



# **Formulas and Calculations Used In Constant Voltage 70v Sound System Design**



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## Ohms Law – Georg Ohm 1827

The current in a circuit is **DIRECTLY** proportional to the applied voltage and **INVERSLY** proportional to the circuit resistance

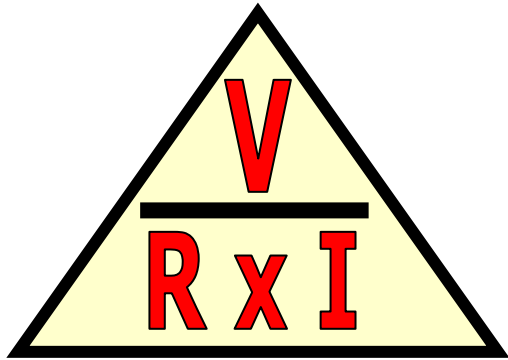
Ohms law may be expressed as an equation:

$$I = \frac{E}{R}$$

Where: I = current in amperes  
E = voltage in volts  
R = resistance in ohms



## Ohms Law – The Magic Triangle



Voltage = Resistance x Current

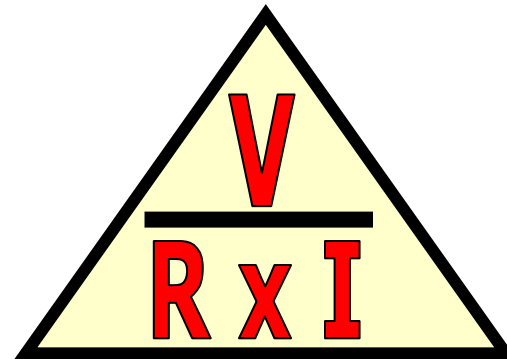
Resistance = Voltage/Current

Current = Voltage/Resistance



## Calculating Power

- Power in Watts = Volts x Amps
- Formula:  $W = V \times I$
- By Ohms Law:
  - $W = I^2R$
  - $W = V^2/R$





## The 3dB Rule (Power)

When speaker power is doubled in Watts,  
the dB level increases by 3dB

*1 watt = 90 dB*

*2 watts = 93 dB*

*4 watts = 96 dB*

*8 watts = 99 dB*



## How dB Levels Differences Are Perceived

- *1 dB ( 7% ) Barely Noticeable*
- *3 dB ( 25% ) Noticeable*
- *6 dB ( 52% ) Very Noticeable*
- *10 dB ( 100% ) Twice As Loud*

For a noticeable increase in loudness (3 dB), we must double the power (3 dB rule)



## 6 dB Rule (DISTANCE)

Doubling the distance away from the sound source will decrease the SPL by 6dB. Cutting the distance in half towards it will increase it by 6dB.

10 feet = 100 dB

20 feet = 94 dB

40 feet = 88 dB

80 feet = 82 dB



## How Much Louder Over Ambient

Background Music = 3 – 6dB over Ambient

Voice Paging = 6 – 10dB over Ambient



## Speaker Spacing

Ceiling Speakers Are Spaced At 2 Times Ceiling Height  
(Center to Center)

<u>Ceiling Height</u>	<u>Spacing</u>
20 ft	40 ft
12 ft	24 ft
10 ft	20 ft
8 ft	16 ft



## Typical Horn Coverage

Average coverage = 2,500 sq. feet  
when mounted 15 ~20 feet high



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## Calculating Number of Ceiling Speakers

### Formula

$$\frac{\text{Area of Room}}{(2 \times \text{CH})^2} = \text{Number of Speakers Required}$$

Where CH = Ceiling Height