Chip Review: The Toshiba TB31262F Wireless Telephone Chip

By Jim Pearce

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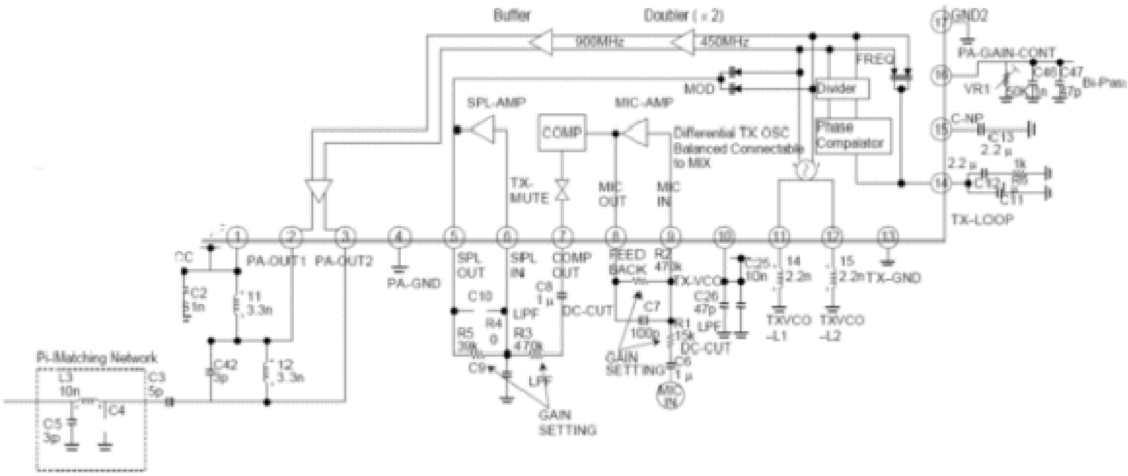
Sometimes you find a chip that does so much more than its original intended function that it is hard to keep from using it. This is how I felt about the Toshiba TB31262F wireless telephone chip. The '262 is a complete RF section for a full duplex analog FM transceiver that also has data communications capability. It is intended to operate in the US 902 MHz to 928 MHz license-free band but with a minor change in external components it can also operate in the European 868 MHz band.

You can download its datasheet here:

Note that even though the datasheet is all English, the pdf file contains codes for Japanese characters and Acrobat Reader will complain. Go ahead and load the Japanese character set when Acrobat complains.

Transmitter

Lets take a look at the transmit side of the '262.



The transmitter uses a phase locked loop frequency synthesizer. Frequency modulation of a PLL can be performed either by summing the modulation voltage with the VCO control voltage, or by varying the reference frequency for the PLL. Which of these techniques is used has a direct impact on the choice of the loop bandwidth of the PLL. The '262 uses the first method of modulation since it must simultaneously transmit and receive, and having the referee frequency modulated would make receiving using the same reference impossible.

This means that the loop bandwidth of the PLL must be lower than the lowest desired modulation frequency. Modulation with frequencies lower than the loop bandwidth will be cancelled out by the feedback action of the PLL. This is the reason for the relatively large values of the components the make up the transmit loop filter, C11 (1uF), R6 (1K), and C12 (2.2uF).

The voltage controlled oscillator for the transmitter operates at half the desired output frequency and is completely integrated except for two inductors. These inductors have a suggested value of 2.2 nH but for operation at lower frequencies such as the European 868 MHz band you may need to use 2.7 nH.

The '262 includes two stages of amplification for the audio signal prior to its application to the VCO modulation varactors. The first stage is a straightforward op-amp that is AC coupled on its input. The output of this stage is available to the designer, but it is also internally connected to a audio level compressor.

The compressor on the transmit side works in conjunction with a matched expander on the receive side to increase the apparent dynamic range of the FM communications channel. A compressor and expander together is called a compandor. More information on the theory and operation of compandors can be found in Philips Application Notes AN174 and AN176.

If compression of the audio signal isn't desired, the output of the first amplifier can be connected to the second amplifier without going through the compressor. On the schematic this would involve connecting C8 to pin 8 instead of pin 7.

If you want to send data using the '262 you simply sum in the data signal with an additional resistor to pin 6. The value of this resistor must be sized so that the digital signals voltage modulates the signal an appropriate amount. You should also keep in mind that the op-amp between pins 4 and 5 will invert the data signal so that a data high level will cause a shift to the low frequency and a data low level will cause a shift to the high frequency.

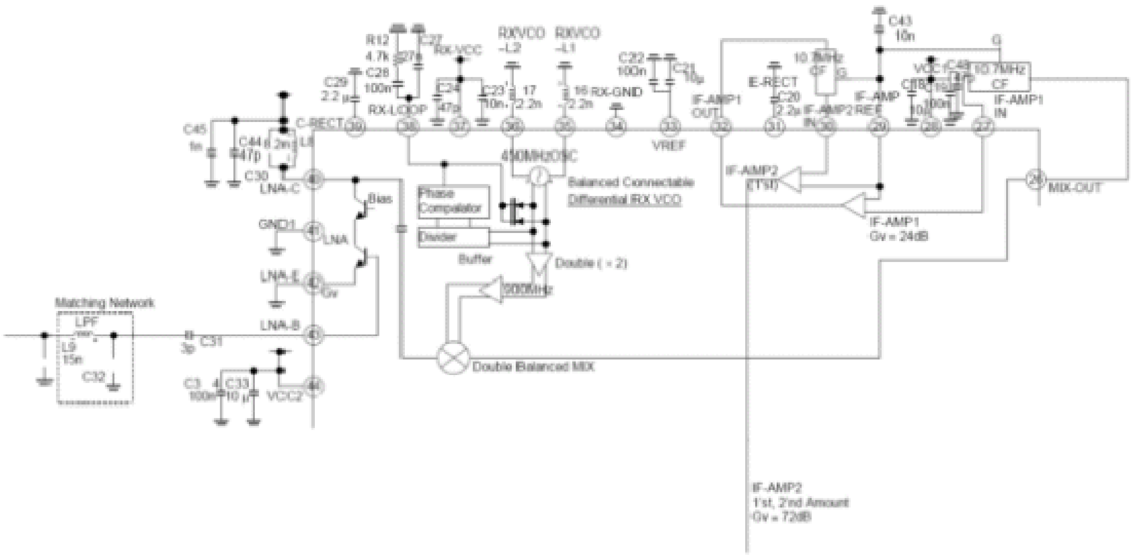
The format of the digital data that you use to modulate the transmitter with will have an impact on how well the system works. Since the system is AC coupled, you should give serious consideration to using Manchester encoding. For more information of Manchester encoding see: [Wikipedia's Article](#).

We have used low bit rates of about 2400 bps, though the '262 should be capable of much higher rates.

The modulated PLL signal passes through a frequency doubler stage and then a power amplifier stage. The power amplifier has a differential output which must use external components to perform the function of a balun (balanced-to-unbalanced). This RF output must then be fed through a bandpass filter. We at Pegasus have found that a SAW filter works best for this. In a cordless telephone application a SAW duplexer is often used.

A duplexer is a pair of filters and a RF combiner. It has two inputs and one output. The inputs are responsive to frequencies at opposite ends of the 902 - 928 MHz band. So you might have the transmit side operate at 903 MHz and the receive side operate at 927 MHz.

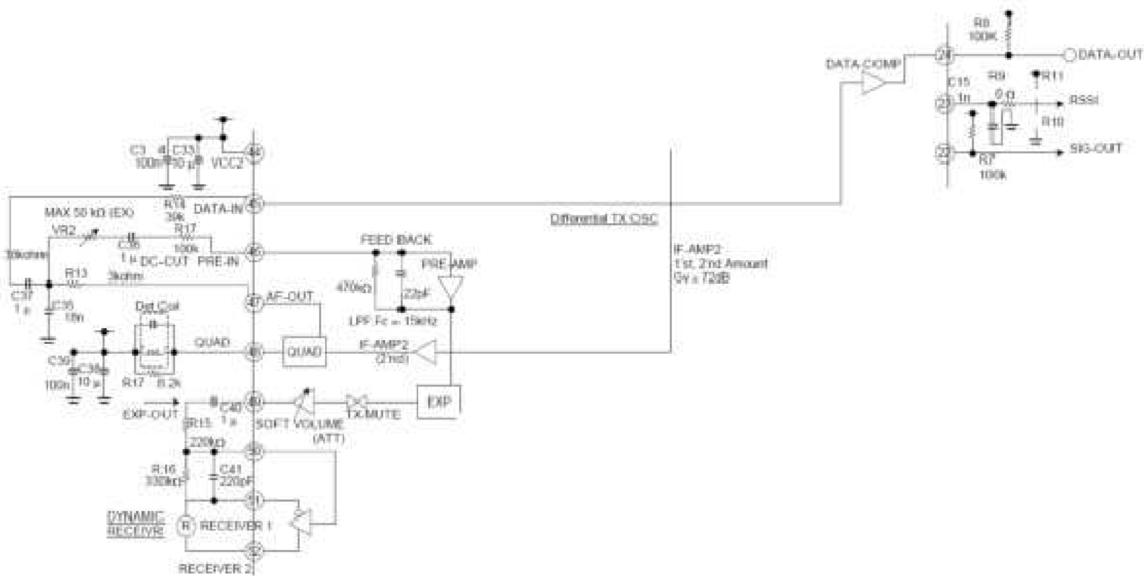
Receiver RF Section:



The receiver in the '262 is amazingly sensitive. We have had good luck with it at signal levels of less than -90 dBm! The input signal is amplified by a low noise amplifier stage and then fed to a double balanced mixer. The local oscillator for the mixer is supplied by a phase locked loop that operates off of the same reference frequency as the transmitter PLL. The receiver PLL does not need to be modulated so its loop bandwidth can be higher so that the phase noise can be reduced. Notice the smaller values of the loop components, C28 and C27.

The output of the mixer is a 10.7 MHz intermediate frequency (IF) signal. This signal is routed through standard ceramic filters like the Toko SK107 series or the Murata SFECS10M7 series or SFECV10M7 series, and is amplified by three stages of IF amplifiers. The amplified IF signal is then routed to the demodulator.

Receiver Baseband:



The IF signal is demodulated using a quadrature demodulator stage. The quadrature coil can be a standard IF can with a tuning slug or a ceramic demodulator. We have had good performance using the Murata CDSCB10M7 series of ceramic demodulators. The advantage to using these is that no turning is needed.

The demodulated audio signal is available on pin 47. Filtering of this signal is performed by R13 and C35 before it is amplified and expanded. The output of the expander goes through a volume control stage whose gain can be set digitally. This signal can them be further amplified by the speaker driver amplifier.

The audio signal also can be routed into pin 45 to perform data slicing. This gives a digital output signal on pin 24 that can be routed into your microcontroller for further processing.

Getting Started with the TB31262F

I have found that this chip is popular in 900 MHz cordless telephones. When I first started using it, I bought a Radio Shack® catalog number 43-3534 cordless telephone for less than $20. I used its FCC identifier on the FCC equipment authorization database to find its certification data and was able to download the phone's schematic.

I could then remove the microcontroller that is in the phone and connect my own. This made a very inexpensive development evaluation board for the TB31262F!