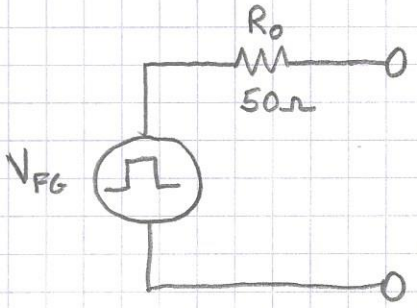
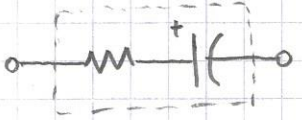
MEASURING CAPACITOR ESR

WITH AN OSCILLOSCOPE & FUNCTION GENERATOR

EQUIVALENT CIRCUIT OF GENERATOR OUTPUT

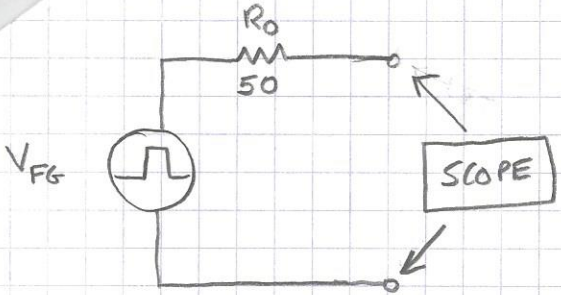


ESR IS "EQUIVALENT SERIES RESISTANCE"

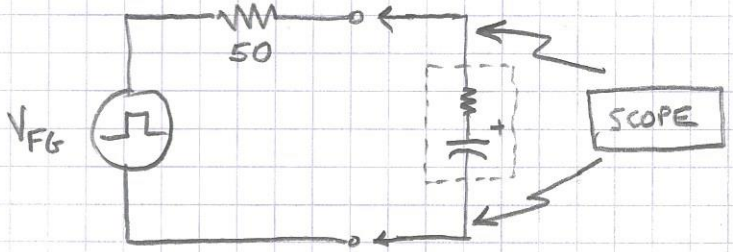


- USE ≈ 200 KHz SQUARE WAVE
  - HIGH ENOUGH FOR TYPICAL ELECTROLYTIC CAPS TO HAVE $X_C < 1\Omega$
  - LOW ENOUGH TO BE ABLE TO IGNORE TRANSMISSION LINE EFFECTS
- 1 V_{PP} IS GOOD FOR "OUT OF CIRCUIT" (200-300 mV$_{PP}$ FOR "IN-CIRCUIT")

W2AEW

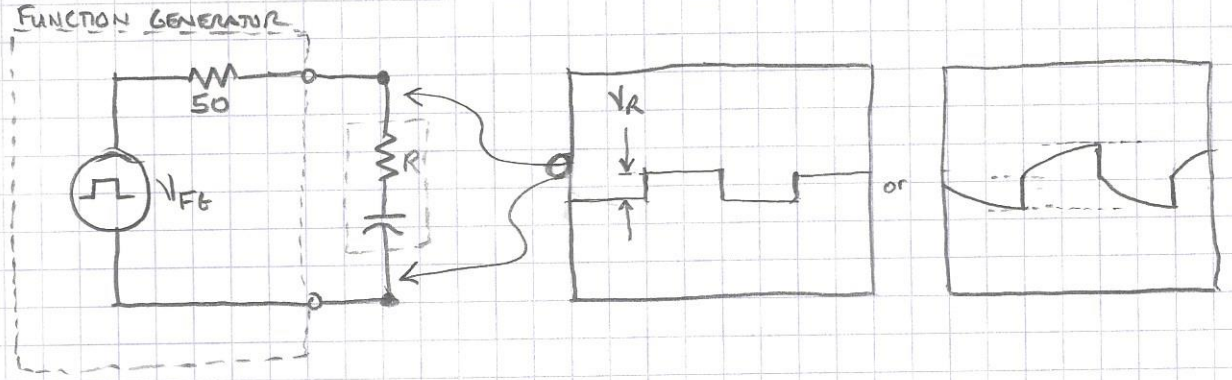


- MEASURE / ADJUST V_{FG} WITH HI-IMPEDANCE INPUT OR PROBE ON SCOPE.



- CONNECT CAPACITOR TO BE TESTED
- MEASURE "STEP" CHANGE VOLTAGE TO CALCULATE ESR
- NOTE THAT OFTEN "C" CHANGES TOO!

  (SEE R-C EXPONENTIAL)
- MANY ESR METERS WILL INCLUDE THE R-C EXPONENTIAL IN MEASUREMENT



CALCULATE R BY SIMPLE VOLTAGE DIVIDER:

$$V_R = V_{FG}\left(\frac{R}{R+50}\right)$$ ASSUMING X_C IS VERY LOW

$$V_R(R+50) = V_{FG} \cdot R$$

$$V_R \cdot 50 = R(V_{FG} - V_R)$$

$$\boxed{R = \frac{V_R \cdot 50}{(V_{FG} - V_R)}}$$