



# METALLIZATION OF PLASTICS

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# PRESENTATION TOPICS

- Introduction to Cybershield
- Metallization Processes, Materials and Design Guidelines
  - Plating on Plastic
  - Conductive Paint Application
  - Dispensed Conductive Gasket
- Shielding Effectiveness of Coating Systems
- RoHS & WEEE Review
- Plastic Metallization Applications
- Summary and Q&A

# CYBERSHIELD OPERATION

- Based in Lufkin, TX
- Business Focus Since 1987
  - EMI Shielding Systems
    - Electroless & Electrolytic Plating
    - Conductive Paint on Plastics
    - Dispensed Conductive Gasket
  - Turnkey Manufacturing Services
    - Injection Molding
    - Decorative Finishing
    - Mechanical Assembly
    - Hardware Installation
    - Part Marking
    - Ultrasonic Welding
- Electronic Component & Equipment Manufacturers



Registered ISO 9001:2008

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# SERVED MARKETS

Connectors	Wireless Devices
Telecom Infrastructure	Networking Equipment
Servers/Routers	Storage Devices
Medical Electronics	Barcode/RFID Equipment
Military/Aerospace	Antenna
Industrial Equipment	ATM Equipment
Instrumentation	Test Equipment
Automotive Electronics	Mobile Handsets
Audio Electronics	GPS Systems

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# PLASTIC METALLIZATION APPLICATIONS

- ESD Coatings
- EMI/RFI Shielding
- RF & Microwave Housings
- Antenna
- IR Heat Barrier
- Vapor Barrier
- Decorative Finishes
- Mil Spec Finishes, Including CARC

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# METALS DEPOSITED

## ■ Plating

- All-Over & Selective Electroless Plating – Copper, Nickel, Tin, Gold
- All-over Electrolytic Plating – Copper, Nickel, Tin, Chrome

## ■ Conductive Paint

- EMI Shielding – Copper and Silver
  - ESD – Nickel and Graphite
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# PLATEABLE RESINS

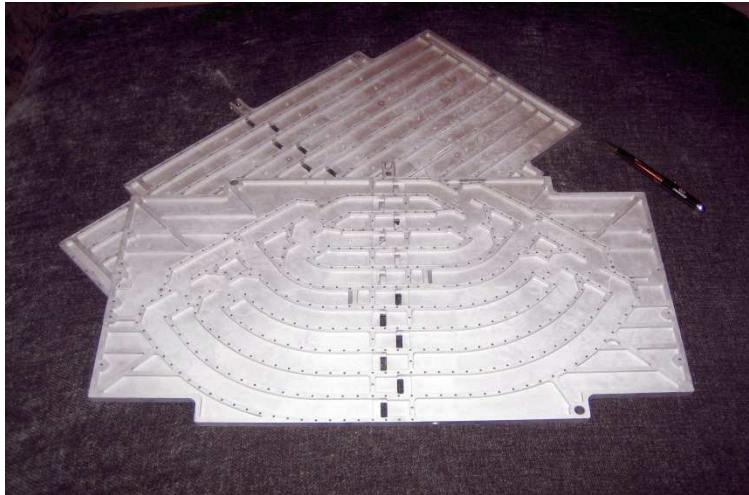
<b>Widely Plateable</b>			
ABS	Polycarbonate (PC)	PC/ABS	PEI (Ultem) $\geq 20\%$ Fill
PPA	Fiberglass	Polystyrene	Liquid Crystal Polymer

<b>Selected or Custom Blended Plateable Grades*</b>			
Noryl	Xylex	Xenoy	Urethane
Nylon	PEEK	PPS	Polypropylene

<b>Not Plateable</b>			
Valox (PBT)	Polyethylene	Polyester	PVC

\* Only Selected or Custom Blended Resins Can Be Plated.

# PLATING ON PLASTICS



## All-Over Electroless

Acid/Caustic Etch or Abrade

Activate with Catalyst

Plate 1-10  $\mu\text{m}$  (40-400  $\mu''$ )  
Copper, Nickel, Tin, Gold

## Selective Plating Catalyst

Mask Part

Apply Auto-Catalytic Primer

Plate 1-5  $\mu\text{m}$  (40-200  $\mu''$ )  
Copper, Nickel, Tin, Gold

## Electrolytic Plating

All-Over Electroless Plate

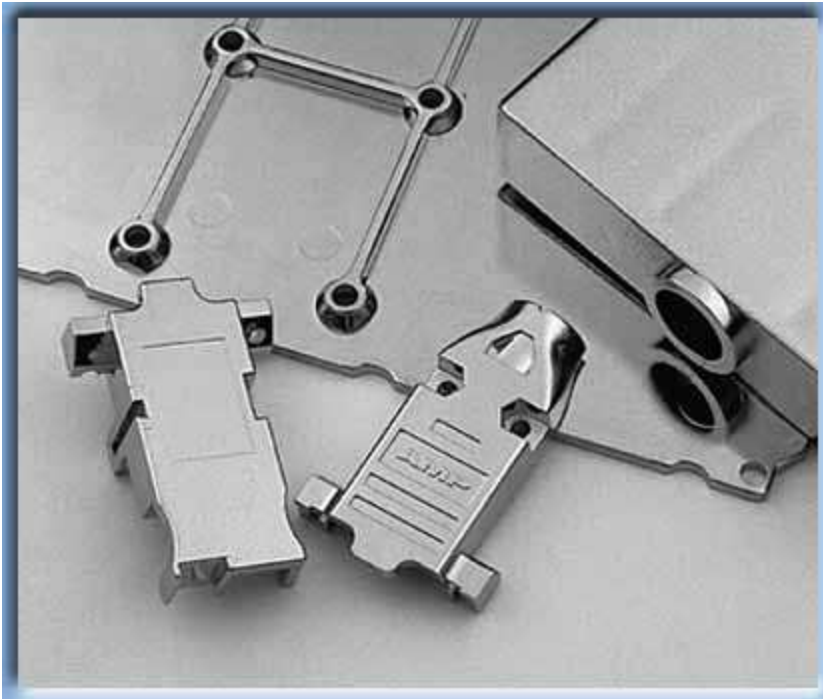
Rack & Contact

Plate 5-75  $\mu\text{m}$  (200  $\mu''$ -.003'')  
Copper, Nickel, Chrome



# ELECTROLYTIC PLATING

- Start with Electroless Copper Plated Plastic Part
- Offers Outstanding EMI Shielding, Includes Magnetic Interference
- Plating Material Options: Copper, Nickel, Tin, Chrome
- Thicker Coatings with Excellent Long Term Performance
- Faster Deposition & Lower Cost Than Electroless Plating
- Line-of-Sight Process with Wider Thickness Variation



# SELECTIVE PLATING

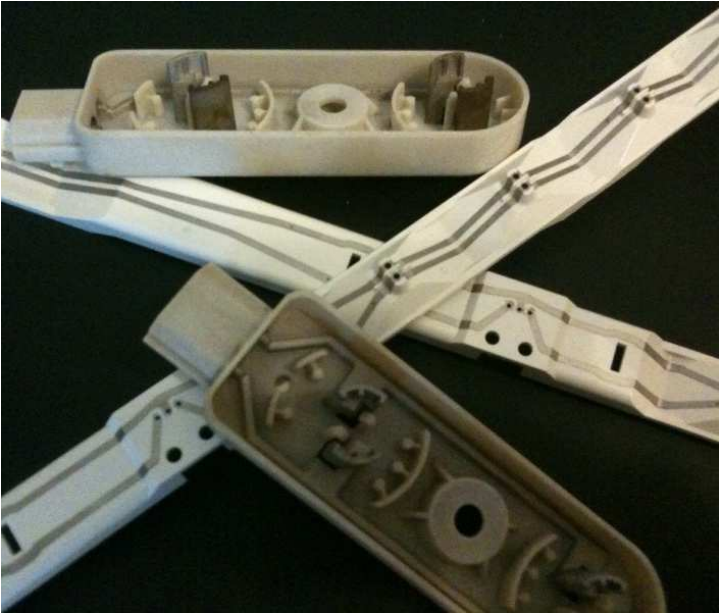


Auto Darkening Welding Helmet Covers

- Mask Selected Areas of Part & Apply Catalytic Plating Primer
- Apply Electroless Copper Plating and Finish with Electroless Ni, Sn, Au
- Mask Line Tolerance +/- 0.020" (0.5 mm)
- Maintain Unplated Part Molded Color & Texture

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# 2-SHOT MOLDING



- Utilize All-Over Plating Process on 2-Shot Molded Parts
    - Plateable Resin - Catalyzed to Promote Plating
    - Non-Plateable Resin
    - Feature Size to  $<0.20''$  (0.5 mm)
  - Mold Tool Designed for 2-shot Molding Process
  - Resins Must Have Compatible Molding Parameters
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# PLATING RESIST

- Similar to PC Board Resist Materials & Processes – Utilize All-Over Plating Process
  - Resist Compatible with Electroless Plating Chemistry
  - Applied onto Required Areas via Dispensing or Spraying, Followed by UV Cure
  - Resist Can Be Left on Part or “Peeled” off After Plating
  - Finish with Electroless Nickel or Electroplate with Copper, Nickel, Tin, and/or Gold
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# PLATING DESIGN ISSUES

<b>Design Don't</b>	<b>Design Alternative</b>
5-sided Box or Cup Design Trap Air and/or Drag Out Plating Chemicals Impact Plating Quality & Cost	Include Drain Holes Design Part to Prevent Entrapment of Air or Plating Solution
Tight Crevices Can Trap Plating Solution	Eliminate Crevices in Design or Include Drain Hole
Small Blind Holes Trap Plating Solution Later Weep Out & Damage Plating	Utilize Through-holes If Blind Holes Required, Plug to Prevent Plating Solution Entrapment

## Inserts

- Brass or Stainless Inserts - Ultrasonic or Heat Stake Before/After Plating
  - Inserts Installed Before Plating - Mask Threads with Screws During Plating
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# CONDUCTIVE PAINT



- Air Atomization of Metallic Paints
- Coatings
  - Graphite, Ni, Cu, Ag, Hybrid Cu-Ag
  - Thickness: 0.5-2.0 mils (12-50  $\mu\text{m}$ )
  - Electro-form Mask for Selective Application
- Thickness Uniformity & Repeatability via Robotic Application
- Widest Resin Capability
- “Flexible” Conductive Paint for Application onto Paper or Fabric
- Avoid Designs with Tight Crevices & Bosses, and Small Blind Holes

# PAINTABLE RESINS

<b>Common Paintable Resins</b>		
ABS	Polycarbonate (PC)	Polybutylene Terephthalate (PBT)
PC/ABS	Poly Aryl Amide	Polyphenylene Oxide (PPO)
PC/PBT	Polyphthalamide (PPA)	Polyether Imide (PEI)
Nylon	Polystyrene (PS)	
<b>Difficult to Paint Resins (May Require Primer)</b>		
Teflon (PTFE)	Polyethylene	Liquid Crystal Polymer
PEEK	Polyimide	Polypropylene

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# CONDUCTIVE PAINT DESIGN

<b>Design Don't</b>	<b>Design Alternative</b>
Difficult to Paint Tight Bosses, Crevices and Holes Line-of-Sight Paint Process	Eliminate Crevices & Small Holes Requiring Coating

## Inserts

Brass or Stainless Inserts - Ultrasonic or Heat Stake Before/After Painting  
Inserts Installed Before Painting - Mask Threads with Screws During Plating

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# SHIELDING EFFECTIVENESS

Coating System	Thickness	(m-ohms/sq) Resistivity	Attenuation (dB)					
			30 MHz	100 MHz	300 MHz	1 GHz	5 GHz	10 GHz
All-Over Plating	40-400 μ” (1.0-10.0 μm)	5-50	90	108	104	120	113	87
Selective Plating	80-200 μ” (2.0-5.0 μm)	15-100	77	73	71	71	60	63
Copper Paint	0.001-.0015” (0.025-.375 mm)	25-100	65	63	59	70	81	63
Copper-Silver Paint	0.0008-.001” (0.020-.25 mm)	15-50	78	73	72	69	85	82
Silver Paint	0.0005-.001” (0.0125-.025 mm)	15-50	70	71	70	62	70	70

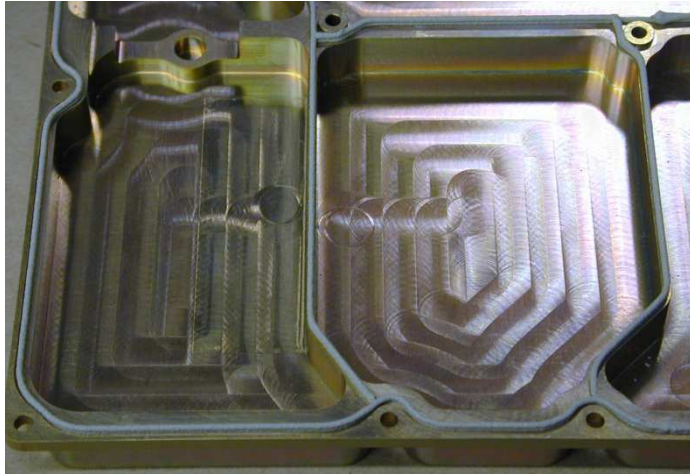
Source: Enthone, Spraylat and Cybershield

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# COATING QUALITY METRICS

- **Metal Deposition Thickness – X-Ray Diffraction to Measure Individual Plating or Conductive Paint Layers**
  - **Resistivity – Point-to-Point or Ohms/Square**
    - ❑ Plating with 10 micro-inches (0.25  $\mu\text{m}$ ) Ni over 40-400 micro-inches (1.0  $\mu\text{m}$ ) Cu: 0.005-.100 Ohms/Square
    - ❑ Copper & Silver Conductive Paint 0.025-0.050 Ohms/Square @ 0.001” Dry Film Thickness
  - **Adhesion – ASTM D-3359**
    - ❑ Destructive or Non-Destructive Test Method
    - ❑ Tape Test: Measure Plating Pulled on Visual Scale (1-5 with 5 Best – No Metal Pulled)
  - **UL QMRX2 Certification**
    - ❑ Certified Resins: [www.cybershieldinc.com/electroless.htm](http://www.cybershieldinc.com/electroless.htm)
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# CONDUCTIVE GASKET CAPABILITIES



- Silicone with Silver Plated Nickel, Copper or Aluminum Filler
- Dispense onto Metal, Painted or Plated Plastic via PC Controlled Robot
- Shielding Effectiveness: 85-120 dB
- Compression Set: <20% @ 50% Deflection
- Shore A Hardness: 48-70
- Gasket Size Range
  - Height: 0.015"-0.090" (0.38-2.3 mm)
  - Width: 0.018"-0.125" (0.46 -3.2 mm)

# CARC PAINT APPLICATION



- Apply Mil Spec Paints
  - ❑ MIL-DTL-64159
  - ❑ MIL-PRF-22750
  - ❑ Apply Manually or on Robots
- Chemically Treat Metal
  - ❑ Zinc Phosphate Steel per TT-C-490
  - ❑ Conversion Coat Aluminum MIL-DTL-5541

# RoHS/REACH & WEEE

- **RoHS: EU Directive - Restriction of Hazardous Substances**
  - Lead, Cadmium, Mercury, Hexavalent Chromium, Polybrominated Biphenyl (PBB), Polybrominated Diphenyl Ether (PBDE) Flame Retardants
  - All Cybershield Coatings RoHS Compliant
- **REACH (Registration, Evaluation, and Authorization of Chemicals)**
  - No Substances of Very High Concern (SVHC) in Any Coatings
- **WEEE - Waste from Electrical and Electronic Equipment**
  - Raise Level of Recycling of Electrical and Electronic Equipment
  - Manufacturers Responsible for Recycling Costs
  - Cybershield Processes to Remove Plating & Paint Coating to Allow for Plastic Recycling (Can Transfer Know-How)

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# INJECTION MOLDING



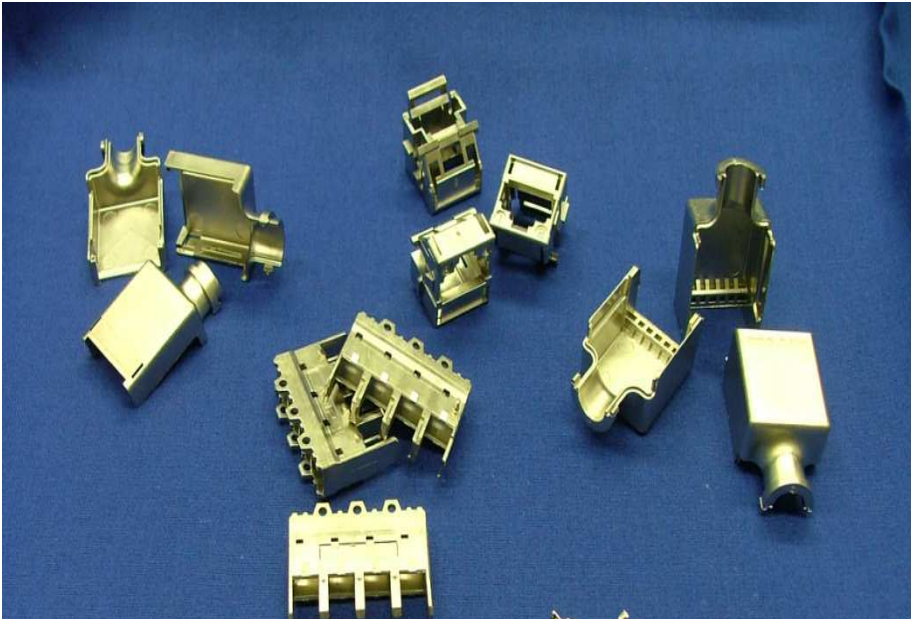
- Two 220T Cincinnati Milacron Presses
    - Capable of Wide Range of Resins
    - Part Size up to 8" x 10"
    - Up to 13 Ounce Shot
  - Streamline Supply Chain
  - Eliminate Freight Costs
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# APPLICATIONS

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# SHIELDED CONNECTORS



- Increasing Need for Shielded Interconnection
  - Medical
  - Military/Aerospace
  - Telecommunications
- Utilize All-Over Plating, 2-Shot
- Eliminate Weight, Space and Cost for Metal Shell



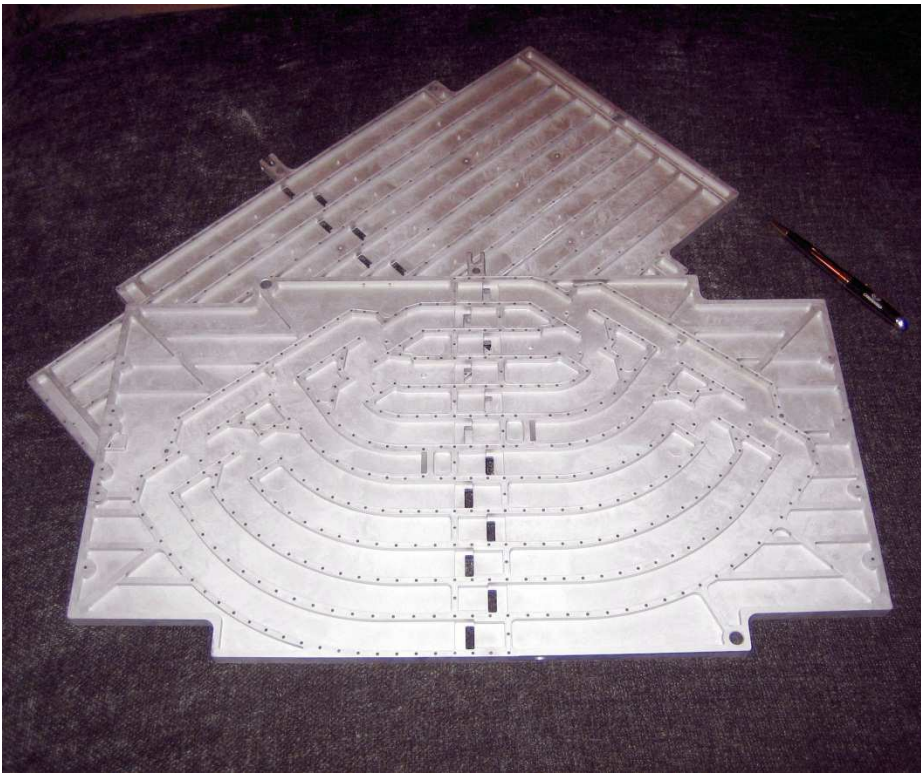
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# MILITARY ELECTRONICS



- Conversion to Plastic to Reduce Weight
    - ❑ EMI Shielding Achieved with Plating or Conductive Paint
    - ❑ High Performance Plastics Meet Military Mechanical & Environmental Requirements
    - ❑ Metallize Wide Range of Plastics
  - Manufacturing Services
    - ❑ Gaskets
    - ❑ Decorative Paint, Including Mil Spec CARC Paint
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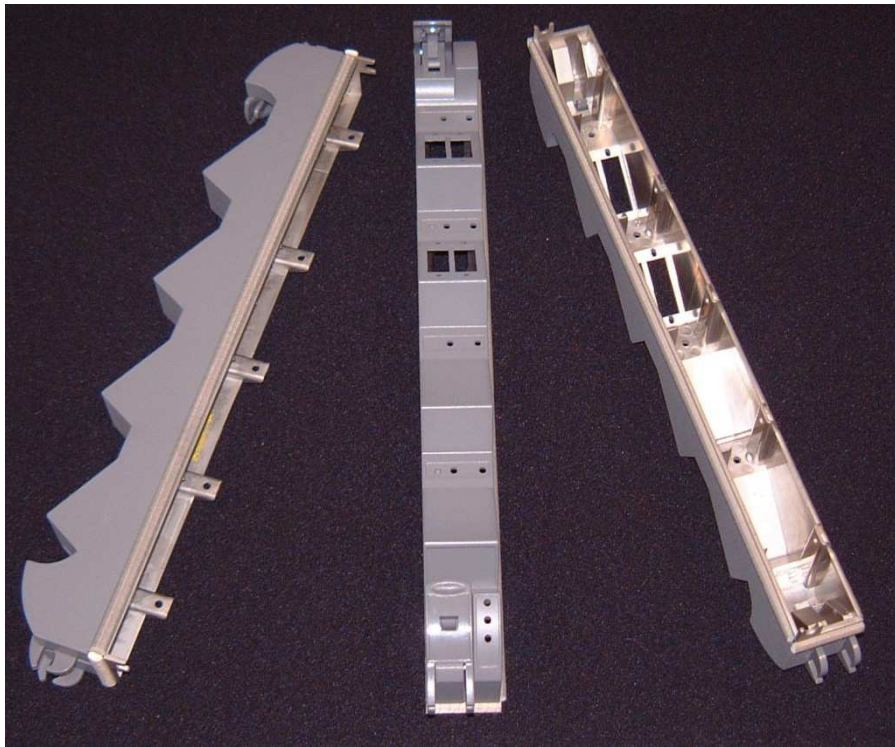
# MOBILE ANTENNA



- Mobile Satellite Antenna Waveguide
- All-Over Plated
  - Copper 300 micro-inches (12.5  $\mu\text{m}$ )
  - Nickel Flash

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# TELECOM SWITCH FACEPLATES



- All-Over Plated & Decoratively Painted Injection Molded Faceplates
  - Meet EMI Requirements
  - Color Match to Metal Chassis
- Mechanical Assembly

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# CONDUCTIVE GASKET



- Silicone Filled with Silver Plated Nickel, Copper or Aluminum
  - Dispensed onto Metal Housing
    - Provide EMI Shield with 85-120 dB Attenuation
    - Mate with PC Board Traces
  - High Volume Capability and Repeatable Precision Dispensing
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# ROUTER CHASSIS



**Router Chassis**

- All Plastic Router Chassis
- All-Over Cu/Ni Plating
- Install 130 Inserts
- Assemble & Bond Chassis
- Decorative Paint
- EMI Shielding: 1-10 GHz
- Cost Effective Option to Sheet Metal Chassis
- Router: 65% Lighter Than Sheet Metal Design – Eliminated Cabling

# GPS SURVEY EQUIPMENT



- Light Weight, Durable, Housing
- EMI Shielding
  - All-Over Electroless Plating on Polycarbonate Frame
  - Conductive Paint on Xenoy (PC/PET) Housing
- Inserts and Part Marking



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# SUMMARY

- Demonstrated Metallization Processes
    - Shielding, Thermal & Vapor Barriers, Antennas
    - Decorative Finishes on Wide Range of Resins
    - Cost Effective
    - High Volume Production Capacity
    - Reliable & Durable
  - Design Flexibility
    - Materials Systems
    - Metallization Mechanical Design
-