# LabVIEW ATE Homework

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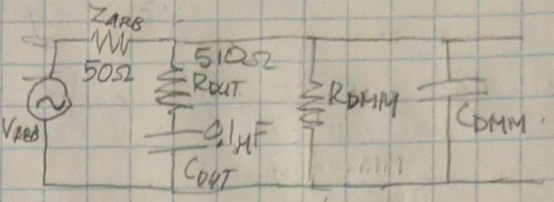
a)

| Input frequency | DUT Input Voltage (RMS) |
|---|---|
| 50 Hz | 1.01351 V |
| 500 Hz | 1.01215 V |
| 5000 Hz | 1.01174 V |
| 50000 Hz | 1.01071 V |

b) Diagram




c)

$$V_{OUT}(j\omega) = V_{ARB}(s)\frac{(R_{OUT}+\frac{1}{sC_{OUT}})\,||\,R_{DMM}\,||\,\frac{1}{sC_{DMM}}}{Z_{ARB}+(R_{OUT}+\frac{1}{sC_{OUT}})\,||\,R_{DMM}\,||\,\frac{1}{sC_{DMM}}}$$

$$\frac{1}{R_{OUT}+\frac{1}{sC_{OUT}}}+\frac{1}{R_{DMM}}+sC_{DMM} = \frac{1}{\frac{sC_{OUT}}{sR_{OUT}C_{OUT}+1}+\frac{1}{R_{DMM}}+sC_{DMM}} = \frac{R_{DMM}}{\frac{sR_{DMM}C_{OUT}}{sR_{OUT}C_{OUT}+1}+1+sR_{DMM}C_{DMM}}$$

$$= \frac{sR_{DMM}R_{OUT}C_{OUT}+R_{DMM}}{s^2R_{DMM}R_{OUT}C_{DMM}C_{OUT}+s(R_{DMM}C_{DMM}+R_{OUT}C_{OUT}+R_{DMM}C_{OUT})+1}$$

sub $\Rightarrow \frac{A}{B}$

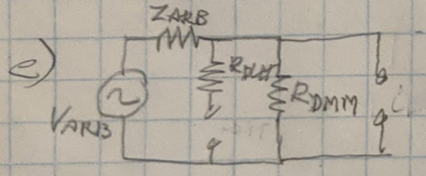
$$= V_{ARB}\frac{\frac{A}{B}}{\frac{A}{B}+Z_{ARB}} = V_{ARB}\frac{\frac{A}{B}}{\frac{A+Z_{ARB}B}{B}} = V_{ARB}\frac{A}{A+Z_{ARB}B}$$

$$= V_{ARB}\frac{A}{A+Z_{ARB}B} \qquad s=j\omega \text{ at Steady State}$$

$$V_{OUT}(j\omega) = \frac{V_{ARB}(j\omega)(j\omega R_{DMM}R_{OUT}C_{OUT}+R_{DMM})}{(j\omega)^2Z_{ARB}R_{OUT}R_{DMM}C_{DMM}C_{OUT}+(j\omega)(R_{DMM}R_{OUT}C_{OUT}+Z_{ARB}(R_{DMM}C_{DMM}+R_{OUT}C_{OUT}+R_{DMM}C_{OUT}))+R_{DMM}+Z_{ARB}}$$

d) $\lim_{\omega\to 0} V_{OUT}(j\omega) = \frac{V_{ARB}(DC)\,R_{DMM}}{R_{DMM}+Z_{ARB}}$

e)

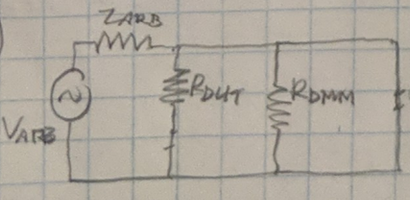



f) $\lim_{\omega\to\infty} V_{OUT}(j\omega) \overset{\text{by l'Hospitals}}{=} \lim_{\omega\to\infty} V_{ARB}(j\omega)\frac{R_{DMM}R_{OUT}C_{OUT}}{2j\omega R_{DMM}R_{OUT}C_{DMM}C_{OUT}Z_{ARB}+R_{DMM}R_{OUT}C_{OUT}+Z_{ARB}(R_{DMM}C_{DMM}+R_{OUT}C_{OUT}+R_{DMM}C_{OUT})}$

l'Hospitals again

$$= \lim_{\omega\to\infty} V_{ARB}(j\omega)\frac{0}{2R_{DMM}R_{OUT}C_{DMM}C_{OUT}Z_{ARB}} = 0$$

g)




h) Since the arbitrary function generator is in hi-Z mode the DC circuit is a simple voltage divider between $Z_{ARB}$ and $R_{DMM}$. Capacitors act as open circuits at DC. The capacitors decrease in impedance as frequency increases according to the equation $X_C = \frac{1}{j\omega C}$ at steady state. As frequency becomes arbitrarily large the capacitor impedance approaches 0, leaving the Multimeter acting as a short circuit