

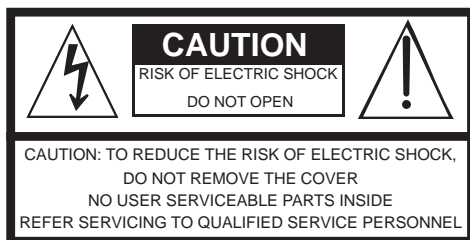
SP4-7

Service Manual

(Includes SP4-7 and the SP76-II)

K U R Z W E I L ®

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The lightning flash with the arrowhead symbol, within an equilateral triangle, is intended to alert the user to the presence of uninsulated "dangerous voltage" within the product's enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.



The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the product.

IMPORTANT SAFETY & INSTALLATION INSTRUCTIONS

INSTRUCTIONS PERTAINING TO THE RISK OF FIRE, ELECTRIC SHOCK, OR INJURY TO PERSONS

WARNING: When using electric products, basic precautions should always be followed, including the following:

1. Read all of the Safety and Installation Instructions and Explanation of Graphic Symbols before using the product.
2. This product must be grounded. If it should malfunction or break down, grounding provides a path of least resistance for electric current to reduce the risk of electric shock. This product is equipped with a power supply cord having an equipment-grounding conductor and a grounding plug. The plug must be plugged into an appropriate outlet which is properly installed and grounded in accordance with all local codes and ordinances.
DANGER: Improper connection of the equipment-grounding conductor can result in a risk of electric shock. Do not modify the plug provided with the product - if it will not fit the outlet, have a proper outlet installed by a qualified electrician. Do not use an adaptor which defeats the function of the equipment-grounding conductor. If you are in doubt as to whether the product is properly grounded, check with a qualified serviceman or electrician.
3. **WARNING:** This product is equipped with an AC input voltage selector. The voltage selector has been factory set for the mains supply voltage in the country where this unit was sold. Changing the voltage selector may require the use of a different power supply cord or attachment plug, or both. To reduce the risk of fire or electric shock, refer servicing to qualified maintenance personnel.
4. Do not use this product near water - for example, near a bathtub, washbowl, kitchen sink, in a wet basement, or near a swimming pool, or the like.
5. This product should be used only with a stand or cart that is recommended by the manufacturer.
6. This product, either alone or in combination with an amplifier and speakers or headphones, may be capable of producing sound levels that could cause permanent hearing loss. Do not operate for a long period of time at a high volume level or at a level that is uncomfortable. If you experience any hearing loss or ringing in the ears, you should consult an audiologist.

7. The product should be located so that its location or position does not interfere with its proper ventilation.
8. The product should be located away from heat sources such as radiators, heat registers, or other products that produce heat.
9. The product should be connected to a power supply only of the type described in the operating instructions or as marked on the product.
10. This product may be equipped with a polarized line plug (one blade wider than the other). This is a safety feature. If you are unable to insert the plug into the outlet, contact an electrician to replace your obsolete outlet. Do not defeat the safety purpose of the plug.
11. The power supply cord of the product should be unplugged from the outlet when left unused for a long period of time. When unplugging the power supply cord, do not pull on the cord, but grasp it by the plug.
12. Care should be taken so that objects do not fall and liquids are not spilled into the enclosure through openings.
13. The product should be serviced by qualified service personnel when:
 - A. The power supply cord or the plug has been damaged;
 - B. Objects have fallen onto, or liquid has been spilled into the product;
 - C. The product has been exposed to rain;
 - D. The product does not appear to be operating normally or exhibits a marked change in performance;
 - E. The product has been dropped, or the enclosure damaged.
14. Do not attempt to service the product beyond that described in the user maintenance instructions. All other servicing should be referred to qualified service personnel.
15. **WARNING:** Do not place objects on the product's power supply cord, or place the product in a position where anyone could trip over, walk on, or roll anything over cords of any type. Do not allow the product to rest on or be installed over cords of any type. Improper installations of this type create the possibility of a fire hazard and/or personal injury.

RADIO AND TELEVISION INTERFERENCE

WARNING: Changes or modifications to this instrument not expressly approved by Young Chang could void your authority to operate the instrument.

IMPORTANT: When connecting this product to accessories and/or other equipment use only high quality shielded cables.

NOTE: This instrument has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This instrument generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this instrument does cause harmful interference to radio or television reception, which can be determined by turning the instrument off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the instrument and the receiver.
- Connect the instrument into an outlet on a circuit other than the one to which the receiver is connected.
- If necessary consult your dealer or an experienced radio/television technician for additional suggestions.

NOTICE

This apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

AVIS

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe B prescrites dans le Règlement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada.

SAVE THESE INSTRUCTIONS

Important Safety Instructions

1. Read these instructions.
2. Keep these instructions.
3. Heed all warnings.
4. Follow all instructions.
5. Do not use this apparatus near water.
6. Clean only with dry cloth.
7. Do not block any of the ventilation openings. Install in accordance with the manufacturer's instructions.
8. Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.
9. Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized plug has two blades with one wider than the other. A grounding type plug has two blades and a third grounding prong. The wide blade or the third prong are provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.
10. Protect the power cord from being walked on or pinched, particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.



11. Only use attachments/accessories specified by the manufacturer.
12. Use only with a cart, stand, tripod, bracket, or table specified by the manufacturer, or sold with the apparatus. When a cart is used, use caution when moving the cart/apparatus combination to avoid injury from tip-over.
13. Unplug this apparatus during lightning storms or when unused for long periods of time.
14. **CAUTION:** Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type (CR2032).
15. Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.

Warning - To reduce the risk of fire or electric shock, do not expose this apparatus to rain or moisture. Do not expose this equipment to dripping or splashing and ensure that no objects filled with liquids, such as vases, are placed on the equipment.

To completely disconnect this equipment from the AC Mains, disconnect the power supply cord plug from the AC receptacle.

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Chapter 1

Introduction

This manual provides service information for the SP4-7 and SP76-II. The SP4-7 and SP76-II are identical, for simplicity both will be referred to as the SP4-7. This chapter provides the service technician with a layout of the front and rear panel features, as well as a brief explanation of their functions. For in-depth descriptions of the many features the SP4-7 includes, consult the *SP4 Musician's Guide*.



Warning: If possible, save all user data before servicing the SP4. See *Back Up User Data* below for details.

Notes, Cautions, Warnings

Please pay special attention to all Notes, Cautions, and Warnings used throughout this manual as they not only point out specific instructions, but also alert you to variations between manufactured units.

A brief description of these symbols follows:



Note: Provides additional information, indicates differences between models, and emphasizes specific instructions.



Caution: Highlights areas to instruct you to proceed cautiously so that damage does not occur to the unit or individual components.



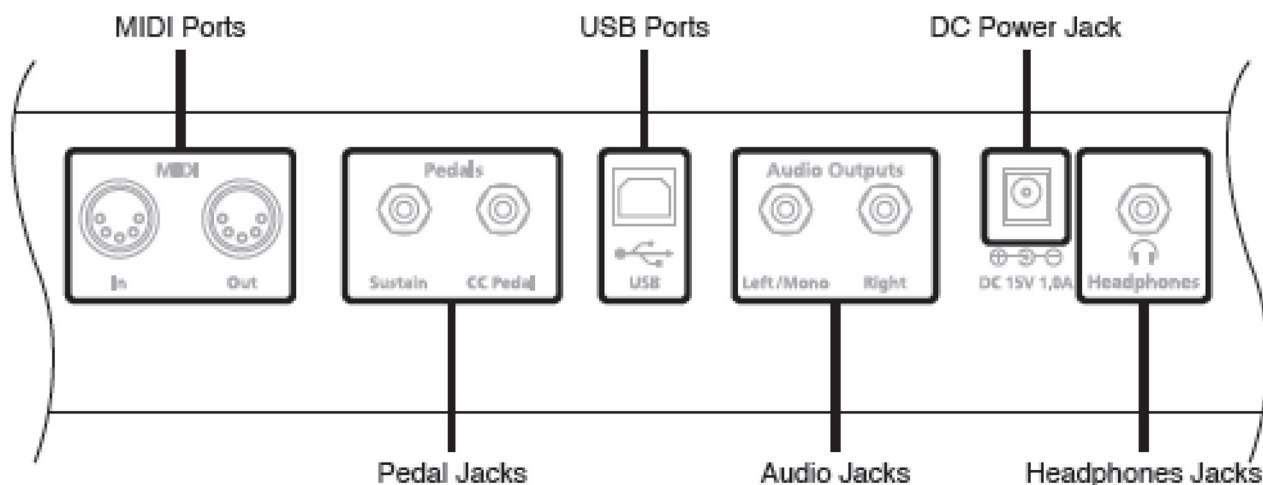
Warning: Alerts you so that damage does not occur to yourself, others, or external equipment and devices.

Operation Quick-Start

Turn the **Volume** slider down and power on the SP4-7 with the switch on the rear left. Plug in headphones to the **Headphones** jack on the rear panel, or connect the SP4-7 to a sound system using the **Audio Outputs** jacks on the rear panel and adjust the volume of your sound system. The SP4-7 should start up in Program Mode, and the **Program** Function button should be lit. Play some notes on the keyboard and turn up the **Volume** slider to adjust the sound level. Use the **Previous** and **Next** buttons below the LCD display to cycle through the available sound presets.

Press the **E** and **F** Sound Select buttons simultaneously to play the **Demo**. While the demo is playing, press any of the Sound Select buttons to stop the demo.

Rear Panel Features



MIDI Ports—In and Out ports to connect the SP4-7 to other MIDI devices to receive and send MIDI data.

Pedals Jacks—The 1/4" **Sustain** jack to connects to a switch pedal that can be assigned to control operations such as sustain, sostenuto, etc. (use 1/4" tip/sleeve). The 1/4" **CC Pedal** jack connects to a pedal that can be assigned to control operations such as volume, expression, etc. (use 10K linear taper potentiometer, 1/4" tip/ring/sleeve, wiper to tip).

USB Port—Use the USB Port to send and receive MIDI or to connect to a computer for file transfer.

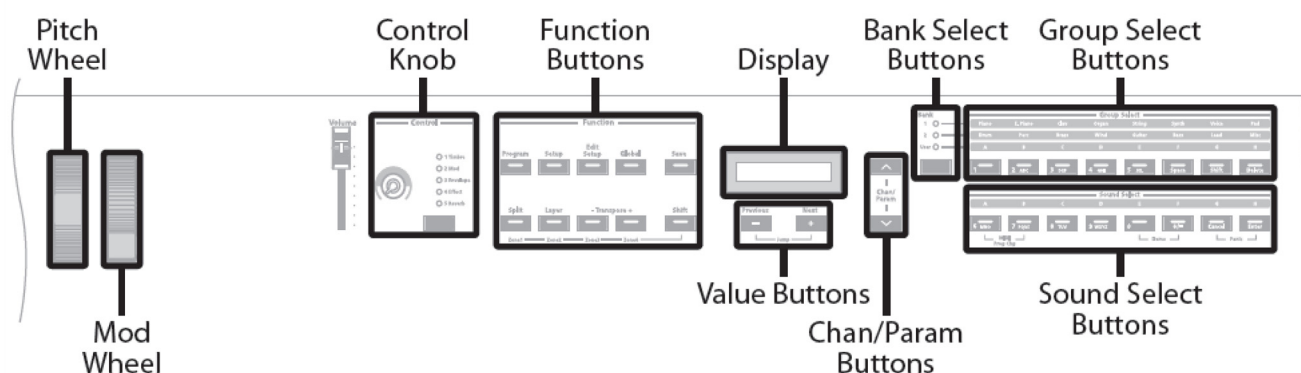
Audio Outputs—Use the two 1/4" Audio Outputs jacks (Left /Mono and Right) to connect to an amplifier, mixer or sound system.

DC Power Jack—Use the DC Power Jack to connect to the included power supply.

Headphones—Standard 1/4" jack to connect headphones.

Power I/O—Switch the power on or off (not pictured above.)

Front Panel Features



Pitch Wheel— Pushing the pitch wheel up bends the pitches of all notes up. Pulling the pitch wheel down bends the pitches of all notes down. It is spring-loaded, such that its center position is restored when it is not being used.

Mod Wheel— The mod wheel is not spring loaded and can be set to and left in any position between fully up and fully down. Typically, the mod wheel is assigned to a parameter that alters some aspect of the sound (e.g., vibrato, filter depth) when changed.

Volume— Slider to adjust the overall volume.

Function buttons— In addition to changing operating Modes, these buttons serve Mode-specific secondary functions. See the *SP4 Musician's Guide* for details on different modes and functions.

Control Knob— The control knob gives you real-time control of five different parameters—the currently selected parameter is indicated by the column of LEDs. Pressing the **Control Select** button (located beneath the column of LEDs) changes the currently selected parameter that is affected by the control knob.

Display— The display shows relevant information, such as the name of the current Program or Setup, and information for other functions.

Value Buttons— Use the **Next** and **Previous** value buttons to scroll through the list of items on the display. Pressing both the **Next** and **Previous** buttons simultaneously will jump to the first entry of the next category of items in the list. For example, when in Program Mode with program **1 Studio Grand** currently selected, pressing **Next** and **Previous** simultaneously will jump up the list of programs to program **8 Stevie's Rhds**, the first of the Electric Piano programs. Pressing the two buttons again will jump up to program **16 Supasticious**, the first of the Clavinet programs.

Chan/Param Buttons— In Program Mode, pressing the **Chan / Param** up or down buttons will change the MIDI transmit channel up or down from the current channel to the next one. In the all of the Modes other than Program Mode and Setup Mode—i.e., Edit Setup, Global, and System—pressing the **Chan / Param** buttons will scroll through the parameter list of the current Mode.

Bank select buttons—Pressing the **Bank** select button will cycle through the three object banks: Bank 1, Bank 2, and User. The column of LEDs indicates the currently selected bank. In Program Mode, Bank 1 contains programs 0-63, Bank 2 contains programs 64-127, and User Bank contains user-created programs numbered 128-191. In Setup Mode, Bank 1 contains setups 0-63 and User Bank contains user-created setups numbered 64-127.

Group Select buttons—Each bank is divided into eight Groups. Pressing the **Group Select** button immediately beneath each Group label will select that Group within the current bank. The LED of the currently selected Group's button will be lit.

Sound Select buttons—Each of the **Sound Select** buttons corresponds to one Sound in the currently selected Group; pressing one of these buttons will select that Sound. The LED of the currently selected sound's button will be lit.

Back Up User Data

Required Tools and Materials

- Computer with USB port
- USB cable

Some maintenance can result in loss of user data (programs and setups), so all user data should be backed up before maintenance by saving to a computer. All user data can be saved to and loaded from a single file. Backed up user data should be reloaded to the SP4-7 after maintenance. If the SP4-7 is malfunctioning it may not be possible to save user data.

User data can be saved to or loaded from a computer via the SP4's USB port. When connected to a computer via USB, the SP4-7 mounts a temporary drive on the computer. When saving user data, files are saved to this drive, which then must be copied to the computer. When loading user data to the SP4, files are copied from the computer to this temporary drive, and the SP4-7 must copy this file to its internal memory by using the Load All feature of Global mode. When the SP4-7 is disconnected from the computer, the temporary drive created by the SP4-7 disappears, along with any data that was not copied off of the drive.



Note: The SP4-7 may disconnect the temporary SP4-7 drive during the process of saving or loading user data. This may cause your computer to display a warning or error message, but no harm will be done to the SP4-7 or your computer.

Save All User Data

To save all user data, first connect a USB cable from the USB port on the SP4's rear panel to the USB port of your computer. Next, power on the SP4-7 and press the **Global** function button to the left of the LCD. With the **Global** function button's LED lit, press the **Chan/Param** down button (to the right of the LCD) until the display reads **Save All?** Press the **Next** button below the LCD, the LCD will show the message "Press Next for saving the file". (Pressing **Previous** will cancel the save operation and recall the "Save All?" dialogue. If the SP4-7 is not connected to a computer, the display will show the error message "Please connect the unit to the computer". Pressing **Previous** will recall the "Save All?" dialogue—pressing **Next** will retry to connect.)

When the LCD displays "Press Next for saving the file", press **Next** to save to the SP4-7 temporary drive and the LCD will show the message "The file is in the temporary drive, copy it to your hard disk". **Copy the file ALLOBJTS.SPX to your computer.** If an error occurs during

the save operation, then the display will show the error message “Save Error”. If the LCD displays “Nothing Saved”, this means that there is no user data to backup on the SP4, in which case the rest of this section may be skipped.

Reload All User Data

After maintenance, all user data should be loaded back to the SP4. To load saved user data, first connect a USB cable from the USB port on the SP4’s rear panel to the USB port of your computer. Next, power on the SP4-7 and press the **Global** function button to the left of the LCD. With the **Global** function button’s LED lit, press the **Chan/Param** down button (to the right of the LCD) until the display reads **Load All?** Press the **Next** button below the LCD, the LCD will show the message “Press Next for loading”. The SP4-7 temporary drive will mount on your computer. Copy the ALLOBJTS.SPF file from your computer to the SP4-7 temporary drive. (If the SP4-7 is not connected to a computer, the display will show the error message “Please connect the unit to the computer”. Pressing Previous will recall the “Load All?” dialogue— pressing Next will retry to connect.) When the file has finished copying to the temporary drive, press the **Next** button below the LCD to load the user data to the SP4, the LCD will display “File loaded” when the operation is complete.

If no file is in the SP4-7 temporary drive during the load, the LCD will display the message “Nothing loaded”. If an error occurs during the load operation, then the LCD will display the error message “Load Error”.

Circuit Boards

Overview

The SP4-7 contains three circuit boards, the Engine Board, the Front Panel Board, and the LCD Board. To generalize, the Engine Board contains everything concerning sample playback, audio effects, and the functions of the SP4-7 OS. The Front Panel Board helps the Engine Board communicate with the SP4’s buttons, LEDs, slider, knobs, wheels, keys, and rear panel connections. The LCD Board contains the LCD display for the front panel.

Front Panel Board Function Summary

The SP4 Front Panel PCB performs the following functions:

1. Scanport interface to 34 front panel LED indicators
2. ScanPort interface to 32 front panel buttons
3. ScanPort interface to the keyboard (76 or 88 notes)
4. MIDI In/Out connector interface to logic-level signals
5. DC power input jack and power switch connector
6. Voltage regulators (+5V, +10V) and negative voltage generator (-10V)
7. USB connector interface
8. LCD contrast voltage adjuster
9. Expression Pedal and Switch Pedal jacks and interface
10. ScanPort interface to Pitch and Mod wheels

11. ScanPort interface to Volume control and Parameter control pots
12. Audio differential amplifiers for Left/Right output jacks
13. Amplifier for Headphones jack
14. ScanPort analog multiplexor
15. Audio Muting circuits

Below are summary descriptions of these functions referenced to SP76-II Front Panel Rev A Ver 1 schematic circuit drawings.

In the SP4, the main CPU on the Engine PCB also performs scanning of the keyboard, LEDs, and controls. This is done through the ScanPort connector, a simple, Kurzweil standardized, CPU-independent interface for scanning. Most of the subsystems on the Front Panel PCB connect to the ScanPort.

Scanport interface to 34 front panel LED indicators (Page 1 Zone D)

The 34 LEDs are in a 5 column 7 row matrix. The column select shift register (U1) drives the next column each time the ScanPort writes new data into the LED row register (U3). A new scan begins when the ScanPort RES signal is low during a row register write cycle. Scan rate is approximately 100Hz (10mS).

The column select shift register outputs are current boosted by transistors Q1-Q5. LEDs light when the column they are connected to is low and the row is high.

ScanPort interface to 32 front panel buttons (Page 1 Zone B)

The 32 buttons are in a 5 column 8 row interface. The columns are shared with the LEDs. The status of the rows is driven back to the ScanPort by buffer U4. A pressed button will send back a zero for its row position when its column select line is low. Buttons that may be pressed simultaneously are never on the same row.

ScanPort interface to the keyboard (76 or 88 notes) (Page 2 Zone 1)

The Keyboard connects to J3 (treble half) and J5 (bass half). Bass is a 10 column by 8 row matrix (40 keys, 80 switches) and treble is a 12 column by 8 row matrix (48 keys, 96 switches). These are combined into a 22 column by 8 row matrix.

Shift registers U9, U5, U8 drive the columns low one-at-a-time. Buffer U12 transmits the state of the rows back to the ScanPort. Each time a row is read, the column shift registers advance one column. A new scan begins with the ScanPort RES signal is low during a keyboard row read cycle. Scan rate is approximately 4KHz (250uS).

MIDI In/Out connector interface (Page 2 Zone D5)

U6 is the MIDI In current loop receiver. Either a PC910 or a 6N138/6N139 may be used. The components around U6 will be different according to the Usage Table. U7-A and U7-B drive the MIDI Out connector current loop.

DC power input jack, power switch connector, voltage regulators (Page 2)

J7 receives +15V 1.0A power from the external power adapter. L4 and L5 provide RFI filtering and J6 connects to the power switch.

U11 is a switching regulator which provides +5V at high efficiency for on-board circuits and the Engine PCB. Note the minimum load spec of 0.25A. Typical load is about 1.0A. U10 is a low current linear regulator which supplies +10V to the audio circuits.

-10V for the audio circuits is created by a charge pump (D36, D37, C13, C14) from the high-power 15V rectangular wave produced by the switching regulator. R27 limits surge currents at startup and ripple currents in the charge pump filter. Even though -10V is not strictly regulated, it is very quiet in the audio range and suitable for analog use. Typical voltage range is -8V to -12V. Note that U13 produces a +5.1V reference for the analog controls.

USB connector interface (Page 2, Zone A3)

The USB jack connects directly to the USB Control and Data cables that go to the Engine PCB. Note that the Data cable must be constructed from special "USB rated shielded cable" for reliable operation in high-speed mode.

LCD contrast voltage adjuster (Page 2 Zone C4)

VR1 is the front panel Contrast control for the LCD. Resistors R25, R117, R118, and R119 set the voltage range and center value so that optimum contrast is achieved near the center of the control's range. Since LCD operating voltages vary by vendor, the values in a particular unit may be different from those in the schematic. Conversely, using a different vendor's LCD may require a change in one or more of these resistors.

Expression Pedal and Switch Pedal jacks and interface (Page 3 Zone D5)

J12 is the Expression Pedal jack and expects a 3-terminal potentiometer with the wiper on the tip (pin 2). The 5.1V reference voltage is supplied through a current limiter (Q6 and R37) to the ring (pin 3). R45 pulls the wiper up to 5V when no pedal is plugged in thus ensuring stable full volume. The wiper voltage is filtered and overvoltage protected by R44, C31, D39, and D40.

J13 is a dual switch pedal input. The switch pedals close when pressed. The top connection controls Sustain so if a single pedal with a mono plug is used, it will control Sustain.

ScanPort interface to Pitch and Mod wheels (Page 4 Zone B4)

The pots in the Pitch/Mod wheel assembly turn through only a small part of their rotation range. U20 and associated components amplify the resulting small voltage swing approximately 4X to make a full 0-5V swing for the ScanPort analog multiplexor (described below). Additionally VR3 is used to center the range of the pitch wheel. If the scanner diagnostic reports a center reading less than 120 or more than 136, VR3 should be adjusted to make it as close to 128 as possible.

The SP4 series does not have keyboard aftertouch so U22 and associated components are not present.

ScanPort interface to Volume and Parameter control pots (Page 3 Zone D4)

These are rotary pots connected between the 5.1V reference voltage and ground. Each wiper is filtered by a 0.1uF capacitor and the resulting voltage passed to the ScanPort analog multiplexor.

ScanPort analog multiplexor (Page 3 Zone D3)

There are 8 different sources of analog voltage that are selected one at a time by U15 then passed to the balanced output amplifier U14 which then drives the selected source voltage to the ScanPort. The balanced outputs are symmetrical around 1/2 of the reference voltage as set by R42, R46, and C32. U16 holds the address of the analog voltage being read during A-to-D conversion by the Engine PCB.

The SP4 series does not have keyboard aftertouch so U21 is not present.

Audio differential amplifiers for Left/Right output jacks (Page 3 Zone A5)

Stereo audio from the Engine PCB comes in as a low-level, unfiltered, balanced signal. U18A (left) and U18B (right) lowpass filters and amplifies this and converts it to single-ended left and right signals with typically 50dB of common-mode rejection. U19A and U19B phase-inverts the single-ended signal then present that plus the non-inverted signal to the output jacks (J14 and J15) as a balanced output signal. Transistors Q7-Q10 mute the outputs during power-up and power-down to prevent clicks. D43, 44, 47-52 protect against static discharge damage.

Amplifier for Headphones jack (Page 3 Zone A2)

U17 amplifies the single-ended left and right audio signals 2X then presents them to J16 for driving headphones. U17 is a special high-current op-amp to better drive low-impedance headphones. Q11 and Q12 mute the phones during power transitions while D53-D56 protect the phones amplifier from static discharge.

Audio Muting circuits (Page 4 Zone D)

Each of the 6 muting transistors requires an isolated current source to turn them on and prevent crosstalk and distortion when off. Q13-Q19 provide this function and are driven together by Q20. Q22 and Q23 sense the incoming DC voltage and ensure that muting is activated whenever the incoming voltage is less than approximately 10V. The MUTE signal from the Engine PCB further extends the mute time at power up until the sound generator circuits are initialized and stable.

Engine Board Function Summary

The SP4 Engine PCB performs the following functions:

1. CPU for the entire system
2. Synthesis and effects for all of the sounds
3. Sample ROM
4. D-to-A converter for the synthesizer
5. Non-volatile storage of all user data
6. Scanner for front panel buttons, LEDs, knobs, wheels, and keyboard
7. USB controllers (Host and Device)
8. MIDI interface, both 5-pin and USB
9. LCD display controller

Below are summary descriptions of these functions referenced to PC3LE Engine Board Rev C Ver 1A schematic circuit drawings.

General

The Engine board has the system CPU (a 200MHz Renesas SH2A integrated microcontroller), sound synthesis ASIC (Kurzweil MARA), and player control/user interface scanning all on one small board. The paragraphs below give a brief summary of these major functions and associated functional blocks.

Boot Sequence

The SP4 uses a modern tiered memory architecture and boots much like a desktop computer. The sequence is essentially:

1. The Front Panel Board, which contains the power supply, produces a signal PWRUPRST_L which goes high when the main DC power (+5V) has been stable for approximately 0.5 seconds.
2. The CPU (U1) is enabled and begins fetching instructions from Boot Flash (U4) which contains the initial bootup code.
3. After initialization, the bootup code checks the contents of the NAND Flash chip, U3. U3 is essentially a solid-state disk drive which acts like the hard disk in a desktop computer. If it is formatted and has the necessary files installed, the "second level" boot loader program is read into RAM (U2) and run. Otherwise a more limited function boot loader program, also in U4, is run. (Normally the latter should only happen at the factory before installing the OS for the first time.)
4. The second level boot loader then loads the operating system software and soundware "object data" from U3. The LCD will show "LOADING..." during this time.
5. Bootup is now complete and the unit is ready to play.

Step 4 is aborted if the DELETE button is held down during bootup. The boot loader can then be used to update the operating system software and soundware objects or run the diagnostics.

CPU

The CPU (U1, Page 1 Zone C4) is a Renesas SH7023 which is a member of the SH-2A family. This highly efficient, low-power, RISC processor is very effective in musical instruments.

X1 is the CPU clock crystal which operates at 16.67MHz. The CPU multiplies that by 4 to produce the 66.67MHz Bus Clock (called SDRAM_CLK, U1-50) and by 12 to make the 200MHz core clock.

Reset to the CPU (U1-59) comes from the reset circuit on Page 6 Zone A4. This circuit receives Power OK from the Front Panel board via J23.

Memory

All of the CPU memory is along the right side of Page 1. As described above, the CPU initially boots from Boot Flash, U4. This is non-volatile memory that is programmed once at the factory. However, if a special Boot EPROM Module is plugged onto J1, then the CPU will boot from it instead. The factory uses this module to load U4 when engine boards are made. If the data in U4 becomes corrupted and the CPU can't boot, the EPROM module can be used to reload U4.

U3 is a NAND Flash chip which is very similar to what is used in memory cards and USB "thumb" drives. It holds the operating system code, sound programs and setups, and user data (user sound programs and MIDI sequences). The capacity is 64MB.

U2 is system RAM. After bootup, the operating software executes from system RAM which also holds currently used sound programs and MIDI sequences.

Scanning

Software in the operating system also performs scanning of the player controls (keyboard, wheels, pedals) and the user interface (UI) controls (buttons, LEDs, knobs). This is accomplished through a Kurzweil simple, standardized, low-cost interface called ScanPort (J7, Page 3 Zone D1). Most of the circuits for scanning are actually on the Front Panel board; only a couple of buffers (U6, U8) an analog amplifier (U9), and decoding logic (U11) are on the Engine board. See the Front Panel Board description for more details about ScanPort operation.

Synthesis ASIC

Page 2 has the MARA synthesis ASIC, U5. This proprietary, Kurzweil designed VLSI chip integrates the following synthesizer circuits:

- * 64 sample playback channels, each with independent playback rate
- * 64 amplitude envelope blocks
- * 256 DSP processors, each with independent envelope
- * Effects processor with 16 processing blocks.
- * Patching array for interconnecting the above resources
- * Digital audio formatting circuits.

The instrument sound samples are stored in Sound ROM (Page 4 Zone 5D). The standard SP4 has 64MB (only U13 installed) of sound ROM. Other products using the same engine board may have additional sound ROM installed at U14.

The effects processor also uses an external Delay RAM (U12, Page 3 Zone A4). Pops, audible crashing sounds, and other extraneous noises are often caused by defective delay RAM or connections to it.

D-to-A converter

U15 (Page 4 Zone D1) is the digital-to-analog converter. It connects directly to MARA on the digital side and directly to the Audio Out header (J11) on the analog side. Amplifiers and reconstruction lowpass filters are on the Front Panel board. Although U15 is an 8-channel DAC, only the first 2 channels (L1 and R1) are used in the SP4.

A separate MUTE signal comes directly from the CPU to suppress pops and clicks during power-up and power-down. MUTE must have a low logic level (less than 0.8V) to enable audio on the Front Panel board.

USB Controller

The CPU has an integrated USB controller that can be either a Master or a Slave but not at the same time. Switching circuits (Page 4 Zone B1) switch between the two functions. In the SP4, the actual USB connectors are on the Front Panel board and connect to the Engine board by 2 cables.

MIDI (5-pin) Interface

The CPU has an integrated UART which is configured for standard MIDI I/O. The actual 5-pin MIDI connectors and interface circuits are on the Front Panel board. J31 carries standard MIDI signals to and from the CPU.

LCD Interface

Although the LCD module is mounted on the front panel, it is actually a separate device which plugs into the Engine board at J19 (Page 4 Zone A3). U21 is a data buffer which isolates the long LCD cable from the CPU data bus. U19 similarly buffers the LCD control signals. R106 regulates the backlight current and J20 selects VCC (+5V) as the backlight power source.

Voltage Regulators

The Front Panel PCB brings in the single +15V power voltage from the AC adapter and converts it to +5V for digital circuits, and +/-8V for the analog circuits. These voltages enter the Engine board on J23 (Page 6 Zone D1). Note that although the analog power signal names are +12V and -12V, the actual voltage level is +8V and approximately -10V.

The various large chips on the Engine board require several different power supply voltages: +3.3V (VCC33), +2.5V (VCC25), +1.8V (VCC18), and +1.2V (VCC12). All of these voltages are regulated by integrated linear voltage regulators.

U23: +5V (VCC) is the source voltage for the VCC33 regulator.

Powers the CPU, MARA chip, and most of the other digital circuits.

U24: VCC33 is the source voltage for the VCC25 regulator.

Powers the Delay RAM for the effects processor in MARA

U25: VCC33 is the source voltage for the VCC18 regulator.

Powers MARA's core logic.

U26: VCC33 is the source voltage for the VCC12 regulator.

Powers the CPU core logic.

Chapter 2

Diagnostics



Note: Throughout this manual many references are made to the MARA IC. For service personnel unfamiliar with the SP4-7, MARA is the name given to the Kurzweil Custom Sound IC.

Boot Loader

Use the SP4's Boot Loader to enter Diagnostics or perform a System Reset to the unit. You can also install operating system updates and objects into Flash memory.

Entering the Boot Loader

Hold the shift button while applying power to the unit. The SP4-7 will enter the bootloader, and display the current bootloader version number.

There are five menu options available in the SP4-7 Boot Loader. The following is a brief description of the available menu options.

Run SP4—Exits the Boot Loader and returns the unit to normal operation.

Update Software—Select this to install new system software and objects.

Run Diagnostics—Enters the diagnostic test menu. Read on for a complete list of tests and the procedure to execute the diagnostic tests.

System Reset—Clears the memory and restores the unit to factory default settings.

File Utilities—Use this to format flash memory, deletes user objects and OS.

Diagnostic Tests

The following lists the diagnostic tests available for the SP4-7.

- SDRAM Refresh
- MARA Validity Check
- MARA Sound ROM
- Internal Flash
- MIDI UART
- MARA Delay RAM
- Audio Output



Warning: If possible, save all user programs and setups before entering diagnostics or performing maintenance or repair. For instructions, refer to *Back Up User Data* in Chapter 1, page 1-4.

Entering Diagnostics

1. Hold the shift button while applying power to the unit. The SP4-7 will enter the bootloader, and display the current bootloader version number.
2. Press one of the **Chan/Param** buttons until the LCD displays **Run Diagnostics**.
3. With **Run Diagnostics** displayed in the LCD, press the **Next** button below the LCD to enter the Diagnostics menu.
4. The first test in the Diagnostics menu, **SDRAM Refresh** will be displayed in the LCD:

Front Panel Buttons

In the Diagnostics menu, the LCD displays the currently selected test. Press the **Chan/Param** buttons to navigate through the available tests. To return to the Boot Loader, press the **Previous** button below the LCD.

To run the selected test, press the **Next** button below the LCD. You may be presented with a menu of additional test options depending on the specific test. In this case, use the **Chan/Param** buttons to navigate through the available options and press the **Next** button below the LCD to choose that option and run the test. To return to the previous menu, press the **Previous** button below the LCD.

Test Results

At the completion of an individual test, the LCD displays the results of the test. For example, a successful **SDRAM Refresh** test will display **RAM Test: Passed**.

Diagnostic Test Modes

Run Once

The **Run Once** test mode allows you to select and run an individual test. With **Run Once** selected in the LCD, press the **Next** button below the LCD to select and run the test once.

At the completion of a test, whether pass or fail, press the **Previous** button below the LCD to exit the test and return to the Diagnostics menu.

To exit the Diagnostics menu, press the **Previous** button below the LCD to return to the Boot Loader.

Loop

Loop continuously runs an individual test. The LCD continuously displays the number of tests performed in the **Run** field, and displays the number of failed tests performed in the **Fail** field. The test continues to run until you press the **Previous** button below the LCD.

Continuous

Continuous is the same as Loop, but stops if a failure is detected.

Description of Tests

SDRAM Refresh

This test verifies the write/read functionality and accuracy of the SDRAM chip (U2) attached to the microprocessor, SH7203 (U1).

A failure of this test indicates a problem with the SDRAM chip or associated circuitry on the Engine Board.

BURN-IN LOOP

Burn-in Loop continuously runs the following sequence of tests.

- SDRAM Refresh
- MIDI UART
- Internal Flash
- MARA Validity Check
- MARA Sound RAM
- MARA Delay ROM

If a failure is detected, the test stops and displays the result.

To exit Burn-in Loop while running and return to the Boot Loader, press and hold the **Previous** button below the LCD.

Scanner DIAG

Use the scanner DIAG to test the functionality of all SP4-7 controls and keyboard contacts. When entering the Scanner DIAG, the LCD displays three screens of information, first the scanner version, second the keyboard size, pitch wheel center, and ADC calibration, and third the keyboard model. The keyboard size is the number of keys the scanner expects. The pitch wheel center is read at power up and stored for center correcting subsequent readings, the stored value is displayed.

The Scanner DIAG test displays the activity of continuous controls (wheels, sliders, knobs, CC pedals,) switch controls (switch pedals,) front panel buttons, LEDs, and keyboard switches. The activity of any of these controls displays code and other relevant information for the control (such as value for continuous controls, and open or closed state for switch controls.) If a panel button has an LED, the LED turns on when the button is pressed and turns off when it is released. If a panel button is associated with multiple LEDs, the next LED in the sequence turns on each time that button is pressed. Pressing any other button resets the sequence. A double press of the Sound Select **F** and **G** buttons will turn on all the LEDs. Double press them again to turn the LEDs off.

Pressing any of the keyboard keys displays information for each key's two contact switches. When any key's first contact is closed, this is displayed:

KY kkk nn

where "KY" is constant, kkk is the musical note name (C4 or F#5 for example), and nn is the MIDI note number. When any key's second contact is closed, its kkk and nn is appended to the existing display so the result is:

KY kkk nn kkk nn example: KY C#4 61 C#4 61

Normally the second contact and first contact belong to the same key and the first contact closes before the second contact. If either is not true, it is an error condition and "KY" should be replaced by "ER". The note name and MIDI number for each closed contact should still be displayed when there is an error.

Moving either wheel will display the wheel's position value which should span from 0 or 1 to 254 or 255. Additionally, when the Pitch Wheel is released, its reading should return to a reading between 120 and 136. If the return value is near the edge or outside that range, trimpot VR3 on the Front Panel board should be adjusted until the return value is within 2 counts of 128.

To exit the Scanner DIAG and return to the Diagnostics menu, press the Group Select buttons **F**, **G**, and **H** simultaneously.

Audio Output



Warning: This test produces loud sine waves. Before beginning this test, turn the volume on your sound system down to minimum. During these tests, the volume slider on the SP4-7 is disabled.

This is not a test that fails. It is an interactive test for the entire audio chain. However for this test to pass reliably, the MARA Validity, MARA Sound ROM, and MARA Delay RAM tests should pass. Sine wave samples are played back by MARA from ROM and the Sawtooth wave from Delay RAM. Therefore, MARA and the Delay RAM need to be functioning for this test to produce a clean audio waveform.

Use the **Chan/Param** buttons to the right of the LCD to select **Play Sawtooth** or **Play Sine Wave**, then press the **Next** button below the LCD to play the selected waveform.

While playing each waveform, use the **Chan/Param** buttons to navigate through a parameter menu for each waveform. Parameters include **Frequency**, **Amplitude**, and **Output**. With any of these parameters displayed in the LCD, press the **Next** button below the LCD to adjust the parameter. Once the parameter value is displayed, use the **Chan/Param** buttons to the right of the LCD to adjust the parameter value. See the table below for each parameter's range of values.



Note: The **Output** parameter controls which of the left and right Audio Outputs that the audio will play from. Audio always plays from the Headphones output despite how the **Output** parameter is set.

After adjusting a parameter, press the **Previous** button below the LCD to return to the menu of parameters. From the menu of parameters, press the **Previous** button below the LCD to stop playing the waveform and return to the Audio Output menu.

Parameter	Default Value	Range Of Values
Frequency (Sine)	1KHz	30Hz, 40Hz, 50Hz, 70Hz, 100Hz, 200Hz, 500Hz, 1KHz, 2KHz, 5KHz, 10KHz, 15KHz, 20KHz
Frequency (Sawtooth)	500Hz	30Hz, 40Hz, 50Hz, 70Hz, 100Hz, 200Hz, 500Hz
Amplitude	-20dB	-60dB, -40dB, -20dB, -10dB, 0dB
Output	Both	Both, Left, Right

MARA Sound ROM

This test calculates and verifies the checksum of the on-board Sound (Sample) ROM. It also tests the data and address lines from the MARA to the Sound ROMs. This test may also report errors when the MARA Validity Test fails.

A failure of this test may indicate a problem with the Sound ROM (U13), or its connections to MARA.

MARA Delay RAM

This is a write/read test to check the Delay RAM connected to MARA. The Delay RAM test first checks address and databus connectivity and then reports which bits are not functioning to aid troubleshooting.

Error reporting for this test identifies whether the error is likely to have occurred during writing or during reading. Data value mismatch errors are reported in hexadecimal values starting with "0x" followed by 8 hex digits. If the data value that was ReadBack differs greatly from the value Wrote, it could mean there was an address bit error, or one or more of the control signals are bad.

A failure of this test would indicate a problem with the DDR SDRAM (U12), MARA (U5), or the connections between them.

MARA VALIDITY Check

This tests verifies the proper content of certain read-only registers and the read/write accuracy of certain read/write registers on MARA. It also writes and reads back the various register blocks in MARA that are implemented as RAM cells.

A failure of this test may indicate a problem with the with the microprocessor (U1), MARA (U5), or related circuitry on the Engine Board.

Internal Flash

This test verifies the manufacturer ID and the size of the NAND Flash installed. The test then writes and reads back one or more blocks not occupied by the file system. This test also indicates if the NAND Flash is formatted or unformatted.

A failure of this test may indicate a problem with the with the microprocessor (U1), NAND Flash (U3), CPLD (U11), or related circuitry on the Engine Board.

MIDI UART

This test performs a loop-back of the serial port by sending a 23-byte pattern over the external MIDI link. This test requires a MIDI loop (a MIDI cable connected from the SP4-7's MIDI Out jack to the SP4-7's MIDI In jack.) If a MIDI cable is not connected between the SP4-7's two MIDI jacks, the LCD will display "Connect MIDI OUT to MIDI IN".

A failure of this test could be caused by failure of the serial port, other MIDI circuitry, or a problem on the Engine Board.

System Reset



Warning: Performing a system reset erases all user data. Before performing a system reset, backup all user data to a computer if possible. See *Back Up User Data* on page 1-4 for details.

If the SP4-7 turns on but does not function properly, a “System Reset” (also known as a “Hard Reset”) may solve the problem. Performing a system reset deletes all user data and restores the SP4’s factory default settings. A system reset cannot be undone. There are two ways to perform a system reset to the SP4.

1. Turn on the SP4. When the OS has loaded, press the **Global** function button to the left of the LCD to enter the Global Mode menu. Use the **Chan/Param** buttons to the right of the LCD to find **Hard Reset?** in the Global Mode menu. With **Hard Reset?** selected, press the **Next** button below the LCD. The LCD displays **Confirm?**. To cancel, press the **Previous** button below the LCD to return to the Global Mode menu. To continue, with **Confirm?** selected, press the **Next** button below the LCD to perform the hard reset. The SP4-7 will restart, all user objects will be erased and the SP4-7 will be restored to its factory default settings.
2. Enter the Boot Loader by holding the **Shift** button while the unit is powering up. Use the **Chan/Param** buttons to the right of the LCD to find **System Reset** in the Boot Loader menu. With **System Reset** selected, press the **Next** button below the LCD. The LCD displays **Delete User Objects?**. To cancel, press the **Previous** button below the LCD to return to the Boot Loader menu. To continue, with **Delete User Objects?** selected, press the **Next** button below the LCD to perform the system reset. All user objects will be erased and the SP4-7 will be restored to its factory default settings. When finished, **Reset Complete** will be displayed in the LCD. Press the **Previous** button below the LCD to return to the Boot Loader menu, or use the Power Switch to restart the SP4.

After performing a system reset, reload any user data that you saved before the system reset. To do this, follow the instructions in the *Reload All User Data* section on page 1-5.

Software Updates



Warning: This procedure requires performing a system reset. All user objects will be erased. Before continuing, be sure to save all user programs and setups to a computer following the procedure on page 1-4.

1. Go to www.kurzweil.com and follow the links to download the latest software version.



Note: Be sure to always read the downloaded release notes and installation instructions in case they have changed since this manual was written.

2. Connect a USB cable from a computer to the USB port on the SP4.
3. Hold the shift button while applying power to the unit. This SP4-7 will enter the bootloader.
4. Check the computer desktop and verify that the “Kurzweil SP4” device is present. This should appear on the desktop as an icon or window. Typically, this should take about 2–3 seconds. However, it can take up to 30 seconds to be recognized.
5. In the SP4-7 Boot Loader menu, use the **Chan/Param** buttons to find **Update Software**, then press the **Next** button below the LCD to enter the Update Software menu.
6. In the Update Software menu, use the **Chan/Param** buttons to find **Update**, then press the **Next** button below the LCD.
7. Copy the downloaded software to the SP4-7 drive mounted on the computer.
8. Once the software has been copied to the SP4-7 drive, unmount the SP4-7 drive from the computer.
9. Press the **Next** button below the LCD to install the software. The LCD displays a message when the process is complete.
10. Press the **Previous** button below the LCD to return to the Boot Loader main menu. In the Boot Loader main menu, use the **Chan/Param** buttons to find **SYSTEM RESET**, then press the **Next** button below the LCD. The LCD displays a warning message that all user objects will be deleted. Press the **Next** button again to reset the SP4-7 to default factory settings.
11. Press the **Previous** button below the LCD to return to the Boot Loader main menu. In the Boot Loader main menu, use the **Chan/Param** buttons to find **RUN SP4**, then press the **Next** button below the LCD and the SP4-7 will restart.

Diagnostics

Software Updates

Chapter 3

Disassembly/Assembly

Introduction

This chapter contains all the procedures for the disassembly and reassembly of the SP4. There are three main sections: *Opening the SP4*, *SP4-7 Keyboard Assembly*, and *Closing the SP4*.



Caution: Make sure the SP4-7 is disconnected from its power source before beginning disassembly or assembly.



Warning: If possible, save all user data before disassembly. For instructions, refer to *Back Up User Data* in Chapter 1.

Notes, Cautions, Warnings

Please pay special attention to all Notes, Cautions, and Warnings as they point out specific instructions and also alert you actions that could potentially damage the SP4.

Cable Connectors

The ribbon cable connections on the LCD and Key Contact boards are not keyed. Pin 1 connects to the red wire in the ribbon cable. The pin 1 location should be marked on the boards before removing these cables. All other cables with connectors are keyed and cannot be reversed. Ribbon cables may have latching ears or clip retainers to hold the plug in which must be removed before the cable can be unplugged (a small flat screwdriver is helpful for this.) All such retainers should be reattached when the unit is reassembled. Additionally, cables may use tape or red glue to hold connectors together. Tape must be removed before the cable can be unplugged. For glued connectors, the glue seal must be broken before the cable can be unplugged. The glue seal may be broken by pulling on the cable's connector (never pull on the wires as this may separate the wires from the connector.) If a glue seal cannot be broken by pulling on a connector, a small knife may be used to break the seal. Where tape or glue is used, a similar tape or rubber based glue should be applied during reassembly.

Cable Routing

In some cases, tape fastens cables to circuit boards or the top and bottom enclosures. When disconnecting cables, always peel back the tape from one side so that the tape remains properly positioned. Many of the wires and cables are also bundled with wire ties. Any cut wire ties must be replaced in the same locations to prevent connectors becoming loose.

Required Tools and Materials

- Anti-static mat
- 3" high foam blocks
- No. 1 Phillips head screwdriver
- No. 2 Phillips head screwdriver
- Small flat screwdriver
- 7/16" hex socket wrench
- Small blunt-end tool (Q-Tip, toothpick, etc.)
- Wire ties
- Rubber based glue
- Small knife

You will need a flat work area large enough to open the SP4-7 onto. A table top that measures at least 60" by 40" is recommended, as well as the use of an anti-static mat or other anti-static device. We also recommend that you place the SP4's top panel on a pair of 3" high foam blocks while you work. This minimizes pressure on the front panel controls and keeps it from getting scratched.



Note: Save all screws and cables from the parts you remove. SP4-7 replacement parts don't ship with these items.

Opening the SP4

SP4-7 Screw Locations

Refer to Figure 3-1. Arrows indicate the locations of the endcap and enclosure screws.

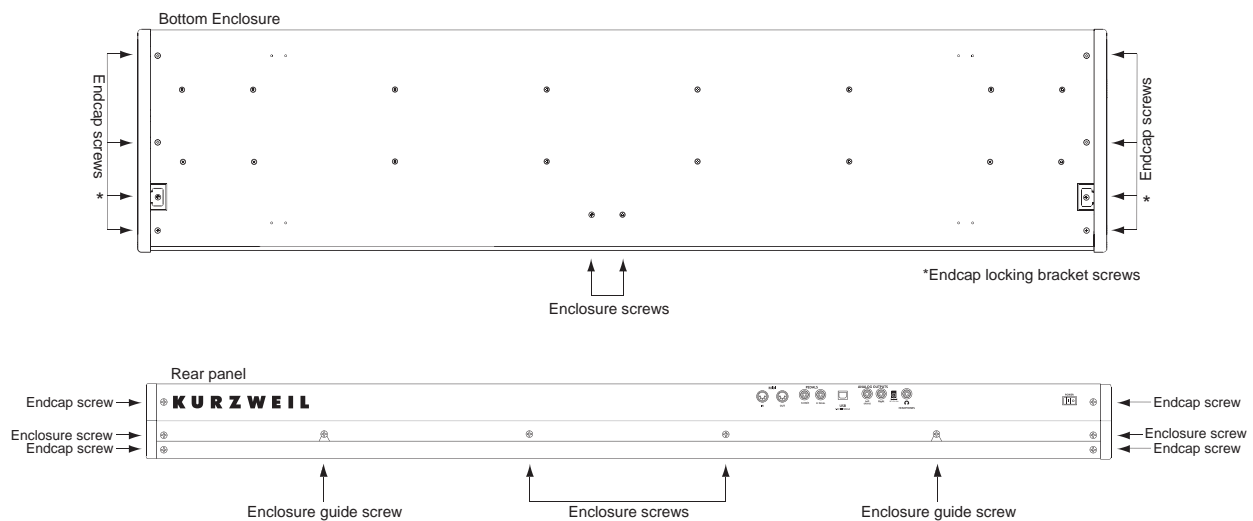


Figure 3-1 SP4-7 Screw Locations

Removing The Endcaps

The first step in opening the SP4-7 is to remove both endcaps. Each endcap includes the endcap and endcap locking bracket (see Figure 3-2 below.)

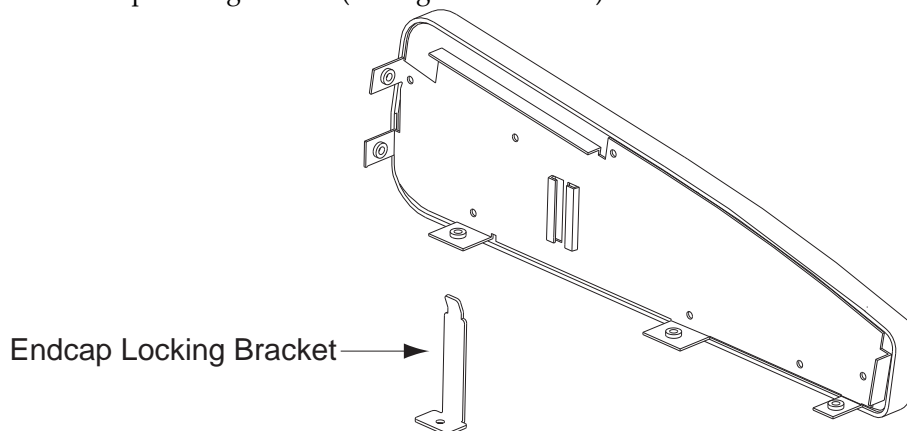


Figure 3-2 Endcap assembly



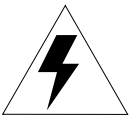
Caution: When you remove the endcap locking bracket screw, the endcap locking bracket may remain loosely in the endcap. However, it can come out of the endcap. When you remove the screw securing the endcap locking bracket, hold it in position so that it does not fall out of the endcap and become lost or damaged.

1. Place the unit flat on your work surface.
2. Move the unit so that one of the endcaps hangs over the edge of your work surface. This gives you access to the six screws that secure one of the endcaps to the bottom enclosure.
3. Remove the six screws for one endcap (see Figure 3-1 for the endcap screw locations.)
4. Lift the endcap locking bracket, remove the endcap and set it aside.
5. Repeat the above steps 2-4 for the other endcap.
6. Slide the unit back onto your work surface.

Removing the Top Enclosure

The following procedure assumes that you have completed Steps 1-6 in *Removing The Endcaps*.

1. Rotate the unit to gain access to the rear panel.
2. Remove the four enclosure screws on the rear panel that secure the top enclosure to the bottom enclosure (see Figure 3-1 for the rear panel screw locations.)
3. Loosen the two enclosure guide screws (see Figure 3-1.) These screws do not need to be removed.
4. Next you must gain access to the two remaining enclosure screws on the bottom of the unit. Firmly hold onto the unit so that it does not fall from your workspace. Move the unit so that the rear panel hangs slightly over the edge of your work surface. Remove the two remaining enclosure screws on the bottom of the unit (see Figure 3-1 for the enclosure screw locations.)
5. Slide the unit back onto your work surface.



Warning: Be sure to have your work surface prepared for the following steps. This includes placing foam blocks behind the unit. When the top enclosure is removed, place it on the foam blocks to avoid damaging the Volume slider, the Control and contrast knobs, the wheels, the display or any of the buttons. The following procedure requires enough room behind the rear of the unit to place the top enclosure face down on your work surface. Also, when removing the top enclosure, move it slowly so that you don't damage cables connected to the bottom enclosure.

6. Grip each end of the top enclosure and slowly lift it up a few inches.
7. Slowly turn the top enclosure over and place it face down onto the foam blocks that you have placed behind the unit (see Figure 3-3 below.)

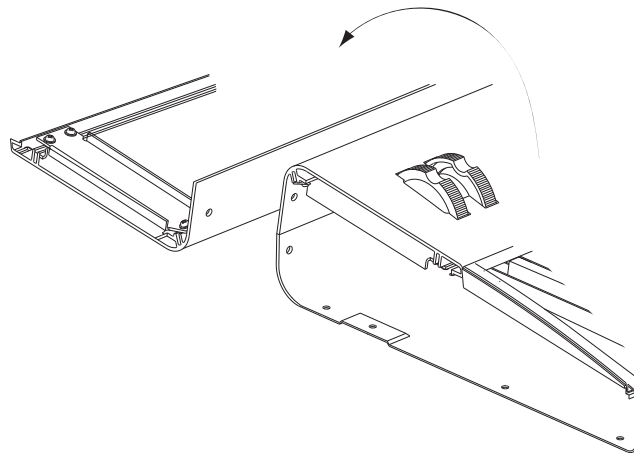


Figure 3-3 **Removing top enclosure**



Caution: Cables from the top enclosure connect to the keyboard on the bottom enclosure. You do not need to disconnect these cables.

Removing The Engine Board

1. Unplug the 7 cables that are attached to the Engine Board (see Figure 3-4 below for cable connector locations.) The cable plugged into connector J11 (see below) is held in place by a wire tie. After disconnecting this cable, carefully move this cable around the wire tie.

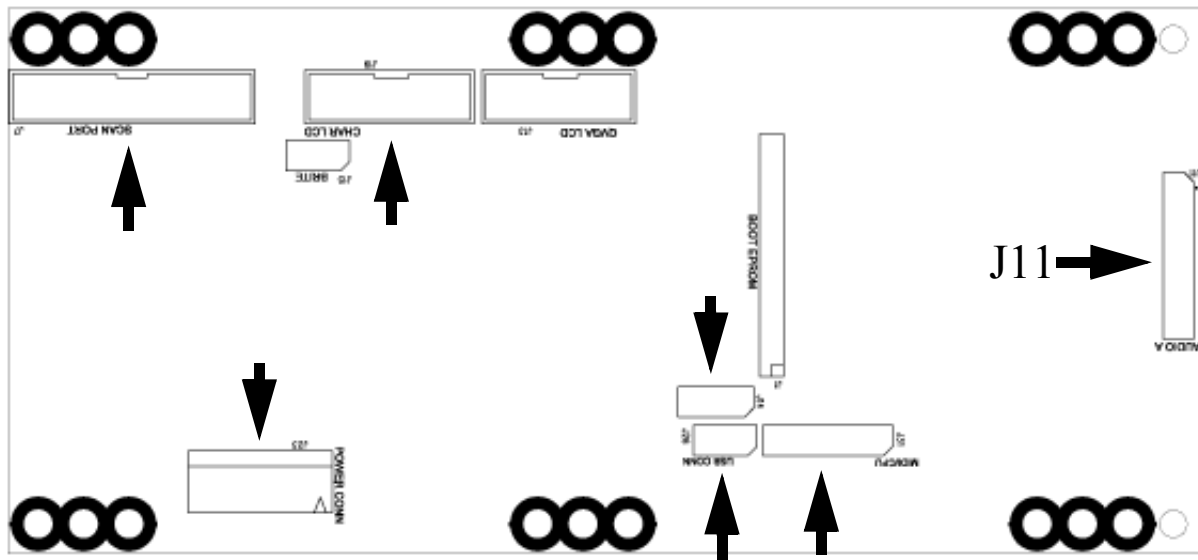


Figure 3-4 Engine Board Connectors Locations

2. Remove the 6 screws attaching the Engine Board to the top enclosure (see Figure 3-5 below for the Engine Board screw locations.) One of the screws (bottom right .Figure 3-5, below) holds a wire tie used to secure one of the cables. Make a note of the wire ties position, and be sure to save this wire tie for later reinstallation of the Engine Board.

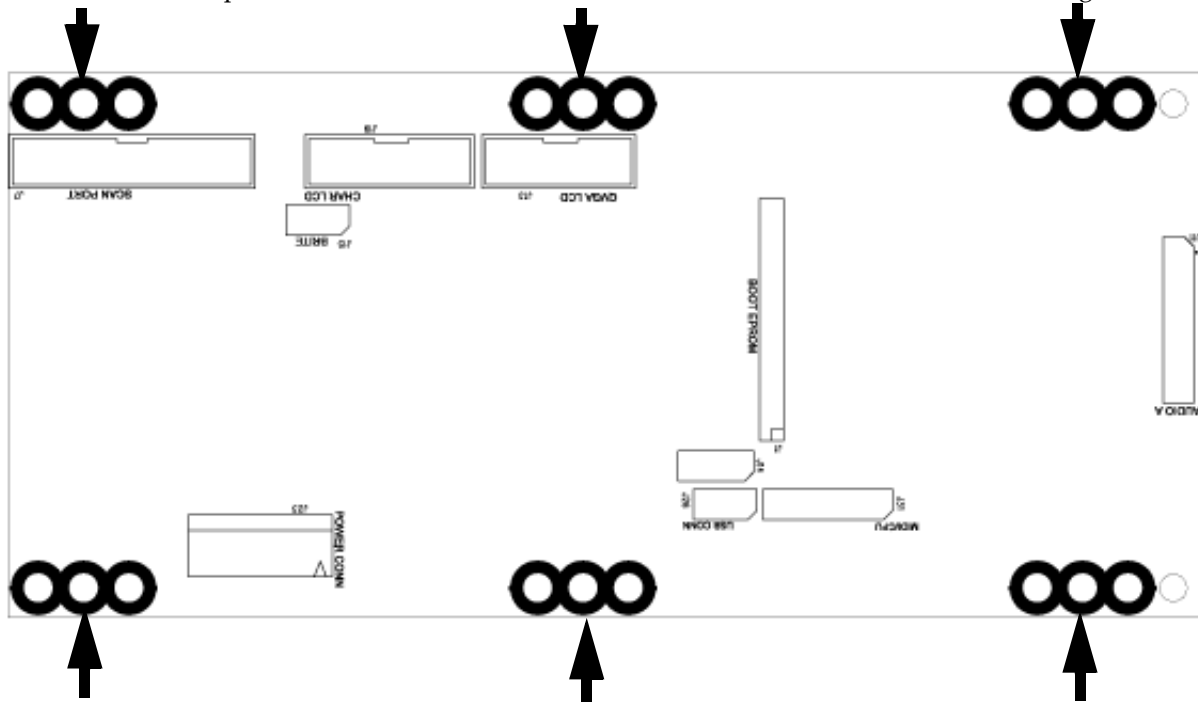


Figure 3-5 Engine Board Screw Locations

3. Remove the Engine Board.

Replacing The Engine Board

1. Align the Engine Board on the top enclosure. The Engine Board is aligned properly if the ribbon cables from the Front Panel Board can reach their connectors on the Engine Board.
2. Replace the 6 screws that attach the Engine Board to the top enclosure (see Figure 3-5 for the Engine Board screw locations.) Make sure to reinstall the wire tie which is held in place by the bottom right screw in Figure 3-5.
3. Plug all cables back into the Engine Board. There are 5 cables in the bundle attached to the Front Panel Board, as well as two ribbon cables attached to the Front Panel Board. See Figure 3-4 (above) for cable connector locations. The cable plugged into connector J11 (see Figure 3-4) must be held in place by the wire tie attached to the bottom right screw in Figure 3-5. Carefully secure this cable underneath the wire tie.

Removing the LCD Board

1. Disconnect the ribbon cable from the LCD board.
2. The LCD is mounted onto a bezel that is secured to the Front Panel Board. Remove the four screws that secure the LCD to the front panel bezel (see Figure 3-6 below for the LCD Board screw locations.)
3. Lift the LCD Board up and remove it.

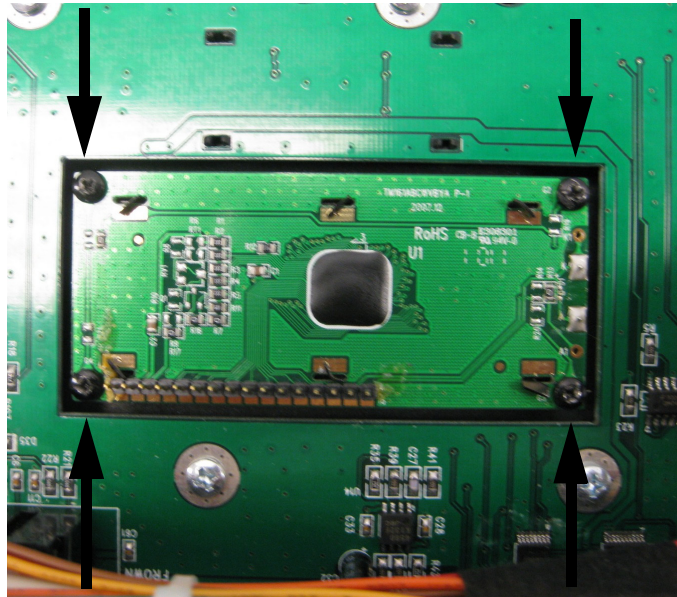


Figure 3-6 LCD Board Screw Locations

Replacing the LCD Board

1. Place the LCD Board in position face down onto the front panel bezel.
2. Install the four screws that secure it to the front panel bezel (see Figure 3-6 for the LCD Board screw locations.)
3. Connect the LCD ribbon cable that is attached to the Engine Board. The end of the ribbon cable that attaches to the LCD board is not keyed, so make sure the red cable in the LCD ribbon cable is aligned with pin 1 on the LCD board. Pin 1 should be labeled on the LCD board.

Removing the Front Panel Board

1. Raise the top enclosure up slightly to gain access to the front panel. Remove the Volume slider and Control knob caps from the front panel by carefully pulling each straight upward from the front panel.
2. Follow the procedure described on page 3-7 to remove the LCD board.

3. Unplug the other ribbon cable that is bundled with the ribbon cable for the LCD board from the connector J1 (see Figure 3-7 below.) Unfasten the tape that holds these ribbon cables in place on the Front Panel Board. Leave the tape attached to these ribbon cables so that they can be properly secured again later.

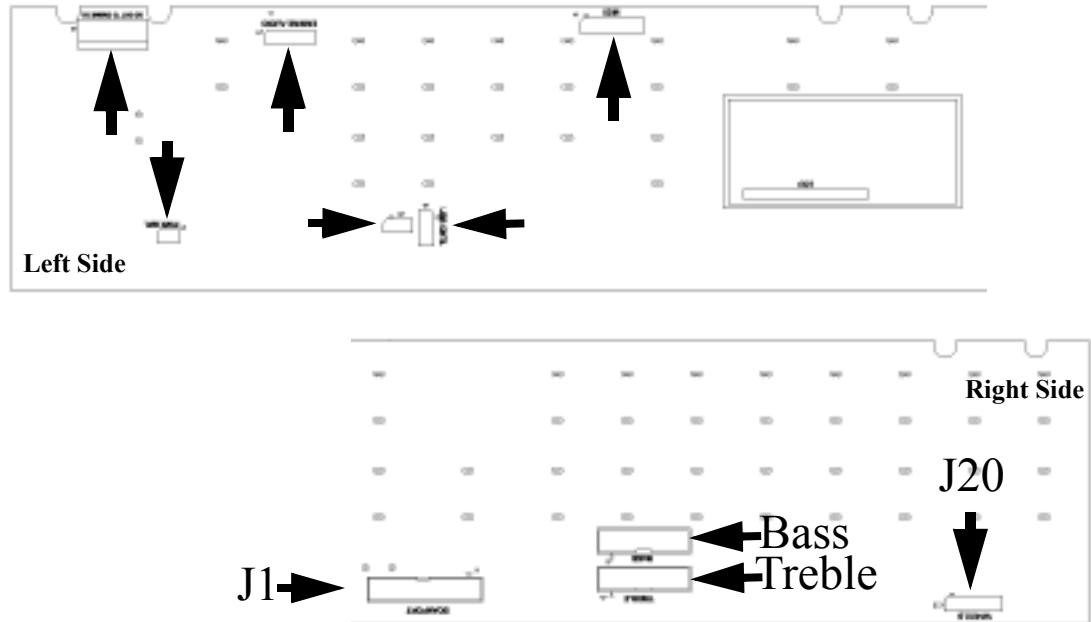


Figure 3-7 Front Panel Board Connectors Locations

4. There are two ribbon cables that connect the keyboard to the Front Panel Board. Use a marker to mark each of the ribbon cables for later reference. The cable coming from the left hand side of the keyboard is connected to the bass keys, while the cable coming from the right hand side of the keyboard is connected to the treble keys. Each cable is connected to a correspondingly named socket on the Front Panel Board (see Figure 3-7 above.) Unplug both of these ribbon cables from the Front Panel Board.
5. Remove the seven remaining cables that are plugged into the Front Panel Board (see Figure 3-7 above for connector locations.)
6. Use a 7/16" hex socket wrench to remove the five jack nuts and washers for each of the 1/4-inch jacks on the rear panel.
7. Remove the 21 screws attaching the Front Panel Board to the top enclosure, and the two screws attaching the support bracket to the top enclosure.
8. Slowly lift the edge of the Front Panel Board from the side opposite the rear panel. The front panel buttons and controls should come out of their front panel holes first. After this, pull the board away from the rear panel and the rear panel connections should come out of their rear panel holes. When all front panel buttons and controls and all rear panel connections are free of the top enclosure, lift the Front Panel Board upward and remove it.

Replacing the Front Panel Board

1. Check that all front panel buttons are attached properly.
2. To replace the Front Panel Board, the rear panel connections must be aligned with their openings on the rear panel. Position the Front Panel Board over the top enclosure and use the USB port to align the rear panel connections with their rear panel openings. When all rear panel connections are seated properly in their rear panel openings, set the board down to rest in its place on the top enclosure.
3. Raise the top enclosure up slightly to verify that the Volume slider, Control knob and contrast knob are correctly positioned through their openings in the top enclosure. Most of the front panel buttons should also be positioned through their openings in the top enclosure, but if not these will be adjusted in the next steps.
4. Attach three of the Front Panel Boards screws, one on each end of the board and one in the center, to temporarily hold the board in place.
5. Raise the top enclosure up slightly and fix any buttons that are not seated properly in their openings by pressing or wiggling them until they move into place.
6. Replace the 21 screws which attach the Front Panel Board to the top enclosure. Do not attach the support bracket at this time.
7. Use a 7/16" hex socket wrench to replace the five jack nuts and washers for each of the 1/4-inch jacks on the rear panel.
8. Attach the ribbon cables from the keyboard to their connections on the Front Panel Board. The ribbon cable from the left of the keyboard goes to the connector labeled "BASS", while the ribbon cable from the right of the keyboard goes to the connector labeled "TREBLE".
9. The two ribbon cables from the Engine Board should still have tape attached to them. Lay these ribbon cables flat on the Front Panel Board and use the tape to hold them in their correct positions. Attach the ribbon cable that fits the remaining connection on the Front Panel Board.
10. Replace the LCD board (see page 3-7 for details.) If you are replacing the Front Panel Board with another board, be sure to use the old LCD board and install it on the new board.
11. Replace the support bracket and attach the two screws which hold it to the top enclosure.

Removing the Wheels

The following procedure assumes that the SP4-7 is open and that you have followed the instructions to remove the top enclosure (see page 3-4.)



Note: Removing and replacing wheels requires cutting and replacing wire ties. Make sure you have enough replacement wire ties before removing and replacing the wheels.

1. There is a bundle of cables and wires in the SP4-7 in the rear of the top enclosure held in place with tape. Peel the tape back a little to gain access to the cables, but leave the tape attached to the top enclosure so that it remains properly positioned.
2. Each wheel is connected to three wires. Each set of three wires connects to the Front Panel Board using the same connector. Follow each set of wires from the wheels to their connector on the Front Panel Board. Note the placement of any wire ties holding the wires for the wheels. Cut these wire ties to remove the wires for the wheels and unplug the connector for the wheels from the Front Panel Board. For the wheels connector location, see J20 in Figure 3-7 on page 3-8.
3. Each wheel has a mounting that holds a potentiometer and a wheel. To remove the wheels, remove the two screws which hold each mounting to the top enclosure. The screws are located on either side of the potentiometer for each wheel.

Replacing the Wheels



Note: Removing and replacing wheels requires cutting and replacing wire ties. Make sure you have enough replacement wire ties before removing and replacing the wheels.

1. Align each wheel in its cut out in the top enclosure, with the mounting for each wheel positioned over the screw posts next to the wheel cut outs. Make sure the pitch wheel (the wheel with the spring) is positioned in the cut out closest to the end of the top enclosure. Replace the two screws for each of the wheel mountings to attach the wheels to the top enclosure.
2. Plug the wires for the wheels into the wheels connector on the Front Panel Board. For the wheels connector location, see J20 in Figure 3-7 on page 3-8. Any wire ties that were cut when the wheels were removed must be replaced. Use the notes you took to replace the wire ties and secure the wheels wires in the proper locations.
3. Re-attach the tape that you peeled back from the top enclosure so that the bundle of cables is held securely to the rear of the top enclosure.
4. After replacement, the Pitch Wheel center (when released) must be checked and may need to be adjusted. See *Scanner DIAG* on page 2-3 for details on Pitch Wheel center adjustment.

SP4-7 Keyboard Assembly

Removing the SP4-7 Keyboard Assembly

The following procedure assumes that the SP4-7 is open and that you have followed the instructions to remove the top enclosure (see page 3-4.)

1. There are two ribbon cables that connect the keyboard to the Front Panel Board. Use a marker to mark each of the ribbon cables for later reference. The cable coming from the left hand side of the keyboard is connected to the bass keys, while the cable coming from the right hand side of the keyboard is connected to the treble keys. Each cable is connected to a correspondingly labeled socket on the Front Panel Board. Unplug both of these ribbon cables from the Front Panel Board.
2. The ribbon cables from the keyboard are secured to the bottom enclosure with tape. Peel back the tape from one side to free the cables, but leave the tape in place on the bottom enclosure so that later the cables can be secured in their correct positions during reassembly.
3. The keyboard is secured to the bottom enclosure using sixteen screws. Refer to Figure 3-8 for the position of the screws. Arrows identify the locations of the screws.
4. Tilt the bottom enclosure up and remove the eight keyboard rear screws, then lay the bottom enclosure flat on your work surface.
5. Move the bottom enclosure forward so that the front hangs over the edge of your work surface to access the remaining screws, and remove the eight keyboard front screws.
6. Slide the SP4-7 back onto your work surface and remove the Keyboard Assembly.

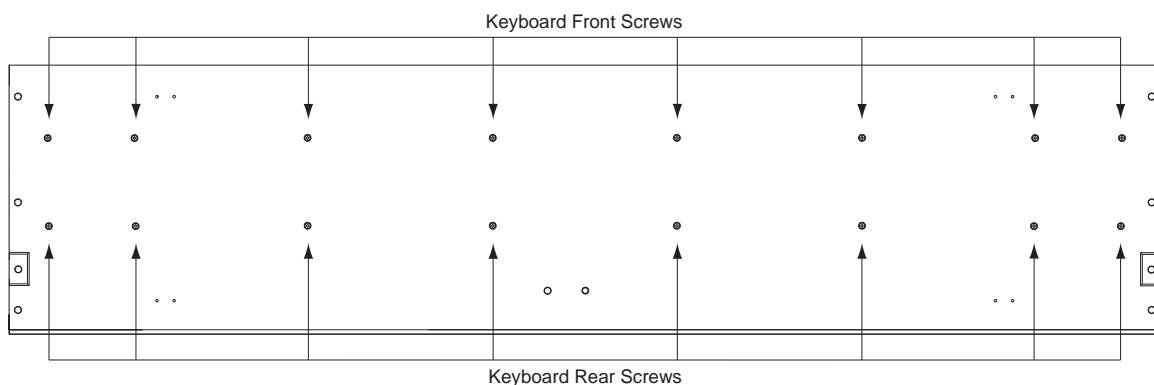


Figure 3-8 **SP4-7 keyboard bottom**

Replacing the SP4-7 Keyboard Assembly

1. Place the keyboard on the bottom enclosure so that the front of the keyboard meets with the front of the bottom enclosure. Check that the white keys have enough clearance between the front of the keys and the front of the enclosure so that they can be fully depressed.
2. Slide the bottom enclosure forward so that you can install the eight keyboard front screws. Refer to Figure 3-8 for the location of the screws. Before fully tightening these screws, check that the white keys have enough clearance between the front of the keys and the front of the enclosure so that they can be fully depressed. If more clearance is needed, move the keyboard slightly farther from the front of the bottom enclosure.
3. Move the bottom enclosure back onto your work surface.
4. Tilt the bottom enclosure up and install the eight keyboard rear screws. Refer to Figure 3-8 for the location of the screws.
5. Position the ribbon cables from the keyboard so that they are secured to the bottom enclosure with tape. Tape should be positioned correctly from removing the keyboard assembly (see page 3-11.)
6. Connect the ribbon cables from the keyboard to the Front Panel Board. The cable coming from the left hand side of the keyboard should be connected to a socket on the Front Panel Board labeled "BASS", while the cable coming from the right hand side of the keyboard should be connected to a socket on the Front Panel Board labeled "TREBLE".

Removing Keys

The following procedure assumes you have removed the top enclosure and the keyboard assembly from the SP4-7 (see page 3-4, page 3-11.) These instructions apply to both the natural and sharp keys. The following diagrams illustrate how the designs of the keys interact with the keyboard chassis and key contact boards.

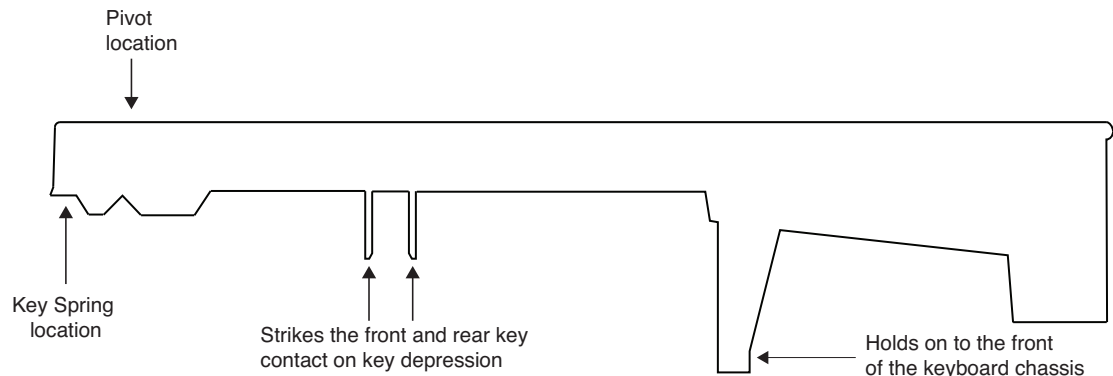


Figure 3-9 **Natural/White Key**

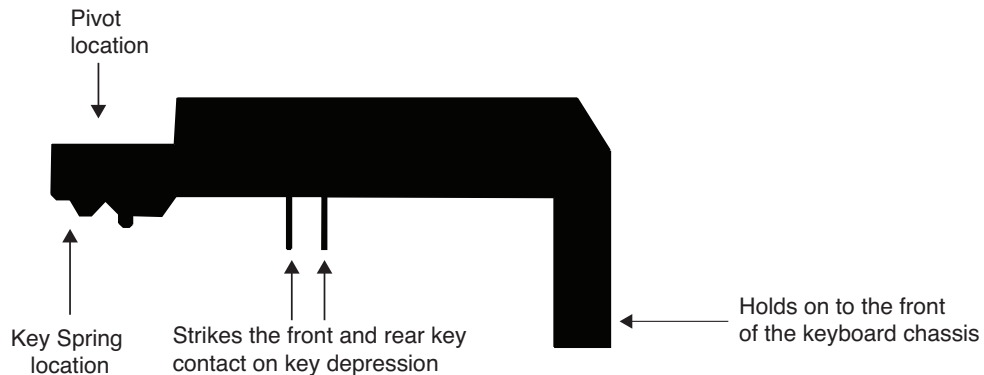


Figure 3-10 Sharp/Black Key



Note: To remove a sharp key, you must first remove the adjacent natural keys.

1. Each key has a spring located at the rear of the key. Insert a small Phillips head screwdriver into the top of the spring and press down to stretch the bottom of the spring past the bottom of the keyboard chassis. Next, pivot the screwdriver away from the keyboard chassis so that the bottom of the spring is no longer held by the keyboard chassis. Once the bottom of the spring is clear of the keyboard chassis, stop stretching the spring with the screwdriver and remove the spring from the key. Do not misplace any removed springs.
2. Unlock the key from the pivot anchoring the key to the keyboard chassis. To do this, insert a small flat screwdriver at the back end of the pivot and press the pivot tab toward the front edge of the keyboard. When the pivot tab is free of the keyboard chassis, the back end of the key (where the spring was positioned) will be able to lift up. Remove the screwdriver.
3. The front of the key is secured by the front of the keyboard chassis. Lift the back of the key up slightly, then move the key away from the back of the keyboard chassis to remove the key.

Replacing Keys



Note: If a sharp key has been removed, replace the sharp key before replacing the adjacent natural keys.

The following instructions apply to both natural and sharp keys.

1. Place the key on the keyboard chassis and lower the key into position. Make sure the front of the key is held in place by the front of the keyboard chassis.
2. Align the pivot with the hole at the rear of the key. Push down on the key. It should snap into position on the pivot.
3. Install the spring. Place the wide end of the spring in the top of the key, with the tapered end facing downward (see other keys for reference.) Insert a small Phillips head screwdriver into the top of the spring and press down to stretch the bottom of the spring past the bottom of the keyboard chassis. Next, pivot the screwdriver towards the keyboard chassis so that the bottom of the spring is held by the keyboard chassis.

Accessing the Keyboard Contact Boards

1. The following procedure assumes you have removed the top enclosure and the keyboard assembly from the SP4-7 (see page 3-4, page 3-11.)
2. Turn the keyboard over and place it upside down on a flat soft surface. Be sure the keys are resting on a soft surface to avoid scratching or other damage. The Treble and Bass Contact Boards are now visible.

Removing the Treble Contact Board

1. A flat ribbon cable is connected to the Treble Contact Board. Use a marker to mark the pin 1 location for the pins on the Treble Contact Board. The pin 1 location connects to the red wire on the ribbon cable. Peel back the tape securing the connector, and disconnect the flat ribbon cable from the Treble Contact Board.
2. Remove the 18 screws that secure the Treble Contact Board to the keyboard chassis, and remove the board.

Replacing the Treble Contact Board

1. Check that the rubber key contact strips are lying completely flat on the contact board, any gaps could interfere with key function. If necessary, adjust the key contact strips by pushing their rubber pegs through the holes in the contact board using a small blunt-end tool (Q-Tip, toothpick, etc.). Do not use too much force or use a tool that can poke a hole through the mounting pegs. Position the Treble Contact Board on the keyboard chassis. The contact board has holes which align with plastic pegs on the keyboard chassis when properly aligned. Be sure that the rubber key contacts line up properly through their openings in the keyboard chassis.
2. Install the 18 screws that secure the Treble Contact Board to the keyboard chassis.
3. Connect the treble ribbon cable to the contact board, be sure to align the connector properly, lining up the red wire of the ribbon cable with the pin you marked as pin 1. Reapply the tape to the connector.

Removing the Bass Contact Board

1. A flat ribbon cable is connected to the Bass Contact Board. Use a marker to mark the pin 1 location for the pins on the Bass Contact Board. The pin 1 location connects to the red wire on the ribbon cable. Peel back the tape securing the connector, and disconnect the flat ribbon cable from the Bass Contact Board.
2. Remove the 24 screws that secure the Bass Contact Board to the keyboard chassis, and remove the board.

Replacing the Bass Contact Board

1. Check that the rubber key contact strips are lying completely flat on the contact board, any gaps could interfere with key function. If necessary, adjust the key contact strips by pushing their rubber pegs through the holes in the contact board using a small blunt tool or Phillips screwdriver. Position the Bass Contact Board on the keyboard chassis. The contact board has holes which align with plastic pegs on the keyboard chassis when properly aligned. Be sure that the rubber key contacts line up properly through their openings in the keyboard chassis.
2. Install the 24 screws that secure the Bass Contact Board to the keyboard chassis.
3. Connect the Bass ribbon cable to the contact board, be sure to align the connector properly, lining up the red wire of the ribbon cable with the pin you marked as pin 1. Reapply the tape to the connector.

Removing the Keyboard Contact Strips

1. Follow the procedure to remove the Bass and Treble Contact Boards (see page 3-14.)
2. Examine the keyboard contact strips and look at the design of an individual contact. The top portion of the contact has two indentations. One indentation is deeper than the other. When replacing the keyboard contact strips, the deeper indentation is always positioned toward the rear of the key.
3. The keyboard contact strips have rubber mounting pegs that secure the contact strips to the keyboard contact boards. To remove a keyboard contact strip, gently lift and free the strip from its position. Be careful not to rip or damage any contact in the process.

Replacing the Keyboard Contact Strips

1. Position the contact strip on the board.



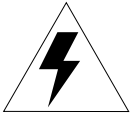
Note: Be sure that the deeper indentation is positioned toward the rear of the key.

2. Line up the contact strip mounting pegs with their respective mounting holes on the keyboard contact board.
3. Using a small blunt-end tool (Q-Tip, toothpick, etc.) gently push the mounting pegs through the holes. Do not use too much force or use a tool that can poke a hole through the mounting pegs. However, be sure that the mounting pegs are installed through the holes and the contact strip is flat against the board at each peg location.

Closing the SP4

Replacing The Top Enclosure

1. With the keyboard's bass and treble ribbon cables connected from the top enclosure to the bottom enclosure, the bottom enclosure should have the keyboard facing towards you, while the top enclosure should be positioned face down behind the bottom enclosure.
2. Grip each end of the top enclosure and rotate the far end towards you so that it is face up. Use the two enclosure guide screws that were not removed from the back panel to find the right position for the top enclosure (see Figure 3-1 for screw locations.) You should be able to guide the two slots in the rear of the top enclosure to rest on these two guide screws in the back panel.
3. Make sure no cables are sticking out between the top enclosure and the keyboard. If any cables are sticking out, lift the top enclosure slightly and tuck the cables underneath.
4. Tighten the two enclosure guide screws (see Figure 3-1 for screw locations.)
5. Install the four enclosure screws in the rear of the unit (see Figure 3-1 for enclosure screw locations.)



Warning: If you wish to rotate the unit to install the six screws in the rear of the unit, do so very slowly and carefully, because at this point the top and bottom enclosures are not yet connected.

6. Next you must gain access to the two remaining enclosure screws on the bottom of the unit. Firmly hold onto the unit so that it does not fall from your workspace. Move the unit so that the rear panel hangs slightly over the edge of your work surface. Replace the two remaining enclosure screws on the bottom of the unit (see Figure 3-1 for the enclosure screw locations.)
7. Slide the unit back onto your work surface.

Replacing The Endcaps



Warning: The following procedure assumes that you have completed Steps 1-4 in *Replacing The Top Enclosure*. If you have not completed these steps, do so before continuing.



Note: In addition to the rear panel screws, the endcap locking bracket secures the endcap to the top enclosure. When the endcap locking bracket is in position, it rests against the endcap clamping bracket located on the underside of the top enclosure. See Figure 3-11.

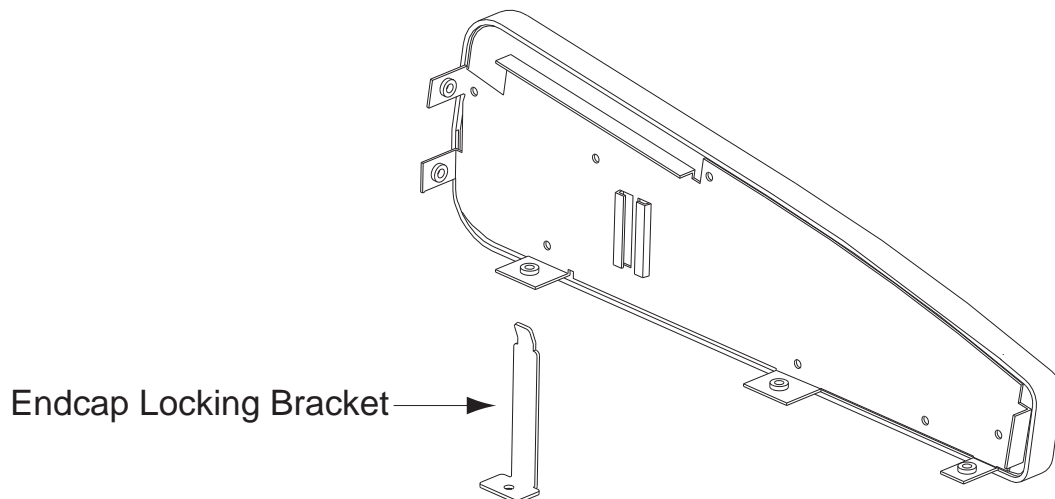
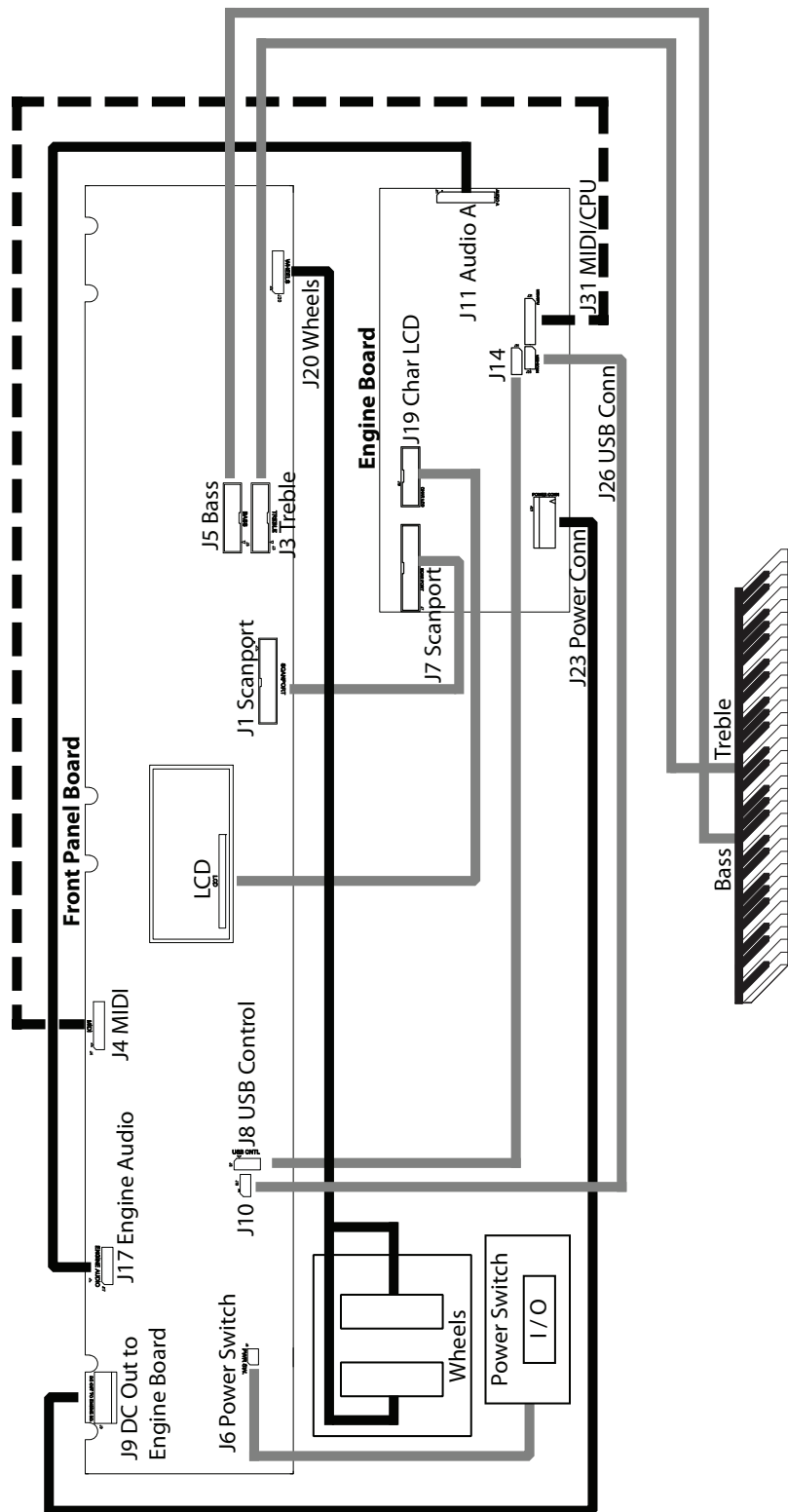


Figure 3-11 Top enclosure, endcap locking and clamping brackets

1. Slide one side of the unit off of your work surface and hold the appropriate endcap and endcap locking bracket in position.
2. Install the endcap locking bracket screw in the bottom enclosure.
3. Install the five remaining endcap screws.
4. Repeat steps 1-3 for the other endcap.

SP4-7 Interconnect Diagram



Chapter 4

Replacement Parts

Boards & Assemblies

Part No.	Description
1010103710	Engine Board
1010301980	Front Panel Board
6180000760	LCD Board
502030006	Key Contact Bass Board
502030005	Key Contact Treble Board
1012400430	Wheels Assembly
305100015	Top Enclosure (SP4-7)
305100014	Top Enclosure (SP76-II)
218040028	LCD Window Lens
6280709550	LCD Cable
306020009	Bottom Enclosure
102990053	Endcap Left Assembly (including bracket)
216020028	Endcap Left Assembly
102990054	Endcap Right Assembly (including bracket)
216020027	Endcap Right Assembly

Front Panel Controls

Part No.	Description
207010017	Slider Cap (Volume)
208010040	Knob (Control)
629020250	Button without LED (no word)
629020258	Button with LED (4 joint, no word)
629020259	Button with LED (no word)
629020251	Button (4 joint, 1-4 GHI)
629020252	Button (4 joint, 5 JKL)
629020253	Button (4 joint, 6 MNO-9 WXYZ)
629020254	Button (4 joint, 0-Enter)
629020255	Button (Direction Chan/Param)
629020256	Button ("-" minus)
629020257	Button ("+" plus)

Keyboard Assembly, 76-note

Part No.	Description
102060073	Medeli Semi-weight Keyboard Assembly (76 Note)
205010069	Medeli Semi-weight Natural Key A
205010070	Medeli Semi-weight Natural Key B
205010071	Medeli Semi-weight Natural Key C
205010072	Medeli Semi-weight Natural Key D
205010073	Medeli Semi-weight Natural Key E
205010074	Medeli Semi-weight Natural Key F
205010075	Medeli Semi-weight Natural Key G
205010086	Medeli Semi-weight Natural Key Low E1
20501008701	Medeli Semi-weight Natural Key High G4
20401001201	Medeli Semi-weight Sharp Key
629010022	Medeli Semi-weight Key Contact Strip
309070060	Medeli Semi-weight Key Spring
299010076	Foot Spacer

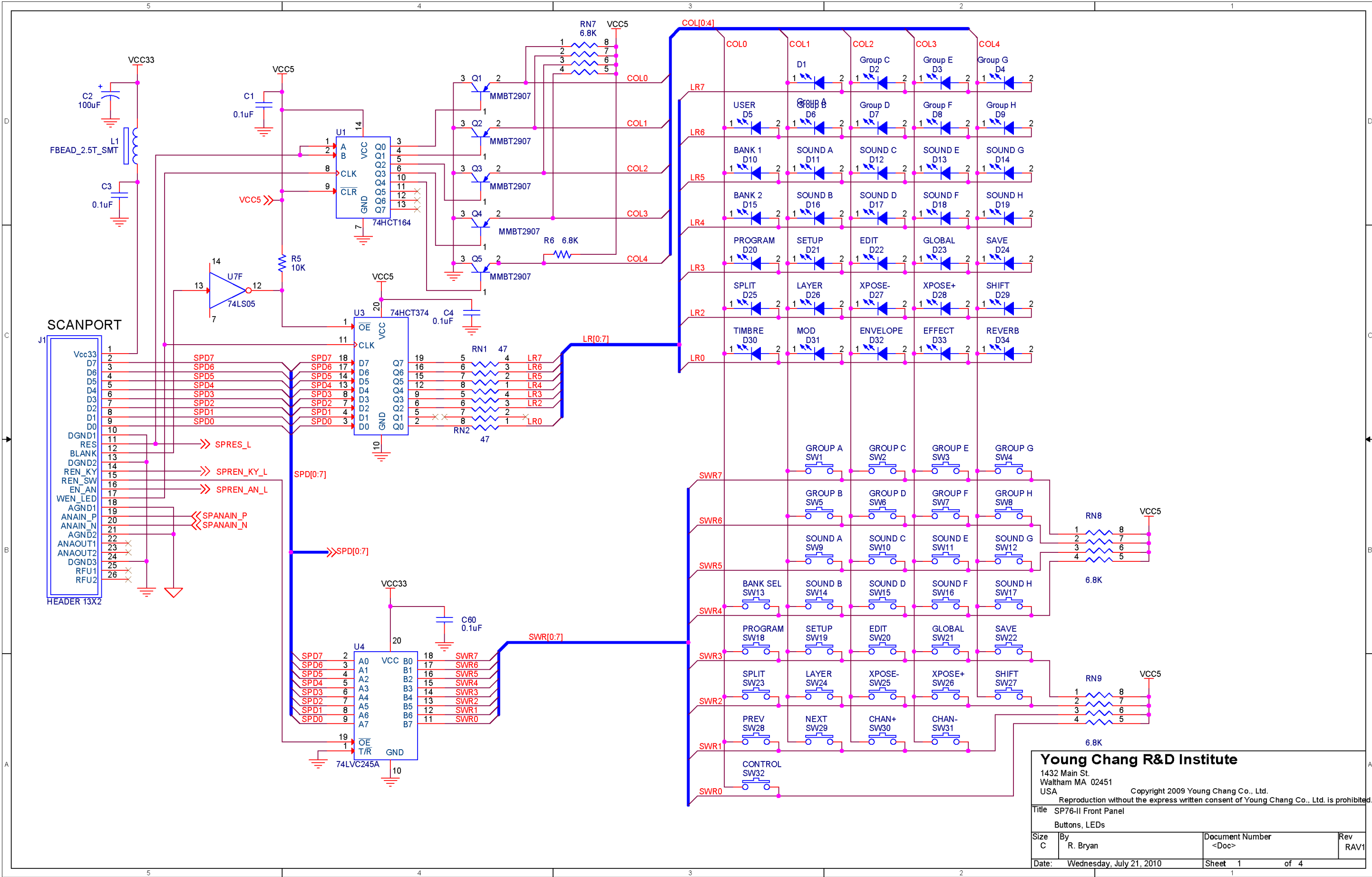
Miscellaneous

Part No.	Description
639000824	SP4 Musician's Guide (Manual)
N043010702	KP-1 Switch Pedal (Sustain)
6380101010	SMPS Adaptor (Power Adaptor) (IN: 100-240V AC 0.7A 50/60Hz OUT: DC 15V 1.0A)
628090012	Power Cable (L=1.5m Europe)
628090015	Power Cable (L=1.5m USA)
621010036	Power Switch

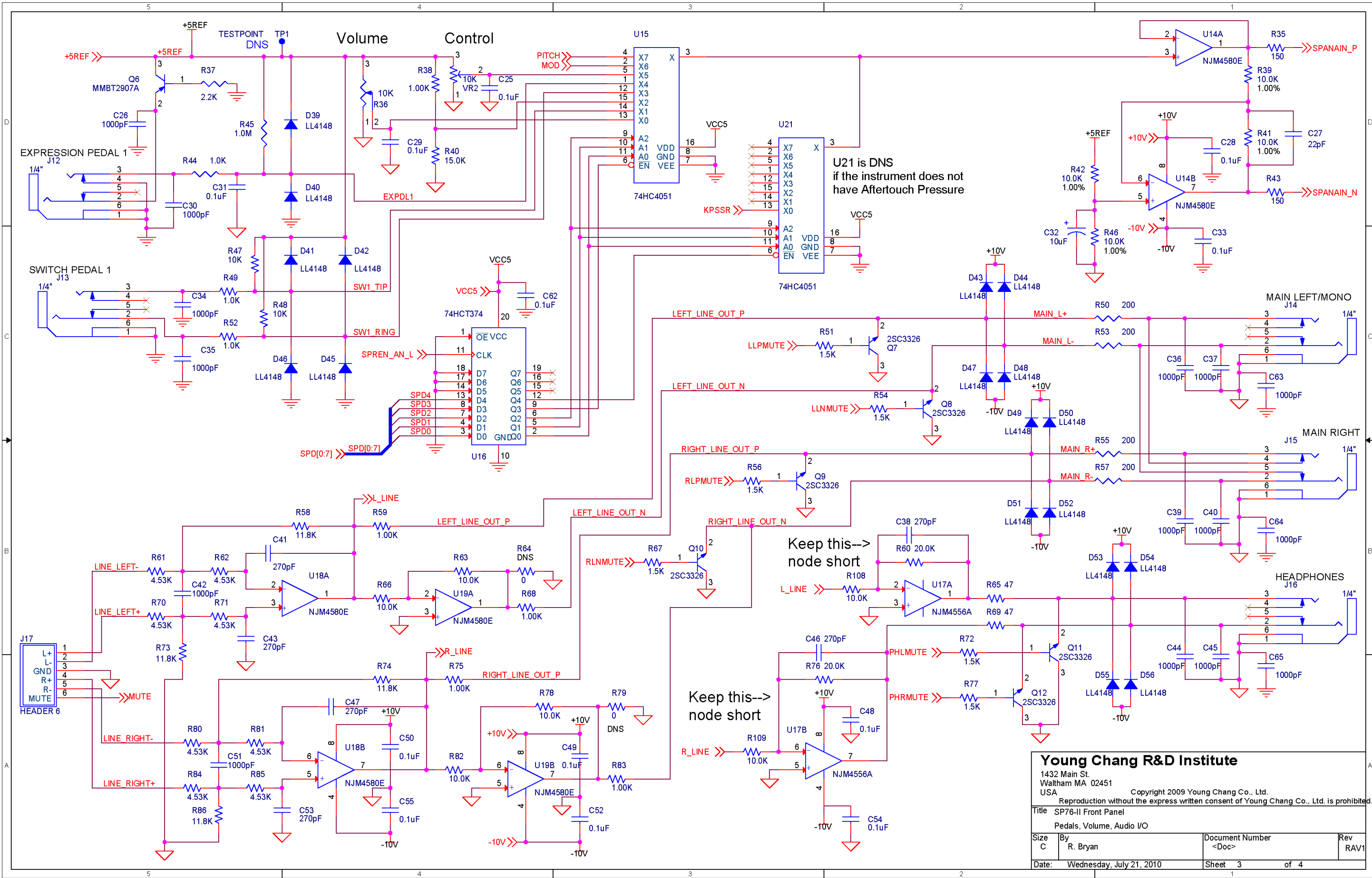
Chapter 5

Schematics

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Front Panel Board Power, MIDI connectors, Treble and Bass keyboard connectors (2 of 4)	page 5-4
Front Panel Board Expression Pedal and Switch Pedal jacks, Volume Slider, Control knob, Audio I/O (3 of 4)	page 5-5
Front Panel Board Muting Transistor drivers, Mod and Pitch Wheel connector (4 of 4)	page 5-6
Engine Board SH7203 CPU, Memory, and Debug UART Header (1 of 5)	page 5-7
Engine Board MARA (2 of 5)	page 5-8
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Engine Board Sound ROM, LCD Intf, Audio Outputs, USB I/F (4 of 5)	page 5-10
Engine Board Power Circuitry, Test Headers, Reset (5 of 5)	page 5-11





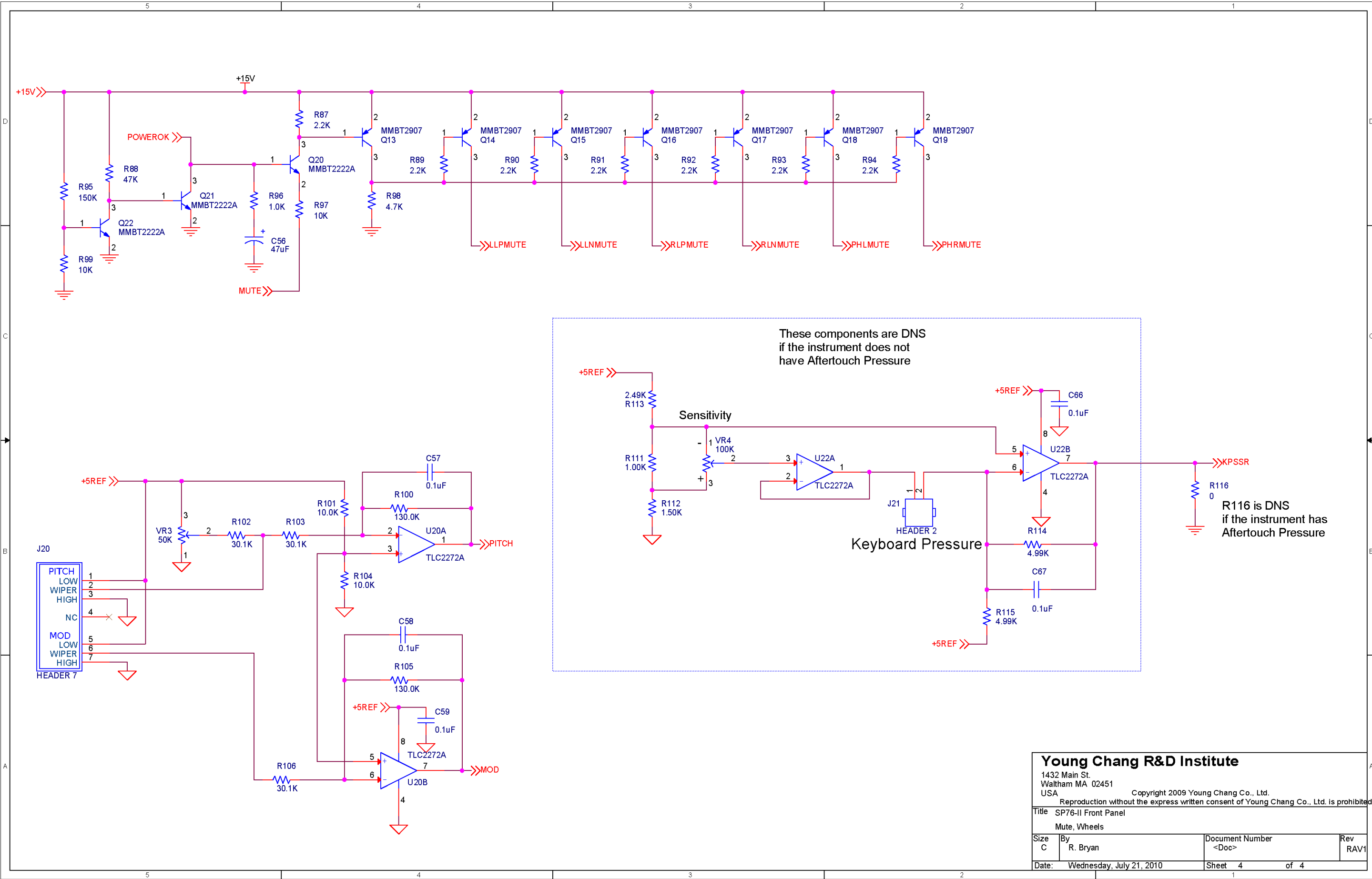


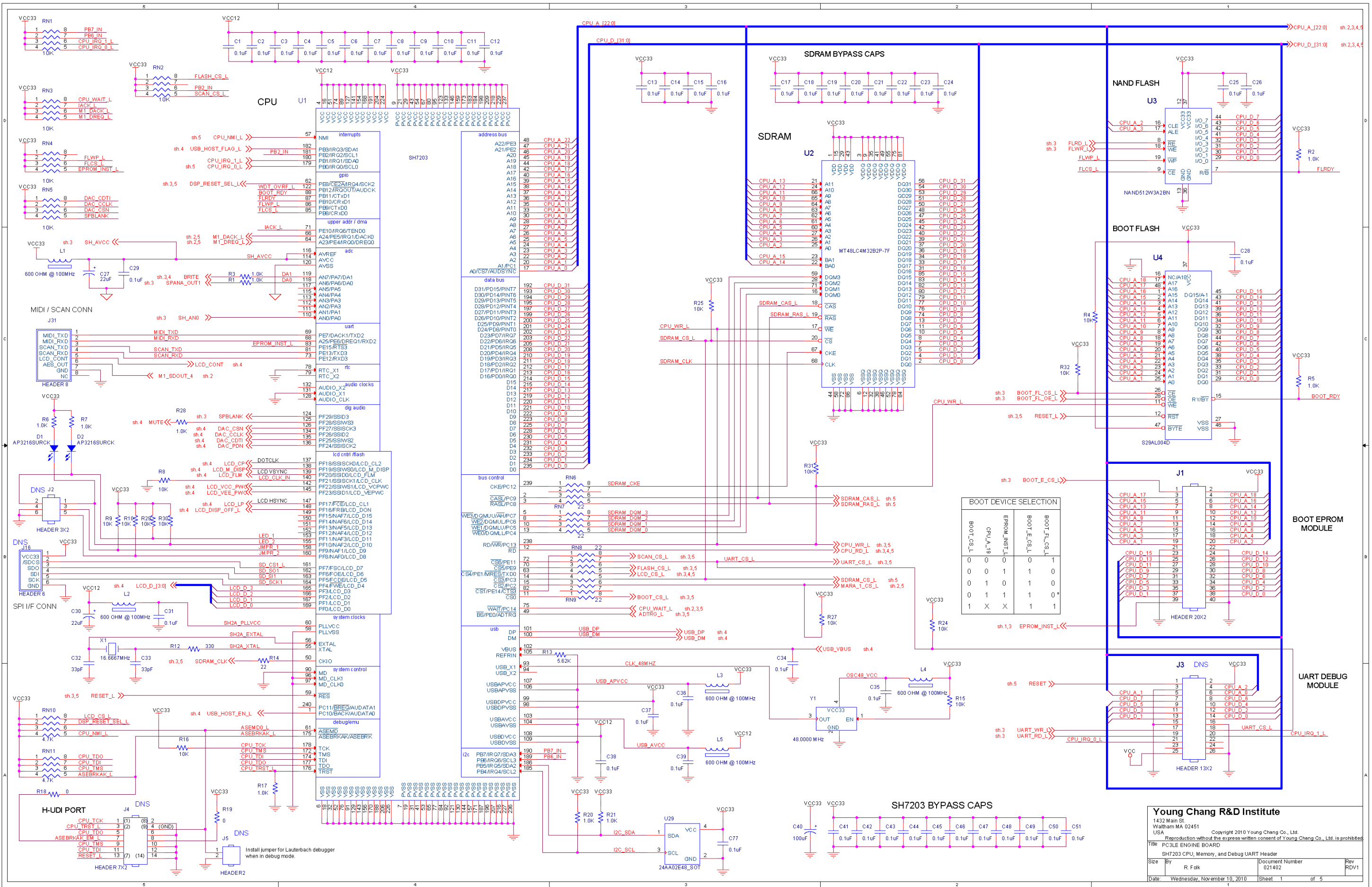
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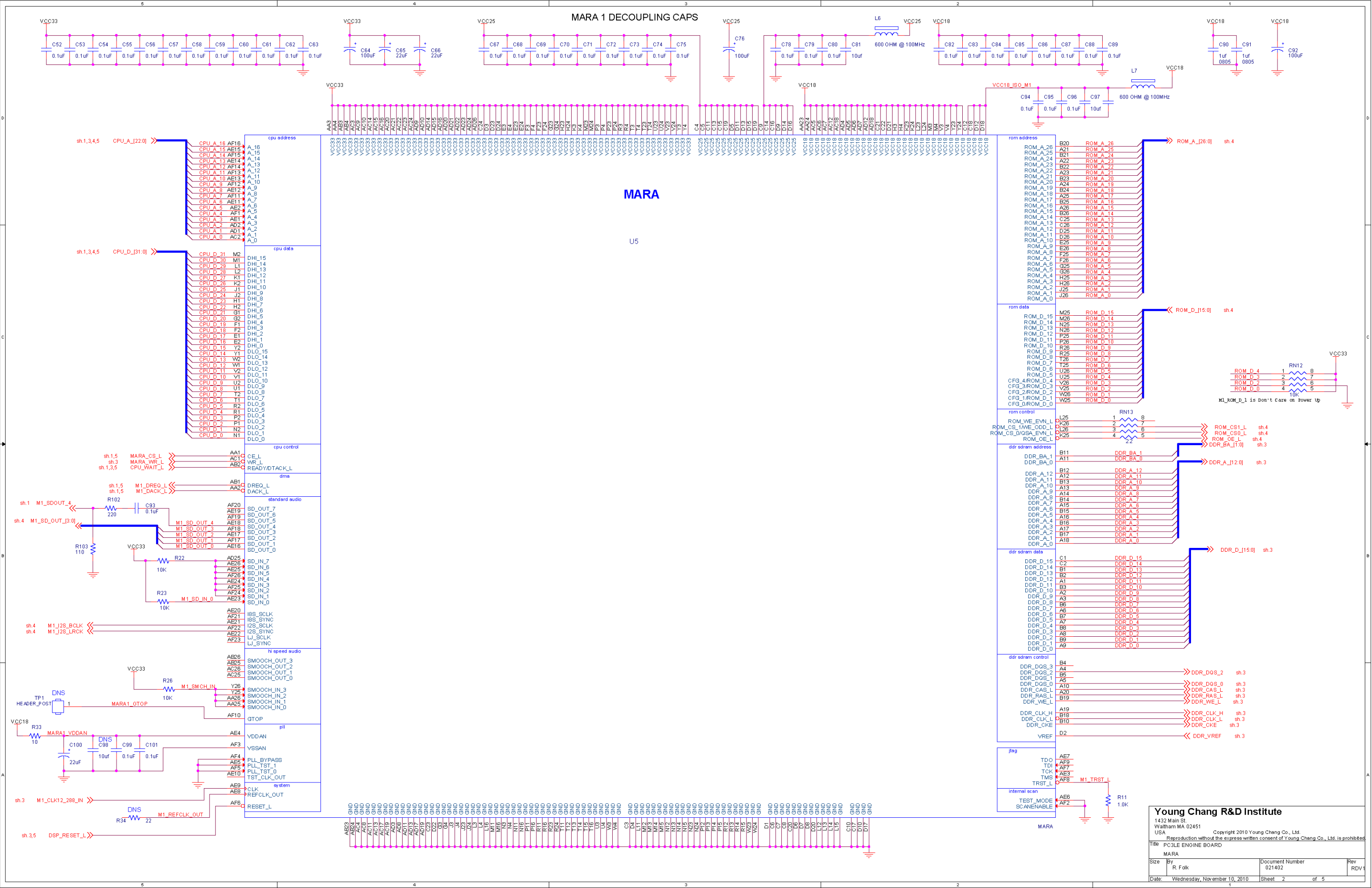
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Pedals, Volume, Audio I/O

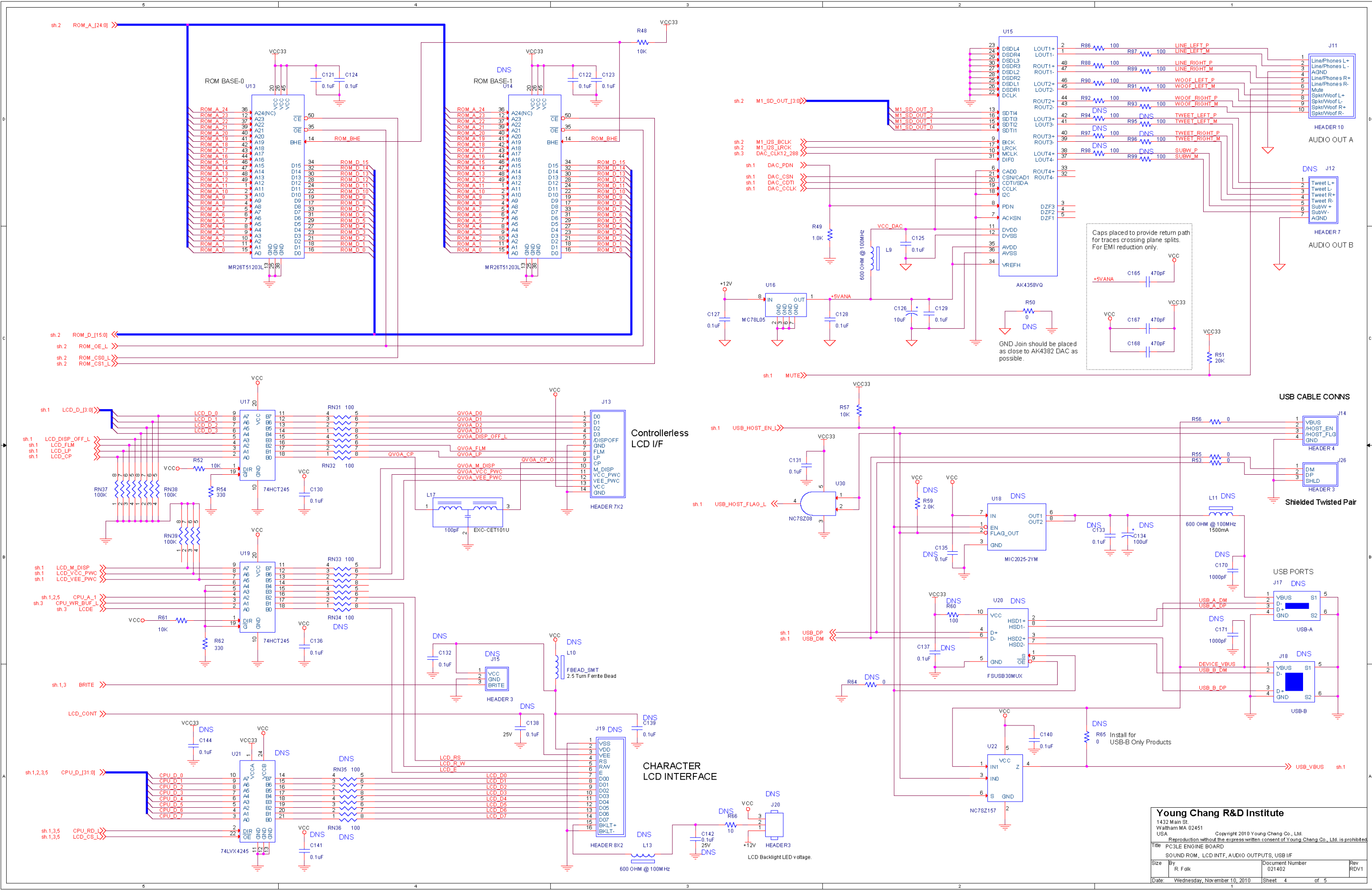
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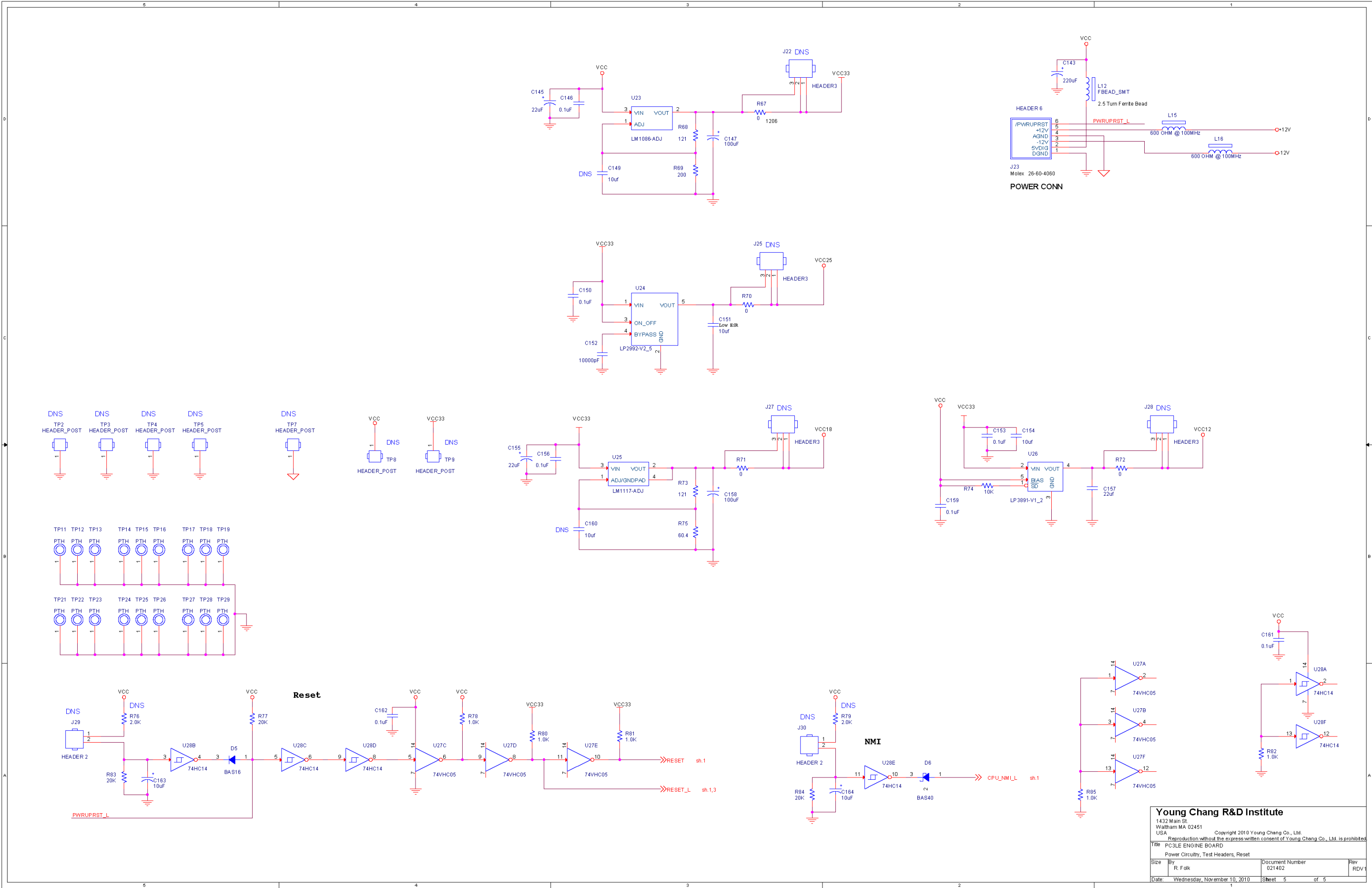












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