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APPLICATION NOTE 3847

DVB-H Portable Terrestrial Tuner with the MAX2165

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Abstract: Digital Video Broadcast—Handheld (DVB-H) covers small, battery-powered, handheld convergence terminals with built-in cellular radio such as GSM, GPRS, or UMTS. This application note presents an overview of the MAX2165, an integrated, direct-conversion tuner IC designed to work with an OFDM demodulator. The discussion will show how the MAX2165 can be applied to a DVB-H system.

Introduction

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

The MAX2165 is an integrated, direct-conversion tuner IC designed to work with an OFDM demodulator for Digital Video Broadcast—Handheld (DVB-H).[1] DVB-H is a specification that covers small, battery-powered, handheld convergence terminals with built-in cellular radio such as GSM, GPRS, or UMTS. These terminals have the functionality of a mobile phone and can receive IP-based services using DVB-H over DVB-T physical layer. The DVB-T antenna and the cellular antenna are both integral with the terminal.

This application note presents an overview of the MAX2165, showing how it can be applied to a DVB-H system. A block diagram, typical tuner specifications, channel allocation, and modulation type will all be shown.

MAX2165 overview

The MAX2165 is a direct-conversion DVB-H tuner which covers an input frequency range of 470MHz to 780MHz. The design features an I/Q baseband signal interface and integrated lowpass filters, and thus requires no IF SAW filter. Gain control and DC-offset correction are fully digital to support time-sliced operation with minimal power-up delay. VCO locking time and close-in phase noise are minimized by use of a fractional-N PLL, which controls the fully integrated VCO. The low close-in noise floor supports lower complexity OFDM demodulator algorithms. A widely adopted interface to the baseband processor makes the MAX2165 an attractive tuner for DVB-H applications.

DVB-H Radio Block Diagram

Figure 1 presents a radio block diagram based on the MAX2165 and a generic baseband processor. RF from the antenna passes through the optional bandpass filter to the LNA. Gain can be adjusted digitally in 16dB steps or set by an analog gain-control voltage. Optional front-end filtering helps to customize the tuner for required blocking performance. After the LNA, the signal is filtered by an adjustable bandpass tracking filter to reduce interferers. Next, the down-converter mixer splits the signal into I and Q paths. The mixer is driven by a quadrature local oscillator, generated by a fractional-N PLL with integrated VCO. A built-in reference oscillator (with external crystal) provides the PLL's reference clock, which is also buffered on-chip and provided to the baseband processor. The I/Q signals go through adjustable lowpass filters and variable gain amplifiers which are controlled by a baseband gain-control voltage. Differential I/Q signals are then processed by baseband and application processors to be displayed or distributed to the peripherals. The baseband processor controls all the adjustable functional blocks through a secondary I²C interface. Dedicated processor outputs provide baseband/RF

gain-control voltages, as well as chip-select, standby, and shutdown control signals. An overload detector output is also provided for RF gain control.

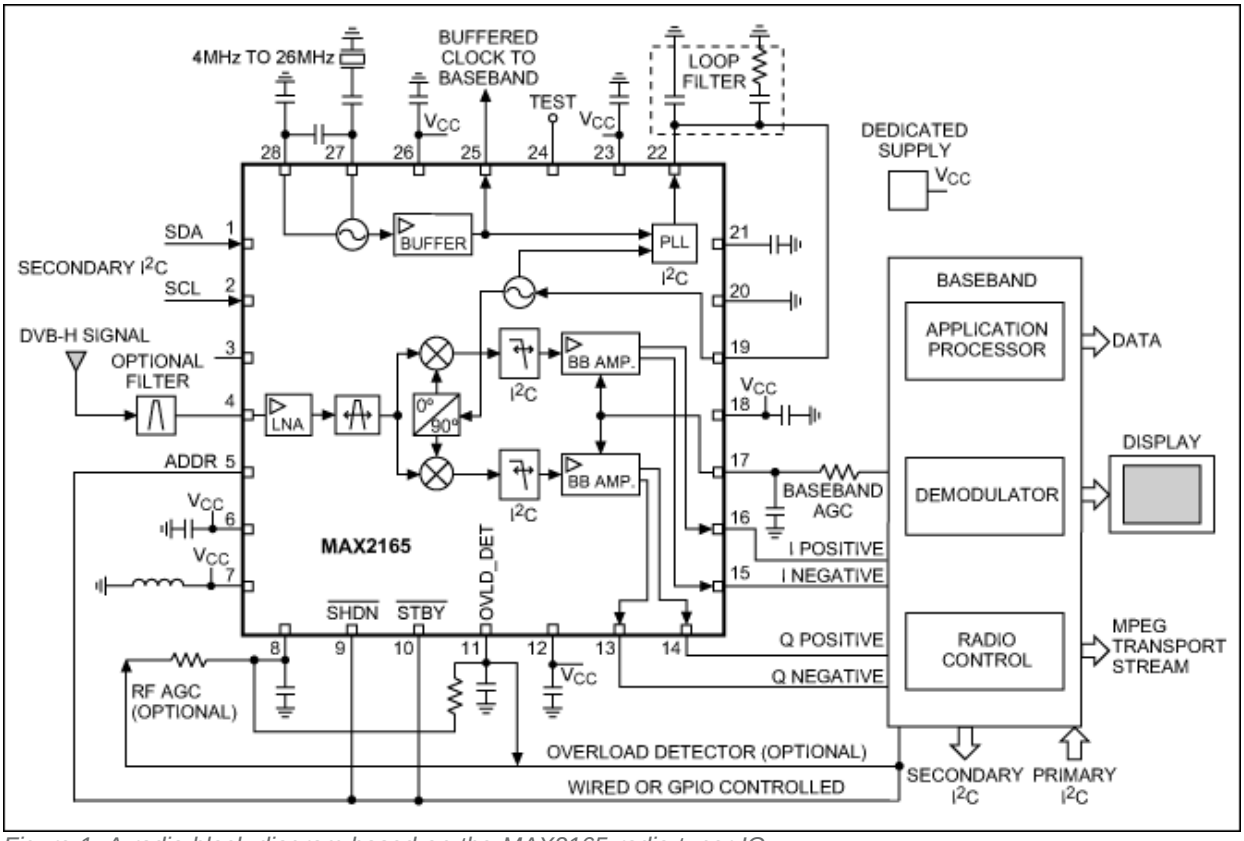

Figure 1. A radio block diagram based on the MAX2165 radio tuner IC.

MAX2165 DVB-H tuner specifications

A DVB-H receiver will, in general, have the same RF performance as a DVB-T receiver. DVB-H uses the DVB-T transmission system as the physical layer, and adds extra error correction and time-slicing mechanisms on the link layer.[2]

Table 1. DVB-H Tuner Specifications*

Parameter	Conditions	Typical
Frequency Range (MHz)		470 to 783
RF Input Impedance (Ω)		75
Return Loss (dB)	75Ω System Impedance	-7
Noise Figure (dB)		5
Input Power per Channel (dBm)	V_{OUT} (DVB-T modulated) $0.5V_{P-P}$	-83
Maximum Input Power (dBm)		-30
Cellular Blocker (dBm)	Single Blocker < 4MHz bandwidth in the 830MHz ... 950MHz band	-5

*These specifications reference EN 300 744 V1.4.1 and IEC 62216-1 for 8MHz channel bandwidth.

Frequencies and channel bandwidths

The receiver can receive UHF bands IV and V with channel bandwidth 8MHz, 7MHz, or 6MHz. Center

frequencies are defined as:

- For countries using 8MHz channel raster:

  fc = 474MHz + (N - 21) x 8MHz + *offset, where*:
  N = {21, ..., 69} (UHF channel number)

- For countries using 7MHz channel raster:

  fc = 529.5MHz + (N - 28) x 7MHz + *offset, where*:
  N = {28, ..., 67} (UHF channel number)

- For countries using 6MHz channel raster:

  fc = 473MHz + (N - 14) x 6MHz + *offset, where*:
  N = {14, ..., 83} (UHF channel number)

In some countries offsets may be used:

Preferred offset is ±1/6MHz, where n = {1,2, ...} (**Figure 2**):

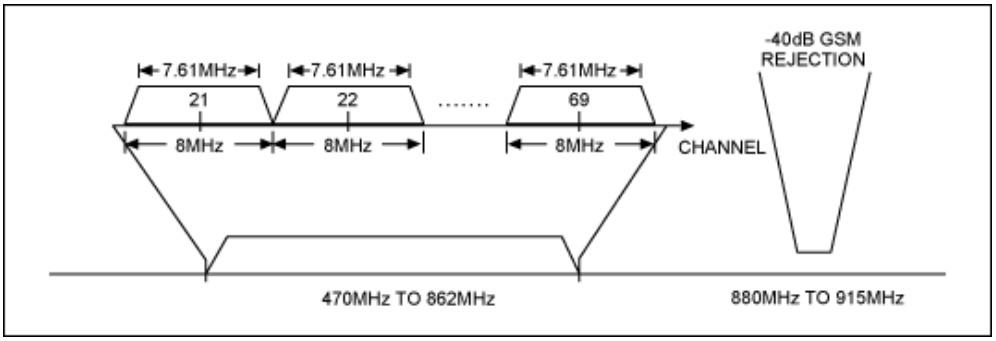

Figure 2. DVB-H channel definitions.

Modulation

The DVB-H system uses Orthogonal Frequency Division Multiplexing (OFDM) where all carriers in one OFDM frame are modulated by either: QPSK, 16-QAM, 64-QAM, non-uniform 16-QAM, or non-uniform 64-QAM. The TPS carriers are modulated by DBPSK.

Conclusion

The MAX2165 has been presented here in a typical DVB-H system. The highly integrated nature of this device, coupled with its flexibility, make it an obvious choice for the application.

References

[1]IEC 62002-2: Mobile and portable DVB-T/H radio access-Part 1: Interface specification.
[2]ETSI EN 300 744: "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television."

Related Parts		
MAX2165	Single-Conversion DVB-H Tuner	Free Samples

More Information
For Technical Support: http://www.maximintegrated.com/support
For Samples: http://www.maximintegrated.com/samples
Other Questions and Comments: http://www.maximintegrated.com/contact

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