MAPLETREE BRANCHES

Sound advice for Mapletree owners, customers, and DIYs • Issue 7. March. 2017

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Focus on customization of Mapletree products: signal and system switching.

- **Line level switching and routing**
- **Speaker switching**
- **System configuration**
- **Technical issues**
- **Customization (EOT-Engineered To Order)**

Line level switching and routing

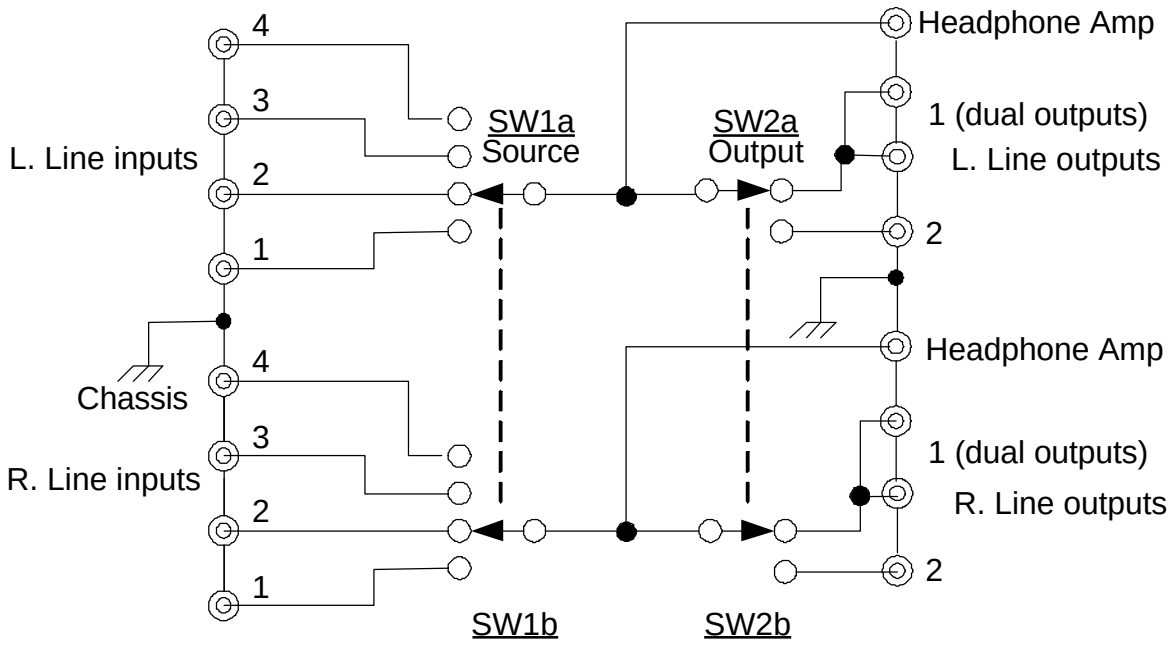
One of the key features of any preamplifier is the provision for selecting from a range of input signal sources. In the “old” days, these included phono, tape, and radio (FM and AM) inputs. Of these, only a tape preamp output or a tuner output could be considered “line level” inputs, or signals in the order of a Volt rms. With the advent of “digital” sources (derived from a digital to analog conversion process), and the diminished interest in FM as a primary program source, most signals entering a preamp are line level and often in the order of several Volts. The output from a phono preamp can also be included in the list. With the uniformly high output levels from most DACs, pre-amplification is usually not required to drive power amplifiers to their full power output when required. Thus, the preamp is usually used as an attenuator; however, input source selection is still often a desired feature. In fact, a “passive” preamp offers a level control and input source selection without any active

devices (tubes or transistors) present. There are some advantages to active preamps however, principally in maintaining desired input (typically high and constant) and output (typically low) impedances. Of course, the sonic contribution of an active tube preamp stage (even if we admit that it is a result of certain types of distortion components) is also felt essential by many listeners.

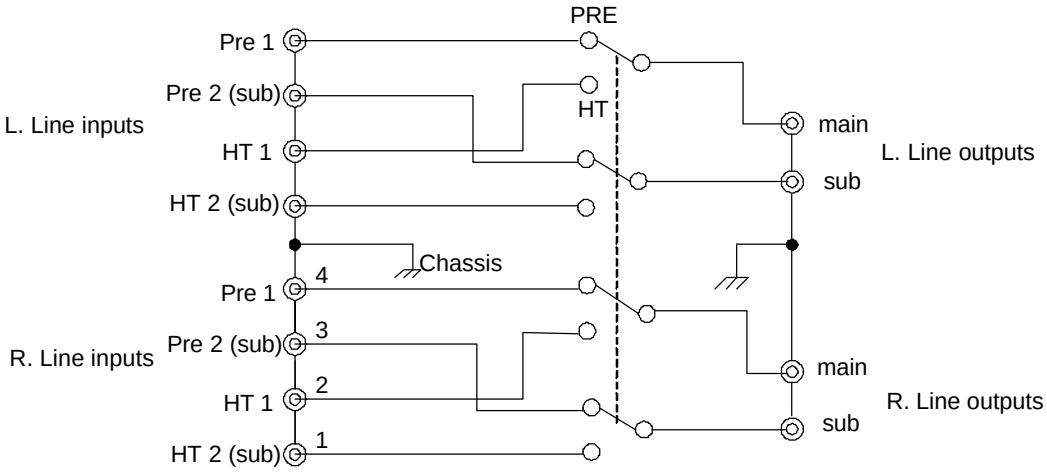
Lots of switching and control functions and profuse connectivity in classic preamps

Generally, modern preamps, active or passive, are simpler in terms of circuit complexity and features offered compared to those of the 1950s and 60s. Following particular minimalist design philosophies, some preamps fail to offer the degree of "connectivity" that a user may find necessary. The lack of a sufficient number of line inputs or outputs is the most common shortcoming of many otherwise excellent components. This gives rise to the most common type of external line level signal routing, namely, input source selection. With a simple selector switch (toggle or rotary), a number or sources can be channelled into one of the preamp inputs, thus greatly increasing the input connectivity. Similarly, outputs can be provided to drive a separate headphone amplifier or more than one preamp or integrated amplifier. This is the function of the *LR 1 Line Router*.

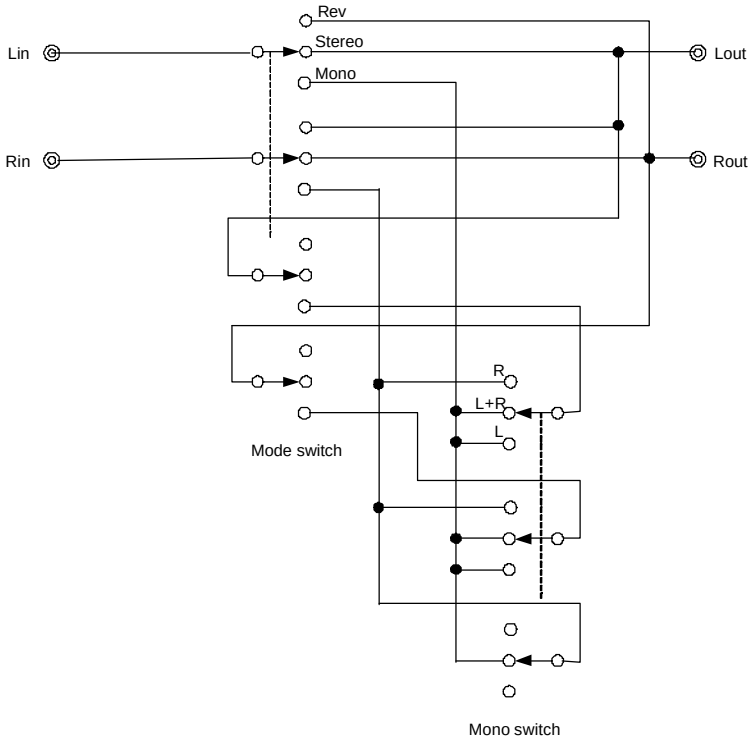
The wiring diagram (schematic) for a typical *LR 1* router is shown below. For illustration, it includes provision for connecting a headphone amplifier as well as parallel outputs for bi-amping applications. Rotary switches of the break-before-make type are used for input and output switching. Both switches are of the compound (2-pole) configuration so that both left and right channel signals are handles identically. The chassis is connected to the signal common (ground).

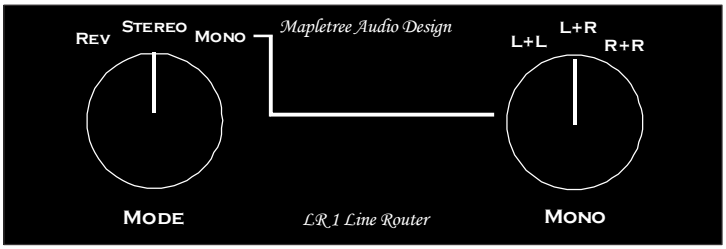


Here is a modification of the *LR 1* to switch between stereo and home theatre modes including main and subwoofer signals.



Finally, here is a mode switch modification to control the stereo-mono modes with the mono signal derived from the sum of L and R signals, only L, and only R. Stereo reverse is also available. The position of the Mono switch only affects the output in mono mode.

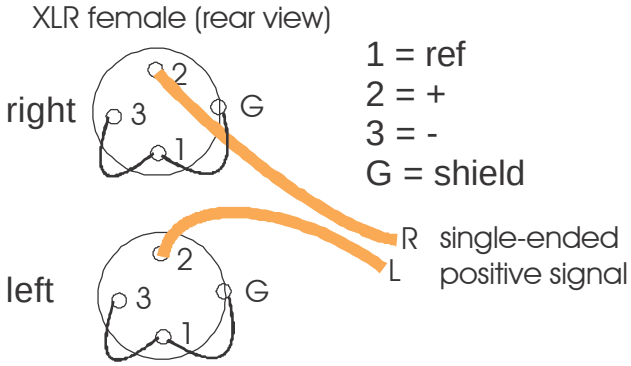




Switching and routing balanced signals

In a balanced audio system, the signal for each channel is derived from the difference between the + and – signals, both measured with reference to a common “ground” signal. This requires 3 pins per channel. There is also (usually) a connection for the interconnect shield via the XLR metal plug. Switching both the + and – signals requires double the number of switch poles compared to a single-ended signal. With the standard switches used in the *LR 1* and *LR 1 Pro*, this limits the number of inputs or outputs to three. It also means that the reference pins are connected together for the input jacks and also for the output jacks. The shield connection is made to the chassis. If more than 3 inputs or outputs are needed, a multi-deck switch is required. The *LR 1 Pro* shown below has four inputs and a single output and uses a two-deck mil spec rotary switch.

A hybrid router with both balanced and single-ended signals requires a balanced to single-ended conversion if input and output signals are not of the same type. This requires connecting the + signal of the balanced connection to the reference pin to produce a single-ended signal equal to just the + signal. If phase inversion is desired, the + signal can be connected to the reference instead. Here is the required wiring for a non-inverting conversion at a XLR input jack.



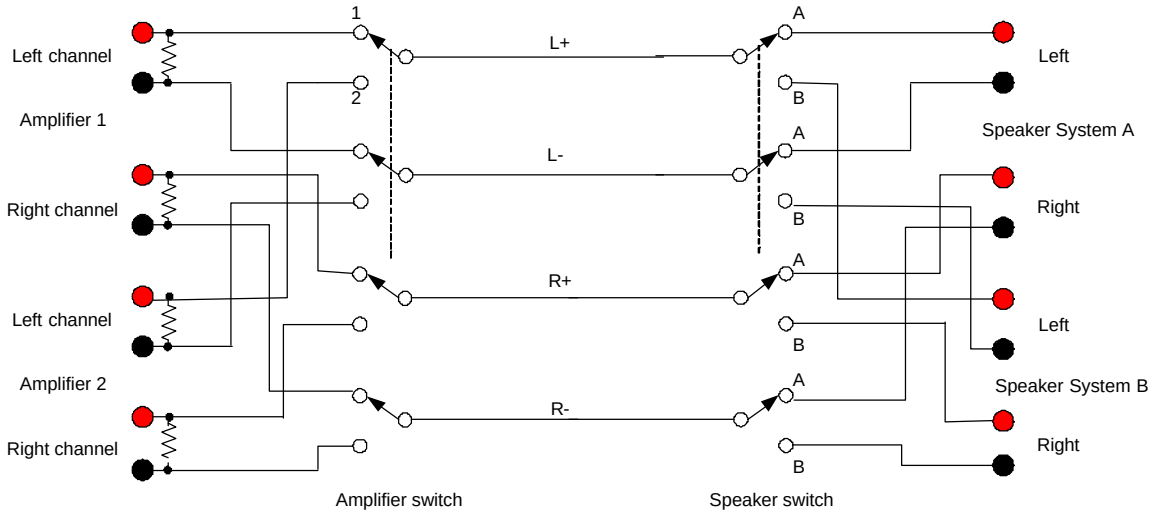
L – Grayhill mulit-deck rotary switch, R – Standard Lorlin (U.K.) rotary switch

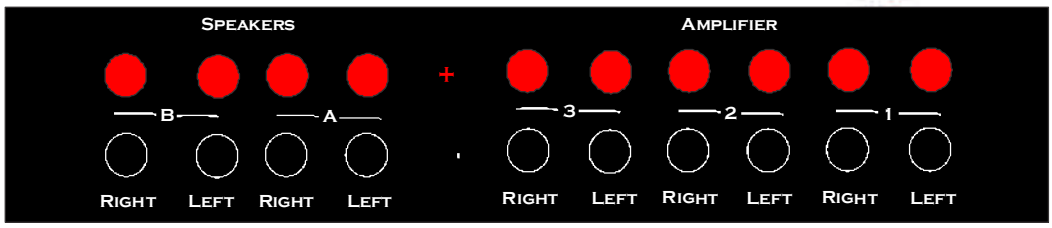
Amplifier and speaker switching

Integrated amplifiers of old usually provided for switching between two speaker systems: A, B, or A+B. This was often an unused feature but useful for operating speakers in two different rooms. Impedance matching to the amplifier output with both speaker systems connected was an issue but most tube and solid-state power amps would perform satisfactorily.

For speaker aficionados, the ability to switch between several systems connected to one or more amplifiers is a welcome convenience compared to moving interconnect from one system to another (it is never long enough!). The Mapletree *SP 1* amplifier/speaker router addresses this issue. As for the *LR 1*, the number of amplifiers and speaker systems that can be handled is configured to suit the customer's needs. All I/O connections are typically made through 5-way binding posts that accept both lug and banana plug terminations on the speaker interconnect. Both the + (red) and – (black) amplifier and speaker connections are switched to avoid problems with common grounds between monobloc outputs or amplifier channels. Also, amplifier inputs to the *SP 1* are terminated with a resistor of around 500 Ohms to ensure a load is always present. For most amplifiers, this is not an issue but it does no harm.

Here is a typical *SP 1* wiring diagram for a system with two amplifiers and two speaker systems. The terminating resistors are rated for 5 W dissipation, the C&K rotary switches are rated at 2.5 A continuous dc current, and the wiring is 18 gauge stranded copper with Teflon insulation. Switch contacts are silver-plated. The chassis is floating since there are no shielding issues for high-level, low impedance signals.

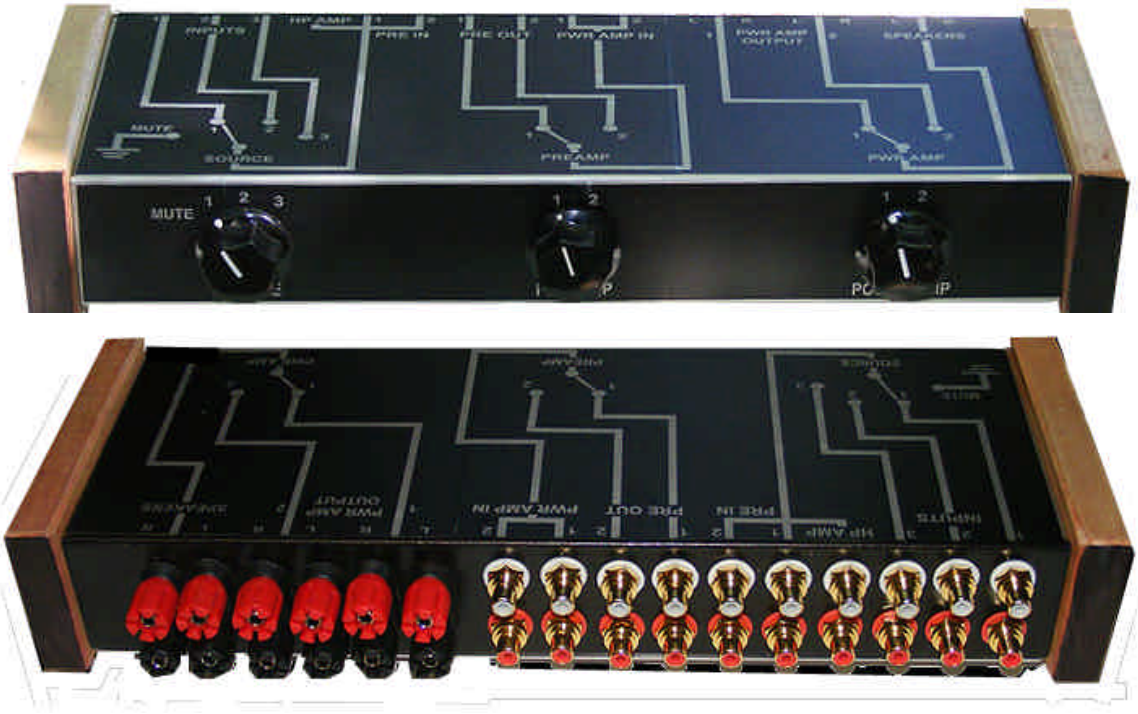




Top – A 3-amplifier to 3-speaker systems *SP 1*. Functional wiring diagram is shown on top of chassis. Bottom – Rear panel layout of a 3 to 2 *SP 1*

A system configuration controller switch: the *SCC 1*

What do you do if you have several sources, preamps, power amps, and speaker systems? A convenient way to connect all of these system components in a myriad of combinations is the *SCC 1 System Configuration Contoller* that combines the functions of several line routers and amplifier/speaker switches in one chassis. A *SCC 1* that provides connections for 3 sources, 2 preamps, a headphone amplifier, 2 power amps, and one speaker system is shown below. Both inputs and outputs of the preamps are switched so there are no loading issues or other interactions between them. Power amplifiers are terminated by 500 Ohm resistors as for the *SP 1*. Chassis is 13.5” x 5” x 2”.



Technical issues

Switches – All switches exhibit parasitic resistance and capacitance, which, if large enough, can cause signal degradation. Rotary switch contact resistance is low relative to the impedances associated with sources and preamps and is not a serious problem unless many contacts appear in series with the signal. Capacitance is a more serious issue. The capacitance between switch contacts is dependent on the switch substrate material (the dielectric of the parasitic capacitance) and the proximity of adjacent contact positions. For the switches used in the Mapletree line routers, there is enough parasitic capacitance to cause signal crosstalk if the gain is high enough to hear it. It is a low-level cross-feed between two or more sources that are active at the same time (and the system gain following the switch is high). Since it is not common for two or more sources to be active at the same time (A-B testing would be an exception) and the crosstalk signal level is very low (only detectable when a switch is turned to an adjacent active position with no other signals present), it has to be traded off against convenience and cost.

Under some circumstances, pops can be heard through a loudspeaker when switching line-level signals. This is due to the capacitance to ground at the signal nodes that accumulates a static charge when not connected to a load resistance. No complete solution to this problem exists including the provision of large-value terminating resistors on all switch contacts. Turning down the system gain (volume control) while switching is a sure remedy. Inclusion of a mute position between active switch positions is also effective. Switches used in all the Mapletree routers are break-before-make (non-shorting) types. Some “experts” believe that make-before-break

(shorting) types eliminate switching noise but this is not entirely true. The charge on adjacent contacts will not be the same so some charge transfer will still take place producing a pop. These switches have other issues including unintentional excessive loading of amplifier outputs during switching.

Line-level switches used in the Mapletree routers are rated at 150 mA continuous dc current and those used in the power amp/speaker switches are rated at 2.5 A. These values seem appropriate for the average currents present in audio systems from source to speaker. The 2.5 A switches also exhibit lower contact resistance, which may be relevant for low impedance speaker loads. In both cases, the switch contacts are silver plated to further reduce contact resistance.

Wiring – Internal wires are short, which influences the gauge required for each tpe of signal. Line-level wiring is typically 20 or 22 gauge while speaker wiring is 18 gauge. All wiring is silver-plated stranded copper, with Teflon insulation, which is more reliable and easier to solder than solid copper types. More importantly, all wiring is point-to-point with adequate spacing between wires. This may not look as nice as neatly cabled wiring but the reduction in crosstalk between adjacent wires is significant. For balanced signals, the + and – signal wires for a given channel are twisted together to maximize the property of common-mode voltage cancellation. Noise is not a problem in either the single-ended or balanced routers since no noise producing elements are present within the chassis, which is itself connected to the signal ground.

Customization (the Engineered To Order (ETO) concept)

It can be seen from the above descriptions and examples that the line, amplifier, and speaker routers and switches are ETO products with an almost infinite range of possibilities for customization. Here are just some of the custom features that can be specified.

- Number of source inputs, including mute switch positions.
- Number of line outputs including parallel outputs.
- Implementation of special control features such as stereo-mono conversion.
- Mixture of balanced and single-ended sources and outputs.
- Number of power amps and speaker systems required.
- Provision for selecting multiple speaker system combinations.
- Arrangement of I/O jacks and binding posts on the rear panel.
- Arrangement of switches and their labelling on the front panel.

And, as is the case for all Mapletree products, you have the choice of chassis color and wood end panel finish.