

APPLICATION NOTE 3908

MAX2170/MAX2171 DAB/T-DMB Digital Radio Tuner

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Abstract: This application note introduces the DAB and T-DMB standards for digital-audio broadcast and cell-phone TV plus music, respectively. A DAB/T-DMB receiver incorporating the MAX2170/MAX2171 tuner is described.

Introduction

Digital-audio broadcast (DAB) is a European digital-audio broadcast standard for Europe, Asia, and Canada. DAB is defined for mobile, stationary and portable receivers. T-DMB (terrestrial digital multimedia broadcast) is a Korean standard for mobile TV and music. T-DMB uses the DAB standard for RF requirements. RF broadcast is in the VHF-III band and L-band using coded orthogonal frequency division multiplexing (COFDM). The [MAX2170/MAX2171](#)¹ DAB/T-DMB tuner converts a desired RF broadcast channel to a low-IF frequency that is supplied to a demodulator.



[Click here for an overview of the wireless components used in a typical radio transceiver.](#)

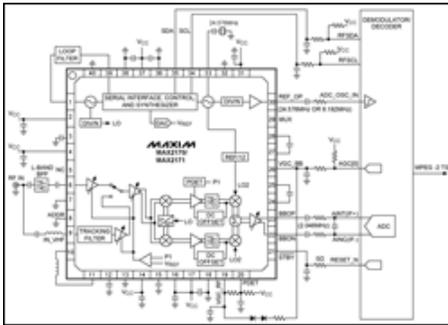
DAB/T-DMB Receiver Incorporating the MAX2170/MAX2171 Tuner

Figure 1 shows a typical DAB/T-DMB receiver block diagram based on the MAX2170/MAX2171 direct-conversion to low-IF tuner and a demodulator/decoder. The tuner converts the RF input to a 2.048MHz low-IF output. The low-IF signal enters the demodulator where it is sampled by an ADC, demodulated, and decoded. The output of the demodulator is a MPEG-2 Transport Stream (TS).

The integrated tuner covers the input frequency ranges of 168MHz to 230MHz and 1452MHz to 1492MHz (VHF-III and L-band). A single-antenna input is fed into the RF IN connector that supplies both VHF and L-band filter paths. A VHF tracking filter minimizes the affects of distant blockers. Similarly, the distant blockers are minimized for L-band by a low-loss, fixed passband, ceramic bandpass filter. An integrated variable passband of the VHF tracking filter is necessary because of the much wider percent bandwidth required in the VHF band. An RF switch selects either the VHF or the L-band path and the RF gain is adjusted in the RF VGA. Then the tuner directly converts the RF signal to baseband and subsequently remodulates it to provide a balanced low-IF output centered at 2.048MHz. This architecture enables implementation of integrated lowpass filtering at baseband to eliminate the IF SAW filter. An integrated power detector typically controls the RF VGA, although demodulator control is also possible. Low-IF VGA control is provided by the demodulator.

The MAX2170/MAX2171 VCO architecture optimizes both close-in and wide-band phase noise for COFDM applications where sensitivity to both 1kHz phase noise and wide-band phase noise related to strong adjacents can be a problem. FM reception is also possible using the integrated filter by setting it to cover the 87MHz to 108MHz frequency range.

The only difference between the MAX2170 and the MAX2171 is the buffered reference oscillator output frequency. The MAX2170 reference output is the same as the crystal frequency; whereas, the MAX2171 reference output is one-third of the crystal frequency. These two reference output options allow use with demodulators that accept only one or the other. The 24.576MHz crystal frequency or a divided version of it is universal for DAB demodulation. A typical ADC sample clock frequency of 8.192MHz (24.576MHz/3) is a tradeoff between satisfying the Nyquist criterion with margin and reducing power consumption by selecting a low frequency.



[More detailed image](#) (PDF, 262kB)

Figure 1. DAB/T-DMB system block diagram incorporating the MAX2170/MAX2171.

System Specifications²

All receiver limits are measured at a BER $\leq 10^{-4}$ after Viterbi decoding.

Parameter	Condition	DAB Standard	Notes
Operating Frequency Range (MHz)	VHF-III	174 to 240	—
	L-band	1452 to 1492	—
Sensitivity (dBm)	—	≤ -81	1
Maximum Input Power (dBm)	VHF-III	≥ -10	2
	L-band	≥ -25	3
Adjacent Channel Selectivity (dB) (Adjacent DAB Channel)	—	≥ 30	—
Far-Off Selectivity (dB) (Unwanted FM Channel at > 5 MHz Offset)	—	≥ 40	—

Note 1: External antenna/cable losses and additional connector losses are not included.

Note 2: Applies to a mobile receiver. Requirement is reduced to -15dBm and -20dBm, respectively, for stationary receivers and portable receivers.

Note 3: Applies to all receivers: mobile, stationary, and portable.

Figure 2 shows that the DAB RF signal is broadcast in a bandwidth of 1.536MHz using a channel spacing of 1.712MHz. An overview of the recommended channel map is also indicated. Certain channels are slightly offset to allow use in areas covered by B/PAL/NICAM television transmitters operating in the lower adjacent channels. Canada has a somewhat different L-band frequency plan that also includes 23 channels, but has a 208kHz guard band and a 48kHz guard band at the band edges.

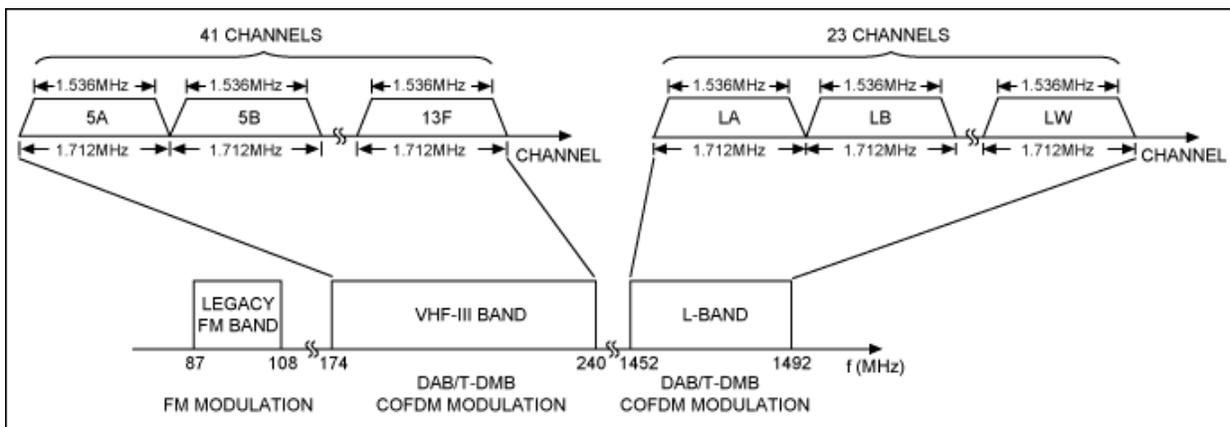


Figure 2. DAB RF signal frequency plan.

References

¹MAX2170/MAX2171 data sheet

²BS EN 50248:2001: "Characteristics of DAB receivers"

Related Parts

[MAX2170](#)

Direct-Conversion to Low-IF Tuners for Digital Audio Broadcast

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>

Application Note 3908: <http://www.maximintegrated.com/an3908>

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