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Special Purpose Radars Formulas

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List of 21 Special Purpose Radars Formulas

Special Purpose Radars

1) Amplitude of Reference Signal

Open Calculator

fx $$A_{ref} = \frac{V_{ref}}{\sin(2 \cdot \pi \cdot \omega \cdot T)}$$

ex $$40.19712V = \frac{1.25V}{\sin(2 \cdot \pi \cdot 99rad/s \cdot 50\mu s)}$$

2) Amplitude of Signal Received from Target at Range

Open Calculator

fx $$A_{rec} = \frac{V_{echo}}{\sin\left((2 \cdot \pi \cdot (f_c + \Delta f_d) \cdot T) - \left(\frac{4 \cdot \pi \cdot f_c \cdot R_o}{[c]}\right)\right)}$$

ex $$125.8165V = \frac{101.58V}{\sin\left((2 \cdot \pi \cdot (3000Hz + 20Hz) \cdot 50\mu s) - \left(\frac{4 \cdot \pi \cdot 3000Hz \cdot 40000m}{[c]}\right)\right)}$$

3) CFA DC Power Input

Open Calculator

fx $$P_{dc} = \frac{P_{out} - P_{drive}}{\eta_{cfa}}$$

ex $$27W = \frac{96.46W - 70W}{0.98}$$

4) CFA RF Drive Power

Open Calculator

fx $$P_{drive} = P_{out} - \eta_{cfa} \cdot P_{dc}$$

ex $$70W = 96.46W - 0.98 \cdot 27W$$

5) CFA RF Power Output

Open Calculator

fx $$P_{out} = \eta_{cfa} \cdot P_{dc} + P_{drive}$$

ex $$96.46W = 0.98 \cdot 27W + 70W$$

6) Distance from Antenna 1 to Target in Monopulse Radar

Open Calculator

fx $$s_1 = \frac{R_o + s_a}{2} \cdot \sin(\theta)$$

ex $$17320.7m = \frac{40000m + 0.45m}{2} \cdot \sin(60^\circ)$$

7) Distance from Antenna 2 to Target in Monopulse Radar

Open Calculator

fx $$s_2 = \frac{R_o - s_a}{2} \cdot \sin(\theta)$$

ex $$17320.31m = \frac{40000m - 0.45m}{2} \cdot \sin(60^\circ)$$

8) Doppler Frequency Shift

Open Calculator

fx $$\Delta f_d = \frac{2 \cdot v_t}{\lambda}$$

ex $$20Hz = \frac{2 \cdot 5.8m/s}{0.58m}$$

9) Echo Signal Voltage

Open Calculator

fx $$V_{echo} = A_{rec} \cdot \sin\left((2 \cdot \pi \cdot (f_c + \Delta f_d) \cdot T) - \left(\frac{4 \cdot \pi \cdot f_c \cdot R_o}{[c]}\right)\right)$$

ex $$101.7281V = 126V \cdot \sin\left((2 \cdot \pi \cdot (3000Hz + 20Hz) \cdot 50\mu s) - \left(\frac{4 \cdot \pi \cdot 3000Hz \cdot 40000m}{[c]}\right)\right)$$

10) Efficiency of Cross Field Amplifier(CFA)

Open Calculator

$$\eta_{cfa} = \frac{P_{out} - P_{drive}}{P_{dc}}$$

$$0.98 = \frac{96.46W - 70W}{27W}$$

11) Measured Position at Nth Scan

Open Calculator

$$x_n = \left(\frac{X_{in} - x_{pn}}{\alpha}\right) + x_{pn}$$

$$6m = \left(\frac{40m - 74m}{0.5}\right) + 74m$$

12) Peak Quantization Lobe

Open Calculator

$$Q_{max} = \frac{1}{2^{2 \cdot B}}$$

$$0.130308 = \frac{1}{2^{2 \cdot 1.47}}$$

13) Phase Difference between Echo Signals in Monopulse Radar

Open Calculator

$$\Delta_{\Phi} = 2 \cdot \pi \cdot s_a \cdot \frac{\sin(\theta)}{\lambda}$$

$$4.221774rad = 2 \cdot \pi \cdot 0.45m \cdot \frac{\sin(60^\circ)}{0.58m}$$

14) Position Smoothing Parameter

Open Calculator

$$\alpha = \frac{X_{in} - x_{pn}}{x_n - x_{pn}}$$

$$0.5 = \frac{40m - 74m}{6m - 74m}$$

15) Predicted Position of Target

Open Calculator

fx $$x_{pn} = \frac{X_{in} - (\alpha \cdot x_n)}{1 - \alpha}$$

ex $$74\text{m} = \frac{40\text{m} - (0.5 \cdot 6\text{m})}{1 - 0.5}$$

16) Range Resolution

Open Calculator

fx $$\Delta R = \frac{2 \cdot H_a \cdot H_t}{R_o}$$

ex $$9\text{m} = \frac{2 \cdot 450\text{m} \cdot 400\text{m}}{40000\text{m}}$$

17) Reference Voltage of CW Oscillator

Open Calculator

fx $$V_{ref} = A_{ref} \cdot \sin(2 \cdot \pi \cdot \omega \cdot T)$$

ex $$1.249996\text{V} = 40.197\text{V} \cdot \sin(2 \cdot \pi \cdot 99\text{rad/s} \cdot 50\mu\text{s})$$

18) Smoothed Position

Open Calculator

fx $$X_{in} = x_{pn} + \alpha \cdot (x_n - x_{pn})$$

ex $$40\text{m} = 74\text{m} + 0.5 \cdot (6\text{m} - 74\text{m})$$

19) Smoothed Velocity

Open Calculator

fx $$v_s = v_{s(n-1)} + \frac{\beta}{T_s} \cdot (x_n - x_{pn})$$

ex $$9.3\text{m/s} = 11\text{m/s} + \frac{8}{320\text{s}} \cdot (6\text{m} - 74\text{m})$$

20) Time between Observations

Open Calculator

fx $$T_s = \left(\frac{\beta}{v_s - v_{s(n-1)}} \right) \cdot (x_n - x_{pn})$$

ex $$320s = \left(\frac{8}{9.3m/s - 11m/s} \right) \cdot (6m - 74m)$$

21) Velocity Smoothing Parameter

Open Calculator

fx $$\beta = \left(\frac{v_s - v_{s(n-1)}}{x_n - x_{pn}} \right) \cdot T_s$$

ex $$8 = \left(\frac{9.3m/s - 11m/s}{6m - 74m} \right) \cdot 320s$$

Variables Used

- A_{rec} Amplitude of Signal Received *(Volt)*
- A_{ref} Amplitude of Reference Signal *(Volt)*
- **B** Mean Lobe
- f_c Carrier Frequency *(Hertz)*
- H_a Antenna Height *(Meter)*
- H_t Target Height *(Meter)*
- P_{dc} DC Power Input *(Watt)*
- P_{drive} CFA RF Drive Power *(Watt)*
- P_{out} CFA RF Power Output *(Watt)*
- Q_{max} Peak Quantization Lobe
- R_o Range *(Meter)*
- s_1 Distance from Antenna 1 to Target *(Meter)*
- s_2 Distance from Antenna 2 to Target *(Meter)*
- s_a Distance between Antennas in Monopulse Radar *(Meter)*
- **T** Time Period *(Microsecond)*
- T_s Time between Observations *(Second)*
- V_{echo} Echo Signal Voltage *(Volt)*
- V_{ref} CW Oscillator Reference Voltage *(Volt)*
- v_s Smoothed Velocity *(Meter per Second)*
- $v_{s(n-1)}$ (n-1)th Scan Smoothed Velocity *(Meter per Second)*
- v_t Target Velocity *(Meter per Second)*
- X_{in} Smoothed Position *(Meter)*
- x_n Measured Position at Nth Scan *(Meter)*
- x_{pn} Target Predicted Position *(Meter)*
- α Position Smoothing Parameter
- β Velocity Smoothing Parameter

- Δ_{Φ} Phase Difference between Echo Signals *(Radian)*
- Δf_d Doppler Frequency Shift *(Hertz)*
- ΔR Range Resolution *(Meter)*
- η_{cfa} Efficiency of Cross Field Amplifier
- θ Angle in Monopulse Radar *(Degree)*
- λ Wavelength *(Meter)*
- ω Angular Frequency *(Radian per Second)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Constant: **[c]**, 299792458.0 Meter/Second
  Light speed in vacuum
- Function: **sin**, sin(Angle)
  Trigonometric sine function
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Time** in Microsecond (µs), Second (s)
  Time Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Power** in Watt (W)
  Power Unit Conversion
- Measurement: **Angle** in Degree (°), Radian (rad)
  Angle Unit Conversion
- Measurement: **Frequency** in Hertz (Hz)
  Frequency 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

Check other formula lists

- **Radar & Antenna Specifications Formulas**
- **Special Purpose Radars Formulas**

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