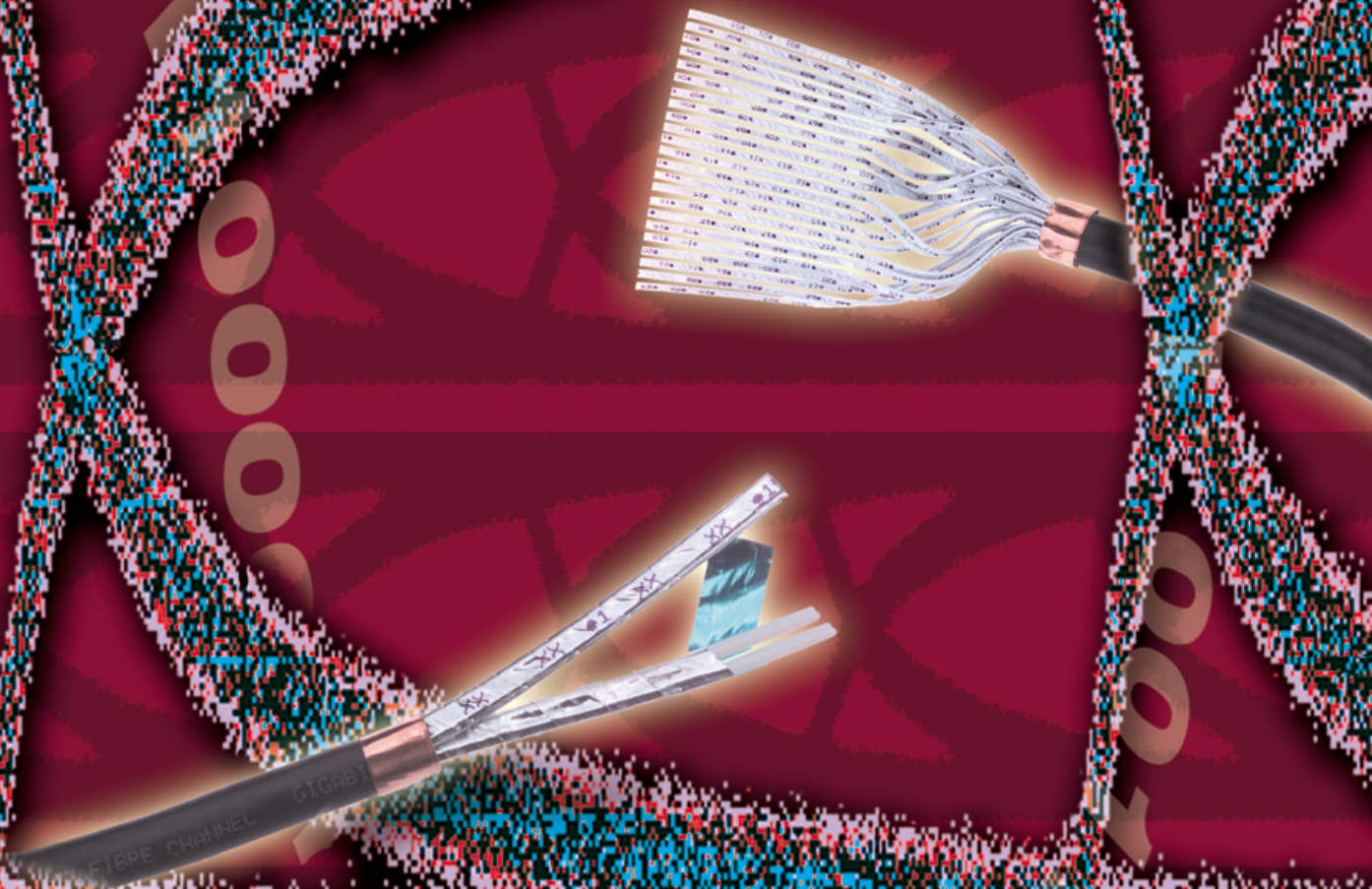


SKEWCLEAR[®]



An Alternative to Fiber Optics

Reducing Skew

InfiniBand. Fibre Channel. Serial ATA. 10 Gb Ethernet.

Today's leading edge serial interconnect standards exert some very demanding requirements on a copper link's ability to deliver usable output waveforms while jumping the hurdles of jitter, ISI, attenuation, reflections, and crosstalk. And as every interconnect standard travels down its own roadmap to higher and higher bandwidths, the signal integrity hurdles get higher and higher. Faster rise times mean more crosstalk, EMI, and signal attenuation. The result? More errors, system latency, and shorter cables.

As your design attempts the jump, high cable skew can trip you up.

Managing Your Skew Budget

In the past, circuit designers used to have the luxury of copper cable links with fat skew budgets. But today's faster speeds mean less time for everything that has to occur between clocking events. That means that cable skew – once virtually ignored by designers — has become a critical factor in skew budgets. The less time that can be budgeted to cable means more time available for set-up, hold, ISI, and jitter. The trick is overcoming two major types of cable skew:

Delay skew is created when multiple signals are transmitted simultaneously, but arrive at the cable ends at different times.

Cables made with pairs, such as twisted or parallel, have two kinds of delay skew—within-pair and pair-to-pair.

Within-pair (or wire to wire) skew causes rise time degradation and thus attenuates the signal, particularly at GHz frequencies. In addition, a high within-pair skew will produce uncanceled currents traveling on the pair shield, creating EMI, crosstalk, and further degrading the signal to the point of possible system failure. If within-pair skew can be reduced, so can the accompanying attenuation, EMI, and crosstalk.

Pair-to-pair skew is the difference between fastest and slowest pairs in the cable. Its control becomes critical when a link uses a separate clock line (e.g. Channel Link) which must be synchronized accurately in relation to the data lines in order to correctly sample the data. Serial links have clocks embedded with the data stream and thus do not have tight restrictions on pair-to-pair skew.

Amplitude skew (imbalance) occurs when two equal but opposite signals are transmitted into a pair, but unequal amplitude results on either leg at the receiver, due to attenuation effects on the leg. The longer the cable, the more problems will be encountered with sampling accuracy.

SKEWCLEAR®

In response to the growing skew budget crunch, we've developed a new concept in individually shielded differential pair cabling for use in high data rate applications.

Called SKEWCLEAR, this cabling features an innovative manufacturing process that effectively corrects the causes of cable skew that creep into cables in the first place. The design consists of individually shielded multiple parallel pairs (Fig. A) which are laminated in a planar configuration to assure equal pair lengths. The pair shields consist of heat sealed spirally wrapped aluminum mylar, with an additional heat seal of .0005" clear mylar to ensure the shield does not unravel. The flat cable pairs are bonded and then slit in a staggered fashion (Fig. B), enabling the cable to be flexibly cabled into a round format (Fig. C), yet keeping the same pair-to-pair physical length of a flat cable construction. Standard impedances are 100, 110, 120, and 150 ohms.

As a result of this unique manufacturing approach, skew values can be consistently reduced to within 2 picoseconds/ft within-pair and 10 picoseconds/ft pair-to-pair, depending on pair count and dielectrics. Compared with industry-standard twisted pair construction, this is a 200% to 400% improvement in skew control. Other cable technologies, if manufactured with extreme care, often can yield very good skew performance. SKEWCLEAR, by design, makes tight skew control consistent, repeatable, and easy.

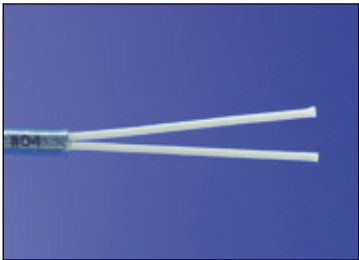


Fig. A

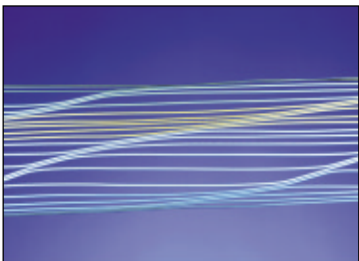


Fig. B

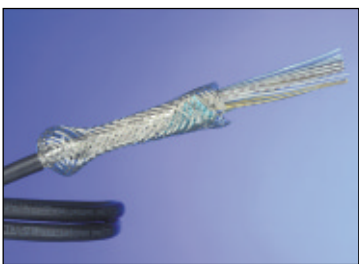
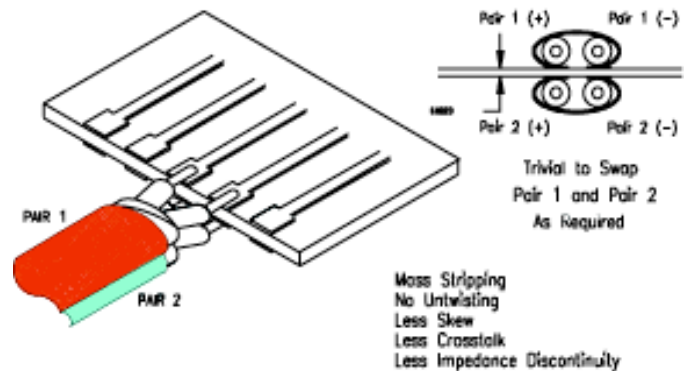


Fig. C

Easier Termination and Superior Cable/Connector Electrical Interface

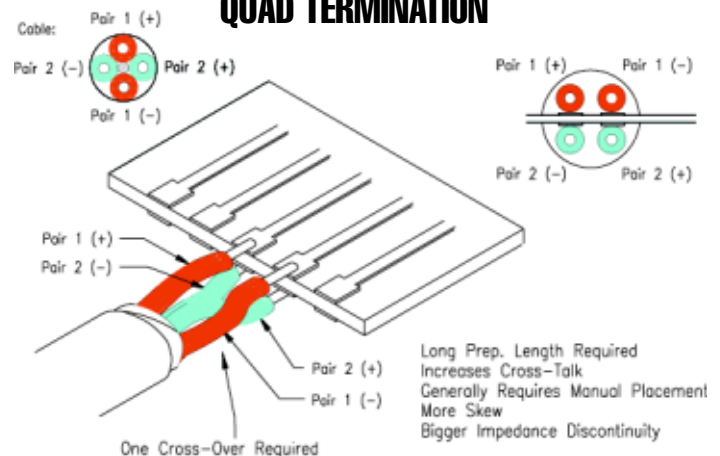
Parallel pairs by nature are easier to strip, since no untwisting of wire is involved in the process, unlike twisted and quad constructions.

PARALLEL PAIR TERMINATION



As shown in the parallel pair termination drawing, the pairs can be brought directly to a paddlecard or to the contact terminals. Special stripping tools are available to mass strip the shield and dielectric.

QUAD TERMINATION



SKEWCLEAR

Features

- ❑ 31-22 awg flat and round constructions
- ❑ 1-50 pair counts
- ❑ Rugged polyolefin resists deformation, crushing, and electrical variations
- ❑ Precision wrapped heat sealed aluminum/mylar, with additional .0005" heat sealed clear mylar on each pair.
- ❑ Parallel pairs eliminate twist length variation and resulting dielectric deformation
- ❑ Unique laminated parallel sections preserve identical electrical length from wire-to-wire and pair-to-pair
- ❑ Unique staggered slit between pairs enables cable to be formed into flexible round format with pair-to-pair uniformity of flat cable
- ❑ Parallel pairs provide easy fixturing and mass stripping for labor savings
- ❑ Optional plenum and zero halogen constructions
- ❑ Double overall shielding for maximum EMI/RFI protection
- ❑ CL2/FT4 listed

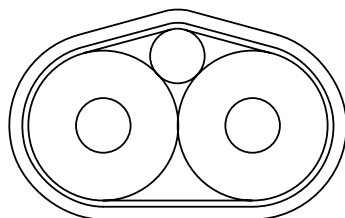
To Drain or Not to Drain

Drain wires in each pair present many design trade-offs in skew, termination ease, and cost. Spectra-Strip applies drains either as "center" or "side" as shown below.

For a more complete discussion of these trade-offs contact Spectra-Strip Engineering.

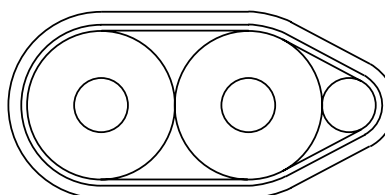
Drain Options

Center Drain



(Better Balance)

Side Drain



(More TD and Amplitude Skew)

Connector Compatibility

SKEWCLEAR can be terminated readily to all industry-standard I/O connectors, including MicroGiga CN™, HSSDC2™, SCSI, VHDCI, D sub, 2mm, MDR™, LFH™, and METRAL™. Spectra-Strip can recommend a manufacturer of precision cable terminations in your area.

MicroGiga CN™ is a trademark of Fujitsu, HSSDC2™ is a trademark of Tyco Electronics, MDR™ is a trademark of 3M, and LFH™ is a trademark of Molex.

SKEWCLEAR® Plus

**Lower installed cost. Minimum termination discontinuity.
Maximum process repeatability. Excellent electrical performance.**

High volume cable assembly manufacturing of a gigabit copper interconnect demands the following:

- Lot-to-lot consistent electrical performance
- Very low in-pair skew to maximize eye opening and control EMI
- Tight impedance control... minimal reflections
- Very close pair shield termination management (< .100" on all pairs) to minimize crosstalk and reflections at the connector.
- Low applied cost
- A cable / connector scheme that satisfies these criteria.

Do the above on all pairs all the time.

Our SKEWCLEAR Plus cable technology is the ONLY ONE that allows you to CONSISTENTLY strip all pairs at the same strip length.

Amphenol Spectra-Strip has developed a unique processing technique that eliminates the process control variables created by traditional concentric cabling techniques.

SKEWCLEAR Plus provides precision differential pairs laid parallel with individual shields for crosstalk isolation. Pairs are then laminated in short, 1.5" programmed "prefixure" sections to form a planar (flat) configuration suitable for mass prepara-

tion and robotic termination. The resulting planar shielded pair groups are then cabled, shielded and jacketed per industry standard. The laminated prefixure sections are programmable, thus permitting many options for termination zones. These zones are readily identifiable by external jacket marking.

Benefits (It's all in the process)

- Significant labor saving mass stripping and pre-fixturing of all pairs on each cable end. Traditional cable requires individual identification and separation of pairs, untwisting, and individual wire prepping. Quad designs in particular, require a difficult cross-over in the termination.
- Programmed pair lamination sections allows the ability to pre-align the stripped wires directly to the connector or paddleboard footprint, thus 'error proofing' the point-to-point termination while providing a means for rapid and volume processing. Traditional cable requires significant handling of the product to individually identify pairs, with subsequent manual fixturing and associated error potential.
- Allows for consistent control of pair shield strip lengths, ensuring close shield-to-termination processing thus providing minimal crosstalk and reflection at the termination. Traditional cable requires untwisting of individual pairs and the subsequent manipulation to minimize shield separation from pair, thus creating the additional potential of assembly electrical problems.



SKEWCLEAR Performance

Durability and Consistency

SKEWCLEAR cable is tough: As part of the SKEWCLEAR qualification process, a 5 meter length of 22 pair 30 awg 100 ohm cable was repeatedly flexed over a 4.0 inch diameter

mandrel for 250, 500, and 1000 cycles. The sample was checked for within-pair skew and differential impedance before and after the flex test. Results are shown on Tables A and B.

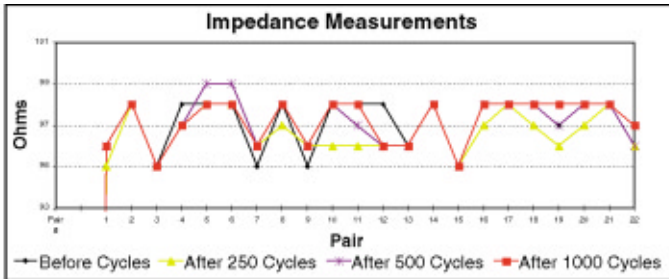


Table A

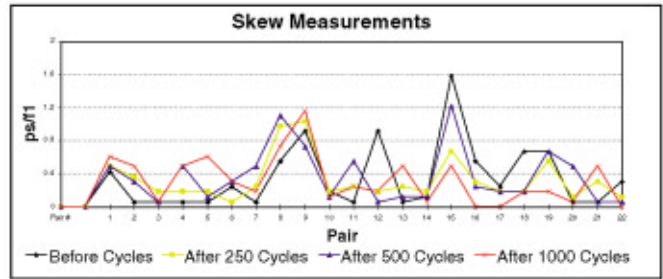
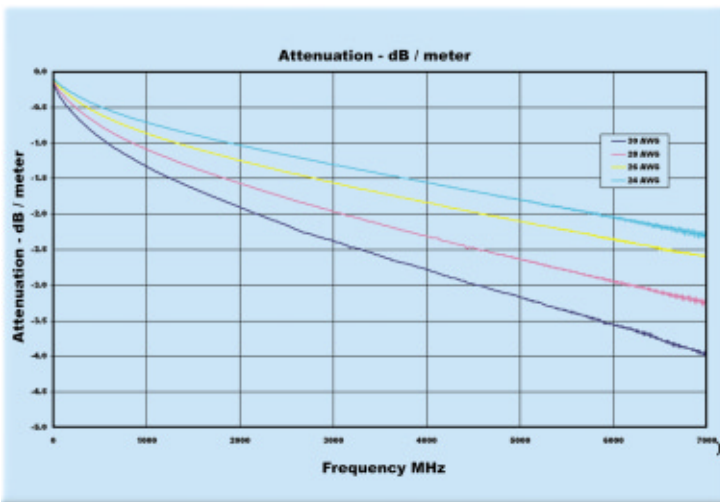
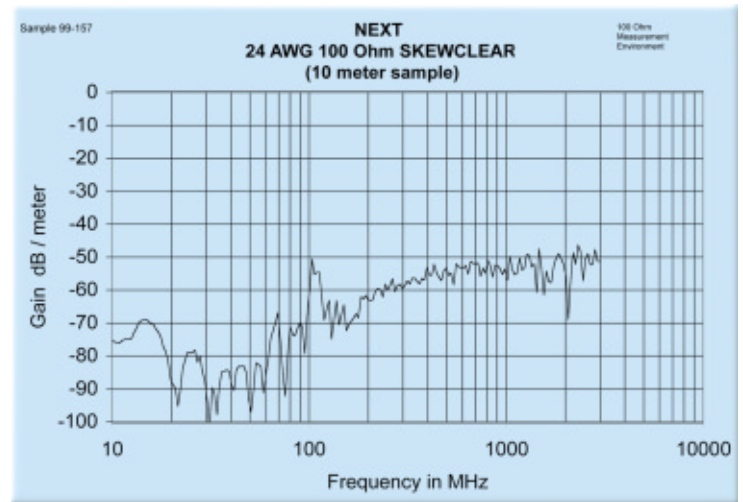


Table B

100 Ohm Skewclear Attenuation Plot dB/meter



Near-End Crosstalk



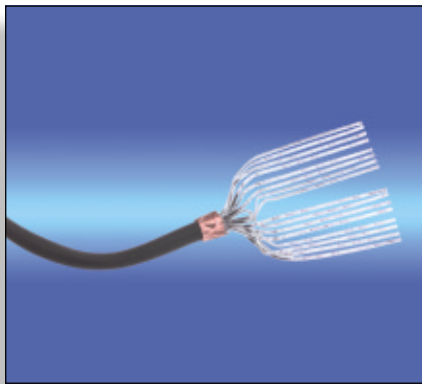
SKEWCLEAR

Applications

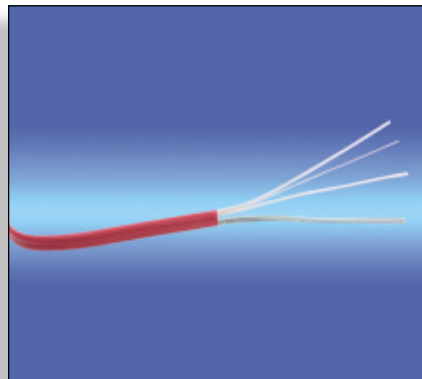
SKEWCLEAR® Applications

Computer

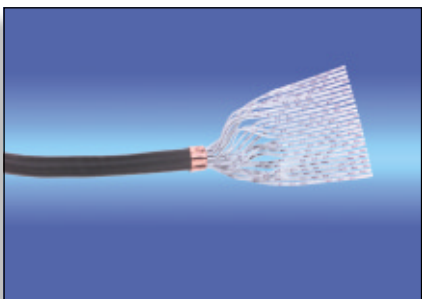
- High bandwidth LVDS signaling
- InfiniBand™ 2, 8, 12, 24 pair
- Double Speed Fibre Channel
- HIPPI 6400 (Super HIPPI)
- Low skew multi coax interconnections
- Digital Video Display
- Serial ATA



Cabled 2.5Gb Backplane



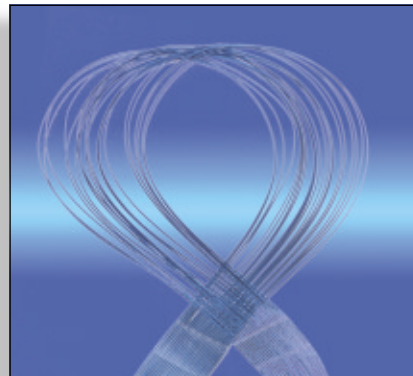
Serial ATA



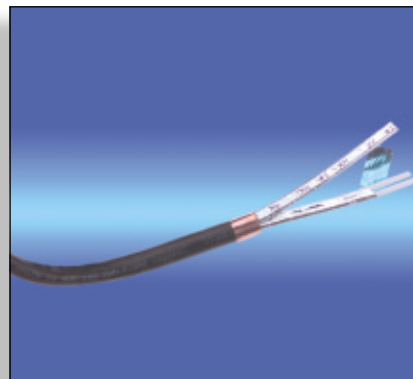
InfiniBand 12 X

Telecom

- SONET/SDH high speed copper links
- Rack-to-rack and frame-to-frame multiplexed copper links, e.g. National Semiconductor LVDS Channel Link™
- InfiniBand™ 2, 8, 12, 24 pair
- Flexible cabled backplanes
- 10 Gb Ethernet
- Alternative to Fiberoptics



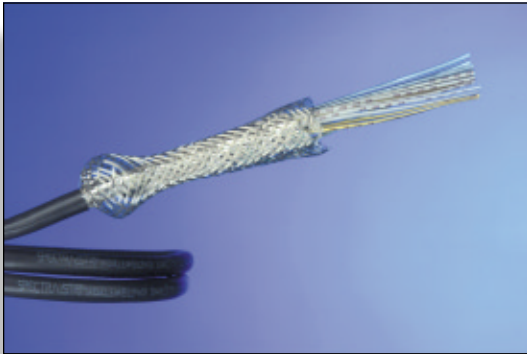
**High Speed
Internal LVDS**



**Double Speed
Fibre Channel**

SPECTRA-STRIP
Amphenol

High Speed LVDS



Features/Benefits

- 100± 5 Ohms differential impedance
- Up to 50 pairs
- Round or flat options
- Non drain wire option available
- High crosstalk isolation
- Extremely tight and consistent skew control
- Stable impedance

Applications

Computing

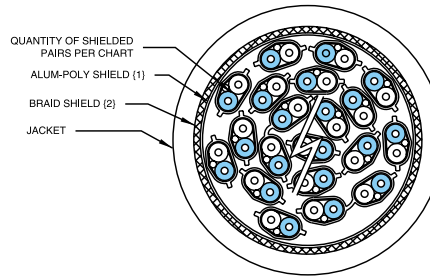
- Flat Panel Displays
- Monitor Link
- SCI processor interconnect
- Printer engine links
- System clustering
- Multimedia peripheral links

Telecom/Data

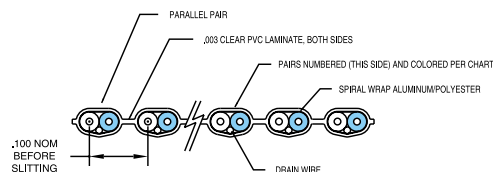
- Switches
- Add/drop multiplexers
- Hubs
- Routers
- Digital copiers
- Box to box and rack to rack

Companies such as National Semiconductor, Texas Instruments, and Silicon Image are marketing LVDS transceiver chipsets that enable low cost copper gigabit interconnects in telecommunications, digital video, and data communications applications. They are designed to provide greater bandwidth than traditional point to point technologies (such as RS232 or RS422). These chipsets typically take 21, 28 or 48 bit CMOS / TTL parallel data and serialize them onto 3, 4 or 8 data pairs. An additional pair acts as a clock to synchronize and sample the data. Depending on clock frequency and bit width, a total data throughput of 5.38 Gigabits / second can be achieved over 8 data pairs. Because of the high data pair frequency and distances involved, precision skew control is critical for accurate clocking of the data and control of EMI.

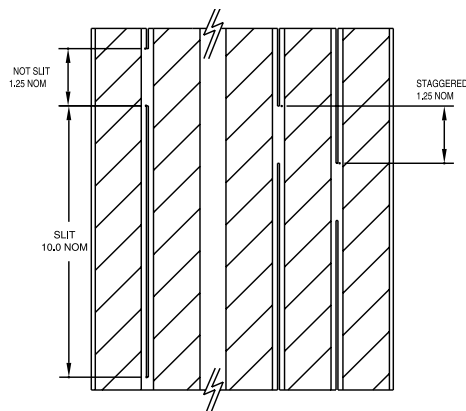
Assembled Round Cable



Flat Core Cable

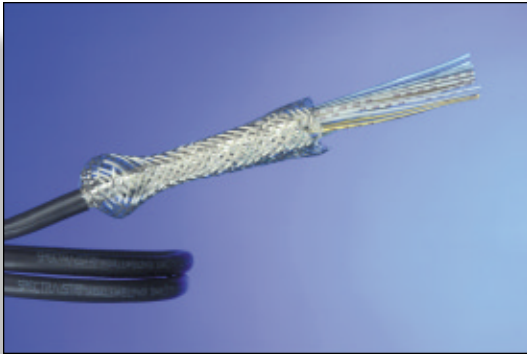


Slit Flat Cable



SKEW CLEAR

High Speed LVDS

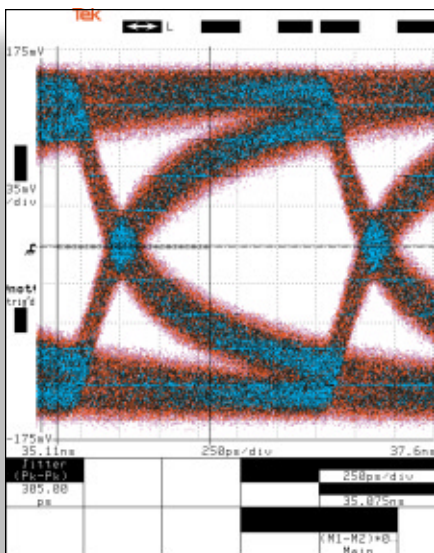


Ordering Information

Part Number	AWG	Pair Count
165-3099-938	30	4
165-3099-939	30	5
165-3099-940	30	8
165-3099-941	30	9
165-3099-942	30	10
165-3099-950	30	12
165-3099-943	30	15
165-3099-951	30	16
165-3099-952	30	18
165-3099-944	30	20
165-3099-945	30	25
165-3099-946	30	30
165-3099-953	30	34
165-3099-947	30	35
165-3099-948	30	40
165-3099-949	30	50
165-2899-941	28	4
165-2899-942	28	5
165-2899-943	28	8
165-2899-944	28	9
165-2899-945	28	10
165-2899-953	28	12
165-2899-946	28	15
165-2899-954	28	16
165-2899-955	28	18
165-2899-947	28	20
165-2899-948	28	25
165-2899-949	28	30
165-2899-950	28	34
165-2899-956	28	35
165-2899-951	28	40
165-2899-952	28	50

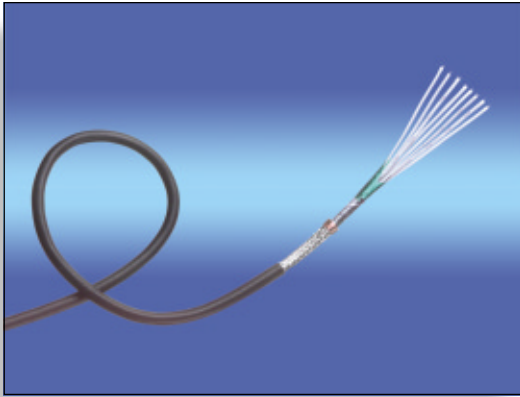
Part Number	AWG	Pair Count
165-2699-958	26	4
165-2699-959	26	5
165-2699-960	26	8
165-2699-961	26	9
165-2699-962	26	10
165-2699-970	26	12
165-2699-963	26	15
165-2699-971	26	16
165-2699-972	26	18
165-2699-964	26	20
165-2699-965	26	25
165-2699-966	26	30
165-2699-973	26	34
165-2699-967	26	35
165-2699-968	26	40
165-2699-969	26	50
165-2499-969	24	4
165-2499-970	24	5
165-2499-971	24	8
165-2499-972	24	9
165-2499-973	24	10
165-2499-981	24	12
165-2499-974	24	15
165-2499-982	24	16
165-2499-983	24	18
165-2499-975	24	20
165-2499-976	24	25
165-2499-977	24	30
165-2499-984	24	34
165-2499-978	24	35
165-2499-979	24	40

28 AWG 100 Ohm Output Eye Pattern



Input	PRBS	Data Rate	Eye Height	Jitter at Crossing	Length
350mv pp	2 ⁻¹⁵ -1	622Mb	140mv	285 ps (19%)	11 meters

SKEWCLEAR InfiniBandsm

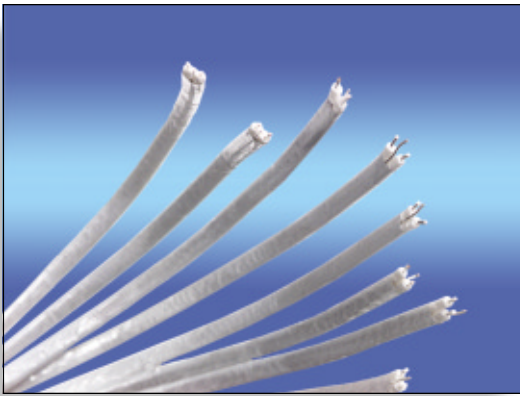


InfiniBand is a developing high bandwidth I/O architecture specification that combines the best of the industry's serial and parallel approaches to the scalable bandwidth demands of the computer and telecom industry.

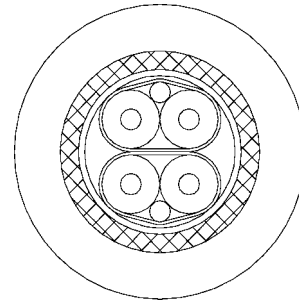
The InfiniBand specification provides for three data rates over high performance copper links: 1X (500 MBytes/s) 4X (2 GBytes/s), and 12 X (6 GBytes/s).

The pair signaling rate is 2.5Gbits (1.25GHz).

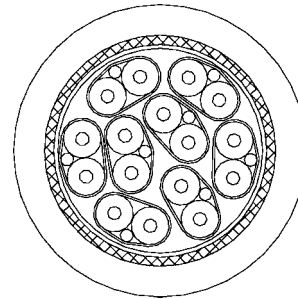
Spectra-Strip supports all speeds of InfiniBand with its family of SKEWCLEAR , precision shielded parallel pair cables. All products are UL CL2 / CSA FT4 listed.



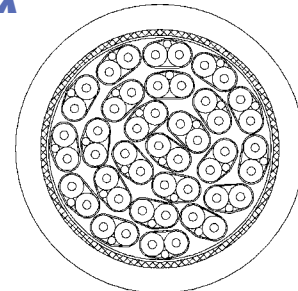
1X



4X



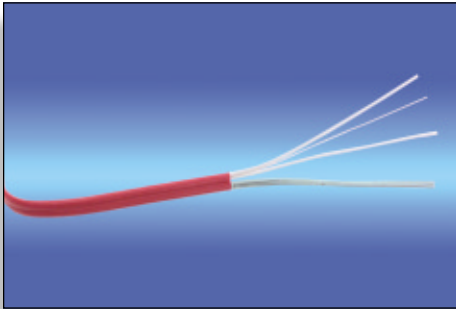
12X



Ordering Information

Part Number	AWG	No. Pairs	Application
160-2899-993	28	2	1X
160-2699-997	26	2	1X
160-2499-997	24	2	1X
160-2299-996	22	2	1X
166-2899-997	28	8	4X
166-2699-997	26	8	4X
166-2499-998	24	8	4X
166-2899-992	28	12	12X (2 cables)
166-2699-991	26	12	12X (2 cables)
166-2499-996	24	12	12X (2 cables)
166-2899-993	28	24	12X
166-2699-992	26	24	12X
166-2499-992	24	24	12X

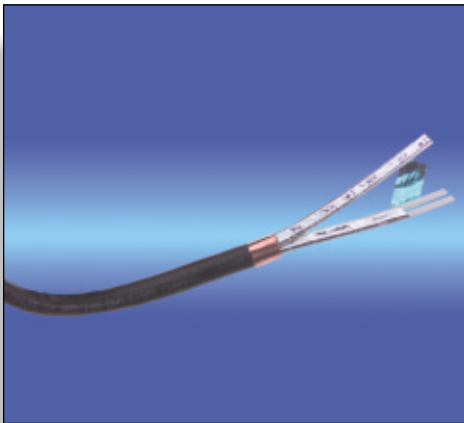
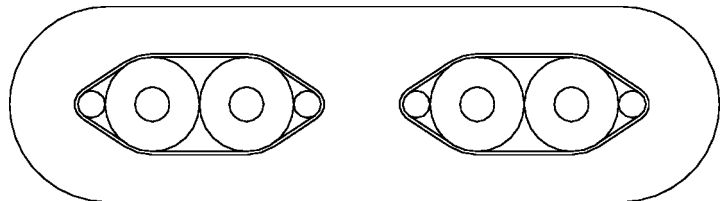
SKEWCLEAR Serial ATA / Fibre Channel



Serial ATA is a developing PC disk drive serial interconnect standard that is intended to replace Ultra ATA / 100's 80 conductor ribbon cable interface with a much smaller, higher data rate cable. The developing standard is roadmapped to support 1.5, 3.0, and 6.0Gb data transfer rates over 1 meter copper cabling. Spectra-Strip is supporting the developing Serial ATA standard with a family of low skew, 100 ohm differential twinaxial constructions.

Ordering Information

Part Number	AWG	No. Pairs
150-2699-947	26	2

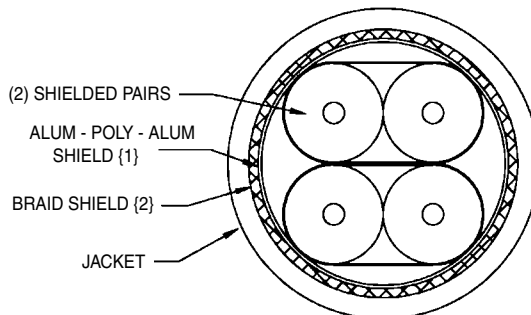


For emerging serial copper applications such as **Double Speed Fibre Channel**, traditional quad cables are found to be lacking in crosstalk and EMI performance at multi-gigabit transfer rates. Since pairs in quad constructions are not individually shielded, a significant impedance discontinuity and source of crosstalk occurs at the connector where pairs are separated for termination. Spectra-Strip has addressed this problem with its SKEWCLEAR line of dual shielded serial cables. The cable line consists of 2, individually shielded 150 ohm parallel pairs, extruded with foam polyolefin dielectric. Pairs are available from 30 awg through 22 awg for both internal and external applications.

Ordering Information

Part Number	AWG
160-3099-998	30 solid silver
160-2899-998	28 solid silver
160-2699-998	26 solid silver
160-2499-998	24 solid silver
160-2299-998	22 solid silver

Key advantages of the SKEWCLEAR construction are extremely low TD and amplitude skew, plus superior crosstalk performance in bidirectional applications. Crosstalk at the connector is minimized due to the heat sealed pair shields, which can be brought very close to the contacts. In addition, the grounding of pair shields to the overall frame ground cable shields throughout the cable length yields better EMI performance than quad type cables.



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Amphenol

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