

Originally Processed With FOIA(s):

S

FOIA Number:

S

# FOIA MARKER

**This is not a textual record. This is used as an administrative marker by the George Bush Presidential Library Staff.**

---

**Record Group/Collection:** George H.W. Bush Presidential Records  
**Collection/Office of Origin:** Speechwriting, White House Office of  
**Series:** Speech File Backup Files  
**Subseries:** Chron File, 1989-1993

---

**OA/ID Number:** 13819  
**Folder ID Number:** 13819-006

---

**Folder Title:**  
Industrial League of Orange County--Irvine, California 6/19/92 [OA 7575] [1]

---

Stack:	Row:	Section:	Shelf:	Position:
<b>G</b>	<b>26</b>	<b>22</b>	<b>6</b>	<b>2</b>

---

ext. 7845

310-643-5300  
Call me  
to let us  
know  
Mark Feldman  
Contact is:  
Ava Systems Info  
Beth -

Supervisor Gadi Vasquez  
(714) 834-3330

ORANGE CO. BUSINESS COMMUNITY ADDRESS

challenges from post WW2

- economic world of 21st century
- balanced budget (future legacy) (long term)
- adjusting to realities: trade, DOD
- government spending reform

State of economy  
 - he understands  
 - low gov. will help (stimulus)  
 - how people must work

MISC. NOTES:

- entirely different economic world than one we grew up in
- 77% support constitutional amendment requiring balanced budget
- think more clearly about government spending in general
- discipline of entitlements and strong effort to ereduce dfcit
- runaway characteristics of entitlement programs; need spending limits and discilpinary mechanisms (tie in reform and balanced budget)

LETTER (Blane Harris of TUSTIN, CA)

--construction manager, unemployed for first time in career, nine months, asks if I'm "able to understand the depth of my despair and the feeling of hopelessness which engulfs me. Mr. President, can you really help?" -- yes, revitalize economy

--pride; entrepreneurial spirit

--Reader's Digest survey -- 67% feel economy better served by less government involvement; 78% prayer important part of daily life

(spbudget)

BALANCED BUDGET:

I want to talk to you today about a big idea -- a big change in the way your government works. For the past 12 years, President Reagan and I have tried to get Congress to act responsibly and restrain federal spending. saddling future generations with a mountain of debt. we're borrowing from the future to pay for indulgences of the present. Our future is at stake. To ensure long-term economic growth, we must get federal spending under control. I've called for big changes in many areas -- revolutionary reforms in how this nation's gridlocked capitol does business. And for some time now, I've been speaking about how we create jobs in this country. Well, high deficits raise interest rates, and high interest rates kill jobs. So to make our economic future strong -- the balanced budget is where we must start. Look at your own family. You know what happens when you spend more than you make. The devil's going to come, demanding his due. Well that's what our American family faces right now. When you hear about our \$360 billion deficit, remember -- that's not Monopoly money. Some day that debt must be paid with your money -- as sure as your own personal debts will have to be paid with your money.

# # # #

(spcircle)

We love America for what it is. But perhaps we love it even more for what it will be -- our vision of the America we'll forge

✓  
together. An America whose economy is bursting upward. An America whose children are prepared for the 21st century.

At one point in a movie called "Awakenings," a fellow who's been asleep for decades wakes up and has the whole world in front of him. When his doctor asks him what he wants to do that day, his face breaks into a huge grin and he shouts: "Everything!" That's what we need in America -- that belief in unlimited possibilities. And I tell you where we have to start. With the family. Our most precious resource. People tell me of lost kids, stoned on drink or drugs or emptiness. Well, as I travel this country I talk to the good people who make up America -- the honest, decent folks this country xxx -- and when I see them, you can't tell me that American kids can't be the finest in the world. But we have to reclaim the values our country was founded upon. With a national call to action that emphasizes family -- not alienation. Right and wrong -- not "moral free fall". Responsibility, hard work, and self-discipline. And it's in the family that those values take root. Where kids learn they can -- and they must -- control their own lives. Where they learn that character means the courage to reach for dreams. For to make it through this world, we must each navigate by the dictates of our own inner moral compass. The family must shape that compass early. That's how our children will thrive -- and how our nation will survive.

(spcomput)

when we work to open markets and expand trade -- we make a priceless investment in our own children's future.

We're entering an entirely different economic world than the one we grew up in -- a new age of American competition in a fiercely challenging global marketplace. As American businesses meet worldwide challenges they will succeed because, as long as the playing field is level, American workers will outcompete and outproduce anyone, anywhere, anytime.

#k

(spdeere)

I see how you've done it. You've succeeded because of your commitment to quality -- to world-class performance. You've succeeded because of your priority of training and educational excellence.

cracking foreign markets creates more American economic growth and more American jobs. In this new global marketplace, America has built a solid foundation. Inflation is down. Interest rates have fallen to the lowest level in years. American exports have skyrocketed 80 percent in the last five years alone. But that doesn't mean we don't face problems. We do. Tough ones, and I know it. As President, I've traveled to 48 states. I've met with all sorts of people -- men and women and kids who are the real heart of America. I've talked with them. I've listened to them. Most of all, I've learned from them. I want to say something to everyone of them -- to every one of you. I hear you. I understand. I care. I want to help. I know that for a person out of a job, the unemployment rate is 100 percent. (letter)

We've got more to do to get this economy moving the way we want it to -- the way we know it will. Together, these measures will help our economy grow -- will create jobs -- and will help every American reach for his or her dream.

we can feel the truth of what FDR said a half-century ago: "The only limit to our realization of tomorrow will be our doubts of today."

\*\*\*

(spgovern.nts)

the heart of it: in this \$6 trillion economy, the way to add jobs is to encourage long-term investment. capital gains tax of 15.4%. You know who this will help -- the bricklayers and the carpenters who now on unemployment. They'll be back on payrolls because the capital gains cut favors growth and jobs for working America.

888

(splal)

--against hope believed in hope  
--hope -- a waking dream  
--strength beyond hope and despair (Eliot)  
--grass-roots heroes

\*\*\*\*

(spminori)

out building your own businesses from scratch -- so a special welcome to the White House, which is, after all, the ultimate mom and pop operation -- Barbara and I both work at home.

Each leader here today and the others across this land bear witness by their presence to the truth of a statement William Jennings Bryan made nearly 100 years ago: "Destiny is not a matter of chance -- it is a matter of choice. It is not a thing to be waited for -- it is a thing to be achieved."

# # # # #

(spnrsc)

free trade.

The world of the new century will be one where competition is in the economic arena. A world in which defeatism produces defeat. But where confidence and self-reliance produce greatness. Through our treaties, we define the America we want to build -- one where we believe in ourselves and in tomorrow. An America ready to seize the opportunities the new world economy offers.

# # # # #

(spsteel)

the struggle against excessive regulation.

American workers have shown to foreign competitors that, given a level playing field, we can out-think, out-perform and out-produce anyone, anytime, anyplace. Well, a level playing field outside the United States is all well and good, but you'll never reach it if you have to run yourselves to exhaustion right here at home on a treadmill of overzealous regulation. \\  
Over-regulation here in the United States can give foreign corporations an advantage over American firms. It also can drive U.S. businesses to move factories and jobs overseas. Let me assure you: I will roll back the tide of over-regulation. \\\

# # # # #

FROM LYNN MARTIN:

--PENSION BENEFITS -- Pension Benefit Guaranty Corporation, begin monitoring legal and professional fees in bankruptcy cases in which it is a major creditor -- responsible for guaranteeing payment of benefits for private pension plans that cover some 40 million workers -- one of largest creditors in many of our nation's biggest bankruptcy cases -- have legal and moral obligation to American workers and taxpayers to see that the scarce resources of bankrupt firms are used to pay promised pension and health benefits, not line the pockets of the bankruptcy bar -- there is ample evidence of exorbitant fees being paid in bankruptcy cases where PBGC has substantial liability for pension benefits -- hourly attorney fees \$500 -- charges of more than \$300/hour just for preparing a bill -- victims are the men and women promised benefits, worked hard to earn them

--also extensive on emergency unemployment compensation program

SPECIFIC SPEECH NOTES:

Industrial League of Orange County, Todd Nicholson, Pres., (714) 476-2242

~~DE~~ --courage to do the hard work of government

~~A~~ --Industrial League will fax me info. today (Thursday)

--business community, Chambers, medium to small size, very business-oriented -- Oct. 1990 was in area --

--Jan. 24, Pres. Reagan spoke there (number from Rolodex), press from that time

--Wilson? Reid Royalty, head of league;

~~82~~ --first time Orange County hit by recession -- really shook confidence, before skated through --

--Irvine Hyatt Hotel, 1,000, lunch

--before that, Aura Systems Inc., Ask George Bush, will fax stuff (check JAG box)

--state of art electronic equipment, research and development work,

--they are hiring when everyone else firing, because small business able to adapt (new paradigm -- from big, bureaucratic mammoth, changing business environments, this has been able to adapt) -- cutting edge of post-Cold War era, leading drive to transform Cold War into productive peace -- scientists and engineers from all over world, even Russia,

--started out as military r&d, virtually all DOD, now 20% military, military conversion, seeing what future is, beating weapons into ploughshares

--two things: electromagnetics and electropoptics

--magnetics, bearings reduces all friction -- shock absorbers -- vibrationless jackhammer; used some technology for finding new ways to operate on cataracts (all of this was SDI), taking components of SDI finding new civilian commercial uses for

it -- from STar Wars to disease wars

--electro-optics -- t.v. projection, different ways of formulating images -- television images a lot cheaper

--risk; not stuck in old ways of thinking -- need to do more to encourage these

--contact: Lawrence Shultz 213 643-5300; or Mark Feldman 310 643 5300

--why hiring while others firing -- small is beautiful, these small companies able to maneuver and adapt to changing marketplace realities, others fataed to die death of the dinosaur

--military laser technology adapted for commercial use (electro-optics) -- Actuated Mirror Display

--commercial revolution, and will be able to be used for next generation -- still learning, evolving, for military -- in the end, this will also help our military to become faster, smarter, leaner, meaner

--big picture -- some kind of, worried about their economy

--check Specter file, outline, paragraph on recession and recovery, coming out of it -- backseat driver --

--Cold War won;

--electromagnetics -- is levitation -- environment-friendly

--gov. needs to encourage risk-taking -- I came to small company to underline this message --

--risk-averse, wan to be big guy in pool but don't want to be first to dive in (Korean company) --

--leapfrogging -- new generation of technology

--Dana Rohrbacher -- conservative, Republican entrepreneurial -- illegal immigration is hot issue there -- 224-3121 (Capitol switchboard)

--reconfigure its economy

--private sector *example*

--gov. working -- balance budget, position that advances growth (trade, etc.)

--get SMU commencement address

DOD Stuff:

--TORELL: -- nothing

--YOCKEY: -- nothing

--CHENEY: -- massive economic dislocation in defense-related industries -- adjustment for private sector decide to diversify or consolidate to adapt to market circumstances -- trends and forces modernization of our economy -- good old-fashioned competition

--Defense drawdown programs -- no longer purchasing weapons and supplies in same quantities as in past --

--genius of entrepreneurial capitalism -- for 200 years our

prosperity has sprung from our ability to innovate, to create, to change as the world changes

--to succeed economically at home must succeed economically abroad -- committed to opening markets to American goods and services, removing Government-imposed barriers that act as hidden tax on American business

--our system is unable to produce the workers the highly competitive world market demands -- we must literally reinvent American education -- need for sophisticated, well-educated work force intensify -- too many businesses forced to pay twice for education -- once through taxes that support our schools and again through job training to remedy the failures of those schools in educating our young -- America 2000 -- a new program, Job Training 2000 initiative, bring coherence to 60 vocational training programs and \$18 billion -- complements revolution now taking place in American education as a whole -- literally reinvent for challenges of 21st century

--what must do together to leave our children a legacy --  
--a truly competitive America cannot waste its talent, its energy, its most precious resource

--Thomas Jefferson: "The pillars of our prosperity are the most thriving when left most free to individual enterprise"

--trade -- enormous job opportunities, expanded job markets for American worker

FORTUNE ARTICLE:

--Cold War -- Berlin wall came down -- iron curtain unlocked -- but military gates being locked -- the post-Cold War challenge -

--treating this very carefully in Washington -- see it as positive -- chance to reposition ourselves in competitive market

-- our budget cut \$3-4 billion -- we can't cut anymore -- we're putting off cuts because we have to give defense contractors and civilian employees the chance to xxxx (not adjust) -- will be hard times and tough challenges -- what if Clinton cuts more?

--key -- military manufacturers turning expertise and products into civilian market -- Grumman turning skills for Seoul police -

- Northrop, from B2 bombers to rail transportation --

--and this lets them keep up with technology, so in case of military crisis, skills and expertise have been developing, latest technology

--diversification

--

MARC FELDMAN:

--from Ron Goldstein -- 213 643-5300 x303 213 658-5316 --  
material will be faxed by 5:30 p.m. Thursday

AURA

## AURA INFO:

- Dick Tracy: "The nation that controls magnetism will control the universe" -- Dick Tracy cartoon on Chairman Harry Kurstzman's office --
- superior competitiveness, increased jobs, new industries
- doubled its jobs in past year
- developing overseas marketplace
- national defense needs transformed to commercial benefits
- both from SDI
- Motto: "The Link Between Problem and Solution"

## WAITING FOR: Industiral League info

- call Congressman
- call S. cal

A: Introduction

- B:
- 1 State of economy
  - 2 First time hit
  - 3 I understand
  - 4 how gov will help (short term)
  - 5 how people must work

- C:
- 1 Challenging time -- post-Cold War
  - 2 Economic world of 21st century

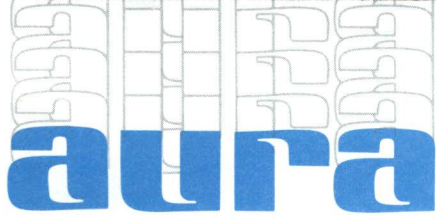
- D:
- 1 gov preparing by spending reform (long-term)
  - 2 balanced budget (future legacy)

~~3~~ *3* ~~part of admin guide (trade, etc.)~~

- E: 1 adjusting to realities

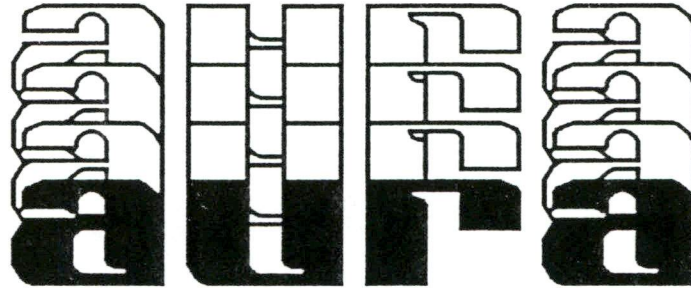
F: DOD

- CW change (Keltson)
- adjustments
- tech. pieces
- systems



*The Link between Problem and Solution.*

**Aura Systems, Inc.**  
2335 Alaska Avenue  
El Segundo, California 90245  
Phone: (310) 643-5300  
FAX: (310) 643-8719



## **CORPORATE FACILITIES AND EXPERIENCE IN MAGNETICS**

FOR FURTHER INFORMAITON  
CONTACT:

RONALD J. GOLDSTEIN  
SENIOR VICE PRESIDENT

# CORPORATE FACILITIES AND EXPERIENCE IN MAGNETICS

## ABOUT THE COMPANY

Aura Systems Inc. (ASI) is a Delaware corporation that was founded in 1987. The company founders are scientists and engineers with many years of experience on major defense programs. From day one, emphasis has been placed on endeavors which require a high degree of sophistication in the engineering and scientific disciplines. This high technology background has resulted in the development of fundamental new technologies in the areas of a) Magnetic suspension applications, b) Infrared scene projection/generation, and c) Advanced software for diagnostics and monitoring (Fig 1). Our experience has been gained from a vigorous investment by the company in internal research and development programs and contracts with research laboratories, aerospace industrial firms and military/government organizations.

Figure 1:

## AURA TECHNOLOGY AREAS



### MAGNETICS

- VIBRATION ISOLATION, POINTING, CONTROL
- GIMBALS
- TEST & MEASUREMENT EQUIPMENT
- ROTATING MACHINERY BEARINGS
- HIGH FORCE ACTUATORS
- MEDICAL TECHNOLOGY

### ELECTROOPTICS

- SCENE PROJECTORS
- SYSTEM INTEGRATION
- SENSOR TESTING
- ALGORITHMS
- SCENE GENERATION

### MICROELECTRONICS

- MIL STANDARD ELECTRONICS
- MICROWAVE COMPONENTS
- FILTERS, OSCILLATORS, SYNTHESIZERS
- HIGH FREQUENCY HYBRIDS

### ADVANCED COMPUTING

- SYSTEM END-TO-END SIMULATION
- REAL TIME DIAGNOSTICS AND MONITORING
- ROBOTICS
- CAD/CAM

## MAGNETIC SYSTEMS

### CAPABILITIES

- High Force/High Response Actuators
- Magnetic Suspended Bearings, Gimbals/Gyros
- Precision pointing systems for sensors
- Vibration-isolation hardware and software
- Digital control algorithms for non-linear systems
- Fabrication of associated hardware and electronics

### PROGRAM EXAMPLES

- LEAP-Thruster Test Stand (Boeing)
- High-speed Molecular Pump (Varian)
- F-16 Tactical Magnetic Gimbal Dev. (GD)
- Spacecraft Vibration Isolation (Special Projects)
- AMS-Missile Program Gimbal Dev. (GD)
- SDI/KEW-Electromagnetic P/L Expt. (HAC)
- Flight Motion Simulator (Aerospatale)
- High Force Actuator (R&D)

## ELECTRO OPTICAL SYSTEMS

### CAPABILITIES

- Electro-optical system designs, simulation and testing
- IR scene-generation and projection H/W & S/W
- High Definition Movie Projector/Television/  
Large Display
- Surveillance System Design

### PROGRAM EXAMPLES

- KHLS-Kinetic Hardware-in-the-Loop Simulator (USAF)
- KEW/SDI-Simulation: E/O Sensor Models (HAC)
- LEAP/SDI-Light Exo Projectile Studies (Litton)
- Scene Projector-Design Studies (USA)
- High definition Projection (R&D)

## ADVANCED COMPUTING

### CAPABILITIES

- Advanced simulation and graphics techniques
- AI for expert systems, including spacecraft diagnostics, monitoring, scheduling and training
- Robotic Control System
- Emulation and Hardware-in-the-Loop testing
- Microcomputer based CAD/CAM applications

### PROGRAM EXAMPLES

#### Robotics

- Fujita Tunneling System

#### Spacecraft

- Galileo-Mission Monitoring Work Station (MMW)-Space flight OPS (JPL)
- Power System Monitor (JPL)
- SDI-Threat Object MAP Dev. Support (HAC)
- Laser Designation Study (USAF)
- SDI/BSTS-Target Detection/Phase I (HAC)

#### SYSTEMS

- End-To-End Simulator and Hardware/Software-in-the-Loop Testing (SDI)

## MICRO ELECTRONICS FABRICATION

Microwave and millimeter wave commercial and defense hybrid components, reducing weight and power, while extending reliability and lifetime.

### CAPABILITIES

- Filter: Voltage & Crystal-Controlled Oscillator (including Phase-Lock Oscillators and Frequency Synthesizer.)
- Amplifiers: GaAs FET, plus-low Noise Amplifiers (LNA)
- Subsystems: Signal Processing  
MIL-I-45208A  
MIL-Q-9858A  
DOD 2000

### CUSTOMER EXAMPLES

- GTE
- ITT
- Sperry Corporation
- Warner Robins Air Logistics Command
- Naval Avionics Center
- U.S. Army CECOM
- Navy Ships Parts
- Northrop Corporation
- Sanders
- General Dynamics

Aura Systems, Inc. has a wide range of analytic computer capabilities specifically purchased for the development of magnetic suspension devices, among them:

- *ALGORISUPERSAP - A finite structural and thermal analysis package.*
- *AUTOCAD VERSION 10 - A complete 3-D mechanical CAD package.*
- *AURACAD/AURACAM - Mechanical Modeling and Automatic Command File Generation for CNC Machines*
- *TANGO PCB - A multi layer printed circuit board design and layout package*
- *SPICE - Analog circuit analysis package*
- *MatriX - A mathematical modeling and analysis system.*
- *MATLAB - A servo development and analysis system.*
- *Maggie - A magnet circuit finite element analysis system.*
- *XILINX - Programmable gate array hardware development.*

## **AURA SYSTEMS' MAGNETICS TECHNOLOGY**

Aura's breakthrough technology capability in magnetics extends to five major areas, at this time: (1) Magnetic gimbals for superior isolation, pointing and tracking control for lighter overall systems. (2) Magnetic suspension for unique test and measurement equipment, approximately an order-of-magnitude better than conventional approaches, (3) Magnetic bearings for rotating machinery, with superior performance, reliability and maintainability; (4) high force actuators, with superior performance, reliability and maintainability, but without the long support "tail" of hydraulics and pneumatics; and (5) medical equipment for heretofore impractical or impossible procedures (Fig. 3).

**FIGURE 3: Aura's Magnetics Technology**



<b>1. Mag. Gimbals for Isolation, Pointing and Tracking</b>	
<b>Application</b>	<b>Benefits</b>
<ul style="list-style-type: none"> <li>• Airborne Cameras</li> <li>• Linear Vibration Isolation</li> <li>• Missile Sensors</li> </ul>	<ul style="list-style-type: none"> <li>• Precision Pointing</li> <li>• Protect Delicate Equipment</li> <li>• Micron level position control</li> </ul>
<b>2. Mag. Suspension for Test and Measurement Equip</b>	
<b>Application</b>	<b>Benefits</b>
<ul style="list-style-type: none"> <li>• Force and Torque Measurement</li> <li>• Flight Motion Simulation</li> </ul>	<ul style="list-style-type: none"> <li>• 6 DOF, High Bandwidth</li> <li>• Simulate High Frequency Jitter</li> </ul>
<b>3. Magnetic Bearings for Rotating Machinery</b>	
<b>Application</b>	<b>Benefits</b>
<ul style="list-style-type: none"> <li>• Turbo-Molecular Pumps</li> <li>• High Speed Motors</li> <li>• Precision Gyros</li> </ul>	<ul style="list-style-type: none"> <li>• Ultra-High Speed, No Lubrication</li> <li>• No Friction, No Lubrication</li> <li>• Ultra-Quiet, Long Life</li> </ul>
<b>4. High Force Actuators</b>	
<b>Application</b>	<b>Benefits</b>
<ul style="list-style-type: none"> <li>• Active Automotive Suspension</li> <li>• Naval Applications</li> </ul>	<ul style="list-style-type: none"> <li>• High Force, High Bandwidth</li> <li>• Large Throw, Quiet, Fast Response</li> </ul>
<b>5. Medical Equipment</b>	
<b>Application</b>	<b>Benefits</b>
<ul style="list-style-type: none"> <li>• Cataract Surgery</li> </ul>	<ul style="list-style-type: none"> <li>• 1 mm Incision, accommodation</li> </ul>

In developing this technology, Aura has maintained focus not only on performance, but also weight and power efficiency, manufacturability, reliability and cost effectiveness (Table 1).

**TABLE 1: AURA'S MAGNETICS FOCUS:**



- |                                 |                                    |
|---------------------------------|------------------------------------|
| <b>1. Dynamic Control</b>       | <b>7. Size Reduction</b>           |
| <b>2. Control Precision</b>     | <b>8. Weight Reduction</b>         |
| <b>3. Responsiveness</b>        | <b>9. Power Efficiency</b>         |
| <b>4. Digital Control</b>       | <b>10. Manufacturability</b>       |
| <b>5. Vibration Isolation</b>   | <b>11. Reliability</b>             |
| <b>6. Force-to-Weight Ratio</b> | <b>12. Installation Simplicity</b> |
|                                 | <b>13. Cost Effectiveness</b>      |

## AURA SYSTEMS' EXPERIENCE IN MAGNETICS

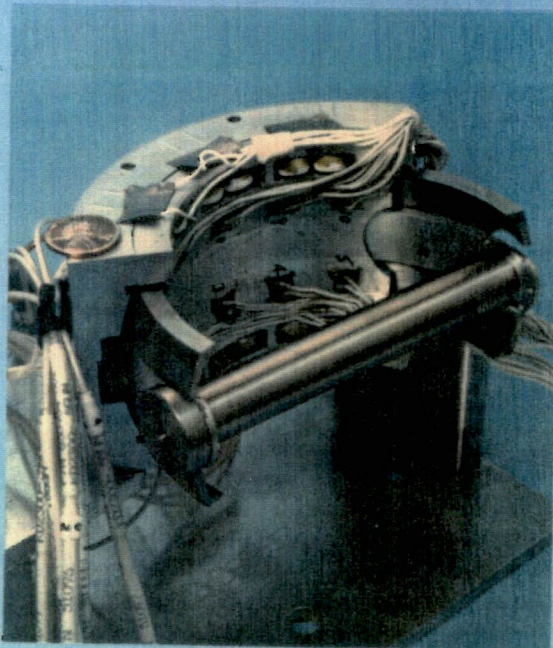
The following paragraphs contain brief descriptions of some of the major military contracts awarded to Aura that utilize our magnetic suspension technology:

### Advanced Missile Arc Gimbal

Aura is under contract with General Dynamics, Pomona Division, to fabricate a magnetic arc gimbal for their advanced missile sensor. The 4" diameter arc gimbal holds the sensor from the back, providing  $\pm 35^\circ$  of look angle without taking up any space on the sides of the sensor. The arc gimbal is being designed to handle  $\pm 55$  G maneuvers. General Dynamics is planning to use the Aura arc gimbal on several missile programs, such as the advanced air-to-missile (AAAM) for the U.S. Navy.

#### ARC GIMBAL ASSEMBLY

**aura**



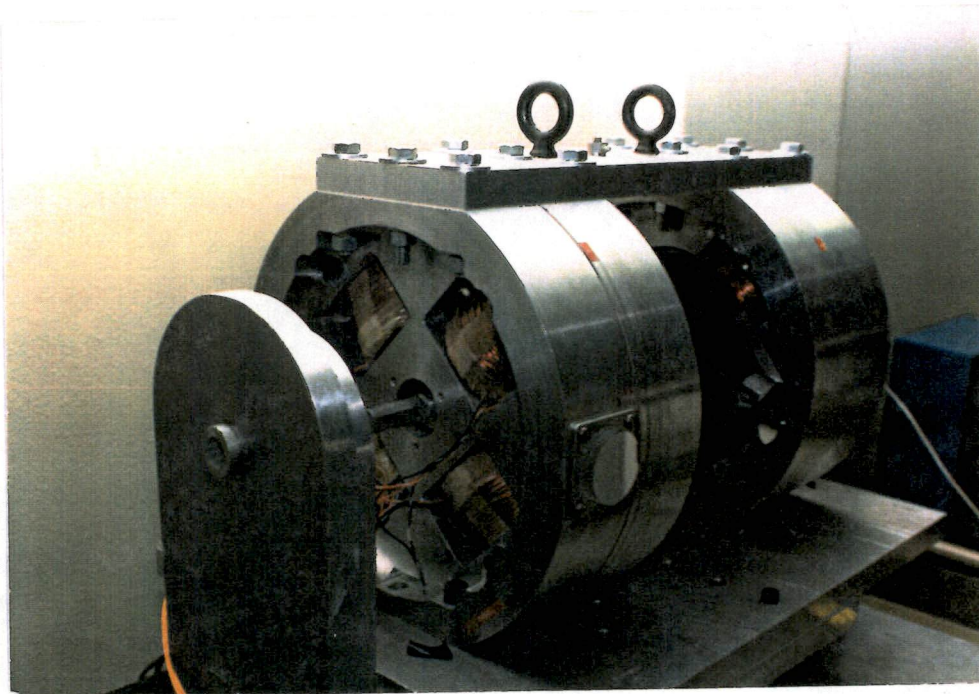
- 4 INCH DIAMETER
- $\pm 55^\circ$  TRAVEL
- OPERATES IN 55G ENVIRONMENT
- RELATIVE TEMPERATURE INSENSITIVITY

A123-4

## KEW Magnetic Gimbal Fabrication and Test Program (MFGT)

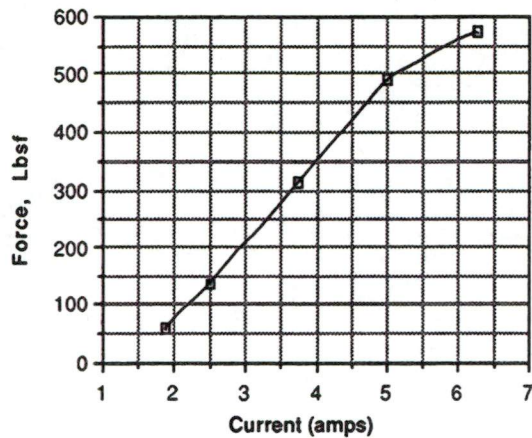
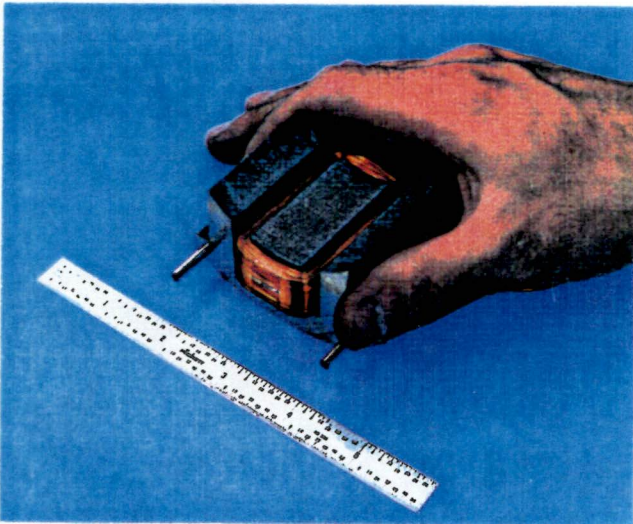
The Vibration Isolation Experiment was performed by Aura as part of SDI Phase I KEW effort. The MFGT produced proof-of-concept hardware to test the ability of utilizing magnetic suspension and active magnetic pointing control to isolate a missile's seeker from the angular vibrations that occur during divert thruster firings. Hardware components were designed, fabricated and integrated into the system by Aura and achieved line-of-sight stability of  $3 \mu\text{rad}$  while under 10 G angular vibrations, achieving -80db of isolation. In comparison with a flex pivot design for this task, the magnetic gimbal tested better by 50db in isolation; 122 micro-radians in jitter; 10x better in pointing accuracy; 8% in overall missile final design weight. This contract also received a STAR (Significant Technical Achievement in Research) award from the U.S. Air Force. As will be seen later, this same performance can be achieved now with an improved Aura gimbal of 9x less mass.

### MGFT in Shake Table Configuration



Aura's excellent science and engineering skills have advanced to further force-to-weight advances-- 300 to 1--in magnetic bearings, as shown in Figure 5-6.

## RADIAL MAGNETIC BEARING ELECTROMAGNET



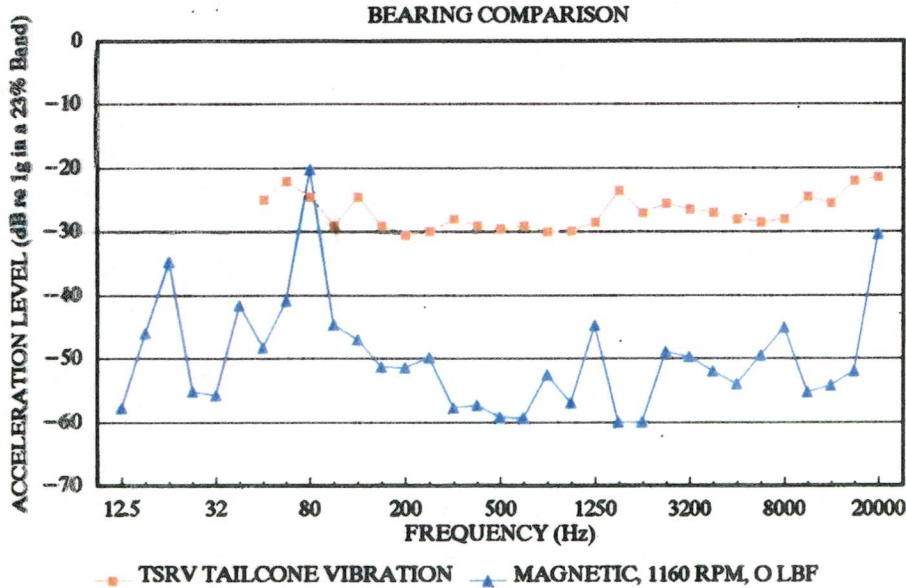
- **LOAD CARRYING CAPACITY:** 450 Lbs @ 4.75 amps, 10 mil gap
- **MAXIMUM FORCE:** 600 lbs @6.5 amps, 10 mil gap
- **TOTAL WEIGHT:** 1.5 LBS
- **SIZE:** 2.75 in. wide, 1.5 in high, 1.9 in. deep
- **POWER DISSIPATION:** 47 watts at 4.75 amps (2.1 ohm resistance)
- **MATERIAL:** Vanadium permendur

L0747-6/90

## Fleet Torpedo Bearing Retrofit

Aura was given 12 weeks to retrofit its available spare frictionless Magnetic Bearing System (MBS) into the Navy's MK48.B fleet torpedo. The resultant MBS system--non-optimized magnetic bearings and digital controllers set--demonstrated nominally 30 db of additional vibration noise reduction of the propulsions shaft compared to the replaced TSRV tailcone bearing set. The MBS 30 db vibration reduction at the nominal RPM midpoint of 1160 RPM was 20 db better than that estimated achievable by the Navy.

### MAGNETIC BEARING TEST – 28 JUN 91



3A.FRN  
5 AUG 1991

**Magnetic Bearing Demonstration**  
**(System Power Consumption)**

**Magnetic Bearing**  
**Radial Bearing**  
**(Two Required)**

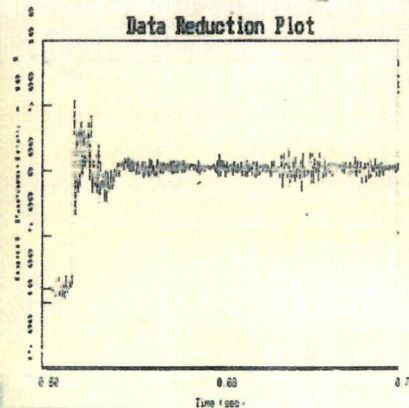
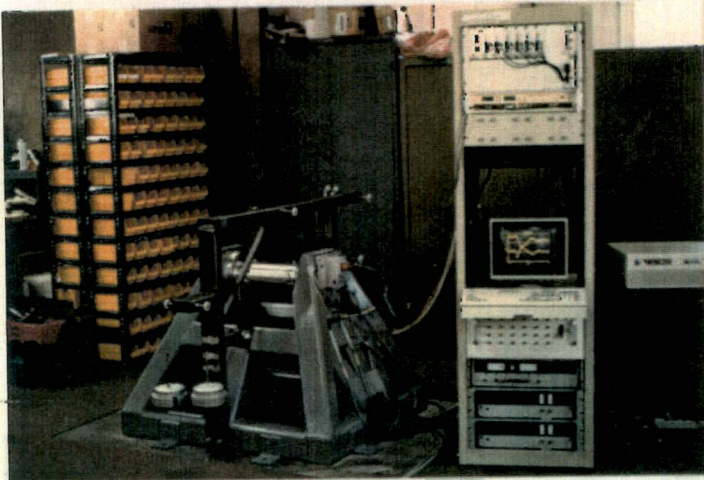
**Feasibility Thrust Bearing**

		design	1	2	3	design	1	2	3
No Load	18.5W	peak load capacity (lbf)	60	200	640	peak load capacity (lbf)	1250	3650	12800
No Axial Load 25 lb Radial	22.1W	steady state load capacity (lbf)	30	100	320	steady state load capacity (lbf)	625	1825	6400
100 lb Axial No Radial Load	33.2W	peak power (W)	55	68	100	peak power (W)	200	240	365
800 lb Axial* No Radial Load	102.1W	steady state power (W)	18	22	35	steady state power (W)	95	110	165
800 lb Axial* 200 lb Radial Load	139.8W	outer diameter (in)	5.75	6.0	6.5	outer diameter (in)	5.5	7.0	10.5
		length (in)	1.75	2.0	3.0	length (in)	2.0	3.0	5.25
		volume (in <sup>3</sup> )	33	42	78	volume (in <sup>3</sup> )	33	94	420
		approx. weight (lbm)	5	6.5	12	approx. weight (lbm)	9	27	120

## Magnetic Suspension Thruster Stand (MSTS) for LEAP

Aura is currently under contract with the Boeing/Air Force LEAP (Light Exo-Atmospheric Projectile) Program to design, fabricate, and test a unique thruster force measurement stand to be used to characterize and measure the LEAP thrusters. The MSTS is based on magnetic suspension technology that was developed by Aura. The MSTS suspends the missile in a magnetic field during the firing of its rocket thrusters. Forces and torques are measured by tracking the forces applied by the magnetic servo systems required to keep the vehicle stationary. The MSTS has attained a measurement bandwidth of 1,000 Hz with a 5% absolute accuracy. This measurement method eliminates the mechanical and structural coupling problems that have limited the bandwidth of typical strain gauges or load-cell based thruster stands. The MSTS is operational and due to be delivered to Boeing in March, 1990.

# THRUST MEASUREMENT



- Six degrees of freedom
- 1% accuracy
- >1000 Hz measurement bandwidth
- Based on Aura Systems magnetic technology

**MSTS Response to 93.5-N Drop Test**

## MAGNETIC BEARING SYSTEM

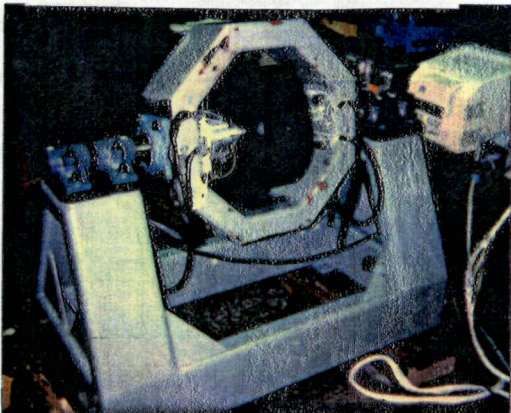
Aura is building a magnetic radial/axial bearing system under contract. The system will permit micro radian pointing accuracy of a slewing payload in a dynamic environment of random gravities of force. The individual bearings are capable of more than 400-to-1 force-to-weight ratios. With its digital control system, the Aura Magnetic Bearing System can adjust not only to real time operations, but also to design, manufacture and test variations.

### MAGNETIC RADIAL/AXIAL BEARING SYSTEM: 600 LBM CAPABILITY

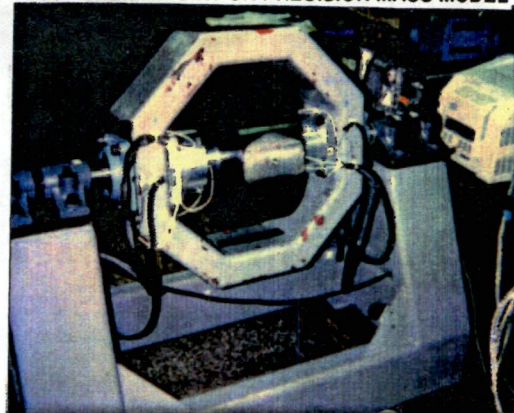


INTENDED SYSTEM PERFORMANCE : (1)  $\mu$ Rad Pointing Accuracy; (2) Degrees/Sec Slew; (3) Random G's of Force

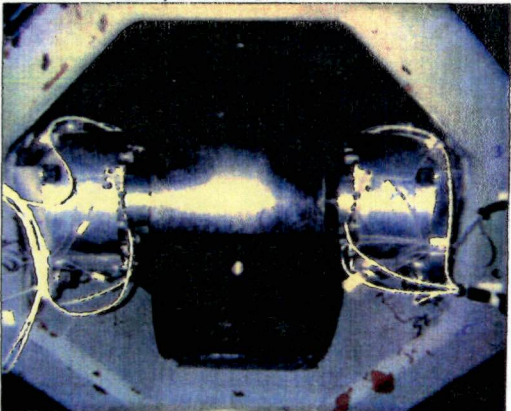
OVERVIEW IN 2-DIMENSIONAL SHAKER RIG



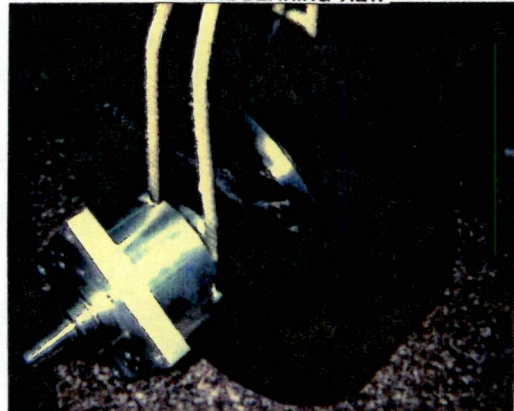
EXTENSION POINT ON PRECISION MASS MODEL



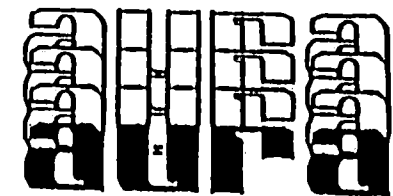
RADIAL BEARINGS, EITHER SIDE PAYLOAD MASS MODEL



AN AXIAL BEARING VIEW



# OVERALL MAGNETIC BEARING SYSTEM WEIGHT/POWER



Aura Systems, Inc.

- TWO RADIAL, ONE AXIAL MAGNETIC BEARING SET PLUS ALL ASSOCIATED ELECTRONICS

(= 2,000 LBM @ 0.1g)\* (=2,000 LBM @ 0.1g)\*

COMPONENT	600 LBM SHAFT (ACTUAL)	200 LBM SHAFT (ESTIMATE)	200 LBM SHAFT (LIGHTWEIGHT MECHANICAL AND ELECTRONICS) (ESTIMATE)
Performance Notes: (A) Not to Exceed 1 urad (B) Degrees/Sec Slew (C) Random G's of Force			
RADIAL MAGNETIC BEARING ASSEMBLY (LBM, FOR TWO BEARINGS)	10.8	5.5	4
AXIAL MAGNETIC BEARING ASSEMBLY (LBM)	7.1	2.5	2
PROXIMITY SENSOR ELECTRONICS (LBM, IN ENCLOSURE)	1.4	1.5	0.5
PROCESSOR ELECTRONICS (LBM, IN ENCLOSURE PLUS POWER SUPPLY)	7	7	2.5
POWER ELECTRONICS (LBM, IN ENCLOSURE)	0.1	3	2
TOTAL MASS (LBM)	40.4	19.5	11
MAXIMUM POWER (WATTS)	1200	400	250
AVERAGE POWER (WATTS) -- <i>.10% Duty Cycle</i>	120	40	25

\*System Note: Total Mass Net \*\*= (+ Mag Bearing Set) - (Savings in Total S/C ACS/Structure/Maneuver/Station Keeping Mass)

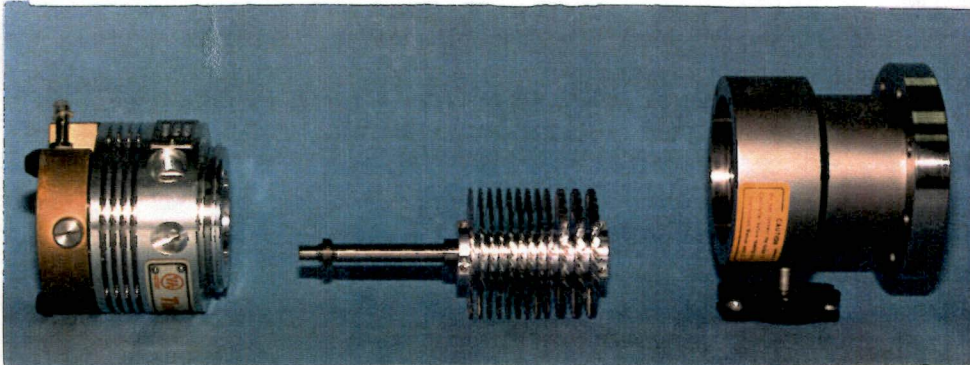
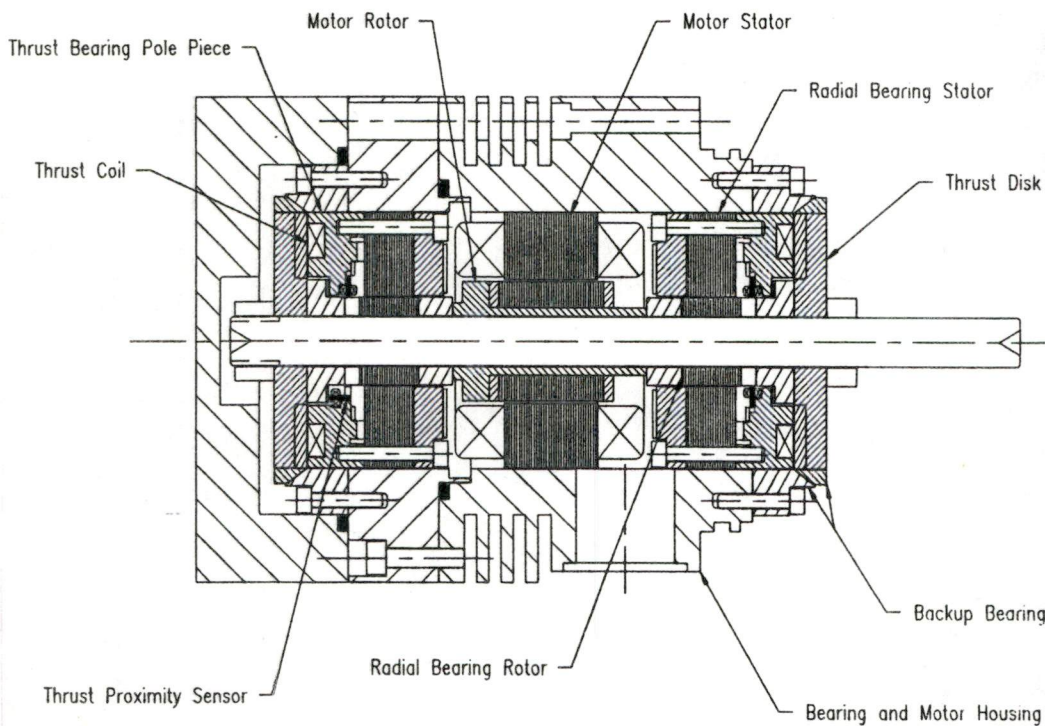
\*Analogous Experience Est. ≈ 6 to 10% Savings in Total

LO835-9/90

## High Speed Pump

Aura has retrofitted the mechanical bearing-and eliminated the lubrication and cooling subsystems-of a turbo-molecular vacuum pump with a magnetic bearing. The unique integrated design of both a radial and thrust bearing (only 2" in diameter, 1.5" in height, and weighing less than one pound) can counter forces of 22 lbs radially and 27 lbs axially, and yet rotate at a speed of 60,000 rpm and higher-using less than 100 watts of power, and accommodating both rotor and external disturbances. Advantages over a mechanical bearing include greatly increased longevity (due to wear-less bearings), oil-free performance (important for purity requirements in high vacuum), and fully suspended shaft which eliminates vibration. Pumps of this type are in preproduction now for a minimum guaranteed quantities of 6500 over five years: they will be in full production in 1992, with bearing and controller set costs of less than \$2000 in quantities of 1,000 units. Costs would approximately \$100 each in quantities of 1 million units.

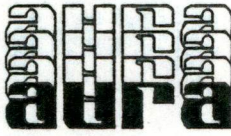
### TURBOMOLECULAR PUMP



## High Force EM Actuator Speaker

The High Force Electro-Magnetic Actuation (HFEMA) capability of Aura has been applied to speaker systems, where both performance and compact sizing cannot compromise one another. The speaker using the HFEMA approach's force, linearity and control combine these requirements very well:

- For a Same Sized Speaker -- Over 3x the maximum linear excursion; 5x the power rating; 7db/1 meter greater maximum output and over 2x better low frequency response.
- For a Speaker One-Half the Diameter of a set of Conventional Speakers; -- Over 5x the maximum linear excursion; 9 db/1 meter greater peak output (at 30 Hz); 10x less% distortion and better than 3x the lowest frequency response.



Aura Systems, Inc

### AURA'S SYSTEM'S HIGH FORCE ELECTRO-MAGNETIC ACTUATOR SUB-WOOFER SPEAKER APPLICATION

	* AURA 12" SUB-WOOFER	vs	CURRENT 12" SUB-WOOFERS
MAXIMUM LINEAR EXCURSION (ONE WAY)	1.0"		0.3"
POWER RATING	1000 WATTS		200 WATTS
MAXIMUM OUTPUT @ 20Hz IN 2 CU. FT. ENCLOSURE	113 dB/1 METER		106 dB/1 METER
LOWEST FREQUENCY RESPONSE	20 Hz		> 40 Hz

\* Projected Performance

### AURA 36" CONCERT WOOFER VS 4-18" WOOFERS IN A TYPICAL CONCERT RIG

	* AURA 36" WOOFER	vs	4-18" WOOFERS
MAXIMUM LINEAR EXCURSION (ONE WAY)	2.0"		.35"
POWER RATING	2000+ WATTS		2400 WATTS TOTAL
MAXIMUM STEADY OUTPUT @ 30 Hz	127-130 dB/1 METER		128 dB/1 METER
PEAK OUTPUT @ 30 Hz	140 dB/1 METER		131 dB/1 METER
DISTORTION	<1% AT 2400 WATTS		+ 10% AT 2400 WATTS
LOWEST FREQUENCY RESPONSE	<10 Hz		> 30 Hz

- ADVANTAGE: (1) Lower distortion  
 (2) Better peak output capability  
 (3) Reduces concert sound rigs in size by 50%, resulting in:
- Quicker set-up times for stage personnel
  - Less trucks needed to transport; therefore lower freight costs on-the-road

\* Projected Performance



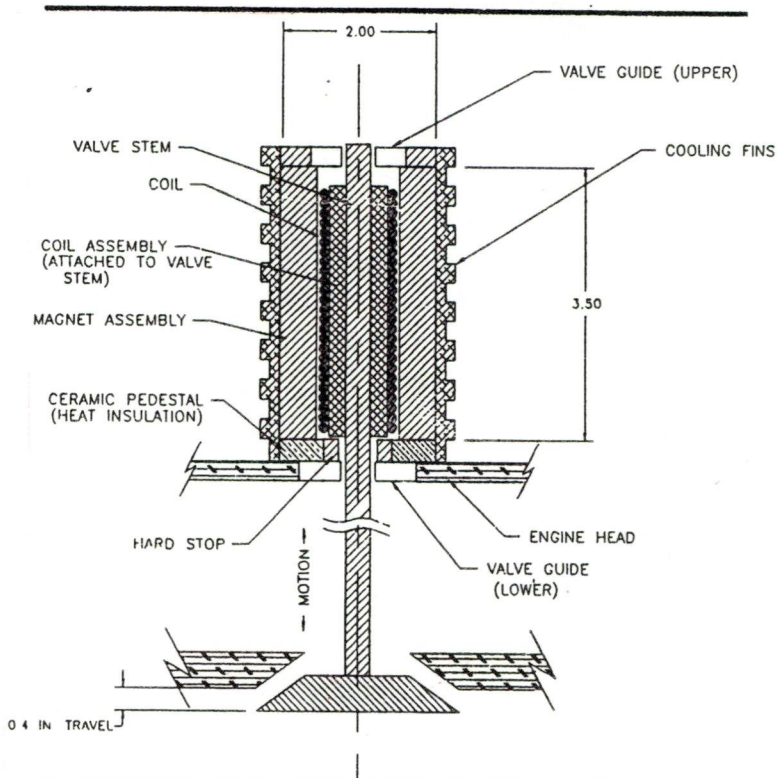
## Infinitely Variable Valve Electronic Timing and Control System (VETACS)

Aura is applying its fundamental breakthrough in magnetic actuation\* to provide optimized automotive engines from idle to flat-out with strikingly improved: Emissions (15\*\* to 28% reduction in HC + NOx); Fuel Usage (4\*\* to 10% reduction depending on engine); Performance (3\*\* to 15% increased torque horsepower); Manufacturability (no camshafts, cogs, belts, hydraulics, cooling fluids, etc.); Simplicity (all solid state magnetics directly attached to engine head, and electronic chip controllers); Reliability (electro-magnetic valving with the lifetime of electronics, no valve stem wear, easier starting...); and Flexibility (all electronic control for valving optimization of any engine--existing or planned).

\*Patented

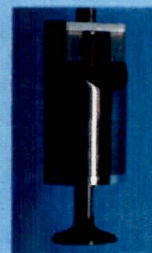
\*\*Demonstrated Mechanically

## HFA APPLICATIONS: ELECTRONICALLY ACTUATED VALVE LIFTER



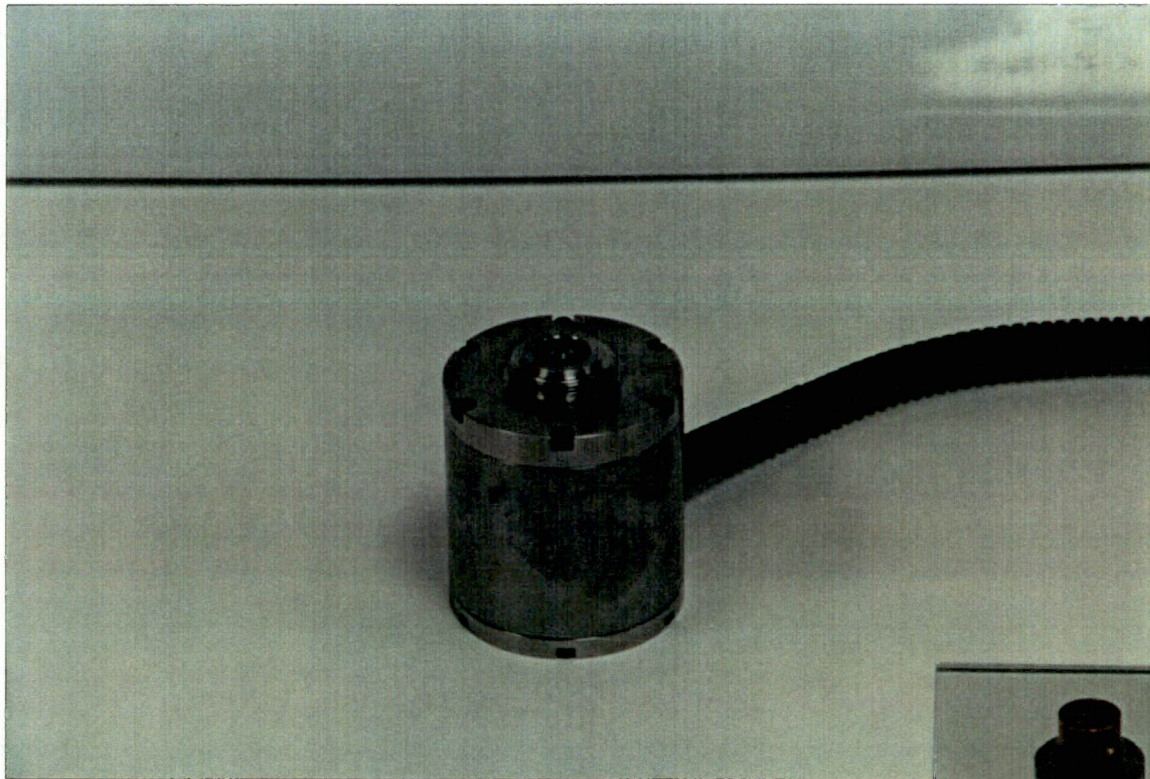
MAGNETIC INFINITE VARIABLE VALVING  
(MIVV)

**aura**  
The Link between Problem and Solution



# FUEL THROTTLE

The Aura Fuel Throttle provides multi-fuel designers and users complete adaptability in force, stroke and modulation to optimize engine/fuel type performance.



	<u>Actual:</u>	<u>Example:</u>
Rated Force	4 Lbf	0.1 Lbf
Impulse Force	40 Lbf	
Maximum Travel	0.18 in.	
Minimum Travel	0.002 in.	
Cyclic Rate at Rated Force Travel	30 Hz	
Current at Rated Force	2.75A	2.5A
Minimum Voltage	9.5 V	0.8V
Power at Rated Force	26 watts	2 W
Length	2.1 in.	0.86 in.
Diameter	1.75 in.	0.53 in.
Total weight	1.1 Lb	0.01 Lbs

## High Force, Linear Actuator (HFA)

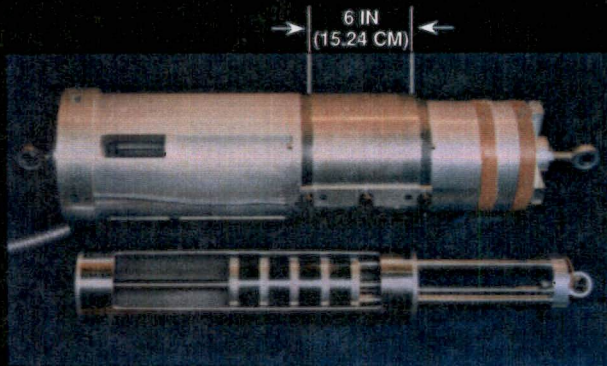
Aura's approach to actuation permits the solution of extremely dynamic, random, one or two-body problems--complex interactive actuation and phasing, active vibration and noise isolation/cancellation/stabilization systems--with an operationally simple, high force actuator (HFA) capable of isolating, suspending, dampening and precisely controlling across the space of a few mils, or tens of feet. The HFA is completely linear in force and position from zero to thousands of Hertz frequency response, has millisecond or better physical response in actuating up to thousands of pounds-force, has nominally unlimited throw, and is flexibly controlled by a digital chip. Over mils of distance, this accomplished by the Aura magnetic bearing.

The HFA accomplishes this essentially without friction--with one moving part and with no lubrication--unlike the slow, complex hydraulic and pneumatic systems in use or contemplated, with their: Pumps, hoses, valves, fluids a/o compressed gasses, pressure, noise, reservoirs, bulky controls, etc. The Aura HFA has a short "tooth-to-tail"--the actuator and its power cord. On a systems basis, the HFA is lighter and uses less power than either hydraulic or pneumatic approaches; it also has considerably better force-to-weight ratios and linear command control than electrical systems; and its bandwidth is hundreds of times superior. The HFA enables levels of performance, efficiency, weight, sizing reliability and maintainability heretofore only dreamed of by engineers.

### aura ELECTROMAGNETIC ACTUATOR BREAKTHROUGH — LINEAR AND ROTARY

SECOND GENERATION  
500 LBS · FORCE,  
WITH 8 INCHES THROW,  
50 LBS WEIGHT  
(22.7 KG)

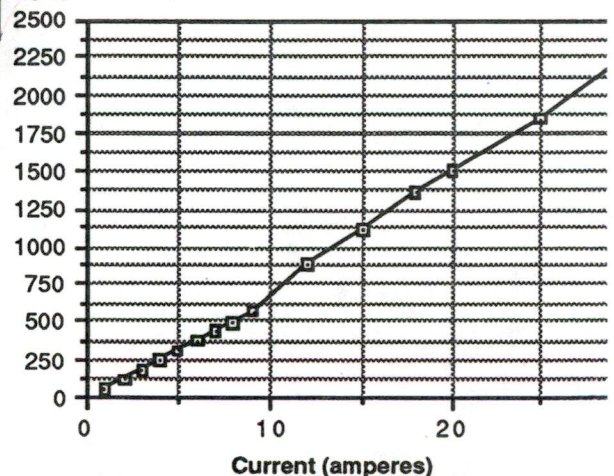
THIRD GENERATION  
25 LBS WEIGHT  
(11.4 KG)



- 10'S TO 1000'S LBS · FORCE
- COMPLETELY LINEAR IN FORCE AND POSITION
- MILLISECOND PHYSICAL THROW RESPONSE
- ROTARY — HIGH TORQUE AT ANY RPM
- ESSENTIALLY UNLIMITED THROW (DISTANCE)
- FRICTIONLESS : NO LUBRICATION
- ACTUATION : LINEAR, TRACTOR, ROTARY
- NO PUMPS, HOSES, ETC.
- COMPACT IN SIZE / LIGHTWEIGHT

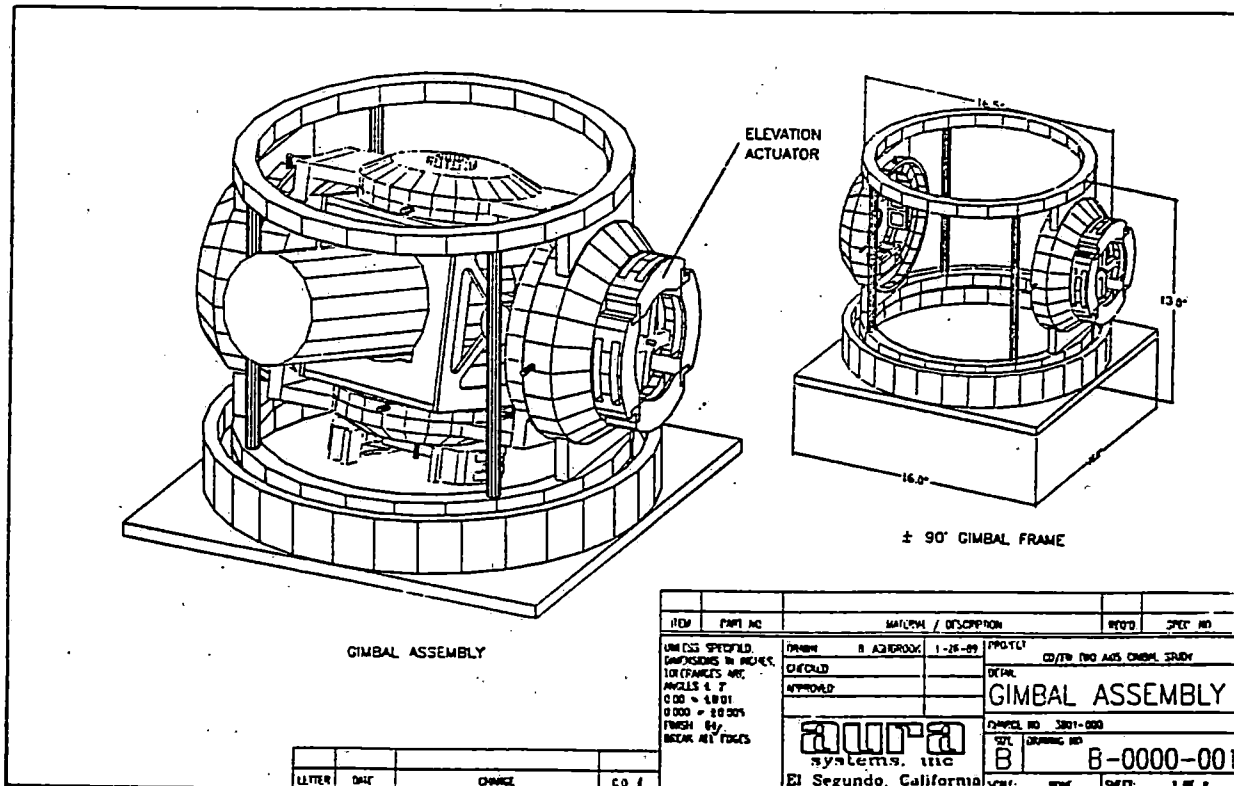
Newtons

Figure contains the measured force-to-current relationship from 0 to 30 amps. This test verified linearity throughout the MHFA's operational range. Many data points were taken over the entire 8 inch travel. It was found that the forces exerted by the MHFA did not vary at all with position.



## Two-Axis Camera Gimbal for the RF-16 Reconnaissance Pod

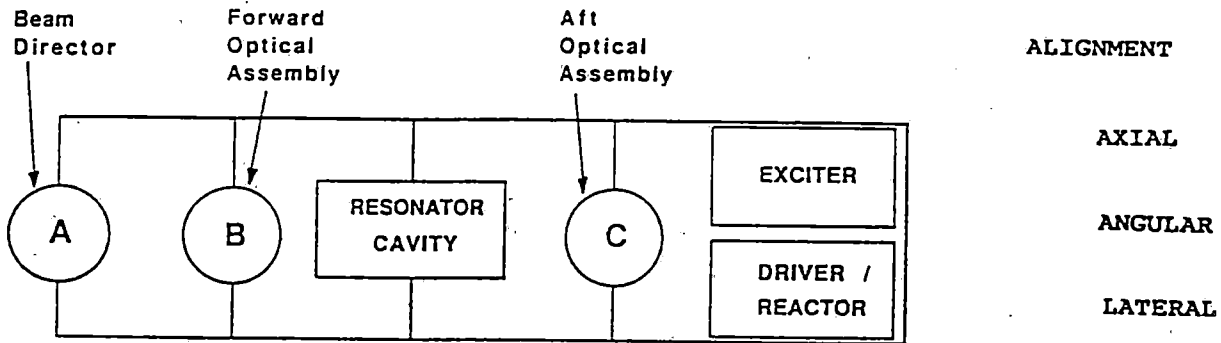
Aura Systems is teamed with General Dynamics, Fort Worth Division to fabricate a two-axis magnetic gimbal system for the RF-16 reconnaissance pod. Possessing its own inertial sensors, this gimbal system will maintain  $8 \mu\text{rad}$  LOS accuracy during  $-3$  to  $+7$  G aircraft maneuvers. Provided with the gimbal is a tracking computer which is tied in with the aircraft's inertial navigation system to allow the pilot to lock onto a target, sweep the terrain, or rapidly step across distant terrain (7 steps per second, 5 degrees per step, 50 msec dwell at  $8 \mu\text{rad}$  LOS stability to facilitate jitter-free photographs) even while the aircraft is performing severe maneuvers.



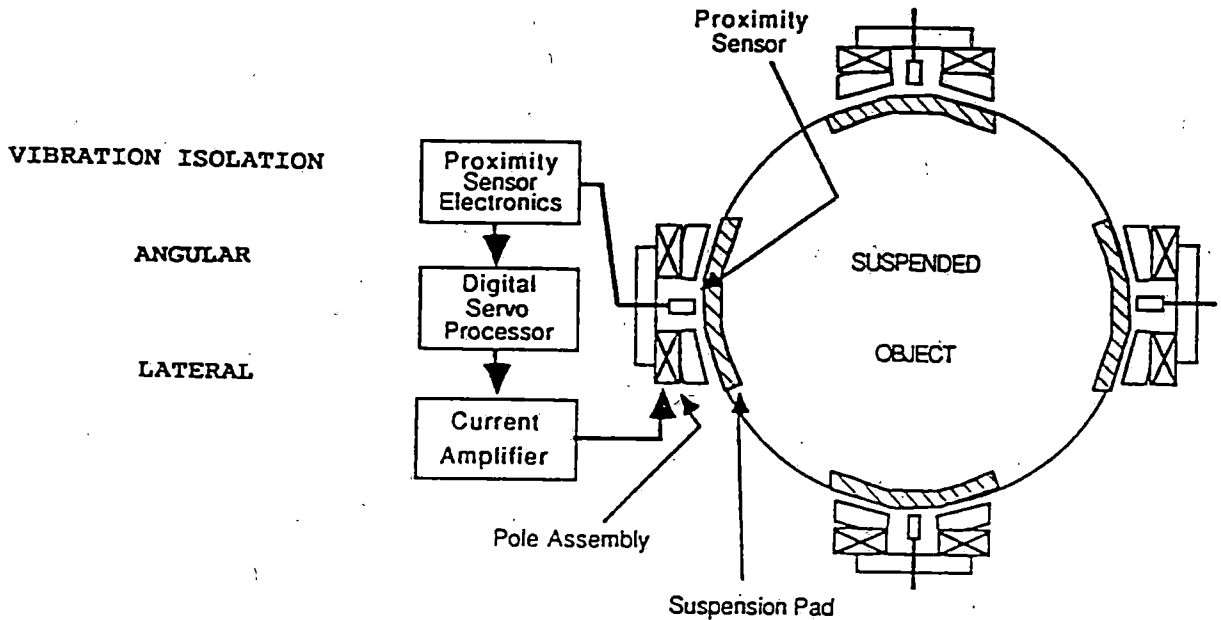


## Falcon Laser Stabilization

Aura designed three magnetic suspension and dynamic alignment systems for the Falcon Laser System for Sandia National Laboratory. The optical assemblies have a static weight in the 2,000 kg to 10,000 kg range. The magnetic suspension systems provide 15 nanoradian vibration isolation, and dynamically align the three optical assemblies with respect to a laser resonator cavity. The alignment is controlled both radially, longitudinally, and angularly. The Falcon Laser System is an advanced concept space-based weapons laser system.



Relative Location of the Falcon Laser Optical Components



Block Diagram of a Magnetic Suspension System

## CURRENT R&D PROJECTS

In addition to the government contracts listed above, Aura is pursuing many commercial applications, including high-speed pumps, high-force actuators, and new medical procedures. The following subsections describe these efforts:

## Medical

Aura Medical Systems (a subsidiary of Aura Systems) is developing a new cataract removal procedure based on magnetic principles. A tiny magnetic bead is injected by syringe into the cataract (clouded eye lens). A surgeon is able to precisely control the bead in order to pulverize and emulsify the cataract. The emulsified material and the bead are then removed via a syringe and replaced by a clear synthetic material. The lens capsule is preserved intact, allowing the internal eye muscles to retain the ability to focus. Other potential medical applications include chemical delivery to required internal sites without poisoning the entire system, and delivering heat to internal locations without damage to covering tissues.

### MAGNETIC CATARACT SURGERY PROOF-OF-CONCEPT

# aura



- JOY STICK CONTROL
- 1MM NEEDLE INCISION
- MAGNABIT SHOWN ON SCREEN



- MAGNABIT EMULSIFYING CATARACT  
(SHOWN ON SCREEN)

### Proximity Sensor Miniaturization

Aura magnetic levitation systems rely on non-contacting proximity sensors to detect the position of the floating member. Previous Aura designs have used off-the-shelf proximity sensor systems that are expensive, bulky and electronically noisy. Aura has engineered a cost-effective proximity sensor design that is tailor-made to magnetic levitation applications. The proximity sensors and the sensor conditioning electronics are small enough to be mounted locally near the floating device. The proximity sensor relies on precise inductive measurements, similar to the angular "pickoff" sensors of miniature navigational gyroscopes. The sensor conditioning electronics convert the measurement immediately to a digital word, thus eliminating most sources of signal corruption. The digital method of signal transfer allows for remote location of the controller and power electronics.

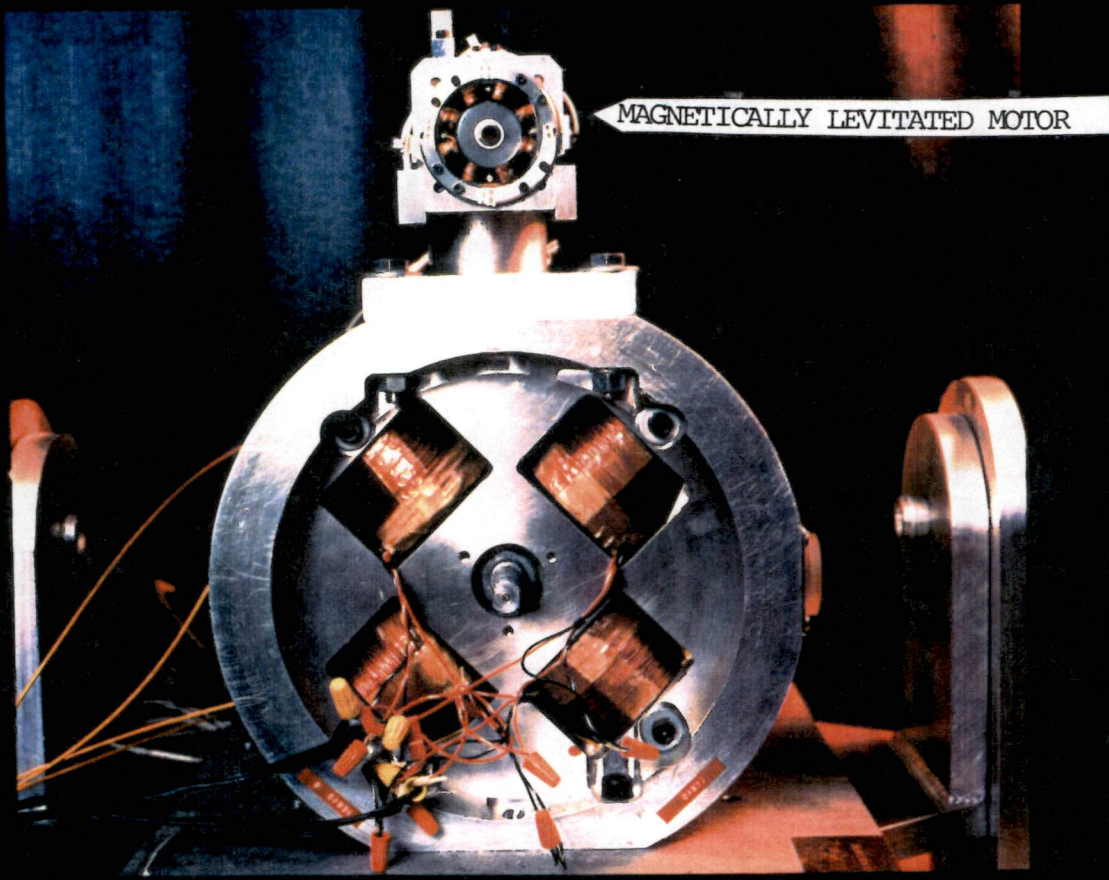
### Electromagnetic Miniaturization

Through Aura's experience with various research projects and funded contracts, electromagnets have been drastically reduced in size and greatly improved in efficiency. Areas which have been studied and improved upon include the shape of the rotor and stator pieces, the length and shape of the air gap, coil organization (both physical and electrical), quality of wire insulation, magnet material selection, precise heat treat annealing, and stable electronic controllers. On one of Aura's most recent projects, optimum magnets were fabricated, weighing just 0.3 kg, yet producing 495 Newtons of force with a 0.5 mm gap.

**NINE TIMES FORCE-TO-WEIGHT RATIO  
IMPROVEMENT**

**aura**

MAGNETICALLY LEVITATED MOTOR



## PRODUCTIZATION AND MINIATURIZATION

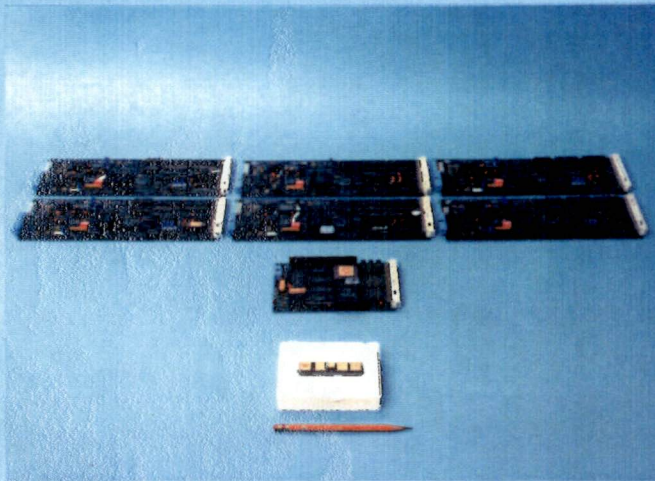
One key to the successful implementation of products utilizing Aura's magnetic suspension technology is the miniaturization of the components. For the past three years, Aura Systems has been actively striving to miniaturize and productize both its electronic and electromagnetic components. The following subsections summarize our progress to date.

### DSP Board Miniaturization

The data processing demands placed on digital magnetic levitation systems drove Aura engineers to develop a controller that utilizes state-of-the-art digital signal processing (DSP) technology. The compact board, measuring only 4" by 6" packs a 24 megaflop DSP chip, plus memory and support electronics to provide a stand-alone magnetic levitation system controller. The board has been designed for magnetic levitation system development as well as turnkey systems. This single board has the necessary data processing throughput capability to control a multi-axis gimbal suspension in 6 degrees-of-freedom. Previous designs utilizing standard microprocessor technology needed an individual processor, with optimized software, per magnetic levitation axis, requiring six 4" x 9" printed circuit cards.

### MAGNETIC BEARING CONTROLLER MINIATURIZATION

**aura**



**PAST**  
(MICROPROCESSOR)

**PRESENT**  
(DIGITAL SIGNAL PROCESSOR)

**FUTURE**  
(HYBRID, CUSTOM IC)

# H. G. WELLINGTON & Co. INC.

14 WALL STREET  
NEW YORK, N.Y. 10005

MEMBERS  
NEW YORK STOCK EXCHANGE, INC.  
AMERICAN STOCK EXCHANGE, INC.  
MIDWEST STOCK EXCHANGE, INC.

TEL (212) 732-6800  
TELEX 971 961 WELCO  
FAX (212) 513-0596

July 1991

## Aura Systems, Inc.

NASDAQ - AURA

			<u>Earnings/ Share</u>	<u>Price/Earnings Ratio</u>
Recent Price	6	1993E*	\$0.50	12.0
Price Range-12 mo.	8 - 1 1/2	1992E	0.15	40.0
Dividend	Nil	1991	(0.22)	
Book Value/	\$14.4 million	1990	(0.16)	
1991 Revenue	\$8.3 million			

### Capitalization:

as of 5/28/91

Long Term Debt	Nil
Shareholders' Equity	\$13 million
Common Stock	25 million shares

\*Fiscal year ending February 28

### Recommendation

BUY FOR RISK-ORIENTED ACCOUNTS

At rare intervals there is a technological development with extraordinarily wide application: the transistor, the copier, and other famous success stories. Aura Systems has developed a technique by which magnetic energy can be focussed and directed by ultra-high speed computer control -- the ramifications of this discovery are remarkably extensive.

A vast amount of machinery and equipment requires the controlling of mechanisms which operate with great precision and at high speed. When these criteria are met, they are often accompanied by excessive vibration. The ability to concentrate magnetic energy, which normally dissipates with distance from its source, enables force to be exerted in a linear direction, for a considerable distance, to very fine tolerances, at speeds measured in milliseconds. Magnetic energy can also be used to suspend metals in mid-air. Magnetic controls are applicable to a spectrum of end-uses currently served by hydraulics, pneumatics, electric motors, solenoids, and other techniques.

Aura Systems has two areas of expertise: magnetics and optics. In the first, the Company has developed and patented a combination of advanced magnetic and digital control technology which is now exhibited in two product lines: linear high force actuators and magnetically-suspended frictionless bearings. In the second, work is being done on high-resolution optical systems. In a curious combination of the two, a magnetic technique is being evolved for removing cataracts without impairing the eye enclosure.

The information contained herein has been obtained from sources considered by us to be reliable. However, we do not make any representations as to its accuracy or completeness. Opinions expressed herein are subject to change. No information or opinion expressed herein constitutes an offer to sell or a solicitation or an offer to buy. This firm or any of its officers may have positions in any of the securities mentioned herein and may buy and sell such securities as either principal or agent.

Aura's stock has risen sharply this year, and the market capitalization is now \$150 million. This price may prove to be generous in a market revaluation of the technological sector, but if Aura's management can achieve the earnings potential inherent in its engineering developments, the stock could sell at substantially higher prices.

WHILE AURA SYSTEMS MAY HAVE OUTSTANDING TECHNOLOGICAL POTENTIAL, THE COMPANY HAS YET TO ESTABLISH MEANINGFUL EARNINGS, AND THE STOCK SELLS AT A PRICE FAR ABOVE SALES AND ASSET VALUE. POSSIBLE PITFALLS ARE DESCRIBED IN GREATER DETAIL IN THIS REPORT. PURCHASE IS RECOMMENDED ONLY FOR SPECULATORS AWARE OF THE HIGH RISKS INHERENT IN A NEW TECHNOLOGY.

### Background

Aura was founded in 1987 to perform high-level corporate and Government research. The Company has now progressed to marketable products with a vast variety of application and is transforming itself into an operating entity. Depending on the nature of the product, it will be manufactured either in-house, or by sub-contract, or through a joint venture. There will be significant adjustments to make in this metamorphosis from the concept to the finished product, in marketing, in cost and quality control, and in personnel. It is unrealistic to anticipate fulfillment of Aura's potential without some growing pains.

By the end of fiscal February 1991 accumulated losses amounted to \$12.6 million. Management expects its first profitable quarter in the period ending May 31, 1991. Fiscal 1991 revenues were \$8.3 million but should begin to accelerate upwards. The three magnetic contracts which the Company has announced could produce sales above \$50 million, and research contracts could continue to produce another \$9 million annually. The timing of production and billing makes precise prognostication of quarterly or annual figures as yet impossible, but the potential numbers are very large.

During the first quarter, conversion of a \$6.7 million note was triggered by the stock trading above \$7 for a specified period. The additional shares brought the capitalization up to 25 million shares, but the Company is debt-free, and its headquarters facility is owned outright. Undoubtedly, anticipated rapid growth will require additional financing via both debt and equity.

### The Company

Aura has come a long way from its inception in 1987 as a group of scientist/engineers dedicated to solving defense-related problems. Work in electromagnetics has resulted in linear power actuators and magnetic suspension systems. Optical research has led to sophisticated projection systems. CAD/CAM (computer-aided

design/computer-aided manufacturing) capability has produced "user-friendly" software compatible with the Apple Macintosh computer. Microwave technology has been combined with microscopy manufacturing expertise for miniaturized products. A number of these capabilities are surfacing as marketable products and systems. The following is an attempt to describe some of them in a non-technical fashion.

The North and South poles of an electromagnet can be exchanged by the reversal of the direction in which the current flows. Aura has developed and patented a software system which enables a computer to adjust current flow at speeds measured in thousandths of a second. One resulting product is a linear actuator, which can produce straight-line force at high speed with extreme accuracy. The size can vary from tiny ounce-pressure units to large ones capable of exerting hundreds of pounds over a distance of feet. The advantages over alternate systems, such as hydraulics, pneumatics, or conversion of the rotary motion of an electric motor, include fewer moving parts, lower manufacturing and maintenance costs, high speed, accurate tolerances, and absence of vibration.

Two current contracts illustrate the scope of this capability. A major auto manufacturer has indicated an interest in 1.7 million actuators to incorporate into its power-steering units which are subject to excessive vibration. Aura's electronic sensor and controller and the high-speed actuator to govern the fluid pressure in the system all fit in a 3-inch cube. The result is not only the elimination of vibration but the capability to reduce power as steering becomes easier at high speeds. Besides steering systems, there are other automotive applications, notably in suspension, transmissions, injection valves and door locks.

Ball Corp. is a manufacturer of aluminum cans, which is accomplished by driving a piston through a metal blank to form the container. Aura's magnetic actuator not only reduces the amount of metal required (because of extreme accuracy), but it permits doubling of the line speed.

The potential of this actuator product line is twofold: it makes possible new equipment heretofore impractical because of speed and accuracy demands, and it can replace a myriad existing products because of price, size and reliability. Many of these applications can be served off-the-shelf without requiring extensive product modification.

The other magnetic capability involves magnetic suspension, and again the end product can range from the Lilliputian to the Herculean. Many electro-mechanical systems involve devices spinning at speeds in thousands of RPM, which results in heavy wear on bearings. Varian Associates manufactures just such a product which operates in a high vacuum. Bearing replacement results in

extended downtime until the vacuum can be re-established. Aura has a contract to provide magnetic frictionless bearings for this application.

A broad spectrum of optical procedures requires the elimination of vibration. Semiconductor chip design, high-tolerance measurement and testing, and sophisticated navigation systems are examples of activities which use vibration-less tables suspended in air, varying in size from square inches to square feet. Aura has an agreement with Technical Manufacturing Corp. of Massachusetts to provide optical tables for these applications.

The Rambo-esque end of the scale is a magnetic suspension system which can hold a rocket engine in various attitudes while its guidance thrust rockets are test-fired. This capability obviates the necessity of firing a \$1 million rocket to carry out a test.

In the optical area, Aura has formed a joint venture with Dr. Charles D. Kelman to develop a cataract removal procedure using magnetic technology. A tiny bead is injected into the lens and under magnetic control uses microscopic blades to liquefy the lens. A syringe is used to remove the emulsified cataract and replace it with a liquid compound which forms a new lens. The key is that the lens capsule remains intact. The Alcon division of Nestle has invested \$1.5 million for 5% of the venture (deducted from Aura's 67%); Dr. Kelman retains a 33% share. The initial design is complete, and work is being done on the computer control system.

Another optical contract is with the military for a high-tech laser projection system for a variety of tactical and strategic uses. In conjunction with this project Aura has developed a high resolution optical system involving literally millions of tiny mirrors, or pixels, on an array analagous to semiconductors on a silicon chip. Non-military applications include high density TV and movie theatre projection. The movie industry spends \$80 million annually for the production and distribution of prints. Aura's projector would permit electronic transmission, storage, and projection of films at a major saving.

Aura has assembled parts of its technological capability by acquisition. Delphi Components, (December 1988) produces the miniature microwave components at a nearby location; and International Micro CAD/CAM Engineering (May 1989) is a separate subsidiary operating in-house. Aura Medical Systems, the cataract joint venture, is 60%-owned.

#### Financial Projections

Since the character of Aura's operation is changing so dramatically, past financial history is of little value in constructing a model for future profitability. However, there are

some guidelines.

Presently operating expenses are running at an annual rate of about \$12 million, most of which is in the nature of fixed costs in the form of scientist salaries and overhead. As product revenues rise, the accompanying increase in costs will be mostly variable, and the fixed portion should grow more moderately. Research and development will continue to be important, but there are physical limits to the rate at which this type of activity can expand, and the percentage of R & D costs to sales should drop below 5%. Depreciation charges are running about \$500,000. A new manufacturing facility is being sought, likely on a lease basis initially and then a purchase, at which time depreciation charges will increase. Interest charges will be virtually nil, following the conversion of the debentures, but a line of credit is being negotiated. It is probable that near-term financing will be by debt, followed by periodic equity infusions.

The nature of Aura's research contracts is mostly cost plus fixed fee, but there are some fixed cost agreements. Government contracts provide for about a 10% profit; some corporate contracts, involving equipment as well as research, have higher profitability.

Much of Aura's output can be priced on the basis of savings and return on investment by the customer, and the potential gross profit margins can be generous. Where the unit volume is small, manufacturing will probably be done in-house. Some production will be subcontracted for cost plus a negotiated profit. Large volume requirements, such as the automotive market, are likely to be via a joint venture with an established manufacturer and involve a profit split. In the last case, the total sales figure will either be part of Aura's revenues, with the partner's profit share included in expenses, or Aura's profit share will be booked with no associated expense. In the latter case, gross profit margins will be distorted upward.

To give an idea of size, the auto manufacturer initial contract should be for \$42.5 million, with a possible expansion to \$100 million annually. The Ball agreement could mean as much as \$8.7 million, and the rest of the industry could amount to over \$100 million. The Varian contract is for \$675,000, but could expand to \$1.5 million per year. The Company has been deluged with requests for quotations for various applications. In our opinion, it is only a matter of time before the broad applications of the technology get translated into product sales of major magnitude.

Table I is a model of what Aura's earning power could be at three levels of revenue production. It is not an annual earnings projection. It implies a gross profit margin in the neighborhood of 50% on equipment sales, which is reasonable in the light of management's disclosure of present contracts. It implies a second facility with associated depreciation and overhead expense. \$10-15

million in additional financing is factored in, and the trade-off between interest costs and potential additional shares indicates little if any earnings dilution.

### Risks

There are a number of risks characteristic of young, rapidly growing technological companies. It is very difficult to keep a tight rein on costs during rapid expansion, and inevitably there will be excesses which will only be addressed during a period of adversity. However, Aura has extended experience in cost accounting for Government contracts, and management habits appear frugal, indicating that this danger may be minimized. Discipline will also be required to avoid spreading available capabilities too thinly, spending R & D funds on intellectually-fulfilling projects which do not maximize profitability, and attempting to serve too many markets.

Aura has impressive patent protection, but the potential in its markets is so great that attempted circumvention is virtually unavoidable. There is protection in proprietary skills not included in patent descriptions and in technological lead time, but we anticipate that management energies will be devoted to ongoing protection and considerable time and money will be spent on patent litigation.

Finally, big contract customers are not quiescent in the face of generous profit margins earned by their suppliers. Price pressure is likely, but until comparable savings are offered by competition, Aura should be in a strong bargaining position.

The key to the Company's success will ultimately lie in management's discipline and its ability to attract, direct and motivate capable people. To date this requirement has been fulfilled with respect to scientists and engineers. It will now have to be repeated with manufacturing and marketing people.

### Conclusion

Aura Systems has the technological lead in two areas which are susceptible of creating revenues approaching \$1 billion in a relatively short number of years. Careful management will be necessary to convert potential into actuality, but if success is achieved, the attendant reward for adventurous shareholders should be substantial. In our opinion, this possible gain outweighs the risks involved, and the stock is recommended for appropriate investors.

Byam K. Stevens, Jr.  
July 15, 1991

Table I

Potential Earning Projection

Based on Three Levels of Revenue

	I	II	III
Revenue (\$Mill)	60.0	100.0	150.0
Gross Profit Margin (%)	51.7	55.0	56.7
Operating Expense (\$Mill)	12.0	15.5	20.5
R & D Expense (\$Mill)	3.0	5.0	7.0
Net Before Tax (\$Mill)	15.9	34.0	56.0
Pre-tax Margin (%)	26.5	34.0	37.3
Tax (\$Mill)	1.0	11.9	19.6
Tax Rate (%)	6.3	35.0	35.0
Net Income (\$Mill)	14.9	22.1	36.4
Earnings Per Share (\$)	0.60	0.88	1.46

# MAGNETICS FACT SHEET:

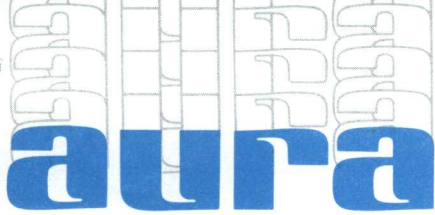
## BREAKTHROUGH CAPABILITIES ENABLED



1. Dynamic Control
  2. Control Precision
  3. Responsiveness
  4. Digital Control
  5. Vibration Isolation
  6. Force-to-Weight Ratio
  7. Size Reduction
  8. Weight Reduction
  9. Power Efficiency
  10. Manufacturability
  11. Reliability
  12. Installation Simplicity
  13. Cost Effectiveness
- (1) Respond to: Complex six degree-of-freedom commands in milliseconds.
  - (2) Act with: Several thousand pound forces under complex multidirectional control commands.
  - (3) Maintain: Dynamic separation distance of mils under acceleration of 10,000 degrees/sec<sup>2</sup>, with forces noted, and with static positional precision of 0.1 mil or better.
  - (4) Maintain: Microradian line-of-sight rotational accuracies for 10s of milliseconds, under at least random 10 gravity loads while slewing over 5 degree or greater angles within 120 millisecond responses.
  - (5) Isolate from: Vibration by 80 or more decibels from at least 10 gravity external forces with millisecond rise times.
  - (6) Induce, while suspending: Vibration spectra of several kilohertz bandwidth.
  - (7) Suspend and differentially spin: Rotors at tens to hundreds of thousands rpm with no bearing wear or lubrication.
  - (8) Linearly or Rotationally actuate: Over large--essentially unlimited--throw distances or rotational angles/directions with tens to thousands of pounds of force with milliseconds responsiveness and 0.1 mil or better position precision; tractor motor or columns extension implementation available.
  - (9) Drive, as a motor, with: High Torque at any RPM, without gearing.
  - (10) Use typically: Less power and weigh less than comparable force hydraulic, pneumatic or electric systems.
  - (11) Install without: Pumps, hoses, fluids, pressure, valves, seals, mechanical drives, lubrication, noise or large control boxes.
  - (12) Assure reliability and safety with: No mechanically touching parts; "fail safe" or "fail to" design alternatives; lightweight digital control/electrical backup redundancy; and flexibility of electrical routing alternatives.

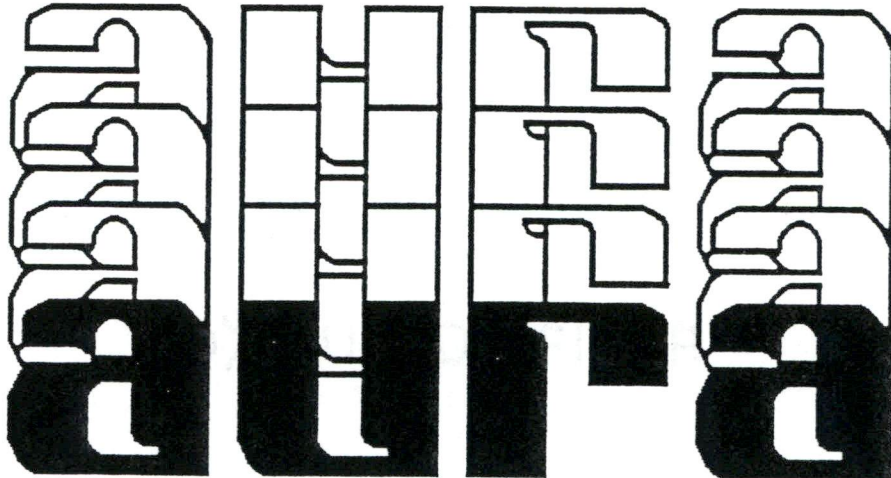
## REMARKS

The information summarized in this document reflects some of the current activities of the Magnetics Division of Aura Systems, Inc. For additional information, please contact Aura Systems Marketing at (213) 643-5300. Aura Systems is fully prepared to cooperate in development programs involving new applications and/or special designs involving magnetic suspension and enthusiastically solicits your inquiries.



*The Link between Problem and Solution.*

**Aura Systems, Inc.**  
2335 Alaska Avenue  
El Segundo, California 90245  
Phone: (310) 643-5300  
FAX: (310) 643-8719



**CORPORATE FACILITIES AND EXPERIENCE.**

FOR FURTHER INFORMATION  
CONTACT:

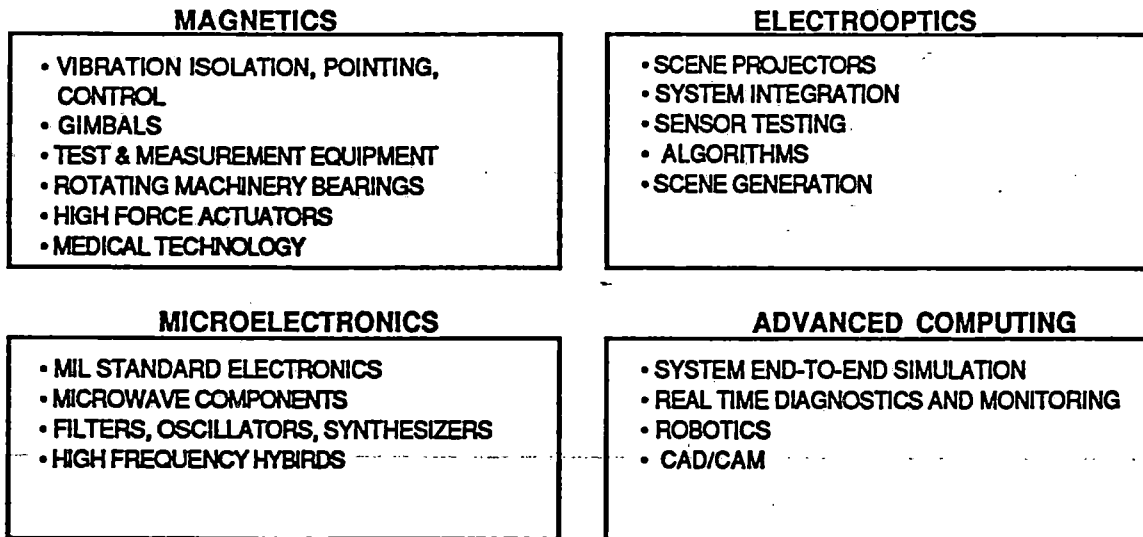
RONALD J. GOLDSTEIN  
SENIOR VICE PRESIDENT

# COMPANY EXPERIENCE AND FACILITIES

## ABOUT THE COMPANY

Aura Systems, Inc. (ASI), is a Delaware, corporation that was founded in 1987. The company founders are scientist and engineers with many years of experience on major defense programs. From day one, emphasis has been placed on endeavors which require a high degree of sophistication in the engineering and scientific disciplines. This high technology background has resulted in the development of fundamental new technologies in the areas of a) Magnetic suspension applications, b) Scene projection/generation, c) Advanced software for diagnostics and monitoring and d) Microelectronics for defense and commercial application (Fig1). Our experience has been gained from a vigorous investment by the company in internal research and development programs and contracts with research laboratories, aerospace industrial firms and military/government organizations.

Figure 1: **AURA TECHNOLOGY AREAS**



## FACILITIES AND EQUIPMENT

Aura Systems has a full range of facilities available to support its projects and development activities. The corporate offices and laboratories are located in a 50,000 square foot facility in El Segundo, California (Fig 2). In addition, the company has a 5,000 square foot laboratory and machine shop in El Segundo and 10,000 square foot manufacturing facility in Laguna Niguel, California.

Figure 2: Corporate and Laboratory Facilities



The company owns a wide variety of state-of-the-art electronic equipment, test equipment, computer work stations, manufacturing tools and equipment, and two complete machine shops. In addition to its research and development work, Aura is currently a qualified supplier of mil-spec electronic components to U.S. military.

**Table 1: AURA SYSTEMS, INC.: A Capabilities Summary**

**MAGNETIC SYSTEMS**

**CAPABILITIES**

- High Force/High Response Actuators
- Magnetic Suspended Bearings, Gimbals/Gyros
- Precision pointing systems for sensors
- Vibration-isolation hardware and software
- Digital control algorithms for non-linear systems
- Fabrication of associated hardware and electronics

**PROGRAM EXAMPLES**

- LEAP-Thruster Test Stand (Boeing)
- High-speed Molecular Pump (Varian)
- F-16 Tactical Magnetic Gimbal Dev. (GD)
- Spacecraft Vibration Isolation (Special Projects)
- AMS-Missile Program Gimbal Dev. (GD)
- SDI/KEW-Electromagnetic P/L Expmt. (HAC)
- Flight Motion Simulator (Aerospaiale)
- High Force Actuator (R&D)

**ELECTRO OPTICAL SYSTEMS**

**CAPABILITIES**

- Electro-optical system designs, simulation and testing
- IR scene-generation and projection H/W & S/W
- High Definition Movie Projector/Television/  
Large Display
- Surveillance System Design

**PROGRAM EXAMPLES**

- KHLS-Kinetic Hardware-in-the-Loop Simulator (USAF)
- KEW/SDI-Simulation: E/O Sensor Models (HAC)
- LEAP/SDI-Light Exo Projectile Studies (Litton)
- Scene Projector-Design Studies (USA)
- High definition Projection (R&D)

**ADVANCED COMPUTING**

**CAPABILITIES**

- Advanced simulation and graphics techniques
- AI for expert systems, including spacecraft
- diagnostics, monitoring, scheduling and training
- Robotic Control System
- Emulation and Hardware-in-the-Loop testing
- Microcomputer based CAD/CAM applications

**PROGRAM EXAMPLES**

- Robotics
- Fujita Tunneling System
- Spacecraft
- Galileo-Mission Monitoring Work Station (MMW)-Space flight OPS (JPL)
- Power System Monitor (JPL)
- SDI-Threat Object MAP Dev. Support (HAC)
- Laser Designation Study (USAF)
- SDI/BSTS-Target Detection/Phase I (HAC)
- SYSTEMS
- End-To-End Simulator and Hardware/Software-in-the-Loop Testing (SDI)

**MICRO ELECTRONICS FABRICATION**

Microwave and millimeter wave commercial and defense hybrid components, reducing weight and power, while extending reliability and lifetime.

**CAPABILITIES**

- Filter: Voltage & Crystal-Controlled Oscillator (including Phase-Lock Oscillators and Frequency Synthesizer.)
- Amplifiers: GaAs FET, plus-low Noise Amplifiers (LNA)
- Subsystems: Signal Processing  
MIL-I-45208A  
MIL-Q-9858A  
DOD 2000

**CUSTOMER EXAMPLES**

- GTE
- ITT
- Sperry Corporation
- Warner Robins Air Logistics Command
- Naval Avionics Center
- U.S. Army CECOM
- Navy Ships Parts
- Northrop Corporation
- Sanders
- General Dynamics

Table 2: Applications--Aura Key Areas of Contribution  
To Increased Cost-Effective Systems

**1. MAGNETICS**

**1.1 Gimbals**

- *Sensor Gimbals*
- *Reactionless/Jitterless Gimbals for Spacecraft/Aircraft/Ships Vehicles*
- *Complex Structure Accommodation*

**1.2 Momentum Gyros (MGs) and Wheels (MWs)**

- *Movement Control of Platforms*
  - *Spacecraft*
  - *Aircraft*
  - *Sensor Platforms*

**1.3 High Force Actuators and Pumps**

- *Bearings*
- *Valves*
- *Simple Linear/Rotary Actuator Replacement for Hydraulic and Pneumatic Complexities*
- *Ultra-reliable pumps/compressors*
- *High speed rotor bearings for turbines*
- *Efficient/Reliable High Torque Electric Motors*
- *Vibration/Isolation*
  - *Active Suspension for Vehicles/Platforms*
  - *Mounts for Engines*
  - *Motors, Pumps, Etc.*
  - *Noise Suppression for Engines, Pumps Etc.*

**1.4 Vibration Isolation**

- *Payload/Equipment Isolation Mounts*
- *Payload Protection*
- *Lower system cost and lightweighting*

**1.5 Test/Diagnostics**

- *Thrust Vector Measurement*
- *Precise Balancing*

**2.0 ELECTROOPTICS**

**2.1 System Engineering/Integration of H/W and S/W in-the-Loop (ESIL) Test Facilities**

**2.2 Dynamic, Physical Scene Projection**

- *High Definition Television*
- *Large Screen Display*
- *Training Displays*
- *IR Throug UV Sensor Test*

**3. ADVANCED COMPUTING**

**3.1 Linkage™: Monitoring/Diagnostics/Control (MDC)**

- *Spacecraft Ground Station Operation*
- *Command & Control Center Operation*
- *Automated Tunneling*
- *Factory/Process Control*
- *Network Control*
- *Utility Operations*

**3.2 Linkage™: System End-to-End Simulator (SEES)**

- *Design Performance Assessment*
- *Hardware/Software-in-the-Loop*
- *Complex Systems Tradeoffs*
- *Performance vs. Technology vs. Cost Tradeoff Assessments*

**3.3 Aura CAD/CAM**

- *Cad-to-Cam-to-Machining in one operation*
- *PersonalComputer Based*
- *Machine Tool Control*
  - *Metal*
  - *Woodworking*
  - *Other Materials*
- *Excellent Construction Editing Tools*
- *Two or Three-Dimension FANUC or any other Language output*
- *Array of Helpful Utilities]*
- *AuraCAM Modules Drive variety of CNC Machine Types*
  - *Milling*
  - *Turning*
  - *Punching*
  - *Wire EDM*
  - *Routing*
  - *Flame Cutting*
  - *Laser machines*

## MAGNETIC SYSTEMS

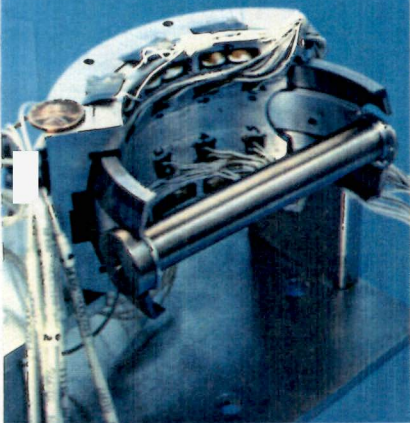
### CAPABILITIES

- High Force/High Response Actuators
- Magnetic Suspended Bearings, Gimbals/Gyros
- Precision pointing systems for sensors
- Vibration-isolation hardware and software
- Digital control algorithms for non-linear systems
- Fabrication of associated hardware and electronics

### PROGRAM EXAMPLES

- LEAP-Thruster Test Stand (Boeing)
- High-speed Molecular Pump (Varian)
- F-16 Tactical Magnetic Gimbal Dev. (GD)
- Spacecraft Vibration Isolation (Special Projects)
- AMS-Missile Program Gimbal Dev. (GD)
- SDI/KEW-Electromagnetic P/L Expmt. (HAC)
- Flight Motion Simulator (Aerospaiale)
- High Force Actuator (R&D)

#### ARC GIMBAL ASSEMBLY



- 4 INCH DIAMETER
- ±5° TRAVEL
- OPERATES IN 55G ENVIRONMENT
- RELATIVE TEMPERATURE INSENSITIVITY

#### MAGNETIC CATARACT SURGERY PROOF-OF-CONCEPT

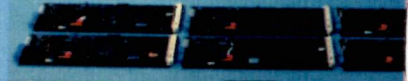


- JOY STICK CONTROL
- 1MM NEEDLE INCISION

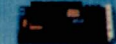
MAGNET SHOWN ON SCREEN

#### MAGNETIC BEARING CONTROLLER MINIATURIZATION

PAST  
(MICRO)



PRESENT  
(DIGITAL SIGNAL PROCESSOR)



FUTURE  
(HYBRID, CUSTOM IC)



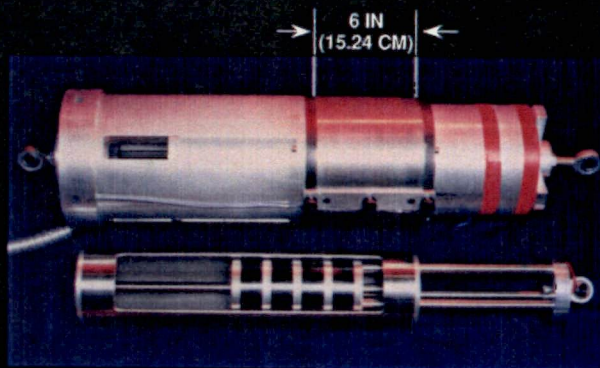
#### aura ELECTROMAGNETIC ACTUATOR BREAKTHROUGH — LINEAR AND ROTARY

##### SECOND GENERATION

500 LBS • FORCE,  
WITH 8 INCHES THROW,  
50 LBS WEIGHT  
(22.7 KG)

##### THIRD GENERATION

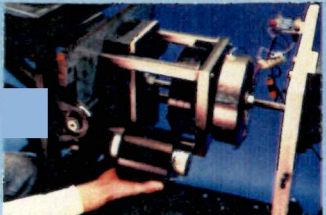
25 LBS WEIGHT  
(11.4 KG)



#### HIGH SPEED PU



#### LAUNCH VIBRATION ISOLATOR (LVI)



- PROOF-OF-CONCEPT ISOLATOR COMPARED TO NOMINAL 6 LB LVI
- PAYLOAD WEIGHT SAVINGS - 5 TO 8% (LESS MASS AND STIFFENING)

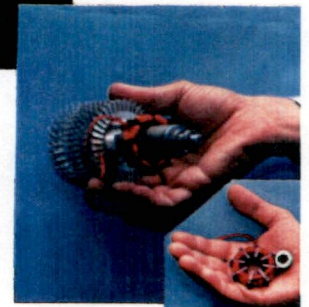
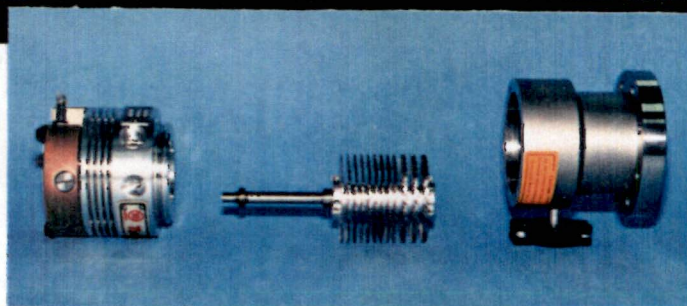
#### THRUST MEASUREMENT



- Six degrees of freedom
- 1% accuracy
- >1000 Hz measurement bandwidth

- 10'S TO 1000'S LBS • FORCE
- COMPLETELY LINEAR IN FORCE AND POSITION
- MILLISECOND PHYSICAL THROW RESPONSE
- ROTARY — HIGH TORQUE AT ANY RPM
- ESSENTIALLY UNLIMITED THROW (DISTANCE)
- FRICTIONLESS : NO LUBRICATION
- ACTUATION : LINEAR, TRACTOR, ROTARY
- NO PUMPS, HOSES, ETC.
- COMPACT IN SIZE / LIGHTWEIGHT

A129-1



**Table 3: Aura Key Areas of Contribution  
To Increased Cost-Effective Systems**

WHAT	WHY
<b>1. <u>MAGNETICS</u></b>	
<b>1.1. Gimbals</b>	<ul style="list-style-type: none"> <li>• Superior payload-vehicle and payload-payload isolation(-80db)</li> <li>• Superior payload control/pointing (<math>\mu</math>rad)</li> <li>• Loose vehicle attitude control with precise payload control               <ul style="list-style-type: none"> <li>-- Significantly lower vehicle cost (\$M)</li> <li>-- Lower overall vehicle mass</li> </ul> </li> <li>• "Jitterless" payload scanning</li> <li>• "Reactionless" gimbal/moment gyro combination</li> <li>• Overall system mass reduction (-8-10% experience)</li> </ul>
<b>1.2. Momentum Gyros (MGs)</b>	<ul style="list-style-type: none"> <li>• Very High Performance/Consistency/Reliability (10 years)</li> <li>• Considerably lower mass/low power (-25%+ )</li> <li>• Unique design flexibility/Multi-axis potential</li> <li>• Applicability to small and large vehicles</li> <li>• Direct applicability to payloads as well as vehicles</li> <li>• Momentum/vibration damping</li> </ul>
<b>1.3 High Force Actuators and</b>	<ul style="list-style-type: none"> <li>• High Performance               <ul style="list-style-type: none"> <li>•• Linear and rotary actuation</li> <li>•• Active suspension/vibration isolation/vibration-noise suppression</li> <li>•• Thousandth of millimeter positional accuracy</li> <li>•• Millisecond response</li> <li>•• Tens to thousands of Newtons force--linear/rotational</li> <li>•• Digital control flexibility</li> </ul> </li> <li>• High Reliability = Simplicity               <ul style="list-style-type: none"> <li>•• One moving part</li> <li>•• No lubrication</li> <li>•• Digital chip control</li> <li>•• 10-year minimum shelf-life</li> </ul> </li> <li>• High Maintainability = Simplicity, with               <ul style="list-style-type: none"> <li>•• No pumps, accumulators, hoses, fluids, maintainability and lubrication, pressure...</li> </ul> </li> <li>• Affordability = Reliability, Maintainability, with               <ul style="list-style-type: none"> <li>•• Low weight-to-force ratio</li> <li>•• Low power-to-force ratio</li> </ul> </li> </ul>
• Pumps	
• Bearings	
• Valves	
•	
<b>1.4 Launch Vibration Isolation</b>	<ul style="list-style-type: none"> <li>• Lower launch vibration loads (-10db)</li> <li>• Lower system stiffening</li> <li>• Lower system mass (- 5 to 8%)</li> <li>• Lower system cost</li> <li>• Reusability if so designed (launch vehicle dependent)</li> </ul>
<b>1.5 Test/Diagnostics</b>	<ul style="list-style-type: none"> <li>• Full vibrational spectrum tests (<math>10^3</math> Hz)</li> <li>• Resonant frequency/harmonics tests (<math>10^3</math>Hz)</li> <li>• Precise center-of-gravity determination (1%)</li> <li>• Balancing (1%)</li> </ul>

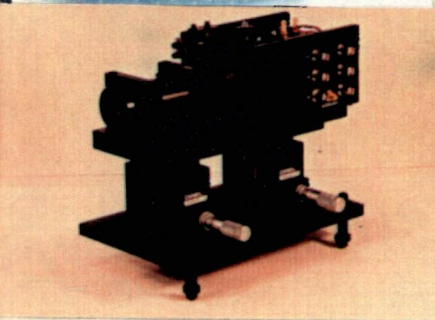
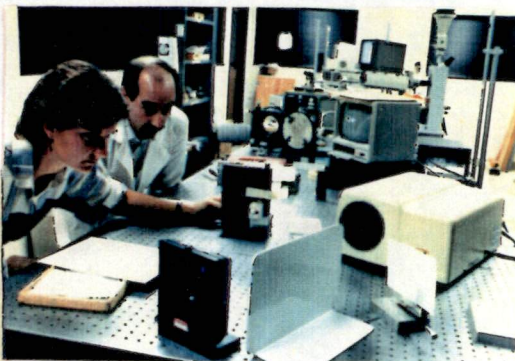
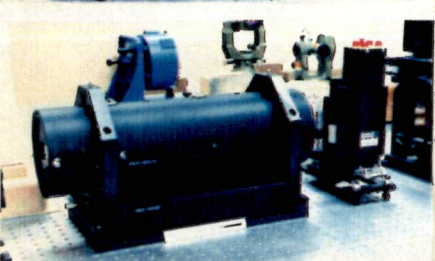
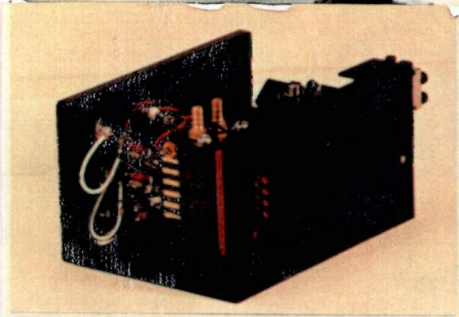
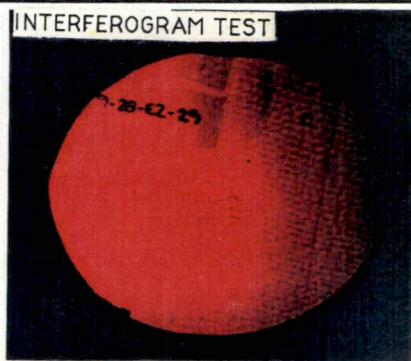
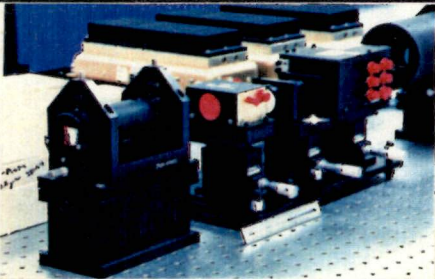
**ELECTRO OPTICAL SYSTEMS**

**CAPABILITIES**

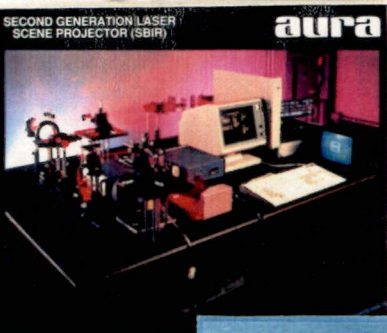
- Electro-optical system designs, simulation and testing
- IR scene-generation and projection H/W & S/W
- High Definition Movie Projector/Television/ Large Display
- Surveillance System Design

**PROGRAM EXAMPLES**

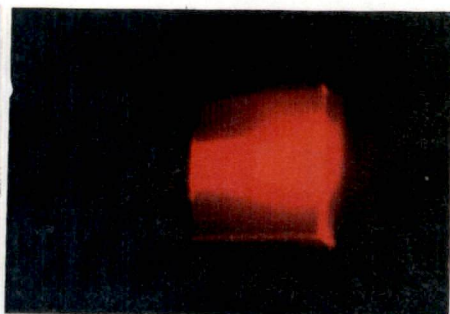
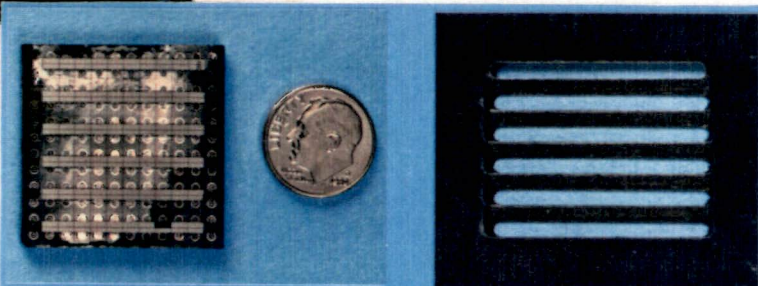
- KHILS-Kinetic Hardware-in-the-Loop Simulator (USAF)
- KEW/SDI-Simulation: E/O Sensor Models (HAC)
- LEAP/SDI-Light Exo Projectile Studies (Litton)
- Scene Projector-Design Studies (USA)
- High definition Projection (R&D)



- MULTI CHANNEL A-O SUBASSEMBLIES FABRICATED AND PREALIGNED
- POWER MODULATORS FABRICATED
- ALL A-O DEVICES COATED FOR EACH WAVEBAND



OPERATOR VIEW



PIEZOELECTRICALLY DRIVEN ARRAY PROTOTYPE FOR ULTRA-MODULATED TELEVISION (IMTV)

BAFFLE FOR PROTOTYPE ARRAY

SCENE PROJECTOR

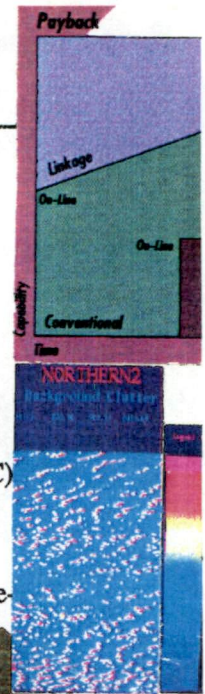
ADVANCED COMPUTING

CAPABILITIES

- Advanced simulation and graphics techniques
- AI for expert systems, including spacecraft
- diagnostics, monitoring, scheduling and training
- Robotic Control System
- Emulation and Hardware-in-the-Loop testing
- Microcomputer based CAD/CAM applications

PROGRAM EXAMPLES

- Robotics**
- Fujita Tunneling System
- Spacecraft**
- Galileo-Mission Monitoring Work Station (MMW)-Space flight OPS (JPL)
  - Power System Monitor (JPL)
  - SDI-Threat Object MAP Dev. Support (HAC)
  - Laser Designation Study (USAF)
  - SDI/BSTS-Target Detection/Phase I (HAC)
- SYSTEMS**
- End-To-End Simulator and Hardware/Software-in-the-Loop Testing (SDI)



**LINKAGE DATA EASILY FOUND CLEARLY REPRESENTED**

**SCHMATIC UNDERSTANDING**

**MULTIPLE MISSIONS**

**ELEMENT TIME HISTORY AND EXPERT PREDICTION**

**MULTIPLE SUBSYSTEMS**

**POINT AND CLICK**

**EXPERT SYSTEM DIALOGUE**

**CHOICE OF DATA DISPLAY MODE**

LINKAGE

**linkage**

Better Monitoring

Prototyping On Day One Of Project

Improved Analyst Performance

Seamless Integration With Existing User S/W

Tailoring Without Recoding

Useful For Software-In-Loop Testing

Aid In Detection And Analysis Of Failures

Reduced Manpower

**cad/cam**

The Link Between Man and Machine.

**2.0 ELECTROOPTICS**

• **System Engineering/  
Integration of H/W and S/W  
In-the-Loop (HSIL)  
Test Facilities**

• **Dynamic, Physical Scene  
Projection**

- For the first time, complete sensor, processing and algorithm tests in physically realistic flight scenarios
- Resolution and Dynamic Range capable of challenging capabilities of sensors approaching  $10^6$  and  $10^4$ , respectively
- Full, realistic flight scene generation, including fields of view, fields of regard, target(s) and platform(s) dynamics, space and earth spectral backgrounds, maneuvers, etc.
- High contrast, high brightness, high definition Television/Movie Projection/Large Screen Displays
- Training, Sensing Evaluation and Control across IR, Visible, UV Spectrum

**3. ADVANCED COMPUTING****3.1 Linkage™: Monitoring/  
Diagnostics/ Control (MDC)**

- Multiple mission control by single position
- Integral expert system for safe, more efficient mission monitoring/control
- Significant improvement in real-time control station personnel productivity ( $5^+x$ )
- Alternatively, fewer control station personnel to safely and effectively control current system ( $5^+x$ )
- Increased missions with same personnel complement
- On-line training and simulation
- Transfer of existing algorithms
- Operating area savings up to 80%
- Day-one prototyping

**3.2 Linkage™:  
System End-to-End  
Simulator (SEES)**

Performance evaluation of all elements of system(s)/ network(s)

- |   |   |
|---|---|
| •• Threats  | •• E/O/RF Sensors<br>(HW & SW)                          |
| •• Backgrounds  | •• Processing   |
| •• Environments   | •• Spacecraft   |
| •• Scenarios  | •• Multiple Spacecraft<br>Types/Networks                |
| •• Platforms<br>(26-degree freedom)                               | •• Mission Management                                   |
|   | •• Network Management                                   |
|   | •• <u>Dynamics—Physical and Electronic</u>              |
| • Design, interface,<br>HW/SW and change<br>performance vs. cost  | • Network of Shells—<br>disparate algorithms<br>welcome |
| • H/W and S/W in-the-<br>Loop, End-to-End, from<br>the beginning. | • Changes—Days, not Months                              |

**3.3 Anra CAD/CAM**

- Microprocessor CAD-to-CAM-to-Machine Tool efficiency and precision
- Apple Macintosh ease of use and training
- Better than 20% (1/5 th) the cost of conventional CAD/CAM systems
- Multi-machine tool language flexibility
- Multilingual availability
- Award winning approach

## MICRO ELECTRONICS

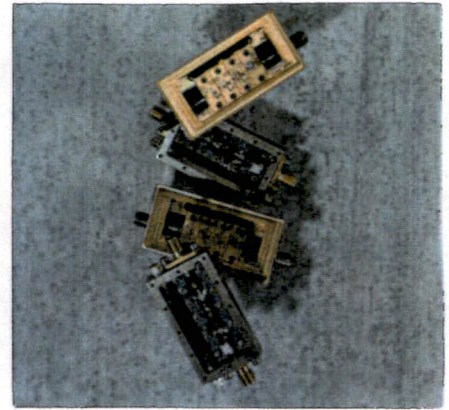
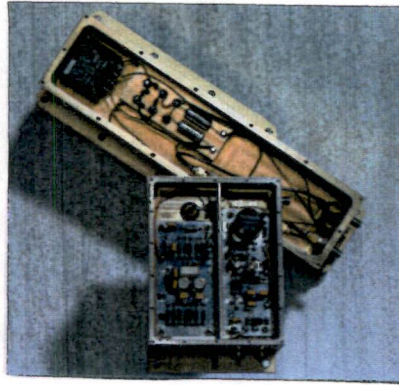
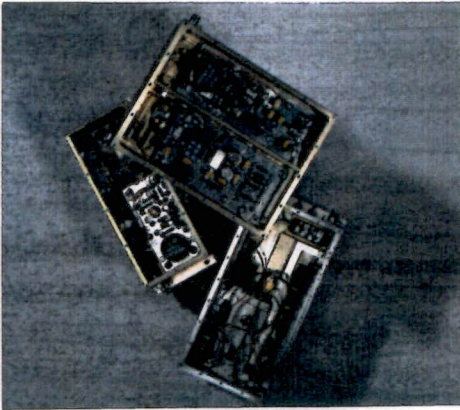
Microwave and millimeter wave commercial and defense hybrid components, reducing weight and power, while extending reliability and lifetime.

### CAPABILITIES

- **Filters: Voltage & Crystal-Controlled Oscillator** (including Phase-Lock Oscillators and Frequency Synthesizers.)
- **Amplifiers: GaAs FET, plus-low Noise Amplifiers (LNA)**
- **Subsystems: Signal Processing**  
MIL-I-45208A  
MIL-Q-9858A  
DOD 2000

### CUSTOMER EXAMPLES

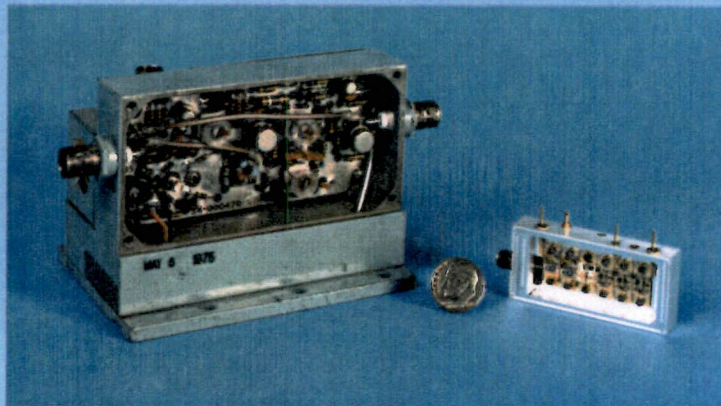
- GTE
- ITT
- Sperry Corporation
- Warner Robins Air Logistics Command
- Naval Avionics Center
- U.S. Army CECOM
- Navy Ships Parts.
- Northrop Corporation
- Sanders
- General Dynamics



AURA MICROELECTRONICS

**aura**

REDUCTION IN SIZE, WEIGHT AND COST . . .



WITH INCREASE IN PERFORMANCE

A122-14

## PERFORMANCE SUMMARIES

**MAGNETICS FACT SHEET:**  
**BREAKTHROUGH CAPABILITIES ENABLED**



- 1. Dynamic Control**
  - 2. Control Precision**
  - 3. Responsiveness**
  - 4. Digital Control**
  - 5. Vibration Isolation**
  - 6. Force-to-Weight Ratio**
  - 7. Size Reduction**
  - 8. Weight Reduction**
  - 9. Power Efficiency**
  - 10. Manufacturability**
  - 11. Reliability**
  - 12. Installation Simplicity**
  - 13. Cost Effectiveness**
- (1) Respond to: Complex six degree-of-freedom commands in milliseconds.
  - (2) Act with: Several thousand pound forces under complex multidirectional control commands.
  - (3) Maintain: Dynamic separation distance of mils under acceleration of 10,000 degrees/sec<sup>2</sup>, with forces noted, and with static positional precision of 0.1 mil or better.
  - (4) Maintain: Microradian line-of-sight rotational accuracies for 10s of milliseconds, under at least random 10 gravity loads while slewing over 5 degree or greater angles within 120 millisecond responses.
  - (5) Isolate from: Vibration by 80 or more decibels from at least 10 gravity external forces with millisecond rise times.
  - (6) Induce, while suspending: Vibration spectra of several kilohertz bandwidth.
  - (7) Suspend and differentially spin: Rotors at tens to hundreds of thousands rpm with no bearing wear or lubrication.
  - (8) Linearly or Rotationally actuate: Over large--essentially unlimited--throw distances or rotational angles/directions with tens to thousands of pounds of force with milliseconds responsiveness and 0.1 mil or better position precision; tractor motor or columns extension implementation available.
  - (9) Drive, as a motor, with: High Torque at any RPM, without gearing.
  - (10) Use typically: Less power and weigh less than comparable force hydraulic, pneumatic or electric systems.
  - (11) Install without: Pumps, hoses, fluids, pressure, valves, seals, mechanical drives, lubrication, noise or large control boxes.
  - (12) Assure reliability and safety with: No mechanically touching parts; "fail safe" or "fail to" design alternatives; lightweight digital control/electrical backup redundancy; and flexibility of electrical routing alternatives.

# IR SCENE PROJECTORS ON THE MARKET



METHOD	FRAME RATE (HZ)	SCENE CONTRAST	SPECTRAL DISTRIBUTION	PIXEL RESOLUTION	TECHNOLOGICAL RISK	COST (ROM)
BLY CELLS	100	50:1	BLACKBODY	100 X 100	HIGH	\$2-4M
HEAT-BUTTONS	1-10	100:1	BLACKBODY	60 X 60	MODERATE	\$1-2M
LIGHT VALVES	60	<100:1	BELOW 5 MICRON ONLY	VARIABLE (UP TO 1024X1024)	MODERATE	\$3-4M
HEATED PANELS	N/A	100:1	BLACKBODY	N/A	NONE	\$0.1-1M
IR LASERS	>5000	10000:1	MULTI-WAVELENGTH	VARIABLE (TYP. 200X200)	MODERATE	\$1-3M

AURA SCOPHONY PROJECTORS

00524-LJ-400-R

## AURA'S UMTV SPECIFICATIONS



SYSTEM PARAMETER	COL FILM (GE, EDCPHOR)	PLASMA (PHOTONICS, NHK, HITACHI)	LCD (NEC, HITACHI, TOSHIBA, HUGHES)	UMTV (HIGH RES. SMALL SCREEN)	UMTV (HIGH RES. LARGE SCREEN)
NUMBER OF LINES	600-1000	1000-2000	1000-2000	1125	1000-2000
SCREEN SIZE (FT)	30	4	NOT AVAILABLE	7	100
CONTRAST	200:1	100:1	50:1	100:1	200:1
MAX. BRIGHTNESS (LUMENS)	4000 WITH 2.5 KW LAMP	350	1000	1000 WITH 500 W LAMP	20,000 WITH 2.5 KW LAMP
POWER EFF. (LUMENS/W)	1	1	1	2	8
GRAY LEVELS	NOT AVAILABLE	200	50	100	250
MTBF (HOURS)	100 (CATHODE PIN)	1000 (GAS LEAK)	NOT AVAILABLE	5000 (EST.)	5000 (EST.)
SIZE (INCH)	35X25X20	45X45X6	35X25X25	25X15X15	30X25X25
WEIGHT (LBS)	160	NOT AVAILABLE	500-1000	50	100
POWER (W)	3-4 KW	300 W	1 KW	550 W	2.6 KW
RETAIL COST (\$)	200,000	NOT AVAILABLE	NOT AVAILABLE	1,000 (EST.) *	20,000-30,000 (EST.) *

\* IN PRODUCTION QUANTITIES

VG472

# LINKAGE™

A New Era in Monitoring

## For Those Who Want —

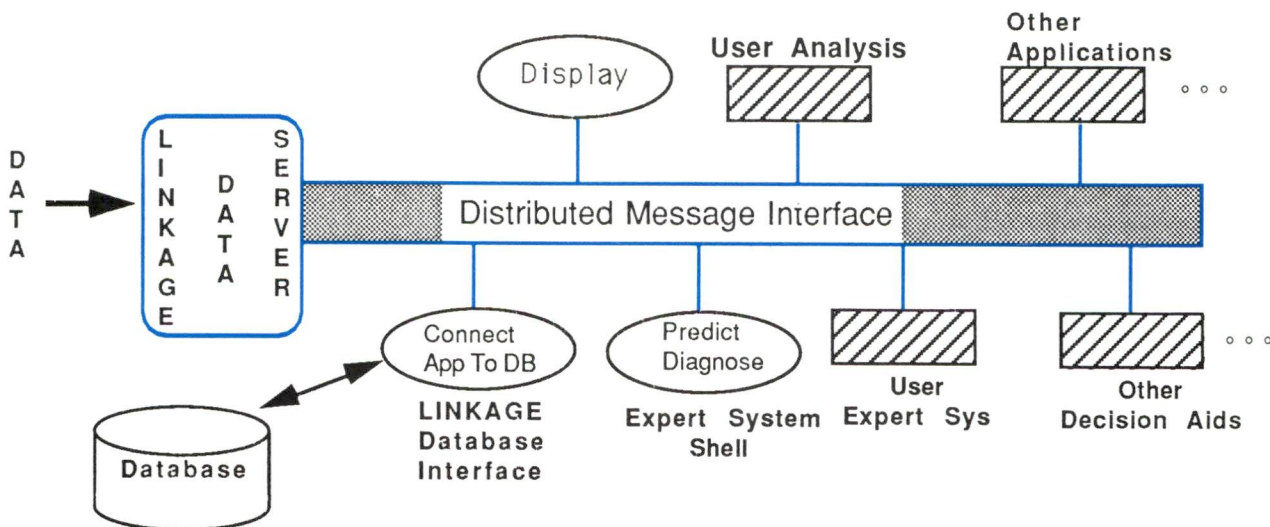
Inexpensive, Maintainable Monitoring Systems  
Prototyping On DAY 1 Of Project  
Improved Analyst Performance  
System Tailoring Without Recoding  
Reusability On Other Projects

## For Developers Of —

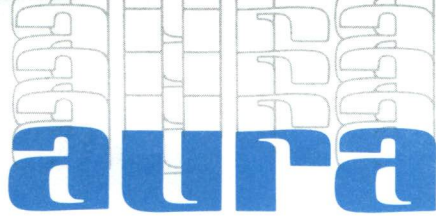
Monitoring, Diagnostic & Control Systems  
System End-To-End Simulations  
H/W In The Loop

## LINKAGE Includes —

- Test-Data Generator
- Data Decommutation
- Alarming
- Archival/Retrieval
- Snapshotting
- Intelligent Filtering
- Configurable Displays
- Playback
- Error Logging
- Graphics
- Engr Units Conversion
- Multi-Stream Capability
- Relational Database
- Report Generation
- Logical Printers
- Distributed Processing Tools
- Expert System Shell
- Derived Channels



Aura Systems, Inc. 2335 Alaska Avenue ♦ El Segundo, California 90245  
Phone: (213) 643-5300 ♦ FAX: (213) 536-9159



The Link between Problem and Solution.

Aura Systems, Inc.
2335 Alaska Avenue
El Segundo, California 90245
Phone: (310) 643-5300
FAX: (310) 643-8719

CAD/CAM

That's right! An affordable CAD/CAM system that pays for itself in just 4 weeks.

"Our use of the auraCAD/CAM has paid for itself in the first month since it was installed," Dick Gobeil [team leader of Manufacturing Engineering, McDonnell Douglas Helicopters Co., Culver City, CA] says. "It has significantly expedited the manufacturing of three parts, resulting in savings greater than the cost of the system." [CNC West]

"This is a significant situation since most microcomputer CAD/CAM installations are likely to be in the early stages of the learning curve after weeks or months of installation...hardly producing parts and paying for itself in just four weeks." [Ed., CNC West]

How is this possible? A revolutionary graphical interface between machinist and machine makes this possible. There are no commands to type, codes to remember, there is minimal keyboard use. Part proofing is done graphically on the computer screen; the NC code is generated automatically in the background.

The enclosed feature article appeared recently in CNC West by its editor. It describes such an installation at McDonnell Douglas Helicopter located right here in Southern California. This is but one of many such companies that are benefitting from auraCAD/CAM.

From print to finished part in under two hours is the record for this [C-17] prototype part made at Ejay's Machine Co., Inc., Fullerton, CA, a Douglas contractor. [Ed., CNC West]

"Using auraCad/Cam simulation, we can eliminate part proofing that takes valuable production machine time," says George Burdorf Senior manufacturing R&D Engineer, McDonnell Douglas Helicopter Co.

auraCAD

Precision 2D and 3D design and drafting program with advanced features for layering and macro-programming. Full support for plotters is provided. A monochromatic version (2.5I ) is available for all Macintosh models. A high performance, full color version (2.5II ) is available for Macintosh SE/30, II Ix and Ix models.

auraCAD/CAM McDonnell Douglas Helicopter's Burdorf discusses one lathe part, a bolt of maraging steel, that has a hardness rating of 34 on the Rockwell C scale. "We go from drawing to actually machining the part and proofing the tape, two different operations in the same day, something we've never done here before. We formerly took a week's worth of work hours proofing a tape, so with this typical part, we dropped down from a week to a single day to produce it."

An integrated system for design and CNC programming to enable users to produce actual parts with a variety of machine tools and controllers. A series of application modules is available for specific types of machine tools. Each module provides capability to simulate the actual tool path and compute process time. Built-in intelligence automatically determines optimum tool path and/or part location, and generates efficient CNC programming code. Modules include:

auraMILL
auraWIRE

auraTURN
auraROUTER

auraPUNCH
auraPOST
auraFLAME

McDonnell Douglas basic standard system has been Unigraphics the CAD/CAM division of McDonnell Douglas. "Now", says Gobeil, "there's an effort underway to eliminate paperwork as much as possible as a company goal. In so doing, we've reached an agreement with Unigraphics to develop the right interface between their high AMP CAD system and our auraCAD/CAM on the MacIntosh and do the NC file development on the Apple."



UNIVERSITY OF VIRGINIA  
SCHOOL OF ENGINEERING AND APPLIED SCIENCE  
CHARLOTTESVILLE  
22901

DEPARTMENT OF MECHANICAL AND  
AEROSPACE ENGINEERING  
THORNTON HALL, MCCORMICK ROAD

16041 024-7421

March 29, 1991

Mr. Harry Kurtzman  
Chief Executive Officer  
Aura Systems

Dear Mr. Kurtzman:

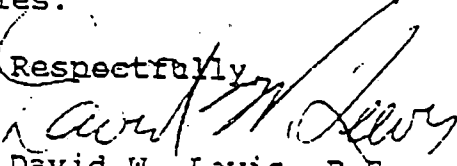
Professor Paul Allaire, Mr. Wally Dahl, and I look forward to visiting you on the afternoon of Monday, June 24, 1991.

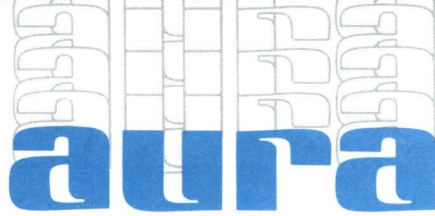
We wish to discuss with you the idea of looking for joint projects that we might work on. We would bring our expertise in rotor dynamics, modeling, et cetera to yours in magnetics and industrial design to problems for which each expertise, by itself, could not solve well.

Further, I would like to discuss with you a course we offer to our senior undergraduates. Specifically, I would like you to give a lecture on "Entrepreneurship".

We look forward to meeting you and possibly having a brief tour of your plant and facilities.

Respectfully,

  
David W. Lewis, P.E.  
Professor



The Link between Problem and Solution.

Aura Systems, Inc.
2335 Alaska Avenue
El Segundo, California 90245
Phone: (310) 643-5300
FAX: (310) 643-8719

Magnetics Customer Applications

HIGH FORCE ACTUATOR

Requested Force Ranges: 0.1 to 16,600 LBF
Requested Stroke Ranges: ± 0.118 to 44 inches

- Vehicle Suspension
Cab Suspension
Power Steering
Pumps
Compressors
Fuel Throttles
Fuel Injectors
Variable Valving
Throttle Positioners
Vibration Cancellation
Clutches
Air Conditioning
Door Locks
Piston Turning Machines
Machine Tool Positioner
Turbocharger
Fluidic Systems
Vibration Cancellation and Variable Power Control
Engine/Motor Mounts
Control Surface Positioners
Industrial Valves
Industrial Tools
Robotics
Fish Machines
Piston Turning Machines
Friction Test Machines
Materials Testing
Precision Machining System Driver
Structural Shakers
Precision Diamond Cutting Machines
Nuclear Facilities Equipment
Antenna Positioner
Antenna Surface Positioner
Reaction Masses
Sewing Machines
Conveyer Belts
Wave Generator
Bonding Machines
X-Y Tables
Speakers

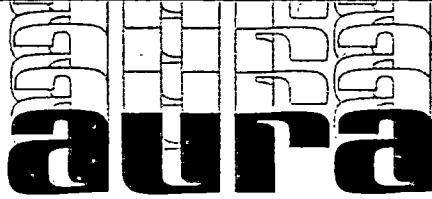
FRICTIONLESS BEARING

Requested Force Ranges : <1 to 3,000 Lbf
Requested RPM Ranges : 0 to 190,000 RPM

- Pumps
Sensor Gimbals
Stabilization and Pointing
Vibration Isolation
Flight Vibration
Spectrum Inducement
Propellor Shaft Isolation
Alternators
Turbine Rotor Suspension, Positioning, Vibration Isolation
Optical Table Isolation
Industrial Tool Spindles
Valve Control
Cataract Emulsification

MAGNETICS DIGITAL CONTROLLER & PROXIMITY SENSOR

As noted above



*The link between Problem and Solution.*

**Aura Systems, Inc.**  
2335 Alaska Avenue  
El Segundo, California 90245  
Phone: (213) 643-5300  
FAX: (213) 643-8719

THE WALL STREET GROUP, INC.  
32 East 57th Street  
New York, New York 10022  
(212) 888-4848

**Summary:** Aura Systems (NASDAQ) receives minimum \$4 million contract from Varian Associates (NYSE) for Aura's magnetic technology to be used in at least 6,750 pumps, plus \$1 million order for Korean and French Governments; first production contracts since founding in 1987.

**Company Contact:**

Harry Kurtzman  
President/CEO  
(213) 643-5300

FOR IMMEDIATE RELEASE

LOS ANGELES, CALIFORNIA, APRIL 15 1991.....AURA SYSTEMS, INC. (NASDAQ: AURA) announced today that it has received a minimum \$4 million contract from Varian Associates, Inc. (NYSE:VAR) to supply Aura's patented magnetic technology for Varian's turbo molecular pumps. Harry Kurtzman, Aura's President and CEO, noted that "this multi-year contract, calling for the delivery of Aura's patented technology for use in more than 6,750 pumps over five years and naming Aura as sole supplier for this activity, is the first production run contract since our founding in 1987 and moves Aura from a development stage company to a manufacturing entity. This acceptance by Varian Associates, an acknowledged world leader in instrumentation and scientific test equipment, is a further validation of our unique technology.

"In addition, we have received our second production contract, valued at about \$1 million, for approximately 100 actuators to be used in ocean wave generators by the Korean and French Governments. This contract was awarded to Aura on behalf of these governments by Davis Engineering Ltd., Montreal, Canada, and lays the foundation for an international sales effort by Aura."

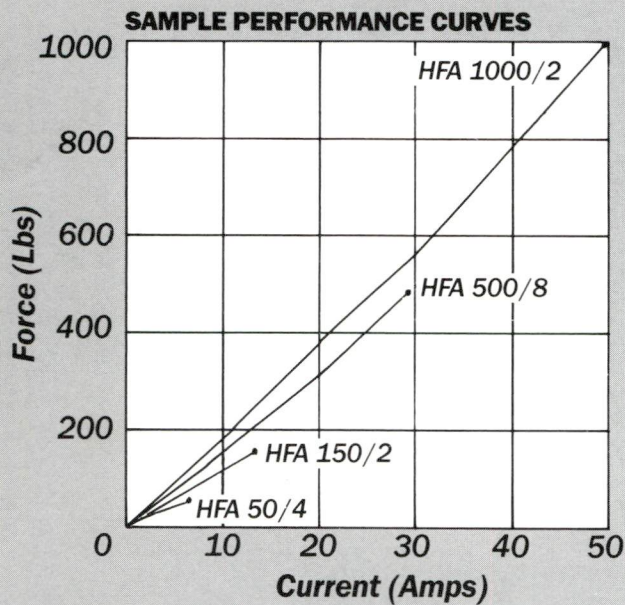
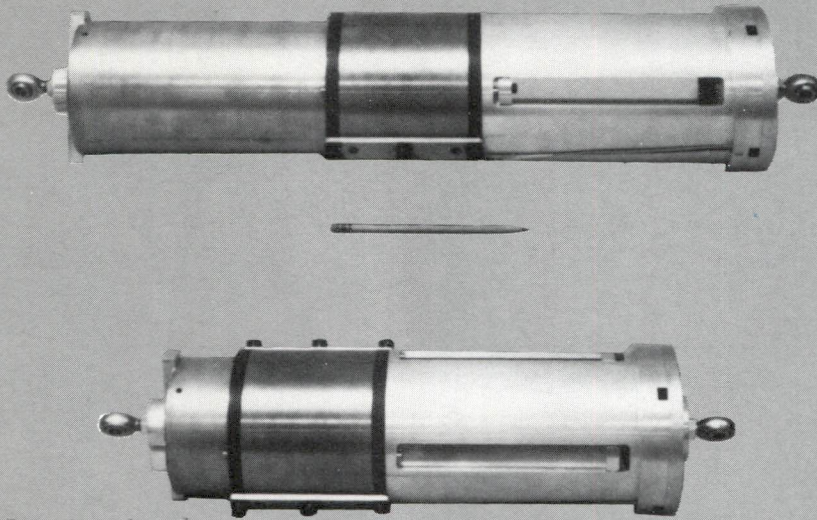
Mr. Kurtzman added that "We continue to receive contracts to develop prototypes for evaluation by some of America's most influential manufacturing companies. We have just been

awarded a \$150,000 contract from Hughes Aircraft Company for our magnetic technology to be used in a new generation of torpedoes, with ocean testing expected this summer, and also will be delivering prototypes next week to Wattera for use in their water pumps, a \$100,000 initial project for Aura. We expect these to lead to production run contracts, as did our earlier Varian prototype contract."

Mr. Kurtzman noted also that "work is progressing on prototypes for Texaco, Caterpillar and the ITEK Division of Litton Industries, as well as for many other companies."

Aura Systems, Inc. is the world's leader in magnetic technology.

###



**ACTUATOR CONFIGURATIONS\***

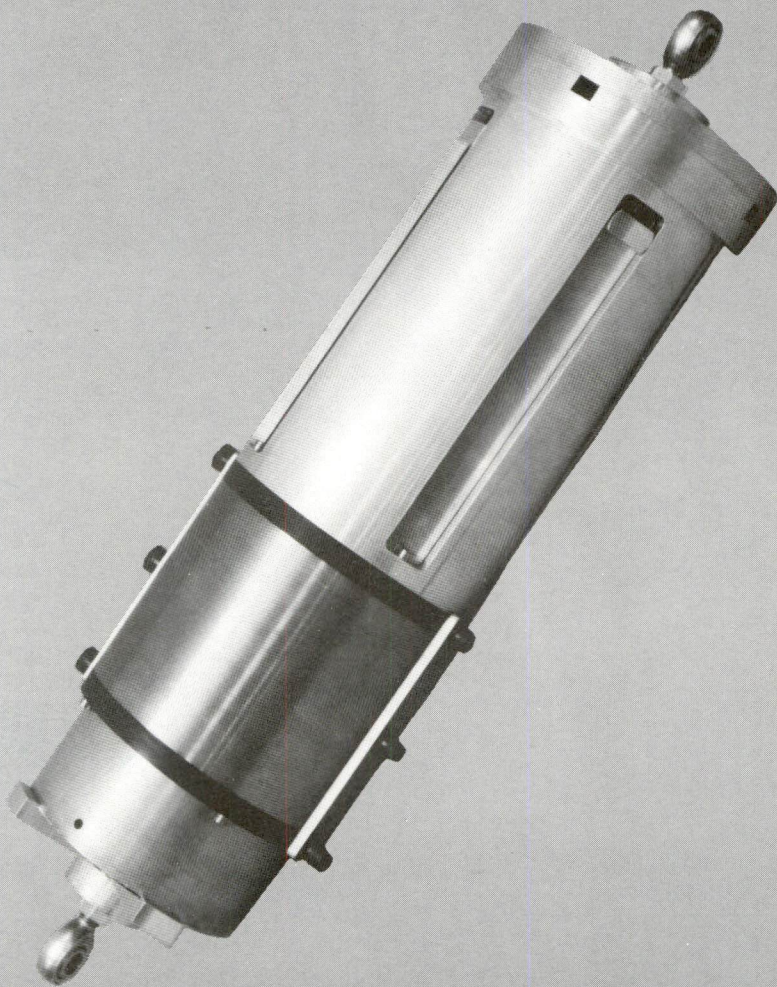
Model	HFA 50/4	HFA 150/2	HFA 500/8	HFA 1000/2
Peak Force (lbs)	50.00	150.00	500.00	1000.00
Actuator travel (In, P-T-P)	4.00	2.00	8.00	2.00
Force Constant (lbs/Amp)	10.00	12.00	17.00	20.00
Back EMF Constant (V/ft/se)	13.50	16.20	22.95	27.00
Peak Current (Amps)	5.00	12.50	29.41	50.00
Coil Resistance (Ohms)	10.38	4.98	3.00	2.08
Total Actuator Weight (lbs)	3.16	7.99	33.14	50.73
Length at Mid-Stroke (In)	11.00	9.00	19.00	12.00
Diameter (In)	2.04	3.06	5.00	5.97

\*We will custom design any configuration to meet your requirements.

# aura

Aura Systems Inc.  
 2335 Alaska Avenue  
 El Segundo  
 California 90245  
 (213) 643-5300 Ext. 209  
 FAX (213) 643-8719

# Electromagnetic Linear Actuator Breakthrough



## The Aura HFA Series

- *Custom designed to your specifications*
- **FORCE:**  
*0 to 2000 Lbs or more.*
- **TRAVEL:**  
*0 to 10 Ft or more.*

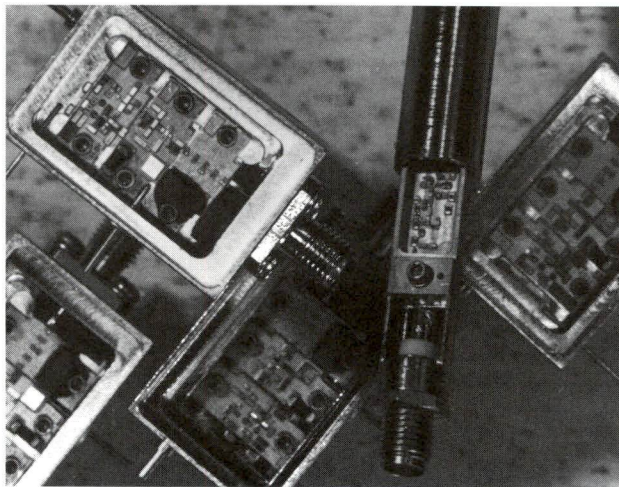
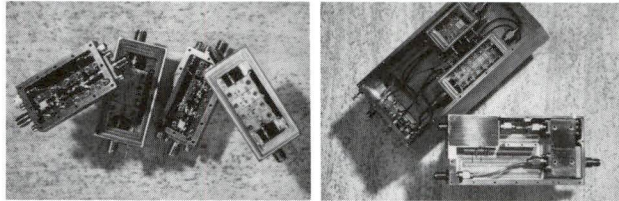
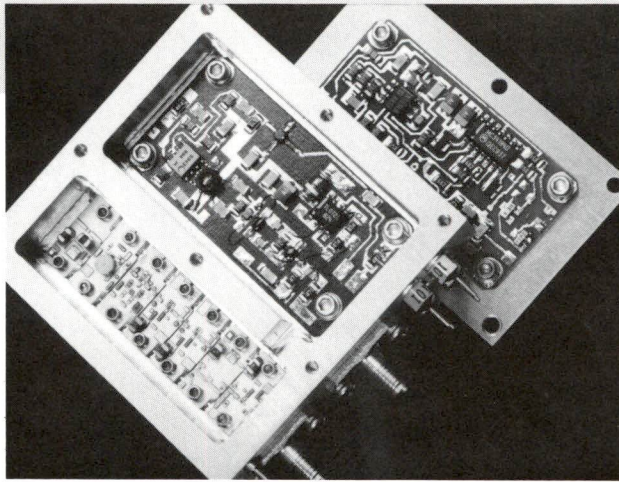
## Model HFA 500/8 Specifications

- *500 Lbs at 30 Amps*
- *100 Hz Bandwidth*
- *8 Inch Travel*

(As Pictured)

# aura

Aura Systems Inc.  
2335 Alaska Avenue  
El Segundo  
California 90245  
(213) 643-5300 Ext. 209  
FAX (213) 643-8719



# MICROWAVE COMPONENT AND INTEGRATED ASSEMBLIES

**delphi**  
Components, Inc.  
*A Division of Aura Systems Inc.*

---



# PROCESSES

Design/Engineering (CAE) tools are used extensively for design of hybrid circuits and surface mount technology (SMT) printed circuit boards. An AURA CAD system interfaces directly with Delphi's CNC machines. A YAG laser supplements Delphi's proprietary hybrid MIC assem-

bly process. All hybrid assemblies are hermetically sealed and manufactured in a clean room. Computerized test equipment with customized software is used in various stages of testing.

## PHASE LOCKED OSCILLATORS

Delphi's SS100 series stabilized sources utilize dielectric stabilized oscillator technology as well as VCO technology. The combination of these technologies and the utilization of MIC and surface mount technology allows the highest performance characteristics with the smallest physical size. When phase locked to a crystal oscillator, these sources offer crystal frequency stability at microwave frequencies. Due to the elimination of the cavity resonator, these oscillators exhibit very low microphonics while retaining excellent phase noise. Buffer amplifiers are contained within the housing to produce output levels to +21 dBm.

	INTERNAL REFERENCE	EXTERNAL REFERENCE
Frequency	0.1 - 23 GHz	0.1 - 23 GHz
Power Output (Note 1)	+10 dBm	+10 dBm
Load VSWR (Max.)	2.0:1	2.0:1
Phase Noise (Typ.)	See Figure 4	Ext Ref Noise (dBc/Hz) +20 log n @ Freq<100kHz
Spurious	-80 dBc	-80 dBc
Harmonics	-25 dBc	-25 dBc
Alarm	Open Collector	Open Collector
Reference Input Freq.	N/A	75 - 150 MHz
Reference Input Power	N/A	0±3dBm
Freq. Stability (Note 2)	± 10 ppm	Same as Reference
Temperature (Note 3)	-30°C. to +70°C.	-30°C. to 70°C.
Power Requirements	+15 VDC @ 250 MA	+15 VDC @ 200 MA
Size	2.25" x 2.25" x 1.25"	2.25" x 2.25" x .62"

FIGURE 2

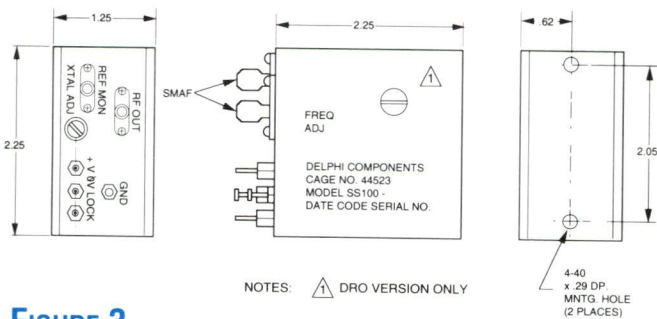
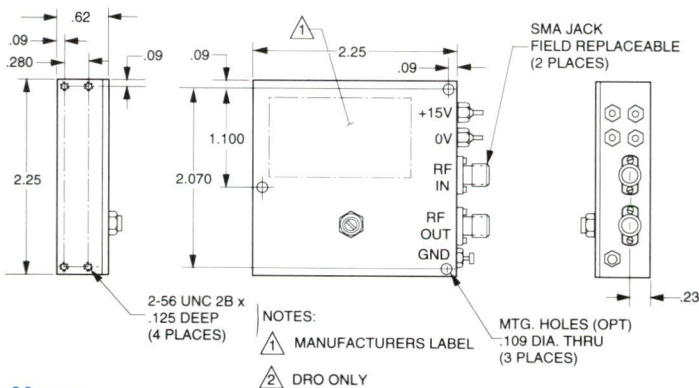


FIGURE 3



### NOTES

1. Output powers to +21 dBm available.
2. Higher stabilities available with optional heater.
3. Full Mil-Spec designs operating at -54°C to +85°C are available.

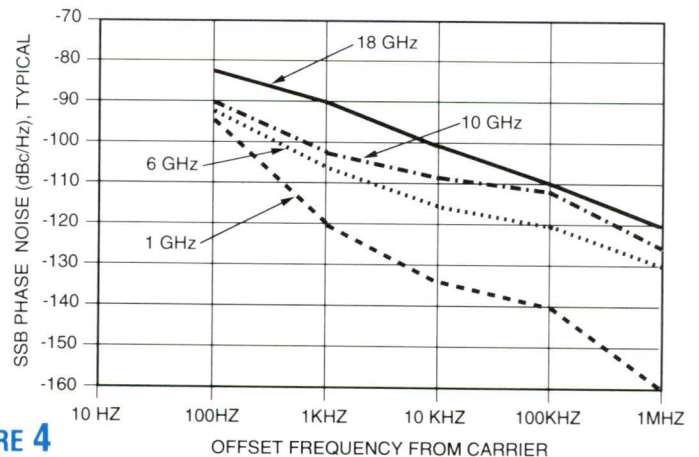
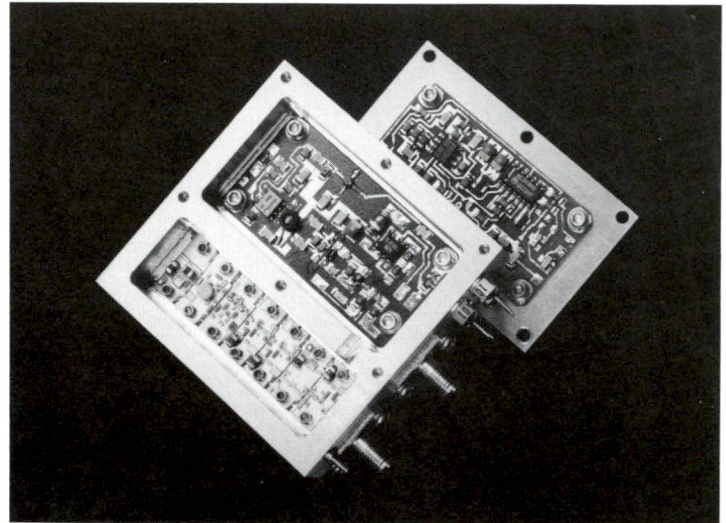


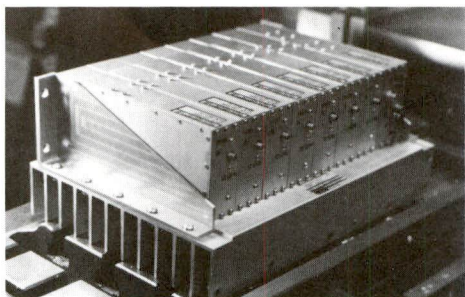
FIGURE 4

## QUALITY AND RELIABILITY

Utilizing proprietary processes with repeatable performance allows Delphi to offer a standard TWO YEAR warranty. Delphi Components, Inc., warrants each product to be free from defects in materials and workmanship. Liability under this warranty is limited to repair or replacement

of any products or parts thereof which shall, within two years after delivery to the original purchaser, be returned by the original purchaser to Delphi Components, Inc., in Laguna Niguel, California and be found to have been defective as determined by examination.

## PHASE-LOCKED COMB GENERATORS

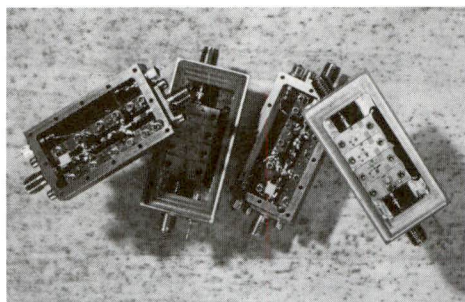


Delphi's phase locked comb generators offer multiple output frequencies with stabilities to +/-1ppm. Output frequency spacing can be adjusted to a customer's specification. Individual outputs can also be filtered for low spurious response. Internal power dividers and amplifiers are optional to produce output frequencies to 23 Ghz at +21 dBm.

### FEATURES

- ❑ 1-23 Ghz
- ❑ Comb Spacing 500 Mhz (optional)
- ❑ +21 dBm output power available
- ❑ +/- 1ppm temperature stability
- ❑ -80 dBc spurious
- ❑ MIC technology

## AMPLIFIERS

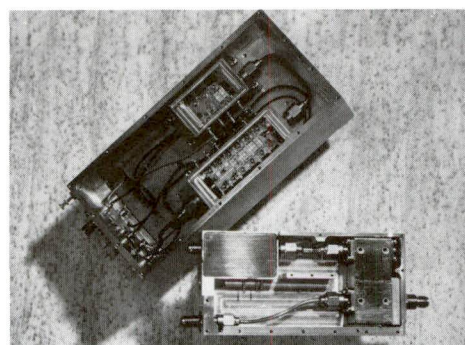


Custom amplifier assemblies are available to meet a manufacturer's specification. All amplifiers utilize Delphi's proprietary processes and MIC technology. The amplifiers are hermetically sealed and contain removable SMA connectors. Full MIL-Qualified and screening is available.

### FEATURES

- ❑ 1-23 Ghz
- ❑ Low Noise
- ❑ Output power to 1 watt
- ❑ MIC technology
- ❑ Small physical size
- ❑ Hermetically sealed

## SUBSYSTEMS AND INTEGRATED ASSEMBLIES



Delphi Components, Inc., offers a variety of subsystems to meet specific environmental conditioning and/or signal processing needs. Receiver front-ends, up/down converters, frequency discriminators, frequency agile digitally tuned oscillators, and linearized VCO's are among the products available. Delphi utilizes a ruggedized MIC technology for reduced size and improved reliability for custom and retrofit requirements.

### FEATURES

- ❑ 100 Mhz to 23 Ghz
- ❑ Reduced size and weight
- ❑ Retrofit & custom housing specialists
- ❑ Typical assemblies include:
  - ❑ Crystal oscillator - VCO - DRO
  - ❑ Amplifiers - Filters - Switches
  - ❑ Multipliers - D/A converters

**delphi**  
Components, Inc.

*A Division of Aura Systems Inc.*

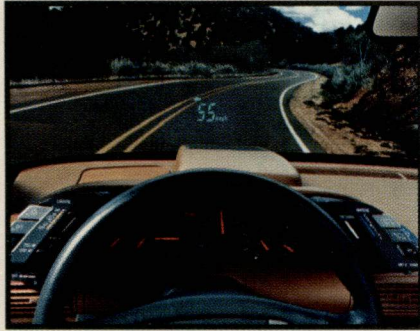
27721-A LaPaz Road  
Laguna Niguel, CA 92677  
Ph: (408) 986-9971  
Fax: (408) 986-0189

# MACHINE DESIGN

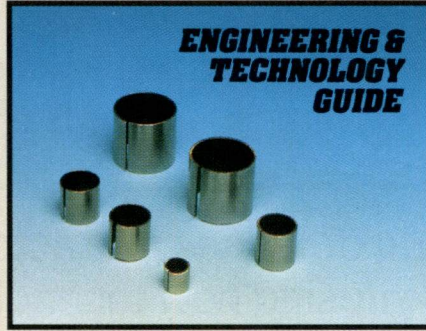
THE ONLY MAGAZINE OF APPLIED TECHNOLOGY FOR DESIGN ENGINEERING

A PENTON PUBLICATION

NOVEMBER 8, 1990



Electronics



PTFE Bearings



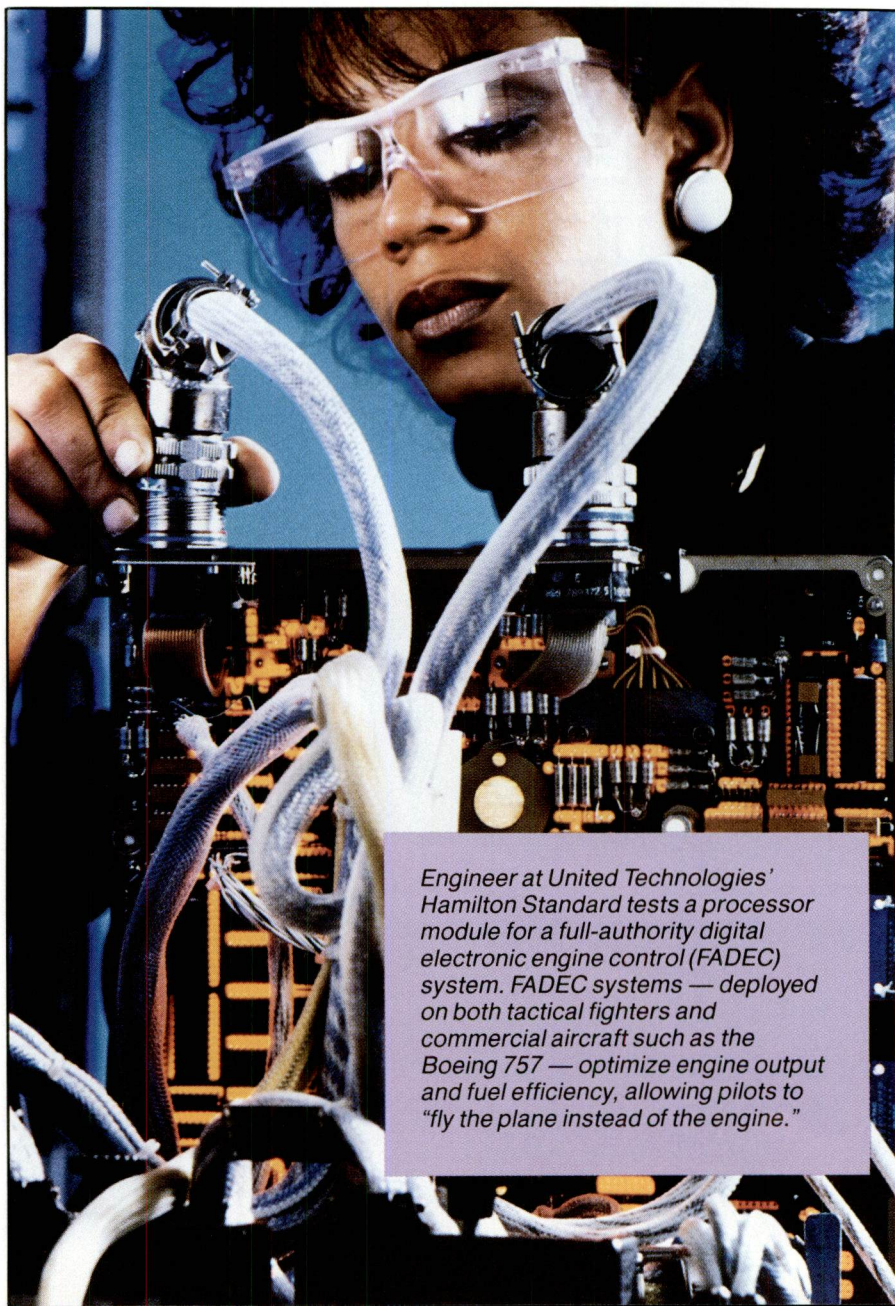
Plastics

## NONDESTRUCTIVE TESTING FOR HUMANS



# BATTLEFIELD TECHNOLOGY SETS PEACEFUL COURSE

Budget cuts are turning defense contractors toward commercial markets, infusing new technology into automotive, industrial, and medical products.



**LAWRENCE A. BERARDINIS**  
Staff Editor

If there is any good news coming out of the Middle East lately, it can be only for the defense industry. Military muscle seems to be the only thing that can keep Iraq in check. The ensuing Gulf standoff and a Mideast buying spree, including a \$25-billion rush order by the Saudi government for helicopters, tanks, missiles, and warplanes, will keep defense contractors busy for some time.

Nonetheless, defense programs are facing major cuts because of political change sweeping through the Soviet Union and Eastern Europe. The Cold War is over, and so, it seems, is the arms race.

Defense spending has fallen from a high of nearly \$340 billion per year during the Reagan years to \$290 billion in 1990. And according to the Electronics Industries Association, the budget will tumble to around \$260 billion by the end of the decade. Even military electronics will be cut back by 10% over the next seven years.

The decline in spending has already chased close to 100,000 manufacturers out of the defense industry. Under 40,000 firms remain, and more are expected to drop out as bidding becomes more aggressive. While many contractors are trimming back and concentrating on niche areas, others are fighting

*Engineer at United Technologies' Hamilton Standard tests a processor module for a full-authority digital electronic engine control (FADEC) system. FADEC systems — deployed on both tactical fighters and commercial aircraft such as the Boeing 757 — optimize engine output and fuel efficiency, allowing pilots to "fly the plane instead of the engine."*

to sustain their revenues by diversifying into commercial markets.

### Survival course

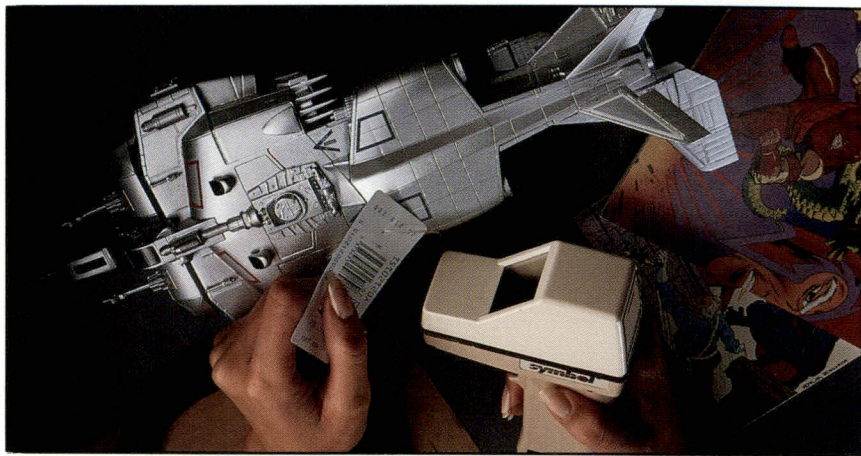
Despite vast differences between the military and commercial worlds, many contractors are finding ways to accommodate the switch. Some firms, such as Hughes Aircraft Corp., have gone the route of partnering.

Hughes is working with Hewlett-Packard Co., for example, to develop high-resolution military workstations that can also be used for industrial applications. Hewlett-Packard is trading Tempest technology to access Hughes' gateway into the military market. In turn, Hughes is carried into the commercial arena on the coattails of Hewlett-Packard.

Hughes is also embarking on a joint venture with Delco Electronics Corp., which became a subsidiary of Hughes when they were purchased by General Motors in 1985. The start-up firm, called HE Microwave, comes under Hughes' Radar Systems Group and is located at the Missile Systems facilities in Tucson, AZ.

HE Microwave — combining Hughes' radar technology with Delco's high-volume production capability — manufactures radar-sensing modules for military and automotive applications. The compact ( $\frac{3}{4} \times \frac{1}{4} \times 5$  in.) transmitter/receiver antenna is based on a GaAs detector array. In cars, the modules will be part of an obstacle detection system to warn drivers of objects alongside or behind them and to provide feedback for cruise controls. Military-qualified versions will fly on next-generation tactical aircraft, configured in elaborate sensing networks.

Another common business strategy is to buy into the commercial market by acquiring an established firm. Textron Inc., for example, owns several commercial businesses to which it transfers technology. Among its holdings are E-Z Go, known for its golf carts, Home-lite, and Jacobsen. Raytheon Co. likewise holds numerous household-name firms such as Amana,



*From Star Wars to price wars, Raytheon chips are finding their way into all kinds of applications. Symbol Technologies uses Raytheon's semicustom linear-array ICs to combine both bar-code scanner and decoder functions in a handheld unit.*

Speed Queen, and Beech Aircraft Corp.

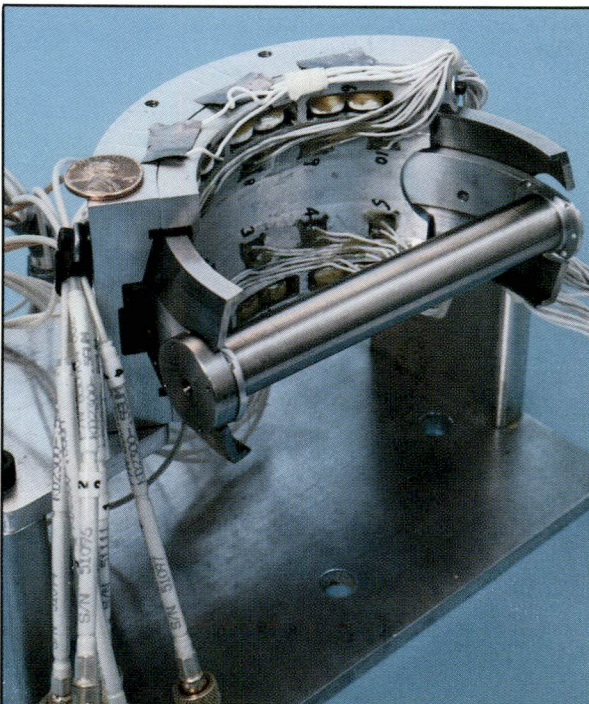
Raytheon is particularly aggressive when it comes to industrial and aerospace business. The firm sees a large potential in the market for application-specific linear components. One of its recent offerings, a ground-fault interrupter IC, is aimed specifically at product designers. The IC can be integrated into hair dryers and other appliances to protect people from electrocution, especially around water.

A few defense firms, primarily subcontractors, enter the commercial market by brute force. Some even opt to manufacture products. Their strong suit, however, is typi-

cally a high-end design or process technology developed for a special military program.

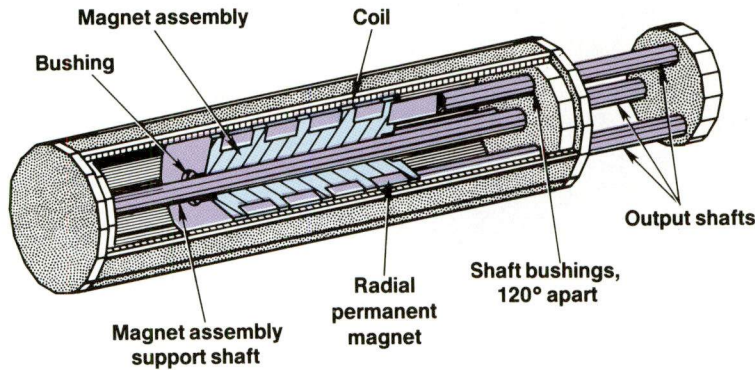
Magnavox Government & Industrial Electronics Co., owned by North American Philips Corp., jumped head first into the automotive market in the early 1980s. Although it took eight years to recover the initial investment, the division now operates in the black, producing solid-state distributors and ignition systems used on Harley-Davidson motorcycles and Buick V6 engines.

But even the automotive market offers no guarantees. A shift by car-makers to in-source major control systems is forcing Magnavox to di-



*Electromagnetic arc gimbal, made by Aura Systems, gives tracking missiles a  $\pm 35^\circ$  look angle on a 4-in. diameter for maneuvers up to 55 G. Although the technology was developed for General Dynamics' advanced air-to-missile program, it is also supporting commercial products such as magnetic bearings and linear actuators.*

**Linear high-force actuator (HFA)**



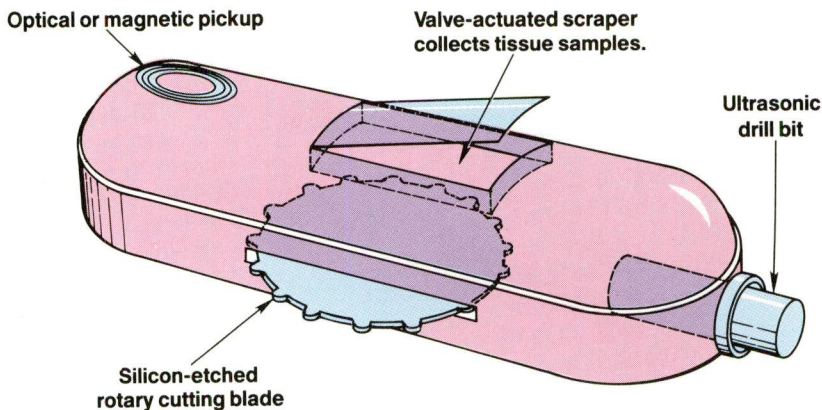
*Linear high-force actuator stacks several radial magnets along the rotorlike piston. A magnetic field induced by the outer-shell winding provides the force to move the actuator. Near homogeneous field distribution and the rotor's magnet stack produce almost maximum force between any two points along the stroke.*

**ARMING INDUSTRY WITH STATE-SPACE CONTROL**

If it were not for digital state-space controllers, astronauts walking on the moon would still be science fiction and stealth fighters would be stuck on the drawing boards. What makes F-111s almost invisible to radar, its revolutionary shape, also makes it impossible to fly by conventional methods. Only state-vector-controlled fly-by-wire technology can get the stealth fighter off the ground. Pilots need only command the plane where to go and do not have to control the aircraft's complex surfaces.

State-space control is now ready for industry, and it is just in time to provide the critical push toward CIM. Sources at CSR (Control Systems Research), Pittsburgh, PA, a firm bringing the technology to the factory floor, claim that state-space control is an improvement over conventional PID control by a factor of ten. PID control theory was developed in the vacuum-tube days for op-amp-based analog computers. State-space control theory, however, is optimized for today's hardware such as 32-bit microprocessors and DSPs.

**Micromachined silicon surgical tool**



*Future magnabit, micromachined from silicon, might deploy rotary cutting blades, ultrasonic drill bits, and valve-actuated scrapers to collect tissue samples. Optical or electromagnetic pickups would provide communication channels between surgeon and tool.*

versify once again. Electronic engine-control technology is being re-directed to industrial manufacturers, while the firm develops sensor and actuator technology for automotive uses.

**Coming attractions**

From lasers to GaAs computers, exotic military spin-offs are often taken for granted. Yet, many would be surprised at what military technology is doing in supposedly less glamorous areas such as electromagnetics. In the coming years, however, advances in this area may be mind boggling.

Aura Systems Inc., El Segundo, CA, another firm parlaying defense technology into profit on the commercial market, targets magnetics as one of its main areas of interest. Aura's game plan is to prove technology in the military and aerospace environment, then apply it to the commercial sector. Military and government contracts as well as awards from various research laboratories and aerospace firms fuel much of its foundational research and development.

The firm's electromagnetic experience stems primarily from gimbal development programs. Gimbals allow tracking sensors to stay fixed on targets despite system movement. Reconnaissance cameras on jet fighters, for example, are mounted on gimbals to isolate them from vibration and point them in a particular direction.

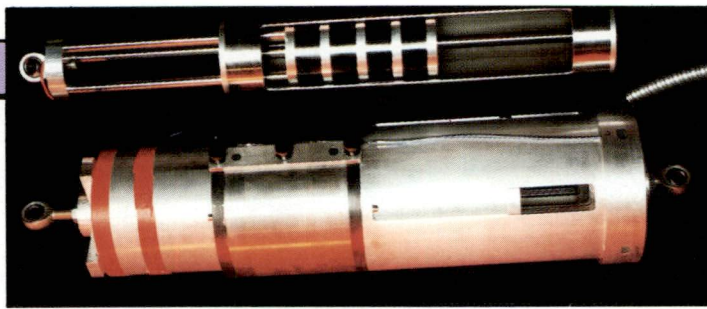
Aura is also developing magnetic-suspension thruster stand (MSTS) technology for the Boeing/Air Force LEAP (Light Exo-Atmospheric Projectile) program. The MSTS balances missiles in a magnetic field during rocket ignition to accurately measure thrust. In the civilian world, this technology is being used in futuristic surgical procedures to remove cataracts.

Working with Dr. Charles Kelman, a world-renown ophthalmological surgeon, Aura Systems is supplying the electromagnetic technology for a revolutionary surgical method called KELMAST (Kelman Magnetic-Assisted Surgical Technique). A tiny magnetic bit is injected by syr-

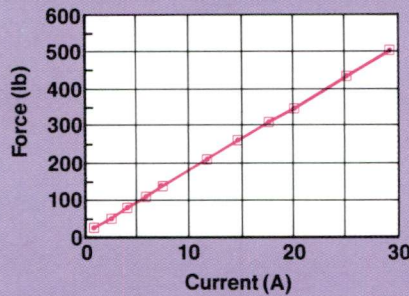
inge into the lens, and a magnetic field suspends it in place. Using a joystick, the surgeon drives the bit around the lens, destroying, or emulsifying, the cataract. The emulsified fluid and bit are then removed by syringe and a transparent material injected.

Future surgical techniques may replace the cutting bit with other payloads. Magnetic capsules, for example, can slowly release chemicals at internal sites without poisoning the entire system, and tiny elements can deliver heat to internal points without damaging protective tissues.

Active cutting bits, fashioned by micromachining techniques, might



**Force vs. current for linear HFA**



High-force electromagnetic actuators can match force and stroke with any hydraulic, pneumatic, or ball-screw actuator system. They are also faster and easier to use. Output force varies linearly with input current and response time is in milliseconds. The 30-lb unit (cutaway) can generate 500 lb continuously over an 8-in. throw.

## GETTING THE BUSINESS ABOUT AIR BEARINGS

Electromagnetic bearings are moving from the laboratory to the manufacturing floor because of advances in electronics and computer-aided design. Key to the transition are accurate proximity sensors, high-speed DSP engines, smart power drivers, and finite-element techniques for modeling magnetic fields. Without these developments, it would be nearly impossible to design a controller for the complex task of balancing a piece of iron in a magnetic field.

Controlling motion in one, two, and even three-dimensional free space is far easier than suspending an object in midair. Not only do all electromagnetic forces need to balance one another, they must also instantaneously balance any disturbance on the load. According to Earnshaw's Theorem, a Murphy's law of levitation, the free-body load is constantly slipping off center. The only way to keep it suspended is with dynamic control.

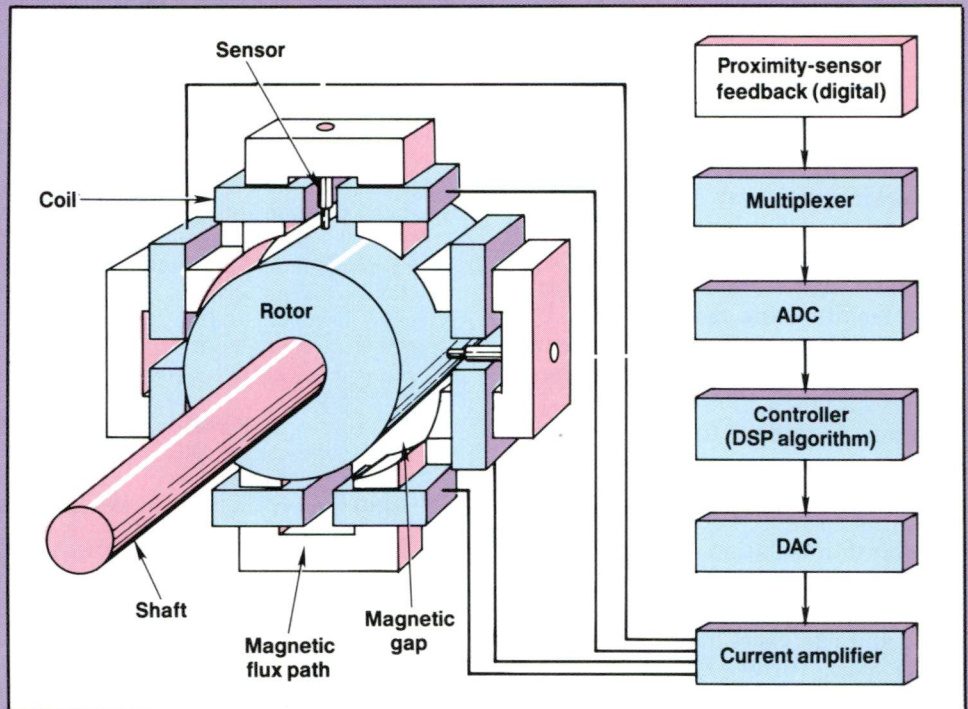
One firm working on electromagnetic bearings, Aura Systems Inc., El Segundo, CA, compares the magnetic-suspension control problem to balancing a pencil on the

tip of your finger. Everything in the control system has to be fast: the sensor, the processor, and the field-current driver. Tired of being slowed by off-the-shelf proximity sensors that are also expensive and bulky, Aura has come up with design of its own. The new sensing device employs technology from an-

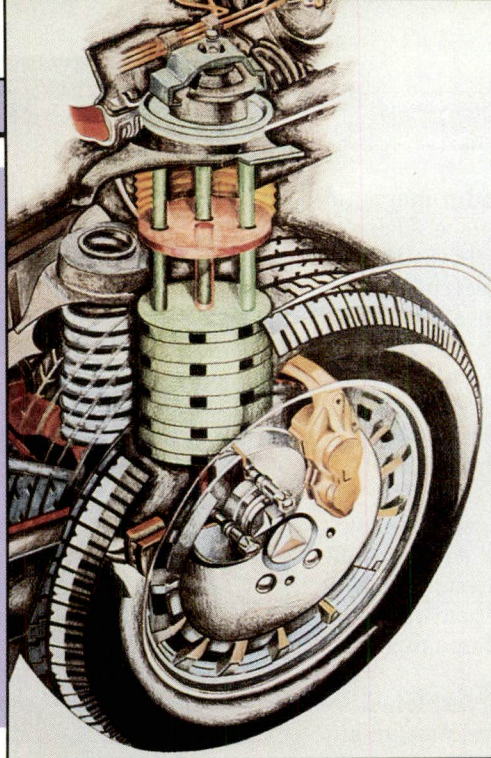
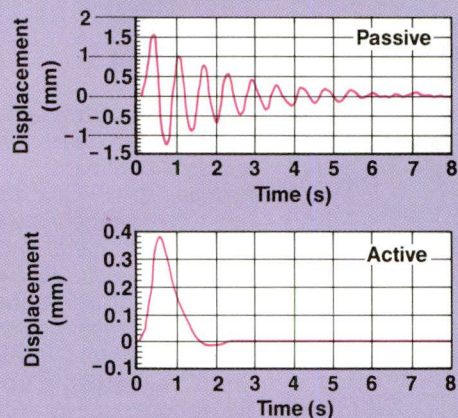
gular "pickoff" sensors used in miniature navigational gyroscopes; it is tailor made for magnetic levitation.

Conditioning electronics integrated within the sensor convert measurements on-site to digital words. Signal corruption associated with transmitting analog signals is eliminated. Also, processor

bandwidth is not spent on conditioning sensor feedback prior to executing the control algorithm. As a result, the bearing controller measures rotor position and adjusts current in all four electromagnets up to 5,000 times per second. This keeps the magnetic forces balanced and holds the rotor afloat.



**Comparing active and passive vibration cancellation**



*Aura's high-force actuators, based on military-related technology, are said to be the only linear actuator with adequate force and stroke to provide active suspension for cars. In tests, active systems reduce both the magnitude and settling time of an impulse response by a factor of four.*

someday roam the body like tiny space probes. Containing drills and rotating blades, they will be able to perform a variety of surgical and exploratory tasks. Microvalves will deploy scrapers to collect samples from deep inside the body without damaging surrounding tissue.

These tools will communicate with surgeons through electro-optic or electromagnetic antennae that transmit sensor signals and receive commands. Optical commands could be sent directly or via fiber, while magnetically coupled information could be passed on a high-frequency carrier.

**Lane change**

Military electromagnetics are working their way into automotive and industrial design as well. Car-makers, for example, are looking at linear high-force actuators (HFAS) to facilitate the move to drive-by-wire. HFAS will control engine valves, provide steering functions, and support active-suspension systems. According to Aura Systems Inc., the new actuator technology is a spin-off from Strategic Defense Initiative (SDI) work on single-axis vibration-isolation equipment.

In their third generation, linear high-force actuators weigh only 30 lb and can exert 500-lb forces over an 8-in. throw. By comparison, standard solenoids typically throw 500 lb no more than 1/2 in. and weigh about 175 lb. Additionally,

**A CLOSER LOOK AT MAGNETIC-ASSISTED EYE SURGERY**

Surgery patients often suffer more from invasive wounds than from the operational procedure itself. But magnetically assisted surgical techniques, made possible by research for military applications, can minimize invasive damage and speed recovery. Dr. Charles Kelman, a New York ophthalmologist credited for pioneering a cataract-removal method called phaeoemulsification, is one of the first to apply the new technology.

In phaeoemulsification, the surgeon uses an ultrasonic knife to liquefy the cataract. Although an artificial lens is transplanted into the eye, recipients are unable to focus it because the surgery destroys the capsular bag around the lens and severs the focusing muscles. As a result, people must rely on strong bifocal glasses. Another complication is that the 6-mm incision to insert the lens frequently causes astigmatic changes that are difficult to correct. Dr. Kelman hopes to reduce these side effects with electromagnetic technology.

Instead of breaking up the cataract with a knife, Kelman's new procedure, called KELMAST (Kelman Magnetic-Assisted Surgical Technique), relies on a tiny bit injected by syringe into the lens. The micro-surgical tool, called a magnabit, is driven by magnetic force. Using a joystick, the surgeon controls magnabit position and spin speed to mill out the cataract.

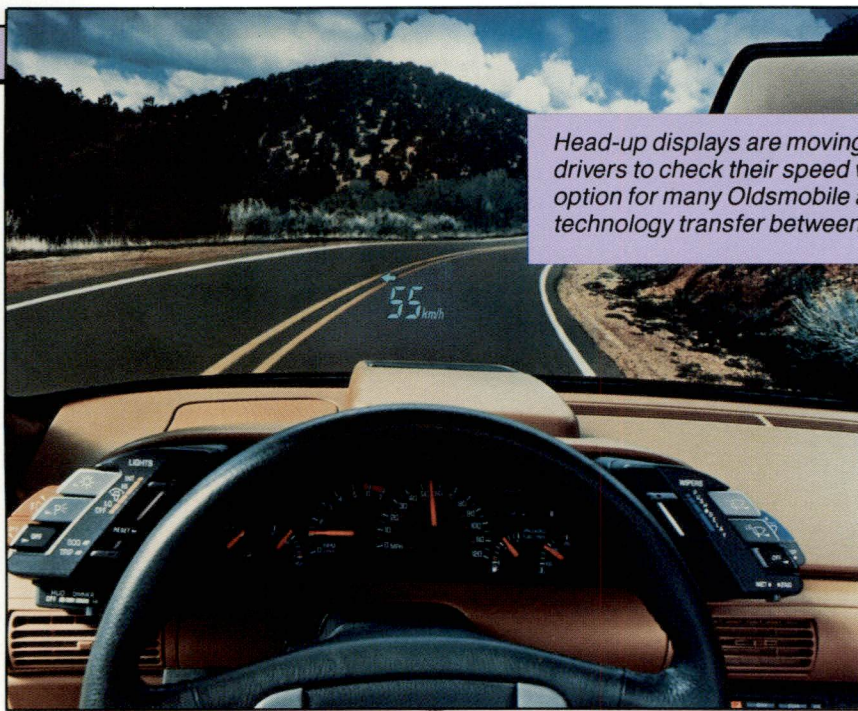
A digital signal processing (DSP) engine drives the servocontrol system. Joystick commands and magnabit-position feedback signals are compared to calculate field currents for several electromagnets. A special algorithm cancels the effect of mechanical vibrations on the sensors to keep bit position constant despite platform motion.

Kelman makes only a 1-mm incision in the eye to insert the magnabit. What's more, the capsular bag is spared in the emulsification process. The bit is removed through the original incision, as are the lens remains.

Prior to the surgery, a tissue sample is taken from the patient to grow a collagen-based material. A doping procedure matches the material's optical indices to those of the lens. Kelman uses the collagen to fill the capsular bag and synthesize a new lens. The liquid collagen is cross matrixed (solidified) with a laser.

Because the capsular bag and eye muscles are kept intact during the KELMAST process, the patient can focus the new lens, which eliminates the need for bifocals. Furthermore, the recovery period is short due to the small incision.

Kelman's new procedure, although performed only on animals so far, may also turn out to be an alternative to multifocal glasses. People wear bifocals and trifocals because their lenses stiffen with age and resist the eye muscles. Collagen-synthesized lenses, however, could restore youthful vision.



Head-up displays are moving from jet fighters to the family sedan, allowing drivers to check their speed without taking their eyes off the road. The new option for many Oldsmobile and Pontiac owners is made possible by a technology transfer between Hughes Aircraft and Delco Electronics.

HFAs are easy to use because they produce output forces that are linearly proportional to current and respond in under 20 ms.

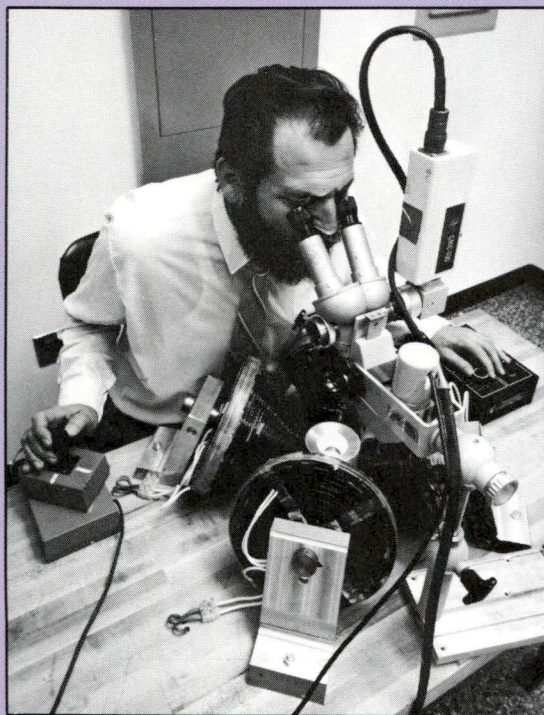
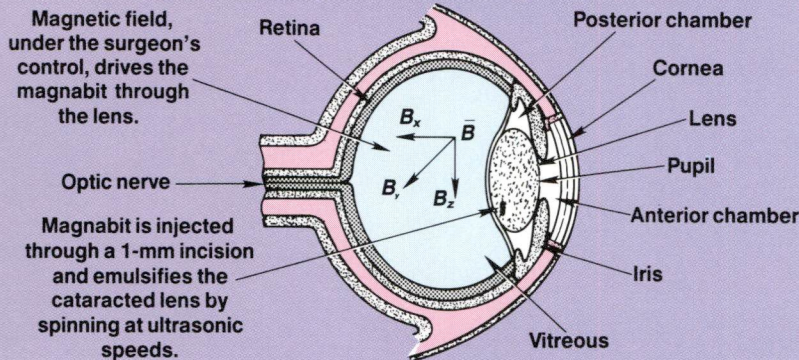
SDI work can also be traced to electromagnetic bearings. Manufacturers of semiconductor-processing equipment, for example, are testing magnetic bearings on vacuum-deposition systems. Turning on turbo-molecular pumps, the electronically controlled bearings support 25 lb at 60,000 rpm without friction, wear, or lubrication. These bearings will improve system uptime on equipment otherwise plagued by roller-bearing failure and vacuum-chamber contamination due to lubricant outgassing.

Top-gun technology in the form of head-up display (HUD) is another military innovation changing lanes. HUD displays project virtual images, such as instrumentation readings, in front of the cockpit windshield. These images allow fighter pilots to simultaneously watch events around the aircraft and keep an eye on critical readings. After 20 years of streaking through the sky, HUD displays are beginning to hit the highway.

General Motors plans to offer head-up display as an option on all 1991 coupe and sedan models in the Oldsmobile Cutlass Supreme International series, and some Pontiac Grand Prix models. In 1990, the system was installed in about 2,000 Cutlass Supreme Coupes, and came standard on nearly 7,000 Grand Prix Turbos.

HUD technology was adapted for use in automobiles by a team from Hughes Aircraft and Delco's Instrumentation and Air Controls unit. The group is also planning to roll out holographic brake indicators. When brakes are applied, holographic lights, transparent to the driver, will flash in the middle of the rear window. The holograms replace conventional rear-deck lights, which block too much of the view in newer sleeker cars. ■

### A bird's-eye view of KELMAST



Experimental eye surgery is performed to test a new cataract-removal method called Kelman Magnetic-Assisted Surgical Technique (KELMAST). Four cone-shaped coils produce a magnetic field to drive a tiny cutting tool called a magnabit. The surgeon controls bit position and spin speed through the joysticks. Special sensors and digital signal processing algorithms provide sufficient control accuracy to maneuver the bit once it is injected into the lens.

**AURA SYSTEMS INC.**

2335 Alaska Avenue  
El Segundo, CA 90245  
Telephone: (301) 643-5300  
Fax: (301) 643-8719

# **aura**

*The Link between Problem and Solution*

---

***1991 Annual Report and Form 10-K***



June 24, 1991

### To Our Shareholders:

Your Company has completed another year of growth and transformation during the fiscal year ended February 28, 1991. Aura has successfully made the transition in 1991 from a business mix dominated by Government R&D work to one where commercial activity predominates. Revenues for the year were \$8.3 million and included first sales of magnetic High Force Actuators in commercial work. This compared with \$9.0 in the prior year. 1991 was another year of heavy research and development that led to the construction of our first commercial products in the magnetics division. These are now embodied in a line of products being sold off the shelf and for prototype purposes. Patent activity remained busy. We have a total of nine patents granted, an additional nine filed and over 22 others in various stages of preparation. This rapid growth in your Company combined with the shift from government work gave rise to a loss of \$4.97 million in 1991 and compares with a \$3.37 million loss in the prior year. The good news however, is that your Company's management believes that this represents the last year of loss. Indeed, the first quarter of the new fiscal period has reported profits!

### Technology

In ELECTRO-MAGNETICS earlier technological achievements were extended and refined into commercial applications during the 1991 fiscal year. The Electromagnetic division has now secured a total of six patents covering various aspects of the magnetic technology. In the latter part of the year commercial interest was evident on the part of such major corporations as General Motors, Texaco, Caterpillar, Toyota, Newport News and others who purchased finished samples of our new High Force Actuator (HFA). These new HFA's are comprised of 4lb, 10lb, 50lb, 60lb, 100lb, 500lb, and 1500lb of force actuators and form the basis of our new product line. These actuators are extremely versatile and have major industrial applications including pumps, industrial generators, power steering systems, can-making equipment and fuel injection systems among many others.

In one application for a major automotive company Aura has developed and demonstrated a device involving an HFA that removes shudder that is induced in the automobile passenger compartment by high pressure in the power steering system. This has application to millions of automobiles and is in the process of testing pre-production units. We anticipate positive news on this product soon.

With respect to ELECTRO-OPTICS we reported last year on our high resolution, large screen very bright display system. Work on this area has resulted in substantial progress. The Company now has a working proof of concept that has resulted in two new government contracts for military applications. Three patents have been granted in this area and others are in process. Commercial interest for television use and for the movie theater industry is extraordinarily high.

Aura has also delivered and installed its multiband infrared scene projector at Eglin AFB. Experts world wide have visited the facility to see this new, state of the art capability. Aura is now firmly established as a world leader in this Electro-optic technology.

## The Future

One year ago we reported the signing of an agreement with Technical Manufacturing Corporation of Massachusetts for use of our actuators on optical tables. This product has been developed and was recently the hit at an industry show. It is now being prepared for ongoing manufacture. Our new water pump which has been developed for Waterra Pumps, Ltd. has been evaluated and is being sold commercially. An agreement with Varian Associates, Inc., has been signed and work has begun to integrate into Varian's family of turbomolecular pumps. Manufacturing will commence this year on the first thousand units.

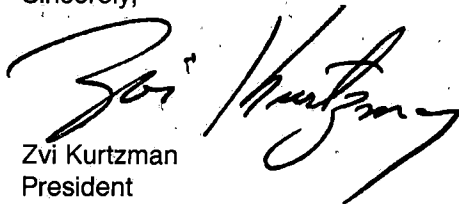
We have recently entered into a letter of intent with Standard Motor Corporation to execute an agreement whereby Standard will manufacture certain diesel fuel injection equipment for a major off-road vehicle manufacturer. This agreement will provide Aura with a substantial up-front payment and significant sales and profits.

With respect to the automotive industry Aura is aware of at least twenty applications for magnetic technology in the automobile. Projects include power steering, air conditioners, clutch actuators, variable valves, suspension systems, ABS, engine mounts, door locks, fuel injectors, among others. These projects are at various stages of development from prototype testing, to pre-production runs and will be going into production planned over the next several years. Discussions are currently under way with a major automotive equipment manufacturer to be our partner in this regard. Also, Aura is currently working under contracts which provide funded development for delivery of actuators in the fields of heavy production machinery, robotics, petroleum and machine vibration.

Finally, in this new fiscal period we expect to report our first profitable year in 1992 with most of our revenues derived from commercial products.

We appreciate the continued support of Aura's family of loyal employees, supportive investors and suppliers for their belief and support of our dream that is now being translated into reality.

Sincerely,



Zvi Kurtzman  
President  
Chief Executive Officer

SECURITIES AND EXCHANGE COMMISSION  
Washington, D.C. 20549

**Form 10-K**

**ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d)  
OF THE SECURITIES EXCHANGE ACT OF 1934**

For the year ended February 28, 1991

Commission File Number 0-17249

**AURA SYSTEMS, INC.**

Exact Name of Registrant as Specified in its Charter

**Delaware**

State or Other Jurisdiction of  
Incorporation or Organization

**95-4106894**

I.R.S. Employer  
Identification No.

2335 Alaska Ave.

El Segundo, California 90245

Address of principal executive offices

**(213) 643-5300**

Registrant's telephone number

Securities registered pursuant to Section 12(b) of the Act:

None

Securities registered pursuant to Section 12 (g) of the Act:

Common Stock

Indicated by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days.  
Yes  No

At May 20, 1991 the aggregate market value of the voting stock held by non-affiliates of the Registrant was \$124,917,370. The aggregate market value has been computed by reference to the average bid and asked price of the stock on May 20, 1991. On such date the Registrant had 25,178,023 shares of Common Stock outstanding.

**Documents Incorporated by Reference**

Those sections or portions of the registrant's Proxy Statement for the upcoming 1991 Annual Meeting of Shareholders described in the cross reference sheet attached hereto are incorporated by reference in this report.

CROSS REFERENCE SHEET

Information incorporated by reference from the registrant's proxy statement for the upcoming 1991 Annual Meeting of Shareholders (the "Proxy Statement"), is herein identified by section.

**PART III**

Item 10. Directors and Executive Officers  
of the Registrant

Proxy Statement, sections entitled  
"Nominees and Voting" and "Business  
Experience of Directors During Past Five  
Years"

Item 11. Executive Compensation

Proxy Statement, sections entitled  
"Compensation of Executive Officers"

Item 12. Security Ownership Of Certain  
Beneficial Owners and  
Management

Proxy Statement, section entitled  
"Security Ownership of Certain Beneficial  
Owners and Management"

Item 13. Certain Relationships and  
Related Transactions

Proxy Statement, section entitled "Certain  
Transactions" and "Nominees and Voting"

## PART I

### ITEM 1. BUSINESS

#### INTRODUCTION

Aura Systems Inc., ("Aura"), a Delaware Corporation, is engaged in the development, commercialization and sales of systems using its proprietary magnetic technology developed for electro-magnetic high force actuators ("HFA") and magnetic bearings ("MB"). In addition the Company is engaged in research and development in advanced electro-optical projection systems; publishes and sells computer software used in CAD/CAM, and monitoring and diagnostic systems; and manufactures and sells microwave components for commercial and military communication. See "BUSINESS-DESCRIPTION OF BUSINESS". References herein to the "Company" include Aura and its subsidiaries Delphi Components, Inc., ("Delphi"), Aura CAD/CAM Systems, Inc. ("CAD/CAM"), Aura Medical Systems, Inc. ("AMSI"), and Aura Distribution Systems, Inc. ("ADSI") unless the context otherwise requires.

The Company's principal business philosophy is to use its proprietary and patented technologies to develop systems and products for commercial, industrial, consumer and government use. To date, a combination of Aura funds, and commercial and government development contracts have been utilized in the process of developing product applications. Prior to November 1990, substantially all of the Company's consolidated revenues have been generated from contracts with the U.S. Government and military defense contractors. Since November 1990 most of the Company's consolidated revenues have been generated from sales of commercial samples and prototypes. Numerous commercial uses of the Company's magnetics technology are under development and testing in such areas as automotive, industrial vibration isolation, industrial machines, pumps and numerous military applications from submarines to spacecraft. See "BUSINESS-DESCRIPTION OF BUSINESS-MAGNETIC TECHNOLOGY". The Company is also conducting advanced research and development to commercialize its projection technology for large high resolution display systems for HDTV and filmless distribution systems to movie theaters. See "BUSINESS-DESCRIPTION OF BUSINESS-PROJECTION TECHNOLOGY".

In April 1988, Aura acquired all of the outstanding capital stock of Amcan Cyphermaster Ltd. in exchange for 3,361,645 shares of Aura's Common Stock. Since then Amcan and its wholly owned subsidiary, Cypher Master, Inc. (both inactive) have been consolidated into Aura. During December 1988, Aura acquired 100% of the outstanding capital stock of Delphi Components, Inc. in exchange for 375,000 shares of Aura common stock. Delphi is in the business of designing and manufacturing microwave components for use in government and commercial communications applications. In May 1989 the Company acquired 100% of the outstanding common stock of International Micro CAD/CAM Engineering, LTD., whose business is the development and publishing of software for computer aided design and manufacturing.

#### DESCRIPTION OF BUSINESS

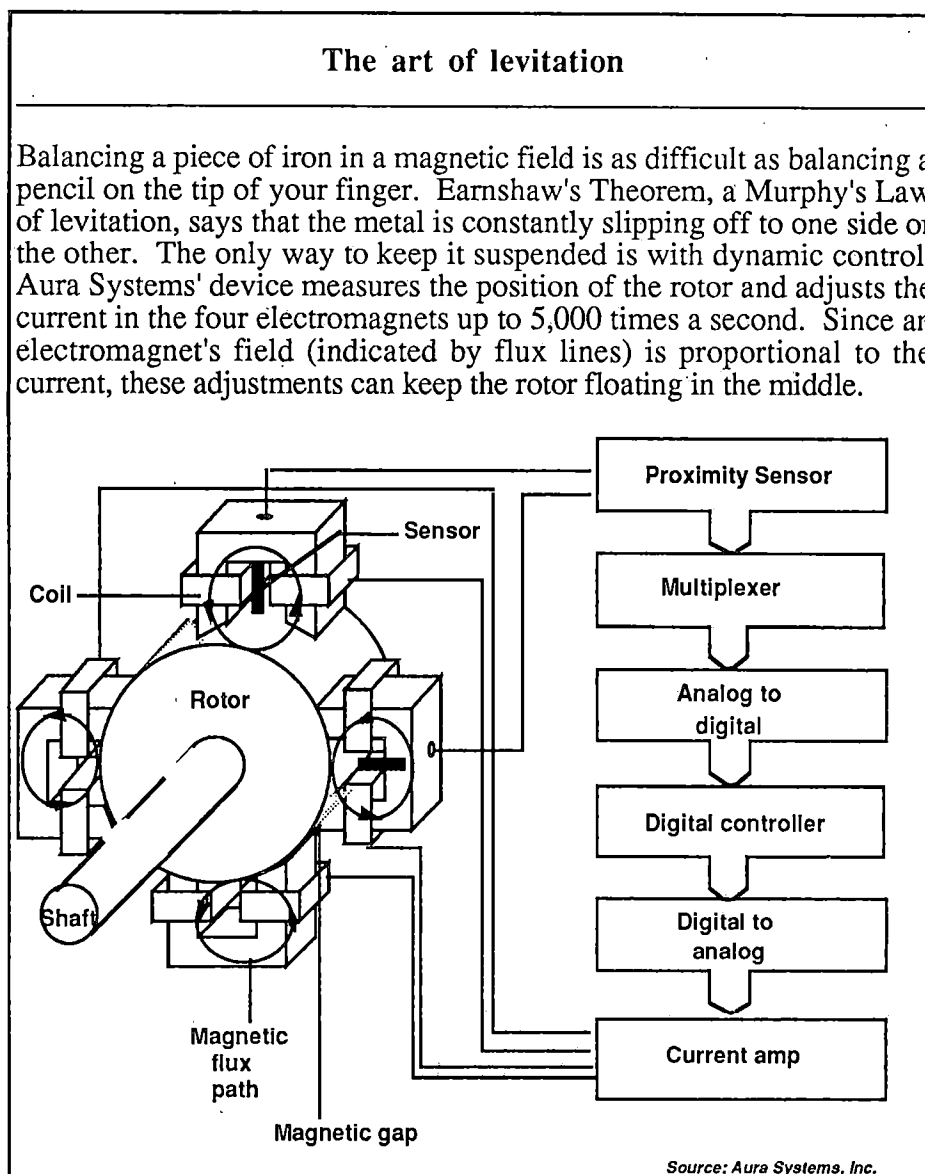
Set forth below is a description of the principal areas of business conducted and intended to be conducted by the Company.

## Magnetics Technology

Aura is a leader in the application of electro magnetic technology for use in magnetic bearings, suspension and actuator systems. The technology is so basic and far reaching that definitive product description limits become very difficult.

Most persons are intuitively familiar with magnetic force fields where metal objects are attracted to or repelled by a magnet. The Company has developed commercial technology by taking this phenomenon one step further-suspending and controlling objects in magnetic force fields.

While conceptually simple, in practice it is difficult to control magnetic forces. Aura scientists and design engineers have mastered the basic technology during the past several years. To illustrate, a schematic diagram of some of the principles behind Aura's levitation technology is presented below:



Once magnetic control has been achieved economically, a wide range of practical applications open up. If objects are caused to revolve in a force field, then a "frictionless" bearing can be built. This basic mechanical part can be made simpler by eliminating completely, the need for lubrication and, since there is no discernible friction, the reliability and life of the bearing is greatly increased while mechanical noise is eliminated.

Similarly, by manipulating the magnetic field, one can move a rod or other moving part (an actuator) a certain distance with a certain force to accomplish a multitude of tasks. Further by being susceptible to infinitely small changes in magnetic forces, variable mechanisms capable of maximum fine tuning can be developed. Also, by eliminating cumbersome mechanical linkages, these devices tend to be reliable, efficient and quiet.

As noted earlier, every piece of machinery with a moving part represents a potential market for Aura. Current mechanical technology is essentially unchanged from that developed in the 19th Century. These involved bearings and actuators requiring lubrication and friction control mechanisms, complicated hydraulic and mechanical systems to transmit forces and a variety of other essentially outmoded mechanical devices. With Aura's technology, many of these can be eliminated and engineering tasks become much simpler.

Aura has been able to apply this magnetic technology by incorporating, in a proprietary manner, continuous electronic sensing and control techniques in a way that allows a countless array of common machinery parts to become more practical, inexpensive and reliable.

In most applications examined to date, Aura's electromagnetic techniques have the added feature of being energy fuel efficient and safer than older technology in use today.

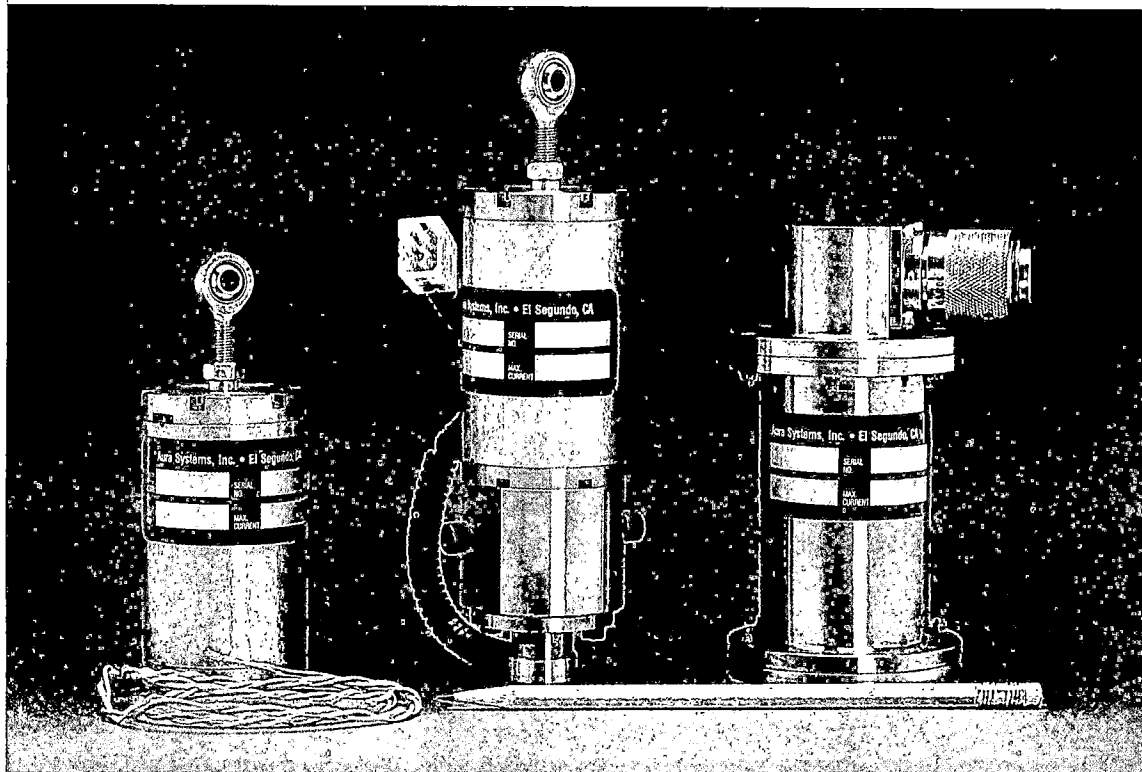
### *The HFA*

One very important, universal component of machinery is an actuator (something that "actuates" or causes things to happen or move). Indeed, they are one of the legendary "moving parts" that are continuously referred to in multiple types of machinery. Aura has developed the "High Force Actuator" that has enormous potential in the machine world. The Company's important patent claims revolve around this device and its ability to do work simply and in an energy efficient manner makes its commercial appeal truly universal.

This technology has potential application in a wide variety of applications in machines of all types. Among some of the more significant are:

- Suspension systems (automotive and other)
- Clutches, pumps, compressors, motors and generators
- Valving systems - fuel injectors
- Vibration control (cancellation systems)
- Robotics and industrial tools
- Motion control systems

Shown below are actuators currently manufactured by the Company.



An understanding of the Company's potential with its magnetic bearing and actuators can be attained by considering what they dispense with. Using simple devices with only one moving part that is controlled by magnetics allows removal of lubrication, hydraulic and complex pneumatic systems, pumps, valves and associated controls, casings, housings other devices.

## *Transportation Applications*

Aura has identified several immediate applications, the most significant of which are in the transportation industry. Since the potential market involves machines, Aura's management has targeted the one that makes the most machines per year-the transportation sector.

The HFA's superior performance, low cost, and simplicity in manufacturing makes it an ideal device for a variety of specific automotive components. Some of the more obvious ones are active suspension systems, active engine mounts, variable assist power steering, fuel injection valves, door locks and air conditioning compressors.

## *Other Applications*

Once the transportation applications are considered, it becomes apparent that there are hundreds of other applications. There are dozens of specialized light equipment manufacturers that could use Aura's magnetic bearings and actuators. Prospective applications include such diverse machines as sewing machines, food processing equipment and copiers. Similarly many potential applications exist in heavy industry from helicopters to can manufacturing, paper making machines, robotics, textile processing etc.

The Company's magnetic bearings allow for the manufacturing of very reliable completely sealed pumps. Aura recently entered into an agreement with Varian Associates for the production of magnetic bearings and pumps. The applications in motors and pumps are practical limitless with the basis being cost. As costs come down with longer manufacturing runs, the number of applications should increase dramatically.

The Company believes that its magnetics technology may have applications in the area of sensitive sensor systems on spacecraft, aircraft, ships and land vehicles to enhance resolution, target detection and signal processing. Designs and prototypes have been developed for this application of the technology. Other applications of the magnetics technology are in the areas of low-maintenance, positively controlled highly stable optical benches (which permit objects such as glass to be ground to precise specifications), high precision pointing and tracking devices (such as lasers and radar), communication line-of-sight stabilization devices (such as laser based navigational systems) and high bandwidth computer controlled vibration test tables (which shake objects such as test tubes at predetermined times and levels of intensity). Designs and prototypes have been developed and built to demonstrate the applications of the technology in all of the foregoing areas.

## *Aura Medical Systems, Inc.*

The Company has formed a joint venture with Dr. Charles D. Kelman to develop a procedure to remove cataract tissue using magnetic principles. The venture is 59.85% owned by Aura and 35.15% owned by Dr. Kelman and an associate. Dr. Kelman is an internationally known ophthalmologist and eye surgeon. Alcon Surgical Inc. a wholly owned subsidiary of Nestles' Inc., has purchased a 5% interest in the venture and a license to distribute the technology for \$1,500,000.

In the proposed cataract procedure, a tiny magnetic bead is injected by syringe into the cataract. By means of a magnetic control apparatus, currently under development, the surgeon controls the magnetic bead to pulverize and liquify the cataract. Both the cataract particles and the magnetic bead are then withdrawn by syringe. A collagen-based liquid compound is then contemplated to be injected into the intact lens capsule to form a new lens. Additionally, these techniques have the potential of easing the trauma of certain kinds of surgery, concentrating

chemical delivery to required sites without poisoning the entire system, and delivering heat to internal locations without damage to covering tissues. The Company has had continuing indications of investment interest in the venture from several sources and believes that an additional sale of equity may be concluded in the near future. There can be no assurance however that sufficient financing will be obtained or that the technology will successfully be implemented.

### *Scene Projector Technology*

In order to adequately test any device with electro-optical sensors, an instrument is required to provide stimuli for testing purposes. This instrument must be able to produce the expected input for the device to be tested at the operational rates and with the resolution and intensity fidelity of real life operations. Modern missiles, spacecraft and other platforms contain infrared electro-optical seekers that operate at rates of hundreds of scenes per second and need a large dynamic range to distinguish the target from other objects that they optically sense. However, existing scene generators are only capable of tens of frames per second with small dynamic ranges. Aura has developed a scene projector which in hardware demonstrates an operational rate of 1000 frames per second with greater than 1000:1 dynamic intensity range. This technology uses lasers, acousto-optical devices, a variety of beam steering techniques and high precision electronics and software to drive the device.

On August 31, 1988 the Company was awarded from the Air Force at the Eglin base a ("Eglin Contract") relating to the development of a missile interceptor test facility. The Company is integrating an infrared scene projector, an advanced three-axis flight motion simulator and an environmental conditioning chamber into the Kinetic Kill Vehicle Hardware-in-the-Loop Simulator ("KHILS"). The facility will provide a scene projector capable of projecting two-dimensional missile targets and plumes against a space or earth background. These scenes will provide a realistic environment for interceptor seeker testing under controlled conditions. The contract provides for the reimbursement of the Company's cost, including an allowance for general overhead, plus a ten percent profit margin. The types of devices that can utilize this technology include all electro-optical missile seekers for both tactical and strategic missions as well as surveillance and reconnaissance sensors for both space-based and atmospheric missions.

### *High Definition Displays*

In 1989 the Company started a research program which has led to its filing of 6 patents for an improved projector utilizing a conventional light source and having the capability of producing a large number of picture elements such as is needed for television and movie projection applications. A proof of concept unit is now operational at Aura's optical laboratory. Aura has won military contracts to utilize this technology for an upgraded capability in sensor testing. The technology is produced by utilizing many of the same techniques used to manufacture computer chips and should therefore be producible at low cost. However, the company cannot assure that there will be unforeseen problems in manufacture nor can it assure the market acceptance of this device.

The new projection technology is capable of supporting the requirements of high definition television (HDTV) images. The Company believes that this technology will provide a high resolution display that provides a projection with exceptional brightness and potential low cost compared to existing technology. An additional advantage of the device is that it operates on light directly, rather than on electrons as in conventional TV sets. This means that as the tubes grow bigger to support HDTV applications, the radiation hazard associated with conventional devices is eliminated as well as the very heavy weights associated with them. Preliminary discussions have been held with television manufacturers with the aim of providing this component for HDTV and conventional large screen televisions. Assurances however cannot be given by the company as to the successful outcome of these discussions.

The same technology utilized for the high density display and advanced military sensor scene projectors can provide a replacement for movie projectors. It is believed that a projector based on Aura's technology will meet and exceed all of the capabilities of current projectors without the mechanical and logistical problems associated with film handling. Such a system could save hundreds of millions of dollars a year in costs of film based distribution. No assurances can be given as to the success of these discussions or the profitability of a venture formed to develop, operate and maintain such a distribution system.

### *Advanced Computing Applications*

Outside the military sector, Aura has developed a software system application for Apple Macintosh computers, IBM/PC computers, Sun computers and other platforms. Aura is currently marketing its product, "Linkage". Linkage is a tool that allows users to rapidly develop monitoring and diagnostic systems for a variety of applications. The applications vary from spacecraft telemetry data to financial data. With Linkage, users of large data systems can use artificial intelligence and other filter technologies to trim data and add intelligence into raw data for quick analysis, alarming and monitoring. Linkage features the ability to operate large systems at a fraction of the manpower currently required. In addition, the expertise and training needed for a Linkage operated system is far lower than in conventional system control operations.

Linkage has been and continues to be used by Jet Propulsion Laboratories for diagnostics and monitoring of satellite systems. Software developed by Aura was incorporated into the Galileo spacecraft test bed which was launched in May 1989. The Galileo mission is planned to explore Jupiter and its moons. Recently TRW and Hughes Communications have purchased Linkage systems for their internal use.

In addition, Aura is continuing its work with Fujita to use expert systems to navigate and control a large robots used to construct tunnels for underground sewage utility lines of transportation tunnels. Where tunnels are dug without the use of open trench techniques, a robot is used to dig a completely subterranean tunnel. If the robot moves off course, the cost to a construction project could be inestimable. Aura Navigator provides an artificial intelligent control system for such robots which are capable of taking into account ground differences to change strategies in digging to stay on course. On February 19, 1990, Aura Navigator was demonstrated in operation during a press conference in Tokyo, Japan.

### *Micro CAD/CAM*

On May 9, 1989, Aura acquired International Micro CAD/CAM Engineering, Ltd., a British Columbia Corporation, and its wholly-owned subsidiary Micro CAD/CAM Systems, Inc., a California corporation. These companies are engaged in the design, development and marketing of computer aided design and manufacturing software for sale to companies utilizing computer numeric controlled machining equipment.

### *Microwave Components*

During December 1988 the Company acquired Delphi Components, Inc., a company that is presently engaged in the design, manufacture and sale of microwave components for commercial communications and military defense systems.

Microwaves are extremely high frequency, short wavelength radio waves. A sharp beam of microwave energy can be readily shaped, focused, concentrated, reflected and transmitted in a straight line over finite distances. The wider bandwidth available at high frequencies permits

greater amounts of information to be transmitted than is possible at lower frequencies. Because of these characteristics, microwave energy is particularly suited for use in point-to-point communications and radar systems.

Much of Delphi's products are built from new designs and/or concepts and upon custom orders. Production levels of up to hundreds of parts per contract are typical orders. Delphi specializes in four basic product areas: filters, oscillators, amplifiers and subsystems.

The oscillator product line is used for signal generation capabilities with application in electronic warfare, radar, and missile guidance systems. Delphi's products meet requirements in the 1GHz to 21GHz frequency range. Within that range, Delphi offers frequency tunable source and frequency stable source capabilities. The tunable sources cover octave bandwidth or greater, analog or digital linearization and heater controlled for special environments applications. The stable source capability offers frequency stability, low phase noise, small size, modularity construction and low residual frequency modulated under severe vibration. Oscillators are manufactured in either conventional solid state or hybrid miniaturized integrated circuit ("MIC") construction with fixed frequency, phase locked, swept frequency or frequency modulated. They employ either programmable digital tuning or modulation control.

Amplifiers are microwave components used to increase the amplitude of certain signals. The amplifier product line consists of both discrete and hybrid MIC design covering the 2GHz to 18GHz in octave bandwidths or greater. Where hybrid MIC construction is applicable, advantages include small size with high reliability and performance characteristics. In addition, precise control realizable by hybrid chip construction allows for computer-optimized amplifier designs.

In addition to contracts dealing with military communications and electronic warfare components and subsystems, Delphi has started to produce commercial electronic components. Microwave communications is utilized in transmission of television, telephonic and commercial aircraft communications.

### *Government Contracts*

While the Company still pursues government R&D revenues it is no longer the principal source of revenues to the Company. Previously, revenues of the Company were derived from either government contracts or subcontracts with prime government contractors. Typically these contracts were structured on the basis of the Company's cost, including an allowance for general overhead and general administration, plus a fixed amount of profit. These contracts typically contained provisions which subjected the Company to a re-negotiation of profits or termination of the contract or subcontract, as the case might be, at the election of the United States government.

### *Competition*

Competition in the industries in which the Company operates is intense in view of the fact that it is competing with a number of other companies, many of which are extremely well capitalized and have extensive research and development facilities.

Although the Company is not as well known or as well capitalized as many of its competitors and is limited in terms of its facilities and number of personnel, it believes that it is capable of competing with larger competitors, either alone or in conjunction with other companies on the basis of the quality of the products it produces and services it provides. Many of the Company's key personnel have substantial previous employment experience with some of the Company's competitors and are regarded as experts in their fields of endeavor. See "Executive Officers of the Registrant".

## Customers

For the year ended February 28, 1991, the Department of the Air Force accounted for approximately 39% of the Company's revenues. For the year ended February 28, 1990, the Department of the Air Force and accounted for approximately 69% of revenues.

## Research and Development Expenditures

During the years ended February 28, 1991, February 29, 1990, and February 28, 1989, the Company spent approximately \$2,221,812, \$1,897,000, and \$495,000, respectively, on Company sponsored research and development activities.

## Patents

The U.S. Patent office has issued 8 patents to Aura, 6 of which pertain to its electro-magnetic systems and two which cover electro-optical projection technology. In addition, Aura has filed 10 patent applications, 5 of which relate to electro magnetic technology and 5 of which relate to High Definition Display System technology. In addition 22 patent applications are in various stages of preparation and filing. However, there are no assurances that any new patents will issue in the future. The Company believes that the patents which have issued will enhance its competitive position in magnetics and optics technology.

## Executive Officers of the Registrant

Following is certain information regarding Executive Officers and key personnel of the Company.

<u>Name</u>	<u>Ages</u>	<u>Position with the Company</u>
Zvi Kurtzman	44	President and Director
Arthur J. Schwartz, Ph.D	43	Executive Vice President and Director
Francis T. Phalen	51	Senior Vice President, Chief Financial Officer
Joseph F. Bevacqua	46	Vice President--Chief Accounting Officer
Cipora Kurtzman	35	Vice President--Director Business Development
Gregory Um, Ph.D	43	Vice President--System Engineering
Keith O. Stuart	35	Vice President--Hardware Development
Neal B. Kaufman	46	Senior Vice President, Director
Rogers Saxon, Ph.D	43	Vice President--Advanced Computing
Ronald J. Goldstein	50	Senior Vice President

**Zvi Kurtzman** has been the President and a director of the Company since February 1987. Mr. Kurtzman has served as the President of IIS since 1982 and served as CMI's President from, 1984 to 1988. Mr. Kurtzman has also served as a director of IIS and CMI since 1982 and 1984 respectively. Mr. Kurtzman obtained his B.S. and M.S. degrees in physics from California State University, Northridge in 1970 and 1971, respectively, and completed all course requirements for a Ph.D. in theoretical physics at the University of California, Riverside. He was employed as a senior scientist with Science Applications International from 1984 to 1985 and with Hughes Aircraft Company from 1983 to 1984. Prior thereto, Mr. Kurtzman was a consultant to major defense subcontractors in the areas of computers, automation and engineering.

**Arthur J. Schwartz, Ph.D.** has been the Executive Vice President and director of the Company since February 1987 and the Executive Vice President and a director of CMI since 1984.

In addition, Dr. Schwartz was appointed President of IIS in 1988 after having served as its Executive Vice President since 1984. Dr. Schwartz has also served as a director of IIS since 1984. Dr. Schwartz obtained his M.S. degree in physics from the University of Chicago in 1971 and a Ph.D. in physics from the University of Pittsburgh in 1978. Dr. Schwartz was employed as a Technical Director with Science Applications International Corp. from 1983 to 1984 and was a senior physicist with Hughes Aircraft Company from 1980 to 1984. While at Hughes, he was responsible for advanced studies and development where he headed a research and development effort for new technologies to process optical signals detected by space sensors.

**Joseph F. Bevacqua** has been the Company's Chief Accounting Officer since November 1988 and a Vice President since 1987. From August 1987 through November 1988 Mr. Bevacqua, served as the Company's chief financial officer. Mr. Bevacqua, a Certified Public Accountant previously associated with KPMG Peat Marwick received his B.S. degree in accounting from California State University, Long Beach in 1968 and his M.B.A. from Pepperdine University in 1978.

**Cipora Kurtzman** was appointed Vice President in charge of Marketing and Contracts for the Company in 1988 and was appointed director of the Company in 1989. Ms. Kurtzman was the Director of Contracts and Marketing for CMI, where she served from 1985 to 1988. She graduated from California State University at Northridge with a B.S. degree in Business Administration.

**Francis T. Phalen** has been Senior Vice President and Chief Financial Officer of the Company since November 1988 and has been a director of the Company since 1989. From August 1987 until Mr. Phalen joined the Company he was Associate Director, Corporate Finance, for Bear Stearns & Co. in Los Angeles, California. From October 1986 through November 1987 Mr. Phalen served as Vice President and Treasurer of Carter Hawley Hale Stores, Inc. For the three years prior thereto Mr. Phalen was a partner in the public accounting firm of Deloitte & Touche.

**Gregory Um, Ph.D** was appointed Vice President in charge of Electro-Optical Systems for Aura in 1988. Prior thereto, he served as Chief Scientist of IIS during 1987 and worked for CMI during 1986. Dr. Um received his B.S. degree in physics from the University of California, Berkeley in 1970 and his Ph.D. in physics from the State University of New York in 1976. From 1983 to 1986, Dr. Um worked for Hughes Aircraft Company as a senior scientist where he was involved in sensor system engineering, signal processing algorithms, wavefront sensors, thermal analysis and electro-optical sensor modeling and simulation.

**Keith O. Stuart** was appointed Vice President in charge of Hardware Development for Aura in 1988. Prior thereto, he served as a Program Manager for IIS during 1987. Mr. Stuart obtained his B.S. and M.S. degrees in electrical engineering from the University of California, Los Angeles in 1978 and 1980, respectively. Mr. Stuart worked for CMI during 1986 and was employed by Hughes Aircraft Company prior thereto. Mr. Stuart has designed and fabricated a digitally controlled, magnetically supported gimbal that isolates the seeker portion of a missile utilizing electro-magnetic suspension for the Kinetic Energy Weapons Program of the United States Space Defense Initiative and has also developed a multi-computer automated test station for the evaluation of sophisticated electro-optical devices.

**Neal B. Kaufman**, appointed as a director in 1989, is Senior Vice President of Aura, where he has served since 1988. Prior thereto, he has served as President and Vice President of CMI since 1984 and 1988, respectively. Mr. Kaufman has also been a director of CMI since 1984. Mr. Kaufman graduated from the University of California, Los Angeles, in 1967 where he obtained a B.S. in engineering. He was employed as a software project manager with Abacus Programming Corp. from 1975 to 1985 where he headed a team of software specialists on the Gas Centrifuge Nuclear Fuel enrichment program for the United States Department of Energy and developed

software related to the Viking and Mariner projects for the California Institute of Technology Jet Propulsion Laboratory in Pasadena, California.

**Rogers Saxon, Ph.D.** was appointed Vice President in charge of Advanced Computing for Aura in 1988. Prior thereto, he was a Program Manager for CMI where he had served since 1986. Dr. Saxon received his B.S. degree in mathematics from Harvey Mudd College in 1966, and M.A. degree in operations research from Claremont Graduate School in 1977 and M.A. and Ph.D. degrees in cognitive psychology from the University of California, Irvine in 1982 and 1985, respectively. From 1984 to 1986, Dr. Saxon worked for Abacus Programming Corp. on the Space Shuttle Project. His services for Abacus were performed at Rockwell International and included leading the team that developed an expert system for Space Shuttle electrical cable configuration and routing.

**Ronald J. Goldstein**, is Senior Vice President in charge of Aura's Business Development. He holds two M.S. degrees in Computing Technology and the Management of R & D from George Washington University and has completed course work for a Ph.D. in Nuclear Engineering from North Carolina State University. Prior to joining Aura in 1989, Mr. Goldstein was Manager, Laboratories and Manager, Space Initiatives at Hughes Aircraft Company where he was responsible for the design, production and marketing of a wide variety of aerospace systems and hardware. Prior to joining Hughes in 1982, Mr. Goldstein was the Special Assistant for National Programs in the Office of the Secretary of Defense, and before that held high level program management positions with the Defense Department and Central Intelligence Agency. Before then, he was a Captain in the Infantry and Special Projects in the Army. Prior to that he was employed in a technical and managerial capacity with Westinghouse.

#### *Family Relationships*

Cipora Kurtzman, a Vice President and director, is the sister of Zvi Kurtzman, who is the President and a director of the Company. There are no other family relationships between any director or executive officer.

#### *Employees*

As of May 20, 1991, the Company employed 126 persons on a full time-basis and three on a part-time basis and believes that its relationship with its employees is satisfactory. The Company is not a party to any collective bargaining agreements.

## **ITEM 2. PROPERTIES**

On March 24, 1989, Aura purchased a 46,000 square foot newly constructed headquarters facility located in El Segundo, California, for \$5,625,000 and spent approximately \$3.1 million for improvements, fixtures and furnishings. The acquisition and improvements were financed principally with the Company's Notes which were converted into common stock in April 1991.

Aura leases a 5,000 square foot actuator manufacturing facility in El Segundo, California under a lease which expires on December 31, 1993 with an annual rental of approximately \$43,000. The Company also maintains a 8,900 square foot manufacturing facility in Laguna Niguel, California, under a lease expiring April 1994. Current annual base rent is \$63,878. The Company believes that these facilities are adequate for its present needs.

## **ITEM 3 LEGAL PROCEEDINGS**

In October 1989, Harry Kurtzman, Arthur Schwartz, Patrick Glenn, Neal Kaufman and Advanced Integrated Systems, Inc. ("AIS"), an inactive company which is controlled by such

individuals, filed a complaint in U.S. District Court, Central District of California (Case No. 89-6155AWT) against Harvey Rosenberg, Harry Rovenger and Henry Warshaw, each of whom are attorneys, alleging numerous violations of the Racketeer Influenced and Corrupt Organizations Act ("RICO") and the Securities Exchange Act of 1934 (the "Exchange Act") arising out of the formation of Amcan and CMI, and Levitron International Ltd. and Levitron of Texas Inc. ("Levitron") including Mr. Rosenberg's failure to disclose his felony perjury conviction and subsequent disbarments in the State of Maryland and District of Columbia. On March 27, 1990, Messrs. Rosenberg and Warshaw filed a Counter-complaint against Aura and certain of its officers and directors (the "Counter-complaint") in such proceeding.

The Counter-complaint alleged, as to Aura, that Aura has violated certain provisions of RICO and otherwise defrauded Rosenberg and Warshaw by wrongfully withholding 180,000 shares of Aura Common Stock registered in the name of Rosenberg being held in escrow by a bank pursuant to the rules promulgated by the British Columbia Superintendent of Brokers. Rosenberg and Warshaw claim damages against Aura in excess of one million dollars and punitive damages in excess of ten million dollars as a result of such wrongful withholding of shares. The Counter-complaint also alleged rights to certain assets and magnetics technology of Aura based upon certain rights allegedly granted to Rosenberg and Warshaw under an agreement entered into in December 1984 between Rosenberg, Warshaw and AIS pursuant to which AIS granted to Rosenberg and Warshaw a right of first refusal with regard to inventions of AIS during the period ending December 1987. Neither Aura nor any of its subsidiaries was a party to such agreement. H. Rovenger, a co-dependent has filed a counter complaint against Aura seeking similar relief. Substantial portions of the counter complaint against Aura were dismissed by the Court in April 1991 including the RICO and fraud allegations. All of these actions are being challenged by Aura. However, the claims by Aura against the defendants have been allowed by the court proceed. Aura believes that the claims of Rosenberg, Warshaw, Bosley and Rovenger are without merit and intends to vigorously defend against these claims.

On July 19, 1989, Levitron instituted a legal action in the U.S. Bankruptcy Court against Aura, IIS and the directors and former directors of Aura arising out of the performance by IIS in 1986 of a contract with Hughes Aircraft Company ("Hughes"). The Company initially received a notice of claim by Levitron relating to such contract in February 1989. The action alleged that a contract between Levitron and Hughes entered into in 1986 was wrongfully cancelled and reassigned to IIS at the direction of certain individuals who were then affiliated with Levitron and who are officers and directors of Aura. The action sought compensatory and punitive damages and possession of a prototype gimbal developed by IIS under the contract. This action was dismissed by the Bankruptcy Court in January 1990 as the court determined that it lacked jurisdiction.

A similar proceeding was instituted by Levitron against substantially the same parties, including present and former officers and directors of Aura, in March 1990 in the District Court of Dallas County, Texas (Case No. 90-03673-H). Certain of such officers and directors were entitled to control Levitron by reason of their stock ownership prior to their resignation from Levitron in 1986. The complaint by Levitron seeks compensatory damages in excess of \$2 million and punitive damages in excess of \$4 million together with the prototype gimbal developed under the Hughes contract and the technology, patents and improvements relating thereto. As part of such proceeding, Robert Bosley, who purports to own 140,000 shares of Aura's Common Stock, has alleged misrepresentations and omissions in connection with Aura's acquisition of Amcan in April 1988. Bosley seeks compensatory damages in excess of \$5 million and punitive damages in excess of \$10 million. The Company believes these claims are without merit and intends to vigorously defend against such claims.

During June 1989 Micro CAD/CAM Systems, Inc., (MCCS) a wholly owned subsidiary of Aura, filed an action against Manufacturing Design Systems, Inc. ("MDS") and certain individuals affiliated with MDS in the U.S. District Court, Central District of California (Case No.

89 3880-TJH). MCCA alleges, among other things, that MDS agreed to distribute software that MCCA developed, and that MDS failed to pay MCCA money owed pursuant to that arrangement and failed to provide MCCA with sales reports and a business plan. The complaint alleges, among other things, breach of contract, fraud, and copyright infringement and seeks both compensatory damages in the amount of \$300,000 and punitive damages according to proof at the time of trial. The defendants in that action have asserted a counterclaim against MCCA, Aura, Harry Kurtzman, Avi Lipski, Emanuel Leibzon, and David Bruce Pickels, alleging, among other things, breach of contract, fraud negligent misrepresentation, intentional interference with economic relations, intentional inducement of breach of contract, unfair competition, misappropriation of trade secrets, and intentional infliction of emotional distress arising from MCCA's termination of its agreement with MDS. This action is presently set for trial on July 31, 1991.

In February 1991 Golden Technologies Company, Inc. ("GTC"), a subsidiary of the Adolph Coors Company ("Coors"), filed a complaint against Aura and Alcoa Packaging Machinery Company, Inc., U.S. District Court, Count of Jefferson, State of Colorado (Civil Action No. 91-CV-0623). The complaint alleges, with respect to Aura, that GTC approached Aura for the manufacture of beverage cans, and that Aura executed confidentiality agreements concerning its use of the technology with GTC. GTC further alleges that Aura, in violation of those agreements, filed a patent application covering the technology discussed, and approached other beverage can manufacturers in an effort to solicit sales of the technology. Accordingly, GTC's complaint seeks a permanent injunction prohibiting Aura's further use of the technology, an assignment of Aura's pending patent application to GTC, and compensatory and punitive damages.

Aura has filed an answer to the complaint, denying that it received any confidential or secret information from GTC. Aura has also filed a counterclaim against GTC and Coors. Aura alleges that GTC and Coors fraudulently induced Aura to enter into the Confidentiality Agreement by promising that they would assist Aura in the development of the technology and would purchase the technology for use in their manufacturing process. Aura further alleges that GTC and Coors did not assist in the development of the technology, but merely waited for Aura to develop and perfect the technology and then initiated the present lawsuit as part of a scheme to obtain sole use of the technology and to obtain the fruits of Aura's labor without having to pay Aura the compensation to which it is entitled. The counterclaim asserts claims of fraud and deceit, conspiracy to defraud, wrongful interference with prospective economic advantages, and unfair competition, and requests that the court enjoin GTC and Coors from making further attempts to restrain trade, and award Aura actual, compensatory and punitive damages. These proceedings are still in the discovery stage.

**ITEM 4 SUBMISSION OF MATTERS TO A VOTE OF SECURITY HOLDERS**

There were no matters submitted to a vote of security holders during the quarter ended February 28, 1991.

## PART II

### ITEM 5. MARKET FOR REGISTRANTS COMMON STOCK AND RELATED STOCKHOLDER MATTERS

Since November 1988 Aura Common Stock has been quoted on the NASDAQ quotation system under the trading symbol "AURA". From March 1987 until November 1988, Aura's Common Stock was traded over-the-counter but was not quoted in any automated quotation system of a registered securities association. On May 21, 1991 Aura shares became listed in the National Market System of the NASD.

Set forth below are high and low bid prices for the Common Stock of Aura for each quarterly period in each of the two most recent fiscal years and through May 20, 1991. Such quotations reflect inter-dealer prices, without retail mark-up, mark-down or commissions and may not necessarily represent actual transactions. The Company has 765 stockholders of record as of May 21, 1991.

<u>Period</u>	<u>High</u>	<u>Low</u>
Fiscal 1990		
First Quarter ended May 31, 1989	5.63	2.88
Second Quarter ended August 31, 1989	4.13	2.94
Third Quarter ended November 30, 1989	5.25	3.56
Fourth Quarter ended February 28, 1990	4.31	3.25
Fiscal 1991		
First Quarter ended May 31, 1990	4.56	3.56
Second Quarter ended August 31, 1990	3.31	2.38
Third Quarter ended November 30, 1990	2.88	1.50
Fourth Quarter ended February 28, 1991	4.00	1.25
Fiscal 1992		
First Quarter through May 20, 1991	7.94	3.69

#### *Dividend Policy*

The Company has not paid any dividends on its Common Stock and currently intends to retain any future earnings for use in its business. Therefore, no dividends will be declared on its Common Stock in the foreseeable future. Dividend payments will be at the discretion of the Company's Board of Directors and will depend on the Company's future earnings, operating and financial condition and capital requirements, as well as general business conditions.

ITEM 6. SELECTED FINANCIAL DATA

AURA SYSTEMS, INC. AND SUBSIDIARIES (1) (2)

	Years Ended				
	February 28, 1991	February 28, 1990	February 28, 1989	February 29, 1988	February 28, 1987
Revenues	\$ 8,339,159	\$ 9,055,581	\$ 2,849,246	\$ 483,883	\$1,557,593
Cost of revenues	7,702,435	8,323,857	2,923,258	587,498	1,090,158
Research and development expenses	2,544,852	1,896,852	494,857	770,000	72,955
General and administrative expenses	2,532,782	2,228,095	992,909	1,433,457	630,747
Interest expense (Income) net	530,608	(9,591)	(10,904)	33,710	—
Total costs and expenses	13,310,677	12,439,213	4,400,120	2,824,665	1,793,860
Net loss	<u>\$(4,971,518)</u>	<u>\$(3,383,632)</u>	<u>\$(1,550,874)</u>	<u>\$(2,340,782)</u>	<u>\$(236,267)</u>
Net loss per common share	<u>\$ .(22)</u>	<u>\$ .(16)</u>	<u>\$ .(09)</u>	<u>\$ .(16)</u>	<u>\$ .(06)</u>
Weighted average number of common shares outstanding	<u>22,471,867</u>	<u>20,586,643</u>	<u>16,399,130</u>	<u>14,860,312</u>	<u>4,044,107</u>

	Unaudited Pro-forma					
	February 28, 1991(1)	February 28, 1991	February 28, 1990	February 28, 1989	February 29, 1988	February 28, 1987
<b>Balance Sheet Data:</b>						
Working capital (deficiency)	\$ 2,928,987	\$ 726,862	\$ 1,116,576	\$ 1,398,987	\$ (415,342)	\$ 696,135
Total assets	20,692,926	18,773,218	17,497,033	7,815,163	1,208,654	1,806,624
Total liabilities	6,278,557	12,978,557	10,456,269	5,092,452	1,838,438	613,418
Net stockholders' equity (deficiency)	14,414,369	5,794,661	7,040,764	2,722,711	(649,784)	1,193,206

(1) The unaudited pro-forma balance sheet data reflects the following transactions which occurred subsequent to February 28, 1991:

- (a) In April 1991, the Company's Secured 7% Convertible Notes were converted into equity, pursuant to the terms of the underlying indenture. The outstanding balance of \$6,700,000, less deferred issuance costs of \$282,417 was credited to equity; thus, all long term debt was retired.
- (b) In the first fiscal quarter of 1992, proceeds of \$2,202,125 were realized through the exercise of warrants to purchase 388,250 shares and exercise of employee options to purchase 130,000 shares at prices of \$4.50 and \$3.50 per share, respectively.

(2) The operations of Delphi Components Inc. are reflected in the February 28, 1989 Statement of Operations from December 19, 1988, the date of acquisition. The accounts of CAD/CAM Ltd. (acquired May 9, 1989) have been included since May 1, 1989, the date effective control was established.

## ITEM 7 MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS

### Introduction

In the Spring of 1988, Aura completed the actions necessary to acquire predecessor companies, Amcan and CMI, which were under common management and control with Aura. Accordingly, financial statements for fiscal 1987 and subsequent years consolidate these companies. The following discussion of the results of operations and liquidity and capital resources of the Company reflects this treatment and additionally includes Delphi since its acquisition in December 1988. The discussion also reflects information related to CAD/CAM Ltd. which was acquired in May 1989.

### RESULTS OF OPERATIONS

#### Fiscal 1991 as Compared to Fiscal 1990

In 1991 the Company reported revenues of \$8,339,159 compared with revenues of \$9,055,581 in 1990. The 1991 net loss was \$4,971,518 compared with a loss of \$3,383,632 in 1990. About 39% of the 1991 revenue was due to billings under a \$9.0 million contract awarded to the Company by the United States Air Force the ("Eglin Contract") compared with 69% of revenues in 1990. This reduced level of billings under the Eglin Contract when compared to 1990's level was partially offset by new billings for commercial and pre-production prototype work. The mix of the Company's revenue has changed in 1991 from a predominance of military work to one where a substantial proportion of billings were for commercial activity. This trend is expected to accelerate in 1992.

Cost of revenues decreased \$621,422, general and administrative expenses increased \$304,687 while research and development expenses increased \$648,000 and net interest expense increased \$540,199, resulting in an increase in total expenses of approximately \$871,464. The decrease in the cost of revenue was primarily the result of decreased labor and materials required to perform under Eglin Contract. The increase in general and administrative expenses was attributable to marketing and selling efforts for developing the commercial applications of the technology. Interest cost of \$562,000 related to the Secured 7% Convertible Notes was included to arrive at net interest expense in 1991. These notes were converted to equity in April 1991. All of 1990's interest cost of \$305,686 was attributable to the construction period when the new headquarters facility was built and was accordingly capitalized.

#### Fiscal 1990 as Compared to Fiscal 1989

The Company reported revenues of \$9,055,581 in 1990 compared with revenues of \$2,849,246 in 1989. The net loss was \$3,383,632 in 1990 compared with a loss of \$1,550,874 in 1989. The revenue increase of \$6,206,335 was primarily due to billings under the Eglin Contract. Revenues generated by Delphi in its first full year increased by \$1,370,000 and the newly acquired CAD/CAM Division added revenues of \$582,000 for the ten months it operated during fiscal 1990.

Cost of revenues increased \$5,400,600; general and administrative expenses increased \$1,235,190 and research and development expenses increased \$1,402,000 resulting in an increase in total expenses of approximately \$8,039,100. The increase in the cost of revenues was primarily the result of labor and materials to perform under the Eglin Contract combined with a full year of operations for Delphi.

The two acquired divisions accounted for an increase of approximately \$1.0 million in general and administrative costs. This category reflects a full year of costs for Delphi (\$332,000 increase) and the ten months of CAD/CAM (\$697,000). The Research and Development cost increase of \$1,400,000 was attributable to several factors. The Delphi Division contributed a increase of \$234,000 related to engineering work undertaken to expand its product line while the CAD/CAM Division expended \$467,000 to enhance software and develop new product offerings. Aura's research and development effort increased by \$700,000 as efforts intensified to develop working models of the High Force Actuator a new innovation in the High Definition Television field and other projects.

#### Fiscal 1989 as Compared to Fiscal 1988

The Company reported net revenues of \$2, 849,246 in 1989 compared with revenues of \$483,883 in 1988. There were net losses of \$1,550,874 in 1989 compared with losses of \$2,340,782 in 1988. The revenue increase of approximately six times was primarily due to billings under the Eglin Contract. Revenues generated by Delphi were not material in fiscal 1989.

Cost of revenues increased \$2,335,760, general and administrative expenses decreased \$440,548 and research and development expenses decreased \$275,143 resulting in a net increase in the total expenses of approximately \$1,600,000. The increased level in staff and operating costs necessary to perform under the Eglin Contract was the major factor contributing to the increased cost of revenues. General and administrative expenses decreased in fiscal 1989 as a result of a reduction in legal fees associated with the merger of Amcan. Prior to the award of the Eglin contract, a majority of personnel was allocated to proposal preparation for the new contract and proof of concept activity.

#### *General*

Management does not anticipate any material negative impact of inflation and changing prices on the Company's net sales and revenues or on income from continuing operations.

On August 31, 1988, the Company was awarded the Eglin Contract relating to the development of a missile interceptor test facility and has since expanded the contract substantially to incorporate added work. The facility is capable of providing a scene projector capable of projecting two-dimensional missile targets and plumes against a space or earth background. The contract has been extended and is now expected to be completed in late 1991 and provides for the reimbursement of the Company's cost, including an allowance for general overhead and general administration expenses, plus a ten percent profit margin.

The Company has adopted Financial Accounting Standards Board, Statement No. 95 ("Statement of Cash Flows") effective with the fiscal year ended February 28, 1989.

## Liquidity and Capital Resources

The Company's cash and cash equivalents were at \$3,156,651 at February 28, 1991, \$2,725,187 at February 28, 1990 and \$3,260,522 at February 28, 1989. The cash balances each include \$2,300,000 of certificates of deposit which were pledged as security for short term borrowing. The fiscal 1991 increase in cash and cash equivalents was due principally to financing activities offset by reduced capital spending and increases in marketing expenses as compared to the prior year.

During fiscal 1991, the Company completed a number of debt and equity transitions. In the first half of fiscal 1991 the Company completed private placements of 793,500 shares of common stock and warrants to purchase 77,500 shares of common stock at \$4.50 per share and resulted in proceeds of \$1,563,500. The Company also placed a \$1,500,000 Secured 7% Convertible bond due in 2000 which was junior to an earlier loan with similar terms. This issue converted into common stock in April 1991.

In the last four months of the fiscal year the Company raised proceeds of \$1,492,000 from sales of warrants to purchase 2,984,000 shares. These warrants were issued under a program which began in late 1990 to issue warrants to purchase common stock at prices from \$2.00 per share until December 31, 1993 and increasing by \$1.00 per year to \$5.00 per share, until expiry on December 31, 1996. These funds were used by the Company to augment its working capital and to provide capital for expansion.

Since February 28, 1991 several major transactions have occurred. The Company's Secured 7% Convertible notes outstanding of \$6,700,000 were converted into equity pursuant to the terms of the underlying indenture. Warrants to purchase 388,250 shares at \$4.50 per share were exercised, in April and May 1991 resulting in \$1,747,125 proceeds to the Company. Also, Employee options to purchase 130,000 shares of common stock were exercised, resulting in additional proceeds of \$455,000 to the Company.

On March 24, 1989, the Company acquired and subsequently completed a new 46,000 square foot office building at a cost of approximately \$8.8 million as a headquarters facility. Financing for the acquisition of the building was obtained initially through a combination of placement of its 7% Secured Convertible Non-Recourse Notes (the "Notes") and interim bank financing through a credit facility in the amount of \$4,000,000. As the entire \$7,250,000 in Notes were sold in April 1989, the bank facility was retired. The balance of the construction cost was financed by a \$1,500,000 private placement of common stock in September 1989.

The Notes accrued interest at 7% and were convertible into common stock of the Company at any time at the option of the holder at a conversion price of \$3.50 per share and were subject to mandatory conversion in the event the market price of common stock exceeded \$7.00 per share for ten consecutive trading days. As of April 26, 1991 all of the outstanding notes were converted into equity. The Notes were secured by a First Deed of Trust on the property. Other spending for furniture and equipment amounted to \$728,000 in fiscal 1990, \$598,144 during the fiscal 1989 and \$15,617 during fiscal 1988. Of the increase in fiscal 1989 \$341,048 was due to the acquisition of Delphi Components and the remainder was due to the expansion of facilities and purchases of equipment which were necessary in connection with research and development activities and services performed under various subcontracts.

Since inception, Aura and predecessor's primary sources of liquidity have been private equity placements, and bank and private borrowings, including borrowings from directors and officers, and revenues.

In fiscal 1990, the Company completed several equity financings in addition to the, secured convertible debt described previously. In April 1989, the Company completed a private placement of 512,767 shares of common stock resulting in increased equity of \$1,459,000. Additionally, 465,000 shares and warrants to purchase 90,000 shares were sold for net proceeds of \$1,860,000 in the quarter ended November 30, 1989. In December 1989, the Company issued an additional 272,750 shares of common Stock and warrants to purchase common stock resulting in net proceeds of \$991,750. The warrants are exercisable at \$4.50 per share and expire on June 14, 1991. These funds were used for additional working capital which the Company required as it expanded its operations and completed its new headquarters facility during fiscal 1990.

Aura repaid all long term debt in fiscal 1989, of which \$715,000 was incurred during fiscal 1988 and \$352,440 during fiscal 1987 to fund operations of major contracts. Long-term debt incurred by Aura in fiscal 1988 in order to finance operations included an aggregate of \$291,137 in non-interest bearing unsecured loans payable to various officers (the outstanding aggregate principal balance of which is currently zero) and a \$500,000 unsecured non-interest bearing note payable to a director. On November 1, 1987, a director of Aura granted a \$500,000 unsecured line of credit to the Company. On May 10, 1988, the amount of available under the line of credit was increased to \$600,000 and was completely drawn. In November 1988 the Company completed a \$5,000,000 private placement of its Common Stock. Net proceeds of \$4,500,000 were used to retire bank indebtedness of \$662,067, loans to officers and directors of \$1,653,930, and to reduce accounts payable by \$150,000. The remaining proceeds of \$2,034,003 were made available for future operations and expansion.

As previously stated, Delphi had engaged in limited business operations at the time of its acquisition and had limited revenues. Delphi had depended on funds generated from operations and loans made to it. Although Delphi's sales are increasing in more profitable commercial work areas with corresponding reduction in government work, these have not as yet been sufficient to provide a full level of working capital and funds needed to acquire capital equipment and working capital. Accordingly, Aura has subsidized the cash needs of this division. The Company acquired CAD/CAM Ltd. on May 9, 1989 and has supported the software development and marketing efforts required to introduce a complete product line. Although working capital needs have diminished, this business is not yet completely self sustaining and additional capital may be required.

In the past, the Company's cash flow generated from operations has not always been sufficient to completely fund its working capital needs. Accordingly, the Company has also relied upon external sources of financing to maintain its liquidity, principally private and bank indebtedness and equity financing. As previously mentioned, the nature of the Company's business is shifting from predominantly government funded research and development to design and manufacture of commercial products with substantially higher margins than heretofore. The extent of manufacturing undertaken by the Company versus the use of subcontractors or joint venture partners will influence the level of capital required for future expansion. The timing and availability of cash flow and profits from these products is not known at this time. Negotiations with certain of the parties may result in contracts that provide substantial up-front cash advances in exchange for the right to manufacture Aura's technology. Additionally, the Company's headquarters facility is now unencumbered by debt. This property is appraised at \$9.6 million and provides a source of potential substantial borrowings. Although the Company has always been successful in raising the capital to cover short and long term working capital needs there is uncertainty that cash flow from future operations will be sufficient to continue to cover all of these needs. Accordingly, the Company continues to seek external sources of capital to maintain liquidity. Such sources include debt and equity financing. The Company has no commitments to obtain funds from any of such sources and, therefore, there are no assurances that such funds will be available at the times or in the amounts required by the Company. The Company's existing

financial arrangements do not preclude or otherwise limit the Company's ability to incur additional long-term debt or to issue new equity. Current fixed monthly expenses average approximately \$900,000; principally for labor, overhead, travel and professional fees.

The Company leases space located in El Segundo, California and Laguna Niguel, California. Minimum monthly rents under the leases and certain equipment leases approximate \$16,000. Rent expense was \$208,000 for fiscal 1991, \$228,000 for fiscal 1990, and \$148,000 for fiscal 1989. Assuming the lease is not terminated, then rent expense is expected to be \$135,000 for fiscal 1992 and 1993 and for fiscal 1994. The Company has no other material long-term capital commitments.

## **PART III**

### **Item 10. DIRECTORS AND EXECUTIVE OFFICERS OF THE REGISTRANT**

Members of Aura's Board of Directors are identified along with their business experience during the past five years in its Proxy statement in connection with its 1991 Annual Meeting of Shareholders (the "Proxy Statement") under the sections entitled "Nominees and Voting" and "Business Experience of Directors During Past Five Years", which sections are incorporated herein by reference. Similar information regarding Aura's executive officers is contained in Part I of this Report.

### **Item 11. EXECUTIVE COMPENSATION**

Information with respect to this item is included under the section entitled "Compensation of Executive Officers" in the Proxy Statement, which section is incorporated herein by reference.

### **Item 12. SECURITY OWNERSHIP OF CERTAIN BENEFICIAL OWNERS AND MANAGEMENT**

Information related to holders of more than 5% of any class of Aura's voting securities and beneficial ownership by directors individually and directors and officers as a group is included in the Proxy Statement in the sections entitled "Security Ownership of Certain Beneficial Owners and Management", which sections are incorporated herein by reference.

### **Item 13. CERTAIN RELATIONSHIPS AND RELATED TRANSACTIONS**

Information pertaining to transactions with management and others, identification of certain business relationships and the indebtedness of management to the Company can be found in the sections entitled "Certain Transactions" and "Nominees and Voting" in the Proxy Statement, which sections are incorporated herein by reference.

## PART IV

### Item 14. FINANCIAL STATEMENTS, SCHEDULES, REPORTS ON FORM 8-K AND EXHIBITS

- (a) Documents filed as part of this Form 10-K:

#### Financial Statements

Included in Part IV of this Form 10-K are the following financial statements, related notes thereto and auditors' reports:

Independent Auditors' report on Consolidated  
Financial Statements and Consolidated  
Supporting Schedules

#### Consolidated Financial Statements of Aura Systems, Inc. and Subsidiaries:

Consolidated Balance Sheets - February 28, 1991  
and February 28, 1990

Consolidated Statements of Operations - Years  
ended February 28, 1991, February 28, 1990  
and February 28, 1989

Consolidated Statements of Stockholders' Equity  
(deficiency) - Years ended February 28, 1991,  
February 28, 1990 and February 28, 1989

Consolidated Statements of Cash Flows - Years  
ended February 28, 1991, February 28, 1990  
and February 28, 1989

Notes to Consolidated Financial Statements

#### Financial Statement Schedules

#### Consolidated Supporting Schedules

II - Amounts Receivable from Related Parties  
and Underwriters, Promoters and Employees  
Other than Related Parties

V - Property, Plant and Equipment

VI - Accumulated Depreciation, Depletion and  
Amortization of Property, Plant and Equipment

IX - Short-Term Borrowings

Schedules other than those listed above are omitted because they are not required or are not applicable, or the required information is shown in the respective consolidated financial statement or notes hereto.

*Exhibits*

<u>Exhibit No.</u>	<u>Description</u>	<u>Sequential Page No.</u>
**	2.1 Agreement for Exchange of Stock, dated December 19, 1988, by and between the Registrant and Amire A. Youness, et al.	
**	2.2 Agreement for Exchange of Stock, dated December 19, 1988, by and between the Registrant and Abdelhamid Youness, et al.	
*	3.1 Certificate of Incorporation of Registrant	
*	3.2. Bylaws of the Registrant	
***	4.1 Form of Common Stock Warrant	
*****	4.2 Form of Common Stock Warrant	
	4.3 Form of Common Stock Warrant	
*	10.1 Lease, dated April 23, 1986, by and between Delphi Components, Inc. and Birtcher Niguel	
*	10.2 Lease, dated April 3, 1987, between International Rectifier Corporation and the Registrant	
*	10.3 Lease, dated April 3, 1987, between Plaza La Reina Office Venture and the Registrant	
#	10.4 Convertible Promissory Note, dated October 27, 1987 between Peter C. Jaquith and the Registrant	
#	10.5 Revolving Credit Agreement, dated November 1, 1987, between Peter C. Jaquith and the Registrant	
*	10.6 Joint Venture Agreement, dated March 3, 1987, between Cypher Master, Inc. and Innovative information Systems, Inc.	
*	10.7 Amendment to Revolving Credit Agreement, dated May 10, 1988, between Peter C. Jaquith and the Registrant	
*	10.8 Aura Systems, Inc. 1987 Stock Option Plan for Non-Employee Directors	
*	10.9 Form of Aura Systems, Inc. Non-Statutory Stock Option Agreement	
*	10.10 Warrant, dated June 1988, between Ervin, Cohen & Jessup and the Registrant	
*	10.11 Sub-Contract, dated May 2, 1988, between Computer Sciences Corporation and the Registrant	

<u>Exhibit No.</u>	<u>Description</u>	<u>Sequential Page No.</u>
* 10.12	Purchase Order, dated May 10, 1988, between General Dynamics Corporation and the Registrant	
* 10.13	Purchase Contract, dated May 26, 1988, between Boeing Aerospace Company and the Registrant	
* 10.14	Cost-Plus-a-Fixed-Fee Research and Development Contract, dated August 15, 1988, by and between the Registrant and California Institute of Technology Jet Propulsion Laboratory	
* 10.15	Award Contract, dated August 31, 1988, between the Department of the Air Force and the Registrant	
+ 10.16	Note, dated as of February 27, 1989, between the Registrant and City National Bank	
+ 10.17	Deed of Trust, Assignment of Rents, dated as of February 27, 1989, by the Registrant in favor of Chicago Title Insurance Company, as Trustee, for the benefit of City National Bank	
+ 10.18	Indenture, dated as of March 1, 1989, between the Registrant and Interwest Transfer Co., Inc., as Trustee, relating to the & 7% Secured Convertible Non-Recourse Notes due 1999.	
+ 10.19	Form of 7% Secured Convertible Non-Recourse Notes due 1999.	
+ 10.20	Deed of Trust, Assignment of Leases and Rents and Fixture Filing, dated as of March 1, 1989, by the Registrant in favor of Ticor Title Insurance Company, as Trustee, for the benefit of Interwest Transfer Co., Inc., as trustee under the Indenture.	
++ 10.21	Employment Agreement, dated as of October 17, 1988 between the Registrant and Francis T. Phalen, Senior Vice President, Chief Financial Officer and Director.	
+++ 10.22	Contract of Purchase and sale and Escrow Instructions, between the Registrant and Plazamerica, Inc.	
+++ 10.23	Form of 7% Secured Convertible Non-Recourse Note due 2000.	
**** 10.24	1989 Stock Option Plan	
22	Subsidiaries of Registrant	
24	Consent of KPMG Peat Marwick, certified public accountants.	

- \* Incorporated by reference to the Exhibits to the Registration Statement on Form S-1 (File No. 33-19530)
- \*\* Incorporated by reference to the Exhibits in the Registrant's Current Report on Form S-K dated December 27, 1988 (File No. 0-17249).
- + Incorporated by reference to the Exhibits in the Registrant's Current Report on Form 8-K dated March 24, 1989 (File No. 0-17249).
- ++ Incorporated by reference to the Exhibits to Pre-effective Amendment No. 1 to the Registration Statement on Form S-1 (File No. 33-27164).
- \*\*\* Incorporated by reference to the Exhibits to Post-Effective Amendment No. 1 to the Registration Statement on Form S-1 (File No. 33-27164).
- +++ Incorporated by reference to the Exhibits to Post-Effective Amendment No. 2 to the Registration Statement on Form S-1 (File No. 33-27164).
- \*\*\*\* incorporated by reference to the Exhibits to the Registrant's Statement on Form S-8 (File No. 33-32993).
- ++++ Incorporated by reference to the Exhibit in the Registrant's Annual Report on Form 10-K for the year ended February 28, 1990 (File No. 0-17249)..
- \*\*\*\*\* Incorporated by reference to the exhibits to the Registrant's Quarterly Report on Form 10-Q for the quarter ended November 30, 1990 (File No. 0-17249).

- (b) Reports on Form 8-K  
The Company filed a Form 8-K dated May 3, 1991, reporting the conversion of the Company's 7% Secured Convertible Non Recourse Notes.

## SIGNATURES

Pursuant to the requirements of Section 13 or 15 (d) of the Securities Exchange Act of 1934, the registrant has duly caused this report to be signed on its behalf by the undersigned, thereunto duly authorized.

Dated: May 25, 1991

AURA SYSTEMS, INC.

By: /s/ Zvi Kurtzman  
Zvi Kurtzman, President

Pursuant to the requirements of the Securities Exchange Act of 1934, this report has been signed below by the following persons on behalf of the registrant in the capacities and on the date indicated.

<u>Signatures</u>	<u>Title</u>	<u>Date</u>
<u>/s/ Zvi Kurtzman</u> Zvi Kurtzman	President and Director (Principal Executive Officer)	May 25, 1991
<u>Arthur J. Schwartz</u>	Executive Vice President and Director	May , 1991
<u>/s/ Francis T. Phalen</u> Francis T. Phalen	Senior Vice President, Chief Financial Officer and Director (Principal Financial Officer)	May 25, 1991
<u>/s/ Joseph F. Bevacqua</u> Joseph F. Bevacqua	Vice President and Chief Accounting Officer (Principal Accounting Officer)	May 25, 1991
<u>/s/ Peter C. Jaquith</u> Peter C. Jaquith	Director	May 25, 1991
<u>/s/ Neal B. Kaufman</u> Neal B. Kaufman	Senior Vice President and Director	May 25, 1991
<u>/s/ Cipora Kurtzman</u> Cipora Kurtzman	Vice President and Director	May 25, 1991
<u>Norman Reitman</u>	Director	May , 1991

**KPMG** Peat Marwick

**AURA SYSTEMS, INC.  
AND SUBSIDIARIES**

**Consolidated Financial Statements**

**February 28, 1991 and 1990**

**(With Independent Auditors' Report Thereon)**

**AURA SYSTEMS, INC.  
AND SUBSIDIARIES**

**Index to Consolidated Financial Statements**

	<u>Page</u>
<b>Independent Auditors' Report on Consolidated Financial Statements and Supporting Schedules</b>	F-2
<b>Consolidated Financial Statements of Aura Systems, Inc. and Subsidiaries:</b>	
Consolidated Balance Sheets – February 28, 1991 and 1990	F-3 to F-4
Consolidated Statements of Operations – Years ended February 28, 1991, 1990 and 1989	F-5
Consolidated Statements of Stockholders' Equity – Years ended February 28, 1991, 1990 and 1989	F-6
Consolidated Statements of Cash Flows – Years ended February 28, 1991, 1990 and 1989	F-7 to F-8
<b>Notes to Consolidated Financial Statements</b>	F-9 to F-17
<b>Consolidated Supporting Schedules:</b>	
II – Amounts Receivable from Related Parties and Underwriters, Promoters and Employees Other Than Related Parties	F-18
V – Property, Plant and Equipment	F-19
VI – Accumulated Depreciation, Depletion and Amortization of Property, Plant and Equipment	F-20
IX – Short-Term Borrowings	F-21

Schedules other than those listed above are omitted because they are not required or are not applicable, or the required information is shown in the respective consolidated financial statements or notes thereto.

Certified Public Accountants

725 South Figueroa Street  
Los Angeles, CA 90017

**INDEPENDENT AUDITORS' REPORT**

The Board of Directors  
Aura Systems, Inc.:

We have audited the accompanying consolidated financial statements of Aura Systems, Inc. and subsidiaries. In connection with our audits of the consolidated financial statements, we also have audited the financial statement schedules as listed in the accompanying index. These consolidated financial statements and financial statement schedules are the responsibility of the Company's management. Our responsibility is to express an opinion on these consolidated financial statements and financial statement schedules based on our audits.

We conducted our audits in accordance with generally accepted auditing standards. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audits provide a reasonable basis for our opinion.

In our opinion, the consolidated financial statements referred to above present fairly, in all material respects, the financial position of Aura Systems, Inc. and subsidiaries as of February 28, 1991 and 1990 and the results of their operations and their cash flows for each of the years in the three-year period ended February 28, 1991, in conformity with generally accepted accounting principles. Also in our opinion, the related financial statement schedules, when considered in relation to the basic consolidated financial statements taken as a whole, present fairly, in all material respects, the information set forth therein.

*KPMG Peat Marwick*

Los Angeles, California  
May 16, 1991



**AURA SYSTEMS, INC.  
AND SUBSIDIARIES**

Consolidated Balance Sheets

February 28, 1991 and 1990

<b>Assets</b>	<u>1991</u>	<u>1990</u>
<b>Current assets:</b>		
Cash	\$ 856,651	425,187
Certificates of deposit securing notes payable	2,300,000	2,300,000
<b>Receivables:</b>		
Trade, less allowance for doubtful accounts of \$150,000 and \$154,000 in 1991 and 1990, respectively	2,623,644	1,844,086
Notes and advances due from related parties	222,425	251,400
<b>Total receivables</b>	<u>2,846,069</u>	<u>2,095,486</u>
Inventories and contracts in process	788,392	576,441
Other current assets	214,307	530,044
<b>Total current assets</b>	<u>7,005,419</u>	<u>5,927,158</u>
<b>Property and equipment, at cost:</b>		
Land	2,000,000	2,000,000
Building	6,835,659	6,763,304
Machinery and equipment	1,406,558	1,080,141
Furniture, fixtures and leasehold improvements	657,186	614,416
	<u>10,899,403</u>	<u>10,457,861</u>
Less accumulated depreciation and amortization	(983,769)	(510,914)
<b>Net property and equipment</b>	<u>9,915,634</u>	<u>9,946,947</u>
Other assets, net of accumulated amortization of \$468,856 and \$224,700 in 1991 and 1990, respectively	1,852,165	1,622,928
	<u>\$ 18,773,218</u>	<u>17,497,033</u>

See accompanying notes to consolidated financial statements.

**AURA SYSTEMS, INC.  
AND SUBSIDIARIES**

Consolidated Balance Sheets

February 28, 1991 and 1990

<b>Liabilities and Stockholders' Equity</b>	<u>1991</u>	<u>1990</u>
<b>Current liabilities:</b>		
Notes payable, secured by certificates of deposit	\$ 2,300,000	2,300,000
Current installments of notes payable to bank	325,804	109,936
Accounts payable	2,531,125	1,610,050
Accrued expenses	1,121,628	790,596
	<u>6,278,557</u>	<u>4,810,582</u>
Notes payable to bank, less current installments	—	240,687
Convertible secured notes payable	6,700,000	5,405,000
<b>Stockholders' equity:</b>		
Common stock. Issued and outstanding 22,993,584 and 21,847,378 shares in 1991 and 1990, respectively	18,600,252	14,908,134
Common stock subscribed	(37,500)	(37,500)
Deferred compensation	(133,157)	(166,454)
Accumulated deficit	(12,634,934)	(7,663,416)
	<u>5,794,661</u>	<u>7,040,764</u>
Net stockholders' equity	<u>5,794,661</u>	<u>7,040,764</u>
	<u>\$ 18,773,218</u>	<u>17,497,033</u>

See accompanying notes to consolidated financial statements.

**AURA SYSTEMS, INC.  
AND SUBSIDIARIES**

**Consolidated Statements of Operations  
Years ended February 28, 1991, 1990 and 1989**

	<u>1991</u>	<u>1990</u>	<u>1989</u>
Revenues	\$ 8,339,159	9,055,581	2,849,246
Costs and expenses:			
Cost of revenues	7,702,435	8,323,857	2,923,258
Research and development	2,544,852	1,896,852	494,857
General and administrative expenses	2,532,782	2,228,095	992,909
Interest expense (income), net	530,608	(9,591)	(10,904)
Total costs and expenses	<u>13,310,677</u>	<u>12,439,213</u>	<u>4,400,120</u>
Net loss	\$ <u>(4,971,518)</u>	<u>(3,383,632)</u>	<u>(1,550,874)</u>
Net loss per common share	\$ <u>(.22)</u>	<u>(.16)</u>	<u>(.09)</u>
Weighted average number of common shares	<u>22,471,867</u>	<u>20,586,643</u>	<u>16,399,130</u>

See accompanying notes to consolidated financial statements.

**AURA SYSTEMS, INC.  
AND SUBSIDIARIES**

Consolidated Statements of Stockholders' Equity  
Years ended February 28, 1991, 1990 and 1989

	Common stock		Capital in excess of par value	Common stock subscribed	Unearned compensation	Accumulated deficit	Net stockholders' equity (deficiency)
	Shares	Amount					
Balance at February 29, 1988	14,861,645	\$ 74,310	2,121,354	(116,338)	—	(2,728,910)	(649,784)
Exercise of stock options	100,000	500	99,500	—	—	—	100,000
Payment to officer and an individual	197,000	983	196,017	(37,500)	—	—	159,500
Private placement, less issuance costs	4,012,000	20,060	4,165,132	(125,000)	—	—	4,060,192
Proceeds from common stock subscribed	—	—	—	41,177	—	—	41,177
Acquisition of Delphi	375,000	1,875	560,625	—	—	—	562,500
Net loss	—	—	—	—	—	(1,550,874)	(1,550,874)
Balance at February 28, 1989	19,545,645	97,728	7,142,628	(237,861)	—	(4,279,784)	2,722,711
Secured notes payable converted	527,143	2,635	1,842,365	—	—	—	1,845,000
Exercise of stock options	120,000	600	179,400	—	—	—	180,000
Issuance to employees	75,000	375	234,625	—	(235,000)	—	—
Amortization of stock award	—	—	—	—	68,546	—	68,546
Private placement, less issuance costs	1,250,517	6,254	4,054,795	—	—	—	4,061,049
Issuance to ESOP	81,046	405	319,330	—	—	—	319,735
Shares canceled	(100,000)	(500)	—	—	—	—	(500)
Proceeds from common stock subscribed	—	—	—	200,361	—	—	200,361
Acquisition of CAD/CAM Ltd.	348,027	1,740	965,776	—	—	—	967,516
CAD/CAM Ltd. acquisition costs	—	—	59,978	—	—	—	59,978
Net loss	—	—	—	—	—	(3,383,632)	(3,383,632)
Balance at February 28, 1990	21,847,378	109,237	14,798,897	(37,500)	(166,454)	(7,663,416)	7,040,764
Private placements, less issuance costs	871,000	4,355	1,346,469	—	—	—	1,350,824
Issuance to ESOP	216,400	1,082	502,431	—	—	—	503,513
Issuance of warrants	—	—	1,492,000	—	—	—	1,492,000
Amortization of stock awards	—	—	—	—	33,297	—	33,297
Secured notes payable converted	58,806	292	160,609	—	—	—	160,901
Contributed capital - Aura Medical	—	—	184,880	—	—	—	184,880
Net loss	—	—	—	—	—	(4,971,518)	(4,971,518)
Balance at February 28, 1991	22,993,584	\$ 114,966	18,485,286	(37,500)	(133,157)	(12,634,934)	5,794,661

See accompanying notes to consolidated financial statements.

**AURA SYSTEMS, INC.  
AND SUBSIDIARIES**

Consolidated Statements of Cash Flows  
Years ended February 28, 1991, 1990 and 1989

	<u>1991</u>	<u>1990</u>	<u>1989</u>
<b>Cash flows from operating activities:</b>			
Net loss	\$ (4,971,518)	(3,383,632)	(1,550,874)
<b>Add (deduct) items not affecting cash:</b>			
Depreciation and amortization of property and equipment and intangible assets	733,668	459,494	171,361
Net (increase) decrease in other assets	93,803	(74,243)	54,258
(Increase) decrease in trade accounts receivable	(779,558)	966,014	(2,771,020)
(Increase) decrease in notes and advances due from related parties	28,975	(27,641)	(9,979)
Increase in contracts in process and inventories	(211,951)	(239,403)	(11,589)
(Increase) decrease in other current assets	315,737	(490,024)	(28,425)
Increase in accounts payable	921,075	1,142,164	265,846
Increase in accrued expenses	331,032	154,941	187,349
Increase (decrease) in billings in excess of cost	—	(1,361,917)	1,361,917
	<u>(3,538,737)</u>	<u>(2,854,247)</u>	<u>(2,331,156)</u>
<b>Net cash used in operating activities</b>			
<b>Cash flows from investing activities – purchase of property and equipment</b>	<u>(441,542)</u>	<u>(9,283,511)</u>	<u>(257,096)</u>
<b>Net cash used in investing activities</b>	<u>(441,542)</u>	<u>(9,283,511)</u>	<u>(257,096)</u>

(Continued)

**AURA SYSTEMS, INC.  
AND SUBSIDIARIES**

Consolidated Statements of Cash Flows, Continued

	<u>1991</u>	<u>1990</u>	<u>1989</u>
<b>Cash flows from financing activities:</b>			
Proceeds from borrowings from bank	\$ 200,000	357,124	—
Net proceeds and repayments of short-term borrowings from bank secured by certificates of deposit	—	—	1,635,080
Increase in certificates of deposit securing notes payable, net	—	—	(1,624,460)
Repayment of borrowings from officers/directors and stockholders	—	—	(532,943)
Repayment of borrowings from bank	(175,181)	(42,111)	(20,669)
Repayment of borrowings from officers/directors and stockholders through issuance of common stock	—	—	(300,000)
Net proceeds from issuance of common stock	1,350,824	4,061,049	4,509,925
Increase (decrease) in common stock subscribed	—	200,361	(121,323)
Net proceeds from issuance of of stock warrants	1,492,000	—	—
Proceeds from issuance of convertible secured notes	1,500,000	7,250,000	—
Structuring fees paid in connection with convertible secured notes	—	(224,000)	—
Amortization of bond costs	44,100	—	—
	<u>4,411,743</u>	<u>11,602,423</u>	<u>3,545,610</u>
Net cash provided by financing activities	4,411,743	11,602,423	3,545,610
Net increase (decrease) in cash	431,464	(535,335)	957,358
Cash at beginning of year	425,187	960,522	3,164
Cash at end of year	\$ 856,651	425,187	960,522
<b>Supplemental disclosures of cash flow information:</b>			
Cash paid during the year for:			
Interest	\$ 519,530	235,000	63,000
Income taxes	800	600	600

**Supplemental disclosure of noncash investing and financing activities:**

In May 1989, Aura Systems, Inc. exchanged 348,027 shares of its common stock with a fair value of \$967,516 for all of the outstanding common stock of International CAD/CAM Ltd.

In December 1989, a \$180,000 note receivable was issued to an officer of the Company.

During the years ended February 28, 1991 and 1990, \$205,000 and \$1,845,000, respectively, of 7% convertible secured notes were converted into 58,806 and 527,143 shares of common stock.

See accompanying notes to consolidated financial statements.

# AURA SYSTEMS, INC. AND SUBSIDIARIES

Notes to Consolidated Financial Statements

February 28, 1991 and 1990

## (1) Summary of Significant Accounting Policies

### Principles of Consolidation

The consolidated financial statements include accounts of the corporation and wholly owned subsidiaries Delphi Components, Inc., Aura CAD/CAM Systems, Inc. and Aura Distribution Systems, Inc. Additionally, Aura Medical Systems, a 60% owned subsidiary, is consolidated. In consolidation, all significant intercompany balances and transactions are eliminated.

### Industry

The Company is primarily involved in the development of technologies for commercial and government applications.

### Revenue Recognition

Substantially all of the Company's revenues are earned under long-term contracts and are recorded using the percentage-of-completion method. Revenue is recorded as costs are incurred, and profit is recognized on each contract based upon the percentage the incurred costs bear to the estimated total cost at the completion of the contract. The effect of changes in estimates is reflected in the year in which these changes become determinable. In the event of a projected loss, the entire estimated loss is charged to operating costs and expenses. Additionally, a subsidiary, which has recently begun manufacturing to stock recognizes revenues on a units-delivered basis.

### Contracts in Process and Inventories

Inventories are stated at the lower of cost or estimated net realizable value. Inventories are primarily attributable to long-term contracts and programs on which the related operating cycles are longer than one year. In accordance with industry practice, these inventories are included in current assets.

### Per Share Information

The consolidated net loss per common share is based on the weighted average number of common shares outstanding during the year. Outstanding stock options have been excluded since inclusion would dilute the reported loss per share.

### Research and Development

Research and development costs funded by the Company are expensed as incurred.

**AURA SYSTEMS, INC.  
AND SUBSIDIARIES**

Notes to Consolidated Financial Statements, Continued

Buildings, Equipment and Leasehold Improvements

Buildings, equipment and leasehold improvements are depreciated using the straight-line method over their estimated useful lives as follows:

Building	40 years
Machinery and equipment	5 years
Furniture and fixtures	7 years
Leasehold improvements	Life of lease

Depreciation and amortization expense of buildings, equipment and leasehold improvements approximated \$473,000, \$255,000 and \$67,000 for fiscal 1991, 1990 and 1989, respectively. In 1990, the Company capitalized \$306,000 in interest related to the construction of their primary facility.

Reclassifications

Certain reclassifications have been made to the 1989 and 1990 consolidated financial statements to conform to the 1991 presentation.

(2) Trade Receivables

The consolidated financial statements as of February 28, 1991 and 1990 include the following amounts:

	1991	1990
Commercial receivables	\$ 1,164,200	622,304
Receivables under U.S. Government contracts:		
Amounts billed	565,087	979,803
Recoverable costs and accrued profits not billed	939,838	293,000
Amount withheld, due upon completion of contracts	104,519	102,979
Total receivables under U.S. Government contracts	1,609,444	1,375,782
Less allowance for uncollectible receivables	(150,000)	(154,000)
	\$ 2,623,644	1,844,086

Trade receivables at February 28, 1991 include amounts aggregating \$1,555,000 billed under uncompleted contracts. Recoverable costs and accrued profits not billed will be billed on the basis and terms of the contract. Substantially all receivables are collectible and are expected to be collected within one year.

# AURA SYSTEMS, INC. AND SUBSIDIARIES

## Notes to Consolidated Financial Statements, Continued

Cost and incentive-type contracts and subcontracts are subject to government audit and review. It is not anticipated that such adjustments, if any, with respect to determination of reimbursability of costs under cost or incentive-type contracts and subcontracts, will have a material effect on the Company's financial condition or results of operations.

U.S. Government contracts and subcontracts are by their terms subject to termination by the government or the prime contractor either for convenience or for default.

### (3) Acquisition

On May 9, 1989, the Company acquired the outstanding common stock of International Micro CAD/CAM Engineering, Ltd. (CAD/CAM Ltd.) in exchange for 348,027 shares of common stock valued at \$967,516. CAD/CAM Ltd. is engaged in the design, development and marketing of computer-aided design and manufacturing software.

The acquisition has been accounted for as a purchase; accordingly, CAD/CAM Ltd.'s assets and liabilities have been recorded at estimated fair market values at the date of acquisition. The Company's consolidated results of operations include CAD/CAM Ltd. from May 1, 1989, the date effective control was achieved.

The following unaudited pro forma information reflects the results of the Company's operations as though the purchase of CAD/CAM Ltd. had been made at the beginning of fiscal 1990 and 1989. Pro forma results of operations are not necessarily indicative of the actual results of operations that would have occurred had the purchase actually been made at the beginning of the respective periods, or of results which may occur in the future.

	Pro forma (unaudited)	
	1990	1989
Revenues	\$ 9,316,567	4,493,686
Net loss	(3,418,632)	(2,171,276)
Net loss per share	(.16)	(.13)

In December 1988, the Company acquired Delphi Components, Inc. (Delphi) for \$562,500. The transaction was accounted for as a purchase and the operations of Delphi have been included from the transaction date.

### (4) Licensing Agreement

In fiscal 1991, the Company entered into a sales and distribution agreement with a major medical supplier. The medical supplier will have exclusive sales rights to certain technology and related products for two years with options for additional years. In consideration, the Company received \$500,000 which has been deferred and is being recognized as revenue over the term of the agreement.

**AURA SYSTEMS, INC.  
AND SUBSIDIARIES**

Notes to Consolidated Financial Statements, Continued

**(5) Related Party Transactions**

Notes and advances due from related parties, all current and unsecured, aggregated \$222,425 and \$251,400 at February 28, 1991 and 1990, respectively, and bear interest at rates to 10%. Included in other assets is \$90,000 of long-term employee notes receivable.

In connection with the Company's private placements and sale of its convertible secured notes payable, a director/stockholder received \$45,000 in 1991. In 1990, in connection with the Company's private placements and sale of its nonrecourse notes, the director/stockholder received \$120,000 and \$290,000, respectively, for structuring services related to these issuances.

**(6) Inventories and Contracts in Process**

Inventories are stated at the lower of cost or market on a first-in, first-out basis. At February 28, 1991 and 1990, inventories were comprised of the following:

	1991	1990
Raw materials	\$ 424,304	223,340
Contracts in process	364,088	353,101
	\$ 788,392	576,441

The U.S. Government has title to, or a security interest in, certain inventories of a subsidiary, Delphi Components, Inc., by reason of progress payments.

**(7) Other Assets**

Intangible assets included in other assets are being amortized between 1 and 17 years based upon their estimated useful lives. All such costs are being amortized on the straight-line basis. Amortization expense approximated \$244,000, \$205,000 and \$104,000 for fiscal 1991, 1990 and 1989, respectively.

Other assets, net of accumulated amortization, and their respective estimated lives follow:

	Cost		Estimated
	1991	1990	life
Purchased computer software	\$ 530,323	706,717	5 years
Contracts and customer lists	211,348	236,938	10 years
Deferred legal fees	390,341	129,319	1 to 10 years
Patents, license and favorable lease	324,875	203,947	2 to 17 years
Deferred convertible secured note offering costs	282,417	206,517	5 to 10 years
Notes receivable and deposits	112,861	139,490	—
	\$ 1,852,165	1,622,928	

**AURA SYSTEMS, INC.  
AND SUBSIDIARIES**

Notes to Consolidated Financial Statements, Continued

Contracts and customer lists and the favorable lease were a result of the Delphi acquisition. Purchased computer software was the result of the CAD/CAM Ltd. acquisition. Deferred legal fees arose in connection with the Company's financing related to a new headquarters facility and the negotiation of certain contracts.

**(8) Notes Payable**

Notes payable, secured by certificates of deposit, aggregated \$2,300,000 at February 28, 1991 and 1990 and bear interest at 7.75% and 9.0%, respectively. The 1991 certificates of deposit and related note payable each mature on March 25, 1991. Their use is restricted to collateralization of notes payable.

Notes payable to bank maturing at \$100,000 per annum aggregated \$125,805 and \$350,623 at February 28, 1991 and 1990, respectively. The notes bear interest at rates ranging from prime plus 1% to prime plus 2% and are secured by certain equipment and furniture. Additionally, \$200,000 in notes bearing interest at 12.5% are due in 1991.

**(9) Accrued Expenses**

Accrued expenses consist of the following at February 28, 1991 and 1990:

	1991	1990
Accrued payroll and related expenses	\$ 487,970	413,725
Accrued legal, professional and other	633,658	205,552
Accrued interest	—	171,319
	\$ 1,121,628	790,596

**(10) Income Taxes**

At February 28, 1991 and 1990, the Company had net operating loss carryforwards for financial reporting and Federal income tax purposes of approximately \$11,100,000 and \$6,680,000, respectively, which expire through 2006. The net operating loss carryforward at February 28, 1991 and 1990 for Federal income tax purposes differs from the net operating loss carryforward for financial reporting purposes principally due to a write-down in an investment and certain accrued costs.

The California state net operating loss carryforward for income tax and financial reporting purposes is approximately \$5,200,000 and \$2,975,000 at February 28, 1991 and 1990, respectively.

The Company adopted the provisions of Statement of Financial Accounting Standards No. 96, "Accounting for Income Taxes," in fiscal 1989.

## AURA SYSTEMS, INC. AND SUBSIDIARIES

### Notes to Consolidated Financial Statements, Continued

#### (11) Common Stock and Stock Options

The Company has 100,000,000 shares of \$.005 par value common stock authorized for issuance.

In April 1989, the Company completed a private placement of 512,767 shares of common stock resulting in proceeds of \$1,459,000. Additionally, 465,000 shares and warrants to purchase 90,000 shares were sold for proceeds of \$1,860,000 in the quarter ended November 30, 1989. In December 1989, the Company issued an additional 272,750 shares of common stock and warrants to purchase common stock resulting in proceeds of \$991,750. The warrants are exercisable at \$4.50 per share and expire on June 14, 1991. These funds were used for additional working capital which the Company required as it expanded its operations and completed its new headquarters facility during fiscal 1990. Private placements during fiscal 1990, less issuance costs of \$249,701, totaled \$4,061,049.

In the quarter ended May 31, 1990, the Company completed a private placement of 77,500 shares of common stock and warrants to purchase 77,500 shares of common stock resulting in proceeds of \$271,250. The warrants are exercisable at \$4.50 per share and expire on June 14, 1991. Additionally, 793,500 shares of common stock were sold for \$1,513,000 in the quarter ended August 31, 1990. Private placements during fiscal 1991, less issuance costs of \$433,426 totaled \$1,350,824.

In January 1991, an additional \$1,492,000 was received through the sale of warrants to purchase 2,984,000 shares of common stock. The warrants are exercisable at various prices per share, beginning at \$2.00 per share through December 31, 1993, increasing by \$1.00 per share in each subsequent year to \$5.00 per share through the expiration date of December 31, 1995.

The Company has granted nonqualified stock options to certain directors and employees. Options are granted at prices approximating fair value at the date of grant, vest immediately and are exercisable at any time within a five-year period from the date of grant. A summary of stock option activity follows:

	Shares	Price
Options outstanding as of February 29, 1988	300,000	\$ .25 - 3.78
Grants	190,000	.50 - 1.50
Exercises	(100,000)	.25
Options outstanding as of February 28, 1989	390,000	.50 - 1.50
Grants	—	—
Exercises	120,000	1.50
Options outstanding as of February 28, 1990	270,000	.50 - 1.50
Grants	300,000	.50 - 3.44
Exercises	(20,000)	.50
Options outstanding as of February 28, 1991	550,000	.50 - 3.44

**AURA SYSTEMS, INC.  
AND SUBSIDIARIES**

Notes to Consolidated Financial Statements, Continued

The aggregate proceeds which would be received upon exercise of the options outstanding at February 28, 1991 approximate \$185,000.

**(12) Employee Stock Plans**

The Company has three employee benefit plans: the 1989 Employee Stock Ownership Plan (the 1989 Plan), the Employee Stock Ownership Plan (ESOP) and the 1989 Stock Option Plan (the Stock Option Plan).

The 1989 Plan is a nonqualified plan which was adopted by the Board of Directors and approved by the stockholders in 1989. Every employee who worked for the Company during the fiscal year ended February 28, 1989 is eligible to participate in the 1989 Plan. The Company contributed \$119,000 during fiscal 1989. No further contributions will be made to the 1989 Plan.

The ESOP is a qualified discretionary employee stock ownership plan that covers substantially all employees. This plan was formally approved by the Board of Directors during fiscal 1990. The Company contributed common stock valued at \$497,000 and \$328,000 to the ESOP in fiscal 1991 and 1990, respectively.

During fiscal 1990, the Company's Board of Directors adopted the Stock Option Plan, a nonqualified plan which was subsequently approved by the stockholders. The Stock Option Plan authorizes the grant of options to purchase the lesser of up to 8% of the Company's outstanding common shares or 2,000,000 common shares. As of February 28, 1991, options have been granted under the Stock Option Plan to purchase 1,800,000 shares at prices ranging from \$1.44 to \$4.12. None of these options have been exercised.

**(13) Commitments**

The Company leases office facilities and equipment under operating leases that expire through April 1994. Other costs, such as property taxes, insurance and maintenance, are also paid by the Company. Rental expense charged to operations approximated \$208,000, \$228,000 and \$140,000 in 1991, 1990 and 1989, respectively.

At February 28, 1991, minimum rentals under noncancelable operating leases are as follows:

Year ending February 28:	
1992	\$ 125,000
1993	103,000
1994	103,000
1995	—
	<hr/>
	\$ 331,000
	<hr/>

## AURA SYSTEMS, INC. AND SUBSIDIARIES

### Notes to Consolidated Financial Statements, Continued

#### (14) Significant Customers

For the years ended February 28, 1991 and 1990, the Department of the Air Force accounted for approximately 39% and 69%, respectively, of the Company's revenues. For the year ended February 28, 1989, the Department of the Air Force and Boeing Company accounted for approximately 70% and 11% of the revenues, respectively.

#### (15) Legal Matters

In October 1989, Harry Kurtzman, Arthur Schwartz, Patrick Glenn, Neal Kaufman and Advanced Integrated Systems, Inc. (AIS), an inactive company which is controlled by such individuals filed a complaint in the U.S. District Court against Harvey Rovenger and Henry Warshaw alleging numerous violations of the Racketeer Influenced and Corrupt Organizations Act (RICO) and the Securities Exchange Act of 1934 arising out of the formation of Amcan and CMI, and Levitron International Ltd. and Levitron of Texas, Inc. On March 27, 1990, Messrs. Rosenberg and Warshaw filed a countercomplaint against Aura and certain of its officers and directors (the Countercomplaint) in such proceeding.

In April 1991 each and every claim based on RICO, fraud and/or fraud-related offenses, was dismissed. The only remaining suit against Aura is that of breach of contract which claims damages in excess of \$1 million.

In a related suit filed in Los Angeles Superior Court by Aura Systems, Inc. et al against Robert Bosley et al, a cross-complaint was filed claiming damages against the Company and others in excess of \$3 million, compensatory damages in excess of \$1.2 million and punitive damages in an undisclosed amount. The Company believes these claims are without merit and intends to vigorously defend against such claims.

A similar proceeding was instituted by Levitron of Texas, Inc. (Levitron) and Robert Bosley against the directors and former directors of the Company in March 1990 in the District Court of Dallas County, Texas relating to a contract between Levitron and Hughes Aircraft company which was subsequently completed by the Company. The plaintiffs have alleged misrepresentation and omission in connection with the Company's acquisition in April 1988. The plaintiffs are seeking to recover approximately \$7 million in actual damages and \$14 million in punitive damages together with the prototype gimbal development under the Hughes contract and technology patents and improvements relating thereto. The Company believes these claims are without merit and intends to vigorously defend against such claims.

During June 1989, Micro CAD/CAM Systems, Inc. (MCCS), a wholly owned subsidiary of Aura, filed an action against Manufacturing Design Systems, Inc. (MDS) and certain individuals affiliated with MDS in the U.S. Central District of California. MCCS alleges, among other things, that MDS agreed to distribute software that MCCS developed, and that MDS failed to pay MCCS money owed pursuant to that arrangement and failed to provide MCCS with sales reports and a business plan. The complaint alleges, among other things, breach of contract, fraud and copyright infringement, and seeks both compensatory damages in the amount of \$300,000 and punitive damages according to proof at the time of trial. The Company believes these claims are without merit.

## AURA SYSTEMS, INC. AND SUBSIDIARIES

### Notes to Consolidated Financial Statements, Continued

A former consultant of a subsidiary of the Company alleges breach of contract, conversion of the Company's common stock, fraud, unfair and deceptive trade practices and conversion of a software program. The plaintiff seeks, among other things, damages in excess of \$500,000 and the rights to the software program. The Company believes these claims are without merit and intends to vigorously defend against such claims.

In May 1991 Coors Brewing Company, Inc. (Coors) filed a lawsuit against Aura Systems, Inc. alleging violations of a confidentiality agreement and willful misappropriation of trade secrets. Coors seeks injunctive relief and compensatory and punitive damages for an unspecified amount, as well as having an accounting for any profits made by the Company during the Company's alleged use of the trade secrets.

In response Aura has filed a counter-claim alleging fraud, conspiracy to defraud, wrongful interference with prospective economic advantage and unfair competition. The Company intends to vigorously defend against Coors' complaint and will prosecute their counter-claim to its conclusion.

Accordingly, in the opinion of management, based in part on the advice of counsel, the ultimate resolution of these matters will not have a material adverse effect. Therefore, no provision has been made in the consolidated financial statements. The Company is also engaged in other legal actions arising in the ordinary course of business.

#### (16) Subsequent Events

In April 1990, the Company issued \$7,250,000, 7% convertible debentures due in March 1999. The debentures were convertible into common stock of the Company at any time at the option of the holder at a conversion price of \$3.50 per share and are subject to mandatory conversion into common stock in the event the market price of the common stock exceeds \$7.00 per share for ten consecutive trading days.

In March 1990, the Company issued a \$1,500,000, 7% convertible nonrecourse note due in March 2000 to provide additional working capital for the Company. The note is convertible into common stock of the Company at any time at the option of the holder at a conversion price of \$3.625 per share and is subject to mandatory conversion into common stock in the event the market price of the common stock exceeds \$7.00 per share for ten consecutive trading days.

During April 1991, all \$6,700,000 of outstanding 7% convertible nonrecourse notes were converted to equity by a combination of voluntary and mandatory conversions under the terms of indentures resulting in approximately 1,900,000 shares of common stock.

In the event, the Company has a need for additional working capital, this property may be used to collateralize future borrowings.

Schedule II  
**AURA SYSTEMS, INC.**  
**AND SUBSIDIARIES**

Amounts Receivable from Related Parties and  
Underwriters, Promoters and Employees  
Other Than Related Parties

Years ended February 28, 1991, 1990 and 1989

Name of debtor	Balance at beginning of period	Deductions			Balance at end of period	
		Additions	Amounts collected	Amounts written off	Current	Not current
<b>Year ended February 28, 1991:</b>						
Francis Phalen	\$ 180,000	—	—	—	180,000	—
Gregory Um, Ph.D.	51,050	—	35,000	—	16,050	—
R. Michael Wilde	25,000	—	7,500	—	7,500	10,000
Avi Lipski	40,000	—	—	—	—	40,000
Emanuel Liebzon	40,000	—	—	—	—	40,000
Others	5,350	18,875	5,350	—	18,875	—
	<u>\$ 341,400</u>	<u>18,875</u>	<u>47,850</u>	<u>—</u>	<u>222,425</u>	<u>90,000</u>
<b>Year ended February 28, 1990:</b>						
Francis Phalen	\$ —	180,000	—	—	180,000	—
Gregory Um, Ph.D.	11,050	40,000	—	—	51,050	—
R. Michael Wilde	15,000	10,000	—	—	15,000	10,000
Norman Olshansky	15,000	—	15,000	—	—	—
Avi Lipski	—	40,000	—	—	—	40,000
Emanuel Liebzon	—	40,000	—	—	—	40,000
Others	2,709	5,350	2,709	—	5,350	—
	<u>\$ 43,759</u>	<u>315,350</u>	<u>17,709</u>	<u>—</u>	<u>251,400</u>	<u>90,000</u>
<b>Year ended February 28, 1989:</b>						
Gregory Um, Ph.D.	\$ 11,050	—	—	—	11,050	—
R. Michael Wilde	—	15,000	—	—	15,000	—
Norman Olshansky	15,000	—	—	—	15,000	—
Others	7,730	2,709	7,730	—	2,709	—
	<u>\$ 33,780</u>	<u>17,709</u>	<u>7,730</u>	<u>—</u>	<u>43,759</u>	<u>—</u>

Schedule V  
**AURA SYSTEMS, INC.**  
**AND SUBSIDIARIES**

Property, Plant and Equipment  
 Years ended February 28, 1991, 1990 and 1989

Classification	Balance at beginning of period	Additions, at cost	Retirements	Other changes	Balance at end of period
<b>Year ended February 28, 1991:</b>					
Land	\$ 2,000,000	—	—	—	2,000,000
Building	6,763,304	72,355	—	—	6,835,659
Machinery and equipment	1,080,141	326,417	—	—	1,406,558
Furniture, fixtures and leasehold improvements	614,416	42,770	—	—	657,186
	<u>\$ 10,457,861</u>	<u>441,542</u>	<u>—</u>	<u>—</u>	<u>10,899,403</u>
<b>Year ended February 28, 1990:</b>					
Land	\$ —	2,000,000	—	—	2,000,000
Building	—	6,763,304	—	—	6,763,304
Machinery and equipment	853,493	226,648	—	—	1,080,141
Furniture, fixtures and leasehold improvements	113,035	424,251	—	77,130	614,416
	<u>\$ 966,528</u>	<u>9,414,203</u>	<u>—</u>	<u>77,130</u>	<u>10,457,861</u>
<b>Year ended February 28, 1989:</b>					
Machinery and equipment	\$ 270,538	582,955	—	—	853,493
Furniture, fixtures and leasehold improvements	97,846	23,426	8,237	—	113,035
	<u>\$ 368,384</u>	<u>606,381</u>	<u>8,237</u>	<u>—</u>	<u>966,528</u>

Schedule VI  
**AURA SYSTEMS, INC.  
 AND SUBSIDIARIES**

Accumulated Depreciation, Depletion and Amortization  
 of Property, Plant and Equipment

Years ended February 28, 1991, 1990 and 1989

<u>Depreciation</u>	<u>Balance at beginning of period</u>	<u>Charged to costs and expenses</u>	<u>Retirements</u>	<u>Other changes</u>	<u>Balance at end of period</u>
<b>Year ended February 28, 1991:</b>					
Building	\$ 27,973	170,890	—	—	198,863
Machinery and equipment	440,409	209,880	—	—	650,289
Furniture, fixtures and leasehold improvements	<u>42,532</u>	<u>92,085</u>	<u>—</u>	<u>—</u>	<u>134,617</u>
	<u>\$ 510,914</u>	<u>472,855</u>	<u>—</u>	<u>—</u>	<u>983,769</u>
<b>Year ended February 28, 1990:</b>					
Building	\$ —	27,973	—	—	27,973
Machinery and equipment	247,642	192,767	—	—	440,409
Furniture, fixtures and leasehold improvements	<u>13,130</u>	<u>15,875</u>	<u>—</u>	<u>13,527</u>	<u>42,532</u>
	<u>\$ 260,772</u>	<u>236,615</u>	<u>—</u>	<u>13,527</u>	<u>510,914</u>
<b>Year ended February 28, 1989:</b>					
Machinery and equipment	\$ 68,044	179,598	—	—	247,642
Furniture, fixtures and leasehold improvements	<u>21,367</u>	<u>—</u>	<u>8,237</u>	<u>—</u>	<u>13,130</u>
	<u>\$ 89,411</u>	<u>179,598</u>	<u>8,237</u>	<u>—</u>	<u>260,772</u>

Schedule IX  
**AURA SYSTEMS, INC.  
 AND SUBSIDIARIES**

Short-Term Borrowings

Years ended February 28, 1991, 1990 and 1989

<u>Category of aggregate short-term borrowings</u>	<u>Balance at end of period</u>	<u>Weighted average interest rate</u>	<u>Maximum amount outstanding during the period</u>	<u>Average amount outstanding during the period</u>	<u>Weighted average interest rate during the period</u>
Year ended February 28, 1991: Amounts payable to bank for borrowing	\$ <u>2,300,000</u>	<u>7.75%</u>	\$ <u>2,300,000</u>	<u>2,300,000</u>	<u>7.75%</u>
Year ended February 28, 1990: Amounts payable to bank for borrowing	\$ <u>2,300,000</u>	<u>9.0%</u>	\$ <u>2,300,000</u>	<u>2,300,000</u>	<u>9.0%</u>
Year ended February 28, 1989: Amounts payable to bank for borrowing	\$ <u>2,300,000</u>	<u>9.0%</u>	\$ <u>2,300,000</u>	<u>2,300,000</u>	<u>9.0%</u>

*AURA SYSTEMS, INC.*  
*2335 Alaska Avenue*  
*El Segundo, CA 90245*  
*(213) 643-5300*