Keywords: MAX3580, DVB-T, direct-conversion tuner

May 12, 2008

APPLICATION NOTE 4173

MAX3580 DVB-T Reference Design

Abstract: The MAX3580 DVB-T reference design meets NorDig and MBRAI requirements. This NIM design includes the MAX3580 direct-conversion tuner and a COFDM DVB-T demodulator. A discrete, active loop-through with low power consumption and low cost is included.

More Information
- Wireless Home
- Application Notes and Tutorials
- EV Kit Software
- Technical Support

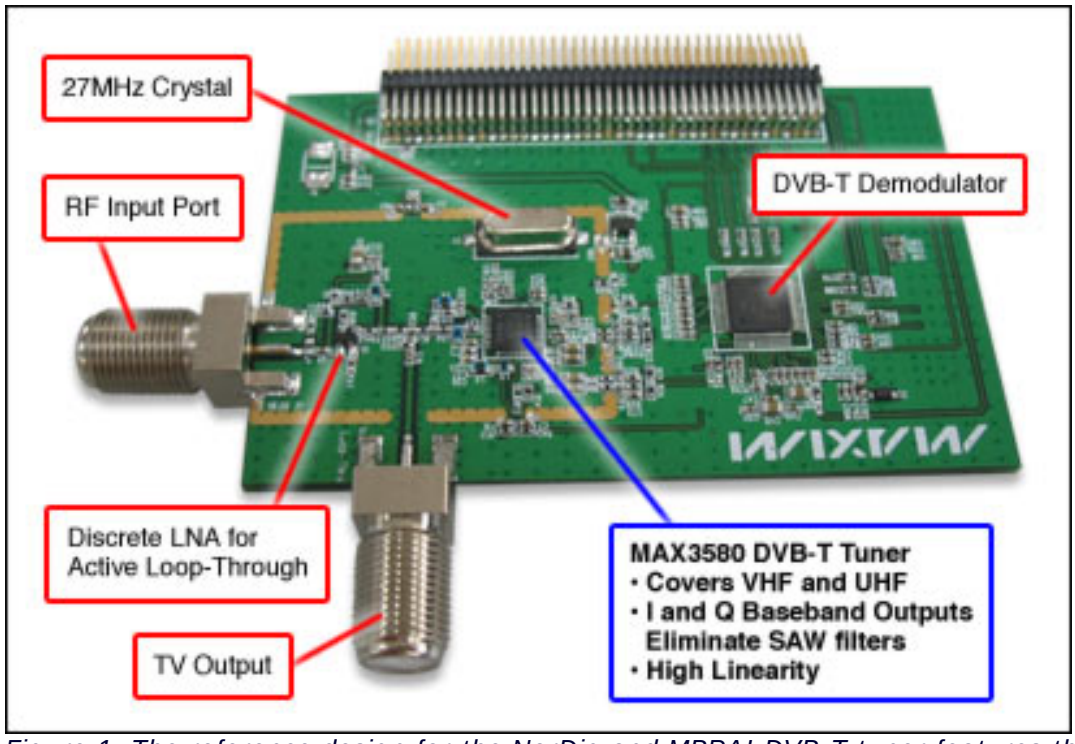

Figure 1. The reference design for the NorDig and MBRAI DVB-T tuner features the MAX3580.

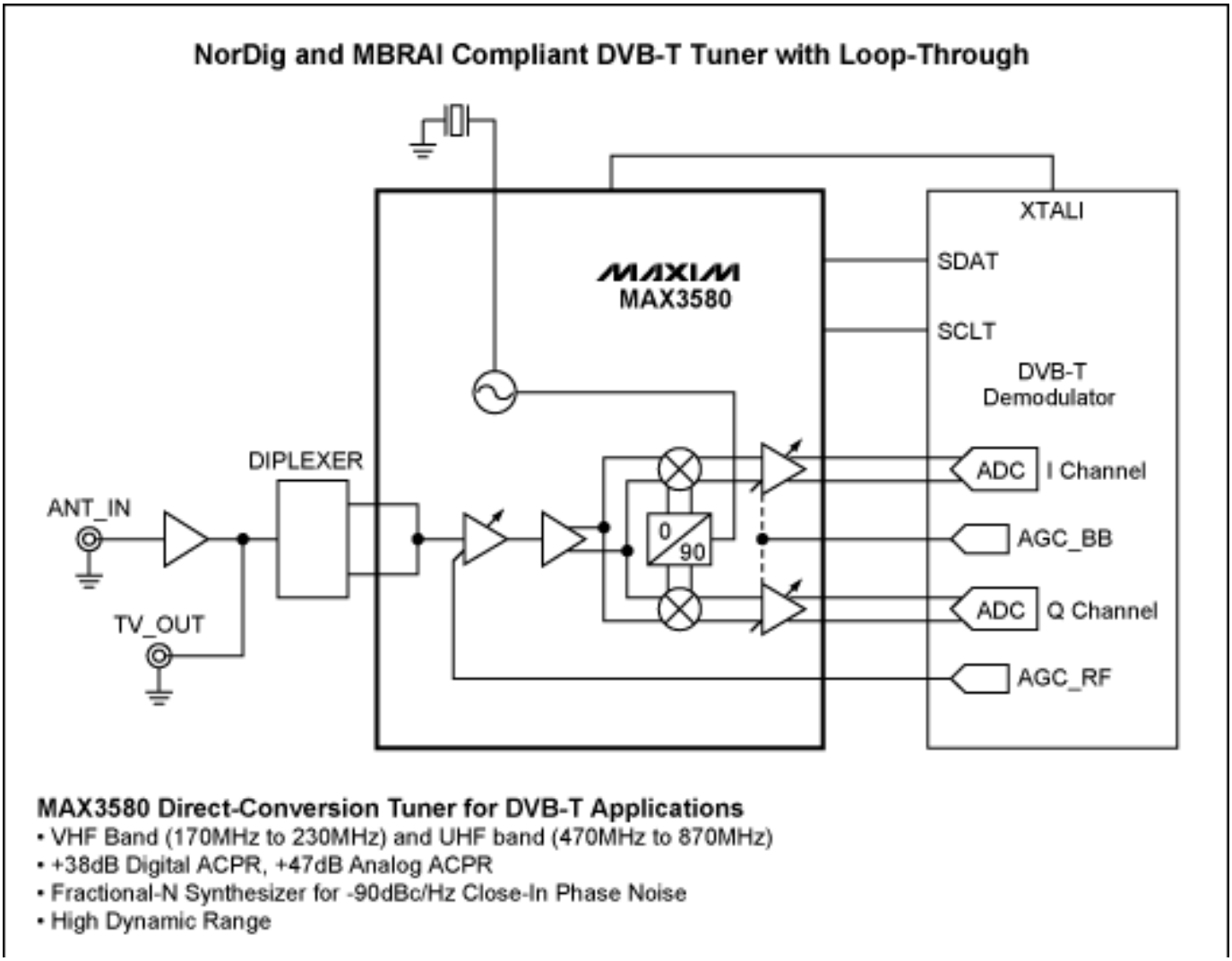

Figure 2. System block diagram.

Lab Measurements

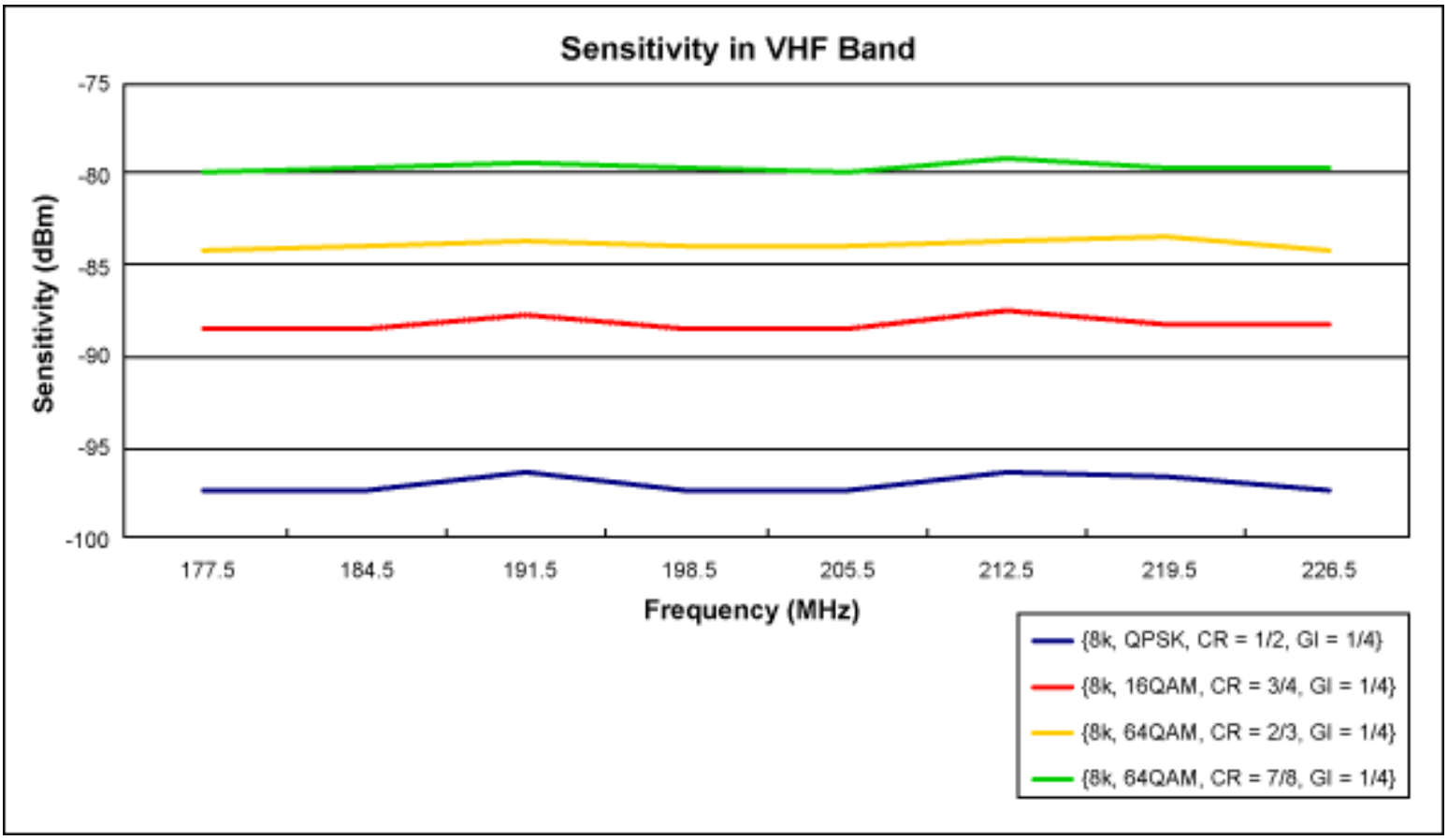

Figure 3. Data shows that there is at least 2dB margin to NorDig 1.0.2 in the VHF band.

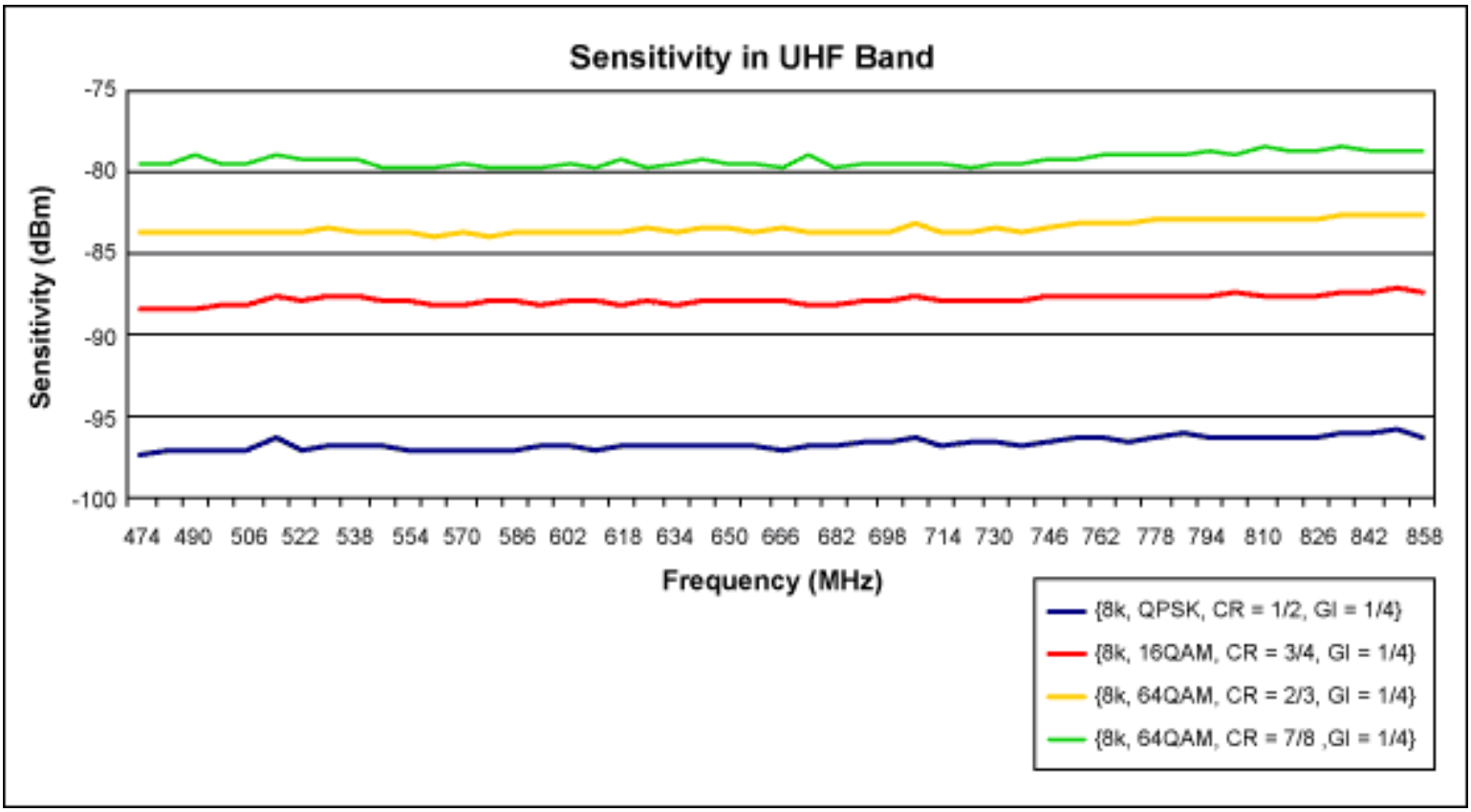

Figure 4. Here the data shows that there is 3.5dB to about 5dB margin to NorDig 1.0.2 in the UHF band.

NorDig Compliance

Parameter	Conditions	Measured	NorDig	Units
Operating Frequency Range	VHF-III Band: 170MHz to 230MHz	–		
	UHF Band: 470MHz to 870MHz	–		
Sensitivity, Gaussian Channel (VHF-III Band)	QPSK, 8k, CR = 1/2, GI = 1/4	-97.3	-94.6	dBm
	16QAM, 8k, CR = 3/4, GI = 1/4	-88.5	-85.1	
	64QAM, 8k, CR = 7/8, GI = 1/4	-79.6	-77.2	
Sensitivity, Gaussian Channel (UHF Band)	QPSK, 8k, CR = 1/2, GI = 1/4	-96.6	-92.1	dBm
	16QAM, 8k, CR = 3/4, GI = 1/4	-87.9	-82.6	
	64QAM, 8k, CR = 7/8, GI = 1/4	-79.6	-74.7	
Maximum Input, Gaussian Channel (VHF-III Band)	64-QAM, 8k, CR = 2/3, GI = 1/8	> 0	-35	dBm
	64-QAM, 8k, CR = 2/3, GI = 1/4	> 0	-35	
	64-QAM, 8k, CR = 3/4, GI = 1/8	> 0	-35	
Maximum Input, Gaussian Channel (UHF Band)	64-QAM, 8k, CR = 2/3, GI = 1/8	> 0	-35	dBm
	64-QAM, 8k, CR = 2/3, GI = 1/4	> 0	-35	
	64-QAM, 8k, CR = 3/4, GI = 1/8	> 0	-35	
Adjacent Channel Selectivity	N+1 DVB-T adjacent channel	47	≥ 28	dBc
	N-1 DVB-T adjacent channel	45		
	N+2 DVB-T adjacent channel	47.8	≥ 38	
	N-2 DVB-T adjacent channel	46		

MBRAI Compliance

	Case	Category	Measure	MBRAI	Units
Selectivity, S1 Pattern	N+1	Category a, b1	48	37	dBc
	N+1	Category b2, c	45	37	dBc
	N-1	Category a, b1	54	37	dBc
	N-1	Category b2, c	51	37	dBc
	N+2	Category a, b1	47	37	dBc
	N+2	Category b2, c	55	37	dBc
	N-2	Category a, b1	45	37	dBc
	N-2	Category b2, c	58	37	dBc
Selectivity, S2 Pattern	N+1	Category a, b1 and b2, c	39	29	dBc
	N-1	Category a, b1 and b2, c	38	29	dBc
	N+2	Category a, b1	43	40	dBc
	N+2	Category b2, c	45	40	dBc
	N-2	Category a, b1	42	40	dBc
	N-2	Category b2, c	44	40	dBc
Linearity L1	–	Category a, b1	45.5	45	dBc
	–	Category b2, c	47	45	dBc
Linearity L2	–	Category a, b1	45.2	45	dBc
	–	Category b2, c	47	45	dBc
Linearity L3	–	Category a, b1	40.7	40	dBc
	–	Category b2, c	42	40	dBc

Sensitivity Details for all Modes

Seven Channels are selected to test the sensitivity for all DVB-T modes.

		VHF		UHF				
	Frequency (MHz)	177.5	226.5	474	570	674	770	858
QPSK, 8k, CR = 1/2, GI = 1/4	Sensitivity (dBm)	-97.3	-97.3	-97.2	-97.1	-96.7	-96.5	-96.2
	Max-Input (dBm)	> 0	> 0	> 0	> 0	> 0	> 0	> 0
QPSK, 8k, CR = 2/3, GI = 1/4	Sensitivity (dBm)	-95.9	-95.7	-95.7	-95.6	-95.3	-94.9	-94.8
QPSK, 8k, CR = 3/4, GI = 1/4	Sensitivity (dBm)	-94.8	-94.8	-94.7	-94.6	-94.5	-94.1	-94
QPSK, 8k, CR = 5/6, GI = 1/4	Sensitivity (dBm)	-93.8	-93.7	-93.6	-93.6	-93.3	-93	-92.8
QPSK, 8k, CR = 7/8, GI = 1/4	Sensitivity (dBm)	-93.3	-93.1	-93.1	-92.7	-92.7	-92.4	-92.2
16QAM, 8k, CR = 1/2, GI = 1/4	Sensitivity (dBm)	-91.7	-91.7	-91.5	-91.5	-91.4	-90.9	-90.7
16QAM, 8k, CR = 2/3, GI = 1/4	Sensitivity (dBm)	-89.8	-89.7	-89.5	-89.5	-89.3	-88.9	-88.8
16QAM, 8k, CR = 3/4, GI = 1/4	Sensitivity (dBm)	-88.6	-88.3	-88.4	-88.1	-88.1	-87.5	-87.3
16QAM, 8k, CR = 5/6, GI = 1/4	Sensitivity (dBm)	-87.1	-87	-87	-86.9	-86.9	-86.4	-86.3
16QAM, 8k, CR = 7/8, GI = 1/4	Sensitivity (dBm)	-86.4	-85.7	-86.1	-85.9	-85.7	-85.4	-85.6
64QAM, 8k, CR = 1/2, GI = 1/4	Sensitivity (dBm)	-87	-86.9	-86.9	-86.6	-86.7	-86.2	-85.9
64QAM, 8k, CR = 2/3, GI = 1/4	Sensitivity (dBm)	-84.1	-84.1	-83.8	-83.8	-83.7	-83.3	-83.2
64QAM, 8k, CR = 3/4, GI = 1/4	Sensitivity (dBm)	-82.5	-82.2	-82.3	-82.4	-81.8	-81.5	-81.4
64QAM, 8k, CR = 5/6, GI = 1/4	Sensitivity (dBm)	-80.9	-80.9	-80.7	-80.7	-80.4	-80.2	-79.8
64QAM, 8k, CR = 7/8, GI = 1/4	Sensitivity (dBm)	-79.9	-79.7	-79.5	-79.5	-79	-78.9	-78.8
	Max-Input (dBm)	-2	-0.2	> 0	> 0	> 0	> 0	> 0

Supply Current

Test conditions for supply current measurements include 75Ω terminations on RF input and TV output, active working mode, and system tuned to channel 69 (858MHz).

Parameter	Conditions	Measured	Units
5V LNA Supply Current		12	mA
5V for Tuner and LNA*	{8k, QPSK, CR = 1/2, GI = 1/4}	196	mA
	{8k, 64QAM, CR = 7/8, GI = 1/4}	196	mA
3.3V Digital Supply Current for Demodulator	{8k, QPSK, CR = 1/2, GI = 1/4}	8	mA
	{8k, 64QAM, CR = 7/8, GI = 1/4}	10	mA
2.5V Analog Supply Current for Demodulator	{8k, QPSK, CR = 1/2, GI = 1/4}	36	mA
	{8k, 64QAM, CR = 7/8, GI = 1/4}	36	mA
1.0V Digital Supply Current for Demodulator	{8k, QPSK, CR = 1/2, GI = 1/4}	90	mA
	{8k, 64QAM, CR = 7/8, GI = 1/4}	92	mA
1.0V Analog Supply Current for Demodulator	{8k, QPSK, CR = 1/2, GI = 1/4}	3	mA
	{8k, 64QAM, CR = 7/8, GI = 1/4}	3	mA

*Note: the MAX3580 uses 3.3V voltage drawn from a 5V LDO.

Detailed Description

This DVB-T receiver reference design is NorDig 1.0.2 and MBRAI compliant. It is intended for terrestrial set-top box applications and has a NIM form factor. The reference design covers the VHF-III band (170MHz to 230MHz) and UHF band (470MHz to 870MHz) and interfaces with a socket board for testing system performance.

The reference design includes:

- A discrete LNA to realize an active loop-through. The loop-through has 14dB gain and less than 3.5dB noise figure, with 60mW of power consumption.
- A MAX3580 fully integrated silicon tuner, which includes an LNA, RF and IF VGAs, mixer and lowpass filtering in the baseband stages. The tuner operates from a single 3.3V power supply. Only a small number of passive components are needed to form a complete DVB-T RF front-end solution.
- A DVB-T/H-compliant demodulator that features the full DVB-T and DVB-H standards framing structure, channel coding, and demodulation.

Application Note 4173: www.maxim-ic.com/an4173

More Information
For technical support: www.maxim-ic.com/support
For samples: www.maxim-ic.com/samples
Other questions and comments: www.maxim-ic.com/contact

AN4173, AN 4173, APP4173, Appnote4173, Appnote 4173