For more information on partnering with the Kansas City Plant, contact:

Office of Business Development
1.800.225.8829
customer_inquiry@kcp.com
Encapsulants, which are made up of two-part compounds that are mixed, injected and molded to shape, provide critical protection for electronic assemblies. Enveloping these assemblies, encapsulants guard against hazards such as a high-voltage hit and damage from vibration and environmental factors. The Kansas City Plant provides several capabilities for encapsulating electronic components, all of which are uniquely suited to different types of highly demanding applications.

**Features**

- **Filled epoxy encapsulation** is used for voltage standoff, shock and vibration survivability, foreign material exclusion and environmental protection
  - Filled epoxies include glass microballoons, aluminum oxide, mica, silica and beta eucryptite. High-temperature and low-temperature epoxy encapsulation is available, depending on the curing agent used.
  - Vacuum deaeration is used for void-free encapsulants
  - Coefficient of thermal expansion is low for filled epoxies. This prevents damage to glass and ceramic components.
- **Foam encapsulation** provides shock and vibration survivability and foreign material and environmental protection
  - Foam encapsulants include toluene diisocyanate (TDI) polyurethane foam, polymethylene diisocyanate (PMDI) polyurethane foam and polystyrene bead foam. The foam encapsulants are lightweight but provide high strength.
  - PMDI polyurethane foam is more operator and environmentally safe
  - Polyurethane foams can be hand-mixed for small assemblies or machine-mixed for large batches
  - Polystyrene bead foam can be dissolved and the electronic assembly can be reworked
- **Urethane elastomer encapsulation** is used for voltage standoff, shock and vibration survivability, foreign material exclusion and environmental protection
  - Urethane elastomers include CONATHANE® EN-7 and EN-8, Adiprene®, Airthane® PET-90
  - Vacuum mix capability is available for void-free encapsulants
Neoprene encapsulation is used for chemical resistance (jet fuel), foreign material exclusion and environmental protection.

- Neoprene is thermoplastic material that is purchased in sheets. The neoprene is heated and transfer molded using a ram to pressure the material to shape.
- Calibrated ovens are used to cure encapsulants at elevated temperatures.
- ES&H considerations are a primary concern during encapsulation processing at the Kansas City Plant.
  - Engineering controls are used to prevent inhalation of the encapsulating compounds. Both vented hoods and point source exhaust are used.
  - Personal protective equipment such as safety glasses and gloves are specified to prevent eye and dermal contact of the encapsulating compounds.
  - Environmentally friendly encapsulating compounds are replacing more hazardous materials. Examples include PMDI foam replacing TDI foam for new electronic assemblies and PET 90 replacing EN-7, EN-8 and Adiprene on cable assemblies.

Applications

**Filled Epoxy Encapsulants**
- Junction boxes
- Pre-flight controllers
- Connector solder joints
- Battery assemblies

**Foam Encapsulants**
- Radars
- Programmers
- Trajectory sensing signal generators
- Filter packs
- Arming, fusing and firing systems

**Urethane Elastomer Encapsulants**
- Cable connections
- Junctions
- Molded shapes
- Impact crystals

**Neoprene Encapsulants**
- Cables
- Cable connections
- Molded shapes
Kansas City Plant engineers are experts in adapting fiber optics to function in unusual, demanding environments and configurations. For example, we polish fiber optic ends and interface them within the size restraints of associated electronic devices. Other uses require that high optical power densities be passed into and out of the fiber ends, thereby placing demands on the fiber end surface preparation to avoid laser-induced surface damage. Kansas City Plant engineers have developed unique capabilities to design, fabricate and test fiber optic assemblies to meet these needs and beyond.

Features

- Lapping and polishing techniques have been developed to produce very smooth surfaces on the ends of optical fibers that are only 0.005” to 0.016” in diameter. The smooth surfaces are necessary in order to avoid damage when high optical power densities are coupled from one fiber to another. The surfaces allow optical power density of a few GW/cm² to be passed reliably. The measured fiber surface smoothness is 1 nanometer, root-mean-square.

- Special techniques for polishing fiber ends secured in very small diameter sleeves have been developed for interfacing fibers with miniature electro-optic devices. Bare fiber ends can also be polished for these interface applications. This is necessary because the industry continually moves toward smaller-scale devices.

- Cable fabrication processes have been developed for making fiber cables that provide a uniformity of light transit time to within 10 picoseconds. These cables can be used with streak cameras that allow measurement of time evolution of an event that may last for only a few microseconds.

- Testing apparatuses and associated analytic techniques are in place to provide the measurement of time-to-failure of optical fiber of a given diameter, under the application of mechanical stress levels induced by bending. Based on the analysis, extrapolations of statistical merit can be made to determine the fiber lifetime, or time-to-failure, at substantially lower bending stress than would be expected for 20- or 30-year fiber survival.
• Special fiber end caps have been fabricated for use of fibers in sensing the presence and timing of a shock wave generated during high-explosive detonation. For these fiber ends, a thin gold coating is applied so that light can be sent into the fibers and retro-reflected internally from the fiber sensor tip end prior to actual use to assure that the fiber is not broken.

• Some applications require optical fiber entry into regions that must be sealed hermetically. Techniques using a CO$_2$ laser have been developed to seal a single fiber in a small machined Kovar connector. The technique also is used to seal two fibers side-by-side in a Kovar connector. Measurements show that the degree of hermeticity of these seals is $10^{-6}$ standard cm$^3$ helium per second.

• Miniature fiber optic splitters and couplers can be custom designed, fabricated and tested. The splitting/coupling ratio can be varied by appropriate choice of parameters in the design. By the nature of the design, the space occupied by a single splitter/coupler is less than one percent of the size occupied by a typical commercial splitter/coupler.

Applications
Increasingly, fiber optics are being used in optical firing systems and in various sensing operations. For example, optical fibers can be used to sense very low levels of hydrogen or placed on high explosives and used to detect and measure the advance of detonation shock waves, as in the High Explosive Radio Telemetry (HERT).
The Kansas City Plant manufactures highly complex single-sided, double-sided and multi-layer designs. Flex circuits and cables can be fabricated for use in high-voltage or low-inductance applications. Our products must meet stringent quality, environmental and electrical requirements.

**Features**

The processes we use to build our circuits and cables are qualified for use in the nation’s nuclear weapons stockpile.

**Circuit Design and Layout**

Customers can present an existing design or work with our designers and engineers to produce a custom layout using popular CAD technologies.

**Phototool and Numerically Controlled Machining**

First-generation artwork is used for phototools. Laser plotting is capable of 0.025-mil resolution. Engineers work closely with numerical control analysts to produce numerically controlled drill, route and verification programs.

**Print and Etch Capabilities**

Dry-film photoresist is applied in a class 10,000 clean room. Conductor lines and spacing of 0.015"/0.010" are routinely produced, with the capability of producing as low as 0.004"/0.004" for prototype orders.

**Machining**

Direct, numerically controlled drilling/contouring is capable of producing through-hole diameters down to 0.008" and blind and buried vias down to 0.010". Hole diameter accuracy is held to +0.001"/-0.002" with a position accuracy of 0.005".

**Hot-Air Solder Leveling**

A hot-air solder leveling machine is used to accurately apply solder to bare copper surfaces.

**Plating**

Flex cables are pretreated by plasma etch and vapor honing. Through-holes are direct-palladium-deposited followed by acid copper sulfate electroplating. Nickel and gold plating are also available options.

**Coverlay Lamination**

Programmed lamination presses are used to apply product-specific time, temperature and pressure profiles to assure a proper adhesion that is free of voids and foreign material.
Precision Dimensional Measurement
Optical coordinate measuring is capable of measuring hole sizes and positions to ±0.0005".

Steel Rule & Hard Die Contouring
Contours are accurate to ± 0.005". Edge spacings as low as 0.050" are possible.

Laser Machining
Coverlay can be laser-stripped to expose circuit lands for solder or weld connections. Cables can also be machined from processing panels, using laser technology, to a contour tolerance similar to or exceeding that of a hard die (± .005").

Hand & Induction Soldering
High-reliability soldering is required, often in very small spaces.

Pulse, Percussive & Laser Welding
Three options are available for welding contacts and wires to flex circuits, depending on materials, geometry and requirements.

Physical & Electrical Testing
Finished products can be tested for physical and electrical integrity. Physical testing includes temperature, pressure, shock and vibration. Electrical testing includes resistance, inductance and high-voltage stand-off resistance. High-voltage testing involves application of up to 10,000 volts DC for a time period with leakage current readings in the micro-amp range.

Applications
The Kansas City Plant designs and produces several types of flat flex circuits and cables consisting of etched metal foil circuitry and polyimide, or mylar, dielectric insulation laminated with acrylic adhesive. These products...
The Kansas City Plant’s high-voltage pulsed power systems include a variety of advanced technologies dedicated to the initiation of high explosives. Many advanced military weapon systems employ electronic initiation systems to detonate explosives in both single- and multiple-detonator scenarios. We are developing product improvements with efforts such as component miniaturization and the integration of precision digital controls. Our miniature initiation systems provide independently controlled distributed firing systems with precise timing control and accuracy, giving weapon designers maximum flexibility and weapon operators maximum safety.

Features
The Kansas City Plant’s high-voltage pulsed power capabilities include:

• Rugged encapsulation processes to ensure longevity and durability of electronics under unfavorable conditions
• Compact fuze systems with repetitive shot capability and a high current discharge
• High power levels in compact packages that provide technological improvements in capacitors (ceramic and wrapped film), HV switches (optical and electrical) and transformers
• Smallest 7,000-volt power supply in existence
• Miniature transformer designs
• Solid-state, high-voltage switches that allow thousands of shots
• Improved design with optical powering and switching that provides greater noise immunity

Current and emerging technologies include:

• Ceramic and nanostructure capacitors
• Miniaturized pot-core and planar transformers
• Miniaturized high-voltage switches (tube-type and solid-state)
• Slapper detonators
• Hermetic optical coupling of power and information

Microtransformer
The microtransformer is the device that provides step-up voltage conversion from the low-voltage power source to charge the high-voltage capacitor and subsequently initiate the multipoint detonator system. The smallest existing transformer for converting 5 V to at least 1 kV utilizes a standard pot-core configuration in a 302 package size (3 mm diameter x 2 mm height).

Solid-State Switches
The output switch in a capacitor discharge unit (CDU) is a critical system component. Kansas City Plant engineers are working to improve the solid-state n-channel MOS-controlled thyristor (n-MCT) semiconductor. The n-MCT switch characteristics are superior to vacuum tubes up to the 1.2 kV maximum operating voltage of the n-MCT. The n-MCT can function reproducibly through millions of cycles in current output and switch closure timing.
Miniature Optical Firing Systems
Leading-edge packaging technologies result in robust, fully integrated laser systems. The miniaturization of our “plug-n-play” laser system, designed for an optical firing system, provides unmatched portability. Even with advancements in size and rugged packaging, this system is extremely cost effective. Laser initiation systems improve weapons safety by preventing accidental firing. These miniature laser packages are also customizable to meet precise customer specifications.

Distributed Initiation Systems
Our distributed initiation control systems provide unparalleled performance for customizing the detonation scenario of a main weapon charge. Highlights of these systems include:

- Independent control of up to 128 individual fire points
  - Resolution of 50 nanoseconds
  - Precision of 25 nanoseconds
  - Total range of 400 microseconds
  - Fire point initiation within 25 nanoseconds of synchronized value
- Fast and precise high-voltage switching

Applications
Capacitive Discharge Systems
High-energy ordnance initiation systems often utilize capacitive discharge units where a high-voltage storage capacitor is used to store energy for a command release through a high-voltage switching device. We have produced compact, highly reliable assemblies that involve the integration of several technologies. Requirements often include low-voltage digital and high-voltage analog subsystems that must coexist in a small package where up to 95% of the volume is occupied by components. Additionally, these systems must withstand environments such as 1 torr vacuum pressure, 3,000 g’s of mechanical shock, and temperature excursions ranging from -65º F to 225º F while providing a 99.7% reliability with over 30 years of product life.
From the smallest wireless telephone to the largest computer systems, microelectronic components are ubiquitous. The Kansas City Plant provides complete design, fabrication, test, assembly and packaging capabilities for hybrid microcircuits, multichip modules and semiconductor devices. And as the demand for smaller microelectronic packages grows, our engineers remain at the forefront of the size revolution. With a host of capabilities in microelectronics fabrication and our steady focus on developing new materials and techniques for microelectronics assembly, we are delivering components that are smaller, lighter and cheaper but that perform better than ever.

**Features**

**Fabrication**

*Substrate Materials*
- Thin film networks consisting of tantalum, tantalum nitride, palladium, titanium and gold
- Thick film networks consisting of gold, silver, palladium, platinum-gold and palladium-gold as conductor materials
- Low temperature cofired ceramics

Thin film metallizations (500 angstroms to 10 microns thick) are applied to substrate materials such as alumina, glass, silicon, fused silica, sapphire and aluminum nitride. Patterning of the films can achieve lines and spaces down to 1 to 3 mils and deposited tantalum nitride resistors can be trimmed to a tolerance as tight as +/- 1%.

Thick film metallizations (12 to 18 microns thick) are screen-printed on substrate materials such as alumina and aluminum nitride. Screen-printed lines and spaces can be achieved down to 7 mils +/- 10%. Printed resistors can be trimmed to a tolerance as tight as +/- 1%. Thick films are primarily used for products requiring a broad range of resistor values but less precise line definition.

Low temperature cofired ceramic (LTCC) metallizations are applied to layers of ceramic/glass tape that are collated together and fired to become a single piece of ceramic. The metallizations include gold, platinum-gold and palladium-gold as conductors along with a resistor ink series. The printed resistors can be trimmed to a tolerance as tight as +/- 1%.
The Kansas City Plant leads in developing new microelectronic technologies to meet design requirements for more electronic functionality in smaller volumes. A number of technology thrusts in microelectronics fabrication include:
- Photosensitive BCB (benzocyclobutane) coatings
- Thick film, high-voltage ceramic capacitors, sensors and inductors
- Buried passives in LTCC
- Plugged thin film vias
- High-frequency LTCC tape

Assembly & Packaging
The Kansas City Plant offers a large breadth of state-of-the-art assembly and packaging technologies for microelectronics, MEMS and optoelectronic devices. In addition, we provide extensive electrical testing capabilities for these products. Some of the features we offer include:
- Gold and aluminum wire bonds from 0.7-mil to 15-mil diameter with 70-micron pitch
- Flip chip attachment using gold stud bumps and solder bumps to 1-micron placement accuracy to 100-micron pitch
- Conductive and nonconductive epoxy die attach with 10-micron placement accuracy
- Eutectic semiconductor die attach using gold-silicon with 10-micron placement accuracy
- Hermetic solder gold-silicon or weld sealing with fine leak rates less than $1 \times 10^{-8}$ atm. per cc per second of helium

Assembly
- Assembly techniques to support microelectronic fabrication include:
  - Automated gold and aluminum wire bonding
  - Epoxy and eutectic semiconductor die attach
  - Flip chips
  - Chip scale packaging
  - Hermetic package sealing
  - Microcircuit preconditioning

Packaging
- Customizable microsystems packaging allows precise placement with 1-micron accuracy of flip chips, MEMS and fiber optics while package materials control electrical noise, protect components from the environment and dissipate heat. Cutting-edge capabilities include:
  - Flip chip bonding and chip scale packages to reduce size by 70 percent
  - Stacked and thinned die to reduce height by 80 percent
  - Packaged integration of MEMS, semiconductors, optoelectronics and optical fibers
  - High-voltage power devices (1,000 volts at 100 amps) packaged together with small signal devices for power hybrid applications
  - RF semiconductor packaging and testing
  - RF hybrids up to 20 GHz using thin film substrates
Applications: Assembly & Packaging

At the Kansas City Plant, microelectronic assemblies are packaged for use on an array of critical systems including magnetic and hydrogen sensors, telemetry systems, firing systems, radar systems, high-speed networks, power hybrids and integrated microsystems containing MEMS, semiconductors and optoelectronics.

- Flip chip production for high explosive radio telemetry (HERT) flight tests
  - Flip chip bonding is a process that allows semiconductors (chips) to be attached upside-down to a substrate, providing both the mechanical and electrical connections between devices and substrates
  - Using a new flip chip bonding process, Kansas City Plant microelectronics assembly teams have produced photodetector arrays for HERT systems
  - Using this process, photodetector devices were attached face-down on a thick film network
  - The completed photodetector arrays measure approximately 1” x 0.2” x 0.03”

- Microelectronics packaging for radio frequency (RF) components
  - Chip and wire assembly processes have been developed for the microelectronic packaging of high-frequency RF components up to 20 GHz
  - After the RF components are fluxless-soldered to metal and to LTCC or metal packages, the uniformity of die attach coverage is determined by X-ray and scanning acoustic microscope analysis

- High-speed, high-density multichip modules are used for digital applications requiring clock frequencies of up to 800 MHz
- LTCC substrates have up to 30 percent semiconductor chips per unit area in the form of application-specific integrated circuits and other large semiconductor devices. The semiconductor devices are interconnected utilizing high-speed automatic gold and aluminum wire bonders.
Microelectronics

Fabrication

- Capacitor technology
  - Dielectric: tape-cast ceramic (2 to 10 mil dielectric thickness)
  - Dielectric (K) is approximately 900 @ operating voltage (more than 200 V)
  - Dielectric field strengths greater than 500 V/mil
  - Very low ESR and tan δ

- Results
  - 0.1 uF, 0.25” x 0.29”, 0.08” thick, 1 kV
  - 10 uF, 3.5” x 4.25”, 1” thick, 2kV
  - 0.1 uF, 0.5” x 1”, 0.08” thick, 1.7 kV
  - 0.05 uF, 0.350” x 0.350”, 0.100” thick, 1 kV
  - 0.03 uF, 0.5” x 1”, 0.125” thick, 3 kV

- Insulator technology
  - Tape-cast ceramic material, thick film printing
  - Variable geometries, including ring, cylinder and cone
  - Material is scaleable (0.5” to 8.75” diameter)
  - Typical breakdown testing greater than 200 kV/cm

High-performance ceramic insulators

High-voltage thick film capacitors
The Kansas City Plant’s experience with radio frequency (RF) and microwave systems began decades ago with the production and testing of weapon radar altimeters. Today our capabilities have expanded to include telemetry systems, transmitters, receivers, antennas and wireless networks. With emerging design capabilities and packaging, production and testing resources that are second to none, we produce some of the highest quality RF and microwave assemblies available.

**Design**
- Custom RF and microwave integrated circuit designs to meet unique customer needs, including miniaturization, custom frequencies and custom transmission schemes
- Experience in design of modulators, power amplifiers, oscillators
- RF output power devices to 25 watts
- Data rates to 100 megabits/second in burst mode and 40 megabits/second in continuous mode
- Expertise in various modulation schemes, including frequency modulation (FM), frequency shift keying (FSK), quadrature phase-shift keying (QPSK) and quadrature amplitude modulation (QAM)
- Experience in frequencies from megaHertz to 10 gigaHertz
- Full suite of RF/microwave design and simulation tools, including Agilent ADS, Ansoft and MicroWave Office
- Custom packaging solutions for RF isolation and shielding

**Manufacturing**
- Secure, state-of-the-art clean rooms, laboratories and production facilities ensure high-quality production
- Capability to produce chip and wire, multichip module, surface mount technology and through-hole designs
- Automatic component placement for speed and precision assembly
- Capability to use both custom design and commercial off-the-shelf (COTS) components
Testing
- Custom design and manufacture of fully automated RF electrical test equipment
- Data acquisition and transmittal to data storage for online retrieval and analysis
- Active laser tuning capabilities
- Environmental and destructive testing including HALT/HASS
- Capability for open set-up testing of RF systems in development or low-volume production, including tuning, programming, troubleshooting and acceptance
- Anechoic chamber for performing antenna characterization and test measurements

Applications

Radar Fuze
The Kansas City Plant has been producing high-quality, highly reliable radar systems for weapons applications for over 50 years. These solid-state designs, and the antenna systems that support them, are used as primary fuzing options for both gravity bombs and re-entry bodies. These ruggedized systems are compact and built to exacting standards.

Material Monitoring
The electronic sensor platform (ESP) is a subsystem within the material monitoring system (MMS) for plutonium management. The primary function of the ESP is to detect unauthorized disturbances of the monitored material and report the event to a control center via an RF data link. The ESP can also periodically gather data from internal or external sensors and transmit these data at programmed state-of-health intervals or when polled by the MMS system. The information is transmitted via radio frequency to an interrogator transceiver for processing by the MMS system. After this information is processed, the state of health of the stored nuclear material can be immediately assessed by an end user. Thus, this system enhances the safety, security and accountability of the material.

High-Explosive Radio Telemetry
The Kansas City Plant has applied its RF capabilities to creating a unique transmitter that captures and transmits data on the performance of a high-explosive detonation event in a weapon flight test environment. This device, known as the high-explosive radio telemetry (HERT), gathers timing data from an array of fiber optic sensors. The HERT transmits data at a rate of 100 megabits/second at S-band frequencies using a unique QAM modulation scheme. This system includes several RF custom designs by the Kansas City Plant, including the modulator, local oscillator and power amplifier. The current product is being produced using custom integrated circuits and multi-chip modules.
The Kansas City Plant has design and production capabilities for a wide variety of round-wire cables and interconnects. We routinely meet the most stringent requirements as our products perform in the high temperatures, g-forces and voltages inherent in nuclear weapons applications.

Typical products that we manufacture include:
- Bridge wire detonators
- Coaxial cables
- Rigid RF cables
- Specialty multi-wire cables
- Shielded cable assemblies
- Hybrid flex/round wire configurations
- Lightning arrestor connectors (LACs)

Features

The processes used to build these products are certified for use in the nation’s nuclear weapons stockpile. Key processes and capabilities include:
- Cable preparation - wire cutting, stripping and tinning
- Soldering - hand soldering and resistance soldering for very small spaces
- Encapsulation - urethane, epoxy and neoprene
- Plasma cleaning - surface activation to clean and promote adhesion for processes such as marking
- Marking - a variety of methods for marking difficult materials and surfaces
- Pulse and percussive arc welding for joining connector contacts to wires
- Physical and electrical testing to ensure the integrity of finished products
- Physical testing - temperature, pressure, shock and vibration
- Electrical testing - resistance, inductance and high-voltage stand-off resistance
- High-voltage testing that involves the application of up to 10,000 volts DC with leakage current readings in the micro-amp range
- Electrical testing of RF/coaxial cables including measurement of impedance, insertion loss, reflection coefficient, phase and VSWR over a frequency range of 45 MHz to 18 GHz
Applications
Coaxial cables are used in high-voltage and radio-frequency applications, including radars, fire sets and telemetry. These cables consist of materials ranging from flexible cable and intricate connectors with welded terminations to solid copper, jacketed cable with soldered radio frequency connectors.

Multi-wire cables consist of multi-pin connectors, wire and sleeving and are fabricated in numerous configurations to interconnect various components. Round wire cables are most common (twisted wire bundles in sleeving). Round wire laminated cables are used for limited or intricate space applications and neoprene jacketed cables are used for harsh external working environments.

Lightning arrestor connectors are advanced interconnect nuclear safety devices designed to limit voltage during lightning strikes and in other extreme high-voltage, high-temperature environments.
Manufacturing tomorrow’s products means challenging today’s technologies. That is why Kansas City Plant scientists and engineers lead the way in applying electro-optics to solve existing problems as we push the science into the future. We provide a wide range of development services in the areas of lasers, electro-optical systems, fiber optics, integrated optics, photonics and the electronics to drive these systems. Our 50 years of digital, analog and high-voltage experience, coupled with our electro-optical expertise, provides the vital skills necessary to make ruggedized lasers that withstand extreme environments beyond those expected of commercial lasers.

Features
Within our highly secure facilities is a complete spectrum of one-of-a-kind lasers. We offer:
- Rapid custom hardware design, fabrication and assembly
  - Flashlamp and diode pumped laser systems
    - High-energy, low-duty cycle, CW and repetition rate
    - Electro-optic and passive Q-switched systems
  - Electro-optic and acousto-optic devices
  - Nonlinear optics (0.265 µm -1.06 µm)
  - Optical alignment and high-energy fiber injection
  - Single-mode fiber and waveguide alignment
  - Fiber optic sensor systems
  - Diffractive optical elements
- Robust configuration and packaging that set standard for durability
  - Hermetic sealing of fiber optics and laser units allows use under adverse field conditions and in high-radiation environments with proven reliability even after prolonged storage
  - Operable through 30 g’s random vibration and long duration shock to 3,500 g’s
  - Complete functionality under wide temperature extremes, from -67˚ F to 311˚ F
- Integrated power control electronics to support portable systems
- Electro-optic diagnostics and characterization facilities to provide precise operating characteristics of each delivered laser system
Applications

The Kansas City Plant’s laser capabilities range from lasers for firing and improving the safety of explosive systems to laser chemistry for environmental detection and remediation.

Miniature Optical Firing Systems

Leading-edge packaging technologies result in robust, fully integrated laser initiation systems. These systems, designed for the optical initiation of explosives, improve weapons safety by preventing unintendedfirings. The Kansas City Plant’s firing systems provide:

- Unmatched portability through miniaturization
- Advanced rugged packaging
- Cost effectiveness
- Customized packages for specialized applications

Explosives Initiation Testing

Our sophisticated explosive initiation testing systems are built to test the response of explosive materials to various types of lasers and configurations. With these highly configurable systems, users can:

- Vary wavelength, energy and pulse width
- Hand-carry the unit into the field
- Adjust the output parameters
- Replace the optical fibers without any additional alignment

These laser-based explosives detonation systems are designed to enhance range safety, incorporating both electrical and optical safety interlocks. Packaging is a key attribute to the success of these systems. Not only are they required to be built quickly and economically and to be reusable, but they must also be designed to function under extreme field conditions.
Our surface-mount facility delivers rapid turn-around manufacturing capability at commercially comparable costs for both production and prototype solder-based printed wiring assemblies, hybrid microcircuits and electronics assemblies. We employ expert electronics assembly teams knowledgeable in printed circuit board and chassis layout and assembly, ball grid array assembly, and hybrid packaging. All operations are performed in electrostatic-discharge-protected areas, and one area of our surface-mount facilities is vaulted with limited access and two-person control areas for those projects that are strictly need-to-know.

Features
- We can produce high-density, two-sided, complex multi-layer boards that range in size from less than 1 in² to 324 in²
- Our surface-mount placement machines can place BGAs, fine-pitch components down to .012” spacing and chip components as small as 0.02” x 0.01”
- Our production equipment uses an automated record-of-assembly system that has the ability to generate real-time records of component part numbers, circuit designators, lot numbers, assembly part numbers, serial numbers and manufacture dates of the product

Our electronics assembly capabilities include:
- Automated solder paste dispensing and stenciling
- Automated surface-mount placement
- Semi-automated placement of high-density through-hole and surface-mount devices
- Nitrogen-purged convection oven reflow process
- Aqueous, alcohol and D-limonene cleaning processes
- Ionic cleanliness testing
- Hot air reflow/rework station
- Automated conformal coating application
- Potting
- Automated optical inspection
- X-ray inspection
- Micro-abrasion equipment

Low temperature cofired ceramic surface mount assembly
Applications
Printed wiring assemblies are used in a wide range of automotive, aerospace, telecommunications and specialty applications involving electronics.
At the Kansas City Plant, we manufacture low-volume, complex, highly reliable electronic products used in extreme environments. Our telemetry department is organized as a factory within a factory to provide exceptional responsiveness and cost effectiveness for custom low-volume requirements. We can provide for your telemetry needs from conceptual definition to design, prototyping and manufacturing development through continuing manufacturing.

Features
Our telemetry engineers have specialized experience in L-band (0.39 to 1.55 GHz) and S-band (1.55 to 5.2 GHz) frequencies, as well as various modulation schemes including frequency modulation (FM), frequency shift keying (FSK), quaternary phase-shift keying (QPSK) and quadrature amplitude modulation (QAM). We have the expertise to tailor our telemetry designs to our customers’ needs. For example, Kansas City Plant telemetry designs:
- Operate from -20°F to 200°F
- Withstand shock environments up to 20,000 g’s
- Transmit data up to 100 megabits/second
- Collect data with a wide variety of electronic and optical sensors
- Have telemetry or contained memory systems with field readout capability

Our layout and assembly features include:
- Technicians capable of assembling products directly from engineering drawings
- Automated pick-and-place up to a 12” board with .0024” placement accuracy for components

Our telemetry testing capabilities include:
- Neutron generating test
- Advanced automated test
- Temperature testing
- Shock and vibration testing
Applications

Telemetry for the Joint Flight Test Program
The Kansas City Plant’s telemetry systems are used in the NNSA’s Joint Flight Test Program. This program simulates an actual mission and is used to certify the viability of the nuclear weapons in our stockpile. The flight test validates the compatibility of the weapon with its delivery vehicle as well as its nuclear functions. Because of the expense of flight testing, the quality level of the telemetry is critical.

Our telemetry systems use RF transmission as a means of data transfer to the user. The telemetry system must contain an RF transmitter and an antennae system. Radiating telemetry systems are either pulse code modulation (PCM)/FM) for digital data only, or a combination of PCM/FM and analog FM, when mixed analog and digital data is transmitted. The transmitters used in these systems operate in the S-band frequency range.

High-Explosive Radio Telemetry
The Kansas City Plant has applied its telemetry capabilities to creating a unique transmitter that captures and transmits data on the performance of a high-explosive detonation event in a weapon flight test environment. This device, known as the high-explosive radio telemetry (HERT), gathers timing data from an array of fiber optic sensors. The HERT transmits data at a rate of 100 megabits/second at S-band frequencies using a unique QAM modulation scheme. This system includes several custom designs by the Kansas City Plant, including the modulator, local oscillator and power amplifier.

HERT incorporates state-of-the-art miniaturization and interconnect technologies including flip chips and integrated electronic/optoelectronic packaging.