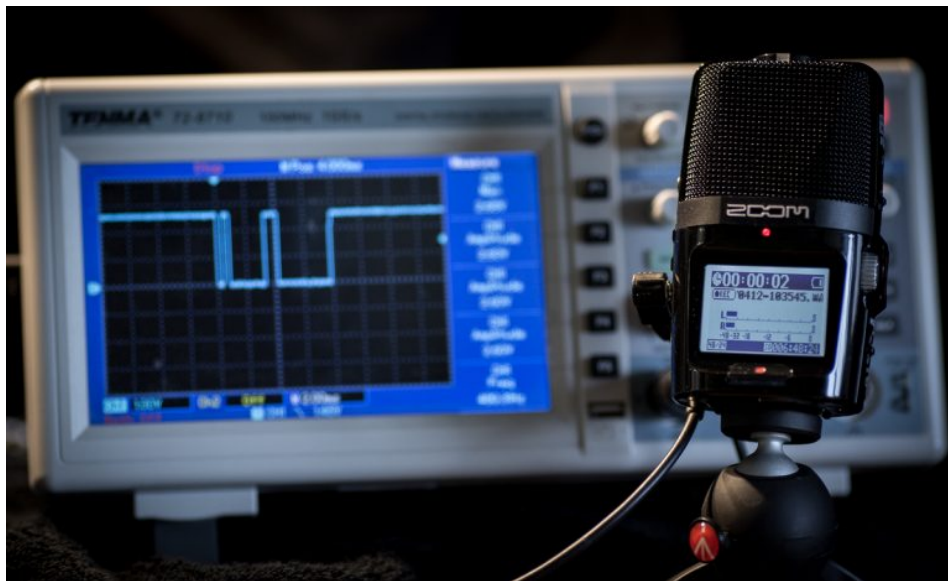


HACKING THE ZOOM H2N REMOTE CONTROL

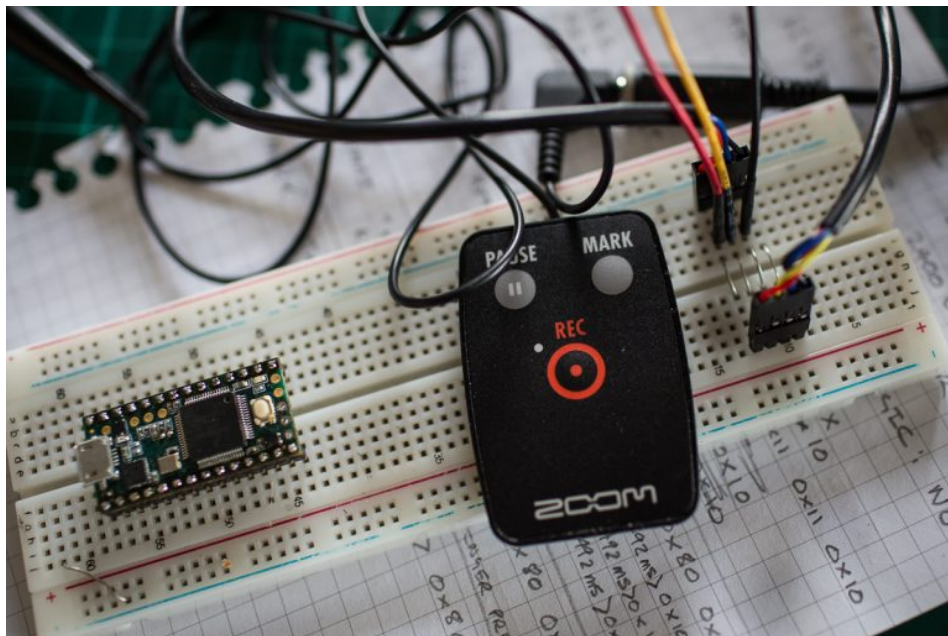
14TH APRIL 2017 | KARL

The Zoom H2n is a portable sound recorder looking like an old fashioned microphone it is a handheld device that provides an assortment of stereo and surround recording modes, it records onto an SD card in MP3 or WAV format with options for various bitrates and frequencies. The unit is powered internally by two AA batteries and can also be powered from the USB port. The recorder I am experimenting on has firmware version 2.00 installed.



A not at all contrived image of the Zoom H2n Portable Recorder

The Zoom Remote Controller RC2 is a wired four pin 2.5mm jack plug connection, this remote has three buttons: record, mark, and pause there is also an LED to show when the H2n is recording. It is purchased separately from the recorder and only appears to be available bundled in an accessory pack. It looks difficult to take apart without leaving some damage, and this may not be necessary for decoding.



Zoom Remote and breadboard for testing

In this post I am looking to see how the remote works and find what control method it employs so in [Part Two](#) I can use an Arduino style micro-controller to provide an external trigger such as for timed recordings.

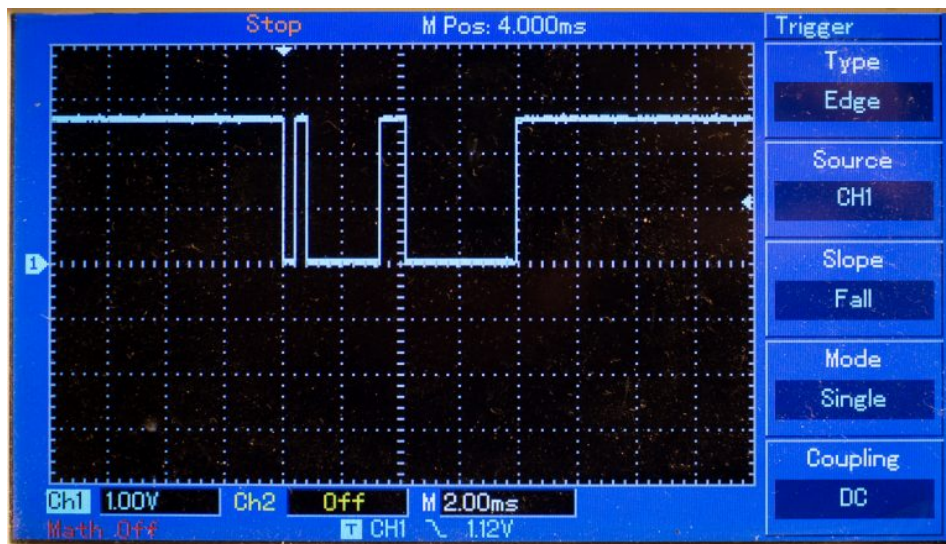
SETUP FOR TESTING

For testing I have made a breakout lead, this is essentially an extension cable split in half with a couple of molex style connectors allowing me to plug it into a breadboard. With this I have found the cable has the following connections, with pin one being the tip of the 2.5mm jack plug:

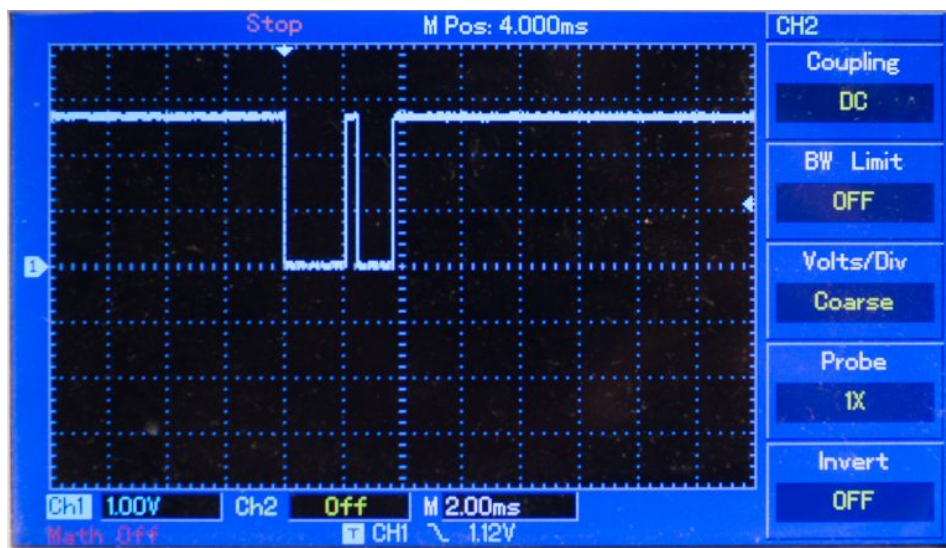
1. Remote Receive – RX
2. Remote Transmit – TX
3. Ground
4. 3.1V – Power

When checking with a multimeter I found continuity from the negative of the left battery (on the Mic Gain side) to pin three, ground, of the jack, there is also a connection between the positive of the right-hand battery to pin one of the jack but on the multimeter in diode mode there looks to be a capacitor, the voltage rises until no apparent connection is indicated. With no activity on the recorder the RX and TX pins show ~2.7 volts.

Determining the RX and TX pins turned out to be straightforward. When you press the record button after a moment the recording LED lights up, on the oscilloscope I can see three different square wave patterns for the three different buttons on the TX pin and a single type of square wave on RX to light the LED. The following images show the signal for the record button then that sent in response to to light the LED.



Signal sent by the remote when Record pressed



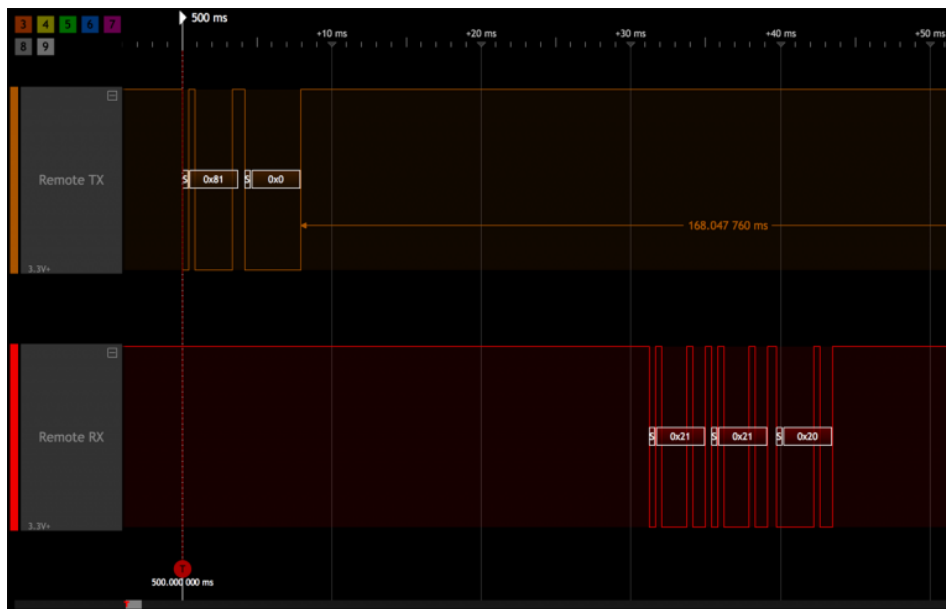
Signal sent by the Zoom recorder to light the LED in the remote

Also when buttons are pressed on the recorder data is seen on the RX line. For a more detailed examination I will need to break out the logic analyser.

SIGNAL ANALYSIS

Following some research where the remote for a Zoom H4n was [examined](#), I set both channels being used on the logic analyser to the following:

- Protocol: UART
- 2400 baud, 8 bits, no parity, 1 stop (8n1)
- Bit Order: LSB first, inverted logic: No



Decoding of the first part of the stop recording command

First I decoded the buttons on the remote with the trigger on the logic analyser set to falling edge on the Remote TX line. On TX there is a pause between the two pairs of command bytes which appears to be the length of time the button was pressed, around 350-500ms, there is also a pause between bytes in the RX response, the value of the response changes depending on which recording mode you are in, those shown below are when the recorder is in XY Stereo:

Record Start				
TX:	0x81 0x0	~	0x80 0x0	
RX:	0x20	1.85s	0x20 0x21	record LED on
Record Stop				
TX:	0x81 0x0	~	0x80 0x0	
RX:	0x21 0x21 0x20	1.9s	0x20 0x20	record LED off
Pause (while recording)				
TX:	0x80 0x2	~	0x80 0x0	
RX:	0x21	51ms	0x21 0x20	then this repeats
		492ms	0x20 0x21	to flash the LED
		492ms	0x21 0x20	until pause is pressed again
Resume from Pause				
TX:	0x80 0x2	~	0x80 0x0	
RX:	0x21 0x21			LED on
Mark				
TX:	0x80 0x1	~	0x80 0x0	

RX:	0x21	492ms	0x20 0x21	LED on
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I was also able to capture the following activity sent to the remote when various buttons were pressed on the recorder itself with the recorder in XY Stereo mode. Other models of the recorders made by Zoom have more advanced remotes, such as the RC4 as featured in [this hack](#) of the H4n. I suspect they would work on this machine too. This time I set the logic analyser to trigger with a falling edge on Remote RX. I think the 0x20 code is used to indicate the display illumination has been turned off. I saw activity on all buttons except the Mic Gain knob.

Power On – Without remote attached				
TX:	Lots of random activity			
RX:	0x10	400ms	0x80 0x81	
		1.2s	0x10 0x0 0x80 0x0	
		140ms	0x0 0x0 0x80 0x80 0x0	
		~2ms	0x0 0x80 0x0 0x0 0x80 0x0	
Power On – With remote attached				
TX:	0x0	five pulses 30ms apart		
		30ms	0x0 0xA1 0x80 0x0 0xA1	
RX:	following pulses on TX		0x80 0x81 0x80 0x10	
		1.2s	0x10 0x0	
		148ms	0x0 0x0	
		~4ms	0x0 0x0 0x0	
Record Start				
RX:	0x20	20ms	0x20 0x21	LED on
Record Stop				
RX:	0x21 0x21 0x21 0x20	~	0x20	
		~283ms	0x20 0x20	LED off
Menu \ Home – Into Menu				
RX:	0x20 0x20 0x0			
Exit from Menu				
RX:	0x20	45ms	0x20	

Play Switch: Up/Down/Press				
RX:	0x20	55ms	0x20	
Clipping detect (tapping the microphone with a pen)				
RX:	0x10 0x2	56ms	0x2	
		59ms	0x10	
		60ms	0x10	
		354ms	0x10	
Volume: Up and Down				
RX:	0x20			
Recording Mode Change: 4 channel surround				
RX:	0x10 0x10 0x30	14ms	0x30 0x30	
		122ms	0x34	
		60ms	0x30	
		60ms	0x30	
Recording Mode Change: XY Stereo				
RX:	0x30 0x30 0x20	216ms	0x20	
Recording Mode Change: 2 channel surround				
RX:	0x20 0x20 0x30 0x30	18ms	0x30	
		148ms	0x30	
		164ms	0x30 0x6	
		56ms	0x14 0x30	
		477ms	0x30	
Recording Mode Change: MS Stereo				
RX:	0x30 0x30 0x10	170ms	0x10	
		50ms	0x12	

I think these response codes are to light up various LED's on the more advanced Zoom RC4 remote, this suggests that other remotes would work in this recorder.

The following table shows the response codes given with different microphone configurations when record is clicked to start recording:

TX:	0x81 0x0 ~100ms delay 0x80 0x0
XY Stereo:	0x20 750ms delay 0x20 0x21
2 Channel Surround:	0x30 750ms delay 0x30 0x31
MS Stereo:	0x10 750ms delay 0x10 0x11
4 Channel Surround:	0x30 750ms delay 0x30 0x31

In **Part Two** I will be covering the use of a Arduino style micro-controller as an alternative remote control.

LINKS AND SOURCES

- **Manufacturers Page:** [Zoom H2n](#)
- **Hacking the Zoom H4n remote**
- **Logic Analyser:** <https://www.ikallogic.com/scanapplus/>