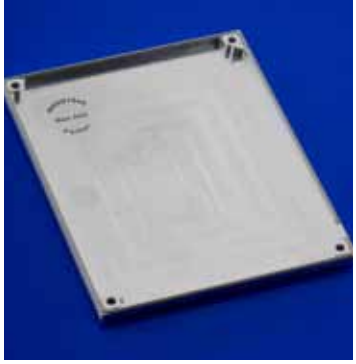
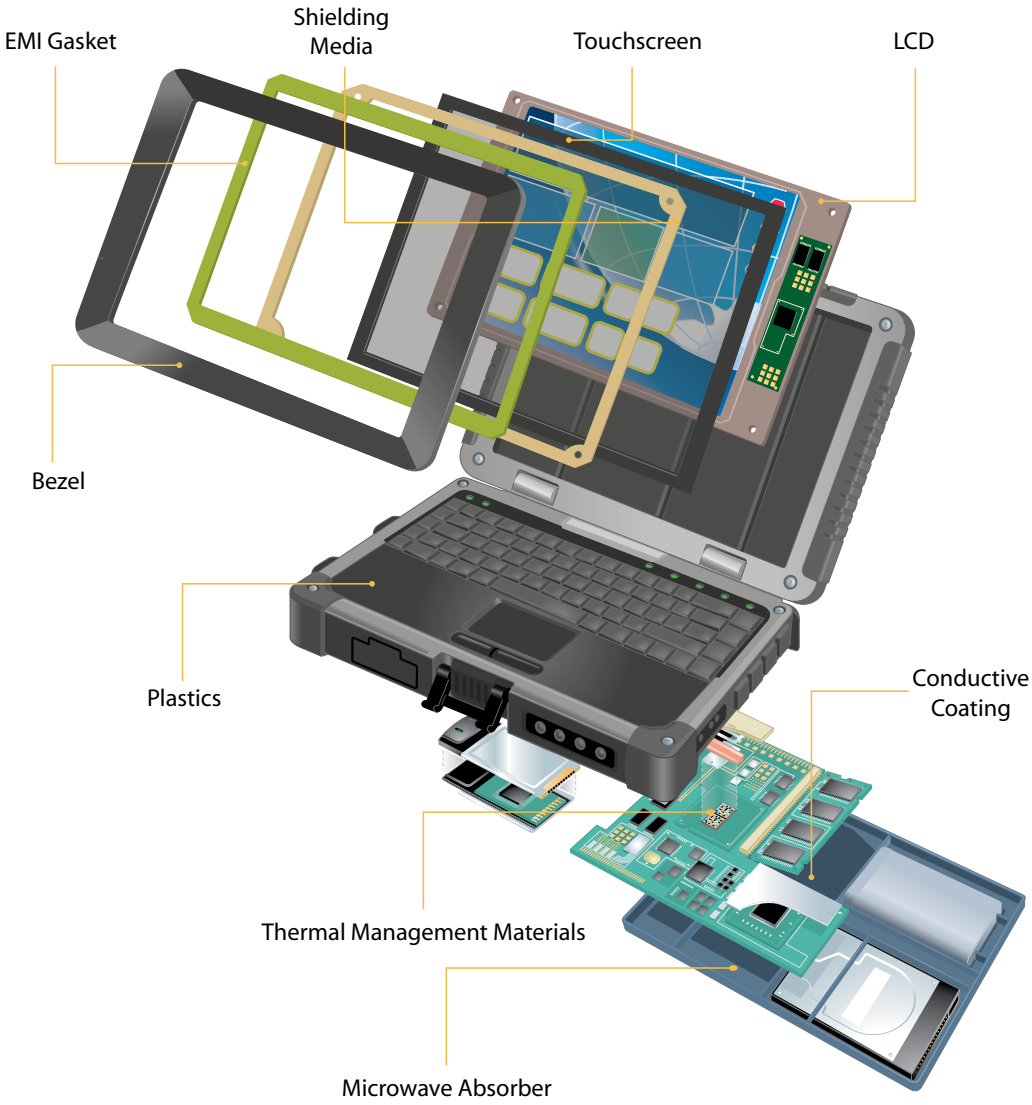


aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding

Enhancing customer value through vertical integration of design expertise, materials and components.



Integrated Solutions
From Design Concept Through Supply Chain Management

Parker | Chomerics

ENGINEERING YOUR SUCCESS.

Parker Chomerics Capabilities Include:

EMI SHIELDING MATERIALS

- Conductive elastomer gaskets
- Conductive foam based gaskets
- Conductive compounds – adhesives, sealants and caulks
- RF and thermal/RF absorbing materials
- EMI shielding plastics and injection molding services
- **Coatings – direct metallization and conductive paints**
- Metal Springfingers, metal mesh and combination gaskets
- Foil laminates and conductive tapes
- EMI shielding vents
- Cable shielding – ferrites and heat-shrink tubing
- Compliance and safety test services

THERMAL MANAGEMENT & CONTROL

- Thermally conductive gap filler pads
- Dispensed thermal gap fillers
- Silicone-free thermal pads
- Phase-change materials (PCM)
- Polymer solder hybrids (PSH)
- Dispensable thermal compounds
- Thermal grease and gels
- Insulator pads
- Thin flexible heat spreaders
- Custom integrated thermal/EMI assemblies

METAL HOUSINGS*

- Machined
- Stampings
- Die castings

*Chomerics will outsource and act as lead supplier for metal housing options using Chomerics product solutions.

PLASTIC INJECTION MOLDING

- PREMIER® and other filled electrically conductive plastics
- Traditional thermoplastics
- EMI and cosmetic coating services
- EMI and environmental gasket integration
- Assembly, pad printing, hot stamping, welding and heat staking
- Insert molding, two-shot molding and overmolding capability

OPTICAL DISPLAY PRODUCTS

- EMI shielding filters (Conductive film & wire mesh)
- AR/contrast enhancement filters
- Plastic or glass laminations
- Hard coated lens protectors
- Touch screen lenses
- Optical assembly including housings, bezels, frames, gaskets and touchscreens

CUSTOMER RESPONSIBILITY

WARNING – USER RESPONSIBILITY

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

- This document and other information from Parker-Hannifin Corporation, its subsidiaries and authorized distributors provide product or system options for further investigation by users having technical expertise.
- The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application, follow applicable industry standards, and follow the information concerning the product in the current product catalog and in any other materials provided from Parker or its subsidiaries or authorized distributors.
- To the extent that Parker or its subsidiaries or authorized distributors provide component or system options based upon data or specifications provided by the user, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the components or systems.

OFFER OF SALE

The items described in this document are hereby offered for sale by Parker Hannifin Corporation, its subsidiaries or its authorized distributors. This offer and its acceptance are governed by the provisions stated in the detailed "Offer of Sale" elsewhere in this document or available at www.chomerics.com or www.parker.com.

Parker Chomerics

Integrated Solutions
Table of Contents

EMI Shielded Thermoplastic Housing Supply Service

SUPPLY CHAIN MANAGEMENT

Parker Chomerics can supply a complete single source solution to your EMI shielding needs in plastic housings regardless of technology. We can

- Reduce your total cost of ownership up to 60% by eliminating secondary machining or providing parts consolidation
- Reduce part weight by up to 75% with thinner walls using a lower material density when compared to aluminum die castings for weight sensitive applications
- Reduce your time to market by providing a single point for part and tooling design including all tool manufacture
- Eliminate cost with multi-supplier part supply logistics and quality management

Our engineering staff can take the project from concept through production. Your project will be assigned a program manager. The engineer will manage

- Part design assistance
- Material selection
- Tooling design & manufacture
- Production start-up with part approval

PLASTICS INJECTION MOLDING

Parker Chomerics Webster Plastics Business Unit has over 45 injection molding presses ranging from 22 to 1,000 tons, enabling the molding of virtually any part. We can use Parker Chomerics EMI Shielding PREMIER® thermoplastic or non-conductive thermoplastics with secondary EMI coatings.

If the design calls for secondary conductive coatings (paints, vacuum metallization, selective plating, or thermal spraying) our in-house or authorized suppliers can provide the solution.

If secondary assembly is needed, we have competency in

- Heat staking
- Sonic welding
- Mechanical assembly

We can apply cosmetic coatings, using manual or robotic spray. Labeling and graphics can be added using pad printing or silk screening.

OPTICAL DISPLAYS

If the device requires a display filter, the Optical Products Business Unit can design and supply using the latest technology. The filters can provide EMI shielding and or improve viewability in any environment. Materials choices can deliver resistance to harsh environments and severe mechanical stress. The display filter may be incorporated into the housing or bezel, ready for assembly.

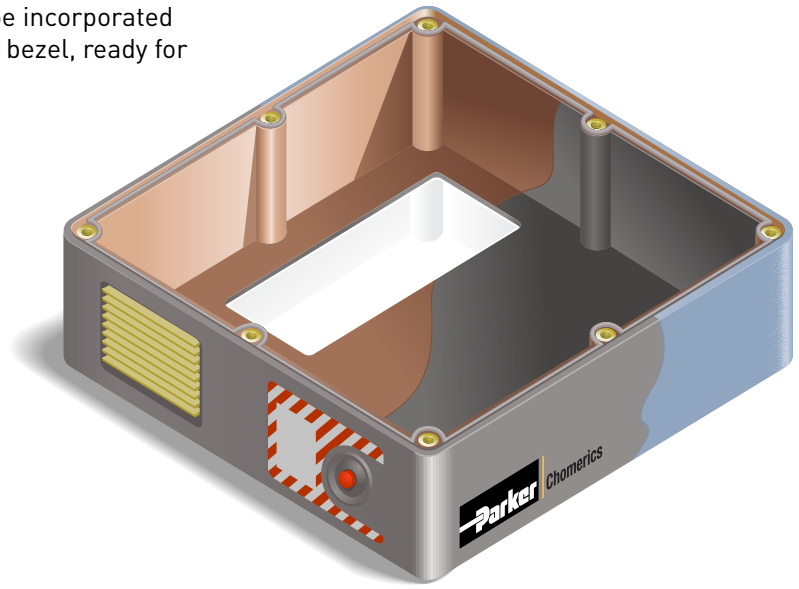
EMI SHIELDING

EMI shielding gaskets can be added as an integral part of the housing using our in house supply of all gasket technologies. If thermal management components are needed we can supply heat sinks with thermal interface materials integrated into the part.

EMC TESTING

Our Test Services Business Unit can perform EMC and Safety compliance testing when the device is ready to go to market We will verify performance and help get your product on the market.

Parker Chomerics wants to be your single source of supply for an integrated solution for your EMI shielded housing. Contact us at 781-935-4850 to learn more about our service.



Injection Molding

Parker Chomerics Webster Plastics Business Unit has over 60 years experience in injection molding precision engineered thermoplastic parts at our Fairport NY facility. Our facility is ISO/TS 16949 certified and was recognized by Industry Week as a Best Plant winner. We regularly mold over 300 different polymer systems to exacting tolerances to supply the Telecom, Information Technology, Consumer Electronics, Military Electronics, Medical Equipment and Transportation markets. With both EMI shielding and non-conductive thermoplastic polymers to choose from, we can meet your performance needs.

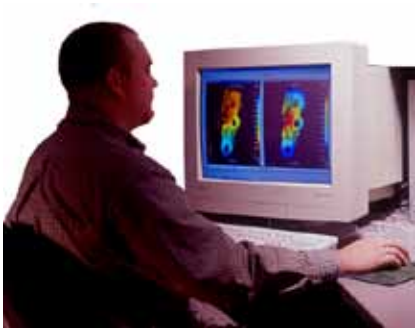
Our engineering staff can take the project from conceptual model through production. When the program is initiated a project engineer will be assigned. We can assist in part design working within your parameters. Part geometry will be optimized for the highest performance and lowest possible material, processing and tooling costs. Using FEA we will ensure part performance to your specifications.

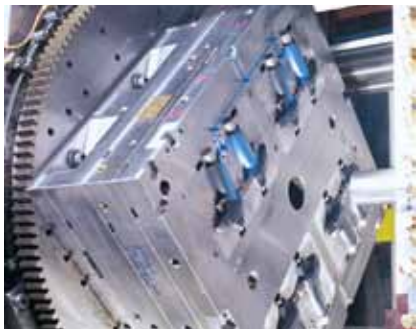
Upon part design completion a mold flow analysis allows us to create a 3-D of flow patterns for the injection molding process. We can graphically and statistically visualize flow rates, pressures, and temperature values throughout the entire part. This tool helps us adjust the molding process by locating entry gates and compensating for variable pressures or cooling rates to avoid part warpage or uneven shrink rates. It will also alert us if part design has to be modified to assure the part's strength and integrity.

We will source the tooling and build the optimal mold. Before entering production the tool is inspected to a tolerance within one ten thousandths of an inch. First articles are fully inspected with full PPAP (Production Part Approval Process) reporting back to the customer. Our in-house tooling department will keep the tool in optimum condition throughout its useful life.

With over 45 injection molding presses ranging from 22 to 1,000 tons we can injection mold virtually any part. Our advanced closed-loop materials delivery system cleans, conditions and delivers precise blends of raw materials to each injection molding machine. An efficient micro filter system traps dust and fine particles and measures the proper portion of re-grind material, delivering high performance thermoplastics 100% of the time.

Once the part enters production a Lean Manufacturing Cellular production team using real time process control takes over to ensure quality and on time delivery. The machines are networked to a CIM system which presents process parameter data to the operators. By anticipating problems before they have a chance to occur, quality is built into the part.





EMI Shielding & Non-Conductive Thermoplastics

Parker Chomerics is in a unique position to offer housing material choices using either EMI Shielding electrically conductive PREMIER or non-conductive thermoplastics.

PREMIER is available in two polymer grades, PC/ABS and PEI. Both are filled with a blend of nickel plated carbon fiber and nickel graphite powder. The engineered filler blend results in high shielding performance at lower volume filling, allowing a high retention of base polymer mechanical characteristics.

The single pellet material allows cost effective injection molding as with any other filled polymer system.

Since PREMIER injection molded parts need no secondary EMI coating they offer the highest potential for part cost reduction. Depending on part size, cost reductions of up to 60% are obtained. As compared to metal die castings, no machining is needed to obtain tolerance control. As compared to standard paint/plated plastics, no secondary operations are required to obtain shielding. The fillers within PREMIER increase the material cost so as the part size increases, the savings from EMI secondary coating operations are reduced.

PREMIER is chosen over non-conductive thermoplastic with secondary EMI coatings for parts with

- Low cosmetic requirements
- Small parts
- < 85 dB shielding effectiveness

Assembly operations on PREMIER are no different than non-conductive versions of the same base polymers. Paint can be applied; however due to the fiber a high gloss finish is not obtainable. A matte finish is recommended.

To learn more about PREMIER please go to:

www.parker.com/chomerics

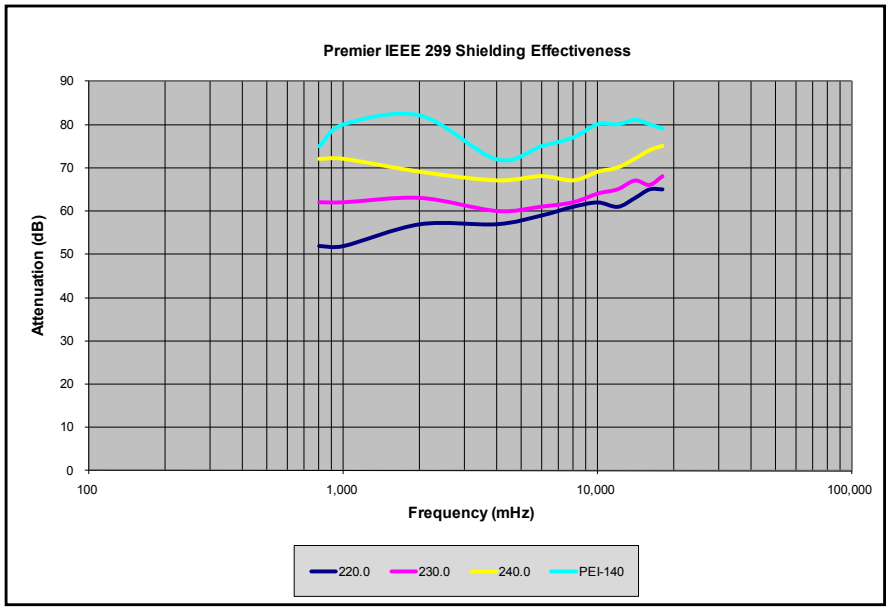
Non-conductive thermoplastics with secondary EMI coatings are generally chosen in place of EMI shielding conductive thermoplastics for parts with:

- High cosmetic requirements
- High temperature
- Chemical resistance
- Low water absorption
- > 85 dB shielding effectiveness
- Thin walls (<1.0 mm)
- Large parts (>200 gram weight)

The choice of thermoplastic is influenced by environmental, mechanical, maximum temperature, flammability and part design needs. Our design engineers can work through your needs and design in the optimum material. A successful plastic part molding application combines all materials and processes to provide the optimal cost model.

Commonly used materials:
ABS, PC, PC/ABS, PBT, PEI and Nylon all have grades which can be post molding treated with an EMI coating and provide shielding up to 100 dB. They each provide a unique performance versus cost benefit. Our expertise is not limited to these materials and we can process any polymer you may need. Let our design engineers evaluate your needs and make recommendations.

If you are considering a metal-to-plastic conversion, polymers with heat distortion temperatures up to 280 °C can be used to provide the desired performance.



EMI Shielding Coating / Plating

There are many secondary operation technologies used to shield thermoplastic housings.

- Conductive paints
- Electroless plating selective & non-selective
- Sputtered vacuum metalization
- Thermal spray

We can have any of these applied to the housing either through in-house application or our authorized suppliers.

The primary factors to consider when choosing a secondary EMI coating are:

- Shielding effectiveness
- Environmental resistance
- Part geometry
- Part production volume

Applied material cost must be balanced with performance to find the best solution. Table 1 shows a relative ranking of the technologies.

Chomerics in-house selection of paints contains all commonly used filler and paint binders. They range from 50 dB controlled environment Ni/Acrylic to >90dB aerospace grade Ag/Epoxy systems. If we do not make the needed paint we will obtain it and apply it for you. We have in house painting abilities ranging from manual spray to robotic paint lines. These are complemented by an authorized paint spray supplier allowing us to provide the best solution.

Metalization by sputtering or plating are done by our authorized supplier base. Sputtered aluminum is a good solution in low shielding applications where volume supports a higher tooling cost and the batch process. Plated nickel over copper can be done selectively or non-selectively for internal non-cosmetic parts. Ni/Cu provides excellent shielding, however it is not recommended for high humidity uncontrolled environments.

Thermal spray of tin-zinc by Parker Chomerics ECOPLATE® process provides high shielding with excellent resistance to harsh environments.

There is no single solution and all solutions vary in cost. Since Parker Chomerics is unique in offering all technologies, let our design engineers assist you in making the best choice for shielding your plastic housing at the lowest total cost of ownership.

Table 1 - EMI Material Application - Relative Cost and Effectiveness

	Filler	Binder	Shielding Effectiveness 200 MHz to 18 GHz	Humidity Resistance	Maximum Operating Temperature	Solvent Resistance	Abrasion Resistance	Masking Tooling Cost	Batch Set Up Costs	Applied Cost
Paint	Ni	Acrylic	*	*	*	*	*	$$	$	$
	Ag/Cu	Acrylic	***	*	*	*	*	$$	$	$$
	Cu	Urethane	***	*****	*****	*****	***	$$	$	$$$$$
	Ag	Urethane	****	*****	*****	*****	***	$$	$	$$$$$
	Ag	Epoxy	****	*****	*****	*****	****	$$	$	$$$$$
Vacuum Metalization	Al	N/A	*	*	***	***	**	$$$$	$$$$$	$
Selective Plating	Ni/Cu	N/A	***	*	***	***	**	$$	$$	$$
Non-Selective Plating	Ni/Cu	N/A	***	*	***	***	**	$	$$	$
Thermal Arc Spray	Sn/Zn	N/A	*****	*****	*****	*****	*****	$$$$$	$	$$

See page 14 for shielding data on secondary EMI coatings / plating

Legend	Lowest	Highest
Effectiveness	*	*****
Cost	$	$$$$$

Optical Assemblies

Parker Chomerics offers a fully integrated plastic or glass optical assembly including housings, bezels, frames, gaskets, cosmetic finishing and supply chain for both EMI and non-shielding applications. We work with your design to incorporate all required mechanical, electrical and cosmetic requirements. We offer EMI compliance and safety testing at interim design stages or at final system certification.

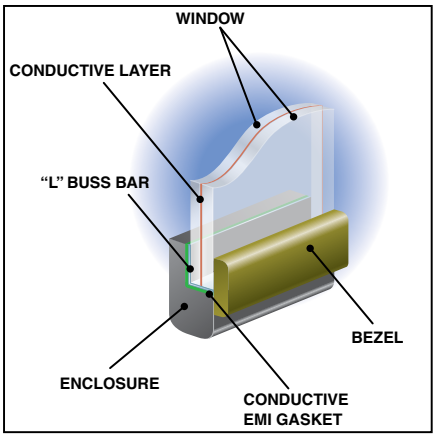
Options for housings, bezels and frames include machined aluminum with Mil C 5541 Class 3 conversion coating or injection molded using Premier electrically conductive plastic or traditional thermoplastic with/ without secondary EMI coating. The specifics of the application environment, cosmetic and electrical requirements, part geometry and cost targets will drive the choice for bezel/frame materials.

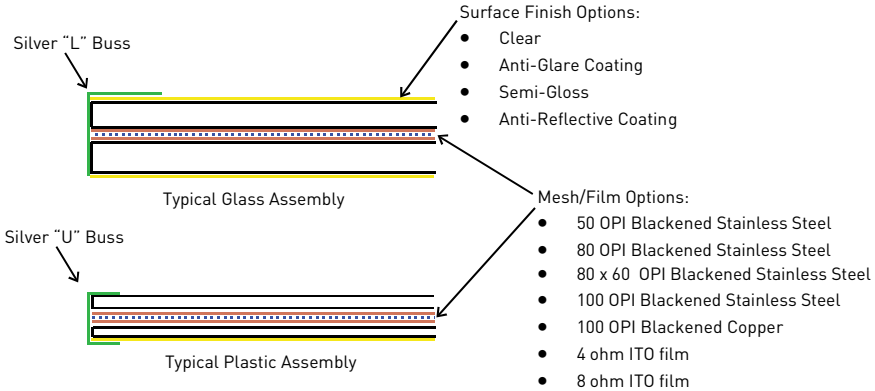
Parker Chomerics will integrate environmental and/or EMI gaskets, tapes, absorbers and thermal management materials into the optical solution. Our wide variety of indoor and outdoor EMI gaskets can be dispensed, or retained with adhesives or mechanical techniques. Materials range from fabric over foam to finger stock to elastomeric. Our line of soft elastomers (Shore A hardness <50) are an ideal choice for an EMI/environmental seal on an optical solution with a plastic housing, frame or bezel.

See Optical Products Brochure (SG 1006) for further details

Parker Chomerics will integrate pad printing, silk screening, hot stamping and decals. We can work with you to design and build the silk screening artwork and will obtain and maintain all tooling to add these features. A cosmetic exterior painting can be added using our authorized painting suppliers. Customer specified hardware can be incorporated along with a variety of final assembly techniques including heat staking and sonic welding to complete the integrated optical solution.

Touchscreens and other user enhancements can be integrated into the optical assembly. Optical bonding materials and techniques are available to improve sunlight readability, optical clarity and contrast enhancement while reducing reflection and the possibility of lamination contaminants.





Secondary Assembly, EMI Gasketing/Thermal Management

SECONDARY ASSEMBLY
Often plastic housings need assembly of secondary components whose features could not be designed into the base part. Parker Chomerics can assemble these elements onto the housing using:

- Heat staking
- Sonic welding
- Solvent bonding
- Mechanical attachment

Depending on the part, assembly is often done at the injection molding press within the cycle time. If we cannot mold these components we will source them including threaded inserts and attachment hardware. The unit is ready for final assembly.

COSMETIC FEATURES
Parker Chomerics can supply component or part decorating using:

- Pad printing
- Silk screening
- Hot stamping
- Decals

All we need is the base artwork and we will obtain and maintain all tooling to add these features. A cosmetic exterior coating can be added using our authorized painting suppliers.

GASKETING (4,5,6)
For many devices an EMI shielding gasket is needed to complete the shielding design. Parker Chomerics has a complete line of EMI gasketing grades that can be installed on the part. For indoor or outdoor applications we have the material. The gaskets can become an integral part of the housing using

- Overmolding
- Dispensing
- Adhesives
- Mechanical retention

This simplifies final assembly allowing you to have only one part to order, inventory and handle. Materials range from fabric over foam to finger stock to elastomeric. Our line of soft elastomers (Shore A hardness <50) are a perfect solution for an environmental/EMI seal on plastics housings.

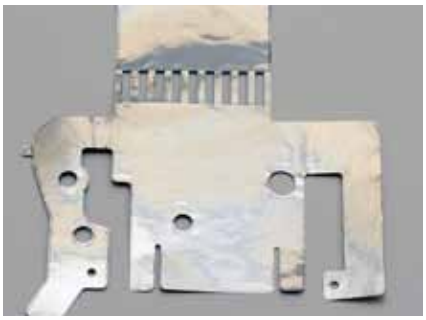
THERMAL MANAGEMENT (2)
Electronic devices often generate excessive amounts of heat during operation which must be channeled from the device. Using heat sinks or other active cooling devices, we can provide thermal management. We can supply these elements on the unit by insert molding or post molding attachment. The thermal elements can be supplied with thermal interface materials ready to efficiently transfer the heat.

Parker Chomerics can also integrate honeycomb based EMI airflow filters to improve a thermoplastic housings shielding and cooling performance.

MICROWAVE ABSORBER MATERIALS
High frequency devices for telecom, medical and military systems often use microwave absorber pads made from powder filled silicone or foam materials. Parker Chomerics can integrate these materials into a plastic housing assembly for higher performance attenuation.

TAPES, FOIL AND FILM LAMINATES (1,3)
Parker Chomerics can integrate fabric or foil tapes with electrically conductive adhesive and or foil/film based faraday cage laminates or ground straps as part of a system solution.

(1)



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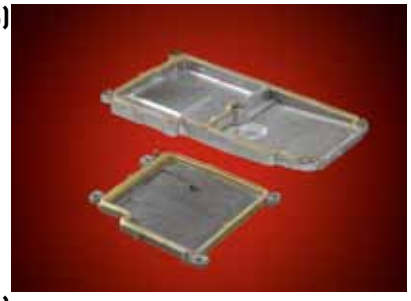
(5)



(6)

(3)

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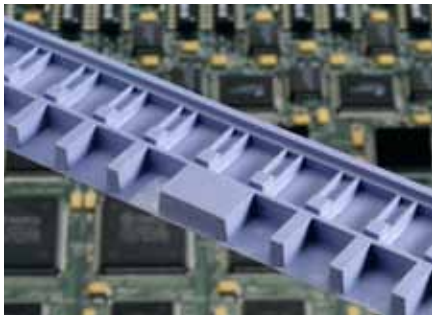


EMI Compliance & Safety Testing

Parker Chomerics can build the EMI shielded housing and then verify performance. Our Test Services Business unit with over 35 years of experience can review EMI package and board level design to avoid compliance testing failures when the product is ready to launch. We offer compliance testing for emissions, immunity, susceptibility and safety requirements for commercial, military and government electronics.

The laboratories have a full range of EMC testing sites

- 3 & 10 meter open field
- Semi-anechoic absorber cone shielded room
- Full anechoic ferrite lined shielded room

We can perform EMC testing to FCC, Industry Canada (IC), CISPR, VCCI, AUSTEL, EN, DO-160, MIL-STD 461 and automotive standards. We can provide your FCC Part 15/18 Class A/B test and submittal for certification.

Parker Chomerics performs safety testing for compliance with the European Low Voltage, Medical Device and Machinery directives. We can prepare safety evaluation to the European requirement with reports for a Manufacturers Technical Construction File and allow a company to apply the CE mark. We have accreditations for:

- FCC
- AUSTEL
- VCCI
- NARTE
- A2LA
- CSA
- BSMI
- KOREA
- Industry Canada

Only Parker Chomerics can assist with design, manufacture and verify your device. This decreases your design cycle, time to market and avoids re-design costs to fix non-compliance problems.

Supply Chain Management

Parker Chomerics can supply a thermoplastic EMI shielded housing for application in any environment. With over 45 years experience in EMI shielding we have materials and know-how to provide a total solution from a single point source for the design support, manufacture and verification testing. No other supplier has the breadth of material technology to provide cost effective materials and technology

- Plastic design support service
- EMI applications support
- In-house injection molding
- EMI shielding thermoplastics
- EMI shielding coatings
- EMI shielding display filters
- EMI shielding gaskets
- EMI shielding honeycomb filters
- Microwave absorbing materials
- Tapes, foil/film laminates
- Thermal management
- Secondary assembly
- Cosmetic finishing
- EMI Testing
- Safety Testing
- Global supply chain access with worldwide Parker Chomerics facilities

By combining these services we can reduce your cost for shielded plastic housings or enable metal-to-plastic conversions to provide

- Cost savings of up to 60%
- Reduce your design cycle
- Reduce your supplier base
- Reduce your assembly costs through part consolidation
- Eliminate re-design at the EMI certification stage
- On time product launch

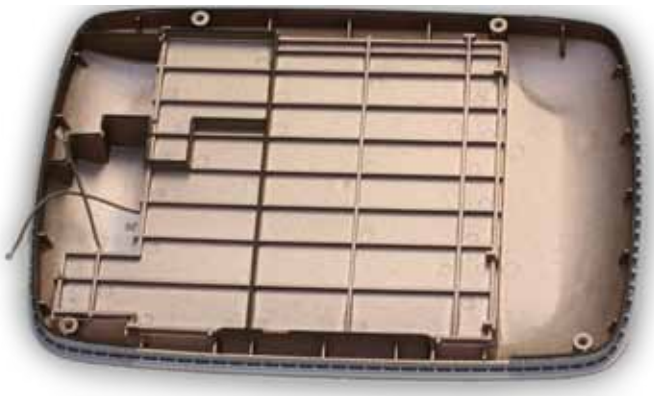
No EMI shielding or environment is too harsh for Parker Chomerics to provide a solution to. We have material choices that provide durability and long term stability to satisfy application requirements for equipment in

- Telecom infrastructure
- Ruggedized PC's and handheld electronics
- Military electronics
- Aerospace electronics
- Medical electronics
- Automotive electronics

We have processing technology to convert our materials into your custom part at the lowest possible cost of ownership. We can simplify your supply chain and ensure ongoing quality and on-time delivery by eliminating multiple suppliers.

In metal to plastic conversions we can offer designs that reduce weight by up to 75% as compared to aluminum die castings. This will increase fuel efficiency for mobile applications or reduce fatigue for portable electronics.

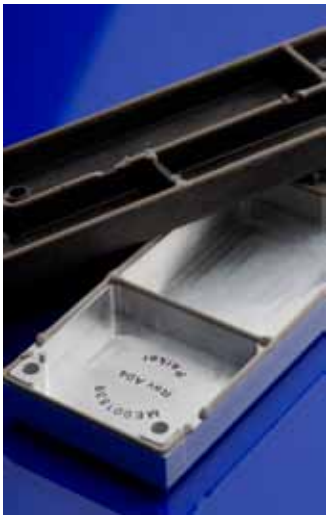
Contact Parker Chomerics to learn more about our EMI Shielded Thermoplastic Housing Supply Service.

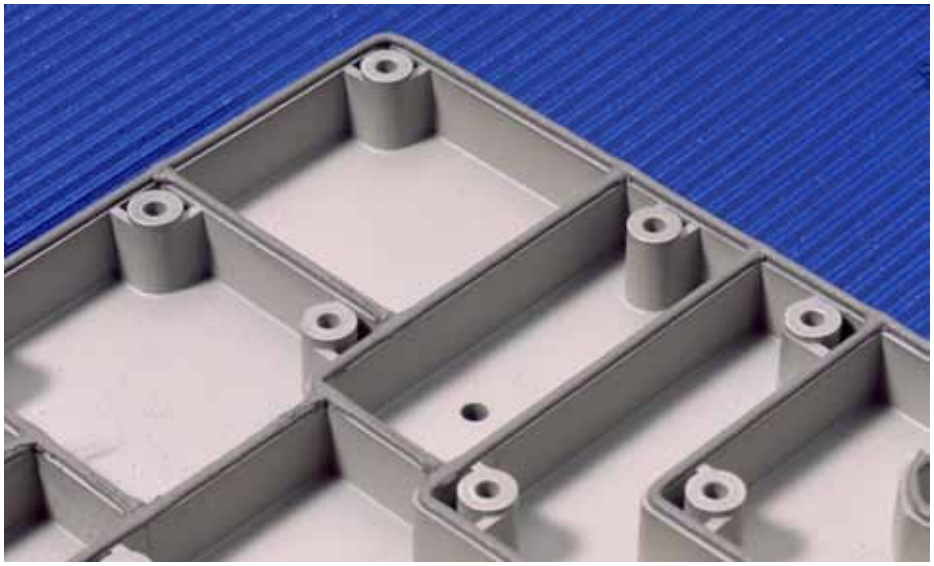


Dispensed EMI & Environmental Gaskets On Plastic Or Metal Housings

Parker Chomerics' Elastomers Business Unit offers a wide variety of integrated solutions utilizing dispensed EMI & environmental gaskets on plastic or metal substrates. By combining our in-house plastic injection molding with dispensed gasketing and supply chain options, we offer a complete solution ready to integrate at the customers highest level of assembly.

We also offer in-house and outsourced metal housing options including machined aluminum (with corrosion resistant coatings as required), castings and stampings as the foundation for our dispensed gasket integrated solution. Our applications engineering team will work with you to specify the appropriate substrate and finishes, gaskets, required supply chain content and even help complete the final level assembly drawing.



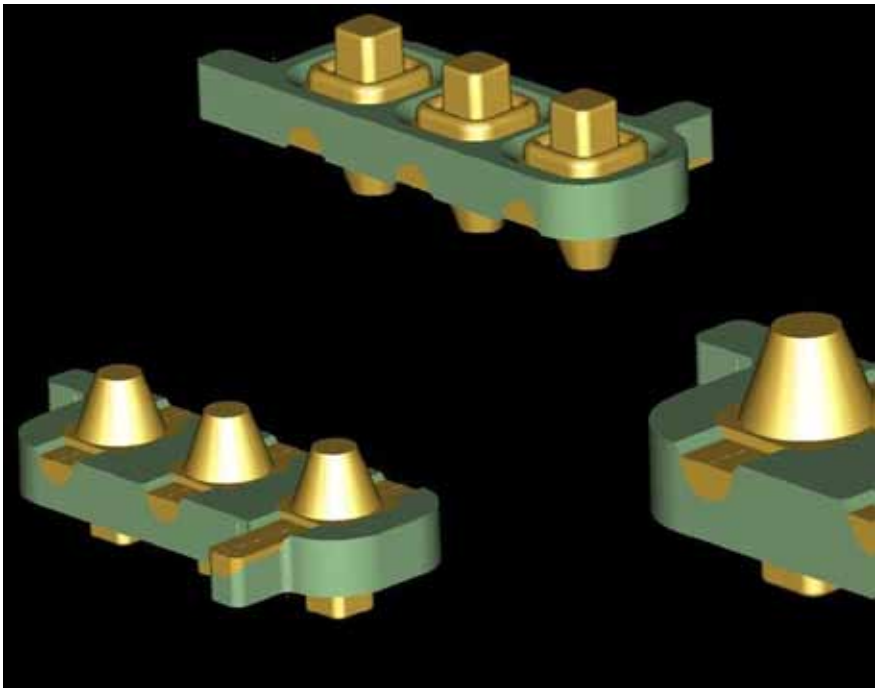


Conductive Elastomer Overmolded Solutions On Plastic & Metal

Conductive elastomer overmolded solutions can be designed with plastic or metal substrates. Over the years, elastomer overmolds on plastic have been used as conductive spacer board shields on handheld electronic devices, charger stations for medical devices and flexible conductive switches. Selection of a high temperature plastic and part design, gasket design including finite element analysis and final packaging for easy integration into a customer assembly are all features of a plastic based conductive elastomer overmold.

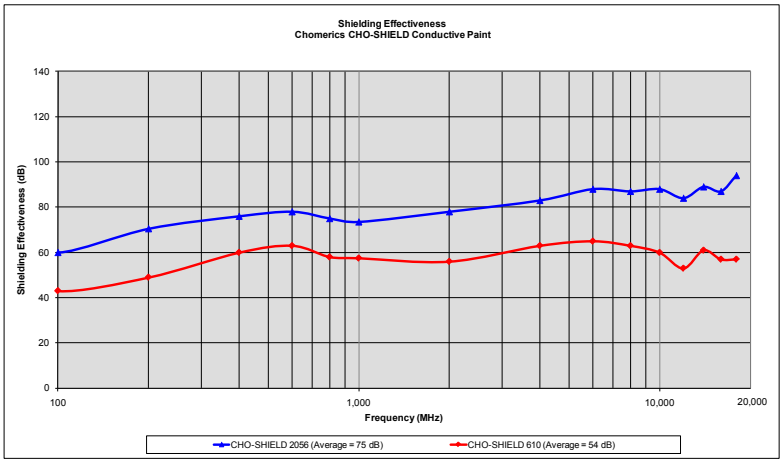
The same conductive elastomer overmolds can be supplied on a variety of metal substrates. These can include stamped metal cans, metal faceplates or covers, knitted wire mesh shrouds and plated or chromate conversion coated machined aluminum housings. The gasket overmold can include formed shapes and profiles and even dual bead conductive/non-conductive perimeter seals.

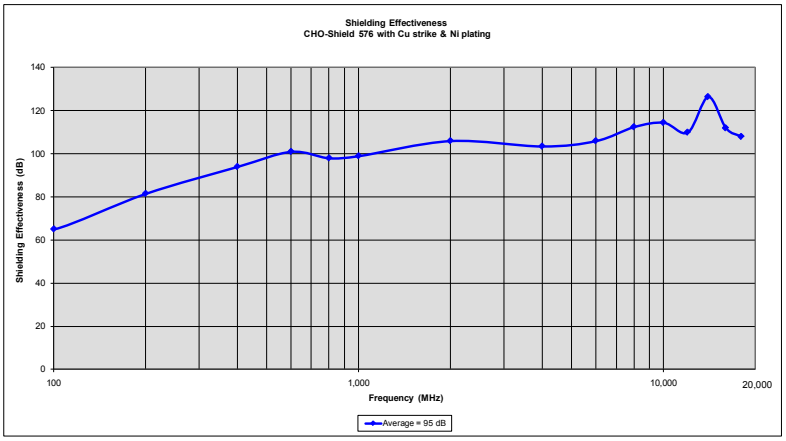
Conductive elastomer overmolds on metal have been specified on a wide variety of military(Vulcanized Covers & Vulcon tm), medical and commercial applications. Chomerics in-house machined metal substrate capabilities are often instrumental in supporting both customer prototyping and production ramp-up efforts.

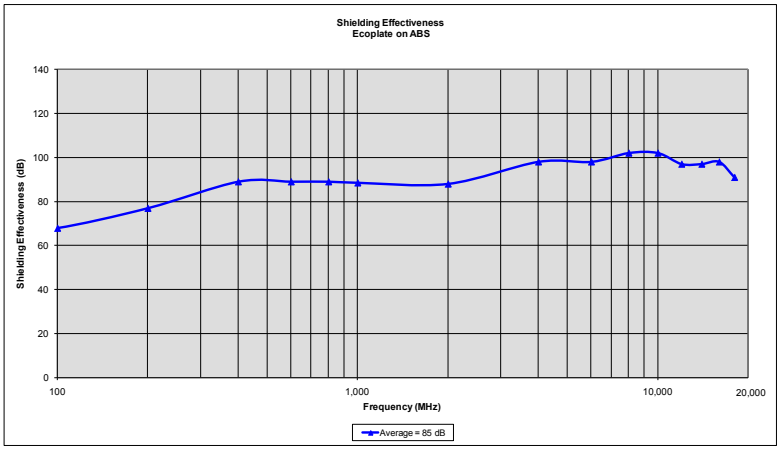


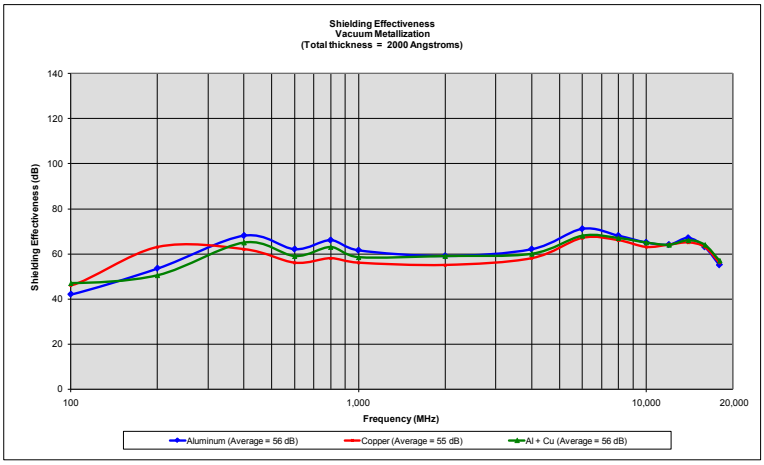
Depictions of conductive elastomer overmolded on plastic substrate

Shielding Data - Secondary EMI Coatings / Plating









Notes

Chomerics Worldwide

North America
Division Headquarters
Woburn, MA
phone +1 781-935-4850
fax +1 781-933-4318
chomailbox@parker.com

Cranford, NJ
phone +1 908-272-5500
fax +1 908-272-2741

Millville, NJ
phone +1 856-825-8900
Fax +1 856-825-8969

Fairport, NY
phone +1 585-425-7000
Fax +1 585-425-7238

South America
Sao Paulo Brazil
phone +55 11 4195 0444
fax +55 11 4195 7580

Europe
High Wycombe, UK
phone +44 1494 455400
fax +44 1494 455466
chomerics_europe@parker.com

Grantham, UK
phone +44 1476 590600
fax +44 1476 591600

Saint Ouen l'Aumône, France
phone +33 1 34 32 39 00
fax +33 1 34 32 58 00

Asia Pacific
Hong Kong
phone +852 2428 8008
fax +852 2786 3446
chomerics_ap@parker.com

Beijing
phone +86 10 6788 4650
fax +86 10 6788 4649

Shanghai
phone +8621 2899 5000
fax +8621 2899 5146

Shenzhen
phone +86 755 8974 8558
fax +86 755 8974 8560

Tokyo, Japan
phone +81 3 6408 2369
fax +81 3 5449 72022

Additional facilities:

Hudson, NH; Guadalajara & Monterrey, Mexico; Oulu, Finland; Sadska, Czech Republic; Tianjin, China; Chennai, India.

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