University of Jordan
School of Engineering
Electrical Engineering Department

EE 219
Electrical Circuits Lab

EXPERIMENT 9 REPORT & PRE-LAB
TRANSFER FUNCTION
OF TWO-PORT NETWORKS

Section # _____ Group # _____

	Student Name	ID
1.		
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EXPERIMENT 9
TRANSFER FUNCTION
OF TWO-PORT NETWORKS

***Note**: Use MATLAB to quickly perform theoretical calculations by defining a vector of frequencies then using array arithmetic.*

PROCEDURE A – RESISTIVE TWO-PORT NETWORK

4. What is the theoretical equation for the transfer function $|\boldsymbol{H}(\boldsymbol{f})|$ in the above circuit?

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5. Is the above equation dependent on frequency or not?

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Table 1

AC Source Frequency (kHz)	$\|V_{in}\|$ (peak) (V)		$\|V_{out}\|$ (peak) (V)		$\|H(f)\| = \|V_{out}\|/\|V_{in}\|$	
	Theory	**Meas.**	**Theory**	**Meas.**	**Theory**	**Meas.**
0.43						
2.9						
4.3						
17						
57						
96						
120						
140						
1900						

8. Using the measured values in Table 1, plot (**by hand** using the graph paper attached at the end of the report) the transfer function $|\boldsymbol{H}(\boldsymbol{f})|$ versus source frequency.

9. For the above plot, state your conclusions under the plot?

PROCEDURE B – LOW-PASS FILTER TWO-PORT NETWORK

4. What is the theoretical equation for the transfer function $|\boldsymbol{H}(\boldsymbol{f})|$ in the above circuit?

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5. Is the above equation dependent on frequency or not?

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6. What is the equation for the cut-off frequency f_c of the first order RC circuit shown above?

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7. Use the above equation to find the frequency f_c, at which the output voltage is approximately 0.707 times the maximum possible output voltage (i.e., the half-power point). Record this value below. **Then** use the oscilloscope to determine this cutoff frequency experimentally by observing the frequency at which the output voltage is approximately 0.707 times the maximum. Record this *experimental* frequency in Table 2.

. . . . . .

Table 2

AC Source Frequency (kHz)	$\|V_{in}\|$ (peak) (V)		$\|V_{out}\|$ (peak) (V)		$\|H(f)\| = \|V_{out}\|/\|V_{in}\|$	
	Theory	**Meas.**	**Theory**	**Meas.**	**Theory**	**Meas.**
0.43						
4.3						
57						
76						
96						
120						
130						
140						
1900						
$f_c =$ _____						

10. Using the measured values in Table 2, plot (**by hand** using the graph paper attached at the end of the report) the transfer function $|H(f)|$ versus source frequency.

11. For the above plot, state your conclusions under the plot? Also identify the cut-off frequency in the plot.

PROCEDURE C – HIGH-PASS FILTER TWO-PORT NETWORK

4. What is the theoretical equation for the transfer function $|H(f)|$ in the above circuit?

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5. Is the above equation dependent on frequency or not?

. . . . . .

6. What is the equation for the cut-off frequency f_c of the first order RC circuit shown above?

. . . . . .

7. Use the above equation to find the frequency f_c, at which the output voltage is approximately 0.707 times the maximum possible output voltage (i.e., the half-power point). Record this value below. **Then** use the oscilloscope to determine this cutoff frequency experimentally by observing the frequency at which the output voltage is approximately 0.707 times the maximum. Record this *experimental* frequency in Table 3.

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Table 3

AC Source Frequency (kHz)	$\|V_{in}\|$ (peak) (V)		$\|V_{out}\|$ (peak) (V)		$\|H(f)\| = \|V_{out}\|/\|V_{in}\|$	
	Theory	**Meas.**	**Theory**	**Meas.**	**Theory**	**Meas.**
0.43						
2.9						
4.3						
5.8						
17						
37						
57						
560						
1900						
$f_c =$ _____						

10. Using the measured values in Table 3, plot (**by hand** using the graph paper attached at the end of the report) the transfer function $|\boldsymbol{H}(\boldsymbol{f})|$ versus source frequency.

11. For the above plot, state your conclusions under the plot? Also identify the cut-off frequency in the plot.

PROCEDURE D – BANDPASS FILTER TWO-PORT NETWORK

4. What is the theoretical equation for the transfer function $|\boldsymbol{H}(\boldsymbol{f})|$ in the above circuit?

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5. Is the above equation dependent on frequency or not?

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6. What are the equations for the two cut-off frequencies of the above ladder circuit?

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7. Use the above equations to find the frequencies, at which the output voltage is approximately 0.707 times the maximum possible output voltage (i.e., the half-power points). Record these values below. **Then** use the oscilloscope to determine such cutoff frequencies experimentally by observing the frequency at which the output voltage is approximately 0.707 times the maximum. Record these *experimental* frequencies in Table 4.

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10. Using the measured values in Table 4, plot (**by hand** using the graph paper attached at the end of the report) the transfer function $|\boldsymbol{H(f)}|$ versus source frequency.

11. For the above plot, state your conclusions under the plot? Also identify the two cut-off frequencies in the plot.

Table 4

AC Source Frequency (kHz)	$\|\boldsymbol{V_{in}}\|$ **(peak) (V)**		$\|\boldsymbol{V_{out}}\|$ **(peak) (V)**		$\|\boldsymbol{H(f)}\| = \|\boldsymbol{V_{out}}\|/\|\boldsymbol{V_{in}}\|$	
	Theory	**Meas.**	**Theory**	**Meas.**	**Theory**	**Meas.**
0.43						
4.3						
5.8						
37						
57						
76						
120						
130						
1900						
$f_{c1} =$ _____						
$f_{c2} =$ _____						

CONCLUSIONS

Summarize in clear but concise format what you learned from this experiment:

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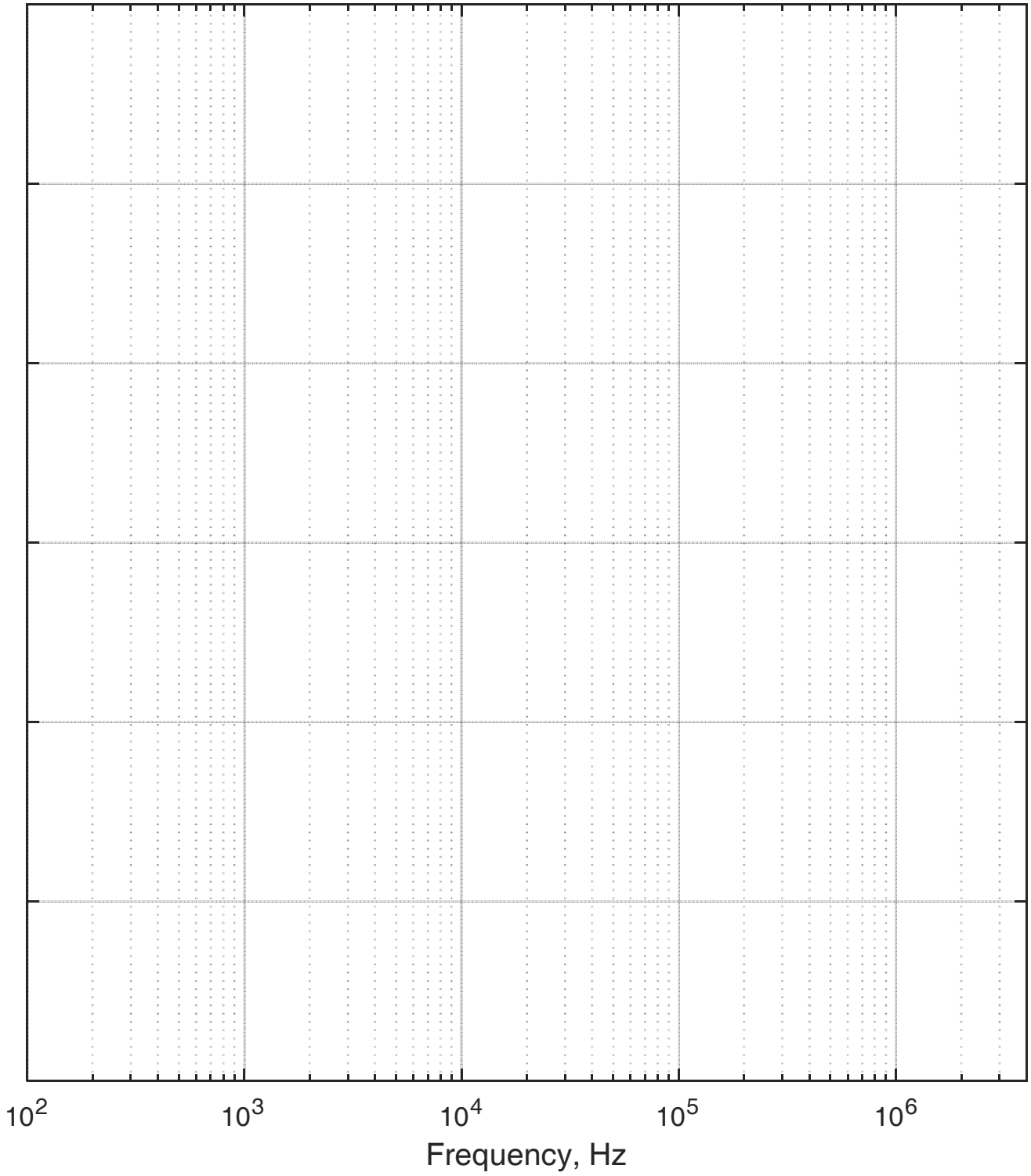
**** End ****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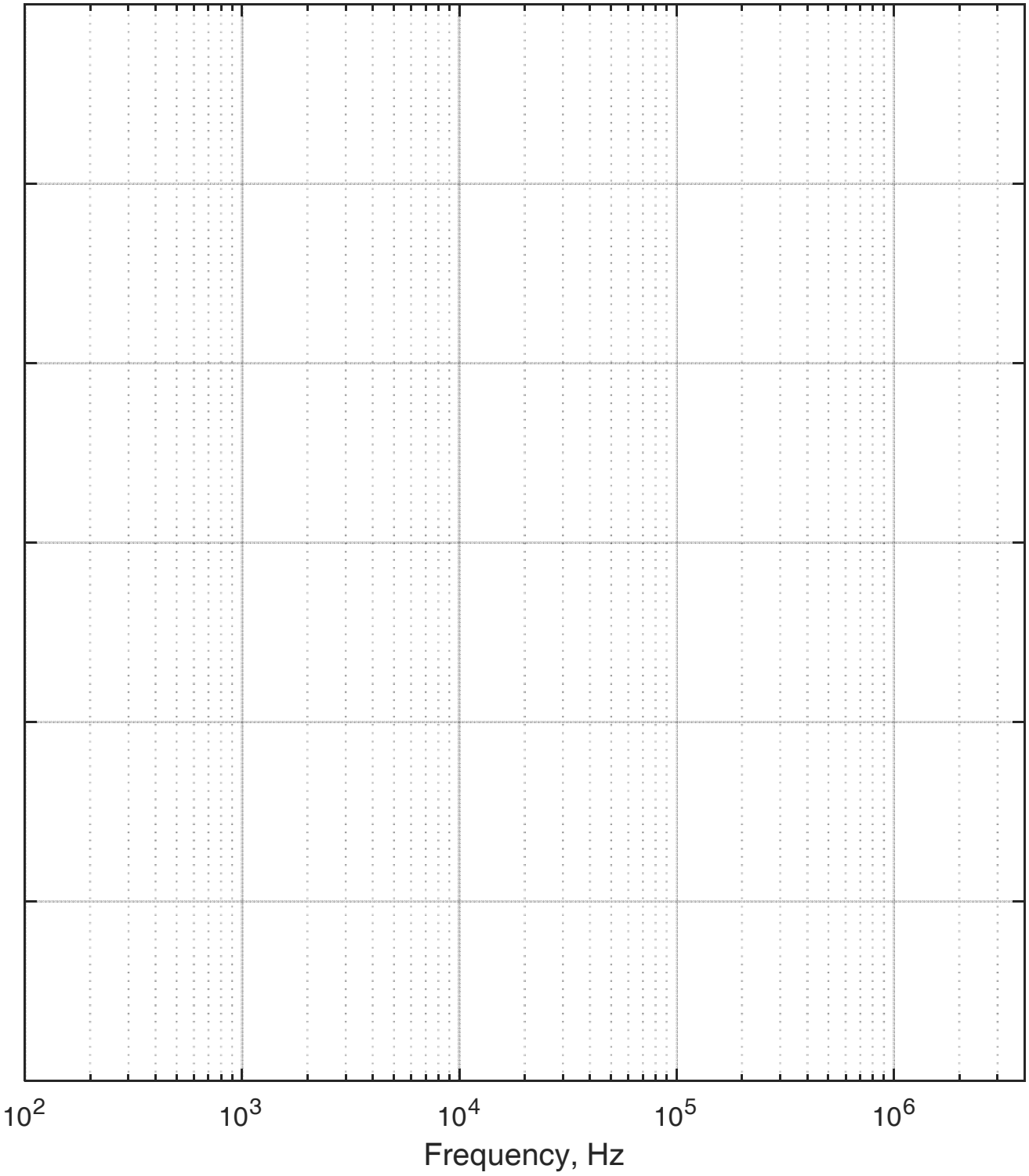
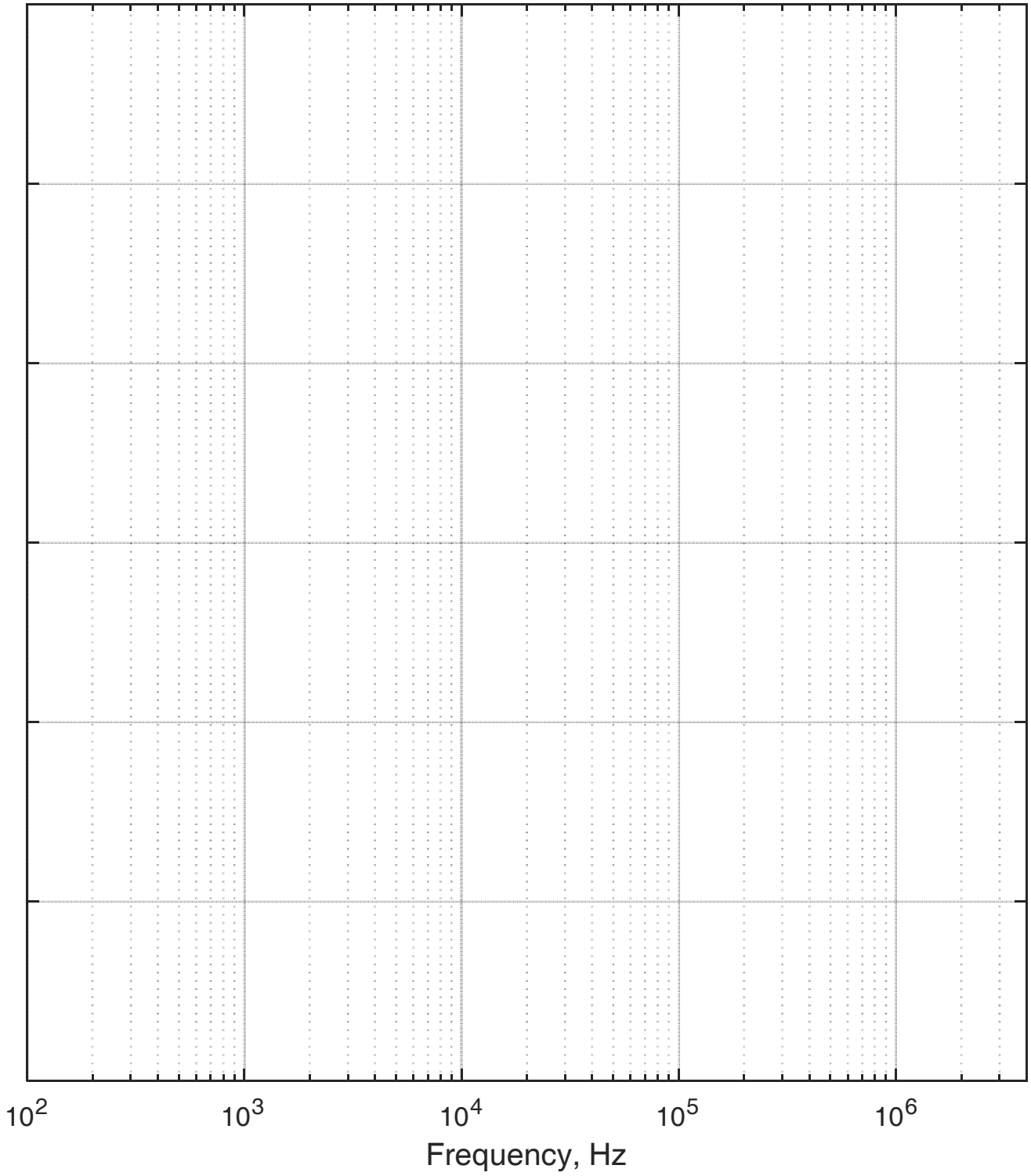
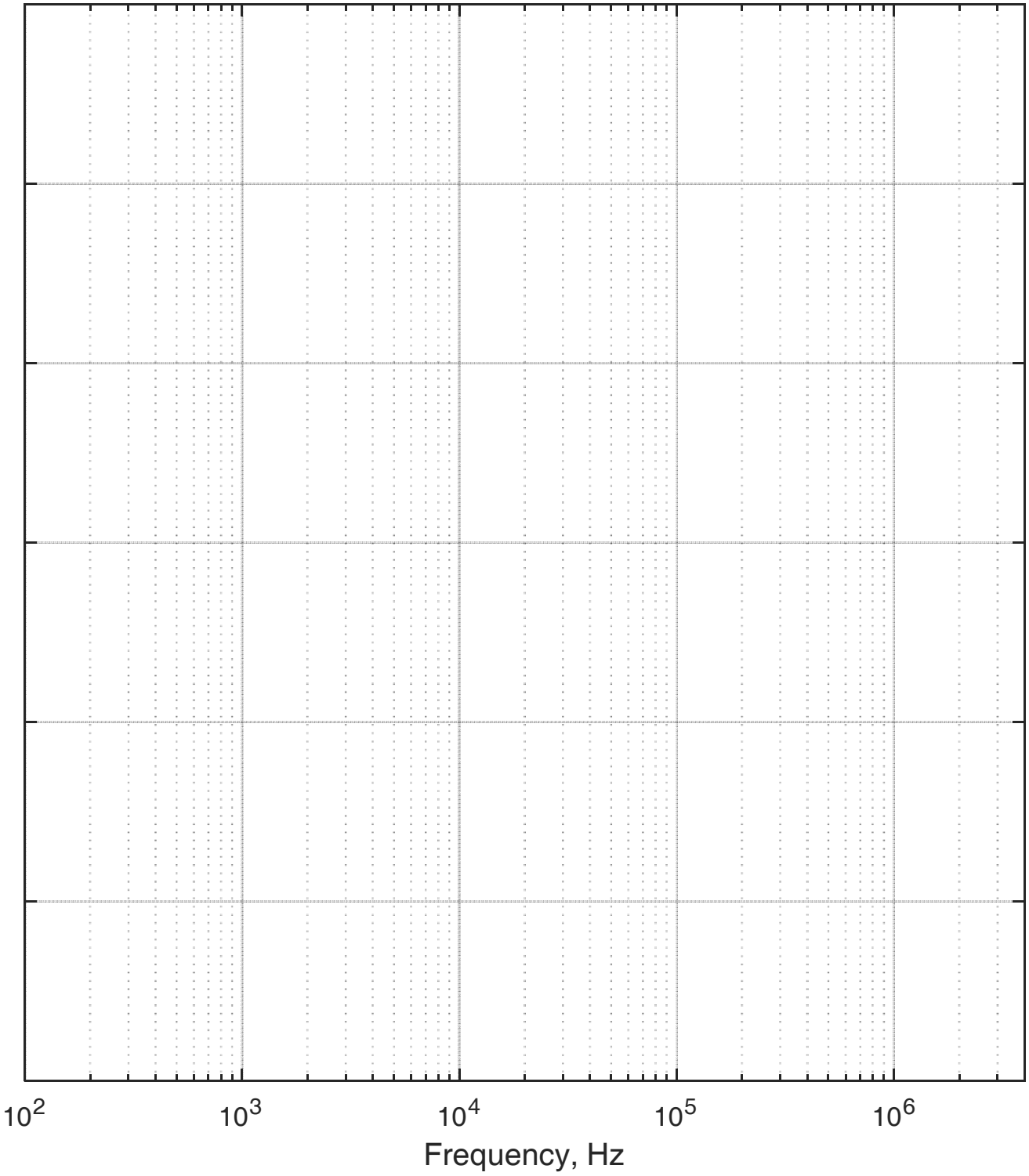
10^3
10^4
10^5
10^6
Frequency, Hz


10^2
10^3
10^4
10^5
10^6
Frequency, Hz


10^2
10^3
10^4
10^5
10^6
Frequency, Hz


10^2
10^3
10^4
10^5
10^6
Frequency, Hz