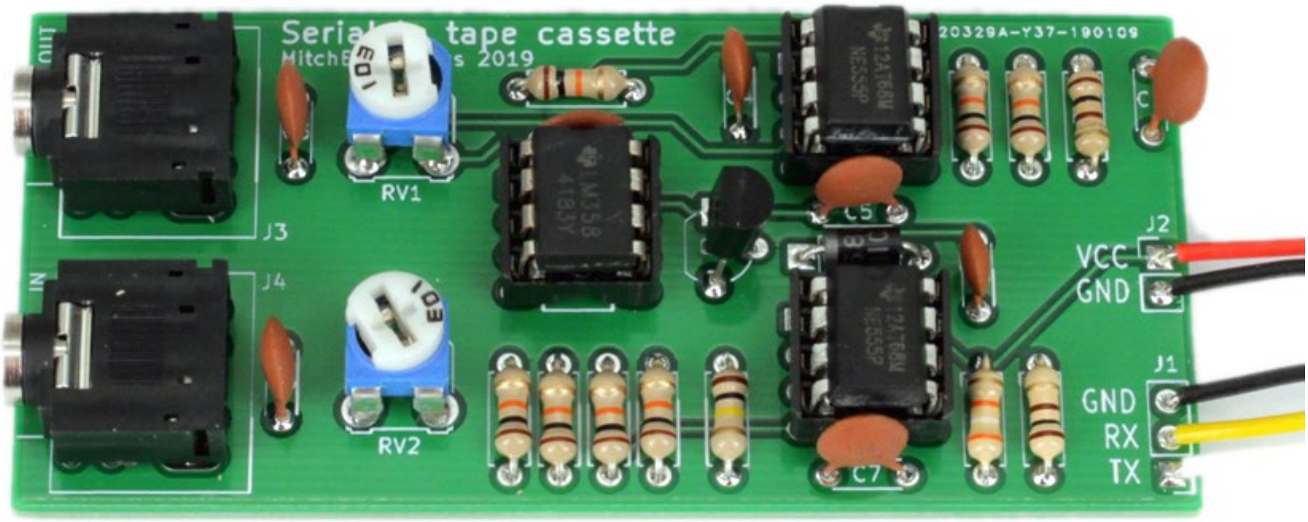
Datacorder Kit

MitchElectronics 2019



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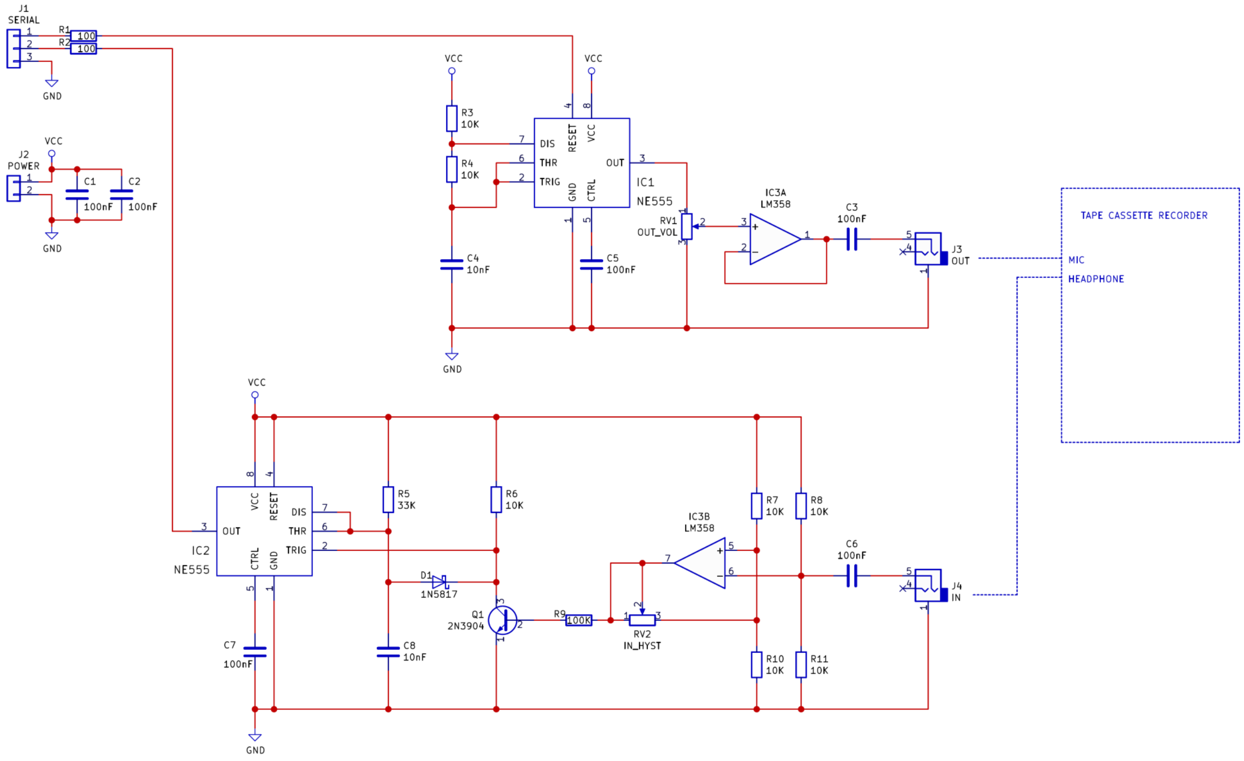
SCHEMATIC



J1
SERIAL
R1
R2
100
100
GND
J2
POWER
VCC
C1
100nF
C2
100nF
GND
VCC
R3
10K
R4
10K
C4
10nF
GND
VCC
DIS
THR
TRIG
RESET
VCC
GND
CTRL
OUT
IC1
NE555
C5
100nF
RV1
OUT_VOL
IC3A
LM358
C3
100nF
J3
OUT
TAPE CASSETTE RECORDER
MIC
HEADPHONE
VCC
IC2
NE555
R5
33K
R6
10K
D1
1N5817
Q1
2N3904
R9
100K
RV2
IN_HYST
IC3B
LM358
R7
10K
R8
10K
R10
10K
R11
10K
C6
100nF
J4
IN
C7
100nF
C8
10nF
GND

HOW IT WORKS

Modern storage for computers include USB drives, hard disks, and even cloud storage. Computers of the past, however, did not have such technological capabilities with hard disks having megabytes instead of terabytes of storage and portable storage being in the form of large floppy disks. Even then, only the most expensive computers had access to such storage methods and home users would be lucky to have a floppy drive. One storage method that was popular with home computers from the 70s to 90s was cassette tapes which could be used to store large amounts of data very cheaply. But how can computer data be stored on a cassette tape that is designed to play music? With sound of course!

While each manufacturer had their own storage protocol, the Datacorder in this kit uses sound to store data. The input to the Datacorder is a digital serial input line that has two possible states; 5V (1) or 0V (0). Serial signals are normally high (1) when idle and during transmission will change state depending on the bit being sent. The logic chart below shows the structure of a serial byte being transmitted.

The Datacorder is made up of two main circuits with several sub-circuits within those. The main two circuits are the serial to tone generation (IC1 and IC3A) and a tone to serial converter (IC2 and IC3B). The serial to tone generator is made up of a 555 astable oscillator (IC1) and a buffer (IC3A) whereby the 555 astable oscillator output is controlled by the serial input. When the input to the Datacorder is "1" the output of the 555 is a tone (square wave) and when the input to the Datacorder is "0" the 555 oscillator output is held low. This oscillating output is fed into a volume adjust circuit made up of a unity gain buffer (IC3A) and a potentiometer (RV1). The volume control potentiometer (RV1) will need to be adjusted during operation to find the optimal volume setting (too loud can distort the recorded sound wave while too little can result in a weak signal). Whenever UART data is sent to the Datacorder the bits in the UART byte are converted into auditable tones which are then recorded to either a tape drive, computer, or Dictaphone.

Converting the auditable tones is done with the use of the 555 (IC2) in a resettable monostable configuration and a Schmitt trigger (IC3B). When the tones are sent to the Datacorder they first go to the comparator circuit which does three things.

1. Remove any DC bias in the signal
2. Add a DC bias voltage of VCC / 2 to the input signal
3. Pass this signal into a Schmitt trigger

The Schmitt trigger (IC3B and RV2) looks for signals that go beyond a range (adjusted by varying RV2) and when those signals are detected it causes the output of the Schmitt trigger to change. These changes are used to control the retriggering of a 555 monostable whose monostable time is set to 300us. Overall, whenever a tone is detected the 555 monostable is reset and the output remains high and when no signal is detected the output turns off. This is how auditable tones are converted into 1's and 0's which recreates the original UART signal fed into the Datacorder.

Now lets see how to use the Datacorder...

HOW TO USE

This Datacorder requires a UART signal and some recording device. The recording device can be anything with a headphone and mic jack which includes

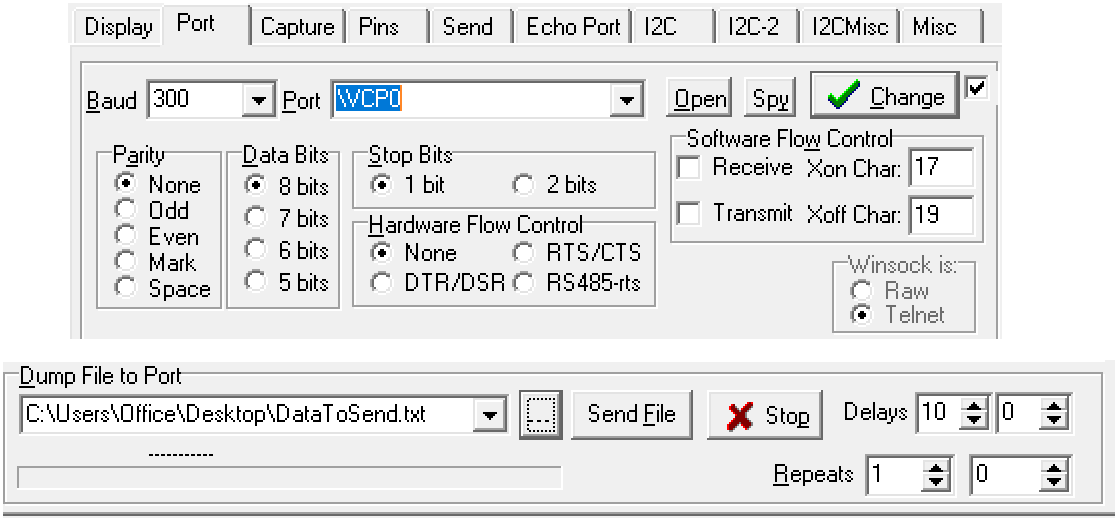
- Dictaphone—Used to record spoken words
- Computer—Use an audio recording program
- Tape cassette drive—If you are going old school this can work too!

The Datacorder has some limitations but these limitations improve accuracy

- Baud rate must be set to 300
- Individual characters must have a delay between them (at least 1ms)
- **Must be powered with same power rail as circuit sending data**

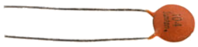
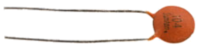
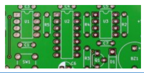
Here is a simple list of instructions to test the Datacorder to ensure its working

- Connect the Datacorder to an FTDI UART to USB converter module
  - FTDI TX connects to TX on Datacorder
  - FTDI RX connects to RX on Datacorder
- Connect the Datacorder to a windows computer via the Mic and Headphone jacks
- Open "Sound Recorder" and ensure recording source is the input mic
- Configure RV1 so that the audio can be heard but is not distorted
- Open RealTerm, select the FTDI port, and set the baud rate to 300
- Set "Dump File to Port" to the text file that you will send to the Datacorder
- Set the "Delays" box to 10ms
- Begin recording on "Sound Recorder"
- Press "Send File" in the Dump File To Port window
- Once the data has been sent stop the recording
- Playback the audio and adjust RV2 until the send data appears in the RealTerm Window



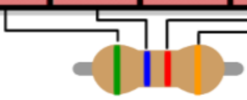
MATERIALS

Check that you have the following components

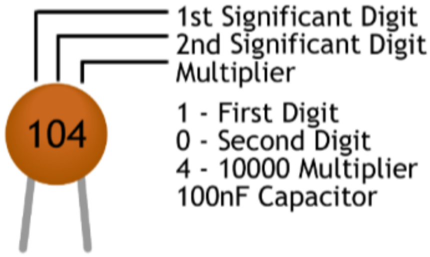
Component	Component Name	Quantity	Looks like
555 Timer	IC1, IC2	2	
LM358	IC3	1	
8 DIP Socket	IC1, IC2, IC3	3	
100Ω Resistor	R1, R2	2	
10kΩ Resistor	R3, R4, R6, R7, R8, R10, R11	7	
33kΩ Resistor	R5	1	
100kΩ Resistor	R9	1	
10nF Capacitor	C4, C8	2	
100nF Capacitor	C1, C2, C3, C5, C6, C7	6	
2N3904 Transistor	Q1	1	
10kΩ Potentiometer	RV1, RV2	2	
Audio Jack	J3, J4	2	
Red and Black Wire	Power	1	
Green and Blue Wire	UART I/O	1	
PCB	-	1	

RESISTOR AND CAPACITOR IDENTIFICATION

Colour	1ST Band	2ND Band	3RD Band	Multiplier	Tolerance
BLACK	0	0	0	1Ω	
BROWN	1	1	1	10Ω	±1%
RED	2	2	2	100Ω	±2%
ORANGE	3	3	3	1kΩ	
YELLOW	4	4	4	10kΩ	
GREEN	5	5	5	100kΩ	±0.50%
BLUE	6	6	6	1MΩ	±0.25%
VIOLET	7	7	7	10MΩ	±0.10%
GREY	8	8	8		±0.05%
WHITE	7	7	7		
GOLD					±5%
SILVER					±10%



4 Band Resistor
5.6k ±5%



CONSTRUCTION

Download the electronics construction manual

To learn how to construct circuits on PCBs download the Electronics Construction Manual from Mitch-Electronics using the link below. This document shows you how to install all electronic components used in MitchElectronics kits. The list below shows the sections relevant to this kit so do not worry if you see component sections in the document that don't come with this kit!

www.mitchelectronics.co.uk/electronicsConstructionManual.pdf

Relevant sections in the electronics construction manual

Resistors

Capacitors

Transistors

Integrated Circuits

Potentiometers

Audio Jacks

Wires

IMPORTANT INFORMATION

RoHS Compliant Kit (Lead free)

Low Voltage Kit

Caution! Soldering Required