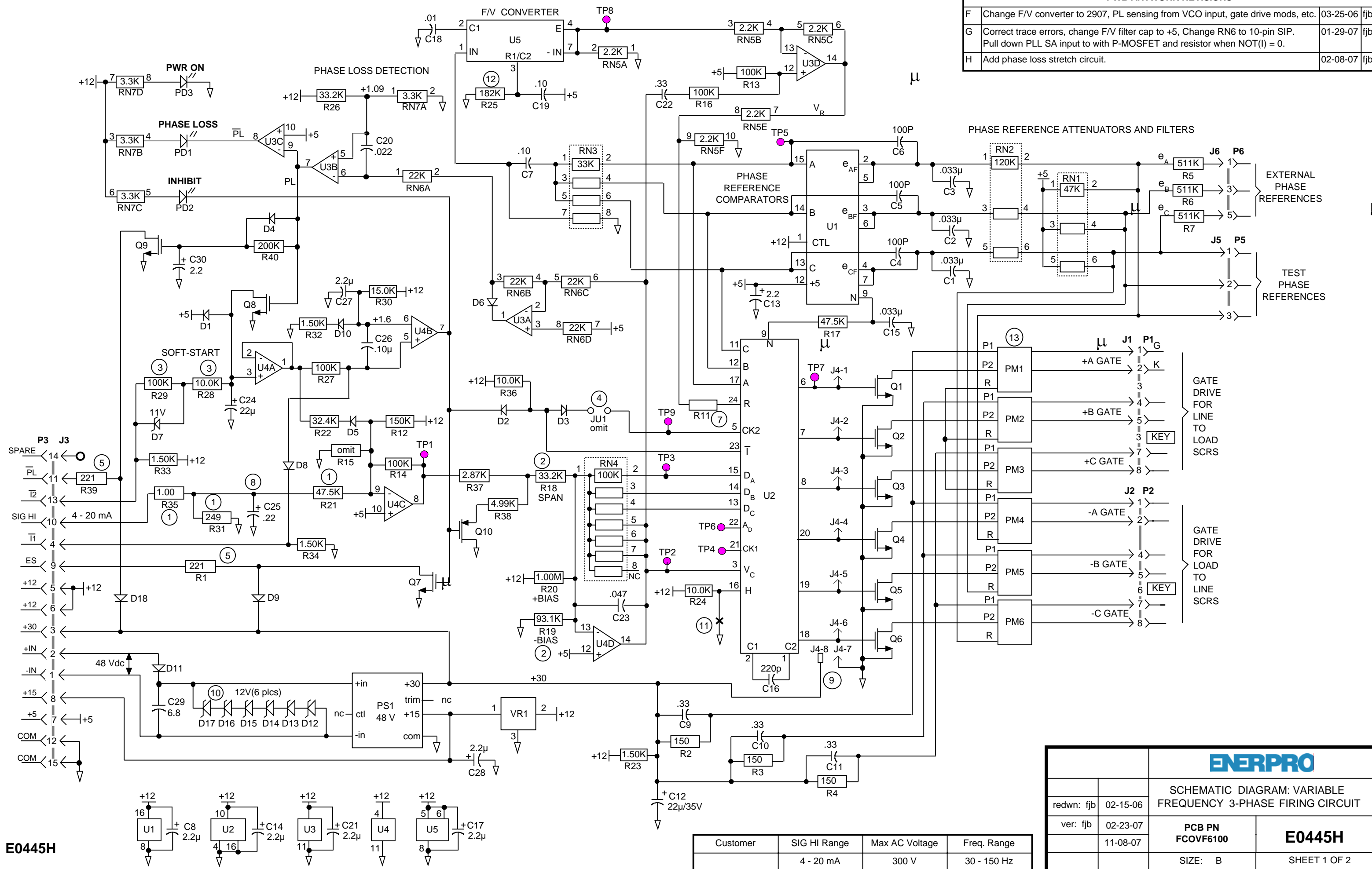


PWB ARTWORK REVISIONS

F	Change F/V converter to 2907, PL sensing from VCO input, gate drive mods, etc.	03-25-06	fjb
G	Correct trace errors, change F/V filter cap to +5, Change RN6 to 10-pin SIP.	01-29-07	fjb
H	Add phase loss stretch circuit.	02-08-07	fjb



E0445H

Customer	SIG HI Range	Max AC Voltage	Freq. Range
	4 - 20 mA	300 V	30 - 150 Hz

ENERPRO	
SCHEMATIC DIAGRAM: VARIABLE FREQUENCY 3-PHASE FIRING CIRCUIT	
redwn: fjb	02-15-06
ver: fjb	02-23-07
	11-08-07
PCB PN FCOVF6100	E0445H
SIZE: B	SHEET 1 OF 2

PART	PART NUMBER	STOCK NUMBER
U1	EP1016	I11016S
U2	EP1014	I11014S
U3-U4	MC34074BC	I134074P
U5	MM2907N-8	I12907N-8
VR1	T2VLM78L12	T2VLM78L12
Q1-Q7	IRFD9110	T2IRFD9110
Q8-Q9	BS170	T2NBS170
Q10	ZVP2110A	T2ZVP2110A
D1	1N4004	D1N4004
D12-D17 (10)	1N5341 6.2V	D1N5241B
D11	1N4004	D1N4004
D1-D6,D8-D10&D18	1N914B	D1N914B
D7	1N5241B 11V	D1N5241B
PD1-PD2	550-2404	DIL5502404R
PD3	550-2204	DIL5502204G
RN1	6R-2-473	R1S061473
RN2	6R-2-124	R1S061124
RN3	8R-2-333	R1S081333
RN4	4308R-101-104	R1S08N104
RN5	8R-2-222	R1S08I222
RN6	8R-2-223	R1S08I223
RN7	8R-2-332	R1S08I332
R1 (5)	CW2C 220	R1W03W220
R2,R3,R4	CW2C 150	R1W03W150
R5,R6,R7	RN65 511K	RN65D5113F
R11-R40	RN60 (see table)	
C1-C3,C15	MKS4 .033u 1% matched	C1FL250333
C4,C5,C6	FKS3 100p	C1FL160101
C7,C19,C26	MKSO2 .10u	C1FL063104
C8,C13,C14,C17 C21,C27,C28,C30	ECS-F1CE16225	C1TN016225
C9,C10,C11	MKS4 .33u 10mm	C1FL063334
C12,C24	ECS-F1CE35226	C1TN035226
C16	FKS3 220p	C1FL160221
C18	MKS4 .01u	C1FL100103
C20	MKS4 .022u	C1FL050223
C22	MKS4 .33u (7.5mm)	C1FL063334S
C23	MKS4 .047u	C1TN100473
C25 (8)	ECS-F1C35224	C1TN035224
C29	ECS-F1C50685	C1TN050685

PART	PART NUMBER	STOCK NUMBER
PS1 (24 V input)	M2ENFC2024	M2ENFC2024
PS1 (48 V input)	NFC20-48D15	M2ENFC2048
PM1-PM6 (13)	EP1024-0	TIPW1024-0
J1-J2	640584-2	C2MNLRP08
J3	350714-2	C2MNLVPH15
J4	1-640458-8	C2MTAVOH08
J5	1-640458-3	C2MTAVOH03
J6	1-350945-0	C2MNLRP05
P1-P2	640582-1	C2MNLPLG08
P3	350736-1	C2MNLPLG15
P4	640440-8	C2MTAPLG08
P5	640440-3	C2MTAPLG03
P6	350809-1	C2MNLPLG05
TP1-TP9	TP-104-01-02	
JU1	J.200x.250	W1J02
COM RING	M1034	W1JCOMM

RN60 RESISTORS (K)					
R11 (7)	select	R22	32.4	R33	1.50
R12	150.0	R23	1.50	R34	1.50
R13	100	R24	10.0	R35 (1)	0 ohm
R14	100	R25 (12)	182	R36	10.0
R15	100	R26	33.2	R37	2.87
R16	100	R27	100	R38	4.99
R17	47.5	R28 (2)	10.0	R39 (5)	.221
R18	33.2	R29 (2)	100	R40	200.0
R19	93.1	R30	15.0		
R20	1000	R31 (1)	249		
R21 (1)	47.5	R32	1.50		

NOTES					
NO.	DESCRIPTION				
1	SIG HI RANGE	R31	R21	R35	
	0-10 V	4.99 K	45.3 K	4.99 K	
	0-5 V	10.0 K	47.5 K	0	
2	4-20 mA	249	47.5 K	0	
	Select R18 for desired delay angle span. Select R19 for desired delay angle bias.				
3	Select R29 for desired soft-start time. Select R28 for desired soft-stop time.				
4	Install JU1 for 2-30 deg. burst mode gating (low inductance load only).				
5	Select R39 and R1 resistance to provide desired status relay or lamp voltage.				
6	For gating paralleled SCRs, connect FCOAUX60 auxiliary firing board via cable to J4.				
7	Select R11 to make TP2 voltage = 5.00 +/- .05 V at TP2 at 60 (or 50) Hz.				
8	Increase C25 capacitance to reduce firing circuit bandwidth.				
9	Outputs to FCOAUX60 Auxiliary Firing Board.				
10	For 48V dc-dc converter use 1N5349B 12.0V zener for D12-D17.				
11	Cut trace where indicated when ac supply is high frequency.				
12	R25 selected for 30 Hz to 150 Hz frequency range.				
13	Install EP1024-0 (no resistor) pulse module for use with external phase reference resistors.				

CHANGE RECORD					
DATE	PCB REV.	BY	CHANGE	REASON FOR CHANGE	
03-07-06	F	fjb	1. Re-draw in SmartDraw. 2. Change the F/V converter circuit from 555 to 2907 type. 3. Change phase loss sensing from comparator operating on filtered sum of phase references to comparator operating on VCO control voltage. 4. Add hysteresis capacitors to phase reference comparators. 5. Change gate drive transistors from ULN2005 IC to individual MOSFETs. 6. Increase spacing between the three gate drive current limiting resistors. 7. Eliminate the single 10 gate current limiting resistor. 8. Change the number of shunt regulator zeners from five to six. 9. Removed C31 and RN4E. Changed RN4 from 10-pos. to 8-pos. SIP.	1. Replace original McDraw format. 2. Increase the F/V converter ripple frequency from 3F to 6F. 3. Make phase loss sensor sensitivity independent of frequency. 4. Improve phase reference comparator noise immunity. 5. Increase drive current capability. 6. Allow reduced resistance and increased gate current. 7. Increase gate current. 8. Increase the shunt regulator current capability.	
08-29-06	G	fjb	1. Change RN6 from 8-pos. to 10-pos. SIP. 2. Change R16 from 76.8 K to 221 K. 3. Remove trace from RN6 to J3-14. 4. Rename R38 as R17, R39 as R18. 5. Change C25 from 680 p to 220 p. 6. Add resistor and trace cut designation to H signal.	1. Make F/V circuit same as on FCOVFS31 board, eliminate 2 resistors. 2. Required due to change #1. 3. Required due to change #1. 4. Permitted due to change #1 5. Because of increased max frequency. 6. When ac supply frequency is greater than 500 Hz.	
01-30-07	G	fjb	1. Change C7 from 2.2 uF to .10 uF 2. Change C12 from 6.8 uF to .33 uF, omit C13, Renumber C14-C30 as C13-C29. 3. Add Q9, R39 and R40 to reduce input voltage to PLL summing amplifier when gating is inhibited. 4. Add 50% voltage divider between J3-10 and R28. 5. Change D16 to 11 V 500 mW zener. 6. Remove zener D7, renumber D8 to D16 as D7 to D15, change D2-D6 to 6.2 V zener. 7. Change phase loss filter cap C25 from .10 uf to .022 uf. 8. Add transistor to drive phase loss indicating relay, change Q7 to BS170. 9. Change relay interface resistors R42 and R43 from 3 W to .25 W.	1. Reduce F/V converter delay. 2. Large capacitance not needed with NFC20-24D15 dc-dc converter. 3. Ensure PLL is in lock before gating is enabled. 4. Allow 0-5V or 0-10 VSIG HI range with no change in buffer amp bias resistors. 5. Reduce enable delay. 6. Revert to original 5 zener design. 7. Improve reliability of phase loss sensing. 8. PL transistor per customer request. 9. Save board space.	
02-08-07	H	fjb	1. Add R40, C30 and D4 phase loss stretch circuit.	1. Prevent chatter in customer's phase loss relay.	
11-08-07	H	drs	1. Corrected a schematic error: resistor R5 changed to R7 and R7 changed to R5.		

Ω

Ω

Customer	SIG HI Range	Freq. Range
Basler	0 - 10 V	30 - 150 Hz

ENERPRO			
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redwn: fjb	02-15-06	PCB PN FCOVF6100	E0445H
ver: fjb	02-23-07	SIZE: B	SHEET 2 OF 2
	11-08-07		