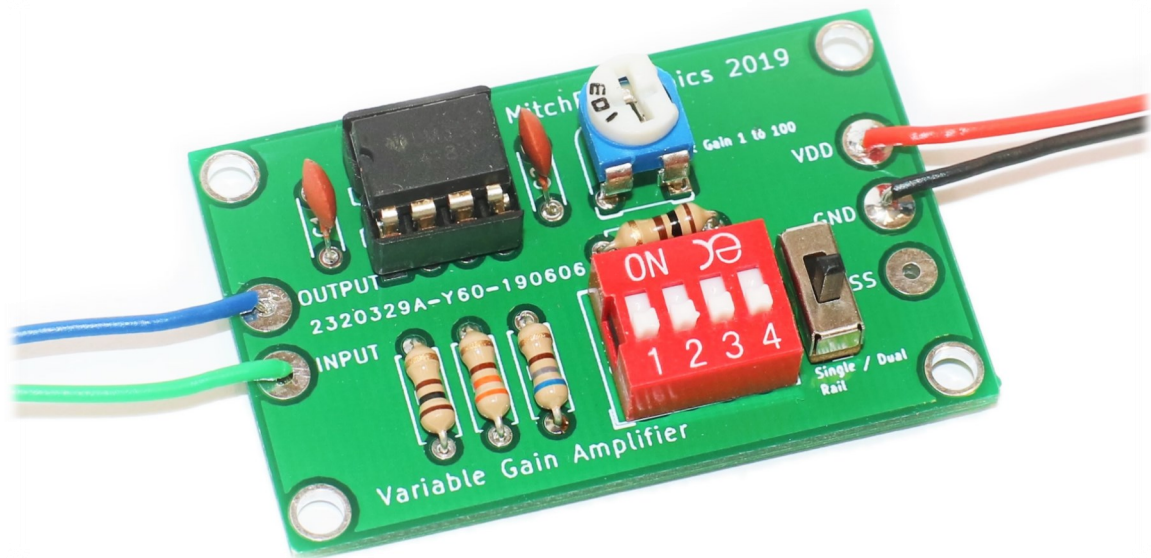


Variable Gain Amplifier

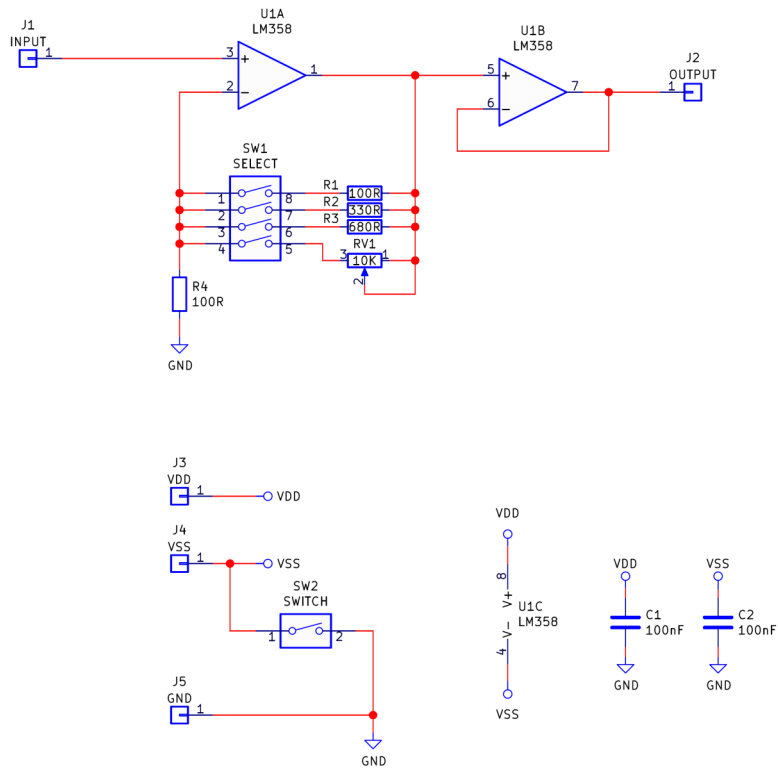
MitchElectronics® 2019



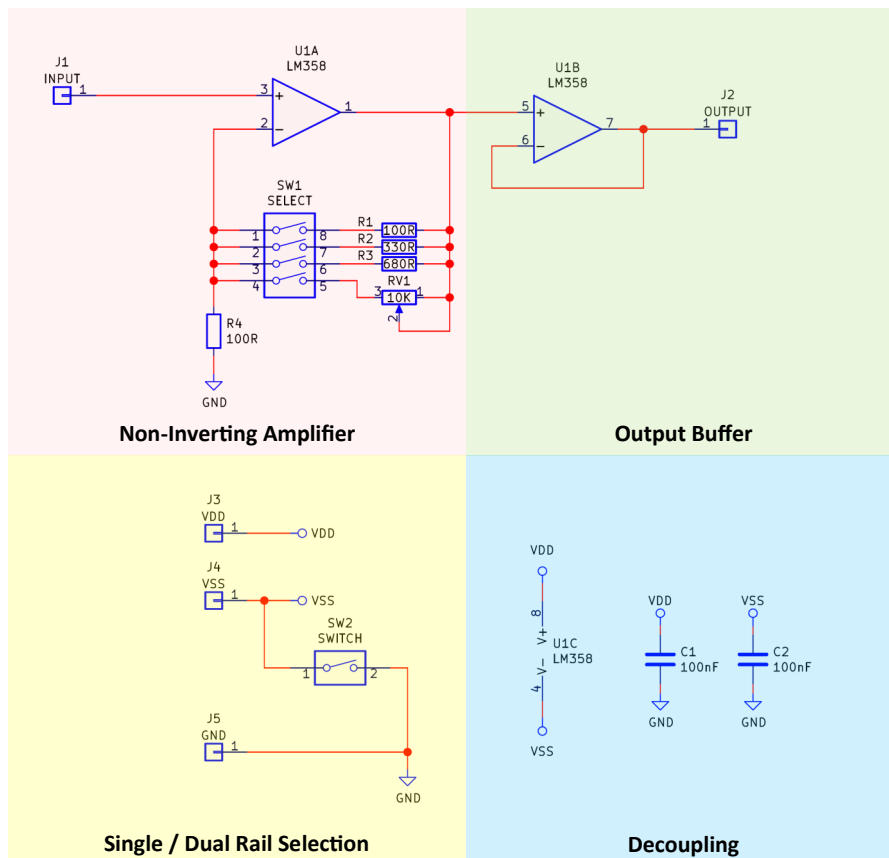
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SCHEMATIC



Schematic (Blocktised)



SCHEMATIC EXPLANATION

The Variable Gain Amplifier is a simple circuit that uses an LM358 to provide a non-inverting amplifier with an adjustable gain. The circuit uses a 4-way DIP switch to allow multiple gains and settings and these settings are shown in the table below

DIP SW 1	DIP SW 2	DIP SW 3	DIP SW 4	Function
1	0	0	0	Gain = 2
0	1	0	0	Gain ≈ 4
0	0	1	0	Gain ≈ 7
0	0	0	1	Gain 1 to 100

The table above shows the gain of the four main stages but what happens if you enable more than one setting? In this situation there will be multiple resistances in parallel and when combined with the potentiometer you can achieve fine gain tuning. The gain of the amplifier can be calculated using the formula below

$$\text{Gain} = 1 + \frac{R_2}{R_1} \quad \text{where } R_1 = 100 \quad \text{and } R_2 = R1, R2, R3, \text{ or } RV1$$







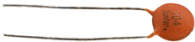



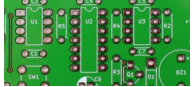
The potentiometer has a resistance range of 0Ω to 10KΩ which provides a wide range of gain values between 1 to 100 but beware that gain values above 20 are effectively unusable due to the inherent limitations in op-amps. The op-amp U1A is connected to a non-inverting unity gain buffer to improve the output impedance and ensure that output devices cannot affect the gain stage of the Variable Gain Amplifier.

Note : The maximum output voltage of the LM358 is VCC—1.5V. This means that if powered by 5V then the maximum output voltage will be 5—1.5 = 3.5V!

The Variable Gain Amplifier also has a switch SW2 which is used to configure the circuit as either a dual rail amplifier or a single rail amplifier. When closed, the circuit shorts the VSS and GND pins together to make the amplifier work on single rails (those that are only + and - such as a battery). When open, the circuit can work with dual rails that include a positive, negative, and ground and this is useful in many analog circuits such as audio.

MATERIALS

Check that you have the following components

Component	Component Name	Quantity	Looks like
LM358	U1	1	
8 DIP Socket	U1	1	
100Ω Resistor	R1, R4	2	
330Ω Resistor	R2	1	
680Ω Resistor	R3	1	
10KΩ Potentiometer	RV1	1	
100nF Capacitor	C1, C2	2	
4 Way DIP Switch	SW1	1	
Slide Switch	SW2	1	
Red, Blue, Green, and Black Wire	-	1	
PCB	-	1	

CONSTRUCTION

Download the electronics construction manual

To learn how to construct circuits on PCBs download the Electronics Construction Manual from MitchElectronics 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

ICs

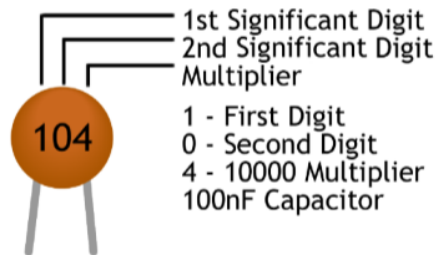
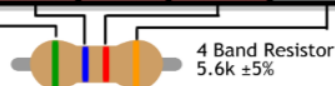
Switches

Potentiometers

Wires

RESISTOR AND CAPACITOR IDENTIFICATION

Colour	1 ST Band	2 ND Band	3 RD 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%



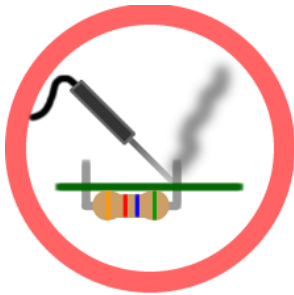
IMPORTANT INFORMATION



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.