

# LAMPIRAN



## Lampiran 1

Tabel. Seleksi Rancangan Faktorial Fraksional  $2^{k-p}$ 

Jumlah Faktor (k)	Pecahan	Jumlah Amatan	Pembangkit Rancangan (p)
3	$2_{III}^{3-1}$	4	$C = \pm AB$
4	$2_{IV}^{4-1}$	8	$D = \pm ABC$
5	$2_V^{5-1}$	16	$E = \pm ABCD$
	$2_{III}^{5-2}$	8	$D = \pm AB$ $E = \pm AC$
6	$2_{VI}^{6-1}$	32	$F = \pm ABCDE$
	$2_{IV}^{6-2}$	16	$E = \pm ABC$ $F = \pm BCD$
	$2_{III}^{6-3}$	8	$D = \pm AB$ $E = \pm AC$ $F = \pm BC$
7	$2_{VII}^{7-1}$	64	$G = \pm ABCDEF$
	$2_{IV}^{7-2}$	32	$F = \pm ABCD$ $G = \pm ABDE$
	$2_{IV}^{7-3}$	16	$E = \pm ABC$ $F = \pm BCD$ $G = \pm ACD$
	$2_{III}^{7-4}$	8	$D = \pm AB$ $E = \pm AC$ $F = \pm BC$ $G = \pm ABC$
8	$2_V^{8-2}$	64	$G = \pm ABCD$ $H = \pm ABEF$
	$2_{IV}^{8-3}$	32	$F = \pm ABC$ $G = \pm ABD$ $H = \pm BCDE$
	$2_{IV}^{8-4}$	16	$E = \pm BCD$ $F = \pm ACD$ $G = \pm ABC$ $H = \pm ABD$
9	$2_{VI}^{9-2}$	128	$H = \pm ACDFG$ $J = \pm BCEFG$
	$2_{IV}^{9-3}$	64	$G = \pm ABCD$ $H = \pm ACEF$ $J = \pm CDEF$
	$2_{IV}^{9-4}$	32	$F = \pm BCDE$ $G = \pm ACDE$

			$H = \pm ABDE$
			$J = \pm ABCE$
	$2_{III}^{9-5}$	16	$E = \pm ABC$
			$F = \pm BCD$
			$G = \pm ACD$
			$H = \pm ABD$
			$J = \pm ABCD$
10	$2_{V}^{10-3}$	128	$H = \pm ABCG$
			$J = \pm ACDE$
			$K = \pm ACDF$
	$2_{IV}^{10-4}$	64	$G = \pm BCDF$
			$H = \pm ACDF$
			$J = \pm ABDE$
			$K = \pm ABCE$
	$2_{IV}^{10-5}$	32	$F = \pm ABCD$
			$G = \pm ABCE$
			$H = \pm ABDE$
			$J = \pm ACDE$
			$K = \pm BCDE$
	$2_{III}^{10-6}$	16	$E = \pm ABC$
			$F = \pm BCD$
			$G = \pm ACD$
			$H = \pm ABD$
			$J = \pm ABCD$
			$K = \pm AB$
11	$2_{IV}^{11-5}$	64	$G = \pm CDE$
			$H = \pm ABCD$
			$J = \pm ABF$
			$K = \pm BDEF$
			$L = \pm ADEF$
	$2_{IV}^{11-6}$	32	$F = \pm ABC$
			$G = \pm BCD$
			$H = \pm CDE$
			$J = \pm ACD$
			$K = \pm ADE$
			$L = \pm BDE$
	$2_{III}^{11-7}$	16	$E = \pm ABC$
			$F = \pm BCD$
			$G = \pm ACD$
			$H = \pm ABD$
			$J = \pm ABCD$
			$K = \pm AB$
			$L = \pm AC$

Lampiran 2

Tabel. Penyusunan Blok untuk Rancangan Faktorial  $2^k$

Jumlah faktor, $k$	Jumlah Blok, $2^p$	Ukuran Blok, $2^{k-p}$	Efek yang dipilih untuk membentuk blok	Interaksi yang dibaurkan dengan blok
3	2	4	ABC	ABC
	4	2	AB, AC	AB, AC, BC
4	2	8	ABCD	ABCD
	4	4	ABC, ACD	ABC, ACD, BD
	8	2	AB, BC, CD	AB, BC, CD, AC, BD, AD, ABCD
5	2	16	ABCDE	ABCDE
	4	8	ABC, CDE	ABC, CDE, ABDE
	8	4	ABE, BCE, CDE	ABE, BCE, CDE, AC, ABCD, BD, ADE
6	16	2	AB, AC, CD, DE	Semua interaksi dua-faktor dan empat-faktor (15 efek)
	2	32	ABCDEF	ABCDEF
	4	16	ABCF, CDEF	ABCF, CDEF, ABDE
	8	8	ABEF, ABCD, ACE	ABEF, ABCD, ACE, BCF, BDE, CDEF, ADF

16	4	ABF, ACF, BDF, DEF	ABF, ACF, BDF, DEF, BC, AD, ABCD, ACDE, BE, CDF, BCDEF, ABCEF, AEF, CE
32	2	AB, BC, CD, DE, EF	Semua interaksi dua-faktor, empat-faktor dan enam factor (31 efek)
2	64	ABCDEF	ABCDEF
4	32	ABCDF, CDEFG	ABCDF, CDEFG, ABDE
8	16	ABC, DEF, AFG	ABC, DEF, AFG, ABCDEF, BCFG, ADEG, BCDEG
16	8	ABCD, EFG, CDE, ADG	ABCD, EFG, CDE, ADG, ABCDEF, ABE, BCG, CDFG, ADEF, ACEG, ABFG, BCEF, ACF, BDEG, BDF
32	4	ABG, BCG, CDG, DEG, EFG	ABG, BCG, CDG, DEG, EFG, AC, ABCD, ABDE, ABEF, BD, BCDE, BCEF, CE, CDEF, DF, ADG, ACDEG, ACEFG, ABCEG, ABCDEF, ABDFG, BEG, BDEFG, BCDFG, CFG, AE, ADEF, ACDF, ABCF, BF, AFG
64	2	AB, BC, CD, DE, EF, FG	Semua interaksi dua-faktor, empat-faktor dan enam-faktor (63 efek)

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Lampiran 3

Tabel. Alias dengan tabel min plus untuk rancangan fraksional  $2^{4-1}$  dengan I = ABCD

No. Amatan	Rancangan Dasar			D=ABC	AB	AC	AD	BC	BD	CD	ABD	ACD	BCD	I=ABCD	Kombinasi Perlakuan
	A	B	C												
1	-	-	-	-	+	+	+	+	+	+	-	-	-	+	(1)
2	+	-	-	+	-	-	+	+	-	-	-	-	+	+	ad
3	-	+	-	+	-	+	-	-	+	-	-	+	-	+	bd
4	+	+	-	-	+	-	-	-	-	+	-	+	+	+	ab
5	-	-	+	+	-	-	-	-	-	+	+	-	-	+	cd
6	+	-	+	-	-	+	-	-	+	-	+	-	+	+	ac
7	-	+	+	-	-	-	+	+	-	-	+	+	-	+	bc
8	+	+	+	+	+	+	+	+	+	+	+	+	+	+	abcd

Dengan melihat tanda min (-) dan plus (+) pada tabel diatas maka kolom :  
 A = BCD  
 B = ACD  
 C = ABD  
 D = ABC  
 AB = CD  
 AC = BD  
 AD = BC

Sehingga dapat dikatakan bahwa hubungan antara dua efek masing-masing tersebut diatas adalah saling beralias.

## Lampiran 4

Data Rancangan Faktorial Fraksional  $2^{5-1}$ 

Aperture setting	Exposure time	Development time	Mask dimension	Etch time	yield	fit	residual
A0	B0	C0	D0	E1	8	6.9375	0.78166
A1	B0	C0	D0	E0	9	10.3125	-0.96558
A0	B1	C0	D0	E0	34	33.0625	0.68970
A1	B1	C0	D0	E1	52	51.4375	0.41382
A0	B0	C1	D0	E0	16	17.1875	-0.87362
A1	B0	C1	D0	E1	22	21.3125	0.50578
A0	B1	C1	D0	E1	45	44.0625	0.68970
A1	B1	C1	D0	E0	60	61.6875	-1.24146
A0	B0	C0	D1	E0	8	5.9375	1.51734
A1	B0	C0	D1	E1	10	10.0625	-0.04598
A0	B1	C0	D1	E1	30	32.8125	-2.06910
A1	B1	C0	D1	E0	50	50.4375	-0.32186
A0	B0	C1	D1	E1	15	16.9375	-1.42538
A1	B0	C1	D1	E0	21	20.3125	0.50578
A0	B1	C1	D1	E0	44	43.0625	0.68970
A1	B1	C1	D1	E1	63	61.4375	1.14950

## Keterangan :

A0 = small

A1 = large

B0 = 20% below nominal

B1 = 20% above nominal

C0 = 30 sekon

C1 = 45 sekon

D0 = small

D1 = large

E0 = 14.5 minutes

E1 = 15.5 minutes

## Lampiran 5

### Fractional Factorial Fit: y versus A; B; C; D; E

Fractional Factorial Design

Factors: 5 Base Design: 5; 16 Resolution: V  
 Runs: 16 Replicates: 1 Fraction: 1/2  
 Blocks: none Center pts (total): 0

Design Generators: E = ABCD

Defining Relation: I = ABCDE

### Struktur Alias

I + ABCDE

A + BCDE

B + ACDE

C + ABDE

D + ABCE

E + ABCD

AB + CDE

AC + BDE

AD + BCE

AE + BCD

BC + ADE

BD + ACE

BE + ACD

CD + ABE

CE + ABD

DE + ABC

### Data Matrix

Run	A	B	C	D	E
1	-	-	-	-	+
2	+	-	-	-	-
3	-	+	-	-	-
4	+	+	-	-	+
5	-	-	+	-	-
6	+	-	+	-	+
7	-	+	+	-	+
8	+	+	+	-	-
9	-	-	-	+	-
10	+	-	-	+	+
11	-	+	-	+	+
12	+	+	-	+	-
13	-	-	+	+	+
14	+	-	+	+	-
15	-	+	+	+	-
16	+	+	+	+	+

### Estimasi Efek dan Koefisien untuk Model Y

Term	Effect	Coef.
Constant		30,4375
A	10,8750	5,4375
B	33,6250	16,8125
C	10,6250	5,3125





## (Lanjutan)

D	-0,6250	-0,3125
E	0,3750	0,1875
A*B	7,1250	3,5625
A*C	0,6250	0,3125
A*D	0,8750	0,4375
A*E	1,3750	0,6875
B*C	0,8750	0,4375
B*D	-0,3750	-0,1875
B*E	0,1250	0,0625
C*D	0,6250	0,3125
C*E	0,6250	0,3125
D*E	-1,6250	-0,8125

## Estimasi Efek dan Koefisien untuk Model Y

Term	Effect	Coef	SE Coef	T	P
Constant		30,4375	0,4531	67,18	0,000
A	10,8750	5,4375	0,4531	12,00	0,000
B	33,6250	16,8125	0,4531	37,11	0,000
C	10,6250	5,3125	0,4531	11,72	0,000
D	-0,6250	-0,3125	0,4531	-0,69	0,508
E	0,3750	0,1875	0,4531	0,41	0,689
A*B	7,1250	3,5625	0,4531	7,86	0,000

## ANOVA

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Main Effects	5	5449,31	5449,31	1089,86	331,80	0,000
2-Way Interactions	1	203,06	203,06	203,06	61,82	0,000
Residual Error	9	29,56	29,56	3,28		
Total	15	5681,94				

## Mean dan Standar Error Efek

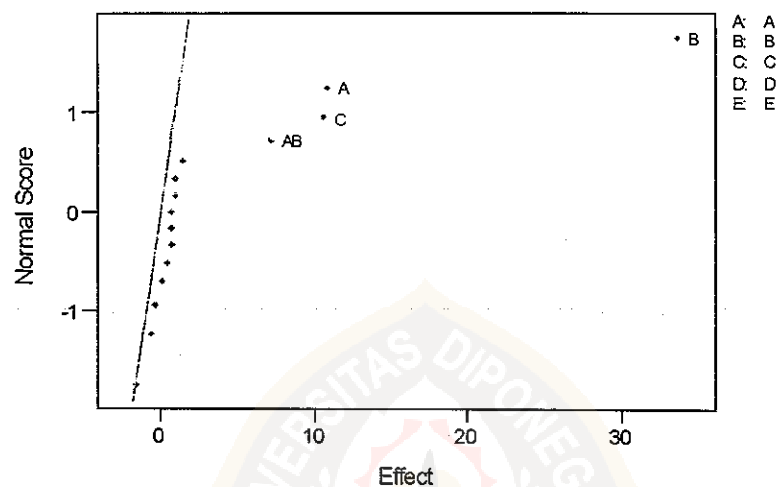
	Mean	SE Mean
A		
-1	25,00	0,6408
1	35,88	0,6408
B		
-1	13,63	0,6408
1	47,25	0,6408
C		
-1	25,13	0,6408
1	35,75	0,6408
D		
-1	30,75	0,6408
1	30,13	0,6408
E		
-1	30,25	0,6408
1	30,63	0,6408

**(Lanjutan)**

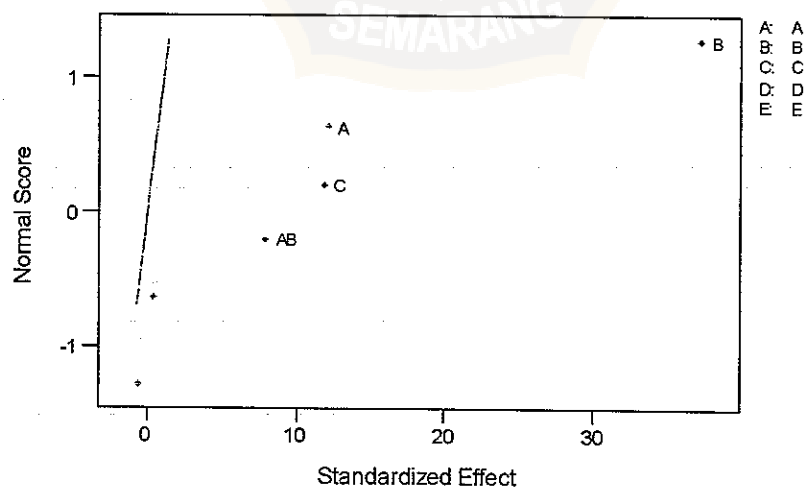
A *B			
-1	-1	11,75	0,9062
1	-1	15,50	0,9062
-1	1	38,25	0,9062
1	1	56,25	0,9062

**Normal Probability Plot of the Effects**

(response is y, Alpha = .01)

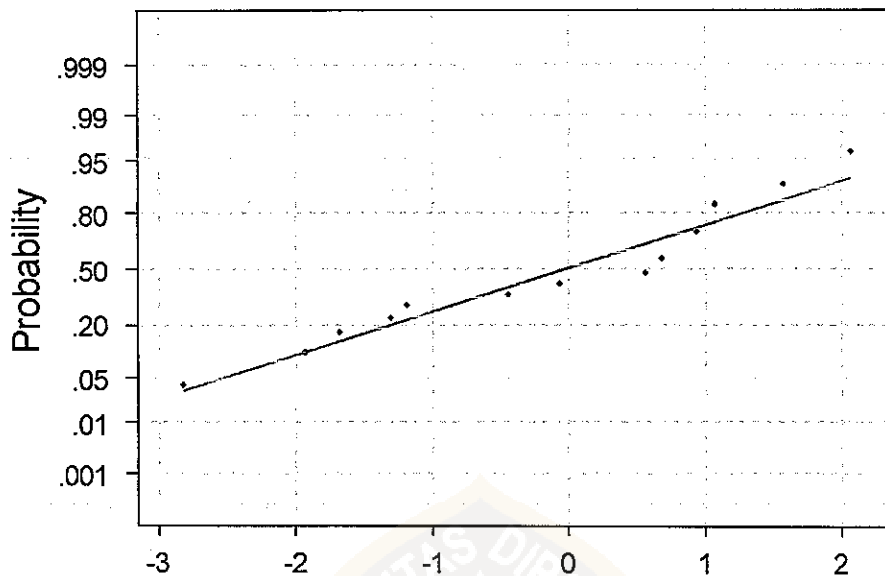
**Normal Probability Plot of the Standardized Effects**

(response is y, Alpha = .01)



(Lanjutan)

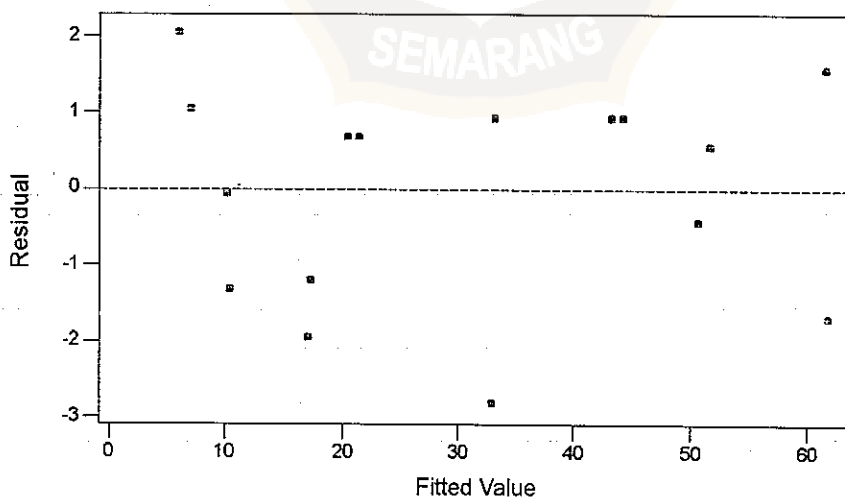
### Normal Probability Plot



Average: 0.0000000  
 StDev: 1.40386  
 N: 16

Kolmogorov-Smirnov Normality Test  
 D+: 0.114 D-: 0.218 D: 0.218  
 Approximate P-Value: 0.045

### Residuals Versus the Fitted Values (response is y)



**Lampiran 6****LISTING PROGRAM**

```

DATA FAKFRAK;
INPUT A B C D E Y;
CARDS;
-1 -1 -1 -1 1 8
 1 -1 -1 -1 -1 9
-1 1 -1 -1 -1 34
 1 1 -1 -1 1 52
-1 -1 1 -1 -1 16
 1 -1 1 -1 1 22
-1 1 1 -1 1 45
 1 1 1 -1 -1 60
-1 -1 -1 1 -1 6
 1 -1 -1 1 1 10
-1 1 -1 1 1 30
 1 1 -1 1 -1 50
-1 -1 1 1 1 15
 1 -1 1 1 -1 21
-1 -1 1 1 -1 44
 1 1 1 1 1 63
;
PROC GLM DATA=FAKFRAK;
CLASS A B C D E;
MODEL Y=A B C D E A*B;
MEANS A B C D E/DUNCAN ALPHA=0.01;
LSMEANS A*B/STDERR PDIFF;
RUN;

```

**OUTPUT PROGRAM**

1  
General Linear Models  
Class Level Information

Class	Levels	Values
A	2	1 -1
B	2	1 -1
C	2	1 -1
D	2	1 -1
E	2	1 -1

Number of observations in data set = 16

**(Lanjutan)**

The SAS System

2

## General Linear Models Procedure

Dependent Variable: Y

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	5751.8750000	958.64583333	366.17	0.0001
Error	9	23.56250000	2.61805556		
Corrected Total	15	5775.43750000			

R-Square	C.V.	Root MSE	Y Mean
0.995920	5.337866	1.61804065	30.31250000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
A	1	495.06250000	495.06250000	189.10	0.0001
B	1	4590.06250000	4590.06250000	1753.23	0.0001
C	1	473.06250000	473.06250000	180.69	0.0001
D	1	3.06250000	3.06250000	1.17	0.3076
E	1	1.56250000	1.56250000	0.60	0.4596
A*B	1	189.06250000	189.06250000	72.21	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
A	1	495.06250000	495.06250000	189.10	0.0001
B	1	4590.06250000	4590.06250000	1753.23	0.0001
C	1	473.06250000	473.06250000	180.69	0.0001
D	1	3.06250000	3.06250000	1.17	0.3076
E	1	1.56250000	1.56250000	0.60	0.4596
A*B	1	189.06250000	189.06250000	72.21	0.0001

**(Lanjutan)**

The SAS System

3

## General Linear Models Procedure

Duncan's Multiple Range Test for variable: Y

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.01 df= 9 MSE= 2.618056

Number of Means 2  
Critical Range 2.629

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	A
A	35.8750	8	1
B	24.7500	8	-1

The SAS System

4

## General Linear Models Procedure

Duncan's Multiple Range Test for variable: Y

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.01 df= 9 MSE= 2.618056

Number of Means 2  
Critical Range 2.629

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	B
A	47.2500	8	1
B	13.3750	8	-1

**(Lanjutan)**

The SAS System

5

## General Linear Models Procedure

Duncan's Multiple Range Test for variable: Y

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.01 df= 9 MSE= 2.618056

Number of Means 2

Critical Range 2.629

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	C
A	35.7500	8	1
B	24.8750	8	-1

The SAS System

6

## General Linear Models Procedure

Duncan's Multiple Range Test for variable: Y

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.01 df= 9 MSE= 2.618056

Number of Means 2

Critical Range 2.629

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	D
A	30.7500	8	-1
A			
A	29.8750	8	1

**(Lanjutan)**

The SAS System

7

## General Linear Models Procedure

Duncan's Multiple Range Test for variable: Y

NOTE: This test controls the type I comparisonwise error rate, not the experimentwise error rate

Alpha= 0.01 df= 9 MSE= 2.618056

Number of Means 2

Critical Range 2.629

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	E
A	30.6250	8	1
A			
A	30.0000	8	-1

The SAS System

8

General Linear Models Procedure  
Least Squares Means

A	B	Y	Std Err	Pr >  T
		LSMEAN	LSMEAN	H0:LSMEAN=0
1	1	56.2500000	0.8090203	0.0001
1	-1	15.5000000	0.8090203	0.0001
-1	1	38.2500000	0.8090203	0.0001
-1	-1	11.2500000	0.8090203	0.0001

Pr &gt; |T| H0: LSMEAN(i)=LSMEAN(j)

i/j	1	2	3	4
1	.	0.0001	0.0001	0.0001
2	0.0001	.	0.0001	0.0048
3	0.0001	0.0001	.	0.0001
4	0.0001	0.0048	0.0001	.

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.



## Lampiran 7

Tabel Data Rancangan  $2^{5-1}$  untuk perbaikan hasil proses pembuatan sirkuit gabungan dengan pembangkit rancangan A = BCDE

No. Amatan	B	C	D	E	A=BCDE	Respon (y)	Kombinasi Perlakuan
1	-	-	-	-	+	9	a
2	+	-	-	-	-	34	b
3	-	+	-	-	-	16	c
4	+	+	-	-	+	60	abc
5	-	-	+	-	-	8	d
6	+	-	+	-	+	50	abd
7	-	+	+	-	+	21	acd
8	+	+	+	-	-	44	bcd
9	-	-	-	+	-	8	e
10	+	-	-	+	+	52	abe
11	-	+	-	+	+	22	ace
12	+	+	-	+	-	45	bce
13	-	-	+	+	+	10	ade
14	+	-	+	+	-	30	bde
15	-	+	+	+	-	15	cde
16	+	+	+	+	+	63	abcde

Tabel Data Rancangan  $2^{5-1}$  untuk perbaikan hasil proses pembuatan sirkuit gabungan dengan pembangkit rancangan B = ACDE

No. Amatan	A	C	D	E	B=ACDE	Respon (y)	Kombinasi Perlakuan
1	-	-	-	-	+	34	b
2	+	-	-	-	-	9	a
3	-	+	-	-	-	16	c
4	+	+	-	-	+	60	abc
5	-	-	+	-	-	8	d
6	+	-	+	-	+	50	abd
7	-	+	+	-	+	44	bcd
8	+	+	+	-	-	21	acd
9	-	-	-	+	-	8	e
10	+	-	-	+	+	52	abe
11	-	+	-	+	+	22	ace
12	+	+	-	+	-	45	bce
13	-	-	+	+	+	10	ade
14	+	-	+	+	-	30	bde
15	-	+	+	+	-	15	cde
16	+	+	+	+	+	63	abcde

(Lanjutan)

Tabel Data Rancangan  $2^{5-1}$  untuk perbaikan hasil proses pembuatan sirkuit gabungan dengan pembangkit rancangan C = ABDE

No. Amatan	A	B	D	E	C=ABDE	Respon (y)	Kombinasi Perlakuan
1	-	-	-	-	+	16	c
2	+	-	-	-	-	9	a
3	-	+	-	-	-	34	b
4	+	+	-	-	+	60	abc
5	-	-	+	-	-	8	d
6	+	-	+	-	+	21	acd
7	-	+	+	-	+	44	bcd
8	+	+	+	-	-	50	abd
9	-	-	-	+	-	8	e
10	+	-	-	+	+	22	ace
11	-	+	-	+	+	45	bce
12	+	+	-	+	-	52	abe
13	-	-	+	+	+	15	cde
14	+	-	+	+	-	10	ade
15	-	+	+	+	-	30	bde
16	+	+	+	+	+	63	abcde

Tabel Data Rancangan  $2^{5-1}$  untuk perbaikan hasil proses pembuatan sirkuit gabungan dengan pembangkit rancangan D = ABCE

No. Amatan	A	B	C	E	D=ABCE	Respon (y)	Kombinasi Perlakuan
1	-	-	-	-	+	8	d
2	+	-	-	-	-	9	a
3	-	+	-	-	-	34	b
4	+	+	-	-	+	50	abd
5	-	-	+	-	-	16	c
6	+	-	+	-	+	21	acd
7	-	+	+	-	+	44	bcd
8	+	+	+	-	-	60	abc
9	-	-	-	+	-	8	e
10	+	-	-	+	+	10	ade
11	-	+	-	+	+	30	bde
12	+	+	-	+	-	52	abe
13	-	-	+	+	+	15	cde
14	+	-	+	+	-	22	ace
15	-	+	+	+	-	45	bce
16	+	+	+	+	+	63	abcde