

# RFS Wireless Cell Site Solutions

Ready for the next generation of wireless services



**RADIO FREQUENCY SYSTEMS**  
The Clear Choice®



# Optimize the value of your sites with the help of a worldwide leader

## The wireless industry: A challenging business environment

In today's highly competitive environment, mobile operators face an array of challenges:

**In emerging markets**, operators must accommodate rapid subscriber growth, by ensuring high-speed deployment of the network. Moreover, they need cost-effective solutions to ensure profitability in a market that generates low Average Revenue per User (ARPU). The introduction of 3G in these markets – at a time when 2G is still widely deployed – is yet another challenge.

**In more mature markets**, data traffic is surging with the advent of 3G USB keys and user-friendly smartphones. As a first step, mobile operators need to optimize network capacity for radio and backhaul, and maximize spectrum usage. Soon, they will have to introduce 4G to accommodate data traffic growth. This deployment will require the use of new frequency bands and therefore new RF components.

**In all markets**, mobile operators must constantly optimize network performance, while providing the best possible quality of service to subscribers.

Whatever their geography or markets, mobile operators will continue to rely on their RF component partners to meet their needs for years to come. Among the areas in which operators can intervene, **the choice of RF components plays a critical role.**

From higher gain antennas for deeper indoor service to lowest possible attenuation cables and conditioning products, **premium performance RF components are by far the most cost-effective way for operators to optimize site quality indicators**, compared to costly capacity and software features.





## Wireless Cellular Sites: RFS has the solution

Meeting all these challenges requires a unique breed of solutions.

Radio Frequency Systems® (RFS) has the answer. With over 50 years of design and development experience, RFS provides a comprehensive portfolio of outdoor cellular site solutions. Our RF solutions cover the entire RF chain, from base station antennas to diplexers and triplexers, feeders, jumpers and tower solutions.

**RFS's leadership in the sector is underpinned by clear differentiators:**

➞ **Premium performance products all along the RF chain**, including leading CELLFLEX® feeder cable solutions; Optimizer antennas with high gain and superior upper sidelobe suppression; and ShareLite diplexer and triplexer suite featuring very low loss.

➞ **Unique Ultra-Broadband Antenna design** for multi-technology, multi-frequency, high-end wireless networks.

➞ Complete suite of RF site solutions suitable **for 2G, 3G and LTE**, whatever the frequency band.

➞ **Innovative solutions** that facilitate **Remote Radio Head deployments**, both for site deployment and site renovation.

➞ The most comprehensive **microwave antenna system solutions designed to answer the most pressing need for precision-engineered systems that mitigate interference** and provide the **flexibility** to meet the capacity requirements of today and tomorrow.

➞ A demonstrated **commitment to R&D**, the source of technology breakthroughs.

➞ A **passion for customer service and technical support**, which helps customers maximize the value they get from RFS solutions as well as minimize their total cost of ownership (TCO).

# RFS Wireless Cellular Sites: The solution at a glance

CLUSTER ASSEMBLIES



MICROWAVE ANTENNAS

DIRECTIONAL  
PANEL ANTENNAS

JUMPER CABLES

TOWER MOUNTED  
AMPLIFIERS

REMOTE ELECTRICAL TILT  
ANTENNA CONTROL

DIPLEXERS AND FILTERS

CONNECTORS

FLEXWELL®  
ELLIPTICAL WAVEGUIDES

CELLFLEX®  
FOAM CABLES

HYBRIFLEX™  
RRH HYBRID CABLING  
SOLUTION

SITE OPTIMIZATION





# RFS Base Station Antennas:

## An extensive portfolio for all frequencies and standards

RFS provides state-of-the-art base station antenna solutions – for different footprints, patterns, gains and tilt types – to suit all mobile standards in all frequency bands.

### High-Band Antennas: Technological advances in design

Taking innovative strides in antenna design, High Band Variable Electrical Tilt antennas from RFS feature a completely re-designed antenna platform for premium network performance. Delivering outstanding performance, reliability and value, this series is truly one-of-a-kind in today's demanding marketplace.

Striking the perfect balance between efficiency and performance, this innovative design model will be the new standard for future RFS base station antenna products.

- ➔ New dipole design delivers superior matching across the entire band
- ➔ Improved antenna radiating geometry improves front-to-back ratio and cross polarization discrimination and minimizes the contact between elements to eliminate intermodulation
- ➔ High performance phase shifter network provides precise control of the USLS suppression and pattern shape across the entire tilt range

The Optimizer® antenna series is specifically designed to offer premium network performance, delivering cost-efficient network capacity. These antennas provide unrivaled performance where it counts!

### Best-in-class PIM performance

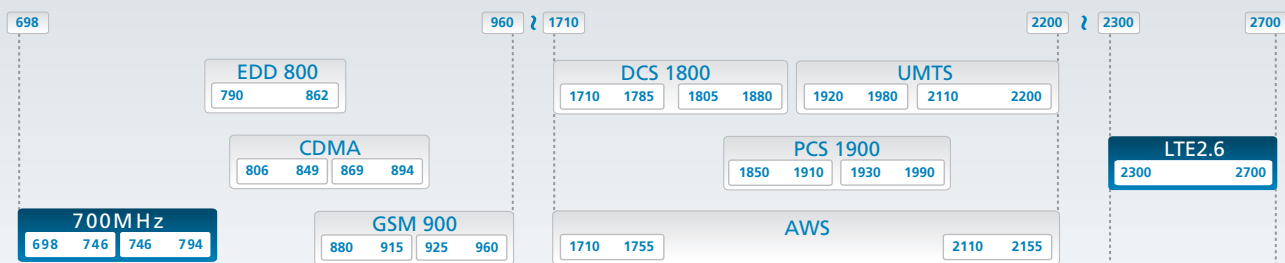
PIM, or Passive InterModulation, is a major concern because it can adversely affect the quality and performance of a typical communications site. Good site design, installation practices and site maintenance can keep PIM from becoming a serious problem.

In base station antennas, PIM can be caused by poor solder joints, loose connections, dissimilar metal junctions, too many contact points, oxidation between metal surfaces in contact with each other, etc.

Through design innovations at every stage, RFS secures best-in-class PIM performance for all of its base station antennas; connectors; cables; block construction; dipole construction and assembly; reflectors; and final assembly.

### Frequency bands and mobile standards

RFS offers the widest range of 2G (GSM/TDMA/CDMA), 3G (UMTS/cdma2000) and 4G (LTE/WiMAX) antenna solutions for network deployment, designed for greenfield players and existing operators alike.



# Technological breakthroughs in base station antenna design

## Optimizer CELLite Antennas: Rugged construction and lightweight design

The best of both worlds: Introducing RFS antennas featuring CELLite and Optimizer technologies for the rapid rollout of wireless networks in densely populated regions.

These antennas are manufactured with premium quality materials to ensure superior performance. The microstripline feed system consists of monolithic aluminum construction allowing for:

- ➔ Minimal welded joints to reduce the possibility of intermodulation problems
- ➔ Minimal power losses to increase the antenna gain
- ➔ Perfect production reliability and repeatability

Each antenna features lightweight, one-piece panel construction for ease of installation, reducing handling cost. All aluminum components are treated to minimize corrosion, assuring reliable operation in icing, salt air and rain conditions.

These antennas support all services between 806MHz and 960MHz. They are ideal for CDMA applications and GSM900 network coverage and optimization.



### ➔ Rugged CELLite construction

Ensures high reliability

### ➔ Low PIM

Eliminates system down-time, provides excellent call quality and reduces the number of dropped calls

### ➔ Dual polarized

Optimizes RX performance

### ➔ Excellent upper sidelobe suppression

Allows strong mechanical tilt

### ➔ High gain

Provides better coverage

### ➔ Wideband frequency performance

Enables future growth and increases flexibility



## Ultra-Broadband Antennas: Ultra-flexible LTE spectrum support

RFS Ultra-Broadband Antennas dramatically simplify antenna requirements by supporting the full range of potential LTE frequencies on a single platform. Ready for LTE testing today, they eliminate the need to replace or add antennas as operators trial and deploy LTE services at different frequencies.

These antennas bring tremendous flexibility to operators with 2G, 3G, PCS, AWS, GSM1800 and mobile TV networks, enabling them to activate LTE in any frequency band, using Software-Defined Radio (SDR) – without changing the antenna. The antennas are thus ideal for meeting rebanding and refarming requirements in the 1710-2700 MHz range.

Available in dual polarization or side-by-side quad polarization versions, the antennas feature RFS premium performance: high gain, high upper sidelobe suppression and performance stability across frequencies. They also provide easy adjustments, optional remote tilt, and a low-profile design to minimize visual impact.

The side-by-side version gives operators increased flexibility to support multiple technologies and seamlessly add capacity – all under a single radome. During LTE rollout, operators will benefit from Multiple Input Multiple Output (MIMO), beamforming and 4-way receive (Rx) diversity.



## Optimizer Rooftop®: Tailored to minimize visual impact

The RFS Optimizer Rooftop – tailored to minimize visual impact, streamline rooftop base station deployment and maximize return on investment – is perfect for the urban skyline.

Unlike any in its class, the Optimizer Rooftop has been designed for the rooftop environment. With a unique base station assembly composed of a base, tilting mast, tri-sector antenna cluster, RF condition equipment, jumpers and transmission line, the Optimizer Rooftop is an all-in-one base station solution that is truly rooftop-ready.

The broad multi-disciplinary strategy adopted by RFS in the development of the Optimizer Rooftop has resulted in a solution that meets the needs of site acquisition teams, procurement/purchasing teams, installation contractors, project managers and network planners/managers.

The Optimizer Rooftop is installed very rapidly. No crane is required. Only two people are needed to complete installation in just four hours.

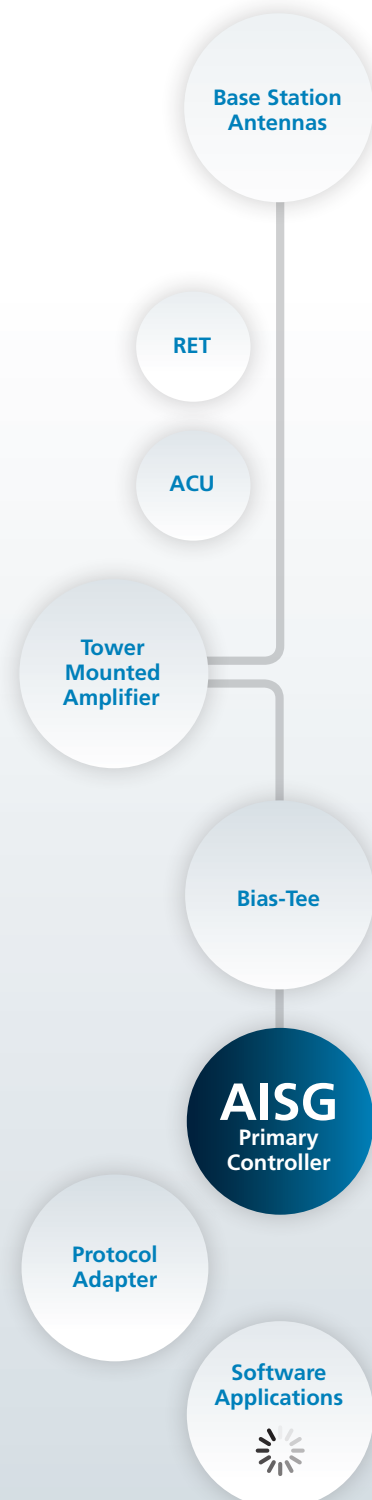
## Talking to the tower-top: RFS' fully AISG-compliant solution set

The Antenna Interface Standards Group (AISG) protocol was designed by RFS and other industry leaders to enable the introduction of antenna line products that feature remote control and monitoring capabilities, while ensuring basic interoperability between these products and the control infrastructure.

Accurate control and monitoring of tower-top components frees the operator from the inherent restrictions associated with proprietary control and monitoring systems. It also enables them to implement cost controls for both greenfield deployments and mature network retrofits.

The latest version of the protocol is AISG version 2.0. RFS offers a unique, end-to-end AISG v2.0-compliant solution set; the company has effectively aligned all key antenna-line elements with this important standard.

RFS' fully AISG-compliant solution set includes its RET (Remote Electrical Tilt) system, the 'Optimizer Universal' Antenna Control Unit (ACU), TMA (UltraAmp™ Tower Mounted Amplifier), Bias-Tee, Primary Controller, Protocol Adapter and Network Element Manager software.



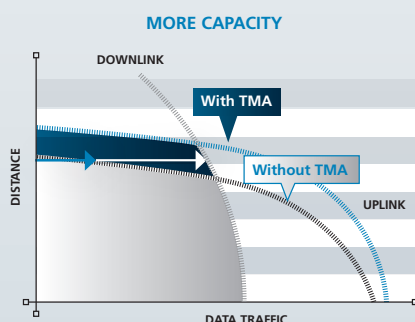
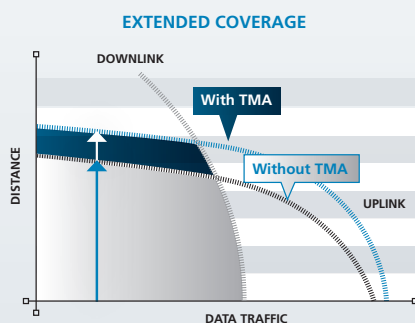
# Site Optimization Products to maximize the effective use of your sites

## UltraAmp™ Tower Mounted Amplifier: Beyond coverage improvement



UltraAmp™ Tower Mounted Amplifier (TMAs) are used in wireless networks to improve coverage by boosting base station sensitivity. Higher BTS sensitivity leads to better voice quality and fewer dropped calls. In the case of 3G, moreover, using a TMA can also improve bit rate coverage for data transmissions, enhancing coverage and capacity.

TMAs can also be used to achieve cell enlargement. This enables operators to serve more subscribers from the same BTS site, ultimately generating additional network revenue.



RFS is one of the leading global suppliers of TMAs, and supports the largest carriers and OEMs. RFS' broad TMA portfolio offers the following:

- ➔ Twin and dual band TMA models that cover the major bands and applications in operation around the globe
- ➔ Dual band units with internal duplexing
- ➔ Current Window Alarm (CWA) base station interface or AISG 2.0 / 3GPP-compliant for use with Remote Tilt antenna systems
- ➔ Flexible mechanical design for easy installation and versatility as the units can be stacked and mounted in a myriad of ways
- ➔ Complimentary power distribution units and bias-tees as part of the RFS' total package solution.

## ShareLite Combining Solutions: Multiplying deployment options while dividing the costs

Combining solutions (duplexers and triplexers) allow several systems to use the same feeder cable between the base station and the antenna, resulting in a lighter tower load and a corresponding cost savings in the streamlined arrangement.

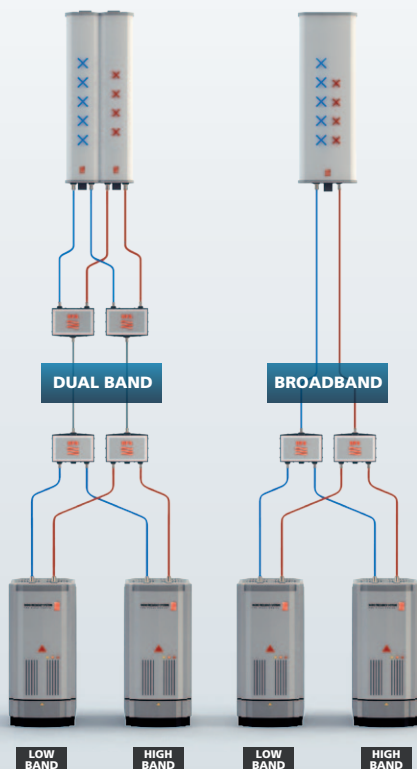
RFS' new ShareLite Combining Solutions efficiently support LTE migration on the cell tower, and are also backwards-compatible with 2G and 3G frequencies.





The solutions' unprecedented compact design allows cell tower installation on a swap-out basis, boosting service capabilities while avoiding added weight to the site.

In addition, ShareLite's very low insertion loss limits the impact on total system loss, ensuring high quality wireless cellular services for years to come.



## Filter solutions: Flexible interference protection

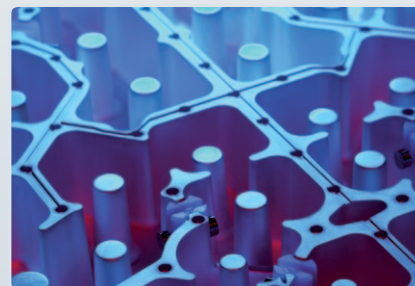
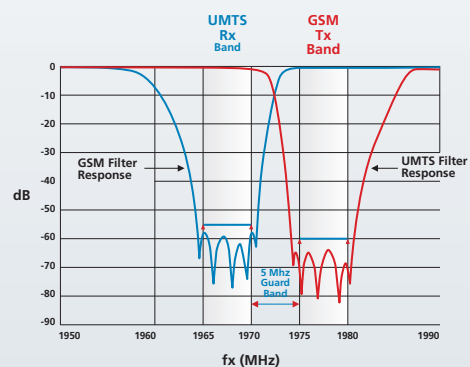
Co-location filters are used to prevent the interference that often exists when RF base stations are co-located. Interference degrades system performance and can increase the number of dropped calls in the network.

As networks have evolved from 1G to 2G, and 3G to 3.5G and 4G overlays, and as environmental considerations have gained ground, the filtering challenge associated with indispensable, modern co-location scenarios has become particularly complex. Each scenario is unique.

RFS is ideally positioned to respond to today's highly sophisticated, tailor-made co-location filtering requirements. It has a wide inventory of RF conditioning products covering all bands, and offers dedicated engineering support on a product-by-product basis.

A proven supplier, RFS ships more than 5,000 filtering products per week across the globe. All its filtering solutions are subject to literally hundreds of rigorous design verification tests, including those for shock, vibration, temperature extremes, salt, fog and other environmental hazards.

RFS' skilled engineering team is ready to engage customers in technical discussions at the earliest stage in the project to help define an optimal solution.



# RFS transmission-line products

## CELLFLEX®: A comprehensive transmission-line portfolio to fit every need

The CELLFLEX® and CELLFLEX® Lite duo make up the largest corrugated transmission-line portfolio in the wireless infrastructure industry. The foam dielectric cables combine remarkable flexibility with high strength and superior electrical performance. This premium transmission line family is backed by a complete line of accessories common to both the copper and aluminum products, including the renowned OMNI FIT™ connector range.

CELLFLEX® cables provide a reliable and technically superior solution when used as backbone feeders in cellular radio systems, including GSM, UMTS, CDMA, PDC and LTE, as well as WIMAX. Other common uses for the CELLFLEX® family include the cabling of antenna arrays, radio equipment interconnections and jumper assemblies.

Twenty unique CELLFLEX® types, ranging in size from 1/8" to 2-1/4", provide users with a perfect match for the most complicated and demanding applications. Every cable comes with a guarantee of reliability, performance and cost-effectiveness from the most experienced and innovative cable manufacturer in the world – Radio Frequency Systems.



### A tradition of innovation

With a long tradition of leadership in cable design, RFS has been responsible for many transmission-line firsts:

⊕ Invention of corrugated, longitudinally welded coaxial cables in 1951 by RFS' direct predecessor, the Hackethaldracht Company

⊕ Launch of foam dielectric coaxial cables in 1962 by the now renamed Kabelmetal Corporation

⊕ Development of the extremely light CELLFLEX® Lite corrugated aluminum outer conductor cable, based on the original copper CELLFLEX® cable

# Total compatibility



## OMNI FIT™ Premium RF-Connectors: The lowest PIM levels in the industry

OMNI FIT™ Premium RF-Connectors guarantee hassle-free installation, safe sealing, and the lowest PIM levels in the industry.

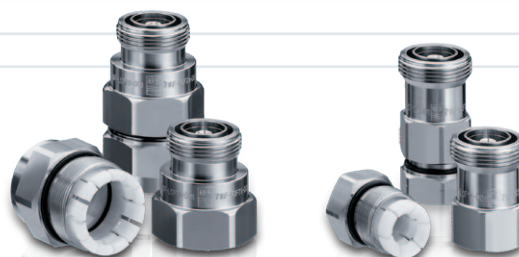
The product of intense research, OMNI FIT™ Premium incorporates groundbreaking concepts in connector design. A new high-tech polymer claw replaces the machined brass version, and the dual grip function on the outer conductor ensures best-in-class PIM performance under static and dynamic conditions. The high-tech polymer claw is a low-friction component for easier installation and eliminates the risk of corrosion.

OMNI FIT™ Premium connectors provide a secure and extremely watertight seal, so that no additional weatherproofing is needed, saving users time and money.



## OMNI FIT™ Standard connectors: Cost-effective performance

RFS' new OMNI FIT™ Standard connectors are designed to provide standard VSWR performance while ensuring excellent PIM performance. The connectors offer a cost-effective, high-quality connector-to-cable interface, ensuring easy, fast and safe connector attachment.



## Cable accessories and tools: The highest quality for a complete cable system

Designed to provide years of trouble-free service, RFS cable accessories and tools are of the highest quality. These components have been thoroughly tested together with RFS transmission line products to insure full interoperability.



RFS offers all necessary accessories and tools for a complete cable system, including:

- ➔ **Grounding kit**  
Uses a tin-plated ground braid; designed for both copper and aluminum outer conductor cables
- ➔ **Connector installation tools**  
Recommended for reliability, repeatability and time savings
- ➔ **Manual and drill tools**



### Total compatibility

All Premium and Standard connectors in the breakthrough OMNI FIT™ product line are fully compatible with CELLFLEX® and CELLFLEX® Lite copper and aluminum transmission lines.

Likewise, all CELLFLEX® accessories work with both copper and aluminum cables, for significant savings in storage and reduced installation errors.



# Revolutionary products for Remote Radio Head technology

## HYBRIFLEX™: The world's first lightweight aluminum hybrid feeder cabling solution for Remote Radio Heads

Operators face a constant challenge to upgrade technology, reduce operating expenditures (OPEX) and decrease CO<sub>2</sub> emissions at cellular sites. In this context, many operators are implementing a distributed base station architecture where Remote Radio Heads (RRHs) are installed next to the antenna on the tower or rooftop rather than deploying old-style macro base stations. Installing the RRH close to the antenna reduces costs by cutting power consumption — typically in half — but means RF transmission, power and grounding cables must all be brought to the RRH on the tower or rooftop.

To meet this challenge, RFS developed HYBRIFLEX™, the world's first lightweight aluminum hybrid feeder cabling solution for RRH. It allows operators to connect up to three sectors with a single composite optical fiber and power cable with the grounding function incorporated in the cable.

With this revolutionary RRH hybrid feeder cabling solution, RFS has become the first company to combine optical fiber and DC power for RRHs in a single lightweight aluminum corrugated cable. RFS' patent pending solution reduces cabling expenditures, provides for easy installation and boosts operational efficiency, enabling mobile operators to evolve their networks while limiting power consumption and carbon footprint at cellular sites.

### HYBRIFLEX™'s unique design and structure:

#### ⊕ Simplifies inventory management

of cable accessories, as HYBRIFLEX™ is designed for standard RF feeder diameters. Commonly available RFS CELLFLEX® LCF ½-inch and LCF 7/8-inch feeder accessories can be used in all HYBRIFLEX™ installations.

#### ⊕ Offers maximum flexibility

HYBRIFLEX™ can be connectorized on-site. Alternatively, pre-connectorized solutions and services are available to help standardize the RRH cabling process.

#### ⊕ Minimizes weight and provides extra protection

The extremely lightweight cable features aluminum armor. Aluminum also offers the fragile fiber optic cables inside more protection than polyethylene tubes and at a much lower cost than cable trays.

#### ⊕ Incorporates the grounding function

This feature, critical to RRHs, also eliminates the need for and cost of cable grounding.

Aluminium OC  
PE external jacket  
Power cable (pair) with an internal jacket (PE)  
Optical cable (pair) with an internal jacket (PE)





## DC-FIT™: An RFS world first and exclusive

RFS DC-FIT is an innovative solution designed to connect a Direct Current (DC) cable with an existing coaxial cable run. Upgrading a conventional coax site to Remote Radio Heads (RRH) technology is a breeze – in contrast to the time-consuming installation of a new DC cable run.



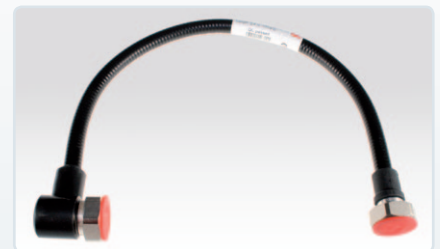
To stay at the forefront of technology, mobile phone system operators constantly upgrade their networks. Most recently, the use of tower-top equipment – known as Remote Radio Heads (RRH) – is increasingly being adopted, especially for 3G systems.

RRH technology helps solve the problem of antenna siting. In many markets, the population has become ever more sensitive to new antenna sites. Using existing sites is a potential answer, but these are often already overcrowded. Dismantling is a time-consuming process and may not be acceptable, as the operator cannot generate revenue from an off-air site.

To resolve this problem, RFS uses existing coaxial foam dielectric cable feeders as the RRH power supply and housing for the fiber optical data connection. Installation time and costs are substantially reduced (by up to 50%) when using existing coaxial feeder lines. The DC-FIT concept is an RFS world first and exclusive innovation.

## Jumpers: Optimized for high-performance telecommunications systems

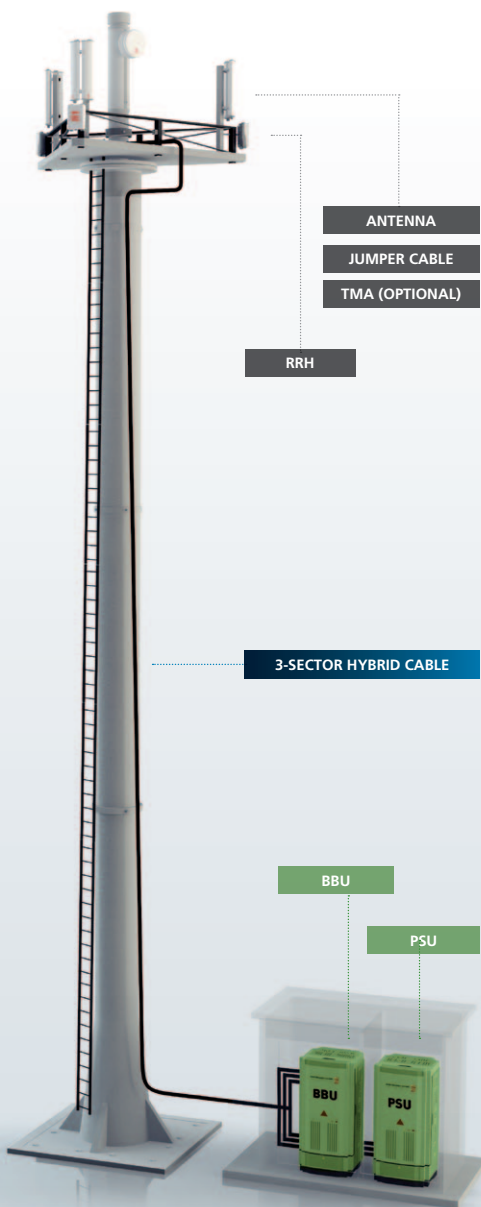
RFS' CELLFLEX® Factory-Fit Jumper Cables feature a unique soldered-on connector for today's high-performance wireless systems. The connector design and manufacturing process has been optimized to produce premium VSWR and PIM levels for mobile communication systems.



### CELLFLEX® foam dielectric cables

combine a remarkable flexibility. The construction of the cables allows for easy handling and easy preparation for the attachment of connectors. Jumper cables are available in standard (LCF12-50) and superflexible versions (SCF12-50); they are made of flame-retardant, halogen-free material and equipped with PE jackets.

**Connectors** for CELLFLEX® foam dielectric cables are of premium quality and feature a self-flaring design for low VSWR and easy installation. For the Factory-Fit Jumper, a special connector protection is offered with the following connector types: 7-16 male, 7-16 male right angle, and 7-16 female.



# Microwave antenna systems

## Five links to success

RFS' leadership in the RF microwave sector is underpinned by five clear differentiators:

### ➞ End-to-end microwave antenna systems

RFS' portfolio encompasses all elements of the RF chain. Our comprehensive suite of microwave antennas includes advanced mounting structures, wind load kits, sway bars, couplers, elliptical waveguides, connectors, grounding kits and pressurization equipment.

### ➞ Total life-cycle performance

The mechanical robustness and electrical performance of RFS microwave solutions are unsurpassed. RFS antenna installations exhibit survival wind speeds of up to 250km/h (155mph).

### ➞ R&D and innovation

Through an unrivalled program of research and design, RFS is a leader and innovator in the microwave systems sector, delivering future-proof systems that can support tomorrow's capacity requirements.



### ➞ Truly global service and support

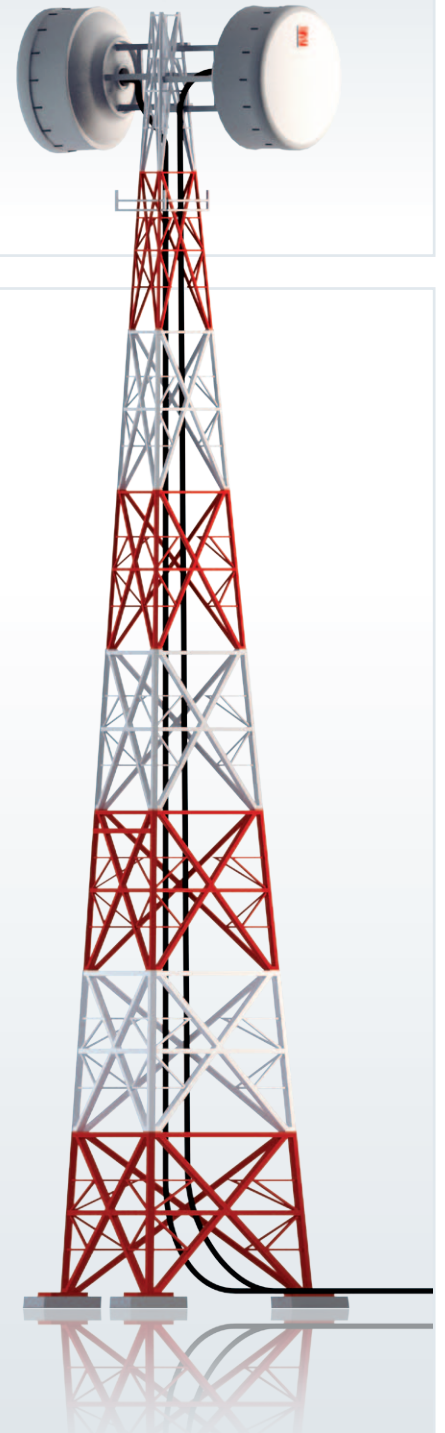
With on-the-ground personnel on every continent, RFS is ideally positioned to offer truly global value-added services, including installation and system design advice, technical training programs, customized logistical services and much more.

### ➞ Engineering excellence

All RFS antenna models and integrated antennas are designed and developed in the company's own state-of-the-art engineering facilities. All prototypes are subjected to extensive testing – including electrical, mechanical and environmental performance.

## Premium electrical performance features by RFS

End-to-end system optimization	➞	Careful matching of customized antenna and waveguide components for optimum system operation
Interference control	➞	Unsurpassed RF pattern/sidelobe control, meeting all – and exceeding most – global radiation standards
High cross-polar discrimination	➞	Dual-polarization antennas provide additional capacity with reduced interference
Low loss and low VSWR	➞	Each antenna and waveguide is custom-made for optimal electrical performance in specific frequency bands
Mechanical stability	➞	Installations feature unsurpassed mechanical stability for premium point-to-point radio link networks



# Why RFS?

## A worldwide leader in wireless and broadcast infrastructure



**Radio Frequency Systems (RFS) is a global designer and manufacturer of cable, antenna and tower systems, along with active and passive RF conditioning modules, providing total-package solutions for wireless and broadcast infrastructure.**

**RFS serves OEMs, distributors, systems integrators, operators and installers in the broadcast, wireless communications, land-mobile and microwave market sectors.**

**As an ISO-compliant organization with manufacturing and customer-service facilities that span the globe, RFS offers cutting-edge engineering capabilities, superior field support and innovative product design.**

### Serious about services

Customers know they can count on RFS for comprehensive logistical capabilities, flawless execution and outstanding technical skills and support. The company's dedicated shipment coordinators, hotline staff and on-site engineers go well beyond mere technology, striving to offer tailored solutions to meet even the most complex site-engineering and delivery challenges.

RFS' value-added services match the exact needs of business partners large and small.

### Ever-present quality guarantee

From design to manufacture, ISO 9001 and ISO 14001 certification standards encompass all aspects of RFS' business worldwide. Every product RFS ships has stood up to the most stringent technical, environmental and quality control tests, continuously meeting and surpassing the expectations of a long list of wireless carriers, transportation and utility operators, and broadcasters.

RFS backs every product bearing its name with a quality guarantee that is unrivaled in the market.

### A tradition of innovation

For over a century, RFS has been at the forefront of the wireless communication industry through its unwavering commitment to design and develop the world's most advanced technology in the field. Dedicated R&D teams, along with a privileged partnership with Bell Labs, are at the source of breakthroughs that are ensuring the mobility of an increasingly wireless world.

RFS is at the frontier of wireless technology innovation, sustaining the boldest ventures to enhance the way people communicate and live.

### A truly global company

With on-the-ground personnel in more than 20 countries and on every continent, RFS always delivers on its commitments, providing a comprehensive range of premium products, systems and services. Its clients benefit from all the advantages of a global supplier, while relying on dedicated support from RFS' local engineering, manufacturing and shipping teams.

RFS' products, systems and personnel can be found in every corner of the planet. As a global group, RFS is committed to upholding the most stringent environmental, health and safety standards, and seeks to integrate green initiatives in every aspect of its business.

**For more information, please contact  
the nearest RFS sales office:**

**Southern Europe, Middle East, Africa & India**  
[www.rfsworld.com/sales/semesai](http://www.rfsworld.com/sales/semesai)

**Northern Europe**  
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