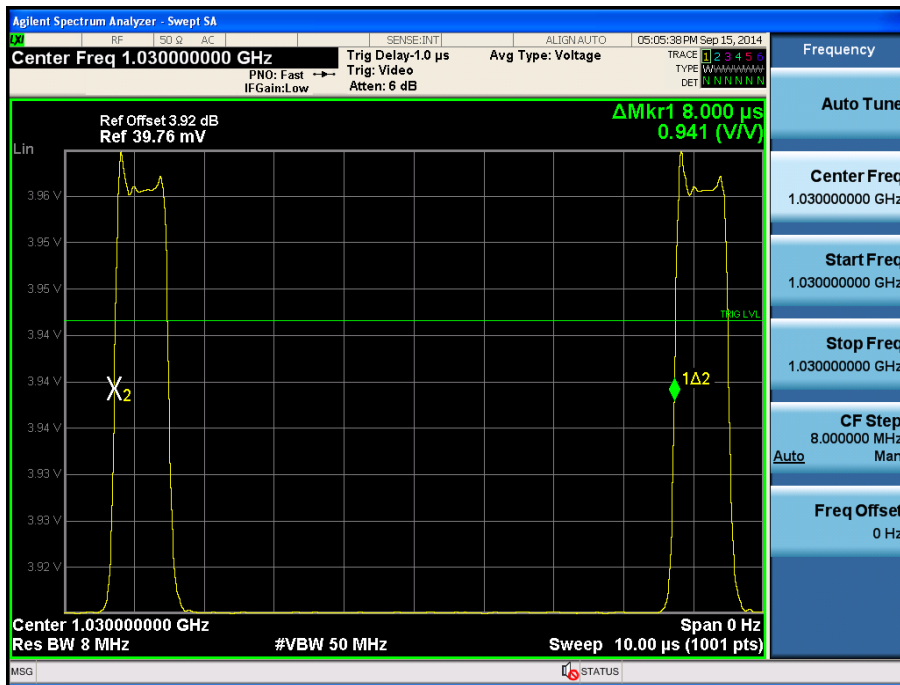


Figure 9-15: Pulse spacing measurement between P1 pulse and P3 pulse

### 9.3 Occupied Bandwidth

47CFR Reference:

2.1049, Occupied Bandwidth

87.135, Bandwidth of Emission

Occupied bandwidth is defined in 47CFR2.1049 as “the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.”

#### 9.3.1 UAT Transmission

##### 9.3.1.1 Occupied Bandwidth Test Equipment Required

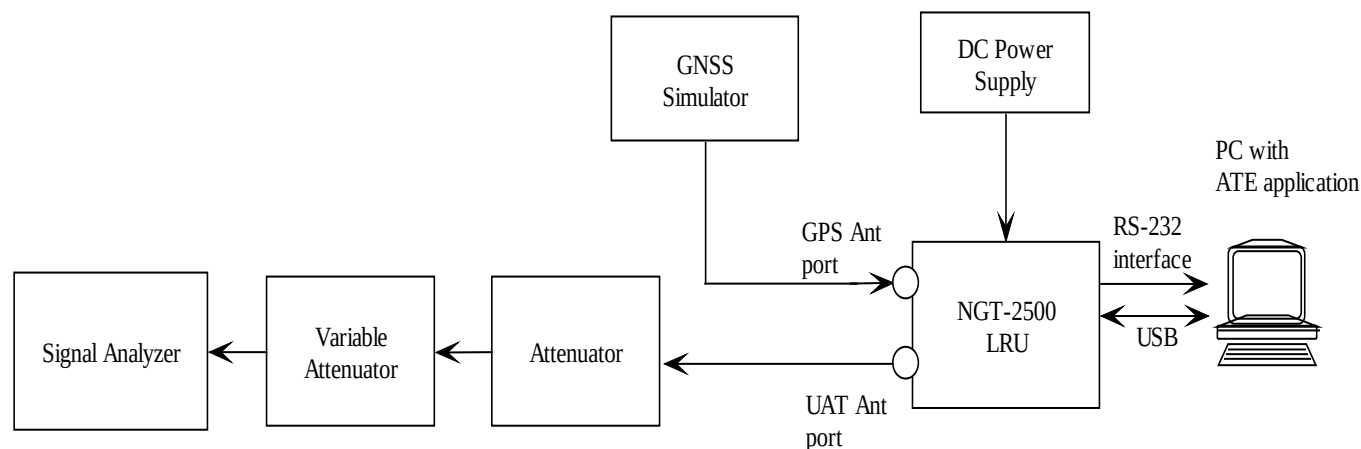
Table 9-10: Occupied Bandwidth Test Equipment Required

| Equipment/Application               | Manufacturer       | Model         |
|-------------------------------------|--------------------|---------------|
| NGT-2500 LRU                        | ACSS               | 9022500-10000 |
| Attenuator (or Equivalent)          | Mini Circuits      | BW-S20W20+    |
| Variable Attenuator (or Equivalent) | Fairview Microwave | SA35110       |
| Signal Analyzer                     | Agilent            | N9020A        |
| GNSS Simulator                      | Accord             | ACC_SIM_04    |
| DC Power Supply                     | Aplab              | L6403         |
| ATE Application                     | Accord             | ATE-APP-2.20  |

Comment: Equivalent equipment may be used.

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### 9.3.1.2 Occupied Bandwidth Test Setup



**Figure 9-16: Occupied Bandwidth Test Setup for UAT Transmission**

### 9.3.1.3 Occupied Bandwidth Test Procedure

1. Connect the equipment as shown in Figure 9-16 above.
2. Adjust the variable attenuator such that 978MHz signal power level at the input of Signal Analyzer is  $-6 \pm 1$  dBm (Total attenuation required between UAT antenna port of UUT and Signal Analyzer input: 53 dB approx.)
3. Configure the Signal Analyzer as per below settings
  - Measurement mode: Occupied bandwidth measurement
  - Center frequency: 978 MHz
  - Span: 7 MHz
  - Resolution bandwidth: 62 kHz
  - Video bandwidth: 620 kHz
  - Sweep time: Auto
  - Trace/Max hold: ON
  - Reference level offset: Total attenuation between the unit and Signal Analyzer
  - Reference level: +55 dBm
4. Configure the NGT-2500 unit to transmit one long message per second with valid payload data using ATE application and control panel.
5. Allow the spectrum to fill up completely
6. Record the displayed occupied bandwidth value

### 9.3.1.4 Occupied Bandwidth Test Results

Measured occupied bandwidth is mentioned in Table 9-11.

|                                |                                               |               |
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**Table 9-11 Occupied Bandwidth**

| NGT-2500 Occupied Bandwidth of UAT Transmission |                  | Limit   |
|-------------------------------------------------|------------------|---------|
| Measurement                                     | UAT antenna port |         |
| Occupied bandwidth (MHz)                        | 1.1151 MHz       | 1.3 MHz |

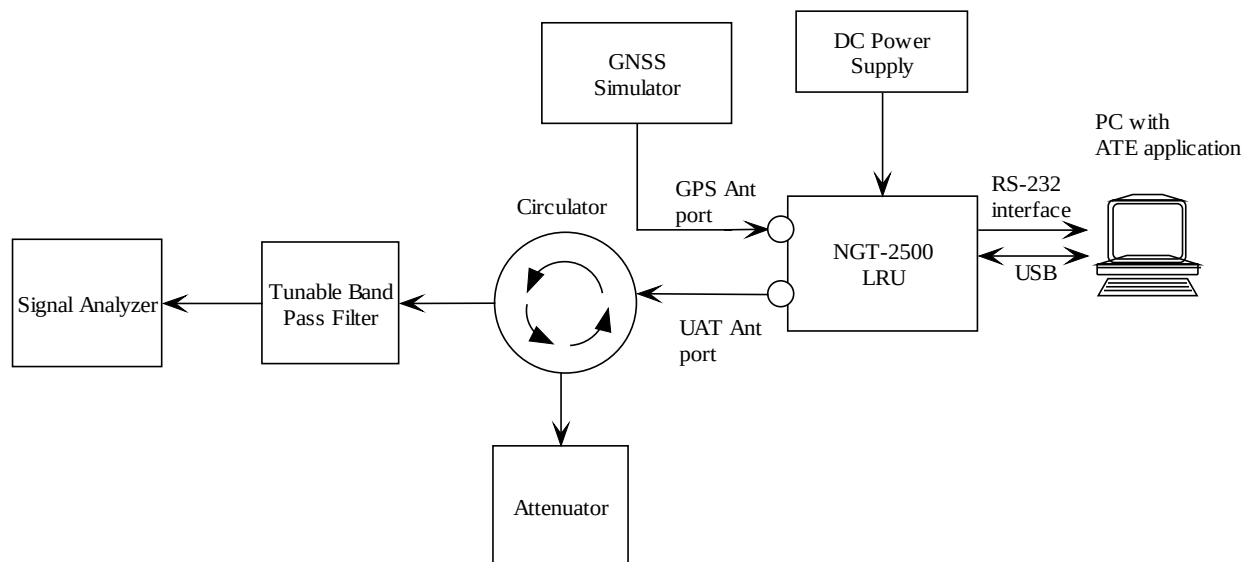
### 9.3.2 Mode A Interrogation

**Table 9-12: Occupied Bandwidth Test Equipment Required**

| Equipment/Application                       | Manufacturer                               | Model         |
|---------------------------------------------|--------------------------------------------|---------------|
| NGT-2500 LRU                                | ACSS                                       | 9022500-10000 |
| Circulator                                  | Renaissance Communications Private Limited | A2NN          |
| Attenuator (or Equivalent)                  | Mini Circuits                              | BW-S20W20+    |
| Tunable Band Pass Filter (Tuned to 1030MHz) | Telonic Berkeley Inc.                      | TTF 1000      |
| Signal Analyzer                             | Agilent                                    | N9020A        |
| GNSS Simulator                              | Accord                                     | ACC_SIM_04    |
| DC Power Supply                             | Aplab                                      | L6403         |
| ATE Application                             | Accord                                     | ATE-APP-2.20  |

*Comment: Equivalent equipment may be used.*

#### 9.3.2.1 Occupied Bandwidth Test Setup



**Figure 9-17: Occupied Bandwidth Test Setup for Mode A Interrogation**

|                                |                                               |               |
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### 9.3.2.2 Occupied Bandwidth Test Procedure

1. Connect the equipment as shown in Figure 9-17 above.
2. Configure the Signal Analyzer as per below settings
  - Measurement mode: Occupied bandwidth measurement
  - Center frequency: 1030 MHz
  - Span: 8 MHz
  - Resolution bandwidth: 2 MHz
  - Video bandwidth: 8 MHz
  - Sweep time: 1 second
  - Trace/Max hold: ON
  - Reference level offset: Total attenuation between the unit and Signal Analyzer
  - Reference level: 0 dBm
3. Configure the NGT-2500 unit to transmit one long message per second with valid payload data using ATE application and control panel.
4. Allow the spectrum to fill up completely
5. Record the displayed occupied bandwidth value

### 9.3.2.3 Occupied Bandwidth Test Results

Measured occupied bandwidth is mentioned in Table 9-13

**Table 9-13: Occupied Bandwidth**

| NGT-2500 Occupied Bandwidth of Mode A Interrogation |                  | Limit |
|-----------------------------------------------------|------------------|-------|
| Measurement                                         | UAT antenna port |       |
| Occupied bandwidth (MHz)                            | 7.6966 MHz       | 8 MHz |

## 9.4 Spurious Emissions at Antenna Terminals

47CFR Reference:

2.1051, Spurious Emissions at Antenna Terminals

87.139, Emission Limitations

47CFR2.1051 states that the radio frequency voltages or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.

47CFR2.1051 says that curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in Sec 2.1049 (Occupied Bandwidth) as appropriate.

### 9.4.1 UAT Transmission

#### 9.4.1.1 Spurious Emissions at Antenna Terminals Test Equipment Required

**Table 9-14: Spurious Emissions at Antenna Terminals Test Equipment Required**

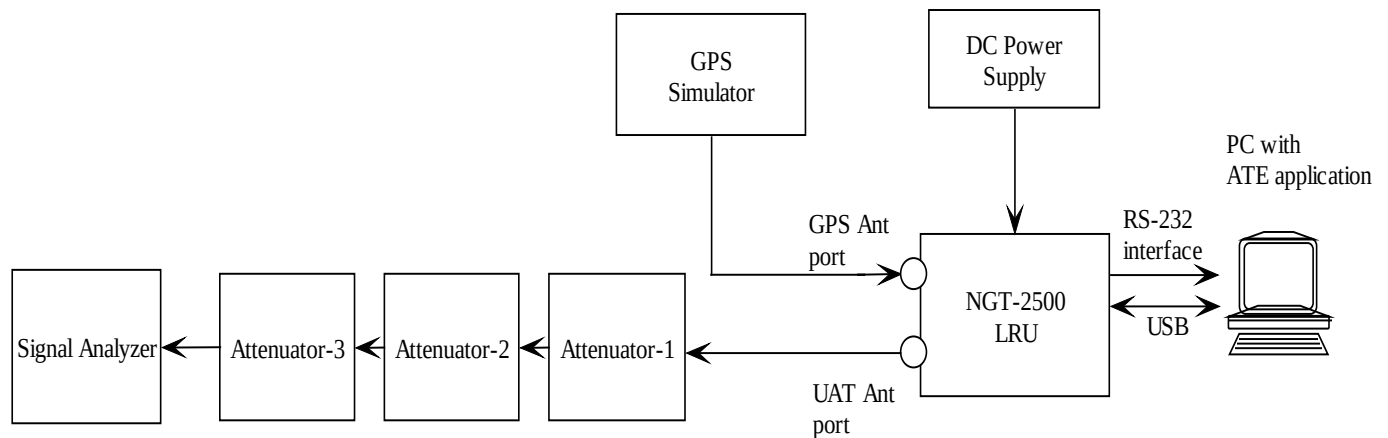
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| Equipment/Application        | Manufacturer          | Model              |
|------------------------------|-----------------------|--------------------|
| NGT-2500 LRU                 | ACSS                  | 9022500-10000      |
| Attenuator-1 (Or Equivalent) | Narda                 | 766-10             |
| Attenuator-2 (Or Equivalent) | Emerson Network Power | ATT-488M-40-SMA-07 |
| Attenuator-3 (Equivalent)    | Arra Inc              | Arra Inc           |
| Spectrum Analyzer            | Rohde and Schwarz     | FSV30              |
| GPS Simulator                | Spirent               | GSS6700            |
| DC Power Supply              | Agilent               | E3610A             |
| ATE Application              | Accord                | ATE-APP-2.20       |

*Comment: Equivalent equipment may be used.*

#### 9.4.1.2 Spurious Emissions at Antenna Terminals Test Setup



**Figure 9-18: Spurious Emissions at Antenna Terminals Test Setup for UAT Transmission**

#### 9.4.1.3 Spurious Emissions at Antenna Terminals Test Procedure

1. Connect the equipment as shown in Figure 9-18 above.
2. A total attenuation 53 dB approx. is provided at the output of UAT antenna port
3. Configure the NGT-2500 unit to transmit one long message per second with valid payload data using ATE application and control panel
4. Record all the spurious emissions below 2 GHz. Use 200 MHz spans and a 100 kHz resolution bandwidth on the Spectrum Analyzer
5. Record the spurious emission levels of the harmonic frequencies up to the tenth harmonic of the UAT transmission frequency (1956 MHz, 2934 MHz, 3912 MHz, 4890 MHz, 5868 MHz, 6846 MHz, 7824 MHz, 8802 MHz and 9780 MHz)
6. Measure and record Attenuator/filter/cable calibration factor for each harmonic.

#### 9.4.1.4 Spurious Emissions at Antenna Terminals Test Results

Refer to Appendix A for NGT-2500 test results for Spurious Emissions at the Antenna Terminals

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## 9.4.2 Mode A Interrogation

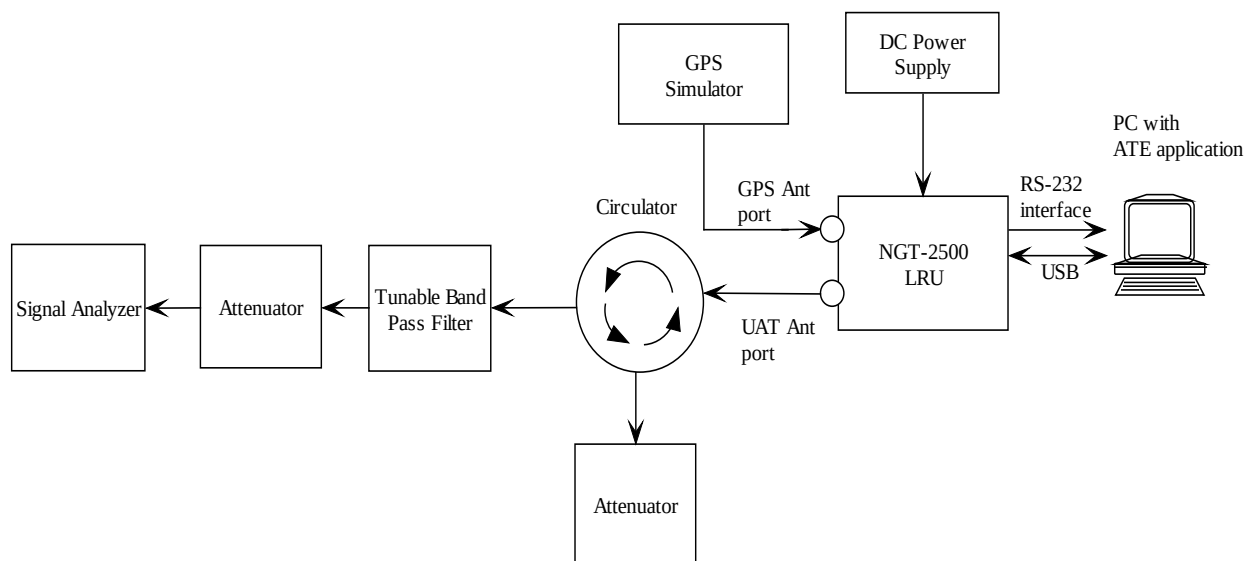
### 9.4.2.1 Spurious Emissions at Antenna Terminals Test Equipment Required

**Table 9-15: Spurious Emissions at Antenna Terminals Test Equipment Required**

| Equipment/Application                            | Manufacturer           | Model         |
|--------------------------------------------------|------------------------|---------------|
| NGT-2500 LRU                                     | ACSS                   | 9022500-10000 |
| Circulator                                       | TRAK                   | C095012/DA    |
| 50Ohm Termination                                | Mini-circuits          | ANNE-50L+     |
| Tunable Band reject Filter<br>(Tuned to 978 MHz) | Maurya microwave Corp. | 1829          |
| Attenuator (Equivalent)                          | Narda                  | 766-10        |
| Spectrum Analyzer                                | Rohde and Schwarz      | FSV30         |
| GPS Simulator                                    | Spirent                | GSS6700       |
| DC Power Supply                                  | Agilent                | E3610A        |
| ATE Application                                  | Accord                 | ATE-APP-2.20  |

*Comment: Equivalent equipment may be used.*

### 9.4.2.2 Spurious Emissions at Antenna Terminals Test Setup



**Figure 9-19: Spurious Emissions at Antenna Terminals Test Setup for Mode A Interrogation**

### 9.4.2.3 Spurious Emissions at Antenna Terminals Test Procedure

1. Connect the equipment as shown in Figure 9-19 above.
2. Configure the NGT-2500 unit to transmit one long message per second with valid payload data using ATE application and control panel
3. Record all the spurious emissions below 2 GHz. Use 200 MHz spans and a 300 kHz resolution bandwidth on the Spectrum Analyzer

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4. Record the spurious emission levels of the harmonic frequencies up to the tenth harmonic of the Mode A interrogation frequency (2060 MHz, 3090 MHz, 4120 MHz, 5150 MHz, 6180 MHz, 7210 MHz, 8240 MHz, 9270 MHz and 10300 MHz)
5. Measure and record Attenuator/filter/cable calibration factor for each harmonic.

#### 9.4.2.4 Spurious Emissions at Antenna Terminals Test Results

Refer to Appendix A for NGT-2500 test results for Spurious Emissions at the Antenna Terminals

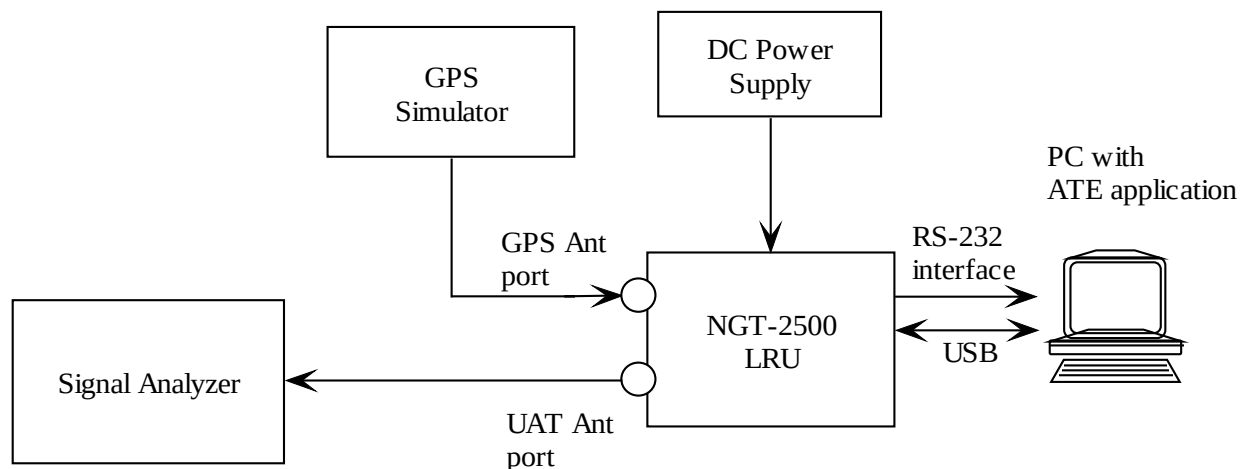
### 9.5 Spurious Emissions at Antenna Terminals Local Oscillator Leakage (907.4 MHz)

#### 9.5.1 Spurious Emissions at Antenna Terminals Local Oscillator Leakage (907.4 MHz) Test Equipment Required

**Table 9-16: Spurious Emissions at Antenna Terminals Local Oscillator Leakage (907.4 MHz) Test Equipment Required**

| Equipment/Application | Manufacturer | Model         |
|-----------------------|--------------|---------------|
| NGT-2500 LRU          | ACSS         | 9022500-10000 |
| Spectrum Analyzer     | Agilent      | N9020A        |
| GPS Simulator         | Spirent      | GSS6700       |
| DC Power Supply       | Agilent      | E3610A        |
| ATE Application       | Accord       | ATE-APP-2.20  |

#### 9.5.2 Spurious Emissions at Antenna Terminals Local Oscillator Leakage Test Setup



**Figure 9-20: Spurious Emissions at Antenna Terminals Local Oscillator Leakage Test Setup**

#### 9.5.3 Spurious Emissions at Antenna Terminals Local Oscillator Leakage Test Procedure

1. Connect the equipment as shown in Figure 9-20 above.
2. Configure the spectrum analyzer for a center frequency of 907.4 MHz and 1814.8 MHz, 100 kHz resolution bandwidth, and a span of 100 MHz
3. Configure the NGT-2500 to be in standby mode.

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- 4 Prior to performing the measurement, verify that the NGT-2500 is not transmitting.
- 5 Using a spectrum analyzer, measure and record the leakage of LO signal and its second harmonic out of the UAT antenna port.

#### 9.5.4 Spurious Emissions at Antenna Terminals Test Results

| LO Leakage At UAT Antenna Port                   |                      |                         |                            | Limit  |
|--------------------------------------------------|----------------------|-------------------------|----------------------------|--------|
| Frequency (MHz)                                  | Measured power (dBm) | Calibration Factor (dB) | LO leakage Corrected (dBm) |        |
| 907.4 (Fundamental)                              | -84.392              | 0.8                     | -83.592                    | -13dBm |
| 1814.8(2 <sup>nd</sup> Harmonic of LO frequency) | -79.219              | 0.8                     | -78.419                    | -13dBm |

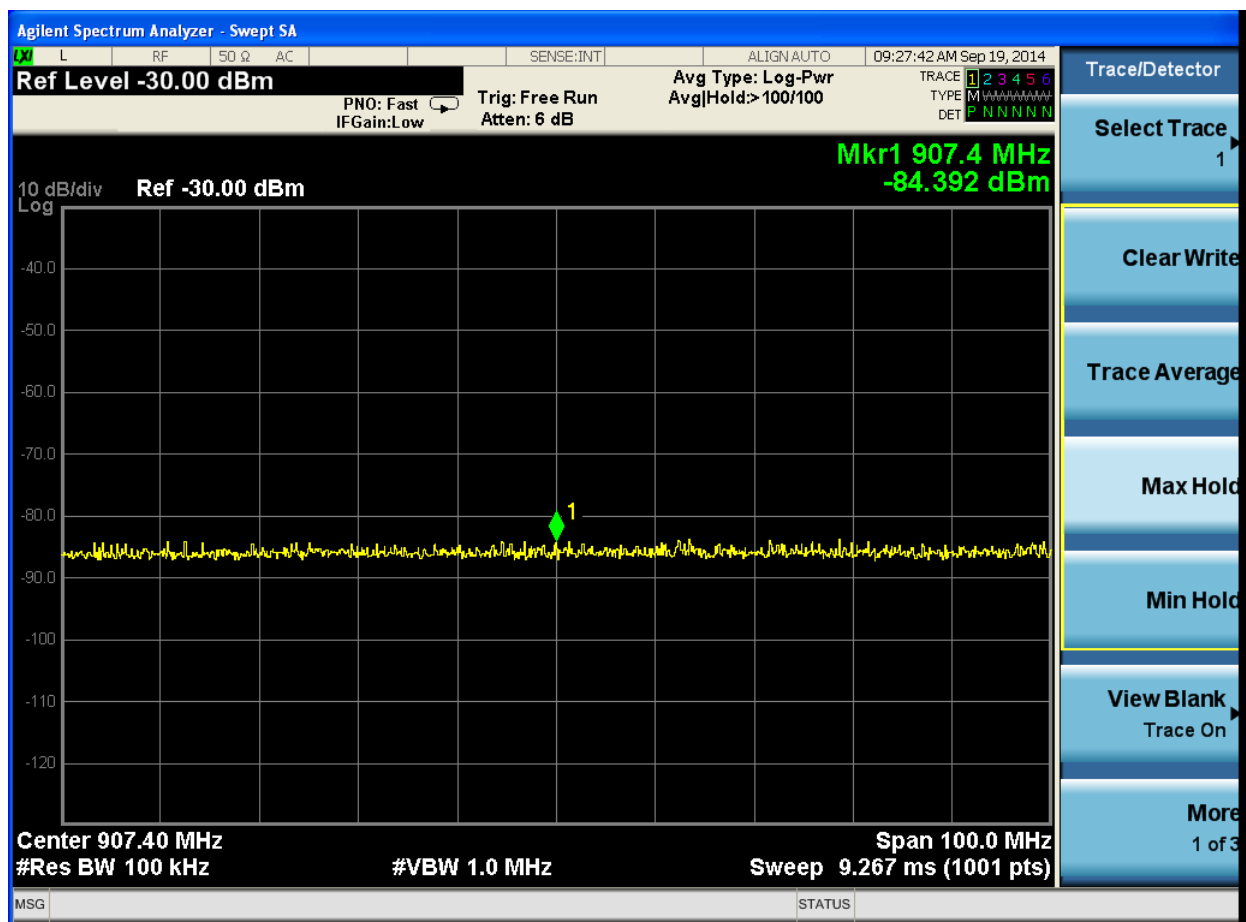


Figure 9-21: Leakage Of Fundamental LO frequency

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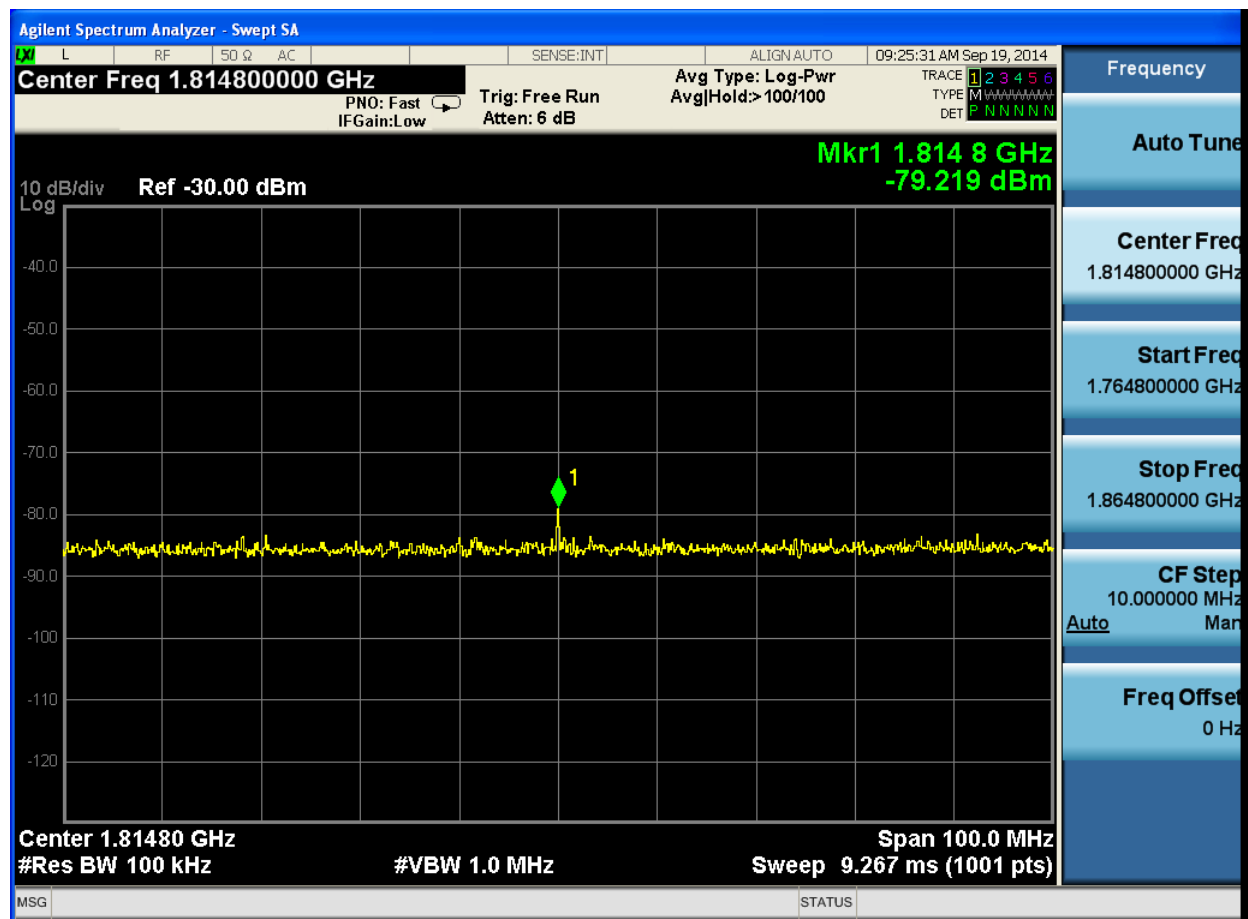


Figure 9-22: Leakage Of Second Harmonic Of LO frequency

## 9.6 Field Strength of Spurious Radiation

47CFR References:

2.1053, Field Strength of Spurious Radiation

15.109, Radiated Emission Limits

15.31, Measurement Standards

15.33, Frequency Range of Radiated Measurements

87.139, Emission Limitations

### 9.6.1 Field Strength of Spurious Radiation Test Equipment Required

Table 9-17: Field Strength of Spurious Radiation Test Equipment Required

| Equipment/Application        | Manufacturer             | Model              |
|------------------------------|--------------------------|--------------------|
| NGT-2500 LRU                 | ACSS                     | 9022500-10000      |
| Attenuator-1<br>(Equivalent) | Narda                    | 766-10             |
| Attenuator-2<br>(Equivalent) | Emerson<br>Network Power | ATT-488M-40-SMA-07 |

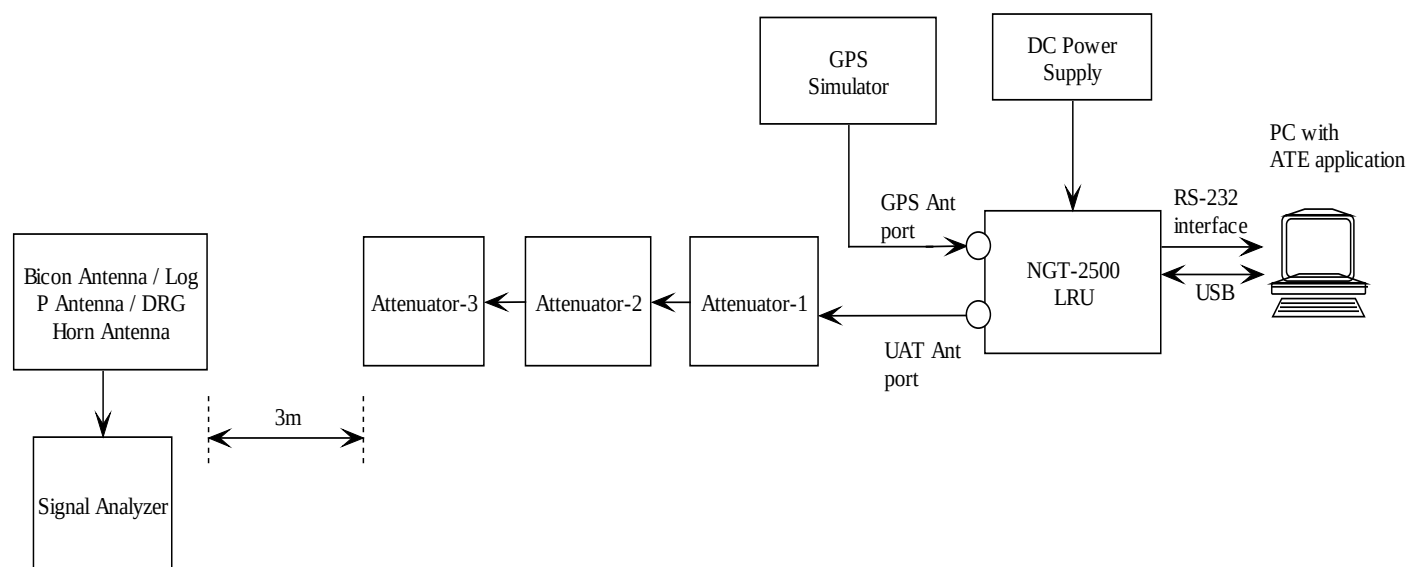
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| Equipment/Application        | Manufacturer      | Model        |
|------------------------------|-------------------|--------------|
| Attenuator-3<br>(Equivalent) | Arra Inc          | Arra Inc     |
| Bicon Antenna                | Schwarzbeck       | BBA9106      |
| Log P Antenna                | Schwarzbeck       | UHAL09107    |
| DRG Horn Antenna             | AH Systems        | SAS-571      |
| GPS Simulator                | Spirent           | GSS6700      |
| DC Power Supply              | Agilent           | E3610A       |
| Spectrum Analyzer            | Rohde and Schwarz | FSV30        |
| ATE Application              | Accord            | ATE-APP-2.20 |

*Comment: Equivalent equipment may be used.*

## 9.6.2 Field Strength of Spurious Radiation Test Setup



**Figure 9-23: Field Strength of Spurious Radiation Test Setup**

## 9.6.3 Field Strength of Spurious Radiation Test Procedure

1. Connect the equipment as shown in Figure 9-23 above.
2. Configure the NGT-2500 unit to transmit one long message per second with valid payload data using ATE application and control panel. Measure all spurious emissions till 10<sup>th</sup> harmonic of 1030 MHz. Dwell at harmonics of 978 MHz and 1030 MHz.
3. Configure the NGT-2500 unit to disable UAT transmissions and measure the unintentional radiations till 30 GHz.
4. Calculate the field strength at 3 m using the recorded power measurement, antenna factor and cable loss for each frequency.

## 9.6.4 Field Strength of Spurious Radiation Test Results

Refer to Appendix A for NGT-2500 test results for Field Strength of Spurious Radiation test results

|                     |                                                                                                               |         |
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## 9.7 Frequency Stability

### 9.7.1 Frequency Stability (Temperature Variation)

47CFR Reference:  
2.1055, Frequency Stability  
15.31, Measurement Standards  
87.133, Frequency Stability

#### 9.7.1.1 UAT Transmission

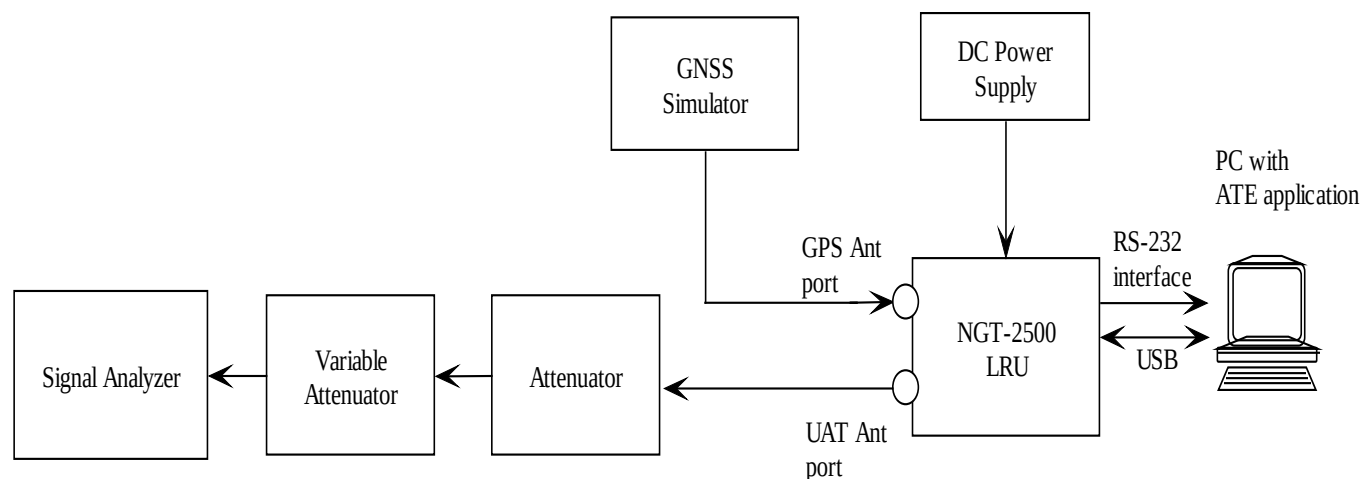
##### 9.7.1.1.1 Frequency Stability (Temperature Variation) Test Equipment Required

**Table 9-18: Frequency Stability (Temperature Variation) Test Equipment Required**

| Equipment/Application               | Manufacturer       | Model         |
|-------------------------------------|--------------------|---------------|
| NGT-2500 LRU                        | ACSS               | 9022500-10000 |
| Attenuator (or Equivalent)          | Mini Circuits      | BW-S20W20+    |
| Variable Attenuator (or Equivalent) | Fairview Microwave | SA35110       |
| Signal Analyzer                     | Agilent            | N9020A        |
| GNSS Simulator                      | Accord             | ACC_SIM_04    |
| DC Power Supply                     | Aplab              | L6403         |
| ATE Application                     | Accord             | ATE-APP-2.20  |

*Comment: Equivalent equipment may be used.*

##### 9.7.1.1.2 Frequency Stability (Temperature Variation) Test Setup



**Figure 9-24: Frequency Stability (Temperature Variation) Test Setup for UAT Transmission**

##### 9.7.1.1.3 Frequency Stability (Temperature Variation) Test Procedure

1. Connect the equipment as shown in Figure 9-24 above.

|                                |                                               |               |
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2. Configure the NGT-2500 unit to transmit one long message per second with valid payload data using ATE application and control panel
3. Set the temperature chamber to -5°C and allow the transmitter (non-operating) temperature to stabilize.
4. Adjust the variable attenuator such that 978 MHz signal power level at the input of Signal Analyzer is  $-40 \pm 1$  dBm (Total attenuation required between UAT antenna port of UUT and Signal Analyzer input: 87 dB approx.)
5. Configure the Signal Analyzer as per the settings given in Table 9-6
6. Apply power to the unit and record the carrier offset value on Trace-4
7. Adjust the variable attenuator such that 978 MHz signal power level at the input of Signal Analyzer is  $-6 \pm 1$  dBm (Total attenuation required between UAT antenna port of UUT and Signal Analyzer input: 53 dB approx.)
8. Configure the Signal Analyzer as per below settings
  - Center frequency: 978 MHz
  - Span: 0 Hz
  - Resolution bandwidth: 2 MHz
  - Video bandwidth: 6 MHz
  - Sweep time: 1 ms
  - Trigger type: Video
  - Trigger delay: -250 us
  - Trace/Max hold: ON
  - Continuous peak search: ON
  - Reference level offset: Total attenuation between the unit and Signal Analyzer
  - Reference level: +55 dBm
9. Record peak output power for UAT transmission
10. Repeat steps 4 through 9 at -45°C, -40°C, -30°C, -20°C, -10°C, 0°C, +10°C, +20°C, +30°C, +40°C, +50°C, +60°C, and +70°C.
11. To calculate UAT transmission frequency, add the measured carrier offset value to 978MHz.

#### 9.7.1.1.4 Frequency Stability (Temperature Variation) Test Results

The transmission frequency offset and the peak power output values recorded during the temperature variation test are tabulated in Table 9-19

|                                |                                               |               |
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**Table 9-19: Frequency Stability (Temperature Variation) Test Results**

| NGT-2500 UAT Transmission |                    |                          | Limits           |                   |
|---------------------------|--------------------|--------------------------|------------------|-------------------|
| Temp Deg C                | Power Output (dBm) | Measured Frequency (MHz) | Power Output     | Frequency         |
| -45                       | +47.449            | 977.9912664              | +44dBm to +48dBm | 978MHz ± 19.56kHz |
| -40                       | +47.622            | 977.9907552              | +44dBm to +48dBm | 978MHz ± 19.56kHz |
| -30                       | +47.302            | 977.9900045              | +44dBm to +48dBm | 978MHz ± 19.56kHz |
| -20                       | +47.351            | 977.9883680              | +44dBm to +48dBm | 978MHz ± 19.56kHz |
| -10                       | +47.463            | 977.9876000              | +44dBm to +48dBm | 978MHz ± 19.56kHz |
| 0                         | +47.162            | 977.9874270              | +44dBm to +48dBm | 978MHz ± 19.56kHz |
| 10                        | +47.137            | 977.9902541              | +44dBm to +48dBm | 978MHz ± 19.56kHz |
| 20                        | +46.725            | 977.9932426              | +44dBm to +48dBm | 978MHz ± 19.56kHz |
| 30                        | +46.941            | 977.9973844              | +44dBm to +48dBm | 978MHz ± 19.56kHz |
| 40                        | +46.857            | 977.9984638              | +44dBm to +48dBm | 978MHz ± 19.56kHz |
| 50                        | +46.104            | 977.9993987              | +44dBm to +48dBm | 978MHz ± 19.56kHz |
| 60                        | +47                | 977.9979162              | +44dBm to +48dBm | 978MHz ± 19.56kHz |
| 70                        | +46.418            | 977.9964435              | +44dBm to +48dBm | 978MHz ± 19.56kHz |

### 9.7.1.2 Mode A Interrogation

#### 9.7.1.2.1 Frequency Stability (Temperature Variation) Test Equipment Required

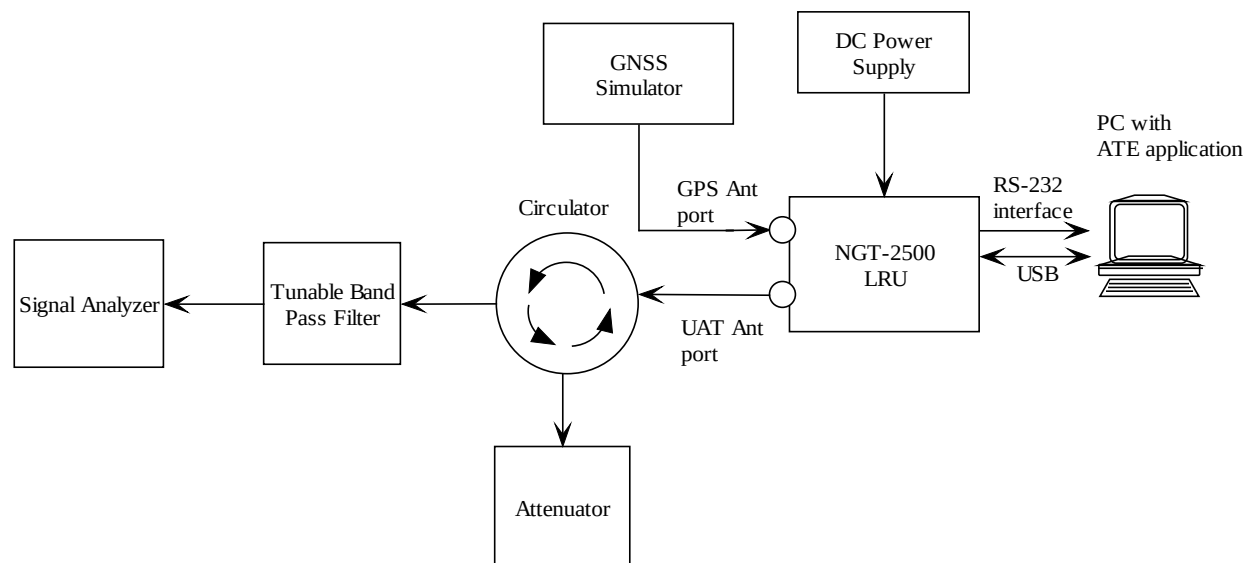
**Table 9-20: Frequency Stability (Temperature Variation) Test Equipment Required**

| Equipment/Application                       | Manufacturer                               | Model         |
|---------------------------------------------|--------------------------------------------|---------------|
| NGT-2500 LRU                                | ACSS                                       | 9022500-10000 |
| Circulator                                  | Renaissance Communications Private Limited | A2NN          |
| Attenuator (or Equivalent)                  | Mini Circuits                              | BW-S20W20+    |
| Tunable Band Pass Filter (Tuned to 1030MHz) | Telonic Berkeley Inc.                      | TTF 1000      |
| Signal Analyzer                             | Agilent                                    | N9020A        |
| GNSS Simulator                              | Accord                                     | ACC_SIM_04    |
| DC Power Supply                             | Aplab                                      | L6403         |
| ATE Application                             | Accord                                     | ATE-APP-2.20  |

*Comment: Equivalent equipment may be used.*

|                                |                                               |               |
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#### 9.7.1.2.2 Frequency Stability (Temperature Variation) Test Setup



**Figure 9-25: Frequency Stability (Temperature Variation) Test Setup for Mode A Interrogation**

#### 9.7.1.2.3 Frequency Stability (Temperature Variation) Test Procedure

1. Connect the equipment as shown in Figure 9-25 above.
2. Configure the NGT-2500 unit to transmit one long message per second with valid payload data using ATE application and control panel
3. Set the temperature chamber to -5°C and allow the transmitter (non-operating) temperature to stabilize.
4. Configure the Signal Analyzer as per below settings
  - Center frequency: 1030 MHz
  - Span: 0 Hz
  - Resolution bandwidth: 8 MHz
  - Video bandwidth: 50 MHz
  - Sweep time: 20 us
  - Trigger type: Video
  - Trigger delay: -5 us
  - Trace/Max hold: ON
  - Continuous peak search: ON
  - Reference level offset: Total attenuation between the unit and Signal Analyzer
  - Reference level: 0 dBm
5. Apply power to the unit and record peak power output value for Mode A interrogation
6. Configure the Signal Analyzer as per below settings
  - Center frequency: 1030 MHz
  - Span: 8 MHz
  - Resolution bandwidth: 2 MHz
  - Video bandwidth: 8 MHz
  - Sweep time: 1 second
  - Trace/Max hold: ON
  - Reference level offset: Total attenuation between the unit and Signal Analyzer
  - Reference level: 0 dBm

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7. Record the Mode A interrogation frequency value
8. Repeat steps 4 through 7 at -45°C, -40°C, -30°C, -20°C, -10°C, 0°C, +10°C, +20°C, +30°C, +40°C, +50°C, +60°C, and +70°C.

#### **9.7.1.2.4 Frequency Stability (Temperature Variation) Test Results**

Mode A interrogation frequency and the peak power output values recorded during the temperature variation test are tabulated in Table 9-21

|                                |                                               |               |
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**Table 9-21: Frequency Stability (Temperature Variation) Test Results**

| NGT-2500 Mode A Interrogation |                    |                          | Limits          |               |
|-------------------------------|--------------------|--------------------------|-----------------|---------------|
| Temp Deg C                    | Power Output (dBm) | Measured Frequency (MHz) | Power Output    | Frequency     |
| -45                           | -8.835             | 1030.020                 | -3dBm to -18dBm | 1030 ± 0.1MHz |
| -40                           | -9.200             | 1029.990                 | -3dBm to -18dBm | 1030 ± 0.1MHz |
| -30                           | -10.229            | 1029.995                 | -3dBm to -18dBm | 1030 ± 0.1MHz |
| -20                           | -11.346            | 1029.960                 | -3dBm to -18dBm | 1030 ± 0.1MHz |
| -10                           | -12.029            | 1030.005                 | -3dBm to -18dBm | 1030 ± 0.1MHz |
| 0                             | -12.896            | 1029.990                 | -3dBm to -18dBm | 1030 ± 0.1MHz |
| 10                            | -13.794            | 1030.025                 | -3dBm to -18dBm | 1030 ± 0.1MHz |
| 20                            | -14.505            | 1029.980                 | -3dBm to -18dBm | 1030 ± 0.1MHz |
| 30                            | -15.418            | 1029.970                 | -3dBm to -18dBm | 1030 ± 0.1MHz |
| 40                            | -16.295            | 1029.990                 | -3dBm to -18dBm | 1030 ± 0.1MHz |
| 50                            | -17.034            | 1029.990                 | -3dBm to -18dBm | 1030 ± 0.1MHz |
| 60                            | -17.520            | 1030.040                 | -3dBm to -18dBm | 1030 ± 0.1MHz |
| 70                            | -17.922            | 1029.975                 | -3dBm to -18dBm | 1030 ± 0.1MHz |

## 9.7.2 Frequency Stability (Primary Power Variation)

47CFR references:

2.1055, Frequency Stability

15.31, Measurement Standards

87.133, Frequency Stability

47CFR15.31 (e) states that measurements of the radiated signal level of the fundamental frequency component of the emission shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage.

For the 14 VDC power, 85%/115% = 11.9 VDC/16.1 VDC will be used

For the 28 VDC power, 85%/115% = 23.8 VDC/32.2 VDC will be used

### 9.7.2.1 UAT Transmission

#### 9.7.2.1.1 Frequency Stability (Primary Power Variation) Test Equipment Required

**Table 9-22: Frequency Stability (Primary Power Variation) Test Equipment Required**

| Equipment/Application      | Manufacturer  | Model         |
|----------------------------|---------------|---------------|
| NGT-2500 LRU               | ACSS          | 9022500-10000 |
| Attenuator (or Equivalent) | Mini Circuits | BW-S20W20+    |
| Variable Attenuator (or    | Fairview      | SA35110       |

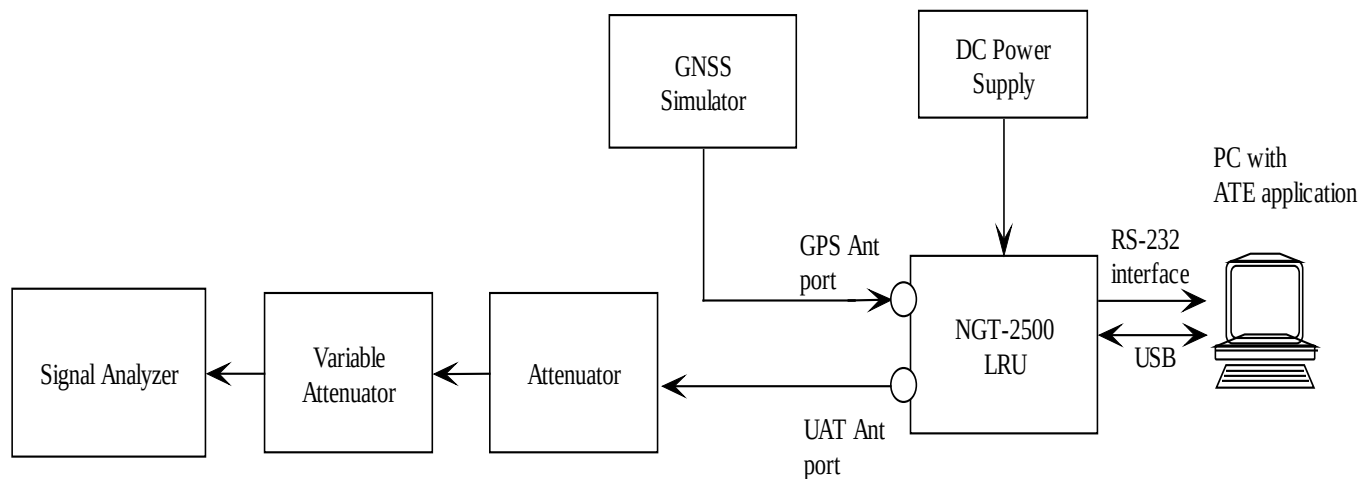
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| Equipment/Application | Manufacturer | Model        |
|-----------------------|--------------|--------------|
| Equivalent)           | Microwave    |              |
| Signal Analyzer       | Agilent      | N9020A       |
| GNSS Simulator        | Accord       | ACC_SIM_04   |
| DC Power Supply       | Aplab        | L6403        |
| ATE Application       | Accord       | ATE-APP-2.20 |

*Comment: Equivalent equipment may be used.*

#### 9.7.2.1.2 Frequency Stability (Primary Power Variation) Test Setup



**Figure 9-26: Frequency Stability (Primary Power Variation) Test Setup for UAT Transmission**

#### 9.7.2.1.3 Frequency Stability (Primary Power Variation) Test Procedure

1. Connect the equipment as shown in Figure 9-26 above.
2. Configure the NGT-2500 unit to transmit one long message per second with valid payload data using ATE application and control panel
3. Adjust the variable attenuator such that 978 MHz signal power level at the input of Signal Analyzer is  $-40 \pm 1$  dBm (Total attenuation required between UAT antenna port of UUT and Signal Analyzer input: 87 dB approx.)
4. Apply +14 VDC power to the unit
5. Configure the Signal Analyzer as per the settings given in Table 9-6
6. Record the carrier offset value on Trace-4
7. Adjust the variable attenuator such that 978MHz signal power level at the input of Signal Analyzer is  $-6 \pm 1$  dBm (Total attenuation required between UAT antenna port of UUT and Signal Analyzer input: 53 dB approx.)
8. Configure the Signal Analyzer as per below settings
  - Center frequency: 978 MHz
  - Span: 0 Hz
  - Resolution bandwidth: 2 MHz
  - Video bandwidth: 6 MHz
  - Sweep time: 1 ms
  - Trigger type: Video
  - Trigger delay: -250 us

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- Trace/Max hold: ON
  - Continuous peak search: ON
  - Reference level offset: Total attenuation between the unit and Signal Analyzer
  - Reference level: +55 dBm
9. Record peak output power for UAT transmission
  10. Repeat steps 5 through 9 for +11.9 VDC, +16.1 VDC, +23.8 VDC, +28 VDC and +32.2 VDC
  11. To calculate UAT transmission frequency, add the measured carrier offset value to 978MHz.

#### 9.7.2.1.4 Frequency Stability (Primary Power Variation) Test Results

The transmission frequency offset and the peak power output values recorded during the primary power variation test are tabulated in Table 9-25

**Table 9-23: Frequency Stability (Primary Power variation) Test Results**

| Frequency Stability (Primary Power Variation) of UAT Transmission |                             |                          | Limits           |                       |
|-------------------------------------------------------------------|-----------------------------|--------------------------|------------------|-----------------------|
| Power Supply Voltage (V)                                          | Measured Power Output (dBm) | Measured Frequency (MHz) | Power Output     | Frequency             |
| 11.9                                                              | +47.013                     | 977.9993146              | +44dBm to +48dBm | 978MHz $\pm$ 19.56kHz |
| 14                                                                | +47.033                     | 977.9992776              | +44dBm to +48dBm | 978MHz $\pm$ 19.56kHz |
| 16.1                                                              | +47.027                     | 977.9992026              | +44dBm to +48dBm | 978MHz $\pm$ 19.56kHz |
| 23.8                                                              | +47.002                     | 977.9992324              | +44dBm to +48dBm | 978MHz $\pm$ 19.56kHz |
| 28                                                                | +46.987                     | 977.9990771              | +44dBm to +48dBm | 978MHz $\pm$ 19.56kHz |
| 32.2                                                              | +46.849                     | 977.9989424              | +44dBm to +48dBm | 978MHz $\pm$ 19.56kHz |

#### 9.7.2.2 Mode A Interrogation

##### 9.7.2.2.1 Frequency Stability (Primary Power Variation) Test Equipment Required

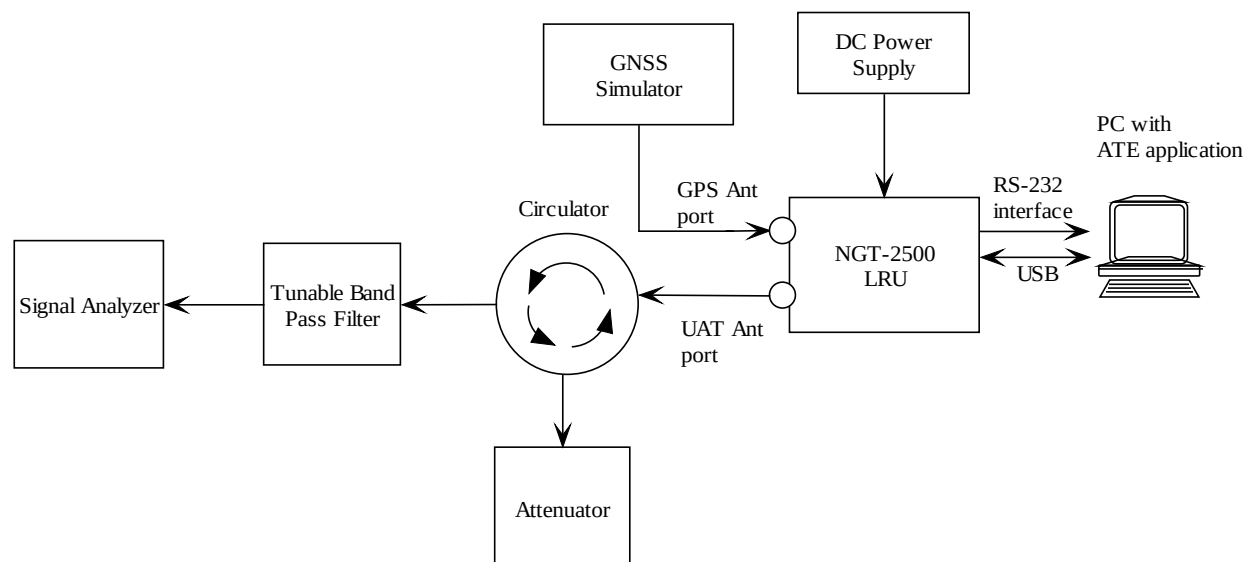
**Table 9-24: Frequency Stability (Primary Power Variation) Test Equipment Required**

| Equipment/Application                       | Manufacturer                               | Model         |
|---------------------------------------------|--------------------------------------------|---------------|
| NGT-2500 LRU                                | ACSS                                       | 9022500-10000 |
| Circulator                                  | Renaissance Communications Private Limited | A2NN          |
| Attenuator (or Equivalent)                  | Mini Circuits                              | BW-S20W20+    |
| Tunable Band Pass Filter (Tuned to 1030MHz) | Telonic Berkeley Inc.                      | TTF 1000      |
| Signal Analyzer                             | Agilent                                    | N9020A        |
| GNSS Simulator                              | Accord                                     | ACC_SIM_04    |
| DC Power Supply                             | Aplab                                      | L6403         |
| ATE Application                             | Accord                                     | ATE-APP-2.20  |

*Comment: Equivalent equipment may be used.*

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#### 9.7.2.2.2 Frequency Stability (Primary Power Variation) Test Setup



**Figure 9-27: Frequency Stability (Primary Power Variation) Test Setup for Mode A Interrogation**

#### 9.7.2.2.3 Frequency Stability (Primary Power Variation) Test Procedure

1. Connect the equipment as shown in Figure 9-27 above.
2. Configure the NGT-2500 unit to transmit one long message per second with valid payload data using ATE application and control panel
3. Apply +14 VDC power to the unit
4. Configure the Signal Analyzer as per below settings
  - Center frequency: 1030 MHz
  - Span: 0 Hz
  - Resolution bandwidth: 8 MHz
  - Video bandwidth: 50 MHz
  - Sweep time: 20 us
  - Trigger type: Video
  - Trigger delay: -5 us
  - Trace/Max hold: ON
  - Continuous peak search: ON
  - Reference level offset: Total attenuation between the unit and Signal Analyzer
  - Reference level: 0 dBm
5. Record peak power output value for Mode A interrogation
6. Configure the Signal Analyzer as per below settings
  - Center frequency: 1030 MHz
  - Span: 8 MHz
  - Resolution bandwidth: 2 MHz
  - Video bandwidth: 8 MHz
  - Sweep time: 1 second
  - Trace/Max hold: ON
  - Reference level offset: Total attenuation between the unit and Signal Analyzer
  - Reference level: 0 dBm

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7. Record the Mode A interrogation frequency value
8. Repeat steps 4 through 7 for +11.9 VDC, +16.1 VDC, +23.8 VDC, +28 VDC and +32.2 VDC

#### 9.7.2.2.4 Frequency Stability (Primary Power Variation) Test Results

Mode A interrogation frequency and the peak power output values recorded during the temperature variation test are tabulated in Table 9-25

**Table 9-25: Frequency Stability (Primary Power variation) Test Results**

| Frequency Stability (Primary Power Variation) of Mode A Interrogation |                             |                          | Limits          |               |
|-----------------------------------------------------------------------|-----------------------------|--------------------------|-----------------|---------------|
| Power Supply Voltage (V)                                              | Measured Power Output (dBm) | Measured Frequency (MHz) | Power Output    | Frequency     |
| 11.9                                                                  | -16.123                     | 1029.950                 | -3dBm to -18dBm | 1030 ± 0.1MHz |
| 14                                                                    | -16.129                     | 1030.005                 | -3dBm to -18dBm | 1030 ± 0.1MHz |
| 16.1                                                                  | -16.115                     | 1030.000                 | -3dBm to -18dBm | 1030 ± 0.1MHz |
| 23.8                                                                  | -16.14                      | 1029.990                 | -3dBm to -18dBm | 1030 ± 0.1MHz |
| 28                                                                    | -16.163                     | 1029.995                 | -3dBm to -18dBm | 1030 ± 0.1MHz |
| 32.2                                                                  | -16.175                     | 1029.985                 | -3dBm to -18dBm | 1030 ± 0.1MHz |

|                                |                                               |               |
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## APPENDIX A DNB TEST DATA – COALVILLE, UTAH

# Appendix A

DNB Test Results - Coalville, Utah

FCC Part 2, Part 15, Part 87  
Model NGT-2500



Foxit PDF Document

**FCC Part 2, Part 15, Part 87**

**Test Report  
for the**

**Transponder**

Model # NGT-2500

Test Report Number UT58018A-002

*Prepared For:*

ACSS, an L-3 Communications & Thales Company  
19810 N. 7th Avenue  
Phoenix, AZ 85027

*Prepared by:*

**DNB Engineering, Inc.  
1100 E. Chalk Creek Road  
Coalville, UT 84017**



NVLAP Lab Code 200634-0



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|  | 1100 E Chalk Creek Road<br>Coalville, UT 84017<br>(435) 336-4433<br>FAX (435) 336-4436<br>www.dnbenginc.com | 20 Sep 2014<br>UT58018A-002 |
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## DOCUMENT HISTORY

| Revision | Number of Pages | Revised Pages | Description                    | Date        |
|----------|-----------------|---------------|--------------------------------|-------------|
| -001     | All             | All           | Report Release                 | 23 Sep 2014 |
| -002     | All             | All           | Add clarification to Section 5 | 9 Oct 2014  |
|          |                 |               |                                |             |

|                                                                                  |                                                                                                             |                             |
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## CERTIFICATION OF TEST DATA

This report, containing electromagnetic immunity and emissions test data and evaluations, has been prepared by an independent electromagnetic compatibility laboratory, DNB ENGINEERING, in accordance with the applicable specifications and instructions required per the Introduction. DNB Engineering has received accreditation to perform these tests by the following authorizations:

**NEMKO EMC Laboratory Authorization No. ELA 116**  
**NIST / NVLAP: Lab Code No: 200634-0**

**FCC Registration No. 90532**

The data evaluation and equipment configuration presented herein are a true and accurate representation of the measurements of the test sample's electromagnetic immunity and emissions characteristics as of the dates and at the times of the test under the conditions herein specified.

This report shall not be reproduced, except in full, without the written approval of DNB ENGINEERING, INC. Results contained in this report relate only to the item tested.

Disclaimer: This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

|                        |                                          |                     |
|------------------------|------------------------------------------|---------------------|
| Report Prepared By:    | Carrie Yates<br>Administrative Assistant | 20 Sep 2014<br>Date |
| Report Reviewed by:    | CL Payne III<br>Facility Manager         | 20 Sep 2014<br>Date |
| Revisiont Reviewed by: | CL Payne III<br>Facility Manager         | 9 Oct 2014<br>Date  |

|                                                                                   |                                                                                                             |                             |
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FCC Part 2, Part 15, Part 87 Test Completion Record for:

ACSS, an L-3 Communications & Thales Company: **Transponder**  
Model # NGT-2500

Test Start Date: 15 Sep 2014

Test Completion Date: 16 Sep 2014

*The EUT was tested in accordance with the requirements of the  
specifications and standards listed below and found to be fully compliant:*

**FCC 47 CFR Reference:**

2.1051, Spurious Emissions at Antenna Terminals  
2.1053, Field Strength of Spurious Radiation  
15.109, Radiated Emission Limits  
87.139, Emission Limitations

|                                              |                                                 |                                      |                                     |
|----------------------------------------------|-------------------------------------------------|--------------------------------------|-------------------------------------|
| <b>Conducted Spurious Emissions:</b>         | <b>Pass</b> <input checked="" type="checkbox"/> | <b>Fail</b> <input type="checkbox"/> | <b>N/A</b> <input type="checkbox"/> |
| <b>Radiated Emissions Digital Devices:</b>   | <b>Pass</b> <input checked="" type="checkbox"/> | <b>Fail</b> <input type="checkbox"/> | <b>N/A</b> <input type="checkbox"/> |
| <b>Field Strength of Spurious Radiation:</b> | <b>Pass</b> <input checked="" type="checkbox"/> | <b>Fail</b> <input type="checkbox"/> | <b>N/A</b> <input type="checkbox"/> |



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1.0

## INTRODUCTION

Electromagnetic Compatibility (EMC) tests were performed on a representative sample(s) of ACSS, an L-3 Communications & Thales Company, Transponder, Model # NGT-2500. The purpose of this test was to demonstrate compliance of the EUT with the applicable limits. The test results have been summarized herein, and all data sheets have been incorporated in Appendix C.

Where applicable, cables were routed consistent with the typical application by varying the configuration of the test sample. The effect of varying the position of cables was investigated to find the configuration that produced maximum emissions and susceptibility.

The EUT was evaluated to determine the “worst case” positioning of both cables and axis. Once the “worst case” configuration was determined care was used to maintain this configuration throughout the test.

2.0

## DEVIATIONS

### **Deviations/Modifications to the EUT**

NONE

### **Deviations/Modifications from the Test Standards**

NONE



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## **TEST SITE AND EQUIPMENT**

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The test equipment utilized in the performance of this test, along with current calibration information, is listed in the Test Equipment Log of Appendix A.

### **UNCERTAINTY TOLERANCE**

DNB Engineering's Coalville Facility is within acceptable uncertainty tolerances per ANSI C63.4 (2009) sections 5.4.6.1 and 5.4.6.2 as well as CISPR 16-1(2002) Annex L, section L.2.

#### **ANSI C63.4 (2009)**

5.4.6.1 Site Attenuation. A measurement site shall be considered acceptable for radiated electromagnetic field measurements if the horizontal and vertical NSA derived from measurements, i.e., the "measured NSA," are within +/- 4 dB of the theoretical NSA (5.4.6.3) for an ideal site.

5.4.6.2 NSA Tolerance. The +/- 4 dB tolerance in 5.4.6.1 includes instrumentation calibration errors, measurement technique errors, and errors due to site anomalies. These errors are analyzed in ANSI C63.6- 1998 [3], wherein it is shown that the performance of a well-built site contributes only 1 db of the total allowable tolerance.

#### **CISPR 16-1 (2002)**

##### **L.2 Error analysis**

...The total estimated errors are the basis for the +/- 4 dB site acceptability criteria consisting of approximately 3 dB measurement uncertainty and an additional allowable 1 dB for site imperfections.

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ .

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## **TEST DESCRIPTION**

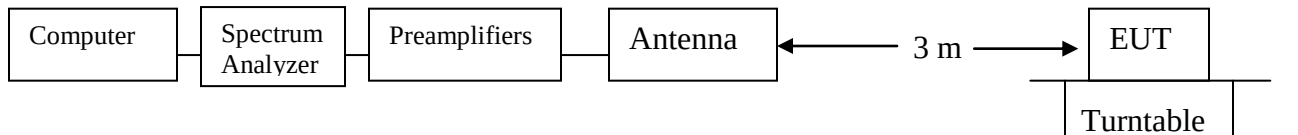
4.2

### **Radiated RF Emissions (ANSI C63.4 2009)**

To measure radiated emissions, the EUT was set up on the 3 or 10-meter open air test site. The EUT is placed on a wooden table, which rests on a wooden turntable. The top of the table is one meter above the ground, and the turntable can be rotated 360 degrees. For each frequency measured, the antenna is raised and lowered for both horizontal and vertical polarities to obtain the maximum reading on the analyzer. The turntable is also rotated throughout the 360 degrees in azimuth to determine the position of the maximum emissions. The applicable frequency range is searched using the antennas listed below. The respective antenna and preamplifier were connected to an HP 8568B Spectrum Analyzer. Preamplifiers were used for all ranges to achieve the needed dynamic range. A list of the equipment used in this test is included in Appendix A. Photographs of this test set up are included in Appendix B.

Antenna(s):

Electro-Metrics 6505-A (.009 - 30 MHz) [ ]  
SAS 200/540 BICONICAL (30 - 200 MHz) [X]  
EMCO 3146 LOG PERIODIC (200 - 1000 MHz) [X]  
EMCO 3115 DRG (1GHz – 18GHz) [X]  
OTHER (See Equipment Log in Appendix B) [X]



|                                                                                   |                                                                                                             |                             |
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CONCLUSIONS

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The ACSS, an L-3 Communications & Thales Company, Transponder, Model #NGT-2500, was tested in accordance with the requirements listed herein. Pass/Fail status for each test is captured on page 5 along with test data in Appendix C. At the completion of testing the EUT and support equipment were returned to representatives of ACSS, an L-3 Communications & Thales Company.

|                                                                                  |                                                                                                             |                             |
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## APPENDIX A

### *Test Equipment Log*

|                                                                                  |                                                                                                             |                             |
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| TEST EQUIPMENT LOG |                          |         |            |           |                    |
|--------------------|--------------------------|---------|------------|-----------|--------------------|
| Description        | Manufacturer/MN          | Asset # | Serial #   | Cal Due   | Used On            |
| Amplifier          | HP/8447D                 | U-067   | 2727A06182 | 13-Jan-15 | Radiated Emissions |
| Amplifier          | HP/8447D                 | U-065   | 2727A06180 | 13-Jan-15 | Radiated Emissions |
| Amplifier          | HP/8447D                 | U-068   | 2727A06184 | 13-Jan-15 | Radiated Emissions |
| Bicon Antenna      | SCH/BBA9106              | U-186   | 7          | 15-May-15 | Radiated Emissions |
| Log P Antenna      | SCH/UHAL09107            | U-010   | 10         | 10-Sep-15 | Radiated Emissions |
| Horn Antenna, DRG  | AH Systems/SAS-571       | U-071   | 417        | 11-Jun-15 | Radiated Emissions |
| Spectrum Analyzer  | Agilent/E7401A           | U-257   | MY42000103 | 8-Jan-16  | Radiated Emissions |
| Spectrum Analyzer  | R&S/FSV30                | U-248   | 101367     | 24-Nov-14 | Radiated Emissions |
| TILE Software      | ETS- Lindgern/ 3.4.11.13 | U-317   | 8112006    | 30-Sep-14 | Radiated Emissions |

|                                                                                  |                                                                                                                            |                                      |
|----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
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## APPENDIX B

### *Photographs*



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## Photos

## Conducted Spurious

Notes: 1GHz – 11GHz





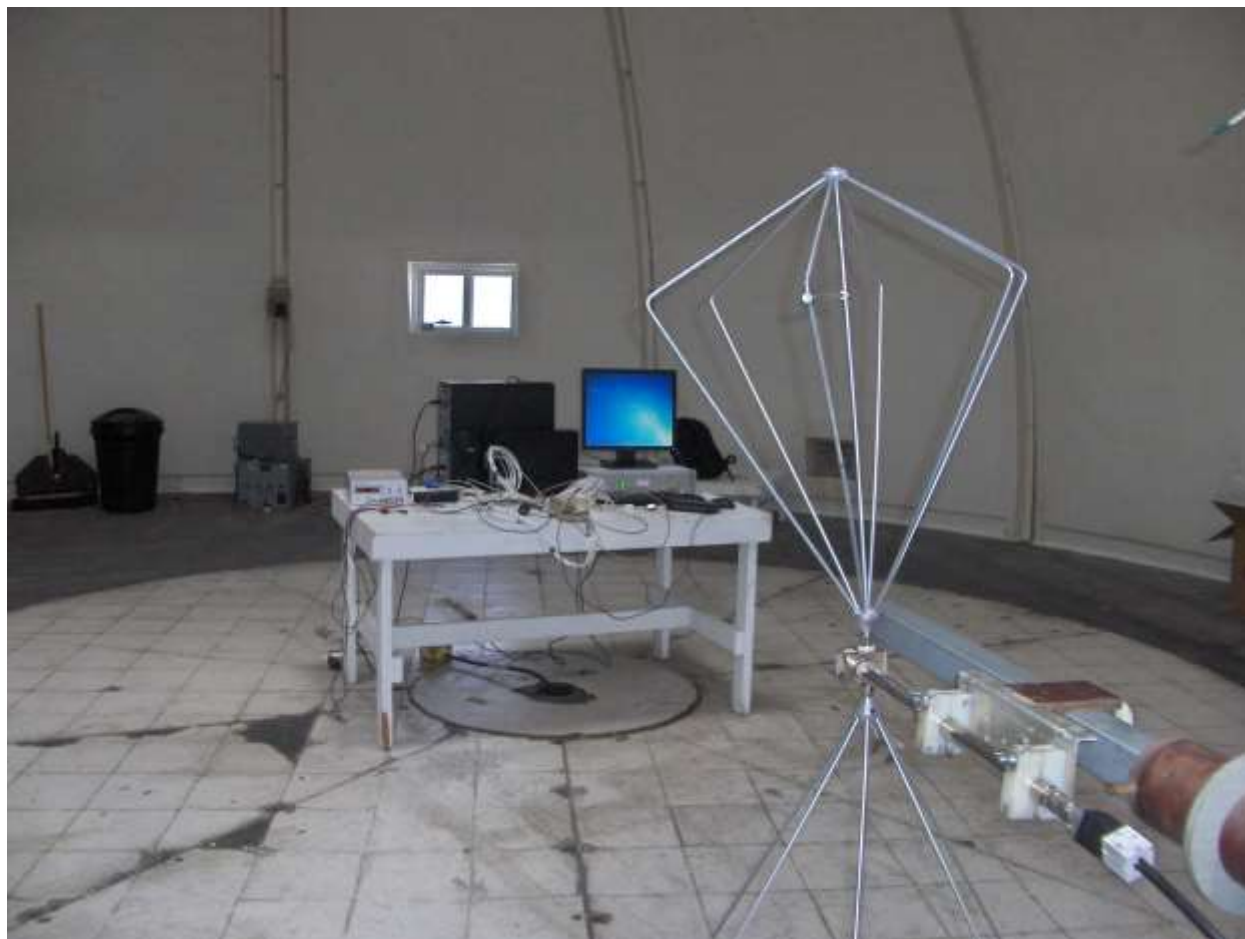
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## Photos

## Radiated Emissions-Bicon

Notes: 30MHz – 300 MHz





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## Photos

## Radiated Emissions – Log Periodic

Notes: 300MHz – 1000MHz





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## Photos

## Radiated Emissions - DRG

Notes: - 1GHz - 18GHz





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## APPENDIX C

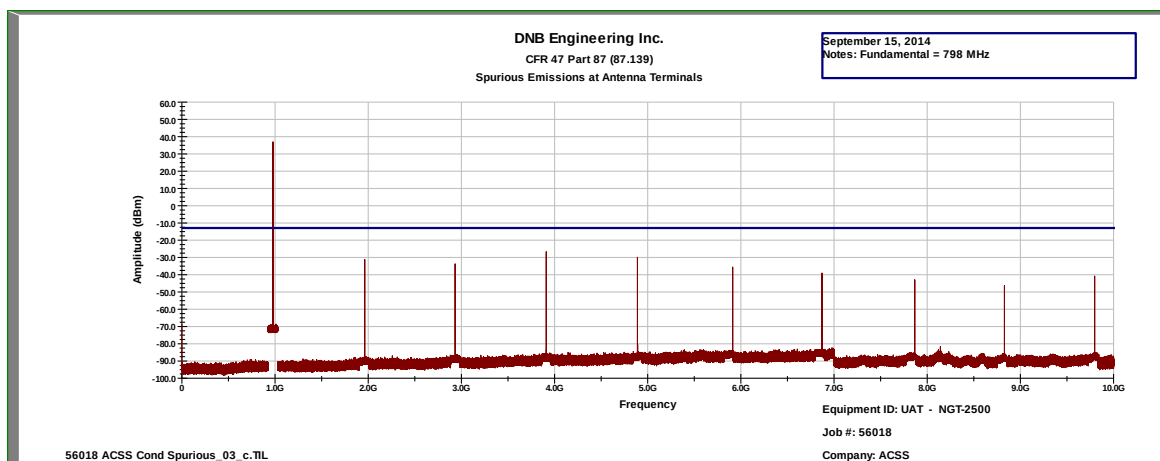
*Test Data*

|                                                                                  |                                                                                                             |                             |
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## Conducted Spurious Emissions

|                                                                                                                                                                    |                                              |                   |                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|-------------------|--------------------------------------------------------|
| DNB Job Number:                                                                                                                                                    | UT58018A-001                                 | Date: 15 Sep 2014 | <b>Specification</b><br>FCC 47 CFR<br>2.1051<br>87.139 |
| Customer:                                                                                                                                                          | ACSS, an L-3 Communications & Thales Company |                   |                                                        |
| Model Number:                                                                                                                                                      | NGT-2500                                     |                   |                                                        |
| Description:                                                                                                                                                       | Transponder                                  | S/N: N/A          |                                                        |
| Test Equipment:<br>(See pg. 11)                                                                                                                                    | Asset #'s: U-248, U-317                      |                   |                                                        |
| EUT performed within the requirements of the applicable Standard(s) YES <input checked="" type="checkbox"/> NO <input type="checkbox"/> SIGNED <i>CL Payne III</i> |                                              |                   |                                                        |

| Freq in MHz | Meter (dBm) | Amp (dB) | Atten (dB) | Corr'd (dBm) | Limit (dBm) | Delta (dBm) |
|-------------|-------------|----------|------------|--------------|-------------|-------------|
| 978         | -17.21      | 0.00     | 54.12      | 36.91        | Fund        | N/A         |
| 1956        | -87.40      | 0.00     | 56.15      | -31.25       | -13.00      | -18.25      |
| 2934        | -85.68      | 0.00     | 51.84      | -33.84       | -13.00      | -20.84      |
| 3912        | -77.25      | 0.00     | 50.47      | -26.78       | -13.00      | -13.78      |
| 4890        | -80.36      | 0.00     | 50.37      | -29.99       | -13.00      | -16.99      |
| 5868        | -83.41      | 0.00     | 47.73      | -35.68       | -13.00      | -22.68      |
| 6846        | -82.99      | 0.00     | 43.85      | -39.14       | -13.00      | -26.14      |
| 7824        | -85.27      | 0.00     | 42.28      | -42.99       | -13.00      | -29.99      |
| 8802        | -85.68      | 0.00     | 39.22      | -46.46       | -13.00      | -33.46      |
| 9780        | -84.10      | 0.00     | 43.21      | -40.89       | -13.00      | -27.89      |

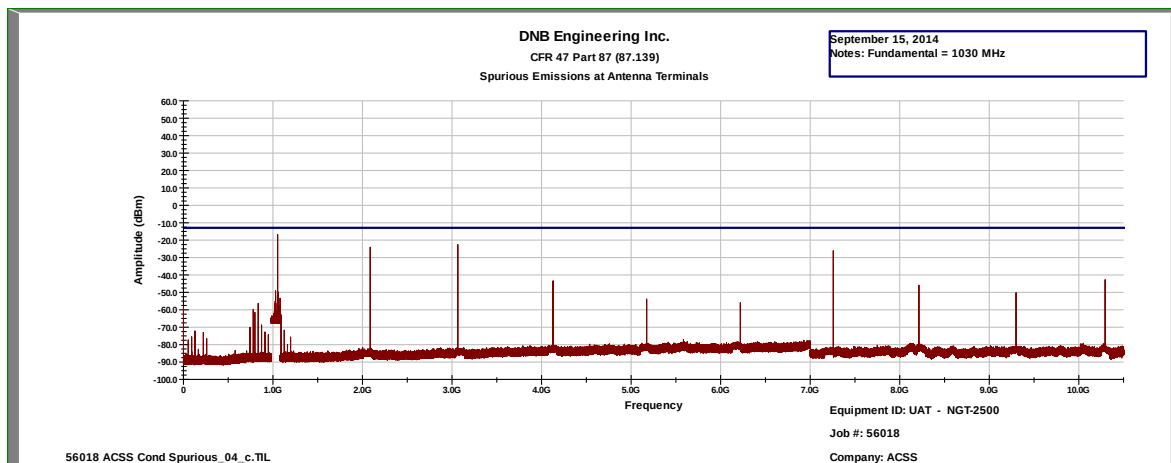


|                                                                                  |                                                                                                             |                             |
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## Conducted Spurious Emissions

|                                                                                                                                                                    |                                              |                   |                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|-------------------|--------------------------------------------------------|
| DNB Job Number:                                                                                                                                                    | UT58018A-001                                 | Date: 15 Sep 2014 | <b>Specification</b><br>FCC 47 CFR<br>2.1051<br>87.139 |
| Customer:                                                                                                                                                          | ACSS, an L-3 Communications & Thales Company |                   |                                                        |
| Model Number:                                                                                                                                                      | NGT-2500                                     |                   |                                                        |
| Description:                                                                                                                                                       | Transponder                                  | S/N: N/A          |                                                        |
| Test Equipment:<br>(See pg. 11)                                                                                                                                    | Asset #'s: U-248, U-317                      |                   |                                                        |
| EUT performed within the requirements of the applicable Standard(s) YES <input checked="" type="checkbox"/> NO <input type="checkbox"/> SIGNED <i>CL Payne III</i> |                                              |                   |                                                        |

| Freq in MHz | Meter (dBm) | Amp (dB) | Atten (dB) | Corr'd (dBm) | Limit (dBm) | Delta (dBm) |
|-------------|-------------|----------|------------|--------------|-------------|-------------|
| 1030        | -46.23      | 0.00     | 29.35      | -16.88       | Fund        | N/A         |
| 2060        | -82.38      | 0.00     | 58.27      | -24.11       | -13.00      | -11.11      |
| 3090        | -81.99      | 0.00     | 59.39      | -22.60       | -13.00      | -9.60       |
| 4120        | -80.43      | 0.00     | 36.99      | -43.44       | -13.00      | -30.44      |
| 5150        | -78.79      | 0.00     | 24.87      | -53.92       | -13.00      | -40.92      |
| 6180        | -77.95      | 0.00     | 21.89      | -56.06       | -13.00      | -43.06      |
| 7210        | -81.45      | 0.00     | 55.24      | -26.21       | -13.00      | -13.21      |
| 8240        | -79.80      | 0.00     | 33.83      | -45.97       | -13.00      | -32.97      |
| 9270        | -81.01      | 0.00     | 30.77      | -50.24       | -13.00      | -37.24      |
| 10300       | -79.25      | 0.00     | 36.46      | -42.79       | -13.00      | -29.79      |



|                                                                                  |                                                                                                             |                             |
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### Radiated Emissions Datasheet

|                                                                                                                                                                    |                                              |                    |                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|--------------------|--------------------------------------------------------|
| DNB Job Number:                                                                                                                                                    | UT58018A-001                                 | Date: 15 Sep 2014  | <b>Specification</b><br>FCC 47 CFR<br>15.109<br>87.139 |
| Customer:                                                                                                                                                          | ACSS, an L-3 Communications & Thales Company |                    |                                                        |
| Model Number:                                                                                                                                                      | NGT-2500                                     | Serial Number: N/A |                                                        |
| Description:                                                                                                                                                       | Transponder                                  |                    |                                                        |
| Test Equipment:<br>(See pg. 11)                                                                                                                                    | Asset #'s: U-010, U-065, U-186, U-248, U-317 |                    |                                                        |
| EUT performed within the requirements of the applicable Standard(s) YES <input checked="" type="checkbox"/> NO <input type="checkbox"/> SIGNED <i>CL Payne III</i> |                                              |                    |                                                        |

| Freq.<br>(MHz) | Meas'd<br>(dBuV) | Amp<br>Factors<br>(dB) | Cable<br>Factors<br>(dB) | Antenna<br>Factors<br>(dB) | Corr'd<br>(dBuV/m) | Limit<br>(dBuV/m) | Delta<br>(dB) | Azimuth<br>(degree) | Height<br>(m) | Hor/<br>Vert | Meas Type<br>QP/Ave/Peak |
|----------------|------------------|------------------------|--------------------------|----------------------------|--------------------|-------------------|---------------|---------------------|---------------|--------------|--------------------------|
| 34.887         | 40.28            | 26.50                  | 1.90                     | 16.80                      | 32.48              | 40.45             | -7.97         | 198                 | 1.23          | Vert         | Peak                     |
| 62.650         | 46.30            | 26.40                  | 1.80                     | 7.30                       | 29.00              | 40.45             | -11.45        | 201                 | 1.00          | Vert         | Peak                     |
| 116.337        | 48.63            | 26.30                  | 2.10                     | 11.80                      | 36.23              | 40.45             | -4.22         | 251                 | 1.00          | Vert         | Peak                     |
| 157.948        | 40.39            | 26.20                  | 2.40                     | 14.30                      | 30.89              | 40.45             | -9.56         | 354                 | 1.00          | Vert         | Peak                     |
| 160.563        | 39.55            | 26.10                  | 2.50                     | 14.70                      | 30.65              | 40.45             | -9.80         | 0                   | 1.00          | Vert         | Peak                     |
| 160.579        | 42.60            | 26.10                  | 2.50                     | 14.70                      | 33.70              | 40.45             | -6.75         | 126                 | 1.53          | Hor/         | Peak                     |
| 186.461        | 38.97            | 26.00                  | 2.80                     | 16.70                      | 32.47              | 40.45             | -7.98         | 327                 | 1.00          | Vert         | Peak                     |
| 186.450        | 41.45            | 26.00                  | 2.80                     | 16.70                      | 34.95              | 40.45             | -5.50         | 318                 | 1.00          | Hor/         | Peak                     |
| 192.010        | 42.17            | 25.90                  | 2.80                     | 17.60                      | 36.67              | 40.45             | -3.78         | 292                 | 1.00          | Vert         | QP                       |
| 191.985        | 41.75            | 25.90                  | 2.80                     | 17.60                      | 36.25              | 40.45             | -4.20         | 278                 | 1.00          | Hor/         | Peak                     |
| 221.192        | 40.27            | 26.00                  | 2.90                     | 16.60                      | 33.77              | 40.45             | -6.68         | 239                 | 1.00          | Vert         | Peak                     |
| 221.189        | 44.95            | 26.00                  | 2.90                     | 16.60                      | 38.45              | 40.45             | -2.00         | 349                 | 1.29          | Hor/         | QP                       |
| 249.996        | 39.61            | 26.00                  | 2.90                     | 16.80                      | 33.31              | 47.45             | -14.14        | 344                 | 1.00          | Vert         | Peak                     |
| 270.354        | 39.80            | 25.80                  | 3.50                     | 19.00                      | 36.50              | 47.45             | -10.95        | 326                 | 1.00          | Vert         | QP                       |
| 270.328        | 45.09            | 25.80                  | 3.50                     | 19.00                      | 41.79              | 47.45             | -5.66         | 339                 | 1.08          | Hor/         | QP                       |
| 308.600        | 31.00            | 25.90                  | 3.80                     | 17.60                      | 26.50              | 47.45             | -20.95        | 257                 | 1.63          | Vert         | QP                       |
| 418.000        | 30.97            | 26.70                  | 4.50                     | 17.90                      | 26.67              | 47.45             | -20.78        | 141                 | 1.00          | Hor/         | QP                       |
| 503.100        | 25.67            | 27.20                  | 5.20                     | 19.80                      | 23.47              | 47.45             | -23.98        | 237                 | 2.71          | Hor/         | QP                       |
| 539.600        | 23.86            | 27.30                  | 5.30                     | 20.40                      | 22.26              | 47.45             | -25.19        | 210                 | 1.60          | Vert         | QP                       |
| 308.600        | 38.70            | 25.90                  | 3.80                     | 17.60                      | 34.20              | 47.45             | -13.25        | 268                 | 1.00          | Hor/         | QP                       |

|                                                                                  |                                                                                                             |                             |
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### Field Strength of Radiated Spurious

|                                                                                                                                                             |                                              |                    |                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|--------------------|------------------------------------------------------------------|
| DNB Job Number:                                                                                                                                             | UT58018A-001                                 | Date: 15 Sep 2014  | <b>Specification</b><br>FCC 47 CFR<br>2.1053<br>15.109<br>87.139 |
| Customer:                                                                                                                                                   | ACSS, an L-3 Communications & Thales Company |                    |                                                                  |
| Model Number:                                                                                                                                               | NGT-2500                                     | Serial Number: N/A |                                                                  |
| Description:                                                                                                                                                | Transponder                                  |                    |                                                                  |
| Test Equipment:<br>(See pg. 11)                                                                                                                             | Asset #'s: U-010, U-071, U-248, U-317        |                    |                                                                  |
| EUT performed within the requirements of the applicable Standard(s) YES <input checked="" type="checkbox"/> NO <input type="checkbox"/> SIGNED CL Payne III |                                              |                    |                                                                  |

Vertical Fundamental = -13.37dBm @ 978MHz  
Horizontal Fundamental = -13.32dBm @ 978 MHz

| Freq (MHz) | Meas'd (dBuV) | Cable Factors (dB) | Antenna Factors (dB) | Corrected (dBuV/m) | Azimuth (degree) | Height (m) | Hor Vert | Meas Type Ave / PK | Substitution Method (dBm) | 30dBc Limit | Delta  |
|------------|---------------|--------------------|----------------------|--------------------|------------------|------------|----------|--------------------|---------------------------|-------------|--------|
| 1956       | 5.17          | 2.82               | 28.08                | 36.07              | 339              | 1.00       | Vert     | Ave                | -59.48                    | -43.37      | -16.11 |
| 2934       | 3.39          | 3.41               | 30.22                | 37.02              | 10               | 1.00       | Vert     | Ave                | -58.21                    | -43.37      | -14.84 |
| 3912       | 4.82          | 4.90               | 31.70                | 41.42              | 355              | 1.18       | Vert     | Ave                | -54.81                    | -43.37      | -11.44 |
| 4890       | 5.31          | 7.89               | 33.30                | 46.50              | 8                | 1.00       | Vert     | Ave                | -49.26                    | -43.37      | -5.89  |
| 5868       | 3.25          | 9.83               | 34.83                | 47.91              | 316              | 1.19       | Vert     | Ave                | -48.57                    | -43.37      | -5.20  |
| 6846       | 3.32          | 8.31               | 36.87                | 48.50              | 320              | 1.80       | Vert     | Ave                | -47.91                    | -43.37      | -4.54  |
| 7824       | -1.57         | 7.86               | 37.13                | 43.42              | 330              | 1.33       | Vert     | Ave                | -51.82                    | -43.37      | -8.45  |
| 8802       | -1.89         | 6.84               | 37.52                | 42.47              | 182              | 1.00       | Vert     | Ave                | -52.75                    | -43.37      | -9.38  |
| 9780       | -1.45         | 5.76               | 37.91                | 42.22              | 128              | 1.00       | Vert     | Ave                | -53.59                    | -43.37      | -10.22 |
| 1956       | 5.47          | 2.82               | 28.08                | 36.37              | 51               | 2.12       | Hor      | Ave                | -59.86                    | -43.32      | -16.54 |
| 2934       | 3.40          | 3.41               | 30.22                | 37.03              | 27               | 1.00       | Hor      | Ave                | -58.46                    | -43.32      | -15.14 |
| 3912       | 4.73          | 4.90               | 31.70                | 41.33              | 0                | 1.40       | Hor      | Ave                | -52.87                    | -43.32      | -9.55  |
| 4890       | 5.28          | 7.89               | 33.30                | 46.47              | 360              | 1.00       | Hor      | Ave                | -49.58                    | -43.32      | -6.26  |
| 5868       | 3.13          | 9.83               | 34.83                | 47.79              | 212              | 3.90       | Hor      | Ave                | -48.55                    | -43.32      | -5.23  |
| 6846       | 3.02          | 8.31               | 37.18                | 48.50              | 353              | 3.71       | Hor      | Ave                | -47.86                    | -43.32      | -4.54  |
| 7824       | -1.57         | 7.86               | 37.13                | 43.42              | 161              | 1.00       | Hor      | Ave                | -52.86                    | -43.32      | -9.54  |
| 8802       | -1.90         | 6.84               | 37.52                | 42.46              | 346              | 3.08       | Hor      | Ave                | -53.88                    | -43.32      | -10.56 |
| 9780       | -1.48         | 5.76               | 37.91                | 42.19              | 350              | 1.16       | Hor      | Ave                | -54.15                    | -43.32      | -10.83 |



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20 Sep 2014  
UT58018A-002

## Field Strength of Radiated Spurious

|                                                                                                                                                                    |                                              |                    |                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|--------------------|------------------------------------------------------------------|
| DNB Job Number:                                                                                                                                                    | UT58018A-001                                 | Date: 15 Sep 2014  | <b>Specification</b><br>FCC 47 CFR<br>2.1053<br>15.109<br>87.139 |
| Customer:                                                                                                                                                          | ACSS, an L-3 Communications & Thales Company |                    |                                                                  |
| Model Number:                                                                                                                                                      | NGT-2500                                     | Serial Number: N/A |                                                                  |
| Description:                                                                                                                                                       | Transponder                                  |                    |                                                                  |
| Test Equipment:<br>(See pg. 11)                                                                                                                                    | Asset #'s: U-071, U-248, U-317               |                    |                                                                  |
| EUT performed within the requirements of the applicable Standard(s) YES <input checked="" type="checkbox"/> NO <input type="checkbox"/> SIGNED <i>CL Payne III</i> |                                              |                    |                                                                  |

| Freq (MHz) | Meas'd (dBuV) | Amp Factors (dB) | Cable Factors (dB) | Antenna Factors (dB) | Total (dBuV/m) | Limit (dBuV/m) | Delta (dB) | Azimuth (degree) | Height (m) | Hor Vert | Meas Type Ave / PK |
|------------|---------------|------------------|--------------------|----------------------|----------------|----------------|------------|------------------|------------|----------|--------------------|
| 2060       | 2.17          | 0.00             | 2.88               | 28.56                | 33.61          | 54.00          | -20.39     | 129              | 1.76       | Vert     | Ave                |
| 3090       | 3.22          | 0.00             | 3.42               | 30.30                | 36.94          | 54.00          | -17.06     | 105              | 1.27       | Vert     | Ave                |
| 4120       | 4.55          | 0.00             | 5.75               | 31.98                | 42.28          | 54.00          | -11.72     | 98               | 2.51       | Vert     | Ave                |
| 5150       | 6.22          | 0.00             | 8.66               | 33.73                | 48.61          | 54.00          | -5.39      | 20               | 1.53       | Vert     | Ave                |
| 6180       | 3.67          | 0.00             | 9.45               | 35.45                | 48.57          | 54.00          | -5.43      | 64               | 2.12       | Vert     | Ave                |
| 7210       | -1.73         | 0.00             | 8.29               | 37.17                | 43.74          | 54.00          | -10.26     | 277              | 4.00       | Vert     | Ave                |
| 8240       | -1.74         | 0.00             | 7.45               | 37.30                | 43.00          | 54.00          | -11.00     | 0                | 1.00       | Vert     | Ave                |
| 9270       | -1.53         | 0.00             | 5.75               | 37.71                | 41.93          | 54.00          | -12.07     | 289              | 3.74       | Vert     | Ave                |
| 10300      | -1.51         | 0.00             | 5.84               | 38.48                | 42.81          | 54.00          | -11.19     | 0                | 1.00       | Vert     | Ave                |
| 2060       | 2.19          | 0.00             | 2.88               | 28.56                | 33.63          | 54.00          | -20.37     | 133              | 1.50       | Hor      | Ave                |
| 3090       | 3.25          | 0.00             | 3.42               | 30.30                | 36.97          | 54.00          | -17.03     | 0                | 2.04       | Hor      | Ave                |
| 4120       | 4.58          | 0.00             | 5.75               | 31.98                | 42.31          | 54.00          | -11.69     | 270              | 2.10       | Hor      | Ave                |
| 5150       | 6.28          | 0.00             | 8.66               | 33.73                | 48.67          | 54.00          | -5.33      | 348              | 3.81       | Hor      | Ave                |
| 6180       | 3.64          | 0.00             | 9.45               | 35.81                | 48.90          | 54.00          | -5.10      | 64               | 4.00       | Hor      | Ave                |
| 7210       | -1.73         | 0.00             | 8.29               | 37.17                | 43.74          | 54.00          | -10.26     | 176              | 3.75       | Hor      | Ave                |
| 8240       | -1.81         | 0.00             | 7.45               | 37.30                | 42.93          | 54.00          | -11.07     | 0                | 1.78       | Hor      | Ave                |
| 9270       | -1.15         | 0.00             | 5.75               | 37.71                | 42.31          | 54.00          | -11.69     | 235              | 3.35       | Hor      | Ave                |
| 10300      | -1.56         | 0.00             | 5.84               | 38.48                | 42.76          | 54.00          | -11.24     | 360              | 1.40       | Hor      | Ave                |

|                                                                                  |                                                                                                                                                               |                                     |
|----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
|  | <p>1100 E Chalk Creek Road<br/>Coalville, UT 84017<br/>(435) 336-4433<br/>FAX (435) 336-4436<br/><a href="http://www.dnbenginc.com">www.dnbenginc.com</a></p> | <p>20 Sep 2014<br/>UT58018A-002</p> |
|----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|

End of Report: DNB UT58018A-002

|                                |                                               |               |
|--------------------------------|-----------------------------------------------|---------------|
| Document Number<br>8010021-001 | NGT-2500 FCC Compliance Test Plan and Results | Revision<br>- |
|--------------------------------|-----------------------------------------------|---------------|

**END OF DOCUMENT**

|                     |                                                                                                               |  |
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