S.I. TECH

Fiber Optic Communication Products

Bringing Fiber To The Desktop

USA & INTERNATIONAL HEADQUARTERS
1101 N. RADDANT ROAD ▪ BATAVIA ▪ IL 60510
PO BOX 609 ▪ GENEVA ▪ IL 60134
NATIONWIDE TOLLFREE 1-866-SITECH-1 [(866) 748-3241]
PHONE: (630) 761-3640 ▪ FAX: (630) 761-3644
WEB SITE: http://www.sitech-bitdriver.com
E-MAIL: sales@sitech-bitdriver.com

S.I. TECH

…an early innovator in the fiber optics industry

Along with the rapidly increasing use of computers and computer-driven equipment, there has been a rising demand for faster, higher quality (error-free) data communications. Fiber optics technology is the answer.

S.I. Tech has been on the leading edge of this technology since its early years. The founder of S.I. Tech managed Belden Corporation's new venture development activity in fiber optics. S.I. Tech acquired Belden's fiber optic systems business in 1984 followed by Honeywell's fiber optics multiplexer business in 1988.

An early entrant in the industry, S.I. Tech has developed numerous well known fiber optic products and application engineering solutions for customers worldwide. Its products today are sold and supported on all five continents. These products are performing in a wide variety of applications and environments from Alaska to Australia. "Mission critical" applications everywhere depend on S.I. Tech – from oil rigs in Asia to a factory in Europe or a University in the United States.

Factory-trained distributors worldwide make S.I. Tech your local source.

To be close to its global customer base, S.I. Tech works closely with a select group of distributors, system integrators, and other value-added resellers. These extensions of S.I. Tech are your "local" source for quality products and technical assistance.

S.I. Tech Offers:

- *Technical Support*
- *Customer Service*
- *Research & Development*
- *Network Solutions*
- *Quality Assurance Testing*
- *All Products Apply to Industry Standards*
- *Product Availability Worldwide*
- *All Products Manufactured in the USA*

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For information or to place an order:

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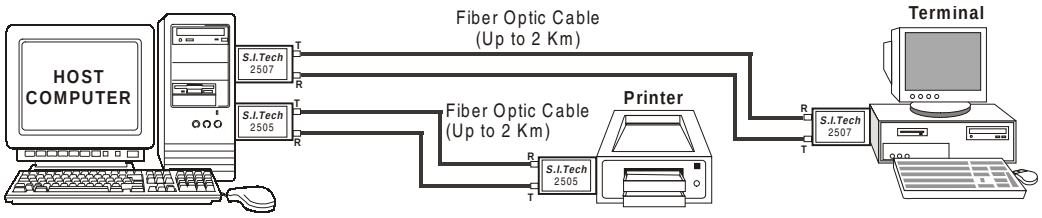
Catalog Index

Product Listing

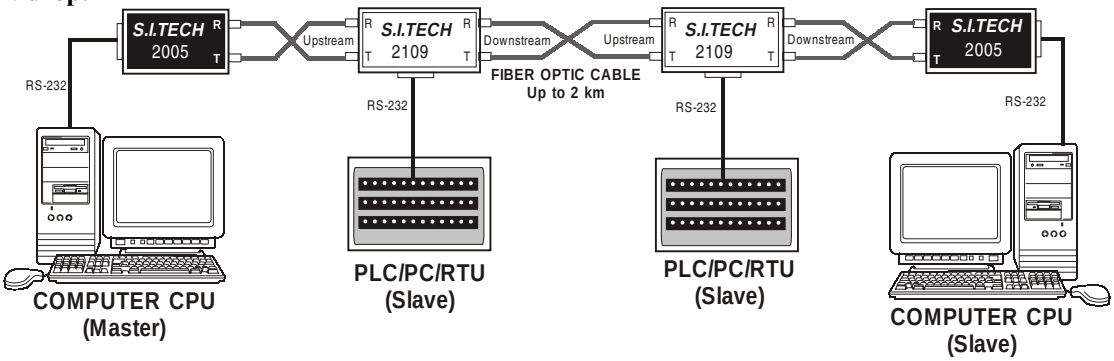
* Indicates a new product

RS-232 PRODUCTS

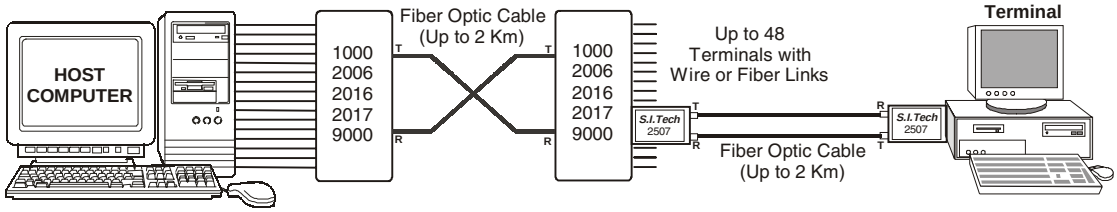
1. Point to Point:



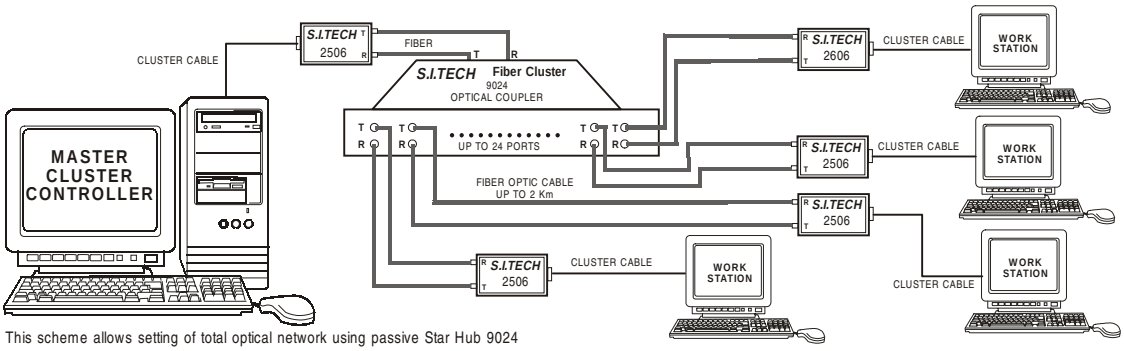
2. Multidrop:



3. Remote Terminal Cluster Using Multiplexers:



4. User Clusters:



This scheme allows setting of total optical network using passive Star Hub 9024

RS-232

S.I. Tech's business and original developments started with RS-232 or so called serial communications. In early 1980 with the need for computerization of various processes, offices, and businesses there was an increasing use of the serial port. It was apparent that longer distance communications was not possible as wire and cables of the day were very limited in data communications capabilities.

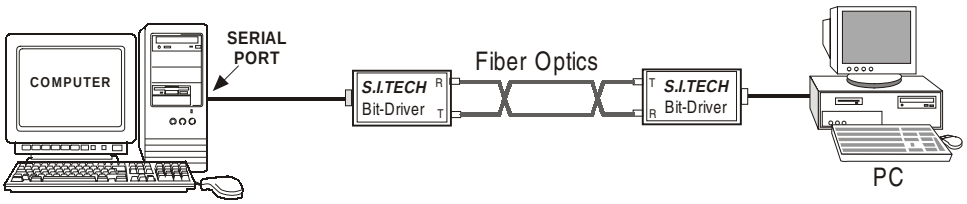
Belden and subsequently S.I.Tech were first to develop affordable fiber optic data communications. The first products were tested and approved by Bell Labs, DEC, and others. S.I.Tech has continued this tradition of developing new and different applications of fiber optics technology. S.I.Tech also develops specific OEM oriented products for very specific applications such as Energy Management Systems, POS Systems, and Process Control.

While S.I.Tech has concentrated on data communications with recent trends of merging datacom and telecommunications, many LAN/WAN products combine these capabilities.

RS-232 SPECIFICATION: Electronic Industries Association (EIA) and American National Standards Institute (ANSI) have issued EIA-232 standard for "Interface between Data Terminal Equipment (such as a computer) and Data Circuit Terminating Equipment Employing Serial Binary Data Interchange".

This standard is also covered under International Standard such as CCITT V.24, V.28, and ISO IS 2110.

Comparisons of various RS-232 products available from S.I. Tech can be found on the following pages. Specific technical data sheets can be viewed from the S.I. Tech web site, **http://www.sitech-bitdriver.com**.



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Web Site: http://www.sitech-bitdriver.com

RS-232 CONNECTOR

EIA-232 (formerly RS-232, which it is called by most of the industry and which it is called in S.I. Tech literature) is a standard for the interface between data terminal equipment (DTE) and data circuit terminating equipment (DCE), employing serial binary data exchange.

The standard calls for a specific 25-position connector that is called DB-25 in S.I. Tech literature. The standard also specifies that the female connector shall be part of the DCE. In general, S.I. Tech RS-232 Bit-Drivers® are DCE's and the connectors, as shown in Tables A, B, and C under "Data Connection", are DB-25F.

Contact numbering for DB-25F and DB-25M is shown in Figure 1. RS-232 assigns a function to each contact as shown in Table 1 but allows for non-standard pinouts for special applications. Individual data sheets for each S.I. Tech Bit-Driver product show the RS-232 pinouts for that product.

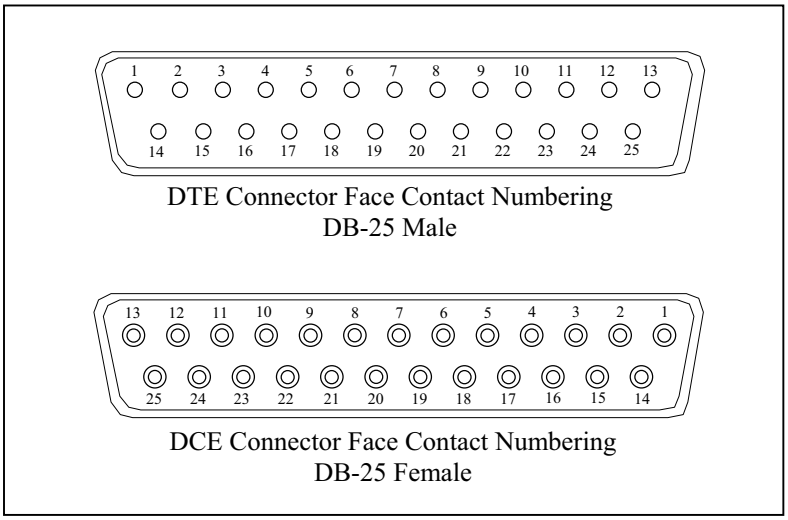

Figure 1. Contact Numbering for DB-25 M and DB-25 F

Interchange circuits between DTE and DCE fall into four general categories:

Ground or Common Return
Data Circuits
Control Circuits
Timing Circuits

Strictly speaking, two-way data communication can be maintained using only 3 pins:

Pin 2 - Transmitted Data
Pin 3 - Received Data
Pin 7 - Signal Ground

Everything else depends on the requirements of the DTE. For example, if the terminal needs to transmit a "request to send" and receive a "clear to send" before it can send data, some Bit-Drivers connect pin 4 directly to pin 5, while others include a delay circuit between 4 and 5.

It must be remembered that most DTE are configured to communicate with each other using modems (modulators-demodulators) so that telephone lines can be employed, and that the modems include circuitry directing the output from pin 2 of the near DTE to pin 3 of the far DTE and vice-versa so that you don't have two "transmit"circuits trying to talk to each other. If two DTE are adjacent, a "null modem" cable having DB-25F connectors at both ends and the proper pinout changes to permit communication as if modems were present can be used.

S.I. Tech Bit-Drivers are intended to replace modems and telephone cable with fiber optic cable (or in some cases dedicated copper cable) and they perform the cross-connection functions of a modem. Simply unplug the DTE RS-232 cable from the modem and plug it into the Bit-Driver at each end of the circuit.

TABLE 1
PIN NUMBER ASSIGNMENTS FROM RS-232-C
DB-25 CONNECTOR

PIN No.	DESCRIPTION AND ABBREVIATION		TYPICAL BIT-DRIVER® PINOUTS ASYNCHRONOUS	SYNCHRONOUS
1	Protective Ground		X	X
2	Transmitted Data	TD	X	X
3	Received Data	RD	X	X
4	Request To Send	RTS	X	X
5	Clear To Send	CTS	X	X
6	Data Set Ready	DSR	X	X
7	Signal Ground	G	X	X
8	Received Line Signal Detector	DCD	X	X
9	Reserved for Testing or Host-Powered Positive Voltage	12VDC	Mini	Mini
10	Reserved For Testing			
11	Unassigned			
12	Secondary Received Line Signal Detector			
13	Secondary Clear To Send			
14	Secondary Transmitted Data			
15	Transmitter Signal Element Timing (DCE Source)			X
16	Secondary Received Data			
17	Receiver Signal Element Timing (DCE Source)			X
18	Unassigned			
19	Secondary Request To Send			
20	Data Terminal Ready	DTR		X
21	Signal Quality Detector			
22	Ring Indicator			
23	Data Signal Rate Selector (DTE/DCE Source)			
24	Transmitter Signal Element Timing (DTE Source)			X
25	Unassigned			

NOTE: EIA-232-D changes Pin 1 Description to “shield” and adds certain test functions which are not implemented in S.I. Tech RS-232 Bit-Drivers®.

NOTE: These are Typical – See Individual Data Sheets for Exact Information

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TABLE A
RS-232 TO FIBER BIT-DRIVERS Ò (MODEMS)

Model No.	Package: Stand Alone	Package: Mini	Package: PC Card	Package: Rack Mount Card	Max. Data Rate Kbps	Data Format: Async	Data Format: Sync	Data Format: Control Signals	Power Option*	Data Connector**	Fiber Connector (Multimode)	Point to Point	Multidrop	Distance *** km: 2	5	10	20	Multimode**** System Wavelength (SM-1300nm) nm	Weight LB/KG	Fiber***** Connector (Single Mode)	Remarks
2001	√				56	√			1,2	DB-25 F	ST/SMA	√		√	√			880	2.2/1		Basic Async Model
2004	√				56		√		1,2	DB-25 F	ST/SMA	√		√	√	√	√	880	3/1.4	ST/FC/SC	
2005	√				56	√			1,2	DB-25 F	ST/SMA	√		√	√	√	√	880	3/1.4	ST/FC/SC	Async Plus Diagnostics
2036	√				64	√	√	√	1,2	DB-25 F	ST/SMA	√		√	√	√	√	820	3/1.4	ST/FC/SC	High Speed RS-232
2105		√			56	√			5	DB-25 F	ST/SMA	√	√	√				880	0.25/0.1		Async - Ring
2109		√			19.2	√			4	DB-25 F	ST/SMA	√	√	√	√	√	√	820	0.25/0.1	ST	Async - Fiber In/Out, RS-232 Drop
2304				√	56		√		1,2	DB-25 F	ST/SMA	√		√	√	√	√	880	0.5/0.2	ST	
2305				√	56	√			1,2	DB-25 F	ST/SMA	√		√	√	√	√	880	0.5/0.2	ST	
2320			√		19.2	√			ISA Bus	ISA Bus	ST/SMA	√	√	√	√	√	√	880	0.5/0.2		IBM PC XT/AT Card - 1/2 Channels
2503		√			19.2	√	√	√	6	DB-25 M	ST/SMA	√		√				820	0.25/0.1		Async/Sync Plus Control
2505		√			76	√			6	DB-25 M/F	ST/SMA	√		√	√			880	0.25/0.1		
2506		√			19.2	√		√	6	DB-25 M/F	ST/SMA	√		√	√			820	0.25/0.1		Async Plus Controls
2507		√			19.2	√			Host	DB-25 M/F	ST/SMA	√		√				820	0.25/0.1		Host Power
2512		√			76	√			6	DB-25 M/F	ST/SMA	√		√				820	0.25/0.1		2506 Mark and Space Reversed******
2515		√			76	√			6	DB-25 M/F	ST/SMA	√		√				880	0.25/0.1		2505 Mark and Space Reversed******
2517		√			19.2	√			Host	DB-25 M/F	ST/SMA	√		√				820	0.25/0.1		2507 Mark and Space Reversed******
2557		√			115	√			9	DB-25 M	ST/SMA	√		√				880	0.25/0.1		2505 +5v
3503		√			19.2	√	√	√	7	DB-25 M	ST/SMA	√		√				820	0.4/0.2		Async/Sync Plus Controls - Tempest

* Power Options: See "Power Options and How to Order" sheet (p. 80) for options and ordering instructions.
** Pin outs are specified in RS-232 pin out chart and data sheets
Temperature range 0 - 50 degrees C unless shown otherwise.
Extended Temperature (ET) range available on some products.
*** Distance: 2 km - STD, 5 km - L, 10 km - XL, 20 km - UL.

**** Use one wavelength throughout system except if WDM is used

***** Only Models having fiber connector entry in this column are available in single mode

****** Example:
2505 TR LED is ON in Mark Condition
2515 TR LED is OFF in Mark Condition
This feature is transparent to the DTEs but is desired by some users to be compatible with other manufacturers' products.

HOW TO ORDER

Base Model Number	Power*	Data Connector**	Distance***	Fiber and Connector: Multimode (MM) - STD	Fiber and Connector: Singlemode (SM) - Specify	Temperature
XXXX	1. 110 VAC - STD 2. 230 VAC - V 4, 5, 6, 7, and 9 See attached chart	M or F (F is STD on most models.)	2 Km - STD Other - Specify L, XL, or UL	ST - STD Other - Specify	ST - STD Other - Specify	0 - 50° C - STD -40 to +80° C - ET Other - Call S.I.Tech

e.g. 2005 = RS 232 to Fiber Bit-Driver, 110 VAC, DB25 Female, 2 Km, Multimode, ST Connectors, 0 - 50° C
2005V-XL-SM-SC = RS-232 to Fiber Bit-Driver, 230VAC, DB25 Female, 10 Km, Single Mode, SC Connectors, 0 - 50° C

Specifications subject to change without notice.

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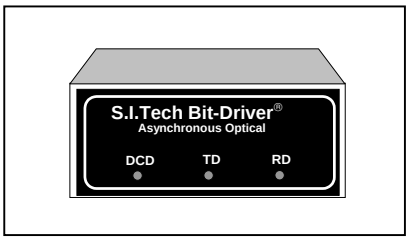
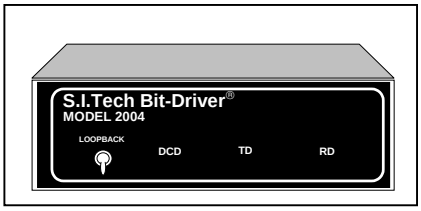
RS-232 TO FIBER OPTIC BIT-DRIVERS®

2001



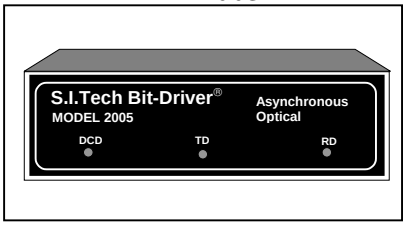
- Basic Asynchronous Simplex or Full Duplex Optical Bit-Driver®
- Max Data Rate is 56 Kbps
- Stand Alone - 110 VAC or 230 VAC Power Cord
- Optional Interfaces: RS-422/TTL/20mA Current Loop

2004



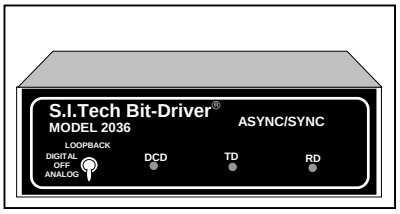
- Synchronous Simplex or Full Duplex Optical Bit-Driver®
- Switchable Internal Clock Rates 2.4 Kbps to 19.2 Kbps
- External Clocking for up to 56 Kbps
- Digital and Analog Loop-Back Tests
- Diagnostic Logic Probe built in

2005



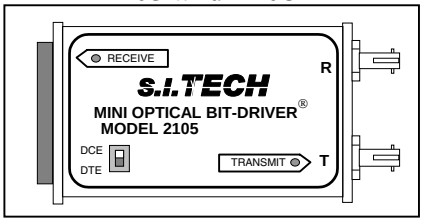
- Most Versatile RS-232 to Optical Asynchronous Bit-Driver®
- DTE/DCE Switch built in
- Diagnostic Logic Probe built in
- Multimode or Single Mode Fiber options
- Installed in Applications Worldwide

2036*



- Synchronous/Asynchronous Full Duplex Optical Bit-Driver®
- Switch-Selectable Synchronous Data Rates 9.6 Kbps to 64 Kbps
  Asynchronous Mode from 2.4 Kbps to 64 Kbps
- Switch Selectable Digital and Analog Loopback Test Capability
  built in

2105 and 2108



- Mini Asynchronous Simplex or Full Duplex Optical Bit-Driver®
- Intended for Single Fiber Optic Multidrop Ring Network using
  1 Fiber
- DTE or DCE Switch Selectable
- Max Data Rate is 56 Kbps
- 2108 consists of two S.I. Tech Model 2105 Optical Bit-Drivers
  in one Structure to Provide Redundant Ring Network

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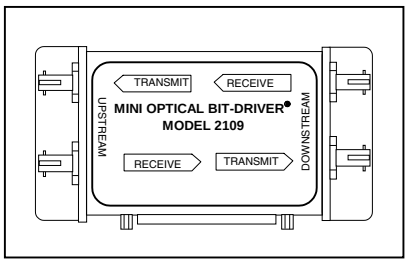
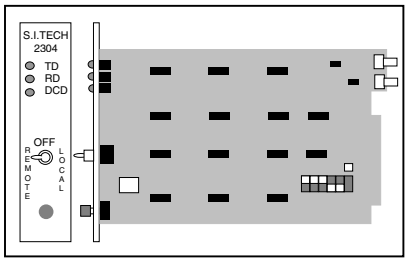
RS-232 TO FIBER OPTIC BIT-DRIVERS®

2109



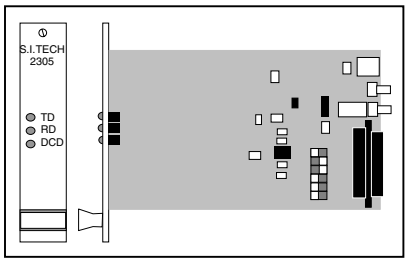
- Mini Asynchronous Half Duplex Optical Bit-Driver®
- Supports SCADA, PLC and other Multidrop Optical Networks
- Fiber ports repeat data through the 2109 and drop/insert data on the RS-232 port
- RS-232 Port only inserts data onto and gets data dropped from the upstream Fiber Port
- Downstream Fiber Port only sends/receives data from upstream Fiber Port
- Max Data Rate 19.2 Kbps
- Powered through RS-232 Port

2304



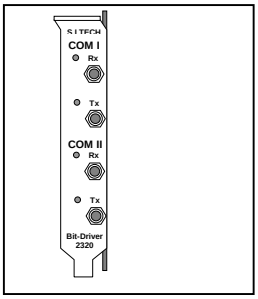
- Card Cage Mounted Synchronous Simplex or Full Duplex Optical Bit-Driver®
- Up to 16 Cards will fit S.I. Tech Model 3000B, 19 inch Rack
- Available on American Standard size Card
- Designed for use with S.I. Tech Model 2004 Standalone Bit-Driver

2305



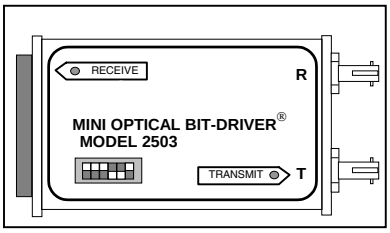
- Card Cage Mounted Asynchronous Simplex or Full Duplex Optical Bit-Driver®
- 2305 A on Eurocard fits S.I. Tech Model 3000A, 19 inch Rack
- 2305 B on American Standard Card fits S.I. Tech Model 3000B, 19 inch Rack
- Up to 16 Cards will fit 19 inch Rack
- Designed for use with S.I. Tech Model 2005/2505 or other Asynchronous Standalone or Mini Bit-Drivers

2320I & 2320II



- Board Level Asynchronous Simplex or Full Duplex Optical Bit-Driver®
- Fully Compatible with IBM PC, XT, AT or PC Compatible Computer
- Designed for use with S.I. Tech Model 2005/2505 or other Asynchronous Standalone or Mini Bit-Drivers
- Max Data Rate is 19.2 Kbps
- 2320 II is a Dual Channel RS-232 Communications Board, while 2320I is a Single Channel
- Software Controlled Diagnostics Supplied with Board

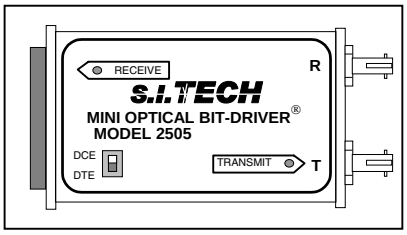
2503



- Mini Asynchronous/Synchronous Full Duplex Optical Bit-Driver®
- Switch Selectable Synchronous Date Rates 1.2 Kbps to 9.6 Kbps Asynchronous to 19.2 Kbps
- Provides for Control Signals (Handshake Lines)
- Recommended for such Applications as ATM Machines
- Designed to work with S.I. Tech 3503 TEMPEST Bit-Driver
- Male RS-232 DB-25 connector is standard

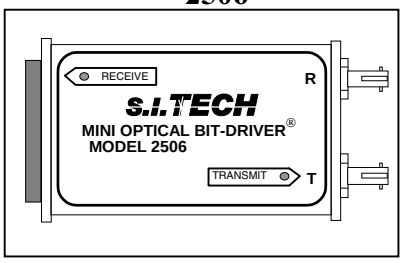
RS-232 TO FIBER OPTIC BIT-DRIVERS®

2505



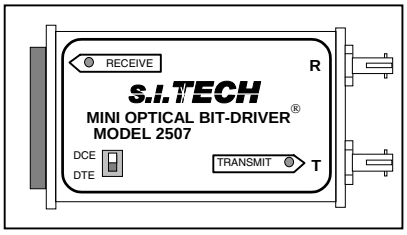
- Mini Asynchronous Simplex or Full Duplex Optical Bit-Driver®
- Low Cost – Most Popular Unit for Multimode Fiber Applications
- Speeds up to 115 Kbps
- Switch Selectable as DTE or DCE. Optionally available with male RS-232 DB-25 connector as 2505 M
- Power Directly thru Pin 9 or Externally with S.I.Tech Model 2121/2122 Power Supply
- Available with Mark and Space Reversed as Model 2515

2506



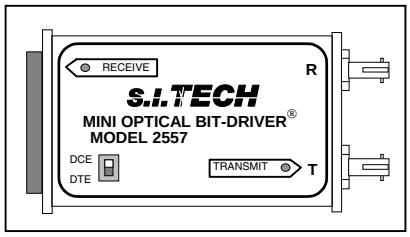
- Mini Asynchronous Simplex or Full Duplex Optical Bit-Driver®
- Implements Full Duplex Control (Handshake) Signals
- Up to 56 Kbps Asynchronous Data Rate
- Powered Directly through Pin 9 or externally with S.I. Tech Model 2121/2122 Power Supply
- Optionally Available with Male RS-232 DB-25 Connectors as 2506M and as Female 2506F

2507



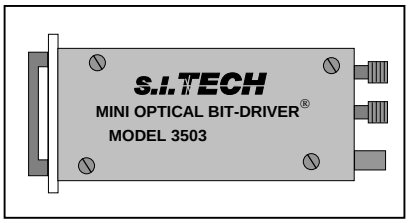
- Mini Asynchronous Simplex or Full Duplex Optical Bit-Driver®
- Powered only from Host Computer
- Up to 19.2 Kbps Asynchronous Data Rate
- Switch Selectable as DTE or DCE. Optionally Available with Male RS-232 DB-25 Connector as 2507M
- Standard Max Operating Distance 1.0Km. Optional Plastic Fiber version is 100 meters max (660nm) #2507-660
- Available with Mark and Space Reversed as Model 2517

2557*



- Mini Asynchronous Simplex or Full Duplex Optical Bit-Driver®
- Intended for use with Process Controller or Computer which supplies +5VDC on Pin 9
- Switch Selectable as DTE or DCE. Standard Model has RS-232 DB-25M Male Connector but RS-232 DB-25F Female Connector is Optional
- Up to 115 Kbps Asynchronous Data Rate
- 1000 Ft (300m) Distance Capability

3503



- Mini Synchronous/Asynchronous Full Duplex Optical Bit-Driver®
- Designed to Meet TEMPEST Specifications
- Connector is RS-232 DB-25M Male
- Switch Selectable Synchronous Date Rates up to 9.6 Kbps
- Asynchronous Date Rates to 19.2 Kbps
- Provides Control (Handshake) Signals
- 6600 Ft (2Km) Max Distance Capability

TABLE B

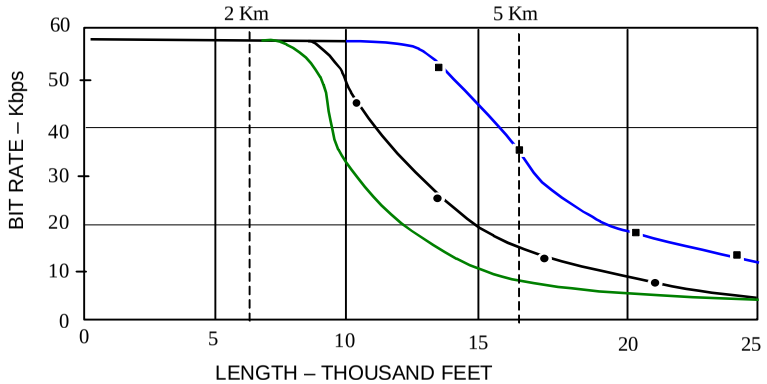
RS-232 METALLIC BIT-DRIVERS (SHORT HAUL MODEMS)

Can be used as Protocol Converters

Model No.	Package: Stand Alone	Package: Mini	Package: Rack Mount Card	Max. Data Rate Kbps	Data Format: Async	Power Option*	Data Connector**	Point to Point	Multidrop	Distance Km ***: 2 For Max. Data Rate	Distance Km ***: 5 See Curves For Data Rate	Weight LB/KG	Remarks
2025	√			56	√	1,2	DB-25 F	√	√	√	√	3/1.4	RS-232 to RS-422 Async
2325			√	56	√	1,2	DB-25 F	√		√	√	0.5/0.14	RS-232 to RS-422 Async
2330			√	19.2	√	1,2	DB-25 F	√		√	√	0.5/0.14	RS-232 to RS-422 Async
2331			√	19.2	√	1,2	DB-25 F	√		√	√	0.5/0.14	RS-232 to RS-422 Async (2 Units)
2526		√		19.2	√	5	DB-25 M/F	√		√	√	0.25/0.1	RS-232 to RS-422 Async
2527		√		19.2	√	Host	DB-25 M/F	√		√	√	0.25/0.1	RS-232 to RS-422 Async
2528		√		19.2	√	5	DB-25 F	√		√		0.25/0.1	RS-232 to RS-485 Async Protocol Converter
9338	√			56	√	1,2	DB-25 F	√		√	√	2.2/1	RS-232 to RS-422 Async, Plastic Case

* Power Options: See "Power Options and How to Order" sheet (p. 80) for options and ordering instructions.
** Pin outs are specified in RS-232 pin out chart and data sheets
Temperature range 0 - 50 degrees C unless shown otherwise.
Extended Temperature (ET) range available on some products.

***** Distance Chart**



National Electrical Code (NEC) Type

9562* 24 GAGE (AWG) TELEPHONE ---------- CM
8723* 22 GAGE (AWG) SHIELD ---------- CM
9184* 22 GAGE (AWG) DATALENE™ SHIELDED -------- CL2X

* Belden No. or Equivalent

Check NEC for suitability in your installation environment

HOW TO ORDER

Base Model Number	Power*	Data Connector**	Temperature
XXXX	110 VAC - STD 230 VAC - V 5. See attached chart	M or F (F is STD on all models)	0 - 50° C - STD Other - Call S.I.Tech

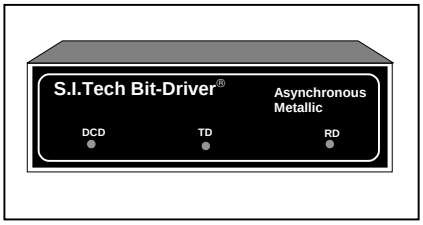
e.g. 9338 = 9338, 110 VAC, DB25 Female, 0 - 50°
2526M = 2526, (Requires S.I.Tech #2101 Power Supply) DB25 Male, 0 - 50° C

Specifications subject to change without notice.

S.I. Tech Inc., Batavia, IL 60510 Phone: (630) 761-3640 Fax: (630) 761-3644
Web Site: http://www.sitech-bitdriver.com

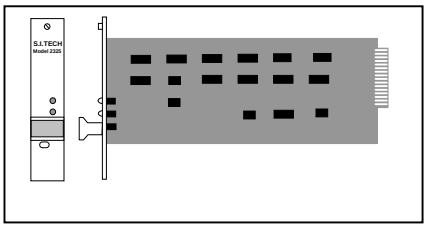
RS-232 METALLIC BIT-DRIVERS®

2025



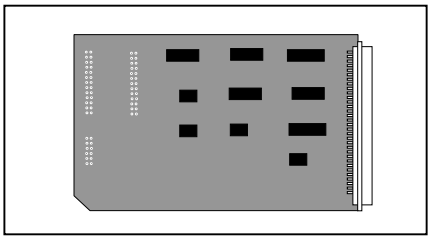
- Most versatile RS-232 to Metallic (RS-422) Asynchronous Simplex or Full Duplex, Stand Alone (Short Haul Modem) Bit-Driver®
- Data Rates up to 56 Kbps
- Transmission Lines protected at 8 volts up to 50 Amp Pulses
- Internal Diagnostic Logic Probe
- Internally switchable DTE/DCE
- Multidrop version available as 2025-MD

2325



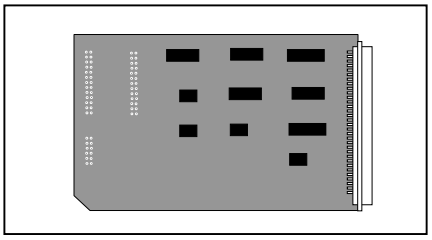
- Rack Mounted Card RS-232 to Metallic (RS-422) Asynchronous Simplex or Full Duplex Bit-Driver® (Short Haul Modem)
- American Standard Card Format for use in Model 3000B Rack
- Data rates up to 56 Kbps
- Work with 2025 Stand Alone Bit-Drivers up to 56 Kbps or with 2526/2527 Mini Bit-Drivers up to 19.2 Kbps

2330



- Rack Mounted Card RS-232 to Metallic (RS-422) Asynchronous Simplex or Full Duplex Bit-Driver® (Short Haul Modem)
- Eurocard Format for use in Model 3000A Rack
- Data Rates up to 19.2 Kbps
- Works with 2025 Stand Alone Bit-Drivers up to 19.2 Kbps or with 2526/2527 Mini Bit-Drivers

2331

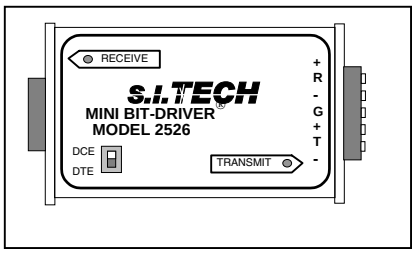


- Rack Mounted Card Dual RS-232 to Metallic (RS-422)
- Asynchronous Simplex or Full Duplex Bit-Drivers® (Short Haul Modems)
- Two independent Model 2330 Bit-Drivers on Single Eurocard
- Saves space – up to 32 Metallic Bit-Drivers will fit in one
- S.I. Tech Model 3000A Rack

S.I. Tech Inc., Batavia, IL 60510 Phone: (630) 761-3640 Fax: (630) 761-3644
Web Site: http://www.sitech-bitdriver.com

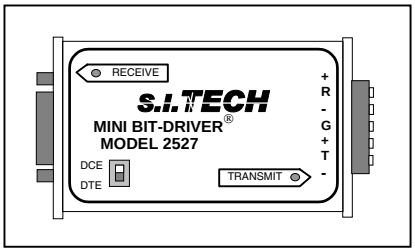
RS-232 METALLIC BIT-DRIVERS®

2526



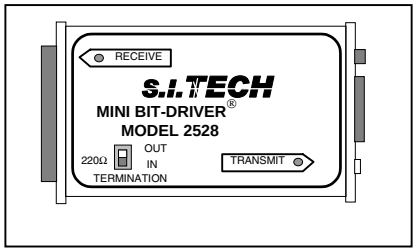
- Mini Asynchronous RS-232 to Metallic (RS-422) Simplex or Full Duplex Bit-Driver® (Short Haul Modem)
- Data rates up to 19.2 Kbps
- Externally Switch Selectable DTE or DCE operation
- Powered by +12V DC on Pin 9 of DTE or by External 12 VDC Power Supply – S.I. Tech Model #2101 (110 VAC) or #2102 (230 VAC)
- Male or Female RS-232 DB-25 Connectors available

2527



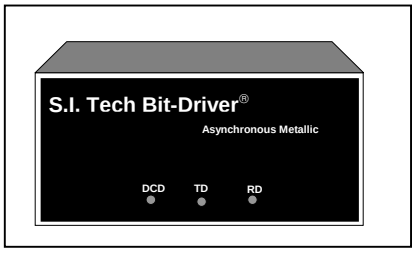
- Mini Asynchronous RS-232 to Metallic (RS-422) Simplex or Full Duplex Bit-Driver® (Short Haul Modem)
- Same details as S.I. Tech Model 2526 except power must come from Data Pins of DTE. No provision for External Power Supply

2528*



- Mini Optically Isolated RS-232 to RS-485 Protocol Converter Bit-Driver®
- RS-232 Interface is DB-25 Male or Female Connector
- RS-485 Interface is Female RJ-45 Connector
- Externally Switchable DTE or DCE Operation
- Externally Switchable 220 Ohm Termination
- Up to 256 Kbps Half-Duplex Operation up to one mile over 24 AWG Cable pairs
- External Power Supply, S.I. Tech Model #2101 (110VAC) or #2102 (230VAC)

9338



- Basic RS-232 to Metallic (RS-422) Asynchronous Simplex or Full Duplex Stand Alone Bit-Driver® (Short Haul Modem).
- Data Rates up to 56 Kbps
- Transmission Lines protected at 8 Volts up to 50 AMP Pulses
- Transmission Line DC Resistance limited to 150 ohms maximum one-way
- Attached Power Supply Cord for 110 VAC. 230 VAC model is available as 9338V

TABLE C
RS-232 TO FIBER OPTIC MULTIPLEXERS

Model No.	Package: Stand Alone	Package: Rack Mount	Max. Data Rate Kbps	Data Format: Async	Data Format: Sync	Data Format: Control Signals	Power Option*	Data Connector**	Number of Channels	Point to Point	Multidrop	Distance *** Km: 2	Distance *** Km: 5	Distance *** Km: 10	Distance *** Km: 20	Weight LB/KG	Multimode (820 nm)/ Singlemode (1300 nm)	Trunk**** Fiber Connector	Remarks
1000		√	19.2	√	√	√	1,2	DB-37/FO	48	√	√	√	√			13/6	MM/SM	ST/SMA	Tempest Option - Fiber In/Fiber Out
2006	√	√	19.2	√	√		1,2	DB-25 F	8	√		√	√	√	√	12/5.5	MM/SM	ST/SMA	
2007	√		19.2	√				DB-25 F	8	√		√				3/1.4	MM	ST/SMA	6 CMOS, 2 RS-232, Tempest Case
2016	√	√	19.2	√			1,2	DB-25 F	16	√		√	√	√	√	12/5.5	MM/SM	ST/SMA	
2017	√	√	76.8	√		√	1,2	DB-25 F	4 or 8	√		√	√			3/1.4	MM/SM	ST/SMA	Requires 7017 Cable
2216	√		19.2	√			1,2	DB-25 F	16	√		√	√			6/3	MM/SM	ST/SMA	2 - 8 Bit Words
9000	√	√	19.2	√			1,2	DB-25 F	16	√		√				13/6	MM	ST/SMA	
9001	√	√	19.2	√			1,2	FO	16	√		√				13/6	MM	ST/SMA	Fiber In/Out
9008	√	√	19.2	√			1,2	DB25 F	8	√		√				11/5	MM	ST/SMA	
9009	√	√	19.2	√			1,2	FO	8	√		√				11/5	MM	ST/SMA	Fiber In/Out

* Power Options: See "Power Options and How to Order" sheet (p. 80) for options and ordering instructions.
** Pin outs are specified in RS-232 pin out chart and data sheets
*** Distance: 2 km - STD, 5 km - L, 10 km - XL, 20 km - UL.
**** Other connector options for singlemode are SC and FC.
Temperature range 0 - 50 degrees C unless shown otherwise.

HOW TO ORDER

Base Model Number	Power Option*	Data Connector**	Distance***	Fiber Connector: Multimode (MM)-STD	Fiber Connector: Singlemode (SM)-Specify	Temperature
XXXX	1. 110 VAC - STD 2. 230 VAC - V	F (F is STD on all models.)	2 Km - STD Other Specify L, XL or UL	ST - STD Other - Specify	ST - STD Other - Specify	0 - 50° C - STD Other - Call S.I.Tech

e.g. 2006A = RS-232 Async, 8 CH to Fiber Multiplexer, 110 VAC, DB25 F, 2 Km, Multimode ST, 0 - 50° C
2006A-V-XL-SM-SC = RS-232 Async 8 CH to Fiber Multiplexer, 230 VAC, DB25 F, 10 Km, Single Mode, SC, 0 - 50° C

Specifications subject to change without notice.

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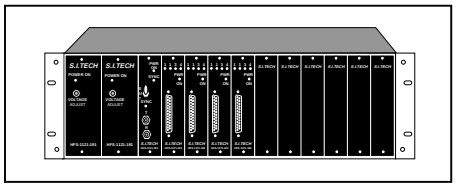
Web Site: http://www.sitech-bitdriver.com

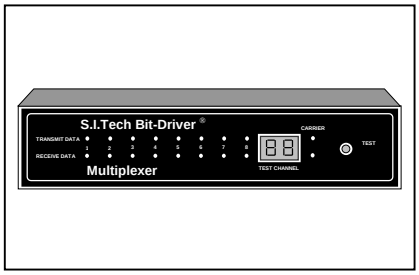
RS-232 TO FIBER OPTIC MULTIPLEXERS

1000



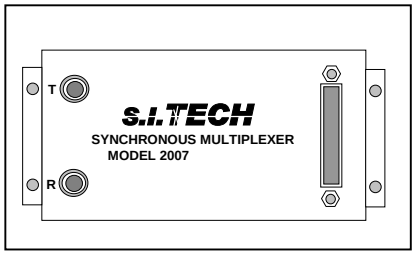
- Flexible Rack Mounted Time Division Multiplexer Bit-Driver® using Eurocard size cards for desired function
- Up to 48 Full Duplex Channels
- Backbone Data Rate is 10 Mbps
- TEMPEST version with Fiber in/out available
- See Series 1000 Data Sheet for card information

2006



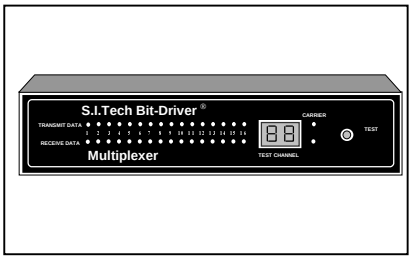
- Eight Channel Asynchronous/Synchronous Simplex or Full Duplex Time Division Multiplexer Optical Bit-Driver®
- Each Channel independently switchable internally for 0 to 19.2 Kbps Asynchronous or 1.2 Kbps through 19.2 Kbps (5 rates) Synchronous.
- Aggregate Speed is 160 Kbps
- Optional Metal Enclosure with ears for mounting in standard 19 inch Rack
- Detachable Power Supply Cord
- Optional Input/Output Interface for RS-422, TTL, 20mA
- Digital/Analog Loopback Test available for each channel independently

2007



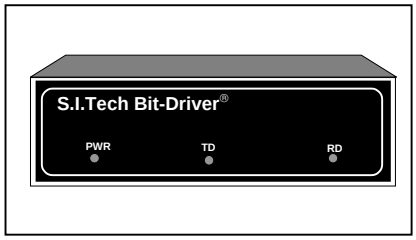
- Eight Channel Synchronous Simplex or Full Duplex Time Division Multiplexer Optical Bit-Driver®
- Two Channels have +/- 12V Swing RS-232 Interfaces
- Six Channels have 0-5V Swing CMOS Interfaces with Pull-up to +5V on each Input
- Max Data Rate is 19.2 Kbps
- Input Power ± 15V DC @ 250mA via RS-232 DB-25 F Connector

2016



- Sixteen Channel Asynchronous Simplex or Full Duplex Time Division Multiplexer Optical Bit-Driver®
- Max Data Rate is 19.2 Kbps
- Digital/Analog Loopback Test available for each channel independently
- Optional Input/Output Interface for RS-422, TTL, 20mA
- Optional Metal Enclosure with ears for mounting in standard 19 inch Rack

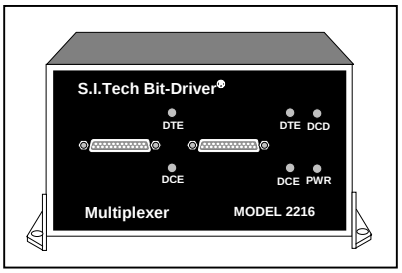
2017



- Four Channel Asynchronous Simplex or Full Duplex Time Division Multiplexer Optical Bit-Driver®
- Each Channel provides Full Duplex Data up to 19.2 Kbps
- Each Channel provides two Control (Handshake) Lines in each Direction
- Two Units can be mounted side by side in standard 19 inch Rack
- Each Unit requires one S.I. Tech #7017 “4-to-1” Cable

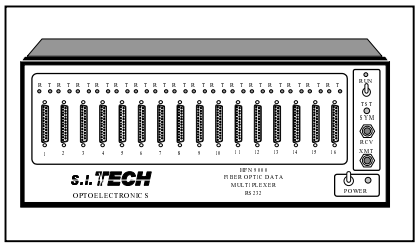
RS-232 TO FIBER OPTIC MULTIPLEXERS

2216



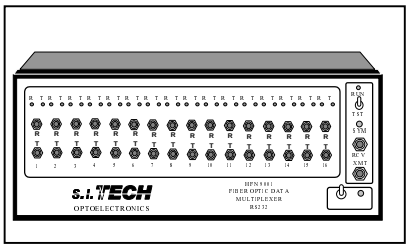
- Sixteen Channel Asynchronous Simplex or Full Duplex Time Division Multiplexer Optical Bit-Driver®
- Intended to move two eight-bit Parallel Words (one per RS-232 DB-25F Cable from DTE, two required).
- Data Rate is 19.2 Kbps per Channel, 320 Kbps Aggregate
- Built-in DCE/DTE jumpers
- Powered through 110 or 230VAC Line Cord

9000



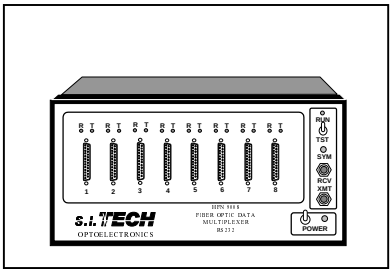
- Sixteen Channel Asynchronous Full Duplex Time Division Multiplexer Optical Bit-Driver® having RS-232 DB-25F Connectors for each Channel
- Max Data Rate is 19.2 Kbps
- Free Standing Metal Case. Rack Mount option available
- Powered through detachable 110 or 230VAC Line Cord
- "Run/Test" Switch enables both Local and Remote Loopback testing
- LED Transmit and Receive Indicators for each Channel

9001



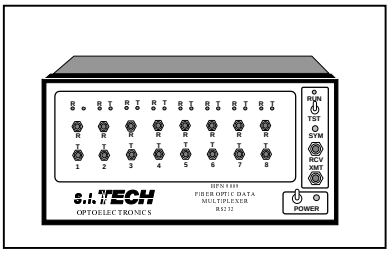
- Sixteen Channel Asynchronous Full Duplex Time Division Multiplexer Optical Bit-Driver® having Fiber Optic Receive and Transmit Connectors for each channel
- Allows for a total Fiber Optic Network (Fiber In, Fiber Out)
- Other details identical to Model 9000

9008



- Eight Channel Asynchronous Full Duplex Time Division Multiplexer Optical Bit-Driver® having RS-232 DB-25F Connectors for each Channel
- Max Data Rate is 19.2 Kbps
- Free Standing Metal Case. 19 inch Rack holds two Units
- Powered through detachable 110 or 230VAC Line Cord
- "Run/Test" Switch enables both Local and Remote Loopback testing
- LED Transmit and Receive Indicators for each Channel

9009



- Eight Channel Asynchronous Full Duplex Time Division Multiplexer Optical Bit-Driver® having Fiber Optic Receive and Transmit Connectors for each Channel
- Allows for a total Fiber Optic Network (Fiber In, Fiber Out)
- Other details identical to Model 9008

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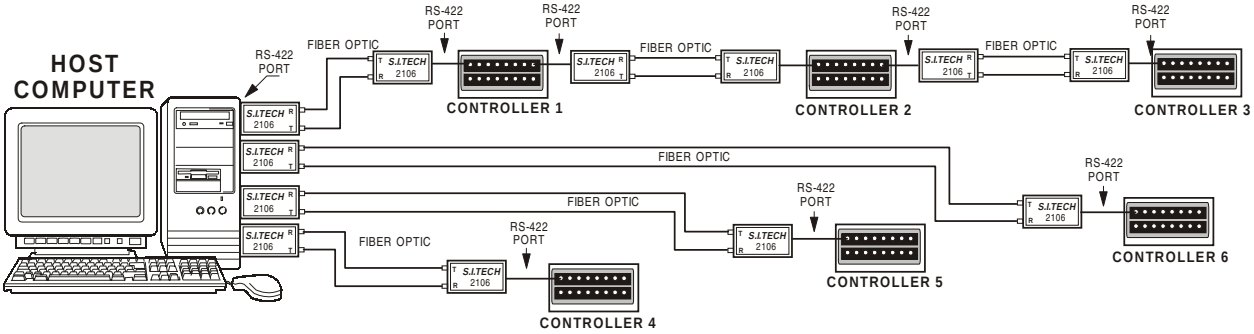
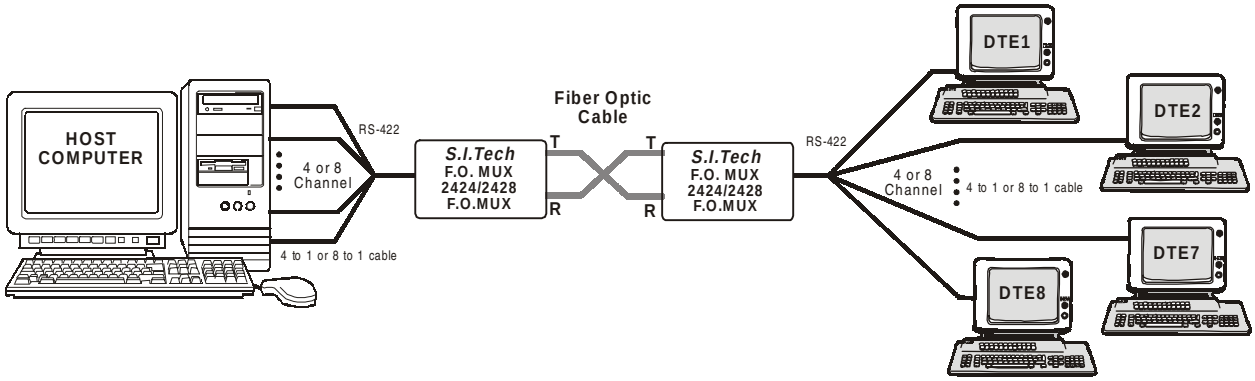
Web Site: http://www.sitech-bitdriver.com

RS-422 PRODUCTS

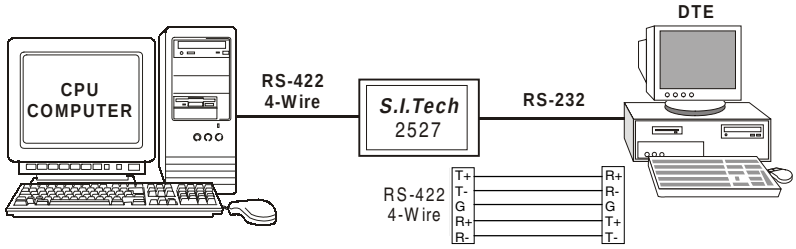
1. Point to Point:



2. Multiplexer:

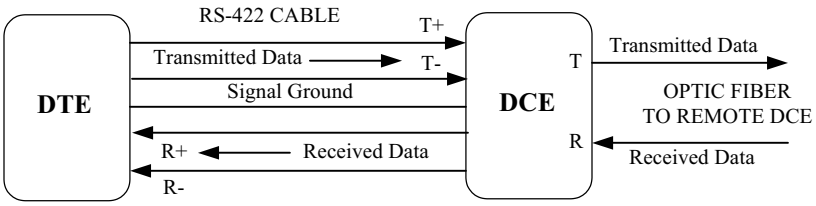


3. Protocol Conversion:



RS-422

EIA-RS-422 is a widely used specification for balanced 4-wire transmission (twisted or 2 twisted shielded pairs) where there is a signal transmit pair and a signal receive pair. Balanced transmission allows much longer distances and reduces the number of data errors.



Typical Setup

S.I.Tech supplies a broad array of products using RS-422 protocol for various applications such as process control, security systems, etc.

EIA-422 Standard specifies the electrical characteristics of the balanced voltage digital interface circuit, normally implemented in integrated circuit technology, that may be employed when specified for the interchange of serial binary signals between Data Terminal Equipment (DTE) and Data Circuit – Terminating Equipment (DCE) or in any point-to-point interconnection of serial binary signals between digital equipment.

The provisions of EIA-422 may be applied to the circuits employed at the interface between equipments where the information being conveyed is in the form of binary signals at the dc baseband level. This Standard shall be referenced by the specifications and specific interface standards applying these electrical characteristics.

EIA-422 is one of the series relating to the interconnection of DTE and DCE. Other EIA Standards in this series include RS-423-A and RS-449. RS-423 is applicable to unbalanced Interface Circuits and RS-449 is comprehensive Standard covering RS-422 plus flow control and timing circuits. EIA-422 is fully compatible with CCITT recommendations V.11 and X.27.

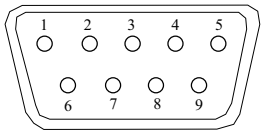
RS-422 CONNECTOR

Unlike RS-232, which is a standard for the interface between data terminal equipment and data terminating equipment, including connector dimensions and pin number assignments, RS-422 and RS-485 are standards for the electrical characteristics of balanced digital systems. They specifically do not cover such details as pin assignments.

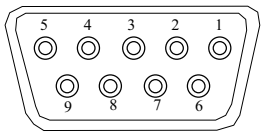
Over the years, individual manufacturers of equipment having electrical characteristics conforming to RS-422 or RS-485 have selected electrical connections ranging from twisted pig-tails through screw terminals, various type D connectors and modular RJ-XX telephone-type plugs and jacks.

S.I. Tech products made for use in RS-422 or RS-485 systems employ all of the above connection methods to comply with standards set by individual manufacturers. Some of these are shown in the sketches below.

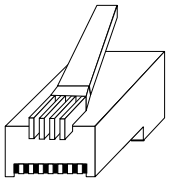
Please check the appropriate tables or individual data sheets to determine which data connection methods are available on the product you are considering and to get pinout information.



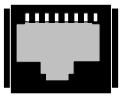
DTE Connector Face Contact Numbering
DB-9 Male



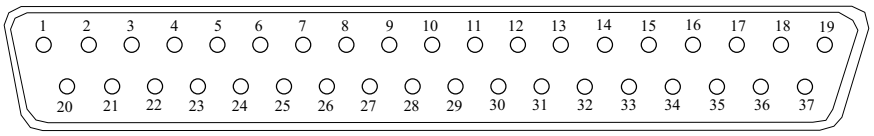
DCE Connector Face Contact Numbering
DB-9 Female



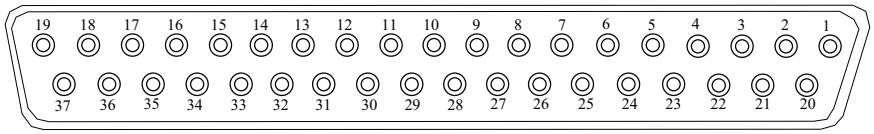
RJ-45 Connector



RJ-45 Connector



DTE Connector Face Contact Numbering
DB-37 Male



DCE Connector Face Contact Numbering
DB-37 Female

TABLE D
RS-422 TO FIBER BIT-DRIVERS^{Ò} (MODEMS)

Model No.	Package: Stand Alone	Package: Mini	Package: Rack Mount Card	Max. Data Rate Kbps	Data Format: Async	Data Format: Sync	Power Option*	4 Wire Data Connector**	Multimode Fiber: Connector	Multimode Fiber: Wavelength **** nm	Singlemode Fiber Connector ***** 1300 nm	Point to Point	Distance *** Km: 2	Distance *** Km: 5	Distance *** Km: 10	Weight LB/KG	Remarks
2012	√			56	√		1,2	Terminal Block	ST/SMA	880	ST/FC/SC	√	√	√	√	3/1.4	Wall Mount
2106		√		56	√		6	DB-9M/F	ST/SMA	880		√	√	√		.25/.1	Mini, 4 Wire RS-422
2116		√		38.4		√	6	DB-9M/F	ST/SMA	880		√	√	√		.25/.1	Variable Speed, 4 Wire
2176		√		256	√		6	DB-9 F	ST/SMA	820	ST	√	√	√	√	.25/.1	High Speed, Mini
2322			√	56	√		1,2	RJ45	ST/SMA	880		√	√	√		.5/.2	Card - 3000 Chassis
2376			√	256	√		1,2	RJ45	ST/SMA	820	ST	√	√	√	√	.5/.2	Card - 3000 Chassis
2857	√			10 M	√		1,2	Terminal Block	ST/SMA	820	ST/FC/SC	√	√	√	√	3/1.4	High Speed RS-422
HFS 1172-132			√	76.8	√	√	1,2	DB-25 F	ST/SMA	820		√	√			.5/.2	Card - 1000 Chassis
HFS 1176-192			√	2 M	√		1,2	Triax	ST/SMA	820		√	√			.5/.2	Card - 1000 Chassis
575-0656-004			√	10 M	√		1,2	Triax	ST/SMA	820		√	√			.5/.2	Card - 1000 Chassis 4 Ch Xmtr
575-0656-005			√	10 M	√		1,2	Triax	ST/SMA	820		√	√			.5/.2	Card - 1000 Chassis 4 Ch Rcvr
FODU	√		√	Various	√		1,2	-	ST/SMA	820		√	√	√		-	System

* Power Options: See "Power Options and How to Order" sheet (p. 80) for options and ordering instructions.
** Pin outs are specified in data sheets
Temperature range 0 - 50 degrees C unless shown otherwise.
Extended Temperature (ET) range available on some products.
*** Distance: 2 km - STD, 5 km - L, 10 km - XL, 20 km - UL

**** Use one wavelength throughout system except if WDM is used

***** Only Models having fiber connector entry in this column are available in single mode

HOW TO ORDER

Base Model Number	Power*	Data Connector**	Distance***	Fiber and Connector: Multimode (MM)-STD	Fiber and Connector: Singlemode (SM) -Specify	Temperature
XXXX	1. 110 VAC - STD 2. 230 VAC - V 6. See Chart	M or F (F is STD on most models)	2 Km - STD Other - Specify L, XL, or UL	ST-STD Other-Specify	ST-STD Other-Specify	0 - 50^{o} C - STD -40 to +80^{o} C - ET Other - Call S.I. Tech

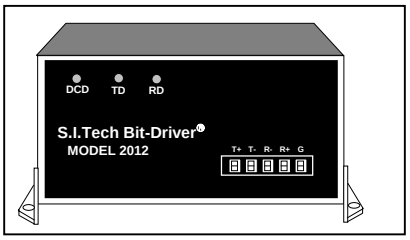
e.g. 2012 = RS 422 to Fiber Bit-Driver, 110 VAC, Terminal Block, 2 Km, Multimode, ST Connectors, 0 - 50^{o} C
2106 = RS-422 to Fiber, Mini Bit-Driver, DB9F, 2 Km, Multimode, ST Connectors, 0 - 50^{o} C, uses 2121 Power Supply

Specifications subject to change without notice.

S.I. Tech Inc., Batavia, IL 60510 Phone: (630) 761-3640 Fax: (630) 761-3644
Web Site: http://www.sitech-bitdriver.com

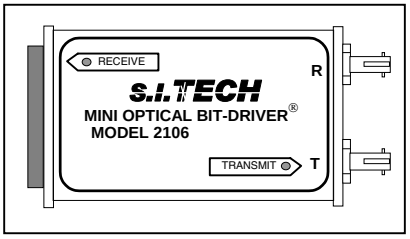
RS422 TO FIBER OPTIC BIT-DRIVERS®

2012



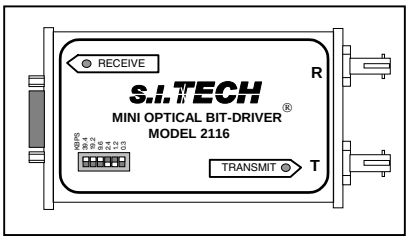
- Wall mounted Asynchronous Simplex or Full Duplex Optical Bit-Driver®
- Max Data Rate is 56 Kbps
- Input/Output Interface is 4 wire (plus ground) Terminal Block for RS-422
- Power Supply Cord for 110VAC. Order S.I. Tech 2012V for 230VAC
- Particularly suitable for use with GE, SIEMENS, and other Programmable
  Controllers in environments such as cargo container cranes at Seaports

2106



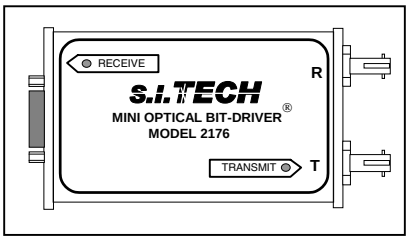
- Mini Asynchronous Simplex or Full Duplex Optical Bit-Driver®
- Max Data Rate is 56 Kbps
- Input/Output Interface DB-9 Female (Male optional)
- Connects directly to Terminal or by RS-422 2 pair cable
- Uses External Power Supply, S.I. Tech Model 2121 (110VAC) or 2122 (230VAC)

2116



- Mini Synchronous Simplex or Full Duplex Optical Bit-Driver®
- Switch Selectable Synchronous Data Rates from 0.3 through 38.4Kbps
- Input/Output Interface is DB-9 Male (Female optional)
- Connects directly to Terminal or by RS-422 2 pair cable
- Designed to work with United Telecom C, X, and L BUS System
- Uses External Power Supply, S.I. Tech Model 2121 (110VAC) or 2122 (230VAC)

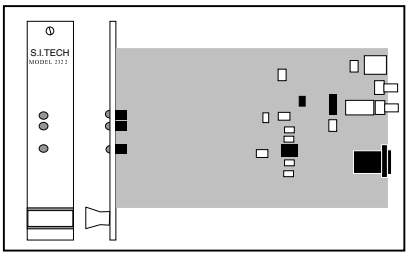
2176



- Mini Asynchronous Simplex or Full Duplex Optical Bit-Driver®
- Max Data Rate is 256 Kbps
- Designed for use with Micros POS Systems
- Works with S. I. Tech Model 2376 Card Mounted Bit-Driver

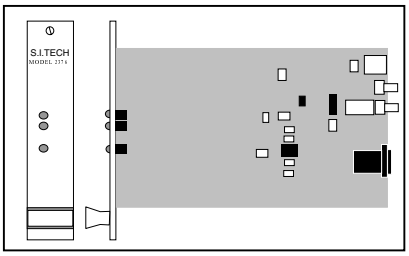
RS422 TO FIBER OPTIC BIT-DRIVERS®

2322



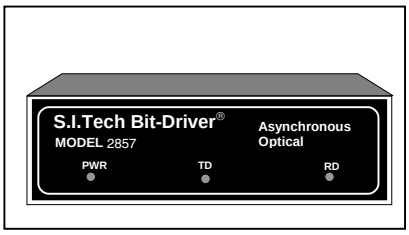
- Card Cage Mounted Asynchronous Simplex or Full Duplex Optical Bit-Driver®
- Max Data Rate is 56 Kbps
- Input/Output Interface is 8 Pin RJ-45 Female Connector
- Available on Eurocard, fits S.I. Tech Model 3000A, 19 inch Rack
- Designed to work with S.I. Tech Model 2106 or 2012 Bit-Drivers®

2376



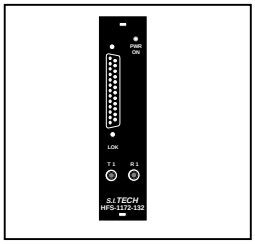
- Card Cage Mounted Asynchronous Simplex or Full Duplex Optical Bit-Driver®
- Max Data Rate is 256 Kbps
- Input/Output Interface is 8 Pin RJ-45 Female Connector
- Switchable Line Termination provided
- Designed for use with Micros System
- Designed to work with S.I. Tech Model 2176 Mini Bit-Driver®

2857



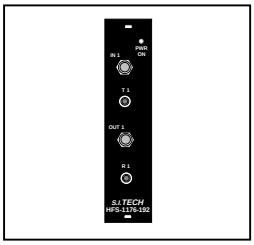
- High Speed Stand Alone Asynchronous Simplex or Full Duplex Optical Bit-Driver®
- Max Data Rate is 10 Mbps
- Input/Output Interface is 4 Wire (plus Ground) Terminal Block for RS-422
- Power Supply Cord for 110VAC. Order S.I. Tech Model 2857V for 230VAC

HFS 1172-132



- Asynchronous/Synchronous RS422 Optical Bit-Driver®
- Eurocard Format for use in S.I. Tech Model 1000 Card Cage
- Max Data Rate is 76.8 Kbps (9.6 Kbps for Handshake Lines)
- Separately Switchable Slave/Not Slave, Asynch/Synch, DTE/DCE
- Switchable Synchronous Data Rate 150 bps through 76.8 Kbps (15 steps)

HFS 1176-192

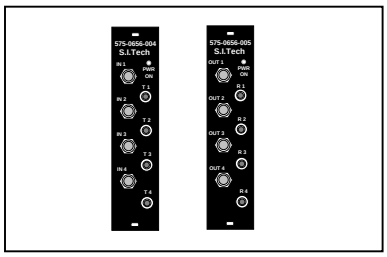


- Asynchronous RS422 Optical Bit-Driver®
- Eurocard Format for use in S.I. Tech Model 1000 Card Cage
- Max Data Rate is 2 Mbps
- Input/Output connectors are Triaxial with Isolated Outer Shield
- Termination is 220 ohms

S.I. Tech Inc., Batavia, IL 60510 Phone: (630) 761-3640 Fax: (630) 761-3644
Web Site: http://www.sitech-bitdriver.com

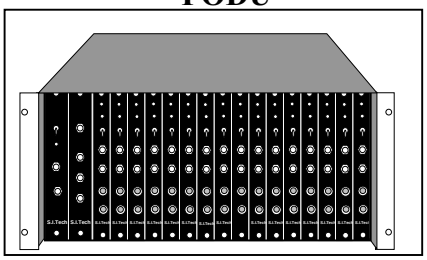
RS422 TO FIBER OPTIC BIT-DRIVERS®

575-0656-004 and 005



- 575-0656-004 is a 4 Channel Asynchronous High Speed RS-422 to Optical Transmitter Bit-Driver®
- 575-0656-005 is a 4 Channel Asynchronous High Speed RS-422 to Optical Receiver Bit-Driver®
- Max Data Rate is 10 Mbps
- Both are Eurocard format for use in S.I. Tech Model 1000 Card Cage and must be used in pairs for duplex operation
- Input/Output connectors are Triaxial with Isolated Outer Shield
- Transmitter Termination is 220 ohms

FODU



- Connect up to 16 Workstation Modules using Fiber
- 4 Km Distance Capability
- Polled Response HDLC Protocol
- Data Rate is 13 to 854 Kbps
- RS422 Interface, NRZ Data

TABLE E
RS-422 TO FIBER OPTIC MULTIPLEXERS

Model No.	Package: Stand Alone	Package: Rack Mount	Max. Data Rate Kbps	Data Format: Async	Data Format: Sync	Data Format: Control Signals	Power Option*	Data Connector**	Number of Channels	Point to Point	Multidrop	Distance *** Km: 2	5	10	20	Weight LB/KG	Multimode (820 nm)/ Singelmode (1300 nm)	Trunk**** Fiber Connector	Remarks
2424	√		256	√			1,2	DB37 F	4	√		√	√	√		3/1.4	MM/SM	ST/SMA	uses 1 to 4 cable 7024
2428	√		76.8	√			1,2	DB37 F	8	√		√	√	√		3/1.4	MM/SM	ST/SMA	uses 1 to 8 cable 7028

* Power Options: See "Power Options and How to Order" sheet (p. 80) for options and ordering instructions.
** Pin outs are specified on data sheets
*** Distance: 2 km - STD, 5 km - L, 10 km - XL, 20 km - UL.
****Other connector options for singlemode are SC and FC.
Temperature range 0 - 50 degrees C unless shown otherwise.

HOW TO ORDER

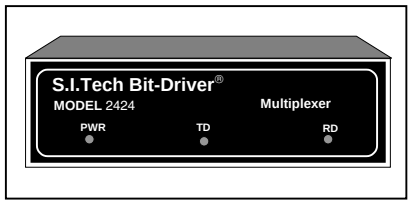
Base Model Number	Power*	Data Connector**	Distance***	Fiber and Connector: Multimode (MM) - STD	Fiber and Connector: Singlemode (SM)-Specify	Temperature
XXXX	110V - STD 230VAC - V	M or F (F is STD on most models.)	2 Km - STD Other - Specify L, XL, or UL	ST - STD Other - Specify	ST - STD Other - Specify	0 - 50° C - STD Other - Call S.I. Tech

e.g. 2424 = RS422 Async, 4 CH Fiber Multiplexer, 110VAC, DB37 F, 2Km, Multimode ST, 0-50 C

Specifications subject to change without notice.

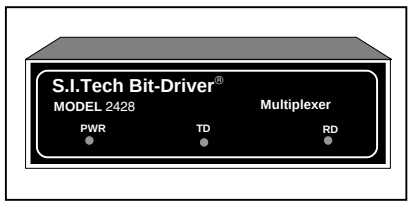
RS-422 TO FIBER MULTIPLEXERS

2424*



- Four Channel Asynchronous Simplex or Full Duplex Time Division Multiplexer Optical Bit-Driver®
- Max Data Rate is 256 Kbps on each channel
- Powered through 110 VAC line cord
- 230 VAC version available as S.I. Tech Model 2424V
- Each unit requires 4-to-1 RS-422 cable S.I. Tech #7024

2428*

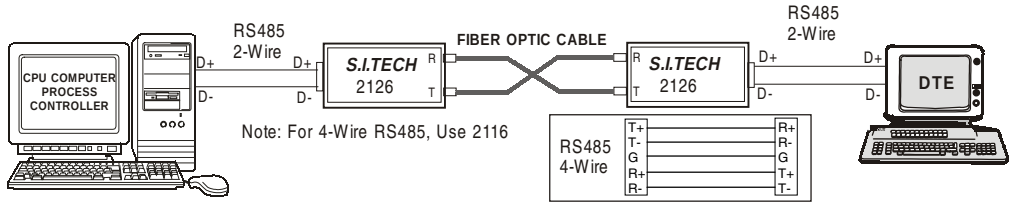


- Eight Channel Asynchronous Simplex or Full Duplex Time Division Multiplexer Optical Bit-Driver®
- Max Data Rate is 76.8 Kbps on each channel
- Powered through 110 VAC line cord
- 230 VAC version available as S.I. Tech Model 2428V
- Each unit requires 8-to-1 RS-422 cable S.I. Tech #7028

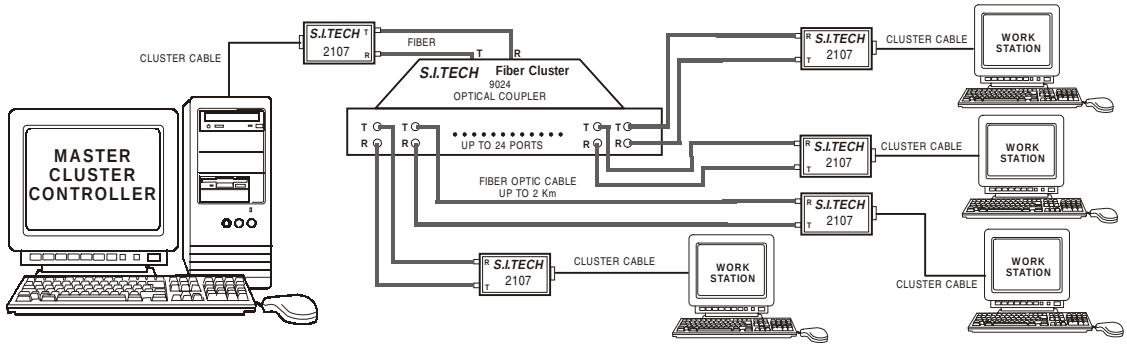
S.I. Tech Inc., Batavia, IL 60510 Phone: (630) 761-3640 Fax: (630) 761-3644
Web Site: http://www.sitech-bitdriver.com

RS-485 PRODUCTS

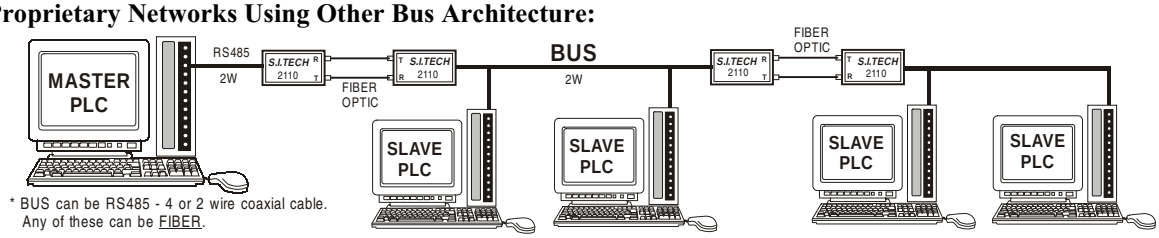
1. Point to Point:



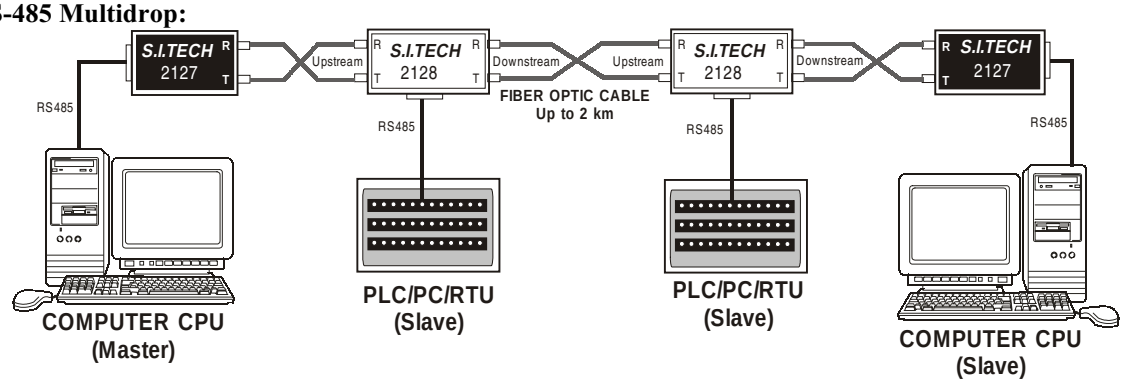
2. User Clusters:



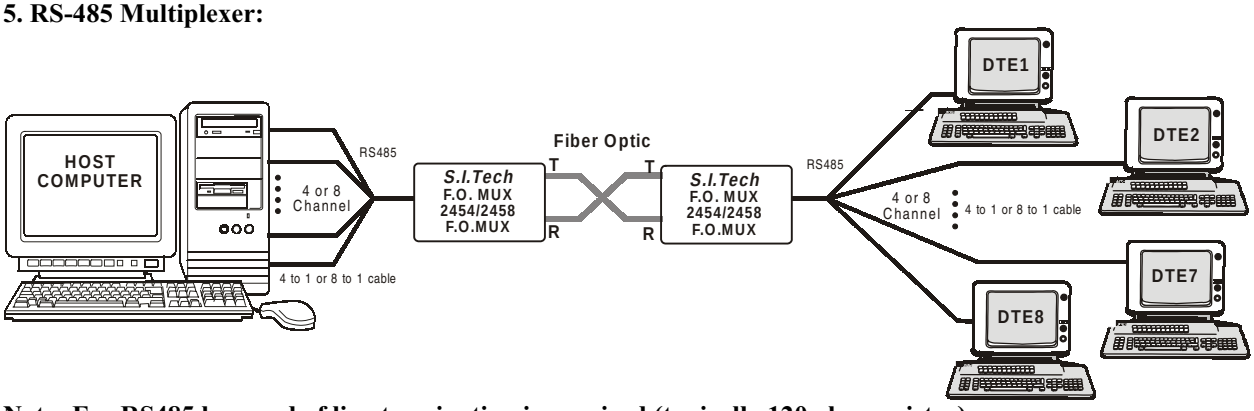
3. Proprietary Networks Using Other Bus Architecture:



4. RS-485 Multidrop:



5. RS-485 Multiplexer:



Note: For RS485 bus, end of line termination is required (typically 120 ohm resistor).

RS-485

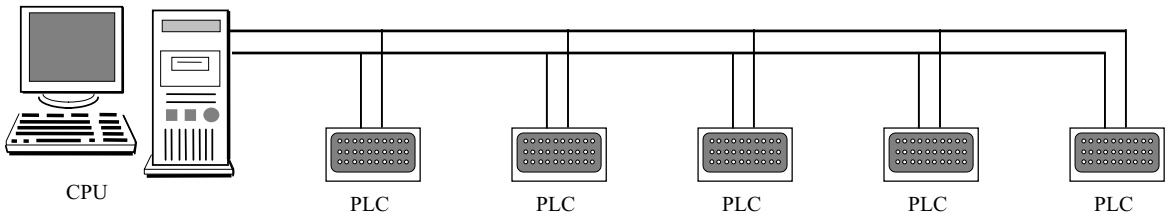
RS-485 (EIA-485) is a newer standard using twisted pair for extended distance communications and is used on process control, energy management, clustered computers, and security systems.

RS-485 is used as a 2 wire or 4 wire systems. In a 2 wire system, 2 wires (twisted pair) are used for both transmit and receive, thereby requiring communication in half-duplex mode. For example data is sent from Point A to Point B and then the line is turned around (also called time out) to send data from Point B to Point A.

Data rates most commonly used range from 4800 bps all the way to 10 Mbps. As the data rate is increased data goes from Point A to Point B in less time so the line can be turned around much faster.

RS-485 is used for distributed data communication in a bus topology or "daisy chain". Star, tree, or branch configurations are generally not recommended.

RS-485 BUS



PLC=Programmable Logic Controller

For all RS-485 applications line termination is necessary – typically 100 to 120 ohms can terminate a line. Many manufacturers provide line termination in their equipment (auto terminating).

EIA-485 specifies generators and receivers capable of operating in balanced digital multipoint systems. The parameter values specified in this Standard are similar to those in TIA/EIA-422-B. These values allow generators and receivers to be designed that can be used to meet the requirements of both standards,
(EIA-422 and 485).

EIA-485 is compatible with ISO/IEC 8482*:* 1993 *Information Technology – Telecommunications and information exchange between systems – Twisted pair multipoint interconnections.*

This Standard specifies the electrical characteristics of generators and receivers that may be employed when specified for the interchange of binary signals in multipoint interconnection of digital equipment. When implemented within the guidelines of this Standard, multiple generators and receivers may be attached to a common interconnecting cable.

An interchange system includes one or more generators connected by a balanced interconnecting cable to one or more receivers and terminating resistors.

RS485 CONNECTORS

Please refer to the RS-422 section for discussion of data connectors.

TABLE F
RS-485 TO FIBER BIT-DRIVERS® (MODEMS)

Model No.	Package			Data Rate Up to Kbps	Data Format		Power Option*	2 Wire Data Connector**	Multimode Fiber		Singlemode Fiber Connector	Point to Point	Daisy Chain Multidrop	Distance *** Km			Weight LB/KG	Remarks
	Stand Alone	Mini	Rack Mount Card		Async	Sync			Connector	**** Wavelength (SM-1300) nm				2	5	10		
2107		√		1.8 M		√	6	DB-9 F	ST/SMA	850		√	√	√	√		.25/.1	Unisys NGEN
2110		√		9.6	√		6	DB-9 M	ST/SMA	880	ST	√	√	√	√	√	.25/.1	Johnson Controls Systems
2126		√		38.4	√		6	DB-9 M	ST/SMA	880	ST	√	√	√	√	√	.25/.1	
2127		√		187.5	√		6	DB-9 F	ST/SMA	850	ST	√	√	√	√	√	.25/.1	Omron Protocol
2128		√		187.5	√		6	DB-9 F	ST/SMA	850	ST	√	√	√	√	√	.25/.1	Omron Protocol
2136		√		3.6 M		√	4	DB-9 F	ST/SMA	850		√	√	√	√		.25/.1	Unisys NGEN
2185		√		38.4	√		6	DB-25 F	ST/SMA	880		√	√	√	√		.25/.1	Texas Instruments Controllers
2228		√		187.5	√		4	DB-9 F	ST/SMA	850	ST	√	√	√	√	√	.25/.1	Omron Protocol High Temperature 2128
2310			√	9.6	√		1,2	Terminal Block	ST/SMA	820	ST	√	√	√	√	√	.5/.2	3000 Rack Card / 2110 / 3520 Motherboard
2345			√	9.6	√		1,2	RJ45	ST/SMA	820	ST	√	√	√	√	√	.5/.2	3000 Rack Card / 2110 / 3500 Motherboard
2385			√	38.4	√		1,2	RJ45	ST/SMA	820		√	√	√	√		.5/.2	3000 Rack Card / 2185 / 3500 Motherboard
2610				9.6	√		6	DB-9 F	ST/SMA	880	ST	√	√	√	√	√	.25/.1	High Temperature 2110
2852	√			1 M		√	1,2	Terminal Block	ST/SMA	820	ST/FC/SC	√	√	√	√	√	3/1.4	Omninet, MODBUS +

* Power Options: See "Power Options and How to Order" sheet (p. 80) for options and ordering instructions.
** Pin outs are specified in data sheets
Temperature range 0 - 50 degrees C unless shown otherwise.
Extended Temperature (ET) range available on some products.
*** Distance: 2 km - STD, 5 km - L, 10 km - XL, 20 km - UL

**** Use one wavelength throughout system except if WDM is used

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Johnson Controls is a trademark of Johnson Controls Inc.
Omron is a trademark of Omron Electronics Inc
Texas Instruments is a trademark of Texas Instruments Inc.
Omninet is a trademark of Corvus Systems Inc.

HOW TO ORDER

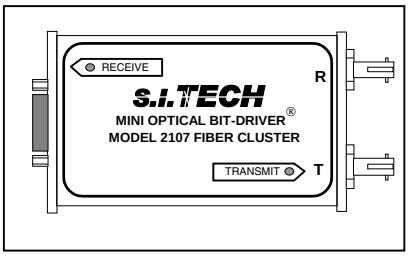
Base Model Number	Power*	Data Connector**	Distance***	Fiber and Connector		Temperature
				Multimode (MM)-STD	Singlemode (SM)-Specify	
XXXX	1. 110 VAC - STD 2. 230 VAC - V 4 & 6 - See Chart	M or F (F is STD on most models)	2 Km - STD Other - Specify L, XL, or UL	ST - STD Other-Specify	ST - STD Other-Specify	0 - 50° C - STD -40 to +80° C - ET Other - Call S.I. Tech

e.g. 2852 = RS-485 to Fiber Bit-Driver, 110 VAC, Terminal Block, 2 Km, Multimode, ST Connectors, 0 - 50° C
2126 = RS-485 to Fiber Bit-Driver, Needs S.I. Tech #2121 Power Supply, DB-9M, 2 Km, Multimode, ST Connectors, 0 - 50° C

Specifications subject to change without notice.

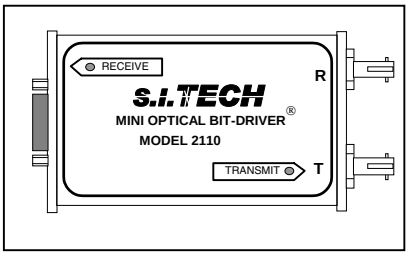
RS-485 TO FIBER OPTIC BIT-DRIVERS®

2107



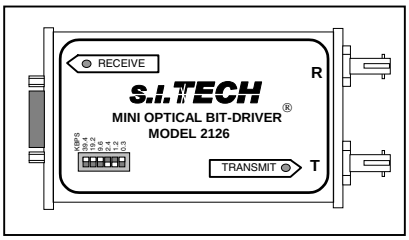
- Mini Synchronous Half-Duplex Optical Bit-Driver®
- Data Rate is 1.8 Mbps
- Termination Built-in
- Designed for Unisys NGEN Workstation B28, B38, and B39 series
- Point-to-Point, 5-Station Daisy Chain, or workstation cluster up to 24 workstations can be configured
- Standard Input/Output Interface is DB-9F Female Connector

2110



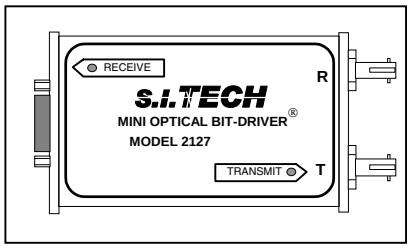
- Mini Asynchronous Half-Duplex Optical Bit-Driver®
- Data Rate up to 56 Kbps must be set at factory
- Designed for Johnson Controls System – N2 Bus and Bacnet
- Available in Eurocard format as Model 2345 for use in S.I. Tech Model 3000A Card Cage
- Standard Input/Output Interface is DB-9F Female Connector

2126



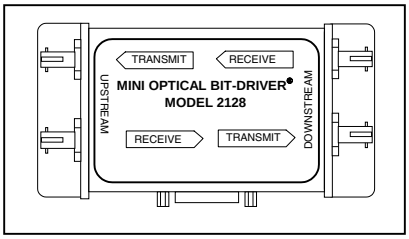
- Mini Synchronous Half Duplex Optical Bit-Driver®
- Data Rate is Switchable from 0.3 to 38.5 Kbps in 6 steps
- Input/Output Interface is RS-485 DB-9M Male Connector
- External Power Supply S.I. Tech Model 2121 (110 VAC) or 2122 (230 VAC)

2127



- Mini Synchronous Half Duplex Optical Bit-Driver®
- Data Rate is 187.5 Kbps
- Custom Designed to work with Omron PLC
- Input/Output Interface is RS-485 DB-9F Female Connector
- External Power Supply S.I. Tech Model 2121 (110 VAC) or 2122 (230 VAC)

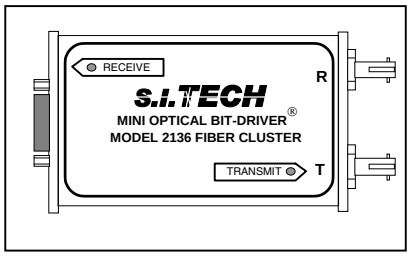
2128



- Mini Synchronous Half Duplex Optical Bit-Driver®
- Data Rate is 187.5 Kbps
- Customized units available with different data rates
- Custom Designed to work with Omron PLC
- Fiber Ports Repeat Data through the 2128 and Drop/Insert Data on the RS-485 Port (DB-9F Female Connector)
- RS-485 Port Inserts Data onto both Fiber Ports and gets Data dropped from either Fiber Port
- External Power Supply S.I. Tech Model 2121 (110 VAC) or 2122 (230 VAC)

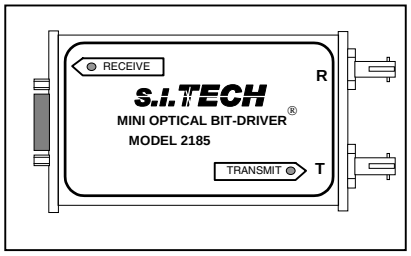
RS-485 TO FIBER OPTIC BIT-DRIVERS®

2136



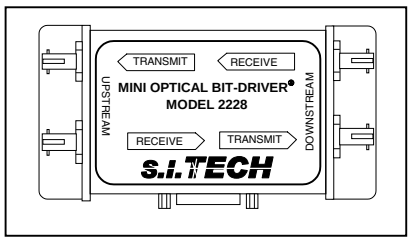
- Mini Synchronous Half Duplex Optical Bit-Driver®
- Data Rates are 1.8 Mbps or 3.6 Mbps
- Termination is Built-in
- Designed for Unisys NGEN Workstation B28, B38, and B39 Series
- Point-to-Point, 5-Station Daisy Chain, or Workstation Cluster having up to 24 Workstations with S.I. Tech Optical Fiber Cluster® coupler Model 9024 can be configured
- Standard Input/Output Interface is RS-485 DB-9F Female Connector

2185



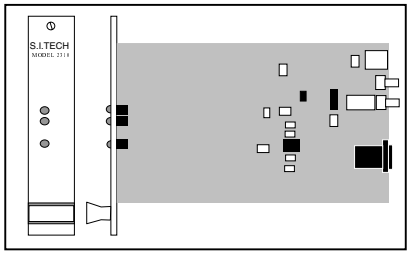
- Mini Asynchronous Half Duplex Optical Bit-Driver®
- Designed to Work with Texas Instruments Process Controllers
- Data Rate is 38.4 Kbps
- Suitable for Point-to-Point or Daisy Chain Configuration
- Powered by +24 VDC from T.I. Device or External Power Supply S.I. Tech #2121 110VAC/+12 VDC or #2122 230VAC/+12VDC

2228



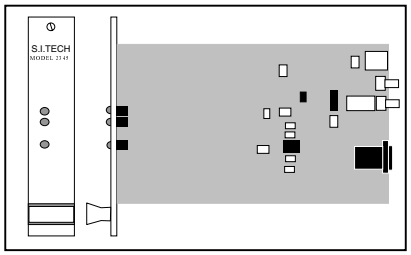
- Mini Synchronous Half Duplex Optical Bit-Driver®
- Data Rate is 256 Kbps
- Fiber Ports Repeat Data through the 2228 and Drop/Insert Data on the RS-485 Port (DB-9F Female Connector)
- RS-485 Port Inserts Data onto both Fiber Ports and gets Data dropped from either Fiber Port
- Host Powered (+12VDC on Pins 8 and 9 of DB-9F connector)
- Extended Temperature Range -40°C to +80°C

2310*



- Card Cage Mounted Asynchronous Half Duplex Optical Bit-Driver®
- Data Rate up to 56 Kbps must be set at factory
- Designed to Work with Johnson Controls System and with S.I. Tech Model 2110 Mini Bit-Driver®
- Eurocard Format, Fits S.I. Tech Model 3000A 19 inch Rack & 3520 Motherboard Bus
- Designed for RS485 Bus

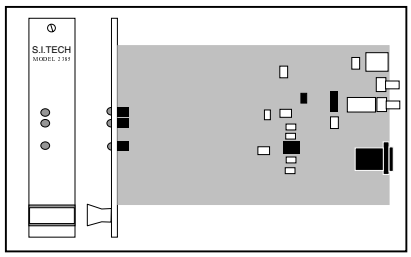
2345



- Card Cage Mounted Asynchronous Half Duplex Optical Bit-Driver®
- Data Rate up to 56 Kbps must be set at factory
- Designed to Work with Johnson Controls System and with S.I. Tech Model 2110 Mini Bit-Driver®
- Input/Output Interface is 8-pin RJ-45 Female Connector
- Eurocard Format, Fits S.I. Tech Model 3000A 19 inch Rack

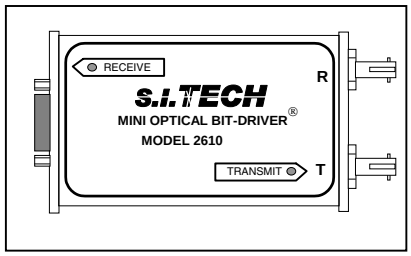
RS-485 TO FIBER OPTIC BIT-DRIVERS®

2385



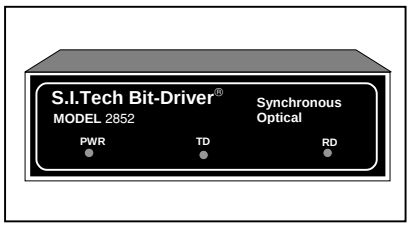
- Card Cage Mounted Asynchronous Half Duplex Optical Bit-Driver®
- Data Rate is 38.4 Kbps
- Designed to work with Texas Instruments Systems and with S.I. Tech Model 2185 Mini Bit-Driver®
- Eurocard Format, Fits S.I. Tech Model 3000A 19 inch Rack
- Input/Output Interface is 8-pin RJ-45 Female Connector

2610*



- Mini Asynchronous Half Duplex Optical Bit-Driver®
- Data Rate up to 56 Kbps must be set at factory
- Designed to work with Johnson Controls System-N2 Bus or other PLC
- Standard Input/Output Interface is DB-9M Male Connector
- Extended Temperature Range (-40°C to +80°C) Version of Model 2110

2852



- Synchronous Simplex or Half Duplex Optical Bit-Driver®
- Normal Operating Data Rate is 1 Mbps
- Designed to work with Omninet by Corvus Systems Inc and MODBUS+
- Stand Alone – 110 VAC or 230 VAC power cord
- Input/Output Interface RS-485 2-wire + Ground Terminal Block

S.I. Tech Inc., Batavia, IL 60510 Phone: (630) 761-3640 Fax: (630) 761-3644
Web Site: http://www.sitech-bitdriver.com

TABLE G
RS-485 TO FIBER OPTIC MULTIPLEXERS

Model No.	Package		Max. Data Rate Kbps	Data Format			Power Option*	Data Connector**	Number of Channels	Point to Point	Multidrop	Distance * Km			Weight LB/KG	Multimode (820 nm)/ Singelmode (1300 nm)	Trunk**** Fiber Connector	Remarks
	Stand Alone	Rack Mount		Async	Sync	Control Signals						2	5	10				
2454	√		256	√			1,2	DB37 F	4	√		√	√	√	3/1.4	MM/SM	ST/SMA	uses 1 to 4 cable 7054
2458	√		76.8	√			1,2	DB37 F	8	√		√	√	√	3/1.4	MM/SM	ST/SMA	uses 1 to 8 cable 7058

* Power Options: See "Power Options and How to Order" sheet (p. 80) for options and ordering instructions.
** Pin outs are specified on data sheets
*** Distance: 2 km - STD, 5 km - L, 10 km - XL, 20 km - UL.
****Other connector options for singlemode are SC and FC.
Temperature range 0 - 50 degrees C unless shown otherwise.

HOW TO ORDER

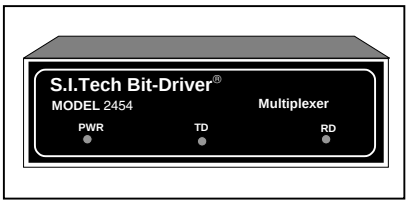
Base Model Number	Power*	Data Connector**	Distance***	Fiber and Connector		Temperature
				Multimode (MM) - STD	Singlemode (SM)-Specify	
XXXX	110V-STD 230VAC-V	M or F (F is STD on most models.)	2 Km - STD Other - Specify L, XL, or UL	ST - STD Other - Specify	ST - STD	0 - 50^{o} C - STD Other - Call S.I. Tech

e.g. 2454 - RS-485 Async, 4 CH Fiber Multiplexer, 110VAC, DB37 F, 2Km, Multimode ST, 0-50 C

Specifications subject to change without notice.

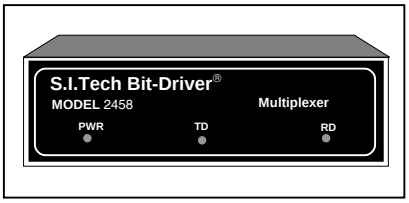
RS-485 TO FIBER MULTIPLEXERS

2454*



- Four Channel Asynchronous Half Duplex Time Division Multiplexer Optical Bit-Driver®
- Data Rate up to 256 Kbps must be set at factory
- Powered through 110 VAC line cord
- 230 VAC version available as S.I. Tech Model 2454V
- Each unit requires 4-to-1 RS-485 cable S.I. Tech #7054

2458*



- Eight Channel Asynchronous Half Duplex Time Division Multiplexer Optical Bit-Driver®
- Data Rate up to 76.8 Kbps must be set at factory
- Powered through 110 VAC line cord
- 230 VAC version available as S.I. Tech Model 2458V
- Each unit requires 8-to-1 RS-485 cable S.I. Tech #7058

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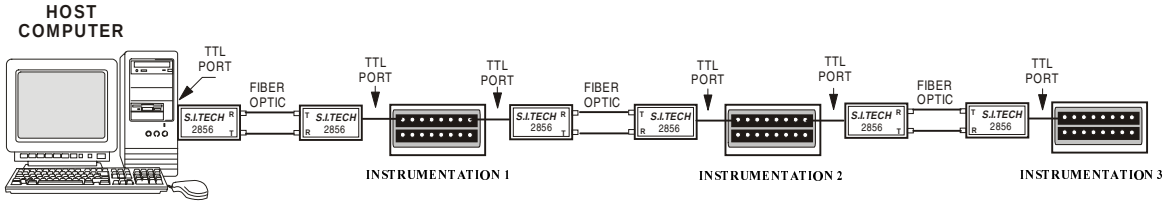
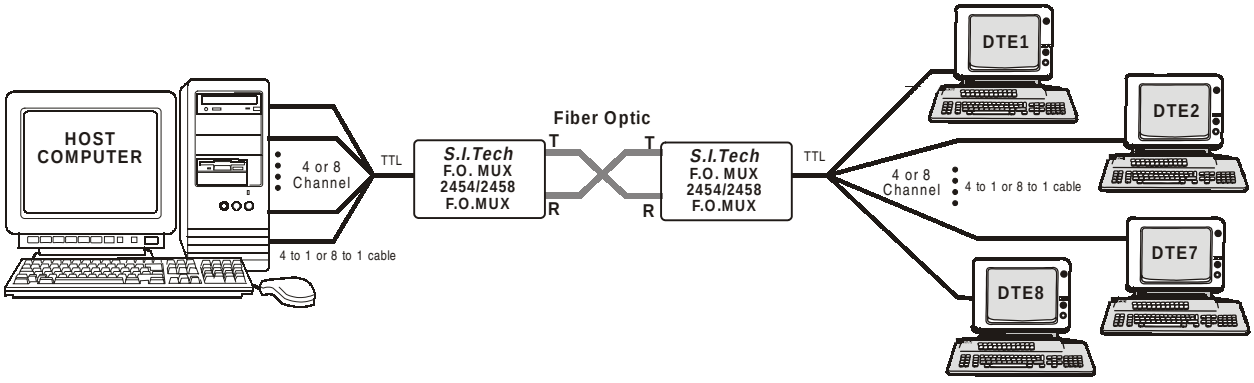
Web Site: http://www.sitech-bitdriver.com

TTL PRODUCTS

1. Point to Point:



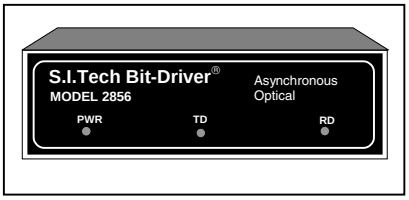
2. Multiplexer:



4

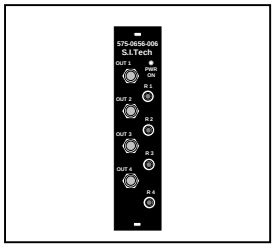
TTL TO FIBER OPTIC BIT-DRIVERS®

2856



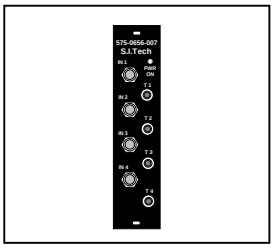
- Asynchronous Simplex or Full Duplex Optical Bit-Driver®
- Max Data Rate is 20 Mbps
- Supports 50 or 75 ohm coax
- Power, Transmit Data, and Receive Data LED indicators

575-0656-006



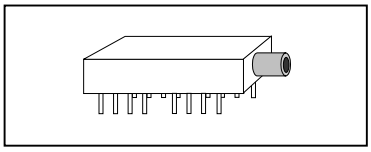
- Card Cage Mounted Optical-to-TTL Bit-Driver® Receiver
- Data Rate is 2 Mbps
- Four Channels
- Data Connector is isolated BNC
- For use in S.I. Tech Model 1000 Card Cage
- Work with Model 575-0656-007 Transmitter

575-0656-007



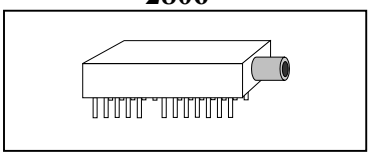
- Card Cage Mounted TTL-to-Optical Bit-Driver® Transmitter
- Data Rate is 2 Mbps
- Four Channels
- Data Connector is isolated BNC
- For use in S.I. Tech Model 1000 Card Cage
- Works with Model 575-0656-006 Receiver

DIP MODELS
2805



- Metal 24 pin DIP configuration TTL-to-Optical Bit-Driver® Transmitter
- Data Rate is DC to 20 Mbps NRZ
- Connection is by solder pads or DIP socket
- Package size is 1.2x0.75x0.37 inches

2806



- Metal 40 pin DIP configuration Optical-to-TTL Bit-Driver® Receiver
- Data Rate is DC to 20 Mbps NRZ
- Connection is by solder pads or DIP socket
- Package size is 2.0x1.12x0.37 inches

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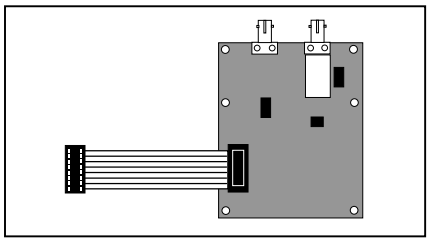
TTL TO FIBER OPTIC BIT-DRIVERS®

2865*



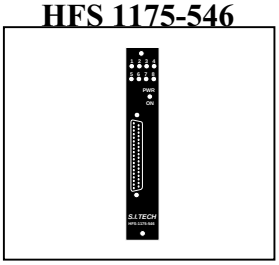
- Unmounted Circuit Card configuration TTL-to-Optical Bit-Driver® Transmitter-Receiver.
- Data Rate is DC to 20Mbps NRZ
- Connection is to solder pads in 16 pin DIP configuration
- Card size is 3¾ x 3 inches with 2.4 x 2.55 inch mounting centers
- Multimode is standard, Single Mode optional

TTL TO FIBER OPTIC MULTIPLEXERS

2006
(See RS232 Section)

- TTL is an Optional Interface on Model 2006

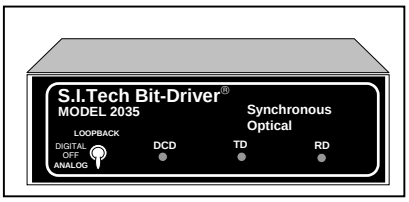
HFS 1175-546



- 8 Channel TTL Low Speed Multiplexer
- Series 1000 Chassis
- Multimode or Single mode
- Data Rate is 19.2 Kbps on each channel
- Uses DB-37 Connector

V.35 FIBER OPTIC BIT-DRIVERS®

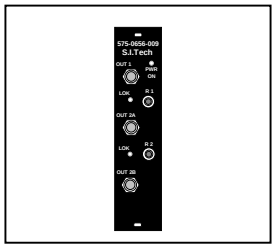
2035



- Synchronous Simplex or Full Duplex Optical Bit-Driver®
- V.35 Synchronous at 2.4, 4.8, 9.6 and 19.2 Kbps or external clock at 56 Kbps data rates
- DCD, Transmit Data, and Receive Data LED indicators
- Transmission line loopback capability to verify link integrity and assist in hardware diagnostic problems

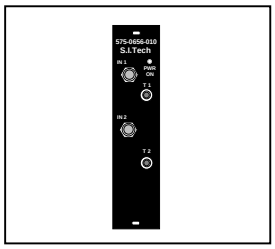
MIL-188-114 BIT-DRIVERS®

575-0656-009



- Card Cage Mounted MIL-118-114 Optical Bit-Driver® Receiver
- Tested at 26 Mbps NRZ data rate
- Two Channels
- Data Connector is isolated Triax for use with Twinax cable
- For use in S.I. Tech Model 1000 Card Cage
- Works with Model 575-0656-010 Transmitter
- Extended temperature range -40ºC to +85ºC

575-0656-010



- Card Cage Mounted MIL-188-114 Optical Bit-Driver® Transmitter
- Tested at 26 Mbps NRZ data rate
- Two Channels
- Data Connector is isolated Triax for use with Twinax cable
- For use in S.I. Tech Model 1000 Card Cage
- Works with Model 575-0656-009 Receiver
- Extended temperature range -40ºC to +85ºC

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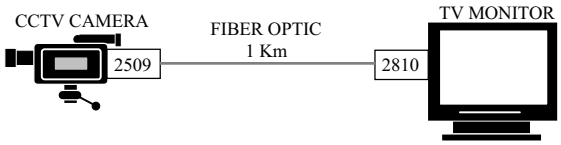
Web Site: http://www.sitech-bitdriver.com

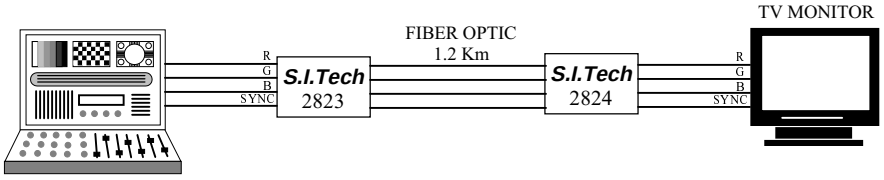
VIDEO, AUDIO, AND ALARM PRODUCTS

VIDEO, AUDIO, AND ALARM SYSTEMS

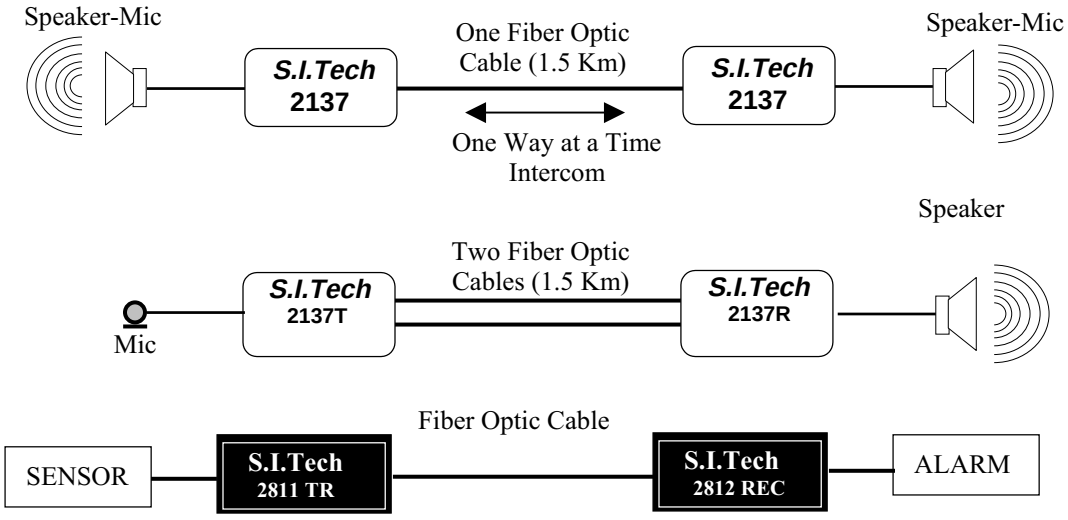
Closed circuit television typically consists of a video camera and a TV monitor that uses a baseband video signal at 6 MHz bandwidth as opposed to broadband video used in cable television or broadcast TV Channels 2 to 900, which uses 950 MHz total bandwidth.



Baseband video is also used with computers. Computer monitors use red, green, blue, and sync pulse schemes. Each color uses a full 6 MHz bandwidth. To remote a computer monitor from a computer, all three colors and sync pulse need to be transmitted from Point A to Point B.



Audio or analog signals are typically low frequency signals usually from 0.03 Hz to 40 KHz range. Voice communications uses these signals. If digitized, audio requires 64 Kbps bandwidth per channel. The standard telephone system uses an analog system. However, all long distance telephone uses digital communication i.e. T1 at 1.54 Mbps (24 Channel voice).



Analog systems are also used for alarm systems or on/off systems such as closing and opening doors. Relay contacts are used.

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TABLE H
VIDEO, AUDIO, AND ALARM PRODUCTS

	Model No.	Package: Stand Alone	Package: Mini	Package: Rack Mount Card	Bandwidth bps	Power Option*	Data Connection**	Fiber Connection	Point to Point	Weight LB/KG	Remarks
Video	2509		√		15M	6	BNC - F	ST/SMA	√	.25/.1	1 Ch CCTV Xmtr
	2809	√			15M	1,2	BNC - F	ST/SMA	√	2/1	2 to 4 Ch CCVT Video Xmtr
	2810	√			15M	1,2	BNC - F	ST/SMA	√	2/1	2 to 4 Ch CCTV Video Rcvr
	2823	√			30M	1,2	BNC - F	ST/SMA	√	2/1	4 Ch RGB Video Xmtr
	2824	√			30M	1,2	BNC - F	ST/SMA	√	2/1	4 Ch RGB Video Rcvr
	HFS-1142			√	7M	1,2	BNC - F	ST/SMA	√	.5/.2	2 Ch Video Rcvr
	HFS-1144			√	45M	1,2	BNC - F	ST/SMA	√	.5/.2	2 Ch Video Xmtr
	HFS-1146			√	40M	1,2	BNC - F	ST/SMA	√	.5/.2	1 Ch each way Video Xmtr-Rcvr
Audio/ Analog	2137	√			40K	1,2	Terminal Block	ST/SMA	√	2/1	Bi-Directional
	2137T	√			40K	1,2	Terminal Block	ST/SMA	√	2/1	Talker
	2137R	√			40K	1,2	Terminal Block	ST/SMA	√	2/1	Listener
	HFS-1151			√	100K	1,2	Twinax	ST/SMA	√	.5/.2	2 Ch Audio Xmtr
	HFS-1152			√	100K	1,2	Twinax	ST/SMA	√	.5/.2	2 Ch Audio Rcvr
	HFS-1153			√	100K	1,2	Twinax	ST/SMA	√	.5/.2	1 Ch each way Audio Xmtr-Rcvr
Alarm	2811	√			***	+12 VDC	Terminal Block	ST/SMA	√	2/1	Transmitter
	2812	√			***	+12 VDC	Terminal Block	ST/SMA	√	2/1	Receiver
	2813	√			***	+12 or 24 VDC	Terminal Block	ST/SMA	√	2/1	Transmitter-Receiver

*** 10 Kbps Square Wave

* Power Options: See "Power Options and How to Order" sheet (p. 80) for options and ordering instructions.

** Pin outs are specified in data sheets

Temperature range 0 - 50 degrees C unless shown otherwise.

Extended Temperature (ET) range available on some products.

HOW TO ORDER

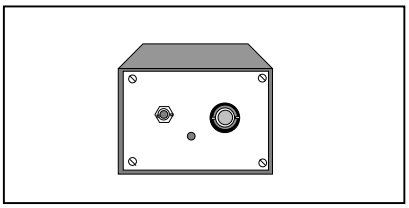
Base Model Number	Power*	Data Connector**	Fiber: Multimode (MM)-STD	Temperature
XXXX	1. 110 VAC - STD 2. 230 VAC - V 6. See Chart	M or F (F is STD on most models)	ST-STD Other-Specify	0 - 50° C - STD -40 to +80° C - ET Other - Call S.I. Tech

e.g. 2823 = 4 Channel RGB Video Transmitter, 110 VAC, BNC Female, ST Connectors, 0-50 Degress C

Specifications subject to change without notice.

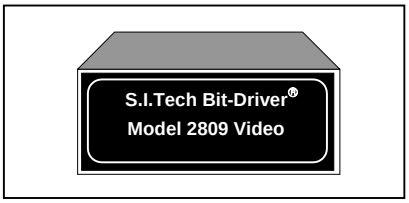
CCTV VIDEO TO FIBER OPTIC BIT-DRIVERS®

2509



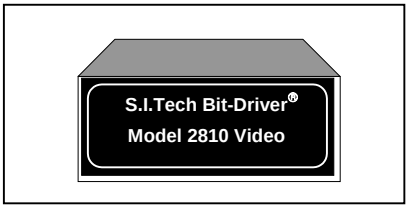
- Mini Optical CCTV Video Bit-Driver® Transmitter
- System Bandwidth is 10Hz to 15MHz
- Powered by +12VDC from camera or external power supply S.I.Tech 2121 (110VAC/12VDC) or 2122 (230VAC/12VDC)
- Video Connector is 75 ohm BNC Female
- Works with S.I. Tech Model 2810 Receiver

2809



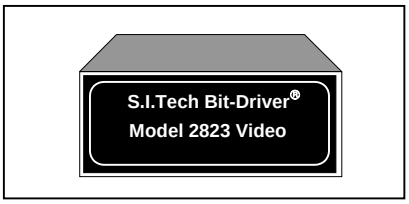
- Stand Alone Optical CCTV Video Bit-Driver® Transmitter
- System Bandwidth is 10Hz to 15MHz
- Powered by 110V or 230V line cord
- Video Connector is 75 ohm BNC Female
- Works with S.I. Tech Model 2810 Receiver
- Also available as 2809-2, 2809-3 and 2809-4, which are 2, 3 and 4 channels, respectively
- Alternately available in 19 inch Rack, 1U high case

2810



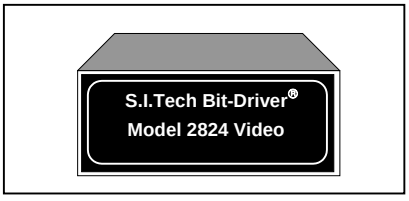
- Stand Alone Optical CCTV Video Bit-Driver® Receiver
- System Bandwidth is 10Hz to 15MHz
- Powered by 110V or 230V Line Cord
- Video Connector is 75 ohm BNC Female
- Works with S.I. Tech Model 2509 and 2809 Transmitters
- Also available as 2810-2, 2810-3 and 2810-4, which are 2,3 and 4 channels, respectively
- Alternately available in 19 inch Rack, 1U high case

2823



- Stand Alone Optical RGB Video Bit-Driver® Transmitter
- Four Channels; R, G, B and Sync
- System Bandwidth is 10Hz to 30MHz
- Input impedance is 75 ohms. BNC Female Coaxial Connector each channel
- Powered by 115V or 230V Line Cord

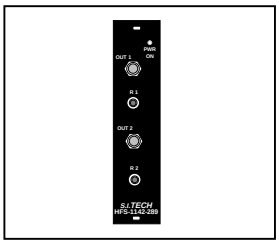
2824



- Stand Alone Optical RGB Video Bit-Driver® Receiver
- Four Channels; R, G, B and Sync
- System Bandwidth is 10Hz to 30MHz
- Receiver output impedance is 75 ohms. BNC Female Coaxial Connector each Channel
- Powered by 115V or 230V Line Cord

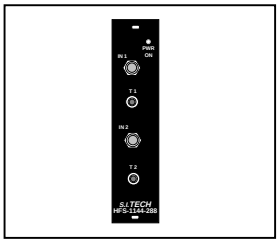
CCTV VIDEO TO FIBER OPTIC BIT-DRIVERS®

HFS-1142



- Card Cage Mounted Optical Video Bit-Driver® Receiver
- Two Channels
- Frequency response to 7MHz
- Output impedance 75 ohms. BNC Female Coaxial Connector
- Eurocard format. Fits S.I. Tech Model 1000 Card Cage
- Works with HFS-1144 Transmitter

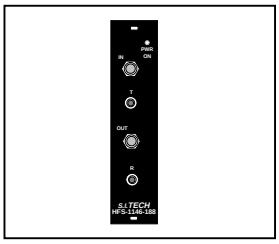
HFS-1144



- Card Cage Mounted Optical Video Bit-Driver® Transmitter
- Two Channels
- Frequency response 6Hz to 40MHz
- Input impedance 75 ohms. BNC Female Coaxial Connector
- Eurocard format. Fits S.I. Tech Model 1000 Card Cage
- Works with HFS-1142 Receiver

5

HFS-1146



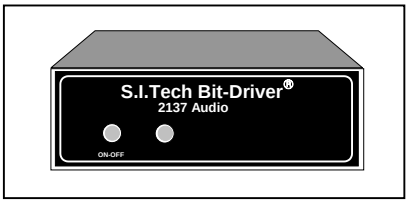
- Card Cage Mounted Optical Video Bit-Driver® Transmitter/Receiver
- Two Channels (one transmit, one receive)
- Transmitter frequency response 6Hz to 40MHz
- Receiver frequency response to 40MHz
- Input Output impedances 75 ohms. BNC Female Coaxial Connector
- Eurocard format. Fits S.I. Tech Model 1000 Card Cage

AUDIO (ANALOG) TO FIBER OPTIC BIT-DRIVERS®

2137

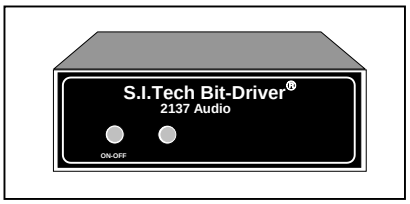
- Stand Alone Optical "push-to-talk" Audio Transceiver Bit-Driver®
- System Bandwidth 10Hz to 40KHz
- Input and Output impedances 600 ohms balanced or unbalanced
- Audio terminals on terminal block
- Powered by 110VAC Line Cord. Add "V" to model number for 230VAC version
- Suitable for audio intercom, control, or AC coupled data signals

2137T



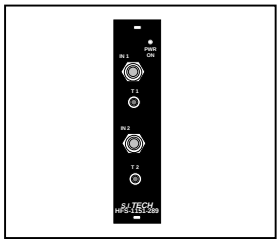
- Stand Alone Optical Audio Transmitter Bit-Driver®
- System Bandwidth is 10Hz to 40KHz
- Input impedance is 600 ohms balanced or unbalanced
- Audio terminals on terminal block
- Powered by 110VAC Line Cord. Add "V" to Model number for 230VAC version
- Use with 2137R Audio Receiver

2137R



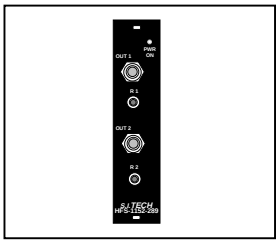
- Stand Alone Optical Audio Receiver Bit-Driver®
- System Bandwidth is 10Hz to 40Khz
- Will drive 8 ohm speaker connected to output terminals
- Powered by 110VAC Line Cord. Add "V" to Model number for 230VAC version
- Use with 2137T and two optical fibers for full-duplex operation

HFS-1151



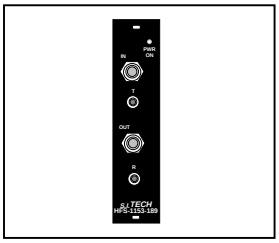
- Card Cage Mounted Optical Analog Audio Bit-Driver® Transmitter
- Two Channels
- Frequency response 6Hz to 100KHz
- Input impedance 600 ohms. Twinax connector
- Eurocard format. Fits S.I. Tech Model 1000 Card Cage
- Works with HFS-1152 Receiver

HFS-1152



- Card Cage Mounted Optical Analog Audio Bit-Driver® Receiver
- Two Channels
- Frequency response 6Hz to 100KHz
- Output impedance 600 ohms. Twinax connector
- Eurocard format. Fits S.I. Tech Model 1000 Card Cage
- Works with HFS-1151 Transmitter

HFS-1153

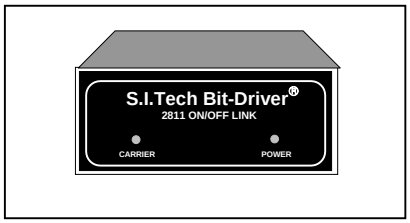


- Card Cage Mounted Optical Analog Audio Bit-Driver® Transmitter-Receiver
- Two Channels -one transmit/one receive
- Frequency response 6Hz to 100 KHz
- Input and Output impedance 600 ohms. Twinax connector
- Eurocard format. Fits S.I. Tech Model 1000 Card Cage

S.I. Tech Inc., Batavia, IL 60510 Phone: (630) 761-3640 Fax: (630) 761-3644
Web Site: http://www.sitech-bitdriver.com

ALARM SYSTEM TO FIBER OPTIC BIT-DRIVERS®

2811

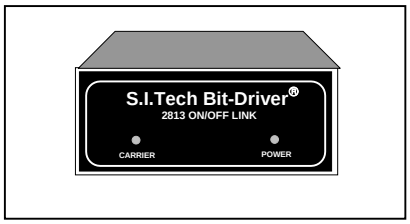


- Stand Alone Optical On-Off Bit-Driver® Transmitter
- Transmits 10KHz Optical square wave when power is applied
- Input power +12VDC to screw terminals
- Must be used with Model 2812 Receiver to complete link

2812

- Stand Alone Optical On-Off Bit-Driver® Receiver
- Detects 10KHz optical square wave from Model 2811 Transmitter and activates 4PDT relay
- Relay contacts rated 2 Amps, 500VAC between open contacts. Each contact is connected to a screw terminal
- Must be used with Model 2811 transmitter to complete link
- Input power +12VDC to screw terminals

2813

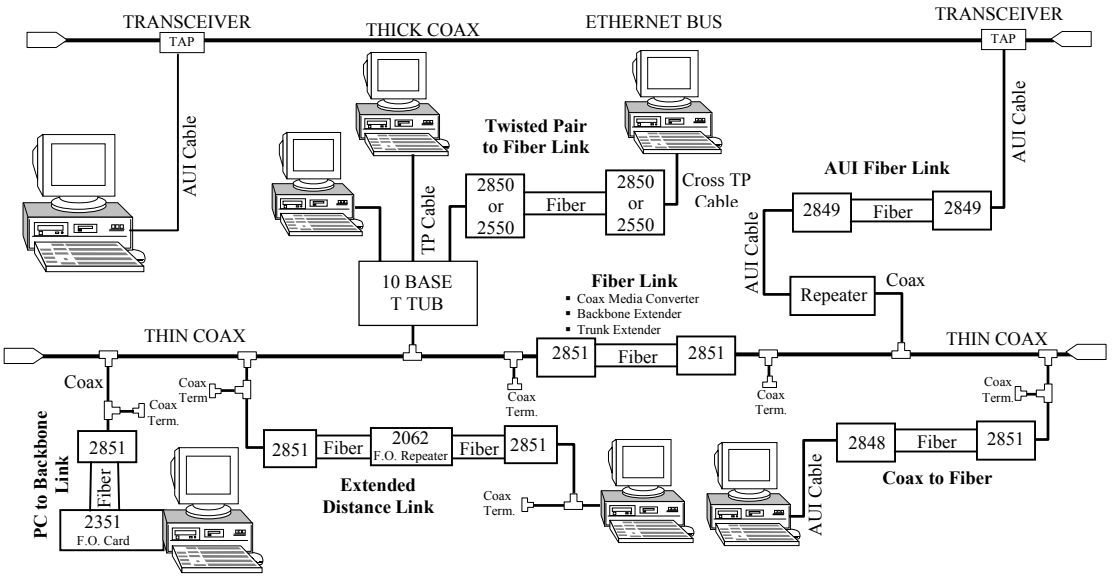


- Stand Alone Optical On-Off Bit-Driver® Link
- Performs functions of one Model 2811 Transmitter and one Model 2812 Receiver
- Input power +12VDC or +24VDC to screw terminal
- One Model 2813 needed at each end of link

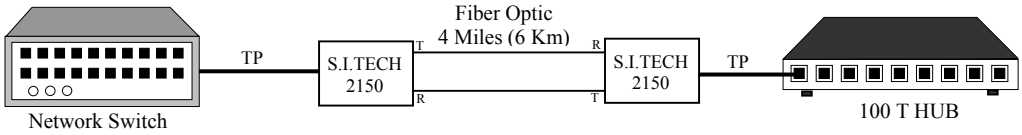
S.I. Tech Inc., Batavia, IL 60510 Phone: (630) 761-3640 Fax: (630) 761-3644
Web Site: http://www.sitech-bitdriver.com

LAN/WAN PRODUCTS
(Local Area and Wide Area Networks)

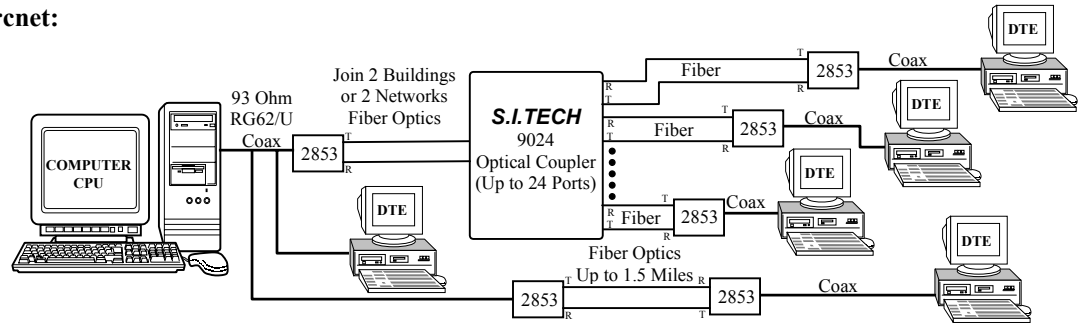
1. Ethernet:



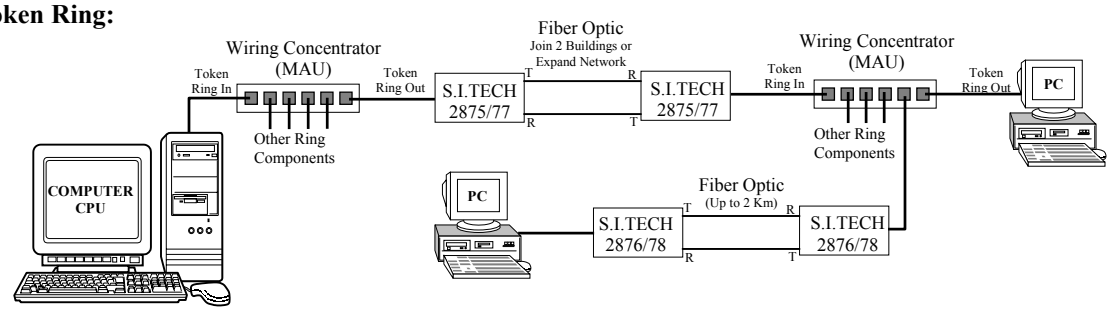
2. 100 Mbps Singlemode Ethernet:



3. Arcnet:



4. Token Ring:



6

LAN/WAN

With a personal computer on each desk, so-called distributed data processing emerged with a need to connect all PC's in a given area and to share data files together. This is how the local area network (LAN) was born.

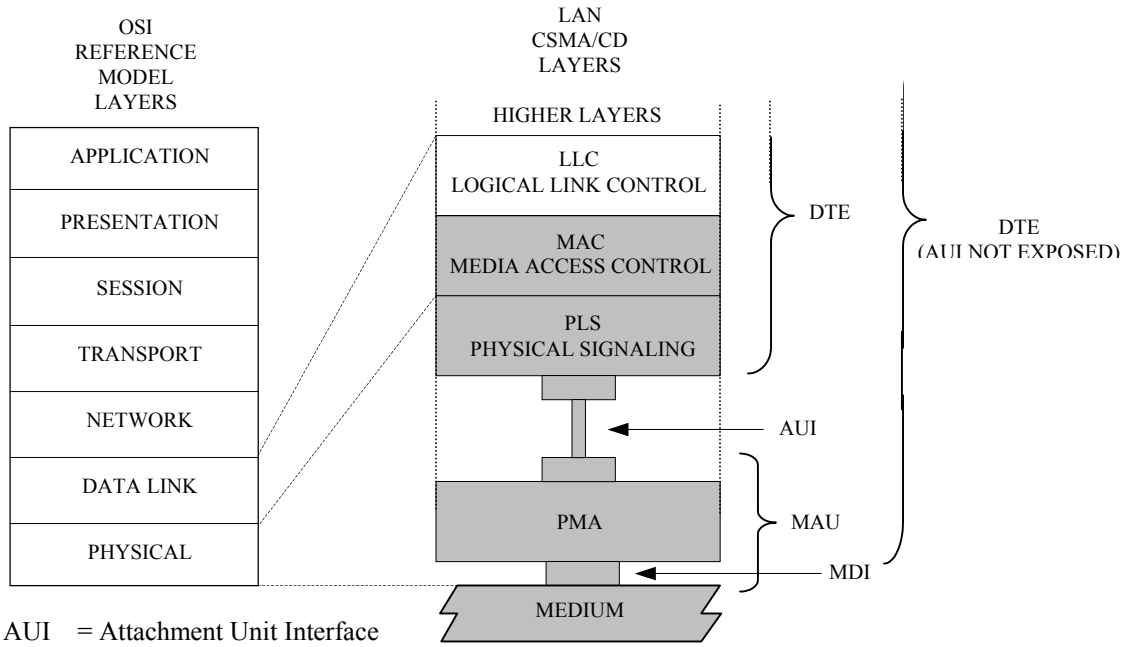
Today LAN's can have hundreds or even thousands of users (nodes) connected together. In large networks, segments are created so that problems can be easily isolated and eliminated. Over the years there have been many networking schemes, each with advantages and disadvantages. Today, Ethernet is the most prominent LAN in offices.

While LAN's are adequate for small companies with one office, larger companies with multiple offices need more complex networks.

So we have:

MAN – Metropolitan Area Network
WAN – Wide Area Network
Global Net – Global - Many countries
Internet – Global - Worldwide
Intranet - Within the same company-multiple networks, networked
Mobile Net - Cellular phone network
Telephone Network - Global
SAN - Storage Area Network

In discussing LOCAL AREA or WIDE AREA NETWORK, typically OSI (Open Systems Interconnection), a reference model, is used as shown below.



AUI = Attachment Unit Interface
MAU = Medium Attachment Unit
MDI = Medium Dependent Interface
PMA = Physical Medium Attachment

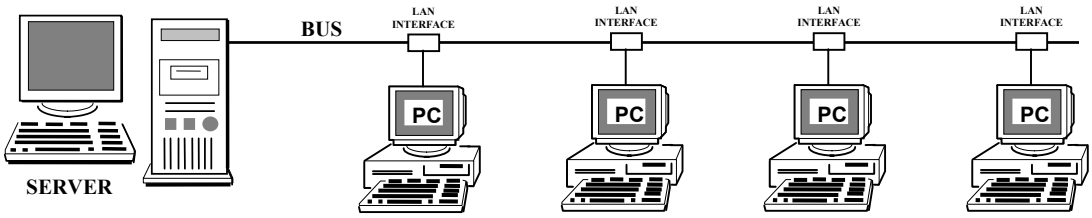
ISO/IEC 8802-3 (IEEE 802.3) relationship to the ISO/IEC Open System Interconnection (OSI) reference model

S.I. Tech Fiber Optic products fall into physical and data link layers of the model. Network Interface Cards (NIC) such as 2351 or 2361 have to deal with all of the OSI model layers, as these are used inside the computer.

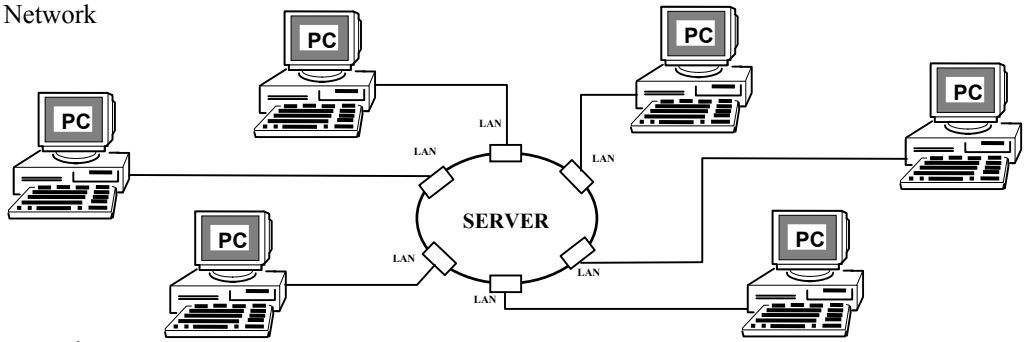
LOCAL AREA NETWORKS

As the term implies, computers located in a given area such as an office or factory can be networked (connected together) in a particular scheme. Today's Local Area Networks are comprised of many special inter connecting schemes, each with unique benefits and disadvantages. Basic configurations are:

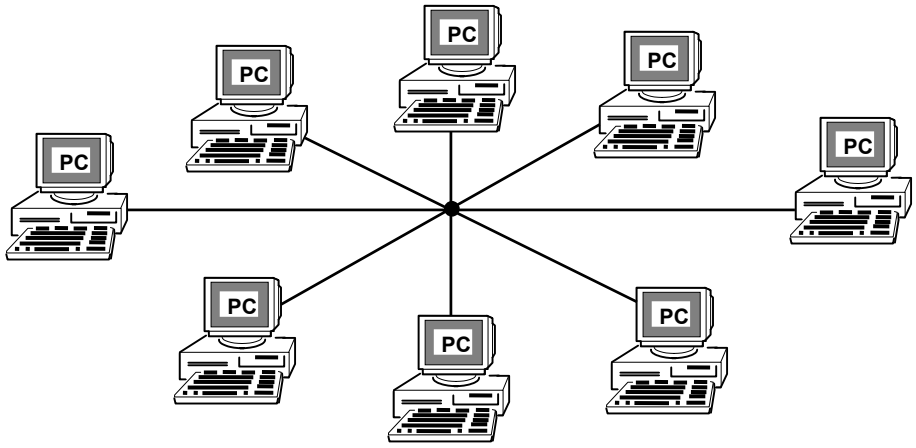
1. Bus Network: all users are attached to a common BUS.



2. Ring Network



3. Star Network



4. Tree Network: Combining these concepts into various fashions, today's complex LAN's are set up.

IEEE – Institute of Electrical and Electronic Engineers have developed many LAN standards and new ones are continually created. Some of the present standards are:

IEEE 802.1 - Relationship between IEEE and ISO model
IEEE 802.2 - Network control protocol
IEEE 802.3 - Ethernet Local Area Network
IEEE 802.4 - Map/Top Local Area Network
IEEE 802.5 - Token Ring Local Area Network
IEEE 802.6 - MAN Network
IEEE 802.7 - Broad Band Local Area Network
IEEE 802.8 - Fiber Optic CSMA/CD
IEEE 802.9 - Integrated Voice and Data
IEEE 802.10 - Interoperable LAN/MAN security
IEEE 802.11 - Wireless LAN
IEEE 802.12 - Demand priority access method. Repeater spec.
IEEE 802.14 – Cable TV based Broad Band Network

A short description on more common networks is given below:

Arcnet:	A token passing BUS network, developed by Datapoint. Runs at 2.5Mbps and uses 93 ohm coaxial cable as a medium.
Ethernet:	Is a BUS network using CSMA/CD scheme. Today's business world predominately uses Ethernet as a networking protocol. Ethernet is well developed with low cost devices for 10 and 100Mbps. 1 gigabit and 10 Gbps systems are under development.
Token Ring:	The token access procedure used on a network with a sequential or ring topology. Popularized by IBM. Runs at 4 and 16Mbps. FDDI, which is token ring, runs at 100Mbps.
Map/Top:	The token passing BUS network for the Manufacturing Industry.
FDDI:	Fiber distributed data and token ring network running at 100Mbps has counter rotating rings for redundancy.
Internet:	Global computer network, where everyone has access to Worldwide Web. Wide ranging access speeds are available.
Telephone Network:	Global network of all telecommunications equipment, telephones.
SONET:	Synchronous optical network – used for high speed telecom connections. Speed ranges from OC-1 to OC-768. (51Mbps to 40Gbps.)

Common features of all fiber optic networking products offered by S.I. Tech:

Industry refers to S.I. Tech products by various names such as line drivers, media converters, transceivers, etc. The basic concept is to use fiber optics wherever possible and required or specified. Fiber can be used in place of unshielded twisted pair (UTP), shielded twisted pair (STP), coax, twinax, radio, satellite connection, etc. with appropriate interface and product design.

While fiber optics can exceed distance limitations of various networking specifications, network engineers should consider networking issues such as time out, software limitations, equipment compatibility, etc.

Typical operating distances for fiber optic cables

Fiber Size (Microns)	Nominal Attenuation dB/Km		Distance* Km		Distance* Feet		Bandwidth MHz/Km	
	850 NM	1310 NM	850 NM	1310 NM	850 NM	1310 NM	850 NM	1310 NM
50	3.0	1.0	2	5	6600	16000	600	-
62.5	3.5	1.0	2	5	6600	16000	200	-
10 SM	-	0.35	-	10	-	33000	-	1000

*Longer distances are possible and available with special designs. Various connector options are available, such as SMA/ST/FC/SC/MT-RJ

S.I. Tech supplies indoor/outdoor Fiber Optic cables and cables with connectors. Fiber Optic Repeater/Mode Converters: S.I. Tech model 2062 and 2082 are designed to convert multimode fiber any size to any other size or can also be used to convert any size multimode to singlemode fiber.

2062 MM/MM
2062 MM/SM
2062 SM/SM
2082 MM/MM
2082 MM/SM
2082 SM/SM

These products can also be used to extend the distance of a fiber optic link or overcome excessive link loss (attenuation).

Power Cord: 3 Pin International Standard Cord

Status Indicators: All products come with status indicator LEDs to show network activity, fiber link activity, power, collision and other indicators. Refer to chart or individual data sheet for specifics.

All S.I. Tech products are UL/CSA listed where applicable.

TRANSMISSION MEDIA:

Twisted Pair
Coaxial Cable
Fiber Optics
Satellite
Radio

TWISTED PAIR – is the lowest cost transmission medium available within buildings, as most of the time, telephone wiring exists in all buildings. Over the years, cable manufacturers have significantly improved transmission properties of unshielded twisted pair (UTP) or shielded twisted pair cables (STP). These are now classified by EIA/TIA (Electronic Industries Association/Telecommunication Industry Association) "category of performance" standards based on carrier frequency in Hz or MHz. This translates roughly into the following data rates in Mbps.

CAT	Cable Type	Max Data Rate
1	UTP	Below 1 Mbps
2	UTP	4 Mbps
3	UTP/STP	16 Mbps
4	UTP/STP	20 Mbps
5	UTP/STP	100 Mbps
5e	UTP/STP	200 Mbps
6	UTP/SFTP*/STP	1000 Mbps

*Foil Shield

COAXIAL CABLES: IBM SNA, ARCNET, and ETHERNET are coaxial cable based networks. Both IBM SNA and ARCNET use 93 ohm, low capacitance cable. Ethernet Trunk Cable is typically 50 ohm thick coax (yellow cable) and Ethernet Distribution Cable is thin coax, RG-58/U.

As we all know, attenuation (loss) in coaxial cable goes up with frequency and distance. The higher the data rate and the longer the distance, the higher the loss. This limits the distance that cable can be used effectively without amplification (Boosters, Repeaters). Cable television, which typically uses 75 ohm coaxial cable, uses repeaters on poles to boost the signal.

TABLE I
ETHERNET LAN

Network	Model #	Package: Stand Alone	Package: Mini	Package: Card	Data Rate up to Mbps	Status Indicators	Power* Option	Data** Connection	Fiber Connection Multimode 820 nm	Fiber Connection Singlemode 1300-nm	Distance Km ***: 2	Distance Km ***: 5	Distance Km ***: 10	Standard Network	Weight LB/KG	Remarks
Ethernet																
	2062		√		16	√	5	FIBER IN/OUT	ST/SMA	ST	√	√	√		.5/.2	Fiber Optic Repeater/Converter
	2082		√		100	√	5	FIBER IN/OUT	ST	ST/FC/SC	√	√	√		.5/.2	Fiber Optic Repeater/Converter
	2150		√		100	√	8	RJ45	ST	ST	√			√	.5/.2	Fast Ethernet
	2351			√	10	√	ISA BUS	ISA BUS	ST/SMA	ST	√	√		√	.5/.2	ISA BUS Card
	2361			√	10/100	√	PCI BUS	PCI BUS	ST	ST	√			√	.5/.2	PCI BUS Card
	2550		√		10	√	6	RJ45	ST	ST	√	√		√	.5/.2	Ethernet 10 Base FL or FOIRL
	2848	√			10	√	1, 2	DB-15 M	ST/SMA	ST/FC/SC	√	√		√	3/1.4	10 Base FL or FOIRL
	2849	√			10	√	1, 2	DB-15 F	ST/SMA	ST/FC/SC	√	√		√	3/1.4	10 Base FL or FOIRL
	2850	√			10	√	1, 2	RJ45	ST/SMA	ST/FC/SC	√	√		√	3/1.4	Ethernet 10 Base FL or FOIRL
	2851	√			10	√	1, 2	BNC	ST/SMA	ST/FC/SC	√	√		√	3/1.4	Ethernet 10 Base FL or FOIRL

* Power Options: See "Power Options and How to Order" sheet (p. 80) for options and ordering instructions.

** Pin outs are specified in data sheets

Temperature range 0 - 50 degrees C unless shown otherwise.

Extended Temperature (ET) range available on some products.

*** Distance: 2 km - STD, 5 km - L, 10 km - XL, 20 km - UL

*** While on Fiber side you can go long distances, check Network Timing & Distance limitations

HOW TO ORDER

Base Model: Number	Power*	Data Connector**	Distance***	Fiber and Connector: Multimode (MM)-STD	Fiber and Connector: Singlemode (SM)-Specify	Temperature
XXXX	1. 110 VAC - STD 2. 230 VAC - V 5,6, & 8 - See Chart	M or F (F is STD on most models)	2 Km - STD Other - Specify L, XL, or UL	ST - STD Other-Specify	ST - STD Other-Specify	0 - 50° C - STD -40 to +80° C - ET Other - Call S.I. Tech

e.g. 2150 = Fast Ethernet to Fiber Bit-Driver, Needs S.I. Tech #2125 Power Supply, RJ-45, 2 Km, Multimode, ST Connectors, 0-50 Degrees C

Specifications subject to change without notice.

TABLE J
LAN/WAN

Network	Model #	Package: Stand Alone	Package: Mini	Package: Rack	Data Rate up to Mbps	Status Indicators	Power* Option	Data ** Connector	Fiber Connection Multimode 820 nm	Fiber Connector Singlemode 1300 nm	Distance Km ***: 2	5	10	20	Standard Network	Weight LB/KG	Remarks
Arcnet																	
	2353			√	2.5	√	1, 2	BNC F	ST/SMA	ST/FC/SC	√	√			√	.5/.2	ARCNET Card, 3000 Rack
	2853	√		√	2.5	√	1, 2	BNC F	ST/SMA	ST/FC/SC	√	√			√	3/1.4	ARCNET
IBM - SEE IBM SECTION																	
Token Ring																	
	2875	√			4	√	1, 2	DB-9F	ST/SMA	ST/FC/SC	√	√			√	3/1.4	MAU to MAU
	2876	√			4	√	1, 2	DB-9F	ST/SMA	ST/FC/SC	√	√			√	3/1.4	MAU to PC
	2877	√			4/16	√	1, 2	DB-9F	ST/SMA	ST/FC/SC	√	√			√	3/1.4	MAU to MAU
	2878	√			4/16	√	1, 2	DB-9F	ST/SMA	ST/FC/SC	√	√			√	3/1.4	MAU to PC
Omninet (RS-485)																	
	2852	√			1	√	1, 2	Terminal Block	ST/SMA	ST/FC/SC	√	√			√	3/1.4	RS-485 Network
WAN/Internet/ Telecom																	
T-1/E-1																	
	2890	√		√	1.54	√	1,2,3	DB-15F	ST/SMA	ST/FC/SC	√	√	√	√	T-1	3/1.4	T-1
	2891	√		√	2.04	√	1,2,3	2 BNC F	ST/SMA	ST/FC/SC	√	√	√	√	E-1	3/1.4	E-1
T-3/E-3/STS-1																	
	2893			√	44	√	1,2,3	2 BNC F	ST	ST/FC/SC	√	√	√	√	T-3	5/2.2	T-3
	2894			√	34	√	1,2,3	2 BNC F	ST	ST/FC/SC	√	√	√	√	E-3	5/2.2	E-3
	2895			√	51.8	√	1,2,3	2 BNC F	ST	ST/FC/SC	√	√	√	√	STS1	5/2.2	STS-1 (OC-1)
LAN: Using RS-232/422/485		**See sections applicable to these standards**															

* Power Options: See "Power Options and How to Order" sheet (p. 80) for options and ordering instructions.

** Pin outs are specified in data sheets

Temperature range 0 - 50 degrees C unless shown otherwise.

Extended Temperature (ET) range available on some products.

*** Distance: 2 km - STD, 5 km - L, 10 km - XL, 20 km - UL

ARCNET is a trademark of Datapoint Corp

IBM is a registered trademark of International Business Machines Corp

Omninet is a trademark of Corvus Systems Inc.

HOW TO ORDER

Base Model Number	Power*	Data Connector**	Distance***	Fiber and Connector: Multimode (MM)-STD	Fiber and Connector: Singlemode (SM)-Specify	Temperature
XXXX	1. 110 VAC - STD 2. 230 VAC - V 3. See Chart	M or F (F is STD on most models)	2 Km - STD Other - Specify L, XL, or UL	ST - STD Other-Specify	ST - STD Other-Specify	0 - 50° C - STD -40 to +80° C - ET Other - Call S.I. Tech

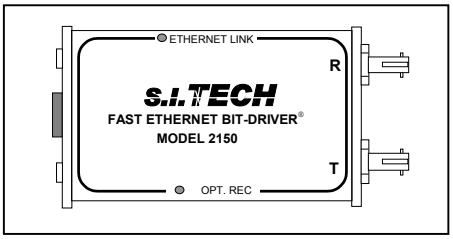
e.g. 2875V=2875, Token Ring MAU to MAU Bit-Driver, 230VAC, DB-9F, 2 Km, Multimode, ST Connectors, 0-50 degrees C

Specifications subject to change without notice.

S.I. Tech Inc., Batavia, IL 60510 Phone: (630) 761-3640 Fax: (630) 761-3644
Web Site: http://www.sitech-bitdriver.com

LAN/WAN
ETHERNET FIBER OPTIC BIT-DRIVERS®

2150

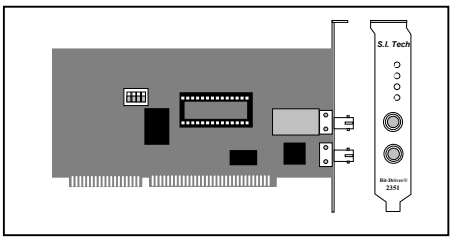


- Mini Optical Bit-Driver®
- Compatible with 100 Base-TX and 100 Base-FX networks
- Link Status, Optical, and Ethernet LED indicators
- Extends distance between Server or Switch and Hub
- Multimode is standard, Single Mode optional

2160*
(Coming Soon)

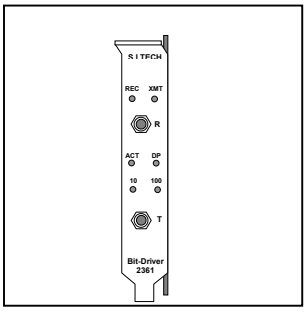
- Mini Optical Bit-Driver
- Data Rate is 1 Gbps

2351



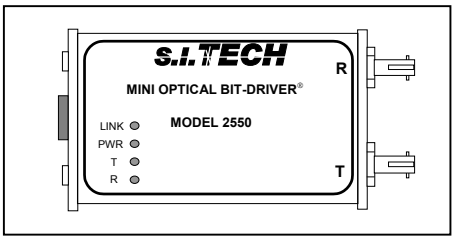
- Board Level Fiber Optic Bit-Driver® supporting 16-bit ISA Bus computers
- Compatible with IBM PC, AT, and XT
- Data rate is 10 Mbps
- LED indicators for easy troubleshooting
- Configuration Software & Operating Instructions come with the Product

2361*



- Board Level Fiber Optic Bit-Driver® supporting 32-bit PCI Bus computers
- Compatible with IBM and other PCs
- Data rate is 10/100 Mbps
- LED indicators for easy troubleshooting
- Configuration Software & Operating Instructions come with the Product

2550*



- Mini Optical Bit-Driver®
- Compatible with 10 Base-FL or FOIRL Standards
- Link Status, Receive Data, Transmit Data, and Power LED indicators
- Connects to RJ45 – Twisted Pair
- Multimode is standard, Single Mode optional

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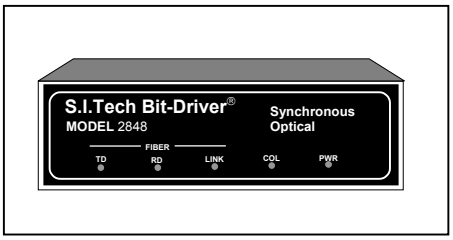
Web Site: http://www.sitech-bitdriver.com

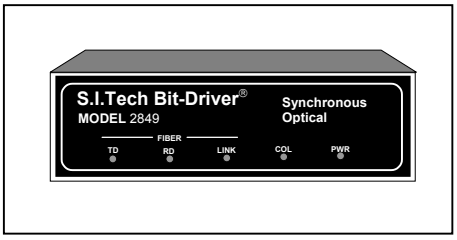
LAN/WAN
ETHERNET FIBER OPTIC BIT-DRIVERS®

2848



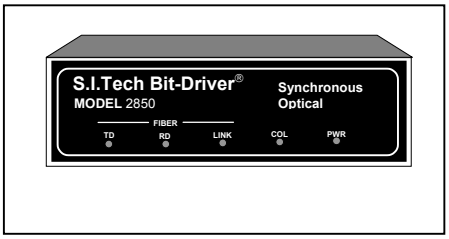
- Stand Alone Bit-Driver®
- Compatible with 10 Base-FL or FOIRL and IEEE 802.3 Standards
- Transmit Data, Receive Data, Link Status, Collision, and Power LED indicators
- DB-15M Male AUI port
- Multimode is standard, Single Mode optional
- Interfaces with either ST, SC, or FC connectors

2849



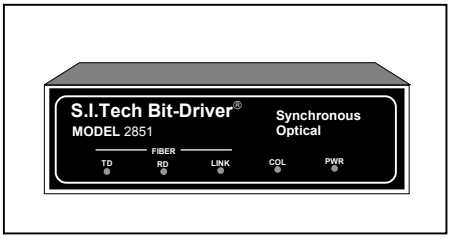
- Stand Alone Bit-Driver®
- Compatible with 10 Base-FL or FOIRL and IEEE 802.3 Standards
- Transmit Data, Receive Data, Link Status, Collision, and Power LED indicators
- DB-15F Female AUI port
- Accesses Ethernet Thick Coax Tap Transceiver
- Multimode is standard, Single Mode optional
- Interfaces with either ST, SC, or FC connectors

2850



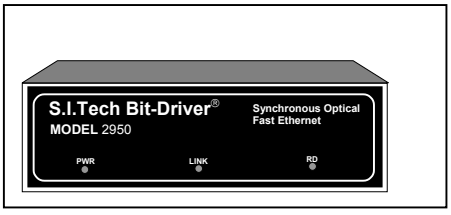
- Stand Alone Bit-Driver®
- Compatible with 10 Base-FL or FOIRL and IEEE 802.3 Standards
- Connects directly to STP cable devices via RJ45 connector
- Transmit Data, Receive Data, Link Status, Collision, and Power LED indicators
- Extends distance of Ethernet based STP LANs to a fiber optic network up to 10 Km
- Multimode is standard, Single Mode optional
- Interfaces with either ST, SC, or FC connectors

2851



- Stand Alone Bit-Driver®
- Compatible with 10 Base-FL or FOIRL and IEEE 802.3 Standards
- Connects directly to Ethernet thin trunk cable via BNC connector
- Transmit Data, Receive Data, Link Status, Collision, and Power LED indicators
- Extends distance of Ethernet based Coax LANs to a fiber optic network up to 10 Km
- Multimode is standard, Single Mode optional
- Interfaces with either ST, SC, or FC connectors

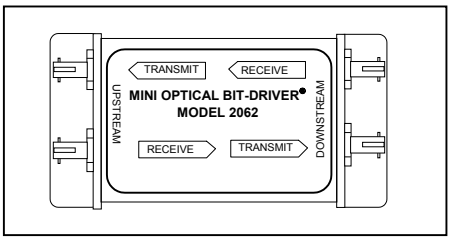
2950



- Stand Alone Bit-Driver®
- Compatible with 100 Base-TX or FX and IEEE 802.3 Standards
- Optical Power, Ethernet Failure, and Power LED indicators
- Extends distance of Ethernet based STP LANs to a fiber optic network up to 10 Km.
- Multimode is standard, Single Mode optional
- Interfaces with either ST, SC, or FC connectors

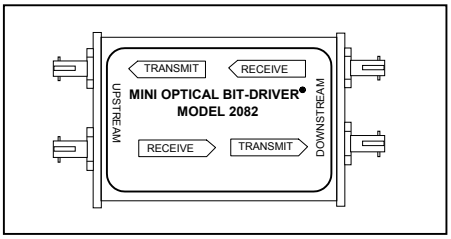
LAN/WAN
FIBER OPTIC REPEATER BIT-DRIVERS®

2062



- Fiber Optic Repeater
- Can be configured to convert Multimode to Single Mode
- Extends Distance of Multimode or Single Mode Segment
- Max Data Rate is 16 Mbps
- ST connector is standard

2082*



- Fiber Optic Repeater
- Can be configured to convert Multimode to Single Mode
- Extends Distance of Multimode or Single Mode Segment
- Max Data Rate is 100 Mbps
- ST connector is standard, SC/FC Optional

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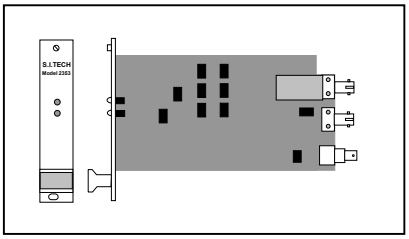
Web Site: http://www.sitech-bitdriver.com

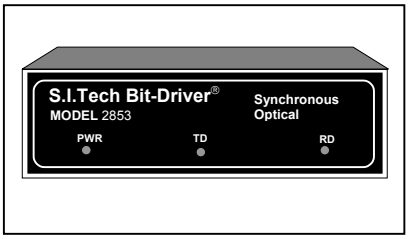
LAN/WAN
ARCNET FIBER OPTIC BIT-DRIVERS®

2353



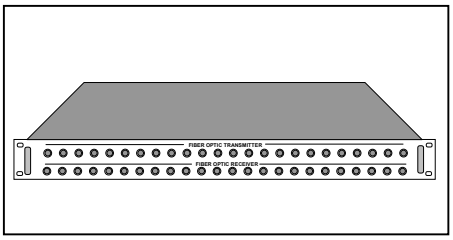
- Card Cage Mounted Fiber Optic Bit-Driver® supporting ARCNET protocol
- Max Data Rate is 2.5 Mbps
- Extends distance of ARCNET based 93 Ohm coax networks
- Series 3000 Rack holds 16 cards

2853



- Synchronous Simplex or Full Duplex Optical Bit-Driver®
- Max Data Rate is 2.5 Mbps
- Extends distance of ARCNET based 93 Ohm coax networks
- Multimode is standard, Single Mode optional

9024

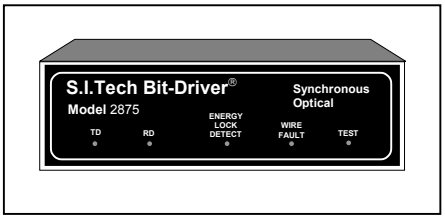


- Passive Optical Star
- Allows for totally optical ARCNET network
- 4 to 24 Ports
- Use in conjunction with 2353 and 2853 Bit-Drivers®

Note: ARCNET is a trademark of Datapoint Corporation

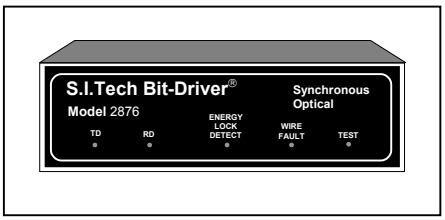
LAN/WAN
TOKEN RING FIBER OPTIC BIT-DRIVERS®

2875



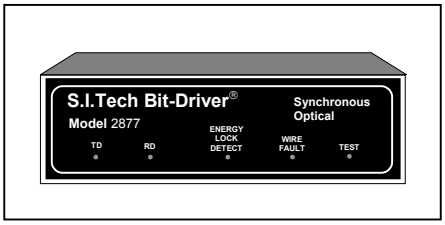
- Stand Alone Synchronous Optical Bit-Driver®
- Compatible with IBM Token Ring Protocol
- Max Data Rate is 4 Mbps
- Transmit Data, Receive Data, Energy Lock Detect, Wire Fault, and Power LED indicators
- Use between Wiring Concentrators (MAU) and MAU

2876



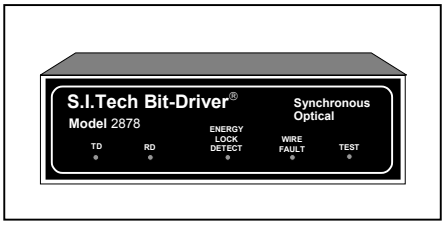
- Stand Alone Synchronous Optical Bit-Driver®
- Compatible with IBM Token Ring Protocol
- Max Data Rate is 4 Mbps
- Transmit Data, Receive Data, Energy Lock Detect, Wire Fault, and Power LED indicators
- Use between MAU and Workstation

2877



- Stand Alone Synchronous Optical Bit-Driver®
- Compatible with IBM Token Ring Protocol
- Data Rate is 4 or 16 Mbps
- Transmit Data, Receive Data, Energy Lock Detect, Wire Fault, and Power LED indicators
- Use between Wiring Concentrators (MAU) and MAU

2878



- Stand Alone Synchronous Optical Bit-Driver®
- Compatible with IBM Token Ring Protocol
- Data Rate is 4 or 16 Mbps
- Transmit Data, Receive Data, Energy Lock Detect, Wire Fault, and Power LED indicators
- Use between MAU and Workstation

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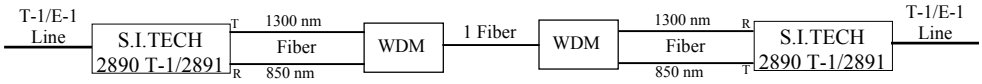
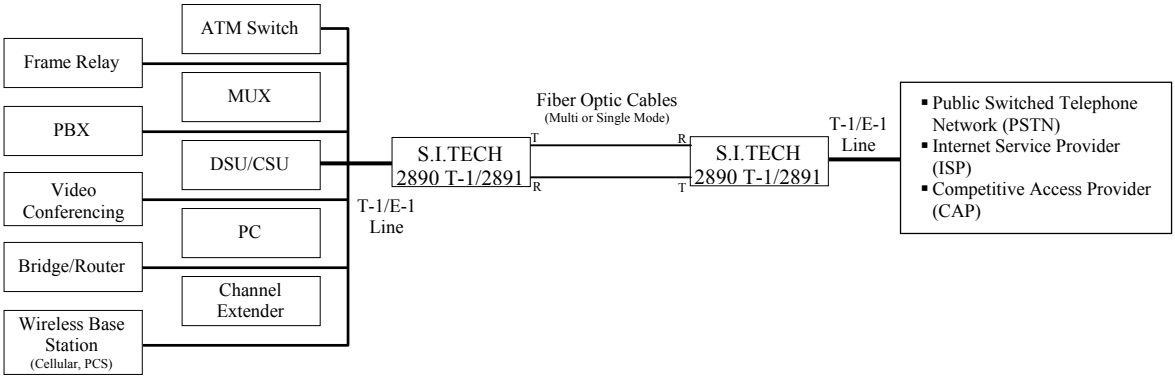
Web Site: http://www.sitech-bitdriver.com

WIDE AREA NETWORKS (WAN)

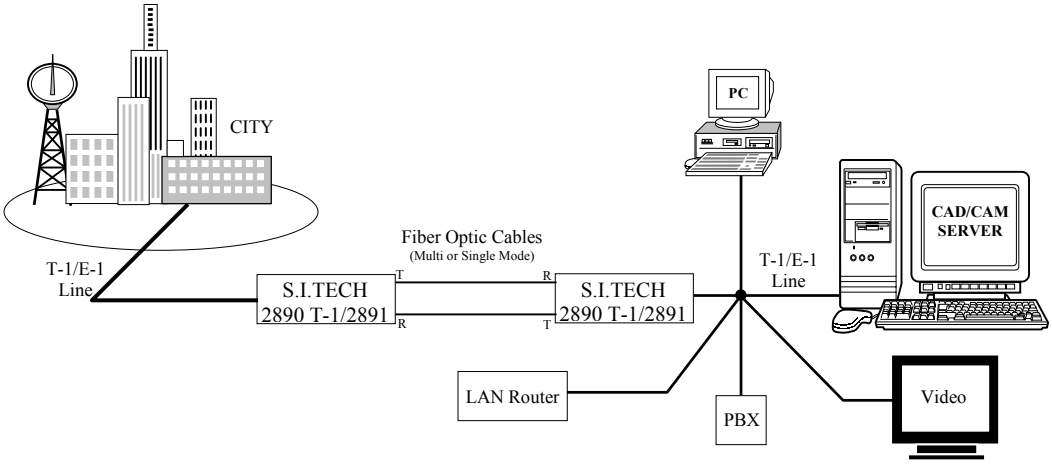
1. Special Application Using Wave Length Division Multiplexing (WDM):



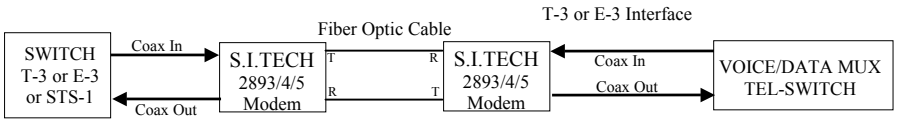
2. Dedicated T-1/E-1 Line with Phone Network:



3. Local Area (Wide Area) Network Using T-1/E-1 Fiber Line:

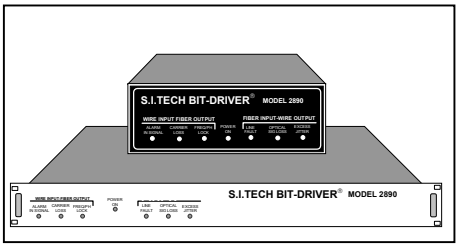


4. T-3/E-3 or STS-1 (OC-1) Applications:



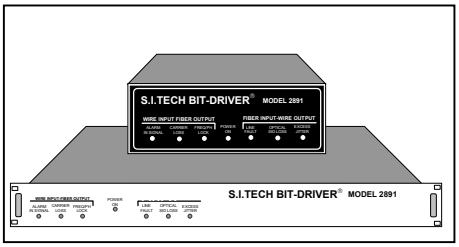
WAN FIBER OPTIC BIT-DRIVERS®

2890



- Synchronous Half or Full Duplex Optical Bit-Driver®
- T1 – AMI or B8ZS Line Coding
- Clear Channel Capability
- Status indicators and alarms for ease of use and maintenance
- Max Data Rate is 1.544 Mbps
- Stand Alone or Rack Mount Options
- Multimode is standard, Single Mode optional
- 110VAC/230VAC/48VDC Options
- Interfaces with either ST, SC, or FC connectors
- 2 Channel T-1 Model #2890-2R

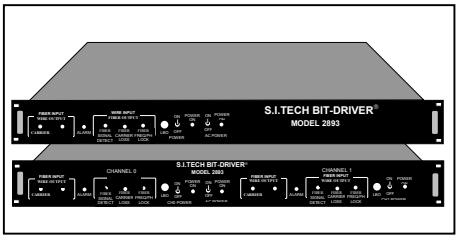
2891



- Synchronous Half or Full Duplex Optical Bit-Driver®
- E1 – AMI or HDB3 Line Coding
- Clear Channel Capability
- Status indicators and alarms for ease of use and maintenance
- Max Data Rate is 2.048 Mbps
- Stand Alone or Rack Mount Options
- Multimode is standard, Single Mode optional
- 110VAC/230VAC/48VDC Options
- Interfaces with either ST, SC, or FC connectors
- 2 Channel E-1 Model #2891-2R

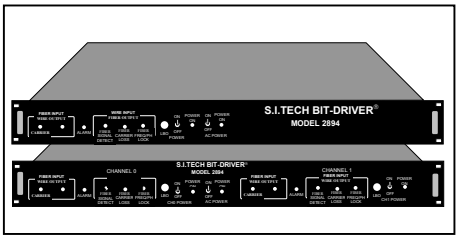
6

2893*



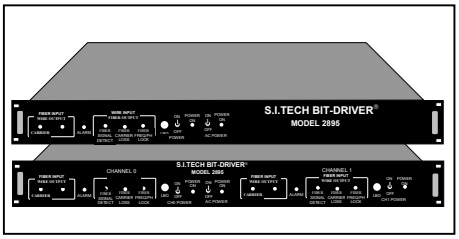
- Synchronous Half or Full Duplex Optical Bit-Driver®
- T-3 Model #2893, 2 Channel T-3 Model #2893-2R
- Status indicators and alarms for ease of use and maintenance
- Max Data Rate is 44.736 Mbps
- 1U High Rack Mounted
- Multimode is standard, Single Mode optional
- 110VAC/230VAC/48VDC Options
- Interfaces with either ST, SC, or FC connectors

2894*



- Synchronous Half or Full Duplex Optical Bit-Driver®
- E-3 Model #2894, 2 Channel E-3 Model #2894-2R
- Status indicators and alarms for ease of use and maintenance
- Max Data Rate is 34.368 Mbps
- 1U High Rack Mounted
- Multimode is standard, Single Mode optional
- 110VAC/230VAC/48VDC Options
- Interfaces with either ST, SC, or FC connectors

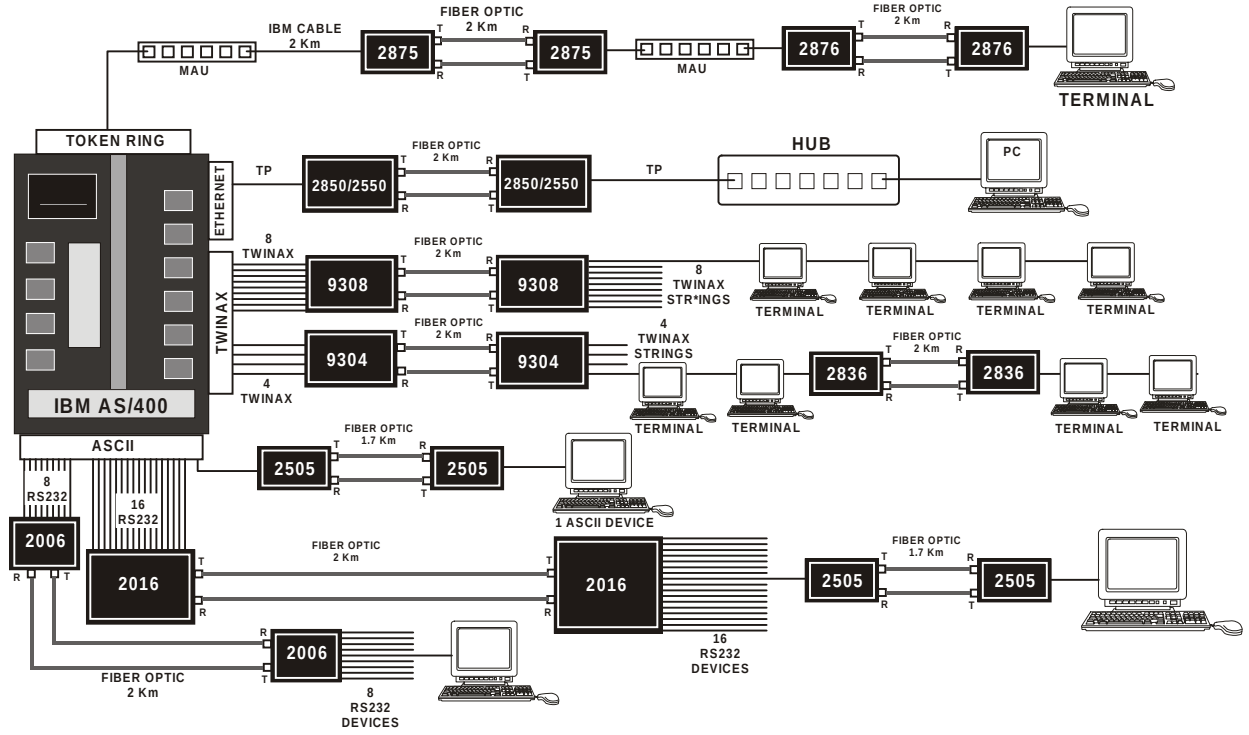
2895*



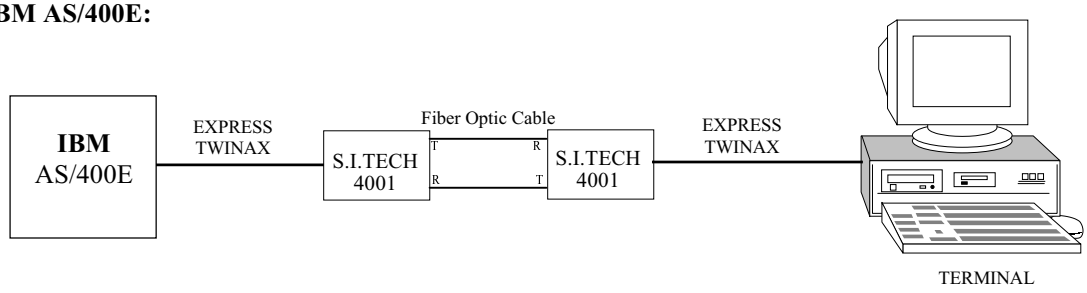
- Synchronous Half or Full Duplex Optical Bit-Driver®
- STS-1 Model #2895, 2 Channel STS-1 Model #2895-2R
- Status indicators and alarms for ease of use and maintenance
- Max Data Rate is 51.84 Mbps
- 1U High Rack Mounted
- Multimode is standard, Single Mode optional
- 110VAC/230VAC/48VDC Options
- Interfaces with either ST, SC, or FC connectors

IBM PRODUCTS

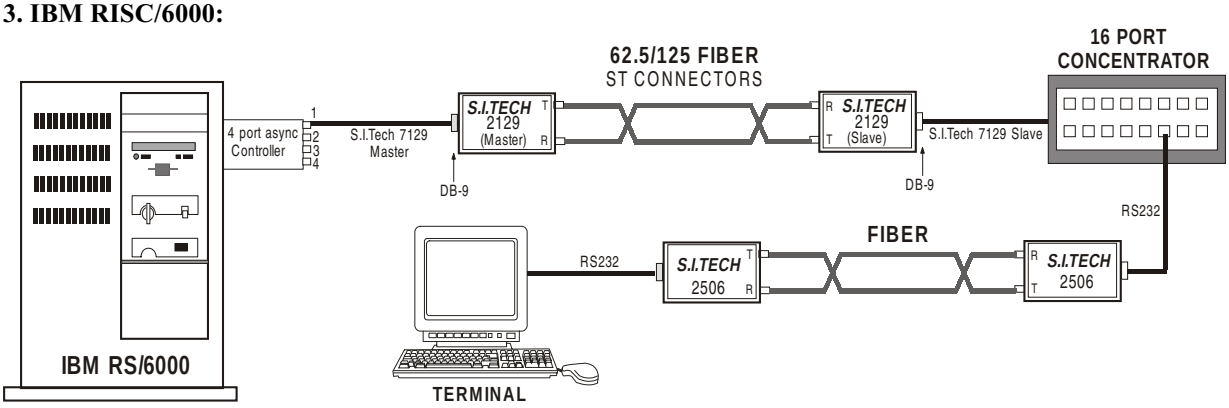
1. IBM 3X/AS 400/AS 400E:



2. IBM AS/400E:

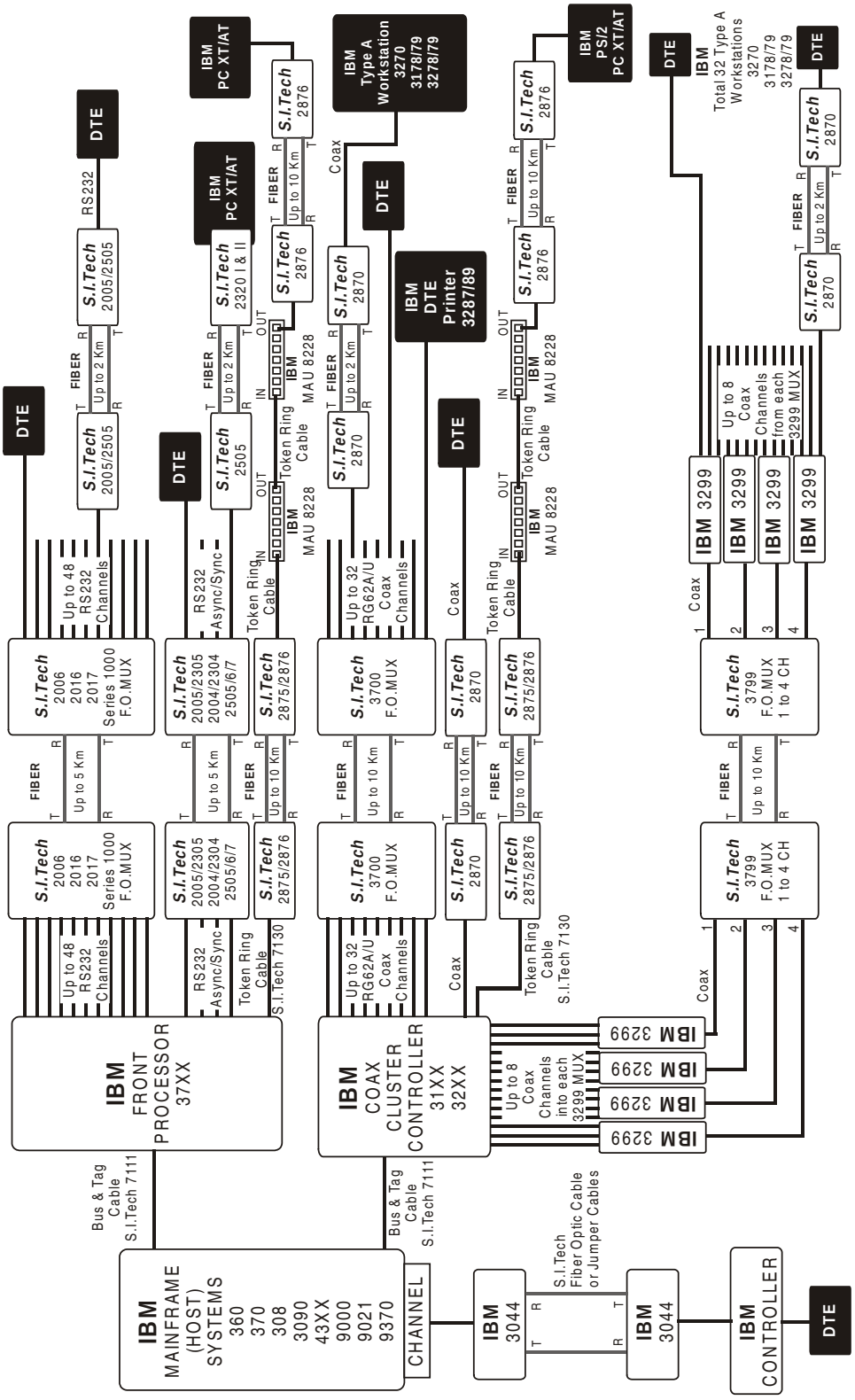


3. IBM RISC/6000:



7

4. IBM Mainframe:



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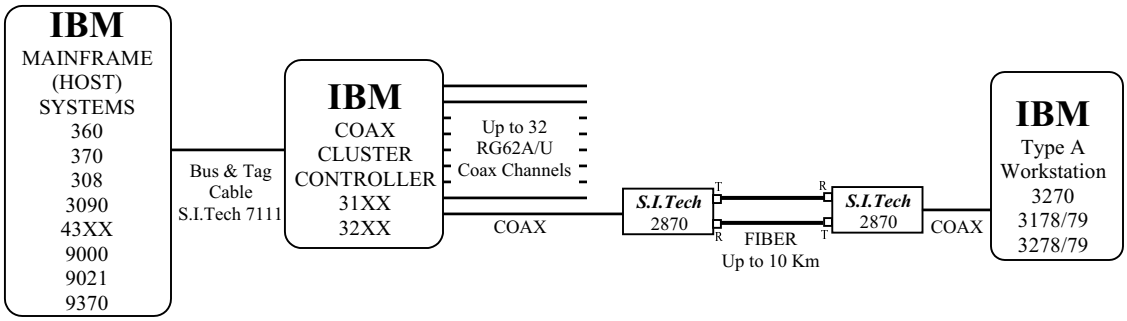
Web Site: http://www.sitech-bitdriver.com

IBM

IBM occupies a unique position in the computer industry being the world's largest computer system manufacturer. The world's largest corporations, governments, and educational institutions use IBM systems, particularly large and medium scale systems. Due to the massive size of these systems, long distance data communication and distributed data communication is a must. Fiber Optics is the most logical choice for these applications.

IBM
308/370/3090/43XX/9000/9021/9370
MAINFRAME NETWORKS
SNA

SNA – System Network Architecture: Basically a tree structure network to interconnect various IBM data processing equipment. It is also called Hierarchical Network. See Diagram below:



IBM MIDRANGE SYSTEMS

IBM Midrange Systems are typically designed for small to midsize corporations that do not require large systems, such as IBM mainframe. In today's environment Midrange systems support a small number of users to several thousand users. IBM Systems in this category are system 3X, AS/400, AS/400E, and RISC/6000

IBM PC AND NETWORKING

IBM PC and Networking – IBM popularized Token Ring Network and Personal Computers. Most IBM systems today support Token Ring as well as other Networks, such as Ethernet, Arcnet, FDDI and other protocols such as; RS-232, RS-422, RS-485, V.35 and so on. S.I. Tech makes Fiber Optic products to support most of the communications protocols and many networking products. These are covered in the appropriate section of this Catalog. Only IBM specific products are covered in the IBM section.

Note: IBM is a registered trademark of International Business Machines Corporation
SNA, AS/400, AS/400E, and RISC/6000 are trademarks of International Business Machines Corporation

TABLE K
IBM SYSTEMS

SYSTEM	Model #	Package: Stand Alone	Package: Mini	Package: Rack	Channel Data Rate Kbps	Number of Channels	Power* Option	Data Connection	Fiber * Connection Multimode 820 nm	Fiber Connection Singlemode 1300 nm	Distance Km ***: 2	Distance Km ***: 5	Weight LB/KG	Remarks
Mainframe 370/390/3270 SNA Networks														
	2370			√	2.35	1	1,2	BNC	ST/SMA	ST/SC/FC	√	√	1/.4	
	2870	√			2.35	1	1,2	BNC	ST/SMA	ST/SC/FC	√	√	3/1.4	
	3700			√	2.35	4-32	1,2	BNC/RJ11	ST/SMA	ST/SC/FC	√	√	12/5.5	
	3799	√			2.35	4	1,2	BNC	ST/SMA	ST/SC/FC	√	√	4.4/2	
Midrange Systems 3X/AS-400/AS-400E														
	2336			√	1.0	1	1,2	RJ45	ST/SMA	ST/SC/FC	√	√	1/.4	
	2836	√		√	1.0	1	1,2	Twinax	ST/SMA	ST/SC/FC	√	√	3/1.4	
	4001	√		√	1 OR 2	1	1,2	Twinax**	ST/SMA	ST/SC/FC	√	√	3/1.4	
	4002	√		√	1 OR 2	2	1,2	Twinax**	ST/SMA	ST/SC/FC	√	√	4/1.8	
	4004	√		√	1 OR 2	4	1,2	Twinax**	ST/SMA	ST/SC/FC	√	√	4/1.8	
	9036			√	1.0	1 TO 7	1,2	RJ45	ST/SMA	ST/SC/FC	√	√	6.5/3	
	9302	√			1.0	2	1,2	Twinax	ST/SMA	ST/SC/FC	√	√	4/1.8	
	9304	√		√	1.0	4	1,2	Twinax	ST/SMA	ST/SC/FC	√	√	12/6.5	
	9308	√		√	1.0	8	1,2	Twinax	ST/SMA	ST/SC/FC	√	√	12/5.5	
	9328	√		√	1.0	8	1,2	TW/RJ45	ST/SMA	ST/SC/FC	√	√	6.5/3	
RS/6000** **														
	2117		√		0.19	1	6	DB9 F	ST/SMA	ST	√		.25/.1	for 64 port HUB
	2119		√		1.2	1	6	DB9 F	ST/SMA	ST	√	√	.28/.13	for 128 port HUB
	2129		√		1.2	1	6	DB9 F	ST/SMA	ST	√	√	.28/.13	for 128 port HUB
LAN/WAN - See LAN/WAN Section														
ASCII - See RS-232/422/485 Section														

* Power Options: See "Power Options and How to Order" sheet p. 80 for options and ordering instructions.

**TW/RJ45/DB9

***Check IBM Timing Specifications

****2117 uses 7117 M&S cable,2119 uses M&S 7119 cable, 2129 uses M&S 7129 cables.

HOW TO ORDER

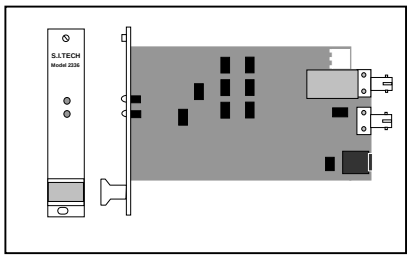
Base Model Number	Power*	Distance***	Fiber and Connector: Multimode (MM) - STD	Fiber and Connector: Singlemode (SM) - Specify	Temperature
XXXX	1. 110 VAC - STD	2 Km - STD	ST - STD	ST - STD	0 - 50° C - STD
	2. 230 VAC - V	Other - Specify	Other - Specify	Other - Specify	
	6. See Power Supply Chart	L			

e.g. 2836 = 1 part Twinax to Fiber Bit-Driver, Standalone, 110VAC, ST Connector

Specifications subject to change without notice.

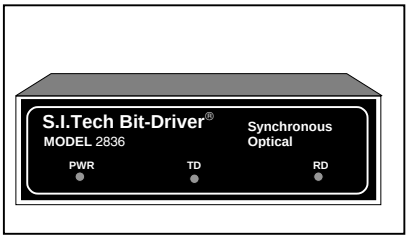
IBM
TWINAX TO FIBER OPTIC BIT-DRIVERS®
(IBM AS/400, AS/400E, & S3/X)

2336



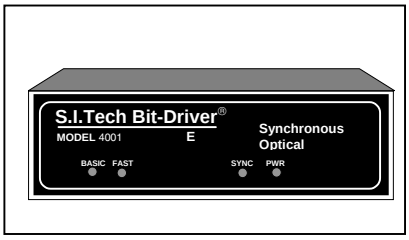
- Card Cage Mounted Fiber Optic Bit-Driver®
- Synchronous Half or Full Duplex Optical Bit-Driver®
- Compatible with IBM 3/X and AS/400 systems
- Power, Transmit Data, and Receive Data LED status indicators
- Supports 1 RJ11 Connector
- Max Data Rate is 1 Mbps
- Fits Series 3000 Card Cage

2836



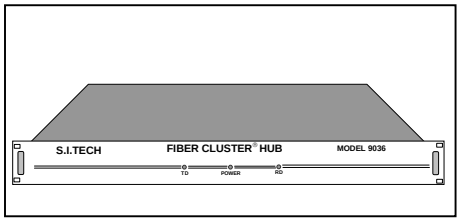
- Synchronous Half or Full Duplex Optical Bit-Driver®
- Compatible with IBM 3/X, AS/400, and AS/400E systems
- Power, Transmit Data, and Receive Data LED status indicators
- Supports 1 Twinax Port
- Works with 9036 Hub to support 7 user terminals
- Max Data Rate is 1 Mbps
- Multimode is standard, Single Mode optional

4001*



- Synchronous Half or Full Duplex Optical Bit-Driver®
- Compatible with IBM 3/X, AS/400, and AS/400E systems
- Power, Transmit Data, and Receive Data LED status indicators
- Supports 1 Twinax Port
- Supports IBM Basic or Fast protocols
- Max Data Rate is 2 Mbps
- Multimode is standard, Single Mode optional

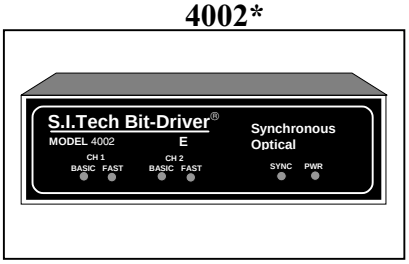
9036



- Synchronous Half or Full Duplex Fiber Cluster® Hub
- Compatible with IBM 3/X and AS/400 systems
- Fully Compatible with 2836 Bit-Driver®
- Max Data Rate is 1 Mbps
- Allows direct connect RJ45 Twisted Pair – 7 Users
- Multimode is standard, Single Mode optional

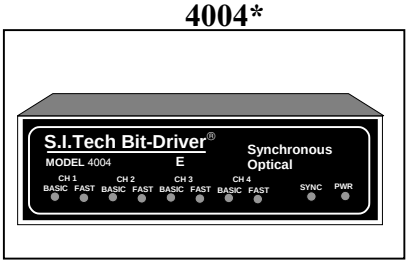
IBM
TWINAX TO FIBER OPTIC MULTIPLEXERS
(IBM AS/400, AS/400E, & S3/X)

4002*



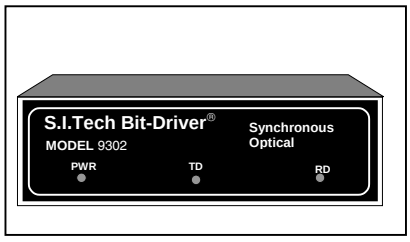
- Two Channel Synchronous Half or Full Duplex Multiplexer Optical Bit-Driver®
- Compatible with IBM 3/X, AS/400, and AS/400E systems
- Power, Transmit Data, and Receive Data LED status indicators
- Supports IBM Basic or Fast protocols
- Max Data Rate is 2 Mbps per Twinax Port
- Multimode is standard, Single Mode optional
- Supports up to 14 Users

4004*



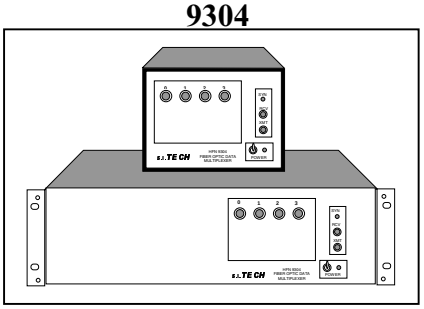
- Four Channel Synchronous Half or Full Duplex Multiplexer Optical Bit-Driver®
- Compatible with IBM 3/X, AS/400, and AS/400E systems
- Power, Transmit Data, and Receive Data LED status indicators
- Supports IBM Basic or Fast protocols
- Max Data Rate is 2 Mbps per Twinax Port
- Multimode is standard, Single Mode optional
- Supports up to 28 Users

9302



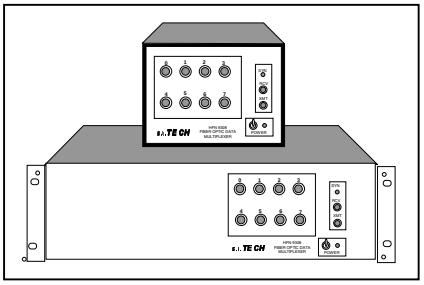
- Two Channel Synchronous Half or Full Duplex Multiplexer Optical Bit-Driver®
- Compatible with IBM 3/X, AS/400, and AS/400E systems
- Power, Transmit Data, and Receive Data LED status indicators
- Max Data Rate is 1 Mbps per Twinax Port
- Multimode is standard, Single Mode optional
- Supports up to 14 Users

9304



- Four Channel Synchronous Half or Full Duplex Multiplexer Optical Bit-Driver®
- Compatible with IBM 3/X, AS/400, and AS/400E systems
- Power, Sync, Transmit Data, and Receive Data LED status indicators
- Stand Alone or Rack Mount Options
- Rack can hold 2 units side by side
- Max Data Rate is 1 Mbps per Twinax Port
- Multimode is standard, Single Mode optional
- Supports up to 28 Users

9308

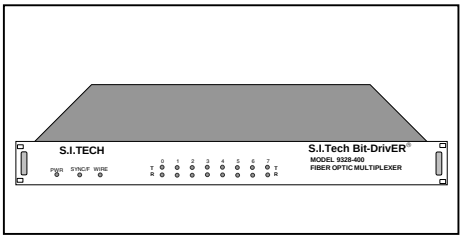


- Eight Channel Synchronous Half or Full Duplex Multiplexer Optical Bit-Driver®
- Compatible with IBM 3/X and AS/400 systems
- Power, Sync, Transmit Data, and Receive Data LED status indicators
- Stand Alone and Rack Mount Options
- Rack can hold 2 units side by side
- Max Data Rate is 1 Mbps per Twinax Port
- Supports up to 40 Users

S.I. Tech Inc., Batavia, IL 60510 Phone: (630) 761-3640 Fax: (630) 761-3644
Web Site: http://www.sitech-bitdriver.com

IBM
TWINAX OR TWISTED PAIR TO FIBER OPTIC MULTIPLEXERS
(IBM AS/400, AS/400E, & S3/X)

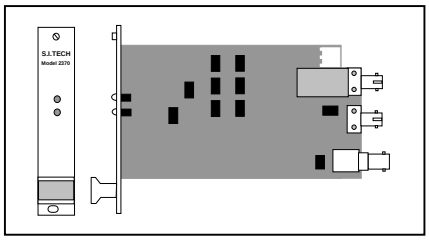
9328



- Eight Channel Synchronous Half or Full Duplex Multiplexer Optical Bit-Driver® having Twinax or Twisted Pair for each channel
- Compatible with IBM 3/X, AS/400 Systems, and Workstation Controllers
- Power, Sync, Transmit Data, and Receive Data LED indicators
- Max Data Rate is 1 Mbps
- 1U High Rack Mounted
- Multimode is standard, Single Mode optional
- RJ45 Twisted Pair or Twinax Options
- Supports up to 40 Users

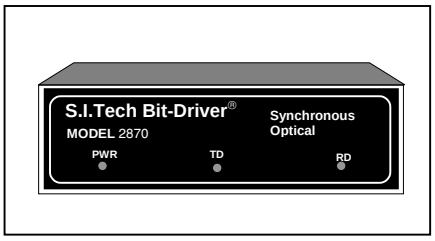
IBM
3270 COAX TO FIBER OPTIC BIT-DRIVERS®
(IBM Systems 370/390 and SNA Networks)

2370



- Card Cage Mounted Synchronous Simplex or Full Duplex Fiber Optic Bit-Driver®
- Fully Compatible with IBM SNA Networks
- Max Data Rate is 2.35 Mbps
- Coax (93 Ohm) BNC Connector is standard
- Series 3000 Card Cage holds 16 Cards

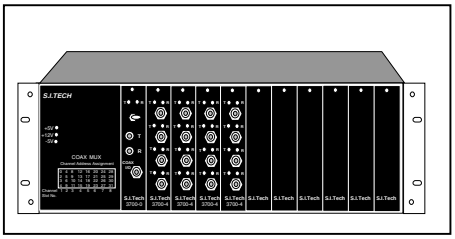
2870



- Synchronous Simplex or Full Duplex Fiber Optic Bit-Driver®
- Fully Compatible with IBM SNA Networks
- Max Data Rate is 2.35 Mbps
- Coax (93 Ohm) BNC Connector is standard
- Multimode is Standard, Single Mode Optional

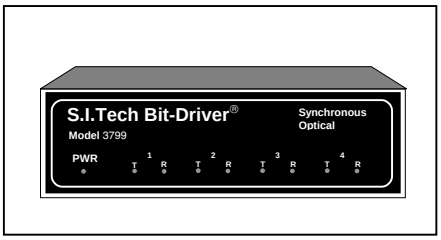
3270 COAX TO FIBER OPTIC MULTIPLEXERS
(IBM Systems 370/390 and SNA Networks)

3700



- Modular Four to Thirty-two Channel Synchronous Simplex or Full Duplex Multiplexer Optical Bit-Driver®
- Compatible with IBM Mainframe Computers, 3174, 3274, and other coaxial controllers
- Fully Compatible with IBM SNA Networks and 3270 Systems
- Max Data Rate is 2.35 Mbps per channel
- RJ11 Twisted Pair or Coax Channel Cards

3799

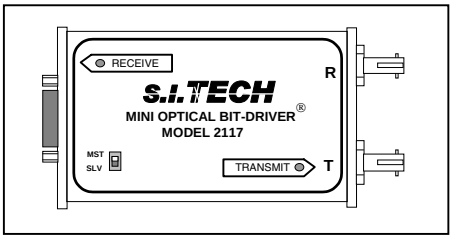


- Four Channel Synchronous Simplex or Full Duplex Multiplexer Optical Bit-Driver®
- Compatible with IBM Mainframe Computers, 3174, 3274 and other controllers, and 3299 multiplexers
- Fully Compatible with IBM SNA Networks and 3270 Systems
- Max Data Rate is 2.35 Mbps per channel

S.I. Tech Inc., Batavia, IL 60510 Phone: (630) 761-3640 Fax: (630) 761-3644
Web Site: http://www.sitech-bitdriver.com

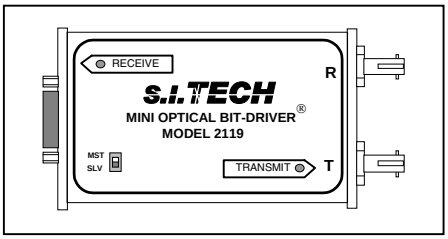
IBM
FIBER OPTIC BIT-DRIVERS® FOR IBM RS/6000

2117



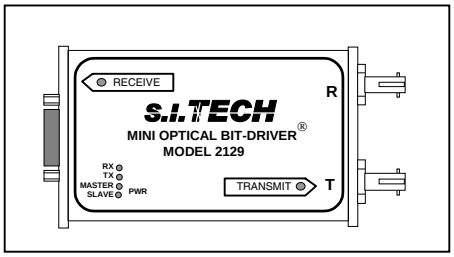
- Mini Synchronous Half or Full Duplex Optical Bit-Driver®
- Compatible with IBM RS/6000 servers and IBM or Dickens Data Concentrator – 64 Users
- Point to Point Links up to 2.5 Km. Each Link consists of one 2117 "master" and one 2117 "slave" Bit-Driver
- Units require S.I. Tech #7117 master/slave cables
- Master or Slave Switch Selectable
- RS-485, 9 wire port operating at 190 Kbps
- RS-485 IBM RS/6000 Protocol

2119



- Mini Synchronous Half or Full Duplex Optical Bit-Driver®
- Compatible with IBM RS/6000 servers and IBM Dickens Data Concentrator – 128 Users
- Point to Point Links up to 2.5 Km. Each Link consists of one 2119 "master" and one 2119 "slave" Bit-Driver
- Units require S.I. Tech #7119 master/slave cables
- Master or Slave Switch Selectable
- RS-485, 9 wire port operating at 1.2 Mbps
- RS-485 IBM RS/6000 Protocol

2129*

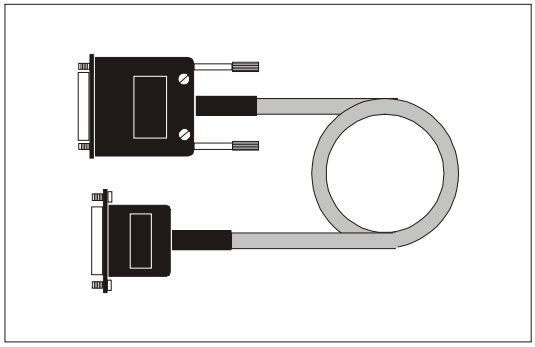


- Mini Synchronous Half or Full Duplex Optical Bit-Driver®
- Compatible with IBM RS/6000 servers and IBM RANS – 128 Users
- Point to Point Links up to 2.5 Km. Each Link consists of one 2129 "master" and one 2129 "slave" Bit-Driver
- Units require S.I. Tech #7129 master/slave cables
- Master or Slave Switch Selectable
- RS-485, 9 wire port operating at 1.2 Mbps
- Receive Data, Transmit Data, Master, and Slave LED Indicators
- RS-485 IBM RS/6000 Protocol

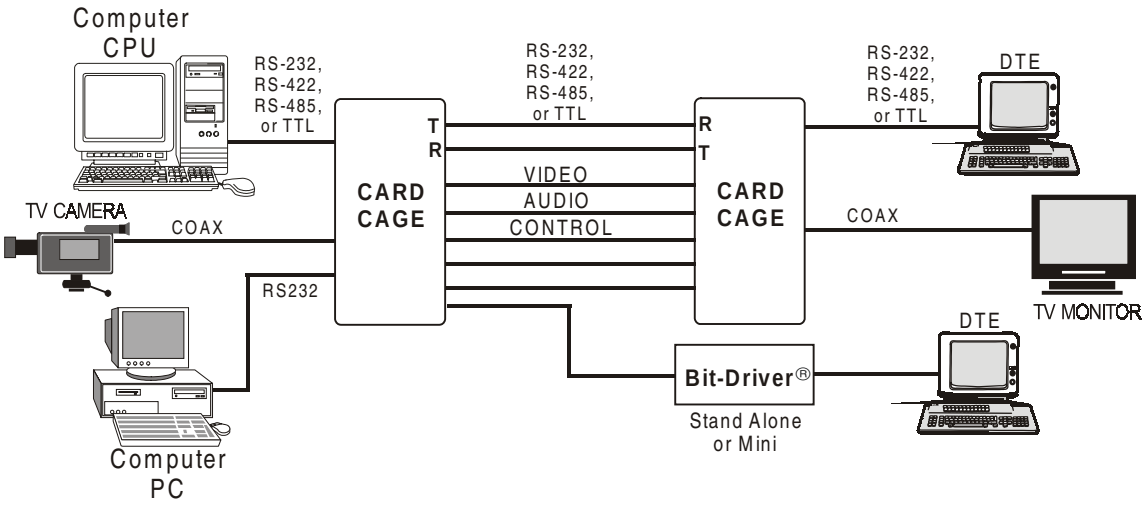
IBM
CABLE ASSEMBLIES

S.I.Tech Part #	IBM Part #	IBM Machine Type	Cable Assembly
7029	6398643	3720	LIC Type 1
7030	6089075/ (1736733)	3705 & 3725	Modem Cable
7031	6398665	3720	
7032	1785928	3705 & 3725	LIC Type 3
7033	1733825	3705 & 3725	LIC Type AB
7034	1733820	3705 & 3725	V.35, LIC Type 3
7036	5993200	3705 & 3725	I/O Modem Cable
7037	1733822	3705 & 3725	V.35, LIC Type3 Direct Attach
7038	1733747/ 6089077	3705 & 3725	LIC Type 1 ACU
7040	2667243	3705/3725/3727	Operator Console
7042	2267351	3705/3725/3726	V.24 LIC Type 1 Direct Attach
7043	1733746	3705 & 3725	External Modem Cable
7044	2667242	3705 & 3725	
7045	5997453	3705 & 3725	I/O Gate Modem
7046	6398685	3720	LIC Type 4A
7047	6398658	3720	LIC Type 4B
7048	1733817	3705 & 3725	LIC Type 2
7050	5997462/ 5997352	3705 & 3725	Modem Cable
7054	5997489	3705 & 3725	I/O Gate Modem
7056	1770789	3705 & 3725	
7057	7837397	3720	V.24 Direct Attach, Async.
7058	6398736/ 1749352	3720	Console Cable
7101	70X8655	9370	
7102	60X8661	9370	
7104	1743532		
7105	5267784		V.35 Modem Cable
7106	1754225		X.21 Line Set 8 & 9
7107	5267781		
7108	7837395	3745	V.24 Direct Attach Sync
7109	03F 5027	3745	Modem, Remote Console
7111	5460185		BUS & TAG Blue Cable
7112	1648394		V.35 Line Set
7113	03F 4946	3745	Local Console Cable
7114	2452259	3745	X.21 Line Set 8 & 9
7116	8636752		
7118	58X9568	3745	
7120	5997479		V.35 Line Set 1K
7122	6398737/ 7837399	3720	Remote Console Cable
7124	6398666	3720	LIC Type 2 Cable
7125	03F 4945	3745	RSF Modem Cable
7127	65X8985	3745	Local Console Cable
7128	4299698		
7130	61X3229		Token Ring
7132	58X9484	3745	V.35
7134	58X9485	3745	V.35 LIC Type 3
7135	58X9344	3745	V.35 Interface
7136	6398668	3745	V.25 DCE Autocall Unit
7138	674570		Adapter
7140	1752941	3705	V.35 I/O Gate to Terminal
7142	03F 4401	3745	Remote Console
7144	1670924		
7145	1670923		
7146	58X9348	3745	X.21 Direct Attach
7148	58X9487	3745	LIC Type 4A
7149	58X9345	3745	X.21 Interface
7150	6423153	3745	Modem Cable with Switch
7153	6937961		

Specifications subject to change without notice.



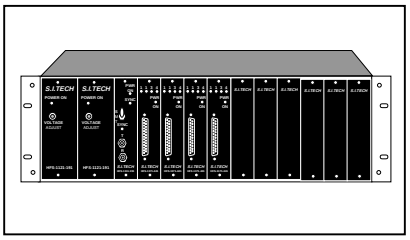
SIGNAL DISTRIBUTION SYSTEMS



8

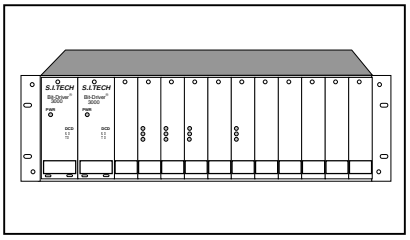
SIGNAL DISTRIBUTION SYSTEMS

SERIES 1000 NON-MUXED



- Card cage to mount in standard 19 inch rack to support various Bit-Driver® products
- Designed to hold up to 12 Eurocard size interface cards plus 2 power supply cards
- Supports Video, Analog, TTL, RS232, RS422, and MIL-188-114 Bit-Drivers®. See individual categories for card details
- Overall height 7 inches, overall depth 15 inches
- Configuration is Point to Point
- 110 VAC or 230 VAC Input Power

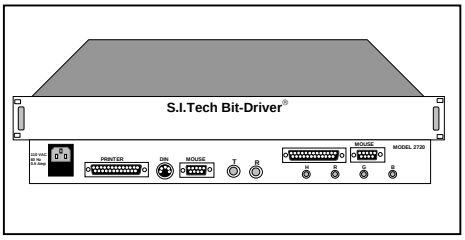
SERIES 3000



- Card cage to mount in standard 19 inch rack to support various Bit-Driver® products
- Model 3000 A is 9 inches deep and 4.5 inches tall to accommodate up to 16 Eurocard size cards plus 2 power supplies
- Model 3000 B is 12 inches deep and 4.5 inches tall to accommodate up to 16 American Standard Size cards plus 2 power supplies
- Supports RS232, RS422, RS485, Video, and several proprietary configuration Bit-Drivers®. See individual categories for card details – Point to Point Configuration
- 110 VAC or 230 VAC Input Power

FIBER OPTIC CONCENTRATOR

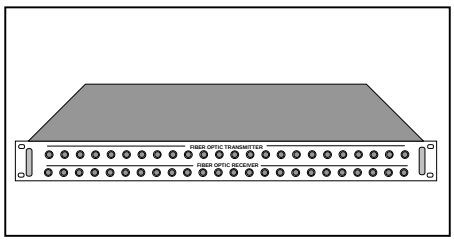
2720



- Rack Mounted Computer-to-Peripherals Optical Bit-Driver®
- Six Fiber cable provides four independent 30 MHz video circuits (R,G,B,H-Sync), plus full duplex signals from a 20 channel digital multiplexer
- Printer Port supports full Centronics parallel printer interface
- Monitor, Keyboard, and Mouse Ports are provided
- Models 2720 V and 2720 C must be used as a pair
- Remoting PC from monitor, keyboard, mouse, and printer

FIBER CLUSTER®

9024

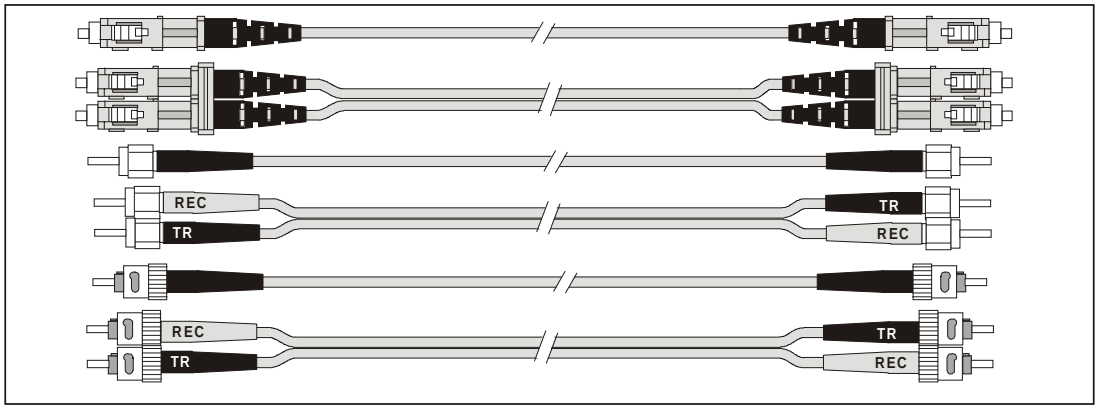


- 4 to 24 Port Passive Optical Star to distribute signals up to 24 workstations
- Totally Passive Optical Network
- 19” Rack Mountable
- Bi-directional

S.I. Tech Inc., Batavia, IL 60510 Phone: (630) 761-3640 Fax: (630) 761-3644
Web Site: http://www.sitech-bitdriver.com

ACCESSORIES

ACCESSORIES
CABLE ASSEMBLIES



S.I.Tech Fiber Optic Cable Assemblies are precision made to customer specifications or S.I.Tech specifications. Each assembly is tested for attenuation, serialized, and individually packed.

FIBER OPTIC CABLE ASSEMBLIES

S.I.Tech Cable Number	Fiber Type	Fiber Size Microns	Number of Fibers	Attenuation dB/Km 850nm-MM 1300nm-SM	Cable Type	Breakout Kit	Connector
5201	Multimode	62.5	1	4	Indoor	No	Specify
5202	Multimode	62.5	2	4	Indoor	No	Specify
6002	Multimode	62.5	2	3	Outdoor	Yes	Specify
7201	Multimode	50	1	3	Indoor	No	Specify
7202	Multimode	50/62.5	2	3	Indoor/R*	No	Specify
8201	Singlemode	8	1	1	Indoor	No	Specify
8202	Singlemode	8	2	1	Indoor	No	Specify
9201	Plastic	1000	1	250	Indoor	No	Specify
9202	Plastic	1000	2	250	Indoor	No	Specify

CONNECTOR TYPES

Installed Part Number	Type
8252	SMA
8255	ST
8257	SMA (Wang)
8261	FC
8263	FDDI
8264	SC
8265	MT to RJ
8266	LC

Cable Assemble Part Number Scheme:

XXXX-XXXX-XXXX-XXXX
1 5 9 13

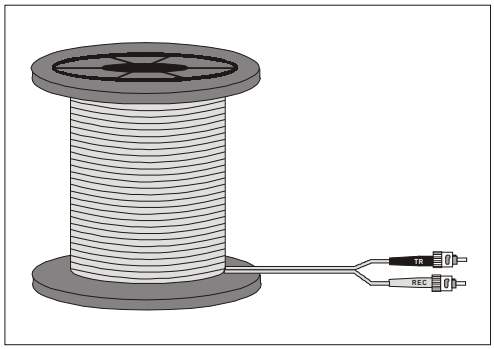
Digits 1, 2, 3, 4 - Specifies Cable Type
Digits 5, 6, 7, 8 - Indicates Length ft. (3 digits for meters)
Digits 9, 10, 11, 12 - Connector to use
Digits 13, 14, 15, 16 - Other Requirements

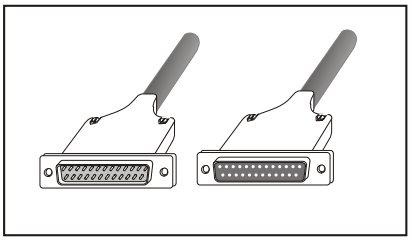
e.g. 1) 10 meters (33 ft.) assembly, 2F, 62.5/125, ST to ST = 5202 - 0033 - 8255
2) Same as 1) expect SMA on one end & ST on the other end = 5202 - 0033 - 5255

Note: Please specify if a particular connector and/or cable manufacturer is required. Cable types such as Plenum, Outdoor, Aerial, Burial, etc. are available upon request.

Specifications subject to change without notice.

Typical standard cables and part numbers:
5201 - 0010 (3m) - 8255 - 10 ft. jumper, 62.5, ST to ST.
5202 - 0010 - 8255 - 2F, 10 ft, 62.5μ, ST to ST.
7202 - 0100 - 8252 - 2F, 62.5 μ, 100 ft, SMA to SMA(R*).
7201 - 0005 - 8255 - 1F, 50 μ, 5 ft, ST to ST.
* R-Ruggedized





- S.I. Tech can suggest and supply bulk cables, both fiber and metallic, for use with all Bit-Drivers
- RS-232/422/485/V.35 data cable assemblies with male or female DB-9, DB-15, DB-25, DB-37, DB-50 or V.35 are custom made for specific applications
- Shielded and unshielded connectors are available

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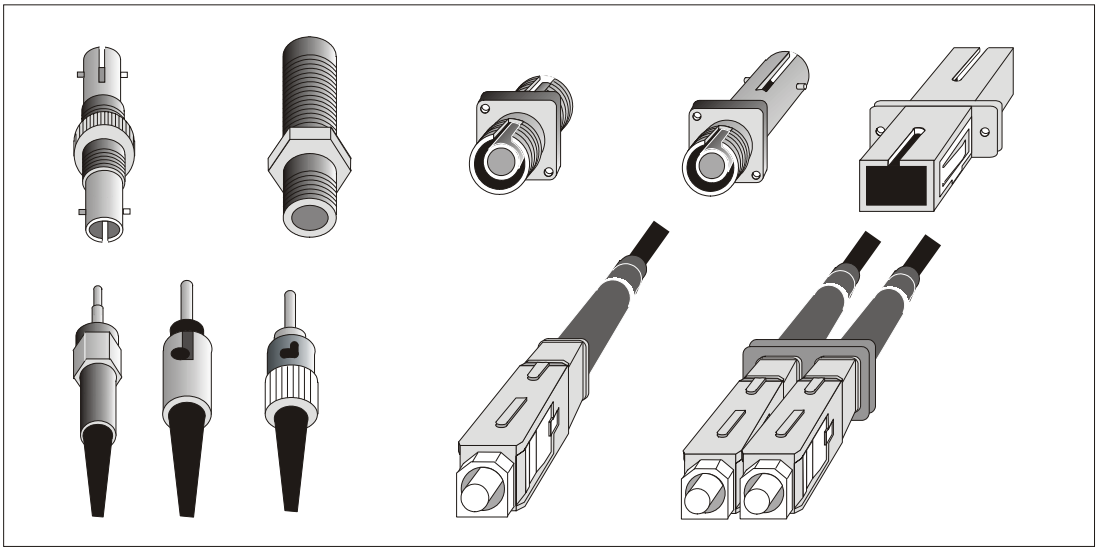
ACCESSORIES



S.I.Tech stocks high quality accessories to support your fiber optic system requirements. If you need a specific part that is not listed bellow, contact S.I.Tech.

Fiber Optic Couplers

8075 Simplex
8076 SMA
8077 ST
8078 SC
8079 FC

Fiber Optic Adapters

8888 SMA to ST*
8889 ST to SC*
Other*

* 1 meter cable assemblies

Test Equipment

Power Meter*
Power Source*
OTDR*

* Call S.I.Tech

Fiber Optic Connectors

8052 SMA
8055 ST
8057 Wang SMA
8061 FC
8063 FDDI
8064 SC
8065 MT to RJ
8066 LC

Termination Kits

SMA*
ST*
SC*

* Call S.I.Tech

Specifications subject to change without notice.

8

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WDM
WAVE DIVISION MULTIPLEXERS/DEMULTIPLEXERS

WDM
(WAVE DIVISION MULTIPLEXERS/DEMULTIPLEXERS)

#8513 (850/1300)*
#1315 (1310/1550)*
#9951 (980/1550)*

- WDM allows combining of 2 or more optical wavelength signals on the same fiber for transmission. Useful when there are limited number of fibers available
- Extremely useful for very long distance transmission to reduce cost of cabling and significantly increase the amount of data transmission
- Light Duty WDM, Single Mode designed to meet Bellcore GR 1209 & 1221

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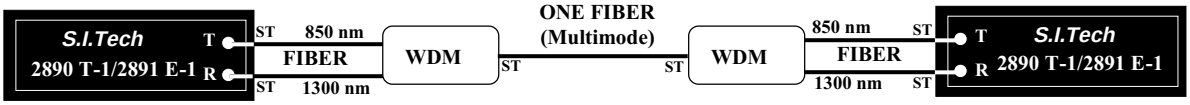

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BIT-DRIVER® PACKAGING

Packaging: S.I. Tech products are available in various sizes and shapes. We offer fiber optic products for most any application.

Mini Bit-Drivers: As the name implies these are miniature units typically 1.75W X 3.0L X 0.625D inches (4.5 X 7.5 X 1.6 cm) in metal enclosures.

These are also the lightest weight units (approx. 100 grams or 0.25 lbs.). These products are made using the latest surface mount components.

Size is such that the unit can be directly mounted to a serial port of a computer. For this purpose most products are offered with male or female type connector options. If the computer has a male connector, purchase a female type connector from S.I. Tech. This way you do not need an RS-232 cable assembly, eliminating clutter behind the PC. A cable can pick up electrical noise so it is best to eliminate it or keep it as short as possible. Typical mini units (exception – host powered unit) require an external power supply. (Host power: Bit-Driver draws power from the computer to which it is attached.)

External Power Supplies: Depending upon the application, several models are offered. Refer to the section on Power Options and How to Order.

Stand Alone Bit-Driver: These products are designed to be used as table top versions or shelf mounted units. Typically 7.5W X 7.0L X 3.0H inches (19 X 17.8 X 7.6 cm) size industrial strength metal case. Power supply is built into these units and some come with board attached power cord and some with detachable power cords. The units offer various power options – with the most common being 110 VAC or 230 VAC input. Products are UL/CSA/CE/FCC approved and listed where required.

Power cord used is a 3 prong with ground connection, international (IEC) rated.

Card and 19" Rack: S.I.Tech makes a Eurocard and American standard size card for many of the products. Typical 19" card cage holds 16 cards with 1 power supply. There is a provision for a redundant power supply where required. 110 VAC/230 VAC/DC power options are available with products being UL/CSA/CE/FCC approved.

Multiplexers: All multiplexer products are in industrial strength metal cases and available as stand-alone or 19" rack mounted units at no additional cost to the customer. 110 VAC/230 VAC/DC power options are available with products being UL/CSA/CE/FCC approved.

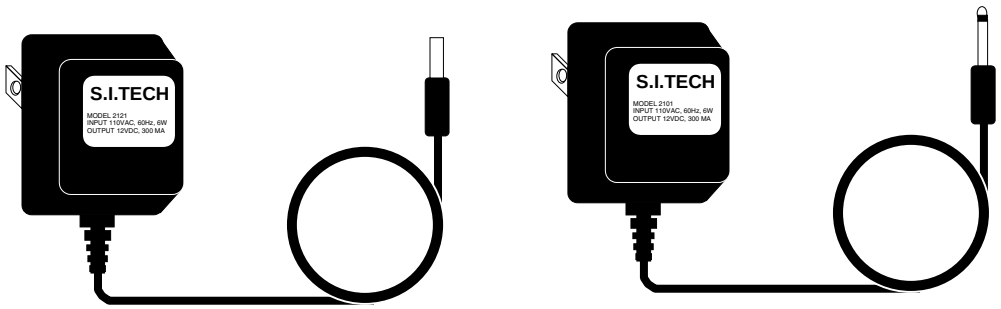
Tempest: S.I.Tech supplies modems and multiplexers certified to Tempest specifications for secure communication applications.

POWER OPTIONS AND HOW TO ORDER

Follow instructions in parenthesis at the end of each option when creating model number to order.

1.	110VAC	(STD - Do not add to Base Model Number)
2.	230VAC	(Add "V" to Base Model Number)
3.	–48VDC	(STD –Do not add to Base Model Number)
4.	+12VDC	(STD – Do not add to Base Model Number)
5.	External Power Supply	S.I. Tech #2101, 110VAC or S.I. Tech #2102 230VAC to +12VDC-Male Connector (specify S.I. Tech model number)
6.	External Power Supply	S.I. Tech #2121, 110VAC or S.I. Tech #2122, 230VAC to +12VDC-Female Connector (specify S.I. Tech model number)
7.	External Tempest Power Supply	S.I. Tech #2103, 110/230VAC to 12VDC special Tempest
8.	External Ethernet Power Supply	S.I. Tech #2125, 110/230VAC to 5VDC 1 Amp capacity,
9.	+5VDC Host Supplied	(STD-Do not add to Base Model Number)

How To Order – The S.I. Tech Model Number is made up from the Base Model Number-plus one or more suffixes, if needed, for details not marked STD in the respective columns in the How To Order Table. Examples are given below each table.



Model 2101: 110 VAC to 12 VDC – Male, 300 mA
Model 2102: 220 VAC to 12 VDC – Male, 300 mA
Model 2103: 110/220 VAC to 12 VDC – Female, Tempest, 300 mA
Model 2121: 110 VAC to 12 VDC – Female, 300 mA
Model 2122: 220 VAC to 12 VDC – Female, 300 mA
Model 2125: 110 VAC to 5 VDC – Female, 1 Amp

Specifications subject to change without notice.

FIBER OPTIC SYSTEM DESIGN

Introduction to System Operation

This guide is intended to help a fiber optic system engineer become familiar with the parameters involved in designing a complete link. It is not intended to answer all design questions, but rather to present alternatives available.

While complete ready-made systems are commercially available, this guide will help the interested engineer develop a system customized to his specific needs.

The first half of this guide is a simple introduction to system operation, component selection, and Local Area, Wide Area Networks (LAN/WAN). The second half is a detailed procedure for system design.

The Advantages of Fiber:

Fiber optics communication offers several advantages over metallic (wire) systems.

Any form of outside electronic, magnetic, or radio frequency interference does not distort the transmitted signals. Therefore, optical systems are completely immune to lightning or high voltage interference.

Furthermore, optical fibers will emit no radiation, which ideally suits them for today's tougher standards in computer applications. Because optical signals do not require grounding connections, the transmitter and receiver are electrically isolated and free from ground loop problems.

With no chance of terminal-to terminal ground potential shifts, plus safety from sparking and shock, fiber optics is increasingly the choice for many processing applications where safe operation in hazardous or flammable environments is a requirement.

Digital computing, telephone, and video broadcast systems require new avenues for improved transmission. The high signal bandwidth of optical fibers means increased channel capability. Also, longer cable runs require fewer repeaters, because fiber optic cables have extremely low attenuation rates. This ideally suits them for broadcast and long distance telecommunications use.

Compared to conventional coaxial cables with the same signal carrying ability, the smaller diameter and lighter weight of fiber optic cables means relatively easier installation, especially in crowded duct areas. A single conductor fiber optic cable weights about 9 lbs. per 1000 ft. A comparable coaxial cable weights 80 lbs. per 1000 ft. – about nine times more. Weight-conscious designers can save precious pounds using fiber optics, and increase capability.

All Dielectric ▪ Low Signal Radiation ▪ Secure Transmission ▪ RFI and EMI Immunity ▪ High Voltage Installations
Small Size ▪ Less Duct Space ▪ Fewer Additional Ducts Installed
Low Attenuation ▪ Greater Distance/Fewer Repeaters ▪ Less Installation and Maintenance
Optical Signals ▪ No Ground Loops ▪ No Spark Hazard ▪ Operation in Flammable Area
High Bandwidth ▪ Future Signal Capability Expansion

Table 1. Features of Fiber Optic Systems

Electronic "bugging" depends on electromagnetic monitoring. Fiber optic systems are immune to this technique. They have to be physically tapped to extract data, which decreases signal levels and increases error rates – both of which are readily detected. Table 1 summarizes the many features of fiber optic systems.

The Fiber Optic Link:

The simple schematic diagram shown in Figure 1 consists of an optical transmitter and receiver connected by a length of optical cable in a point-to-point link.

The optical transmitter converts electronic signal voltage into optical power, which is launched into the fiber by a light emitting diode (LED), laser diode (LD) or laser.

At the photodetector point, either a positive-intrinsic-negative (PIN) or avalanche photodiode (APD) capture the lightwave pulses for conversion back to electrical current.

It is the system designer's job to determine the most cost and signal efficient means to convey this optical power, knowing the trade-offs and limits of various components. He must also design the physical layout of the system.

The first of these concerns, signal quality, involves such factor as signal-to-noise ratio (SNR) in analog systems, and bit-error-rate (BER) in digital systems. When designing a system "from scratch" the designer must determine the required SNR or acceptable BER necessary to transfer the data. The next step is to determine the minimum optical power necessary at the receiver end. This can be obtained from component manufacture's published data.

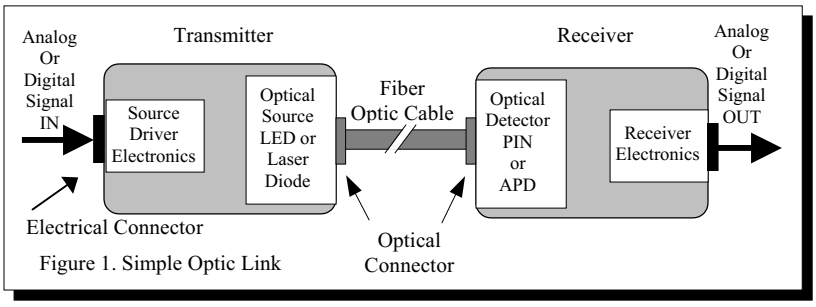


Figure 1. Simple Optic Link

Note: System Design Guide is reprinted with permission from Belden Corp.

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System Operation (Continued)

Losses and Limitations:

Link design consists basically of two functions: (1) the measuring of optical power losses occurring between the light source and the photodetector, and (2) determining bandwidth limitations on data carrying abilities imposed by the transmitter, fiber, and receiver.

Reductions in optical power loss, or attenuation, as the light pulse travels through the fiber are expressed in dB/Km (decibels per kilometer)

The decibel is a logarithmic expression of the ratio of the power entering a component and the power leaving it.

$dB = 10 \log_{10}$ (Power Out/Power In)

A 3dB loss means that half the power is lost. For example, starting with 500µw, you would now have 250µw. A 10 dB loss means that 10% of the power arrives at the receiver, a 90% loss.

Fiber optic links can operate with as little as 0.1% of the input power being received by the stated minimum requirements of the receiver selected.

Transmission Power Loss:

The prime causes of optical attenuation in fiber systems are:

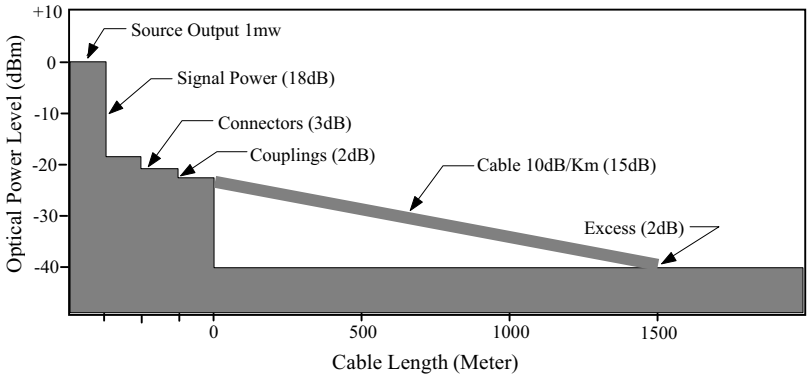
- Coupling loss
- Optical fiber loss
- Connector loss
- Splice loss

The sum of all the losses of each individual component between transmitter and receiver comprise the Optical Link Power Budget shown in Figure 2.

The designer must consider these losses and select a transmitter and receiver combination that will deliver enough power to faithfully reproduce the signal.

However, these losses are not exact, and manufacturers typically state ranges, or "best" and worst" case situations in order to account for product variations. Also some allowance may be required for such things as temperature variations.

Some safety margins should also be made for future repairs or splices to the system, and age degradation of the source emitter. For example, a 3dB margin for repairs and aging of the emitter is commonly employed.



	Actual Power	Optical Power Level
Minimum optical power required by the receiver	0.1 µW	-40 dBm
Source output optical power	1 mW	0 dBm
Total operating budget (optical power)		40 dB
SNR voltage ratio required in the receiver is 36dB. The equivalent optical power is *		18 dB
Remaining optical power for link		22 dB
Link optical power losses:		
Cable	15 dB	
Connectors	3 dB	
Couplings	2 dB	
Total	20 dB	
	Excess budget	**2 dB**

*The optical power is related to the signal voltage ratio by a factor of two because $dB=10\log P_1/P_2=10\log I_1^2R/I_2^2R$. Since V=IR then $dB=20\log V_1/V_2$.

Figure 2. Typical Optical Link Power Budget

Coupling Loss:

The amount of optical power coupled into the fiber is dependent on the physical nature of the fiber used, and the source emitter.

Obviously, the larger the core diameter of the fiber, the more potential for accepting light. However, larger core fibers suffer bandwidth limitations that may outweigh coupling efficiency.

A change in core diameter from 50µm to 100µm (microns) represents an increase of four times in the amount of light coupled to the fiber.

Besides core size, the other measure of a fiber's ability to collect optical power is called numerical aperture (NA). This is a mathematical measure of the fiber core's ability to accept lightwaves from various angles and transmit them down the core.

A large difference between the refractive indices of the core and cladding means a larger NA.

For equal core size, a fiber with a larger NA will accept more lightwaves. A power increase by about a factor of two is achieved by going from an NA of 0.20 to one of 0.29.

We've combined the effects of core size and NA into an Optical Collection Factor, which can be considered a measure of the fiber's efficiency for optical radiation (see Table 2).

Fiber Core Dia. Microns	Numerical Aperture	Collection Factor	
		Relative*	dB Ratio
300	0.27	14.1	+11.5
200	0.27	6.2	+8.0
200	0.18	1.6	+2.2
100	0.28	1.0	+0.0
85	0.26	0.62	-2.1
62	0.29	0.4	-3.8
50	0.20	0.13	-8.9

*Values normalized to short length of 100 micron core fiber.

Table 2. Optical Collection Factor

Component Selection

Source Emitters:

Optical emitters couple light into a fiber according to NA and core size. Using a light source not matched to a particular fiber's NA and core size will cause less than optimum light coupling for the system.

LED's are relatively inexpensive, reliable and easy-to-use because their electronic circuitry is less complex than that required for a laser. Typical laser and LED characteristics are shown in Table 3.

	Laser	LED
Light Output	6 dBm	0.6 dBm
Coupling Loss	3 dB	20 dB
Spectral Width at 800 nm at 1300 nm	 2 nm 4 nm	 40 nm 100 nm
Temperature Sensitivity	Strong	Weak
Feedback Control	Yes	No
Failure Machanisms	Many	Few
Cost (Relative)	100	1

Table 3. Comparison of Typical Parameters of Lasers and LEDs

Semiconductor lasers and LEDs are both direct transducers from electrical to optical radiation. LEDs couple less power into the fiber because they emit the optical radiation over a broader angle area. The laser is a much more complicated structure due to the requirement for a small dual-face cavity. Also its output is temperature dependent and the lifetime is less than the LED.

Several different LED packaging styles are commercially available, as seen in Figure 3.

The LED or laser diode can be packaged so that the fiber cable plugs directly into the device package. An alternative is fastening the fiber directly to the chip and leaving the opposite end available for a connector.

Matched transmitter and receiver units, plus a wide variety of other optic components ranging from discrete elements like LEDs, laser diodes, and detectors to complete rack-mounted modules are all readily available.

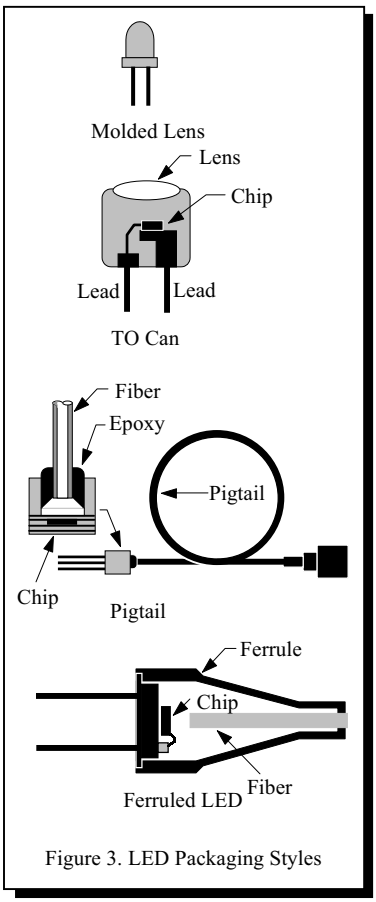


Figure 3. LED Packaging Styles

Detectors:

Lightwave receivers use photodetectors, where the photons of light generate photoelectrons. A minimum average number of photons in each pulse is necessary to achieve a given error probability (21 photons for 10^{-9} error probability). Considerable amplification is necessary. For an avalanche-photodiode (APD) initial amplification is internal. For positive-intrinsic-negative detectors (PIN) this amplification is by external electronic amplifiers.

Optical Fiber Loss:

We've already considered core size and numerical aperture as measures of fiber's ability to accept the optical power. Now let's consider what happens to the optical signal once it's launched.

In coaxial cable, high frequency signal strength decreases with distance and this is referred to as attenuation. Fiber does not have the same frequency dependent attenuation. Fiber frequency is constant until it reaches its bandwidth limit. Thus optical loss is proportional to distance. This attenuation within the fiber is caused by absorption and scattering of lightwaves due to chemical impurities and molecular structure. These fiber properties absorb or scatter the optical radiation so that it escapes the core and is lost.

Attenuation within a fiber is specified by the manufacturer at certain wavelengths: for example 5dB/Km at 820 nanometers. This is done because fiber loss varies with wavelength, as seen in Figure 4.

These wavelength are measured in nanometers (nm) – billionths of a meter – which represent the distance between two cycles of the same wave. Wavelength is a descriptive property of electromagnetic radiation. Light and infrared radiation are portion of the total electromagnetic spectrum.

Microwaves, radar, television and radio operate in the longest wavelength areas. In between the ultraviolet and the microwave spectrums, we have fiber optic wavelengths, which are in the infrared spectrum.

Fiber Selection:

Fibers are therefore optimized for operation at certain wavelengths. For example, less than 1dB/Km loss is attainable in $^{50}/_{125}$ µm multimode fiber operating at 1300 nm, and less than 3dB/Km (50% loss) is attainable for the same fiber operating at 850 nm. The $^{50}/_{125}$ nomenclature indicates both the outside diameter of the core (50 microns) and the cladding (125 microns).

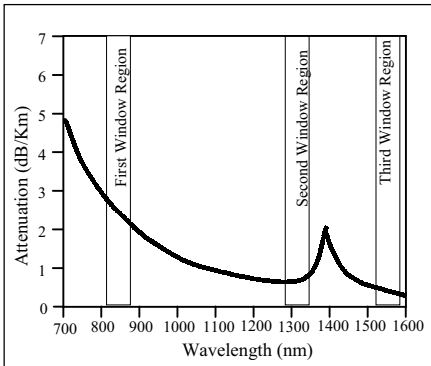


Figure 4. Transmission optical power loss, or attenuation, must be measured in specific wavelength for each fiber type

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Component Selection (Continued)

The favorable transmission regions within the optical spectrum for a fiber are referred to as “windows”. The 800 to 900 nanometers region is the first window, 1100 to 1300 nanometers is the second window, and the third window occurs at about 1500 nanometers. In these spectral windows fibers have very low attenuation. The lowest losses occur in the infrared region around 1300 nm and again around 1500 nm.

Great improvements have been made in all fiber types so that premium fibers exhibit losses of less than 0.5dB/Km at wavelengths of 1300 and 1500 nm. However, source emitters and detectors for these regions are currently more expensive.

If the fiber is to perform well, the source chosen should provide optical radiation at the specified wavelength, and the detector should be sensitive to the same wavelength.

In coaxial and other metallic cables, very high frequency signals tend to be attenuated rapidly with distance. As a result, amplifiers and equalizers are required at periodic intervals to build up signals to usable levels.

However, each time an analog amplifier is added, noise is introduced to the metallic system, and the overall system signal-to-noise ratio degrades.

With optical communications, all of the light energy is at approximately the same frequency or wavelength. As a result, the attenuation of a specific wavelength is dependent only on distance. See Figure 5 for a comparison of attenuation differences between coaxial and fiber optic cable. The requirement for repeaters is, therefore, minimized and the need for equalizers is eliminated in fiber system.

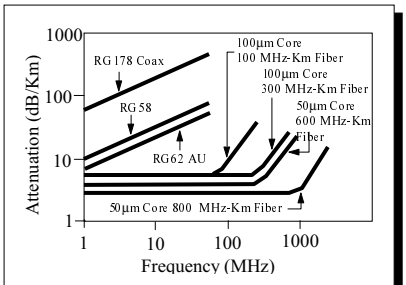

Figure 5. Performance of typical coaxial and optical cables

Connector Loss:

Connector loss is a function of the physical alignment of one fiber core to another fiber core.

Scratches and dirt can also contaminate connector surfaces and severely reduce system performance, but most often the connector loss is due to misalignment or end separation.

Several styles of fiber optic connectors are available from major connector suppliers.

Typically, each has its own design and is generally not compatible with any other manufacturer’s connectors. However, an SMA, ST, or SC type connectors do offer mechanical compatibility.

Depending on connector type, different terminating techniques are used:

- Epoxy and polish: The fiber is epoxied in place in an alignment sleeve, then polished at the ferrule face.

- Optical and mechanical: Both lenses and rigid alignment tubes are commonly used. In addition, index matching mediums may be employed.

The optical power loss of a connector-to-connector interface typically runs between 0.25 and 1dB, depending on the style of the connector and the quality of the preparation.

Splice Loss:

Two fibers may be joined in a permanent fashion by fusion, welding, chemical bonding, or mechanical joining. A splice loss that is introduced to the system may vary from as little as 0.15dB to 0.5dB.

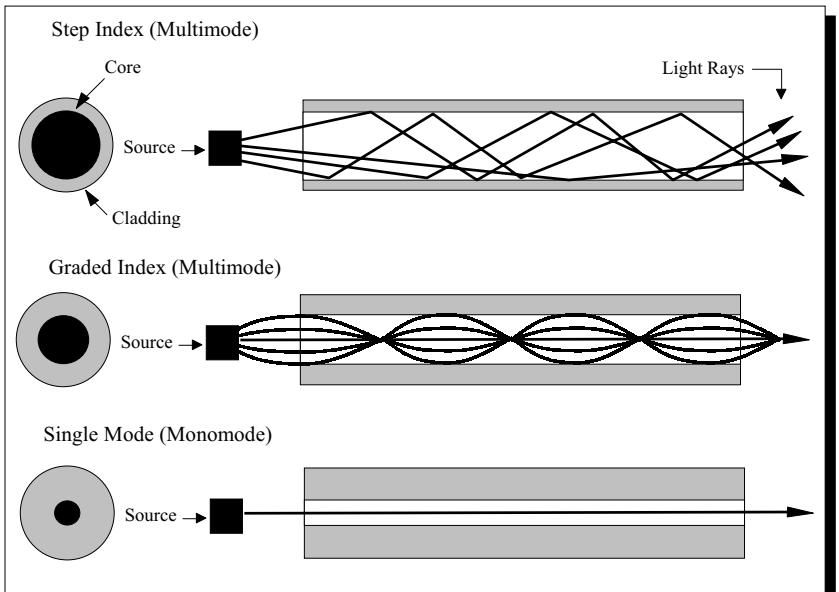

Figure 6. A graphic representation of how light rays travel in three fiber types

Bandwidth

Up to this point, we've covered loss of optical signal power both within the fiber and within the system.

Now let's examine the other major determinant of fiber optic signal performance: bandwidth.

Because of their large comparative bandwidths, fibers can carry large amounts of information. A single graded index fiber can easily carry 500 million bits/second (Mb/s) of information. However, bandwidth capacity limits exist for all types of fibers and depend on the fiber and type of emitter employed.

The three fiber types shown in Figure 6 can be identified by the type of paths that the rays of each light pulse travel within their fiber cores.

To accurately reproduce data, light pulses must be kept separate and distinct with correct shape and spacing during transmission. Yet, the rays comprising each pulse travel in many different paths within a multimode fiber. For step index fibers, for example, modes traveling at different angles as they zigzag down the fiber arrive at the receiver end at different times.

This arrival time variance results in distorted and overlapping pulses at the receiver end as seen in Figure 7. This "modal dispersion", or spreading of the light pulse limits the frequency that can be transmitted, because the detector cannot tell where one pulse ends and the next begins.

The time difference between the fastest and slowest mode of light entering the fiber at the same time and traveling a kilometer may only be 1 to 3 nanoseconds, yet this modal dispersion causes major limitations on the system's operating speeds over long distance. Doubling the distance, doubles the dispersion effect.

Just as optical power loss reduces signal performance, a system can be bandwidth limited when the shape of the light pulse is distorted beyond specified limits.

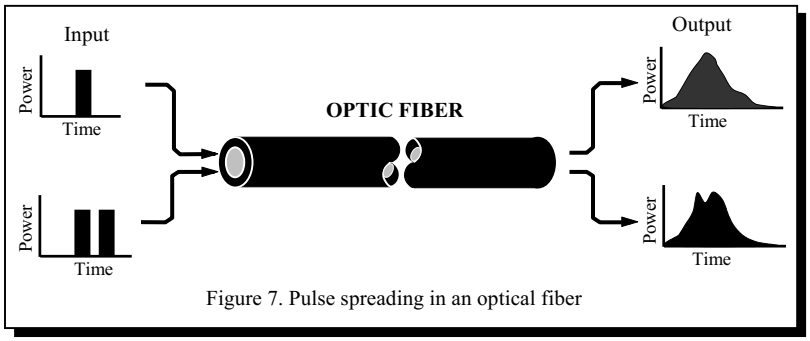

Figure 7. Pulse spreading in an optical fiber

Modal dispersion is often expressed in nanoseconds per kilometer, e.g. 30ns/km. The same effect may also be expressed as a frequency, such as 200 MHz-km. This indicates that the fiber or system will operate efficiently up to 200 MHz before dispersion adversely affects signal performance over a one kilometer length. The same system could transmit a 100 MHz signal as far as two kilometers.

Dispersion makes the multimode step index fiber the least bandwidth efficient of the three types. It is therefore used for shorter runs and lower operating frequencies, e.g. 20 MHz-km.

Single mode fiber has small core sizes of 8 to 10 µm diameter in order to allow only one lightwave ray to propagate down the fiber. Because modal dispersion is completely eliminated, this fiber has much greater bandwidths which can exceed several hundred gigahertz per kilometer (GHz-km).

However, fibers are susceptible to another type of dispersion problem caused by the fact that different wavelengths traveling at different velocities through a medium.

This "spectral dispersion" is evident when white light decomposes into a rainbow of colors by a glass prism. Each wavelength travels at a different speed leading to unequal amounts of bending of the rays associated with each color.

If the fiber system's spectral source emitted a single frequency of light, this spectral dispersion, or material dispersion (or chromatic dispersion, as it is also often called) would be eliminated. However, an LED light source has a spectral range of about 20 times that of a laser, and thus has much greater spectral dispersion. Dispersion in glass fiber disappears around 1.3 µm, allowing monomode fibers extremely large bandwidth capacities at this wavelength.

Monomode fiber is typically used with laser emitters, because of their greater spectral purity. Precision connectors and splicing are required.

Because of their low loss, and high capacity qualities, monomode fibers are the choice for constructing long, high data rate links, such as cross-country telecommunications.

Between monomode and step index fibers, there are graded index fibers. Rays in a graded index fiber are gradually redirected back toward the core's axis during propagation to reduce the effects of modal dispersion. Graded index fibers have much greater bandwidth capacities than step index fibers. A 600 MHz-km graded index fiber can transmit a 20 MHz modulation signal as far as 30 km. The cost of this glass fiber is currently one of the lowest. Its low loss plus high bandwidth make it the fiber of choice for most local area network applications, for example.

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Local Area Networks

Bandwidth Summary:

To this point we've covered how pulse spreading or dispersion limits the maximum bandwidth that may be used with fibers. The different propagation pathways cause delays, or modal dispersion in multimode fibers.

Modal dispersion is the principal bandwidth limitation for laser-based multimode fiber systems at 850 nanometers, and for both laser and LED systems at 1300 nanometers.

Spectral dispersion provides the principal bandwidth limitation for LED based systems at the first window of 850 nanometers of about 100 MHz-km, and for single mode laser-based systems (typically more than 50 GHz-km) at the 1300 nanometer region.

The basic loss mechanism, or attenuation, within fibers is caused by light scattering which varies by wavelength. The 1300 nanometer wavelength is important because not only is attenuation low at this point, but spectral dispersion is generally a minimum at this wavelength.

Fibers have a constant loss over a wide range of modulation rates, bur there is a rapid increase in effective loss when pulse dispersion becomes compatible to the pulse period. Contrast this with base band metallic systems where attenuation increases as the square root of the modulation rate. Provided dispersion is small, fiber systems do not require equalization and line amplifiers which are necessary with metallic systems.

Local Area Networks (LAN):

The explosive growth of personal computing in the business marketplace and the increasing sophistication of multiple-function local area networks are forcing system developers into an examination of not only what operating systems to use, but also what would be the optimum cable/system design.

The growing requirements for bandwidth in computer applications, and the need to adapt to other inter-and intra-building telecommunications needs such as telephone, security, alarm and video have all dramatically increased the demand for optical fiber.

Fiber optic LANs generally have a maximum link distance between transmitter/receiver pairs of 2 km. They may be isolated to only one floor or one building, or be interconnected with other networks among several buildings.

A system can be low-speed, low-capacity such as telephone, or high-speed, high-capacity such as video. Although cooper and fiber can both be used or intermixed in a LAN system, the high information capacity and upgradeability of fiber is increasingly making it the choice. Instead of rewiring to add future capacity, changing the electronic hardware at the system ends is all that's necessary to alter these systems. Many designers add extra fibers to a system for this purpose.

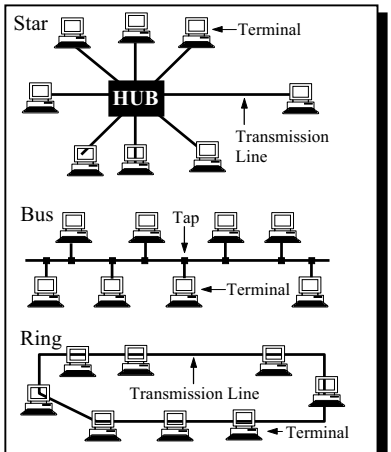


Figure 8. Several basic LAN topologies

Figure 8 shows several examples of the basic LAN topologies: star, ring, and bus.

Star LANs are arranged around a single hub that may act as a central controller for network. Transmission sent from one node or terminal must first pass through the hub. This hub can simply be a passive star coupler or an active controller.

In a ring type network, all terminals are linked in a point-to-point series. If one part fails, the system is down unless bypass components are used. To avoid conflicting data demands such systems use a bit pattern, called a token. The token is circulated to each node allowing that node to capture the token and the right to transmit data. IBM has a ring setup shown in Figure 9. Other systems and software are also on the market.

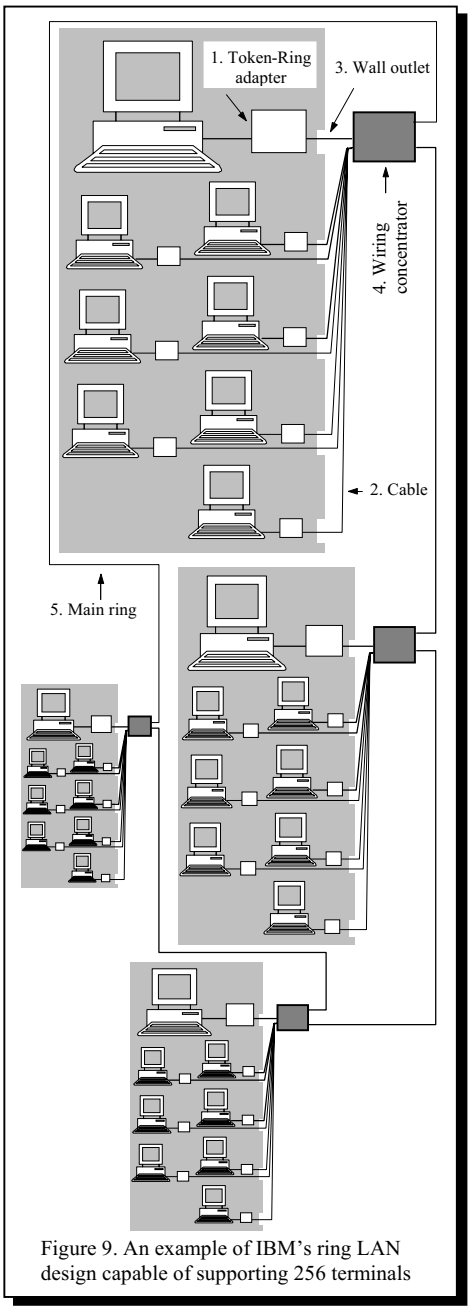


Figure 9. An example of IBM's ring LAN design capable of supporting 256 terminals

Networks based on a bus topology also use a token passing scheme, or an access scheme known as carrier-sense multiple access with collision detection (CSMA/CD), or collision avoidance (CSMA/CA). Like a ring, messages on the bus are broadcast to all terminals. Since all the terminals tap into a single main trunk channel like branches on a tree, messages do not have to be repeated.

Most LANs use combinations of bus and star networks today because of speed, easy installation or retrofit, and the fact that each node can be passive so that if one fails the network keeps functioning.

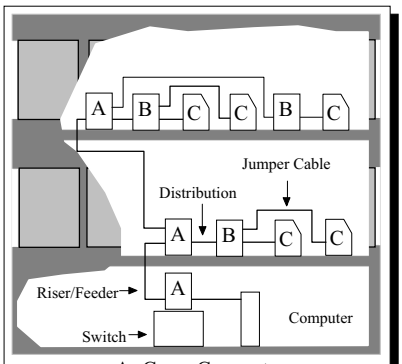
Local Area Networks (Continued)

Interconnecting Components:

LAN networks can be easily configured because the fiber optic cable can be easily strung in a plenum on a single floor, up a raceway between floors, or among several buildings.

Figures 10 and 11 show typical examples of LAN layouts for multi-premise and single locations. There are fiber optic component pieces corresponding to every piece of electronic hardware used with any other LAN type. These devices appear in a system wherever a user connects, or where several lines join together at a node. These devices can be active, such as the transmitters and receivers that have already been discussed, or passive such as taps, distributors, couplers, concentrators, switches, relays, multiplexers, and cross connection cabinets. They are available from a variety of vendors as discrete components, in rack-mounted modules, or as fully integrated system.

Optical taps or 'Ts", and optical mixers or "star" couplers are shown in Figures 12 and 13. Both are examples of concentrators which actively or passively combine signals at nodes or user connection points in a LAN system.



A=Cross Connect
B=Concentrator
C=Device

Figure 11. A typical Single premise LAN

Simple LAN systems use "Ts", stars and other passive components between transmitter/receiver pairs. More complex systems require active components to combine, route and sometimes re-amplify the signal. Data transmission trends as outlined in Figure 14 are moving toward more active nodes as the need for greater fiber optic system flexibility, data speed, and link length increases.

As previously discussed, optical power losses occur whenever a fiber is terminated or coupled. Therefore, allowance for tapped bus or other LAN configuration requires that connectors must be factored into the system's loss budget analysis. Since many connectors are used in typical LAN networks, each must have a known loss factor.

Figure 12. A T-coupler taps off or injects optical energy by fusing two fibers together. Used for inline bus configurations. Light coupled varies with interface length and core-to-core proximity

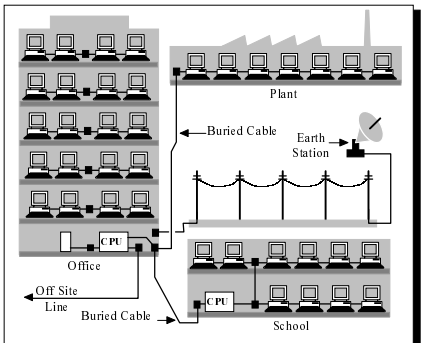


Figure 10. A typical multi-premise LAN

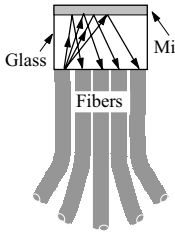


Figure 13. A star coupler allows one terminal to communicate with all others by reflecting light from one port through a glass mixer into a mirror

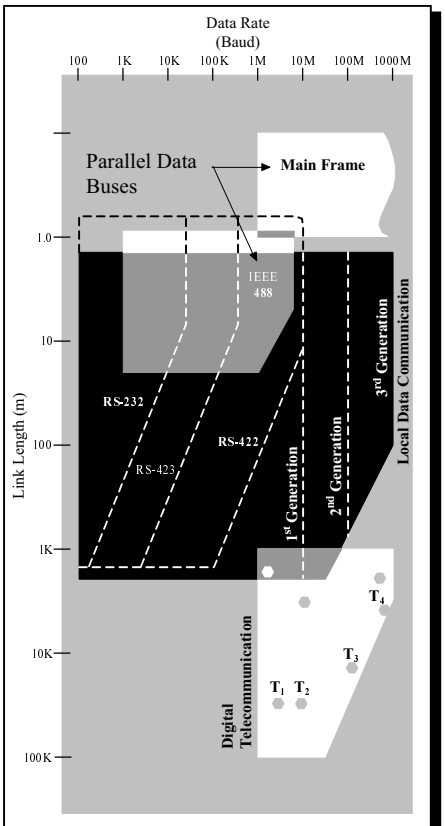


Figure 14. Data transmission standards and trends with respect to data rate vs. link length

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System Design Procedure

System Analysis:

The system designer must proceed through the following five steps in order to develop a fiber optic communication system:

1. Specify the system's operational requirements.
2. Describe the physical and environmental requirements.
3. Compute the signal optical power budget.
4. Perform a signal bandwidth analysis.
5. Review the system design.

Important considerations in these steps of the design process are detailed in Figure 15. Worksheets for compiling all the data necessary to complete the design are included in the back of this brochure.

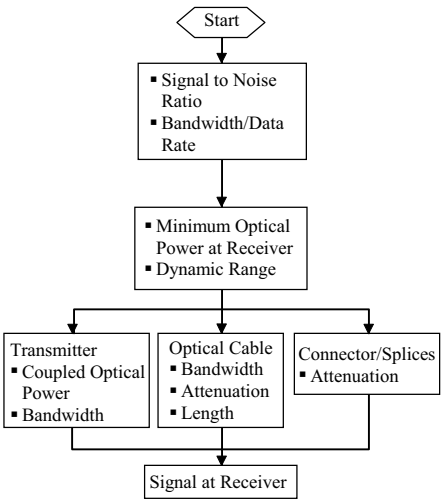

Figure 15. Considerations in developing a fiber optic system

System Operational Requirements: (Step 1)

The system design process begins with a determination of the signal-to-noise ratio which depends on the bandwidth or data rate for an application. This implies a choice of signal types, either analog or digital, since even a simple point-to-point link will employ appropriate hardware. The goal is to establish what optical power level will be required at the optical detector inside the receiver unit.

As shown in Figure 16, fiber can handle either analog or digital transmission and it offers the additional option of future upgrading by simply changing the electronics hardware at the transmitter and receiver ends. For this reason most fiber system designers specify more fiber bandwidth capacity than is minimally required.

Analog Signals:

Analog signal such as video and audio can directly modulate optical output by causing the optical emitter to brighten and dim. This is called intensity modulation and is a simple and straightforward method of encoding lightwave signals.

Improvements in both signal-to-noise and linearity can be obtained by the use of frequency modulation (FM) techniques. Here the information source is used to frequency modulate a subcarrier, then this signal is used to intensity modulate an LED or laser. Because of material and intermodal dispersion factors, FM links normally require fibers with bandwidths of 200 MHz-km and higher. Short unrepeatered links are occasionally analog modulation. However most lightwave applications today use digital transmission with simple on-off modulation.

Digital Signals:

In fiber optics, a digital pulse can be formed by turning the source "on" for a brief instant. The time of optical radiation emission is the pulse. A binary "1" state can be used to represent optical power turned "on", while a binary "0" state is used to represent "off". These two states represent binary signals. Digital signals consist of a series of bits that result in the emitter being "on" or "off" as shown in Figure 17.

The time it takes for a pulse to reach full amplitude is the rise time. Faster rise and fall times allow more pulses per second, consequently more bits of information can be transmitted.

In digital systems one parameter for system performance is bit error rate (BER). The majority of digital systems achieve a BER of 1 X 10^{-9} (1 error in 10^{9} bits)

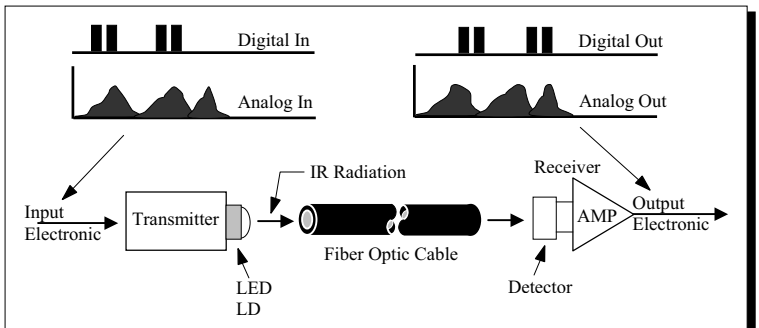

Figure 16. Fiber optic system for analog or digital transmission

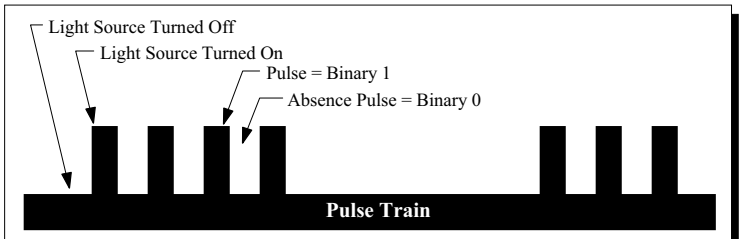

Figure 17. Each pulse represents a bit in digital transmission and therise and fall times of a series becomes the bit rate (Bps)

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System Design Procedure (Continued)

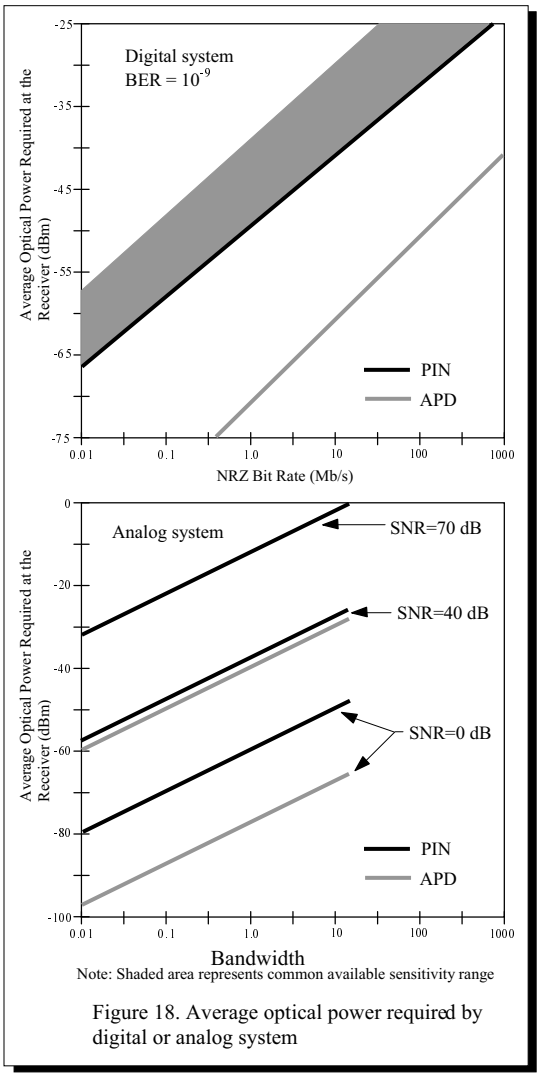

Figure 18. Average optical power required by digital or analog system

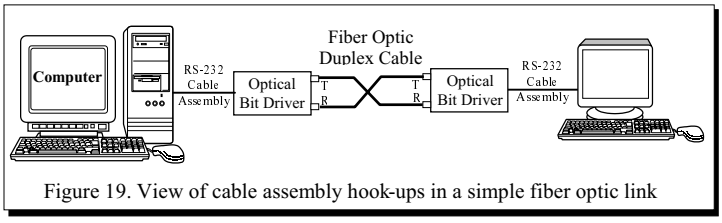

Figure 19. View of cable assembly hook-ups in a simple fiber optic link

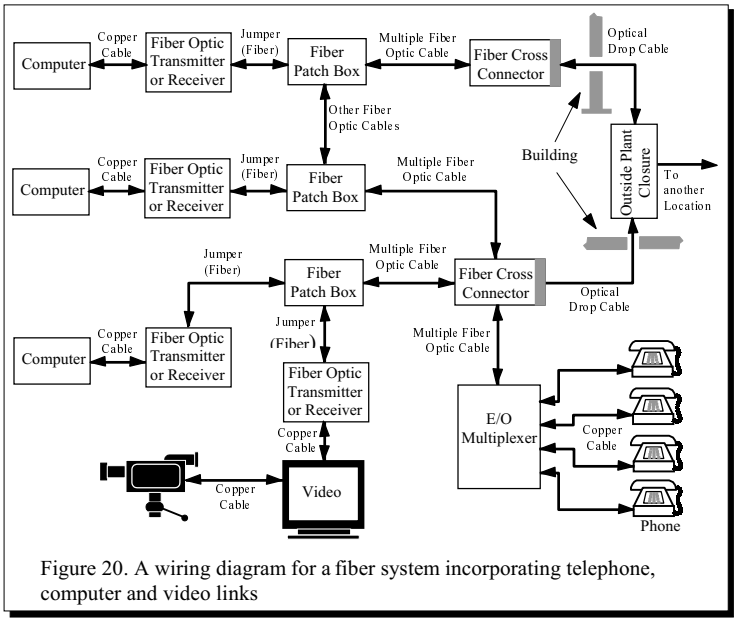

Figure 20. A wiring diagram for a fiber system incorporating telephone, computer and video links

There is a length dependence with digital systems because the farther a pulse has to travel down a fiber the more distortion occurs. The resulting optical power level required at the detector is a function of the data rate or bandwidth. These levels for digital and analog signals are indicated for silicon detectors at 850 nm in Figure 18.

Once the application (TV, telephone, or computer), the type of signals (analog, digital), and the data rate have been determined, the next step is to describe the physical layout and environmental requirements.

System Layout: (Step2)

To determine the components necessary to complete a fiber optic system requires detailing run lengths and determining system operating environments.

A simple point-to-point system as shown in Figure 19, or a more elaborate local area network involving telephone, data, video, control and alarm functions as shown in Figure 20, are both becoming commonplace installations for fiber optic cable. Current fiber optic technology employs a separate fiber to transmit the signals in one direction.

Therefore most point-to-point systems will require at least two fibers for duplex communications. Higher fiber count cables are also readily available.

The system designer should develop a layout schematic similar to the one shown in Figure 20 and use the resulting information on the worksheets at the back of this brochure.

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System Design Procedure (Continued)

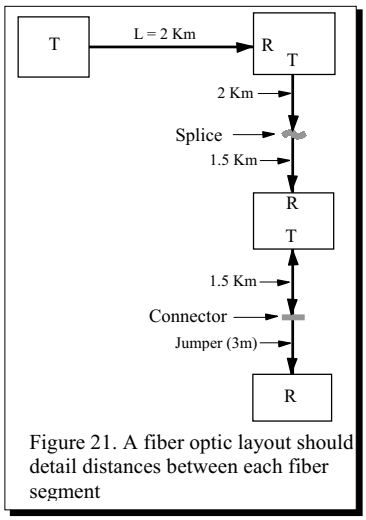


Figure 21. A fiber optic layout should detail distances between each fiber segment

Signal Optical Power Budget: (Step 3)

With the system layout and components known, it's now possible for the designer to compute expected losses at each point in the system as shown in Figure 22.

Every component including fiber has a range of optical loss due to variations in manufacture. An LED device, for example, will be specified with a minimum, average, and maximum optical output power. The range may be as much as 4 dB (60%).

Detectors also have sensitive ranges. It is up to the system designer to determine the optical power necessary at the detector surface from information supplied by the manufacturer.

Once the receiver and transmitter power levels have been established it is possible to consider the power transmitted by various cable lengths. This can be seen by plotting the power on a diagram such as in Figure 23.

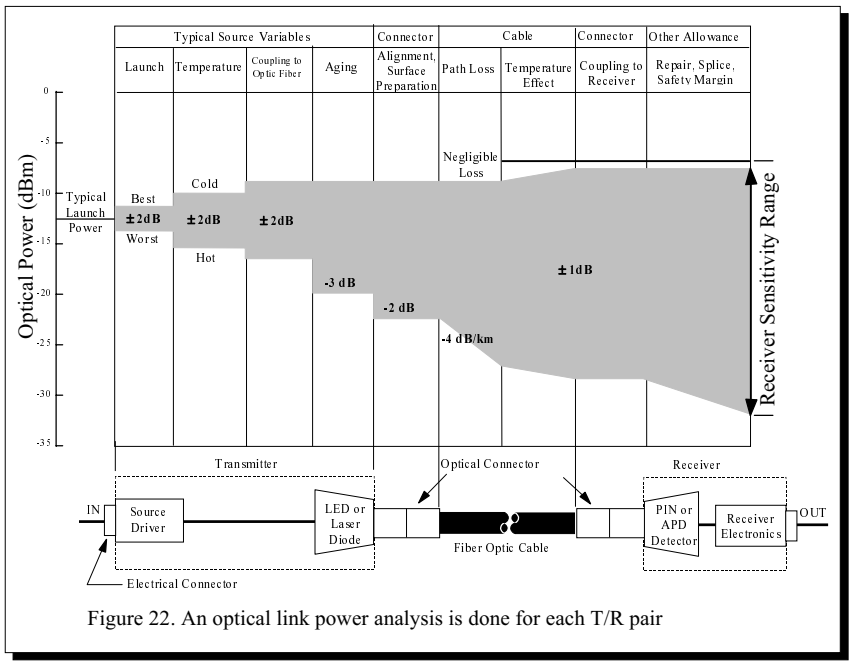


Figure 22. An optical link power analysis is done for each T/R pair

In the example shown, a fiber with a 100 micron core has been analyzed for use with a 10 Mb/s transmitter at the 850 nm wavelength. Both the best and worst case curves are shown with the average expected range in between.

The detector sensitivity upper and lower limits are also shown. This figure indicates that a transmission distance of about 1.4 km is maximum.

The same technique can be used to compare two fiber core sizes as shown in Figure 24. Here the 50/125 fiber is acceptable if the maximum length is less than 0.5 km.

Starting power levels vary due to the emitter launch range. When taps and splices are included, their values can be considered as part of the launch loss, or displayed where they might occur in the system as in Figure 25.

Worksheets are included at the end of this brochure for determining your optical power budget. Use either peak or average optical power values for determining attenuation throughout the system. Be consistent in your choice throughout the system analysis.

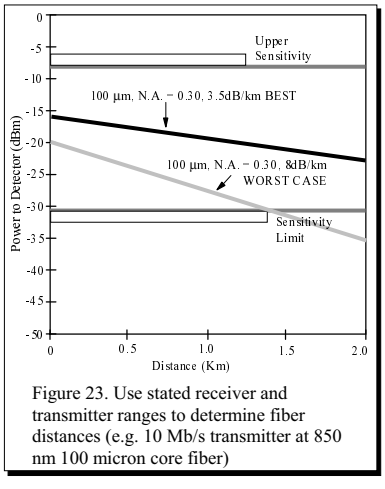


Figure 23. Use stated receiver and transmitter ranges to determine fiber distances (e.g. 10 Mb/s transmitter at 850 nm 100 micron core fiber)

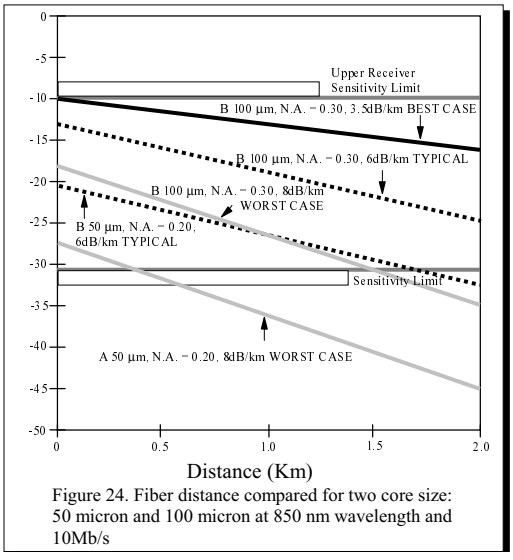


Figure 24. Fiber distance compared for two core size: 50 micron and 100 micron at 850 nm wavelength and 10Mb/s

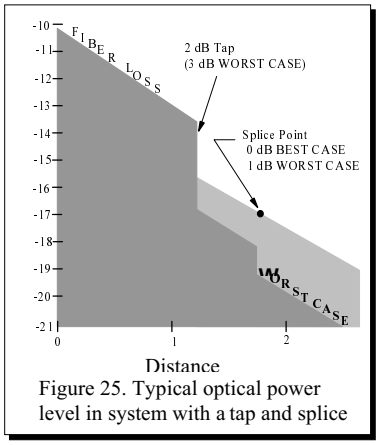


Figure 25. Typical optical power level in system with a tap and splice

9

System Design Procedure (Continued)

Power coupled to various fiber types by a few typical source emitters is detailed in Figure 26. Coupled power for each fiber type under consideration should be entered in the appropriate column on the worksheet. Allow approximately 4 to 6 dB to account for thermal variations in the optical fiber, repair of damaged cable, and source degradation over time.

Fiber Selection:

Basic fiber types are presented in Figure 27. The various fiber properties such as attenuation, numerical aperture (NA), core diameter have all been covered earlier in this brochure. NA and core diameter must be considered for launch conditions. All fibers can be compared over one kilometer lengths for fiber properties and relative optical power as in Table 4.

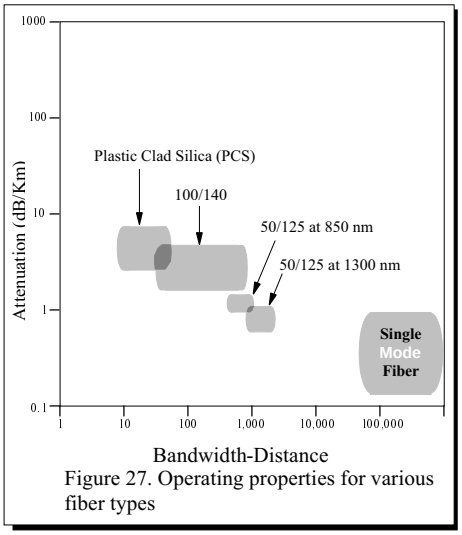


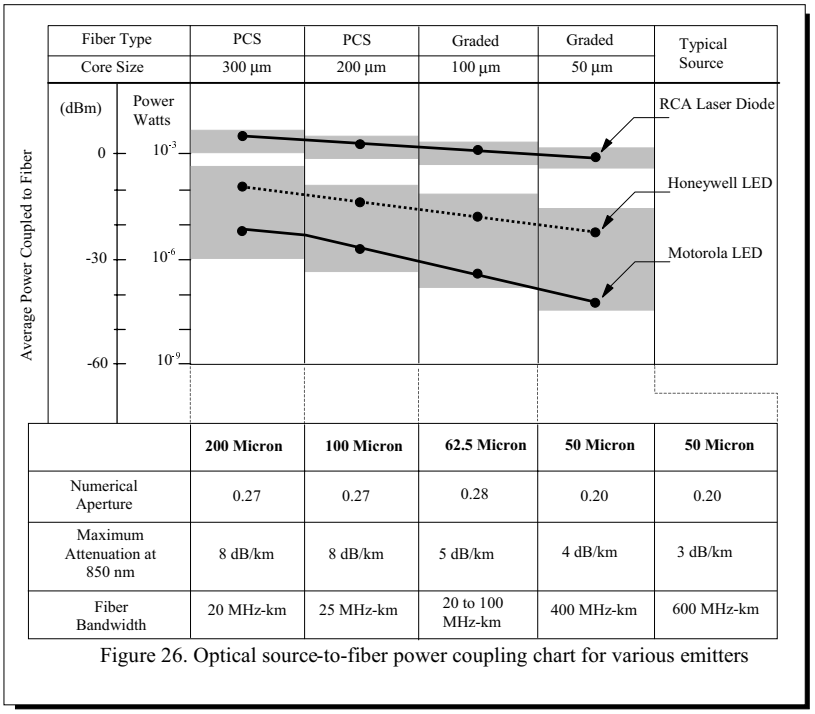
Figure 27. Operating properties for various fiber types

Certain fiber types have proven suitable for special applications.

Choices for most LAN or data systems, for example, currently centers on the all-silica fibers. Here various core/cladding constructions are available with tradeoffs in performance, cost, and standardization. Currently four sizes are most often considered:

Core	Cladding	Bandwidth	
		850	1300
50	125	400	400
62.5	125	100	400
85	125	200	600
100	125	150	500

All are multimode, graded-index fibers to assure adequate bandwidth and low enough loss to be ideal for typical LAN capacity and size requirements.



	200 Micron	100 Micron	62.5 Micron	50 Micron	50 Micron
Numerical Aperture	0.27	0.27	0.28	0.20	0.20
Maximum Attenuation at 850 nm	8 dB/km	8 dB/km	5 dB/km	4 dB/km	3 dB/km
Fiber Bandwidth	20 MHz-km	25 MHz-km	20 to 100 MHz-km	400 MHz-km	600 MHz-km

Figure 26. Optical source-to-fiber power coupling chart for various emitters

Type of Fiber			Numerical Aperture	Relative Collection Factor (dB)[1]	Relative Optical Power (dB) at 1 km[2]
Material Structure	Type	Core Dia. Micron (µm)			
Silica	Single Mode	10	0.08	-31.0 [3]	-28.0
Silica	Multimode	50	0.20	-8.9	-6.9
Silica	Multimode	62.5	0.29	-3.8	-2.8
Silica	Multimode	85	0.26	-2.1	-1.1
Silica	Multimode	100	0.28	0.0	0.0
PCS	Multimode	200	0.27	+5.7	+3.7
PCS	Multimode	300	0.27	+9.2	+7.2

1. Relative amount of radiation coupled to fiber based on 1 km length NA value. Shorter lengths may have higher values.
2. Based on the difference in transmission over a 1 km length of cable using the 100 micron core fiber at 5 dB/km (850 nm) as the basis for normalization.
3. Primary use at 1300 nm or 1550 nm.

Table 4. Optical power comparison for various fiber types

Video and CATV systems often employ 50/125 and single mode fibers because of their high bandwidth and low loss performance characteristics. Modern intercity telephone trunks also employ single mode fibers.

Fibers may be selected in a variety of bandwidths and attenuations, in either one or two window versions. Again, attenuation of optical fibers will vary depending on the source wavelength of the transmitter. A fiber cable loss table for typical products is shown in Table 5, and can be used with the Step 3 Worksheet at the end of this brochure.

Material Structure	Core Dia. Micron (µm)	Numerical Aperture	Attn * DB/km	Bandwidth MHz/km
Silica	50	0.20	4	400
Silica	50	0.20	3	600
Silica	62.5	0.29	4	400
Silica	85	0.26	4	200
Silica	100	0.28	5	100
PCS	200	0.27	7	25
PCS	300	0.27	7	20

*Values for 850 nm wavelength

Table 5. Typical optical fiber cable performance

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System Design Procedure (Continued)

Bandwidth Analysis: (Step 4)

While attenuation is one major determinant in fiber optic system performance, bandwidth is the other. Here the goal is to assure that all components have sufficient bandwidth to transmit the required signal. Local area networks typically require 20 to 600 MHz-km fiber bandwidth. On the other hand, long-haul telephone systems employ large distances between repeaters and require the 100,000 MHz-km bandwidths associated with single mode fiber.

A fiber has a 3dB (half power) optical signal magnitude decrease at the bandwidth specified for that fiber. Conversion between electrical and optical bandwidth for the system or any component such as a fiber, receiver, or transmitter unit is performed by using: BW optical = 1.41 BW electrical. In some cases a receiver or transmitter manufacturer will specify risetimes. The electrical bandwidth (BW in MHz) for a component is related to its 10% - 90% risetime (t in nanoseconds) by: BW=350/t and the total system electrical bandwidth is obtained from individual component bandwidth by:

$$\frac{1}{BW^2} = \frac{1}{BW^2_R} + \frac{1}{BW^2_C} + \frac{1}{BW^2_T}$$

Where BW_R, BW_C and BW_T are the electrical bandwidth of the receiver, cable and transmitter respectively.

For digital systems the system bandwidth will depend on the data rate (R in bits per second) and the coding format according to:
BW system = R/K
Where K equals 1.4 for a non-return-to-zero (NRZ) coding format and 1.0 for a return-to-zero (RZ) format.

The system bandwidth is limited by the lowest bandwidth component in the link. When high bandwidth fiber is used for example, the system frequency response may be more influenced by the terminal equipment than the fiber.

A general guideline in selecting the terminal equipment is to choose a receiver with a bandwidth equal to or greater than the required system bandwidth. The transmitter and optical fiber should then have bandwidths about 1.5 to 2 times greater than the receiver.

Again, systems are usually more cost effective at higher data rates. And allowing for more fiber bandwidth than is minimally required, for example, allows system capacity to be upgraded later. Care should be taken in estimating the optical bandwidth in MHz-km of series connected cable runs with lengths greater than a kilometer.

The approximate relationship between the total cable bandwidth (BW_{CO}) and one kilometer section fiber bandwidth (BW_f) is:
$BW_f = BW_{CO}\ (L)^x$
L is the fiber length in kilometers. The x equals 1.0 for cable run lengths (L) of one kilometer or less. And x equals 0.75 for fiber in cable run lengths greater than one kilometer.

The Step 4 Worksheet provides a simple example and a blank form to fill in the necessary values for a bandwidth analysis. Here the $1/BW^2$ terms are individually calculated and then combined in a series of steps to yield the total system bandwidth.

System Review: (Step 5)

Now is the time for the system designer to review all of the pieces to determine that all work together to deliver the right signal to the right place at the right time. These combined parameters can be listed Step 5 Worksheet.

The complete cable structure can be established using the following criteria:

- Cable Construction
  Hybrid _____ All Dielectric _____
  Metal Strength Members _____

- Jacket Materials
  PVC _____ Polyurethane _____
  Polyethylene _____ Other _____

- Environmental Protection
  Flame Retardancy _____
  Or UL code _____
  Sunlight Resistance _____
  Abrasion Resistance _____
  Water Blocking (gel fill) _____
  Rodent Protection (armor) _____
  Nuclear Radiation Resistance _____
  Other _____

- Chemical Resistance
  To Oil _____, Acid _____
  Alkali _____, Solvents

- Fiber Features
  Number of Fibers _____
  Fiber Type ____ Core Size _____
  Wavelength _____
  Attenuation _____
  Bandwidth _____
  NA _____
  Double Window _____

- Number and Type of Electrical Connectors _____

Specific materials and multi-fiber constructions have resulted in numerous cable designs which incorporate a variety of fibers to meet specific applications. Hybrid designs having both optical fibers and metallic conductors are also part of Belden's fiber optic cable line.

Hopefully this guide will permit the identification and description of a useful fiber optic system. Due to advancing technology and extensive tradeoffs, system design is constantly changing. This guide is based on currently available components. To keep abreast of changes, ask questions, or to request design assistance, contact S.I. Tech's technical support.

Worksheets

Step 1. System Operational Requirements

Application
TV _____ Telephone/WAN _____ Computer/LAN _____ Other _____

Type of Signals
Analog:
- System Bandwidth _____ MHz
- System Signal-to-Noise Ratio _____ dB

Digital:
- Coding Scheme NRZ _____ RZ _____ Other _____
- Data Rate _____ Bits Per Second
- Bit Error Rate 10^{-8} _____ 10^{-9} _____ Other _____
- Logic Format _____ TTL _____ ECL _____
  Other

Optical:
- (A) Minimum Required Optical Power _____dBm Average_____ Peak _____
  (from manufacturer's data)
- (R) Receiver Dynamic Range (from manufacturer's data) _____dBm
- (S) Maximum Optical Power allowed at receiver (A+R) _____dBm Average_____ Peak _____

Number of Channels _____

Terminal Equipment
Space available for:
Transmitter_____" x _____" x _____"
Receiver _____" x _____" x _____"
Repeater _____" x _____" x _____"
Terminal Equipment Connections RS-232 ___ RS-422 ___RS-485 __Twinax ___TP __Other __
Terminal Equipment Mounting PC Board _____ Rack _____ Other _____

Power Supply Requirements:
Voltages AC_____DC_____
Current_____mA
Frequency_____Hz

Step 2: System Layout

System Location
Locations of Equipment Building _____ Other _____
Distance Between Stations Meters _____
Routing Plan for Cables _____

System Environment
For Terminals and Repeaters Indoor _____ Outdoor _____
For Cables (based on routing) Ducts _____ Buried _____ Aerial _____ Other _____
Temperature Range _____ °C to _____ °C
High Voltage Present Yes _____ No _____ Volts _____
Water Presence Yes _____ No _____

Installation Constraints
Installation Equipment _____
Cable Pull Lengths _____ Meters

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Worksheets (Continued)

Step 3. Signal Optical Power Budget

***Example*:**

	Required Bandwidth (Data Rate)	(NRZ, 1.4 Mbps)
	Required Bit Error Rate	10^{-9}
(L)	Required Length of Run	2 Km
(A)	Minimum Optical Power Required for PIN Type Receiver	-39 dBm Average
(R)	Receiver Dynamic Range	20 dB
	Maximum Optical Power Allowed at Receiver (A+R)	-19 dBm
	Transmitter Type (Wavelength)	LED 850 nm

	Source-to-Fiber Coupling: Fiber (Core Diameter)	200 µm	100 µm	62.5 µm
(B)	Coupled Power (From Figure 26)	-5 dBm	-11 dBm	-20 dBm
(C)	Power Difference (B-A)	34 dB	28 dB	19 dB
(D)	Degradation Allowance	6 dB	6 dB	6 dB
(E)	Power Margin (C-D)	28 dB	22 dB	13 dB
(F)	2 Connectors (Average Loss: 0.5 to 3dB/Connector)	6 dB	1 dB	1 dB
(G)	0 Splice (Average Loss: 0.25 dB/splice)	0 dB	0 dB	0 dB
(H)	Maximum Cable Attenuation Allowed (E-F-G)	22 dB	21 dB	12 dB
(I)	Cable Attenuation at 850 nm (From chart in Figure 26)	8 dB/Km	6 dB/Km	5 dB/Km
(J)	Total Cable Loss (I x L)	16 dB	12 dB	10 dB
	Maximum cable Length Allowed (H/I)	2.75 Km	3.5 Km	2.4 Km
(K)	Excess Power Margin	6 dB	9 dB	2 dB

Worksheet:

	Required Bandwidth (Data Rate)	_____				
	Required Bit Error Rate	_____				
(L)	Required Length of Run	_____ Km				
(A)	Minimum Optical Power Required for Receiver	_____ dBm	Average	_____	Peak	_____
(R)	Receiver Dynamic Range	_____ dB				
	Maximum Optical Power Allowed at Receiver (A+R)	_____ dBm				
	Transmitter Type (Wavelength)	_____ nm	Laser Diode (nm)	_____	Other Source (nm)	_____

	Source-to-Fiber Coupling: Fiber (Core Diameter)	µm	µm	µm
(B)	Coupled Power (From Figure 26)	dBm	dBm	dBm
(C)	Power Difference (B-A)	dB	dB	dB
(D)	Degradation Allowance	dB	dB	dB
(E)	Power Margin (C-D)	dB	dB	dB
(F)	Connectors (Average Loss:____dB/Connector)	dB	dB	dB
(G)	Splice (Average Loss:_____dB/splice)	dB	dB	dB
(H)	Maximum Cable Attenuation Allowed (E-F-G)	dB	dB	dB
(I)	Cable Attenuation at 850 nm (From chart in Figure 26)	dB/Km	dB/Km	dB/Km
(J)	Total Cable Loss (I x L)	dB	dB	dB
	Maximum cable Length Allowed (H/I)	Km	Km	Km
(K)	Excess Power Margin	dB	dB	dB

Worksheets (Continued)

Step 4. Signal Bandwidth Analysis

Example:

Receiver Bandwidth PIN Type: $BW_R = 10$ Mhz
(A) $1/BW_R^2 = 10^{-2}$ MHz^{-2}
Transmitter Bandwidth LED Type $BW_T = 20$ Mhz
(B) $1/BW_T^2 = 2.5 \times 10^{-3}$ MHz^{-2}
Fiber Optic Cable Bandwidth
(C) Fiber Length L = 2 Km

Fiber (Core Diameter Type)		200 µm	100 µm	62.5 µm
(D)	Bandwidth BW_f	25 MHz-Km	20 MHz-Km	200 MHz-Km
(E)	Cable Optical Bandwidth BW_{CO}	12.5 MHz	11.9 MHz	118.9 MHz
(F)	Cable Electrical Bandwidth BW_C (E/1.41)	8.9 MHz	8.4 MHz	84.3 MHz
(G)	$1/BW_C^2$	1.3×10^{-2} MHz^{-2}	1.4×10^{-2} MHz^{-2}	1.4×10^{-2} MHz^{-2}
System Bandwidth				
(H)	Sum of Squares (A+B+G)	2.5×10^{-2} MHz^{-2}	2.6×10^{-2} MHz^{-2}	1.3×10^{-2} MHz^{-2}
(I)	System Bandwidth $1/\sqrt{H}$	6.3 MHz	6.2 MHz	8.8 MHz
(J)	Required System Bandwidth	1.0 MHz	1.0 MHz	1.0 MHz
(K)	Bandwidth Margin (I-J)	5.3 MHz	5.2 MHz	7.8 MHz

Worksheet:

Receiver Bandwidth___Type: $BW_R =$ _____Mhz
(A) $1/BW_R^2 =$ _____MHz^{-2}
Transmitter Bandwidth___Type $BW_T =$ _____Mhz
(B) $1/BW_T^2 =$ _____MHz^{-2}
Fiber Optic Cable Bandwidth
(C) Fiber Length L =

Fiber (Core Diameter Type)				
(D)	Bandwidth BW_f	MHz-Km	MHz-Km	MHz-Km
(E)	Cable Optical Bandwidth BW_{CO}	MHz	MHz	MHz
(F)	Cable Electrical Bandwidth BW_C (E/1.41)	MHz	MHz	MHz
(G)	$1/BW_C^2$	MHz^{-2}	MHz^{-2}	MHz^{-2}
System Bandwidth				
(H)	Sum of Squares (A+B+G)	MHz^{-2}	MHz^{-2}	MHz^{-2}
(I)	System Bandwidth $1/\sqrt{H}$	MHz	MHz	MHz
(J)	Required System Bandwidth	MHz	MHz	MHz
(K)	Bandwidth Margin (I-J)	MHz	MHz	MHz

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Worksheets (Continued)

Step 5. System Review

System Considerations	Example	Requirements for Operation
Data Rate (Bandwidth)	1.4 Mbps (1.0 MHz)	
Signal-to-Noise Ratio (Analog)		
Bit Error Rate (Digital)	10^{-9}	
Coding Scheme (Digital)	NRZ	
Type	PIN	
Bandwidth	10 MHz	
Sensitivity		
Minimum Optical Power	-39 dBm Average	
Bit Error Rate	10^{-9}	
Dynamic Range	20 dB	
Bandwidth	20 MHz	
Coupled Optical Power	-5 dBm	
Wavelength/Type	850 nm/LED	
Fiber Type	200 µm core	
Bandwidth	25 MHz-Km	
Attenuation (at Transmitter Source Wavelength)	8 dB/Km	
Fiber Length	2 Km	
Number of Splices	0	
Total Splice Attenuation	0 dB	
Number of Connectors	2	
Total Connector Attenuation	6 dB	
Degradation Allowance	6 dB	
Bandwidth Margin	5.3 MHz	
Excess Power Margin	6 dB	

Step 6. System Costs

The cost of each component should be totaled to determine the system cost.

QTY					
_____	Connectors at $	_____	/connector	= $	_____
_____	Transmitters at $	_____	/transmitter	= $	_____
_____	Receivers at $	_____	/receiver	= $	_____
_____	Km of Cable at $	_____	/kilometer	= $	_____
_____	Repeaters at $	_____	/repeater	= $	_____
			Installation Costs	= $	_____
			Maintenance Costs	= $	_____
			Other Costs	= $	_____
			Total System Costs	= $	_____

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TERMS & CONDITIONS, WARRANTY, STANDARDS, AND GLOSSARY OF TERMS

TERMS & CONDITIONS

THREE EASY WAYS TO ORDER:

MAIL OR E-MAIL ORDER FORM	PHONE	FAX 24 HOURS

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C. Return 60 days: Between 31 and 60 days of invoice date, standard catalog products may be retuned with 30% restock charge provided the product is in original condition and packaging with complete instructions and power cord(s).
D. Custom Products: No cancellations or returns available after order acceptance date. No returns of special or custom-built products ordered by Buyer, including copper or fiber optics data cable assemblies, will be accepted by Seller.

DELIVERY AND SHIPMENT DATES: Any dates and delivery schedules for delivery of Products stated in Seller's quotation or acknowledgment represent Seller's best estimate made at the time of quotation and are not binding upon Seller, **Seller shall have no liability, whatsoever, to Buyer, buyer's customers, or any third party for direct, liquidated, consequential, incidental or indirect damages, losses or expenses resulting from delays in shipment of the Products.**

FREIGHT: All shipments are F.O.B. Seller's manufacturing plant, located in Batavia, IL. 60510 USA

WARRANTY

Seller warrants that the copper and fiber optics data cable assemblies which it manufactures will be free from defects in material and workmanship for a period of thirty (30) days from delivery. Seller warrants that all other Products which it manufactures will be free from defects in material or workmanship for a period of one (1) year from the date of delivery. In the event any product is not warranted, Seller's sole obligation, and Buyer's exclusive remedy, is as hereinafter provided. Buyer can also purchase extended warranty.

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STANDARDS

ISO 9001: ***International Standards Organization*** issues a series of international standards, ISO 9000, which require documented systems for controlling the processes used to develop and produce products. S.I. Tech is quality certified by one of the leading registrars in the world, AFAQ, Inc. This quality assurance system covers contract review, design, development, purchasing production, installation, inspection and servicing. S.I. Tech follows the quality policy of "total customer satisfaction."

EIA: ***Electronic Industry Association*** publishes many commonly used data communications standards.
RS-170 – CCTV video transmission quality
RS-232 – Interface between data terminal equipment (DTE) and data communications equipment (DCE). Employing serial binary data interchange. (V.24 & V.28, ISO 2110).
RS-422 – Electrical characteristics of balanced voltage digital interface circuits.
RS-423 – Electrical characteristics of unbalanced voltage digital interface circuits.
RS-449 – Digital interface circuits for longer distances.
RS-485 – Electrical characteristics of balanced digital multipoint systems.

IEC: ***International Electrotechnical Commission*** publishes many data communications standards used throughout the world. (Also CCITT – Consultative Committee for International Telephone and Telegraph)
V.21 – General purpose interface between DTE and DCE for synchronous operation on telephone networks.
V.24 – List of definitions for interchange circuits between DTE and DCE (RS-232).
V.27 – 4800 BPS modem for leased circuits.
V.28 – Electrical characteristics for unbalanced double current interchange circuits (RS-232).
V.29 – 900 BPS modem for leased circuits
V.35 – Data transmission at 48 KBPS

IEEE: ***Institute of Electrical and Electronics Engineers*** develops many standards.
IEEE 488 – Standard defines the digital interface for programmable instrumentation.
IEEE 802.1 – Relationship between IEEE and ISO model
IEEE 802.2 – Network control protocol
IEEE 802.3 – Ethernet Local Area Network
IEEE 802.4 – Map/Top Local Area Network
IEEE 802.5 – Token Ring Local Area Network
IEEE 802.6 – MAN Network
IEEE 802.7 – Broad Band Local Area Network
IEEE 802.8 – Fiber Optic CSMA/CD
IEEE 802.9 – Integrated Voice and Data
IEEE 802.10 – Interoperable LAN/WAN Security
IEEE 802.11 – Wireless LAN
IEEE 802.12 – Repeater Specs
IEEE 802.14 – Cable TV Based Broadband Network

UL: ***Underwriters Laboratory*** covers safety related issues as they apply to data communications devices, e.g. standards 478 and 1950. Many S.I. Tech products are UL approved and labeled.

CSA: ***Canadian Standards Association*** also publishes safety related guidelines for data communication products, e.g. standard C22.2 and 950. Many S.I. Tech products are CSA approved and labeled.

FCC: ***Federal Communications Commission*** is primarily concerned with radio, TV, (RFI/EMI) and other electronic devices and noise problems. It publishes dockets (rules) regarding conducted, emitted and radiated noise. Class A, part 15 applies to computing devices for industrial and office use. Class B, part 15 applies to computing devices in homes. S.I. Tech products meet Class A, part 15 requirements.

VDE: ***West German Standards.*** Some are similar to IEC, EIA, UL and other standards. However, some are more Stringent and different. Power supplies used in many S.I. Tech products meet VDE requirements.

STANDARDS

CE: ***European Regulatory Requirements*** regarding EMC/EMI/RFI, etc.

Military: ***U.S. military agencies*** publish communications products standards, e.g. MIL-STD-188, MIL-STD-1552 and Tempest. S.I. Tech offers products meeting MIL-STD-188 and Tempest.

TIA: *Telecommunication Industry Association* publishes telecom standards

T-1 (DS-1): Trunk Level 1, basic protocol (1.54 Mbps) used by telecommunication companies for long distance communications in North America.

T-3 (DS-3): Digital signal communication protocol running at 44.736 Mbps, used by telecommunication carriers and high speed internet communications in North America.

SONET: Sonet standards are used for synchronous optical networks, numbered OC-1 to OC-768
STS-1 (OC-1) - 51.84 Mbps
OC-3 - 156 Mbps
OC-12 - 622 Mbps
OC-48 - 2.5 Gbps
OC-192 - 10 Gbps
OC-768 - 40 Gbps

CCITT: *Consultative Committee for International Telephone & Telegraph* publishes telecom standards.
E-1 - 2.048 Mbps Digital Service
E-3 - 34.368 Mbps Signal Carries 16 E1 Circuits

Glossary of Terms

10BASE2	An Ethernet standard that uses a thin coaxial cable. Also called Thin Ethernet. 10-Mbps baseband signal.
10BASE5	The original Ethernet Standard that uses a thick coaxial cable. Also called Thick Ethernet, 10-Mbps.
10BASE-FL	The portion of the 10BASE-F standard that defines a fiber optic link between a concentrator and station. Ethernet over fiber.
100BASE-T	A high-speed version of Ethernet (IEEE 802.3). Also called Fast Ethernet, 100BASE-T transmits at 100 Mbps.
AC	Abbreviation for Alternating Current.
Access	The ability to manipulate data, or to communicate with a computer resource.
ADSL	Asymmetric Digital Subscriber Line. A high-speed copper wire link that connects a Jetstream IAD to a DSLAM.
Analog	Representation of data that varies in a continuous manner. A voice signal.
Amplitude	The instances of the maximum value of a varying wave form.
ASCII	American Standard Code for Information Interchange. A coding scheme wherein letters, numbers, and special symbols are represented as unique 7-bit values, allowing for standardization between data communications devices.
ASP	Application Service Provider or Apple Talk Session Protocol
Asynchronous Communication	A serial stream of data sent as generated. Characters are delimited by start and stop bits whose function is to synchronize character bit timing.
ATM	Asynchronous Transfer Mode. A technology used for high-speed packet switching and transmission on a Broadband Integrated Services Digital Network (B-ISDN). ATM is designed to take advantage of high-speed transmission media.
Attenuation	The decrease in magnitude of a wave as it travels through any transmitting medium, such as a cable or circuitry. Attenuation is measured as a ratio or as the logarithm of a ratio (decibel).
Audio Frequency	That range of frequencies lying within the range of human hearing: approximately 20 to 20,000 Hz.
AUI	Abbreviation for Attachment Unit Interface, used with Ethernet.
Balanced Line	A cable having two identical conductors with the same electromagnetic characteristics in relation to other conductors and to ground.
Balun	A device for matching an unbalanced coaxial transmission line to a balanced two-wire system. Normally gives impedance transformation, e.g. 100 ohm balanced to 75 ohm unbalanced.
Bandwidth	The difference between the upper and lower limits of a given band of frequencies. Usually expressed in Hertz.
Baseband	The frequency band occupied by a single or composite signal in its original or unmodulated form.
Baseband LAN	A local area network using baseband signalling.
Baud	A unit of signaling speed equal to the number of signal events per second.
Bend Loss	A form of increased attenuation caused by (a) having the fiber curved around a restrictive radius of curvature or (b) mircobends caused by minute distortions in the fiber imposed by externally induced perturbations.
Bend Radius	Radius of curvature that a cable can bend without any adverse effects.
Bridge	A device that connects two LAN segments together, which may be of similar or dissimilar types, such as Ethernet and Token Ring.
Buffer	A protective coating over the fiber.

Glossary of Terms

Broadband	A transmission type that has multiple carrier signals. Commonly used in cable television.
Carrier Frequency	The electromagnetic wave frequency selected to transmit information. Optical carrier frequency is from the infrared, visible or ultraviolet spectrum areas (10^{12} Hz and above).
Cladding	A low refractive index material that surrounds the core and provides optical insulation and protection of the core.
CLEC	Competitive (or Certified) Local Exchange Carrier. A company that offers local exchange services to end users.
Controller	A component of a computer system that directs data traffic within the system.
Core	The light transmission part of the fiber with a refractive index higher than that of the cladding.
CoS	Class of Service
C.S.A.	Abbreviation for Canadian Standards Association.
CSMA/CD	Carrier sense multiple access with collision detection, used in Ethernet.
Current Loop	A two wire transmit/receive interface.
Daisy Chain	A connection technique where components are attached in a serial fashion.
Data Communications	Movement of data messages to and from remote system through a medium.
Data Compression	The "squeezing" of data for the purpose of throughput. This squeezing can be done on a character basis by reducing the character size of transmitted and received characters, or on a message basis by eliminating redundant characters.
Data Rate	A measure of the signal rate of a data link.
DCE	Abbreviation for Data Circuit Terminating Equipment. Carrier equipment, installed at the user's premises that provides all the functions required to establish, maintain, and terminate a connection, and which provides the signal conversion and coding between the data terminal equipment and the common carrier's line.
Decibel (dB)	One-tenth of a bel. It is equal to 10 times the logarithm of the power ratio, 20 time the log of the voltage ratio, or 20 times the log of the current ratio. One decibel is the amount by which the pressure of a pure sine wave of sound must be varied in order for the change to be detected by the average human ear. The decibel can express an actual level only when comparing with some definite reference level that is assumed to be zero dB.
Dedicated	Committed to one specific use, such as a dedicated port on a computer to a specified terminal or microcomputer.
Degradation	Deterioration in the quality or speed of data transmission, caused as more users access a computer or computer network.
Dispersion	The cause of bandwidth limitations in a fiber. Dispersion causes a broadening of input pulses along the length of the fiber. Two major types are (a) mode dispersion caused by differential optical path lengths in a multimode fiber, and (b) material dispersion caused by a differential delay of various wavelengths of light in a waveguide material.
Digital	Representation of data by discrete characters (1's and 0's), e.g. 0 or 1
DS3	The DS3 port adapter is used for wide-area connectivity, to link multiple campuses, or to connect to public networks. The DS3 port adapters support standard BNC coaxial cable connectors.
DSL	Digital Subscriber Line. A technology that uses copper wire pairs for high-speed transmission of voice and data.
DSLAM	Digital Subscriber Line Access Multiplexer.

Glossary of Terms

DTE	Abbreviation for Data Terminal Equipment. The end-user machine, be it terminal, computer, controller, etc., that plugs into a unit that is the termination point of a communications circuit (DCE).
EBCDIC	Extended binary coded decimal interchange code. A coding scheme wherein letters, numbers and special symbols are represented as unique 8-bit values, allowing for standardization between data communications devices; popularized by IBM.
EIA	Electronic Industries Alliance (formerly RMA or RETMA).
Echo	Data communications devices typically can be informed that they are to return to the sender all received characters. This is known as echoing characters and can be used to provide positive feedback to the initiator.
Electromagnetic	Referring to the combined electric and magnetic fields caused by electron motion through conductors.
Electrostatic Coupling	The transfer of energy by means of a varying electrostatic field. Capacitive coupling.
EMF	Abbreviation for Electromotive Force (voltage).
Emulation	Referring to “acts like”. In computer equipment an emulation card makes a PC resemble a certain mainframe or mini-computer to another device.
Ethernet	A baseband local area network specification developed jointly by Xerox Corp., Intel Corp., and Digital Equipment Corp. (DEC) to interconnect computer equipment using coaxial cable, twisted pairs and transceivers.
Fiber	A single, separate optical transmission element characterized by a core and a cladding.
Fiber Optics	Light transmission through optical fibers for communication or signaling.
Firewall	A network node set up as a boundary to prevent one segment’ traffic from crossing over to another segment.
FM	Frequency Modulation.
FOIRL	Fiber Optic InterRepeater Link: An IEEE standard for fiber optic Ethernet.
Frequency	The number of times a periodic action occurs in a unit of time. The number of cycles that an electric current completes in 1 second.
Frequency Response	The characteristic of a device denoting the range of frequencies over which it may be used effectively.
Full-Duplex Transmission	Allows for simultaneous bi-directional movement of data communications.
Gateway	A special node that interfaces two or more dissimilar networks, providing protocol translation between the networks.
Gigahertz (GHz)	A unit of frequency equal to one billion hertz.
Graded Index	A type of fiber where the refractive index of the core is lower toward the outside of the fiber. It bends the rays inward and also allows them to travel faster in the lower index of refraction region. This type of fiber provides high bandwidth capabilities.
Ground Loop	A completed circuit between shielded pairs of multiple pair cable created by random contact between the shields. An undesirable circuit condition in which interference is created by ground currents when grounds are connected at more than one point.
Half-Duplex	Allows for movement of communications in both directions, but in a single direction only at any point in time.

Glossary of Terms

HDLC	High-level Data Link Control. The International Standards Organization's physical link protocol. Various manufacturers have their own derivative of HDLC, the most common of which is IBM's SDLC (Synchronous data link control).
Head-End	A central point in broadband networks that receives signals on one set of frequency bands and retransmits them on another set of frequencies. Viewed as a central hub.
Hertz	The unit of frequency, one cycle per second.
Host Computer	The primary or controlling computer in a multiple computer operation upon which the smaller computers depend to do most work.
IAD	Integrated Access Device. A device that supports voice, data and video streams over a single, high-capacity circuit.
IEEE-488	Institute of Electrical and Electronic Engineers 488. An IEEE standard parallel interface bus consisting of eight bi-directional data lines and eight signal grounds, which provides for connection to an IEEE-488 device. Formerly EPIB.
IEEE-802	Standards for the interconnection of local area networking computer equipment. It deals with the Physical and Link Layers of the ISO/OSI reference model.
ILEC/PPT	Incumbent Local Exchange Carrier
Impedance	The total opposition a circuit, cable or component offers to alternating current. It includes both resistance and reactance and is generally expressed in ohms.
Impedance, Characteristic	In a transmission cable of infinite length, the ratio of the applied voltage to the resultant current at the point the voltage is applied. Or, the impedance which makes a transmission cable seem infinitely long, when connected across the cable's output terminals. For a wave guide, it is the ratio of rms voltage to total rms longitudinal current at certain point on a diameter, when the wave guide is match terminated.
Inductance	A property of a conductor or circuit which resists a change in current. It causes current changes to lag behind voltage changes and is measured in henrys.
Injection Laser Diode (Source)	Sometimes called the semiconductor diode. A laser in which the lasing occurs at the junction of n-type and p-type semiconductor materials.
Interface	The place where two systems or a major and a minor system meet and interact with each other.
Interference	Disturbances of an electrical or electromagnetic nature that introduce undesirable responses into other electronic equipment.
Internet	The worldwide computer network used for reference, e-mail, and other services.
Intranet	A network that connects a related set of standard Internet protocols and files in HTML format with employees using Internet browsers in an organization's network and within corporate firewalls.
IP (Internet Protocol)	The protocol used in gateways to connect networks at the OSI Network Level (Layer T3) and above. IP routes a message across networks.
IPSEC (IP Security)	An IETF working group tasked with developing standards for security protocols to provide IP security services that will support combinations of authentication, integrity, access control and confidentiality.
ISDN	Integrated Services Digital Network: Communication protocol, offered by telephone companies that permits telephone networks to carry data, voice, and other source traffic.

Glossary of Terms

ISO/OSI Reference Model	The International Standards Organization Reference Model for Open Systems Interconnection. A standard approach to network design that introduces modularity by dividing the complex set of functions into more manageable, self-contained, functional slices.
Isolation	The ability of a circuit or component to reject interference, usually express in dB.
IXC	Inter-Exchange Carrier. These are typically long-distance phone companies.
KPSI	Tensile strength in thousands of pounds per square inch.
Laser	A coherent source of light with a narrow beam and a narrow spectral bandwidth.
Line Driver	A power amplifier for local data transmission.
Link	The combination of communication devices, media and software intelligence that is required to effect data transmission.
Light-Emitting Diode (LED)	A semiconductor device that emits incoherent light formed by the P-N junction. Light intensity is roughly proportional to electrical current flow.
Local Area Network (LAN)	A network that is located in a localized geographical area, such as an office, building, complex of buildings or campus, with communications technology that provides a high-bandwidth, low-cost medium to which many nodes can be connected.
Megahertz (MHz)	Unit of frequency equal to one million hertz.
Micron	Millionth of a meter=10^{-6} meter.
Mode	A permitted electromagnetic field pattern within an optical fiber.
Modem	Device that converts signals in one form to another form compatible with another kind of equipment.
Modular	A style of easily connected or disconnected components.
Modulation	The coding of information onto the carrier frequency. Modulation means include (among others) amplitude, frequency, or phase, plus many forms of on-off digital coding.
MPLS	Multiprotocol Label Switching Traffic engineering software enables an MPLS backbone to replicate and expand upon the traffic engineering capabilities of Layer 2 ATM and Frame Replay networks.
Multiplex	Placing two or more signals into a single channel.
Multiplexing	The use of common physical channel to make two or more logical channels, either by splitting the frequency band transmitted by the common channel into narrower bands, each of which is used to constitute a distinct channel (frequency division multiplex), or by allotting this common channel in turn to constitute different, intermittent channels (time division multiplex).
Multiplexer	Equipment that permits simultaneous transmission of multiple signals over one physical circuit.
Multi-tasking	The sharing of routines, data space and files to execute several jobs at once.
Nanometer (nm)	One billionth of a meter (10^{-9} meter).
NEC	National Electrical Code.
Network	A logical arrangement of data communications devices and software whose purpose is to provide data processing capabilities to end users at optimal efficiency.
Network Interface Controller	A communications device that allows interconnection of information processing devices to a network.
Network Management	Administrative services performed in managing a network, such as network topology and software configuration, downloading of software, monitoring network performance, maintaining network operations, and diagnosing and troubleshooting problems.

Glossary of Terms

Nibble	One half byte (4 bits)
Node	Interface unit, or station, that contains logic for measuring the flow of network traffic that passes through it. May be connected to more than one device.
Noise	In a cable or circuit, any extraneous sound or signal which tend to interfere with the sound or signal normally present in or passing through the system.
Numerical Aperture (NA)	A measure of the angular acceptance for a fiber. It is approximately the sin of the half-angle of the acceptance cone. $NA=\sqrt{n_1^2-n_2^2}$ Where n_1 and n_2 are, respectively, the refractive index of the core and the cladding.
OC-1 (Optical Carrier Level 1)	The lowest optical-transmission rate in the SONET standard, 51.48 Mbps.
OC-3	155 Megabit per second connection often associated with an ATM or Packet over SONET link.
Octopus Cable	A fan-out cable with multiple baluns and one 25 pair telco connector.
Ohm	The electrical unit of resistance. The value of resistance through which a potential difference of one volt will maintain a current of one ampere.
ONS	Optical Networking System
Optical Waveguide Fiber	A transparent filament of high refractive index core *and* low refractive index cladding that transmits light.
PABX	Private Automatic Branch Exchange. Equipment originally used as a means of switching telephone calls within a business site and from the site to outside lines. Can also be used for low-speed transmission of data in addition to voice.
Packet	A collection of bits that contain both control information and data. The basic unit of transmission in a packet-switched network. Control information is carried in the packet, along with the data; to provide for such functions as addressing, sequencing, flow control, and error control at each of several protocol levels. A packet can be of fixed or variable length but generally has a specified length.
Packet Format	The exact order and size of the various control and information fields of a packet, including header, address and data fields.
Packet Overhead	A measure of the ratio of total packet bits occupied by control information to the number of bits of data, usually expressed as a percent.
Packet Switching	A method in which data is transmitted in addressed packets and a transmission channel is only occupied for the duration of packet transmission. The channel is then available for use by packets being transferred between different data terminal equipment.
Parity	The integrity of each character transmitted over a communications link can be tested by generation and subsequent checking of character parity. Computed using the bit-wise "or" of the character bits and added a bit to get an even or odd results.
Phase	The location of a position on a waveform of an alternating quality, in relation to the start of a cycle. Measured in degrees, with 360 corresponding to one complete cycle.
Phase Shift	A change in the phase relationships between two alternating quantities.
Photo detector (receiver)	Transforms light into electricity. The silicon photo diode is most commonly used for relatively fast speeds and good sensitivity in the 0.75 µm to 0.95 µm wavelength region. Avalanche photodiodes (APD) combine the detection of optical signals with internal amplification of photocurrent. The internal gain is realized through avalanche multiplication of carriers in the junction region. The advantage in using an APD is its higher signal-to-noise ratio, especially at high bit rates.
Pin-diode	A photodetector used to convert optical signals to electrical signals in a receiver.

Glossary of Terms

Point-to-point	Transmission of data between only two nodes, one sender and one receiver.
Polling	The continuous checking of device status. A method of controlling the transmission sequence by requiring each device on a multipoint line to wait until the controlling processor requests it to transmit.
POP (Point-of-Presence)	In OSS, a physical location where an interexchange carrier has installed equipment to interconnect with an LEC (local exchange carrier).
Propagation Delay	Time required for a signal to pass from the input to the output of a device.
Protocol	A set of rules and conventions that governs the orderly and meaningful exchange of information between or among communicating parties. Hardware and software protocols can be defined.
Protocol Converter	A device for translating the data transmission code and/or protocol of one network or device to the corresponding code or protocol of another network or device, enabling equipment with different conventions to communicate with one another.
Public Data Network (PDN)	A packet-switched or circuit-switched network that is available for use by many customers. A PDN may offer value-added services at a reduced cost because of communications resource sharing, and it will usually provide increased reliability due to built-in redundancy.
QoS (Quality of Service)	Measure of performance for a transmission system that reflects its transmission quality and service ability.
Receiver	An electronic package that converts the optical signal to an electrical signal.
Refractive Index	The ratio of light velocity in a vacuum to its velocity in the transmitting medium.
Repeater	Bi-directional device that amplifies and/or resynchronizes signals into standard voltages, currents, and timing.
Resistance	In dc circuits, the opposition a material offers to current, measured in ohms. In ac circuits, resistance is the real component of impedance and may be higher than the value measured at dc.
Response Time	The interval between the execution of a command or inquiry at a terminal and the subsequent receipt of a response at the same terminal.
Ring	A network topology in which stations are connected to one another in a closed, logical circle. Typically, access to the media passes sequentially from one station to the next by means of polling from a master station, or by passing an access token from one station to another.
RS-232	A technical specification that specifies mechanical and electrical characteristics of the interface for connecting DTE to DCE. It defines interface circuit functions and their corresponding connector pin assignments. The standard applies to both asynchronous and synchronous serial binary data transmission at speeds up to 20 kilobits per second in half- or full-duplex mode. It defines 20 specific functions and the physical connection is made through plug-in, 25-pin connectors.
RS-422	A standard operating in conjunction with RS-449 that specifies the electrical characteristics for balanced circuits.
RS-449	A standard for DTE/DCE connection that specifies interface requirements for expanded transmission speeds, up to 2 megabits per second (Mbps), longer cable lengths, and 10 additional functions. It applies to binary, serial, asynchronous and synchronous communication in half- or full-duplex mode. The physical connection is made through a 37-contact connector; a separate 9-contact connector is specified to service secondary channel interchange circuits when used.
RS-485	A standard for multipoint half-duplex data generators and receivers.

Glossary of Terms

SDH	Synchronous Digital Hierarchy
SDLC	Synchronous Data Link Control: IBM computer networking protocol associated with SNA. It provides for a control of a single communications link or line, accommodates a number of networking arrangements, and operates in half- or full-duplex over private or switched facilities.
Serial Interface	An interface requiring serial transmission or the transfer of information in which the bits composing a character are sent sequentially.
Serial Transmission	Transmission of one bit at a time.
Server	A processor that provides a specific service to the network. An example is a file server, which provides an interface between compatible peripheral devices on a LAN.
Simplex Communications	Allows movement in a single direction only.
Single-Ended	Unbalanced, such as grounding one side of a circuit or transmission line.
Single Mode Fiber	A fiber wave-guide in which only one mode will propagate. The fiber has a very small core diameter of approximately 8µm. It permits signal transmissions at extremely high bandwidths and is generally used with laser diodes.
Skew Rays	A ray that does not intersect the fiber axis. Generally, a light ray that enters the fiber core at a very high angle.
SNA	Systems Network Architecture: Network for moving IBM mainframe data.
Source	The means (usually LED or laser) used to convert an electrical information-carrying signal into a corresponding optical signal for transmission by an optical wave-guide.
Spectral Bandwidth	The difference between wavelengths at which Bandwidth the radiant intensity of illumination is half its peak intensity.
Speed of Light (c)	2.998×10^8 meters per second.
Splicing	Permanent joining of identical or similar fiber ends without a connector.
Star	A network topology consisting of one central node with point-to-point links to several other nodes. Control of the network is usually located in the central node or switch, with all routing of network message traffic performed by the central node.
Start Bit	Serial asynchronous data transmission relies upon the start bit to signify to the receiver that a character follows. The start bit is longer in duration than normal data bits, and this extended length allows it to be distinguished from normal data bits.
Station	A network node.
Step-Index Fiber	A fiber in which the core is of a uniform refractive index and there is a sharp decrease in the index of refraction at the cladding.
Stop Bit(s)	Serial asynchronous data transmission relies upon the stop bit(s) to signify to the receiver that no more data bits follow. Stop bits are longer in duration than normal data bits and this extended length allows them to be distinguished from normal data bits. Serial communications may be configured to allow for either 1, 1.5, or 2 stop bits (however, the most common number is 1).
Tap	A Device in the feeder cable that connects a device to a network.
TCP/IP	Transmission control protocol/Internet protocol. A specification that conforms to the latest Department of Defense Arpanet standard. The protocol corresponds to layers three and four of the ISO/OSI model.

Glossary of Terms

TDM	Time Division Multiplexing. A method of using channel capacity efficiently, in which each node is allotted a small time interval, in turn, during which it may transmit a message or portion of a message. Nodes are given unique time slots during which they have exclusive command of the channel. The messages of many channels are interleaved for transmission and then de-multiplexed into their proper order at the receiving end.
Terabits	1 Trillion Bits
Throughput	The total useful information processed or communicated during a specified time period. Expressed in bits per second or packets per second.
Token Bus	A network with a bus or tree topology using token passing access control.
Token Passing	A method whereby each device on a local area network receives and passes the right to use the channel. Tokens are special bit patterns or packets, usually several bits in length, which circulate from node to node when there is no message traffic. Possession of the token gives exclusive access to the network for message transmission.
Token Ring	The token access procedure used on a network with a sequential or ring topology.
Topology	Network topology can be centralized or distributed. Centralized networks, or star-like networks, have all nodes connected to a single node. Alternative topology is distributed; that is, in the limit each node is connected to every other node. Typical topology names include bus, ring, star, and tree.
Traffic	The measurement of data movement, volume, and velocity over a communications link.
Transceiver	A device required in baseband networks that takes the digital signal from a computer or terminal and imposes it on the baseband medium, and the reverse.
Transceiver Cable	Cable connecting the transceiver to the network interface controller, allowing nodes to be placed away from the baseband medium.
Transmission Line	An arrangement of two or more conductors or a wave-guide used to transfer signal energy from one location to another.
Transmission Medium	The physical mechanism that allows for signals to be passed from one data communications device to another.
Transmitter	The electronic package that converts an electrical signal to an optical signal.
Transparency	A data communications mode that enables equipment to send and receive bit patterns of any form, without regard to interpretation as control characters. The user is unaware that this is taking place.
Trunk Cable	See Feeder Cable.
U.L.	Underwriters Laboratories, Inc.
Unbalanced Line	A transmission line in which voltages on the two conductors are unequal with respect to ground, e.g., a coaxial cable.
Velocity of Propagation	The transmission speed of an electrical signal down a length of cable compared to speed in free space. Usually expressed as a percentage.
VoDSL	Voice over Digital Subscriber Line
VoIP	Voice over Internet Protocol
VPN (Virtual Private Network)	An encrypted connection between private networks over a public network, such as the Internet.
WAN	Wide Area Network
WDM	Wavelength Division Multiplexing
Wave Form	A graphical representation of a varying quantity. Usually, time is represented on the horizontal axis, and the current or voltage value is represented on the vertical axis.

Glossary of Terms

Wavelength	The distance between the nodes of a wave. The ratio of the velocity of the wave to the frequency of the wave.
X.25	A CCITT (Consultative Committee on International Telegraphy and Telephone) standard that defines the interface between a public display network (PDN) and a packet-mode user device (DTE). It also defines the services that these user devices can expect from the X.25 PDN, including the ability to establish virtual circuits through a PDN to another user device, to move data from one user device to another, and to destroy the virtual circuit when through.
XDSL	Group term used to refer to ADSL, HDSL, SDSL and VDSL. All are digital technologies using the existing copper infrastructure provided by the telephone companies. XDSL is a high-speed alternative to ISDN.

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