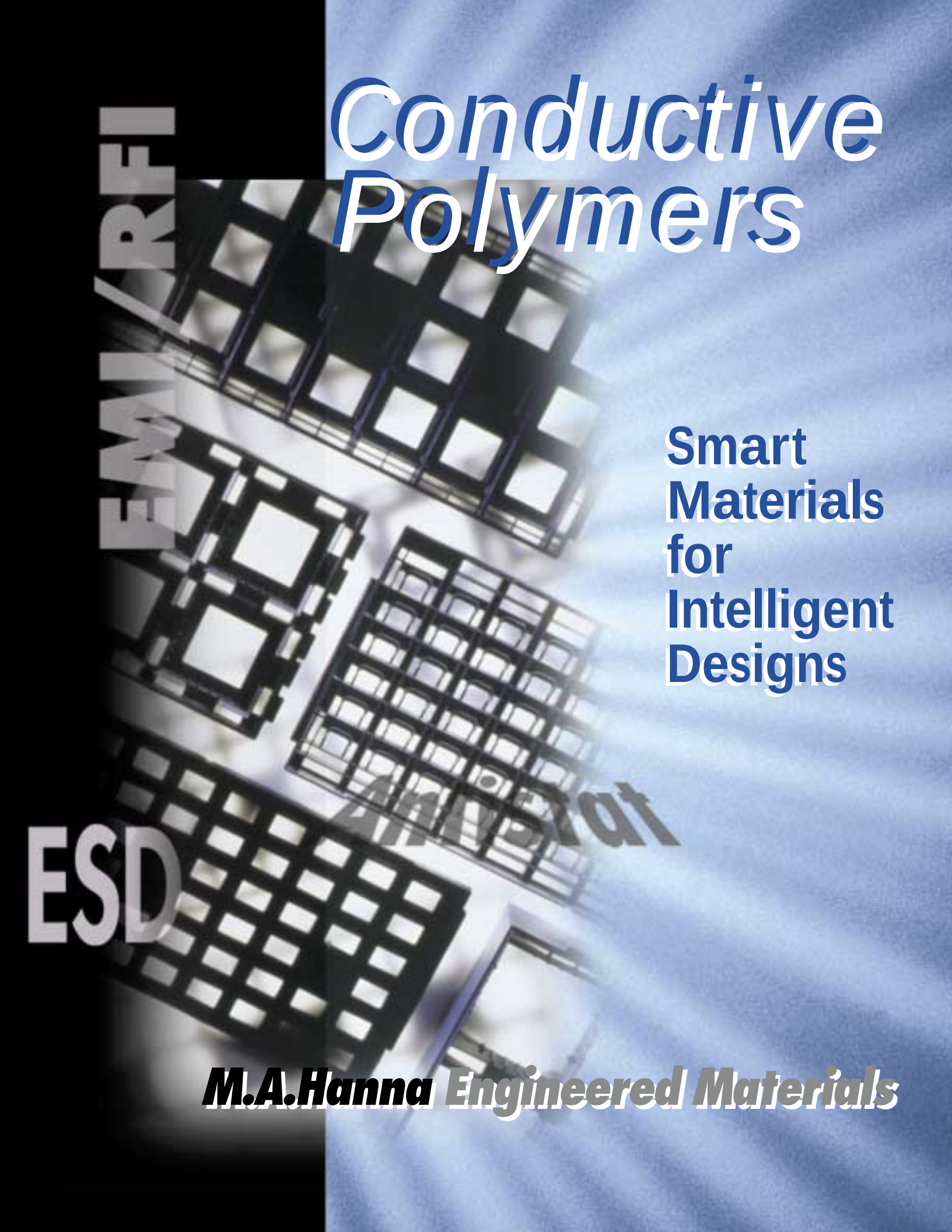
Conductive Polymers



Smart Materials for Intelligent Designs

M.A.Hanna Engineered Materials

Imagine the Possibilities…

Antistat materials that aren't moisture dependent,
- – that don't require time to bloom,
- – that are non-corrosive,
- – and that are permanent – and won't rub or wash off your part…

ESD materials that can be colored…
- – And not just basic black and grey,
- – but, greens, blues, and browns…

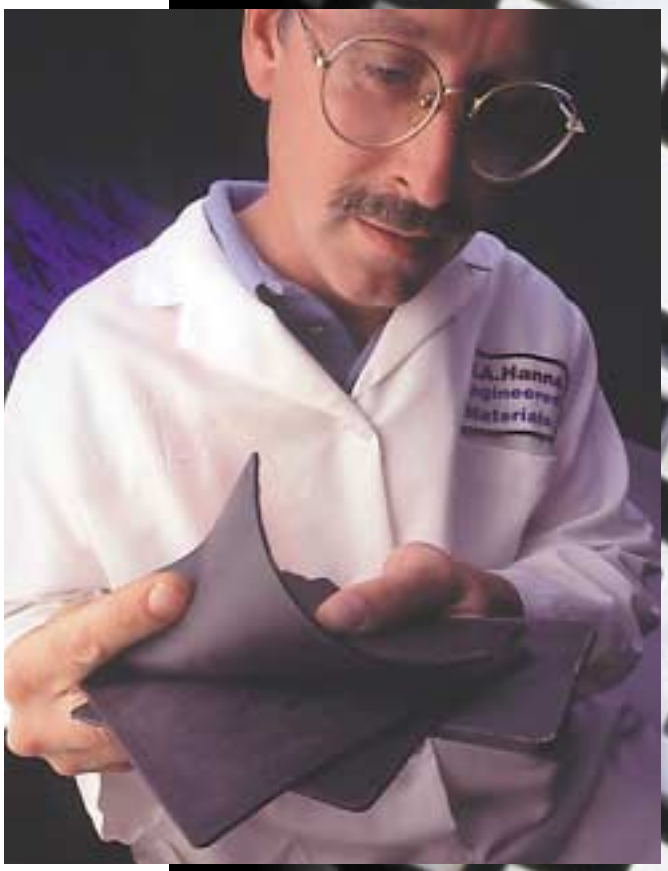
EMI/RFI materials that are permanent,
- – that won't lose their properties if they're scratched…

Conductive polymers that can be recycled –
- – at the molding machine or after their useful life is done…

Conductive polymers with inherent lubrication for ease of manufacturing,
- – with additives that have been proven safe for use with electronics…

Have you ever wished for a conductive polymer that was flexible?

- – Where would you use it?
  - – What about a gasket around a housing?
  - – A seal around a switch?
- – Do you need conductive materials in thinner wall sections?
  - – What about a film?



Talk with us.

We're M.A. Hanna Engineered Materials, a business unit of the M.A. Hanna Company and one of the world's leading independent compounders of thermoplastic resins. We're the company with smart materials that help you make more intelligent, more marketable designs.

Glossary: Understanding Your Electrical Requirements

Antistat Material
A material with the ability to resist generation of triboelectric charges. There are 2 types of antistat materials: non-permanent and permanent. The non-permanent type is blended, sprayed, or dipped into a chemical agent, which often functions by attracting moisture from the air to create a conductive layer of surface moisture on the part. Many antistats require 15% RH for effective performance and will gradually lose their effectiveness over time due to physical wear or evaporation. In contrast, permanent antistat materials use fillers and additives that make the part permanently antistatic and that do not rely on humidity in the air to achieve the level of conductivity. The term antistatic no longer refers to a material's resistivity range. Resistance range = 10^{9} – 10^{12}ohms.

Attenuation
Reduction of a signal's strength by an EMI / RFI shield or housing, usually expressed in decibels (dB). A shield's attenuation strength is determined by the absorption / reflection characteristics of the material used to fabricate it, as well as its thickness, and the manufacturing tolerances used to fabricate the shield / housing.

Conductive Polymer
A plastic that has been blended with various electrically conductive fibers, powders, and / or additives in order to change the base resin's natural electrical insulating properties. Conductive polymers can be antistatic, electrostatic dissipative, or EMI / RFI shielding.

Conductivity
The ability of a material to carry an electrical current. A good conductor (e.g. metals) is a poor insulator.

Decibel (dB)
A unit of measurement showing the relative differences in power between 2 signals. A decibel measurement is equivalent to 10 x the common logarithm of the ratio between signal strengths.

Electromagnetic Interference (EMI)
Electrical energy radiated by electromagnetic fields that can be picked up by circuits in other electronic equipment, impairing the latter's function.

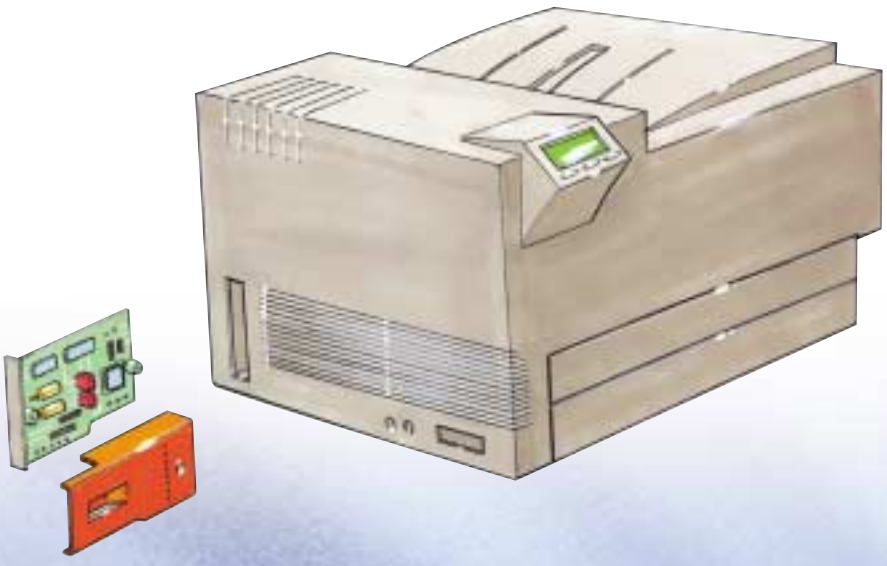
Electromagnetic Shielding
Property of being able to resist the effects of both electric and magnetic fields.

Electrostatic Discharge (ESD)
An electrical potential or voltage built up in a localized area of an insulative material by rubbing , sliding, or other intimate contact that is then discharged when the material comes in contact with a second body at a significantly different electrical potential

The Right Material for Your Application

We have the broadest materials portfolio in the plastics industry – from olefins to PEEK and TPEs and we can make any of them conductive: from antistat to ESD to EMI / RFI shielding materials.

Our technology is permanent and becomes an inherent part of the polymer. This means it won't rub or wear off over time, causing premature part failure, because we know how important long-term reliability is to you and to your customers. An extra benefit is that our technology is compatible with recycling – both post-industrial and post consumer. By comparison, conductive technologies that rely on coatings usually can't offer this feature.



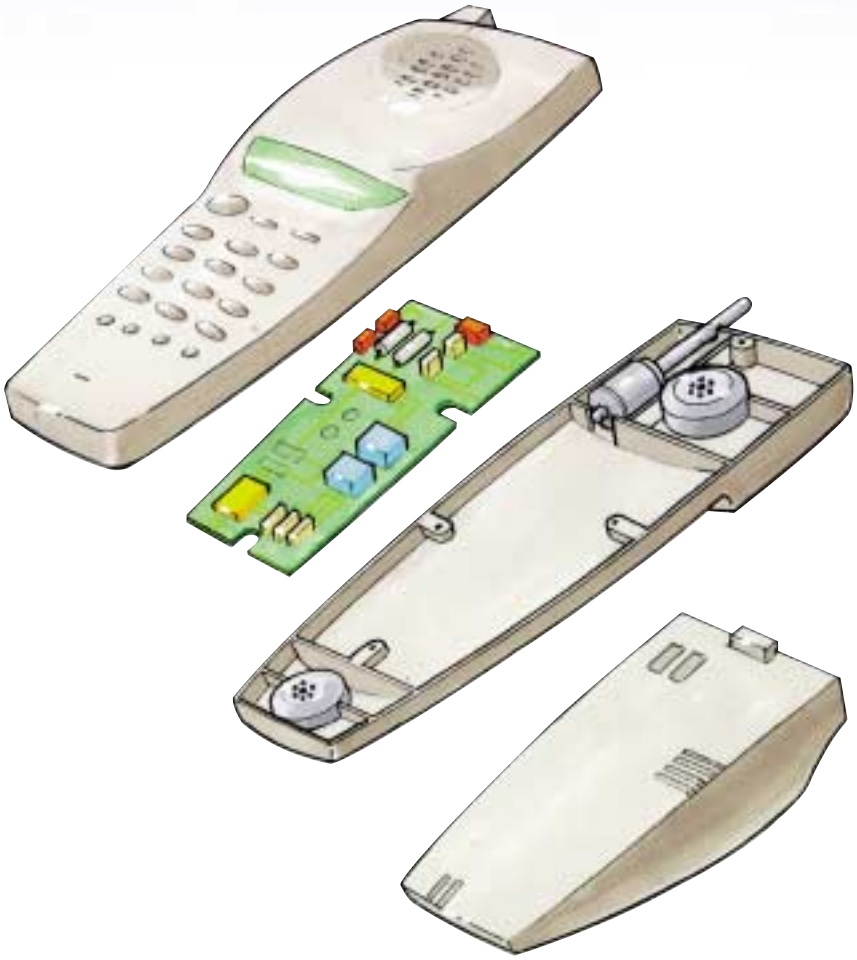
Custom-Compounded Solutions For Real-World Problems

Because we compound most major thermoplastic-resin families – both rigid and flexible – we have the freedom to choose the material that's right for your application.

In fact, you can count on us for an unbiased opinion on what polymer, alloy, or blend makes the most sense from a performance and economic standpoint.

Although we've developed and standardized many compounds to meet the requirements of conductive applications, when needed, M.A. Hanna Engineered Materials will design a material that is specific to your application – at no additional cost. We don't force your components to accomodate our standard products.

In fact, we prefer to work in close partnership with our customers from the very start of a program, as this lets us alert them to issues that can arise when part designs conflict with materials or with tooling.



Full-Service Support – When & Where it Counts

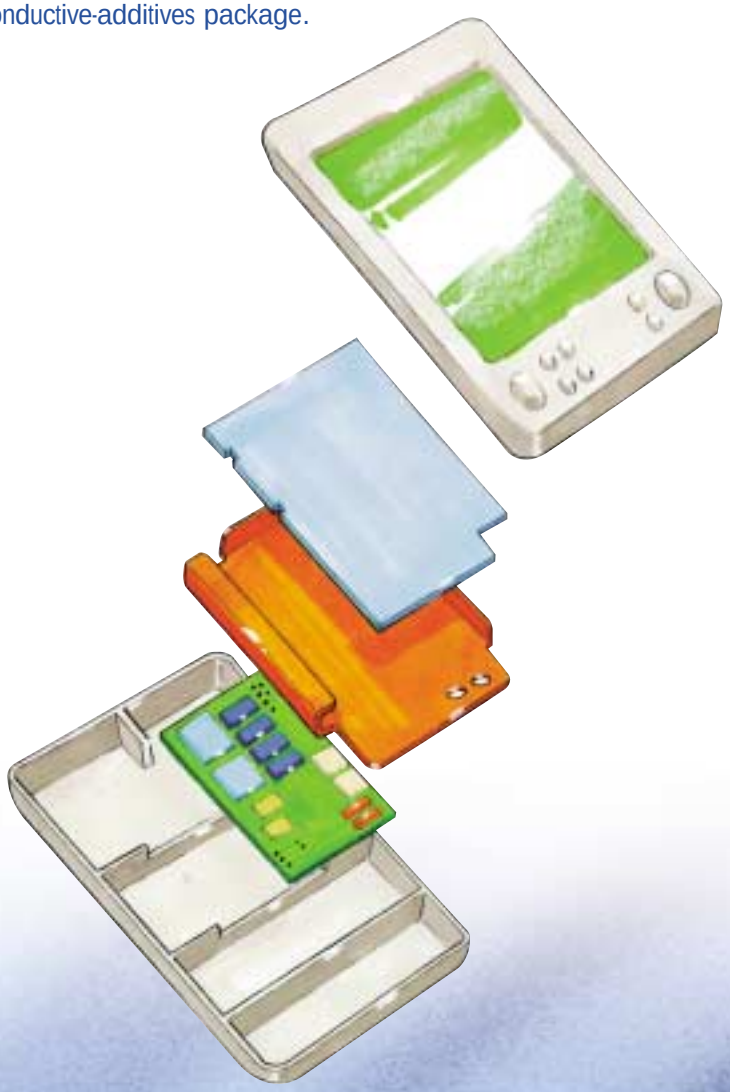
We understand the impact of design on conductivity as well as on other physical properties and processing. In fact, we have in-house CAE and design services – including 3-D solids modeling, stereolithography (SLA) models for fit and finish, and FEA-based structural and filling analyses – that are free to customers to assist them in achieving the most effective design to meet all their requirements – performance, processing, and financial.

We also have some of the most extensive laboratory and testing facilities of any compounder in the business. We offer a wide range of physical and analytical capabilities such as:

- surface / volume conductivity / resistivity testing
- tensile, flexural, & creep testing
- Dynatup, Izod, and Gardener impact testing
- ash testing

- UL® 94 flammability testing
- Shore A / D Rockwell hardness testing
- QUV ultraviolet testing
- differential scanning calorimeter / thermogravimetric analysis (DSC / TGA)
- Fourier transform infrared (FTIR) spectroscopy
- atomic absorption spectroscopy
- gas chromatography
- surface analyzer
- moisture analyzer
- prototyping

If aesthetics are an concern in your application, M.A. Hanna Color, the leading colorant and special effects supplier to the plastics industry, is right around the corner to help customize a color / gloss package that's right for your application and that works with – not against – our conductive-additives package.



Glossary: Understanding Your Electrical Requirements (continued)

(e.g..: person walking across a nylon carpet and then touching another person, thereby releasing the stored electrical charge.) A spark or arc of static electricity (as much as several thousand volts) can be discharged between 2 bodies having different electrical potentials, damaging sensitive electronic components. Resistance range = 10^5 – 10^9ohms.

EMI / RFI Interference
Electromagnetic and radio-frequency waves emitted from electronic equipment such as computers, electronic games, radio transmitters, TVs, fluorescent lights, electric motors, automotive ignition systems, electronic cash registers, telephones, etc., that can interfere with proper function of other electronic equipment. Resistance range = 10^2 – 10^{-2} ohms.

Insulating
In this case, a material's ability to resist carrying an electrical current. A good insulator (unmodified plastics, ceramics, or glass) is typically a poor conductor.

Ohm (Ω)
A unit of measurement for electrical resistance.

Percolation Threshold
Point at which conductive filler forms a continuous path or network of conductive particles. Below this point, a resin is an insulator; at or above the threshold, the resin is a conductor.

Radio-Frequency Interference (RFI)
A form of EMI energy, from such sources as computers, broadcast equipment, lightning, or an ESD spark, that is generally in the radio-frequency range and that is capable of interfering with the proper functioning of various electrical / electronic equipment.

Resistivity
Resistance of a material to conducting electricity. Expressed in ohms (Ω), this is essentially an inverse measurement of the ability of the material to conduct electricity. Lower resistivity = higher conductivity.

Static Decay
The ability and rate of a resin to discharge or dissipate a charge from its surface to ground.

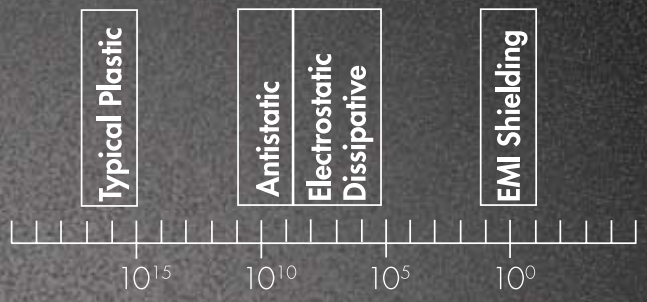
Surface Resistivity
The measurement of surface resistance between 2 electrodes forming opposite sides of a square (Ohms / Sq). This represents the ability of a material to resist the passage of electricity across its surface.

Volume Resistivity
The measurement of volume resistance between opposite faces of a 1-cm cube of material (Ohms / cm). This represents the ability of a material to resist the passage of electricity through its cross-section.

Typical End-Uses for Conductive Polymer Compounds

	Antistatic	ESD	EMI/RFI
Diagnostic/Scientific			
Oscilloscope Housings			X
Laser Calibration Equip.			X
Navigation Equipment			X
Electronic Monitors		X	
Medical Devices			X
Gas Detection Monitor			X
Communications			
Telephone Components			
(Landline & Cellular)			X
Pager Components		X	
Modem Enclosures			X
2-Way Radios			X
Input/Output Devices			
Computer Enclosures			X
Cassettes		X	
Card Enclosures		X	
Radio Receivers			X
TVs			X
Infrared Mice/Light Pens			X
Printers	X		
Photocopiers	X		
Paper Handling Trays	X		
Materials Handling			
Tote Boxes		X	
Storage Trays/Bins		X	
JEDEC Trays		X	
Equip. Cases		X	
Pallets		X	
Chip Carriers		X	
Transport Enclosures		X	
Floor Mats	X		
Other			
Electric Motors			
Fluorescent Light Comp.			X
Auto. Ignition Systems			X
Tote Bins	X		

Conductivity Range with Common Applications



Select Material Families Available in Various Levels of Conductivity

RIGID
- ABS
- Acetal
- Alloys & Blends
- Liquid Crystal Polymers (LCPs)
- Melt-Processable Fluoropolymers
- Modified Polyphenylene Oxide (MPPO)
- Polybutylene Terephthalate
- Polycarbonate (PC)
- Polyetheretherketone (PEEK)
- Polyetherimide (PEI)
- Polyethersulfone (PES)
- Polyethylene (PE)
- Polyphenylene Sulfide (PPS)
- Polyphthalamide (PPA)
- Polypropylene (PP)
- Polysulfone (PSU)

ELASTOMERIC
- Copolyamides
- Copolyesters
- Melt-Processable Fluoroelastomers
- PVC/Nitrile Blends
- Styrenic Block Copolymers
- Thermoplastic Polyolefins (TPOs)
- Thermoplastic Polyurethanes (TPUs)
- Thermoplastic Vulcanizates (TPVs)

Call Us We want to be your preferred supplier of conductive and non-conductive plastic compounds – worldwide or next door.

M.A.Hanna Engineered Materials

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