

Power Wave[®] S350 CE & STT Module Service Training

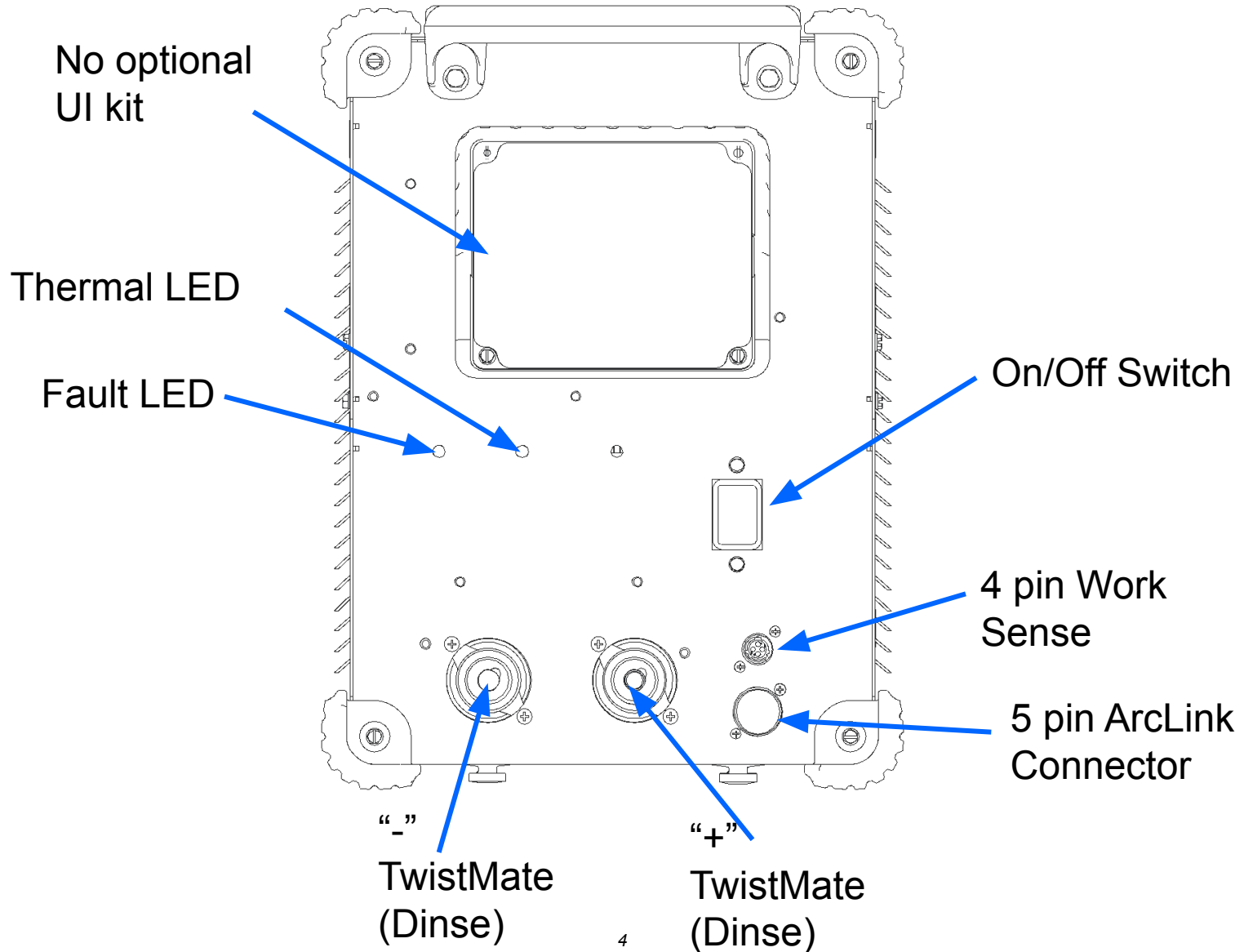


OUTPUT CABLE GUIDELINES (Table A.1)

Amperes	Percent Duty Cycle	CABLE SIZES FOR <u>COMBINED</u> LENGTHS OF ELECTRODE AND WORK CABLES [RUBBER COVERED COPPER - RATED 167°F (75°C)]**				
		0 to 50 Ft.	50 to 100 Ft.	100 to 150 Ft.	150 to 200 Ft.	200 to 250 Ft.
200	60	2	2	2	1	1/0
200	100	2	2	2	1	1/0
250	30	3	3	2	1	1/0
250	40	2	2	1	1	1/0
250	60	1	1	1	1	1/0
250	100	1	1	1	1	1/0
300	60	1	1	1	1/0	2/0
300	100	2/0	2/0	2/0	2/0	3/0
350	40	1/0	1/0	2/0	2/0	3/0

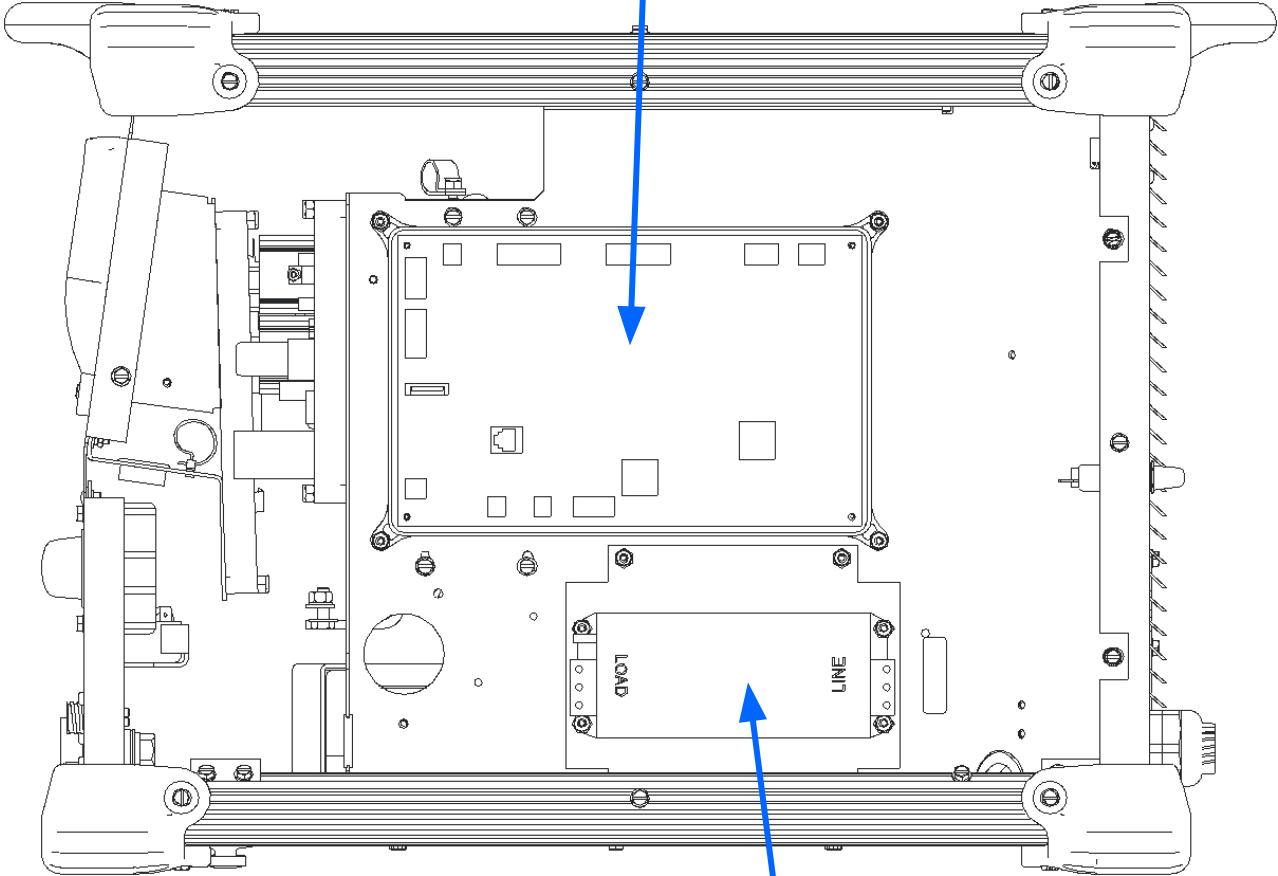
** Tabled values are for operation at ambient temperatures of 104°F (40°C) and below. Applications above 104°F (40°C) may require cables larger than recommended, or cables rated higher than 167°F (75°C).

S350CE



S350CE

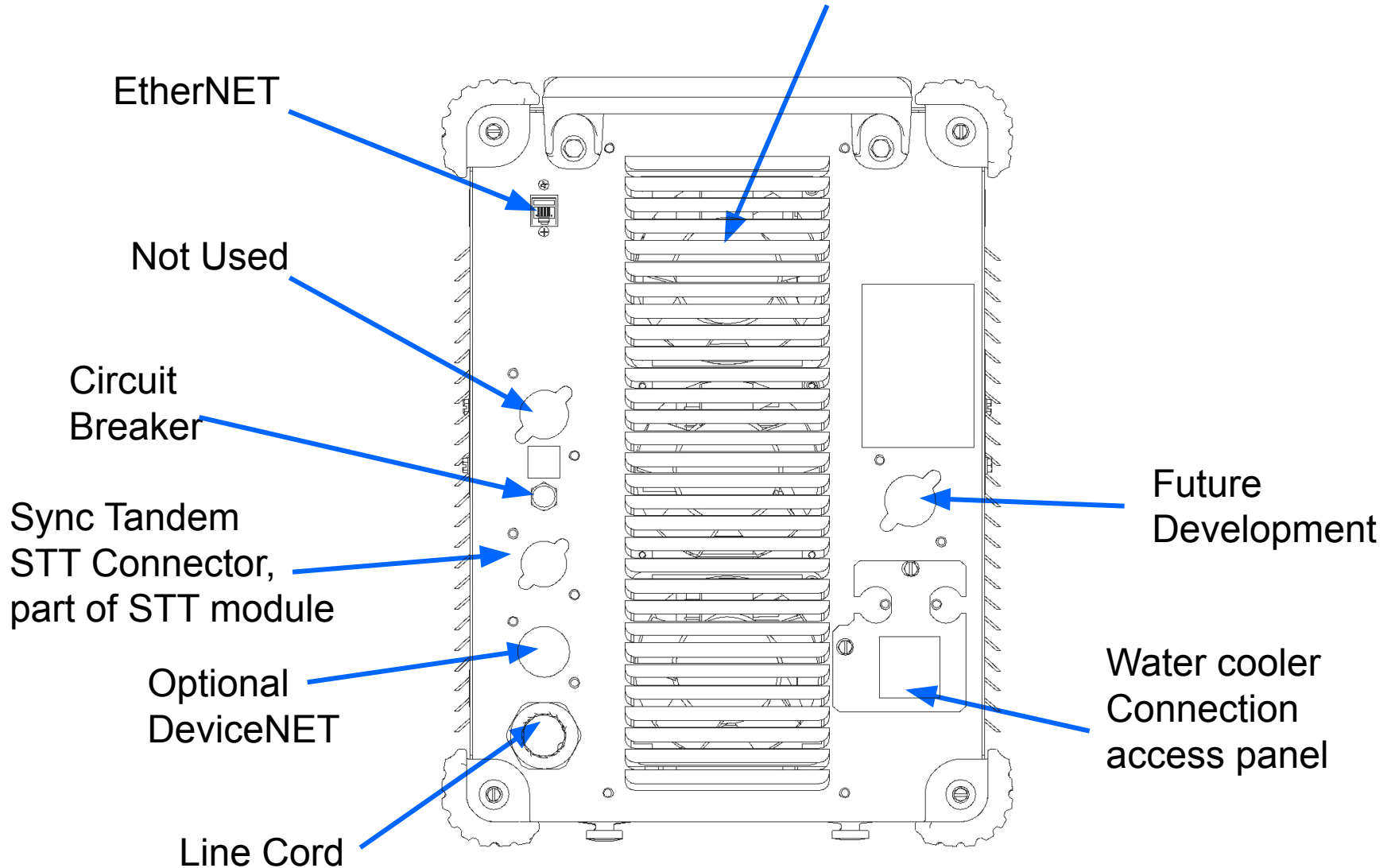
G6682 Control Board



CE Filter

S350CE

Easy access fans



S350CE

POWER WAVE[®] S350 CE

Manufactured in the USA
From USA and imported components
THE LINCOLN ELECTRIC CO. CLEVELAND, OHIO U.S.A.

CODE - SERIAL NO. / N° DE CODE - N° DE SERIE / NO. CODIGO - NO. DE SERIE



IEC 60974-1
GB15579.1-2004

		X	40%	60%	100%
55A/22.2V TO 325A/33V	$U_o =$ 60 V AVG. 100 V PK	I_2	325 A	275 A	250 A
5A/10.2V TO 350A/24V	$U_o =$ 24 V AVG. 100 V PK	U_2	33 V	31 V	30 V
40A/16V TO 350A/31.5V	$U_o =$ 40-70 V AVG. 100 V PK	I_2	350 A	325 A	300 A
		U_2	24 V	23 V	22 V
		I_2	350 A	320 A	300 A
		U_2	31.5 V	30 V	29 V

 50/60 HZ 	U_1	I_1 MAX	I_1 EFF
	220/230 V	35 A	28 A
	380/400/415 V	19 A	15 A
	460 V	17 A	14 A
	575 V	14 A	11 A

IP 23

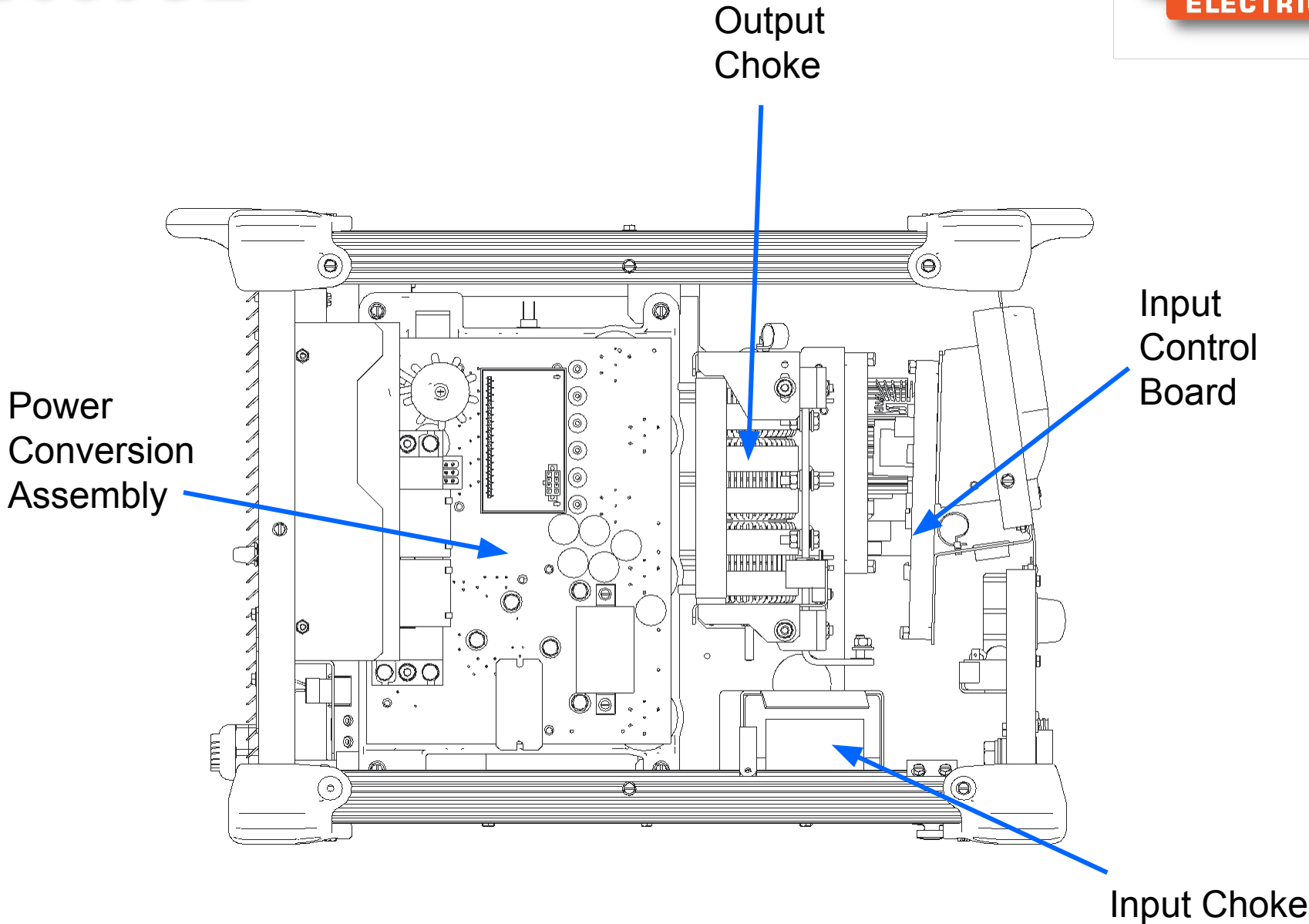
INS. CL.155(F)



S28056-1 VM

- ◆ 3 phase only
- ◆ Replace line cord when operating over 450 VAC

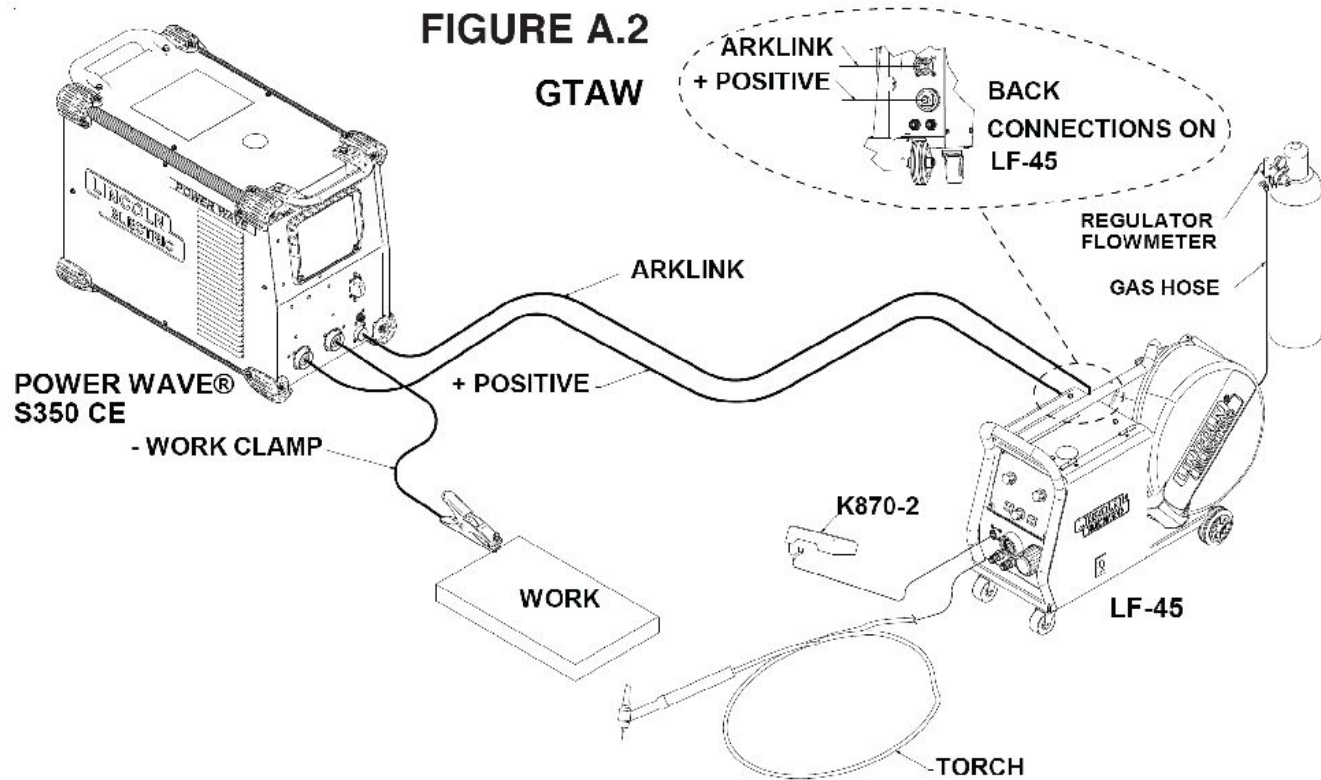
S350CE



CONNECTION DIAGRAMS

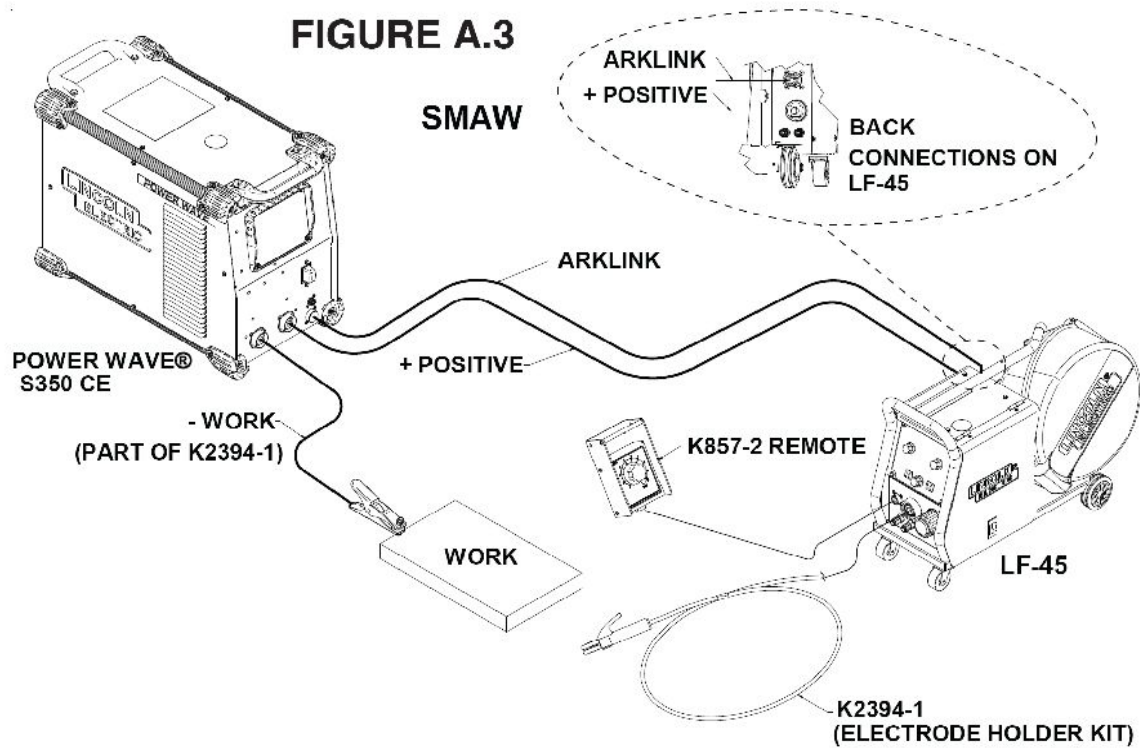
GTAW (TIG) WELDING

TIG welding from a LF-45 wire feeder can be used with the power source as shown in **(Figure A.2)**,



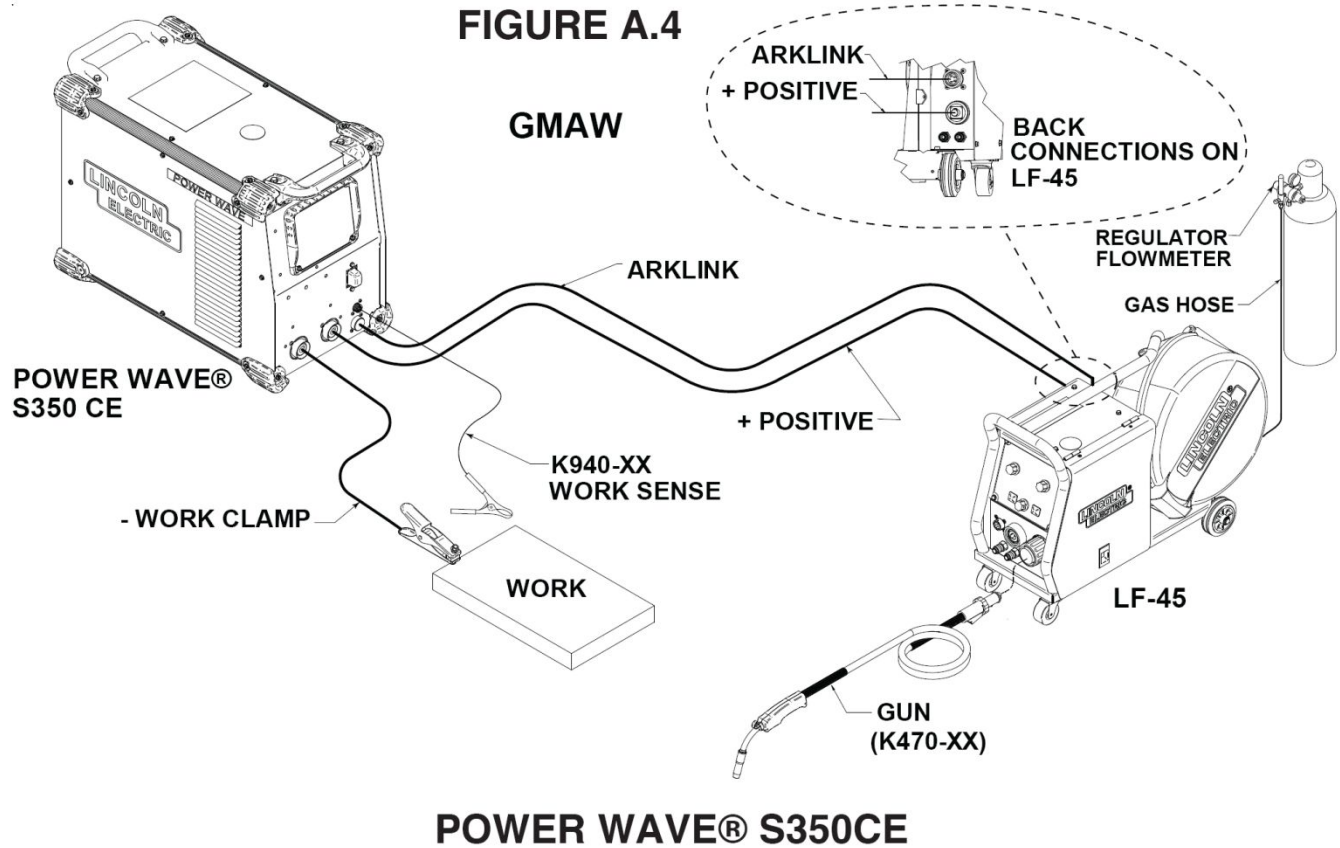
SMAW (STICK) WELDING

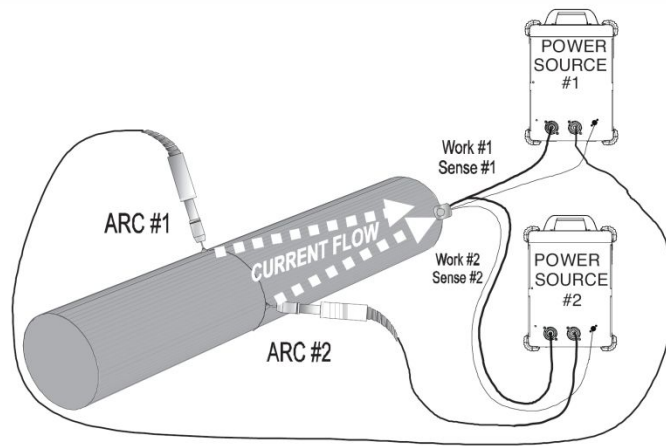
Stick welding from a LF-45 wire feeder can be used with the power source as shown in (Figure A.3).



GMAW (MIG) WELDING

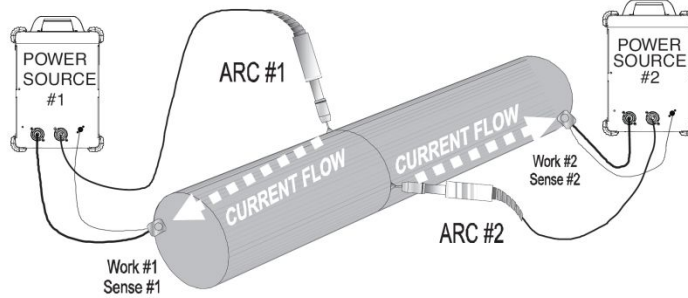
MIG welding from a LF-45 wire feeder can be used with the power source as shown in (Figure A.4).





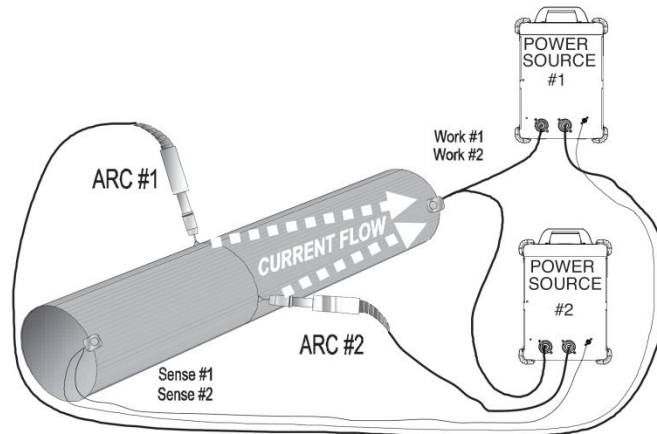
BAD

- CURRENT FLOW FROM ARC #1 AFFECTS SENSE LEAD #2
- CURRENT FLOW FROM ARC #2 AFFECTS SENSE LEAD #1
- NEITHER SENSE LEAD PICKS UP THE CORRECT WORK VOLTAGE, CAUSING STARTING AND WELDING ARC INSTABILITY



BETTER

- SENSE LEAD #1 IS ONLY AFFECTED BY CURRENT FLOW FROM ARC #1
- SENSE LEAD #2 IS ONLY AFFECTED BY CURRENT FLOW FROM ARC #2
- DUE TO VOLTAGE DROPS ACROSS THE WORKPIECE ARC VOLTAGE MAY BE LOW, CAUSING NEED FOR DEVIATION FROM STANDARD PROCEDURES



BEST

- BOTH SENSE LEADS ARE OUT OF THE CURRENT PATHS
- BOTH SENSE LEADS DETECT ARC VOLTAGE ACCURATELY
- NO VOLTAGE DROP BETWEEN ARC AND SENSE LEAD
- BEST STARTS, BEST ARCS, MOST RELIABLE RESULTS

TABLE A.2

Process	Electrode Voltage Sensing ⁽¹⁾ 67 lead	Work Voltage Sensing ⁽²⁾ 21 lead
GMAW	67 lead required	21 lead optional
GMAW-P	67 lead required	21 lead optional
FCAW	67 lead required	21 lead optional
GTAW	Voltage sense at studs	Voltage sense at studs
SMAW	Voltage sense at studs	Voltage sense at studs

- (1) The electrode voltage sense lead (67) is automatically enabled by the weld process, and integral to the 5 pin arclink control cable (K1543-xx).
- (2) When a work voltage sense lead (21) is connected the power source will automatically switch over to using this feedback (if the auto sense feature is enable).

Feeder:

P.81	Sense Leads Selection Used in place of DIP switches for configuration of the work and electrode sense leads. This option will only appear in the list if the power source has a hardware selection option. <ul style="list-style-type: none">• 67 pos polarity = An electrode sense lead is connected using positive polarity. This is used by most GMAW welding procedures.• 67 neg polarity = An electrode sense lead is connected using negative polarity. This is used by most GTAW welding procedures and some Innershield procedures.• 67 & 21 = An electrode sense lead and work sense lead are connected. Hardware Config = The hardware determines the best remote sensing configuration. This is applicable to MIG welding procedures only.
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S350CE

◆ Software Location

- Control Board

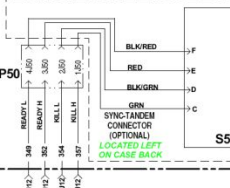
◆ Hardware

- Operates with K2921-1 STT Module
- Use PF-25M's, PF-10M's LF-45 for feeders

USED FOR PRODUCTION MONITORING, DOWNLOADING SOFTWARE, OR UPLOADING MACHINE INFORMATION

ETHERNET CONNECTOR RJ45 TYPE

LOCATED TOP RIGHT REAR PANEL

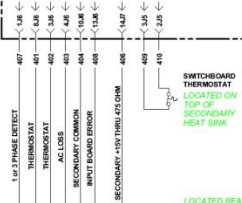


CONTROL P.C. BOARD (SCHEMATIC 04795)

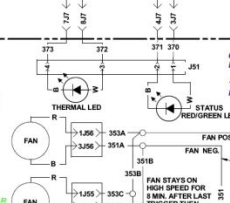
LOCATED ON VERTICAL DIVIDER PANEL
 3RD IN POWER UP SEQUENCE

VOLTAGE FEEDBACK
 TYPICAL FEEDBACK 4 VDC = 500 A

FOLDS BACK TO 37A WITH A SHORT CIRCUIT



LOCATED REAR



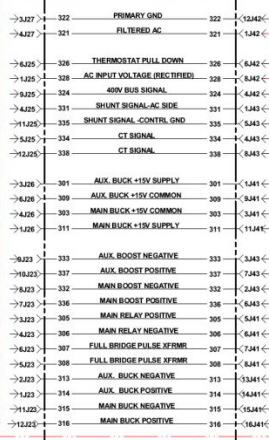
3-φ 208V DETECT
 THERMOSTAT
 THERMOSTAT
 AC LOSS
 RECT. BOARD BURN
 SECONDARY +15V THRU J12 OHM

P.F.C. CONTROL BOARD LED LEGEND
 LED1: ERROR CODE (BUZZER ALSO SOUNDS)
 LED2: +15V POWER SUPPLY FUNCTIONING

PFC CONTROL P.C. BOARD (SCHEMATIC 04797)

LOCATED LEFT SIDE INNER CASE FRONT

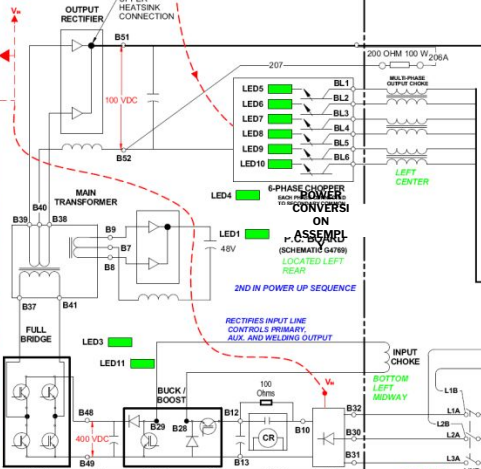
REGULATES PRIMARY VOLTAGE AND CONTROLS DEVICE SWITCHING
 1ST IN POWER UP SEQUENCE



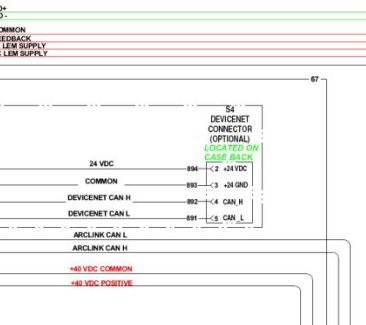
REGULATES PRIMARY VOLTAGE AND CONTROLS DEVICE SWITCHING
 1ST IN POWER UP SEQUENCE

11: HIGH VOLTAGE IS FLOATING VOLTAGE POTENTIAL TO GROUND

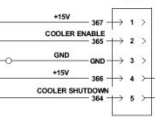
SWITCHBOARD P.C. BOARD LED LEGEND
 LED1: +48V AUXILIARY
 LED3: BOOST ROBT DRIVE
 LED4: +15V SUPPLY
 LED5-LED10: CHOPPER IGBT DRIVES
 LED11: BUCK ROBT DRIVE



SWITCHBOARD P.C. BOARD LED LEGEND
 LED1: +48V AUXILIARY
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 LED4: +15V SUPPLY
 LED5-LED10: CHOPPER IGBT DRIVES
 LED11: BUCK ROBT DRIVE



COOLER CONNECTOR
 JUMPER SIMULATES COOLER FLOW SENSOR. REMOVAL WILL DISABLE OUTPUT

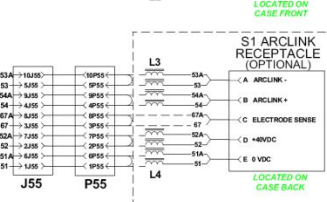
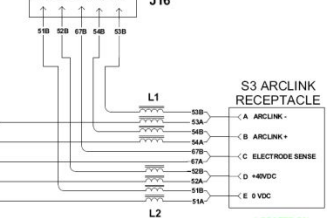
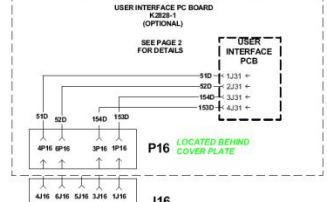


LOCATED ON CASE FRONT
 ON VERTICAL DIVIDER PANEL

DC BUS BOARD
 SUBSTRATE: M2223
 ASSEMBLY: L18732
 +40VDC = 4.147
 -40VDC = 4.147
 COMMON = 1.147

LOCATED ON CASE FRONT

(See page 2 for LED information)



LOCATED ON CASE BACK

CONNECTS OUTPUT STUDS TO CASE



MOUNTED ON CASE FRONT ABOVE OUTPUT STUDS

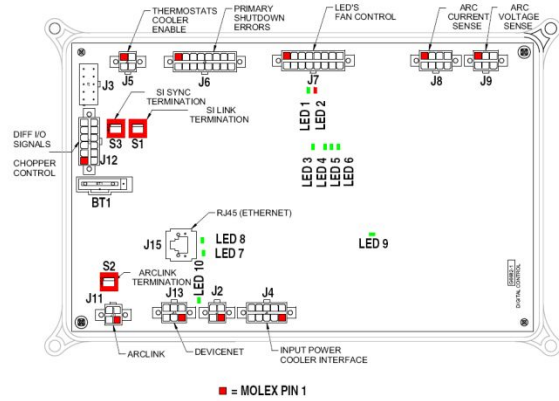


LOCATED NEAR LEFT OF MACHINE



MOUNTED ON CASE FRONT ABOVE OUTPUT STUDS

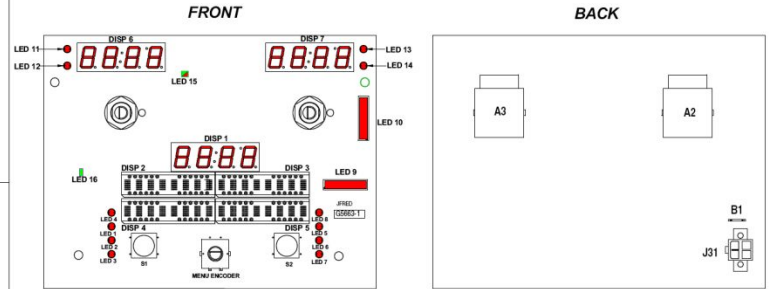
CONTROL P.C. BOARD



Description of LED functions on Power Wave S350CE For reference only

G6682 CONTROL P.C. BOARD	
LED #	COLOR FUNCTION
1	GREEN STATUS "OK"
2	RED STATUS "ERROR" (CHECK CODE FOR SPECIFIC ERROR)
3	GREEN OUTPUT ENABLE
4	GREEN SINGLE PHASE FAULT
5	GREEN ELECTRODE SENSE
6	GREEN WORK SENSE
7	GREEN ETHERNET LINKACTIVITY STATUS
8	GREEN ETHERNET SPEED STATUS
9	GREEN INPUT SUPPLY 30 VDC TO 55 VDC
10	GREEN DEVICENET EXTERNAL 24 VDC PRESENT

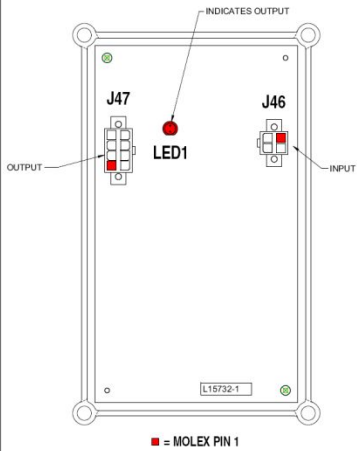
F.R.E.D. P.C. BOARD (OPTIONAL)



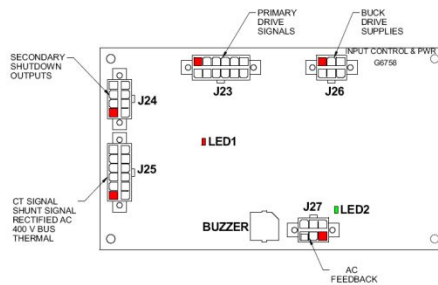
Description of LED functions on Power Wave S350 For reference only

G5663 J.F.R.E.D P.C. BOARD					
LED #	COLOR	FUNCTION	LED #	COLOR	FUNCTION
1	RED	MEMORY SELECT	7	RED	POST-WELD CONTROL SELECT
2	RED	WAVE CONTROL SELECT	8	RED	N/A
3	RED	N/A	9	RED	SETUP MENU ENABLED
4	RED	N/A	10	RED	THERMAL FAULT MEASURED
5	RED	2 STEP - 4 STEP SELECT	11	RED	WIRE FEED SPEED SELECT
6	RED	PRE-WELD CONTROL SELECT	12	RED	AMPS SELECT
			13	RED	VOLTS SELECT
			14	RED	TRM SELECT
			15	GREEN	STATUS "OK"
			16	RED	STATUS "ERROR" (CHECK CODE FOR SPECIFIC ERROR)
				GREEN	POWER SUPPLY FUNCTION "OK"

+40 VDC BUS P.C. BOARD



PFC CONTROL P.C. BOARD



Description of LED functions on Power Wave S350 For reference only

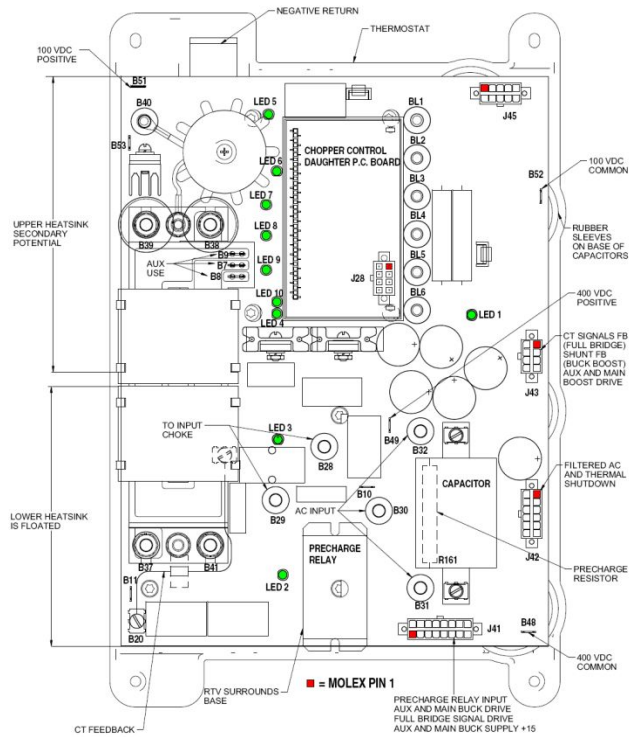
G6758 PFC CONTROL P.C. BOARD	
LED #	COLOR FUNCTION
2	GREEN 15 VDC POWER SUPPLY FUNCTIONING PROPERLY WHEN ON
1	RED ERROR CODE (LED WILL FLASH ERROR AND BUZZER WILL SOUND) SEE TABLE BELOW FOR DETAILS

ERROR CODE	
ERROR	EXPLANATION
331	PEAK INPUT CURRENT LIMIT
334	START UP CURRENT CHECK FAILURE
335	START UP VOLTAGE CHECK FAILURE
336	THERMAL FAULT (NO FIRST STAGE FAN)
337	PRECHARGE TIMEOUT
340	TRANSFORMER PRIMARY OVERCURRENT

3 STAGE INVERTER POWER CONVERSION ASSEMBLY

Description of LED functions on Power Wave S350
 For reference only

G4770 SWITCHBOARD P.C. BOARD		
LED #	COLOR	FUNCTION
1	GREEN	40 VDC AUXILIARY POWER FUNCTIONING WHEN ON
3	GREEN	BOOST IGBT DRIVE FUNCTIONING WHEN ON
4	GREEN	15 VDC POWER FUNCTIONING PROPERLY WHEN ON
5	GREEN	CHOPPER IGBT 1 DRIVE FUNCTIONING WHEN ON
6	GREEN	CHOPPER IGBT 2 DRIVE FUNCTIONING WHEN ON
7	GREEN	CHOPPER IGBT 3 DRIVE FUNCTIONING WHEN ON
8	GREEN	CHOPPER IGBT 4 DRIVE FUNCTIONING WHEN ON
9	GREEN	CHOPPER IGBT 5 DRIVE FUNCTIONING WHEN ON
10	GREEN	CHOPPER IGBT 6 DRIVE FUNCTIONING WHEN ON
11	GREEN	BUCK IGBT DRIVE FUNCTIONING WHEN ON



Power Wave S350

Power-Up Sequence

- Once voltage is applied to the machine via the input switch, the auxiliary power supply located on the PFC Control board will turn on.
 - This power supply is responsible for regulating the +/- 15 volts for the control circuits, as well as the +15 volts for the buck & boost IGBTs.
 - LED 2 on PFC Control Board indicates a proper functioning power supply.
- Once the auxiliary power supply is functioning, the PFC control and full bridge circuits will turn on, close a relay, and provide a soft-start function for the buck-boost power section and simultaneously for the full bridge inverter located on the Power Conversion Assembly.
 - The PFC Control Board soft-start function begins with a low duty cycle and gradually increases the duty cycle until the buck-boost has met its pre-charge requirements. Completion time is dependant on the input voltage to the machine.

Power Wave S350

Power-Up Sequence

- After the soft-start sequence is complete, the primary side of the inverter will be regulated at 400 Volts and the secondary of the inverter will be 100 Volts.
- The Planar transformer has two auxiliary windings, the first one is used to provide a 48 Volt power supply for the fans & the DC Bus Board. The DC Bus Board then provides 40VDC to the Control Board & Arclink Receptacle (S3 5Pin).
 - The 48 Volt secondary follows the same pre-charge sequence as the 100 Volt secondary.
 - Fan defaults to low speed unless a weld is made.
- The machine is now idle and ready to make a weld

S350CE

POWER WAVE[®] S350 CE

Manufactured in the USA
From USA and imported components
THE LINCOLN ELECTRIC CO. CLEVELAND, OHIO U.S.A.

CODE - SERIAL NO. / N° DE CODE - N° DE SERIE / NO. CODIGO - NO. DE SERIE



IEC 60974-1
GB15579.1-2004

		X	40%	60%	100%
55A/22.2V TO 325A/33V	$U_o =$ 60 V AVG. 100 V PK	I_2 U_2	325 A 33 V	275 A 31 V	250 A 30 V
5A/10.2V TO 350A/24V	$U_o =$ 24 V AVG. 100 V PK	I_2 U_2	350 A 24 V	325 A 23 V	300 A 22 V
40A/16V TO 350A/31.5V	$U_o =$ 40-70 V AVG. 100 V PK	I_2 U_2	350 A 31.5 V	320 A 30 V	300 A 29 V

 50/60 HZ 	U_1	I_1 MAX	I_1 EFF
	220/230 V	35 A	28 A
	380/400/415 V	19 A	15 A
	460 V	17 A	14 A
	575 V	14 A	11 A

IP 23 INS. CL.155(F)

S28056-1 VM

- ◆ 3 phase only
- ◆ Replace line cord when operating over 450 VAC
- ◆ If S350CE detects single phase Error 54 will Flash

First Stage Function On the Power Conversion Assembly & PFC PCB

◆ Relay Provides Softstart function for DC Link Capacitor

- Limits inrush current during DC Link capacitor charging
- Activated via open-collector signal from PFC PCB

◆ PFC Control Board

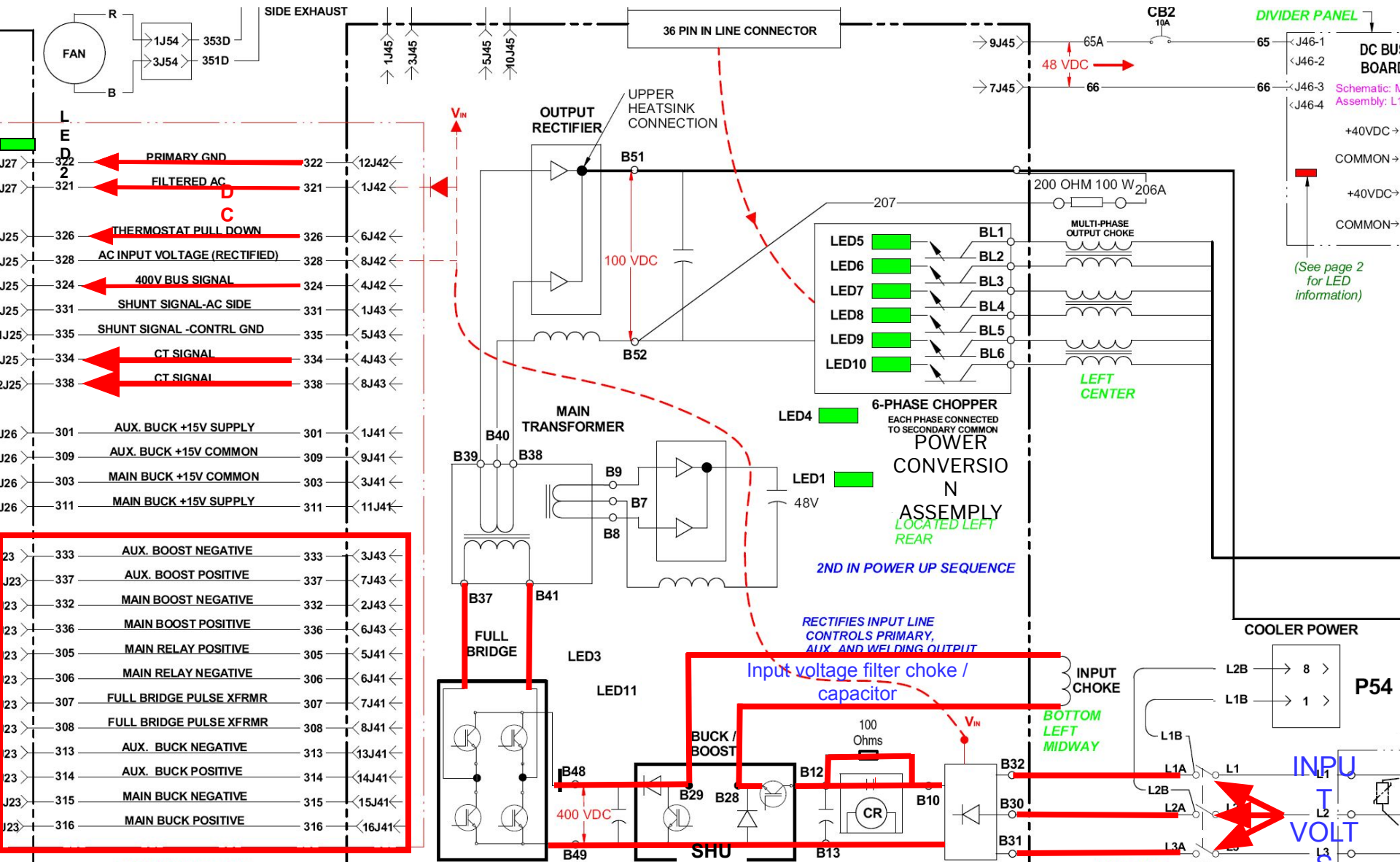
- Powered from the AC line via a diode on the Power Conversion Assembly and an auxiliary power supply on the PFC Control Board
- Auxiliary power supply requires 180 – 900 Vdc, LED 2 must be on during proper operation
- Analog and Digital circuits control the current shaping, regulated bus voltage, and gate drive signals for the main and auxiliary buck and boost switches

◆ Relay Operation

- Under normal operating conditions, the relay should close 50 ms after power is applied to the machine
- Shorts 100 Ohm resistor after pre-charge
- Under Fault Conditions the relay will generally close 50 ms after power is applied to the machine and immediately reopen.

◆ Power Conversion Assembly Converts rectified 60Hz input to a regulated 400 Volts dc

- Topology consists of a buck converter followed by a boost converter
- Boost switch operates at 230 Vac or less, buck switch is held on (LED 3 is On and LED 11 is On)
- Buck switch operates at 325 Vac or more, boost switch is held off for the most part (LED 3 may be off at idle, LED 11 is ON)



!!! HIGH VOLTAGE !!!
 FLOATING VOLTAGE
 POTENTIAL TO GROUND

POWER CONVERSION ASSEMBLY
 LED1: +48V AUXILIARY
 LED3: BOOST IGBT DRIVE
 LED4: +15V SUPPLY
 LED5-LED10: CHOPPER IGBT DRIVES
 LED11: BUCK IGBT DRIVE

The Shunt sends a feedback signal to the PFC Bd to help Control the Power Factor up to 97%

DC BUS BOARD
 Schematic: M
 Assembly:
 +40VDC →
 COMMON →
 +40VDC →
 COMMON →
 (See page 2 for LED information)

INPUT VOLTAGE SENSE
 L1B → 1 >
 L1A → 1 >
 L2B → 8 >
 L2A → 1 >
 L3A → 1 >

2ND IN POWER UP SEQUENCE

RECTIFIES INPUT LINE
 CONTROLS PRIMARY,
 AUX. AND WELDING OUTPUT

Input voltage filter choke / capacitor

INPUT CHOKE

48V

100 Ohms

400 VDC

100 VDC

200 OHM 100 W

206A

65A

48 VDC

65A

66

9J45

7J45

36 PIN IN LINE CONNECTOR

UPPER HEATSINK CONNECTION

OUTPUT RECTIFIER

MAIN TRANSFORMER

FULL BRIDGE

BUCK / BOOST

SHUNT

6-PHASE CHOPPER POWER CONVERSION ASSEMBLY

LOCATED LEFT REAR

LEFT CENTER

MULTI-PHASE OUTPUT CHOKE

COOLER POWER

P54

INPUT VOLTAGE SENSE

FRONT RIGHT

LINE

DC BUS BOARD

Schematic: M

Assembly:

+40VDC →

COMMON →

+40VDC →

COMMON →

(See page 2 for LED information)

207

200 OHM 100 W

206A

65A

48 VDC

66

9J45

7J45

36 PIN IN LINE CONNECTOR

UPPER HEATSINK CONNECTION

OUTPUT RECTIFIER

MAIN TRANSFORMER

FULL BRIDGE

BUCK / BOOST

SHUNT

6-PHASE CHOPPER POWER CONVERSION ASSEMBLY

LOCATED LEFT REAR

LEFT CENTER

MULTI-PHASE OUTPUT CHOKE

COOLER POWER

P54

INPUT VOLTAGE SENSE

FRONT RIGHT

LINE

DC BUS BOARD

Schematic: M

Assembly:

+40VDC →

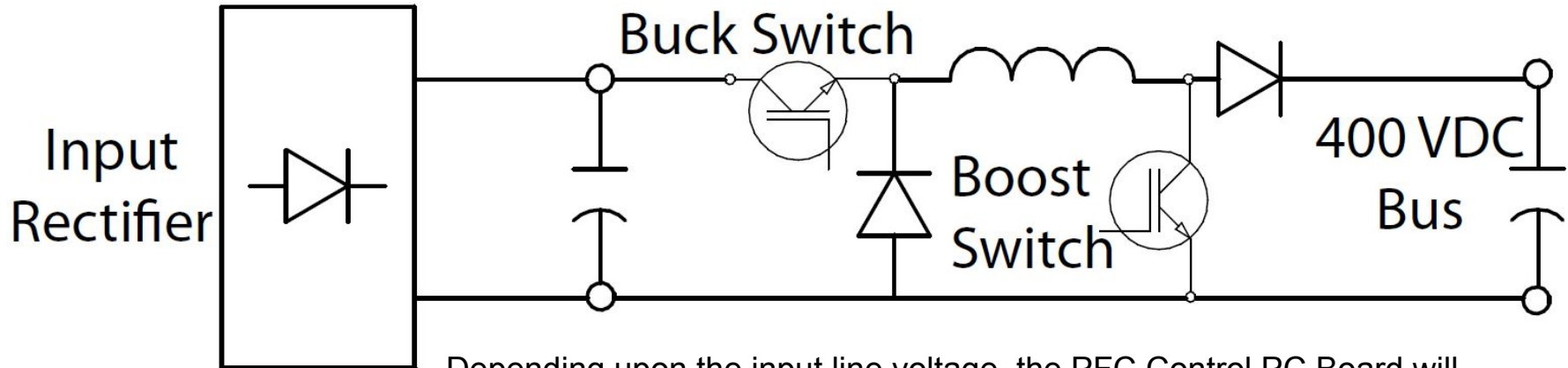
COMMON →

+40VDC →

COMMON →

(See page 2 for LED information)

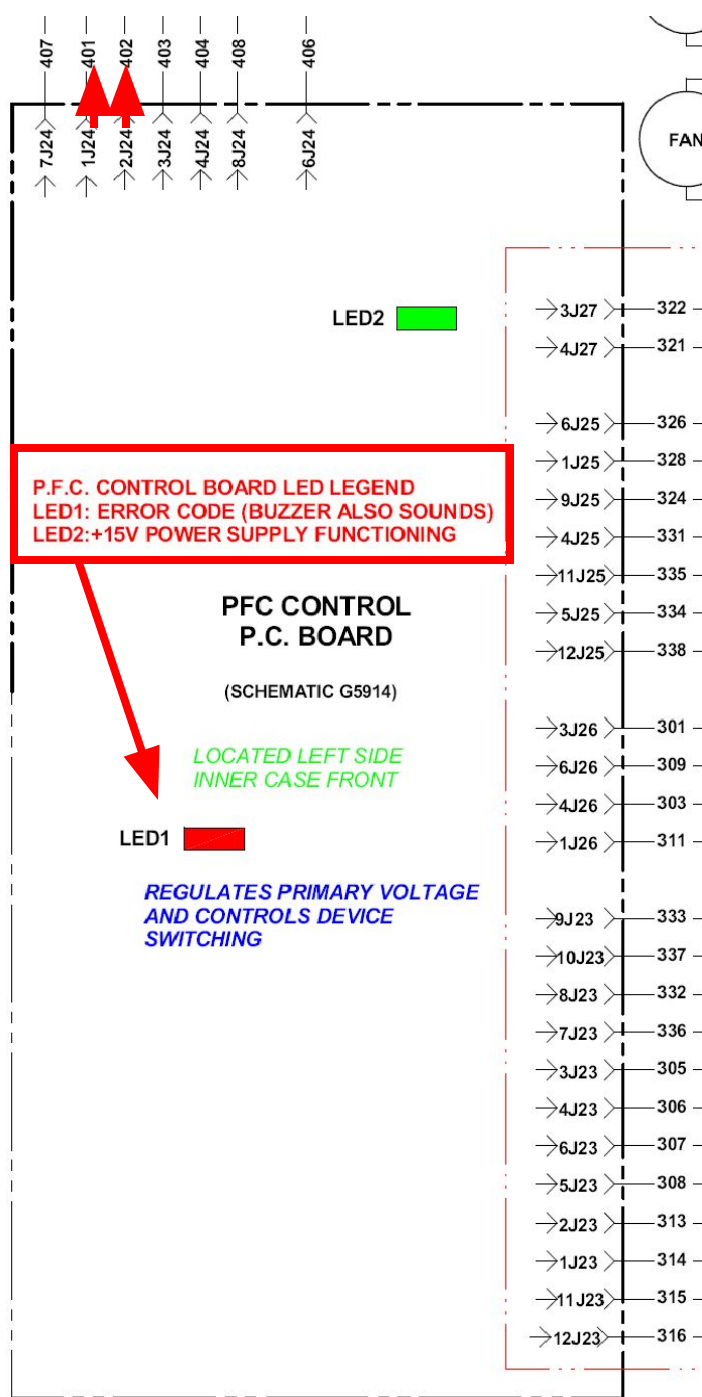
Buck/Boost Theory of Operation



Depending upon the input line voltage, the PFC Control PC Board will vary the ON time of the Buck and/or the Boost switches in order to obtain a constant 400 VDC supply.

<u>Line Voltage</u>	<u>Rectified Value</u>	<u>Buck Switch</u>	<u>Boost Switch</u>
200 - 208 VAC	282 - 293 VDC	On	On
230 VAC	324 VDC	On	On
380 - 415 VAC	536 - 585 VDC	On	Off
460 VAC	649 VDC	On	Off
575 VAC	811 VDC	On	Off

Thermostat Signal to Control Board



PFC Control Board (G5915 series)

Buzzer Error Codes

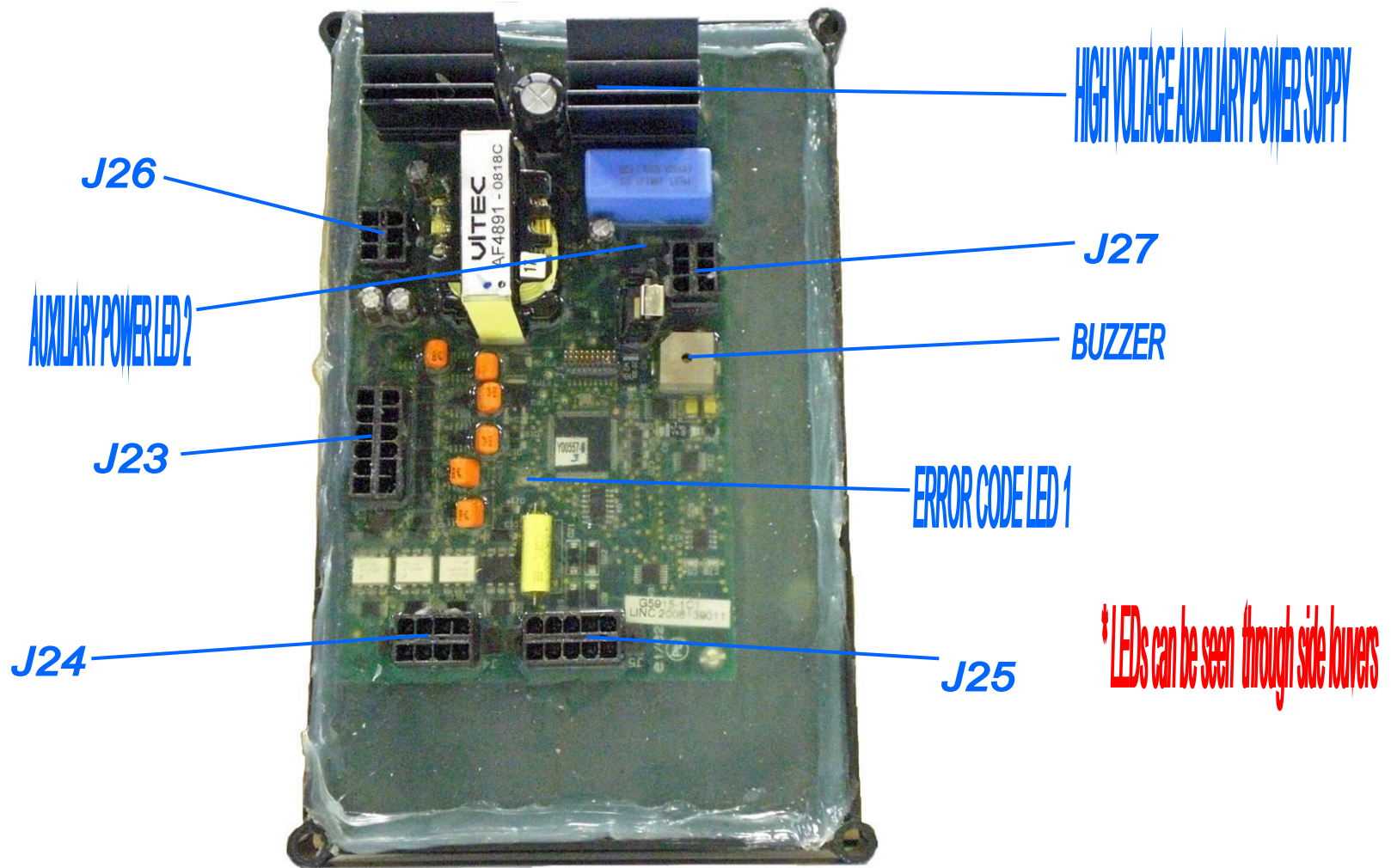
- ◆ **First and Second Stage Error Codes are sounded on buzzer and LED 1 on Input Control Board**
 - **RED LED 1 can be seen through the side louvers of the machine**

Error Code #	Indication
331 Peak input current limit	Input current limit has been exceeded. Typically indicates short term power overload. If problem persists contact Service Department.
333 Under-voltage lockout	+15 VDC supply on Input control board too low. Verify input voltage is within the acceptable range. If problem persists contact service department.
336 Thermal Fault	Thermostat on primary module tripped. Typically caused by bottom fan not working.
337 Pre-charge timeout	Problem with start-up sequence. If problem persists contact Service Department.
346 Transformer primary over current	Transformer current too high. Typically indicates short term power overload. If problem persists contact service department.
Other	Contact the Service Department.

- ◆ Pause before repeating the code: 3.5 seconds
- ◆ Pause between digits of the code: 1.5 seconds
- ◆ Pause between sounds/flashes indicating a specific digit: 0.5 seconds

PFC Control Board (G5915 series)

Auxiliary Power Supply and PFC Circuits



PFC CONTROL BOARD

◆ Auxiliary Power Supply Failure

- Machine will not power up
 - LED 2 will be off or blinking if there is a problem with the PFC Control Board
 - Can be seen through side louvers of the machine
 - Failure of this circuit will fail the auxiliary input diode
- **POWER CONVERSION ASSEMBLY Auxiliary Input Diode Failure**
 - Use DVM Diode check function from 8J42 to 1J42
 - Forward Voltage should be greater than 0.3 Volts
 - Failure of this component is a result of a auxiliary power supply failure

First Stage Function

- ***Detects thermal trips that may occur on the first stage heatsink (single thermostat located on the primary module)***

Input and Output Signals

- ◆ ***Signals from PFC Control Board to Power Conversion Assembly***
- ◆ ***Connector J23 & J26 on PFC Control Board***
 - ***Main & Auxiliary Boost Gate Drives***
 - ***Main & Auxiliary Buck Gate Drives***
 - ***+15 Volt dc Power Supplies for the Main and Auxiliary Buck Drives***
 - ***Main Relay Drive***
 - ***Full Bridge Gate Drives***
- ***Connector J27 on PFC Control Board***
 - ***Filter AC Input Power Supply for the Input Control Board***
- ◆ ***Signals from Power Conversion Assembly to PFC Control Board***
 - ***Connector J25 on PFC***
 - ***Buck-Boost Current Feedback***
 - ***Rectified AC Input Voltage***
 - ***Regulated 400 Volt Bus Feedback***
 - ***Thermostat Pull-Down Signal***
 - ***Full Bridge CT Feedback***

Primary Thermal Protection

Function

◆ **Primary Thermal Circuit**

- **Protects machine against reduced airflow or overload.**
 - **Fan OFF / Output disabled**
 - **All stages cease operation and machine appears to be off – Buzzer will continue to sound**
- **Location:**
 - **SMT Part, First and Second Stage Module (M21214-10)**

◆ **All Thermostats are normally closed**

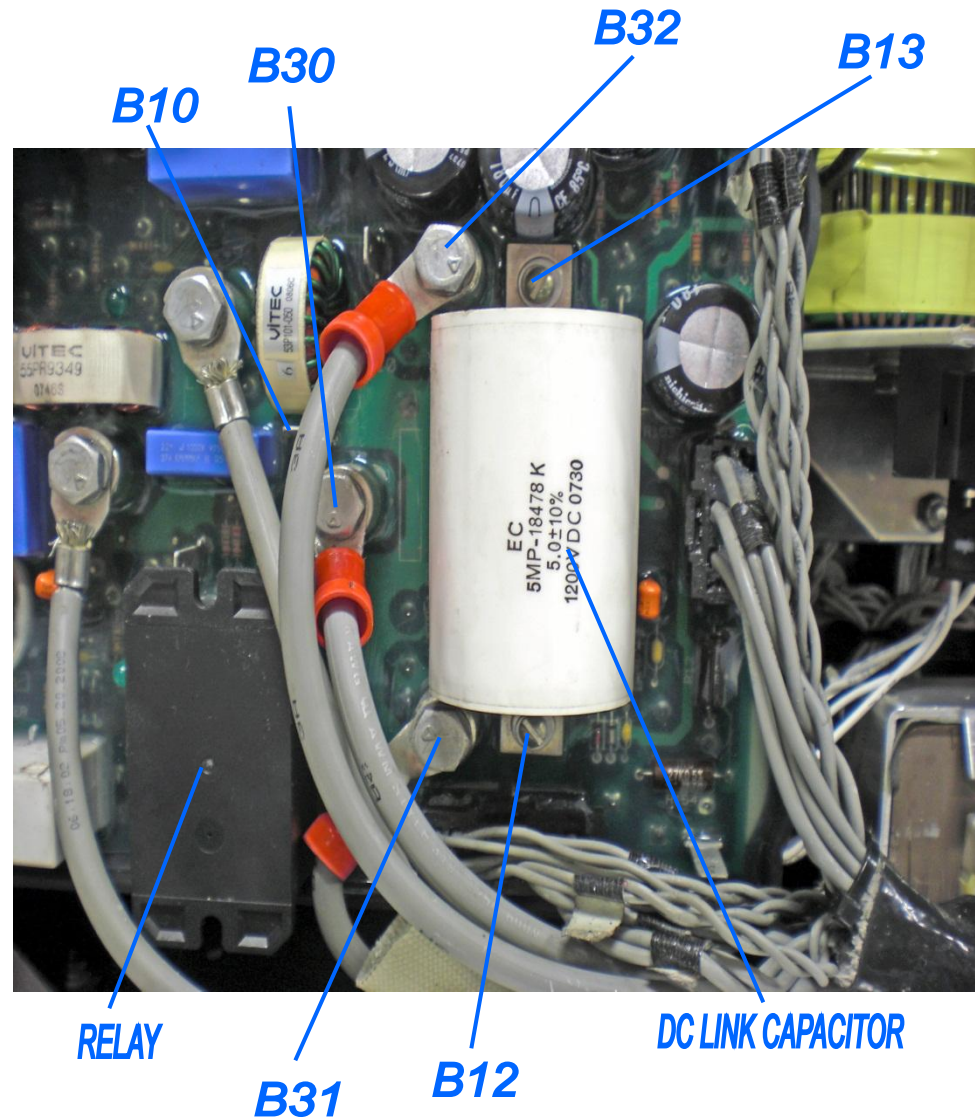
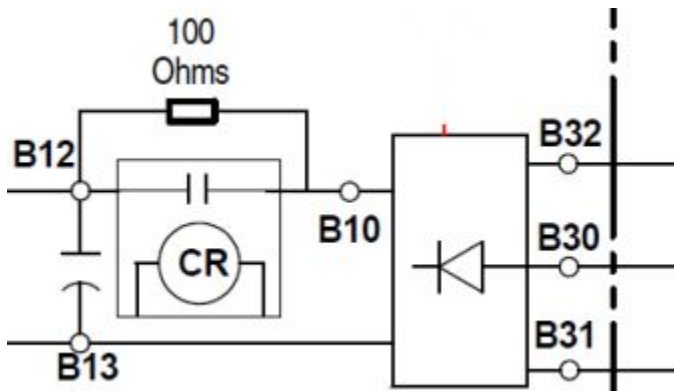
- **Mechanical thermostats DO NOT immediately reset!**
 - **First stage module thermostat opens at 90°C, resets at 60°C**

◆ **Thermostat Test**

- **Primary Circuit**
 - **G4770 board (6J42 to B49) – should measure short**

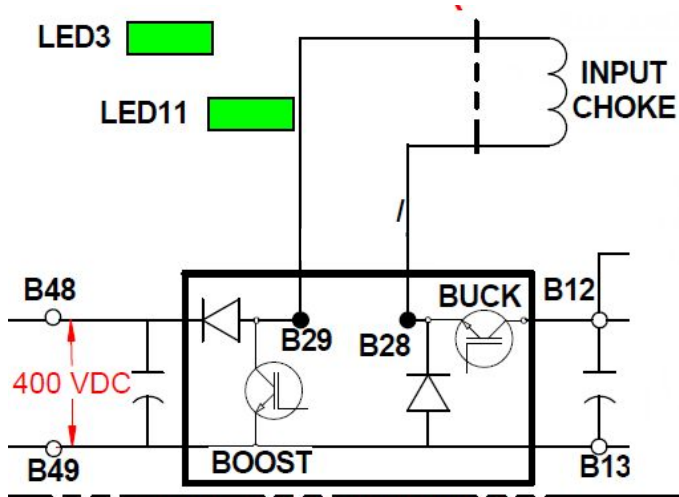
Relay and DC Link Capacitor

- ◆ **3-phase input rectifier converts AC line voltage to DC**
 - Perform diode tests between line input (B30, B31, B32) and rectifier outputs (B10, B13)
- ◆ **100 ohm resistor provides precharge path for DC Link Capacitor. Relay closes after precharge is complete.**
 - Measure resistance from B12 to B10 with machine turned off.
 - 100 ohms expected
 - OPEN indicates resistor failure
 - SHORT indicates fused relay contacts

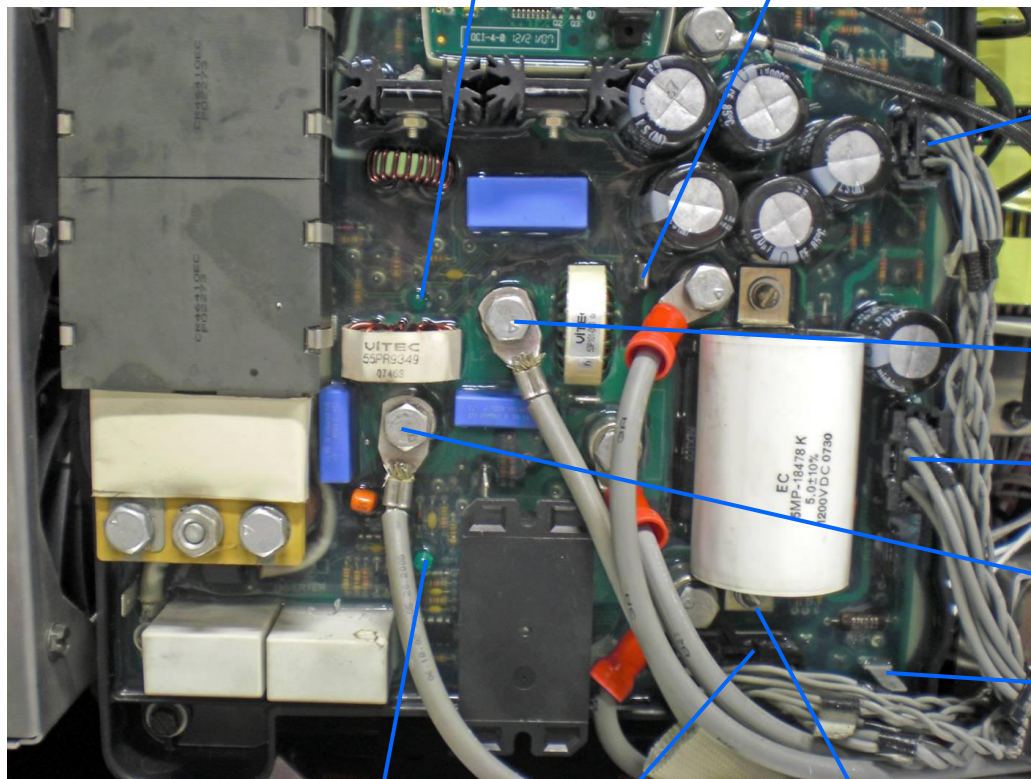


Power Conversion Assembly

First Stage – Buck Boost



LED3: BOOST IGBT DRIVE
LED11: BUCK IGBT DRIVE



Line Voltage	Rectified Value	Buck Switch	Boost Switch
200 - 208 VAC	282 - 293 VDC	On	On
230 VAC	324 VDC	On	On
380 - 415 VAC	536 - 585 VDC	On	Off
460 VAC	649 VDC	On	Off
575 VAC	811 VDC	On	Off

Depending upon the input line voltage, the PFC Control PC Board will vary the ON time of the Buck and/or the Boost switches in order to obtain a constant 400 VDC supply.

Second Stage Functions

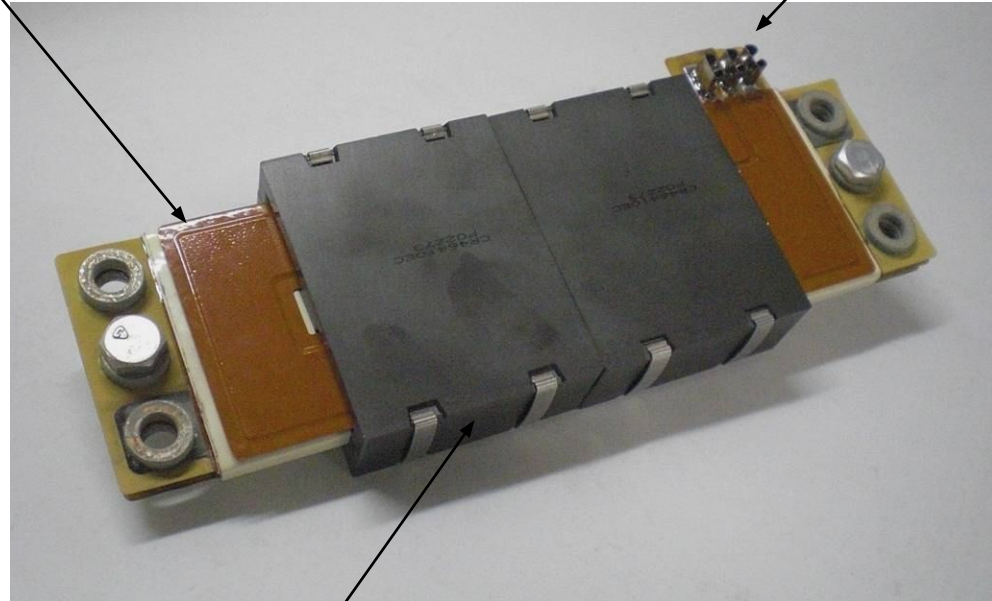
- ◆ **The Planar transformer has two auxiliary windings.**
 - **The first one is used to provide a 48 Volt power supply for the fans & the DC Bus Board. Green LED1 on if 48VDC power supply is present on Power Board.**
 - **The DC Bus Board then provides 40VDC to the Control Board & Arclink Receptacle (S3 5Pin).**
- ◆ **Converts rectified 400 Volts dc input to an unregulated 100 Volts dc output**
 - **Topology consists of a full bridge inverter followed by a center tap rectifier**
 - **Full bridge switches at 60 Khz with a 150 ns dead time**
 - **Open-loop control is used and the 100 Volts dc output is unregulated**
 - **Interacts directly with Input Control Board**
 - **Power Board provides primary side current feedback for inverter protection**
- ◆ ***The machine is now idle and ready to make a weld***

Planar Transformer

Design Features

*Printed circuit board
Individually sealed*

Incorporated auxiliary winding



*Small footprint allows
for mounting directly onto switchboard*

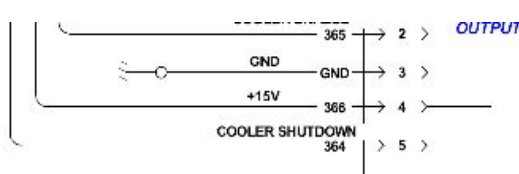
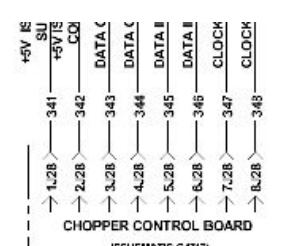
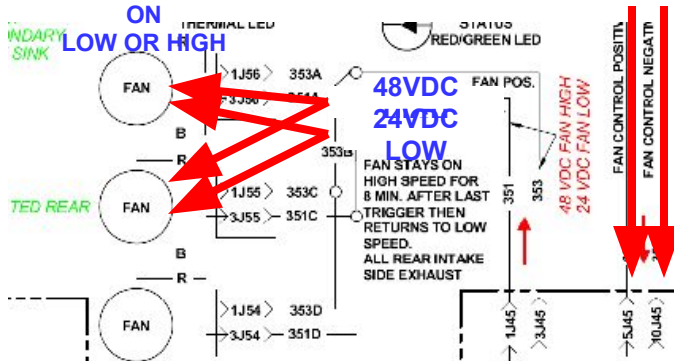
Multi-Phase Chopper

Functions

- ◆ **Used to control welding Voltage and Current**
 - 100 Volt DC input with regulated output
 - Six chopper phases in parallel that turn on 60 degrees out of phase
 - Two phases each conduct 180 degrees out of phase through the same output choke
 - Power Board receives commands from the Control board. Power Board uses this command and determines the on-time of the six chopper IGBTs.

FAN ALWAYS ON

LOW OR HIGH



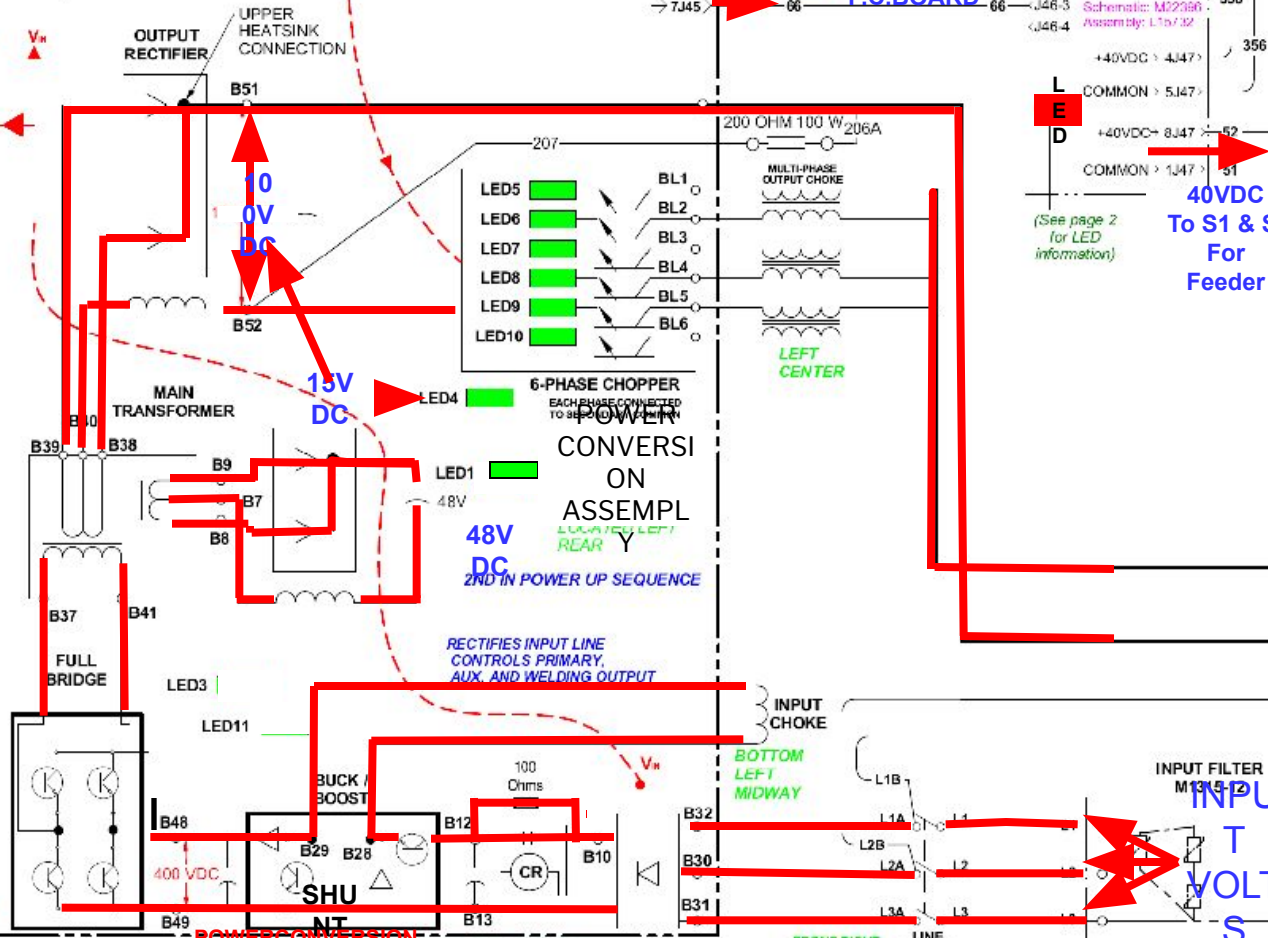
40VDC To Control Board

322 to 321= Input Volts

322 to 324=400

322	PRIMARY GND	322	12J42
321	FILTERED AC	321	1J42
326	THERMOSTAT PULL DOWN	326	6J42
328	AC INPUT VOLTAGE (RECTIFIED)	328	8J42
324	400V BUS SIGNAL	324	4J42
331	SHUNT SIGNAL-AC SIDE	331	1J43
335	SHUNT SIGNAL-CONTRL GND	335	5J43
334	CT SIGNAL	334	4J43
338	CT SIGNAL	338	8J43
301	AUX. BUCK +15V SUPPLY	301	1J41
309	AUX. BUCK +15V COMMON	309	9J41
303	MAIN BUCK +15V COMMON	303	3J41
311	MAIN BUCK +15V SUPPLY	311	11J41
333	AUX. BOOST NEGATIVE	333	3J43
337	AUX. BOOST POSITIVE	337	7J43
332	MAIN BOOST NEGATIVE	332	2J43
336	MAIN BOOST POSITIVE	336	6J43
305	MAIN RELAY POSITIVE	305	5J41
306	MAIN RELAY NEGATIVE	306	6J41
307	FULL BRIDGE PULSE XFMR	307	7J41
308	FULL BRIDGE PULSE XFMR	308	8J41
313	AUX. BUCK NEGATIVE	313	3J41
314	AUX. BUCK POSITIVE	314	4J41
315	MAIN BUCK NEGATIVE	315	15J41
316	MAIN BUCK POSITIVE	316	16J41

**!!! HIGH VOLTAGE !!!
FLOATING VOLTAGE
POTENTIAL TO GROUND**



POWER CONVERSION ASSEMBLY

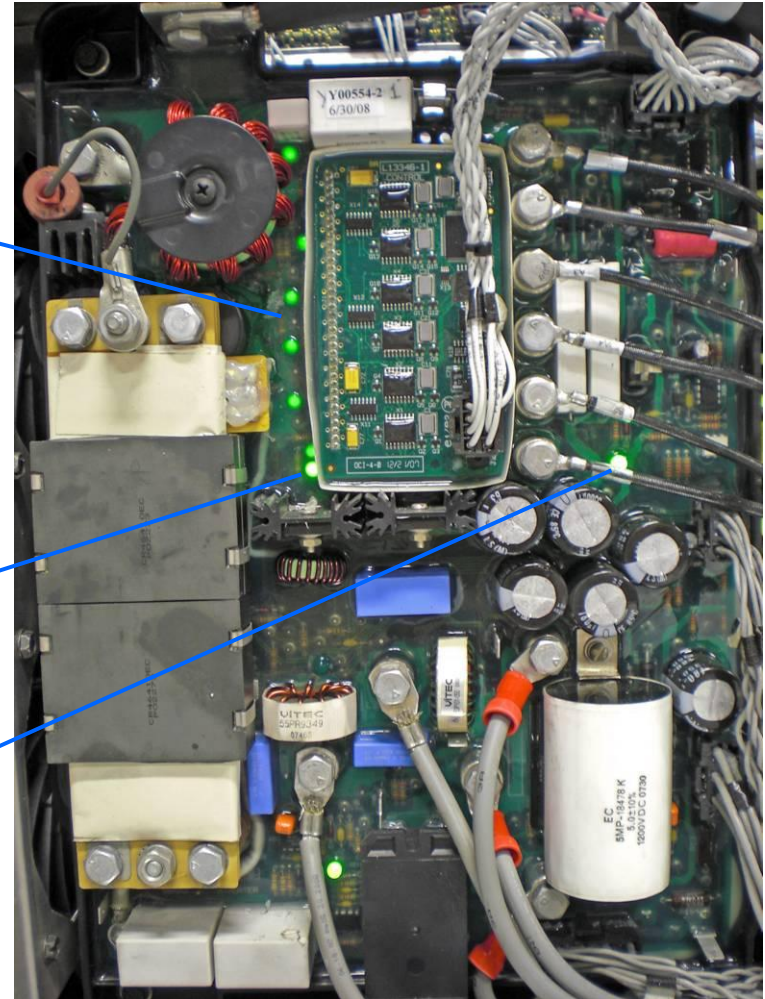
LED LEGEND
LED1: +15V AUXILIARY
LED3: BOOST IGBT DRIVE
LED4: +15V SUPPLY
LED5-LED10: CHOPPER IGBT DRIVES

40VDC To S1 & S3 For Feeder

Multi-Phase Chopper

Implementation

- ◆ **Six LEDs are used to indicate a turn-on of a chopper phase**
 - Intensity of each LEDS 5-10 is related to the on-time of each of the IGBTs
- ◆ **+15 Volt dc power supply for secondary control circuits LED4**
- ◆ **+ 48 Volt dc auxiliary power supply indicator LED1**



Control PC Board

Functions

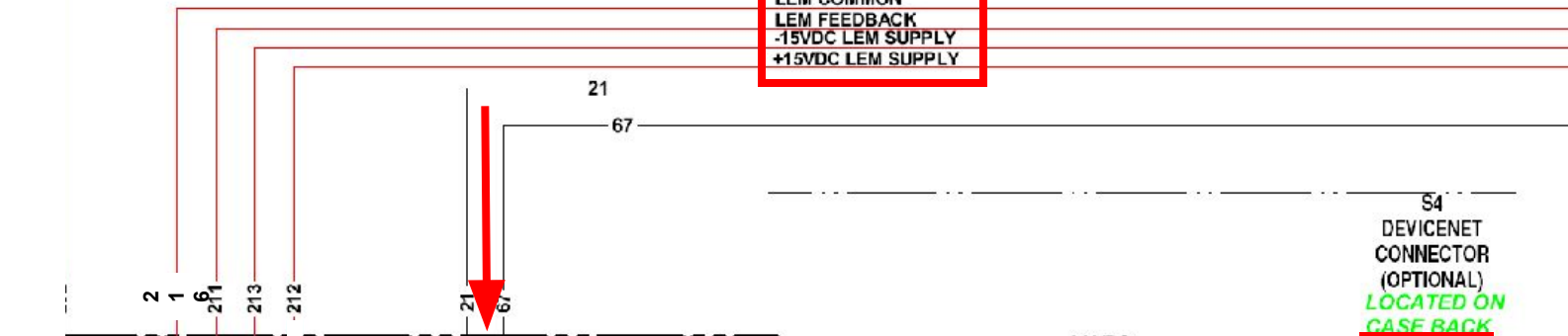
- ◆ **Controls the Chopper power plant**
 - Transmits welding commands via differential signaling

- ◆ ***Controls welding output based on ...***
 - *User settings*
 - *Voltage and Current feedback*
 - *Welding software*

- ◆ **Serves as the main communication interface**
 - *ArcLink master*
 - *Ethernet*

STUD+
STUD-

LEM COMMON
LEM FEEDBACK
-15VDC LEM SUPPLY
+15VDC LEM SUPPLY



S4
DEVICENET
CONNECTOR
(OPTIONAL)
LOCATED ON
CASE BACK

ArcLink
To and
From
Receptacle
S3
PF10M

Voltage
Sense
Leads

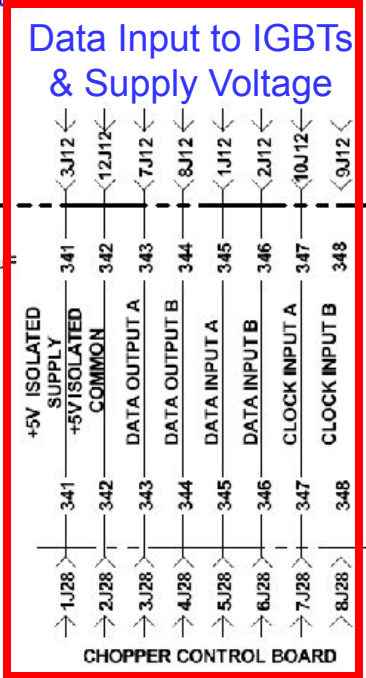
TYPICAL FEEDBACK
4 VDC = 500 A

FOLDS BACK TO
375 A WITH A
SHORT CIRCUIT

VOLTAGE
FEEDBACK

Low & High
Speed Fan
Control to
Power
Board

Data Input to IGBTs
& Supply Voltage



24 VDC FAN LOW
FAN CONTROL POSITIVE
FAN CONTROL NEGATIVE

+40 VDC COMMON
+40 VDC POSITIVE

40VDC From
Bus BD

COOLER
CONNECTOR

LOCATED LOWER
REAR OF MACHINE

JUMPER SIMULATES
COOLER FLOW SENSOR.
REMOVAL WILL DISABLE
OUTPUT

P52

+15V 367
COOLER ENABLE 365
GND GND
+15V 366
COOLER SHUTDOWN 364

USED FOR PRODUCTION MONITORING,
DOWNLOADING SOFTWARE, OR
UPLOADING MACHINE INFORMATION

ETHERNET
CONNECTOR

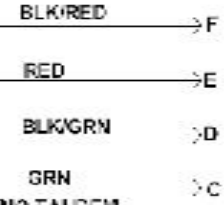
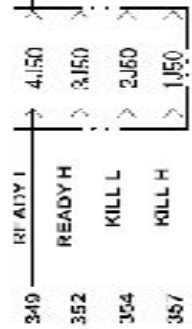
RJ 45
TYPE

LOCATED TOP
RIGHT
REAR PANEL

ETHERNET
CABLE

J15

P50



LOCATED LEFT
ON CASE BACK

S5

This is where
The STT
Differential
I/O
Connects to
S350

G6682 Control Board
- Depopulated version
of G4800

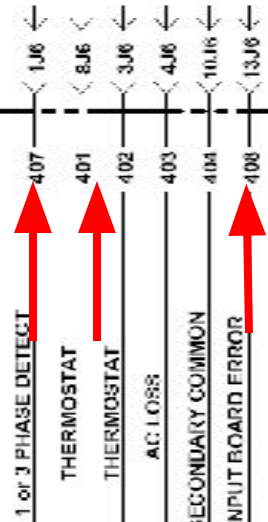
CONTROL
P.C. BOARD

Secondary
Thermostat

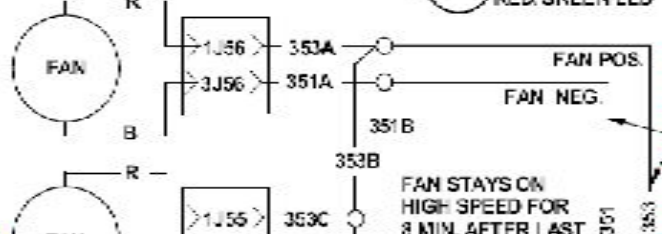
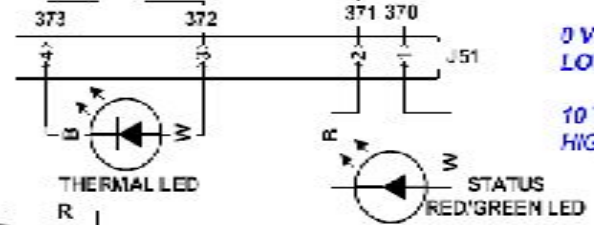
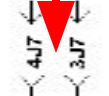
Thermostat
LED
On Front

Status LED
On Front

SEE PAGE 2 FOR
BOARD LAYOUT HELP



SWITCHBOARD
THERMOSTAT
LOCATED ON
TOP OF
SECONDARY
HEAT SMK



Thermal Protection

Function

◆ **Secondary Thermal Circuit**

- **Protects machine against reduced airflow or overload.**
 - **Fan ON / Output disabled**
 - **Thermal fault logged and indicated by Thermal Error and Thermal LED on User Interface board (Error 36)**
- **Locations:**
 - **Secondary Heatsink**

◆ **All Thermostats are normally closed**

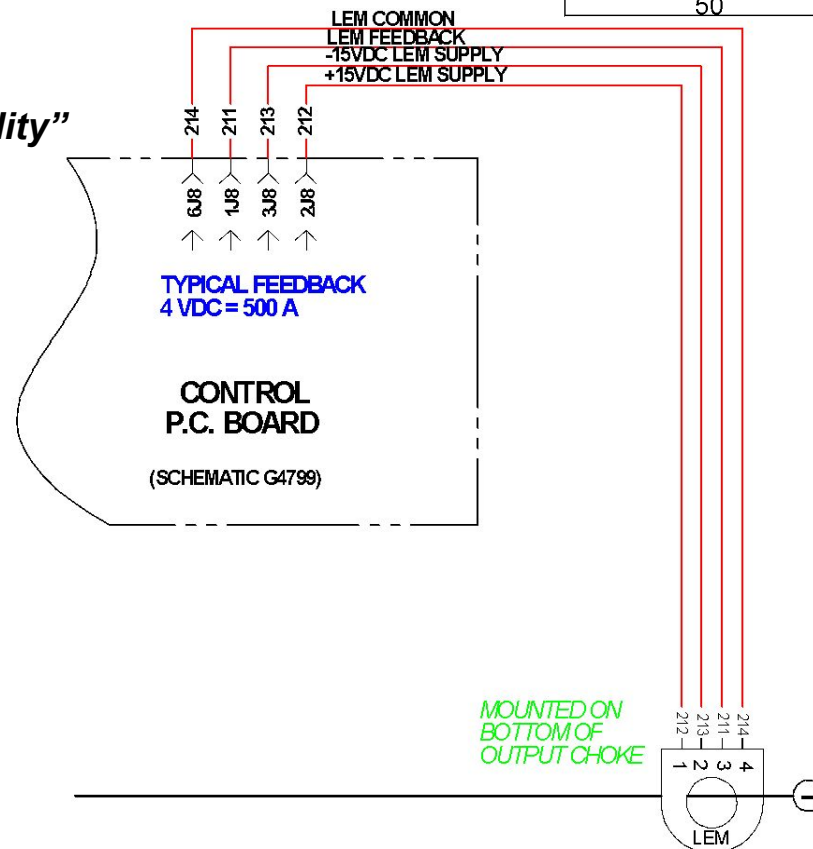
- **Mechanical thermostats DO NOT immediately reset!**
 - **Secondary heatsink thermostat opens at 68°C, resets at 48°C**
- **Secondary Circuit**
 - **Digital Control board (2J5 to 3J5) – should measure short**

Current Transducer (s18504-6)

Simplified Test Procedure

- Verify 30 VDC present at supply leads
- Check the feedback with a Constant Current Output into a load (Mode 200).
 - Calibration tab in the "Lincoln Diagnostic Utility"
 - Verify Transducer V_{fb} versus actual Output Current per chart

OUTPUT CURRENT	TRANSDUCER V_{fb} (8mV/Amp)
500	4.0
450	3.6
400	3.2
350	2.8
300	2.4
250	2.0
200	1.6
150	1.2
100	0.8
50	0.4



Control PC Board

**DIP Switches – Factory Default Shown
All ON**

Status LED's

◆ “Must Have” LED's



9 Power Supply



1 Board Status

◆ Ethernet Connectivity



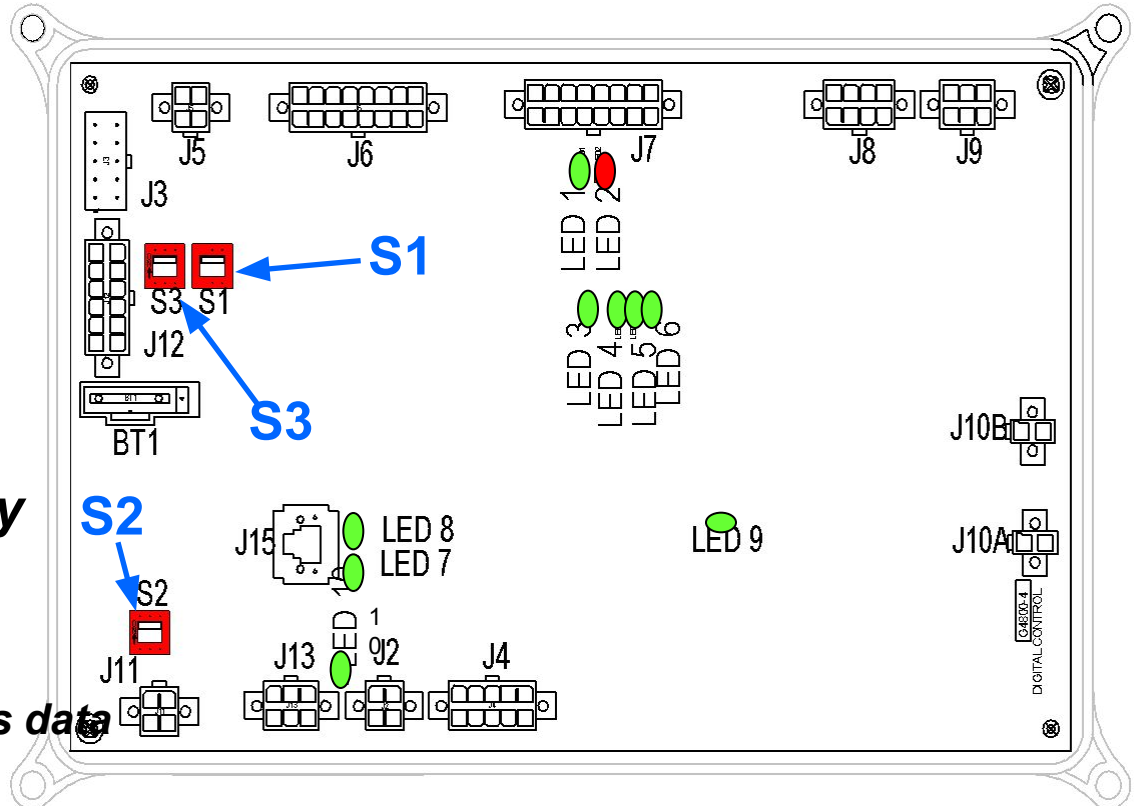
7 Ethernet Status

- **Flashing indicates data**

◆ DeviceNet Connectivity



10 DeviceNet Power

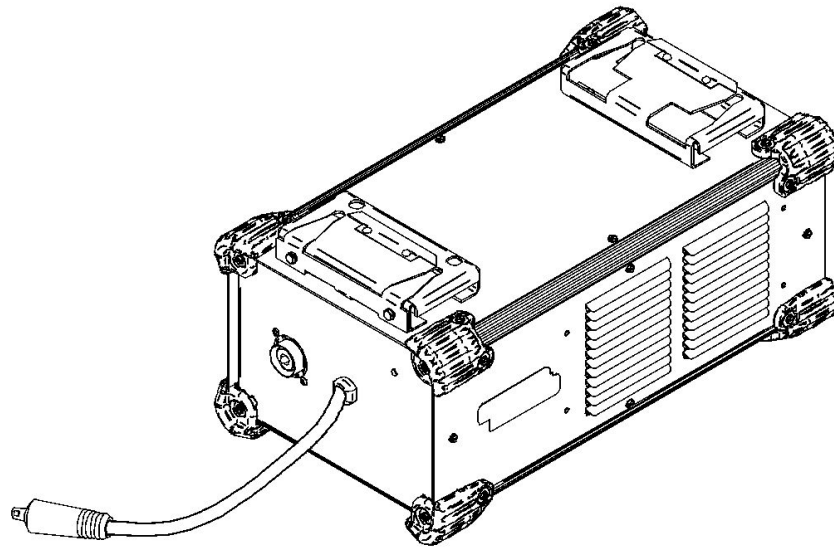


ERROE CODES POWER WAVE S350

Code	Fault	1st Stage	2nd Stage	Relay	Recovery	Signaling
331	Peak input current limit (4ms)	OFF	ON	OPEN	Cycle Power	G4800 & A / V signal
none	Peak input current limit	ON	ON	CLOSED	Self-recovering	G4800 to turn off output
333	Under-voltage lock-out	OFF	OFF	OPEN	Cycle Power	G4800 & A / V signal
336	Thermal fault	OFF	ON	OPEN	Self-recovering	G4800 & A / V signal
337	Precharge timeout	OFF	ON	OPEN	Cycle Power	G4800 & A / V signal
346	Transformer primary overcurrent	OFF	OFF	OPEN	Cycle Power	G4800 & A / V signal
342	No/low AC input voltage (4s)	OFF	ON	OPEN	Cycle Power	G4800 & A / V signal
none	No/low AC input voltage	OFF	ON	OPEN	Self-recovering	G4800 to turn off output
none	Cap under-voltage	ON	ON	CLOSED	Self-recovering	G4800 to turn off output
341	Start Up Current Fault (50 Amps)	OFF	OFF	OPEN	Cycle Power	A / V signal

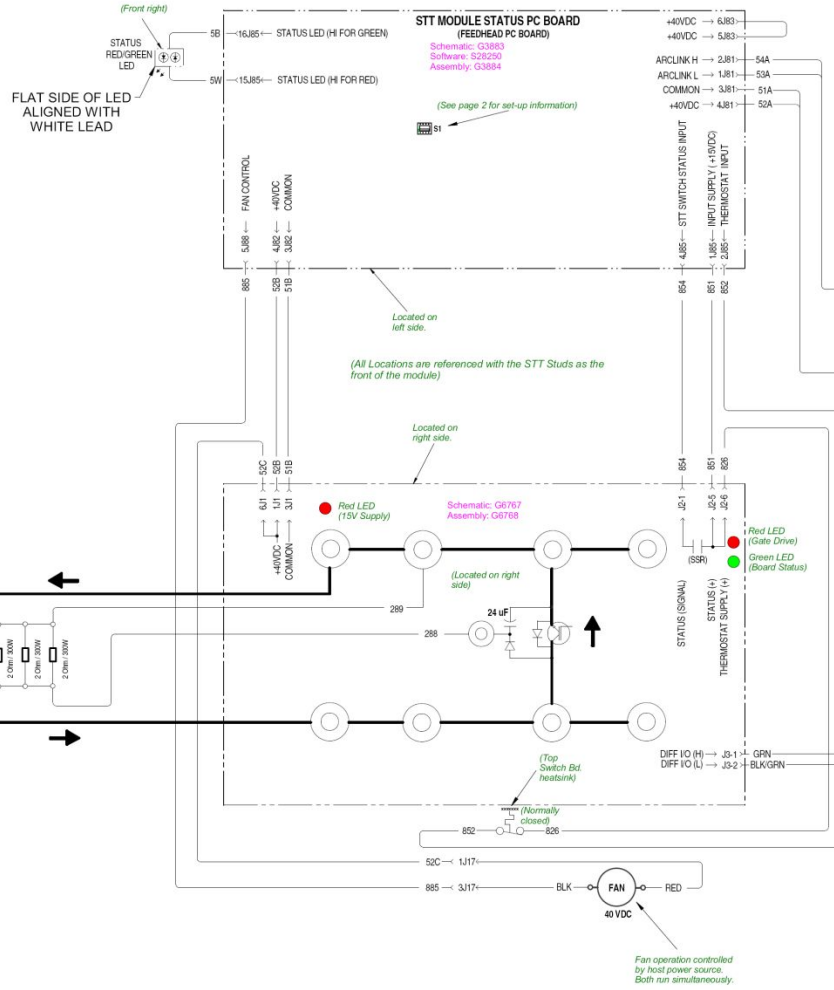
STT Module

Service Training



K2921-1

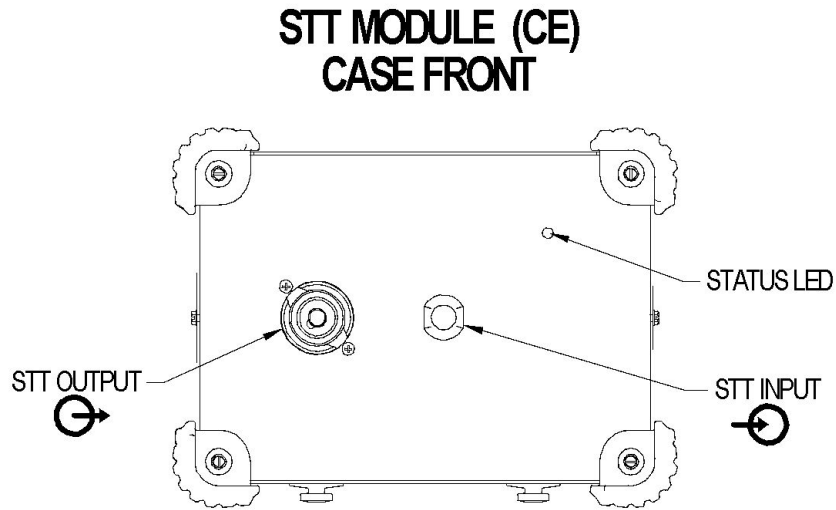




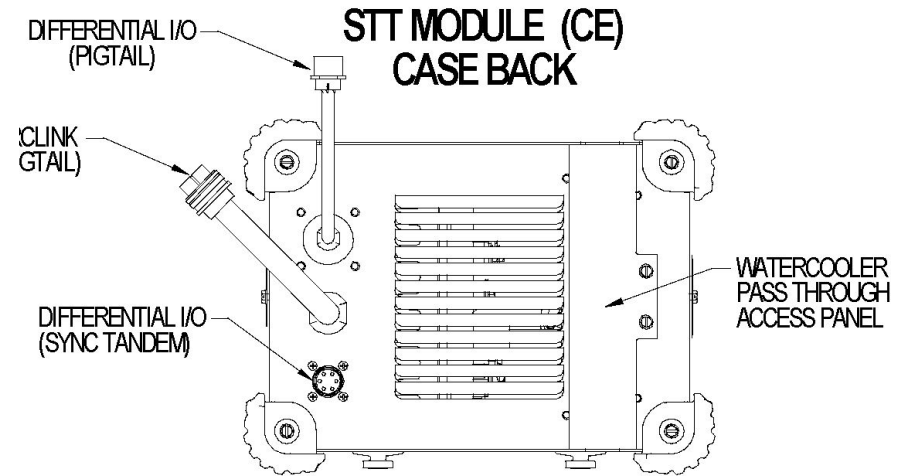
Schematic numbers and Part numbers are given for reference only.

STT Module

Front View

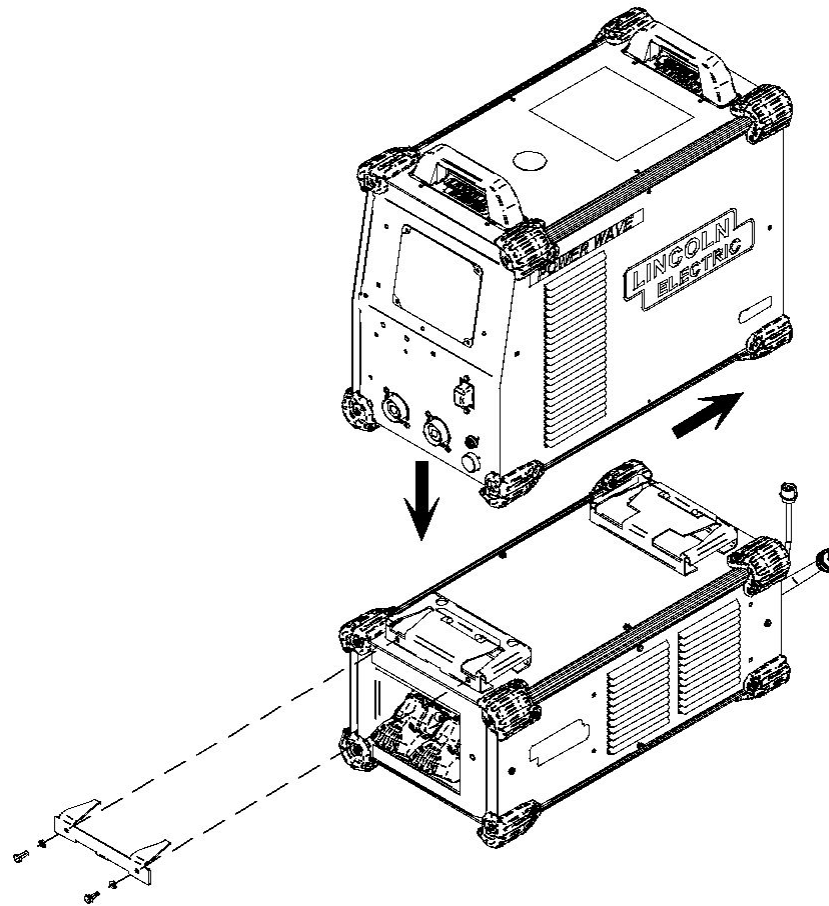


Rear View



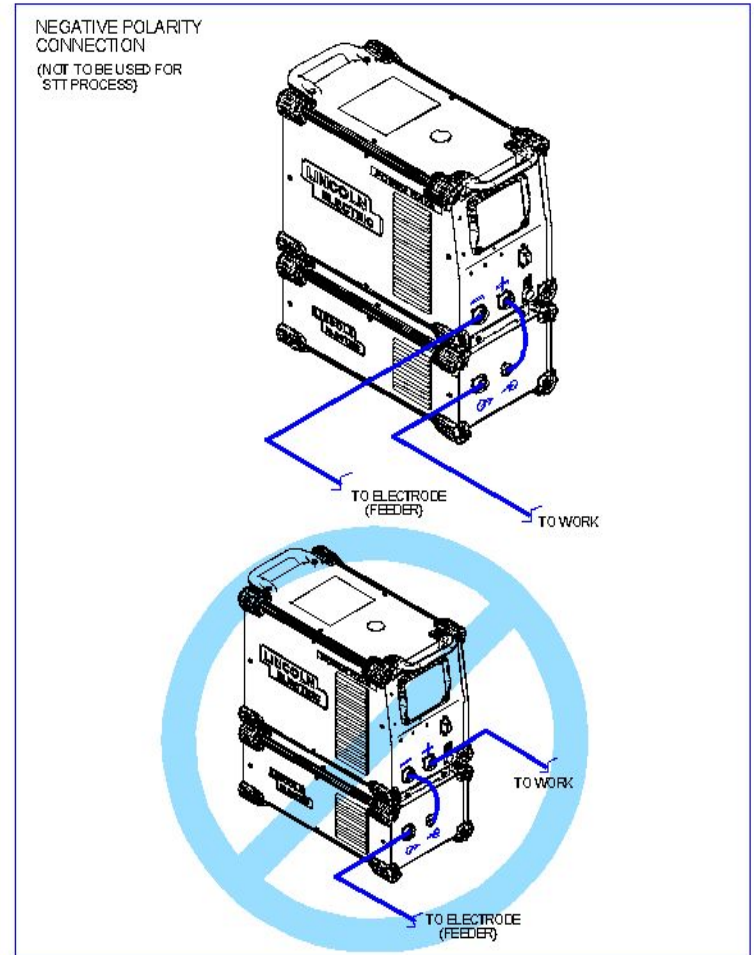
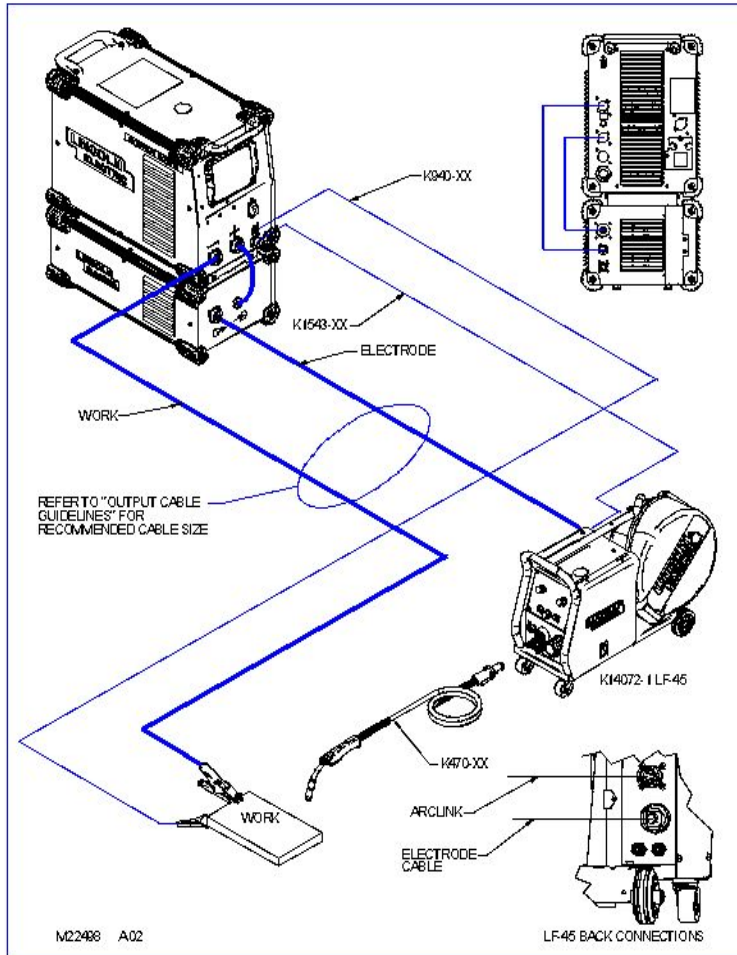
STT Module

Typical Mounting



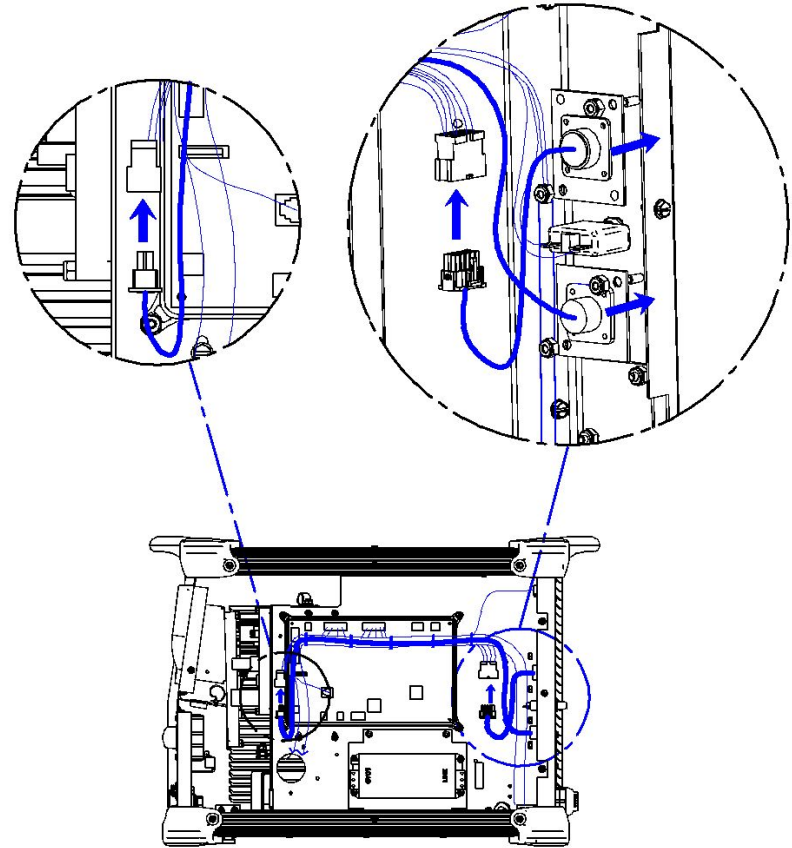
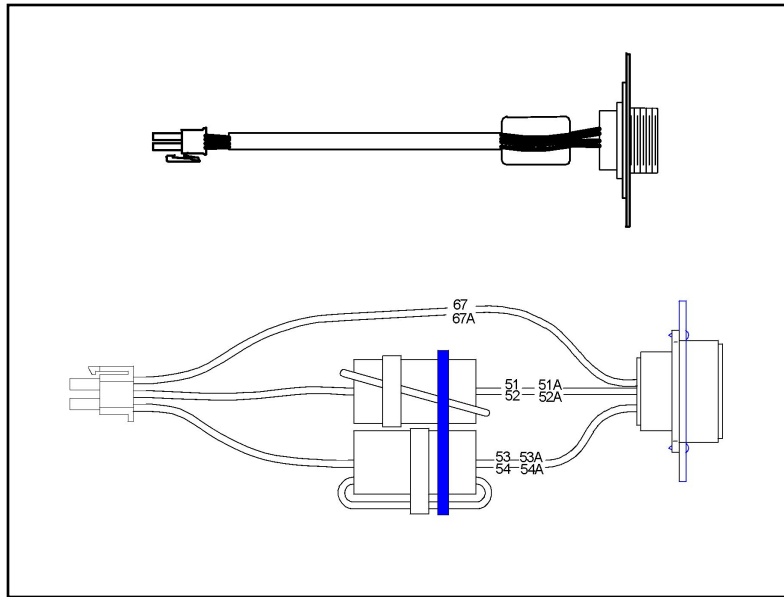
STT Module

Connection Diagram (CE) (Reference M22498)



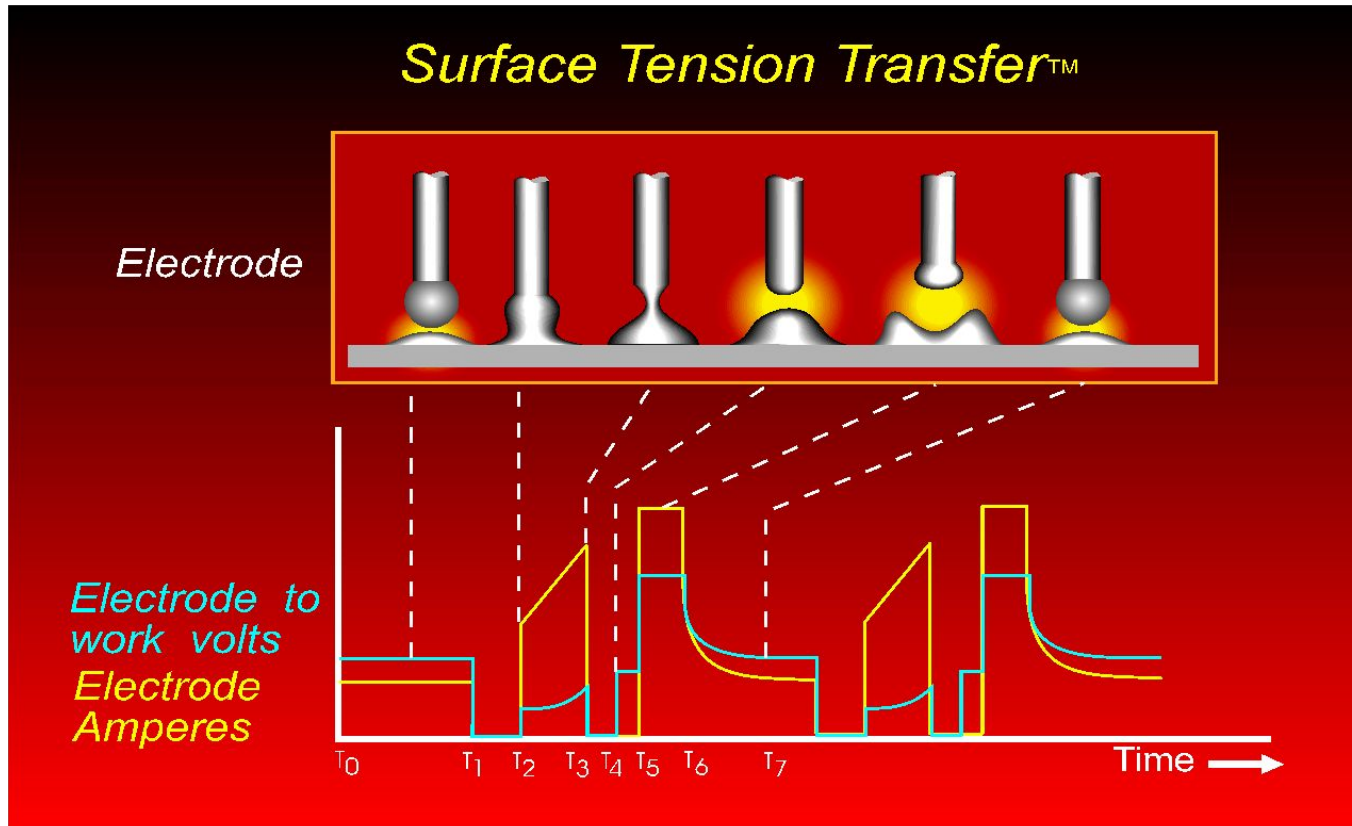
STT Module

STT Update Kit (CE) Included with K2921-1 for S350 CE



STT Module

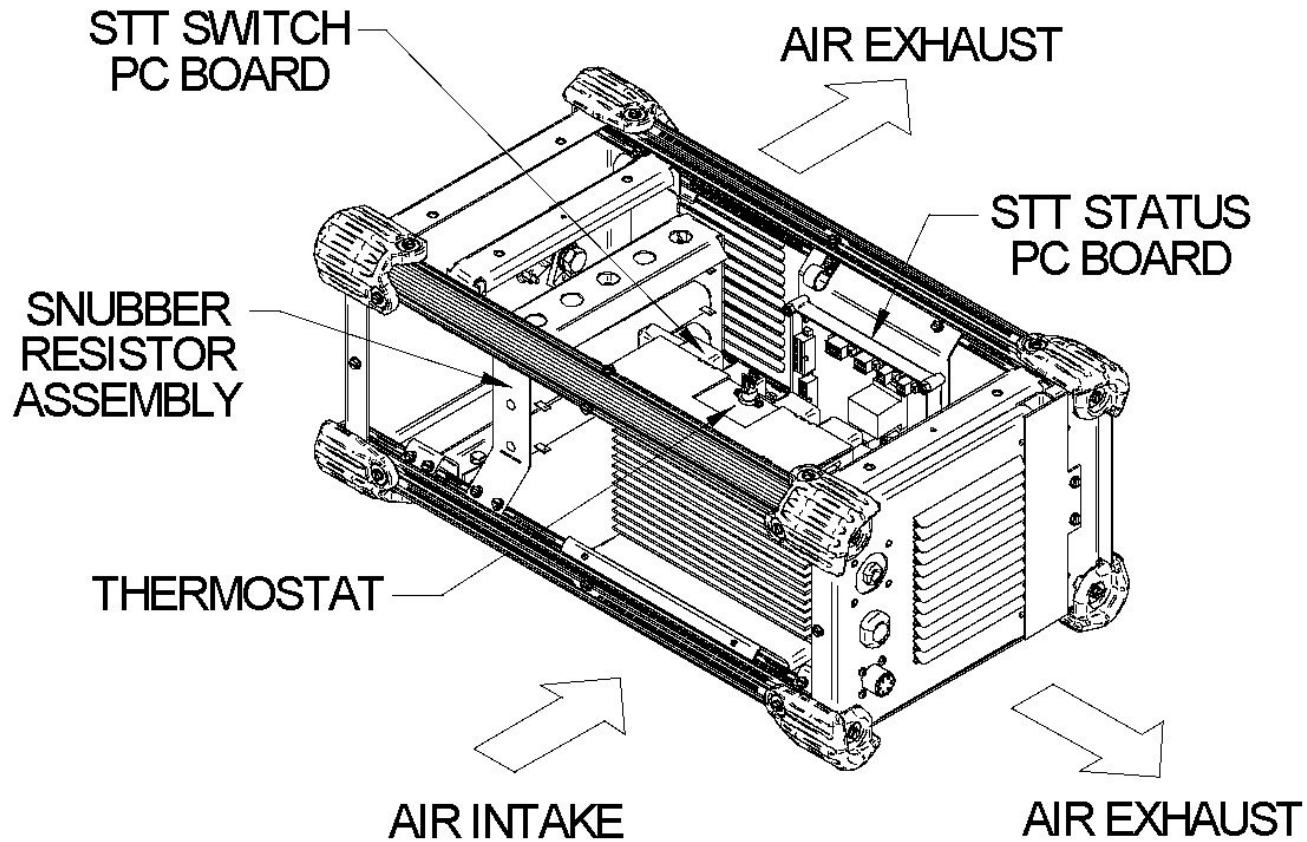
STT - The Basics



- **Typical shorting frequency \approx 100 - 120Hz**

STT Module

Component Location

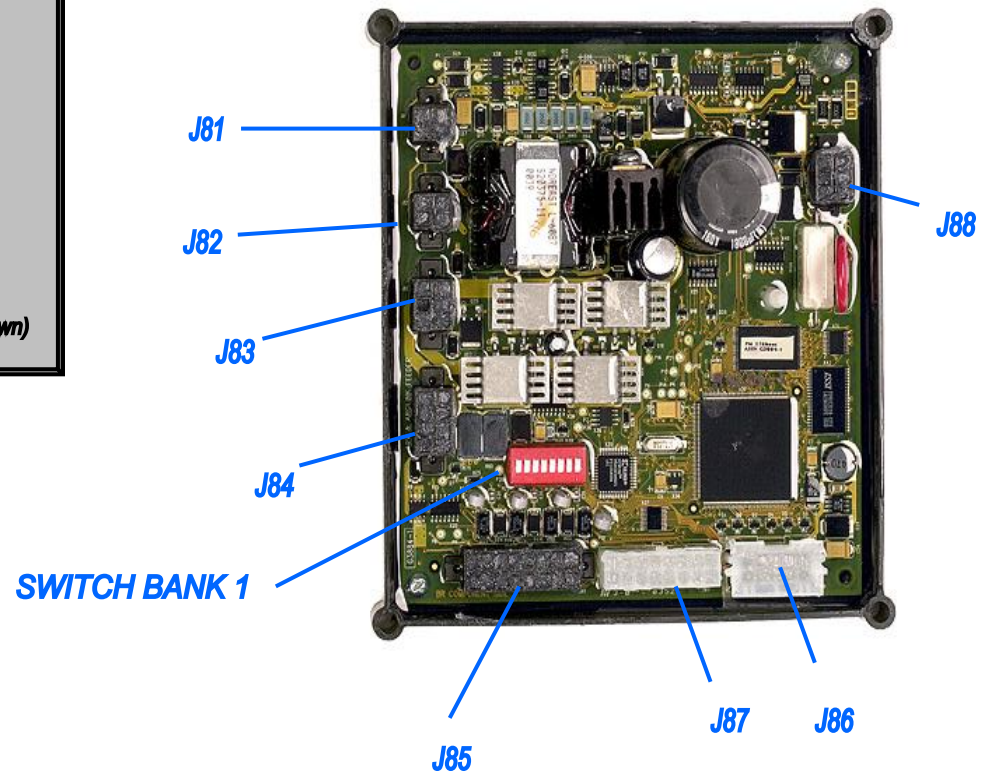
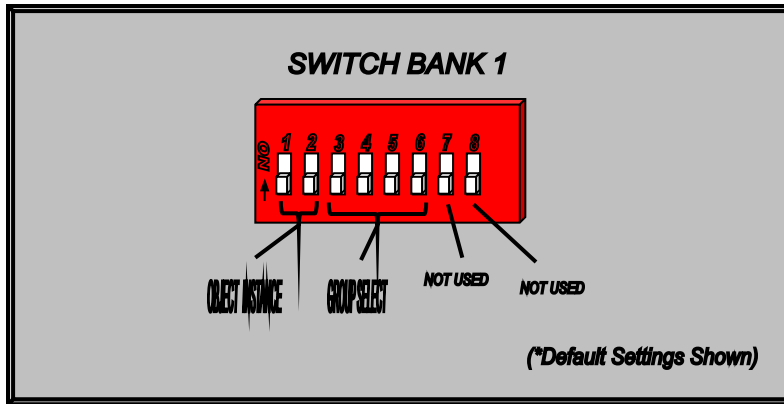


STT Status PC Board (S28250/G3884 series)

Functions

- ◆ ***Identifies STT Module to ArcLink Network***
 - *Receives Switch PCB Status and Thermal information*
 - *Communicates Errors to Power Source via ArcLink*
- ◆ ***Drives Fan***
 - *Fan driven via Power Source Control Board command*
- ◆ ***Controls external Status LED***

STT Status PC Board (S28250/G3884 series)



STT Status PC Board (S28250/G3884 series)

Troubleshooting with External LED

◆ No LED

- Check LED placement and connections***
- Verify 40 Vdc input (J81-4 to J81-3)***

◆ Fast blinking Green LED – Mapping Error

- Verify continuity of ArcLink cable (pins “A” and “B”)***
- Verify ArcLink Pigtail to Status PCB***
 - Pin “A” to J81-1***
 - Pin “B” to J81-2***

◆ Red and Green Blinking LED

- Read and interpret Error Code***
 - Power Wave Manager Diagnostic Tab***

STT Status PC Board (S28250/G3884 series)

Troubleshooting with External LED

Error codes for the Power Wave STT Module

(Indicated on the externally mounted Status LED)

STT Module	
Error Code #	Indication
36 Thermal error	Indicates over temperature. Usually accompanied by Thermal LED on the host power source. Check fan operation. Be sure process does not exceed duty cycle limit of the machine.
39 Misc. hardware fault	Unknown glitch has occurred on the fault interrupt circuitry. Sometimes caused by intermittent connections in the thermostat circuit.
99 STT Status error	Error reported by the STT Switch PC Board. Generally caused by misconnection of welding leads (reverse polarity). May also be caused by loss of input voltage or board failure. Observe diagnostic LED's on the STT Switch PC Board to determine the exact cause.
Other	A complete list of error codes is available in the Power Wave Manager Utility (available at www.powerwavesoftware.com). Error codes that contain three or four digits are defined as fatal errors. These codes generally indicate internal errors on the Power Source Control Board. If cycling the input power on the machine does not clear the error, contact the Service Department.

STT Status PC Board (S28250/G3884 series)

Troubleshooting Input and Output Circuits

◆ *Thermostat Input*

- *Best Measured across the Thermostat*
 - *Closed < 1VDC*
 - *Open > 10VDC*

◆ *Switch PCB Status Input*

- *Best Measured at STT Switch PC Board (J2-5 to J2-1)*
 - *Closed < 1VDC*
 - *Open > 10VDC*

◆ *Fan Output*

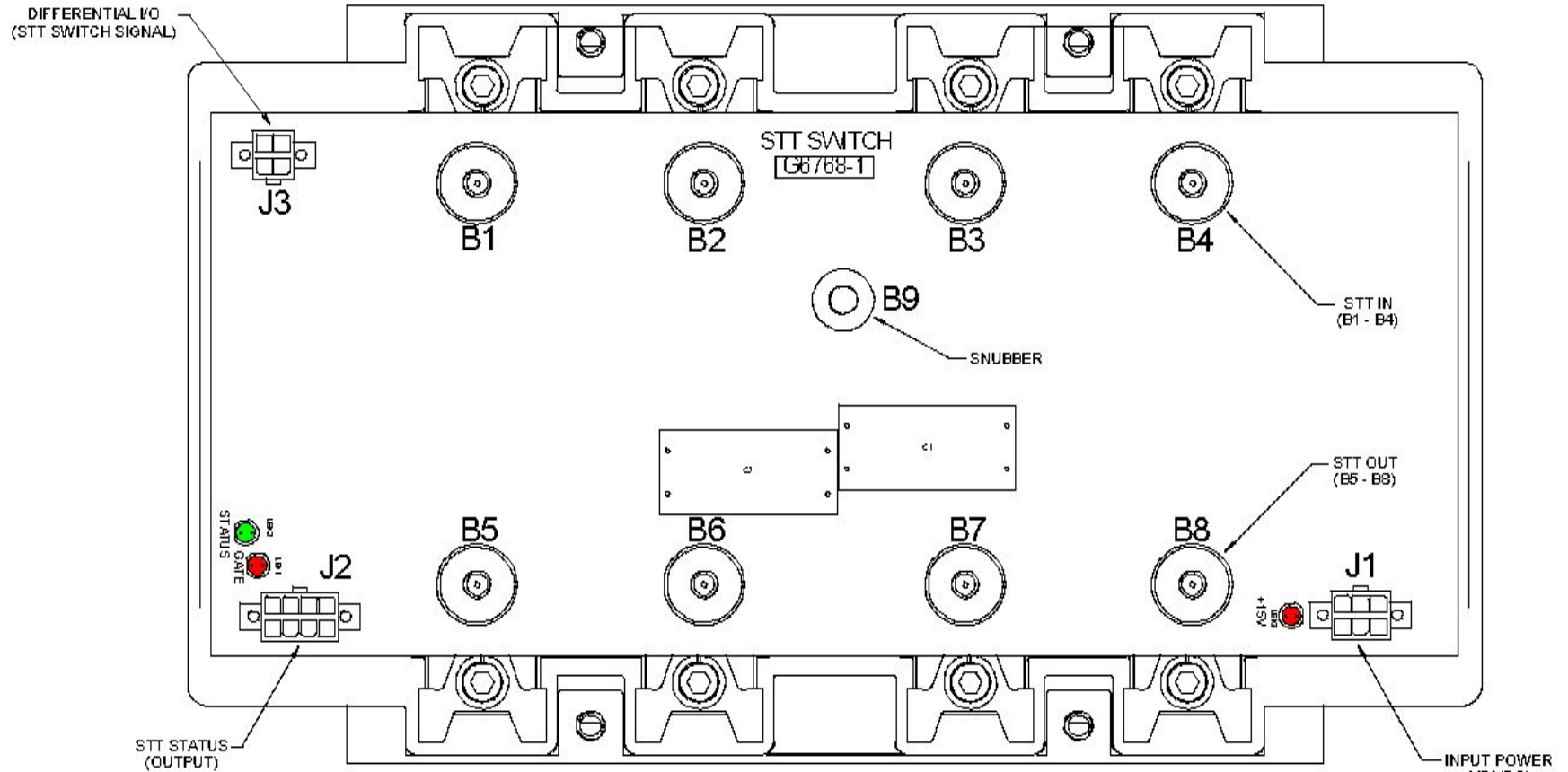
- *Open Collector style (J88-5)*
- *Supplied from STT Switch PCB (J1-6)*

STT Switch PC Board (G6768 series)

Functions

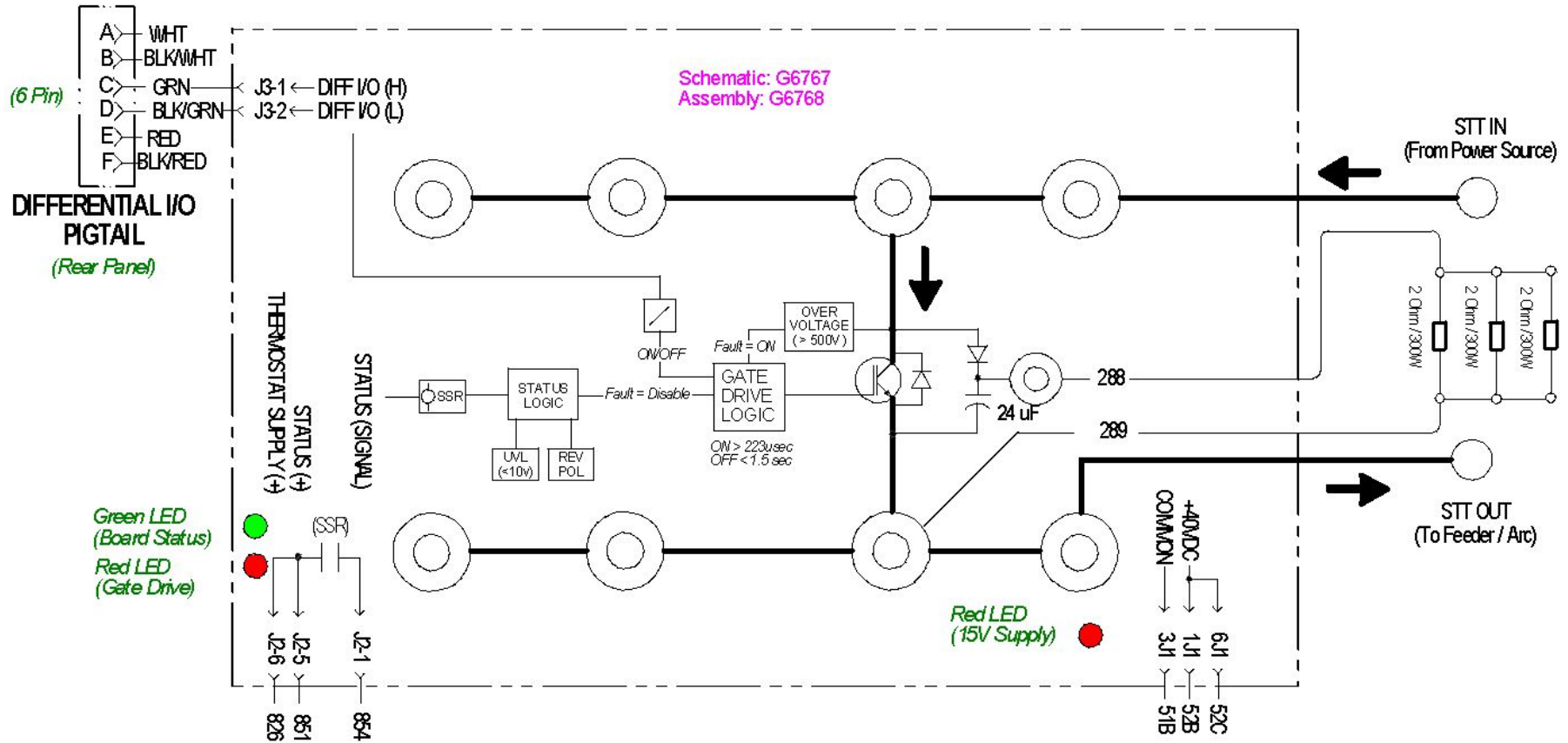
- ◆ ***Interrupts Power Source Output Current***
 - ***Includes integral snubber diodes and capacitors***
 - ***Resistor bank located off Board***
- ◆ ***Includes on board Protection Circuitry***
 - ***Intelligent Gate Drive***
 - ***Minimum ON time = 223μsec***
 - ***Maximum OFF time 1.5 seconds***
 - ***Under Voltage Lockout (ERROR 99)***
 - ***Over Voltage Protection***
 - ***Turns Switch ON if Snubber voltage exceeds 500V***
 - ***Reverse Polarity Protection (ERROR 99)***
 - ***Only when connected through Status PCB (ArcLink)***

STT Switch PC Board (G6768 series)



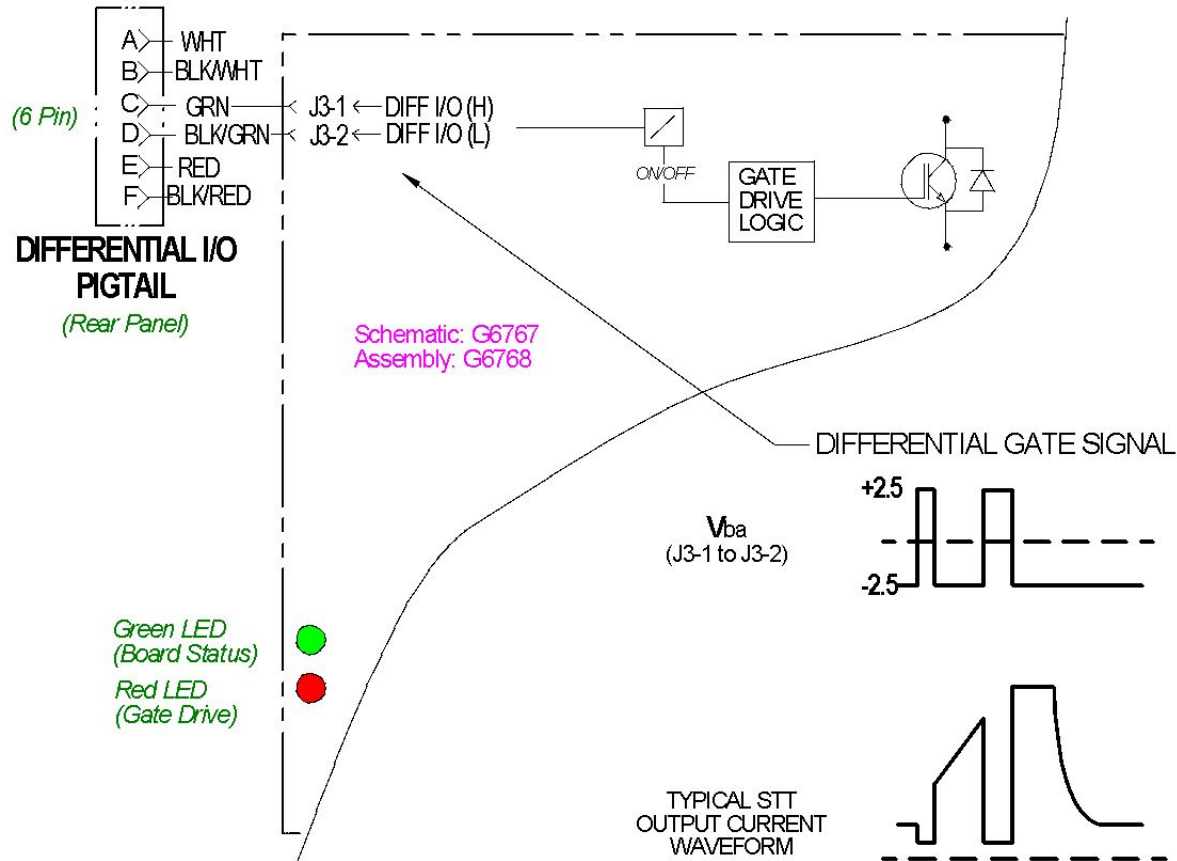
STT Switch PC Board (G6768 series)

Functional Block Diagram



STT Switch PC Board (G6768 series)

Gate Drive Signal (RS-485 Differential signal from Power Source)



STT Switch PC Board (G6768 series)

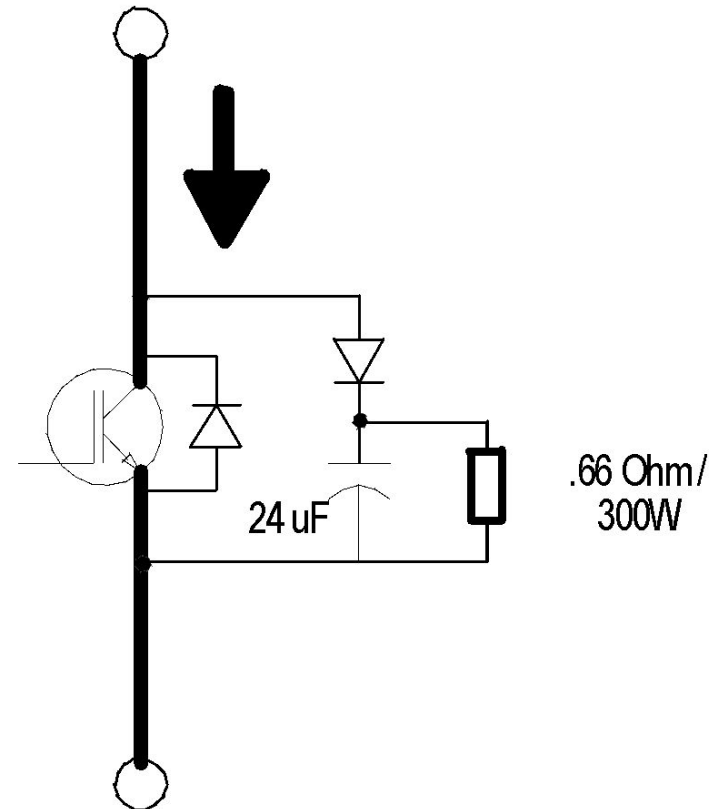
Snubber Configuration

◆ Capacitor

- Absorbs initial energy

◆ Resistor

- Limits maximum voltage
- Provides path to sustain arc current
- Dissipates Energy from weld circuit inductance



STT Switch PC Board (G6768 series)

Troubleshooting

On Board LED's for the STT Switch PC Board

(Visible through the rear and left side louvers)

STT Switch PC Board				
MACHINE OUTPUT	LED1 (GATE)	LED2 (STATUS)	LED3 (+15V)	Indication
ON/OFF	ON	ON	ON	Normal Condition – STT Switch is ON
ON	OFF	ON	ON	Normal Condition – STT Switch has been commanded OFF Note: During normal STT operation the OFF state of the LED may only be detectable as a slight dimming.
ON	OFF	OFF	ON	Status Failure (only when triggered). Should be accompanied by Error 99 on the external STT Module Status LED. Most likely caused by weld cable misconnection (reverse polarity).
ON/OFF	OFF	OFF	ON/OFF	Status Failure (constantly). Should be accompanied by Error 99 on the external STT Module Status LED. Most likely caused by the on board power supply under-voltage lockout. Verify input voltage to the STT Switch board.