Coax vs. Twisted Pair
Smaller. Lighter. Simpler. Cheaper. These attributes of CAT 5-type UTP cable, in relation to coaxial cable, are well known. The small, lightweight cable fits into smaller conduit than larger, stiffer coaxial cable and is easier to pull, lowering overall project costs and allowing it to be used in applications where space is an issue. Terminations are simpler and less expensive with CAT 5-type cable than with coaxial cable.
With the price of copper increasing dramatically over the past few years, low-cost twisted pair cable has made a difference in keeping many projects within budget. Especially when cable runs exceed 200 feet or more, the cost of twisted pair equipment and inexpensive CAT 5-type cable can be significantly less than an equivalent run of coaxial cable, for which an interface or peaking amplifier might also be required.

Extron engineers have developed a broad product line that capitalizes on the benefits offered by the physical characteristics of CAT 5-type cable. Through superior quality, advanced technology, and award-winning design, we offer system designers and integrators even more reasons to consider using twisted pair for A/V applications. Let’s explore some of those reasons.

**Comprehensive Product Selection**

Our broad range of options provides A/V designers the ability to “right size” the twisted pair products at all points in the signal path. In this regard, we offer the most comprehensive twisted pair product selection in the industry.

Our MTP Series alone includes hundreds of transmitters, receivers, switchers, matrix switchers, distribution amplifiers, cables, and accessories. For example, with the Extron MTP Series, a system designer can select the right low resolution or high resolution transmitter or receiver for a given signal type and place a skew equalizer only where needed.

Figure 1 represents a point-to-point system using Extron MTP Series transmitters and receivers. The simple system depicted is transmitting one computer video signal, one S-video signal, and one composite video signal. With our products, a designer has much broader freedom to specify precisely the right transmitter and receiver for each signal type. Because our low resolution transmitters and receivers have a lower price point, the cost savings, compared to using a competitor’s products, is dramatic.

Extron twisted pair products feature professional grade connectors and proper connectivity for the application, eliminating the need for additional cable adapters and increasing the savings.
Imagine the magnitude of the savings Extron’s comprehensive selection of products would provide in a larger, more complex twisted pair application.

**Integration-Friendly Features**

In addition to providing dramatic savings over both coaxial cable-based systems and the twisted pair offerings of our competitors, MTP Series twisted pair products are designed to help solve common A/V integration challenges. Extron engineers carefully consider how the design of each product will help integrators and installers with the efficient use of costly rack space, effective cable management, fast access to controls and adjustments, and ease of mounting. All rack-mountable transmitters, receivers, switches, matrix switchers, distribution amplifiers, and accessories in the MTP Series feature connectors that are all on the back panel. This eliminates the need to run cables over or under the rack shelf and through the rack, saving valuable rack space and making it easier to manage the cables. See Figure 2.

Front panel adjustments make it easy to dial in image quality from one location, without having to repeatedly move from the front of the rack to the back during set up. This can save a considerable amount of time and frustration, especially in applications where space near the rack is limited.

Extron twisted pair products are designed in a wide range of form factors to provide integrators and installers with flexibility and freedom when it comes to deciding where and how to mount them. Rack-mountable products are housed in metal enclosures that are rack, under-desk, and projector pole-mountable using any of dozens of specialized Extron mounting products.

Many transmitter models are also available in wall-mount versions, as well as Extron’s popular AAP and MAAP configurations. Some receiver models are small enough to mount behind a flat-panel display. Extron has the product and mounting solutions to help meet the architectural requirements of most any application.

**MTP U Series Universal Receivers**

Extron MTP U Series Universal Mini Twisted Pair Receivers accept a wide variety of video formats along with RS-232 or audio signals on a single UTP cable, providing dramatic cost savings with superior performance. With advanced features, including the ability to automatically route the incoming UTP signal to the appropriate video, audio, and RS-232 output connector, systems require only one receiver and one cable for each display.

**MTPX Plus Series Matrix Switchers**

For complex matrix switching applications, the MTPX Plus Series Twisted Pair Matrix Switchers are available in six I/O sizes from 8x16 to 32x32. Each model is compatible with Extron MTP Series transmitters and receivers. They are capable of routing video signals, along with audio or RS-232 control signals, on a single twisted pair cable. MTPX Plus Series matrix switchers offer an innovative feature set not available on any others.

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*Figure 2: Connectors on the back make for a cleaner look and save on rack space.*
Local video and audio inputs and outputs enable direct connection of equipment located within the same rack as the MTPX Plus Matrix Switcher, greatly simplifying system complexity by eliminating additional MTP transmitters and receivers.

MTPX Plus Series matrix switchers also feature dynamic skew equalization on all inputs and outputs. This industry-first innovation ensures that CAT 5-type cable skew is eliminated—no matter which combination of input/output cable lengths are selected.

Yet another innovative feature, local RS-232 insertion ports, allows a control system located near the MTPX Plus to connect to and control remote displays over the same CAT 5-type output cable that carries the A/V signal. Additional features include switchable pre-peaking on a number of the outputs to drive signals long distances, audio input gain and attenuation to balance audio levels, output volume control for the local outputs, and IP Link® Ethernet connectivity.

These powerful features found in MTPX Plus Series Switchers enable integrators to greatly reduce installation time and costs associated with rack space, cabling, and installation, when compared to traditional twisted pair matrix switching.

More Reasons to Consider Twisted Pair
Twisted pair systems eliminate the need for separate cables for audio and control signals, since those signals can be carried together with the video on a single cable.

It is worth noting that twisted pair A/V systems require a dedicated cable infrastructure that is completely separate from that used for data networking or voice applications. Although twisted pair A/V and data network systems may seem interchangeable by virtue of a common type of cabling, they must be considered separate, distinct, and incompatible. A/V signals are not formatted as packetized digital data for transmission over Ethernet, and therefore cannot coexist with data network signals within the same CAT 5-type cabling.

Conclusion
The bottom line is that twisted pair A/V systems offer cost-effective, long-distance transmission capability with performance and picture quality similar to coax systems.

Although CAT 5-type cable was designed for data networking, it is also a viable, cost-effective alternative to running analog video and audio signals over conventional coaxial cabling. There are plenty of reasons to consider using twisted pair for your next application and even more reasons to choose Extron twisted pair solutions.

Extron offers the most comprehensive twisted pair product line with over 100 products for every type of application. The Extron MTP Series comprises the most integration friendly twisted pair transmitters, receivers, DAs, switchers, and matrix switchers available, enabling A/V systems to be installed more easily and more economically than ever before.

We understand that time, quality, and profitability are crucial in any installation. Extron has the experience and manufacturing capability to provide the highest quality products you need, backed by our 100% Satisfaction Guarantee.
MTP 1500RL Twisted Pair Receivers
Long Distance Performance and Integration-Friendly Features

When a project calls for long distance distribution of high resolution video, twisted pair transmission is increasingly the logical solution, especially when audio and/or serial control signals are also needed. The new Extron MTP 1500RL Mini Twisted Pair Receivers enable integrators to precisely dial in the best image possible over extended cable distances. Advanced electronics and an integrator-friendly design make these four new receivers the ideal choice for any application that requires high resolution video signals to be sent as far as 1,500 feet.

The four new MTP 1500RL extended distance receivers work with all versions of Extron MTP Series transmitters for distribution of high resolution computer video, along with audio or RS-232 control signals 1,500 feet (450 meters) over a single CAT 5-type cable.

Why Just a Receiver?
When video signals are transmitted long distances on twisted pair cable, the signal degrades due to the physical properties of the cable. Resistance results in signal attenuation, which reduces the amplitude or brightness and the image appears to have been dimmed. Capacitance compromises low frequencies, affecting video transient response and resulting in a smearing effect on the image, as well as blurring fine details and reducing the sharpness of the image. The longer the cable run, the more signal degradation occurs. Pre-peaking the signal at the front end is very useful for minimizing signal degradation on the longest cable runs and all Extron high resolution MTP Series transmitters include pre-peaking circuitry.

The real work of signal restoration, however, is done by the twisted pair receiver. In fact, the quality and design of the receiver are the greatest determining factors in how far video signals can be transmitted over twisted pair cable. With advanced level and peaking compensation in the MTP 1500RL receivers, high resolution video signals can be fully restored to match the quality of the input signal, even at the longest distances.

Up to 1920x1200 Video Resolution
The receivers can handle WUXGA 1920x1200 resolution computer video and HD component video, including 1080p. They are also capable of supporting standard definition component video, S-video, and composite video.

Extended Distance Applications
Long cable runs are called for in a wide range of places, such as corporate and school campuses, shopping malls, airports, sports stadiums, concert halls, and houses of worship—especially those that simulcast a program across multiple buildings. These four new receivers give system designers even more reason to consider using twisted pair for such applications.

When selecting twisted pair products for a system with long cable runs, it is critical that the receivers can deliver what is promised. The technology and feature set in these new receivers ensure fully restored signal integrity, even for high resolution video over an extended distance, for the best image possible.

Multi-Stage Peaking Adjustment
As with all MTP Series receivers, these newest models offer separate continuously variable level and peaking controls, allowing integrators to dial in the exact amount of video signal adjustment required to precisely optimize image quality for each cable run and at every cable length.

For these new receivers, the peaking adjustment uses an advanced multi-stage peaking adjustment technology to compensate for long cable runs. With this advanced technology, there are no sweet spots in terms of distances at which the quality of the signal is best, and outside of which image quality suffers. There is no need to press a button or flip a switch.

Installers are able to use the smooth, continuously variable dial to make precise adjustments without pre-selecting the gain stage for a given distance.

continued on page 6
Four New MTP 1500RL Receivers

MTP 1500RL 15HD RS
Extended Distance Mini Twisted Pair Receiver for VGA and RS-232 with Loop-Through

MTP 1500RL 15HD RS SEQ
Extended Distance Mini Twisted Pair Receiver for VGA and RS-232 with Loop-Through and Skew Equalization

MTP 1500RL 15HD A
Extended Distance Mini Twisted Pair Receiver for VGA and Audio with Loop-Through

MTP 1500RL 15HD A SEQ
Extended Distance Mini Twisted Pair Receiver for VGA and Audio with Loop-Through and Skew Equalization

MTP 1500RL Twisted Pair Receivers — continued

continuously variable peaking adjustment simplifies the set up process and eliminates a lot of the guesswork.

Integrated Skew Equalization
Two of the four new MTP 1500RL receivers feature an integrated skew equalizer. Extron skew equalization technology ensures that the arrival of color signals is synchronized, improving image quality while maintaining full signal integrity.

Skew is the color misalignment present in twisted pair A/V systems using CAT 5-type cable. Each pair of wires in typical data-grade twisted pair cable has a different twist ratio, and therefore, each pair is a different length. This is very good for network applications, because it helps to eliminate crosstalk.

Buffered Output for Daisy-Chaining Displays
Each MTP 1500RL receiver features an additional buffered RJ-45 output, allowing the signal to be looped through to another receiver without affecting image quality. Designers can use this buffered output to daisy-chain up to eight displays on a single long distance cable run.

It is worth noting that the total recommended distance for an entire daisy chain is the same as for a single transmitter and receiver. The ability to daisy-chain displays together dramatically reduces overall cable requirements and simplifies installation for many projects, such as digital signage and kiosk applications.

Low Profile Enclosure
The slim 1” (2.5 cm) high, half-rack width metal enclosure offers versatile mounting options. The receivers can be discreetly installed out of sight, such as behind a flat-panel display. When rack-mounted, the MTP 1500RL receivers occupy minimal rack space and provide ample air space to help keep the equipment cool.

Integration-Friendly Design
As with all Extron products, the new MTP 1500RL receivers have been designed with the integrator’s needs in mind. Each receiver features front panel controls and connectors on the rear panel. This eliminates the need to wrap cables from the front of the rack through to the back makes adjustments easy without the need to move cables out of the way. Extron rack-mountable products slide in and out of the rack easily and allow integrators to deliver a clean-looking rack installation to the customer.

A Comprehensive Twisted Pair Family
Advanced technology, easy integration, and a robust feature set make the MTP 1500RL Mini Twisted Pair Receivers an obvious choice for applications with long cable runs. With the addition of these new long-distance receivers, the entire Extron MTP Series family offers integrators and system designers the most comprehensive twisted pair product line in the industry.
An Exciting Time of Growth - New East Coast Office

This is an exciting time of growth here at Extron. New offices are under construction and are being built worldwide. Here in North America, we are expanding our operations on the East Coast with the construction of a new 140,000 square foot building in Raleigh, NC. This new facility, near Extron’s current 12,400 square foot facility, will house a service and support center, an S3 Technical Institute training facility, a product distribution center, and a state-of-the-art research and development center.

This new facility will enhance our ability to provide our acclaimed S3 - Service, Support and Solutions for our Eastern time zone customers. Customers accustomed to traveling to California for our S3 Technical Institute will be able to travel shorter distances to attend specialized trainings, or certifications. Also, product delivery and repair turn-around will be quicker as the new product warehouse and our state-of-the-art repair facility are completed.

Over the past couple of years, Extron East operations grew beyond the capabilities of the current facility in Raleigh, and adding on to the existing structure wasn’t going to be enough. Plans were laid for a new, landmark Extron office that would accommodate our current needs and, with more than ten times the space of our current facility, provide for future growth as we continue to expand operations to better serve our East Coast customers.

Extron’s corporate headquarters in Anaheim, California will continue to be the base of operations for sales, marketing, research and development, and manufacturing. The new East Coast Office will grow over the next several years to supplement many of these activities as well. Other Extron office locations include The Netherlands, Singapore, Japan, China, and Dubai.

New Extron East building in Raleigh, North Carolina
New Office in Holland Opening This Summer

As Extron celebrates its 25th anniversary, our EMEA office responsible for Europe, Middle East, and Africa marks a significant milestone of its own: the opening of a new 27,870 square meter, or 300,000 square foot, three-story facility. The highly anticipated building, in a new industrial area designed by a well-known architect, provides us the opportunity for continued growth in the support of this market. At nearly nine times the size of our current European facility, the new building will enable Extron to continue to grow our presence and support capabilities in Europe.

Located in Vathorst, a modern industrial area of Amersfoort featuring a mix of private homes and corporate buildings, the office is a short distance from a commuter rail line and 50 km (31 miles) from the largest airport in the Netherlands. The location is ideal for employees and visitors alike, whether they are coming from across town for work, or from throughout Europe to attend an Extron Institute in the new training facility. In addition to increased training opportunities, the new office also enables us to expand our warehousing and shipping capabilities, as well as our sales support and marketing teams.

Growing to Serve You Better

Our new Amersfoort facility enlarges our warehousing capacity to approximately 9,290 square meters, ensuring ample supplies of products for timely distribution to EMEA customers. That area will also house Operations and the repair center.

The new and considerably larger 232 square meter training center will enables us to provide even more of the in-depth, classroom, and hands-on training you have come to expect. We have included the latest A/V signal processing and display equipment in a custom, comfortable environment designed with you in mind. In January, we also added a full-time training manager to grow and oversee the department.

Our expert sales and support teams are the primary sources of personal customer contact. Consequently, we are expanding both groups in order to keep pace with anticipated growth. Just as we have been deploying more teams to the field, we are also to grow the regionally dedicated sales and support teams at our Amersfoort headquarters, all with the goal of helping you meet the needs of your customers.

We began enhancing our marketing department earlier last year in order to offer increasing resources tailored to various language groups and regions. You may have already seen some of the earliest results.

Through a joint effort between the US and European offices, we published our first International Catalogs in German and French in the first quarter of 2008. The Spanish-language edition is in the works, and editions in additional languages are possible in the future. Meanwhile, we continue to produce regionally localized brochures and other collateral, as well as update our localized Web sites. That requires additional staff, from graphic artists, writers, and managers, to product experts to help provide you with regionally appropriate products and effective support materials.

Our long-term goal is to increase product marketing capacity in order to review the needs of the local market and tailor the development of new products according to those needs. All of our growth is designed to ensure that as we launch new products, you will have even more access to the specific marketing materials and dedicated support staff you need for your region.

No doubt, when we look back on 2008 a few years from now, the opening of our new European office will stand out as a significant milestone in our ability to provide EMEA customers the Service, Support, and Solutions that have been woven into the very fabric of our history for the past 25 years.
As I think about discussing transmission of DVI and HDMI signals over twisted pair cable, I had an unexpected forty-year flashback to a well-known Star Trek phenomenon… Scotty beams the Captain and his crew back and forth using the transporter; an intermittent system always providing nail-biting precision at the critical moment. Now that we have wrist-sized communicators, displays, and computers much like those used in that revered TV series, I suppose a real transporter is not that far-fetched. Considering current day network cabling infrastructures, is it not reasonable to assume that before we see it a reality, the transporter process must first be accomplished over CAT 5 cable? Based on what I see, I think that’s a rational assumption.

Transporting DVI and HDMI video/audio over unshielded twisted pair, UTP, and shielded twisted pair, STP, cable has certainly come into the fore. Since the heyday of sending RGB analog video long distance over CAT 5 UTP cable, it seems only fitting that DVI and HDMI are next. Accomplishing such a feat seems almost magical considering the ongoing challenge of simply buying a good quality dedicated DVI or HDMI cable. DVI transmission over UTP is something of a recent marvel. A fundamental understanding of its challenges and guidelines are necessary in order to take full advantage of long distance extender systems, while avoiding transmission failure. So, let’s take a look at how this is accomplished and the relative performance differences offered by the three leading Category cable styles.

Why the Difference in Cables?

I think that answering a fundamental cable question is a good place to start. Why is a DVI or HDMI cable only a few meters long, but Extron can send those signals many meters over UTP or STP cable? You might be thinking: “I thought digital signals required some kind of special handling.” Further, you might think: “Should I buy the longest regular DVI or HDMI cable I can get, or use an extender system with UTP cable?” The decision process can be perplexing.

Let’s start with the basic off-the-shelf DVI or HDMI dedicated cable. The original DVI and HDMI cables satisfied a limited-distance interface. For DVI, the interface is the computer graphic card to the monitor. For HDMI, the interface is from, say, a DVD player to a home TV display. In each case, no more than about six feet is necessary and certainly no more than three times that distance for all typical uses. Within this realm, cable construction employs wire gauges smaller than the 24-gauge wire in the typical UTP cable. Twisted pair wire size in those dedicated cables ranges from about 28 gauge to 32 gauge. This step-down in wire size yields substantial additional cable loss and is manageable only for short distances. Why use it? Small wire size makes for small diameter, flexible, easy-to-handle cables. For HDMI, it is a cable not likely to fall out of the basic friction-dependent receptacle.

Some DVI and HDMI cables support distances to 75 feet, or so. If you inspect one of these cables, you will find the physical diameter significantly larger. These longer designs often use 22 gauge wire and lower-loss dielectric construction. Larger wire size translates to larger diameter and stiffer, heavier cable. With proper active equalization circuits, often referred to as cable drivers or equalizers, extension to 200 feet is possible. An example of such a cable driver is the Extron HDMI 101 in the VersaTools product group.

Something else bears mentioning while on this topic. DVI cables historically extended only about 5 meters. Release of the HDMI specification ushered in the notion of 75-foot transmission distances as if the standard or the electrical interface somehow improved. Nothing changed. Both specifications include the same electrical requirements for signal transmission. Why is 75 feet promoted in HDMI? After much complaining about short DVI cable distance capability, cable manufacturing improved to the point that this distance is possible under the same specification.
The critical elements within the DVI/HDMI cable design are the four shielded twisted pairs transporting the clock signal and the three video/audio data signals. There are three primary design parameters of concern: 1) Transmission line attenuation, 2) data timing skew, and 3) twisted pair crosstalk. Crosstalk is virtually nonexistent since the cable pairs are shielded. This leaves us with attenuation and skew. Larger wires and foamed dielectrics have less attenuation per unit length. Careful construction of pairs with the same twist rate and position controls skew.

A Skewed Notion
In contrast with DVI/HDMI cable history, the notion of transporting DVI and HDMI over low-cost category cabling may seem technically troubling, but it is possible. Successfully sending DVI and HDMI signals over category 5e, 6, or 7 cable is possible with special cable drivers for two reasons: 1) Those cable driver/receiver circuits are designed for 100 meters distance; and, 2) Wire gauge for UTP starts at 26 AWG, with most being 24 gauge, and the better cables as large as 22 gauge. UTP, unshielded twisted pair, cable works with network systems because it employs differentially driven wire pairs along with varied twist rates that minimize data crosstalk.

Integrated circuit manufacturers invest heavily into IC designs capable of the varied demands of network cabling and its growing transmission speeds. UTP cable requires varied twist rates for pairs within a cable assembly so as to minimize crosstalk; however, this creates timing skew. ICs driving DVI/HDMI TMDS data over UTP cable must compensate for the timing differences between pairs as well as attenuation variation. Migration of transmission speeds for networks has necessitated flexibility in cable transmitter/receiver IC combinations. The A/V industry is able to take advantage of this technology to exploit DVI and HDMI over inexpensive twisted pair cable.

Challenging Cable Specs
Using available network cable driver technology, 24 gauge UTP cable can transport DVI and HDMI over modest distances of about 100 to 150 feet. Why not farther? It’s not that cable drivers cannot overcome the attenuation of longer cables, but that crosstalk between pairs impedes the receiver’s ability to recover data. Even with the best 23 gauge UTP cable, crosstalk effects ultimately take over. In addition, most receiver blocks available with built-in equalization are limited to about +40 dB, a gain of 100. As receiver gain increases, crosstalk effects magnify.

Figure 1 shows how attenuation and crosstalk interplay. With increasing cable length, crosstalk rises. As attenuation and crosstalk approach intersection, receiver circuitry can no longer recover clock or data due to crosstalk interference; thus, data recovery becomes increasingly difficult and eventually fails. As the margin narrows to less than 10 dB, transmission failure becomes eminent. The absolute minimum margin we have found for reliable operation is 5 dB. This minimum figure is highly dependent on receiver IC design and, in particular, its equalizer.

Ok, so you might suggest using STP cable, since it significantly reduces crosstalk effects. That helps; but are you ready for a surprise? The cable is only part of the problem. A significant contributor to the crosstalk issue is the RJ-45 connector. Parasitic capacitance between connector pins provides significant cross-coupling that exacerbates the problem.

So, fundamentally, we see that the parameters controlling UTP transmission distance are the cable attenuation and collective crosstalk. Receiver system gain attempts to overcome cable attenuation while it’s equalizer adjusts to counteract the slope of cable attenuation over various frequencies.

The Great Equalizer
Cable equalization is a very important function in all digital transmission systems. The concept is identical to that which we nobly pursued in the analog domain; that is, to actively control receiver gain at high frequencies in order to compensate for cable loss. The perfect equalizer system creates a “mirror image” of the cable attenuation curve to enhance the receiver’s gain characteristic. In digital transmission, this is important since the receiver attempts to “level” the signal amplitude so that the data bit edge detector, or slicer, can do its job. See Figure 2.

Cable equalizers have a finite range of compensation capability and are tailored for the typical cable type to be used. The serial digital interface, SDI, equalizer is usually designed for specific
TECHNICALLY SPEAKING...

Figure 3: The role of gain, equalization, and data slicing in digital data receivers.

Figure 4: Comparison of attenuation and crosstalk performance between CAT 5e, 6, and 7 type network cables. Data is normalized to 100 feet of cable.

types of low-loss coaxial cable. For DVI and HDMI, equalizer designs center on twisted pair cable, whether it may be a dedicated cable or generic Category-style UTP/STP cable. The compensation gain curve, or transfer function, attempts to fit most applications although it usually is not perfect due to all the cable variations.

Why all the fuss with leveling the received signal? You have probably seen digital signal evaluation in the form of “eye patterns” both in my articles and in those of others. The purpose in all this processing is to present the data signal to some form of detection and recovery circuitry for data reconstruction. One common form of reconstruction is the “data slicer”. Data slicers are basically comparator circuits that “look” for edge transitions in the digital data stream by centering the signal on an average DC level, then triggering a threshold comparator to change state as positive-going and negative-going data transitions come along. When the signal level is not equalized, the average DC value drifts around the data slicer set point and this movement is translated at the output as increased signal jitter. Too much jitter corrupts clock and data recovery. See figure 3.

STP to the Rescue

For a modest cost increase, shielded twisted pair, or STP, cable greatly extends transmission capability. Even with construction enhancements in Category 6 UTP cabling extending network performance to gigabit bandwidth, the effects of crosstalk eventually overtake any performance gains. Shielding and grounding the pairs significantly reduces near-end and far-end crosstalk. Crosstalk elimination extends receiver gain and equalizer performance to their full limit. STP is mandated for Category 7, ISO Class F and FA. STP cabling supports 600 MHz and 1000 MHz signaling, thus extending performance from one gigabit to 10 gigabits over a 100 meter link. Refer to the CAT 5e, 6, and 7 sidebar for more information on basic Category 7, or Class F.

How does STP compare on attenuation and crosstalk to UTP? This question brings us to Figure 4. Figure 4 combines attenuation and crosstalk values for category 5e, 6, and 7 cables. First, consider the large margin of crosstalk between the CAT 7 crosstalk curve and both the CAT 5e and 6 crosstalk curves. The difference is on the order of about 30 dB. It is obvious that shielding will help us extend transmission distance substantially. Also note the large difference in frequency range. The CAT 5e curve stops at 100 MHz at the TIA network standard limit for that class of service. CAT 6 service extends to 250 MHz. Of course, these cables do not stop performing at higher frequencies. It is necessary to extrapolate their performance, or measure it, to determine how they work in the application. We see an improved crosstalk margin for CAT 6.
Lower crosstalk curves indicate better performance on the graph of Figure 4. 
CAT 7 service extends to 600 MHz in this data example. Even at 600 MHz, the 
attenuation to crosstalk margin for CAT 7 is about 20 dB.

More lessons from Figure 4
I have normalized the data used to create this graph to represent a 100 foot cable. 
Why? Extending DVI or HDMI over CAT 5e cable is effective to about 100 feet; 
perhaps a bit longer with CAT 6 cable. 
With 22 AWG CAT 7 cable, DVI or HDMI 1.2 may function to the full 100 meters. 
Since the CAT 5e standard stopped at 100 MHz and the nominal distance is 
100 feet for extending DVI/HDMI, this length provides a reasonable point of comparison.

Recall that the maximum TMDS data-signaling rate for DVI and HDMI is 
1.65 Gbps prior to HDMI version 1.3. However, the maximum channel clock 
frequency is 165 MHz. Transmission at 1.65 Gbps means that we need be 
concerned about the fundamental at one-half the data rate, or 825 MHz. 
This makes transmission more complex because the video/audio signaling bit 
rates are ten times the clock rate. Although the clock frequency does not carry video 
information, I’m referencing it in this discussion to provide simplified insight 
into the basic challenge that long UTP and STP network-style cabling present. 
The actual attenuation and crosstalk performance is governed by the actual 
loss effects at one-half the video data symbol rate: 825 MHz for standard DVI/ 
HDMI and 1.7 Gbps for HDMI Category 2 performance. These frequencies are well 
beyond the standard data specifications for network cable. Therefore, transporting 
DVI and HDMI over long twisted pair cables requires some “command of the art” – so to speak.

Figure 4 shows that for the 165 MHz 
clock, the CAT 5e cable will have 
attenuation and crosstalk approaching 
intersection with a very small margin. The 
825 MHz associated with the bit rate is 
way beyond the usable range based on the 
attenuation and crosstalk curves. 
Certainly, the clock signal just falls inside 
the usable range. What gives? How does it work at all?

By the time video/audio data completes 
the journey through 100 feet or more, 
the UTP cable’s low-pass filtering effect 
reduces the data symbols to mere 
sine waves. The eye pattern will no 
longer be recognizable to us, but will be 
decipherable to a good receiver equalizer 
and detection recovery system. This is 
where the receiver’s gain and equalization 
range becomes important. Physics 
works in our favor since the rise and fall 
time on the data signal diminishes, so 
does a proportionate level of crosstalk. 
Remember that we need at least a 5-dB margin. With careful receiver design and 
board layout, 100 feet is just attainable for 
DVI and HDMI. CAT 6 cabling provides 
us additional margin due to its 250 MHz 
specification or more distance with the 
same margin. At 165 MHz in Figure 
4, CAT 6 margin is about twice that of 
CAT 5e cable.

The CAT 7 STP cable exhibits very ample 
margin at 165 MHz. In fact, considering 
HDMI 1.3, an HDMI category 2 cable 
design supporting the 340 MHz clock and 
3.4 Gbps data channel still has almost 30 
dB margin at 100 feet. In addition, we can 
extrapolate past the 600 MHz limit in the 
chart to realize that CAT 7 has possibilities 
for us with the one-half signaling rate, or 
1.7 Gbps. Now, crosstalk is no longer 
the main issue, but attenuation and available 
receiver gain become the limiting factors.

Consider for a moment the slope 
of the CAT 7 attenuation curve in 
figure 4. Since attenuation is linear with 
unit length increase, we realize that at 
about 340 MHz, the cable loss is nearly
-40 dB. This is typically the maximum receiver gain figure available in most implementations. For regular DVI and HDMI implementations, distances to 100 meters are possible. Our current experience shows we can transport DVI or HDMI on 26 AWG CAT 7 STP to about 200 feet. With 22 AWG STP cable, we have transported DVI and HDMI a full 100 meters, or 328 feet.

**Oh, Yes, the Connectors**

Just as connection systems play an important role in network systems bandwidth, they are no less important for transporting DVI and HDMI data. From the previous review on signaling rates for these video interfaces, it is obvious that the selection of RJ-45 modular connectors will impact electrical losses.

I mentioned earlier that the regular RJ-45 connector impinges additional crosstalk between data pairs by virtue of its construction. Figure 5 illustrates the relative difference in allowable crosstalk within CAT 5e and CAT 6 hardware connections systems. Lower dB values are better. The CAT 6 connector is about 20 dB better at frequencies above 4 MHz. Crosstalk performance for new CAT 7 style connection systems can only be better.

**Re-skinnig the CAT**

This brings us to a new connector system recently adopted for Category 7, or ISO Class F, service. The Siemon Company offers the TERA™ connector to support 600 MHz and above. See Figure 6. The TERA connection system provides significant isolation between data pairs with radically different construction. Crosstalk budget greatly exceeds that of Category 6, or Class E, service. The TERA connector will support us on into 10 gigabit Ethernet.

The TERA connection system along with 22 AWG shielded twisted pair cable supports Category 1 DVI and HDMI data rates up to 100 meters with significant headroom. I’ll have to report back to you at a future date on its capabilities to deliver HDMI Category 2 data rates. However, if you find yourself in a situation where you need some additional distance with existing extender systems, using CAT 7 style STP cable will reduce crosstalk significantly and perhaps provide the distance boost you need. Try substituting it for only the primary video/audio data cable between transmitter and receiver.

**CAT With at Least 9 Lives**

Yes, it really is the year of the “CAT”. During my research, I uncovered discussions on Category 8 proposals, which solidly identify 1.2 GHz as the next step in network data rates over twisted pair cable. How about CAT 9? Does this CAT have more than nine lives? This technological progression reminds me of the venerable CRT and the small technical innovations that edged it forward in the face of a growing flat panel display market; like a surfer’s toes inching toward the front of his board, just before the big wave breaks over him and he disappears.

Perhaps just due to simplicity, copper wires will be with us for some time to come. Already, we find ourselves pondering the relative cost and advantage of replacing copper with fiber cable. That nagging point of consternation will likely always be with us for one reason or another. With improvements in digital data interfaces, the crossover point between copper and fiber constantly changes.

**Wait. I’m having another flashback...**

**Captain Kirk:** “Scotty, we need that transporter running now.”

**Scotty:** “Sorry Kaptun, the main energy feed fiber, she’s melted! Ah don’t think I can fix ‘er.”

**Captain Kirk:** “Scotty, remember back in 2015 when they tested the first prototype transporter in the Federation Lab? They paralleled ten of those old CAT 5 cables for the main feed and routed them in water to keep them cool.”

**Scotty:** “Aye, Kaptun, Ah can borrow the cables from yur 10.1 surround system in yur cabin ‘n make ‘er work.”

**Captain Kirk:** “Good, Scotty. Just make sure both ends are wired for TIA-568A convention, I don’t want my arms and legs reversed! Kirk out.”

---

*Figure 6: The new Siemon TERA™ connector for Category 7, Class F, service.*
**CAT 5, 6, 7 Primer**

- **Category definition:** The term “category” describes a performance level for cabling and connection components within the Telecommunications Industry Association, TIA, structured cabling standards for network communications. The channel data rate is also described as a category level. Though the International Standards Organization, ISO, describes components as a “category”, like TIA, it describes the data rate performance utilizing a performance “class”. Frequency bandwidth determines the TIA and ISO equivalent performance grades.

- **Categories & capabilities:** The table below lists TIA and ISO equivalent classifications.

<table>
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<tr>
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<th>TIA Component</th>
<th>TIA Data Channel</th>
<th>ISO Component</th>
<th>ISO Data Channel</th>
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<td>Category 5e</td>
<td>Category 5e</td>
<td>Class D</td>
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<tr>
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<td>Category 6</td>
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<td>Class F</td>
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<tr>
<td>1 – 1000 MHz</td>
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<td>pending</td>
<td>Category 7A</td>
<td>Class FA</td>
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</table>

- **Category 5e (Class D) snapshot:** published in 2000, this standard increased performance headroom over Category 5 limits and included criteria for support of Gigabit Ethernet in a bi-directional, full four-pair transmission scheme. CAT 5e is the 100baseT with extended capabilities and is supported by ANSI/TIA/EIA-568-B.2 and ISO/IEC 11801, 2nd edition.

- **Category 6 (Class E) snapshot:** published in 2002, it is primarily supports 100baseT and 1000baseT (Gigabit Ethernet) applications. Improved transmission parameters and frequency bandwidth allow demonstration of limited applicability for 10GBaseT applications. Category 6 details are available in ANSI/TIA/EIA-568-B.2-1 and ISO/IEC 11801, 2nd edition.

- **Category 6A (Class EA) snapshot:** initially designed to support 10GBaseT over 100 meters and four connectors, this category provides positive performance to 500 MHz over four twisted pairs. Category 6A details are available in ANSI/TIA/EIA-568-B.2-10 and Amendment 1 to ISO/IEC 11801, 2nd edition.

- **Class F snapshot:** first published in 2002, this class is the first to describe a fully shielded twisted pair cable, STP. Unofficially called “Category 7”, this standard provides positive performance to 600 MHz and greatly improved electromagnetic capability over four shielded pairs. This class provides support for 10GBaseT service and beyond. Class F utilizes a non-RJ style connector system that is specified in IEC 61076-3-104:2002.

- **Class FA snapshot:** now in development, this class extends frequency bandwidth from 600 MHz on up to 1000 MHz. Class FA should support broadband video, such as CATV, operating up to 862 MHz. This is also a fully shielded cable solution.

- **Impact on DVI & HDMI:** DVI and HDMI signals have no direct relationship with Category style cabling systems. Technological development of data networks capitalized on the relatively low cost of twisted pair cable construction. In recent years, both analog and digital signals of various formats have utilized existing UTP and STP cabling infrastructures because of their cost-effectiveness. This has made RGB video and analog/digital audio transmission possible via special interface circuits that compensate for the unique electrical characteristics of UTP and STP cabling. In this way, new digital media interfaces can take advantage of the economies offered by network data cabling. Data networks are not compatible with DVI, HDMI, or analog video/audio transmission via twisted pair cabling.


TERA™ is the property of the Siemon Company
The Need For a Notification Alternative
Classrooms and lecture halls often have few options available to teachers for immediately notifying administration and local or campus authorities. A fire alarm system is usually available in each room in the event of a fire. But what about other urgent situations? Solutions that depend on telephones, cell phones, and dedicated paging or intercom systems might be used, but those are not always accessible and may be expensive to implement.

What if you could easily configure an instant alert notification system using components you were already planning to install, or have already installed in the classroom? Fortunately, Extron technology provides just such a solution. A special instant alert button can be installed at the instructor’s desk or lectern and used to immediately notify school administration officials and local or campus authorities via e-mail. For fast action, e-mails can be sent to multiple addresses, including cell phones and wireless PDAs.

What it Takes to Make it Happen
To put this alert notification system together, all you need is a simple pushbutton and an IP Link-enabled Extron MediaLink® Controller or System 5 IP A/V Switcher. Several other Extron products will also work, as long as they are equipped with IP Link technology and feature at least one contact closure input or Flex I/O port. Here’s a complete list of the Extron products that will support this solution:

- MLC 104 IP MediaLink Controllers
- MLC 226 IP MediaLink Controllers
- PoleVault® Systems
- VoiceLift™ Sound Field Systems
- System 5 IP A/V Switchers
- IPL T CR48
- IPL T PC1 and IPL T PC1i
- IPL T SF24
- IPL T SFI244

Most of the Extron products listed above feature at least one contact closure input. The IPL T SF24 and IPL T SFI244 Ethernet Control Interfaces each feature four Flex I/O ports that can be configured in one of three ways: analog input, digital input, or digital output. Configured as digital inputs, the Flex I/O ports can connect to switches, motion sensors, and moisture sensors, and tally feedback. For an emergency alert notification application, you will need to configure at least one of the Flex I/O ports as a digital input.

Making the Connections
You will need a contact closure button or switch that can be mounted under the teacher’s desk or in some other inconspicuous location. That is, it should be out of the way for everyone but the teacher. The idea is that the button or switch should be activated only in the event of a real problem.

For the example in this article, we have selected an Extron CCR 2BLB Two-Button Contact Closure Remote as the pushbutton. Only one of the buttons is necessary to activate the alert notification process, but you could configure the other button for sending out a cancellation or “all clear” notice or in the event of an accidental or unauthorized activation. In this article, we’ll cover the single button configuration. The CCR 2BLB can be mounted directly to a table, desk, or lectern using the AAP 100 Mounting Frame.

Use a two-conductor cable with spliced ends to connect the button or switch to one of the digital inputs on the IP Link-enabled controller in the room. On the controller side, one conductor connects to Digital I/O #1 on the MLC 104 IP Plus and the other to ground. The CCR 2BLB features backlit buttons, but since this application calls for it to be discreetly hidden away, there is no need to enable that feature.
Configuring the Instant Alert Notification Button

The next step is to configure the MediaLink controller to monitor the state of the contact closure input and to send an e-mail when it is activated. For this example, we will configure an MLC 104 IP Plus using the free Global Configurator software that is included with IP Link-equipped products. The steps will be nearly identical for any of the other compatible Extron products listed earlier.

This example assumes that the MLC 104 IP Plus has already been added to the network and that a configuration project exists that contains the controller.

Run Global Configurator and open your project file that includes the MLC 104 IP Plus. Under the IP Link tab, select the MLC 104 IP Plus. See Figure 1.

Before setting up a Monitor condition for the Digital I/O port, you will need to configure the e-mail that will be sent when it is activated. On the main toolbar, click Edit->Contact Manager. Add the contacts who will receive the alert notification e-mail to the Contact Manager. Type in the Contact Information for each intended recipient and click Add to add each one to the list. When you have added all the contacts, click OK to exit. See Figure 2.

Now, create the e-mail message that will be sent when the button is pressed. On the main toolbar, click Edit->E-mail Manager. Create a name for emergency alert e-mail and fill in the subject line. Write the text of the e-mail in the Body field. When finished, click Add to add the new e-mail to the configuration file. Click Done to close the E-mail Manager window. See Figure 3.

To configure the Digital Input port, select the Advanced tab. In the Digital Input/Output area, click the down arrow next to Digital I/O #1 to open the drop-down list. Select “Input” if you used an active pushbutton or “Input with Pull-up” if you used a passive push button. The Extron CCR 2BLB is a passive push button, so we’ve selected “Input with Pull-up” for this example. See Figure 4.

![Figure 1: Global Configurator Project File](image1)

![Figure 2: Contact Manager](image2)
The last step is to create a monitor for the specific input to which the button is connected. Select the Monitor tab and click on Add Monitor. Click on Condition and select the Digital Input and “Digital I/O Port is Closed.” Click on Apply Condition. Click E-mail and select the emergency alert e-mail you created earlier. Highlight the intended recipients from the list of contacts and click Apply E-mail/Contacts to complete the Monitor. Click Done to return to the main Global Configurator window. See Figure 5.

While there are certainly limitations to this type of notification system, this quick and easy solution provides an teacher with one more way to signal for help when needed. With a press of a button, an e-mail is sent out to school administration, security, and campus or local authorities. Naturally, successful implementation depends heavily on the school's commitment to diligently monitor e-mail destinations to ensure the fastest possible response. Now, classrooms and lecture halls with select IP Link-equipped products can provide fast access to an instant alert notification system directly from the teacher's workstation.
Taking Resource Management to the Next Level:
GlobalViewer® Enterprise

In this day and age of AV-enabled classrooms, conference rooms, and meeting spaces, it becomes more challenging for the AV/IT support group to do their job effectively. Responding to the ever-increasing end-user demand for systems that “just work,” while maintaining a high level of uptime, is a balancing act that is critical to the daily operations of most educational or corporate customers that have more than a handful of rooms to manage. Single-site facilities, with anywhere from a dozen to a hundred A/V rooms to manage, can handle day-to-day operations with a basic management tool like our free GlobalViewer Web application. Multiplying that number by ten-fold or more, however, creates the need for a more robust A/V system management solution. It is becoming commonplace for organizations to standardize on an in-room control solution based on the IP Link® technology that spans not only buildings, but cities, states, and countries.

This year, at InfoComm 2008, Extron introduces GlobalViewer Enterprise, a new highly scalable software application, which will simplify servicing and supporting any size installed base of IP Link-controlled rooms. Most readers of this column are already familiar with how easy it is to configure your system using Global Configurator 2 and how it custom generates a GlobalViewer Web-based management solution allowing remote diagnostics and maintenance. Building upon this philosophy of configuration-based solutions, GlobalViewer Enterprise is an advanced server-based management solution designed to allow a quick and easy import of the system configured with Global Configurator 2. That’s right, no programming knowledge is required! GlobalViewer Enterprise is a more sophisticated product than GlobalViewer, but just as simple to learn and use.

You might ask, “Isn’t this just Extron’s free GlobalViewer running on a PC server?” Far from it! GlobalViewer Enterprise was designed from the ground up for multi-tiered, multi-user, resource management. This browser-independent solution is fully customizable and has a very easy-to-learn user interface that will be familiar to existing users of GlobalViewer. In fact, GlobalViewer Enterprise was designed as a simple direct upgrade path for existing GlobalViewer customers when their needs require it. Those of you who “roll” on the IT side of the business will enjoy the seamless integration with Microsoft® Outlook® via Microsoft Exchange Server, or one of the other popular facility scheduling applications, such as CollegeNET’s Resource 25 or Banner software from SunGard, for viewing room availability and managing meeting schedules.

GlobalViewer Enterprise includes a SQL-based data repository for logging device and room data. Data is gathered 24/7 and time-stamped for use in preparing valuable management reports. The software includes a comprehensive collection of customizable reports covering network connections, device usage, and A/V equipment inventory. Reports can be used to maintain inventory lists, track and analyze device and room usage, calculate ROI, and proactively plan maintenance activities to reduce system downtime.

Reports can be exported in PDF or Microsoft Excel format for printing and analysis.

Additionally, support for SSL and unlimited regional and partial access permissions give you the flexibility to manage who has visibility and is responsible for the data the system collects. Additional features, including Webcam support, comprehensive global monitoring and scheduling, and firmware management, make easy work of supporting your users in real time, managing your equipment proactively, and responding to “Event Alert List” room events that you deem are critical to function. All of this, plus minimal network load impact, makes GlobalViewer Enterprise the logical upgrade path when integrating with the rest of your IT infrastructure.

As your deployed base of IP-enabled room control solutions grows, having the ability to proactively service, support, and justify new build-out projects, or product expenditure based on real usage statistics makes GlobalViewer Enterprise your most valuable tool for A/V system asset management.
**Location Tree**
Rooms can be organized for easy drill down to detailed room data and remote room control Web pages.

**Help Desk View**
Offers a view of the entire enterprise in a single window and access to detailed room data with just a click of a mouse.

**Room Calendar**
Integration with 3rd-party scheduling applications enable real-time access to room schedules.

**Event Alert List**
Dynamic view of user-defined critical room events.

**WebCam Support**
Enables real-time view of the classroom for troubleshooting and security purposes. Requires an IP-enabled camera.
**NEW PRODUCTS**

**MTP 1500RL 15HD A**
Extended Distance Mini Twisted Pair Receiver for VGA and Audio

The **MTP 1500RL 15HD A** and **MTP 1500RL 15HD A SEQ** are extended distance mini twisted pair receivers that work with MTP Series transmitters to send high resolution video and audio signals 1,500 feet (450 meters) or more over a single CAT 5-type cable. The SEQ model features independent skew compensation adjustments for each color. The extended distance receivers are compatible with resolutions up to 1920x1200, and feature separate continuously variable level and peaking adjustments that precisely optimize image quality for various cable lengths. Each receiver also offers an additional female RJ-45 buffered output, enabling up to eight receivers to be connected in series, reducing the number of parallel cable runs required. The receivers are housed in low profile, rack-mountable metal enclosures that can be discreetly mounted in racks or behind wall-mounted displays.

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<th>Model</th>
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<td>MTP 1500RL 15HD A SEQ</td>
<td>Receiver w/Skew Equalizer</td>
<td>60-959-02</td>
<td>$1,790</td>
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</tbody>
</table>

**MTP 1500RL 15HD RS**
Extended Distance Mini Twisted Pair Receiver for VGA and RS-232

The **MTP 1500RL 15HD RS** and **MTP 1500RL 15HD RS SEQ** are extended distance mini twisted pair receivers that work with MTP Series transmitters to send high resolution video and RS-232 signals 1,500 feet (450 meters) or more over a single CAT 5-type cable. The SEQ model features independent skew compensation for each color. The extended distance receivers are compatible with resolutions up to 1920x1200, and feature separate continuously variable level and peaking adjustments that precisely optimize image quality for various cable lengths. Each receiver also offers an additional female RJ-45 buffered output, enabling up to eight receivers to be connected in series, reducing the number of parallel cable runs required. The receivers are housed in low profile, rack-mountable metal enclosures that can be discreetly mounted in racks or behind wall-mounted displays.

<table>
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<tr>
<th>Model</th>
<th>Version Description</th>
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<td>Receiver w/Skew Equalizer</td>
<td>60-960-02</td>
<td>$1,790</td>
</tr>
</tbody>
</table>

**MTP SW6**
Six Input MTP - Mini Twisted Pair Switcher

The Extron **MTP SW6** is a six input, one output UTP switcher designed for applications that require up to six MTP transmitters to be switched to a single MTP receiver. It is compatible with all Extron MTP Series Mini Twisted Pair products, enabling a complete twisted pair solution from source to display. When paired with the Extron MTP Universal Receiver, the MTP SW6 is ideal for applications where a variety of signal formats, including composite, S-video, component, HD component, or RGB, must be switched to a single display. Several features of the MTP SW6 enable easy integration, including video level and peaking compensation, dynamic skew equalization, and a local RS-232 insertion port to extend serial control over long distances, eliminating the need for a separate control cable infrastructure.

<table>
<thead>
<tr>
<th>Model</th>
<th>Version Description</th>
<th>Part Number</th>
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<td>MTP SW6</td>
<td>Six Input</td>
<td>60-928-01</td>
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SW USB
Two and Four Input USB Switchers

The Extron SW2 USB and SW4 USB are two- and four- input USB switchers that allow switching between multiple host devices and multiple USB peripherals. Integration-oriented features include: port status indication, RS-232 pass-through, front panel security lockout, and multiple control points. The SW4 USB Plus offers added capability with Emulation Mode, which ensures continuous communications between hosts and peripherals for increased reliability in KVM applications. The SW USB Series is ideal for applications such as KVM, interactive whiteboard, annotator based applications in education, judicial, or corporate settings, or wherever reliable, multi-I/O USB switching is needed.

<table>
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<td>SW4 USB Plus</td>
<td>Four Input USB with Emulation</td>
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</tr>
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</table>

CrossPoint Ultra
Ultra-Wideband Matrix Switchers with ADSP™ for RGB and Stereo Audio

CrossPoint Ultra is designed to deliver exceptional performance in the most demanding, very high resolution computer-video and stereo audio routing systems. CrossPoint Ultra sets a new standard for engineering excellence in all critical measures of matrix switcher performance, including bandwidth, frequency response, efficiency, reliability, power consumption, and control. CrossPoint Ultra is available in six I/O sizes from 8x4 to 16x16 and is ideal for complex A/V routing applications that require efficient, reliable operation at the highest computer-video resolutions without signal loss or degradation.

- **Ultra-wideband performance:**
  8x4, 8x8, 12x4, and 12x8: 525MHz (-3dB), fully loaded
  8x16, 12x12, 16x8, and 16x16: 600MHz (-3dB), fully loaded
- **Ultra-flat frequency response:** ±0.5 dB from 0 to 130 MHz or better
- **Ultra-low crosstalk:** -56 dB or better @ 100 MHz
- **Ultra-low power consumption:** 30 watts at 120 VAC, full load
- **Ultra-efficient power supply:** Silent, fan-free enclosure
- **Ultra-reliable architecture:** 5th Generation Extron design
- **Ultra-flexible control:** Front panel, serial, and IP Link Ethernet

<table>
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<td>$17,090</td>
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New DVI, HDMI, and Fiber Matrix Boards Expand the Versatility of the SMX System MultiMatrix

Extron is introducing a new range of matrix boards designed to enhance the versatility and ease of integration of the SMX System MultiMatrix, our truly modular, field-configurable matrix switcher.

In addition to the new matrix boards listed below, we added a new, 4x8 I/O size to our existing, standard DVI Matrix Switcher Boards.

The SMX DVI Pro Series Matrix Switcher Boards are designed for routing single link DVI-D video signals with HDCP – High-bandwidth Digital Content Protection to one or more displays. These HDCP-compliant matrix boards support computer video to 1920x1200 and HDTV to 1080p, and provide +5 VDC, 250 mA of power on each output for external peripheral devices. For installation convenience and flexibility in cable selection, the boards are equipped with DVI-I connectors for inputs and outputs. They are available in four I/O sizes: 4x4, 4x8, 8x4, and 8x8.

The SMX HDMI Series Matrix Switcher Boards are designed for routing HDMI video signals with embedded audio and control signals. They support computer video to 1920x1200 and HDTV to 1080p at data rates up to 1.65 Gbps. SMX HDMI matrix boards are HDCP-compliant and provide +5 VDC, 250 mA of power on each output for external peripheral devices. They are available in four I/O sizes: 4x4, 4x8, 8x4, and 8x8.

The FOX 4G Fiber Optic Matrix Switcher Board is designed for high speed digital switching up to 4.25 Gbps over singlemode or multimode fiber optic cables. It is fully compatible with the Extron FOX Series Fiber Optics Extender product line and is equipped with industry-standard LC connectors for integration convenience. The SMX FOX 4G Fiber Optic Matrix Switcher Board is available in two versions: 8x8 for use with singlemode fiber, and 8x8 for use with multimode fiber.

<table>
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<td>SMX 44 DVI Pro</td>
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<tr>
<td>SMX 84 HDMI</td>
<td>8x4 HDMI; 2 Slots</td>
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<td>$7,990</td>
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<tr>
<td>SMX 88 HDMI</td>
<td>8x8 HDMI; 2 Slots</td>
<td>70-773-03</td>
<td>$9,500</td>
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<td>SMX 88 FOX 4G MM</td>
<td>8x8 Fiber Optic, Multimode; 1 slot</td>
<td>70-634-03</td>
<td>$15,390</td>
</tr>
<tr>
<td>SMX 86 FOX 4G SM</td>
<td>8x8 Fiber Optic, Singlemode; 1 slot</td>
<td>70-635-03</td>
<td>$18,310</td>
</tr>
</tbody>
</table>

GlobalViewer® Enterprise
Server-Based Resource Management Software

Extron GlobalViewer Enterprise server-based software is the next step up for managing larger A/V installations that use IP Link® technology via the Web browser. Compatible with most Web browsers, GlobalViewer Enterprise provides enhanced help desk functionality, enterprise-wide scheduling and monitoring, time-stamped A/V system data collection for reporting, and integration of rooms controlled by other control systems, such as AMX and Crestron. It provides an easy upgrade path for existing users of Extron’s GlobalViewer Web application. The easy-to-use interface offers a view of the entire enterprise in a single window and access to detailed room data with just a click of a mouse. As with Extron’s free GlobalViewer application, no programming is required to set up and use.

<table>
<thead>
<tr>
<th>Model</th>
<th>Version Description</th>
<th>Part Number</th>
<th>MSRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>GlobalViewer Enterprise</td>
<td>Server-Based Asset Management Software</td>
<td>79-529-01</td>
<td>$5,000</td>
</tr>
</tbody>
</table>
**DVI 104**  
**DVI Fiber Optic Extender**

The Extron DVI 104 Fiber Optic Extender is a transmitter and receiver set that provides an effective, economical solution for extending single link DVI-D signals significantly beyond the specified 5 meter (15 foot) limitation for standard DVI cables. Engineered for reliability and exceptional high resolution image performance, it uses all digital, zero compression technology to deliver perfect pixel-for-pixel transmission of computer-video images up to 1920x1200 resolution, including HDTV 1080p/60. The DVI 104 extends DVI-D signals over four multimode fiber optic cables at lengths up to 500 meters (1,640 feet).

<table>
<thead>
<tr>
<th>Model</th>
<th>Version Description</th>
<th>Part Number</th>
<th>MSRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>DVI 104 TxA/Rx</td>
<td>Transmitter/Receiver Set</td>
<td>60-977-01</td>
<td>$990</td>
</tr>
</tbody>
</table>

Pre-terminated multimode fiber optic cables are available from Extron in various lengths from 10 meters (33 feet) to 300 meters (984 feet).

---

**3G HD-SDI 101**  
**One Input, One Output Cable Equalizer for Multi-rate SDI**

The 3G HD-SDI 101 is a cable equalizer for multi-rate SDI signals that enables SDI, HD-SDI, or 3G-SDI digital video to be sent long distances on coaxial cable. This broadcast quality equalizer accepts all common serial digital video data rates including SMPTE 259M, SMPTE 292M, and SMPTE 424M, as well as embedded audio, ancillary ID, and metadata information. The 3G HD-SDI 101 is ideal for a variety of applications that require high resolution signal equalization for long cable runs.

<table>
<thead>
<tr>
<th>Model</th>
<th>Version Description</th>
<th>Part Number</th>
<th>MSRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>3G HD-SDI 101</td>
<td>Multi-Rate SDI Cable Equalizer</td>
<td>60-963-01</td>
<td>$790</td>
</tr>
</tbody>
</table>

Pre-terminated multimode fiber optic cables are available from Extron in various lengths from 10 meters (33 feet) to 300 meters (984 feet).

---

**SW4 3G HD-SDI**  
**Four Input Multi-Rate SDI Switcher**

The Extron SW4 3G HD-SDI is a multi-rate SDI digital video switcher. It is a convenient and economical solution for switching up to four HD-SDI signals as well as embedded audio, ancillary ID and metadata information. The switcher automatically recognizes and adapts to common SMPTE and ITU serial digital data rates, including 270 Mbps SDI, 1.485 Gbps HD-SDI, and 2.97 Gbps 3G-SDI. The switcher is housed in a compact, 1U high, half-rack width metal enclosure that is suitable for rack mounted or mobile applications. The SW4 3G HD-SDI is ideal for applications where multi-rate HD-SDI digital video signals must be switched then sent over long cable runs.

<table>
<thead>
<tr>
<th>Model</th>
<th>Version Description</th>
<th>Part Number</th>
<th>MSRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW4 3G HD-SDI</td>
<td>Four Input Multi-Rate SDI Switcher</td>
<td>60-956-01</td>
<td>$1,790</td>
</tr>
</tbody>
</table>

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www.extron.com
NEW PRODUCTS

DVI DA Plus
Four, Six, and Eight Output DVI Distribution Amplifiers

The DVI DA Plus DVI distribution amplifiers offer four, six, or eight outputs. Each product accepts a single link DVI signal from a source and distributes the signal to multiple attached devices. All DVI DA Plus models feature EDID Minder, and source signal presence indication. They are ideal for use in all applications that require reliable distribution of high resolution DVI digital video signals.

<table>
<thead>
<tr>
<th>Model</th>
<th>Version Description</th>
<th>Part Number</th>
<th>MSRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>DVI DA4 Plus</td>
<td>Four Output DVI Distribution Amplifier</td>
<td>60-931-01</td>
<td>$890</td>
</tr>
<tr>
<td>DVI DA6 Plus</td>
<td>Six Output DVI Distribution Amplifier</td>
<td>60-932-01</td>
<td>$1,290</td>
</tr>
<tr>
<td>DVI DA8 Plus</td>
<td>Eight Output DVI Distribution Amplifier</td>
<td>60-933-01</td>
<td>$1,390</td>
</tr>
</tbody>
</table>

DVI DA4
Four Output DVI Distribution Amplifier

The DVI DA4 is a four-output DVI distribution amplifier that accepts a DVI input signal and outputs up to four identical signals to attached devices. The DVI DA4 provides automatic input equalization to ensure optimal image quality on all outputs. It is ideal for use in all applications that require reliable, high resolution DVI signal distribution.

<table>
<thead>
<tr>
<th>Model</th>
<th>Version Description</th>
<th>Part Number</th>
<th>MSRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>DVI DA4</td>
<td>Four Output Distribution Amplifier</td>
<td>60-922-01</td>
<td>$750</td>
</tr>
</tbody>
</table>

DVI DL 101
Dual Link DVI Cable Equalizer

The Extron DVI DL 101 is a dual link DVI equalizer that offers a convenient, economical solution for extending dual link and single link DVI signals beyond the specified 5 meter (15 foot) limitation with dual link DVI cables. The DVI DL 101 attaches to the end of a long DVI cable run of up to 200 feet (60 meters). It automatically provides the necessary active equalization to ensure optimal image quality with high resolution computer-video signals up to 2560x1600 as well as all HDTV signals including 1080p/60. The DVI DL 101 is ideal for temporary as well as permanent installations with long DVI cable runs that require reliable presentation of high resolution graphics, including training, simulation, visualization, and command and control environments in medical, university, government, and other applications.

<table>
<thead>
<tr>
<th>Model</th>
<th>Version Description</th>
<th>Part Number</th>
<th>MSRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>DVI DL 101</td>
<td>Dual Link DVI Cable Equalizer</td>
<td>60-962-01</td>
<td>$450</td>
</tr>
</tbody>
</table>
**DVI DL 201**  
*Dual Link DVI Twisted Pair Extender*

The Extron DVI DL 201 is a transmitter and receiver set that enables dual link or single link DVI signals to be carried over distances significantly greater than the specified 5 meter (15 foot) limitation for dual link DVI cables. Linked together using three economical and integration friendly CAT 5, CAT 5e, CAT 6, or CAT 7 cables, the DVI DL 201 transmitter and receiver work together to send dual link or single link DVI-D signals up to 200 feet. Supporting resolutions up to 2560x1600, the DVI DL 201 is ideal for installations that require long distance digital video transmission and reliable presentation of high resolution graphics, including training, simulation, visualization, and command and control environments in medical, university, government, and other applications.

<table>
<thead>
<tr>
<th>Model</th>
<th>Version Description</th>
<th>Part Number</th>
<th>MSRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>DVI DL 201 Tx/Rx</td>
<td>Transmitter/Receiver Set</td>
<td>60-957-01</td>
<td>$1,590</td>
</tr>
<tr>
<td>DVI DL 201 Tx</td>
<td>Transmitter</td>
<td>60-957-12</td>
<td>$1,060</td>
</tr>
<tr>
<td>DVI DL 201 Rx</td>
<td>Receiver</td>
<td>60-957-13</td>
<td>$610</td>
</tr>
</tbody>
</table>

**RGB-DVI 300**  
*RGB to DVI Scaler*

The Extron RGB-DVI 300 is a high performance RGB to DVI scaler that converts incoming analog component video and RGBHV signals to DVI-D signals. It accepts HDTV and high resolution computer-video signals up to 1920x1200, and offers multiple, selectable single link DVI output rates up to 1920x1200, including HDTV 1080p/60. The RGB-DVI 300 is housed in a compact, low-profile enclosure for placement behind flat-panel displays, and offers several features for streamlining integration and enhancing system operation, including Auto Input Memory, Auto-Image™ setup, and RS-232 serial control.

<table>
<thead>
<tr>
<th>Model</th>
<th>Version Description</th>
<th>Part Number</th>
<th>MSRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>RGB-DVI 300</td>
<td>RGB to DVI Scaler</td>
<td>60-906-01</td>
<td>$790</td>
</tr>
</tbody>
</table>

**RGB-HDMI 300**  
*RGB to HDMI Scaler*

The Extron RGB-HDMI 300 is a high performance RGB to HDMI scaler that converts incoming analog component video and RGBHV signals to HDMI signals. It accepts HDTV and high resolution computer-video signals up to 1920x1200, and offers multiple, selectable HDMI output rates up to 1920x1200, including HDTV 1080p/60. The RGB-HDMI 300 is housed in a compact, low-profile enclosure for placement behind flat-panel displays, and offers several features for streamlining integration and enhancing system operation, including Auto Input Memory, Auto-Image™ setup, and RS-232 serial control.

<table>
<thead>
<tr>
<th>Model</th>
<th>Version Description</th>
<th>Part Number</th>
<th>MSRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>RGB-HDMI 300</td>
<td>RGB to HDMI Scaler</td>
<td>60-907-01</td>
<td>$790</td>
</tr>
</tbody>
</table>
FOX 2G AV  
Fiber Optic Extender for Video, Audio, and RS-232

The Extron FOX 2G AV Fiber Optic Extender is a transmitter and receiver set for long haul transmission of standard definition video, audio, and RS-232 control signals over a single fiber. Engineered for reliability and exceptional video performance, it uses Extron’s exclusive all digital, zero compression technology, to deliver perfect pixel-for-pixel transmission of video signals including component video, S-video, and composite video. Designed specifically for A/V systems, the FOX 2G AV also includes a host of integrator-friendly features such as auto input format detection, rack-mount capability, and real-time system monitoring.

<table>
<thead>
<tr>
<th>Model</th>
<th>Version Description</th>
<th>Part Number</th>
<th>MSRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOX 2G Tx AV MM</td>
<td>Multimode - Transmitter</td>
<td>60-941-11</td>
<td>$1,290</td>
</tr>
<tr>
<td>FOX 2G Rx AV MM</td>
<td>Multimode - Receiver</td>
<td>60-941-21</td>
<td>$1,290</td>
</tr>
<tr>
<td>FOX 2G Tx AV SM</td>
<td>Singlemode - Transmitter</td>
<td>60-941-12</td>
<td>$1,590</td>
</tr>
<tr>
<td>FOX 2G Rx AV SM</td>
<td>Singlemode - Receiver</td>
<td>60-941-22</td>
<td>$1,590</td>
</tr>
</tbody>
</table>

FOXBOX 4G VGA  
Fiber Optic Extender for RGBHV, Audio, and RS-232

The Extron FOXBOX 4G VGA Fiber Optic Extender is a transmitter and receiver set for long haul transmission of high resolution VGA, audio, and RS-232 control signals over a single fiber. It uses Extron’s exclusive all digital, zero compression technology, to deliver perfect pixel-for-pixel transmission of computer-video images up to UXGA (1600x1200) resolution. Designed specifically for A/V systems, the FOXBOX 4G VGA also includes a host of integrator-friendly features such as image adjustments and calibration, auto input memory, RS-232 control from multiple locations, internal test patterns, and real-time system monitoring. Compact, low profile enclosures allow for discreet installation behind a flat-panel display, and multiple receivers can be daisy-chained.

<table>
<thead>
<tr>
<th>Model</th>
<th>Version Description</th>
<th>Part Number</th>
<th>MSRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOXBOX 4G Tx VGA MM</td>
<td>Multimode - Transmitter</td>
<td>60-934-11</td>
<td>$2,190</td>
</tr>
<tr>
<td>FOXBOX 4G Rx VGA MM</td>
<td>Multimode - Receiver</td>
<td>60-934-21</td>
<td>$2,190</td>
</tr>
<tr>
<td>FOXBOX 4G Tx VGA SM</td>
<td>Singlemode - Transmitter</td>
<td>60-934-12</td>
<td>$2,740</td>
</tr>
<tr>
<td>FOXBOX 4G Rx VGA SM</td>
<td>Singlemode - Receiver</td>
<td>60-934-22</td>
<td>$2,740</td>
</tr>
</tbody>
</table>

FOXBOX 4G DVI  
Fiber Optic Extender for DVI, Audio, and RS-232

The Extron FOXBOX 4G DVI Fiber Optic Extender is a transmitter and receiver set for long haul transmission of DVI, audio, and RS-232 control signals over a single fiber. It uses Extron’s exclusive all digital, zero compression technology, to deliver perfect pixel-for-pixel transmission of computer-video images up to UXGA (1600x1200) resolution, including HDTV 1080p/60. Designed specifically for A/V systems, the FOXBOX 4G DVI also includes a host of integrator-friendly features such as an EDID emulation mode, Auto Input Memory, RS-232 control from multiple locations, internal test patterns, and real-time system monitoring, as well as compact, low profile enclosures and the capability to daisy-chain multiple receivers.

<table>
<thead>
<tr>
<th>Model</th>
<th>Version Description</th>
<th>Part Number</th>
<th>MSRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOXBOX 4G Tx DVI MM</td>
<td>Multimode - Transmitter</td>
<td>60-935-11</td>
<td>$2,190</td>
</tr>
<tr>
<td>FOXBOX 4G Rx DVI MM</td>
<td>Multimode - Receiver</td>
<td>60-935-21</td>
<td>$2,190</td>
</tr>
<tr>
<td>FOXBOX 4G Tx DVI SM</td>
<td>Singlemode - Transmitter</td>
<td>60-935-12</td>
<td>$2,740</td>
</tr>
<tr>
<td>FOXBOX 4G Rx DVI SM</td>
<td>Singlemode - Receiver</td>
<td>60-935-22</td>
<td>$2,740</td>
</tr>
</tbody>
</table>
FOX 4G Matrix 14400
Modular Fiber Optic Matrix Switcher

The Extron FOX 4G Matrix 14400 is a high performance, modular fiber optic matrix switcher for complete, end-to-end digital A/V signal transmission and routing over fiber optic cable. The FOX 4G Matrix 14400 is expandable in sizes from 16x16 up to 144x144, and is fully compatible with the FOX Series of fiber optic transmitters and receivers. Supporting rates up to 4.25 Gbps, it accepts and routes standard definition video, high resolution computer-video, DVI-D, and multi-rate SDI. Equipped with the integration-friendly features common to Extron matrix switchers, together with hot-swappable I/O boards and fan, real-time system monitoring, and redundant, hot-swappable power supplies, the FOX 4G Matrix 14400 delivers highly reliable, enterprise-wide switching of fiber optic A/V and control signals for any mission-critical environment.

<table>
<thead>
<tr>
<th>Model</th>
<th>Version Description</th>
<th>Part Number</th>
<th>MSRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOX 4G Matrix 14400 Frame</td>
<td>Modular Fiber Optic Frame</td>
<td>60-969-01</td>
<td>Call</td>
</tr>
<tr>
<td>FOX 4G Matrix I/O Board</td>
<td>Multimode</td>
<td>70-771-01</td>
<td>Call</td>
</tr>
<tr>
<td>FOX 4G Matrix I/O Board</td>
<td>Singlemode</td>
<td>70-771-02</td>
<td>Call</td>
</tr>
</tbody>
</table>

MLC 52 RS MK
Basic MediaLink® Controller with IR and RS-232 Display Control - MK Wallplate for the UK

The Extron MLC 52 RS MK Basic MediaLink® Controller is an economical control panel specifically designed for mounting in a 47 mm deep single MK junction box for the UK, Singapore, Hong Kong and other markets that use MK-type junction boxes. With IR and unidirectional RS-232 display control, the MLC 52 RS MK provides easy input selection, power, and volume control, making classroom A/V operations simple. Includes a white metal faceplate.

<table>
<thead>
<tr>
<th>Model</th>
<th>Version Description</th>
<th>Part Number</th>
<th>MSRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>MLC 52 RS MK</td>
<td>IR and RS-232 Control - MK - White</td>
<td>60-744-23</td>
<td>$650</td>
</tr>
</tbody>
</table>

MLC 52 RS VC MK
Basic MediaLink® Controller with IR, RS-232 and Volume Control - MK Wallplate for the UK

The Extron MLC 52 RS VC MK Basic MediaLink® Controller is a two-gang, economical control panel with an integrated volume control knob specifically designed for mounting in a 47 mm deep double MK junction box for the UK, Singapore, Hong Kong and other markets that use MK-type junction boxes. The volume control knob is for remote volume control of an Extron MPA Series or HPA Series power amplifier. With IR and unidirectional RS-232 display control, the MLC 52 RS VC MK provides easy input selection, power, and volume control, making classroom A/V operations simple. Includes a white metal faceplate.

<table>
<thead>
<tr>
<th>Model</th>
<th>Version Description</th>
<th>Part Number</th>
<th>MSRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>MLC 52 RS VC MK</td>
<td>IR, RS-232, Volume Control - MK - White</td>
<td>60-745-23</td>
<td>$700</td>
</tr>
</tbody>
</table>
Extron has great career opportunities!

Sales, Marketing, Technical Support, and Product Support
Extron USA is seeking qualified applicants for a variety of career opportunities in Sales, Marketing, Technical Support, and Product Support.

As an industry leader, Extron is committed to maintaining the outstanding level of quality services our customers expect. We strive to continually provide Service, Support, and Solutions to our customers; dealers, consultants, and A/V professionals. Our customers are our most important asset, and our employees are essential to maintaining that asset. We seek individuals who can help us grow and who desire to achieve a rewarding career in a technical environment.

Engineering
Audio Power Electronics Design Engr.
Audio Repair Technician
Design Engineer
DSP Engineer
Embedded Software Engineer
International Manufacturing Engineer
Mechanical Engineer
Power Electronics Design Engineer
Quality Assurance Test Engineer

Product Development
Applications Developer
Applications Developer – NC
Applications Engineer
Applications Engineer – NC
Compiler / Components Developer
Software Applications Engineer
Software Applications Engineer – NC
Software Development Manager – NC
Technical Writer

Sales & Marketing
Applications Engineer
Applications Support Technician
Applications Support Technician – NC
Applications Technology Engineer
Customer Support Representative – NC
Educational Market Developer
Product Marketing Managers
Product Marketing Specialists
Regional Trainer
Technical Support Specialist

Extron Institute
Jul 23 Montreal, Canada
Jul 23-24 China
Aug 7-8 Melbourne, Australia
Aug 14-15 Anaheim, CA
Aug 18-19 Dubai, United Arab Emirates
Aug 20-21 Dubai, United Arab Emirates
Aug 18-19 San Jose, CA
Aug 20 San Jose, CA
Aug 21-22 China
Aug 27-28 Philippines
Sep 1-2 The Netherlands
Sep 15-16 The Netherlands
Sep 17 Chicago, IL
Sep 29-30 The Netherlands

Tradeshows
Jun 18-20 InfoComm US
Jun 24-26 CEDIA UK
Jul 8-10 PALME Asia
Jul 31-Aug 2 CEDIA Australia
Sep 4-7 CEDIA Expo
Sep 28-Oct 1 BICSI Fall Conference

Las Vegas, NV
Docklands, London
Singapore
Queensland, Australia
Denver, CO
Las Vegas, NV

NC - Based in North Carolina, all others in California.

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E-Mail: jobs@extron.com

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Fax: +1.714.491.1517

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Fax: +31.33.453.4050

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Fax: +971.4.2991880

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