Test Procedure Addendum

This addendum details the computation of the proper input stimuli for a Sirius Satellite Radio transceiver, based on the XM Satellite Radio FCC approved test procedure and stimuli.

1.) Satellite Receive Antenna Characteristics:

    In this SIRIUS transceiver, the satellite receive antenna (which feeds the transmitter) has an in-band passive gain of **+5 dBi** and an effective active gain of **+25 dB** (low noise amplifier gain minus cable loss), resulting in a **receive chain gain of +30 dB, 5 dB more than the receive chain gain of the device detailed in the XM Satellite Radio FCC approved test procedure.** The manufacturer also states that the antenna used in both the XM and SIRIUS receive antenna modules are identical, and exhibit **the same front to back ratio**. The following section details the effect on test stimuli applied.

2.) The XM Satellite Radio FCC approved test procedure details the stimuli that must be applied to an XM transceiver to demonstrate compliance. However, the current DUT is a SIRIUS transceiver with increased receive chain gain. The following table details how the stimuli are modified appropriately:

Stimuli	Amplitude @ XM Transceiver (dBm)	Amplitude with Receive Chain Gain Removed (-27 dB)	SIRIUS Receive Chain Gain (dB)	Amplitude @ SIRIUS Transceiver (dBm)
XM Base Satellite Signal	-66	-93	30	**-63**
XM Satellite Signal	-55 to –75	-82	30	**-52 to -72**
SIRIUS Satellite Signal	-60 to –80	-87	30	**-57 to -77**
XM Terrestrial Signal	-20 to –70	-47	30	**-17 to -67**
Sirius Terrestrial Signal	-20	-47	30	**-17**

In addition, spurious stimuli is computed for the SIRIUS receiver as on Page 8 of the test procedure, resulting in:

f_{sirius} = 2326.25 MHz
$\lambda = 3x10^8/f = 0.129$

$$Pr = ((500\ uV/m)^2/377 \times (0.129\ m)^2 \times (0.0794)) / (4\ \pi)$$
$$= 6.97 \times 10^{-11}\ mW$$
$$= -101.6\ dBm$$

The SIRUS home antenna has an active gain of +25 dB, resulting in a required spurious stimuli of **-76.6 dBm into the device.**

4 Specific Design Information

4.1 Automatic Gain Control (AGC) and Output Power

Through the use of wide-band AGC control (detector bandwidth > 50 MHz), the repeater design can be made to set the transmit power at a level which will comply with FCC requirements in any SDARS source signal condition. The AGC function will respond equally to any input energy in the SDARS band.

The AGC has been set up to limit the output power to +12.75 dBm under all conditions. This will effectively limit the power of the transmitted E field to be within F.C.C. requirements. This is based upon the analysis below.

The relationship between power and |E| is known to be as follows (in linear terms):

Pt * Gt = ((|E|^2/377) * 4 * pi * R^2))

where:

Pt = transmitter power Gt = transmitter antenna gain |E| = magnitude of transmitted electric field at a distance R from transmitter R = distance from transmitter

From a bandwidth perspective, the worst-case valid signal (in terms of minimum bandwidth) expected at the input to the repeater will be the case where only one Sirius satellite is received. The overall transmit bandwidth of a Sirius satellite is 4.1 MHz. For the equation above, it is desirable to work in a 120 kHz bandwidth. This effectively factors down the power by 4100 / 120 which equals 34.167. (Note that the SDARS spectra is essentially flat and uniform for calculation purposes.)

Pt' = +12.75 dBm (18.83 mW)

Pt = 18.83 mW / 34.167 = .55 mW (worst-case power in a 120 kHz bandwidth).

Gt = 1 (maximum linear gain of transmit antenna)

R = 3 m (distance from D.U.T. used for F.C.C. electric field measurements)

Solving for |E|: |E| = 42.81 mV/m

The F.C.C. limit per 15.249 is 50 mV/m in a 120 kHz bandwidth. Thus, the unit is designed to limit power appropriately under worst-case conditions.

4.2 Out-Of-Band Filtering

The design strategy to be utilized for this product will be to limit emissions outside the ISM band to be below the 15.209 limit (200uV/m) under all valid input conditions. In order to accommodate this, substantial filtering has been designed into the transmitter to limit emissions to only be in the ISM band.

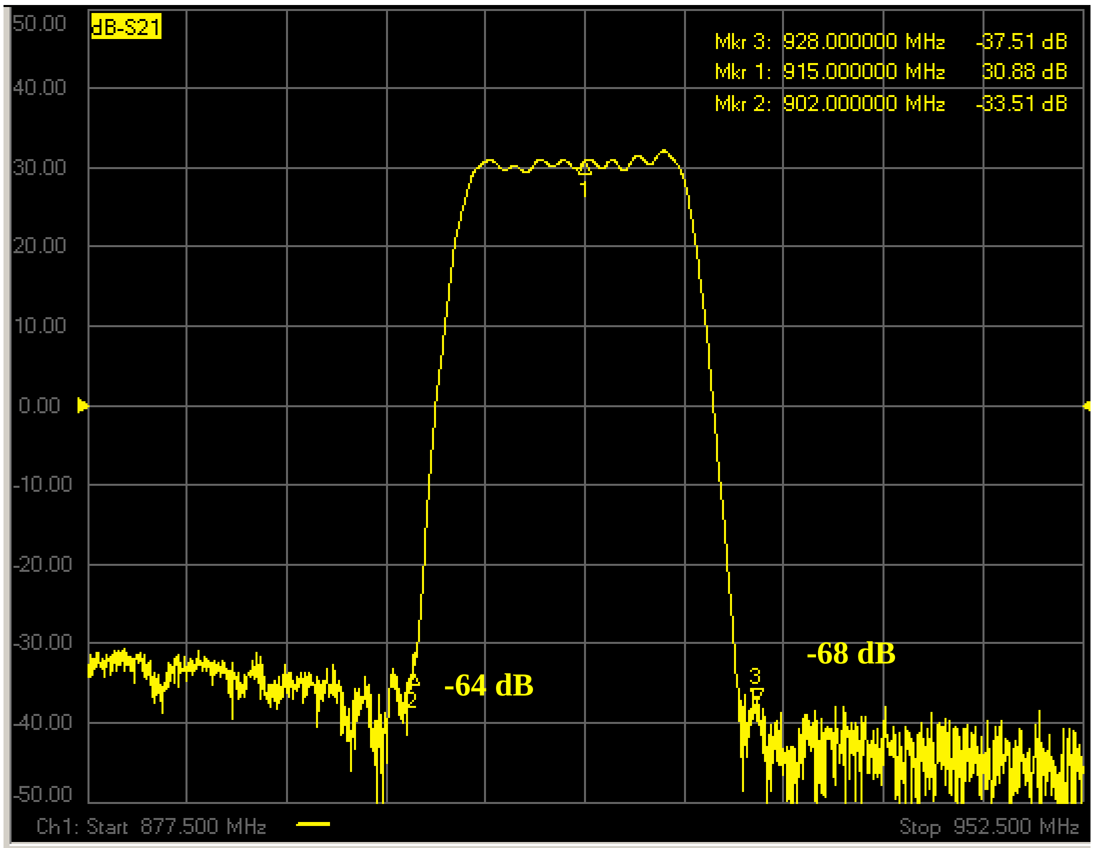

Figure 4: Transmitter Filter Response

Per Figure 4, the rejection at 902 MHz is 64 dB and rejection at 928 MHz is 68 dB. This will provide excellent ability of the device to only transmit signals that are in the SDARS band as well as limiting emissions to be specifically in the ISM band.

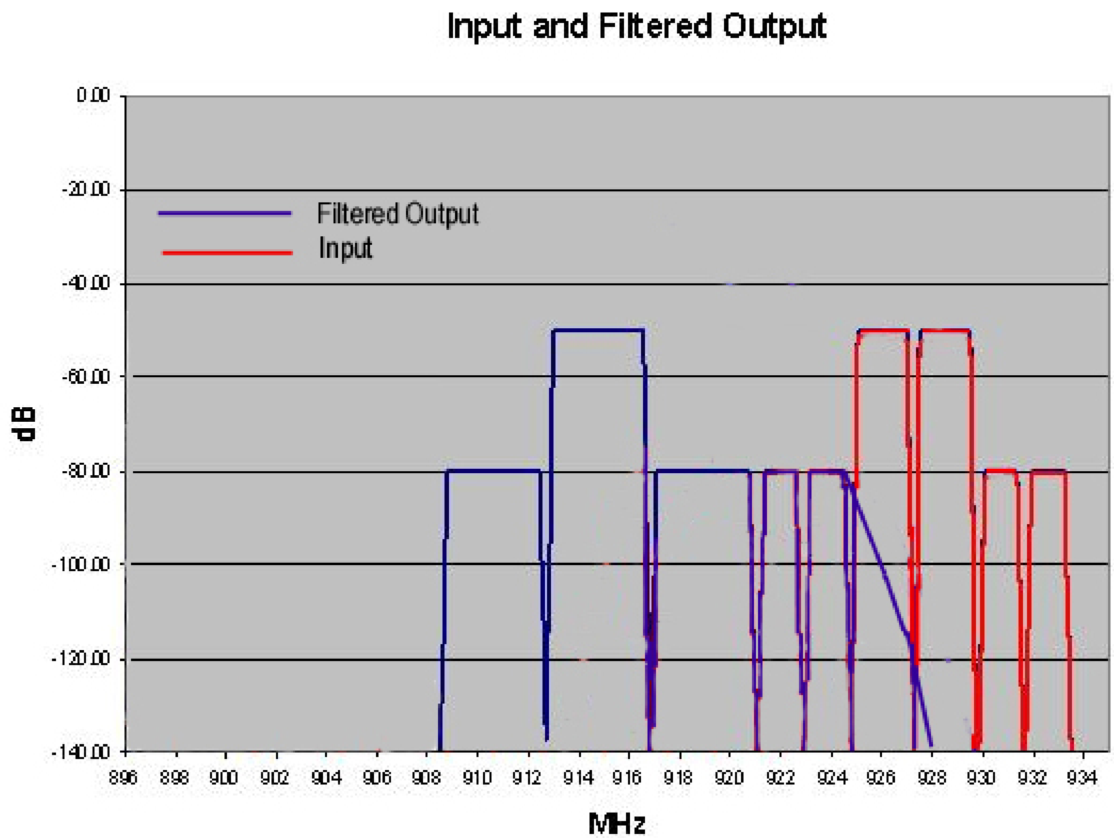

Figure 5: Signal Filtering Example

As a further clarification of the signal filtering characteristics, Figure 5 shows an example relative received SDARS spectrum and the effective filtering operation that is imposed upon the input signal. As can be seen from the figure, the following occurs:

a) The low-frequency satellite content of XM is allowed.
b) The XM OFDM signal is heavily filtered.
c) Any spurious tones that land outside the ISM band will be heavily filtered.