
	<p>VEGAS</p> <p>Valon Synthesizer RFI Test Report</p>	<p>Doc #: VEGAS-003-A-REP Date: 2013-03-18 Status: Released Page: Page 1 of 10</p>
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Valon Synthesizer RFI Test Report

VEGAS-003-A-REP

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Prepared By:		
Name(s) and Signature(s)	Organization	Date
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Change Record

Version	Date	Affected Section(s)	Change Request #	Reason/Initiation/Remarks
A	2013-03-18	All	-	First release.


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1 Introduction and Scope

1.1 Scope

This document describes the RFI testing of the Valon 5007 dual synthesizer [AD 01], commonly used as the ADC clock source for CASPER-based instruments at NRAO-GB.

The bulk of this document is taken from the original RFI test report, written by Carla Beaudet in November of 2011, with the filename *ValonSynthBoardRFITestReport.doc*.

1.2 Introduction

The Valon 5007 synthesizer has two RF outputs that have a range of 137.5 MHz to 4400 MHz. It can accept an external reference signal, or use its own internal reference. The output level can be adjusted to 0, +3, +6, or +8dBm. It also has on-board flash that can retain the desired settings when power cycled.

Given the high speed digital nature of these synthesizer boards, they produce substantial RFI emissions, as purchased. Also, since these synthesizer units will be primarily used in CASPER hardware based instruments, they will inherently be installed close to the sensitive ADC sampler boards. Due to this close proximity, the RFI emissions from the 5007 boards could couple into, and degrade, the input signals to the ADC boards. These two issues made it necessary to fully shield the synthesizer electronics.


1.3 Abbreviations and Acronyms

ADC	Analog to Digital Converter
CASPER	Collaboration for Astronomy Signal Processing and Electronics Research
EUT	Equipment Under Test
GBT	Green Bank Telescope
NRAO	National Radio Astronomy Observatory
RFI	Radio Frequency Interference
VEGAS	VErsatile GBT Astronomical Spectrometer

2 Documentation

2.1 Applicable documents

No	Document Title	Reference
AD01	Valon Synthesizer for VEGAS	VEGAS-002-A-REP

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AD02	Valon RFI Enclosure mechanical drawing	D35215M006
AD03	Valon RFI Enclosure Lid mechanical drawing	D35215M007

3 RFI Enclosure Features

A custom RFI enclosure [AD 02],[AD 03] was developed to house the Valon 5007. This enclosure consists of an aluminum housing with an RFI-gasketed aluminum lid. The gasket material used for the lid is “SRF gasket material” made by Compac Development Corporation. Figure 1 below shows this gasket installed on the lid.

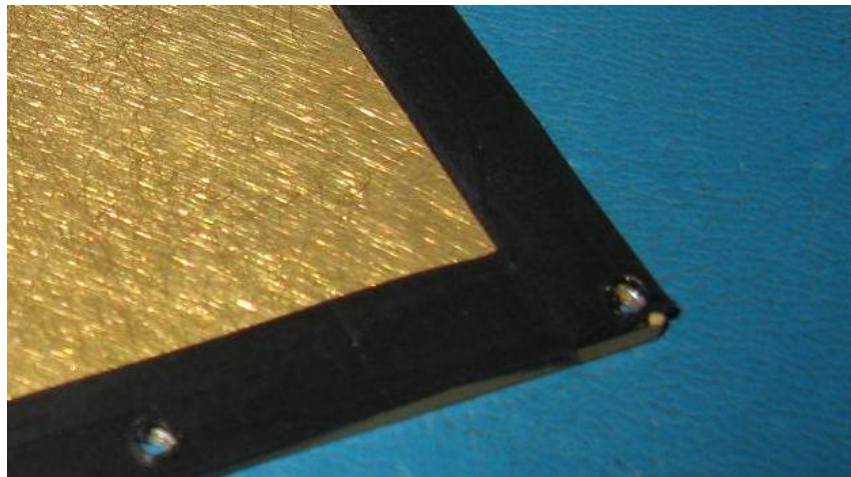


Figure 1 - SRF Gasket Material

Tubular feedthru PI filters are used to bring +12VDC into the box.

SMA bulkhead connectors are used for the reference input and RF outputs of the 5007. Fully shielded cables are used to connect to these ports, and any unused ports are capped off with a 50ohm terminator.

A filtered DB-9 connector is used for the RS232 connection. The RS232 adapter boards were custom ordered with Spectrum Control filtered DB-9 connectors installed in place of the standard connectors. NRAO provided the filter connectors to Valon Technology, which they used to assemble the RS232 boards. Figure 2 shows the RS232 adapter board.

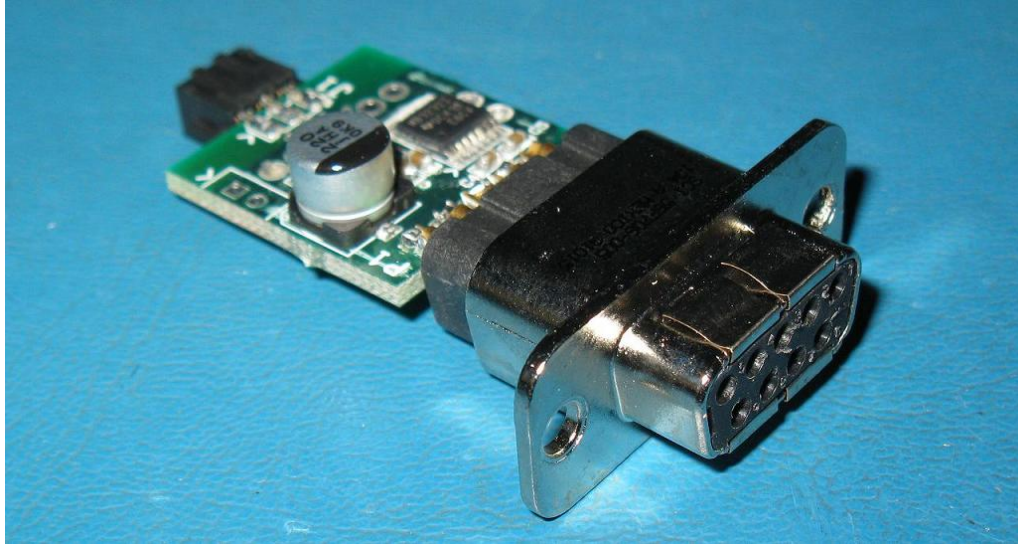


Figure 2 - Valon RS232 Adapter Board

Figure 3 shows the assembled Valon RFI enclosure.



Figure 3 - Valon 5007 RFI Enclosure



4 RFI Test Results

On Tuesday, November 29, 2011, Carla Beudet performed RFI tests on a Valon 5007 Synthesizer Board, henceforth referred to as the EUT, (Equipment Under Test). The board was installed in a shielded box, with a 400 pF PI filter on the serial programming port, and two AB001 tubular cap filters on the 12VDC input. The reference signal input (10MHz) enters the box on a SMA connector, and the two synthesizer outputs were also on SMA's and were 50 Ohm terminated. The EUT is intended for installation in zone 2 in the Jansky Lab shielded rooms at a distance of 1801 m from the GBT, and with 40dB of shielding allowance.

For testing purposes, a power supply and a 10MHz input signal generator were housed in the quiet box, and connected to the EUT via filtered and coaxial connections, respectively. The EUT was verified to have locked onto its input signal before the box containing it was sealed. The device allows for four pre-programmed output power level settings, and was set to the highest one, +8dBm. The EUT was tested in the anechoic chamber at a distance of 7m from the receive antenna over the range 20 MHz to 1 GHz using the EM-6950 log periodic antenna, and from 1GHz to 4 GHz using the EM-6961 horn antenna. Between 20 MHz and 4 GHz, the only emission seen from the EUT was the intentionally generated 1500 MHz. We proceeded to replace the two AB001 tubular cap filters on the 12VDC input with two SCI-1720-016 tubular PI filters, and were able to quiet the 1500 MHz emission to a level below that of the measurement system noise floor. The resolution bandwidth used for all measurements was 10 kHz. Spectral plots of the emissions follow:

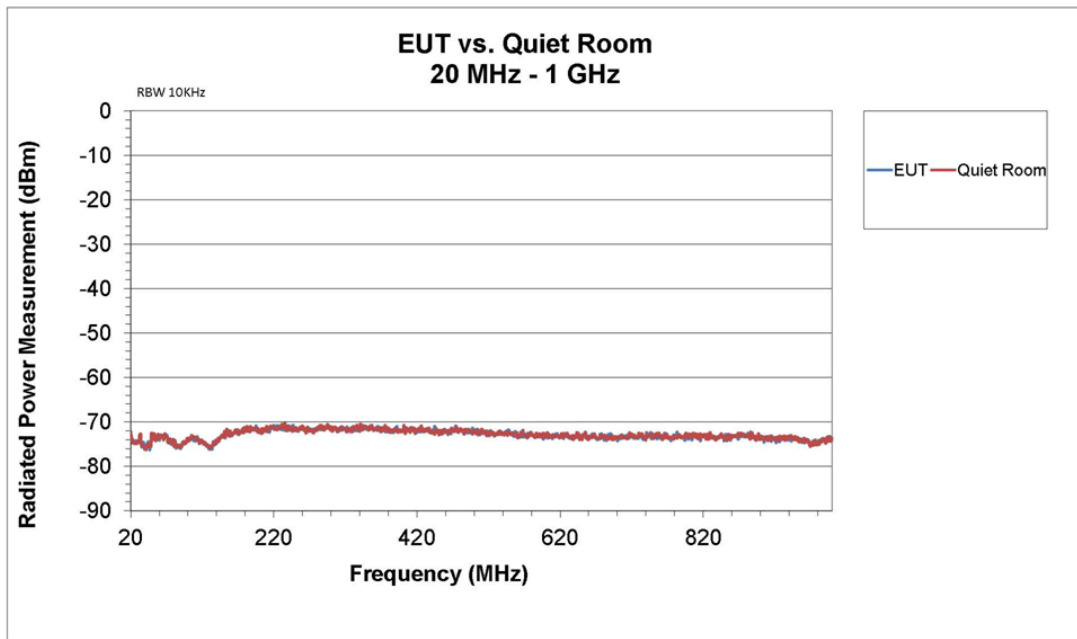


Figure 4 - EUT vs Quiet Room, 20 MHz – 1 GHz



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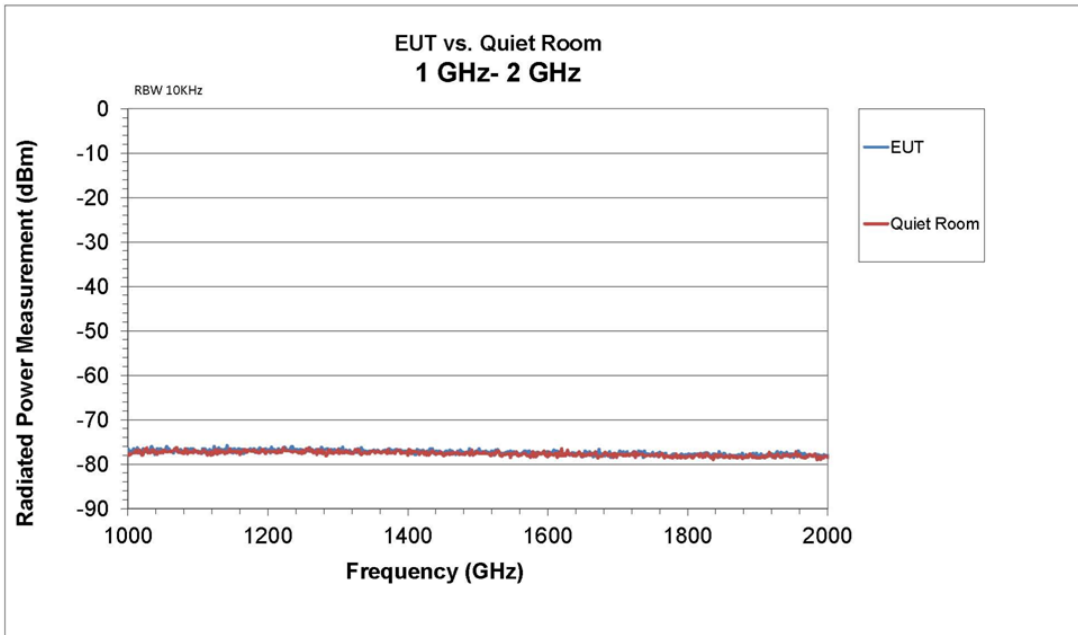


Figure 5 - EUT vs Quiet Room, 1 GHz – 2 GHz

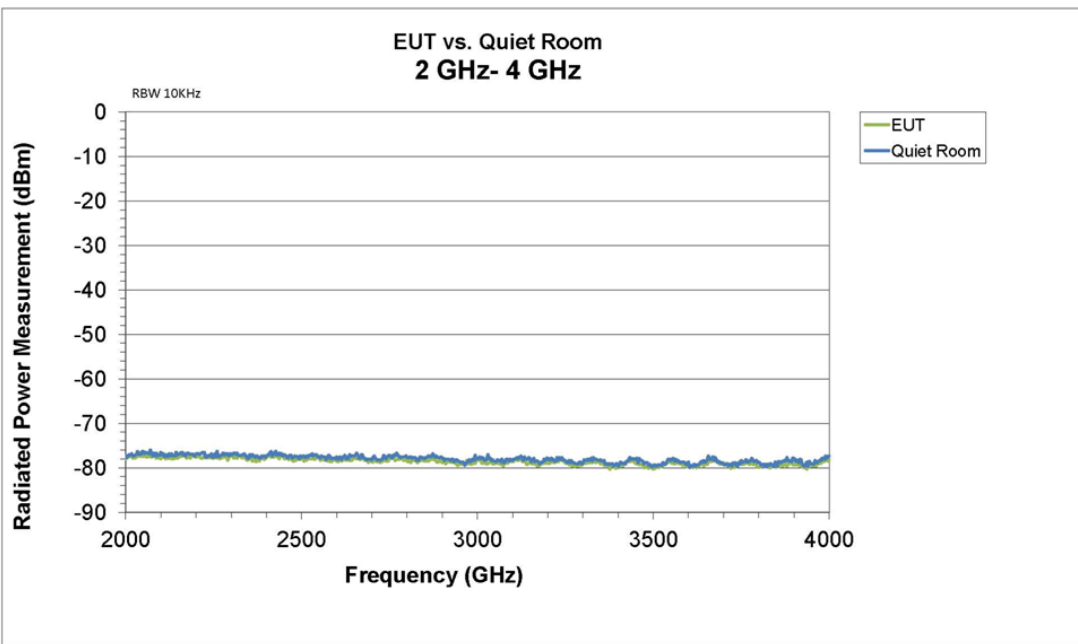



Figure 6 - EUT vs Quiet Room, 2 GHz - 4 GHz

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In Zone 2, installed equipment falls into three categories:

- a. **Equipment that runs continuously:** Equipment that runs continuously includes equipment that is vital to the operation of the facility, for example, equipment responsible for the climate control of the buildings, security equipment, etc. This category also includes equipment used to operate and take data from the RA instruments, the LAN equipment, plus any other equipment that is intentionally, or in practice, left running continuously. Personal computers are not included in this category; see (c). This category of electrical equipment is subject to the same limits as equipment in Zone 1, and must be contained in a filtered, shielded enclosure which provides sufficient attenuation of its emissions to bring it into compliance with these limits.
- b. **High-Risk Equipment:** Equipment that is not run continuously but has very strong (>25dB over limit) emissions and/or a long duty cycle must be contained in a filtered, shielded enclosure which provides sufficient attenuation of its emissions to bring it into compliance with the Zone 1 limits. Microwave Ovens are one example in this category.
- c. **Equipment that is powered down when not in use:** This category includes non-compliant, but still low-risk equipment that is operated on a temporary basis and not left running while not in use. Since the emissions of a typical PC located in the Jansky Laboratory exceed the limit at the GBT, it is part of this policy that the staff of NRAO Green Bank must power down their PC's and other office equipment on a daily basis when they leave work. This practice provides a lower-risk window for observations in the evening hours.

The EUT classifies as Zone 2, category a. equipment because it will be necessary for astronomical observations. In summary, the EUT has been quieted to the noise floor of the measurement setup and is recommended for installation in Zone 2.

Note #1: No allowance was made for shielding from incidental structure.

Note #2: RFI limits to radio astronomy are found J. R. Fisher's report "RFI Radiation Limits in the Vicinity of the GBT" dated May 9, 1997.

Note #3: Methods & calculations used for RFI tests are established by J. R. Fisher's report of August 1994, "Evaluation of Electrical Device Interference Potential to Radio Astronomy Observations."