Novel Application of Lock-In Amplifiers With 2-bit FSK

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Emergency responders need devices that send digital information and communicate in weak-signal environments without using existing infrastructure. The researcher created a receiver capable of demodulating 2-bit Frequency Shift Keying (2FSK) using two Lock-In Amplifiers (LIA) and a researcher-programmed Raspberry Pi Pico (RPi Pico) and tested with a dual-channel function generator simulating the transmitter. The 2FSK modulation method uses two channels and transfers information by shifting each channel between high and low, thus sending binary information. The receiver was tested 2,000 times to determine the output of the LIA when connected to the RPi. The RPi's 16 bit Analog to Digital Converter calculates the ratio of input to supply voltages which are converted to a logic level from 0 to 65,535. When the desired signal was present, output mean was 59,738 (SD=63), vs. mean of 19,083 (SD=6506) when only noise was present. The researcher programmed an RPi Pico to read the binary information from the LIAs, then print the message. The researcher then created a 2FSK transmitter and coded an RPi Pico to control it. However, oscilloscope testing showed errors in modulation which is currently being addressed. In practice, any properly modified 2FSK transmitter will work with the receiver. In the future, the researcher plans to integrate the transmitter with the receiver to create a fully combined unit. While 2FSK can be received with other methods, LIAs are the most sensitive and selective receivers ever, detecting weaker signals and having wide applicability to communications.

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