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**ECE 221 Lab #1**

**Part I**

* 1. In order to determine if a DC offset is present, the oscilloscope can be put on DC coupling and the signal would not be centered about 0V. The deviation from 0V is the offset voltage.
  2. AC coupling removes the DC component of the signal. It will show the oscillations present in the waveform and center the signal about 0V. DC coupling shows both AC and DC components of the waveform.

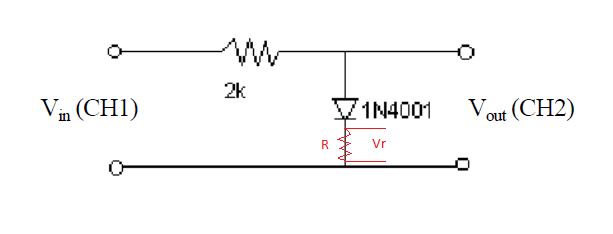
Part II

|  |  |
| --- | --- |
| Signal = 0.8Vpp triangular waveform at 1KHz | |
| C:\Users\template\Desktop\2a.bmp | C:\Users\template\Desktop\2a vout vs vin.bmp |
| Vin vs time shown in yellow Vout vs time shown in blue | Vout vs Vin |

Note that the Vin vs time waveform does not show up on the left figure. This is because the Vout vs time waveform is on top of it. Vin vs time and Vout vs time are effectively identical in this scenario.

|  |  |
| --- | --- |
| Signal = 4.0Vpp triangular waveform at 1KHz | |
| C:\Users\template\Desktop\2b.bmp | C:\Users\template\Desktop\2b vout vs vin.bmp |
| Vin vs time shown in yellow Vout vs time shown in blue | Vout vs Vin |

|  |  |
| --- | --- |
| Signal = 20.0Vpp triangular waveform at 1KHz | |
| C:\Users\template\Desktop\2c.bmp | C:\Users\template\Desktop\2c vout vs vin.bmp |
| Vin vs time shown in yellow Vout vs time shown in blue | Vout vs Vin |

**Part III**

* 1. The current going through the diode can be measured by inserting a known resistor in series with the diode as shown in the schematic diagram above. The resistor we used is R = 14.87kΩ. Vr can be measured. The current going through resistor R can be deduced with the expression . Since the diode and resistor are in series, the current going through the resistor is equivalent to the current going through the diode.

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| --- | --- |
| Signal = 4Vpp square waveform at 1KHz | |
| C:\Users\template\Desktop\ts at 4vpp 1khz.bmp | C:\Users\template\Desktop\tr at 4vpp 1khz.bmp |
| The storage time is measured to be 1.516µs. | The recovery time is measured to be 7.884µs. Note that so 0.1IR is measured at 0.1\*2 ≈ 200mV. |
| Half period is the duration that the input waveform stays at one value (whether it be -2V or 2V). The period of the waveform is so the half period is 500µs. Unfortunately, this duration of time cannot be shown by these two figures. | |

|  |  |
| --- | --- |
| Signal = 4Vpp square waveform at 10KHz | |
| C:\Users\template\Desktop\ts at 4vpp 10khz.bmp | C:\Users\template\Desktop\tr at 4vpp 10khz.bmp |
| The storage time is measured to be 1.456µs. | The recovery time is measured to be 7.924µs. |
| The period of the waveform is so the half period is 50µs. Unfortunately, this duration of time cannot be shown by these two figures. | |

|  |  |
| --- | --- |
| Signal = 4Vpp square waveform at 100KHz | |
| C:\Users\template\Desktop\ts at 4vpp 100khz.bmp | C:\Users\template\Desktop\tr at 4vpp 100khz.bmp |
| The storage time is measured to be 444ns.  Note that the Vout waveform does not actually drop all the way down to -2V. This is because the half period is not long enough. | The recovery time is measured to be 4.556µs.  Note that the Vout waveform cannot reach 0.1IR which is 0.1\*2V = -200mV. This is because the half period is not long enough for the Vout signal to reach this point. |
| The period of the waveform is so the half period is 5µs. The half period is clearly shown on both figures as the duration that the yellow waveform drops down to -2V before going back up to +2V. It can be measured by inspecting either figure.  Using the figure on the left, (+2.8µs – (-2.2µs) = 5µs) | |

|  |
| --- |
| Signal = 4Vpp square waveform at 1MHz |
| C:\Users\template\Desktop\ts at 4vpp 1mhz.bmp |
| Again, the shortness of the half period is shown. This time, the recovery time characteristic is not even distinguishable. Instead, this blue waveform looks like the characteristic of a capacitor charging and discharging in an RC circuit. |
| The period of the waveform is so the half period is 5ns. The half period is clearly shown to be 500ns. |

Consolidating everything into a table:

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency (kHz) | Recovery time (µs) | Time of half period (µs) | Ratio |
| 1 | 7.884 | 500 | 0.0158 : 1 |
| 10 | 7.924 | 50 | 0.1585 : 1 |
| 100 | 4.556 | 5 | 0.9112 : 1 |
| 1000 | -- | 0.5 | 1.0000 : 1 |

It can be deduced that as the frequency of the input signal increases, the recovery time takes a greater portion of the half period.

1. The voltage across the 2kΩ resistor can exceed the peak source voltage when the diode is in its recovery time. During that time, the diode acts like a discharging capacitor. This induced current flow in addition to the current from the voltage source cause the voltage across the 2kΩ resistor to exceed -2.0V.