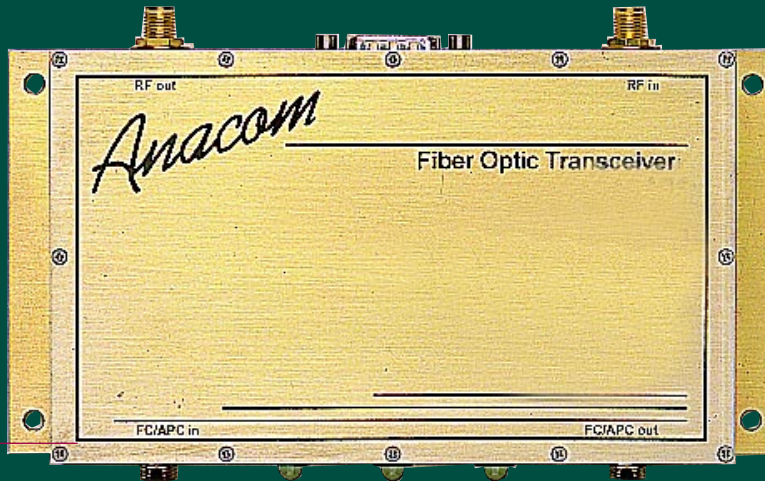


Anacom

RF ON FIBER™
FOR
WIRELESS APPLICATIONS

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



- PCS/PCN
- DISTRIBUTED ANTENNA
 - CELLULAR
 - 70/140 MHz IF
- ANTENNA REMOTING
 - WIRELESS LOCAL LOOP
 - LMDS
- RADAR SYSTEMS
 - ESMR

DESIGN
GUIDE

IN-BUILDING DISTRIBUTED ANTENNA

Assure reliable and ubiquitous coverage with a fiber based distributed antenna system. Cost-effective fiber optic transceiver modules can be distributed throughout a building, mall, subway station or any location where consistent coverage is required. The head end unit can be located anywhere on the premises, as the performance of the system is maintained even over long fiber runs.

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 fibers 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.

WDM TRANSCEIVER

Wavelength Division
Multiplexing is an optical technique that allows two or more optical signals to be combined onto a single fiber. WDM is widely used to reduce fiber leasing costs. In a typical system, both the uplink and downlink paths are multiplexed onto a single fiber. In advanced system designs, a third channel for uplink antenna diversity is provided—all on one fiber.



HIGHWAY OR LONG DISTANCE BACKHAUL SYSTEMS

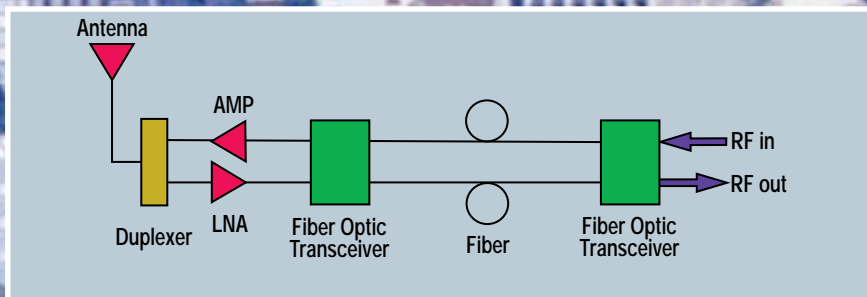
The beauty of fiber optic transmission is its low RF loss over long distances. Anacom offers fiber optic subsystems that can transmit over 20km, 30km or more. A trunk line system can be designed using bidirectional optical taps at the antenna sites. And with the use of WDM technology, fiber usage can be reduced by half or more.

CELLULAR BAND TRANSCEIVER

The AC 106 is optimized for use in the cellular band of 800 to 1000 MHz. This transceiver, as is the case with all our fiber optic transceivers, is transparent to the signal format or modulation technique. Higher power and high spur-free dynamic range options are available.

PCS TRANSCEIVER

The AC 206 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 100dB/Hz^{2/3}. The unit utilizes advance MQW laser diode technology for stable wide temperature range performance.



RF/Fiber Optic 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 operate in the city, in the suburbs, over long highway runs or in-building, Anacom Systems Corporation offers you a fiber optic solution that will make your wireless network work reliably and ubiquitously. Anacom's high performance, yet cost-effective rugged fiber optic transceivers give you the freedom to go far and wide, with impunity. Welcome to the wireless revolution.

RF ON FIBER™

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INTRODUCTION

WITH ITS 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

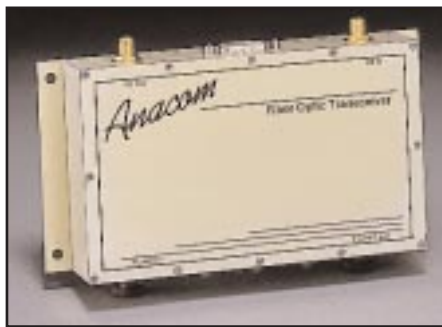
The fiber optic transmitter converts an RF signal into an optical signal at 1.3 μm . The input impedance of the transmitter is 50 ohms.

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 μm . 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 the 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

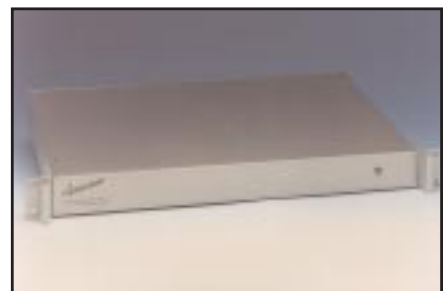
Constant and unrelenting efforts in the area of quality control are the small price we pay to earn our customers confidence in our products. From design through production to final test, our emphasis is on delivering a product that meets or exceeds your expectations. All of our fiber optic transmission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



TX & RX modules, DC powered



FC/APC and SC/APC fiber optic connectors

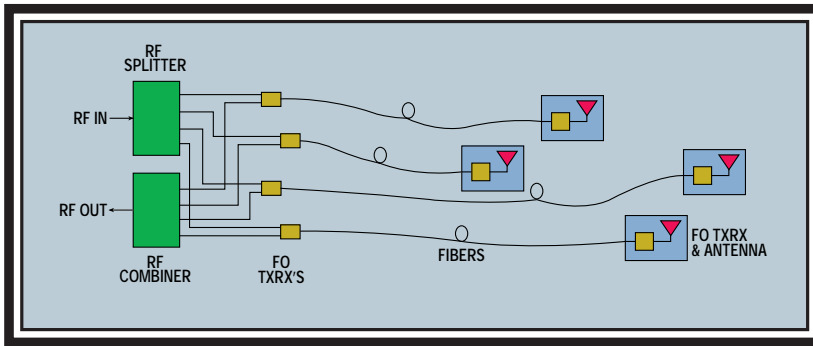


19" Subrack Unit, AC powered

APPLICATIONS

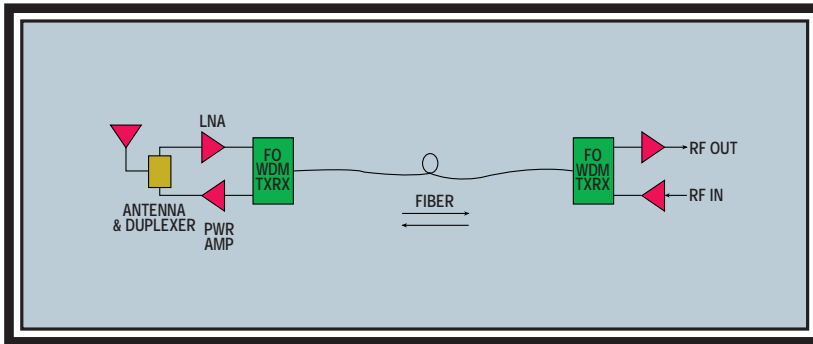
ANACOM SYSTEMS OFFERS A UNIQUE LINE OF COMPACT AND COST-EFFECTIVE TRANSMITTERS, RECEIVERS, TRANSCEIVERS AND SUBSYSTEMS FOR WIRELESS AND RF TRANSMISSION OVER FIBER OPTICS.

APPLICATIONS



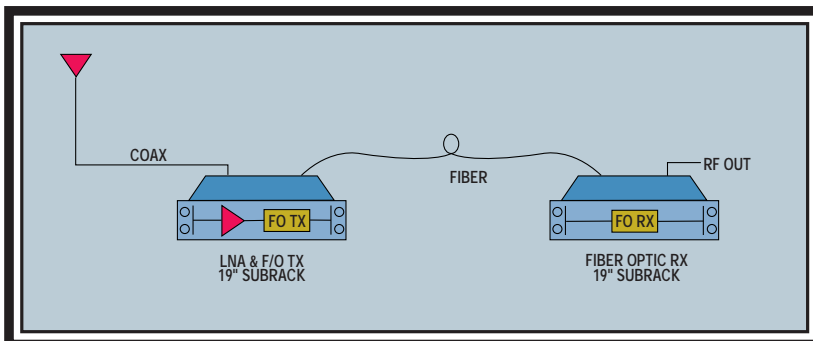
Distributed Antenna

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



Dual Transmission over Single Fiber

Single fiber transmission is used to overcome a shortage of fiber or to realize a savings when fiber is leased at a recurring monthly cost. Whether the mode is bidirectional or multiple forward channels on a single fiber, a second transmitter is used at 1.55 um and the optical combining and splitting is done with a WDM or Wavelength Division Multiplexer.



LMDS and Wireless Local Loop

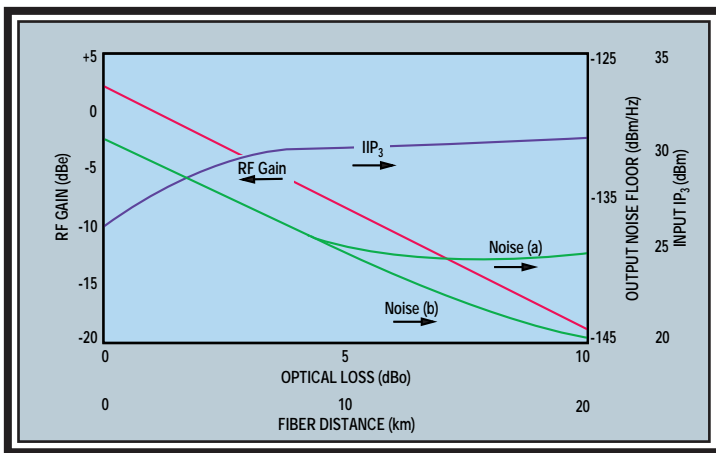
Fiber Optics permit you to consolidate your modulators and radio equipment at a common location. Fiber cables with their low loss are an ideal solution. Added benefits are immunity from EMI and lightning strikes.

RF ON FIBER

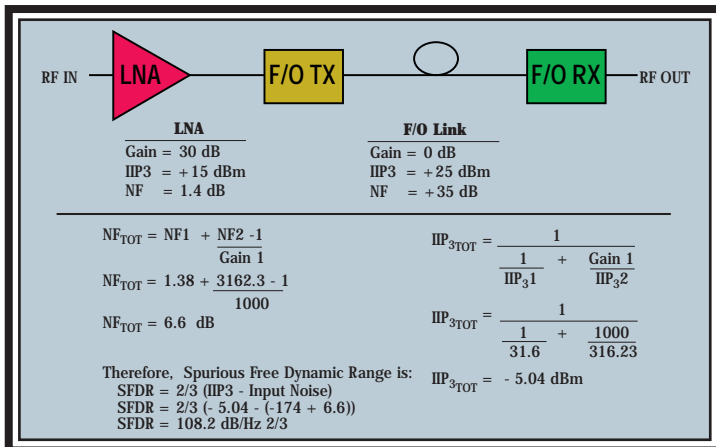
Anacom

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.



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.

RF on Fiber™ Basics

Fiber Optics have been used widely and successfully in digital telecommunications systems and analog CATV systems. These systems capitalize on fibers high bandwidth and low loss. Anacom Systems Corp has advanced the state-of-the-art by developing a means to transmit RF signals over fiber linearly and nearly transparently. 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. Internal optical feedback is used to monitor the lasers 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 ohm's. Fiber Optics are the tentacles of the fast growing wireless network.

Attenuation vs. Optical loss

There is a 2 to 1 relationship between optical loss and RF loss. One dBo of optical loss corresponds to 2 dBe of RF loss. The units dBo and dBe 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 dBe per kilometer. Connectors typically have less than 1 dBe loss. Optical splitters have losses which depend on their configuration. A 1x2 optical splitter has an optical loss of 3.5 dBo or 7dBe RF loss.

Optical Reflections and noise and distortion

As with RF systems, reflections, in RF / Optical systems are an issue. Optical reflections back into the laser diode cause a disturbance in the lasers gain cavity creating noise and distortion. The main sources of optical reflections are connector interfaces. 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 degree angle. This is the optimal angle to minimize reflections from traveling back down the fiber into the laser. At this angle most reflections occurring due to the connector will be angled out of the fiber and dissipated harmlessly. Other general rules to minimize reflections: keep the connector tip clean and scratch free and always replace the cap onto the tip when the connector is not mated.

Wavelength Division Multiplexing - WDM

In fiber optic repeater applications where leasing fiber may be a costly proposition, WDM transceivers offer the means to transmit both the uplink and downlink 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. For diversity antenna applications, a 3 channel, one fiber system is used - one downlink and two uplinks.

Our experienced RF & fiber optics specialists provide you with complete solutions.



Fiber & Wireless:
Offers you clear, reliable and ubiquitous communications.



Satellite Ground Station
11 Meter Dish

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: Three 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/APC's

Product Features

Product features include optically stabilized transmitters for wide temperature range, single power supply operation. Monitors and alarms for enhanced system features. Bidirectional transmission over a single fiber and very high dynamic range performance for transparent transmission.



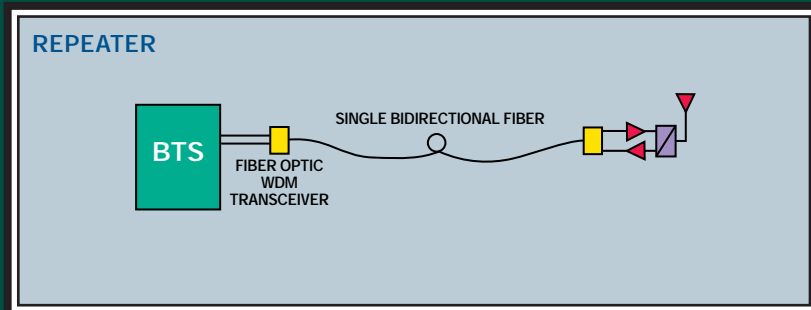
PRODUCT SPECIFICATIONS

PRODUCTS BY MODEL NUMBER

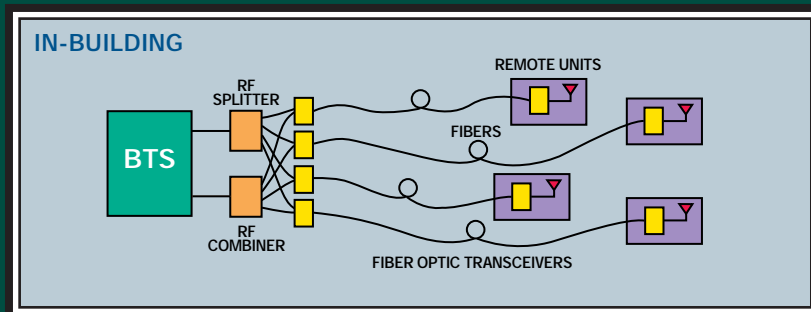
MODULES - COMPACT DC POWERED UNITS						
MODEL NO.	TYPE	BANDWIDTH	GAIN @ FIBER LENGTH	OUTPUT NOISE @ 5 dB0	IIP3 @ 5dB0	COMMENTS
AC 102	IF Link	5 to 500 MHz	0 dB @ 1 km	-135 dBm/Hz	+26 dBm	70 & 140 MHz IF Links
AC 106	Cellular Band Transceiver	50 to 1000 MHz	0 dB @ 1 km	-135	+26	Distributed Antenna Transceiver
AC 106LN	Low Noise Link	50 to 1000 MHz	-12 dB @ 15 km	-145 @ 10 dB0	+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	+25	DFB Transmitter
AC 231-1.5	1.5 um Link DFB	100 to 2200 MHz	0 dB @ 1 km	-135	+25	Bidirectional or Dual Channel Systems
AC 231W-1.3 AC 231W-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	+28	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	+28	Temp. Controlled Link Integrated Transceiver, WLL & MMDS Distribution
AC 223Wxx	Broadband / DWDM	100 to 2200 MHz	0 dB @ 1 km	-135	+25	High Performance DFB 1.5um ITU Grid wavelengths
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
19 inch SUBRACK UNITS WITH INTERNAL POWER SUPPLY						
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

RF ON FIBER™

ANACOM 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. Anacom's high performance RF/Fiber Optic 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/Fiber Optic transceivers allow you to remote dozens of low power antenna with impunity.

Anacom's proprietary RF/Fiber Optic transceivers are rugged, compact OEM modules designed for easy integration into your AMPS, GSM, PCS/PCN, LMDS, WLL, IF or other antenna system. Anacom's responsive product support group and flexible volume manufacturing methods assure you an efficient design and a successful transition to production. Welcome to the wireless revolution.

FIBER IS IN HIGH DEMAND

SEE WHY FIBER IS IN HIGH DEMAND FOR WIRELESS SYSTEMS AND WHY ANACOM HAS ESTABLISHED AN OUTSTANDING TRACK RECORD AS THE SUPPLIER TO THE FIBER & WIRELESS INDUSTRY.

ABOUT THE COMPANY...

Anacom Systems Corporation designs, manufactures, and markets a unique line of fiber optic links used to transmit Wireless and RF signals. The product line includes transmitter and receiver modules as well as complete subsystems. These fiber optic links are used worldwide by wireless communication system OEM's, RF system integrators and military system designers. The company was founded to design and bring to market a new class of fiber optic communications equipment. This new class of products was needed for an emerging, explosive new field: Wireless Communications. These wide ranging wireless applications cover many communications systems, many of which involve the transmission or reception of signals by an antenna.

Anacom Systems Corporation developed a proprietary technology that permitted new performance levels in linear modulation of semiconductor laser diodes. This new technology permitted for the first time the wide spread use of fiber optics in a broad range of RF systems. RF / Fiber Optics overcomes the problems of signal loss, EMI, long distance transmission, and distribution to multiple locations. It is an elegant way to remote radio and base station equipment from the signal source such as an antenna or modulation equipment. Welcome to the Wireless Revolution.

RF ON FIBER™

Anacom

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