

**LAMPIRAN A**  
**DATA PERCOBAAN**



Frekuensi (Hz)	n	Jarak Speaker ke mikrofon (m)	Amplitudo (Volt)
2000	0	0	$A_0 = 3,1$ $A_1 = 2,1$ $A_2 = 1,9$ $A_3 = 1,5$
	1	0,09	$A_0 = 3,0$ $A_1 = 2,0$ $A_2 = 1,8$ $A_3 = 1,5$
	2	0,17	$A_0 = 2,9$ $A_1 = 1,9$ $A_2 = 1,8$ $A_3 = 1,5$
	3	0,26	$A_0 = 2,8$ $A_1 = 1,9$ $A_2 = 1,7$ $A_3 = 1,4$
	4	0,34	$A_0 = 2,7$ $A_1 = 1,8$ $A_2 = 1,7$ $A_3 = 1,4$
	5	0,43	$A_0 = 2,6$ $A_1 = 1,8$ $A_2 = 1,7$ $A_3 = 1,3$
	6	0,51	$A_0 = 2,5$ $A_1 = 1,8$ $A_2 = 1,6$ $A_3 = 1,2$
	7	0,06	$A_0 = 2,4$ $A_1 = 1,8$ $A_2 = 1,6$ $A_3 = 1,2$
	8	0,69	$A_0 = 2,4$ $A_1 = 1,9$ $A_2 = 1,6$ $A_3 = 1,2$

Frekuensi (Hz)	n	Jarak Speaker ke mikrofon (m)	Amplitudo (Volt)
2500	9	0,77	$A_0 = 1,9$ $A_1 = 1,3$ $A_2 = 0,9$ $A_3 = 0,7$
	0	0	$A_0 = 2,9$ $A_1 = 2,4$ $A_2 = 2,0$
	1	0,07	$A_0 = 2,8$ $A_1 = 2,3$ $A_2 = 2,0$
	2	0,14	$A_0 = 2,7$ $A_1 = 2,3$ $A_2 = 2,0$
	3	0,21	$A_0 = 2,6$ $A_1 = 2,3$ $A_2 = 2,0$
	4	0,27	$A_0 = 2,5$ $A_1 = 2,3$ $A_2 = 2,0$
	5	0,34	$A_0 = 2,4$ $A_1 = 2,2$ $A_2 = 2,0$
	6	0,41	$A_0 = 2,3$ $A_1 = 2,2$ $A_2 = 2,0$
	7	0,48	$A_0 = 2,2$ $A_1 = 2,1$ $A_2 = 2,0$
	8	0,55	$A_0 = 2,2$ $A_1 = 2,1$ $A_2 = 2,0$
9	0,62	$A_0 = 2,1$ $A_1 = 2,0$ $A_2 = 2,0$	

Frekuensi (Hz)	n	Jarak Speaker ke mikrofon (m)	Amplitudo (Volt)
3000	0	0	$A_0 = 2,8$ $A_1 = 2,4$ $A_2 = 2,0$
	1	0,06	$A_0 = 2,7$ $A_1 = 2,4$ $A_2 = 2,0$
	2	0,11	$A_0 = 2,6$ $A_1 = 2,4$ $A_2 = 1,9$
	3	0,17	$A_0 = 2,5$ $A_1 = 2,3$ $A_2 = 1,9$
	4	0,23	$A_0 = 2,4$ $A_1 = 2,3$ $A_2 = 1,9$
	5	0,29	$A_0 = 2,3$ $A_1 = 2,3$ $A_2 = 1,9$
	6	0,34	$A_0 = 2,3$ $A_1 = 2,2$ $A_2 = 1,9$
	7	0,40	$A_0 = 2,3$ $A_1 = 2,1$ $A_2 = 1,9$
	8	0,46	$A_0 = 2,2$ $A_1 = 2,1$ $A_2 = 1,9$
	9	0,51	$A_0 = 2,1$ $A_1 = 2,1$ $A_2 = 1,9$

Frekuensi (Hz)	n	Jarak Speaker ke mikrofon (m)	Amplitudo (Volt)
3500	0	0	$A_0 = 2,7$ $A_1 = 2,4$ $A_2 = 2,0$
	1	0,05	$A_0 = 2,5$ $A_1 = 2,4$ $A_2 = 2,0$
	2	0,10	$A_0 = 2,5$ $A_1 = 2,3$ $A_2 = 2,0$
	3	0,15	$A_0 = 2,4$ $A_1 = 2,3$ $A_2 = 2,0$
	4	0,20	$A_0 = 2,4$ $A_1 = 2,2$ $A_2 = 2,0$
	5	0,25	$A_0 = 2,3$ $A_1 = 2,1$ $A_2 = 2,0$
	6	0,29	$A_0 = 2,2$ $A_1 = 2,1$ $A_2 = 2,0$
	7	0,34	$A_0 = 2,2$ $A_1 = 2,1$ $A_2 = 2,0$
	8	0,39	$A_0 = 2,1$ $A_1 = 2,1$ $A_2 = 2,0$
	9	0,44	$A_0 = 2,1$ $A_1 = 2,1$ $A_2 = 2,0$

Frekuensi (Hz)	n	Jarak Speaker ke mikrofon (m)	Amplitudo (Volt)
3750	0	0	$A_0 = 2,4$ $A_1 = 1,9$ $A_2 = 1,2$
	1	0,05	$A_0 = 2,4$ $A_1 = 1,9$ $A_2 = 1,2$
	2	0,09	$A_0 = 2,2$ $A_1 = 1,9$ $A_2 = 1,2$
	3	0,14	$A_0 = 2,1$ $A_1 = 1,9$ $A_2 = 1,2$
	4	0,18	$A_0 = 2,0$ $A_1 = 1,9$ $A_2 = 1,2$
	5	0,23	$A_0 = 2,0$ $A_1 = 1,8$ $A_2 = 1,2$
	6	0,27	$A_0 = 1,9$ $A_1 = 1,8$ $A_2 = 1,2$
	7	0,32	$A_0 = 1,9$ $A_1 = 1,8$ $A_2 = 1,2$
	8	0,37	$A_0 = 1,9$ $A_1 = 1,8$ $A_2 = 1,2$
	9	0,41	$A_0 = 1,8$ $A_1 = 1,8$ $A_2 = 1,2$

Frekuensi (Hz)	n	Jarak Speaker ke mikrofon (m)	Amplitudo (Volt)
4000	0	0	$A_0 = 1,6$ $A_1 = 1,4$ $A_2 = 0,8$
	1	0,04	$A_0 = 1,6$ $A_1 = 1,5$ $A_2 = 0,8$
	2	0,09	$A_0 = 1,5$ $A_1 = 1,3$ $A_2 = 0,8$
	3	0,13	$A_0 = 1,5$ $A_1 = 1,3$ $A_2 = 0,8$
	4	0,17	$A_0 = 1,4$ $A_1 = 1,2$ $A_2 = 0,8$
	5	0,21	$A_0 = 1,4$ $A_1 = 1,2$ $A_2 = 0,8$
	6	0,26	$A_0 = 1,3$ $A_1 = 1,2$ $A_2 = 0,8$
	7	0,30	$A_0 = 1,3$ $A_1 = 1,2$ $A_2 = 0,6$
	8	0,34	$A_0 = 1,3$ $A_1 = 1,2$ $A_2 = 0,6$
	9	0,39	$A_0 = 1,2$ $A_1 = 1,1$ $A_2 = 0,9$

Frekuensi (Hz)	n	Jarak Speaker ke mikrofon (m)	Amplitudo (Volt)
4750	0	0	$A_0 = 1,1$ $A_1 = 0,6$ $A_2 = 0,5$
	1	0,04	$A_0 = 1,1$ $A_1 = 0,6$ $A_2 = 0,5$
	2	0,07	$A_0 = 1,1$ $A_1 = 0,6$ $A_2 = 0,5$
	3	0,11	$A_0 = 1,4$ $A_1 = 1,2$ $A_2 = 0,8$
	4	0,14	$A_0 = 1,0$ $A_1 = 0,5$ $A_2 = 0,4$
	5	0,18	$A_0 = 1,0$ $A_1 = 0,5$ $A_2 = 0,4$
	6	0,22	$A_0 = 0,9$ $A_1 = 0,4$ $A_2 = 0,3$
	7	0,25	$A_0 = 0,9$ $A_1 = 0,4$ $A_2 = 0,3$
	8	0,29	$A_0 = 0,8$ $A_1 = 0,4$ $A_2 = 0,2$
	9	0,33	$A_0 = 0,8$ $A_1 = 0,4$ $A_2 = 0,2$

Volt div = 0,5 Volt  
 Time div = 0,5 ms  
 V input = 0,2 mV  
 V output = 40 mV  
 Vcc = 11,45 V





**LAMPIRAN B**  
**PERHITUNGAN FREKUENSI BUNYI DAN RALAT**

### 1. Pada Frekuensi Generator 2000 Hz

Posisi Speaker Ke Mikropon $X \rightarrow \lambda = \frac{V}{f}$ (m)	Jarak $\frac{1}{2} \lambda$ (Y) $Y = (X_n \pm S_{X_n}) - (X_{n+1} \pm S_{X_{n+1}})$ (m)	Jarak $\lambda$ (B) $B = 2Y$ (m)	Frekuensi Bunyi $f = \frac{V}{\lambda}$ (Hz)	Amplitudo (Volt)			
				A <sub>0</sub>	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>
(90000,000 ± 4,250) 10 <sup>-6</sup>	(90000,000 ± 4,250) 10 <sup>-6</sup>	(180000,000 ± 8,500) 10 <sup>-6</sup>	1888,8889 ± 0,0892	3,0	2,0	1,8	1,5
(17000,000 ± 8,500) 10 <sup>-6</sup>	(80000,000 ± 9,500) 10 <sup>-6</sup>	(16000,000 ± 1,900) 10 <sup>-6</sup>	2125,0000 ± 0,2523	2,9	1,9	1,8	1,5
(26000,000 ± 1,275) 10 <sup>-5</sup>	(90000,000 ± 1,532) 10 <sup>-5</sup>	(18000,000 ± 3,065) 10 <sup>-5</sup>	1888,8889 ± 0,0892	2,8	1,9	1,7	1,4
(34000,000 ± 1,700) 10 <sup>-5</sup>	(80000,000 ± 2,125) 10 <sup>-5</sup>	(16000,000 ± 4,250) 10 <sup>-5</sup>	2125,0000 ± 0,2523	2,7	1,8	1,7	1,4
(43000,000 ± 2,125) 10 <sup>-5</sup>	(90000,000 ± 2,721) 10 <sup>-5</sup>	(18000,000 ± 5,443) 10 <sup>-5</sup>	1888,8889 ± 0,0892	2,6	1,8	1,7	1,3
(51000,000 ± 2,550) 10 <sup>-5</sup>	(80000,000 ± 3,319) 10 <sup>-5</sup>	(16000,000 ± 6,639) 10 <sup>-5</sup>	2125,0000 ± 0,2523	2,5	1,8	1,6	1,2
(60000,000 ± 2,975) 10 <sup>-5</sup>	(90000,000 ± 3,918) 10 <sup>-5</sup>	(18000,000 ± 7,837) 10 <sup>-5</sup>	1888,8889 ± 0,0892	2,4	1,8	1,6	1,2
(90000,000 ± 3,400) 10 <sup>-5</sup>	(90000,000 ± 4,518) 10 <sup>-5</sup>	(18000,000 ± 9,036) 10 <sup>-5</sup>	1888,8889 ± 0,0892	2,4	1,9	1,6	1,2
(77000,000 ± 3,825) 10 <sup>-5</sup>	(80000,000 ± 5,118) 10 <sup>-5</sup>	(16000,000 ± 1,025) 10 <sup>-5</sup>	2125,0000 ± 0,2523	1,9	1,3	0,9	0,7

Keterangan :

Frekuensi Bunyi rata-rata ( $\bar{f} \pm Sf$ ) = (1909,4293 ± 0,0786) Hz.

## 2. Pada Frekuensi Generator 2500 Hz

Posisi Speaker Ke Mikropon $V$ $X \rightarrow \lambda = \frac{V}{f}$ (m)	Jarak $\frac{1}{2} \lambda$ (Y) $Y = (X_n \pm S_{X_n}) - (X_{n-1} \pm S_{X_{n-1}})$ (m)	Jarak $\lambda$ (B) $B = 2Y$ (m)	Frekuensi Bunyi $f = \frac{V}{\lambda}$ (Hz)	Amplitudo (Volt)		
				A <sub>0</sub>	A <sub>1</sub>	A <sub>2</sub>
(7000,000 ± 2,720) 10 <sup>-6</sup>	(7000,000 ± 2,720) 10 <sup>-6</sup>	(14000,000 ± 5,440) 10 <sup>-6</sup>	(2428,5714 ± 0,944)	2,7	2,4	2,0
(14000,000 ± 5,440) 10 <sup>-6</sup>	(70000,000 ± 2,720) 10 <sup>-5</sup>	(14000,000 ± 1,216) 10 <sup>-5</sup>	(2428,5714 ± 0,2110)	2,7	2,3	2,0
(21000,000 ± 8,160) 10 <sup>-6</sup>	(70000,000 ± 1,961) 10 <sup>-5</sup>	(14000,000 ± 1,961) 10 <sup>-5</sup>	(2428,5714 ± 0,3402)	2,6	2,3	2,0
(27000,000 ± 1,088) 10 <sup>-5</sup>	(6000,000 ± 2,720) 10 <sup>-5</sup>	(12000,000 ± 2,720) 10 <sup>-5</sup>	(2833,3333 ± 0,6422)	2,5	2,3	2,0
(43000,000 ± 1,360) 10 <sup>-5</sup>	(7000,000 ± 3,483) 10 <sup>-5</sup>	(14000,000 ± 3,483) 10 <sup>-5</sup>	(2428,5714 ± 0,6042)	2,4	2,2	2,0
(41000,000 ± 1,632) 10 <sup>-5</sup>	(7000,000 ± 4,249) 10 <sup>-5</sup>	(14000,000 ± 4,249) 10 <sup>-5</sup>	(2428,5714 ± 0,7370)	2,3	2,2	2,0
(48000,000 ± 1,904) 10 <sup>-5</sup>	(7000,000 ± 5,015) 10 <sup>-5</sup>	(14000,000 ± 5,015) 10 <sup>-5</sup>	(2428,5714 ± 0,8700)	2,2	2,1	2,0
(55000,000 ± 2,176) 10 <sup>-5</sup>	(7000,000 ± 5,783) 10 <sup>-5</sup>	(14000,000 ± 5,783) 10 <sup>-5</sup>	(2428,5714 ± 1,0031)	2,2	2,1	2,0
(62000,000 ± 2,448) 10 <sup>-5</sup>	(7000,000 ± 1,551) 10 <sup>-5</sup>	(14000,000 ± 1,551) 10 <sup>-5</sup>	(2428,5714 ± 1,1363)	2,2	2,1	2,0

Keterangan :

Frekuensi Bunyi rata-rata ( $\bar{f} \pm Sf$ ) = (2434,9654 ± 0,0807) Hz.

### 3. Pada Frekuensi Generator 3000 Hz

Posisi Speaker Ke Mikropon $X \rightarrow \lambda = \frac{V}{f}$ (m)	Jarak $\frac{1}{2} \lambda$ (Y) $Y = (X_n \pm S_{n,0}) - (X_{n+1} \pm S_{n+1,1})$ (m)	Jarak $\lambda$ (B) $B = 2 Y$ (m)	Frekuensi Bunyi $f = \frac{V}{\lambda}$ (Hz)	Amplitudo (Volt)		
				A <sub>0</sub>	A <sub>1</sub>	A <sub>2</sub>
(6000,000 ± 1,889) 10 <sup>-6</sup>	(6000,000 ± 1,889) 10 <sup>-6</sup>	(12000,000 ± 3,778) 10 <sup>-6</sup>	2833,3333 ± 0,0892	2,7	2,4	2,0
(11000,000 ± 3,778) 10 <sup>-6</sup>	(5000,000 ± 4,224) 10 <sup>-6</sup>	(10000,000 ± 8,447) 10 <sup>-6</sup>	3400,0000 ± 0,1995	2,6	2,4	1,9
(17000,000 ± 5,667) 10 <sup>-6</sup>	(6000,000 ± 6,811) 10 <sup>-6</sup>	(12000,000 ± 1,362) 10 <sup>-5</sup>	2833,3333 ± 0,3216	2,5	2,3	1,9
(23000,000 ± 7,556) 10 <sup>-6</sup>	(6000,000 ± 9,445) 10 <sup>-6</sup>	(12000,000 ± 1,889) 10 <sup>-5</sup>	2833,3333 ± 0,4460	2,4	2,3	1,9
(29000,000 ± 9,445) 10 <sup>-6</sup>	(6000,000 ± 1,210) 10 <sup>-5</sup>	(12000,000 ± 2,419) 10 <sup>-5</sup>	2833,3333 ± 0,5712	2,3	2,3	1,9
(34000,000 ± 1,632) 10 <sup>-5</sup>	(5000,000 ± 1,475) 10 <sup>-5</sup>	(10000,000 ± 2,950) 10 <sup>-5</sup>	2400,0000 ± 1,0031	2,3	2,2	1,9
(40000,000 ± 1,322) 10 <sup>-5</sup>	(6000,000 ± 1,741) 10 <sup>-5</sup>	(12000,000 ± 3,483) 10 <sup>-5</sup>	2833,3333 ± 0,8223	2,3	2,1	1,9
(46000,000 ± 1,511) 10 <sup>-5</sup>	(6000,000 ± 2,008) 10 <sup>-5</sup>	(12000,000 ± 4,016) 10 <sup>-5</sup>	2833,3333 ± 0,9482	2,2	2,1	1,9
(51000,000 ± 1,700) 10 <sup>-5</sup>	(5000,000 ± 2,275) 10 <sup>-5</sup>	(10000,000 ± 4,549) 10 <sup>-5</sup>	3400,0000 ± 1,5467	2,1	2,0	1,9

Keterangan :

Frekuensi Bunyi rata-rata ( $\bar{f} \pm Sf$ ) = (2920,0246 ± 0,0761) Hz

#### 4. Pada Frekuensi Generator 3500 Hz

Posisi Speaker Ke Mikropon $X \rightarrow \lambda = \frac{V}{f}$ (m)	Jarak $\frac{1}{2} \lambda$ (Y) $Y = (X_n \pm S_{X_n}) - (X_{n-1} \pm S_{X_{n-1}})$ (m)	Jarak $\lambda$ (B) $B = 2 Y$ (m)	Frekuensi Bunyi $f = \frac{V}{\lambda}$ (Hz)	Amplitudo (Volt)		
				A <sub>0</sub>	A <sub>1</sub>	A <sub>2</sub>
(50000,000 ± 1,388) 10 <sup>-6</sup>	(50000,000 ± 1,388) 10 <sup>-6</sup>	(100000,000 ± 2,776) 10 <sup>-6</sup>	3400,0000 ± 0,0994	2,5	2,4	2,0
(100000,000 ± 2,776) 10 <sup>-6</sup>	(50000,000 ± 3,103) 10 <sup>-6</sup>	(100000,000 ± 6,206) 10 <sup>-6</sup>	3400,0000 ± 0,2110	2,5	2,3	2,0
(150000,000 ± 4,163) 10 <sup>-6</sup>	(50000,000 ± 5,004) 10 <sup>-6</sup>	(100000,000 ± 1,000) 10 <sup>-5</sup>	3400,0000 ± 0,3402	2,4	2,3	2,0
(200000,000 ± 5,551) 10 <sup>-6</sup>	(50000,000 ± 6,939) 10 <sup>-6</sup>	(100000,000 ± 1,387) 10 <sup>-5</sup>	3400,0000 ± 0,4717	2,4	2,2	2,0
(250000,000 ± 6,939) 10 <sup>-6</sup>	(50000,000 ± 8,886) 10 <sup>-6</sup>	(100000,000 ± 1,777) 10 <sup>-5</sup>	3400,0000 ± 0,6042	2,3	2,2	2,0
(290000,000 ± 8,327) 10 <sup>-6</sup>	(4000,000 ± 1,084) 10 <sup>-5</sup>	(8000,000 ± 2,168) 10 <sup>-5</sup>	4250,0000 ± 1,1516	2,2	2,2	2,0
(340000,000 ± 9,714) 10 <sup>-6</sup>	(5000,000 ± 1,279) 10 <sup>-5</sup>	(10000,000 ± 2,559) 10 <sup>-5</sup>	3400,0000 ± 0,8700	2,2	2,1	2,0
(390000,000 ± 1,110) 10 <sup>-5</sup>	(5000,000 ± 1,475) 10 <sup>-5</sup>	(10000,000 ± 2,950) 10 <sup>-5</sup>	3400,0000 ± 1,0031	2,1	2,1	2,0
(51000,000 ± 1,249) 10 <sup>-5</sup>	(5000,000 ± 1,671) 10 <sup>-5</sup>	(10000,000 ± 3,342) 10 <sup>-5</sup>	3400,0000 ± 1,1363	2,1	2,1	2,0

Keterangan :

Frekuensi Bunyi rata-rata ( $\bar{f} \pm Sf$ ) = (3404,1116 ± 0,0805) Hz

### 5. Pada Frekuensi Generator 3750 Hz

Posisi Speaker Ke Mikropon $X \rightarrow \lambda = \frac{V}{f}$ (m)	Jarak $\frac{1}{2} \lambda$ (Y) $Y = (X_n \pm S_{X_n}) - (X_{n-1} \pm S_{X_{n-1}})$ (m)	Jarak $\lambda$ (B) $B = 2 Y$ (m)	Frekuensi Bunyi $f = \frac{V}{\lambda}$ (Hz)	Amplitudo (Volt)		
				A <sub>0</sub>	A <sub>1</sub>	A <sub>2</sub>
(50000,000 ± 1,209) 10 <sup>-6</sup>	(50000,000 ± 1,209) 10 <sup>-6</sup>	(100000,000 ± 2,418) 10 <sup>-6</sup>	3400,0000 ± 0,0822	2,3	1,9	1,2
(90000,000 ± 2,418) 10 <sup>-6</sup>	(40000,000 ± 2,703) 10 <sup>-6</sup>	(80000,000 ± 5,406) 10 <sup>-6</sup>	4250,0000 ± 0,2872	2,2	1,9	1,2
(140000,000 ± 3,627) 10 <sup>-6</sup>	(50000,000 ± 4,359) 10 <sup>-6</sup>	(100000,000 ± 8,718) 10 <sup>-6</sup>	3400,0000 ± 0,2964	2,1	1,9	1,2
(180000,000 ± 4,836) 10 <sup>-6</sup>	(40000,000 ± 6,045) 10 <sup>-6</sup>	(80000,000 ± 1,209) 10 <sup>-5</sup>	4250,0000 ± 0,6422	2,0	1,9	1,2
(230000,000 ± 6,045) 10 <sup>-6</sup>	(50000,000 ± 7,741) 10 <sup>-6</sup>	(100000,000 ± 1,548) 10 <sup>-5</sup>	3400,0000 ± 0,5264	2,0	1,8	1,2
(270000,000 ± 7,253) 10 <sup>-6</sup>	(40000,000 ± 9,442) 10 <sup>-6</sup>	(80000,000 ± 1,884) 10 <sup>-5</sup>	4250,0000 ± 1,0032	1,9	1,8	1,2
(320000,000 ± 8,462) 10 <sup>-6</sup>	(5000,000 ± 1,115) 10 <sup>-5</sup>	(10000,000 ± 2,229) 10 <sup>-5</sup>	3400,0000 ± 0,7579	1,9	1,8	1,2
(370000,000 ± 9,671) 10 <sup>-6</sup>	(5000,000 ± 1,285) 10 <sup>-5</sup>	(10000,000 ± 2,570) 10 <sup>-5</sup>	3400,0000 ± 1,8739	1,9	1,8	1,2
(41000,000 ± 1,088) 10 <sup>-5</sup>	(5000,000 ± 1,456) 10 <sup>-5</sup>	(8000,000 ± 2,991) 10 <sup>-5</sup>	4250,0000 ± 0,9899	1,8	1,8	1,2

Keterangan :

$$\text{Frekuensi Bunyi rata-rata } (\bar{f} \pm S\bar{f}) = (3476,6896 \pm 0,0744) \text{ Hz}$$

### 6. Pada Frekuensi Generator 4000 Hz

Posisi Speaker Ke Mikropon $X \rightarrow \lambda = \frac{V}{f}$ (m)	Jarak $\frac{1}{2} \lambda$ (Y) $Y = (X_n \pm S_{X_n}) - (X_{n+1} \pm S_{X_{n+1}})$ (m)	Jarak $\lambda$ (B) $B = 2 Y$ (m)	Frekuensi Bunyi $f = \frac{V}{\lambda}$ (Hz)	Amplitudo (Volt)		
				A <sub>0</sub>	A <sub>1</sub>	A <sub>2</sub>
(40000,000 ± 1,388) 10 <sup>-6</sup>	(40000,000 ± 1,060) 10 <sup>-6</sup>	(80000,000 ± 2,125) 10 <sup>-6</sup>	4250,0000 ± 0,1126	1,6	1,3	0,8
(90000,000 ± 2,776) 10 <sup>-6</sup>	(50000,000 ± 2,376) 10 <sup>-6</sup>	(100000,000 ± 4,752) 10 <sup>-6</sup>	3400,0000 ± 0,1616	1,5	1,3	0,8
(130000,000 ± 4,163) 10 <sup>-6</sup>	(40000,000 ± 3,831) 10 <sup>-6</sup>	(80000,000 ± 7,662) 10 <sup>-6</sup>	4250,0000 ± 0,4070	1,5	1,3	0,8
(170000,000 ± 5,551) 10 <sup>-6</sup>	(40000,000 ± 5,313) 10 <sup>-6</sup>	(80000,000 ± 1,063) 10 <sup>-5</sup>	4250,0000 ± 0,5645	1,4	1,2	0,8
(210000,000 ± 6,939) 10 <sup>-6</sup>	(40000,000 ± 6,803) 10 <sup>-6</sup>	(80000,000 ± 1,361) 10 <sup>-5</sup>	4250,0000 ± 0,7229	1,4	1,2	0,8
(260000,000 ± 8,327) 10 <sup>-6</sup>	(50000,000 ± 8,928) 10 <sup>-6</sup>	(100000,000 ± 1,660) 10 <sup>-5</sup>	3400,0000 ± 1,5643	1,3	1,2	0,8
(300000,000 ± 9,714) 10 <sup>-6</sup>	(40000,000 ± 9,796) 10 <sup>-6</sup>	(80000,000 ± 1,959) 10 <sup>-5</sup>	4250,0000 ± 0,0408	1,3	1,1	0,8
(340000,000 ± 1,110) 10 <sup>-6</sup>	(4000,000 ± 1,129) 10 <sup>-5</sup>	(80000,000 ± 2,259) 10 <sup>-5</sup>	4250,0000 ± 0,2000	1,3	1,1	0,8
(390000,000 ± 1,249) 10 <sup>-6</sup>	(5000,000 ± 1,279) 10 <sup>-5</sup>	(10000,000 ± 2,559) 10 <sup>-5</sup>	3400,0000 ± 0,8699	1,2	1,1	0,8

Keterangan :

Frekuensi Bunyi rata-rata ( $\bar{f} \pm Sf$ ) = (3974,1873 ± 0,0864) Hz

### 7. Pada Frekuensi Generator 4750 Hz

Posisi Speaker Ke Mikropon $X \rightarrow \lambda = \frac{V}{f}$ (m)	Jarak $\frac{1}{2} \lambda$ (Y) $Y = (X_n \pm S_{X_n}) - (X_{n+1} \pm S_{X_{n+1}})$ (m)	Jarak $\lambda$ (B) $B = 2 Y$ (m)	Frekuensi Bunyi $f = \frac{V}{\lambda}$ (Hz)	Amplitudo (Volt)		
				A <sub>0</sub>	A <sub>1</sub>	A <sub>2</sub>
(40000,000 ± 7,535) 10 <sup>-7</sup>	(40000,000 ± 1,388) 10 <sup>-7</sup>	(80000,000 ± 1,507) 10 <sup>-6</sup>	4250,0000 ± 0,0801	1,1	0,6	0,5
(70000,000 ± 1,507) 10 <sup>-6</sup>	(30000,000 ± 3,103) 10 <sup>-6</sup>	(60000,000 ± 3,700) 10 <sup>-6</sup>	5666,6667 ± 0,3182	1,1	0,6	0,5
(110000,000 ± 2,260) 10 <sup>-6</sup>	(40000,000 ± 5,004) 10 <sup>-6</sup>	(80000,000 ± 5,443) 10 <sup>-6</sup>	4250,0000 ± 0,2886	1,0	0,5	0,4
(140000,000 ± 3,014) 10 <sup>-6</sup>	(30000,000 ± 6,939) 10 <sup>-6</sup>	(60000,000 ± 7,534) 10 <sup>-6</sup>	5666,6667 ± 0,4003	1,0	0,5	0,4
(180000,000 ± 3,767) 10 <sup>-6</sup>	(40000,000 ± 8,886) 10 <sup>-6</sup>	(80000,000 ± 9,649) 10 <sup>-6</sup>	4250,0000 ± 0,5126	1,0	0,5	0,4
(220000,000 ± 4,521) 10 <sup>-6</sup>	(40000,000 ± 1,084) 10 <sup>-6</sup>	(8000,000 ± 1,177) 10 <sup>-5</sup>	4250,0000 ± 0,6252	0,9	0,4	0,3
(250000,000 ± 5,276) 10 <sup>-6</sup>	(30000,000 ± 1,279) 10 <sup>-6</sup>	(6000,000 ± 1,389) 10 <sup>-5</sup>	5666,6667 ± 1,3121	0,9	0,4	0,3
(290000,000 ± 6,028) 10 <sup>-6</sup>	(40000,000 ± 1,475) 10 <sup>-6</sup>	(8000,000 ± 1,602) 10 <sup>-5</sup>	4250,0000 ± 0,8510	0,8	0,4	0,2
(330000,000 ± 6,781) 10 <sup>-6</sup>	(40000,000 ± 1,671) 10 <sup>-6</sup>	(8000,000 ± 1,813) 10 <sup>-5</sup>	4250,0000 ± 0,9610	0,9	0,4	0,2

Keterangan :

$$\text{Frekuensi Bunyi rata-rata } (\bar{f} \pm Sf) = (4372,2059 \pm 0,0719) \text{ Hz}$$





**LAMPIRAN C**  
**PERHITUNGAN FREKUENSI BUNYI RATA-RATA**

## Perhitungan $\bar{f} \pm S_f$

Dengan Ralat Berbobot

$$f = \frac{\sum_{n=1}^k \frac{f_n}{S_n^2}}{\sum_{n=1}^k \frac{1}{S_n^2}}$$

$$S_f = 1 / \left[ \sum_{n=1}^k \frac{1}{S_n^2} \right]^{1/2}$$

$$\begin{aligned}
 1. \quad \bar{f} &= \frac{\frac{f_1}{S_{f1}^2} + \frac{f_2}{S_{f2}^2} + \frac{f_3}{S_{f3}^2} + \frac{f_4}{S_{f4}^2} + \frac{f_5}{S_{f5}^2} + \frac{f_6}{S_{f6}^2} + \frac{f_7}{S_{f7}^2} + \frac{f_8}{S_{f8}^2} + \frac{f_9}{S_{f9}^2}}{\frac{1}{S_{f1}^2} + \frac{1}{S_{f2}^2} + \frac{1}{S_{f3}^2} + \frac{1}{S_{f4}^2} + \frac{1}{S_{f5}^2} + \frac{1}{S_{f6}^2} + \frac{1}{S_{f7}^2} + \frac{1}{S_{f8}^2} + \frac{1}{S_{f9}^2}} \\
 &= \frac{\frac{1888,8889}{(0,0892)^2} + \frac{2125,0000}{(0,2523)^2} + \frac{1888,8889}{(0,3216)^2} + \frac{2125,0000}{(0,5645)^2} + \frac{1888,8889}{(0,5711)^2} + \frac{2125,0000}{(0,8817)^2} + \frac{1888,8889}{(0,8224)^2} + \frac{1888,8889}{(0,9482)^2} + \frac{2125,0000}{(1,3594)^2}}{\frac{1}{(0,0892)^2} + \frac{1}{(0,2523)^2} + \frac{1}{(0,3216)^2} + \frac{1}{(0,5645)^2} + \frac{1}{(0,5711)^2} + \frac{1}{(0,8817)^2} + \frac{1}{(0,8224)^2} + \frac{1}{(0,9482)^2} + \frac{1}{(1,3594)^2}}
 \end{aligned}$$

$$\begin{aligned}
 &= \frac{310423,0132}{162,5737182} \\
 &= 1909,4293 \text{ Hz}
 \end{aligned}$$

$$\begin{aligned}
 S_f &= \frac{1}{\left( \frac{1}{S_{f1}^2} + \frac{1}{S_{f2}^2} + \frac{1}{S_{f3}^2} + \frac{1}{S_{f4}^2} + \frac{1}{S_{f5}^2} + \frac{1}{S_{f6}^2} + \frac{1}{S_{f7}^2} + \frac{1}{S_{f8}^2} + \frac{1}{S_{f9}^2} \right)^{1/2}} \\
 &= \frac{1}{\sqrt{\frac{1}{(0,0892)^2} + \frac{1}{(0,2523)^2} + \frac{1}{(0,3216)^2} + \frac{1}{(0,5645)^2} + \frac{1}{(0,5711)^2} + \frac{1}{(0,8817)^2} + \frac{1}{(0,8224)^2} + \frac{1}{(0,9482)^2} + \frac{1}{(1,3594)^2}}} \\
 &= \frac{1}{(162,5737182)^{1/2}} \\
 &= 0,0786 \text{ Hz}
 \end{aligned}$$

$$\begin{aligned}
 2. \quad \bar{f} &= \frac{\frac{f_1}{S_{f1}^2} + \frac{f_2}{S_{f2}^2} + \frac{f_3}{S_{f3}^2} + \frac{f_4}{S_{f4}^2} + \frac{f_5}{S_{f5}^2} + \frac{f_6}{S_{f6}^2} + \frac{f_7}{S_{f7}^2} + \frac{f_8}{S_{f8}^2} + \frac{f_9}{S_{f9}^2}}{\frac{1}{S_{f1}^2} + \frac{1}{S_{f2}^2} + \frac{1}{S_{f3}^2} + \frac{1}{S_{f4}^2} + \frac{1}{S_{f5}^2} + \frac{1}{S_{f6}^2} + \frac{1}{S_{f7}^2} + \frac{1}{S_{f8}^2} + \frac{1}{S_{f9}^2}}
 \end{aligned}$$

$$\begin{aligned}
 & \frac{2428,5714}{(0,0944)^2} + \frac{2428,5714}{(0,2110)^2} + \frac{2428,5714}{(0,3402)^2} + \frac{2428,5714}{(0,6422)^2} + \frac{2428,5714}{(0,6042)^2} + \\
 & \frac{2428,5714}{(0,7370)^2} + \frac{2428,5714}{(0,8700)^2} + \frac{2428,5714}{(1,0031)^2} + \frac{2428,5714}{(1,1363)^2} \\
 = & \frac{1}{(0,0944)^2} + \frac{1}{(0,2110)^2} + \frac{1}{(0,3402)^2} + \frac{1}{(0,6422)^2} + \frac{1}{(0,6042)^2} + \\
 & \frac{1}{(0,7370)^2} + \frac{1}{(0,8700)^2} + \frac{1}{(1,0031)^2} + \frac{1}{(1,1363)^2} \\
 = & \frac{373724,3274}{153,4823995} \\
 = & 2434,9654 \text{ Hz}
 \end{aligned}$$

$$\begin{aligned}
 S_f &= \frac{1}{\left( \frac{1}{S_1^2} + \frac{1}{S_2^2} + \frac{1}{S_3^2} + \frac{1}{S_4^2} + \frac{1}{S_5^2} + \frac{1}{S_6^2} + \frac{1}{S_7^2} + \frac{1}{S_8^2} + \frac{1}{S_9^2} \right)^{1/2}} \\
 &= \frac{1}{\sqrt{\frac{1}{(0,0944)^2} + \frac{1}{(0,2110)^2} + \frac{1}{(0,3402)^2} + \frac{1}{(0,6422)^2} + \frac{1}{(0,6042)^2} + \frac{1}{(0,7370)^2} + \frac{1}{(0,8700)^2} + \frac{1}{(1,0031)^2} + \frac{1}{(1,1363)^2}}}
 \end{aligned}$$

$$\begin{aligned}
 &= \frac{1}{(153,4823995)^{1/4}} \\
 &= \frac{1}{12,3888013} \\
 &= 0,0807 \text{ Hz}
 \end{aligned}$$

$$\begin{aligned}
 3. \quad \bar{f} &= \frac{\frac{f_1}{S_{f1}^2} + \frac{f_2}{S_{f2}^2} + \frac{f_3}{S_{f3}^2} + \frac{f_4}{S_{f4}^2} + \frac{f_5}{S_{f5}^2} + \frac{f_6}{S_{f6}^2} + \frac{f_7}{S_{f7}^2} + \frac{f_8}{S_{f8}^2} + \frac{f_9}{S_{f9}^2}}{\frac{1}{S_{f1}^2} + \frac{1}{S_{f2}^2} + \frac{1}{S_{f3}^2} + \frac{1}{S_{f4}^2} + \frac{1}{S_{f5}^2} + \frac{1}{S_{f6}^2} + \frac{1}{S_{f7}^2} + \frac{1}{S_{f8}^2} + \frac{1}{S_{f9}^2}} \\
 &= \frac{\frac{2833,3333}{(0,0892)^2} + \frac{3400,0000}{(0,1995)^2} + \frac{2833,3333}{(0,3216)^2} + \frac{2833,3333}{(0,4460)^2} + \frac{2833,3333}{(0,5712)^2} + \frac{3400,0000}{(1,0031)^2} + \frac{2833,3333}{(0,8223)^2} + \frac{2833,3333}{(0,9482)^2} + \frac{3400,0000}{(1,5467)^2}}{\frac{1}{(0,0892)^2} + \frac{1}{(0,1995)^2} + \frac{1}{(0,3216)^2} + \frac{1}{(0,4460)^2} + \frac{1}{(0,5712)^2} + \frac{1}{(1,0031)^2} + \frac{1}{(0,8223)^2} + \frac{1}{(0,9482)^2} + \frac{1}{(1,5467)^2}} \\
 &= \frac{504046,9481}{172,6173665} = 2920,0246 \text{ Hz}
 \end{aligned}$$

$$\begin{aligned}
 S_f &= \frac{1}{\left(\frac{1}{S_1^2} + \frac{1}{S_2^2} + \frac{1}{S_3^2} + \frac{1}{S_4^2} + \frac{1}{S_5^2} + \frac{1}{S_6^2} + \frac{1}{S_7^2} + \frac{1}{S_8^2} + \frac{1}{S_9^2}\right)^{1/2}} \\
 &= \frac{1}{\sqrt{\frac{1}{(0,0892)^2} + \frac{1}{(0,1995)^2} + \frac{1}{(0,3216)^2} + \frac{1}{(0,4460)^2} + \frac{1}{(0,5712)^2} + \frac{1}{(1,0031)^2} + \frac{1}{(0,8223)^2} + \frac{1}{(0,9482)^2} + \frac{1}{(1,5467)^2}}} \\
 &= \frac{1}{(172,6173665)^{1/2}} \\
 &= \frac{1}{13,13839284} \\
 &= 0,0761 \text{ Hz}
 \end{aligned}$$

$$\begin{aligned}
 4. \quad \bar{f} &= \frac{f_1}{S_1^2} + \frac{f_2}{S_2^2} + \frac{f_3}{S_3^2} + \frac{f_4}{S_4^2} + \frac{f_5}{S_5^2} + \frac{f_6}{S_6^2} + \frac{f_7}{S_7^2} + \frac{f_8}{S_8^2} + \frac{f_9}{S_9^2} \\
 &= \frac{1}{S_1^2} + \frac{1}{S_2^2} + \frac{1}{S_3^2} + \frac{1}{S_4^2} + \frac{1}{S_5^2} + \frac{1}{S_6^2} + \frac{1}{S_7^2} + \frac{1}{S_8^2} + \frac{1}{S_9^2}
 \end{aligned}$$

$$\frac{3400,0000}{(0,0944)^2} + \frac{3400,0000}{(0,2110)^2} + \frac{3400,0000}{(0,3402)^2} + \frac{3400,0000}{(0,4717)^2} + \frac{3400,0000}{(0,6042)^2} +$$

$$\frac{4250,0000}{(1,1516)^2} + \frac{3400,0000}{(0,8700)^2} + \frac{3400,0000}{(1,0031)^2} + \frac{3400,0000}{(1,1363)^2}$$


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$$\frac{1}{(0,0944)^2} + \frac{1}{(0,2110)^2} + \frac{1}{(0,3402)^2} + \frac{1}{(0,4717)^2} + \frac{1}{(0,6042)^2} +$$

$$\frac{1}{(1,1516)^2} + \frac{1}{(0,8700)^2} + \frac{1}{(1,0031)^2} + \frac{1}{(1,1363)^2}$$

$$= \frac{525829,6376}{154,4689782}$$

$$= 3404,1116 \text{ Hz}$$

$$S_f = \frac{1}{\left( \frac{1}{S_n^2} + \frac{1}{S_2^2} + \frac{1}{S_E^2} + \frac{1}{S_H^2} + \frac{1}{S_D^2} + \frac{1}{S_R^2} + \frac{1}{S_T^2} + \frac{1}{S_B^2} + \frac{1}{S_B^2} \right)^{1/2}}$$

$$= \frac{1}{\sqrt{\frac{1}{(0,0944)^2} + \frac{1}{(0,2110)^2} + \frac{1}{(0,3402)^2} + \frac{1}{(0,4717)^2} + \frac{1}{(0,6042)^2} + \frac{1}{(1,1516)^2} + \frac{1}{(0,8700)^2} + \frac{1}{(1,0031)^2} + \frac{1}{(1,1363)^2}}}$$

$$= \frac{1}{(154,4689782)^{1/2}}$$

$$= \frac{1}{13,51208002}$$

$$= 0,07401 \text{ Hz}$$

$$\begin{aligned}
 5. \quad \bar{f} &= \frac{\frac{f_1}{S_{f1}^2} + \frac{f_2}{S_{f2}^2} + \frac{f_3}{S_{f3}^2} + \frac{f_4}{S_{f4}^2} + \frac{f_5}{S_{f5}^2} + \frac{f_6}{S_{f6}^2} + \frac{f_7}{S_{f7}^2} + \frac{f_8}{S_{f8}^2} + \frac{f_9}{S_{f9}^2}}{\frac{1}{S_{f1}^2} + \frac{1}{S_{f2}^2} + \frac{1}{S_{f3}^2} + \frac{1}{S_{f4}^2} + \frac{1}{S_{f5}^2} + \frac{1}{S_{f6}^2} + \frac{1}{S_{f7}^2} + \frac{1}{S_{f8}^2} + \frac{1}{S_{f9}^2}} \\
 &= \frac{\frac{3400,0000}{(0,0822)^2} + \frac{4250,0000}{(0,2872)^2} + \frac{3400,0000}{(0,2964)^2} + \frac{4250,0000}{(0,6422)^2} + \frac{3400,0000}{(0,5264)^2} + \frac{4250,0000}{(1,0032)^2} + \frac{3400,0000}{(0,7579)^2} + \frac{3400,0000}{(0,8739)^2} + \frac{4250,0000}{(0,9899)^2}}{\frac{1}{(0,0822)^2} + \frac{1}{(0,2872)^2} + \frac{1}{(0,2964)^2} + \frac{1}{(0,6422)^2} + \frac{1}{(0,5264)^2} + \frac{1}{(1,0032)^2} + \frac{1}{(0,7579)^2} + \frac{1}{(0,8739)^2} + \frac{1}{(0,9899)^2}} \\
 &= \frac{532497,3122}{133,9889842} = 3974,1873 \text{ Hz}
 \end{aligned}$$



$$\begin{aligned}
 S_f &= \frac{1}{\left(\frac{1}{S_{f1}^2} + \frac{1}{S_{f2}^2} + \frac{1}{S_{f3}^2} + \frac{1}{S_{f4}^2} + \frac{1}{S_{f5}^2} + \frac{1}{S_{f6}^2} + \frac{1}{S_{f7}^2} + \frac{1}{S_{f8}^2} + \frac{1}{S_{f9}^2}\right)^{1/2}} \\
 &= \frac{1}{\sqrt{\frac{1}{(0,0822)^2} + \frac{1}{(0,2872)^2} + \frac{1}{(0,2964)^2} + \frac{1}{(0,6422)^2} + \frac{1}{(0,5264)^2} + \frac{1}{(1,0032)^2} + \frac{1}{(0,7579)^2} + \frac{1}{(0,8739)^2} + \frac{1}{(0,9899)^2}}} \\
 &= \frac{1}{(133,9889842)^{1/2}} \\
 &= \frac{1}{11,575} \\
 &= 0,0864 \text{ Hz}
 \end{aligned}$$

$$\begin{aligned}
 6. \quad \bar{f} &= \frac{\frac{f_1}{S_{f1}^2} + \frac{f_2}{S_{f2}^2} + \frac{f_3}{S_{f3}^2} + \frac{f_4}{S_{f4}^2} + \frac{f_5}{S_{f5}^2} + \frac{f_6}{S_{f6}^2} + \frac{f_7}{S_{f7}^2} + \frac{f_8}{S_{f8}^2} + \frac{f_9}{S_{f9}^2}}{\frac{1}{S_{f1}^2} + \frac{1}{S_{f2}^2} + \frac{1}{S_{f3}^2} + \frac{1}{S_{f4}^2} + \frac{1}{S_{f5}^2} + \frac{1}{S_{f6}^2} + \frac{1}{S_{f7}^2} + \frac{1}{S_{f8}^2} + \frac{1}{S_{f9}^2}}
 \end{aligned}$$

$$= \frac{1}{(133,9889842)^{1/2}}$$

$$= \frac{1}{11,575}$$

$$= 0,0864 \text{ Hz}$$

$$7. \quad \bar{f} = \frac{\frac{f_1}{S_{f1}^2} + \frac{f_2}{S_{f2}^2} + \frac{f_3}{S_{f3}^2} + \frac{f_4}{S_{f4}^2} + \frac{f_5}{S_{f5}^2} + \frac{f_6}{S_{f6}^2} + \frac{f_7}{S_{f7}^2} + \frac{f_8}{S_{f8}^2} + \frac{f_9}{S_{f9}^2}}{\frac{1}{S_{f1}^2} + \frac{1}{S_{f2}^2} + \frac{1}{S_{f3}^2} + \frac{1}{S_{f4}^2} + \frac{1}{S_{f5}^2} + \frac{1}{S_{f6}^2} + \frac{1}{S_{f7}^2} + \frac{1}{S_{f8}^2} + \frac{1}{S_{f9}^2}}$$

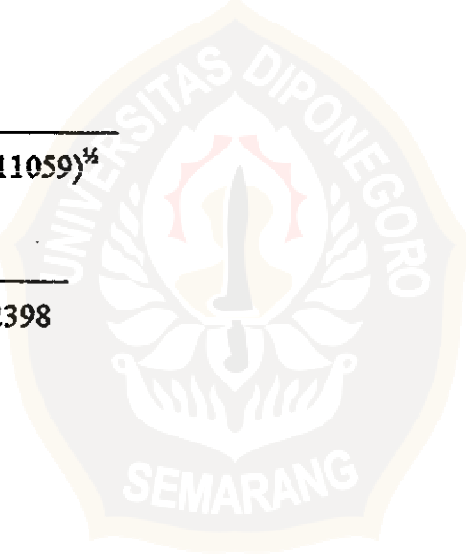
$$= \frac{\frac{4250,0000}{(0,0801)^2} + \frac{5666,6667}{(0,3182)^2} + \frac{4250,0000}{(0,2886)^2} + \frac{5666,6667}{(0,4000)^2} + \frac{4250,0000}{(0,5126)^2} + \frac{4250,0000}{(0,6252)^2} + \frac{5666,6667}{(1,3121)^2} + \frac{4250,0000}{(0,8510)^2} + \frac{4250,0000}{(0,9640)^2}}{\frac{1}{(0,0801)^2} + \frac{1}{(0,3182)^2} + \frac{1}{(0,2886)^2} + \frac{1}{(0,4000)^2} + \frac{1}{(0,5126)^2} + \frac{1}{(0,6252)^2} + \frac{1}{(1,3121)^2} + \frac{1}{(0,8510)^2} + \frac{1}{(0,9640)^2}}$$

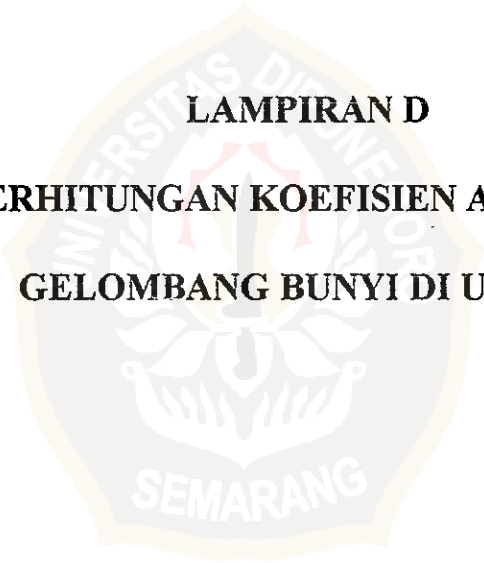
$$= \frac{846289}{193,5611059}$$

$$= 4372,2059 \text{ Hz}$$

$$\begin{aligned}
& \frac{4250,0000}{(0,1129)^2} + \frac{3400,0000}{(0,1616)^2} + \frac{4250,0000}{(0,4070)^2} + \frac{4250,0000}{(0,5645)^2} + \frac{4250,0000}{(0,7229)^2} + \\
& \frac{3400,0000}{(0,5643)^2} + \frac{4250,0000}{(1,0408)^2} + \frac{4250,0000}{(1,2000)^2} + \frac{3400,0000}{(0,8610)^2} \\
& = \frac{1}{(0,1129)^2} + \frac{1}{(0,1616)^2} + \frac{1}{(0,4070)^2} + \frac{1}{(0,5645)^2} + \frac{1}{(0,7229)^2} + \\
& \frac{1}{(0,5643)^2} + \frac{1}{(1,0408)^2} + \frac{1}{(1,2000)^2} + \frac{1}{(0,8610)^2} \\
& = \frac{532497,3122}{133,9889842} \\
& = 3974,1873 \text{ Hz} \\
S_f &= \frac{1}{\left( \frac{1}{S_1^2} + \frac{1}{S_2^2} + \frac{1}{S_3^2} + \frac{1}{S_4^2} + \frac{1}{S_5^2} + \frac{1}{S_6^2} + \frac{1}{S_7^2} + \frac{1}{S_8^2} + \frac{1}{S_9^2} \right)^{1/2}} \\
&= \frac{1}{\sqrt{\frac{1}{(0,1129)^2} + \frac{1}{(0,1616)^2} + \frac{1}{(0,4070)^2} + \frac{1}{(0,5645)^2} + \frac{1}{(0,7229)^2} + \\
& \frac{1}{(0,5643)^2} + \frac{1}{(1,0408)^2} + \frac{1}{(1,2000)^2} + \frac{1}{(0,8610)^2}}}
\end{aligned}$$

$$\begin{aligned}
S_f &= \frac{1}{\left(\frac{1}{S_{f1}^2} + \frac{1}{S_{f2}^2} + \frac{1}{S_{f3}^2} + \frac{1}{S_{f4}^2} + \frac{1}{S_{f5}^2} + \frac{1}{S_{f6}^2} + \frac{1}{S_{f7}^2} + \frac{1}{S_{f8}^2} + \frac{1}{S_{f9}^2}\right)^{1/2}} \\
&= \frac{1}{\sqrt{\frac{1}{(0,0801)^2} + \frac{1}{(0,3182)^2} + \frac{1}{(0,2886)^2} + \frac{1}{(0,4000)^2} + \frac{1}{(0,5126)^2} + \frac{1}{(0,6252)^2} + \frac{1}{(1,3121)^2} + \frac{1}{(0,8510)^2} + \frac{1}{(0,9640)^2}}} \\
&= \frac{1}{(193,5611059)^{1/2}} \\
&= \frac{1}{13,91262398} \\
&= 0,0719 \text{ Hz}
\end{aligned}$$





**LAMPIRAN D**  
**PERHITUNGAN KOEFISIEN ABSORBSI**  
**GELOMBANG BUNYI DI UDARA**

## PERHITUNGAN KOEFISIEN ABSORBSI GELOMBANG BUNYI DI UDARA

### 1. Untuk Frekuensi Bunyi = 1909,4293 Hz

Dengan rumus

$$\alpha = \frac{1}{r C} \sqrt{\frac{\eta_c 2 \pi f}{2 \rho_o}}$$

Diketahui :  $C = 340 \text{ m/dt}$

$$r = 0,0145 \text{ m}$$

$$\eta_c = 0,000181 \text{ Pa.s}$$

$$\rho_o = 1,21 \text{ kg/m}^3$$

$$\begin{aligned} \alpha &= \frac{1}{0,0145 \cdot 340} \sqrt{\frac{0,000181 \cdot 2 \cdot 3,14 \cdot 1909,4293}{2 \cdot 1,21}} \\ &= \frac{1}{4,93} \sqrt{\frac{2,17041}{2,42}} \\ &= \frac{1}{4,93} \cdot 0,9470 \\ &= 0,1921 / \text{m} \end{aligned}$$

Perhitungan ralatnya

$$\frac{\Delta \alpha}{\Delta r} = - \frac{1}{r^2 C} \sqrt{\frac{\eta_c 2 \pi f}{2 \rho_o}}$$

$$\begin{aligned}
 &= - \frac{1}{(0,0145)^2 \cdot 340} \sqrt{\frac{0,000181 \cdot 2 \cdot 3,14 \cdot 1909,4293}{2 \cdot 1,21}} \\
 &= - \frac{1}{0,07148} \sqrt{\frac{2,1704}{2,42}} \\
 &= - \frac{1}{0,07148} \sqrt{0,8969} \\
 &= - 13,9899 \cdot 0,9470 \\
 &= - 13,2488
 \end{aligned}$$

$S_r = \frac{1}{2}$  skala terkecil

$$= \frac{1}{2} \cdot 0,05$$

$$= 0,025 \text{ mm} = 0,000025 \text{ m}$$

$$\begin{aligned}
 \frac{\Delta \alpha}{\Delta f} &= \frac{1}{r C} \sqrt{\frac{\eta_e \pi}{4 \rho_o f}} \\
 &= \frac{1}{0,0145 \cdot 340} \sqrt{\frac{0,000181 \cdot 3,14}{4 \cdot 1,21 \cdot 1909,4293}} \\
 &= \frac{1}{4,93} \sqrt{\frac{0,0025}{9241,636}} \\
 &= 0,2028 \cdot 0,0005 \\
 &= 0,0001
 \end{aligned}$$

$$S_f = 0,0786 \text{ Hz}$$

$$\text{Jadi } S_\alpha = \sqrt{\left(\frac{\Delta \alpha}{\Delta r} \cdot S_r\right)^2 + \left(\frac{\Delta \alpha}{\Delta f} \cdot S_f\right)^2}$$

$$\begin{aligned}
 &= \sqrt{(13,2488 \cdot 0,000025)^2 + (0,0001 \cdot 0,0786)^2} \\
 &= \sqrt{0,0000001 + 0,0000000006} \\
 &= \sqrt{0,0000001} \\
 &= 0,0003 /m
 \end{aligned}$$

Ralat Nisbi :

$$\frac{S_{\alpha}}{\alpha} \times 100\% = \frac{0,0003}{0,1921} \times 100\% = 0,1562\%$$

$$\begin{aligned}
 \text{Dengan keseksamaan} &= (100 - 0,1562) \% \\
 &= 99,8438 \%
 \end{aligned}$$

## 2. Untuk Frekuensi Bunyi = 2434,9654 Hz

Dengan rumus

$$\begin{aligned}
 \alpha &= \frac{1}{r C} \sqrt{\frac{\eta_e 2 \pi f}{2 \rho_0}} \\
 \alpha &= \frac{1}{4,93} \sqrt{\frac{0,000181 \cdot 2 \cdot 3,14 \cdot 2434,9654}{2 \cdot 1,21}} \\
 &= 0,2028 \sqrt{\frac{2,7678}{2,42}} \\
 &= 0,2028 \cdot 1,0694 \\
 &= 0,2169 /m
 \end{aligned}$$



Perhitungan ralatnya

$$\begin{aligned}
 \frac{\Delta \alpha}{\Delta r} &= - \frac{1}{r^2 C} \sqrt{\frac{\eta_e 2 \pi f}{2 \rho_o}} \\
 &= - \frac{1}{0,07148} \sqrt{\frac{0,000181 \cdot 2 \cdot 3,14 \cdot 2434,9654}{2 \cdot 1,21}} \\
 &= - \frac{1}{0,07148} \sqrt{\frac{2,7678}{2,42}} \\
 &= - 13,9899 \cdot 1,0694 \\
 &= - 14,9614
 \end{aligned}$$

$S_r = \frac{1}{2}$  skala terkecil

$$\begin{aligned}
 &= \frac{1}{2} \cdot 0,05 \\
 &= 0,025 \text{ mm} \\
 &= 0,000025 \text{ m}
 \end{aligned}$$

$$\begin{aligned}
 \frac{\Delta \alpha}{\Delta f} &= \frac{1}{r C} \sqrt{\frac{\eta_e \pi}{4 \rho_o f}} \\
 &= \frac{1}{4,93} \sqrt{\frac{0,0025}{11785,2325}} \\
 &= 0,2028 \cdot 0,0005 \\
 &= 0,00009
 \end{aligned}$$

$S_f = 0,0807 \text{ Hz}$

$$\text{Jadi } S_\alpha = \sqrt{\left(\frac{\Delta \alpha}{\Delta r} \cdot S_r\right)^2 + \left(\frac{\Delta \alpha}{\Delta f} \cdot S_f\right)^2}$$

$$\begin{aligned}
 &= \sqrt{(14,9614 \cdot 0,000025)^2 + (0,00009 \cdot 0,0807)^2} \\
 &= \sqrt{0,0000001 + 0,00000000005} \\
 &= \sqrt{0,0000001} \\
 &= 0,0003 \text{ /m}
 \end{aligned}$$

Ralat Nisbi :

$$\frac{S_{\alpha}}{\alpha} \times 100\% = \frac{0,0003}{0,2169} \times 100\% = 0,1458\%$$

$$\begin{aligned}
 \text{Dengan keseksamaan} &= (100 - 0,1458) \% \\
 &= 99,8542 \%
 \end{aligned}$$

### 3. Untuk Frekuensi Bunyi = 2920,0246 Hz

Dengan rumus

$$\begin{aligned}
 \alpha &= \frac{1}{r C} \sqrt{\frac{\eta_e 2 \pi f}{2 \rho_o}} \\
 \alpha &= \frac{1}{4,93} \sqrt{\frac{0,000181 \cdot 2 \cdot 3,14 \cdot 2920,0246}{2 \cdot 1,21}} \\
 &= 0,2028 \sqrt{\frac{3,3191}{2,42}} \\
 &= 0,2028 \sqrt{1,3715} \\
 &= 0,2028 \cdot 1,1711 \\
 &= 0,2375 \text{ /m}
 \end{aligned}$$

Perhitungan ralatnya

$$\begin{aligned}
 \frac{\Delta \alpha}{\Delta r} &= - \frac{1}{r^2 C} \sqrt{\frac{\eta_e 2 \pi f}{2 \rho_o}} \\
 &= - \frac{1}{0,0718} \sqrt{\frac{0,000181 \cdot 2 \cdot 3,14 \cdot 2920,0246}{2 \cdot 1,21}} \\
 &= - 13,9899 \sqrt{\frac{3,3191}{2,42}} \\
 &= - 13,9899 \sqrt{1,3715} \\
 &= - 13,9899 \cdot 1,1711 \\
 &= - 16,3837
 \end{aligned}$$

$S_r = \frac{1}{2}$  skala terkecil

$$= \frac{1}{2} \cdot 0,05$$

$$= 0,025 \text{ mm} = 0,000025 \text{ m}$$

$$\begin{aligned}
 \frac{\Delta \alpha}{\Delta f} &= \frac{1}{r C} \sqrt{\frac{\eta_e \pi}{4 \rho_o f}} \\
 &= \frac{1}{4,93} \sqrt{\frac{0,0025}{14132,9191}} \\
 &= 0,2028 \cdot 0,0004 \\
 &= 0,00008
 \end{aligned}$$

$$S_f = 0,0761 \text{ Hz}$$

$$\text{Jadi } S_\alpha = \sqrt{\left(\frac{\Delta \alpha}{\Delta r} \cdot S_r\right)^2 + \left(\frac{\Delta \alpha}{\Delta f} \cdot S_f\right)^2}$$

$$\begin{aligned}
 &= \sqrt{(-16,3837 \cdot 0,000025)^2 + (0,00008 \cdot 0,0761)^2} \\
 &= \sqrt{0,00000017 + 0,00000000004} \\
 &= \sqrt{0,0000002} \\
 &= 0,0004 /m
 \end{aligned}$$

Ralat Nisbi :

$$\frac{S_{\alpha}}{\alpha} \times 100\% = \frac{0,0004}{0,2375} \times 100\% = 0,1684\%$$

$$\begin{aligned}
 \text{Dengan keseksamaan} &= (100 - 0,1684) \% \\
 &= 99,8316 \%
 \end{aligned}$$

#### 4. Untuk Frekuensi Bunyi = 3404,1116 Hz

Dengan rumus

$$\begin{aligned}
 \alpha &= \frac{1}{r C} \sqrt{\frac{\eta_c \cdot 2 \pi f}{2 \rho_o}} \\
 \alpha &= \frac{1}{4,93} \sqrt{\frac{0,000181 \cdot 2 \cdot 3,14 \cdot 3404,1116}{2 \cdot 1,21}} \\
 &= 0,2028 \sqrt{\frac{3,8694}{2,42}} \\
 &= 0,2028 \cdot 1,2645 \\
 &= 0,2564 /m
 \end{aligned}$$

Perhitungan ralatnya

$$\begin{aligned}
 \frac{\Delta \alpha}{\Delta r} &= - \frac{1}{r^2 C} \sqrt{\frac{\eta_c 2 \pi f}{2 \rho_o}} \\
 &= - \frac{1}{0,07148} \sqrt{\frac{0,000181 \cdot 2 \cdot 3,14 \cdot 3404,1116}{2 \cdot 1,21}} \\
 &= - \frac{1}{0,07148} \sqrt{\frac{3,8694}{2,42}} \\
 &= - 13,9899 \cdot 1,2645 \\
 &= - 17,6900
 \end{aligned}$$

$S_r = \frac{1}{2}$  skala terkecil

$$= \frac{1}{2} \cdot 0,05$$

$$= 0,025 \text{ mm} = 0,000025 \text{ m}$$

$$\begin{aligned}
 \frac{\Delta \alpha}{\Delta f} &= \frac{1}{r C} \sqrt{\frac{\eta_c \pi}{4 \rho_o f}} \\
 &= \frac{1}{4,93} \sqrt{\frac{0,0025}{16475,9001}} \\
 &= 0,2028 \cdot 0,0004 \\
 &= 0,00008
 \end{aligned}$$

$S_f = 0,0805 \text{ Hz}$

$$\begin{aligned}
 \text{Jadi } S_\alpha &= \sqrt{\left(\frac{\Delta \alpha}{\Delta r} \cdot S_r\right)^2 + \left(\frac{\Delta \alpha}{\Delta f} \cdot S_f\right)^2} \\
 &= \sqrt{(-17,6900 \cdot 0,000025)^2 + (0,00008 \cdot 0,0805)^2}
 \end{aligned}$$

$$\begin{aligned}
 &= \sqrt{0,0000002 + 0,00000000004} \\
 &= \sqrt{0,0000002} \\
 &= 0,0004 \text{ /m}
 \end{aligned}$$

Ralat Nisbi :

$$\frac{S_{\alpha}}{\alpha} \times 100\% = \frac{0,0004}{0,2564} \times 100\% = 0,1744\%$$

$$\begin{aligned}
 \text{Dengan keseksamaan} &= (100 - 0,1744) \% \\
 &= 99,8256 \%
 \end{aligned}$$

#### 5. Untuk Frekuensi Bunyi = 3476,6896 Hz

Dengan rumus

$$\begin{aligned}
 \alpha &= \frac{1}{r C} \sqrt{\frac{\eta_c 2 \pi f}{2 \rho_o}} \\
 \alpha &= \frac{1}{4,93} \sqrt{\frac{0,000181 \cdot 2 \cdot 3,14 \cdot 3476,6896}{2 \cdot 1,21}} \\
 &= 0,2028 \sqrt{\frac{3,9519}{2,42}} \\
 &= 0,2028 \cdot 1,2779 \\
 &= 0,2592 \text{ /m}
 \end{aligned}$$

Perhitungan ralatnya

$$\frac{\Delta \alpha}{\Delta r} = \frac{1}{r^2 C} \sqrt{\frac{\eta_c 2 \pi f}{2 \rho_o}}$$

$$\begin{aligned}
 &= - \frac{1}{0,07148} \sqrt{\frac{0,000181 \cdot 2 \cdot 3,14 \cdot 3476,6896}{2 \cdot 1,21}} \\
 &= - \frac{1}{0,07148} \sqrt{\frac{3,9519}{2,42}} \\
 &= - 13,9899 \cdot 1,2779 \\
 &= - 17,8764
 \end{aligned}$$

$S_r = \frac{1}{2}$  skala terkecil

$$= \frac{1}{2} \cdot 0,05$$

$$= 0,025 \text{ mm} = 0,000025 \text{ m}$$

$$\begin{aligned}
 \frac{\Delta \alpha}{\Delta f} &= \frac{1}{r C} \sqrt{\frac{\eta_e \pi}{4 \rho_a f}} \\
 &= \frac{1}{4,93} \sqrt{\frac{0,0025}{16827,1777}} \\
 &= 0,2028 \cdot 0,0004 \\
 &= 0,00008
 \end{aligned}$$

$$S_f = 0,0740 \text{ Hz}$$

$$\begin{aligned}
 \text{Jadi } S_\alpha &= \sqrt{\left(\frac{\Delta \alpha}{\Delta r} \cdot S_r\right)^2 + \left(\frac{\Delta \alpha}{\Delta f} \cdot S_f\right)^2} \\
 &= \sqrt{(-17,8764 \cdot 0,000025)^2 + (0,00008 \cdot 0,0740)^2} \\
 &= \sqrt{0,0000002 + 0,0000000004} \\
 &= \sqrt{0,0000002} \\
 &= 0,0004 \text{ /m}
 \end{aligned}$$

Ralat Nisbi :

$$\frac{S_{\alpha}}{\alpha} \times 100\% = \frac{0,0004}{0,2542} \times 100\% = 0,1726\%$$

$$\begin{aligned} \text{Dengan keseksamaan} &= (100 - 0,1726) \% \\ &= 99,8274 \% \end{aligned}$$

#### 6. Untuk Frekuensi Bunyi = 3974,1873 Hz

Dengan rumus

$$\begin{aligned} \alpha &= \frac{1}{r C} \sqrt{\frac{\eta_e 2 \pi f}{2 \rho_o}} \\ \alpha &= \frac{1}{4,93} \sqrt{\frac{0,000181 \cdot 2 \cdot 3,14 \cdot 3974,1873}{2 \cdot 1,21}} \\ &= 0,2028 \sqrt{\frac{4,5174}{2,42}} \\ &= 0,2028 \cdot 1,3663 \\ &= 0,2771 / \text{m} \end{aligned}$$

Perhitungan ralatnya

$$\begin{aligned} \frac{\Delta \alpha}{\Delta r} &= \frac{1}{r^2 C} \sqrt{\frac{\eta_e 2 \pi f}{2 \rho_o}} \\ &= \frac{1}{0,07148} \sqrt{\frac{0,000181 \cdot 2 \cdot 3,14 \cdot 3974,1873}{2 \cdot 1,21}} \end{aligned}$$



$$\begin{aligned}
 &= -13,989 \sqrt{\frac{4,5174}{2,42}} \\
 &= -13,9899 \cdot 1,3663 \\
 &= -19,1139
 \end{aligned}$$

$S_r = \frac{1}{2}$  skala terkecil

$$= \frac{1}{2} \cdot 0,05$$

$$= 0,025 \text{ mm}$$

$$= 0,000025 \text{ m}$$

$$\begin{aligned}
 \frac{\Delta \alpha}{\Delta f} &= \frac{1}{r C} \sqrt{\frac{\eta_e \pi}{4 \rho_o f}} \\
 &= \frac{1}{4,93} \sqrt{\frac{0,0025}{19235,0665}} \\
 &= 0,2028 \cdot 0,0000001 \\
 &= 0,00000003
 \end{aligned}$$

$$S_f = 0,0864 \text{ Hz}$$

$$\begin{aligned}
 \text{Jadi } S_x &= \sqrt{\left(\frac{\Delta \alpha}{\Delta r} \cdot S_r\right)^2 + \left(\frac{\Delta \alpha}{\Delta f} \cdot S_f\right)^2} \\
 &= \sqrt{(-19,1139 \cdot 0,000025)^2 + (0,00000003 \cdot 0,0864)^2} \\
 &= \sqrt{0,0000002 + 0,000000003} \\
 &= \sqrt{0,0000002} \\
 &= 0,0005 / \text{m}
 \end{aligned}$$

Ralat Nisbi :

$$\frac{S_{\alpha}}{\alpha} \times 100\% = \frac{0,0005}{0,2771} \times 100\% = 0,1624\%$$

$$\begin{aligned} \text{Dengan keseksamaan} &= (100 - 0,1624) \% \\ &= 99,8376 \% \end{aligned}$$

### 7. Untuk Frekuensi Bunyi = 4372,2059 Hz

Dengan rumus

$$\begin{aligned} \alpha &= \frac{1}{r C} \sqrt{\frac{\eta_c 2 \pi f}{2 \rho_o}} \\ \alpha &= \frac{1}{4,93} \sqrt{\frac{0,000181 \cdot 2 \cdot 3,14 \cdot 4372,2059}{2 \cdot 1,21}} \\ &= 0,2028 \sqrt{\frac{4,9698}{2,42}} \\ &= 0,2028 \cdot 1,4331 \\ &= 0,2906 /m \end{aligned}$$

Perhitungan ralatnya

$$\begin{aligned} \frac{\Delta \alpha}{\Delta r} &= \frac{1}{r^2 C} \sqrt{\frac{\eta_c 2 \pi f}{2 \rho_o}} \\ &= \frac{1}{0,07148} \sqrt{\frac{0,000181 \cdot 2 \cdot 3,14 \cdot 4372,2059}{2 \cdot 1,21}} \end{aligned}$$

$$\begin{aligned}
 &= -13,989 \sqrt{\frac{4,9698}{2,42}} \\
 &= -13,9899 \cdot 1,4331 \\
 &= -20,0476
 \end{aligned}$$

$S_r = \frac{1}{2}$  skala terkecil

$$= \frac{1}{2} \cdot 0,05$$

$$= 0,025 \text{ mm}$$

$$= 0,000025 \text{ m}$$

$$\begin{aligned}
 \frac{\Delta \alpha}{\Delta f} &= \frac{1}{r C} \sqrt{\frac{\eta_e \pi}{4 \rho_o f}} \\
 &= \frac{1}{4,93} \sqrt{\frac{0,0025}{21161,4766}} \\
 &= 0,2028 \cdot 0,0003 \\
 &= 0,00007
 \end{aligned}$$

$$S_f = 0,0719 \text{ Hz}$$

$$\begin{aligned}
 \text{Jadi } S_x &= \sqrt{\left(\frac{\Delta \alpha}{\Delta r} \cdot S_r\right)^2 + \left(\frac{\Delta \alpha}{\Delta f} \cdot S_f\right)^2} \\
 &= \sqrt{(-20,0476 \cdot 0,000025)^2 + (0,00007 \cdot 0,0719)^2} \\
 &= \sqrt{0,00000002 + 0,0000000003} \\
 &= \sqrt{0,00000002} \\
 &= 0,0004 \text{ /m}
 \end{aligned}$$

Ralat Nisbi :

$$\frac{S_{\alpha}}{\alpha} \times 100\% = \frac{0,0004}{0,0719} \times 100\% = 0,6220\%$$

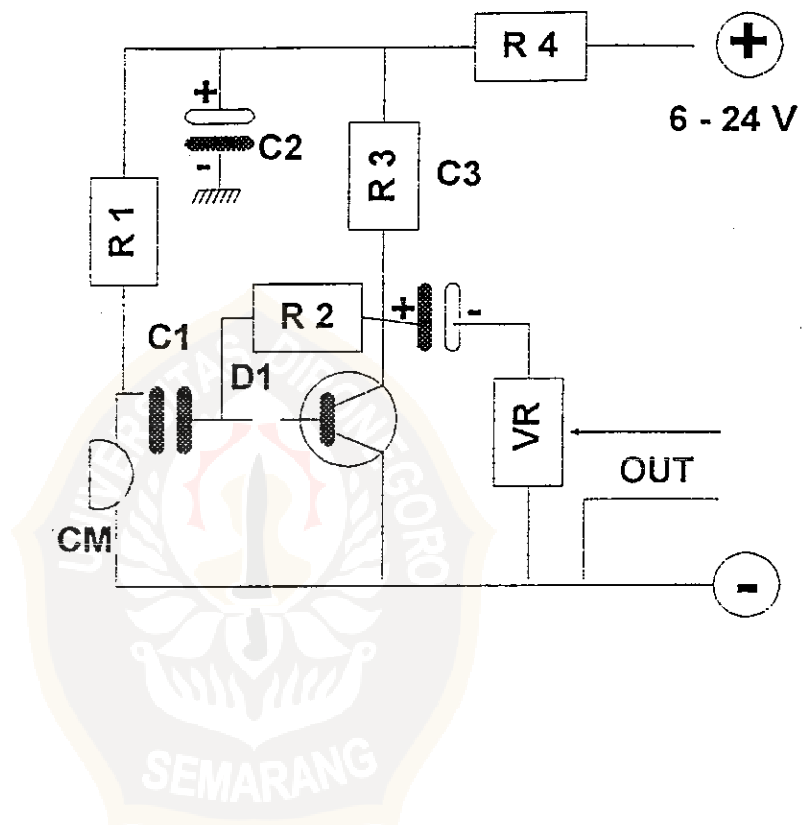
$$\begin{aligned} \text{Dengan keaksamaan} &= (100 - 0,6220) \% \\ &= 99,3780 \% \end{aligned}$$



**LAMPIRAN E**  
**RANGKAIAN PRE - AMPLIFIER MIC**



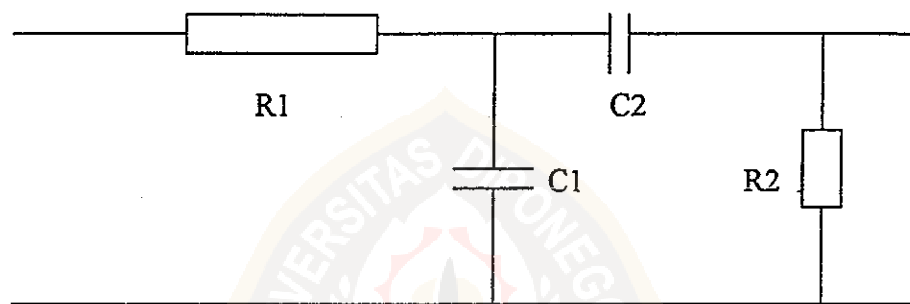
R1 ..... 10 K  
 R2 ..... 220 K  
 R3 ..... 5K6  
 R4 ..... 560  
 VR ..... 10K  
 C1 ..... 100nF  
 C2 ..... 47uF  
 Q ..... C828  
 CM ..... Con mic  
 ROBO RB.051



Rangkaian Pre - Amplifier Mic

**LAMPIRAN F**  
**RANGKAIAN BAND PASS FILTER**





Rangkaian Band Pass Filter

$$C1 = 474 \text{ K}$$

$$R1 = 170 \text{ Ohm}$$

$$C2 = 474 \text{ K}$$

$$R2 = 70 \text{ Ohm}$$



**LAMPIRAN G**  
**FOTO RANGKAIAN PERALATAN**





Foto Rangkaian Peralatan