ANALOG ELECTRONIC

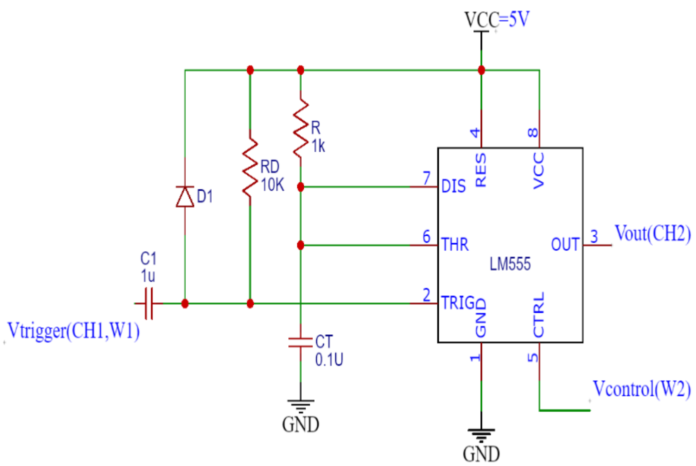
ULTRA CONCURRENT REMOTE LAB

Contents:

Objectives:

1. Use of 555 timer as single pulse generator
2. Need of signal conditioning of input signal
3. Applications of 555 Timer as Mono stable MV for simple real time applications
4. Verify the output response with the expected values.
5. Analyze the impact of each parametric variation on the circuit.

Circuit diagram



Design equations

$$V_C = V_F - (V_F - V_I)e^{-\frac{t}{RC}} \qquad \text{----(1)}$$

With $V_I = 0$, $V_F = V_{CC}$, at t=T, $V_C = \frac{2}{3}V_{CC}$

Equation (1) becomes,

$$\frac{2}{3}V_{CC} = V_{CC} - (V_{CC} - 0)e^{-\frac{T}{RC}}$$

Pulse width $T = \ln(3)\,RC \approx 1.1RC$

Pulse width with External voltage at $V_{control}$

$$T = RC\ ln\left(\frac{V_{CC}}{(V_{CC} - V_{EXT})}\right)$$

The Monostable Multivibrator in Ultra concurrent Laboratory has option to vary R, control voltage and signal parameters and is listed in the Table 1. Fig shows the schematic of Monostable Multivibrator with variable parameters. The signal frequency is fixed at 1 KHZ to obtain the frequency response of the circuit. However, to realize the frequency response of the Monostable Multivibrator the input signal frequency is swept from 1 KHZ to 500 KHZ

TABLE: 1

Parameter	Variations
R	1kΩ, 10kΩ ,10k‖1k
RD	10kΩ
Vin	1V,2v
LM555	#1

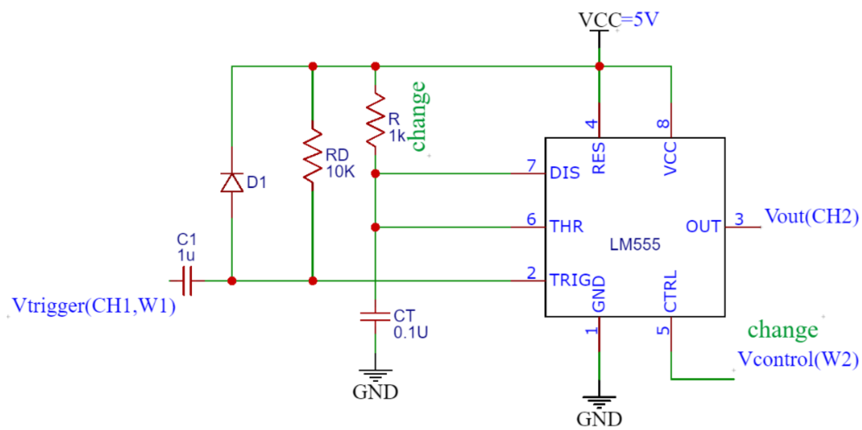


Fig. 1: Schematic of Monostable Multivibrator with variable options

Fig. 2: View of the Monostable Multivibrator output response

The laboratory has three important views to give real-time feeling during the conduction of the experiment. Fig.1 shows the circuit view and parameters to be changed.Fig.2 shows the scope of the waveform application that has input sine wave, dc voltage, frequency, amplitude, offset voltage, output response and transfer characteristics.

1. Effect of parametric variations on the circuit performances

As there are many variations are possible in the Monostable Multivibrator, let's see the impact of each one on the circuit performance in detail.

1. Impact of control voltage (V control) on the Monostable Multivibrator Circuit:

In the Monostable Multivibrator Schematic, it is possible to modify the value of control voltage.

From the set of design equations shown above it can be verified that as $V_{control}\uparrow \longrightarrow$

Pulse width ↑.

In order to verify the effect of control voltage change the offset voltage to 2.31v to 1.71v. We can notice the change in the pulse width of the output waveform. If we increase value of control voltage the pulse width of the output waveform will also get increased as shown in Fig.3.Similarly, if the value of control voltage starts decreasing. we can notice that there is a decrease in the pulse width of the output waveform as shown in Fig.4.If the control voltage is reduced further there will be no output waveform as shown in Fig.5. This is because of the spike that will not go below half of the control voltage i.e. V_{TL} so we cannot get the output waveform.

Various output parameters of the Monostable Multivibrator circuit noted from the different views for the changes in V control are recorded and tabulated in TABLE: 2

TABLE: 2

Expt.	R (Ω)	V_{EXT} , (V)	Amplitude(V)	Frequency (HZ)	Pulse Width T msec Calculated	Pulse Width T msec Measured
Mono 1	1K	2.73v	2v	2k	78.9u	186.1u
		2.59v	2v	2k	72.94u	4.43u
		1.07	1v	1k	4.83u	5.67u

NOTE: C=0.1uF

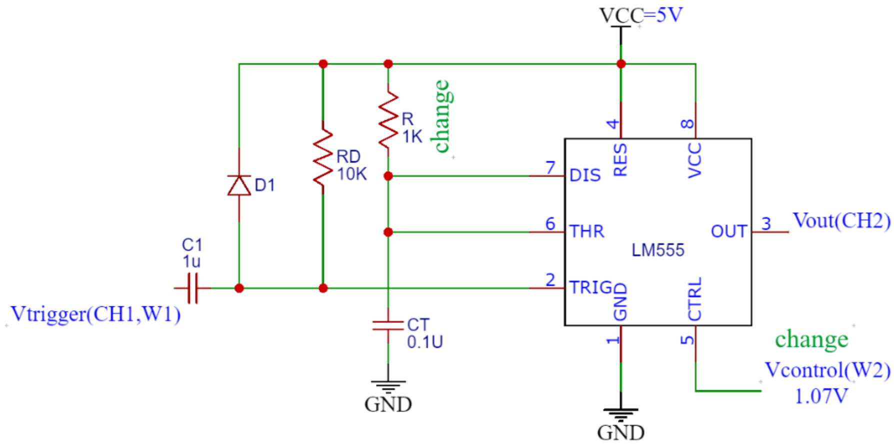
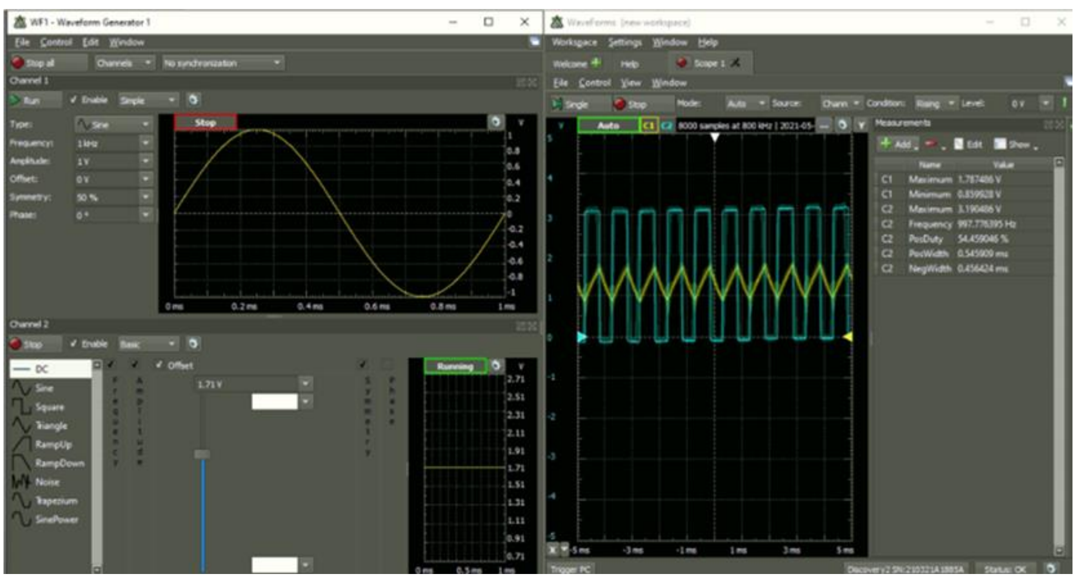
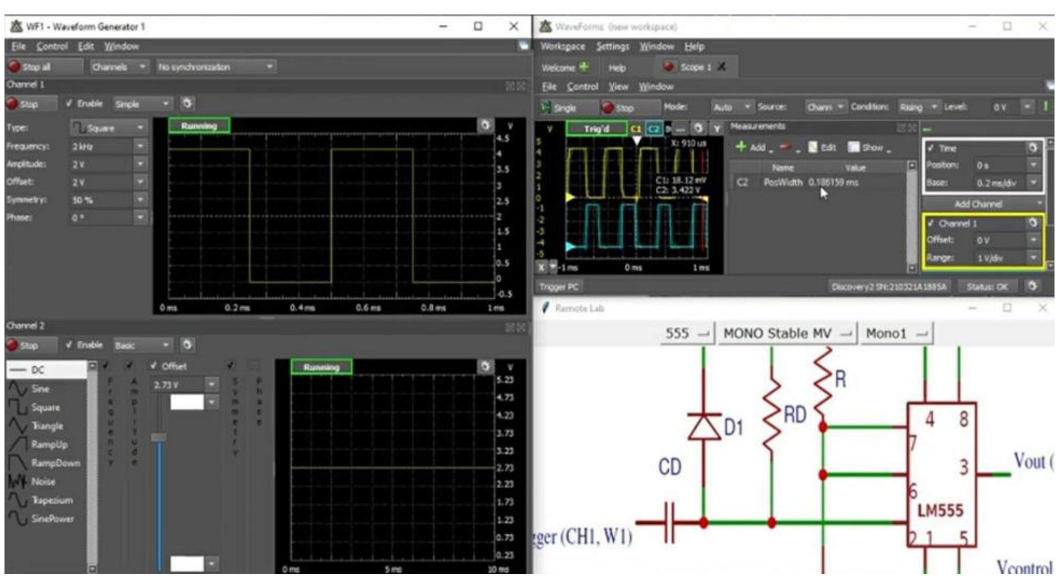


Fig. 3: View of Inverting Schmitt Trigger circuit for variation in V $_{control}$ value





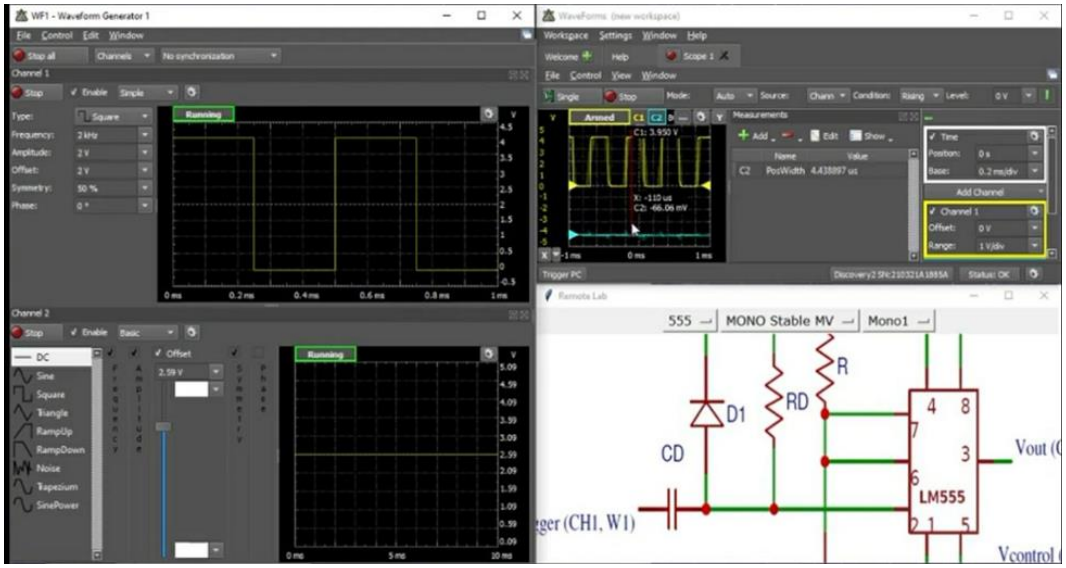


Fig. 4: Various views of the Monostable Multivibrator output response for variation in V control

Similar analysis is done by changing the choosing different combinations of constant parameter of V_{IN}.

2. Impact of R on the Monostable Multivibrator:

In the Monostable Multivibrator circuit schematic, it is possible to modify the value of R from 1 kΩ to 10 kΩ and 1 kΩ || 10 kΩ. To understand the effect of change in resistor R. Observe the change in the pulse width as per the new value of resistor R from the set of design equations shown above it can be verified that as R ↑ ⟶ Pulse width ↑ and viceversa.

When value of the resistor R is increased to 10 kΩ we can notice that the pulse width of the output waveform will get increased.Fig.4 shows the non -re triggerable condition of the 555 timer. When a valid trigger signal is initialized the pulse width of the output waveform starts and it goes till the end of the pulse width. As shown in the above figure even though we are having one more trigger signal the pulse width will stay in the quasi-stable state. Whatever the trigger signal that comes before the end of the pulse width trigger will not be valid. So, it is called as non - re triggerable condition.

Similarly, if the value of the resistor R is decreased the pulse width will also get reduced. Whenever a valid trigger is applied the output enters quasi stable state for some time after the end of the pulse width it will come back to stable state.

In this way we can able to demonstrate the working of 555 timer as Monostable Multivibrator where pulse width can be varied by changing the value of the timing resistor R.

Various output parameters of the Monostable Multivibrator noted from the different views for the changes in resistor R value are recorded and tabulated in TABLE: 3.

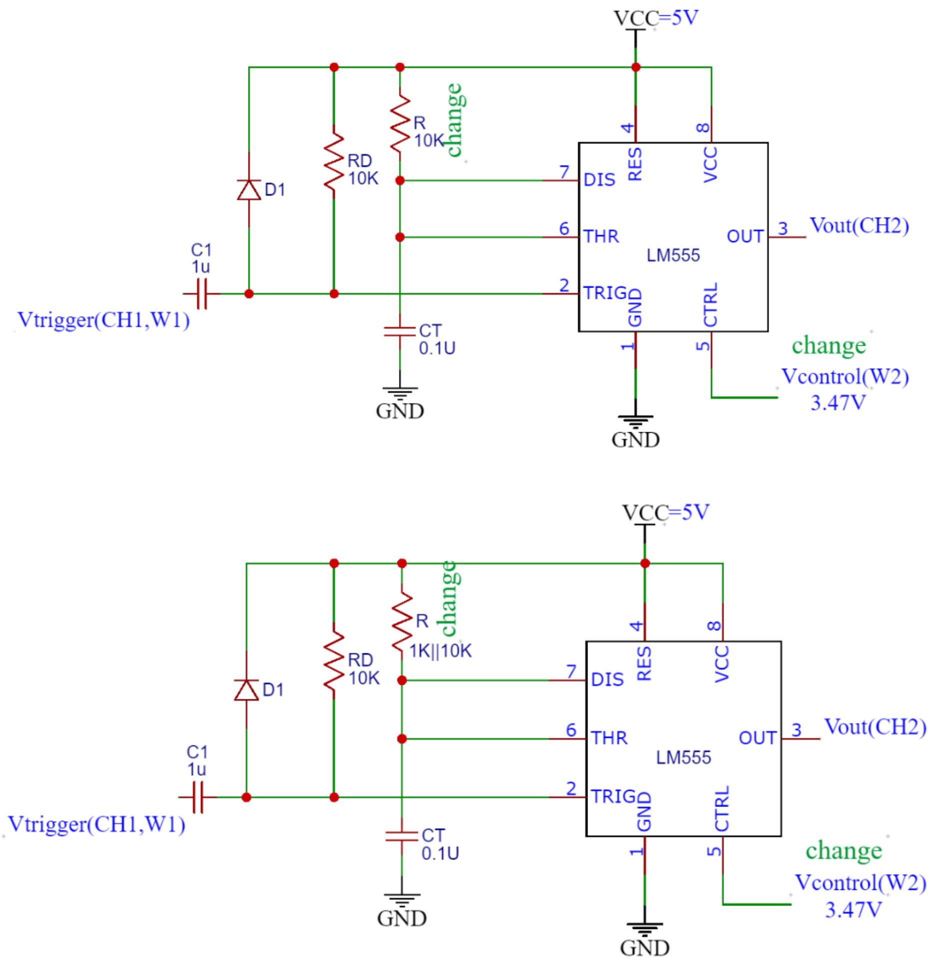
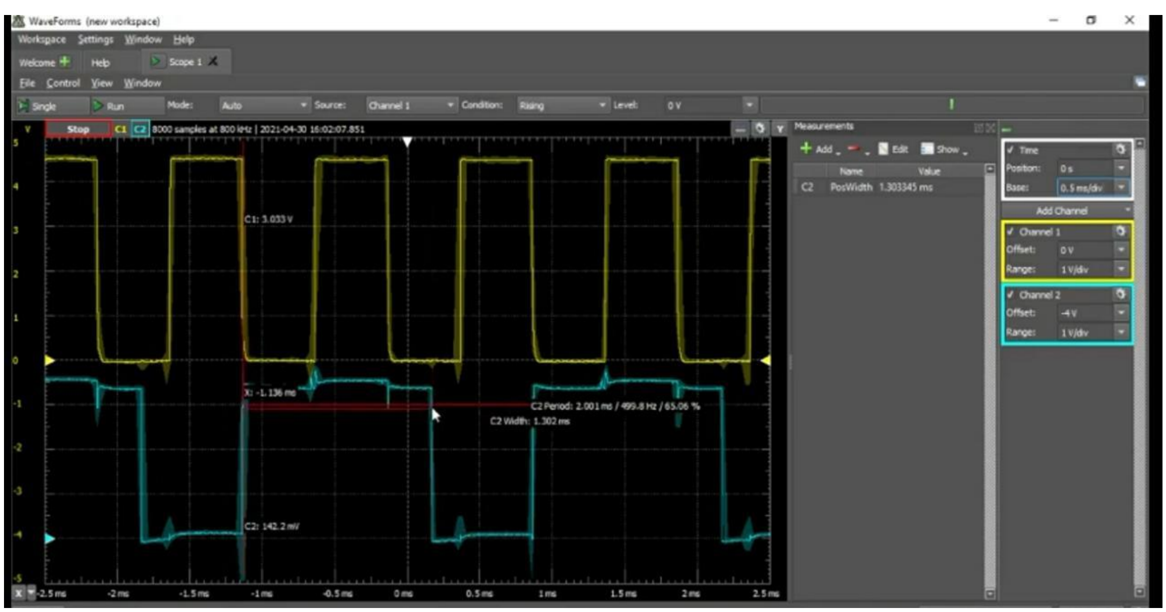


Fig. 5: Views of Inverting Schmitt Trigger circuit for variation in R value



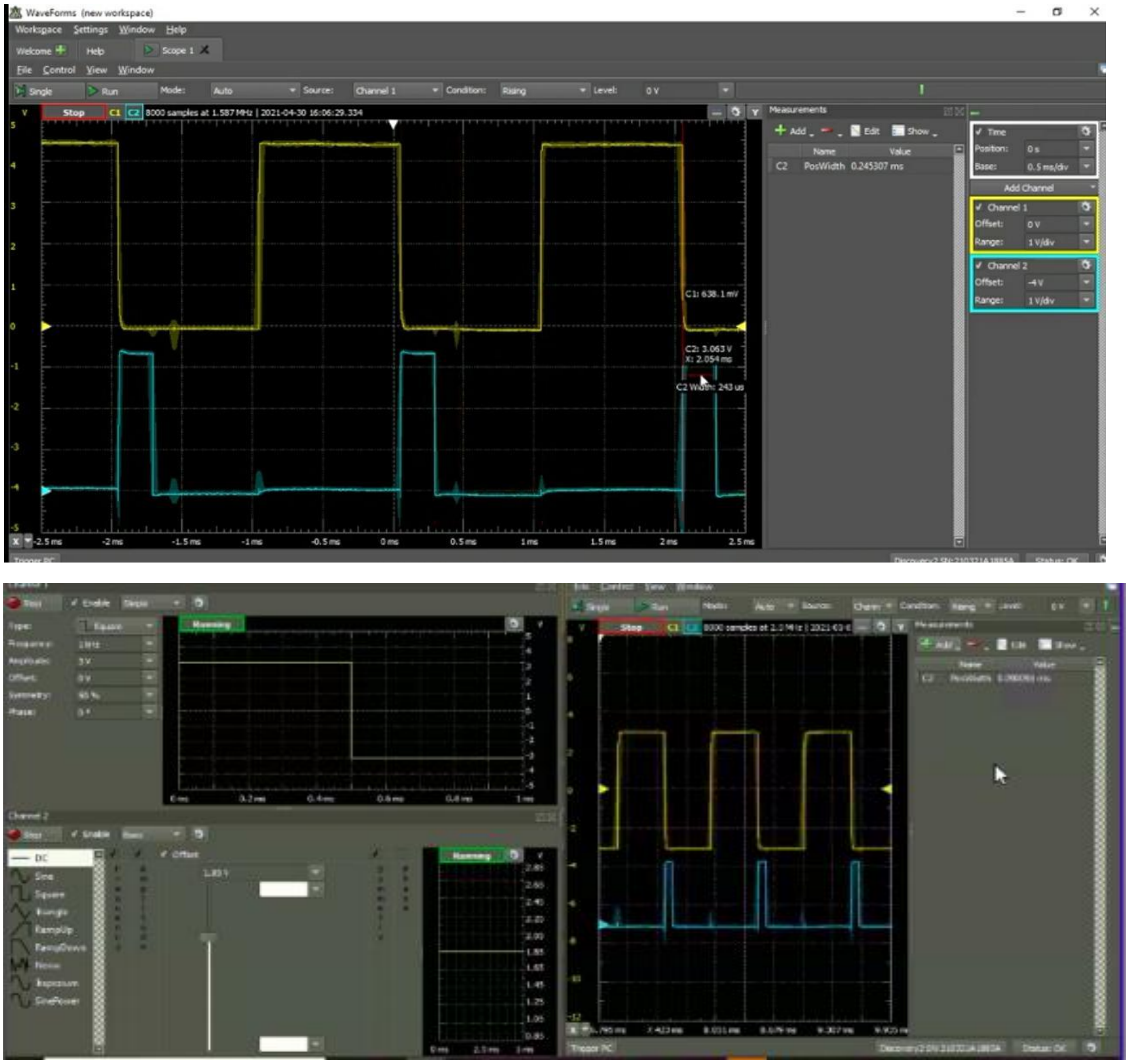


Fig.6.Various views of Monostable Multivibrator response for variation in R value

TABLE: 3

Expt.	R (Ω)	V_{EXT} , (V)	Pulse Width T msec Calculated	Pulse Width T msec Measured
Mono 1	1K	1.03	23.03u	24.43u
Mono 2	10K	3.47	118.38u	130.34u
Mono 3	1K || 10K	3.47	107.624u	245.3u

Note: C= 0.1uF

Similar analysis is done by choosing different combinations of constant parameters.

TABLE:4 is used to record various output response for different variation can be entered for further analysis. LM555 Timer, C= 0.1uF.

TABLE:4

Expt.	R (Ω)	V_{EXT} , (V)	Pulse Width T msec Calculated	Pulse Width T msec Measured
Mono 1	1K	3.01	92.13u	85.09u
		1.44	33.96u	49.04
		1.07	4.83u	5.67u
Mono 2	10K	3.64	1.30m	1.35m
		2.31	2.236m	2.87m
		1.71	4.89m	5.21m
Mono 3	10K||1K	3.32	101.34u	190.2u
		1.5v	34.5u	38.7u