Application Note 28

Data Squelch Using the MICRF002

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Introduction

There are many new applications being created every day which use low power radio as a link for simple remote actuation such as garage doors, keyless entry, remote controls etc... With the release of the Micrel MICRF001 RF receiver and data demodulator IC, the design of such a link has never been easier. Applications which implement this Micrel receiver IC often require both low price and low power consumption, with the digital functions, including data decoding, often performed by low cost 4-bit microcontrollers.

As is common with all superheterodyne AM receivers, the output will contain noise when there is no RF carrier present. The operation of the AGC (automatic gain control) and the demodulator in the MICRF001 converts very low level noise into a corresponding logic level output noise. This output noise combined with the relatively low processing power of the 4-bit microcontroller consequently takes up a great deal of the processing time which could be better spent on other functions. There are two ways in which this problem can be addressed: introducing analog squelch and introducing digital squelch.

Analog Squelch

Adding a small offset to the C_{TH} pin can prevent noise from producing logic-level transitions at the data output. Since we have now added a signal path attenuation, the range will be somewhat reduced.

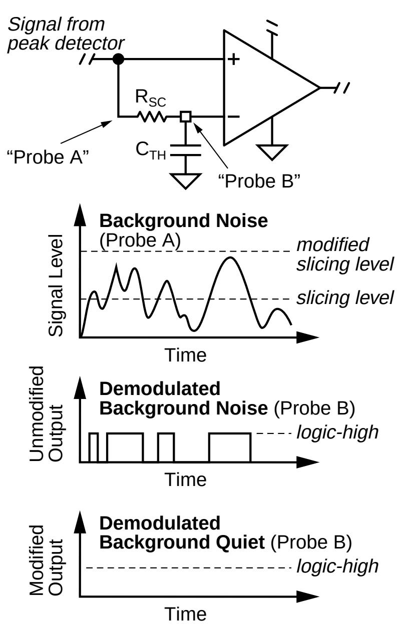

Figure 1. Adding Offset (Analog Squelch)

Digital Squelch

Introduction to MICRF002 Features

The MICRF002 includes two important features that differentiate it from the MICRF001 and MICRF011:

Shutdown (SHUT) allows duty-cycled operation to extend battery life in battery operated systems.

Wake up (WAKEB) operates as a simple data-preamble detector output and can be used to interrupt a microcontroller. If only one microcontroller input is available, it can be used as a control signal for a digital data squelch circuit.

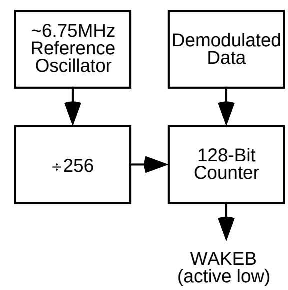

Figure 2. Simplified Wake-Up Block Diagram

To utilize the wake-up function, an uninterrupted 5ms must be transmitted at the start of each data word, or a single 5ms carrier at the start of the data pattern. (Sending carrier at the start of each data word is recommended as it improves communication reliability). When uninterrupted carrier is detected for 128 clock cycles of the nominal 26.4kHz clock, WAKEB will transition low and stay low until data begins.

This output can be used directly by the microcontroller if there is an available I/O pin. Alternatively, we can use some discrete circuitry to effectively 'filter' the data output. The following discusses a possible solution for this function.

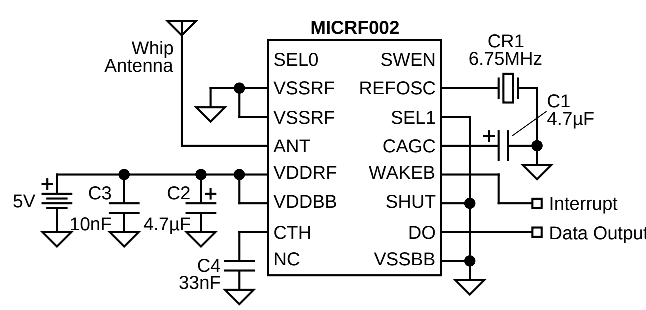

Figure 3. Receiver with Data and Interrupt Outputs

WAKEB can be connected directly to a microcontroller input pin and used as an enable signal (interrupt) for the microprocessor's data input as shown in Figure 3.

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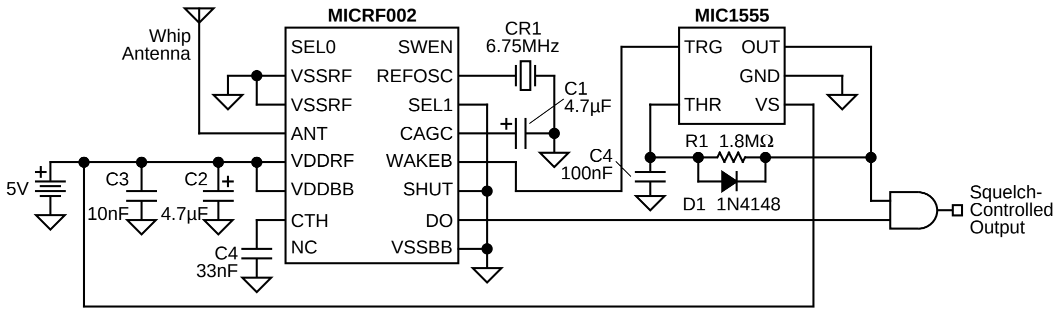

Figure 4. Receiver with Digital Data Squelch

Digital Data Squelch

Figure 4 shows the MICRF002 controlling an add-on digital data squelch. The WAKEB output triggers an MIC1555 monostable which allows the digital output to pass through the AND gate.

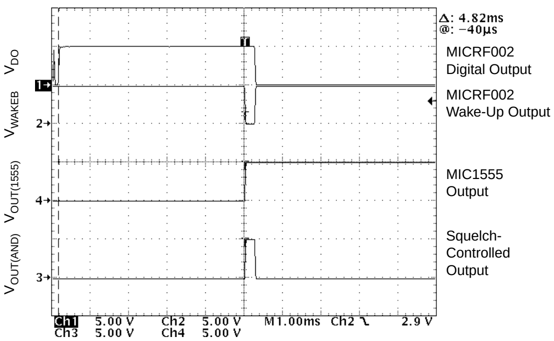

Figure 5. Digital Output Behavior with Carrier

Figure 5 demonstrates that a continuous carrier of 4.8ms is required to trigger the WAKEB output of the MICRF002. Trace 4 represents the output of the MIC1555 monostable going high as a result of the DO pin (trace 1) detecting a continuous tone for approximately 4.8ms. This “Carrier Detect” signal remains high for approximately 120ms (set by R1 and C4) before returning to zero.

Figure 6 is an example using the Micrel RF evaluation board which uses a Holtek decoder chip connected to the squelch-controlled output.

The Holtek decoder must receive three successful codes before it indicates a successful decode. As expected, the code following the 10ms preamble is successfully decoded and the decoder output is asserted to indicate this.

Figure 7 shows a comparison of unfiltered output (trace 2) and filtered output. Note that prior to the 4.8ms continuous signal, the filtered output (trace 3) remains low.

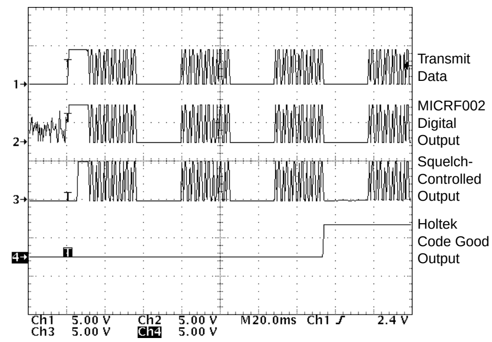

Figure 6. Circuit Applied to Evaluation Board

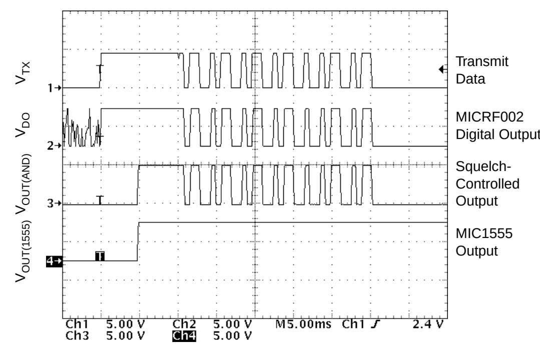

Figure 7. DO-Pin Noise Prior to Squelch

MICRF002 Advantages

The MICRF002 is ideal for systems that need to reduce power consumption and unnecessary processing when there is no RF signal present. The MICRF002 shutdown current is approximately 1µA and start-up time is approximately 8ms. It can give a significant reduction in power consumption if used in a duty-cycled mode which can be easily achieved by clocking the SHUT pin at some user defined duty ratio.

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