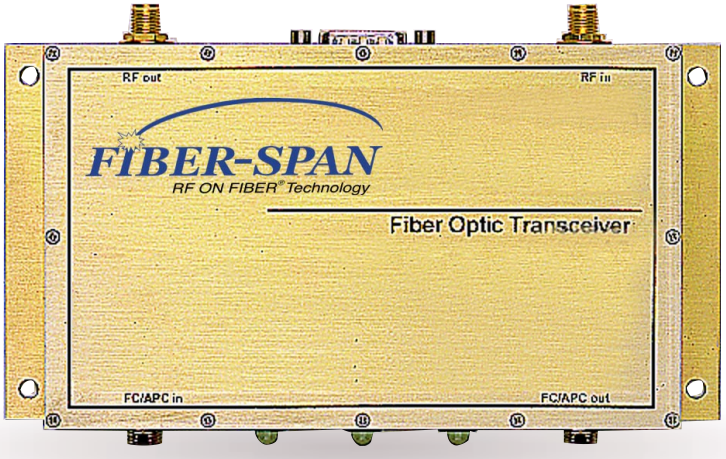
FIBER-SPAN

RF ON FIBER® Technology

FIBER OPTIC TRANSMITTERS, RECEIVERS, TRANSCEIVERS AND SUBSYSTEMS FOR WIRELESS AND RF SIGNAL DISTRIBUTION

PCS/PCN •
DISTRIBUTED ANTENNA •
CELLULAR •
HF/VHF/UHF •
L-BAND INTERFACILITY •
70/140 MHz IF •
ANTENNA REMOTING •
WIRELESS LOCAL LOOP •
MMDS / LMDS •
GPS •
SMR •

DESIGN GUIDE



With broad bandwidth and capacity for unlimited expansion, fiber optics is ideal for today's and tomorrow's applications

Fiber Optic transmission is the most efficient means to transmit Wireless and RF signals. Fiber cable has a much lower signal loss, is much lighter and is much less expensive than coaxial cable. For these reasons alone, fiber optics has grown to be a significant factor in the wireless revolution.

Transmitter

The fiber optic transmitter converts an RF signal into an optical signal at 1.3 um. The input impedance of the transmitter is 50 ohms. The output is an optical signal whose amplitude (or brightness) is proportional to the RF voltage input. This is referred to as direct or intensity modulation.

The laser diode driver circuitry utilizes optical feedback to maintain the optical output of the laser constant. An optical detector internal to the laser transmitter is used to monitor the output power and to adjust the bias current of the laser to maintain a constant average optical output. This assures consistency in performance, optimal linearity and maximum operating life of the system

Fiber & Connectors

Singlemode fiber is the fiber of choice in RF / Fiber applications. The fiber has a core and cladding size of 9/125 um. An optical connector aligns the cores for optimal stability and coupling of the light. Angle-polished connectors are used because they reduce the potential for optical reflections at the connector. Reflections in RF / Fiber systems cause increased noise and distortion. Scratches and dirt on lthe connector tip (ferrule) will result in higher connector loss, and will cause reflections. The connector tip must always be kept clean. Use 99% alcohol and lint free wipes to clean the ferrule tips. Always replace the cap on the ferrule when the connector is not in use.

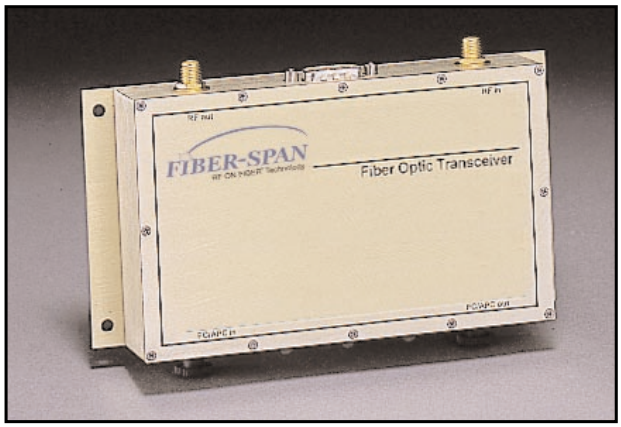
Receiver

The receiver uses a high-speed, high linearity PIN diode photodetector to convert the optical signal back to the RF domain. Low noise linear gain stages boost the signal back up to the desired RF level. A monitor is provided to indicate the optical power seen by the detector.

Quality Assurance

Constant and unrelenting efforts in the area of quality control are the small price we pay to earn our customers confidence in our products. From design through production to final test, our emphasis is on delivering a product that meets or exceeds your expectations. All of our fiber optic transmission modules and subsystems undergo temperature cycling, burn-in, and RF testing at elevated temperatures to assure stable, long term performance.

Mini plug-in module



Transceiver module

19" 1RU Subrack Unit, AC powered

FC/APC and SC/APC fiber optic connectors

In–Building Public Safety Applications

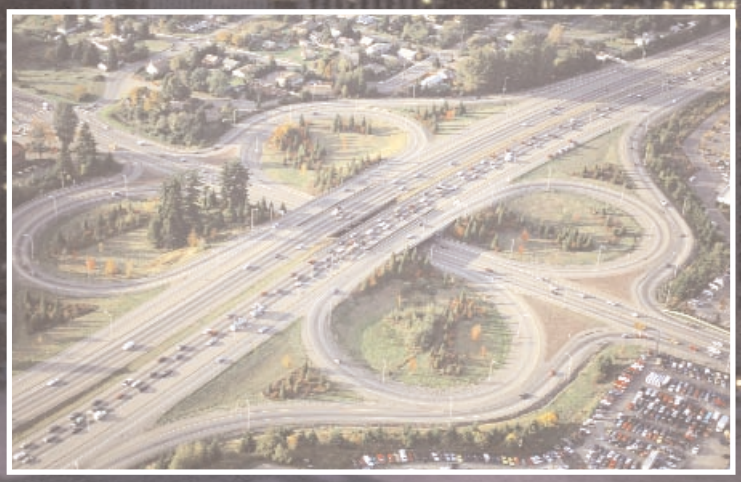
Fiber-Span's technology and bidirectional transceivers deliver critical radio frequency (RF) communications across a fiber optic network for in-building signal distribution. The benefits of fiber optics are endless. Fiber-Span's modular equipment transports RF ON FIBER® throughout a building for effortless and distortion-free communications to a wide variety of public safety, emergency, fire and police radio RF systems. Capacity issues facing conventional systems are eliminated while enhancing performance and reliability throughout the network. Fiber-Span is making communications less costly, secure and more dependable for users, equipment manufacturers and service providers.

Wireless Local Loop Transceiver

New wireless local loop systems are being designed with fiber antenna distribution as a fundamental system design approach. Systems designers are taking advantage of fiber's ability to remote the RF heads and to consolidate the modulators at a common location. The AC 206-2.5 has a flat pass band up to 2.5 GHz. Optical splitters and combiners can be incorporated for unique optical system configurations.

Military Applications

Today's global battlefields are sophisticated networks of Army, Navy, Coast Guard and Air Force defense organizations requiring robust, mission-critical telemetry, surveillance and tracking as well as high quality voice, video and data communications. Fiber-Span's RF ON FIBER® solutions offer unmatched performance for radio-frequency transport applications ranging from low frequency through VHF, UHF to satellite-band transmissions. Fiber optic cables offer the highest performance for secure and reliable military applications. Fiber-Span's equipment is designed and mission-ready for the most demanding applications.



Highway or long distance backhaul systems

The beauty of fiber optic transmission is its low RF loss over long distances. Fiber-Span offers fiber optic subsystems that can transmit over 20km, 30km or more. A trunk line system can be designed using bidirectional optical routing at the antenna sites. And with the use of DWDM technology, fiber capacity is maximized.

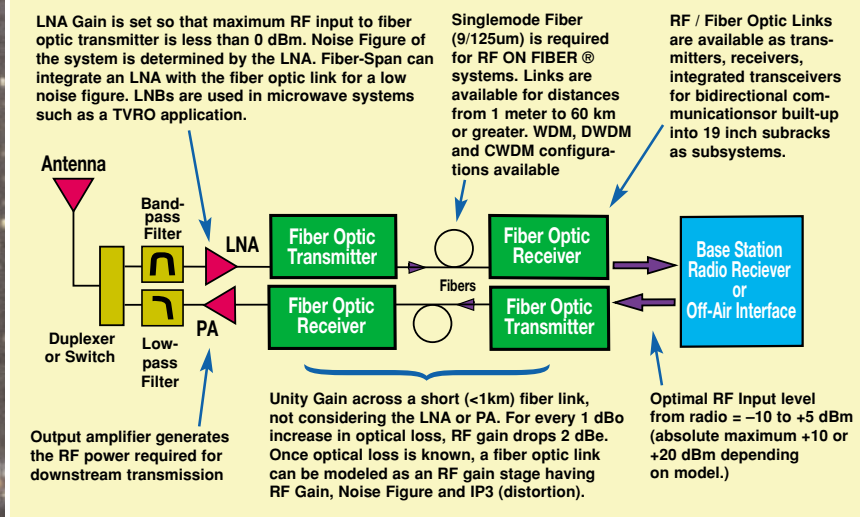
Wireless Data Transmission Systems

The advent of Broadband and the Internet has spawned an increasing demand for mobile communications and computing, wireless in the local loop (WLL) plus Wireless LAN technologies and protocols such as IEEE 802.11. Fiber-Span's RF ON FIBER® transceiver technology provides flexibility in architecture design, extended radio frequency coverage and enhanced performance in the wireless spectrum. Emerging technologies such as PDAs and hand/palm-held computers are shaping the world and providing greater capabilities to the mobile and wireless communications user. The desire and drive for faster and more reliable communications solutions will grow. Fiber-Span is leading the way by supplying OEMs with economical and durable modules and subsystems to address this exciting industry.

PCS Transceiver

The AC 231 is a high performance broadband transceiver optimized for PCS antenna remoting applications. It provides flat bandwidth from 1700 to 2200 Mhz and a wide spur-free dynamic range greater than 105dB/Hz$^{2/3}$. The unit utilizes advance MQW laser diode technology for stable wide temperature range performance.

RF ON FIBER ® Applications Diagram
Bidirectional system shown. TVRO systems utilize uni-directional configurations.



RF ON FIBER® links are used between the remote antenna and the base station. The remote unit usually includes an LNA for the uplink and a linear power amplifier for the downlink. If a common antenna is used for both transmit and receive, a duplexer ties the two paths together.

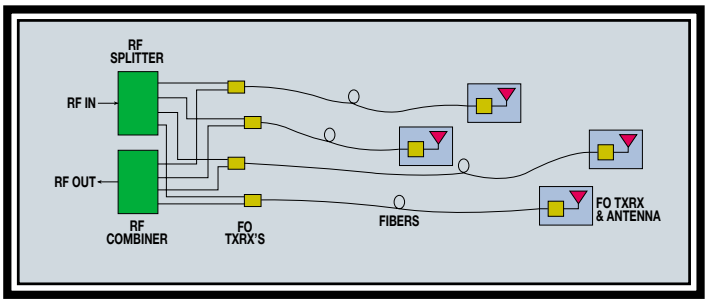
Welcome to the wireless revolution

Whether you communicate in the city, the suburbs, in your home or office building, Fiber-Span offers you a fiber optic solution that will make your wireless network work harder, more reliably and ubiquitously. Fiber Span's high performance, yet cost-effective rugged fiber optic transceiver gives you the freedom to go far and wide, with impunity.

Welcome to the wireless revolution.

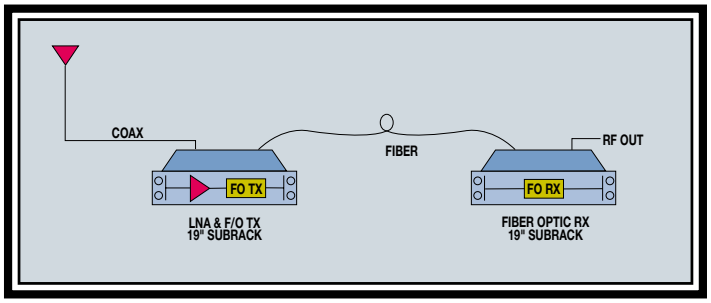
APPLICATIONS

Fiber–Span offers a unique line of compact and cost effective transmitters, receivers, transceivers and subsystems for wireless and RF transmission over fiber optics.



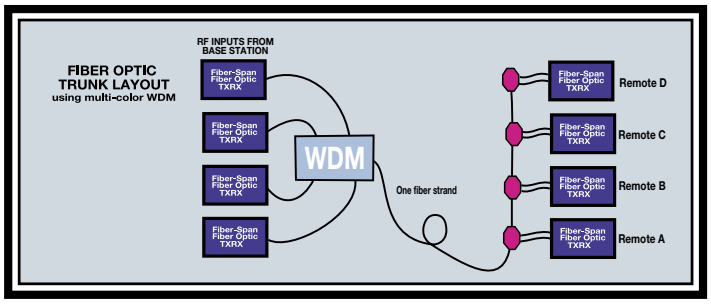
Distributed Antenna

A typical antenna remoting application requires the addition of a Low Noise Amplifier (LNA), a power amplifier (PA) and a duplexer. The far left side of the link would be connected to the radio equipment for demodulation down to the base-band channel. This approach is often used for in-building distributed antenna systems.



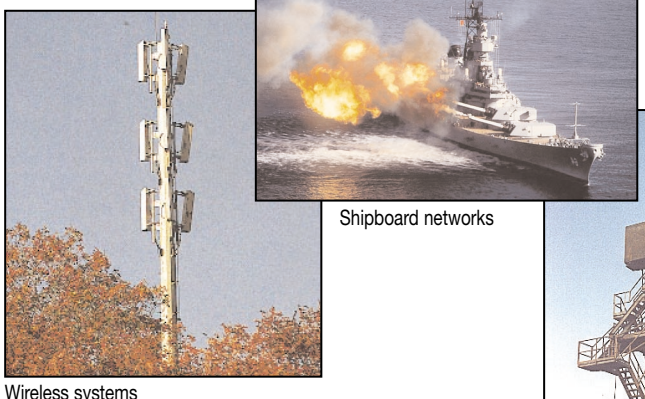
MMDS/LMDS and Wireless Local Loop

Fiber Optics empowers you to consolidate your modulators and radio equipment at a common location, such as a Central Office or Headend. Fiber cables are ideal for offering high performance, secure, lightweight and low loss transmission along with the added benefits of immunity from EMI/RFI, hum and lightning strikes.



Wavelength Division Multiplexing

Multi-color WDM is used when high performance is required or when only one or a few fibers are available. Either CWDM (Coarse Wavelength Division Multiplexing) or DWDM (Dense WDM) can be used. When the highest RF performance is required, DWDM is the technology of choice. Fiber-Span has standard configurations for all node count combinations. Also, a multi-band system can take advantage of this technique as well.



Wireless systems

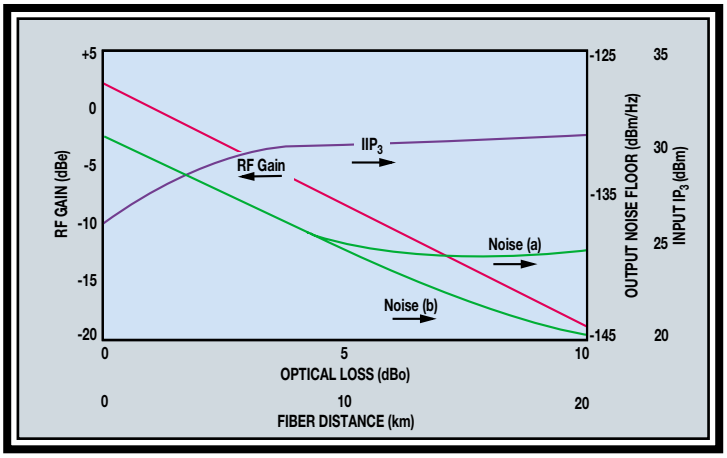
Shipboard networks

Satellite Ground Station*

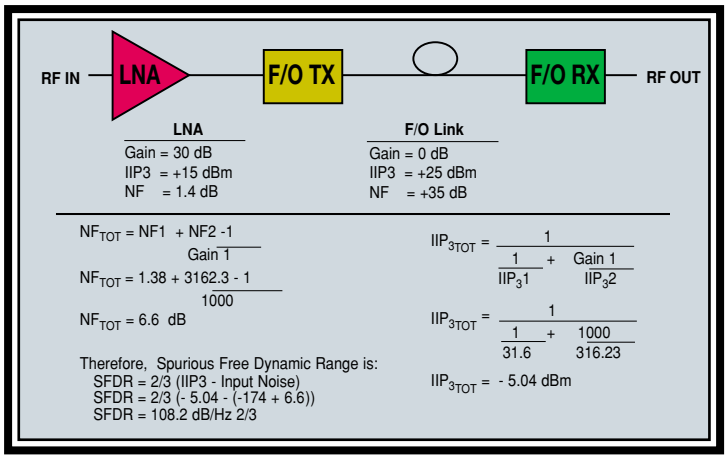
Wireless over fiber offers clear and reliable communications.

* Dish antenna photo courtesy of Vertex Communications

FIBER-SPAN
RF ON FIBER® Technology



Note: Noise (a) = Standard Receiver Noise (b) = Low Noise Receiver



When adding RF stages such as low noise amplifiers at the input of a fiber optic link, cumulative intercept points and noise figures can be determined as shown.

System Design

An RF / Fiber Optic link can be modeled as an RF gain stage. The link has a 50 ohm input and output and just as a 50 ohm gain block it has (1) RF Gain, (2) Input Noise and (3) an Intercept Point. These three factors are defined at a given optical loss or fiber distance. As the fiber distance between the transmitter and receiver changes, all three parameters will change. Shown here in this graph is the typical relationship between these three parameters and optical loss.

RF ON FIBER®Basics

Fiber Optics have been used widely and successfully in digital telecommunications systems and analog broadband CATV systems for years. These systems capitalize on fiber's high bandwidth and naturally low loss transmission characteristics. Fiber-Span has advanced the state-of-the-art by developing a means to transmit RF signals, in their native format over fiber optics, linearly and efficiently. In RF ON FIBER® systems, the RF signal directly modulates, at frequency, the bias current of a semiconductor laser diode that is internally matched to 50 ohms impedance. Internal optical feedback is used to monitor the lasers operating condition and adjust the bias quiescent point for maximum dynamic range. The receiver is composed of a high-speed linear photo-detector that is also matched to 50 ohms (75 ohm impedance options available for both transmitter and receiver configurations). Fiber networks and RF ON FIBER® are the tributaries of the fast growing wireless world.

Attenuation vs. Optical loss

There is a 2 to 1 relationship between optical loss and RF loss. One dB_O of optical loss corresponds to 2 dB_e of RF loss. The units dB_O and dB_e are used to eliminate confusion between optical dB and electrical dB. There are several sources of loss in fiber optic systems 1) fiber, 2) connector and 3) splitter loss. Fiber has an RF loss of under 1 dB_e per kilometer. Connectors typically have less than 1 dB_e loss. Optical splitters have losses dependent on their configuration. A 1x2 optical splitter has a typical optical loss of 3.5 dB_O or 7 dB_e RF loss.

Optical reflections, noise and distortion

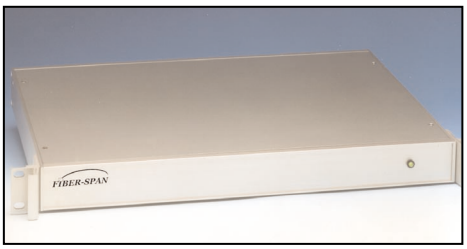
As with RF systems, reflections in RF / Optical systems are an issue. Optical reflections that propagate back into the laser diode cause a disturbance in the laser's gain cavity creating noise and distortion. The main sources of optical reflections are connector interfaces in the optical path. A simple way to avoid most of the reflections at the interfaces is through the use of angle-polished connectors. The tip of an angle-polished, or APC connector is polished at an 8 ° angle. This is the optimal angle to minimize reflections from traveling back down the fiber into the laser. At this angle most reflections that occur due to optical impairments will be angled out of the fiber and dissipated harmlessly. As a rule of thumb to minimize reflections and maximize performance, you must keep the connector tip clean and scratch-free, plus always replace the connector cap when not in use.

Dense Wavelength Division Multiplexing - DWDM

In fiber optic applications where fiber is a premium and a significant investment, DWDM and WDM transceivers offer the means to transport bi-directional signals onto the same fiber. This is achieved by using two laser transmitters operating at two different wavelengths - one at 1.3um and the other at 1.5um. In DWDM applications, multiple RF ON FIBER® wavelengths can be optically multiplexed and transmitted over one fiber via ITU GRID 1550nm lasers and consequently optically demultiplexed prior to the optical receiver. For applications requiring multiple wavelengths, such as diversity antenna configurations, one fiber system is used for both downlink and uplink transmissions.

Our experienced RF and fiber optics specialists provide complete solutions.

Product Specifications PRODUCTS BY MODEL NUMBER



Fiber Optic Accessories

Fiber Cable

Singlemode Fiber, terminated with optional connectors

Example 1: SMF1mFC/APC
Description: singlemode fiber cable, 1 meter length, FC/APC connectors on both ends

Example 2: SMF25mFC/APC
Description: singlemode fiber cable, 25 meter length, FC/APC connectors on both ends

Example 3: SMF1.1kmSC/APC
Description: singlemode fiber cable, 1.1 kilometer length, SC/APC connectors on both ends

Fiber Optic Connector Mating Adapters

Bulkhead type adapter for mating two male fiber optic connectors
MA-FC FC type mating adapter
MA-SC SC type mating adapter

Fiber Optic Couplers/Splitters

Singlemode Fiber combiners and/or splitters. Specify number of inputs for couplers and splitting ratio for splitters.

Example 4: AC 1x2FC/APC
Description: Two to one singlemode coupler/splitter, FC/APC connectors on all ports

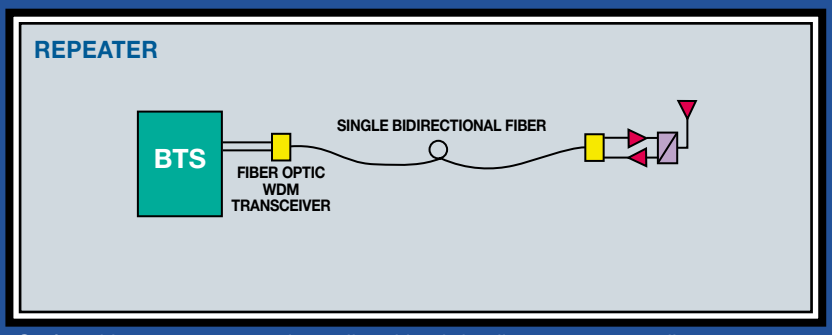
Example 5: AC 10/90FC/APC
Description: 10% fiber optic splitter ("tap") with FC/APCs

Product Features

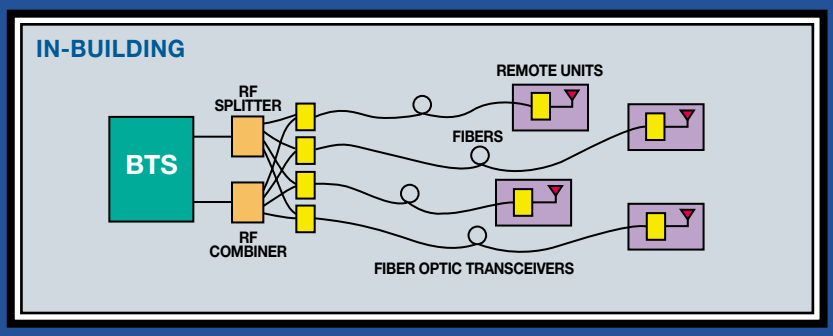
- Optical stabilization
- Wide temperature range
- High dynamic range
- Link gain stabilized
- Monitoring and alarm capability
- Bi-directional WDM transmission
- ITU grid DWDM architectures

19 inch (1RU) SUBRACK UNITS WITH INTERNAL POWER SUPPLY						
MODEL NO.	**TYPE**	**BANDWIDTH**	**GAIN @ FIBER LENGTH**	**OUTPUT NOISE @ 5 dBo**	**IIP3 @ 5dBo**	**COMMENTS**
AC 1106	Distribution Rack	100 to 1000MHz	0 dB @ 1 km	-135	+26	Distributed Antenna Configurable
AC 1208	L-Band	900 to 2200 MHz	0 dB @ 1 km	-135	+26	Interfacility Distribution
AC 1102-LNA	IF Link with LNA	5 to 500 MHz	+15 dB @ 1 km	-140	+10	70/140 MHz with Low Noise Pre-amp
AC 1206	PCS System	100 to 2200 MHz	0 dB @ 1 km	-135	+26	PCS repeaters, in-building distributed Antenna
MODULES – COMPACT DC POWERED UNITS						
AC 102	IF Link	5 to 500 MHz	0 dB @ 1 km	-135 dBm/Hz	+26 dBm	70 & 140 MHz IF Links
AC 106	Cellular Band Transceiver	50 to 1000 MHz	0 dB @ 1 km	-135	+26	Distributed Antenna Transceiver
AC 106LN	Low Noise Link	50 to 1000 MHz	-12 dB @ 15 km	-145 @ 10 dBo	+26	Long Fiber Distance or high splitter losses
AC 106-1.5	1.5um Transceiver	50 to 1000 MHz	0 dB @ 1 km	-135	+26	For WDM Applications
AC 106W-1.3	WDM Transceiver	50 to 1000 MHz	0 dB @ 1 km	-135	+26	Bidirectional, Single Fiber Links, Internal WDM
AC 106W-1.5	WDM Transceiver	50 to 1000 MHz	0 dB @ 1 km	-135	+26	Bidirectional, Single Fiber Links, Internal WDM
AC 123	Very High Dynamic Range	50 to 1000 MHz	-8 dB @ 10 km	-137	+30	Temp. Controlled Link Integrated Transceiver High Performance DFB
AC 206	PCS Transceiver	100 to 2200 MHz	0 dB @ 1 km	-135	+26	PCS Repeaters, In-Building Distributed Antenna
AC 206W-1.3 AC 206W-1.5	WDM Transceiver	100 to 2200 MHz	0 dB @ 1 km	-135	+26	Bidirectional, Single Fiber Links, 1.3um and 1.5um
AC 206-2.5	High Frequency	100 to 2500 MHz	0 dB @ 1 km	-135	+25	Wireless Local Loop & MMDS Distribution
AC 208	L-Band	900 to 2100 MHz	0 dB @ 1 km	-135	+26	Interfacility Distribution
AC 231	1.3 um Link DFB	100 to 2200 MHz	0 dB @ 1 km	-135	+29	DFB Transmitter
AC 231-1.5	1.5 um Link DFB	100 to 2200 MHz	0 dB @ 1 km	-135	+28	Bidirectional or Dual Channel Systems
AC 221W-1.3 AC 221W-1.5	WDM PCS DFB	100 to 2200 MHz	0 dB @ 1 km	-135	+25	Single Fiber Transceiver Internal WDM
AC 223	Very High Dynamic Range	100 to 2200 MHz	-8 dB @ 10 km	-137	+30	Temp. Controlled Link Integrated Transceiver High Performance DFB
AC 223W	WDM, Very High Dynamic Range	100 to 2200 MHz	-8 dB @ 10 km	-137	+30	Temp. Controlled Link Integrated Transceiver
AC 223-2.5	Very High Dynamic Range	100 to 2500 MHz	-8 dB @ 10 km	-136	+30	Temp. Controlled Link Integrated Transceiver, WLL & MMDS Distribution
AC 223W-2.5	WDM, Very High Dynamic Range	100 to 2500 MHz	-8 dB @ 10 km	-136	+30	Temp. Controlled Link Integrated Transceiver, WLL & MMDS Distribution
AC 231	Broadband/ Dual Band	100 to 2200 MHz	0 dB @ 1 km	-135	+25	High Performance DFB 1.3um or 1.5um
AC 231-2.5	High Frequency	100 to 2500 MHz	0 dB @ 1 km	-135	+25	High Performance DFB
AC 233S	WDM PCS	1700 to 2200 MHz	0 dB @ 1 km	-132	+25	3 optical channels per fiber WDM, Slave
AC 233M	WDM PCS DFB	1700 to 2200 MHz	0 dB @ 1 km	-132	+25	3 optical channels per fiber WDM, Master
AC 233SL	WDM WLL DFB	2200 to 2500 MHz	0 dB @ 1 km	-132	+25	3 path WDM, Slave
AC 233ML	WDM WLL DFB	2200 to 2500 MHz	0 dB @ 1 km	-132	+25	3 path WDM, Master
AC 234S	WDM PCS DFB	1700 to 2200 MHz	0 dB @ 1 km	-132	+25	4 path WDM, Slave
AC 234M	WDM PCS DFB	1700 to 2200 MHz	0 dB @ 1 km	-132	+25	4 path WDM, Master
AC 300	Mini Plug-in	100 to 2000 MHz	-5 dB @ 1 km	-136	+25	Low-cost module

Fiber–Span gives you the freedom to go far and wide.



Go far with your repeater, microcell and back-hauling systems needing a remote antenna from the base station. Fiber-Span's high performance RF ON FIBER® modules give your system the capability to transmit 10km, 20km or more - all at <1 dB/km RF loss.



Cover wide areas in your distributed antenna, in-building or pico-cell systems requiring reliable coverage over a large area. Cost-effective RF ON FIBER® transceivers allow you to remote dozens of low power antenna with confidence.

Fiber-Span's proprietary RF ON FIBER® transceivers are rugged, compact OEM modules designed for easy integration into your commercial AMPS, GSM, PCS/PCN, M/LMDS, WLL, IF, satellite terminal or distinctive antenna system configuration. Fiber-Span is addressing public safety needs by providing fiber optic wireless solutions for police, fire, emergency, first responder and Homeland Security radio systems applications. Our solutions for Defense and Military organizations are also leading the way by providing reliable and secure communications links for ground, airborne, shipboard, radar, telemetry, GPS and intelligence solutions in the HF/UHF/VHF and microwave radio frequencies.

Fiber is the answer…Fiber-Span is the solution.

Fiber is the answer

See why fiber is the answer for today's commercial wireless networks, public safety and defense systems. Fiber–Span has established itself as a leader by providing the public and private sectors with cost–effective RF ON FIBER® technologies and solutions.

ABOUT THE COMPANY...

Fiber-Span designs, manufactures, and markets a unique line of fiber optic links used to transmit Wireless and RF signals. The company, originally founded as Anacom Systems Corporation, markets and manufactures an innovative class of fiber optic communications equipment. The product line includes transceivers, transmitters and receiver modules as well as complete sub-systems. These fiber optic links are used globally by wireless communication systems original equipment manufacturers (OEM), radio frequency (RF) system integrators, and military system architects. Fiber-Span's evolving class of products address the growing demand and movement toward the convergence of wireline and wireless networks, and the requirement for high performance, high bandwidth RF ON FIBER® solutions and networks. Today's emerging and wide ranging wireless applications challenge service providers and equipment manufacturers, alike. Fiber-Span's modules and subsystems are meeting the challenge and providing the wireless solutions of tomorrow, today.

Fiber-Span's proprietary technology delivers unprecedented performance levels that permit the wide spread use of fiber optics in a broad range of RF applications. Whether you are transporting radio signals, remoting antennas and base stations, receiving mission critical tracking data or simply trying to alleviate signal loss and EMI/RFI emanations, we have your wireless solution covered—cost effectively and reliably.

FIBER-SPAN
RF ON FIBER® Technology

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