Master List of Formulas and Symbology Descriptions

Disclaimer: Here are some common formulas; however this is not an exhaustive list and you may not need all of them.

Video Camera Image Size

$$IS = 2 * D * \tan\left(\frac{A}{2}\right)$$

Where IS is the image size
D is the distance from the lens to the subject
A is the lens angle of view

Projector Lumens Output

$$Brightness = \frac{\left(\frac{L * C * A}{Sg}\right)}{Dr}$$

Where L is ambient light at screen location*
C is the desired contrast ratio
7:1 – Passive Viewing – Television
15:1 – Basic Decision Making Presentations
50:1 – Analytical Decision Making – Art work, Medical
80:1 – Full Motion Video – Home Theater
A is the area of screen **
Sg is the gain of the screen. Assume a screen gain of 1 unless otherwise noted.
Dr is the projector derating value. Assume a derating value of 0.75 unless otherwise noted.

* Light units are in either lux or footcandles
** area in square meters or square feet

Loudspeaker Coverage Pattern (Ceiling Mounted)

$$D = 2 * (H - h) * \tan\left(\frac{C_{\angle}}{2}\right)$$

Where D is diameter of coverage circle at ear height
H is overall ceiling height
h is height of the listener's ears (48 inches)
$C_{\angle}$ is off-axis coverage angle of polar pattern

Loudspeaker Spacing (Ceiling Mounted)

$$D = 2 * r \quad \text{(Edge-to-edge)}$$
$$D = r * \sqrt{2} \quad \text{(Minimum overlap)}$$
$$D = r \quad \text{(Center-to-center)}$$

Where D is the distance between loudspeakers
r is the radius of loudspeaker coverage circle

Wattage at the Loudspeaker

$$EPR = 10^\wedge\left(\frac{L_p + H - L_s + 20\log\left(\frac{D_2}{D_r}\right)}{10}\right) * W_{ref}$$

Where EPR is electrical power required at loudspeaker
L_P is SPL required at distance D_2
H is required headroom
L_S is loudspeaker sensitivity at 3.28 feet (1 m)
D_2 is distance from loudspeaker to listener
D_r is distance reference value
W_{ref} is the wattage reference value. Assume a wattage reference value of 1 unless otherwise noted.

Parallel Loudspeaker Impedance

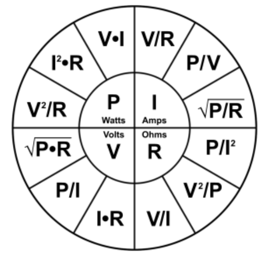
$$Z_T = \frac{1}{\frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3} \cdots \frac{1}{Z_N}}$$

$$Z_T = \frac{Z_1}{N}$$

Where Z_T is the total impedance of the loudspeaker system
Z_1 is the measured impedance of a loudspeaker
N is the quantity of loudspeakers in the circuit

Ohm's Law Related

$$I = \frac{P}{V}$$



Where I is current
V is circuit voltage
P is power *

* Look up amplifier power in owner's manual before adding to the other AV devices.

Needed Acoustic Gain

$$NAG = 20 \log\left(\frac{D_0}{EAD}\right)$$

Where NAG is Needed Acoustic Gain
D_0 is distance from source to listener
EAD is Equivalent Acoustic Distance

Potential Acoustic Gain

$$PAG = 20 \log\left(\frac{D_0 * D_1}{D_2 * D_S}\right)$$

Where PAG is Potential Acoustic Gain
D_0 is distance from source to listener
D_1 is distance from loudspeaker to mic
D_2 is distance from loudspeaker to listener
D_S is distance from source to microphone

Audio System Stability (PAG NAG Complete Formula)

$$20 \log_{10}\left(\frac{D_O}{EAD}\right) < 20 \log_{10}\left(\frac{D_0 D_1}{D_2 D_S}\right) - 10 \log_{10}(NOM) - FSM$$

Where NOM = Number of Open Microphones
FSM = Feedback Stability Margin
EAD = Equivalent Acoustic Distance
D_0 = the distance between the talker and the farthest listener
D_1 = the distance between the closest loudspeaker to the microphone and the microphone
D_2 = the distance between the loudspeaker closest to the farthest listener and the farthest listener
D_s = the distance between the sound source (talker) and the microphone

Power Amplifier Wattage (Constant Voltage)

$$W_t = W * N * 1.5$$

Where W_t is required wattage
W is watt tap used at individual loudspeaker
N is total number of loudspeakers
1.5 is 50 percent amplifier headroom

Power Amplifier Heat Load

$$Total\ BTU = W * 3.4 * (1 - E_D)$$

Where $Total\ BTU$ is the total British Thermal Units released
W is the wattage of the amplifier
E_D is the efficiency of the device

Heat Load

$$Total\ BTU = W_E * 3.4$$

Where *Total BTU* is the total British Thermal Units released
W_E is the total watts of equipment in the room

Jam Ratio

$$JAM = \frac{ID}{\left(\frac{OD_1 + OD_2 + OD_3}{3}\right)}$$

Where ID is the inner diameter of the conduit
OD is the outer diameter of each conductor

Conduit Capacity

Where *ID* is the inner diameter of the conduit
OD is outer diameter of each conductor

$$ID > \sqrt{\frac{OD^2}{0.53}}$$ One Cable

$$ID > \sqrt{\frac{OD^2+OD^2}{0.31}}$$ Two Cables

$$ID > \sqrt{\frac{OD^2+OD^2+OD^2...}{0.40}}$$ 3+ Cables

Computer Video Signal Bandwidth

$$HF = \frac{H_{pix} * V_{pix} * f_v}{2} * 3$$

Where *HF* is the highest frequency in Hertz
H_{pix} is the total number of horizontal pixels
V_{pix} is the total number of vertical pixels
f_v is the refresh rate

Minimum Video System Bandwidth

$$SF = HF * 2$$

Where *SF* is the system frequency in Hertz
HF is the highest frequency in Hertz of the computer signal

Digital Video Data Rate

$$R = H_{pix} * V_{pix} * C * 1.25 * FPS * 3$$

Where R is the data rate in bits per second
H_{pix} is the total number of horizontal pixels
V_{pix} is the total number of vertical pixels
C is the color depth (bit depth) in bits
FPS is the number of frames per second

Minimum Task Lighting

$$Light_{Min} = \frac{\left(\frac{L_P}{A}\right)}{3}$$

Where $Light_{Min}$ is the minimum task lighting in Lux
L_P is projector lumens
A is the area of the screen in meters squared

*Assume unity gain unless otherwise directed.