Grimm AUDIO

TPR assemblies

Pinout sheet for Grimm Audio cables

E.G. & J.V. V1.0
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Index

1 Cable assemblies

The production of audio cable assemblies can be a challenge at times since there are many ways to make them. Official standards exist, but they do not cover every type of connector or cable, let alone instructions about how to wire dual core cables for unbalanced connections. To offer our customers a clear description of what they will receive when ordering our cables, we made this document.

1.1 How to use this document

This document first describes which connectors we supply and how these are mounted (the **pin out**). Next, the cable assemblies are introduced including the possible combinations of connectors and their technical properties.

For instance, if you want to order an XLR female to balanced jack cable and like to check the connections, you browse for the XLR and the 3-pin jack in the connectors chapter. There you will find the pinout of both connectors. By combining this information you will find the desired information, see Table 1 below.

XLR pin	Signal	Jack pin
1	Shield	1, Sleeve
2	Positive	2, Tip
3	Negative	3, Ring

Table 1

In chapter 5.2 you will find the connections for 2-pin to 3-pin (adapter) cables.

2 Connectors

The following connectors are covered in this document.

- XLR (Female and Male)
- RCA
- Jack 6.35 Unbalanced
- Jack 6.35 Balanced
- Amphenol sub D

2.1 XLR

The XLR connectors we supply with our cables are the standard 3 pin XLR connectors that are common for balanced audio signal transport. Figure 1 below shows the connectors and their standard pinning. On the left is the female type and on the right is the male.

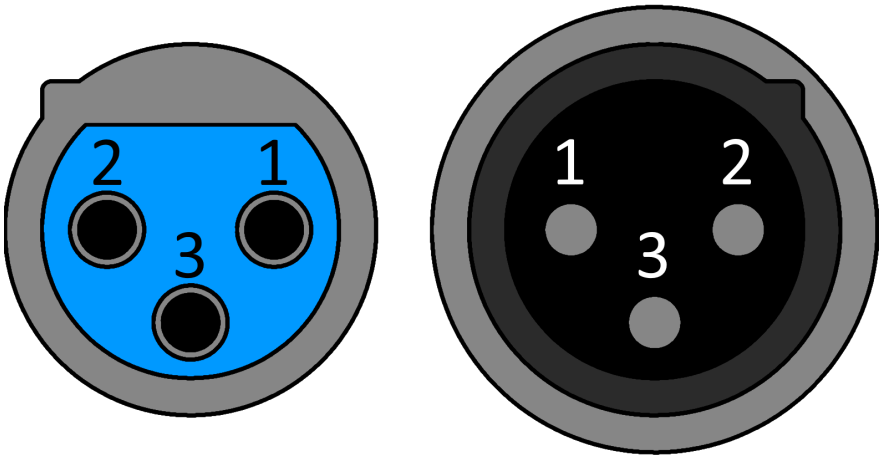

Figure 1: XLR connector pinout

The following pin assignment is used with our cables:

- Pin 1 acts as shield.
  NOTE The housing of the connector ("pin 4") is also connected to the shield and pin 1.
- Pin 2 is used to transport the positive (live) signal.
- Pin 3 is used to transport the negative (neutral) signal.

We use the Neutrik gold plated connectors.

- For the male connectors we use the NC3MXX-B and is shown in figure 2 below on the left.
- For the female connectors we use the NC3FXX-B and is shown in figure 3 below on the right.

Figure 2: Neutrik male XLR connector

Figure 3: Neutrik female XLR connector

2.2 RCA

RCA connectors are '2-pin' male connectors. They are common in hifi systems and can only be used for unbalanced connections like analog mono connections and digital stereo connections (S/PDIF).

For TPR cable we use the Amphenol M series with gold plated contacts and black or red housing. The red connector is shown in figure 4 and the black connector is is shown in figure 5.

Figure 4: Amphenol red RCA connector

Figure 5: Amphenol black RCA connector

NOTE When ordering a stereo pair, one cable will have red connectors and one will have black connectors.

The RCA connector has 2 "pins". Pin 2 is the tip and pin 1 is the sleeve. The tip is used for the positive signal and the sleeve acts as return path and shield.

2.3 Jack

Jack 6.35 is known as ¼" jack, phone jack, audio jack or jack plug. It is a well known family of connectors for analog audio signals. The 6.35 stands for 6.35mm, which is equal to ¼ inch.

Jacks are available with 2 to 5 contacts, but we only supply the 2-pin and 3-pin variants, that are in wide spread use in audio.

Next to the standard ¼" jack, we supply the 0.173" (4.4mm) Bantam jack plug, also called Tiny Telephone or 'TT' plug. These are common for use with patch bays.

2.3.1 Jack 6.35 Unbalanced

The 2-pin Jack (also known as TS, tip / sleeve) is used for analog unbalanced connections, like an RCA connector. Figure 6 below shows an example.

Figure 6: Neutrik unbalanced jack connector

In the 2-pin Jack, Pin 2 is the tip and pin 1 is the sleeve. The tip is used for the positive signal and the sleeve acts as return path and shield.

2.3.2 Jack 6.35 Balanced

The 3-pin Jack (also known as TRS, tip / ring / sleeve) can be used for balanced analog connections, like an XLR connector. They can also be used for analog stereo connections.

For cable assemblies we selected the Neutrik PX-B series connector, 2-pin for unbalanced and 3-pin for balanced connections. This connector has gold plated contacts and a black housing.

The balanced jack is shown in figure 7 below.

Figure 7: Neutrik balanced jack connector

The 3-pin jack connector has 3 contacts. Pin 1 is the sleeve, pin 2 is the tip and pin 3 is the ring. The tip is used for the positive signal, the ring for the negative signal and the sleeve acts as shield.

NOTE 3-pin connectors fit in a 2-pin receptacle, but this can short pin 1 and pin 3.

2.3.3 Bantam (TT) Balanced

The 3 pin Bantam, or Tiny Telephone (TT), jack plug can be used for balanced connections in patch bay jack fields.

For cable assemblies we selected a Neutrik connector with silver plated contacts and a black housing that fits on TPR. It is shown in figure 8 below.

Figure 8: Neutrik Bantam jack connector

The 3-pin Bantam jack connector has 3 contacts. Pin 1 is the sleeve, pin 2 is the tip and pin 3 is the ring. The tip is used for the positive signal, the ring for the negative signal and the sleeve acts as shield.

2.4 DB25 Sub-D

The sub-D connector with 25 pins is named DB25 connector. Since the company Amphenol supplies the sturdy DB25 connectors that we selected, we often refer to them as Amphenol sub-D. Figure 9 below shows the Amphenol sub-D connector on a TPR8 cable.

Figure 9: Amphenol sub-D connector

These connectors are used for multichannel analog and digital connections with a multi-cable like TPR8.

The pinout for digital and analog multi-cables is not the same. In an analog sub-D to sub-D cable system each channel is connected directly (channel 1 to channel 1, 2 to 2, 8 to 8 etc.). In a digital sub-D to sub-D connector however there are 4 input and 4 output channels, and the outputs need to be connected to the inputs. As a result, digital multi-cables have different internal connections than analog multi-cables, although they may look the same from the outside.

Digital multi-cables have the following setup: Channel 1 **out** to channel 1 **in**, channel 2 **out** to channel 2 **in** etc. For this reason, when ordering sub-D cables you must specify whether the cable is used in an analog or digital system.

The pinout for the *analog* sub-D connector is shown in figure 10 below (cable connector, front view):

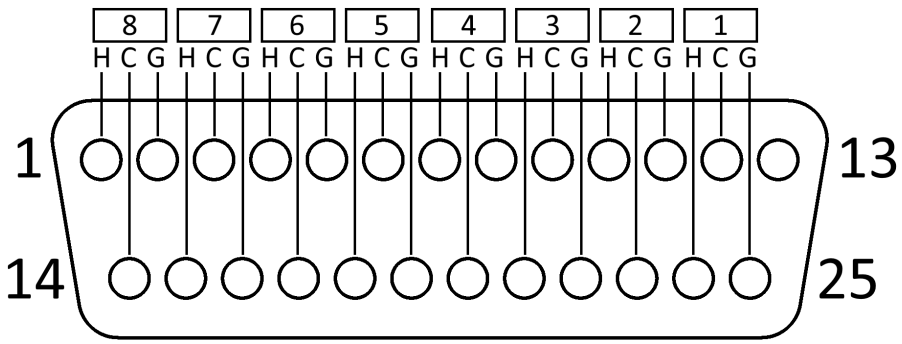

Figure 10: Amphenol sub-D analog pinout

The pinout for the *digital* sub-D connector is shown in figure 11 below (cable connector, front view):

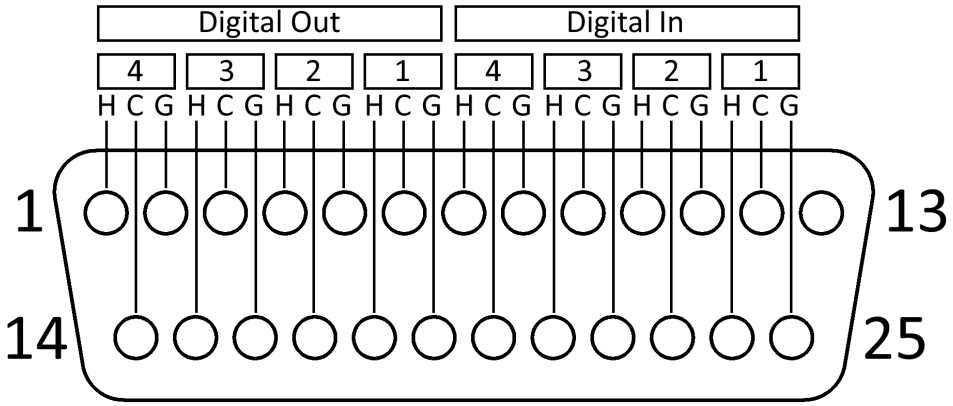

Figure 11: Amphenol sub-D digital pinout

Where:

- H is hot, the positive signal.
- C is cold, the negative signal.
- G is ground, which is connected to the shield of the cable.

NOTE Each digital channel (in- and output) contains a left and right audio signal, meaning that there are actually 8 input channels and 8 output channels.

For cable assemblies with sub-D connectors we use Amphenol Sub-D 25 pin with gold plated contacts.

3 Cables

The following cables are described in this document:

- TPR (“Twisted Pair Reference”) cable.
- TPR8 cable (8 channels of TPR in one snake).

3.1 TPR

TPR is a twisted pair cable, meaning that the cable has 3 conductors in total. The conductors that carry the signals are twisted. The third conductor is the shield.

Figure 12 below shows the cross section of TPR. Note that this is just illustrative and not to scale.

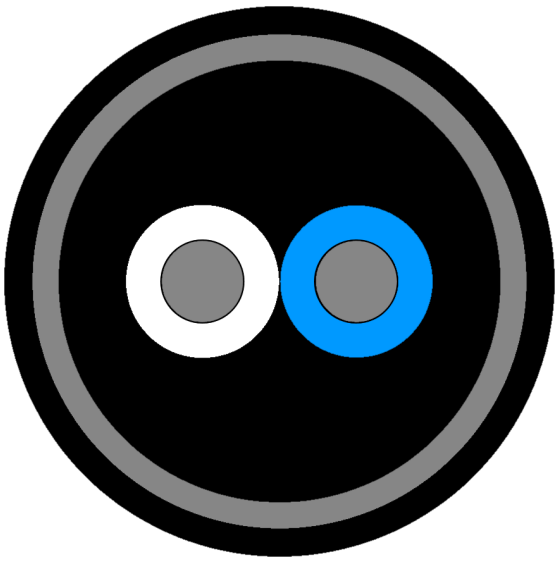

Figure 12: TPR cross-section

The two twisted conductors are in the center (grey), each has isolation (white and blue).
They are surrounded by isolation (black).
This black isolation is surrounded by the shielding (grey), and on the outside is the final isolation.

All the conductors are stranded wire.

3.2 TPR8

TPR8 consists of 8 channels of a slightly thinner version of TPR. The 8 TPR cables are held together by the outer isolation. TPR8 is a multi-cable, often referred to as ‘snake’. Figure 13 below shows an illustrative cross section of TPR8.

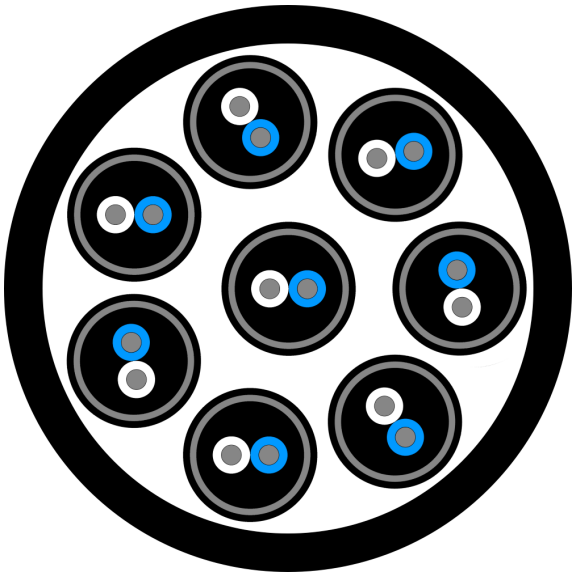

Figure 13: TPR8 cross-section

Between the strands of TPR is isolation (white).

When the cable is ‘split’ into eight separate cables, this is called the ‘Fanback’. The fanback length of our TPR 8 cable assemblies is approximately 30cm (1 foot). When the total cable length is mentioned, this includes the length of (both) fanback(s). Figure 14 below shows an example.

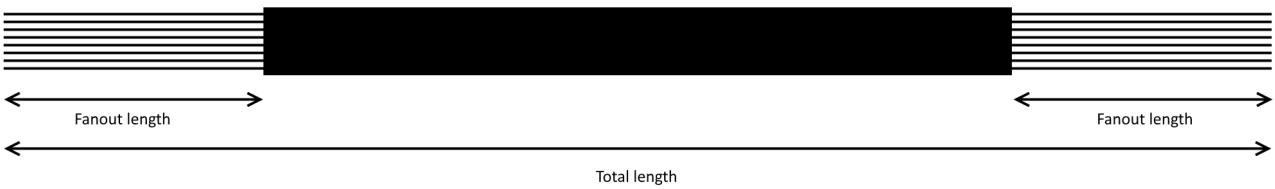

Figure 14:TPR8 length overview

Other fanback lengths are available on request, please contact us in advance if you need this. When an order is placed it is no longer possible to change the fanback length.

Each of the eight strands has a unique number, 1 to 8, so they can be identified at both ends. Table 2 below shows which number is connected to which channel in a sub D connector.

TPR 8 Strand	**Sub D analog**	**Sub D digital**
1	Channel 1	Input channel 1/2
2	Channel 2	Input channel 3/4
3	Channel 3	Input channel 5/6
4	Channel 4	Input channel 7/8
5	Channel 5	Output channel 1/2
6	Channel 6	Output channel 3/4
7	Channel 7	Output channel 5/6
8	Channel 8	Output channel 7/8

Table 2

4 Technical specifications of cable

This chapter offers technical specifications of TPR and TPR8 cable.

4.1 TPR

The technical specifications of TPR are as follows.

TPR	
Capacitance	37pF/m
Loss @ 1MHz	0,02dB/m
Loss @ 10MHz	0,06dB/m
Loss @ 100MHz	0,25dB/m
Resistance	0,19Ω/m (0,085Ω/m per conductor)
Shield coverage	89%
Conductive polymer coverage	100%
Microphonics per Mil C17	2mV-pk
Microphonics (open circuit)	50nV/Pa (source impedance is cable capacitance)
Characteristic impedance	110Ω
Minimal bending radius	55mm
Cable diameter	5,5mm
Weight	40gr/m

Table 3

4.2 TPR8

The technical specifications of TPR8 are shown in Table 4 below.

TPR8	
Capacitance	75 pF/m
Resistance	0,43Ω/m (0,215Ω/m per conductor)
Shield coverage	89%
Conductive polymer coverage	100%
Microphonics per Mil C17	2mV-pk
Microphonics (open circuit)	50nV/Pa (source impedance is cable capacitance)
Characteristic impedance	110Ω
Minimal bending radius	100mm
Cable diameter	13mm

Table 4

5 Connections

In previous chapters the connector pin-out and cable layout was introduced. Now we focus on the wiring between connectors. We elaborate on cables with different connectors per side, since this not always well defined in a standard.

In the examples we use TPR. For TPR8 the same rules apply for each of the eight channels.

5.1 Connector definitions

The available connectors are various 2-pin (‘mono’) or 3-pin (‘stereo’) connectors. Our types are shown in Table 5 below.

Connector name	**2-pin or 3-pin**
XLR (male and female)	3-pin
RCA	2-pin
Jack 6.35 Unbalanced	2-pin
Jack 6.35 Balanced	3-pin

Table 5

For each 2-pin connector the same connection strategy is applied, and for that reason they will be referred to as 2-pin connector. The same applies for the 3-pin connectors.

5.2 Electrical connections

5.2.1 3-pin to 3-pin

For analog and digital 3-pin to 3-pin connections the (straightforward) schematic is shown in figure 15 below.

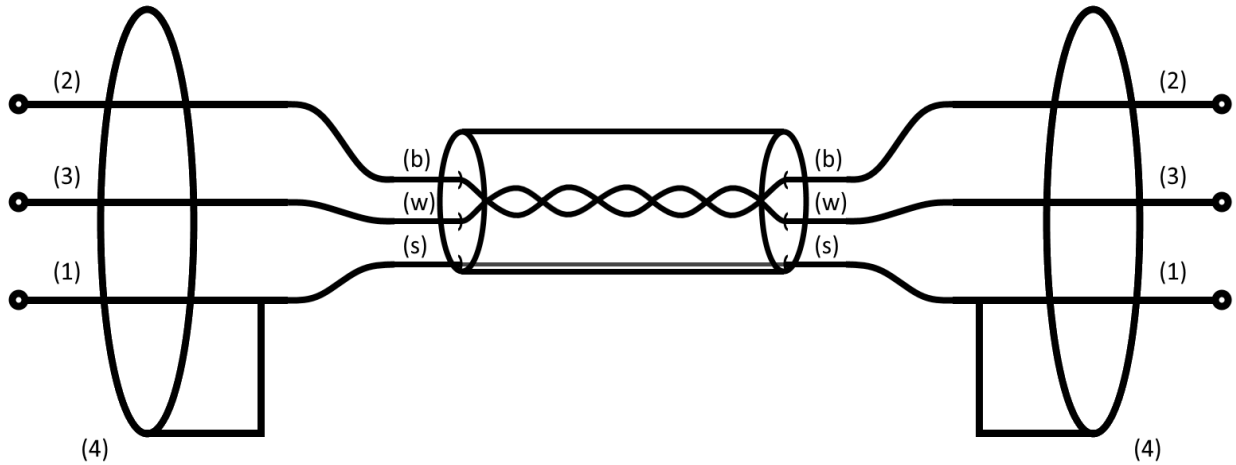

Figure 15: 3-pin to 3-pin schematic

The blue (b) wire is connected to pin 2 of both XLR's or jacks, the white (w) wire to pen 3. Pin 4 is only applicable to XLR, where the shield of the connector should always be connected to pin 1.

5.2.2 2-pin to 2-pin

For analog 2-pin to 2-pin connections we apply the schematic shown in figure 16.

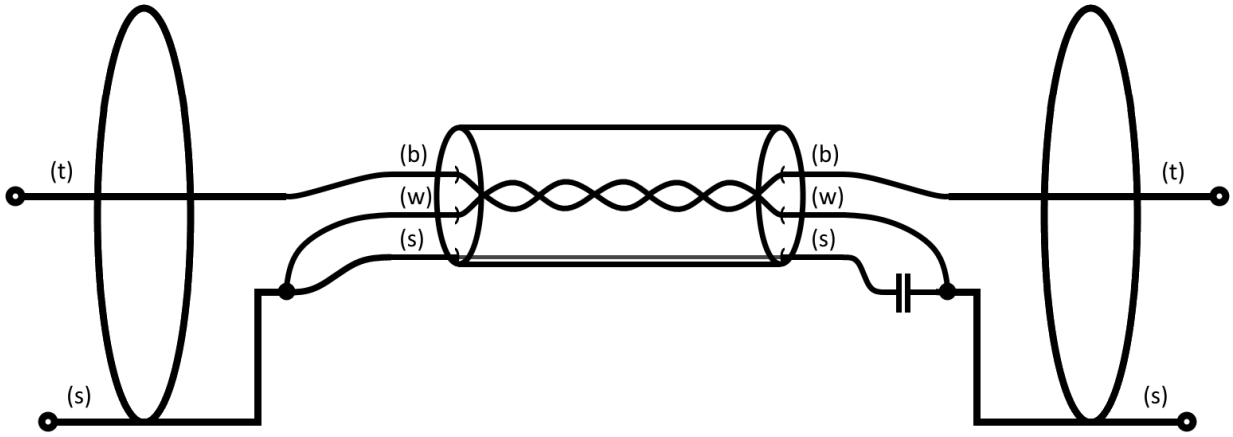

Figure 16: 2-pin to 2-pin schematic

Please mark that the negative signal and shield are connected on one end only. By leaving the shield open on one side, the magnetic shielding of the cable improves since the induced current can only flow through the two inner wires. These are well twisted so the susceptibility to magnetic fields is relatively small. By leaving the shield open on one side, the susceptibility of the cable to radio frequency pickup however becomes larger. By adding a small capacitor we close the cable shield for RF frequencies but leave it open for power line frequency induced hum. This means that the audio signal will pass through the proper twisted wires and not through the shield, but the shield still works as a shield since it will pass the radio frequency interference (RF).

NOTE We do not recommend to use TPR RCA cables for digital unbalanced (S/PDIF) connections. A digital audio signal is an HF signal of several MHz and for this type of unbalanced connections so called 'coax' cables are strongly recommended. These cables have one central conductor in a cylindrical shield and offer superior HF performance for unbalanced connections. Mark that the professional audio AES3 and AES/EBU standards specify a balanced cable and 3-pin connectors on both sides for digital transfer. TPR is very well suited for that application.

5.2.3 2-pin to 3-pin

For analog 2-pin to 3-pin connections the schematic shown in figure 17 is recommended.

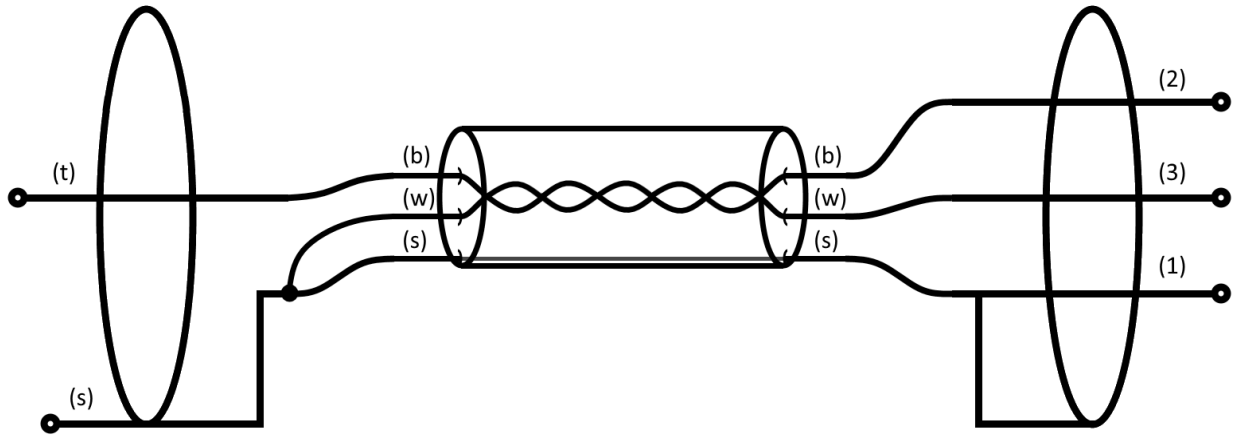

Figure 17: 2-pin to 3-pin schematic

The major part of the interference suppression capabilities of balanced audio systems is offered by the differential input side. “Unbalanced to balanced” wiring should be designed in such a way that it takes optimal advantage of these qualities. This means that the negative signal should be connected to ground at the unbalanced transmitter side.

5.2.4 3-pin to 2-pin

For 3-pin to 2-pin connections we deliver two different layouts, depending on the electronic output topology of your device.

In general, there exist two different types of outputs: electronically balanced outputs and transformer balanced outputs:

- The electronically balanced output is the most common and usually consists of 2 output buffers that drive the signal in positive and negative phase, both relative to ground.
- The transformer-output usually has no direct electrical ground reference, but just a balanced signal on pin 2 and pin 3.

NOTE Some transformer equipped outputs have a ground reference in the center of the output-winding. These types of outputs should be treated as if they were electronically balanced.

NOTE 2 Electronically balanced outputs exist that behave like a transformer balanced output (their 'common mode impedance' from pin 2 and 3 to ground is very high). These type of outputs should be treated as if they were transformer balanced. Please consult the manual or manufacturer of your device, to check what kind of output it has.

The different types of output systems demand for different types of cable assemblies. When the 'transformer' cable assembly type is used on an electronically balanced output, half of the signal will be shorted to ground. This generates dissipation in the output stage and in rare cases can even break the output stage of the device. In the other case, when the 'electronically balanced' cable assembly type is used on a transformer output, no signal connection is achieved.

There is no (passive) solution that serves both systems. We wire our cables by default for the most common output, which is the electronically balanced one. Please always check the manual of your device to see if this is the right type of assembly. If this information is missing from the documentation, please contact your supplier or the manufacturer. If you need a cable for a transformer balanced output, do contact us before ordering. We can supply TPR cables for these output systems.

The schematic shown in figure 18 below shows the standard way (for electronically balanced outputs) of connections for 3-pin to 2-pin cables. This is also the connection that we use for the cables we offer in our webshop.

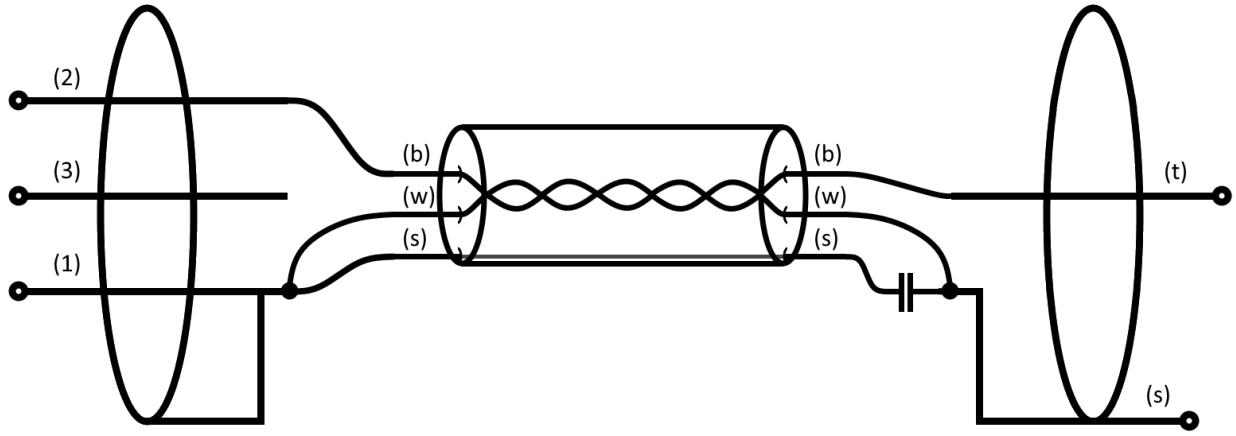

Figure 18: standard 3-pin to 2-pin schematic

Mark that pin 3 of the 3-pin connector is not connected. If it was connected to the ground of the 2-pin connector, it would short the signal. Since pin 3 is not used, this type of 3-pin to 2-pin connections is effectively completely unbalanced, just like a 2-pin to 2-pin connection. And like in the latter case, the small capacitor makes sure that the audio signal flows through the inner twisted wires while the shield still conducts RF and thus keeps the 'cage of Faraday' closed.

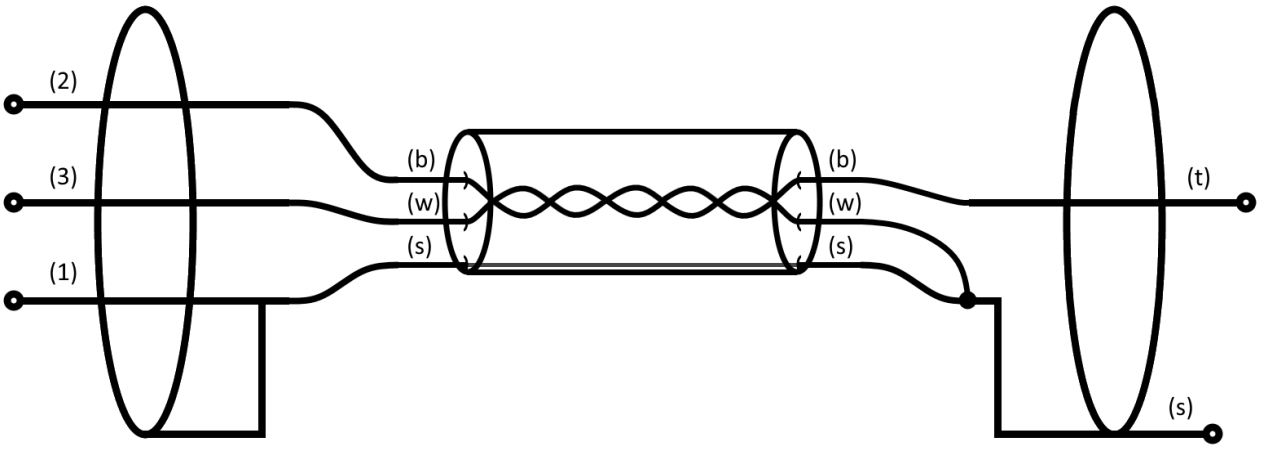

Figure 19: 3-pin to 2-pin schematic for transformer balanced outputs

The schematic in figure 19 shows the transformer balanced output connection for 3-pin to 2-pin cables. TPR with this kind of connection is available on request, please contact us. This cable is not available in the webshop as it might damage some devices.

As you can see, pin 3 (negative signal) is shorted to ground in the 2-pin connector. Transformer balanced outputs need this connection since the output signals are floating. The audio signal will pass through the inner wires and the shield is connected to the casing on both sides.

6 Connectors for TPR assemblies

TPR can be delivered with XLR, RCA, balanced Jack and unbalanced Jack connectors. A standard cable (both for analog and digital signals) has a female XLR on one end and a male XLR on the other end.

It is possible to specify different connectors on each end of the cable, like XLR and RCA or RCA and unbalanced Jack cable.

6.1 Available combinations

Table 6 below shows the possibilities.

	XLR Male	**XLR Female**	**RCA**	**Jack (unbalanced)**	**Jack (balanced)**
XLR Male	No	**Yes**[(C)]	**Yes**[(C)]	Yes	Yes
XLR Female		No	**Yes**[(C)]	Yes	Yes
RCA			Yes	Yes	Yes
Jack (unbalanced)				Yes	Yes
Jack (balanced)					Yes

Table 6

(C) This is a common cable and a couple of lengths are usually in stock.

NOTE This table shows that XLR cables with the same gender on both ends of the cable are not in our catalog (eg male to male or female to female). These cables should be avoided since they lead to problems and confusion. However, in some cases they are necessary. We can supply them on special request.

6.1.1 Common combinations and their application

XLR male to XLR female cable

This cable is a typical interconnection between two professional audio devices. It can be used for analog mono connections and for digital stereo connections (AES3 or AES/EBU). Figure 20 shows a 3m TPR cable with XLR male and XLR female connectors.

Figure 20: TPR XLR assembly

When used for an analog connection, please note that you need two cables for a stereo connection. For this reason we also offer a stereo pair assembly, with two cables in one package.

RCA to XLR male or XLR female cable

This type of cable is commonly used for connecting an analog hifi device to a professional one. Again you need two for a stereo connection.

NOTE Traditionally, hifi systems had RCA connectors for analog signal transport, where professional audio had XLR. Recently, XLR connector are becoming more popular on hifi devices.

- The RCA to XLR **male** cable is used when the device on the XLR side is an **input** and the device on the RCA side is an **output**.
- The XLR **female** to RCA cable is used when the device on the XLR side is an **output** and the device on the RCA side is an **input**.

NOTE this type of cable is not intended to use for S/PDIF to AES3 connections. We recommend a coaxial cable with a proper build in impedance converter. We have these in our catalog, please contact us for a quote.

6.2 Connectors for TPR8

TPR8 is available with many different connectors. Important to note is that with DB25 style connectors, differences exist between analog and digital cables that are invisible from the outside, which may lead to confusion. The goal of this chapter is to bring clarity. However, if questions remain please do not hesitate to contact us!

As discussed at chapter 2.4 there are differences between a digital multi-cable and an analog multi-cable. Let's start with the most common combinations of connectors for analog and digital. We also offer other combinations of connectors, these are described in the next chapter.

6.2.1 Available combinations of connectors for TPR8

The available combinations for digital multi-cable are shown in Table 7 below:

	1x Amphenol Sub D	**4x XLR Male and 4x XLR Female**	**8x XLR Male**	**8x XLR Female**	**8x RCA**
1x Amphenol Sub D	**Yes**[(c)]	**Yes**[(c)]	**Yes**[(c)]	**Yes**[(c)]	Yes
4x XLR Male and 4x XLR Female		**Yes**[(c)]	No	No	Yes
8x XLR Male			No	Yes	
8x XLR Female				No	
8x RCA					Yes

Table 7

(C) This is a common cable and it is described in the next chapter.

Available combinations for analog multi-cable are shown in Table 8 below:

	8x XLR Male	8x XLR Female	8x RCA	8x Jack (unbalanced)	8x Jack (balanced)	4x XLR Male and 4x XLR Female	1x Amphenol Sub D
8x XLR Male	No	**Yes(C)**	Yes	Yes	Yes	No	**Yes(C)**
8x XLR Female		No	Yes	Yes	**Yes(C)**	No	**Yes(C)**
8x RCA			Yes	Yes	Yes	Yes	Yes
8x Jack (unbalanced)				Yes	Yes	Yes	Yes
8x Jack (balanced)					Yes	Yes	Yes
4x XLR Male and 4x XLR Female						Yes(1)	**Yes(C)**
1x Amphenol Sub D							**Yes(C)**

Table 8

(1) Each channel of the cable has a Male and Female connector. Looking in one direction, channel 1 to 4 are male to female and channel 5 to 8 are female to male.
(C) This is a common cable and it is described in the next chapter.

6.2.2 Common analog TPR8 connector combinations and their application

1x Amphenol Sub D to 8x XLR male.

This cable is common for analog connections and serves as a breakout cable for outputs. In some cases, when the equipment has the option, it can also be used as an 8 channel digital multicable. This cable supports 8 analog channels. When used for a digital connection, these are 16 **output** channels.

1x Amphenol Sub D to 8x XLR female.

This cable is common for analog connections and serves as a breakout cable for inputs. In some cases, when the equipment has the option, it can also be used as an 8 channel digital multicable. This cable supports 8 channels. When used for a digital connection, these are 16 **input** channels.

1x Amphenol Sub D to 4x XLR male and 4x XLR Female.

This cable can be found in analog systems and serves as a combined input & output breakout cable.

- The male XLR connectors are connected to channel 1 to 4 of the Sub D connector.
- The female XLR connectors are connected to channel 5 to 8 of the Sub D connector.

1x Amphenol Sub D to 1x Amphenol Sub D.

This cable is an interconnection cable for analog multichannel systems. Each channel is connected to the same channel at the other end of the cable. Channel 1 goes to channel 1, 2 to 2, etc.

Please note that this is cable is different than its digital counterpart, but the cable looks the same!

8x XLR male to 8x XLR female.

This cable has 8 mono channels. Each channel has a male and a female connector.

8x XLR Female to balanced jack

Many budget systems have balanced jacks in stead of XLR's to save space and money. In Electronic Musical Instruments jacks are the standard. Professional devices usually have XLR's. To interconnect 8 channels between a professional and an MI or budget device, this cable can be used.

6.2.3 Common digital TPR8 connector combinations and their application

1x Amphenol Sub D to 1x Amphenol Sub D.

This cable is a multi interconnection cable for digital connections. It is common for multitrack devices.

- Channel 1 to 4 of the digital **output** connector are connected to 'channel 5 to 8' of the digital **input** connector. So from an analog Sub D standpoint, channel 1 connects to channel 5, 2 to 6 etc.
- Channel 5 to 8 of the digital **input** connector are connected to channel 1 to 4 of the digital **output** connector. So from an analog Sub D standpoint, channel 5 connects to channel 1, 6 to 2 etc.

This means that the cable swaps the input and output channels, in such a way that all outputs connect to an input and all inputs connect to an output.

1x Amphenol Sub D to 4x XLR male and 4x XLR Female.

This cable is common for digital multichannel connections and serves as a breakout cable.

- The male XLR connectors are connected to channel 1 to 4 of the digital **output** channels of the Sub D connector.
- The female XLR connectors are connected to channel 1 to 4 of the digital **input** channels of the Sub D connector.

4x XLR male and 4x XLR Female to 4x XLR male and 4x XLR Female.

This cable has 4 stereo output channels (female to male) and 4 stereo input channels (male to female)

Each channel has a male and a female connector.

1x Amphenol Sub D to 8x XLR male.

Some devices have the possibility to set each channel of the digital multi-cable connection as output. This cable should be used for such a setting.

1x Amphenol Sub D to 8x XLR female.

Some devices have the possibility to set each channel of the digital multi-cable connection as input. This cable could be used for such a setting.

7 Notes

There are many ways cables can be made. With this document we tried hard to clarify what our choices in assembly construction are. Especially for cables with different connectors on each end it can be confusing at times to know the best solution for your setup. If this document does not clarify everything for you, or if you find information in this document to be incomplete or wrong, please contact us. We will answer your questions and update this document if applicable.