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Digital Switching System Formulas

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List of 15 Digital Switching System Formulas

Digital Switching System

1) Average Switching Time per Stage

$$\text{fx } T_{st} = \frac{T_{cs} - T_{other}}{K}$$

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b_img.jpg\)](#)

$$\text{ex } 0.081s = \frac{0.353s - 0.11s}{3}$$

2) Equipment Utilization Factor

$$\text{fx } EUF = \frac{S}{T_{SE}}$$

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d_img.jpg\)](#)

$$\text{ex } 6 = \frac{42}{7}$$

3) Instantaneous Resistance of Microphone

$$\text{fx } R_i = R_q - R_{max} \cdot \sin(\omega \cdot T)$$

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d_img.jpg\)](#)

$$\text{ex } 26.67385\Omega = 1.68\Omega - 25\Omega \cdot \sin(25.5\text{rad/s} \cdot 30s)$$



4) Maximum Variation Resistance by Carbon Granules

$$fx \quad R_{\max} = \frac{R_q - R_i}{\sin(\omega \cdot T)}$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$ex \quad 24.99615\Omega = \frac{1.68\Omega - 26.67\Omega}{\sin(25.5\text{rad/s} \cdot 30\text{s})}$$

5) Number of SE in Equivalent Multistage

$$fx \quad S_{\text{em}} = \frac{S_{\text{sw}}}{\text{SEAF}}$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$ex \quad 4.671338 = \frac{14}{2.997}$$

6) Number of SE in Single Switch

$$fx \quad S_{\text{sw}} = S_{\text{em}} \cdot \text{SEAF}$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$ex \quad 13.99599 = 4.67 \cdot 2.997$$

7) Number of SE when SC Fully Utilised

$$fx \quad S = T_{\text{SE}} \cdot \text{EUF}$$

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754_img.jpg\)](#)

$$ex \quad 42 = 7 \cdot 6$$



8) Number of Switching Elements

$$\text{fx } n_{\text{sw}} = \frac{C_{\text{sw}} - C_{\text{ch}} - C_{\text{c}}}{C_{\text{s}}}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$\text{ex } 0.25 = \frac{29 - 26.05 - 2.45}{2}$$

9) Number of Switching Stage

$$\text{fx } K = \frac{T_{\text{cs}} - T_{\text{other}}}{T_{\text{st}}}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$\text{ex } 3 = \frac{0.353\text{s} - 0.11\text{s}}{0.081\text{s}}$$

10) Power Ratio

$$\text{fx } P_{\text{R}} = 20 \cdot \log_{10} \left(\frac{V_2}{V_1} \right)$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$\text{ex } 20 = 20 \cdot \log_{10} \left(\frac{500\text{V}}{50\text{V}} \right)$$

11) Quiescent Resistance of Microphone

$$\text{fx } R_{\text{q}} = R_{\text{i}} + R_{\text{max}} \cdot \sin(\omega \cdot T)$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b_img.jpg\)](#)

$$\text{ex } 1.676154\Omega = 26.67\Omega + 25\Omega \cdot \sin(25.5\text{rad/s} \cdot 30\text{s})$$



12) Sinusoidal Input 

$$fx \quad V_{\sin} = e_Q \cdot 2 \cdot V$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

$$ex \quad 2.88 = 0.012 \cdot 2 \cdot 120V$$

13) Switching Element Advantage Factor 

$$fx \quad SEAF = \frac{S_{sw}}{S_{em}}$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)


$$ex \quad 2.997859 = \frac{14}{4.67}$$

14) Theoretical Maximum Load 

$$fx \quad N = \frac{2 \cdot SC}{TC}$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

$$ex \quad 15 = \frac{2 \cdot 33.75}{4.5}$$

15) Total Number of SE in System 

$$fx \quad T_{SE} = \frac{S}{EUF}$$

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80_img.jpg\)](#)

$$ex \quad 7 = \frac{42}{6}$$



Variables Used





- C_c Cost of Common Control System
- C_{ch} Cost of Common Hardware
- C_s Cost per Switching Element
- C_{sw} Cost of Switching System
- e_Q Quantization Error
- **EUF** Equipment Utilization Factor
- **K** Number of Switching Stage
- **N** Number of Subscriber Lines
- n_{sw} Number of Switching Element
- P_R Power Ratio
- R_i Instantaneous Resistance (*Ohm*)
- R_{max} Maximum Variation in Resistance (*Ohm*)
- R_q Quiescent Resistance (*Ohm*)
- **S** SE when SC Fully Utilized
- S_{em} Number of SE in Equivalent Multistage
- S_{sw} Number of SE in Single Switch
- **SC** Switching Capacity
- **SEAF** Switching Element Advantage Factor
- **T** Time Period (*Second*)
- T_{cs} Call Setup Time (*Second*)
- T_{other} Time Required Other than Switching (*Second*)



- T_{SE} Total Number of SE
- T_{st} Average Switching Time per Stage (Second)
- TC Traffic Handling Capacity
- V Voltage (Volt)
- V_1 Voltage1 (Volt)
- V_2 Voltage2 (Volt)
- V_{sin} Sinusoidal Input
- ω Angular Frequency (Radian per Second)



Constants, Functions, Measurements used

- **Function:** **log10**, $\log_{10}(\text{Number})$
Common logarithm function (base 10)
- **Function:** **sin**, $\sin(\text{Angle})$
Trigonometric sine function
- **Measurement:** **Time** in Second (s)
Time Unit Conversion 
- **Measurement:** **Electric Resistance** in Ohm (Ω)
Electric Resistance Unit Conversion 
- **Measurement:** **Electric Potential** in Volt (V)
Electric Potential Unit Conversion 
- **Measurement:** **Angular Frequency** in Radian per Second (rad/s)
Angular Frequency Unit Conversion 



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