Keywords: satellite tuner ic, MAX2120, DVB-S tuner

REFERENCE DESIGN 4178 INCLUDES: √Tested Circuit √Board Available √Description √Test Data

DVB-S Half-NIM Tuner Reference Design Uses the MAX2120 Tuner

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Abstract: This reference design is a commercial Half-NIM DVB-S tuner that uses Maxim's MAX2120 satellite tuner IC. The reference design connects to the motherboard through a 12-pin connector. The downconverted satellite signal from the LNB is supplied to an active, discrete loop-through, which splits the signal into two paths. One signal goes to the MAX2120 and the other provides an additional output from the STB.

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

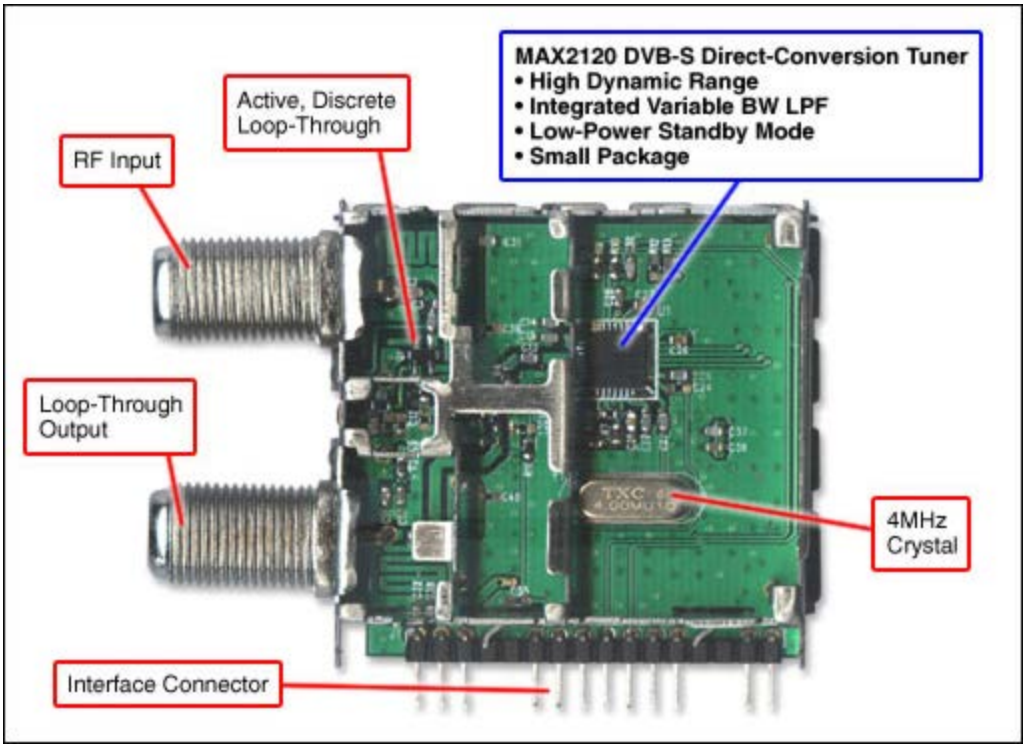

Figure 1. DVB-S Half-NIM reference design features the MAX2120 tuner.

Important Design Features

- A Popular Form Factor Often Used in the Chinese DVB-S Market; Can Be Adopted Without Physical Modifications
- Active Loop-Through Using a Discrete LNA
- LNB 12V Power Feed-Through

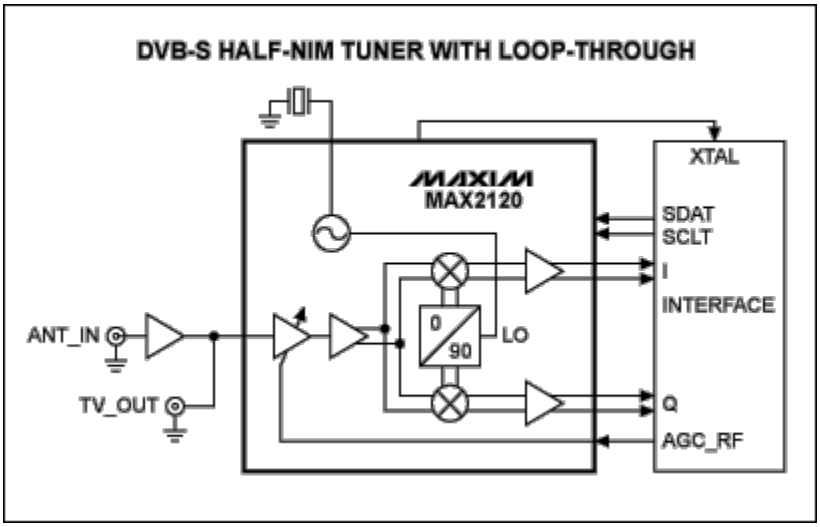

Figure 2. System block diagram.

Lab Measurements

Supply Current

Parameter	Conditions	Measured	Units
Supply Current	LNA supply 3.3V, T_a = +25°C	26	mA
	LNA + MAX2120 3.3V, T_a = +25°C	115	mA

Main Signal Path Performance

Test conditions include V_{CC} =+3.3V; RF input signals as specified in the following table; default register settings; and T_a = +25°C.

Parameter	Test Conditions	Frequency	Measured	Target	Units
RF Input Frequency		950 to 2150	—	—	MHz
Input Return Loss (75Ω system)	Measure at input port	—	< -6	< -6	dB
Overall Voltage Gain	Unbalanced source impedance = 75Ω, GC1 = 0.5V and GC2 = +15dB	1050MHz	91	> 80	dB
		1550MHz	88		
		2150MHz	83		
Noise Figure	GC2 = +10dB, GC1 = 0.5V	1050MHz	5.5	< 7	dB
		1650MHz	5.54		
		2150MHz	7.45		
I/Q Amplitude Error	Measured at 2MHz; filter bandwidth set to 22MHz	—	0.25	< ±1	dB
I/Q Quadrature Phase Error	Measured at 2MHz; filter bandwidth set to 22MHz	—	< 2.5	< 3.5	Deg
IIP3 (In Band)	GC1 set to provide the nominal baseband output drive when mixing down a -23dBm tone at 2055MHz to 5MHz baseband (f_{LO} = 2050MHz). GC2 set for 7dB gain. Two tones at -26dBm each are applied at 2056MHz and 2060MHz. The IM3 tone at 2MHz is measured at baseband.	—	-1.5	-2	dBm
IIP3 (Out of Band)	GC1 set to provide the nominal baseband output drive when mixing down a -23dBm tone at 2055MHz to 5MHz baseband (f_{LO} = 2050MHz). GC2 set for 7dB gain. Two tones at -20dBm each are applied at f_{LO} -100MHz and f_{LO} -195MHz. The IM3 tone at 5MHz is measured at baseband.	—	10	5	dBm

IIP2 (Broadband)	GC1 set to provide the nominal baseband output drive when mixing down a -23dBm tone at 2175MHz to 5MHz baseband (f_{LO} = 2170MHz). GC2 set for 7dB gain. Two tones at -20dBm each are applied at 925MHz and 1250MHz. The IM2 tone at 5MHz is measured at baseband.	—	12.5	14	dBm
Phase Noise	1kHz offset, f_{LO} =1000MHz	—	-73.3	-70	dBc/Hz
	10kHz offset, f_{LO} = 1000MHz		-85.6	-82	
	100kHz offset, f_{LO} = 1000MHz		-108.1	-102	
	1MHz offset, f_{LO} = 1000MHz		-120.8	-122	
Local Oscillator Signal Leakage at RF Input Terminal	Measured at RF input port with 50MHz increment step from 925MHz to 2175MHz	—	< -80	< -63	dBm

Loop-Through Performance

Parameter	Conditions	Measured	Target	Units
Frequency Range	925MHz to 2175MHz	—	—	MHz
Return Loss at TV_OUT	Antenna input terminated with 75Ω	< -6	< -6	dB
Power Gain at TV_OUT	—	-0.4 to 2.8	-1 to 3	dB
Noise Figure at TV_OUT	—	< 5.5	< 6	dB
TV_OUT to ANT_IN Isolation	—	35.1	35	dB

System Performance

DVB-S system measurements for the MAX2120 Half-NIM are made by connecting to a DVB-S demodulator.

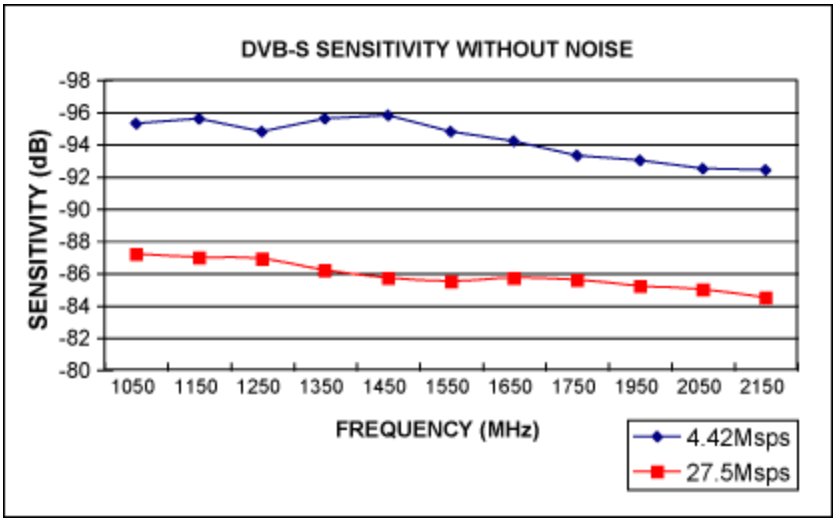

Figure 3. The DVB-S sensitivity without noise is better than -92.5dBm for 4.42Msps, and better than -84dBm for 27.5Msps across the band.

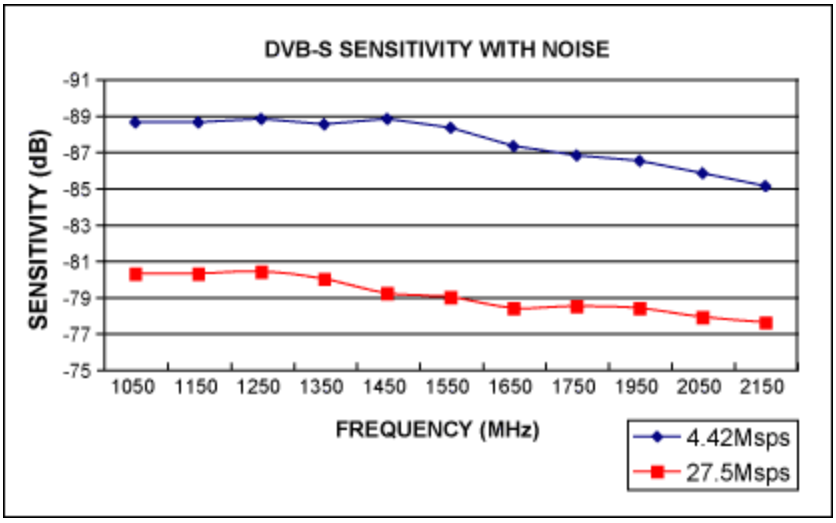

Figure 4. When noise is added, the DVB-S sensitivity is better than -85dBm for 4.42Msps, and better than -77.5dBm for 27.5Msps across the band. For this case, AWGN noise is added with C/N = 5dB. For the 4.42Msps data rate, the noise bandwidth is 5.7MHz; for the 27.5Msps data rate, the noise bandwidth is 35.2MHz.

Detailed Description

This MAX2120 reference design is a compact Half-NIM DVB-S tuner for satellite STB applications. The design covers the RF range from 925MHz to 2175MHz. The MAX2120 is a fully integrated silicon tuner, which includes a LNA, RF and IF VGAs, a mixer, and a variable-bandwidth LPF in the baseband stage. The tuner is powered by a single 3.3V supply. A small number of passive components are needed to form a complete DVB-S RF front-end solution.

Related Parts

MAX2120	Complete, Direct-Conversion Tuner for DVB-S and Free-to-Air Applications	Free Samples

More Information
For Technical Support: http://www.maximintegrated.com/support
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Application Note 4178: http://www.maximintegrated.com/an4178
REFERENCE DESIGN 4178, AN4178, AN 4178, APP4178, Appnote4178, Appnote 4178