The MUTE LED is on the RH PCB, at the bottom of LED ladder 1. When an attack occurs, the control voltage rises to 0V to turn on the FETs, and TR6 (RH PCB) is turned on via R19, extinguishing LED1.

Incoming signals arrive from S8-C (RH PCB) which removes the audio drive when the gate is not used. It also applies a ground to turn on TR6 via R186 (RH) to keep the MUTE LED off when the gate is not used. The main gate in/out selection is via S8-D (RH). S8-A (RH) ensures that the filter section is transferred back into the main path and out of the sidechain when the gate is not used, despite the position of the filters-to-sidechain switch S6 (RH).

The connection between S6-B Pin 4 and CN5 3 (RH PCB) ensures that the filter block is always in circuit when it is switched into the sidechain, regardless of the position of the normal filter in/out switch S5.

NOISE GATE ALIGNMENT.
There are only two presets, and neither should require adjustment unless components in the low-noise amplifier section have been replaced.

PR1 sets the shutoff null. To adjust, apply a 1kHz signal at nominal level, and turn THRESHOLD up to maximum so that the gate is off. Measure the output at the insert send (insert switched PRE) and adjust PR1 for a null. Measuring equipment reading down to -90dBu is desirable, but in an emergency simply setting PR1 to mid-position should give acceptable results.

PR2 compensates for FET tolerances. Use the LK2 position (calib) and adjust PR2 for a fixed attenuation of -10dB. There is a distinct time-lag in this adjustment due to C22, which makes it rather awkward, but it should never be necessary to alter PR2 except in the unlikely event of one or both of the FETs being replaced.

INSERT SEND AMP. (RH PCB)
This is a ground-cancelling unity-gain stage built around IC3-A. In the usual unbalanced mode, ground-cancel pin CN2A 7 is grounded at the console, and incoming signals are attenuated by 6dB by R21,25, before 6dB amplification set by feedback network R22,23, giving overall unity gain. In ground-cancel mode, CN2A 7 is connected to the ground of the remote equipment, and any unwanted ground voltages are added to the output signal via R25, so that as far as the remote equipment is aware they cancel. Output impedance is very low due to feedback around R24. R26 holds down the ground-cancel line (note that this is an INPUT and not an output) if it is left unconnected.

INSERT RETURN AMP. (RH PCB)
This is a standard differential amplifier (IC2-B) configured for unity gain. C6 gives DC blocking. S10-B switches between the insert return and direct signals, and S9-A,C,D switch the insert before or after the EQ.

EQ SECTION. (LH PCB)
The EQ sections are apparently quite standard, but in fact incorporate subtle optimisations of impedance and loading to give the lowest possible noise. As usual, when the EQ is switched out it is completely removed (by S12-C, LH PCB) from the audio path and the input to it is also removed by S12-A, minimising the generation of redundant ground currents.

The HF section is based on IC10. The frequency is set by VR5-B and VR5-C in parallel, forming a simple high-pass filter with C28. This time-constant is driven by unity-gain buffer IC10-B to isolate it from the source impedance of the attenuator R72,73 that sets maximum boost/cut. Wrong resistor values here can cause HF oscillation. Boost and cut are controlled by VR5-A, which selects feedforward or feedback from before or after inverter IC10-A; this signal is then passed through the sidepath filter, which removes LF so that the control is only effective at HF, and applied to IC10-A non-inverting input.

The HI-MID section is a parametric equaliser with a state-variable filter in the sidepath. This filter has fully variable centre-frequency and Q (bandwidth); note that the Q pots are on the RH PCB. Feedback/feedforward is taken by VR6-A around inverting stage IC11-A, and fed to the SVF via R86. The filter bandpass output is taken from IC12-A, attenuated by 6dB by R78,80, and applied to the non-inv i/p of IC11-A to produce boost/cut over a defined band of frequencies only. The state-variable filter is composed of adder/subtractor IC11-B, and integrators IC12-A,IC12-B. The related capacitors C30,31 define the basic frequency range while VR6-B,VR6-C provide the centre-frequency tuning. R87,88 define the tuning range. Feedback to the adder/subtractor is via R83 & R85, and is controlled by VR1 (RH PCB) to set the Q.

The LO-MID section is identical to the HI-MID section, except for the higher values of the integrator capacitors C32,33, to give lower operating frequencies.

The LF section is very similiar to the HF section, though the sidepath filter is either lowpass, or low-Q bandpass, in shelving and peaking modes respectively. No sidepath buffer is required.

The peak/shelf network consists of R34,C10,S11 on the RH PCB. In shelving mode (S11 not depressed) C10 is shorted out and R34 sets maximum boost/cut; VR9-B and VF9-C in parallel form a lowpass filter with C34 that sets the frequency of operation. In peak mode S11-C brings the additional time-constant of C10 into the sidepath, and S11-A reconfigures VR9-C to form the bottom arm of a Wien network that determines the centre-frequency for peak/dip operation.

PEAK DETECTOR. (RH PCB)
This consists of D3-D8, IC1-B as a multi-point full-wave peak-detector, and TR1 as LED driver. If any one of the peak-detect lines goes above the threshold set by R3,4,5, one of D3,5,7 conducts and the junction of R3-R4 is pulled up, lifting IC1-B inverting input above the non-inv i/p, and causing the opamp o/p

to fall. Similarily, on negative peaks one of D4,6,8 conducts and pulls the opamp non-inv i/p below the inv i/p, and once more the o/p pulses low. This rapidly discharges C1 via D9, turning off TR1, and allowing LED2 to light.

When the peak passes C1 charges slowly through R185 and TR1 turns off again; this gives a fast-attack slow-decay action that clearly shows short transients.

PFL/AFL SWITCHING. (RH PCB)
The pre-fade listen (PFL) takeoff point is immediately after the normal position of the insert return, R72 being the mix resistor summing the input signal into the PFL virtual-earth bus. Normally analog gate IC15-C is off; IC15-B is on, shorting R72 to ground. When the input is soloed the gates reverse their states and current is allowed through to the PFL bus via IC15-C.

The after-fade listen (AFL) takeoff point is immediately after the fader post-amp, and works in the same way. The mix resistor is R71.

Both PFL and AFL buses are balanced, with in-phase and anti-phase buses running parallel at all points so that capacitative crosstalk is largely cancelled. The anti-phase tracks to IC15 simply stop dead on reaching it.

If IC15 is replaced, use only 4066 devices or crosstalk and distortion will suffer. However, in an emergency 4016 devices will give acceptable results.

ELECTRONIC MUTING. (LH PCB)
This is centred on IC16, and is performed by the series-shunt pair of FETs TR11,TR12. As in many circuits in the S3200, the sophistication of this circuit is not immediately obvious, but need not concern the maintenance engineer as it is a property of the configuration employed rather than adjustment or selection of components. When muting occurs TR11 turns on, grounding R174, and TR12 turns off, preventing signal current reaching the virtual - earth point on the inverting i/p of IC16-B. IC16-A reverses the phase-inversion produced by IC16-B. The gate-control voltages for TR11,12 are carefully tailored and are generated by the Logic Section. (see below) The voltage on TR11 gate swings between 0V and -7.5V, and that on TR12 between +0.4V and -7.5V. It is important that the gates do not swing more positive than this, or the gate diodes will conduct,injecting DC into the signal path.

R111 and C46 form a feedback network that prevents the offset voltages of IC16-B from causing clicks.

The input metering feed may be taken from either pre-mute (install R173, 100 Ohm) or post-mute,prefade. (install R175, 100 Ohm) Do not install both.

FADER POSTAMP. (LH PCB)
A conventional stage (IC17-A) with +10dB gain, high drive capability and low noise. Feedback is taken around R115 to keep the output impedance very low.

ACTIVE PANPOT. (LH PCB)

This is built around VR15 and IC18. The buffer stages provide a modest amount of gain, (approx 1.2 times) set by R117,118 and R120,121, that is modified by impedance-controlled feedback through R116,119. The exact mode of operation is not entirely obvious but faultfinding is straightforward.

SOUNDCRAFT ACTIVE PANPOT TECHNOLOGY
IS COVERED BY
PROVISIONAL PATENT No. 8800168.

ROUTING MATRIX. (BOTH PCBS)

This is straightforward in all except its physical construction; if you are unable to find the summing resistors they are located under the front of the routing switches. If resistor replacement is necessary 1/8 Watt types must be used, with care taken that they do not foul the switch-cap when installed. The Soundcraft proprietary routing system is used which combines the minimal bus noise of conventional switching with the low-crosstalk capabilities of back-grounding. This Third Method has been in use since 1980 and offers overwhelming advantages over standard techniques. When combined with the use of fully balanced buses the routing crosstalk is almost beyond detection by instrumentation.

The routing matrix falls into two sections; the lower 24 groups and the upper 8. (known as the high groups) They are different because the lower 24 have intelligent switching that removes the audio drive to the mix resistors when none are in use. The upper 8 do not have this, and are accessible by the RTG system as well as by the conventional path.

The component references in the following section refer to the routing matrix on the LH PCB. The balanced group buses require an anti-phase drive, and so each routing switch has two resistors associated with it. (eg Group 1 is S1 and R133,134) The antiphase drive is given by buffer IC19-A and inverter IC19-B, driven via FET TR13. When the lower routing matrix is not in use, ie no switches are depressed, the audio drive to the matrix is removed by TR13 turning off, in order to reduce power consumption and eliminate any possibility of crosstalk to the group buses. This is done by passing a small current from R165 through the back-contacts of the routing switches S1-D to S12-D. If none of these switches are pressed this current keeps TR14 turned on, pulling TR13 gate down to -24V and turning it off. Pressing any switch breaks the current, TR14 turns off, D14 is reverse-biased, and TR13 is turned on by bootstrap resistor R124.

Signal flow to the MIX switch must not be interrupted by this system, so IC17-B is another inverter that gives an anti-phase drive to MIX switch S22 (RH PCB).

The routing matrix on the RH PCB operates in exactly the same way. The RTG switching for the high 8 groups is dealt with under AUX SENDS.

AUX SENDS.
There are two stereo sends and 8 mono sends, the latter switching on/off and pre/post in pairs. Electronic pre/post switching and manual on/off is on the RH PCB, while the level controls are on the LH PCB.

Stereo-A pre/post switching is done by IC16, making up two series-shunt switchers working at virtual-earth, as used in the PFL system. IC6-A is a shunt-feedback stage that generates the virtual-earth at its inverting i/p. R73,74 are grounded by IC16-A and IC16-B respectively, when not used. C22 gives HF stability. The prefade feed to R73 can be taken either pre or post the muting stage, set by LK5,LK6; for example, with LK6 in place Stereo-A will not cut off when the input is muted.

The complementary logic control signals are applied through isolating resistors R76,77; these prevent a failure in one IC from affecting the control bus, and hence the whole desk. The other auxes have identical switchers; that for Auxes 5 & 6 also has switch S17 to swop the incoming control lines, giving the REV facility. (Local pre/post status reverse)

The Stereo-A send includes a level control (VR9-A) and a conventional panpot (VR9-B,VR9-C) on the LH PCB. The summing resistors (R103,104) and on/off switch (S13-A,S13-C) are on the RH PCB. Other sends (except 7 & 8) are similiar. switching

RTG SYSTEM. (RH PCB)
This allows Auxes 7 & 8 to be transferred to the upper section of the routing matrix to generate extra sends.

In normal use (RTG not pressed) pre/post switcher IC21,IC5-B drives IC10-A and IC10-B via S19-F and R116,R122. The signals are inverted again by IC12, pass through ON switch S20, and go to the LH PCB, to level controls VR14-A,VR14-B. On returning to the RH PCB, they are applied to aux buses 7 and 8 through summing resistors R113,114, and the back-contacts of S19-A,S19-D. In this normal mode, the high group section of the routing matrix is fed with the panpot signal through R115,121, into the virtual-earth points of IC9-B and IC11-A. IC9-A and IC11-B complete the antuphase drive to the balanced routing matrix.

When RTG is pressed, R116,122 are grounded, and R115,121 instead feed the virtual-earth points of IC10-A and IC10-B with panpot signals. These are re-inverted by IC12, sent over to the LH PCB for level control, and then applied to the matrix drivers IC9,IC11 through the normally-open contacts of S19-A,S19-D.

Note that in RTG mode, the signal from the 7-8 pre/post switcher is not used, and no signals are sent to aux buses 7 & 8 from the module concerned. These buses may, however, be used normally by other modules not in RTG mode.

LOGIC SECTION. (RH PCB)
This has several functions, namely:

1) Solo control, and implementation of muting for Solo-In-Place.
2) On/off control of module, and mute FET drive.
3) Control of mic/line input switching, and FET drive.

All logic operates with +7.5V as HIGH, and -7.5V as LOW, unless otherwise stated.

SOLO CONTROL.
Solo status is held in a flipflop built from IC13- A,IC13-B. This is toggled by a contact closure of the SOLO button, aplied to CN8 pins 4,5. The flipflop state is normally maintained by positive feedback through R38, but on shorting pins 4,5 the charge on C11 briefly overpowers the influence of R38, and the opposite logic level is applied to IC13-A, changing the flipflop state. Since R37 is higher than R38, holding down the switch produces no further action, and the circuit has inherent debouncing. Two antiphase outputs are taken to control the PFL/AFL switching, and the active-high SOLO signal also

R40 is the SOLO-detect resistor, which sums a DC current into the virtual-earth SOLO-detect bus. This bus is a proprietary Soundcraft feature that prevents any possibility of clicks being induced into the audio mix buses. When fault-finding it is important to remember that the SOLO-detect bus does not in normal operation change its DC level when a PFL button is pressed.

A SOLO condition is indicated by illuminating the solo button; TR11 is turned off via R67, and the current of LED ladder 3 is allowed to pass through the two LEDs in the switch assembly. LED ladder 3 current is defined at approx 14mA by current-source TR12, biased by D20,21.

The SOLO status is reset on power-up by the brief low generated by R39,C12. D10 quickly discharges C12 on power-down, so that the circuit is ready to operate again at once.

ON/OFF CONTROL.
On/off status is stored in flipflop IC14-A,B which operates as for the SOLO flipflop. The flipflop power-up state may be selected by installing either LK1 or LK2; R41,42 pull up whichever is the unused input. Regardless of whether the button is set as an ON or a CUT button, a low at the output of IC14-B represents ´mute´. IC14-C effectively ORs in muting from the Solo-In-Place (SIP) and programmable mute buses, and IC14-D provides the antiphase drive for the series/shunt FET muting.

The electronic muting shunt FET requires a gate voltage between -7.5V and 0V, provided by D23-R51. The series FET however is biased very slightly positive (+0.3V) when on, to reduce on-resistance and hence distortion, by R48 across D22. The control voltages are slew-limited by R49-C14 and R50-C15, to minimise charge-injection into the audio, and define the fade time at approx 10 mSec.

Solo-In-Place mutes are applied by raising the solo-mute line (coming in via CN3A 1) from -7.5V to -6V, turning on TR14 and pulling down pin 8 of IC14-C, and forcing a mute despite the flipflop status. The module originating the SIP state must not mute, and therefore the solo output from IC13-B, when high, turns on TR13 via R70, and inhibits the incoming solo-mute. For module safeing, switch S27-B defeats the incoming SIP mute by opening the collector circuit of TR14.

The mute buses are selected by switches S23-S26, and any mute signals OR-ed together by D12-D15. A mute is signalled by the bus going from -7.5V to -6V. TR15 is then turned on through R47, once more pulling down pin 8 of IC14-C and forcing a mute.

Input on/off status is displayed by turning off TR10 via R66 to illuminate the two LEDs in the switch. Install LK3 for ON operation. (illuminate when audio on) Install LK4 for CUT operation. (illuminate when audio muted) Power-up state may be chosen by installing LK1 for unmuted, or LK2 for muted. This is quite independent of the ON/CUT selection made.

MIC/LINE CONTROL.

Mic/line status is stored in flipflop IC13-C,D which operates as for the SOLO flipflop, except that it can also be toggled directly by the mic/line master control bus, on an edge-triggered basis. The control bus goes high (-6V) for line mode, turning on TR8, and producing a negative-going edge at its collector. This is coupled into the flipflop by C17, changing its state if necessary. The capacitor coupling allows the flipflop to still be toggled locally if the control bus should cease working. Otherwise the malfunction of any part of the master control could disable the entire console.

Initial reset is performed via the control bus, the power-up state being user-selected on the master-control module.

The audio part of the mic/line switching was described above. The shunt FETs require a gate voltage between -7.5V and 0V, provided by D16-R61 and D19-R64. The series FETs are biased very slightly positive when on, to reduce on-resistance and hence distortion, by R59,R60. The control voltages are slew-limited by R57-C18 and R58-C19, to minimise charge-injection into the audio, and define the crossfade time at approx 10 mSec.

Mic/line status is displayed by the S4 LED, controlled by TR9.

POWER RAILS.

Main +/-17V rail decoupling and fusing is by R35,R36 and C8,C9 on the RH PCB, and R102,R105 on the LH PCB. If a serious fault such as a short between the rails occurs, it is localised to the module. If these resistors are replaced, they should be 1/4W 10 Ohm types spaced off the PCB.

The noise gate sidechain has separate +/-17V decoupling by R103,104 and C38,39 (LH) to keep attack transients etc out of the audio rails

+24V is fused by R179,(LH) and -24V by R180.(RH)

INPUT MODULE LED LADDERS.
The large number of LEDs on this module are connected in series ladders for current economy. When an LED is off, it is shorted out to allow the current to continue to flow down the chain. The LEDs are inevitably spread out over several circuit diagrams, and they are therefore listed below in complete ladders. The ladders on the two PCBs that make up the module are quite separate. In all cases the top of the list is the positive end. Associated switch numbers and LED colours are also given.

LH PCB.

TR15 Current source 6mA
Gp 1 routing S 1 GRN
Gp 3 routing S 2 GRN
Gp 5 routing S 3 GRN
Gp 7 routing S 4 GRN
Gp 9 routing S 5 GRN
and so on...
Gp 31 routing S16 GRN

RH PCB.

LED LADDER 1. (RH PCB)
TR18 6mA Current source
Gp 32 routing S43 GRN
Gp 30 routing S42 GRN
Gp 28 routing S41 GRN
Gp 26 routing S40 GRN
Gp 24 routing S39 GRN
and so on... GRN
Gp 2 routing S28 GRN
Phantom +48V S 1 RED
Phase Reverse S 2 YLO
Line B. S 3 YLO
Filters in. S 5 GRN
Fil to sdchn. S 6 YLO
Nse gate mute LED RED

LED LADDER 3.
TR12 Current source 14mA
Mic/line switch S 4 YLO
ON/CUT switch GRN
SOLO switch RED

LED LADDER 2. (RH PCB)
TR7 6mA Current source
Sdchn ext i/p S 7 YLO
Noise gate in S 8 GRN

Insert PRE S 9 YLO
Insert in S10 GRN
EQ LF peak S11 YLO
EQ in S12 GRN
Stereo A on S13 GRN
Stereo B on S14 GRN
Aux 1 & 2 on S15 GRN
Aux 3 & 4 on S16 GRN
Aux 5 & 6 rev S17 RED
Aux 5 & 6 on S18 GRN
Aux 7 & 8 RTG S19 YLO
Aux 7 & 8 on S20 GRN
Panpot in S21 GRN
Mix routing S22 GRN
Mute bus A S23 YLO
Mute bus B S24 YLO
Mute bus C S25 YLO
Mute bus D S26 YLO
SIP safe S27 RED
Peak detect LED RED

POWER SUPPLY.
LH PCB- Audio opamps are fused by R102,105 and R169,170. Sidechain opamps (IC7-9) are fused by R103,104.

RH PCB- audio opamps are fused by R35,36.

7.02 OUTPUT MODULE.
(SC2795,SC2796)

This consists of the monitor section and the group section. The monitor circuitry is very similiar to that of the input module, and only areas that differ are described below.

MONITOR SECTION CIRCUITRY.

INPUT SELECTION. (RH PCB)
This is done in two stages, using two virtual-earth crossfade circuits as per the input module mic/line selector. The first (IC2-A) selects between Line-A and Line-B. The second (IC2-B) selects between Tape (ie Line-A or B) and Group.

STEREO-A and B.
The pre/post switchers are on the LH PCB rather than RH. However the circuitry is the same.

AUXES 7 & 8. (RH PCB)
There is no RTG switch; instead PAN (S19) switches the feed to auxes 7 & 8 from pre/post switcher IC5-B to the monitor pan feeds, so that pan left feeds aux 7 and pan right feeds aux 8.

FADER SWAP. (RH PCB)
S22 is the fader swap switch. It swaps both the faders and postamps; ie the group postamp stays with the group fader. This ensures that all contacts on S22 are at low impedance, and minimises group-monitor crosstalk. Both postamps have +6dB gain.

MON TO GROUP (RH PCB)
When S21 (simply labelled GRP on the front panel) is pressed, the post-pan monitor signal is removed from the stereo mix bus by lifting the routing resistors R147-150 from it. R148,149 are simply grounded, while R147,150 are instead used to drive two local virtual-earth buses that mix in to the group section in this and the adjacent module.

GROUP CIRCUITRY.

SUMMING AMP. (RH PCB)
The balanced group summing amp is is built around IC10 and TR21,TR22. As with the mic preamp, the requirement is to achieve the low noise of discrete devices combined with the high linearity and economy of industry-standard ICs. A unique differential-mode summing action is produced by TR21,22 that uses common-mode rejection to prevent supply-rail perturbations from degrading the crosstalk figures. If this is not taken into account it can easily provide the ultimate limitation on a console signal isolation. DC conditions are set by R166,168 and negative shunt feedback applied to generate the bus virtual earth through R170,179. IC10-A is a unity-gain inverter that provides a balanced feedback path to the transistor pair, maintaining symmetry and supply-rail rejection. C28 and C49 give HF loop stability.

GROUP INSERT, FADER, ETC.
IC11-A is the ground-cancelling insert- send amplifier. Operation is as for the input module insert.

IC11-B is a standard differential amp that makes up the balanced insert-return. IC22-A is a summing-amp that mixes in the monitor path signal from this and the adjacent output module when the MON TO GPS is pressed, and the monitor signal is being panned between the two group sections. From here the signal feeds S29, the group PFL switch, via R188 the associated routing resistor, and also the group fader via FADER SWAP switch S22. The group fader postamp is a conventional low-noise stage with 6dB of gain. The group postfade signal passes through S22 again, and then drives the group EBOS (see below) and the unity-gain inverter IC22-B, which corrects the phase before applying the group signal to the group/tape input switcher at the start of the monitor path. This group postfade signal also drives the group panpot (LH PCB) which pans it between the stereo mix buses. On the RH PCB, two unity gain inverters IC23-A,B generate balanced signals to drive the buses. R194,195 and R198,199 are the mix resistors.

GROUP EBOS.
IC24 is the EBOS (Electronically Balanced Output Stage), that simulates a floating output-transformer. This operates by virtue of balanced negative/positive feedback and current-sensing through R200-211. Maintenance of this stage is normally limited to IC replacement if the opamp encounters something unpleasant in the outside world. The preset PR2 that controls output balance should be adjusted for equal amplitude on the hot and cold output legs; it should not require adjustment unless resistors in the circuit block have been replaced.

LOGIC CIRCUITRY. (RH PCB)
The solo and mute flipflops are exactly as on the input module. Initial reset is from R39,C12.

Line A/B switching logic is controlled by local flipflop IC13-C,D, with global control via TR8 and C17. Operation is as for mic/line switching on the input module.

Tape/group switching logic is more complex, as it must also allow for tape+group modes, and possible interfacing with the tape machine. The basic tape/group status is stored in flipflops IC30-A and IC30-B. IC30-A Q output goes lo for GROUP monitoring, and high for either TAPE or TAPE+GROUP modes. IC30-B Q output goes high for TAPE+GROUP, and low for all other states. Latch IC26-C,D stores the information that both buttons have been pressed.

When the TAPE button is pressed, pin 12 of OR-gate IC28-D goes high, taking the output high. This sets IC30-A, taking Q high and the output of inverter IC25-C low. These two signals drive the TAPE fets in the group/tape switching block, via R134-137 etc. R134,C39 and R136,C40 control the risetimes of the control voltages, while D26,R135 and D27,R137 prevent the voltages going positive enough to make the fet gates conduct. R139 allows the series-fet gate to go to +300mV to reduce nonlinearity when on. IC25-C also turns off TR19 via R144, allowing the TAPE pushbutton LEDs to light.

When GROUP is pressed the R input of IC30-A is taken high, the flipflop is reset and Q goes low. Normally IC27-B output will be high, and so NAND-gate IC27-C output goes high, taking IC27-D output low. This drives both the group fets (via R130-133 etc) and turns off TR20 via R145, lighting the GROUP pushbutton LEDs.

When the MON TO GROUP button is pressed, pin 13 of IC27-D is held low, keeping its output high, and preventing the group from feeding the monitor section, which would create a feedback loop.

When both TAPE and GROUP are pressed, the output of OR-gate IC28-A goes low, taking the output of IC25-A high, and setting IC30-B, so that Q goes high, turning on direct group metering via IC29-A. IC25-D output goes low, turning off normal monitor metering through IC29-B. IC26-A output also goes low only when both buttons are pressed, setting latch IC26-C,D so that IC26-C output goes high and IC26-D output goes low. IC30-A is therefore set, while the output of IC27-A is forced high, applying a low to the R input of IC30-B. When both buttons are pressed, IC28-B output goes high, and IC28-C output goes high, enabling IC27-A.

Note that both buttons must be released before a single-button press can switch the system out of TAPE+GROUP mode. When both are released, the output of IC26-B goes low, resetting the IC26-C,D latch, and enabling IC27-A.

Master control of tape/group mode is via a line that controls TR24 via R220. When the line goes low, to signal TAPE, TR24 collector goes high, applying a transient high to IC28-D via C73. Negative pulses are clamped by D33. When the line goes high, signalling GROUP, IC13-E output goes high, pulsing IC28-B pin 6 high. These edge-triggered actions are equivalent to manual button-presses.

If a master-record line is available, it drives TR29 via a control line (REC BUS) which originates from an opto-isolator on the first output motherboard (Groups 1-8) It is assumed that REC BUS will transition high to signal "entering record" and go low to signal "leaving record". On entering record, TR29 collector goes low, forcing IC27-B output high. If the logic is in TAPE+GROUP mode, then pin 8 of IC27-C is high, but the output will be low, taking IC27-D output high, and turning on TR20, which would extinguish the GROUP switch LEDs. However, in TAPE+GROUP mode IC30-B Q will be high, and IC25-D output low. TR30 is therefore free to be turned on and off by the flash bus via R225, flashing the GROUP button LEDs to remind the operator that while TAPE is being monitored, GROUP is being metered.

On leaving record, TR29 collector goes high, applying a positive pulse to IC28-C via C75. This resets IC30-B, so that the system leaves TAPE+GROUP and is left in the normal TAPE mode.

Meter source switching is done by analogue gates IC29-A,B, which select either group or monitor as source; in the latter case the monitor source switching performs meter switching. The 22k resistors in resistor-pack SR2 reduce the incoming signals by 6dB to keep them within the +/-7.5 rails of the gates. This is allowed for in meter calibration.

LED LADDERS ETC.
RH PCB. Thc small switch LEDs are driven from current-sources TR7,TR16,TR18, while the large pushbutton LEDs are driven from TR12 and TR31.

LH PCB.
Carries no LEDs.

POWER SUPPLY.
LH PCB- Opamps are fused by R102,105 and R169,170. The Noise-gate sidechain is separately fused by R103,104. CMOS gates IC20,21 are fused by R156,157.

RH PCB- Monitor section opamps are fused by R120,121. Group section opamps are fused by R163,164. Cmos is fused by R124,125.

7.03 AUX MASTER/OSCILLATOR MODULE. (SC2799,SC2800)

OSCILLATOR.
The actual oscillator is on the RH PCB, centred on IC1,IC2 and TR1. The output amplifier, level controls, routing, and interlock logic are on the LH PCB.

RH PCB.
IC1 and IC2-A form a state-variable bandpass filter. IC1- A is the adder/subtractor and IC1-B,IC2-A are the two integrators, with integration capacitors C1,C2 and C3,C4. Switching between the two sets of capacitors with S9 performs the 10x range-switching. Fine frequency selection is done by switching the integrator input resistors with a mechanically- interlocked switchbank. The amplitude of oscillation is regulated by the TR1,D1-4 network, which is the upper arm of a potential divider feeding the non-inv i/p of IC1-A. The lower arm is R20, and oscillation only occurs when the bottom end of this is grounded by FET TR1 (LH PCB). As the oscillation amplitude increases, TR1 is turned on via divider R25,26, and reduces the dynamic impedance of the upper arm. This increases the negative feedback and thus reduces the oscillator level again. D1-4 form a full-wave bridge that always applies the signal to TR1 in the correct polarity.

LH PCB.
The oscillator signal is sent over to the LH PCB via C5, and is controlled in level by either VR1 or preset PR1, depending on S5. IC1-A provides 2dB of gain and impedance buffering. IC2 is the oscillator EBOS (electronically balanced output stage) that is routed permanently to the patchbay.

When RED LIGHT is true, a logic high originates on the effects/comms module and reaches R14 via the upper motherboard and CN4 pin 2. This turns on TR18, pulling the gate of TR1 low, turning it off and stopping oscillation. S4-B, the oscillator ON switch, kills oscillation by placing a short across TR18, with the same effect. A low on TR18 collector also disables the oscillator routing switches S1,2,3, to prevent any possibility of crosstalk to the buses.

ROUTING SYSTEM.
The system for routing the oscillator to the group, mix, and aux buses is shared by the listen and talkback signals, and therefore each feed has a source-select circuit as well as on/off arrangements that ground unused slate resistors; oscillator has the lowest priority. When the oscillator is slated to the groups the signal, IC7-A is off, and IC7-B on, allowing signal through R35 to inverting stage IC3-A. IC7-D and IC8-B are held off to prevent listen or talkback signals getting through. The signal is again inverted by IC3-B to provide antiphase drive to the balanced group buses, and both signals pass through series FETs TR5,6 to reach the buses. The group slating resistors are in SIL packages RP3-RP10; when not in use they are grounded by TR7,8 to prevent crosstalk to the groups.

The oscillator/talkback feed to the stereo mix bus is similiar, though there is no listen feed. The oscillator signal passes through R32 and IC8-D to inverters IC4-A and IC4-B, which provide balanced drive. Signal passes through series FETs TR10,11, and across to the RH PCB, where slate resistors R34-39 are mounted. TR12,13 ground them when not used.

Only the oscillator routes directly to the aux buses; there is no source selection, and the oscillator signal passes through TR15 to the slate resistors R40-R51 on the RH PCB. When not in use they are grounded by shunt FET TR16.

The listen signal originates from the listen mic preamp on the effects-return/comms module, and reaches the aux master module in virtual-earth format, to prevent crosstalk on the upper master motherboard. IC2-B on the RH PCB acts as a summing amplifier, turning the signal back into a voltage. From here it goes to the LH PCB, and is applied to R34, the listen input of the group slating source selector.

The talkback signal also comes from its mic preamp on the effects/comms module via a motherboard virtual-earth line that is picked up and converted bu IC1-B on the LH PCB. This feeds R31 (mix source select) and R33. (group source select)

INTERLOCK LOGIC.
There is only one set of slate resistors for each set of buses and so interlock logic ensures that only one source uses them at a time. Talkback has highest priority, then listen, and finally oscillator.

The oscillator routing is set by switches S1,S2,S3, as follows:

OSC TO GROUPS
(MTRK switch S2) Normally D3,D4 are reverse-biased and the collector of TR18 is high, so pressing S2 applies a high to IC5-D. This applies a low to IC7-A turning it off, and through inverter IC6-A applies a high to IC7-B, turning it on and allowing oscillator through to IC3-A. If either talkback or listen are enabled, D3 or D4 will pull down IC5 pin12 and prevent pin 11 going low, so the osc routing is inhibited.

The high at IC7-B turns on TR9 via D9, pulling down D12 and turning off shunt FETS TR7,8. TR30 turns off via R41, and D13,D14 become reverse-biased, allowing R39,40 to pull the gates of the series FETs high, and thus turning them on, and giving access to the slate resistors. Listen and talkback obtain access via D10 and D11 respectively.

OSC TO MIX
(2TRK switch S1) This applies a high to IC5-C. If no talkback is requested IC5 pin 9 is high and pin 10 goes low, turning off IC8-C, and turning on IC8-D via IC9-C, (wired as an inverter).

The high at IC8-D turns on TR14 via D15, pulling D17 low and turning off shunt FETs TR12,13. TR32 turns off via R51 and D18,19 become reverse-biased, allowing R49,50 to turn on series FETs TR10,11. Talkback obtains bus access by means of a high on D16.

OSC TO AUXES
(AUX switch S3) There is no interlock as only the oscillator goes direct to the aux buses. A high from S3 turns on level-shifter TR17 via R56,57, and D21 is pulled low, turning off shunt FET TR16. TR32 is turned off via R176, allowing D20 anode to be pulled high by bootstrap resistor R59, and turning on series FET TR15.

Listen and talkback routing operate as follows; three active-low logic signals demanding slate resistor access come from the effects/comms module via the upper motherboard; these are 'request listen to groups','request talkback to groups', and 'request talkback to mix'. The three signals are sent to the LH PCB via CN4, where they control TR2,TR3, & TR4 respectively. In each case, the collector going high signals that bus access is required.

The RED LIGHT signal over-rides all three via R17 and diodes D6,7,8, which turn on TR2,3,4 when RED LIGHT goes high, preventing talkback/listen access to the bus during recording.

LISTEN->GROUPS.
The high on TR2 collector is applied to IC5-B; if no talkback is required IC5 pin 6 is high, allowing pin 4 to go low, turning off IC7-C, and turning on IC7-D. The slate resistors are enabled via D10. The oscillator path is disabled via D4.

When talkback is enabled, IC5-B is prevented from responding.

TALKBACK TO GROUPS.
The high on TR3 collector is inverted by IC5- A, and the resulting low turns off IC8-A, and turns on IC8-B via inverter IC6-C. The slate resistors are enabled via D11.

Listen is disabled at IC5-B, and oscillator routing is disabled via D3.

TALKBACK TO MIX.
The high on TR4 collector turns on IC9-B and turns off IC9-A via inverter IC9-D. The inverter output also disables the oscillator routing by pulling IC5 pin 9 low, forcing IC5-C output to remain high.

STEREO AUX MASTERS.
There are two identical stereo master sections. Each channel consists of a discrete/opamp hybrid summing amp, with headroom enhanced by Negative Impedance Converter techniques applied to the level control/postamp combination. This is followed by the ON switch and EBOS. (Electronically balanced output stage)

The Stereo-A summing amplifier is composed of TR2,TR3, and IC3-A,IC4-A on the RH PCB. TR2 accepts the virtual-earth bus at its emitter, via C11, while TR3 forms the other half of the balanced circuitry. This gives excellent linearity and rejection of supply-rail disturbances. Emitter resistors R60,61 are decoupled from supply by R73,C31. Collector loads R63,64 are decoupled by R65,C32. The signals at the collectors are subtracted by IC3-A, which provides the combined o/p signal through DC-blocker C12. The main feedback path that creates the virtual-earth is via R68, IC4-A and R66. C13 gives HF stability.

The level is set by VR2 on the LH PCB, followed by postamp IC10-A; the basic gain of this stage is set by R63,64,65. The signal is passed back to the RH PCB via C17, as is an attenuated version taken from R63,64, which is applied to feedback inverter IC4-A on the RH PCB. This increases its gain, being equivalent to operating IC4-A as a form of negative impedance converter that places a negative resistance in parallel with R66. In other words, the effective resistance of R66 is increased as the level control is advanced towards maximum. This allows the basic summing amp to be run at a low gain, giving high headroom, but with its gain increasing as the level control is advanced. Therefore there is no noise penalty at low gain, as it is not necessary to have a high gain postamp after the level control to restore the total gain.

The ON switch S10 is conventional, and feeds an EBOS as used the output module. (See above) The AFL switch is S11; the two stereo channels are summed to mono by dual .mix resistors R77,78 and R79,80. Both PFL and AFL buses are fed so that the solo signal is always AFL no matter which bus is selected by the master switch on the CSP module.

Only Stereo-A has its EBOS on the aux master module. The other EBOSs are carried on the RH PCB of the module to the left of the aux master. In 32-group consoles this is apparently blank, but is still fitted with its RH PCB. In 24-group consoles the LH PCB is also fitted, carrying summing amps for buses 25-32, gain controls and AFL switches, etc.

MONO AUX MASTERS.
These are very similar to the stereo masters, the main difference being that the EBOS stages are not fitted in the aux master module, and that no mono-summing is required on the AFL feeds.

PRE/POST MASTER SWITCHING. (LH PCB)
Only that for Stereo-A is described; the rest are identical. S6 is the pre/post switch, and IC12-A,B provide the antiphase logic signals that are applied to the control lines. Their risetime is controlled by R66,C18 and R67,C19.

FLASH BUS OSCILLATOR.
This is a simple 2Hz sinewave generator that drives the flash bus. This distributes the slow sinewave throughout the desk, and it is used whenever a flashing LED is required. A sinewave is used to eliminate any possibility of inducing clicks into audio.

IC11-A is a multiple-feedback bandpass filter with 2Hz centre-frequency. Its output is soft-clipped by IC11-B, with diodes D22.23 in its feedback loop to set the clipping. The clipped waveform is fed back to the filter to maintain oscillation, and the flash bus driven from the filter output via R77, after most of the clipping distortion has been filtered out. The output should be a clean sinewave of about 2V pk-pk amplitude, centred about -7.5V

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LED LADDERS.

There are two ladders on the RH PCB and one on the LH PCB, arranged as shown below. The lower section of the TR4 ladder on the RH PCB comprises all the AFL buttons and their associated LEDs, and are flashed on and off by the 2Hz flash bus. This bus drives TR9 (RH PCB) by R86, which in turn drives level-shifter TR30 on and off, and this drives TR8, which intermittently pulls down the anode of LED S11-E to -24V. Thus the lower LEDs are shorted out at 2Hz, while those in the upper section of the ladder are unaffected due to the constant-current feed from TR4.

Note that the LEDs are labelled as part of the switch to which they are asociated, eg the Stereo-A ON switch LED is called S10-E.

LH PCB LADDER.	RH PCB LADDERS.	
TR19 Current source	TR4 Current Source	TR5 Current source
S1 2TRK	S8 2000	S12 ON
S2 MTRK	S7 1500	S14 ON
S3 AUX	S6 1000	S16 ON
S4 ON	S5 700 .	S18 ON
S5 CAL	S4 400	S20 ON
S6 PRE	S3 100	S22 ON
S7 PRE	S2 50	S24 ON
S8 PRE	S1 20	S26 ON
S9 PRE	S9 X10	S28 ON
S10 PRE	S10 ON	-24V rail
S11 PRE	S11 AFL flash	
-7.5V rail.	S13 AFL	
	S17 AFL	
	S21 AFL	
	S25 AFL	
	S29 AFL	
	-24V rail	

POWER SUPPLY.

RH PCB- The oscillator is fused by R52,53 on RH PCB. The Stereo-A EBOS is separately fused by R120,121, and the summing amps are fused in groups of 4 by R98,99 etc. The +/-7.5V rails are fused by R30,31.

LH PCB- Alignment oscillator and 2Hz flash oscillator are fused by R132,133. Aux postamps are fused by R134,135. CMOS rails are fused by R136,137.

7.04 EFFECTS-RETURN/COMMUNICATIONS MODULE. (SC2801,SC2802)

EFFECTS-RETURN SECTIONS.
(LH PCB) There are 4 identical stereo return sections. The L channel of Section 1 will be described.

IC1-B is a standard differential amplifier that converts the incoming balanced line-level signal to a single-ended format at the nominal internal level of -2dBu; C3 gives DC blocking. IC2-B is the HF/LF equaliser stage, giving a Baxandall tone-control characteristic, though the circuit configuration is somewhat different from that of a standard Baxandall. VR1-A controls HF cut and boost in the usual way by controlling the amount of negative feedback applied via R7; C4 limits this action to high frequencies. VR2-A controls LF cut/boost by applying a variable amount either of feedback or feedforward to the non-inverting opamp input. R6,8 & C5 limit the action to LF and define maximum cut/boost. VR3-B controls the stereo auxiliary send.

VR4-A acts as the return fader; it is in fact part of an active gain-control stage (IC3-A, IC4-A) that provides superior noise and headroom performance, as well as optimising stereo balance as gain is altered. Similar circuitry is used on the CSP module. IC3-A is a unity-gain buffer that prevents loading of the pot, while IC4-A provides the gain; max gain is set by the ratio of R11 and R12.

The signal now passes to the RH PCB, and to the submix resistors R10,11 via the ON switch; when not pressed the switch grounds these resistors by its back-contacts. A submix is generated by IC1-A,2-B so that it is only necessary to convert to balanced format once rather than 4 times; this is done by IC1-B,2-A which act as shunt-feedback inverters, with unity-gain defined by R45,47 and R50,52.

Also on the RH PCB, S1 switches the stereo aux send between Stereo-A and Stereo-B, back-grounding whichever pair of routing resistors (R6-R9) are not in use, to minimise crosstalk.

S3 routes PFL to both PFL and AFL buses, so the solo mode here is PFL regardless of the selection made at the master PFL/AFL switch. The L and R stereo channels are summed to mono for each bus. R1 signals the PFL/AFL condition by injecting a small positive current into the virtual-earth enable/detect bus.

TALKBACK CIRCUITRY. (LH PCB).
IC17 is the talkback mic preamp, with a gain between 20 and 70dB, set by VR18. This is a high- quality implementation with very low THD due to the balanced feedback structure employed, and the same low noise as the preamps in the input modules. One phase of negative feedback is via R113; IC17-B is a unity-gain inverter that gives antiphase feedback through R112. C88 ensures that direct feedback dominates at HF. R200 sets maximum gain, while R205 defines the input impedance at 2KOhm. Its unswitched output is sent to the other master modules via virtual-earth buses on the motherboard; this minimises crosstalk. The routing resistors for this are R61,62 on the RH PCB.

In addition three switched talkback outputs (EXT1, EXT2, & BOOTH) are fitted om the LH PCB; only EXT1 is described, the others being identical. IC19-A is an electronic muting block similar to those on the input modules; when muted fet TR6 is on, grounding R135, and TR7 is off. The stage acts as a ground-cancelling output, as remote grounds may be sampled via the cold input at R136; the spurious ground voltage is added to the output of IC19-A. (See input module description for more details of ground-cancelling operation)

The logic control signal EXT 1 is high (+7.5V) to turn the mute-block on. It is inverted by TR5, risetime-limited by R131,C99 and R132,C98, and prevented from forward-biasing the fet gates by D5,6 and R133,134. The EXT 1 logic signal originates from the illuminated pushbutton connected to CN7; when this pressed R172 is pulled high (assuming RED LIGHT is not on) and IC23-E output goes low, turning off TR19 and allowing the pushbutton LEDs to come on. IC26-B output goes high, and turns on the mute-block IC19-A. IC26-B may also be sent high by pulling the not-ALL signal low. This comes from IC25-C, and turns on all talkback destinations at once.

Other talkback destinations are also triggered from this module, though the actual audio switching is on either the aux master or the crm/phones module. Logic signals are sent out via the motherboard, at the usual CMOS levels of +7.5V high, -7.5V low.

When any of the talkback destinations are accessed, the monitor path is dimmed. Diodes D1-3, and D13-18 OR together the talkback enable logic signals, and IC23-B,C generate DIM and not-DIM.

LISTEN CIRCUITRY. (LH PCB).
The listen mic preamp is IC18, with a gain range of 20 to 70dB, set by VR17. It is identical to the talkback mic preamp. Its output is sent to the other master modules via virtual-earth buses on the motherboard; this minimises crosstalk. The routing resistors for this are R63,64 on the RH PCB.

LISTEN TO CRM
(ie Route listen to the control-room monitors) is a latching function, enabled by the flipflop IC21-A,B. This works in the same way as the input module flipflops. IC21-C is used to disable the function, via the not-DIM line, when any talkback is in use. TR16 controls the switch LEDs via R167. The flipflop is initially set to off by the power-up reset circuit R194,C35, which applies a momentary low to IC21-A, via the not-RL line.

LISTEN TO TAPE
(ie Route listen to group buses) is a momentary function, disabled when not-RL (not-red-light) goes low. IC21-D generates an inverted logic signal that is sent to the aux master module via the motherboard. TR17 controls the switch LEDs via R171.

RED LIGHT CIRCUITRY. (LH PCB)
This is a latching function, controlled by the flipflop IC25-A,B. It is initially set off by the not-IR line going momentarily low. TR31 controls the switch LEDs via R191. The RED LIGHT logic signal is sent to the other master modules via the upper motherboard. An opto-isolator IC3 (RH PCB) provides a floating closure to signal RED LIGHT to outside equipment. The current capability of the opto transistor is limited, and further amplification will be required before a mains contactor to control warning lights can be driven.

LED LADDERS ETC.
RH PCB. The pushbutton LED ladders are driven by current-sources TR15,18,22,26,30. These all share reference diodes D11,12. Note that a break in any of the ladders can cause this reference to collapse, turning all the LEDs off.

LH PCB.
The single ladder is driven from current-source TR1. The upper half runs steady LEDs for the ST-B and ON switches, while the lower flashes the PFL LEDs; TR2 is turned on and off by the flash bus, and when on diverts current away from the lower half of the ladder.

POWER SUPPLY.
The whole module is fused for +/-17V on the RH PCB, by R58,59. The +/-7.5V rails are fused by R163,164 on the LH PCB.

7.05 CONTROL-ROOM/STUDIO/PHONES (CSP) MODULE. (SC2803,SC2804)

MIX PATH. (RH PCB)

The left and right mix paths each consist of a low-noise balanced summing amplifier, a ground-cancelling insert-send amp, a balanced insert return amp, the fader, postamp, and electronically balanced output stage.(EBOS) In addition a mono output is derived from the L and R summing amps, and this path also has a similar insert, fader, postamp, and EBOS. The left mix path is described below.

The balanced summing amplifier is built around TR40,41 and IC15. As in the mic amp, the discrete devices provide low noise while the opamps give open-loop gain and drive capability. The two balanced buses are applied to the transistor emitters through C106,107, and a virtual earth is generated at each of these by balanced shunt feedback through R205,206. The output from each transistor collector is summed by IC15-A, and this stage drives both feedback resistor R206, and the unity-gain inverter IC15-B which generates feedback of opposite phase. C109 ensures that feedback at high frequencies is dominated by the direct route rather than that through the inverter, to maintain Nyquist stability. Power to the transistors is smoothed and decoupled by R199,200 & C104,105.

The insert-send outputs are ground-cancelling; in other words the cold leg is used as an INPUT to sample the ground potential of the external equipment. This is then added to the console output, so that the external equipment has its ground and input moving together, and experiences no input-to-ground signal that would allow the entry of interference. For example, on insert-send Left, based on IC17-A, R214 defines the cold leg impedance as very low, and R209,R213 sum the signal from the external ground with the desired signal. The network R211,212,C110 provides a near-zero output impedance (typically less than 1 Ohm) together with stability when driving cable capacitance. The L and R insert-send amps are non-inverting.

The insert-return amp IC18-A is a standard differential amplifier which gives a balanced input. The signal then passes to one section of the stereo mix fader via connector CN11, and then to fader postamp IC19-A, which provides 5dB of make-up gain and gives the necessary low-Z drive to EBOS stage IC20. The EBOS stage is dealt with above in the output module technical description.

The mono path is derived from the two phase-inverted summing-amp outputs, via R255,256. These are combined in IC22-A, an inverting insert-send stage. The remainder of the siganl path is identical to Mix L & R.

The separate mono fader is connected to CN13.

CONTROL-ROOM SELECT. (RH PCB).
The left of the two stereo channels is described.

Selection is performed by switches S1-S8, which select the input resistors for differential amp IC1-A. Unused resistors are grounded on the inward end to prevent crosstalk. R9,10 define the gain for the cassette input.

The main stereo meters are switched between the selected source and PFL/AFL by fets TR1,3. When D1 cathode is high (+17V) D1 is reverse-biased, and TR1 is turned via R37. C9 blocks DC. When D1 cathode is taken low (-22V) it conducts, pulling down TR1 gate and turning it off. TR3 operates in reverse as the logic signals METER and NMETER are complementary.

The monitor source is switched between the selected source and PFL/AFL by fets TR5,6, which work in the same way, driven by logic signals PAFL and NPAFL.

MONO, DIM & LISTEN. (RH PCB).
The mono-check switch S14 sums the two channels by joining R43,44 together. The monitor signal is dimmed by switching on TR11, which connects R43 to ground via R48 and the DIM RATIO control (on LH PCB) to form an attenuator. LISTEN signals are injected into the monitor signal by turning on TR9, which connects the signal to R43 via R45. The low value of R45 automatically dims the monitor signal by a fixed 20dB.

The LISTEN signal reaches the CSP module from the FX/COMMS module at virtual-earth (ie as a current), to prevent crosstalk on the motherboard. IC5-A is a standard summing-amp that converts the signal to normal voltage format.

MONITOR MUTE & LEVEL CONTROLS. (RH PCB).
This is implemented by TR13,15 and IC2-A, the circuit being identical to that used in the input module. It is controlled by drive signals CUT, NCUT from the mute flipflop IC6-A,B. This is the same as the flipflops described on the input module. Initial reset is by R109,C40 briefly holding low an input of IC6-A.

From here the signal passes to the LH PCB via IDC Link 1, where it drives two active gain-control stages, IC4-A,5-A (main vol) and IC6-A,7-A (alt vol) This active control of gain has the advantage that noise with the gain less than maximum is minimised, and the stereo matching is superior. The technique synthesises a log law from a linear pot, eliminating the tolerances inherent in log pot fabrication. The circuit action also eliminates the effect of variations in absolute track resistance, so that only the mechanical construction of the pot can affect balance accuracy. IC4-A is a unity-gain buffer, preventing loading of the pot, while shunt inverting stage IC5-A defines the maximum gain by the ratio of R46 to R47. C14 gives HF stability.

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MONITOR SPEAKER SWITCHING. (RH PCB).
The monitor signal is directed to the MAIN, ALT, or NFS outputs by interlocking switches S25,16 & S15 respectively. The feed to S25 comes from the main volume control block, and the feed to the others from the ALT volume control. From here the main and ALT monitor signals go to standard EBOSs, and then to the external monitor power amplifiers, etc. The near-field (NFS) signal, however, goes through the unity-gain buffer IC25-A, and then switching stage TR31,33 that allows the NFS signal to be replaced by PFL/AFL when the PFL TO NFS button is pressed.

STUDIO SELECT & VOLUME. (LH PCB).
Left channel described. Selection is performed by switches S1-S8, switching input resistors to the differential amp IC1. Once again the inward end of unused input resistors are grounded by the switch back- contacts. The signal then passes through active gain-control stage IC2-A,3-A, as described above, and then to the RH PCB via Link2.

The studio output amps IC13 (RH PCB) are ground-cancelling, as described above, S9 providing muting. TR35,36 inject talkback into the path when switched on by TBSTU going high; the studio signal is dimmed by 20dB, an amount set by R151,153.

The talkback, like the LISTEN signal, reaches this module from the FX/COMMS module as a virtual-earth signal, which is received by IC14-A. IC14-B phase-inverts the talkback ready for injection into the four phones mixers when required.

PHONES MIXER SECTIONS. (LH PCB).
The four stereo sections are identical, and only Section 1, L channel, is described.

The Stereo-A output is acquired on its return from the patchbay, and converted from balanced to single-ended by differential amp IC8-A. The studio feed and Stereo-A Left are summed together by IC9-A in proportions set by VR6 and VR8-A, via R78,79,80. Crossfeed resistors R100,101 sum in the R channel when the Stereo-A input is switched to mono by S17 on RH PCB. R78 is normally shorted out by S17, but is brought into circuit in mono mode to compensate for the gain rise on adding more signals together.

The combined signal is sent to the RH PCB via Link 6, to the PFL/AFL switch S18. Talkback is injected via TR8 (LH PCB) when D5 cathode is pulled high (+17V) by logic inverter TR7, which is in turn driven by level-shifter/inverter TR6. R84,85 give an associated dim of the main signal by 20dB. VR9 is the main phones volume control, feeding inverting ground-cancelling output amp IC10-A.

PFL/AFL SYSTEM. (RH PCB) **PROVISIONAL**

There are separate summing systems for PFL and AFL. Both are fully balanced; this not only cancels crosstalk but also simplifies signal paths, as a PFL switch on any module can access whichever bus is convenient for correct phasing. IC3-A,IC4-A sum the PFL buses, and IC3-B,IC4-B the AFL buses. PFL or AFL is selected by S11, and this feeds the PFL/AFL level trim circuit IC21 (on LH PCB) The returning signal (PAFLTRIM) is applied to the switching fets described above, and also to fets TR33,34, which switch the PFL/AFL directly into the near-field speakers (NFS) when required.

PFL/AFL LOGIC. (LH PCB).

Both PFL/AFL and SIP (solo-in-place) conditions are signalled by injecting a small current into a DC virtual-earth bus. PFL/AFLs are detected by IC20-A, whose output is normally kept at +7.5V by R247. The detect bus remains at 0V. When PFL/AFL is signalled by injecting a small positive current into this bus, IC20-A output goes low until clamped by D9 at - 0.6V. This is insuffıcent to turn on TR22, and its collector goes high, producing a high at the output of CMOS inverter IC22-E, and turning on level-shifter/fet-driver TR18 (RH PCB) which turns off TR19 via R77, thus generating the drive signals for the stereo meter-switching. (See above). If PAFL TO NFS (S12) is not pressed, then TR20,21 act in the same way to switch the PFL/AFL signal into the monitor path.

IC22-A output goes low during PFL and turns off TR4, allowing LED1 to flash and indicate a solo. Flashing is implemented by the flash bus turning TR26 on and off, which in turn controls TR5, in parallel with TR4.

If S12 is pressed, however, nand IC6-D output goes high, turning on TR24, and TR25,26 off, to dim the main monitors and light the DIM LED. (Part of S13; this is the switch for manually dimming) Also TR27 is turned on and TR28 turned off, to drive the fets that switch PFL/AFL into the NFS path. (see above)

This NFS switching must be suppressed when the monitors are muted, as the main monitor mute-block is upstream of the NFS switching, and therefore could not mute a PFL signal. Hence a monitor mute state disables the above NFS switching by applying a low to nand-gate IC6-C.

SIP LOGIC. (LH PCB).

SIP detection is by IC20-B, which works exactly as the PFL/AFL detector described above. A SIP condition switches the output to -0.6V, and turns off TR23.

In SIP mode, when logic signal SIP1 is high (ie when SIP switch S10 on RH PCB is pressed in) this sends the output of and-gate IC24-C high, and the output of IC23-C low, turning on TR25 and pulling up the SIP mute line to its active state, which will mute all modules that are not generating a SIP, and have not been safed. (The active state is -6.0V; the inactive state is -7.5V) R268,C87 control the risetime to prevent clicks being induced. When SIP1 is high, the output of IC23-B is low, keeping IC24-B output low, and preventing the SIP signal reaching D13.

PROVISIONAL

When in PFL/AFL mode (S10 not in), SIP1 is low, and IC24-C output is held low, preventing SIP mutes from being generated. Instead IC24-B is now enabled, so that a SIP condition triggers the PFL/AFL detector via D13 and R254. Thus in this mode, solo conditions originated via the Bonella pushbuttons on input and output modules are treated as PFL/AFL.

A PFL/AFL condition generates a low at the output of IC22-B. This forces the output of IC23-C high, if J1 is installed, suppressing the generation of a SIP mute; thus PFL/AFL states can override SIPs.

RED LIGHT LOGIC. (LH PCB).
RED LIGHT conditions are originated on the FX/COMMS module, and via the motherboard, turn on TR24. This takes IC22-D output low, and SIP mutes are suppressed via D14 and IC24-C.

LED LADDERS, ETC.
On the RH PCB the LED current sources are TR37, TR38. The PFL switches are in the TR38 ladder, flashed by TR39 turning on and off. The SIP LED (part of S10) is separate, with current-limit resistor R70, and controlling transistor TR17.

On the LH PCB the LED current sources are TR1 and TR2. TR1 drives 6mA through the studio-select LEDs, and then TR2 adds in another 6mA from the +7.5V line to give more current through the Bonella illuminated pushbuttons. (connected to CN10) The CUT pushbutton LED is controlled by TR3, which is driven by the CUT flipflop on the RH PCB.

POWER SUPPLY.
Many sections have separate decoupling to minimise the impact of faults. For example, the main, ALT, and NFS output EBOS pairs are decoupled separately by R123,124, R133,134, and R146,147.

7.06 MASTER-CONTROL MODULE.
(SC2837).

This is a straightforward PCB that places control voltages on the console bus to set master status conditions.

MIC/LINE SWITCHING.
This is controlled by flipflop IC1-A,B. This operates as follows; whatever logic state set on Pin 1 of IC1 is held stable by positive feedback through R8. The opposite state is stored on C6 by R9, and when pins CN7 3,4 are connected by the master switch, this is fed to pin 1 where it overcomes the effect of R8. Both gates change state, and are held by feedback through R8. Holding the switch closed produces no more transitions as R9 is higher in value than R8, and so the switch must be opened for a short time to allow C6 to charge to its new value before the flipflop can toggle again. This implements switch debouncing.

Master status controls are locked out when RED LIGHT is on, in this case by IC5-A, which switches off when the signal not-RL goes low. Not-RL is generated by inverter IC4-D from the RED LIGHT signal; this comes from the effects/comms module via the lower motherboard.

Power-up status is determined by jumper J3, which can be set in MIC or LINE position. This decides the significance of the two flipflop states. The flipflop always powers-up in the same state, due to a low on the not-IR line; this is in fact initially the wrong state, as will be explained. At power-up, not-IR is held briefly low by C11, which is then charged by R26 to end the reset period. D6 allows the circuit to generate a reset even after a short power interruption, by quickly discharging C11 as the +7.5V rail falls. After a longer delay set by R27,C12, the second stage of initial reset is applied by IR2 through C5, reversing the original flipflop state. This two-stage process ensures that the critical transition that sets the whole console in the desired state only occurs after the various modules have completed their power-up.

The master status is indicated by the switch internal LEDs, controlled by TR5 via R7. The flipflop output swings from +7.5V to -7.5V, and this is converted to the bus control levels of -6.0V and -7.5V by TR6 and its associated components.

GROUP/TAPE & LINE-A/B SWITCHING.
These operate exactly as the mic/line switching described above.

MASTER MUTE SWITCHING.
These circuits (all four identical) use the same flipflop as described above, but with simple initial-reset from not-IR. For example, Mute bus A is controlled by IC2-C,D. The switch LEDs are controlled by TR16, via level-shifter R23,TR17, and TR18 and associated components transfer the logic swing to the appropriate control-line voltages as above.

LED LADDER.
This is powered by current source TR19, biased by D4,D5, and runs between The +24V and -7.5V rails.

7.07 HIGH-GROUPS MODULE.
(SC2807,SC2806).

The module to the left of the aux master is either apparently blank (in 32-group consoles) or carries what is effectively the aux masters for groups 25-32. (in 24-group consoles) In both cases the RH PCB is fitted and carries the EBOS circuitry for auxes 1 to 8 and Stereo-B. (The EBOSs for Stereo-A are mounted on the aux master module itself) The LH PCB is only fitted for 24-group consoles, and carries the summing amps and level controls for groups 25-32.

Only Group 25 is described.

SUMMING AMPLIFIER. (LH PCB).
This is very similiar to the output module group summing amp described above. The balanced virtual- earth buses are applied to the transistor emitters through C3,C4, while balanced shunt negative feedback is applied through R7,R8. IC1-A is the unity-gain inverter that generates the inverse feedback phase. C5,6 ensure HF stability.

LEVEL CONTROL & POSTAMP. (LH PCB).
VR1 is a normal log pot for level control, with IC2-B as its postamp, giving 10dB of gain. R14,C9 ensure stability into capacitive loads. C10 blocks DC, and the signal passes to the RH PCB.

SWITCHING AND EBOS. (RH PCB).
S2 is the AFL switch, routing the postfade signal to both PFL and AFL buses via R2,3, so that the switch provides AFL whatever the position of the master PFL/AFL switch. S1 is the ON switch, IC1 the EBOS stage, which is exactly the same as those described before, giving a gain of 6dB when driving a balanced input; in other words the two outputs have the same amplitude as the input, but are in opposite phase to each other. VR1 is the output balance preset.

LED LADDER. (RH PCB).
TR1 is a 6mA current source that drives all the module LEDs in one chain. The steady ON LEDs are at the top half, whereas the flashing AFL LEDs are in the lower half, and are intermittently shunted out by TR2, which is driven by the 2Hz flash bus.

POWER SUPPLY. LH PCB.
All summing and post amps are fused by R117,118 on the RH PCB.

RH PCB- Each pair of Group EBOSs are separately fused, so that a fault will only disable a small part of the module. eg Gp 25 & 26 are fused by R15,16.

AUX SEND EBOSs. (RH PCB).
These are as described before, giving 6dB of gain when driving a balanced input. Each has a DC blocking capacitor on its input. They are divided into pairs for power rail fusing, so that a fault in one IC does not disable the whole module.

7.08 METERING SYSTEMS.

Circuit Description - 4-way VU Driver. (SC2877)

The 4-way VU driver card is used for the group and auxiliary meters.

The PCB contains four identical circuits.

The op-amp (IC1-B) is configured as a differential amplifier, the amount of negative feed-back, and hence gain, being set by VR1. This signal is fed to the VU meter, which contains its own rectifier circuit.

Signals to the meters are brought to the drive card by a 26-way ribbon cable containing 8 signals. Links LK1-LK16 select which four of the eight signals the drive card uses.

The auxiliary meters (and high groups meters on small frame consoles) are balanced signals at +4dBu. For group metering, the signal is unbalanced at a level of -8dBu, the "cold" input being grounded at the group motherboard. The preset allows sufficient trim for both levels.

Meter illumination is provided by internal bulbs. The pairs of meters are connected in series across a 24 volt supply, drawing about 70mA. A 10 ohm resistor acts as a fuse in case both sets of bulbs go short-circuit.

The group meter illumination is taken between +24V and 0V, while the mix and auxiliary meter illumination is taken from 0V and -24V.

Circuit Description - Balanced PPM Drive Card (SC2711)

The balanced PPM drive card is used for the mix left and right meters.

IC3-A acts as a differential input amplifier, gain set by VR1. When single-ended signals are used, J4 shorts the cold input to ground. For VU meter use, the output signal is fed straight to the VU meter via a DC blocking capacitor, C2.

For PPM use, IC2-B and IC2-A are used as a precision full-wave rectifier. IC3-B and IC1-B buffer the capacitor C3, which is used to provide the peak hold, giving a negative-going DC level. IC1-A and TR1-TR5 provide the PPM "law" for the meter by piece-wise approximation. At low output levels, the gain is -6.7. As the output level rises, TR5 through to TR1 turn on successively, reducing the gain for the stage, giving the correct law for the meter. The reference chain for the transistors is driven from a voltage regulated by REG1 to prevent supply fluctuations affecting the calibration of the meter.

Meter illumination is provided by internal bulbs, driven from a 24 volt supply.

Circuit Description - Phase Correlation Meter. (SC1847)
The input signals (the left and right mix meter feeds) are converted by IC1-A and IC1-B into square waves 1.2V peak-to-peak.

These are then amplified by IC1-C and IC1-D to give levels suitable to drive the inputs of CMOS gates IC2-A and IC2-B.

The two signals are fed to the inputs of EX-OR gate IC2-C.

This gives a high output only when the two inputs are different. Thus in-phase signals on the two inputs produce no output. As the relative phase of the input signals changes, the inputs of the EX-OR gate spend a larger proportion of each cycle in different states, and so the output of the gate spends more time high. The output of the gate thus produces a square-wave whose duty-cycle is proportional to the magnitude of the phase shift between the input signals.

C3 filters this signal to give a DC voltage proportional to the phase shift between the mix left and right signals. This is fed to IC3, IC4, IC5 and IC6 which drive a 40-segment bar-graph display.

7.09 POWER SUPPLY SYSTEM.

Note: The CPS650 circuit is detailed in ED2769
The CPS550 circuit is detailed in ED2881

The CPS550 and CPS650 are LINEAR power supplies, the operation of which avoids the induction of switching noise, associated with switch-mode designs, in audio signal paths. It has been possible to produce a design which is silent in operation, and which will function over a greatly improved range of mains input voltages. Additionally, the design of each supply is very similar and of a "modular" format that will assist when servicing.

SERVICING.
Initial operational tests on the power supply can be carried out by switching the unit on and checking the voltages present on the output connector on the back of the unit. While the unit remains disconnected from the mixing console the DC voltage rails are floating with respect to each other, that is they do not all have a common reference within the unit. When connection is made to the mixing console the "0V" output pins become earthed to a common star-point, which has a mains earth return in the power supply cable itself. See MI____ and MI____ for the DC connector pin arrangement of each unit.

An indication of obvious fault condition is the failure of one or more of the front-panel LED's to light.

Any fault condition, with the exception of simple mains fuse failure due to underrating or an unusual mains input condition, will require removal of the top cover to enable fault correction. This is achieved using a No.1 or No.2 cross-head screwdriver to remove the five retaining screws and washers. Carefully lift the cover to avoid the earth connecting lead to the cover from snatching. Place the cover face down behind the unit.

NOTE that at the front of the unit just below the top cover is the MAINS PCB, which carries HIGH VOLTAGES directly from the mains input. Therefore care should be taken when carrying out any servicing operation with the top cover removed.

THE PRIMARY CIRCUIT
This is identical for each power supply unit in the series.

The mains supply is applied to the unit via the 3-pin IEC inlet on the back. The earth feed is led directly to the chassis earth stud: AT NO TIME SHOULD THIS CONNECTION BE BROKEN. The LIVE (brown) and NEUTRAL (blue) feeds are led to the double-pole, double-throw rocker switch on the front of the unit, so that live and neutral switching to the following circuitry is made simultaneously.

From this switch, the neutral feed is led directly to the MAINS PCB. The live feed passes through the USER-SERVICEABLE mains fuse situated in the fuseholder on the front, below the ON-OFF switch, and from there to the MAINS PCB.

On the MAINS PCB there is another fuse, in series with the first fuse in the LIVE feed, but of a higher rating (8 AMPS, 250 VOLTS TIME LAG). This is not intended as a user-serviceable component, but is intended to protect the primary circuit in the event of the first fuse being replaced by another device, the breaking capacity of which is above the rating stated on the front panel of the unit.

MAINS VOLTAGE SELECTION is achieved through the three double-pole, double-throw switches on the MAINS PCB. These are used to select the correct combination of transformer primary windings across which the mains voltage is applied. User-access to these switches is via the three pluggable holes in the top cover.

All connections to the MAINS PCB (live,neutral and transformer primary lead-outs) are made through the single, 10-way, latching connector.

SECONDARY CIRCUITS

The design of the regulator circuitry is essentially the same for each supply rail, but with different component values for the different voltage levels and power requirements of the rails.

Each regulator circuit is fused at the input from the transformer secondary winding, to protect against an over-current condition, in the event of component failure in the regulator circuit.

Regulation is achieved using positive, adjustable voltage regulators, each housed in a standard TO3 package, with the exception of the high voltage regulator for the +48 volts rail, which is in a TO220 package.

The following is a general description of the operation of a single regulator circuit as used throughout this series of power supplies.

See figure 1.

1 The mains transformer steps-down the mains voltage to produce the required alternating voltage across each secondary winding. The appropriate pair of lead-outs (same colour) are connected to the REGULATOR PCB via two adjacent pins of a 6-way locking connector of the same type used on the MAINS PCB. One side of this secondary feed is led directly to the bridge rectifier, while the other is routed to the bridge rectifier via the secondary protective fuse. The level of the secondary voltage may be measured by applying an AC voltmeter between points 1 and 2, as shown. This level should be between the limits given in table A.

2 The voltage waveform between points 3 and 4 should be full-wave rectified, and smoothed by the large electrolytic capacitor, so that it should appear as a DC voltage with a small AC 'ripple' element. This level may be measured with the voltmeter set for DC. A 100nF capacitor in parallel with the smoothing capacitor but closer to the regulator ensures its stability under any condition of capacitive load.

3. The regulator is adjustable, the output voltage being set by a preset, in series with a fixed resistance, between the adjustment pin and the "0v" reference. This allows a degree of adjustment approximately equal to:

THE NOMINAL RATED OUTPUT VOLTAGE (V.dc) -10% +(10% + 0.7 VOLTS)

(each preset is set and fixed at the factory test stage)

The actual regulated output voltage level is given by:

Vout = Vref x (1 + Radj/R1) + Iadj x R2

~ Vref x (1 + Radj/R1)   as Iadj is neglible (~100uA)

FOR LM317,LM338 REGULATORS Vref = 1.25V
FOR TL783C REGULATOR Vref = 1.27V

The value of R1 is optimised for each regulator type:

FOR LM317 REGULATOR R1 = 240
FOR LM338 REGULATOR R1 = 120
FOR TL783C REGULATOR R1 = 82

4. The electrolytic capacitor in parallel with the adjustment resistor, Radj ,improves ripple rejection in the regulator, and also produces a time constant that causes the DC output of the regulator to rise more slowly when the unit is switched on. In the case of the +17 and -17 volts rails the rise time is about 3 seconds.

5. The output filter capacitor, between the regulator output and the "0V" reference, eliminates 'ringing' and a slow regulator shut-down time in the event of the output becoming short-circuited.

6. The two diodes around the regulator, situated adjust-output and output-input, provide protection for low-current paths within the regulator in the event of a reverse-bias condition. This occurs when the regulator input voltage is less then the voltage present at the rulator output, causing the output filter capacitor and the capacitor across the adjustment resistor to discharge 'backwards' through the circuit. In this situation the reverse-current would pass through the diodes instead of the regulator.

7. The LED and resistor in series, across the output of the regulator provide a visual indication that the regulator circuit is operational, with the led situated on the forward edge of the circuit board, projecting through the front panel of the unit.

The resistor provides a current limit of approximately 10mA through the led in normal operation.

8. The regulated output voltage between the regulator output and the "0V" reference line are led to the DC OUTPUT CONNECTOR on the back of the unit by a pair of 24/0.2 insulated wires that are soldered directly to solder pads through the circuit board.

NEGATIVE SUPPLY RAILS

Where a negative supply rail is required within the mixing console, two methods are used in the power supply design.

1. For the 'audio' supply at +17 and -17volts, which provides power for all direct audio signal paths in the mixing console, the negative rail is derived from the same positive regulator circuit but the regulator output is connected to the "0V" reference of the complementary positive supply rail THROUGH A LINK ON THE CIRCUIT BOARD. This means that the "0V" reference of the negative supply rail becomes the negative output with respect to the regulator output pin (for LM317's and LM338's the output 'pin' is the case).

2. The CPS650 power supply unit is used to power the 3200. A +24V rail and -24V rail are required to power the 3200. The output rails of the CPS650 are floating, and where -24 volts is required in the console, the positive output of one +24 volts supply rail is connected to the "0V" reference of the other rail IN THE CONSOLE.

The same technique is used to provide a complementary -7.5 volts rail to the +7.5 volts rail.

REPLACING COMPONENTS

REPLACEMENT OF ANY COMPONENTS SHOULD BE UNDERTAKEN ONLY AFTER DISCONNECTING THE MAINS SUPPLY LEAD FROM THE POWER SUPPLY UNIT.

Replacement of any of the fuses and regulators in the power supply units is possible without the removal of a circuit board.

The fuses are held in open fuseholders on the board, close to the other components associated with that circuit. Use a flat-bladed screwdriver to lever-up one end of the fuse and remove it by hand. In the case of the secondary fuses associated with the +7.5 volts and -7.5 volts rails of the CPS650, it will probably be necessary to use a pair of long-nose pliers to remove them, as they are located just under the edge of the mains pcb.

The regulators that are in metal T03 packages can be removed by unscrewing the two M3 screws on each end and lifting them by hand.

If the electrically insulating SIL PAD between the regulator and the heatsink bracket looks damaged then it should be replaced before refixing a regulator. It should be noted that the regulator relies on good contact with the screws themselves to conduct its output to the rest of the circuit on the pcb. The case of the T03 package is at the output potential of the device.

The high voltage (TL783C) regulator, for the +48volts supply in each unit, is in a TO220 package, and can be removed by first drawing back the sleeve on the centre leg, desoldering the three wires and unscrewing the M3 fixing screw, taking care to retain the small insulating bush beneath the head of the screw. Again, an insulating SIL PAD is used and this should be replaced if it appears to be damaged. The metal tab at the top of the package is at the output potential of the device, as is the centre lead.

When refixing or replacing the device, it is easier to screw the device down before resoldering the wires to the leads. Draw the sleeve back over the centre lead afterwards.

NOTE that the heatsink bracket should be earthed through its contact with the rest of the chassis and so a faulty SIL PAD may cause the output of the regulator to be connected to earth. In the case of a positive voltage rail the output then becomes short circuited when the mixing console is connected. In this case the regulator will shut down safely, unless faulty, and the associated front-panel LED will not light. In the case of a negative voltage rail the regulator output is normally earthed at the console anyway, and. so a faulty SIL PAD may not be as apparent. It may, however, affect the noise performance of the supply rail by producing a ground loop. This can be checked against the maximum expected noise figures listed in the specification at the front, if a noise analyser is available. Alternatively, if necessary the negative supply rail can be isolated from its complementary positive rail by removing the link on the circuit board, and an individual load can be applied across the output of the supply rail with the "0v" reference side commoned to the chassis. The front-panel LED will not light if the output is short-circuited.

To replace any other components in a regulation circuit it is necessary to withdraw the circuit board/heatsink sub-assembly from the unit.

First unscrew the four outer M4 fixing screws and washers on the front of the unit and remove the front panel. Next, unscrew the four main M4 heatsink-fixing screws, two at the front and two at the back. Withdraw the large black connector(s) from their sockets on the board. Using a pair of pliers, close the locking pcb supports near the edge of the board, at the same time lifting the pcb up above each latch, and withdraw the complete assembly until the back edge of the heatsink clears the chassis. The assembly should then be drawn backwards so that the LEDs clear the front panel and it may then be fully withdrawn from the unit. (In the case of the CPS650 power supply, the small 4-way connector on the 'LED' wireform can be disconnected after withdrawing the assembly about half-way).

In the CPS650 power supply unit, the regulation circuits for the +7.5 volts and -7.5 volts rails are located beneath the mains PCB and replacement of soldered components in these circuits will require its removal. To do this, tip the heatsink onto its outer face so that the PCB assembly is vertical, and unscrew the No.4 self-tapping screws from the pillars, on the underside of the regulator circuit board.

After servicing these circuits, be sure to screw the mains board FIRMLY back onto the regulator board.

After servicing, re-assemble the unit in reverse order to the above, ensuring that all screws are fixed tightly and that the PCB supports are latched onto the board.

GENERAL

Before replacing the top cover on the unit, carefully remove any dust from surfaces within the unit.

CAREFULLY CHECK ALL WIRING CONNECTIONS AND ENSURE THAT THERE ARE NO LOOSE PARTS LYING AROUND INSIDE THE UNIT.