MEASURE TOTAL HARMONIC DISTORTION WITH AN OSCILLOSCOPE FFT

W2AEW

- RATIO OF THE SUM OF THE RMS VOLTAGES OF THE HARMONICS OF THE SIGNAL TO THE RMS VOLTAGE OF THE FUNDAMENTAL

$$THD = \frac{\text{TOTAL RMS VOLTAGE OF HARMONICS}}{\text{RMS VOLTAGE OF FUNDAMENTAL}}$$

- YES, THERE WILL BE MATH 
  (BUT WE WILL USE SOME SHORT CUTS TO HELP)

$$THD = \frac{\sqrt{V_2^2 + V_3^2 + V_4^2 + \cdots}}{V_F}$$

TO ADD UP RMS VOLTAGES,
- SQUARE EACH VOLTAGE
- ADD THEM UP
- TAKE SQUARE ROOT

WHERE:

V_n = RMS VOLTAGE OF n^{TH} HARMONIC

V_F = RMS VOLTAGE OF FUNDAMENTAL

- FFT SHOWS FREQUENCY DOMAIN CONTENT
  - MAGNITUDE OF FUNDAMENTAL
  - MAGNITUDE OF HARMONIC COMPONENTS
  - ABSOLUTE & RELATIVE AMPLITUDES
- WE WILL USE THE dBc VALUES OF HARMONICS = HOW MANY dB DOWN FROM THE FUNDAMENTAL (dB OF POWER RATIO)
- MATH SHORT-CUTS:

$$THD = \frac{\sqrt{V_2^2 + V_3^2 + \cdots}}{V_F} = \sqrt{\frac{V_2^2}{V_F^2} + \frac{V_3^2}{V_F^2} + \cdots}$$

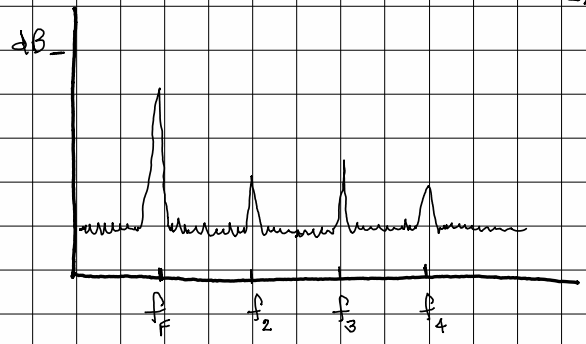
$$dB_C = 10 \log\left(\frac{P}{P_C}\right)$$

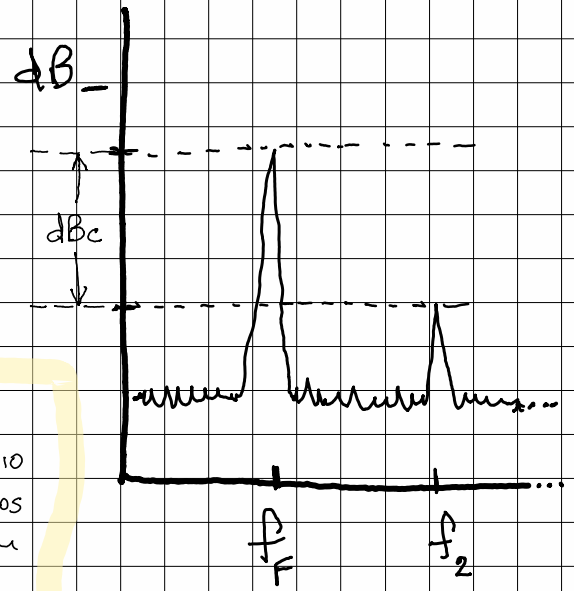
$$\frac{P}{P_C} = \frac{V^2/R}{V_C^2/R} = \frac{V^2}{V_C^2}$$

$$\frac{P_n}{P_F} = \frac{V_n^2}{V_F^2} = 10^{\left(\frac{dBc}{10}\right)}$$

TO COMPUTE THD

- CONVERT dBc TO POWER RATIO
- SUM ALL HARMONIC POWER RATIOS
- TAKE THE SQRT OF THE SUM
- MULTIPLY BY 100%





DUT = AUDIO LEVELER CIRCUIT FROM #157, 162 W2AEW

INPUT SIGNAL = 1 kHz @ 1 Vpp
DUT O/P ≈ 50 mVpp

MEASURED dBc VALUES

HARMONIC	dBc	$10^{\frac{dBc}{10}}$
2	-19.7	10.715×10^{-3}
3	-35.5	281.84×10^{-6}
4	-49.8	10.471×10^{-6}

SUM = 11.0073×10^{-3}

$\sqrt{SUM} = 0.1049$

THD = 10.49%

VIDEOS: #65 - BASICS OF USING FFT
#136 - BASICS OF dB