

BULLETIN

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Digital Studio Cable Guide

We are in the midst of a digital revolution. Radio and television broadcasters are going digital. Digital formats have worked their way into recording studios, video post-production, film production and many associated applications, and the reason is clear — digital provides superior audio and video performance.

Binary coding is a vast simplification of complex audio and video signals. But because the signal is binary, receiving equipment can decipher the bit stream, ignore any noise and correct for any attenuation. Audio and Video signals are so sophisticated and complex however — reducing them to binary code requires much higher frequencies than if they were left in analog sine waves. Digital A/V cables need to handle ever-higher digital frequencies. Also because this is A/V, it must be processed in real-time, in sequence, and live. We only give alphanumeric "data" the luxury of re-transmits, processing delay, and blank screen tolerance. A/V signals must remain on-air, without any pause to "compile." These are the challenges broadcast quality A/V cables have to meet.

Digital is very stable, which reduces equipment adjustments significantly. Copies or reproductions retain the quality of the original. Signal

degradation is virtually eliminated, and noise immunity is greatly improved. Whether it's a radio, TV or post-production application, all of these advantages result in improved picture and sound quality as well as interactivity, high-speed data and Internet access, pay-per-view services, simultaneous data/Internet access and personalized electronic news.

Although digital promises to revolutionize the A/V industry as we know it, it also poses a challenge when it comes to designing, choosing, and installing a new system. It has been estimated that there may be as many as 18 different DTV formats to choose from, with new ones being proposed all the time, all of which vary in the level of compression and transmission frequency. Various options also face the radio industry.

With all of these equipment options available, it becomes very important in the design phase to determine the correct cable to connect each of these pieces of equipment. The wrong choice in cable can be as costly as the wrong choice in equipment.

This Digital Studio Cable Guide will help you understand the important aspects of digital cables and the correct part numbers to use for a given format.

Belden

BRILLIANCE™

Although digital promises to revolutionize the A/V industry as we know it, it also poses a great challenge when it comes to designing, choosing, and installing a new system.

Digital Audio

The specification for digital audio was developed jointly by the Audio Engineering Society and European Broadcast Union (AES/EBU). The two key electrical parameters in this specification that pertain to cable are the data rate, which depends on the sampling rate (see table below) and impedance of 110 ohms $\pm 20\%$ for twisted pair constructions and 75 ohms for coax designs.

Sampling Rate	Bandwidth
32.0 kHz	4.096 MHz
38.0 kHz	4.864 MHz
44.1 kHz	5.645 MHz
48.0 kHz	6.144 MHz
88.2 kHz	11.289 MHz
96.0 kHz	12.228 MHz
192.0 kHz	24.576 MHz

Twisted Pair Parameters

The AES/EBU specification, with its broad impedance tolerance, allows for cables with impedances from 88 ohms to 132 ohms to be used, with 110 ohms being ideal. The twisted pair should be shielded, and in the case of multi-pair, each pair individually shielded. Foil shielding is recommended for permanent installs, and foil plus braid for flexed applications. One pair is capable of carrying two channels of digital audio.

The cables are terminated with either XLR connectors or are punched down or soldered in patch panels. Most digital audio cables utilize foam polyethylene to minimize the cable's size. Standard foam polyethylenes are susceptible to crushing which can change impedance. Belden cables utilize a special foam high-density polyethylene that provides exceptional crush resistance when compared to standard foam insulations.

The advent of digital microphones requires AES/EBU cable designs with added flexibility, such as Belden 1800F, a 110 ohm design featuring our ultra-flexible "French Braid" construction.

Although AES/EBU specifications require shielding on each channel of data, data-grade UTP "Category 5" can easily meet the common mode balance requirements (-30 dB) without being shielded.

Can analog cables be used for digital? Yes, but only for distances of roughly 50 ft. or so. The actual length is determined by the error correction and jitter tolerance of the receiving device. The impedance of most analog cables ranges from 40 ohms

to 70 ohms. This large mismatch from the nominal 110 ohms results in signal reflection and jitter causing bit errors at the receiver. Also, the high capacitance of analog cables greatly increases the rise time of the digital square wave.

Can digital cables (paired) be used for analog? Absolutely! The capacitance of digital cables is extremely low, making them a superior analog cable.

Digital Audio Over Coax

The transmission of digital audio over 75 ohm coax requires the use of baluns unless the device contains unbalanced coax AES inputs or outputs or the audio signal is embedded on a digital video signal. The baluns convert the unbalanced coax signal to a 110 ohm balanced transmission.

Much greater transmission distances are obtainable over coax as compared to twisted pair. The same coax used for digital video is ideal for digital audio. The coax used should have a pure copper center conductor (no copper covered steel or aluminum) and have good braid coverage (90% or more). Using one coax for both audio and video gives the added advantage of using one type of strip and crimp tool and one type of connector.

Embedding the audio is popular in TV applications. Embedded signals are often used in "pass through" installations such as cable head-ends. However, if audio manipulation is desired such as spot insertion or replacement, then audio must be "de-embedded" or de-multiplexed from the video stream. This is a complex and expensive procedure. For maximum versatility, separate audio and video runs are suggested.

Digital and HD Radio

When radio broadcast converts to digital – the cable selection will be equally critical and arguably more so. The basic specification parameters for digital audio cable are entirely different than for analog audio. The key attribute for the cable is no longer lower capacitance as in analog audio. The Digital Audio signal is impedance specific and it is the impedance of the cable that is now critical. Fortunately, by nature of their design, Digital Audio cables have built-in low capacitance which makes them excellent analog cables. (The converse is not true: almost no excellent (or even good) analog audio cables are suitable for digital, because they were not designed with digital audio's impedance in mind.) The point: whether you're converting to





digital now or later, whether you're converting wholly or partially, whether you'll be broadcasting 100% digitally or simulcasting analog and digital – Digital Audio cabling is essential to efficient design and value engineering. Even if your immediate needs are strictly analog, installing AES/EBU digital audio cable, like 1800B, now will give you the best performing analog audio service, and will spare you cable replacement when the day arrives that you upgrade to digital. This is the key to "futureproofing."

Where AES/EBU format is used, 110 ohm shielded balanced line cables are the standard. IP technology may be employed to integrate station data networking resources and requirements with programming and advertising content. Where IP technology is deployed, high quality UTP (Category 5e, Category 6 UTP, or MediaTwist[®]) can be used. Television stations may choose to use AES3 format, employ baluns, and multiplex digital audio over 75 ohm coax infrastructure. Where the environment may be electrically noisy, the shielded AES/EBU cables, or AES 3, and coax will be preferred.

Radio Broadcasts will benefit tremendously from Digital Conversion and will be driven by the benefits it offers – even without government mandate: AM clarity equal to current FM; FM clarity rivaling current CD's; new embedded text offering news, weather, traffic, and financial market information, interactivity, customization, and audio-on-demand. Digital Conversion in radio broadcasting may happen quickly because of low entry barriers: A low cost to convert, it's use of the existing spectrum, and the preservation of existing analog service permitting consumers to upgrade on their own timetable. However this revolution unfolds, and however your station deploys: Belden has the cable for AES/EBU, IP or AES 3 digital and HD Radio upgrades.

Digital Video (SDI)

The Society of Motion Picture and Television Engineers (SMPTE) has developed two different standards for serial digital transmissions (SDI). A third format that transmits at 540 Mb/s is under development. There is also a European standards body known as ITU (formerly CCIR) that developed the specifications for Europe known as PAL. Each of these specifications differs in frequency and transmission technology, i.e., composite or component.

- > **SMPTE 259M** – Covers digital video transmissions of composite NTSC

143 Mb/s (Level A) and PAL 177 Mb/s (Level B). It also covers 525/625 component transmissions of 270 Mb/s (Level C) and 360 Mb/s (Level D).

- > **SMPTE 292M** – Covers the newest format for HDTV transmissions at 1.458 Gb/s.
- > **SMPTE 344M** – Covers component widescreen transmissions of 540 Mb/s.
- > **ITU-R BT.601** – International standard covers component PAL transmissions of 177 Mb/s.

Coax Parameters

All of the above standards were designed to work with standard analog video coax cables. It is true, analog coax cables of precision grade will work okay at the higher digital frequencies. However, newer coax constructions that have been designed specifically for digital transmissions offer performance advantages over the old analog designs. These new constructions employ several design parameters to provide the precision electrical characteristics required for high frequency transmissions over longer distances.

- > **Center Conductor** – The center conductors are solid bare copper. Solid conductors provide better impedance stability and return loss (RL). RL expresses the amount of signal lost due to the signal reflecting back to the source. This reduces the signal reaching the receiver, thus increasing attenuation and decreasing effective transmission distance.

Digital transmissions contain low frequency elements that travel down the center of the conductor and high frequency elements that travel on the outside of the conductor due to skin effect. For these reasons, uncoated pure copper conductors are used for optimum performance.

- > **Dielectric** – The dielectric material (insulation) consists of solid or foam high-density polyethylene. The special formulation Belden uses is more crush-resistant than standard foam polyethylenes and is less prone to conductor migration. Both crushing and conductor migration can cause a change in the cables impedance which, in turn, will cause an increase in RL. While the nominal velocity of propagation of a solid dielectric is 66%, gas injection technology provides extremely consistent foaming and high velocities of propagation (82 to 84%). The velocity is kept

very constant to minimize timing problems. Foam dielectrics reduce the size of the coax compared to older solid dielectric designs.

- > **Shield** – Precision analog cables utilize double braid shields which are effective but not optimum for digital's high frequencies. Braid shields are ideal for frequencies under 10 MHz while foil shields work best above that frequency. Since digital transmissions contain both low and high frequencies, foil-braid designs are used.
- > **Testing** – Lastly, to ensure that the cables are electrically sound, every reel must be 100% sweep tested for RL to at least the third harmonic of the fundamental frequency and exhibit no less than SMPTE's minimum suggested level of 15 dB. For HD cables at an uncompressed data rate of 1.485 Gb/s, this gives a bandwidth of 750 MHz and a third harmonic frequency of 2.25 GHz (3 x 750). Belden sweep tests all of its HD cables to 3 GHz, with guaranteed minimum RL steps of 23 dB to 850 MHz and 21 dB from 851 MHz to 3 GHz. More technical information on RL and other cable parameters can be found on Belden's Web site at www.belden.com.

Installable Performance[®]

When looking at guaranteed performance on a cable's data sheet, one naturally expects that the cable will deliver that same performance after it has been installed. This assumption doesn't always hold true, however, because the installation itself can dramatically alter the cable performance.

Typically, when cables are installed they are pulled and yanked on, bent around corners, stepped on, and may kink when coming off the reel. All of these factors can change the physical properties of the cable, which in turn may degrade the cable's electrical performance.

To help ensure that the cable's electrical performance is not compromised through improper installation techniques, three key cable attributes must be held to a high level: conductor adhesion, crush resistance and Return Loss.

Conductor Adhesion

Conductor adhesion is most important to connectorization and connector reliability. Improper levels of conductor adhesion can make the connectorization process harder and can cause connector failures both during and after installation. If adhesion levels are too low, the conductor can



With digital audio cables,
much greater transmission
distances are obtainable
over coax versus twisted pair.
The coax used should have a
pure copper center conductor
and good braid coverage.

move within the dielectric and actually migrate and appear to grow or lengthen in the cable. A cable with low conductor adhesion may appear to be fine prior to installation. However, the rigors of installation can break the conductor adhesion due to all of the pulling and bending that occurs. Once the bond between the conductor and insulation is broken, the conductor migration can, in some cases, result in the center pin of the BNC connector being pushed out of the casing. To prevent this from occurring, Belden uses a skin/foam insulation process that ensures a high degree of conductor adhesion. In addition, all Belden cables are tested for conductor adhesion to further ensure performance.

Crush Resistance

As stated earlier, most of the cables used for SDI are foam dielectrics. Foam dielectrics are, by nature, softer than their solid counter parts. If the cable is improperly handled or installed, the dielectric can be crushed and deformed thereby changing the impedance and causing RL. The special proprietary formulation Belden uses is more crush-resistant than standard foam polyethylene making it far less prone to deformation.

Return Loss Headroom

In order to ensure the SMPTE minimum level of 15 dB RL is met, the cables used must be several dB better to ensure the minimum level is met after the rigors of installation. Other components in the transmission chain can also degrade RL such as a bad termination or improper patch bay connections. Belden's guaranteed minimum level of 21 dB RL gives the user 6 dB of RL headroom to account for such potential inconsistencies.

Careful attention to all of the above attributes ensures that the cable the customer receives from Belden will meet performance specifications after installation. After all, that is what Installable Performance is all about.

Can analog coax cables be used for digital? Yes, only if it is of precision video grade. Standard video cables may have stranded center conductors or copper covered steel. They also may not have adequate shielding as mentioned above. Standard video cables are usually not tested for RL. Beware of plain old coax!

Can digital coax cables be used for analog? Yes, but only if your plant has cable equalization (EQ) designed to work within the loss characteristics of the particular coax. If the transmission distance is short, equalization may not be

a problem. Many equipment manufacturers are now making equalization cards designed specifically for the new digital cables when running analog.

Can I mix foam and solid polyethylene designs together in the same run?

If you run analog in short un-equalized runs, you can mix cables together. However, you will have two connectors, with different dimensions, two different stripping tools, and two different crimping tools. For longer EQ'd runs you will need two different EQ cards as well. Belden suggests you standardize on one cable for as long as you can. Foam core cables have a delay of 1.24 ns/ft compared to 1.54 ns/ft. for solid polyethylene. The loss characteristics of the cables will also be different. Both parameters must be taken into consideration if mixing cable types. As a rule of thumb, it's best to stay with one design throughout.

Video Connectors

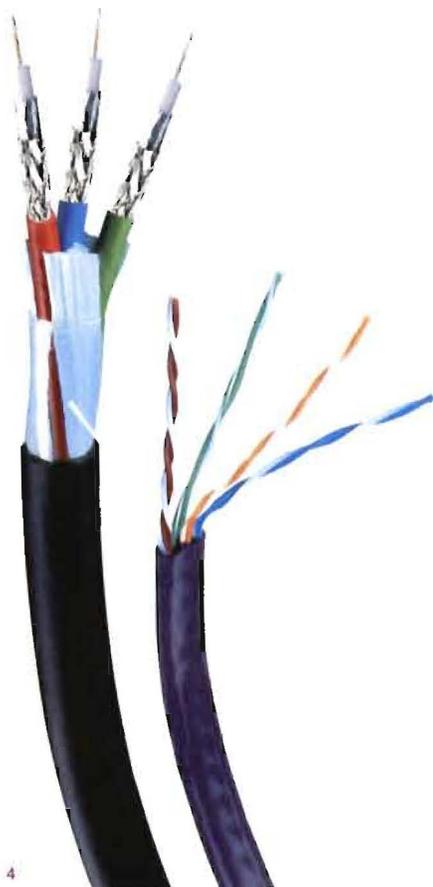
Most connectors used for analog video are 50 ohm BNCs. In analog video, where the quarter wavelength of the signal is approximately 60 feet, the impedance mismatch of a 1/2 inch BNC connector, or even a dozen in a row, is minimal. However, the quarter wavelength of a digital signal can be as short as three inches at HD frequencies. While one or two 50 ohm connectors would probably not have an effect, a dozen of them (6 inches) is significant and will result in a RL problem. Most video signals go through many connectors in a typical studio. For this reason, it is recommended to use not only 75 ohm connectors, but also connectors demonstrated to maintain their impedance up to at least the third harmonic (2.25 GHz).

Cable Installation

Care must be taken when installing digital, and especially high definition, coax. Improper handling, cable pulling and installation techniques can deform the cables which can in turn cause a RL problem. The following practices should be utilized when installing any digital cable.

Installation Basics

- > Do not step on the cables.
- > Do not lay equipment on the cables.
- > Do not kink the cables.
- > Cable pulls should be done in a slow steady fashion – no jerking. Do not exceed the cables maximum pulling tension (call the manufacturer for this information).





- > Do not exceed the minimum bend radius of the cable: 10 times the diameter of the cable.
- > Do not cinch cable ties too tightly. If you cannot move any cable inside a tied bundle, the cable tie is too tight.
- > Do not put cable ties or J hooks at identical distances apart. This can lead to deformation at a given wavelength, which can cause RL. Place cable ties at random distances.
- > Cables should be supported by cable trays, J-hooks, etc. to take the gravitational forces off of the cable. Cable sag should be less than 8 inches.
- > Conduit runs in excess of 90° and/or with more than two 90° equivalent turns should include a pull box. Each 90° turn is equivalent to the friction of a 30' straight conduit run.
- > If cable is pulled into conduit, an anti-friction lubricant should be used that is compatible with the cable jacketing material.
- > Maintain the original physical shape of the cable.

Testing Digital Video

Currently there are no standards to test digital video or HDTV. However, Belden suggests measuring and documenting the RL on every link to ensure that the SMPTE minimum suggested level of 15 dB is met. RL is the measurement of reflected signal caused by impedance discontinuities in the channel. These discontinuities are caused by connectors, cable, transition devices, patch panels and improper cable installation or handling. Any reflected energy reduces the power of the transmitted signal. Measuring RL will give a good expectation of just how well each link will do with SDI or HD video.

Digital Camera Cables

In 1998 the Society of Motion Picture and Television Engineers (SMPTE) developed the industry standard SMPTE 311 for High-Definition Television Camera cables to assure clear, reliable transmission of audio, video and camera control cables.

Belden's new composite cable incorporates two tight-buffer, single-mode 10µm optical fibers for video, four 20 AWG or two 16 AWG conductors (depending on the design) are used for power and two 24 AWG conductors for control and sound. The fibers, color-coded blue and yellow, permit long-haul transmission of critical audio and video signals with extraordinary reliability and clarity. The new standard

provides a cable smaller in diameter and lighter in weight than traditional camera cables resulting in easier handling during installation or in field applications.

Belden's SMPTE 311 cables are 7804R and 7804C. 7804R is made with tight buffer fiber designs and (4) 20 AWG auxiliary (power) conductors per traditional design parameters. 7804C has been designed with breakout fibers to enhance ruggedness and with (2) 16 AWG auxiliary (power) conductors to simplify termination and reduce installation time. In addition, a central stainless steel strength member is used for additional durability during installation. The overall jacket is black Belflex® providing exceptional flexibility.

The Future

Unshielded Twisted Pairs (UTP)

The digitization of audio and video signals has given rise to a convergence with data wiring technology, which utilizes unshielded twisted pairs.

It is a misconception to equate digital A/V signals to digital data signals though, simply because "they are both digital." Ethernet is digital coding of very discreet alphanumeric data: 26 letters and 10 numbers. And Ethernet protocols allow for the use of packets which may be scrambled, transmitted, certain packets re-transmitted, unscrambled and recompiled before the information is presented. All that processing and reprocessing introduces delay which we tolerate for this media. A/V signals are comprised of millions of colors, hues and tones, with different volumes, inflections, tempo and motion. And we require its playback to occur live and in real time. Just as a picture is worth a thousand words and can be taken in the blink of an eye – A/V signals are much more than "data" – even when they are digital.

While almost any UTP cable can handle low-bandwidth or low data-rate applications (such as a telephone), few cables can handle signals like 270 Mb/s digital video for appreciable distances. Like coax, it's a question of what bandwidth (frequency) or data rate and how far. Distance is the key.

The consistency of a UTP cable determines the transmission distance. Physical characteristics of concentricity, conductor-to-conductor and pair-to-pair spacing relationships, and how well they are maintained along the length of the cable determine how far a signal at a given frequency can be carried without

excessive attenuation. The quality of the cable determines the quality of the signal at a distance.

NanoSkew®

NanoSkew (7987R) is a 4-pair, 100 ohm 24 AWG UTP cable with no EIA/TIA data category rating. It is designed for the lowest possible skew delay difference between pairs, which is the critical factor for component video applications. NanoSkew is designed specifically for video, and is strictly for video applications. It should not be used where Ethernet data will be transmitted. See Belden new product bulletin NP212 for complete details about NanoSkew Cables.

Brilliance VideoTwist®

Brilliance VideoTwist cables are Category 5e and Category 6 cables incorporating low-skew characteristics for video performance. Ethernet cables not designed with video in mind do not pay as close attention to minimizing skew and to delivering consistent skew performance. The insulated conductors of each pair are bonded together so they maintain their spacing and orientation throughout the run, around bends, and enduring the rigors of installation. This gives them the consistent physical characteristics so important for stable impedance. Their blend of Video performance (low skew between pairs) and Data rating make Brilliance VideoTwist the ideal choice for shared sheath applications, for video over IP, for KVM applications, and where one cable is preferred for both data circuits and for video circuits. Belden bulletin NP212 gives the full details of Brilliance VideoTwist.

Fiber Optic Cables

At some point, either in bandwidth or distance, copper cables may not be able to perform the task at hand. In these cases, fiber optic cables are an option. Fiber comes as either single-mode or multimode core constructions. Multimode has a 50 micron or 62.5 micron fiber core. 62.5 micron fiber has a modal bandwidth of 160 MHz at 850 nm and 500 MHz at 1300 nm. Single-mode has an 8.3 micron core with a theoretical exit bandwidth into the gigahertz, essentially unlimited. Technologies are now extending even these bandwidths. Multimode and single-mode connectors are easy to install and can be field installed in minutes. Belden offers a comprehensive line of fiber optic cables.

AES/EBU Digital Audio Cable
Single- and Double-Pair Cables



Description	Part No.	UL NEC/ C(UL) CEC Type	No. of Pairs	Color Code	Standard Lengths		Standard Unit Weight		Nom. DCR		Nominal OD		Nom. Imp. (Ω)	Nom. Vel. of Prop.	Nom. Capacitance			
					Ft.	m	Lbs.	kg	Cond.	Shield	Inch	mm			* pF/ Ft.	* pF/ m	** pF/ Ft.	** pF/ m

26 AWG Stranded (7x34) .018" Tinned Copper • Twisted Pair • Beldfoil® Shield • 26 AWG Stranded TC Drain Wire

Datalene® Insulation • Chrome or Violet PVC Jacket

2-Conductor Digital Video Time Code Cable 80°C	9180	NEC: CMR CEC: CMG FT4	1	Black, White	1000	304.8	11.0	5.0	37.3Ω/M' 122.3Ω/km	23.1Ω/M' 75.8Ω/km	.144	3.66	110	76%	13	43	26	85
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Shorting Fold

For cross-connect use with 7891A (et al.) Digital Audio Snake Cables, see page 7.

24 AWG Stranded (7x32) Tinned Copper • Twisted Pairs • Overall 100% Beldfoil Shield • 24 AWG Drain Wire

Datalene Insulation • Slate Gray or Violet PVC Jacket

60°C	1800B	NEC: CMG CEC: CMG FT4	1	Black, Red	500*	152.4	12.0	5.5	23.7Ω/M' 77.7Ω/km	18.9Ω/M' 62.0Ω/km	.177	4.57	110	76%	13	43	26	85
					U-1000	U-304.8	18.0	8.2										
					1000	304.8	18.0	8.2										
					5000*	1524.0	88.8	40.4										



For cross-connect use with 1803F (et al.) Digital Audio Snake Cables, see page 7.
For Plenum version of 1800B, see 1801B.

*500 ft. put-up available in Gray only, 5000 ft. put-up available in Violet only.
The jacket and shield are bonded so both can be removed with automatic stripping equipment.

24 AWG Stranded (42x40) HC Bare Copper • Conductors Cabled with Fillers • TC "French Braid" Shield (95% Coverage) • BC Drain Wire

Datalene Insulation • Matte PVC Jacket (Red, Yellow, Green, Blue, Gray or Black)

Digital Mic Cable High-Flex 60°C	1800F	NEC: CL2R	1	Black, Red	500*	152.4	13.5	6.1	23.7Ω/M' 77.7Ω/km	5.0Ω/M' 16.4Ω/km	.211	5.36	110	76%	13	43	26	85
					U-1000	U-304.8	26.0	11.8										
					1000*	304.8	26.0	11.8										



French Braid

*500 ft. and 1000 ft. put-ups available in Black only.

24 AWG Stranded (7x32) Tinned Copper • Twisted Pairs • Overall 100% Beldfoil Shield • 24 AWG Drain Wire

Plenum • Foam FEP Teflon® Insulation • Natural White or Violet Flamarrest® Jacket

75°C, Non-conduit	1801B	NEC: CMP CEC: CMP FT6	1	Black, Red	500†	152.4	9.0	4.1	23.7Ω/M' 77.7Ω/km	18.9Ω/M' 62.0Ω/km	.165	4.19	110	78%	13	43	26	85
					U-1000†	U-304.8	14.0	6.4										
					1000†	304.8	14.0	6.4										



The jacket and shield are bonded so both can be removed with automatic stripping equipment.

24 AWG Stranded (7x32) Tinned Copper • Dual Twisted Pairs • Overall 100% Beldfoil Shield • 24 AWG Drain Wire

Datalene Insulation • Violet PVC Jacket in Zip-Cord Construction

60°C	1802B	NEC: CMG CEC: CMG FT4	2	Black, Red	500	152.4	18.5	8.4	23.7Ω/M' 77.7Ω/km	18.9Ω/M' 62.0Ω/km	.180	4.57	110	76%	13	43	26	85
					U-1000	U-304.8	36.0	16.4			x	x						
					1000	304.8	37.0	16.8			.360	9.14						



22 AWG Stranded (7x30) Tinned Copper • Twisted Pair with Fillers • Overall 100% Beldfoil Shield + 90% TC Braid Shield • 24 AWG Drain Wire

Datalene Insulation • Black High-Flex Matte PVC Jacket

High-Flex 60°C	1696A		1	Blue, White	250	76.2	8.0	3.6	14.8Ω/M' 48.5Ω/km	4.6Ω/M' 15.2Ω/km	.234	5.94	110	76%	13	43	26	85
					U-1000	U-304.8	32.0	14.5										
					1000	304.8	32.0	14.5										



Z-Fold®

BC = Bare Copper • DCR = DC Resistance • HC = High-conductivity • TC = Tinned Copper

*Capacitance between conductors. **Capacitance between one conductor and other conductors connected to shield.
†Spools and/or UnReel® cartons are one piece, but length may vary ±10% for spools and ±5% for UnReel from length shown.

Teflon is a DuPont trademark.



Belden Electronics Division Technical Support: 1-800-BELDEN-1 or 1-800-BELDEN-3 • www.belden.com

AES/EBU Digital Audio Cable

Multi-Pair Snake Cables
Individually Shielded and Jacketed Pairs



Individually Shielded and Jacketed Pairs NEC: CMG (CEC: CMG FT4)

Product Description

26 AWG or 24 AWG stranded tinned copper conductor. Datalene® insulation. Pairs individually shielded with bonded Beldfoil® and have numbered and color-coded PVC jackets (see Chart 7 in Technical Information Section for colors). Pair jackets and shields are bonded so both strip simultaneously with automatic stripping equipment. Overall Beldfoil shield plus overall Purple PVC jacket and nylon rip cord.

Datalene insulation features include low dielectric constant and a dissipation factor for high-speed, low-distortion data handling. Physical properties include good crush resistance and light weight.

Color Code: Black, Red.

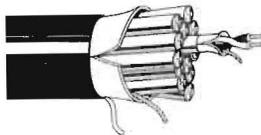
Specifications

Nominal OD — Conductor	
26 AWG	.019" (.48mm)
24 AWG	.024" (.60mm)
Nominal OD — Insulation	
26 AWG	.054" (1.37mm)
24 AWG	.070" (1.78mm)
Inner Pair Jacket OD	
26 AWG	.136" (3.45mm)
24 AWG	.167" (4.24mm)
Approvals	
NEC: CMG (CEC: CMG FT4)	
Nominal DCR (26 AWG)	
Conductor	37.3Ω/M' (122.3Ω/km)
Shield	23.1Ω/M' (75.8Ω/km)
Nominal DCR (24 AWG)	
Conductor	23.7Ω/M' (77.7Ω/km)
Shield	18.9Ω/M' (62.0Ω/km)
Nominal Impedance	
110Ω ±10Ω	
Nominal Velocity of Propagation	
76%	
Nominal Capacitance	
Between Conductors	13 pF/Ft. (43 pF/m)
Between Conductor/Shield*	26 pF/Ft. (85 pF/m)

DCR = DC Resistance

*Capacitance between one conductor and other conductors connected to shield

For AV cable assemblies, visit the Belden Web site for a list of Belden Certified Assemblers



Part No.	No. of Pairs	Standard Lengths		Standard Unit Weight		Nominal OD	
		Ft.	m	Lbs.	kg	Inch	mm

Individually Shielded & Jacketed

26 AWG (7x34) • NEC: CMG (CEC: CMG)							
7891A NEW	2	500	152.4	28.0	12.7	.343	8.71
		1000	304.8	56.0	25.5		
7890A NEW	4	100	30.5	8.2	3.7	.399	10.13
		250	76.2	18.0	8.2		
		500	152.4	31.0	14.1		
		1000	304.8	61.0	27.7		
7880A [†] NEW	8	250	76.2	29.8	13.5	.541	13.74
		500	152.4	57.0	25.9		
		1000	304.8	141.0	64.1		

Fits D-Sub connectors.

7892A NEW	12	500	152.4	85.0	38.6	.679	17.25
		1000	304.8	174.0	79.1		
7893A NEW	16	500	152.4	109.5	49.8	.770	19.56
		1000	304.8	240.0	109.1		

24 AWG (7x32) • Flexible • NEC: CMG (CEC: CMG FT4)

1803F	4	250	76.2	30.0	13.6	.488	12.40
		500	152.4	57.5	26.1		
1805F	8	250	76.2	52.3	23.8	.661	16.79
		500	152.4	103.5	47.0		
		1000	304.8	205.0	93.2		
1806F	12	250	76.2	78.8	35.8	.829	21.06
		500	152.4	156.0	70.9		
		1000	304.8	322.0	146.4		
1850F NEW	16	250	76.2	99.5	45.2	.944	23.98
		500	152.4	209.5	95.2		
		1000	304.8	410.0	186.4		
1852F NEW	24	250	76.2	156.0	70.9	1.205	30.61
		500	152.4	322.0	146.4		
		1000	304.8	646.0	293.6		
1854F NEW	32	250	76.2	224.0	101.8	1.346	34.19
		500	152.4	434.0	197.3		
		1000	304.8	846.0	384.5		

Length may vary -10% to +0% from length shown.

[†]7880A is designed to fit in 25-pin D-sub connectors used in digital console board equipment



Belden Electronics Division Technical Support: 1-800-BELDEN-1 or 1-800-BELDEN-3 • www.belden.com

AES/EBU Digital Audio Cable

Plenum-Rated, Multi-Pair Snake Cables
Individually Shielded Pairs



Individually Shielded Pairs NEC: CMP (CEC: CMP FT6)

Product Description

24 AWG stranded (7x32) tinned copper conductor. Foam FEP insulation. Twisted pairs individually shielded with 100% Beldfoil®. Overall Gray fluorocopolymer jacket (except 82729 which has Natural Flamarrest® jacket). 24 AWG stranded tinned copper drain wire.

Color Code: See Chart 5 (in Technical Information Section)

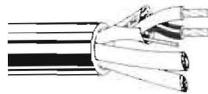
Specifications

Nominal OD — Conductor	.024" (.60mm)
Nominal OD — Insulation	.062" (1.57mm)
Approvals	NEC CMP CEC CMP FT6
UL Ratings	Non-conduit Plenum
Voltage Rating	300V RMS
Nominal DC Resistance	Conductor 23.7Ω/M' (77.7Ω/km) Shield 18.9Ω/M' (62.0Ω/km)
Nominal Impedance	100Ω
Nominal Velocity of Propagation	76%
Nominal Capacitance	Between Conductors 13.5 pF/Ft. (44 pF/m) Between Conductor/Shield* 22.5 pF/Ft. (73.8 pF/m)

*Capacitance between one conductor and other conductors connected to shield

Part No.	No. of Pairs	Standard Lengths		Standard Unit Weight		Nominal OD	
		Ft.	m	Lbs.	kg	Inch	mm
Plenum Individually Shielded NEC: CMP (CEC: CMP FT6)							
24 AWG							
82729	2	U-1000	U-304.8	27.0	12.3	.255	6.48
		1000	304.8	28.0	12.7		
89729	2	500	152.4	18.5	8.4	.261	6.63
		1000	304.8	31.0	14.1		
89730	3	500	152.4	23.0	10.5	.278	7.06
		1000	304.8	40.0	18.2		
89728	4	500	152.4	26.5	12.0	.307	7.80
		1000	304.8	50.0	22.7		
89705	5	500	152.4	30.5	13.9	.327	8.31
		1000	304.8	62.0	28.2		
89731	6	500	152.4	35.0	15.9	.361	9.17
		1000	304.8	71.0	32.3		
89757	7	500	152.4	39.5	18.0	.361	9.17
		1000	304.8	80.0	36.4		
89732	9	1000	304.8	106.0	48.2	.433	11.00
89734	12	500	152.4	71.0	32.3	.498	12.65
		1000	304.8	140.0	63.6		
89758	18	500	152.4	100.5	45.7	.616	15.65
		1000	304.8	204.0	92.7		

Spools are one piece, but length may vary ±10% from length shown.



Digital Audio Attenuation

Part Number	2 MHz		4 MHz		5 MHz		6 MHz		12 MHz		25 MHz	
	dB/100 Ft.	dB/100m										
9180, 7880A Series	1.67	5.48	2.11	6.92	2.30	7.55	2.46	8.07	3.16	10.37	4.22	13.85
1800F	1.28	4.20	2.17	7.12	2.62	8.60	3.01	9.88	4.72	15.49	7.17	23.52
1800B, 1801B, 1802B, 1803F Series	1.30	4.27	1.56	5.12	1.70	5.58	1.81	5.94	2.28	7.48	3.08	10.10
1696A	.93	3.05	1.15	3.77	1.20	3.94	1.30	4.27	1.60	5.25	1.97	6.46
1790T (coax)	1.34	4.40	1.67	5.48	1.74	5.71	1.99	6.53	2.77	9.09	3.83	12.57
1855A (coax)	.57	1.86	.82	2.70	.92	3.02	1.00	3.29	1.30	4.27	1.80	5.91
1505A (coax)	.41	1.35	.58	1.89	.63	2.07	.69	2.25	.90	2.95	1.30	4.27
1505F (coax)	.34	1.11	.53	1.74	.60	1.97	.67	2.20	.98	3.22	1.44	4.72
1694A (coax)	.16	.52	.48	1.57	.54	1.77	.59	1.93	.80	2.62	1.00	3.28

Values reflect typical results

Maximum Recommended Transmission Distance at Digital Audio Data Rates (AES3-2003)*

Part Number	2 MHz		4 MHz		5 MHz		6 MHz		12 MHz		25 MHz	
	Ft.	m	Ft.	m	Ft.	m	Ft.	m	Ft.	m	Ft.	m
9180, 7880A Series	1198	365	948	289	870	265	813	248	633	193	474	144
1800F	1563	476	922	281	763	233	664	203	424	129	279	85
1800B, 1801B, 1802B, 1803F Series	1538	469	1282	391	1176	359	1105	337	877	267	649	198
1696A	2151	655	1739	530	1667	508	1538	469	1250	381	1015	309
1790T (AES3)†*	1493	455	1198	365	1149	350	1005	306	722	220	522	159
(AES-3id)††	597	182	479	146	460	140	402	123	289	88	209	64
1855A (AES3)†*	3521	1073	2427	740	2174	663	1992	607	1538	469	1111	339
(AES-3id)††	1408	429	970	295	869	265	796	242	615	188	444	135
1505A (AES3)†*	4866	1483	3478	1060	3175	968	2911	887	2222	677	1538	469
(AES-3id)††	1946	593	1391	424	1270	387	1164	355	888	270	615	188
1505F (AES3)†*	5882	1793	3774	1150	3333	1016	2985	910	2041	622	1389	423
(AES-3id)††	2353	717	1509	460	1333	406	1194	364	816	249	556	169
1694A (AES3)†*	5882	1793	4184	1275	3704	1129	3407	1039	2500	762	2000	610
(AES-3id)††	2353	717	1673	510	1482	452	1363	416	1000	305	800	244

* Longer transmission distances are achievable but are contingent upon system component quality of input/output voltages.

† Transmission distance calculations assume maximum allowable output signal amplitude (2V per AES3-2003) and minimum allowable input signal amplitude (200mV per AES3-2003).

†† Per AES3-2001, when using analog video distribution equipment to implement AES-3id, maximum transmission distances are 40% of AES3 values assuming a minimum allowable output signal amplitude of 1V and a minimum allowable input signal amplitude of 320mV.

* Implementation of AES3 with coaxial cable and 110-75Ω baluns can be achieved with transmission distances of 91% of the AES3 coaxial distances listed above.



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Precision Video Cable for Analog and Digital

DigiTruck™ Miniature Coax for Broadcast Production Trucks and Sub-Miniature RG-59/U Type



Description	Part No.	UL NEC/ C(UL) CEC Type	Standard Lengths		Standard Unit Weight		Conductor (stranding) Diameter Nom. DCR	Nominal Core OD		Shielding Materials Nom. DCR	Nominal OD		Nom. Imp. (Ω)	Nom. Vel. of Prop.	Nominal Capacitance		Nominal Attenuation		
			ft.	m	Lbs.	kg		Inch	mm		Inch	mm			pF/ft.	pF/m	MHz	dB/ 100 Ft.	dB/ 100m

28.5 AWG Solid .012" Bare Copper • Duobond® Foil (100%)+ 95% Tinned Copper Braid Shield

Gas-injected Foam HDPE Insulation • PVC Jacket (Red, Green, Blue, White, Yellow, Brown, Orange, Gray, Violet, Black)																			
DigiTruck SDI/HDTV Digital Video 75°C	179DT	NEC:	500	152.4	4.2	1.9	28.5 AWG (solid) .012" BC 108Ω/M' 350Ω/km	.056	1.42	Duobond Foil (100%) + 95% TC Braid 8.9Ω/M' 29.2Ω/km	.100	.254	75	77%	17.4	57.4	1	1.18	3.87
		CMR	1000	304.8	8.0	3.6											3.6	1.54	5.05
		CEC:															10	2.25	7.38
																	71.5	5.66	18.57
																	135	7.51	24.64
																	270	10.50	34.45
																	360	12.20	40.03
																	540	15.10	49.54
																	720	17.50	57.41
																	750	17.80	58.40
					1000	20.70	67.91												
					1500	25.40	83.33												
					2250	31.50	103.35												
					3000	36.70	120.41												

25 AWG Stranded (19x37) .021" Bare Copper • Duofoil® + 95% Tinned Copper Braid Shield

Gas-injected Foam HDPE Insulation • PVC Jacket (Available in 10 colors)*																			
SDI/HDTV Digital Video 75°C	1865A	NEC:	1000	304.8	16.0	7.3	25 AWG (19x37) .021" BC 27 4Ω/M' 89.9Ω/km	.094	2.39	Duofoil + 95% TC Braid 6.0Ω/M' 19.8Ω/km	.150	3.81	75	82%	16.5	54.1	1	5	1.5
		CMR															3.6	1.0	3.1
		CEC:															10	1.6	5.2
																	71.5	3.7	12.1
																	135	5.0	16.4
																	270	7.1	23.3
																	360	8.2	26.9
																	540	10.1	33.1
																	720	11.8	38.7
																	750	12.0	39.4
					1000	13.9	45.6												
					1500	17.0	55.8												
					2250	20.8	68.2												
					3000	24.0	78.7												

23 AWG Solid .023" Bare Copper • Duofoil + 95% Tinned Copper Braid Shield

Gas-injected Foam HDPE Insulation • PVC Jacket (Available in 10 colors)*																			
SDI/HDTV Digital Video 75°C	1855A	NEC:	500*	152.4	9.0	4.1	23 AWG (solid) .023" BC 20 1Ω/M' 65.9Ω/km	.102	2.59	Duofoil + 95% TC Braid 4.1Ω/M' 13.5Ω/km	.159	4.03	75	83%	16.3	53.5	1	4	1.3
		CMR	1000	304.8	18.0	8.2											3.6	8	2.6
		CEC:	U-1000*	U-304.8	18.0	8.2											10	1.2	3.9
																	71.5	3.1	10.2
																	135	3.8	12.5
																	270	5.4	17.7
																	360	6.2	20.3
																	540	7.7	25.3
																	720	9.5	31.2
																	750	9.6	31.5
					1000	10.5	34.5												
					1500	13.0	42.7												
					2250	16.0	52.5												
					3000	18.5	60.7												

*500 ft. put-up available in Black only
 *U-1000 ft. put-up available in Gray only

BC = Bare Copper • DCR = DC Resistance • HDPE = Foam High-density Polyethylene • TC = Tinned Copper

For Connector Cross Reference, visit www.belden.com or call Customer Service 1-800-BELDEN-1 For A/V cable assemblies, visit the Belden Web site for a list of Belden Certified Assemblers.

*Available in Brown, Red, Orange, Yellow, Green, Blue, Violet, Gray, White or Black



Belden Electronics Division Technical Support: 1-800-BELDEN-1 or 1-800-BELDEN-3 • www.belden.com

Precision Video Cable for Analog and Digital
RG-59/U Type



Description	Part No.	UL NEC/ C(UL) CEC Type	Standard Lengths		Standard Unit Weight		Conductor (stranding) Diameter Nom. DCR	Nominal Core OD		Shielding Materials Nom. DCR	Nominal OD		Nom. Imp. (Ω)	Nom. Vel. of Prop.	Nominal Capacitance		Nominal Attenuation	
			Ft.	m	Lbs.	kg		Inch	mm		Inch	mm			pF/Ft.	pF/m	MHz	dB/100 Ft

23 AWG Solid .022" Bare Copper • Duofoil® + 95% Tinned Copper Braid Shield

Polyethylene Insulation • Black Polyethylene Jacket

80°C	9209		U-500	U-152.4	15.0	6.8	23 AWG	.146	3.71	Duofoil + 95%	.220	5.59	75	66%	21.0	68.9	1	4	1.2
				U-1000	U-304.8	29.0	13.2	(solid) .022" BC 20.4Ω/M' 66.9Ω/km			TC Braid 4.5Ω/M' 14.8Ω/km							3.6	5
																	10.0	1.2	3.8
																	71.5	2.9	9.5
																	135	4.0	13.0
																	270	5.6	18.4
																	360	6.6	21.5
																	540	8.3	27.2
																	720	9.7	31.7
																	750	9.9	32.5
																	1000	11.6	38.0

20 AWG Solid .032" Bare Copper • Duofoil + 95% Tinned Copper Braid Shield

Gas-injected Foam HDPE Insulation • PVC Jacket (Available in 10 colors)*

SDI/HDTV	1505A	NEC:	500*	152.4	17.5	8.0	20 AWG	.145	3.68	Duofoil + 95%	.234	5.94	75	83%	16.3	53.5	1	3	1.0	
Digital Video		CMR	1000*	304.8	36.0	16.4	(solid) .032"			TC Braid								3.6	6	2.0
75°C		CEC:	5000*	1524.0	165.4	75.2	BC 10.0Ω/M' 32.8Ω/km			3.8Ω/M' 12.5Ω/km								10	9	3.0
		CMG FT4																71.5	2.1	6.9
																		135	2.7	8.9
																		270	3.8	12.5
																		360	4.4	14.4
																		540	5.5	18.0
																		720	6.4	21.0
																		750	6.5	21.3
																		1000	7.6	24.9
																		1500	9.3	30.5
																		2250	11.6	38.1
																		3000	13.4	44.0

*500 ft. put-up available in Black, Red or Blue only.

*1000 ft. and 5000 ft. put-ups available in all ten colors: Black, Brown, Red, Orange, Yellow, Green, Blue, Violet, Gray or White.

22 AWG Stranded (7x29) .031" Bare Compacted Copper* • Double Tinned Copper Braid Shield

Gas-injected Foam HDPE Insulation • PVC Jacket (Matte Black, Red, Green, Blue, Yellow, White or Violet)

High-Flex	1505F	NEC:	1000	304.8	44.0	20.0	22 AWG	.145	3.68	TC Double	.242	6.15	75	80%	17.0	55.7	1	2	.7	
SDI/HDTV		CM					(7x29) .031"			Braid								3.6	.5	1.6
Video Patch		CEC:					BCC 12.2Ω/M' 40.0Ω/km			95% Shield Coverage 2.4Ω/M' 7.8Ω/km								10	9	2.9
75°C		CM																71.5	2.5	8.2
																		135	3.5	11.5
																		270	5.1	16.7
																		360	6.0	19.7
																		540	7.4	24.3
																		720	8.7	28.5
																		750	8.9	29.2
																		1000	10.5	34.4
																		1500	13.3	43.6
																		2250	16.9	55.4
																		3000	20.3	66.6

20 AWG Solid .032" Bare Copper • Duofoil + 95% Tinned Copper Braid Shield

Plenum • Foam FEP Insulation • Flamarrest® Jacket (Available in 10 colors)*

SDI/HDTV	1506A	NEC:	500†*	152.4	16.5	7.5	20 AWG	.133	3.38	Duofoil + 95%	.199	5.05	75	84%	16.1	52.8	1	3	1.0	
Digital Video		CMP	1000†*	304.8	33.0	15.0	(solid) .032"			TC Braid								3.6	.6	2.0
75°C		CEC:					BC 10.0Ω/M' 32.8Ω/km			3.8Ω/M' 12.5Ω/km								10	1.1	3.4
		CMG FT6																71.5	2.3	7.4
																		135	3.2	10.5
																		270	4.6	14.9
																		360	5.3	17.2
																		540	6.4	21.0
																		720	7.3	23.9
																		750	7.5	24.6
																		1000	9.4	30.8
																		1500	12.8	42.0
																		2250	17.5	57.4
																		3000	21.9	71.8

Suitable for Outdoor and Direct Burial applications.

*500 ft. put-up available in Black or Natural only.

†1000 ft. put-up available in all ten colors: Black, Brown, Red, Orange, Yellow, Green, Blue, Violet, Gray or Natural.

BC = Bare Copper • BCC = Bare Compacted Copper • DCR = DC Resistance • HDPE = High-density Polyethylene • TC = Tinned Copper

For Connector Cross Reference, visit www.belden.com or call Customer Service 1-800-BELDEN-1. For AV cable assemblies, visit the Belden Web site for a list of Belden Certified Assemblers.

*Compacted conductor combines impedance uniformity of solid conductors and "nick-resistance" of stranded conductor.

†Spools are one piece, but length may vary ±10% from length shown.



Belden Electronics Division Technical Support: 1-800-BELDEN-1 or 1-800-BELDEN-3 • www.belden.com

Precision Video Cable for Analog and Digital
Double Braided RG-59/U Type



Description	Part No.	UL NEC/ C(UL) CEC Type	Standard Lengths		Standard Unit Weight		Conductor (stranding) Diameter Nom. DCR	Nominal Core OD		Shielding Materials Nom. DCR	Nominal OD		Nom. Imp. (Ω)	Nom. Vel. of Prop. (%)	Nominal Capacitance		Nominal Attenuation	
			ft.	m	Lbs.	kg		Inch	mm		Inch	mm			pF/ft.	pF/m	MHz	dB/100 ft.

20 AWG Solid .031" Bare Copper • 98% Tinned Copper Double Braid Shield

Polyethylene Insulation • Polyethylene Jacket (Available in Red, Yellow, Green, Light Blue, White, Orange or Black)																				
80°C	8281		500*	152.4	37.0	16.8	20 AWG (solid)	.031"	.198	5.03	TC Double Braid	.305	7.75	75	66%	21.0	68.9	1	.3	.8
			1000	304.8	74.0	33.6												3.6	.5	1.8
							9.9Ω/M'				98% Shield Coverage							71.5	2.1	6.9
							32.5Ω/km				1.1Ω/M'							135	3.0	9.8
											3.6Ω/km							270	4.3	14.1
																		360	5.1	16.6
																		540	6.3	20.7
																		720	7.4	24.3
																		750	7.6	24.9
																		1000	9.2	30.2

*500 ft. put-up not available in White.

Flame-retardant Semi-Foam Polyethylene Insulation • PVC Jacket (Available in 10 colors)*

UL AWM Style 1354 (30V 80°C)	8281B	NEC: CMR CEC: CMG FT4	1000	304.8	85.0	38.6	20 AWG (solid)	.031"	.198	5.03	TC Double Braid	.305	7.75	75	66%	21.0	68.9	1	.3	.8
																		3.6	.5	1.8
							9.9Ω/M'				98% Shield Coverage							71.5	2.1	6.9
							32.5Ω/km				1.1Ω/M'							135	3.0	9.8
											3.6Ω/km							270	4.4	14.4
																		360	5.1	16.6
																		540	6.6	21.5
																		720	7.8	25.4
																		750	8.0	26.2
																		1000	10.2	33.5

*8281B available in Brown, Red, Orange, Yellow, Green, Blue, Violet, Gray, White or Black.

22 AWG Stranded (7x29) .031" Bare Compacted Copper* • Double Tinned Copper Braid Shield

Polyethylene Insulation • PVC Jacket (Matte Red, Blue, Green, Gray or Black)																				
High-Flex 60°C	8281F		500*	152.4	32.0	14.5	22 AWG (7x29)	.031"	.193	4.90	TC Double Braid	.305	7.75	75	66%	21.0	68.9	1	3	.9
			1000	304.8	65.0	29.5												3.6	.5	1.7
							12.2Ω/M'				98% Shield Coverage							71.5	2.5	8.0
							40.0Ω/km				1.7Ω/M'							135	3.6	11.6
											5.6Ω/km							270	5.1	16.7
																		360	6.0	19.7
																		540	7.4	24.3
																		720	8.7	28.5
																		750	8.9	29.2
																		1000	10.5	34.4

*500 ft. put-up available in Black only.

20 AWG Solid .031" Bare Copper • 98% Tinned Copper Double Braid Shield

Plenum • FEP Insulation • Black Fluorocopolymer Jacket																				
150°C	88281	NEC: CMP CEC: CMP FT6	500†	152.4	46.0	20.9	20 AWG (solid)	.032"	.185	4.70	TC Double Braid	.271	6.88	75	71%	19.0	62.4	1	2	.7
			1000†	304.8	86.0	39.1												3.6	.5	1.6
							9.9Ω/M'				98% Shield Coverage							71.5	2.3	7.5
							32.5Ω/km				1.1Ω/M'							135	3.3	10.8
											3.6Ω/km							270	5.1	16.7
																		360	6.1	20.0
																		540	8.0	26.2
																		720	9.7	31.8
																		750	10.0	32.8
																		1000	12.3	40.3

Suitable for Outdoor and Direct Burial applications

BC = Bare Copper • BCC = Bare Compacted Copper • DCR = DC Resistance • HDPE = High-density Polyethylene • TC = Tinned Copper

For Connector Cross Reference, visit www.belden.com or call Customer Service 1-800-BELDEN-1. For AV cable assemblies, visit the Belden Web site for a list of Belden Certified Assemblers.

*Compacted conductor combines impedance uniformity of solid conductors and "nick-resistance" of stranded conductor.

†Spools are one piece, but length may vary ±10% from length shown.



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Precision Video Cable for Analog and Digital

Low Loss Serial Digital Coax
RG-6/U, RG-7/U and RG-11/U Type



Description	Part No.	UL NEC/ C(UL) CEC Type	Standard Lengths		Standard Unit Weight		Conductor (stranding) Diameter Nom. DCR	Nominal Core OD		Shielding Materials Nom. DCR	Nominal OD		Nom. Imp. of Prop. (Ω)	Nom. Vel. of Prop.	Nominal Capacitance		Nominal Attenuation	
			ft.	m	Lbs.	kg		Inch	mm		Inch	mm			pF/ft.	pF/m	MHz	dB/100 ft.

RG-6/U Type • 18 AWG Solid .040" Bare Copper • Duofoil® + 95% Tinned Copper Braid Shield

Gas-injected Foam HDPE Insulation • PVC Jacket (Available in 10 colors)*

SDI/HDTV	1694A	NEC:	500*	152.4	23.0	10.5	18 AWG	.180	4.57	Duofoil	.275	6.99	75	82%	16.2	53.1	1	.2	.7
Digital Video	new	CMR	1000	304.8	45.0	20.5	(solid)			+ 95%							3.6	.5	1.6
75°C		CEC:	4500	1371.6	207.0	94.3	.040"			TC Braid							10	.7	2.3
							BC			2.8Ω/M'							71.5	1.6	5.2
							6.4Ω/M'			9.2Ω/km							135	2.1	6.9
							21.0Ω/km										270	3.0	9.8
																	360	3.4	11.2
																	540	4.3	14.1
																	720	4.9	16.1
																	1000	5.9	19.4
																	1500	7.3	24.0
																	2250	9.1	29.9
																	3000	10.7	35.1



For Plenum version of 1694A, see 1695A.
Also available in bundled versions. See 7710A through 7713A.
100% Sweep tested. 5 MHz to 3 GHz.

*500 ft. put-up available in Black only

Plenum • Foam FEP Insulation • Flamarrest® Jacket (Available in 10 colors)**

SDI/HDTV	1695A	NEC:	500*†	152.4	22.5	10.2	18 AWG	.170	4.32	Duofoil	.234	5.94	75	82%	16.2	53.1	1	.2	.8
Digital Video	new	CMR	1000†	304.8	45.0	20.5	(solid)			+ 95%							3.6	.5	1.5
75°C		CEC:					.040"			TC Braid							10	.8	2.5
							BC			2.8Ω/M'							71.5	1.8	5.8
							6.4Ω/M'			9.2Ω/km							135	2.4	7.9
							21.0Ω/km										270	3.4	11.2
																	360	4.0	13.1
																	540	5.2	17.1
																	720	6.1	20.0
																	1000	7.5	24.6
																	1500	9.2	30.2
																	2250	11.6	38.0
																	3000	13.7	44.9

*500 ft. put-up available in Black, Red, Yellow, Violet or Natural only

RG-7/U Type • 16 AWG Solid .064" Bare Copper • Duofoil + 95% Tinned Copper Braid Shield

Gas-injected Foam HDPE Insulation • PVC Jacket (Available in 10 colors)*

SDI/HDTV	7855A	NEC:	500*	152.4	32.5	14.8	16 AWG	.225	5.71	Duofoil	.320	8.13	75	84%	16.1	52.8	1	.2	.6
Digital Video		CMR	1000	304.8	62.0	28.2	(solid)			+ 95%							3.6	.4	1.2
75°C		CEC:					.064"			TC Braid							10	.6	1.9
							BC			1.7Ω/M'							71.5	1.1	3.6
							1.2Ω/M'			5.6Ω/km							135	1.8	5.8
							3.9Ω/km										270	2.5	8.1
																	360	2.9	9.4
																	540	3.6	11.7
																	720	4.2	13.7
																	1000	5.0	16.3
																	1500	6.1	20.0
																	2500	7.9	25.9
																	3000	8.7	28.5



100% Sweep tested. 5 MHz to 3 GHz.

*500 ft. put-up available in Black only

RG-11/U Type • 14 AWG Solid .064" Bare Copper • Duofoil + 95% Tinned Copper Braid Shield

Gas-injected Foam HDPE Insulation • PVC Jacket (Available in 10 colors)*

SDI/HDTV	7731A	NEC:	500*	152.4	48.0	21.8	14 AWG	.280	7.11	Duofoil	.405	10.3	75	85%	16.0	52.4	1	.2	.5
Digital Video		CMR	1000	304.8	94.0	42.8	(solid)			+ 95%							3.6	.3	1.0
75°C		CEC:	4000	1219.2	467.0	212.3	.064"			TC Braid							10	.5	1.5
							BC			1.5Ω/M'							71.5	1.1	3.6
							2.5Ω/M'			4.9Ω/km							135	1.5	4.8
							8.2Ω/km										270	2.1	6.9
																	360	2.5	8.0
																	540	3.1	10.0
																	720	3.6	11.7
																	1000	4.3	14.1
																	1500	5.5	18.0
																	2250	6.9	22.6
																	3000	8.2	26.9



100% Sweep tested. 5 MHz to 3 GHz.

*500 ft. put-up available in Red or Black only

Plenum • Foam FEP Insulation • Fluorocopolymer Jacket (Available in 10 colors)**

SDI/HDTV	7732A	NEC:	500*	152.4	45.0	20.5	14 AWG	.274	6.96	Duofoil	.348	8.84	75	83%	16.3	53.5	1	.2	.5
Digital Video	new	CMR	1000	304.8	88.0	40.0	(solid)			+ 95%							3.6	.3	.9
150°C		CEC:	2000*	609.6	176.0	80.0	.064"			TC Braid							10	.4	1.3
							BC			2.5Ω/M'							71.5	1.2	4.1
							2.5Ω/M'			8.2Ω/km							135	1.8	5.8
							8.2Ω/km										270	2.6	8.5
																	360	3.1	10.2
																	540	3.9	12.8
																	720	4.6	15.0
																	1000	5.5	18.0
																	1500	6.9	22.7
																	2250	9.2	30.2
																	3000	10.2	33.5

*500 ft. put-up available in Black or Natural only

**2000 ft. put-up available in Natural only. Suitable for Outdoor and Direct Burial applications.

BC = Bare Copper • DCR = DC Resistance • HDPE = High-density Polyethylene • TC = Tinned Copper

For Connector Cross Reference, visit www.belden.com or call Customer Service 1-800-BELDEN-1.

* Available in Black, Brown, Red, Orange, Yellow, Green, Blue, Violet, Gray or White.
** Available in Black, Brown, Red, Orange, Yellow, Green, Blue, Violet, Gray or Natural.
† Spools are one piece, but length may vary ±10% from length shown.



Belden Electronics Division Technical Support: 1-800-BELDEN-1 or 1-800-BELDEN-3 • www.belden.com

VideoFLEX® Snake Cable for Precision Analog and Digital
Bundled Miniature and RG-59/U Type



Description	Part No.	UL NEC/ C(UL) CEC Type	No. of Cond.	Standard Lengths		Standard Unit Weight		Conductor (stranding) Diameter Nom. DCR	Nominal Core OD		Shielding Materials Nom. DCR	Nominal OD		Nom. Imp. (Ω)	Nom. Vel. of Prop.	Nominal Capacitance		Nominal Attenuation	
				ft.	m	Lbs.	kg		Inch	mm		Inch	mm			pF/ft.	pF/m	MHz	dB/ 100 ft.

Miniature • 23 AWG Solid .023" Bare Copper • Duofoil® + 95% Tinned Copper Braid (100% Shield Coverage)

Solid Copper, Gas-injected Foam HDPE Insulation • Overall Matte Black PVC Jacket (Color Code: See chart below)

SDI/HDTV Digital Video 75°C (1855A Bundled)																			
7787A	new	NEC: 3	500	152.4	47.5	21.6	23 AWG (solid)	.102	2.55	Duofoil + 95% TC Braid	.432	10.97	75	83%	16.5	54.1	1	.4	1.3
		CMR	1000	304.8	94.0	42.7	.023" BC	.159	4.03	4.1Ω/M' 13.5Ω/km							3.6	.8	2.6
		CEC: CMG FT4					20.1Ω/M' 65.9Ω/km										10	1.2	3.9
7788A	new	NEC: 4	1000	304.8	111.0	50.5	same as above	.102	2.55	same as above	.481	12.22					71.5	3.2	10.5
7789A	new	NEC: 5	500	152.4	72.5	33.0	same as above	.102	2.55	same as above	.539	13.69					135	3.9	12.8
7790A	new	NEC: 6	500	152.4	88.5	40.2	same as above	.102	2.55	same as above	.597	15.16					270	5.5	18.0
7791A	new	NEC: 10	500	152.4	155.5	70.7	same as above	.102	2.55	same as above	.796	20.22					360	6.3	20.7
7792A	new	NEC: 12	500	152.4	171.5	78.0	same as above	.102	2.55	same as above	.825	20.96					540	7.9	25.9

Sweep tested 5 MHz to 3 GHz.

RG-59/U Type • 20 AWG Solid .032" Bare Copper • Duofoil + 95% Tinned Copper Braid (100% Shield Coverage)

Gas-injected Foam HDPE Insulation • Overall Matte Black PVC Jacket (Color Code: See chart below)

SDI/HDTV Digital Video 75°C (1505A Bundled)																			
7794A	new	NEC: 3	500	152.4	94.5	43.0	20 AWG (solid)	.145	3.68	Duofoil + 95% TC Braid	.631	16.03	75	83%	16.3	53.1	1	.3	1.0
		CMR	1000	304.8	188.0	85.5	.032" BC	.235	5.97	3.8Ω/M' 12.5Ω/km							3.6	.6	2.0
		CEC: CMG FT4					10.0Ω/M' 32.8Ω/km										10	.9	3.0
7795A	new	NEC: 4	500	152.4	116.5	53.0	same as above	.145	3.68	same as above	.706	17.93					71.5	2.1	6.9
7796A	new	NEC: 5	500	152.4	150.0	68.2	same as above	.145	3.68	same as above	.790	20.07					135	2.8	9.2
7798A	new	NEC: 10	500	152.4	319.5	145.2	same as above	.145	3.68	same as above	1.166	29.62					270	3.9	12.8

Sweep tested 5 MHz to 3 GHz.

BC = Bare Copper • DCR = DC Resistance • HDPE = High-density Polyethylene • TC = Tinned Copper

For Connector Cross Reference, visit www.belden.com or call Customer Service 1-800-BELDEN-1. For A/V cable assemblies, visit the Belden Web site for a list of Belden Certified Assemblers.

Color Code Chart

Cond.	Color	Cond.	Color	Cond.	Color
1	Red	5	Yellow	9	Violet
2	Green	6	Brown	10	Black
3	Blue	7	Orange	11	Pink
4	White	8	Gray	12	Tan



Belden Electronics Division Technical Support: 1-800-BELDEN-1 or 1-800-BELDEN-3 • www.belden.com

VideoFLEX® Snake Cable for Precision Analog and Digital RG-6/U Type



Description	Part No.	UL NEC/ C(UL) CEC Type	No. of Cond.	Standard Lengths		Standard Unit Weight		Conductor (stranding) Diameter Nom. DCR	Nominal Core OD		Shielding Materials Nom. DCR	Nominal OD		Nom. Imp. (Ω)	Nom. Vel. of Prop.	Nominal Capacitance		Nominal Attenuation	
				Ft.	m	Lbs.	kg		Inch	mm		Inch	mm			pF/Ft.	pF/m	MHz	dB/ 100 Ft.
RG-6/U Type • 18 AWG Solid .040" Bare Copper • Duofoil® + 95% Tinned Copper Braid Shield																			
Gas-injected Foam HDPE Insulation • Overall Matte Black PVC Jacket (Color Code: See chart below)																			
SDI/HDTV Digital Video 75°C (1694A Bundled)	7710A	NEC: CMR CEC: CMG FT4	3	500 1000	152.4 304.8	131.5 273.0	59.8 124.1	18 AWG (solid) .040" BC 6.4Ω/M' 21.0Ω/km	.180 Coax OD: .257	4.57 6.99	Duofoil + 95% TC Braid 2.8Ω/M' 9.2Ω/km	.770 19.56	75	82%	16.2 53.1	1 2	3.6 5 10 135 175 270 360 540 720 750 1000 1500 2500 3000	.7 1.6 2.3 5.2 6.9 10.2 11.5 14.4 16.4 16.7 19.7 24.3 30.5 35.8	
	7711A	NEC: CMR CEC: CMG FT4	4	500 1000	152.4 304.8	174.0 339.0	79.1 154.1	same as above	.180 Coax OD: .257	4.57 6.99	same as above	.900 22.86				1000 1500 2500 3000	6.0 7.4 9.3 10.9	19.7 24.3 30.5 35.8	
	7712A	NEC: CMR CEC: CMG FT4	5	500 1000	152.4 304.8	209.5 440.0	95.2 200.0	same as above	.180 Coax OD: .257	4.57 6.99	same as above	.942 23.93							
	7713A	NEC: CMR CEC: CMG FT4	10	500 1000	152.4 304.8	450.0 878.0	204.5 399.1	same as above	.180 Coax OD: .257	4.57 6.99	same as above	1.386 35.20							

Sweep tested 5 MHz to 3 GHz.

BC = Bare Copper • DCR = DC Resistance • HDPE = High-density Polyethylene • TC = Tinned Copper

Color Code Chart

Cond.	Color	Cond.	Color	Cond.	Color
1	Red	5	Yellow	9	Violet
2	Green	6	Brown	10	Black
3	Blue	7	Orange		
4	White	8	Gray		

Video Triax Cable RG-11/U Type

Description	Part No.	UL NEC/ C(UL) CEC Type	Standard Lengths		Standard Unit Weight		Conductor (stranding) Diameter Nom. DCR	Nominal Core OD		Shielding Materials Nom. DCR	Nominal OD		Nom. Imp. (Ω)	Nom. Vel. of Prop.	Nominal Capacitance		Nominal Attenuation		
			Ft.	m	Lbs.	kg		Inch	mm		Inch	mm			pF/Ft.	pF/m	MHz	dB/ 100 Ft.	dB/ 100m
14 AWG Solid .064" Bare Copper • Two Bare Copper Braids (95% Shield Coverage)																			
Gas-injected Foam HDPE Insulation • Black PVC Jacket (PVC Insulation between Braids)																			
80°C	8233A	NEC: CMR CEC: CMG FT4	1000 2000 4000	304.8 609.6 1219.2	142.0 240.0 574.0	64.5 109.1 260.9	14 AWG (solid) .064" BC 2.5Ω/M' 8.2Ω/km	.285 Coax OD: 7.24	7.24	(2) BC Braids 95% Coverage Inner: 1.6Ω/M' 5.2Ω/km Outer: 1.4Ω/M' 4.6Ω/km	.475 12.07	75	84%	16.1 52.8	1 2	3.6 5 10 135 175 270 360 540 720 750 1000 1500 2250 3000	.7 1.0 1.3 3.6 4.9 7.5 8.9 11.5 13.8 14.1 17.1 23.3 31.5 39.4		

For additional sweep-tested digital video Triax Cables, see the Belden Master Catalog and/or www.belden.com

BC = Bare Copper • DCR = DC Resistance • HDPE = High-density Polyethylene • PE = Polyethylene

For Connector Cross Reference, visit www.belden.com or call Customer Service 1-800-BELDEN-1. For A/V cable assemblies, visit the Belden Web site for a list of Belden Certified Assemblers.



Belden Electronics Division Technical Support: 1-800-BELDEN-1 or 1-800-BELDEN-3 • www.belden.com

Audio and Video Composite Camera Cable

SMPTE 311M HDTV Cables
Single-mode Fiber with Copper Conductors

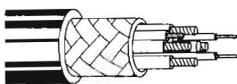


Description	Part No.	UL NEC/ C(UL) CEC Type	Standard Lengths		Standard Unit Weight		Conductor (stranding) Nom. DCR	Nominal Core OD		Shielding Materials Nom. DCR	Nominal OD		Nominal Optical Attenuation (@1310nm)	
			ft.	m	Lbs.	kg		Inch	mm		Inch	mm	dB/1000 Ft.	dB/km

4 Power Conductors • SM Fiber w/ 24 and 20 AWG Stranded (7x32 and 19x32) Tinned Copper • Overall 95% TC Braid Shield

PVC Insulation • Black Belflex® Jacket

75°C	7804R <small>(NEW)</small>	NEC:	328	100.0	33.5	15.2	(2) Fibers:	.079	2.00	36 AWG TC Braid 95% Shield Coverage 2.9Ω/M' 9.5Ω/km	.362	9.20	.14	.45
		CMR:	500	152.4	50.0	22.7	SM/125µ/900µ							
		CEC:	1000	304.8	98.0	44.5	(core/clad/buffer)							
		CMG FT4	1640	500.0	155.8	70.8	(2) Cond.:	.050	1.27					
			3280	1000.0	321.4	146.1	24 AWG (7x32) .024"							
							Tinned Copper							
							23.3Ω/M' 76.4Ω/km							
							(4) Cond.:	.063	1.60					
							20 AWG (19x32) .037"							
							Tinned Copper							
							8.8Ω/M' 28.9Ω/km							

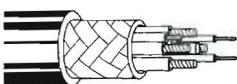


Plenum version and other conductor counts/diameters available by special order.

2 Power Conductors • SM Fiber w/ 24 and 16 AWG Stranded (7x32 and 65x34) Tinned Copper • Overall 95% TC Braid Shield

PVC Insulation • Black Belflex® Jacket

75°C	7804C <small>(NEW)</small>	NEC:	328	100.0	32.0	14.5	(2) Breakout	.079	2.00	38 AWG TC Braid 95% Shield Coverage 2.8Ω/M' 9.2Ω/km	.362	9.20	.14	.45
		CMR:	500	152.4	46.0	20.9	Fibers:							
		CEC:	1000	304.8	87.0	39.5	SM/125µ/900µ							
		CMG FT4	1640	500.0	140.0	63.6	(core/clad/buffer)							
			3280	1000.0	288.0	130.9	(2) Cond.:	.050	1.27					
							24 AWG (7x32) .024"							
							Tinned Copper							
							23.3Ω/M' 76.4Ω/km							
							(2) Cond.:	.093	2.36					
							16 AWG (65x34) .059"							
							Tinned Copper							
							4.3Ω/M' 14.1Ω/km							



Plenum version and other conductor counts/diameters available by special order.

DCR = DC Resistance • SM = Single-mode • TC = Tinned Copper

For Connector Cross Reference, visit www.belden.com or call Customer Service 1-800-BELDEN-1. For AV cable assemblies, visit the Belden Web site for a list of Belden Certified Assemblers.



Belden Electronics Division Technical Support: 1-800-BELDEN-1 or 1-800-BELDEN-3 • www.belden.com



Brilliance® Precision Digital Video Coaxial Cables 3 GHz Sweep Tested for Return Loss

Maximum Transmission Distance at Serial Digital Data Rates

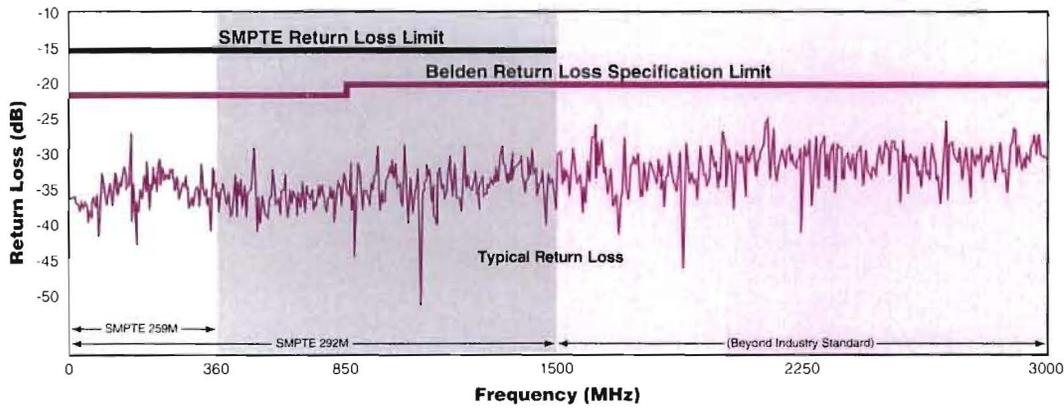
Data Rate:	143 Mb/s		177 Mb/s		270 Mb/s		360 Mb/s		540 Mb/s		1.5 Gb/s	
Spec:	SMPTE 259M		ITU-R BT. 601		SMPTE 259M		SMPTE 259M		SMPTE 344M		SMPTE 292M	
Application:	Composite NTSC		Composite PAL		Component Video		Component Widescreen		Component Widescreen		HDTV	
Part No.	Ft.	m	Ft.	m	Ft.	m	Ft.	m	Ft.	m	Ft.	m
179DT	504	154	457	139	384	117	242	74	196	60	110	34
1865A	810	247	760	232	600	183	520	158	420	128	170	52
8279	910	277	810	247	640	195	550	168	440	134	170	52
1855A-7787A	1000	305	910	277	750	229	650	198	530	162	210	64
9209	1030	314	930	283	750	229	650	198	540	165	200	61
9209A	1030	314	930	283	750	229	650	198	540	165	200	61
1505A-7794A	1430	436	1320	402	1110	338	960	293	790	241	300	91
1505F	1200	366	1071	326	857	261	732	223	588	179	225	69
1506A	1360	415	1200	366	940	286	810	247	670	204	270	82
9231	1430	436	1270	387	1000	305	850	259	680	207	260	79
9141	1430	436	1270	387	1000	305	850	259	680	207	260	79
8281	1430	436	1270	387	1000	305	860	262	700	213	260	79
8281B	1430	436	1270	387	1000	305	850	259	680	207	250	76
8281F	1250	381	1100	335	860	262	730	222	590	180	240	73
88281	1300	396	1150	351	910	277	770	235	600	183	200	61
1694A-7710A	1760	536	1620	494	1360	415	1180	360	970	296	370	113
1695A	1670	509	1520	463	1250	381	1080	329	880	268	310	94
7855A	2220	677	2000	610	1670	509	1460	445	1210	369	470	143
7731A	2730	832	2460	750	2000	610	1740	530	1430	436	540	165
7732A	2420	738	2140	652	1690	515	1440	439	1150	351	430	131

The serial digital interconnect standards are designed to operate where the signal loss at 1/2 the clock frequency does not exceed the approximate loss values listed below. The maximum length values shown are based on typical attenuation values for the cables listed and the following criteria:

Maximum length = 30 dB loss at 1/2 the clock frequency: SMPTE 259M, PAL, Widescreen.
Maximum length = 20 dB loss at 1/2 the clock frequency: SMPTE 292M.

The bit error rate (BER) can vary dramatically as the calculated distances are approached. BER is dependent on receiver design and the losses of the actual coax used. Distribution and routing equipment manufacturers should be contacted to verify their maximum recommended transmission.

Return Loss Headroom (1694A)



For More Information:

www.belden.com

Belden Electronics Division Technical Support 1-800-BELDEN-1 or 1-800-BELDEN-3