Voltage Doubler Basics

Components, use and operation

$G_e = 1N34$ or similar

$C_1$ 10uF

$S_i = 1N4149$ or similar

$C_2$ 10uF

To input or Source

To meter probes
Components of Voltage Doubler

• There are basically two types of components to a Voltage Doubler.
  – Two $10\mu F$ capacitors
  – One Silicon Diode
  – One Germanium Diode
Diodes

• Diodes are semiconductors
  – Any of the various solid crystalline substances, such as germanium or silicon, having electrical conductivity greater than insulators.
Schematic Symbol of a Diode

Cathode

Anode
Pictorial View of a Diode

Cathode

Anode
Parts of a diode

Cathode

Anode

The anode is more positive than the Cathode.
Basic diode operation

• A diode acts as a one-way valve to electricity/current flow.
  – This means current will only flow in one direction
  – Current flows from negative to positive, so from cathode to anode. (Forward Biased) (On Switch)
  – If the diode is Reversed Biased, current does not flow (Off/Open Switch)
• Diodes are made of silicon or germanium
• Silicon diodes drop approximately 0.5 - 0.7 Volts when forward biased.
• Germanium diodes drop approximately 0.3 – 0.4 Volts when forward biased
  – The diodes are conducting when forward biased
  – Forward Biased: The voltage at the Anode is more positive than Cathode voltage
Electrolytic Capacitors

• Take care to place the capacitor correctly in the circuit. Electrolytic capacitors have a polarity marked on the capacitor’s case.

• Take care not to exceed the voltage marked on the capacitor’s case.
• Note the negative lead is shorter than the positive lead, or the positive lead is longer

• Other types of capacitors do not have a polarity and have different functions in circuits
Pictorial View of an Electrolytic Cap

Positive

10µF 50V   10µF 50V
Schematic Symbol of an Electrolytic Capacitor
Voltage Doubler in 1418-1

- $G_v = 1N34$ or similar
- $1N34$
- $C_1 = 10\mu F$
- $Si = 1N4149$ or similar
- $C_2$
- $10\mu F$

To input or Source

To meter probes
Things to Remember about Voltage Doublers

• We are using the Voltage Doubler primarily with the Analog Multimeter to measure extremely small values.

• The Silicon (Si) and the Germanium (Ge) diodes can swap positions in the circuit and the circuit will work fine.
• Remember: The Blocking Capacitor coming from the sine wave generator on the trainer is used only with Analog Multimeters.

• Digital Multimeters do not need the Blocking Capacitor
  – You will not measure a signal if the blocking capacitor is used
    • There is already one built into the meter
• Make sure the polarity of the diodes and electrolytic capacitors are correct before applying power.

• It does not matter if you ground pin 1 or pin 2 of the potentiometer.

• You can use pin 1 or pin 3 with pin 2 as long as either pin 1 or 3 are not connected/open.
Voltage Doubler in 1418-1

\[ G_e = 1N34 \text{ or similar} \]

\[ 1N34 \]

\[ C_1 = 10\mu F \]

\[ Si = 1N4149 \text{ or similar} \]

\[ C_2 = 10\mu F \]

To input or Source

To meter probes
Voltage Doubler Operation

• C2 charges, ≅ to 5 V (4.5 V considering the diode drop) on the negative half cycle of AC input. The right end is grounded by the conducting diode Ge. The left end is charged at the negative peak of the AC input. This is the operation of the clamper.
• During the positive half cycle, the half-wave rectifier comes into play. Diode Ge is out of the circuit since it is reverse biased. C2 is now in series with the voltage source. Note the polarities of the generator and C2, series aiding.
Thus, rectifier diode Si sees a total of 10 V at the peak of the sinewave, 5 V from generator and 5 V from C2. Si conducts, charging C1 to the peak of the sine wave riding on 5 V DC. The output of the doubler, stabilizes at 10 V (8.9 V with diode drops) after a few cycles of sinewave input.
Voltage Doubler Breadboarded
Circuit with Voltage Doubler

Si = 1N4149 or similar

C2 10uF

+ C2

To meter probes

Si

+ C1

10uF

Ge = 1N34 or similar

GND

Blocking Capacitor

Sine (Signal Generator)

Capacitor under test

Slide Switch

Ground

1 100KΩ pot

Pin 3 is not connected
Questions?
The End

Developed and Produced by the Instructors in the CIE Instruction Department.

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