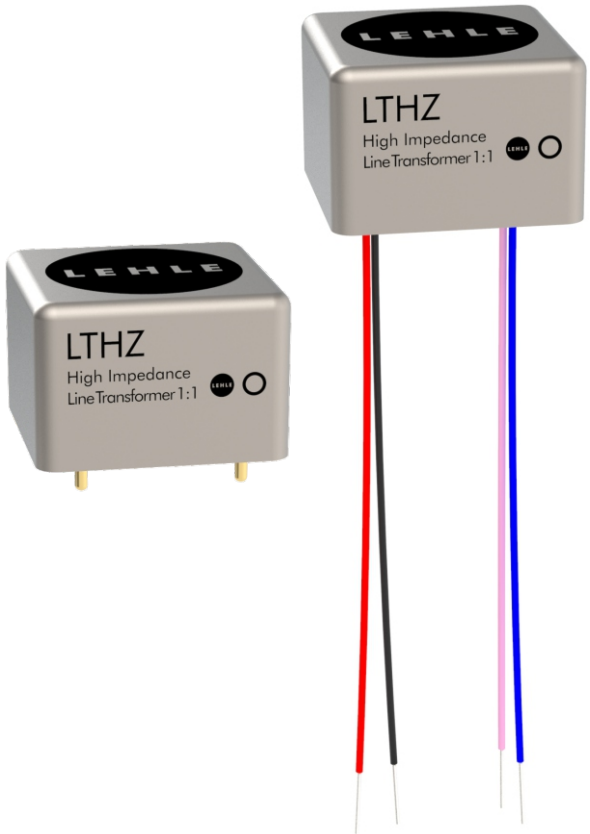
LEHLE TRANSFORMER HZ

HIGH IMPEDANCE 1:1 LINE ISOLATION AUDIO TRANSFORMER



- Galvanic isolation of high impedance audio signals at line or musical instrument level
- Transforms balanced to unbalanced line signals or unbalanced to balanced line signals
- Toroidal ringcore design for a extremely low loss, strong coupling and a very low noise
- Frequency response of 4 Hz to 450 kHz - 3 dB
- CMRR of 111 dB at 50 Hz
- Input levels of up to 19.5 dBu at 50 Hz
- Low distortion of 0.003 % at 1 kHz / 0 dBu
- Wide impedance range of signal sources, from high to low impedance
- Electrical isolation of 2 kV between shield, secondary and primary windings
- Comes in a magnetic shielded enclosure
- Completely potted to avoid microphonic issues
- Available with leads HZ-L or as PCB version HZ-P

The Lehle Transformer HZ is the ideal component to avoid hum loops or to balance and unbalance signals without degrading the sound of high impedance signal sources. When these signals from passive pickups of stringed instruments or from vintage tube equipment for example are isolated by standard transformers, the load of these transformer normally degrade the sound. These very weak signals deserve a special transformer that does not load the signal. The self load of the Lehle Transformer HZ is in the range over 5 MOhm at 1kHz. This minimal load in combination with the really strong coupling of the windings plus the excellent bandwidth guarantee that no detail of your sound gets lost.

With the maximum level of 7.3 VRMS at 50 Hz and very low distortion it is perfectly suited to pro audio environments which run typically with 1.2 VRMS (+4 dBu) level. It will also work perfectly with high end audio devices for home use. Using the Lehle Transformer HZ as an input or output transformer also prevents your device and the user from electrical shocks through it's dielectric withstanding voltage of 2 kV.

The toroidal core of the transformer is completely potted into the magnetically shielded enclosure, so there will be no microphonic issues. The HZ-L version with the coloured leads comes with two M3 screws, which make it very easy to mount.

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TECHNICAL SPECIFICATIONS

Turns ratio	1:1	
Input impedance	885 kOhm	test circuit 1, 1 kHz, 0 dBu, $R_S = \infty$, $R_L = 1$ MOhm
Load impedance	7.5 MOhm	test circuit 1, 1 kHz, 0 dBu, $R_S = 50$ Ohm, $R_L = \infty$
Primary inductance	56 H	secondary winding open
Leakage inductance	670 mH	secondary winding shorted
Magnetic coupling	98 dB	
Voltage gain	-0.06 dB	test circuit 2, 1 kHz, 0 dBu
Frequency response total range	4 Hz 450 kHz	min, test circuit 3, -3 dB max, test circuit 3, -3 dB
Level audio range	-0.2 dBu -0.04 dBu	test circuit 2, 20 Hz, 0 dBu test circuit 2, 20 kHz, 0 dBu
Phase shift	5 deg -2 deg	test circuit 2, 20 Hz, 0 dBu test circuit 2, 20 kHz, 0 dBu
Maximum input level	11.5 dBu / 2.9 V_{RMS} 19.5 dBu / 7.3 V_{RMS}	test circuit 2, max 1% THD, 20 Hz test circuit 2, max 1% THD, 50 Hz
Distortion (THD)	0.003 %	test circuit 2, 1 kHz, 0 dBu
Self resonance point	375 kHz	test circuit 1, 0 dBu
Common mode rejection ratio	111 dB 87 dB	test circuit 4+5, 50 Hz, U_1= 0 dBu U_1' = 20 dBu, IEC 60268-3 test circuit 4+5, 1 kHz, U_1 = 0 dBu, U_1' = 20 dBu, IEC 60268-3
DC resistance	74 Ohm 85 Ohm	primary winding secondary winding
Capacitances	92 pF 143 pF	secondary winding to shield, 1 kHz, 0 dBu primary to secondary winding, 1 kHz, 0 dBu
Electrical isolation	2 kV	10 sec, between windings and between shield and windings
Temperature range	-20 °C [-4 °F] +125 °C [257 °F]	min max
Weight	63 g [2.3 oz]	
Compliance	RoHS II	according to Directive 2011/65/EU

ORDERING INFORMATION

Order code HZ-L	4006
EAN13 Barcode HZ-L	4260142210453
Order code HZ-P	4007
EAN13 Barcode HZ-P	4260142210460
Included in the package w HZ-L	2 pcs M3 x 5 screws DIN 84

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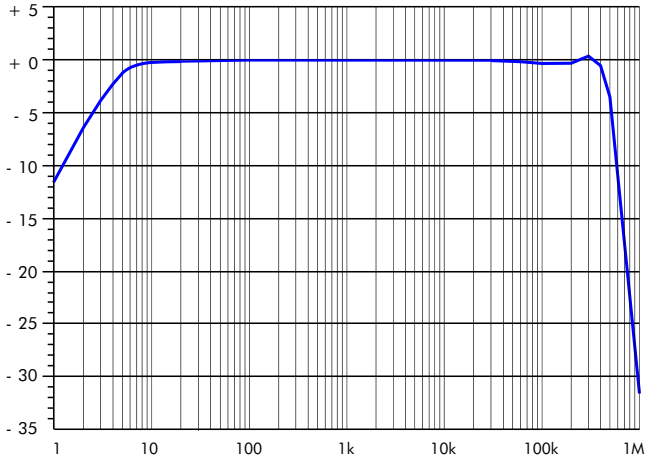
MEASURING RESULTS

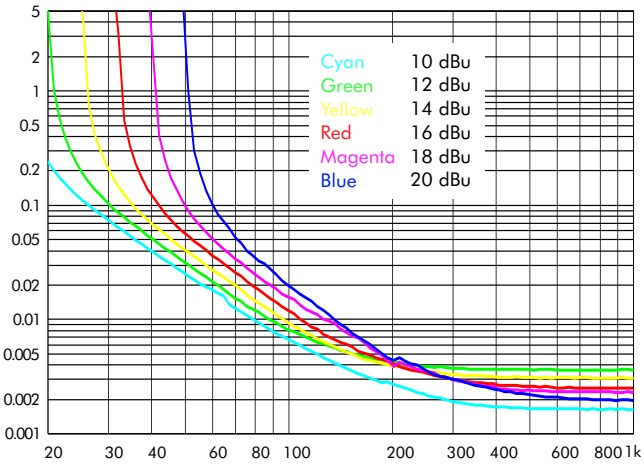
LEVEL FREQUENCY RESPONSE TOTAL RANGE

Level [dBu] vs Frequency [Hz], test circuit 3



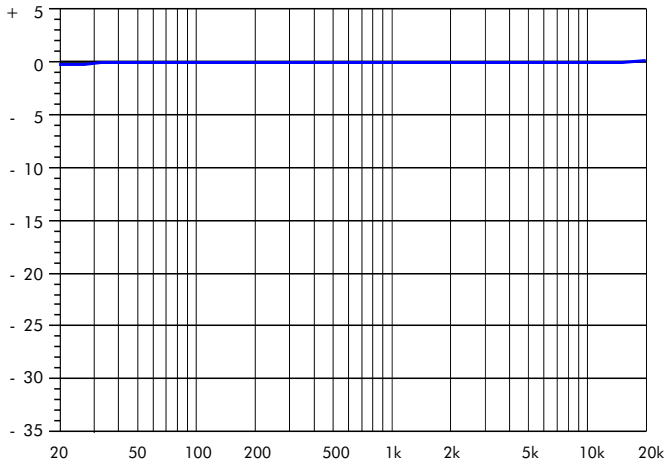
TOTAL HARMONIC DISTORTION PLUS NOISE

Distortion [%] vs Frequency [Hz], test circuit 2



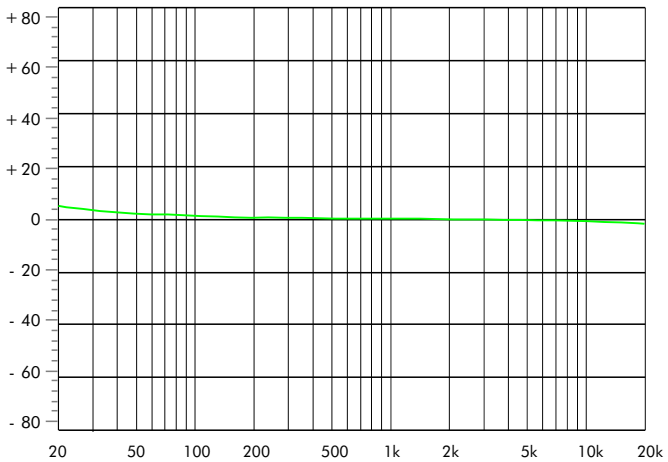
LEVEL FREQUENCY RESPONSE AUDIO RANGE

Level [dBu] vs Frequency [Hz], test circuit 2



PHASE FREQUENCY RESPONSE AUDIO RANGE

Phase [deg] vs Frequency [Hz], test circuit 2



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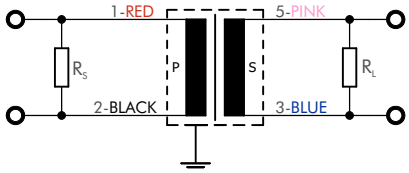
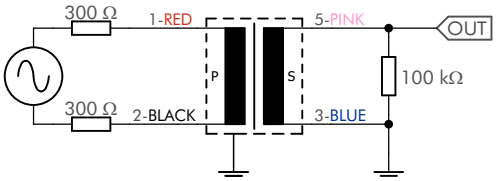
TEST CIRCUITS

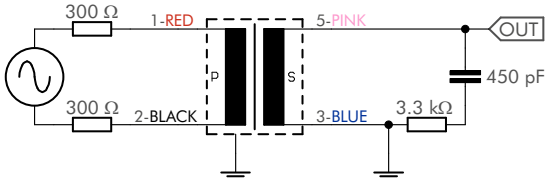
Test circuit 1 - impedance, self resonance point



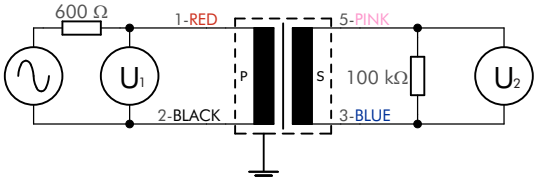
Test circuit 2 - voltage gain, level and phase audio range, max input level, distortion



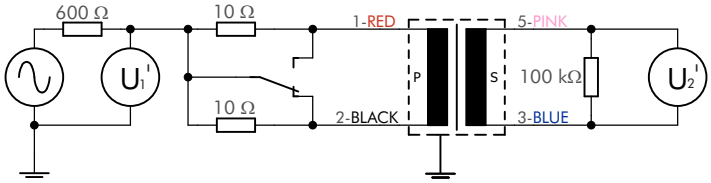
Test circuit 3 - frequency response total range



Test circuit 4 - common mode rejection ratio part 1



Test circuit 5 - common mode rejection ratio part 2



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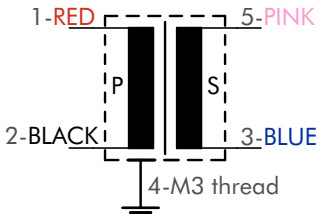
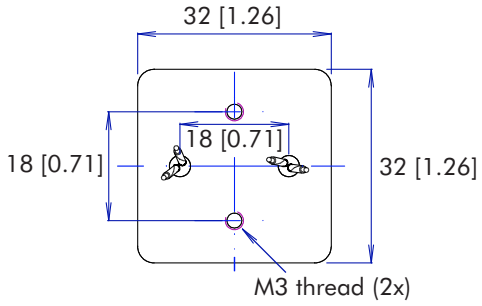
TECNICAL DRAWING

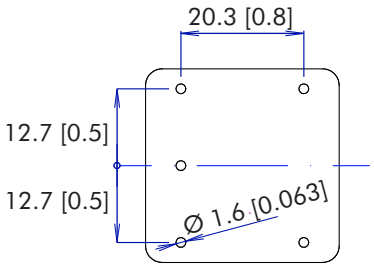
Connections	HZ-L with leads	HZ-P for PCBs
Primary winding	red lead wire black lead wire	Pin 1 Pin 2
Secondary winding	pink lead wire blue lead wire	Pin 5 Pin 3
Ground	M3 thread	Pin 4



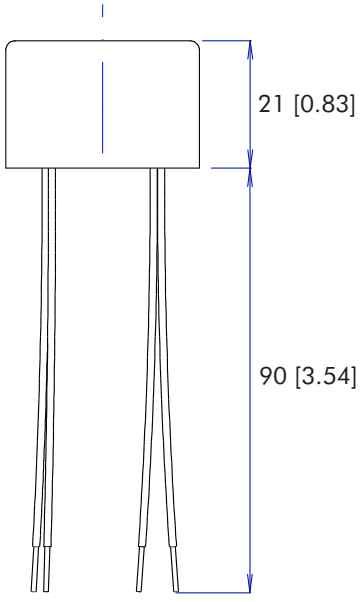
BOTTOM VIEW HZ-L



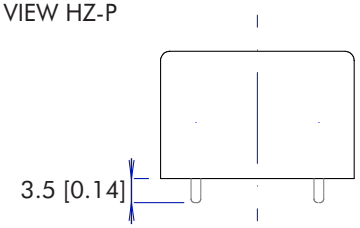
BOTTOM VIEW HZ-P



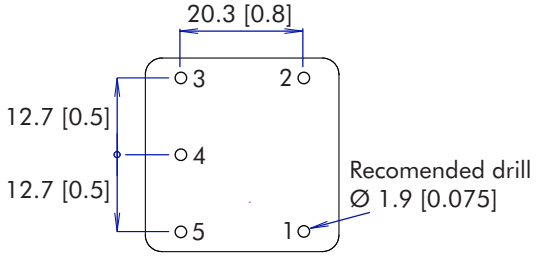
SIDE VIEW HZ-L



SIDE VIEW HZ-P



PCB TOP VIEW MZ-P



all measurements in mm [inch]

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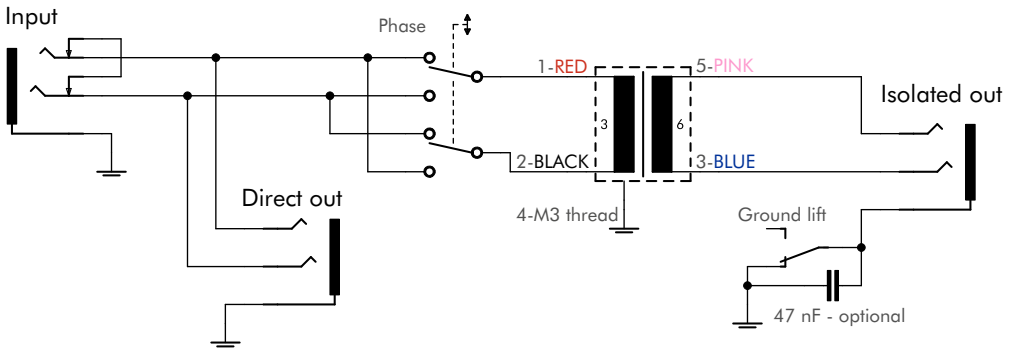
APPLICATIONS

IMPEDANCE

The Lehle Transformer HZ is designed for low or high impedance audio line signal sources. When used as an input transformer or basic splitter the optimal source impedance delivered to the transformer can be anything up to a maximum of 20 kOhm, (lower is always better). The input or load impedance of the device that receives a signal from the transformer when used as an output transformer or basic splitter should be in the range of 1 MOhm.

BASIC HIGH IMPEDANCE SPLITTER FOR BALANCED OR UNBALANCED AUDIO SIGNALS



This basic splitter combines passive splitting with maximum signal fidelity. The Lehle transformer HZ electrically isolates the two outputs, eliminating the possibility of ground loops. The signal can be picked off either symmetrically or asymmetrically from the isolated output. A phase inverter switch permits reversal of input signal phase at the isolated out, preventing phase cancellation if the signal processing of the receivers at the two outputs are out of phase.
The classical application for this circuit is the splitting of an input signal to two outputs, enabling you to connect your instrument or source to two devices, which may, for example, be two amplifiers, or an amp and a mixer or recording unit (PC/DAW).

Thanks to the possibility of feeding the input with a balanced or unbalanced signal, this basic splitter is eminently suitable for use as a high-quality compact DI solution for nearly all types of pro-audio and high-end signals. Another useful application for this splitter is as an effective suppressor for unwanted hum. Background noise occurs again and again, caused by ground loops when two electronic devices are connected to each other. This splitter can be installed between the two units. Using the isolated output, the two devices are electrically isolated and this background noise becomes a thing of the past.
This splitter needs no separate power supply because it's 100 % passive!

PRE-CONDITIONS FOR PASSIVE SPLITTING

The Lehle Transformer HZ can be used to split a high impedance signal to a pair of high impedance inputs. There are certain pre-conditions which must be met to ensure that this is achieved without problems and with no loss of sound quality.

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High impedance signal sources and inputs:
Passive magnetic pickups as generally found on electric guitars and basses supply high impedance signals. High impedance signals have an output impedance in a range of 10 kOhm; the higher the figure, the more sensitive the signal is to interference. High impedance inputs are found on guitar and bass amplifiers and on audio interfaces with a "Hi-Z" input.
High impedance signals are generally transmitted unbalanced and are relatively susceptible to interference. Long cables audibly attenuate high frequencies. Electromagnetic interference from the environment is also more noticeable than with a low impedance or balanced signal. A high impedance input generally has an input impedance in the range of 1 MOhm or more. Here too, a higher figure means higher sensitivity.

Low impedance signal sources and inputs:
Keyboards, active pickups, preamp outputs, audio interfaces and mixers supply low impedance signals. The output impedance of such signals is typically 100 to around 600 Ohm. Low impedance inputs are most commonly used in the line input of mixing desks, power amps and sound cards with no Hi-Z inputs. They are also found in microphone inputs and virtually all balanced inputs. Low impedance inputs have an input impedance range between 600 Ohm and 10 kOhm.

What is possible:
The Lehle Transformer HZ can be used to split the signal from an electric guitar or electric bass (with passive magnetic pickups) to two amplifiers, each of which has high impedance inputs. Please use the shortest, best quality possible cables for this purpose. You will hear the 100% of the original signal on both amps. Instead of an amplifier, you can also split the signal to the Hi-Z input of a sound card. It's important to remember this rule: a high impedance signal can only be passively split if you connect it to a pair of high impedance inputs. You can however split a low impedance signal, for example from the output of a preamp, an active buffer or audio interface, into a high and a low impedance input, such as a tube amp with a high impedance input and the low impedance input of a power amp. This scenario won't be a problem because the starting signal to be split has a low impedance.

What is not possible:
Audible sound losses will occur if you use long cable routings from the passive guitar to the splitter and from the splitter to the amps. The total cable lengths to the splitter and to the amps combined should ideally not be more than 10m. Your individual taste will ultimately be a big part of this decision. Splitting your high impedance instrument signal to a low impedance input, such as the line input of a mixing desk, for example, and to a high impedance input on a tube amplifier using the Lehle Transformer HZ will result in the high impedance input being attenuated by the low impedance input of the mixing desk. The signal will become significantly quieter and will totally lose presence.
Solution: these problems can be effectively eliminated by connecting a preamp or a buffer, which will convert the high impedance signal to a low impedance signal.

Input	Direct Out	Isolated Out	
Hi-Z Passive Instrument Source	Hi-Z	Hi-Z	✓
	Low-Z	Hi-Z	×
	Hi-Z	Low-Z	×
	Low-Z	Low-Z	×
Lo-Z Active Instrument Source	Hi-Z	Hi-Z	✓
	Low-Z	Hi-Z	✓
	Hi-Z	Low-Z	✓
	Low-Z	Low-Z	✓

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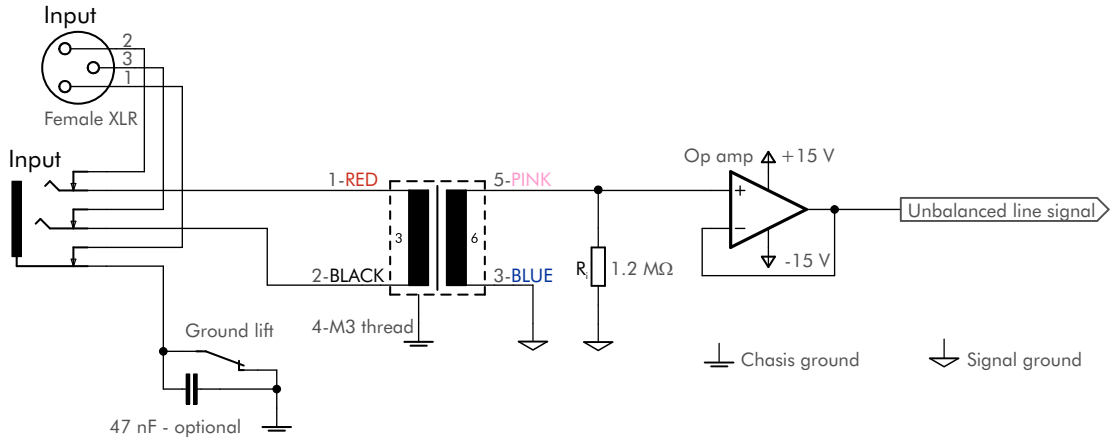
INPUT ISOLATION AND BALANCING FOR LOW TO HIGH IMPEDANCE INPUT SIGNAL SOURCES



This simple input stage works with a very wide range of signals. The signal sources can be balanced or unbalanced and can be low or high impedance signals. In addition you benefit from the galvanic isolation, which will help to avoid any hum and buzz from ground loops. The input impedance here is 1 MOhm at 1 kHz. It is calculated by:

$$\frac{1}{Z} = \frac{1}{7.5\ M\Omega} + \frac{1}{R_i}$$

This circuit works well with numerous low noise op amps like the OPA134 or others. Please note that the op amps have to have an input impedance in the range of 1 MOhm or more.