Keywords: MAX2140,SDARS,XM,XM Radio,satellite,direct broadcast

APPLICATION NOTE 3851

SDARS MAX2140 XM Radio Tuner Solution

Jun 26, 2006

Abstract: The following note introduces the SDARS XM radio tuner solution using MAX2140, including basic RF to demodulator block, signal path from antenna to demodulator, features of the MAX2140 tuner and some critical RF specifications of an SDARS receiver.

Introduction

Satellite digital audio radio service (SDARS) is a satellite-based direct-broadcast radio service. In SDARS, digitally encoded audio entertainment material, is broadcast to earth-based receivers either directly from an orbiting satellite, or in cases in which the receiver is in a shielded location from the satellite, to the receiver via a repeater station. Maxim's MAX2140 is a complete RF to base-band SDARS receiver.

Wireless Technology Overview

Click here for an overview of the wireless components used in a typical radio transceiver.

Complete SDARS Receiver MAX2140

MAX2140 complete receiver is designed for SDARS, and includes the following features:
* Integrated receiver requiring only one SAW filter
* Self-contained RF AGC Loop
* Differential I/Q interface
* Complete integrated frequency generation
* Bias supply for external LNAs
* Over-current protection
* Low power standby mode
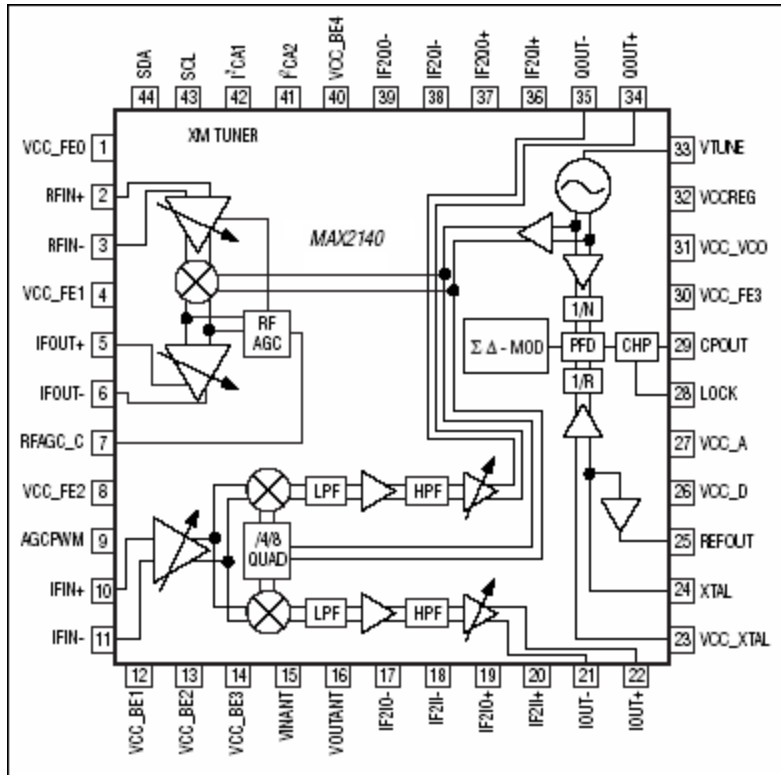
Figure 1 shows the MAX2140 block diagram.

Figure 1. MAX2140 Block diagram/pin configuration.

XM Radio Tuner Block Diagram

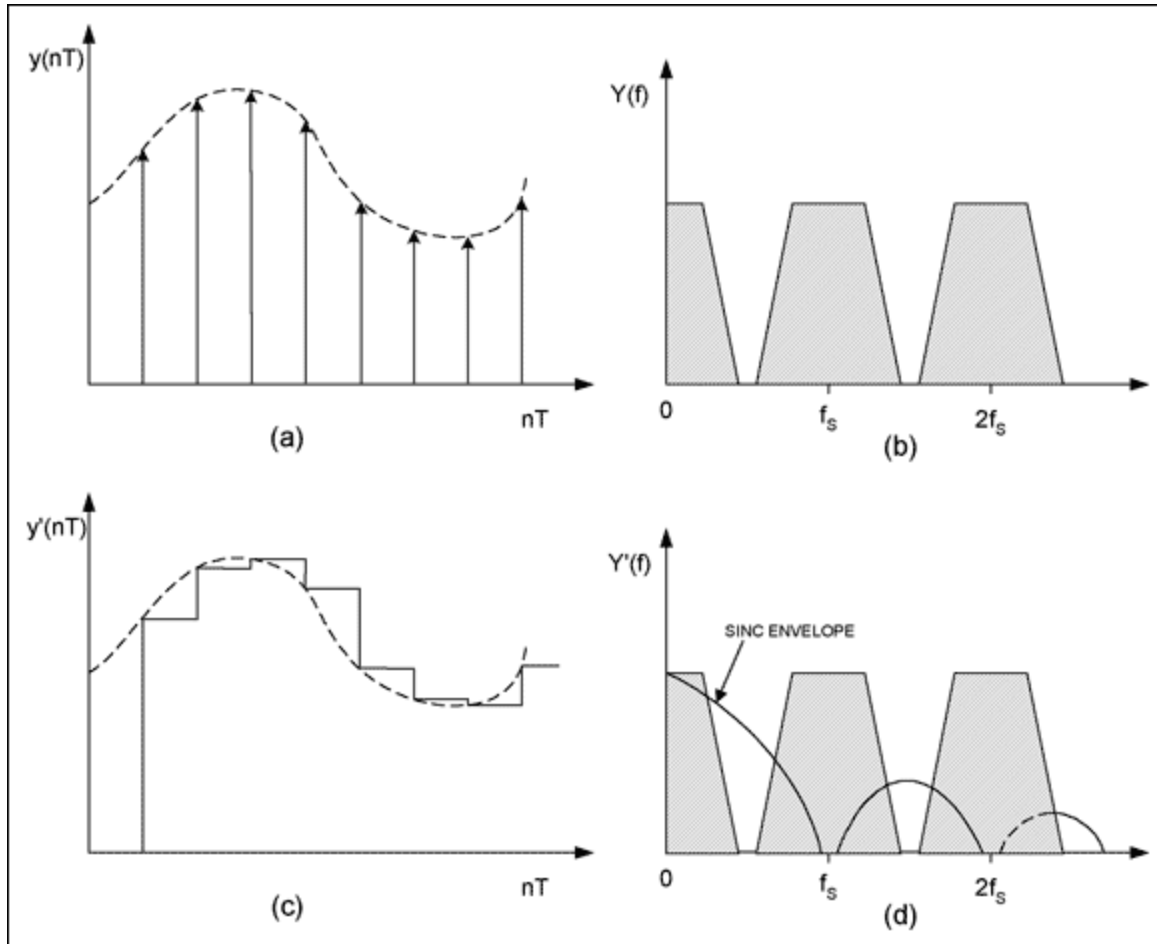An RF input to Demodulator block diagram is shown as the following **Figure 2**.

Figure 2. SDARS radio tuner block diagram.

- The audio signal is first received by antenna, and in order to satisfied the sensitivity requirement an external low-noise amplifier (LNA) is required, which can be controlled by a base-band controller;
- This tuner includes a self-contained RF AGC loop and baseband-controlled IF AGC loop, effectively providing a total dynamic range of over 92dB. The operation of IF AGC and RF AGC is shown as Annex A;
- Channel sensitivity is ensured by SAW filter and by on-chip monolithic low-pass filters. High-pass filters are also inserted in the back-end signal paths, which removes DC offset;
- In order to achieve sufficient image rejection, this IC includes an image reject mixer which also ensures good half IF rejection;
- The fractional-N PLL allows a very small frequency step, making possible the implementation of an AFC loop. Additionally, the reference is provided by external XTAL and on-chip oscillator. A reference buffer output is also provided.

Specifications of SDARS Tuner

1. Frequencies and Channel Bandwidth

XM is assigned 12.5MHz of spectrum range from 2332.5 to 2345MHz centered on 2338.75MHz. This spectrum is roughly divided into sixths. Four bands are assigned to the transmitting satellite and two are assigned to a terrestrial repeater network.
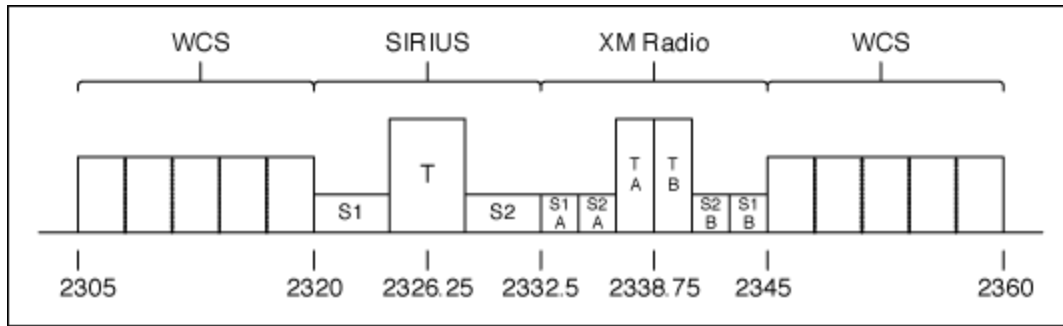
Figure 3. SDARS frequency bands.

2. Modulation

Satellites use QPSK modulation and Repeaters use COFDM modulation to realize the requirements of terrestrial broadcasting.

3. RF Specifications for the MAX2140

Table 1. MAX2140 RF specifications (see data sheet for more info.)

PARAMETER	CONDITIONS	TYPICAL	UNITS
Frequency	SDARS Band	2320 to 2345	MHz
Channel Bandwidth		12.5	MHz
Input Power Range	Over RF and IF AGC Range	-91 to +3	dBm
Noise Figure	RF AGC is at maximum gain. IF AGC is at reference	8.5	dB
Out-of-Band Input IP3	At Maximum Gain	-9	dBm
Out-of-Band Input IP2	At Maximum Gain	+38	dBm

Annex A : the operation of IF AGC and RF AGC
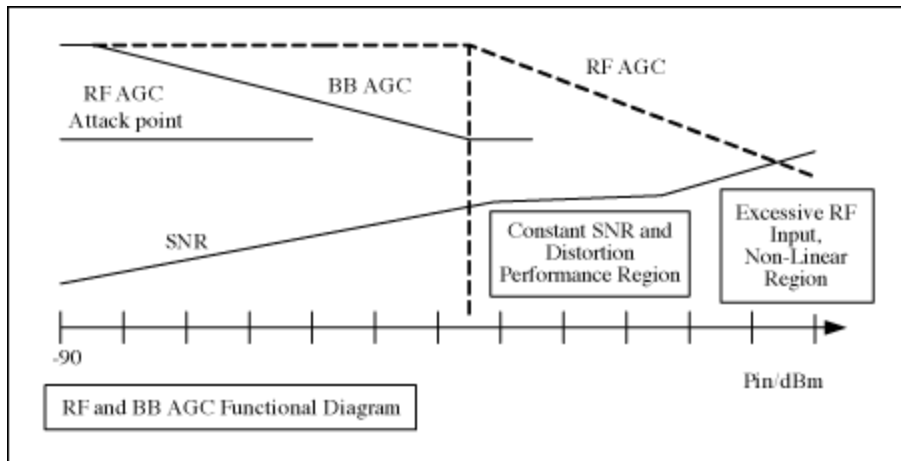
Related Parts	
MAX2140	Complete SDARS Receiver

More Information

For Technical Support: http://www.maximintegrated.com/support
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