

CPX400A

Bench Power Supply

Service Manual



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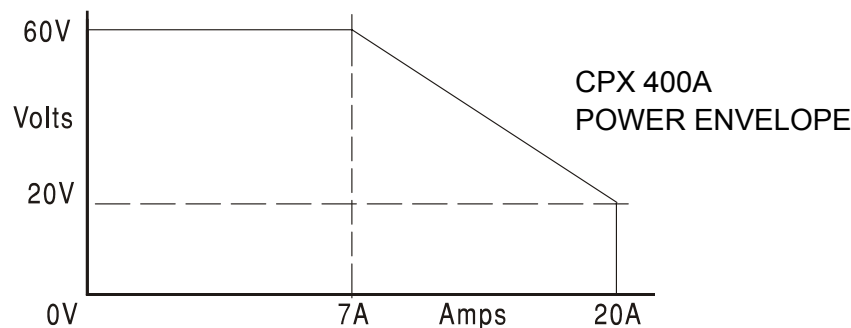
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Specification

General specifications apply for the temperature range 5°C to 40°C. Accuracy specifications apply for the temperature range 18°C to 28°C after 1 hour warm-up with no load and calibration at 23°C. Typical specifications are determined by design and are not guaranteed.

OUTPUT SPECIFICATIONS

Voltage Range:	0V to 60V
Current Range:	0A to 20A
Power Range:	Up to 420W
Output Voltage Setting:	By coarse and fine controls.
Output Current Setting:	By single logarithmic control.
Operating Mode:	Constant voltage or constant current with automatic cross-over provided that the power demanded stays within the power envelope, see graph. Outside of this envelope the output becomes unregulated.



Output Switch:	Electronic. Preset voltage and current displayed when off.
Output Terminals:	4mm terminals on 19mm (0.75") pitch. 30A max.
Sensing:	Switchable between local and remote. Spring-loaded push terminals for remote connection.
Output Protection:	Forward protection by Over-Voltage Protection (OVP) trip; maximum voltage that should be applied to the terminals is 70V. Reverse protection by diode clamp for reverse currents up to 3A.
Over-temperature Protection:	The output will be tripped off if a fault causes the internal temperature to rise excessively.
OVP Range:	10% to 110% of maximum output voltage set by front panel screwdriver adjustment.
Line Regulation:	Change in output for a 10% line change: Constant voltage: <0.01% of maximum output Constant current: <0.01% of maximum output
Load Regulation:	Change in output for any load change within PowerFlex envelope, remote sense connected: Constant voltage: <0.01% of maximum output Constant current: <0.05% of maximum output
Ripple & Noise (20MHz bandwidth):	4mVrms max; typically <2mVrms, <10mV pk-pk, at maximum load, CV mode.

Transient Load Response:	<250us to within 50mV of set level for a 5% to 95% load change.
Temperature Coefficient:	Typically <100ppm/°C
Status Indication:	Output on lamp. Constant voltage mode lamp. Constant current mode lamp. Unregulated (power limit) lamp Trip message on display.

METER SPECIFICATIONS

Meter Types:	Dual 4 digit meters with 12.5mm (0.5") LEDs. Reading rate 4 Hz.
Meter Resolutions:	10mV, 10mA
Meter Accuracies:	Voltage 0.1% of reading \pm 2 digits, Current 0.3% of reading \pm 2 digits

GENERAL

AC Input:	110V – 240V AC \pm 10%, 50/60Hz. Installation Category II.
Power Consumption:	1250VA max.
Operating Range:	+5°C to +40°C, 20% to 80% RH.
Storage Range:	–40°C to + 70°C.
Environmental:	Indoor use at altitudes up to 2000m, Pollution Degree 2.
Safety:	Complies with EN61010-1.
EMC:	Complies with EN61326.
Size:	210 x 130 x 375mm (WxHxD) half rack width x 3U height (optional rack mounting kit available).
Weight:	6kg

Safety

This power supply is a Safety Class I instrument according to IEC classification and has been designed to meet the requirements of EN61010-1 (Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use). It is an Installation Category II instrument intended for operation from a normal single-phase supply.

This instrument has been tested in accordance with EN61010-1 and has been supplied in a safe condition. This instruction manual contains some information and warnings that have to be followed by the user to ensure safe operation and to retain the instrument in a safe condition.

This instrument has been designed for indoor use in a Pollution Degree 2 environment in the temperature range 5°C to 40°C, 20% - 80% RH (non-condensing). It may occasionally be subjected to temperatures between +5° and -10°C without degradation of its safety. Do not operate while condensation is present.

Use of this instrument in a manner not specified by these instructions may impair the safety protection provided. Do not operate the instrument outside its rated supply voltages or environmental range.

WARNING! THIS INSTRUMENT MUST BE EARTHED

Any interruption of the mains earth conductor inside or outside the instrument will make the instrument dangerous. Intentional interruption is prohibited. The protective action must not be negated by the use of an extension cord without a protective conductor.

When the instrument is connected to its supply, terminals may be live and opening the covers or removal of parts (except those to which access can be gained by hand) is likely to expose live parts. The apparatus shall be disconnected from all voltage sources before it is opened for any adjustment, replacement, maintenance or repair. Capacitors inside the power supply may still be charged even if the power supply has been disconnected from all voltage sources but will be safely discharged about 10 minutes after switching off power.






Any adjustment, maintenance and repair of the opened instrument under voltage shall be avoided as far as possible and, if inevitable, shall be carried out only by a skilled person who is aware of the hazard involved.

If the instrument is clearly defective, has been subject to mechanical damage, excessive moisture or chemical corrosion the safety protection may be impaired and the apparatus should be withdrawn from use and returned for checking and repair.

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of makeshift fuses and the short-circuiting of fuse holders is prohibited.

Do not wet the instrument when cleaning it.

The following symbols are used on the instrument and in this manual: -

	Earth (ground) terminal.
	Standby.
	mains supply ON.
	alternating current (ac)
	direct current (dc)

This instrument has been designed to meet the requirements of the EMC Directive 89/336/EEC. Compliance was demonstrated by meeting the test limits of the following standards:

Emissions

EN61326 (1998) EMC product standard for Electrical Equipment for Measurement, Control and Laboratory Use. Test limits used were:

- a) Radiated: Class B
- b) Conducted: Class B
- c) Harmonics: EN61000-3-2 (2000) Class A; the instrument is Class A by product category.

Immunity

EN61326 (1998) EMC product standard for Electrical Equipment for Measurement, Control and Laboratory Use.

Test methods, limits and performance achieved were:

- a) EN61000-4-2 (1995) Electrostatic Discharge : 4kV air, 4kV contact, Performance A.
- b) EN61000-4-3 (1997) Electromagnetic Field, 3V/m, 80% AM at 1kHz, Performance A.
- c) EN61000-4-11 (1994) Voltage Interrupt, 1 cycle, 100%, Performance B.
- d) EN61000-4-4 (1995) Fast Transient, 1kV peak (AC line), 0.5kV peak (DC Outputs), Performance B.
- e) EN61000-4-5 (1995) Surge, 0.5kV (line to line), 1kV (line to ground), Performance B.
- f) EN61000-4-6 (1996) Conducted RF, 3V, 80% AM at 1kHz (AC line only; DC Output connections <3m not tested), Performance A.

According to EN61326 the definitions of performance criteria are:

Performance criterion A: 'During test normal performance within the specification limits.'

Performance criterion B: 'During test, temporary degradation, or loss of function or performance which is self-recovering'.

Performance criterion C: 'During test, temporary degradation, or loss of function or performance which requires operator intervention or system reset occurs.'

Where Performance B is stated it is because DC Output regulation may deviate beyond Specification limits under the test conditions. However, the possible deviations are still small and unlikely to be a problem in practice.

Note that if operation in a high RF field is unavoidable it is good practice to connect the PSU to the target system using screened leads, which have been passed (together) through an absorbing ferrite sleeve fitted close to the PSU terminals.

Cautions

To ensure continued compliance with the EMC directive observe the following precautions:

- a) after opening the case for any reason ensure that all signal and ground connections are remade correctly and that case screws are correctly refitted and tightened.
- b) In the event of part replacement becoming necessary, only use components of an identical type, see the Part List.

Installation

Mains Operating Voltage

This instrument has a universal input range and will operate from a nominal 115V or 230V mains supply without adjustment. Check that the local supply meets the AC Input requirement given in the Specification.

Mains Lead

Connect the instrument to the AC supply using the mains lead provided. Should a mains plug be required for a different mains outlet socket, a suitably rated and approved mains lead set should be used which is fitted with the required wall plug and an IEC60320 C13 connector for the instrument end. To determine the minimum current rating of the lead-set for the intended AC supply, refer to the power rating information on the equipment or in the Specification.

WARNING! THIS INSTRUMENT MUST BE EARTHED.

Any interruption of the mains earth conductor inside or outside the instrument will make the instrument dangerous. Intentional interruption is prohibited.

Ventilation

The power supply is cooled by an intelligent multi-speed fan which vents at the rear. Take care not to restrict the air inlets at top, bottom and side panels or the exit at the rear. In rack-mounted situations allow adequate space around the instrument and/or use a fan tray for forced cooling.

Mounting

This instrument is suitable both for bench use and rack mounting. It is delivered with feet for bench mounting. The front feet include a tilt mechanism for optimal panel angle.


A rack kit for mounting one or two of these Half-width 3U high units in a 19" rack is available from the Manufacturers or their overseas agents.

Connections

All connections are made from the front panel.

The load should be connected to the positive (red) and negative (black) terminals marked OUTPUT.

Remote sense connections to the load, if required, are made from the positive (+) and negative (–) SENSE terminals. Switch the LOCAL/REMOTE switch to REMOTE when remote sensing is required. Switch back to LOCAL when remote sensing is not in use.

The terminal marked  is connected to the chassis and safety earth ground.

Service Handling Precautions

Service work or calibration should only be carried out by skilled engineers using high quality test equipment. If the user is in any doubt as to his competence to carry out the work, the instrument should be returned to the manufacturer or their agent overseas for the work to be carried out.

The tracks on the printed circuit boards are very fine and may lift if subjected to excessive heat. Use only a miniature temperature-controlled soldering iron and remove all solder with solder wick or suction before attempting to remove a component.

Dismantling the instrument

WARNING!

Disconnect the power supply from all voltage sources before it is opened for adjustment or repair. Capacitors inside the supply may still be charged even if the supply has been disconnected from all voltage sources but will be safely discharged about 10 minutes after removing power.

If any adjustment or repair of the opened supply under voltage is inevitable it shall be carried out only by a skilled person who is aware of the hazard involved. The incoming AC supply to the unit under test should be isolated for safety by means of a 1:1 isolation transformer of at least 1500VA. High voltages (up to 400V) are always present in the primary-side circuitry, which lies in a clearly defined area at the rear of the main printed circuit boards.

1. Remove the 6 side screws to release the top cover.
2. To remove a Power PCB assembly, undo the two nuts securing the orange and black wires to the Main PCB studs and disconnect wires. Unplug the cable assembly between Power PCB assembly and Control PCB noting the orientation (brown wire to pin 1 corner marker). Undo the two screws on the side of the unit, remove the two plastic rivets, and lift the board assembly out.
3. Remove the other Power PCB assembly in the same way.
4. Disconnect the cable assemblies between the Control and the Main board.
5. The front panel assembly can be removed by disconnecting all wires between Main PCB and front panel and undoing the 4 screws that secure the front panel to the chassis. The Control board may then be removed by undoing the 5 screws that secure it to the front panel and gently lifting it out.
6. To remove the Main board disconnect the chassis earth connection and undo the 8 screws that secure the Main PCB support pillars to the chassis (i.e. the screws accessible underneath the chassis) and lift out the PCB assembly with its mounting pillars attached.
7. Reassemble in the reverse order taking great care to ensure that all connections are exactly as before dismantling and that no insulation creepage and clearance distances have been compromised. Ensure that only the correct fasteners have been used otherwise earthing, and hence EMC and safety performance, may be impaired.

Circuit Descriptions

Main Board

Mains Input, Filtering and Rectification

The AC input is via a PCB mounted IEC inlet.

X-capacitors C1, C5 together with the Y-capacitors C3, C4, C6, C7, the common mode inductors L1 and L2 and differential choke L3 comprise an input filter which ensures that the supply meets both conducted emission and conducted immunity EMC requirements.

VD1 clips mains spikes for component protection, while R1 discharges the X-capacitors after removal of the mains supply.

PCB mounted fuse FS1 limits damage in the event of forward converter failure. The front panel switch enables / disables the unit and is connected to the Main PCB via two wires soldered at point PJ. Disconnect the Main board by unplugging the connections from the switch.

Diodes D1 and D2 form a bridge rectifier and have capacitors C8 and C9 connected across them to bypass noise signals and to snub reverse recovery transients in the diodes D1, D2.

C10 decouples the rectified Mains and R2 provides a discharge path for R2 once the mains supply has been removed.

R1 limits inrush current and is shorted out by RL1B once the inrush is over (see section on sequencing later in this document).

Auxiliary Supply

IC2 and associated components form a simple flyback power supply to generate the auxiliary rails needed.

The auxiliary power supply is self starting and operates in 'burst mode', switching at approximately 44kHz when running but being periodically disabled by Q8 to provide a regulated supply of approximately 18 to 19V (set by D20/D21 conduction point). This rail, '+18VPRIM', also supplies IC3 which provides a regulated 12-volt supply. C26 and C27 provide energy storage and decoupling for the '+18VPRIM' and '+12VPRIM' rails respectively.

D17 and D18 clamp the voltage across the Primary of T1 to protect IC2. C24 provides local decoupling for the Auxiliary supply

Sequencing

IC1 and associated components control the start-up and shut-down sequencing of the unit.

On application of the mains the start-up sequence is: (1) allow bulk capacitance C18/C19 to charge with R1 limiting current. (2) Close relay RL1B. (3) after a suitable delay, to allow for switch bounce, enable PFC section and Power boards. Once the supply is removed the shutdown sequence is: (1) disable PFC section and Power boards (2) after short delay open relay RL1B. This not only ensures that the relay is always switched with zero current, prolonging the life of the relay, but also that inrush current is always limited even if the mains supply drops out and recovers.

IC1-A monitors the rectified mains voltage (divided down by R17-19 and R21) to ensure that the supply voltage is sufficient, generating pulses at pin1. If the supply voltage is adequate then the output of IC1-D (pin14) goes permanently high. R26 and C21/C22 now provide a suitable delay for the inrush current when the output of IC1-C goes high, switching RL1 on via D14, R30, R31 and Q1. This shorts out R1 so that it does not dissipate any power when the unit is running. R28 and C23 now introduce a second delay after which the output of IC1-C (pin8) goes high. This provides a second path to hold RL1 on via D15 and switches Q2 to enable both the PFC section and the Power boards.

When the ac supply is removed or reduced (for example a prolonged brown out) IC1-B output goes low. This causes IC1-B output to go low which immediately disables the PFC section and the Power boards via D12, Q2 etc. There is now a small delay introduced by R29, D11 and C23, after which IC1-C goes low and RL1 opens (via Q1)

PFC Section

L5, D5 and Q5/Q6 form a classic boost converter to generate a supply of approximately 390 volts.

This operates in the following manner. When the FETs Q6/Q6 are on the current in L5 increases, storing energy. When they turn off this energy is transferred to the bulk capacitors thus raising the output voltage. There are various snubbers R11/C14, R15/C16 and R16/C17, which slow down switching edges to reduce EMI and reduce losses in the power components Q5/Q6/D3.

Gate drive is provided by Q3 and Q4; C11/C12/C13 provide local decoupling. R6/R7/D7 and R3/R4/R5 shape the gate drive to control switching times.

The primary boost stage control is by means of IC4.

This contains all the processing circuitry to shape the current taken by the power supply from the mains supply such that it is sinusoidal and in phase with the voltage.

For a detailed description refer to the ST Microelectronics 'Power Factor Corrector Applications Manual'.

The start-up of the PFC section is controlled by IC1 (the sequencing circuit) which releases the soft start signal 'SS' for IC4, via Q10, at the end of the start-up sequence described above. IC4 starts generating gate drive pulses to the boost converter; C38 provides a degree of soft start.

The output of IC4 pin 8 is the output of an internal multiplier; this generates a current proportional to the desired input current. It has 4 inputs:

- R42, R43 and R44 supply a current derived from the full wave rectified mains voltage to pin 4.
- The fixed reference on pin 6.
- The output from the voltage error amplifier on pin 13. The inputs to the error amp are an internal reference (of about 5.1 volt) and a potential divider chain (VR1, R46-50). This monitors the HT voltage across the output of boost converter. Thus a steady output of about 390 volts (set by VR1) is obtained.
- A signal proportional to the mains voltage, applied to pin 7. This signal is generated by the two-stage R-C filter formed by the component chain R36-41, C28, C29 between 'VRECT+' and pin 7 of IC4.

This output forms one of the inputs to an error amplifier; the other input (pin 9) is in effect the actual input current as sensed by the voltage across shunt resistor R60. The output of this error amplifier, pin 5, is the input to the PWM and thus controls the duty cycle of the converter; C34 and R58 are loop compensation.

Over-voltage protection feeds into pin 3 via another potential divider chain shutting the PFC stage down if the output goes too high.

Shutdown

The unit can be switched off by an enable switch or by the Control board (using IC6 or IC8) in the event of a fault. This is achieved by pulling down the 'shutdown' signal, IC1-A pin3. This appears to the sequencing circuit as a 'mains supply is low' signal and thus disables the Power boards and PFC section.

Setup

There are two pots on the Main board. VR2 adjusts the switching frequency and should be set to give 65kHz. VR1 adjusts the HT supply voltage and should be set to give 390 volt with no load at the output.

Power Boards

There are two Power boards, one for each channel. They have different PCB layouts but identical circuitry.

Oscillator and Forward Converter

IC1-A, B, C, C2, R43, R3 form a 160kHz oscillator. D-type bistable IC2-A produces a square wave at 80kHz. The square wave at Q output of the D-type is processed by R4, D4, C9 and IC1-D to give a drive pulse of about 45% duty ratio. The output from IC1-D is buffered by IC1-E and IC1-F to drive the complimentary emitter followers Q3, Q4 which in turn drive the gate drive transformer T2. The transformer is ac coupled via C13.

R14 in series with the primary winding of T2 and is used to control the switching speed of the MOSFETs. R13 in parallel with T2 primary dampens any ringing.

A dual-ended forward converter comprising Q1, Q2 and T1 converts the boost voltage from the PFC stage to provide the main low voltage secondary and also the secondary auxiliary voltages.

T1 leakage and magnetising energy is returned to the high voltage supply rail via D5, D6 and D7, D8. The turn-off voltage rise is controlled by 'loss less' snubber network C3, C4, D1, D2, D3, L1.

C37 and R52 subdue residual ringing across the primary winding.

The current in the forward converter is monitored by R8 and, if excessive, activates latch Q6, Q10 to provide a pulse-by pulse current limit.

A power-back winding is rectified by D9 and filtered by C6, C7.

The cooling fan is supplied by Q11, the base of which is driven from an opto isolator. The drive to the fan increases as the output load current increases.

Main output.

The voltage on the secondary winding is rectified and L-C filtered and fed to a linear regulator. To minimise power dissipation in the linear regulating element, the voltage across it is maintained at about 1V by means of a magamp.

The linear regulation is performed by MOSFET Q9, which receives gate drive from the Control PCB. The voltage across Q9 is monitored by Q8, which generates reset current to the magamp MA1 whenever the voltage across Q9 forward biases the base-emitter junction of Q8.

D19, D18 are the main rectifier and flywheel diodes. The rectified pulse is filtered by L3 and C23, C24.

D11, R12 and C11 generate a negative rail to sink the base bias current of Q8, which would otherwise cause the output to remain slightly positive when 0V was set on the front panel.

In the event of a fault where control of the magamp is lost and the voltage across the filter capacitors rises above 49V, the opto isolator IC5 is activated via zener diode D22 and R28 and causes primary side latch Q6, Q10 to inhibit drive pulses to the converter transistors Q1, Q2.

The forward current pulses in the secondary winding are monitored with current transformer T3. D33 rectifies and averages this signal to control the drive to the cooling fan via opto isolator IC7. D26 rectifies the signal and feeds it to the front panel to be used by the power-flex control circuit.

PTC TH1 monitors the temperature of the secondary heatsink and, in the event of excessive heatsink temperature, Q7 is switched on which in turn causes the op-amp IC4-B to disable the linear output MOSFET. This is a latched condition and requires the interruption of the mains supply to resume operation

Secondary Auxiliary Power Supply.

The power rails for the control electronics are generated from an auxiliary winding on the main converter transformer.

The +15V rail is derived from R1, D16, C18, R24, R49 and transistor switch Q12. During power down, the +15V rail is switched off by Q13, which detects the reduction of voltage to the switch Q12. This causes the output from the power supply to quickly reduce to zero.

The +5V rail is rectified by D17, D30 and filtered by L4 and C17. The inductor L4 is held in continuous conduction and thus the voltage at the input to the three terminal regulator IC6 is maintained at low value.

The -5V rail is peak rectified by D13, C15 and regulated by IC8.

Control Board

The control board contains two identical control circuits one for each output. The following description is for channel A but may also be used for channel B except all component references for channel B are 100 higher than the equivalent component on channel A ; for example, where this description discusses IC1, the channel B reference is IC101.

Voltage Control

D6 provides the reference (V_{REF}), nominally 2.45V. IC7C buffers the voltage control potentiometers VR1 and VR2; VR5 sets the maximum output voltage.

The voltage at IC7-C pin 8 will be between 0V and approximately 8.09V depending on output voltage.

IC7-A is a differential amplifier; VR9 trims differential gain to ensure good voltage regulation, see Calibration section.

The output of IC7-C drives the input of IC7-A when the ON-OFF switch, SW1A, is in the ON position. When SW1A is in the OFF position the input of IC7-A is grounded via Q4 switched by R92, setting the output volts to zero.

The output of IC7-A provides the gate drive (GATE) to the regulating MOSFET on the Main PCB via D3.

SW1-B selects between local and remote sense.

Current Control

IC7-D is the error amplifier, which compares the voltage on the wiper of VR3, the current limit control, with the voltage generated across the current sense resistor R21 and amplified by IC7-B. When the output current reaches the set limit, IC7-D takes control via D4, changing the supply from constant voltage to constant current mode. At the same time Q1 is turned on by IC7-D. This turns on the 'constant current' LED via IC9.

VR4 sets the maximum output current; VR8 adjusts the output current to be the same as the preset current at low levels, see Calibration section.

Power-flex Control

IC8-B provides power-flex control. This operates on the principal that, for any forward converter with constant primary supply voltage, the output power is proportional to the average current in the forward diode. This current is sensed using a current transformer on the Power board (T3). In practice the proportionality has to be modified slightly because at higher output voltages the maximum output current is lower, resulting in lower losses on the Power board, and the output power can be a little higher (e.g. 420W at 42V cf. 400W at 20V). To reflect this the current limit also has to be slightly proportional to the peak current in the forward diode.

T3, D26 and R38 on the power board provide a signal representing the forward diode current. IC8-B compares this signal (averaged by R95, R19, R68 and C44) with a reference generated by VR13 and modified slightly (by VR15, R49, D12 and C43) to give a slight proportionality to the peak of the current. At the maximum power level its output starts to go low, thus reducing the output voltage demand via D13 and R10 limiting the maximum output power.

IC8-C detects when this circuit is operating, providing a signal to IC9-B via R76 and Q5 to light LED4 'UNREG'.

The UNREG mode should not be thought of as a constant power mode; it is instead a rough power limit. In this mode there will be increased output noise and poorer regulation.

OVP Trip and Setpoint.

Each channel has a user settable OVP trip. This is set by VR5, adjustable through a hole in the front panel with a tool such as a small screwdriver). The OVP level is buffered by IC11-A. If an OVP condition occurs then the output of IC11-B goes high; D14 and R89 provide positive feedback to latch the output high and Q4 is turned on via D15 to force the output voltage demand to zero. Switch K1 provides a signal to the microcontroller to display the OVP set point. When the user switches the output off, via SW1A, Q6 turns on resetting the latch.

Measurement and Display

IC9 provides the logic to drive the mode indicator LEDs: LED1 'Constant voltage', LED2 'constant current' and LED4 'unreg'; LED3 'output on' is switched directly by SW1A.

The two 4-digit LED displays DIS1 and DIS2 are driven by the microcontroller IC3. This displays each digit in turn, writing the correct bit pattern for each digit to IC6 and then selecting the digit via IC1. The microcontroller uses the signal 'SW1A' to decide if it should display actual or preset levels.

IC2 is a Delta-Sigma type A to D converter; its 2.45-volt reference is applied between pins 9 and 10 and buffered by IC4. It measures the output voltage differentially (between pins 15 and 16) and also the programmed voltage (between pins 14 and 18); this allows VR16 to be used to correct for any input offset voltage error in IC7A. The other measurements, OVP setting, output current and current limit are single-ended measurements measured with respect to Aux 0V. All communication between IC2 and IC3 is transmitted along a serial (SPI) interface.

Calibration

Refer to the General section for dismantling instructions and safety precautions. All adjustments are on the front panel Control board.

Allow 5-minute warm-up before commencing calibration.

Equipment Required

A 5½ digit multimeter with better than 0.05% accuracy on dc Volts and better than 0.1% accuracy on dc current to 20 Amps; alternatively use a precision shunt for current measurement.

Rheostat or other high power load arrangement to provide up to full load. 1kΩ 1% 0.25W resistor.

Voltage Calibration

Switch O/P ON and set Volts controls so that Volts display reads 0.02V exactly. Switch O/P OFF and adjust VR16/116 (preset Volts offset compensation) for 0.02V exactly on the display.

Switch O/P ON and connect multimeter to output. Check output LED is ON. Check current display reads 0.00 to 0.01A. Increase voltage and current controls to MAX. Adjust VR5/105 (maximum output volts) for a reading of 61.7XVolts on multimeter.

Adjust VR17/117 (measured volts) to match UUT voltage display to external meter +/- 0.02V.

Switch O/P OFF. Adjust VR10/110 (preset volts) for previous reading on voltage display exactly.

Current Calibration

With O/P OFF, set Voltage to 10.0XVolts (Current still at MAX). Connect a 1k resistor to output. Set O/P ON. Adjust VR11/111 (current sense amp offset compensation) for 0.01A on UUT current display. Remove 1k resistor.

Set current limit to MIN (Volts still at 10.0X). Connect load across output. Switch O/P ON. Adjust VR8/108 (current control amp offset compensation) for a reading of 0.003A +/- 0.001A on external current meter. Check CI LED is ON and current display reads 0.00A.

With O/P ON increase current control to MAX (Volts still at 10.0X). Adjust variable load for a reading of 18.XXAmps on current meter. Adjust VR7/107 (measured output current) to match UUT current display to external current meter +/- 0.02A.

Powerflex Calibration plus Volts and Current Max Adjustments

Increase voltage controls to MAX (Current still at MAX). Adjust variable load for a reading of 7.3XAmps. Adjust VR13/113 (Powerflex limit at max volts) until UNREG LED just lights (and CV LED is off).

Adjust VR5/105 (maximum output volts) for a reading of 60.21Volts to 60.36Volts on DUT display.

Adjust variable load for a reading of 20.1XAmps (ensure DUT remains in UNREG mode, not CI mode). Adjust VR15/115 (Powerflex limit at max current) until output voltage is 21.1XVolts (UNREG mode).

Adjust variable load until CI LED comes on. Adjust VR4/104 (maximum output current) for a current meter reading of 20.2XAmps.

Set OVP

Switch O/P OFF. Disconnect load. Adjust VR14/114 fully clockwise. With front panel OVP button held down, adjust front panel SET OVP pot until display shows 18.XXVolts. Release OVP button and adjust voltage controls until preset output volts match OVP voltage setting +/- 0.02V. Switch O/P ON. Adjust VR14/114 slowly anticlockwise until display just shows 'trip'.

Turn O/P OFF, reduce fine O/P volts a little and turn O/P ON again. Increase fine volts slowly until O/P just trips again; check that O/P volts are the same as OVP volts +/-0.05V. Repeat a. if not, otherwise reset front panel OVP pot to MAX.

Voltage Regulation

Connect +sense to the +output terminal, connect –sense to the –output terminal.

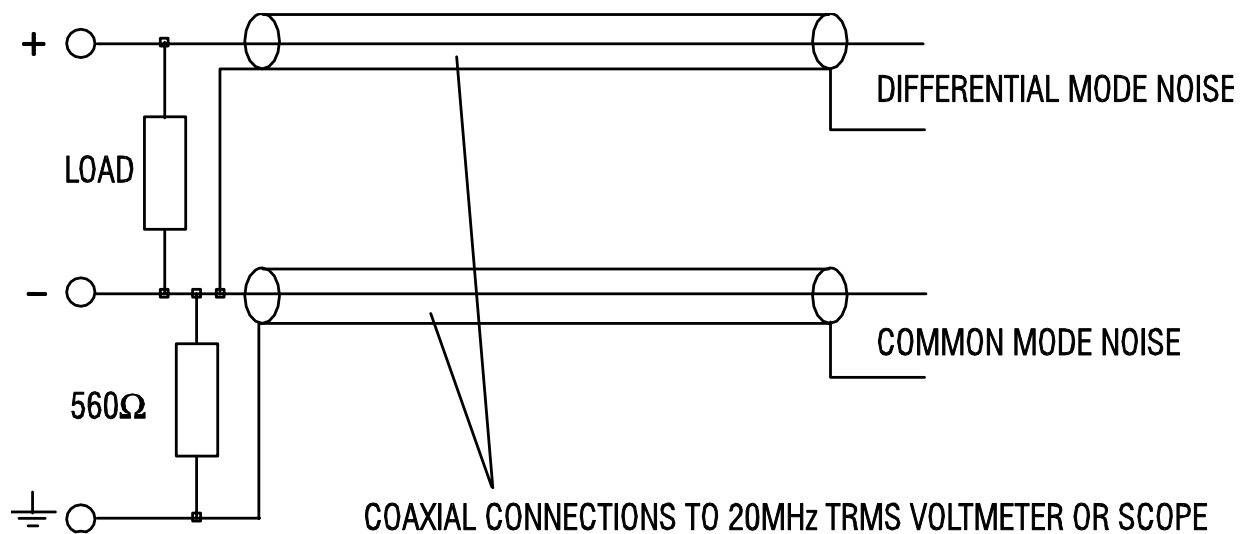
Connect the DMM (set to Volts) across the sense terminals, no load, output ON.

Adjust voltage controls for a reading of 18.xxxx on the DMM; note exact reading.

Connect approximately 19A load to the output terminals and adjust VR9 (differential voltage gain) until the external DMM matches the previous reading.

Noise Measurements

Differential and common-mode noise checks can be made using the arrangement below. Keep all unshielded connections as short as possible.



Make measurements with the output fully loaded. Measure differential and common-mode noise one at a time on a 20MHz TRMS voltmeter or use a 20MHz bandwidth-limited scope for peak-to-peak measurements.

Parts List

PCB ASSEMBLY – CPX400A MAIN– Part No. 44115-2000

Part Number	Description	Position
20205-0700	STUD M4 X 10 KFH-M4-10ET	OUTPUT TERMINALS (4)
20234-0034	SCREW M4 X 6 PNHDPZ ZPST	FOR HS1 and HS2
20234-0100	SCREW M3 X 6 PNHD C/W EX SH/P	FOR PCB SPACERS
20613-0018	WASHER SIL-PAD TO-3P/247 PLAIN	FOR HSD3
20613-0026	SIL-PAD 900S 100MM X 25MM	FOR HSD1, D2, Q5, Q6
20661-0225	SPACER Hex M3 x 12 NPBR	PCB SPACERS
20670-0364	CLIP MAX01H FOR TO220+MAX H/S	FOR D1, D2, D3
20670-0365	CLIP MAX03H FOR TO247+MAX H/S	FOR Q5, Q6
20670-0520	HEATSINK MAX505 178MM PLAIN	HS1
22040-0940	BEAD (DOUBLE) - FERRITE	FB1
22109-0310	TRANSFORMER - AUX - CPX400A	T1
22154-0680	CHOKER 1.2mH/12A COMMON MODE	L1,L2,L4
22154-0690	INDUCTOR BOOST - CPX400a PFC	L5
22154-0740	CHOKER 17.5uH/12A CPX400A	L3
22247-0030	RELAY 1P C/O 16A 12V	RL1
22312-0250	FUSE CLIP 0.25in. PCB MTG	FOR FS1
22315-0255	FUSE 15AT HRC CER 1.25 X 0.25	FS1
22520-0190	AC RECEPT 10AMP R/A SOLDER MTG	P6
22573-0048	HEADER 3WAY STR SIL STD/GOLD	PJ4
22573-0070	HEADER 4WAY STR SIL STD	TP1
22573-0211	HEADER 3 WAY STR F/LOCK .156	LK1
22573-0222	HEADER 2 WAY STR F/LOCK .156	PJ5-7
22573-0247	HEADER 2 WAY STR .1P F/LOCK	P4
22575-0076	HEADER 8 WAY (2x4) STR SKELTN	PJ1, 2, 101, 102
23105-0150	RES SM0805 15R0F W1	R3, 6
23105-0220	RES SM0805 22R0F W1	R4, 7
23105-1100	RES SM0805 100RF W1	R63
23105-1120	RES SM0805 120RF W1	R35
23105-1220	RES SM0805 220RF W1	R56
23105-2100	RES SM0805 1K00F W1	R22, 23, 34, 64, 73, 74
23105-2150	RES SM0805 1K50F W1	R57, 59
23105-2180	RES SM0805 1K80F W1	R29
23105-2220	RES SM0805 2K20F W1	R62
23105-2470	RES SM0805 4K70F W1	R30, 32, 33, 65, 66, 67
23105-2680	RES SM0805 6K80F W1	R71, 72

PCB ASSEMBLY – CPX400A MAIN – Part No. 44115-2000 /continued...

Part Number	Description	Position
23105-2910	RES SM0805 9K10F W1	R50
23105-3100	RES SM0805 10K0F W1	R24, 68, 70
23105-3220	RES SM0805 22K0F W1	R21, 31, 55
23105-3330	RES SM0805 33K0F W1	R41, 61
23105-3390	RES SM0805 39K0F W1	R58
23105-4100	RES SM0805 100KF W1	R5, 45
23105-4180	RES SM0805 180KF W1	R39, 40, 46, 47, 48
23105-4200	RES SM0805 200KF W1	R28
23105-4220	RES SM0805 220KF W1	R17, 18, 19, 49
23105-4390	RES SM0805 390KF W1	R37, 38, 43, 44, 54
23105-4470	RES SM0805 470KF W1	R36, 42, 51, 52, 53
23105-5100	RES SM0805 1M00F W1	R25, 26
23185-0000	RES ZERO OHM	R10
23202-4220	RES 220KF W60 MF 50PPM	R69
23209-4220	RES 220KF W75 MF 100PPM	R2
23210-4150	RES 150KJ 2W MF 250PPM	R14
23271-0019	RES 0R01J 2W MR	R60
23274-0210	RES 39R0J 7W MF (STAND-OFF)	R1
23275-0010	RES 47R0J 3W MO	R11, 15, 16
23377-2220	RES PS/H 2K2 CF 10MM	VR1, 2
23386-0010	VARISTOR V275LA20A	VD1
23405-0101	CAP SM0805 100P CER COG	C47, 48
23406-2474	CAP SM0805 470NK 16V CER X7R	C21, 22, 38
23424-0459	CAP 4N7 250V AC CER STR/LNG Y	C3, 4, 6, 7, 8, 9
23424-0459	CAP 4N7 250V AC CER STR/LNG Y	C4
23424-0468	CAP 470PK 1KV CER P5	C16, 17
23424-0469	CAP 220PK 1KV CER P5	C14
23461-0020	CAP SM0805 100NZ 50V CER Y5V	C49
23461-0030	CAP SM0805 220NK 16V CER X7R	C29
23461-0040	CAP SM0805 1N0K 50V CER X7R	C34, 35, 36, 37
23461-0080	CAP SM0805 47NJ 50V CER X7R	C32
23461-0200	CAP SM0805 2N2J 50V CER X7R	C33
23461-0300	CAP SM0805 100NK 25V CER X7R	C11, 12, 13, 20, 23, 25, 31, 41
23557-0612	CAP 1U0 100V/50V ELEC RE2 P2	C40
23557-0665	CAP 2U2 50V ELEC RE2 P2	C45
23557-0667	CAP 220U 25V ELEC RE2 P3.5	C26, 27, 30

PCB ASSEMBLY – CPX400A MAIN – Part No. 44115-2000 /continued...

Part Number	Description	Position
23557-0825	CAP 100U 50V LOW ESR P3.5	C44
23557-0827	CAP 470U 100V LOW ESR P7.5	C42, 43
23557-0831	CAP 10U 400V ELEC P5	C24
23557-0950	CAP 470U 400V ELEC S/I P10	C18, 19
23620-0247	CAP 220NK 63V P/E P5	C28
23684-0020	CAP 1UM 250VAC X2 P/P P27.5	C1, 46
23684-0021	CAP 2U2K 400V P/P P27.5	C10
23684-0023	CAP 2U2M 275VAC X2 P/P P27.5	C5
25021-0010	DIO SM LL4148 SWITCHING MM	D6, 7, 10-16, 22, 24, 26, 27
25031-0200	DIO BYC10-600 TO-220AC	D3
25115-1010	DIO SM US1J 1A 600V 75ns	D18, 19
25118-0110	DIO 2x11A 800V IXYS DSP8-08A	D1, 2
25130-0915	DIO ZEN 75V W4	D17
25132-0230	DIO SM ZEN 5V1 W35 SOT23	D23, 25
25132-0240	DIO SM ZEN 9V1 W35 SOT23	D20, 21
25340-1020	TRAN SM PNP FZT751 60V 3A	Q4
25377-1000	TRAN SM NPN BC849C SOT23	Q1, 2, 8, 9, 10
25377-1000	TRAN SM NPN BC849C SOT23	Q10
25381-1020	TRAN SM NPN FZT651 60V 3A	Q3
25601-0740	TRAN MOSFET N CHAN IRFPS 37N5UA	Q5, 6
27001-0060	OPTO-COUPLER SFH615A-3	IC5, 6
27106-0506	IC LM324N 14 PIN READ TECH SPEC	IC1
27160-0017	IC V/REG 7812 TO220	IC3
27168-0040	IC L4981A 20 PIN	IC4
27168-0060	IC TNY254P 8 PIN	IC2
35555-4310	PCB - MAIN - CPX400A	PCB

PCB ASSEMBLY – CPX400A POWER L/R – Part No. 44115-2070

Part Number	Description	Position
20073-9801	SCREW No.4x1/4in. Plastite	HS2 FIXING LEFT & RIGHT
20105-0510	INSERT THREADED KF2-M3-ET	CHASSIS FIXINGS
20234-0034	SCREW M4 X 6 PNHDPZ ZPST	HS1 FIXING LEFT & RIGHT
20613-0018	WASHER SIL-PAD TO-3P/247 PLAIN	FOR HS1,2
20613-0026	SIL-PAD 900S 100MM X 25MM	FOR HS2
20653-0210	CABLE TIE 370 X 4.8MM	FOR T1, L3, MA1 LEFT & RIGHT
20670-0360	HEATSINK MAXS515 100MM PLAIN	HS2L,HS2R
20670-0364	CLIP MAX01H FOR TO220+MAX H/S	FOR HS1/2 LEFT & RIGHT (8)

PCB ASSEMBLY – CPX400A POWER L/R – Part No. 44115-2070 /continued...

Part Number	Description	Position
20670-0365	CLIP MAX03H FOR TO247+MAX H/S	FOR HS1/2 LEFT & RIGHT (6)
20670-0480	HEATSINK MAXS526 100MM PLAIN	HS1L, HS1R
22040-0060	FERRITE SLEEVE 2.25IDx7.55L	L5L, L5R
22040-0940	BEAD (DOUBLE) - FERRITE	FB1L, 1R, 3L, 3R
22109-0130	TRANSFORMER GATE DRIVE - EX	T2L, 2R
22109-0280	TRANSFORMER CURRENT SENS CPX400	T3L, 3R
22109-0340	TRANSFORMER HF POWER - CPX400A	T1L, 1R
22154-0160	CHOKE 1mH AXIAL 1.3 OHMS	L4L, 4R
22154-0460	CHOKE 1mH (EF16) - EX	L1L, 1R
22154-0550	MAGAMP - CPX400	MA1L, 1R
22154-0630	CHOKE OUTPUT (ETD) CPX400	L3L, 3R
22154-0650	CHOKE 760uH CM CPX400	L6L, 6R
22573-0041	HEADER 2WAY STR SIL STD/GOLD	TP1L, 1R, 2L, 2R
22573-0048	HEADER 3WAY STR SIL STD/GOLD	TP3L, 3R
22573-0209	HEADER 9 WAY STRAIGHT .156P	PJ4L, 4R
22574-0308	SKT 8 WAY (2x4)	PJ1L, 1R, 2L, 2R
23185-0000	RES ZERO OHM	LK1L, LK1R, R25L, R25R
23202-0100	RES 10R0F W60 MF 50PPM	R56L, 56R
23202-1100	RES 100RF W60 MF 50PPM	R38L, 38R
23202-1220	RES 220RF W25 MF 50PPM	R19L, 19R
23202-1330	RES 330RF W25 MF 50PPM	R7L, 7R, 44L, 44R, 45L, 45R
23202-1470	RES 470RF W60 MF 50PPM	R13L, 13R, 21L, 21R
23202-1680	RES 680RF W60 MF 50PPM	R54L, 54R
23202-2100	RES 1K00F W60 MF 50PPM	R4L, 4R, 33L, 33R
23202-2220	RES 2K20F W60 MF 50PPM	R37L, 37R
23202-2270	RES 2K70F W25 MF 50PPM	R3L, 3R
23202-2390	RES 3K90F W25 MF 50PPM	R30L, 30R
23202-3100	RES 10K0F W60 MF 50PPM	R32L, 32R, 35L, 35R, 39L, 39R, 40L, 40R, 41L, 41R, 42L, 42R, 47L, 47R, 48L, 48R, 55L, 55R
23202-3220	RES 22K0F W25 MF 50PPM	R43L, 43R
23202-3470	RES 47K0F W25 MF 50PPM	R16L, 16R
23202-4100	RES 100KF W25 MF 50PPM	R46L, 46R, 51R
23206-5680	RES 6M80F W60 MF 50PPM	R23L, 23R, 31L, 31R
23207-1220	RES 220RJ 1W MF 250PPM	R24L, 29R, 49L, 49R
23207-4390	RES 390KJ 1W MF 250PPM	R50L, 50R

PCB ASSEMBLY – CPX400A POWER L/R – Part No. 44115-2070 /continued...

Part Number	Description	Position
23210-0470	RES 47R0J 2W MF 250PPM	R9L, 9R
23210-1100	RES 100RJ 2W MF 250PPM	R22L, 22R
23210-2100	RES 1K00J 2W MF 250PPM	R15L, 15R
23210-2120	RES 1K20J 2W MF 250PPM	R20L, 20R
23210-2220	RES 2K20J 2W MF 250PPM	R53L, 53R
23210-3560	RES 56K0J 2W MF 250PPM	R26L, 26R
23222-0022	RES 2R20J W33 MF FUSIBLE NRF25	R17L, 17R, 18L, 18R
23222-0047	RES 4R70J W33 MF FUSIBLE NFR25	R1L, 1R
23222-0220	RES 22R0J W33 MF FUSIBLE NRF25	R10L, 10R, 34L, 34R
23222-0470	RES 47R0J W33 MF FUSIBLE NFR25	R28L, 28R
23222-1220	RES 220RJ W33 MF FUSIBLE NFR25	R12L, 12R, 27L, 27R
23222-1330	RES 330RJ MF FUSIBLE NFR25	R29L, 29R
23274-0020	RES 0R10J 2W5 WW T	R8L, 8R
23275-0010	RES 47R0J 3W MO	R11L, 11R, 52L, 52R
23388-0010	THERMISTOR PTC TAG 90 DEG	TH1L, 1R, 2R
23424-0459	CAP 4N7 250V AC CER STR/LNG Y	C44L, 44R
23424-0466	CAP 1N0K 1KV CER P5	C14L, 14R
23424-0468	CAP 470PK 1KV CER P5	C10L, 10R, 16L, 16R
23424-0469	CAP 220PK 1KV CER P5	C37L, 37R
23424-0472	CAP 2N2K 1KV CER P5/P7.5	C3L, 3R, 4L, 4R
23557-0661	CAP 470U 25V ELEC RE2 P5	C17L, 17R
23557-0673	CAP 22U 35V ELEC RE2 P2	C15L, 15R
23557-0776	CAP 680U 100V ELEC P7.5	C23L, 23R, 24L, 24R, 32L, 32R
23557-0820	CAP 10U 50V ELEC LOW ESR P2	C6L, 6R, 18L, 18R, 30L, 30R
23557-0825	CAP 100U 50V LOW ESR P3.5	C28L, 28R
23620-0246	CAP 100NK 63V P/E P5	C5L, 5R, 7L, 7R, 8L, 8R, 12L, 12R, 21L, 21R, 22L, 22R, 26L, 26R, 27L, 27R, 35L, 35R, 40L, 40R
23620-0264	CAP 100NK 400V P/E 368 SER P15	C11L, 11R, 38L, 38R
23620-0268	CAP 220NK 400V P/E 468 SER P15	C25L, 25R
23620-9007	CAP 10NK 100V P/E P5	C19L, 19R, 20L, 20R
23621-0314	CAP 1U0K 400V P/E P27.5	C1L, 1R
23685-0002	CAP 1N0J 100V P/P FKP2	C2L, 2R
23685-0013	CAP 330NK 160V P/P P15	C13L, 13R
23685-0015	CAP 470PJ 100V P/P FKP2 P5	C9L, 9R

PCB ASSEMBLY – CPX400A POWER L/R – Part No. 44115-2070 /continued...

Part Number	Description	Position
25021-0910	DIO BAV21	D4L, 4R, 9L, 9R,10L,10R,12L,12R,13L,13R,14L,14R,15L,15R,16L,16R, 24L, 24R, 27L, 27R, 28L, 28R, 29L, 29R, 31L, 31R
25031-0060	DIO BYW100-200	D17L, 17R, 30L, 30R
25031-0100	DIO BAX12A	D26L, 26R, 33L, 33R
25031-0110	DIO BYV26C	D1L,1R, 2L, 2R, 3L, 3R, 5L, 5R, 6L, 6R, 7L, 7R, 8L, 8R, 11L, 11R
25031-0240	DIO BYV42E-200 TO-220AB	D18L, 18R, 19L, 19R
25130-0207	DIO ZEN 15V W4	D23L, 23R
25130-0916	DIO ZEN 3V3 W4	D32L, 32R
25130-0918	DIO ZEN 68V W4	D22L, 22R
25349-3500	TRAN PNP MJE350	Q8L, 8R
25349-4210	TRAN PNP BF421	Q5L, 5R
25349-5560	TRAN PNP BC556	Q6L, 6R, 7L, 7R,10L,10R,12L,12R,13L,13R
25384-9001	TRAN PNP ZTX751	Q4L, 4R
25388-0211	TRAN NPN ZTX651	Q3L, 3R,11L,11R
25601-0700	TRAN MOSFET N CHAN IRFP064	Q9L, 9R
25601-0740	TRAN MOSFET N CHAN IRFPS 37N5UA	Q1L,1R, 2L, 2R
27001-0060	OPTO-COUPLER SFH615A-3	IC5L, 5R, 7L, 7R
27106-0513	IC LM358N 8 PIN	IC4L, 4R
27160-0009	IC V/REG 7805 TO220	IC6L, 6R
27160-0013	IC V/REG 7815 TO220	IC3L, 3R
27160-0014	IC V/REG 7905 TO220	IC8L, 8R
27226-0130	IC 4013B 14 PIN	IC2L, 2R
27226-0690	IC 4069UB 14 PIN	IC1L,1R
35555-4060C	PCB - PWR LEFT/RIGHT - CPX400	PCB

PCB ASSY – CPX400A Control/Front Panel/Terminals – Part No. 44115-2060

Part Number	Description	Position
20030-0263	WASHER M3 ZPST BULK STOCK	FOR R21, R121
20038-9501	WASHER M3 Spring BULK STOCK	FOR R21, R121
20234-0011	SCREW M3 X 10 PNHDPZ ZPST BULK STOCK	FOR R21, R121
20670-0510	HEATSINK - BOLT ON - 15DEGC/W	HS1, 101
22041-0010	BEAD FERRITE SM0805	FB1, 2, 101, 102
22218-0214	SWITCH SLIDE - KNITTER MFP221N	SW2, 102
22225-0220	SWITCH PUSH/PUSH SPPH11470B	SW1, 101
22226-0101	KEYSWITCH - ALPS SKHHBW	K1, 101

PCB ASSY – CPX400A Control/Front Panel/Terminals – Part No. 44115-2060 /continued...

Part Number	Description	Position
22467-0120	TERMINAL BLOCK 2W - LIGHT GREY	SK1, 101
22573-0071	HEADER 5WAY STR SIL STD	PJ3, 103
22573-0209	HEADER 9 WAY STRAIGHT .156P	PJ1, 101
22573-0222	HEADER 2 WAY STR F/LOCK .156	PJ7, 107
22573-0247	HEADER 2 WAY STR .1P F/LOCK	PJ2, 102
22574-0167	SKT 32W SIL TURNED PIN	FOR DISPLAYS
22575-0064	HEADER 26 WAY (2X13) STR SKEL	PJ4, PJ104
23105-0470	RES SM0805 47R0F W1	R8, 108
23105-0560	RES SM0805 56R0F W1	R203-210, 303-310
23105-1100	RES SM0805 100RF W1	R40, 140
23105-1330	RES SM0805 330RF W1	R95, 195
23105-1470	RES SM0805 470RF W1	R45, 145
23105-1680	RES SM0805 680RF W1	R22, 122
23105-1820	RES SM0805 820RF W1	R84, 184
23105-2100	RES SM0805 1K00F W1	R11, 12, 19, 23, 27, 42, 59, 61, 65, 67, 67, 70, 74, 79, 80, 81, 82, 83, 94, 96, 111, 112, 119, 123, 127, 142, 159, 161, 165, 167, 170, 174, 174, 179, 180, 181, 182, 183, 194, 196
23105-2150	RES SM0805 1K50F W1	R47, 147
23105-2220	RES SM0805 2K20F W1	R10, 110
23105-2330	RES SM0805 3K30F W1	R2, 7, 102, 107
23105-2360	RES SM0805 3K60F W1	R46, 55, 56, 146, 155, 156
23105-2470	RES SM0805 4K70F W1	R38, 39, 72, 138, 139, 172
23105-2510	RES SM0805 5K10F W1	R34, 134
23105-2750	RES SM0805 7K50F W1	R85, 185
23105-3100	RES SM0805 10K0F W1	R14, 15, 16, 18, 20, 30, 32, 41, 43, 44, 48, 51, 52, 62, 63, 66, 68, 69, 71, 73, 75, 76, 77, 78, 86, 87, 89, 98,100,114,115,116, 118,120,130,132,141,143,144,148,151, 152,162,163, 166, 168,169,171,173, 175, 176,177,178, 186, 187, 189, 198, 200
23105-3105	RES SM0805 10K5F W1	R33, 88, 133, 188
23105-3150	RES SM0805 15K0F W1	R4, 53, 104, 153
23105-3220	RES SM0805 22K0F W1	R64, 164
23105-3270	RES SM0805 27K0F W1	R5, 25, 105, 125
23105-3300	RES SM0805 30K0F W1	R160
23105-3300	RES SM0805 30K0F W1	R60
23105-3330	RES SM0805 33K0F W1	R91, 191

PCB ASSY – CPX400A Control/Front Panel/Terminals – Part No. 44115-2060 /continued...

Part Number	Description	Position
23105-3470	RES SM0805 47K0F W1	R6, 50, 92, 96, 99, 106, 150, 196, 196, 199
23105-3560	RES SM0805 56K0F W1	R131
23105-3560	RES SM0805 56K0F W1	R136
23105-3560	RES SM0805 56K0F W1	R137
23105-3560	RES SM0805 56K0F W1	R211
23105-3560	RES SM0805 56K0F W1	R212
23105-3560	RES SM0805 56K0F W1	R31, 36, 37, 131, 137, 211, 212, 311, 312
23105-3680	RES SM0805 68K0F W1	R3, 103
23105-4100	RES SM0805 100KF W1	R17, 117, 202, 302
23105-4150	RES SM0805 150KF W1	R49, 149
23105-4180	RES SM0805 180KF W1	R93, 193
23105-4270	RES SM0805 270KF W1	R90, 190
23105-4470	RES SM0805 470KF W1	R28, 29, 128, 129
23105-4560	RES SM0805 560KF W1	R1, 24, 101, 124
23105-5100	RES SM0805 1M00F W1	R13, 113
23105-5200	RES SM0805 2M00F W1	R54, 154
23105-5470	RES SM0805 4M7F W1	R201, 301
23105-6100	RES SM0805 10M0F W1	R9, 26, 109, 126
23202-1220	RES 220RF W25 MF 50PPM	R57, 58, 157, 158
23296-0020	RES 0R01D 4 TERM 30PPM PBV	R21, 121
23347-0140	POT 10K LIN VO12L-PV25F-B10K	VR1, 2, 101, 102
23347-0150	POT 10K LOG VO12L-PV25F-15A10K	VR3, 103
23382-3100	RES PS/H 10K CERMET MIN	VR12, 112
23385-1200	RES PS/H 200R CF 6MM	VR7, 107
23385-1470	RES PS/H 470R CF 6MM	VR4, 104
23385-2220	RES PS/H 2K2 CF 6MM	VR5, 9, 10, 105, 109, 110
23385-2470	RES PS/H 4K7 CF 6MM	VR17, 117
23385-3100	RES PS/H 10K CF 6MM	VR13, 113
23385-3470	RES PS/H 47K CF 6MM	VR14-16, 114, 116
23385-4100	RES PS/H 100K CF 6MM	VR8, 11, 108, 111
23388-0030	THERMISTOR PTC 100 OHM 265V	TH1, 2, 101, 102
23405-0100	CAP SM0805 10P CER COG	C5, 45, 56, 66
23405-0101	CAP SM0805 100P CER COG	C59, 159
23405-0221	CAP SM0805 220P CER COG	C13,15,19, 24, 68,113,115,119,124,168
23405-0470	CAP SM0805 47P CER COG	C132
23427-9211	CAP 470PK 100V CER MED K P2.5	C32

PCB ASSY – CPX400A Control/Front Panel/Terminals – Part No. 44115-2060 /continued...

Part Number	Description	Position
23427-9211	CAP 470PK 100V CER MED K P2.5	C114
23461-0015	CAP SM0805 10NK 50V CER X7R	C117
23461-0015	CAP SM0805 10NK 50V CER X7R	C139
23461-0015	CAP SM0805 10NK 50V CER X7R	C14,17, 32, 39,114,117,139,169
23461-0020	CAP SM0805 100NZ 50V CER Y5V	C2, 6, 7, 8, 9,10,11,12,16, 23, 27, 28, 33, 34, 35, 37, 43, 46, 53, 54, 60, 61, 62, 63, 70, 71,102,106,107,108,109,110,111,112, 116,123,127,128,133,134,135,137,143, 146,153,154,160,161,162,163,170,171
23461-0030	CAP SM0805 220NK 16V CER X7R	C44, 144
23461-0040	CAP SM0805 1N0K 50V CER X7R	C1, 101
23557-0612	CAP 1U0 100V/50V ELEC RE2 P2	C52, 152
23557-0731	CAP 100U 100V ELEC LOW ESR P5	C20, 22, 120, 122
23559-2221	CAP SM 220U 10V AL ELEC	C21, 51, 121, 151
23559-3470	CAP SM 47UF 16V AL ELEC	C4, 104
23559-5100	CAP SM 10UF 35V AL ELEC	C3, 25, 26, 49, 50, 55, 57, 103, 125, 126, 149, 150, 155, 157
23559-6010	CAP SM 1U0F 50V AL ELEC	C18, 58, 64, 65, 118, 158, 164, 165
23620-0264	CAP 100NK 400V P/E 368 SER P15	C36, 136
23620-0268	CAP 220NK 400V P/E 468 SER P15	C30, 67, 130, 167
23620-0288	CAP 100NK 100V P/E P5	C31, 41, 42, 47, 53,131,141,142,147,153
25021-0010	DIO SM LL4148 SWITCHING MM	D1-4, 7-9,12-16,101-104,109-109,112-116
25061-0304	LED SM0805 RED	LED1-4, 101, 104
25061-0520	DISPLAY 4 DIG .56 LED 9MM LEG	DIS1, 2, 101, 102
25117-0020	DIO 1N5401	D10, 110
25340-1000	TRAN SM PNP BC859C SOT23	Q1, 3, 5, 101, 103, 105
25601-1000	TRAN SM MOSFET N CHAN BSS138	Q4, 6, 104, 106
27106-1110	IC SM LM358M DUAL OP AMP SO8	IC11, 111
27106-1160	IC SM LM324M OP AMP SO14	IC7, 8, 107, 108
27106-1350	IC SM OPA277 PREC AMP SO8	IC4, 104
27153-1160	IC SM ADS1241 8x24 ADC SSOP28	IC2, 102
27161-2030	IC SM V/REF ZRC250 2.5V 2%	D6, 106
27164-1060	TRAN SM ULN2803AFW NPN SOL18	IC1, 101
27239-1320	IC SM 74HC132 SO14	IC9, 109
27239-5740	IC SM 74HC574 SO20	IC6, 106
27250-2140	IC SM PIC16F72-I/SS SSOP28	IC3, 103
28500-0800	XTAL - 4.9152MHZ - MICROPROCSR	XTL1, 2
35555-4570	PCB - CNTL/F.PNL/TERM - CPX400A	PCB
43171-2440	CONN ASSY CNTL/FPNL 26W CPX400	PJ5, 105

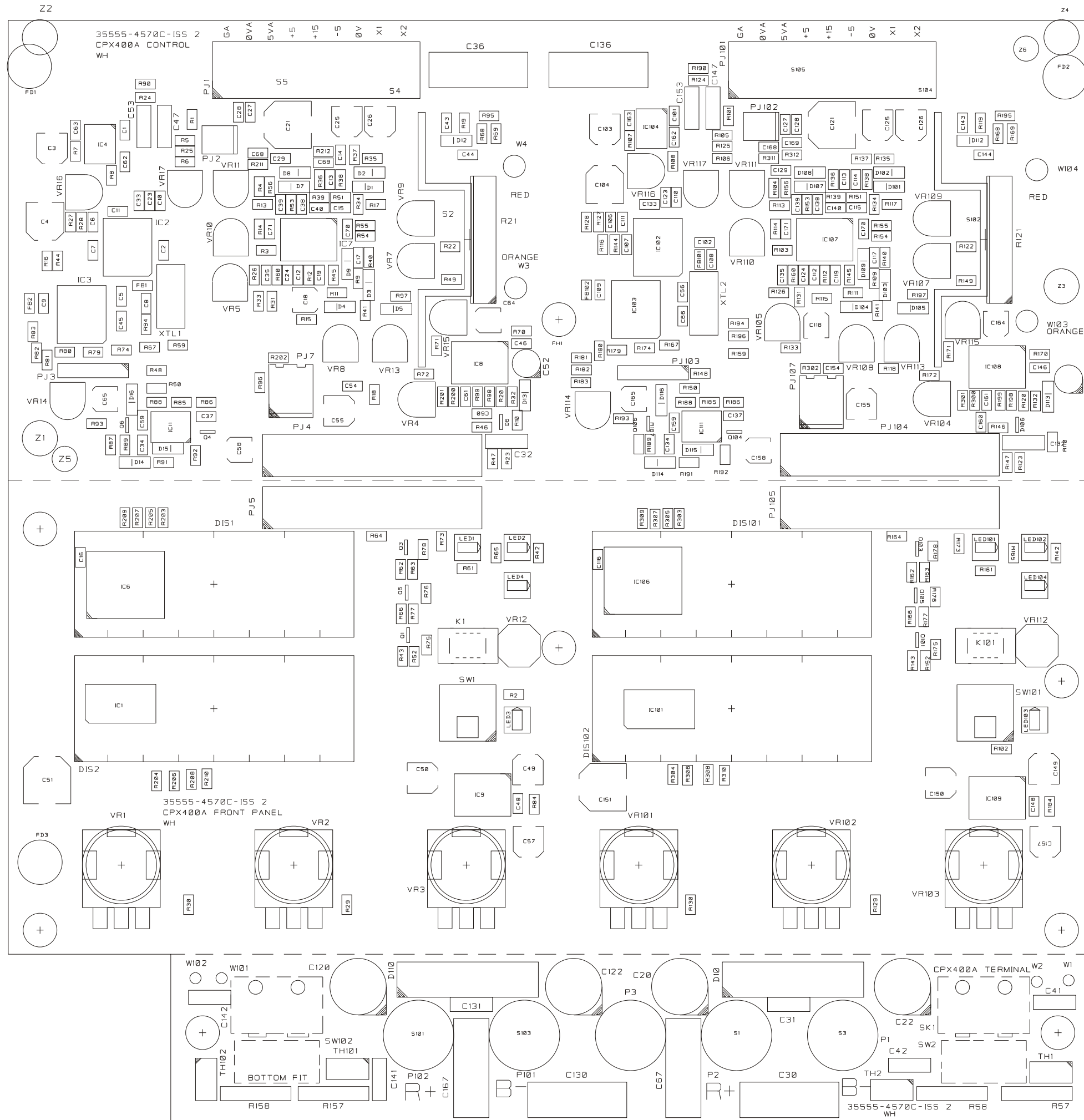
Casing and Other Items

Part Number	Description	Location
20010-0255	RIVET SNAP-LOCK 4.1IDx7.5TH	FAN GUARD/FAN TO REAR PANEL
20010-0256	RIVET SNAP-LOCK 4.1IDx7.5TH T	POWER PCBS/CHASSIS
20010-0257	RIVET SNAP-LOCK 3.6IDx2.2-3.1T	R.PANEL/CHASSIS
20030-0263	WASHER M3 ZPST	CONTROL PCB/F.PANEL
20030-0266	WASHER M4 ZPST	EARTH
20037-0244	WASHER 2BA SHK/PROOF E/T ZPST	TERMINAL PCB/F.PANEL TERMINALS
20037-0301	WASHER M3 SHK/PROOF I/T ZPST	CONTROL PCB, CHASSIS/PILLARS, F.PANEL/CHASSIS, TERMINAL PCB/F.PANEL, POWER PCBS/CHASSIS
20037-0304	WASHER M4 SHK/PROOF I/T ZPST	FRONT FEET
20037-0401	SOLDER TAG SHAKEPROOF - M4	EARTH
20038-9502	WASHER M4 SPRING	EARTH, STUDS
20063-0010	SCREW No.6 x 3/8 NIB HDPZ ST/AB	CASE UPPER, R.PANEL/CHASSIS
20065-0070	SCREW No.2 x 1/4 PLAST PNHDPZ	BEZEL FIXING
20210-0102	NUT M4 ZPST	EARTH, STUDS
20213-0040	CAPTIVE NUT SPIRE NO.6	CASE UPPER/CHASSIS, REARPANEL
20234-0016	SCREW M4 x 16 PNHDPZ ZPST	BACK FEET
20234-0024	SCREW M3 x 16 PNHDPZ ZPST	CONTROL PCB/F.PANEL
20234-0027	SCREW M3 x 6 PNHDPZ ZPST	CONTROL PCB, PCB SPACERS, POWER PCBS/CHASSIS, TERMINAL PCB
20234-0028	SCREW M4 x 10 PNHDPZ ZPST	FRONT FEET
20234-0100	SCREW M3x6 PNHDPZ C/W EXT SH/P	FRONT PANEL
20236-0010	SCREW M4 x 12 TAMPERPROOF	EARTH
20500-0010	FAN GUARD 80MM	TO FAN
20661-0280	SPACER HEX STUD M3 x 8 NPBR	DISPLAY PCB/F.PANEL
20661-0292	SPACER Clr No.4x7.9MM SELF/RET	CONTROL PCB
20661-0293	SPACER RND M4 CI x 4 NUL	POWER PCBS/CHASSIS
20662-0570	FOOT SELF ADHESIVE GREY	FRONT FEET
20662-9101	INSTRUMENT FOOT	BACK FEET
22040-0030	FERRITE SLEEVE APPROX 8/16/14L	QTY 1 EARTH REAR PANEL (3 PASSES, 2 TURNS), QTY 2 NINE WAYCONNECTORS CONTROL/MAIN, POWER L/R
22219-0130	SWITCH ROCKER GOLD SPST UL SP	FRONT PANEL SWITCH
22571-1050	TERMINAL TP/5LT RED/LGREY	+VE OUTPUT TERMINAL
22571-1060	TERMINAL TP/5LT BLACK/LGREY	-VE OUTPUT TERMINAL

Casing and Other Items /continued...

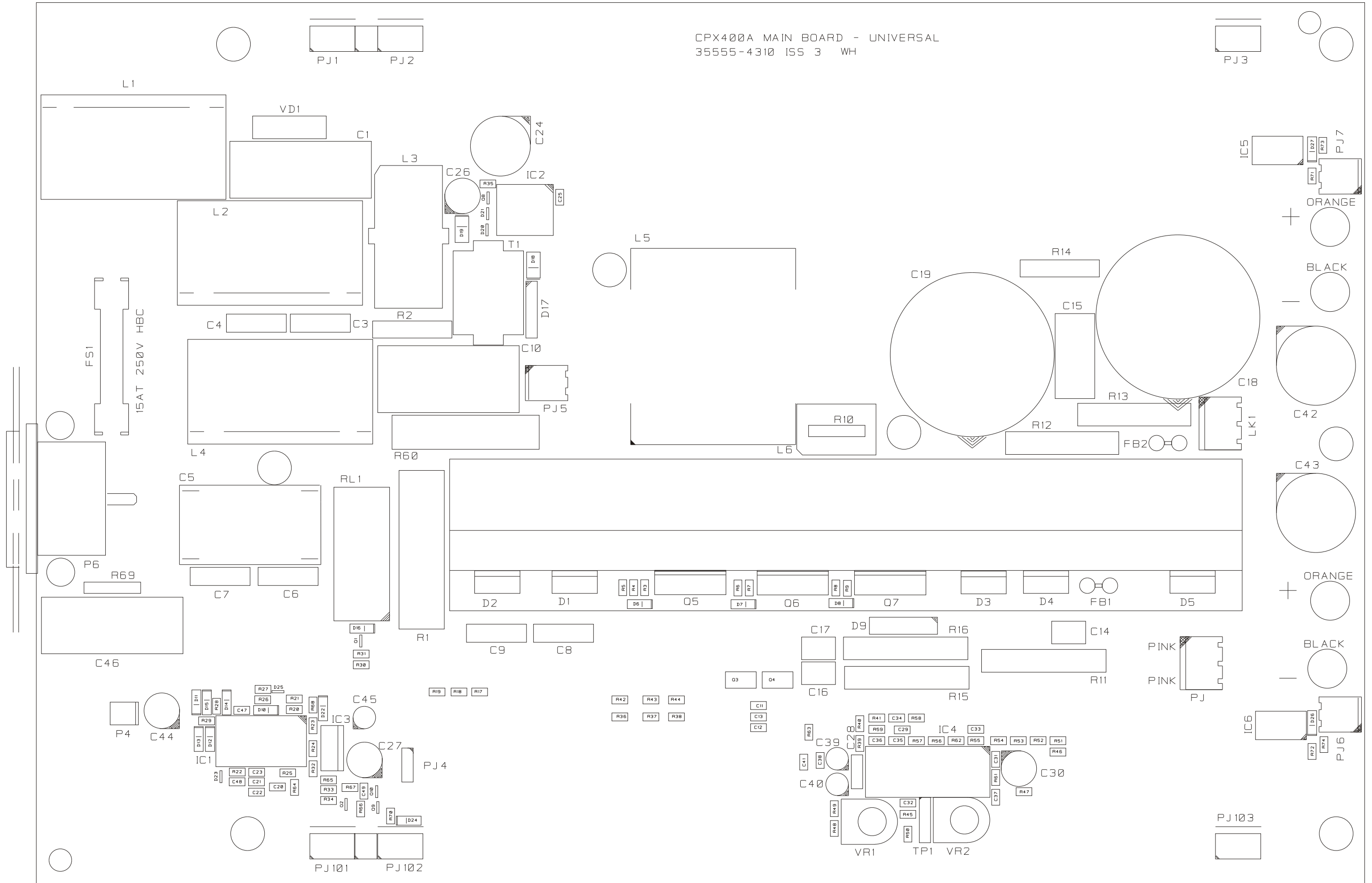
Part Number	Description	Position
22571-1070	TERMINAL TP/5LT LGREY/LGREY	EARTH TERMINAL
22575-0077	SKT 2 WAY IDT .1P	FAN, FRONT PANEL
22575-0202	SKT 2W .156 20AWG (YELLOW) IDT	PJ5 ON MAIN (PINS 1 & 2 LINKED), PJ2 ON CNTL TO PJ7 ON MAIN, PJ102 ON CNTL TO PJ6 ON MAIN.
22575-0203	SKT 3W .156 20AWG (YELLOW) IDT	LK1 ON MAIN
22575-0209	SKT 9W .156 20AWG (YELLOW) IDT	CONTROL/POWER PCBS
25061-0350	LIGHT PIPE LED STR 12.7MM	FOR FRONT PANEL LEDS
28522-0030	FAN 80MM 24VDC 3000RPM	
31346-0260	INSULATOR FOR MAX505 x 180MM	
31711-0180	BEZEL - HALF RACK 3U NEW FR UL	
33143-0290	FOOT - TILT - HOUSING	
33143-0300	FOOT - TILT - SUPPORT	
33331-7370	FRONT PANEL - CPX REV	
33331-8120-3	REAR PANEL PRTD - CPX400A	
33331-8730	OVERLAY FRONT PANEL CPX400A	
33537-0990	CASE LOWER - CPX400	
33537-1000	CASE UPPER - CPX400	
37113-2030	KEYCAP 8 x 3MM LIGHT GREY F/R	
37113-2060	KEYCAP 8 x 6MM LIGHT GREY F/R	
37151-0440	KNOB 16MM D-SHAFT L/GREY F/R	
43187-1720	WIRE SET CUT - CPX400A	

Component Layouts

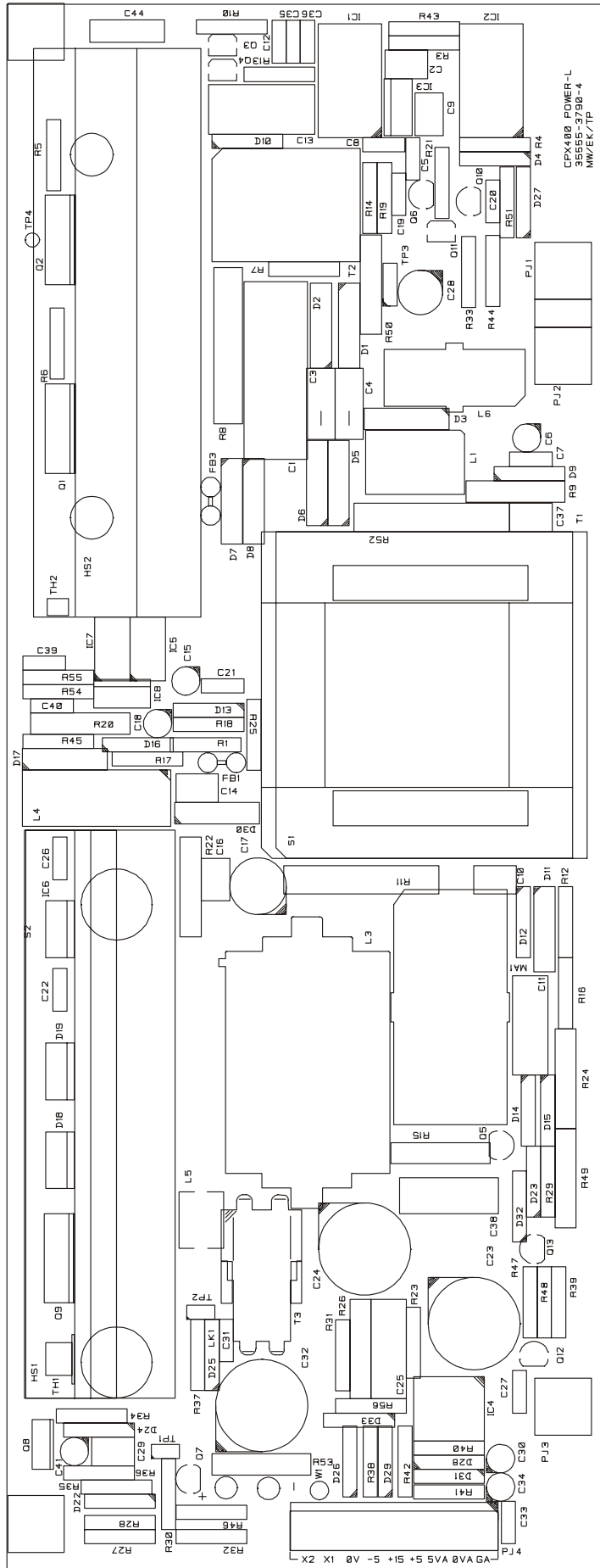


Control/Front Panel/Terminal Pcb

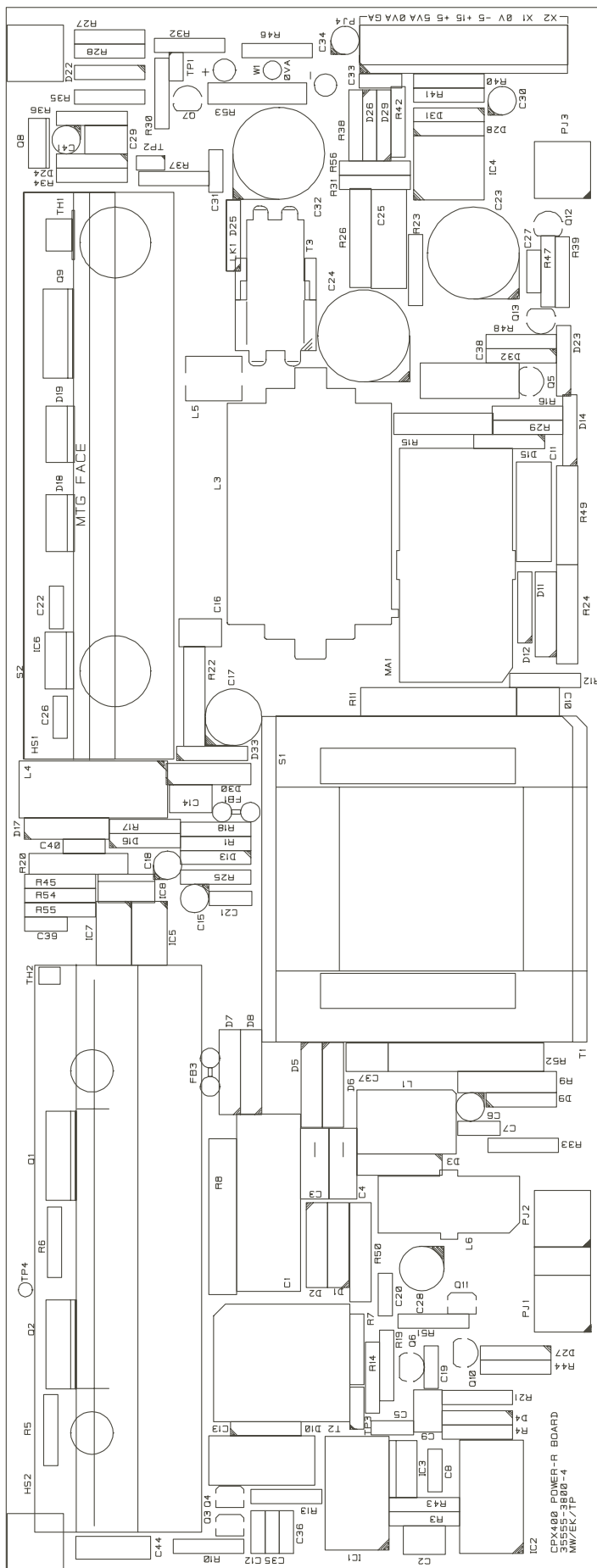
CPX400A MAIN BOARD - UNIVERSAL
35555-4310 ISS 3 WH



Main Pcb

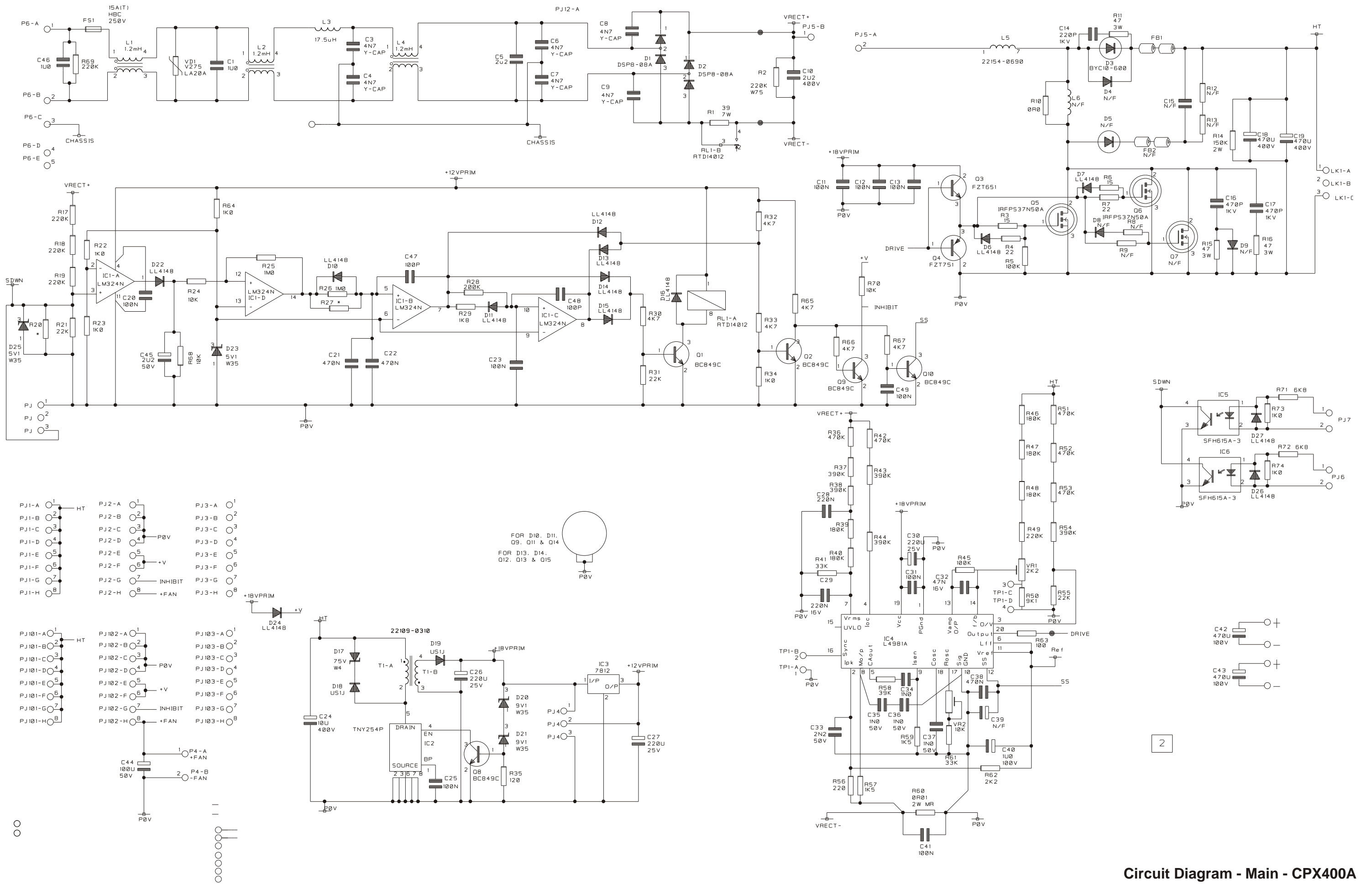


Power Board - Left

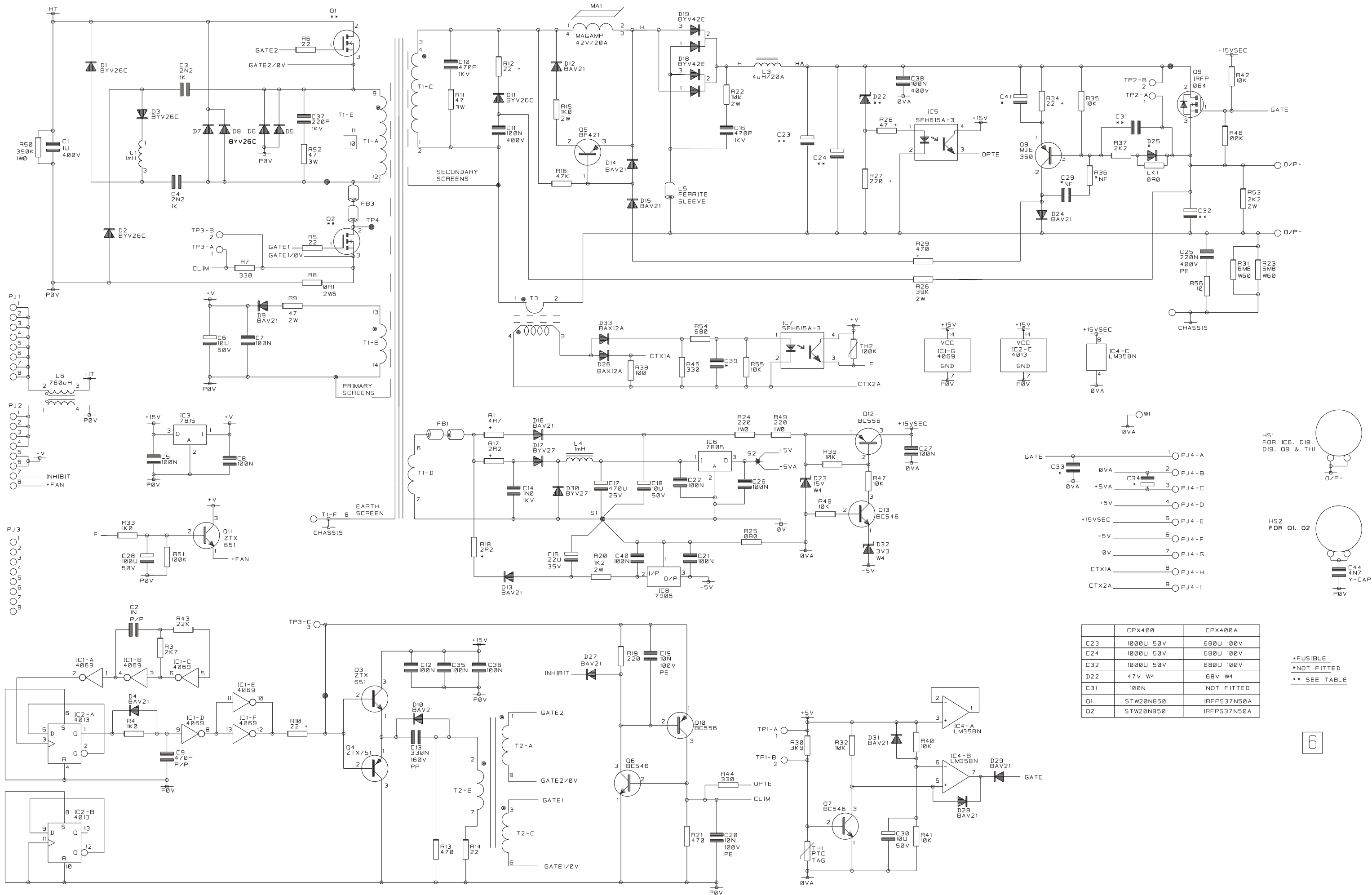


Power Board - Right

Circuit Diagrams



Circuit Diagram - Main - CPX400A



Circuit Diagram - Power - CPX400/400A

