# Model 206L

## High Efficiency Cabinet Power Supply
## Operations Manual

SERIAL NUMBER: 1309XXXXX and higher
PCB Issue D, 010-0206-001

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## Table of Contents

## SECTION 1 GLOSSARY

| | | | |
|---|---|---|---|
| A | Amperes | mVpp | millivolt peak to peak |
| AC | Alternating Current | PCB | Printed Circuit Board |
| C | Celcius | PDA | Power Distribution Assembly |
| DC | Direct Current | PFC | Power Factor Correction |
| EG | Equipment Ground | RMS | Root Mean Square |
| F | Farenheit | uF | micro farad |
| Hz | Hertz | VAC | Voltage Alternating Current |
| LED | Light Emitting Diode | VDC | Voltage Direct Current |
| m | milli | | |

## SECTION 2 GENERAL

The Model 206L Cabinet Power Supply is a rack mounted high efficiency switching power supply that provides a single regulated +24VDC output for a PDA #2 or PDA #3 assembly commonly found in a 332 or 336 style cabinet. The Model 206L is plug-in compatible with a Caltrans Model 206 Cabinet Power Supply.

## SECTION 3 GENERAL CHARACTERISTICS

The Model 206L provides full output regulation across changes in AC Line voltage and output load over the full operating temperature range of -34C to +74C. Power Factor Correction is also provided reducing peak AC Line input current and associated stress on wiring. The AC Line input is rated for 80 to 270 Vac operation at 50 or 60 Hz.

## SECTION 4 INSTALLATION

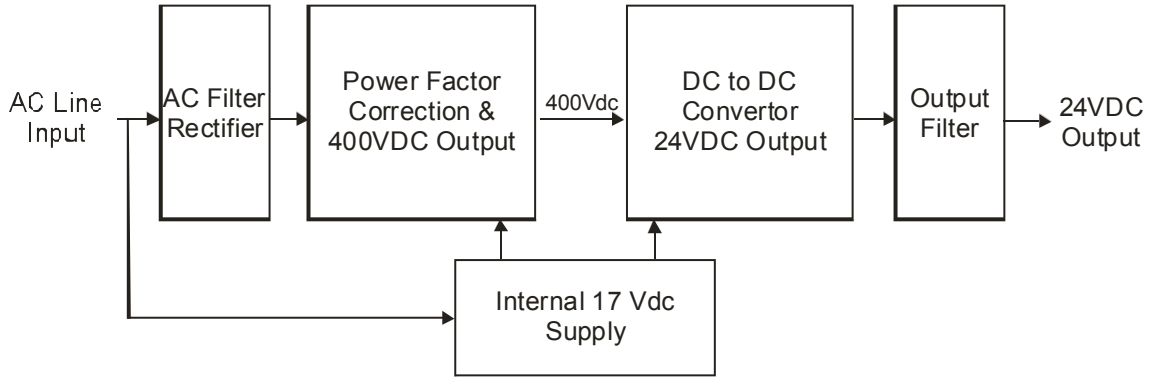
The Model 206L is a rack mounted device that requires no adjustments or programming when installed. The Model 206L requires no maintenance or periodic adjustments.

## SECTION 5 ADJUSTMENTS

The Model 206L requires no adjustments or programming. Test jacks are provided to measure the 24VDC output.

## SECTION 6 THEORY OF OPERATION

### 6.1 SYSTEM DESCRIPTION



### 6.2 CIRCUIT OPERATION

The internal 17Vdc supply is a buck type integrated switching supply used to generate the 17Vdc voltage which supplies operating power to both the PFC and 24VDC output controller circuits. The integrated controller (U6) uses rectified AC from C28 and down converts it to 17 Vdc (VCC). The front panel LED (DS1) indicates the AC Line is applied and the 17 Vdc output is active.

The AC Filter and Rectifier circuit converts the incoming AC Line voltage to a rectified voltage at T1.2. Filter network C11, R45, R46, T3, and C27 prevent high frequency switching noise from being coupled back into the AC Line. The AC input is fused for over-current protection with a 3 Amp slow blow fuse.

The integrated PFC controller (U1) converts this rectified voltage to a 400 Vdc value (HV+) stored in C29. Comparator circuit U2-A is used to shut down the PFC controller during low AC Line conditions. **Caution: Internal LED DS3 is used to warn a service technician that high voltage is present on C29 (HV+)**.

DC to DC Controller (U5) down converts the 400 Vdc to create an isolated and regulated +24 Vdc output at C8, C9, and C10. Components L1, C6, and C7 filter out switching noise to the output. The front panel LED DS2 indicates that the 24Vdc output is active. Signal PFC_RDY is used to shut down the DC to DC Controller (U5) during low AC Line conditions.

The output is fused for over-current protection with an 8A slow blow fuse. The output is protected against voltage transients by a 1500 Watt suppressor (Z1).

### 6.3 SPECIFICATIONS

AC Operating Voltage Minimum ..... 80 Vac
AC Operating Voltage Maximum ..... 270 Vac
AC Operating Frequency ..... 45 to 65 Hz
Power Factor (120 Vac at full load)..... 0.98
Efficiency (120 Vac at full load)..... 86%
DC Output Voltage..... 24 Vdc +/- 1 Vdc
DC Output Current Maximum..... 5 Amps
DC Output Ripple Maximum ..... 200 mVpp
Note: Ripple is measured at 20MHz of bandwidth using a 12" twisted pair-wire terminated with a 0.1uf & 47uf capacitor.
Minimum Holdup Time (5 Amp load)..... 50 milliseconds
Height ..... 6.0 inches
Width..... 5.5 inches
Depth (excluding handle & connector pins) ..... 7.35 inches
Storage Temperature Range ..... -45 to +85 $^{o}$C
Operating Temperature Range ..... -34 to +74 $^{o}$C
Humidity (non-condensing) ..... 0 to 95% Relative

## SECTION 7 MAINTENANCE

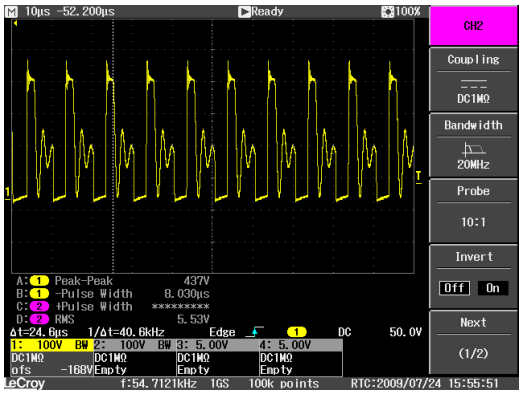
A green LED indicator is provided to display AC Line input status and fuse integrity. A separate green LED indicator is provided to display output status and fuse integrity for the 24VDC output.

The Model 206L requires no adjustments or programming. Test jacks are provided to measure the 24VDC output.

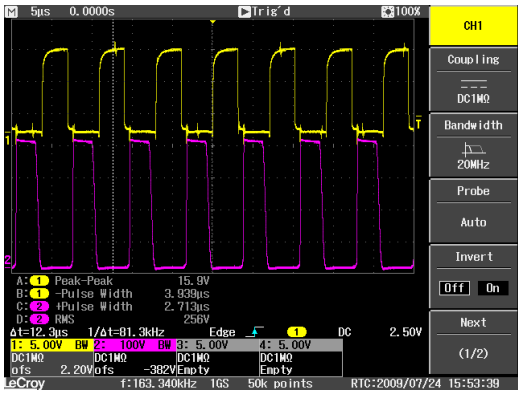
## 7.1 TROUBLE ANALYSIS

1) AC Line indicator DS1 is not illuminated:
   a. Check that AC Line input fuse (F2) is not blown. Replace with 3A SB fuse.
   b. Check that AC Line voltage is greater than 80 Vac.
   c. Check that internal 17Vdc supply is operating (VCC).
2) DC Output indicator DS2 is not illuminated:
   a. Check that internal 17Vdc supply is operating.
   b. Check that DC output fuse (F1) is not blown. Replace with 8A SB fuse.
   c. Check that PFC Controller is providing 400 Vdc at HV+, DS3 should be illuminated.
3) DC Output is not active:
   a. Check that the DC to DC controller has not shut down because of an output load that exceeds the maximum value. Once the overload is removed a power cycle will reset the operation of the controller.

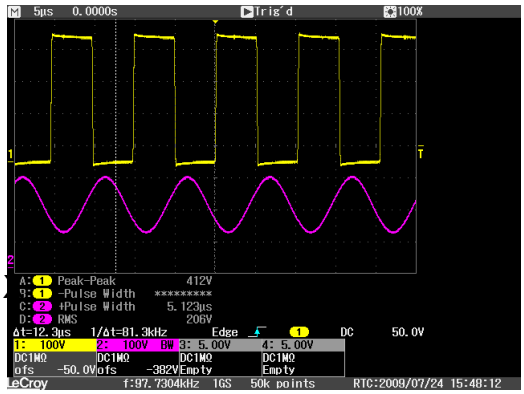
## 7.2 WAVE FORMS




Internal VCC Supply, U6 pin 3



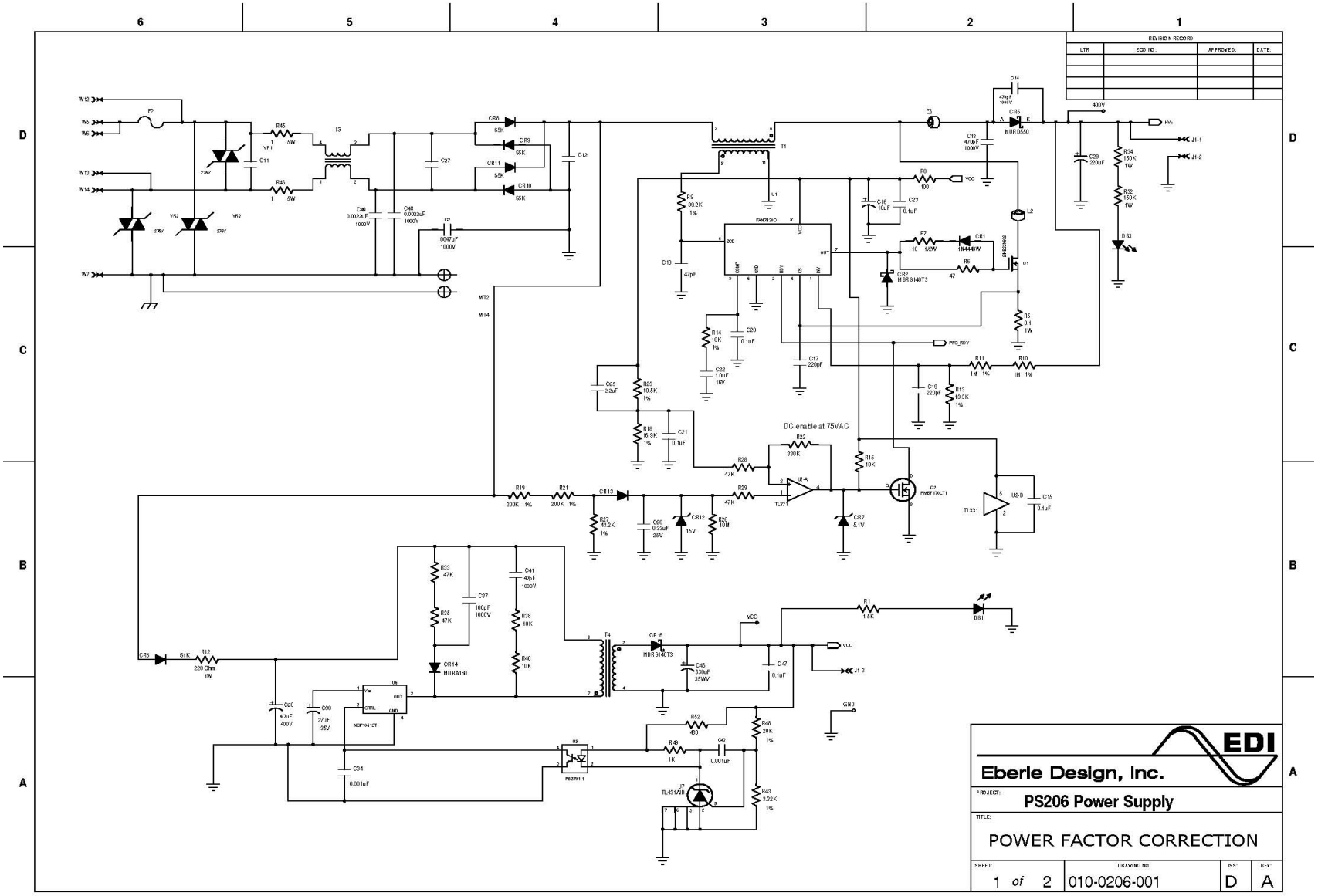

PFC Supply: Ch 1 = U1 pin 7
Ch 2 = Q1 drain

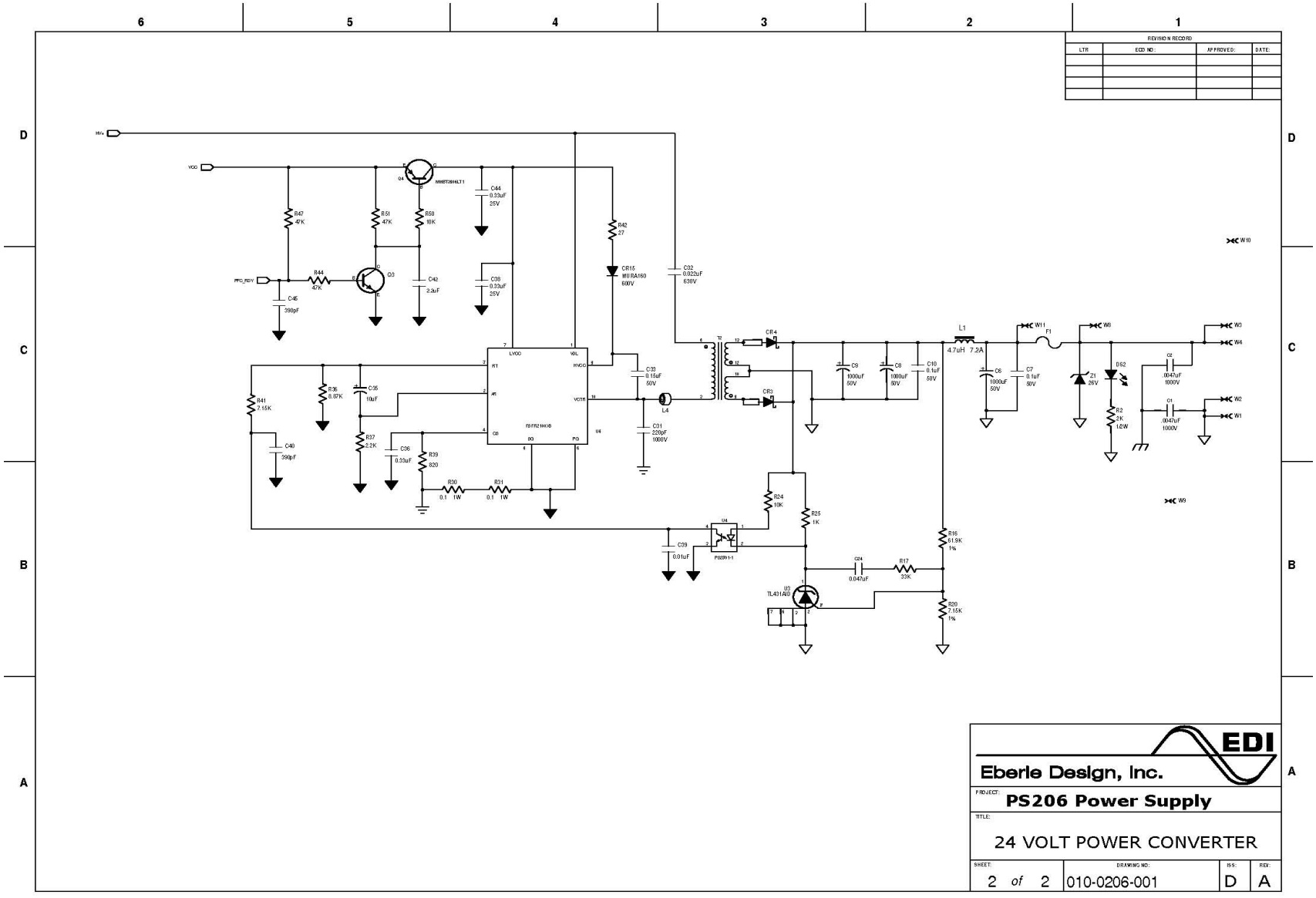



DC to DC Supply: Ch 1 = U5 pin 10
Ch 2 = T2 pin 5

## SECTION 8 TECHNICAL INFORMATION

### 8.1 SCHEMATICS




REVISION RECORD
LTR
ECO NO:
APPROVED:
DATE:
Eberle Design, Inc.
PROJECT:
PS206 Power Supply
TITLE:
24 VOLT POWER CONVERTER
SHEET:
2 of 2
DRAWING NO:
010-0206-001
RIS:
D
REV:
A

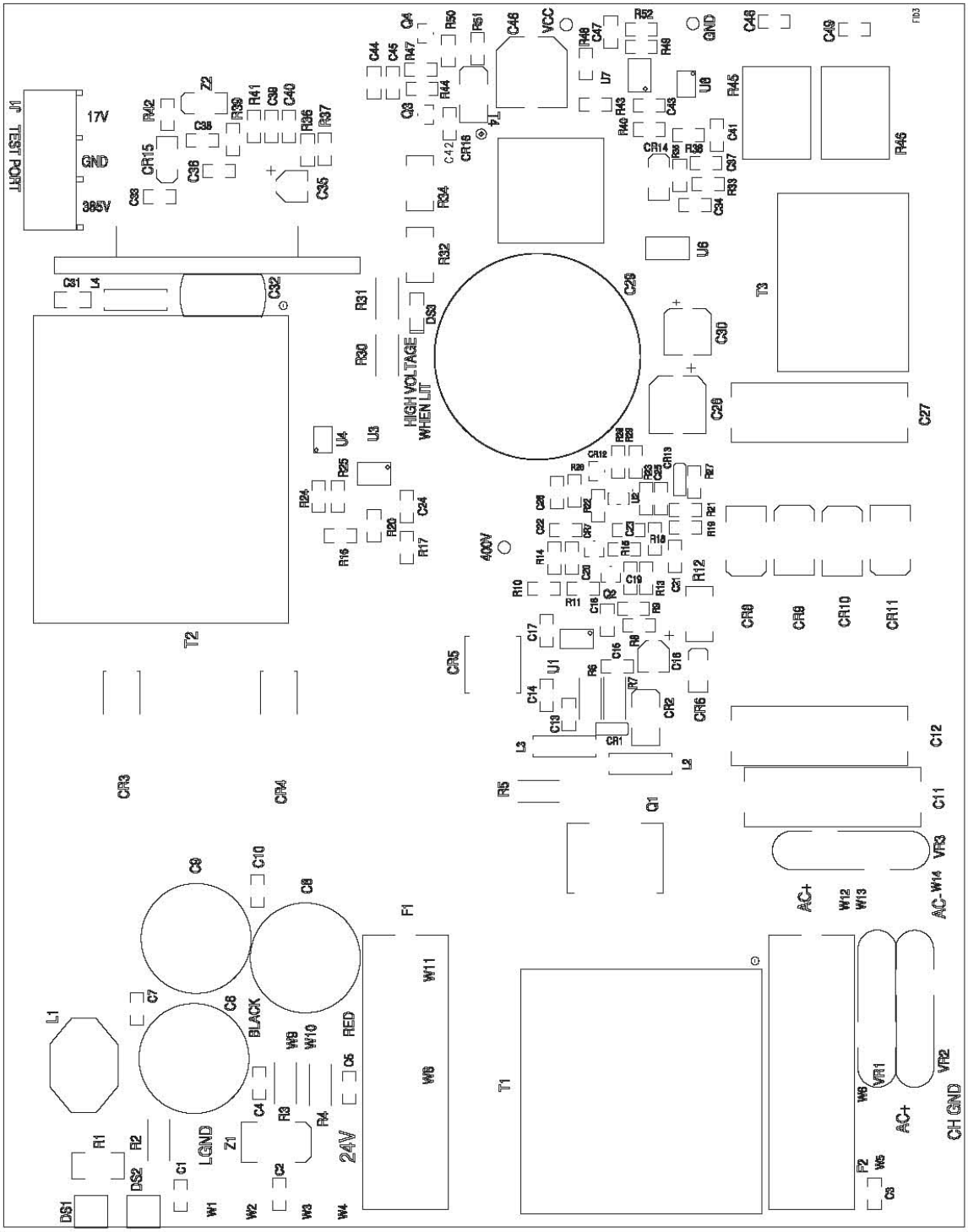
## 8.2 BILL OF MATERIALS

| Item | EDI Part Number | Qty | Description | Reference | Manufacturer |
|---|---|---|---|---|---|
| 1 | | 3 | (NO COMPONENT) | 400V GND VCC | |
| 2 | | 11 | 16 guage wire mounting hole | W1-8 W11 W13-14 | |
| 3 | | 3 | 22 guage wire mounting hole | W9-10 W12 | |
| 4 | | 2 | | MT2 MT4 | |
| 5 | 215-1000-S | 1 | RESISTOR, 1/2W, 10 OHMS, 5%, 2010 surface mount | R7 | |
| 6 | 215-1520-S | 1 | Resistor, 1.5K, 1/2W, 5%, 2010 surf. mnt. | R1 | |
| 7 | 215-2020-S | 1 | Resistor, 2K, 1/2W, 5%, 2010 surf. mnt. | R2 | |
| 8 | 215-4700-S | 1 | RESISTOR, 1/2W, 47 OHMS, 5%, 2010 surface mount | R6 | |
| 9 | 220-0001-S | 3 | RESISTOR, 1W, 0.1 OHMS, 1%, 2010 surface mount | R5 R30-31 | |
| 10 | 220-1540-S | 2 | RESISTOR,1W,159K,5%,2512 SMD | R32 R34 | Vishay CRCW2512154 |
| 11 | 225-0010 | 2 | RESISTOR, 1.0 Ohm, 5W, 5%, RADIAL | R45-46 | OHMITE TWW5J1R0E |
| 12 | 251-1002-S | 1 | RESISTOR, 1/8W, 10K, 1%, 1206 surface mount | R14 | |
| 13 | 251-1004-S | 2 | RESISTOR, 1/8W, 1M, 1%, 1206 surface mount | R10-11 | |
| 14 | 251-1052-S | 1 | RESISTOR, 1/8W, 10.5K, 1%, 1206 surface mount | R23 | |
| 15 | 251-1332-S | 1 | RESISTOR, 1/8W, 13.3K, 1%, 1206 surface mount | R13 | |
| 16 | 251-1692-S | 1 | RESISTOR, 1/8W, 16.9K, 1%, 1206 surface mount | R18 | |
| 17 | 251-2002-S | 1 | RESISTOR, 1/8W, 20K, 1%, 1206 surface mount | R48 | |
| 18 | 251-2003-S | 2 | RESISTOR, 1/8W, 200K, 1%, 1206 surface mount | R19 R21 | |
| 19 | 251-3321-S | 1 | RESISTOR, 1/8W, 3.32K, 1%, 1206 surface mount | R43 | |
| 20 | 251-3922-S | 1 | RESISTOR, 1/8W, 39.2K, 1%, 1206 surface mount | R9 | |
| 21 | 251-4322-S | 1 | RESISTOR, 1/8W, 43.2K, 1%, 1206 surface mount | R27 | |
| 22 | 251-6192-S | 1 | RESISTOR, 1/8W,61.9K, 1%, 1206 surface mount | R16 | |
| 23 | 251-7151-S | 2 | RESISTOR, 1/8W,7.15K, 1%, 1206 surface mount | R20 R41 | |
| 24 | 251-8871-S | 1 | RESISTOR, 1/8W, 8.87K, 1%, 1206 surface mount | R36 | |
| 25 | 255-1010-S | 1 | RESISTOR, 1/8W, 100, 5%, 1206 surface mount | R8 | |
| 26 | 255-1020-S | 2 | RESISTOR, 1/8W, 1K, 5%, 1206 surface mount | R25 R49 | |
| 27 | 255-1030-S | 5 | RESISTOR, 1/8W, 10K, 5%, 1206 surface mount | R15 R24 R38 R40 R50 | |
| 28 | 255-1060-S | 1 | RESISTOR, 1/8W, 10M, 5%, 1206 surface mount | R26 | |
| 29 | 255-2220-S | 1 | RESISTOR, 1/8W, 2.2K, 5%, 1206 surface mount | R37 | |
| 30 | 255-2700-S | 1 | RESISTOR, 1/8W, 27 Ohm, 5%, 1206 surface mount | R42 | |
| 31 | 255-3330-S | 1 | RESISTOR, 1/8W, 33K, 5%, 1206 surface mount | R17 | |
| 32 | 255-3340-S | 1 | RESISTOR, 330K, 1/8W, 5%, 1206 surface mount | R22 | |
| 33 | 255-4310-S | 1 | RESISTOR, 1/8W, 430 Ohm, 5%, 1206 surface mount | R52 | |
| 34 | 255-4730-S | 7 | RESISTOR, 1/8W, 47K, 5%, 1206 surface mount | R28-29 R33 R35 R44 | |
| | | | | R47 R51 | |
| 35 | 255-8210-S | 1 | RESISTOR, 820, 1/8W, 5%, SMT 1206 | R39 | |

| | | | | | |
|---|---|---|---|---|---|
| 36 | 261-2210-S | 1 | RESISTOR,PULSE RATED,1W,220 Ohm,5%,2512 SMD | R12 | ROHM RPC2512 220R 5% |
| 37 | 300-1060-025S | 2 | CAPACITOR,10uF,20%, ELECTROLYTIC, 25V, low ESR, 4x5.8mm | C16 C35 | Nichicon UUD1E100MCL1GS |
| 38 | 300-1081-050R | 3 | CAPACITOR, ELECT, 1000uF, 50WV, 20 %, LOW ESR,RDL | C6 C8-9 | ILLINOIS 108RZM050M |
| 39 | 300-2270-450R | 1 | CAPACITOR, ELECT, 220uF, 450WV, 20 %, RDL | C29 | |
| 40 | 300-2760-035S | 1 | CAPACITOR, ELECTROLYTIC, 27uF, 35V, LOW ESR, 20%, SMT | C30 | ILLINOIS 276AXZ035MD10 |
| 41 | 300-3370-035S | 1 | CAPACITOR, ELECTROLYTIC, 330uF, 35V, LOW ESR, 20%, SMT | C46 | NICHICON UPL1V221MPH |
| 42 | 300-4750-250S | 1 | CAPACITOR, ELECT,4.7uF,400WV, 20 %, 8.0mm SM | C28 | NICHICON ULR2G4R7MNL1GS |
| 43 | 320-1010-1000S | 1 | CAPACITOR, CER.MULT, 100pF, 1000V, 10%,C0G,1206 CHIP | C37 | AVX 1206AA101KAT1A |
| 44 | 320-1020-050S | 2 | CAPACITOR, CER.MULT, 0.001uF, 50V, 10%, 1206 CHIP | C34 C43 | |
| 45 | 320-1030-100S | 1 | CAPACITOR, CER.MULT, 0.01uF, 100V, 10%, 1206 CHIP | C39 | |
| 46 | 320-1040-050S | 7 | CAPACITOR, CER.MULT, 0.1uF, 50V, 10%, 1206 CHIP | C7 C10 C15 C20-21 C23 C47 | |
| 47 | 320-1050-016S | 1 | CAPACITOR, CER.MULT, 1.0uF, 16V, 10%, 1206 | C22 | ECJ-3VF1C105Z |
| 48 | 320-1540-050S | 1 | CAPACITOR, CER.MULT, 0.15uF, 50V, 10%, 1206 CHIP | C33 | |
| 49 | 320-2210-050S | 2 | CAPACITOR, CER.MULT, 220pF, 50V, 10%, 1206 CHIP | C17 C19 | |
| 50 | 320-2210-1000S | 1 | CAPACITOR, CER.MULT, 220pF, 1000V, 10%,C0G,1206 CHIP | C31 | AVX 1206AA221KAT1A |
| 51 | 320-2220-1000S | 2 | CAPACITOR, CER.MULT, 2200pF, 1000V, 10%, X7R,1206 CHIP | C48-49 | AVX 1206AC222KAZ1A |
| 52 | 320-2250-050S | 2 | CAPACITOR, CER.MULT, 2.2uF, 50V, 10%, 1206 CHIP | C25 C42 | Murata GRM31CR71H225KA88L |
| 53 | 320-3340-025S | 4 | CAPACITOR, CER.MULT, 0.33uF, 25V, 10%, 1206 | C26 C36 C38 C44 | |
| 54 | 320-3910-050S | 2 | CAPACITOR, CER.MULT, 390pF, 50V, 10%, 1206 CHIP | C40 C45 | |
| 55 | 320-4700-050S | 1 | CAPACITOR, CER.MULT, 47pF, 50V, 10%, 1206 CHIP | C18 | |
| 56 | 320-4700-1000S | 1 | CAPACITOR, CER.MULT, 47pF, 1000V, 10%,X7R,1206 CHIP | C41 | AVX 1206AC470KAT1A |
| 57 | 320-4710-1000S | 2 | CAPACITOR, CER.MULT, 470pF, 1000V, 10%,C0G,1206 CHIP | C13-14 | AVX 1206AA471KAT1A |
| 58 | 320-4720-1000S | 3 | CAPACITOR, CER.MULT, 4700pF, 1000V, 10%, X7R,1206 CHIP | C1-3 | AVX 1206AC472KAZ1A |
| 59 | 320-4730-050S | 1 | CAPACITOR, CER.MULT, 0.047uF, 50V, 10%, 1206 | C24 | |
| 60 | 330-2230-630R | 1 | CAPACITOR, POLYPRO, 0.022uF,630V, 5%, RDL | C32 | PANASONIC ECW-F6223HL |
| 61 | 335-4740-275R | 3 | CAPACITOR, 0.47uF, 275VAC, 20%, METALIZED FILM | C11-12 C27 | PANASONIC ECQU2A474ML |

| | | | | | |
|---|---|---|---|---|---|
| 62 | 405-0311-S | 1 | IC, TL331IDBVR, COMPARATOR,5 PIN SOT | U2 | TEXAS INSTRUMENTS TL331IDBVR |
| 63 | 410-0140-S | 2 | DIODE, SCHOTTKY, MBRS140T3, 40V,1A, SMB | CR2 CR16 | ON SEMI |
| 64 | 410-0160-S | 2 | DIODE, ULTRAFAST, MURA160T3, 600V,1A, SMA | CR14-15 | ON SEMI |
| 65 | 410-0550-S | 1 | DIODE, ULTAFAST, MURD550PFT4, 520V,5A, DPAK | CR5 | ON SEMI |
| 66 | 410-1526-S | 1 | TRANSORB, SMCJ26A, 26V, 1500W | Z1 | DIODES, INC. |
| 67 | 410-4005-S | 1 | DIODE, S1K, 800 PIV, 1A | CR6 | |
| 68 | 410-4448-S | 2 | DIODE, HI SPD SWITCHING, 1N4448W,SOD123 | CR1 CR13 | VISHAY |
| 69 | 410-5231-S | 1 | DIODE, ZENER, MMBZ5231BLT1, 5.1V, 225mW,SOT-23 | CR7 | ON SEMI |
| 70 | 410-5245-S | 1 | DIODE, ZENER, MMBZ5245BLT1, 15V, 225mW,SOT-23 | CR12 | ON SEMI |
| 71 | 410-5800-S | 4 | DIODE, RECTIFIER, SILICON, S5KL, 800V,5A,SMC | CR8-11 | DIODES Inc |
| 72 | 410-8010-S | 2 | DIODE, SCHOTTLY, SS8PH10, 100V,8A, D2PAK | CR3-4 | VISHAY SS8PH10 |
| 73 | 420-2811-S | 2 | OPTOCOUPLER, PS2801-1, 4 PIN SOP | U4 U8 | NEC PS2801-1 |
| 74 | 425-0150-RS | 1 | LED, RED, WC LENS, 1206, FLAT, SMT | DS3 | LITEON LTST-C150KRKT |
| 75 | 425-0322-G | 2 | LED, GREEN, T1 , RIGHT ANGLE, WITH LOCATING PINS | DS1-2 | SUNLED XPV1LUG147D |
| 76 | 430-1700-S | 1 | N-CHANNEL MOSFET, PMBF170LT1 | Q2 | MOTOROLA |
| 77 | 430-2260-S | 1 | TRANSISTOR,SIHB22N60E,MOSFET,650V,22A,D2PAK | Q1 | Vishay SiHB22N60E |
| 78 | 430-3904-S | 1 | TRANSISTOR, MMBT3904LT1, NPN, SOT-23 | Q3 | |
| 79 | 430-3906-S | 1 | TRANSISTOR, PNP, MMBT3906LT1, SOT23 | Q4 | |
| 80 | 440-0431-S | 2 | REGULATOR, TL431AID, VOLTAGE REF., 1%, SO8 | U3 U7 | MOTOROLA |
| 81 | 440-1051-S | 1 | REGULATOR, SWITCHING, OFFLINE | U6 | ON SEMI NCP1051ST136T3 |
| 82 | 440-2101 | 1 | IC, FSFR2100XS, PWR. SUPPLY CNTLR | U5 | FAIRCHILD FSFR2100XS |
| 83 | 440-3275 | 3 | REGULATOR, METAL OXIDE VARISTOR, V275LA40A, 20mm | VR1-3 | |
| 84 | 440-7930-S | 1 | IC, FAN7930CMX, PF CNTLR, SO8 | U1 | Fairchild FAN7930CMX |
| 85 | 520-0429-P | 1 | CONNECTOR, HEADER, 3-Pin, Mate-N-Lock | J1 | Tyco (AMP) 350429-1 |
| 86 | 740-0022 | 2 | FUSE , HOLDER PCB HORIZONTAL MOUNT | F1-2 | LITTELFUSE |
| 87 | 800-0140-S | 1 | TRANSFORMER, PCMT, OFFLINE,2.5W | T4 | Signal H-1480 |
| 88 | 800-0182 | 1 | TRANSFORMER,COMMON MODE FILTER, 3.2mH, 2.2A | T3 | CWS 24V-3K2 |
| 89 | 800-0190 | 1 | TRANSFORMER,PFC, 200uH | T1 | Santronics SNX-2126 |
| 90 | 800-0200 | 1 | TRANSFORMER, PCMT, OFFLINE, 200W, DUAL SEC. | T2 | Santronics SNX2446 |
| 91 | 850-1047-S | 1 | INDUCTOR, 4.7uH,7.2A,SURFACE MOUNT | L1 | SIGNAL SC3326F-4R7 |
| 92 | 860-0100-S | 3 | BEAD,FERRITE,TYPE 61,SMT | L2-4 | FAIR-RITE 2761021447 |

## 8.3 ASSEMBLY DRAWING



## 8.4 CONNECTOR

Connector intermates with Beau S-5406 or equivalent:

| Pin | Function | Pin | Function |
|---|---|---|---|
| 7 | +24VDC Output | 10 | No Connect |
| 8 | DC Ground | 11 | AC Neutral |
| 9 | Equipment Ground | 12 | AC Line + |

Viewed from Connector end: