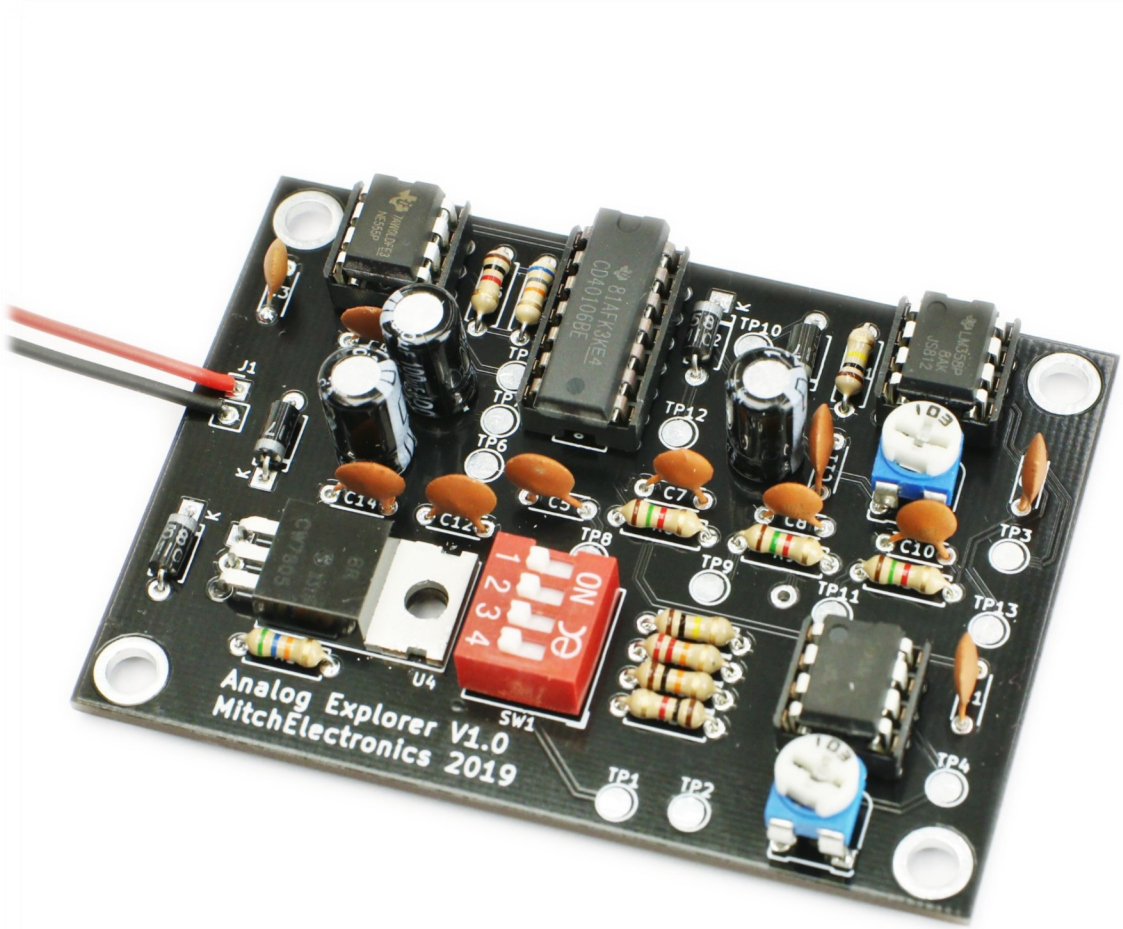
Analog Explorer V1

MitchElectronics® 2019



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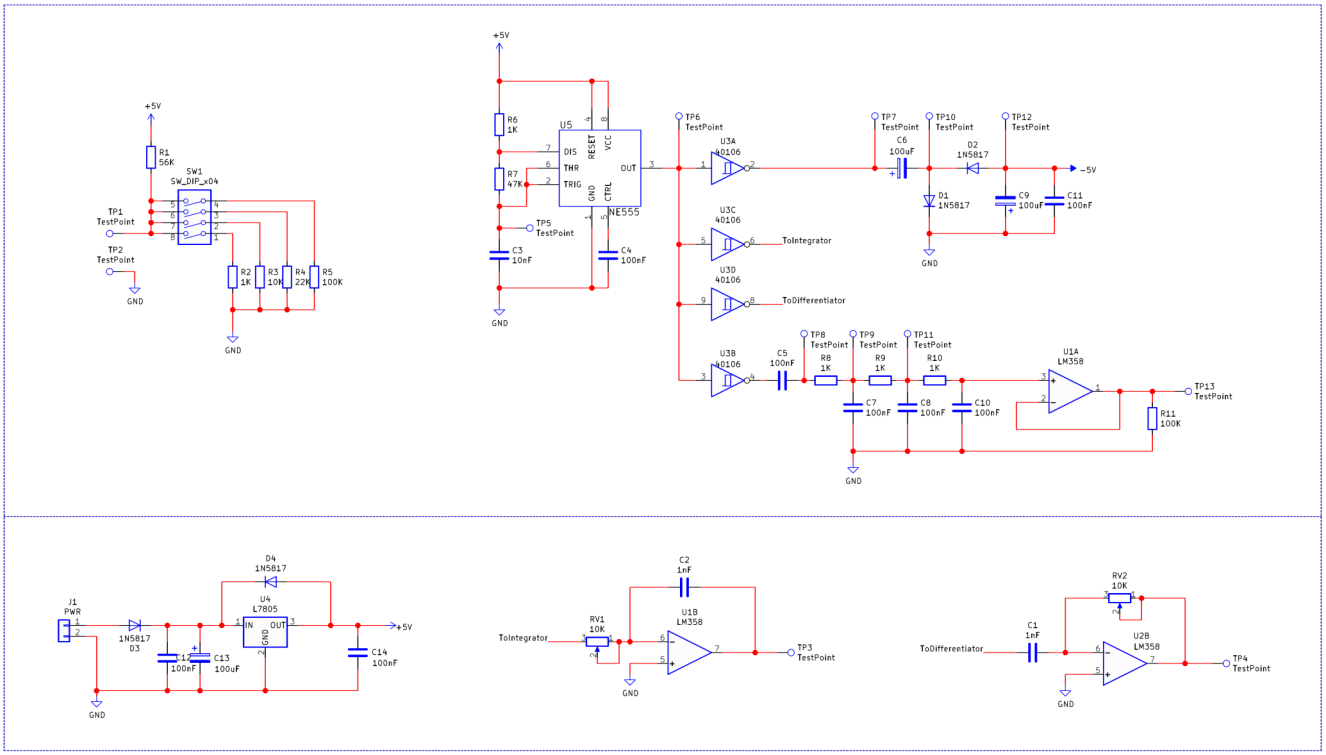
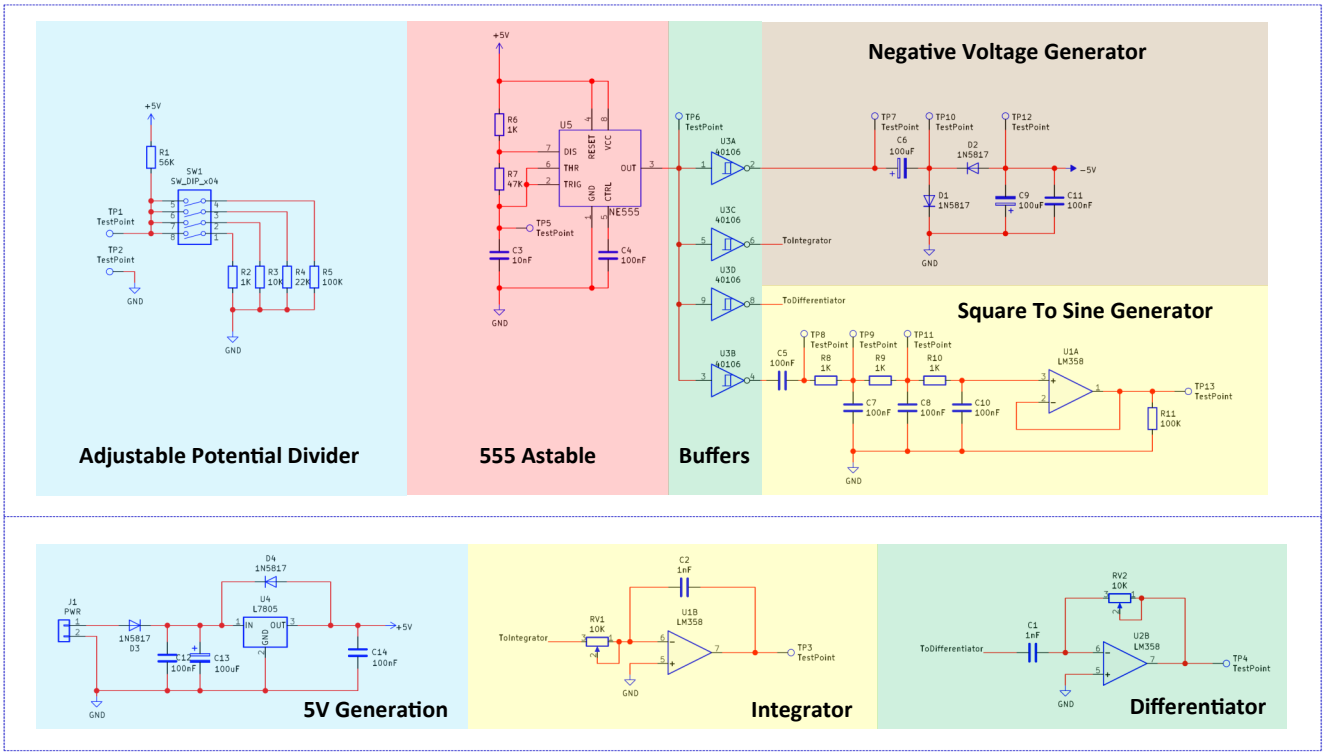


Schematic (Blocktised)



SCHEMATIC EXPLANATION

The Analog Explorer V1 is a mixture of different analogue and digital circuits that allows for the exploration of signals, how some circuit configurations work, and how components behave when used. Therefore it is imperative that you have the following equipment so that you may test and probe signals:

- A multimeter—For testing DC voltages such as the potential divider
- An oscilloscope—For probing AC signals

If a typical bench oscilloscope is used then the multimeter is not needed as these can measure both AC and DC signals but if the MitchElectronics Sound Card Scope is being used then a multimeter is needed to measure DC voltages such as those from the negative voltage generator and the potential divider.

The Analog Explorer V1 contains the following sub-circuits

- Adjustable Potential Divider
- 555 Astable
- Buffers
- Negative Voltage Generator
- Square To Sine Wave Generator
- 5V Generation
- Integrator
- Differentiator

While component leads can be probed there are many test points on the PCB which are large silver contact pads that make it easier to probe key areas of the board. These test points are listed below with each test points function. Note that test point 2 is ground and this is your negative reference when exploring!

Test Point	Function
TP1	Adjustable Potential Divider Output
TP2	Ground < This is your (-)reference point
TP3	Integrator Output
TP4	Differentiator Output
TP5	555 Capacitor Output
TP6	555 Output / Buffer Input
TP7	Buffer Output
TP8	Square / Sine Stage 1
TP9	Square / Sine Stage 2
TP10	Negative Voltage Stage 1
TP11	Square / Sine Stage 3
TP12	Negative Voltage Rail
TP13	Square / Sine Wave Output

EXPLORE

Adjustable Potential Divider

The Adjustable Potential Divider is a circuit made up of R1, R2, R3, R4, R5, and the DIP switch SW1. This circuit allows you to connect and disconnect the four resistors R2 to R5 and produce different voltage outputs. You can print this document off and fill in the table below to see what voltages you get when you change different settings. While the table below only has five different combinations the DIP switch actually allows for 16 different combinations!

1	2	3	4	V Output
OFF	OFF	OFF	OFF	
ON	OFF	OFF	OFF	
OFF	ON	OFF	OFF	
OFF	OFF	ON	OFF	
OFF	OFF	OFF	ON	

555 Astable / Buffer Circuit

The 555 Astable circuit is made up of R6, R7, C3, C4, and the 555 timer (U5). This circuit produces a square wave that feeds into a buffer stage which consists of multiple inverting Schmitt trigger gates (U3). Try probing TP5, TP6 and TP7 to see what you find and determine what the frequency of the output of the 555 is!

Test Point	What do you observe?
TP5	
TP6	
TP7	
555 Frequency (Hz)	

EXPLORE

Negative Voltage Generator

The negative voltage generator on the Analog Explorer V1 is imperative for the op-amp circuits to function correctly. But how exactly does the negative voltage generator work? This circuit demonstrates the effects of “capacitive coupling” and by probing TP7, TP10, and TP12 you can see for yourself how this circuit works!

Test Point	What do you observe?
TP7	
TP10	
TP12	
Negative Voltage Value (V)	

Square To Sine Wave Generator

If it’s one thing that any designer knows is that creating sine waves electronically can be very difficult. One method for doing this is the use of a series of RC filters and this is done in this circuit with the use of C5, C7, C8, C10, R8, R9, R10, R11, and U1A. But what does each RC filter stage look like and why does this circuit create a sine wave?

Test Point	What do you observe?
TP8 (Stage 1)	
TP9 (Stage 2)	
TP11 (Stage 3)	
Sine Wave Frequency (Hz)	

EXPLORE

Integrator Circuit

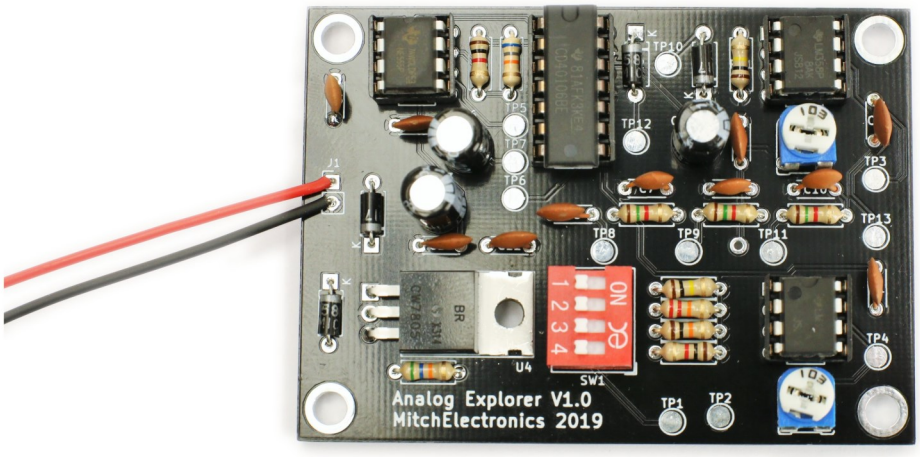
Integrator circuits are very useful for signal processing and can be used to perform mathematical operations as well as provide accumulated error readings. The integrator in this circuit is very simple and uses a single potentiometer (RV1), capacitor (C2), and an op-amp U1B but how does the output change as the potentiometer is adjusted? Adjust RV1 and find out!

Test Point	What do you observe?
TP3	

Differentiator Circuit

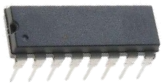
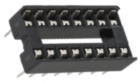
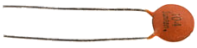
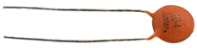
Differentiator circuits are also very useful for signal processing and can be used to perform mathematical operations as well as provide predicted error readings. The differentiator in this circuit is very simple and uses a single potentiometer (RV2), capacitor (C1), and an op-amp U1B but how does the output change as the potentiometer is adjusted? Adjust RV1 and find out!

Test Point	What do you observe?
TP4	



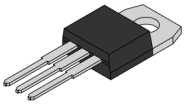
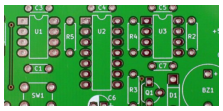
MATERIALS

Check that you have the following components

Component	Component Name	Quantity	Looks like
LM358	U1, U2	2	
NE555	U5	1	
40106	U3	1	
8-DIP Socket	U1	3	
14-DIP Socket	U3	1	
10nF Capacitor	C3	1	
100nF Capacitor	C1, C2, C4, C5, C7, C8, C10, C11, C12, C14	10	
100uF Capacitor	C6, C9, C13	3	
1K Resistor	R2, R6, R8, R9, R10	5	
10K Resistor	R3	1	
22K Resistor	R4	1	
47K Resistor	R7	1	
56K Resistor	R1	1	
100K Resistor	R5, R11	2	
10K Potentiometer	RV1, RV2	2	

MATERIALS

Check that you have the following components

Component	Component Name	Quantity	Looks like
7805	U4	1	
4 Way DIP Switch	SW1	1	
1N5817	D1, D2, D3, D4	4	
PP3 Connector	J1	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

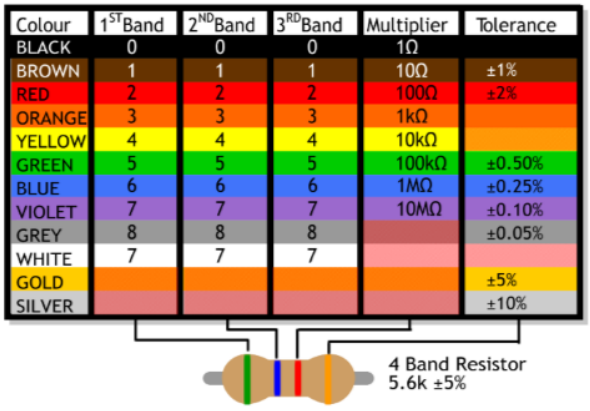
Diodes

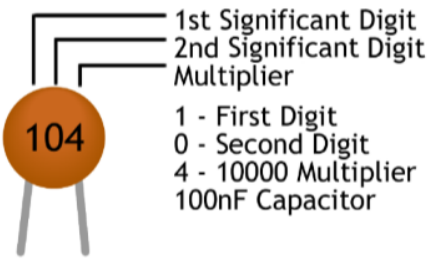
ICs

Switches

Wires

RESISTOR AND CAPACITOR IDENTIFICATION

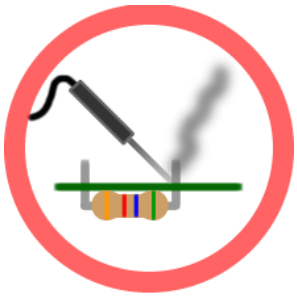




IMPORTANT INFORMATION

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.