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BENSHAW®
ADVANCED CONTROLS & DRIVES

SG Series Variable Frequency Drive

Service Manual

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BENSHAW®
ADVANCED CONTROLS & DRIVES

Section 1

Spare Parts List

SG SPARE PARTS LIST - 230V (7.5 - 40 HP)

Description	Part Number	Specification	Horsepower						
			7.5	10	15	20	25	30	40
CONTROL PCB assembly	PC-100062-00	PCB ASS'Y,CONTROL,SV-IP5 (New) - for Benshaw	1	1	1	1	1	1	1
POWER PCB assembly	PC-100006-00	PCB ASS'Y,POWER,SV-IP5,055-2	1						
	PC-100007-00	PCB ASS'Y,POWER,SV-IP5,075-2		1					
	PC-100009-00	PCB ASS'Y,POWER,SV-IP5,110-2			1				
SMPS (CTRL) PCB assembly	PC-100003-00	PCB ASS'Y,SMPS,SV-IS5(UL),CONTROL(200V)				1	1	1	1
SMPS (DRV) PCB assembly	PC-100015-00	PCB ASS'Y,SMPS,SV-IP5,150~185-2				1	1		
	PC-100001-00	PCB ASS'Y,SMPS,SV-IS5,185-2						1	1
DM+CT PCB assembly	PC-100011-00	PCB ASS'Y,DM-CT,SV-IP5,150~185-2				1	1		
	PC-100013-00	PCB ASS'Y,DM-CT,SV-IP5,220~300-2						1	1
SNUBBER PCB assembly	PC-100017-00	PCB ASS'Y,SNUBBER,SV-IP5,150~185-2/4				1	1		
	PC-100016-00	PCB ASS'Y,SNUBBER,SV-IP5,220~300-2/4						1	1
IGBT	IGBT-100035-00	TR,IGBT,SKIIP32NAB063,600V,81A,B,SEMIKRON		1	1				
	IGBT-100039-00	TR,IGBT,SKIIP31NAB063,600V,45A,B,SEMIKRON	1						
	IGBT-100031-00	TR,IGBT,CM150TU-12F,600V,150A,B,MIT				1	1		
	IGBT-100032-00	TR,IGBT,CM200TU-12F,600V,200A,B,MIT						1	1
Diode	DI-100041-00	DIODE,DM,DF150BA80,800V,150A,B,SANREX				1	1		
	DI-100043-00	DIODE,RD,DFA200AA80, ,800V,200A,R,SANREX						1	1
Fan	FA-100028-00	F6025X24B-AH	1	2	2				
	FA-100030-00	G9225X24B				2	2		
	FA-100031-00	B35129-51 (Nidec TA450DC)						2	2
Keypad/Display	LCD-100000-00	Assy,Loader(LCD) BENSHAW, SV-IP5A	1	1	1	1	1	1	1
Terminal Block Kit, Control Bd.	TE-100883-00	For Control Bd. All 6 terminal blocks (new style after Aug 2008)	1	1	1	1	1	1	1

SG SPARE PARTS LIST - 460V (7.5 - 40 HP)

Description	Part Number	Specification	Horsepower						
			7.5	10	15	20	25	30	40
CONTROL PCB assembly	PC-100062-00	PCB ASS'Y,CONTROL,SV-IP5 (New) - for Benshaw	1	1	1	1	1	1	1
POWER PCB assembly	PC-100034-00	PCB ASS'Y,POWER,SV-IP5,055-4	1						
	PC-100008-00	PCB ASS'Y,POWER,SV-IP5,075-4		1					
	PC-100010-00	PCB ASS'Y,POWER,SV-IP5,110-4			1				
SMPS (CTRL) PCB assembly	PC-100004-00	PCB ASS'Y,SMPS,SV-IS5(UL),CONTROL(400V)				1	1	1	1
SMPS (DRV) PCB assembly	PC-100002-00	PCB ASS'Y,SMPS,SV-IS5,150-4				1	1	1	1
DM+CT PCB assembly	PC-100012-00	PCB ASS'Y,DM-CT,SV-IP5,150~185-4				1	1		
	PC-100014-00	PCB ASS'Y,DM-CT,SV-IP5,220~300-4						1	1
SNUBBER PCB assembly	PC-100017-00	PCB ASS'Y,SNUBBER,SV-IP5,150~185-2/4				1	1		
	PC-100016-00	PCB ASS'Y,SNUBBER,SV-IP5,220~300-2/4						1	1
IGBT	IGBT-100036-00	TR,IGBT,SKIIP30NAB12T10,1200V,33A,B,SEMIKRON	1						
	IGBT-100037-00	TR,IGBT,SKIIP32NAB12T1,1200V,65A,B,SEMIKRON			1				
	IGBT-100038-00	TR,IGBT,SKIIP31NAB12T11,1200V,45A,B,SEMIKRON		1					
	IGBT-100034-00	TR,IGBT,CM100TU-24F,1200V,100A,B,MIT						1	1
	IGBT-100033-00	TR,IGBT,CM75TU-24F,1200V,75A,B,MIT				1	1		
Diode	DI-100042-00	DIODE,DM,DF150AA160,1600V,150A,B,SR				1	1		
	DI-100044-00	DIODE,RD,DFA150AA160, ,1600V,150A,B,SANREX						1	1
Fan	FA-100028-00	F6025X24B-AH	1	2	2				
	FA-100030-00	G9225X24B				2	2		
	FA-100031-00	B35129-51 (G1238E24B) (Nidec TA450DC)						2	2
Keypad/Display	LCD-100000-00	Assy,Loader(LCD) BENSHAW, SV-IP5A	1	1	1	1	1	1	1
Terminal Block Kit, Control Bd.	TE-100883-00	For Control Bd. All 6 terminal blocks (new style after Aug 2008)	1	1	1	1	1	1	1

SG SPARE PARTS LIST - 460V (50 - 125 HP)

Description	Part Number	Specification	Horsepower				
			50	60	75	100	125
Control PCB assembly	PC-100063-00	PCB ASS'Y,CONTROL,IP5A,370~900-4	1	1	1	1	1
Main SMPS PCB assembly	PC-100065-00	PCB ASS'Y,MAIN SMPS,IP5A,370-4	1				
	PC-100066-00	PCB ASS'Y,MAIN SMPS,IP5A,450-4		1			
	PC-100067-00	PCB ASS'Y,MAIN SMPS,IP5A,550-4			1		
	PC-100068-00	PCB ASS'Y,MAIN SMPS,IP5A,750-4				1	
	PC-100069-00	PCB ASS'Y,MAIN SMPS,IP5A,900-4					1
Drive SMPS PCB assembly	PC-100024-00	PCB ASS'Y,DRIVE SMPS,IP5A,370~550-4	1	1	1		
	PC-100025-00	PCB ASS'Y,DRIVE SMPS,IP5A,750~900-4				1	1
FAN SMPS PCB assembly	PC-100023-00	PCB ASS'Y,FAN SMPS,IP5A,370~900-4	1	1	1	1	1
SCR SNUBBER PCB assembly	PC-100026-00	PCB ASS'Y,SCR SNUBBER,IP5A,370~550-4	1	1	1		
	PC-100027-00	PCB ASS'Y,SCR SNUBBER,IP5A,750~900-4				1	1
CT PCB assembly	PC-100030-00	PCB ASS'Y,CT BOARD,IP5A,370/450-4	1	1			
	PC-100031-00	PCB ASS'Y,CT BOARD,IP5A,550-4			1		
	PC-100032-00	PCB ASS'Y,CT BOARD,IP5A,750-4				1	
	PC-100033-00	PCB ASS'Y,CT BOARD,IP5A,900-4					1
CAP PCB assembly	PC-100028-00	PCB ASS'Y,CAP BOARD,IP5A,370~550-4	1	1	1		
	PC-100029-00	PCB ASS'Y,CAP BOARD,IP5A,750~900-4				1	1
Rectifier diode Module	DI-100045-00	DIODE,SCR,SKKH57/16E,1600V,60A,B,SEMIKRON	3				
	DI-100047-00	DIODE,SCR,SKKH92/16E,1600V,95A,B,SEMIKRON		3	3	3	6
IGBT	IGBT-100042-00	TR,IGBT,SKIM350GD128DM,1200V,300A,B,SEMIKRON	1	1	1		
	IGBT-100043-00	TR,IGBT,SKIM501GD128DM,1200V,450A,B,SEMIKRON				1	1
Fuse	FU-100472-00	FUSE,PF,660GH 160S UL,660V,160A,HINODE	1	1			
	FU-100473-00	FUSE,PF,660GH 200S UL,660V,200A,HINODE			1		
	FU-100474-00	FUSE,PF,660GH 250S UL,660V,250A,HINODE				1	
	FU-100475-00	FUSE,PF,660GH 315S UL,660V,315A,HINODE					1
Fuse detector (micro switch)	FU-100476-00	S/W,DECTECTOR,AMS-3B,HINODE,3A(250VAC)	1	1	1	1	1
Fuse, PC Bd. mount (fan+SMPS)	FU-603	Fuse, 1A, 600V, PC Bd. mount (Fan & SMPS)	2	2	2	2	2
Electrolytic capacitor	CA-100133-00	CAP,CE,LNX2G472MSMHZH,DC400V,4700UF,M,85C,76.2*115	4				
	CA-100134-00	CAP,CE,LNX2G562MSMCZH,DC400V,5600UF,M,85C,76.2*115		4			
	CA-100135-00	CAP,CE,LNX2G682MSMBZH,DC400V,6800UF,M,85C,76.2*130			4		
	CA-100136-00	CAP,CE,LNX2G682MSMCZH,DC400V,6800UF,M,85C,76.2*155				6	
	CA-100137-00	CAP,CE,LNX2G822MSMAZH,DC400V,8200UF,M,85C,76.2*155					6
Fan	FA-100021-00	FAN,DF,D09C-24PS5B,DC24V,92SQ*32MM,NIDEC	2	2			
	FA-100022-00	FAN,DF,V35377-68,DC24V,120SQ*38MM,NIDEC			2		
	FA-100023-00	FAN,DF,FFB1424VHG-R00,DC24V,140SQ*50.8MM,DELTA				2	2
Charging Resistor	RES-100180-00	RES,METAL CLAD,MCRBC60W60J,60W,60,J,B,Fullohm	1				
	RES-100181-00	RES,METAL CLAD,MCRBC60W40J,60W,40,J,B,Fullohm		1	1		
	RES-100179-00	RES,METAL CLAD,MCRBC150W30J,150W,30,J,B,Fullohm				1	1
Keypad/Display	LCD-100000-00	Assy,Loader(LCD) BENSHAW, SV-IP5A	1	1	1	1	1
Bezel, Keypad mount	VFD-KEYPAD-SG-BEZEL	COVER,LOADER BRK,SV-iP5A	1	1	1	1	1
Terminal Block, Control Bd.	TE-100883-01	Terminal Block, SG Ctrl Board, 5P, SG (new style after Aug 2008)	1	1	1	1	1
Terminal Block, Control Bd.	TE-100883-02	Terminal Block, SG Ctrl Board, 6P, SG (new style after Aug 2008)	1	1	1	1	1
Terminal Block, Control Bd.	TE-100883-03	Terminal Block, SG Ctrl Board, 7P, SG (new style after Aug 2008)	1	1	1	1	1
Terminal Block, Control Bd.	TE-100883-04	Terminal Block, SG Ctrl Board, 7P, SG (new style after Aug 2008)	1	1	1	1	1
Terminal Block, Control Bd.	TE-100883-05	Terminal Block, SG Ctrl Board, 7P, SG (new style after Aug 2008)	1	1	1	1	1
Terminal Block, Control Bd.	TE-100883-06	Terminal Block, SG Ctrl Board, 7P, SG (new style after Aug 2008)	1	1	1	1	1

SG SPARE PARTS LIST - 460V (150 - 400 HP)

Description	Part Number	Specification	Horsepower				
			150	200	250	350	400
Control PCB assembly	PC-100064-00	PCB ASS'Y,CONTROL,IP5A,1100~4500-4 (New) - for Benshaw	1	1	1	1	1
Main SMPS PCB assembly	PC-100053-01	PCB ASS'Y,MAIN SMPS,IP5A,1100-4	1				
	PC-100053-02	PCB ASS'Y,MAIN SMPS,IP5A,1320-4		1			
	PC-100053-03	PCB ASS'Y,MAIN SMPS,IP5A,1600-4			1		
	PC-100053-04	PCB ASS'Y,MAIN SMPS,IP5A,2200-4				1	
	PC-100053-05	PCB ASS'Y,MAIN SMPS,IP5A,2800-4					1
FAN SMPS PCB assembly	PC-100053-06	PCB ASS'Y,FAN SMPS,IP5A,1100~4500-4	2	2	2	3	3
SCR SNUBBER PCB assembly	PC-100053-07	PCB ASS'Y,SCR SNUBBER,IP5A,1100~2800-4	1	1	1	1	1
Rectifier diode module	DI-100057-00	DIODE,SCR,SKKH132/16E,1600V,130A,B,SEMIKRON	3				
	DI-100057-01	DIODE,SCR,SKKH162/16E,1600V,160A,B,SEMIKRON		3			
	DI-100057-02	DIODE,SCR,SKKH273/16E,1600V,273A,B,SEMIKRON			3	3	
	DI-100057-03	DIODE,SCR,SKKH330/16E,1600V,330A,B,SEMIKRON					3
IGBT	IGBT-100045-00	TR,IGBT,BSM300GB120DLC,1200V,300A,B,EUP	6	6			
	IGBT-100045-01	TR,IGBT,FF400R12KE3,1200V,400A,B,EUP			6		
	IGBT-100045-03	TR,IGBT,CM900DU-24NF,1200V,900A,B,MITSBISHI				3	
	IGBT-100045-02	TR,IGBT,CM1400DU-24NF,1200V,1400A,B,MITSBISHI					3
Fuse	FU-100473-00	FUSE,PF,660GH-200SUL,660V,200A,HINODE	2				
	FU-100474-00	FUSE,PF,660GH-250SUL,660V,250A,HINODE		2		3	
	FU-100475-00	FUSE,PF,660GH-315SUL,660V,315A,HINODE			2		3
Fuse detector (micro switch)	FU-100476-00	S/W,DECTECTOR,AMS-3B,HINODE,3A(250VAC)	1	1	1	1	1
Fuse, PC Bd. mount (fan+SMPS)	FU-603	Fuse, 1A, 600V, PC Bd. mount (Fan & SMPS)	3	3	3	4	4
Electrolytic capacitor	CA-100136-00	CAP,CE,LNX2G682MSMCZH,DC400V,6800UF,M,85C,76.2*155	8			16	
	CA-100137-00	CAP,CE,LNX2G822MSMAZH,DC400V,8200UF,M,85C,76.2*155		8	10		16
Fan	FA-100504-00	FAN,DF,FFB1424VHG-R00,DC24V,140SQ*50.8MM(550MM),DELTA	3	3	3		
	FA-100504-01	FAN,DF,FFB1424VHG-R00,DC24V,140SQ*50.8MM(700MM),DELTA				4	4
	FA-100504-02	FAN,DF,F9225X24B2-FS-WS,DC24V,92SQ,DCC				2	2
Charging resistor	RES-100286-00	RES,METAL CLAD,MCRB400W15J(600MM),400W,15,J,B,YS	1	1	1		
	RES-100286-01	RES,METAL CLAD,MCRB400W15J(300MM),400W,15,J,B,YS				1	1
IGBT interface board	PC-100053-14	PCB ASS'Y,GATE DRIVE,IP5A,110~132KW	6	6			
	PC-100053-15	PCB ASS'Y,GATE DRIVE,IP5A,160-4			6		
	PC-100053-16	PCB ASS'Y,IGBT INTERFACE,IP5A,2200-4				3	
	PC-100053-17	PCB ASS'Y,IGBT INTERFACE,IP5A,3150-4					3
Thermistor	TH-100036-00	SENSOR,NTC,TH225J37G,Thermometrics	1	1	1	1	1
Keypad/Display	LCD-100000-00	Assy,Loader(LCD) BENSHAW, SV-IP5A	1	1	1	1	1
Bezel, Keypad mount	VFD-KEYPAD-SG-BEZEL	COVER,LOADER BRK,SV-iP5A	1	1	1	1	1
Terminal Block, Control Bd.	TE-100883-01	Terminal Block, SG Ctrl Board, 5P, SG (new style after Aug 2008)	1	1	1	1	1
Terminal Block, Control Bd.	TE-100883-02	Terminal Block, SG Ctrl Board, 6P, SG (new style after Aug 2008)	1	1	1	1	1
Terminal Block, Control Bd.	TE-100883-03	Terminal Block, SG Ctrl Board, 7P, SG (new style after Aug 2008)	1	1	1	1	1
Terminal Block, Control Bd.	TE-100883-04	Terminal Block, SG Ctrl Board, 7P, SG (new style after Aug 2008)	1	1	1	1	1
Terminal Block, Control Bd.	TE-100883-05	Terminal Block, SG Ctrl Board, 7P, SG (new style after Aug 2008)	1	1	1	1	1
Terminal Block, Control Bd.	TE-100883-06	Terminal Block, SG Ctrl Board, 7P, SG (new style after Aug 2008)	1	1	1	1	1

SG SPARE PARTS LIST - 460V (500 - 700 HP)

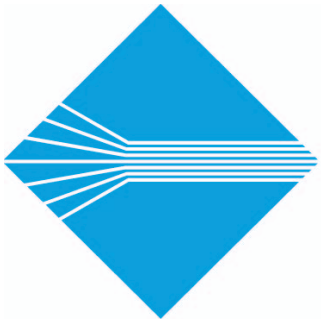
Description	Part Number	Specification	Horsepower		
			500	600	700
Control PCB assembly	PC-100064-00	PCB ASS'Y,CONTROL,IP5A,1100~4500-4 (New) - for Benshaw	1	1	1
Main SMPS PCB assembly	PC-100053-08	PCB ASS'Y,MAIN SMPS,IP5A,3150-4	1		
	PC-100053-09	PCB ASS'Y,MAIN SMPS,IP5A,3750-4		1	1
FAN SMPS PCB assembly	PC-100053-06	PCB ASS'Y,FAN SMPS,IP5A,1100~4500-4	3	3	3
SCR SNUBBER PCB assembly	PC-100053-10	PCB ASS'Y,SCR SNUBBER,IP5A,3150~4500-4	1	1	1
SCR INTERFACE PCB ass'y	PC-100053-11	PCB ASS'Y,SCR INTERFACE,IP5A,3150~4500-4	6	6	6
IGBT INTERFACE PCB assembly	PC-100053-12	PCB ASS'Y,IGBT INTERFACE,IP5A,3150-4	3		
	PC-100053-13	PCB ASS'Y,IGBT INTERFACE,IP5A,3750~4500-4		3	3
Rectifier diode module	DI-100057-02	DIODE,SCR,SKKH273/16E,1600V,273A,B,SEMIKRON	6		
	DI-100057-03	DIODE,SCR,SKKH330/16E,1600V,330A,B,SEMIKRON		6	6
Pre-charge diode module	DI-100057-06	DIODE,MDD26-16N1B,1600V,36A,B,IXYS	1	1	1
IGBT	IGBT-100045-02	TR,IGBT,CM1400DU-24NF,1200V,1400A,MITSUBISHI	3		
	IGBT-100045-03	TR,IGBT,CM900DU-24NF,1200V,900A,MITSUBISHI		6	6
Fuse	FU-100532-00	FUSE,PF,170M5464,690V, 800A,BUSSMANN	3		
	FU-100533-00	FUSE,PF,170M5465,690V, 900A,BUSSMANN		3	
	FU-100534-00	FUSE,PF,170M5466,690V, 1000A,BUSSMANN			3
Fuse detector (micro switch)	FU-100535-00	S/W,DECTECTOR,170H0235,BUSMANN,250V,2A	3	3	3
Fuse, PC Bd. mount (fan+SMPS)	FU-603	Fuse, 1A, 600V, PC Bd. mount (Fan & SMPS)	4	4	4
Electrolytic capacitor	CA-100182-00	CAP,CE,HXA2G682Y,DC400V,6800UF,HIT	20	22	24
Fan	FA-100504-03	FAN,DF,9LB1424S5,DC24V,140SQ*50.8MM(SP),SANYO	5	6	6
Charging resistor	RES-100286-02	RES,METAL CLAD,ULH500(24),500W,24,J,RARA	2		
	RES-100286-03	RES,METAL CLAD,ULV1000(10),1000W,10,J,RARA		1	
	RES-100286-04	RES,METAL CLAD,ULV1000(8),1000W,8,J,RARA			1
Thermal switch	TH-100035-00	SENSOR,OHD,OHD-90B,TOKIN	1	1	1
Thermistor	TH-100036-00	SENSOR,NTC,TH225J37G,Thermometrics	1	1	1
Keypad/Display	LCD-100000-00	Assy,Loader(LCD) BENSHAW, SV-IP5A	1	1	1
Bezel, Keypad mount	VFD-KEYPAD-SG-BEZEL	COVER,LOADER BRK,SV-iP5A	1	1	1
Terminal Block, Control Bd.	TE-100883-01	Terminal Block, SG Ctrl Board, 5P, SG (new style after Aug 2008)	1	1	1
Terminal Block, Control Bd.	TE-100883-02	Terminal Block, SG Ctrl Board, 6P, SG (new style after Aug 2008)	1	1	1
Terminal Block, Control Bd.	TE-100883-03	Terminal Block, SG Ctrl Board, 7P, SG (new style after Aug 2008)	1	1	1
Terminal Block, Control Bd.	TE-100883-04	Terminal Block, SG Ctrl Board, 7P, SG (new style after Aug 2008)	1	1	1
Terminal Block, Control Bd.	TE-100883-05	Terminal Block, SG Ctrl Board, 7P, SG (new style after Aug 2008)	1	1	1
Terminal Block, Control Bd.	TE-100883-06	Terminal Block, SG Ctrl Board, 7P, SG (new style after Aug 2008)	1	1	1

SG SPARE PARTS LIST - 575V (7.5 - 40 HP)

Description	Part Number	Specification	Horsepower						
			7.5	10	15	20	25	30	40
Control PCB assembly	PC-100062-00	PCB ASS'Y,CONTROL,SV-IP5 (New) - for Benshaw	1	1	1	1	1	1	1
POWER PCB assembly	PC-100074-00	PCB ASS'Y,POWER,SV-IP5A,0055-6	1						
	PC-100074-01	PCB ASS'Y,POWER,SV-IP5A,0075-6		1					
	PC-100074-02	PCB ASS'Y,POWER,SV-IP5A,0110-6			1				
	PC-100074-03	PCB ASS'Y,POWER,SV-IP5A,0150-6				1			
	PC-100074-04	PCB ASS'Y,POWER,SV-IP5A,0185-6					1		
	PC-100074-05	PCB ASS'Y,POWER,SV-IP5A,0220-6						1	
	PC-100074-06	PCB ASS'Y,POWER,SV-IP5A,0300-6							1
MAIN SMPS PCB assembly	PC-100075-00	PCB ASS'Y,MAIN SMPS,SV-IP5A,0150/0185-6				1	1		
	PC-100075-01	PCB ASS'Y,MAIN SMPS,SV-IP5A,0220/0300-6						1	1
SAFETY PCB assembly	PC-100073-00	PCB ASS'Y,SAFETY,IP5A,0055~0110-6	1	1	1				
	PC-100072-00	PCB ASS'Y,SAFETY,IP5A,0150~0300-6				1	1	1	1
Rectifier diode module	DI-100084-00	DIODE,RD,SKD53/18,1800V,53A,B,SEMIKRON	1	1	1	1			
	DI-100084-01	DIODE,RD,SKD83/18,1800V,83A,B,SEMIKRON					1	1	1
IGBT	IGBT-100083-00	TR,IGBT,FS50R17KE3_B17,1700V,50A,INFINEON	1	1	1	1	1		
	IGBT-100083-01	TR,IGBT,FS75R17KE3,1700V,75A,INFINEON						1	
	IGBT-100083-02	TR,IGBT,FS100R17KE3,1700V,100A,INFINEON							1
Terminal Block Kit, Control Bd.	TE-100883-00	For Control Bd. All 6 terminal blocks (new style after Aug 2008)	1	1	1	1	1	1	1
Keypad/Display	LCD-100000-00	Assy,Loader(LCD) BENSHAW, SV-IP5A	1	1	1	1	1	1	1

SG SPARE PARTS LIST - 575V (50 - 125 HP)

Description	Part Number	Specification	Horsepower				
			50	60	75	100	125
Control PCB assembly	PC-100063-00	PCB ASS'Y,CONTROL,IP5A,370~900-4 (New) - for Benshaw	1	1	1	1	1
Main SMPS PCB assembly	PC-100076-00	PCB ASS'Y,MAIN SMPS,SV-IP5A,0370-6	1				
	PC-100076-01	PCB ASS'Y,MAIN SMPS,SV-IP5A,0750-6		1		1	
	PC-100076-02	PCB ASS'Y,MAIN SMPS,SV-IP5A,0900-6			1		1
Drive SMPS PCB assembly	PC-100077-00	PCB ASS'Y,DRIVE,SV-IP5A,0750-6	1	1	1	1	
	PC-100077-01	PCB ASS'Y,DRIVE,SV-IP5A,0900-6					1
FAN SMPS PCB assembly	PC-100078-00	PCB ASS'Y,FAN SMPS,IP5A,0370~1100-6	1	1	1	1	1
SCR SNUBBER PCB assembly	PC-100079-00	PCB ASS'Y,INPUT SNUBBER,SV-IP5A,0370~0550-6	1	1	1		
	PC-100079-01	PCB ASS'Y,INPUT SNUBBER,SV-IP5A,0750~0900-6				1	1
CT PCB assembly	PC-100080-00	PCB ASS'Y,C/T,SV-IP5A,0450-6	1	1			
	PC-100080-01	PCB ASS'Y,C/T,SV-IP5A,0550-6			1		
	PC-100080-02	PCB ASS'Y,C/T,SV-IP5A,0750-6				1	
	PC-100080-03	PCB ASS'Y,C/T,SV-IP5A,0900-6					1
Rectifier diode module	DI-100085-00	DIODE,SCR,SKKH57/18,1800V,55A,B,SEMIKRON	3	3			
	DI-100085-01	DIODE,SCR,SKKH92/18,1800V,95A,B,SEMIKRON			3		
SCR gate PCB	PC-100081-00	Silk Screen 10110003340	1	1	1	1	1
IGBT	IGBT-100084-00	TR,IGBT,FF200R17KE3,1700V,200A,INFINEON	3	3	3	3	
	IGBT-100084-01	TR,IGBT,FF300R17KE3,1700V,300A,INFINEON					3
IGBT GATE PCB assembly	PC-100082-00	PCB ASS'Y,IGBT GATE SUB,SV-IP5A,0370~1100-6	3	3	3	3	3
Fuse (with indicator)	FU-100472-00	FUSE,PF,660GH 160S UL,660V,160A,HINODE	1	1			
	FU-100473-00	FUSE,PF,660GH 200S UL,660V,200A,HINODE			1		
	FU-100474-00	FUSE,PF,660GH 250S UL,660V,250A,HINODE				1	
	FU-100475-00	FUSE,PF,660GH 315S UL,660V,315A,HINODE					1
Fuse, PC Bd. mount (fan+SMPS)	FU-603	Fuse, 1A, 600V, PC Bd. mount (fan & SMPS)	2	2	2	2	2
Electrolytic capacitor	CA-100308-00	CAP,CE,FX22H272NE130,DC500V,2700UF,M,85C,77x130,HITACHI	4				
	CA-100309-00	CAP,CE,FX22H332N,DC500V,3300UF,M,85C,77x130,HITACHI		4		6	
	CA-100310-00	CAP,CE,FX22H392NSE130R,DC500V,3900UF,M,85C,77x130,HITACHI			4		
	CA-100311-00	CAP,CE,FX22H392N,DC500V,3900UF,M,85C,77*155,HITACHI					6
Fan	FA-100022-00	FAN,DF,G1238E24B-FS-EM,DC24V,120SQ(300mm),DCC	2	2	2		
	FA-100023-00	FAN,DF,FFB1424VHG-R00,DC24V,140SQ*50.8MM,DELTA				2	2
Charging resistor	RES-100181-00	RES,METAL CLAD,MCRBC60W40J,60W,40,J,B,Fullohm	1	1	1		
	RES-100179-00	RES,METAL CLAD,MCRBC150W30J,150W,30,J,B,Fullohm				1	1
Thermistor	TH-100036-00	SENSOR,NTC,TH225J37G,Thermometrics	1	1	1	1	1
Keypad/Display	LCD-100000-00	Assy,Loader(LCD) BENSHAW, SV-IP5A	1	1	1	1	1
Bezel, Keypad mount	VFD-KEYPAD-SG-BEZEL	COVER,LOADER BRK,SV-iP5A	1	1	1	1	1
Terminal Block, Control Bd.	TE-100883-01	Terminal Block, SG Ctrl Board, 5P, SG (new style after Aug 2008)	1	1	1	1	1
Terminal Block, Control Bd.	TE-100883-02	Terminal Block, SG Ctrl Board, 6P, SG (new style after Aug 2008)	1	1	1	1	1
Terminal Block, Control Bd.	TE-100883-03	Terminal Block, SG Ctrl Board, 7P, SG (new style after Aug 2008)	1	1	1	1	1
Terminal Block, Control Bd.	TE-100883-04	Terminal Block, SG Ctrl Board, 7P, SG (new style after Aug 2008)	1	1	1	1	1
Terminal Block, Control Bd.	TE-100883-05	Terminal Block, SG Ctrl Board, 7P, SG (new style after Aug 2008)	1	1	1	1	1
Terminal Block, Control Bd.	TE-100883-06	Terminal Block, SG Ctrl Board, 7P, SG (new style after Aug 2008)	1	1	1	1	1



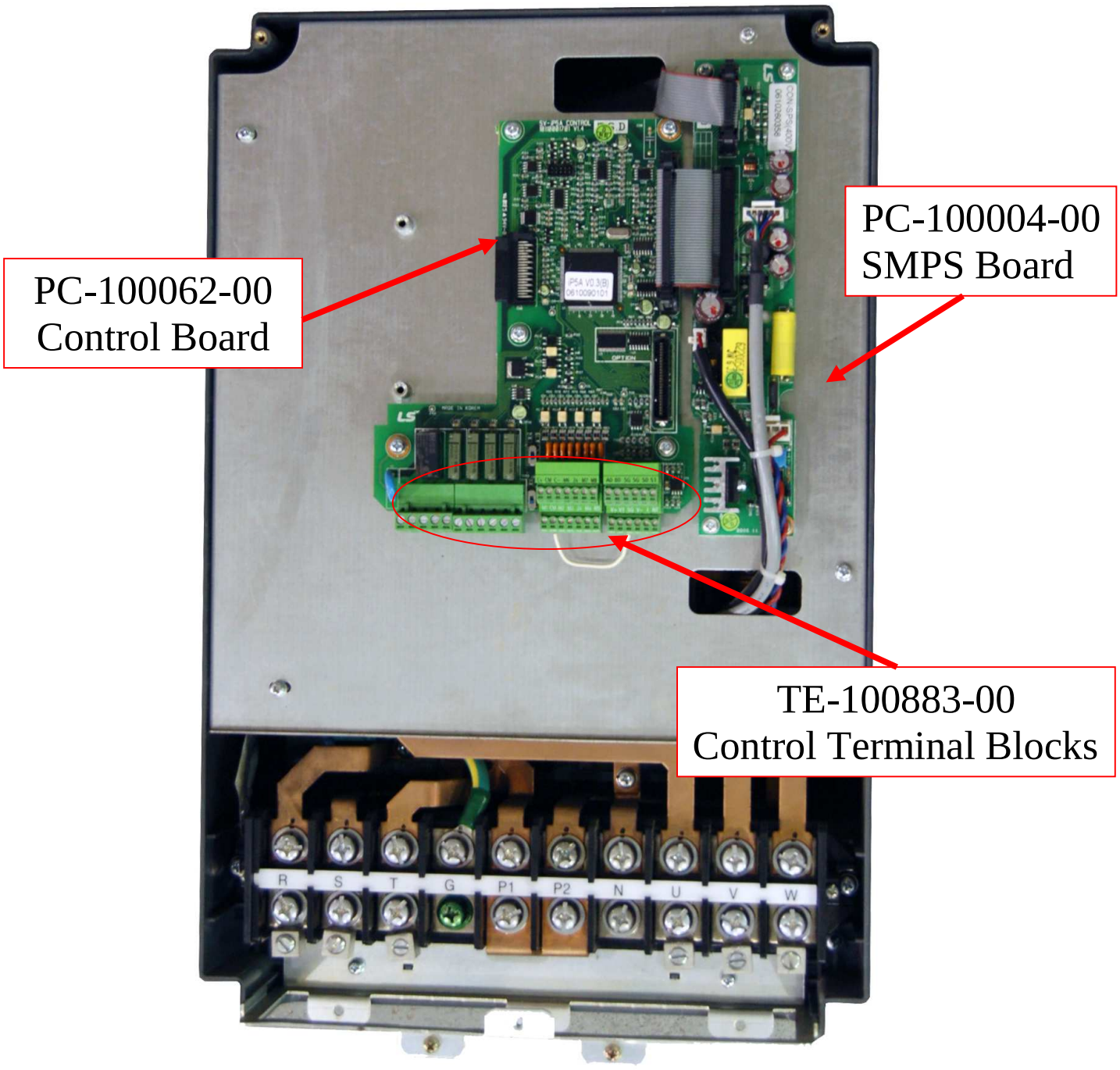
BENSHAW®
ADVANCED CONTROLS & DRIVES

Section 2

Drive Component Layouts

BENSHAW®
ADVANCED CONTROLS & DRIVES

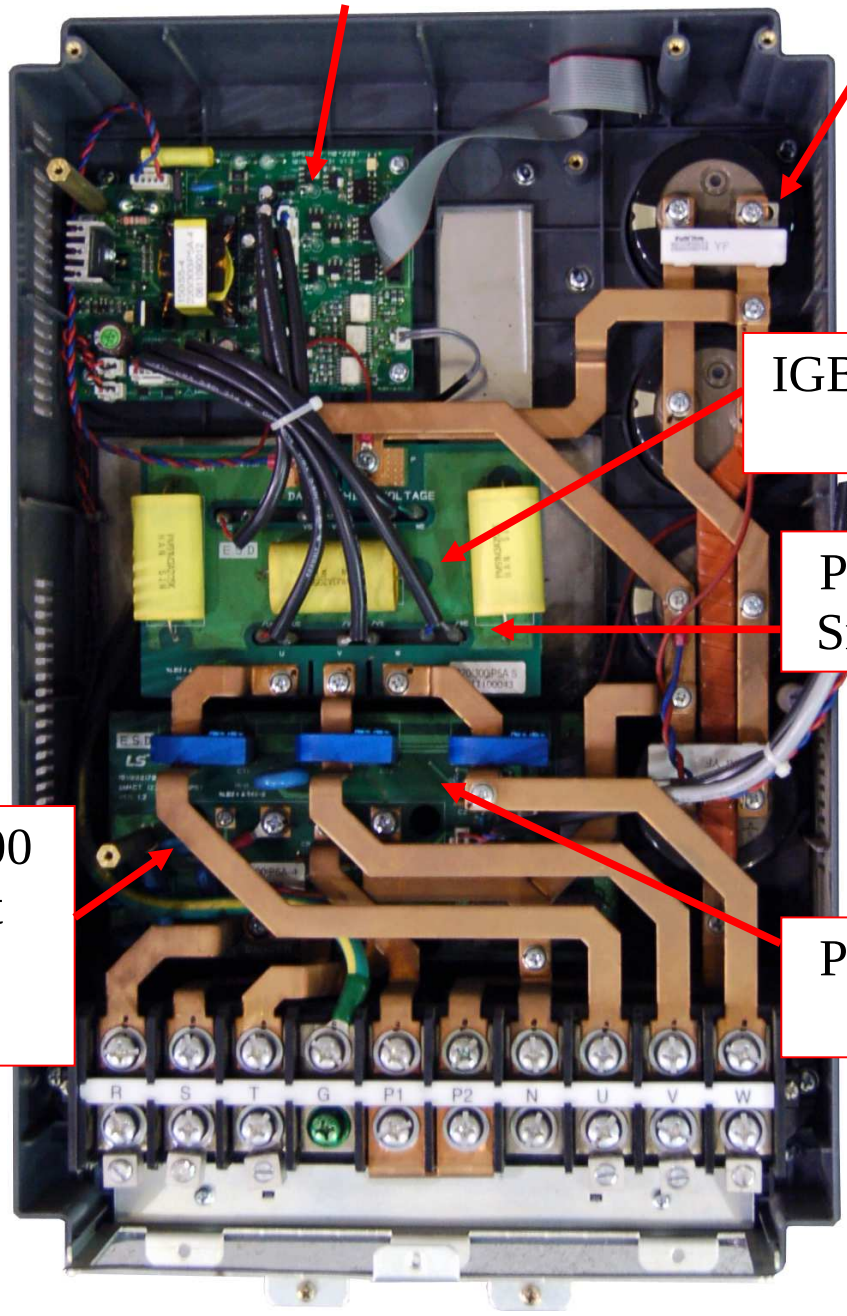
RSi-030-SG-4B
RSi-040-SG-4B



RSi-030-SG-4B
RSi-040-SG-4B

PC-100002-00
DRV SMPS
Board

CA-100132-00
3300uF Capacitors
Qty 4



IGBT-100034-00
IGBT

PC-100016-00
Snubber Board

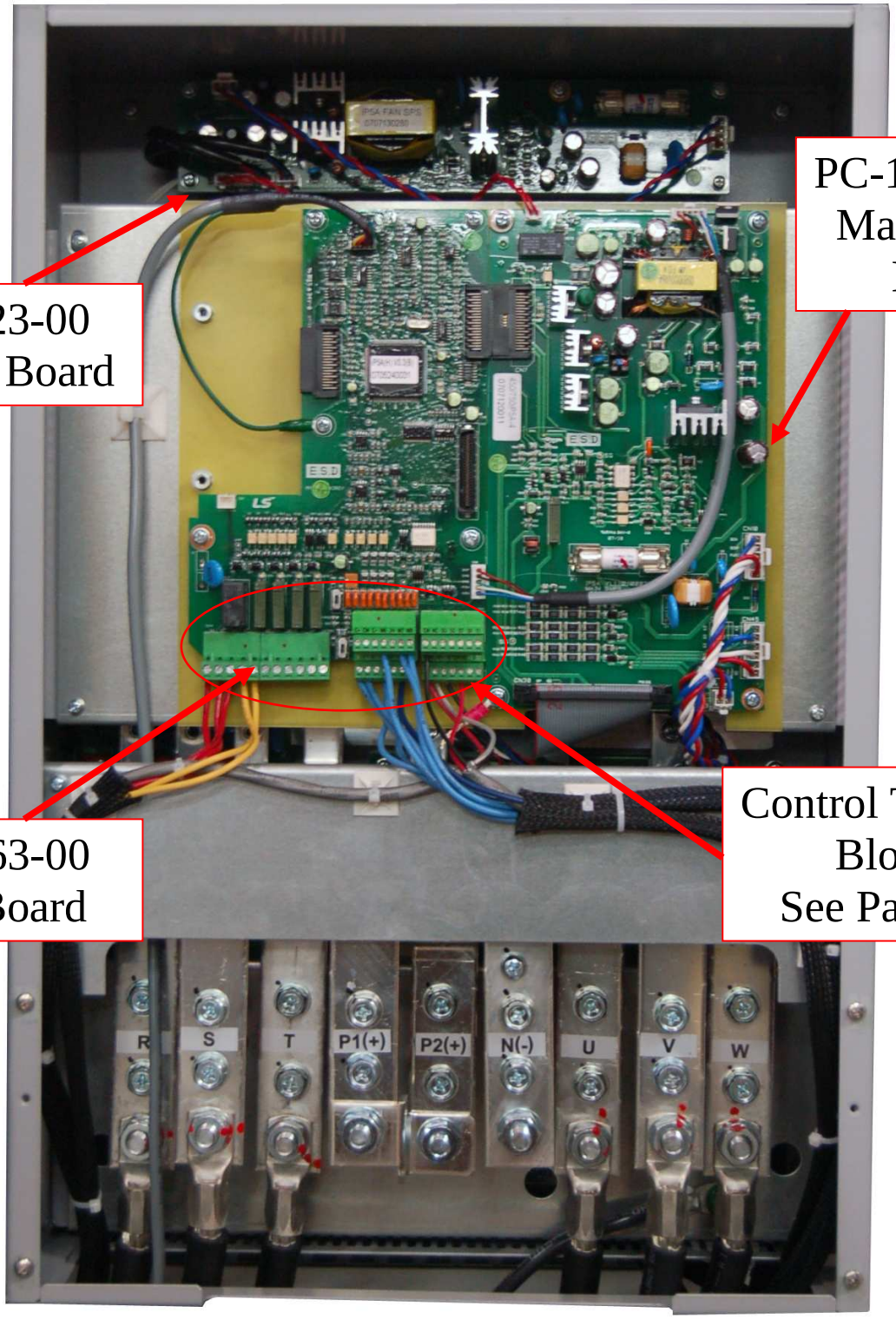
DI-100044-00
150A Input
Diodes
Qty 1

PC-100014-00
CT PCB

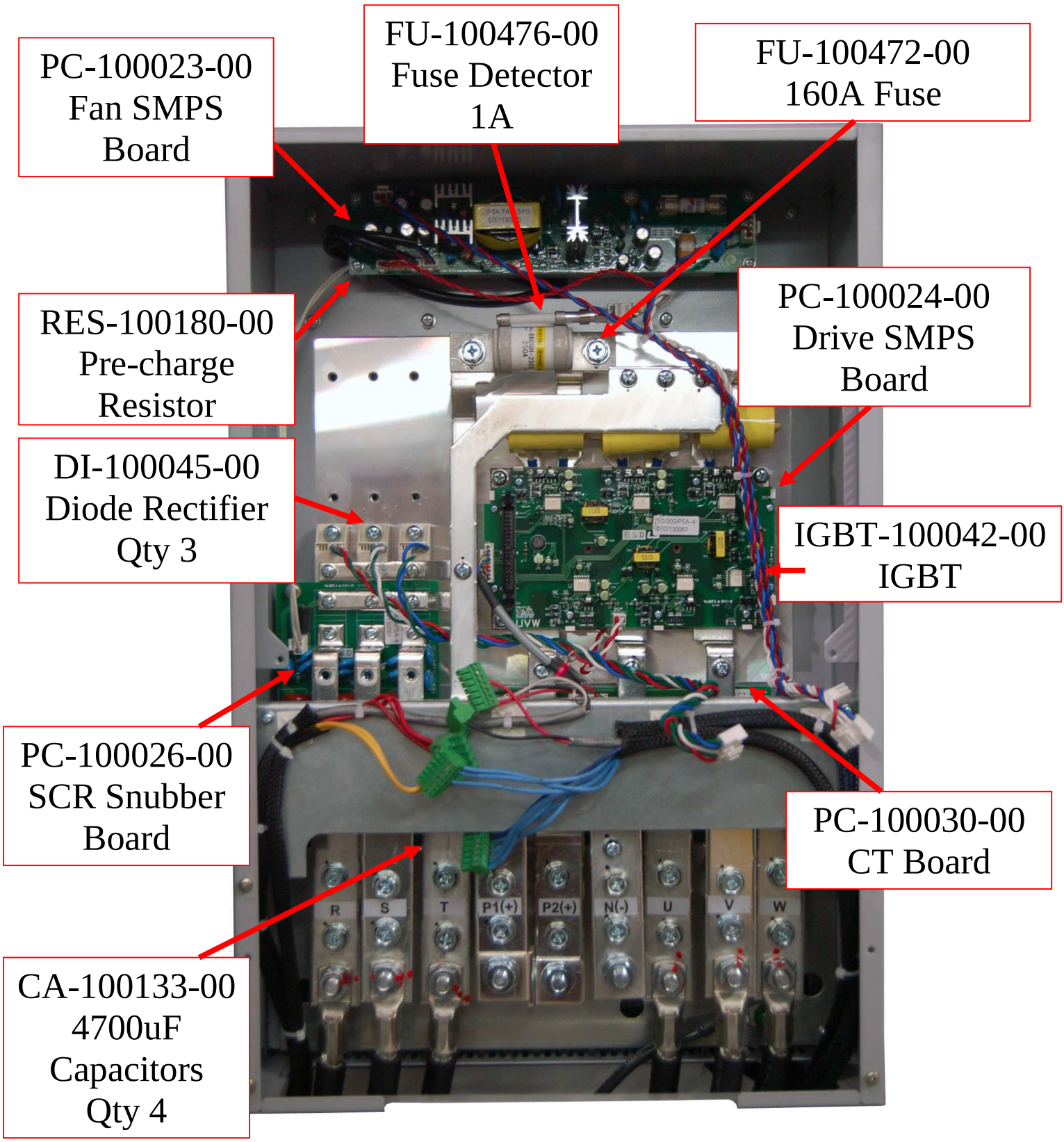
RSi-030-SG-4B
RSi-040-SG-4B

BENSHAW®
ADVANCED CONTROLS & DRIVES

RSi-050-SG-4B


PC-100065-00
Main SMPS
Board
PC-100023-00
Fan SMPS Board
PC-100063-00
Control Board
Control Terminal
Blocks
See Parts List
R
S
T
P1(+)
P2(+)
N(-)
U
V
W

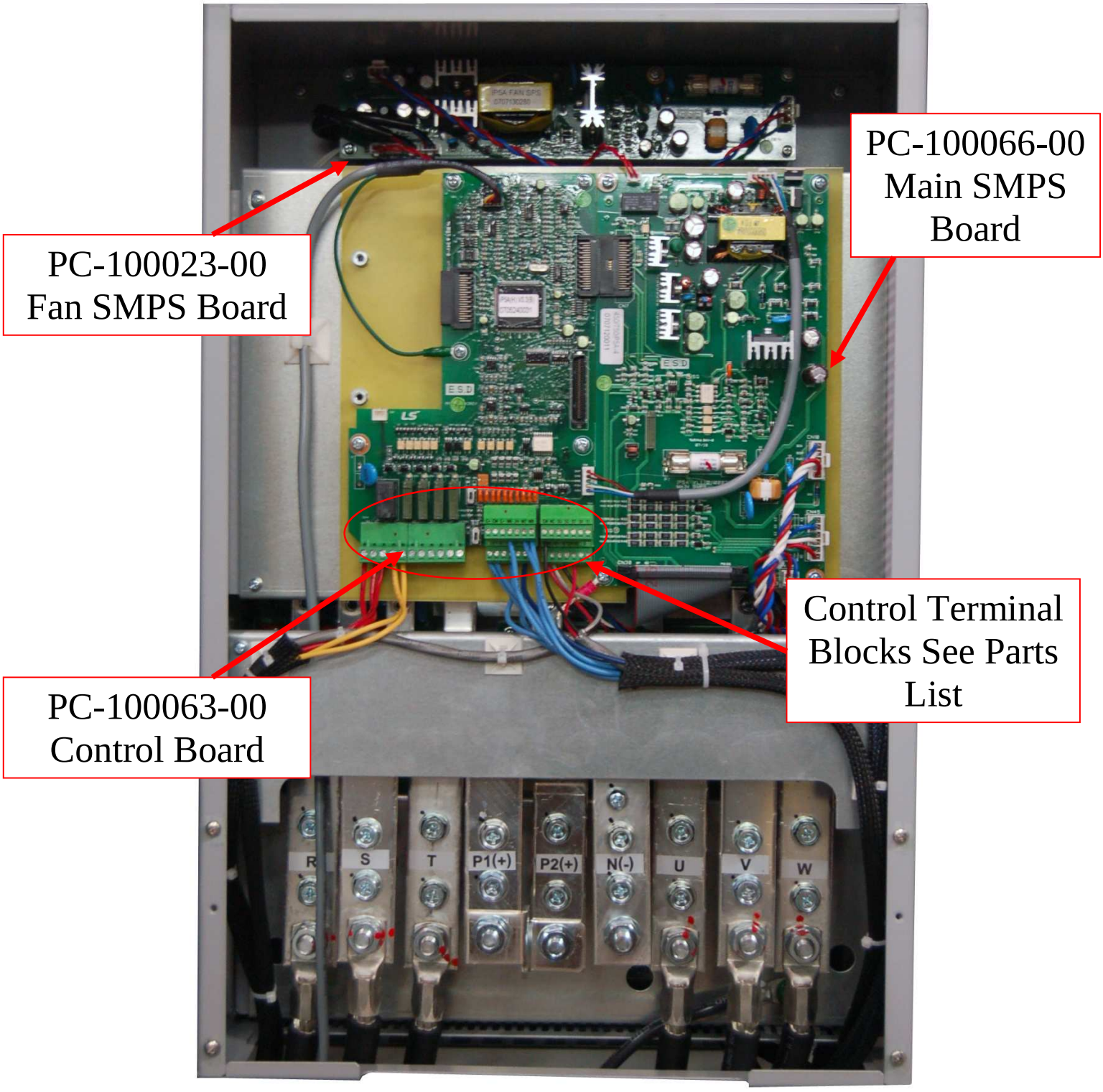
RSi-050-SG-4B


PC-100023-00
Fan SMPS
Board
FU-100476-00
Fuse Detector
1A
FU-100472-00
160A Fuse
RES-100180-00
Pre-charge
Resistor
PC-100024-00
Drive SMPS
Board
DI-100045-00
Diode Rectifier
Qty 3
IGBT-100042-00
IGBT
PC-100026-00
SCR Snubber
Board
PC-100030-00
CT Board
CA-100133-00
4700uF
Capacitors
Qty 4
R
S
T
P1(+)
P2(+)
N(-)
U
V
W

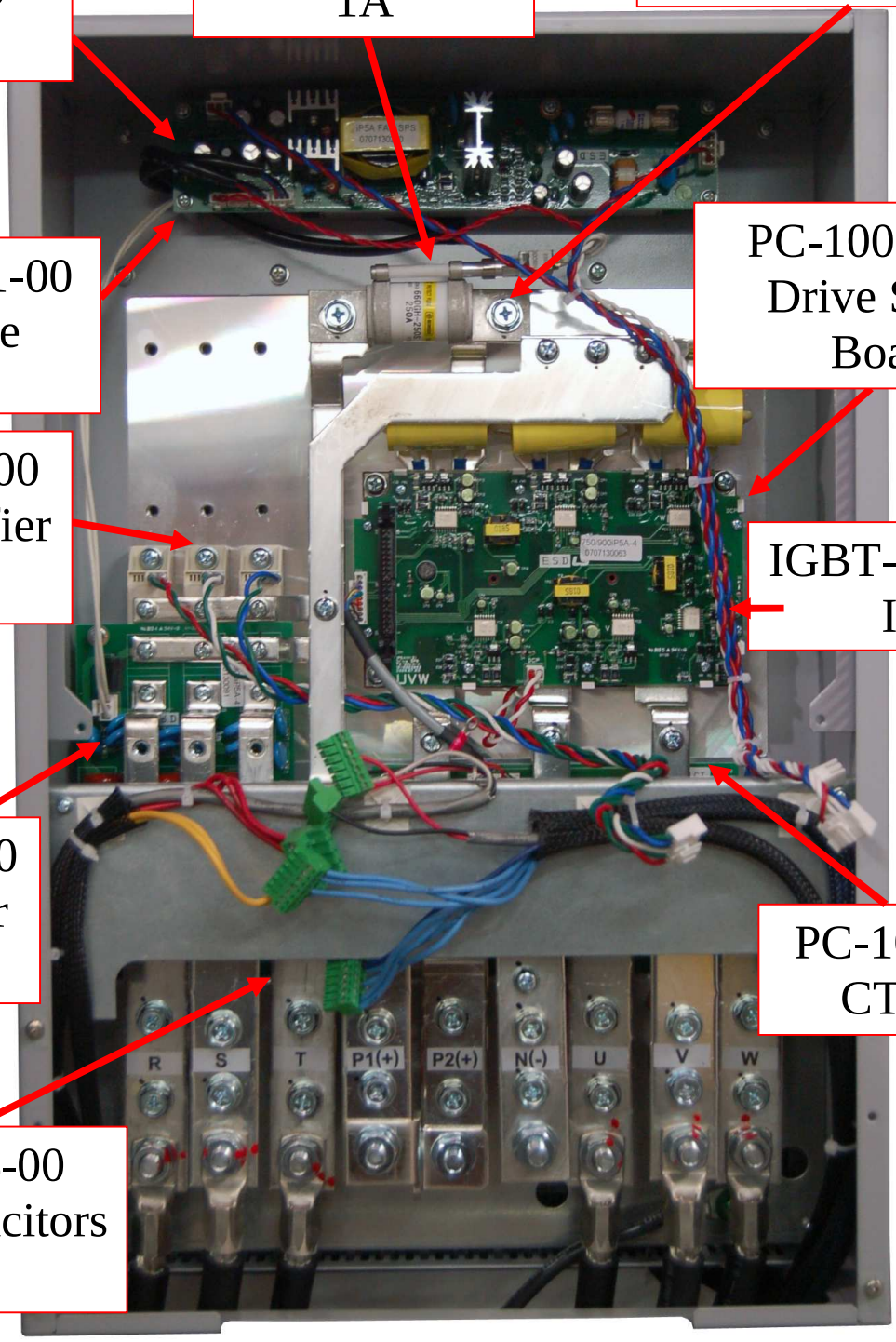
RSi-050-SG-4B

BENSHAW®
ADVANCED CONTROLS & DRIVES

RSi-060-SG-4B


PC-100066-00
Main SMPS
Board
PC-100023-00
Fan SMPS Board
Control Terminal
Blocks See Parts
List
PC-100063-00
Control Board
R
S
T
P1(+)
P2(+)
N(-)
U
V
W

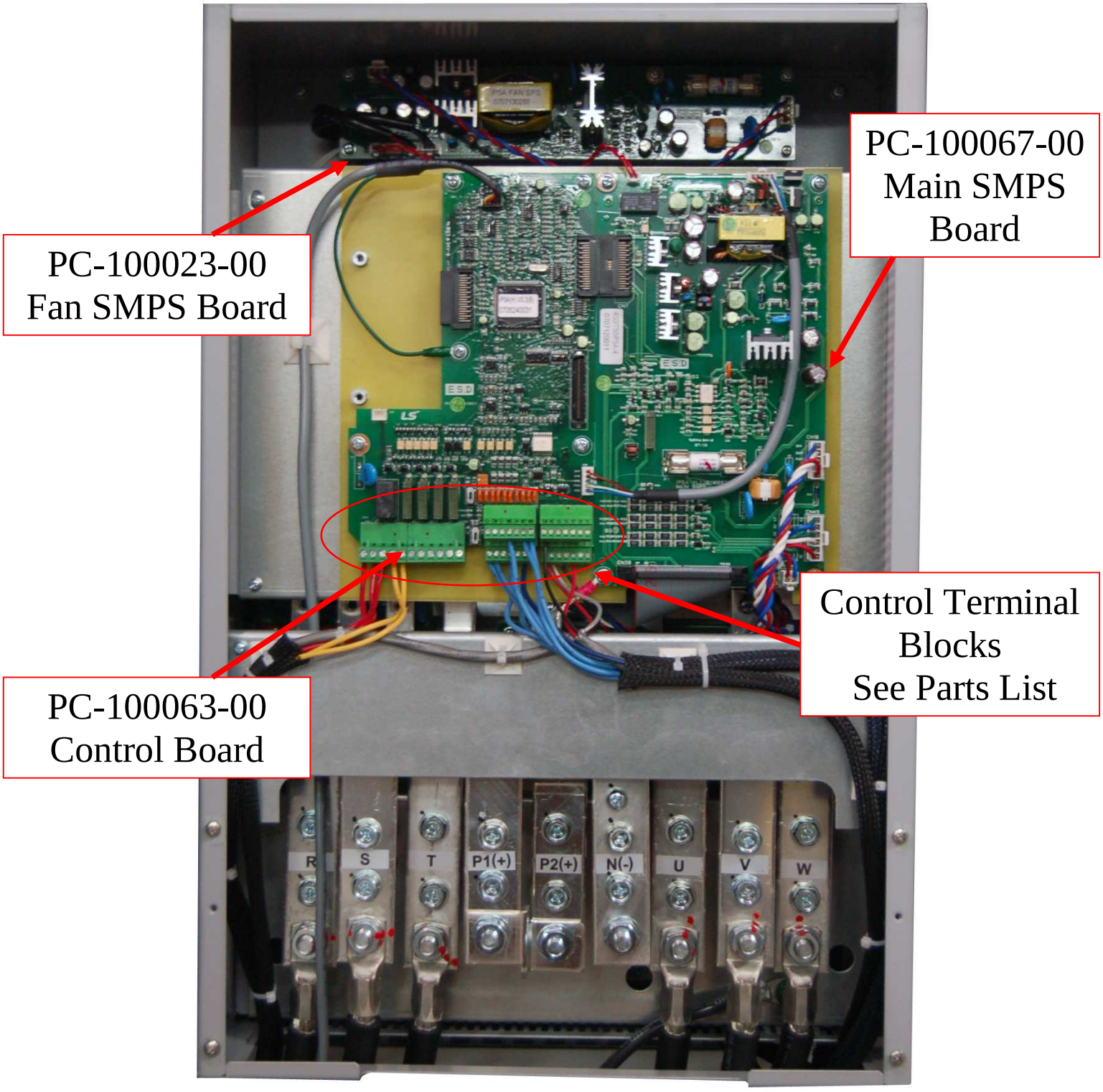
RSi-060-SG-4B


PC-100023-00
Fan SMPS
Board
FU-100476-00
Fuse Detector
1A
FU-100472-00
160A Fuse
RES-100181-00
Pre-charge
Resistor
PC-100024-00
Drive SMPS
Board
DI-100047-00
Diode Rectifier
Qty 3
IGBT-100042-00
IGBT
PC-100026-00
SCR Snubber
Board
PC-100030-00
CT Board
CA-100134-00
5600 uF Capacitors
Qty 4
R
S
T
P1(+)
P2(+)
N(-)
U
V
W

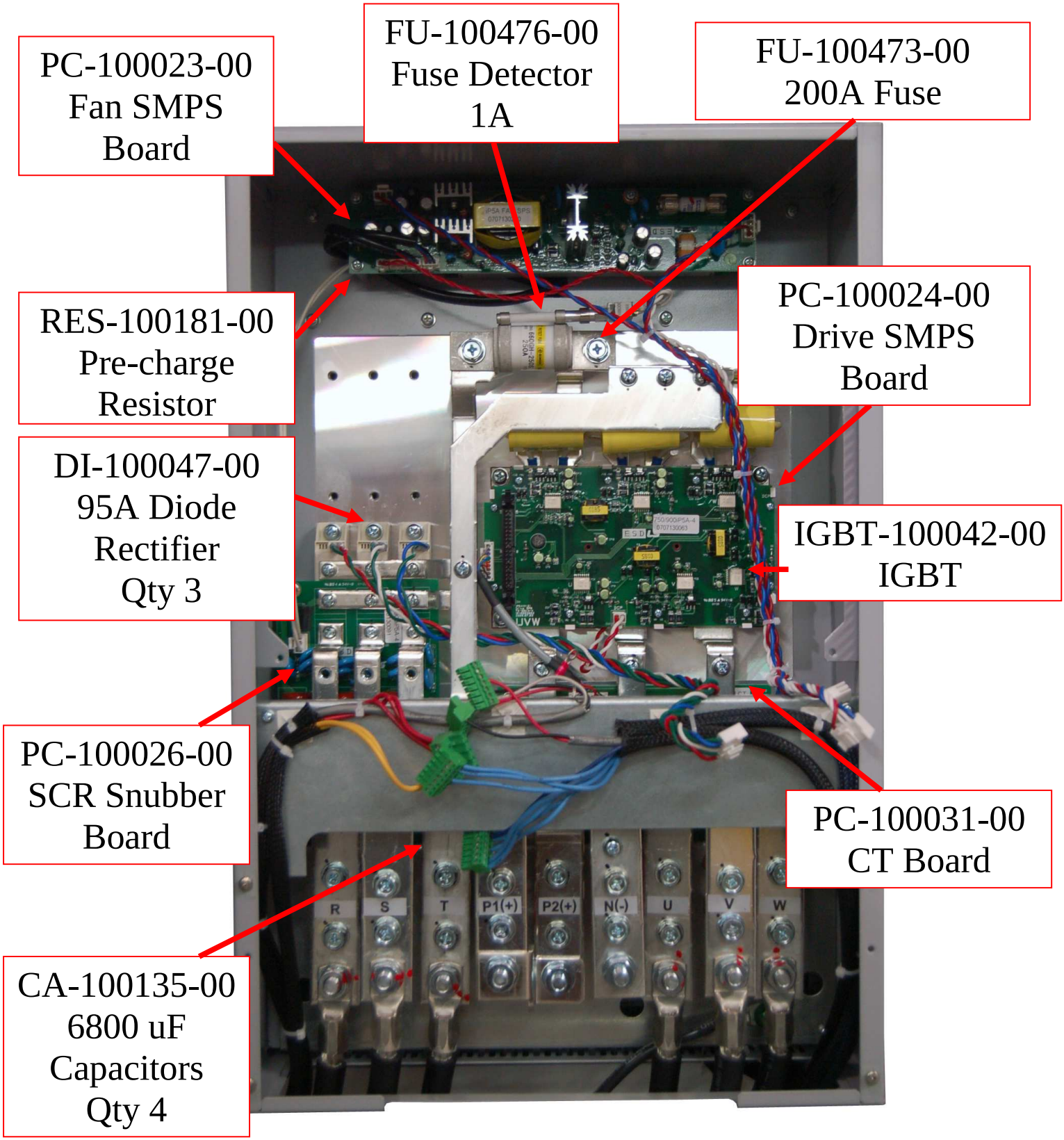
RSi-060-SG-4B

BENSHAW®
ADVANCED CONTROLS & DRIVES

RSi-075-SG-4B


PC-100023-00
Fan SMPS Board
PC-100067-00
Main SMPS
Board
Control Terminal
Blocks
See Parts List
PC-100063-00
Control Board
R
S
T
P1(+)
P2(+)
N(-)
U
V
W

RSi-075-SG-4B


PC-100023-00
Fan SMPS
Board
FU-100476-00
Fuse Detector
1A
FU-100473-00
200A Fuse
RES-100181-00
Pre-charge
Resistor
PC-100024-00
Drive SMPS
Board
DI-100047-00
95A Diode
Rectifier
Qty 3
IGBT-100042-00
IGBT
PC-100026-00
SCR Snubber
Board
PC-100031-00
CT Board
CA-100135-00
6800 uF
Capacitors
Qty 4
R
S
T
P1(+)
P2(+)
N(-)
U
V
W

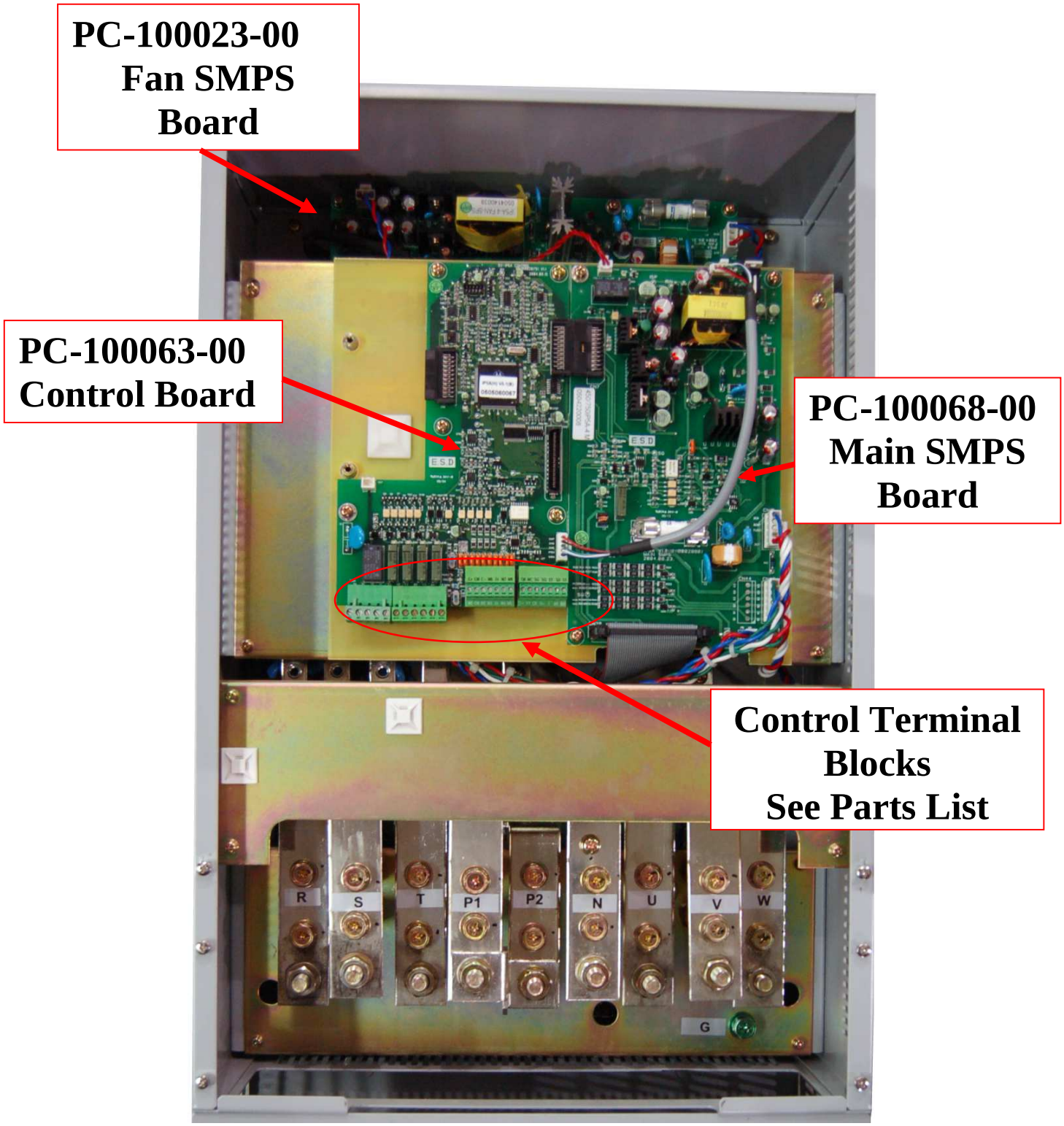
RSi-075-SG-4B

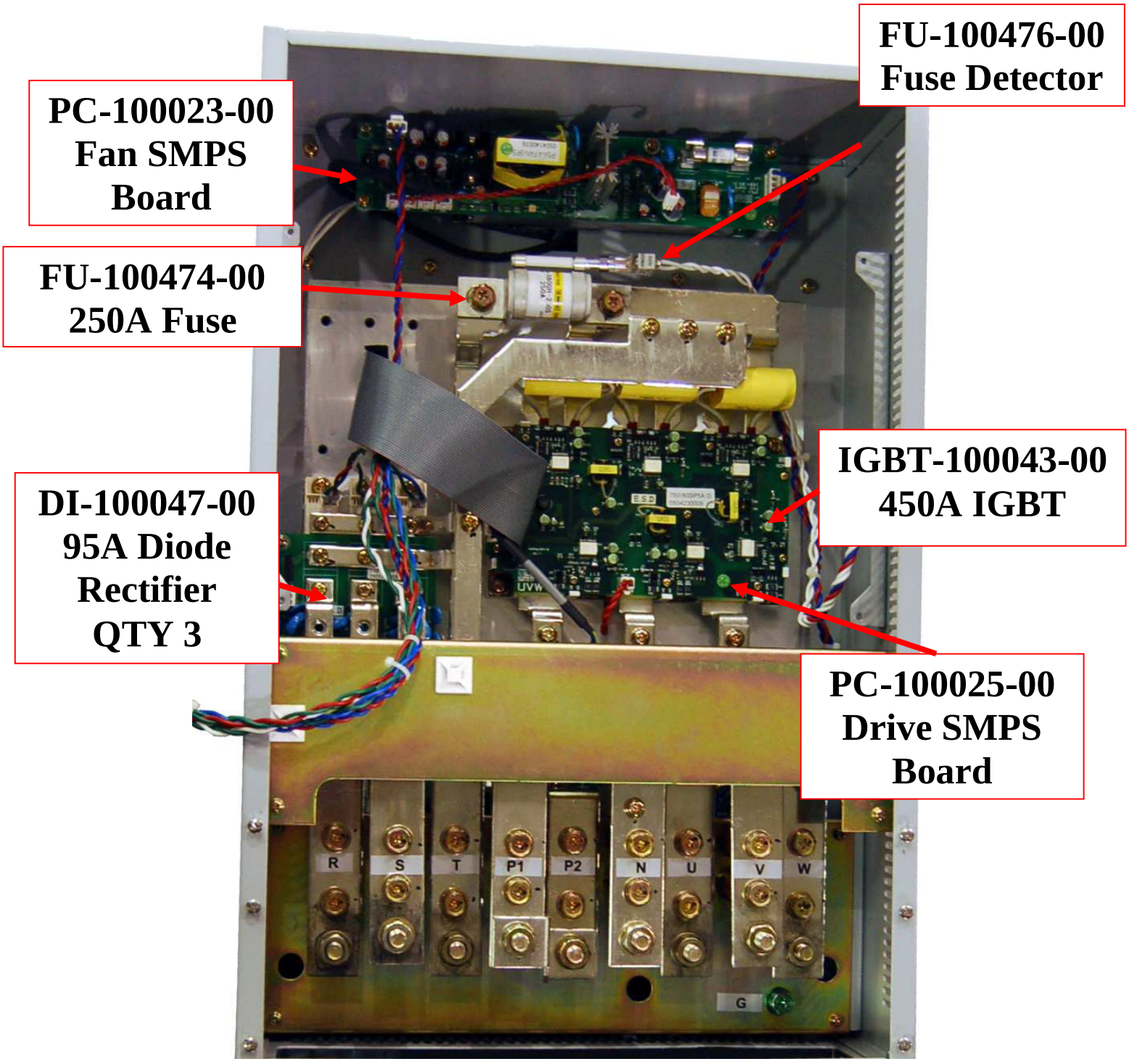
Pub # 890046-10-00
Dec. 2015

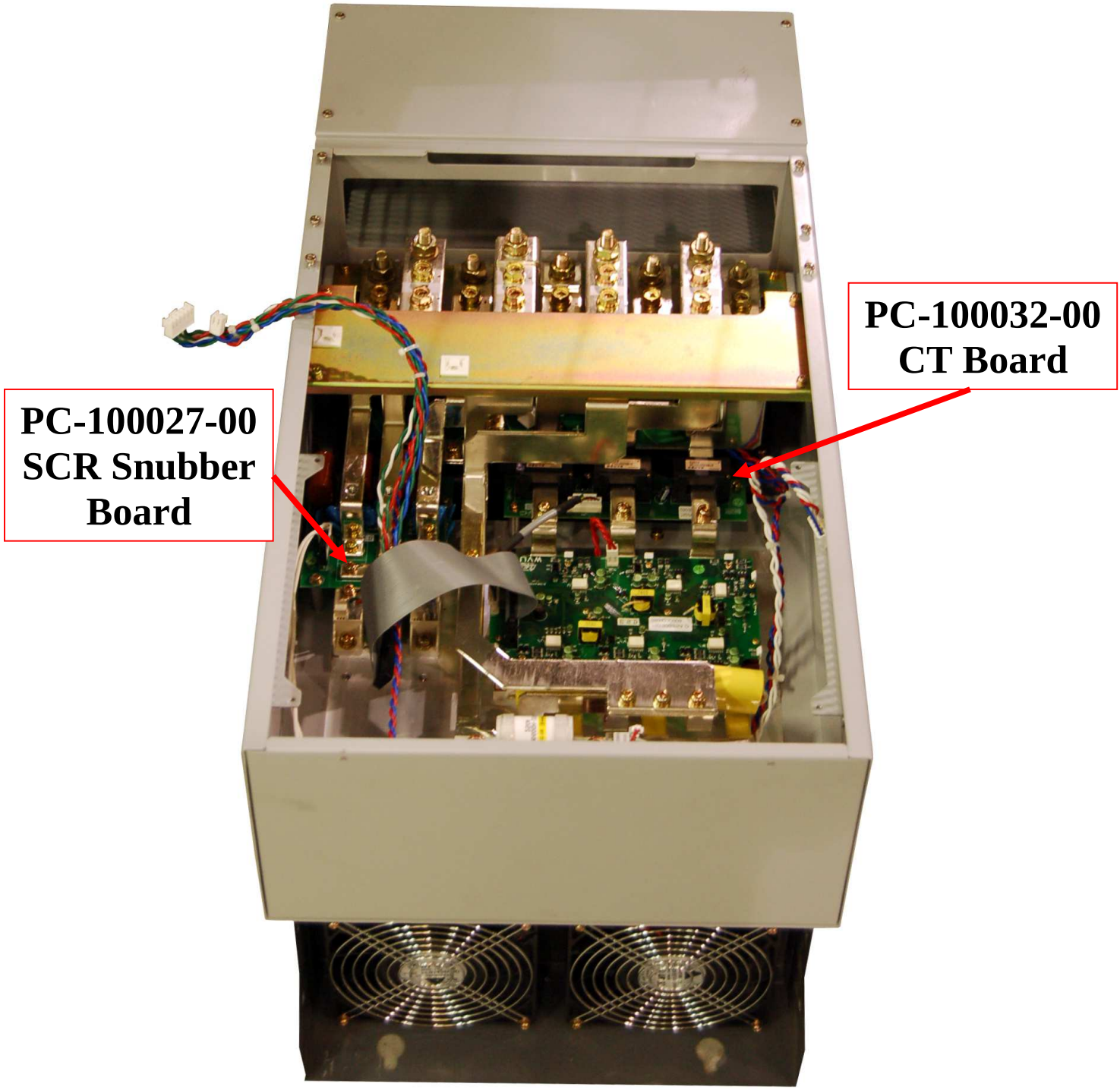
BENSHAW®
ADVANCED CONTROLS & DRIVES

RSi-100-SG-4B


LCD-100000-00
RSi-100-SG-4B
FA-100023-00
QTY 2
SG
SERIES
VARIABLE FREQUENCY DRIVE
BENSHAW
ADVANCED CONTROLS & DRIVES


PC-100023-00
Fan SMPS
Board
PC-100063-00
Control Board
PC-100068-00
Main SMPS
Board
Control Terminal
Blocks
See Parts List
R
S
T
P1
P2
N
U
V
W
G


FU-100476-00
Fuse Detector
PC-100023-00
Fan SMPS
Board
FU-100474-00
250A Fuse
IGBT-100043-00
450A IGBT
DI-100047-00
95A Diode
Rectifier
QTY 3
PC-100025-00
Drive SMPS
Board
R
S
T
P1
P2
N
U
V
W
G



RSi-100-SG-4B

BENSHAW®
ADVANCED CONTROLS & DRIVES

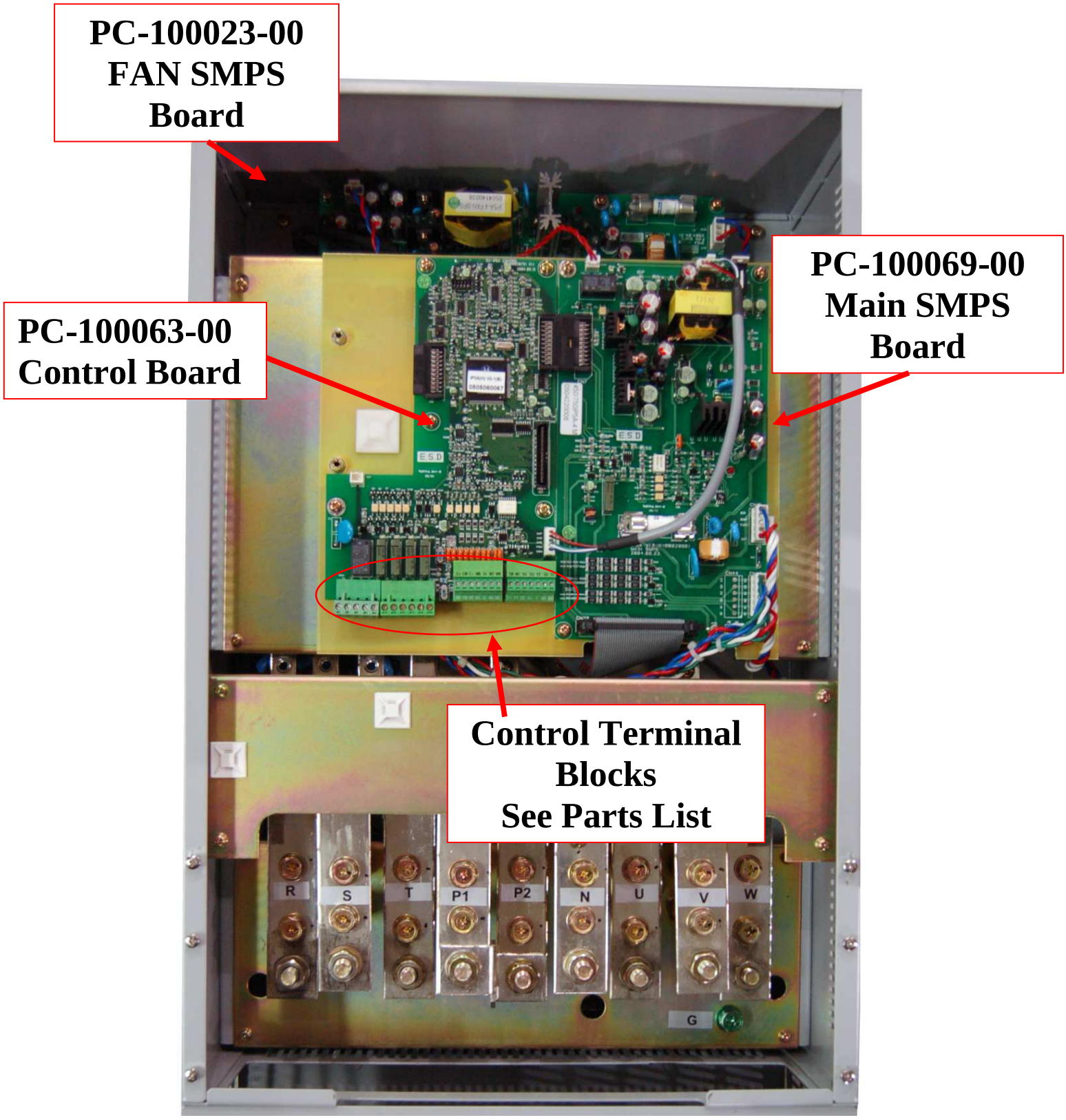
RSi-125-SG-4B

LCD-100000-00

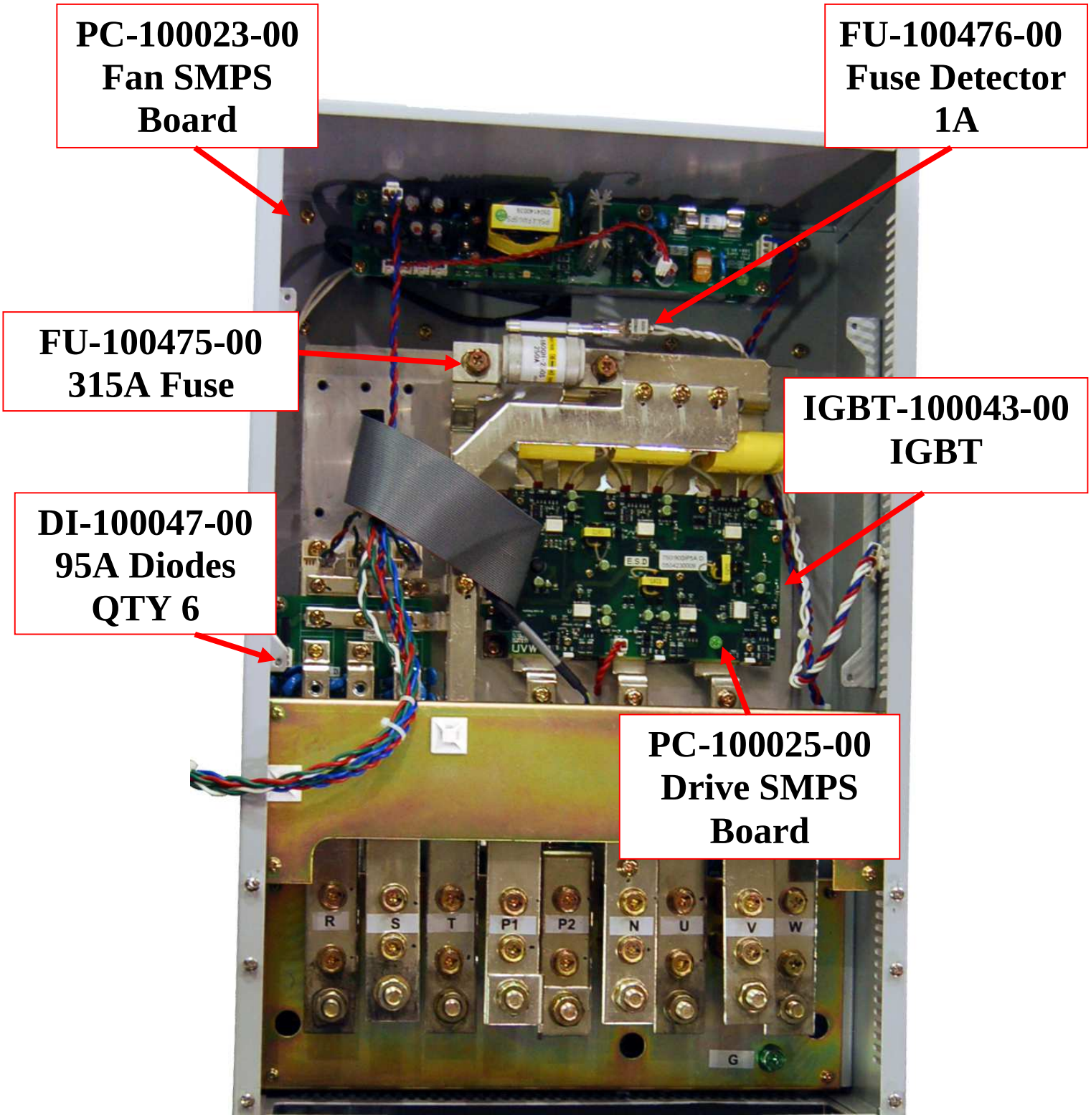
RSi-125-SG-4B

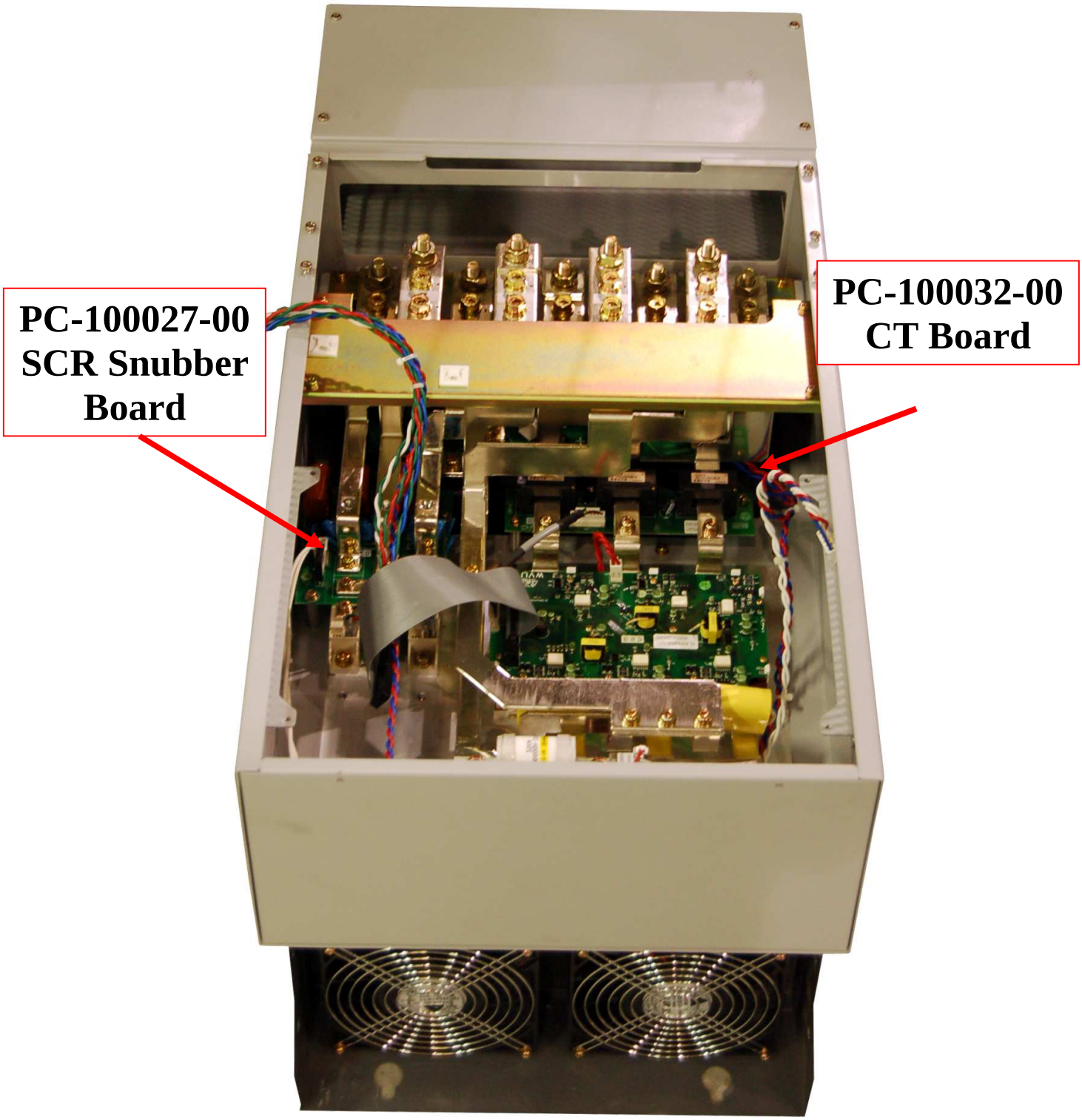
FA-100023-00
Cooling Fan
QTY 2

RSi-125-SG-4B


PC-100023-00
FAN SMPS
Board
PC-100063-00
Control Board
PC-100069-00
Main SMPS
Board
Control Terminal
Blocks
See Parts List
R
S
T
P1
P2
N
U
V
W
G

RSi-125-SG-4B


PC-100023-00
Fan SMPS
Board
FU-100476-00
Fuse Detector
1A
FU-100475-00
315A Fuse
IGBT-100043-00
IGBT
DI-100047-00
95A Diodes
QTY 6
PC-100025-00
Drive SMPS
Board
R
S
T
P1
P2
N
U
V
W
G



RSi-125-SG-4B

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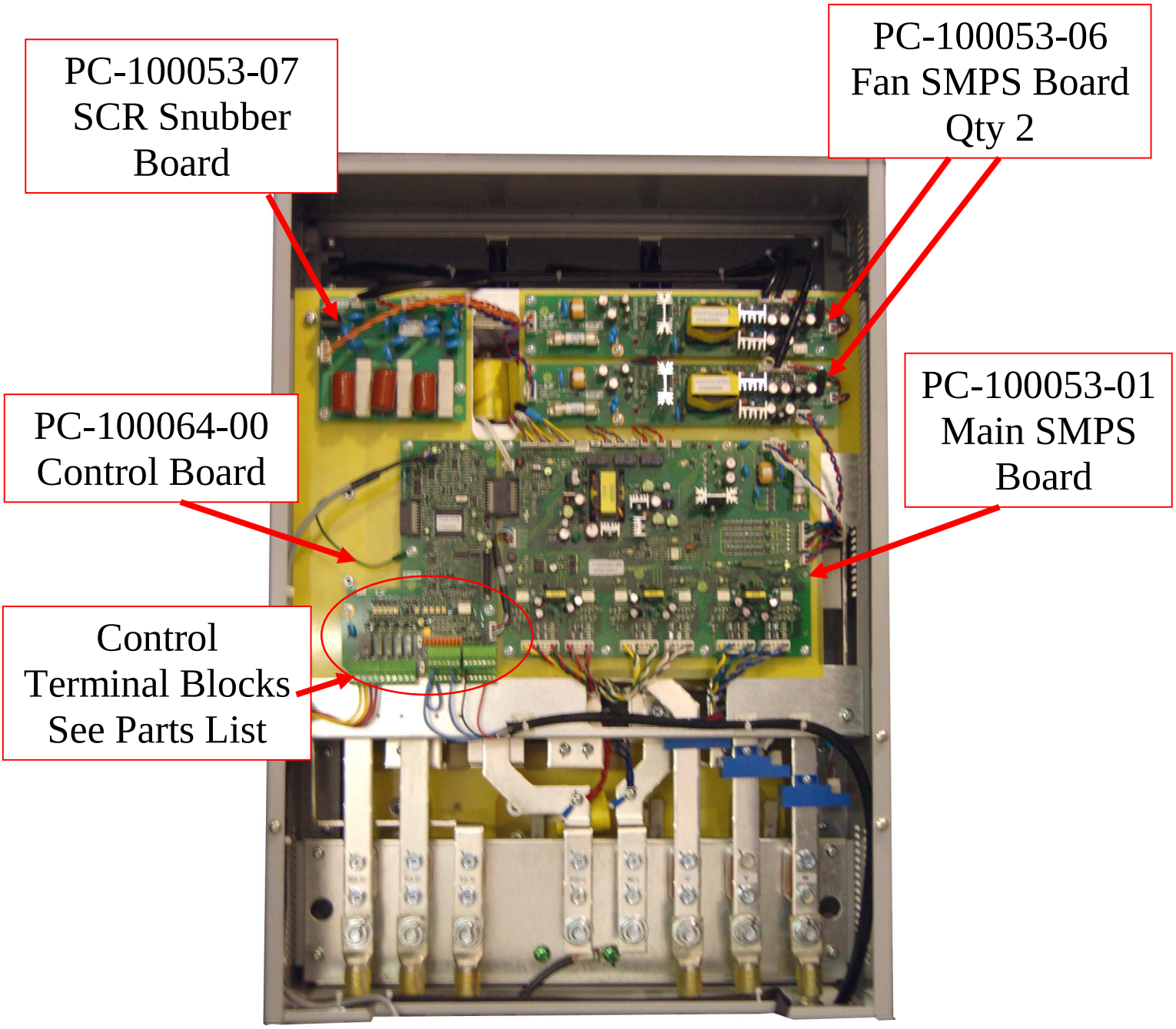
ADVANCED CONTROLS & DRIVES

RSi-150-SG-4

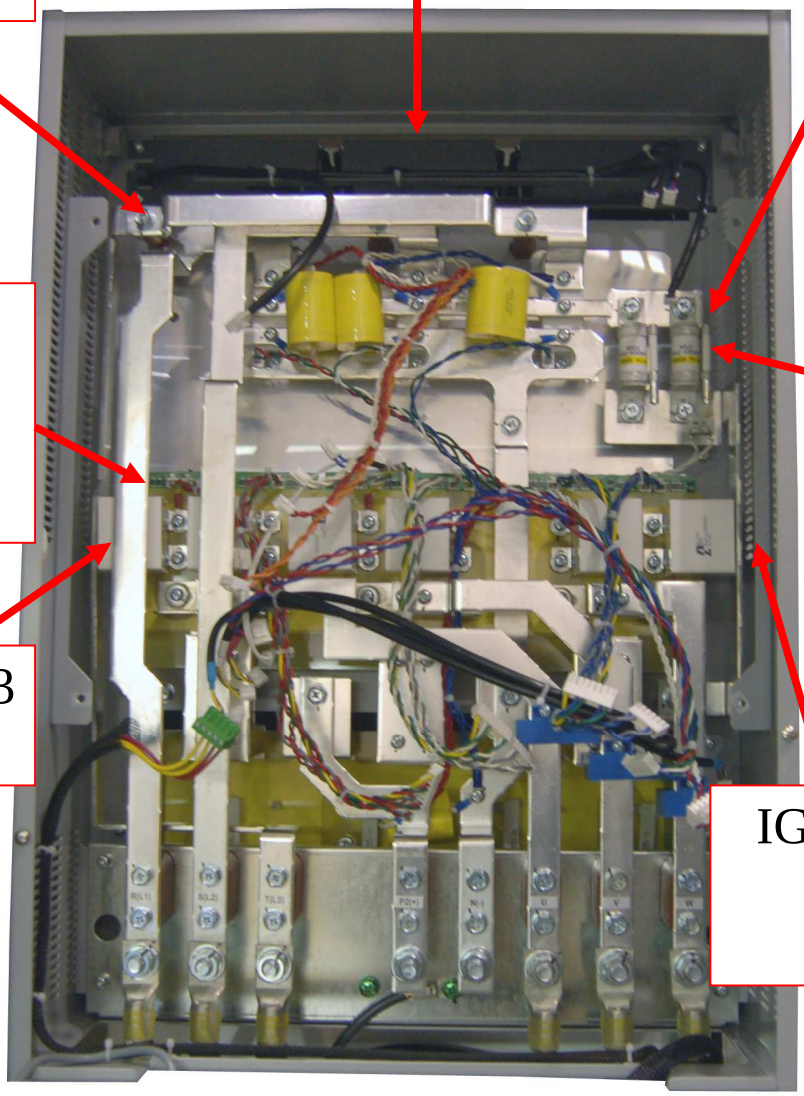

PC-100053-07
SCR Snubber
Board
PC-100053-06
Fan SMPS Board
Qty 2
PC-100064-00
Control Board
PC-100053-01
Main SMPS
Board
Control
Terminal Blocks
See Parts List

RSi-150-SG-4

DI-100057-00
130A Diode
Qty 3

FA-100504-00
Cooling Fan
Qty 3

FU-100476-00
Fuse Detector



FU-100473-00
200A Fuse
Qty 2

PC-100053-14
IGBT Gate
Board
Qty 6

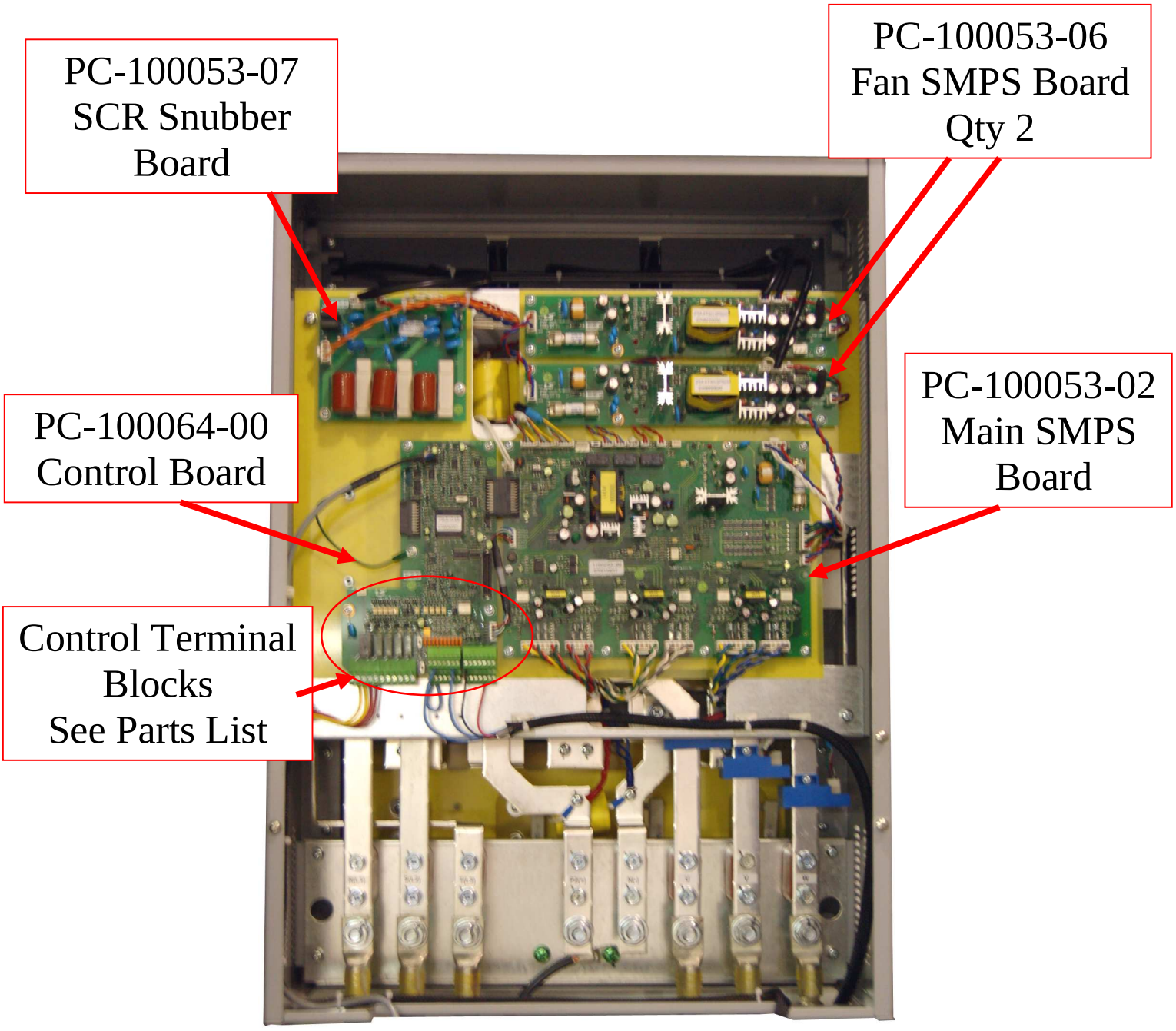
CA-100180-03
Snubber

IGBT-100045-00*
IGBT
Qty 6

* Need to order with PC-100053-14

BENSHAW®
ADVANCED CONTROLS & DRIVES

RSi-200-SG-4


PC-100053-07
SCR Snubber
Board
PC-100053-06
Fan SMPS Board
Qty 2
PC-100064-00
Control Board
PC-100053-02
Main SMPS
Board
Control Terminal
Blocks
See Parts List

FA-100504-00
Cooling Fan
Qty 3

DI-100057-01
160A Diode
Qty 3

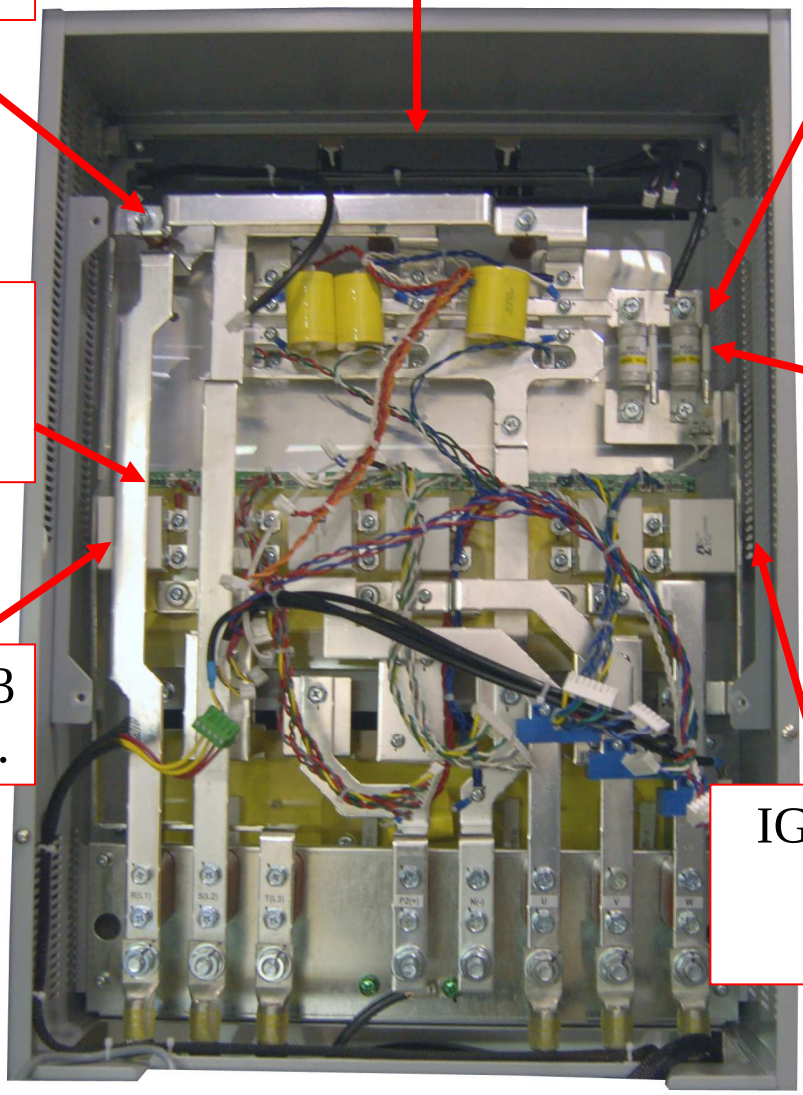
FU-100476-00
Fuse Detector

FU-100474-00
250A Fuse
Qty 2

PC-100053-14
Gate Board
Qty 6

CA-100180-03
Snubber Caps.

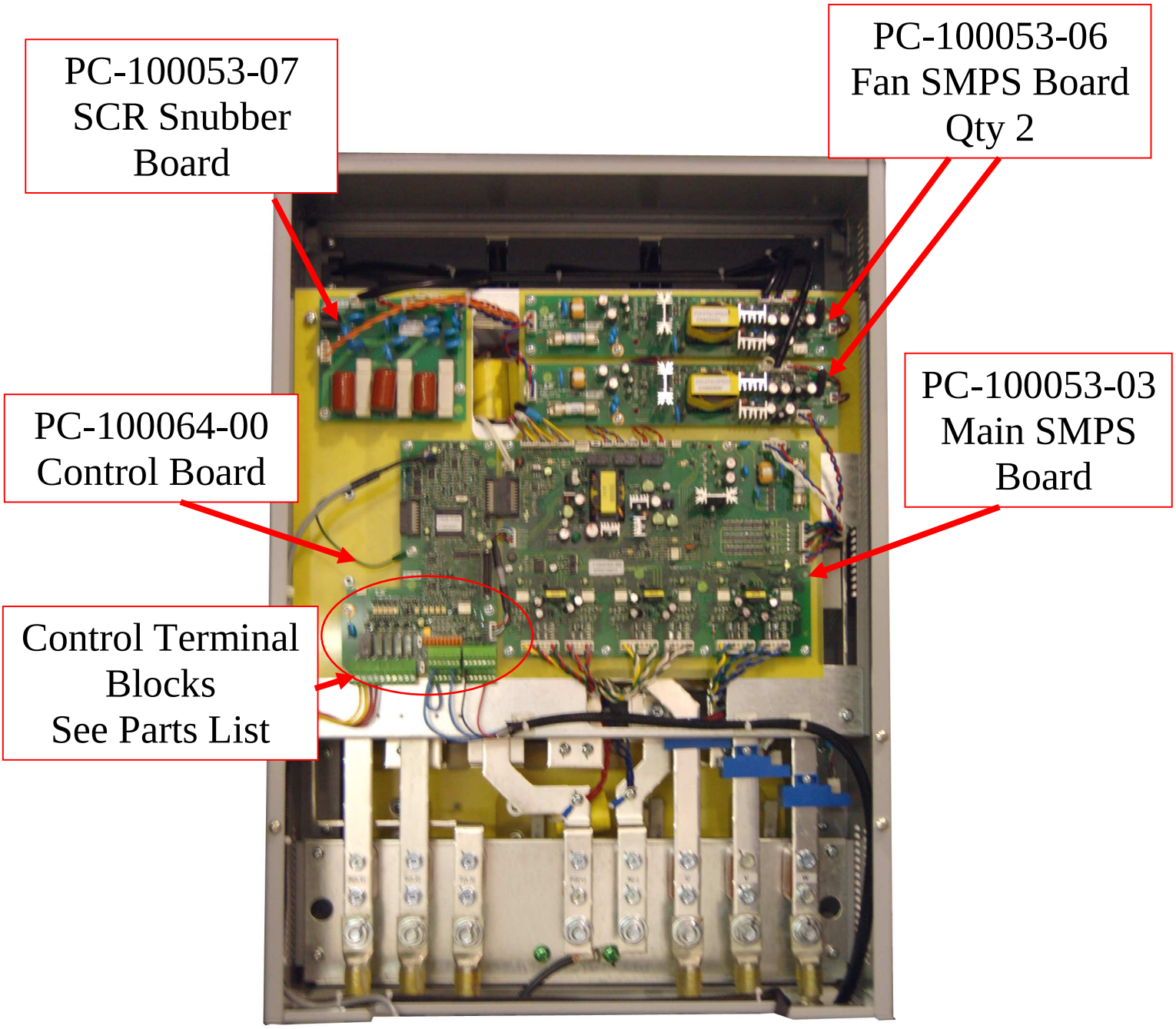
IGBT-100045-00*
IGBT
Qty 6



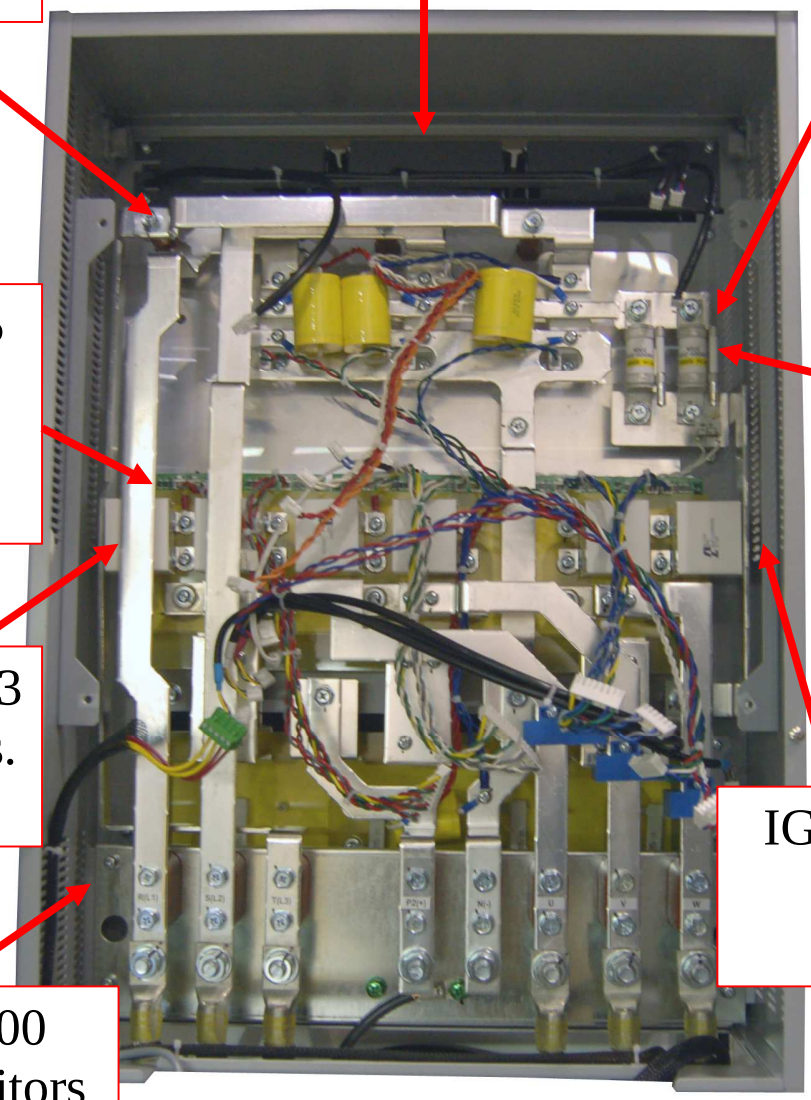
* Need to order with PC-100053-14

BENSHAW®
ADVANCED CONTROLS & DRIVES

RSi-250-SG-4


PC-100053-07
SCR Snubber
Board
PC-100053-06
Fan SMPS Board
Qty 2
PC-100064-00
Control Board
PC-100053-03
Main SMPS
Board
Control Terminal
Blocks
See Parts List

RSi-250-SG-4

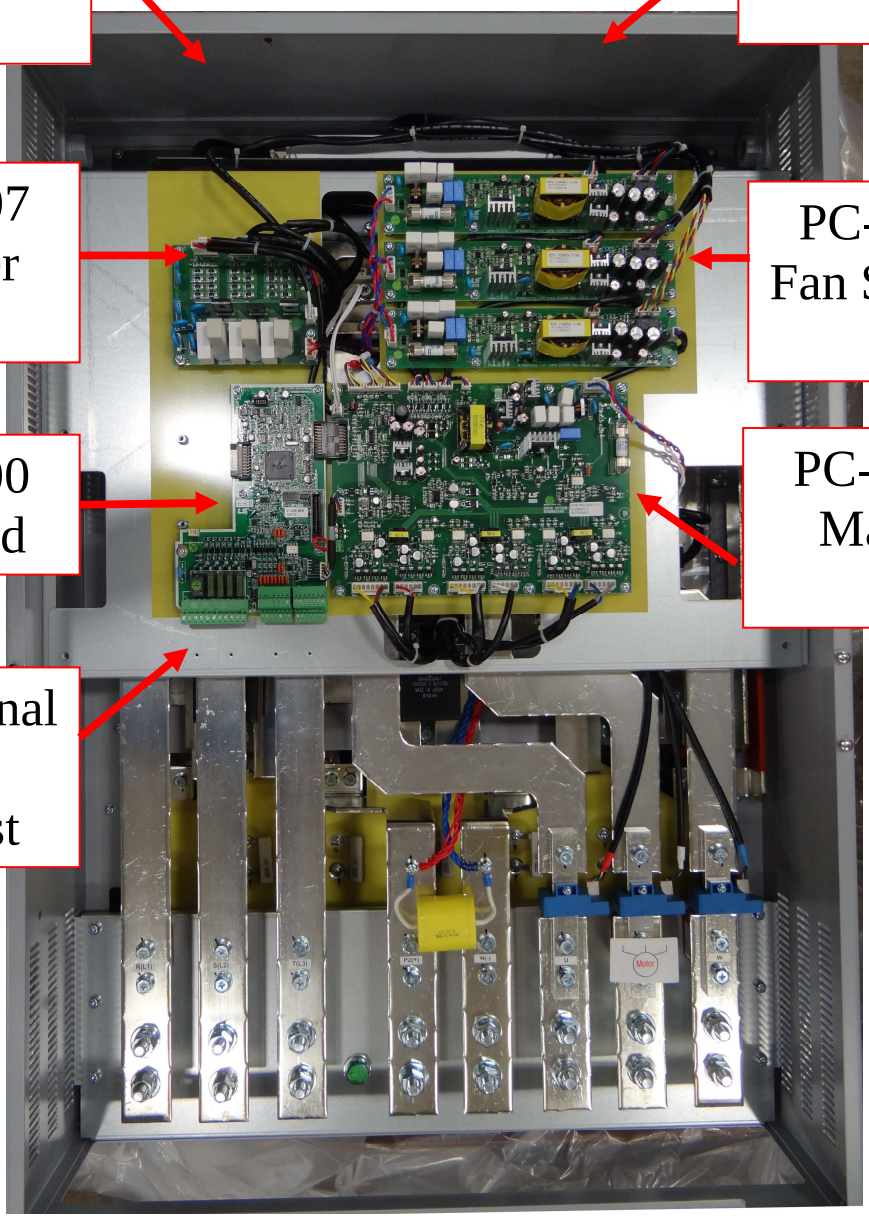


*Need to order with PC-100053-15

RSi-250-SG-4

BENSHAW®
ADVANCED CONTROLS & DRIVES

RSi-350-SG-4


FA-100504-01
Cooling Fans
Qty 4
FA-100504-02
Cooling Fans
Qty 2
PC-100053-07
SCR Snubber
Board
PC-100053-06
Fan SMPS Board
Qty 3
PC-100064-00
Control Board
PC-100053-04
Main SMPS
Board
Control Terminal
Blocks
See Parts List

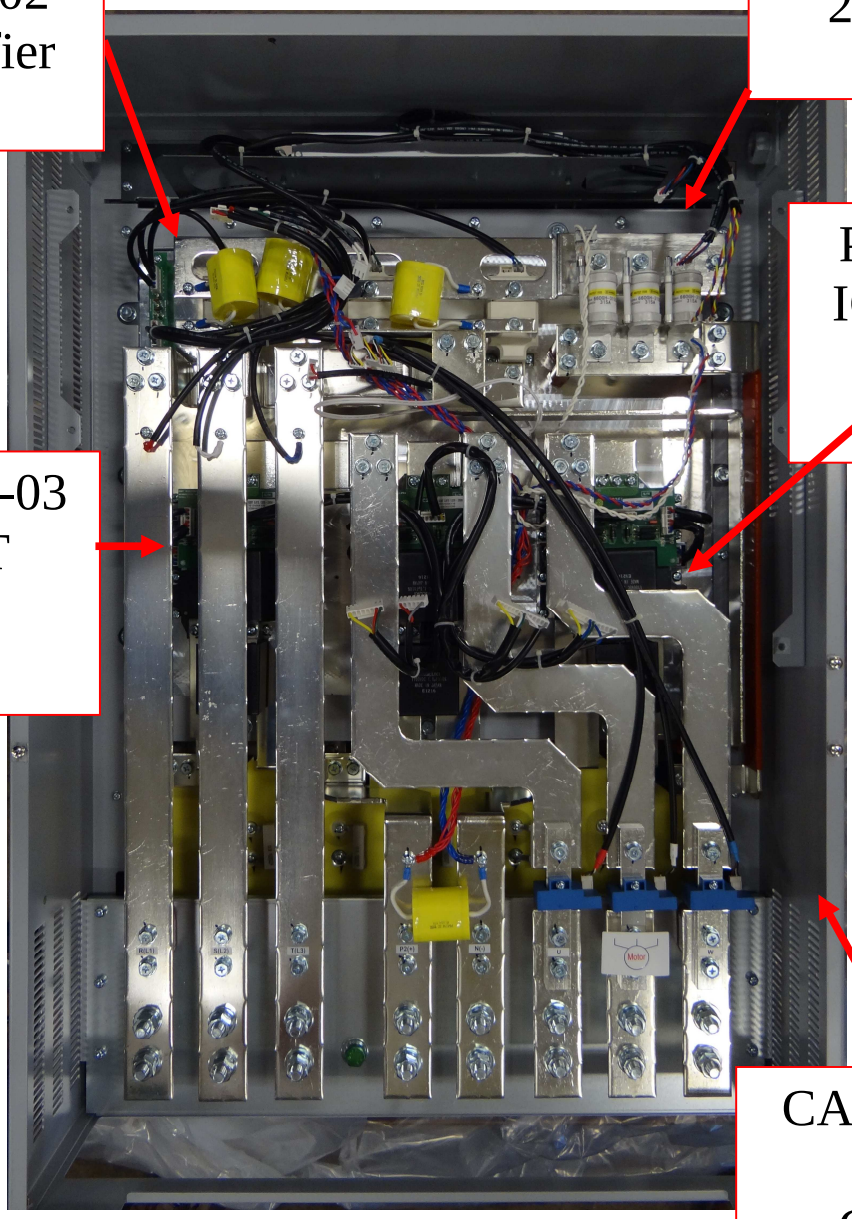
RSi-350-SG-4

DI-100057-02
253A Rectifier
Qty 3

FU-100474-00
250A E Fuse
Qty 3

PC-100053-16
IGBT Interface
Board
Qty 3

IGBT-100045-03
900A IGBT
Qty 3

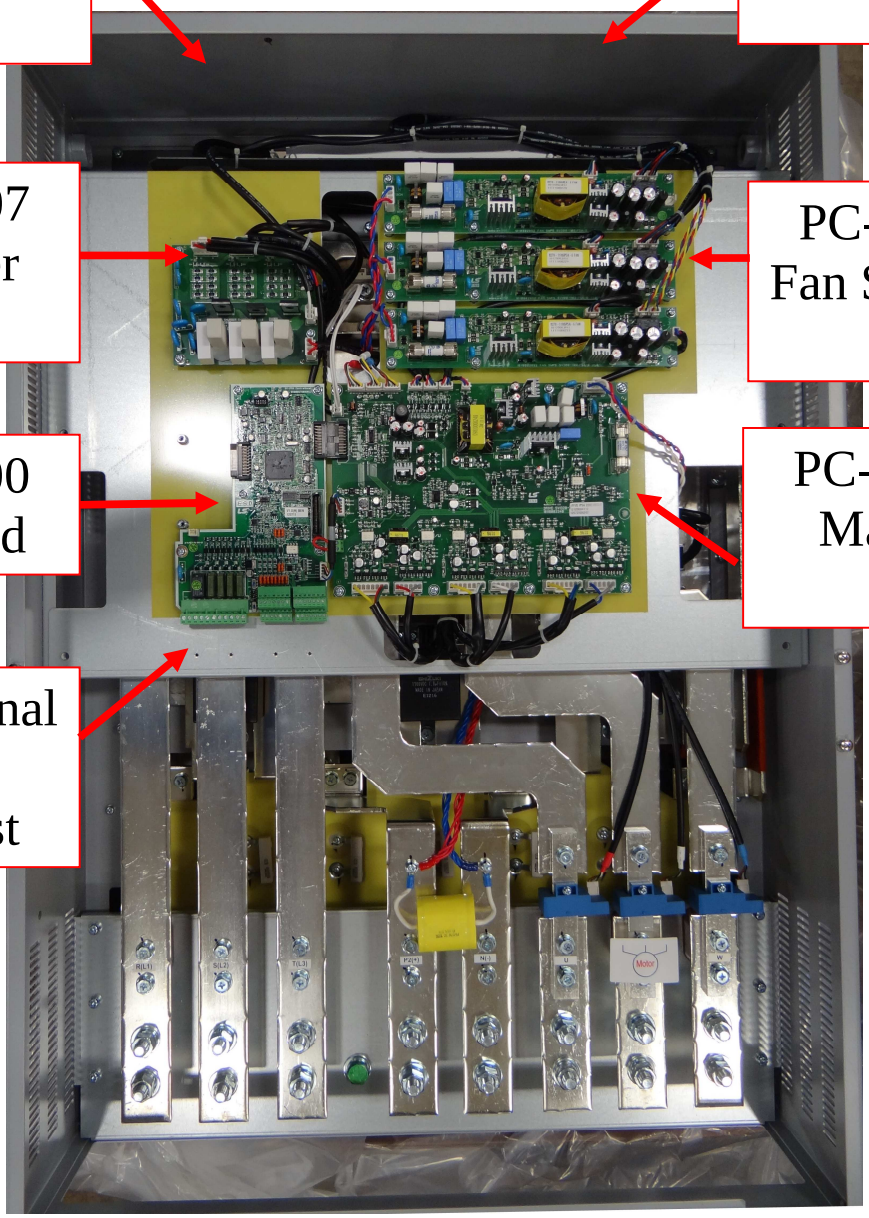


CA-100136-00
6800uF
Capacitor
Qty 16

RSi-350-SG-4

BENSHAW®
ADVANCED CONTROLS & DRIVES

RSi-400-SG-4


FA-100504-01
Cooling Fans
Qty 4
FA-100504-02
Cooling Fans
Qty 2
PC-100053-07
SCR Snubber
Board
PC-100053-06
Fan SMPS Board
Qty 3
PC-100064-00
Control Board
PC-100053-05
Main SMPS
Board
Control Terminal
Blocks
See Parts List

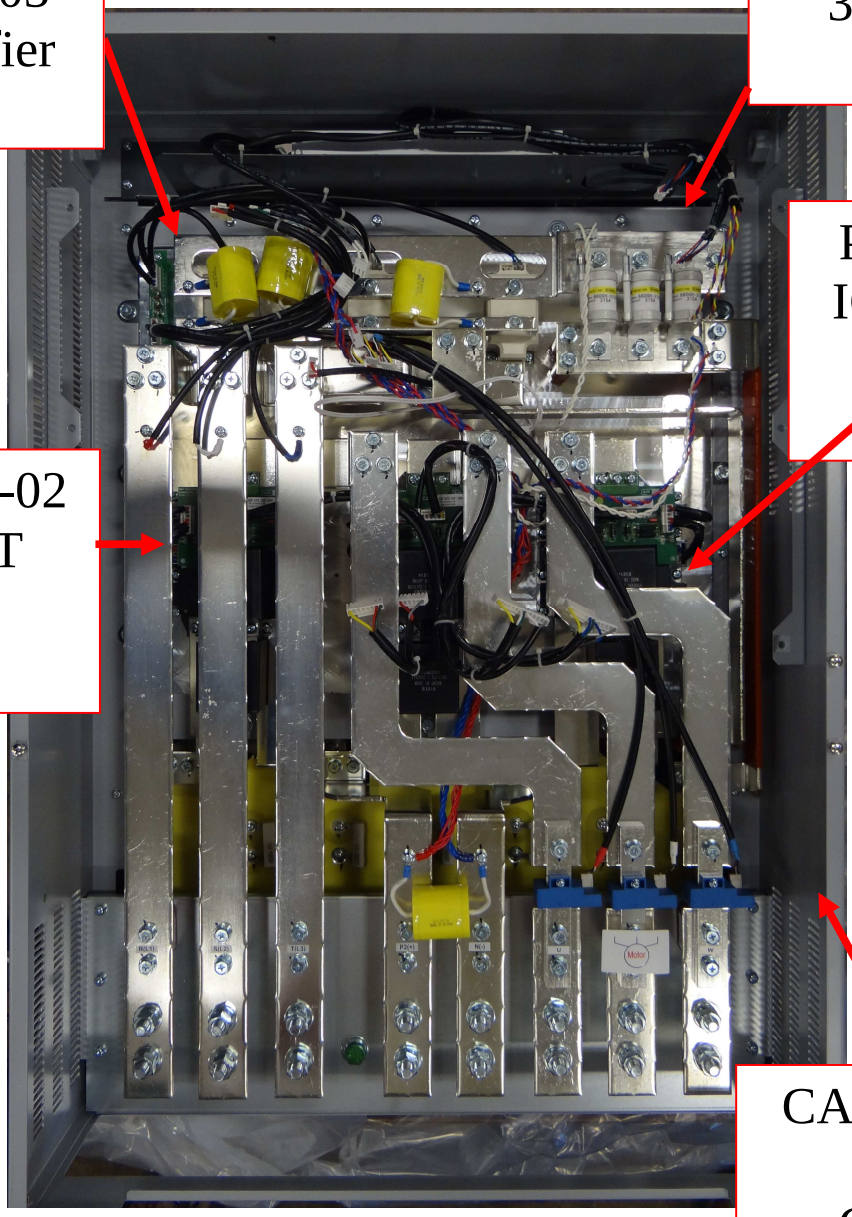
RSi-400-SG-4

DI-100057-03
330A Rectifier
Qty 3

FU-100475-00
315A E Fuse
Qty 3

PC-100053-17
IGBT Interface
Board
Qty 3

IGBT-100045-02
1400A IGBT
Qty 3

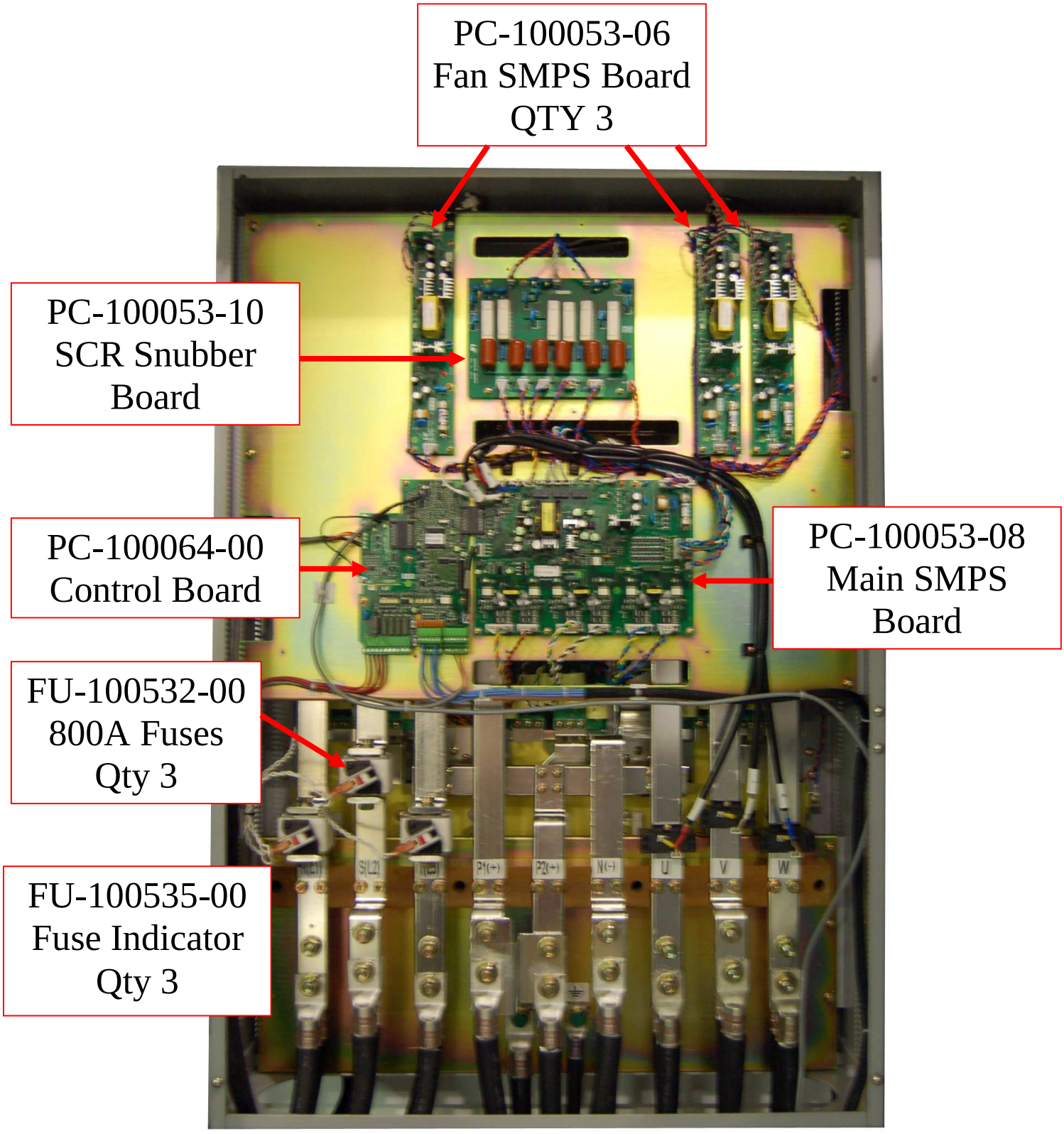


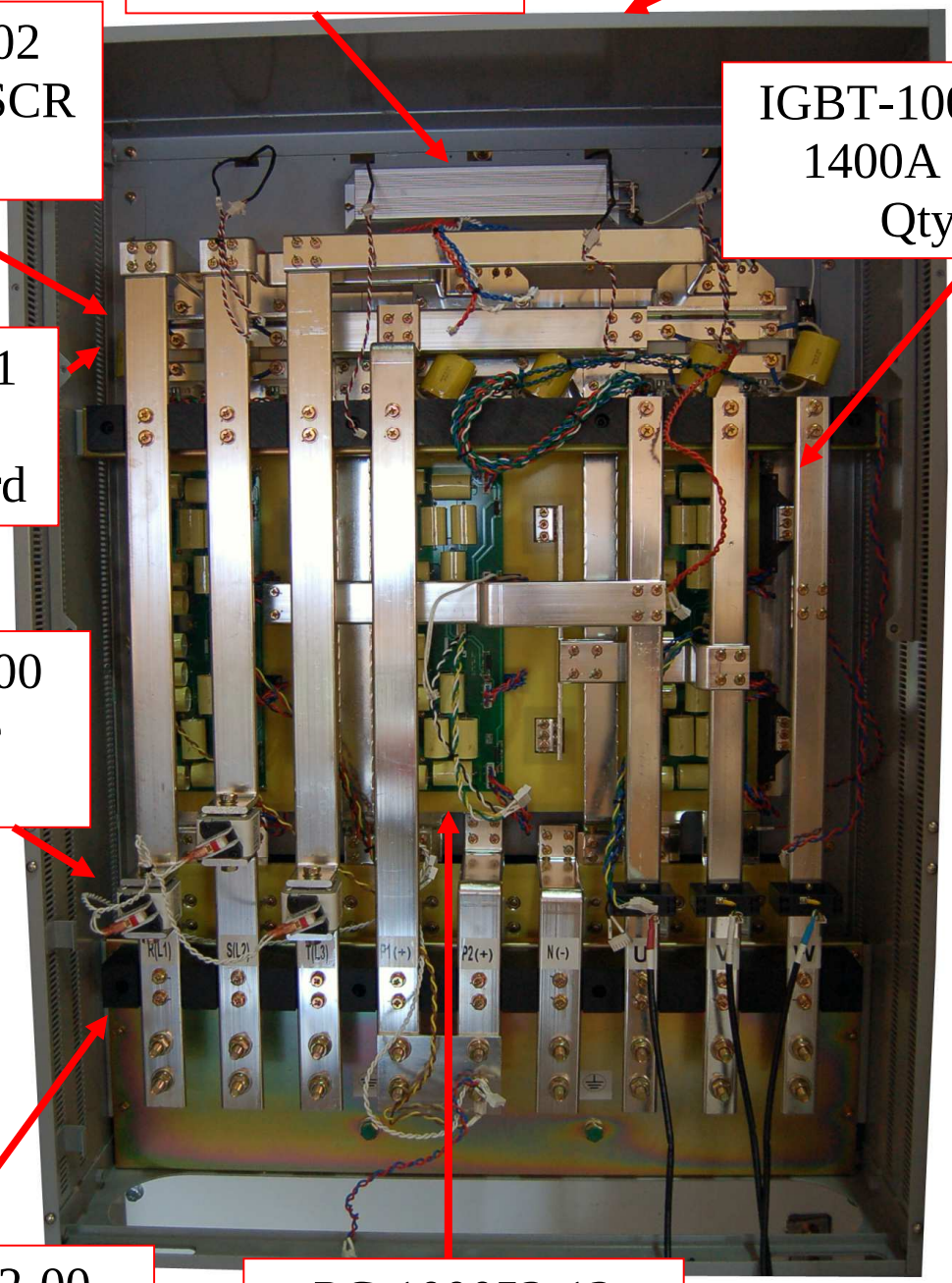
CA-100137-00
8200uF
Capacitor
Qty 16

RSi-400-SG-4

BENSHAW®
ADVANCED CONTROLS & DRIVES

RSi-500-SG-4

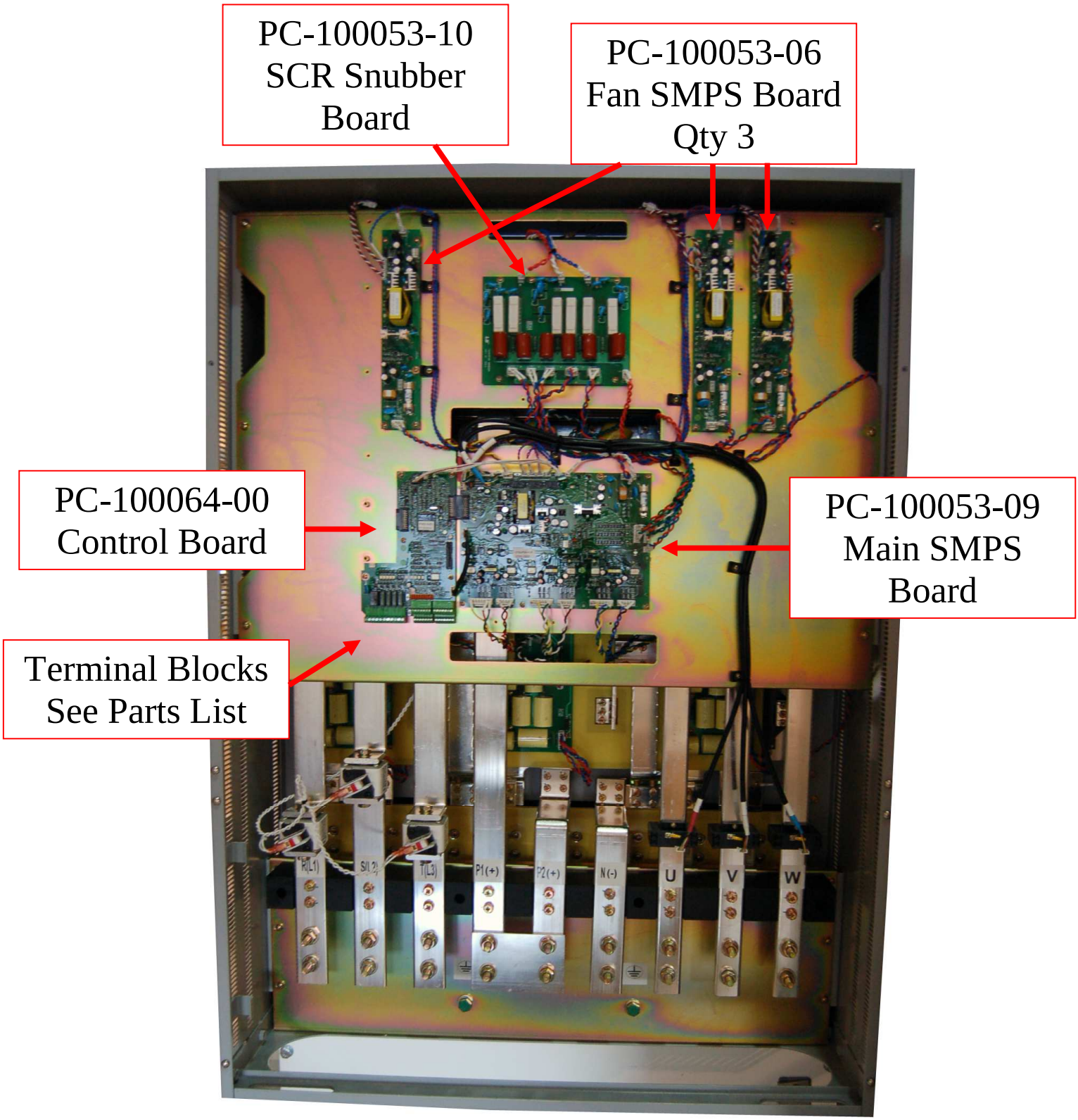

PC-100053-06
Fan SMPS Board
QTY 3
PC-100053-10
SCR Snubber
Board
PC-100064-00
Control Board
PC-100053-08
Main SMPS
Board
FU-100532-00
800A Fuses
Qty 3
FU-100535-00
Fuse Indicator
Qty 3


RES-100286-02
Precharge
Resistor
FA-100504-03
Cooling Fans
Qty 5
DI-100057-02
273A Diode/SCR
Qty 6
IGBT-100045-02
1400A IGBT
Qty 3
PC-100053-11
Diode/SCR
Interface Board
FU-100532-00
800A Fuse
Qty 3
CA-100182-00
6800uF Capacitor
Qty 20
PC-100053-12
IGBT Interface
Board Qty 3

RSi-500-SG-4

BENSHAW®
ADVANCED CONTROLS & DRIVES

RSi-600-SG-4


PC-100053-10
SCR Snubber
Board
PC-100053-06
Fan SMPS Board
Qty 3
PC-100064-00
Control Board
PC-100053-09
Main SMPS
Board
Terminal Blocks
See Parts List
R(L1)
S(L2)
T(L3)
P1(+)
P2(+)
N(-)
U
V
W

RSi-600-SG-4

RES-100286-03
Precharge
Resistor

DI-100057-03
330A Diode/SCR
Qty 6

IGBT-100045-03
900A IGBT
Qty 6

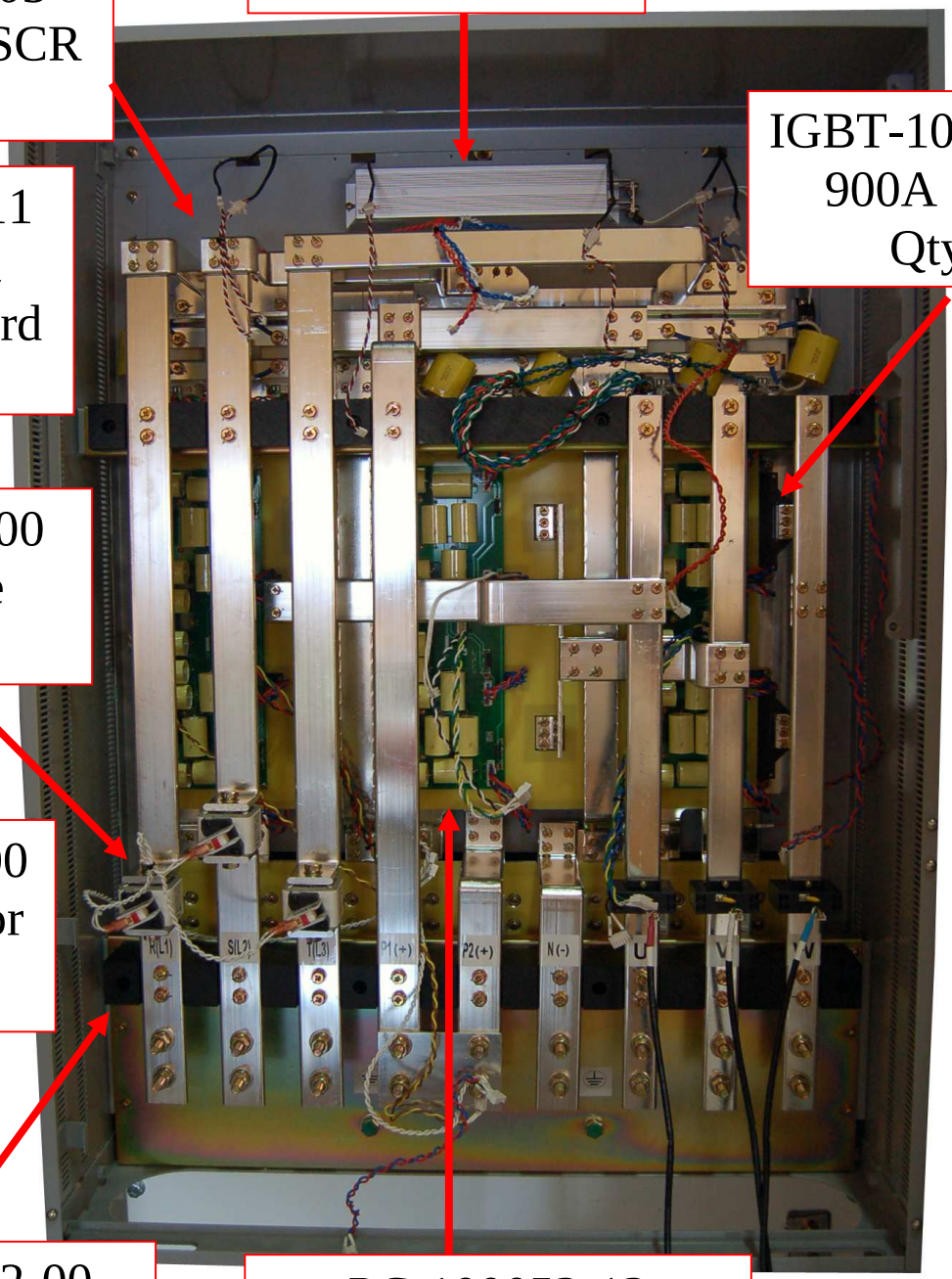
PC-100053-11
Diode/SCR
Interface Board
Qty 6

FU-100533-00
900A Fuse
Qty 3

FU-100535-00
Fuse Indicator
Qty 3

CA-100182-00
6800uF Capacitor
Qty 22

PC-100053-13
IGBT Interface Board
Qty 3



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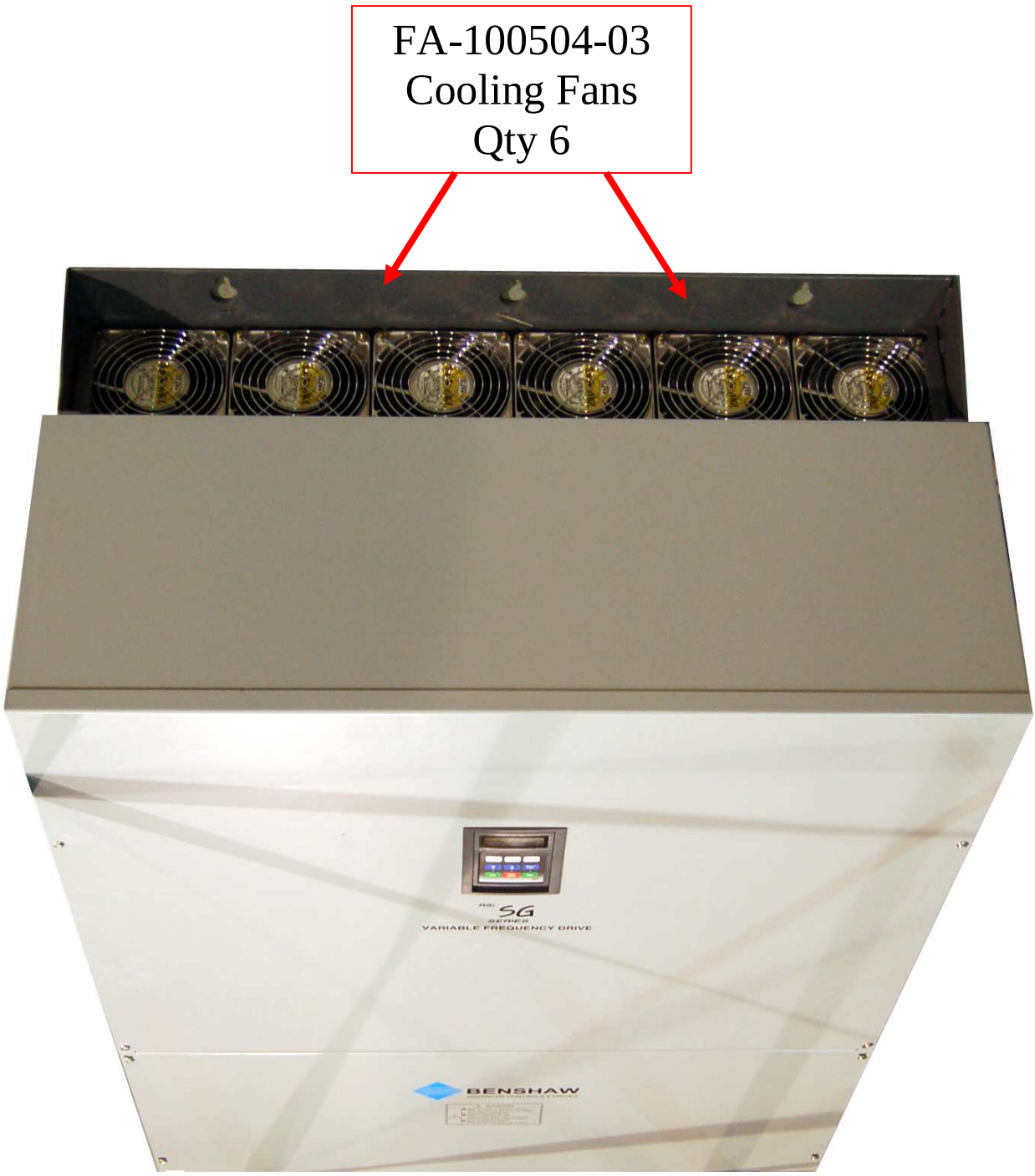
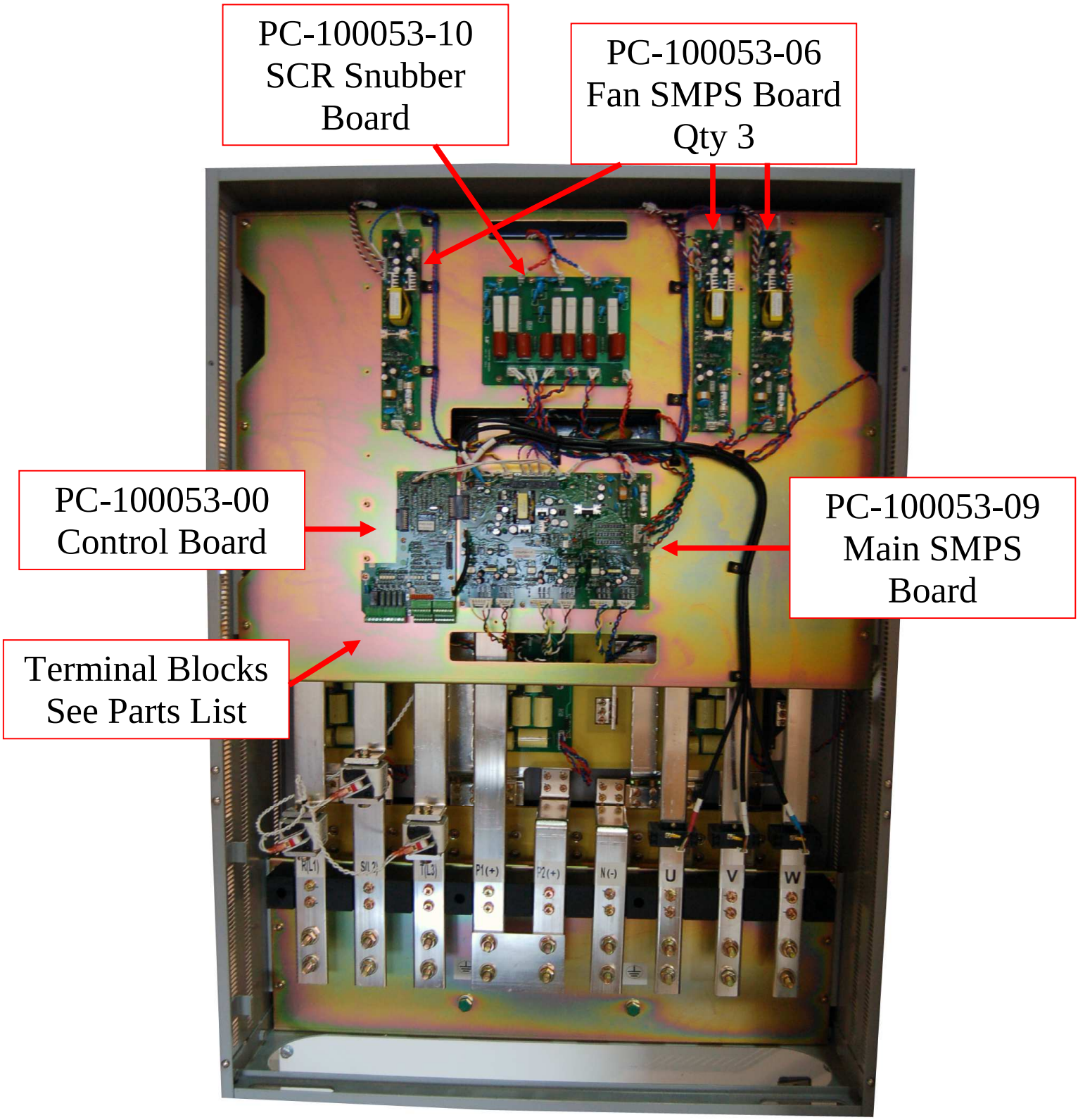

FA-100504-03
Cooling Fans
Qty 6
RSi SG SERIES
VARIABLE FREQUENCY DRIVE
BENSHAW

RSi-600-SG-4

BENSHAW®
ADVANCED CONTROLS & DRIVES

RSi-700-SG-4


PC-100053-10
SCR Snubber
Board
PC-100053-06
Fan SMPS Board
Qty 3
PC-100053-00
Control Board
PC-100053-09
Main SMPS
Board
Terminal Blocks
See Parts List
R(L1)
S(L2)
T(L3)
P1(+)
P2(+)
N(-)
U
V
W

RSi-700-SG-4

RES-100286-04
Precharge
Resistor

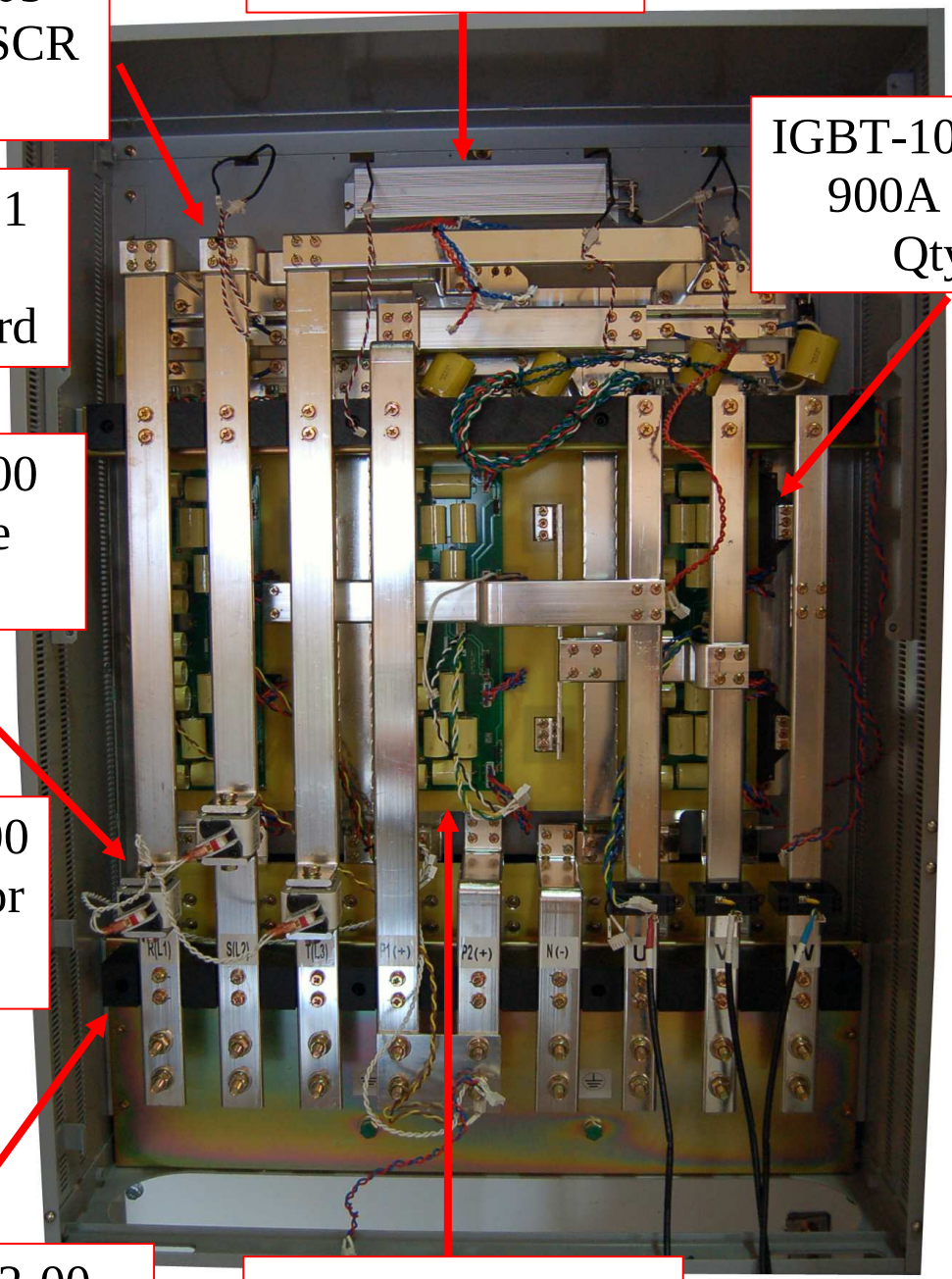
DI-100057-05
330A Diode/SCR
Qty 6

IGBT-100045-03
900A IGBT
Qty 6

PC-100053-11
Diode/SCR
Interface Board

FU-100534-00
1000A Fuse
Qty 3

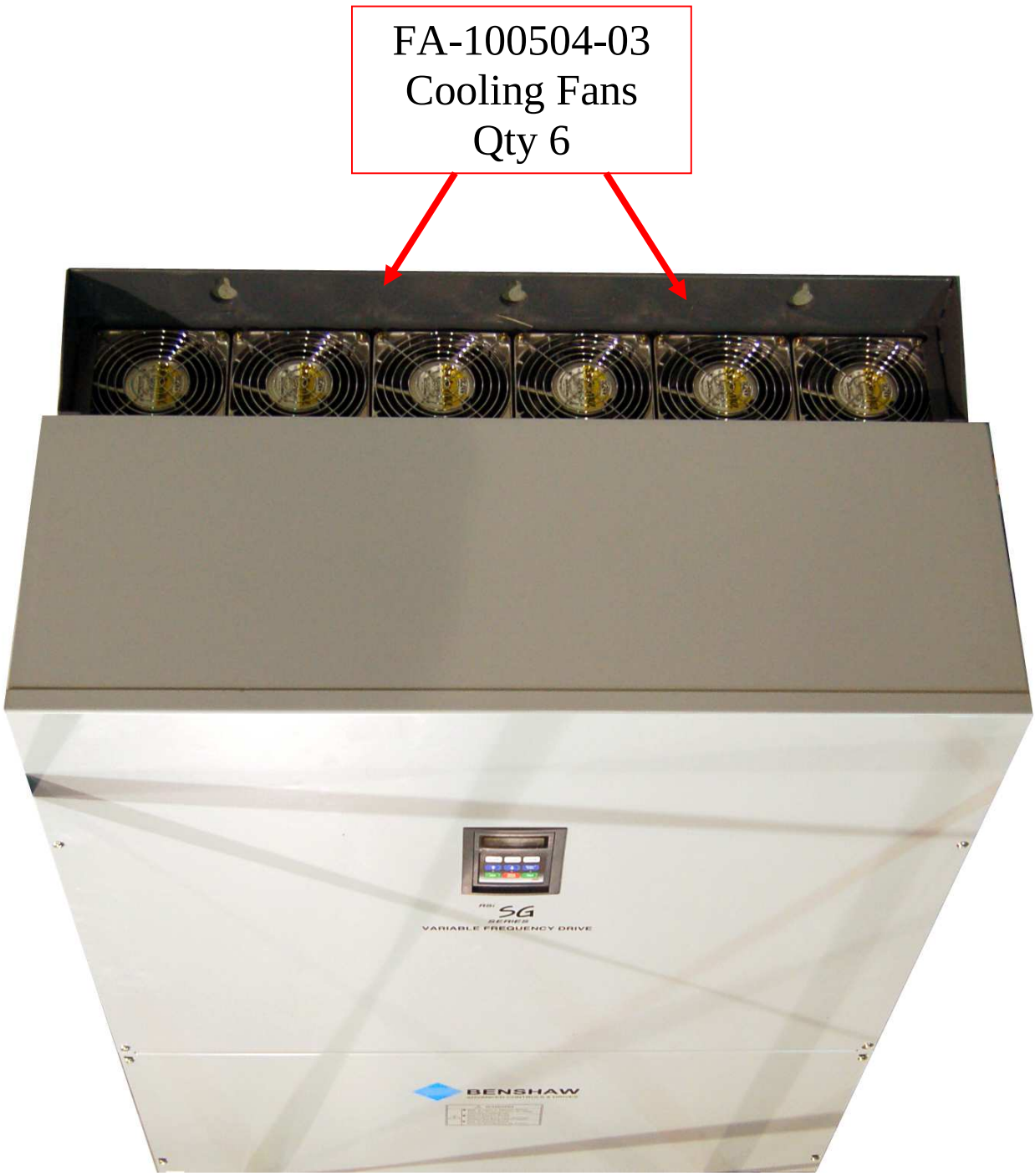
FU-100535-00
Fuse Indicator
Qty 3



CA-100182-00
6800uF Capacitor
Qty 24

PC-100053-13
IGBT Gate Board
Qty 3

RSi-700-SG-4


FA-100504-03
Cooling Fans
Qty 6
SG
VARIABLE FREQUENCY DRIVE
BENSHAW

RSi-700-SG-4

Pub. # 890046-10-00
Dec. 2015

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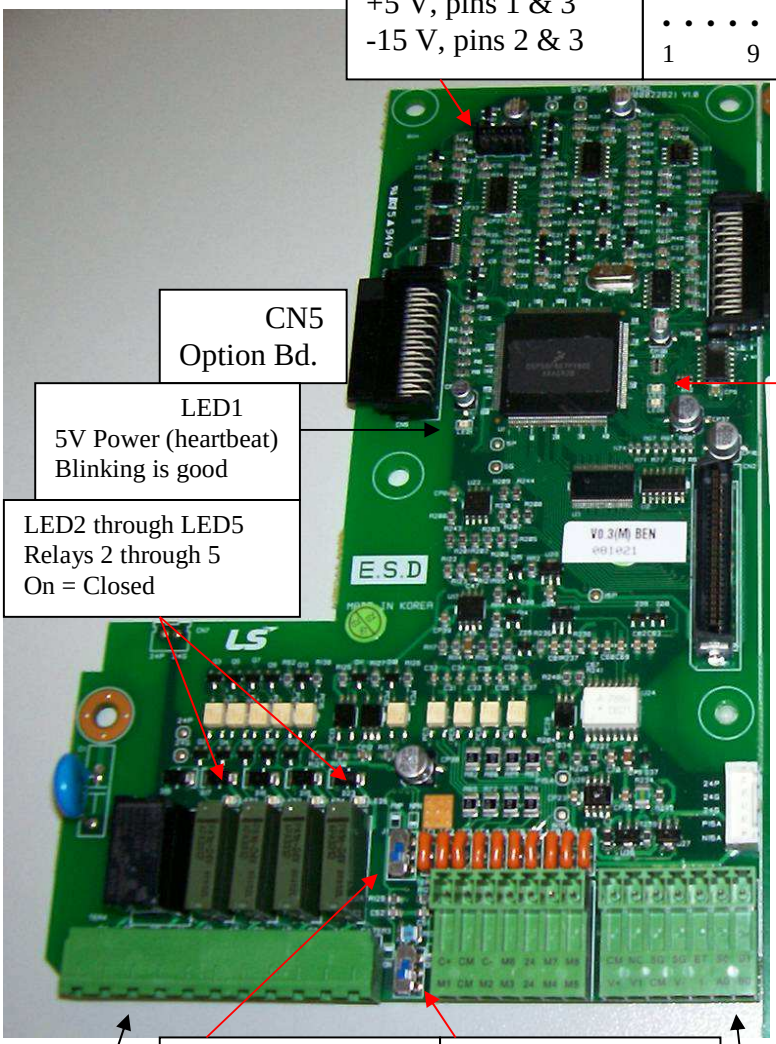
Section 3

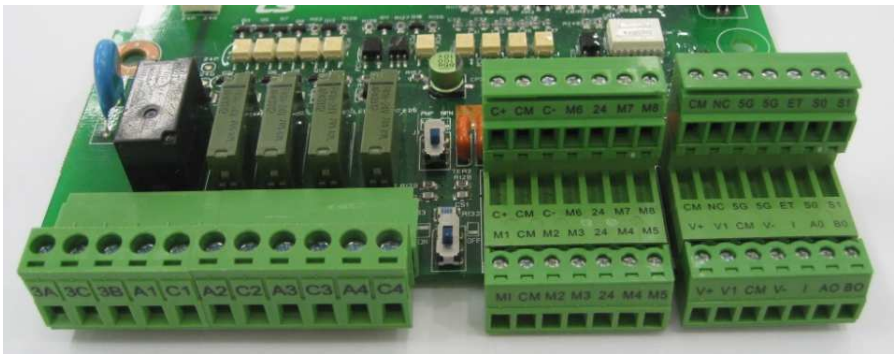
PC Board Descriptions

Control Board **Part # PC-100063-00**
50 – 125 HP, 460V



	Part #	HP Where Used	Description
Control Board	PC-100063-00	50 - 125	Contains the 16 bit DSP for all signal processing including (2) 6 channel PWM modules for generating the IGBT firing signals, (4) 12 bit A/D converters, Serial Communications Interface, and memory for Software (program) and Data. All the I/O is accessed via the terminal strips at the bottom of the board.
	Connector ID	Terminals	Description
	CN1	40 pin edge connector	For mating to Main SMPS board
	CN2	50 pin connector	For connection of top mounted option boards.
	CN3	Keypad cable connector	Keyed 10 pin for keypad cable
	CN5	40 pin edge connector	For connection of side mounted option boards.
	CN6 (pins 1 & 2) CN6 (pins 4 & 5)	24P - 24G P15A - N15A	24 VDC input from Main SMPS (CN2) pos. 15V and neg. 15V input from Main SMPS (CN2), 24G is CM
	J1	PNP (Up), NPN (down)	PNP (Up) - NPN (down) switch. For switching I/O terminals. PNP~use 24V to Mx. NPN~use CM to Mx.
	J3	ON (Up), OFF (Down)	To connect a 120 ohm termination resistor for Modbus communications. ON (Up), OFF (Down)
	LED1		Power LED, 5 VDC Power (heartbeat) blinking is OK
	LED2 through LED5		Output Relays (RLY2 - RLY5) closed ~ on
	LED6		Transmit LED
	LED7		Receive LED

I/O Terminal Details **Part # PC-100063-00**
Control Board
50 – 125 HP, 460V



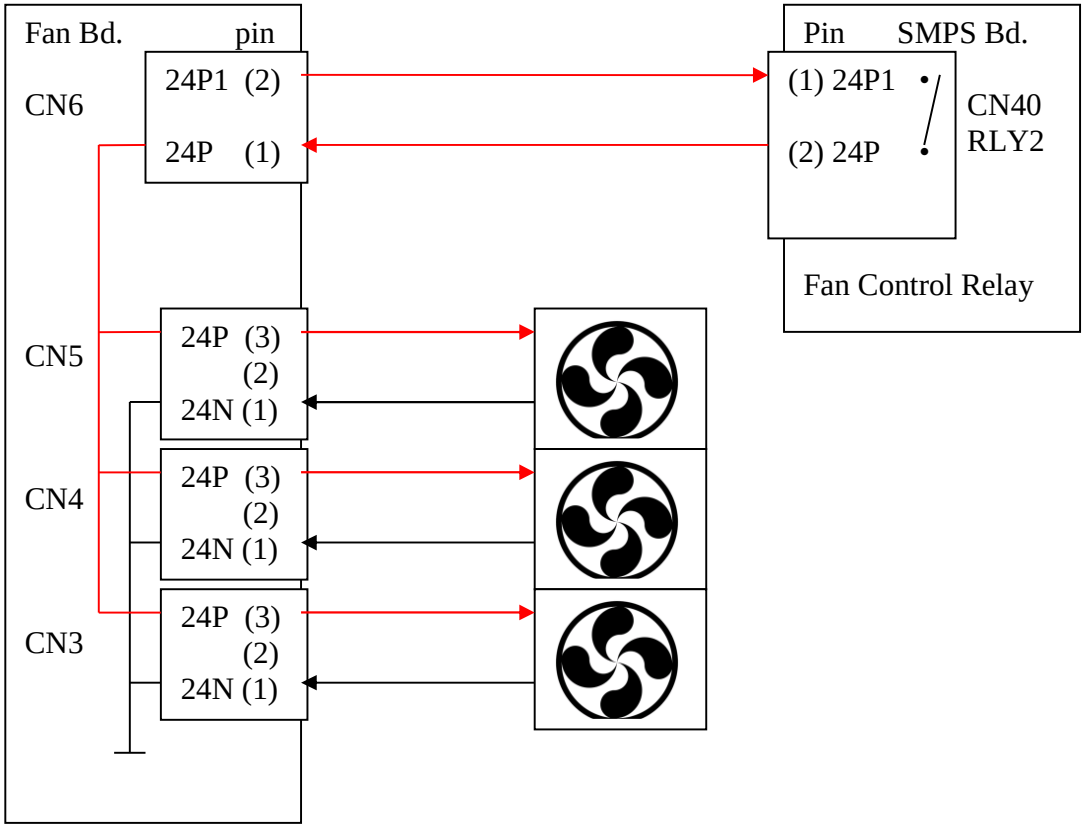
Terminal	Description	Ratings	Default Setting	Related Parameters
3A, 3C, 3B	Dedicated Fault Relay, Form C 3A-3C NO, 3C-3B NC	250 Vac, 1A 30 VDC, 1A		None
A1 - C1	Output Relays, Programmable	250 Vac, 1A 30 VDC, 1A	None	I/O-76
A2 - C2			None	I/O-77
A3 - C3			None	I/O-78
A4 - C4			None	I/O-79
C+	Modbus Signal, High		N/A	I/O-90 ~ I/O-94
CM	Common (24V Ground)		N/A	
C-	Modbus Signal, Low		N/A	
M1 ~ M8	Multi-Function Input Terminals, Close to Enable	Optically Isolated, 24VDC	See Note on Switch J1	I/O-20 ~ I/O 27
24	24 VDC Supply	50 mA	N/A	
CM	Common (24V Ground)			
S0	Analog Output Terminal	12 VDC, 1 mA	Frequency	I/O-70, I/O-71
S1	Analog Output Terminal	12 VDC, 1 mA	Voltage	I/O-72, I/O-73
5G	Ground for output terminals S0, S1			
ET	External Thermal Sensor Input	PTC or NTC		I/O-97, I/O-98
V+	12 VDC Supply	100 mA		
V1	Analog Input Voltage	20 Kohms		DRV-04, I/O-01 ~ I/O-05
V-	neg. 12 VDC Supply	100 mA		
I	Analog input Current	250 ohms		DRV-04, I/O-06 ~ I/O-10
A0 - CM	Frequency Control via Pulsed Input	0 - 100 KHz.	0 - 10 KHz.	DRV-04, I/O-11 ~ I/O-16
B0 - CM	Frequency Control via Pulsed Input	0 - 100 KHz.	0 - 10 KHz.	DRV-04, I/O-11 ~ I/O-16

NOTE: J1 Switch PNP/NPN ---- Source or Sink Mx Terminals. PNP for source. Uses the 24 VDC terminal through external switch to the Mx terminal. NPN for sink. Switches the negative at the Mx terminal to Common. Uses internal 24 VDC.

Fan SMPS Board **Part # PC-100023-00**
50 – 125 HP, 460V

	Part #	HP Where Used	Description
Fan SMPS Board Fuse, 1A, 600V, 100Kaic. Fast Acting	PC-100023-00 FU-603	50 - 125 All	Receives DC Bus voltage from the capacitor bank. Creates 2 power supplies, 6 VDC and 24 VDC. The 6 VDC is sent to the Main SMPS board for SCR gate power. The 24 VDC is also sent to the Main SMPS board (through RLY2 contact) then returned to the fan board to power up to 3 fans.
	Connector ID	Terminals	Descritpion
	CN1 (pins 1 & 4)	DCP-DCN	DC Bus Voltage into board
	CN2 (pins 1 & 3)	P6-G6	6 VDC out to Main SMPS CN43
	CN3 (pins 1 & 3) CN4 (pins 1 & 3) CN5 (pins 1 & 3)	24N-24P 24N-24P 24N-24P	50 - 125 HP - 24VDC Connectors CN3, CN4 & CN5 are all parallel out of the fan board to power up to 3 fans. The number of fans depends on the size of the VFD. Some fans have a center wire used for fan monitoring going to pin 2 of these connectors. This fan board does not have a fan monitoring circuit. Pin 2 is not used.
	CN6 (pins 1 & 2)	24P-24P1	Pin 2 (24P1) sends 24 VDC out to Main SMPS board CN40, pin 1. 24 VDC goes through a contact from the fan control relay (RLY2) on the Main SMPS board. The relay is controlled from a fan control circuit on the Main SMPS board. 24 VDC exits the Main SMPS board from CN40 pin 2 as 24P. The 24 VDC then comes back to Fan board on 24P (CN6). This 24P is paralleled to CN3, CN4 and CN5 as 24P-24N which powers the (up to 3) fans.
	LED1		Power, DC Bus keeps this lit until discharged.

Fan Board Circuit, PC-100023-00
50 – 125 HP, 460V

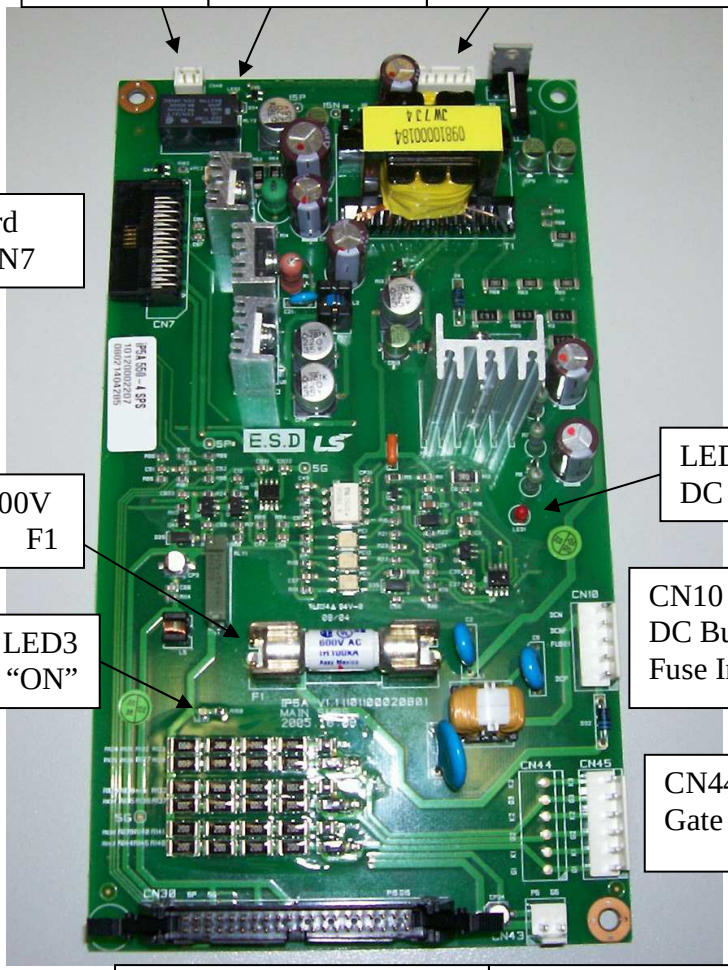


Description
24 VDC
The fan board generates 24 VDC from a switch mode power supply on the fan board. This 24 VDC is sent to the Main SMPS board as 24P1. At the Main SMPS board, the 24P1 passes through contacts of the fan control relay (RLY2) and is returned to the fan board as 24P. This 24V (24P) is used to power up to 3 fans per fan board from connectors CN3, CN4 & CN5.

Pin 2 of CN3, CN4 & CN5 of this Fan Board has no connection. If a fan was provided that has 3 wires, the middle wire is for a fan fault monitor. This Fan Board has no fan fault monitoring. Pin 2 is an open circuit and has no connection into the board.

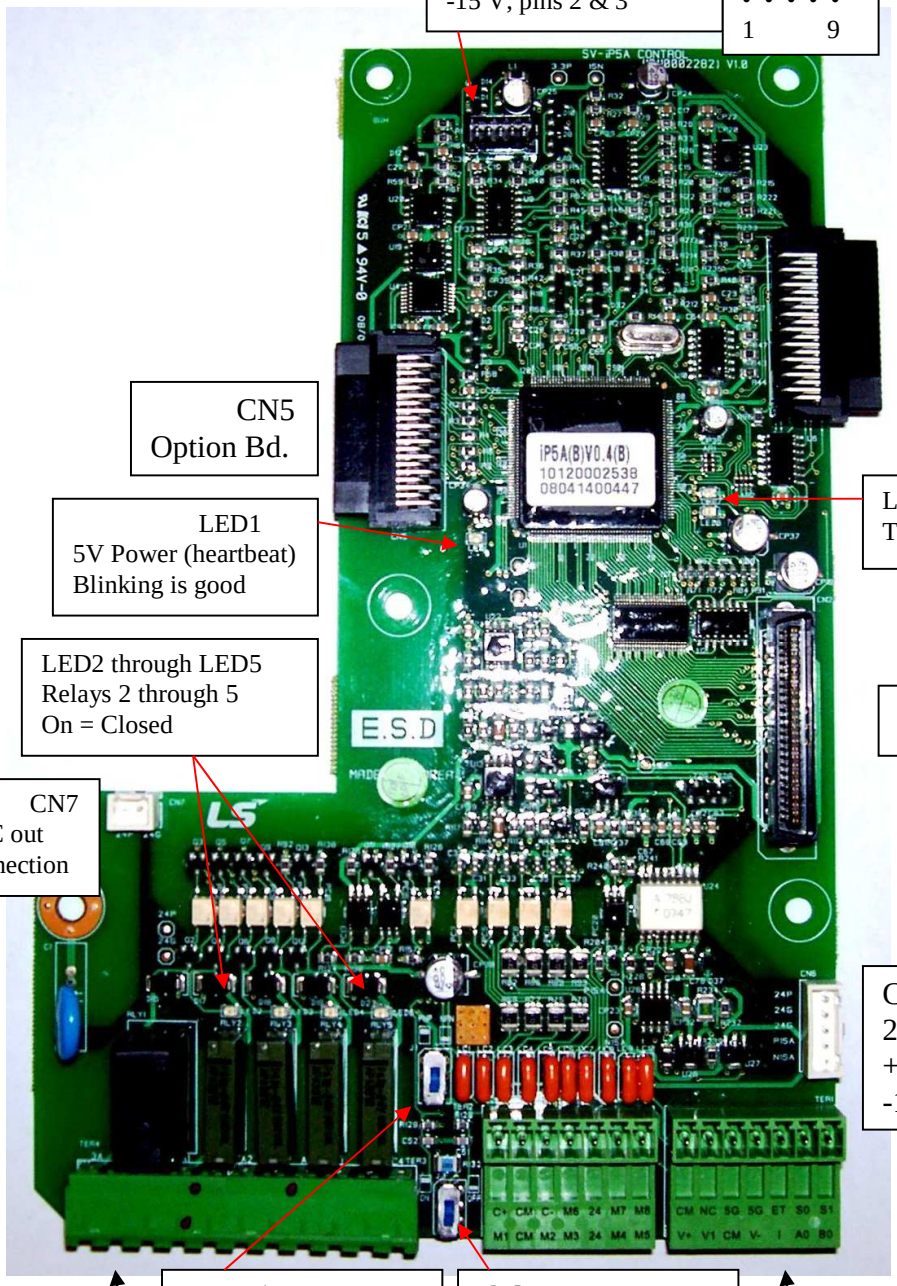
Operation of the Fan Control Relay is always ON when power is on. See parameters I/O-84 and I/O-85 for other options.

Main SMPS Board **Part # PC-100065-00**
50 – 125 HP, 460V **PC-100066-00**
PC-100067-00
PC-100068-00
PC-100069-00



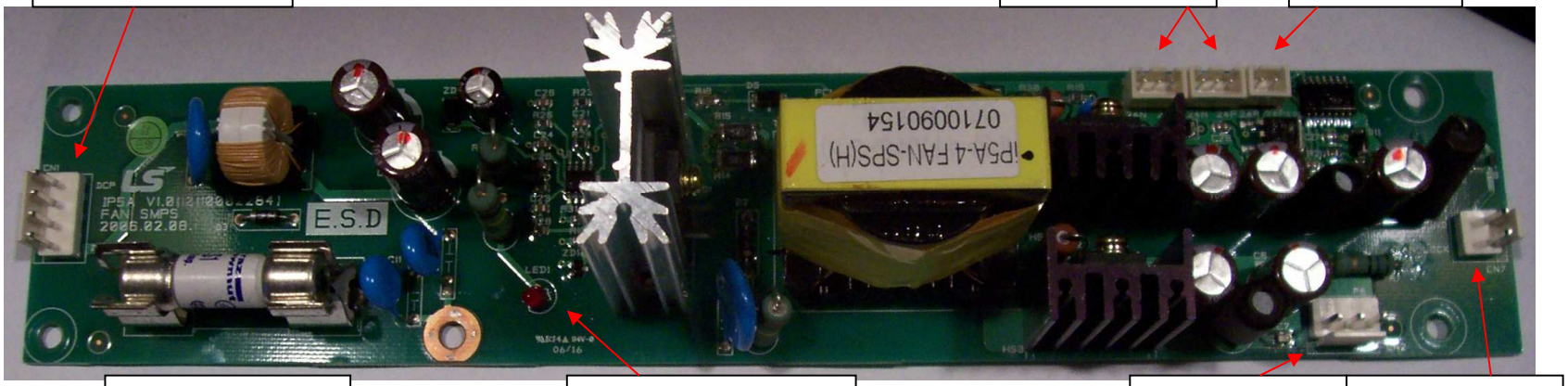
	Part #	HP Where Used	Description
Main SMPS Board	PC-100065-00 PC-100066-00 PC-100067-00 PC-100068-00 PC-100069-00	50 60 75 100 125	The board contains circuits for Fan control, Input SCR control, IGBT Gate Firing signals, Current Transformer Feedback, DC Bus Voltage/DC Bus Fuse monitoring and IGBT temperature monitoring. Receives DC Bus voltage from capacitor bank. Creates (5) DC power supplies. 15 VDC (P15-G15) dedicated to IGBT Gate Power. +/-15 VDC (P15A, N15A - 24G) for Control Bd. I/O. 15 VDC (15P-15N) for component power. 24 VDC (24P-24G) for Control Bd. I/O. 5 VDC (5P-5G) for component power.
Fuse, 1A, 600V, 100Kaic. Fast Acting	FU-603	All	
	Connector ID	Terminals	Description
	CN10 (pin 1 - 5)	DCN - DCP	DC Bus Voltage into board
	CN10 (pin 2 - 3)	DCNF - FUSE1	DC Bus Fuse Indicator (NC)
	CN10 (pin 4)	Not Used	
	CN2 (pin 3)	24G	GND (pins 2 & 3 tied together)
	CN2 (pins 1 & 2)	24P - 24G	24V supply to Control Board terminal CN6 (pins 1 & 2)
	CN2 (pins 4 & 5)	P15A - N15A	pos.15V and neg. 15V supply to Control Board terminal CN6 (pins 4 & 5)
	CN30 (pins 1 - 40)	40 pin connector	Ribbon Cable out to IGBT Driver Board
	CN40 (pins 1 & 2)	Fan_24P1 & Fan 24P	Fan Control Relay RLY2, contacts close to send 24VDC back to Fan board at CN6. Parameter Controlled, See I/O-84.
	CN43 (pins 1 & 2)	G6 - P6	6 VDC from Fan board CN2, Used to power Input SCR's gate circuit.
	CN44 (pins 1 & 2)	K3, G3	125 HP only, Second set, SCR Gate signal, T phase
	CN44 (pins 3 & 4)	K2, G2	125 HP only, Second set, SCR Gate signal, S phase
	CN44 (pins 5 & 6)	K1, G1	125 HP only, Second set, SCR Gate signal, R phase
	CN45 (pins 1 & 2)	K3, G3	SCR Gate signal, T phase
	CN45 (pins 3 & 4)	K2, G2	SCR Gate signal, S phase
	CN45 (pins 5 & 6)	K1, G1	SCR Gate signal, R phase
	CN7	40 pin edge connector	Interface to Control Board
	LED1		DC Bus Power
	LED2		Fan Control Relay, RLY2 energized (CN40, pins 1&2 closed), Parameter Controlled, See I/O-84
	LED3		SCR Gates "ON" LED (6VDC)

Control Board **Part # PC-100064-00**
150 – 700 HP, 460V



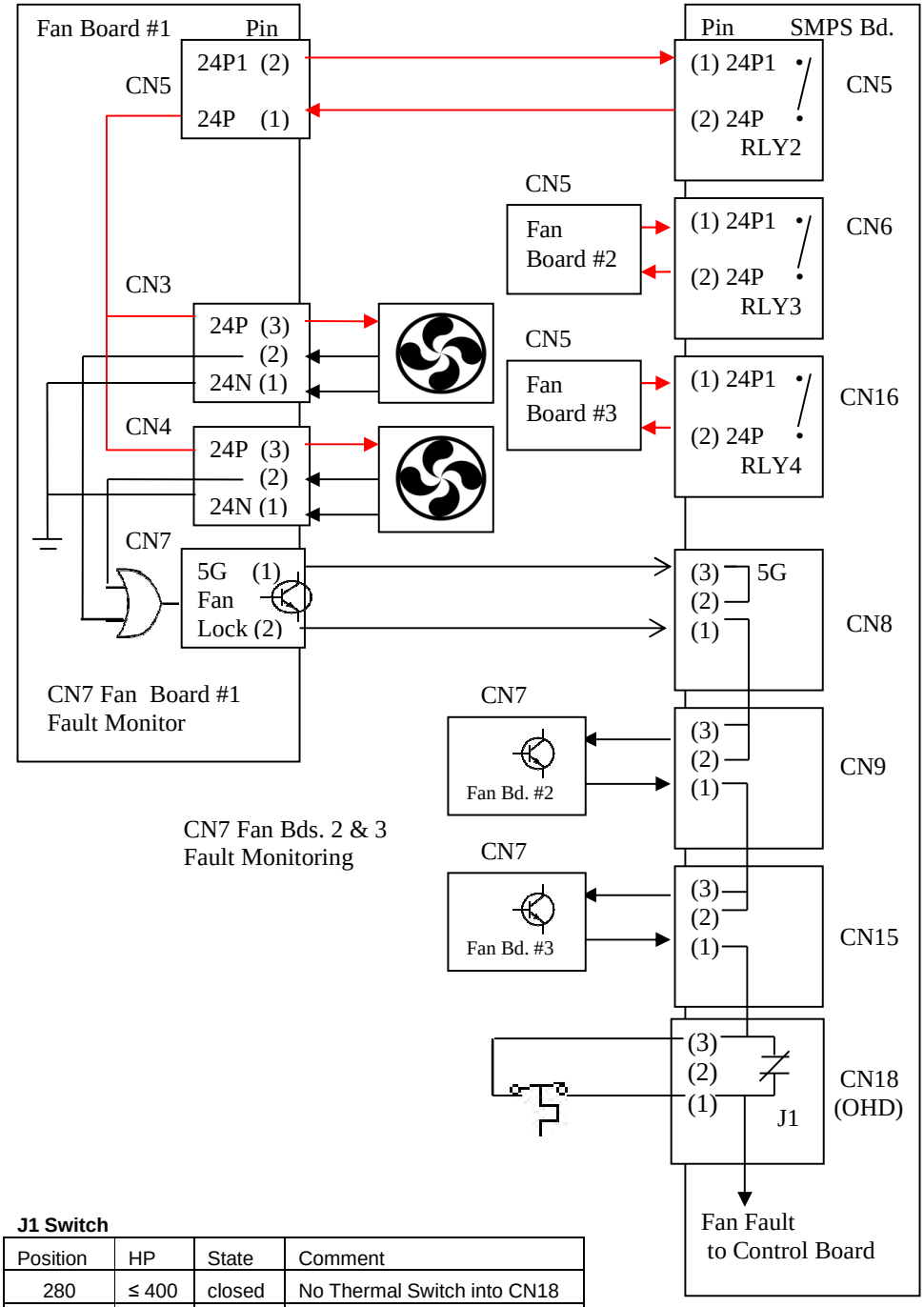
	Part #	HP Where Used	Description
Control Board	PC-100064-00	150 - 700	Contains the 16 bit DSP for all signal processing including (2) 6 channel PWM modules for generating the IGBT firing signals, (4) 12 bit A/D converters, Serial Communications Interface, and memory for Software (program) and Data. All the I/O is accessed via the terminal strips at the bottom of the board.
	Connector ID	Terminals	Description
	CN1	40 pin edge connector	For mating to Main SMPS board
	CN2	50 pin connector	For connection of top mounted option boards.
	CN3	Keypad cable connector	Keyed 10 pin for keypad cable
	CN5	40 pin edge connector	For connection of side mounted option boards.
	CN6 (pins 1 & 2) CN6 (pins 4 & 5)	24P - 24G P15A - N15A	24 VDC input from Main SMPS (CN4) pos. 15V and neg. 15V input from Main SMPS (CN4), 24G is CM
	CN7	24P- 24G	24V Supply, not used
	J1	PNP (Up), NPN (down)	PNP (Up) - NPN (down) switch. For switching I/O terminals. PNP~use 24V to Mx. NPN~use CM to Mx.
	J3	ON (Up), OFF (Down)	To connect a 120 ohm termination resistor for Modbus communications. ON (Up), OFF (Down)
	LED1		Power LED, 5 VDC Power (heartbeat) blinking is OK
	LED2 through LED5		Output Relays (RLY2 - RLY5) closed ~ on
	LED6		Transmit LED
	LED7		Receive LED

Fan SMPS Board **Part # PC-100053-06**
150 – 700 HP, 460V



*Connectors CN3 and CN4, Pin 2 is Fan Fault Monitor. See Description in Table

	Part #	HP Where Used	Description
Fan SMPS Board Fuse, 1A, 600V, 100Kaic. Fast Acting	PC-100053-06	150 - 700	Receives DC Bus voltage from the capacitor bank. Creates 2 power supplies, 6 VDC and 24 VDC. The 6 VDC is sent to the Main SMPS board for SCR gate power. The 24 VDC is also sent to the Main SMPS board (through RLY2, RLY3 & RLY4 contacts) then returned to each fan board to power up to 2 fans.
	FU-603	All	
	Connector ID	Terminals	Description
	CN1 (pins 1 & 4)	DCP-DCN	DC Bus Voltage into board
	CN2 (pins 1 & 3)	G6-P6	6 VDC out to Main SMPS CN11
	CN3 (pins 1, 2 & 3) CN4 (pins 1, 2 & 3)	24N-24P 24N-24P	These Fan boards power 2 fans only. CN3 and CN4 (Pins 1 & 3) provide 24 VDC to fans. CN3 & CN4 use pin 2 as part of an additional Fan Monitoring circuit. Pin 2 from each fan feeds a comparator (OR gate) on the fan board. Both low signals (0 VDC), no fault. If one fan locks up, a +5V at the OR Gate generates a +5 V output, This generates a Fan Fault and sends a Fan LOCK fault out on CN7 (5VDC). CN7 wires out to the Main SMPS at CN8, CN9 and/or CN15. When only one fan is connected to this fan board, the other connector (CN3 or CN4) pin 2 must be jumpered to GND (pin 1) to avoid generating a Fan Fault.
	CN5 (pins 1 & 2)	24P-24P1	Pin 2 (24P1) sends 24 VDC from the fan board out to Main SMPS at pin 1 of CN5, CN6 or CN16 through a contact of the fan control relays RLY2, RLY3, RLY4. The relays are controlled by a fan control circuit on the Main SMPS board. From the Main SMPS (24P-A. -B, -C), the 24 VDC then comes back to each of the Fan Boards on pin 1 (24P) of CN5. 24P is paralleled to pins 3 of CN3 and CN4. 24P from each fan board can power up to 2 fans from CN3 and CN4.
	CN7 (pins 1 & 2)		5VDC Fan Lock fault output to Main SMPS at CN8, CN9 or CN15.
	LED1		Power, DC Bus keeps this lit until discharged.



J1 Switch

Position	HP	State	Comment
280	≤ 400	closed	No Thermal Switch into CN18
315	≥ 500	open	Thermal Switch at CN18

Description

24 VDC

The fan boards generate 24 VDC from a switch mode power supply on the fan board. This 24 VDC is sent to the Main SMPS board as 24P1. At the Main SMPS board, the 24P1 is passed through contacts of the fan control relays (RLY2, RLY3, & RLY4) and is returned to the fan boards as 24P. This 24V (24P) is used to power up to 2 fans per fan board. The larger horse power VFD's can have up to 3 fan boards powering up to 2 fans each from connectors CN3 and CN4.

Operation of the Fan Control Relays is always ON when power is on. See parameters I/O-84 and I/O-85 for other options.

Fan Fault Monitoring (150 HP and larger)

These fan boards have a fan monitoring circuit which uses an additional signal from the fans. The fans have 3 wires. The middle wire (pin 2) is a fan fault monitor from each fan. Look at this as a normally closed switch. The Fan board monitors each fan (pin 2) and sends each signal to an OR gate. Inputs to the OR are low (zero volts). Output of the OR gate is low, no faults. This low signal keeps a transistor (part of fan monitor circuit) in the on state, representing a closed switch out of CN7. All 3 fan boards send this normally closed signal (CN7) to the Main SMPS board connectors CN8, CN9 & CN15. The connectors form a series circuit of all 3 fan board inputs.

If either fan (or both) fail, the OR gate input signal is pulled high which outputs a high from the OR gate. This will turn off the transistor (i.e. open switch) out on CN7. At the Main SMPS board, if any of the fan board signals (from CN7) open, this interrupts the series string. The Main SMPS generates a fan lock fault.

Jumpers

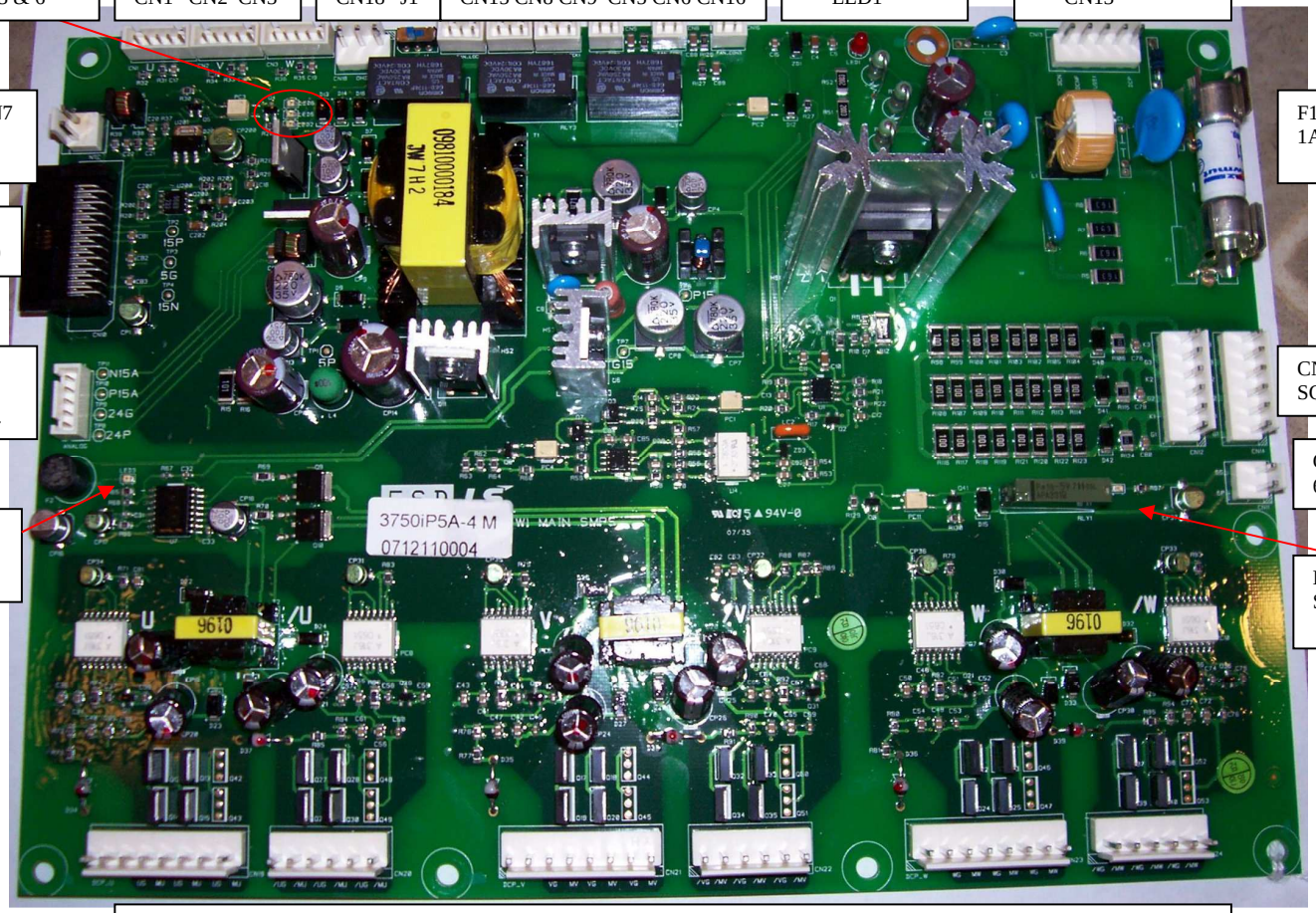
When a fan board powers only one fan, the unused connector (CN3 or CN4) must have a jumper installed to hold the fault signal low. Jumper pins 1 & 2.

At the Main SMPS board, when any one of the 3 connectors (CN8, CN9 or CN15) is not used, the unused connector must have a jumper installed to maintain the series connection of all 3 connectors. Jumper pins 1 & 2.

Switch J1 (280/315)

Switch positions are labeled 280 and 315. 280kW is 400 HP (and below), 315kW is 500 HP (and above). The larger HP's (500 and above) have a heat sink thermal switch plugged into terminal CN18. The smaller HP's do not. The J1 switch position determines if the thermal switch is monitored or not. The 280 position bypasses the thermal switch input, the 315 position puts the thermal switch in series with the fan monitoring connectors, CN8, CN9 & CN15. When the thermal switch opens (90^{o}C), the VFD still trips on a Fan Lock Fault as the thermal switch is part of the Fan Monitoring circuit.

Main SMPS Board **Part # PC-100053-01 thru -05,**
150 – 700 HP, 460V **-08 and -09**



	Part #	HP Where Used	Description
Main SMPS Board	PC-100053-01 PC-100053-02 PC-100053-03 PC-100053-04 PC-100053-05 PC-100053-08 PC-100053-09	150 200 250 350 400 500 600 & 700	The board contains circuits for Fan control, Input SCR control, IGBT Gate Firing signals, Current Transformer Feedback, DC Bus Voltage/DC Bus Fuse monitoring and IGBT temperature monitoring. Receives DC Bus voltage from capacitor bank. Creates 5 DC power supplies. 15 VDC (P15-G15) dedicated to IGBT Gate Power. +/-15 VDC (P15A, N15A - 24G) for Control Bd. I/O. 15 VDC (15P-15N) for component power. 24 VDC (24P-24G) for Control Bd. I/O. 5 VDC (5P-5G) for component power.
Fuse, 1A, 600V, 100Kaic. Fast Acting	FU-603	All	
	Connector ID	Terminals	Descritpion
	CN1, CN2, CN3 (pin 1)	15P	pos. 15V for CT's
	CN1, CN2, CN3 (pin 2)	15N	neg. 15V for CT's
	CN1, CN2, CN3 (pin 3)	IAS, IBS, ICS	Current Feedback
	CN1, CN2, CN3 (pins 4&5)	5G	Ground
	CN4 (pins 1 & 2)	24P - 24G	24V supply to Control Bd. CN6
	CN4 (pins 4 & 5)	P15A, N15A	pos. & neg. 15V supply to Control Bd. CN6
	CN4 (pin 3)	24G	Ground (same as pin 2)
	CN5 (pins 1 & 2) CN6 (pins 1 & 2) CN16 (pins 1 & 2)	24P1 - 24P-A 24P1 - 24P-B 24P1 - 24P-C	Fan Board Control Circuit, Relays RLY2, RLY3 & RLY4 contact closure sends 24P-A, 24P-B, 24P-C back to each Fan Board(s) at CN5 pin 1 (24P). The Main SMPS sends this 24 V back to the (up to) 3 separate fan boards.
	CN8 (pins 1, 2 & 3) CN9 (pins 1, 2 & 3) CN15(pins 1, 2 & 3)		Fan Fault monitoring from CN7 of fan board(s). The fan board has an Optocoupler that opens when a fan fault is sensed by the fan board. The Main SMPS board monitors each fan board via the optocoupler Up to 3 fan board signals are sent to the Main SMPS at pins 1 & 3 of CN8, CN9 & CN15.. The fan board signals at CN8, CN9 and CN15 are configured in series on the Main SMPS board. If any of the (up to 3) signals open, the Main SMPS sends a Fan Lock fault to the control board. When the VFD has less than 3 fan boards, the unused connector (CN8, CN9 or CN15) must have a jumper installed between pins 1 & 2 so avoid generating a Fan Fault.
	CN18 (pins 1 & 3)	OHD (Over Heat Detect)	Larger HP's (500 ~ 700) have a thermal switch connected to this terminal. Lower HP's (150 ~ 400) do not. There is a two position PC board switch (J1) associated with this thermal switch input. See description of J1 switch.

	Connector ID	Terminals	Description
Main SMPS Board continued	CN11 (pins 1 & 2)	P6 - G6	6 VDC from Fan Board, CN2. Used to power Input SCR's gate circuit.
	CN13 (pin 1 - 5)	DCN - DCP	DC Bus Voltage into board
	CN13 (pin 2 - 3)	DCNF - FUSE1	DC Bus Fuse Indicator (NC)
	CN13 (pin 4)	Not Used	
	CN12 (pins 1 & 2)	K3, G3	500 - 700 HP only, Second set, SCR Gate signal, T phase
	CN12 (pins 3 & 4)	K2, G2	500 - 700 HP only, Second set, SCR Gate signal, S phase
	CN12 (pins 5 & 6)	K1, G1	500 - 700 HP only, Second set, SCR Gate signal, R phase
	CN14 (pins 1 & 2)	K3, G3	SCR Gate signal, T phase
	CN14 (pins 3 & 4)	K2, G2	SCR Gate signal, S phase
	CN14 (pins 5 & 6)	K1, G1	SCR Gate signal, R phase
	CN7 (pins 1 & 2)	NTC	Thermistor Input
	LED1		DC Bus Power
	LED2		Fan Bd. Control Relay, RLY2 energized (CN5, pins 24P1 & 24P-A closed), Parameter Controlled, See I/O-84
	LED3		15 VDC for IGBT Gate Drive Circuits
	LED4		SCR Gates "ON" LED (6VDC)
	LED5		Fan Bd. Control Relay, RLY3 energized (CN6, pins 24P1 & 24P-B closed), Parameter Controlled, See I/O-84
	LED6		Fan Bd. Control Relay, RLY4 energized (CN16, pins 24P1 & 24P-C closed), Parameter Controlled, See I/O-84
	J1 (switch)	280/315	Switch positions are labeled 280 and 315. 280kW is 400 HP (and below), 315kW is 500 HP (and above). The larger HP's (500 and above) have a heat sink thermal switch(s) plugged into terminal CN18. The smaller HP's do not. The J1 switch position determines if the thermal switch is monitored or not. The 280 position bypasses the thermal switch input, the 315 position puts the thermal switch in series with the fan monitoring connectors, CN8, CN9 & CN15. When the thermal switch opens (90°C), the VFD still trips on a Fan Lock Fault as the thermal switch is part of the Fan Monitoring series circuit.

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BENSHAW®
ADVANCED CONTROLS & DRIVES

Section 4

Troubleshooting

4.1 *Over Voltage Fault*

Fault Display: Over Voltage **Auto Resettable:** Yes

Background - What is the DC Bus Voltage?

The line voltage (input) to the drive gets rectified with a 3 phase full bridge rectifier. This DC voltage is filtered with the capacitor bank within the drive. The DC voltage (referred to as the DC Bus Voltage or DC Link Voltage) on the capacitor bank is the peak value of the AC input voltage and can be calculated by multiplying the line voltage by √2. The drive uses the DC Bus voltage to create the PWM output voltage. The drive monitors the DC Bus to detect low voltage and over voltage conditions. The DC Bus voltage can be viewed at parameter DRV-11. It can also be measured across terminals P and N at the drive power terminals.

Description: What is an Over Voltage Fault?

The DC Bus voltage of the drive has reached ~123% of the normal DC Bus voltage. **Note: The trip level is not adjustable as it is a hardware protection fault.**

Summary

System Voltage (Vac)	Normal DC Bus (VDC)	Trip Level (VDC)
460/480	650/680	800
230/240	325/340	400
575	813	1000

Causes: Over Hauling Load conditions. Any time during running or stopping, when the load causes the motor to rotate faster than the drive commanded speed, the motor will produce torque in the opposite direction (negative torque or brake torque) resulting in energy fed back into the drive from the motor. The result of this regenerative power is an increase in the DC Bus voltage. Drives can handle some regenerated energy (~15% of their HP/kW rating), but certain loads or operating conditions will increase the DC Bus voltage to the trip level resulting in an over voltage trip.

The most common cause of an over voltage trip is trying to decelerate the motor/load too quickly. Increasing the deceleration time is the most common solution. However, if this does not solve the tripping, dynamic braking (resistor and module) may be required. Typical applications are high inertia type loads (centrifuges, large fans/blowers, large conveyors, loads that use a flywheel). When decelerating or changing to slower speeds an over voltage fault could occur. Other applications where over voltage faults are likely involve changing load conditions from heavy load to light load (lumber mill saws or simply belts slipping).

Check Fault History: At parameter AFN-01 (most recent fault), hit the program button, then up arrow to view data captured at time of fault (Hz, Volts, Amps, Status). AFN-02 through AFN-05 are previous faults.

Fault	Causes	Solutions
Over Voltage while stopped	Line Voltage Disturbance - A high line voltage or spike to higher than normal levels. • Other equipment (breakers, switches, starters) being switched on or off. • Utility switching power. • Switching of capacitor banks on the source. • Generator source - over compensating or regulation problems.	Determine cause of line voltage fluctuation. While stopped, isolation of the drive from the source may be required. A filter (transformer or reactor) typically will not help under no load conditions. An Isolation contactor may be required, keeping the drive powered off when stopped. Increase Accel time (DRV-01). Verify generator sizing at least 2 times drive KW rating.
Over Voltage at start command (instantaneously)	Output Short Circuit - The reaction of the drive when starting into a short circuit is an immediate trip because of the spike in current. Turning off all IGBT's causes a spike (ringing) of the DC Bus voltage, resulting in an Over Voltage Fault.	With motor leads disconnected from drive, Ohm check phase-phase and phase-ground. Meggar test including motor leads. With motor leads disconnected, restart drive. If drive still trips on OC-2, drive IGBT short. See Power Device checks.
Over Voltage during Acceleration	Regenerative Load - Feeders, Crushers, Stamping Press.	Decrease Accel time (DRV-01). Enable Stall Mode (FUN-70) - This function attempts to regulate the DC Bus below the trip level by increasing the speed of the motor (forcing the regen power back out to the motor). Add Dynamic Braking Module and Resistor.
	Belts Slipping	Check belts.
	Generator source - over compensating or regulation problems.	Increase Accel time (DRV-01) Verify generator sizing at least 2 times the drive KW rating.

Fault	Causes	Solutions
Over Voltage during running	Regenerative Load - Feeders, Crushers, Stamping Press.	Enable Stall Mode (FUN-70) - This function attempts to regulate the DC Bus below the trip level by increasing the speed of the motor (forcing the regen power back out to the motor). Add Dynamic Braking Module and Resistor.
	Sudden change in speed reference signal.	Increase Accel and Decel times (DRV-01 and DRV-02)
	Changes in load from full load to no load.	Avoid rapid changes in load.
Over Voltage during Deceleration	Decel Time too short	Increase Decel time (DRV-02). Change stop mode (FUN-23) to Coast to Stop (Free Run).
	Regenerative Load.	Enable Stall Mode (FUN-70) - This function attempts to regulate the DC Bus below the trip level by increasing the speed of the motor (forcing the regen power back out to the motor). Add Dynamic Braking Module and Resistor.

4.2 *Over Current Faults*

Fault Display: Over Curr-1 **Auto Resettable:** Yes

Description: Over Curr-1 ~ 200% drive rated current (standard duty rating)

Check Fault History: At parameter AFN-01 (most recent fault), hit the program button, then up arrow to view data captured at time of fault (Hz, Volts, Amps, Status). AFN-02 through AFN-05 are previous faults.

Fault	Causes	Solutions
Over Current-1 During Acceleration	Acceleration time is too short.	Increase Accel time (DRV-01) Enable Current Limit (Stall Function, FUN-70 and FUN-71).
	Load Related • Load too large • Load is jammed	Verify sizing of drive and motor Verify motor can spin freely
	Motor rotating the wrong direction and mechanically cannot run in reverse.	Verify rotation.
	Motor rotating at start command.	Start drive only after motor has completely stopped or use DC Injection at start (FUN-20) or use speed search function (AFN-22).
	Single Phase output from drive.	With no motor connected, measure phase-phase voltage output at 60 Hz.
	Low Line Voltage (Low DC Bus Voltage)	Measure line voltage. View DC Bus voltage (DRV-11) or measure P-N terminals during ramp. See Low Voltage Fault.
	Voltage Boost too low.	Load may require voltage boost at start (AFN-67, 68). **Caution:** Too high of a boost setting will also cause over current faults.
Over Current-1 During Deceleration	Deceleration time is too short compared to the inertia of the load.	Increase Decel time (DRV-02).
Over Current-1 During Running	Sudden changes in load.	Avoid no load to full load operation.
	Sudden change in speed reference signal.	Increase Accel and Decel times (DRV-01 and DRV-02)

Fault Display: Over Curr-2 **Auto Resettable:** No

Description: Over Curr-2 ~ instantaneous at ~300% drive rated current (standard duty rating)

Check Fault History: At parameter AFN-01 (most recent fault), hit the program button, then up arrow to view data captured at time of fault (Hz, Volts, Amps, Status). AFN-02 through AFN-05 are previous faults.

Fault	Causes	Solutions
Over Current-2 Instantly (on start command)	Output Short Circuit - motor or cables.	With motor leads disconnected from drive, Ohm check phase-phase and phase-ground. Meggar test including motor leads.
	Output Short Circuit - IGBT's	With motor leads disconnected, restart drive. If drive still trips on OC-2, drive IGBT short. See Power Device checks.
	Long motor lead length. Distance between drive and motor is too long.	Add output reactor or long lead filter (dV/dT).
	Multiple motors connected to output of drive.	Add output reactor or long lead filter (dV/dT).
	Motor leads run in parallel with power leads, or in same conduit.	Separate power and motor leads.
	Power factor capacitors or other surge filters connected to output of drive or at motor.	Remove capacitors or filters from output of drive.
	Control wiring - Noise is shield connection.	Remove shield connection at drive I/O terminal strip.
	Voltage Boost too high	Decrease boost percentage (AFN-67, 68)
	Motor cables laying in high moisture environment.	Relocate cables.

4.3 Overload Faults

The model SG drives have two different motor overload protection settings along with drive overload protection. Each is described below.

A. E-Thermal
B. Overload
C. Inverter Overload

A. E-Thermal

Fault Display: E-THERMAL Auto Resettable: No

Related Parameters: **DRV-05** – Motor rated current.

DRV-06 – **ETH select** Yes/No, activate or deactivate the protection, default set to yes.

DRV-07 – **ETH 1 min** default 130% for one minute, programmable.

DRV-08 – **ETH continuous** 100% continuous (**service factor**, set to motor nameplate).

DRV-09 – Motor Type **Self Cooled** motor to address slow speed heating (under 20 Hz). **Force cooled** disables the slow speed factor.

Description: The ETH function is an electronic overload (I^2t) calculation that monitors motor amps along with speed of the motor to detect motor overload and motor overheating conditions. Parameter DRV-07 is the one-minute trip level (% of DRV-05) and DRV-08 is the motor service factor. Amps above service factor amps are used to determine overload. Also, at any speed below 60 Hz. motor heating is a factor in the calculation, especially at slow speeds below 20 Hz. The fault cannot be reset immediately. There is a required cool down period (thermal retention) of 1 minute.

Check Fault History: At parameter AFN-01 (most recent fault), hit the program button, then up arrow to view data captured at time of fault (Hz, Volts, Amps, Status). AFN-02 through AFN-05 are previous faults.

Fault	Causes	Solutions
E-Thermal (Electronic Thermal Overload, ETH)	The internal electronic thermal overload protection of the drive has determined that the motor is overloaded and/or over heated.	Check fault history. DRV-13 if still tripped, AFN-01 if reset. Note the amps and frequency recorded when the trip occurred. Inspect load and motor for causes of high current draw.
	ETH settings too low.	Check/Adjust motor settings and ETH levels: DRV-05 through DRV-08 AFN-40 motor capacity.
	Motor was operated at low speeds for extended period of time.	If low speed operation is normal, options are: Turn off low speed ETH (FUN-09 to forced cool) and add separate motor cooling fan. Turn of ETH completely (FUN-06, No) and use FUN-66, 67 and 68.
	Incorrect motor capacity selected.	Select correct motor capacity (AFN-40, Motor select).
	Incorrect drive capacity selected.	Select correct drive capacity (MAK-01, Inverter capacity).
	Incorrect V/F pattern.	Select correct V/F pattern (FUN-40) or operating mode (AFN-60).
	Load is too large for the rating of the drive.	Reduce Load and/or Increase drive capacity.

B. Overload

Fault Display: Overload **Auto Resettable**: No

Related Parameters: **DRV-05 Motor rated current**
FUN-66 Overload Trip Selection Yes/No
FUN-67 Overload Trip Level
FUN-68 Overload Trip Time

Description: General overload protection for the drive and the motor. The Overload Trip function is activated with FUN-66 (set to Yes). The drive will trip when the drive output current exceeds the Overload trip level (FUN-67, percentage of DRV-05) for the Overload Trip time (FUN-68, seconds). Speed of the motor is not a factor (like Eth) using this overload protection.

Other Functionality: A drive output relay (A1-C1, A2-C2, etc.) can be activated to provide a remote signal when the drive trips on Overload. Program one of I/O-76 through I/O-79 to "OL". Additionally, a drive output relay (A1-C1, A2-C2, etc.) can be activated to provide an "OL Warning" when programmed to the OL function (I/O-76 through I/O-79) along with parameters FUN-64 (OL warning level) and FUN-65 (OL warning time).

Check Fault History: At parameter AFN-01 (most recent fault), hit the program button, then up arrow to view data captured at time of fault (Hz, Volts, Amps, Status). AFN-02 through AFN-05 are previous faults.

Fault	Causes	Solutions
Overload	Drive output current is larger than the overload settings.	Verify settings in FUN-66, 67 and 68. Check fault history. DRV-13 if still tripped, AFN-01 if reset. Note the amps and frequency recorded when the trip occurred. Inspect load and motor for causes of high current draw.
	Load is too large for the rating of the drive.	Reduce Load and/or Increase drive capacity.
	Incorrect drive capacity selected.	Select correct drive capacity (MAK-01, Inverter capacity). Note when changing MAK-01, the motor amps (DRV-05) will reset to a default value based on MAK-01 selection.
	Incorrect V/F pattern.	Select correct V/F pattern (FUN-40) or operating mode (AFN-60).

C. Inverter Overload

Fault Display: Inv. OLT **Auto Resettable**: No

Description: The Inverter Overload trip level is an electronic overload (I^2t) calculation for protection of the drive. The trip settings are fixed at **110% of the drive Std. Duty rating** for 60 seconds. The drive current rating is shown in Parameter MAK-63. The fault cannot be reset immediately. There is a required cool down period (thermal retention) of 1 minute.

Other Functionality: A drive output relay (A1-C1, A2-C2, etc.) can be activated when programmed as IOL. The relay closes at 36 secs (60% of 1 min) for alarm, the drive trips at 60 secs. These are also fixed settings, no adjustment.

Check Fault History: At parameter AFN-01 (most recent fault), hit the program button, then up arrow to view data captured at time of fault (Hz, Volts, Amps, Status). AFN-02 through AFN-05 are previous faults.

Fault	Causes	Solutions
Inverter Overload	Drive output current is larger than drive rating.	Check fault history. DRV-13 if still tripped, AFN-01 if reset. Note the amps and frequency recorded when the trip occurred. Inspect load and motor for causes of high current draw.
	Incorrect drive capacity selected.	Select correct drive capacity (MAK-01, Inverter capacity). Note when changing MAK-01, the motor amps (DRV-05) will reset to a default value based on MAK-01 selection.

4.4 Ground Fault

Fault Display: Ground Fault **Auto Resettable**: No

Related parameters: DRV-05, DRV-30, MAK-26

Description: The drive has detected a level of ground current higher than the programmed ground fault setting in the drive. Parameter MAK-26 is set as a percentage of motor amps (DRV-05). When running, the ground current can be viewed at parameter DRV-30.

Background: Ground fault monitoring is done residually. The instantaneous values of the three phase output currents are monitored and summed. Under ideal conditions the vector sum would be zero. Any difference is assumed to be ground current.

Fault	Causes	Solutions
Ground Fault	Output Short Circuit - motor or cables.	With motor leads disconnected from drive, Ohm check phase-phase and phase-ground. Meggar test including motor leads.
	Output Short Circuit - IGBT's	With motor leads disconnected, restart drive. If drive still trips on ground fault or OC-2, drive IGBT short. See Power Device checks.
	Single Phase output from drive.	With no motor connected, measure phase-phase voltage output at 60 Hz.
	Ground Current setting too low.	Increase ground current percentage, parameter MAK-26. See adjustment below.
	IGBT gate firing circuit	Pull and reseat IGBT connectors CN19 through CN24 at bottom of the Main SMPS board.
	Missing Feedback Signal	Larger drives ($\geq$ 150 HP) The Main SMPS board receives feedback current signals from LEM's, Check the connection at the Main SMPS board, connectors CN1, CN2, CN3.
	SMPS Board malfunction	Replace Main SMPS board.
	Line Voltage Imbalance	The spec for voltage input imbalance is +/-2%. This can cause an imbalance in the output voltages, leading to imbalance of current, which is the main detection for ground fault current. Partial solution is line reactor.

Fault	Causes	Solutions
Ground Fault (continued)	Type of Cable	Insulation Rating? Higher rating may be required for PWM type signals as leakage (parasitic capacitance) can cause drive to sense and trip on ground fault.
	Long motor lead length. Distance between drive and motor is too long.	Add output reactor or long lead filter (dV/dT).
	Type of Cable	Shielded or Non-Shielded? Shielded is not necessarily required unless there are sensitive devices (sensors, weight scales, comms. network, computers, etc.) that could be affected by the Noise (EMI/RFI) emitted from the drive and the output cables. If specs refer to EMC standards, cable should be shielded.

1. **Adjust the ground fault setting**. Access to the hidden group of parameters is required.

Accessing the MAK group

a) Push the Mode button twice to get to the AFN Group.

b) Push the down arrow button to get to parameter AFN-94, Parameter Lock.

c) Push the Program button.

d) Using the Shift and Up/Down arrow buttons, enter code 0291 in Parameter AFN-94. **NOTE:** the zero does not show but there are 4 spaces. Just make sure the 291 is entered as _291, not 2910.

e) Push Enter button.

f) Push the Mode button four (4) times to get to parameter MAK-00.

Adjust Ground Fault Level

g) Push the up arrow to get to parameter MAK-26, Ground Fault.

h) Push the Program button.

i) Using the left and up arrow buttons, increase the percentage to an acceptable level.

CAUTION: Do not increase above 20%.

j) Push Enter button to save the setting.

2. Check PC Board Connections

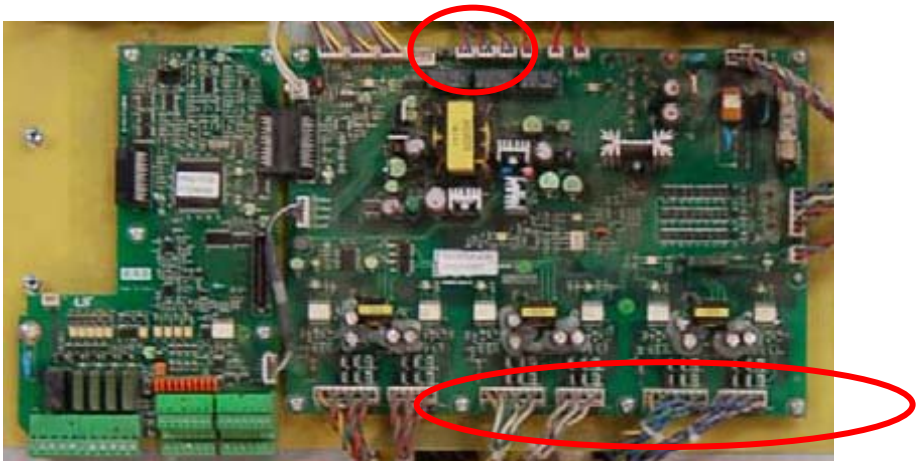
a) Power Down.

b) Remove upper cover of VFD.

c) Below is a picture of the internal PC Boards (Control Bd. And Main SMPS).

d) LEM Feedback / DC Power connectors are in the upper left of the Main SMPS board. Push in, wiggle. Possible intermittent connection of current feedback.

e) IGBT firing connectors along bottom of board. Same routine.



f) Start VFD. Monitor output current. Clamp on, etc.

4.5 Speed Reference Inputs / Transducer Wiring

Problem: Drive does not respond to the 4-20mA input source.

Description: The output frequency (speed) of the drive can be controlled with a 4-20mA input source. Input terminals on the control board are designated “I” and “CM” (or 5G). There are a number of input wiring schemes that could be used. See the drawings at the end of this section.

If the drive does not respond to the 4 – 20 mA speed reference signal, possible causes are listed in the table below.

Problem	Causes	Solutions
Drive does not respond to 4-20mA signal.	Parameter not set to "I".	Check the drive parameter for the reference source. See table on dwgs. based on application.
	Connections.	Check polarity of 4-20 signal cable.
		Verify proper connections to control bd. terminal strip. See dwgs.
	Missing 24 VDC from drive terminal.	Measure between terminals 24 and CM. 24 VDC comes from Main SMPS Bd.
	Missing Jumper - This applies only to drives ≤ 40 HP.	If using 2-wire transducer connection, install jumper between terminals 5G and CM.
	Short in signal cable causing 24VDC input at the "I" terminal.	Verify resistance at control bd. terminal strip. ≤ 40 HP = 250 ohms I - 5G ≥ 50 HP - 10 ohms I - CM If open or high resistance, the input resistor has failed due to high current. Replace control bd. and fuse the 4-20mA input. See dwgs.
	Missing 4-20mA signal.	Simulate the input with another 4-20 mA source. View parameter DRV-19. This is the digital representation of the 4-20mA signal.
Reference at 20mA (100%) does not produce 60 Hz. Output.	Scaling adjustment	Check settings of parameters I/O-07 through I/O-10
		Calibrate the Control Bd. 4-20mA signal. See calibration procedure below.

4–20mA CONTROL SCHEMATICS

FIG. 1:
TWO–WIRE SENSOR 4–20mA
USING VFD DC POWER

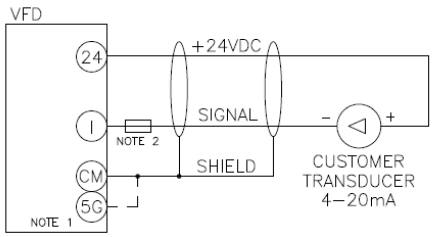


FIG. 2:
TWO–WIRE SENSOR 4–20mA
USING EXTERNAL DC POWER

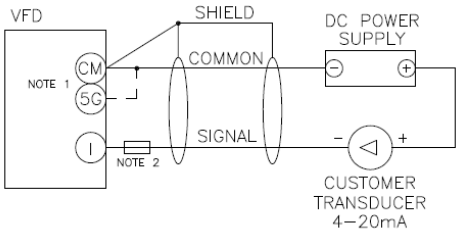


FIG. 3:
THREE–WIRE SENSOR 4–20mA
USING VFD DC POWER

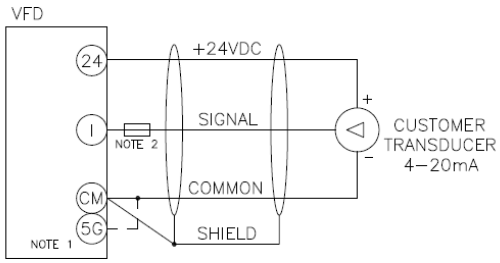
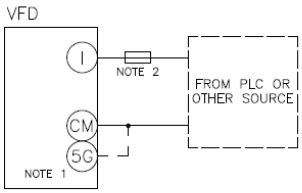


FIG. 4:
DIRECT 4–20mA CONTROL



NOTES:

1. GROUND TERMINALS ON SG VFD ARE AS FOLLOWS
   ≤40HP, USE 5G , JUMPER TO CM
   ≥50HP, USE CM
2. RECOMMENDED FUSE SIZE: 100mA

PARAMETERS for 4–20mA CONTROL SOURCE
FIGS. 1 through 4

DIRECT (LOCAL)	DRV–04 = 1	–
REMOTE	DRV–92 = 1	I/O–20(M1) = LOC/REM
PI CONTROL	APP–06 = 1	APP–02 = YES

0–10V CONTROL SCHEMATICS

FIG. 5:
THREE–WIRE SENSOR 0–10V
USING VFD DC POWER

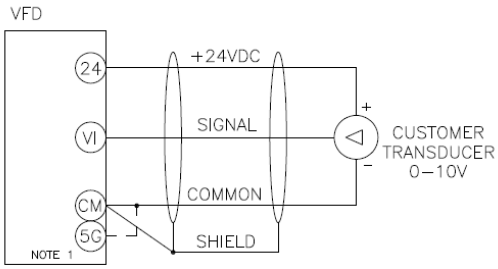


FIG. 6:
THREE–WIRE SENSOR 0–10V
USING EXTERNAL DC POWER

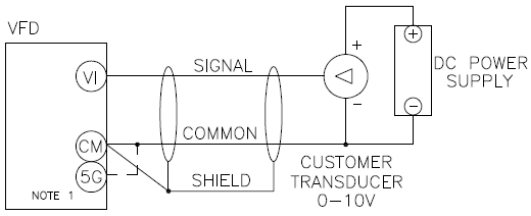


FIG. 7:
FOUR–WIRE SENSOR 0–10V
USING EXTERNAL DC POWER

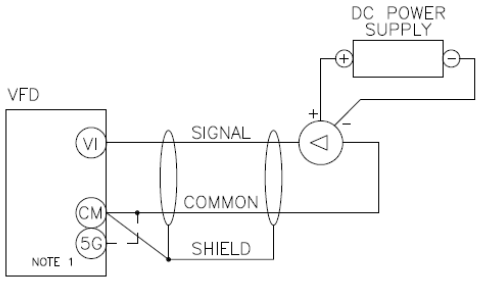


FIG. 8:
POTENTIOMETER WIRING
USING VFD DC POWER

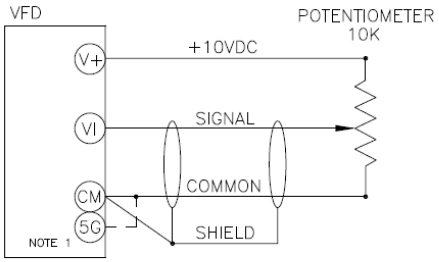
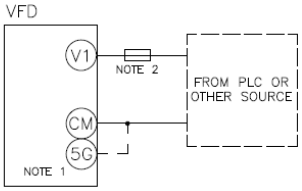


FIG. 9:
DIRECT 0–10V CONTROL



NOTES:

1. GROUND TERMINALS ON SG VFD ARE AS FOLLOWS
   ≤40HP, USE 88 , JUMPER TO CM
   50HP, USE CM
2. RECOMMENDED FUSE SIZE: 100mA

PARAMETERS for 0–10V CONTROL SOURCE
FIGS. 5 through 9

DIRECT (LOCAL)	DRV–04 = VI	–
REMOTE	DRV–92 = VI	I/O–20(M1) = LOC/REM
PI CONTROL	APP–02 = YES	APP–06 = V1

SG Analog Input Calibration Procedure

This procedure defines how to calibrate the analog input signals of the SG VFD.
Required equipment: A calibrated current/voltage source (4–20 mA, 0–10 VDC and/or 0 to +/-12 VDC).
Using a calibrated source, input the analog signal (max then min) to the appropriate drive terminals. The drive is told, via a parameter to read the signal. Access to a hidden group of parameters, designated MAK, is required. This group contains the factory calibration parameters.

1. Accessing the MAK group

A. Push the Mode button twice to get to the AFN Group.
B. Use the down arrow button to get to parameter AFN-94, Parameter Lock.
C. Push the Program button.
D. Using the Shift and Up/Down arrow buttons, enter code _291 in Parameter AFN-94. There are four digits, do not enter 2910.
E. Push Enter button.
F. Push the Mode button four (4) times to get to the MAK group (parameter MAK-00).

2. Calibration Procedure

A. For 4 – 20 mA Input

1) Input a 20 mA signal at terminals I and CM (or 5G on ≤ to 40 HP).
2) Using the UP arrow button, go to parameter MAK-30 (I max cal).
3) Program to YES, push enter.
4) Input a 4 mA signal.
5) Go to parameter MAK-31 (I min cal).
6) Program to YES, push enter.

B. For 0 – 10 VDC

1) Input a 10 VDC signal at terminals V1 and CM (or 5G on ≤ to 40 HP).
2) Using the arrow buttons, go to parameter MAK-28 (V1 max cal).
3) Program to YES, push enter.
4) Input a 0 VDC signal.
5) Go to parameter MAK-29 (V1 min cal).
6) Program to YES, push enter

C. For 0 to 12 VDC and 0 to -12 VDC

1) Input a 12 VDC signal at Terminals V1 and CM of the VFD.
2) Using the arrow buttons, go to parameter MAK-32 (V1S 12V cal).
3) Program to YES, push enter.
4) Input a -12 VDC signal.
5) Go to parameter MAK-33 (V1S-12V cal).
6) Program to YES, push enter.
7) Input a 0 (zero) VDC signal
8) Go to parameter MAK-34 (V1S 0V cal)
9) Program to YES, push enter.

Parameter Summary

Group	Code	Display	Default	Range
MAK	28	V1 max cal	No	No, Yes
MAK	29	V1 min cal	No	No, Yes
MAK	30	I max cal	No	No, Yes
MAK	31	I min cal	No	No, Yes, default
MAK	32	V1S 12V cal	No	No, Yes
MAK	33	V1S-12V cal	No	No, Yes
MAK	34	V1S 0V cal	No	No, Yes

4.6 Output Phase Open Fault / No Motor Trip

Faults: Output Phase Open and No Motor Trip

Fault Display: Out Phase Open and/or No motor Trip **Auto Resettable**: Yes

Related Parameters: Output Phase Open parameters

DRV-05 Motor rated Current

AFN-40 Rated motor selection (motor HP)

AFN-44 No Load motor current

and

FUN-57 No Motor Selection

FUN-58 Trip Current Level

FUN-59 Trip Time Setting

No motor Trip, parameters DRV-05, FUN-57, 58 and 59 **only**.

Description– The drive monitors output current of all three phases. The drive turns off its output when one or more of the output phase currents is detected as low current.

The **No motor Trip** fault is simply a low current detection level comparing the actual output current to DRV-05 setting and is based on percentage and time set in parameters FUN-58 and FUN-59.

For **Output Phase Open fault**, both conditions below must be met to result in an open phase fault.

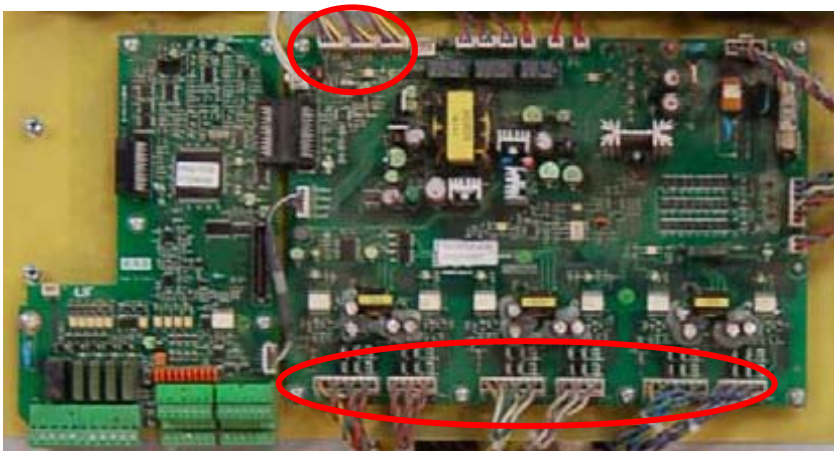
1. Output Current is less than 25% of the No-Load Current, AFN-44 for more than 1 second.

2. Output Current is less the No Motor Detection Level (percentage), FUN-58 for more than time set in FUN-59.
   Note: Output current percentage is based on DRV-05, Motor Amps.

Check Fault History: At parameter AFN-01 (most recent fault), hit the program button, then up arrow to view data captured at time of fault (Hz, Volts, Amps, Status). AFN-02 through AFN-05 are previous faults.

Fault	Causes	Solutions
Out Phase Open	Open Output - either wiring or contactor/switch on output of drive.	Check output wiring and connections. Check output contactor/switch if applicable.
	Low Current - Drive has detected low current or no current flow out of drive.	Parameter checks: AFN-40 Motor Capacity. AFN-44 No Load Current (if not know ~ 33% of motor amps). FUN-57, if yes, FUN-58 current level (percentage of motor amps, DRV-05). FUN-59 trip time.
	Single Phase output from drive.	Measure phase-phase voltage output at 60 Hz. with no motor connected. Change FUN-57 to "No" for this test.
	Poor connections at Main SMPS PC Board (≥150 HP)	Perform check of PC Board connections per 1) below.
No Motor Trip	Same as Output Phase Open except specifically related to parameters FUN-57, FUN-58 and FUN-59	Parameter checks: FUN-57, if yes, FUN-58 current level (percentage of motor amps, DRV-05). FUN-59 trip time.

1) Check PC Board Connections
   a. Power Down.
   b. Remove upper cover of VFD.
   c. Below is a picture of the internal PC Boards (Control Bd. And Main SMPS).
   d. LEM Feedback / DC Power connectors are in the upper left of the Main SMPS board. Push in, wiggle. Possible intermittent connection of current feedback.
   e. IGBT firing connectors along bottom of board. Same routine.



   f. Start VFD. Monitor output current. Clamp on, etc.

4.7 Inverter Capacity Setting

Fault: Initialize Inverter Capacity

Fault Display: Flashing Message **"Init. Inv Cap"**

Auto Resettable: No

Description: When installing a new Control Board, you will get a message "Init. Inv Cap" which is interpreted as Initialize Inverter Capacity. You have to assign the VFD Horse Power and Voltage ratings. This is referring to parameter MAK-01, Inverter Capacity. You have to access the MAK group of parameters. Follow instructions below.

Accessing the MAK group

a) Push the Mode button twice to get to the AFN Group.

b) Push the down arrow button to get to parameter AFN-94, Parameter Lock.

c) Push the Program button.

d) Using the Shift and Up/Down arrow buttons, enter code 0291 in Parameter AFN-94. **NOTE:** the zero does not show but there are 4 spaces. Just make sure the 291 is entered as _291, not 2910.

e) Push Enter button.

f) Push the Mode button four (4) times to get to parameter MAK-00.

g) Push the up arrow once to get to parameter MAK-01, Inverter Capacity.

h) Push the Program button.

i) Using the down arrow button, find the Horse Power (displayed in kW) and the voltage rating of your VFD. See Table 1 for the choices of parameter MAK-01.

j) Push Enter button on your VFD ratings.

Table 1: SG VFD Maker Group Selection		
MAK 01 Display	Equivalent Std. Duty HP	Voltage
280.0 kW-6	400	575
220.0 kW-6	350	575
160.0 kW-6	250	575
132.0 kW-6	200	575
110.0 kW-6	150	575
90.0 kW-6	125	575
75.0 kW-6	100	575
55.0 kW-6	75	575
45.0 kW-6	60	575
37.0 kW-6	50	575
30.0 kW-6	40	575
22.0 kW-6	30	575
18.5 kW-6	25	575
15.0 kW-6	20	575
11.0 kW-6	15	575
7.5 kW-6	10	575
5.5 kW-6	7.5	575
450.0 kW-4	700	460
375.0 kW-4	600	460
315.0 kW-4	500	460
280.0 kW-4	400	460
220.0 kW-4	350	460
160.0 kW-4	250	460
132.0 kW-4	200	460
110.0 kW-4	150	460
90.0 kW-4	125	460
75.0 kW-4	100	460
55.0 kW-4	75	460
45.0 kW-4	60	460
37.0 kW-4	50	460
30.0 kW-4	40	460
22.0 kW-4	30	460
18.5 kW-4	25	460
15.0 kW-4	20	460
11.0 kW-4	15	460
7.5 kW-4	10	460
5.5 kW-4	7.5	460
30.0 kW-2	40	230
22.0 kW-2	30	230
18.5 kW-2	25	230
15.0 kW-2	20	230
11.0 kW-2	15	230
7.5 kW-2	10	230
5.5 kW-2	7.5	230

4.8 Power Component Check

50 - 125 HP Configuration/Description

- <125HP Input rectifier circuit arrangement consists of 3 diode/SCR modules.
- 125 HP has 6 diode/SCR modules.
- All SCR's have a snubber circuit across them.
- Pre-charge resistor circuit between R and P1/P2 (jumper) parallel with the snubber circuit.
- One DC Bus fuse in the Positive DC Bus rail.
- One 3-phase output module (IGBT bridge)
- Thermistor (PTC) internal to IGBT output module

Module		Test polarity		Reading
		+	-	
DC Bus Fuse	Fuse 1	across fuse		Closed
SCR's	*SCR1 D1	R	P2 (+)	Open
		P2 (+)	R	Open
	SCR2	S	P2 (+)	Open
		P2 (+)	S	Open
	SCR3	T	P2 (+)	Open
		P2 (+)	T	Open

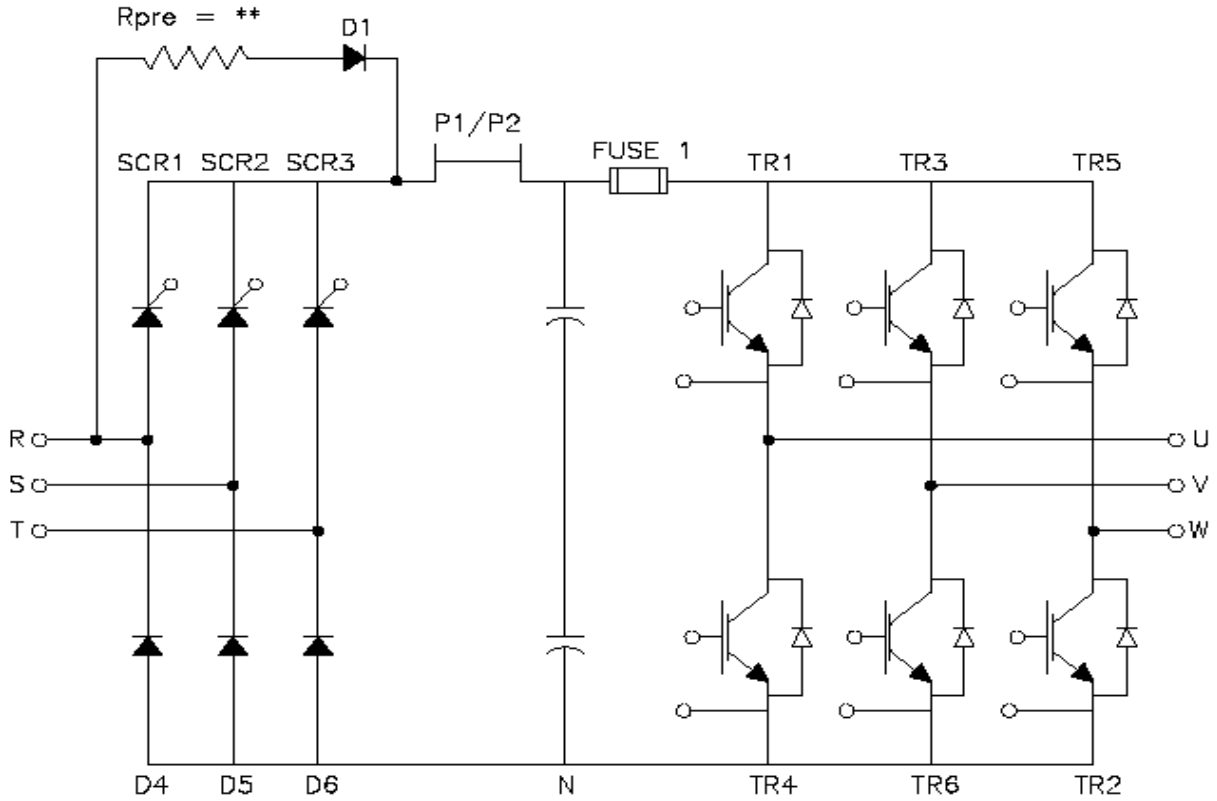
*measurement is across R_{pre}/D1 (series) in parallel with SCR1
125 HP has 6 SCR/Diode modules (SCR1a, SCR2a, D1a, D2a, etc.)

Module		Test polarity		Reading
		+	-	
Fuse Indicator	Fuse 1	across indicator		Closed
Diodes	D4	R	N (-)	Open
		N (-)	R	Closed
	D5	S	N (-)	Open
		N (-)	S	Closed
	D6	T	N (-)	Open
		N (-)	T	Closed

IGBT's	Tr1	U	P2 (+)	Closed
		P2 (+)	U	Open
	Tr3	V	P2 (+)	Closed
		P2 (+)	V	Open
	Tr5	W	P2 (+)	Closed
		P2 (+)	W	Open

IGBT's	Tr4	U	N (-)	Open
		N (-)	U	Closed
	Tr6	V	N (-)	Open
		N (-)	V	Closed
	Tr2	W	N (-)	Open
		N (-)	W	Closed

50 HP – 125 HP POWER CIRCUIT (SIMPLIFIED)



** Rpre

HP	ohms
50	60
60–75	40
100–125	30

POWER TERMINALS								
R	S	T	P1 +	P2 +	N–	U	V	W

150 - 250 HP Configuration/Description

- Input rectifier circuit arrangement consists of 3 Diode/SCR modules.
- Pre-Charge resistor/diode circuit between R and P1/P2 (jumper).
- No P1 terminal due to a DC Link Reactor in the Positive DC Bus rail.
- Two DC Bus fuses in the DC Positive Bus Rail.
- Six dual IGBT Modules.
- Three Heat Sink Fans
- No Thermal Switch Input (OHD Terminal, connector CN18). See Switch J1 description.
- Three Heat Sink Fans
- NTC input to main SMPS

Module		Test polarity		Reading
		+	-	
DC Bus Fuses	Fuse 1	across fuse		Closed
	Fuse 2	across fuse		Closed

Module		Test polarity		Reading
		+	-	
Fuse Indicators	Fuse 1	across indicator		Closed
	Fuse 2	across indicator		Closed

Fuses are in parallel, visual check indicators first

SCR's	SCR1	R	P2 (+)	Open
		P2 (+)	R	Open
	SCR2	S	P2 (+)	Open
		P2 (+)	S	Open
	SCR3	T	P2 (+)	Open
		P2 (+)	T	Open

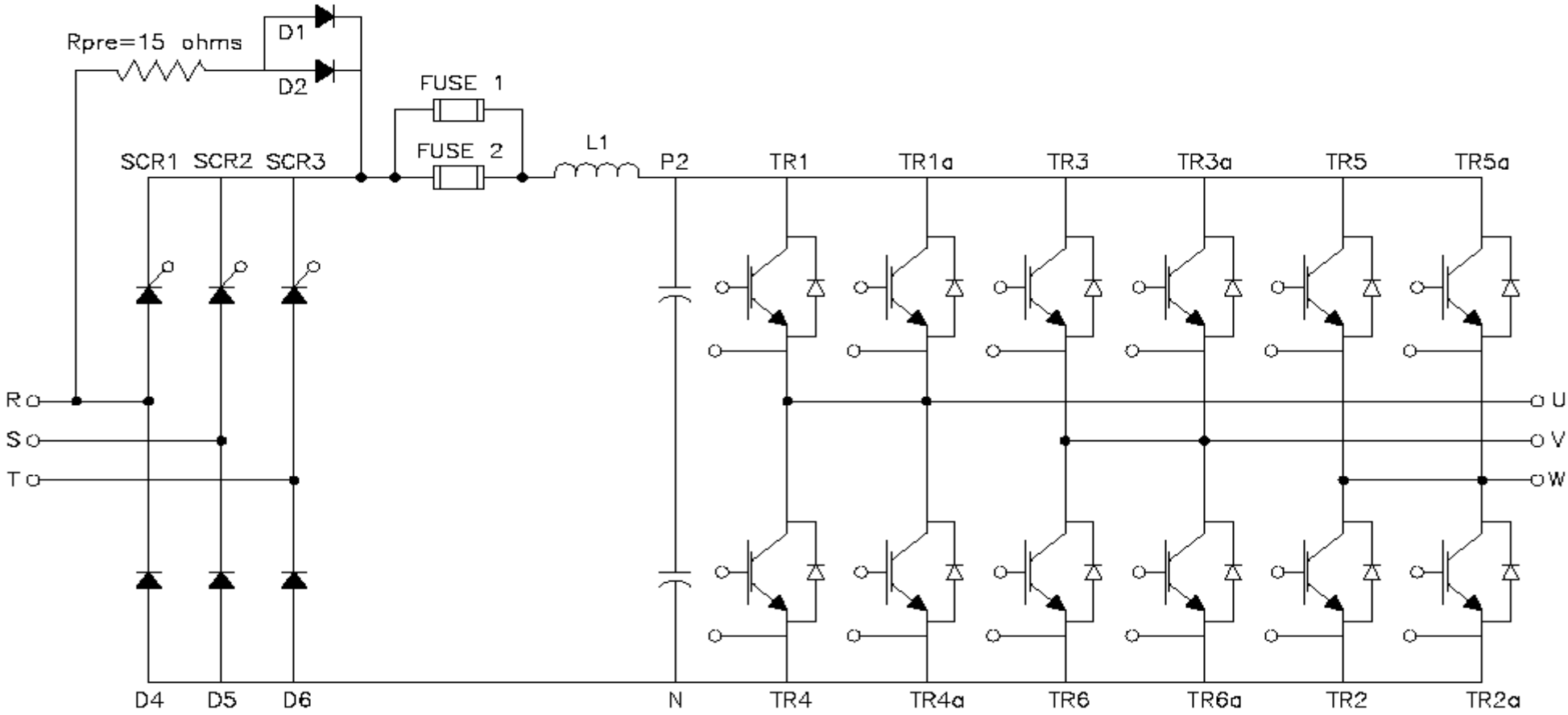
Diodes	D4	R	N (-)	Open
		N (-)	R	Closed
	D5	S	N (-)	Open
		N (-)	S	Closed
	D6	T	N (-)	Open
		N (-)	T	Closed

All SCR's have a snubber circuit across them.

IGBT's	Tr1(1A)	U	P2 (+)	Closed
		P2 (+)	U	Open
	Tr3(3A)	V	P2 (+)	Closed
		P2 (+)	V	Open
	Tr5(5A)	W	P2 (+)	Closed
		P2 (+)	W	Open

IGBT's (cont'd)	Tr4(4A)	U	N (-)	Open
		N (-)	U	Closed
	Tr6(6A)	V	N (-)	Open
		N (-)	V	Closed
	Tr2(2A)	W	N (-)	Open
		N (-)	W	Closed

150 HP – 250 HP POWER CIRCUIT (SIMPLIFIED)



POWER TERMINALS								
R	S	T		P2 +	N–	U	V	W

350 - 400 HP Configuration/Description

- Input rectifier circuit arrangement consists of 3 Diode/SCR modules.
- Pre-Charge resistor/diode circuit between T phase to P2.
- No P1 terminal due to a DC Link Reactor in the Positive DC Bus rail.
- Three DC Bus fuses in the DC Negative Bus rail.
- Three dual IGBT Modules.
- Four Heat Sink fans and 2 more Capacitor Fans.
- No Thermal Switch Input (OHD Terminal, connector CN18) See Switch J1 Description
- NTC Input to Main SMPS

Module		Test polarity +	Test polarity -	Reading
DC Bus Fuses	Fuse 1	across fuse		Closed
	Fuse 2	across fuse		Closed
	Fuse 3	across fuse		Closed

Module		Test polarity +	Test polarity -	Reading
Fuse Indicators	Fuse 1	across indicator		Closed
	Fuse 2	across indicator		Closed
	Fuse 3	across indicator		Closed

Fuses are in parallel, visual check indicators first

SCR's	SCR1	R	P2 (+)	Open
		P2 (+)	R	Open
	SCR2	S	P2 (+)	Open
		P2 (+)	S	Open
	*SCR3	T	P2 (+)	Open
		P2 (+)	T	Open

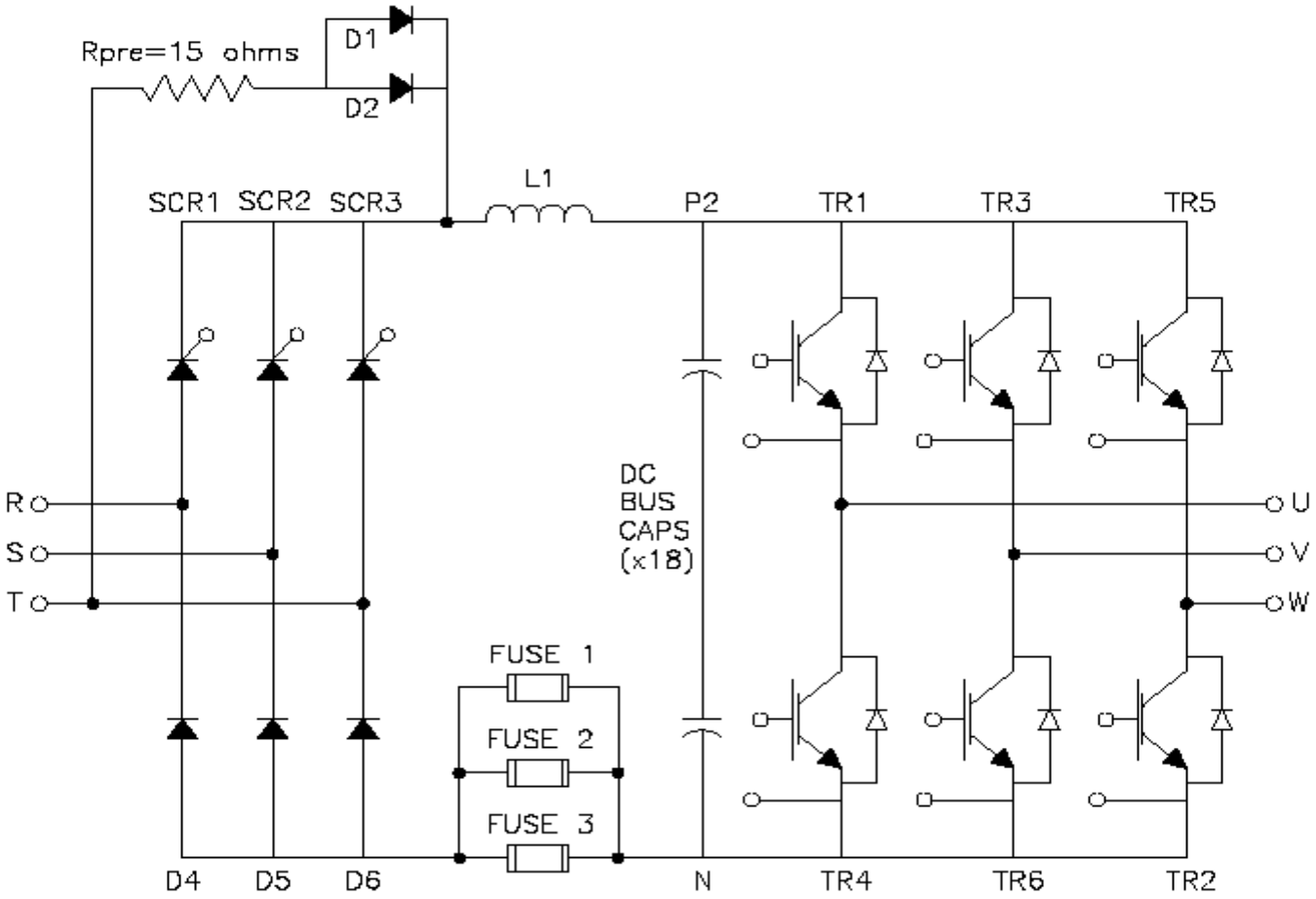
Diodes	D4	R	N (-)	Open
		N (-)	R	Closed
	D5	S	N (-)	Open
		N (-)	S	Closed
	D6	T	N (-)	Open
		N (-)	T	Closed

*SCR3: Measurement is D1/D2 and Pre-Charge Resistor

IGBT's	Tr1	U	P2 (+)	Closed
		P2 (+)	U	Open
	Tr3	V	P2 (+)	Closed
		P2 (+)	V	Open
	Tr5	W	P2 (+)	Closed
		P2 (+)	W	Open

IGBT's (cont'd)	Tr4	U	N (-)	Open
		N (-)	U	Closed
	Tr6	V	N (-)	Open
		N (-)	V	Closed
	Tr2	W	N (-)	Open
		N (-)	W	Closed

350 HP – 400 HP POWER CIRCUIT (SIMPLIFIED)



POWER TERMINALS								
R	S	T		P2 +	N–	U	V	W

500 - 700 HP Configuration/Description

- Input rectifier circuit arrangement consists of 6 Diode/SCR modules.
- Pre-Charge circuit resistor/diode circuit between T phase to P1.
- Pre-Charge Resistors 500 HP 8 ohms
  600 HP 10 ohms
  700 HP 12 ohms (2 - 24 ohms parallel)
- Three internal **inline** fuses, no DC Bus fusing. The fuse indicators are monitored via the same DC Bus input (CN13) to the Main SMPS bd.
- No DC Link Reactor.
- 500 HP has 3 dual IGBT Modules. 600 - 700 HP have 6 dual IGBT Modules.
- 500 HP uses 5 fans (see paragraph under Fan Bds. Dealing with jumpers). 600 - 700 HP have 6 fans.
- All have both a Thermal switch (CN18) and an NTC Thermistor (CN7) input to the Main SMPS Bd. See Switch J1 description. Related Faults: Fan Lock Fault from fans and/or heat sink temperature from thermal switch (See Fan Board Description), NTC Open for IGBT over temperature from Thermistor.

Module		Test polarity +	Test polarity -	Reading
Line Fuses	Fuse 1	R across fuse		Closed
	Fuse 2	S across fuse		Closed
	Fuse 3	T across fuse		Closed

Module		Test polarity +	Test polarity -	Reading
Fuse Indicators	Fuse 1	across indicator		Closed
	Fuse 2	across indicator		Closed
	Fuse 3	across indicator		Closed

These indicators are connected in series.

SCR's	SCR1/ SCR2	R	P1 (+)	Open
		P1 (+)	R	Open
	SCR3/ SCR4	S	P1(+)	Open
		P1(+)	S	Open
	SCR5/ SCR6*	T	P1(+)	Open
		P1(+)	T	Open

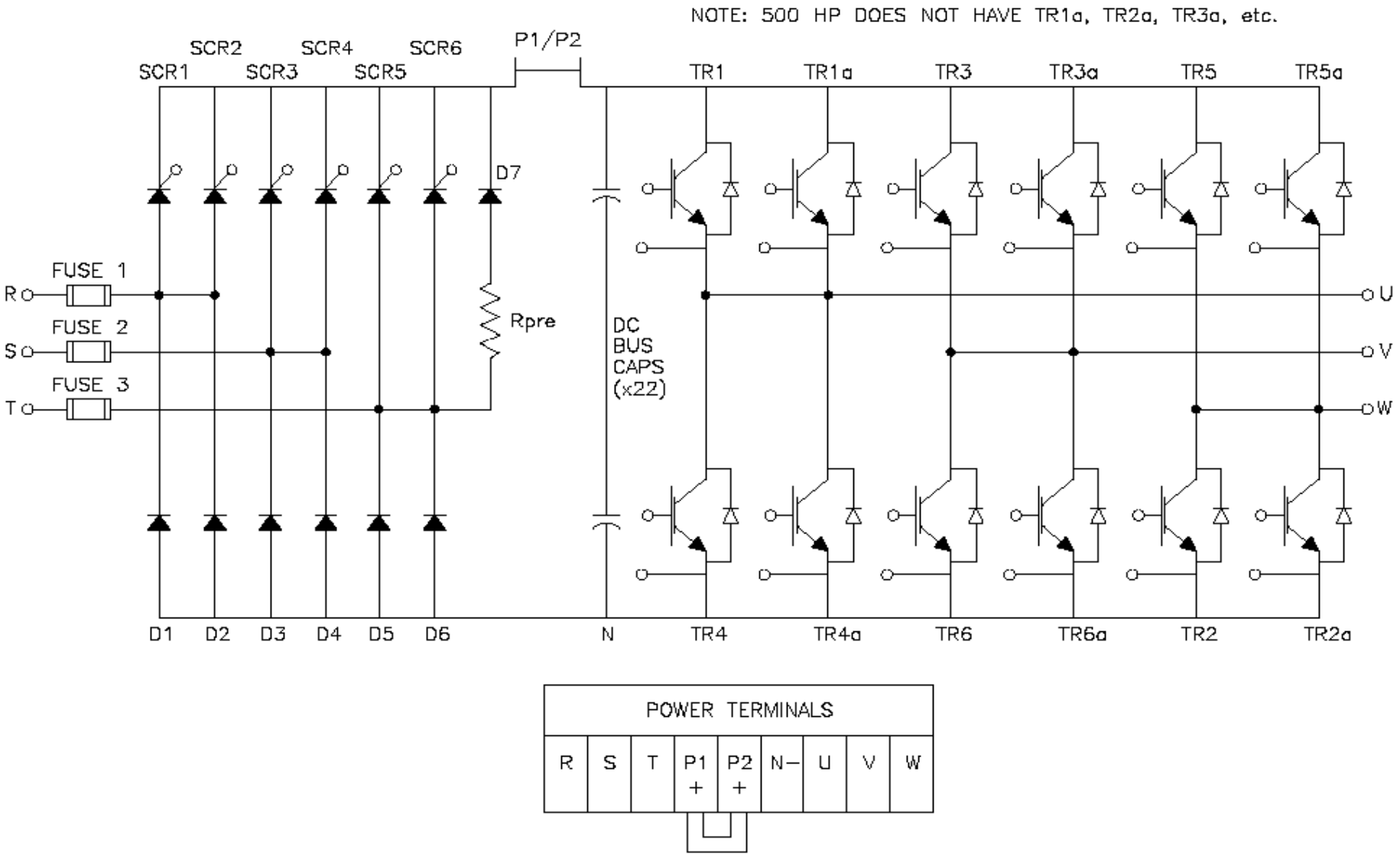
Diodes	D1/ D2	R	N (-)	Open
		N (-)	R	Closed
	D3/ D4	S	N (-)	Open
		N (-)	S	Closed
	D5/ D6	T	N (-)	Open
		N (-)	T	Closed

*SCR5/6: Measurement is D7 and Pre-Charge Resistor

IGBT's	Tr1(1a)	U	P1(+)	Closed
		P1(+)	U	Open
	Tr3(3a)	V	P1(+)	Closed
		P1(+)	V	Open
	Tr5(5a)	W	P1(+)	Closed
		P1(+)	W	Open

IGBT's (cont'd)	Tr4(4a)	U	N (-)	Open
		N (-)	U	Closed
	Tr6(6a)	V	N (-)	Open
		N (-)	V	Closed
	Tr2(2a)	W	N (-)	Open
		N (-)	W	Closed

500 HP – 700 HP POWER CIRCUIT (SIMPLIFIED)



Revision History

Manual #	Rev.	Date	Changes	ECO#
890027-14-00	-00	Jan. 2, 2008	First Release	None
890027-14-01	-01	May 28, 2009	Added Section 3 and General Updates	None
890046-10-00	-00	Dec. 15, 2015	New Manual # to group with other SG Manuals Added Trouble Shooting, Updated Parts List	E4954

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