ESP-RTI

ROUTER

Fairlight

FIELD CHANGE NOTICE

DATE 03/ 10/ 93
NUMBER 138

ORIGINATOR Chris Alfred

PRODUCT: CMI / MFX

ASSEMBLY No. ESPRT1   DESCRIPTION ROUTER

This FCN applies to REV No: 2.3   New REV No is: 2.4

REASON FOR CHANGE:

EXCESSIVE CROSSTALK IN MODES 1 AND 2 WHEN A DUAL ROUTER CONFIGURATION IS USED

DETAILS OF CHANGE:

1\ REPLACE RTPAL WITH RTPAL2.
2\ UPDATE CARD REVISION NUMBER.

ORIGINATOR:	DATE:	TEST:	DATE:
		PROD:	DATE:
SERVICE:	DATE:	KIT LIST CHANGE:	YES NO

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FIELD CHANGE NOTICE

DATE 8/ 6 / 93
NUMBER 130

ORIGINATOR John Lancken

PRODUCT: CMI / MFX

ASSEMBLY No. RT-1 **DESCRIPTION** Router Module

This FCN applies to REV No: Rev 2.2 **New REV No is:** Rev 2.3

REASON FOR CHANGE:

SCSI / Data noise on router outputs.

Replacing the +5V digital voltage (VCC) with +5V regulator voltage from +15V analog voltage.

DETAILS OF CHANGE:

1. Cut Tracks from edge connector pins A36, A37, B36, B37 (+5V input) These tracks are on either side of pcb.

2. Connect input pin of 7805 (Use T0-220 type) regulator to +15V pcb track. Edge connector pins B32,B33.
Scrape the pcb clean of solder resist and tin. This should be done on the component side of the pcb OR use the feed thru hole.

3. Connect the center pin of the regulator to 0V audio (GND) with a short piece of wire. Edge connector pins B28, B29. Scrape the pcb clean of solder resist and tin.

4.Connect output pin of the regulator to the component side of the pcb track cut (Vcc). Scrape the pcb clean of solder resist and tin OR use the feed thru hole.

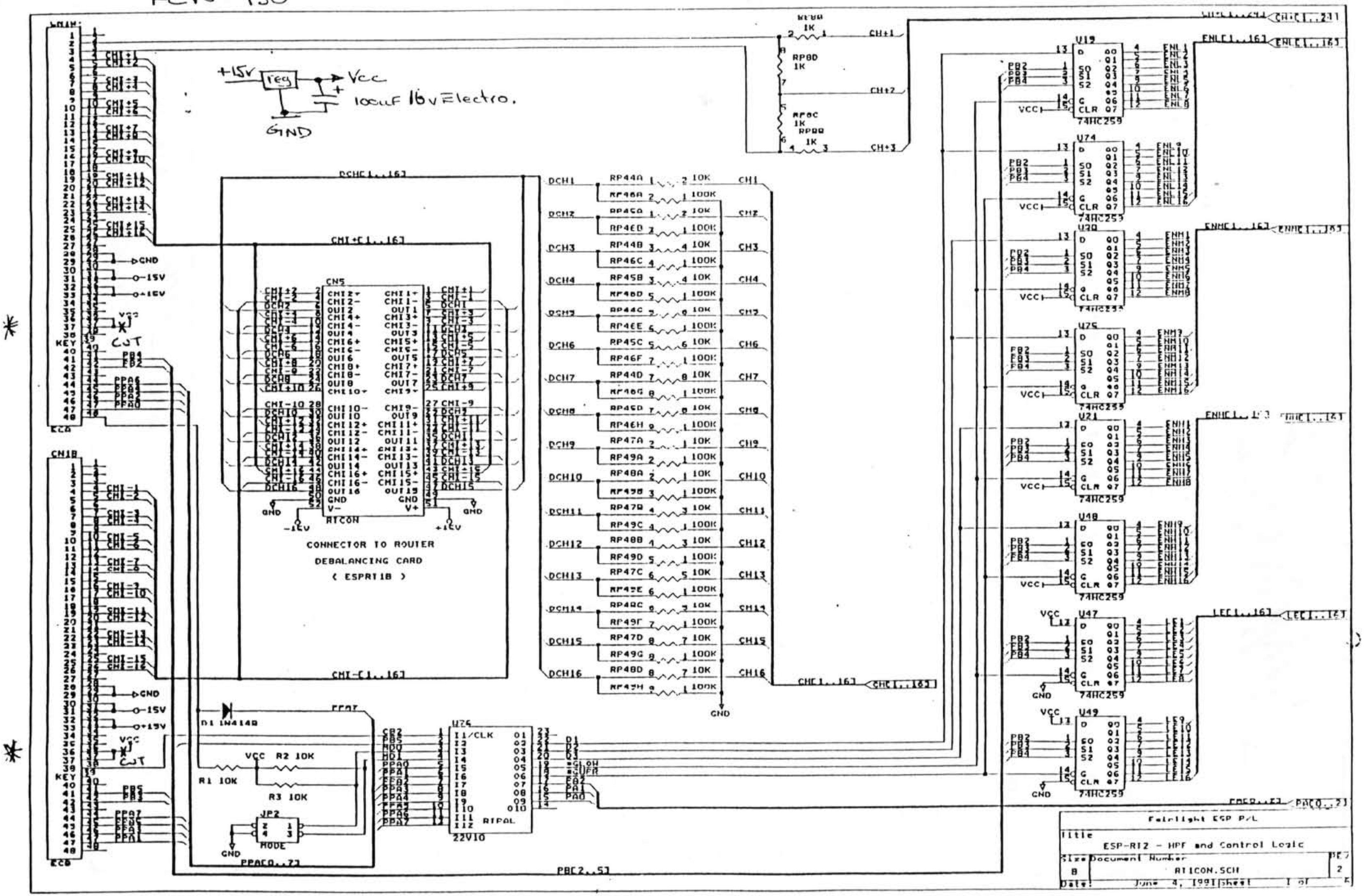
5. Add 100uF 16V capacitor from the 0V (GND) to the +5V output pin of the regulator.

6 Check all connections and track cuts before switching on.

7. Label the board Rev 2.3.

ORIGINATOR: [signature]	DATE: 23/6/93	TEST: [signature]	DATE: 23/6/93
		PROD: M. Perkins	DATE: 23/6/93
SERVICE:	DATE:	KIT LIST CHANGE:	(YES) NO

FCN-130



+15v reg Vcc
100uF 16v Electro.
GND
CONNECTOR TO ROUTER
DEBALANCING CARD
(ESPRT1B)
CN5
RTCON
22V10
RTPAL
74HC259
D1 1N4148
R1 10K
R2 10K
R3 10K
JP2 MODE
CUT
Fairlight ESP P/L
Title
ESP-RT2 - HPF and Control Logic
Size Document Number REV
B RTICON.SCH 2
Date: June 4, 1991 Sheet 1 of 5

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FIELD CHANGE NOTICE

DATE 18/ 2 /93
NUMBER 120

ORIGINATOR Shane Morris **PRODUCT: CMI / MFX**

ASSEMBLY No. ESP-RT1 **DESCRIPTION** ROUTER BOARD

This FCN applies to REV No: REV 2.1 **The New REV No is:** REV 2.2

REASON FOR CHANGE:

To eliminate D.C.. off set at the output of the de balancing amplifiers on the top router board (RT1B REV 2 pcb).

The D.C.. offset is heard as a click at the beginning of a clip i.e. when a channel is routed to a track output.

DETAILS OF CHANGE:

Earlier revisions of the router did have capacitors installed in the output.
These were 2 x 470nF in parallel. If this is the case remove 1 of the 470nF and replace with 4.7uF 25V non polarized capacitor.

Later revisions of the router had both the 470nF replaced with links. If this is the case remove both links and install 1 x 4.7uF 25V non polarized capacitor.

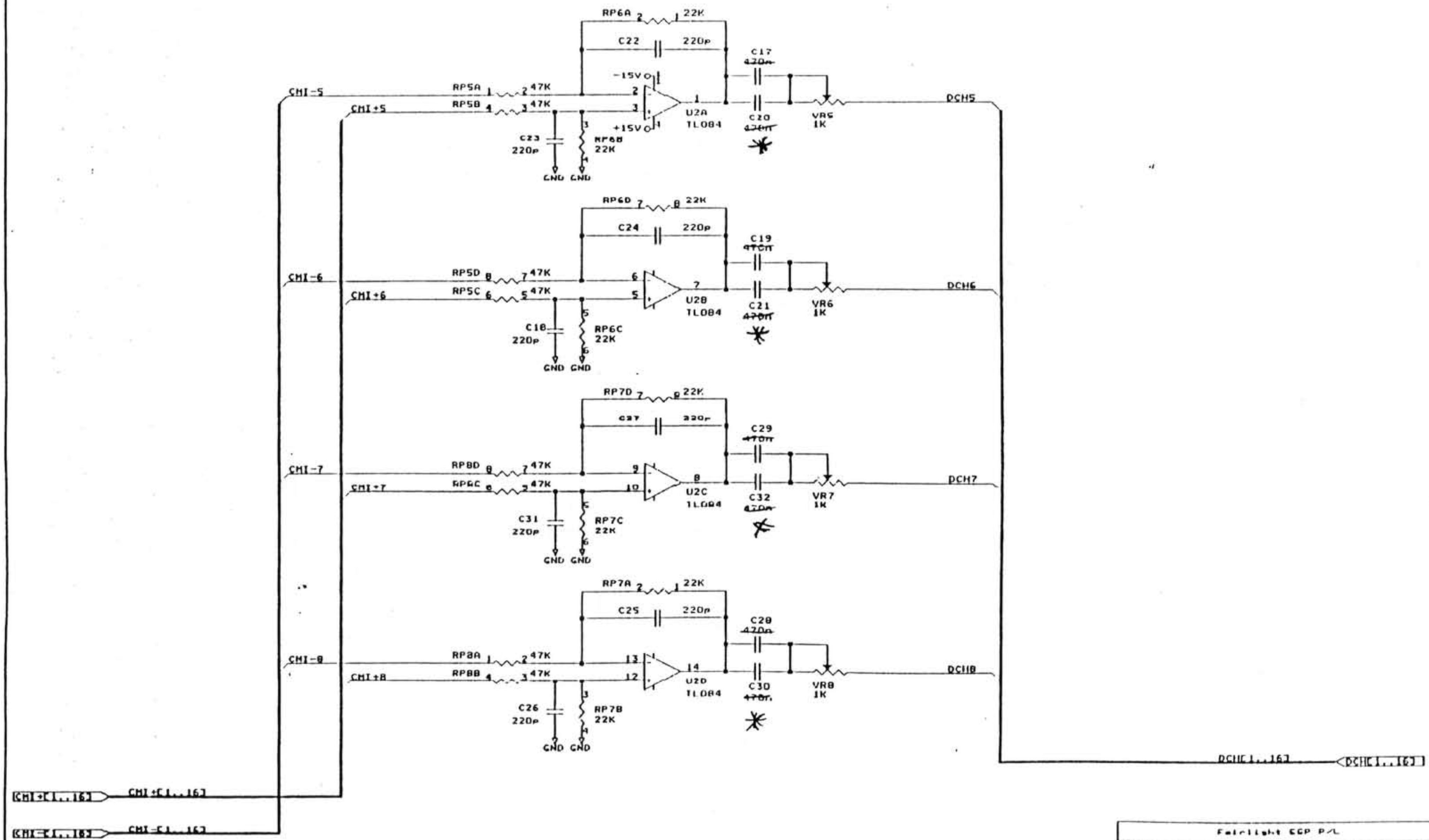
Make sure that the capacitors are not standing higher that the width of the module.

See circuit for the reference. Note capacitors are in parallel

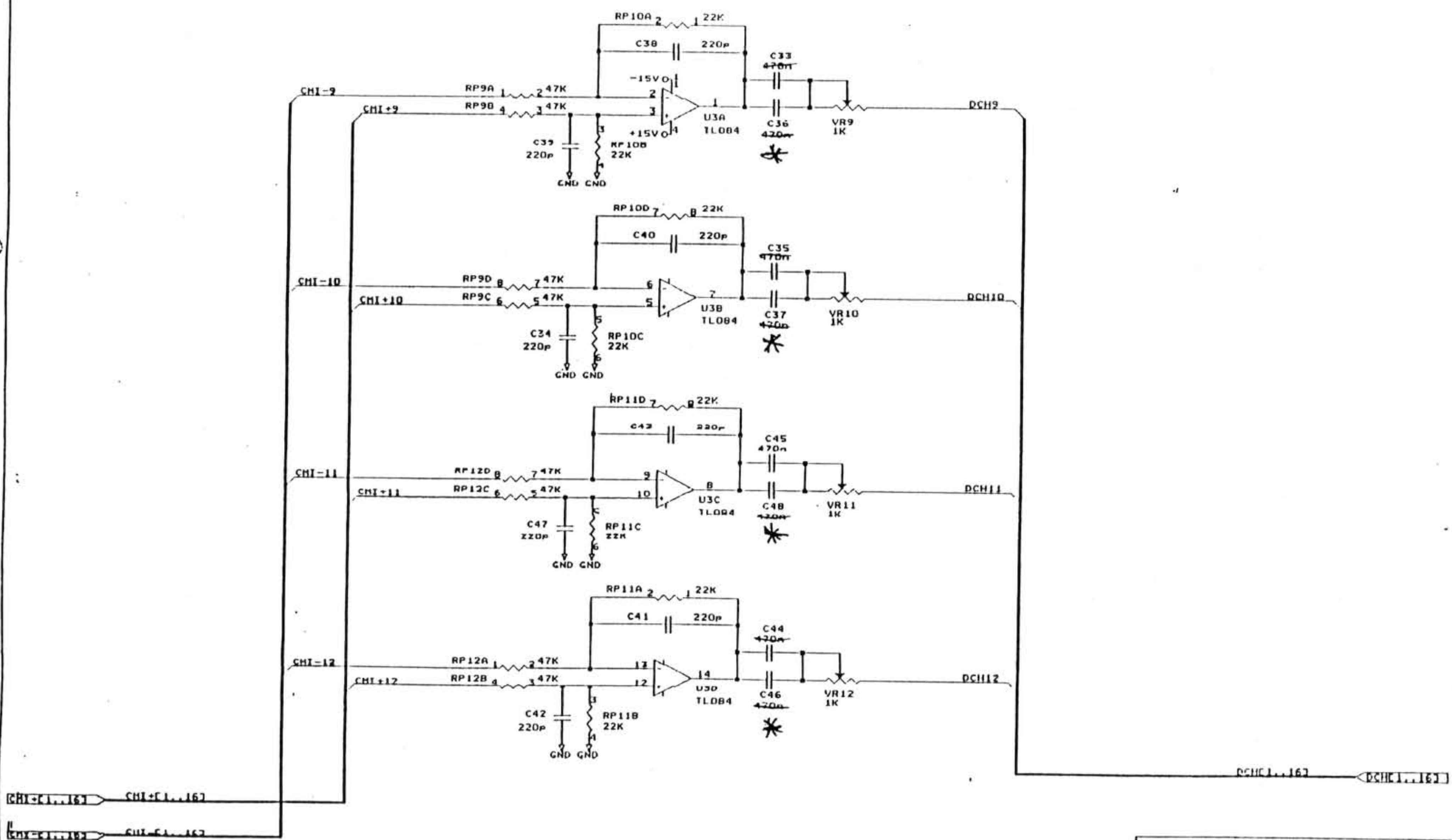
Capacitor / link locations are:
C1,3,4,5,12,13,14,16,17,19,20,21,28,29,30,32,33,35,36,37,44,45,46,48,49,51,52,53,60,61,62,64.

Label board REV 2.2

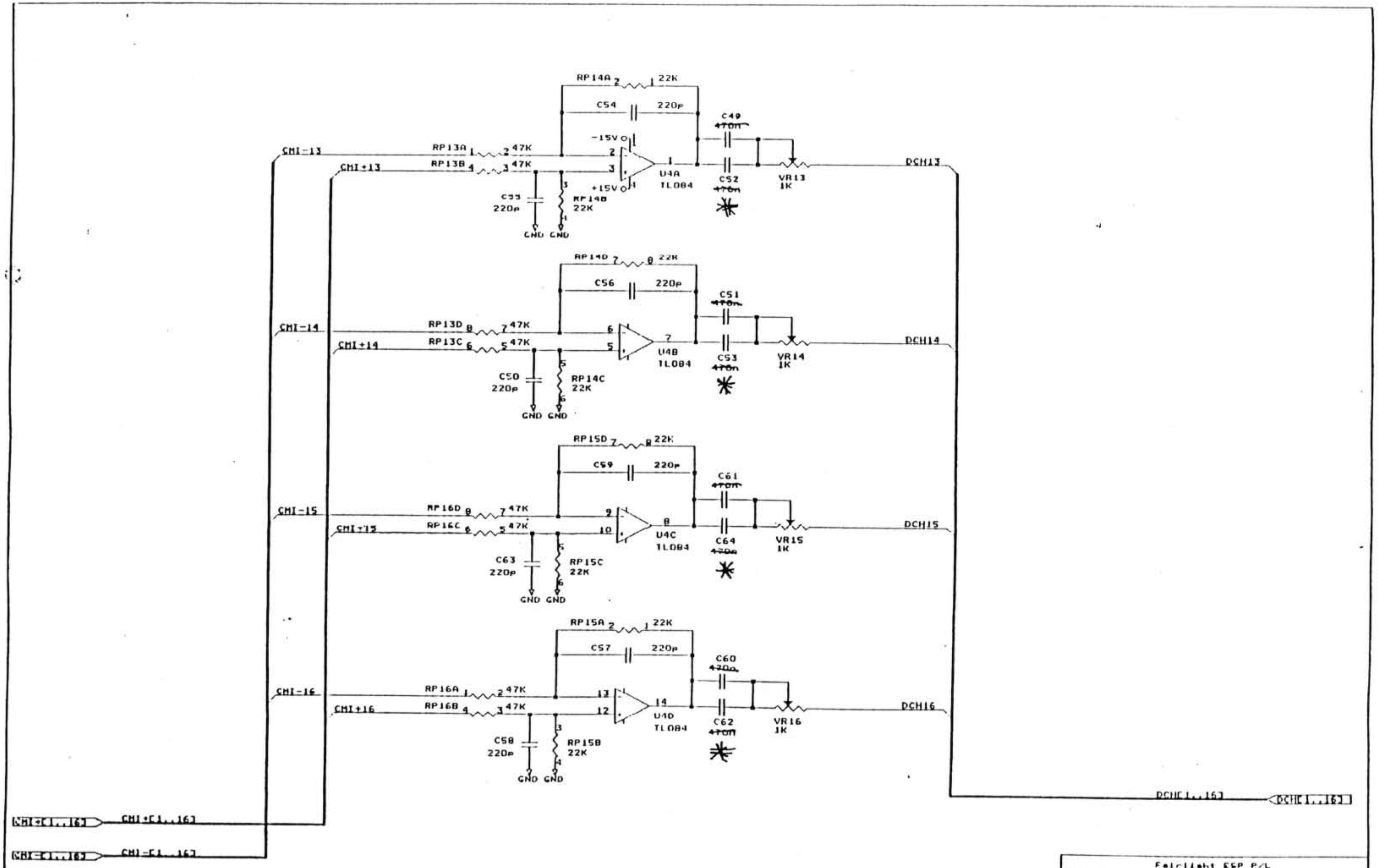
ORIGINATOR: Morris	DATE: 18/2/93	PROD: [signature]	DATE: 18/02/93
SERVICE:	DATE:	KIT LIST CHANGE:	(YES) NO



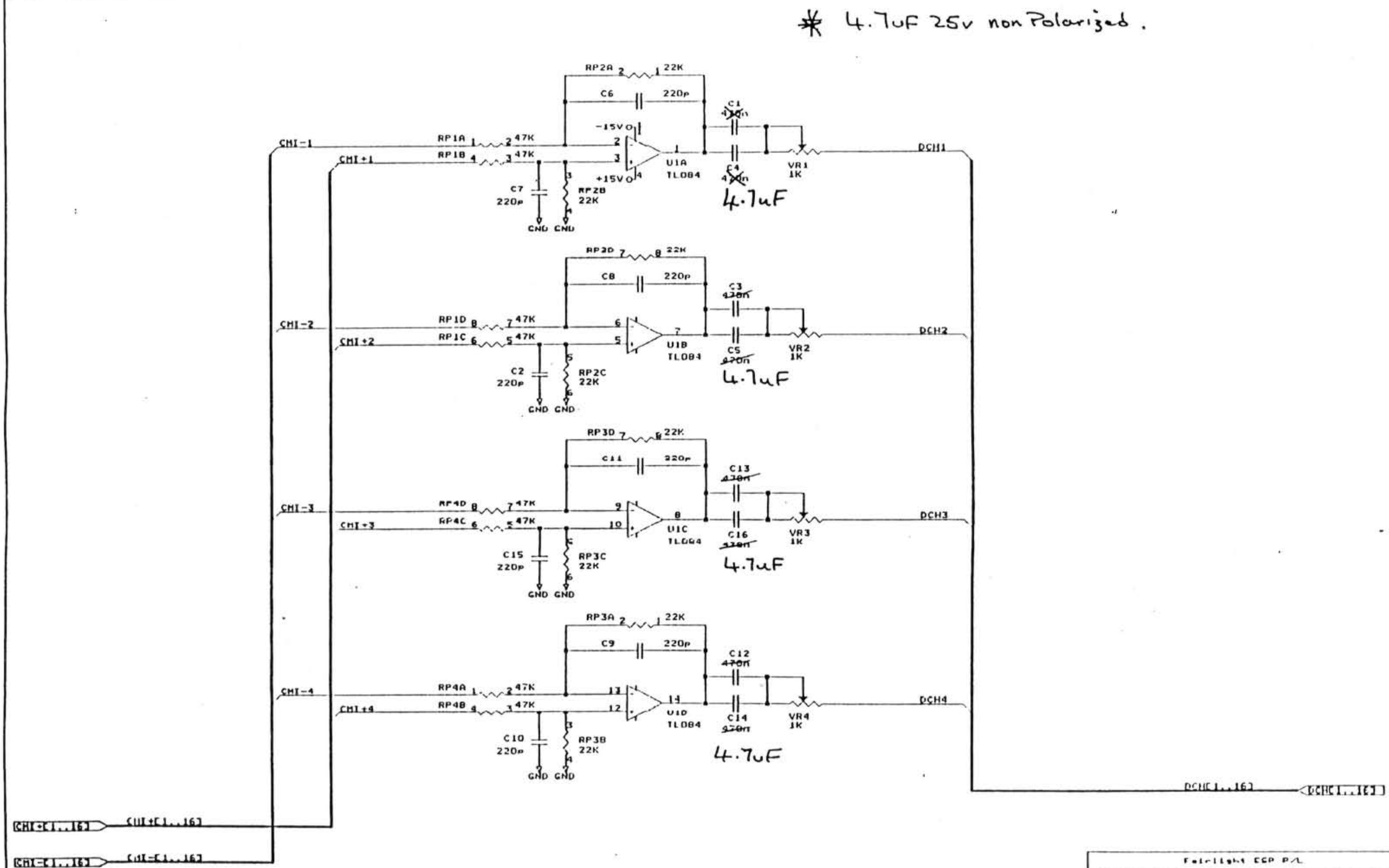
Fairlight ESP P/L		
Title: ESP-RT18 DIFFERENTIAL AMPLIFIERS		
Size: B	Document Number: ESPRT181.SCH	REV: 2
Date: June 17, 1991	Sheet 2 of 4	



Fairlight ESP P/L		
Title: ESP-RT1B DIFFERENTIAL AMPLIFIERS		
Size: B	Document Number: ESPRT1B1.SCH	REV: 2
Date: June 17, 1991	Sheet 3 of 4	



Fairlight ESP P/L		
Title: ESP-RT1B DIFFERENTIAL AMPLIFIERS		
Size: B	Document Number: ESPRT1B1.SCH	REV: 2
Date: June 17, 19	Sheet 4 of 4	



Fairlight ESP P/L	
Title: ESP-R11B DIFFERENTIAL AMPLIFIERS	
Size: B	Document Number: ESPRT1B1.SCH	REV: 2
Date: June 17, 1991	Sheet 1 of 4

fairlight

FIELD CHANGE NOTICE

DATE 21/ 12/ 92
NUMBER 115

ORIGINATOR Chris Alfred **PRODUCT: CMI / MFX**

ASSEMBLY No. ESP-RT1 **DESCRIPTION** ROUTER

This FCN applies to REV No: REV 2 **The New REV No is:** REV 2.1

REASON FOR CHANGE:
Removal of headphone mixing resistors.

NOTE: This applies only to NEW systems that have the headphone amplifier circuitry removed.
This modification removes crosstalk between outputs 1, 2, 3 in units with NO headphone amplifier.
This modification can also be done if crosstalk between outputs 1, 2, 3 has been noticed. This will remove signals form the headphone output.

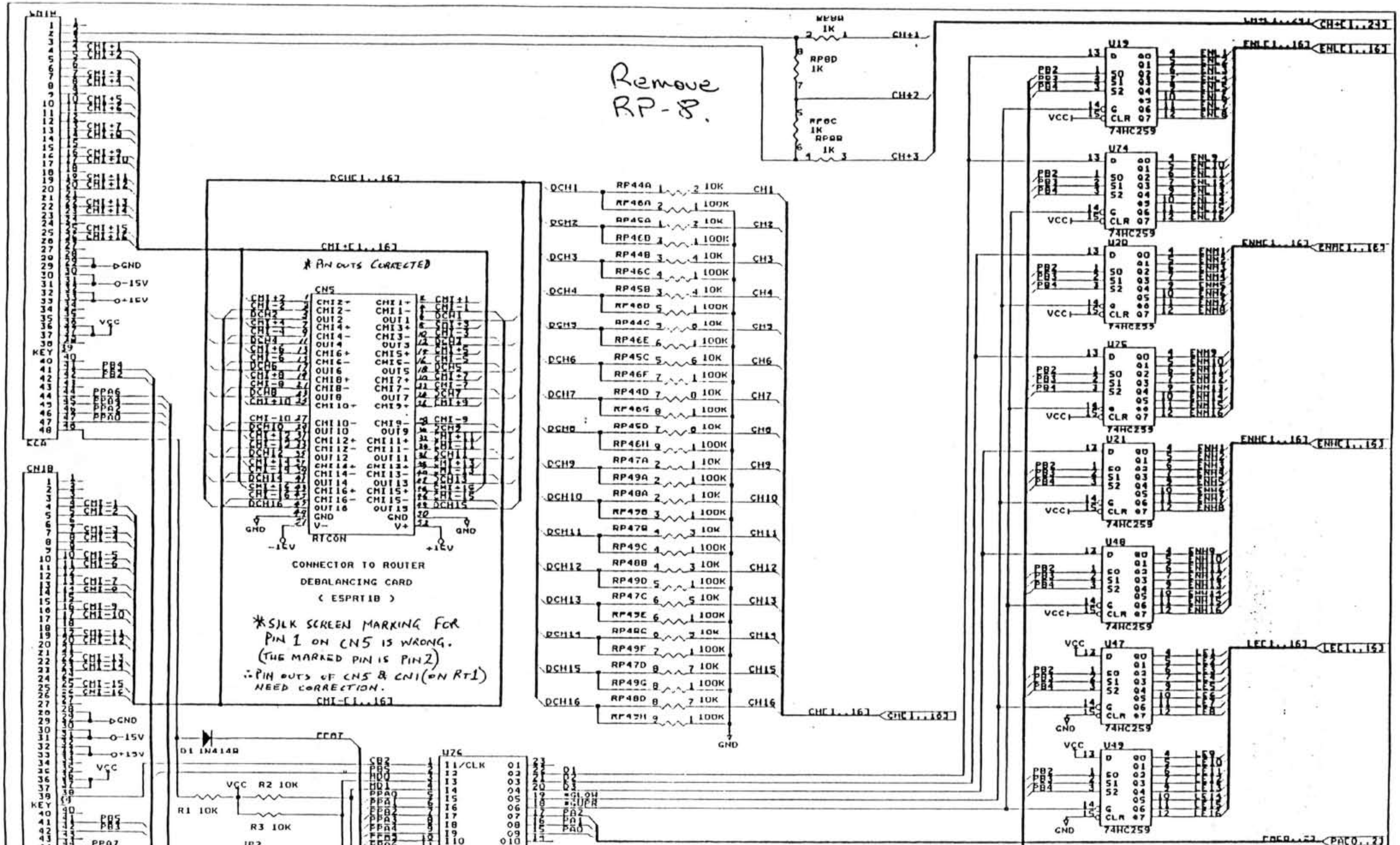
DETAILS OF CHANGE:

1. Remove resistor pack RP-8 (1K ohm)

2. Mark PCB as REV 2.1.

NOTE: Kit list change is removal of resistor pack.

ORIGINATOR: C Alfred	DATE: 22-12-92	PROD: 100 Hans Peeler	DATE: 22/12/92 22/12/92
SERVICE:	DATE:	KIT LIST CHANGE:	(YES) NO



Fairlight ESP P/L		
Title: ESP-RT2 - HPF and Control Logic		
Size: B	Document Number: RT1CON.SCH	REV: 2
Date: June 4, 1991	Sheet 1 of 6	

Fairlight ESP

FIELD CHANGE NOTICE

Field Change Notice No	62

PRODUCT CMI [X] CVI [ ]

ORIGINATOR: Chris Alfred **DATE:** 27 / 11 / 90

ASSEMBLY No: RT1B

DESCRIPTION: ROUTER Balancing board (The top PCB)

This FCN applies to rev No: 1.1A **The New rev No is:** 1.2A

REASONS FOR CHANGE:

To correct an artwork error which causes a +6 db gain on CMI channel 6

Please Note: This FCN only applies to Routers that have the plug-in Balancing board. Earlier revision Routers that have the top and bottom boards joined via mod wires do NOT require this modification.

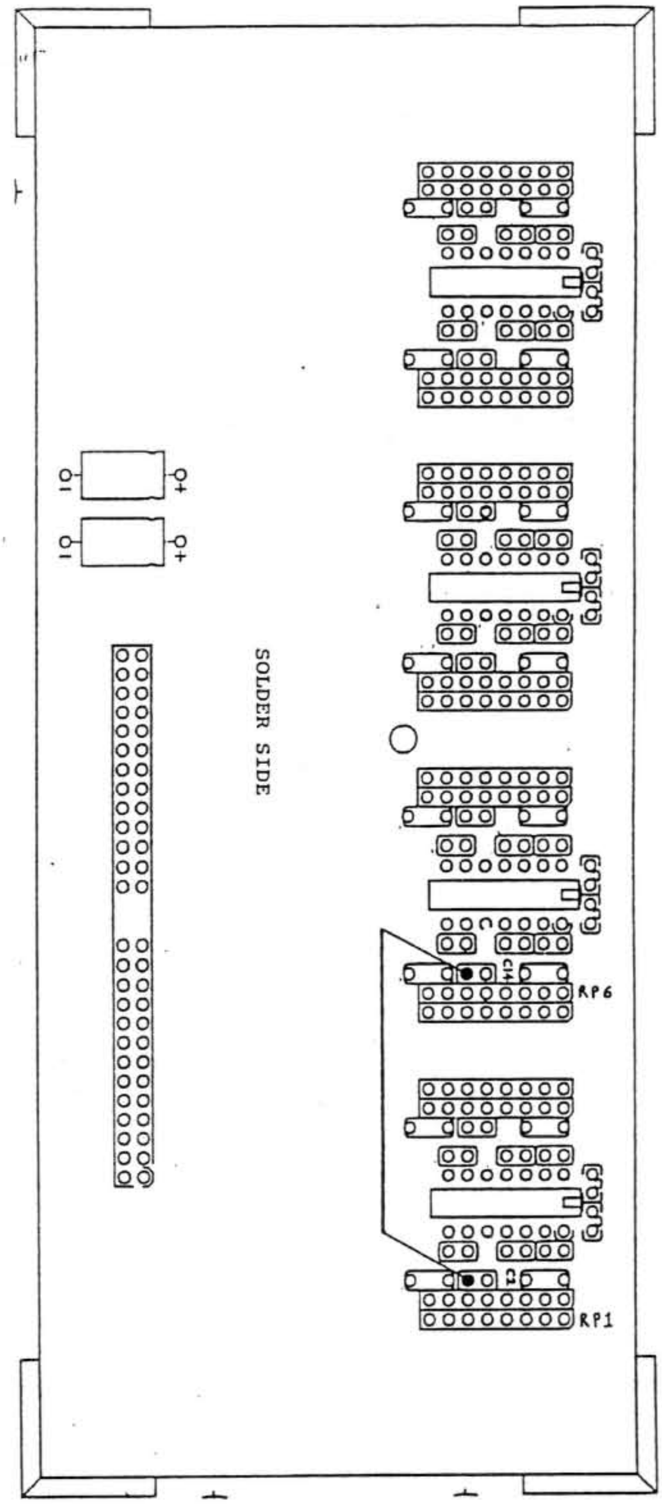
DETAILS OF CHANGE:

On the solder side, connect resistor pac RP2 pin 6 to RP6 pin 6

(This is best done on nearby capacitors C2 and C14 as shown on the overlay)

DEPT	SIGNATURE	DATE	COMMENTS
Project Manager	C L Alfred	27/11/90	
Customer Service	Mario Paolino		

FCN 62



1. Terminology

Router	ESP-RT1 or ESP-RT2 router	
AM	CMI331	Audio Module
AMM	CMI334	Audio Mixer Module
AMB	CMI335	Audio Mother Board

Active low signals are prefixed by '*'.

2. Router Overview

Revision 8 and higher software allows the CMI to dynamically select Channel Cards to play voices and/or Disk Recorder tracks. This allows the CMI to not limit one voice to each Channel Card; but rather only limit the number of simultaneous voices playable.

Dynamic allocation cannot guarantee that a particular audio voice will be assigned to a specific audio output on the Audio Modules. By dynamically routing the CMI channels, the voices can be re-ordered for direct connection to a mixing desk. A CMI channel cannot be routed to multiple router outputs.

Routers are installed in the AMB slots used for the Audio Mixer Modules. The router may be placed in either AMM slot (and a second router may be placed in the other slot).

The ESP-RT2 is an updated version of the ESP-RT1 which allows re-mapping of the router outputs, and disconnection of CMI ground to the outputs - otherwise, they are functionally equivalent.

3. Router Schematics

RTCON.SCH	digital control of the router
RTMUX1.SCH RTMUX2.SCH	router output matrix
RTMIX.SCH	router output channel mixing
RTOUT1.SCH RTOUT2.SCH	router output balancing

4. The Router Matrix
(see schematics RTCON.SCH,RTMUX1.SCH,RTMUX2.SCH)

CMI audio outputs are sent as balanced signals to the input de-balancing card ESP-RT1B through CN5; and return single-ended and AC coupled (DCH1..16) to the router. 10K series resistors set the input impedence of CH1..16 to the router matrix.

Central to the operation of the router is a 16 (number of CMI channels CH1..16) by 24 (number of router outputs MIX1..24) audio switchpoint matrix implemented in 48 x 74HC4351s. For each CMI channel there are 3 x 74HC4351s connected as a 1-of-24 selectable switch. To store a new router output, the latch enable (LEx) is strobed high latching the low order output selects (PA0..2) into the 74HC4351s. As the 74HC4351 is a 1-of-8 demultiplexor, there are three mutually exclusive enables (ENLx,ENMx,ENHx where is the CMI channel) used to enable one of three 74HC4351s.

Each CMI channel will appear at only one of the 24 mix busses (MIX 1..24). The mix busses are all virtual earth so the 74HC4351s may be operated in current mode to reduce DC offsets.

5. Router Control
(see schematic RT1CON.SCH)

Control signals for the router originate at the expansion PIA (E9,10,11) on the Q133 CPU Control Card (also called the 'Debug' card). PIA output ports arrive at the router edge connector as PPA0..7 and PB2..5.

To route a CMI channel to a router output, the software configures the PIA to be a simple output port on port A, and port B as an output port with CB2 strobe on writes to the port. The desired router output is written to port A (0 - router output 1 .. $17 - router output 24), then the CMI channel to be routed is written to port B bits 2..5 (0 - CMI channel 1 .. $3C - CMI channel 16). The write to port B strobes CB2 which is used to latch the two port values into the router.

PPA7 is connected through a diode (D1 1N4148) to the PIA CA1 input. Writting to port A with bit 7 (PPA7) clear will set CA1 low. This is used to detect whether the router is installed.

When a CMI channel is routed, one of D1..3 will be asserted indicating which one of the 3 74HC4351s for the channel will need to be enabled. The state of D1..3 is latched into U19,U20,U21 (for CMI channels 1-8) or U74,U75,U48 (for CMI channels 9-16, note that U48 is U76 on ESP-RT1) - configured as selectable latches gated by the *GLOW or *GUPR strobe. *GLOW (CMI channel 1-8 strobe) and *GUPR (CMI channel 9-16 strobe) are generated by gating PB5 with the CB2 strobe in U48 (74HC00) on ESP-RT1; or RTPAL (U76) on ESP-RT2.

The latch strobe for the 74HC4351s (LEx) is generated by the active high 1-of-16 decoder formaed by U47 (74HC259) and U49 (74HC259) gated by *GLOW and *GUPR respectively.

6. Mix Buss Summing
(see schematic RTMIX.SCH)

Each of the 24 mix buss signals are summmed by low noise TL084 JFET op-amps to produce the 24 unbalanced router outputs SUM1..24. The input impedences for the op-amps are set by RN44,45,47,48 (all 10K on schematic RTCON.SCH), and the feedback resistors are RP4,12,19,16,33,40 (all 3K3). The feedback resistors are placed in sockets so that the gain of the router may be adjusted.

7. Output Balancing
(see schematics RTOUT1.SCH RTOUT2.SCH)

Pairs of LM837 bi-polar opamps are used to generated inverted (CH-1..16) and non-inverted (CH+1..16) replicas of the single-ended SUM1..24 signals. To protect agains shorting of the router outputs to ground, 100R series resistors are placed at the op-amp outputs. Note that the ESP-RT1 and ESP-RT2 are NOT DESIGNED TO HAVE PHANTOM POWER CONNECTED to them.

JP1 on ESP-RT2 is used to select whether the CMI ground appears on the router balanced output connectors. ESP-RT1 always has the CMI ground connected.

8. Headphone Mix
(see schematic RTCON.SCH)

RP1 (1k) is used to sum signals CH+1,CH+2 and CH+3 to the headphone amplifier (on the CMI310 power-supply). The headphone output will have CH1 on the left, CH2 in the centre, and CH3 on the right.

9. RTPAL mapping on ESP-RT2

(see schematic RTCON.SCH)

By re-mapping the router output selected by PPA0..7, RTPAL is capable of re-ordering the outputs of the router. There are 4 mapping modes enabled by JP2.

MODE 0	pins 1,2 open pins 3,4 open	Normal 24 channel router
MODE 1	pins 1,2 shorted pins 3,4 open	Low 12 channels of dual router system
MODE 2	pins 1,2 open pins 3,4 shorted	High 12 channels of dual router system
MODE 3	pins 1,2 shorted pins 3,4 shorted	Re-ordered output 24 channel router

(JP2 pins 1 and 2 are closest to the edge connector key)

By experiment, it has been found that the noise level on odd numbered switches in the 74HC4351 are substantially lower than the even numbered switches. Modes 1..3 have been added to take advantage of this phenomenon.

Mode	Output order
0	1 .. 24
1	1,3,5,7,9,11,13,15,17,19,21,23 for the low 12 outputs
2	1,3,5,7,9,11,13,15,17,19,21,23 for the high 12 outputs
3	1,3,5,7,9,11,13,15,17,19,21,23 2,4,6,8,10,12,14,16,18,20,22,24

When modes 1 and 2 are used, a CMI channel which is to be routed to the other card is sent to router output 2. This is required as the virtual earth mixing system used by the router cannot have floating outputs to the mix buss as they become voltage mode introducing noise.

1. Terminology

ESP-RT1	16 to 24 channel router
ESP-RT2	16 to 24 channel router with output mapping
ESP-RT1B	debalancing card (or debalancer)

2. Overview

The ESP-RT1 and ESP-RT2 router cards route single-ended signals. To reduce the common-mode noise, the CMI audio channels are differentially buffered by the ESP-RT1B before returning to the router.

3. Hardware Description

CN5 on ESP-RT1/2 is connected to CN1 on ESP-RT1B and supplies the balanced CMI audio data to the de-balancing card. Once the signals have been differentially buffered, CN1 returns the single-ended signals for routing.

The debalancer card consists of 16 identical differential amplifiers - on for each CMI channel. A TL084 op-amp for each channel takes the difference of the CMI channel inputs (CMI-1..16 and CMI+16) to generate DCH1..16.

On the output of each amplifier, there is a variable resistor used to trim the level sent to the ESP-RT1/2 router card. Level trimming compensates for variations in output level from the Audio Modules. Once an Audio Module is aligned, only these trimmer resistors need be adjusted to align the output levels.

1. Checking Router Operation

1. Run the AUDIOCAL Router Test - all 16 CMI channels will play full amplitude 1kHz sinewaves routed to outputs 1 to 16 respectively.

2. Check power supplies at the following locations:

Ground	C65-,C66+
+15V	C65+
-15V	C66-
+5V	RTPAL/24

3. On the ESP-RT1B daughter board:

   Check there are clean sinewaves of approximately equal amplitude at the output of each differential amplifier.

4. On the ESP-RT1/2 router board:

   Check that there are clean sinewave at signals SUM1..16
   Check that there is a clean sinewave at CH+1..16.
   Check that ther is a clean inverted sinewave at CH-1..16
   Check that there is no signal at SUM17..24.
   Check there is no signal at CH+17..24 and CH-17..24

5. Press > to route each CMI channels to the next output
   (i.e. CMI channel 1 now goes to output 2, output 1 is silent and CMI channel 16 goed to output 17).

   Repeat steps 4 and 5 until CMI channel is routed back to output 1
   (i.e. 24 iterations).

2. Debugging

1. Faulty ESP-RT1B debanacler

   - wrong gain
     - feedback resistor wrong value
     - input to opamp open-circuit
   - half-amplitude output
     - one side of the balanced CMI channel open circuit to opamp
     - input to opamp shorted
   - no output
     - incorrect capacitor value
     - feedback resistor open-circuit

2. Routing matrix faulty (RTCON.SCH)

   [a single CMI channel can be routed by pressing <SET> to enter the parameter setting functions of AUDIOCAL and typing:
   m <x> <y> M X Y ⏎
   where <x> is the CMI channel to route, <y> is the output to route it to
   ...when finished To return to the AUDIOCAL test, type g<RETURN>]

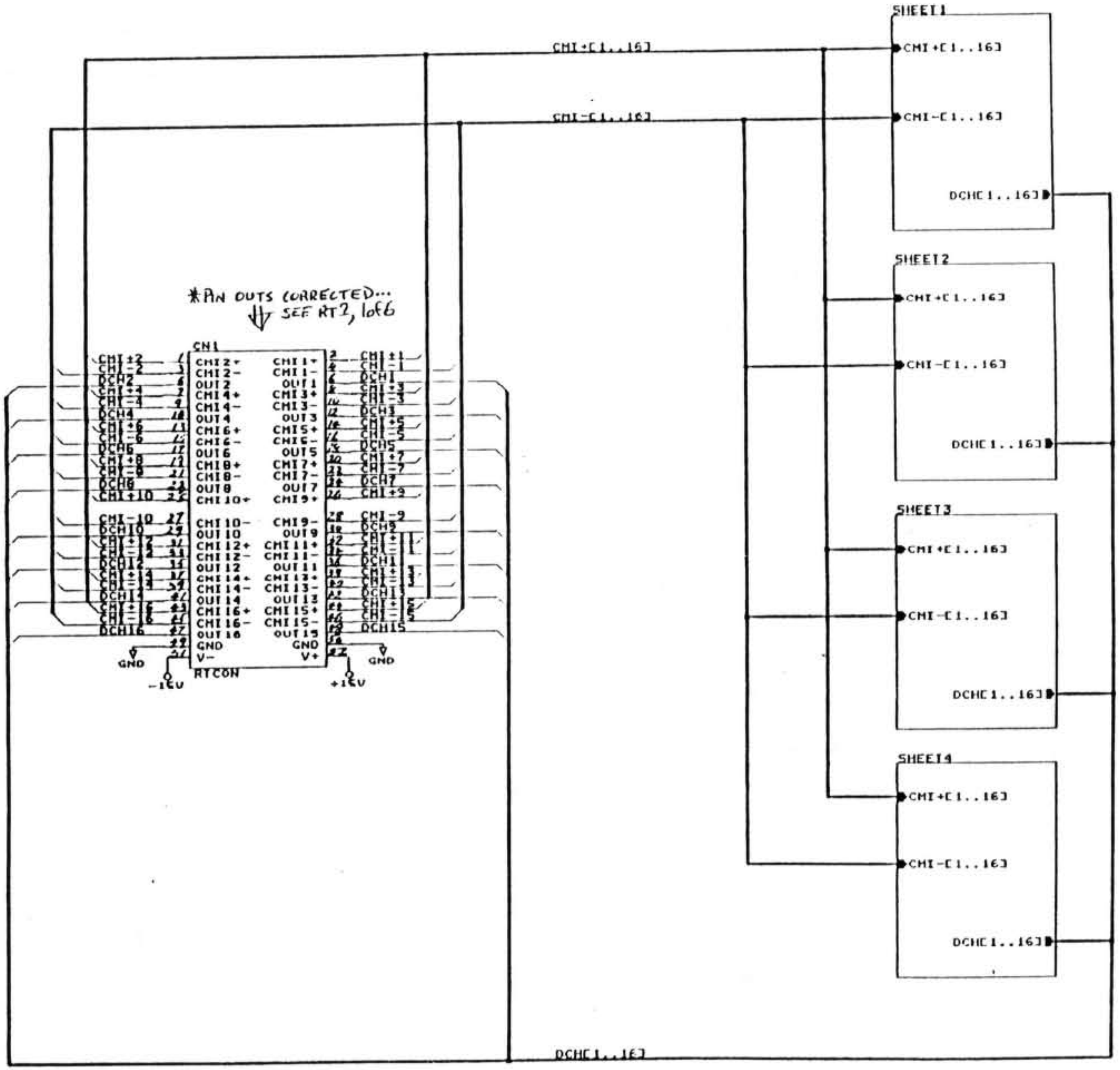
- distorted outputs
  - reset router (press .) if router powered-down and CMI was not powered-down
- routing confined to certain outputs
  - PPA0..7 to RTPAL incorrect
  - RTPAL faulty
  - PA0..2 lines faulty
- routing only working on some CMI channels
  - PPB2..5 lines faulty
  - 74HC259 not producing LEx strobe
  - RTPAL outputs faulty

3. SUM buss faults (RTMIX.SCH)

- level too high
  - feedback resistors incorrect
  - input to opamp open circuit
- no signal
  - check input resistors RP44..49
  - faulty 74HC4351
  - 74HC259 not generating LEx strobe
  - 74HC259 not generating ENLx,ENMx,ENHx enable

4. Balanced output faults (RTOUT1.SCH RTOUT2.SCH)

- level too high
  - feedback resistors incorrect
  - input to opamp open-circuit
- one side of balanced output zero
  - check input to both opamps
  - feedback resistor open-circuit
- noisy output
  - replace LM837



NOTES ON ESP-RT1B CARD

(1) +15V AND -15V TO BE DECOUPLED VIA 25uF ELECTROLYTICS

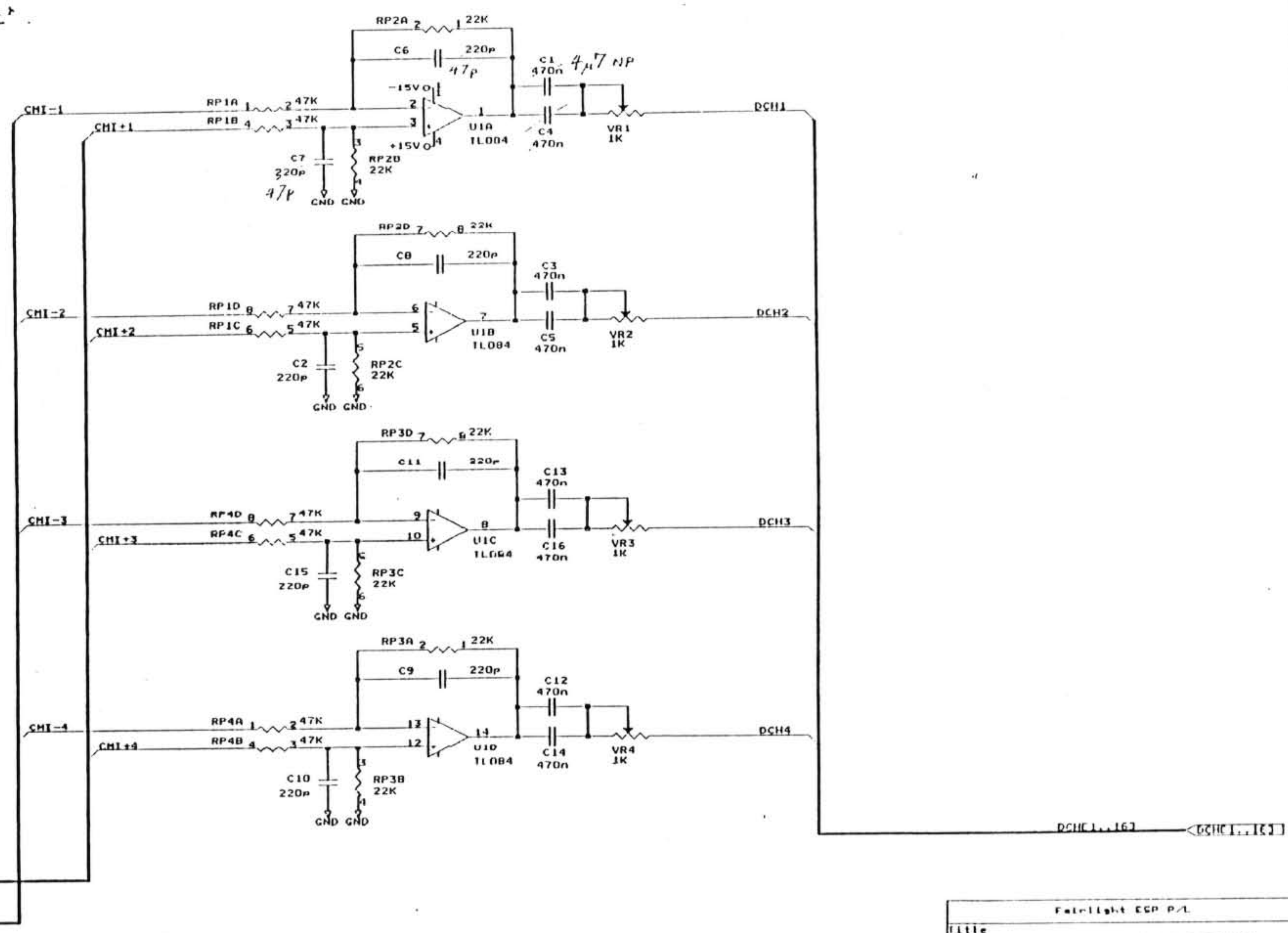
(2) EVERY TL084 MUST HAVE 0.1uF MONO CERAMIC DECOUPLING AT THE CHIPS

(3) ALL UNUSED REGIONS OF THE BOARD TO BE GROUND PLANE

Fairlight ESP P/L		
Title: ESP-RT1B DEBALANCER CARD		
Size: B	Document Number: ESP-RT1B	REV: 2
Date: June 17, 19[illegible]	Sheet	of

* CHANGE TO
CAP. VALUES ...

- DISTORTION...
47K R. PACKS
MADE IN 8909
ARE DUDS!
ALSO SOME 9232's



Fairlight ESP P/L		
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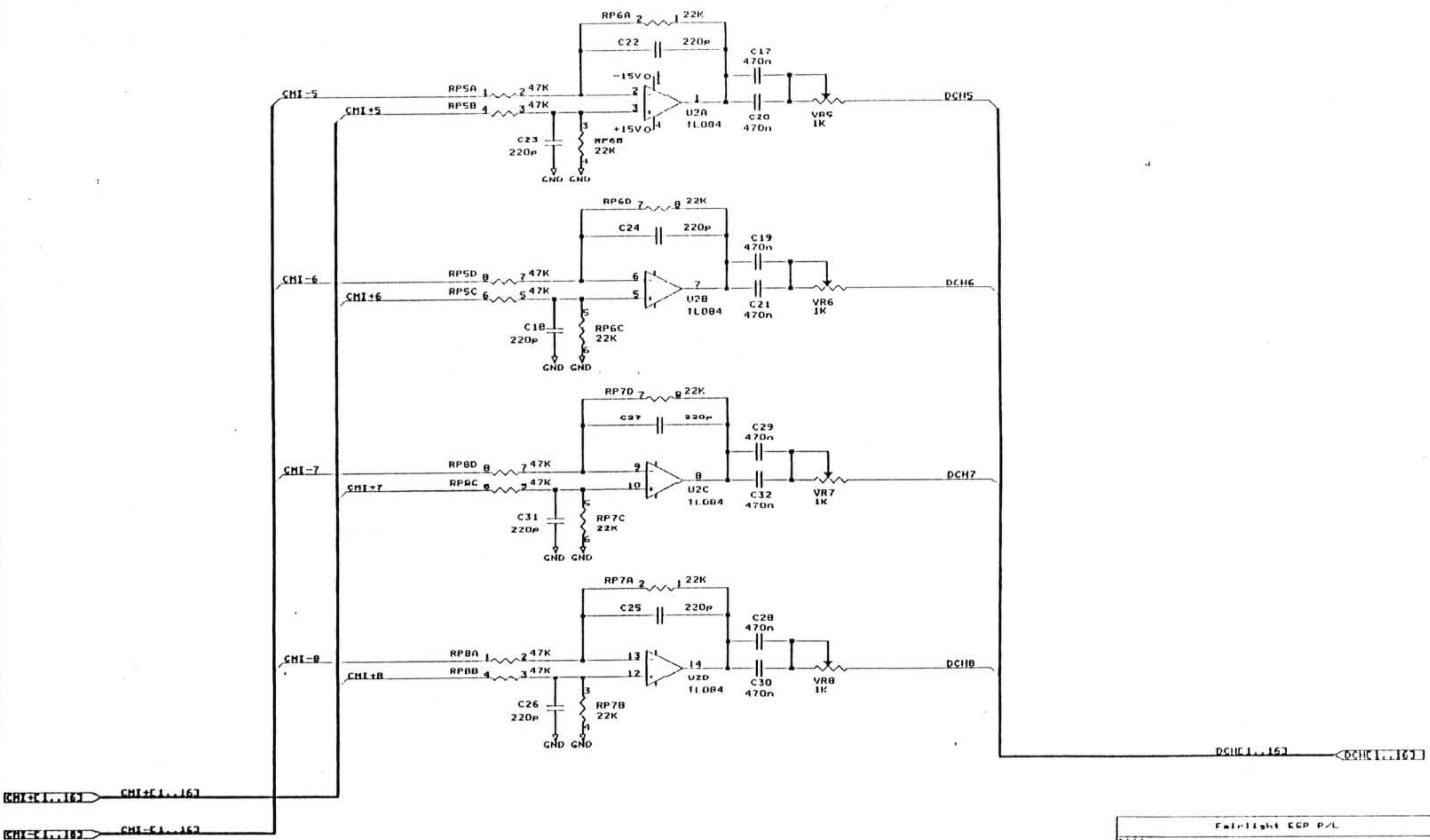
Size B	Document Number ESPRI1B1.SCH	REV 2
Date: June 17, 1991	Sheet 1 of 4	



Fairlight ESP P/L	
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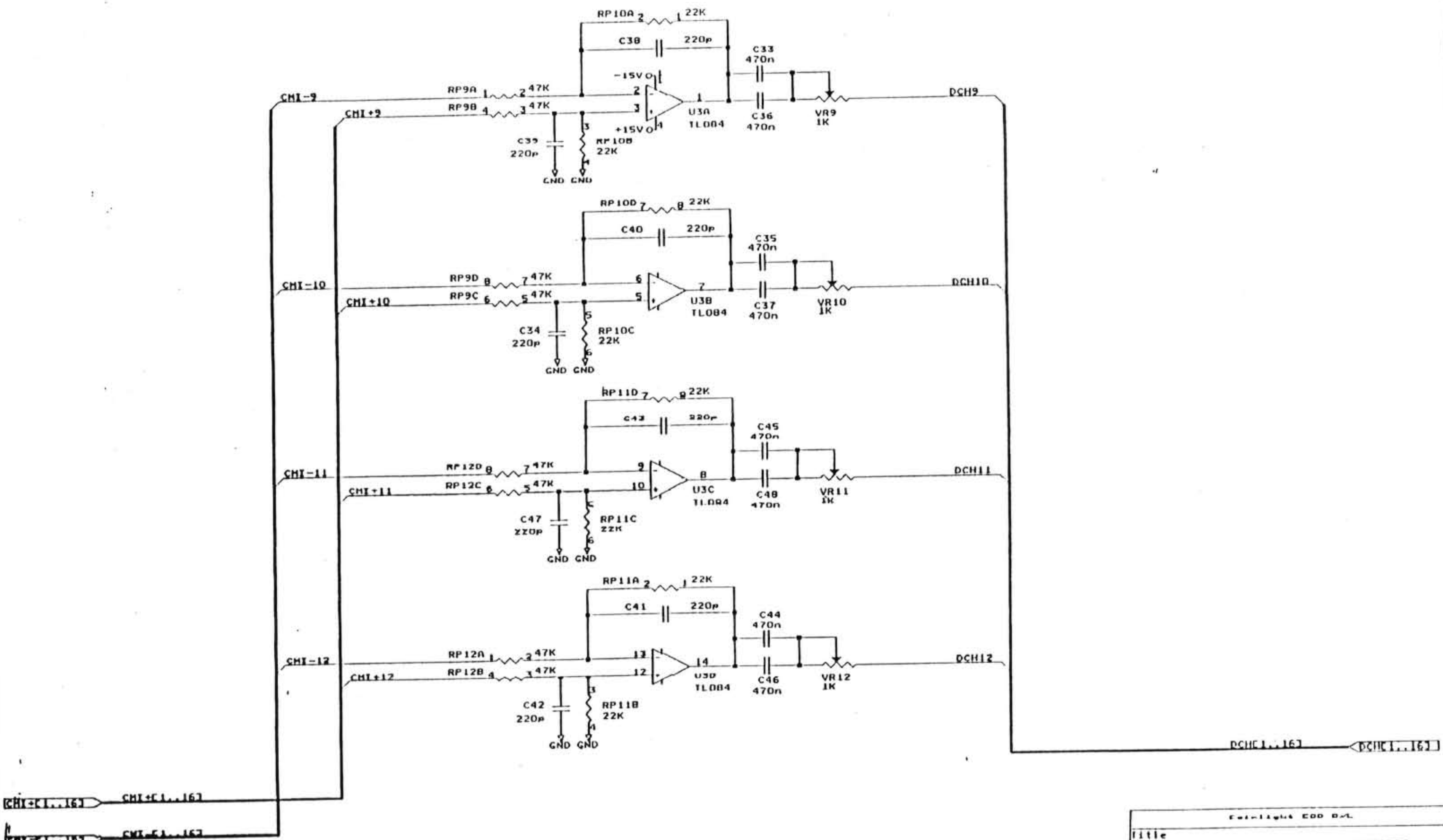
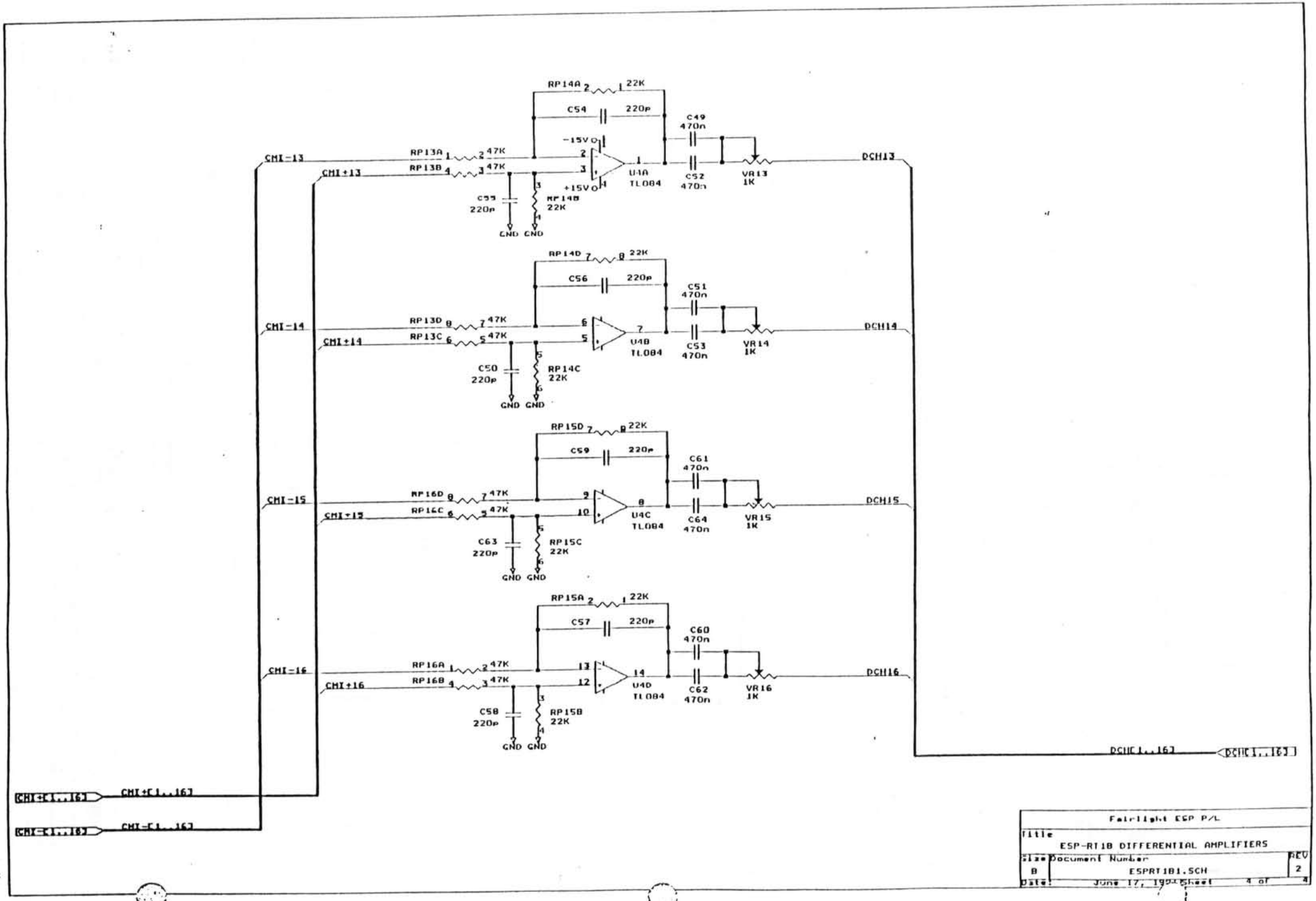
Size: B — Document Number: ESPRT1B1.SCH	REV: 2
Date: June 17, 1991	Sheet 2 of 4

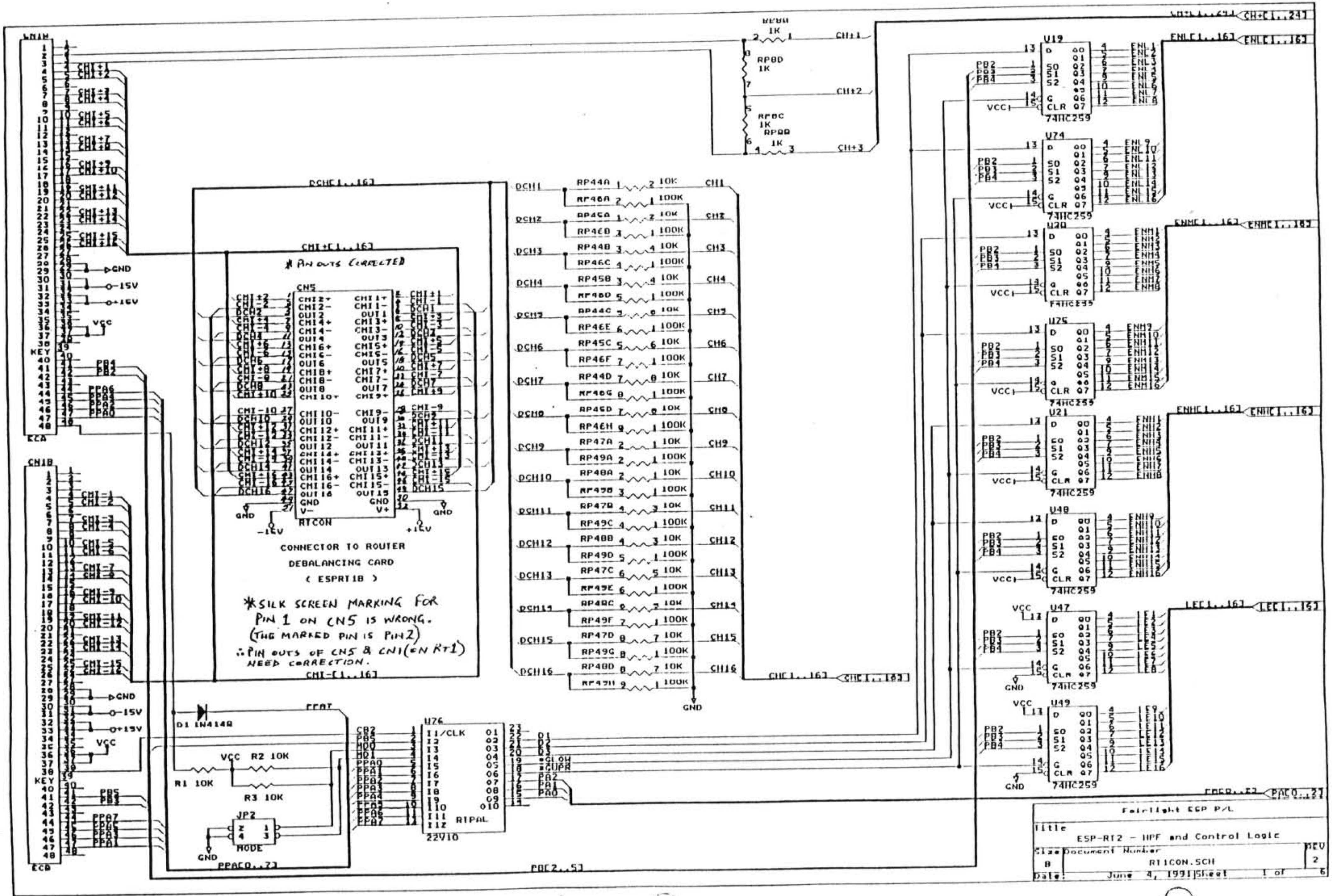


Fairlight ESP P/L

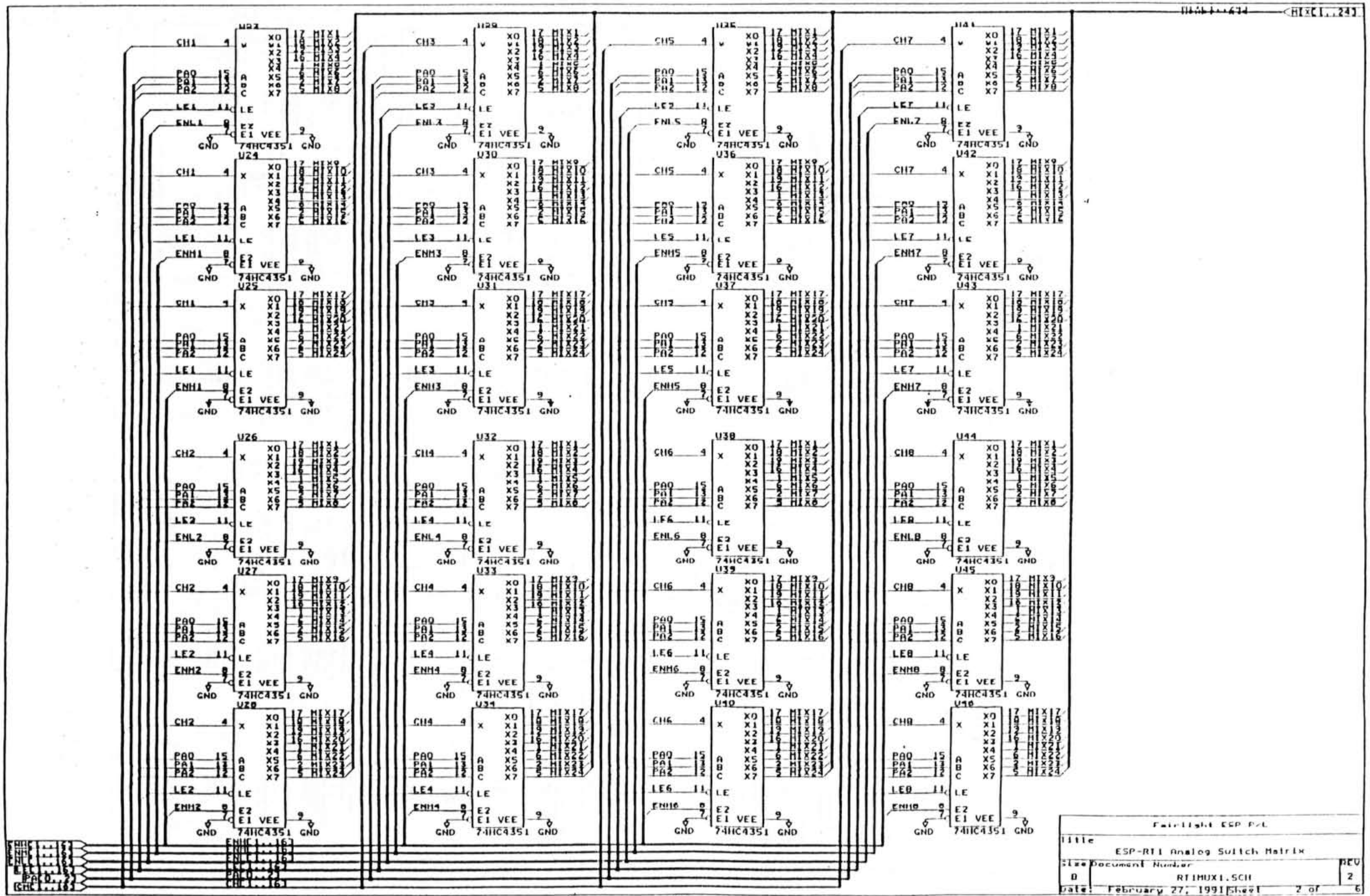
Title	ESP-RT18 DIFFERENTIAL AMPLIFIERS	
Size	Document Number	REV
B	ESPRT181.SCH	2
Date: June 17, 1991	Sheet 3 of 4	



RP14A 2 1 22K
C54 220p
C49 470n
-15V
+15V
RP13A 1 2 47K
RP13B 4 3 47K
CMI-13
CMI+13
U4A TL084
C52 470n
VR13 1K
DCH13
C55 220p
RP14B 22K
GND GND
RP14D 7 8 22K
C56 220p
C51 470n
RP13D 8 7 47K
RP13C 6 5 47K
CMI-14
CMI+14
U4B TL084
C53 470n
VR14 1K
DCH14
C50 220p
RP14C 22K
GND GND
RP15D 7 8 22K
C59 220p
C61 470n
RP16D 8 7 47K
RP16C 6 5 47K
CMI-15
CMI+15
U4C TL084
C64 470n
VR15 1K
DCH15
C63 220p
RP15C 22K
GND GND
RP15A 2 1 22K
C57 220p
C60 470n
RP16A 1 2 47K
RP16B 4 3 47K
CMI-16
CMI+16
U4D TL084
C62 470n
VR16 1K
DCH16
C58 220p
RP15B 22K
GND GND
DCH[1..16]
CMI+[1..16]
CMI-[1..16]
Fairlight ESP P/L
Title
ESP-RT1B DIFFERENTIAL AMPLIFIERS
Size B
Document Number ESPRT1B1.SCH
REV 2
Date: June 17,
Sheet 4 of 4



Fairlight ESP P/L
Title ESP-RT2 - HPF and Control Logic
Size B
Document Number RT1CON.SCH
REV 2
Date: June 4, 1991 Sheet 1 of 6
* Pin outs Corrected
CONNECTOR TO ROUTER DEBALANCING CARD (ESPRT1B)
*SILK SCREEN MARKING FOR PIN 1 ON CN5 IS WRONG. (THE MARKED PIN IS PIN2)
∴PIN OUTS OF CN5 & CN1(ON RT1) NEED CORRECTION.
CN5
RTCON
U76
RTPAL
22V10
74HC259
JP2
MODE
D1 1N4148
R1 10K
R2 10K
R3 10K

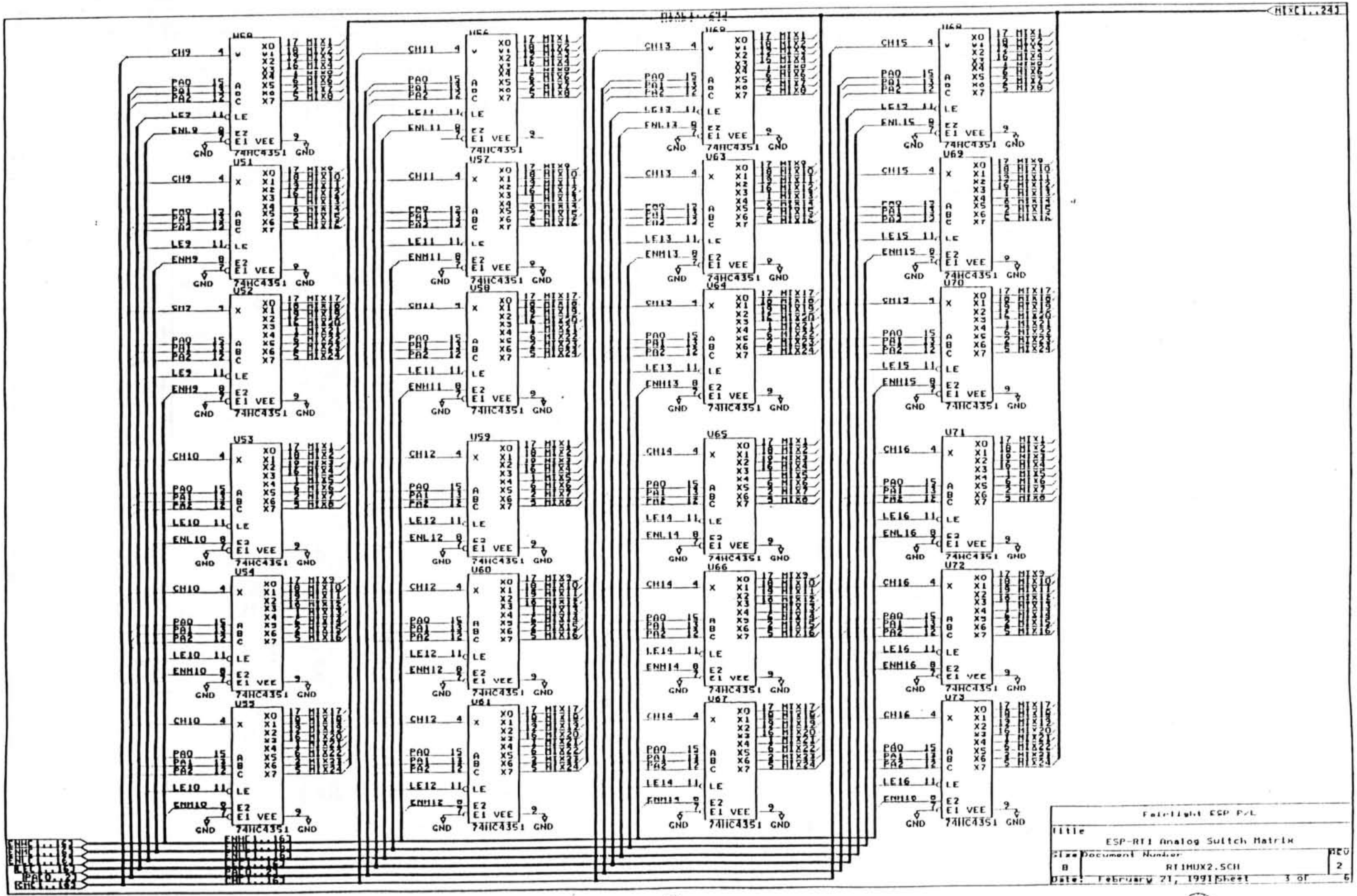


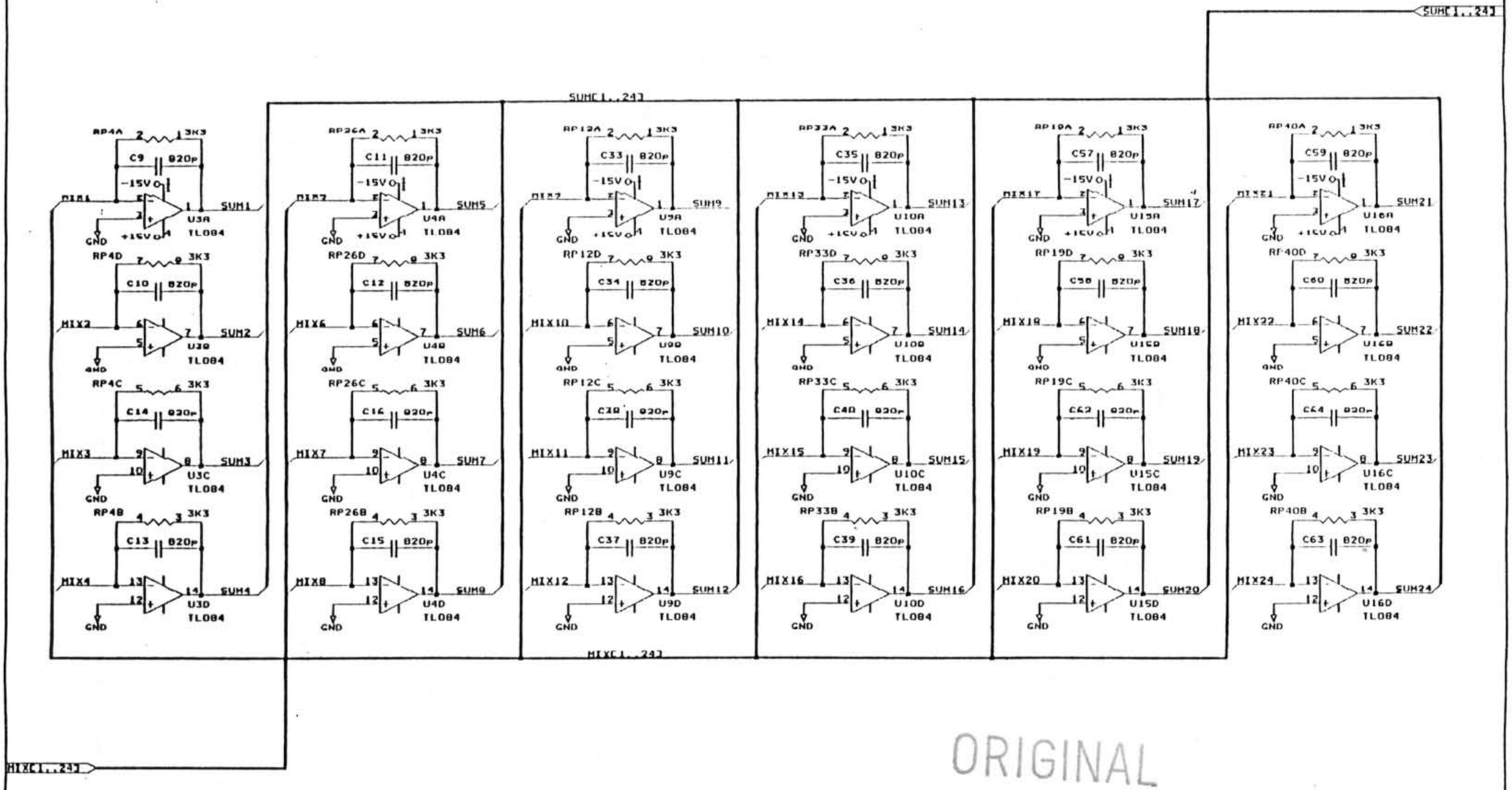
Fairlight ESP P/L

Title: ESP-RT1 Analog Switch Matrix

Size: B | Document Number: RT1MUX1.SCH | REV: 2

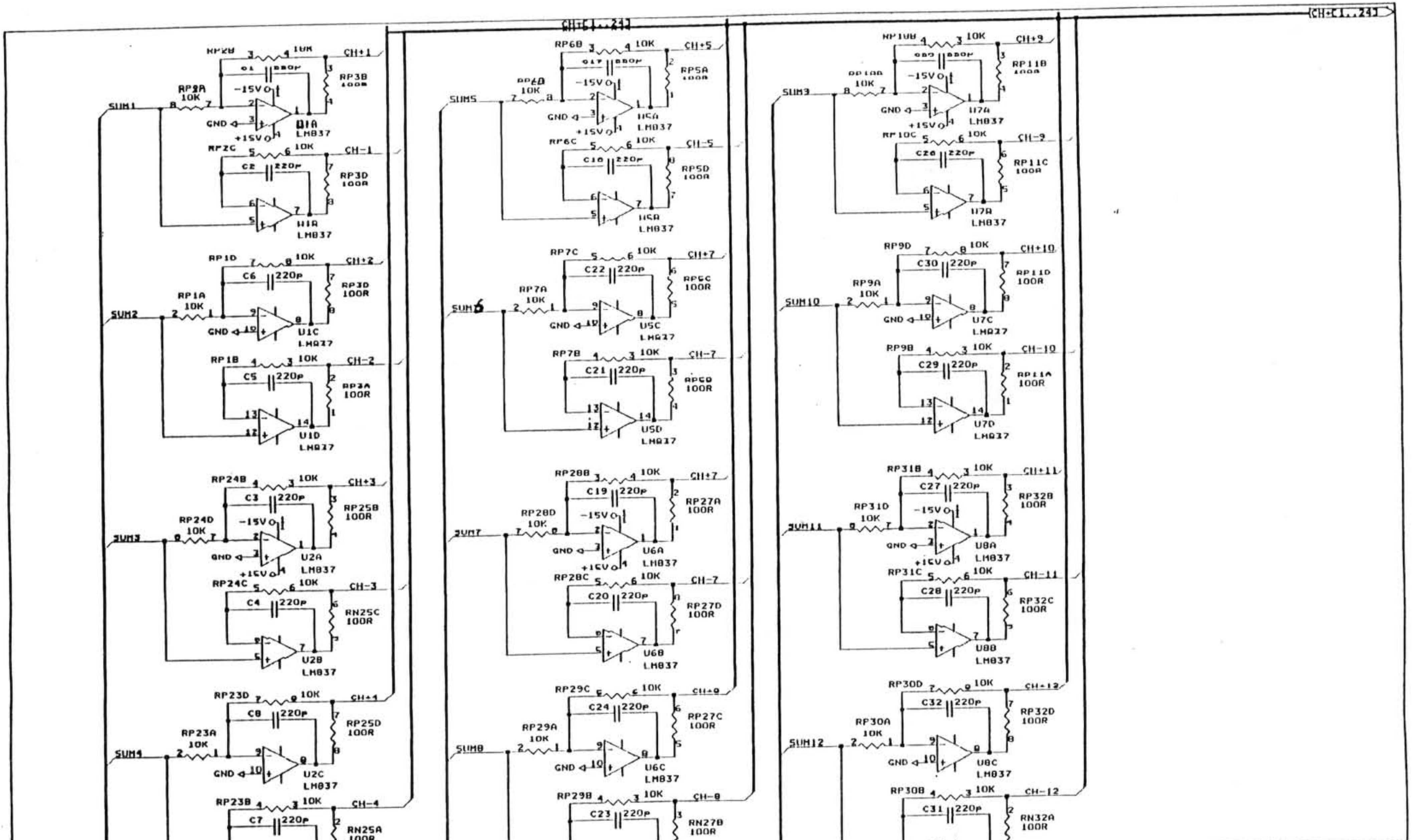
Date: February 27, 1991 | Sheet 2 of 6


MIX[1..24]
Fairlight ESP P/L
Title
ESP-RT1 Analog Switch Matrix
Size Document Number
B
RT1MUX2.SCH
REV
2
Date: February 21, 1991 Sheet 3 of 6



ORIGINAL

Fairlight ESP P/L		
Title: ESP-RT1 - Audio Mixing		
Size: B	Document Number: RT1MIX.SCH	REV: 2
Date: February 21, 1991	Sheet 4 of 6	



Fairlight ESP P/L		
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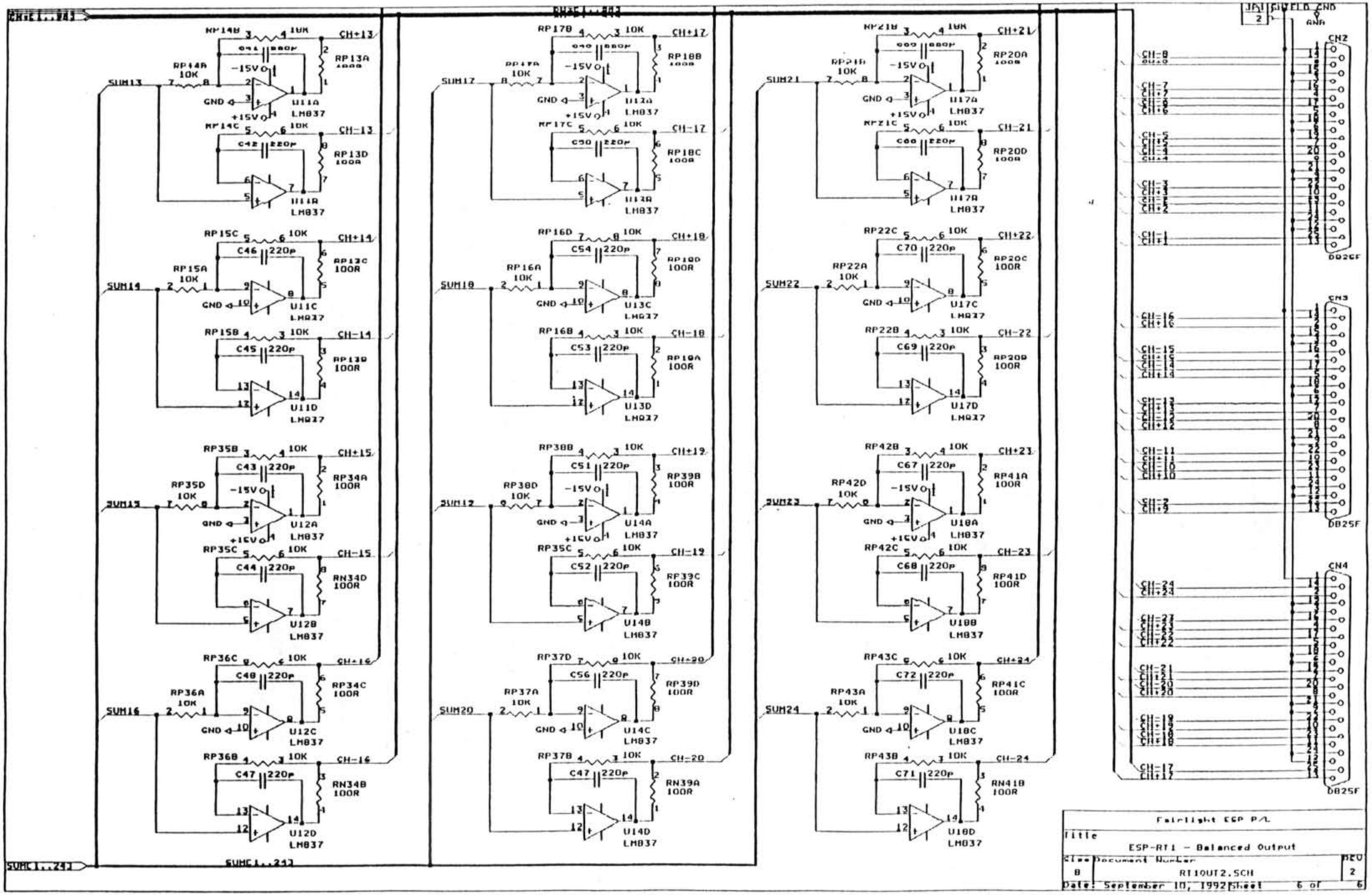

Fairlight ESP P/L
Title
ESP-RT1 - Balanced Output
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CN2
CN3
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LM837

ROUTER AND CHANNEL OUTPUT CARD
JANUARY 1992

1.01 FREQUENCY RESPONCE

1.02 It was found that the frequency responce of the channel card was poor, where the -3dB point would vary from 16khz to 20Khz and very dependent on temperature. Heating the tracking filters would add more attenuation to the output which tested a 6dB drop at 20Khz. The -3dB point is a critical alignment which requires much patience from the test technicians. Once the -3dB point is aligned the cards then require powering up for 10 minutes until the card has reached its final operating temperature. The -3dB alignment then requires final adjustment. Whilst the -3dB point is a critical alignment, another problem encounted was erratic oscillations by the tracking filters during alignment.

1.03 SOLUTIONS

1.04 After checking the alignment procedure there was only one alignment which needed changing. This alignment was the rolloff frequency of the tracking filter when fully opened. The alignment procedure originally requested that the technician align the required trim pot for a -3dB point at 15Khz when the filter was opened slightly. This means for a particular digital value the tracking filter's -3dB point will now be set to 15Khz.

1.06 This alignment has now been changed so that a peak reading be adjusted at 15Khz using the level meter. The final result is that the rolloff for a particular digital code has now shifted up in frequency. EG 17Khz. By changing this adjustment, the tracking filters are far more stable, the antennuation at 20Khz is now -1.6dB, and after servere heating of the tracking filters there was only a change of -1dB at 20Khz.

1.07 The first channel card that was modified was checked in the studio for basic frequency rolloff changes, resonance, and tracking during sample rate conversion. At lower sample rates there was slight aliasing noises detected, but this must be the compromise. The resonance didn't seem to change drastically.

2.01 SAMPLER CARD ROLLOFF

2.02 Frequency rolloff measurements were made via the output channel card. The test showed that the final rolloff was -3.4dB at 20Khz. The rolloff of the actual sampler card at 20Khz is 0.5dB. The remaining 2.9dB is the 1.6dB rolloff of the channel cards and 1.3dB due to the degradation of the sampled signal. The test results are showen in section 4.

3.01 ROUTER CARD ROLLOFF

3.02 The router card frequency responce test showed -2dB at 20Khz. So if the channel card rolloff at 20Khz was -3dB then the final router output signal would be attenuated by 5dB at 20Khz. Because the channel card rolloff was effected by temperature changes, the final router output rolloff could reach as much as -10dB at 20Khz.

3.03 At the lower end of the spectrum, the rolloff at 20Hz tested -2.5dB. Although this is not critical, the lower part of the spectrum should be flat to near DC.

3.04 SOLUTIONS

3.05 There are amplifier stages in the router circuitry which provide various amounts of gain and frequency attenuation. The filter networks used were mainly attenuating from 30Khz upwards. One section of the filter started attenuating at 15Khz. The resolution to the high spectrum attenuation was to change the various capacitor values in the filter networks.

3.06 The lower end of the spectrum rolloff was resolved by removing two capacitors in each channel and replacing with a wire link. The capacitors were configured in a series highpass network and thus by eliminating these, a DC flow was possible and an improvement of the attenuation at 20Hz.

4.01 FREQUENCY RESPONCE OF CHANNEL OUTPUT CARD.

FREQUENCY	RIGHT CH	LEFT CH
20HZ	0.2dB	0.2dB
100Hz	0.0dB	0.1dB
200Hz	0.0dB	0.0dB
500Hz	0.0dB	0.0dB
1Khz	0.0dB	0.0dB
2Khz	0.0dB	0.0dB
5Khz	0.0dB	0.0dB
10Khz	0.2dB	0.2dB
12Khz	0.2dB	0.3dB
15Khz	1.2dB	1.3dB
16Khz	1.3dB	1.4dB
17Khz	1.4dB	1.5dB
18Khz	1.5dB	1.5dB
19Khz	1.5dB	1.6dB
19.5Khz	1.6dB	1.6dB
20Khz	1.6dB	1.7dB

4.02 FREQUENCY RESPONSE OF CHANNEL AND SAMPLER CARD

FREQUENCY	48KHZ	44KHZ
20Hz	0.2dB	0.2dB
100Hz	0.1dB	0.1dB
200Hz	0.0dB	0.0dB
500Hz	0.0dB	0.0dB
1Khz	0.0dB	0.0dB
2Khz	0.0dB	0.0dB
5Khz	0.2dB	0.2dB
10Khz	0.8dB	0.8dB
12Khz	1.2dB	1.3dB
15Khz	2.1dB	2.2dB
16Khz	2.4dB	2.4dB
17Khz	2.7dB	2.6dB
18Khz	3.0dB	2.7dB
19Khz	3.2dB	2.7dB
20Khz	3.4dB	2.8dB

4.03 FREQUENCY RESPONSE OF ROUTER AND CHANNEL CARD

FREQUENCY	RIGHT CH	LEFT CH
20HZ	0.2dB	0.2dB
100Hz	0.0dB	0.1dB
200Hz	0.0dB	0.0dB
500Hz	0.0dB	0.0dB
1Khz	0.0dB	0.0dB
2Khz	0.0dB	0.0dB
5Khz	0.0dB	0.0dB
10Khz	0.2dB	0.2dB
12Khz	0.2dB	0.3dB
15Khz	1.2dB	1.3dB
16Khz	1.3dB	1.4dB
17Khz	1.5dB	1.6dB
18Khz	1.6dB	1.6dB
19Khz	1.6dB	1.7dB
19.5Khz	1.7dB	1.7dB
20Khz	1.7dB	1.8dB