SABER PLUS
Modular Sound Mixing Consoles
building on success
Saber Plus is yet a further advance on the best selling series of consoles launched in 1986 and now the world’s most popular 16/24 track music production consoles.

The visual design has been retained but still further technical advances in the Mute Automation, equalisation and operator information areas have been achieved.

Now the leadership of Saber in its new ‘Plus’ format is re-confirmed.

Saber Plus is for 16 and 24 track recording studios and for live sound, both installed and touring. Significant improvements in sound transparency further enhance its role in the digital multitrack studio.

The matrix module further enhances Saber Plus’ claim as a leading PA console, Saber Plus PA offers up to 48 inputs, 8 subgroups, 10 x 8 matrix and 6 auxiliaries plus enhanced Mute Automation, equalisation and operator information.

The fully modular range is designed to allow maximum flexibility now and in the future, while all models accept optional facilities.

**SABER PLUS STUDIO CONSOLES**

- Mute Automation for all Saber Plus consoles allows memory control of audio muted individually, in 'snap-shot' combination, in synchronisation with the performance, and with full MIDI compatibility. Channel, echo return and multitrack monitor mutes are automated.
- 16 track recording versions with 24, 32, 40 and 48 input channels plus 16 track monitoring and metering. Up to 84 inputs with EQ and fader for mixdown plus four returns.
- 24 track recording versions with 28, 36 and 44 input channels with 24 track monitoring and metering. Up to 68 inputs with EQ and fader for mixdown plus four returns.
- Four Band Equalisation with two swept overlapping mid-frequency controls, with 20:1 frequency range. The upper-mid range is from 12kHz to 60kHz centre frequency, and the lower mid-range 1.5kHz to 70Hz centre frequency. The high and low frequency shelving sections operate with corner frequencies 8kHz and 16kHz switched HF, and 40Hz and 80Hz switched LF.
- Two Band Equalisation for all multitrack monitor returns.
- Three input connections per channel: mic, track and line inputs.
- Three input connections per monitor section: group, track and line inputs.
- EQ and fader reverse on all multitrack monitors for use as remix return inputs.
- Ergonomically efficient control layout with EQ close to hand.
- Unique checking system providing PFL and Solo In Place as set by master status switch.
- Mic, line and tape inputs, and mono, stereo and group outputs electronically balanced.

**SABER PLUS PA CONSOLES**

- Based on the architecture of Studio Saber Plus, special refinements are added to provide a PA console to incorporate the latest technology.
- Saber Plus PA consoles for live sound applications feature the output matrix system which puts control plus creativity in the hands of the operator.
- Output system with 8 subgroups, 16 x 8 output matrix, and main stereo mix.
- Versions with 24, 32, 48 and 48 input channels.
- Six auxiliary mixes from channels including pre EQ, pre-fader and post fader sources.
- Pre-fader auxiliary source includes "with mute" option, necessary for radio mic foldback control.
- Mute Automation for channel, echo return, group and matrix audio mutes.
- Ultra smooth 100mm faders throughout.
- Standard theatre intercom interface.
- Operator "gooseneck" lamp sockets included.

**STUDIO CONSOLE OPTIONS**

Standard models are listed under the console specification. Saber Plus is also available in versions which are part loaded for future expansion, and which include the following options.

- Frame sizes for: 24, 28, 32, 40, 44, 48 channel capacity.
- 16 or 24 track monitoring and metering.
- Choice of VU or Bargraph meterbridge.
- Integral patchbay, with multipin studio interface.
- Stereo input channels with "solo safe" facility and RIAA option.
- Penny & Giles and Automated fader options.
- Soft cover.

**PA CONSOLE OPTIONS**

Standard models are listed under the console specification. Saber Plus is also available in versions which are part loaded for future expansion, and which include the following options.

- Four frame sizes: 24, 32, 40, 48 channel capacity.
- Stereo input channels with RIAA option.
- Floor stand, to suit each size.
- Penny & Giles and Automated fader options.
- Soft cover.

**MUTE AUTOMATION "V4"**

Mute Automation is the latest expression of Allen & Heath's success with integrating the console into the operating environment. Mute events are stored in the console’s memory for replay later on with "hands free" for other tasks.

The process of Mute Automation is invisible to the operator who continues to use familiar mute switches in the traditional manner with the benefit of instantaneous control and with manual override available at all times.

Memory is included within the console to store mute data in two forms during rehearsal for subsequent playback. One memory area is for "snap-shots" of the console status at any instant in time. Data is entered and recalled manually. The second memory area is for sequences of mutes and "snap-shot" recall events in synchronisation with MIDI clock from an external source.

**UNIQUE TO ALLEN & HEATH’S "V4"**

Mute Automation system is its independence from any external memory for these operations. Mute Automation becomes possible in environments without MIDI memory, and when such memory is available conflicts of data interpretation are avoided.

The system has full MIDI compatibility which allows off-line editing and archiving on MIDI sequencers.

**SPECIFICATION**

- 32 internal patch memories for mute "snap-shots".
- 32 internal mute song sequence memories for synchronisation use.
- On-board editing for individual events, erase all, erase forward and erase last.
- On-board editing for patch recall events.
- Channel-by-channel automation isolation.
- Ultrafast automatic cueing after FF and REW operations.

**BATTERY-BACK-UP OF MEMORY CONTENTS AND SYSTEM DEFAULT SETTINGS**

- MIDI IN, OUT, and THRU connections.

**BASIC MIDI IMPLEMENTATION**

- MIDI Channel: user selectable 1-16.
- Program Change: patch memory recall.
- Control Change: mute ON/OFF (user option).
- Note On/Off: mute ON/OFF (user option).
- Advanced NOTE ON/OFF protocol avoids external sequencer 'throu-out' problems.
- System Exclusive: Allen & Heath User I.D.
- System Common/Real-Time received: Song Select, Song Position Pointer, Start, Stop, Continue, Clock.
INPUT M310-1
+4V
D.C. on switch for supplying phantom power for condenser microphones.

PAD
16dB per attenuation mic input, actively reducing gain and noise.

TAPE
Balanced tape input, paralleled with monitor on recording group.

LINE
Balanced line input.

B SWITCH
Phase reverse for all sources.

GAIN
Variable input gain control.

ASSIGN
Routing selector buttons for connecting channels to groups: 1-8.

SHIFT splits groups 1-8 or 9-16.

L-R
Connects channel to L-R mix.

AUX SENDS
Six levels controls for sending input to the auxiliary master outputs, for control and effects mixes.

Internal links allow all six to be pre-eq, pre-fade or post-fade.

Panel switch for aux 1 and 2 pre or post selection.

PA control and signal source select "pre-fade with mute", and recording consoles are shipped with "pre-fade with mute".

INSERTION POINT
Rear panel 1/4" unbalanced break-put, post-iso, pre-fader.

HF
Corner for high frequency shelf switchable 8kHz or 16kHz.

MF 1
Continuously variable up to 15kHz cut or boost with control knob.

MF 2
Continuously variable up to 15kHz cut or boost with control knob.

LF
Continuously variable up to 15kHz cut or boost.

EQ ON
EQ on button with indicator.

EQ ON
80Hz high pass filter, operates independently of EQ section.

PAN
Pan control for positioning sound in the left/right mix, for routing to or from even groups.

CHECK
Button with indicator for either solo in place or PFL.

MUTE
Large numbered audio mute button.

High quality "soft-hard" switch with pre and post fader action.

PEAK
PEAK indicator illuminates at 3dB before overload.

SIG
Signal presence indicator.

The duration and brightness of indication correspond to the strength of the input signal. Its use in conjunction with the PEAK indicator gives signal metering.

100mm smooth acting Alps fader with 100dB of boost available. Can be replaced with Penny and Giles 3000 series fader and can also be fitted with a varying number of fader automation packages. Please ask for a quotation.
PA MONITOR M355

TALKBACK MIC
XLR mic. input (balanced with internal phantom power option)

L-R METERS
illuminated Vu meters for the L-R Master outputs, PFL level and Ext monitor input level

TALKBACK PRESELECT
Sends talkback signal to any or all of Aux 1, Aux 2 and L-R mix

TWO STATION INTERCOM SYSTEM
Compatible with Directcom and Teacor systems. Can speak to two systems selected by Station selectors. Listen to selected systems on controls or ext monitor. Call lights indicate call function from external stations. Call button mutes incoming intercom and sends talkback mic to selected system(s)

EXT MONITOR
Source select switch for monitor output. Normally the L-R output, alternatively an external stereo source, eg. dummyhead

MONO
Monaural monitor signal

DIM
LED indicates monitors dimmed by active talkback

MUTE
Mutes monitor output

MONITOR LEVEL
Monitor output level control

HP LEVEL
Headphone level control. HP program is the same as monitor

PFL IN USE? INDICATOR LED CHECK MODE
Selector switch between PFL or SOLO IN PLACE for check switches. PFL interrupts monitor LS and meters. Solo in Place mutes Inputs which are not soloed

SOLO ON
illuminated monitor solo enable with protective cover, prevents accidental operation during the performance

SOLO ENABLE CONTROLS
Mutes enable switches for channel and monitor SOLO IN PLACE. Link combines channel and monitors SOLO IN PLACE operations. The selection of the solo systems allows SOLO IN PLACE to be accompanied by echo returns via monitors

TB LEVEL
Talkback microphone level control

HEADPHONE SOCKET
TALK SWITCH
Press to activate talkback

MUTE AUTOMATION KEYBOARD AND DISPLAY WA. FOR CONTROL OF THE PROGRAMMABLE AUDIO MUTE MEMORY SYSTEM

MULTI-FUNCTION Display, showing memory numbers, system modes and MIDI channel

EIGHT Control keys and associated indicators give control over the system modes, MIDI communications and memory data

SHIFT Function key which gives access to pre-set control modes and the LOCAL, AUTO and DUMP keys

TOGGLE Switches the display to read last used memory

LOCAL Used to turn on or turn off the internal MIDI line so that only commands arriving via MIDI IN are recognized. CLEAR Erases the working memory resets all audio inputs to auto ON, and also has editing functions. RECORD Arm the internal sequence memory to store mute information. RECALL Transfers mute or song memory to the MIDI output; also Arm the internal Song. Fill the CP-DUMP Memory pre-selector keys. AUTO Arms the external sequencer for synchronization with remote CP-DUMP. CP-DUMP Initiates transfer of memory contents for archiving via MIDI

Memory is organized into two areas, 32 patch memories for snap-shots of mute settings, 32 song memories for mute sequences. In addition memory areas are available for special purposes. Patch and Song also have working memory areas which contain the current mute status and the current song status respectively.

PA MATRIX OUTPUT M326

SYSTEM OVERVIEW
Main output sources are a powerful tool for successful operation of the distributed loudspeaker packages often employed for large, not concerence work. Creativity and control are the twin benefits of output mainlining, creativity freedom for the sound designer to provide tailored sound coverage to distributed loudspeakers, and control where it is needed in the hands of the operator. SABER's matrix outputs each derive programme from the eight group outputs. The main L-R output and an external line input. Standard systems have eight M326B matrix output modules.

OUTPUT METER
Switched between Group or Matrix output. Twenty segment LED bargraph having peak-reading feature. LED display indicates its position relative to Reference Level (48dB) indicating a reference level (48dB) output level. Post fader group or matrix signal is displayed, refer also to Options

GROUP TO L-R LEVEL AND PAN CONTROLS for mixing the group output into the main L-R output. The level switch has given LED 'on' indication. Group post-fader source is factory standard, refer also to Options

MIDI CONTROLS
Ten source level controls adjust the balance of the matrix output. Overall control of the output is made with the LEVEL control. MIDI adjusts the contributions from the rear panel input jack (one per module). L-R adjusts the contribution from the main L-R mix (in form). Controls 1-8 adjust the contributions of each group output to the matrix output. Group post-fader source is the factory standard, refer also to Options. External processors such as equalisers can be patched into the matrix via the pre-fader insert point. Each matrix output receives the output level from the correct M326B master module for that processing. Each matrix has an individual ENABLE pushbutton for this function. FFL gives headphone and master meter indication of each matrix mix sources before the Level control. MUTE switches the matrix output on or off according to any configuration using the on-board Multi Processors. Group post-fader level control advances such as snap-shot scene change mutes and MIDI synchronisation to show tracks are easily achieved. The mute is achieved with high reliability and solid switching and is instant in operation

GROUP CONTROLS
Inputs are muted to groups 1 to 8, summed pass via the rear panel insertion point connect to the GROUP FADE and then to the balanced XLR output panel connector. Above the write in strip to Group control CHECK (with LED indication) is dual function FFL or Solo-in-Place. PFL indicates group pre-fader level. Operation of MUTE turns the XLR output and the post fader sends to the mix, to the meter and matrix controls. Mute is programmable, like Matrix mute. The standard tape is 1000mm Amps calibrated with 120dB volume

USER CONFIGURABLE OPTIONS
Internal sockets/jumpers links allow reconfiguration of the system to individual requirements

SYSTEM
STANDARD OPTION
Group master post fader
Group to L-R post fader
Group to Matrix post fader
Matrix master post fader

In all cases post fader is also post-mute and pre fader is pre mute

CONNECTOR PANELS
The panels illustrated below are fitted at the rear of the console to suit the required modules

M301
Connector panel for eight M310 (M310X) input modules

M300
Connector panel for eight M326B PA Matrix output modules

M306
Connector panel for four M306 stereo input modules

M305
Connector panel for the M305B PA monitor module

CONNECTORS SUMMARY
MIC IN XLR female, balanced, pin 2 hot
TAPE IN XLR female, balanced, pin 2 hot parallel with group member tape input
LINE IN 1/4" jack, balanced, tip hot
GROUP OUT L, MONO OUT XLR male, balanced, pin 2 hot
INSERT 1/4" jack, tip-sends, ring-return
DIRECT OUT, AUX OUT, MONITOR LS OUT
RETURN IN, STEREO TAPE IN, all 1/4" jack, unbalanced
PA VERSIONS ONLY; COMMS IN/OUT XLR pin 1 ground, pin 2 loop DC, pin 3 audio
AMP/DEC, connection to console BNC sockets
RECORDING VERSIONS ONLY, MUTE CONTROL, locking 5 pin DIN connector output from module M305X
M306 ONLY: Input 1, RCA phone, L & R inputs, unbalanced, additional 5 pin DIN or RCA equivalent (module M306X option)
REMOTE, locking 5 pin DIN connector, start/stop interface
Input 2, 1/4" jack, balanced, L & R inputs
PATCHBAY SYSTEM M391

In-board patchbay system for 16 and 24 track recording applications having 480 pre-wired sockets. The patchbay occupies eight module spaces at the right-hand end of the frame. Construction includes all internal wiring to the modules and to the multipin rear panel. Six EDAC 50 pin connectors provide the interface for 24 track recording/playback and 2-track Out line bays. The jack socket is "TT" (Tannoy) type and has a dedicated blade tip-ring-sleeve configuration. Circuits except Rack In/Out are normalised, each jack pair has an internal switch connecting the upper socket to the lower socket when no jack is present.

GROUP INSERT SEND 1-16 from the group insert point, out normally connected internally via:
GROUP INSERT RETURN 1-16 to the group insert point input.

GROUP OUT 1-16: Select main group outputs normally connected internally via:

MULTI-TRACK OUT 1-24 to the tape selector switches on the group monitor section and input section.

AUX 1-6: Outputs from auxiliary masters normally connected internally via:
AUX 1-5 to the rear panel connectors.

PB1/PB2: Rear panel sockets for stereo tape playback, normally connected internally via:
PB1/PB2: To the tape inputs on monitor module M50.

ST LS/CUE: Signals for studio monitoring from monitor module normally connected internally via:
ST LS/CUE to studio LS and CUE rear panel connectors.

RET 1-4: Sockets on rear of lower normally connected internally via:
RET 1-4 to the return input section of monitor module.

CR LS: Signals from control room loudspeakers are output normally connected internally via:
CR LS to the main LS rear panel connectors.

L/R INSERT: Signals from L/R mix, normally connected internally via:

L/R INSERT to the insert return on the monitor L/R section.

OUTPUT L/R from the main L/R main outputs normally connected internally via:
OUTPUT L/R to the rear panel sockets.

MONO OUT from the mono sum output connected in parallel with the rear panel MONO connector.

OSC OUT from oscillator connected in parallel with the rear panel OSC connector.

PARALLEL: is a four jacks paralleled together to allow a signal to be split and sent to more than one location.

RACK IN 1-36 to rear panel multi-pin connector for inputs of external effects equipment.

RACK OUT 1-36 to rear panel multi-pin connector for outputs of external effects equipment. There is no normal connection between rack in and rack out.

USER DEFINED REMOTE SWITCH POSITIONS

Space is provided in the latter area below the patchbay for up to ten user installed switches.

RECORDING PATCH BAY

CONNECTIONS: Rear connector panel M399 is supplied (6 module widths)

Group Outputs 1-24: EDAC 50 pin connector, 24 balanced outputs.
Monitor Tape Inputs 1-24: EDAC 50 pin connector, 24 balanced inputs to Channel and Monitor Tape Inputs 1-24.

1/4 inch jack sockets, 16 balanced inputs to Channel Tape Inputs 25-40 (not via patchbay).
2 EDAC 50 pin connectors, 36 balanced connections for external equipment inputs.
2 EDAC 50 pin connectors, 36 balanced connections for external equipment outputs.

All other console inputs and outputs are via rear panel jack and XLR connectors shown on "PB" version panel illustrations. Matching EDAC multipin connectors are available and, if required, should be included with the order for the console.

16 Track patchbay M399

There are 480 sockets and 4 multipin connectors. Full facilities are available for 32 channel 16 track operation and this version will be supplied as the standard large frame 16 track patchbay unless the M391 version is specified. This original version of Sabre patchbay will be replaced by the M391 system for all models.
SPECIFICATION & AUDIO PERFORMANCE

ELECTRONIC PERFORMANCE

- DIBU = 0.775 Vrms
- DOU = 44 dB (1.23V) or -82 dB (300mV)
- Reference Frequency = 4 kHz

GAIN

- Input to Group: L-R or Mono Outputs
  - Channel Mic: 10dB (PAD IN) to 2dB
  - Line In: -48dB to -3dB
- Tape In: -12dB to -2dB
- Monitor Tape In: -6dB or -12dB (linkable)
- See circuit for illustrations for further info

FREQUENCY RESPONSE

- Referred to 1kHz = -4dB, DOU Out
  - Mic In to Group Out: 44dB gain
  - Group Out, 24 inputs routed, faders closed
  - L-R Out: 1 input open
  - Mic In, equivalent input noise -27/46 dBm
    (200 ohm source)
  - Group Out, 1 input open, faders closed
  - Mono Out: -82dB
  - L-R Out: 1 input open, faders closed
  - Mono Out: -82dB
- Crosstalk
  - Referenced to driven output: 1kHz = -42dB
  - Mixed, Input to L-R Out
  - faders closed
- L-R Separation
  - 56dB - 68dB

METERING

- Standard meterbridge for all recording models includes 16 rack meters plus L&R meters, optionally.
- VU type: 16 or 26 illuminated analogue VU meters
- RS type: 16 or 26 25-segment LED PM4 bargraph, -24 to +12dB
- PA versions have metering incorporated in modules.
- M320 Group: 20-segment LED Peak bargraph
- M330: -152dB
- M350: Illuminated analogue VU meters

CONSTRUCTION

- All steel frame with grey eggshell stove enameled finish.
- Recording versions supplied with rugged cardniter stand.
- PA versions for table-top use, stand optional.
- Padded arm rest and solid wood trim.
- Modules individually modular, constructed of steel enameled aluminum with stoved epoxy screen printed graphics.
- Complete mixer serviceable from top and rear.

SABER PLUS PA Version

Including optional stand, lamp and microphone. 24x8.8 SPX & stand S.

SABER PLUS Recording Version

Including VU meters. 32:16:16 MVU.

SABER PLUS Recording Version

With 24 track monitoring and metering, 36:16:24 LBG.

Note 1: 4 track version having a 4 x M320 pre-wired for 8 x M320.

SABER PLUS Recording Version shown on the front cover is a 36:16:24 XLBG with Patchbay option and is shown with accessories which are not included.

DIMENSIONS mm (INS)

<table>
<thead>
<tr>
<th>Model</th>
<th>WIDTH</th>
<th>FRONT-TO-BACK</th>
<th>HEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>S Frame</td>
<td>1243</td>
<td>800 (31.5)</td>
<td>1060 (41.75)</td>
</tr>
<tr>
<td>M Frame</td>
<td>1503</td>
<td>800 (31.5)</td>
<td>1060 (41.75)</td>
</tr>
<tr>
<td>L Frame</td>
<td>1763</td>
<td>800 (31.5)</td>
<td>1060 (41.75)</td>
</tr>
<tr>
<td>XL Frame</td>
<td>2023</td>
<td>800 (31.5)</td>
<td>1060 (41.75)</td>
</tr>
<tr>
<td>PA Versions</td>
<td>S, M, L, XL</td>
<td>800 (31.5)</td>
<td>230 (9)</td>
</tr>
</tbody>
</table>

19 inch rack 170 (7) 3U

STANDARD MODELS

Recording versions: including meterbridge, stand and RPS4

<table>
<thead>
<tr>
<th>Small Frame</th>
<th>Medium Frame</th>
<th>Large Frame</th>
<th>Extra Large Frame</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>24x8.8 SVU</td>
<td>32x8.8 MVU</td>
<td>40x8.8 LUV</td>
</tr>
<tr>
<td>24x8.8 SBG</td>
<td>32x8.8 MBG</td>
<td>40x8.8 LBG</td>
<td>48x8.8 XBG</td>
</tr>
</tbody>
</table>

Recording Patchbay Versions

- - 32:16:16 LUGPB | 40:16:16 XULUPB |
- - 32:16:16 LDBGPB | 40:16:16 XULDBGPB |
- - 28:16:24 LUGPB | 36:16:24 XULUPB |
- - 28:16:24 LDBGPB | 36:16:24 XULDBGPB |
- - 28:16:24 LUGPB | 36:16:24 XULDBGPB |

PA Versions: including RPS4 and meters on output modules. Excluding stand.

| 24x8.8 SPX | 32x8.8 MPX | 40x8.8 LPX | 48x8.8 XLP      |

See Note 1
SAVER Recording Console Operators Manual Serial Number M32000 Onwards

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PLEASE NOTE THAT THE COVER OF THIS MANUAL CONTAINS IMPORTANT INFORMATION ABOUT CONSOLE OPERATION.
READ IT CAREFULLY

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PLEASE NOTE THAT THE COVER OF THIS MANUAL CONTAINS

IMPORTANT INFORMATION ABOUT CONSOLE OPERATION

READ IT CAREFULLY.
1.1 Stand Assembly

Unpack the mixer from its shipping carton

Assemble the Stand

The Saber stand assembly is designed to slide fit into support brackets screwed onto the sides of the Saber frame.

For easy assembly, read these instructions through before beginning.

1) Check that you have received all required parts using the diagram below. Screws may be found installed in their fixing positions in the mixer chassis and stand legs.

2) Remove the Support Brackets (Item C) from the top of the Stand Legs (Item A) by unscrewing the Locking Screws (Item F).

3) Remove the 8mm bolts (Item D) from the ends of the Main desk. Use these to mount the Support Brackets (Item C) to the same holes with the channel facing outwards. Tighten fully.

4) Place one of the Stand Legs (Item A) flat on the floor with the screw holes facing upward. Screw the Stand Support Arm (Item B) to it using three 6mm screws (Item E). Lay the assembly on the front edges of the leg, and fit the other leg in the same way. Tighten the screws while ensuring that the stand assembly rests level on the floor.

5) With the help of an assistant, lift the main desk above the legs and align the Support Brackets with the slots in the legs. Lower evenly to prevent binding. Fix in position using the two 4mm Locking Screws (Item F).

6) The foot of each stand leg contains two anchoring bolt holes to allow the mixer to be secured to the floor.
Item F - 2 pieces
H4 Locking Screw
Part No. AB0061

Item E - 6 pieces
M6 Screw
Part No. AB0196

Item B - 1 piece
Stand Support Arm
Part No.
36 way Chassis AA0929
44 way Chassis AA0919
52 way Chassis AA0924

Item A - 1 pair
Stand Legs
Part No. AA0933

Item H - M6 Screw
Part No. AB0196

Item D - 4 pieces
M8 Bolts
Part No. AB0268

Item C - 2 pieces
Stand Support Bracket
Part No. AA00937

Removable Wood Trim
1.2 Electrical Installation

1.2.1 Connecting the Power Supply

1) Check that the voltage selector on the power supply is set correctly. Also ensure that the correct value of fuse is fitted.

2) Place the PSU in a suitable location. The rear of the power supply requires free air movement to cool the heat sinks. Additionally, to minimise hum it should not be mounted under the console. We recommend that it is mounted in an equipment rack remote from the console.

3) The DC cable should be coupled to the connector labelled DC IN on rear panel M302. Clip it in place using the connector latches.

1.2.2 Earthing/Grounding

Earthing/grounding in an audio system is provided for two purposes:

1) Safety - prevention of electric shock
2) Shielding - preventing external electrical interference from causing noise on the wanted audio signal.

In addition to solving problems, earthing can also cause them. If there are multiple earth paths in a system then a "earth loop" can be formed. This usually results in an excess hum on the system, but can also cause the breakthrough of RF and other noises.

Safety

Mains electricity is dangerous and can kill. Many pieces of mains powered equipment have an earth wire running from the case to the mains plug. Some are "double insulated" and do not need this.

Equipment will continue to work if it is not earthed. This does not mean it is safe. There are many horror stories in the audio industry of earths being left off of equipment and individuals being killed. Government and insurance underwriters' electrical codes must be observed. These codes take precedence over any suggestions in this manual.

The Saber console is powered by an external power supply. There are no dangerous voltages within the console frame. The power supply MUST be connected to a suitable earth via its power cord. If your electricity supply does not provide an earth contact, then provide a bonding point in consultation with your local electricity supply company.
Practical Solutions

The sound quality problems caused by earthing are hum and interference, due to the several paths to earth through the audio shields and down all the mains earths. Domestic audio equipment is usually not earthed via its mains plug, but provides a terminal on the rear to allow the various pieces of equipment to be earthed back to one point if necessary. Frequently the audio earthing takes place via the screens of the interconnecting leads.

Earth loop problems can be overcome by having just one piece of equipment connected to power earth - usually the power amplifier. But the audio leads must remain in place for safety. Do not leave the earth wire loose in a mains plug as it may touch a live terminal.

Having only one item connected to mains earth means that all the others rely on the audio screen or earth for safety. It is important to remember this. Test regularly that all exposed metal equipment including microphones, guitar strings and DI boxes have a low resistance to power earth.

In fixed installations, an alternative approach is to earth all pieces of equipment via their mains connections, and to break potential earth loops by connecting the screens of audio cables at one end only.

Saber's mixer frame is not connected to mains earth for the audio reasons mentioned above, and it contains no dangerous voltages. The mixer power supply case is earth, and this must not be removed.

It is best to plan ahead and have your installation checked by a competent engineer before you commence. Do not trust equipment and installations modified by others before you.

RPS4 Power Supply Ground Connections

The rear of RPS4 power supply includes two terminals for ground connection, illustrated here, marked EARTH; AC, DC. As supplied there is no connection between these two grounds, the DC earth, console ground is not connected to AC earth. This connection may be made on-site in order to earth the console and provide a central "technical" earth.
(This does not have sufficient current carrying capacity to be an electrical safety earth.) When this is done then in order to prevent earth loops each audio connection to an external piece of earthed equipment should have the screen connection made at one end only.

RPS2 Power Supply Ground Connections

This unit does not have external ground terminals. In order to earth the console on site to provide a "technical" earth, a separate earth wire should be run from a mains supply earth point to pin 1 of an XLR plug in the MONO OUT socket. (This does not have sufficient current carrying capacity to be an electrical safety earth.) When this is done then in order to prevent earth loops each audio connection to an external piece of earthed equipment should have the connection made at one end only.

Electrical Installation
Section 1.2 - Page 2
1.3 Planning and Plugging Up the Recording System

The installation of your Saber console is straightforward, but planning the way the system is plugged-up is essential to efficient operation. Here are a few suggestions to get you started in the right direction. Section 3.1 contains a summary of external equipment connections and detailed wiring information.

Preferred sequence of plugging up.

It is recommended that the system is plugged up in the following order to ease trouble-shooting. Listen to each component on the monitor via L-R or PFL as it is plugged up in order to detect faults, earth loops, or level mis-match. If the latter occurs, read section 3.3 for details of changing the normal operating level of inputs and outputs. Section 1.4 gives instructions for checking mixer function.

1.3.1 Power Supply

Saber power supply model RPS3 (RPS4 from serial number M32000 onwards) is shipped complete with interconnection cable. This is plugged into the DC IN socket on the M302 rear panel.

1.3.2 Monitoring Systems

All monitor outputs are jacks, located on rear panel M302.

Two sets of control room monitor outputs are provided for connection to external power amplifiers. These are labelled Main and Alt Monitor Outputs. Check out the control room monitor function using the console oscillator routed through L-R.

The studio is often provided with one set of monitor loudspeakers, and at least one stereo headphone loop (Cue or Foldback). These are connected to the Studio and Cue monitor outputs respectively. These outputs require an external power amplifier. Unlike the CR monitor outputs, studio outputs receive talkback from the console's built-in talkback microphone. Check out using the console oscillator. It will not route directly, select control room on the studio monitor source combiner.

1.3.3 Multi-track Tape Machine

The group outputs and monitor tape returns are link selectable to match either professional (+4 dBu/ 0 VU) or semi-professional (300 mV/ -8 dBu) operating levels. Saber is shipped linked for professional levels unless otherwise requested. See your tape machine operations manual to determine which level is required. Section 3.3 gives details on altering the internal links.
Multi-track Outputs

On all Saber versions, the multi-track recorder outputs are returned to the mixer via the Tape inputs on Input Channel modules 1-16 (1-24) which are internally wired in parallel with the tape inputs on the Group Monitors. On consoles fitted with a patchbay, the connections are located on the multi-pin labelled Monitor Tape Inputs on rear panel M309. On non-patchbay models these located on rear panels M301.

It is often convenient to use the input channels to monitor the tape during the entire recording process, since this provides access to the full equaliser, all auxiliaries, and a full travel fader. It also has the advantage of allowing the channels to be set up during recording for what becomes the final mix. To do this requires a decision to reserve channels 1-16 (1-24) for tape inputs unless other channels are used up

Multi-track Inputs

When M330 Dual Group Modules are fitted, 16 groups are available in total and there is one group output for each track of a 16 track recorder.

When M335 Dual Monitor modules are also fitted 24 track machines are easily connected.

Console Outputs: Tracks 1-16 should be connected to outputs 1-16.
Tracks 17-24 should be connected to outputs 1-8.
Rear panel M308 behind the monitor modules 17-24 has XLR outputs 1-8 repeated for this purpose.

Console Inputs: Tracks 1-24 should be connected to Tape Input XLRs 1-24.
Internal connections link the signal to channels and monitors 1-24.

On patchbay consoles, these connections are located on rear panel M309 multi-pin labelled Group Outputs. On non-patchbay models, they are on rear panel M303 (and M308).

Check out the multi-track by playing back a test tape or previously recorded material into the mixer via group monitors selected to tape. Preselect SIlent on the oscillator at 1 kHz. With group monitors set to group (buttons up), set the group level up to your reference recording level (usually 0 vu, or 0dB on the saber peak meters). Check the tape machine meter readings, and confirm that record to playback level is correct.

1.3.4 Stereo Recorders

Recorder Inputs are normally connected to the L and R outputs of the mixer. The operating level of L and R is set to the professional level of +4 dBu (VU). An additional semi-pro/domestic level output is provided on phono sockets which can be used simultaneously.

When using OdBu calibrated machines e.g. Revox B77 use of the low level phono connections is recommended.

Planning and Plugging Up the Recording System
Section 1.3 - Page 2
1.3.4 Cont'd

Recorder Outputs are normally connected to mixer Playback Inputs 1 and/or 2. As shipped, PB 1 is set to the +4 dBu (OVU) and PB 2 to the 300 mV level.

Check out as the multi-track above but with oscillator preselect set to L-R. Select Tape 1 or 2 as required on the M350 control room monitor.

1.3.5 Effects Devices

These are usually divided into two types; fixed effects such as reverb, which are used most of the time and have inputs from many mixer channels via auxiliary sends; and floating effects such as compressors which are patched into channel or group insertion points as required.

Fixed effects usually have their inputs connected to aux outputs 3-6. This is because during track-laying and overdub, aux 1 and 2 are usually used as Cue/FB sends. The effect output can be returned to the console on the Return Inputs located on the Mon/Master Module, or into spare channel line inputs. An advantage of using the Return inputs is that they do not mute when an input channel is soloed. During re-mix auxiliaries 1 and 2 are also available for use as effects sends.

Floating effects are usually plugged to insert points or connected in series with mixer outputs or line inputs. Other effect inputs are provided by the group monitor line inputs during re-mix. These also do not usually mute when an input is soloed. If the effect send comes from the input channel and returns to the group monitor line inputs it will remain when that channel is soloed unless solo enable link is pressed.

1.3.6 Real-time Electronic Sources

By this we mean samplers, drum machines, synths, etc. which can be synchronised to tape and repeatedly played back during the track-laying and overdubbing stages without recording them. They are normally connected to Line Inputs. If these are going to be run live until final re-mix, then connecting them in ascending order from channel 17 makes sense unless channels become scarce. If this happens, build from 17 toward 1, or connect to Group Monitor line inputs.

1.3.7 Microphones

These can only be connected to the channel mic inputs. It is useful to connect these to the highest numbered channels. This places them closest to the centre of the console (the ideal monitoring position) and nearest to the patchbay if fitted, for quick plugging up of compressors, etc. The channel input accepts all high quality microphone types. Use balanced screened cable of good quality. +48V DC is available at each input XLR for use with condenser microphones. Check out each in turn by routing to L-R and listening on the CR monitor, or using PFL.

Planning and Plugging Up the Recording System
Section 1.3 - Page 3
1.3.8 MIDI
Connect and check out using the instructions in section 2.1.2.

1.3.9 External Mute Control

When M310X modules are fitted, remote control contacts are available for turning on "ON AIR" warning lights, muting external loudspeakers, etc. The connector is located on rear panel M302 and labelled MUTE CONTROL. See section 3.3.1 for details of setting the links on the M310X module.

1.3.10 Mute Processor

A socket labelled REMOTE is provided on rear panel M302 for an external Mute Processor control panel, contact your dealer or the factory for details.

1.3.11 Meters

Your Saber mixing console is normally delivered with the inputs to the metering system already plugged in. If for some reason these are not connected, note that the cable loom is numbered corresponding to the group numbers on the console meter phono connectors. It is necessary to plug-up the meter system power cable to the METER DC connector on rear panel M302.

1.3.12 Talkback

Saber includes a simple two-way talkback system. Outgoing talkback from the console to the studio, stereo output (L-R) or groups (Slate) is provided by the built-in talkback microphone. An external unit is required to talk from remote areas back to the console. Details can be found in section 3.1 page 9.

1.3.13 M360 Stereo Input Channel - Remote Control

Optional input module M360 provides the capability to remote control the start and stop functions of cart machines, tape recorders, record decks, etc. The connectors for these are found on the related M306 rear panels - labelled REMOTE. See section 3.1. page 5 and following for details of operation.
1.4 Mixer Check-Out

Your new Saber console has been carefully tested in the factory to ensure that it is supplied to you defect free. Before phoning for help, follow the check-out procedure below to locate any fault and determine whether it is in the console, the connected equipment, or most likely in the connections.

1) **Clear the deck.** By this we mean:
   - Clear all selected routing switches.
   - Clear all mutes.
   - Release all other pushbuttons.
   - Place all faders and level controls at minimum.
   - Centre all pan, pots and equaliser boost/cut controls.
   - Pull any cords out of the patchbay (if fitted).
   - Ensure that the mute processor is in local operation and stop any external MIDI equipment or even better unplug it.
     a) Press any mute button, the adjacent LED should illuminate.
     b) The LED above Toggle/Local on the Mute Processor control panel should be extinguished (located on M350 Monitor/Master module).
     c) If not, refer to the separate booklet Mute Processor operating instructions.

2) **Plug in a set of headphones.** Ensure that the volume is not set too high.

3) **Select Osc on the top of the M350 module.** Select L-R in the preselect buttons. Set the L-R fader to the 0 position. Set the oscillator level to read 0 on the L-R meters. This verifies the L-R circuitry. Leave the L-R fader as set, release Osc L-R.

4) **Select Slate on the preselect.** Open one group fader to 0 on the M330 module set. The associated meter should read 0 +/- 1 dB. Turn the associated monitor level control up until the L-R meters read 0. Mute each monitor, leaving the monitor level control set. Do this for each group in turn. This verifies group operation. If a meter indication is not obtained check the fader position, release Fader Rev and Tape In/Line in.

5) **Release Slate on the preselect,** this clears the oscillator output from desk busses. Patch between the Osc socket and Return Input 1 on the rear panel. Select L-R on the return routing buttons. Set return level to get 0 on the L-R meters. The pan control should be central. Deselect L-R, and select 1-2. Set the group faders to 0. Group meters should read 0 +/- 1 dB. L-R should read 0. Carry on selecting group pairs one at a time until all have been tested. Use shift to access outputs 9-16. Reselect L-R and check pan pot operation. Leave the pan pot central, L-R selected and the oscillator level set for 0 on the L-R meter. This confirms the return channel main functions. Repeat for Rest 2-4.

Mixer Check Out
Section 1.4 – Page 1
1.4 Cont'd – Mixer Check-Out

6) Release OSC SLATE, check that monitors 1-16 are muted. Patch between the rear panel Out socket and channel 1 line input. Set all group faders and channel fader to the 0 position. Select line on the input selector switches. Select L-R on the channel routing buttons. Set channel input gain to get 0 on the L-R meters. The pan control should be central. De-select L-R, and select 1-2. Group meters should read 0 +/- 1 dB, L-R should read 0 +/- 1 dB. Carry on selecting group pairs one at a time until all have been tested. Re-select L-R and check pan pot operation. This confirms the input channel main functions and the continuity of group mixing buses.

7) Continuing with the same channel, de-select all routing switches. Press Check on the channel. The red LED on M350 control room monitor section check mode – PFL should illuminate and the L-R meter should read 0. Headphones should also listen to the audio tone. This confirms PFL operation. Release the Check button.

8) Continuing with the same channel, select L-R on the routing switches. The L-R meter should read 0. On the M350 module, enable Solo in Place by pressing the check mode switch and channel on the solo enable section directly below, the adjacent LEDs should illuminate. Select Check on ANY OTHER CHANNEL. The channel with tone on it should mute and the channel mute LED should light on all channels except the one with check pressed. This confirms Solo in Place mode operation. Release the check button, and reset check mode to PFL. Release the channel L-R button.

9) Patch Aux Output 1 to Return Input 1 in the rear panel. Continuing with the same channel, rotate the channel Aux 1 control until the L-R meter reads 0 VU. Press aux 1/2 post selector. The level should not change. Reduce the channel fader. The L-R level should reduce. Reset the fader to 0 and deselect aux 1/2 post. Patch Aux Output 2 to return Input 1 and repeat. The tests on Aux Sends 3-6 are similar, except they have no pre/post switches. They are shipped wired post fader. These tests confirm the operation of the basic functions of Aux Send Masters 1-6.

10) Return the channel controls to their original settings (step 1).

11) Repeat steps 6-10 as desired to check out the remaining channels. Testing of M360 Stereo Input channels are similar. Once basic operation is confirmed, the remaining controls on the modules can be tested using program material.
12) Check out the Programmable Muting System. If necessary switch mixer power off and on again after 15 seconds. On power-up the muting system should be in the following condition:
   a) Memory number 0 should appear in the mute processor window.
   b) All console mutes should be clear - un-muted.
   c) MIDI channel 16 is selected.
   d) Mute memories are battery backed and may contain mute snapshots.

   On any channel press Mute. The adjacent LED should light. Set any pattern of mutes on the channels. Press Update on the Mute Processor Panel on module M350. Press UP to step to memory 1. Change the mute pattern and press Update again. Press DOWN to step back to memory 0. Press Recall to recall the mute pattern in memory 0, the LEDs should change to indicate the first mute pattern you set up. Press UP to step up again to memory 1. Press Recall to recall the second mute pattern which you saved. This verifies mute processor operation.

   Follow the instructions in the separate booklet Mute Processor operating instructions.
2.1 In-Depth Operation

There are several powerful and unique functions provided by the Saber console which warrant an in-depth treatment. To obtain the best results from your Saber, please read the following carefully and follow the step-by-step operational demonstration.

2.1.1 Saber "CHECK" System

PFL and SOLO are well known terms in the recording industry. They are part of the Control Room monitor function of more sophisticated consoles, providing the ability to both hear and measure the audio signal in many parts of the mixer. Saber provides a particularly useful form of these facilities which is labelled CHECK on each module.

PFL or Prefade Listen

What is PFL

The console control room monitoring system allows the choice of several sources for the monitor loudspeakers and headphones, and for visual monitoring on the L-R meters. These are detailed on the module descriptions on the inside cover of this handbook.

Operation of PFL automatically switches the control room monitor audio and L-R metering away from the source chosen on the Control Room Monitor Selector. The PFL mixing bus is connected instead. When PFL is enabled, any channel, group monitor, auxiliary send or return which has CHECK pressed will be mixed onto this bus, heard on the CR monitor and be metered on the L-R meter. This enables one or more sources to be listened to for noise or overload, examination of studio microphone separation, allows a source to be equalised, or cueing of turntables or cart machines. As many sources as required can be PFL'd at the same time.

Even while SOLO is selected, PFL continues to operate on Aux Masters and Returns 1-4.

Advantages of PFL

1) PFL works with the fader open or shut. The audio is taken before the fader.

2) PFL meters the source pre-fader, revealing an overload when a channel is running too hot.

3) PFL has no effect on the outputs of the mixer, so it can be used live, or in the middle of a take with no effect on the recording.
Disadvantages of PFL

1) The CR monitor PFL listening level of the source is not necessarily the same its level within the L-R mix. Since the frequency response of the ear is level dependent, equalisation may not be set correctly.

2) Accompanying effects like echo, delay or chorus which are fed via the auxiliary sends disappear from the CR monitor as well. These can be re-instated by pressing PFL on the aux returns, but other sources fed to these effects will then be heard as well.

3) If PFL is being used to locate a problem such as noise or overload, the effect of external devices is not heard.

SOLO or SOLO IN PLACE

The SOLO mode of the check system gives a different facility to the PFL mode. In SOLO mode the effect of selecting CHECK any where is to turn off other audio channels in the console while preserving the checked channel EXACTLY AS IT IS ALREADY SET UP. The only thing that has changed on a channel (or monitor) in CHECK SOLO is that an LED has been turned on next to the pushbutton! however all the other audio sources become silent.

Activating a CHECK in SOLO mode causes all other sources to be muted after their faders. The MUTE ELEMENT (fully described in the MUTE section 2.1.2) does the actual muting. As many sources as desired can be SOLO’d at the same time.

SOLO does not change the source selected to the Monitor. The change in monitoring occurs because all other channels and/or group monitors are muted.

Advantages of SOLO IN PLACE

1) The fader, pan and routing of the solo’d source are unaffected. You hear the source exactly as set up, on its own.

2) Several inputs can be solo’d together allowing a check on the balance between sounds, each having its level pan and echo send settings preserved.

3) If the CHECK is being used for trouble-shooting purposes, all equipment in the audio path will be heard, eg insert points, group faders, echo returns etc.

4) Pre-fade and pre-eq auxiliaries will not be affected. Therefore cue/foldback sends to performers will be unchanged.

5) Inputs via Returns 1-4 are not muted by any solo operation, so echo returns are heard with the solo’d input.
Disadvantages of SOLO IN PLACE

1) Accidental operation of a solo while recording tracks can be destructive since other sources are muted.

CHECK MODE SELECTION on the M350 Monitor Module

On the M350 Monitor/Master Module, a set of pushbuttons is provided to set up the function of the module CHECK buttons.

- Selects PFL if up. Green LED lights. Red LED indicates PFL is activated by pressed CHECK button. Selects SOLO IN PLACE function of CHECK if down.
- If pressed enables SOLO IN PLACE on channels only. Yellow LED lights.
- Links SOLO IN PLACE on channels and group monitors. Red LED lights.
- If pressed enables SOLO IN PLACE on group monitors only. Green LED lights.

In-Depth Operation - Saber "CHECK" System
Section 2.1.1 - Page 3
Channel and Group Monitor - Solo Enable and Link Modes

First select Solo by pressing the Check Mode switch. Seven operating modes are possible:

1) Solo selected, but Channel and Group Monitor Solos NOT Enabled - a solo selection on a combination of modules can be preselected and then enabled by pressing the Channel and/or Group Monitor Solo Enables.

2) Channel Solo Enable Only - Channel CHECK buttons solo channels, group monitor CHECK buttons do not function.

3) Monitor Solo Enable Only - Group Monitor CHECK buttons solo group monitors, channel CHECK buttons do not function. Used while recording to multi-track where channel solos would be destructive.

4) Channel and Monitor Solos Enabled - either section will only mute modules within its own section. Most common setting during rehearsal.

5) Channel Solo Enable plus Link - Channel CHECK buttons will mute channels and group monitors, Monitor CHECKs have no effect.

6) Monitor Solo Enable plus Link - Group Monitor CHECK buttons will mute group monitors and channels, Channel CHECKs have no effect.

7) Channel and Monitor Solos Enabled plus Link - Channel or Group Monitor CHECK buttons will mute all other modules.

Experiment to find creative applications of the various Solo operating modes.

Linking Channel and Monitor SOLOS

1) Normally channel and group monitor solos will be separate.

   For example, consider input channel 5 which is panned between groups 3 and 4. These in turn appear on L and R outputs respectively via group monitors 3 and 4. L-R mix is selected on the Control Room Monitor Selector. Channel and Monitor solos are NOT linked.

Soloing channel 5 will mute all other channels and channel 5 only will continue to appear unchanged on the Control Room Monitor.

Linking channel and monitor solos would result in group monitors 3 and 4 muting as well. Channel 5 would continue to appear on group 3 and 4 outputs, but would not be heard in the L-R mix.

If an effects device is returned to the console on Returns 1-4 or Group Monitors 1-8 and solos are not linked, then soloing an input would leave the effects device in operation, allowing a channel to be heard with its reverb or other effect intact.
2) If the group monitors are selected to Line in order to bring large numbers of external sources into the L-R mix, they would then be equivalent to channels. In this case LINK with Channels and Monitors Enabled would be the right choice, allowing all input sources to be solo'd together.
2.1.2 SABER Mute Processing System

Introduction: Refer also to the separate booklet Mute Processor operating instructions.

SABER introduces MIDI controlled muting to the medium priced recording console. In today's studio equipped with extensive MIDI controlled equipment including keyboards, samplers and effects devices, the programmable muting system brings most of the benefits of more expensive fader automation. Up to 33 preset "snapshots" can be recalled directly by the console, or by any external MIDI device which can issue Program Change commands. In addition to the 33 presets, real-time replay of mute operations can take place when a sequencer is in use.

The MIDI port handles four types of Mute information:

Mute Switch Activity - each time a mute button is pressed a MIDI message is sent out. These can be recorded by a MIDI sequencer for synchronised playback.

Mute Memory Recall - each time a memory is recalled by the console keypad, a Program Change message is sent out of the MIDI port. A sequencer can record these. Additionally any external MIDI device capable of issuing Program Change messages can recall the console mute memories.

Mute Auto-Update - when in Record Mode, the complete console mute status is sent out automatically every two seconds. A sequencer will record these, ensuring an up-to-date mute condition in the console whenever playback is started. Play Mode recovers this data.

Memory Dumps - enables all mute memories to be archived externally. Programmable muting in the SABER console is particularly versatile and easy to use. To get the most out of your SABER, read the instructions below.

See the block diagrams on the rear side of this folder.

System Basics

The MUTE PROCESSING SYSTEM (MPS) consists of five basic elements:

MUTE SWITCHES - Momentary acting mute switches are installed at key console positions. Depressing these sends a mute command to the MUTE COMPUTER.

MUTE COMPUTER - At the heart of the system, the mute computer receives mute requests from both the mute switches and the MIDI port. In addition, it manages the mute processor control panel, and the mute memories.

In-Depth Operation - Saber Mute Processing System
Section 2.1.2 - Page 1
MUTE ELEMENTS  Each audio path is interrupted just after the final fader or level control by a Field Effect Transistor (FET) switch. This is controlled by the mute computer, and is not directly affected by the nearby mute switch. The mute element is also used by the CHECK system in Solo-In-Place mode. See the following block schematic.

MUTE ELEMENTS  When a MUTE is active, the audio path from the fader wiper is disconnected, muting the output and ALL POST FADER SIGNALS. Thus if an auxiliary send is set up post-fader it will mute, while all pre-fader or pre-eq auxiliary sends will remain active. This is useful since cues or foldbacks (usually pre-fader or pre-eq) can be maintained, while the direct audio and reverb (usually post-fader) is removed from the mix.

MUTE PROCESSOR KEYBOARD  Is located at the bottom of the M350 Monitor/Master module. While the creation of mutes takes place via the mute switches; the control of storage and recall of up to 32 mute SNAPSHOTS, as well as MIDI functions takes place on the mute processor keyboard. This also contains a two digit display of memory or MIDI channels numbers. It is controlled by the mute computer.

In-Depth Operation - Saber Mute Processing System
Section 2.1.2 - Page 2
MIDI INTERFACE

A standard MIDI interface to revision 1.0 is provided including In, Out and Thru connectors. MIDI data is transmitted by the system each time a mute button is pressed, and a complete update of all console mutes is transmitted every two seconds when in Record mode.

Note: from serial number M32000 the audio mute element is re-located before the fader in the diagram above. The system function is identical except that it is now possible to mute pre-fader auxiliary sends at the same time as post fader outputs.
MUTE SWITCHES

Not all mute switches are under processor control. Processor controlled mute switches can be recognized by their momentary action. Direct acting mutes have mechanically latching pushbuttons. All mute switches are detailed below:

<table>
<thead>
<tr>
<th>Module</th>
<th>Mute Button Details</th>
<th>Processor Control</th>
<th>Direct Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>INPUT M310</td>
<td>- Mute Switch</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>STEREO INPUT M360</td>
<td>- Chan On Switch</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>GROUP M320</td>
<td>- Upper Monitor Mute Switch</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Lower Monitor Mute Switch</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Group Mute Switch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DUAL GROUP M330</td>
<td>- Upper Monitor Mute Switch</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>- Lower Monitor Mute Switch</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>RECOROIND MONITOR M350</td>
<td>- Auxiliary Send 1-6 Mute</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Returns 1-4 Mute Switch</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>- Studio Monitor Mute</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Control Room Monitor Mute</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Manual Muting

When the console is first powered up all mutes are unmuted. If no external MIDI equipment is connected, all mute buttons behave as if they are only direct acting - I.E. one press mutes the audio path, another unmutes it. The adjacent LED displays mute status. In this case the only other muting action which can take place is caused by Solo-In-Place (see CHECK FUNCTION Sect. 2.1.1).

Muting of the control room monitor can take place when M310X Input Modules are fitted. In this case the monitor AUTOMUTE LED will illuminate. See Sect. 3.1.6

In-Depth Operation - Saber Mute Processing System
Section 2.1.2 - Page 4
2.2 THE SESSION

This is not a "how to record" primer - if you are a beginner, then we recommend that you pick up one of the many excellent books about recording. The purpose of this section is to show some effective ways to use Saber during the different phases of music recording. Please experiment with your own ideas to improve on what we suggest.

Music recording is typically broken down into three main stages:

- **Track-laying** - the creation of the main backing tracks onto which the remaining music is laid.
- **Overdubbing** - adding vocals, harmony, and musical texture.
- **Re-mix** - balancing the recorded tracks and adding effects to achieve the required result.

We will give suggested operating set-ups on Saber for each of these modes. We will assume that in addition to microphones, SMPTE time code and a sequencer are being used with MIDI controlled instruments as inputs to the system.

2.2.1 Track-laying

Start with a plan of the song structure and some idea of the instrumentation to be used. This will be altered of course, but is necessary to give order to the session. Initially all tape tracks are assumed to be blank.

1) **Stripe the multi-track tape with time code.** It is useful to do this over the whole length of the tape even if only part is used for this session. Use an outside track to minimise crosstalk to adjacent tracks. Set this track to SAFE on the recorder, and the other tracks to Record.

2) **Electronic sources like synth, drum machine, etc. can be routed directly from the input channels to L/R for monitoring purposes.** Unless you are short of channels, these can be run in real-time until re-mix and recorded straight onto the stereo master recorder. The channel fader is used to give the required monitoring level. It is usual to use input channel numbers 17 and above, leaving 1-16 clear for tape inputs later on.

3) **Live mic sources, DI's from instruments, etc., will be routed from the input channels to the required tape tracks via the groups.** Alternatively, for minimum noise, when recording a single source onto a tape track, plug from the channel direct output straight onto the tape track input. This is especially easy when the patchbay is fitted. The channel fader is used to set peak recording level on the loudest sounds from that source, providing the lowest tape noise on playback.
Several sources – for example top kit drum mics – might be mixed onto one or two groups to save recorded tracks. The balance between these mics is set on the channel faders, with the group fader setting the level to tape.

The monitoring for the tracks being recorded is provided by the group monitor sections. These are normally set to Tape since most tape machines automatically switch their inputs to their outputs when they are placed in record mode. If your tape machine does not automatically switch, then select Groups on the monitor when recording and switch to Tape on playback. Since the group send level is usually fixed, Fader Rev can be used to bring the monitored signal onto the main group faders for easy operation.

4) The performers can listen while they play via the Studio/Cue circuit and Aux 1 and 2, which are usually used as Cue or Foldback sends. If these are switched pre-fader then their relative levels can be mixed on the aux send controls but will not be affected by changes in the main fader levels. The Aux Master controls set the overall loudness.

5) Effects devices such as compressor/limiters, reverb, chorus, etc., can be patched into the signal path at insertion points, or between external equipment and the mixer inputs or outputs (except mic inputs).

7) Mute all sources which are not in use, using Saber's mute automation with your MIDI system to record the mutes while you work.

8) When the "Take" is complete, the tape can be rewound and played directly through the monitor system without resetting anything. Musicians in the studio can hear the result by choosing Control Room Monitor on the Studio Monitor selector.

### 2.2.2 Overdubbing

After the first tracks are laid, the musicians must synchronise themselves to the previously recorded material. This is the overdubbing phase.

1) Place all previously recorded tracks on the tape machine in SAFE mode and SYNC. This allows the previously recorded audio to be played from the record head – in time with the currently recording audio.

2) As in track-laying mode, real-time playback of synths, etc., is routed directly from the inputs to L/R. Any Foldback/Cue sends are taken from the inputs as well.

The Session

Section 2.2 - Page 2
3) Depending upon the number of inputs needed while recording, previously recorded tracks can be connected in either of two ways:

If only a few channels are required for live mics, then any of Input channels 1-16 can be used as monitors at an early stage. Pressing TAPE at the top of the input module will select the output of the tape machine to the input module. This has the advantage of allowing all of the input module’s facilities: EQ, 6 auxes, etc. to be used in the monitor mix. In re-mix mode this monitor mix becomes the basis of the final mix, saving time later and giving the best idea of the final results. In this case CUE/FB sends are taken from the input aux sends, usually 1 and 2. The input is routed to L/R only and the fader adjusts the monitor level.

If there is a shortage of channel inputs, then previously recorded tracks can come in via the group monitor sections. This time the monitor source on the groups must be selected to TAPE and Aux 1 and 2 on the same modules must be used for CUE/FB. Fader control on the group monitors can be obtained by pressing Fader Rev.

4) Sources which are currently being recorded are routed from the inputs to the required tape track via the groups, or patched from channel direct outputs direct to tape track inputs as before. These are monitored via the group monitor sections selected to Tape or Group as required. Remember to use the input/group faders to set the peak recording level.

5) Playback of the recorded results takes place as before.

2.2.3 Re-mix

Re-mix is (usually) the final stage in music recording. Everything is plugged up at once and your full creative potential will be utilised.

1) Recorded tape tracks are selected into inputs 1-16 by pressing TAPE at the top of the module. The multi-track is switched to Replay and all tracks are SAFE. If groups are not in use, their faders can be switched to control the signal on monitor line inputs using the Fader Rev buttons.

2) Real-time electronic inputs (synth, etc.), plus effects returns are connected to input channels and group monitor line inputs using fader reverse where the group outputs are not in use. With pre-planning these are already connected to the required inputs and all controls are set near their final positions.
3) Most inputs will be routed directly to L/R, which is now not only the monitor, but also the output to the master recorder. Again ensure that the L/R fader is set to put peak level on the tape in the loudest recorded sections.

4) Groups can be used to provide master controls for several related sources. For example the drum kit tracks, whether live or electronic, might be mastered on two groups. In this case the inputs are routed and panned appropriately to the groups, and the group monitors selected to Group with the group faders switched to fader reverse mode.

5) All auxiliaries are now available to be used as effects sends.

6) If there are more sources than input modules, group monitor line inputs with fader reverse and effects returns can be used to bring them into the final mix.

8) Use the mute processor system to gate all momentarily unused inputs/returns/group monitor inputs unless this is audible due to a change in "atmosphere".

The Session
Section 2.2 - Page 4
2.3 Module Operation Overview

The following notes expand upon the information shown on the manual cover:

2.3.1 M310 and M310-1 Mono Input Module

Microphone Input Operation

M310 or M310-1 are suitable for use with any modern microphone. Standard XLR type connectors are provided with transformerless balanced inputs. Mic In can be used to directly connect a guitar pickup, in that case connect a DI Box between instrument and mixer.

Mic Input is selected by releasing both Line and Tape buttons.

Gain is set as follows: PFL the channel, and ask the musician to play the loudest part - set gain to get about 0VU on the L-R meter (or +8dB with Bargraph versions). If the instrument is too loud in the mix, pull down the fader. This input gain still gives the best performance. If the fader gets below -20, recheck on the meter using PFL and adjust the input gain if necessary.

PAD reduces the level on mic input only. It is needed when close miking of loud instruments. If gain is reduced to settings of about 2 or 3 to get the correct operating level, try using PAD and increasing the gain control.

∅ is used to correct phase problems. If two mics are close together and the sound is strange or deficient in bass when both are in use, try switching phase in one of the channels only. ∅ can also be used deliberately to reduce stray bass pickup when miking higher frequency instruments. ∅ is operational on all input selections.

Line Input Operation

Line is used for electronic instruments, effects inputs, disc, CD, etc. Line is active if LINE is down and TAPE is up. It is electronically balanced and reasonably high in impedance.

Tape Input Operation

Tape on channels 1-16 (1-24) is wired in parallel with the group tape monitor inputs. They are normally connected to multi-track recorder outputs. Pressing TAPE on channels 1-16 (1-24) places the console in normal Re-Mix condition. Since channels can be routed direct to the L-R outputs, they can be switched to TAPE at any time for use as monitor returns with full eq. and auxiliary facilities. TAPE overrides the LINE switch.

SEE THE INSIDE COVER OF THIS MANUAL FOR BASIC MODULE INFORMATION
Additional Module Operation Details - M310 and M310-1 Mono Input Module
Section 2.3.1 - Page 1
Equaliser

The equaliser is inserted by the EQ switch. The high pass (bass cut) filter is separately switched. Example equaliser curves are shown on the following pages. M310 and M310-1 have different equalisers.

AUTO-MUTE (only on M310X and M310-1X versions) - details of operation are given in section 3.1.6 and of option selection in section 3.3.1.

CHANNEL DIRECT OUTPUT appears on the console rear panel or patchbay. It is a post-fader, post-mute, buffered output of the channel signal.

SIGNAL PRESENCE INDICATOR. The M310-1 Input Module has a signal presence indicator. The operation of this is explained on the manual cover.
SEE THE INSIDE COVER OF THIS MANUAL FOR BASIC MODULE INFORMATION
Additional Module Operation Details— M310 Mono Input Module
Section 2.3.1 - Page 3
M310-1 Equaliser Curves

SEE THE INSIDE COVER OF THIS MANUAL FOR BASIC MODULE INFORMATION
Additional Module Operation Details - M310-1 Mono Input Module
2.3.2. Auxiliary Sends

From serial number M32000 Saber M310 input module aux send options include the facility to provide a pre-fader send for foldback mixing which mutes when the channel mute switch is operated. For recording applications however a pre-fader send which does not mute is preferred.

Saber recording consoles are shipped having pre-fader sends independent of the mute switch.

Saber PA consoles are shipped having pre-fader sends dependant on the mute switch.

Auxiliary send option selections are illustrated later in this manual.

M360(X) Stereo Line Input Module

Auxiliary Sends

Aux 1 and 2 are normally used for cue, foldback, or stage monitors and are factory linked for Pre/Post Fader switching. They operate as a stereo pair with common gain and bal control. To send to only one aux, rotate bal fully CW or CCW. Remember that Aux 1 and 2 are also accessible from the group monitors when planning their use.

Auxes 3-6 are factory linked for post-fader operation and would normally be used as effects sends. Aux 3 and 4 are configured as a stereo pair, while aux 5 and 6 are separate. See table for Aux inputs

<table>
<thead>
<tr>
<th>Auxiliary</th>
<th>Input Source from</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 and 3</td>
<td>L and R selector</td>
</tr>
<tr>
<td>2 and 4</td>
<td>Outputs</td>
</tr>
<tr>
<td>5 and 6</td>
<td>Left</td>
</tr>
<tr>
<td></td>
<td>Right</td>
</tr>
<tr>
<td></td>
<td>Left plus Right</td>
</tr>
</tbody>
</table>

Any aux can be changed to pre-fader operation by internal links. See section 3.3.2 for details.

Solo Safe allows the SOLO IN PLACE service to be used in the remainder of the console channels without causing a Mute of this channel.

CHAN ON acts in reverse of the Mute switches on the remainder of the console modules. It also acts as a part of the remote start function described in section 3.1.5. CHAN ON is a part of the programmable muting system described in detail in section 2.1.2. Please read section this as wrong master control settings can produce apparent failure of the ON switch.

SEE INSIDE COVER OF THIS MANUAL FOR BASIC MODULE INFORMATION
Module Operation Overview - M360(X) Stereo Input Module
Section 2.3.2 - Page 1
2.3.3 M330 Dual Group Module/M335 Dual Monitor Module

Each module strip contains two monitor return sections, with multiple input sources. Module M330 also provides two group outputs.

**FADER M330** includes a fader and Fader Rev for each of the 16 group mixing busses. **M335** includes faders for each of two monitor inputs.

**Group Insertion Points** are located on the rear of the console on standard consoles and on the patch on patchbay consoles. The insert output is pre-fader.

**Monitor insertion points (M335 only)** are located on the rear of the console, two per module.

**Operating Levels**

Unless otherwise ordered, Saber is delivered set up to interface with equipment to the professional operating level of +4 dBu / 0 VU. Internal links allow group outputs, meters and monitor returns to be set to semi-pro levels of 300 mV instead. If your equipment is fitted with phono plug (Cinch) inputs and outputs, it is likely to require this lower level for correct operation. See section 3.3 for details.

**Metering**

**VU Meters** have their 0 VU position corresponding to either the +4 dBu professional level setting, or to the 300 mV / -8 dBu semi-pro setting according to links set in the group module (see operating levels above). VU meters are designed to display the volume or loudness of a signal, and therefore have a slow attack time and a fast decay time. They do not indicate the peaks which cause tape distortion. Therefore, VU meters are usually operated at a lower level than peak meters, and the displayed VU level changes dramatically relative to the peak level depending on the type of input signal. The normal VU operating level is in the range -10 to +3 VU.

**Peak Meters** respond more closely to the peak level of the signal. Thus they show up the distortion causing mechanisms on analogue and digital tape machines more readily, but they are not so useful to gauge the loudness. The 0 dB position on the meters corresponds to either the +4 dBu professional level setting, or to the 300 mV / -8 dBu semi-pro setting according to links set in the group module (see operating levels above). The normal bar graph operating level will be in the range -6 to +8 dB.

The change in colour which occurs at 0 dB draws attention to reference level relevant to sine wave test tones. When audio material is being mixed then adjust gain and fader controls so that the red meter portion is illuminated. The consoles handles levels up to maximum meter indication (+12dB above reference) without distortion.
2.3.4. 24 Track Operations

Saber versions having twenty four track facilities are fitted with four M335 modules in addition to the usual M330 modules.

Each M335 module accepts two TAPE inputs (from the XLRs behind the input modules) and two LINE inputs (from the rear panel jack sockets behind the M335 modules. The switch marked LINE determines whether TAPE (switch released) or LINE (switch pressed) will be active.

Meters 17-24 are driven from these M335 modules and show TAPE input ONLY.

Recording

Tracks 17-24 are driven from console outputs 1-8. When recording tracks 17-24 route inputs to these outputs 1-8 and adjust the output faders 1-8 for the record level required.

Remixing

Tracks 17-24 may be played back through monitors 17-24. Release the line switch in each monitor section. Meters show track replay level. Adjust the faders on each M335 module for the level of each track wanted in the mix.

Echo returns, synth parts etc connected to monitor LINE inputs 17-24 can be heard by pressing the LINE switches on each monitor section.

SEE THE INSIDE COVER OF THIS MANUAL FOR BASIC MODULE INFORMATION
Module Operation Overview - 24 track operations
Section 2.3.4 – Page 1
2.3.5 M350 Monitor/ Master Module

Aux Return Section

The aux returns can be regarded as additional mono line level inputs into the console. Normally they are used to bring back the returns from reverb and echo devices. All controls described are identical in 1/2 and 3/4 where fitted. The aux returns have a fixed nominal input level of 0 dBu, but the operating range of the return level provides for a wide range of input signals.

PFL allows the return to be monitored on the control room monitor and the pre-fade level to be measured on the L-R meter. PFL on the Returns operates as PFL no matter what the setting of console "Check" mode.

MUTE removes the return signal from all console busses. These mutes are part of the console programmable muting system. Note however that SOLO operation does not mute Returns 1-4.

Master Outputs

L-R Master Outputs are the sum of all the L-R assign switches and the group monitor pan controls. Mono Master is a sum of L and R.

STEREO MASTER FADER controls the level of the L and R Master Outputs. Since L + R = Mono, it affects the level of Mono as well.

Insertion Points are provided for the L and R outputs only. The insert output is pre-fader.

Operating Levels

The XLR type L, R, and Mono outputs are delivered set up to the professional operating level of +4dBu or 0 VU. If your equipment is fitted with phono plug (Cinch) inputs and outputs, it is likely to require the lower semi-pro level for correct operation. See section 3.3.5 for details of adjustment of the Mono output at low level. The phono L and R outputs are already fixed at the lower 300 mV level.

When using OdBu reference level equipment best results will be obtained by use of the phono socket connections and adjusting the equipment input gain.

SEE THE INSIDE COVER OF THIS MANUAL FOR BASIC MODULE INFORMATION
Module Operation Overview - M350 Monitor / Master Module
Section 2.3.5 Page 1
Metering

When PFL is active in the console, the L and R meter’s normal function is interrupted, and the level of the signal on the PFL bus is displayed instead. This is useful for locating noise or overload problems and setting correct console operating levels. Adjust input gain controls for the highest meter indication that is free from overload; on VU consoles OVU on peaks; on Bargraph consoles +8 or +10dB on peaks.

The following are located on the right-hand half of the module.

Oscillator/ Talkback Section

External Talkback can be returned to the console through the rear panel TB In connector. Activating the external talkback pushbutton takes over the PFL bus, switching the CR monitors to listen to the talkback audio which is injected onto the bus. A block schematic of an external talkback unit is given in section 3.1.7.
Studio Monitor Section

This is intended to control the playback of recorded material into the studio, or to send cue or foldback signals to artists. Two pairs of output connectors are provided for connection to external power amplifiers. It has been carefully designed for ease of operation.

Studio Monitor Source Combiner mixes together all of the selected sources as follows:

<table>
<thead>
<tr>
<th>Selected Source</th>
<th>Studio O/P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aux 1 only</td>
<td>Aux 1</td>
</tr>
<tr>
<td>Aux 2 only</td>
<td>Aux 2</td>
</tr>
<tr>
<td>Aux 1 and 2</td>
<td>Aux 1 Aux 2</td>
</tr>
<tr>
<td>L-R</td>
<td>L R</td>
</tr>
<tr>
<td>Control Room</td>
<td>CR-L CR-R</td>
</tr>
</tbody>
</table>

 Aux 1 Aux 1 (mono) - used as cue/foldback
 Aux 2 Aux 2 (mono)
 Aux 1 Aux 2 (stereo)
 L R (stereo) - can be cue/foldback
 CR-L CR-R (stereo) - used for tape replay

Mute is not under programmable control, it cuts the audio programme and leaves the talkback path operational.

Output sends the studio monitor combination selected above to either of two rear panel output sockets: CUE for the studio headphone amplifier feed or STUDIO for the studio playback monitor amplifier feed.

Talkback also affects the studio monitor section. Pressing the console talkback button first dims the programme monitoring level, then routes the talkback signal to the selected outputs.

SEE THE INSIDE COVER OF THIS MANUAL FOR BASIC MODULE INFORMATION
Module Operation Overview – M350 Monitor / Master Module
Section 2.3.5 Page 3
The manual cover contains a photograph and description of patchbay connections. When the patchbay is fitted, Group Outputs and Multi-track Tape Returns normally located on the group rear panel M303/304 are moved to the multi-pin plugs on the rear panel of the patchbay. Additionally, all insertion sockets on rear panels M301, M303 and M304 are relocated to the patch panel along with Channel Direct Outputs, except for Stereo Module M360 insert points which remain on the rear panel.

All other circuits use the rear panel connectors, but are diverted via the patchbay, except for microphone inputs which are not available on the patch.

Information on jack wiring is given in section 3.1.4. The patchbay uses standard TT (tiny telephone) or bantam jacks, which should be 3 conductor types to maintain the balanced circuit configuration.

Normalling is a term used to describe what we have called Normally Internally Connected on the cover description. This means that some jacks have switches built into them which are wired to route the signal directly somewhere when no jack is plugged in. For example, the insertion output path of a module must be returned to the insertion input path in order for the module to work if nothing is plugged into the patchbay jack socket. Normalling can be done in at least two ways: half normalling (described below) is used in Saber, full normalling can be found on patchbays with microphone inputs.

**FROM SIGNAL SOURCE**

```
  |     |     |     |
  |     |     |     |
  |  T  |  H  |  R  |

```

**SEND**

**HALF NORMALLING**

**RETURN**

**TO DESTINATION**

Half Normalling means that it is possible to "Listen" to the output by plugging in a jack plug without interrupting the return path. This is the way that most line level signals are normalled. Thus a jack could be plugged from the insert Out jack of channel 1 and into the Line Input jack of channel 2. If channel 1 had a microphone plugged in, the mic amp in channel 1 would bring the signal up to line level. This would then appear in channel 1 insert out and via the jack cord to channel 2 input. The two channels could have completely different equalisations and routing selections but the same input signal.

See the inside cover of this manual for basic module information

Module Operation Overview – M390 Patchbay

Section 2.3.6 – Page 1
Half Normaling Cont'd

Then using the programmable muting system, the mic could be changed instantly from one sound at one location to another sound at another location.

If the insert is used to connect in some external device then the insert send goes into the device and the return comes back from the device. Plugging into the insert return breaks away the internally wired path, and uses the path through the external equipment instead.
2.3.6 cont'd - M390 Patchbay

The following two pages show the signal routing to and from the patchbay.

From Channel Line In - Rear Panel M301
To M310 Channel Line Input

From Channel Module Direct Output

From Insertion Output
To Insertion Input

From Group Line In Rear Panel M303/304
To Group Module Mon Line In

From Group Module Output
To Group Outputs 1-16 Multi-pin Rear Panel M309

From Mon Tape In 1-16 Multipin Rear Panel M309
To Group Monitor Module Tape Input and Input Channel Modules 1-16

From M350 Monitor/Master Module Auxiliary Master Outputs
To Aux Outputs on Rear Panel M302

SEE THE INSIDE COVER OF THIS MANUAL FOR BASIC MODULE INFORMATION
Module Operation Overview - M390 Patchbay
Section 2.3.6 - Page 3
From PBI and PB2 on Rear Panel M302

To Tape 1 and Tape 2 Inputs on M350 Monitor/Master Module

From Studio and Cue Outputs on M350 Monitor/Master Output Module

To Studio and Cue Outputs on Rear Panel M302

From Return 1-4 Inputs on Rear Panel M302

To Return Inputs 1-4 on M350 Monitor/Master Module

From Control Room Main Outputs on M350 Monitor/Master Module

To Main Monitor Outputs on Rear Panel M302

From L-R Outputs on M350 Monitor/Master Module

To L Out and R Out Sockets on Rear Panel M302

From MONO OUT and OSC connectors on Rear Panel M302

To External Effects Rack

From External Effects Rack

SEE THE INSIDE COVER OF THIS MANUAL FOR BASIC MODULE INFORMATION
Module Operation Overview - M390 Patchbay
Section 2.3.6 - Page 4
2.3.7 M391 Patchbay (24 Track Version)

The facilities described for the M390 patchbay are all included for the 24 track version M391. In addition facilities are provided as follows:

1) Connections for console tape inputs 17-24 on input channels and monitors, via the patchbay, identical to M390 MON TAPE IN 1-16.

2) Insertion points for console monitor sections 17-24.

3) Line inputs for console MONITOR LINE INPUT sections 17-24 identical to M390 MON LINE IN 1-16.

4) Connections for 12 more RACK IN/OUT circuits on multipin connectors.

5) Connections to the insert points of four (maximum) stereo M360 channels.

6) Connections to input channels 33-48 identical to M390 channels 1-32.
3.1 Connector Wiring Details

Details of connector function and suggested usage are given in section 1.3 - Planning and Plugging-Up the System, on the manual inside cover, and in the relevant module descriptions of section 2.3.

The table in section 3.1.1 below gives a summary of standard audio connections.

### Audio Connection Table

<table>
<thead>
<tr>
<th>Source</th>
<th>Module Type</th>
<th>Module No.'s</th>
<th>Patch Fitted</th>
<th>Console Connector Type</th>
<th>Console Connector Loc</th>
<th>Imp (ohms)</th>
<th>Nominal Level</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-track outputs</td>
<td>M310(x)</td>
<td>1-16</td>
<td>No</td>
<td>Female XLR</td>
<td>Balanced</td>
<td>M301</td>
<td>Channel Input</td>
<td>20 k</td>
</tr>
<tr>
<td>Multi-track inputs</td>
<td>M330</td>
<td>1-16</td>
<td>No</td>
<td>Male XLR</td>
<td>Balanced</td>
<td>M303</td>
<td>Group</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>M335</td>
<td>17-24</td>
<td>No</td>
<td>Male XLR</td>
<td>Balanced</td>
<td>M308</td>
<td>Group</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>M330</td>
<td>1-16</td>
<td>Yes</td>
<td>Multi-pin</td>
<td>Balanced</td>
<td>M309</td>
<td>Group</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>M335</td>
<td>17-24</td>
<td>Yes</td>
<td>Multi-pin</td>
<td>Balanced</td>
<td>M309</td>
<td>Group</td>
<td>50</td>
</tr>
<tr>
<td>Stereo Tape outputs</td>
<td>M350 Mon</td>
<td>Yes/No</td>
<td>1/4&quot; Jack</td>
<td>Unbal</td>
<td>M302</td>
<td>B1 In L,R</td>
<td>30 k</td>
<td>+4 dBu</td>
</tr>
<tr>
<td></td>
<td>/Master</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M302</td>
<td>B2 In L,R</td>
<td>30 k</td>
</tr>
<tr>
<td></td>
<td>M350 Mon</td>
<td>Yes/No</td>
<td>Male XLR</td>
<td>Balanced</td>
<td>M302</td>
<td>L Out, R Out</td>
<td>50</td>
<td>+4 dBu std.</td>
</tr>
<tr>
<td></td>
<td>/Master</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M302</td>
<td>L/R 300 mV</td>
<td>22</td>
</tr>
<tr>
<td>Microphones</td>
<td>M310(x)</td>
<td>Prefer</td>
<td>N/A</td>
<td>Female XLR</td>
<td>Balanced</td>
<td>M301</td>
<td>Microphone Input</td>
<td>2 k</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17+</td>
<td>use highest available channels</td>
<td>Inputs</td>
<td></td>
<td></td>
<td>-26 dBu</td>
<td>-5 dBu w/Pad</td>
</tr>
<tr>
<td>Electronic Sources:</td>
<td>M310(x)</td>
<td>Prefer</td>
<td>Yes/No</td>
<td>1/4&quot; Jack</td>
<td>Balanced</td>
<td>M301</td>
<td>Channel Input</td>
<td>40 k</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17+</td>
<td>use lowest available channels &gt;17</td>
<td>Line In</td>
<td></td>
<td></td>
<td>+4 dBu</td>
<td></td>
</tr>
<tr>
<td>Synth, Drum Machine, etc</td>
<td>M320</td>
<td>Any</td>
<td>Yes/No</td>
<td>1/4&quot; Jack</td>
<td>Balanced</td>
<td>M301</td>
<td>Monitor Input</td>
<td>40 k</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17+</td>
<td>use during re-mix</td>
<td>Line In</td>
<td></td>
<td></td>
<td>+4 dBu</td>
<td></td>
</tr>
<tr>
<td>Fixed Effect Unit Inputs</td>
<td>M350 Mon</td>
<td>Yes/No</td>
<td>1/4&quot; Jack</td>
<td>Unbal</td>
<td>M302</td>
<td>Aux Outputs</td>
<td>22</td>
<td>+4 dBu</td>
</tr>
<tr>
<td></td>
<td>/Master</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1-6</td>
<td>+21 max 5k</td>
<td>Aux 1 &amp; 2</td>
</tr>
<tr>
<td>Fixed Effect Unit Outputs</td>
<td>M350 Mon</td>
<td>Yes/No</td>
<td>1/4&quot; Jack</td>
<td>Unbal</td>
<td>M302</td>
<td>Return Outputs</td>
<td>20 k</td>
<td>0 dBu</td>
</tr>
<tr>
<td></td>
<td>/Master</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Inputs 1-4</td>
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### Audio Connection Table (cont’d)

<table>
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<tr>
<th>Source</th>
<th>Module Type</th>
<th>Module No.’s</th>
<th>Patch Fitted</th>
<th>Console Connector Type</th>
<th>Console Conn. Type</th>
<th>Imp (ohms)</th>
<th>Nom Level</th>
<th>Comment</th>
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<tbody>
<tr>
<td>Floating</td>
<td>M310(x)</td>
<td>Any</td>
<td>No</td>
<td>1/4&quot; Jack</td>
<td>M301 Insert</td>
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<tr>
<td>Effect Input</td>
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<td>Input /Output</td>
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<td>No</td>
<td>1/4&quot; Jack</td>
<td>M302 L/R Insert</td>
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<td>0 dBu</td>
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<tr>
<td>Master</td>
<td>M310/320</td>
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<td>Multi-pin</td>
<td>M309 Rack In</td>
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<td>M330/350</td>
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<td>22</td>
<td>+4 dBu nom</td>
<td>patchbay to req’d module</td>
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</tbody>
</table>

### 3.1.2 Balanced Outputs: Group Out, L/R Out, Mono

These are electronically servo-balanced (ground compensated) outputs which maintain their level even if one leg is grounded. If the output is taken between one leg and ground, the output level is reduced by 6 dB. See drawing below.

---

**SEE MANUAL INSIDE COVER FOR BASIC INFORMATION**

Connector Wiring Details

Section 3.1 - Page 2
3.1.3. Multipin Connectors.

Group outputs, Tape In, Rack In/Out, 16 track version M390/309
24 track version M391/309B

Tape Machine Inputs should be connected to the Group Output multi-pin. Twenty four output circuits are provided, outputs 1-8 are repeated for circuits 17-24.

Tape Machine Outputs should be connected to the Monitor Tape Inputs multi-pin. Twenty four input circuits are provided.

16 track version: Inputs 1-16 pass via the patchbay to channels and monitors 1-16. Inputs 17-24 do not pass via the patchbay, instead they reach channels 17-24 via 0.25" sockets on the rear panel.

24 track version: Inputs 1-24 pass via the patchbay to channels and monitors 1-24.

External Effects Inputs should be connected to the Rack In multi-pin.

External Effects Outputs should be connected to the Rack Out multi-pin.

Multi-pin connector part nos.

<table>
<thead>
<tr>
<th>EDAE 516 Series 90 pin</th>
<th>Varelco 8016 Series</th>
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</thead>
<tbody>
<tr>
<td>Plug Body   516 090 301</td>
<td>00-8016-090-000-701</td>
</tr>
<tr>
<td>Plug Cover  516 230 590</td>
<td>30-8016-9832-00-000</td>
</tr>
<tr>
<td>Solder Contacts 516 290 500</td>
<td>60-8017-0513-00-339</td>
</tr>
</tbody>
</table>

Multi-pin Connector Pin-outs are as follows.
3.1.4 Jack Connectors:

All are "large tip" gauge A types commonly used with musical instruments.

Insertion Points - Channel / Group / L-R: Wiring convention is tip = send, ring = return, sleeve = earth.

Inputs: Channel and Monitor Line Inputs are electronically balanced. Tip = + phase, ring = - phase, sleeve = screen (earth).

Outputs: Direct Outputs and M302 panel inputs and outputs are all unbalanced. Tip = + phase; ring and sleeve = earth.

SEE MANUAL INSIDE COVER FOR BASIC INFORMATION
Connector Wiring Details
Section 3.1 - Page 4
3.1.5 M360 Stereo Input - Remote Control Connections

The M360 Stereo Inputs have dedicated remote control facilities operated either from the fader back stop switch or the channel on switch to control turntables, cartridge players, etc. The fader switch is activated within 3 mm of the fader endstop.

On the M360 module, plug-on-links 1 and 2 provide the following alternative remote signals to interface with a variety of equipment.

See M306 drawing on inside cover for connection details.

Mode 1) Lk1 Position B
Lk2 Position B

The remote socket is active only while line 1 input is selected. It provides a momentary start pulse of approximately 0.5 seconds when the channel is opened and a momentary stop pulse of the same length when the channel is closed. The channel can be opened by any of the following combination of controls:

- Line 1 selected, Channel On selected, opening fader will then send a start pulse.
- Line 1 selected, fader open, selecting Channel On will then send a start pulse.
- Channel On selected, fader open, selecting line 1 will then send a start pulse.

The channel can be closed by reversing any of the above operations to send out a stop pulse.

In this mode:
- Line 1 only - momentary start = relay contact pair 1
  - momentary stop = relay contact pair 2

Mode 2) Lk1 Position B
Lk2 Position A

Operation of the remote socket is now the same as above except that it operates in both Line 1 and Line 2 input selections. Therefore, switching between Line1 and Line 2 will no longer send out start and stop pulses.

In this mode:
- Line 1 and Line 2 - momentary start = relay contact pair 1
  - momentary stop = relay contact pair 2
Mode 3) Lk1 Position A  
Lk2 Position A

The remote socket will now provide independent latched outputs for both Line 1 and Line 2. Now, when a channel is opened, one of the two outputs, depending on whether Line 1 or Line 2 is selected, will have a permanent contact closure and this will only be released when the channel is closed.

In this mode:
Line 1 - latched control = relay contact pair 1 (labelled "start" on panel)  
Line 2 - latched control = relay contact pair 2 (labelled "stop" on panel)

Remote Socket Connections on rear panel M306

The remote start/stop facilities on the stereo channels have the connectors on each channel. The socket is a 5 pin DIN socket connected as below.

Pin 1  
Relay Contact Pair 1
Pin 4
Pin 3  
Relay Contact Pair 2
Pin 5
Pin 2  
Not used

Maximum relay contact ratings 50 Vdc, 100 mA.

UNDER NO CIRCUMSTANCES SHOULD AC MAINS BE CONNECTED TO THIS SOCKET.

3.1.6 Auto Mute and Mute Control Connections (M302 Connector Panel)

The following applies only when M310X and M310-1X type input modules are supplied. Inspection of the module pcb will show components fitted in the area indicated in the illustration below.

SEE MANUAL INSIDE COVER FOR BASIC INFORMATION  
Connector Wiring Details  
Section 3.1 - Page 6
There are three sections to this system:

1) Links on M310X and M310-1X module which determine the operating mode:

   Link LOCAL: when fitted operates the console LOCAL mute bus and control output.
   Link DISTANT: when fitted operates the console DISTANT mute bus and control output.

   When neither link is fitted, no action occurs. Modules are shipped with both links fitted as standard from the factory.

   The module circuit sends out a control signal change when the fader is operated over a 3 mm distance nearest the operator. When any M310X fader is open, the mute bus(es) are operated and do not release until all faders are closed.

2) Audio mute circuit in the M350 Monitor/Master module

   This responds to the 'Local' mute bus by muting the control room monitor outputs L and R. The panel LED 'Automute' illuminates when a LOCAL mute is in force. The purpose is to prevent feedback between the control room monitor and microphones in the same room as the console.

3) Control of external equipment in response to channel fader movement

   The MUTE CONTROL socket provides two control outputs on a locking 5 pin 180 DIN socket located on the M302 panel.

   **DO NOT CONNECT TO AC MAINS VOLTAGES.**

Setting Up the M310X or M310-1X Automute System

There is no change to the panel legend on the M310, modules which have the X option can be recognised by a simple test:

The fader has slightly more mechanical resistance than the normal fader. Open each fader in turn and watch the Automute indicator LED on the M350 module. All modules that operate the LED are X types. Assuming the module is set-up as described in section 1 above i.e. both links fitted, then proceed as follows.

1) Microphones in the control room (with console).

   Plug the microphone into an M310X or M310-1X module input. Remove the module and cut out the DISTANT link. Leave the LOCAL link in place. Replace the module. See section 3.2 for module removal instructions. If an indicator light, eg. RECORDING, is required, connect this to the Mute Control Socket via a suitable interface and use the Local Control - pin 1. Now opening the mic channel fader mutes the CR loudspeaker and turns the red light on.
2) Microphones in the studio (acoustically isolated from the console CR monitors).

Plug the microphone into another M310X module input. Remove the module and cut out the LOCAL link. Leave the DISTANT link in place. Replace the module.
If an indicator light - eg. RECORDING - is required, connect this to the Mute Control Socket via a suitable interface and use the Distant Control - pin 3. Now opening the mic channel fader turns the red light on.

3) Microphones and loudspeakers in the same room but not in the control room.

If it is required to mute the loudspeakers which are in the same room as the Distant microphone then also connect pin 3 to a suitable audio on-off switch (relay) which interrupts the console audio outputs to the studio loudspeaker amplifier. In order to operate as an external loudspeaker mute it is necessary to provide one make/break relay contact per loudspeaker line - thus 2 relay break contacts are required for stereo. For greatest reliability, these should be arranged to break when the fader opens, I.E. when the control output is switched to ground.

Mute Control Interface

Output circuit detail

Open collectors conduct to chassis (0 v) whenever the mute bus is operated. This occurs when the fader is opened.

Maximum applied voltage with respect to chassis is +24 Vdc or 24 Vac, maximum current sink is 100 mA.

!!! DO NOT CONNECT TO AC MAINS VOLTAGES !!!

SEE MANUAL INSIDE COVER FOR BASIC INFORMATION
Connector Wiring Details
Section 3.1 - Page 8
The following are suitable ways of creating an interface:

1) A custom remote control switcher available from studio supply companies. These would include a control terminal that connects to the console mute control socket, plus separate LOAD terminals for the mains operated lamps, relays, etc.

2) A solid state relay having safety isolated control terminals and AC load switching terminals. Connect the control terminals to the console mute control socket. Observe the suppliers recommendations. Suitable items can be found in the RS Components Solid State Relays section.

These items are not available directly from Allen and Heath Brenell Ltd.

### 3.1.7 Talkback Return Connections

A block schematic of a typical external talkback unit is given below. This connects to the rear panel M302 TALKBACK socket. External talkback comes into the console by engaging the PFL bus when the button is pressed, placing the console into PFL mode, and injecting the audio onto the console PFL bus.

---

SEE MANUAL INSIDE COVER FOR BASIC INFORMATION
Connector Wiring Details
Section 3.1 - Page 9
3.2 Module Removal and Replacement

Module Identity

Input Modules have no identity. They will take up the position related to their location in the frame. They may be replaced or interchanged without affecting their function.

Group Modules M330 have a unique identity signified by their module numbers. IE. wherever group 3/4 may be placed in the frame, it will always be group 3/4. Therefore they cannot be interchanged or replaced without care. Groups may be internally connected to match a different module position, but this requires changing a soldered link on the PCB.

M330 and M335 Group Modules from VU and Bar Graph consoles are not interchangeable without altering pluggable jumpers on the PCB. Interchange of these modules will result in mis-operation of the metering system. See the service manual for further information.

Module Preset Trimmers

M330 / M335/ M350 modules contain factory preset trimmers for meter calibration and output balance adjustment. Do not alter these without suitable test equipment and a copy of the service manual.

Removal

1) Switch off the console power supply.

2) Slide the write-on strip out of the left or right-hand sides of the console.

3) Remove the module retaining screws. Most modules have three fixing screws. The patchbay has 12 fixing screws and the M350 module six fixing screws. Do not forget to remove the central screws beneath the write-on strip.

4) Lift the module carefully upward. To change the links described in section 3.3, it is not necessary to remove the wiring harnesses. If the module must be removed completely from the frame, unplug the wiring harnesses from the various connectors. Carefully note the orientation of the harness connectors to facilitate replacement.

5) Remove the module completely from the frame.

Replacement

1) Perform the above steps in reverse order.

2) Carefully dress the harness into position as the module is settled into the frame - DO NOT FORCE.

3) Replace ALL screws, problems may result from operation with the module improperly fixed into the frame.
MODULE REMOVAL AND REPLACEMENT
SERIAL NO. M32001 ONWARDS
MODULE REPLACEMENT

FADER HARNESS

WHEN REPLACING MODULE
ENSURE THAT HARNESS IS NOT TRAPPED AGAINST MIXER
FRAME AT THIS POINT.

M310, 360

M330

M350, 355 L(R)

M350, M355 MONITOR

M326

CABLE HARNESS POSITIONS

MODULE SERVICE EXTENDER

STOCK NUMBER AL0454
Selecting Options - M330 Dual Group Module
Section 3.3.3 - Page 1
MONO OUTPUT LEVEL
SHOWN HIGH +4dBu
OPTION LOW -8dBu
REPLACE AND REPOSITION JUMPER
3.4 Guarantee

Saber products are made in the U.K. by ALLEN and HEATH BRENEW LTD., and are guaranteed against defective parts and workmanship for a period of ONE YEAR from the date of purchase by the original owner.

The defective component or module should be returned to Allen and Heath or its authorised agent and subject to the following conditions will be repaired or at our option replaced free of charge for labour and materials.

Conditions:

1) The equipment has been installed and operated in accordance with the instructions in the Operators Manual.

2) The equipment has not been subject to abuse, neglect, or alteration other than described in the Operators Manual.

3) Any necessary adjustment, alteration or repair has been made by Allen and Heath or its authorised agent.

4) The defect must be notified promptly.

5) The defective item is to be returned carriage prepaid to Allen and Heath or its authorised agent and proof of purchase made available on request.

Units to be returned should only be packed in the original AHB packing and be accompanied by the Power Unit.

These terms of guarantee apply to U.K. sales. In other territories, the terms may vary according to legal requirements.

Factory:

ALLEN and HEATH BRENEW
Kernick Industrial Estate
Penny, Falmouth, Cornwall,
TR10 9LU, U.K.
3.5 Service Policy and Spare Parts

Allen and Heath products are designed to give trouble free service with the minimum of attention. Repair under warranty is the responsibility of the selling agent who has been equipped with spare parts and technical manuals, and has the relevant repair equipment and service personnel.

In territories outside the U.K., refer to the selling agent for the details of service and repair procedures.

Outside warranty, owners may use the services of the service agent or undertake service themselves. Spare parts and manuals are chargeable.

Service item availability:

Owner manual - order Saber Recording Owner Manual
- or Saber P.A. Owner Manual

- AP0103 After Serial Number M32000

Spare Parts - order Saber Spares Kit ZX300-068 applicable to all models, see contents overleaf.

Spare Modules - contact sales agent, include serial number of console.

Power Supply - contact sales agent, include serial number of console.

Technical Support - contact Sales Agent first, or ALLEN & HEATH direct if an unsatisfactory response is received.

Packing - Cartons for module shipping are available on request.

IMPORTANT: Orders for spare modules for service on console expansion MUST be accompanied by the console serial number. When a serial number is not given errors are the liability of the customer.

Preventative Maintenance

Owners can prolong the service life of the equipment and minimise service costs by attention to a few simple points:

Protect the operating surface of the console from liquid spillage.

During building/moving operations, cover the console to protect it from dust entry and accidental damage, Allen & Heath can provide suitable covers.

Clean the controls and panels using a cloth dampened with a little dilute detergent. Avoid the use of aerosol and liquid solvent cleaners. Avoid the use of abrasive cleaning materials. The white write-on strip slides off for cleaning purposes.

Ensure that your power supply is installed with adequate support and free air flow from below to provide ventilation for cooling. Do not expect a power supply sitting on carpeted floor to remain at normal operating temperature indefinitely. Do not use any other type of power supply than the one supplied with the console.

Do not attempt module removal while the console is switched on. This is to avoid accidental short circuit damage when parts touch each other. If you intend to undertake service operations yourself, then order the technical manual and spare parts kit immediately, do not wait until a failure occurs.
3.5.2 Ordering Spare Parts

1) Standard Saber Spares Kit: order code \texttt{XX300-068}. All items listed below are included in a cabinet of drawers. The purpose is to enable in-field service repairs to recording and live sound versions by component replacement independent of Allen and Heath’s factory. Common resistors, capacitors and soldering equipment are not supplied. The kit of parts applies to all serial numbers manufactured.

2) Individual spare parts from the list may be ordered. Please include the order reference code for the part required.

3) This list replaces the list in the owner manuals dated October 1988, and is suitable for all Saber units produced.

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<th>Description</th>
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<th>Qty</th>
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<td>Fader, Alps 100 mm, 10 k, log</td>
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<td>Fader Knob</td>
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<td>Fader Screw, M3 CSK</td>
<td>AB0215</td>
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<tr>
<td>Module Fixing Screws – Countersunk Head 6AB</td>
<td>AB0195</td>
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<tr>
<td>- Pan Head 6AB</td>
<td>AB0170</td>
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<tr>
<td>- Spire Clip (Nut clip) 6AB</td>
<td>AB0258</td>
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<td>- Pan Head 4AB, module assy</td>
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<td>- Joint block, Nylon, A138</td>
<td>AB0253</td>
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<td>Pots – STEREO GAIN, Alps 10k Ax2 AHB 18</td>
<td>AI0119(+Nut)</td>
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<td>- GAIN, Alps 10k C AHB 3</td>
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<td>- LEVEL, Alps 100k AHB 4</td>
<td>AI0054</td>
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<td>AI0055</td>
<td>&quot;</td>
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<tr>
<td>- HF, LF, EQ, Alps 100k B, CC AHB 2</td>
<td>AI0052</td>
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<td>- MF SWEEP, Alps 100k Cx2, AHB 15</td>
<td>AI0130</td>
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<td>- LEVEL, Alps 10k A, AHB 16</td>
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<td>- PAN, Alps 10k B, CC AHB 1</td>
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<td>- STEREO HF, LF Alps 100kCXX2 AHB 12</td>
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<td>- BALANCE Alps 10kCXX2 AHB 17</td>
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<td>Knobs – Knob Body, TP110-006 Grey</td>
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<td>- Knob Cap – RED C111</td>
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<td>- BLUE C111</td>
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<td>- GREY C111</td>
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<td>- GREEN C111</td>
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<td>VU Meter Complete, SQ10 Type</td>
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<td>VU Meter Lamp, SQ10 Type</td>
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<td>Jack Socket, 1/4&quot; 3-pole, switched, metal bush</td>
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<td>Tools – Ring Spanner M6 (10mm AF)</td>
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<td>- Screw Driver No. 2</td>
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<td>- Screw Driver No. 1</td>
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Ordering Spare Parts
Section 3.5.2 – Page 1
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<td><strong>Resistor</strong></td>
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<td>Zener, 5.6v 400mW</td>
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<td>20 x 5mm AC 1.6A Anti-surge 220/240v</td>
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<td><strong>Service Extender</strong></td>
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<td>ZX300</td>
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<td><strong>Additional Items</strong></td>
<td>(Not included with Standard Spares)</td>
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<td>Complete tested pcb assemblies</td>
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<td>Led Bar graph master pcb</td>
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<td>079</td>
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<td>Led Bar graph Display + Rectifier combination</td>
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<td>ZX100</td>
<td>078 + ZX100</td>
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