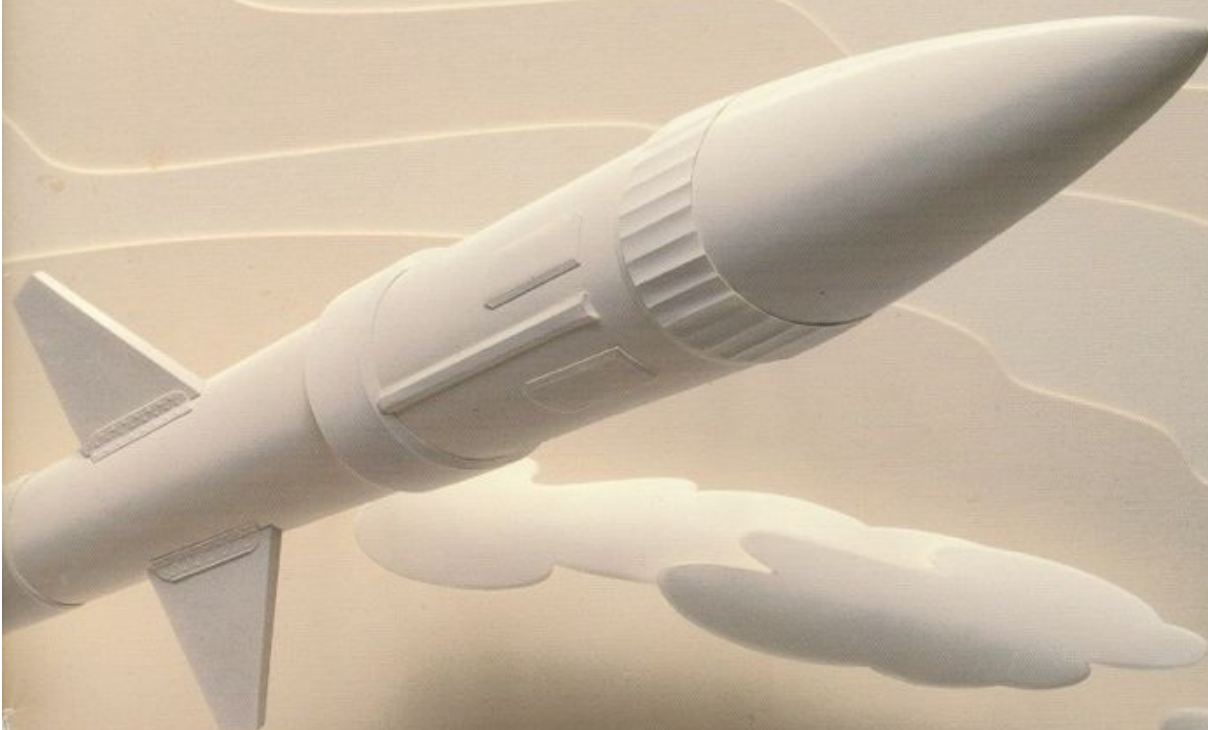




***GE Solid State***

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# *HIGH-RELIABILITY CAPABILITIES*



# GE SOLID STATE

## GE/RCA/Intersil Semiconductors

These three leading brands are now one leading-edge company. Together, we have the resources—and the commitment—to help you conquer new worlds.

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## Your Partner in High-Reliability Systems

GE/RCA/Intersil high-rel products—a broad spectrum of integrated circuits and discrete semiconductors for military, aerospace, and critical industrial applications.

GE high-reliability products for aerospace/military programs

- CD4000-Series  
CMOS Digital Logic Circuits
- CDP1800-Series  
CMOS Microprocessor,  
Memory, and I/O Circuits
- CA3000-Series Linear (Bipolar  
and BiMOS) Circuits and DMOS
- Analog Switches
- Data Acquisition ICs
- RAMs (Bulk and SOS)
- High-Speed CMOS  
(CMOS and TTL Logic Levels)
- ACL—Advanced CMOS Logic
- Custom Products  
(COMSEC and FUZES)
- ASIC Products (Gate Arrays,  
Standard-Cell Families, and  
Foundry Services)
- Emulation and Programmable  
Integrated Circuit (EPIC) 8-Bit  
Slice-Microcomputer Family
- Bipolar Discrete Devices
- Power MOSFET's
- Small-Signal Discrete  
MOS Devices
- Transient Surge Suppressors  
(MOV's and Surgeclors)
- Radiation-Hardened Versions  
of Selected Types Listed Above



# GE SOLID STATE

Mountaintop, PA



Cupertino, CA



Somerville, NJ (GE Solid State Headquarters)



Findlay, OH

GE Solid State has high-rel fabrication, assembly, and design facilities throughout the world.

# GE SOLID STATE

Brussels, Belgium



Taoyuan, Taiwan



Kuala Lumpur, Malaysia



Dundalk, Ireland



Research Triangle Park, NC



# HIGH-REL OVERVIEW

## GE Solid State: Your Partner in High Reliability

**Offering you facilities, technical expertise, development capabilities, and a product line unduplicated by any other manufacturer in the country.**

In military electronics and outer space, you don't get a second chance if your hardware fails. Reliability of components is critical to survival—and success. Which is why dozens of key defense and aerospace programs count on high-rel IC's and discrete power devices designed, manufactured, and supported by GE Solid State.

### **An entire organization dedicated to your success**

At GE Solid State, we've spent millions to create a high-rel semiconductor organization built with only one goal in mind: the success of your program. It's an organization that's here for the long haul. To serve your high-rel semiconductor needs into the 1990's and beyond.

### **Proven leadership in high reliability**

GE Solid State offers you one of the broadest lines of military-approved high-rel components: everything from standard and high-speed CMOS logic IC's and ASIC's to discrete power devices and CMOS microprocessors, memories, and peripherals to bipolar and MOSFET discrete power devices and transient surge suppressors. IC products can be screened to Class S and Class B standards for use in a wide range of military, aerospace, and commercial applications—including satellites, missiles, radios, fuzes, telecommunications, torpedoes, weapons systems, and space craft. Similarly, discrete devices can be supplied to JAN, JANTX, and JANTXV screening requirements.

Today, GE Solid State high-rel IC's and discrete power devices are employed in dozens of critical defense and space programs, from the AEGIS shipboard radar system and Minute Man ICBM, to the MX Missile, small ICBM, and Voyager space mission.

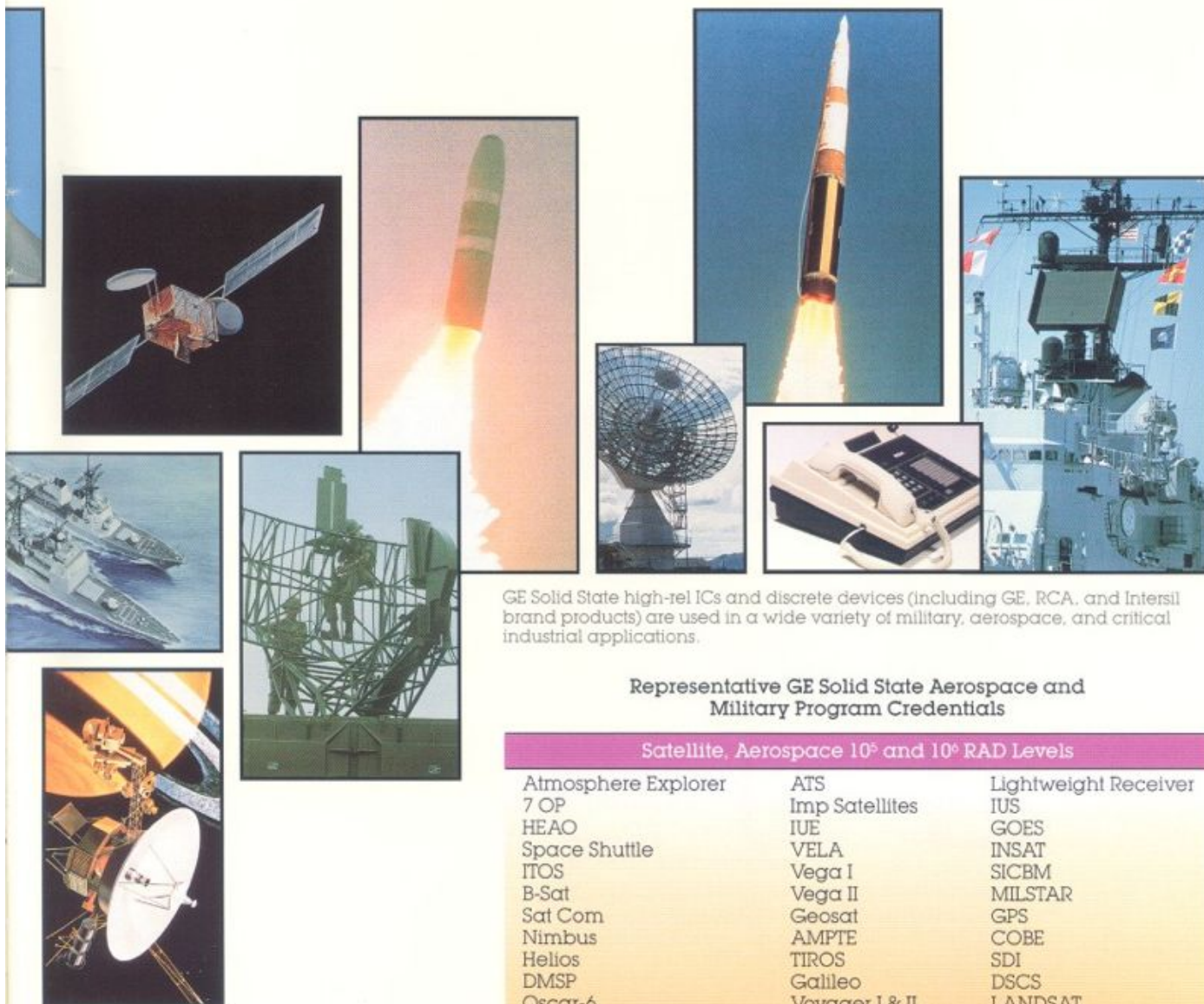
### **And the technology continues to evolve . . .**

Our high-rel production facilities are being geared to produce the new 1.25-micron geometries. Meanwhile, we continue to introduce new devices that are lighter, smaller, faster, and more resistant to extremes of electrical conditions, physical abuse, temperature, and radiation. Use of statistical process control and stringent quality-assurance standards throughout fabrication, assembly, and screening assure that your reliability requirements, product specifications, and delivery schedules are met or exceeded—every time. (In our ASIC group, for example, the first-time success rate in a recent year was 97 percent).



GE Solid State headquarters, Somerville, NJ

# HIGH-REL OVERVIEW



GE Solid State high-rel ICs and discrete devices (including GE, RCA, and Intersil brand products) are used in a wide variety of military, aerospace, and critical industrial applications.

## Representative GE Solid State Aerospace and Military Program Credentials

### Satellite, Aerospace 10<sup>5</sup> and 10<sup>6</sup> RAD Levels

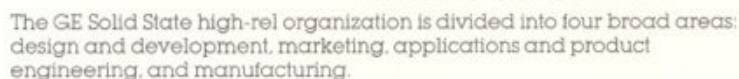
Atmosphere Explorer	ATS	Lightweight Receiver
7 OP	Imp Satellites	IUS
HEAO	IUE	GOES
Space Shuttle	VELA	INSAT
ITOS	Vega I	SICBM
B-Sat	Vega II	MILSTAR
Sat Com	Geosat	GPS
Nimbus	AMPTE	COBE
Helios	TIROS	SDI
DMSP	Galileo	DSCS
Oscar-6	Voyager I & II	LANDSAT
Pioneer-F		

### Tactical Military Programs

Tow Cobra	AN/ALE 139	FMU-112B
Tenley	DMD/PLARS	FMU-117B
S-3A Aircraft	Parkhill	Ptarmigan
Lans Program	Multi-Role	TICM
TD-1065	Combat Air	Sparrow
Communication	AN-TPN-19	SINCGARS
Vinson	AN-ASQ-119	GEMNS
Airs	Arctic Beacon	GATOR
ARC-150	AWACS	KG84A
ARC-164	MK 46	KG84C
PRC-85	NYVO	STU II
Stinger	BI55	STU III
Captor	M-56	KGV10
Manpack	XM-70	Copperhead
Skiru	ADAM	Hellfire



## GE Solid State High-Rel Organization



The new GE Solid State was created by combining the technological manufacturing resources of three giants in the field: GE Semiconductor, RCA Solid State, and Intersil.

wide as a first-class R&D facility. One recent invention is a new all-silicon package that allows us to produce smaller, lighter, and less costly power devices. Also, our GE-MOVs are the first metal-oxide varistors on the Qualified Parts List.

● **RCA Solid State** has a long list of firsts in IC's and discrete power devices, including the first CMOS microprocessors and peripherals, first CMOS flash converters, first MOS-gated bipolar transistor, and first logic-level power FET. We invented the silicon-on-sapphire technology that allows

# HIGH-REL OVERVIEW

ICs to resist transient radiation in outer space. And we have more than 1,000 IC's on DESC's Qualified Parts List. In addition, we invented the COMFET and have the first logic level power MOSFET's and the first p-channel power MOSFET's on the Qualified Parts List.

- **Intersil** introduced its first QPL product, the 2N5114 JFET, in 1974. The current product line includes analog switches, high-resolution, high-speed A/D and D/A converters, linear and micro peripherals, multiplexers, accumulators, converters, and flash ADC's. Intersil pioneered analog CMOS technology, and our most recent innovation is a applications oriented line of integrated signal processing devices.

Together, these three organizations, which are combined to form GE Solid State, represent a powerful industry force in high-rel IC's and discrete devices.

## High-rel is organized to serve your needs

GE Solid State is dedicated to high-rel success. Which is why we have a separate and distinct organization which serves this marketplace exclusively. The major divisions within this organization are:

- **Design and development.** We can meet your needs by converting any of our commercial products to high-rel types (built-in quality often enables us to do this with no redesign, simply by subjecting existing products to military screening standards). Or, we can build a high-rel product from scratch to satisfy the challenges of your special requirements. An example is our 1750A processor chip set. Developed jointly with Rockwell, this rad-hard SOS processor—designed for use on the small ICBM Program—processes 800 thousand instructions per second.

- **Marketing.** The marketing group's mission is to meet the customer's requirements with the

best possible device at the lowest possible cost. But at the same time, we keep a sharp eye on where the market is going, so that GE Solid State can develop high-rel devices that **anticipate** your future needs. An example is our new high-speed advanced CMOS logic (ACL) line, which matches Fairchild's FAST™ devices in speed but at a fraction of the power consumption.

- **Applications and product engineering.** These groups assure that our components meet your precise specifications. We work closely with customers, converting detailed specifications, RFP's, and source control drawings into high-volume production runs of parts that make the grade. Sometimes, this means modifying a standard component. In other cases, development of an equivalent ASIC circuit.

- **Manufacturing.** In 1986, GE Solid State shipped more than 7 million high-rel components. Our plants, located worldwide, use the most sophisticated equipment for wafer fabrication, assembly, and burn-in, life-cycle and radiation-hardness testing. The RCA high-rel IC manufacturing facility in Findlay, Ohio, and the Intersil facility in Santa Clara, California, are both MIL-M-38510-certified plants capable of large-volume IC production. In addition, the GE/RCA power-device manufacturing facility in Mountaintop, PA, is MIL-STD-19500 certified for both bipolar and MOS power technologies.

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FAST is a trademark of Fairchild Corporation



# HIGH-REL PRODUCTS

## GE Solid State accomplishments in CMOS and high-rel (a partial list)

- Invented CMOS technology in 1962. Also the first company to put MOS and bipolar semiconductors on a single chip (BiMOS technology).
- Introduced first CMOS microprocessor in 1975.
- A leader in JAN Class S and Class B products.
- Specialist in radiation-hardened and SOS (silicon-on-sapphire) technology. Products include a 16K SOS rad-hard RAM.
- GE Solid State high-rel HC/HCT devices incorporated in more than 80 standard military drawings. Sole-source supplier of SOS HCS/HCTS high-speed CMOS products.
- First large-scale high-rel fabrication facility to be qualified to MIL-M-38510. Scanning-electron-microscope inspection used in screening procedures since 1972.
- More IC's and power discretes on Qualified Parts List than any other supplier. Only manufacturer with MOV's on QPL.
- Pioneered development of analog CMOS, BiMOS, SOS, Logic-Level Power MOSFETs, COMFET, IGT, 200-volt CMOS process, and Integrated Signal Processing.
- Broadest line of CMOS logic devices compliant with MIL 883 Rev. C. Over sixty CD4000 Class S and B CMOS logic IC's approved by DESC.

## 1C Reliability Levels

Screening Levels		Application	Description
Packaged Devices			
/MS	Class S with SEM Inspection and Condition A Precap Visual Inspection	Aerospace and Missiles	For devices intended for use where maintenance and replacement are difficult and reliability is imperative
/MSR	Same as /MS + Radiation Hardened to 10 <sup>5</sup> rads(Si)		
/MSH	Same as /MS + Radiation Hardened to 10 <sup>6</sup> rads(Si)		
/3A	Class B (Full Compliance)	Military and Industrial, for Example, in Air-borne Electronics	For devices intended for use where maintenance and replacement can be performed but are difficult and expensive
/3	Class B, Modified		
/1R	Modified Class S with SEM Inspection and Modified Condition A Precap Visual Inspection	Aerospace and Missiles	For devices intended for use where maintenance and replacement are difficult and reliability is imperative
/1RZ	Same as /1R + Radiation Hardened to 10 <sup>5</sup> rads(Si)		
Chips			
/S	SEM Inspection and Condition A Visual Inspection	Aerospace and Missiles	For hybrid applications where maintenance and replacement are extremely difficult and reliability is imperative
/SR	Same as /S + Radiation Hardened to 10 <sup>5</sup> rads (Si)		
/SH	Same as /S + Radiation Hardened to 10 <sup>6</sup> rads (Si)		
/M	Condition B Precap Visual Inspection	Military and Industrial	For general applications

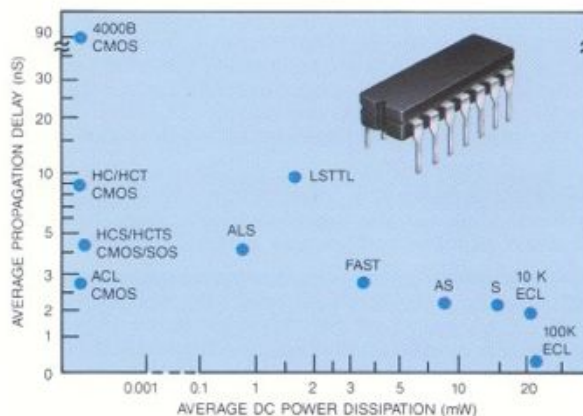
## RCA High-Rel ICs

## A CMOS evolution

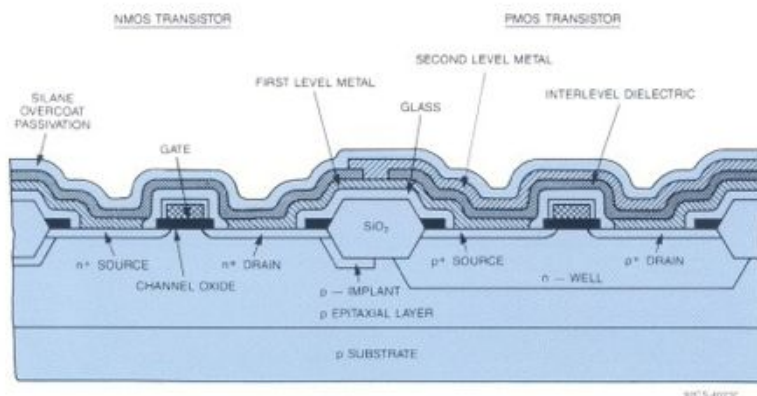
In addition to this proven line of high-speed CMOS devices, we manufacture a full line of bipolar and BiMOS linear IC's and 8-bit CMOS LSI microprocessors. Plus a CMOS/SOS/LSI series of RAMs, IO's, and support circuits, radiation-hardened to withstand the rigors of outer space.



IC manufacturing facility at Findlay, Ohio (MIL-M-38510 certified)



RCA's advanced high-speed CMOS IC's achieve speeds equal to Fairchild's FAST™ bipolar device at a fraction of the power.



ACL two-level-metal CMOS process provides switching speeds 3 to 4 times faster than HC/HCT high-speed CMOS devices.



# HIGH-REL PRODUCTS

The RCA high-rel IC product line at a glance . . .

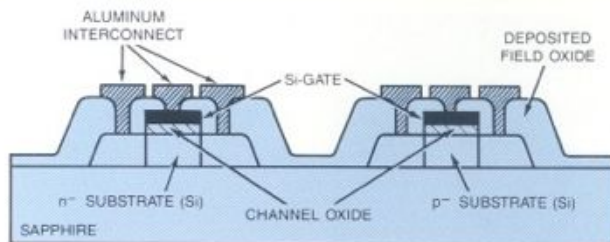
Product	Description
<b>CD4000B Series</b>	<b>CMOS digital logic circuits.</b> Series includes SSI, MSI, and LSI functions: simple gates, complex counters, registers, arithmetic units. High-rel IC's screened for military and aerospace applications. Compliant with MIL-M-38510 QPL and MIL-STD-883C. Low power consumption. High noise immunity. High speed. High fan-out. TTL and DTL logic-compatible. Temperature stability. Fully protected inputs and outputs.
<b>54HC/HCT Series</b>	<b>High-speed CMOS logic IC's.</b> Drop-in replacements for 54LSTTL and CMOS 4000 series digital logic types. 10-ns gate delay with 30-MHz operating frequency (typical). Available Class S and Class B types. Power supply from 2 to 6 volts. Noise immunity up to 3 times better than LSTTL. Static power consumption less than 1 microwatt. Over 225 parts available. Radiation hardened versions of HC/HCT types are now becoming available. While specifications call for 100 K rads (Si), higher levels can be provided for very critical applications.
<b>ACL</b>	<b>Advanced CMOS Logic AC/ACT IC's.</b> The "next generation" of CMOS logic. Gate delay less than 3 ns. Can operate at over 150 MHz. Matches speed of Fairchild FAST™ bipolar devices but at substantially lower CMOS power consumption. Interface compatibility with CMOS and TTL. Output drive capability is 24 milliamps. The AC/ACT series is now becoming available in fully compliant MIL-STD 883 versions and in SMD (Standard Military Drawings) format.
<b>CA3000 Series</b>	<b>Bipolar and BiMOS linear IC's.</b> Screened to modified Class S and B ratings. Product line includes voltage regulators, amplifiers, transistor arrays, switches, comparators, and A/D converters.
<b>CDP1800 Series</b>	<b>8-bit CMOS LSI microprocessors, memories, I/O's, and peripherals.</b> Screened to Class B equivalent, MIL-STD-883. Ideal for battery-operated mobile ground equipment in harsh environments. Provides reliable low-power operation throughout full military temperature range. High noise immunity. Fully static. Single power supply.
<b>CMOS/SOS/LSI</b>	<b>RAMs, I/O's, and support circuits available.</b> Combines SOS and silicon-gate technology with CMOS architecture. Low power, high speed. Immune to latch-up. Resistant to total-dose, transient, and cosmic radiation single-event upsets. Can function without danger of temporary upset at radiation levels up to $3 \times 10^{10}$ rads/sec. Capable of surviving $10^{12}$ rads per second. Can be designed with high packing density.
<b>CMOS ASICs</b>	<b>Application-specific integrated circuits.</b> Bulk CMOS gate arrays and standard cells in 1.5-, 2-, and 3-micron geometries. CMOS/SOS types, with and without total-dose hardening, in 3-micron geometries. Supported by worldwide state-of-the-art design centers.
<b>EPIC Family</b>	<b>8-bit slice architecture chip set.</b> Emulation and Programmable IC (EPIC). Chips include: processor, controllers, sequencer, multiplier, shifter, ROMs, double-register and address-select units. Used to upgrade and emulate existing computers. Applications include: radar, navigation systems, space-borne computers, and digital communications. Screened to Class S (rad hard).
<b>16K RAM</b>	<b>Stand-alone RAM radiation-hardened to 200 Krad.</b> 3-micron, SOS technology. Access time of 80 to 100 ns. Used on MILSTAR satellite.
<b>COMSEC</b>	<b>Secure Communications program.</b> RCA is a leading supplier of IC's for COMSEC telecommunications circuits.

## A leader in rad-hard SOS technology

We offer rad-hard versions of CD4000 logic IC's and many other high-rel devices. These rad-hard parts are screened to withstand radiation up to 1.0 meg rads (Si).

In addition, GE Solid State is a pioneer in the silicon-on-sapphire technology that allows semiconductors to resist transient radiation, total-dose radiation and the single-event upsets caused by cosmic rays and heavy particles. In CMOS/SOS devices, a sapphire substrate dielectrically isolates n and p channels preventing latch-up. Memories produced using SOS technology suffer fewer radiation-induced bit errors, because the space charge associated with junction isolations is not present on the sapphire substrate. At the customer's request, we can fabricate standard high-rel bulk CMOS devices in the silicon-on-sapphire technology.

# HIGH-REL PRODUCTS

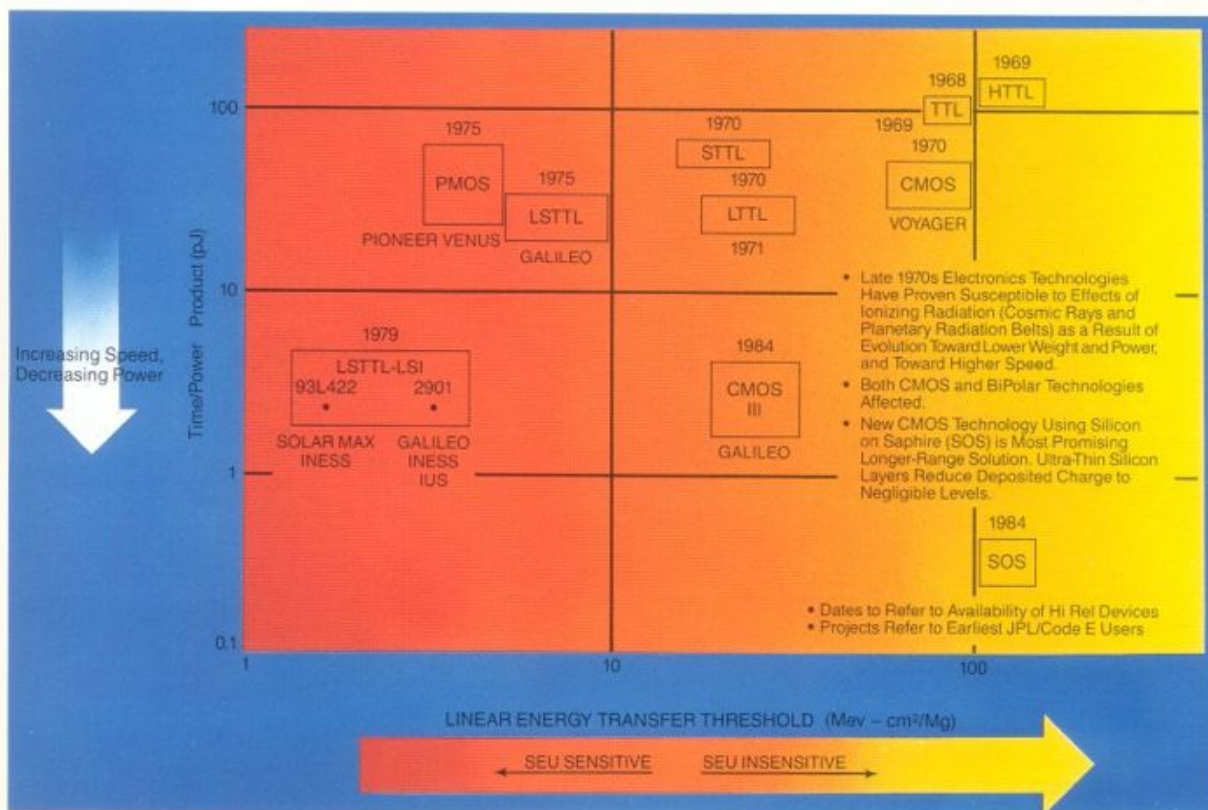


CMOS/SOS structure uses sapphire substrate to insulate the n- and p-transistors from each other. This structure is highly resistant to transient radiation, total-dose radiation, and single-event upsets.

## TECHNOLOGY CHOICE

Requirement	Bipolar	CMOS Bulk	CMOS/SOS
• Transient Radiation Tolerance			✓
• Cosmic Ray Upset			✓
• High Speed	✓		✓
• Low Power		✓	✓
• Noise Immunity		✓	✓
• Temperature Range	✓	✓	✓
• Power Supply Range		✓	✓
• Neutron		✓	✓

CMOS/SOS (silicon-on-sapphire) technology offers superior radiation tolerance, high speed, low power, good noise immunity, and neutron resistance over the full military temperature range.



Evolution of integrated-circuit technology with respect to single-event-upset (SEU) sensitivity. CMOS/SOS technology is the most promising, longer range solution to the SEU problem.



# HIGH-REL PRODUCTS



Photo of an ASIC made with radiation-hardened CMOS/SOS standard cells.

## Semicustom and fully customized devices available

GE Solid State boasts one of the most advanced ASIC (application-specific integrated circuit) capabilities in the world. Our ASIC Design Centers, located on the East and West Coast and overseas, are fully staffed and equipped with the most sophisticated computers, software tools, data libraries, and technical support teams to help you convert your design into a finished high-rel product fast.

Our new **silicon compiler technology** allows you to create high-rel systems that are heavily bus-structured, with ROMs, RAMs, PLAs, and ALUs compiled right into the design. Or, you can work with our broad library of standard cells and gate arrays.

We have hundreds of verified standard cells, with gate lengths as small as 1.5 microns and double-level metal for higher chip density and speed. In gate arrays, you can choose from a standard family with arrays containing up to 66,550 gates.

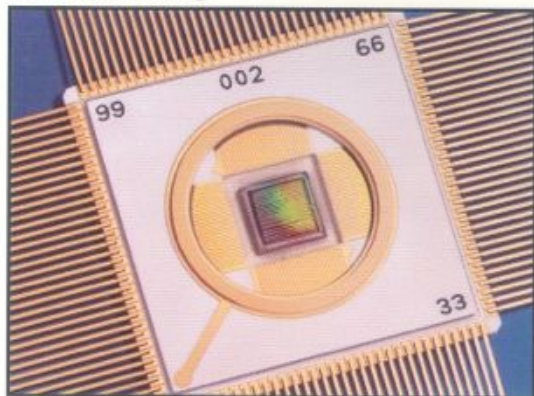
For those customers with more specialized requirements, GE Solid State offers a fully customized high-rel service. Recent custom products include a state-retention RAM, micro-processor fuzes, and a 1750A processor (see R&D section of this brochure for more details).

# HIGH-REL PRODUCTS

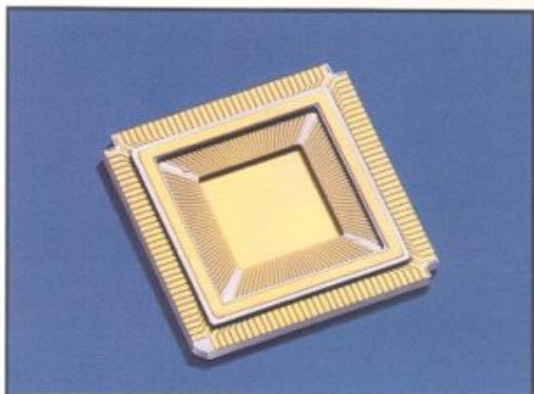
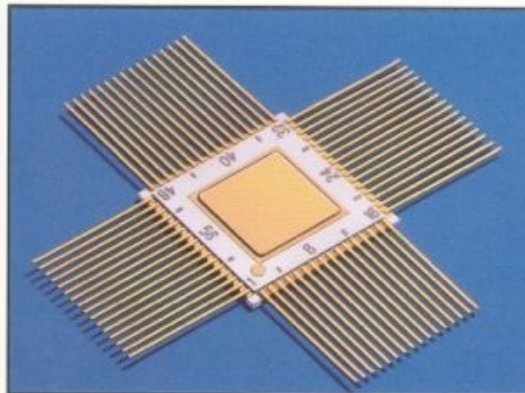
## High-Rel IC Packages

State-of-the-art hermetically sealed IC packages specially designed for high-rel applications.

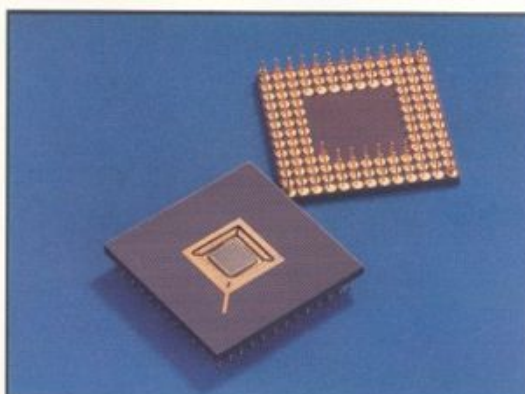
132-terminal flat pack with protective lid removed to show chip mounting.



64-terminal flat package.



132-terminal leadless chip carrier, (currently in development).



120-terminal pin-grid array.

**An advanced high-rel packaging capability to accommodate today's devices . . . and tomorrow's.**

### Standard and custom packages for high-rel IC devices

In high-rel, the package has to be as reliable as the integrated circuit it contains. Which is why we've developed a special line of hermetically sealed packages exclusively for our high-rel customers.

One recent innovation is our new leadless chip carrier, used for our CD4000B logic IC's and CDP1800-series microprocessors. Screened to Class S and Class B, the leadless carrier offers several advantages including a smaller package outline, smaller package inductance and capacitance with less weight, elimination of

mounting holes, denser packing on PC boards, simplified soldering of devices to boards, and lower cost for higher-pin-count LSI circuits. For hybrid manufacturers, use of the leadless chip carrier in place of multichip hybrids improves yield and enhances reliability, because devices can be screened to mill specs before boards are assembled.

Other high-rel packages include hermetically sealed ceramic dual-in-line, ceramic flat packs, and pin-grid arrays. Currently we supply packages with up to 132 terminals or more. Terminal-center spacings range from 100 mils for dual-in-line packages down to 25 and 40 mils for flat



# HIGH-REL PRODUCTS

GE Solid State currently supplies high-rel packages with up to 132 terminals. Packages with even larger terminal counts are currently under development.

Package Type	Seal	Number of Terminals	
		Class S	Class B
Flat Pack	Weld	14, 16, 24, 28	14, 16, 24, 28
	Frit	—	42
Quad Flat Pack	Braze	—	40
	Weld	64	64, 132
Dual-In-Line CERDIP	Frit	14, 16	14, 16, 18, 20, 22, 24, 28
Side Braze	Weld	14, 16, 18, 20, 24	14, 16, 18, 20, 22, 24, 28, 40, 64
Leadless Chip Carrier			
	50-mil Centers	Braze	—
		Weld	20, 68, 84
	40-mil Centers	Weld	20, 28, 32, 44
25-mil Centers	Braze	24, 64	24, 32, 40, 48, 64
Pin-Grid Array 13 x 13	Weld	—	132
		Weld	120

NOTES: 1. Other packages are available on a custom basis.  
2. Packages with terminal counts up to 256 in advanced development.

packs and chip carriers, respectively. To date, we have packages that house IC chips as large as 364 by 364 mils, and we can produce larger packages to accommodate bigger IC's.

Package leads come in a variety of finishes including solder-coated tin plate, gold-plated, or solder-dipped nickel. Packages can be branded with the customer's logo, part number, and date code. All RCA high-rel packages meet MIL-M-38510 case-outline requirements.

## A unique weld-seal technique gives us a competitive edge

RCA is the only U.S. manufacturer to use a unique weld-seal technique to seal packages. The weld seal can be made at lower temperatures than conventional brazed seals, reducing moisture content in many situations. Unlike braze sealing, the weld process

does not require a gold-tin preform—a source of heavy metal that can adversely affect performance under some radiation conditions. What's more, the weld seal forms high walls that may be used as boundaries for special coatings used to prevent reverse engineering.

## Devices are packed for safe shipping and handling

All RCA high-rel devices are packed and shipped to meet MIL-M-38510 Section 5 requirements for protection against electrostatic discharge—a potential source of damage to which today's larger devices are especially susceptible. High-rel parts are carefully packed and shipped, using procedures unique to the device to assure safe delivery and virtually eliminate damage.

# HIGH-REL PRODUCTS

## GE and RCA High-Rel Discrete Power Devices



Discrete power devices manufacturing facility at Mountaintop, PA, is MIL-STD-19500 certified for both bipolar and MOS power technologies.

**A full line of bipolars, MOSFETs, rectifiers, and MOV's... with special high-rel packaging and rad-hard versions available.**

**A track record in high-rel power that's hard to beat.**

Quite simply, GE Solid State is #1 in high-rel power semiconductors, with more power discretes on the Qualified Parts List than any other U.S. manufacturer. These include 120 bipolars and 81 MOSFETs. We're also the only manufacturer with DESC-approved MOV's (four to date).

GE and RCA power discretes are currently used in more than a dozen key defense programs, ranging from AEGIS and MOTAR to Sparrow and Peacekeeper. Products are screened to JAN, JANTX, and JANTXV specifications. In a recent year, our Pennsylvania-based power production plant shipped more than 2 million high-rel devices.

### A pioneer in high-rel power discretes

GE Solid State offers a full range of high-rel bipolars. Our programs involving MOSFET technology are also truly extraordinary.

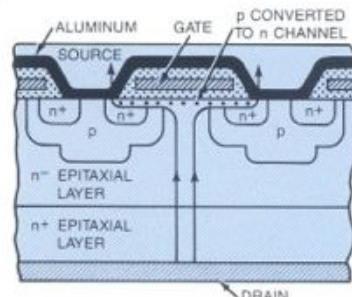
- For example, we recently introduced the logic-level FET, a 5-volt gate drive power MOSFET that offers a 2:1 improvement in transconductance over

conventional 10-volt power MOSFETs. The L<sup>2</sup>FET is now available in high-rel versions rated at 100 and 200 volts. And we have the first p-channel power MOSFETs on the QPL.

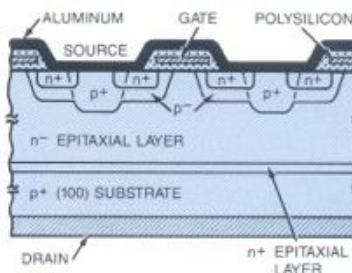
- An RCA invention, the COMFET, uses a **conductivity modulation** technique to achieve a 10:1 improvement in on-state resistance over conventional power MOSFETs when operating in the 400-to-500-volt range. GE developed essentially the same device—called the IGT—independent from RCA. Selections from our COMFET/IGT line, generically referred to as insulated-gate bipolar transistors (IGBT's), are planned for QPL qualification in 1988.

- The latest technology to come out of our Mountaintop, PA, facility is the GE/RCA **rugged MOSFET**. The rugged device—which is screened to withstand "avalanche energy" that can destroy conventional MOSFETs when breakdown voltage is exceeded—has an improved circuit reliability that makes it ideal for military and aerospace applications.

RCA N-CHANNEL POWER MOSFET (STANDARD TYPE OR L<sup>2</sup>FET)



COMFET (CONDUCTIVITY-MODULATED FIELD-EFFECT TRANSISTOR)



Cross sections of chip structures

By reducing gate insulator thickness from 100 to 50 nm in the L<sup>2</sup>FET (a), we achieve a 2:1 performance improvement while operating off a more economical 5-volt power supply. The COMFET (b), which offers a 10:1 reduction in  $R_{DS(ON)}$  at high voltages, is similar to a conventional MOSFET but built on a p+ substrate instead of the usual n+. A thin n+ epitaxial layer is added to increase COMFET switching speed to levels competitive with regular power MOSFETs.



# HIGH-REL PRODUCTS

## SCR's and MOV's round out the high-rel power line

In high-rel SCR's, we offer the 2N680 series, consisting of 9 parts rated at 25 amps, from 50 to 600 volts.

In MOV's, we are the first and only manufacturer to have our product approved for the Qualified Parts List. In addition, through our **value added program**, we can screen any of our 248 standard GE-MOV metal-oxide varistors to various high-rel test standards needed to satisfy special customer requirements.

### Value added program

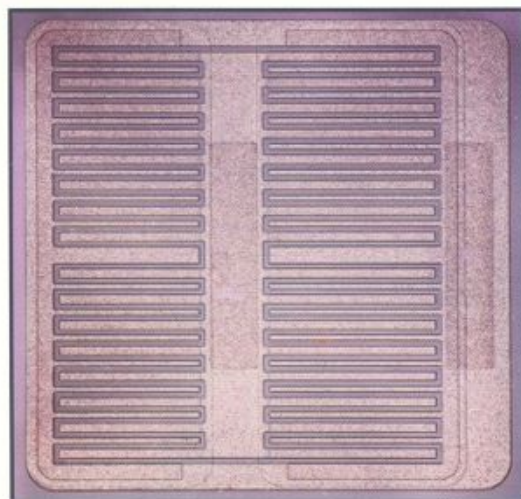
Our value added program is not limited to just MOV's. Any of our standard discrete power devices can be subjected to value added screening to meet specific customer requirements.

### New advances in rad-hard power

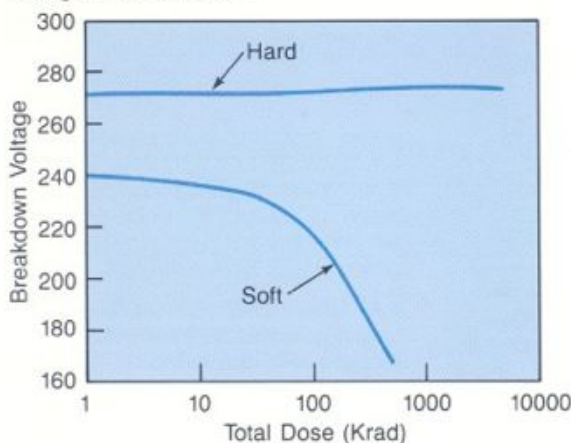
GE Solid State has an active ongoing program to study the effects of radiation on power discretes and—where necessary—modify existing structures to increase radiation hardness to acceptable high-rel levels.

Gamma radiation, for example, causes high photocurrents to flow in conventional power MOSFET structures, turning on the parasitic n-p-n transistor and destroying the device. Most power MOSFETs cannot survive doses exceeding 100 Krads. In recent experiments, engineering test cells of a new rad-hard RCA MOSFET survived doses greater than 500 Krads.

Our "hardest" bipolar power device developed to date is the RCA TA9107 transistor, which can withstand neutron fluence of  $10^{14}$  neutrons per square centimeter and a gamma dose rate of up to  $10^6$  rads per second. The TA9107's rad-hard design features a collector-to-base depletion region only 0.7 mil wide plus a doping concentration in the collector region of  $10^{15}$  atoms per  $\text{cm}^2$ .



RCA TA9107 radiation-hardened bipolar transistor chip. Unique multiple-emitter-site design and narrow base width and collector depletion region are used to increase resistance to both neutron and gamma radiation.



An experimental rad-hard power MOSFET withstands more than 500 Krads, while the conventional ("rad soft") MOSFET fails at approximately 100 Krad exposure.

### Value Added Reliability Screening

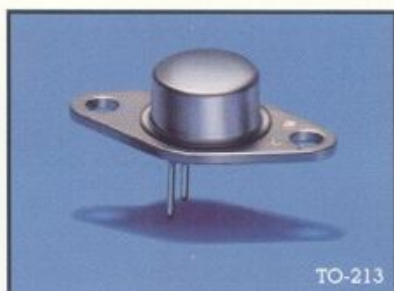
Screen	Mil-750	"S"	"TXV"	"TX"
1. Pre-Cap Visual	2072	•	•	•
2. High Temp Bake	1032	•	•	•
3. Temp Cycle	1051	•	•	•
4. Acceleration	2006	•	•	•
5. Hermetic Seal	1071	•	•	•
6. Serialization	—	•	—	—
7. Read & Record	—	•	—	—
8. Htrb	1039	48H	48H	48H
9. Interim Electrical	—	•	•	•
10. Power Burn-In	—	240H	160H	160H
11. Post Electrical	—	•	•	•
12. Hermetic Seal	—	•	—	—
13. Pind Test	—	•	—	—
14. X-Ray	2076	•	—	—
15. External Visual	2071	•	—	—

# HIGH-REL PRODUCTS

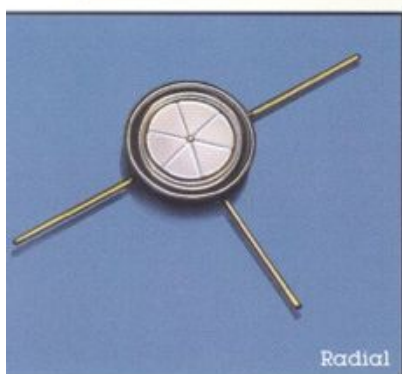
The GE/RCA line of high-rel discrete power devices are supplied in a variety of standard and specially designed hermetically sealed packages.



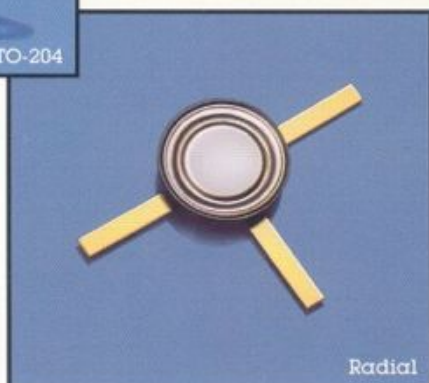
TO-204



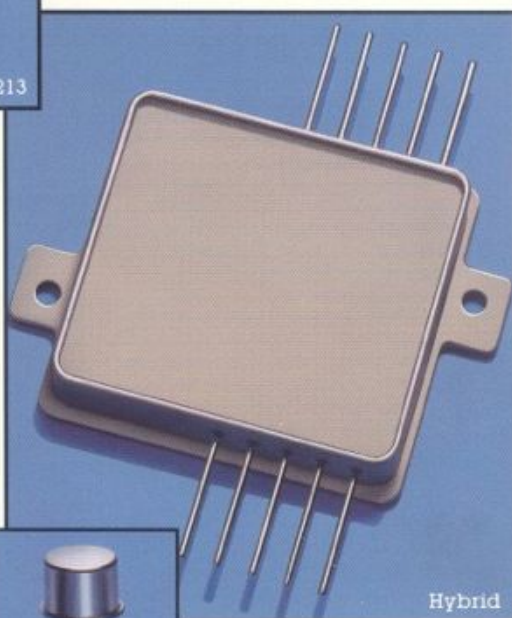
TO-213



Radial



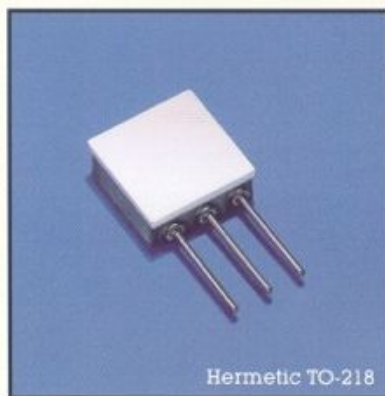
Radial



Hybrid



Hermetic TO-220



Hermetic TO-218



TO-205

## An expanding line of power packages

In addition to standard hermetic packages, such as TO-205, TO-204, and TO-213, we offer hermetically sealed packages designed specifically for high-rel power applications. These packages include our radial packages and hermetic versions of the TO-220 and TO-218. Custom packages are also available for special requirements.

Virtually all high-rel power parts are available in die form for use by hybrid manufacturers. In addition, our discrete power device manufacturing facility at Mountaintop, PA. offers you a full hybrid manufacturing capability, and currently supplies hybrid parts for both the AEGIS shipboard radar and SPARROW missile programs.



# HIGH-REL PRODUCTS

## Intersil High-Rel Products



Intersil operations, Cupertino, CA  
— a powerful addition to the GE Solid State family.

### Meeting the challenge of high-rel in digital and analog signal-processing IC's

#### A powerful addition to the GE Solid State family

The new GE Solid State includes California-based Intersil, a leader in the design and manufacture of signal-processing IC's. In almost every category, Intersil's product offerings **complement** the GE and RCA CMOS and bipolar IC's and discrete power devices rather than compete with them.

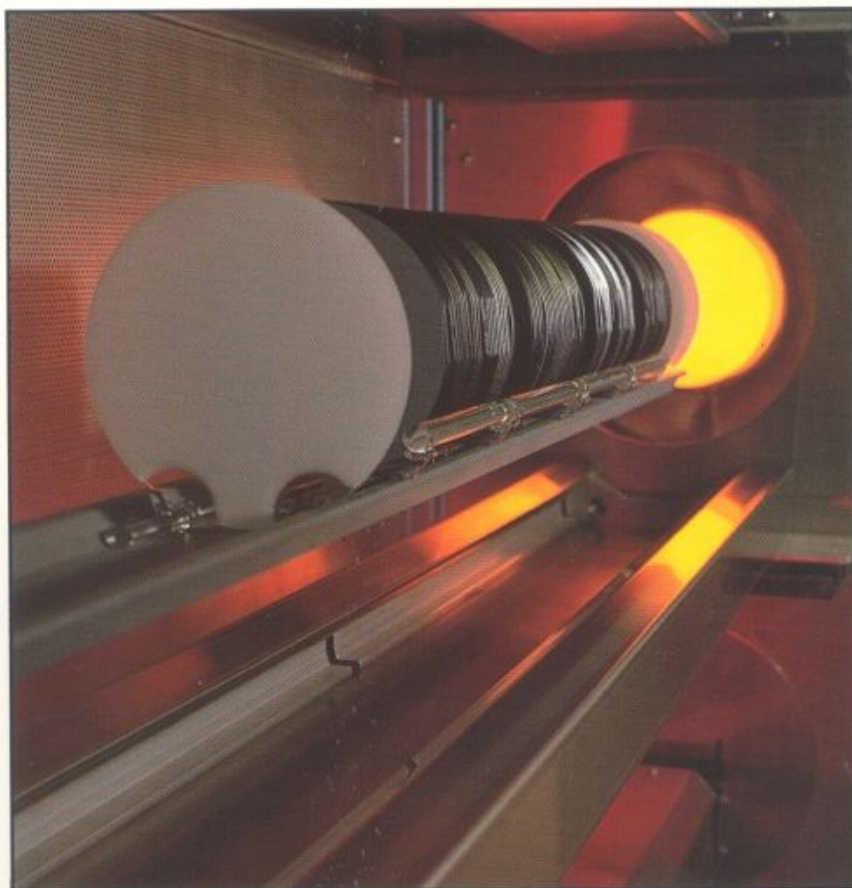
Current Intersil product offerings include analog switches, multiplexers, JFET's, voltage converters, power-supply-management IC's, UART's, EPROMs, timers, data-acquisition products, analog-to-digital, digital-to-analog converters, and a brand new line of digital signal processing devices. Intersil has received 38510 QPL status for our AD7541 12-bit multiplying D/A converter. And we continue to add new devices and technologies to meet your changing needs in signal processing.

#### A strong commitment to the high-rel market

At Intersil, we've been manufacturing high-rel devices for over a decade. Our fabrication facility, in Santa Clara, California, is DESC certified for JAN38510 military parts production. And we have hundreds of different parts approved for the QPL, MIL-STD-883 compliant, or incorporated into standard military drawings. What's more, Intersil has engineered high-rel parts to meet the specifications of more than 10,000 different active customer source-control drawings.

Intersil supplies QPL devices to MIL-M-38510 and MIL-S-19500, processed in accordance with MIL-STD-883B Rev. C and MIL-STD-750. Intersil discrete devices can be screened to meet JAN, JANTX, and JANTXV standards. We also offer additional high-rel processing options that are equal or similar to Class S screening for IC's and discretes. You can choose to have your parts screened to a large variety of high-rel tests and standards as required by your application.

# HIGH-REL PRODUCTS



Intersil's Santa Clara, CA, MIL-M-38510 certified high-rel production facility is geared up for 5-inch wafer processing and was designed for future conversion to 6-inch wafers.

## A commitment to quality in high-rel production

Meeting high-rel standards requires a firm dedication to quality control. Intersil has instituted a number of quality programs to ensure that our parts meet customer and military specifications—consistently and reliably.

- Our **Individual Excellence** program focuses on the employee's personal commitment to quality. Our high-rel engineers, technicians, and plant personnel are made aware of how important quality is to your high-rel success... and to ours.
- A **Quality Audits** program assures that all systems, processes, and operations comply with your specifications. Operations and processes are audited regularly by a separate Quality Assurance Department within the organization.

- Our **Parts Per Million** program helps us meet your demand for lower defect levels. Designed to monitor and control the quality of final product, this program will help us achieve an average outgoing quality level of less than 100 ppm by year end.

- In our **Failure Analysis Laboratory**, specially trained scientists, engineers, and technicians use scanning electron microscopy, voltage contrast, electronic beam-induced current, back-scatter electron imaging, energy dispersive spectroscopy, and x-ray radiography to identify specific failure mechanisms.



# RESEARCH AND DEVELOPMENT

**A** long track record as a pioneer in solid state . . .  
plus a continuing stream of new ideas and innovations  
in high-reliability

**Following the leadership  
tradition**

GE has long been the nation's leader in industrial R&D, holding more patents than any other U.S. firm. In a recent year, GE's research and development budget was \$2.9 billion.

The combined GE Solid State represents a powerful force in semiconductor development. The new organization meshes GE's famed Schenectady, NY, research center with our research facility in Triangle Park, NC, and the SRI Laboratory in Princeton, NJ (formerly an RCA-owned R&D facility).

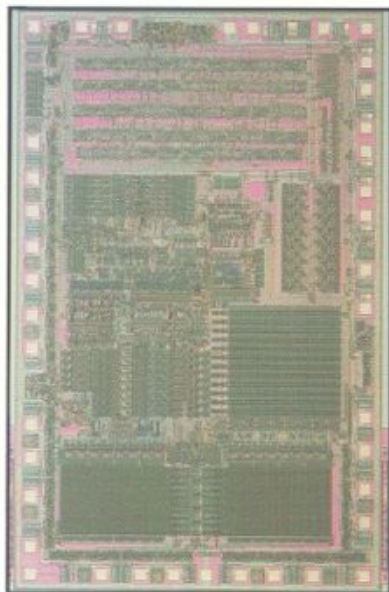
**What have we done in  
R&D lately?**

Recent innovations include a state-retention RAM that accurately retains data, even in outer space or during nuclear events . . . a mask set that allows us to introduce new high-speed CMOS IC's to the marketplace faster and more economically . . . a 1750A processor used in the small ICBM . . . plus microprocessor fuzes that control detonations with solid-state precision.



Scientists at the Research Triangle Park, NC, Microelectronics Research Center conduct fundamental research to advance the state-of-the-art in semiconductor technology.

# RESEARCH AND DEVELOPMENT



Microprocessor fuze IC chip.

## Recent GE Solid State product developments (a partial list)

**NAME:** State Retention RAM

**THE MISSION:** Develop a memory for the small ICBM.

**REQUIREMENTS:** Good total-dose and transient radiation hardness.

**TECHNICAL SOLUTION:** Put resistors and capacitors into a 5-transistor memory cell to slow the write speed so the device won't accidentally lose bits when exposed to transient radiation.

**RESULT:** Transient radiation hardness of up to  $10^{10}$  rads/second in silicon. Total-dose hardness up to 200 Krads.

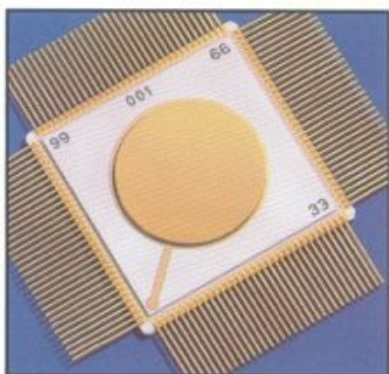
**NAME:** HC/HCT multiple-function mask set

**THE MISSION:** Rapidly introduce a complete line of rad-hard HC/HCT high-speed CMOS IC's to the high-reliability marketplace.

**REQUIREMENTS:** Produce photomask sets for new parts faster and at less cost.

**TECHNICAL SOLUTION:** A set of six masks, each with 10 to 20 functions, capable of producing 125 functional HC/HCT type devices.

**RESULT:** Initial usage has produced 7 types of new HC/HCT IC's from a single mask set. A full line of 125 new rad-hard SOS HC/HCT devices will be brought to market faster and cheaper. Customers will be able to build an entire rad-hard system from a single family of HC/HCT parts.



1750A processor IC.

**NAME:** 1750A processor

**THE MISSION:** Develop a processor chip set for the small ICBM. Must be screened to Class S standards.

**REQUIREMENTS:** Accurately process 800 thousand instructions per second—even when the device is exposed to high doses of radiation.

**TECHNICAL SOLUTION:** Employ silicon-on-sapphire technology. Build entire processor using six RCA ASIC standard cells (rad hard) packaged in 132-terminal flat packs.

**RESULTS:** 1750A processor operating at clock cycle of 174 nanoseconds. Can function without upset in transient radiation environment of more than  $10^{10}$  rads (Si)/second over the full military temperature range. Single-event-upset rate is less than  $10^{-10}$  upsets per bit-day.

**NAME:** Microprocessor fuze

**THE MISSION:** Develop a CMOS microprocessor fuze.

**REQUIREMENTS:** Low power consumption and high stability over wide temperature range. Voltage variation not to exceed  $\pm 1$  millivolt/degree Celsius.

**TECHNICAL SOLUTION:** Custom device built using 3-micron, single-level-metal high-speed CMOS process.

**RESULTS:** Device is stable over 4-6 volts power supply and from  $-55$  to  $+125^{\circ}\text{C}$ , with very low power consumption.



# HIGH-REL PRODUCTION

## Production Capabilities

**A** worldwide network of fabrication, assembly, and test facilities geared up for high-volume production of the high-rel parts you need.

**Fully certified for MIL-STD-38510 production**

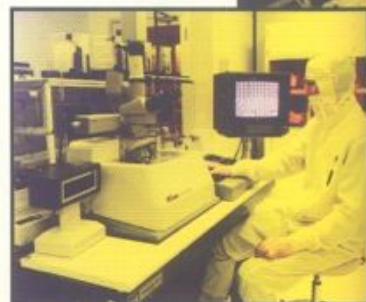
Our main high-rel wafer fabrication, assembly, and testing facility is located in Findlay, Ohio. Fully MIL-M-38510 certified, this 260,000-square-foot plant shipped more than 5 million high-rel IC's in a recent year.

High-rel power discretes are fabricated and assembled in Mountaintop, PA.

This plant, which recently switched from 4- to 5-inch wafers to substantially increase capacity, boasts an average outgoing quality of only 15 ppm. Intersil also manufactures IC's and power discretes at its fabrication facility, in Santa Clara, CA. Additional GE Solid State assembly operations are located in Taiwan, Kuala Lumpur, Bombay, Singapore, and Dundalk, Ireland.



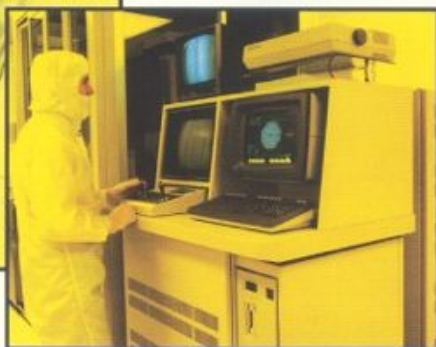
Projection aligner uses a series of intricate mirrors to automatically align and expose wafers.



Plasma etch system is used for smaller-geometry wafers. The required etching of the exposed patterns is accomplished in a gaseous atmosphere, which allows more precise tolerance control, rather than in a wet sink.



# HIGH-REL PRODUCTION



In this system, a coater / developer is mated to a stepper. Wafers can be coated, aligned, exposed, and developed automatically in a controlled internal atmosphere. The wafers are contained in SMIF (standard mechanical interface carriers) that provide added protection by keeping the wafers in a controlled atmosphere even when they are not being processed.



Operating-life test station, for high-rel discrete power devices.

Temperature-cycling test chamber for high-rel discrete power devices.

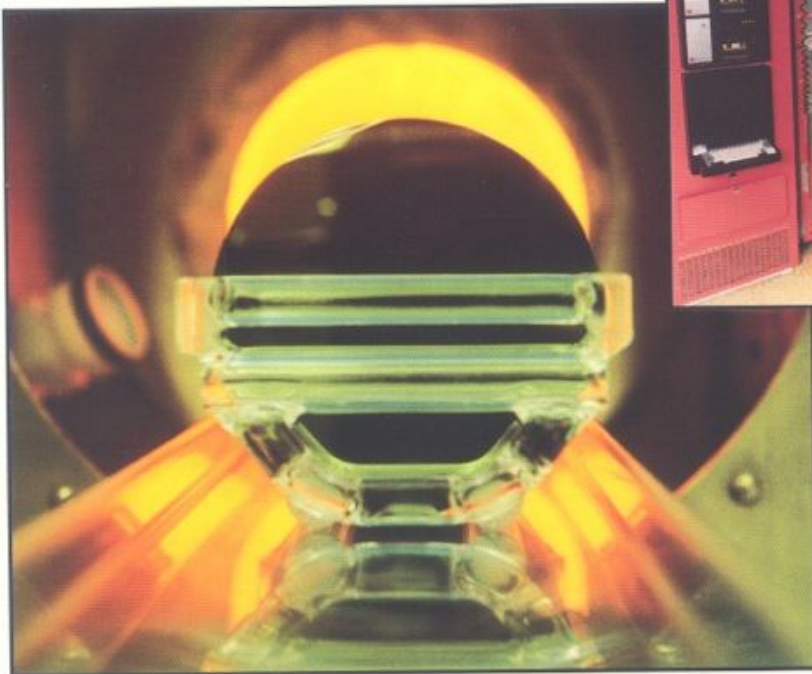
Lorlin test station is used to test electrical parameters of high-rel discrete power devices.



Ion implanter bombards wafer with ions at a high rate in a gaseous atmosphere to change its basic structure. Depending upon the atmosphere, the exposed wafer-pattern area may be changed to the opposite polarity.



# HIGH-REL PRODUCTION

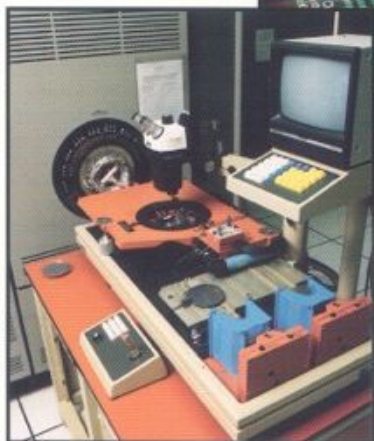


In this furnace, a mixture of heated gases diffuses into the wafer to a precisely controlled depth, forming the next layer of the part.



Waveless solder machine applying solder finish to leads on high-rel parts. The machine slowly passes the leads through a hot solder bath to ensure that a uniform layer of solder is applied.

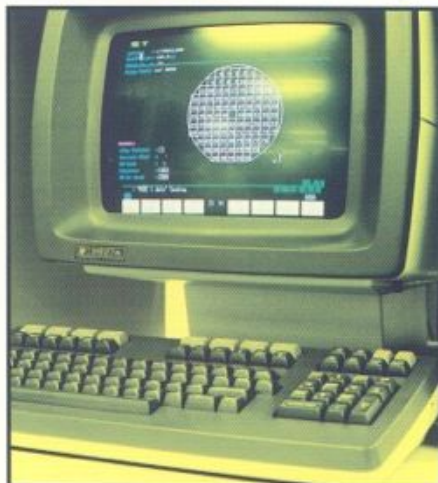
# HIGH-REL PRODUCTION



With auto-prober, a full cassette of wafers can be automatically probed without operator assistance and individual wafer setup.



After usage, masks are inspected to ascertain whether they can be used in further processing, or whether they should be scrapped.



Stepper automatically aligns and exposes one to six identical patterns on a wafer then moves, or steps, to the next position until wafer is completely exposed. Currently used for 1.5-micron technology. In future, will be used for 1.2-micron and submicron technologies.

## The state-of-the-art in wafer fabrication

Findlay provides a clean-room environment for fabrication of geometries down to 1.25 micron. Wafers not undergoing processing are stored and transported in SMIF (standard mechanical interface carriers) that provide a controlled atmosphere, protecting the wafer from contamination and handling. Fab units are equipped with modern processing equipment—including projection aligners, plasma etching, ion sputtering, diffusion furnaces, and an ion implanter that bombards the wafers with ions to change its basic structure as required. A mask inspection unit tests each wafer to determine which are good enough to be made into high-rel parts... and which must be scrapped.



# HIGH-REL PRODUCTION

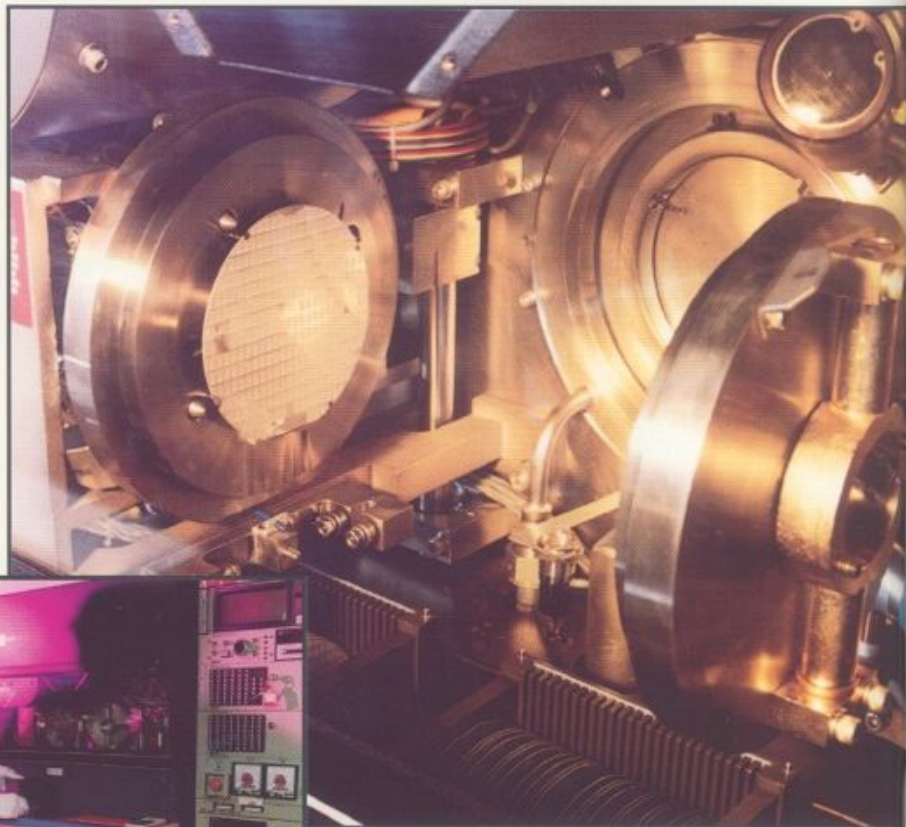
Using our sophisticated on-line manufacturing and control system, we can accurately track the progress of each lot through the entire fabrication, assembly, and testing process. This fully computerized system tells us the location and status of your lot... whether the job is on schedule... yields... and, it provides confirmation from the factory floor that screening procedures called for in the specs were performed.



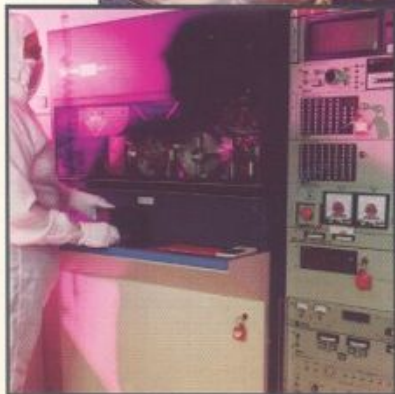
Frame sink furnace seals units in a clean-room atmosphere using infrared rays to heat the epoxy and quickly seal the cover to the frame.

## Automated assembly accommodates large production volumes while maintaining quality

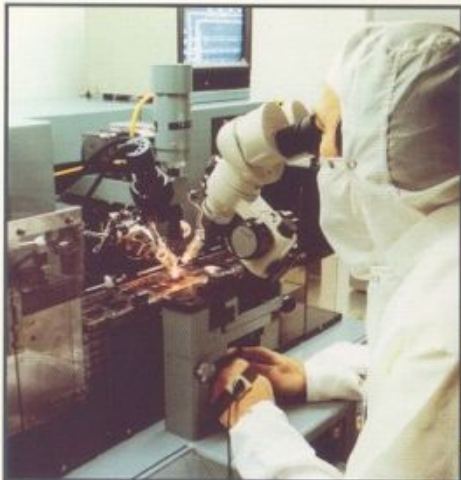
Automatic equipment is used to ultrasonically bond wires to lead frames and pellets and then trim package leads to the customer's specifications. Test equipment can automatically probe a full cassette of wafers without intervention by operators. A sink frame furnace uses infrared rays to heat epoxy for a good seal between cover and frame.



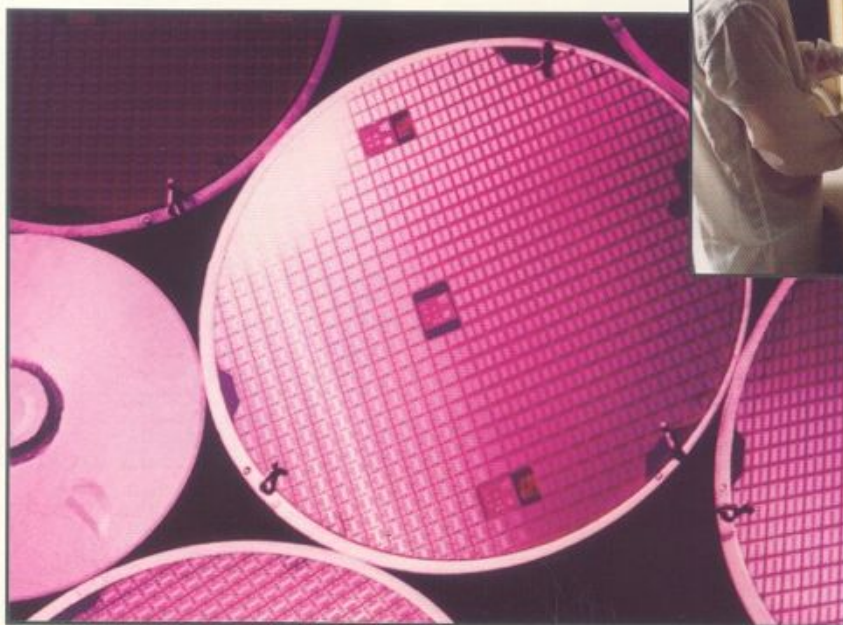
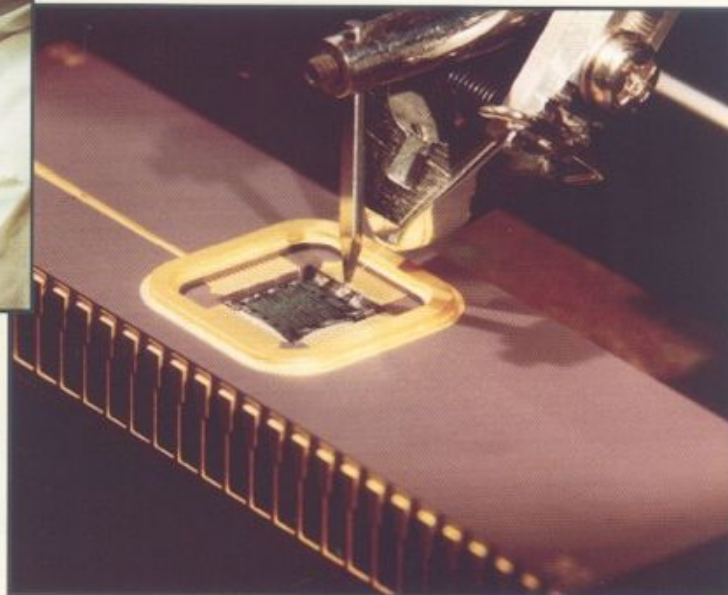
Sputterer coats wafers with a layer of aluminum using a plasma in an argon atmosphere.



# HIGH-REL PRODUCTION



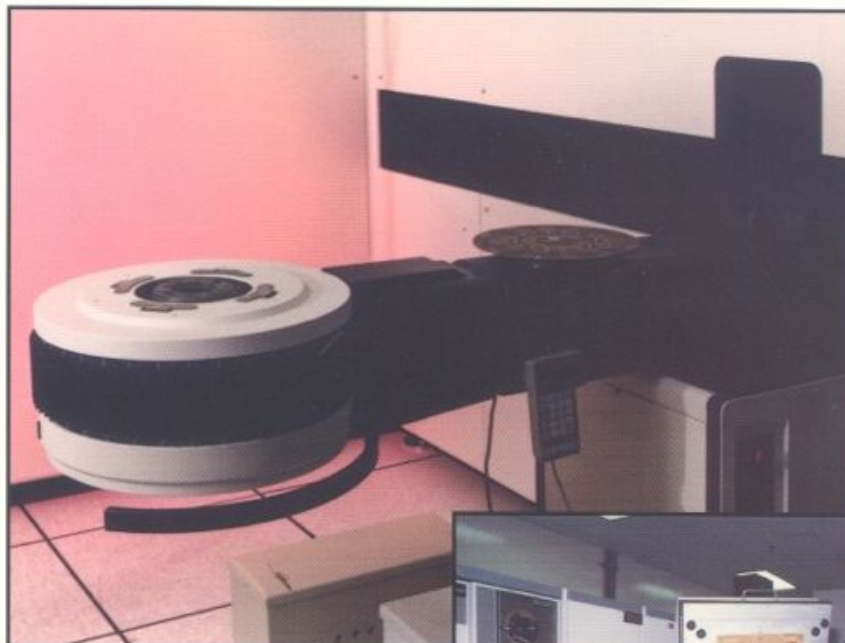
Bond wires are ultrasonically bonded to lead frame and pellet automatically in a uniform, approved manner.



Wafers are loaded on planets to expose surface to an atmosphere of evaporated aluminum. Wafers are coated to a specific thickness that later will be exposed to an etch pattern that leaves thin lines of aluminum metallization.



# HIGH-REL PRODUCTION



All high-rel products are subjected to electrical burn-in to reduce the probability of "infant mortality" types of failures.

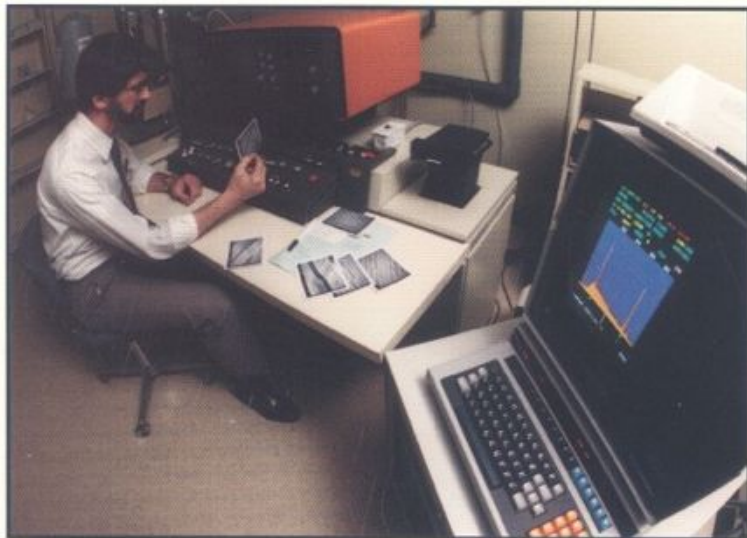


New Trillium high-speed tester tests devices with up to 128 pins at frequencies of 40, or 80 MHz multiplex.

Sentry 21 high-speed tester can test devices with up to 120 pins at frequencies up to 20 MHz, or 40 MHz multiplex.

# HIGH-REL PRODUCTION

Scanning electron microscope gives us a close-up look at small circuits, while an energy dispersion X-ray analyzer provides a full elemental analysis on materials examined under the microscope.



Rad-hard products are placed in gamma cells and bombarded with gamma rays. Products are then tested to determine whether they have been hardened sufficiently to withstand required radiation levels.



## High-rel products are inspected and tested to exacting specifications

All high-rel products are subjected to many hours of electrical burn-in tests at elevated temperatures as required by military and customer specifications. For instance, one standard temperature test rapidly cycles each part 10 times through the upper and lower limits of the full military temperature range. We also bombard rad-hard components with gamma rays to make sure the parts can survive in nuclear and outer space environments. Rigorous testing, fully compliant with Class B and S standards, ensures that all products shipped meet your requirements for high-rel performance.

## The end result? Proven reliability and quality in every part we ship

Average outgoing quality on all fab lines is less than 100 ppm and in many cases less than 25 ppm. These measurements are based on tests conducted with more than 23.5 million CMOS IC's and 5 million power discretes.

Product reliability at GE Solid State is also setting records. The reliability of our HC/HCT high-speed CMOS IC's, for example, is only 1 FIT at 55°C. (Translated into everyday terms, that means only one device failure per one billion hours—or 114 **millenniums**—of device operation.)



# SUPPORT SERVICES

## Service and Support

**Delivery of the parts you need—when you need them—with full support from the entire GE Solid State engineering, marketing, and customer service team.**

**Working with the customer is our #1 priority**

Our applications and product engineering group takes full responsibility for getting your product properly designed, tested, and fabricated. Source control drawings are carefully reviewed to ensure that we can meet your requirements. All exceptions are instantly brought to your attention, and our engineers work closely with you to quickly resolve potential problems. The final product, delivered in the quantities you require, is guaranteed to meet all your requirements—from electrical characteristics, radiation tolerance, and dimensions down to shipping details and the branding on the package.

### **Program management keeps things running smoothly and on time**

At GE Solid State, we consider effective program management an essential customer service—so much so that we have a separate group that handles it exclusively.

We assign an individual program manager to each major project. The program manager serves as the liaison between your organization and ours, ensuring fast answers to questions and immediate attention to problem situations. Monthly program review sessions summarize project status and schedules, so you're always kept informed. In addition, the program manager appointed to work with you stays with the project throughout its duration—providing a highly desirable continuity of service and support.

### **ASIC capability**

Over 20 years in the making, GE Solid State's sophisticated **Semcustom Design System** stands ready to help high-rel customers create their own semicustom designs.

By computerizing the entire ASIC design process—from initial idea and schematic capture, through logic design, simulation, placement, routing, verification, and finished artwork—we have dramatically shortened the time it takes to create and fabricate the ASIC's you need. What's more, the GE/RCA ASIC system is fully compatible with most popular CAD/CAM systems—including Daisy Systems, Valid Logic, Futurnet, and Mentor Graphics—so you can work right at your own terminals, without leaving your office.

Or, if you prefer, you can take advantage of the experience and equipment available at GE/RCA Design Centers, located in New Jersey, California, Brussels, Hamburg, London, Paris, Milan, and Munich. Here you can work hand-in-hand with experienced GE/RCA applications engineers and run your design on our powerful VAX computers. The Design Centers provide a unique environment—a combination of the most sophisticated design tools with nearby GE/RCA experts always ready to lend a hand.



GE Solid State provides sophisticated design centers at various locations throughout the world to help high-rel customers create their own ASIC designs.

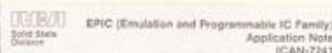


High-Reliability

## SUPPORT SERVICES



GE Solid State technical publications provide detailed technical data on our full line of high-rel products.

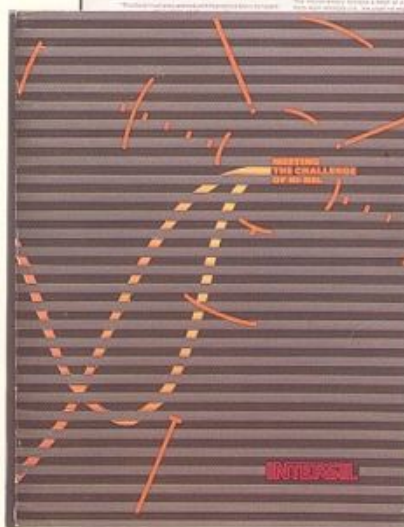


A 16-BIT MICROPROGRAMMABLE BIT-SLICE  
COMPUTER DESIGN USING THE GP001 CPU  
AND GP502 CONTROLLER FROM THE EPIC FAMILY

By M. J. Griffin

[illegible]

**New Technology**  
 The latest computer technology is shown in Fig. 1. It uses the 1975 COMPASS data storage and retrieval system (Fig. 2). The processing system contains two microcomputers that use the COMPASS data storage system. The system is a combination of a microcomputer and the COMPASS system with several tape drives and disk drives.



There's more information—  
yours for the asking

This brochure is intended only as an overview of our capabilities and product offerings in high-reliability IC's and power discretes. For additional information, consult the **RCA High-Reliability Products DATABOOK**, **Intersil Component Data Catalog**, or other available publications on the full GE Solid State high-reliability product line.

High-Rel Publications Available	
Publication No.	Title
SSD-230B	RCA High-Reliability Products DATABOOK
900301-003	Intersil Component Data Catalog 1987
HRP-479C	High-Reliability Products—Selection Guide
900351-001	Meeting the Challenge of Hi-Rel
RHC-750	High-Reliability, Radiation-Hardened CMOS/SOS Standard-Cell Family
ICAN-7241	A 16-Bit Microprogrammable Bit-Slice Computer Design Using the GP001 CPU and GP502 Controller from the EPIC Family (Application Note)
ICAN-7319	CMOS-SOS LSI Family Form High-Performance Rad-Hard Processor (Application Note).