Operating Manual Addendum

OPTIMOD-FM®

2200

Digital Audio Processor

Technical Data, Parts Lists, Schematics, and Parts Locator Drawings for all Manufacturing Variants through July 2003

orban

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About This Addendum

This publication is an addendum to the Optimod-FM 2200 Operating Manual. It replaces Section 6 of that manual.

Over the years, there have been a number of manufacturing variants of the 2200 circuit boards. This publication contains parts lists, schematics, and parts locator diagrams for each variant. It therefore serves as a complete reference to all manufacturing variants of the 2200.

For the most part, the variations have not affected the 2200's specifications except to improve minor aspects of its performance. We implemented the variations mainly to improve manufacturing efficiencies or to replace components that their manufacturers have obsoleted. In some cases, this required creation of small daughterboards to plug in the circuit board footprints originally occupied by the obsoleted parts.

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Specifications

It is impossible to characterize the listening quality of even the simplest limiter or compressor based on the usual specifications because such specifications cannot adequately describe the crucial dynamic processes that occur under program conditions. Therefore, the only way to evaluate the sound of an audio processor meaningfully is by subjective listening tests.

Certain specifications are presented here to assure the engineer that they are reasonable, to help plan the installation, and to help make certain comparisons with other processing equipment. Some specifications are for features that are only available on the 2200-D.

Performance

Specifications apply for measurements from analog left/right input to stereo composite output and to FM analog left/right output.

Frequency Response (Bypass Mode): Follows standard 50μs or 75μs pre-emphasis curve ±0.15 dB, 2.0 Hz–15 kHz. Analog left/right output and Digital output can be user configured for flat or pre-emphasized output.

Dynamic Range: Output noise floor will depend upon how much gain the processor is set for (Limit Drive, AGC Drive, Two-Band Drive, and/or Multi-Band Drive), gating level, equalization, noise reduction, etc. It is primarily governed by the dynamic range of the A/D Converter, which has a specified overload-to–noise ratio of 110 dB. The dynamic range of the digital signal processing is 144 dB.

Total System Distortion (de-emphasized, 100% modulation): <0.01% THD, 20 Hz–1 kHz, rising to <0.05% at 15 kHz. <0.02% SMPTE IM Distortion.

Total System Separation: >60 dB, 20 Hz–15 kHz.

Polarity (Bypass Mode): Absolute polarity maintained. Positive-going signal on input will result in positive-going signal on output.

Installation

Analog Audio Input

Configuration: Left and right.

Impedance: Electronically balanced 600Ω or 10kΩ load impedance, jumper-selectable.

Dynamic Range: 90 dB.

Common Mode Rejection: 70 dB at 50-60 Hz. 45 dB at 60 Hz-15 kHz.

Sensitivity: –20 dBu to +20 dBu to produce 10 dB gain reduction at 1 kHz, software- and jumper- adjustable.

Maximum Input Level: +27dBu.

Connector: XLR-type, female, EMI-suppressed. Pin 1 Chassis Ground, Pins 2 (+) and 3 electronically balanced, floating and symmetrical.

A/D Conversion: 20-bit.

Filtering: RFI-filtered, with high-pass filter at 0.15 Hz.

Analog Audio Output

Configuration: Left and right. Flat or pre-emphasized (at 50µs or 75µs), software-selectable.

Source Impedance: 30Ω, ±5%, electronically balanced and floating.

Load Impedance: 600Ω or greater, balanced or unbalanced. Termination not required.

Output Level: Adjustable from –20 dBu to +20 dBu into 600Ω or greater load, software-adjustable.

Output Noise Level: –90.0 dB (Bypass mode, de-emphasized, 20 Hz-15 kHz bandwidth, referenced to 100% modulation).

Crosstalk: <–70 dB, 20 Hz-15 kHz.

Distortion: <0.05% THD (Bypass mode, de-emphasized, 20 Hz-15 kHz bandwidth).

Connector: XLR-type, male, EMI-suppressed. Pin 1 Chassis Ground, Pins 2 (+) and 3 electronically balanced, floating and symmetrical.

Filtering: RFI-filtered.

Digital Audio Input (2200-D Only)

Configuration: Two-channel per AES/EBU-standard. 20-bit resolution.

Sampling rate: 25-55 kHz, automatically-selected.

Connector: XLR-type, female, EMI-suppressed. Pin 1 Chassis Ground, Pins 2 and 3 transformer balanced and floating.

Input Reference Level: Adjustable from 0 dBFS to –20 dBFS, software-controlled.

Digital Audio Output (2200-D Only)

Configuration: Two-channel AES/EBU-standard. 18-bit resolution. Software-controllable for flat, pre-emphasized to the selected processing pre-emphasis, J.17 pre-emphasized, or pre-emphasized to the selected processing pre-emphasis plus J.17 pre-emphasis.

Sampling rate: 32 kHz, 44.1 kHz, or 48 kHz, software-selected.

Connector: XLR-type, male, EMI-suppressed. Pin 1 chassis ground, Pins 2 and 3 transformer-balanced and floating.

Status Bits: AES/EBU status bits are implemented to control pre-emphasis in the Orban 8218 digital Stereo Encoder.

Output Level Adjustment: Output at 100% modulation, adjustable from 0 to –22.8 dBFS, software-controlled.

Composite Baseband Outputs

Configuration: Two outputs, each with an independent output level control, output amplifier and connector.

Source Impedance: 0Ω voltage source or 75Ω (jumper-selectable), single ended, floating over chassis ground.

Load Impedance: 37Ω or greater. Termination not required.

Level (0Ω source impedance, 75Ω or higher load impedance): Adjustable 0.4 Vp-p to 8.8 Vp-p with front panel multi-turn output level controls, one per output.

Pilot Level: Adjustable from 8% to 10%, software-controlled.

Pilot Stability: 19 kHz, ±0.5 Hz (10° to 40° C).

D/A Conversion: 18-bit.

Signal-to-Noise Ratio: –85 dB (Bypass mode, demodulated, de-emphasized, 20 Hz-80 kHz bandwidth, referenced to 100% modulation, unweighted).

Distortion: <0.05% THD (Bypass mode, demodulated, de-emphasized, 20 Hz-15 kHz bandwidth, referenced to 100% modulation, unweighted).

Stereo Separation: At 100% modulation = 3.5Vp-p, >60 dB, 30 Hz-15 kHz. >65 dB typical at 1 kHz; at 100% modulation = 1.0Vp-p, >50 dB, 30 Hz-15 kHz.

Crosstalk (Linear): –80 dB, main channel to sub-channel or sub-channel to main channel) referenced to 100% modulation).

Crosstalk (Non-Linear): –80 dB, main channel to sub-channel or sub-channel to main channel) referenced to 100% modulation).

38 kHz Suppression: –70 dB; –75 dB typical (referenced to 100% modulation).

76 kHz and Sideband Suppression: –70 dB; –80 dB typical (referenced to 100% modulation).

Connector: BNC, floating over chassis ground. EMI-suppressed.

Maximum Load Capacitance: 0.047µF (0Ω source impedance).

Maximum Recommended Cable Length (0Ω source impedance): 100ft/30m RG-58A/U.

Filtering: RFI-filtered.

Remote Control Interface

Configuration: Eight opto-isolated inputs, user-programmable to select any eight of: User Presets, Factory Presets, Bypass, Tone, Exit Test (returns from Bypass or Tone), Stereo, Mono from Left, Mono from Right, Mono from Sum, Input Analog, Input Digital.

Control: Momentary or continuous low side contact closure. 10mA minimum sink current; 9VDC, 50mA rating.

Power Supply: Current-Limited 9VDC provided to facilitate use with contact closure.

Connector: DB-25, EMI-suppressed.

Filtering: RFI-Filtered.

Power

Voltage: 90-120VAC, 100-132VAC or 200-264VAC, 50-60 Hz; 40VA.

Connector: IEC; detachable 3-wire power cord supplied. AC is EMI-suppressed.

Ground: Circuit ground is independent of chassis ground; can be isolated or connected with a rear panel switch.

Safety Standards: UL, CE, CSA

Environmental

Operating Temperature Range: 32°F to 122°F, 0°C to 50°C at nominal operating voltages.

Humidity: 0-95% RH, non-condensing.

Dimensions (W x D x H): 19” x 14.25” x 1.75”/48.3cm x 36.2cm x 4.5cm. 1 rack unit high.

Weight: 12 lbs/5.4kg.

Shipping Weight: 15 lbs/6.8kg.

Warranty

One Year, Parts and Labor: Subject to the limitations set forth in Orban’s Standard Warranty Agreement.

Specifications are subject to change without notice.

Circuit Description

This section provides a detailed description of circuits used in the 2200/2200-D. It starts with an overview of the 2200/2200-D system, identifying circuit sections and describing their purpose. Then each section is treated in detail by first giving an overview of the circuits followed by a component-by-component description. Keywords are highlighted throughout the circuit descriptions to help you quickly locate the information you need.

Overview

The block diagram on page 6-44 illustrates the following overview of 2200/2200-D circuit sections.

- The 16.384 MHz Oscillator and System Clocking section provides the various clocks needed by the control, I/O and DSP circuits to carry out their functions.
- The Control Circuits administrate control of the 2200/2200-D system.
- The User Control Interface and LED Display Circuits section includes the connector, RF-filtering, and circuitry for the remote control inputs. It also includes circuitry for the front panel pushbutton switches, LED control status indicators, and LED Meters. The LED Meters measure various 2200/2200-D signal levels and display the results on six front panel 10-segment LED meters.
- The L/R Input Circuits include the connectors and RF-filtering for the left and right audio inputs and the digital audio input, and the circuitry to interface these inputs to the digital processing.
- The L/R Output Circuits include the connectors and RF-filtering for the left and right audio outputs and the digital audio output, and the circuitry to interface the digital processing to these outputs.
- The Composite Output Circuits include the connectors and RF-filtering for the two composite outputs, and the circuitry to interface the digitally processed, stereo encoded signal to these outputs.
- The DSP Circuits implement the bypass, test tone, audio processing, and stereo encoding functions using digital signal processing.
- The Power Supply provides power for all 2200/2200-D circuits.

16.384 MHz Oscillator and System Clocking

The 2200/2200-D uses a synchronous clocking scheme to eliminate any asynchronous clocks operating in the sensitive regions of the L/R input A/D converter. A single 16.384 MHz crystal oscillator provides the timing reference for all system digital

clock signals. The only clocks that run asynchronous to this clock are the AES/EBU digital audio input related clocks and the 11.2896 MHz free running crystal clock oscillator providing the 44.1 kHz AES/EBU output sample rate (this does not fall within a sensitive region of the A/D). Synchronous counters divide the 16.384 MHz clock to produce the various clock signals for the system. A PLL circuit synthesizes an 18.432 MHz clock for operating the host microprocessor and a 6.144 MHz clock for providing the 48 kHz AES/EBU output sample rate clock in addition to providing the AES/EBU input receiver with the ability to measure the input sample rate.

Component-Level Description:

The 16.384 MHz digital output from crystal oscillator Y602 feeds the master clock (MCLK) inputs of both the input and the output SRC chips IC603 and IC615. The 16.384 MHz clock also feeds flip-flop IC604, which divides by two to produce an 8.192 MHz clock. The 8.192 MHz clock feeds digital multiplexer chip IC610, which routes the 8.192 MHz to AES/EBU digital audio transmitter chip IC616 when an internally generated 32 kHz output sample rate is selected. The 8.192 MHz clock is also sent to an 8-bit synchronous counter, implemented in programmable logic array (PLA) IC613.

This counter divides down to obtain the lower frequency system clocks. All outputs of the PLA have their transitions coincident with the rising edge of the 8.192 MHz clock. The 8.192 MHz clock is inverted by buffers IC605-A, -B to provide clocks 8.192M HZA* and 8.192M HZB* that have falling edges coincident with the transitions of the lower frequency clocks. 8.192M HZA* feeds the bit clock of the inter-DSP communication links following buffers IC710-B, -D. 8.192M HZB* feeds the A/D input clock (256 x sample rate), the L/R output D/A master clock, and the input bit clock on both the L/R output D/A and the composite D/A.

The 2.048 MHz clock output from IC613 feeds the PLL circuit made up of PLA IC618, 74HC4046 phase detector/VCO IC619 and associated components. The PLA first buffers the 2.048 MHz signal, providing a clean 2.048 MHz output at pin 12 used as the reference input to the PLL phase detector (IC619 pin 14). Of the three detectors included in the 74HC4046, the phase frequency detector (PFD) is used by the 2200/2200-D. The output of the phase detector (pin 13) feeds the loop filter made up of resistors R607, R608 and capacitor C605 that provide a single pole low-pass filter forming a second order loop. Pin 9 of IC619 is the input control voltage to the VCO. Resistor R614 eliminates subharmonic frequency modulation of the VCO caused by parasitic capacitance. Resistors R605 and R606 set the PLL's lock-in frequency range. A divide-by-nine counter is placed between the VCO output and the phase detector comparator input. This places the VCO output at 18.432 MHz. The PLA IC618 between pins 2 and 15 implements the divide-by-nine. A 6.144 MHz clock is derived at the counter's divide-by-three point and is provided at pin 17 of the PLA. The PLA provides a buffered 18.432 MHz output at pin 14, which feeds Z-180 microprocessor IC100.

IC614-A, -D provide buffered clocks 2.048M HZA and 2.048M HZB for driving the EXTAL inputs (pin 27) of the DSP chips. Each buffer drives four DSP chips.

The 256 kHz clock output of IC613 (pin 15) is required for the DSP-to-composite D/A interface. The 128 kHz clock (pin 14) is used for the inter-DSP word clock.

The 128 kHz, 64 kHz, and 32 kHz clocks are all used in the LCD backlight drive circuit. The 32 kHz clock is also used for the input word clock of both the output sample-rate converter (SRC) and the L/R output D/A. The 32 kHz clock is used to generate DSP interrupt request signals (IRQBA, IRQBB) required for process timing and interchip synchronization. The circuit consisting of flip-flop IC612 and IC614-B, -C is required to ensure that the first falling edges of all IRQB signals are coincident. This synchronization occurs every time the unit is powered up and when there is a processing algorithm change. It is controlled by the Z-180 via pin 2 of latch IC611. The 32 kHz clock is also used, along with IC313, in the A/D clock synchronizing circuit. This circuit makes the IRQB and the L/R clocks, both operating at 32 kHz, phase synchronous. This ensures that the process-to-output buffer transfer internal to the DSP does not overlap the output buffer-to-peripheral transfer. The 8.192M HZB* clock that feeds the A/D input clock (IC312 pin 19) is internally divided down to produce a 32 kHz word clock at IC312 pin 13 and a 2.048 MHz bit clock at pin 14. These clocks are used to control the A/D-to-DSP serial interface and the input SRC-to-DSP serial interface.

AC terminations are used on various clocks throughout the board to improve signal integrity for sensitive devices.

Control Circuits

The control circuits process and execute user-initiated requests to the system. The source of these requests is the front panel buttons and the remote contact closures. These changes affect hardware function and/or DSP processing. The control circuits also send information to the LCD display, LED status, and LED meter circuits. A RAM chip stores code segments. For quick access, an EEPROM chip stores dynamic system state information. A ROM chip contains the executable form of 2200/2200-D DSP and Control software.

1. Microprocessor and Power Monitoring Circuit

A Z-180 microprocessor executes software code required to control the functionality of the 2200/2200-D. The EXTAL port of the Z-180 receives an 18.432 MHz clock signal from the clock divider/PLL circuit and is internally divided down to 9.216 MHz to provide the Z-180 system clock frequency. ROM contains control software for the Z-180. User system setup and other dynamic system state information that must survive power down is stored in non-volatile EEPROM. Power monitoring circuitry prevents data corruption by placing and holding the Z-180 in reset if AC mains power is insufficient.

The Z-180 communicates to the DSP through the synchronous serial data host port. When the DSP requires executable code, the Z-180 reads it from the ROM and sends it to the DSP. The Z-180 sends parameter control data to the DSP and receives status data from the DSP. If status from DSP is irregular, the Z-180 will place the 2200/2200-D hardware and DSP in a reset state and execute initialization procedures.

Component-Level Description:

The Z-180 is IC100. Watchdog timer/voltage monitor IC122 provides the system reset function. IC122 pin 7 monitors pulses generated every 1 second by the Z-180. If the Z-180 is not operating correctly to provide the pulses, IC122 will reset the Z-180. IC122 also monitors the voltage on the +5V source that supplies power to the 2200/2200-D digital electronics. When the +5V line is above the minimum operating voltage of +4.75V, R103 will pull RESET* high which allows the Z-180 to exit the reset condition. When the +5V line is below the minimum operating voltage, the open-collector output of IC122 pulls Z-180's RESET* low which puts the Z-180 into the reset condition, thereby preventing the Z-180 and the 2200/2200-D electronics from executing incorrectly due to low +5V line voltage.

Z-180 IC100 pins 55, 56, and 57 comprise the host serial data communication port. The Z-180 uses this port to communicate with the DSP IC700-IC707 via host port interface pins 26, 35, and 41; and with EEPROM IC107 via pins 2, 5, and 6. Communication is SPI type with Z-180 as master and DSP as slave.

2. RAM, ROM and EEPROM

A RAM chip provides temporary storage for Z-180 data and program code segments. A ROM chip provides permanent storage of the executable control software and the executable DSP software. System state information that must be maintained while the 2200/2200-D is powered down is stored in an EEPROM. The EEPROM does not lose data when the 2200/2200-D is powered down.

Component-Level Description:

IC104 decodes Z-180 memory addresses to access instructions to execute from ROM IC105 and to read or write data from 32KB RAM IC106. EEPROM IC107 is selected by latch IC611 pin 6.

3. Data Latches, Tri-State Data Buffers and Address Decoders

Digital logic decodes Z-180 I/O addresses, allowing the Z-180 to access RAM, ROM and EEPROM. The logic provides Z-180 data bus allocation by using latches and tri-state data buffers to allow other 2200/2200-D hardware to communicate to the Z-180. To control other hardware, the Z-180's data bus state is latched at the appropriate time, and the latched control signals are provided to other hardware. For the Z-180 to read information from other hardware, the Z-180's data bus is connected at appropriate times to other hardware's source signals through tri-state data buffers (e.g. IC120).

Component-Level Description:

Decoder IC104 allows the Z-180 to access ROM IC105 and RAM IC106. Decoders IC101, IC102, and IC103 allow the Z-180 to access all other 2200/2200-D hardware. The decoded outputs from IC101, IC102, and IC103 are used to latch the state of the Z-180 data bus at appropriate times with data latches IC202, IC205, IC207, IC303, IC305, IC609, IC611, IC708, and IC709, and to allocate

the Z-180 data bus at appropriate times to various peripherals via tri-state data buffers IC120, IC204, and IC601. IC120 buffers or tri-states status information from the remote contact closure circuitry onto the Z-180 data bus. IC204 buffers or tri-states information from the user control interface onto the Z-180 data bus. IC601 buffers or tri-states status information from AES/EBU Receiver IC600 onto the Z-180 data bus.

User Control Interface and LED Display Circuits

The user control interface enables the user to control the functionality of the 2200/2200-D unit. A rear panel remote interface connector enables remote control of certain functions. Front panel pushbutton switches select between various operational modes and functions. Data latches detect and store the commands entered with these switches. Front panel status LEDs indicate the control status of the unit, and meter LEDs indicate signal levels and processing activity within the unit.

1. Remote Interface

A remote interface connector and circuitry enables remote control of certain operating modes; the 2200 has eight remote contact closure inputs.

A valid remote signal is a momentary pulse of current flowing through the particular remote signal pins. Current must flow consistently for 50 msec for the signal to be interpreted as valid. Generally, the 2200/2200-D will respond to the most recent control operation whether it came from the front panel, or remote interface.

Component-Level Description:

J101 is a 25-pin D-connector that connects the remote control input signals. The connector incorporates a ferrite block to filter out RFI from the signals. The associated opto-isolators (e.g. IC110) isolate the inputs from the detector circuitry on the 2200/2200-D. The associated diodes (e.g. CR102) prevent the opto-isolators from breaking down under a reverse bias. The outputs of the opto-isolators are inverted and buffered (e.g. by IC118-A) and latched by tri-state data buffer IC120. When REMOTE* signal provided to IC120 pin 19 is brought low, IC120 places remote signals on the Z-180 data bus.

2. Switch Matrix and LED Indicators

Ten front panel pushbutton switches are arranged in a matrix, configured as two columns and six rows (the FUNCTION and CONTRAST keys have dedicated rows). These switches are the primary element of the physical user interface to the 2200/2200-D control software. The host microprocessor controls the system setup and function of the DSP according to the switch/rotary encoder entered commands, the AES Status bits from the Digital Input signal, and the remote control interface status; it then updates the LED control status indicators accordingly.

Component-Level Description:

S200-S208 and S210 are the front panel pushbutton switches. CR200-CR204 and CR206 are the front panel LED control status indicators. Via decoder IC102, the host microprocessor Z-180 periodically selects data latch IC202 (on the display board) to drive one of the two columns in the switch matrix low, then commands tri-state data buffer IC204 (also on the display board) to read its inputs to determine if any new information is being received from one or more of the switches in that column. If no switches are closed, pull-up resistors R202, R210-R213 pull the buffer inputs to +5V. The buffer, in turn, de-bounces the signals and places the appropriate word on the data bus for the Z-180 to read. The Z-180 transmits the updated information to data latch IC202 which directly drives the LED Control Status Indicators.

3. LED Meter Circuits

The meter LEDs are arranged in an 8x8 matrix, in rows and columns. Each row of LEDs in the matrix has a 1/8 duty cycle ON time. The rows are multiplexed at a fast rate so that the meters appear continuously illuminated. Via the serial port, the DSP sends meter data values to the Z-180, which alternately sends pairs of mapped 8-bit words to the data bus. One of the words, latched by a <169>row selector<170> latch, has a single rotating active bit to select one of the eight rows. The other word, latched by a <169>column selector<170> latch, has active bits corresponding to those of the eight LEDs in the selected row that are to be lit. The latched words control high-current Darlington transistor arrays, which drive the LED matrix.

Component-Level Description:

The meter LED matrix consists of six 10-segment LED bargraph assemblies (CR208-CR213) and three discrete LEDs (CR214-CR216). IC208 contains eight Darlington transistors, each of which is connected to the cathodes of a row of the LEDs. Row selector latch IC207, controlled by the Z-180, alternately turns one of the eight transistors on, such that it will sink current through the LEDs selected by column selector latch IC205, also controlled by the Z-180. IC205 turns on the appropriate transistors inside current driver IC206 to drive the selected row of LEDs. IC206 gets its current from a storage capacitor fed directly by the power transformer's lower voltage secondary winding. Resistors RP200 function as current limiting resistors.

L/R Input Circuits

This circuitry interfaces the analog and digital audio to the DSP. The analog input stages scale and buffer the input audio level to match it to the analog-to-digital (A/D) converter. The A/D converts the analog input audio to digital audio. The digital input receiver accepts AES/EBU-format digital audio signals from the digital input connector, and transmits them to the input sample rate converter (SRC). The digital audio from the A/D and SRC is transmitted to the DSP.

1. Analog Input Stages

The RF-filtered left and right analog input signals are each applied to a resistor load and a resistor pad. The pad and load are enabled or disabled by jumpers that are positioned by hand. The loaded and padded signal is applied to a floating-balanced amplifier that has an adjustable (digitally controlled) gain. FET transistors and analog switches set the gain. The state of the FETs and switches is set by the outputs of a latch. The control circuits control the gain according to what the user specifies from the front panel controls by writing data to the latch. The gain amplifier output feeds a circuit that scales, balances, and removes DC from the signal. This circuit feeds an RC low-pass filter, which applies the balanced signal to the analog-to-digital (A/D) converter.

Component-Level Description:

The left channel balanced audio input signal is applied to the filter/load/pad network made up of L300, L301, L302, L303, R300-R305, C323 and C324. J301 is a jumper that removes or inserts the optional 600Ω termination load (R300) on the input signal. J302 and J303 are the jumpers that remove or insert the resistive divider (R301-R303) that pads the input signal before it is applied to IC300, a differential amplifier. R306, R307, R310-R313, FETs Q300-Q301, and quad analog switch IC307 make up the circuit that sets the gain of IC300. The FETs, along with IC307, are used as switches to change the resistive paths in the circuit. The state of the FET switches is set by the outputs of digital latches IC304 and IC305. The latch outputs feed IC306, a quad comparator, which outputs 0V to turn on a FET and –15V to turn off a FET. The control circuit writes directly to IC307 to control the state of the switches on IC307. IC300 feeds IC302 and associated components. This stage balances the signal and attenuates by 3.5 dB to scale the signal to the proper level for the analog-to-digital (A/D) converter. IC301-B and associated components comprise a servo amp to prevent DC from passing to the DSP. R334, R337, C302, and C303 make a simple RC filter necessary to filter high frequency energy that would otherwise cause aliasing distortion in the A/D converter. The corresponding right channel circuitry is functionally identical to that just described.

2. Stereo Analog-to-Digital (A/D) Converter

The A/D is a stereo, 20-bit sigma-delta converter. The A/D oversamples the audio at 2.048 MHz. It applies noise shaping; then it filters and decimates to a 32 kHz sample rate. The samples are output in two's complement, 32-bit word, two-word frame serial format, with SPI compatible timing, MSbit first, and transmitted to the DSP. The 32 kHz frame clock and 2.048 MHz bit clock from the A/D function as master clocks for the 2200/2200-D input to the DSP. For more information on 2200/2200-D input clocking, please refer to *16.384 MHz Oscillator and System Clocking* on page 6-5.

Component-Level Description:

The balanced left and right analog inputs are applied to the A/D (IC312). The maximum differential signal that the A/D can accept is ±7.36Vpeak. The A/D samples the left and right inputs simultaneously at 64 times the 2200/2200-D sample rate of 32 kHz. ICLKD, the master clock input of the A/D (pin 19), is fed an 8.192 MHz clock providing the 2.048 MHz input sample rate required. The A/D sends the digitized stereo audio to the first DSP chip (IC700) via its synchronous serial port formed by the data SDATA (pin 15), the bit clock SCLK (pin 14) and the word clock L/R* (pin 13). The SPI communication standard is used for this audio interface, with A/D as master and DSP IC700 as slave. The SPI format is: 32-bits/word, multiplexed stereo, word clock low represents left data present, MSB first, data transitions occur on rising edge of the bit clock, first 18 bits are valid, trailing bits are set low, MSB delayed one bit period from word clock edge. IC314 provides buffering to reduce the drive requirement of the on-board drivers on the A/D and to ensure that there are no overshoots or undershoots as a result of transmission line reflections that may degrade the performance of the A/D. IC109-D is required to invert the word clock to support the SPI interface.

3. Digital Input Receiver and Sample Rate Converter (SRC)

The digital input receiver accepts digital audio signals using the AES/EBU interface format (AES3-1992). The receiver and input sample rate converter (SRC) together will accept and sample-rate convert any of the “standard” 32 kHz, 44.1 kHz, 48 kHz rates in addition to any digital audio sample rate within the range of 25 kHz and 55 kHz. The audio signal received is decoded by the AES receiver and sent to the SRC. The SRC converts the input sample rate to the 32 kHz 2200-D system sample rate. Via a synchronous serial interface, the SRC sends the 32 kHz sample rate audio to the DSP for processing.

Component-Level Description:

The differential digital input signal is received through a shielded 1:1 pulse transformer (T600). T600 has very low inter-winding capacitance, providing a high level of isolation for high frequency common mode interference. IC600 is a dedicated AES/EBU digital audio receiver integrated circuit. It contains a phase locked loop that recovers the clock and the synchronization information present in the AES/EBU signal. A Schmitt trigger at the input provides 50mV of hysteresis for added noise immunity. R600 provides an 110Ω input impedance per the AES/EBU specification.

The Z-180 provides the active high reset signal (AES_RST) to IC600 mode control pins 17, 18, and 23, via latch IC609 pin 6. This is used when the 2200-D is asked to respond to analog audio input. When in the reset state, the receiver holds all outputs inactive (except MCK pin 19).

IC600 pins 2 through 6 and pin 27 are an output latch that provides AES/EBU status information, selected by the STATSEL line. The information on this latch is provided to the Z-180 data bus via tri-state data buffer IC601. STATSEL signal from IC611 pin 12 is applied to IC600 pin 16. When STATSEL is high, pins 2

through 6 and pin 27 contain information about the channel status bits. When STATSEL is low, pins 2 through 6 and pin 27 contain input sample rate and error information. The Z-180 reads these to determine if a valid AES/EBU signal and sample rate is present. CHSEL is used to select whether channel A or channel B status bits are present on IC600's output latch. When STATSEL is low, left channel status is made available, and when STATSEL is high, right channel status is made available.

Received AES audio is transmitted from the AES receiver to the input sample rate converter (SRC IC603), in the synchronous serial SPI format. The AES receiver is master and the SRC is slave. The AES receiver outputs data on pin 26, the bit clock on pin 12, and the frame clock on pin 11. The frame clock is inverted by IC605-F for compatibility with the SRC's input port. These signals are sent to the SRC serial input interface pins 3, 4, and 6 respectively.

The MCK clock output at pin 19 of the AES receiver chip has a frequency 256 times the input sample rate of the received signal. This is used to drive the output AES/EBU transmitter when an output sample rate that is synchronous to the input sample rate (external sync) is required.

The crystal oscillator (Y602) provides the SRC a master clock of 16.384 MHz on pin 2. This MCLK frequency allows the input SRC to operate with input sample rates in the range of 8.192 kHz (MCLK/2000) to 57 kHz (MCLK/286). SRC_RST is an active low reset signal tied to pin 13 of the SRC. This signal is controlled by the Z-180 via pin 2 of latch IC609.

The MSDLY_I, BKPOL_I, and TRGLR_I pins of the SRC chip configure the chip for SPI format. Pin 1 of the SRC (GPDLYS) is tied high to minimize the chip's group delay to approximately 700µs as opposed to approximately 3ms, giving up some tolerance to variations in sample rates. Pin 28 (SETLSLW) is tied high to cause the SRC to settle slowly to changes in sample rates, resulting in the best rejection of sample rate jitter.

The sample rate converted output of the input SRC feeds the first DSP chip (IC700). The SRC output port and the DSP input port are both slaves, with clocks supplied by the L/R input A/D converter (IC312). The SRC generates DIG_IN (data) on pin 23, and receives the bit clock and the word clock on pins 26 and 24 respectively. An inverted version of this word clock is used by the DSP chip to conform with the SPI format it requires.

L/R Output Circuits

This circuitry interfaces the DSP to the analog and digital audio outputs. The digital audio from the DSP is transmitted to the digital-to-analog converter (D/A) and output sample rate converter (SRC). The digital-to-analog (D/A) converter converts the digital audio words generated by the DSP to analog output audio. The MDAC stages scale and buffer the D/A output signal to drive the analog output stages to the correct level. The analog output stages drive the analog output XLR connectors with a low impedance, floating balanced output. The digital output transmitter accepts the digital audio words from the

output sample rate converter (SRC) and transmits them in AES/EBU-format digital audio signals on the digital output connector.

1. Stereo Digital-to-Analog (D/A) Converter

The D/A is a single chip, stereo, 20-bit delta-sigma converter.

For information on 2200/2200-D system clocking, please refer to *16.384 MHz Oscillator and System Clocking* on page 6-5.

Component-Level Description:

IC400 is the digital-to-analog (D/A) converter for the left and right output signals. The synchronous serial input interface consists of the bit clock, data and latch enable pins that are configured for the SPI format via DIF0 and DIF1 pins (for details on SPI, see page 6-12. The processed digital output (ANLG_OUT) is provided by DSP IC706 on its SAI output port SDO0 (pin 47), and is received by the D/A on pin 18.

An 8.192 MHz bit clock is provided from the system clock circuitry to both the DSP and the D/A chips. The DSP output data format is SPI (32 bits per word, two words per frame). DSP chip IC706 receives a 128 kHz frame clock at its WST input (pin 50) that sets the word transfer rate to eight words per 32 kHz period. The D/A receives a 32 kHz clock at its LRCK input (pin 20). LRCK delineates the left and right samples used by the D/A; therefore the D/A uses the first sample received for the left output and the fifth sample for the right output. The DSP output samples are formatted to ensure that the D/A uses a left and right output pair that represent the simultaneously sampled analog input.

2. Analog Output Stages

The left and right analog signals emerging from the digital-to-analog (D/A) converter are each RC low-pass filtered and applied to an inverting amplifier having an adjustable (digitally controlled) gain. The gain is set by an MDAC. The state of the MDAC is set by the outputs of a latch. The control circuits control the gain according to what the user specifies from the front panel controls by writing data to the latch. The gain amplifier feeds a programmable de-emphasis filter stage with its response digitally controlled by JFET switches. The de-emphasis stage feeds a floating-balanced line driver, having a 30Ω ±5% output impedance. The line driver outputs are applied to the RF-filtered left and right analog output connectors.

Component-Level Description:

The left channel signal emerging from the digital-to-analog (D/A) converter is RC low-pass filtered by R402 and C407 to remove high frequency images. It is then applied to an adjustable gain amplifier formed by VR400, R404-R406, C409, IC401, and IC402-A. These components form an inverting amplifier circuit. IC401 is an 8-bit MDAC, which is a resistor ladder with a programmable resistance. The control circuit writes an 8-bit word directly to IC401, which has a latch

on board to store the word. The word sets the resistance value between pin 15 and pin 1 of IC401. IC402-A forces pin 1 of IC401 to virtual ground. The resistance between pin 1 and pin 16 of IC401, and resistors R404-R406 and VR400 are in the feedback loop of IC402-A. C409 stabilizes this stage. VR400 is a factory gain trim to correct for tolerances in IC401, IC400, and the rest of the analog output circuits.

IC402-A feeds the stage consisting of IC402-B and associated components, which are a programmable de-emphasis filter. JFETs Q400 and Q401 are used to switch C410 and C411, respectively, in or out of the circuit. The state of the JFET switches is set by the outputs of IC305, a digital latch. The latch outputs feed IC407, a quad comparator, which outputs 0V to turn on a FET and –15V to turn off a FET. If neither of the JFETs are on, the circuit is a unity-gain inverting amplifier. The circuit becomes a first-order low-pass filter if one of the JFETs is turned on. If Q400 is on, capacitor C410 is in circuit to create a 75µs time constant. If Q411 is on, capacitor C401 is in circuit to create a 50µs time constant.

IC402-B feeds the stage consisting of IC403-A, IC403-B, IC408-A, and associated components, which is a floating-balanced line driver. The floating characteristic is achieved by complex cross-coupled positive and negative feedback between two 5532 opamps, and its operation is not readily explainable except by a detailed mathematical analysis. Opamps may be replaced; resistors are specially matched and should not be replaced. IC408-A, R444, R445, R447, and C419 comprise a servo amplifier that centers around ground the average DC level at output connector J400.

The balanced audio output signal is applied to the RF filter network made up of L400, L401, L402, and L403, and then to XLR connector J400.

The corresponding right channel circuitry is functionally identical to that just described.

3. Digital Sample Rate Converter (SRC) and Output Transmitter

An output sample rate converter (SRC) chip is used to convert the 32 kHz 2200-D system sample rate to any of the standard 32 kHz, 44.1 kHz or 48 kHz rates. A digital audio interface transmitter chip is used to encode digital audio signals using the AES/EBU interface format (AES3-1992). A synchronous serial interface is used for all interchip communication.

Component-Level Description:

The processed digital output (DIG_OUT) provided at the SAI output port SDO0 (pin 47) of DSP IC706 is received by asynchronous sample rate converter (SRC) IC615 pin 3. An 8.192 MHz bit clock is provided from the system clock circuitry to both the DSP and the SRC chips. The DSP output data format is SPI (32 bits per word two words per frame). DSP chip IC706 receives a 128 kHz frame clock at its WST input (pin 50) that sets the word transfer rate to eight words per 32 kHz period. The SRC receives a 32 kHz clock at its L/R*_I input (pin 6). L/R*_I

delineates the left and right samples used by the SRC; therefore the SRC uses the first sample received for the left input and the fifth sample for the right input. The DSP output samples are formatted to ensure that the SRC uses a left and right output pair that represent the simultaneously sampled analog input.

The crystal oscillator (Y602) provides the SRC a master clock of 16.384 MHz on pin 2. This MCLK frequency allows the output SRC to operate with an output sample rate in the range between 30 kHz and 57 kHz (operation between 8 kHz and 30 kHz will result in a one sample delay between the left and right channels). SRC_RST is an active low reset signal tied to pin 13 of the SRC. This signal is controlled by the Z-180 via pin 2 of latch IC609.

The MSDLY_I, BKPOL_I, and TRGLR_I pins of the SRC chip configure the chip for SPI format. Pin 1 of the SRC (GPDLYS) is tied high to minimize the chip's group delay to approximately 700µs as opposed to approximately 3ms, giving up some tolerance to variations in sample rates. Pin 28 (SETLSLW) is tied high to cause the SRC to settle slowly to changes in sample rates, resulting in the best rejection of sample rate jitter.

The output side of the sample rate converter is tied directly to IC616, an AES/EBU digital audio transmitter integrated circuit. This interface uses the SPI format with the AES transmitter as master. The transmitter chip encodes the audio data it receives to the AES/EBU interface standard, and transmits it.

The SRC output sample rate and the sample rate that the AES/EBU transmitter transmits with is based on the MCK clock provided to pin 5 of IC616. This clock is received via digital multiplexer chip IC610 which is used to select one of four available clocks. Three free-running clocks provide the standard sample rates of 32 kHz, 44.1 kHz and 48 kHz when an internal sync is requested. These clocks run at a frequency that is 128 times the sample rate they represent. They have a frequency stability of ±100PPM. The fourth clock is the EXTMCK clock that is recovered from the AES/EBU receiver chip. This clock has a frequency of 256 times the input sample rate of the received signal. This is used to drive the output AES/EBU transmitter when an output sample rate is required that is synchronous to the input sample rate (external sync).

The inter-chip serial data format, the input MCK multiplication factor, and the output channel status data are controlled by the Z-180 via internal control registers and data memory accessed through the parallel port made up of the 5-bit address bus (pins 9-13), the 8-bit data bus (pins 1-4, 21-24) and the CS* and RD/WR* control pins (pins 14 and 16) of IC616.

The on-chip RS422 line driver provided by IC616 is a low skew, low impedance, differential output capable of driving a 110Ω transmission line with a 4Vp-p signal. Shielded 1:1 pulse transformer T601 transmits the differential digital output signal to XLR connector J601. T601 has very low inter-winding capacitance, providing a high level of isolation from high frequency common mode interference.

Composite Output Circuits

This circuitry provides several functions. It interfaces the digital stereo multiplex output from the stereo encoder DSP to a digital-to-analog (D/A) converter, which converts it to an analog signal. The low-pass reconstruction filter removes high frequency images from the D/A converter output and feeds the output buffers. Two output stages with separate level controls buffer the stereo multiplex signal and feed the composite output connectors.

1. Digital-to-Analog (D/A) Converter

The composite D/A is a single chip, 18-bit resistor ladder type. It has a single channel serial input that receives the digital stereo encoded output samples from the DSP. It is a surface-mount part that is mounted on a small daughterboard, replacing the DIP package previously used in the 2200.

Component-Level Description:

IC500 is the digital-to-analog converter for the stereo-encoded composite signal. The synchronous serial input interface consists of the bit clock, data and latch enable pins. DSP IC707 provides serial data (COMP_O) to pin 7 of the composite D/A.

An 8.192 MHz bit clock is provided from the system clock circuitry to both the DSP and the D/A chips. The DSP output data format is 32-bits per word two words per frame, MSB first (first 24-bits are significant). DSP IC707 receives a 128 kHz frame clock at its WST input (pin 50) that sets the word transfer rate to 256 kHz. The D/A receives a 256 kHz clock at its latch enable (LE) input (pin 6). The D/A uses the last 18-bits received prior to the falling edge of LE (last 18-bits are significant). Flip-flop IC604-A is used to invert and shift the 256 kHz system clock to produce an LE signal that has a falling edge aligned with the 18^{th} significant data bit.

Pin 9 is the analog voltage output of IC500. The voltage changes to the current sample value on the falling edge of the 256 kHz clock. A full scale output is approximately ±3.0Vpeak, which corresponds to 141% modulation. C517 prevents slew-induced distortion.

2. Analog Reconstruction Filter

The reconstruction filter removes the ultrasonic energy “images” present at the D/A output. It is a passive seventh-order elliptic filter with a cutoff frequency of approximately 70 kHz and >90 dB stopband attenuation above 203 kHz.

Component-Level Description:

The reconstruction filter is a passive seventh-order LC ladder filter, realized by resistors R501, R502 and R504, capacitors C508-C512, C516, and C518, and in-

ductors L500-L502. The frequency response of this filter cannot be measured by applying a swept sine wave at the 2200/2200-D analog inputs. This is because the filter has bandwidth much larger than the analog-to-digital converter. (The analog-to-digital converter band-limits the input to 16 kHz.) Stereo separation is a very sensitive function of the frequency and phase response of this filter in the frequency range of 20-53,000 Hz.

The filter is buffered by non-inverting amplifier IC502-A and applied to the output stages. IC501-A is a DC servo to prevent DC from appearing at the composite outputs.

3. Composite Baseband Output Stages

The buffered filter output is applied to two power buffers each capable of driving two 75Ω loads in parallel.

Component-Level Description:

The stereo modulator output is fed into two separate output buffers. The first consists of IC503-A and IC504. IC504 is a special high slew rate power buffer, which is located within the overall amplifier feedback loop. It isolates IC503-A from the destabilizing effects of capacitive loads and permits 75Ω loads to be driven without degradation. This line driver will drive up to ±1.5Vpeak into 0.047uF in parallel with 37.5Ω before significant nonlinear errors (increases in spurious components as observed on a baseband spectrum analyzer) or linear errors (noticeable deterioration of baseline flatness at 15 kHz in the separation test mode) are apparent. Output level is adjusted by varying the feedback resistor VR500. The second output buffer made by IC505-A and IC506 is functionally identical to the one just described.

DSP Circuits

The DSP circuits consist of eight general-purpose DSP chips that execute DSP software code to implement digital signal processing algorithms. The algorithms filter, compress, limit, and stereo encode the audio signal. The eight DSP chips, operating at 25 million instructions per second (MIPS) for a total of 200MIPS, provide the necessary signal processing. Sampling rates from 32 kHz to 128 kHz are used. Two of the on-board serial audio interface (SAI) peripherals on each DSP chip are used to transfer data chip-to-chip at a 16.384Mbit/s rate maintaining a 24-bit word length. The DSP chips are cascaded, processing the audio serially. The first chip receives the analog input via the A/D chip and the digital input via the SRC chip. Input source selection is performed seamlessly, internal to the DSP chip.

During system initialization (which normally occurs when power is first applied to the 2200/2200-D), and when processing algorithms are changed, the Z-180 downloads the DSP executable code stored in the ROM, via the serial host interface (SHI) port of each DSP chip. Once a DSP chip begins executing its program, execution is continuous. The Z-180 provides the DSP program with parameter data, and extracts the front panel metering data from the DSP chips via this same SHI port.

The left and right analog and digital outputs are sent to the L/R output D/A and the output SRC chip via the SAI port of DSP chip IC706. The last DSP chip (IC707) outputs the composite audio signal on its SAI port where it is directed to the composite D/A.

Component-Level Description:

IC700 thru IC707 are the DSP chips. Do not attempt to remove these chips from the PCB; only the Orban service department should remove these chips. A chip can be ruined by static discharge or by damage to its delicate pins.

The EXTAL pin of each DSP chip receives a 2.048 MHz clock. All DSP chips use their internal PLL to multiply this by 24 to operate the chip's internal oscillator (Fosc) at 49.152 MHz. Each DSP chip is reset by the Z-180 via latch IC709. DSP mode configuration is controlled by the state of the MODA, MODB and MODC (pins 37, 38, 39) on each chip as the chip is brought out of reset. All DSP chips are configured to bootstrap via the SHI port. The MODB pin, which also serves as the IRQB input after leaving the reset state, is forced low prior to bringing the DSP chips out of reset.

Pins 26, 35, 41 and 42 comprise the DSP host port. Host port communication conforms to the SPI format with the Z-180 set-up as the master and the DSPs as slaves. The Z-180 generates the HOSTCK clock signal and provides it to SCK (pin 26) of each DSP. The Z-180 provides the data on the HOSTTX line tied to pin 41 of each DSP. The data output (pins 35) of each DSP have tri-state outputs that are wire-ORed to provide the data on the HOSTRX line sent to the Z-180. The Z-180 controls the slave select (SS*) (pin 42) of each DSP via latch IC708. The SS* pin is used to enable each of the slaved DSP SPI ports for transfer.

DSP IC700 pins 56 and 57 receive serial stereo audio from the digital and analog inputs. These are the two input ports of the synchronous serial audio interface (SAI) receiver internal to the DSP. The communication protocol is SPI with DSP as a slave, and L/R input A/D converter IC312 as master. Left and right data words, each of 32-bit length, constitute a frame. Eighteen significant bits are received from the analog input A/D and twenty significant bits are received from the digital input SRC. The two serial stereo audio streams are received simultaneously. Both inputs share the same frame clock, L*/R (32 kHz) provided to DSP IC700 pin 55 and the same bit clock, SCK (2.048 MHz) provided to DSP IC700 pin 51.

Communication between DSP chips IC700 (first) thru IC707 (last) is one-way, in series from the first to the last. Two of the on-board SAI peripherals on each DSP are used to transfer eight words each per frame chip-to-chip. The SPI communication protocol (two 32-bit words per cycle of the word clock) is used with the DSPs as slaves, and the 2200/2200-D system clocking as master. Data is sent from the two transmit data port pins 46 and 47 of one chip to the next chip's receive data port pins 56 and 57. A 128 kHz word clock is provided to the transmit pin 50 and the receive pin 55. An 8.192 MHz bit clock is provided to the transmit pin 49 and the receive pin 51. The SAI links between DSPs are synchronized to each other (to align the SAI time slots) by making the first occurrence of all IRQBs coincident, (controlled by Z180 and external hardware) and having all

DSPs initialize their SAI ports on the first reception of IRQB.

The "analog" and digital outputs are transferred respectively to the L/R output D/A and the output SRC from the second to the last DSP chip (IC706). These signals are identical except for any De-Emphasis, J.17 Pre-Emphasis, J.17 Emphasis makeup gain, or output attenuation (DO 100% level) applied to the digital output. The "analog" output is also passed on to the last DSP chip (IC707) for stereo encoding. ("Analog"refers to DSP signal that ultimately gets converted to analog.)

The composite FM stereo signal is output from the last DSP chip (IC707) via its SAI transmitter, formed by DSP IC707 pins 47, 49, and 50. A communication protocol compatible with the composite D/A (IC500) is used with the DSP and D/A as slave and the 2200/2200-D system clocking as master. The serial composite audio bit stream output on pin 47 feeds D/A IC500 pin 7. DSP IC707 pin 50 receives a 128 kHz frame clock and pin 49 receives an 8.192 MHz bit clock. Two consecutive composite audio data words, each of 32-bit length, constitute a frame.

Power Supply

The power supply converts an AC line voltage input to various power sources used by the 2200/2200-D. Five linear regulators provide ±15VDC and ±5VDC for the analog circuits and +5VDC for the digital circuits. An unregulated voltage powers the LED meters and the LED backlight on the LCD display.

Component-Level Description:

L1 is a power line filter that filters out RFI. F1 is a ½-amp "Slo-Blo" fuse. T1 is a dual-primary dual-secondary power transformer used to step down the input voltage for the ±15VDC analog and +5VDC digital supply regulators. Each primary winding has a metal-oxide varistor (V1, V2) connected in parallel to suppress high-voltage spikes across the AC line. Rear panel switch S1 configures the primary windings either in parallel (for 115V ±15% line voltages) or series (for 230V ±15% line voltages).

T1 has two pairs of secondary windings for stepping down the AC line voltage. The lower voltage pair is configured in parallel, and feeds storage capacitors C15 and C19 through full-wave bridged rectifier diodes CR13, CR14, CR15, CR17, and CR18. C15 filters the rectified voltage for input to low-dropout linear voltage regulator IC5, which provides the +5VDC source used to power all of the digital circuits in the 2200/2200-D. C19 filters the rectified voltage to power the LED backlight on the LCD display, and the LED meters. Components Q1, Q2, R3-R7, and CR20 form a pulsed current source to illuminate the 25x2 LED array (the backlight on the LCD display). The signal LEDPULSE, a 32 kHz pulse at ⅛ duty cycle, feeds the base of high-current Darlington transistor Q1. The feedback circuit consisting of Q2, CR20 and R3-R7 controls the magnitude of the signal LEDPULSE so as to limit Q1's current pulses to about 1.5A (1/8 duty cycle). These current pulses illuminate the 25 x 2 LED array via keyed header J201, which attaches the LED array between the collector of Q1 and supply cap C19. The signal LEDPULSE is gated on for approximately one hour after the 2200 has last been powered up or a front panel button has last been pressed; otherwise, it is

gated off. This drastically increases the lifetime of the LCD display and saves about two Watts of power. The LED meter circuits are described in *User Control Interface and LED Display Circuits* on page 6-9.

The higher voltage pair of transformer secondary windings is configured in series to form a single center-tapped winding. This winding is connected to rectifier diodes CR1-CR4 in a full-wave center tap configuration. C1 and C2 filter the rectified voltage for input to the voltage regulators IC1 and IC2. These regulators provide the +15VDC and –15VDC sources used to power most of the analog circuits in the 2200/2200-D. They also serve as the respective inputs to the voltage regulators IC3 and IC4. These regulators provide the +5VDC and –5VDC analog supplies for the converter chips, which draw only a modest amount of current.

Test points and supply bypass capacitors are placed throughout the PC board. S2 is the ground lift switch used to connect or lift 2200/2200-D circuit ground from chassis ground.

Abbreviations

Some of the abbreviations used in this manual may not be familiar to all readers:

A/D (or A to D)	analog-to-digital converter
AES	Audio Engineering Society
AGC	automatic gain control
A-I	analog input
A-O	analog output
BAL	balanced (refers to an audio connection with two active conductors and one shield surrounding them).
BBC	British Broadcasting Corporation
BNC	a type of RF connector
CALIB	calibrate
CIT	composite isolation transformer
CMOS	complementary metal-oxide semiconductor
COM	serial data communications port
D/A (or D to A)	digital-to-analog converter
dBm	decibel power measurement. 0 dBm = 1mW applied to a specified load. In audio, the load is usually 600Ω. In this case only, 0 dBm = 0.775V rms.
dBu	decibel voltage measurement. 0 dBu = 0.775V RMS. For this application, the dBm-into-600Ω scale on voltmeters can be read as if it were calibrated in dBu.
DI	digital input
DJ	disk jockey, an announcer who plays records in a club or on the air
DO	digital output
DOS	Microsoft disk operating system for IBM PC
DSP	digital signal processor (or processing). May also refer to a special type of microprocessor optimized for efficiently executing arithmetic.
EBU	European Broadcasting Union
EBS	Emergency Broadcasting System (U.S.A.)
EMI	electromagnetic interference
ESC	escape
FCC	Federal Communications Commission (USA regulatory agency)

FDNR	frequency-dependent negative resistor—an element used in RC-active filters
FET	field effect transistor
FFT	fast Fourier transform
FIFO	first-in, first-out
G/R	gain reduction
HF	high-frequency
HP	high-pass
IC	integrated circuit
IM	intermodulation (or “intermodulation distortion”)
I/O	input/output
ITU	International Telecommunications Union (formerly CCIR). ITU-R is the arm of the ITU dedicated to radio.
JFET	junction field effect transistor
LC	inductor/capacitor
LCD	liquid crystal display
LED	light-emitting diode
LF	low-frequency
LP	low-pass
LVL	level
MHF	midrange/high-frequency
MLF	midrange/low-frequency
MOD	modulation
N&D	noise and distortion
N/C	no connection
OSHOOT	overshoot
PC	IBM-compatible personal computer
PCM	pulse code modulation
PPM	peak program meter
RAM	random-access memory
RC	resistor/capacitor
RDS/RBDS	Radio (Broadcasting) Data Service—a narrowband digital subcarrier centered at 57 kHz in the FM baseband that usually provides program or network-related data to the consumer in the form of text that is displayed on the radio. Occupied bandwidth is ±2500 Hz.
REF	reference
RF	radio frequency
RFI	radio-frequency interference
RMS	root-mean-square
ROM	read-only memory
SC	subcarrier
SCA	subsidiary communications authorization — a non program-related subcarrier in the FM baseband above 23 kHz (monophonic) or 57 kHz (stereophonic)
S/P-DIF	Sony/Philips digital interface
TRS	tip-ring-sleeve (2-circuit phone jack)
THD	total harmonic distortion
TX	transmitter
μs	Microseconds. For FM pre-emphasis, the +3 dB frequency is $1/(2\pi\tau)$, where τ is the pre-emphasis time constant, measured in seconds.
VCA	voltage-controlled amplifier
VU	volume unit (meter)
XLR	a common style of 3-conductor audio connector
XTAL	crystal

Parts List

Obtaining Spare Parts

Special or subtle characteristics of certain components are exploited to produce an elegant design at a reasonable cost. It is therefore unwise to make substitutions for listed parts. Consult the factory if the listing of a part includes the note "selected" or "realignment required."

Orban normally maintains an inventory of tested, exact replacement parts that can be supplied quickly at nominal cost. Standardized spare parts kits are also available. When ordering parts from the factory, please have available the following information about the parts you want:

Orban part number
Reference designator (e.g., C3, R78, IC14)
Brief description of part
Model, serial, and "M" (if any) number of unit — see rear-panel label

To facilitate future maintenance, parts for this unit have been chosen from the catalogs of well-known manufacturers whenever possible. Most of these manufacturers have extensive worldwide distribution and may be contacted through their local offices. Addresses for each manufacturer's USA headquarters are given on page 6-43.

About the Parts List

Parts are listed by ASSEMBLY, then by ECO (engineering change order) NUMBER (in chorological order, earliest to latest), then by TYPE, then by REFERENCE DESIGNATOR. The ECO can be found on the schematics for each version of the assembly. In this way, you can associate a given parts list to a given schematic.

Full parts lists are only shown for the oldest version of the board. After that, parts lists only show parts that have changed from one version to the next. [deleted] in a list indicates that a part existing in the next oldest version has been removed.

Widely used common parts are described generally below (examine the part to determine its exact value). See the following assembly drawings for locations of components.

- **Signal diodes**, if not listed by reference designator in the following parts list, are:

  Orban part number 22101-000; JEDEC part number 1N4148; also available from many other vendors. This is a silicon small-signal diode with ultra-fast recovery and high conductance. It can be replaced with 1N914 (BAY-61 in Europe).

  (BV: 75V min. @ Ir = 5μA; Ir: 25nA max. @ Vr = 20V; Vf: 1.0V max. @ If = 100mA; trr: 4ns max.)

- See Miscellaneous list for **Zener Diodes** (reference designator VRxx).
- **Resistors** should only be replaced with the same style and with the exact value marked on the resistor body. If the value marking is not legible, consult the schematic or the factory. Performance and stability will be compromised if you do not use exact replacements. Unless listed by reference designator in the following parts list, you can verify resistors by their physical appearance:
- **Metal film resistors** have conformally coated bodies, and are identified by five color bands or a printed value. They are rated at ⅛ watt @ 70°C, ±1%, with a temperature coefficient of 100 PPM/°C. Orban part numbers 20038-xxx through 20045-xxx, USA Military Specification MIL-R-10509 Style RN55D. Manufactured by R-Ohm (CRB-1/4FX), TRW/IRC, Beyschlag, Dale, Corning, and Matsushita.
- **Carbon film resistors** have conformally-coated bodies, and are identified by four color bands. They are rated at ¼ watt @ 70°C, ± 5%. Orban part numbers 20001-xxx, Manufactured by R-Ohm (R-25), Piher, Beyschlag, Dale, Phillips, Spectrol, and Matsushita.
- **Carbon composition resistors** have molded phenolic bodies, and are identified by four color bands. The 0.090 x 0.250 inch (2.3 x 6.4 mm) size is rated at ¼ watt, and the 0.140 x 0.375 inch (3.6 x 9.5 mm) size is rated at ½ watt, both ± 5%. Part numbers 2001x-xxx, USA Military Specification MIL-R-11 Style RC-07 (<$E1/4> watt) or RC-20 (<$E1/2> watt). Manufactured by Allen-Bradley, TRW/IRC, and Matsushita.
- **Cermet trimmer resistors** have ⅜-inch (9 mm) square bodies, and are identified by printing on their sides. They are rated at ½ watt @ 70°C, = ±10%, with a temperature coefficient of 100 PPM/°C. Orban part numbers 20510-xxx and 20511-xxx. Manufactured by Beckman (72P, 68W- series), Spectrol, and Matsushita.

Display Assembly

2200 PCA Display 31875.000.01 Rev 01, ECO 2216A

Schematic Rev 01	ECO 2216A	Displ r01	ECO 2216A
Orban Part #	**Description**	**Quantity**	**Reference Designators**
15057.010.01	SPACER, .100" HIGH	24	
15061.005.01	LED MNT,1 POS'N,.240"HIGH	6	CR203, CR204, CR206, CR214, CR215, CR216
20121.274.01	RESISTOR, METAL FILM 1/8W 1%	8	R200, R201, R203, R204, R205, R206, R207, R209
20125.100.01	RESISTOR,TF,1/8W,1%,100K	6	R202, R208, R210-R213
20226.184.01	RESISTOR, NETWORK, DIL PACKAGE,2%,180 OHM	1	RP200
21131.410.01	CAPACITOR, SUFACE-MOUNT 1206,0.1UF,50V,20%	2	C200, C201
24740.000.01	IC ULN2803LW SMD OCTAL	1	IC208
24741.000.01	IC UDN2982 SMD OCTAL	1	IC206
24851.000.01	IC,SOL20,SMT	1	IC204
24857.000.01	IC 74HC374 DLATCH SOL20	3	IC202, IC205, IC207

Schematic Rev 01	ECO 2216A	Displ r01	ECO 2216A
25106.001.01	LED,YELLOW,T-1,HIGH EFFICIENCY LAMP	5	CR200, CR201, CR202, CR214, CR215
25106.002.01	LED,GREEN,T-1,HIGH EFFICIENCY LAMP	3	CR203, CR204, CR206
25106.003.01	LED,RED,T-1,HIGH EFF LAMP	1	CR216
25167.000.01	LED,ARRAY,1 RED,1 YEL,8 GREEN	3	CR211, CR212, CR213
25168.000.01	LED,ARRAY,10 position,9 YEL,1 RED	3	CR208, CR209, CR210
31876.000.01	CIRCUIT BOARD, DISPLAY 2200	1	
42028.040.01	ASSEMBLY CABLE RIBBON 16PIN 4"	1	P203
61182.000.01	SCHEMATIC, DISPLAY 2200	0	

2200 PCA Display 31875.000.01 Rev 02, ECO 2234

Schematic Rev 01	ECO 2216A	Displ r02	ECO 2234
Orban Part #	**Description**	**Quantity**	**Reference Designators**
15057.010.01	SPACER, .100" HIGH	18	
27214.004.01	CABLE FLAT 4 COND	1	P202
31876.000.02	CIRCUIT BOARD, DISPLAY 2200	1	
42009.040.01	ASSEMBLY CABLE RIBBON 16PIN 4"	1	P203
42028.040.01	ASSEMBLY CABLE RIBBON 16PIN 4"	1	P203 [delete]

2200 PCA Display 31875.000.01 Rev 03, ECO 2310

Schematic Rev 01	ECO 2216A	Displ r03	ECO 2310
Orban Part #	**Description**	**Quantity**	**Reference Designators**
31876.000.03	CIRCUIT BOARD, DISPLAY 2200	1	
61182.000.01	SCHEMATIC, DISPLAY 2200	0	

2200 PCA Display 31875.000.01 Rev 04, ECO 2255

Schematic Rev 01	ECO 2216A	Displ r04	ECO 2255
Orban Part #	**Description**	**Quantity**	**Reference Designators**
20121.274.01	RESISTOR, METAL FILM 1/8W 1%	8	R200, R201, R203, R204, R205, R206, R207, R209, [delete]
20122.274.01	RESISTOR,274OHM 1%1/8W	8	R200, R201, R203, R204, R205, R206, R207, R209

2200 PCA Display 31875.000.01 Rev 05, ECO 2364

Schematic Rev 01	ECO 2216A	Displ r05	ECO 2364
[no difference]			

2200 PCA Display 31875.000.01 Rev 06, ECO 2418

Schematic Rev 01	ECO 2216A	Displ r06	ECO 2418
Orban Part #	**Description**	**Quantity**	**Reference Designators**
20122.274.01	RESISTOR,TF,1/8W,1%,274 ohm	8	R200, R201, R203-R207, R209
27218.004.01	CABLE,FLAT,8 LONG,4 CONDUCTOR	1	P202
42009.040.01	SUBASSEMBLY-CABLE-FLAT-16PIN-4	1	P203
61182.000.01	SCHEMATIC, DISPLAY 2200	0	
72876.000.02	CIRCUIT BOARD-DSPLY- 2200	0	

2200 PCA Display 31875.000.01 Rev 07, ECO 2463

Schematic Rev 02	ECO 2463	Displ r07	ECO 2463
Orban Part #	**Description**	**Quantity**	**Reference Designators**
20226.000.01	RESISTOR, NETWORK, DIL PACKAGE,2%,100 OHM	1	RP200
24740.000.01	IC ULN2803LW SMD OCTAL	1	IC208 [deleted]
24741.000.01	IC UDN2982 SMD OCTAL	1	IC206 [deleted]
24851.000.01	IC,SOL20,SMT	1	IC204
24857.000.01	IC 74HC374 DLATCH SOL20	1	IC202
24908.000.01	IC,OCTAL,D TYP,FLIP/FLOP	1	IC200
24932.000.01	IC, 74FCT534	2	IC205 IC206
31876.000.06	CIRCUIT BOARD, DISPLAY 2200	1	
61182.000.02	SCHEMATIC, DISPLAY 2200	0	

2200 PCA Display 31875.000.01 Rev 08, ECO 2575

Schematic Rev 03	ECO 2575	Displ r08	ECO 2575
Orban Part #	**Description**	**Quantity**	**Reference Designators**
24932.000.01	IC, 74FCT534	2	IC205, IC206 [deleted]
24936.000.01	IC,OCTAL D,FLIP/FLOP,3 ST	2	IC205, IC206
31876.000.06	CIRCUIT BOARD DISPLAY BOARD 2200	1	
61182.000.03	SCHEMATIC, DISPLAY 2200	0	

2200 PCA Display 31875.000.01 Rev 09, ECO 2766

Schematic Rev 03	ECO 2575	Displ r09	ECO 2766
Orban Part #	**Description**	**Quantity**	**Reference Designators**
15057.010.01	SPACER, .100" HIGH	24	

Schematic Rev 03	ECO 2575	Displ r09	ECO 2766
31876.000.07	CIRCUIT BOARD DISPLAY BOARD 2200	1	

Main Board

2200 PCA Main 31810.001 Rev 01, ECO 2216A, 2254, 2284

Schematic Rev 01	ECO 2216A	Main r01	ECO 2216A, 2254, 2284
Orban Part #	**Description**	**Quantity**	**Reference Designators**
15051.000.01	PAD,COMPONENT MOUNTING,.365	2	IC504, IC506
20020.025.01	RESISTOR,1/4W,0 ohm,(JUMPER)	4	R100, R349, R602, R603
20039.100.01	RESISTOR, METAL FILM,1/8W,1%,10 ohm	1	R611
20039.221.01	RESISTOR, METAL FILM,1/8W,1%,22.1 ohm	2	R125, R515
20039.392.01	RESISTOR, METAL FILM,1/8W,1%,39.2 ohm	4	R334, R337, R343, R346
20039.511.01	RESISTOR, METAL FILM,1/8W,1%,51.1 ohm	4	R348, R402, R403, R500
20039.750.01	RESISTOR, METAL FILM,1/8W,1%,75.0 ohm	2	R509, R512
20040.110.01	RESISTOR, METAL FILM,1/8W,1%,110 ohm	9	R129, R513, R514, R604, R600, R609, R610, R612, R613
20040.118.01	RESISTOR, METAL FILM,1/8W,1%,118 ohm	16	R108-R123
20040.249.01	RESISTOR, METAL FILM,1/8W,1%,249 ohm	2	R306, R322
20040.432.01	RESISTOR, METAL FILM,1/8W,1%,432 ohm	1	R353
20040.511.01	RESISTOR, METAL FILM,1/8W,1%,511 ohm	2	R307, R323
20040.604.01	RESISTOR, METAL FILM,1/8W,1%,604 ohm	4	R300, R316, R516, R517
20040.845.01	RESISTOR, METAL FILM,1/8W,1%,845 ohm	2	R303, R319
20041.100.01	RESISTOR, METAL FILM,1/8W,1%,1.00 kohm	6	R406, R425, R503, R508, R511, R601
20041.105.01	RESISTOR, METAL FILM,1/8W,1%,1.05 kohm	2	R310, R326
20041.182.01	RESISTOR, METAL FILM,1/8W,1%,1.82 kohm	2	R311, R327
20041.200.01	RESISTOR, METAL FILM,1/8W,1%,2.00 kohm	1	R216
20041.215.01	RESISTOR, METAL FILM,1/8W,1%,2.15 kohm	1	R608
20041.232.01	RESISTOR, METAL FILM,1/8W,1%,2.32 kohm	1	R505
20041.249.01	RESISTOR, METAL FILM,1/8W,1%,2.49 kohm	2	R338, R347
20041.294.01	RESISTOR, METAL FILM,1/8W,1%,2.94 kohm	2	R414, R433

Schematic Rev 01	ECO 2216A	Main r01	ECO 2216A, 2254, 2284
20041.301.01	RESISTOR, METAL FILM,1/8W,1%,3.01 kohm	2	R350, R606
20041.316.01	RESISTOR, METAL FILM,1/8W,1%,3.16 kohm	1	R607
20041.392.01	RESISTOR, METAL FILM,1/8W,1%,3.92 kohm	2	R312, R328
20041.402.01	RESISTOR, METAL FILM,1/8W,1%,4.02 kohm	2	R448, R453
20041.432.01	RESISTOR, METAL FILM,1/8W,1%,4.32 kohm	2	R446, R451
20041.499.01	RESISTOR, METAL FILM 1/8W 1% 4.99 Kohm	10	R301, R302, R317, R318, R335, R336, R344, R345, R405, R424
20041.634.01	RESISTOR, METAL FILM,1/8W,1%,6.34 kohm	2	R313, R329
20041.665.01	RESISTOR, METAL FILM,1/8W,1%,6.65 kohm	2	R331, R340
20042.100.01	RESISTOR, METAL FILM,1/8W,1%,10.0 kohm	15	R101, R102, R104, R105, R107, R128, R214, R215, R314, R315, R351, R404, R423, R434, R443
20042.133.01	RESISTOR, METAL FILM,1/8W,1%,13.3 kohm	1	R605
20042.150.01	RESISTOR, METAL FILM,1/8W,1%,15.0 kohm	1	R352
20042.200.01	RESISTOR, METAL FILM,1/8W,1%,20.0 kohm	5	R103, R330, R339, R507, R510
20042.475.01	RESISTOR, METAL FILM,1/8W,1%,47.5 kohm	8	R308, R309, R324, R325, R409, R410, R427, R429
20042.499.01	RESISTOR, METAL FILM,1/8W,1%,49.9 kohm	4	R407, R408, R426, R428
20042.698.01	RESISTOR, METAL FILM,1/8W,1%,69.8 kohm	2	R332, R341
20042.750.01	RESISTOR, METAL FILM,1/8W,1%,75.0 kohm	1	R614
20043.100.01	RESISTOR, METAL FILM,1/8W,1%,100 kohm	37	R126, R304, R305, R320, R321, R700-R731
20043.432.01	RESISTOR, METAL FILM,1/8W,1%,432 kohm	1	R504
20044.100.01	RESISTOR, METAL FILM,1/8W,1%,1 MEG	4	R333, R342, R444, R449
20044.365.01	RESISTOR, METAL FILM,1/8W,1%,3.65 MEG	4	R445, R447, R450, R452
20045.100.01	RESISTOR, METAL FILM,1/8W,1%,10 MEG	1	R506
20056.154.01	RESISTOR, METAL FILM,1/8W,0.1%,15.4 ohm	4	R413, R420, R432, R440
20058.301.01	RESISTOR, METAL FILM,1/8W,0.1%,3.01 koh	2	R418, R438
20058.357.01	RESISTOR, METAL FILM,1/8W,0.1%,3.57 kohm	1	R501
20058.453.01	RESISTOR, METAL FILM,1/8W,0.1%,4.53 kohm	4	R416, R417, R436, R437
20058.464.01	RESISTOR, METAL FILM,1/8W,0.1%,4.64 kohm	4	R415, R419, R435, R439
20058.475.01	RESISTOR, METAL FILM,1/8W,0.1%,4.75 kohm	1	R502

Schematic Rev 01	ECO 2216A	Main r01	ECO 2216A, 2254, 2284
20059.102.01	RESISTOR, METAL FILM,1/8W,0.1%,10.2 koh	4	R412, R422, R431, R442
20059.133.01	RESISTOR, METAL FILM,1/8W,0.1%,13.3 kohm	4	R411, R421, R430, R441
20080.301.01	RESISTOR, METAL FILM,1/2W,1%,301 ohm	1	R127
20221.101.01	RESISTOR,NETWORK, SIP,2%,100K,10PIN	2	R106, R124
20511.310.01	TRIMPOTS,10K,20%,TOP ADJ	2	VR400, VR401
20512.325.01	TRIMPOTS, CERMET 15T 25K	2	VR500, VR501
20513.000.01	ADAPTER, TRIMPOT	2	
21017.015.01	CAPACITOR,RAD LEADS,15PF,500V	1	C509
21017.022.01	MICA 1/2PF CD15 22PF	2	C521, C522
21017.033.01	CAPACITOR,RAD LEADS,33PF,500V	1	C518
21018.051.01	CAPACITOR,RADIAL LEADS,51PF,500V,1%	3	C513, C514, C516
21018.122.01	CAPACITOR,RADIAL LEADS,220PF,500V,1%	1	C512
21018.139.01	CAPACITOR,RADIAL LEADS,390PF,500V,1%	1	C508
21022.162.01	CAPACITOR,RADIAL LEADS,620PF,500V,1%	1	C511
21022.182.01	CAPACITOR,RADIAL LEADS,820PF,500V,1%	1	C510
21022.210.01	CAPACITOR,RADIAL LEADS,1000PF,500V	2	C411, C417
21022.215.01	CAPACITOR,RADIAL LEADS,1500PF,500V	2	C410, C416
21127.010.01	CAPACITOR,AXIAL LEADS,10PF,100V,5%	2	C412, C418
21127.033.01	CAPACITOR,AXIAL LEADS,33PF,100V,5%	9	C103, C409, C415, C515, C519, C600, C608, C612, C613
21127.068.01	CAPACITOR,AXIAL LEADS,68PF,100V,5%	1	C517
21127.115.01	CAPACITOR,AXIAL LEADS,150PF,100V,5%	1	C604
21127.168.01	CAPACITOR,AXIAL LEADS,680PF,100V,5%	2	C523, C525
21127.210.01	CAPACITOR,AXIAL LEADS,1NF,100V,5%	4	C323, C324, C325, C326
21131.410.01	CAPACITOR, SUFACE-MOUNT 1206,0.1UF,50V,20%	105	C11-C53, C56-C62, C66-C71, C73-C78, C85-C90, C100, C101, C200, C306, C307, C311, C313, C314, C316-C319, C321, C322, C401, C402, C404, C405, C413, C500, C503, C504, C506, C524, C601, C603, C606, C609, C611, C801, C803, C805, C807, C809, C811, C812, C815
21209.522.01	CAPACITOR,RAD,LDS,2.2UF,63V,20%	1	C102
21263.610.01	CAPACITOR,RADIAL LEADS,10uF,25V,10%	5	C82-C84, C91, C92
21263.710.01	CAPACITOR,RADIAL	1	C607

Schematic Rev 01	ECO 2216A	Main r01	ECO 2216A, 2254, 2284
	LEADS,100uF,25V,10%		
21303.710.01	CAPACITOR,RADIAL LEADS,100UF,10V,10%	1	C308
21305.610.01	CAPACITOR,RADIAL LEADS,10UF,20V,10%	1	C406
21307.510.01	CAPACITOR,RADIAL LEADS,1.0UF,35V,10%	10	C312, C315, C320, C400, C403, C414, C501, C502, C505, C507
21445.247.01	CAPACITOR,M/POLY,.0047UF,50V,5%	4	C302-C305
21445.310.01	CAPACITOR,M/POLY,.01UF,50V,5%	10	C407, C408, C800, C802, C804, C806, C808, C810, C813, C814
21445.347.01	CAP M/PLYES 50V 5% .04UF	1	C602
21445.410.01	CAPACITOR,M/POLY,0.1UF,50V,5%	6	C201, C300, C301, C419, C420, C520
21445.422.01	CAPACITOR,M/POLY,.22UF,50V,5%	2	C309, C310
21445.510.01	CAPACITOR,M/POLY,1.0UF,50V,5%	1	C605
22102.001.01	DIODE 1N5711TR	8	CR300-CR307
22201.400.01	DIODE REC IN4004 PRV400V	8	CR102-CR109
23402.101.01	TRANSISTOR,JFET/N	4	Q300-Q303
23406.101.01	TRANSISTOR	4	Q400-Q403
24008.202.01	IC,LINEAR,SNGL OP-AMP	3	IC502, IC503, IC505
24207.202.01	IC,LINEAR,DUAL OP AMP	4	IC302, IC311, IC403, IC406
24209.202.01	IC,LINEAR,DUAL OP AMP	6	IC301, IC310, IC402, IC405, IC408, IC501
24643.000.01	IC,CS5389 DIP/28 600 WIDE	1	IC312
24644.000.01	IC,D/AUDIO TX CS8401A	1	IC616
24707.102.01	IC,LT1010 OBS USE 24026	2	IC504, IC506
24710.302.01	IC,SPECIAL FUNCTION,4 COMPARTR	2	IC306, IC407
24714.302.01	IC,MULTIPLYING DAC,8 BIT	2	IC401, IC404
24727.402.01	IC,SLF CONTND AUD,PREAMP	2	IC300, IC308
24728.302.01	IC,QUAD,SPST SWITCH,DIP/16	2	IC307, IC309
24733.000.01	IC,ST ASYNC S.R.C AD1890JP	2	IC603, IC615
24742.000.01	IC, AD1861N DIP/16	1	IC500
24817.000.01	IC,SRAM,32K X 8	1	IC106
24821.000.01	IC,CS4328KP	1	IC400
24822.000.01	IC,PLCC/68,SMD	1	IC100
24829.000.01	IC,TMS27C010A 10JL DIP/32	1	IC105
24847.000.01	IC,D/AUDIO INT REC CS8412CS	1	IC600
24850.000.01	IC,SO/14,SMT	5	IC201, IC314, IC606, IC614, IC710
24851.000.01	IC,SOL20,SMT	2	IC120, IC601
24853.000.01	IC,74HC00 SIOC/14 SMD	1	IC602
24857.000.01	IC,74HC374 DLATCH SOL20	6	IC303, IC305, IC609, IC611, IC708, IC709
24858.000.01	IC,SO/14,SMT	3	IC313, IC604, IC612
24872.000.01	IC,DIP/8	1	IC122
24896.000.01	IC,74HC153 SOIC/16 SMD	1	IC610
24897.000.01	IC,QFP/80,SMT	8	IC700-IC707
24898.000.01	IC,NM25C04M8	1	IC107
24899.000.01	IC,SO/16,SMT	4	IC101-IC104
24900.000.01	IC,HEX INVERTER,SMT	4	IC109, IC118, IC119, IC605
24901.000.01	IC,S016 HC/HCT4046A	1	IC619
24902.000.01	IC,74HC373 SMT SOL20	1	IC304
25003.000.01	IC,OPTOISOLATOR	8	IC110-IC117
26081.000.01	SWITCH,ROTARY,HORIZONTAL	1	S209

Schematic Rev 01	ECO 2216A	Main r01	ECO 2216A, 2254, 2284
	MNT,2 BIT		
27017.025.01	CONNECTOR,RIGHT ANGLE,PC MOUNT,25 P	1	J101
27053.003.01	CONNECTOR,MALE,INSERT,RIGHT ANGLE	3	J400, J401, J601
27054.003.01	CONNECTOR,FEM,INSERT,RIGHT ANGLE	3	J300, J304, J600
27106.000.01	CONNECTOR,BNC,RIGHT ANGLE,PC MOUNT	2	J500, J501
27147.008.01	IC,SOCKET,DIP,8 PINS,DUAL	6	IC300, IC308, IC403, IC406, IC503, IC505
27147.020.01	IC,SOCKET,DIP,20 PIN,DUAL	2	IC613, IC618
27147.024.01	IC SOCKET 24PIN DIP	1	IC616
27147.032.01	IC,SOCKET,DIP,32 PIN,DUAL	1	IC105
27161.016.01	IC SOCKET DIP/16	3	J203, J900, J901
27165.128.01	IC, SOCKET DIP/28	2	IC312, IC400
27401.000.01	CONNECTOR,JUMPER,RECPT,BLACK	9	JA, JB, J301, J302, J303, J305, J306, J307, J308
27406.014.01	CONNECTOR,SOCKET,STRIP,14 PIN	1	J200
27421.004.01	CONNECTOR,HEADER,DBL RW,4P,2 X 2	6	JA, JB, J302, J303, J306, J307
27421.006.01	CONNECTOR,HEADER,DBL RW,6P,2 X 3	1	J100
27426.003.01	CONNECTOR,HEADER,3 PIN,SINGLE RW	3	J301, J305, J308
27630.001.01	JUMPER,PC MOUNT,TEST POINT	32	TP1-TP6, TP300-TP305, TP400-TP403, TP500, TP501, TP600-607, TP609-611, TP700, TP701, TP901
28071.000.01	OSC-XTAL-11.2896MHz-50PPM	1	Y601
28073.001.01	OSC-XTAL-8.192MHz-50PPM	1	Y602
29015.000.01	TRANSFORMER PULSE 1:1 AES/EBU	2	T600-601
29501.004.01	INDUCTOR-.007mH-OHMITE Z-50	8	L100, L400, L401, L404, L405, L802-L804
29503.000.01	INDUCTOR-1.2mH-MILLER 73F	4	L301, L303, L305, L307
29505.002.01	BEAD, FERRITE .56" ID	9	
29508.210.01	FLTR-EMI SUPPRESSION-50V-	12	L300, L302, L304, L306, L402, L403, L406, L407, L600-603
29705.008.01	INDUCTOR-9.725MH-1%-SELECTED	1	L500
29705.009.01	INDUCTOR-10.41MH-1%-SELECTED	1	L502
29705.012.01	INDUCTOR-12.91MH-1%-SELEC	1	L501
31811.000.01	CIRCUIT BOARD MAIN 2200	1	
44031.100.01	ASSEMBLY-PAL-PRGD-N_DIV.JED-2	1	IC618
44032.100.01	ASSEMBLY-PAL-PRGD-8B_CNTR.JED	1	IC613
61171.000.01	SCHEMATIC, MAIN 2200D	0	

2200 PCA Main 31810.001 Rev 01, ECO 2227

Schematic Rev 02	ECO 2227	Main r01	ECO 2227
Orban Part #	**Description**	**Quantity**	**Reference Designators**
20040.604.01	RESISTOR, METAL FILM,1/8W,1%,604 ohm	2	R300, R316

Schematic Rev 02	ECO 2227	Main r01	ECO 2227
20221.101.01	RESISTOR,NET,SIP,2%,100K,10PIN	3	R106, R124, R615
21131.410.01	CAPACITOR, SUFACE-MOUNT 1206,0.1UF,50V,20%	105	C11-C53, C56-C62, C66-C71, C73-C78, C85-C90, C100, C101, C200, C306, C307, C311, C313, C314, C316-C319, C321, C322, C401, C402, C404, C405, C413, C500, C503, C504, C506, C524, C601, C603, C606, C609, C611, C801, C803, C805, C807, C809, C811, C813, C815
21445.310.01	CAPACITOR,M/POLY,.01UF,50V,5%	10	C407, C408, C800, C802, C804, C806, C808, C810, C812, C814
27147.124.01	IC SOCKET 24PIN DIP	1	IC616
28074.001.01	OSC-XTAL-16.384MHz-50PPM	1	Y602
31811.000.02	CIRCUIT BOARD MAIN 2200	1	

2200 PCA Main 31810.001 Rev 01, ECO 2253

Schematic Rev 03	ECO 2253	Main r01	ECO 2253
Orban Part #	**Description**	**Quantity**	**Reference Designators**
20040.604.01	RESISTOR, METAL FILM,1/8W,1%,604 ohm	4	R300, R316, R516, R517
20512.325.01	TRIMPOTS,CERMET 15T 25K	2	VR500, VR501
21019.027.01	CAPACITOR, 1/2PF CD15	2	C521, C522
27147.124.01	IC,SOCKET,DIP,24 PIN,DUAL	1	IC616
31811.000.03	CIRCUIT BOARD MAIN 2200	1	
44058.110.01	ASSEMBLY-EPROM-PROGRAMED-V1.1	1	IC105
61171.000.03	SCHEMATIC, MAIN 2200D	0	

2200 PCA Main 31810.001 Rev 02, ECO 2416, 2416A, 2408

Schematic Rev 04	ECO 2416, 2416A, 2491	Main r02	ECO 2416, 2416A, 2408
Orban Part #	**Description**	**Quantity**	**Reference Designators**
16015.000.01	HEAT SINK	1	
20039.221.01	RESISTOR, METAL FILM,1/8W,1%,22.1 ohm	2	R125
20040.200.01	RESISTOR, METAL FILM,1/8W,1%,200 ohm	2	R508, R511
20041.100.01	RESISTOR, METAL FILM,1/8W,1%,1.00 kohm	6	R406, R425, R503, R508, R511, R601,
20041.402.01	RESISTOR, METAL FILM,1/8W,1%,4.02 kohm	2	R448, R453,
20512.325.01	TRIMPOTS, CERMET 20T 5K	2	VR500, VR501
21019.027.01	CAPACITOR, 27pF MICA CD15	2	C521, C522
24643.000.01	IC, CS85389	1	IC312
27161.016.01	IC,SOCKET,DIP,16 PIN	3	J203, J900, J901

29505.002.01	BEAD, FERRITE, .56" ID	9	
61171.000.04	SCHEMATIC, MAIN 2200D	0	

2200 PCA Main 31810.001, Rev 03, ECO 2449, 2459, 2475

Schematic Rev 04	ECO 2416, 2416A, 2491	Main r03	ECO 2449, 2459, 2475
Orban Part #	**Description**	**Quantity**	**Reference Designators**
27147.008.01	IC,SOCKET,DIP,8 PINS,DUAL	8	IC300, IC308, IC402, IC403, IC405, IC406, IC503, IC505

2200 PCA Main 31810.001, Rev 04, ECO 2471

Schematic Rev 04	ECO 2416, 2416A, 2491	Main r04	ECO 2471
Orban Part #	**Description**	**Quantity**	**Reference Designators**
31811.000.04	CIRCUIT BOARD MAIN 2200	1	

2200 PCA Main 31810.001, Rev 05, ECO 2491

Schematic Rev 04	ECO 2416, 2416A, 2491	Main r05	ECO 2491
Orban Part #	**Description**	**Quantity**	**Reference Designators**
24933.000.01	IC, CS5390KP 20 BIT	1	IC312

2200 PCA Main 31810.001, Rev 06, ECO 2492

Schematic Rev 04	ECO 2416, 2416A, 2491	Main r06	ECO 2492
Orban Part #	**Description**	**Quantity**	**Reference Designators**
31811.000.05	CIRCUIT BOARD MAIN 2200	1	

2200 PCA Main 31810.001, Rev 07, ECO 2531

Schematic Rev 04	ECO 2416, 2416A, 2491	Main r07	ECO 2531
[no difference]			

2200 PCA Main 31810.001 Rev 08, ECO 2552

Schematic Rev 05	ECO 2552	Main r08	ECO 2552
Orban Part #	**Description**	**Quantity**	**Reference Designators**
20020.025.01	RESISTOR,1/4W,0 ohm,(JUMPER)	6	R100, R131, R349, R515, R602, R603
20039.221.01	RESISTOR, METAL FILM,1/8W,1%,22.1 ohm	1	R125
20041.100.01	RESISTOR, METAL FILM,1/8W,1%,1.00 kohm	4	R406, R425, R503, R601

Schematic Rev 05	ECO 2552	Main r08	ECO 2552
20041.402.01	RESISTOR, METAL FILM,1/8W,1%,4.02 kohm	4	R448, R453, R507, R510
20042.100.01	RESISTOR, METAL FILM,1/8W,1%,10.0 kohm	16	R101, R102, R104, R105, R107, R128, R130, R214, R215, R314, R315, R351, R404, R423, R434, R443
20042.200.01	RESISTOR, METAL FILM,1/8W,1%,20.0 kohm	3	R103, R330, R339
20512.250.01	TRIMPOTS, CERMET 20T 5K	2	VR500, VR501
21018.012.01	CAPACITOR,MIC 500V ,1% 120PF	2	C521, C522
21131.410.01	CAPACITOR, SUFACE-MOUNT 1206,0.1UF,50V,20%	105	C11-C53, C56-C62, C66-C71, C73-C78, C85-C90, C100, C101, C200, C306, C307, C311, C313, C314, C316-C319, C321, C322, C401, C402, C404, C405, C413, C500, C503, C504, C506, C524, C601, C603, C606, C609, C611, C801, C803, C805, C807, C809, C811, C812, C815
21445.310.01	CAPACITOR,M/POLY,.01UF,50V,5%	10	C407, C408, C800, C802, C804, C806, C808, C810, C813, C814
61171.000.05	SCHEMATIC, MAIN 2200D	0	

2200 PCA Main 31810.001 Rev 09, ECO 2727

Schematic Rev 05	ECO 2552	Main r09	ECO 2727
Orban Part #	**Description**	**Quantity**	**Reference Designators**
27171.028.01	IC, SOCKET 28P PLCC SMT	2	IC603, IC615

2200 PCA Main 31810.001 Rev 10, ECO 2772

Schematic Rev 05	ECO 2552	Main r10	ECO 2772
Orban Part #	**Description**	**Quantity**	**Reference Designators**
27165.128.01	IC, SOCKET DIP/28	2	IC312, IC400 [deleted]

2200 PCA Main 31810.001 Rev 11, ECO 2786

Schematic Rev 06	ECO 2786	Main r11	ECO 2786
Orban Part #	**Description**	**Quantity**	**Reference Designators**
20020.025.01	RESISTOR,1/4W,0 ohm,(JUMPER)	6	R100, R131, R349, R401, R515, R602, R603
20080.300.01	RESISTOR, METAL FILM,1/2W,1%,300 ohm	1	R127
20512.250.01	TRIMPOTS,5K,20%,SIDE ADJ	2	VR500, VR501
21018.012.01	CAPACITOR,RADIAL LEADS,120PF,500V,1%	2	C521, C522
21127.010.01	CAPACITOR,AXIAL	4	C412, C418, C421, C422

Schematic Rev 06	ECO 2786	Main r11	ECO 2786
	LEADS,10PF,100V,5%		
21445.347.01	CAPACITOR,METALIZED POLYESTER,.047UF,50V,5%	1	C602
27630.001.01	JUMPER,PC MOUNT,TEST POINT	32	TP1-TP6, TP300-TP305, TP400-TP403, TP500, TP501, TP600-607, TP609-611, TP700, TP701, TP901
31811.000.06	CIRCUIT BOARD MAIN 2200	1	
61171.000.06	SCHEMATIC, MAIN 2200D	0	

2200 PCA Main 31810.001 Rev 12, ECO 2869

Schematic Rev 07	ECO 2869	Main r12	ECO 2869
Orban Part #	**Description**	**Quantity**	**Reference Designators**
20041.182.01	RESISTOR, METAL FILM,1/8W,1%,1.82 kohm	4	R311, R327, R331, R340
20041.665.01	RESISTOR, METAL FILM,1/8W,1%,6.65 kohm	2	R332, R341
32140.000	CIRCUIT BOARD ASSEMBLY A/D ADAPT 5390-5394	1	IC312
61171.000.07	SCHEMATIC, MAIN 2200D	0	

2200 PCA Main 31810.001 Rev 13, ECO 2878

Schematic Rev 08	ECO 2878	Main r13	ECO 2878
Orban Part #	**Description**	**Quantity**	**Reference Designators**
24026.000.01	IC, BUF634T TO220	2	IC504, IC506
61171.000.08	SCHEMATIC, MAIN 2200D	0	

2200 PCA Main 31810.001 Rev 14, ECO 2934

Schematic Rev 09	ECO 2934	Main r14	ECO 2934
Orban Part #	**Description**	**Quantity**	**Reference Designators**
20040.174.01	RESISTOR, METAL FILM 1/8W 174ohm	2	R303 R319
24030.000.01	IC, OPAMP RPL2017 DIP8	2	IC300 IC308
44058.110.01	ASSEMBLY-EPROM-PROGRAMED-V1.1	1	IC105
61171.000.09	SCHEMATIC, MAIN 2200D	0	

2200 PCA Main 31810.001 Rev 15, ECO 2995

Schematic Rev 10	ECO 2995	Main r15	ECO 2995
Orban Part #	**Description**	**Quantity**	**Reference Designators**
20039.100.01	RESISTOR, METAL FILM,1/8W,1%,10 ohm	1	R611 [deleted]

Schematic Rev 10	ECO 2995	Main r15	ECO 2995
20041.215.01	RESISTOR, METAL FILM,1/8W,1%,2.15 kohm	1	R608 [deleted]
20041.301.01	RESISTOR, METAL FILM,1/8W,1%,3.01 kohm	1	R350
20041.316.01	RESISTOR, METAL FILM,1/8W,1%,3.16 kohm	1	R607 [deleted]
20042.133.01	RESISTOR, METAL FILM,1/8W,1%,13.3 kohm	1	R605 [deleted]
20042.750.01	RESISTOR, METAL FILM,1/8W,1%,75.0 kohm	1	R614 [deleted]
21127.115.01	CAPACITOR,AXIAL LEADS,150PF,100V,5%	1	C604 [deleted]
21263.710.01	CAPACITOR,RADIAL LEADS,100uF,25V,10%	1	C607 [deleted]
21131.410.01	CAPACITOR, SUFACE-MOUNT 1206,0.1UF,50V,20%	104	C11-C53, C56-C62, C66-C71, C73-C78, C85-C90, C100, C101, C200, C306, C307, C311, C313, C314, C316-C319, C321, C322, C401, C402, C404, C405, C413, C500, C503, C504, C506, C524, C601, C603, C609, C611, C801, C803, C805, C807, C809, C811, C812, C815
21445.510.01	CAPACITOR,M/POLY,1.0UF,50V,5%	1	C605
24901.000.01	IC,S016 HC/HCT4046A	1	IC619 [deleted]
27147.020.01	IC,SOCKET,DIP,20 PIN,DUAL	1	IC613
32220.000	PC ASY, 4046 CLOCK ADAPTER	1	
61171.000.10	SCHEMATIC, MAIN 2200D	0	
62220.000.01	SCHEMATIC, 4046 CLOCK ADAPTER	0	

2200 PCA Main 31810.001 Rev 16, ECO 3041

Schematic Rev 10	ECO 2995	Main r16	ECO 3041
Orban Part #	**Description**	**Quantity**	**Reference Designators**
24821.000.01	IC CS4328KP	1	IC400 [deleted]
32225.000	CIRCUIT BOARD ASSEMBLY ADAPTER, CS4328	1	

Power Supply

2200 Power Supply 31865.000 Rev 01

Schematic Rev 01	ECO 2216	Power r01	31865.000
Item	**Description**	**Quantity**	**Reference Designators**
10012.405.01	SCREW,MS,SEM,PH,4-40 X 5/16	2	
10012.406.01	SCREW,MS,SEM,P/P,4-40 X 3/8	2	
12001.408.01	NUT,HEX,STL,C2,4-40 X 1/4	2	
15023.001.01	INSULATOR,SILICONE TO-3	1	IC5

Schematic Rev 01	ECO 2216	Power r01	31865.000
15025.000.01	TRANSISTOR,MTG,KIT TO 220	2	IC1, IC2
16013.000.01	HEATSINK,CLIP-ON TO 220	3	IC3, IC4, Q1
20021.920.01	RESISTOR,CF,1/2W,5%,2.0 ohm	4	R3-R6
20039.221.01	MF 1/8W 1% 22.1 OHM	1	R2
20042.100.01	RESISTOR, METAL FILM,1/8W,1%,10.0 kohm	1	R7
21129.410.01	CAPACITOR,AXIAL LEADS,0.1uF,50V,20%	11	C3, C4, C, 7-C10, C12, C13, C16, C17, C20
21206.747.01	CAPACITOR,RADIAL LEADS,470UF,25V,20%	1	C18
21255.000.01	CAPACITOR,SNP IN,6800uF,16V,20%	1	C15
21256.000.01	CAPACITOR,RADIAL LEAD,1000uF,35V,20%	3	C1, C2, C19
21263.710.01	CAPACITOR,RADIAL LEADS,100uF,25V,10%	4	C5, C6, C11, C14
22004.056.01	ZENER-DIODE-1W-5%-5.6V-1N	3	CR10, CR12, CR16
22015.000.01	DIODE,SCHOTTKY RECTIFIER,SBL	3	CR13, CR14, CR15
22101.000.01	DIODE,SIGNAL	1	CR20
22201.400.01	DIODE REC IN4004 PRV400V	13	CR1-CR9, CR11, CR17, CR18, CR19
22500.271.01	ZENER,TRANSISTOR,VARISTOR	2	V1, V2
23202.101.01	TRANSISTOR	1	Q2
23606.201.01	TRANSISTOR,PWR,NPN	1	Q1
24303.901.01	IC,LINEAR,DC REGULATOR,15V NEG	1	IC2
24304.901.01	IC,REG	1	IC1
24307.901.01	IC,LINEAR,DC REGULATOR,5V POS	1	IC3
24308.901.01	IC,LINEAR,DC REGULATOR,5V NEG	1	IC4
24321.000.01	VOLTAGE REGULATOR	1	IC5
26143.000.01	SWITCH,SLIDE,VOLT,115/230	1	S1
26146.000.01	SWITCH,SLIDE,SPDT,VERTICAL MOUNT	1	S2
27406.004.01	CONNECTOR,SOCKET,STRIP,4 PIN	1	J202
27421.004.01	CONNECTOR,HEADER,DBL RW,4P,2 X 2	1	J201
27421.010.01	CONNECTOR,HEADER,DBL RW,23",2 X 5	1	J1
27621.006.01	LUG SOLDER #6	1	
27630.001.01	JUMPER,PC MOUNT,TEST POINT	8	TP1-TP8
27711.206.01	TERM,CRIMP,RING,INS,6R	1	
28004.150.01	FUSE,3AG,SLOBLO,1/2 AMP	1	F1
28012.000.01	FILTER, LINE 3A PC MOUNT	1	L1
28112.001.01	FUSEHOLDER DOM PC MOUNT	1	F1
31866.000.01	CIRCUIT BOARD POWER SUPPLY 2200	1	
42028.040.01	ASSEMBLY FLAT CABLE 16 PIN 4"	2	P900, P901
50281.000.01	HEATSINK-2200	1	
55033.000.02	TRANSFORMER PWR 2200	1	T1

Schematic Rev 01	ECO 2216	Power r01	31865.000
61181.000.01	SCHEMATIC, POWER SUPPLY 2200/6200/	0	

2200 Power Supply 31865.000 Rev 02

Schematic Rev 02	ECO 2235	Power r02	31865.000
Item	**Description**	**Quantity**	**Reference Designators**
27621.006.01	LUG SOLDER #6	1 [deleted]	
31866.000.02	CIRCUIT BOARD POWER SUPPLY 2200	1	
42009.040.01	SUBASSEMBLY-CABLE-FLAT-16PIN-4	2	
42028.040.01	ASSEMBLY FLAT CABLE 16 PIN 4"	2	P900, P901 [deleted]
61181.000.02	SCHEMATIC, POWER SUPPLY 2200/6200/	0	

2200 Power Supply 31865.000/32045.000 Rev 01

Schematic Rev 01	ECO 2636	Power r01	31865.000/32045.000
Item	**Description**	**Quantity**	**Reference Designators**
10012.405.01	SCREW,MS,SEM,PH,4-40 X 5/16	2	H1, H2
10012.406.01	SCREW,MS,SEM,P/P,4-40 X 3/8	2	H3, H4
12001.408.01	NUT,HEX,STL,C2,4-40 X 1/4	2	H5, H6
15023.001.01	INSULATOR,SILICONE TO-3	1	H7
15025.000.01	TRANSISTOR,MTG,KIT TO 220	2	H8, H9
16013.000.01	HEATSINK,CLIP-ON TO 220	3	H10, H11, H12
20020.025.01	RESISTOR,1/4 ZERO OHM	1	R2
20039.221.01	MF 1/8W 1% 22.1 OHM	1	R2 [deleted]
20140.120.01	RESISTOR,MO 1W 5% 120OHM	8	R8-R15
21129.410.01	CAPACITOR,AXIAL LEADS,0.1uF,50V,20%	11	C3, C4, C7-C10, C12, C13, C16, C17, C20
22003.068.01	ZENER 1W 10% 6.8V 1N4736	2	CR21, CR22
27060.000.01	CONNECTOR, MOLEX VERTICAL HEAD	1	J4
27493.000.01	CONNECTOR,VERT HDR 2X3 6POS	1	J6
27630.001.01	JUMPER,PC MOUNT,TEST POINT	8	TP1-TP8 [deleted]
27711.206.01	TERM,CRIMP,RING,INS,6R	1	H13
28112.001.01	FUSEHOLDER DOM PC MOUNT	1	F1A F1B
31866.000.02	CIRCUIT BOARD POWER SUPPLY 2200	1 [deleted]	
32046.000.01	CIRCUIT BOARD POWER SUPPLY 2200	1	H15
42009.040.01	SUBASSEMBLY-CABLE-FLAT-16PIN-4"	1	P901

Schematic Rev 01	ECO 2636	Power r01	31865.000/32045.000
42009.085.01	SUBASSEMBLY-CABLE-FLAT-16PIN-8.5"	1	P900
50281.000.01	HEATSINK-2200	1	H14
55033.000.02	TRANSFORMER PWR 2200	1	T1 [deleted]
61181.000.02	SCHEMATIC, POWER SUPPLY 2200/6200/	0 [deleted]	
62045.000.01	SCHEMATIC, POWER SUPPLY 2200/6200/	0	

2200 Power Supply 31865.000/32045.000 Rev 02

Schematic Rev 02	ECO 2691	Power r02	31865.000/32045.000
Item	**Description**	**Quantity**	**Reference Designators**
27630.001.01	JUMPER, PC MOUNT TEST POINT	2	TP3, TP8
32046.000.02	CIRCUIT BOARD POWER SUPPLY 2200	1	H15
62045.000.02	SCHEMATIC, POWER SUPPLY 2200/6200/	0	

2200 Power Supply 31865.000/32045.000 Rev 05

Schematic Rev 03	ECO 2748	Power r05	31865.000/32045.000
Item	**Description**	**Quantity**	**Reference Designators**
22003.068.01	ZENER 1W 10% 6.8V 1N4736	2	CR21, CR22 [deleted]
22083.033.01	DIODE, VOLTAGE SUPPRESSOR, 33 VOLT	2	
27630.001.01	JUMPER, PC MOUNT TEST POINT	1	TP8
28012.000.01	FILTER, LINE 3A PC MOUNT	1	L1 [deleted]
28112.003.01	KNOB FUSE DOM GRY FOR281	1	F1B
28112.005.01	BODY FUSEHOLDER PC MOUNT	1	F1A
29262.000.01	LINE FLTR PC MOUNT 1A	1	
32046.000.04	CIRCUIT BOARD POWER SUPPLY 2200	1	H15
62045.000.03	SCHEMATIC, POWER SUPPLY 2200/6200/	0	

2200 Power Supply 31865.000/32045.000 Rev 07

Schematic Rev 04	ECO 3047	Power r07	31865.000/32045.000
Item	**Description**	**Quantity**	**Reference Designators**
20040.332.01	RESISTOR, METAL FILM,1/8W,1%,332 ohm	1	R16
23605.501.01	TRANSISTOR,PWR,PNP	1	Q3
24321.000.01	VOLTAGE REGULATOR	1	IC5 [deleted]
24332.000.01	IC VREGLDO LP2950-5.0	1	IC6

Schematic Rev 04	ECO 3047	Power r07	31865.000/32045.000
32046.000.05	CIRCUIT BOARD POWER SUPPLY 2200	1	
62045.000.04	SCHEMATIC, POWER SUPPLY 2200/6200/	0	

Schematics, Assembly Drawings

The following drawings are included in this manual. Complete drawings are included for the first version of the product. For later versions, drawings are included only if a given drawing has changed compared to the previously shown version of that drawing.

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Page	Function	Description	Drawing
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6-83	Power Supply ver 2		Schematic Diagram
6-84	Power Supply ver 3		Schematic Diagram
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NOTES:

Vendor Codes

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AD Analog Devices, Inc.
2105 S Bascom Ave
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95008

BEK Beckman Industrial Corporation
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Fullerton, CA 92635-1025

BRN Bourns, Inc
2533 N 1500 W
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BUS Bussmann Division
Cooper Industries
PO Box 14460
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CD Corning

CEN Mepcopal/Centralab
See Mepcopal

CSC Crystal Semiconductor Corp.
50 Airport Parkway
San Jose, CA 95110

CW CW Industries
130 James Way
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DAL Dale
1122 23rd St
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PO Box 49007
San Jose, CA 95161-9007

FR Fair-Rite

FSC Fairchild Camera & Instr. Corp.
See National Semiconductor

GI General Instruments
Optoelectronics Division
See Quality Technologies

GS General Silicones Co. USA Inc.
650 W Duarte Rd, Ste 401
Arcadia, CA 91007

HP Hewlett-Packard Co.
321 E Evelyn Ave
Mountain View, CA 94039

KEM KEMET Electronics Corporation
Post Office Box 5928
Greenville, South Carolina 29606

LFE Littlefuse
A Subsidiary of Tracor, Inc.
800 E. Northwest Hwy
Des Plaines, IL 60016

LT Linear Technology Corp
1630 McCarthy Blvd.
Milpitas, CA 95035

LUM Lumex Opto/Components Inc.
292 E. Hellen Road
Palatine, IL 60067

MAT Matsushita Electric Corp
of America
One Panasonic Way
Secaucus, NJ 07094

MIL J.W. Miller Division
Bell Industries
306 E. Alondra
Gardena, CA 90247

MOT Motorola Semiconductor
5005 E McDowell Rd
Phoenix, AZ 85008

MUR Murate Erie North America
2200 Lake Park Drive
Smyrna, GA 30080

NAT National Semiconductor Corp.
2900 Semiconductor Drive
PO Box 61659
Santa Clara, CA 95051

NEU Neutrik USA Inc.
195 Lehigh Ave
Lakewood, NJ 08701-4527

NIC Nichicon
927 East State Parkway
Schaumburg, IL 60713

NOB Noble USA Inc.
5450 Meadowbrook Industri
Rolling Meadows, IL
60008-3800

OHM Ohmite Manufacturing Company
PO Box 49150
Chicago, IL 60678

ORB Orban, Inc.
1525 Alvarado Street
San Leandro, CA 94577

PHI Phillips Components – Signetics
See Signetics

PAN Panasonic Industrial Company
Two Panasonic Way
7E-2T
Secaucus, NJ 07094

QT Quality Technologies, Inc.
610 North Mary Ave.
Sunnyvale, CA 94086

ROH Rohm Electronics
3034 Owens Dr.
Antioch, TENN 37013

SIE Siemens Components Inc.
Heimann Systems Div.
186 Wood Avenue South
Iselin, NJ 08830

SIG Signetics - Philips Components
North American Phillips Corp.
811 E. Arques
Sunnyvale, CA 94088

SPR Sprague Magnetics, Inc
15720 Stagg Street
Van Nuys, CA 91406

SPE Spectrol

SW Switchcraft
A Raytheon Company
5555 N. Elation Avenue
Chicago, IL 60630

TAI Taiga America, Inc.
700 Frontier Way
Bensenville, IL 60106

TAT Taitron

TI Texas Instruments, Inc.
PO Box 655012
Dallas, TX 75265

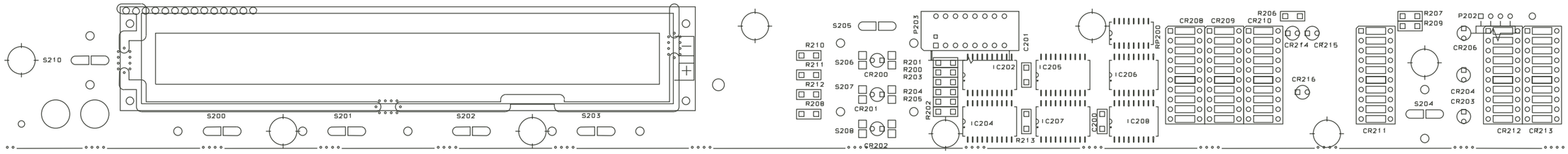
TOS Toshiba America, Inc.
9740 Irvine Blvd.
Irvine, CA 92718

TRW TRW Electronics Components
Connector Division
1501 Morse Avenue
Elk Grove Village, IL 60007

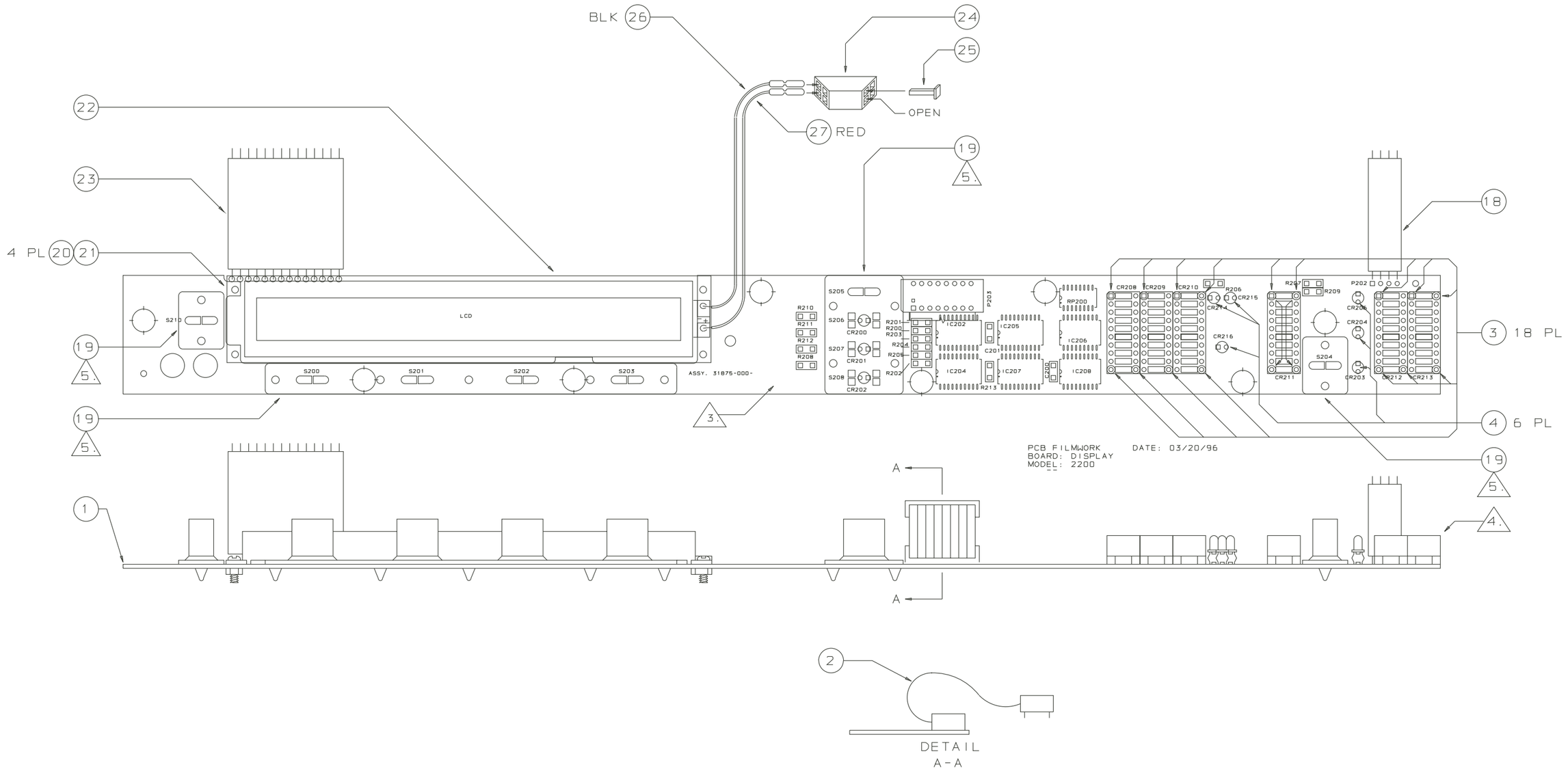
XI Xicor

WIM Wima Division
2269 Saw Mill Rd
Building 4C
PO Box 217
Elmsford, NY 10533

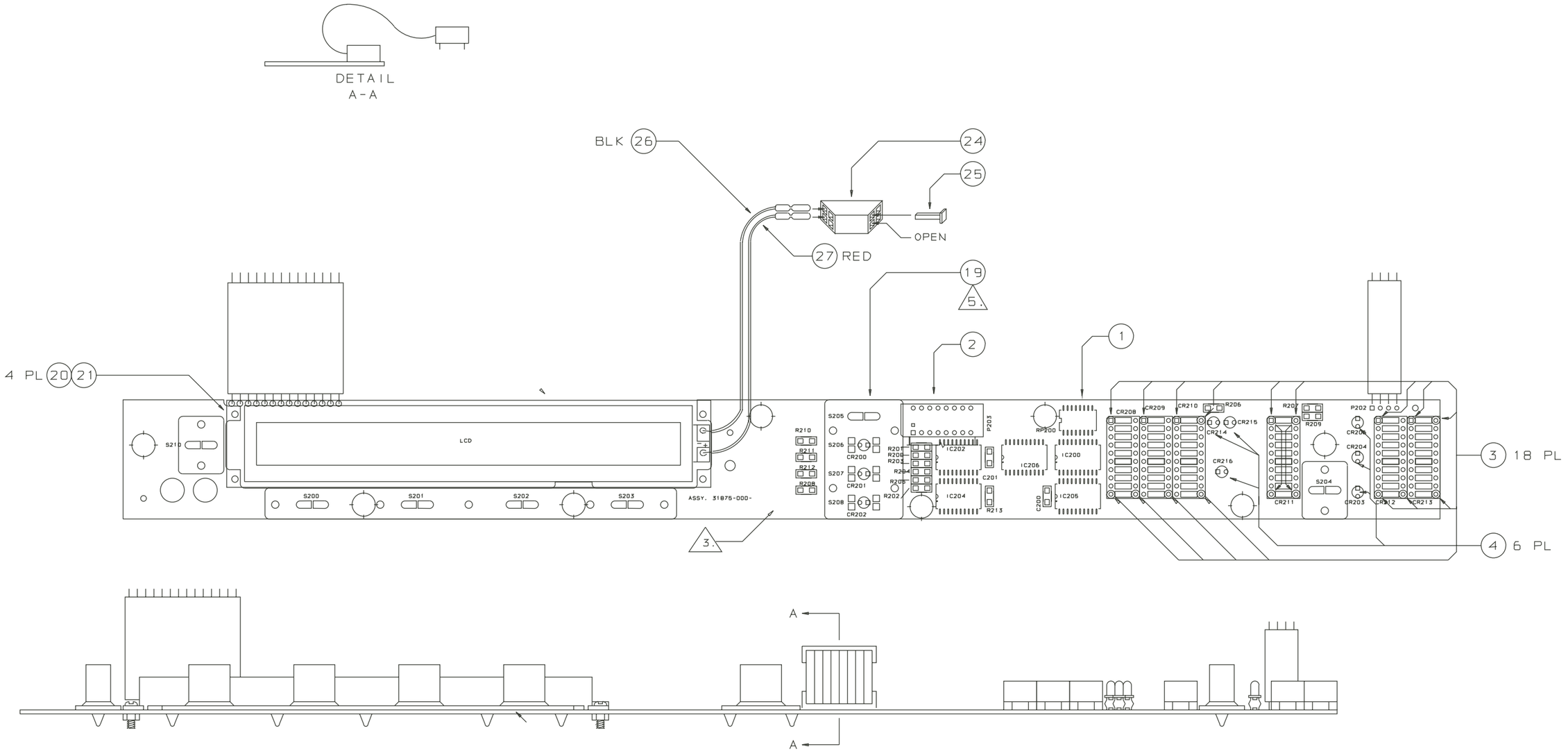
ZI ZILOG Inc.
210 Hacienda Ave.
Campbell, CA 95008



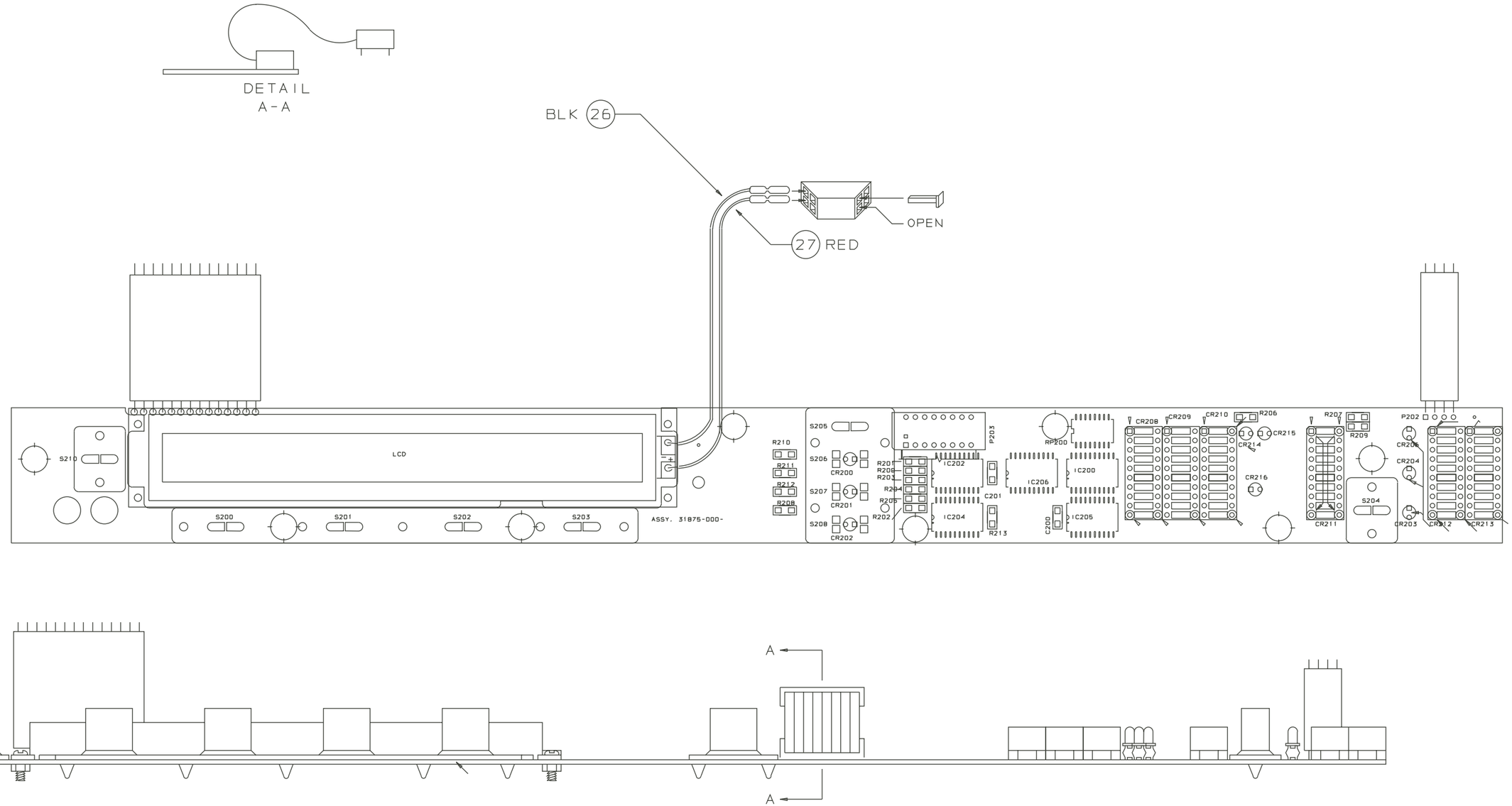
Display Board version 1
Drawing 31875.000.01
Reference schematic 61182.000.01



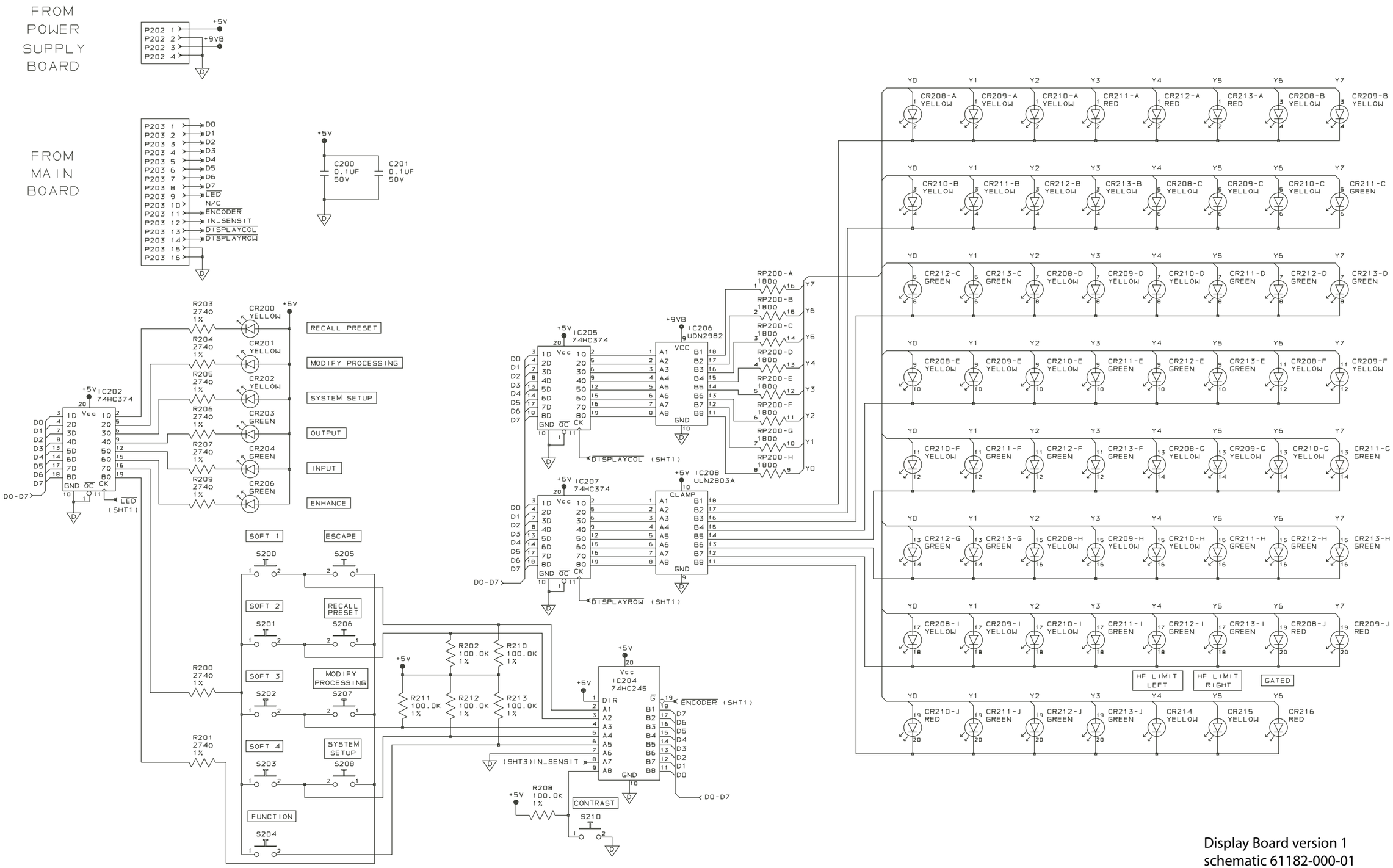
Display Board version 2
Drawing 31875.000.01
Reference schematic 61182.000.01



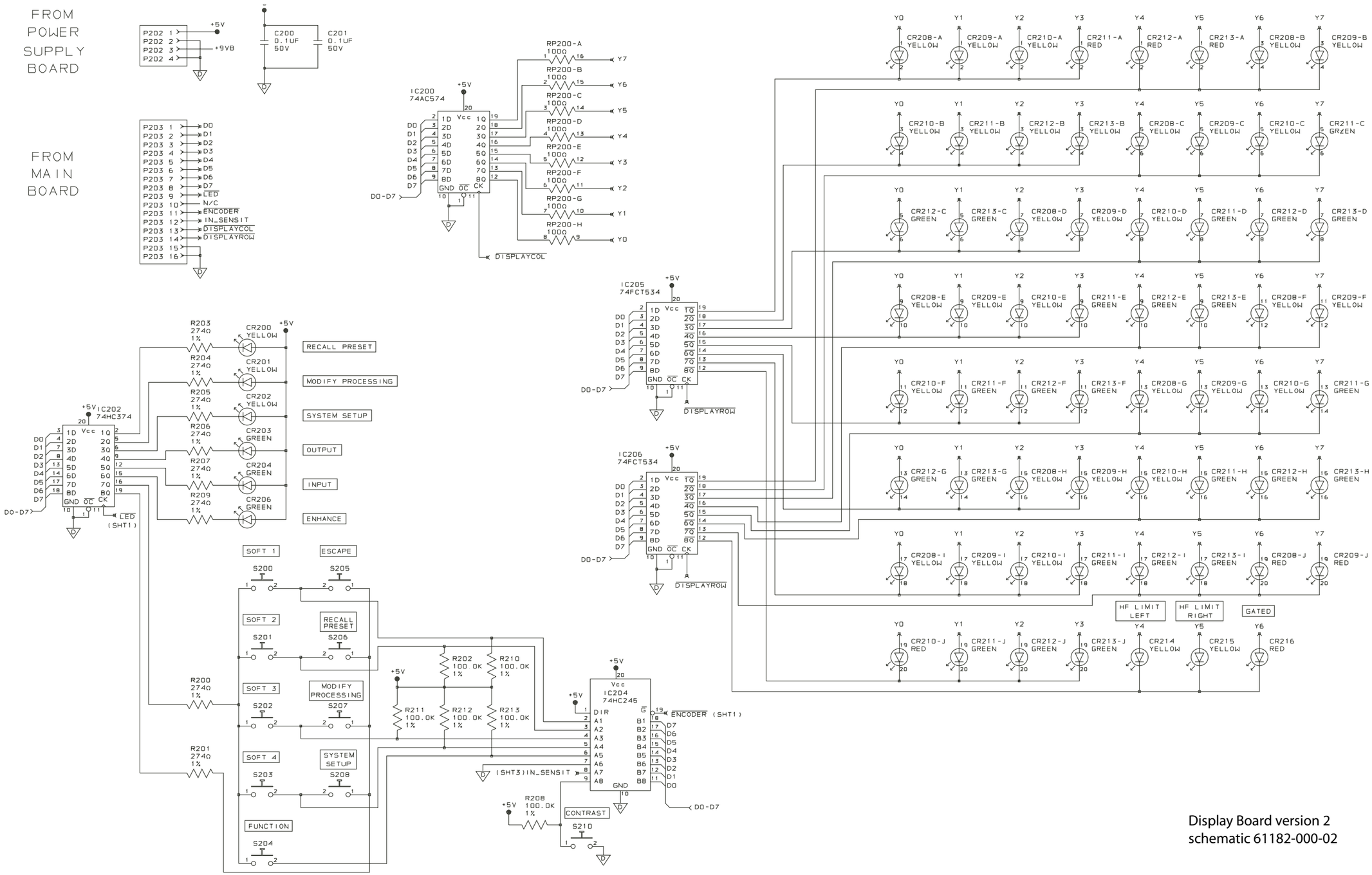
Display Board version 3
Drawing 31875.000.08
Reference schematic 61182.000.03



Display Board version 4
Drawing 31875.000.09
reference schematic 61182.000.03



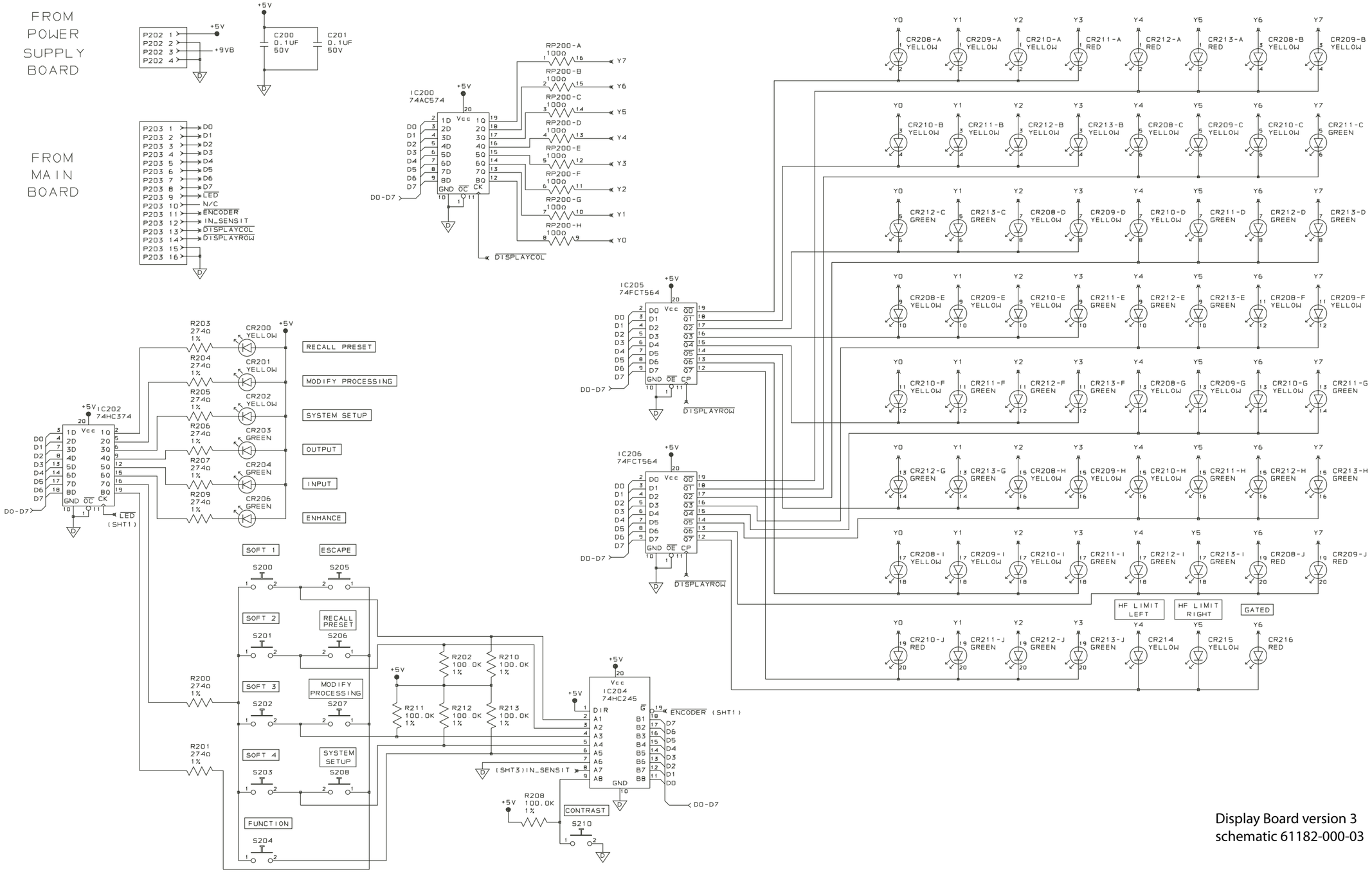
Display Board version 1
schematic 61182-000-01



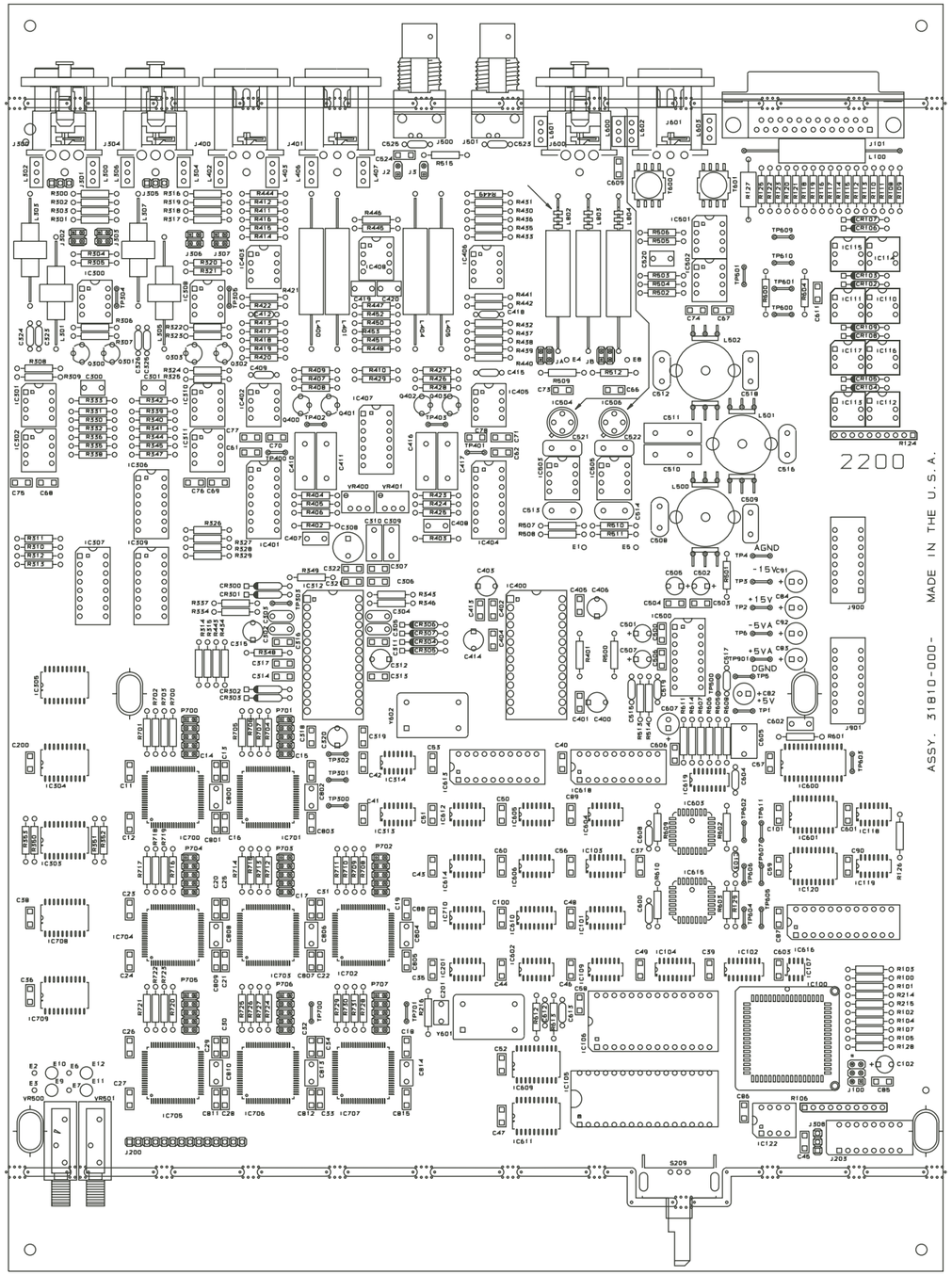
Display Board version 2
schematic 61182-000-02

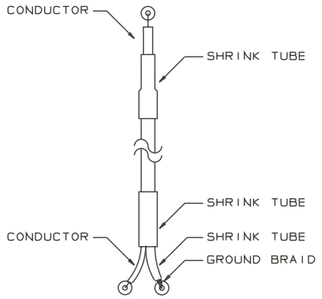
FROM POWER SUPPLY BOARD

FROM MAIN BOARD

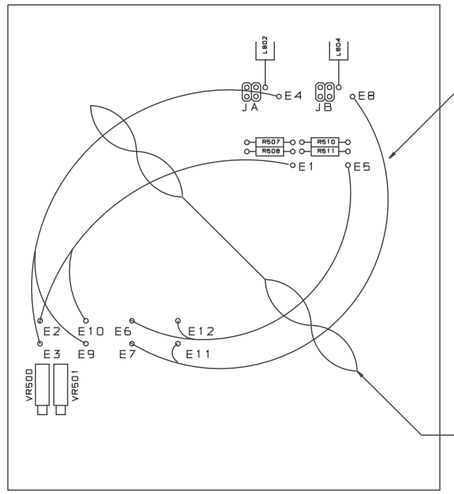


Display Board version 3
schematic 61182-000-03





CABLE DRESSING DETAIL

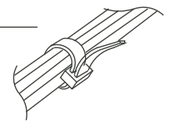


COMPONENT SIDE SHOWN
SCALE: NONE

4 PL
12" LENGTH

COAX CONNECTIONS SOLDER SIDE		
FROM	TO	GND
E1	E2	E10
E3	E4	E9
E6	E5	E12
E7	E8	E11

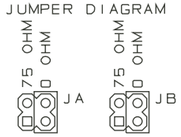
BUNDLE CABLES TOGETHER
WITH TIE-WRAP
APPROX. AT MIDPOINT



PCB FILMWORK DATE: 2/2/95
BOARD: MAIN
MODEL: 2200
LAYER: COMPONENT SIDE
FILM#: 31812-000-01

3 MARK ASSEMBLY REVISION LEVEL IN SPACE PROVIDED
2. REFERENCE SCHEMATIC DRAWING NO. 61171-000-B
1. SQUARE PADS INDICATE PIN 1 OF CONNECTORS, CATHODE OF DIODES POS. SIDE OF CAPS., PIN 1 OF IC'S

JUMPER DIAGRAM



PLACE JUMPER RECEPTICLES
IN SECOND POSITION

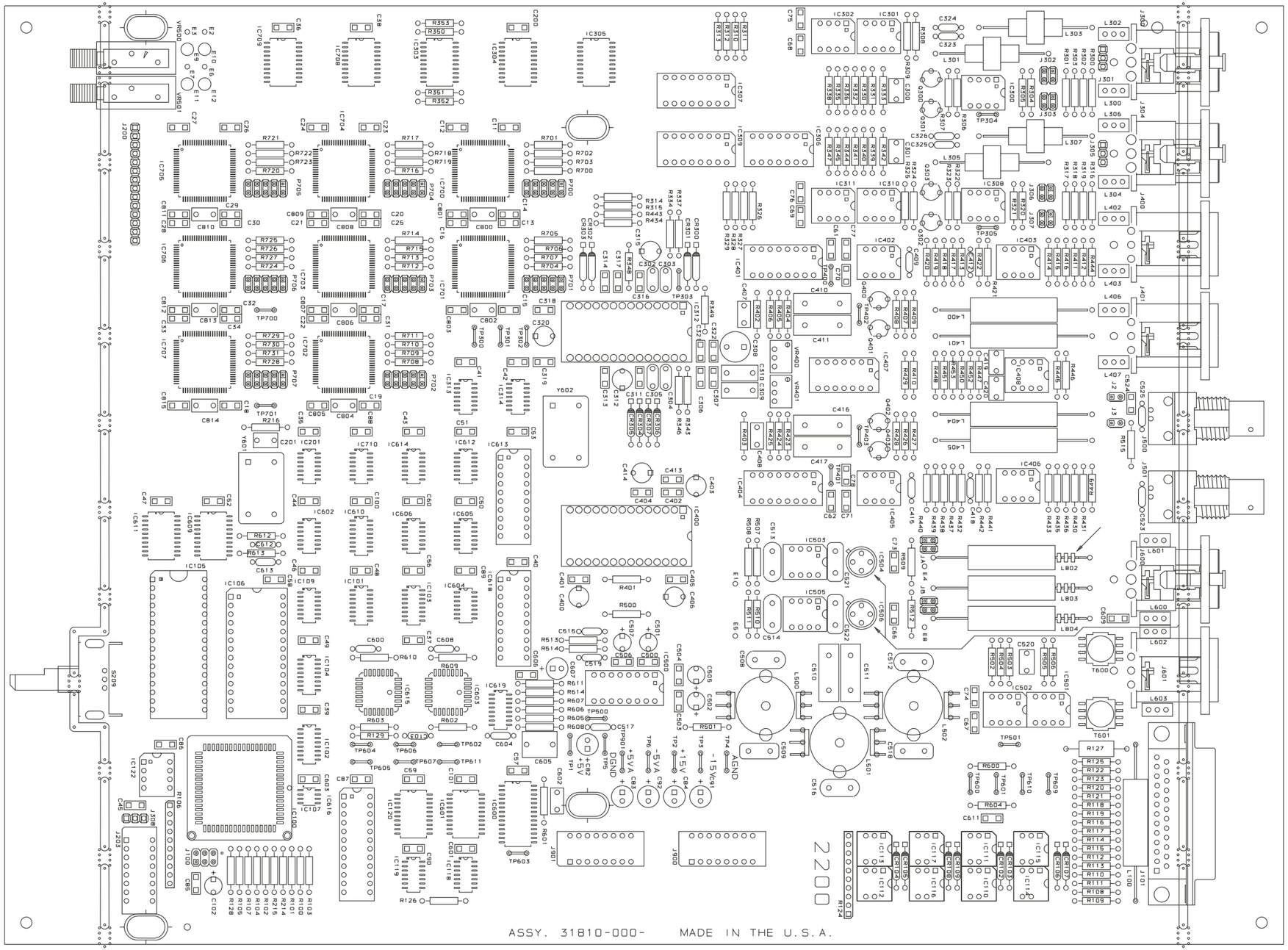


TYPICAL ARRANGEMENT FOR
J302, J303, J306 & J307

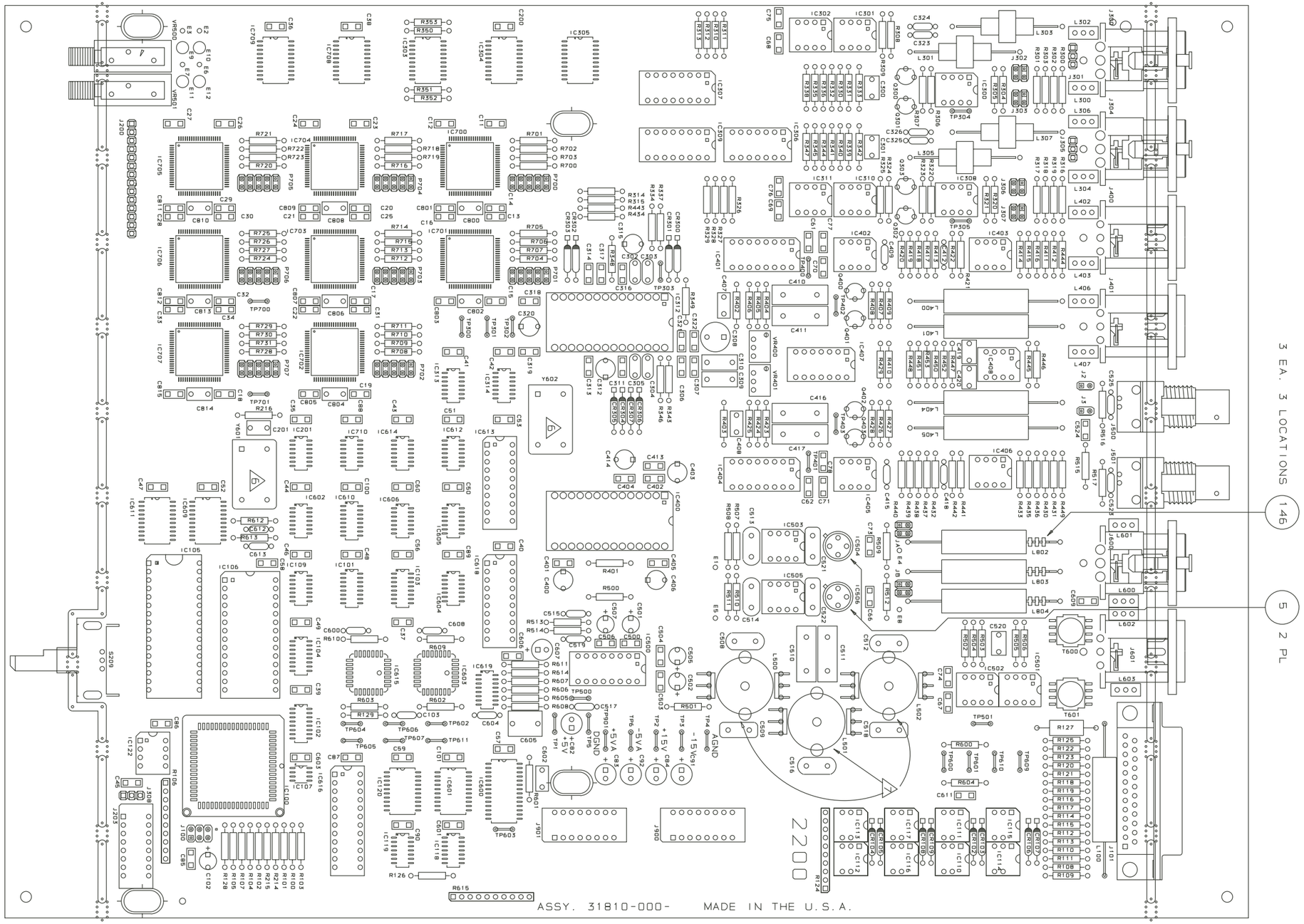


TYPICAL ARRANGEMENT FOR
J301 & J305

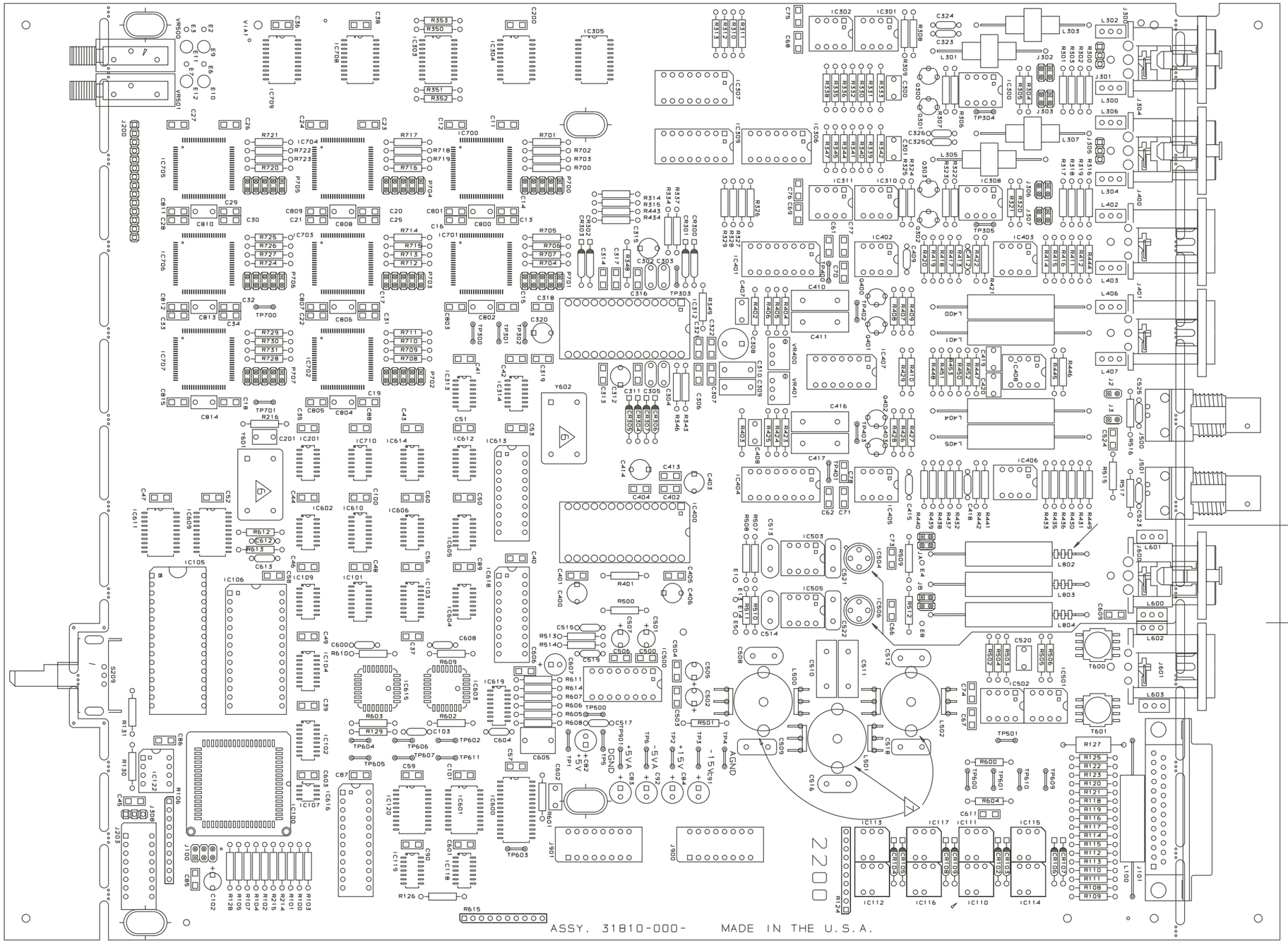
Main Board version 1 (1 of 2)
reference schematic 61171-000-8



Main Board version 1 (detail: 2 of 2)
reference schematic 61171-000-8

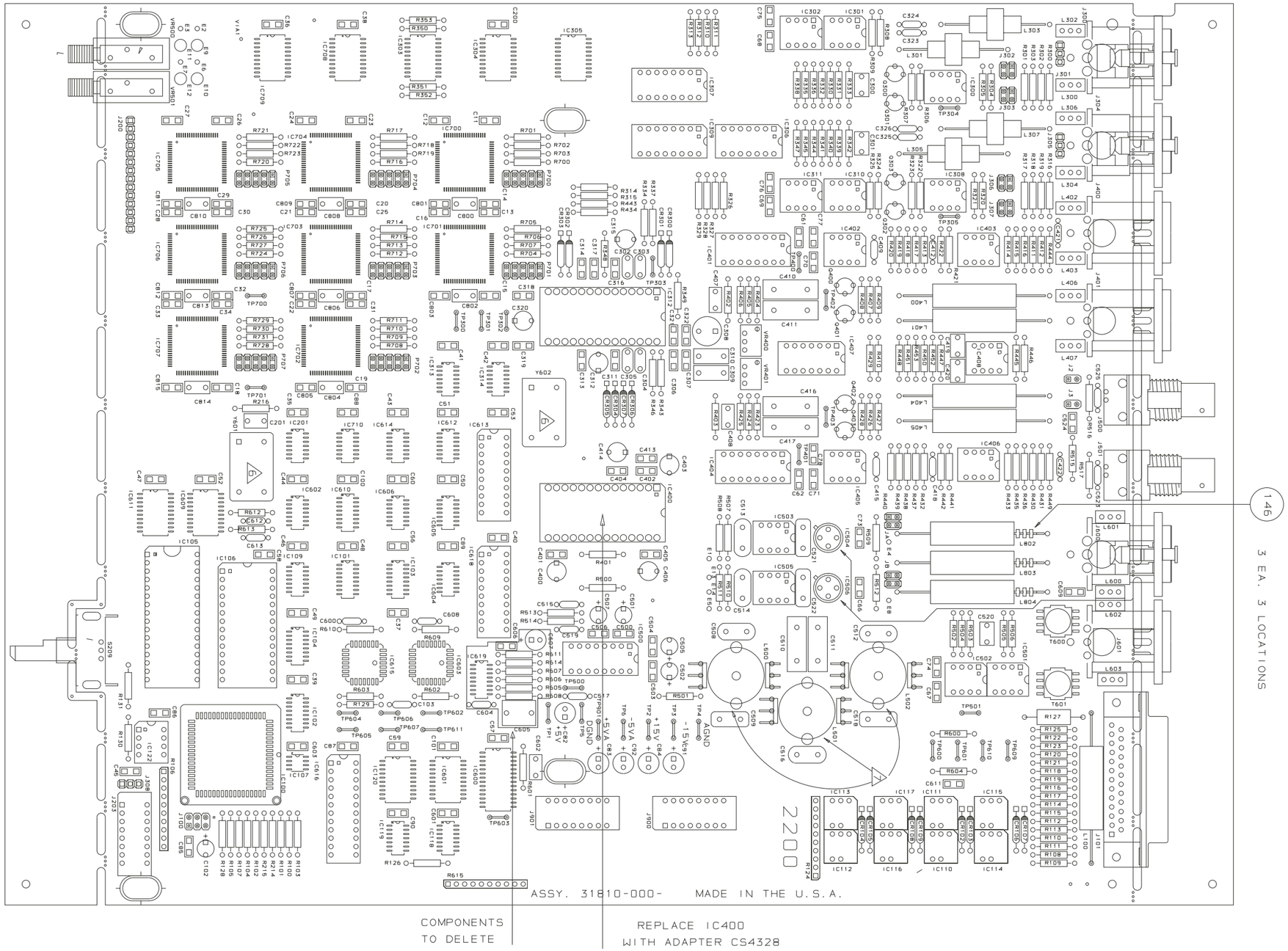


Main Board version 2
reference schematic 61171-000-



TABULATION		
P/N	MODEL	
31810.000.05	2200D DIGITAL	FULLY POPULATED
31810.001.03	2200 ANALOG	OMIT: IC600, IC602, IC603, IC609, IC610, IC615, IC616+SOCKET; C601-C603, C609, C611, C612; R600-R604, R612, J600, J601; T600, T601; Y601; L600-L603; TP600-TP607, TP609-TP611
31810.000.06 FRENCH VERSION	2200D DIGITAL	FULLY POPULATED

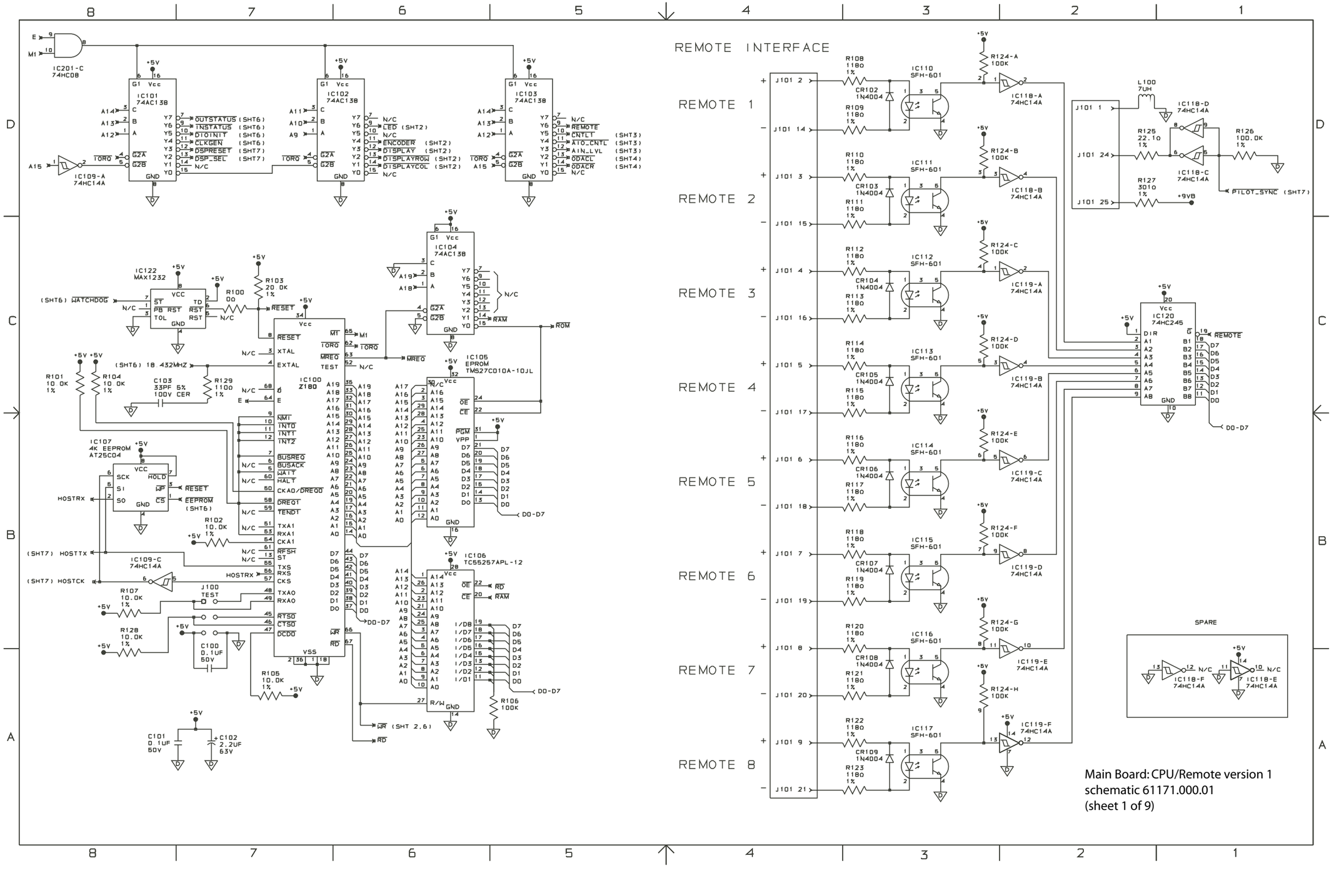
Main Board version 3
reference schematic 61171-000-

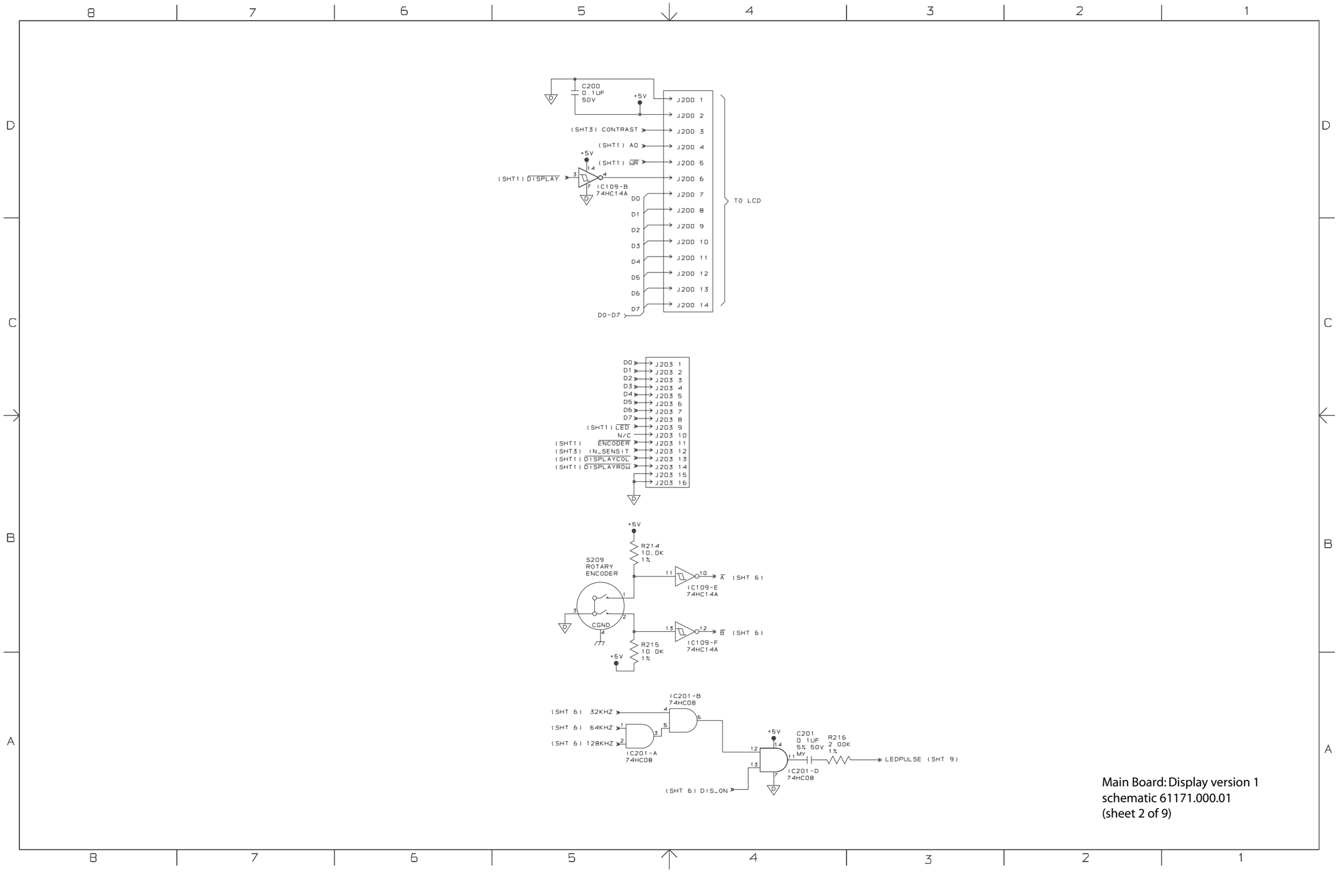


TABULATION		
P/N	MODEL	
31810.005	2200D DIGITAL	FULLY POPULATED
31810.001	2200 ANALOG	OMIT: IC600, IC602, IC603, IC609, IC610, IC615, IC616+SOCKET; C601-C603, C609, C611, C612; R600-R604, R612; J600, J601; T600, T601; Y601; L600-L603; TP600-TP607, TP609-TP611
31810.006 FRENCH VERSION	2200D DIGITAL	FULLY POPULATED

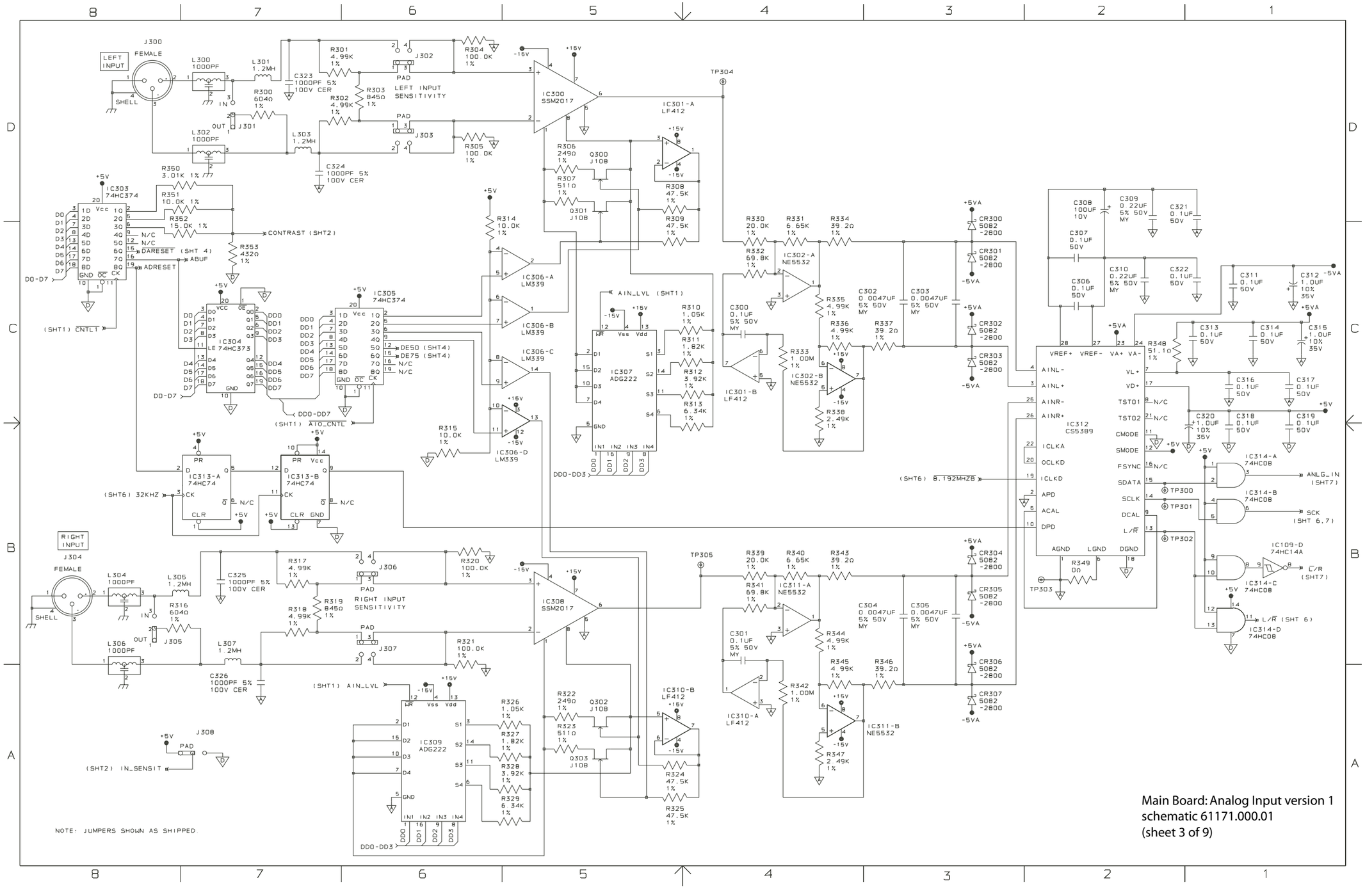
PCB FILMWORK DATE: 4/28/00
BOARD: MAIN
MODEL: 2200
LAYER:
FILM#: 31812-000-06

Main Board version 4
reference schematic 61171-000-

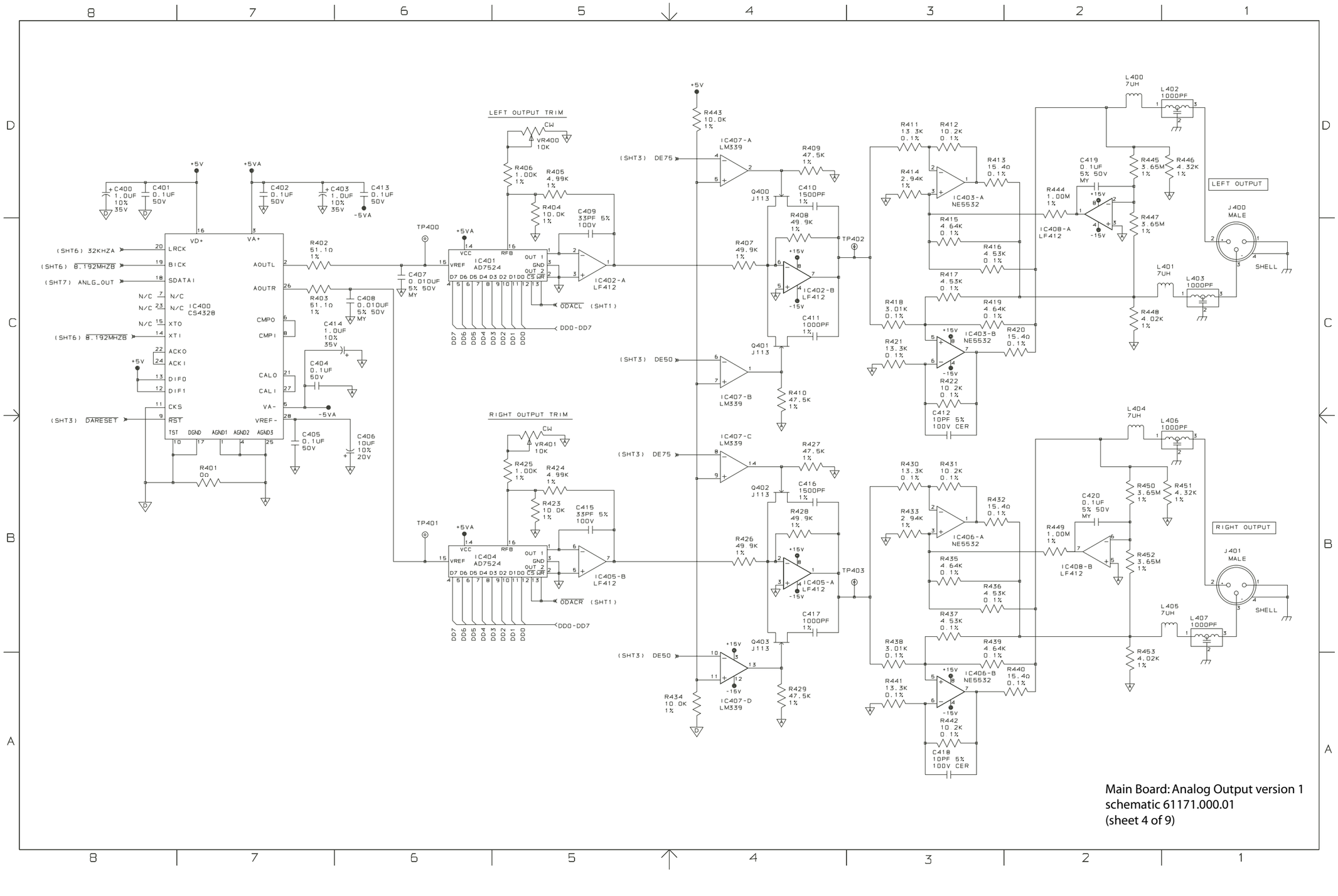

REMOTE INTERFACE
REMOTE 1
REMOTE 2
REMOTE 3
REMOTE 4
REMOTE 5
REMOTE 6
REMOTE 7
REMOTE 8
SPARE
Main Board: CPU/Remote version 1
schematic 61171.000.01
(sheet 1 of 9)

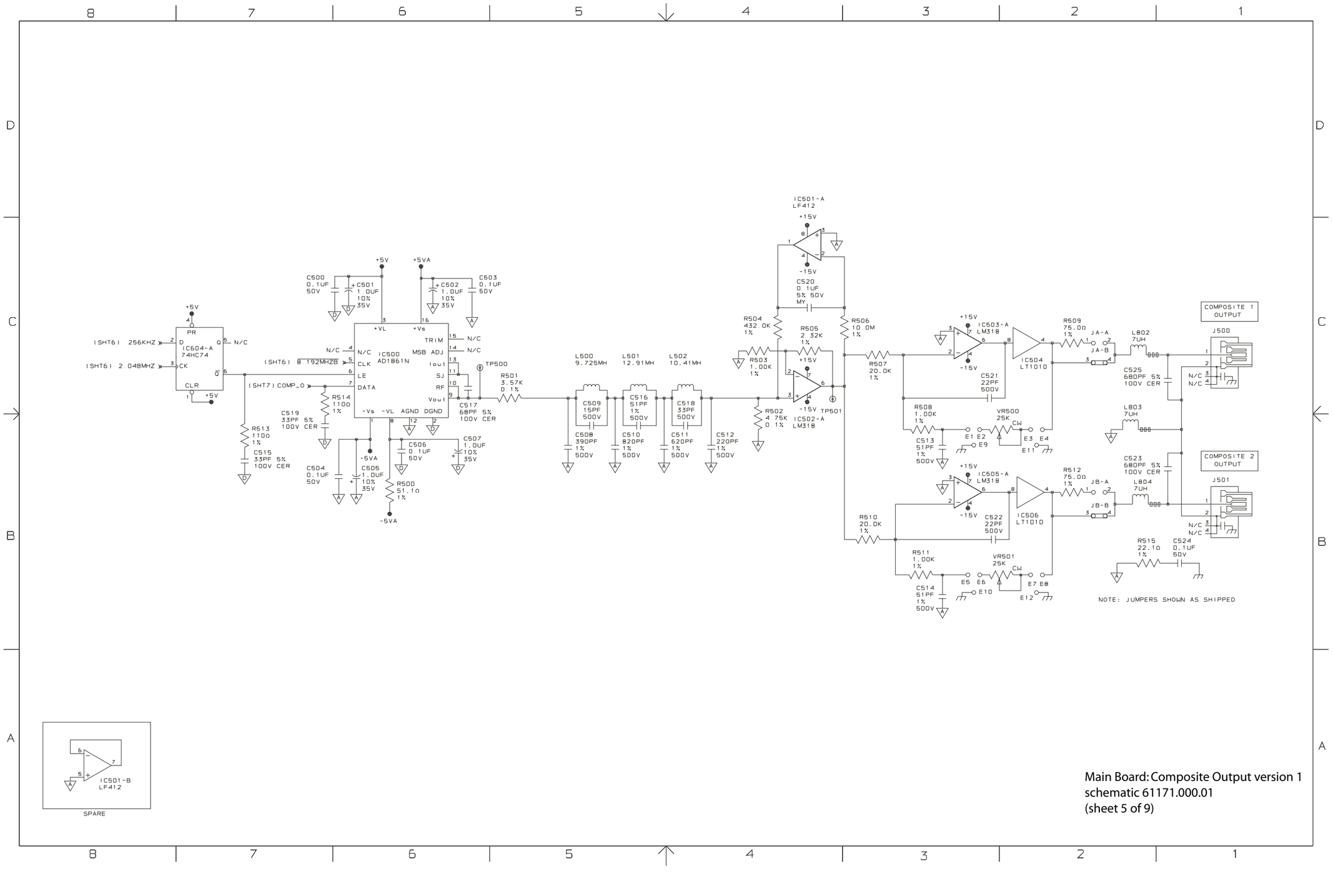


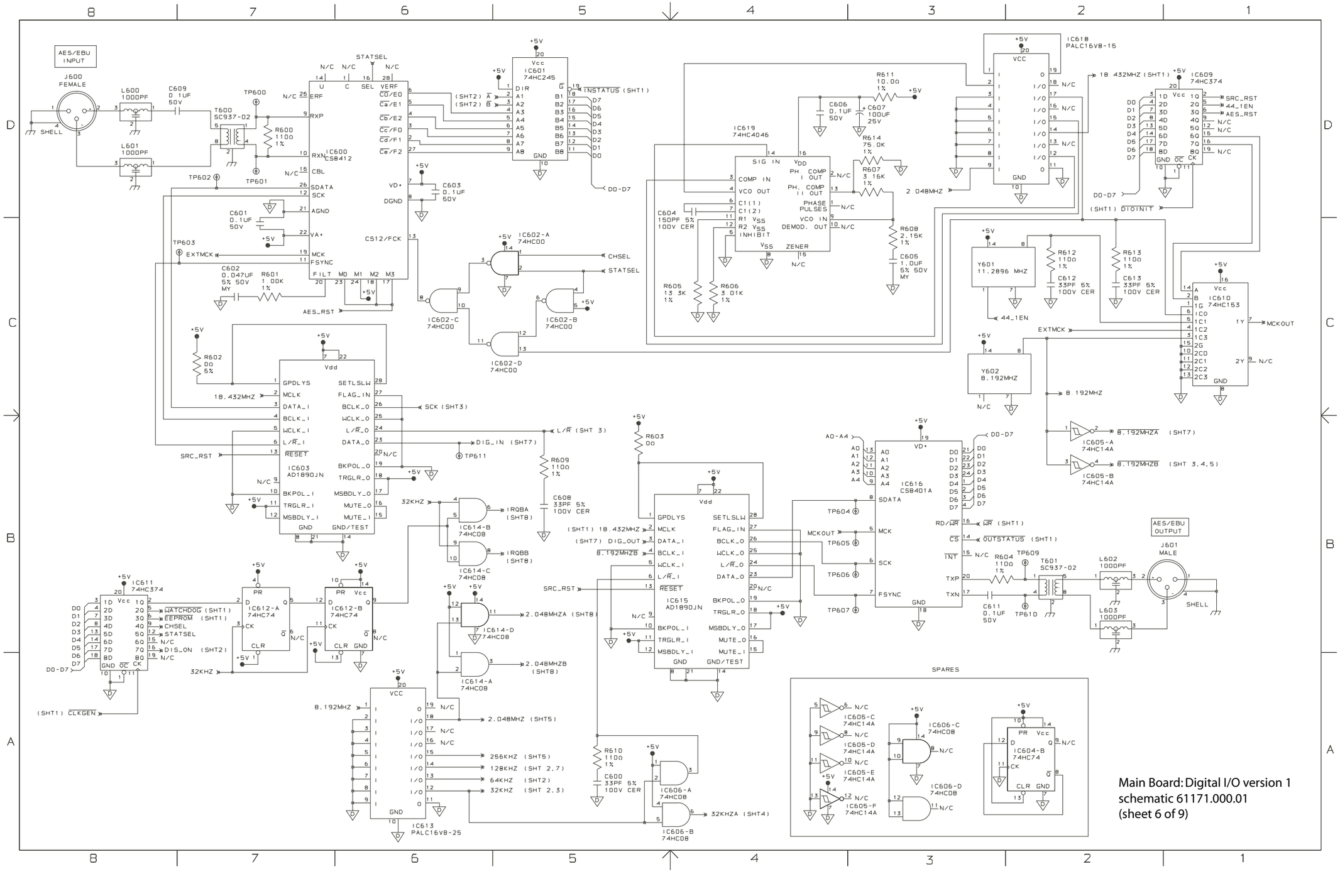
Main Board: Display version 1
schematic 61171.000.01
(sheet 2 of 9)

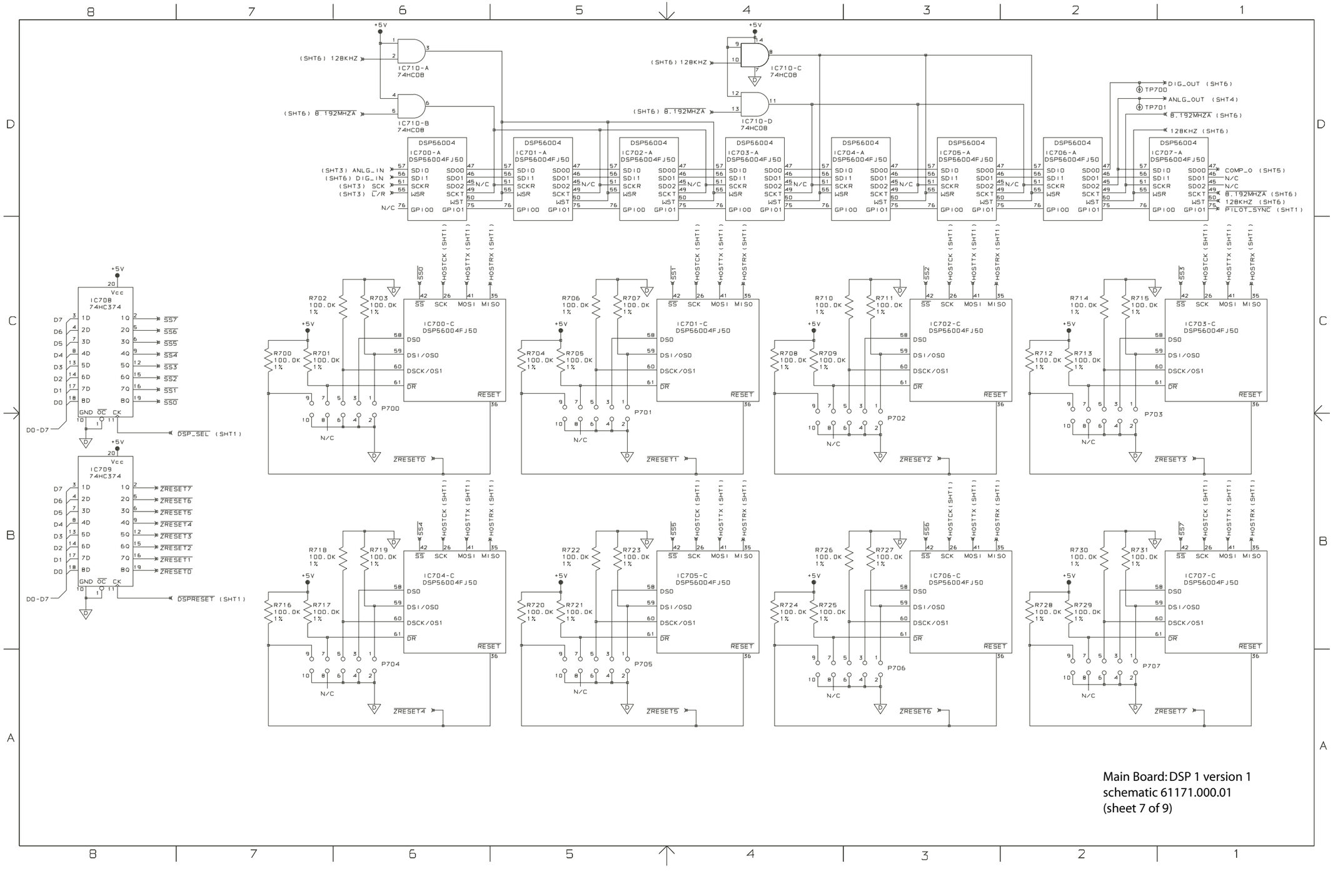


Main Board: Analog Input version 1
schematic 61171.000.01
(sheet 3 of 9)

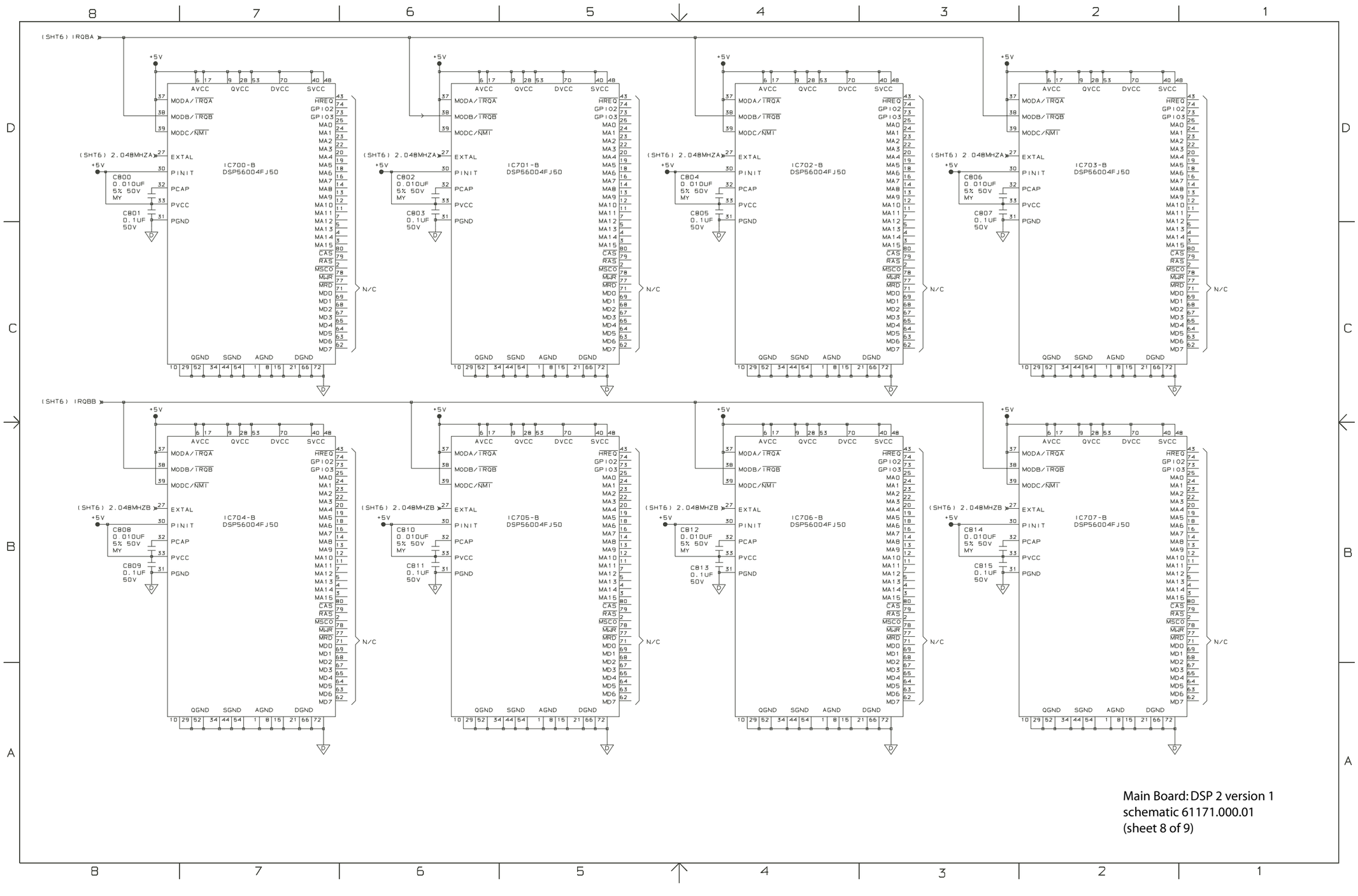

LEFT OUTPUT TRIM
RIGHT OUT PUT TRIM
IC400 CS4328
IC401 AD7524
IC404 AD7524
IC402-A LF412
IC405-A LF412
IC405-B LF412
IC408-A LF412
IC408-B LF412
IC407-A LM339
IC407-B LM339
IC407-C LM339
IC407-D LM339
IC403-A NE5532
IC403-B NE5532
IC406-A NE5532
IC406-B NE5532
LEFT OUTPUT
RIGHT OUTPUT
J400 MALE
J401 MALE
SHELL
DD0-DD7
Main Board: Analog Output version 1
schematic 61171.000.01
(sheet 4 of 9)


IC501-A
LF412
+15V
-15V
C520
0.1UF
5% 50V
MY
R504
432.0K
1%
R505
2.32K
1%
R506
10.0M
1%
R503
1.00K
1%
R507
20.0K
1%
IC503-A
LM318
C521
22PF
500V
IC504
LT1010
R509
75.0Ω
1%
JA-A
JA-B
L802
7UH
C525
680PF 5%
100V CER
COMPOSITE 1
OUTPUT
J500
N/C
N/C
L803
7UH
R508
1.00K
1%
C513
51PF
1%
500V
VR500
25K
CW
E1 E2 E9
E3 E4 E11
C523
680PF 5%
100V CER
COMPOSITE 2
OUTPUT
J501
L804
7UH
IC505-A
LM318
R512
75.0Ω
1%
JB-A
JB-B
IC506
LT1010
C522
22PF
500V
R510
20.0K
1%
R511
1.00K
1%
C514
51PF
1%
500V
VR501
25K
CW
E5 E6 E10
E7 E8 E12
R515
22.1Ω
1%
C524
0.1UF
50V
NOTE: JUMPERS SHOWN AS SHIPPED
+5V
+5VA
C500
0.1UF
50V
C501
1.0UF
10%
35V
C502
1.0UF
10%
35V
C503
0.1UF
50V
IC500
AD1861N
+VL
+Vs
TRIM
MSB ADJ
Iout
SJ
RF
Vout
-Vs
-VL
AGND
DGND
N/C
CLK
LE
DATA
TP500
R501
3.57K
0.1%
C517
68PF 5%
100V CER
IC502-A
LM318
TP501
-5VA
C504
0.1UF
50V
C505
1.0UF
10%
35V
C506
0.1UF
50V
C507
1.0UF
10%
35V
R500
51.1Ω
1%
R513
110Ω
1%
C515
33PF 5%
100V CER
R514
110Ω
1%
C519
33PF 5%
100V CER
IC604-A
74HC74
PR
D
CK
CLR
Q
N/C
(SHT6) 256KHZ
(SHT6) 2.048MHZ
(SHT6) 8.192MHZB
(SHT7) COMP_O
L500
9.725MH
L501
12.91MH
L502
10.41MH
C508
390PF
1%
500V
C509
15PF
1%
500V
C510
820PF
1%
500V
C511
620PF
1%
500V
C512
220PF
1%
500V
C516
51PF
1%
500V
C518
33PF
1%
500V
R502
4.75K
0.1%
R503
1.00K
1%
IC501-B
LF412
SPARE
Main Board: Composite Output version 1
schematic 61171.000.01
(sheet 5 of 9)

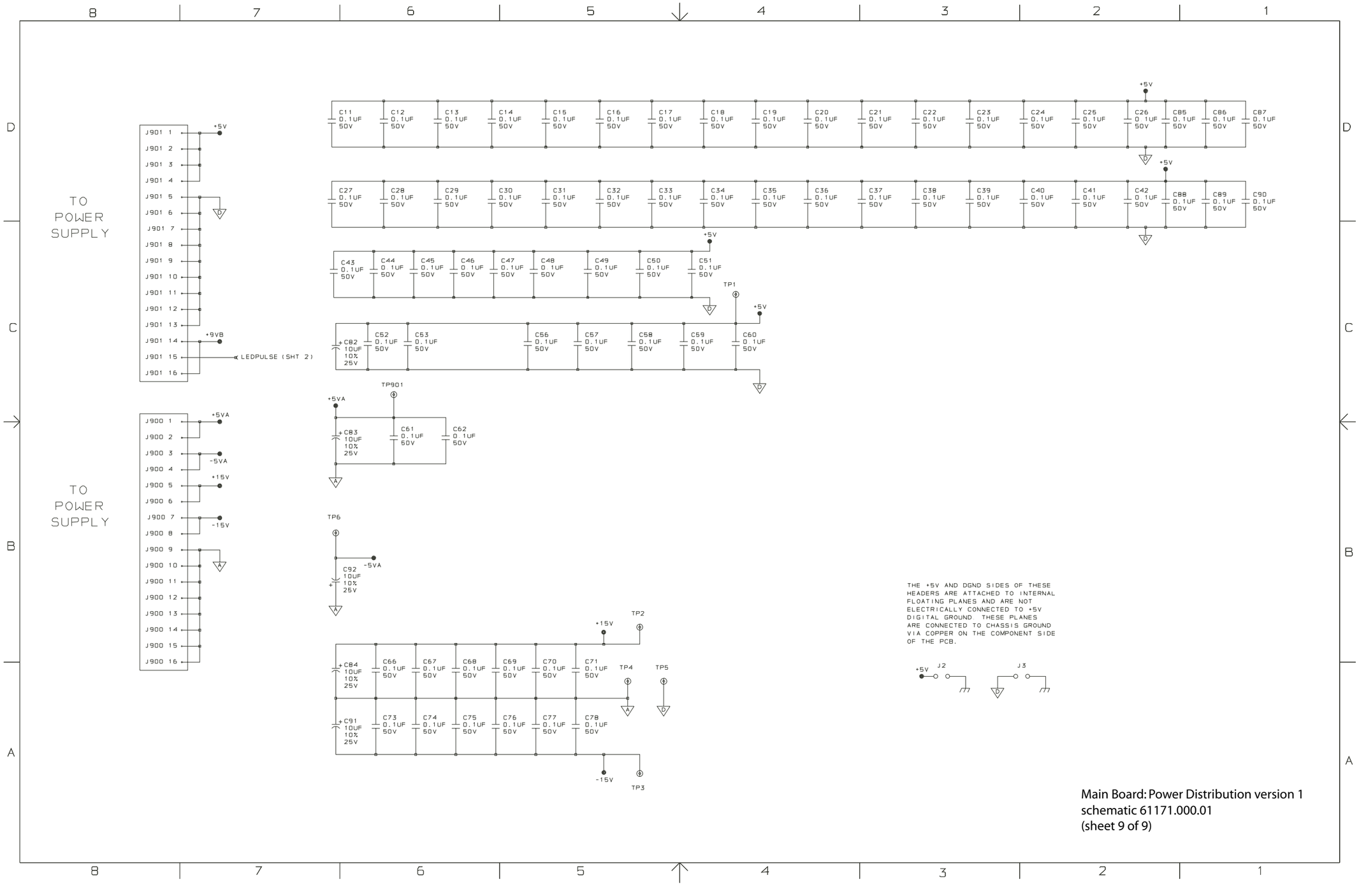

AES/EBU INPUT
J600 FEMALE
SHELL
L600 1000PF
L601 1000PF
C609 0.1UF 50V
T600 SC937-02
R600 110Ω 1%
TP600
TP601
IC600 CS8412
TP602
TP603
EXTMCK
C601 0.1UF 50V
C602 0.047UF 5% 50V MY
R601 1.00K 1%
AES_RST
STATSEL
N/C ERF
RXP
RXN
CBL
SDATA
SCK
AGND
VA+
MCK
FSYNC
CS12/FCK
VD+
DGND
C603 0.1UF 50V
FILT M0 M1 M2 M3
IC601 74HC245
DIR
A1 A2 A3 A4 A5 A6 A7 A8
B1 B2 B3 B4 B5 B6 B7 B8
GND
(SHT2) A
(SHT2) B
INSTATUS (SHT1)
D0-D7
IC602-A 74HC00
IC602-B 74HC00
IC602-C 74HC00
IC602-D 74HC00
CHSEL
STATSEL
IC603 AD1890JN
R602 00 5%
18.432MHZ
Vdd
GPDLYS
MCLK
DATA_I
BCLK_I
WCLK_I
L/R_I
RESET
SETLSLW
FLAG_IN
BCLK_O
WCLK_O
L/R_O
DATA_O
BKPOL_O
TRGLR_O
MSBDLY_O
MUTE_O
MUTE_I
GND/TEST
SCK (SHT3)
L/R (SHT 3)
DIG_IN (SHT7)
TP611
R609 110Ω 1%
C608 33PF 5% 100V CER
32KHZ
IC614-B 74HC08
IC614-C 74HC08
IRQBA (SHT8)
IRQBB (SHT8)
IC614-D 74HC08
IC614-A 74HC08
2.048MHZA (SHT8)
2.048MHZB (SHT8)
IC611 74HC374
WATCHDOG (SHT1)
EEPROM (SHT1)
CHSEL
STATSEL
N/C
DIS_ON (SHT2)
CLKGEN (SHT1)
IC612-A 74HC74
IC612-B 74HC74
IC613 PALC16V8-25
8.192MHZ
2.048MHZ (SHT5)
256KHZ (SHT5)
128KHZ (SHT 2,7)
64KHZ (SHT2)
32KHZ (SHT 2,3)
R610 110Ω 1%
C600 33PF 5% 100V CER
IC606-A 74HC08
IC606-B 74HC08
32KHZA (SHT4)
R603 00
(SHT1) 18.432MHZ
(SHT7) DIG_OUT
8.192MHZB
IC615 AD1890JN
IC616 CS8401A
SDATA
MCK
SCK
FSYNC
MCKOUT
TP604
TP605
TP606
TP607
AD-A4
VD+
RD/WR
CS
TNT
TXP
TXN
WR (SHT1)
OUTSTATUS (SHT1)
R604 110Ω 1%
C611 0.1UF 50V
TP609
TP610
T601 SC937-02
L602 1000PF
L603 1000PF
AES/EBU OUTPUT
J601 MALE
IC618 PALC16V8-15
18.432MHZ (SHT1)
IC609 74HC374
GRC_RST
44.1EN
AES_RST
IC619 74HC4046
SIG IN
COMP IN
VCO OUT
PH. COMP I OUT
PH. COMP II OUT
PHASE PULSES
VCO IN
DEMOD. OUT
INHIBIT
ZENER
R611 10.0Ω 1%
C606 0.1UF 50V
C607 100UF 25V
R614 75.0K 1%
R607 3.16K 1%
2.048MHZ
C604 150PF 5% 100V CER
R605 13.3K 1%
R606 3.01K 1%
R608 2.15K 1%
C605 1.0UF 5% 50V MY
Y601 11.2896 MHZ
Y602 8.192MHZ
R612 110Ω 1%
C612 33PF 5% 100V CER
R613 110Ω 1%
C613 33PF 5% 100V CER
IC610 74HC153
1G 2G
1C0 1C1 1C2 1C3
2C0 2C1 2C2 2C3
1Y 2Y
44.1EN
EXTMCK
8.192MHZ
8.192MHZA (SHT7)
8.192MHZB (SHT 3,4,5)
IC605-A 74HC14A
IC605-B 74HC14A
SPARES
IC605-C 74HC14A
IC605-D 74HC14A
IC605-E 74HC14A
IC605-F 74HC14A
IC606-C 74HC08
IC606-D 74HC08
IC604-B 74HC74
Main Board: Digital I/O version 1
schematic 61171.000.01
(sheet 6 of 9)



Main Board: DSP 1 version 1
schematic 61171.000.01
(sheet 7 of 9)



Main Board: DSP 2 version 1
schematic 61171.000.01
(sheet 8 of 9)



Main Board: Power Distribution version 1
schematic 61171.000.01
(sheet 9 of 9)

2227	2/21/96	02	CHANGE CLOCK/ADD RES NET	DB	
2216A	1/25/96	01	RELEASE TO PRODUCTION	DB	

AES/EBU INPUT

J600 FEMALE

SHELL

L600 1000PF

L601 1000PF

C609 0.1UF 50V

T600 SC937-02

TP600

TP601

R600 110Ω 1%

IC600 CS8412

STATSEL

N/C N/C N/C

U C SEL VERF

ERF

RXP

RXN

CBL

SDATA

SCK

AGND

VA+

MCK

FSYNC

CS12/FCK

VD+

DGND

FILT M0 M1 M2 M3

C603 0.1UF 50V

C601 0.1UF 50V

EXTMCK

TP602

TP603

R601 1.00K 1%

C602 0.047UF 5% 50V MY

AES_RST

CHSEL

STATSEL

IC602-A 74HC00

IC602-B 74HC00

IC602-C 74HC00

IC602-D 74HC00

+5V

R602 00 5%

16.384MHZ

Vdd

GPDLYS

MCLK

DATA_I

BCLK_I

WCLK_I

L/R_I

RESET

BKPOL_I

TRGLR_I

MSBDLY_I

GND

SETLSLW

FLAG_IN

BCLK_O

WCLK_O

L/R_O

DATA_O

BKPOL_O

TRGLR_O

MSBDLY_O

MUTE_O

MUTE_I

GND/TEST

IC603 AD1890JN

SRC_RST

R615-G 100K

IC605-F 74HC14A

SCK (SHT3)

L/R (SHT 3)

DIG_IN (SHT7)

TP611

R615-H 100K

R609 110Ω 1%

C608 33PF 5% 100V CER

IC609 74HC374

D0 D1 D2 D3 D4 D5 D6 D7

Vcc

1D 2D 3D 4D 5D 6D 7D 8D

1Q 2Q 3Q 4Q 5Q 6Q 7Q 8Q

GND OC CK

SRC_RST

44_1EN

AES_RST

N/C

DIOINIT (SHT1)

D0-D7

Y601 11.2896 MHZ

44_1EN

R612 110Ω 1%

C612 33PF 5% 100V CER

IC610 74HC153

A B 1G 2G

1C0 1C1 1C2 1C3

2C0 2C1 2C2 2C3

EXTMCK

MCKOUT

R603 00

AO-A4

IC616 CS8401A

SDATA

MCK

SCK

FSYNC

MCKOUT

TP604 TP605 TP606

RD/WR (SHT1)

CS OUTSTATUS (SHT1)

TNT

TXP TXN

R604 110Ω 1% TP609

T601 SC937-02

TP610

C611 0.1UF 50V

L602 1000PF

L603 1000PF

AES/EBU OUTPUT

J601 MALE

SHELL

IC605-E 74HC14A

TP607

R615-I 100K

ALL ITEMS ON THIS SHEET ARE USED ON THE 2200D
ALL ITEMS TO THE LEFT ARE NOT USED ON THE 2200

(SHT2) A

(SHT2) B

IC601 74HC245

DIR A1 A2 A3 A4 A5 A6 A7 A8

B1 B2 B3 B4 B5 B6 B7 B8

D7 D6 D5 D4 D3 D2 D1 D0

GND

INSTATUS (SHT1)

D0-D7

R615-A 100K

R615-B 100K

R615-C 100K

R615-D 100K

R615-E 100K

R615-F 100K

SPARES

IC606-C 74HC08

IC605-C 74HC14A

IC606-D 74HC08

N/C

R611 10.0Ω 1%

C606 0.1UF 50V

C607 100UF 25V

R613 110Ω 1%

C613 33PF 5% 100V CER

2.048MHZ

VCC

I/O

N/C

18.432MHZ (SHT1)

IC618 PALC16V8-15

C604 150PF 5% 100V CER

SIG IN

COMP IN

VCO OUT

C1(1)

C1(2)

R1 R2 INHIBIT

VDD

PH. COMP I OUT

PH. COMP II OUT

PHASE PULSES

VCO IN

DEMOD. OUT

VSS

ZENER

R605 13.3K 1%

R606 3.01K 1%

IC619 74HC4046

R614 75.0K 1%

R607 3.16K 1%

R608 2.15K 1%

C605 1.0UF 5% 50V MY

IC611 74HC374

WATCHDOG (SHT1)

EEPROM (SHT1)

CHSEL

STATSEL

N/C

DIS_ON (SHT2)

CLKGEN (SHT1)

IC612-A 74HC74

IC612-B 74HC74

PR D Q CK CLR GND

32KHZ

IC614-B 74HC08

IC614-C 74HC08

IRQBA (SHTB)

IRQBB (SHTB)

IC604-B 74HC74

8.192MHZ

IC605-A 74HC14A

8.192MHZA (SHT7)

IC605-B 74HC14A

8.192MHZB (SHT 3,4,5)

16.384MHZ

Y602 16.384MHZ

C600 33PF 5% 100V CER

R610 110Ω 1%

IC605-D 74HC14A

(SHT4) 32KHZA

IC606-A 74HC08

IC606-B 74HC08

IC613 PALC16V8-25

2.048MHZ (SHT5)

256KHZ (SHT5)

128KHZ (SHT 2,7)

64KHZ (SHT2)

32KHZ (SHT 2,3)

IC614-D 74HC08

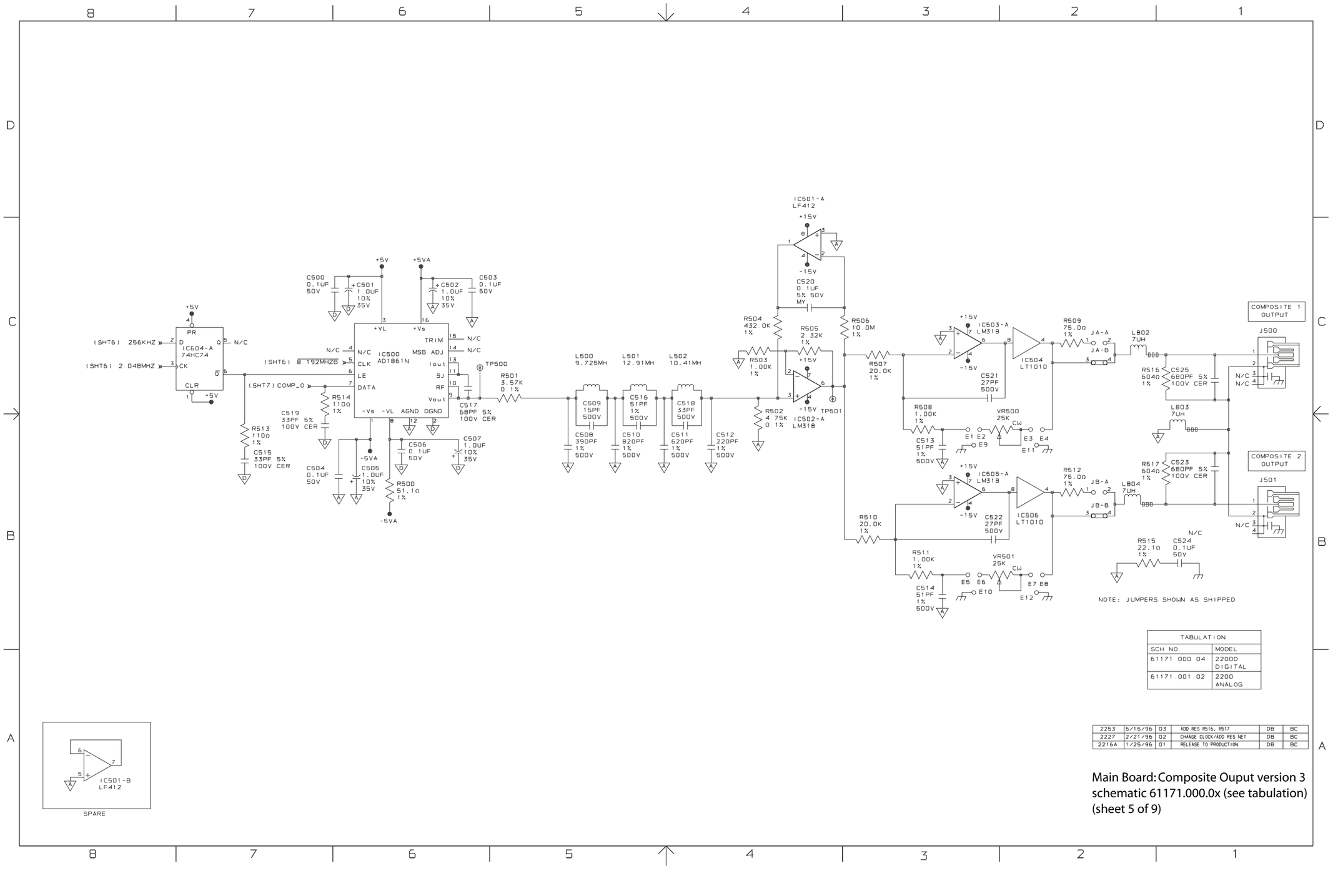
IC614-A 74HC08

2.048MHZA (SHTB)

2.048MHZB (SHTB)

TABULATION	
SCH. NO.	MODEL
61171.000.03	2200D DIGITAL
61171.001.01	2200 ANALOG

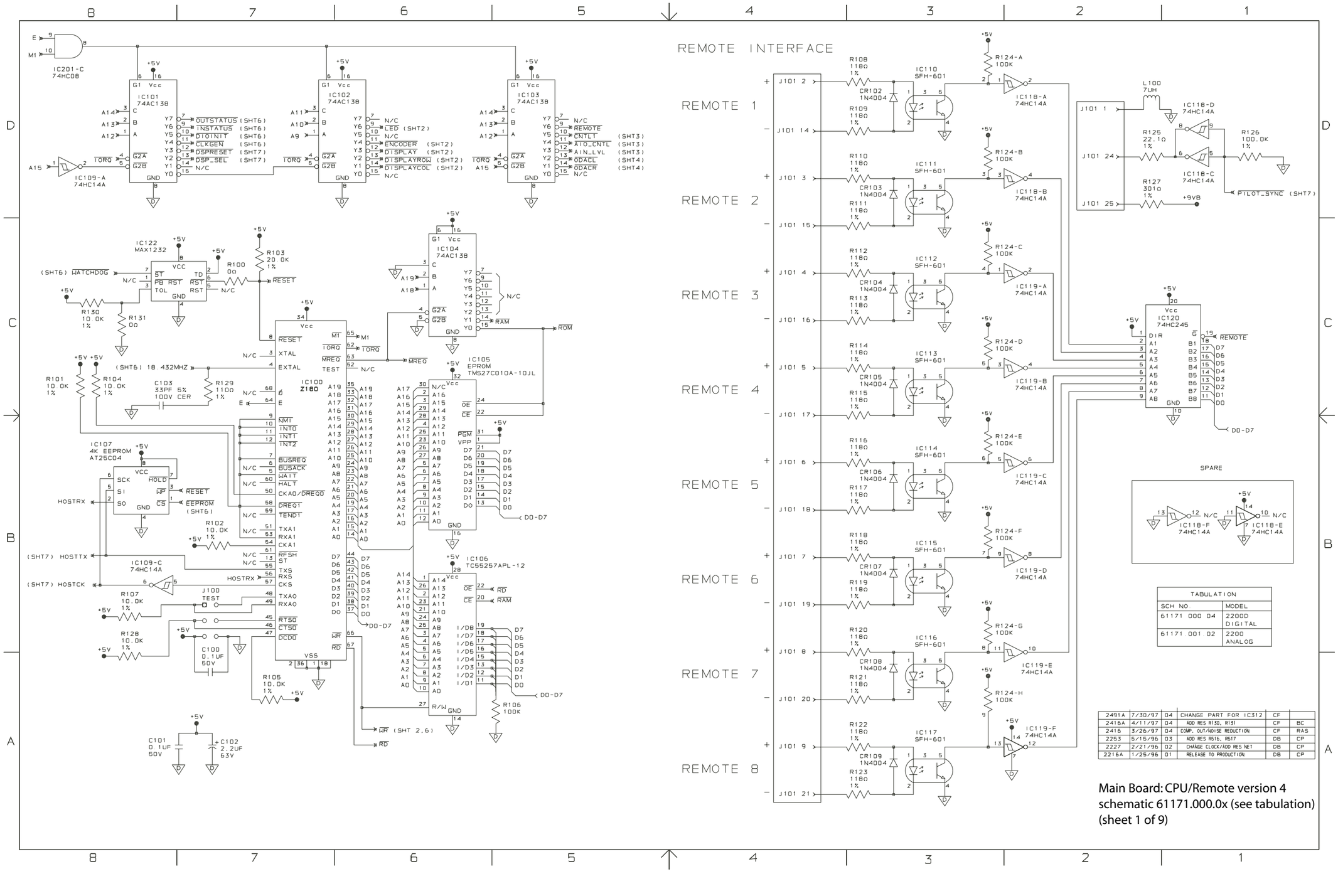
Main Board: Digital I/O version 2 schematic 61171.000.0x (see tabulation) (sheet 6 of 9)



TABULATION	
SCH NO	MODEL
61171.000.04	2200D DIGITAL
61171.001.02	2200 ANALOG

2253	5/15/96	03	ADD RES R516, R517	DB	BC
2227	2/21/96	02	CHANGE CLOCK/ADD RES NET	DB	BC
2216A	1/25/96	01	RELEASE TO PRODUCTION	DB	BC

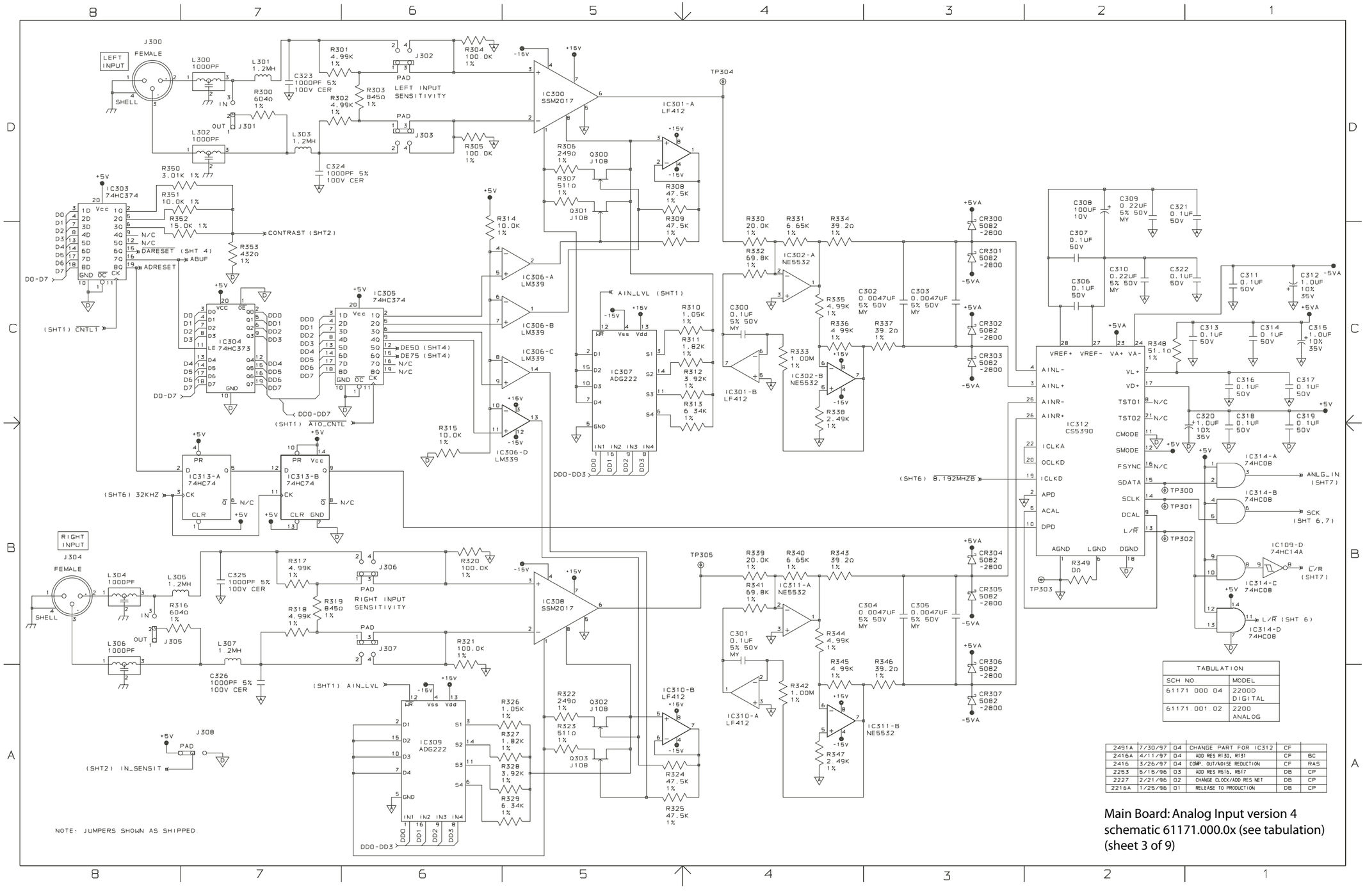
Main Board: Composite Ouput version 3
schematic 61171.000.0x (see tabulation)
(sheet 5 of 9)



TABULATION	
SCH NO	MODEL
61171 000 04	2200D DIGITAL
61171 001 02	2200 ANALOG

2491A	7/30/97	04	CHANGE PART FOR IC312	CF	
2416A	4/11/97	04	ADD RES R130, R131	CF	BC
2416	3/26/97	04	COMP. OUT/NOISE REDUCTION	CF	RAS
2253	5/15/96	03	ADD RES R516, R517	DB	CP
2227	2/21/96	02	CHANGE CLOCK/ADD RES NET	DB	CP
2216A	1/25/96	01	RELEASE TO PRODUCTION	DB	CP

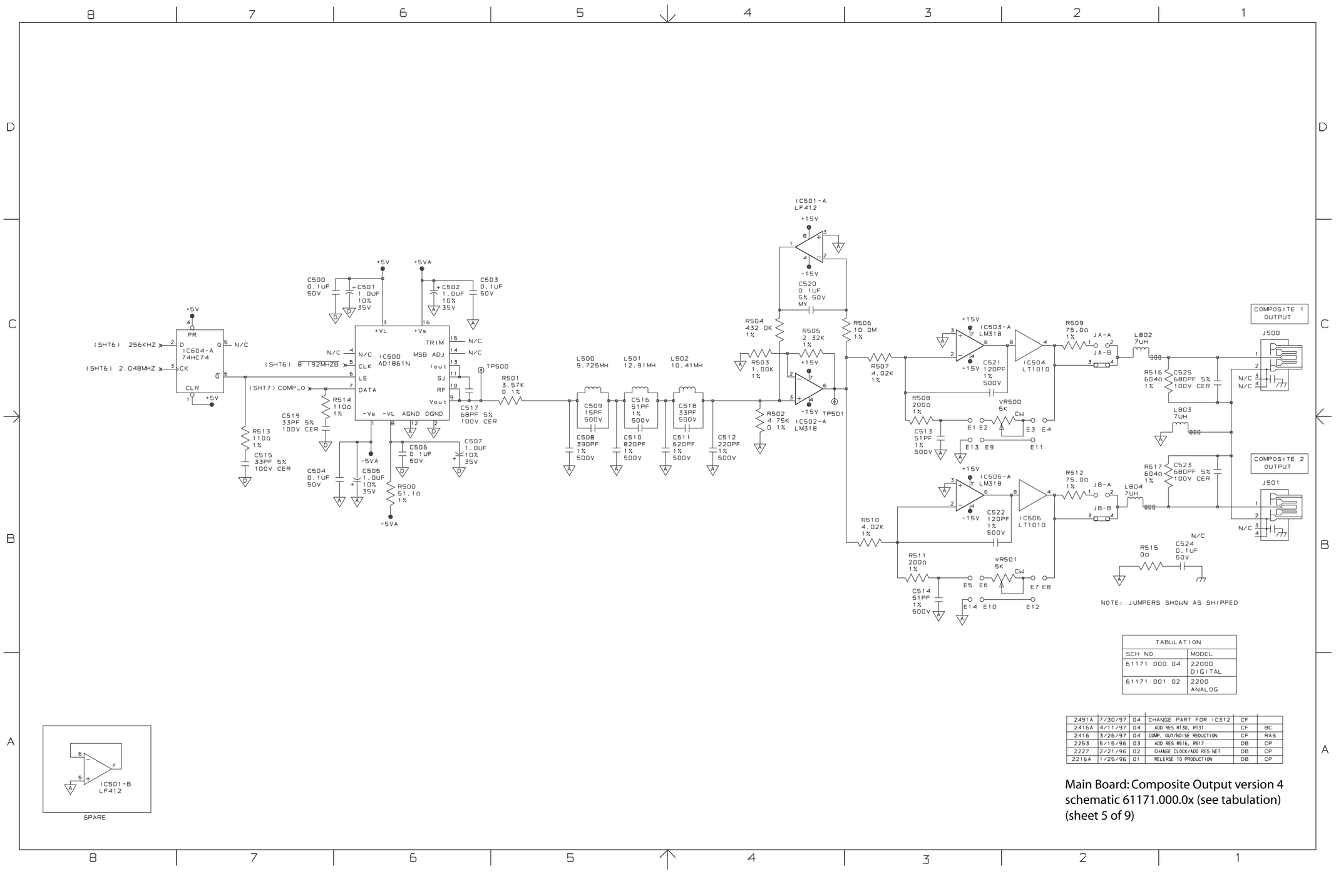
Main Board: CPU/Remote version 4 schematic 61171.000.0x (see tabulation) (sheet 1 of 9)



TABULATION	
SCH NO	MODEL
61171 000 04	2200D DIGITAL
61171 001 02	2200 ANALOG

2491A	7/30/97	04	CHANGE PART FOR IC312	CF	
2416A	4/11/97	04	ADD RES R130, R131	CF	BC
2416	3/26/97	04	COMP. OUT/NOISE REDUCTION	CF	RAS
2253	5/16/96	03	ADD RES R516, R517	DB	CP
2227	2/21/96	02	CHANGE CLOCK/ADD RES NET	DB	CP
2216A	1/25/96	01	RELEASE TO PRODUCTION	DB	CP

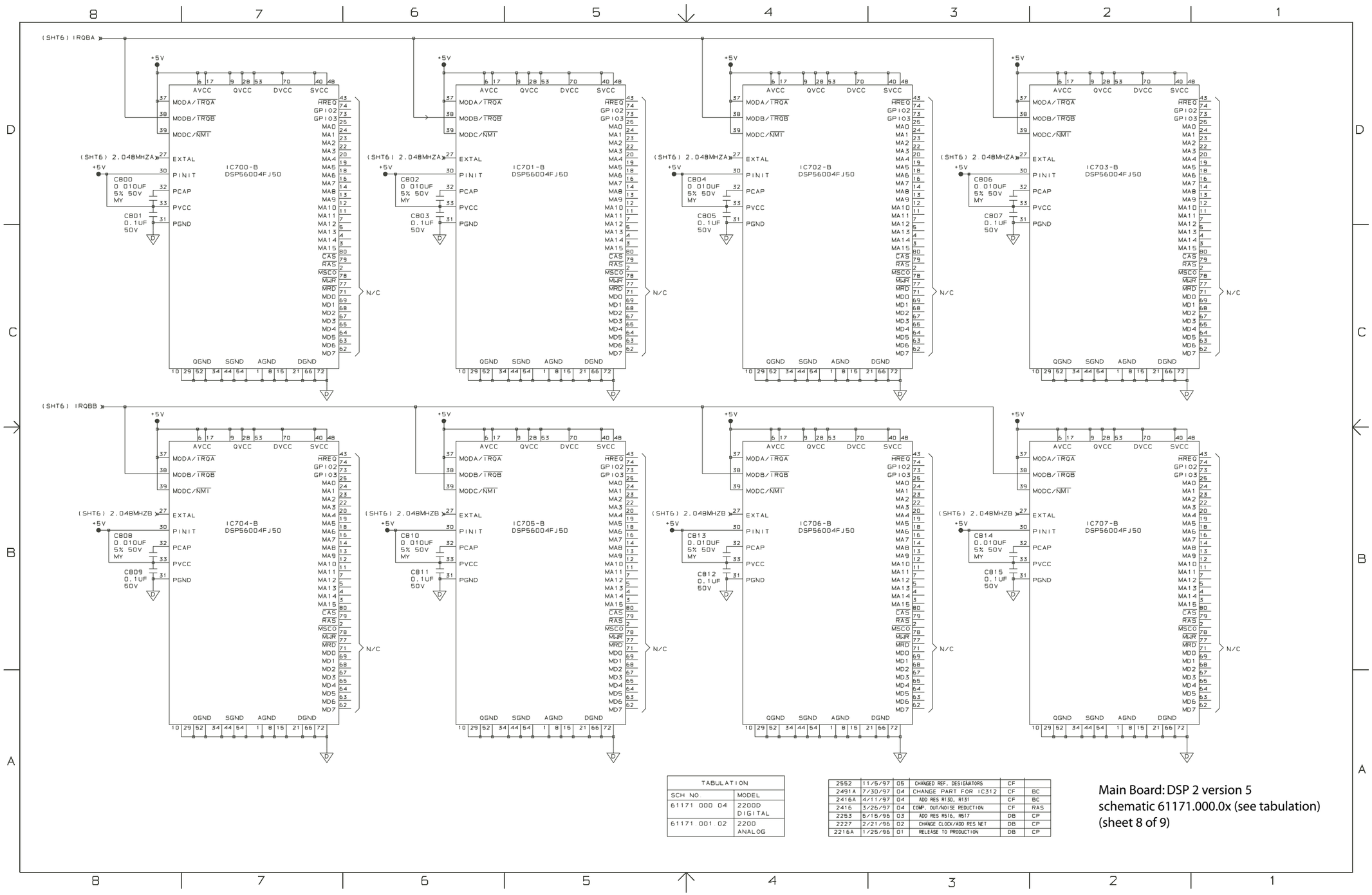
Main Board: Analog Input version 4
schematic 61171.000.0x (see tabulation)
(sheet 3 of 9)



TABULATION	
SCH NO.	MODEL
61171 000 04	2200D DIGITAL
61171 001 02	2200 ANALOG

2491A	7/30/97	04	CHANGE PART FOR IC312	CF	
2416A	4/11/97	04	ADD RES R130, R131	CF	BC
2416	3/26/97	04	COMP. OUT/NOISE REDUCTION	CF	RAS
2253	6/15/96	03	ADD RES R516, R517	DB	CP
2227	2/21/96	02	CHANGE CLOCK/ADD RES NET	DB	CP
2216A	1/25/96	01	RELEASE TO PRODUCTION	DB	CP

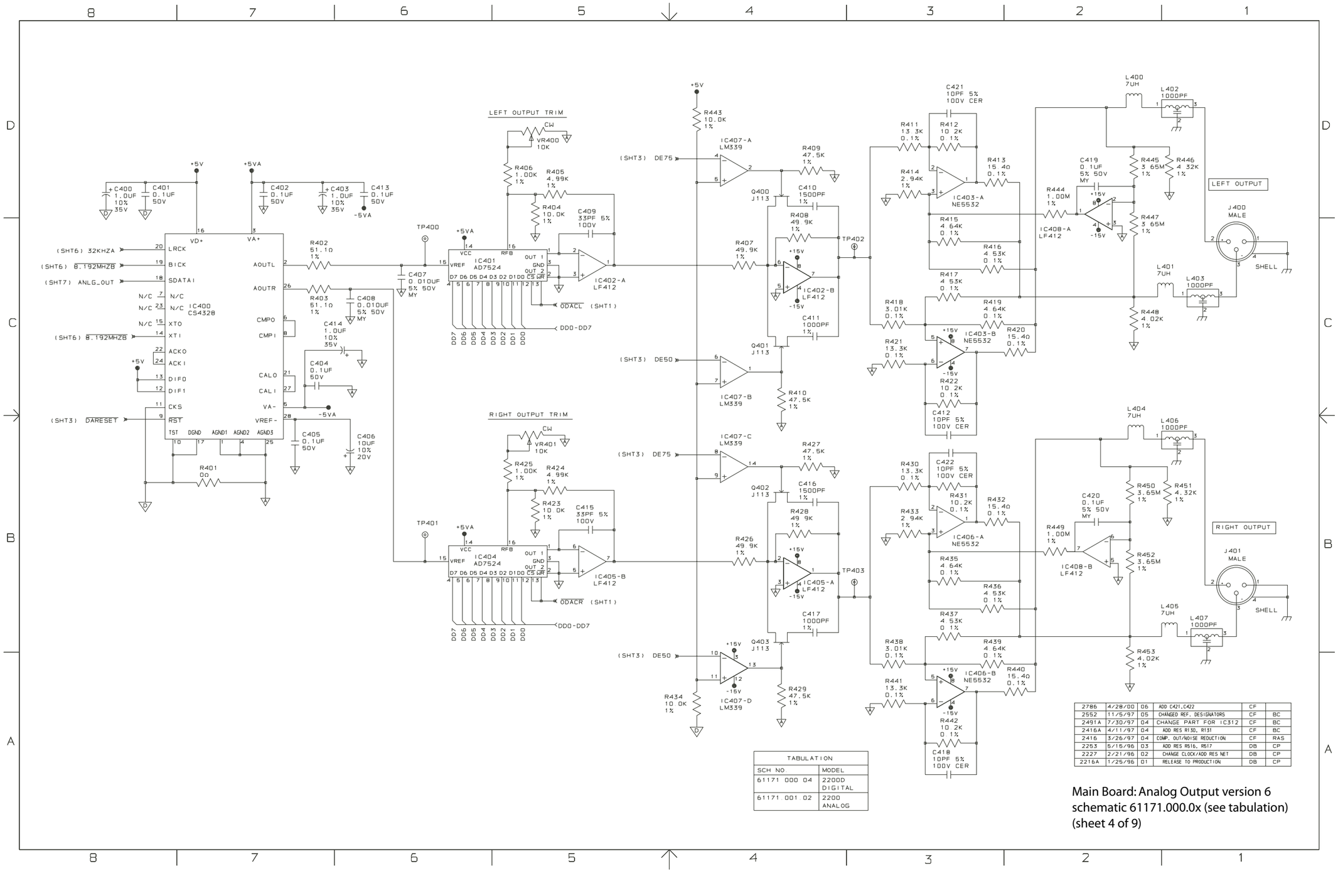
Main Board: Composite Output version 4 schematic 61171.000.0x (see tabulation) (sheet 5 of 9)



TABULATION	
SCH NO	MODEL
61171.000.04	2200D DIGITAL
61171.001.02	2200 ANALOG

2552	11/5/97	05	CHANGED REF. DESIGNATORS	CF	
2491A	7/30/97	04	CHANGE PART FOR IC312	CF	BC
2416A	4/11/97	04	ADD RES R130, R131	CF	BC
2416	3/26/97	04	COMP. OUT/NOISE REDUCTION	CF	RAS
2253	5/15/96	03	ADD RES R516, R517	DB	CP
2227	2/21/96	02	CHANGE CLOCK/ADD RES NET	DB	CP
2216A	1/25/96	01	RELEASE TO PRODUCTION	DB	CP

Main Board: DSP 2 version 5
schematic 61171.000.0x (see tabulation)
(sheet 8 of 9)



TABULATION	
SCH NO	MODEL
61171 000 04	2200D DIGITAL
61171 001 02	2200 ANALOG

2786	4/28/00	06	ADD C421,C422	CF	
2552	11/5/97	05	CHANGED REF. DESIGNATORS	CF	BC
2491A	7/30/97	04	CHANGE PART FOR IC312	CF	BC
2416A	4/11/97	04	ADD RES R130, R131	CF	BC
2416	3/26/97	04	COMP. OUT/NOISE REDUCTION	CF	RAS
2253	5/15/96	03	ADD RES R516, R617	DB	CP
2227	2/21/96	02	CHANGE CLOCK/ADD RES NET	DB	CP
2216A	1/25/96	01	RELEASE TO PRODUCTION	DB	CP

Main Board: Analog Output version 6 schematic 61171.000.0x (see tabulation) (sheet 4 of 9)

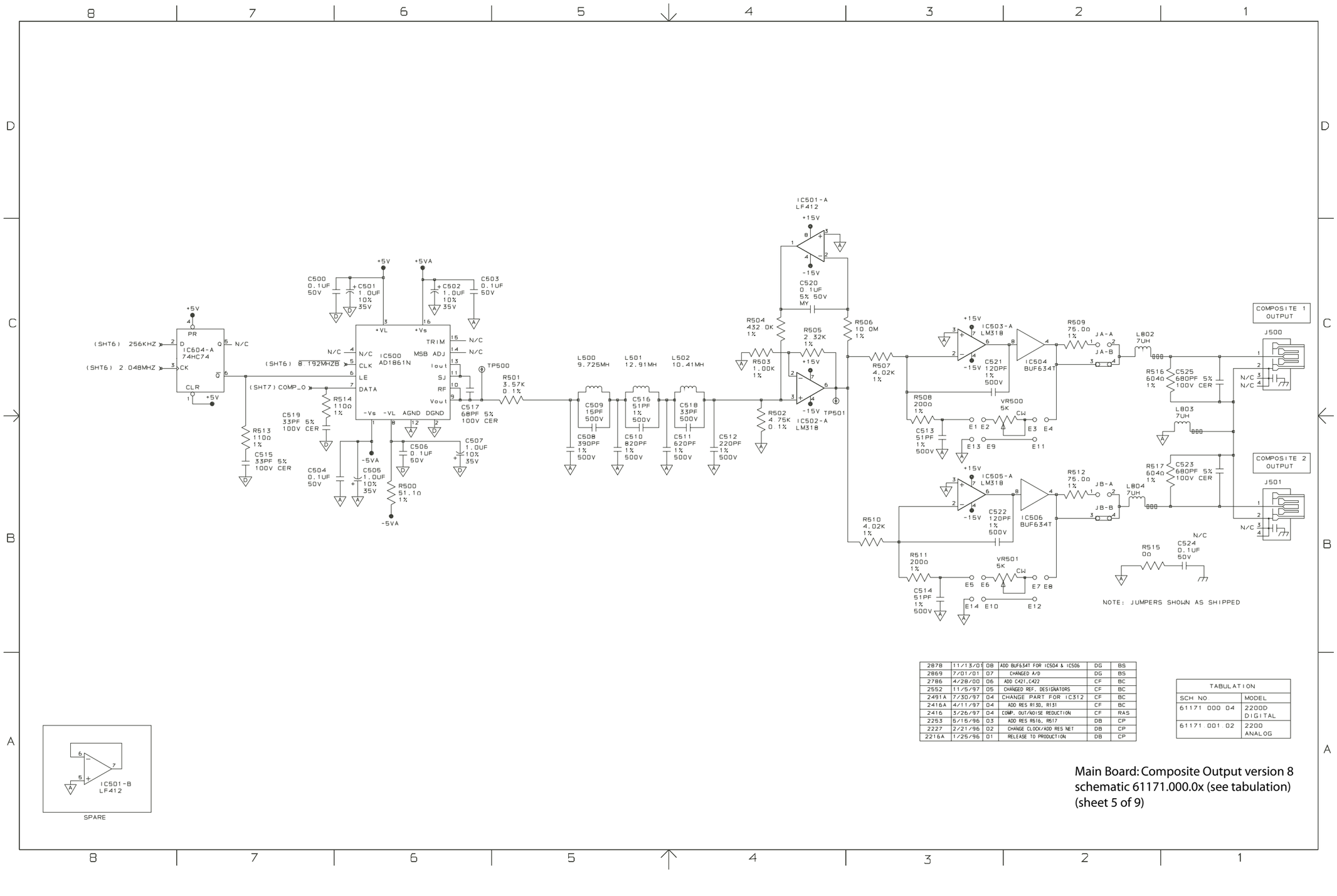
2869	7/01/01	07	CHANGED A/D	DG	BS
2786	4/28/00	06	ADD C421,C422	CF	BC
2552	11/5/97	05	CHANGED REF. DESIGNATORS	CF	BC
2491A	7/30/97	04	CHANGE PART FOR IC312	CF	BC
2416A	4/11/97	04	ADD RES R130, R131	CF	BC
2416	3/26/97	04	COMP. OUT/NOISE REDUCTION	CF	RAS
2253	5/15/96	03	ADD RES R516, R517	DB	CP
2227	2/21/96	02	CHANGE CLOCK/ADD RES NET	DB	CP
2216A	1/25/96	01	RELEASE TO PRODUCTION	DB	CP

NOTE: ORIGINAL A/D CS5390 DESIGN, UNITS BUILT PRIOR TO JULY, 2001

NOTE JUMPERS SHOWN AS SHIPPED

TABULATION	
SCH NO.	MODEL
61171 000 04	2200D DIGITAL
61171 001 02	2200 ANALOG

Main Board: Analog Input version 7
schematic 61171.000.0x (see tabulation)
(sheet 3 of 9)



2878	11/13/01	08	ADD BUF634T FOR IC504 & IC506	DG	BS
2869	7/01/01	07	CHANGED A/D	DG	BS
2786	4/28/00	06	ADD C421,C422	CF	BC
2552	11/5/97	05	CHANGED REF. DESIGNATORS	CF	BC
2491A	7/30/97	04	CHANGE PART FOR IC312	CF	BC
2416A	4/11/97	04	ADD RES R130, R131	CF	BC
2416	3/26/97	04	COMP. OUT/NOISE REDUCTION	CF	RAS
2253	6/15/96	03	ADD RES R616, R617	DB	CP
2227	2/21/96	02	CHANGE CLOCK/ADD RES NET	DB	CP
2216A	1/25/96	01	RELEASE TO PRODUCTION	DB	CP

TABULATION	
SCH NO.	MODEL
61171 000 04	2200D DIGITAL
61171 001 02	2200 ANALOG

Main Board: Composite Output version 8 schematic 61171.000.0x (see tabulation) (sheet 5 of 9)

2934	1/17/03	09	IC100,IC308 CHANGE	CF	
2878	11/13/01	08	ADD BUF634T FOR IC504 & IC506	DG	BS
2869	7/01/01	07	CHANGED A/D	DG	BS
2786	4/28/00	06	ADD C421,C422	CF	BC
2552	11/5/97	05	CHANGED REF. DESIGNATORS	CF	BC
2491A	7/30/97	04	CHANGE PART FOR IC312	CF	BC
2416A	4/11/97	04	ADD RES R130, R131	CF	BC
2416	3/26/97	04	COMP. OUT/NOISE REDUCTION	CF	RAS
2263	5/15/96	03	ADD RES R616, R617	DB	CP
2227	2/21/96	02	CHANGE CLOCK/ADD RES NET	DB	CP
2216A	1/25/96	01	RELEASE TO PRODUCTION	DB	CP

TABULATION	
SCH NO	MODEL
61171 000 04	2200D DIGITAL
61171 001 02	2200 ANALOG

NOTE: ORIGINAL A/D CS5390 DESIGN, UNITS BUILT PRIOR TO JULY, 2001

NOTE JUMPERS SHOWN AS SHIPPED

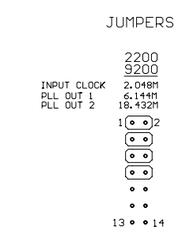
Main Board: Analog Input version 9
schematic 61171.000.0x (see tabulation)
(sheet 3 of 9)

2996	1/17/03	10	4046 CLK ADAPTER	CF	
2934	1/17/03	09	IC500, IC508 CHANGE	CF	
2878	11/13/01	08	ADD BUF634T FOR IC504 & IC506	DG	BS
2869	7/01/01	07	CHANGED A/D	DG	BS
2786	4/28/00	06	ADD C421,C422	CF	BC
2552	11/5/97	05	CHANGED REF. DESIGNATORS	CF	BC
2491A	7/30/97	04	CHANGE PART FOR IC312	CF	BC
2416A	4/11/97	04	ADD RES R130, R131	CF	BC
2416	3/26/97	04	COMP. OUT/NOISE REDUCTION	CF	RAS
2253	6/15/96	03	ADD RES R516, R517	DB	CP
2227	2/21/96	02	CHANGE CLOCK/ADD RES NET	DB	CP
2216A	1/25/96	01	RELEASE TO PRODUCTION	DB	CP

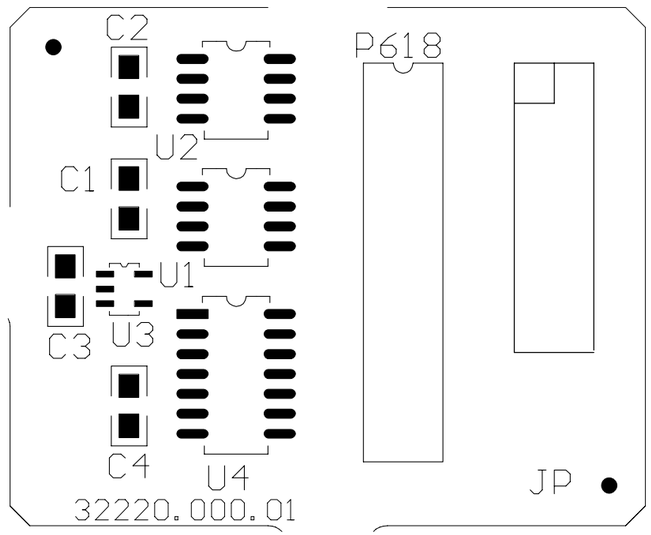
TABULATION	
SCH NO.	MODEL
61171.000.04	2200D DIGITAL
61171.001.02	2200 ANALOG

ALL ITEMS ON THIS SHEET ARE USED ON THE 2200D
ALL ITEMS TO THE LEFT ARE NOT USED ON THE 2200

Main Board: Digital I/O version 10
schematic 61171.000.0x (see tabulation)
(sheet 6 of 9)

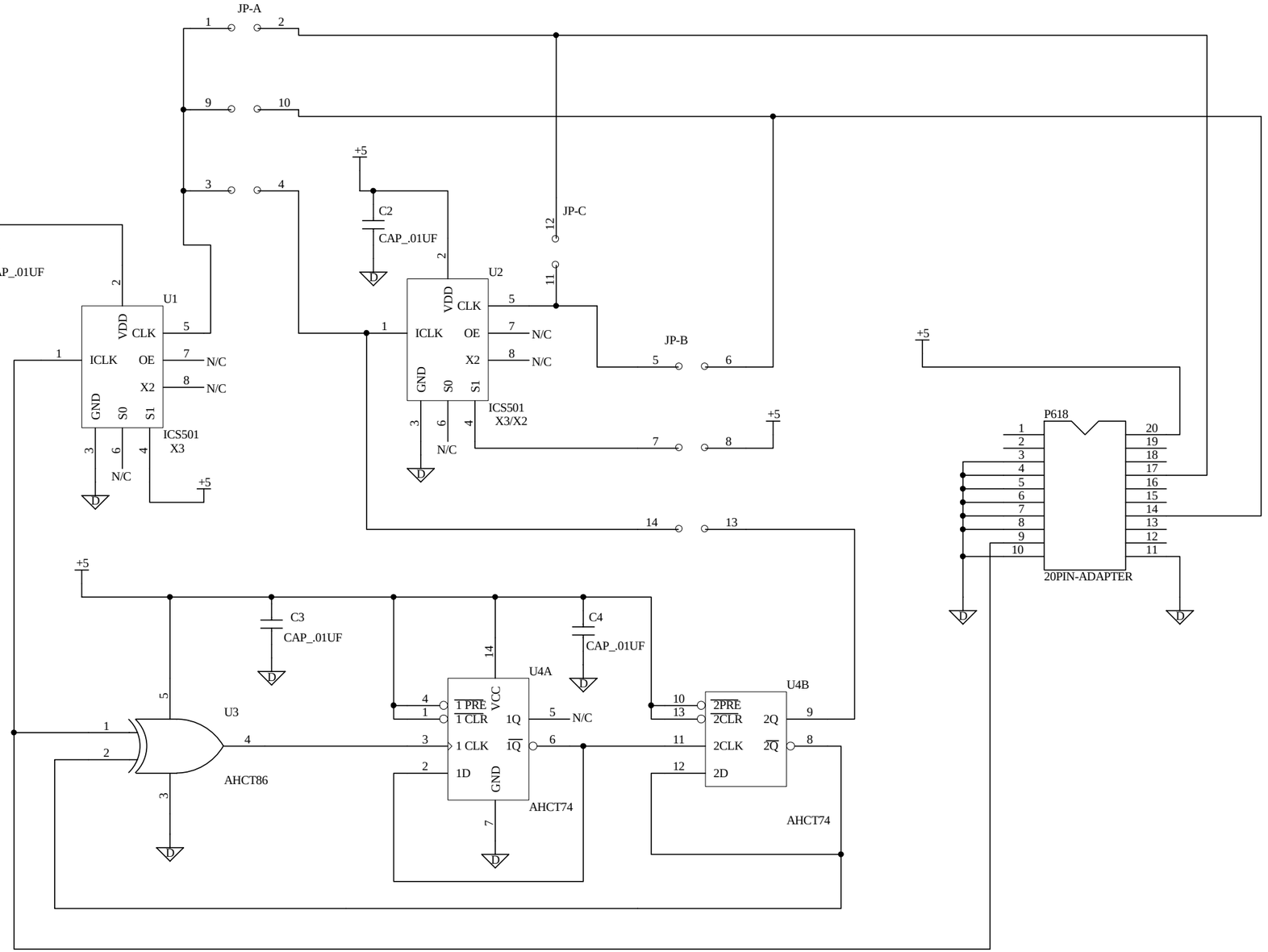


2200,9200 2.048M X3 = 6.144M
6.144M X3 = 18.432M



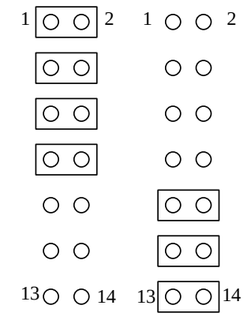
1. SQUARE PADS INDICATE PIN 1 OF CONNECTORS, CATHODE OF DIODES, POS. SIDE OF CAPS. PIN 1 OF IC'S.

Clock Generator version 1
Drawing 32220.000.01
Reference schematic 62220.000.01



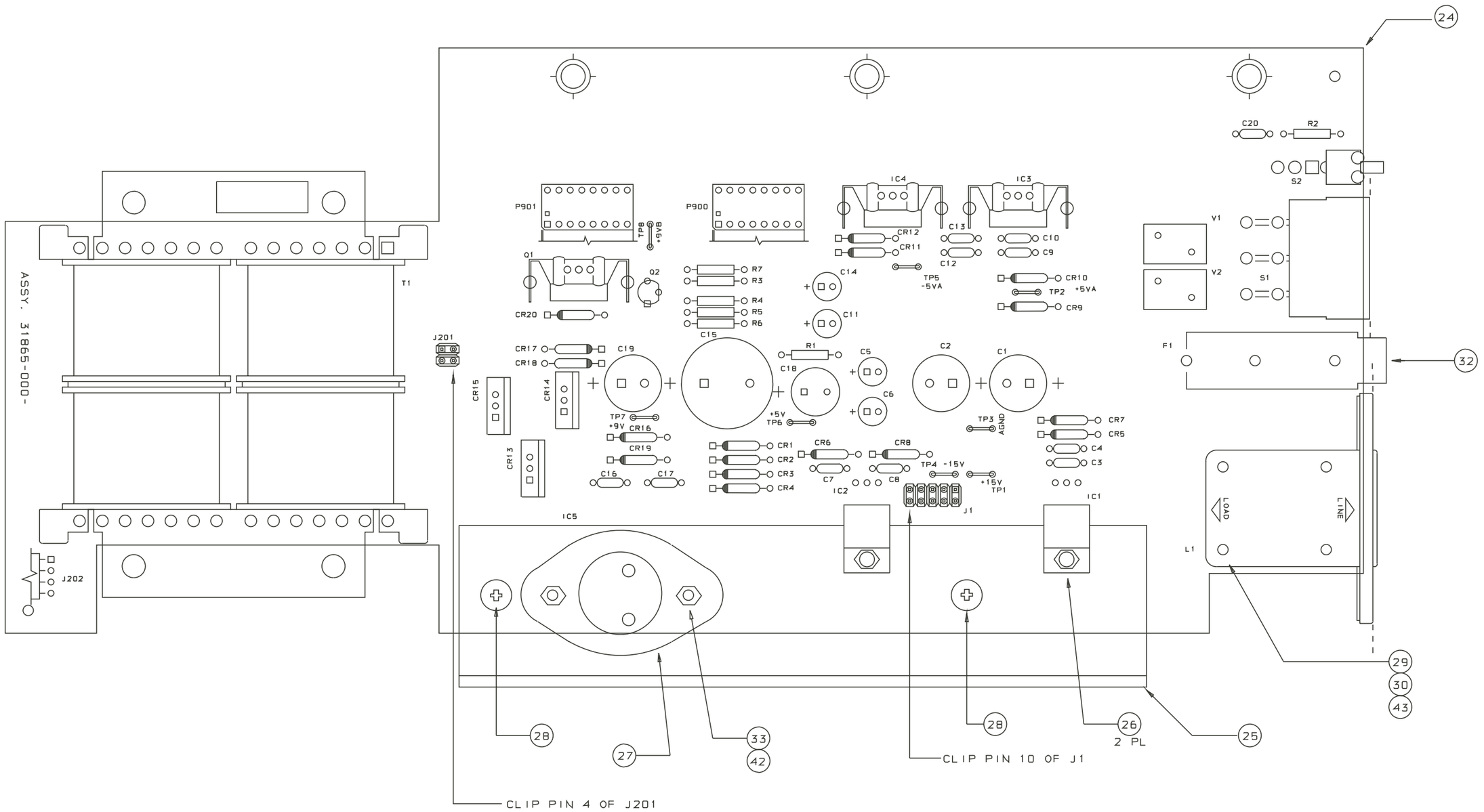
JUMPERS

	2200 9200	6200
INPUT CLOCK	2.048M	6.144M
PLL OUT 1	6.144M	4.096M
PLL OUT 2	18.432M	18.432M



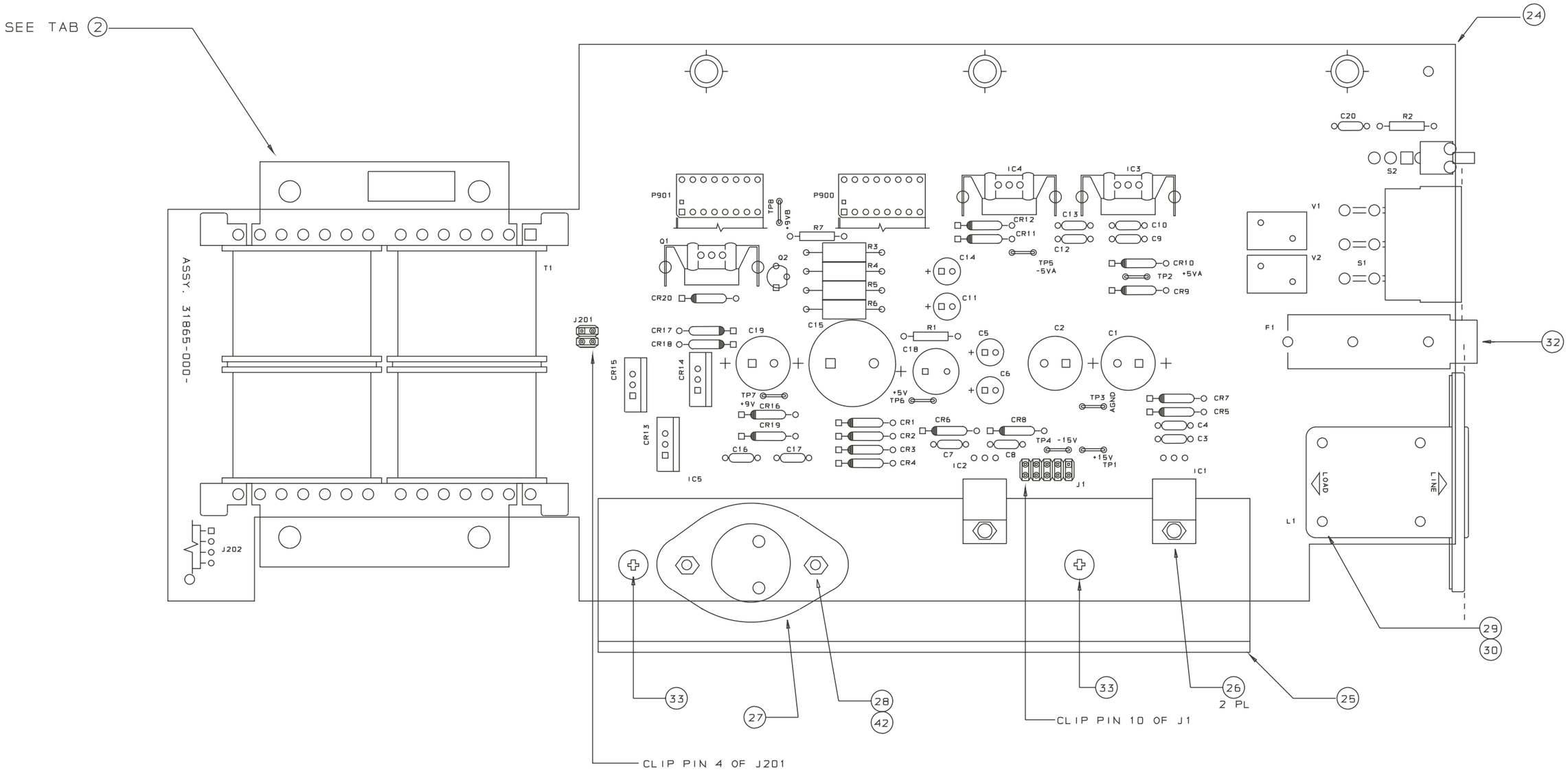
2.048M X3 = 6.144M
6.144M X3 = 18.432M

Clock Generator version 1
Schematic 62220.000.01



COMPONENT SIDE

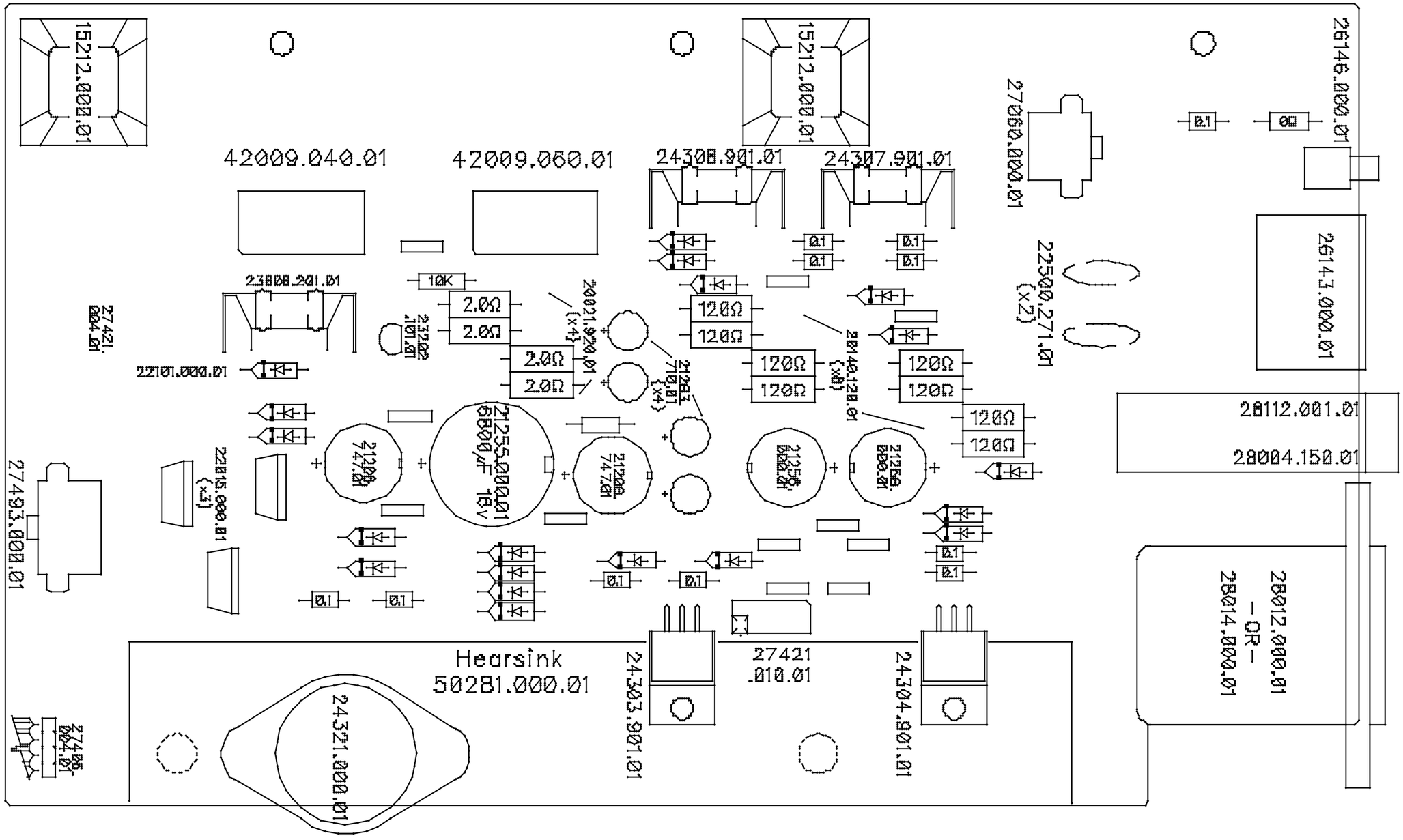
Power Supply version 1
Drawing 31865.000.01
Reference schematic 61181.000.01



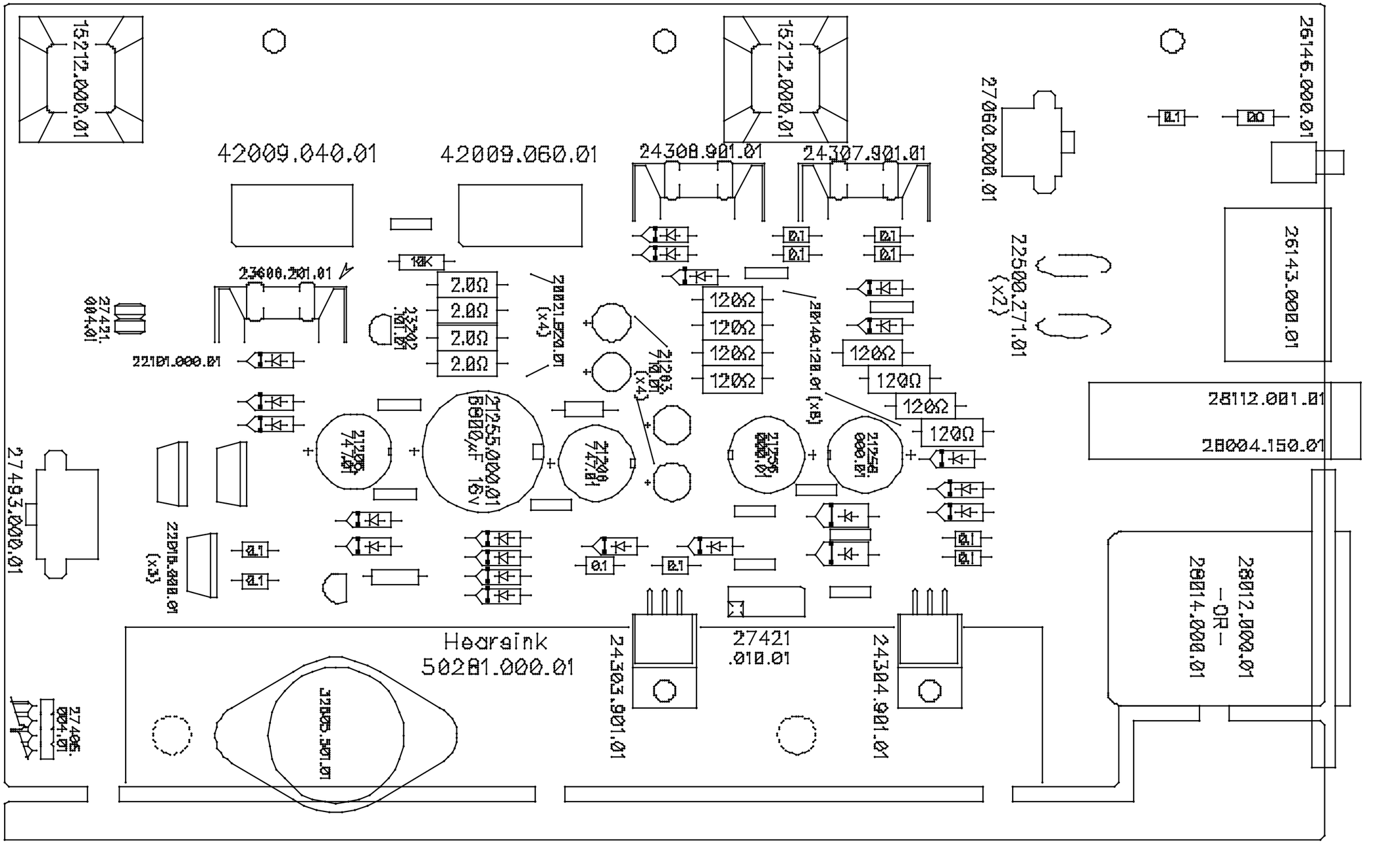
COMPONENT SIDE

TABULATION	
VER	XFMER
000	55033-000
001	55034-000

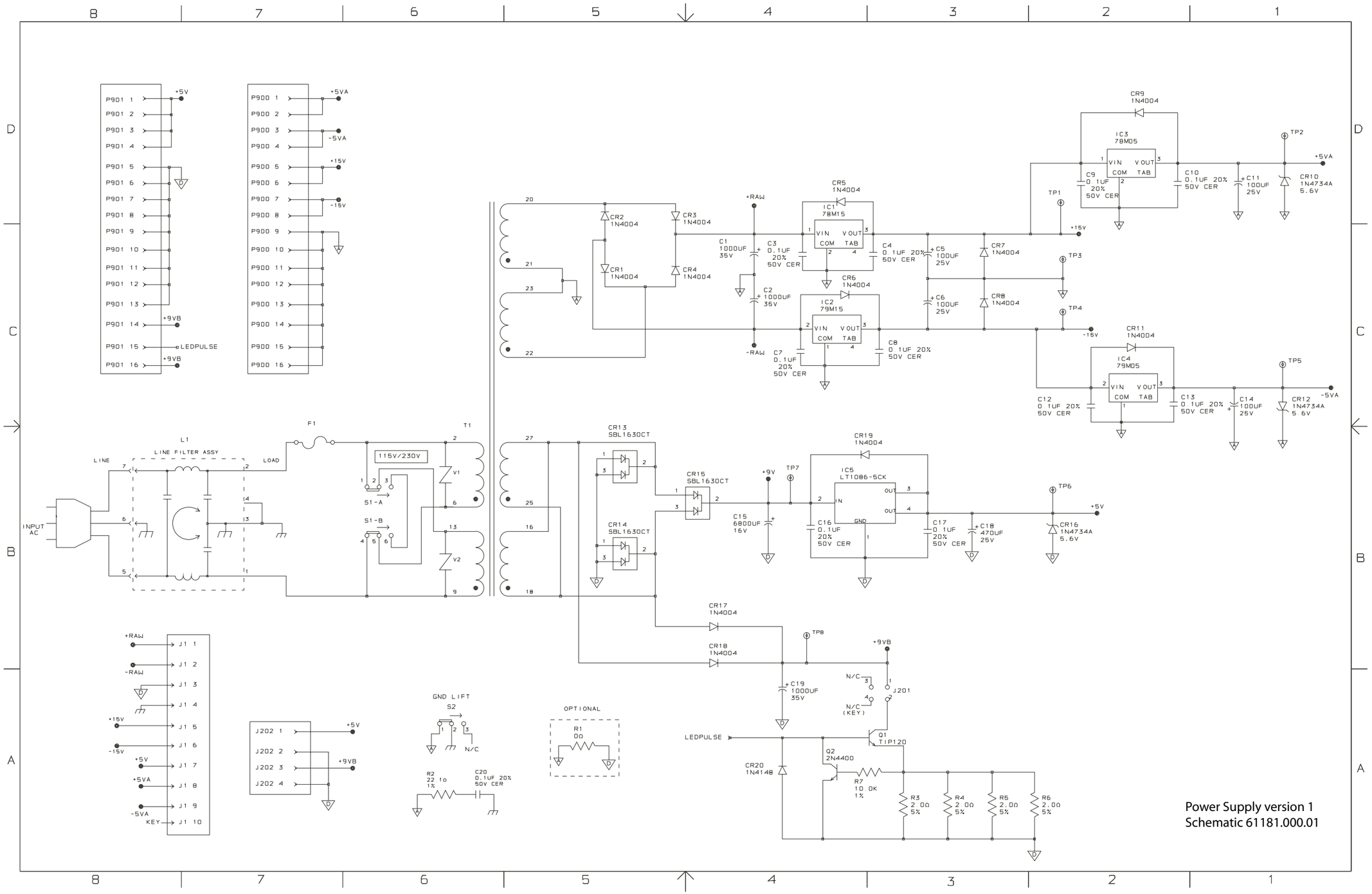
Power Supply version 2
Drawing 31865-[see tab]-02
Reference schematic 61181.000.02

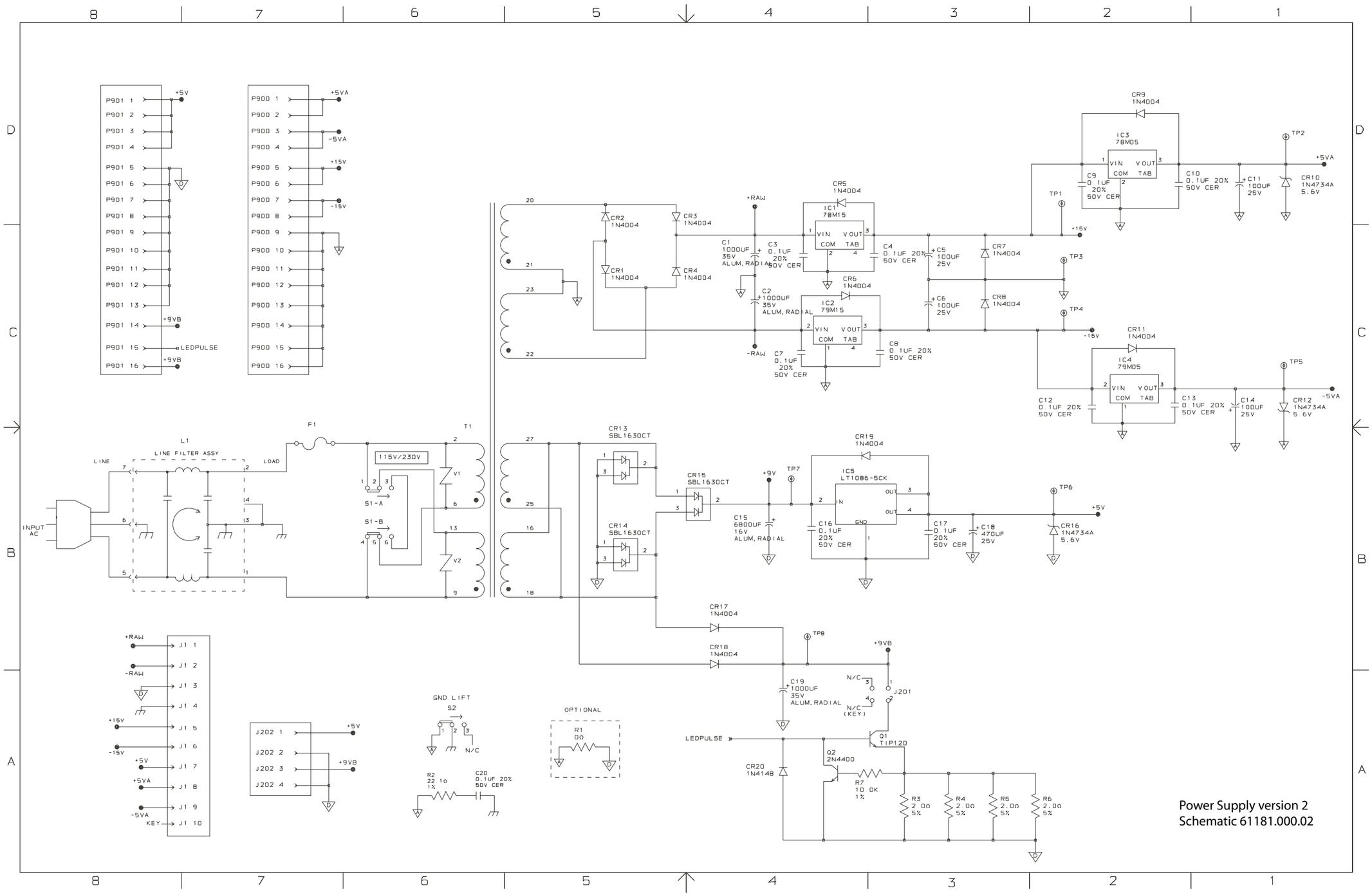


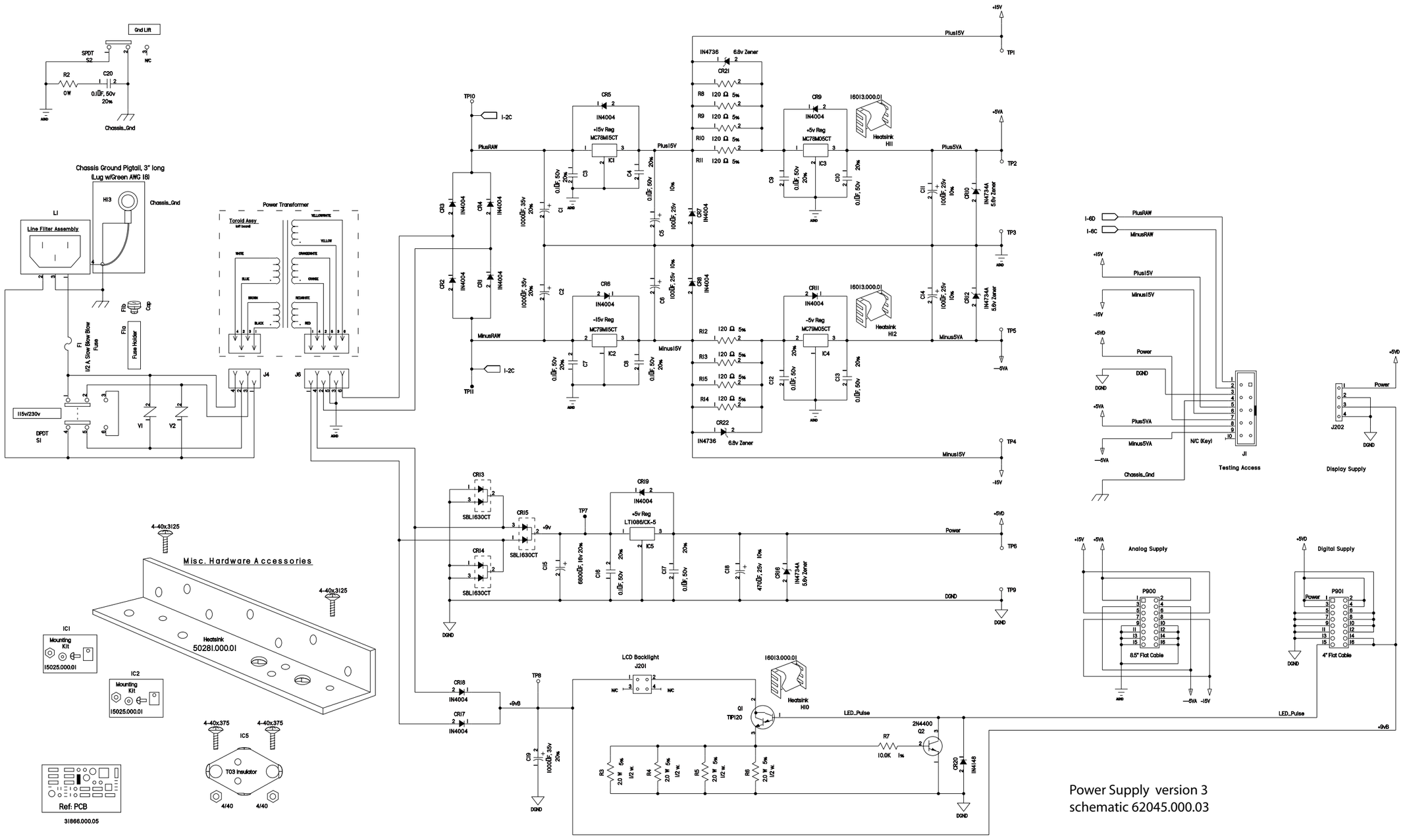
Power Supply version 3
Drawing 32045.000.02
Reference schematic 60245.000.03



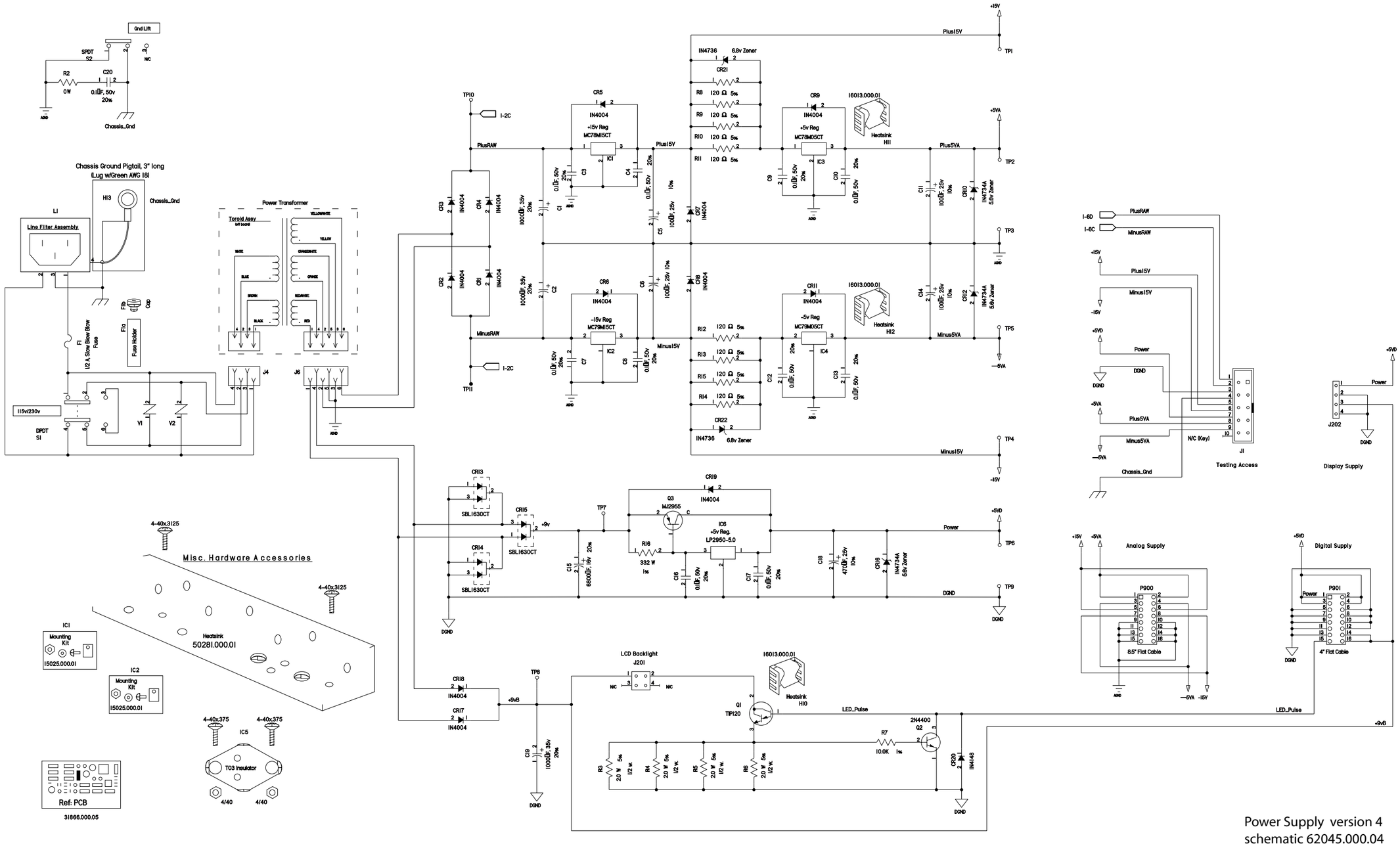
Power Supply version 4
Drawing 32045.000.05
Reference schematic 60245.000.04


P901 1 +5V
P901 2
P901 3
P901 4
P901 5
P901 6
P901 7
P901 8
P901 9
P901 10
P901 11
P901 12
P901 13
P901 14 +9VB
P901 15 LEDPULSE
P901 16 +9VB
P900 1 +5VA
P900 2
P900 3 -5VA
P900 4
P900 5 +15V
P900 6
P900 7 -15V
P900 8
P900 9
P900 10
P900 11
P900 12
P900 13
P900 14
P900 15
P900 16
L1
LINE FILTER ASSY
LINE
LOAD
INPUT AC
F1
115V/230V
S1-A
S1-B
T1
V1
V2
20
21
23
22
27
25
16
18
CR1 1N4004
CR2 1N4004
CR3 1N4004
CR4 1N4004
CR5 1N4004
CR6 1N4004
CR7 1N4004
CR8 1N4004
CR9 1N4004
CR11 1N4004
CR13 SBL1630CT
CR14 SBL1630CT
CR15 SBL1630CT
CR17 1N4004
CR18 1N4004
CR19 1N4004
CR20 1N4148
CR10 1N4734A 5.6V
CR12 1N4734A 5.6V
CR16 1N4734A 5.6V
IC1 78M15
IC2 79M15
IC3 78M05
IC4 79M05
IC5 LT1086-5CK
+RAW
-RAW
C1 1000UF 35V
C2 1000UF 35V
C3 0.1UF 20% 50V CER
C4 0.1UF 20% 50V CER
C5 100UF 25V
C6 100UF 25V
C7 0.1UF 20% 50V CER
C8 0.1UF 20% 50V CER
C9 0.1UF 20% 50V CER
C10 0.1UF 20% 50V CER
C11 100UF 25V
C12 0.1UF 20% 50V CER
C13 0.1UF 20% 50V CER
C14 100UF 25V
C15 6800UF 16V
C16 0.1UF 20% 50V CER
C17 0.1UF 20% 50V CER
C18 470UF 25V
C19 1000UF 35V
C20 0.1UF 20% 50V CER
R1 0Ω
R2 22.1Ω 1%
R3 2.00 5%
R4 2.00 5%
R5 2.00 5%
R6 2.00 5%
R7 10.0K 1%
TP1
TP2
TP3
TP4
TP5
TP6
TP7
TP8
+15V
-15V
+5VA
-5VA
+9V
+9VB
+5V
J1 1 +RAW
J1 2
J1 3 -RAW
J1 4
J1 5 +15V
J1 6 -15V
J1 7 +5V
J1 8 +5VA
J1 9 -5VA
J1 10 KEY
J202 1 +5V
J202 2
J202 3
J202 4 +9VB
GND LIFT
S2
N/C
OPTIONAL
J201
N/C
N/C (KEY)
LEDPULSE
Q1 TIP120
Q2 2N4400
Power Supply version 1
Schematic 61181.000.01


P901 1 +5V
P901 2
P901 3
P901 4
P901 5
P901 6
P901 7
P901 8
P901 9
P901 10
P901 11
P901 12
P901 13
P901 14 +9VB
P901 15 LEDPULSE
P901 16 +9VB
P900 1 +5VA
P900 2
P900 3 -5VA
P900 4
P900 5 +15V
P900 6
P900 7 -15V
P900 8
P900 9
P900 10
P900 11
P900 12
P900 13
P900 14
P900 15
P900 16
F1
L1
LINE FILTER ASSY
LINE
LOAD
INPUT AC
115V/230V
S1-A
S1-B
T1
V1
V2
CR1 1N4004
CR2 1N4004
CR3 1N4004
CR4 1N4004
CR5 1N4004
CR6 1N4004
CR7 1N4004
CR8 1N4004
CR9 1N4004
CR10 1N4734A 5.6V
CR11 1N4004
CR12 1N4734A 5.6V
CR13 SBL1630CT
CR14 SBL1630CT
CR15 SBL1630CT
CR16 1N4734A 5.6V
CR17 1N4004
CR18 1N4004
CR19 1N4004
CR20 1N4148
+RAW
-RAW
C1 1000UF 35V ALUM, RADIAL
C2 1000UF 35V ALUM, RADIAL
C3 0.1UF 20% 50V CER
C4 0.1UF 20% 50V CER
C5 100UF 25V
C6 100UF 25V
C7 0.1UF 20% 50V CER
C8 0.1UF 20% 50V CER
C9 0.1UF 20% 50V CER
C10 0.1UF 20% 50V CER
C11 100UF 25V
C12 0.1UF 20% 50V CER
C13 0.1UF 20% 50V CER
C14 100UF 25V
C15 6800UF 16V ALUM, RADIAL
C16 0.1UF 20% 50V CER
C17 0.1UF 20% 50V CER
C18 470UF 25V
C19 1000UF 35V ALUM, RADIAL
C20 0.1UF 20% 50V CER
IC1 78M15
IC2 79M15
IC3 78M05
IC4 79M05
IC5 LT1086-5CK
VIN VOUT COM TAB
IN OUT GND
TP1 +15V
TP2 +5VA
TP3
TP4 -15V
TP5 -5VA
TP6 +5V
TP7 +9V
TP8 +9VB
J1 1 +RAW
J1 2 -RAW
J1 3
J1 4
J1 5 +15V
J1 6 -15V
J1 7 +5V
J1 8 +5VA
J1 9 -5VA
J1 10 KEY
J201
N/C
N/C (KEY)
J202 1 +5V
J202 2
J202 3
J202 4 +9VB
GND LIFT
S2
N/C
OPTIONAL
R1 0Ω
R2 22.1Ω 1%
R3 2.00 5%
R4 2.00 5%
R5 2.00 5%
R6 2.00 5%
R7 10.0K 1%
Q1 TIP120
Q2 2N4400
LEDPULSE
Power Supply version 2
Schematic 61181.000.02



Power Supply version 3
schematic 62045.000.03



Power Supply version 4
schematic 62045.000.04