

Electronics Grade **Silicone** Product Selection Guide
for electronic devices and component assemblies

NOVAGARD[®]
Performance Silicones | Woman Owned

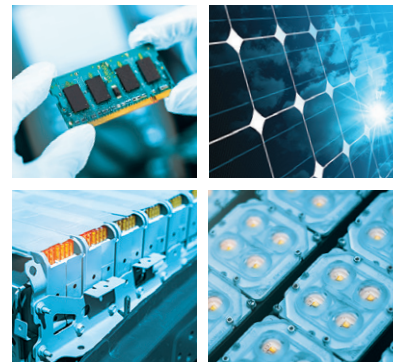
Why choose **silicones** for your electronics?

Their unique molecular structure provides the rare combination of increased flexibility and high temperature resistance, allowing more versatility in the design, assembly process, and performance characteristics of modern electronics:

- **Maximize stress relief** caused by thermal cycling
- **Extraordinary protection** against shock and vibration
- **Extreme thermal stability** for more reliable performance at sustained temperatures ranging from -40°C to 200°C
- **High dielectric strength** and **insulation resistance**
- **Stronger resistance** to chemicals and UV radiation
- Simple **solvent-free** handling and processing

Silicones reliably **seal, bond, coat, gasket, and encapsulate** to protect delicate components and modules, such as:

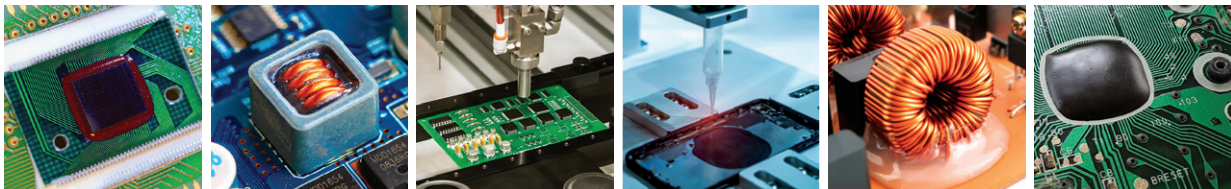
- Power Converters and Inverters
- Hybrid ICs
- Membrane Switches
- Photo Couplers
- Wire Connectors
- High-Voltage Insulation
- Micro-Electronic Packaging
- Sensors
- Computer Control Modules
- Thermal Gap Fillers
- Charging Systems
- Circuits and Terminals
- Terminal Box Potting
- EVA Plate Sealing
- Diode Encapsulation
- Power Module Protection
- Wiring Enclosures



What is electronics grade **silicone**?

Standard silicones utilize acetoxy or oxime cure mechanisms, releasing acetic or ketonic acid fumes, which will corrode copper and other metals. By using an **alkoxy cure**, electronics-grade silicones release only non-corrosive methanol which is not harmful to sensitive electronics.

In addition, Novagard Electronics-Grade Silicones are formulated with **100% reactive materials** – containing no non-reactive plasticizers – for superior performance within a **wide range of possible uses**.



Attaching
Components

Potting &
Encapsulating

Conformal
Coating

Gasketing

Staking

Glob Topping

Why should you put Novagard on your team?

Our **three decades of silicone expertise** are fortified by a multi-year, \$30 million dollar investment in our people, plant, and processes. Our **robust R&D center of excellence and innovation** is focused on delivering products that meet your specific needs.

We are certified as **ISO 9001:2015** (QMS with Design) and **IATF 16949:2016** (QMS with Design).

As you review our products on the following pages, please keep in mind they're only the beginning—our engineers are able to manipulate the various silicone properties and **modify numerous performance characteristics** to provide you an electronics grade silicone solution **perfectly customized** for your specific needs.

Novagard products are known for their **durability**

Thousands of consumer, business, medical, and military electronic systems depend on our silicone technology to seal, bond, and encapsulate electrical parts in order to protect delicate components and modules, enhance their reliability, and extend the useful life of the product.



Aerospace



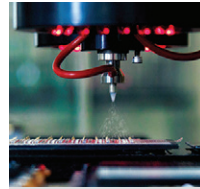
Appliances & HVAC



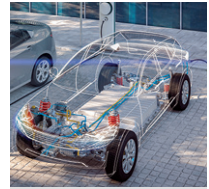
Automotive & Transportation



Consumer Electronics



Electronics/PCB Manufacturing



EV / Battery



General Construction



Industrial / Manufacturing



Leisure (Pool & Spa, RV)



Lighting & Optical



Medical Equipment



Metal Roofing & Wall Panel Installation



Military



Residential & Commercial Roofing



Siding, Window & Door Installation



Telecom



Water, Energy & Power



Window & Door Manufacturing

Path to perfection: “What do you need it to do?”

Are any fine wires or dense components endangered by thermal cycling? Will your component be exposed to moisture or dust? Is your board supposed to withstand intense vibration or impact?

Your electronics have very specific operational goals—good thing silicone has so many diverse properties, allowing our experienced Novagard engineers to expertly combine those that will cater to your every requirement.

Modifications to silicone properties may include

LOW

HARDNESS

HIGH

Provides thermal and physical stress relief

- Allows components to expand and contract at different rates without crowding/contacting/harming each other
 - Absorbs shock so vibration does not get transmitted to components
- Best for:** Dense topography, high thermal environments

Provides abrasion and impact resistance

- Protects raised, delicate components from being broken or knocked off
 - Protects integrity of entire board/build against violent jolts and collisions
- Best for:** Delicate topography, protruding components, punishing environments

LOW

VISCOSITY

HIGH

Provides speedier and assured coverage throughout

- High-speed application and superior ‘wet-out’ ability
 - Easily flows into tight spaces, under components, and through vias
- Best for:** Intricate architecture, delicate potting, high-speed manufacturing, automated dispensing

Provides precise flow and distance spread control

- Allows for extremely targeted ‘spot’ application with no spread into ‘keep-out’ areas
 - Permits damming and filling larger, tightly defined areas
 - Thicker application provides extra protection and vibration damping
- Best for:** Staking, laminating, filling large gaps, vertical surfaces

LOW

ADHESION

HIGH

Provides more controlled adhesion

- Permits future access to components for reworking and repair
 - Coating will come off clean leaving substrate ready for reapplication
- Best for:** Products that reach ‘failure mode’ or require regular maintenance

Permanent adhesion, including low energy surfaces

- Simplifies process with no primer or corona treatment necessary
 - Various types of substrates may be permanently bonded together
- Best for:** Assembly of difficult substrates, protecting unique technologies

LOW

THERMAL CONDUCTIVITY

HIGH

No conductive fillers, no fuss

- Meets the needs of most standard applications
- Best for:** Products emitting minimal heat, cost effectiveness

Actively moves heat away from components

- Protects components from thermal damage
 - Standard thermal filler packages provide pathway for heat to travel & dissipate
 - Capable of reaching very high levels of thermal conductivity 16 W/mK and higher
- Best for:** Semiconductors (Si, SiC, GaN), batteries, LED lighting, power supplies

THIXOTROPY

When you need absolute precision during dispensing, we can adjust thixotropy ratios to achieve it with your machinery. So when the pressure stops, the flow stops, and the bead holds its shape perfectly. Crucial for dot placement, bead formation, dam contours, and precise injections into extremely small crevices with no sagging, no spreading, and no dripping.

CURE TIME

Depending on your application and your process — and even the precise set-up of your line — we can adjust and fine tune our silicone formulations to cure as quick (or not) as you need, and offer you tack-free handling in less than 5 seconds.

Novagard **Silicone** Conformal Coatings, Encapsulants & Pottants

Silicones with a low modulus are a superior choice for coating delicate surface-mount devices and any application subject to harsh thermal cycling. Not only do these materials protect against high temperatures, they also offer excellent moisture protection. The low viscosity of a sprayable silicone allows the coating to flow through vias and under chips, completely protecting Printed Circuit Boards (PCBs).

General Purpose Conformal Coating

500-210

Novagard 500-210 is a balanced-performance silicone coating featuring a room temperature alkoxy moisture cure that can be accelerated with heat. Soft enough to reduce strain on components while being tough enough to resist abrasion. Good adhesion to a variety of electronics substrates. May be applied via spray or dip coating, as well as brushing or flow coating.

Tough Security Conformal Coating and Encapsulant

500-224

Novagard 500-224 is an opaque, single-component silicone coating and encapsulating compound that cures at room temperature to form an extremely tough, strong, abrasion-resistant coating that completely hides your circuitry and components.

Optically Clear Conformal Coating and Encapsulant

500-211

Novagard 500-211 is a compliant, optically clear coating. Ideal for LED and other lighting applications, this non-hazardous elastomeric enhances reliability through vibration damping and stress relief. Good adhesion to many substrates including FR4, plastics, and metals. May be sprayed, dispensed, brushed, dip coated, or flow coated.

Tough Optically Clear Conformal Coating and Encapsulant

500-222

Novagard 500-222 is an optically clear, single-component silicone coating and encapsulating compound that cures at room temperature to a tough, abrasion-resistant coating that isn't brittle. May be sprayed, dispensed, brushed, dip coated, or flow coated.

Deep Section 2-Component Pottant

500-607

Novagard 500-607 is a soft, very low viscosity clear pottant that flows easily into intricate architectures and complex designs, with low shrinkage and long working times. This deep section formulation allows for unlimited deep section cure at room temperature. The cured pottant enhances reliability via vibration damping and stress relief.

	500-210	500-224	500-211	500-222	500-607
PHYSICAL PROPERTIES					
Application	Conformal Coating	Conformal Coating and Encapsulant	Conformal Coating and Encapsulant	Conformal Coating and Encapsulant	Pottant and Encapsulant
Cure Chemistry	1 Component Alkoxy Moisture	1 Component Alkoxy Moisture	1 Component Alkoxy Moisture	1 Component Alkoxy Moisture	Two-Part Alkoxy
Appearance	Clear	Opaque/Black	Optically Clear	Optically Clear	Clear
Mix Ratio					1:1 (v/v)
UV Indicator	Available	Available	Available	Available	Available
Specific Gravity	0.98	0.99	0.98	0.99	Part A: 0.95-1.05 Part B: 0.95-1.05
Viscosity (cPs)	1,000	4,000	1,000	2,500	Part A: 100-200 Part B: 1,500-2,500
Gel Start Time (min)	<25	<20	5	<25	300-360
Durometer Shore A	40	60	30	50	13-18 (after cure*)
Durometer Shore 00			80		
Tensile Strength (psi)	110	700	150	650	
Elongation (%)	125	180	160	200	
Tear Resistance (pli)					1.5-2.5 (after cure*)
ELECTRICAL PROPERTIES					
Dielectric Strength	16 kV/mm 406 V/mil	15.1 kV/mm 383 V/mil	14.3 kV/mm 363 V/mil	13.9 kV/mm 352 V/mil	
Dielectric Constant at 100 Hz	1.87	1.72	1.22	1.69	
Dielectric Constant at 100 kHz	1.86	1.72	1.22	1.68	
Dissipation Factor at 100 Hz	.0030	.0010	.00987	.0011	
Dissipation Factor at 100 kHz	.0005	.0010	.000142	.0011	
Volume Resistivity (Ω cm)	2.74x10 ¹³	1.83x10 ¹⁴	3.11x10 ¹³	1.72x10 ¹⁴	

*7 days @ 25°C/50% RH

Immediately advance to your next production step
 We also offer UV cure and UV/dual cure deep section pottants. The UV only option offers a 1-2" cure depth, while the UV/dual cure offers better adhesion while curing to 1/2" .

UV/dual
 cure deep
 section
 pottants

Novagard **Silicone Gels**

Gels make ideal pottants and encapsulants because they cure-in-place, forming a soft, flexible, resilient cushion. Gels provide stress relief to protect delicate circuitry and interconnections from thermal and mechanical stresses. They also isolate circuits from moisture and other contaminants while providing insulation for high voltage electrical currents.

Dielectric Soft Gel

500-223

Novagard 500-223 cures to an extremely soft gel to provide maximum stress and strain relief in addition to great dielectric properties. This moderate viscosity formulation dispenses and flows easily around complex geometries.

Tough Gel

500-228

Novagard 500-228 offers primerless adhesion to most electronics substrates. This material begins to gel within 15 minutes, curing to a tough, strong, flexible elastomer, while providing protection, vibration dampening, and electrical isolation to protect sensitive electronic assemblies.

	500-223	500-228
	PHYSICAL PROPERTIES	
Application	Pottant and Encapsulant	Pottant and Encapsulant
Cure Chemistry	1 Component Alkoxy Moisture	1 Component Alkoxy Moisture
Appearance	Optically Clear	Clear
UV Indicator	Available	Available
Specific Gravity	0.98	0.97
Viscosity (cPs)	14,000	7,500
Gel Start Time (min)	~20	<15
Durometer Shore A		15
Durometer Shore 000	40	
Tensile Strength (psi)	15	170
Elongation (%)	1,600	425
	ELECTRICAL PROPERTIES	
Dielectric Strength	15.1 kV/mm 383 V/mil	12.5 kV/mm 317 V/mil
Dielectric Constant at 100 Hz	0.89	2.30
Dielectric Constant at 100 kHz	0.89	2.30
Dissipation Factor at 100 Hz	.0014	.0107
Dissipation Factor at 100 kHz	.00005	.000054
Volume Resistivity (Ω cm)	3.22x10 ¹³	1.58x10 ¹²

UV cure gel

If you want to increase throughput, consider our UV cure gel. This non-corrosive, single component silicone will cure to a solid elastomer in seconds upon exposure to ultraviolet (UV) light. Applied by automated needle dispense, hand dispense, flow coating, or hand brushing.

Novagard **Silicone** Adhesives/Sealants

These electronics-grade alkoxy silicones benefit from our proprietary functionalized polymers. They achieve a primerless adhesion to most substrates, including aluminum, polycarbonate, glass, and steel. Their fast tack and early strength enable units to move quickly from station to station. They deliver a uniform bond, yet remain flexible to help dampen vibrations and seal out moisture and dust.

General Purpose Electronics Adhesive

500-150

Novagard 500-150 is a single-component translucent alkoxy paste with moderate tensile strength and extremely high elongation for applications that require quick cures and early green strength development on sensitive components. 500-150 skins over in 10 – 30 minutes, and is completely cured within 72 hours.

UL-Rated Electronics Adhesives

500-090 (white), 500-091 (gray), 500-092 (black)

Novagard 500-090, 500-091, and 500-092 are a family of UL-rated electronics adhesives. With a good balance of tensile strength and elongation, these one-part UL flame rated pastes are for applications that require superior bond strength and flame resistance. Specially formulated to retain their physical properties even during service in extreme environmental conditions, 500-09x skins over in 5 – 15 minutes, and is completely cured within 72 hours.

Fast Cure Electronics Adhesive

500-652 Coming in Q4 2022

This two-part, electronics grade adhesive paste provides initial green strength in only 5 minutes, optimizing your production efficiency. 500-652's fast room temperature cure quickly builds strength as it cures into a solventless elastomeric adhesive. 500-652 maintains its strength even in high temperature bonding applications, and can be used to dampen vibrations and relieve stress. UL 746C certified.

	500-150	500-090 500-091 500-092	500-652 <i>Preliminary Data</i>
PHYSICAL PROPERTIES			
Cure Chemistry	1 Component Alkoxy Moisture	1 Component Alkoxy Moisture	Two-Part Alkoxy
Appearance	Translucent Paste	White/Gray/Black Paste	Part A: Black Part B: White Mixed: Black
Mix Ratio			2A : 1B (v/v)
Specific Gravity	1.00-1.05	1.30-1.40	Part A: 1.32 Part B: 1.62 Mixed: 1.42
Viscosity (cPs)			Part A: 110k-140k Part B: 30k-45k
Extrusion Rate (g/min)	30	40	
Skin Over Time (min)	5-30	5-15	
Cure Time	72 hrs. max.	72 hrs. max.	
Durometer Shore A	18 +/-5	35 +/-5	55-65
Tensile Strength (psi)	175-225	200-300	250-350
Elongation (%)	950-1,050	325-425	125-175
Flammability Class		Black = UL94 V0 White = UL94 VI	
		Snap Time (min)	3-5
		Tack-Free (min)	5-10
		Sag, Boeing Jig	<0.1"

CIPG (Cured-in-Place Gasket) provides greater gasket design flexibility and allows the opening and closing of lids to repair components inside. FIPG (Formed-in-Place Gasket) adheres to both substrates, ideal for non-reenterable enclosures.



CIPG: Adheres to one side of substrate



FIPG: Adheres to both sides of substrate

CIPG
& FIPG

Novagard Foaming **Silicone** Encapsulant – *Coming in 2023!*



If your mission is designing next gen battery systems to supercharge the movement of the entire electric vehicle market—while helping save the planet at the same time—you’ll need our advanced foaming silicone technology. This very low density silicone foam is incredibly lightweight – you’ll see as much as 85% weight reduction compared to other encapsulation methods – which translates into improved performance with less material. Engineer a lighter vehicle without sacrificing impact resistance from collisions and road projectiles. In the end, our soon-to-be foaming silicone will protect your battery cells, your budget, your reputation, and—ultimately—the planet. Contact us now to talk more.

Clean and Green

Most Novagard silicones have no solvents, so there is no harmful VOC emissions or outgassing. Our 100% solid coatings are simply safer for people and the planet, while removing complexity, cost, and time from your manufacturing processes.



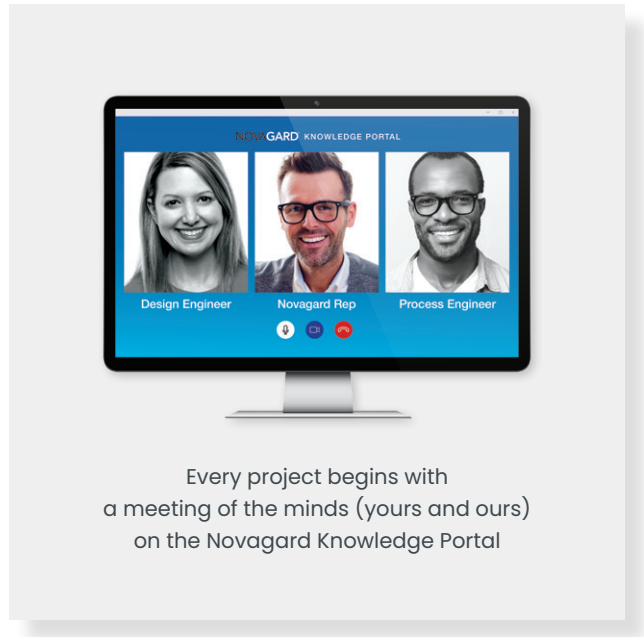
Enough about us. Now it's about **you.**

Even with 40 years of silicone expertise, and hundreds of successful formulations, our accomplished engineers know the first thing to focus on is you: *"What are you building? Why? What's the end goal?"*

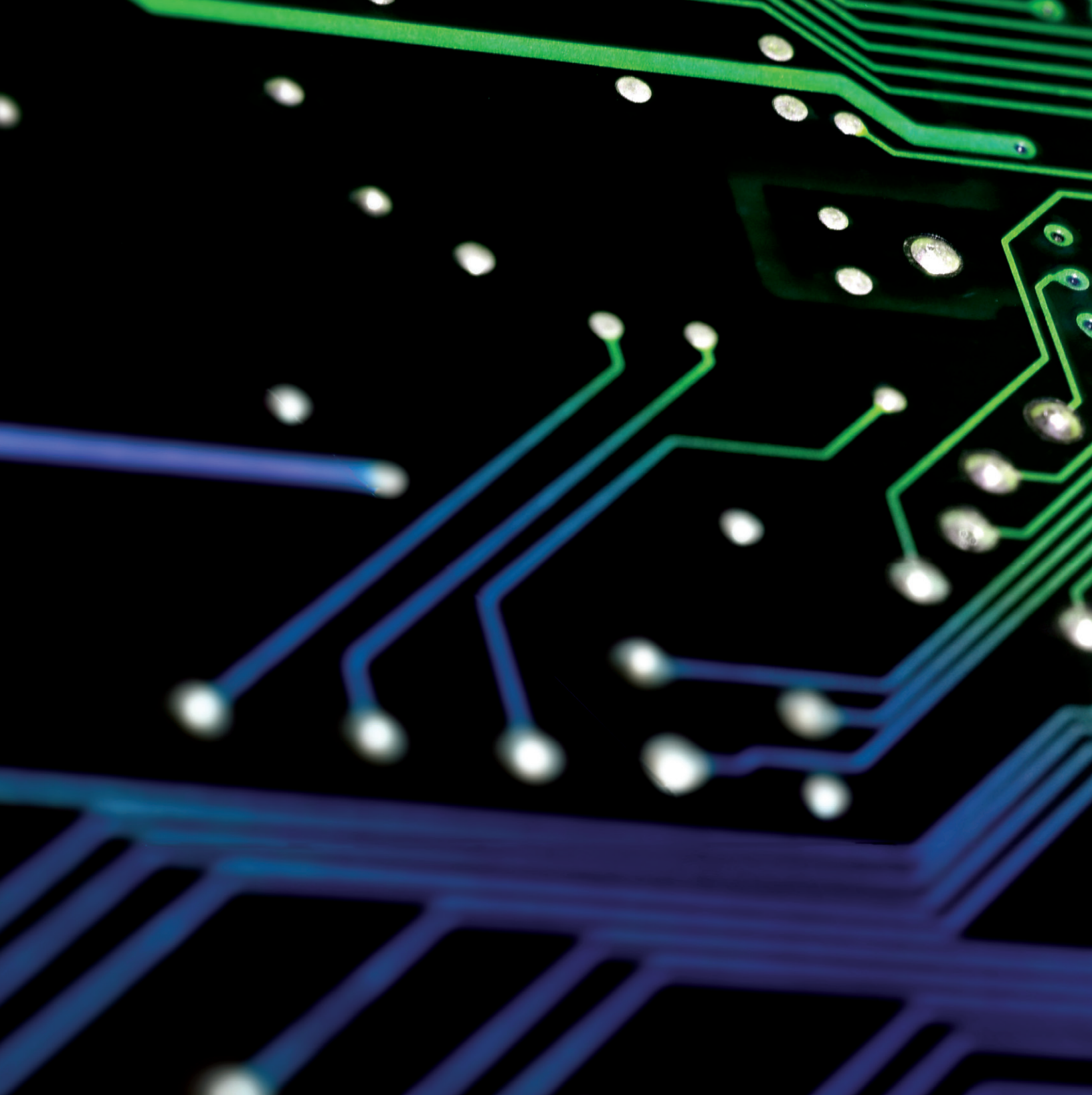
Our end goal is to help you reduce time, risk, and cost at every stage of your product development.

Oh, and pain. Tell us exactly what pains you: *"What product has already failed you? In what way is it letting you down? Is there a reason you're not happy with how the supplier is trying to fix the problem ... and end the pain?"*

With every consideration now on the table, we'll start with selecting our most promising candidate formulation. It may be just what you need. But if it's not quite right, we'll begin making the modifications to further improve both the desired performance of your electronics and the efficiency of your manufacturing process.



The values outlined in the enclosed tables reflect testing that was conducted under laboratory conditions, actual results may vary. Some data in the enclosed tables are derived from pre-production samples and are subject to change. The information provided in the tables is not intended for use in preparing specifications. Please consult manufacturer for additional info.



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