

Measurement and troubleshooting

Solutions · step by step

- 01**
1. Deviation: $-2\ \Omega$.
 2. Divide by nominal $1000\ \Omega$.
 3. Result: -0.2% .

$$\delta = \frac{998 - 1000}{1000} \cdot 100\% = -0.2\%$$

- 02**
1. Other components may form parallel paths.
 2. The meter sees their equivalent resistance.
 3. Measure unpowered; isolate one lead if necessary.

- 03**
1. Lower equivalent resistance: $9990.01\ \Omega$.
 2. $U = 10 \cdot 9990.01 / (10000 + 9990.01)$.
 3. Reading: $4.9975\ \text{V}$.

$$U_m \approx 4.9975\ \text{V}$$

- 04**
1. Lower resistor parallel meter: $5\ \text{M}\Omega$.
 2. Divider: $10\ \text{M}\Omega$ upper, $5\ \text{M}\Omega$ lower.
 3. Reading: $3.333\ \text{V}$ rather than unloaded $5\ \text{V}$.

$$U_m = 10 \frac{5}{10 + 5} = 3.333\ \text{V}$$

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- 05**
1. Peak-to-peak = $2 \cdot 3 = 6 \text{ V}$.
 2. For a symmetrical sine, peak is half that.
 3. Peak voltage: 3 V .

$$U_{pp} = 6 \text{ V}; \quad \hat{U} = 3 \text{ V}$$

- 06**
1. Divide peak by $\sqrt{2}$.
 2. $3/\sqrt{2}$.
 3. RMS = 2.121 V .

$$U_{rms} = \frac{\hat{U}}{\sqrt{2}} = 2.121 \text{ V}$$

- 07**
1. Period = $5 \cdot 0.2 \text{ ms} = 1 \text{ ms}$.
 2. Frequency = $1/\text{period}$.
 3. Frequency = 1 kHz .

$$f = \frac{1}{0.001 \text{ s}} = 1000 \text{ Hz}$$

- 08**
1. Period = 1 ms .
 2. Offset is one quarter cycle.
 3. Phase magnitude = 90° .

$$|\varphi| = 360^\circ \cdot \frac{0.25}{1} = 90^\circ$$

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- 09**
1. Ratio = 0.5.
 2. $20 \log_{10}(0.5)$.
 3. Gain = -6.02 dB.

$$G = 20 \log_{10} \frac{1}{2} = -6.02 \text{ dB}$$

- 10**
1. $T = 0.005 \text{ s}$.
 2. Take reciprocal.
 3. About 200 Hz; not a universal hard lower accuracy limit.

$$\Delta f \approx \frac{1}{T} = 200 \text{ Hz}$$

- 11**
1. Duration = 1/resolution.
 2. $1/50 = 0.02 \text{ s}$.
 3. 20 ms.

$$T \approx \frac{1}{50} = 20 \text{ ms}$$

- 12**
1. Delay = extra path/speed.
 2. $1.715/343$.
 3. Reflection arrives 5 ms later.

$$\Delta t = \frac{1.715}{343} = 5 \text{ ms}$$

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- 13**
1. Check relative polarity.
 2. Check timing reference and relative delay.
 3. Check microphone position, angle and complex summation.
- 14**
1. The module loads the divider.
 2. Its input resistance is parallel to the lower resistor.
 3. Calculate the loaded divider; use appropriate regulation for a power supply.
- 15**
1. No: the load sees only 0.1 V.
 2. Check base drive, pinout and shared reference.
 3. A correctly saturated switch would have a much lower collector voltage.
- 16**
1. The time is approximately τ .
 2. $C = \tau/R$.
 3. $C = 47 \mu\text{F}$.

$$C = \frac{0.47}{10000} = 47 \mu\text{F}$$

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- 17**
1. Component tolerance: 99 to 101 Ω .
 2. Measurement interval: 100 to 104 Ω .
 3. Intervals overlap; no definite conclusion without better measurement.

- 18**
1. Resistor: $P = 4/8 = 0.5 \text{ W}$.
 2. A driver has complex, frequency-dependent impedance.
 3. Real active power requires current and phase relationship.

$$P_R = \frac{2^2}{8} = 0.5 \text{ W}$$

- 19**
1. No, only presentation changed.
 2. Narrow peaks and dips can be hidden.
 3. Compare before and after using identical settings.

- 20**
1. Record circuit and component values including tolerances.
 2. Note source, instruments, probe/load and frequency points.
 3. Document input/output voltage, phase reference and model deviations.