

LiLo

Revision 2

16 Channel Line Mixer
24 Channel Line Mixer

Reference Manual

Warranty

Speck Electronics products are warranted to the original owner to be free of defects in material or workmanship.

This warranty does not apply to any product subject to accident, misuse, neglect or failure to comply with normal maintenance procedures or if the serial number has been defaced, altered, or removed; nor will Speck Electronics accept responsibility for damages resulting from improper installation, alteration or unauthorized parts or repairs. If the product is modified by the customer without permission, the customer agrees to pay for parts and labor necessary to remove the modification before repair. The cause of the defect is in the sole judgment of Speck Electronics.

Should a defect develop within one year of purchase from Speck Electronics or an authorized dealer, Speck Electronics will supply the part or parts necessary at no charge. Labor is covered in this warranty for a period of one year. Outside service, repairs or pickups are not covered under this warranty.

Any item returned for warranty repair should be sent, if possible, in the original packing container, prepaid to Speck Electronics, 341 E. Alvarado Street, Fallbrook, California, 92028. If in our opinion the packing container is improper for return shipping, we reserve the right to supply a new container at a minimal charge.

In the interest of improving Speck products; designs and specifications are subject to change without notice. It should be mentioned that if a change is necessary for any reason, we make every effort to document that change and send an "update notice" to all customers at no charge.

Notice

Speck Electronics makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Speck Electronics shall not be liable for errors contained herein or for incidental consequential damages in connection with the furnishing, performance, or use of this material.

This document contains proprietary information which is protected by copyright. All rights are reserved. No part of this document may be photocopied, reproduced, or translated into another language without the prior written consent of Speck Electronics.

The information contained in this document is subject to change without notice.

All trademarks are the property of their respective owners.

Edition

First Printing - November 2009

Speck Electronics
341 East Alvarado Street
Fallbrook, California 92028
USA
760-723-4281
www.speck.com

Contents

Chapter 1 Introduction

General	1
Unpacking and inspection	1
Repacking	1
Operator safety summary	2
LiLo general description	2
LiLo features	3
"Dual Path" signal routing feature	4
Standard Accessories.....	5
Optional Accessories.....	5
Dimensions	5-8
Specifications	9
Signal flow diagrams	10-11

Chapter 2 Installation

General	13
Power supply installation	13
Fuse Replacement	14
Environmental considerations	14
Physical placement of adjacent equipment	14
Hooking up the mixer	14
Removing modules for service	15
Cleaning	16

Chapter 3 Operation

Overview.....	17
Default control settings	17
Input Channel Controls	18-22
Input Channel I/O Connectors	23-24
Master Module Controls	25-30
Master Module I/O Connectors	31-34
Optional Expander I/O connector	35

Chapter 4 Wiring and Other

General	37
AC Distribution and safety	37
Proper AC grounding	37
Quality AC system	37
AC distribution	37
Clock noise and AC	38
Safety earth connection	38
Audio earth	38
Proper audio grounding and shielding	38
EMI and RFI	39
Sources of EMI	39
Reducing EMI	39

Introduction

General Thank you for purchasing our LiLo Mixer. The LiLo has operational features that are easy to understand and you should be up and running in no time. If you are unfamiliar with audio equipment or audio signal flow, it is recommended that you read this manual. If you have any questions regarding the LiLo or any Speck product, do not hesitate to contact Speck Electronics.

Speck Electronics
341 E. Alvarado Street
Fallbrook, CA 92028
Phone +760-723-4281
email sales@speck.com
www.speck.com



Unpacking & Inspection The LiLo is delivered in a special, protective container and was carefully inspected both mechanically and electrically before shipment. The power supply, cable, and manual are packed in a separate container. All items should be physically free of marks and scratches and in perfect electrical order upon receipt. To confirm this, the mixer and power supply should be inspected for physical damage that may have occurred in transit. Any damage should be reported to your dealer and delivery company as soon as possible.

Repacking If the product is to be shipped to Speck Electronics for service or repair, attach a tag to the product, identifying the owner and indicating the service or repair to be accomplished. Include the model number and serial number of the product. Place the product in the original container if available. If the original container is not available, a suitable one can be purchased from Speck Electronics.

Mark shipping container with "Delicate Instrument" or "Fragile", and insure the shipment for the proper amount.

**Operator Safety
Summary**

This product and its power supply are intended to operate from a single phase AC power source that does not apply more than 240 Volts RMS between the supply conductors or between either supply conductor and ground.

The external power supply for the LiLo is grounded through the “earth” conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before making any connection from the power supply to the mixer. A protective ground connection, by the way of the grounding conductor in the power cord, is essential for safe operation.

The three conductor line cord and plug assembly is wired in accordance with NEMA convention (line - black, Neutral - white, and safety earth - green). When using the LiLo and its power supply outside North America, it may be necessary to adapt a different power cord for that specific country. To avoid a fire hazard, use only a fuse of the correct type, voltage rating and current rating as specified in this manual. See Figure 14 on Page 9 for fuse chart.

To avoid personal injury, do not remove the top cover from the power supply, and never operate the external power supply without the cover properly installed. If it becomes necessary to service any part of the mixer, always unplug the AC power and disconnect the DC interface cable before proceeding.



Upon loss of the protective ground connection, all accessible conductive parts, including knobs and controls that may appear to be insulating, can render an electric shock.

**LiLo General
Description**

Short for “Line-in/Line-out”, the **LiLo** is a high-definition desktop analog line mixer for routing and blending your external gear. With more than 100 balanced input/output connections, this modular console will mix over 36 signals with unmatched signal routing, generous amounts of headroom, and a neutral signal path. The LiLo is targeted at recording studios, project studios, and audio post-production installations.

The LiLo is a modular mixer design with 16 or 24 input channels and a master module fit into a solid frame. All inputs, outputs, and bussing are fully balanced with transformers on the mix and group outputs. All input channels have secondary configuration switches as well as configuration jumpers on the circuit board.

LiLo Features

Each input module is designed with plug-in preamp PC boards for Line-A, Line-B. The master module is also designed with plug-in preamp PC boards for most of the critical circuit stages including the mix and group summing amps, and output line amps. This type of design will facilitate future circuit upgrades from Speck Electronics and/or 3rd party manufacturers.

The locations and types of the plug-in preamp cards are shown in Figures 1a, 1b, and 1c below.

An important benefit of the LiLo is the ability to mix 32 line signals in “Real-Time” from the standard 16 channel mixer (or 48 with the 24 channel LiLo). You could, for example, have the 16 outputs from D/A converters (Protools, Radar, etc.) connected to the 16 Line-B inputs and at the same time the Line- A inputs can be used for 16 other line signals such as mic preamps, samplers, or additional outputs from D/A converters... all ending up at the stereo and group mix busses.

Figure 1a. Input channel P.C. Assembly

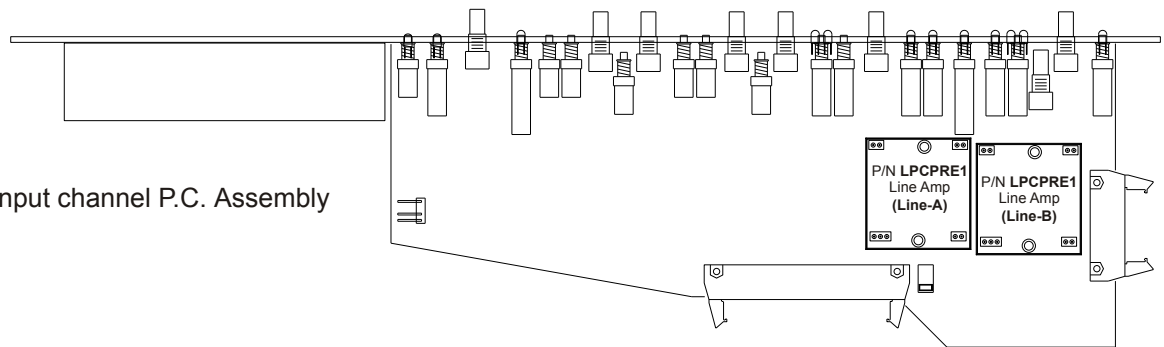


Figure 1b. Master 1 P.C. Assembly

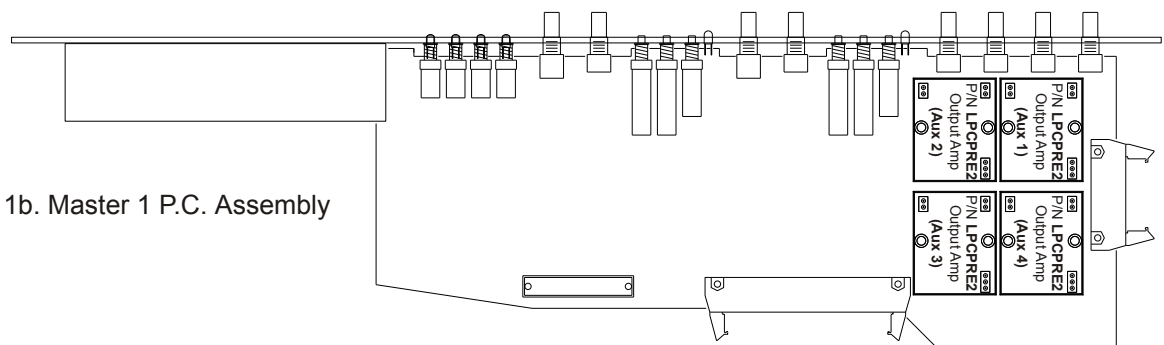
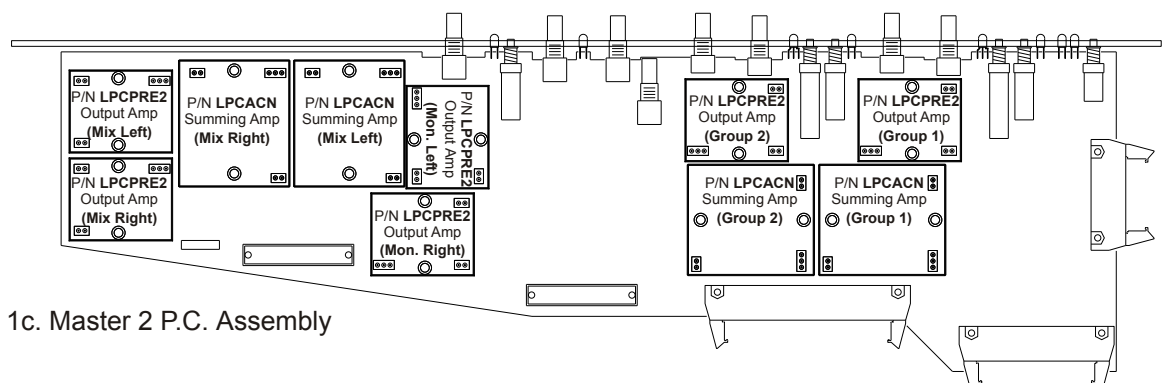


Figure 1c. Master 2 P.C. Assembly



Dual Path Signal Routing Feature

The dual path signal routing is possible because the LiLo's input channels use separate line preamps for Line-A and Line-B rather than switching XLR inputs into a common preamp stage. The combination of dual channel line amps, **Group Select** switch, and **Aux Select** switch can virtually double the input capacity of the LiLo.

Figure 2 shows one example of the “Dual Path” signal flow. In this example, the **Group Select** switch is pushed to select Line-B as the source for the GRP 1 / GRP 2 assign switches. These group assigns are then routed to their respective group masters that are then mixed to the stereo mix output. At the same time Line-A is mixed through the channels fader, pan, and mix assign.

The Aux sends can also take advantage of the dual path signal routing. This is accomplished when the **Aux Source** select switches are selected to Line-B as the source of the aux sends.

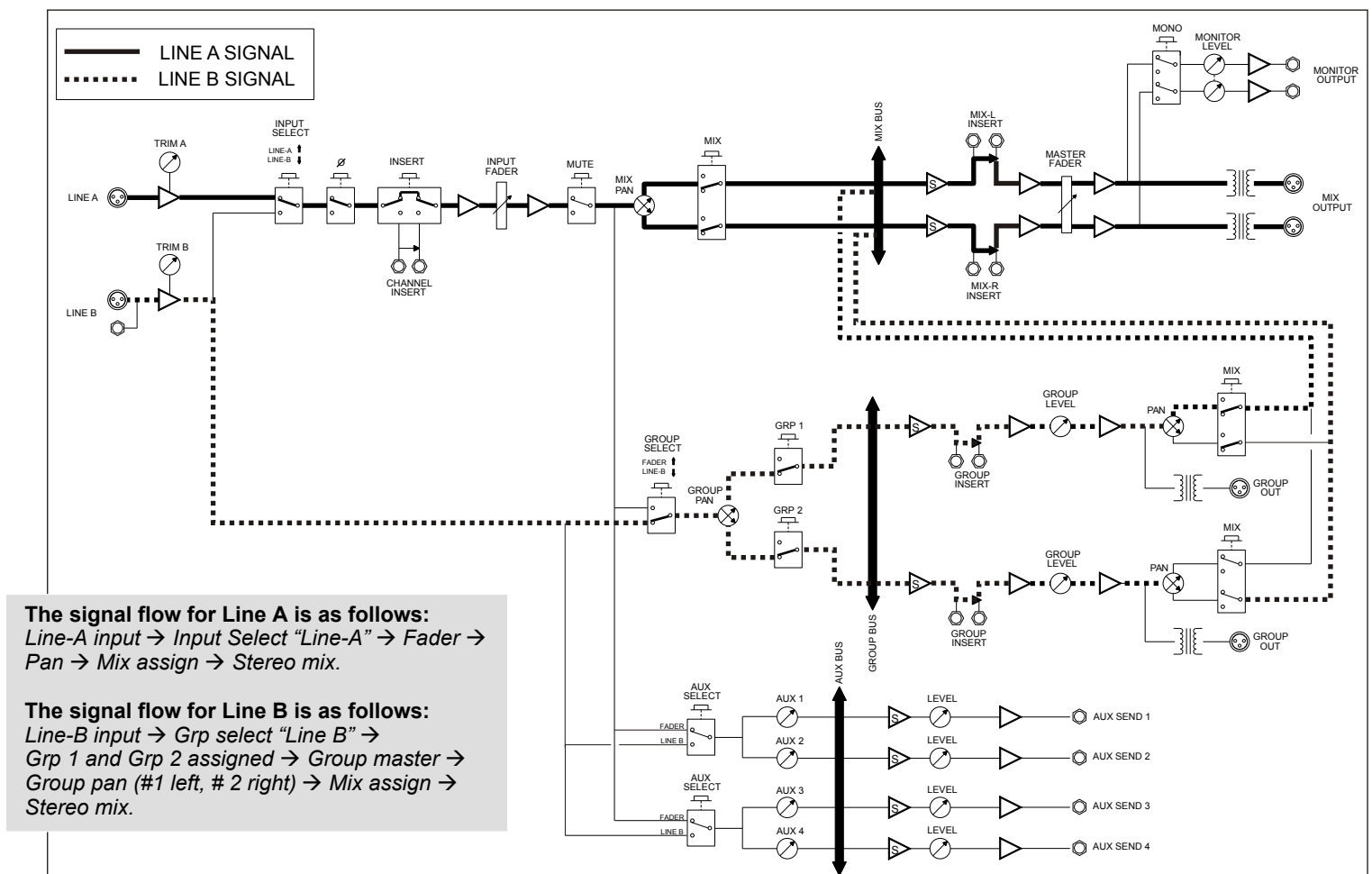


Figure 2. Dual path signal routing

Standard Accessories The LiLo is supplied with the following list of accessories:

- External regulated power supply:
Model PS5-3 for the LiLo-16 -or- Model PS5-5 for the LiLo-24
- DC Power supply cable (10 foot, 7 conductor)
- AC Power cord (NA version only)
- Operations Manual

Optional Accessories The following is a list of optional accessories that are available for the LiLo mixer. These options are available from the factory or your Speck dealer:

- **Model LC8-VU0-T0** eight channel LiLo expander
- **Model LD16-VU0-T0** sixteen channel LiLo expander
(As shown below in Figure 3a)
- LiLo expander interface cable
- Spare regulated power supplies for LiLo-16 or LiLo-24
- Mixer stands for LiLo-16 or LiLo-24
(As shown below in Figure 3b)



Figure 3a. Optional LiLo 16 channel expander



Figure 3b. Optional LiLo stand

LiLo-16 Dimensions

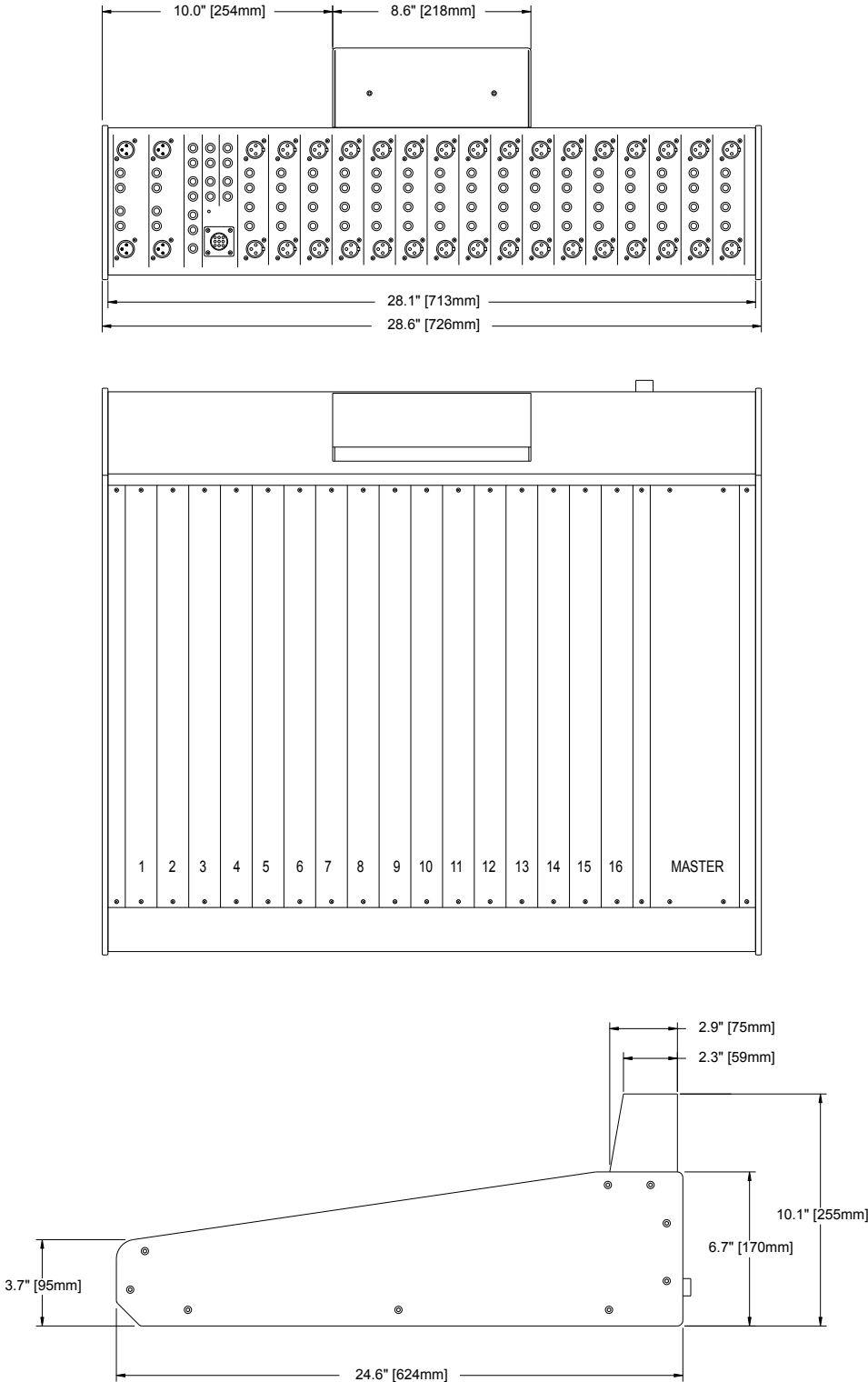


Figure 4a. LiLo-16 Mixer dimensions

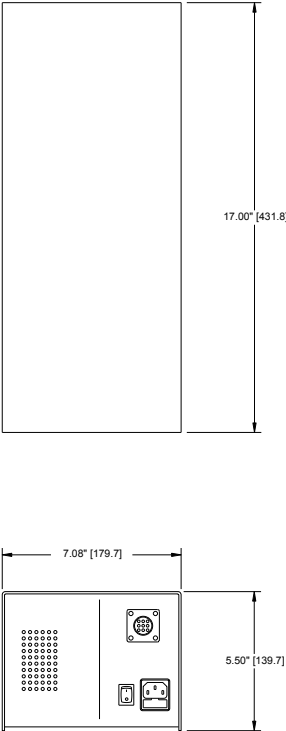


Figure 4b. Power supply

LiLo-24 Dimensions

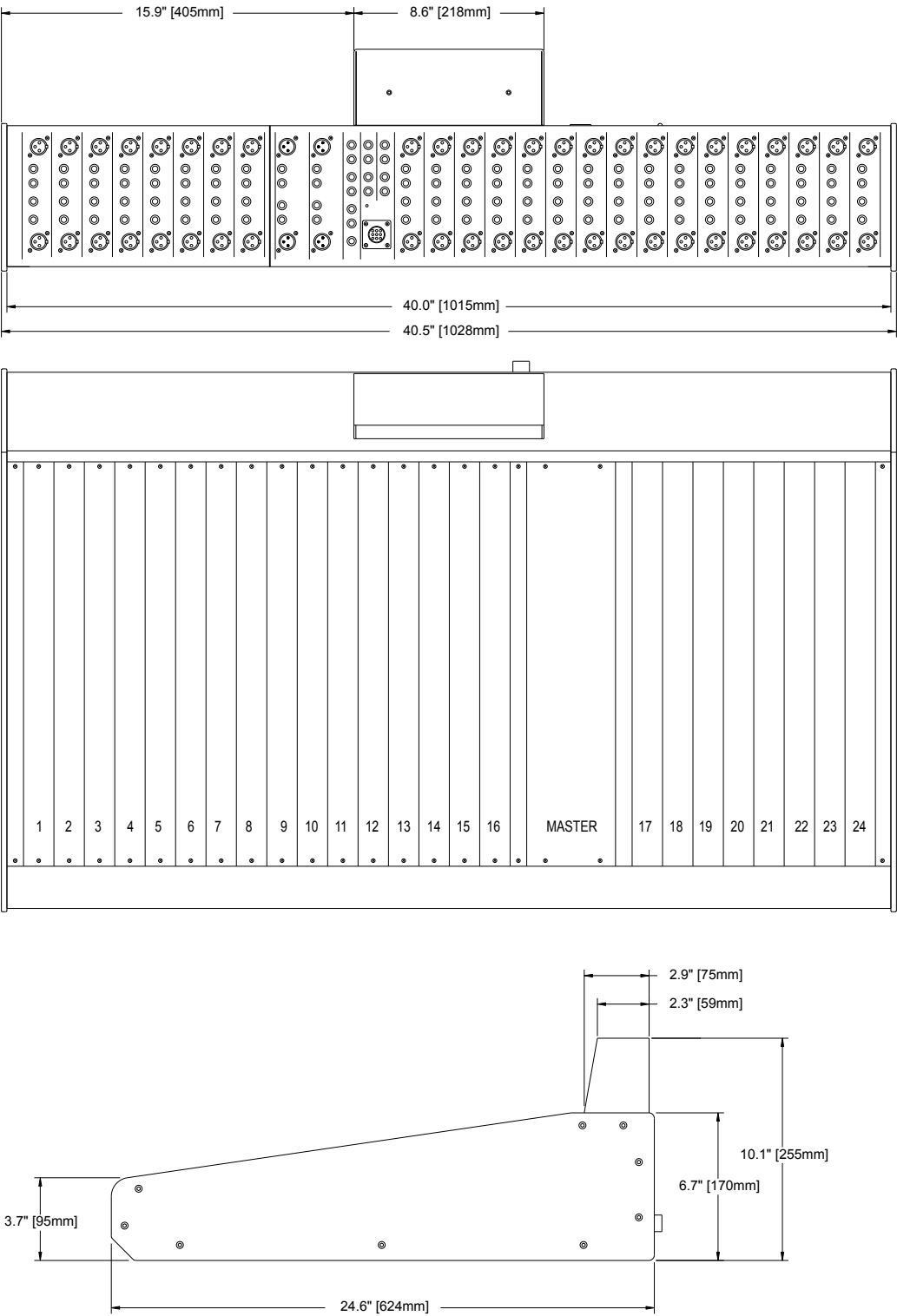


Figure 5a. LiLo-24 Mixer dimensions

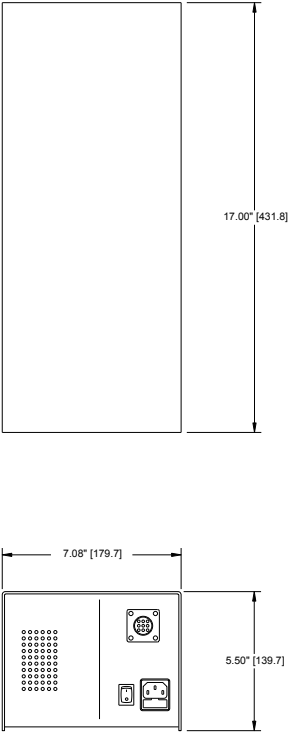


Figure 5b. Power supply

Mixer Stand Dimensions

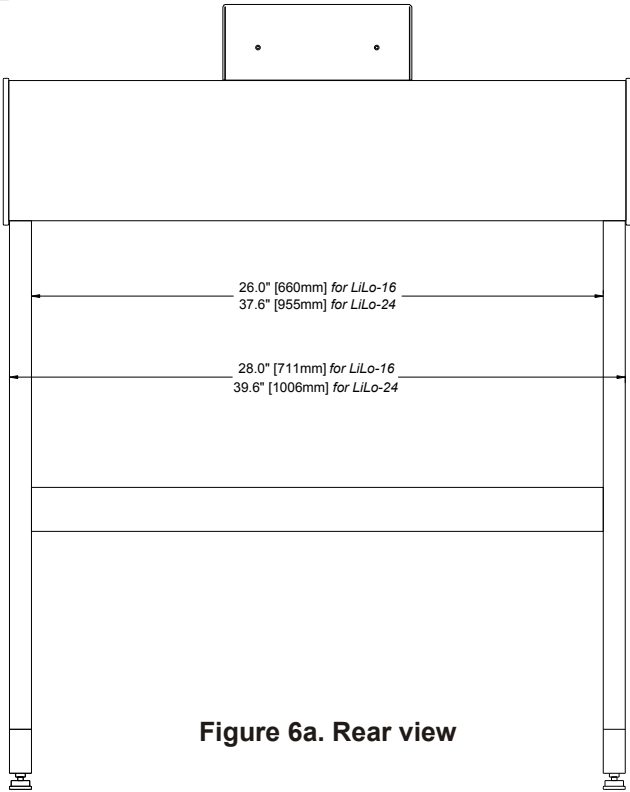


Figure 6a. Rear view

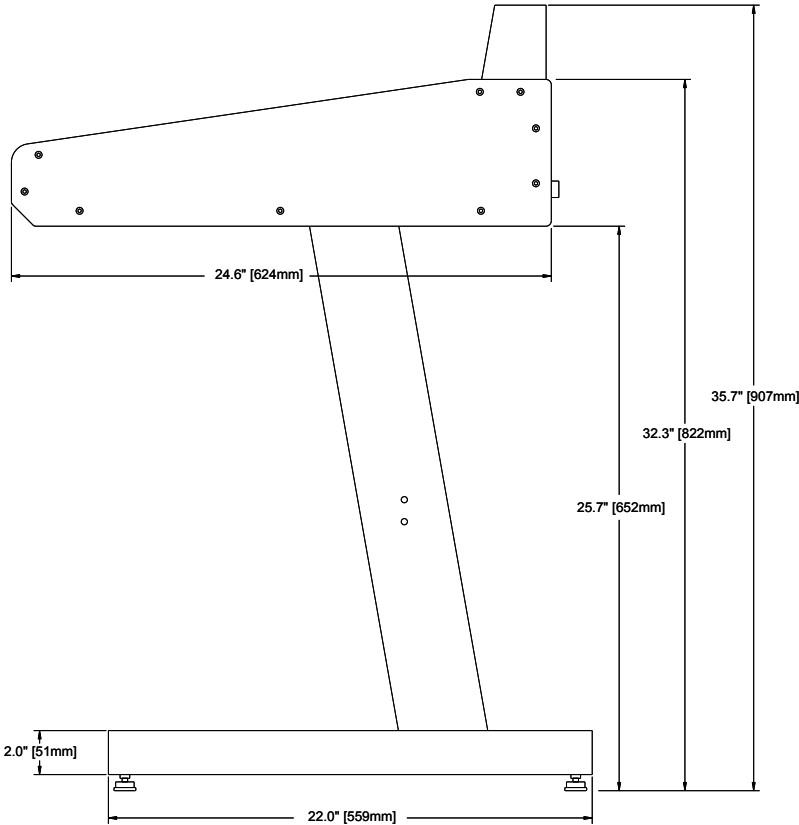


Figure 6b. Side view

Specifications

Line input impedance	
Line-A and Line-B	15K ohms
Insert returns	30K ohms
2T, DAW, and Aux returns	20K ohms
Maximum input level	
Line A	+28dBu
Line B	+28dBu
Channel insert return	+28dBu
Mix insert return	+28dBu
Output Impedance	
All Active-balanced outputs	60 ohms
All transformer-balanced outputs	600 ohms
Maximum output level (2k load)	
All Active-balanced outputs	+28dBu (Balanced)
All transformer-balanced outputs	+24dBu (Balanced)
Frequency Response (12 dB gain) (Any line input to mix output)	
	10Hz-30kHz (+0/- .5dB)
THD+n	
(+4dBu any line input, Gain 0, +4dBu mix out)	.0032%
(+12dBu any line input, Gain 12, +24dBu mix out)	.0024%
Crosstalk (1kHz)	
Channel to channel	-100dBu
Input to Mix out, channel muted	-95dBu
Input to Mix out, channel fader off	-89dBu
Noise (22Hz-22kHz)	
Residual Mix and Group output noise	-102dBu
Mix output - 16 channels routed, faders up	-81dBu
Mix output - 16 channels routed, faders off	-84dBu
Mix output - 16 channels routed, faders off, muted	-90dBu
DC Power Requirements	
16 channel mixer	+/- 17.0 VDC @ 2.3A +6.25 VDC @ 2.7A
24 channel mixer	+/- 17.0 VDC @ 3.2A +6.25 VDC @ 3.8A
AC Power Requirements (External supply)	
	100-120 VAC 50/60Hz 5 amp 220-240 VAC 50/60Hz 3Amp
Dimensions	
16 channel mixer	WxDxH=28.5" x 24.5" x 10" (724mm x 645mm x 254mm)
24 channel mixer	WxDxH=40.5" x 24.5" x 10" (1030mm x 645mm x 254mm)
Dimensions (External supply)	
	WxDxH=7" x 17" x 5.5" (178mm x 432mm x 140mm)
Weight	
16 channel mixer	50 Lbs (22.7kg)
24 channel mixer	72 Lbs (33.6kg)
External power supply	19 Lbs (8.6kg)
Total shipping weight (mixer and power supply)	
16 channel mixer	86 Lbs (39kg)
24 channel mixer	115 Lbs (52kg)

Speck Electronics LiLo - Input Channel Signal Flow

Revision 2

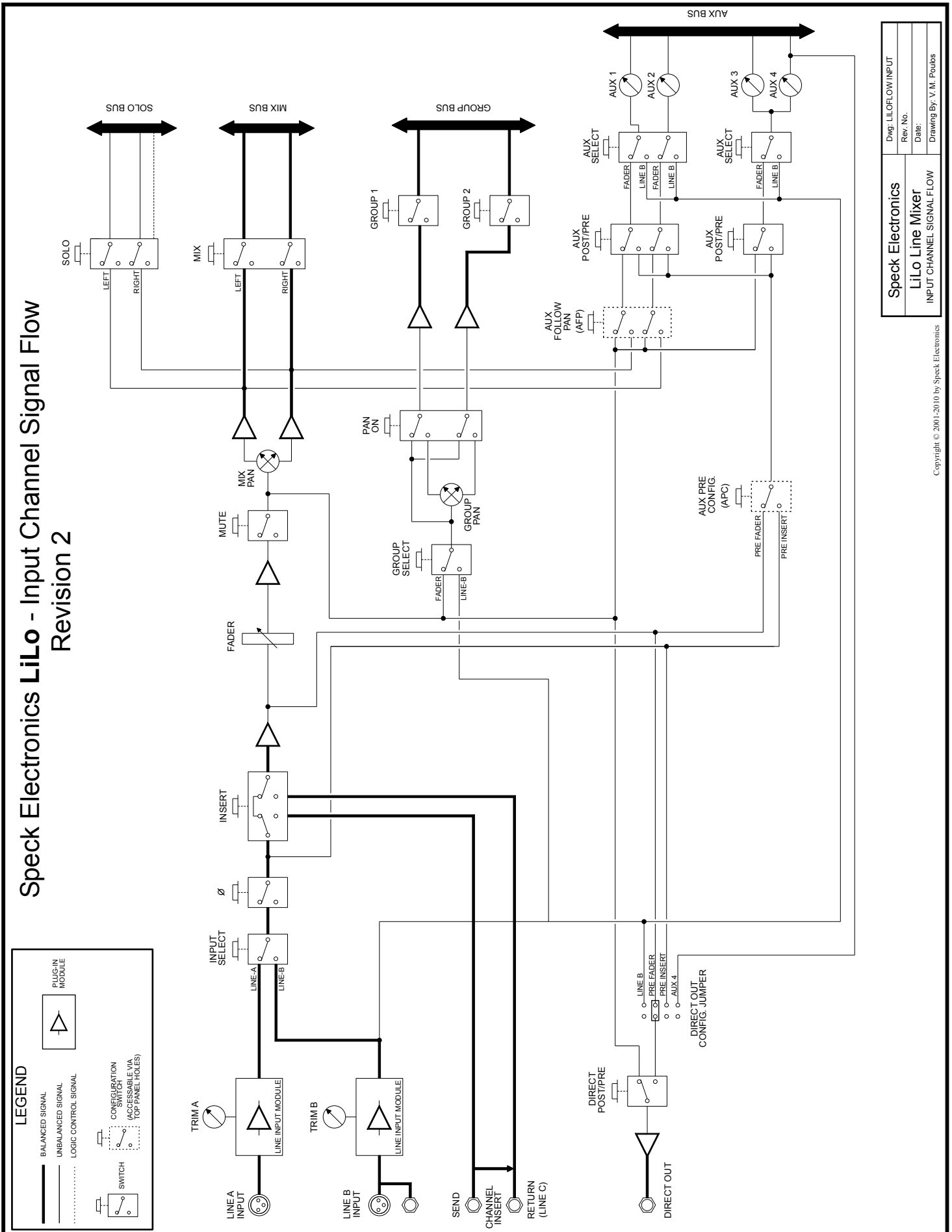


Figure 7. Input Channel signal Flow

Speck Electronics

LiLo Line Mixer

INPUT CHANNEL SIGNAL FLOW

Dwg: LILLOFLOW INPUT
Rev. No.
Date:
Drawing By: V. M. Poulos

Speck Electronics LiLo - Master Section Signal Flow

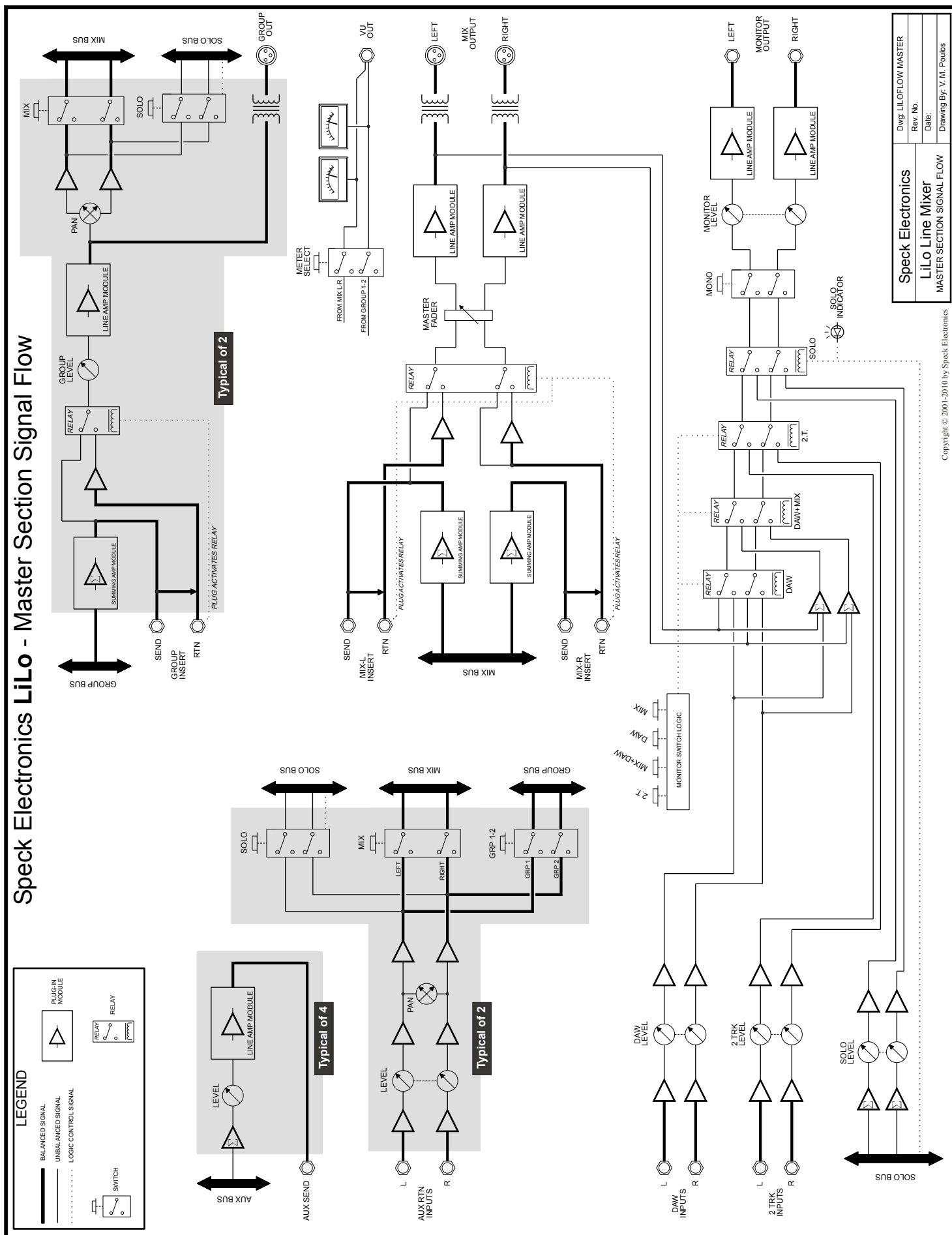


Figure 8. Master Module Signal Flow

~ This page left intentionally blank ~

Installation & Setup

General The following information should give you the basics on how to install the LiLo mixer and power supply. The proper installation of the LiLo requires a clear understanding of audio wiring, AC distribution, grounding, and shielding techniques.

If the LiLo is being installed into a larger studio or as a sidecar/expander to a host console, it may be necessary to retain the services of someone experienced in these matters.

Power Supply Installation One of the primary reasons that the power supply of the LiLo is external is to insure that the power transformer enclosed within the power supply chassis maintains a safe distance from the active electronics of the LiLo. For that matter, any device that has a strong magnetic power field should be kept at a reasonable distance from the LiLo and its audio cables.

Because the power supply does not use a cooling fan, it is silent and can be located in the same room as the mixer. It is important that the ventilation holes are not obstructed and that the unit is operated in free air to prevent overheating. Allow a minimum of 4”(100mm) of clearance from all ventilation holes.

The LiLo's power supply can operate with 100 VAC, 120 VAC, 220 VAC, 230 VAC, or 240 VAC 50/60hz. Before switching “on” the power, you should verify that the voltage setting on your power supply is configured to match the AC mains requirements of your country. If the AC mains voltage needs to be changed, this procedure should be performed and checked by a qualified technician.

Before connecting the DC power supply cable to the LiLo, make certain the power switch is set to the “off” position.

To connect the power supply to the mixer, fit the circular connectors at each end of the DC power supply cable to the chassis mount receptacles that are mounted on the power supply and the rear of the Lilo. The respective connectors are keyed so the plug and chassis mount receptacle can fit in only one direction. When the connectors have been mated, rotate the circular locking ring clockwise until it stops.



Always turn the power supply “off” and disconnect the DC power cable before servicing the LiLo mixer.

Fuse Replacement In the unlikely event that a fuse blows, it is **EXTREMELY** important that a fuse of the same type and current rating be replaced. The chart below in Figure 9 lists the fuse current ratings to be used for your countries mains voltage. All fuses are 20mm x 5mm slow blow type.

Fuse Chart for PS5-3 Power Supply					Fuse Chart for PS5-5 Power Supply				
100 VAC	120 VAC	220 VAC	230 VAC	240 VAC	100 VAC	120 VAC	220 VAC	230 VAC	240 VAC
5 Amp	5 Amp	2.5 Amp	2.5 Amp	2.5 Amp	6 Amp	6 Amp	3 Amp	3 Amp	3 Amp

Figure 9.

The power supply also has (2) internal 20mm x 5mm slow fuses for additional protection. In the unlikely event that one or both of these fuses fail it will be necessary to remove the power supply chassis cover to gain access to these fuses. This procedure should be preformed by a qualified technician.

Environmental Considerations

The LiLo will operate satisfactorily over a wide range of ambient temperatures, and the external power supply will operate from -10° C to +30 ° C. If the power supply is installed in an equipment rack that also contains heat producing equipment, adequate ventilation should be provided. This will prolong component life and maximize operational stability.

While the internal circuitry of the Lilo is fully shielded by the chassis, installation should nevertheless be planned to avoid locating the LiLo immediately adjacent to power amplifiers, power supplies, or any source of Electromagnetic emissions.

Physical Placement of Adjacent Equipment

Any device that emits a high EMI (Electro Magnetic Interference) or RFI (Radio Frequency Interference) energy field should be treated with suspicion. EMI is considered any unwanted signal which adversely affects the operation of the mixer or the mixing system. This subject is discussed in Chapter 4.

Electronic equipment such as power amplifiers, power supplies (especially wall mount type), video monitors, computers, certain synths and samplers must be located away from the LiLo and its associated cables. It may be necessary to alter the positions of certain equipment that you feel would cause buzzes or hums in the mixer system.

Hooking up the Mixer

A quality installation is essential when wiring any audio system. When the time comes to actually interconnect your equipment, proceed slowly. Interfacing the many pieces of electronic equipment to your mixer and audio system should be a logical, methodical process.

Start by connecting only the monitor power amp (or powered speakers) to the mixer, and then add one line signal to the mixer at a time; carefully listening and monitoring your progress. If a problem arises, such as a buzz, hum, intermittent signal, or nonexistent signal, stop at that point and solve the problem before proceeding.

Due to the high performance of the LiLo, it is recommended that you use only the highest quality audio cable. A high quality cable by definition is a cable that provides good mechanical strength, high microphonic noise immunity, high frequency response, low crosstalk, and 100% shielding ability. All audio cable used with the LiLo should be a 3 conductor foil shield type (2 inner conductors and a shield drain conductor). It is not recommended that the 2 conductor "off the shelf cables" be used.

All wire and cable interfaced to the LiLo should be terminated with high quality connectors. A ¼" plug or XL connector should make a positive connection to its respective mating jack and provide adequate strain relief to its cable. All connectors should also have a metal shell to provide 100% shield for exposed conductors.



Always turn the power supply "off" and disconnect the DC power cable before servicing the LiLo mixer.

Removing Modules for Service

Removing the Input Module

To remove an input module for maintenance, remove the Philips screws at the top and bottom of the module. Carefully pull the input module straight up by holding the knobs. Once the module is clear of the main chassis, remove the ribbon cable at the rear of the module by releasing the ejector tabs, and then remove the larger ribbon cable at the bottom. To re-install the module just reverse the procedure being certain that the ribbon connectors have been inserted completely into the receptacles and that the ejector tabs "snap" back into position.

Removing the Master Module

Before removing the master module, it is recommended that some kind of protective material is laid over the input modules adjacent to the master module. A small soft towel would work fine.

To remove the master module, remove the Phillips screws (4) at the top and bottom of the module. The module will need to be lifted up and the front tilted up slightly until the module completely clears the main chassis. Once the module is clear of the chassis, lay the module on its side. Remove the (6) ribbon cables that are identified "A through E" by releasing the ejector tabs. Next, remove the (2) larger ribbon cable connectors at the bottom of each circuit board.

To re-install the module just reverse the procedure being certain that the ribbon connectors have been inserted completely into the receptacles and that the ejector tabs "snap" back into position. All cables are labeled to match the label on the module's receptacles.

Cleaning The module and chassis are a high quality painted surface and the panel lettering is applied using a silkscreen printing technique.

To clean the top or rear panel, wipe the surface gently using a soft lint-free cloth to avoid scratching the panel or markings. Paper towels are not recommended. Commercially available window cleaner solutions may be used; however, the solution should be applied to the cloth and not the panel to avoid the seepage of liquid to the inside of the enclosure.

Do not use brushes or feather dusters to remove dust. This may cause dust to fall into the openings around the pushbutton switches.

Mixer Operation

Overview In this section we hope to give you basic information on the operation of the LiLo and adequately describe its controls, switches, and connectors.

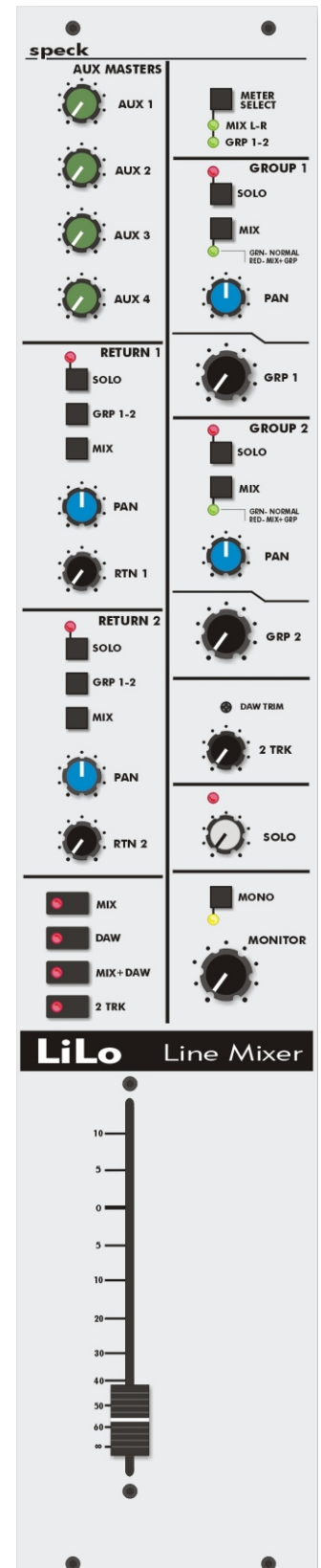
The information in this section of the manual is intended to help with the technical process when using your LiLo. Words alone could not adequately describe how to adjust the controls for every situation you might encounter with the Lilo. You should experiment with settings and routing techniques to achieve the best results for any particular situation. Your ears should be your best gauge of how to adjust the settings on the LiLo to make the sound fit your requirements.

Default Control Settings

Before any attempt is made to operate the mixer, it would be a good idea to set all the mixers controls to their neutral positions. This gives you a reference point to work from when adjusting controls and switches.

All volume controls, including aux sends, aux returns, and master level controls should be set to their full counter-clockwise setting. All pan controls should be set centered. All pushbutton switches on the input channels and master module should be set to the up position.

When any future reference is made to the controls or switches of the LiLo, it will be assumed that they have been set to their neutral positions.



Input Channel Signal Flow Diagram

Use this **Input Channel Signal** flow diagram shown below in Figure 10 as a reference when reading the descriptions of the controls, switches, and connectors [1] through [26] in this chapter.

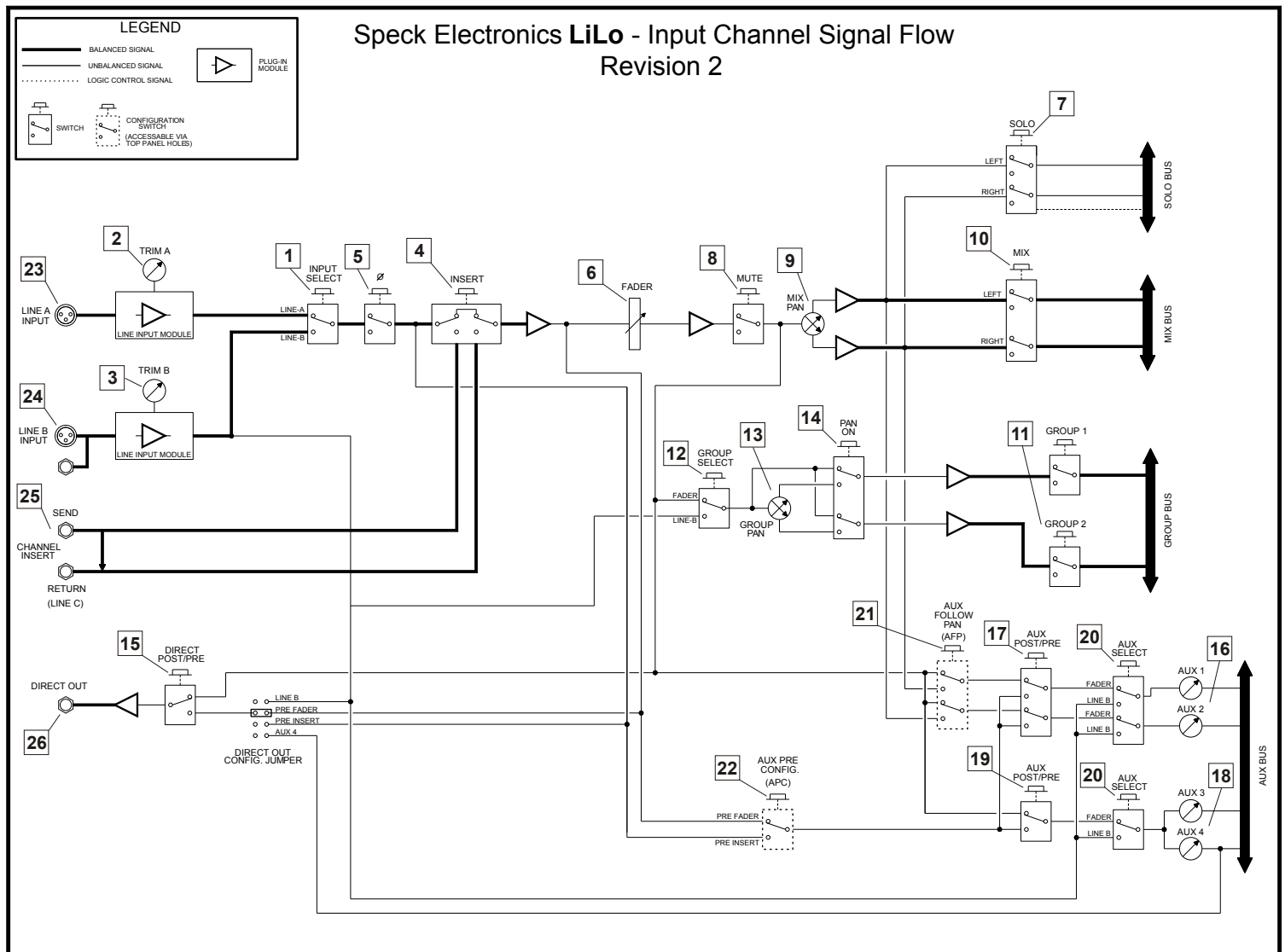
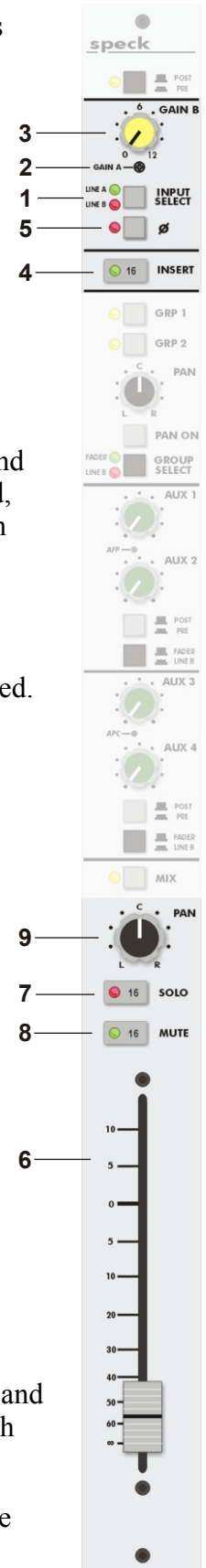


Figure 10. Input module signal flow

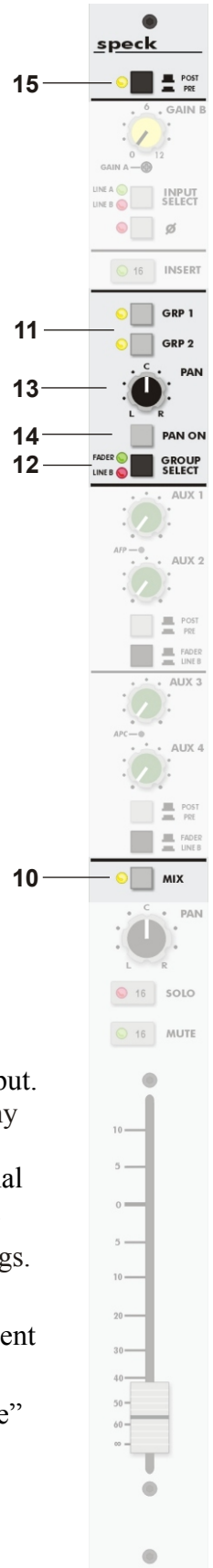
Input Channel

1. **Line Input Select** The Lilo has separate line amp modules for each input as well as separate trim controls. This switch selects the Line-A or Line-B line amp module. LED's display the status of the switch; green for Line-A or red for Line-B.
2. **Line-A Gain Trim** This control provides up to 12dB of gain for the Line-A input. The factory setting is fully counter-clockwise (0 dB). A small flat blade screwdriver can be used to adjust this pot.
3. **Line-B Gain** This control provides up to 12dB of gain for the Line-B input.
4. **Insert Select** Each input channel on the LiLo has a balanced send and return available via separate 1/4" TRS jacks on the rear connector panel. The insert signal path is immediately after the **Polarity** switch and just before the **Slide Fader**. When this insert switch is depressed, any audio device connected to the insert connectors is inserted in the channel's audio path. If the insert switch is depressed and nothing is plugged into the send/return jacks the signal will pass through the channel since the jacks have switching (normaling) contacts that are only broken by the insertion of a plug. A green LED on this switch illuminates indicating that the insert is enabled.
5. **Polarity** This switch reverses the polarity of the Line-A or Line-B input signal by 180 degrees. A red LED on this switch illuminates indicating that the polarity is enabled.
6. **Slide Fader** This 100mm slider adjusts the level for the input channel. The operation of the slide fader will control the level to the stereo mix, aux sends, group assigns, and the direct output. A good starting position for this slide fader is to align the slider knob to the "0" mark on the panel.
7. **Solo** Depressing this switch allows you to isolate any input channel to the monitor outputs while maintaining stereo perspective.

Any combination of input channels, group assign, or aux returns may be soloed without interrupting the flow of the signal to the main mix feed. A red LED on this switch as well as the master Solo indicator will illuminate if a channel is soloed.
8. **Mute Switch** Depressing this button eliminates all signal flow to the channels left/right mix, group assigns, the aux sends (if set to post fader), and the direct output (if set to post fader). A green LED on this switch illuminates indicating that the Mute is enabled.
9. **Mix Pan Control** This center detent pan control places the channel anywhere in the stereo left/right mix when the **Mix Assign** [10] is enabled.



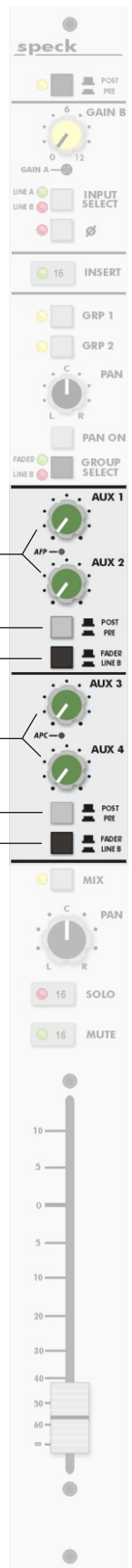
- 10. Mix Assign** The Mix Assign switch, in conjunction with the **Pan** control, allows an input channel to be mixed to the left/right main output. A yellow LED on this switch illuminates indicating that the Mix Assign has been enabled
- 11. Group Assigns** The GRP 1 and GRP 2 pushbutton switches allow an input channel to be assigned and mixed to the two individual subgroups. The group assigns operate independent of the channel's Mix pan and L-R mix assign. These switches operate under the control of the **Group Pan** control when the **Pan On** switch is depressed.
- 12. Group Select** This switch selects the source for the GRP 1 and GRP 2 assigns. In the "Fader ↑" position the source for the Group Assigns is the channel fader. When depressed to the "Line-B ↓" position the source for the group assign switches is "exclusively" the channel's Line-B line amp. LED's display the status of the switch; Green for Fader or red for Line-B.
- 13. Group Pan** This center detent pan control when used in conjunction with **Group Assign** switches allows signal that is selected with the **Group Select** switch to be panned between the between groups 1 and 2.
- 14. Pan On Switch** This switch enables the group assign pan control. When this switch is on the ↑ position the **Group Pan** is inactive. When this switch is on the ↓ position the Group Pan is active and will allow signal that is selected with the **Group Select** switch to be panned between the between groups 1 and 2.
- 15. Direct Out Select** This switch selects the signal source for the balanced direct output. The "Post ↑" position is after the slide fader and responds to any adjustment of the slider fader. The "Pre ↓" position is user configurable with an internal jumper to select four possible signal sources; Pre Fader, Pre Insert jack, Line-B input, or Aux 4 send. See Figure 11 on page 24 for the direct out configuration settings. The factory default setting for the "Pre" position is Pre Fader which is before the slide fader and is unaffected by any adjustment to the slide fader. A yellow LED on this switch illuminates indicating that the "pre" position has been enabled.



Aux Sends

Each input channel has four aux sends that can be switched pre or post the slide fader. The Pre/Post functions can be configured to accommodate different mixing applications.

- | | |
|--------------------------------|--|
| 16. Aux Sends 1 & 2 | Adjusts the level to the Aux busses 1 and 2. |
| 17. Aux Post/Pre Select | This switch selects the source of Aux Sends 1 & 2. In the “Post ↑” position, the aux sends reflect any adjustment to the slide fader or mute. In the “Pre ↓” position the channel fader has no affect on the level set at the Aux Sends. |
| | When the “AFP” switch is pushed, the pan control allows the signal to be panned across the 1 and 2 Aux Sends. The "AFP" function is described on page 22. |
| 18. Aux Sends 3 & 4 | Adjusts the level to the Aux busses 3 and 4. Aux 4 can be configured to send a signal to the direct output. (See jumper configuration Figure 11 on Page 24) |
| 19. Aux Post/Pre Select | This switch selects the source of Aux Sends 3 & 4. In the “Post ↑” position, the Aux Sends reflect any adjustment to the fader or mute. In the “Pre ↓” position, the channels fader has no effect on the level set at the Aux Sends. |
| | The source of the “Pre” switch position for Aux Sends 3-4 can be pre-fader (default) or pre-insert using “APC” switch. The APC function is described on page 22. |
| 20. Aux Source Select | This function is similar to the Group Select in that it selects the source for the Aux Sends 1 & 2 and Aux Sends 3 & 4. In the up position, the source for the send is the channels fader. When depressed to the Line-B position, the source for Aux Sends is “exclusively” the channels Line-B line input. |



AFP, APC Configuration Switches

Each input channel on the LiLo has a secondary level of signal routing that is made possible with two push switches that are accessible via small holes in the panel. These switches change the configuration of the aux sends. Any small diameter object (like a paper clip) can be used to push this switch.

21. AFP **(Aux Follow Pan)**

AFP means “Aux Follow Pan”. When this switch is pushed to the down position, the levels set at **Aux Send 1** and **Aux Send 2** will follow the position on the channels pan control. The AFP switch does not affect Aux Sends 3 & 4.

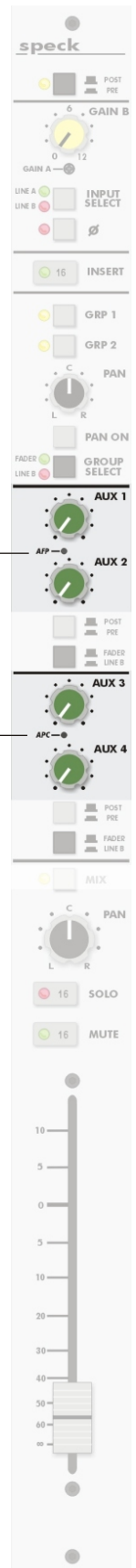
22. APC **(Aux Pre Configure)**

APC means “Aux Pre Configure”. This switch changes the operation of the Aux 1 & 2 and Aux 3 & 4 Pre/Post switches. When the APC switch is pushed to the down position, the Pre/Post switches are no longer “Post ↑/ Pre Fader ↓” but instead becomes “Post ↑ / Pre Insert ↓”.

The Pre Insert audio signal is after the **Polarity** switch and before the **Insert** switch.

21

22



Input Channel I/O Connectors

Each of the input channels has a balanced XLR Line-A input connector, balanced XLR and TRS connectors for Line-B, balanced ¼" TRS connectors for the Inserts, and a balanced ¼" TRS Direct Out.

The pin configuration for all XLR connectors is:
Pin 1=Ground, Pin 2=High (+), Pin 3=Low (-)

The pin configuration for all ¼" TRS jacks is:
Tip=High (+), Ring=Low (-), Sleeve=Ground

- 23. Line-A Input** This XLR active-balanced input is suitable for any high level line source. The maximum input level is +28dBu.
- 24. Line-B Input** This active-balanced input is suitable for any high level line source. The XLR connector and ¼" TRS jack are wired in parallel. The maximum input level is +28dBu.

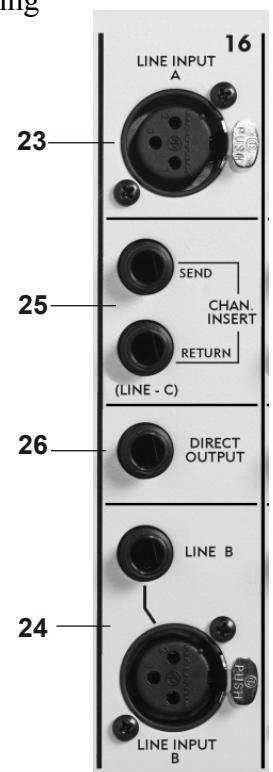
- 25. Insert Send and Return** Each input channel on the LiLo has a balanced send and return available via separate ¼" TRS jacks. The inserts signal path is located immediately after the **Polarity** switch and just before the **Fader**. When the channel's **Insert** switch is depressed, any audio device (such as an equalizer or filter) connected to the send/return connectors is inserted in the channel's audio path. If the **Insert** switch is enabled and nothing is plugged into the return jack, the signal will pass through because the jacks have switching (normalling) contacts that are only broken by the insertion of a plug. The insert send/return operates at nominal level of +4dBu.

The insert return can also be used as a "Line-C" input by connecting a source to the insert return jack and depressing the **Insert** switch.

- 26. Direct Output** The Direct Output provides an active-balanced line level signal from the channel and operates at a nominal level of +4dBu. The Direct Output is ideal for minimum signal path connection to multitrack recorder.

The direct out audio signal can be selected with the Direct post/pre select switch on the input module. In the "post" position the direct out signal is after the slide fader, whereas any adjustment to the slider fader will control the volume at the direct output connector. In the "pre" position the direct out signal is before the slide fader and is unaffected by any adjustment to the side fader.

Additional settings may be the Pre Insert jack, Line-B input, or Aux 4 send as explained on page 24.



Note - All active-balanced output circuits of the LiLo were designed for balanced lines and should only be connected to balanced inputs. If that is not possible and it is necessary to connect to an unbalanced input, care must be taken not to connect the low (-) terminal to ground. If the low (-) terminal of these outputs is connected to ground, the result will be a high level of audio distortion.

Direct Out Circuit board configuration jumpers

Figure 11 below shows the location and designations for the Direct Out configuration jumper.

The direct out audio signal can be selected with the Direct Post/Pre select switch on the input module. In the “Post” position the direct out signal is after the slide fader, whereas any adjustment to the slider fader will control the volume at the direct output connector. In the “Pre” position the direct out signal is before the slide fader and is unaffected by any adjustment to the side fader.

By default the Direct Out configuration jumper is set to the “Pre Fader” position. The other settings may be the Pre Insert jack, Line-B input, or Aux 4 send.

The input module must be removed to perform this configuration change. Refer to page 15 for instructions on removing the input modules.

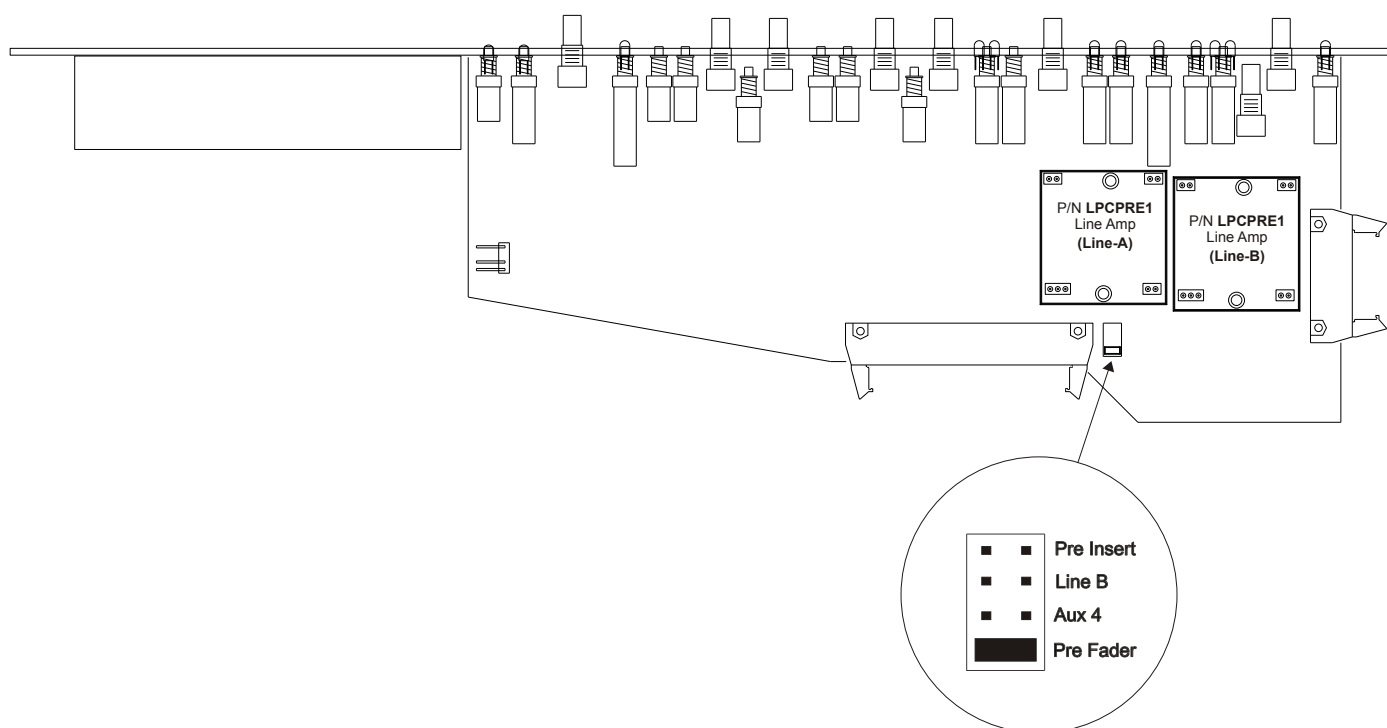


Figure 11. Direct Out configuration jumper

Master Module Signal Flow Diagram

Use the **Master Section Signal** flow diagram shown below in Figure 12 as a reference when reading the descriptions of the controls, switches, and connectors [27] through [54] in this chapter.

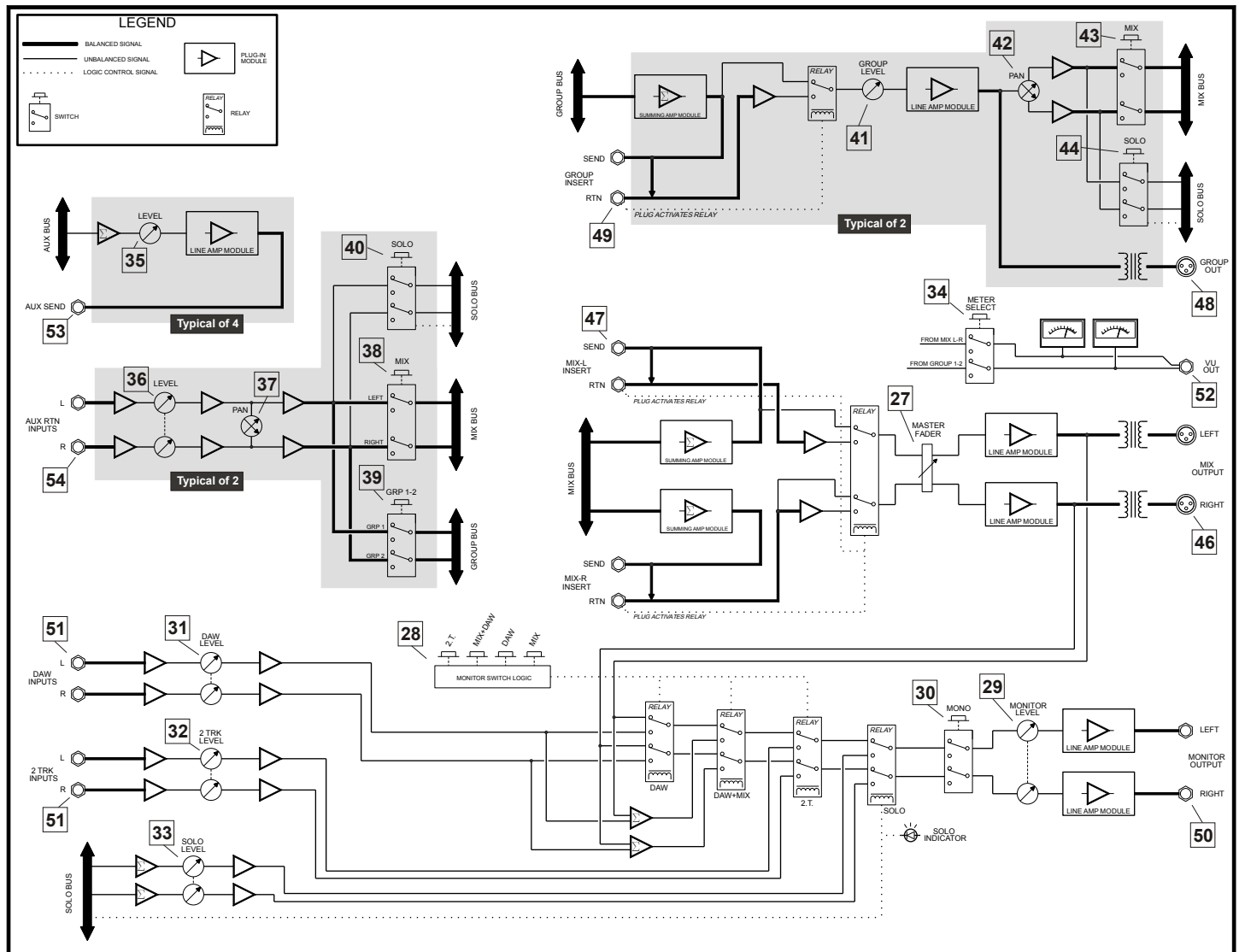


Figure 12. Master section signal flow

Master Module

27. Stereo Master

This 100mm dual slider is the master volume to the transformer balanced mix outputs. The VU meters will display any adjustment to this Stereo Master control when the **Meter Select** switch is set to the "Mix L-R" position.

Under normal operating conditions the fader should always be set at maximum. If it has to be pulled down a significant distance it indicates that the levels at the input channels are too high and should be reduced.

28. Monitor Source Select

Four momentary pushbutton switches select the source to the **Monitor Master** control. Each switch has a red LED.

The source for the monitor can be:

Mix- This is the stereo mix of the LiLo post the stereo master fader

DAW- This is any mono/or stereo signal that is connected to the DAW return.

Mix+DAW - When pressed, any signal from the DAW return is combined with the overall mix, post the stereo fader.

2T - This is any mono/or stereo signal that is connected to the 2 Track return.

When power is initially applied to the LiLo, the **Monitor Source Select** will be automatically set to the "Mix" selection.

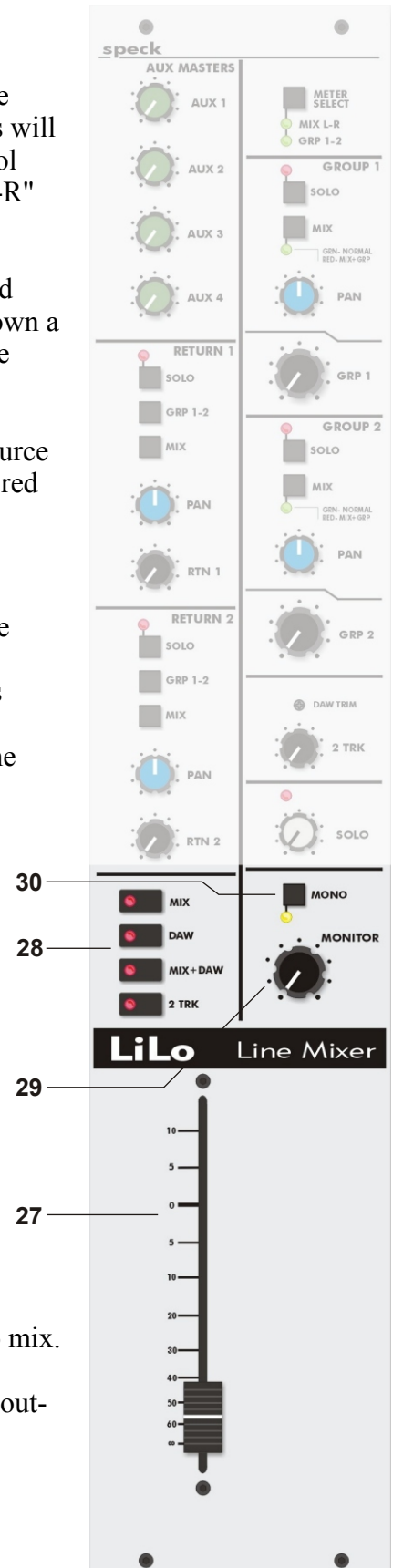
29. Monitor Master

This adjusts the overall level to the stereo monitor outputs on the rear panel. The Monitor Master typically controls the volume to a stereo power amplifier or powered speakers.

30. Mono Select

When depressed, this switch sums the left and right signal together, creating a mono composite for the monitor mix. The operation of the Mono switch does not affect the main stereo mix.

The Mono switch allows the user to check for any out-of-phase signals or simply monitoring your mix in monaural.



31. DAW Return Level

This trim pot adjusts the level of any external stereo source connected to the DAW returns on the rear panel. This could be the stereo mix of a DAW or any other stereo source. This return is selected with the DAW, or the Mix+DAW **Monitor Source Select** switch [28].

The factory setting for this pot is about the 2 o'clock position. A small flat blade screwdriver can be used to adjust this pot.

32. 2 Track Return Level

This controls the level of any stereo source connected to the 2T returns on the rear panel. This could be a DAT recorder, CD player/recorder or any stereo audio signal. This return is selected with the 2T **Monitor Source Select** Switch [28].

33. Solo Master

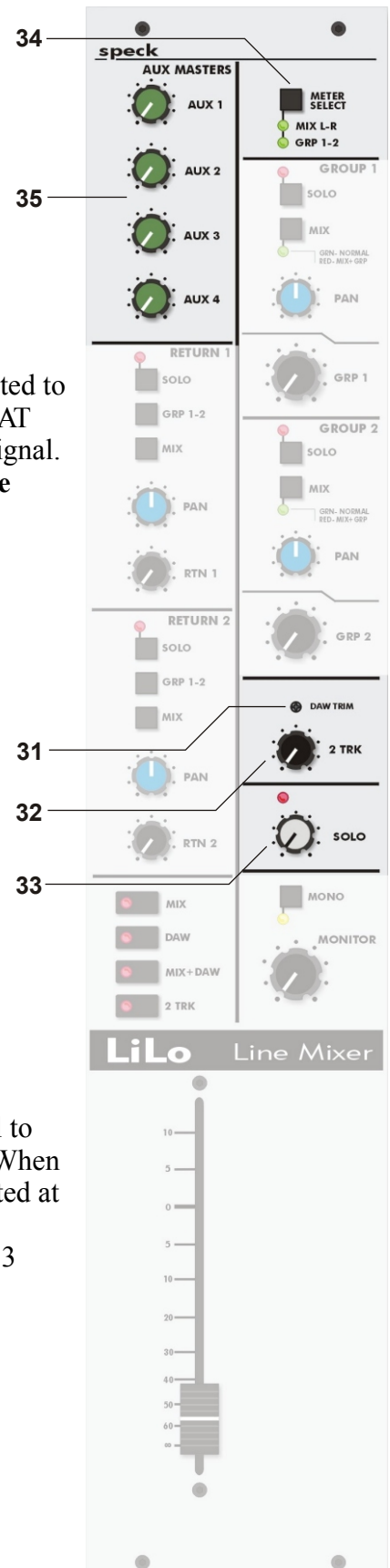
This control adjusts the overall solo listening level to the monitor outputs. The adjustment of this control permits the volume of a soloed signal to match the level of the normal stereo mix. An associated LED illuminates when a solo switch on any input channel, group assign, or aux return is soloed.

34. VU Meter Select

This switch selects the source to the VU meter pod as well as the $\frac{1}{4}$ " VU output on the rear panel. This switch can be either the "L-R Mix" outputs or "Group 1-2" outputs. Two yellow LED's display the status of the selected outputs.

35. Aux Masters

The four Aux Masters provide master level control to the balanced aux send outputs on the rear panel. When matched with an effects unit that is properly operated at a professional input level of +4 dbu, the optimum setting for this pot is typically anywhere from 2 to 3 o'clock.



Aux Return Section

There are two aux return sections incorporated into the LiLo. Each stereo return includes a stereo **Return Level** control, **Pan** control, **Mix Assign**, **Group Assign**, and in-place **Solo** switch.

36. Aux Return Level

This dual pot simultaneously and equally adjusts the left and right aux return level.

37. Pan/Balance Control

This center detent control acts as the left/right balance for any stereo output effects device connected to an aux return. When a mono output effects device is connected to the aux return, then this control would act as a traditional pan.

38. Mix Assign

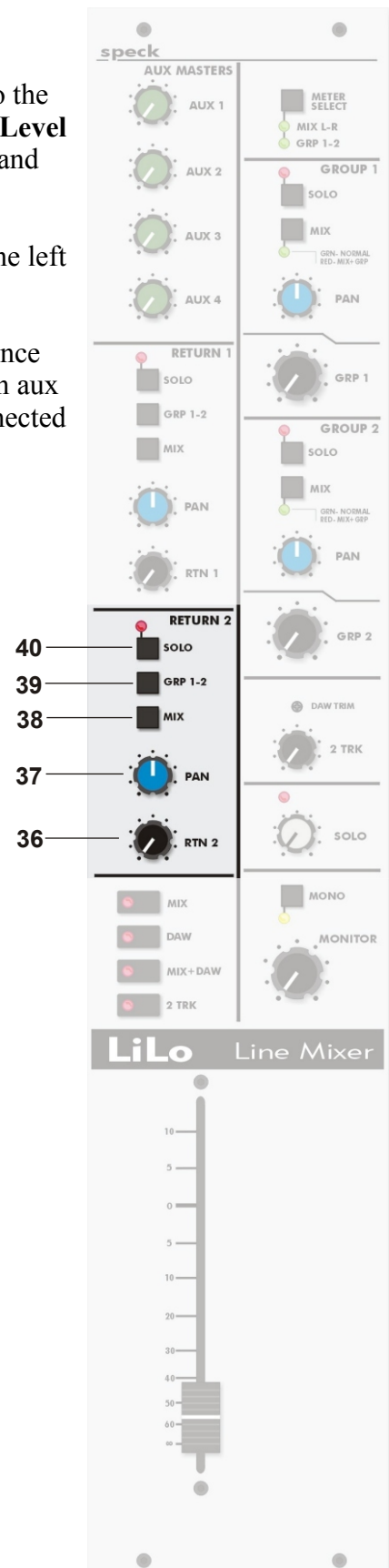
The Mix Assign switch, in conjunction with the **Pan** control, allows an aux return to be mixed to the left/right main output.

39. Group Assign

The GRP 1-2 pushbutton switch allows the aux return to be assigned and mixed to the two individual subgroups. This switch operates under the control of the pan/balance control.

40. Solo

Depressing this switch allows you to isolate any aux return to the monitor outputs while maintaining stereo perspective. The source for the in-place solo circuit is post (after) the aux **Return Level** control. This allows you to solo multiple effects returns while retaining their relative levels. A red LED above this switch, as well as the master Solo LED, will illuminate when the return is soloed.



Group Section

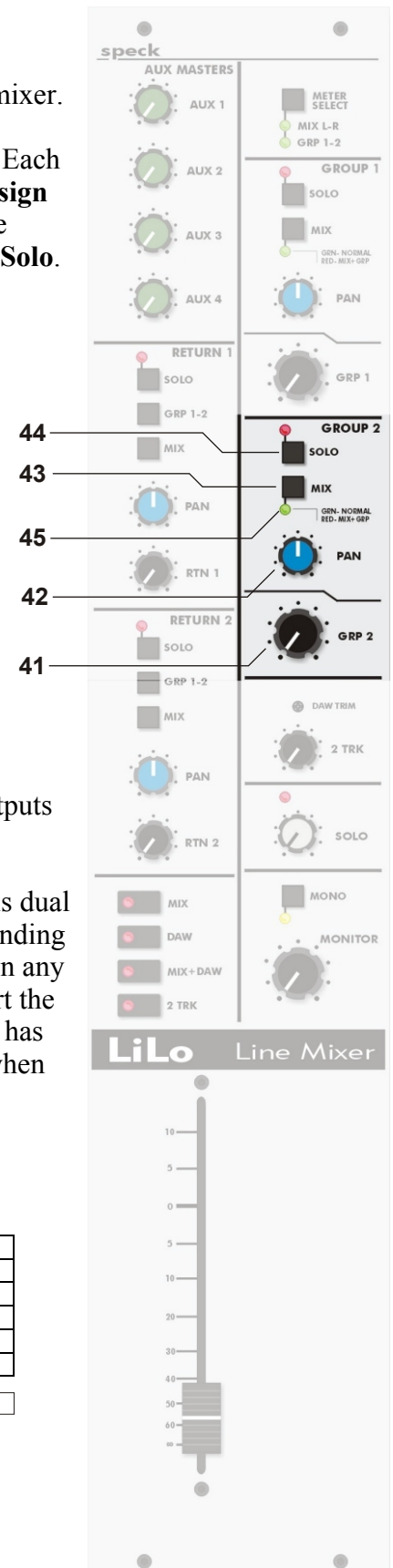
There are two group master sections on the LiLo mixer. Each section includes a **Group Master** level that controls a balanced XLR output on the rear panel. Each group section also includes a **Pan** control, **Mix Assign** that in conjunction with the pan control assigns the group mix to the main left/right mix, and In-place **Solo**.

- 41. Group Master Level** This control is the master to the group output on the rear panel. The VU meters will display any adjustment to the **Group Master** controls when the meter select switch is selected to the GRP 1-2 position.
- 42. Pan Control** This center detent pan control places the group master anywhere in the stereo left/right mix when the **Mix Assign** is enabled.
- 43. Group Mix Assign** This switch, in conjunction with the **Pan** control, assigns the group mix to the main left/right mix.
- 44. Solo** Depressing this In-place solo switch allows you to isolate the groups panned signal to the monitor outputs while maintaining stereo perspective.
- 45. Mix Assign LED Display** When a group **Mix Assign** switch is depressed, this dual color LED will illuminate either green or red depending on the combination of switches that are assigned on any input channel. The reason for this display is to alert the user that a common signal from any input channel has been assigned to both the Mix and Group. Only when the group mix switch [43] is assigned is this LED relevant.

Logic Truth Table					
Group Mix Assign [41]	↑	↓	↓	↓	↓
Channel Mix assign [10]	X	↑	↓	↓	↓
Channel Group 1 Assign [11]	X	↓	↑	↓	↓
Channel GRP Select [12]	X	↑	↑	↓	↑
LED color [43]	Off	G	G	G	R

G=Green, R=Red, X=Irrelevant, ↓=Switch Down, ↑=Switch Up

Figure 13. Mix assign LED truth table



VU Meters The analog style meter pod uses two high quality illuminated taut-band VU meters. The VU meters are calibrated to indicate 0VU when the audio outputs equal the standard pro audio reference level of +4dBu.

+4dBu is equal to 1.23 Vrms.

The **Meter Switch** [34] on the master module selects the source to the VU meters. This switch can be either the "L-R Mix" outputs or "Group 1-2" outputs.

VU Lamp Replacement

Replacing a defective lamp on the analog meter requires removing the cover of the VU pod by removing the (6) phillips screws. Each VU meter has (1) incandescent lamp that is fitted into a lamp assembly. This lamp assembly is held in place at the rear of the meter with (1) small Phillips screw.

To remove the white lamp assembly, insert a small Phillips screwdriver through the access holes (A) as shown in Figure 14a. When the white lamp assembly (Figure 14b) has been removed from the VU meter, remove the old lamp by pulling it away from the copper spring clips. Replace with a miniature festoon (6mm x 25mm), 5 volt incandescent lamp (available from Speck Electronics).

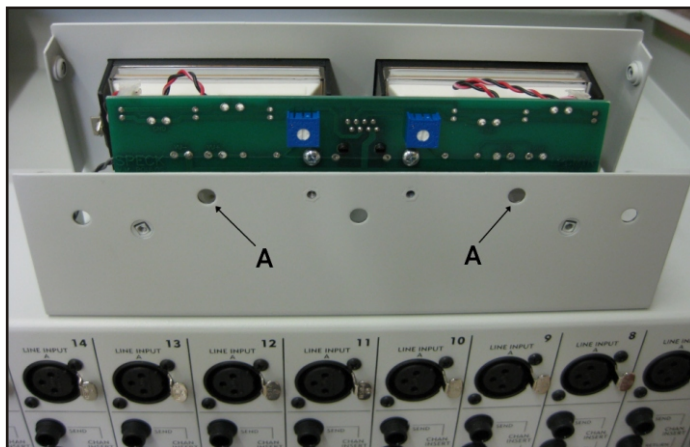


Figure 14a. Screw driver access holes

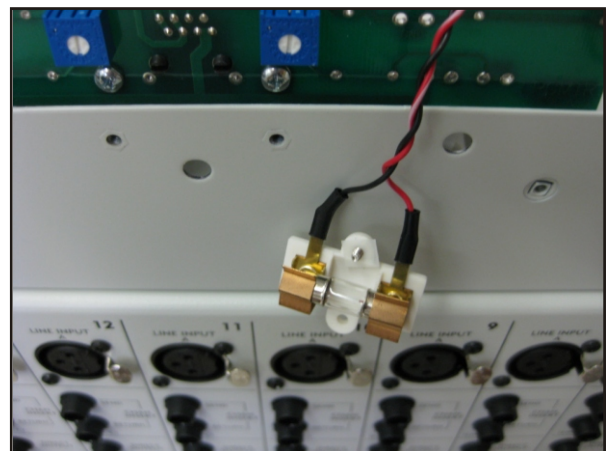


Figure 14b. Lamp assembly

Master Module I/O connectors

The master section has a full compliment of XLR and 1/4" TRS jacks for the main **Mix Outputs**, **Group Outputs**, **Monitor Outputs**, **Aux sends** and **Aux returns**, the stereo **DAW Return** and **2 Track Return**, and a external **VU Meter Output**.

The pin configuration for all XLR connectors is:
Pin 1=Ground, Pin 2=High (+), Pin 3=Low (-)

The pin configuration for all 1/4" TRS jacks is:
Tip=High (+), Ring=Low (-), Sleeve=Ground

The pin configuration for VU output jacks is:
Tip=Left, Ring=Right, Sleeve=Ground

46. Mix Outputs

The balanced left and right mix outputs are adjusted by the mix **Master Control** [27] on the front panel.

Transformers are standard on the mix left and right outputs but can be ordered with Active-Balanced outputs.

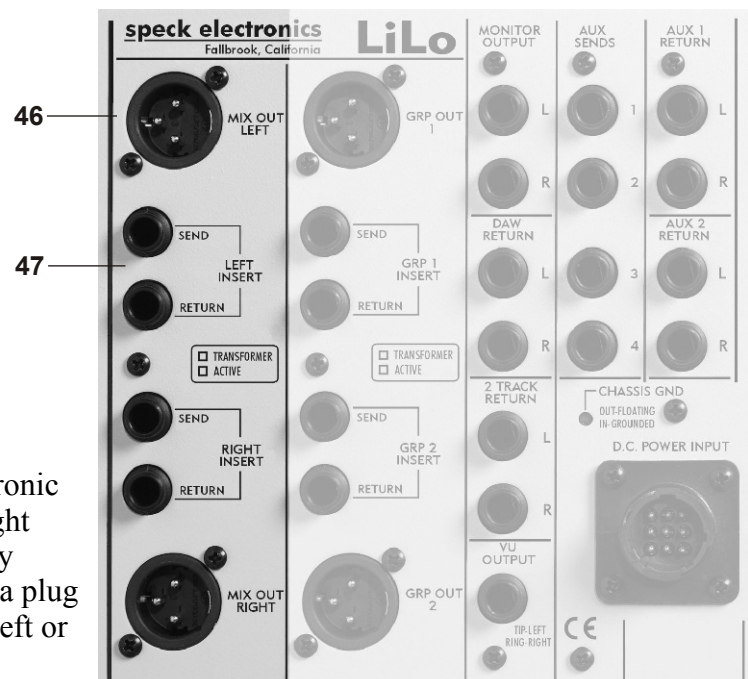
Note - All active-balanced output circuits of the LiLo were designed for balanced lines and should only be connected to balanced inputs. If that is not possible and it is necessary to connect to an unbalanced input, care must be taken not to connect the low (-) terminal to ground. If the low (-) terminal of these outputs is connected to ground, the result will be a high level of audio distortion.

47. Mix Insert Jacks

The Insert Jacks provide line level inter-stage access to the mix bus before (pre) the stereo **Master Fader**. This means that any device interfaced to this jack will not be affected by any adjustments of the stereo **Master Fader**.

The insert jacks may be utilized to connect processors such as limiters, equalizers, or noise reduction.

The active-balanced electronic circuitry of the left and right insert returns is completely bypassed via a relay until a plug is inserted into either the left or right mix return jack.



48. Group Output Connectors

The balanced group outputs are adjusted by the Group 1 and Group 2 masters [41] on the master module.

Active-Balanced outputs are standard on the group outputs but may be ordered with transformer-balanced outputs.

49. Group Insert Jacks

Each group channel has ¼" TRS send and return insert jacks. The insert jack provides line level inter-stage access to the group bus before (pre) the **Group Master** level control. This means that any device interfaced to these jacks will not be affected by any adjustments of the **Group Master** control.

The insert jacks may be utilized to connect processors such as limiters, equalizers, or noise reduction.

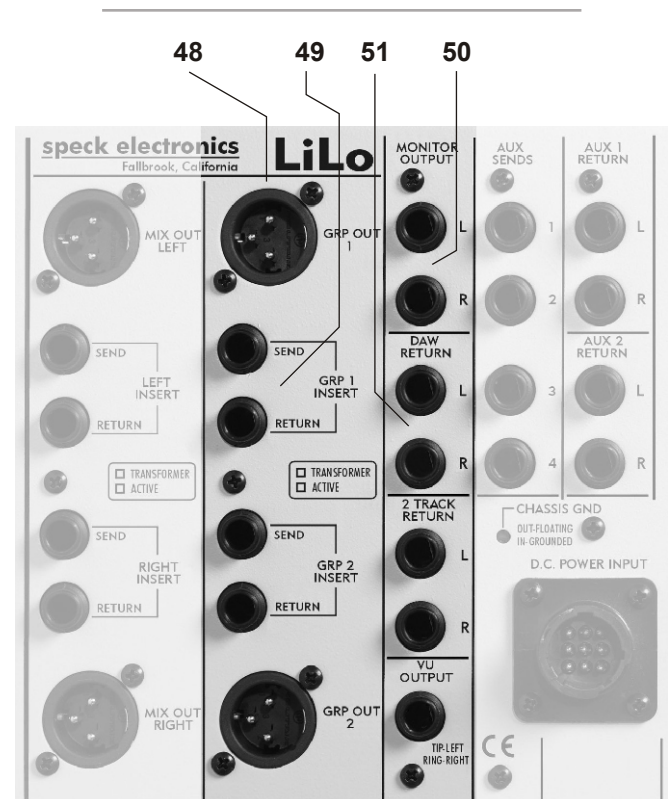
The active-balanced electronic circuitry of each group insert return is completely bypassed via a relay until a plug is inserted into its respective insert return jack.

50. Monitor Output Jacks

These balanced ¼" TRS jacks are available for hooking up a power amp or powered speakers. The signal present at these jacks is adjusted by the **Monitor Master** control on the front panel.

51. DAW and 2T Return Jacks

These active-balanced ¼" TRS connectors allow the interface of an external stereo signal, such as a DAW, DAT, CD recorder/player, or any stereo line level source. These inputs are selected with the **Monitor Select** [28] on the master module. The 2T and DAW returns may be operated in mono when a single signal is plugged into the left input jack only.



52. VU Meter Output This 1/4" TRS jack is available as an unbalanced output for an external stereo VU meter and is selected with the **VU Meter Select** switch on the master module. The tip of the stereo jack is the left VU signal, and the ring of the jack is the right VU signal.

The use of this output connector does not affect the operation of the VU meter pod on the LiLo.

53. Aux Send Jacks Each of the four Aux Send channels have an active-balanced 1/4" TRS jack to interface to the input of an effects device.

54. Aux Return Jacks Each Aux Return provides stereo balanced 1/4" TRS jacks for connection from the outputs of a stereo effects device. In order to operate the stereo aux return as a mono return, plug into the left input jack only.

55. DC Power Input Connector The DC power cable that comes from the power supply connects to this 9 pin circular connector. This connector and its respective plug is keyed so they will only fit in one direction. For power supply installation instructions, refer to the Interface & Setup Section in this manual.

The following connector illustration (Figure 15a) and chart (Figure 15b) represents the DC voltages to the 9 pin circular connector required to power the LiLo.

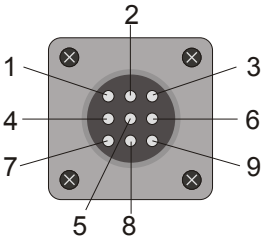
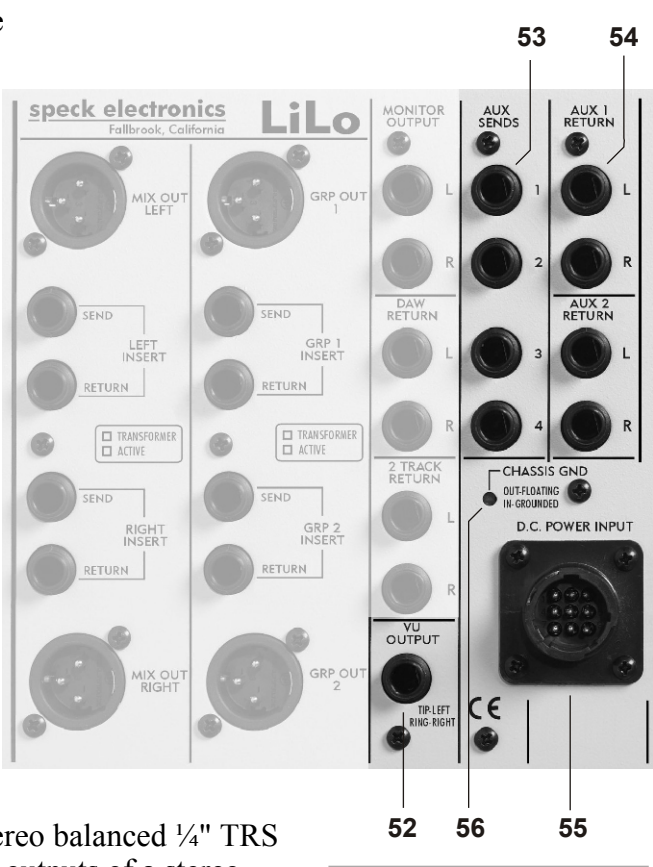


Figure 15a

PIN 1	0 VDC
PIN 2	+17.5 VDC
PIN 3	+17.5 VDC
PIN 4	0 VDC
PIN 5	-17.5 VDC
PIN 6	-17.5 VDC
PIN 7	0 VDC
PIN 8	+6.5 VDC
PIN 9	N.C.

Figure 15b

- 56. Chassis Ground Lift** When depressed, this switch disconnects the chassis ground of the LiLo from the power DC common. This can reduce the chance of ground loops and eliminate unwanted hums or buzzes.

A few words about hums, buzzes, and the role of a ground lift.

Not to suggest that the reasons for hums in an audio system can't be explained...they can... but the explanation, cure, and costs are very often out of the reach of the average project studio. This is why manufacturers sometimes include a ground lift switch on their products. It just saves you the trouble of clipping or soldering ground wires on your cables. Hence, there is not a right or wrong position for a ground lift switch. If either position improves an otherwise hummy-buzzy situation, that is the right position.

Optional Expander Connector

An optional expander interface connector may be installed on the LiLo-24 as shown in Figure 16a. This connector provides summing inputs for all the audio busses and logic busses.

The 38 pin EDAC connector along with a optional interface cable will allow the LiLo-24 to be connected to the **Model LC8-VU0-T0** eight channel LiLo expander, or **Model LD16-VU0-T0** sixteen channel LiLo expander. Contact the factory for information.

Shown below in Figure 16b is an enlarged view of the 38 pin EDAC interface connector. The summing and logic pin designations are shown in Figure 16c.

Optional expander interface connector



Figure 16a

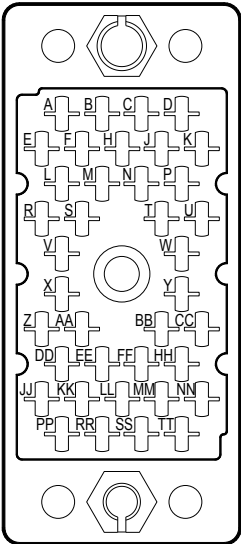


Figure 16b

PIN	DESCRIPTION
A	Common
B	Common
C	NC
D	Shield
E	+16VDC
F	NC
H	-16VDC
J	NC
K	+5VDC
L	Mix Left +
M	Mix Left -
N	Mix Right +
P	Mix Right -
R	Grp 1 +
S	Grp 1 -
T	Grp 2 +
U	Grp 2 -
V	NC
W	NC
X	NC
Y	NC
Z	Aux 1
AA	Aux 2
BB	Aux 3
CC	Aux 4
DD	Solo L
EE	Solo R
FF	NC
HH	Solo Logic
JJ	Grp Logic 1
KK	Grp Logic 2
LL	NC
MM	NC
NN	NC
PP	NC
RR	NC
SS	NC
TT	NC

Figure 16c

~ This page left intentionally blank ~

Wiring & Other

General The following information is not specific to the operation of the LiLo, but rather general information regarding the “care and feeding” of an audio system.

A general discussion about AC, AC grounding, audio grounding, EMI, and quality wiring is discussed in this section. These subjects are very often overlooked or misunderstood, and should be given consideration when interfacing your equipment to any audio product.

AC Distribution and Safety

Proper AC grounding When you are evaluating voltage and current requirements for your audio system, it is important that your LiLo and/or audio system does not exceed the capacity of your AC service. You should make certain that the earth (green) wire for the AC system makes a reliable earth connection, and determine as best as possible that the AC system is free of noise that could generate unwanted audible sounds or cause problems in microprocessor based equipment.

Quality AC system When using a larger studio system it is recommended that a dedicated and isolated AC service be provided. This service should have its own AC wires, isolated receptacle, and breaker and not be shared with other unrelated equipment.

Even with an isolated AC system, it may still be necessary to make use of surge protectors, line filters, isolation transformers, or all of the above. Power conditioners should be selected with care, since they sometimes generate undesirable switching noises in audio systems.

AC distribution When connecting many pieces of electronic equipment to an AC system it is important that the AC is properly distributed. It is better to connect all plugs to a common AC source than to have AC receptacles in different locations.

When installing a large audio system, it may be necessary to consult a qualified electrician that is familiar with the specialized style of electrical wiring required for recording studios.

Clock noise and AC

Clock noise is one of the greatest enemies of the audio racks AC system. If a computer or any microprocessor based device (most samplers and effects are) emits or somehow couples its clock signal with the neutral or earth of its own power cable, it will contaminate your AC system and carry the clock noise into other equipment; almost always with undesirable results.

Safety earth connection

The AC earth connection exists to protect you, your equipment and possibly your building from an electrical disaster. In a properly wired system, if a 120 volt AC wire were to break within your equipment's chassis, it should make contact with the Safety Earth Wire that is connected to the chassis, and blow the fuse or trip the circuit breaker until the problem has been corrected. Given the same circumstances, if the AC safety ground has been defeated with a ground lift or the AC service is incorrectly wired, the equipment's chassis and quite possibly everything attached in that rack would be "live" with 120 volts.

Audio earth

In an electronics context, an earth provides a path for unwanted EMI noise to be carried away from your audio equipment. If you disable your earth with a ground lift or do not have a reliable earth connection, the unwanted noise (EMI or RFI), will find an electrical path of least resistance. That will most likely be your audio equipment and would result in unwanted buzzes or hums.

Proper Grounding and Shielding

In order for any audio signal to get from "Point A" to "Point B" requires a cable with a minimum of 2 conductors. One conductor is the hot, or high, or whatever you are familiar with; the other conductor is the ground or common. Additionally, all audio wires must be protected from environmental occurrences such as EMI (Electro Magnetic Interference) and RFI (Radio Frequency Interference) with an outer shield. An outer shield protects the 2 inner conductors from outside interference, and prevents that cable from inducing its signal onto adjacent audio cables.

One common misconception is that the shield of a cable should act as the common. This may be acceptable for guitar cords or semi-professional applications, but not for professional applications. The audio signals must be carried only by the 2 inner conductors and the shield must act only to cover these 2 conductors without transmitting the signal from one location to another. It is recommended that the shield be attached to the common (ground) at one connector's end, and the shield not be connected at the other connector's end. It is recommended that all shields be connected at the mixer end, and the shields not be connected at the other ends (synths, effects, power amps, etc.).

If a patchbay is utilized in your mixing system, the rules for shielding change. With a patchbay, normally all shields are connected at the patchbay jacks, and not connected at the mixer or external audio equipment.

EMI and RFI

The occurrence of EMI (Electro Magnetic Interference) and RFI (Radio Frequency Interference) in a contemporary studio system should be of great concern and not overlooked when installing the LiLo. EMI is defined as any unwanted signal which adversely affects the operation of the LiLo or your audio system.

Stated simply, the undesirable effects of EMI may be perceived as a low frequency smooth sounding 60Hz hum; a low frequency "edgy" sounding 120Hz buzz; or a higher frequency "whine" caused by the timing circuits in microprocessor based devices.

Almost every electronic device generates some amount of EMI emissions. These emissions can be transmitted as electromagnetic radiation or simply conducted through audio cables and power cords. In the same respect, most electronic devices are also very susceptible to the EMI emissions generated by other electronic devices.

Sources of EMI

There are natural and man made sources of EMI that you can't do anything about. These sources include radio, TV, and radar transmitters, as well as motors, lights, and computers. Even the Sun and atmospheric conditions can be contributors to noise that you experience in your audio system.

Reducing EMI

There are generally 3 elements that must be present for EMI to exist. These include the source of the EMI (conducted or radiated), the propagation medium by which EMI is transmitted (directly on the cables or through the air), and the receptor that suffers the adverse affects of EMI. If any of these 3 elements are eliminated or reduced, the EMI interference will be eliminated or reduced.

The more electronic equipment operating within a studio or equipment rack, the higher the EMI emissions. The more audio cable and low level audio equipment that exists within the same proximity, the greater possibility of unwanted noise. The result of EMI in an audio system manifests itself as a buzz, hum, whine, or all three.

The most common EMI occurrence in an audio system is radiated emissions from microprocessors in computers, samplers, and magnetic field sources from transformers and power supplies.