

# **ULTIMATION**

# **Service Manual**

## **Section 2**

### **Console Service Information**

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**CAUTION**

The moving fader cassette cards contain static-sensitive devices. Proper anti-static precautions should be observed when handling these assemblies. Furthermore, always ensure that power is removed from the fader bus cards by turning off *both* the SL569 and the SL668 (or SL564) power supplies before inserting or removing fader cassettes.

## 2. Console Service Information

### 2.1 Card Descriptions

#### 2.1.1 SL678 Moving Fader Cassette Cards

The SL678 Moving Fader Cassette contains two cards, the 82E352 Control Card and the 82E353 Servo Card.

##### *82E352 Control Card*

This card interfaces the various lamp, switch and signal inputs and outputs to the 8-bit CA Data Bus, and connects the fader into the audio signal path.

IC3 is the Read Buffer for the Studio Computer, and IC5 is the Write Buffer. Data flow through IC3 and IC5 is controlled by the READ, WRITE and CHANNEL\_SELECT lines and their associated logic. IC8 decodes the thumbwheel switch setting. IC11 selects one of the eight GROUP D.C. lines from the bus cards. The four thumbwheel data lines from IC8 also feed via IC3 to appear on bits 0-3 of the CA Data Bus in READ mode. The CA Data Bus bit functions are as follows:

Bit	0	1	2	3	4	5	6	7
CA Read	Grp. Bit 0	Grp. Bit 0	Grp. Bit 0	Grp. Bit 0	status	Switch	cut	Switch
CA Write	TR Select	trim LED	alt LED	abs LED	Grp. Isolate	Cut from CA	Servo Fail	Touch Sense
							Motor Off	VCA Select

Group Isolate signals (*either* from the CA via IC5 *or* via thumbwheel switch selection of VCA Group 0 and via IC8) inhibit the GROUP DC OUTPUT line via IC10 and TR1. The signal from IC10 also inhibits IC11, and hence the GROUP D.C. lines from the bus cards. A simple reset circuit clears the outputs of IC5 on power-up.

The balanced audio signal appears on the input of a unity-gain buffer, IC6. The single-ended output from IC6 feeds to the fader via PL2, the signal from the fader wiper passing via a unity-gain buffer (IC7) to IC2 and IC1, which convert it back to balanced mode. A 3-pole filter is situated between IC7 and IC1. This filter eliminates any likelihood of beat frequency modulation of the audio signal from ultrasonic frequencies generated in the touch sense detection circuitry (H1 and associated components) on the 82E353 Servo Card.

##### *82E353 Servo Card*

This card controls and senses the current supply to the moving fader motor, detects stall condition on the motor, and also contains the touch sense interface circuitry.

The fader servo wiper voltage feeds an inverter, IC4 (gain adjustable via VR5). A second inverter (IC4) sums the resulting voltage with an offset (adjustable via VR4). Output phase-lead compensation (C21-22) caters for rapid movement of the fader.

Under normal operation TR3 is *on* and the fader voltage thus feeds the Computer Send Buffer (IC3). In Total Recall Mode, TR3 is *off* and TR2 is *on* (controlled by the TR SELECT signals from the 82E352 Control Card), and thus the TR voltage passes via TR2 to the Send Buffer.

The balanced CA RETURN signal is converted to single-ended mode, and summed with the buffered GROUP DC RETURN signal (by IC3) to produce the LIN\_CONTROL\_VOLTAGE signal. This is then summed with the phase-lead compensated fader servo voltage (see above) by a high-gain (100) amplifier, IC4, to provide an output (at R62) that essentially ranges between  $\pm 15V$  to correspond with the required forward or reverse movement of the fader from its current position. C13 prevents the stage from going into oscillation.

A quad opto-isolator, IC7, is used to isolate the audio stages from the motor power circuitry. The control voltage now feeds via R62 to an inverting amplifier (IC4), the gain of which is set by the transfer ratio of the two opto-isolator stages in the feedback loop and R62. Isolation of audio and motor power occurs at the next stage (IC5), the gain of which is set by the transfer ratio of the two opto-isolator stages in the feedback loop and R63.

The output of IC5 drives the motor power output darlings TR9-10, configured as a Class B output stage. R74-75 provide current sensing in either motor direction. D15-16 provide back e.m.f. protection for TR9-10. The voltages across R74 and R75 (CURRENT\_SENSE\_1 and CURRENT\_SENSE\_2) are summed by a x10 amplifier (R19-22, IC5) before being compared with a 3.3V reference (D9). If the voltage across R74-75 exceeds about 0.33V, the comparator output (IC5 pin8) switches low, causing IC5 pin 14 to switch high. This causes TR5 and TR4 (via IC8) to switch off the motor power darlings TR9 and TR10 respectively, and switches the MOTOR FAIL line (to the 82E352 Control Card) low via TR7 and IC9. The voltages across R74 and R75 will now be zero, and after a delay based on the values of R65 and C25, TR4-5 and TR7 will turn off. If the previously high motor current persists, the process repeats.

Any touch sense detection (via Touch Sense hybrid H1) will turn on TR6, activating opto-isolator IC8 and turning off the motor power darlings TR9 and TR10 via TR4-5 as described above. H1 also drives the TOUCH SENSE line on the 82E352 Control Card. Capacitor C15, which sets the operating frequency of H1 (around 150kHz.), is supplied with and matched to H1, therefore if ever H1 is replaced, C15 must also be replaced.

Further circuitry on this card modifies the LIN\_CONTROL\_VOLTAGE characteristic to produce a 'four slope' shape. IC1 is used to buffer both the 5V Reference voltage and the LIN\_CONTROL\_VOLTAGE. Each of the four shaping sections (based around IC2) sums the LIN\_CONTROL\_VOLTAGE with a different proportion of the 5V Reference. The outputs of the four shaping sections are summed by a further IC1 stage to produce VCA CONTROL VOLTAGE (LAW CORRECTED), which varies between the range +1V to -10V. VR3 adjusts the overall offset of the shaping circuit, VR1 adjusts the gain of the first slope of the characteristic and VR2 adjusts the gain of the second slope.

A further IC1 stage generates VCA CONTROL VOLTAGE (LIN+CUT), which varies from 0-10V for mono channels. For stereo channels the VCA Control Link on the bus card, which sums LIN\_CONTROL\_VOLTAGE into this stage, must be inserted. For stereo channels VCA CONTROL VOLTAGE (LIN+CUT) varies from 0-5V under normal operation, and is set at 10V when CUT SELECT (from the 82E352 Control Card) is activated.

### **2.1.2 82E354 VCA Card** (*Component references in brackets refer to PCB Revs. AB and CD only.*)

This card is mounted in each SL611 module and carries the VCA, fader send/return, overload detection, and audio routing circuitry.

Under control of the relevant SELECT signals from the Master Logic Board, the MON INPUT and CHANNEL INPUT signals are buffered by IC7. The signal from IC7 feeds the PRE FADE OUTPUT. The signal also feeds IC6 (IC8-9), which convert it into balanced form for the FADER SEND output, and the two VCA hybrids H1-2 via the gain adjust preset VR2 (VR1).

The VCA CONTROL VOLTAGE (LAW CORRECTED) signal from the 82E353 Card feeds IC4 (IC14) via VR3 (which adjusts the gain of IC4 (IC14) and hence the VCA attenuation characteristic). The output of IC4 (IC14) is inverted by IC4 (IC13); these two signals provide the control voltages for VCA hybrids H1-2. VR1 (VR2) adjusts the VCA symmetry. IC5 generates the VCA TO METERS signal by level-shifting the VCA CONTROL VOLTAGE (LAW CORRECTED) signal.

The current output from VCA hybrids H1-2 is summed by IC3 (IC10) before feeding to IC2 (IC4), which is configured as a single-pole changeover switch. The FADER RETURN signal is unbalanced by IC3 (IC12) before feeding to the second input of IC2 (IC4). The output from IC2 (IC4) is buffered by IC8 (IC11) to provide the VCA OUTPUT line. RV1 on the 82E361 piggy back card (if fitted) or VR4 on the 82E354 card provides an overall unity gain adjustment.

The switch control logic, based around IC9 and IC11 (IC2 and IC3), defeats the CH. MUTE RETURN if either TR or 5V REF are low, meaning that the channel MUTE Switch works locally. Otherwise the VCA/FAD line controls the signal path through IC2 (IC4) unless CH. MUTE RETURN is high, in which case both signal paths are muted.

LK1 moves the feed to the AFL bus from pre to post fade. It is normally fitted in the post fade position, but for consoles with AFL/PFL changeover cards fitted the link is removed.

### **2.1.3 Fader Bus Cards**

There are three types of bus card: the 82E355 Moving Fader 8 Channel Bus Card, the 82E359 Moving Fader 4 Channel Bus Card, and the 82E358 Moving Fader Group Bus Card. The circuitry for all of these cards is similar.

The fader bank address lines ADDR 0-2 from the 82E357 Analogue Output Card (*q.v*) are decoded by IC2 to provide STROBE lines for each fader. The RS-422 ENABL lines from the 82E356 card are converted to normal logic level by IC3, the resulting signal being used to enable IC2.

Except on the 82E358 Group Bus Card, a VCA Control Link is provided for each fader for use with stereo channels and patchable VCAs.

On the 82E358 Group Bus Card only, a +5V Reference (adjustable by means of VR1) is generated by IC5, and is carried along all of the bus cards via S13E.

S16E carries the VCA CONTROL VOLTAGE (LIN+CUT) signals from the 82E353 card, and carries the TR/CUT signals to the 82E352 card. In addition S13E carries the GROUP D.C. signals along the bus cards, where they are fed to the 82E352 cards.

## 2.2 Test and Calibration

All presets will have either been factory set or (in the case of retrofits) aligned by our commissioning engineer. However, should calibration be necessary, the procedures are as follows.

### 2.2.1 SL678 Moving Fader Cassette Cards

#### *Mono Channel Faders*

All presets are on the 82E353 card.

VR4 and VR5 adjust the servo loop, i.e. the offset and gain of the computer send respectively. They do not normally need adjustment but should be checked as follows:

Type '!TES EX' to access the computer test program. Now select the Analogue Input Test to view all the fader input values.

Move the fader to the top of it's travel and check that the input *just* reaches 0000. Adjust VR4 if necessary.

Close the fader and check that the input *just* reaches 1023. Adjust VR5 if necessary.

Both presets can be reached through holes in the bus card by removing the knee panel. VR5 is nearest the front of the console.

VR1, 2 and 3 modify the action of the law shaping circuit on the VCA control output. These are factory set to correspond to the law of a particular fader. If a new fader is fitted these must be reset to minimise the level change when switching between VCA and fader. A four slope design is used. *VR1-3 should only be adjusted after the Servo Ajustments have been carried out as described above.*

VR3 adjusts the overall offset, VR1 sets the gain of the first leg of the characteristic and VR2 sets the gain of the second leg. The change in level at any point between +10 and -50 should be no more than 1dB, and typically should be less than 0.5dB over most of the fader travel.

Use the MOTORS ON ('MO EX') command to toggle a particular channel between the two signal paths.

Set the fader to the top of it's travel and check for no change in level when switching signal paths. Adjust VR3 if necessary.

Set the fader to the '-5dB' position. Check for no change in level when switching paths. Adjust VR1 if necessary.

Set the fader to the '-25dB' position. Check for no change in level when switching paths. Adjust VR2 if necessary.

### Stereo Channel Faders

The servo offset and gain presets may need adjustment. Follow the procedure above if necessary. None of the other presets affect the stereo VCA law.

The fader law should be adjusted as follows:

With the SL611S fitted to an extender, input +4dBu at the left Line Input. Switch the Insert to 'POST VCA' and measure at the Insert Send.

All presets are on the 82E213 card.

Set the fader to the '0dB' position and adjust VR4 for +4dBu. Set the fader to the '+10dB' position and adjust VR5 for +14dBu. Check that the '-5dB' fader position corresponds to a level of -5dBu  $\pm 0.5$ dBu. Below this position the scale markings and the fader law bear only a distant relationship to each other.

Check the right channel in the same way and adjust the Tracking preset (VR2) if necessary. VR1 and VR3 adjust the symmetry of the left and right VCAs respectively.

### SL688 Mix Matrix Module Calibration (SL6000 Consoles only)

Power down the SL688 section and lift the module up on its slides. All presets are on the 82E157 card except where otherwise stated. Starting with the 'A' bus, withdraw its 82E157 card and refit it on an extender.

Select MONITOR FROM 4 TRACK, FADERS TO MONITOR and MONITOR TAPE on A, B and C buses.

Input +4dB into 4 Track Tape Monitor input A and measure at Mono Monitor insert send.

Set the fader to 0dB and adjust the preset fitted in place of R69 for +4dBu. Set the fader to +10dB. Check for +14dBu  $\pm 0.5$ dBu. If the error is greater than this then the value of R76 may have to be adjusted (*increase* the value if the level is too high, *decrease* the value if the level is too low). Repeat this procedure for the B and C buses.

Check that the '-5dB' fader position corresponds to a level of -5dBu  $\pm 1.0$ dBu. Below this position the scale markings and the fader law bear only a distant relationship to each other.

Select MONITOR FROM 8 TRACK, FADERS TO MONITOR and MONITOR TAPE on the A, B and C buses.

Input +4dB into 8 Track Tape Monitor input AL and measure at Left Monitor insert send.

Set the fader to 0dB and check for 4dB  $\pm 0.25$ dB. Adjust VR2 on the 82E256 card if necessary.

Repeat for AR measuring at Right Monitor Insert send.

Repeat the procedure above for buses B and C.

### 2.2.2 82E354 Card (Component references in brackets refer to PCB Revs. AB and CD only.)

Fit the SL611 to an extender and inject +4dB into the Line Input. Switch the fader into circuit using the MOTORS ON ('MO EX') command. Measure at the Group Output with DIRECT selected (console in MIX status). Set the fader to the 0dB position and adjust RV1 on the 82E361 piggy back card (if fitted) or VR4 on the 82E354 card for +4dB.

The 82E354 card is set up in the factory and apart from the overall unity gain preset adjustment described above should not require adjustment. If calibration is necessary, the procedure is as follows.

Use the 'MO' command (described above) to turn the VCA on.

Measure on end of R9 (adjacent to IC5) furthest from the edge of the card.

Set the fader so that the control voltage is 0 Volts.

Measure on IC4 pin 11 (or IC1 pin 4 on the 82E361 piggy back card if fitted). Adjust VR1 (VR2) for 0dB (i.e. 4dB below input).

Set the fader so that the control voltage is -2 Volts.

Adjust VR3 for -20dB (i.e. 20dB of attenuation) measured on IC4 pin 11 (or IC1 pin 4 on the 82E361 piggy back card if fitted).

VR2 (VR1) adjusts the VCA symmetry. Adjustment should be carried out using a distortion analyser.

### 2.2.3 82E320 Patchable VCA Card

Input +4dBu into the left channel of the Patchable VCA and measure at left output.

All presets are on the 82E320 cards, mounted in the Patchable VCA rack, which is fitted below the computer keyboard.

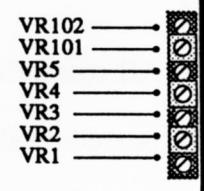
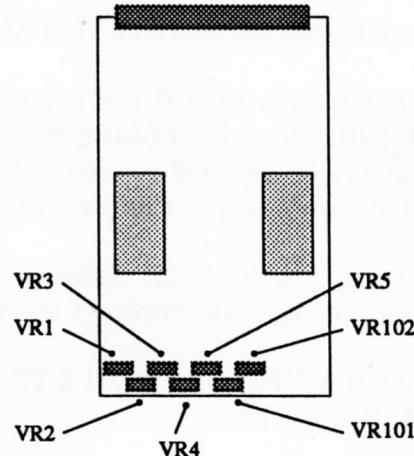
Set the fader to 0dB and adjust VR3 for +4dBu out. Set the fader to +10dB and adjust VR4 for +14dBu out.

Check that the '-5dB' position corresponds to a level of -5dBu  $\pm 0.5$ dBu. Below this position the scale markings and the fader law bear only a distant relationship to each other.

Check the right channel in the same way and adjust the Tracking preset (VR5) if necessary.

VR1 and VR101 adjust the Symmetry of the left and right VCAs respectively.

VR2 and VR102 adjust the left and right output balance respectively.



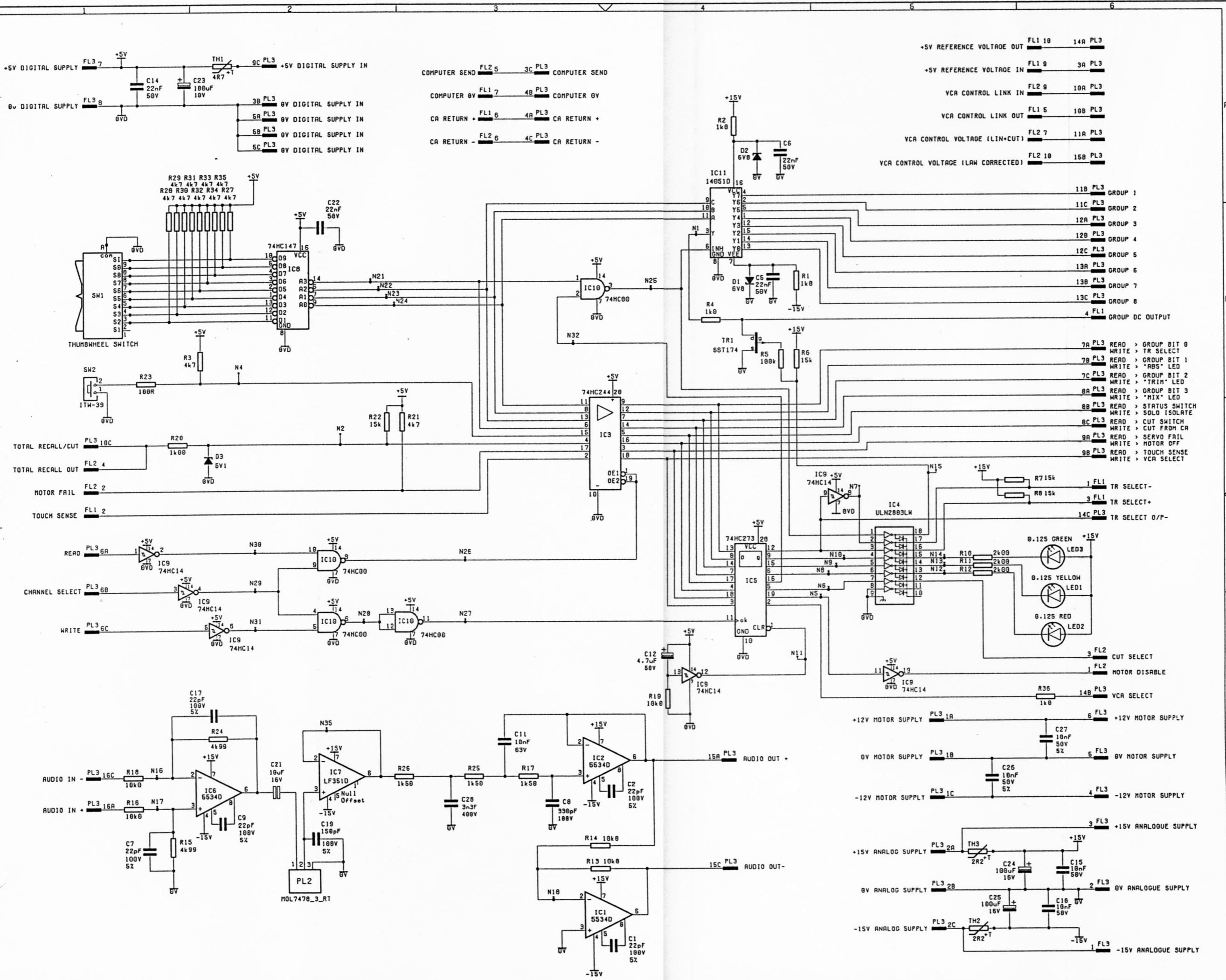
View from front of Card Rack

## 2.3 Drawings

Overleaf you will find the following drawings:

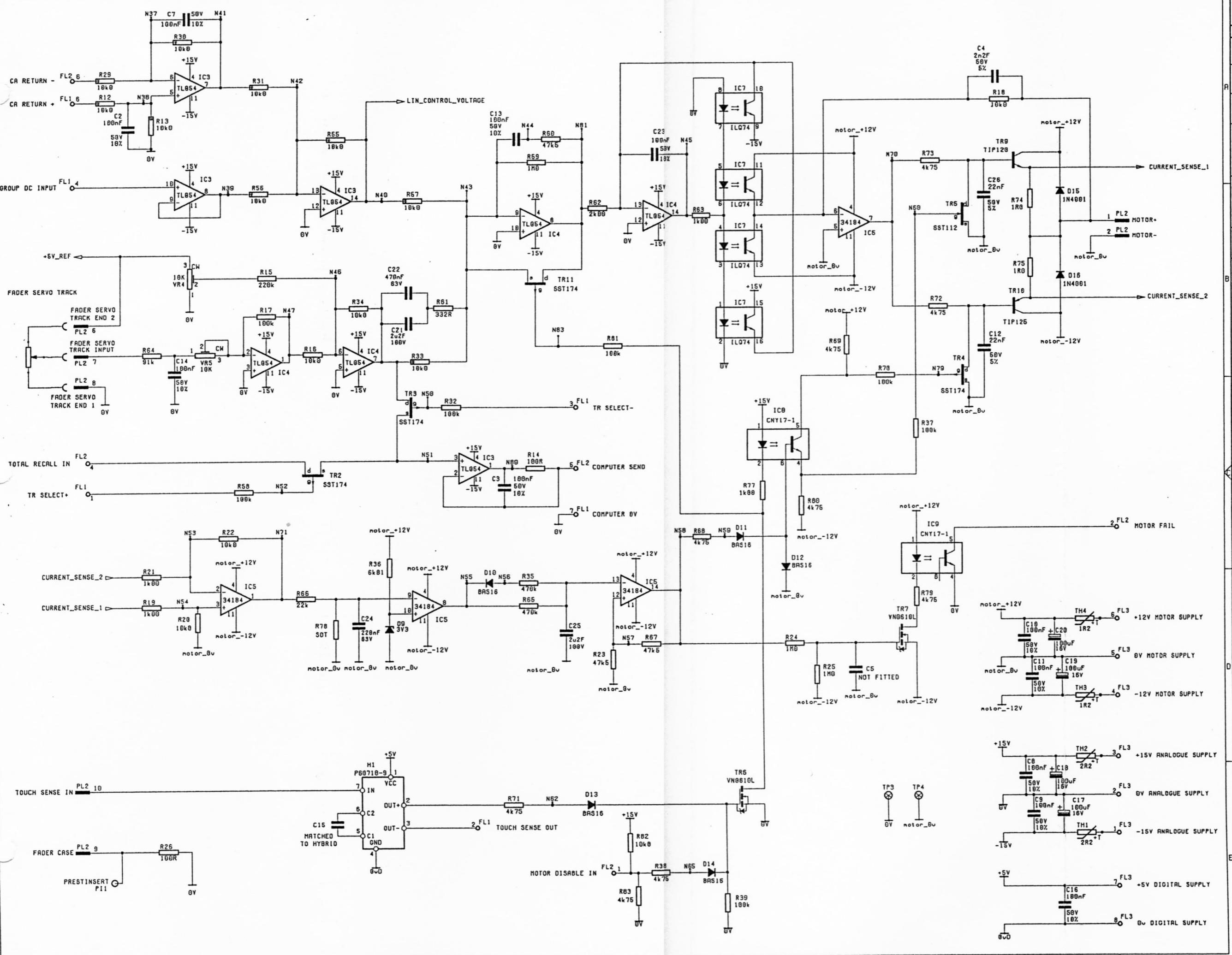
T82352.71	Moving Fader Control Sheet 1 of 1
T82353.71	Moving Fader Servo Sheet 1 of 2
T82353.72	Moving Fader Servo Sheet 2 of 2
T82354.71.2	Moving Fader Channel VCA Sheet 1 of 1
T82355.71	Moving Fader 8 Channel Buscard Sheet 1 of 1
T82358.71	Moving Fader Group Buscard Sheet 1 of 1
T82359.71	Moving Fader 4 Channel Buscard Sheet 1 of 1
T82213.70.2	Stereo VCA and Image Control (Audio) Sheet 1 of 2
T82213.71.2	Stereo VCA and Image Control Sheet 2 of 2
T82157.70.2	SL688V Mono Group/Monitor Sheet 1 of 2
T82157.71.2	SL688V Mono Group/Monitor Sheet 2 of 2
T82320.71.2	SL622 G Series Stereo Patchable VCAs (Mvg. Fader) Sht. 1 of 2
T82320.72.2	SL622 G Series Stereo Patchable VCAs (Mvg. Fader) Sht. 2 of 2



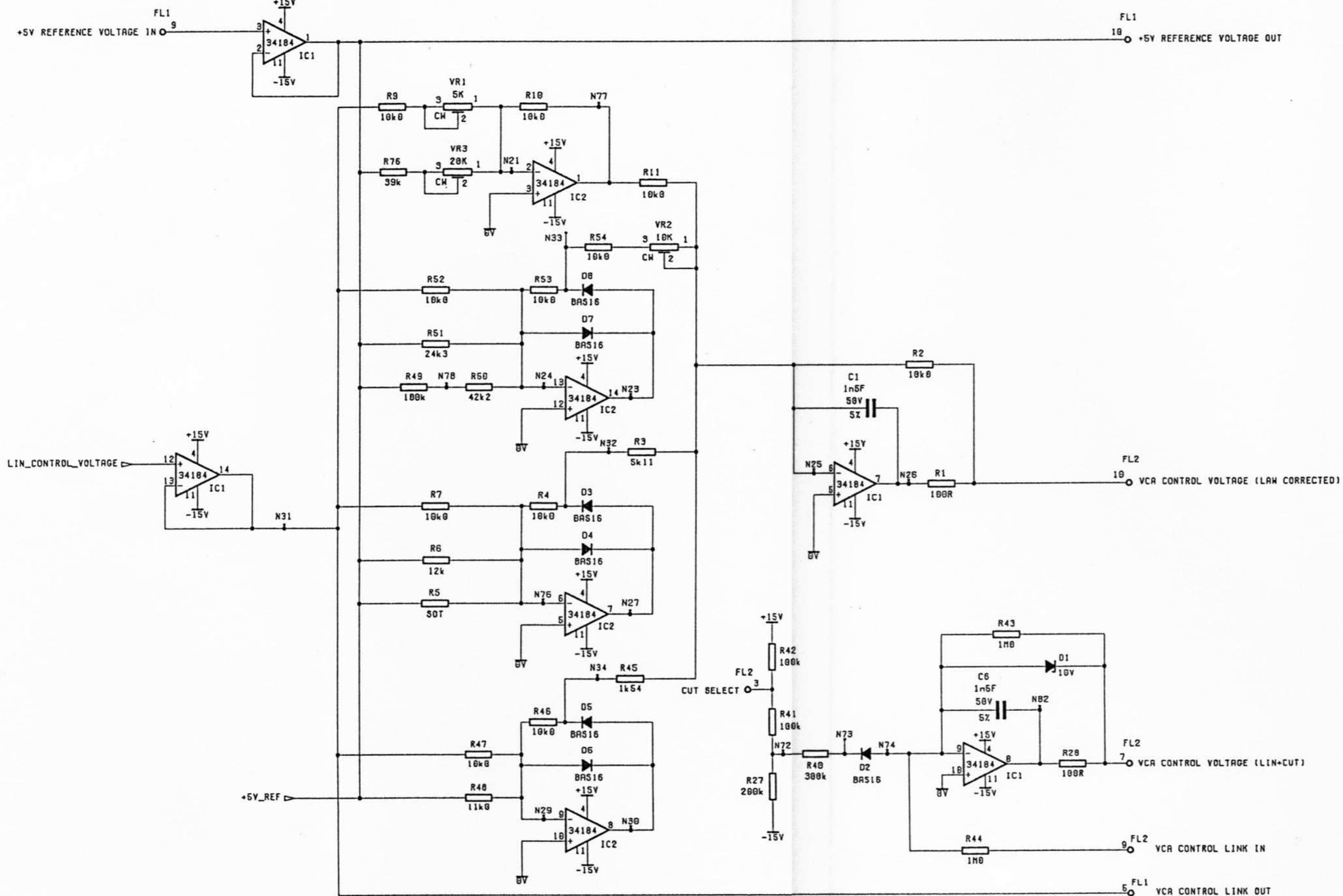


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REV	ISS	DATE	DETAILS			
0	A	20 FEB 91	NEW DRAWING	BC MM		
1	A	18 SEP 91	ECO 4K/734 NO CHANGE	MM		
2	A	18 SEP 91	ECO 4K/747 C10 C18 NOW NPO CERAMIC CAPACITORS (ULTRA STABLE)	BC MM		
3	A	18 SEP 91	ECO 4K/854 C3 C4 C13 WERE 22N NOW NOT FITTED IC7 WAS 5534D NOW LF351D	BC MM		
3	B	18 SEP 91	DCR 420 R36 1K ADDED	MM		
4	A	21 NOV 91	ECO 4K/886 INTRODUCE JK PCB	MM		
			PCB ISSUE JK			
USED ON		SL678	A2			
TITLE MOVING FADER CONTROL						
DRG. NO. T82352.71						
SHEET 1 OF 1						

REV	ISS	DATE	DETAILS
0	A	20 FEB 91	NEW DRAWING BC MM
0	B	26 FEB 91	DCR 130 BC C15 WAS SOT NOW MM MATCHED TO HYBRID
1	A	12 APR 91	ECO 4K/718 BC FLEXI-LINKS WERE MM TEFLON NOW NOFLEX
2	A	17 MAY 91	ECO 4K/748 BC JFET ADDED ACROSS R59 AND 100K ADDED TR6 DRAIN TO JFET GATE MM
3	A	17 MAY 91	ECO 4K/788 BC INTRODUCE GH PCB WITH TR11 & R81 R60 WAS 100K NOW 47K5 MM
4	A	7 OCT 91	ECO 4K/865 BC NO CHANGE MM



REV	ISS	DATE	DETAILS
0	A	20 FEB 91	NEW DRAWING BC MM
1	A	12 APR 91	ECO 4K/718 BC FLEXI-LINKS WERE MM TEFILON NOW NOMEX
2	A	17 MAY 91	ECO 4K/748 BC NO CHANGE MM
3	A	17 MAY 91	ECO 4K/788 BC INTRODUCE GH PCB MM
4	A	7 OCT 91	ECO 4K/865 BC R41 R42 WERE 1K00 NOW 100K R27 WAS 2K00 NOW 200K R40 WAS 3K01 NOW 300K R43 R44 WERE 10K0 NOW 1M0 MM

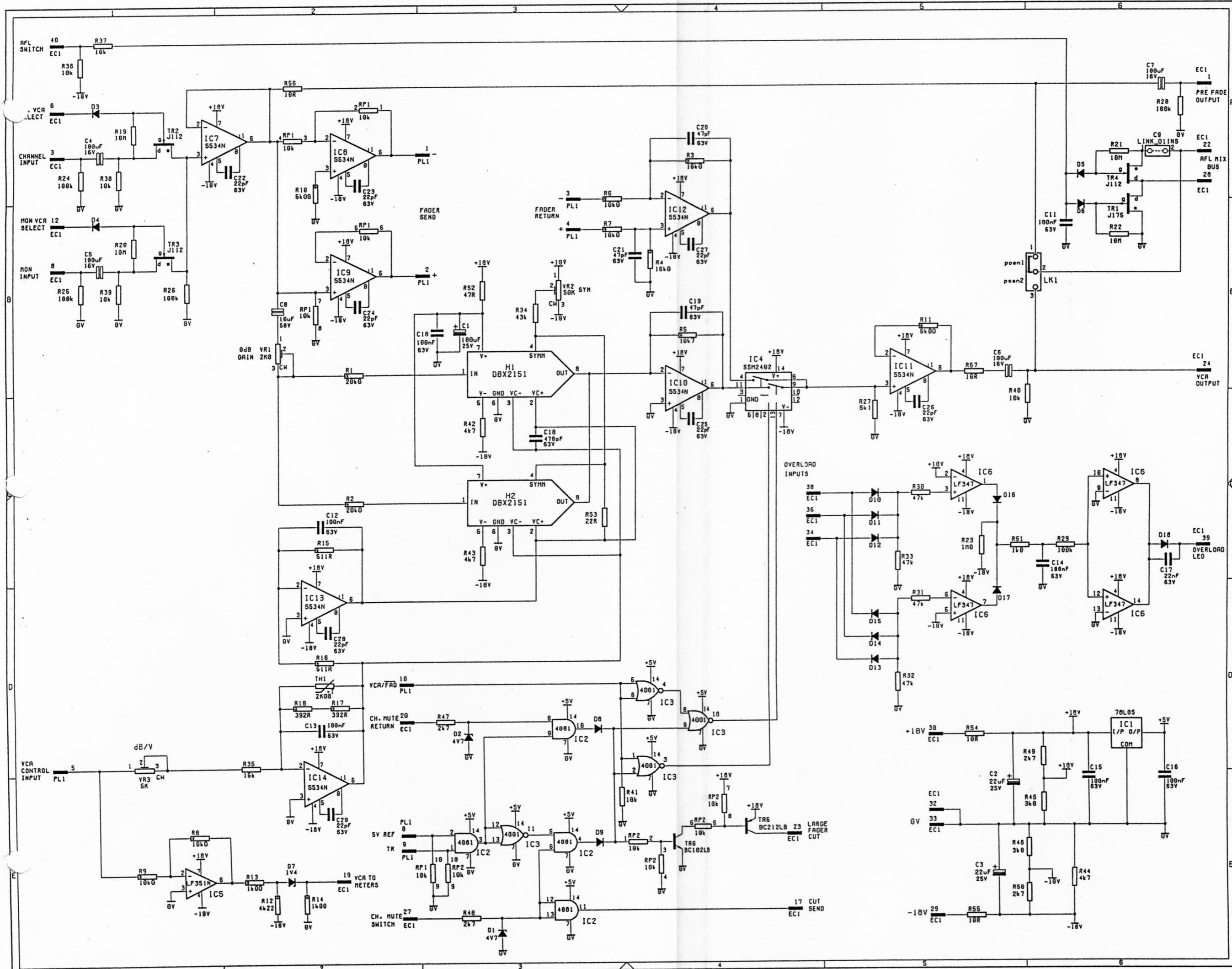


PCB ISSUE GH  
USED ON SL678 A2

TITLE MOVING FADER SERVO  
E

ORG.NO. T82353.72  
SHEET 2 OF 2

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REV	ISS	DATE	DETAILS
0	A	6 DEC 98	NEW DRAWING BC MM
1	A	31 JAN 99	ECO 4K/703 07 WAS DIODE NON ZENER DIODE 1V4 BC MM

RCB ISSUE 60

USED ON SI 678 B2

MOVING FADER  
CHANNEL VCA

DRG. NO.

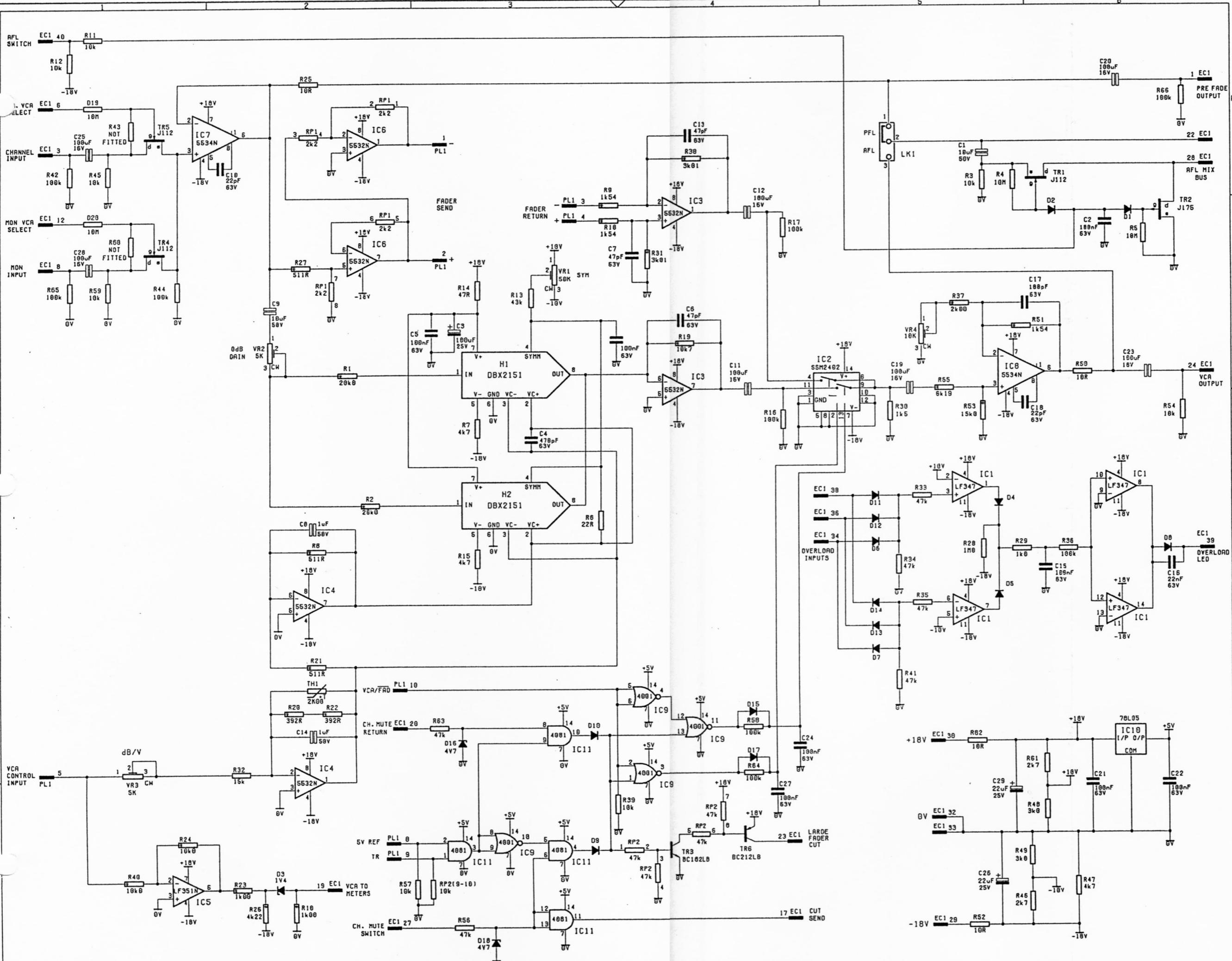
182354.71

SHEET 1 OF 1

## Solid State Logic

# Solid State Logic

REV	ISS	DATE	DETAILS
0	A	22 APR 91	NEW DRAWING BC MM
1	A	11 JULY 91	ECO 4K/786 R43 R60 WERE 10M NOT FITTED D19 D20 WERE DIODES NOW 10M RESISTORS MM
2	A	11 JULY 91	ECO 4K/794 BC NO CHANGE MM
3	A	11 JULY 91	ECO 4K/800 BC VR2 WAS 2K NOW 5K MM
4	A	21 AUG 91	ECO 4K/832 SD 100nF CAPACITOR MM ADDED AT H2 PIN 4
5	A	7 OCT 91	ECO 4K/854 BC R56 R63 WERE 2K7 NOW 47K. RP2 WAS 5x10K NOW 4x47K RP2 (9-10) 10K ADDED. R30 WAS 100K NOW 1K5 MM



E2 VERSION

PCB ISSUE EF

USED ON SL678 A2

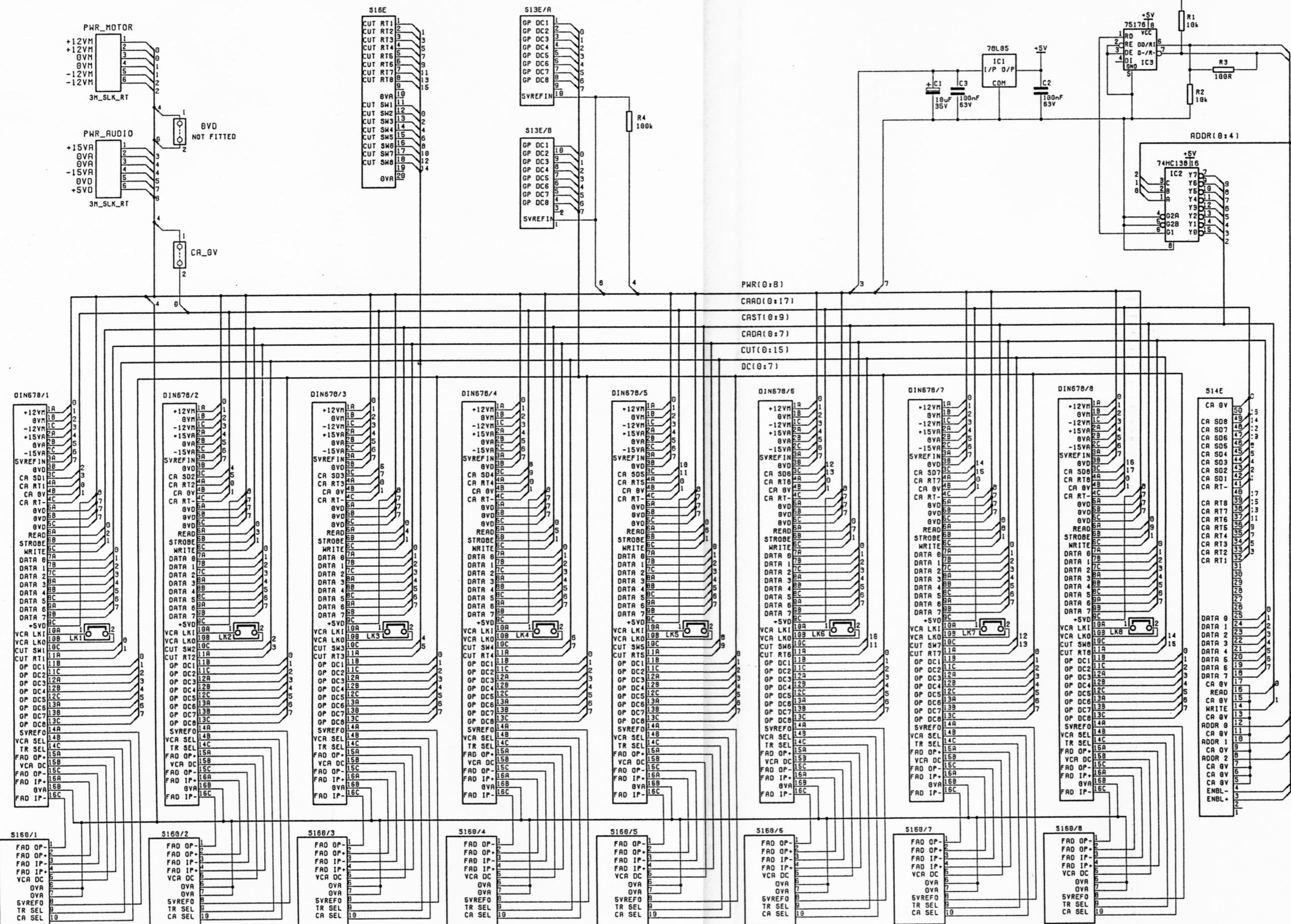
TITLE MOVING FADER  
CHANNEL VCA

ORG.NO. T82354.71.2

SHEET 1 OF 1

Solid State Logic

REV	ISS	DATE	DETAILS
0	A	7 MAR 91	NEW DRAWING MM



NOTE:  
LK1 TO LK8 ARE  
NOT INSTALLED

PCB ISSUE EF  
USED ON SL678 A2

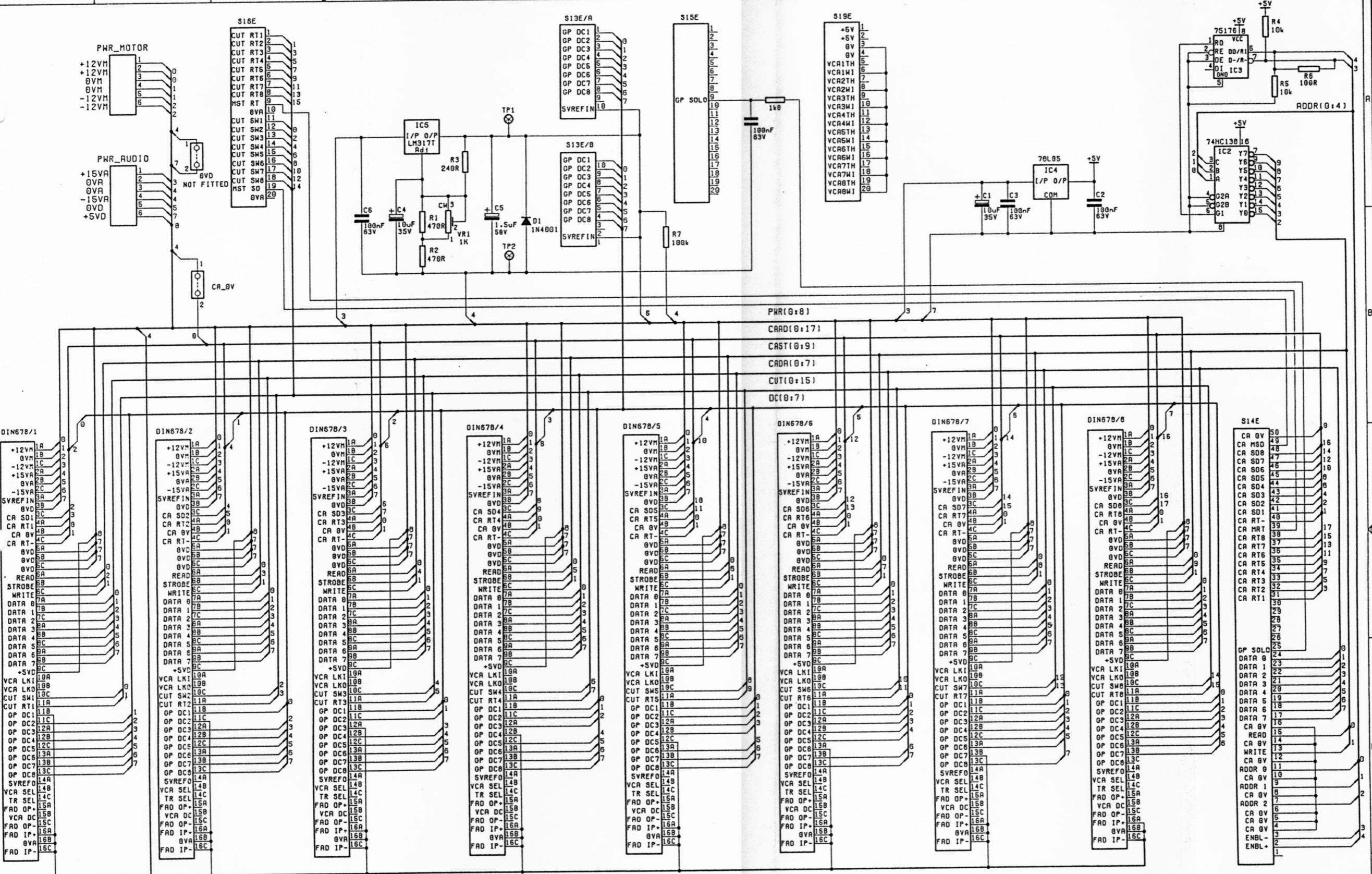
TITLE MOVING FADER  
8 CHANNEL BUSCARD

DRG.NO. T82355.71

SHEET 1 OF 1

**Solid State Logic**

REV	ISS	DATE	DETAILS
0	A	7 MAR 91	NEW DRAWING MM
1	A	21 MAR 91	ECO 4K/723 1K RESISTOR AND 100nF CAPACITOR ADDED MM



PCB ISSUE EF

USED ON SL678 A2

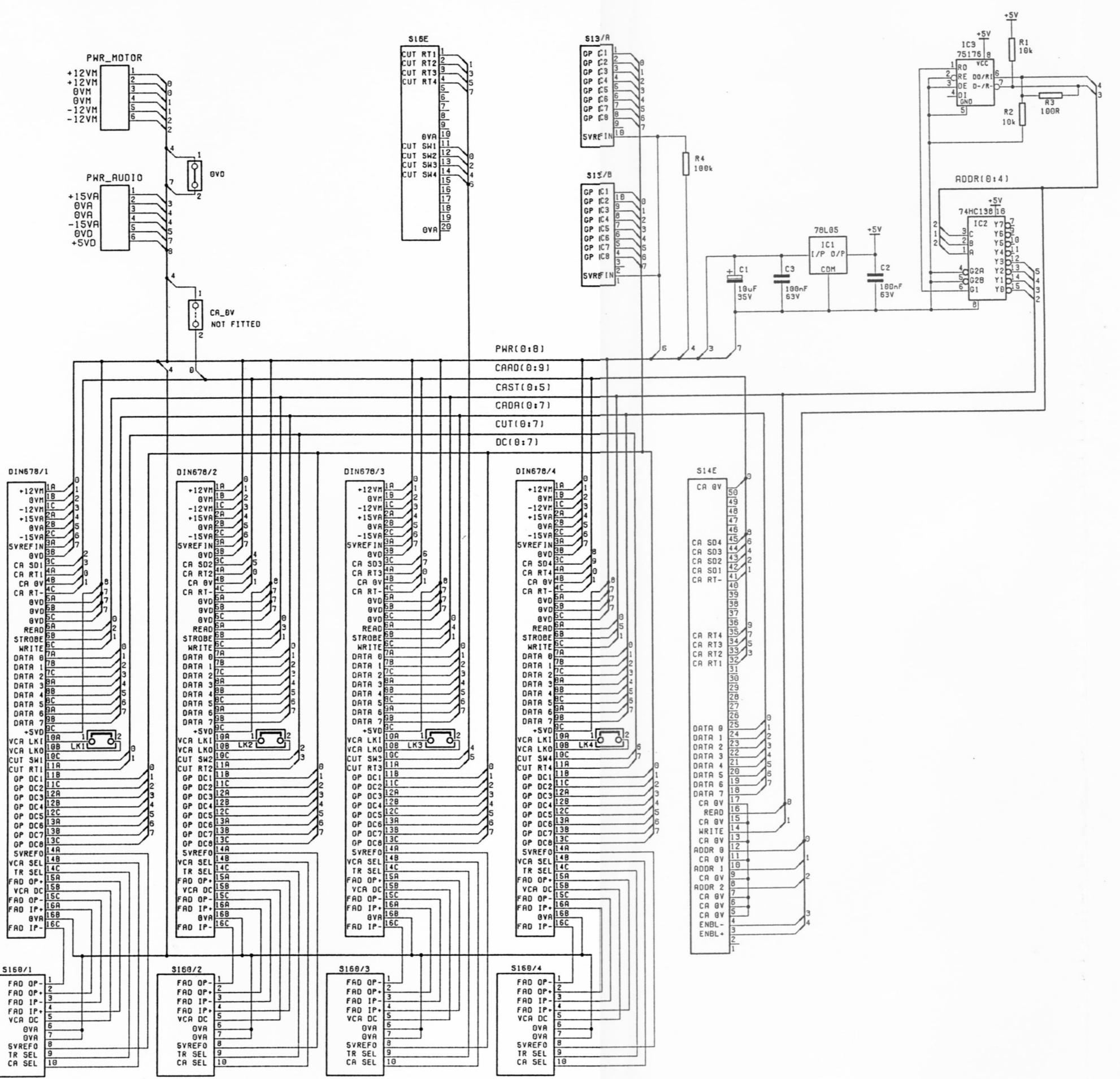
TITLE MOVING FADER  
GROUP BUSCARD

ORG.NO. T82358.71

SHEET 1 OF 1

**Solid State Logic**

SS	DATE	DETAILS
	27 MAR 91	NEW DRAWING

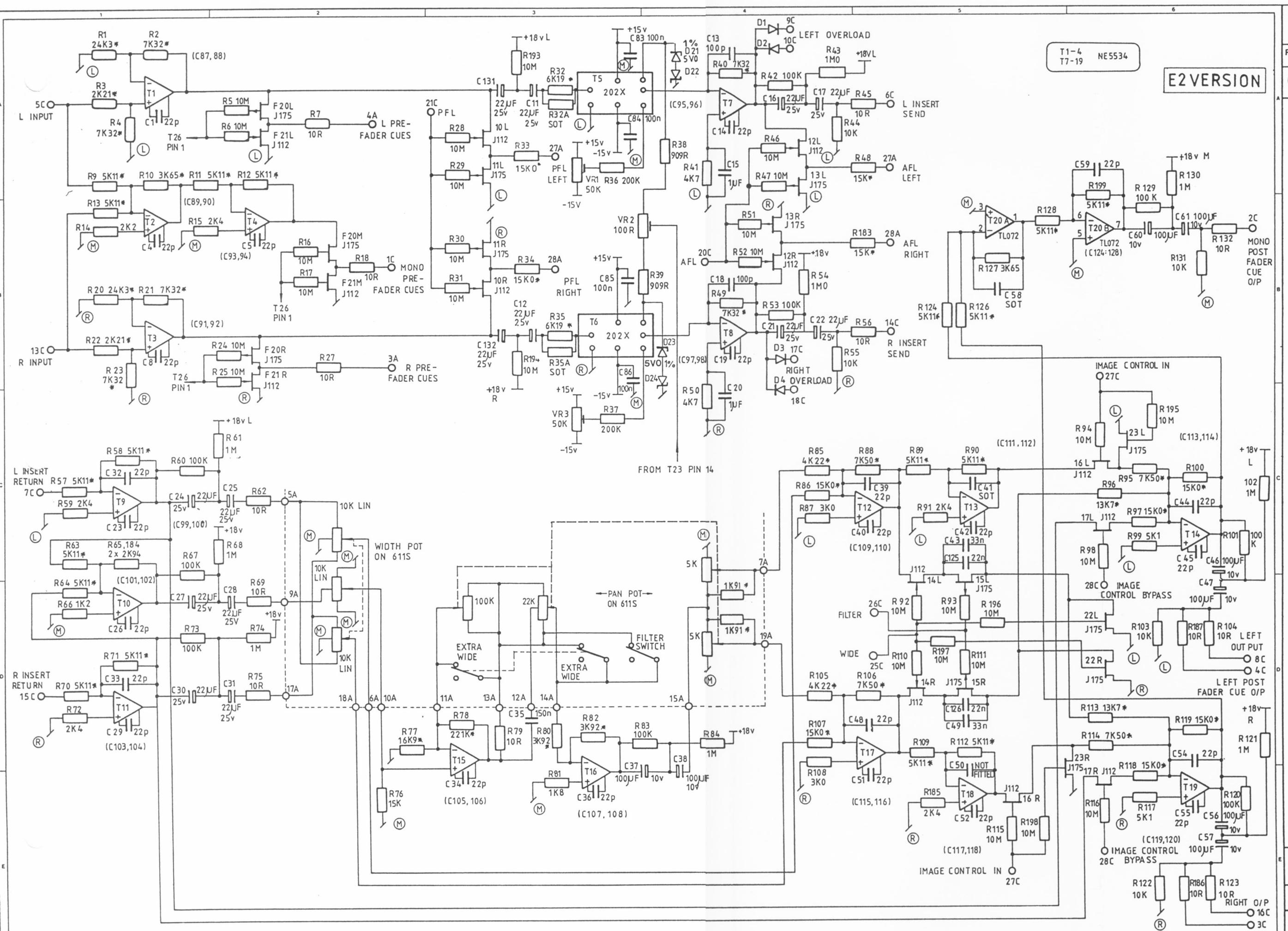


NOTE:  
OMIT LK1-4  
IF USED FOR  
611 MONO CHANNELS

	PCB ISSUE EF
D ON	SL678 A2
LE	MOVING FADER
CHANNEL	BUSCARD
.NO.	T82359 71

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Rev.	Issue	Chkd	Details
0	A	MM NOV	NEW DRAWING

SHEET 1 OF 2

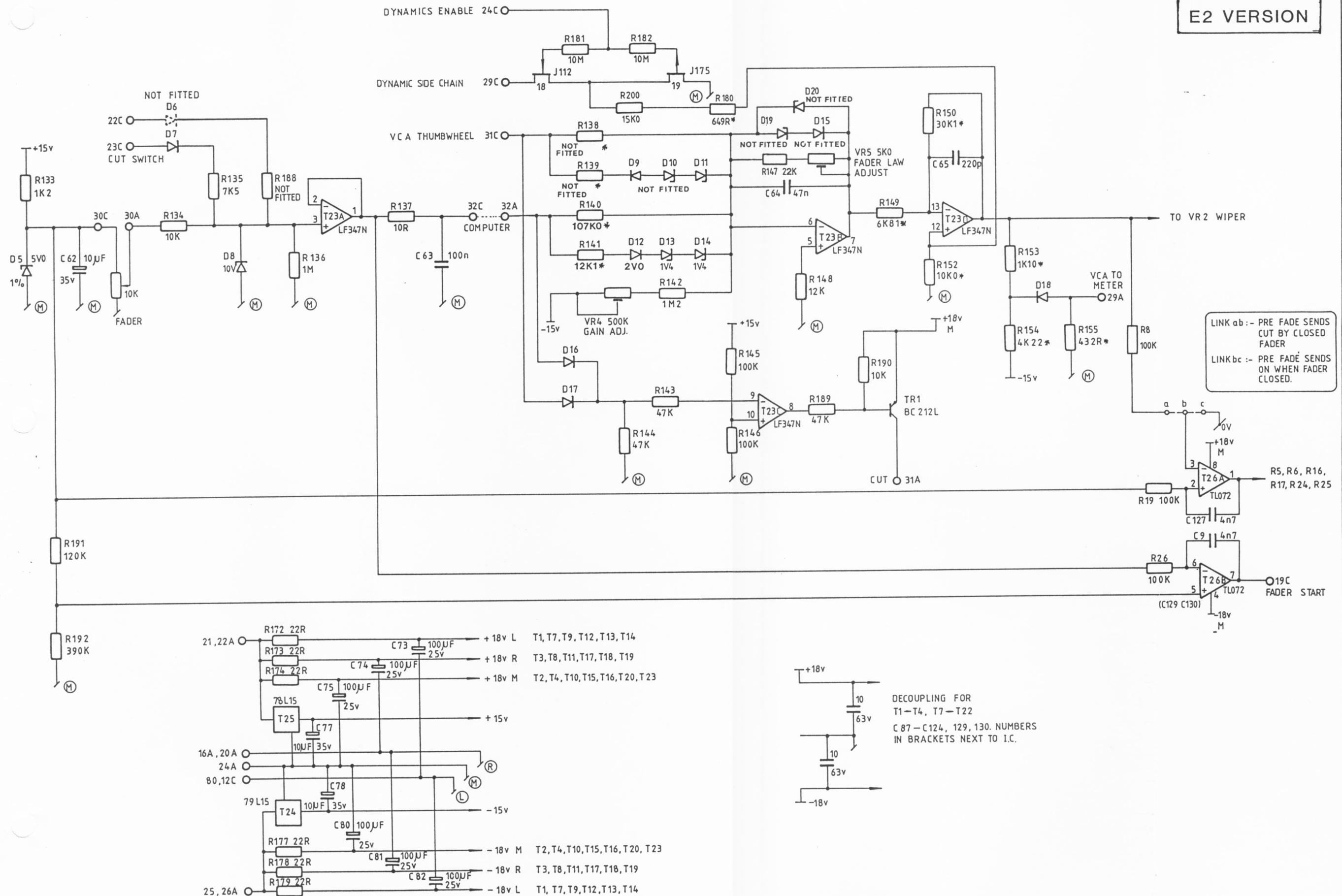
STEREO VCA AND IMAGE  
CONTROL (AUDIO)

Drg. No. T93313-70-2

## Solid State Logic

Rev.	Issue	Chkd	Details
0	A	MM NOV 90	NEW DRAWING

## E2 VERSION



10  
63v  
DECOUPLING FOR  
T1-T4, T7-T22  
C 87-C124, 129, 130. NUMBER  
IN BRACKETS NEXT TO IC

SHEET 2 OF 2

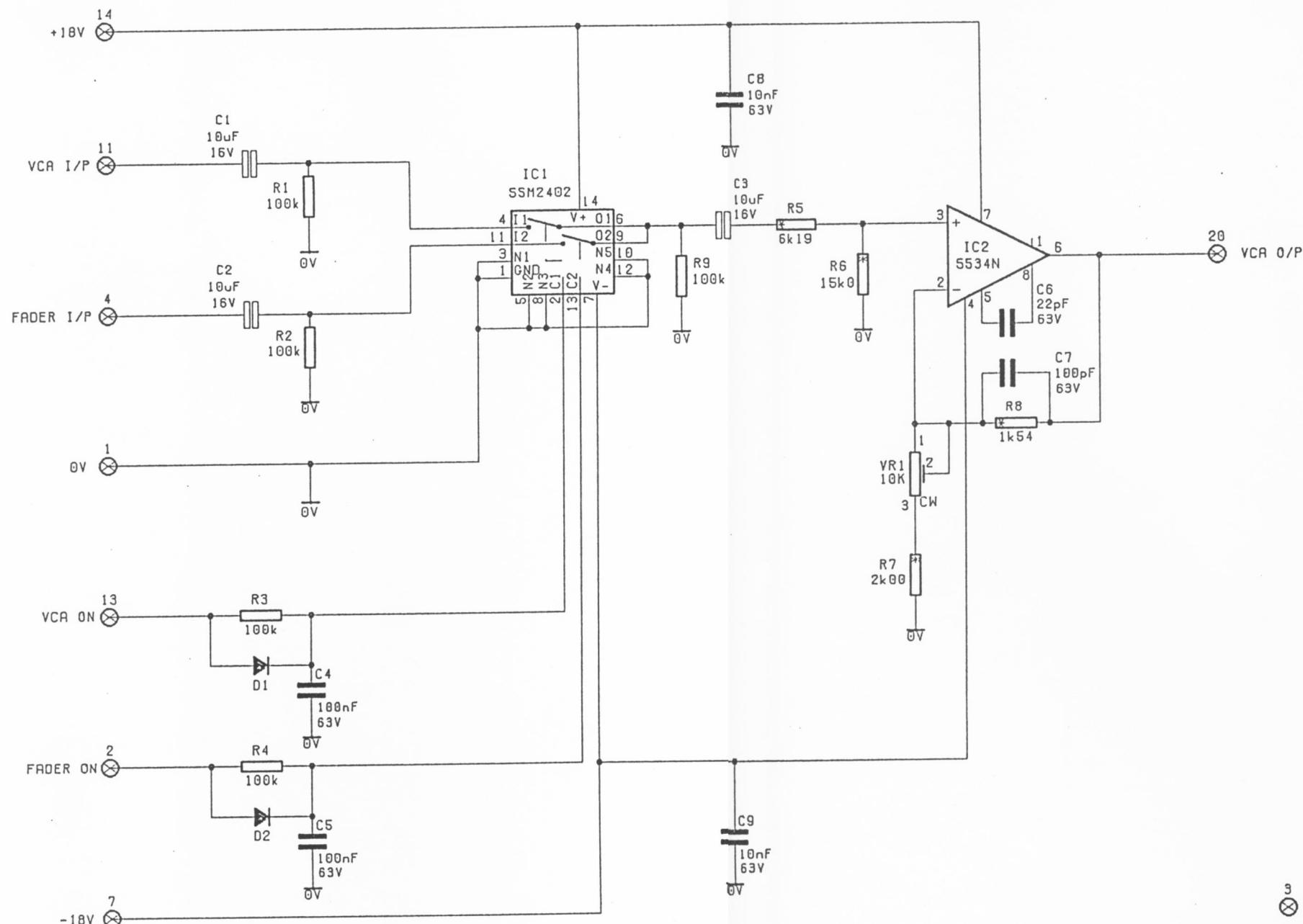
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## STEREO VCA & IMAGE CONTROL

No. T82213-71-2

## Solid State Logic

EV	ISS	DATE	DETAILS	
0	A	25 JAN 91	NEW DRAWING	BC MM



PCB ISSUE AB

SEARCHED ON 06/07/00 115

## TITLE MOVING FADER VCA TIMING INTERFACE

DRG. NO. 700001-81

182361.71

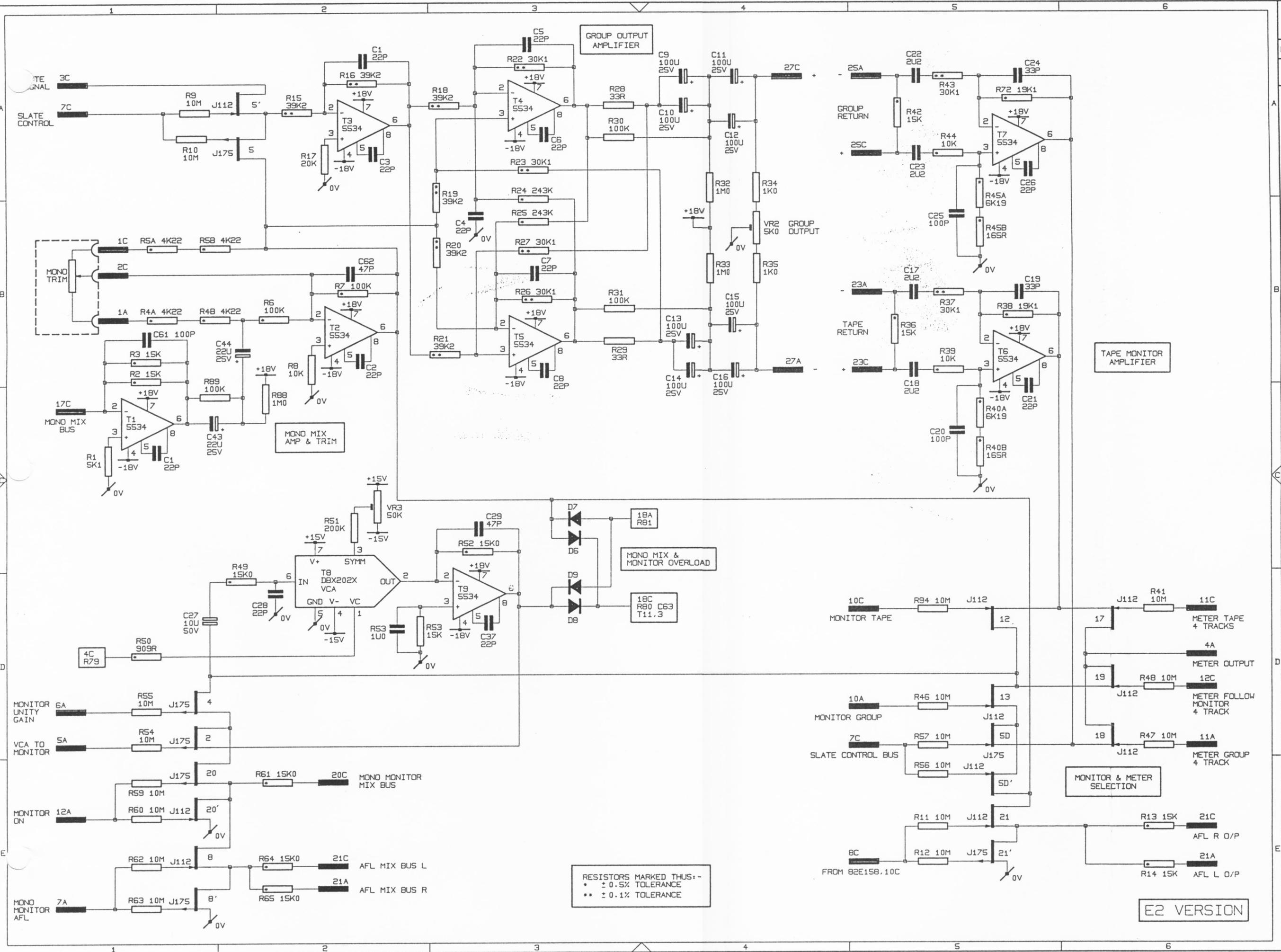
SHEET 1 OF 1

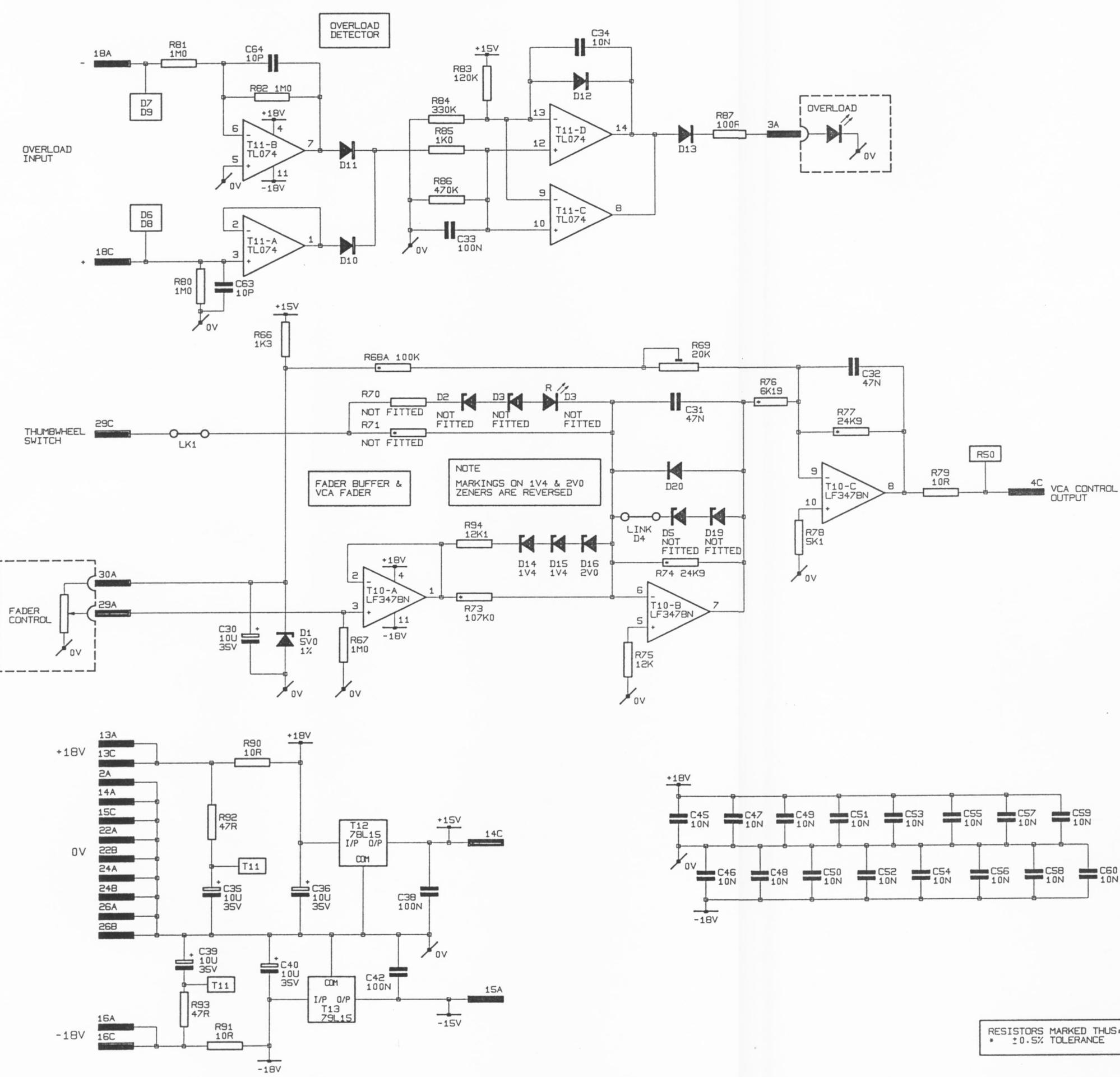
— 16 —

# Solid State logic

# Solid State Logic

REV	ISSUE	DATE	DETAILS
0	A	25 JAN 91	NEW DRAWING BC MM





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ISSUE	DATE	DETAILS	
A	25 JAN 91	NEW DRAWING	BC MM

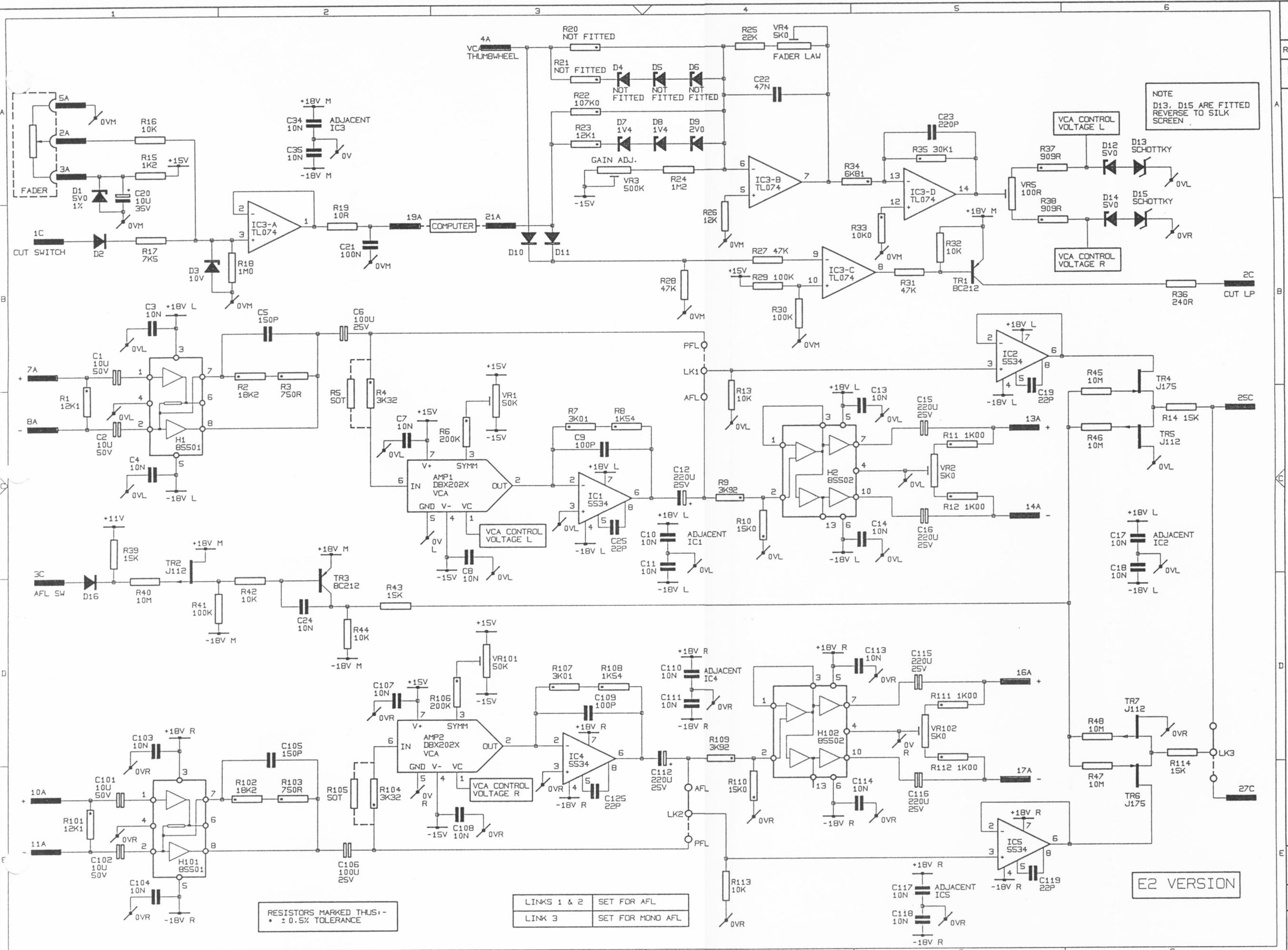
SHEET 2 OF 2

688V  
MONO GROUP/MONITOR

TOP SECRET 34 2

## Solid State Logic

REV	ISSUE	DATE	DETAILS
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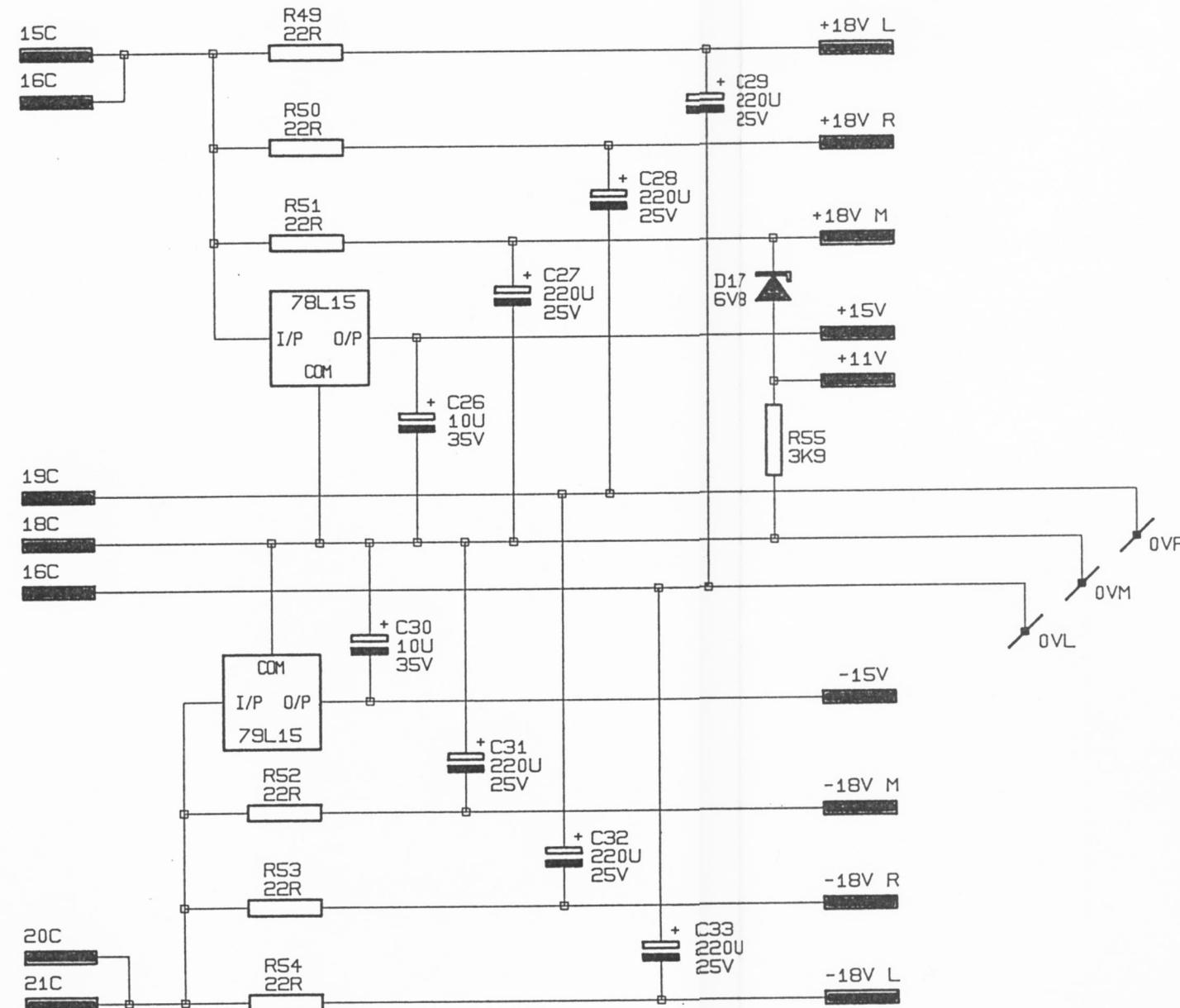
SHT 1 OF 2  
REF: T6228 A2

TITLE SL622  
GSERIES STEREO PATCHABLE  
VCA'S ( MOVING FADER )

DRG. NO. T82320.71.2

Solid State Logic

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## E2 VERSION