BY IRWIN MATH, WA2NDM

MATH'S NOTES

WHAT'S NEW AND HOW TO USE IT

It's Receiver Time Again!

Every time we describe a new receiver chip or circuit, we get lots and lots of mail. I expect this month will be no different. I'm not sure why that is, but if that's what it takes to spark some homebrewing, I certainly will pass along as much information in this vein as possible.

The latest offering is from Micrel Semiconductor, who, interestingly enough in this digital world, tout themselves as providing "total analog solutions." The MICRF001 is the first member of their new QwickRadio™ family that "even your granny could design with." As shown in fig. 1, a modified block diagram, the device is a single-chip UHF receiver that operates over the range of 300 to 440 MHz. All that is necessary for operation is a low-cost ceramic resonator, a couple of capacitors, an antenna, and a 5 volt power supply. The chip does the rest.

Contained within the 14-pin DIP package is a basic superheterodyne receiver that contains all normal functions including mixer, local oscillator IF strip, and detector. Also included is circuitry to reshape digital logic signals that the receiver is normally intended to receive. The design of the MICRF001 is such that virtually no external components of any real significance are required. Fig. 2 from the data sheet shows just how simple a receiver can be. This example is for a 387 MHz 1200 baud receiver for remote-control applications such as garage-door openers, but can be used for data rates of up to 4.8 kbps by changing the position of the jumpers on pins 1 and 12. Although the chip is normally intended for remote-control applications, the undigitized output could be obtained from pin 7. More on this subject later.

In operation, RF from the antenna is applied to pin 1, where it is amplified and then applied to a mixer. Also applied to the mixer is the output of a synthesizer driven by an on-chip oscillator that is controlled by an external ceramic resonator or crystal. This synthesizer is unique in that it may be used in two different modes. Pulling pin 14 high enables a so-called "SWP mode." This causes the local oscillator to sweep about ±3% around a chosen center frequency so that signals not precisely at the center frequency can be received. If this mode is chosen, a low-cost ceramic resonator may be used as the frequency-controlling device, since the sweeping of the unit requires a less-demanding local oscillator.

When pin 14 is pulled low, the circuit reverts to a standard superhet configuration and only receives the chosen frequency commensurate with the 1 MHz IF bandwidth. In this mode the recommended frequency-determining device would be a quartz crystal. In either case, the resonator frequency is determined by dividing the desired receiving frequency by 130.7. As an example, operation at 420 MHz would require a 420/130.75, or 3.212 MHz crystal. After mixing (or down converting—the "modern' term), the signal is applied to the IF strip and then to a peak detector. The recovered signal is then shaped up be a comparator. The final

c/o CQ magazine

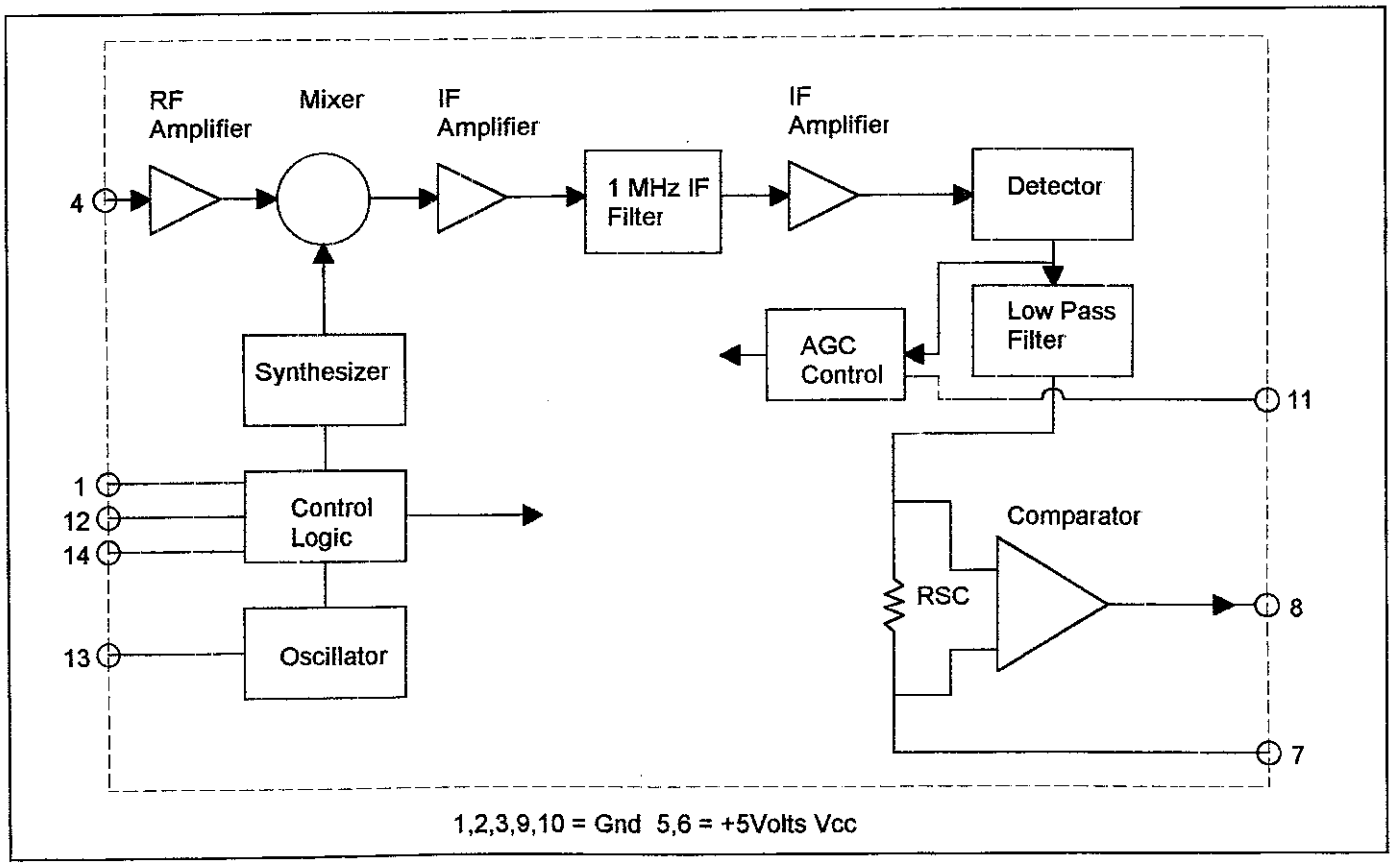

Fig 1– Internal block diagram of the MICRF001.

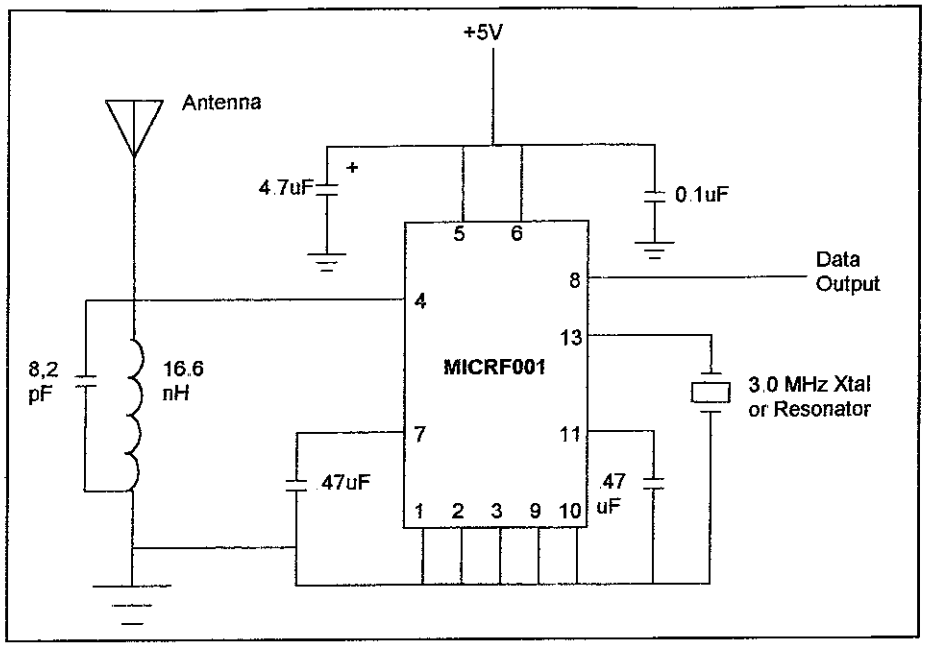

Fig. 2– The 387 MHz remote-control receiver.

CMOS-compatible digital output appears on pin 8.

Other features and specifications for the MICRF001 include an AGC time constant that may be varied by changing the value of the capacitor on pin 11 and a programmable low-pass filter (pins 1 and 12) that covers the range of 600 Hz to 4.8 kHz. Sensitivity of the chip is said to be –95 dBm, which if I have done the math correctly, works out to approximately 2.5 microvolts across 50 ohms. The operating temperature range is –40 to +85°C, making both indoor and outdoor applications possible. The recommended supply voltage is 5 volts at 6.3 ma, making this a low-power device as well.

As already noted, the MICRF001 is normally intended for remote-control digital applications. Examining the internal circuitry, however, shows that pin 7 is used to connect a capacitor to the internal RSC resistor, which then forms a filter that is used to develop the reference voltage for the internal data comparator. If this capacitor is not used, the comparator will not operate properly. However, the analog output of the detector should be present at this pin.

Although we personally have not tried this approach, it looks as if it could work, and if it does, the chip could be used for audio as well. How well it would work for narrow-band FM also remains to be seen, although the IF bandwidth is certainly adequate. Nevertheless, here is a good opportunity for experimentation. To get you going, fig. 3 is a proposed 420 MHz AM (or FM?) receiver circuit that I would use as a first approach.

Again, I have not tried this circuit, so please bear in mind that it almost certainly will need some "tweaking." Also please let me know how you make out. I will be glad to publish a couple of working approaches in a future column.

If this sort of thing "turns you on," I would strongly suggest that you get on the Internet, contact Micrel at <http://www.micrel.com>, and download the data sheet for the MICRF001 as well as the detailed 20-page application note #22. Both contain a wealth of information on the use of this versatile chip. Oh, yes. Before I close, cost of the device is only $3.25 in 1000 piece quantities and somewhat more for a few pieces.

See you next month!

73, Irwin, WA2NDM

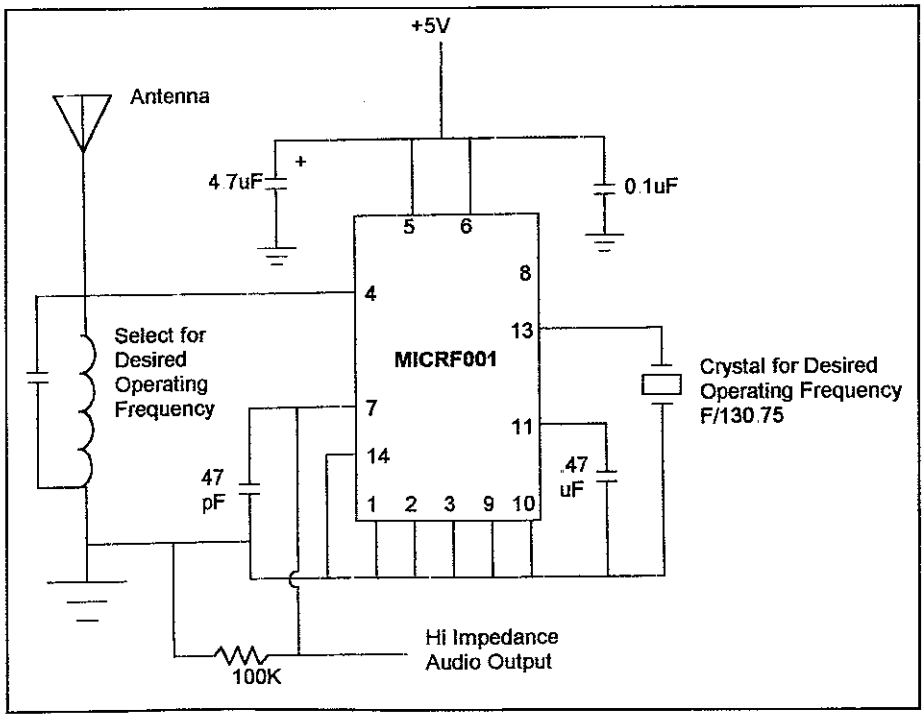

Fig. 3– Starting point for the AM (FM?) audio receiver.