LAMPIRAN A

DATA PENGUKURAN

Tabel A-1. karakteristik penguatan op-amp 741 terhadap frekuensi.

Vin = 2 Volt

Frekuensi (Hz)	V_{out} (Volt)	log f	A
1	0,3	0	0,15
2	0,6	0,3	0,3
4	1,0	0,6	0,5
6	1,3	0,78	0,65
8	1,5	0,9	0,75
10	1,6	1	0,8
20	1,9	1,3	0,95
40	2,0	1,6	1
100	2,0	2	1
1K	2,0	3	1
20K	2,0	4,3	1
40K	2,0	4,6	1
60K	2,0	4,78	1
80K	2,0	4,9	1
100K	1,9	5	0,95
200K	1,1	5,3	0,55
400K	0,9	5,6	0,45
600K	0,6	5,78	0,3
800K	0,5	5,9	0,25
1M	0,5	6	0,25

Tabel A-2. Hasil Pengujian Rangkaian Penjumlah (*Adder*)

No	Vin (mV)	Vout (mV)	Vin (mV)	Vout (mV)	Vin (V)	Vout (V)
1	25,00	75,0	100,0	299,5	1,000	3,000
2		75,2		299,0		3,000
3		75,2		299,0		2,995
4		75,0		299,5		3,000
5		75,2		300,0		3,000
6		75,0		299,5		2,995
7		75,2		299,0		2,995
8		75,2		300,0		3,000
9		75,2		300,0		3,000
10		75,0		299,5		3,000
$\overline{V}$		$(75,12 \pm 0,03)$		$(299,50 \pm 0,13)$		$(2,9985 \pm 0,0008)$

Tabel A-3. Hasil pengujian rangkaian PID dengan masukan sinus

$e(t) = 60.10^{-3} \sin 10^3 \pi t$

Vpp input = 120 mV

Vout = Vpp (mV)	Δt (ms)
357	0,340
356	0,340
356	0,352
356	0,338
358	0,340
358	0,342
357	0,350
358	0,346
359	0,348
356	0,344

Vpp output = (357,1 ± 0,34) mV Δt = (0,344 ± 0,001) ms

Vp output = ½ Vpp output = (178,55 ± 0,17) mV

Sudut fase = 360° x (Δt/t) = (61,92 ± 0,18)°

Tabel A-4. Hasil pengujian rangkaian PID dengan masukan segitiga

$e(t) = 120t$.

Vpp input = 120 mV

P (mV)	I (mV)	D (mV)	PID (mV)
120,4	29,80	239,5	358,0
120,4	29,85	239,0	358,0
120,2	29,75	240,0	360,0
120,0	29,95	239,0	358,0
120,2	29,80	240,0	362,0
120,6	29,90	239,5	360,0
120,4	29,80	239,5	362,0
120,2	29,80	240,0	358,0
120,2	29,90	239,5	362,0
120,2	29,80	239,5	362,0
(120,28 ± 0,06)	(29,84 ± 0,02)	(239,56 ± 0,12)	(360,00 ± 0,14)

Tabel A-5. Hasil pengujian rangkaian PID dengan masukan kotak

e(t) = 60 mV.

Vpp input = 120 mV

P (mV)	I (mV)	D (V)
120,0	60,0	4,00
120,0	60,4	4,00
119,8	61,2	3,98
119,8	60,8	3,99
120,2	61,4	3,99
121,0	60,8	3,97
120,4	60,0	4,01
120,8	60,6	3,98
120,6	60,4	3,99
120,6	60,8	4,00
(120,32 ± 0,14)	(60,64 ± 0,14)	(3,990 ± 0,004)

Tabel A-6. Perbandingan antara Teori, Praktek dan Program EWB.

a. Masukan sinus $e(t) = 60.10^{-3} \sin 10^3 \pi t$, diperoleh keluaran :

keluaran	u(t)
teori	$179{,}62.10^{-3} \sin(10^3\pi t+70{,}5^\circ)$
osiloskop	$(178{,}55 \pm 0{,}17) \sin\{10^3\pi t+(61{,}92 \pm 0{,}18)^\circ\}$
EWB	$189{,}74 \sin(10^3\pi t+63^\circ)$

b. Masukan segitiga $e(t) = 120t$, diperoleh keluaran :

keluaran	u(t) (mV)
teori	195
osiloskop	$180{,}0 \pm 0{,}07$
EWB	172,33

c. kotak $e(t) = 60$ mV, diperoleh keluaran :

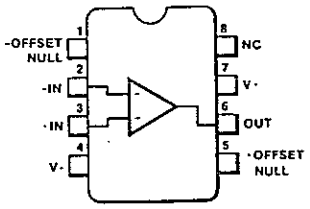
keluaran	u(t)		
	P (mV)	I (mV)	D
teori	60	30	Impuls
osiloskop	$(60{,}16 \pm 0{,}07)$	$(30{,}32 \pm 0{,}07)$	Impuls
EWB	60	29,69	Impuls

LAMPIRAN B

DATA SHEET KOMPONEN

Spesifikasi Op-amp 741

Diagram Kaki



Description
The μA741 is a high performance Monolithic Operational Amplifier constructed using the Fairchild Planar epitaxial process. It is intended for a wide range of analog applications. High common mode voltage range and absence of latch-up tendencies make the μA741 ideal for use as a voltage follower. The high gain and wide range of operating voltage provides superior performance in integrator, summing amplifier, and general feedback applications.

- **NO FREQUENCY COMPENSATION REQUIRED**
- **SHORT-CIRCUIT PROTECTION**
- **OFFSET VOLTAGE NULL CAPABILITY**
- **LARGE COMMON MODE AND DIFFERENTIAL VOLTAGE RANGES**
- **LOW POWER CONSUMPTION**
- **NO LATCH-UP**

Absolute Maximum Ratings

Supply Voltage	
μA741A, μA741, μA741E	±22 V
μA741C	±18 V
Internal Power Dissipation (Note 1)	
Metal Package	500 MW
DIP	310 mW
Flatpak	570 mW
Differential Input Voltage	±30 V
Input Voltage (Note 2)	±15 V
Storage Temperature Range	
Metal Package and Flatpak	−65°C to +150°C
DIP	−55°C to +125°C
Operating Temperature Range	
Military (μA741A, μA741)	−55°C to +125°C
Commercial (μA741E, μA741C)	0°C to +70°C
Pin Temperature (Soldering 60 s)	
Metal Package, Flatpak, and Ceramic DIP	300°C
Molded DIP (10 s)	260°C
Output Short Circuit Duration (Note 3)	Indefinite

Karakteristik Elektrik

μA741 and μA741C
Electrical Characteristics $V_S = \pm 15$ V, $T_A = 25°C$ unless otherwise specified

Characteristic		Condition	μA741			μA741C			Unit
			Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage		$R_S \leq 10$ kΩ		1.0	5.0		2.0	6.0	mV
Input Offset Current				20	200		20	200	nA
Input Bias Current				80	500		80	500	nA
Power Supply Rejection Ratio		$V_S = +10, -20$ $V_S = +20, -10$ V, $R_S = 50\ \Omega$		30	150		30	150	μV/V
Input Resistance			.3	2.0		.3	2.0		MΩ
Input Capacitance				1.4			1.4		pF
Offset Voltage Adjustment Range				± 15			± 15		mV
Input Voltage Range						± 12	± 13		V
Common Mode Rejection Ratio		$R_S \leq 10$ kΩ				70	90		dB
Output Short Circuit Current				25			25		mA
Large Signal Voltage Gain		$R_L \geq 2$ kΩ, $V_{OUT} = \pm 10$ V	50k	200k		20k	200k		
Output Resistance				75			75		Ω
Output Voltage Swing		$R_L \geq 10$ kΩ				± 12	± 14		V
		$R_L \geq 2$ kΩ				± 10	± 13		V
Supply Current				1.7	2.8		1.7	2.8	mA
Power Consumption				50	85		50	85	mW
Transient Response (Unity Gain)	Rise Time	$V_{IN} = 20$ mV, $R_L = 2$ kΩ, $C_L \leq 100$ pF		.3			.3		μs
	Overshoot			5.0			5.0		%
Bandwidth (Note 4)				1.0			1.0		MHz
Slew Rate		$R_L \geq 2$ kΩ		.5			.5		V/μs

Notes
4. Calculated value from $BW(MHz) = \frac{0.35}{\text{Rise Time } (\mu s)}$
5. All $V_{CC} = 15$ V for μA741 and μA741C.
6. Maximum supply current for all devices
   25°C = 2.8 mA
   125°C = 2.5 mA
   −55°C = 3.3 mA

Karakteristik Elektrik

μA741 and μA741C
Electrical Characteristics (Cont.) The following specifications apply over the range of $-55°C \leq T_A \leq 125°C$ for μA741, $0°C \leq T_A \leq 70°C$ for μA741C

Characteristic	Condition	μA741			μA741C			Unit
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage							7.5	mV
	$R_S \leq 10\ k\Omega$		1.0	6.0				mV
Input Offset Current							300	nA
	$T_A = +125°C$		7.0	200				nA
	$T_A = -55°C$		85	500				nA
Input Bias Current							800	nA
	$T_A = +125°C$		.03	.5				μA
	$T_A = -55°C$		.3	1.5				μA
Input Voltage Range		± 12	± 13					V
Common Mode Rejection Ratio	$R_S \leq 10\ k\Omega$	70	90					dB
Adjustment for Input Offset Voltage			± 15			± 15		mV
Supply Voltage Rejection Ratio	$V_S = +10, -20$; $V_S = +20, -10\ V$, $R_S = 50\ \Omega$		30	150				μV/V
Output Voltage Swing	$R_L \geq 10\ k\Omega$	± 12	± 14					V
	$R_L \geq 2\ k\Omega$	± 10	± 13		± 10	± 13		V
Large Signal Voltage Gain	$R_L = 2\ k\Omega$, $V_{OUT} = \pm 10\ V$	25k			15k			
Supply Current	$T_A = +125°C$		1.5	2.5				mA
	$T_A = -55°C$		2.0	3.3				mA
Power Consumption	$T_A = +125°C$		45	75				mW
	$T_A = -55°C$		60	100				mW

Notes
4. Calculated value from $BW(MHz) = \frac{0.35}{\text{Rise Time } (\mu s)}$
5. All $V_{CC} = 15\ V$ for μA741 and μA741C.
6. Maximum supply current for all devices
   25°C = 2.8 mA
   125°C = 2.5 mA
   −55°C = 3.3 mA