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## LAMPIRAN

Parameter simulation rangkaian

Var./Param.	LCL+R	LLCL+R	LCL 2-leg's	LCL 3-leg's	LCL bridge
Lin	10 mH	10 mH	10 mH	10 mH	10 mH
Lg	4.7 mH	4.7 mH	4.7 mH	4.7 mH	4.7 mH
Lf1	-	1 mH	3 mH	3 mH	3 mH
Lf2	-	-	3 mH	3 mH	3 mH
Cf1	470 uF	4.7 uF	0.11 uF	0.11 uF	0.11 uF
Cf2	-	-	0.11 uF	0.11 uF	0.11 uF
R	8 Ohm	80 Ohm	-	31 Ohm	200 Ohm



Tabel 21: Data pengukuran filter LCL 2-leg PWM

V	DC inv			AC inv			AC Filtr						Eff (P)	
	I	P(kW)	THD (V)	V	THD (I)	I	P(kW)	THD (V)	V	THD (I)	I	P(kW)	DC/ AC	AC/ AC
Setelah beban														
Beban R														
275	84.423	-	30.9%	181	3.7%	70.019	6.1376	0.51%	266	0.51%	45.681	5.8766	78%	98%
		21.738	30.9%	181	3.7%	70.019	6.1376	0.51%	266	0.51%	45.681	5.8766		
		-	30.9%	181	3.7%	70.019	6.1376	0.51%	266	0.51%	45.681	5.8766		
Total Daya keluaran														
17.630														
Beban R+L														
275	82.754	-	30.9%	181	3.7%	70.002	5.9836	0.51%	266	0.51%	45.676	5.9353	78%	98%
		21.739	30.9%	181	3.7%	70.002	5.9836	0.51%	266	0.51%	45.676	5.9353		
		-	30.9%	181	3.7%	70.002	5.9836	0.51%	266	0.51%	45.676	5.9353		
Total Daya keluaran														
17.806														
Beban R+C														
275	84.423	-	30.9%	181	3.7%	71.439	6.1376	0.51%	272	0.51%	45.564	6.0358	78%	98%
		22.134	30.9%	181	3.7%	71.439	6.1376	0.51%	272	0.51%	45.564	6.0358		
		-	30.9%	181	3.7%	71.439	6.1376	0.51%	272	0.51%	45.564	6.0358		
Total Daya keluaran														
1492														
Beban R+C+L														
275	84.423	-	30.9%	181	3.7%	71.439	6.1376	0.51%	272	0.51%	45.564	6.0358	78%	98%
		22.134	30.9%	181	3.7%	71.439	6.1376	0.51%	272	0.51%	45.564	6.0358		
		-	30.9%	181	3.7%	71.439	6.1376	0.51%	272	0.51%	45.564	6.0358		
Total Daya keluaran														
1499														





Tabel 22: Data pengukuran filter LCL 2-leg SPWM

Data Hasil Pengukuran													
DC inv			AC inv			AC Filtr					Eff (P)		
V	I	P(kW)	THD (V)	V	THD (I)	I	P(kW)	THD (V)	V	THD (I)	I	P(kW)	DC/ACAC/AC
Setelah beban													
Beban R													
275	66.682	14.567	63.5%	180	2.5%	56.064	3.5598	0.09%	206	0.09%	35.299	3.4278	72%
													72%
													72%
Total Daya keluaran													
10.283													
Beban R+L													
275	64.855	14.551	63.5%	180	2.5%	55.908	3.5254	0.09%	205	0.09%	35.260	3.4158	72%
													72%
													72%
Total Daya keluaran													
10.247													
Beban R+C													
275	66.023	14.770	63.5%	180	2.5%	56.952	3.5116	0.09%	211	0.09%	35.260	3.5254	72%
													72%
													72%
Total Daya keluaran													
10.535													
Beban R+C+L													
275	58.773	14.782	63.5%	180	2.5%	57.016	3.5151	0.09%	211	0.09%	35.233	3.4709	72%
													72%
													72%
Total Daya keluaran													
10.545													

Tabel 23: Data pengukuran filter LCL 3-leg

V	DC inv			AC inv			AC Filtr					Eff (P)		
	I	P(kW)	THD (V)	V	THD (I)	I	P(kW)	THD (V)	V	THD (I)	I	P(kW)	DC/ AC	AC/ AC
Setelah beban														
Beban R														
275	85.450	22.072	31.8%	181	3.5%	74.666	6.1991	0.52%	264	0.52%	39.00	4.6751	64%	75%
Total Daya keluaran														
Beban R+L														
275	86.714	22.069	31.8%	181	3.5%	74.651	6.1990	0.52%	264	0.52%	39.00	4.7424	64%	76%
Total Daya keluaran														
Beban R+C														
275	87.829	22.441	31.8%	181	3.5%	76.016	6.3108	0.52%	270	0.52%	38.779	4.8418	64%	76%
Total Daya keluaran														
Beban R+C+L (Over load)														
275	..	...	..%	..	..%	..	...	..%	...	..%	...	...	...	..%
Total Daya keluaran														
Total Daya keluaran														



Tabel 24: Data pengukuran filter LCL 3-leg SPWM

DC inv			AC inv			AC Filtr					Eff (P)		
V	I	P(kW)	THD (V)	V	THD (I)	I	P(kW)	THD (V)	V	THD (I)	I	P(kW)	DC/ACAC/AC
Setelah beban													
Beban R													
275	66.453	14.750	63.1%	180	2.23%	59.561	3.6064	0.083%	209	0.083%	29.978	2.8124	57%
			63.1%	180	2.23%	59.561	3.6064	0.083%	209	0.083%	29.978	2.8124	78%
			63.1%	180	2.23%	59.561	3.6064	0.083%	209	0.083%	29.978	2.8124	
Total Daya keluaran													
8.4371													
Beban R+L													
275	70.742	14.729	63.1%	180	2.23%	58.597	3.6485	0.083%	205	0.083%	30.223	2.7290	56%
			63.1%	180	2.23%	58.597	3.6485	0.083%	205	0.083%	30.223	2.7290	75%
			63.1%	180	2.23%	58.597	3.6485	0.083%	205	0.083%	30.223	2.7290	
Total Daya keluaran													
8.1868													
Beban R+C													
275	76.274	14.940	63.5%	180	2.23%	59.852	3.7225	0.083%	209	0.083%	30.023	2.7670	56%
			63.5%	180	2.23%	59.852	3.7225	0.083%	209	0.083%	30.023	2.7670	74%
			63.5%	180	2.23%	59.852	3.7225	0.083%	209	0.083%	30.023	2.7670	
Total Daya keluaran													
8.3011													
Beban R+C+L (Over load)													
275	..	...	..%	..	..%	..	...	...%	...	...%	...	...	...%
			..%	..	..%	..	...	...%	...	...%	...	...	...%
			..%	..	..%	..	...	...%	...	...%	...	...	...%
Total Daya keluaran													
....													



Tabel 25: Data pengukuran filter LCL H-bridge

Data Hasil Pengukuran														
DC inv			AC inv			AC Filtr						Eff (P)		
V	I	P(kW)	THD (V)	V	THD (I)	I	THD (V)	P(kW)	THD (I)	V	THD (I)	I	P(kW)	DC/ACAC/AC
Setelah beban														
Beban R														
275	76.11	13.810	33.9%	221	2,4%	71.84	0.52%	4.6351	0.52%	243	2.4%	71.14	4.4564	96%
													4.4564	95%
													4.4564	
													13.374	
Total Daya keluaran														
Beban R+L														
220	75.85	13.824	33.9%	221	2,4%	71.816	0.52%	4.6615	0.52%	243	2.4%	71.126	4.4587	96%
													4.4587	95%
													4.4587	
													13.376	
Total Daya keluaran														
Beban R+C														
220	77.45	14.161	33.9%	221	2,4%	73.48	5.7%	4.7777	5.7%	265	2.4%	72.77	4.5664	96%
													4.5664	95%
													4.5664	
													13.699	
Total Daya keluaran														
Beban R+C+L														
220	77.72	14.162	33.9%	221	2,4%	73.474	0.52%	4.7771	0.52%	270	2.4%	72.77	4.5663	96%
													4.5663	95%
													4.5663	
													13.699	
Total Daya keluaran														



Tabel 26: Data pengukuran filter LCL H-bridge SPWM

Data Hasil Pengukuran														
DC inv				AC inv				AC Filtr				Eff (P)		
V	I	P(kW)	THD (V)	V	THD (I)	I	THD (V)	P(kW)	THD (V)	V	THD (I)	I	P(kW)	DC/ACAC/AC
Setelah beban														
Beban R														
275	54.924	8.1715	63.1%	181	1.69%	54.867	0.13%	2.7577	0.13%	194	1.69%	54.216	2.6061	96%
Total Daya keluaran														
Beban R+L														
275	54.974	8.1519	63.1%	181	1.69%	54.845	0.13%	2.7425	0.13%	194	1.69%	54.180	2.3558	96%
Total Daya keluaran														
Beban R+C														
275	55.689	8.0169	63.1%	181	1.69%	56.224	0.13%	2.7370	0.13%	194	1.69%	55.567	2.6723	96%
Total Daya keluaran														
Beban R+C+L														
275	55.689	8.0169	63.1%	181	1.69%	56.224	0.13%	2.7370	0.13%	194	1.69%	55.567	2.6723	96%
Total Daya keluaran														
Beban R+C+L														
275	55.689	8.0169	63.1%	181	1.69%	56.224	0.13%	2.7370	0.13%	194	1.69%	55.567	2.6723	96%
Total Daya keluaran														
Beban R+C+L														
275	55.689	8.0169	63.1%	181	1.69%	56.224	0.13%	2.7370	0.13%	194	1.69%	55.567	2.6723	96%
Total Daya keluaran														
Beban R+C+L														
275	55.689	8.0169	63.1%	181	1.69%	56.224	0.13%	2.7370	0.13%	194	1.69%	55.567	2.6723	96%
Total Daya keluaran														
Beban R+C+L														
275	55.689	8.0169	63.1%	181	1.69%	56.224	0.13%	2.7370	0.13%	194	1.69%	55.567	2.6723	96%
Total Daya keluaran														



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**Algorithm 8** Kode rangkaian LCL tuned-single terhubung sistem inverter
 

---

Vs 1 0 275V ; DC input voltage

Vy 1 10 0V ; Monitors input current

Vx1 6 6a 0V ; Monitors output phase

Vx2 8 8a 0V

Vx3 7 7a 0V

.PARAM freq=50 vctrl=20

\*PWM circuit

Vca 23 0 PULSE (0 vctrl 0 1ns 1ns 1/(2\*freq)-2ns 1/freq)

Vcb 24 0 PULSE (0 vctrl 1/freq/3 1ns 1ns 1/(2\*freq)-2ns  
1/freq)

Vcc 25 0 PULSE (0 vctrl 1/freq/6 1ns 1ns 1/(2\*freq)-2ns  
1/freq)

*E<sub>A</sub>BM23200VALUEvctrl* – V(23)

*E<sub>A</sub>BM24220VALUEvctrl* – V(24)

*E<sub>A</sub>BM25210VALUEvctrl* – V(25)

\*Driver for switching component

E1 11 3 23 0 10 ; Voltage controlled voltage source

E2 14 0 25 0 10

E3 12 4 24 0 10

E4 16 0 20 0 10

E5 13 5 21 0 10

E6 15 0 22 0 10

\*CIRCUIT

.SUBCKT IGBT 42 43 44 45 46 47 48 49 50 51 52

Z1 43 47 44 IXGH40N60 ; IGBTs with a model IXGH40N60

Z2 46 50 42 IXGH40N60

Z3 43 48 45 IXGH40N60

Z4 44 52 42 IXGH40N60

Z5 43 49 46 IXGH40N60

Z6 45 51 42 IXGH40N60

.MODEL IXGH40N60 NIGBT (TAU=287.56E-9 KP=50.034 AREA=37.500E-  
6 AGD=18.750E-6 VT=4.1822

+KF=.36047 CGS=31.942E-9 COXD=53.188E-9 VTD=2.6570)

.ENDS IGBT

\*Subcircuit for MOSFET

M1 43 47 44 0 IRFP460 ; MOSFET with a model IRFP460

M2 46 50 42 0 IRFP460

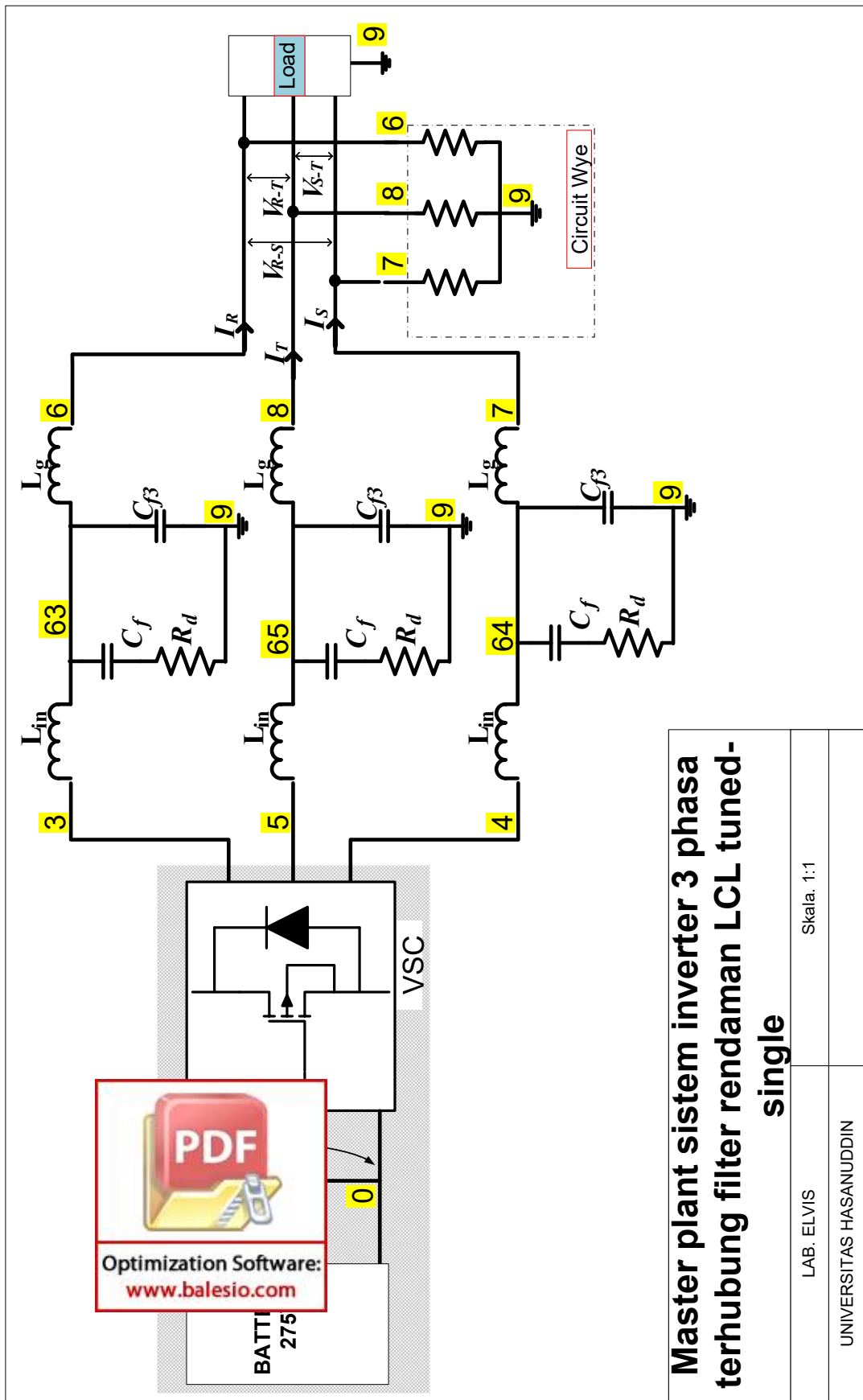
M3 43 48 45 0 IRFP460

M4 44 52 42 0 IRFP460

M5 43 49 46 0 IRFP460

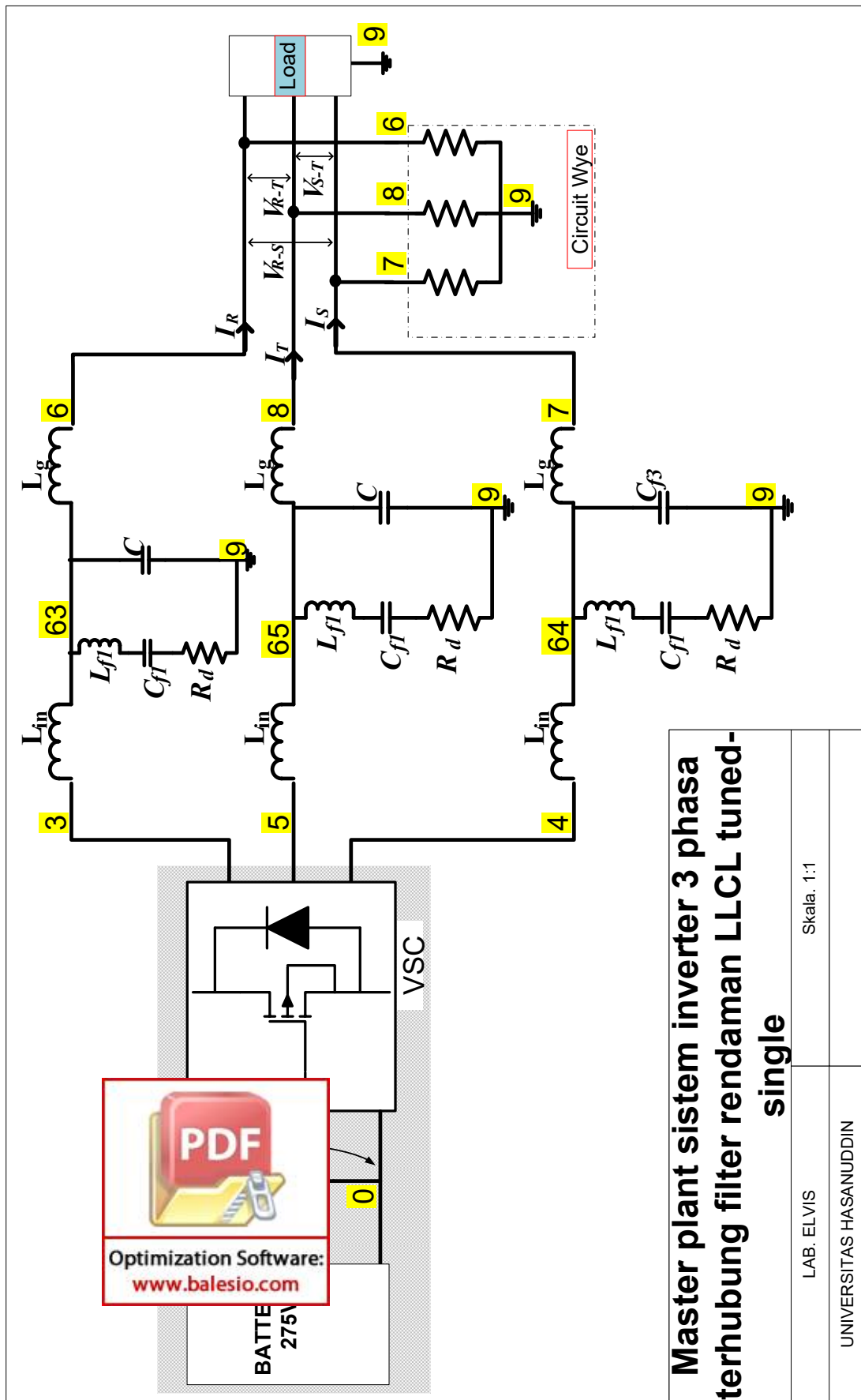
M6 45 51 42 0 IRFP460



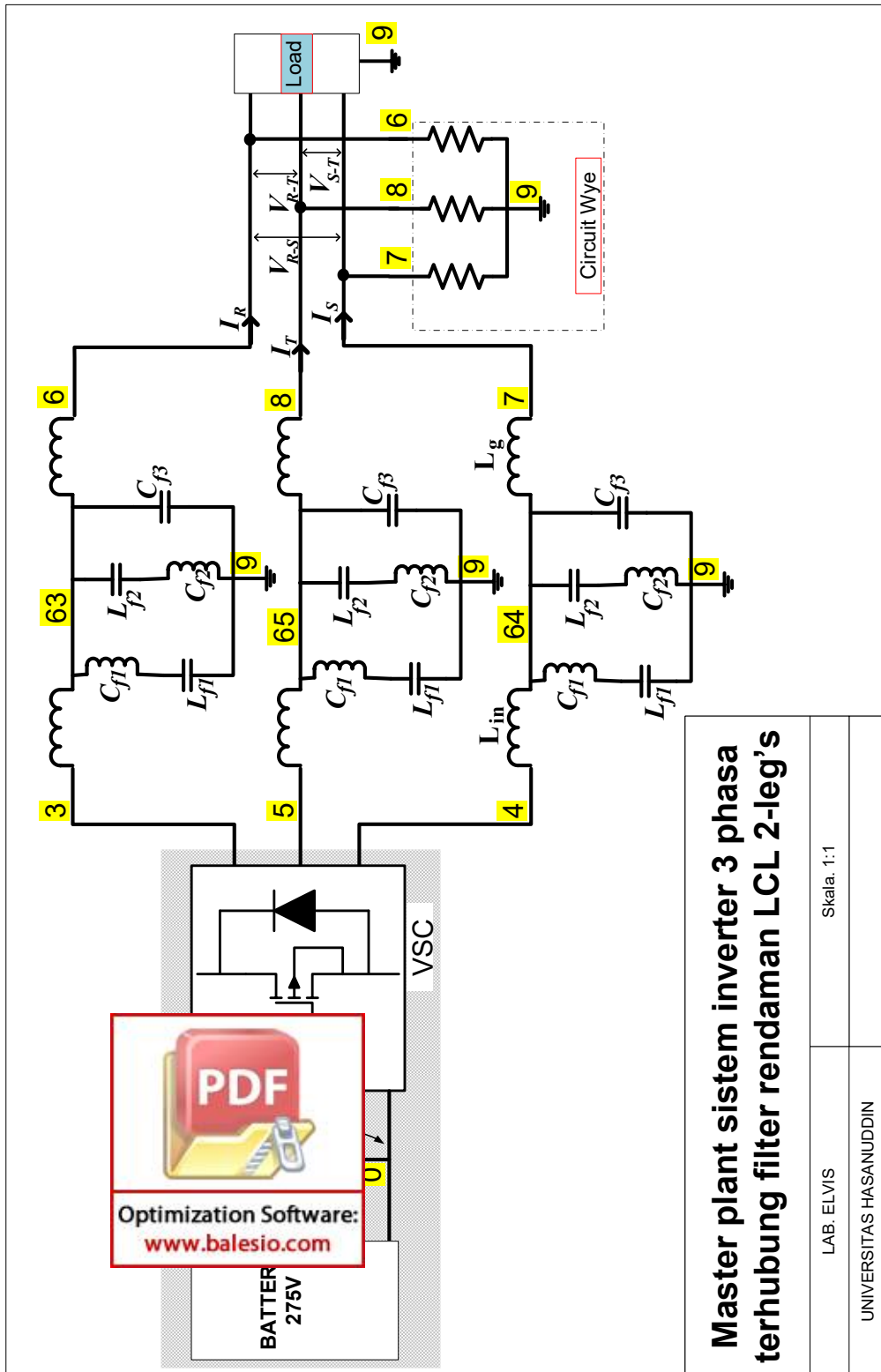


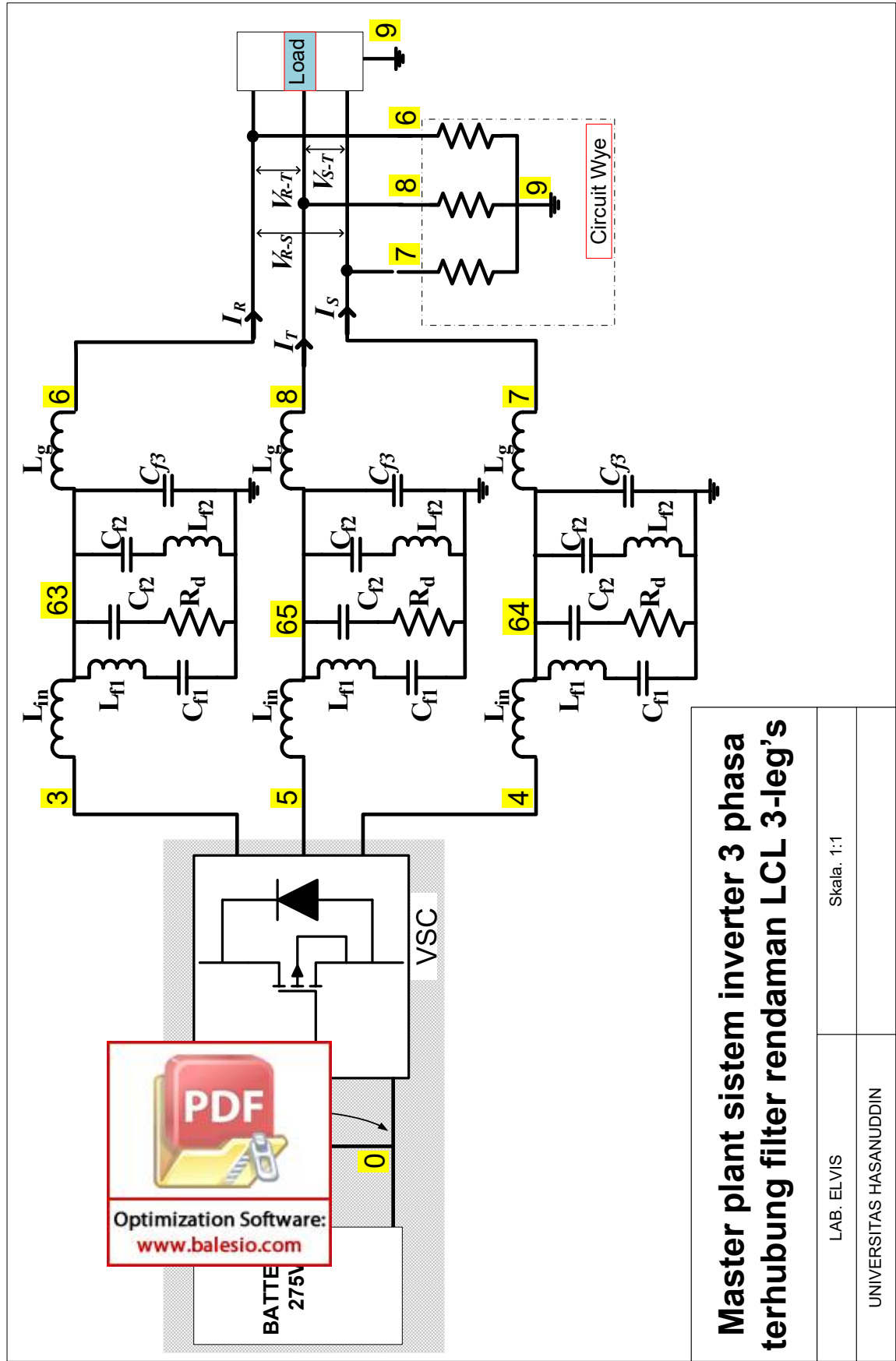
**Master plant sistem inverter 3 phasa terhubung filter rendaman LCL tuned-single**

LAB. ELVIS	Skala. 1:1
UNIVERSITAS HASANUDDIN	



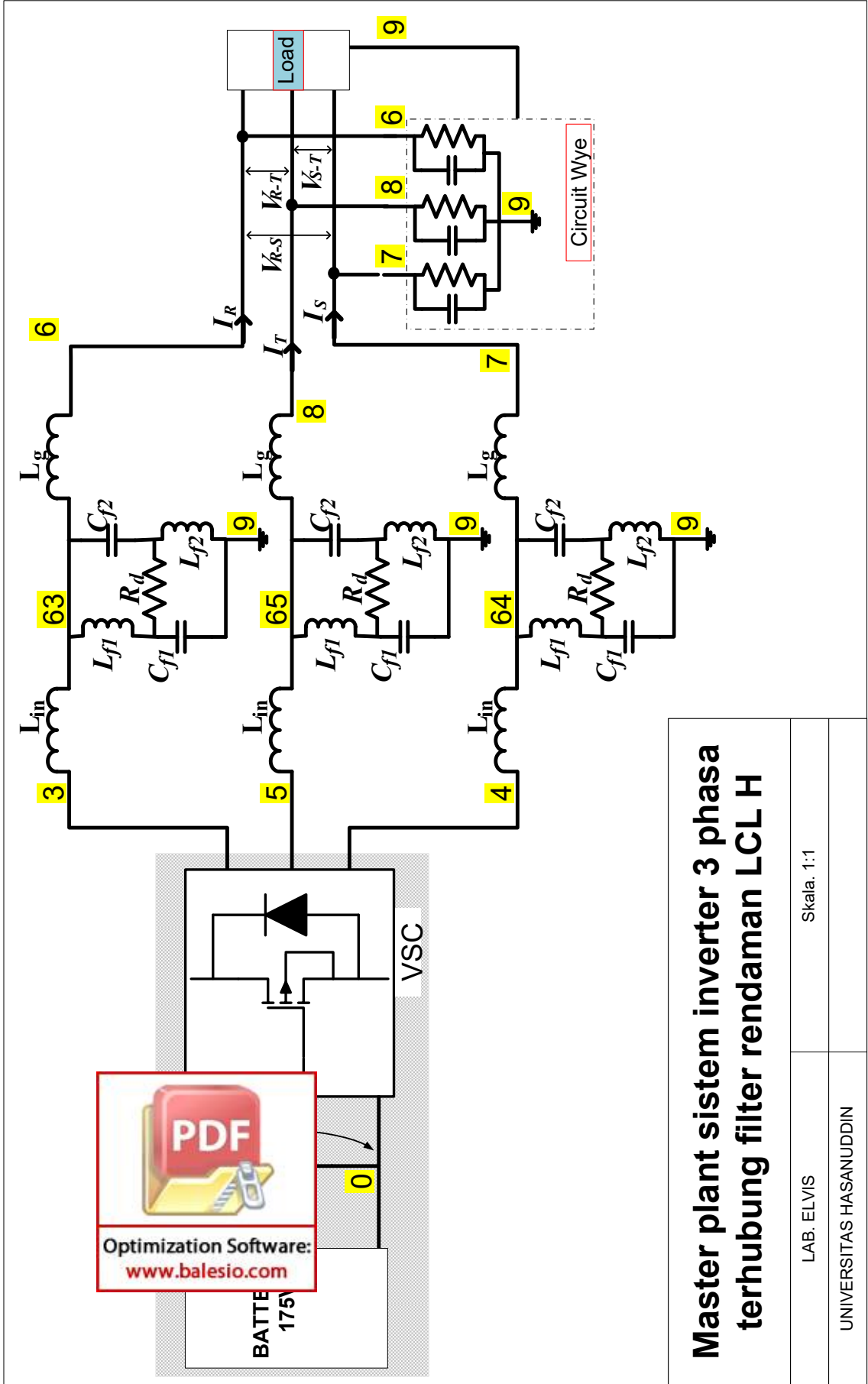






**Master plant sistem inverter 3 phasa terhubung filter rendaman LCL 3-leg's**

LAB. ELVIS	Skala. 1:1
UNIVERSITAS HASANUDDIN	



## Master plant sistem inverter 3 phasa terhubung filter rendaman LCL H

LAB. ELVIS

Skala. 1:1

UNIVERSITAS HASANUDDIN

```

.MODEL IRFP460 NMOS (VTO=.831 KP=20.53U L=2U W=.3
CGDO=3.358N
CGSO=18.054N)
D1 3 2 DMD
D2 0 5 DMD
D3 4 2 DMD
D4 0 3 DMD
D5 5 2 DMD
D6 0 4 DMD
.MODEL DMD D(IS=2.2E-15 BV=1800V TT=0)
* Filter
L1 3 63 10mH;
L2 5 65 10mH;
L3 4 64 10mH
C7 63 83 470uF;
C8 65 85 470uF;
C9 64 84 470uF
R1 83 0 8;
R2 85 0 8;
R3 84 0 8
L10 63a 6 4.7mH;
L11 65a 8 4.7mH;
L12 64a 7 4.7mH
R4 6 9 7.2;
R5 8 9 7.2;
R6 7 9 7.2

* Beban Terpasang
*R01 6 9 220;
*R02 8 9 220;
*R03 7 9 220

* Subcircuit call for switching component:
X2 0 2 3 4 5 11 12 13 14 15 16 MOSFET
*ANALYSIS
.TRAN 0.1US 100MS 0MS 0.1e-4 ; Transient Analysis
.OPTIONS ABSTOL=1uA CHGTOL=0.01nC ITL2=100 ITL4=150 REL-
TOL=0.1 VNTOL=0.1
.FOUR 50Hz 100 V(6,7) V(8,6) V(7,8) V(6,9) V(8,9) V(7,9) I(Vx1)
I(Vx2) I(Vx3)
.PROBE V(6,7) V(8,6) V(7,8) .PROBE V(6,9) V(8,9) V(7,9)
.PROBE V(20) V(21) V(22) V(23) V(24) V(25) I(Vx1) I(Vx2) I(Vx3)
.PROBE V(4,0) V(5,0) I(Vy) V(1,0)

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**Algorithm 9** Kode rangkaian LLCL tuned-single terhubung sistem inverter
 

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Vs 1 0 275V ; DC input voltage

Vy 1 10 0V ; Monitors input current

Vx1 6 6a 0V ; Monitors output phase

Vx2 8 8a 0V

Vx3 7 7a 0V

.PARAM freq=50 vctrl=20

\*PWM circuit

Vca 23 0 PULSE (0 vctrl 0 1ns 1ns 1/(2\*freq)-2ns 1/freq)

Vcb 24 0 PULSE (0 vctrl 1/freq/3 1ns 1ns 1/(2\*freq)-2ns  
1/freq)

Vcc 25 0 PULSE (0 vctrl 1/freq/6 1ns 1ns 1/(2\*freq)-2ns  
1/freq)

$E_{ABM23200V} ALU Evctrl - V(23)$

$E_{ABM24220V} ALU Evctrl - V(24)$

$E_{ABM25210V} ALU Evctrl - V(25)$

\*Driver for switching component

E1 11 3 23 0 10 ; Voltage controlled voltage source

E2 14 0 25 0 10

E3 12 4 24 0 10

E4 16 0 20 0 10

E5 13 5 21 0 10

E6 15 0 22 0 10

\*CIRCUIT

.SUBCKT IGBT 42 43 44 45 46 47 48 49 50 51 52

Z1 43 47 44 IXGH40N60 ; IGBTs with a model IXGH40N60

Z2 46 50 42 IXGH40N60

Z3 43 48 45 IXGH40N60

Z4 44 52 42 IXGH40N60

Z5 43 49 46 IXGH40N60

Z6 45 51 42 IXGH40N60

.MODEL IXGH40N60 NIGBT (TAU=287.56E-9 KP=50.034 AREA=37.500E-  
6 AGD=18.750E-6 VT=4.1822

+KF=.36047 CGS=31.942E-9 COXD=53.188E-9 VTD=2.6570)

.ENDS IGBT

\*Subcircuit for MOSFET

M1 43 47 44 0 IRFP460 ; MOSFET with a model IRFP460

M2 46 50 42 0 IRFP460

M3 43 48 45 0 IRFP460

M4 44 52 42 0 IRFP460

M5 43 49 46 0 IRFP460

M6 45 51 42 0 IRFP460



```

.MODEL IRFP460 NMOS (VTO=.831 KP=20.53U L=2U W=.3
CGDO=3.358N
CGSO=18.054N)
D1 3 2 DMD
D2 0 5 DMD
D3 4 2 DMD
D4 0 3 DMD
D5 5 2 DMD
D6 0 4 DMD
.MODEL DMD D(IS=2.2E-15 BV=1800V TT=0)
L1 3 63 10mH;
L2 5 65 10mH;
L3 4 64 10mH
L4 63 83 1mH
L5 65 85 1mH
L6 64 84 1mH
C1 83 583 4.7uF
C2 85 585 4.7uF
C3 84 584 4.7uF
R1 583 9 80
R2 585 9 80
R3 584 9 80
L10 63a 6 4.7mH;
L11 65a 8 4.7mH;
L12 64a 7 4.7mH
R4 6 9 7.2;
R5 8 9 7.2;
R6 7 9 7.2
* Beban Terpasang
*R01 6 9 220;
*R02 8 9 220;
*R03 7 9 220
* Subcircuit call for switching component:
X2 0 2 3 4 5 11 12 13 14 15 16 MOSFET
*ANALYSIS
.TRAN 0.1US 100MS 0MS 0.1e-4 ; Transient Analysis
.OPTIONS ABSTOL=1uA CHGTOL=0.01nC ITL2=100 ITL4=150 REL-
TOL=0.1 VNTOL=0.1
.FOUR 50Hz 100 V(6,7) V(8,6) V(7,8) V(6,9) V(8,9) V(7,9) I(Vx1)
I(Vx2) I(Vx3)
.PROBE V(6,7) V(8,6) V(7,8) .PROBE V(6,9) V(8,9) V(7,9)
.PROBE V(20) V(21) V(22) V(23) V(24) V(25) I(Vx1) I(Vx2) I(Vx3)
.PROBE V(4,0) V(5,0) I(Vy) V(1,0)

```

