

Category 7 Cable: Secure, High Definition AV Signal Delivery

Executive Summary

Category 7 cabling has been embraced in Europe as the basis for high speed premise cabling infrastructure. Its broadband performance, crosstalk attenuation, low radiated emissions and high noise immunity make it an attractive solution for high speed network applications. The same characteristics make Category 7 cable a good candidate for specialized non-network applications as well, including AV signal distribution. In fact, the well shielded, four pair construction makes it suitable for carrying high resolution analog and digital signals through operating environments unsuitable for unshielded Category 5/6 and other cables.

Category 7 infrastructure can be implemented on a facility wide basis to support high speed data networks together with AV signal delivery or it can be used independently and specifically for AV.

Industry experts are projecting that the performance capabilities of Category 7 infrastructure will support a useful lifespan of 15 years or an equivalent of three generations of network equipment. With such anticipated longevity and application flexibility, Category 7 infrastructure is an excellent value proposition.

What is Category 7?

“Category” cable and infrastructure designations are defined by the TIA (Telecommunications Industry Association) and, to date; a Category 7 specification has not been ratified by that organization. Category 7 is more properly known by its ISO designation which is Class F cabling, since this organization has fully developed specifications for it. Even though the TIA hasn’t yet recognized Category 7, the designation has been embraced and various connectors and infrastructure components are available and branded to support the “Category 7” environment.

Features of the cable:

As shown in figure 1, Category 7 or Class F cable has four individually foiled twisted pairs that are bundled together and surrounded by either an additional foil (F/FTP) or braided screen (S/FTP). The redundant screening or shielding provides more consistent transmission characteristics among each of the pairs. It also substantially reduces inter-pair and alien crosstalk. Inter-pair crosstalk is the tendency for signals carried by one pair to interfere with one or more of the other four pairs in the cable. Alien crosstalk describes the condition where interfering signals are coupled into a cable from another adjacent cable, a nearby power source, wireless communications device or electrical equipment. Unlike Category 5/6 cable, the individually shielded pairs don’t rely on varying twist rates to control crosstalk. Each pair is twisted at nearly an identical rate, rendering closely matched propagation speeds. This minimizes inter-pair skew.

Despite its differences in construction and specifications, Category 7 can support legacy Category 5/6 infrastructure. Cross connection patch cables and patch panels are available to adapt standard RJ-45 connections to the Category 7 environment.

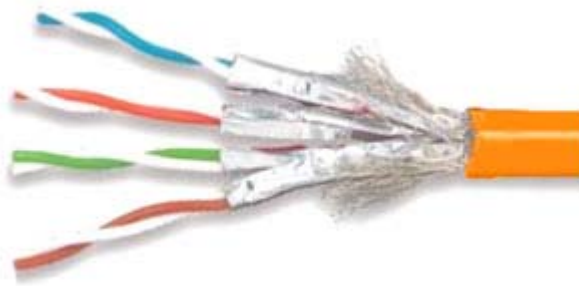


Figure 1

Applications:

The primary intended use for Category 7 cable is to support high speed data network infrastructure. Technically, the cable is available as Category 7 and 7_A (also class F and F_A). Category 7 is rated for a bandwidth of 600MHz while for 7_A, its 1000 MHz. Either version of cable supports 10GBASE-T. Most Category 7 cables are now certified to 7_A.

Even though the cable is primarily intended for data networks, its multi-pair construction, relatively low insertion loss and 100 Ohm impedance make it a good fit with audiovisual signal distribution applications. By using the appropriate equipment at either end of the cable, Category 7 can be used for the following AV signal types:

- RGB/HV
- RG₅B
- YUV
- HDMI
- DVI

Because of the four lane construction and available bandwidth, these signal formats can be carried without video compression — a requirement for high quality content presentation.

While large scale (facility wide) Category 7 infrastructure can support both high quality AV signal distribution and high speed network connectivity, it can also serve effectively and economically as a stand alone solution for AV. Point to point, point to multi point and full matrix switching can all be supported by Category 7 cable.

Advantages of Category 7 cable for AV:

IP delivery of audiovisual signals is steadily improving. For now however, it still falls short of being the best solution for applications demanding uncompressed, full motion, full resolution video. Base band signal delivery is the best solution when an application calls for:

- High quality, uncompressed video
- Many sources and displays
- High system level security
- Delivery of protected content

With equipment available from Magenta Research, Category 7 cable can support all of these application requirements. Magenta’s equipment portfolio includes the following components to support the Category 7 connectivity environment:

Signal Formats	Max Resolution	Product Series
HDMI / DVI (HDCP supported)	1080p/60 to 200ft	HD-1
DVI w/stereo & duplex EIA-232	1920 X 1200 to 600ft	Infinea DVI
VGA x/stereo & duplex EIA-232	1920 X 1200 to 500ft	AK 500 C7
DVI embeddable receiver w/ctrl	1080p/60 to 200ft	T Link

Combining Category 7 with these components results in robust signal management solutions that exceed the noise immunity realized with Category 5/6, especially for digital formats.

Analog solutions for Category 7:

Magenta Research offers the AK 500 C7 which is a 500ft Category 7 cable optimized AV receiver. It’s compatible with all of the other Multi View equipment, including transmitters, 9D (1 X 9 hub) and switches. Together with the AK 500 C7, all of the MultiView equipment can be used with Category 7 cable. The following primary signal formats can be supported:

- RGB/HV (VGA)
- YUV, SD & HD
- Composite Video (NTSC, PAL and SECAM)
- S-Video (Y/C)
- Additional or auxiliary signals are also supported and include:
- Mono audio or simplex serial (standard)
- Stereo audio with duplex serial
- Stereo audio with addressable duplex serial

The characteristics of Category 7 cable together with the MultiView equipment makes for a very rugged signal management solution. Like all MultiView solutions,

there is absolutely no compression, latency or reduction in frame rate. The resistance to external sources of electrical noise and much lower sensitivity to ground potential differences mean that very high quality AV signal distribution can now be used in application environments that may be unsuitable for Category 5/6 cables.

Following the MultiView paradigm, signals can be routed from point to point, point to multipoint and through a full matrix switch.

In point to multipoint and in switched applications, Category 5, 6 & 7 can be used in harmony. Taking this approach, MultiView's 500ft extension distance capability with Category 7 cable can be augmented by the standard Category 5/6 extension distance of 609m. It's also possible to outfit the back room environment within expensive, Category 5/6 cabling, reserving Category 7 for runs to the destination equipment.

Digital solutions for Category 7:

Magenta has multiple solutions for digital AV signal management and the best solution depends on the application.

HD-1 is a point to point solution that supports full HD with HDCP. HD-1 is a pixel for pixel accurate system and uses no compression. The system uses a single Category 7 cable and power is carried over the cable from the transmitter to the receiver, eliminating a power supply at the receiver location. HD-1 is also compatible with Category 5/6 cable, but the distance is improved by using the Category 7 spec cable. Most market-available HDMI over Category cable solutions are very sensitive to nearby cellular communications devices. HD-1 is better than most and by using Category 7; the immunity to cellular devices is substantially improved.

Infinea DVI is a unique daisy chainable copper cable & optical fibre digital AV solution. The system supports unprotected formats up to 1080p and 1920 X 1200. Either Category 5/6 or Category 7 cables are supported by Infinea. The system also permits the mixed use of copper and fibre as the distance requirements dictate. YCC colour space or bit-truncation compression techniques are used to constrain the bandwidth while preserving the best image quality. In addition to video, the system can also carry stereo audio and addressable duplex serial communication over a single Category cable. Infinea DVI carries true digital signals farther than any other Category cable based technology.

T Link is a new offering from Magenta. It's specifically designed to carry uncompressed digital HD signals over Category 7 cable on board public transportation equipment. The receiver is available as a module that's embedded directly into LCD's or other types of display panels. Performance is very similar to the HD-1 except that no provisions are provided for HDCP.

Whether analog or digital, Magenta's Category 7 compatible equipment is designed to support robust and secure AV distribution applications like these:

- High quality AV delivery via Category 7 infrastructure
- Outdoor applications
- Gas stations
- Theme parks
- Outdoor malls
- On board trains
- Buses
- Military vehicles
- Military operations
- Government operations
- Law enforcement
- High resolution security systems
- Industrial locations
- Command and control centres
- Shipboard A/V

Benefits & Conclusions:

Category 7 cable can be successfully implemented to support high resolution AV signal distribution in either the analog or digital format domain. This statement may beg the question: why can't all AV signals simply be handled by the data network in the IP domain? The answer is that not all applications can be adequately served by highly compressed, network grade video. And, even if network grade video is acceptable for certain applications, even a moderate density of AV signals will necessitate a network designed, built and managed to handle multicast traffic. For the present time, base band distribution and delivery of high resolution AV is still more practical and cost effective.

As a standalone solution, the cable can enable successful AV extension and distribution in electrically noisy environments. It can also provide the basis for AV extension in on board transportation, outdoor, industrial and commercial installations. It can help to assure proper functionality even in situations where there are discontinuous electrical grounding systems*. Heavy shielding improves the cables, and ultimately, the system's ability to operate properly despite alien crosstalk conditions. For digital video applications, this is especially helpful when the equipment may be in operation near cellular or other wireless communications equipment. The shielding provides inter-pair crosstalk isolation and the individual pairs are twisted at more uniform rates. More uniform twist rates equate to lower signal skew. With less skew, digital AV extension ranges are increased and analog extension equipment requires less skew compensation.

Looking beyond standalone implementation, Category 7 is a copper infrastructure solution with a lifespan expectancy of 15 years vs. 10 years for Category 6. This has a significant and positive impact on the investment value and ROI. For new installations where 10G performance is part of the system philosophy, Category 7 provides the bandwidth and flexibility needed. The infrastructure can support both LAN and high quality base band A/V signal delivery. As improved A/V over IP

solutions become available, Category 7 ample bandwidth provides a practical migration path for that approach as well.

*There are varying opinions about how cable shielding should be terminated, but there is only one correct method. Shielding must always be bonded to the chassis enclosure at both ends of the cable. The chassis enclosures must be bonded to the internal electronics as well as the local mains (or Edison) ground reference at either end. Assuring shield continuity through the cable, any cross-connection points and properly terminating it at both ends is important. Under these conditions, the shielded cable behaves like a 1:1 common mode transformer in which the shield forms a primary and signal conductors form a secondary "winding." Ground disturbances are then communicated as common mode signals. At the destination input port, the shield reference and input terminals receive the disturbance signal in the common mode and can be rejected by the receiving equipment's circuitry. Ground fault currents resulting from ground potential differences between the transmitter and receiver locations follow the shield and help to prevent destructive currents from flowing exclusively through the signal conductors.