Electronic Supplementary Information (ESI)

# NMR-DMF: a modular nuclear magnetic resonance–digital microfluidic system for biological assays

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**NMR electronics components and measurement:**

The forefront amplifier of the NMR receiver is VCA2615 from Texas Instruments (Dallas, TX). It features a high input impedance of >100 kΩ and is with variable-gain control of 52 dB range. An operational amplifier OPA842 from Texas Instruments (Dallas, TX) was employed to provide additional gain and convert the differential signal into single-ended for frequency down-conversion. Mixers TUF-3HSM+ from Mini-Circuits (Brooklyn, NY) are chosen as the down-mixing module. The NMR transmitter is constructed by simple digital electronics (Flip-flops, switches and buffers) which are products from Texas Instruments (Dallas, TX).

The electrical performances of the NMR electronics were characterized before sample measurements. Fig. S1 shows the gain of the receiver measured at different RF frequencies. Sinusoidal RF signals with frequency from 19.9975 to 20.0075 MHz were injected to the receiver and a reference local oscillator (LO) signal of 20.0025 MHz was provided for the mixer. The gain of the overall system is stable around 95.7 to 95.8 dB within ±5 kHz of intermediate frequency (IF). The gain can be further boosted by increasing the gain of the IF low-pass filter.

For the sensitivity of the receiver, the spectrum of the received signal was plotted in Fig. S2. A 100 nV sinusoidal signal at 20 MHz was injected to the receiver. This amplitude is similar to the amplitude of the NMR stated in the Paper - Section 2. The frequency of the LO was set at 20.0025 MHz and results an IF frequency of 2.5 kHz. The resulting signal contains a fundamental tone with amplitude of –20 dBm at 2.5 kHz. The noise floor is 30 dB below the injected signal. Thus the receiver is capable to detect signal with amplitude down to 100 nV.

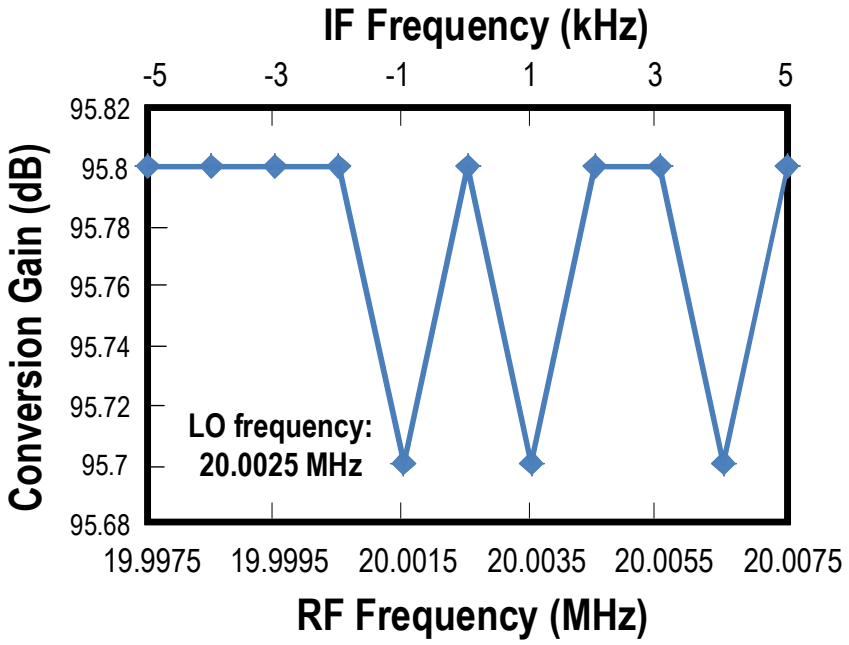


Fig. S1 Measured gain of the NMR receiver.

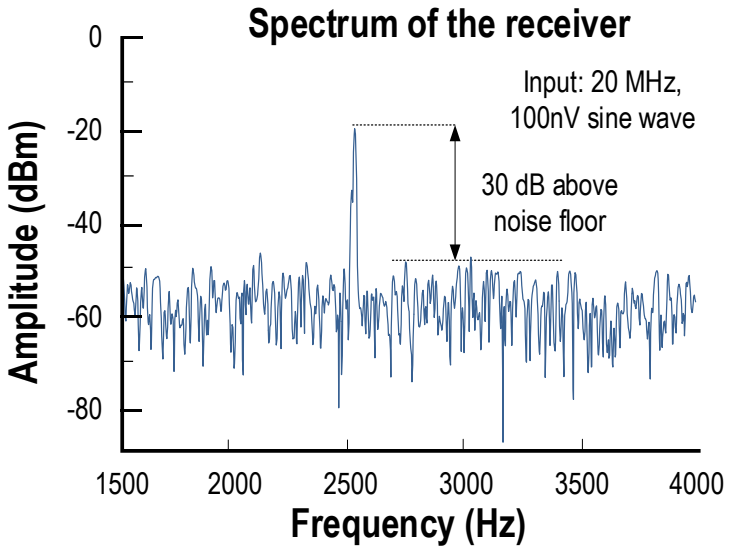


Fig. S2 Measured output spectrum of the receiver with a 100 nV, 20 MHz sinusoidal input.

**Received NMR signal of water:**

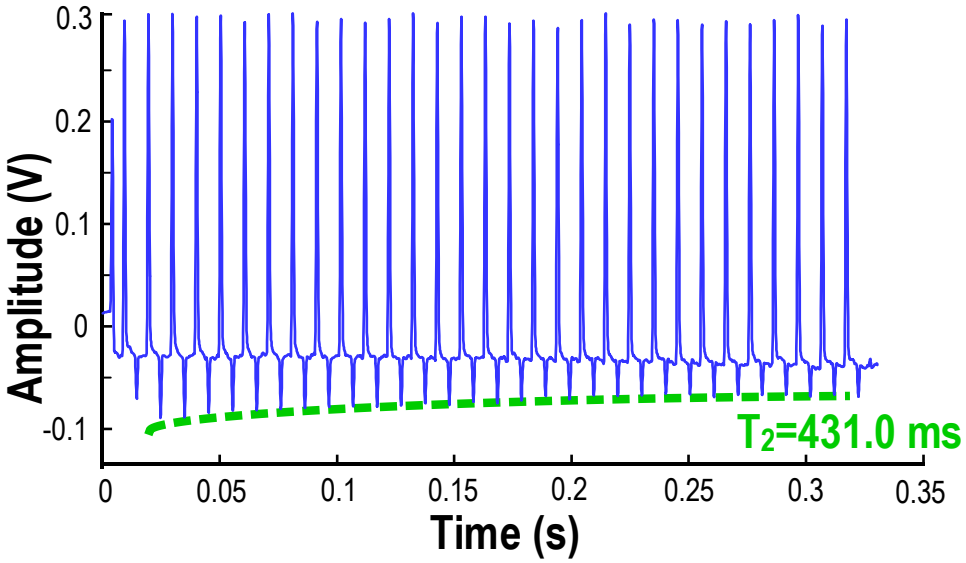


Fig. S3 Received NMR signal of water. $T_2$ extraction result (431.0 ms) shows that it is similar to the case without DMF platform. This indicates that the system performs at least as good as the conventional NMR system.