M/A-COM Antenna Solutions for Aerospace and Defense

Tyco Electronics

Our commitment. Your advantage.

The Tyco Electronics M/A-COM business has provided RF and microwave solutions to the Aerospace and Defense industry for than a half century—aggressively pursuing advanced technologies and manufacturing processes, providing expert consultation, leveraging our experience in commercial markets, and always delivering maximum value at a competitive price.

It's no surprise that M/A-COM complex antennas and cable assemblies have been integral components in virtually every high-performance aircraft and many space launch vehicles.

cover photo:
Antenna mock-up under test in 60 ft long conical anechoic chamber, one of eight in-house anechoic chambers

About Tyco Electronics M/A-COM Capabilities

Reliability, Performance, Value

For decades, M/A-COM antennas have held a strong market position in high performance aircraft, unmanned vehicles, missiles, precision guided munitions and space launch vehicles—for good reason. Because our antennas are designed to exceed your most stringent requirements, they excel in extreme environments, delivering consistently reliable performance. We work closely as a team with you to provide new and evolving designs that provide both rugged performance and remarkable value. We also manufacture build-to-print antenna designs using the same rigorous manufacturing processes.

Going to Extremes

With missions and lives on the line, no one demands more from a custom antenna solution than our military and aerospace platform customers. Having designed, produced and supported thousands of unique antenna products, we know what it takes to satisfy your requirements. Our track record is one of exacting RF performance and durability, often in the most extreme environments. In fact, our specialty is reliable operation in highly dynamic environments such as:

- Random vibration up to 150 GRMS
- Pyro-shock up to 17,000 Gs
- Steady state operating temperatures over +/- 300°F
- Dash temperature conditions to +1200°F
- Altitudes to 330,000 feet
- Salt, fog, humidity, sand, dust, etc.

Examples of flush mount/conformal fighter aircraft antenna assemblies

Engineering Capabilities

World-class Engineering Design

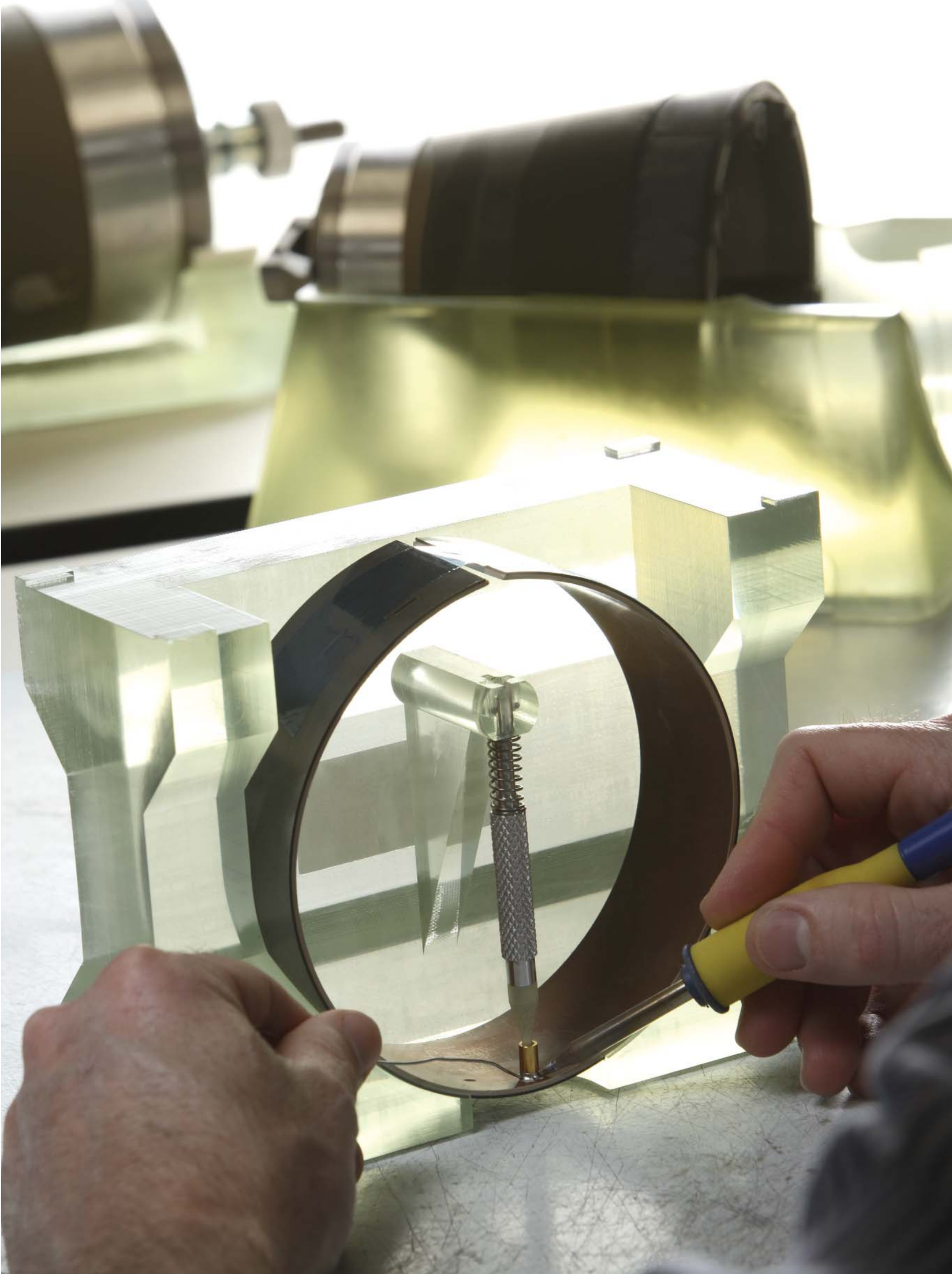
Reliable performance is not an add-on—it has to be engineered into the earliest design and incorporated into every step. Having amassed a world-class knowledge base, our M/A-COM antenna engineering team has developed an expansive library of proven designs supported by the most modern design and analysis software available, including ADS, HFSS, CST Microwave Studio, Radome Analysis Software, Ansys, Sonnet and Matlab.

For maximum control and fast turn-around, engineering design and development is closely supported by our in-house machine shop and prototype assembly and test teams. The result is faster prototypes—and highly-optimized designs.

As part of the Tyco Electronics Wireless Systems segment, our engineering design team brings to every project a broad range of technologies and capabilities from diverse markets, including Aerospace and Defense, Public Safety, Commercial Telecommunications, and Automotive. These capabilities include:

- RF, microwave and millimeter components
- Subsystem solutions
- High volume manufacturing: as a key supplier to highly-competitive commercial markets, our M/A-COM antenna team has led the way in developing manufacturing techniques and processes that lower costs, increase volume and improve quality
- Lean and Six Sigma strategies for process improvement
- Design for reliability: based on our pioneering work studying the "Physics of Failure," this approach goes beyond reliability based on abstract mathematical calculations and enables us to achieve continuous improvement by "designing out the opportunity to fail."

Examples of EW and direction finding horn antennas



M/A-COM Capabilities – Manufacturing

Comprehensive Manufacturing Capabilities

The M/A-COM antenna product team operates from a dedicated facility that includes all the required functions under a single roof: complete RF and mechanical design engineering, structural and thermal analyses, manufacturing engineering, fabrication, qualification, testing and production.

Working as an integrated unit, mechanical, manufacturing and RF design engineering organizations; product line leaders; administrative staff; and the manufacturing team are located in one centralized location utilizing 120,000 square feet of a 900,000 square foot facility that includes:

- Engineering labs and prototype shop
- Manufacturing facilities
  - Assembly
  - Complete state-of-the-art RF test and analysis capability
  - Eight indoor anechoic chambers
  - Outside ground reflection range (275 ft)
  - Full capability machine shop
  - Paint shop
- Full environmental test capability
  - Custom thermal test chambers for cycling of +/- 300° F (computer controlled, RF and temp monitored)
  - High power at altitude, temperature test capability up to 100,000 ft
  - Random & sinusoidal vibration capability
    - Three shaker models
    - Digital controllers
    - Force up to 8000 ft/lbs
    - Up to 2 inch displacement
- Mechanical shock—sine and sawtooth pulse

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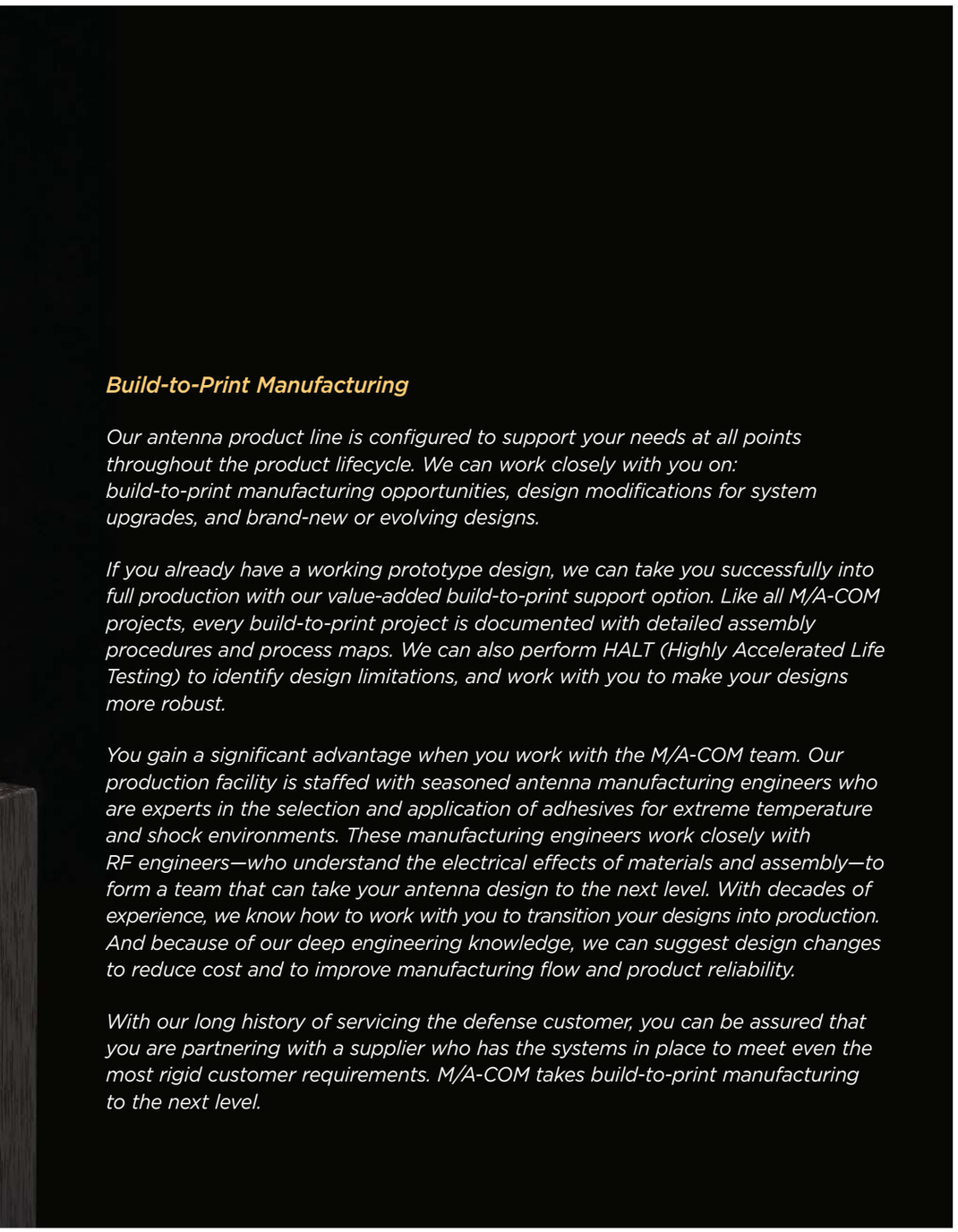
Examples of Build-to-Print antenna assemblies



Build-to-Print Manufacturing

Our antenna product line is configured to support your needs at all points throughout the product lifecycle. We can work closely with you on: build-to-print manufacturing opportunities, design modifications for system upgrades, and brand-new or evolving designs.

If you already have a working prototype design, we can take you successfully into full production with our value-added build-to-print support option. Like all M/A-COM projects, every build-to-print project is documented with detailed assembly procedures and process maps. We can also perform HALT (Highly Accelerated Life Testing) to identify design limitations, and work with you to make your designs more robust.

You gain a significant advantage when you work with the M/A-COM team. Our production facility is staffed with seasoned antenna manufacturing engineers who are experts in the selection and application of adhesives for extreme temperature and shock environments. These manufacturing engineers work closely with RF engineers—who understand the electrical effects of materials and assembly—to form a team that can take your antenna design to the next level. With decades of experience, we know how to work with you to transition your designs into production. And because of our deep engineering knowledge, we can suggest design changes to reduce cost and to improve manufacturing flow and product reliability.

With our long history of servicing the defense customer, you can be assured that you are partnering with a supplier who has the systems in place to meet even the most rigid customer requirements. M/A-COM takes build-to-print manufacturing to the next level.

Manufacturing Capabilities (cont'd)

- Constant acceleration
- Salt fog chambers
- Digital temperature/humidity chambers
  - -68°C to +177°C
  - 10% to 98% relative humidity
- Thermal shock chambers
  - -70°C to +200°C
  - Internal elevators hot to cold
- Radiant/aeroheating
  - Dash temperatures to +1200° F
- Highly Accelerated Stress Testing (HAST)
- Highly Accelerated Life Testing (HALT)
- Leak test (helium for altitude)
- Liquid immersion for temperature shock

The Process Ensures the Solution

Most of our products releases are customized to meet each customer's requirements using fully documented procedures under configuration control. For designs requiring new processes, we use tools such as cause and effects matrices and process FMEAs. These identify key process characteristics that require monitoring using statistical process control. Our facility and business practices have been set-up to maintain and protect information designated as customer proprietary, competition sensitive and DoD classified.

To ensure efficient production, we employ a fully-integrated manufacturing process that takes advantage of enterprise resource planning. This is complemented by continuous use of Six Sigma and Lean Manufacturing improvement programs led by a manufacturing engineering team who are all Six Sigma Black Belts.

Quality systems in use include: ISO 9001, AS 9100 and ISO 14001.

Market Focus

Missile antennas including GPS and data links

Extraordinary Market Focus and Application Breadth

The M/A-COM antenna team has expertise in all facets of antenna design, manufacturing and testing. We have designed and built antennas to meet almost every kind of performance and installation requirement imaginable—operating across broad bands from 20 MHz to 40 GHz in every polarization, with some even providing polarization diversity. The applications supported are equally diverse, including C3, CNI, telemetry, data links, ECM, GPS, EW, missiles, and PGM.

Our broad experience in aerospace and defense means that we are more than just technologically qualified to serve your needs. It means that we understand how best to work with you, whether you are a government agency or a prime contractor. That is also why we can support the broadest range of platforms, including high performance aircraft, unmanned vehicles, shipboard, land vehicles, Manpack, space launch, missiles, precision guided munitions, and hypersonic vehicles.

Because of our broad engineering and manufacturing capabilities, we are often sought out for our unique strength in solving the most challenging problems involving any combination of these factors:

- Broad frequency range
- High power
- Special patterns
- Low VSWR
- Polarization diversity
- Severe environments

In Electronic Warfare (EW), M/A-COM antennas have been particularly successful in broadband, high power applications—with thousands of antennas shipped to military customers since 1958. Our antennas are in use on virtually every U.S. military platform, including high power, broadband, and multifunction designs for a variety of platforms, from ground to sea to air and space.

Over the years, our capabilities have grown along with the needs of the market. For example, our Communication, Navigation, and Identification (CNI) antennas evolved from our traditional multi-band capability. We offer conformal designs for supersonic military as well as commercial aircraft. And as more customers approached us with unique requirements for small, lightweight, and low cost antennas, we responded by offering a series of antennas—many of them high power—that are custom-designed for air, sea, and ground-launched missiles and expendable decoys.

M/A-COM space-qualified antennas have been used on many launch vehicles for command/destruct, telemetry, and tracking applications. Built for harsh launch environments, these antennas offer proven performance under extreme heat, noise, shock, vibration, and acceleration. Most designs can be readily modified to meet your special needs. Our staff of antenna design engineers has earned a longstanding reputation for working closely with customers from concept through prototype and production. Their collaborative expertise, coupled with our flexibility of design and large technology base, ensures that we can fulfill all your requirements—no matter how stringent.

As a leading antenna solutions provider to both commercial and government customers, we are able to pass along unique benefits to you. Military and aerospace customers benefit from the low-cost, high-volume processes we have developed to support our commercial customers, while commercial customers benefit from the new technology expertise we have developed through government investment.

Technologies and Products

- Polarizers
- Radomes
- Heat shields
- Low RCS treatments

Compact GPS and telemetry antennas for custom application.

- Planar array antennas
- Microstrip patches
- Horns, monopoles, dipoles, slots
- Multiband communication blades
- Broadband and special purpose spirals
- Double and quad-ridge waveguide horns

Mastering Tomorrow's Extreme Environments

As the result of decades of antenna design, development and production for high performance aircraft and space launch vehicles, our antennas excel in extreme environments, compiling a proven record of reliable performance.

In recent years, this proven capability has been extended to increasingly more challenging applications such as guided missiles, bombs, projectiles and precision guided munitions. M/A-COM engineers are now leveraging the technology even further to address applications for platforms capable of hypersonic speeds.

Innovating Beyond Conventional Antennas

Increasingly, application needs are demanding antenna solutions that preclude conventional antennas—often due to very wide bandwidth requirements or physical space constraints. In response, we have developed a series of radiating cable antenna products that are designed to replace conventional antennas. These unique antenna assemblies use a special low-loss flexible coaxial cable construction which includes radiating apertures in the cable outer conductor. With this design, the amount of radiation can be controlled by adjusting the aperture parameters, allowing for performance to be easily tailored for a wide range of application specific requirements. Because of their low weight and small bend radius, these radiating cable antenna assemblies can be quickly installed in locations with restricted access. They also support frequency ranges of 400 MHz to 6000 MHz with insertion losses of 1.5 dB/100 ft @ 400 MHz and 7.5 dB/100 ft @ 6000 MHz.


Tyco Electronics

We work with you

Tyco Electronics is a leading global provider of engineered electronic components, network solutions and wireless systems with 2006 sales of $13 billion to customers in 150 countries. We design, manufacture and market products for customers in industries from automotive, appliances, and aerospace and defense to telecommunications, computers and consumer electronics. With over 8,000 engineers and worldwide manufacturing, sales and customer service capabilities, Tyco Electronics' commitment is our customers' advantage.

The M/A-COM business is in the Wireless Systems segment of Tyco Electronics and is a leading innovator of wireless technology for critical communications, radar and defense applications. We are happy to work with you on customized products or standard product variations.

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