<u>Lynx-2 To Alesis AI-2 Transport Cable</u>

01/23/2018 by Bill Bainbridge (brainditch)

The following document was generated via direct observation and measurement of an actual physical specimen of the TimeLine produced Lynx-2 To Alesis AI-2 Transport Cable (TimeLine Part #71384). It is an attempt to recreate the information contained within original company-produced documents that have been lost in time, due to financial closure or posterity disinterest of the companies in question. The accompanying Cable Schematic was drawn up by myself from these observations, with aid of the following (company-produced) original documents:

1. TimeLine Lynx-2 User Manual (73A020-H, first printed 09/15/1994; Table 3-4, pg. 3-12).

2. Alesis AI-2 Service Manual (73A024-A, first printed and produced 05/23/1994 by TimeLine Vista, and the accompanying schematic by TimeLine Vista, document #70346-20)

The measurements were obtained using a Digital Multimeter (DMM), specifically- a Radio Shack 22-174B True RMS Digital Multimeter, using a continuity checking feature for rapid assessment. Although the DMM used may not be the most accurate device commercially available, its use was deemed accurate enough for simple continuity assessment. Prior to the measurements, a visual examination of the termination ends was performed that precluded the possibility of “extra” (non-wire) electronic components being utilized in the final assembly (which might have otherwise disturbed the readings).

The initial visual inspections of the cable revealed the following:

1. The cable is approx. 20' 5" (245") in length.

2. The cable sheathing is black in color, with a definite gloss to it, probably indicating a PVC-type material.

3. The sheathing has slight ripples in its surface, with periodic "cross-hatching" possibly indicating a twisted-pair configuration of the internal conductors.

4. The flexibility of the cable is relatively good for its approx. 3/8" diameter, possibly indicating a small quantity, or small diameter of stranded wires making up each conductor.

5. The cable sheath has white printed ID letters and numbers on it (repeated approx. every 10-3/4") which read:

TimeLine 53D021 E62291 CL2 75(degree symbol)C (UL) STYLE 2464 ALSO AWMLL-41319 CSA AWM(Roman numeral 2)II A/8 80(degree symbol)C 300V FT-4

6. The cable had a white printed paper label on it (presumably an "assets tag" of the equipment rental company), attached/ protected by clear tape, which read:

"Lynx-2 to

Alesis

ADAT

SN: 5038"

7. The cable termination observations are:

A. One end has a 25-pin D sub male connector on it, with only partial loading of the connector body with conductor pins. Pinout Numbers are embossed on the connector Pin Face, and read from left to right, with #1 being at the upper left. 11 pins are loaded into the following Pinout Numbers (as viewed from the Interface or "Mating" Side, looking directly at the pin tips) - Top Row: Pin 1, Pin 2, Pin 3, Pin 5, Pin 6, Pin 7, Pin 12, Pin 13; Bottom Row: Pin 15, Pin 16, and finally Pin 18.

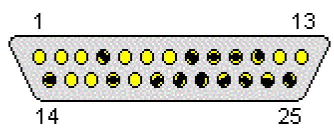

Figure 1. Alesis AI-2 25-pin Male D-sub

(Yellow dots are filled with pins, Black dots are empty holes)

B. The other end has a 50-pin D sub connector on it. Additionally, coming out of the cable entry side of the connector hood is a short pigtail of cable (approx. 6") which is terminated with a:

C. 1/4" Tip, Ring, Sleeve (TRS) Male plug.

D. The 50-pin D sub connector itself is also partially loaded as expected (similar to the 25-pin D-sub connector), but with only 9 pins loaded (presumably the TRS connector contains the 2 missing conductors). The D sub pin loading will be described using the same viewpoint as in "A" above- Top Row: Pin 1, Pin 7, Pin 16; Middle Row: Pin 23, Pin 24, Pin 32; Bottom Row: Pin 37, Pin 49, and finally Pin 50.

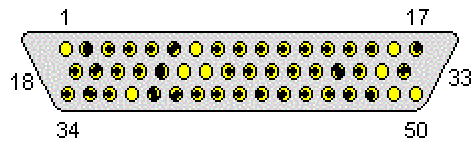

Figure 2. Lynx-2 50-pin Male D-sub

(Yellow dots are filled with pins, Black dots are empty holes)

E. Both D sub connectors are of the same source manufacturer, with a stylized graphical logo which could either be the letters "JI" or "SI" embossed on the hood for each end of the cable. They are of the type which has integrated, trapped #6-32 knurled turnscrews at the outer edges of the connector, for positive mechanical lock to the female connectors of the electronic devices the cable interfaces with. The 1/4" TRS plug appears to be of Switchcraft origin, with a brown fiber washer-style insulator between the Tip and Ring sections, and a white PVC-style insulator between the Ring and Sleeve sections.

8. Partial disassembly of the hoods (via two Flat Head Slotted Machine Screws - possibly #4-40 X 1/2") to reveal possible electronic components, such as resistors, capacitors, or diodes, (or to quickly reveal the presence of Jumper or Bridging Wires within the hood) yielded the following:

A. No electronic components (other than wire and heat shrink tubing) were used in the assembly.

B. 25-pin D sub end: small diameter conductor wires (possibly 26 AWG) with color-coded insulating jacket (possibly also PVC). Under an approx. 3/8" pinched-tip cap of clear heat shrink tubing (appro. 1/4" diameter) are the clipped ends of what I believe are an additional 9 conductors (clipped as a tight group of the same length), bringing the total conductor count of the cable to 20 conductors. One conductor has a colorless transparent insulating jacket, the others are associated wth the following Pinout:

P1 = Clear insulated conductor

P2 = Red/White (red w/ white stripe)

P3 = Dark Blue

P5 = Red/Green

P6 = Black/Blue

P7 = Blue (has a black binding ring, like insulation, or a very small “O” ring, binding it to P6 conductor at the cable sheath edge)

P12 = Green

P13 = Black/Green

P15 = White

P16 = Red/Blue

P18 = Green

C. 50-pin D sub end:

The 1/4” TRS terminated "pigtail" cable mentioned earlier has three conductors, color-coded and pinout thusly:

Clear = Pin 1 of 50-pin D sub

Red = "Flying Spliced" (i.e., no physical connection to any other hardware which helps support the splice) to Blue conductor exiting cable sheath (under clear heat shrink tubing)

Black = "Flying Spliced" to Black/Blue exiting cable sheath same dress as above

The 50-pin D sub Pinout:

P1 = Clear insulated conductor of pigtail cable, as described above

P7 = Black/Green

P16 = Red/Blue

P23 = Green

P24 = Green

P32 = Blue

P37 = Red/Green

P49 = Red/White

P50 = White

As with the 25-pin end, the unused conductors are clipped and capped but they are more visible, extending out of the sheath approx. 1/2". The colors are: Orange, Black/Orange, Black/Brown, Brown, White, Black/White, Red, Yellow, and Black/Yellow. The only conductor not seen was a Clear insulated one from the main cable originating from the 25-pin D-sub, Pin 1, which might mean that either: it was trimmed so close to the sheath (1/2 terminated, as an electronic ground wire sometimes is to prevent ground loops) that it got pulled back out of clear view; or a different wire color was stripped completely and re-coded Clear using heat shrink tubing. Only an electrical test will verify this, and allow the same color wires to be pin-to-pin matched. Incidentally, there was no obvious evidence that the cable has even a foil shield (unless it was trimmed, and pulled back inside the cable sheath), and since the hoods for the connectors were plastic-type, there would be no evidence of any shielding at all.

The completed visual and measurement inspections outlined above were followed by the continuity checks, which yielded the following data.

9. Continuity Checks:

Since no extra electronic component devices were observed during the visual inspections above, the continuity testing should be relatively straightforward, i.e. no concerns about Forward Bias, DC blocking, etc. need be addressed. The next page contains the results of this testing.

Pinout connections are shown as an equation statement. The 25-pin D-sub connector pin numbers are shown on the left of the equality symbol (=) , and the 50-pin D-sub or 1/4” TRS plug on the right:

Pin 1 = ? (subsequently revealed as connected to a hidden, uninsulated “Cable Shield Drain Wire”

Pin 2 = Pin 49

Pin 3 = Pin 32

Pin 5 = Pin 37

Pin 6 = 1/4” TRS Tip

Pin 7 = 1/4” TRS Ring

Pin 12 = Pin 24

Pin 13 = Pin 7

Pin 15 = Pin 50

Pin 16 = Pin 16

Pin 18 = Pin 23

N/A = Pin 1 = 1/4” TRS Sleeve

10. Combination of Observed Pin Connections and Schematic Pinout Identities:

Taking a moment of reflection to combine observed pin to pin (or pin to solder terminal) connections with company-documented Pinout Identities yields the following assertions. As with the results of item 9 above, the 25-pin D-sub (Alesis AI-2) will be represented on the left, and Lynx-2 connectors (50-pin D-sub and 1/4” TRS plug) on the right of the equality symbol. For reading and interpretive clarity, the results will be print-formatted to appear on the next page.

Digital Ground, pin 1 = Cable Shield Drain Wire

EDIT TRANSMIT OUT MINUS (ETX-) , pin 2 = pin 49, (RCV-) RS-422 RECEIVE MINUS

LYNX RECEIVE IN PLUS (LRX+), pin 3 = pin 32, (TX+) RS-422 TRANSMIT PLUS

RECEIVE TRANSPORT COMMAND IN (RXT IN), pin 5 = pin 37, PLAY COMMAND

GENERATOR TIMECODE OUT PLUS (GTO+), pin 6 = Tip, 1/4” TRS Plug, ->Lynx-2 TC IN (+)

GENERATOR TIMECODE OUT MINUS (GTO-), pin 7 = Ring, 1/4” TRS Plug, ->Lynx-2 TC IN (-)

TAPE DIRECTION IN (TACH OS), pin 12 = pin 24, REWIND COMMAND

TACH IN, pin 13 = pin 7, FAST FORWARD / DIRECTION TALLY

EDIT TRANSMIT PLUS (ETX+), pin 15 = pin 50, (RCV+) RS-422 RECEIVE PLUS

LYNX RECEIVE IN MINUS (LRX-), pin 16 = pin 16, (TX-) RS-422 TRANSMIT MINUS

DIGITAL GROUND, pin 18 = pin 23, TRANSPORT COMMAND COMMON

11. The mystery of the missing 25-pin D-sub Pin 1 is resolved:

Having done as much as possible to avoid modifying the assembly in any way, the mystery of the missing connection to Pin 1 of the 25-pin D-sub could only be resolved with a (relatively) minor modification: the cable's insulating sheath needed to be stripped back slightly to reveal either a full-length "drain wire" (uninsulated), or some evidence of a foil (or other type) shield. The results of this operation follow:

1. There is in fact: a spiral-wrapped aluminum foil shield, pulled back into the insulating sheath by approx. 1/4".
2. There is in fact: an uninsulated "Cable Shield Drain Wire”, pulled back an additional approx. 3/16" into the foil shield.
3. The connection between this "Cable Shield Drain Wire” and the 25-pin D-sub, Pin 1; as measured by continuity test, is complete and “solid” (non-intermittent)- therefore the “Pin 1 Mystery” is solved.

12. The de-sheathed cable reveals more data:

Having revealed more of the conductor lengths by stripping back the cable sheath by approx. 3/8", more data is apparent:

1. There is a definite "twist" apparent to the individual conductors.This appears to not merely be a result of the anticipated twist of all conductors under a common sheath, but is “wriggled” more tightly (smaller diameter helixes), as if part of a multi-conductor, twisted-pair construction.

2. More of the small, black "binding rings" (much like small diameter and toroid "O" rings) are evident, apparently mating the conductors up into twisted pairs.

3. The following **unconnected** conductor pairings are evident:

1 . Yellow to Yellow/Black

2. Black to Red

3. Orange to Black/Orange

4. Brown to Black/Brown

5. White to Black/White

4. The following **connected** conductor pairings are evident:

1. Green to Red/Green (50-pin D-sub, pin 23 & pin 37 respectively)

2. Green to Black/Green (50-pin D-sub, pin 24 & pin 7 respectively)

3. Blue to Red/Blue (50-pin D-sub, pin 32 & pin 16 respectively)

4. White to Red/White (50-pin D-sub, pin 50 & pin 49 respectively)

5. Blue to Black/Blue - TRS Plug: (Blue, via Red wire of 6” “pigtail” cable becomes) TRS Tip, & (Black/Blue, via Black wire of 6” “pigtail” cable becomes) TRS Ring.

6. The individual conductors appear to be 22 AWG (0.025”) with 30 AWG (0.010”) wires measured by examination of a stripped wire using a General Tool Co. #20 American Standard Wire Gauge For Non-ferrous Metals, making the cable a:

22 AWG (7X30) Strand, Tinned, 10 Twisted Pair (20 Conductor) PVC Jacket Cable with Foil Shield & Drain Wire

12. The twisted pairings as related to Signal Identities:

The above Conductor Pairings data relate to approved twisted pairs as Signal Identities thusly (from documentation within lynx-2 User manual and Alesis AI-2 Service Manual Schemo), this time as viewed from the Lynx-2 connector on the left of the equality symbol:

1A. Lynx-2 pin 23, TRANSPORT COMMAND COMMON = AI-2 pin 18, DIGITAL GROUND

1B. Lynx-2 pin 37, PLAY COMMAND = AI-2 pin 5, RECEIVE TRANSPORT COMMAND IN (RXT IN) [or does RXT IN stand for Receive External Timecode In? If so, then it seems to be the one of the only unbalanced signals present- this seems unlikely, as the other timecode signal - from the AI-2 to the eventual destination of the Lynx-2 “TC IN” 1/4” TRS Jack - is presumably balanced on the 1/4" TRS plug via a Tip, **Ring**, and Sleeve connection].

2A. Lynx-2 pin 24, REWIND COMMAND = AI-2 pin 12, TAPE DIRECTION IN, (TACH OS)

2B. Lynx-2 pin 7, FAST FORWARD/DIR Tally = AI-2 pin 13, TACH IN

3A. Lynx-2 pin 32, RS-422 TRANSMIT (TX+) = AI-2 pin 3, LYNX RECEIVE (LRX+)

3B. Lynx-2 pin 16, RS-422 TRANSMIT (TX-) = AI-2 pin 16, LYNX RECEIVE (LRX-)

4A. Lynx-2 pin 50, RS-422 RECEIVE (RCV+) = AI-2 pin 15, EDIT TRANSMIT (ETX+)

4B. Lynx-2 pin 49, RS-422 RECEIVE (RCV-) = AI-2 pin 2, EDIT TRANSMIT (ETX-)

5A. 1/4" TRS Tip, TC IN (+) (Timecode Reader +) = AI-2 pin 6, GENERATOR TIMECODE OUT (GTO+)

5B. 1/4" TRS Ring, TC IN (-) (Timecode Reader -) = AI-2 pin 7, GENERATOR TIMECODE OUT (GTO-)

13. Some speculation as to the technical reasons for the above pairings:

1. It is well known that twisted pair wiring has greater immunity to externally induced Electro-Magnetic Interference (EMI) noise, and as such is often a prerequisite to high-speed data communication lines (Category 5 & Category 6 Ethernet Cable construction, for example).

2. Quite a few of the Signal Identity pairings appear to be or are quite clearly utilizing electronically balanced inputs and outputs (with a separate "+" and "-" line each). The RS-422 TRANSMIT data lines are one example, as are their complement, the RS-422 RECEIVE data lines. The Timecode signal line is another. It's quite possible that the choosing of the other data lines as pairs reveals something about their stability or EMI sensitivity. From other sources (including other TimeLine documentation), a common signal to be found when synchronizing Analog Tape Recorder (ATR) machines is the so-called "Capstan Servo" line. It is an Analog signal that is apparently so sensitive to EMI that it is often recommended to be sent down a separately shielded cable from other "digital-level" (+5V TTL) transport control signals to preserve its fragile stability!

3. The other pairings may reveal their stability, as suggested above. The TRANSPORT COMMAND COMMON/ DIGITAL GROUND line paired with the PLAY/TRANSPORT COMMAND line may well be one example, as anything carrying a ground potential may also be used as a sort of shield (although in the case of twisted pair wiring, a very permeable one).

4. The last signal pairing is rather odd: REWIND COMMAND/TAPE DIR IN makes some sense, in that a source (Lynx-2) to destination (AI-2) coupling is implied from their port names in the documentation, and thus implies a single direction of communication- from Lynx-2 to AI-2. However, the FAST FORWARD/DIR TALLY to TACH IN as a signal source is rather strange, as I'll go over eventually in 4B. For now, let's explore the pair's first member carefully (in 4A, below).

4A. The term COMMAND most often implies a fixed output (not Bidirectional), and the TAPE DIR signal flow (from the AI-2 Service Manual Schematic) is seemingly shown as an input. The signal TACH OS signal present at pin 12 of the 50-pin D-sub becomes TAPE DIR after some minor Logic processing. It is connected to one of two dual inputs to a buffer of some kind (normally, schematically depicted as a triangle with a single input, and single output). The schematic symbol used *looks like a buffer,* but there are two inputs instead of one, and further, one of the inputs has a "Logic Inverting Bubble" on it. This situation requires a bit more analysis.

This Logic Inverted input is tied to a two resistor voltage divider from the +5V supply, with the divider ratio setup to provide a nominally low voltage to the device input (+5V->1K->Input+330 Ohm->Ground). This voltage divider would provide approx. 1.24V to the "inverting input" nominally, and would hold its possible contribution to the OR output state low. Unless there is something tricky going on here, this would ordinarily not be considered "best practice" since the input appears to be running in the "indeterminacy range" between 0.4V and 2.0V (for regular TTL devices).

Continuing on despite this aberration, the other input is fed from a similarly tied voltage divider, but the values are instead: +5V->10K->Input+220 Ohm, with no Ground present. This input is fed from the signal TACH OS, on pin 12 of the 50-pin D-sub. What this implies is that when there is no active signal present, the voltage divider isn't dividing (due to no Ground being "sensed") and holds its input high, and therefore the output is held high. When an active signal goes low, the input gets pulled down to approx. 0.11V (the signal is acting as a Virtual Ground), and the output goes low. When the signal goes high, the input returns to a high state, but is being supplied a bit more current from the external driving device.

A barely legible device callout appears to name the TACH OS/TAPE DIR device U11B, and is either a 26LS32 or 26LS37 device (bad schemo printing prevents adequate distinction between a "2" and a "7" here). This illegibility required a direct inspection of an AI-2 PCB for confirmation, which revealed that the U11 device installed on that particular unit was in fact a 26LS32. This revelation makes some things clearer; instead of an OR Gate (were the device a 74LS32), this device is a Quad RS-422 receiver with Tri-State Outputs. As such, it has a differential data input (two inputs for one source signal, one inverting, and one non-inverting, such as found in Analog Op-Amps). Pin 7 of a 26LS32 is in fact an inverting input (technically OK to consider this for an "inversion bubble" symbol), which means that the "low" (-ish) voltage from the divider at the input would yield a high, rather than low output. A high voltage at pin 6 (the non-inverting input)- such as when no signal is present, would still yield a high output, as would a high level of an actual signal source. A Logic Low input signal would naturally produce a low output, just like a Logic Buffer.

What I think is going on here is that the designer had the other Receiver Stages of the Quad device being used for other parts of the circuit, and even though the inputs didn't need to be differential for this signal (nor either for its neighboring signal TACH IN), it was convenient and efficient to use the device as a Logic Buffer (with the added bonus of hysteresis for the inputs and Tri-State outputs), rather than spec an additional part.

4B. The other member of the pair, the FAST FORWARD/DIR TALLY to TACH IN data line is odd in that the usual use of the word "Tally" with regards to sync signals is as an input, not an output, yet here it is obviously being used as such. A similar input voltage biasing scheme as the above 4A case is being used here, as well as the fact that a different Receiver stage of the same U11 is being used (U11C, instead of U11B as mentioned above). The same conservative use of a Differential Receiver as a Logic Buffer has been employed as well.

The naming of the Lynx-2 output lines implies a complementary pair of signals and functions. FAST FORWARD and REWIND commands could be considered to be opposites, therefore work as a complementary pair. When one is active, the other should not be. When neither is active, yet PLAY is, the deck should be in normal Play Mode. If none of those signals are active, then the deck must be in Stop Mode.

The trouble comes from attempting to interpret what's going on with the AI-2 side of the signal flow. TACH IN sort of doesn't make sense, given the presumed nature of the Lynx-2 to AI-2 relationship, unless there's something I didn't catch. A Tach signal is usually presented to a synchronizer as a means of describing how fast the attached deck's Transport is moving, particularly when the deck is moving in either Fast Forward or Rewind Modes, and the speed of the passing Timecode is potentially not going to be read accurately. This signal should not be coming from a Lynx-2, as the AI-2 (and its controlled ADATS) are considered the only Transport involved here, unless the Tach signal is being passed to the Lynx-2 from another Lynx-2 in a larger system. If a Microlynx were to be directly involved rather than the Lynx-2, the other Transports connected to it would be producing Tach signals which the AI-2 might need to keep track of. It would seem that further study of the AI-2 User Manual is appropriate to determine if there is anything further to "read between the lines".

There is less likelihood for this level of technology to have achieved a feature such as converting a Logic Input to become a Logic Output, however, it is possible that the anomalous port pairings and naming could happen because the *meaning, or intended signal carried could be modified in software, possibly "on the fly".*

14. **The results: A Schematic for the Lynx-2 to Alesis AI-2 Interface Cable**:

Note: The color-coding of the Pin Identities denotes data lines that were twisted pairs in the original cable, one color per pair.

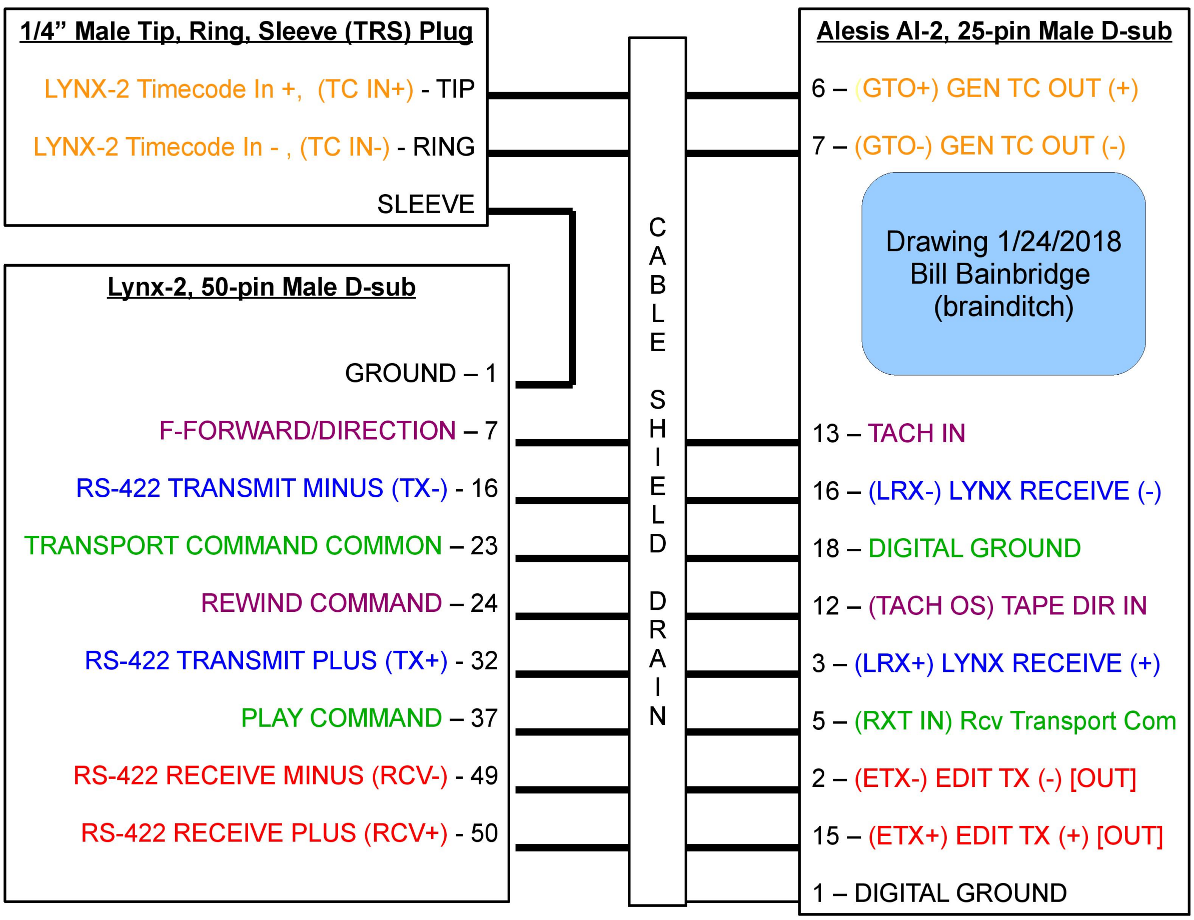

Figure 3. Lynx-2 To Alesis AI-2 Cable Schematic