PRODUCTS & SOLUTIONS GUIDE

Microlab

microlabtech.com

TABLE OF CONTENTS

Return Loss & VSWR

VSWR (Voltage Standing Wave Ratio) and Return Loss are both a measure of the same parameter. They define the amount of signal reflected backwards by a component. It is a major factor contributing to the total signal efficiency of the product.

Return Loss is the portion of a signal that is lost due to a reflection of power at a transmission line discontinuity. It is a logarithmic measurement specified in decibels (dB).

VSWR, also referred to as Standing Wave Ratio (SWR), is the ratio of voltage applied to voltage reflected. VSWR is a function of the reflection coefficient, which describes the power reflected from the device. It is a linear measurement specified as a ratio to 1, such as 1.5:1.

Convenient Electrical Conversions										
VSWR	1.1:1	1.2:1	1.3:1	1.4:1	1.5:1	1.6:1	1.7:1	1.8:1	1.9:1	2.0:1
Return Loss (-dB)	26.444	20.828	17.692	15.563	13.979	12.736	11.725	10.881	10.163	9.542
Voltage Reflection Coeff.	0.048	0.091	0.13	0.167	0.2	0.231	0.259	0.286	0.31	0.333
Match Efficiency (%)	99.97	99.17	98.3	97.22	96	94.675	93.278	91.837	90.369	88.89
Mismatch Loss (-dB)	0.01	0.036	0.075	0.122	0.177	0.238	0.302	0.37	0.44	0.512

Passive Intermodulation (PIM)

PIM is the generation of interfering signals caused by nonlinearities in the mechanical components of a wireless system. Two signals mix together to produce sum and difference signals and products causing interference. The interaction of mechanical components generally causes the nonlinear elements, especially anywhere that two different metals come together. Junctions of dissimilar materials are a prime cause. PIM occurs in antennas, coax components, coax connectors, and coax cable. It can be caused by rust, corrosion, loose connections, dirt, oxidation, contamination, or any combination of these factors. Even nearby metal objects such as guy wires and anchors, roof flashings, and pipes can cause PIM. The result is a diode-like nonlinearity that makes an excellent mixer. As nonlinearity increases, so does the amplitude of the PIM signals.

PIM is a significant challenge that the wireless industry faces. When PIM products fall within the uplink (Rx) band, the level must be below the noise floor of the receiver.

CONNECTOR OPTIONS

Microlab offers components and cables with many different connector options. The highlights of each connector type are extolled below.

7/16 DIN

The 7/16 DIN series name derives from the metric dimensions of the connector interface: 7mm OD of inner contact, 16 mm ID of outer contact. These connectors provide superior performance for both return loss and PIM. These connectors are very robust, extremely stable and mostly with waterproof specifications, making them ideal for applications where vibration resistance and environmental protection is important. Because they are designed to minimize signal distortion from intermodulation, 7/16 connectors are especially suitable for base stations and broadcast communication systems. Products with 7/16 DIN connectors have a ''D'' suffix.

4.3-10

The 4.3-10 connectors offer the same, robust design as 7/16 connectors but are smaller and up to 40% lighter, allowing for much more dense, lighter weight applications. These designs are IP67 compliant to protect against dust and water ingress for outdoor applications and provide excellent VSWR performance up to 6.0 GHz. Separate electrical and mechanical components yield very stable PIM performance regardless of coupling torque, allowing for easier installation. Silver plated contacts and White Bronze plated bodies offer a high-degree of conductivity, corrosion resistance, and durability. They also come in three (3) different coupling mechanisms for the plug connectors screw, quick-lock/push-pull, and hand-screw types can mate with all jack connectors. Products with 4.3-10 connectors have an ''E'' suffix.

N-Type

N-Type (or Type N) connectors are designed to satisfy the need for a durable, weatherproof, medium-size RF connector with consistent performance through 11 GHz. N-Type connectors feature threaded coupling mechanisms and are fully interchangeable with N-Type connectors made to the MIL-C-39012 specification. These connectors are used in all systems where excellent RF and mechanical performance is critical. Products with Type N connectors have an ''N'' suffix.

SMA

SMA 50 Ohm connectors are threaded, semi-precision units that provide excellent electrical performance from DC to 26.5 GHz and outstanding mechanical durability. SMA connectors are not recommended for PIM, as the PIM performance cannot be guaranteed. Products with SMA connectors have an ''S'' suffix.

NEX10

The NEX10 series is a miniature and lightweight RF Coaxial connector with excellent intermodulation performance for outdoor telecom applications up to 20 GHz. NEX10 connectors also features a compact design which is 50% smaller than 4.3-10. This unique solution also offers separation of electrical and mechanical reference planes, which maximizes intermodulation performance under static, dynamic, vibrations, and torque stress conditions. NEX10 connectors can only support up to ¼in diameter cables. Products with NEX10 connectors have a ''T'' suffix.

2.2-5

The 2.2-5 series enables a robust and PIM stable design in the smallest space. The 2.2-5 series is 53% smaller than 4.3-10, and 70% smaller than 7/16. Despite the clear reduction in size and weight, the 2.2-5 series possesses comparable electrical properties to the 4.3-10 series. Despite the small size, relatively thick and therefore low loss cables up to ½'' can be used. Products with 2.2-5 connectors have a ''G'' suffix.

QMA

The QMA connector is a quick connect/disconnect version of the SMA connector and shares the same internal construction, which allows the connector to have excellent performance up to 6 GHz. Because of the innovative coupling mechanism, a 360-degree butt joint is maintained resulting in low RF leakage. Since the RF line is identical to the SMA series, the QMA connectors also offer the same high-power handling capability. Another benefit of eliminating the threaded coupling is the denser packaging. The pitch between connector can be reduced because there is no requirement for wrench clearance. Connectors can be rotated 360 degrees after they are mated which greatly improves the flexibility of installations. QMA connectors are not recommended for PIM, as the PIM performance cannot be guaranteed. Products with QMA connectors have a ''Q'' suffix.

Other

Microlab can provide nearly any connector configuration that is commercially available. If we do not carry a connector option that you need, please contact us.

PRODUCT CATEGORIES

Custom Assembly

Antennas

Attenuators

Duplexers

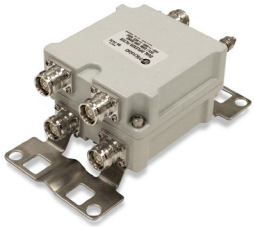
DC Block

Couplers

Tappers

Hybrid Couplers

Cables



Multiband Combiners

Terminations

Power Splitters

Microlab custom designs a variety of assembly solutions for customers.

These include:

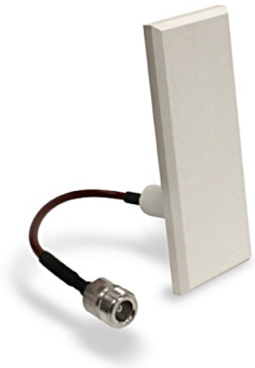
- DCC® Series – D-RAN Point-Of-Interface (POI) trays
- DCC® Series – DAS Signal Conditioners
- SCC™ Series – Outdoor Small Cell Signal Combiners
- Public Safety and Commercial Wireless combiners for hybrid deployments
- Combiner and Splitter Trays
- Patch Panels
- Attenuator trays – with and without fans

MODULAR ASSEMBLIES

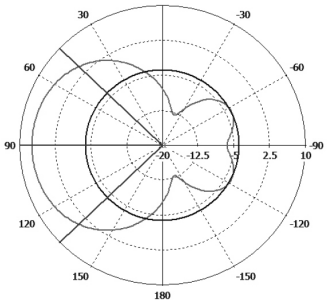
The MCC™ series is a Passive Modular Carrier Combiner for Neutral Host DRAN Architectures. It helps combine RAN remote heads for RF distribution. It allows many configurations to support multi-carrier multi-band Neutral Host MIMO or SISO applications. The design has been optimized for low-loss in a modular enclosure that is compatible with standard 19'' Racks.

- ''Plug and play'' architecture for D-RAN deployments
- 19'' Sub-Rack, for Indoor Applications
- Up to 8 Crossband Combining Cards
- System support for 617 - 5,925 MHz with CBRS & LTE-LAA Expansion Options
- Multiple Neutral Host Configurations
- Indoor and Outdoor (IP67) Models
- High Isolation & Low Loss
- Low PIM Design, 4.3-10 connectors
- Up to 40W per Input

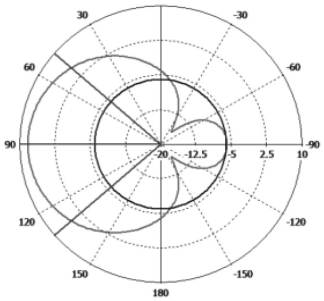
In-building wireless signal propagation is enhanced by a strategically placed network of low PIM, high performance antennas. Microlab's antenna products cover wireless frequencies between 380 MHz to 6,000 MHz. Our guaranteed low PIM improves coverage and capacity thereby optimizing network performance. Configurations include SISO (single input, single output) and 2x2 MIMO (multiple input, multiple output). We carry ceiling or panel mount options with omni and directional radiation patterns.
Example Radiation Patterns



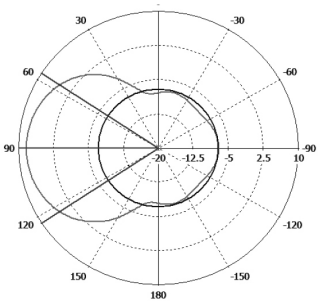
700 MHz



850 MHz



1800 MHz



ATTENUATORS

Low PIM Attenuators

Microlab's low PIM attenuators absorb RF power without reflecting power or adding PIM to the signal. Microlab offers low PIM attenuators from 600 – 2700 MHz, with power levels from 10W to 200W, and multiple connector options.

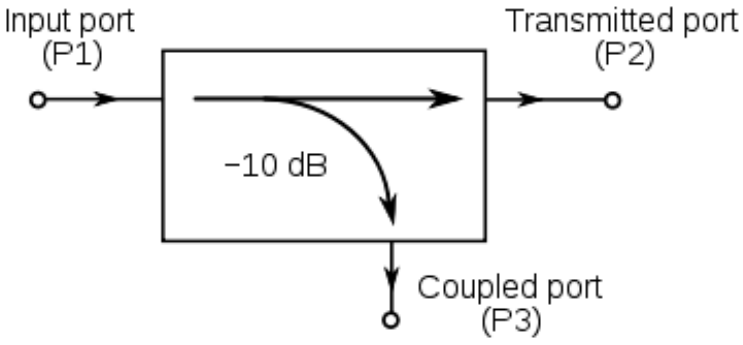
Resistive Attenuators

The Microlab resistive attenuators cover DC to 6 GHz and above. Average powers range from 11W to a full 200 Watts average rating. These attenuators are constructed of resistive elements in a conventional series circuit. The construction does not favor PIM performance, so these products should be used in applications where PIM is not required. Microlab offers resistive attenuators from DC to 6 GHz, with power levels from 1W to 250W, and multiple connector options.

Microlab XA and XP series diode detector mounts are general-purpose video detector mounts designed to accommodate commonly available diodes such as point contact, Schottky, etc. They are constructed in two detachable sections to allow access to the crystal. Both ends of the diode are held by beryllium copper contact springs to maintain uniform contact. They are available for frequencies up to 18GHz with 50 ohm Type N male input connectors and positive polarity output female BNC connectors.

DIRECTIONAL COUPLERS

Directional couplers provide flat coupling of one signal path to another in one direction only (known as directivity) and low VSWR over one full octave or more. Directivity is the key performance metric for directional couplers. It is defined as how well a coupler differentiates between the forward and the reverse waves. A directional coupler with high directivity would provide the highest isolation between uplink signals at the antenna. Microlab's coupler directivity is typically greater than 20dB for printed couplers, 25dB or more for air dielectric couplers. The couplers have excellent Return loss (or VSWR) on all ports. with 50 ohm Type N male input connectors and positive polarity output female BNC connectors.



S31 is the ratio of coupling between input port and coupled port
S21 is the insertion loss between the input and output port
S32 is the isolation between the coupled port and output port

Directional couplers are used whenever part of a signal needs to be separated off or two signals need to be combined. Microlab offers wide- band directional couplers with coupling ranging from 5 dB to 30 dB, referenced to the input port. They are available in different power levels and frequency ranges with multiple connector options.

DC Blocks

DC Blocks are used to prevent the flow of direct current (DC) and low frequency current surges along the inner and/or the outer conductors of a transmission line, while permitting the unimpeded flow of RF signals. Applications include the blocking of current surges that can occur in subway tunnels and rail systems, at base-station/cell-sites during lightning storms, to route DC to tower mounted amplifiers (TMA's) or whenever DC isolation is required. Units are available with a DC block on the inner and/or outer conductor, and all units are built with special attention to effects of PIM. They are available in multiple connector and power levels.

Duplexers

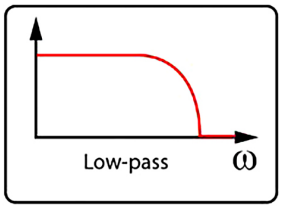
A Duplexer is a 3-port device most commonly used to allow a transmitter and receiver, operating on different frequencies, to share a common antenna while operating simultaneously. Duplexers allow combination and separation of the Transmit (downlink) and Receive (uplink) signals in a Frequency Division Duplex (FDD) system. They provide high isolation between ports, and low insertion loss in. Attention to mechanical design ensures a compact design with high reliability. Models available for many different FDD frequency bands, power levels, and connectors. Our duplexers are separated into 2 categories: cavity and non-cavity. Cavity duplexers provide the highest isolation, but usually are the largest. Non-cavity duplexers have a suspended substrate.

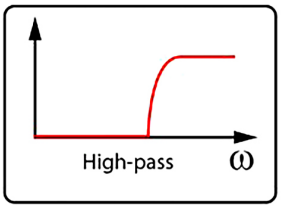
Note: Diplexers are used to separate different bands, while duplexers are used to separate Tx and Rx in the same band.

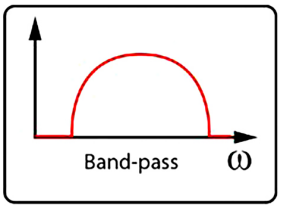
FILTERS

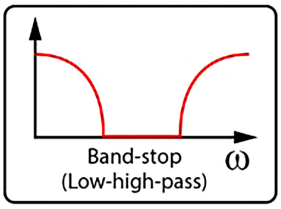
Microlab's filters are designed to suppress harmonics and out of band noise and interference to improve signal quality in high power system applications and bench testing. The designs ensure a low loss pass band, low PIM, and excellent in-band VSWR.

Microlab designs and manufactures filters on-demand for customers' unique applications and requirements. This includes bandpass, high-pass, low-pass, and band-reject or "notch" filters.







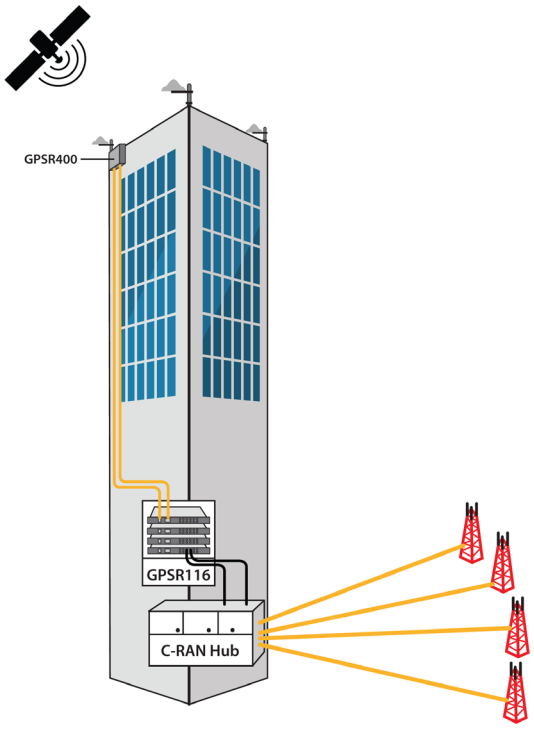


Digital GPS Repeaters

A GPS-over-fiber link extends the antenna feeder cable well beyond the maximum distance supported by coaxial cable-based systems. It extends the distance between the GPS antenna and the GPS receiver to reach places where GPS signals are otherwise unavailable, or where installation of coaxial cable is impractical.

Microlab's patent pending Digital GPS Repeater provides an industry leading solution for transmitting GPS signals in challenging locations. The GPS signal is captured by an antenna with a clear line of sight to the satellites in space. The outdoor unit digitizes the GPS RF via a software-defined radio, and it is converted to the industry standard CPRI for optical transport. The indoor unit converts the CPRI back to RF. The indoor unit provides 16 GPS RF output ports for use in C-RAN hubs (aka BBU Hotels) and DAS. The RF outputs can easily be scaled to over 100 using the GPS splitter trays.
Microlab's proprietary software measures the delay from GPS RF input to GPS RF output with typical accuracy below 25ns. This ensures that C-RAN hub can accommodate 4G and 5G synchronization requirements.

Microlab manufactures a standard model that supports 2km of single-mode fiber optic cable, and the long-range model supports up to 15km single-mode fiber optic cable. The default connectors are LC/UPC, but multi-mode fiber with alternate fiber connectors are available upon request.



GPS Splitters

Microlab's active and passive GPS Signal Splitters can be used to distribute UTC synchronization. Passive GPS splitters provide DC bias pass-through on Port 1 with DC bias termination on all other ports. This prevents the GPS receivers from going into antenna alarm condition.

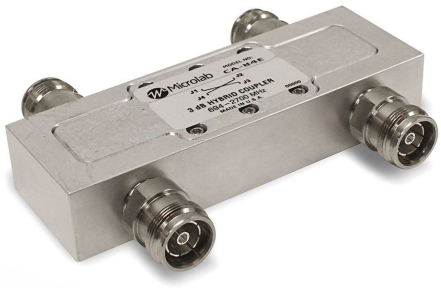
Active GPS splitters have gain to compensate for signal losses between the antenna and receiver. They also provide DC bias pass-through on Port 1 with 200ohm DC bias termination on all other ports. This prevents the GPS receivers from going into antenna alarm condition.

The rack-mount GPS splitters can be used to distribute GPS RF signal to up to 32 remote units using only 1 GPS antenna. A 2nd antenna input is provided for redundancy with auto-switchover upon fault detection. The GPS signal quality and antenna are actively monitored by this system. The rack-mount splitters have 0dB or +10dB selectable gain. These are ideal for C-RAN hubs (aka BBU hotels) where minimizing rack space is important, and synchronization with redundancy and fault detection is paramount.

The GPS splitter products and can be combined with the Microlab Digital GPS Signal Repeater where GPS signals are not readily available to expand the outputs to over 100 GPS signals.

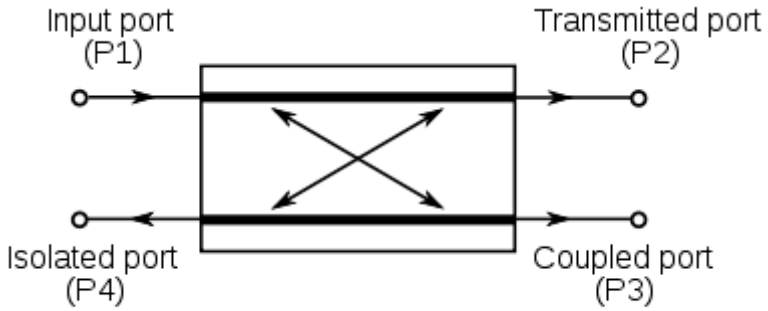
Hybrid Couplers, Combiners

Hybrid Couplers and Combiners are very important building block in neutral host combining systems for In-Building communication networks and small cells.



Hybrid Coupler (aka Hybrid Combiner)

When a coupler is designed to be 3dB it is called a hybrid coupler. Microlab 2x2 Hybrid Couplers are used to combine two signals without interaction regardless of how close the frequencies of the signals may be. This feature can eliminate the need for filters, as they are considered ''lossless'' combiners. Microlab's Hybrid Couplers have several bandwidth options, low PIM, and minimal insertion loss. Hybrid couplers are commonly referred to as hybrid combiners when one of the output ports is terminated. Hybrid Couplers are a suitable alternative to Wilkinson power combiners, as Microlab Hybrids provide ultra-low PIM performance with excellent Return Loss/VSWR.



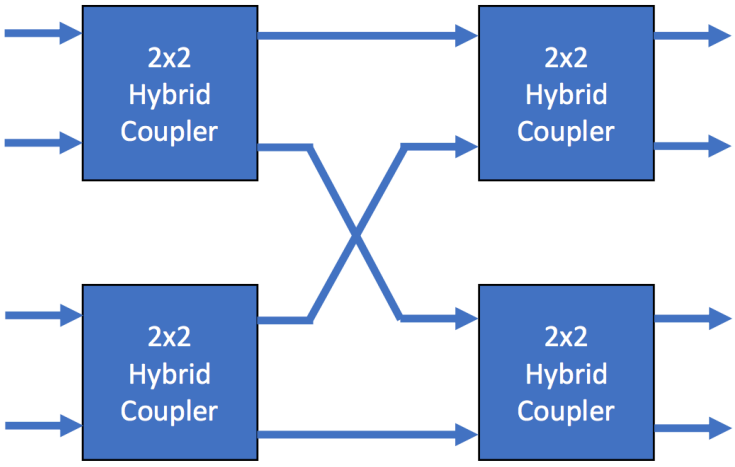
Hybrid Combiners are low cost alternative for in-band/same band combining of signals instead of filters.

HYBRID MATRICES

When the number of ports exceeds 4, the Hybrid is considered a Hybrid Matrix. Microlab provides 3x3 (6 port) and a 4x4 (8 port) Hybrid Matrices. The RF from each input port is present equally at each one of the output ports.

These products are available in power levels up to 500W, covering 350-5,925 MHz, with multiple connector options. Hybrid Matrices are excellent choices for high order MIMO applications.

Microlab's proprietary 3x3 Hybrid Matrix provides the highest isolation in the industry at 30dB !!! Note that the phase of the output signals is not equal.



DC to 6GHz

JA Series

JD Series

JE Series

Microlab Coaxial Jumper Cables are built for consistent low PIM performance. Designed for use in systems where l excellent electrical performance and mechanical reliability are paramount. With an operating range of DC to 6 GHz, these cables are ideal for all telecommunication applications. They are available in multiple lengths, diameters, and connector options.

These ruggedized cables come with tri-metal plated connectors made to MIL-C-39012 specifications. Microlab's jumper cables are also available with DC block features.

These products are available in power levels up to 500W, covering 350-5,925 MHz, with multiple connector options. Hybrid Matrices are excellent choices for high order MIMO applications.

Microlab's proprietary 3x3 Hybrid Matrix provides the highest isolation in the industry at 30dB !!! Note that the phase of the output signals is not equal.

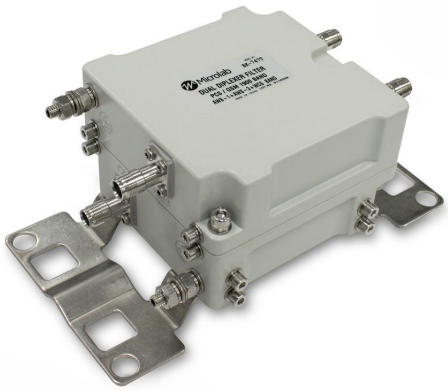
Series	JA Series	JB Series	JD Series	JE Series
Frequency Range	DC-6GHZ	DC-6GHZ	DC-6GHZ	DC-6GHZ
Power Rating	100W	100W	140W	380W
Cable Diameter	0.141in	0.141in	0.25in (1/4in)	0.5in (1/2in)
PIM	-158dBc	-158dBc	-160dBc	-160dBc
Connectors	4.3-10 7/16 N	4.3-10 Right Angle N Right Angle	4.3-10 7/16 N NEX10 2.2-5	4.3-10 7/16 N 2.2-5
Temperature	-40C to +125C	-40C to +125C	-40C to +125C	-40C to +125C
Max Insertion Loss/meter				
380MHz	0.3dB	0.3dB	0.2dB	0.1dB
960MHz	0.5dB	0.5dB	0.3dB	0.1dB
1700MHz	0.6dB	0.6dB	0.4dB	0.2dB
2700MHz	0.8dB	0.8dB	0.5dB	0.2dB
6000MHz	1.2dB	1.0dB	0.8dB	0.4dB

MULTIPLEXERS/CROSS-BAND COMBINERS/MULTI-BAND COMBINERS

Microlab offers a broad range of multiplexers, also known as filters, multi-band combiners, or cross-band couplers. These products are designed to meet the rigorous demands of the wireless market. The focus is to provide extremely high isolation with minimum loss and low PIM. These products are used for multi-band LTE-A carrier aggregation and multi-carrier neutral host deployments. They can also be used for same band combining instead of hybrids when the receive signals must be isolated.
A diplexer combines 2 bands, triplexer combines 3 bands, quadraplexer 4 bands, pentaplexer 5 bands, hexaplexer 6 bands.

Microlab's multiplexers are available in many different power levels from 20W to 500W, multiple connector options, and various configurations such as dual or quad stack to support 2x2 and 4x4 MIMO applications.

Microlab specializes in providing custom multiplexer designs for customers, and we release new models on a regular basis.



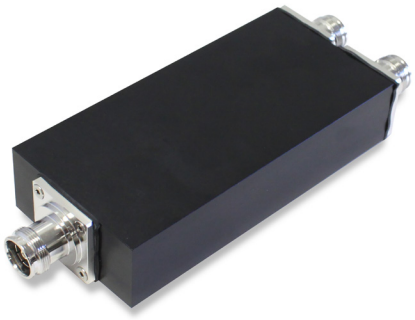
RF Splitters, also known as Power Dividers, split the RF power evenly between output ports. The insertion loss is calculated as the loss ABOVE the split loss. For example: a 2-way splitter has a 3db split loss, to divide the power in half between the outputs. The insertion loss is the loss above the 3dB.

Reactive, Low PIM Splitters

Reactive splitters are offered in 2, 3 and 4 ways. They have excellent input VSWR, high power ratings, low PIM and very low losses usually 0.05 dB or less. Our design techniques allow bandwidths that extend from 380 to 2700 MHz, 575 to 2700MHz, and 1700-5925MHz. Reactive splitters are frequently employed in in-building systems because they are virtually indestructible with low loss and low PIM.

Our reactive low PIM splitters are available in a variety of bandwidths from 380 to 5925MHz with multiple connector options and power levels up to 500W. They are available with opposed and in-line connector alignments. Each reactive splitter comes with a complimentary bracket for mounting.

Reactive splitters cannot be used as combiners due to the poor output return loss and lack of isolation.



WILKINSON POWER DIVIDERS & COMBINERS

Wilkinson power dividers/splitters are offered in 2, 3, 4, 6 and 8 ways. The resistors limit the PIM performance to -153dBc, so Wilkinson dividers/splitters should not be used when low PIM is a requirement. Microlab offers wireless designs with bandwidths including 70-2700MHz, 694-3800MHz, and 350-5925MHz. They are available in power levels up to 100W with multiple connector options.

Because each port has ultra-low VSWR, the Wilkinson can also be used for signal combining with better than 20dB isolation between ports.

Note: For combining, maximum power is 100mW.

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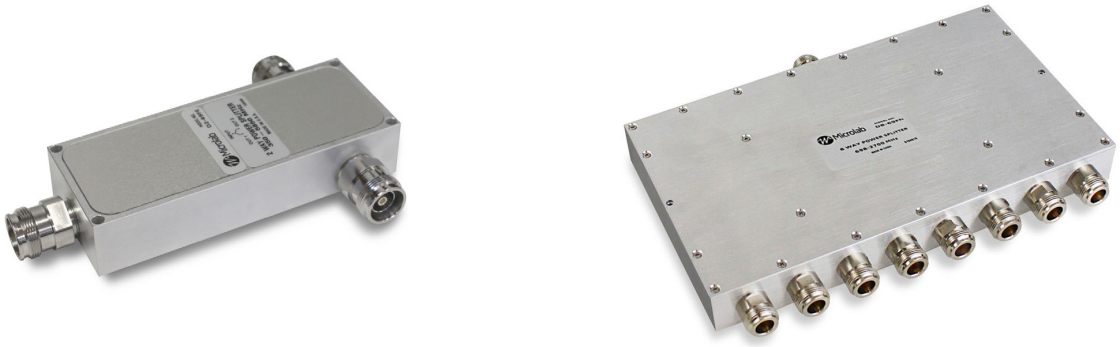


Tappers

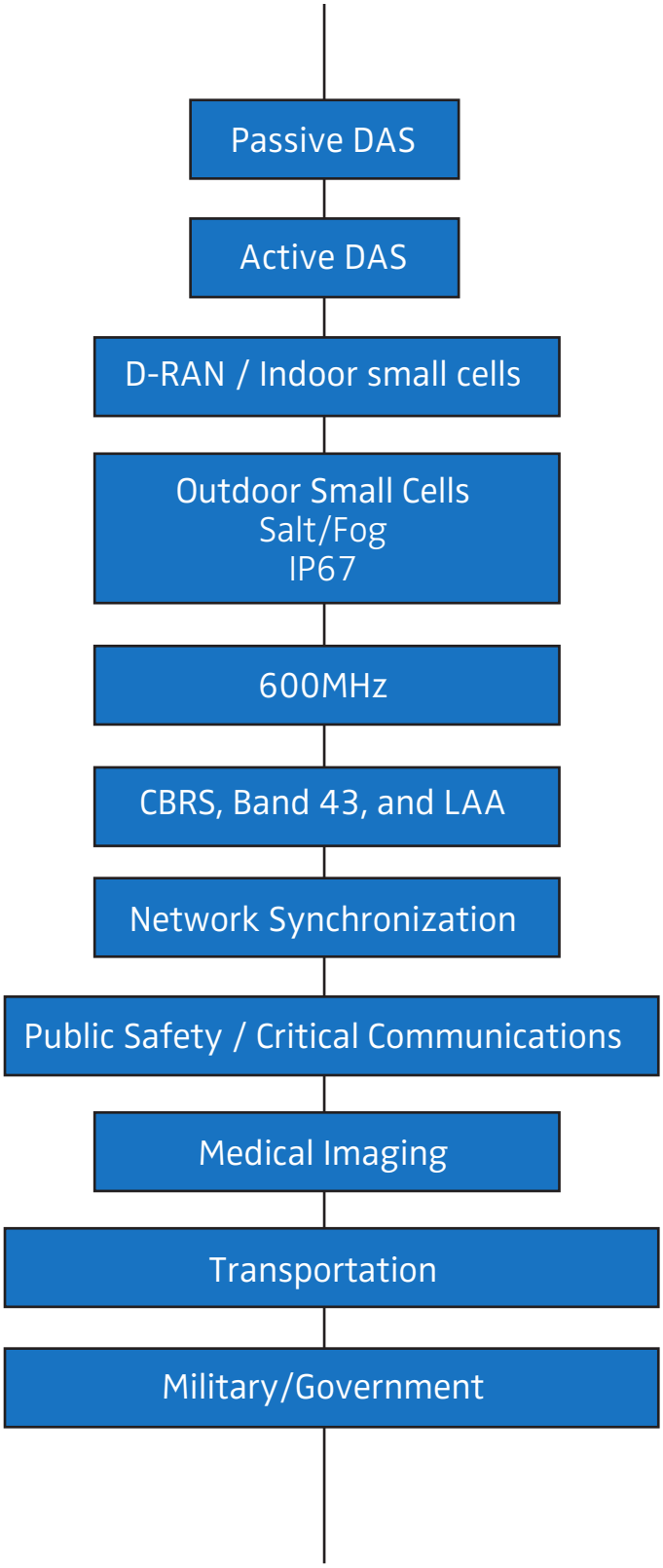
Tappers, also known as Signal Samplers, operate similarly to Directional Couplers but without the directivity. Tappers have the benefit of compact size, broad bandwidths, low PIM, and are virtually indestructible. Microlab tappers are frequently used in DAS and D-RAN deployments, and 30dB tappers can also be used as sniffers to monitor the signal without disconnecting the network. They are available in output splits from 2:1 (3dB) to 1000:1 (30dB), power levels up to 500W, and multiple connector options. Each tapper comes with a complimentary bracket for on-site mounting.

Terminations/Dummy loads

Terminations, also known as RF loads or dummy loads, are used to terminate unused ports on passive components with a near perfect 50 ohm impedance match.
Microlab offers low PIM terminations using coaxial loads from 5W to 200W in multiple connector options.

Microlab also offers resistive termination which operate from DC to up to 6 GHz but are not specified for PIM. They are also available in multiple connector options.

Higher power models have cooling fins help to minimize temperature rise of case.

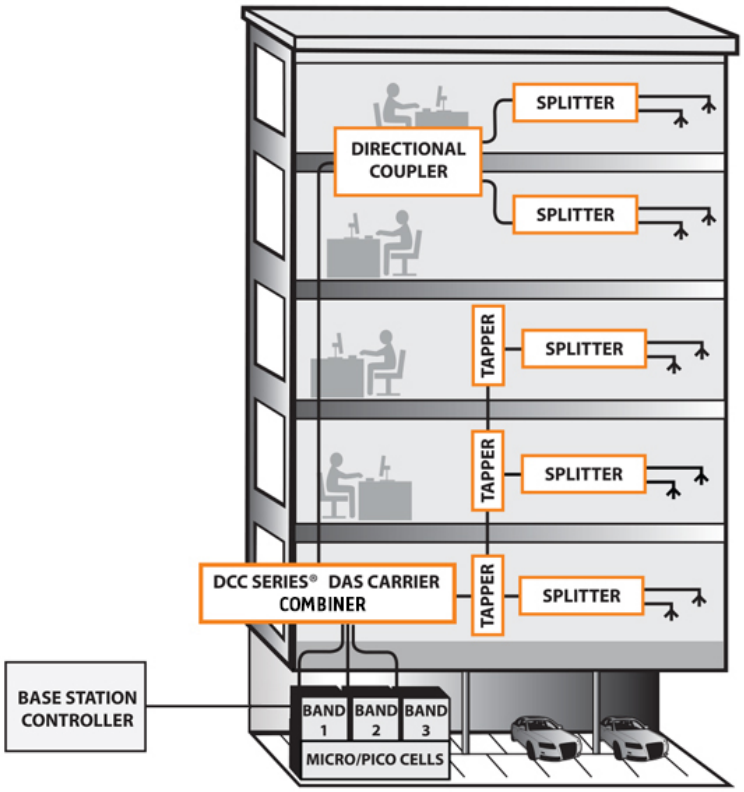

Passive DAS
Active DAS
D-RAN / Indoor small cells
Outdoor Small Cells
Salt/Fog
IP67
600MHz
CBRS, Band 43, and LAA
Network Synchronization
Public Safety / Critical Communications
Medical Imaging
Transportation
Military/Government

Passive Distributed Antenna Systems (DAS) amplify RF signal which is then distributed throughout the building via a network of passive components, including coaxial cable, splitters, couplers, and antennas.

The source of the signal can be from a repeater/signal booster/bi-directional amplifier that connects to a "donor" antenna – usually on the roof of the building– and rebroadcast the signal inside the building. The source could also be a base station that is connected via fiber.

A passive DAS does not use any active electronic components between the antennas and base station, only a coaxial cable and components. RF signal gradually loses signal strength the farther it gets from the source. A combination of equal and unequal signal splitters establishes the same path loss between the source and each antenna. To make the most of the benefits of coaxial DAS systems, it is necessary to minimize loss at every stage and have the bandwidth to cover present and future needs.

Microlab's in-building components and solutions are designed especially for these requirements. Microlab products offer low capital investment costs with extremely high quality to support the total lifetime of a system.



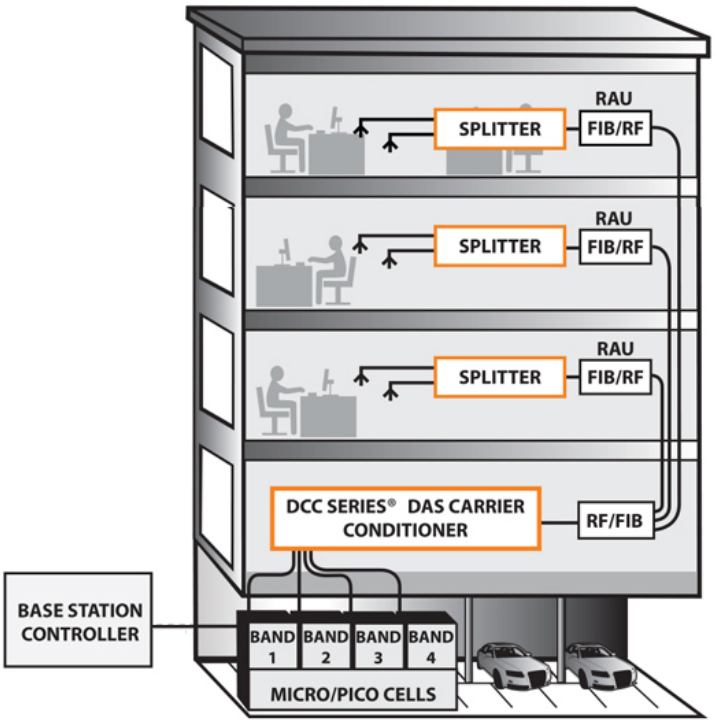
PASSIVE DAS SYSTEM
(LARGER BUILDING USING CELLULAR NETWORK)

ACTIVE DAS

Frequency division duplex (FDD) communication systems utilize different receiving (Rx) and transmitting bands (Tx). For economic reasons, it is desirable to combine these signals in passive DAS systems. Active fiber DAS systems convert RF signals into light that is distributed via fiber optic cable. The RF over fiber (RFoF) is then converted back to RF at the remotes where RF must be transmitted. The remotes and antennas are placed to ensure optimal wireless coverage.

In an active DAS, both Downlink (Tx) and Rx signals must be adjusted to the right power level, to ensure proper operation of the fiber system. Tx signal levels that are too high can distort or even damage the fiber system front-end. High Rx power levels will overload the radios and cause distortion that decrease cell site capacity.

Microlab's DCC® series are designed to split the Tx and RX signals and condition their power levels appropriately based on each deployment.

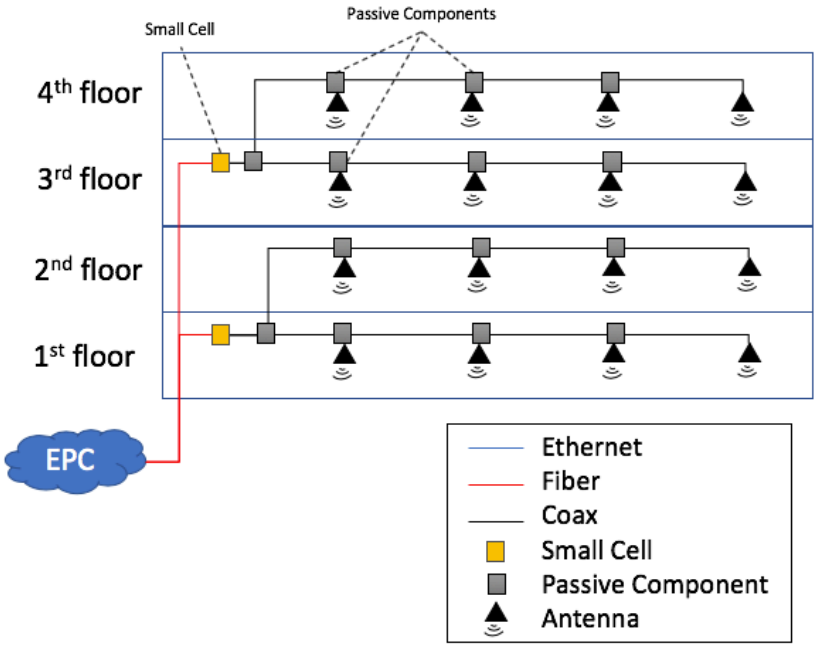


ACTIVE DAS SYSTEM
(IN-BUILDING)

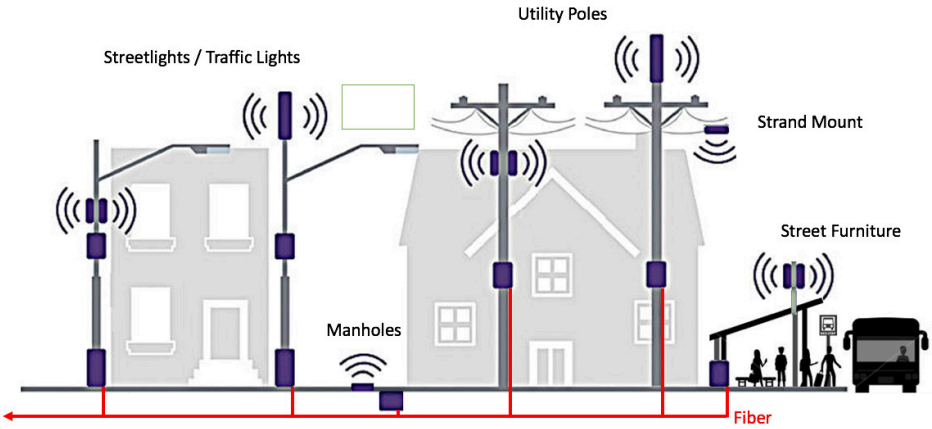
An emerging trend for in-building wireless deployments is a Distributed Radio Access Network (D-RAN) which extends the native RAN technology closer to the network edge and end user. D-RAN leverages low power small cells or remote radio heads using the same macro BBU. The system looks like a digital DAS but enables a massive increase in capacity with a significant decrease in deployment cost over a digital DAS.

D-RAN is an excellent choice for Neutral host deployments. The Neutral Host Distributed Radio Access Network or "NH D–RAN" architecture leverages the latest Operator-approved spectrum band specific small cell radios, shared antenna systems, and common passive physical infrastructure, resulting in a low deployment cost solution that is fully feature-coordinated with the Operator's core LTE networks.

By allowing the Wireless Operators to deploy band-specific active radio small cell components over a neutral host infrastructure of fiber, coax cable, and multi-band antennas, the D-RAN solution eliminates expensive and cumbersome carrier-coordination and maintenance requirements associated with DAS deployments while providing a ready upgrade path to new network features and technologies



Outdoor small cells come in many different shapes and sizes. Wireless equipment that is located outdoors must be designed to meet a wide range of temperatures and weather effects. Microlab offers 3 types of products for outdoor applications: IP67 and Salt/Fog rated for components, and NEMA4 rated enclosures for assemblies.



IP67 rated products are certified against ingress protection of dust (solids level 6) and ingress of water in complete immersion in 1m of water for 30 minutes (water level 7).

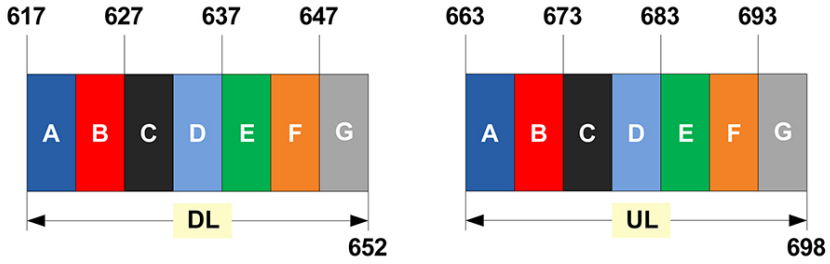
Salt/Fog rated products are intended for extremely harsh environments where corrosive salt-fog conditions are present. Complies with Telcordia GR-3108-CORE paragraph 6.2 "Salt Fog Exposure" as Class 4 products for 30 Days as defined by ASTM-B117. These products are hard anodized, which results in an even harder and more durable coating. They come with an IP68 rating, which means they are protected against the effects of immersion in water under pressure for prolonged periods. The connector interface accepts the JMA© Weather Protection System port seal and boot.

NEMA4 enclosures are constructed for either indoor or outdoor use to provide several protective features. First it protects personnel against incidental contact with the enclosed equipment. Second it provides protection against falling dirt, rain, sleet, snow, windblown dust, splashing water, and hose-directed water. Finally, it will be undamaged by the external formation of ice on the enclosure NEMA4 has an equivalent rating of IP66, which is dust tight and prevents water ingress from heavy seas or water projected from powerful jets.

600MHz (LTE Band 71) Products

In 2017, the FCC auctioned LTE Band 71 that uses 617-652MHz for downlink (Tx) and 663-698MHz for uplink (Rx). Previously this band was occupied by UHF TV channels 38 to 51. This band can now be used for 4G LTE and 5G in the future.

Microlab has modified many of its legacy components to extend the bandwidth down to 617MHz. In addition, we have released many new components to address the specific needs of this band.

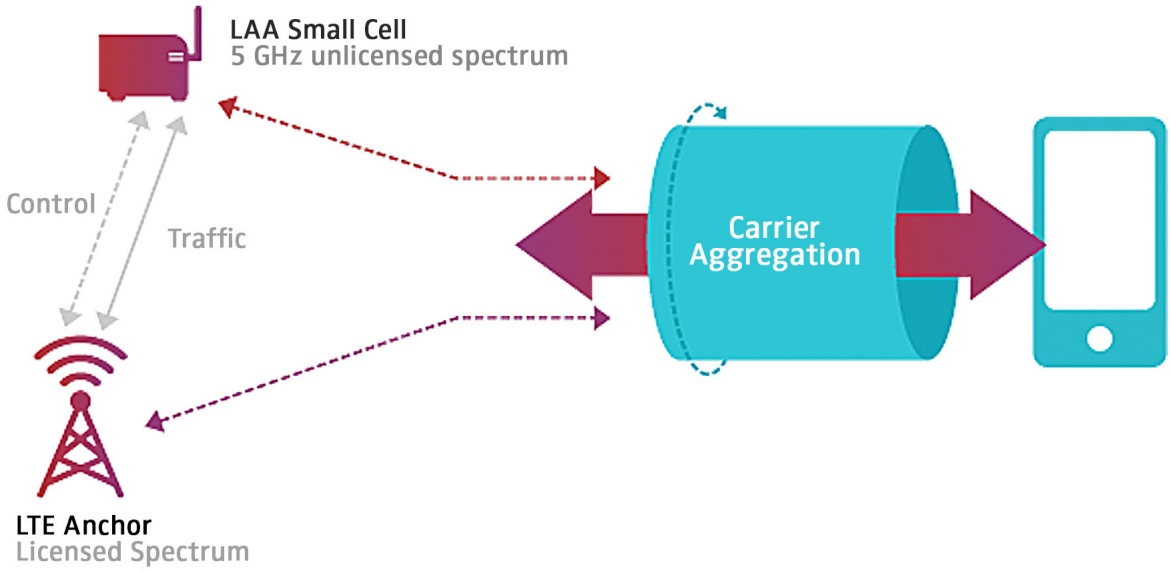


LTE Band	Block(s)	Uplink (MHz)	Downlink (MHz)
71	A-G	663-698	617-652

Mid and High Band Products

Microlab's Extended Bandwidth products cover the mid-band spectrum up to 3800MHz to cover CBRS (LTE Band 48) and LTE Band 43.

Our Ultra-Wideband products extend the bandwidth further to 5925MHz for Wi-Fi, LTE-U (LTE-unlicensed), LTE-LAA (LTE licenses assisted access), LWA (LTE-WLAN aggregation), and MuLTEfire applications.



NETWORK SYNCHRONIZATION

Modern wireless telecommunications networks rely on accurate frequency and phase to synchronize base stations and mobile devices throughout the network. Unlike older 2G/3G wireless technologies which required only an accurate frequency reference, 4G and 5G systems require very tight phase alignment. GPS timing signals are used as a primary reference clock to ensure optimal signal quality and coverage, high speed data service with high capacity, spectral efficiency and advanced features.

Digital GPS Signal Repeater System

Microlab's digital GPS repeater system can be used for cellular communications UTC synchronization for locations where the GPS signals are not readily available. The system is built with Microlab's patent-pending Digital SkyTiming Technology™ offering industry-first GPS signal transmission via CPRI for highly accurate timing and location. The system offers several configurations and accessories any application.

Active GPS/GNSS Splitter Trays

Microlab's Lossless GPS Signal Splitters can be used to distribute UTC synchronization to up to 32 remote units located where the GPS signals are available via coax. The GPS signal quality and antenna status are actively monitored by this system, with auto switch-over to the backup antenna upon fault detection. The splitters can be combined with the Microlab Digital GPS Signal Repeater to expand the RF outputs. It offers 16-channel and 32-channel options.

Active GPS/GNSS Splitter Components

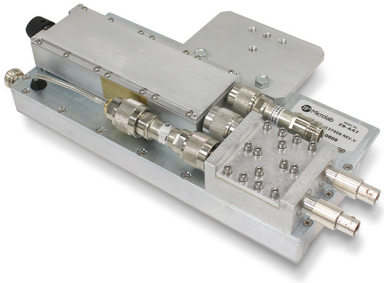
Microlab's Active GPS/GNSS Signal Splitters can be used to distribute GPS/GNSS RF signals from a single antenna to multiple devices. They are designed for locations where extra gain is needed in the RF path. The splitter has an LNA with an extremely low noise figure and bandpass filter. The splitters do not require any external power supply and operate directly from the power provided by the GPS receiver. The other outputs are DC terminated.

Public Safety communications worldwide are becoming increasingly important to ensure that first responders communicate reliably during emergencies for the protection and preservation of life and property. Public Safety agencies like the National Fire Protection Association (NFPA) and the International Fire Code (IFC) have created in-building communication requirements and best practices. Local municipalities and authorities at different government levels in the U.S. are now mandating these safety codes for new and existing buildings and facilities.

There are many challenges faced by Public Safety communication networks. They are primarily designed for a high level of coverage, especially in areas like equipment rooms and stairwells where commercial coverage may not be present. It is imperative to have high quality and high reliability equipment for these life safety applications.

Microlab offers a wide variety of reliable RF passive components suited for critical communication deployments. They are ideal for enterprise and public solutions supporting all major commercial wireless and public safety bands including VHF, UHF, 700 MHz, 800 MHz, and 900 MHz. Our trusted products help provide full coverage across independent and/or hybrid mobile radio and cellular networks.

MEDICAL DIAGNOSTIC IMAGING



Microlab has almost 70 years of experience designing, manufacturing, and testing high quality RF and Microwave components and custom assemblies. The company has over 25 years of experience providing highly precise designs for the medical field.

This includes

- Custom auto frequency control (AFC) assemblies for linear accelerators systems used to treat cancer with highly precise targeting and dose rates.
- Diode detector mounts for radio-oncology equipment.
- Diode detector mounts for linear accelerator systems used in scanning devices for cargo and vehicles in the security sector.

Whether you are looking for an off-the-shelf solution or a custom product, Microlab can deliver the high-precision products that you need.

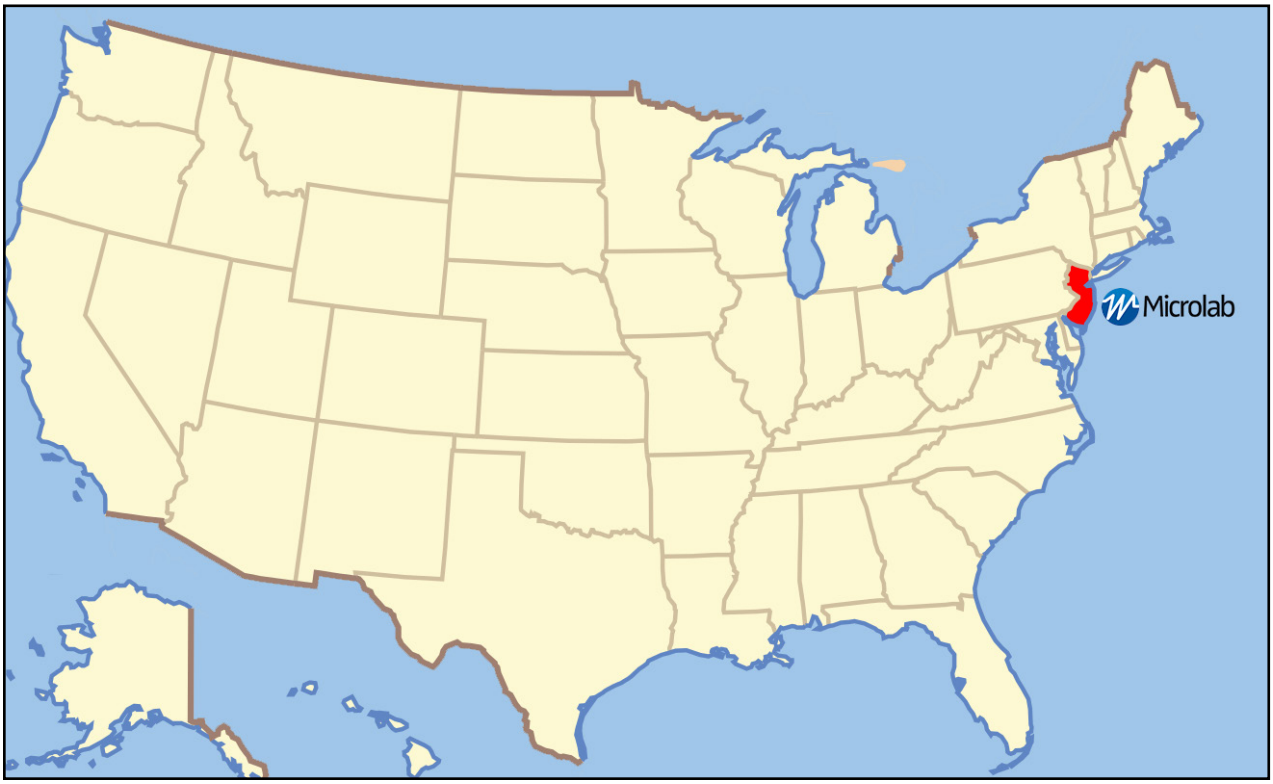
Microlab offers Transportation Products that meet the requirements for rolling stock and rail networks. Microlab EN50155 qualified products have been subjected to a series of environmental, safety, and electrical performance tests to validate compliance with EN50155 ''Railway Applications-Electronic Equipment used on rolling stock''.

The EN50155 standard defines and calls on many other standards for the design and operation requirements to withstand the challenges in railway applications. This standard ensures robust wireless and public safety services to trains and buses.

EN50155 compliance requirements include the following environmental and performance tests:

- Vibration, Shock and Bump Test
- Cooling Test
- Dry Heat Test
- Damp Heat Cycling Test
- Low Temperature Test
- Salt Mist Test
- Insulation Measurement Test
- Voltage Withstanding Test

The EN50155 standard is vital to transportation to ensure reliability and safety. Microlab's trusted EN50155 qualified products have been designed and manufactured to operate over harsh environmental conditions and offer unique electrical and mechanical performance.



With its headquarters and production facilities in Parsippany, NJ Microlab proudly offers products assembled in the USA. Many of our products are made to military standard specifications (MIL-STD / MIL-SPEC).

microlabtech.com

Our website contains all the latest product and application updates.
Orders can be placed directly on the web.

We can also be reached via the contact info below:

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