Vector Impedance Meter

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Vector Impedance Meter:

The Vector Impedance Meter is employed for measuring both the amplitude and phase angle of impedance.

- Normally in other measuring techniques of impedance, the individual values of resistance and reactance are obtained in rectangular form.
- But here it can be obtained in polar form also.
- In many applications it is not only necessary to determine the magnitude of the impedance, but it may also be important to find the ratio of the reactance to the resistance and whether the reactance is inductive or capacitive.

Two things are measured:

1. Magnitude of impedance;

- Constant Voltage: Constant voltage is applied across the unknown impedance with that current is measured across unknown impedance, then the meter measures the magnitude of impedance proportional to current.

$$z \propto 1/i$$

- Constant Current: Constant current is applied across the unknown impedance with that voltage is measured across unknown impedance, then the meter measures the magnitude of impedance proportional to voltage.

$$z \propto V$$

2 . Phase Angle: θ = Phase(V) / Phase(i)

The meter so designed that it measures the zero crossing points of v and I, with that it measures the difference of both and hence the phase angle is obtained.

These measurements can be done by CRO also, then why Vector Impedance Meter?

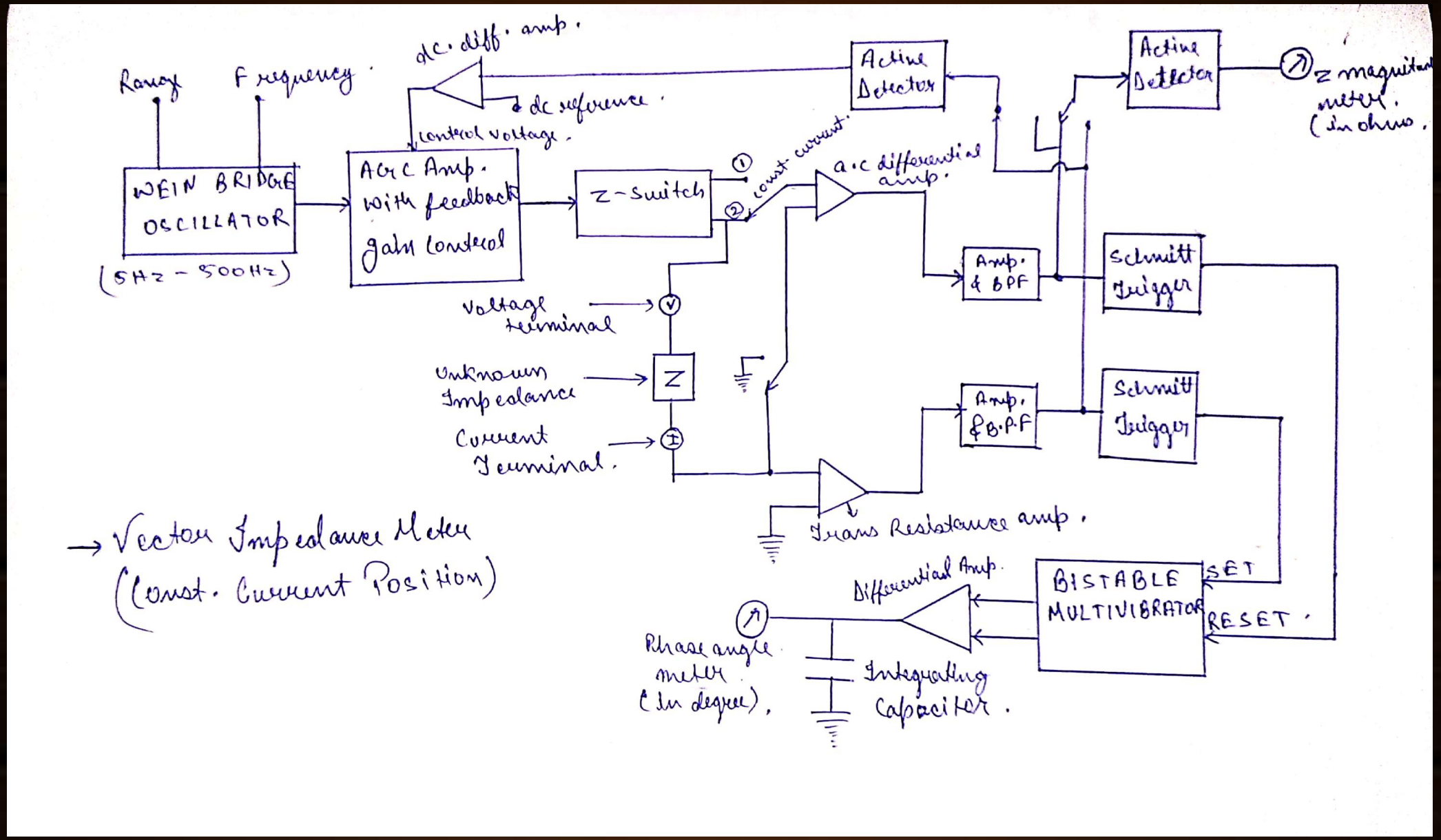
Here is the answer!

In CRO these readings can be done only for a particular frequency, we'll have to measure again after doing some adjustment for different frequencies.

Whereas Vector Impedance Meter provides us to measure the impedance for a range of frequency. We don't need to change the setup or make any arrangement to the circuit.

Here we are provided with a knob with which we can change the frequency.

Block Diagram: [Const. Current Mode]



→ Vector Impedance Meter
(Const. Current Position)

Working:

- At first there is signal generator, which has adjustment freq. & range, using which we can change frequency.
- We connect the unknown impedance at a point as shown in figure.
- Here we have oscillator which is just used to provide different signal frequencies.
- Next we have AGC(Automatic Gain Control) block, which have a feedback connected to it. In other words feedback is also said as control voltage in this circuit.
- AGC amplifies the signal and then it controls the voltage changes or control the output voltage from it.
- Then z-switch comes into picture which selects the mode of operation.

I. Const. Current : Ranges-(x1, x10,x 100)

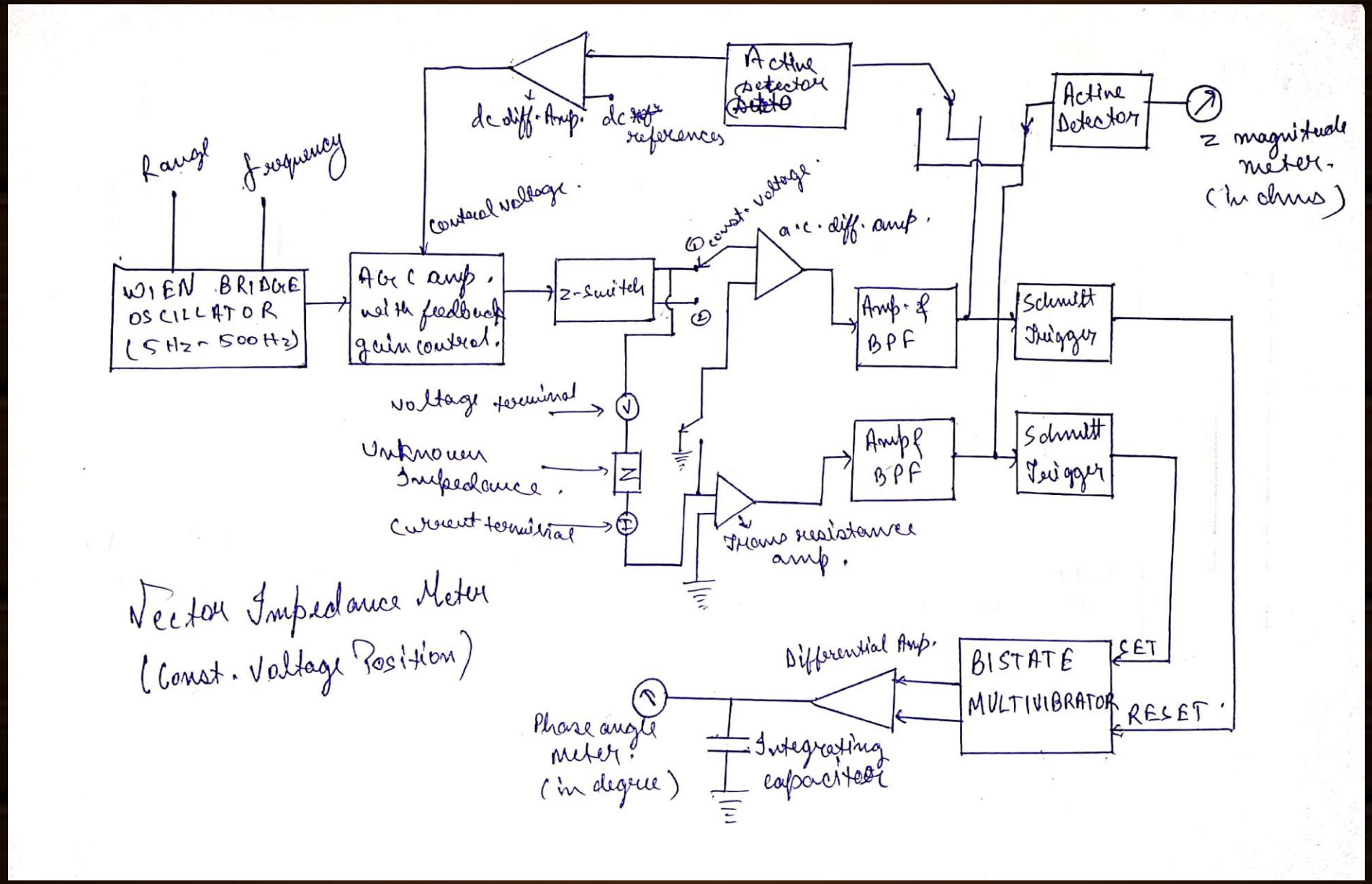
II. Const. Voltage : Ranges-(x1k, x10k, x100k, and x1M)

- Now we have a differential amplifier and a trans resistance amplifier.
- The diff. amp. gives the output proportional to the difference between inputs.
- The trans resistance amp. produces an output which is proportional to the input current.

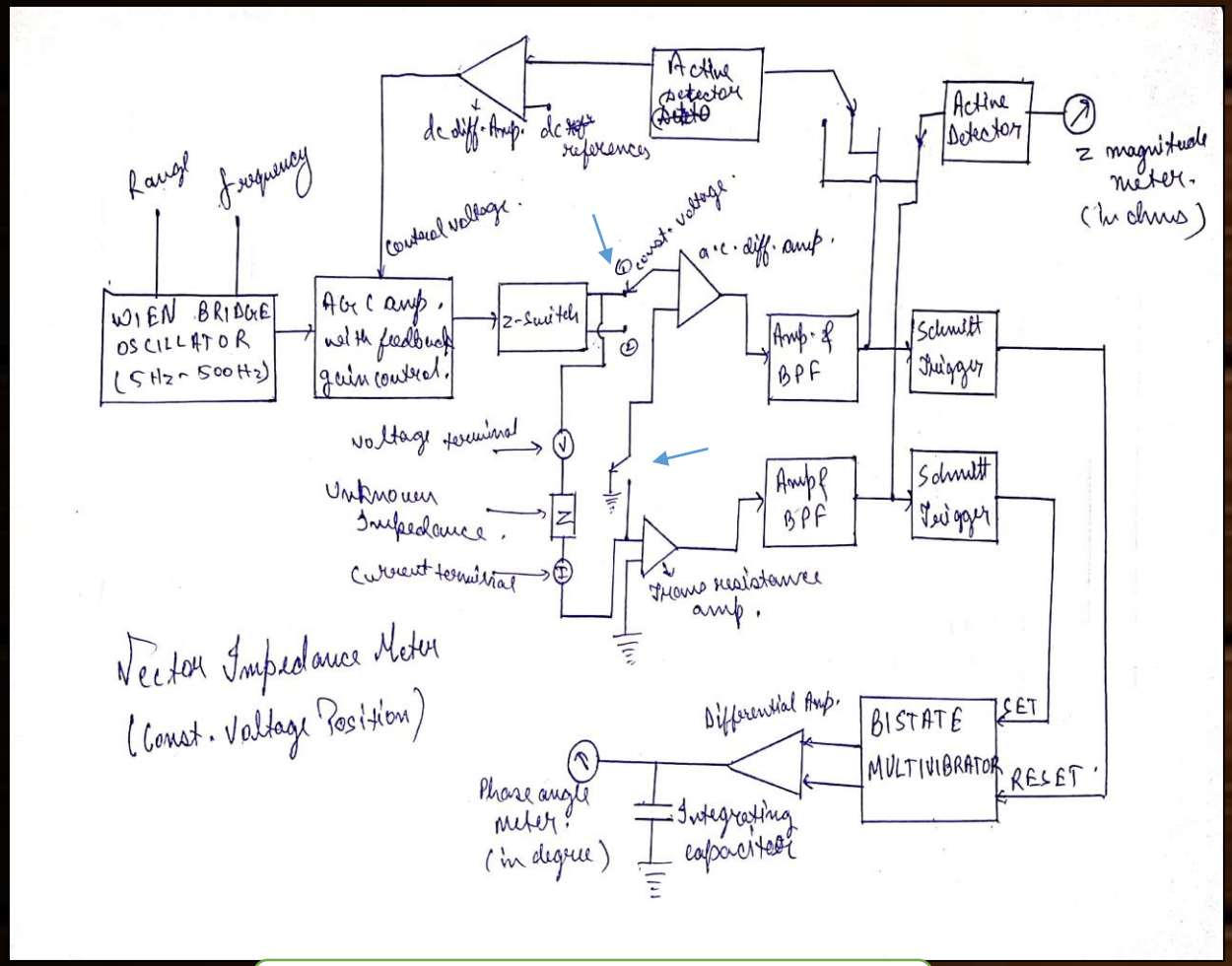
- The output from trans resistance amplifier and differential amplifier goes to Amplifier and filter section. These are like signal conditional circuits which allows the signal or make the signal suitable for the meter display.
- Next there is Schmitt-trigger blocks, which is used to produce possible spikes. We can say it produces spikes for the bi-stable multivibrator.
- The bi-stable multivibrator, as we know, have two stable states, and it changes state only when trigger is applied. So trigger are provided by spikes which schmitt trigger provides.
- The bi-stable multivibrator produces two outputs which is fed to difference amplifier.
- Then the integrating capacitor gets charged with the voltage output produced by diff. amp.
- At last, the phase angle meter gives reading proportional to the voltage to which the integrating capacitor charges.
- The meters here are so designed that, they gives the reading according to the quantity they measure. Here for phase, it measures the voltage across the capacitor and gives the phase angle.
- In another meter it either measures the current or the voltage across unknown impedance and gives corresponding impedance magnitude.

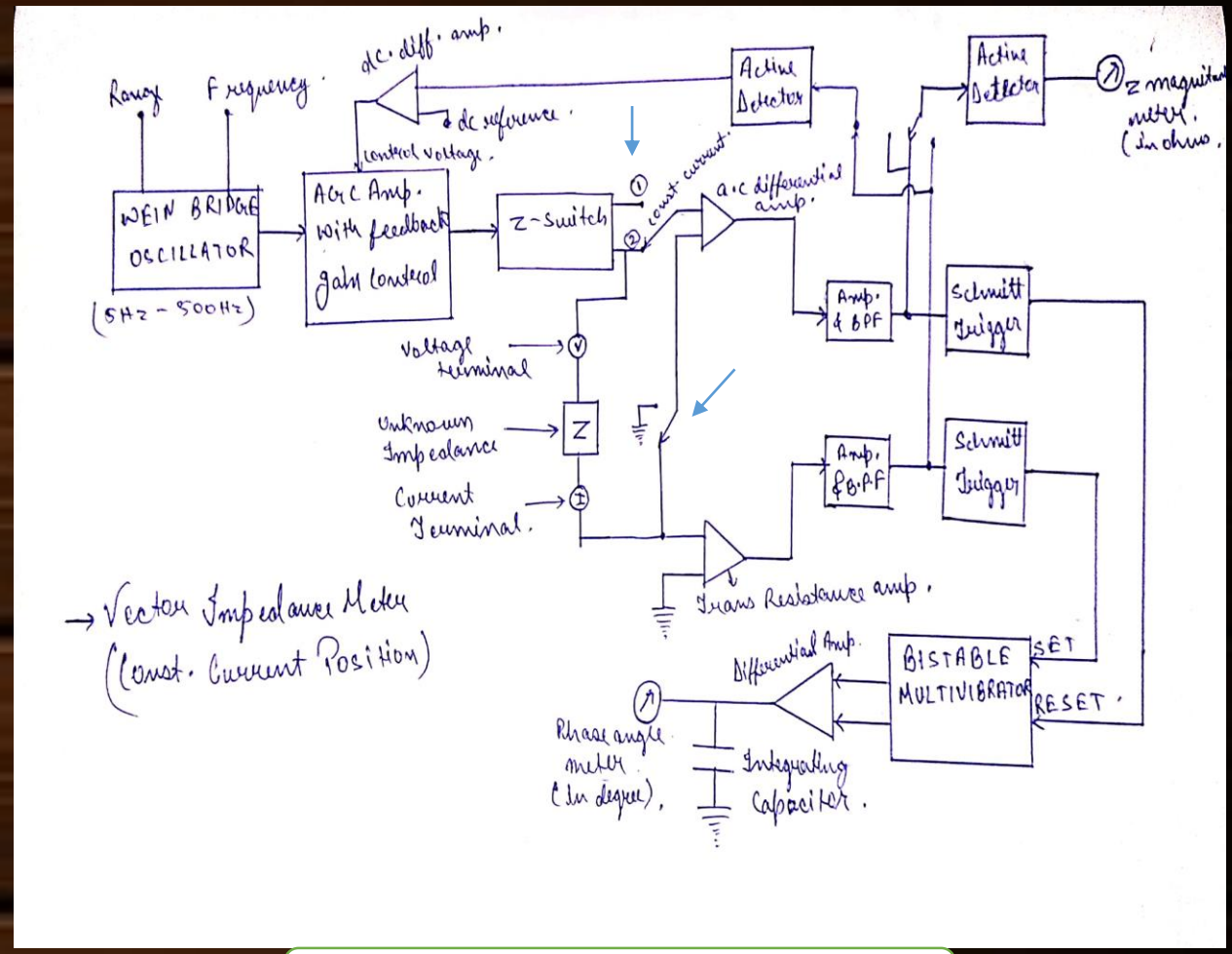
- Now for the measurement of magnitude the output of Amp. & BPF block goes to Active Detector block which is nothing but signal conditioning circuit again, which makes the signal suitable for the meter to give proper reading.
- If we chase the feedback path of AGC, we can see the Trans resistance amp. is connected to the feedback of AGC.
- So, basically current is maintained constant using the Trans resistance amplifier.

Block Diagram: [Const. Voltage Mode]



Slide just for #Comparision





Const. Voltage Mode

Const. Current Mode

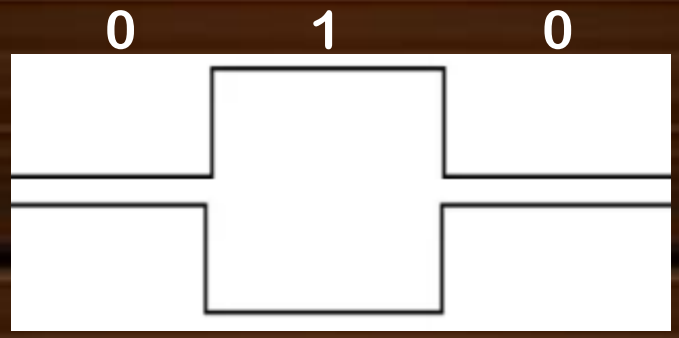
- Here in this circuit, only some differences are there rest all working is similar.

The differences are:

- The input of Differential Amp. is now connected to the constant voltage mode pin and unknown impedance also connected to the same pin.
- The other input of the Differential Amp. Is now connected to the ground while in const. current case it was connected to the Trans Resistance Amp. input.
- Also in const. current case, the impedance magnitude meter was connected to AC differential amplifier and Trans Resistance Amp. was connected to the feedback loop, but here in const. voltage case it is reverse. The impedance magnitude meter is connected to the Trans Resistance Amp. and AC differential amplifier is connected to to the feedback loop.

How circuit identifies the zero crossing for phase measurement?

- Whenever the current waveform crosses 0 then set becomes 1.
- Whenever the voltage waveform crosses 0 then reset becomes 1.



- If the period of zero crossing point will be calculated then, it's phase will be obtained.
- Thus it is done by Differential Amp. which provides an output voltage to which capacitor charges and gives the corresponding phase angle reading.
- So, the set time of amplifier measures the phase angle and gives the reading.

Thank You!!