

LOG OF MEETING
DIRECTORATE FOR ENGINEERING SCIENCES

SUBJECT: Update of Arc Fault Circuit Interrupter Technology by Zlan, Ltd.

DATE OF MEETING: May 7, 1998

PLACE OF MEETING: East West Towers, Room 410A

LOG ENTRY SOURCE: Doug Lee, ESEE *Gal*

COMMISSION ATTENDEES:

Aaron Banerjee, ESEE
Sheela Kadambi, ESEE
William King, ESEE
Doug Lee, ESEE
Anna Luo, ESEE
Andrew Trotta, ESEE
Ed Krawiec, LSE
Diane Porter, LSE
Ron Reichel, LSE

NON-COMMISSION ATTENDEES:

George Spencer, Zlan, Ltd.
Lee Blanton, Zlan, Ltd.
Ken Krogh, Zlan, Ltd.
Scott Spencer, Zlan, Ltd.
Crystal Lyons, Zlan, Ltd.
Ed Storm, Zlan, Ltd.
Ruben Sonnino, SGS Thomson Microelectronics, Inc.
Tom Hopkins, SGS Thomson Microelectronics, Inc.
Steve Rose, SGS Thomson Microelectronics, Inc.
Charles Cooke, Rep. Ralph Hall
Saul Rosenbaum, Leviton
John Dougherty, GE

SUMMARY OF MEETING:

The purpose of the meeting was to update the Commission's technical staff on Zlan's Arc Fault Circuit Interrupter (AFCI) technology, present AFCI installation and maintenance concepts (Zlan's Load Center Module (LCM)) and to introduce Zlan's relationship with SGS Thomson Microelectronics, Inc. (ST), a chip set manufacturer. Zlan had previously presented to the Commission's technical staff in March of 95 and April of 96. A copy of the Zlan and ST presentation package is appended to the meeting log. Product literature on the Digitally Enhanced Circuit Breaker and the Load Center Module is also appended.

Mr. Lee opened the meeting citing two current events with AFCIs. First is the 1999 National Electrical Code (NEC) final voting (May 17-21) on the requirement that would require AFCIs on bedroom circuits by the year 2002. Second is the revising of the NEMA version of the AFCI draft standard to a UL draft standard, UL subject 1699. The first edition is expected to be released in

1999.

Mr. Krogh gave an overview of Zlan and introduced the Zlan staff. Mr. Spencer stated that Zlan is a research company that is dedicated to the design and development of electrical safety products and is not in the manufacturing business. Zlan has developed and patented their AFCI or Digitally Enhanced (DE) Circuit Breaker® to detect arcing faults. Additionally, Zlan has developed and patented support technology to aid in installation and maintenance with the DE Circuit Breaker. This technology is used in their Load Center Module (LCM) that interfaces to all of the DE circuit breakers and has recording functions similar to an airplane's "black box".

Mr. Spencer said that Zlan has developed a relationship with ST to help bring a low cost AFCI solution to circuit breaker manufacturers. Zlan's relationship with ST will allow ST to manufacture a custom chip set with Zlan's AFCI technology that could be sold to the circuit breaker manufacturers. The cost to a circuit breaker manufacturer is estimated to be much lower than a circuit breaker manufacturer could produce on their own.

Mr. Blanton described some of the technical aspects of both Zlan's DE Circuit Breaker and LCM. A time-versus current graph was presented that compared conventional circuit breaker trip times with the fusing of a No. 26 AWG wire and a Zlan AFCI. The DE circuit breaker is capable of detecting high current parallel arcing, series arcing down to 5 Amps, and ground faults. Additional features include a status indicator for fault identification and performance testing, a serial port for communicating to a LCM, and the ability to avoid nuisance tripping.

The DE Circuit Breaker has extensive testing capabilities. It has an auto self test plus manual testing. It can test ground fault, arc fault, and the solenoid with or without tripping.

Zlan's DE Circuit Breakers can be programmed to provide important operating features. Mr. Spencer is looking to the industry to help decide how some of the features should be implemented. Some of these features include: how to implement AFCI and GFCI testing, open neutral testing, and bypassing for events such as arc welding.

Although the DE Circuit Breakers can function without the LCM, Mr. Spencer believes that the LCM is a critical part of the AFCI system for fault identification and analysis. The LCM fits in a standard circuit breaker case and is capable of coordinating and storing valuable information that would otherwise be lost. The LCM is connected to each DE Circuit Breaker and can provide audible and visual indication of faults; store fault reason with parameters and a time date stamp of events; and provide communications to monitoring systems.

Mr. Spencer also believes that low current series arcing is a significant percentage of arcing faults and believes that technologies such as Zlan's can address the problem. Mr. Spencer had several questions regarding the 1999 NEC proposals and the NEC process. Mr. King briefly described the NEC process of how a proposal becomes an NEC requirement.

Mr. Ruben Sonnino gave an overview of SGS-Thomson Microelectronics, Inc. (ST). Mr. Sonnino showed that ST is a global semiconductor company with extensive resources to manufacture and support this technology.

Mr. Hopkins presented a block diagram of the DE Circuit Breaker and discussed ST's emulation capabilities for the microprocessor. Mr. Hopkins also presented their plan for marketing the chip set to the circuit breaker manufacturers in June and their ability to design and manufacture samples by the first quarter of 1999.

REPORT

to the

United States Consumer Products Safety Commission

by



Zlan, Ltd.

and



SGS THOMSON Microelectronics, Inc. (ST)

This report will:

- provide a review and update of the Arc Fault Circuit Interruption technology;
- present new concepts and features as they relate to the installation and maintenance of AFCI technology, and
- introduce a new relationship between Zlan, Ltd., a technical resource group and ST, a chip set manufacturer;

May 7, 1998

Consumer Products Safety Commission
4330 East West Highway
Bethesda, MD

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INTRODUCTION

Zlan, Ltd. is an electronics research and development firm dedicated to providing a FIRE SAFE electrical environment. Zlan was formed after a decade of researching electrical fire problems in homes and businesses throughout the United States.

The focus of this research has been to develop a circuit breaker with a fast response time to detect arcing conditions and the intelligence to avoid nuisance (false) tripping. Zlan has developed and patented such a breaker in Zlan's Digitally Enhanced (DE) Circuit Breaker. To support the installation, maintenance, and consumer's security in home electrical safety, Zlan has developed and patented the Load Center Monitor.

The purpose of this program is to provide the CPSC and other interested parties with a technical update of these developments and to introduce a low cost solution to the problem of electrical fire safety.

The material in this manual presents our program agenda, documentation supporting the performance test results, literature describing the DE Breaker and the Load Center Monitor.

Company Overview



Zlan, Ltd.

Zlan, Ltd. (pronounced Zee'-Lan) is an electronics research and development laboratory dedicated to providing a FIRE SAFE electrical environment. The partnership was formed in 1990 by Mr. George Spencer and Mr. Karl Davenport. The formation of the company was the result of over a decade of researching the problem of electrical fires in homes and buildings throughout the United States.

The emphasis was first devoted to the assumption that faulty wiring was the main cause of electrical fires. Thus, Mr. Spencer devoted his early research to building a tester, the CRV-2, to analyze installed electrical wiring. Since the tester only detected the problem but did not solve it, the tester was never extensively marketed. The solution proved to be in providing a safer circuit breaker that would respond faster stop the flow of electrical current when a problem was detected.

Zlan has now developed and patented this new, safer Digitally Enhanced (DE) Circuit Breaker. In addition Zlan has developed and patented support technology in the Load Center Monitor (LCM) to aid in the installation, maintenance and consumer's security in home electrical safety. The company is located in Wylie, Texas with a second facility located in Sachse, Texas.



SGS-THOMSON Microelectronics, Inc. (ST)

SGS-THOMSON Microelectronics is a global independent semiconductor company which designs, develops, manufactures and markets a broad range of semiconductor integrated circuits ("ICs") and discrete devices used in a wide variety of microelectronic applications, including telecommunications systems, computer systems, consumer products, automotive products and industrial automation and control systems.

In 1997, SGS-THOMSON's net revenues were US\$4.02 billion and net earnings were US\$406.6 million. On the basis of the most recent independent industry data, SGS-THOMSON is the world's supplier of analog ICs, mixed-signal ASICs, Smartcard ICs, non-volatile EPROM and EEPROM memories, special automotive ICs and MPEG-2 decoder ICs.

The Company currently offers more than 3,000 main types of products to more than, including Alcatel, Bosch, Creative Technology, Ford, Hewlett-Packard, IBM, Motorola, Nokia, Northern Telecom, Philips, Seagate Technology, Siemens, Sony, Thomson Multimedia and Western Digital. In 1997, more than 56% of ST's revenue derived from differentiated products, a combination of dedicated, semi-custom and programmable products designed to suit a specific customer or a specific application and therefore having a high system content.

ST has 28,000 employees, 9 advanced research and development units, 31 design and application centers, 17 manufacturing sites and 60 sales offices in 24 countries.

CPSC Presentation
ST/Zlan
May 7, 1998 (9:00am – 12:00 noon)

Objectives:

To introduce a new relationship with chip set manufacture; provide a review and update of Arc Fault Circuit Interruption technology and present new concepts and features as they relate to the support and installation of AFCI technology specifically:

- Introduce ST as manufacture of the chip set.
- Provide review and update on AFCI technology.
- Present new concepts of features which support the installations and maintenance of AFCI technology.

I. Introduction

II. Introduction Zlan, Ltd. (Power Point Update)

- Overview of Company (Who we are & Who we are not)

III. Parameters of Circuit Protection

- Needs and Limitation.
- Overcoming Limitation.
- Audible/Visual Notification of faults.

IV. Available Technology

- Circuit Breaker (Review & Update)
- Information Management (Controller & Feature)

V. Patents

VI. SGS-THOMSON Microelectronics (ST)

- ST Corporate Overview
- Chip Set Description
- Emulator and Support

VII. Summary Q & A



ZLAN LIMITED

“An electronics research and development firm dedicated to providing a
FIRE SAFE
electrical environment.”

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Our Mission

“To resolve electrical fire hazards associated with today’s circuit breakers.”

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The Problem

- ◆ There is a fire in the US every 16 seconds.
- ◆ There is a building fire every 49 seconds.
- ◆ There is a home fire every 67 seconds.

(NFPA Journal, Vol. 87 No. 5, Sept - Oct 1993)

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NFPA reported 1992 had:

- ◆ 1,964,500 fires.
- ◆ 4,730 people killed in those fires.
- ◆ 21,600 people injured in those fires.
- ◆ \$8.3 billion in property damage.

(NFPA Journal, Vol. 87 No. 5, Sept - Oct 1993)

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Partnership

- ◆ The 95th Congress stated that government and industry must work together to resolve the electrical wiring fire problem.

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ZLAN *Failure Modes in Residential Fires*

- ◆ Branch - Circuit Wiring 34%
- ◆ Receptacle Outlets/Switches 19%
- ◆ Cords and Plugs 19%
- ◆ Service equipment 14%
- ◆ Lighting Fixtures and Lamps 13%

99%

(Fire Journal, Jan - Feb 1990, Page 21)

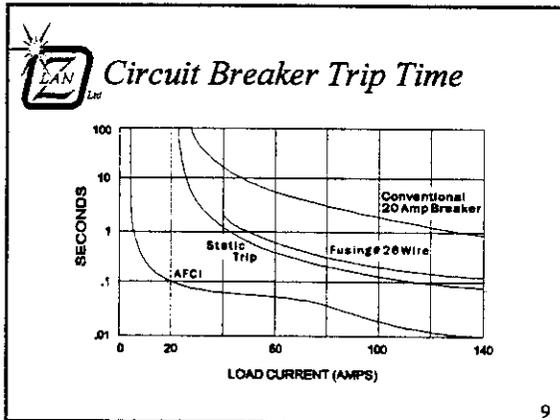
7

ZLAN *The Root Cause*

Fires may start when there is enough energy to start a fire;
but not,
 enough energy to trip the ...

Circuit Breaker.

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ZLAN *Zlan's Digitally Enhanced Circuit Breaker*

Key Benefits:

- ◆ Same Size and Rating ... as present day circuit breakers.
- ◆ Easy to Install ... Simply snap out the old and snap in the new DE Circuit Breaker.
- ◆ Enhances Safety up to 10,000 % ... Retains thermal, magnetic & GFCI technology to preserve their existing features but dramatically improve the level of safety.

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ZLAN *DE Circuit Breaker Key Features*

- ◆ Provides fast tripping for hazardous electrical problems, yet it will...
- ◆ Avoid false trips for routine power surges, i.e. motor start-up, etc...
- ◆ Arc detection to analyze problems that occur above or below the breaker rating.
- ◆ LED status indicator light for fault ID and performance assurance testing.
- ◆ Serial port for communication with a Load Center Monitor.

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ZLAN *The Load Center Monitor*

- ◆ Monitors DE Breakers for functionality of AFCI and actuates alarms for customer security.
- ◆ Alarm has temporary reset with graduated timeout to encourage attention/repair.
- ◆ Stores reason for the trip:
 - ◆ Current overload trip.
 - ◆ High current parallel arcing.
 - ◆ Medium current short circuit.
 - ◆ Low current series arcing.
 - ◆ Ground fault trip.
 - ◆ Motor start with low line voltage. Etc.

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Load Center Monitor *cont'd 1*

- Stores parameters of event in non-volatile memory, with time stamp:
 - Arcing level.
 - Peak current.
 - Average current.
 - Soak (thermal) current.
 - Phase angle of current.
 - Line voltage.
 - Series arcing/noise level.
 - Breaker contacts temperature.

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Load Center Monitor *cont'd 2*

- Stored parameters are available for fault analysis by service technician.
- The LCM can download configuration and mode parameters to individual DE Breakers.
- Trouble-shooting mode to report fault signals, in real time, to repair person via Electrician Test Unit.
- Communication to offsite tech center for parameter interpretation and assistance.

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Load Center Monitor *cont'd 3*

- Alarm indicators are both visual and audible.
- They may be remote from Load Center via built-in devices and/or wall socket plug-ins.
- Alarm may be sounded as 'serious'; or, a 'warning' where analysis indicates an unsafe condition exists.
- Reason for alarm indicated by light coding with additional detail available via communication link.

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Load Center Monitor *cont'd 4*

- Additional communication applications:
 - Receiving shutdown codes from Fire Marshall.
 - Provide communication to central controllers, power management, security and other home monitoring systems.
 - Up-loading of data to a computer with bulk storage and additional event analysis capabilities.

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Parameters of Circuit Protection,
Summary

- We have discussed available technology:
 - Its Needs and Limitations.
 - Overcoming Limitations.
 - The Digitally Enhanced Circuit Breaker.
- Introduction of the Load Center Monitor, supporting:
 - Audible and Visual Notification of Faults.
 - Communication and Information Management Solutions.
 - Test and Fault analysis.

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Digital Enhanced Circuit Breaker

Thomas Hopkins
Manager, Power Systems Application Lab



Enhanced Circuit Breaker

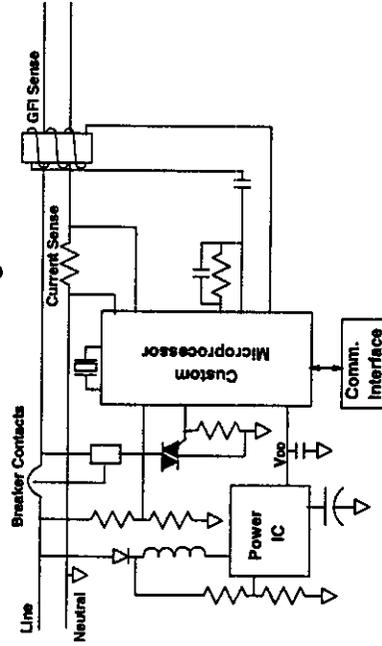
Status

- Preliminary evaluation underway
- Visit circuit breaker manufacturers
 - ▶ June
- Target design specification
 - ▶ End of summer
- Sample IC's
 - ▶ Late Q4 '98, Early Q1 '99



Enhanced Circuit Breaker

Block Diagram



Enhanced Circuit Breaker

Emulator & Support

- Emulator for Micro core is available today
- Customized Emulator based on standard ST emulator
- Preliminary Emulator
 - ▶ Based on Target specification
 - ▶ Available end of summer
- Support
 - ▶ Emulator available through ST sales network
 - ▶ Regional Field Applications support



APPENDIX SECTION

- **Biographical Data**
- **Brochure – Major Advancement in Electrical Safety (DE-CB)**
- **Brochure – Field Test Monitor**
- **Brochure – Load Center Monitor**



Biographical Data

GEORGE A. SPENCER

Mr. Spencer is founder, General Partner and C.E.O. of ZLAN, LIMITED, a well established research laboratory dedicated to the development of electrical safety products. In separate business ventures devoted to improving electrical fire safety in homes, George developed and received his first patent in 1981 for the CRV-2 Wiring Systems Tester. Following the establishment of Zlan, Ltd., George received his second patent in 1990 for the development of the Circuit Overload Protection that increases circuit breaker performance and safety.

George completed a 10 year tour of duty with the U. S. Navy as a communication, radar and cryptography specialist, joined Texas Instruments where he was involved with the development of Category I Air-borne Landing System. Following Texas Instruments, George joined ADAR Memory Testing Unit as a part of a multi-company team, including ESI and Motorola, devoted to laser repair of memories. ADAR was purchased by Scientific Atlanta, later merged with Teradyne, where George was a Senior Application Engineer providing world wide support for Memory Test and Laser Repair. Following Teradyne, George was a Senior Engineer with the SGS Thomson providing memory test and laser redundancy repair. George has over 30 years of research and development experience in the electrical and electronics fields.

LEE BLANTON

Lee Blanton is Vice President of Zlan, Ltd., a research laboratory dedicated to the design and development of electrical safety products. Lee is responsible for the administration and technical management of the Laboratory, the DE (Digitally Enhanced) Circuit Breaker Project and Zlan's Test and Repair Division. Lee also provides client consulting support through both design studies and project design reviews. Such projects have included IC wire bonder motion (path) control, magnetic suspension bearings for steam turbine electrical power generators, load sharing-dumping of dual electrical generators for the B1 bomber, and laser drilling of micro-sized holes in ceramic substrates used in the electronics industry.

Areas of Lee's expertise include: Analog circuit design (linear, pulse, auto switching time measurement); Digital circuit design (TTL and ECL); Computer programming languages ('C', Pascal, Basic, & Assembly); ATE System design and H/W design in VLSI, Memory, Linear, and Magnetic Bubble Memory Test Systems. Before joining Zlan, Lee completed a 26 year career with Texas Instruments where he was recognized as Senior Member Technical Staff (SMTS) the first year it was established. SMTS is a technical merit classification shared by less than 7% of the technical community.

KENNETH C. KROGH

Kenneth C. Krogh is serving as Operations Manager of Zlan, Ltd, a research laboratory dedicated to the design and development of electrical safety products. Ken's primary responsibility is the coordination of Zlan's Circuit Overload Protection (COP) technology product development team, including administration, Field Test Monitoring Program, communication with circuit breaker manufacturers, electrical code and fire protection organizations and market development programs. Mr. Krogh is also President of Jenkins-Krogh International, Inc., a management consulting firm specializing in strategic planning and management development.

Ken has some 30 years of experience in educational research and management consulting. He has conducted work experience programs in Central America; taught industrial psychology courses at Purdue University and later at the University of New Mexico; and managed corporate human resource departments in industrial and research organizations. Prior to forming his own consulting firm in 1972, Ken was responsible for management consulting for KPMG Peat Marwick & Co. in the Southwest. Prior to KPMG, Ken was responsible for management development at Argonne National Laboratories (University of Chicago) and Sandia Laboratories (Western Electric/Bell Laboratories) in Albuquerque, N. M. He has conducted international management seminars for executives in Mexico, Russia, Ukraine, Western Europe and South Africa. Ken is listed in Who's Who in the South and Southwest and is a member of the American Management Association, American Society for Training and Development, Public Personnel Association and Rotary International.



SGS-THOMSON Microelectronics, Inc. (ST)

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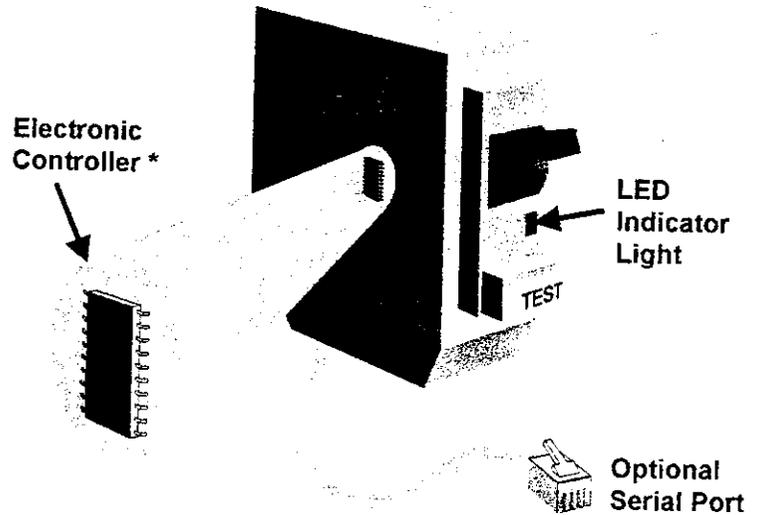
Phone: (972) 466-6412
FAX: (972) 466-7044



Major Advancement in Electrical Safety

KEY BENEFITS

- ✓ **Same Size & Rating** as the present day circuit breaker.
From 15 amp, 20 amp, 30 amp ...
- ✓ **Easy to Install ...**
Simply snap out the old and snap in the new Zlan DE Circuit Breaker.
- ✓ **Enhances Safety to 10,000%**
Works with old breakers to raise their safety level up to 10,000%.



Zlan's Digitally Enhanced Circuit Breaker®

KEY FEATURES

- ❑ Works in conjunction with existing circuit breaker to enhance safety.
- ❑ Uses Microprocessor Controller for state of the art technology.
- ❑ Arc detection to analyze low current problems in the electrical wiring.
- ❑ Avoids false trips for routine power surges, i.e., motor start-ups, etc.
- ❑ Auto self test plus manual test capability.
- ❑ LED status light for performance assurance and fault identification.
- ❑ Serial Port options:
 - Remote monitoring of current and voltage activity.
 - Select performance curve to match application requirements.
 - Remote test and remote trip capability.

ZLAN LTD.

"an electronics research and development
firm dedicated to providing a

FIRE SAFE
electrical environment"



The Company

Zlan, Ltd. (pronounced Zee'-Lan) is an electronics research and development laboratory dedicated to providing a FIRE SAFE electrical living environment. The partnership was formed in 1990 by Mr. George Spencer and Mr. Karl Davenport. The formation of the company was the result of over a decade of researching the problem of electrical fires in homes and buildings throughout the United States.

Emphasis was first devoted to the assumption that faulty wiring was the main cause of electrical fires. Thus, Mr. Spencer devoted his early research to building a tester, the CRV2, to analyze installed electrical wiring. Since the tester only detected the problem but did not solve it, the tester was never extensively marketed. The solution proved to be in providing a safer circuit breaker that would respond faster to stop the flow of electrical current when a problem is detected.

Zlan has now developed and patented* this new, safer, Digitally Enhanced Circuit Breaker.

The Problem

Each year thousands of people die or are seriously injured and billions of dollars are lost because of electrical fires.

The 1,964,500 fires to which the fire service responded in 1992 caused approximately \$8.3 billion in direct property damage. Fire departments respond to a fire somewhere in the U.S. every 16 seconds. There is a structure fire every 49 seconds and a residential fire every 67 seconds. The NFPA (National Fire Protection Association) reports that 4,730 people died and estimates that 21,600 were injured in residential fires in 1992. Over 20% of these fires are attributed to electrical causes.

Over time, extremely hazardous conditions develop within electrical wiring circuits in the home and business. For example, the inside of walls becomes potentially flammable and explosive due to the concentration of small dust particles. Just a few sparks from an electrical arc can set a building in flames.

The early research by Mr. Spencer revealed that in all the homes and businesses tested, the wiring was found to be critically undersized, resulting in a dangerous increase in the

expected circuit breaker trip times. Also, wiring which measured in a safe zone at the outlet became unsafe when using an extension cord. The delay time between the occurrence of a short circuit and the tripping of the breaker may vary from a few tenths of a second to several minutes, depending upon the available short circuit current. In small homes the typical short circuit current, measured at the outlets, varies from 900 Amps down to less than 100 Amps (without extension cord). While in a larger home it may be less than 30 Amps, at which level the trip time would exceed 1 minute! The variance in short circuit current is due to the type, size, and length of wire installed.

The Solution

Today's electrical fire problem requires a circuit breaker with a fast response time to detect arcing conditions and the intelligence to avoid nuisance (false) tripping.

The technology used in today's circuit breakers, thermal and magnetic, is most effective for very high current overloads; 10 times the rating of a magnetic breaker, and 15 times the rating of a thermal breaker. For a 20 Amp thermal breaker the electrical fire protection falls off sharply when a short produces currents less than 300 Amps. Magnetic breakers are fast but their trip current has to be raised to avoid nuisance tripping due to such things as motor start-ups and incandescent lights.

Zlan's focused its efforts on short circuit currents and arcing conditions which occur at or below the protection of thermal and magnetic breakers. Zlan can demonstrate that its technology will protect a single strand of #26 gauge wire from melting with a load from 40 Amps to 500 Amps and yet avoid nuisance tripping with motor startups. Zlan is now working on a concept which will extend protection to an even smaller wire gauge.

Digitally Enhanced Technology

Zlan has made the technology of fast response time to detect arcing conditions and the intelligence to avoid nuisance tripping available to both new and old homes and businesses. This was done by using the latest integrated circuit technology to reduce the size of Digitally Enhanced circuit protection to a micro-size chip, thereby making it possible to be incorporated in residential and business circuit breakers.

For further information, contact:

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* Patent No. 4,949,214

Zlan Ltd. envisions the Digitally Enhanced Circuit Breaker® will be brought to market through the existing circuit breaker manufacturers and their distribution system.



Field Test Monitoring Program

Objective

The Field Test Monitoring Program (FTM) was developed and administrated during the first six months of 1996 in order to evaluate the performance of Zlan's new Digitally Enhance (DE) Circuit Breaker. Several units of Zlan's DE Circuit Breaker were developed for the FTM Program. See Figure 1. In addition to assembling the prototype models, computer monitoring equipment and software were designed to test and evaluate the validity and reliability of the many key features of the DE Circuit Breaker.

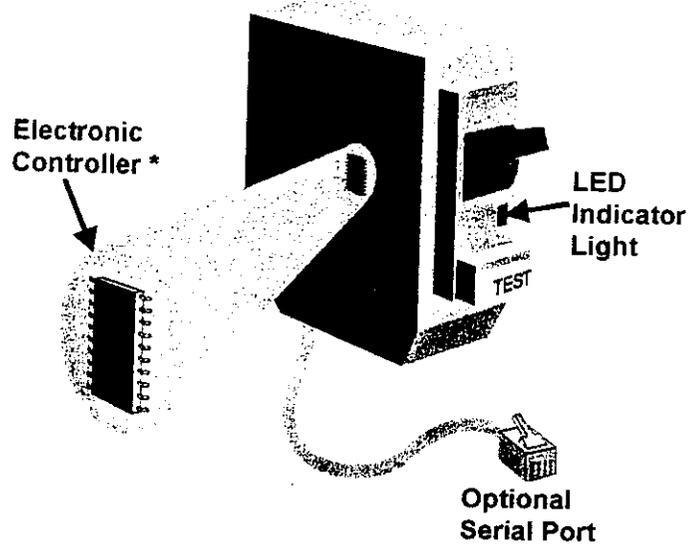


FIGURE 1

FTM Test Sites

Field test sites were selected that would provide typical residential or professional office building electrical circuits, offering a high level of activity and a variety of applications such as garbage disposals, microwave ovens, treadmills, washing machines, copy machines, etc. Owners of prospective test sites were sought that would lend strong credibility and objectivity to the FTM Program. Insurance executives, city officials, fire marshals, owners of professional buildings, etc. were all recruited to participate in the program.

The DE Breaker was installed in series with the test sites' existing circuit breaker so that the present level of circuit overload protection was not diminished. Once installed, the DE Breaker was connected to an on site computer for data storage. By way of a modem connection, data from the selected circuit could be periodically downloaded throughout the 30 to 60 day field test period. See Figure 2, illustration of the setup.

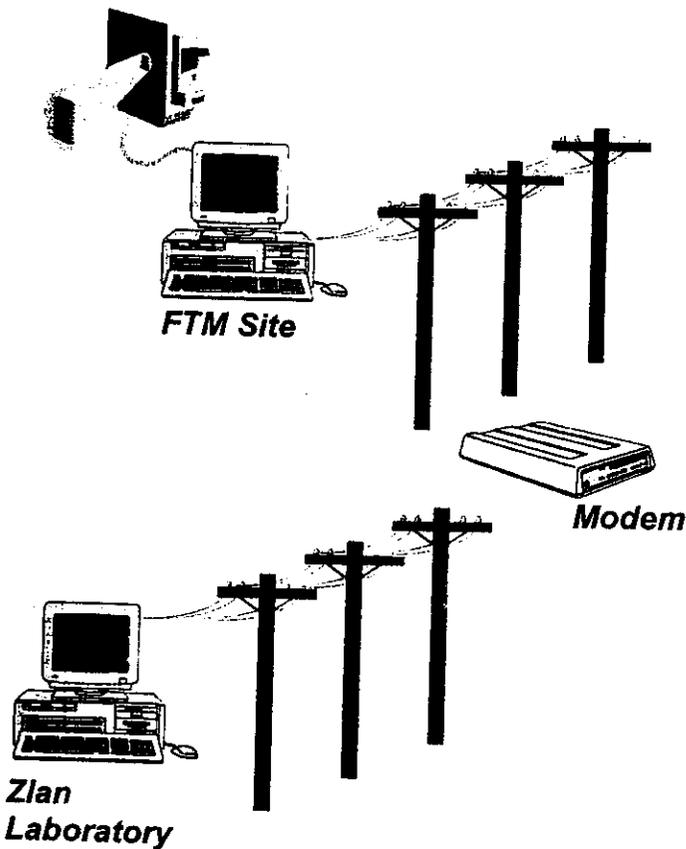
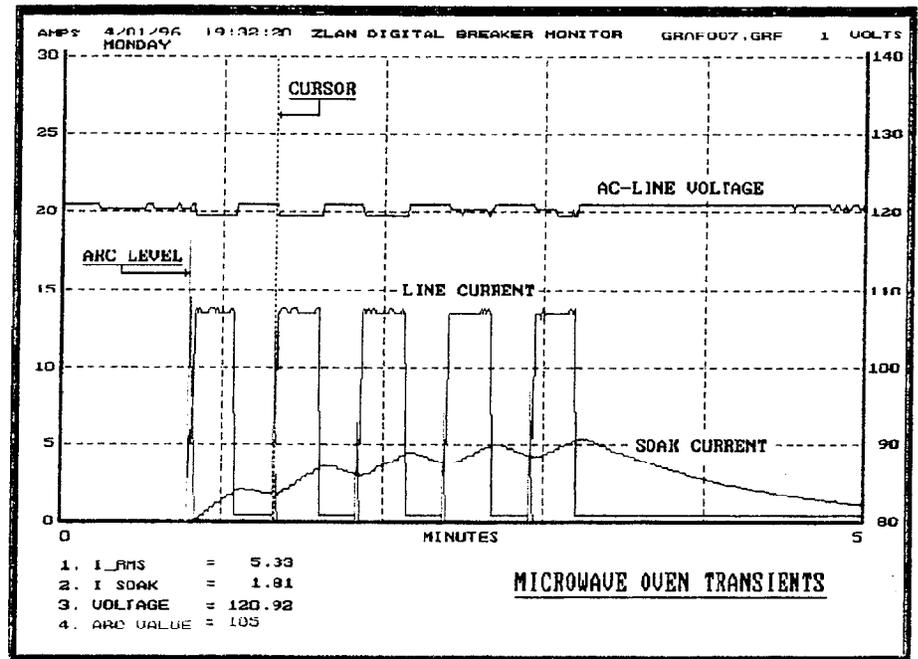


FIGURE 2

Field Test Monitoring Program

Test Data Parameters

More than a dozen different parameters were designed to be data logged with an update rate of 500 milliseconds. Data were also logged whenever 'events' occurred, where an event is defined as a parameter shift greater than a specified threshold. The raw data were saved on the hard drives of both the monitoring computer at the site location and through periodic modem transfers to Zlan's Laboratory. The main parameters were filtered and displayed in graphical form for analysis. Figure 3 shows a typical display screen during live data monitoring for the following parameters:



- Line Current — The AC line current in amps RMS.
- Line Voltage — The AC line voltage in volts RMS.
- Series Arcing — The arc level is a number between 0 and 255.
- Soak Current — The long term running average of the line current. This parameter has a time constant of 68 seconds.

FTM Results

Test sites were operational for 24 hours a day for a six to eight week period. Refinements were made throughout the test period and a representative cross section of the activity was collected on each circuit. The data collected were both continuous and comprehensive providing a significant population of data for interpretation.

Conclusions

Analysis of the database shows that:

- Data collected on circuits in older model homes, where old appliances were in use, produced some high arcing conditions. This data provided information enabling improvements in the Arc Detection Feature.
- The overall database provided useful information concerning the margin of safety for various electrical appliances and the program trip curve.
- The data logging features designed into the circuit breaker proved to be very useful in collecting data at the various site locations.
- Transferring data to our office via modem was much more convenient than visiting each site periodically.

In conclusion, the Field Test Monitoring Program served as a valuable data input, and to **validate** Zlan's DE Circuit Breaker's overall design objectives.

For further information, contact:

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DE Breaker Support

Load Center Monitor (LCM)

It is change, continuing change, inevitable change, that is the dominant factor in society today. No sensible decision can be made without taking into account not only the world as it is, but the world as it will be ... **Isaac Asimov**, author of science fiction (1920-92), *The Encyclopedia of Science Fiction*.

How well this applies to the computer revolution and the race to apply the newest electronic technology. The computer is an important tool supporting what has now become the Information Age. Too much information is thrown away every day, and in many cases, it is critical information.

Valuable Information That Could Be Lost

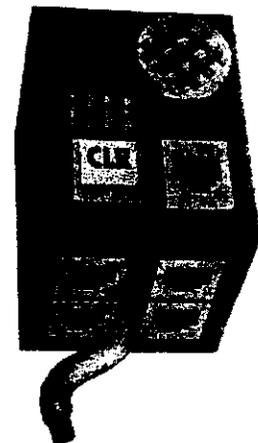
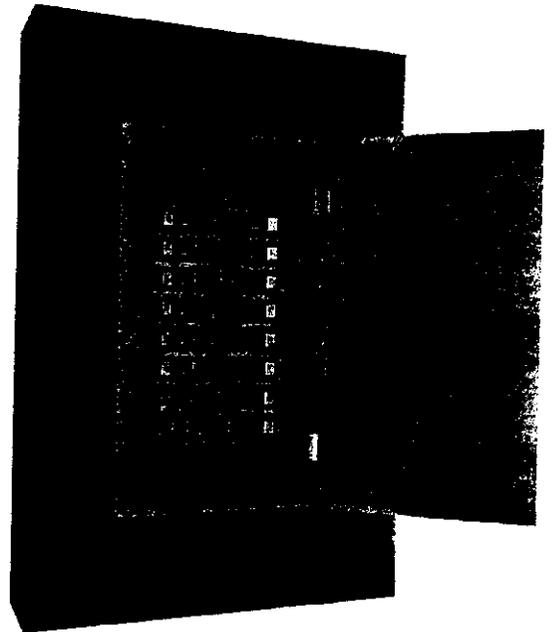
The most important example would be not informing the customer that a fault was detected by a circuit breaker. It could be an arcing fault; or, it may mean a problem has been detected within the AFCI electronics itself.

When a 'trip' does occur, what was the reason: a current overload, high current parallel arcing, medium current short circuit, low current series arcing, ground fault, or low line voltage present when the Air Conditioner tried to start?

Series arcing at loose terminals on the power transformer, or within power line splices at the home, is an example of conditions that affect all breakers on a given service line. Consequently, there is a need to coordinate information from multiple breakers within the load center.

The performance of each Digitally Enhanced circuit breaker is checked only by its internally executing program. The results need to be independently monitored and the customer alerted to possible faults. An audible alarm will be needed to alert the home owner that the circuit breaker needs to be repaired.

Finally, it is desirable to store event/history data when a total power failure occurs, yet eliminate the burden of non-volatile memory and time-stamp requirements from individual DE Breakers. This is similar to the 'black box' on an airplane.



The Load Center Monitor

Communication with multiple DE Circuit Breakers

The LCM continually monitors status of all breakers in the load center for possible fault detection, and if present, will actuate both a visual and an audible alarm. Signals will also be sent to remote alarm devices. A breaker may have tripped but may not have been noticed by the home owner.

Circuit breaker alarm signals may also be a warning that there are indications of potential electrical problems, even though no breaker has tripped.

A Microprocessor with a Real Time Clock and a Non-Volatile memory will regularly datalog numerous parameters such as: peak, average, and soak current, arcing level, and line voltage for each branch circuit. Whenever a change in operating level occurs, an 'event' will be recorded, along with its time stamp, into the LCM's most recent event history file.

Analyze patterns of system activity that are common to several breakers to detect upstream arcing problems or near-brownout voltage conditions. Large motors used in air conditioners (A/C), shop air compressors, and pool pumps generally have great difficulty starting with low line voltage, resulting in dangerous operating conditions for the motor. Should a breaker repetatively trip under these conditions, the customer should be informed that replacing their A/C unit may not be the solution to the problem.

A temporary shutoff push-button is provided on the LCM to disable both the visual and audible alarms. The Load Center Monitor will maintain information about all faults for use by the repair technician. However, if a repair person does not

access the LCM within 48 hours, another alarm/alert will be sounded followed by only a 24 hour grace period, then 12 hours, etc.

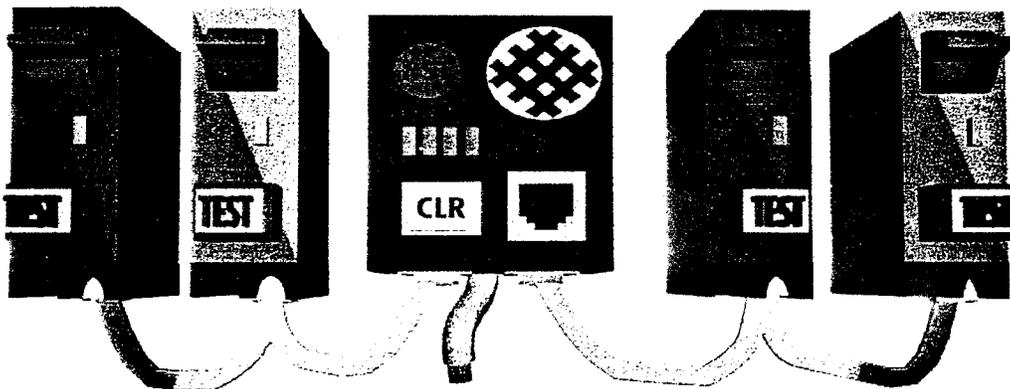
Support data communications with the Electrician Test Unit, including DE Breaker ID and circuit path/location information for trouble shooting branch circuits.

The LCM can download configuration/mode parameters to individual DE Breakers. When trouble-shooting wiring/appliance faults, the repair person can temporarily place a DE Breaker in the thermal-only mode where electronically detected faults are reported but not acted upon. In this Test mode, the technician can now use test equipment designed to aid in tracing faults and their location. The repair person also could place a selected branch DE Breaker into the learn mode when it is necessary to support future new and unusual loads.

Upload log data to another data collection system with bulk storage and analysis capability. Perform first level data gathering and compression for use by Smart Home controllers. Communicate load levels for use in power management applications. Also interface security and alarm systems to report faults while away from home.

Receive encrypted shutdown code from Fire Marshal to command all DE Breakers to trip.

The LCM is designed as a form fit into a standard circuit breaker case and is powered from the ac bus.



For further information, contact:

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1615 W. Brown St.
Wylie, Texas 75098

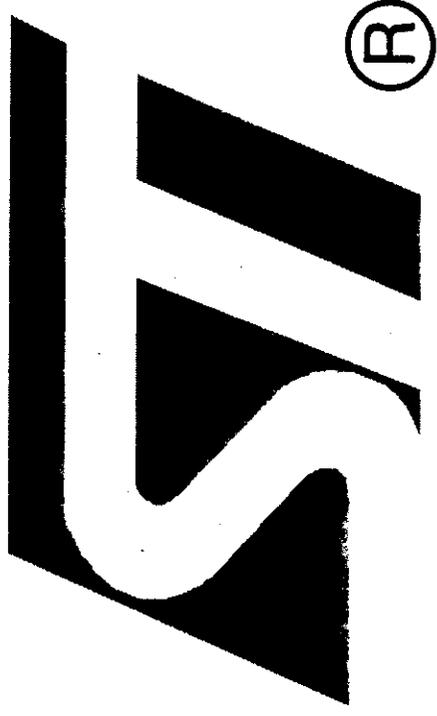
Telephone (972) 442-0558
FAX (972) 442-0569
zlan@msn.com

Please visit our web site at: www.zlan.com

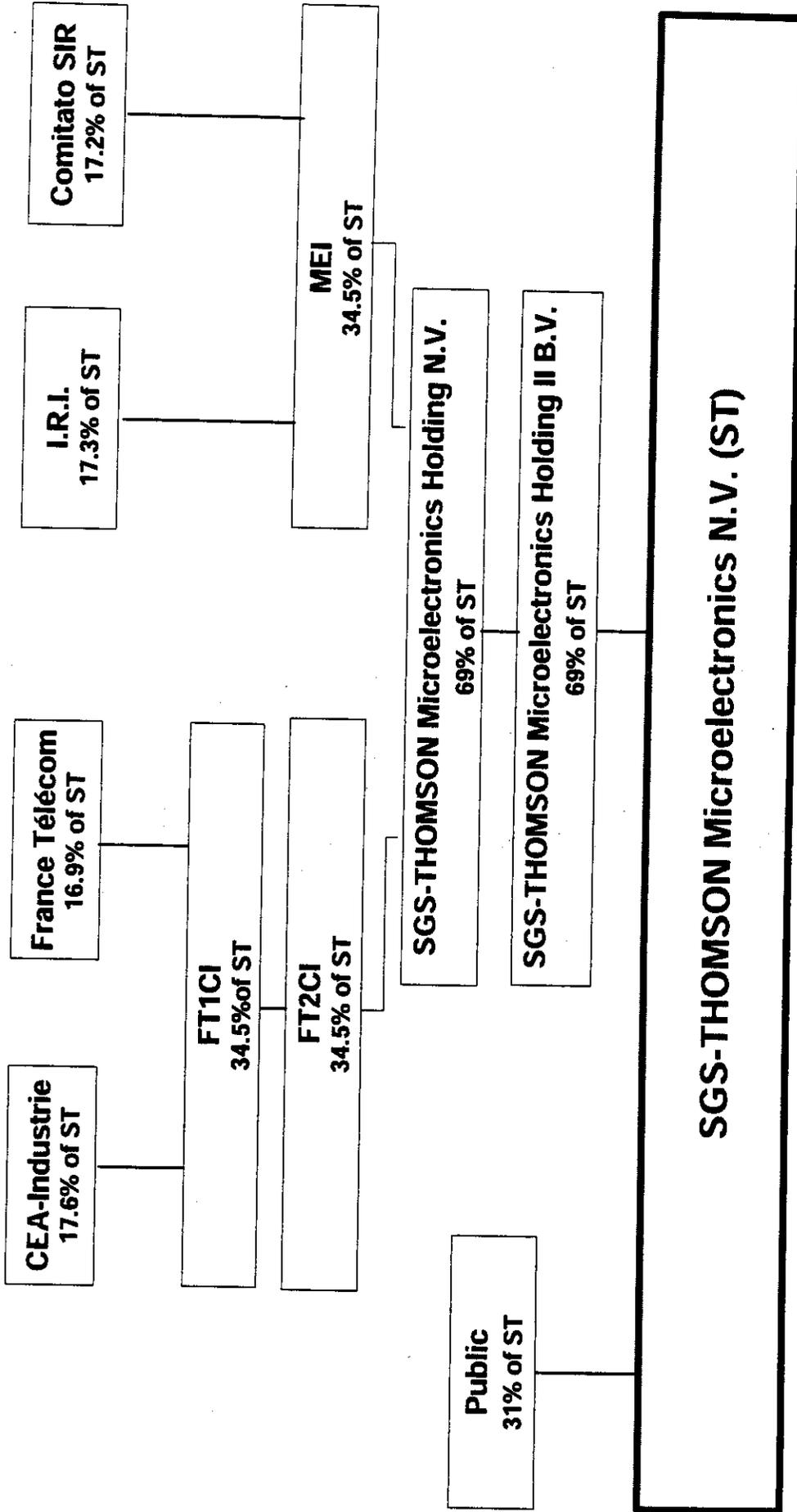
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SGS-THOMSON Microelectronics



SHAREHOLDING STRUCTURE

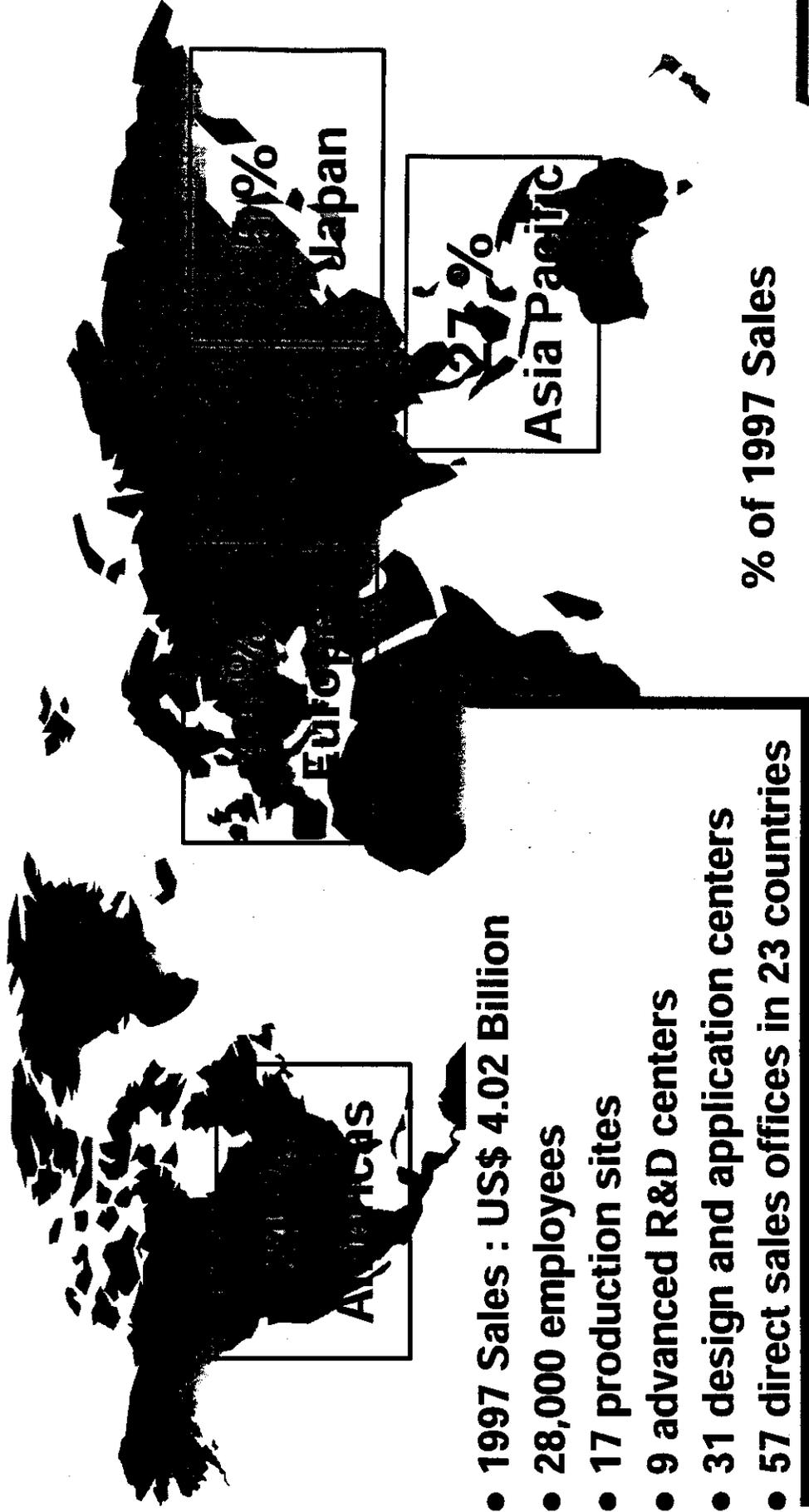


MISSION

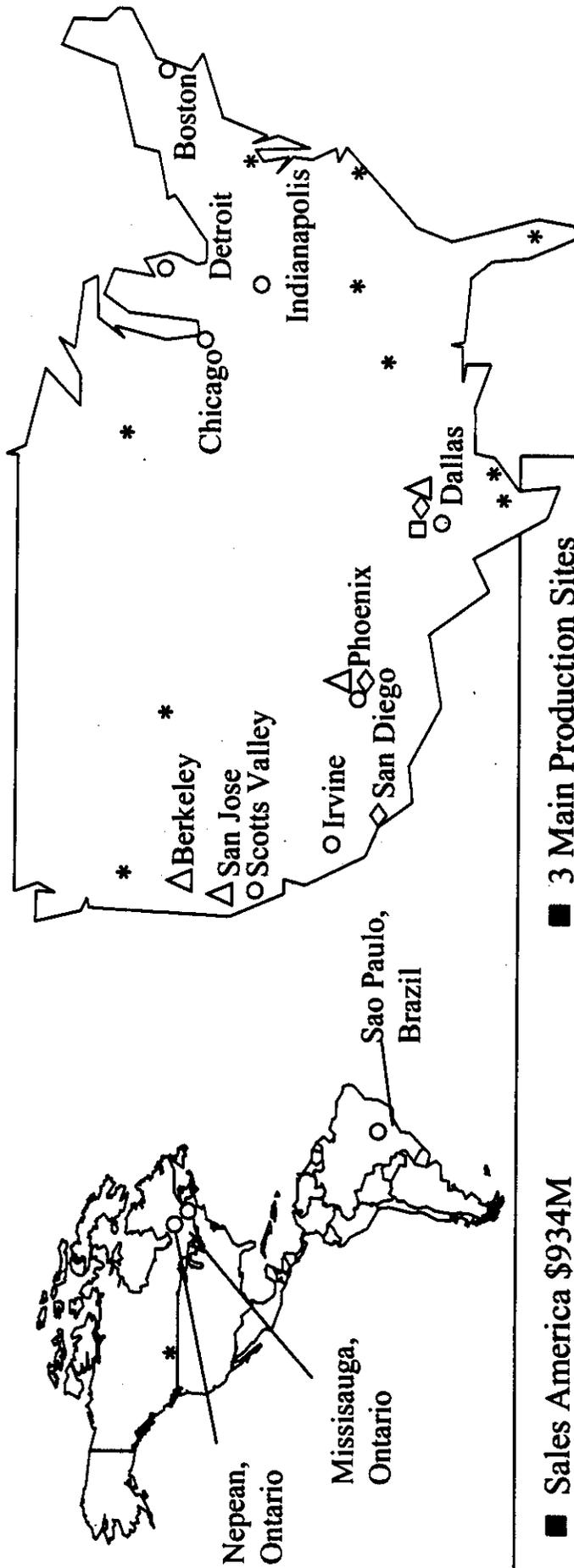
To offer strategic independence
to our partners worldwide,
as a profitable and viable broad range
semiconductor supplier.



SGS-THOMSON : A GLOBAL SEMICONDUCTOR COMPANY



SGS-THOMSON AMERICA : A FULLY-INTEGRATED PRESENCE

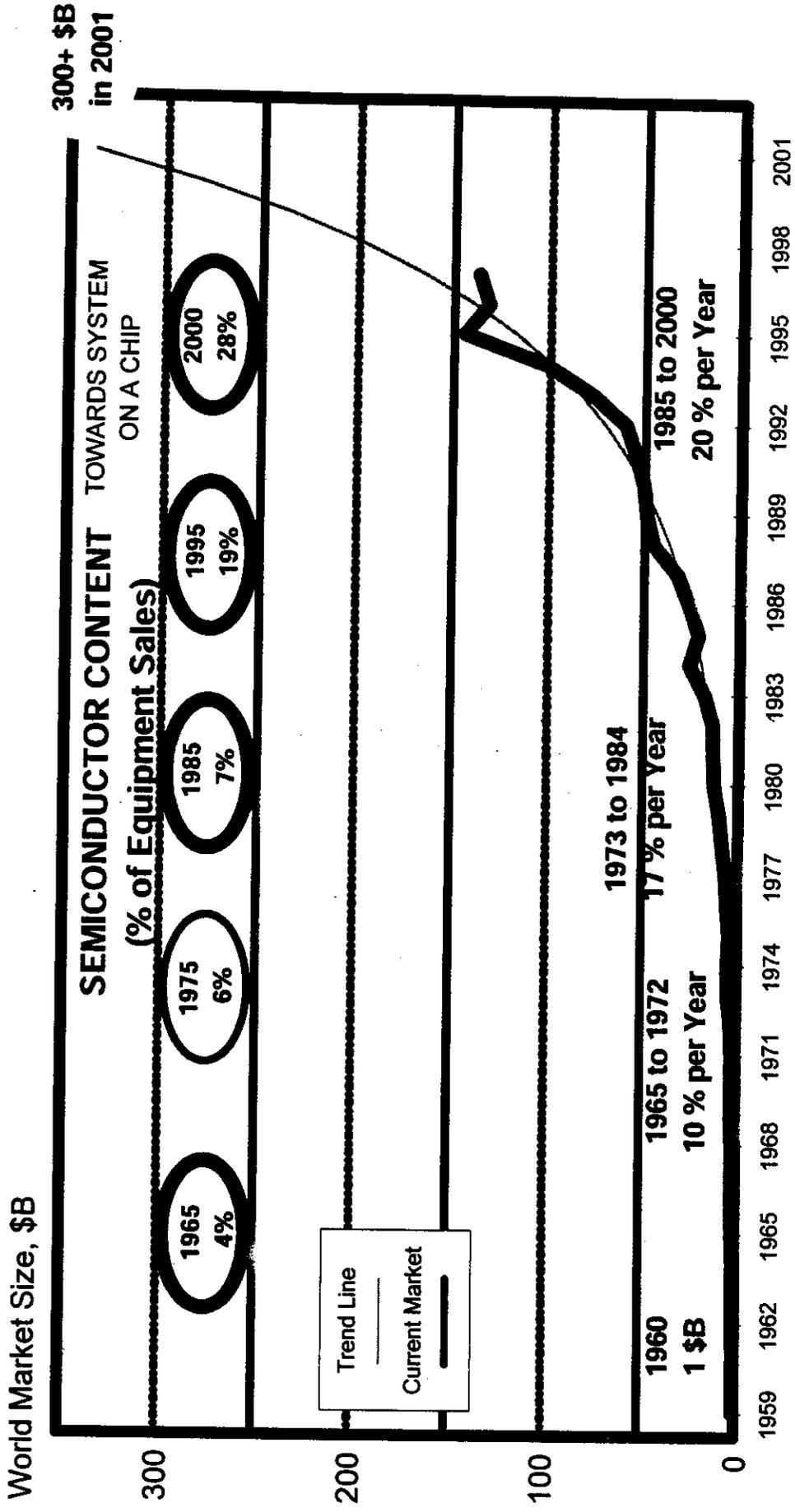


- Sales America \$934M
 - Sales WW America \$1498M
 - 2.2% Market Share
 - 2600 Employees:
 - Production: 1400
 - R&D: 100 (excluding designers)
 - Sales & Marketing: 280
- 3 Main Production Sites
 - 4 R&D and Design Centers
 - 8 Major Sales Offices
 - 24 Total Sales Locations

- Headquarters
- Direct Sales Offices
- △ R&D Design Centers
- ◇ Manufacturing
- * Other Sales Locations



RISING SEMICONDUCTOR CONTENT FUELS DEMAND



Sources: WSTS, DATAQUEST, SGS-THOMSON

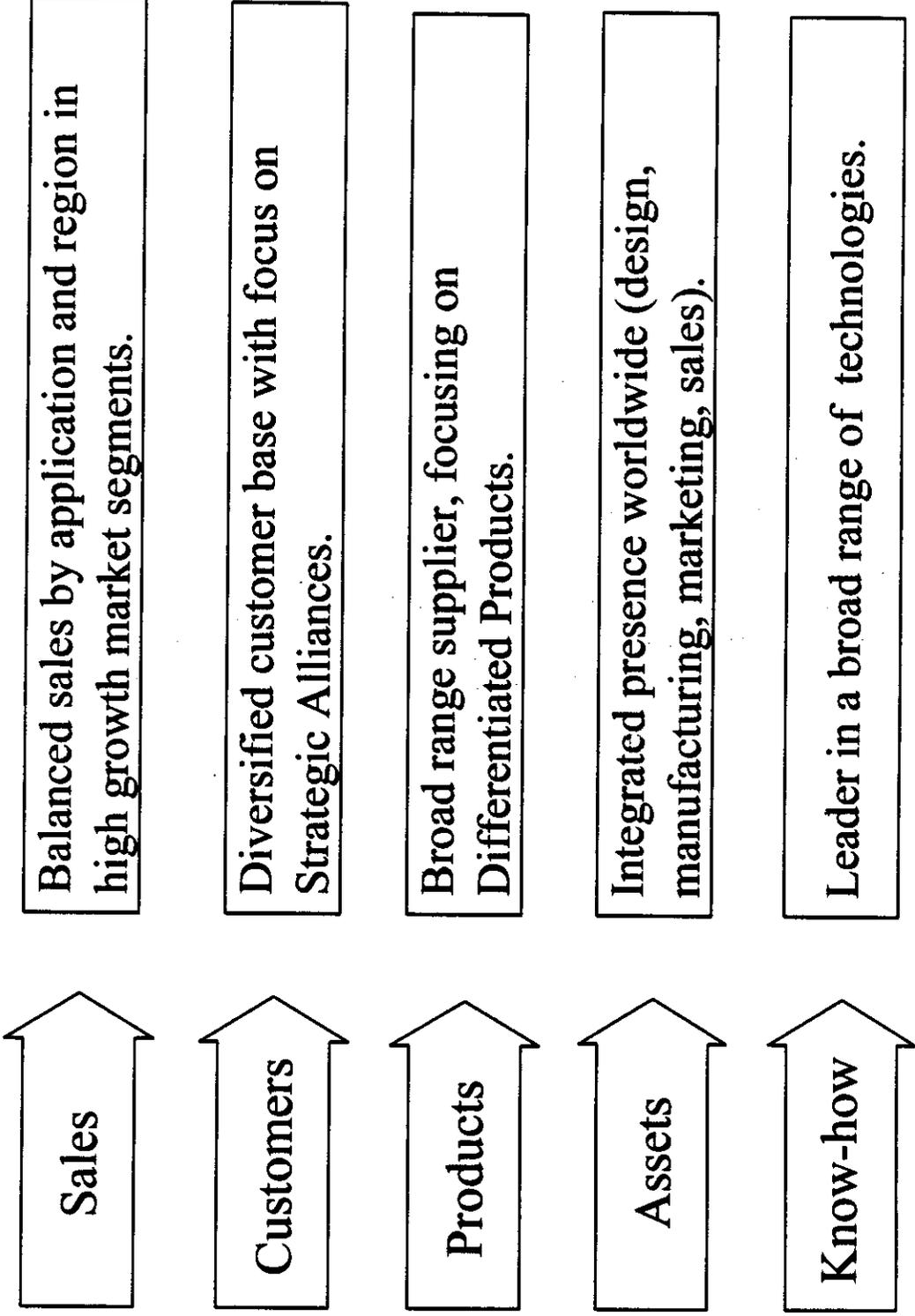


THREE MAIN STRATEGIC GUIDELINES

- ▣ Innovation, driven by the market through strategic alliances
- ▣ Globalization
- ▣ Productivity drive through TQM

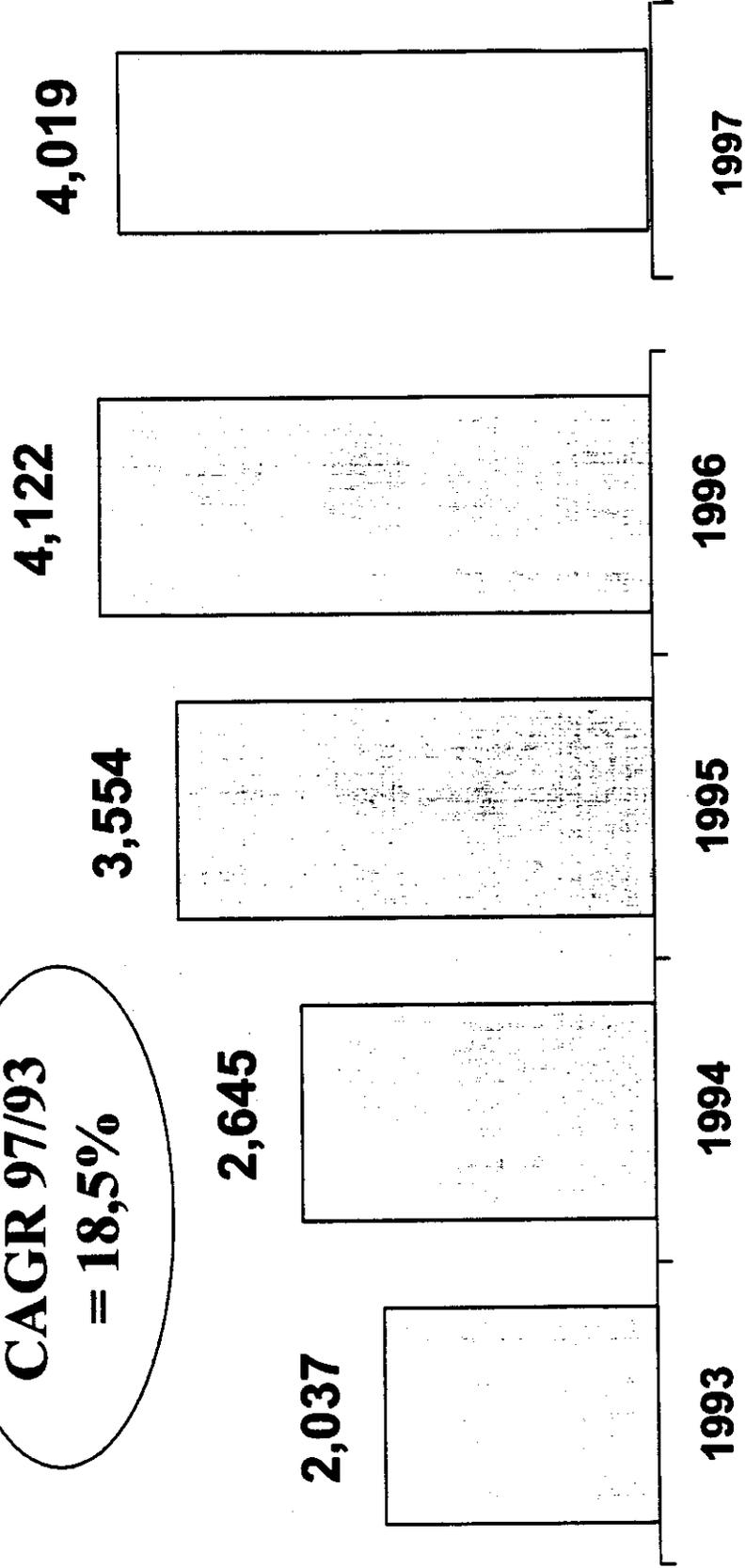


STRATEGY BASED ON FIVE KEY PRINCIPLES



SALES EVOLUTION

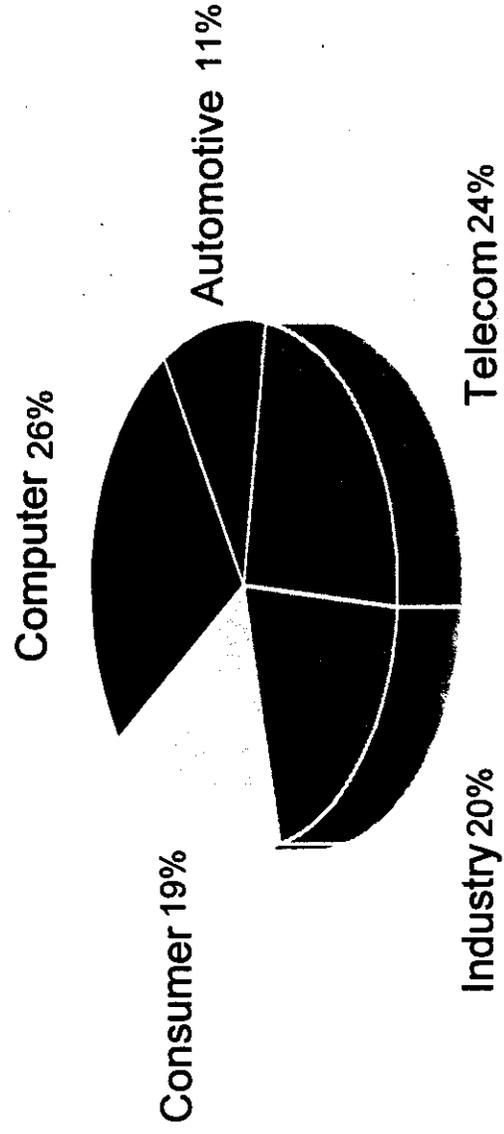
**CAGR 97/93
= 18,5%**



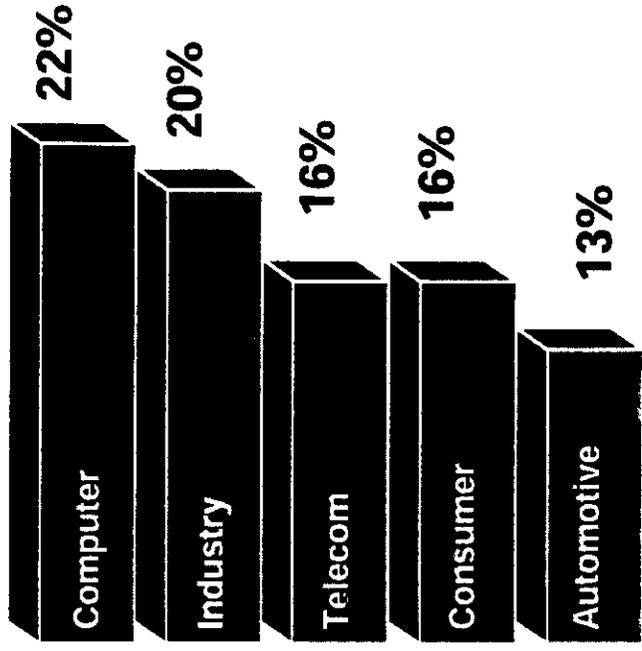
In US\$ Million

BALANCED SALES IN HIGH GROWTH MARKET SEGMENTS

ST 1997 SALES
100% = US\$ 4.02 Billion



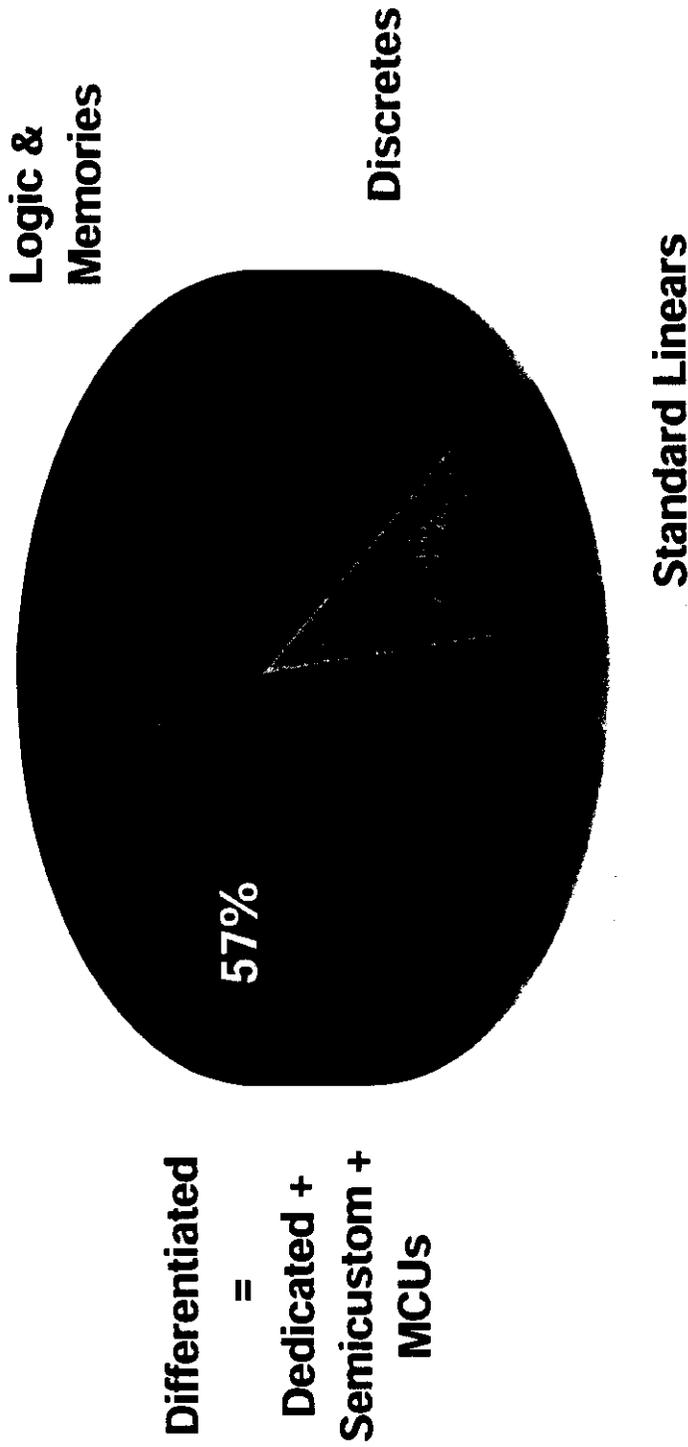
MARKET GROWTH
CAGR 1997- 2001



Source : Dataquest



SGS-THOMSON : STRONG BASE OF DIFFERENTIATED PRODUCTS



% Sales 1997



SGS-THOMSON AMERICA : A BROAD BASE OF OEM CUSTOMERS

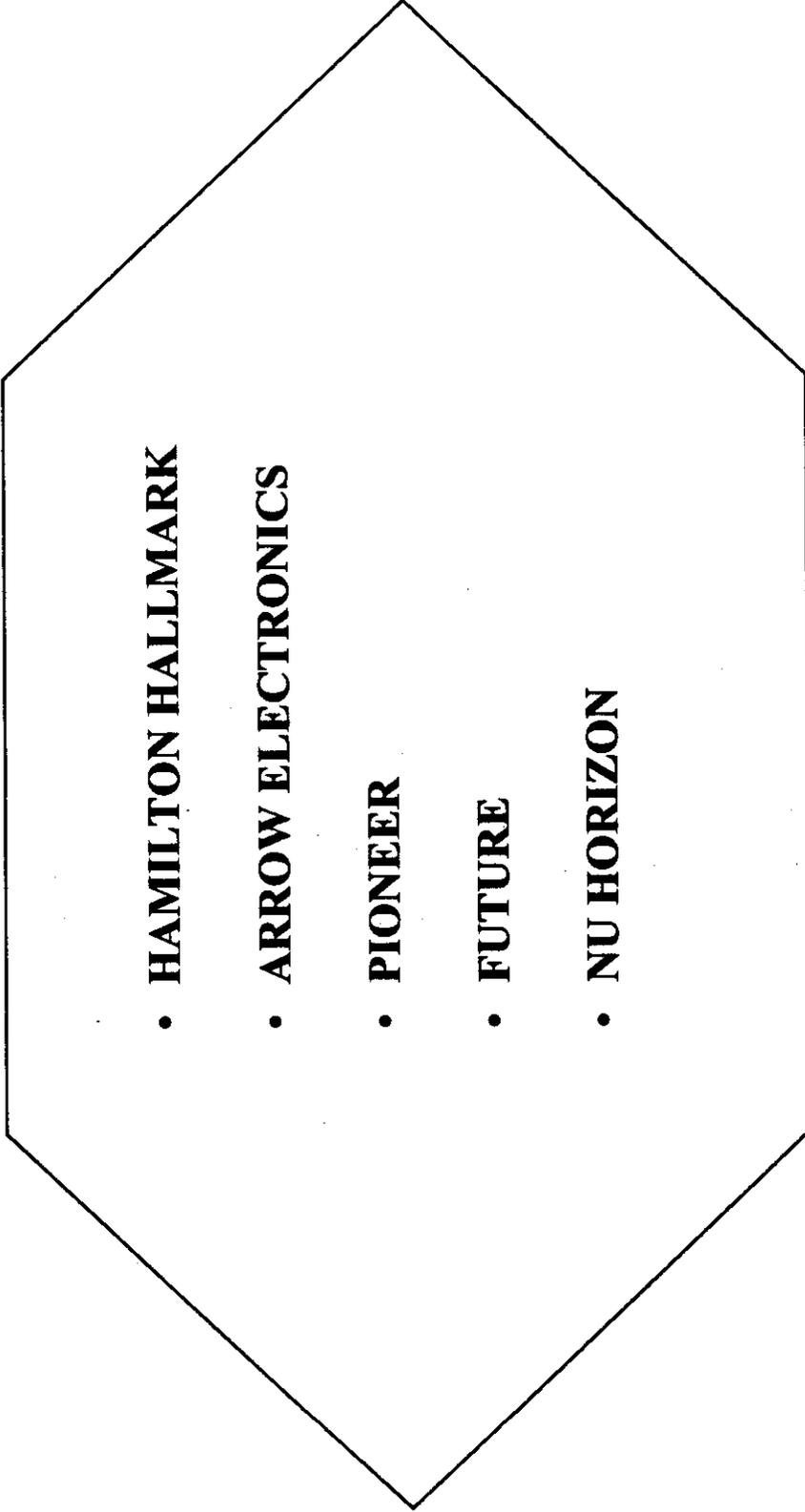
COMPUTER	CONSUMER	TELECOM	AUTOMOTIVE
• Western Digital	• Thomson MM (RCA)	• Northern Telecom	• Chrysler
• Seagate	• Sony	• Motorola	• Delco
• Hewlett Packard	• GI	• Lucent	• Ford
• IBM	• Bose	• Ericsson	
• ATI Technologies	• Zenith		

**Four strategic partners
are US-based
multinationals:**

- Hewlett Packard
- Northern Telecom
- Seagate
- Western Digital



**SGS-THOMSON AMERICA :
SERVING THE TOP US DISTRIBUTORS**



• **HAMILTON HALLMARK**

• **ARROW ELECTRONICS**

• **PIONEER**

• **FUTURE**

• **NU HORIZON**



SGS-THOMSON 1996 WORLD RANKING

No. 10 world largest semiconductor suppliers

and

1 in Analog Monolithic ICs

1 in Mixed Signal ASIC ICs

1 in MPEG Decoder ICs (*)

1 in Smart Card ICs (**)

1 in EPROM and EEPROM ICs

1 in Special Automotive ICs

2 in Telecom ICs

Source : DATAQUEST estimates on 1996 data

(*) 1995

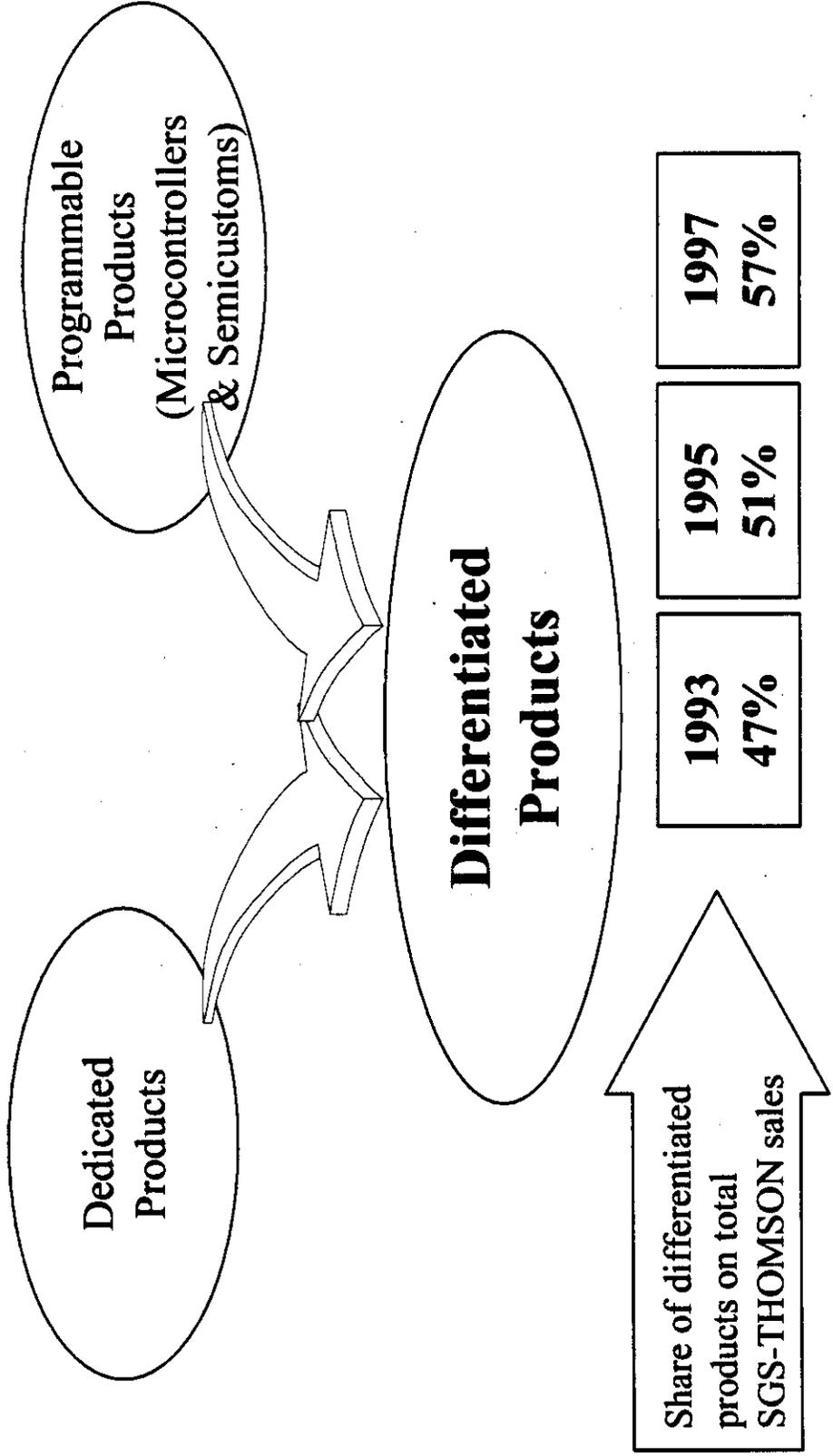
(**) Source : IMS



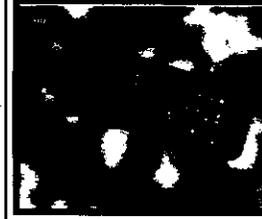
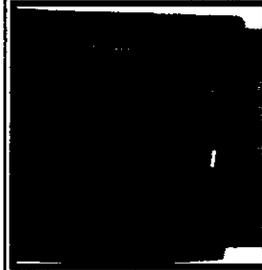
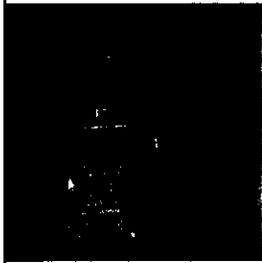
FOCUS ON DIFFERENTIATED PRODUCTS

Combining worldwide analog/
mixed signal leadership...

...with a strong presence in high
growth digital applications



COMPLETE PRODUCT SOLUTIONS FOR HIGH GROWTH APPLICATIONS



Automobile

Telecom

Smart Cards

- Mass storage
- Imaging
- Monitors and Displays
- Set Top Boxes
- DVDs
- Digital TVs

- Engine/Body Safety
- Car Radio
- Car Multimedia

- Wireless XDS/ATM
- High Speed Serial Bus

- Coprom
- Banking
- U/P/D

A LEADING PORTFOLIO OF TECHNOLOGIES

Technology	96/97	98/99	2000+	Ranking
Microtype launch	0.35/0.25μ 5 - 6 ML	0.18μ 6 - 7 ML	0.12μ 8 ML+	● In the Top 5
High Performance Logic	0.5/0.35μ 3 - 5 ML	0.25μ 5 - 6 ML	0.18μ 6 - 7 ML	● Leader
CMOS (Analog/Digital)	0.6/0.5μ 3 ML	0.35μ 3 - 5 ML	-	● Leader
Programmable Logic	0.6/0.5μ 3 ML	0.35/0.25μ 5 - 6 ML	0.18μ 6 - 7 ML	● Leader
SRAM/Memory	8/16M 0.4μ 3V	32/64M 0.35/0.25μ 2.5/1.8V	256M 0.18μ 0.9V	● In the Top 5

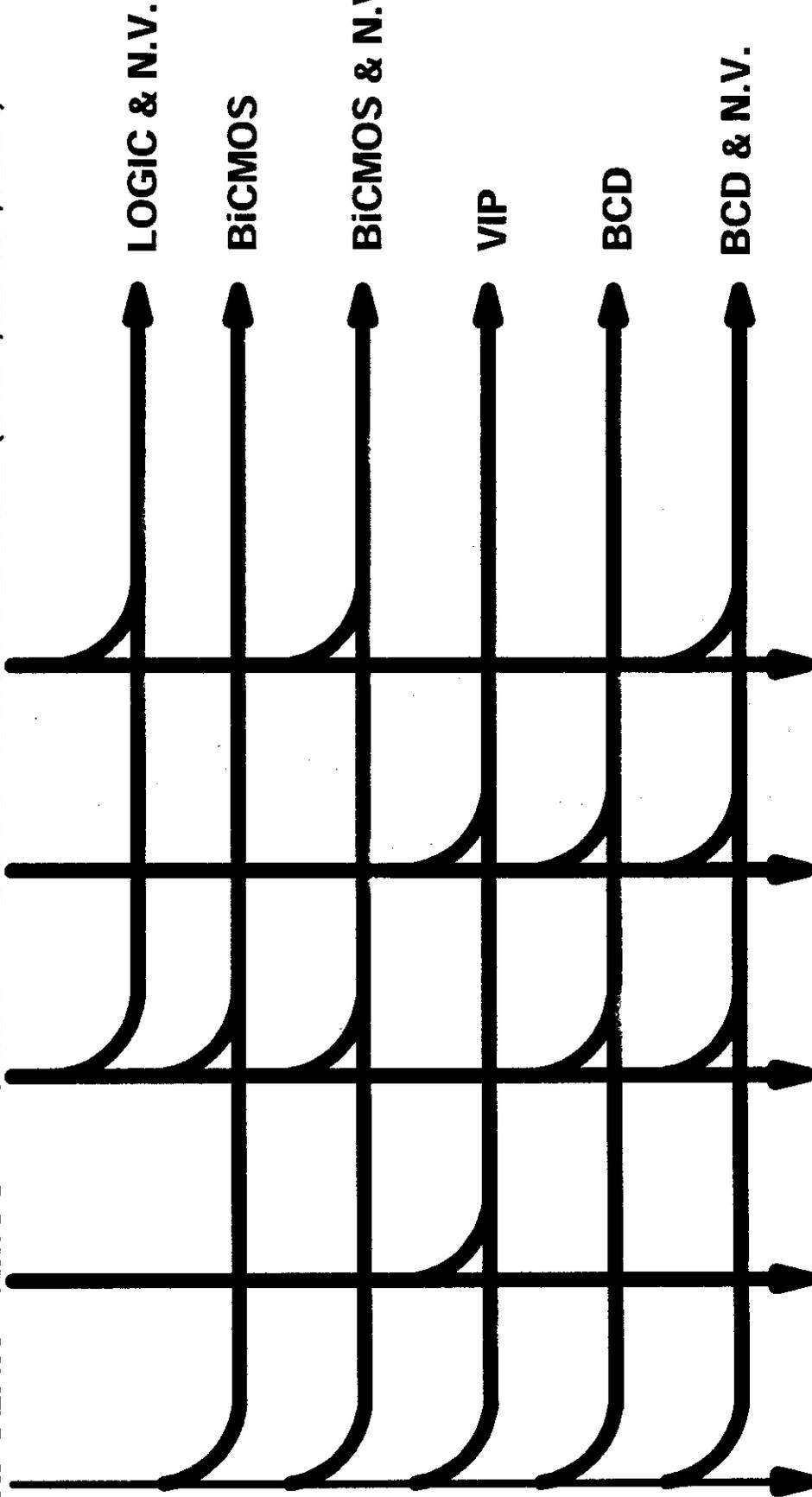
*Non-volatile Memory capability



LEADERSHIP IN

SYSTEM ORIENTED TECHNOLOGIES

BIPOLAR NMOS CMOS DMOS NON-VOLATILE (EPROM, EEPROM, FLASH)

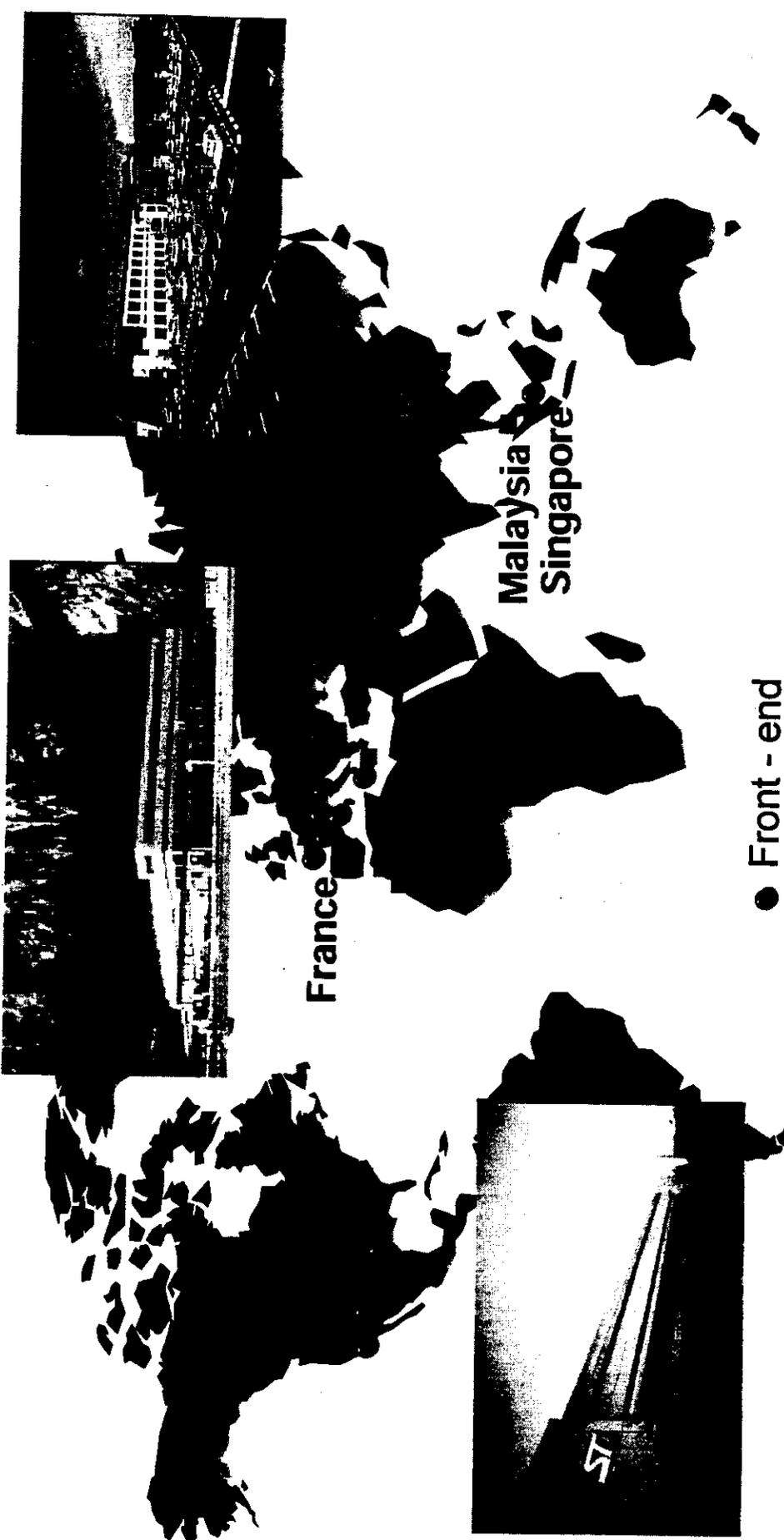


FUNCTION ORIENTED BASIC TECHNOLOGIES

SYSTEM ORIENTED TECHNOLOGIES



GLOBAL MANUFACTURING INFRASTRUCTURE



- Front - end
- Back - end



SGS-THOMSON : PROGRESSING ON THE CAPACITY EXPANSION PROGRAM

WAFER SIZE	LOCATION	VOLUME PRODUCTION	PROGRESS 1997
8"	CROLLES (FRANCE)	1994*	Saturated (moving to 0.25 μ)
8"	PHOENIX (AZ, USA)	1996	Ramping up
8"	CATANIA (ITALY)	1997	Starting of Volume Production
8"	ROUSSET (FRANCE)	1998	Structure Completed
8"	AGRATE R1 (ITALY)	1998**	Structure Completed
8"	AMK (SINGAPORE)	1999	Starting Construction
8"	ONE NEW FAB (ITALY)	1999/2000	Planned

* Expansion under construction

** Conversion of the existing 6" Fab and expansion

SGS-THOMSON AMERICA : A LONG-TERM COMMITMENT



MANUFACTURING

- 1985: Mostek acquisition
- 1986: Phoenix facility building completed
- Expansion and technology ramp-up of Carrollton fabs
- Phoenix 8" Fab installation
- Rancho Bernardo acquisition from Northern-Telecom and expansion of new 6" line
- Conversion of Carrollton Fabs to 6"



HIGHLIGHTS OF THE 1997 FINANCIAL RESULTS

- 1997 sales US\$4.02 Billion vs. US\$4.12 Billion in 1996
- Gross margin progressively increased from 38% (Q4 '96) to 38.7%* (Q4 '97)
- R&D expenses reached US\$ 611 Million in 1997 and 15.2% of total revenues
- A net profit of US\$407 Million or 10% of net revenues in 1997

* excluding revenues from license fees



BALANCE SHEET HIGHLIGHTS

(US\$ Million)	1993	1994	1995	1996	1997
Total Assets	2,241	3,225	4,486	5,005	5,446
Equity	1,004	1,680	2,662	3,260	3,307
Net Debt	-278	-138	+65	-67	-79
Net Debt/Equity	0.28x	0.08x	N.S.	0.02x	0.02x



1997 : A TENTH ANNIVERSARY RICH IN RECOGNITION FOR ST

□ **EQA (European Quality Award) for total quality in Business Excellence**

□ **Environmental Awards**

- EMAS for all 17 manufacturing sites worldwide
- Environmental Management Certificate from the French Government
- Award from the US Environmental Protection Agency

□ **Media Prizes**

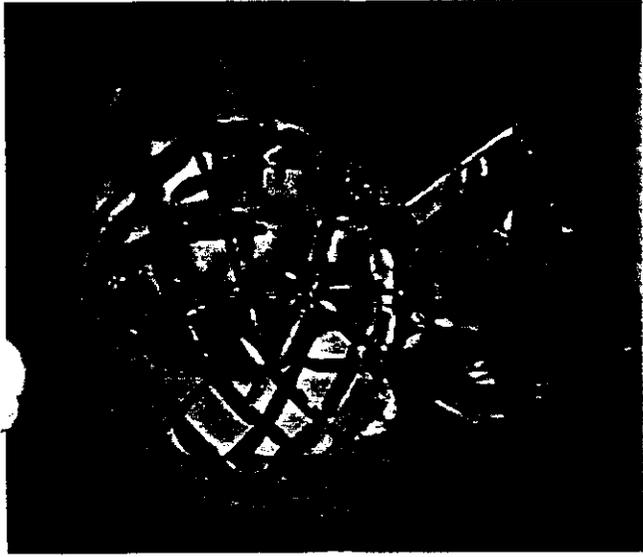
- The most innovative company (La Tribune/La Recherche)
- One of the 100 Best Managed Companies in the World (Industry Week)
- Best Manufacturing Site - Crolles (L'Usine Nouvelle/INSEAD)
- Second best "value creating" semiconductor company (Upside)
- Ranked second in a study of company longevity (FT/INSEAD)



VISION 2000

- ▣ Solid member of top 10 worldwide suppliers
- ▣ Financial performance superior to top 10 average
- ▣ Best-in-class in service and environmental protection





SGS-THOMSON: 1997 EQA WINNER!!

- ST.... Winner of the 1997 European Quality Award by the European Foundation for Quality Management.
- EQA was launched in 1991 to recognize companies showing high level of commitment to Total Quality Management.
- Awarded for *Business Excellence* in the category of large businesses.

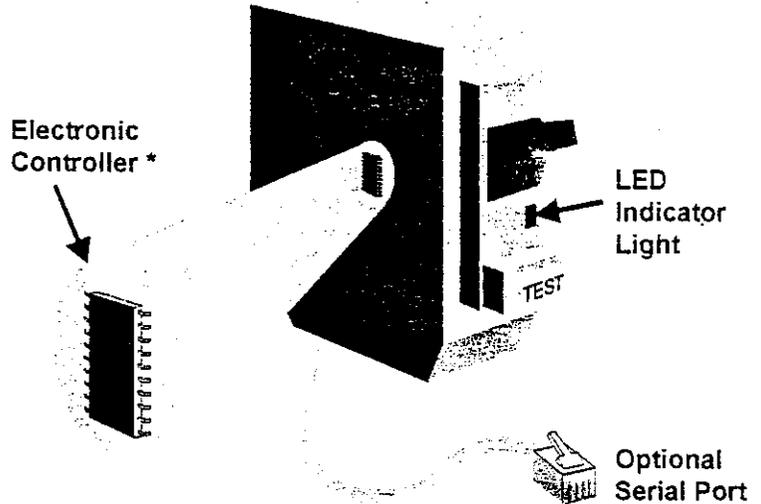




Major Advancement in Electrical Safety

KEY BENEFITS

- ✓ **Same Size & Rating** as the present day circuit breaker.
From 15 amp, 20 amp, 30 amp ...
- ✓ **Easy to Install ...**
Simply snap out the old and snap in the new Zlan DE Circuit Breaker.
- ✓ **Enhances Safety to 10,000%**
Works with old breakers to raise their safety level up to 10,000%.



Zlan's Digitally Enhanced Circuit Breaker®

KEY FEATURES

- ❑ Works in conjunction with existing circuit breaker to enhance safety.
- ❑ Uses Microprocessor Controller for state of the art technology.
- ❑ Arc detection to analyze low current problems in the electrical wiring.
- ❑ Avoids false trips for routine power surges, i.e., motor start-ups, etc.
- ❑ Auto self test plus manual test capability.
- ❑ LED status light for performance assurance and fault identification.
- ❑ Serial Port options:
 - Remote monitoring of current and voltage activity.
 - Select performance curve to match application requirements.
 - Remote test and remote trip capability.

ZLAN LTD.

"an electronics research and development firm dedicated to providing a

FIRE SAFE
electrical environment"



The Company

Zlan, Ltd. (pronounced Zee'-Lan) is an electronics research and development laboratory dedicated to providing a FIRE SAFE electrical living environment. The partnership was formed in 1990 by Mr. George Spencer and Mr. Karl Davenport. The formation of the company was the result of over a decade of researching the problem of electrical fires in homes and buildings throughout the United States.

Emphasis was first devoted to the assumption that faulty wiring was the main cause of electrical fires. Thus, Mr. Spencer devoted his early research to building a tester, the CRV2, to analyze installed electrical wiring. Since the tester only detected the problem but did not solve it, the tester was never extensively marketed. The solution proved to be in providing a safer circuit breaker that would respond faster to stop the flow of electrical current when a problem is detected.

Zlan has now developed and patented* this new, safer, Digitally Enhanced Circuit Breaker.

The Problem

Each year thousands of people die or are seriously injured and billions of dollars are lost because of electrical fires.

The 1,964,500 fires to which the fire service responded in 1992 caused² approximately \$8.3 billion in direct property damage. Fire departments respond to a fire somewhere in the U.S. every 16 seconds. There is a structure fire every 49 seconds and a residential fire every 67 seconds. The NFPA (National Fire Protection Association) reports that 4,730 people died and estimates that 21,600 were injured in residential fires in 1992. Over 20% of these fires are attributed to electrical causes.

Over time, extremely hazardous conditions develop within electrical wiring circuits in the home and business. For example, the inside of walls becomes potentially flammable and explosive due to the concentration of small dust particles. Just a few sparks from an electrical arc can set a building in flames.

The early research by Mr. Spencer revealed that in all the homes and businesses tested, the wiring was found to be critically undersized, resulting in a dangerous increase in the

expected circuit breaker trip times. Also, wiring which measured in a safe zone at the outlet became unsafe when using an extension cord. The delay time between the occurrence of a short circuit and the tripping of the breaker may vary from a few tenths of a second to several minutes, depending upon the available short circuit current. In small homes the typical short circuit current, measured at the outlets, varies from 900 Amps down to less than 100 Amps (without extension cord). While in a larger home it may be less than 30 Amps, at which level the trip time would exceed 1 minute! The variance in short circuit current is due to the type, size, and length of wire installed.

The Solution

Today's electrical fire problem requires a circuit breaker with a fast response time to detect arcing conditions and the intelligence to avoid nuisance (false) tripping.

The technology used in today's circuit breakers, thermal and magnetic, is most effective for very high current overloads; 10 times the rating of a magnetic breaker, and 15 times the rating of a thermal breaker. For a 20 Amp thermal breaker, the electrical fire protection falls off sharply when a short produces currents less than 300 Amps. Magnetic breakers are fast but their trip current has to be raised to avoid nuisance tripping due to such things as motor start-ups and incandescent lights.

Zlan's focused its efforts on short circuit currents and arcing conditions which occur at or below the protection of thermal and magnetic breakers. Zlan can demonstrate that its technology will protect a single strand of #26 gauge wire from melting with a load from 40 Amps to 500 Amps and yet avoid nuisance tripping with motor startups. Zlan is now working on a concept which will extend protection to an even smaller wire gauge.

Digitally Enhanced Technology

Zlan has made the technology of fast response time to detect arcing conditions and the intelligence to avoid nuisance tripping available to both new and old homes and businesses. This was done by using the latest integrated circuit technology to reduce the size of Digitally Enhanced circuit protection to a micro-size chip, thereby making it possible to be incorporated in residential and business circuit breakers.

For further information, contact:

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Zlan@msn.com

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* Patent No. 4,949,214

Zlan Ltd. envisions the Digitally Enhanced Circuit Breaker® will be brought to market through the existing circuit breaker manufacturers and their distribution system.



Field Test Monitoring Program

Objective

The Field Test Monitoring Program (FTM) was developed and administrated during the first six months of 1996 in order to evaluate the performance of Zlan's new Digitally Enhance (DE) Circuit Breaker. Several units of Zlan's DE Circuit Breaker were developed for the FTM Program. See Figure 1. In addition to assembling the prototype models, computer monitoring equipment and software were designed to test and evaluate the validity and reliability of the many key features of the DE Circuit Breaker.

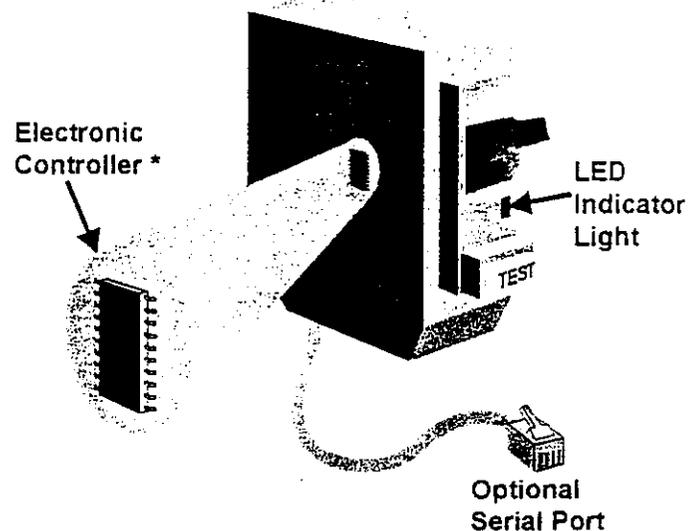


FIGURE 1

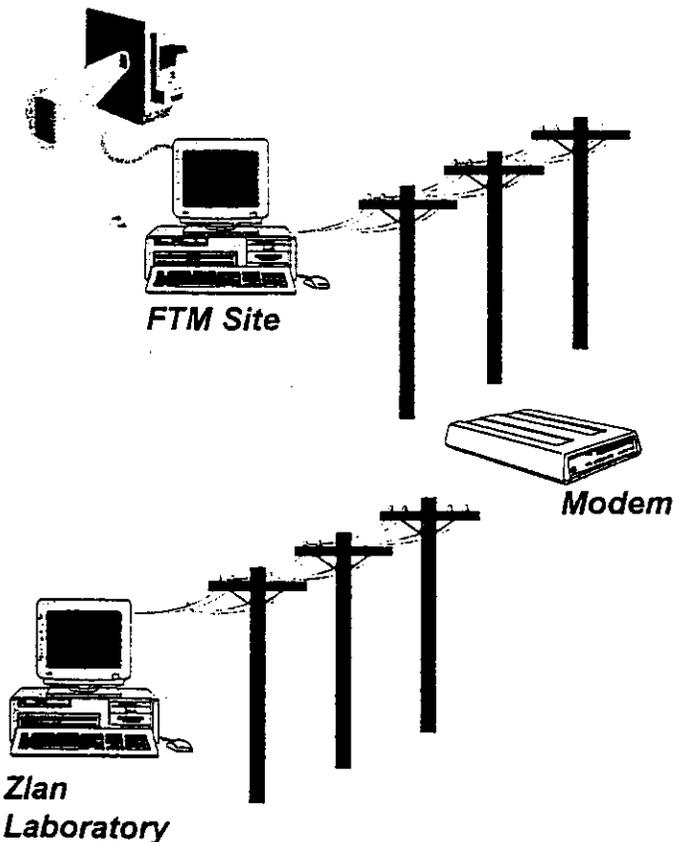


FIGURE 2

FTM Test Sites

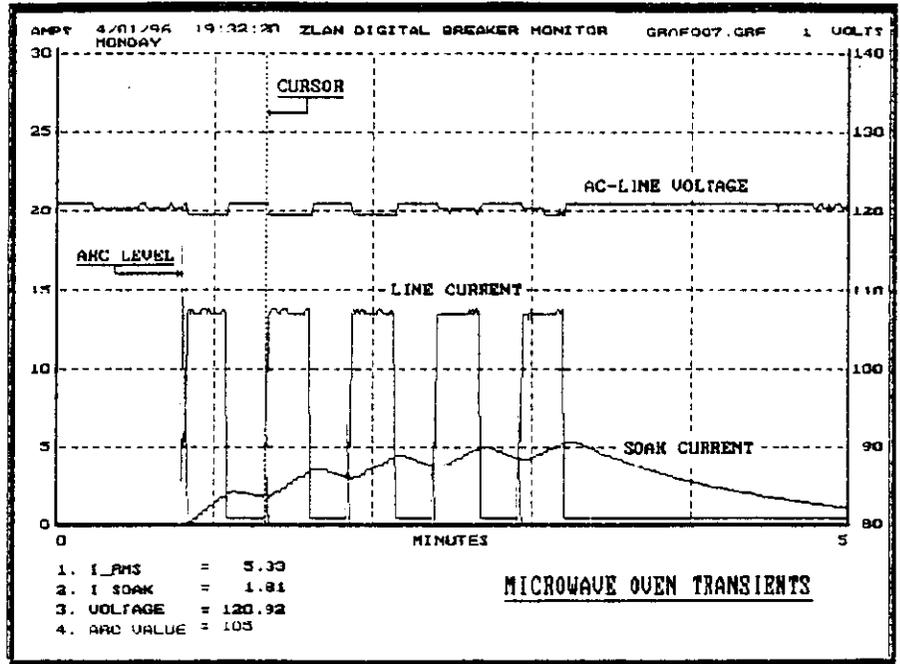
Field test sites were selected that would provide typical residential or professional office building electrical circuits, offering a high level of activity and a variety of applications such as garbage disposals, microwave ovens, treadmills, washing machines, copy machines, etc. Owners of prospective test sites were sought that would lend strong credibility and objectivity to the FTM Program. Insurance executives, city officials, fire marshals, owners of professional buildings, etc. were all recruited to participate in the program.

The DE Breaker was installed in series with the test sites' existing circuit breaker so that the present level of circuit overload protection was not diminished. Once installed, the DE Breaker was connected to an on site computer for data storage. By way of a modem connection, data from the selected circuit could be periodically downloaded throughout the 30 to 60 day field test period. See Figure 2, illustration of the setup.

Field Test Monitoring Program

Test Data Parameters

More than a dozen different parameters were designed to be data logged with an update rate of 500 milliseconds. Data were also logged whenever 'events' occurred, where an event is defined as a parameter shift greater than a specified threshold. The raw data were saved on the hard drives of both the monitoring computer at the site location and through periodic modem transfers to Zlan's Laboratory. The main parameters were filtered and displayed in graphical form for analysis. Figure 3 shows a typical display screen during live data monitoring for the following parameters:



- Line Current — The AC line current in amps RMS.
- Line Voltage — The AC line voltage in volts RMS.
- Series Arcing — The arc level is a number between 0 and 255.
- Soak Current — The long term running average of the line current. This parameter has a time constant of 68 seconds.

FTM Results

Test sites were operational for 24 hours a day for a six to eight week period. Refinements were made throughout the test period and a representative cross section of the activity was collected on each circuit. The data collected were both continuous and comprehensive providing a significant population of data for interpretation.

Conclusions

Analysis of the database shows that:

- Data collected on circuits in older model homes, where old appliances were in use, produced some high arcing conditions. This data provided information enabling improvements in the Arc Detection Feature.
- The overall database provided useful information concerning the margin of safety for various electrical appliances and the program trip curve.
- The data logging features designed into the circuit breaker proved to be very useful in collecting data at the various site locations.
- Transferring data to our office via modem was much more convenient than visiting each site periodically.

In conclusion, the Field Test Monitoring Program served as a valuable data input, and to **validate** Zlan's DE Circuit Breaker's overall design objectives.

For further information, contact:

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DE Breaker Support

Load Center Monitor (LCM)

It is change, continuing change, inevitable change, that is the dominant factor in society today. No sensible decision can be made without taking into account not only the world as it is, but the world as it will be ... **Isaac Asimov**, author of science fiction (1920-92), *The Encyclopedia of Science Fiction*.

How well this applies to the computer revolution and the race to apply the newest electronic technology. The computer is an important tool supporting what has now become the Information Age. Too much information is thrown away every day, and in many cases, it is critical information.

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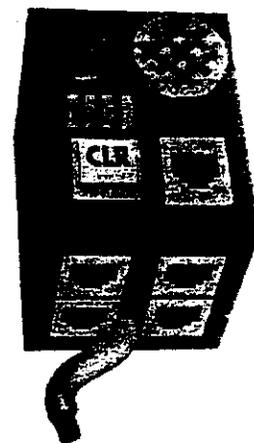
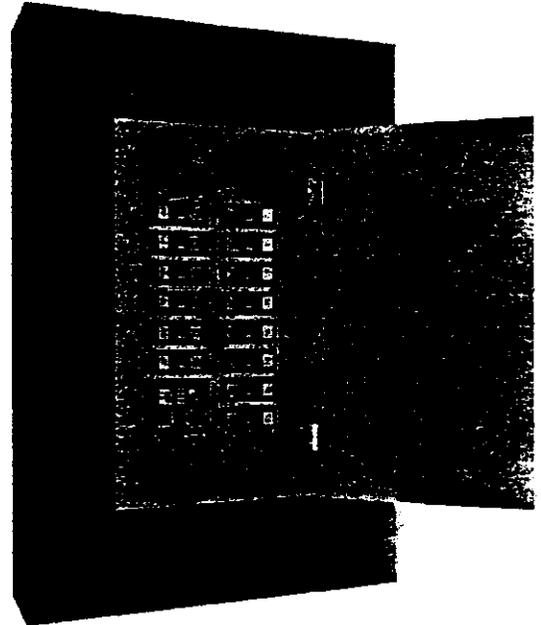
The most important example would be not informing the customer that a fault was detected by a circuit breaker. It could be an arcing fault; or, it may mean a problem has been detected within the AFCI electronics itself.

When a 'trip' does occur, what was the reason: a current overload, high current parallel arcing, medium current short circuit, low current series arcing, ground fault, or low line voltage present when the Air Conditioner tried to start?

Series arcing at loose terminals on the power transformer, or within power line splices at the home, is an example of conditions that affect all breakers on a given service line. Consequently, there is a need to coordinate information from multiple breakers within the load center.

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Circuit breaker alarm signals may also be a warning that there are indications of potential electrical problems, even though no breaker has tripped.

A Microprocessor with a Real Time Clock and a Non-Volatile memory will regularly datalog numerous parameters such as: peak, average, and soak current, arcing level, and line voltage for each branch circuit. Whenever a change in operating level occurs, an 'event' will be recorded, along with its time stamp, into the LCM's most recent event history file.

Analyze patterns of system activity that are common to several breakers to detect upstream arcing problems or near-brownout voltage conditions. Large motors used in air conditioners (A/C), shop air compressors, and pool pumps generally have great difficulty starting with low line voltage, resulting in dangerous operating conditions for the motor. Should a breaker repetitively trip under these conditions, the customer should be informed that replacing their A/C unit may not be the solution to the problem.

A temporary shutoff push-button is provided on the LCM to disable both the visual and audible alarms. The Load Center Monitor will maintain information about all faults for use by the repair technician. However, if a repair person does not

access the LCM within 48 hours, another alarm/alert will be sounded followed by only a 24 hour grace period, then 12 hours, etc.

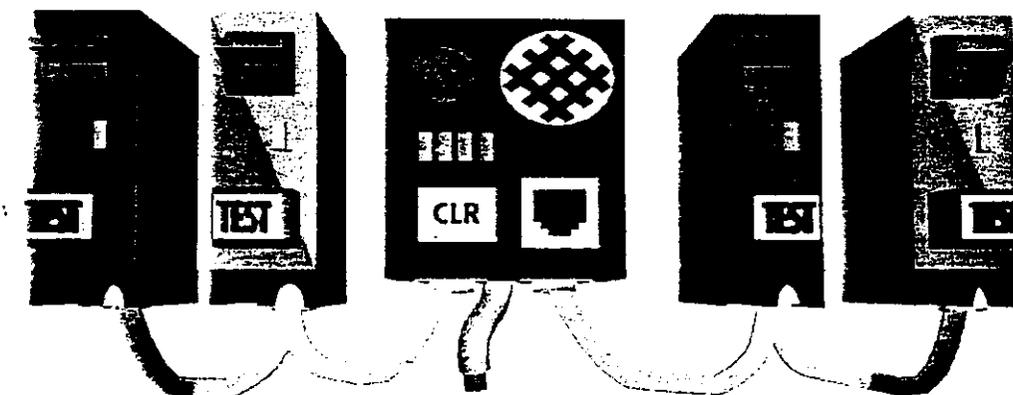
Support data communications with the Electrician Test Unit, including DE Breaker ID and circuit path/location information for trouble shooting branch circuits.

The LCM can download configuration/mode parameters to individual DE Breakers. When trouble-shooting wiring/appliance faults, the repair person can temporarily place a DE Breaker in the thermal-only mode where electronically detected faults are reported but not acted upon. In this Test mode, the technician can now use test equipment designed to aid in tracing faults and their location. The repair person also could place a selected branch DE Breaker into the learn mode when it is necessary to support future new and unusual loads.

Upload log data to another data collection system with bulk storage and analysis capability. Perform first level data gathering and compression for use by Smart Home controllers. Communicate load levels for use in power management applications. Also interface security and alarm systems to report faults while away from home.

Receive encrypted shutdown code from Fire Marshal to command all DE Breakers to trip.

The LCM is designed as a form fit into a standard circuit breaker case and is powered from the ac bus.



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