TECHNICAL NOTE

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RJ45 CONNECTION SYSTEM SPECIFICATION NOTES
For DiGiCo D-Rack, D2-Rack and compatible mixers and devices

The following notes are intended as a guide to system engineers planning external RJ45 connection cables systems for permanent building installation, external patch systems etc.

Communications Protocol Note

The Digico connection used with (for example) the D-Rack and SD9 consoles and others such Purple box format converter and Digico systems using DMI interfaces, is a proprietary Madi over Cat5 protocol designed to operate with specific types of Cat 5 and Cat 6 style cables.

It is NOT compatible in any way Ethernet (as normally used for computer networks) and no attempt should be made to combine these signals with Ethernet, e.g. in a network switch. See further notes below.

It should be noted that the data voltage is approximately 1V RMS 125MHz serial data. Earth (ground) differentials of over 0.5V due to poor power wiring will effectively stop the system from functioning.

Using Digico standard cables:
Standard external cables are supplied by DiGiCo for use with these systems (length & p/n)
2m LEADS0057, 10m LEADS0054, 75m LEADS0053, 100m LEADS0055 are manufactured as follows

Digico supply an extra robust cable for 75m and 100m (see below for 2m & 10m)
Van Damme brand "Tourcat series Cat6 S/FTP" Shielded Twisted Pair (Van Damme p/n 268-662-000) alternatively Tourcat Cat6a (Van Damme p/n 268-466-000) may be used

Each end is terminated with shielded RJ45 plug and Neutrik NE8-MC1 EtherCON shells.
Each end fitted with Essentra (formally Richco) RRC-14-7-28-M-K5B ferrite suppressor (Digico P/N SUPP002)

The suppressors are fitted at each end using this clamp type ferrite. These ensure immunity to electrical interference common in on-stage environments and to meet International emission and immunity standards

Before Jan 2018 cables were made from Van Damme brand "Tourcat-Flexible" Cat 5e Shielded Twisted Pair (STP) cable (Van Damme p/n 268-450-000) This is no longer available in longer lengths but is still used for 2m and 10m links

Each end is terminated with shielded RJ45 plug and Neutrik NE8-MC1 EtherCON shells.
Each end is fitted with Laird-Signal Integrity Product type 28A0593-0A2 ferrite suppressor (Digico P/N SUPP001)

Digico also offered a 100m cable (p/n LEADS0058) more robust cable (up to the 100m limit) as an alternative to the above cables for longer length cables Van Damme brand "Tourcat-SF/UTP" Cat 5e Shielded Twisted Pair (STP) cable (Van Damme p/n 268-462-000) These are replaced by LEADS0055

Each end terminated with shielded RJ45 plug and Neutrik NE8-MC1 EtherCON shells.
Each end fitted with Essentra (formally Richco) RRC-14-7-28-M-K5B ferrite suppressor (Digico P/N SUPP002)

Alternative cable types that may be substituted at the factory from time to time, being different to the standard type.

Contrik (formally Neutrik brand) EtherFLEX Slightly more bulky, robust Cat 5e Shielded Twisted Pair (STP) cable (see www.contrik.ch/en-ch/products/znk-ct2672601)
Use with Laird-Signal Integrity Product type 28A0640-0A2 ferrite suppressor, terminated with shielded RJ45 plug and Neutrik NE8-MC1 EtherCON shells

TMB.com Proplex PCCAT5EP cable, This a premium robust low loss Cat 5e Shielded Twisted Pair (STP)
Each end fitted with Essentra (formally Richco) RRC-14-7-28-M-K5B ferrite suppressor (Digico P/N SUPP002) terminated with shielded RJ45 plug and Neutrik NE8-MC1 EtherCON shells

An alternative suppressor is available for the "Tourcat-SF/UTP", EtherFLEX or Proplex large diameter cables. Wurth Electronic Star-Tec 74271131S. This clips on but has a squarer profile and requires a special tool for removal.

Plug wiring is normal Cat 5 cable, pin 1 to pin 1 etc. to the "A" colour scheme,
that is twisted pairs 1-2, 3-6, 4-5, 7-8

1 White-Green 2 Green
3 White-Orange 4 Blue
5 White-Blue   6 Orange
7 White-Brown 8 Brown

Using custom cabling
Any cables not supplied by the factory should be made to strictly the same construction as the factory cables, as noted above. These parts are widely distributed through professional audio and industrial electronics supply sources.

Note the specified cable is Cat5e or Cat 6 Shielded Twisted Pair (STP). Do NOT attempt to use Unshielded Twisted Pair (UTP) connectors.

EtherCON shells must be used. Note the Neutrik EtherCON-Cat6 connector will not mate with EtherCON (Cat 5e) connections.

Cables made to Cat6, Cat6a or Cat 7 can be used but the specific characteristics is of no special added benefit as these are principally for very high speed networks. Note also performance data referring to Ethernet characteristics are not relevant for use with the Digico systems Madi over Cat 5 which does not use Ethernet.

For installed single uninterrupted cabling for longer runs using the specified cable, the absolute maximum length is 100m. Note this MUST NOT be interrupted by any connection (such as a patch bay or wall plate).

As such, for installed systems where there must be outlet points in walls and floors to connect to the mixer or rack, then sufficient permanent cable "tails" should be allowed. Provision for storage of such tails in suitable wall and floor boxes may be required as a result. The use of short patch cables for interconnection purposes at walls and floors is not permissible.

It is also important the Madi over Cat 5 connection is kept electrically isolated from any other systems using a common route, such as ducting, and multicore network cables should not be used.

Also note the importance of maintain a low electrical earth (ground) potential difference between ends of the installed cable present mixer and rack mains supplies, see note above regarding this.

It perfectly permissible for the cable to pulled or installed in the building prior to terminating with the correct plugs, whilst other building work is carried out. The plugs may then be fitted later when the site is ready, as is normal for such installation work.

Ferrite suppressors to suit the cable must be fitted (and captive) adjacent the rack and the mixer. These clamp suppressors may be fitted after the cable has been pulled and terminated on site.

Even for short link cables (less than 10m) the cable is still important, the correct cable with the suppressor clamps should still be fitted to ensure immunity from external interference. In order to avoid possible standing waves problems, the minimum cable length should be 2m.

Using ready-installed (or "structured") cabling

In general this should not be attempted.

As noted above, the Madi over Cat 5 does not use Ethernet. No attempt should be made for connection via Ethernet hubs, switches, repeaters etc.

Note, again, the system uses specific branded, high performance STP cable types, not the more common UTP as used in many structured wiring systems.

Connections
The use of good quality terminations cannot be overstated. A properly made crimp is a reliable and low loss connection. A bad connection will cause much trouble.

The use of EtherCON shells is obligatory for interference suppression.

It is obvious but worth noting again, that these RJ45 connections carry up to 56 channels of audio. A cable failure will affect this number of channels, not just 1. A poorly made cable may prevent the entire mixer system from functioning.

Extending cables
As noted, the absolute limit of connection is 100m. This cannot be extended in copper cable.

Note the Little Box interfaces are combiners and format converters and are NOT repeaters and cannot be used to extend the overall length. The total length of cable to either side of the box must remain within the 100m limit.

The Purple Box which converts the Cat5 signal to optical Madi, can be used to extend the connection distance considerably using optical cables.