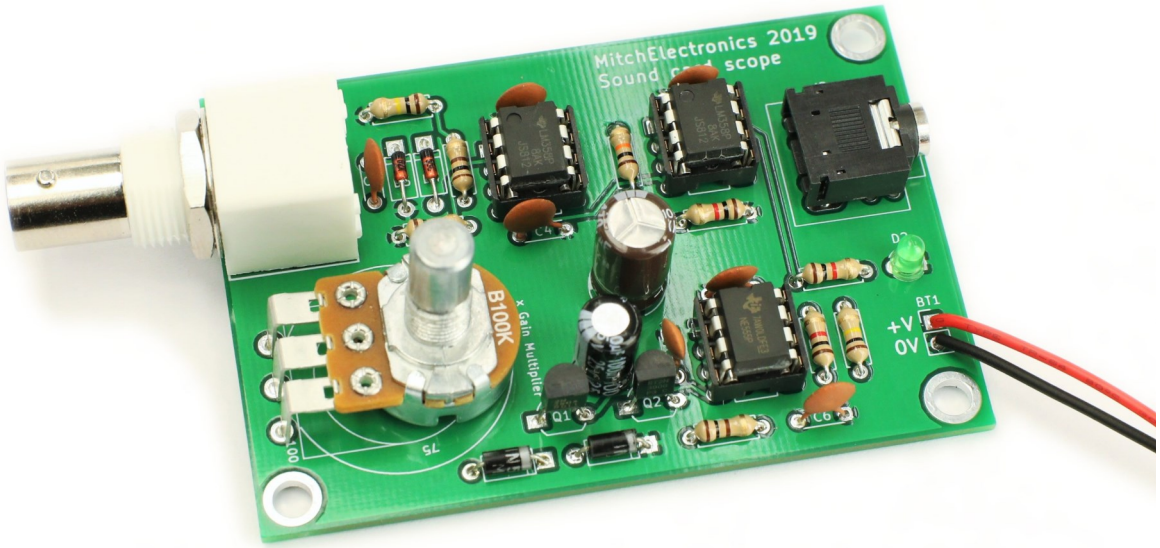
Sound Card Scope

MitchElectronics® 2019



www.mitchelectronics.co.uk

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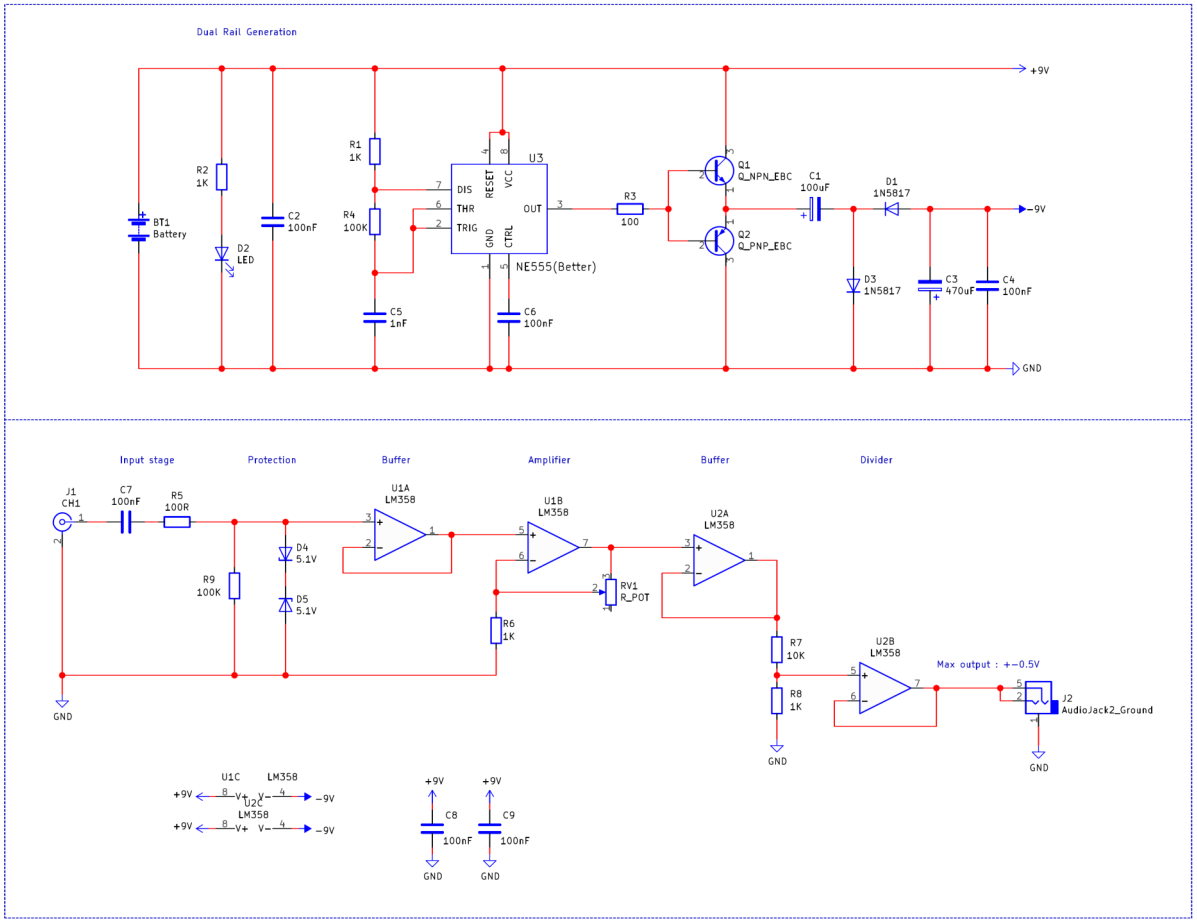
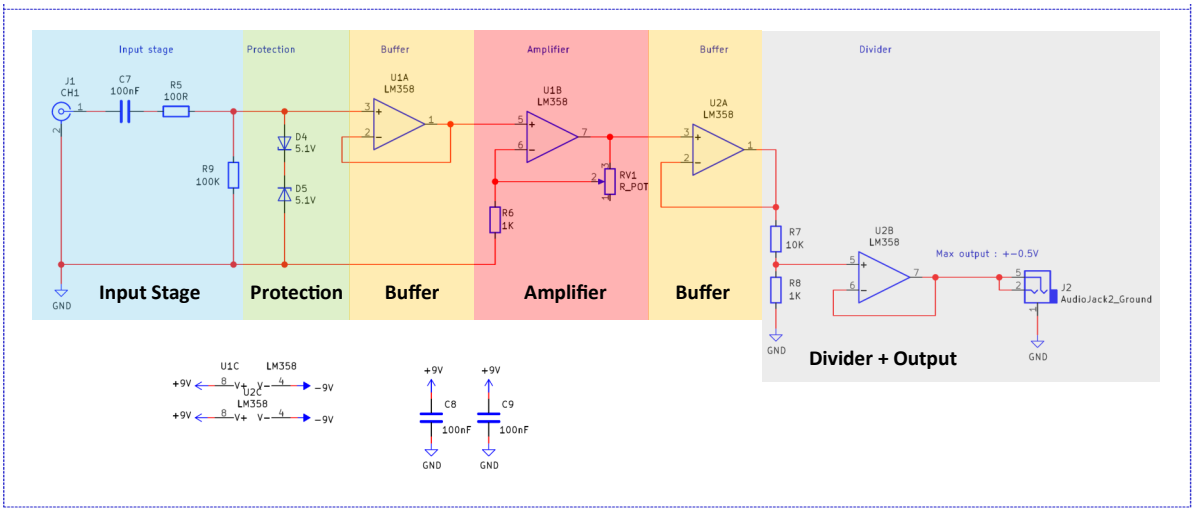


Schematic (Blocktised)



SCHEMATIC EXPLANATION

The Sound Card Scope is a circuit that allows any maker to turn their microphone port on their computer or laptop into a low frequency oscilloscope that is capable of measuring frequencies between 50Hz and 18 kHz (this depends on the sound card being used). While microphone ports are primarily used to read analogue voltages from a microphone they can be used to plot the "volume level" that they are currently detecting on a graph and this is essentially what an oscilloscope does!

The Sound Card Scope kit is made up of two main circuits:

- Dual Rail Generation
- Scope Circuit

The Dual Rail Generation circuit is powered by a 555 IC (U3) and is used to generate –9V for the scope circuit. The explanation of this circuit will not be given here as this is covered in another MitchElectronics kit; the Negative Voltage Generator. The Scope Circuit is an analogue circuit that consists of the following sub-circuits which converts incoming analogue signals into ones that can be read by typical microphone ports

- Input Stage
- Protection Stage
- Buffer Stage
- Amplifier Stage
- Buffer Stage
- Divider / Output Stage

Stage 1—Input Stage

The first stage is the input stage which is made up of a single capacitor C7. The purpose of this capacitor is to remove any DC offset that may be present on a signal being probed and the reason for doing this is due to the fact that microphone ports cannot read DC signals and must only be fed with AC signals (this does mean that the Sound Card Scope can only read AC waveforms and not DC signals).

Stage 2—Protection Stage

The second stage is the protection stage which is made up of R5, R9, D4, and D5. R5 is a current limiting resistor which prevents large amounts of current from the input from damaging the zener diodes D4 and D5 as well as the op-amp U1A. The two zener diodes D4 and D5 are voltage clamps that prevent voltages greater than ±5V from reaching the rest of the circuit. The purpose of R9 is to provide stability to the input of the op-amp U1A as charge can build up and result in a steadily increasing DC voltage.

Stage 3—Buffer Stage

The third stage is the Buffer stage which reads the voltage from the input stage and then copies this voltage to the following amplification stage. The reason why buffers are used is because they prevent circuits that may have a low impedance (AC resistance), from affecting signals from sources that have a high output impedance. In simple terms, the signal from the input stage is very weak and easily upset and the amplifier stage requires a signal that is more "powerful" than what the input stage can provide. The buffer in this case takes the weak input signal without affecting it and then reproducing this signal for the amplification stage but making the signal "stronger" . Note—"powerful", "weaker", and "stronger" are loose terms here and are used to avoid complicated mathematics surrounding impedance matching etc.

SCHEMATIC EXPLANATION

Stage 4—Amplification Stage

The fourth stage is the amplifier (U1B) which can multiply our signal by up to 100 times. The amplifier is a standard non-inverting amplifier configuration and uses a potentiometer as a feedback resistor which adjusts the gain of the amplifier. If the potentiometer is set to its minimum resistance of 0Ω then the op-amp has a gain of 1 and this is the setting that you will mostly use (the amplifier is only useful for very weak signals).

Stage 5—Buffer Stage

The fifth stage (U2A) is another buffer stage and is used to ensure that the amplified signal is correctly passed to the sixth stage that divides the output and then sends the AC waveform to the computer.

Stage 6—Divide & Output

The sixth and final stage is a divider circuit consisting of R7 and R8 which divide the AC waveform by approximately 10 and this is done to match the voltage typically found in microphone ports. While different ports vary the voltage used on mic ports is generally around ±0.5V and so our divider divides our read voltages into this region. The output stage also has a buffer to ensure that the divided signal can be easily read by low impedance devices.

USING THE SOUND CARD SCOPE

To use the Sound Card Scope you will need (none are included with the kit)

- BNC Probe
- 3.5mm male / male cable
- 9V Battery
- Windows 7 to 10
- Soundcard Oscilloscope Software (Free to download)
- Recommended Extra—Analog Explorer V1.0

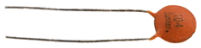
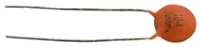
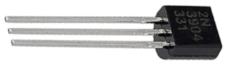
The first step into using the Sound Card Scope is to install the Soundcard Oscilloscope program that turns a Windows computer into a simple oscilloscope using the sound card. This software can be downloaded from the link below and is free to use for non-commercial purposes:

https://www.zeitnitz.eu/scope_en

With the software installed the Sound Card Scope can be powered, connected to the computer via the mic port using a 3.5mm audio jack, connect a BNC scope probe to the BNC connector, and then start probing! The soundcard software has many controls that allow for many typical oscilloscope features including triggering, individual channel amplification, and time division changing. Remember that this scope uses the microphone port and as such can only be used to read AC voltages and not DC voltages. Also note that MitchElectronics is not liable for any damage done to any hardware that the Sound Card Scope causes and is advisable that a USB external sound card is used to avoid damage to in-built microphone ports.

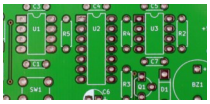
MATERIALS

Check that you have the following components

Component	Component Name	Quantity	Looks like
LM358	U1, U2	2	
NE555	U3	1	
8-DIP Socket	U1	3	
1nF Capacitor	C5	1	
100nF Capacitor	C2, C4, C6, C7, C8, C9	6	
100uF Capacitor	C1	1	
470uF Capacitor	C3	1	
100 Resistor	R3, R5	2	
1K Resistor	R1, R2, R6, R8	4	
10K Resistor	R7	1	
100K Resistor	R4, R9	2	
100K Potentiometer	RV1	1	
2N3904	Q1	1	
2N3906	Q2	1	
1N5817	D1, D3	2	

MATERIALS

Check that you have the following components

Component	Component Name	Quantity	Looks like
5.1V Zener Diode	D4, D5	2	
3mm LED	D2	1	
3.5mm Socket	J2	1	
BNC Connector	J1	1	
PP3 Connector	BT1	1	
PCB	-	1	

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

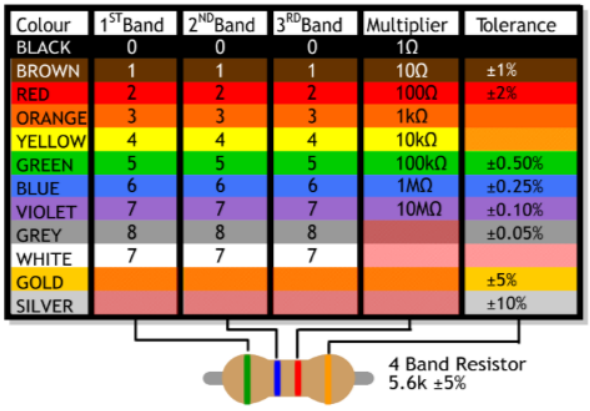
Diodes

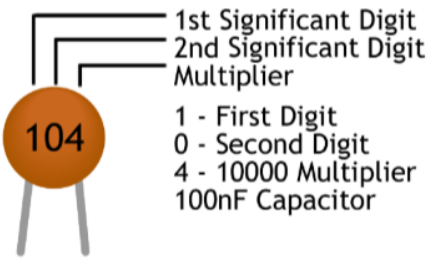
ICs

Potentiometers

Connectors

RESISTOR AND CAPACITOR IDENTIFICATION

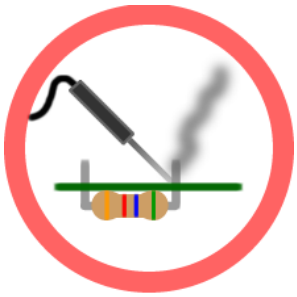




IMPORTANT INFORMATION

RoHS Compliant Kit (Lead free)

Low Voltage Kit



Caution! Soldering Required

TERMS AND CONDITIONS

MitchElectronics Mission

The main goal of MitchElectronics products is to provide safe electronics to makers and professionals alike while keeping the cost affordable. MitchElectronics kits are ideal for classrooms whereby students can learn about electronics using a hands-on approach which is not only highly effective at teaching students but also improves hand-eye co-ordination as well as grow interest in electronics. Since MitchElectronics kits are aimed at novices and those who are new to electronics they are designed to use low voltage power supplies such as 9V batteries which are inherently safe due to their limited voltage and current capabilities.

MitchElectronics Liability

MitchElectronics kits must be inspected and tested by a competent individual before use and must be constructed by those who are competent to do so. MitchElectronics is not liable for kits and products that are constructed incorrectly or to a poor standard whereby poor standard includes (but not limited to) poor solder connections, overheated components, and damaged components. MitchElectronics is not liable for harm, injury, or damage caused by the misuse of kits and/or products if

- Incorrectly constructed
- Powered by sources other than “portable batteries” or the specified power supply
- Kits used outside their operational range (such as voltage supply, temperature etc.)
- Used as a sub-system (i.e. connected to additional circuits and modules)
- Used in a non-educational environment
- Used in a commercial environment
- Used in any dangerous or potentially hazardous environment
- Purchased from an unauthorised third party

Portable batteries refers to low powered alkali batteries. Lithium-based batteries and those with large current capabilities (such as lead-acid batteries) are not considered portable or safe

The use of the kits or products in the above scenarios automatically voids any warrantee or guarantee of that kit or product.

Kits must be

- Inspected for damage before and after construction
- Inspected for missing parts
- Constructed correctly by a qualified individual
- Used in an appropriate manner (i.e. within operational ranges)
- Purchased from an authorised seller

Those who are not competent to construct, inspect, and test kits and products must be accompanied by a competent individual and that competent individual assumes all responsibility for harm or damages and MitchElectronics is not liable for any harm or damage.

Missing Parts

MitchElectronics is only liable for missing parts for kits that have been purchased within 28 days and that have been purchased directly from www.mitchelectronics.co.uk. MitchElectronics is not liable for any product sold by an unauthorised third party.