THE MAGAZINE FOR PROFESSIONAL ELECTRONIC AND COMPUTER SERVICERS

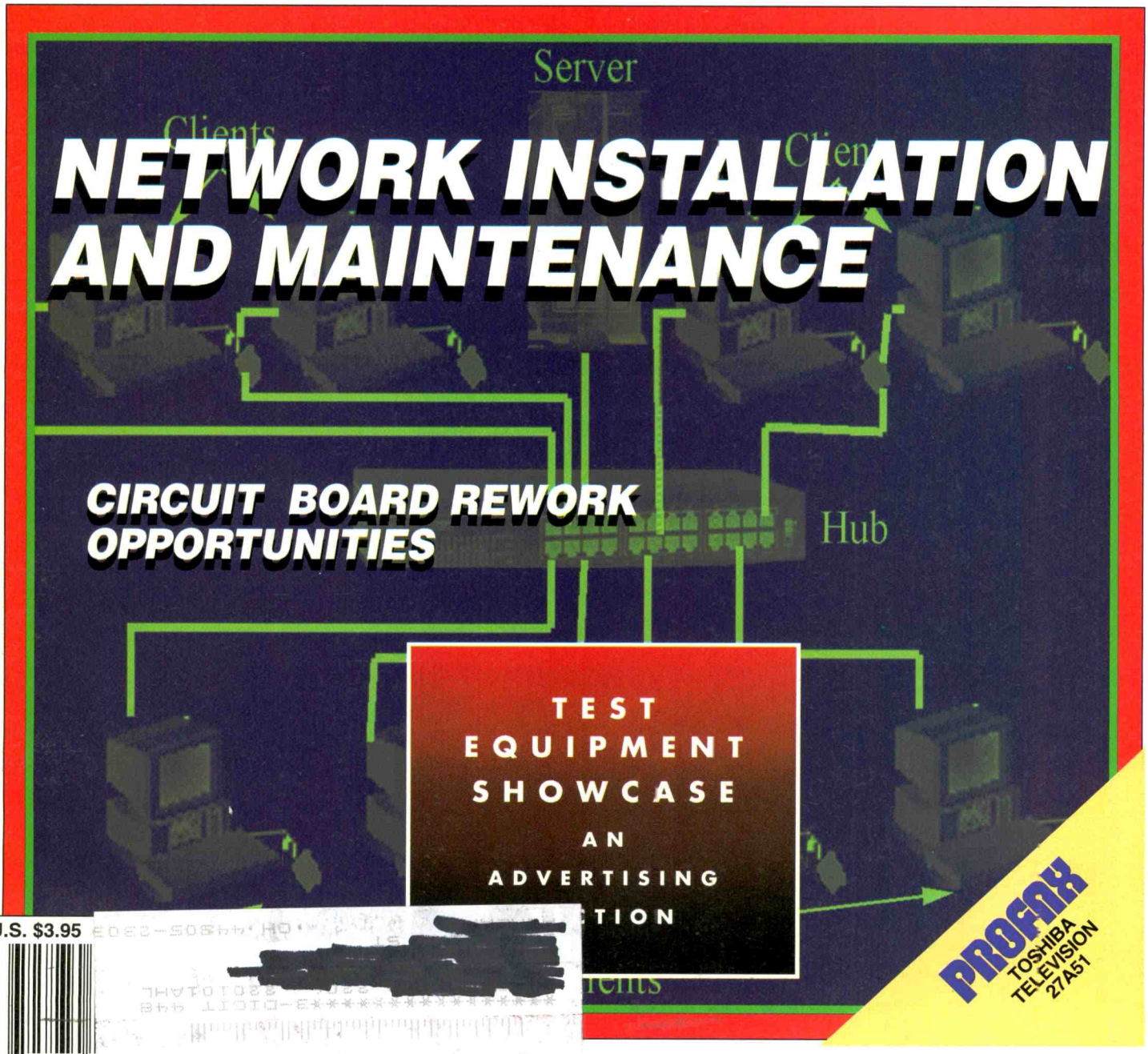
ELECTRONIC™

Servicing & Technology

March 2002

TROUBLE SHOOTING A DEAD CHASSIS

COLOR PRINTER SERVICE



NETWORK INSTALLATION AND MAINTENANCE

CIRCUIT BOARD REWORK OPPORTUNITIES

TEST EQUIPMENT SHOWCASE

AN ADVERTISING

TION

PROFAX
TOSHIBA TELEVISION 27A51

U.S. $3.95

7 25274 80067 0

ES&T WHOLE HOUSE ELECTRONICS VIDEO TRAINING

BEGIN TRAINING TODAY... Order Your Video Toll Free 800-462-4659

For professional servicers who are increasingly involved in home theater, Smart home and networking installations and maintenance, ES&T introduces this series of training videos from THE TRAINING DEPT. Each training course provides in-depth instruction on the fundamentals, planning and installation. Every training course is complete with a WORKBOOK, an EXAMINATION to test your comprehension, a BLANK ANSWER SHEET, and an ANSWER KEY. Skill Builders focus in-depth on a specific topic or skill.

Order TOLL FREE!
800-462-4659
VISA, MC, AMEX and DISCOVER

All items shipped FedEx Ground in U.S.
We will advise S&H for non U.S. shipments.

Outside U.S. Call: 516-883-2154

Order by Fax or Mail
VISA, MC, AMEX, DISCOVER
Include Credit Card# and expiration date.
Checks and Money Orders accepted (U.S. funds only).
Make your selection and indicate your name, address and telephone number with order.

***ES&T* Customer Service**
P.O. Box 748
Port Washington, NY 11050
Fax: 516-883-2162

All videos come with a 100% GUARANTEE! If you are not satisfied you may return your purchase within 30 days to receive a full refund less S&H charges.

Residential Retrofit Wiring
Training Course

This 2-hour 30 minute course teaches everything you need to know to perform retrofit wiring installations. It includes basic principles of house construction, house framing types, retrofit tools, and retrofit installation techniques. It takes you through three complete residential retrofit wiring projects, each a different house construction type.

TC-03 $ 195.00

FedEx Ground S&H.....$12.50

Residential Infrastructure Wiring
Training Course

This 2-hour 45 minute course teaches everything you need to know to install structured wiring in new construction. It covers basic wire and cable principles for home networks and audio/video distribution, installation planning, and takes you through three complete residential installations from prewire to trim-out.

TC-01 $ 195.00

FedEx Ground S&H $12.50

Residential Installation Basics
Training Course

This 2-hour course lays the foundation of technical knowledge needed for successful performance in residential installation. It also helps prepare for low voltage testing such as the CEDIA Installer Level 1 Exam. Topics covered include Safety and Codes, Wire and Cable Basics, Connector Types and Installation, Basic Installation Techniques, Equipment Installation Requirements, and Basic System Operation.

TC-04 $ 195.00

FedEx Ground S&H.....$12.50

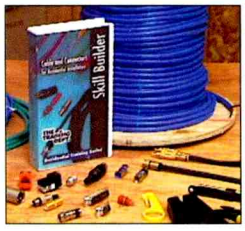
Testing for the Future
Skill Builder

In 45 minutes learn the theory, equipment, and techniques to perform field testing of typical residential infrastructure cables. This video covers static and dynamic testing of TP, coax, and fiber optic cable. It also covers complete certification testing techniques and test equipment for CATEGORY 5 cable.

SB-01 $ 59.00

FedEx Ground S&H.....$12.50

Cable and Connectors
Skill Builder



This 1 hour video is designed to teach the professional installer everything they need to know about the cable and connectors used for residential installation, including infrastructure wiring, security, audio, video, and home networks. The video covers cable characteristics and application areas, proper connector use and field and shop connector installation.

SB-05 $ 59.00

FedEx Ground S&H $12.50

Codes, Standards, and Safety Practices
Skill Builder

This 45+ minute video covers all codes and standards applicable to residential low-voltage system installation. It includes NEC requirements for grounding, electrical safety, cable listing, OSHA required site safety practices, UBC regulation, as well as TIA, EIA, and IEEE standards that affect residential installation.

SB-04 $ 59.00

FedEx Ground S&H. $12.50

Wiring Your Home for the Future
Consumer Education

This 23-minute video introduces the concept of state-of-the-art residential infrastructure wiring, or "structured wiring", and how it is installed and used in the home. It explains the coming wide bandwidth services and why "traditional wiring" is inadequate. It educates the viewer on the benefits and applications that structured wiring brings to the home.

CO-01 $ 29.00

FedEx Ground S&H.....$12.50

CALL TODAY
800-462-4659

THE MAGAZINE FOR PROFESSIONAL ELECTRONIC AND COMPUTER SERVICERS
ELECTRONIC
Servicing & Technology

Volume 22, No. 3 March 2002

CONTENTS

Electronic Servicing & Technology is edited for servicing professionals and managers who service consumer electronics equipment. This includes owners, managers, service technicians, field service personnel and avid servicing enthusiasts who repair and maintain audio, video, computer and the new digital consumer electronics equipment.

ELECTRONIC SERVICING & TECHNOLOGY Magazine
403 Main Street, 2nd Floor
Port Washington, NY 11050 USA
516-883-3382 Fax 516-883-2162
mmei@mainlymarketing.com

EDITORIAL
Editor: NILS CONRAD PERSSON
P.O. Box 12487, Overland Park, KS 66212
913-492-4857
cpersedit@aol.com

CONSULTING EDITORS
TV Servicing Consultant: BOB ROSE
TV Servicing Consultant: HOMER L. DAVIDSON
Components Consultant: VICTOR MEELDIJK
Audio Consultant: ALVIN G. SYDNOR

BUSINESS
Publisher: MARIE MARCELLINO
mmarcellino@mainlymarketing.com

President: DAVID L. ALLEN
dallen@mainlymarketing.com

CIRCULATION
Circulation Coordinator: GEORGINA MARTINES
Tel: 516-883-3382 admin@mainlymarketing.com

PRODUCTION
Production: JENNIFER COSTELLO
jcostello@mainlymarketing.com

SALES STAFF
Sales Director: DAVID L. ALLEN
dallen@mainlymarketing.com

Sales: JONI JONES
P.O. Box 346, Port Washington, NY 11050
Tel: 516-944-8068 Fax: 516-944-2739
jmjones@ix.netcom.com

International: JAY FEBRER
jfebrer@mail.com

Classified/Display Classified: LYNDIANE PAOLETTI
Tel: 516-883-3382 admin@mainlymarketing.com

Sales Coordinator: LYNDIANE PAOLETTI
admin@mainlymarketing.com

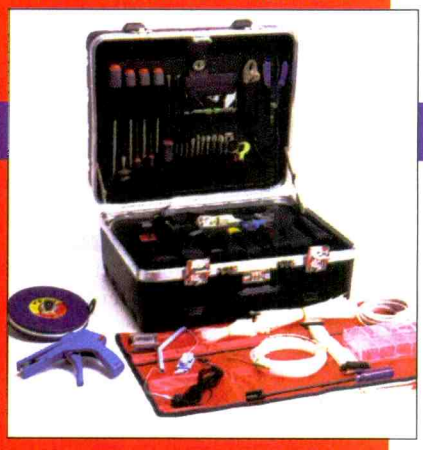
***FOR SUBSCRIPTIONS** — new or renewal — use our subscription website:* **www.electronic-servicing.com**

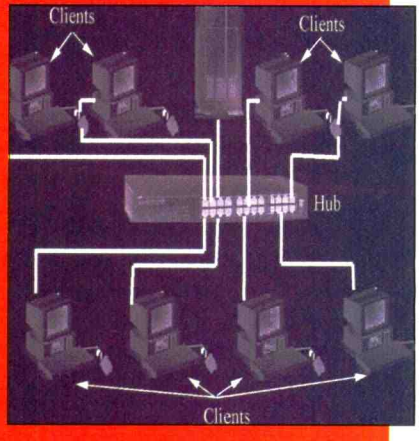
Electronic Servicing & Technology (ISSN 0278-9922) is published monthly by Mainly Marketing, 403 Main Street, Port Washington, NY, 11050. Telephone 516-883-3382. Periodical class postage paid at Port Washington, NY and additional offices. Canada: Postage agreement number 1885766. Subscription prices (payable in US dollars only): Domestic—one year $29.95, two years $55.95, three years $75.95. Canadian—one year $39.95, two years $75.95, three years $105.95. Foreign Air Post—one year $49.95, two years $95.95, three years $134.95. Allow six weeks for delivery of first issue and for change of address.

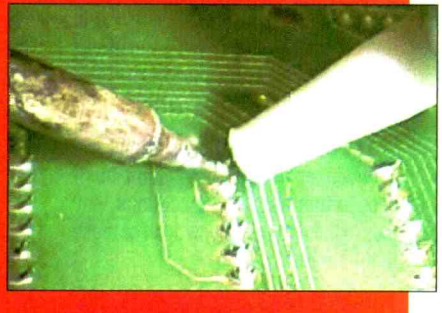
Printed in the United States of America.

Postmaster: Please send change of address notice to Electronic Servicing & Technology, 403 Main Street, Port Washington, NY 11050.

FEATURES







DEPARTMENTS

Editorial

by Nils Conrad Persson

IS CERTIFICATION FOR YOU?

Those of you who are not members of one of the associations that cater to consumer electronics service centers, and who don't get to spend a lot of time on the internet, may not be aware of a program that has recently been established to provide certification for service centers. The program was conceived and initiated by a consortium of organizations as a way to enhance the image of consumer electronics service providers and service centers, and to provide a degree of confidence to consumers that the service center that they have chosen to service their TV, VCR, DVD player or whatever possesses the professionalism, the skills, the tools and more, to provide that service promptly, ethically, and competently.

The following paragraphs descrive the program as stated on the Consumer Electronics Association website.

Mission

The mission of the Certified Service Center (CSC) program is to encourage professionalism within the service industry and to publicly identify those service facilities that strive to provide honest, competent and professional service. The program is designed to provide positive service experiences to all consumers. The Certified Service Center designation is presented to those service facilities that provide a level of service professionalism that meets or exceeds the high levels established by the requirements of this certification.

Certification Process

Service facilities initiate the process to become a CSC by completing an official application form and submitting it to one of the certifying associations with the appropriate fees attached. The certifying association will then review the completed application form and verify that the service center candidate complies with all of the requirements as specified. The application will then be sent to the CSC National Certification Committee for final review and approval. All certifications are valid for a period of three years from the date of certification.

The CSC certification is open to all service, repair and installation businesses that submit applications, pay fees in full and comply with all of these requirements.

1: Repair Facility

Each CSC is asked to have a storefront or other fixed, permanent and professional place of business suitable to the nature of the business and that complies with all applicable zoning laws. Exceptions to the visible repair facility requirement will be reviewed by the Certification Oversight Committee.

2: Code of Conduct

Each CSC shall agree to abide by the established code of ethics.

- We will conduct business in a manner that will insure the confidence of our customers.
- We will not participate in any false or misleading advertising.
- We will provide an estimate of charges before work is performed.
- We will perform only such service as is necessary and authorized by the customer.
- We will provide new and first quality parts, unless otherwise specified.
- We will provide accurate invoices that list all parts that were used and service that was performed.
- We will resolve all complaints promptly and courteously.
- We will handle customer property carefully and will maintain insurance to protect this property while in our control.
- We will strive to continually improve the image and reputation of our industry.

3: Approved Equipment

Each CSC shall have and maintain in good repair the industry approved minimum test equipment for each product category for which they are certified.

4: Customer Service

Each CSC agrees to have a written customer service program that includes a customer communication and relations process.

5: Technical Certification

At least 25% of all technicians and technical workers employed by each CSC applicant must be certified by a recognized national certification provider. Upon renewal, 25% or more of technicians employed by each CSC must have journeyman level certifications.

6: Service Manager Certification

Each Certified Service Center shall employ at least one manager who has passed the Certified Service Manager exam, the equivalent approved management training courses, or a two-year associate business degree (or higher).

7: Licensing Requirements

Each Certified Service Center shall comply with all federal, state and local business licensing and zoning laws.

8: Insurance Coverage

Each Certified Service Center agrees to maintain insurance coverage for business liability and customer merchandise.

9: Service Warranty

Each CSC shall provide a reasonable warranty on labor performed and on parts replaced from the date the product was returned to the customer. Each service center shall post warranty policy and comply with local, state, and federal warranty laws.

10: Professional Appearance

Each CSC r shall:

- display prominent signage on the outside of the building that clearly identifies the business and meets all applicable codes
- maintain a neat, clean and professional appearance
- maintain a written dress code for the employees that greet the public including employees that assist the customer in person and those that assist the customer in the field. The dress code should include a statement describing the image that the employee should project, a statement that describes any required elements of dress, appearance and grooming, and a statement that describes any prohibited elements of dress, appearance and grooming.

Need More Information?

For more information, contact one of the certifying agencies:

Consumer Electronics Assoc
Tel: 703 907 7600
http://www.ce.org/

Electronic Technicians Association
(800) 288-3824
http://www.eta-sda.com/

National Assoc. of Service Dealers
Phone: 800-621-0298
http://www.narda.com/

NESDA
817/921-9061
http://www.nesda.com/

Professional Service Association
Toll Free 888-777-8851
Fhttp://www.psaworld.com/

United Servicers Association
Voice: 714-335-1951
http://www.unitedservicers.com/

Is Certification a Good Idea?

In most states, anyone can call themselves a consumer electronics service technician and start fixing productsunlike the requirements for plumbers, electricians and even cosmotologists

The lack of any kind of certification or license requirement, taken together with with the unethical practices of a few bad apples in the business, gives many people pause when they think about having an electronics product serviced. That is not to say that there are not a lot of good service facilities with excellent reputations in existence to whom anyone aware of their good reputation would bring their products for attention. There are, of course.

However, there are many good, ethical, competent service centers in existence that haven't had the good fortune, or longevity in the business to establish such a solid reputation. A certification program, backed by all of the pertinent organizations provides a good way for a service center to let the public know that they do business in accordance with the highest standards.

Conrad Persson

HDTV Service. . .
Are You Ready?

HA325 Portable
Horizontal Output & Flyback Analyzer

- Improves The Skill Of Your Service Technicians For Faster More Profitable Repairs.
- Reduces Second (and third) Visits To The Home On Field Calls And Reworks
- Cuts Down On Replacement Repair Costs
- Increases The Accuracy Of Your Estimates
- Durable, Hand-Held and Battery Operated

Assistance Screens Guide You To The Defective Component!

VP300 **Video**Pro
Multimedia Video Generator

- All ATSC HDTV and SDTV Formats (1080i, 720p, etc.)
- 4:3 and 16:9 Aspect Ratios
- Component Video (YPbPr) and RGB Video Output
- Composite and S-Video NTSC/PAL Outputs
- Monitor Output (SVGA, XGA, etc.)
- Setup and Alignment Test Patterns
- Hand-Held, Portable and Battery Operated (8 hours)
- Format and Pattern Update Ready (RS232 Interface)

See On-Line Demos At www.sencore.com

SENCORE

1-800-SENCORE • www.sencore.com • email: hdtvservice@sencore.com

Circle (1) on Reply Card

Thomson Loses Patent Suit

INDIANAPOLIS (AP) - A judge has ordered Thomson Multimedia to pay more than double the $10.65 million damage award a jury granted in a patent dispute with a Japanese company over components in cassette tape players and portable stereos.

A jury in October found that Thomson violated patents held by Tanashin Denki Co. Ltd. of Tokyo.

U.S. District Judge Richard L. Young on Friday issued a final judgment increasing Tanashin Denki's award to $21.3 million, plus $4.3 million in interest covering the period when the infringement occurred.

Tanashin Denki filed a motion to triple the damages, but Young stopped short of that request and doubled the amount.

"Thomson's actions were willful, both prior to and at the inception of litigation" in 1998, the judge wrote.

Young also ordered Thomson to stop buying, selling or making items with a tape drive mechanism patented by Tanashin Denki.

Dave Arland, a spokesman for Thomson Multimedia at the French firm's North American headquarters in the Indianapolis suburb of Carmel, said Tuesday the company will appeal the decision.

"Thomson disagrees in all respects that the damage award contained in the court's final judgment is supported by either the law or facts," Arland said.

Tanashin Denki's lawsuit alleged that Thomson used illegal knockoff versions of its tape drive mechanisms in more than 135 models of RCA- and GE-brand tape players, boom boxes and other audio components since the mid 1990s.

The lawsuit originally was filed in Falls Creek, Va., but was transferred to Indianapolis at Thomson's request.

Desco Acquires Engineeredstatic

Desco Industries, Inc. of Chino California has purchased the assets and operations of ENGINEERED-STATIC Corporation of Cinnaminson New Jersey. Desco will continue the business of ENGINEEREDSTATIC, which is a manufacturer of specialty shielding bags for the electronics and toner cartridge industry.

Sales for ENGINEEREDSTATIC products will be handled through Desco's Custom Manufacturing Group located in Chino California. Manufacturing will be moved to Descoís operations in Canton MA.

Questions regarding the purchase should be directed to Mark Hempel, Manager of the Custom Manufacturing Group at 909-627-8178.

Warrantech Unveils New Web-Based Platform at International Consumer Electronics Show

EULESS, Texas - Warrantech Corporation provider service contracts and aftermarket warranties, has announced the launch of a new web-based platform from its Consumer Products Services division.

WCPS Online is a comprehensive web-based tool. The site will provide real-time capabilities that meet the needs of dealers, service providers and consumers. It is designed to reduce paperwork and cut the time and costs of administering warranties for dealers and service providers, while providing a better experience and faster service for their customers.

"The introduction of WCPS Online underscores our continuing commitment to lead the industry with innovative product offerings and ground breaking service to our customers," said Ron Glime, Warrantech executive vice president and president of U.S. operations. "It is yet another example of the world-class support for which we've become known among many of the country's top retailers and manufacturers."

Targeted Benefits

Dealers that want to leverage the capabilities of WCPS Online will be issued password-protected user IDs to access critical customer and business management data such as real-time warranty sales analysis, service contract profitability and customer contact and warranty registration information.

Service centers have access to real-time management of the complete service process, including contract and coverage verification, repair authorization, claims management, and electronic billing.

Consumers can access WCPS Online to register products and warranties, verify warranty coverage and obtain repair authorization and nationwide service locations, thereby reducing the time required to repair or replace failed products.

WCPS Online also has an e-commerce component that allows consumer electronics and appliance OEMs to offer private label service contracts directly to consumers.

IntelliNet Controls Announces New Dealer Pricing & Product Kits

Newmarket, N.H. - IntelliNet Controls, a leading developer of whole house audio distribution systems, announced that it has restructured its dealer pricing. The company has introduced a variety of product kits for dealers to purchase and in some cases, reduced prices for some of the existing IntelliNet Controls Products. The new IntelliNet Controls Dealer Price List features color images of each product and kit, as well as product descriptions, MSRP pricing and dealer cost. What's more, the new dealer price list features reduced pricing for IntelliNet Controls products like the IR Remote Control, effective May 1, 2002. The newly created product kits include complete systems, zone expansion, rack mounting and IR configurations.

For more information: http://news.russound.com/icdealer-pricing.htm

CEA Urges California State Assembly to Pass Low-Cost Initiative Aimed at Bridging Digital Divide

Arlington, Va. A sales tax "holiday" for computer and computer-related products would help narrow Californiaís digital divide and help arm families with the "educational necessity of the new century," said Doug Johnson, director of technology policy for the Consumer Electronics Association (CEA). Johnson made his comments during testimony delivered yesterday before the California State Assembly's Committee on Revenue and Taxation, in which he strongly encouraged the members of the Assembly to consider the merits of a sales tax holiday for computer products.

"Creating a state sales tax holiday for computers and computer-related products is a way to encourage California residents to embrace technology," said Johnson. "A sales tax holiday clearly motivates people who might not otherwise be so motivated to go to their local retailer and buy a computer."

Assembly Bills 1977 and 2056 propose the enactment of a sales tax "holiday" that would take place during a two or three-day period. During the tax holiday, consumers would be able to purchase computers and related products without paying the state sales tax. While back-to-school tax holidays have traditionally been applied to such items as clothing and school supplies, Johnson stated that home computers and technology products are now critical educational tools.

Johnson also described the "digital divide" that exists in California and the benefits a computer sales tax holiday could provide in narrowing the gap. He cited statistics from the U.S. Department of Commerce, which showed that 43 percent of California households do not have a computer, while 53 percent lack Internet access.

"CEA believes sales tax holidays for computer products are an innovative approach to bridging the 'digital divide'," said Johnson, ìbecause they help to put technology in the hands of more people. Allowing consumers the opportunity to purchase computers without the added burden of a sales tax is a successful means to encourage more families to enter the digital age."

Recent CEA research shows that consumers across the country overwhelmingly support the concept of sales tax holidays on high technology items. Specifically, 65 percent of consumers support the idea of a sales tax holiday targeted directly to purchases of personal computers. As a result of the tax holiday, Californians could save $70 to $140 on the purchase of a $1,000 to $2,000 computer system. Johnson added, "This savings is especially significant to families with low to moderate incomes. We have seen how successful computer sales tax holidays have been in Georgia, Pennsylvania, and South Carolina during the past year in boosting consumer spending and stimulating the local economy, and believe that California will also greatly benefit from this program."

For more information about sales tax holidays for computer products, please visit CEA's website at http://www.ce.org/taxholiday www.ce.org/taxholiday.

FCC Grants 9 DTV Stations More Time, Warns Others

WASHINGTON, on May 16 nine big city television stations were given an extra six months to fully broadcast digital signals and federal regulators warned smaller stations that unreasonable delays will not be tolerated.

The Federal Communications Commission granted the nine stations in six cities, from Hartford, Connecticut to Denver and involving affiliates of the four major networks, six more months to air their full broadcast signal in digital, almost three years later than was required of other stations.

The agency also proposed a litany of sanctions it may impose on the other 1,300 stations who cannot show that their inability to broadcast in digital by the May 1, 2002 deadline was due to unforeseen or other circumstances beyond control.

"While there are opportunities for waivers, the leash is short as it must be," FCC Chairman Michael Powell said at the agency's monthly open meeting.

"We're not going to be unreasonable about it, the transition is complicated, there are bumps on the road, there are things that are beyond peoples' control," he said.

The FCC proposed that stations initially be admonished in the first six months and submit reports on progress but ratchet up to financial penalties and eventually revocation of authorization to broadcast in digital.

So far, about 580 stations have been granted a six-month extension, until Nov. 1, to be broadcasting fully in digital and the FCC is seeking more information from another 300 or so seeking extensions.

Some of the nine stations are already broadcasting to part of their area in digital but were given the extra six months to get up to full power. The leading reason for the stations' delays included still pending decisions on zoning at the local level.

Three of those stations are owned by Sinclair Broadcast Group Inc. and one each by General Electric Co.'s NBC network, Viacom Inc.'s CBS network, McGraw-Hill Cos. Inc., Tribune Co. Outlet Broadcasting and Meredith Corp.

Network Installation and Maintenance

by John A. Ross

Computer networks have become commonplace for organizations that rely on communication between multiple computer systems, peripherals, mass storage systems, and other devices. Networks also allow users to exchange electronic mail, share licensed applications software, gain access to common resources, and to collaborate on projects. Given this flexibility, the number of small business network installations has increased dramatically.

In addition to flexibility, the capabilities of networks have also triggered growth in computing applications. Compared to early designs, modern networks offer faster data transmission speeds and greater bandwidth. Architectures have evolved from simple peer-to-peer to client-server and thin client and then to hybrid peer-to-peer network designs that utilize the Internet. The convergence of voice, video, and data communications technologies has produced desktop videoconferencing, video on-demand, virtual private networks, and Voice over IP solutions for business tasks.

This article introduces basic information about computer networks, the equipment needed for the installation, and the equipment needed for maintenance of the network. The basic information includes an overview of the OSI (Open Systems Interconnection) model, definitions of access methods that emphasizes Ethernet technologies, and a look at cables and connectors. In addition, the article provides information about network interface cards, hubs, switches, bridges, and routers. The article concludes by considering test equipment needed for the maintenance of the network.

Network Functions and the OSI Model

Networks provide the lowest level of information transport in client/server and distributed computing environments. From this perspective, a network consists of equipment and physical media that interconnects two or more computers. Because a wide variety of network configurations exists, the size of a network may range from three desktop computers connected through a cable to a large group of computer systems that serve an international airlines reservation system. The latter system could utilize global communication satellites, large processors, and thousands of terminals and workstations.

Local-area networks (LANs) connect electronic devices within a single building or a cluster of adjacent buildings. Most local-area networks operate within a radius of six miles. Modern local-area network designs must provide the capability to connect across proprietary systems and form a single system with comparable physical interfaces and control protocols.

To ensure flexibility for the system, the design must satisfy not only current needs for the transmission of voice, video, and data information but also accommodate technological advances. Because users require the capability to communicate with other users located outside the system, the LAN also must serve as an interface or gateway for that communication.

The OSI Model

The Open Systems Interconnection model consists of seven layers of protocols that cover the communication of raw data and the networking of applications. Looking at the model, the layers range from the Physical Layer, which covers the transportation of data to, the Application Layer, which contains user applications. With this, the OSI model establishes a reference for layered networking architectures. The model offers "open" standards because the interconnection between networks occurs without specifying any type of hardware. Instead, the communications software adheres to given standards. The following segments provide definitions of each of the OSI layers.

Physical layer

The Physical Layer resides at the lowest layer of the OSI model and provides the service of transferring bits of data across some type of physical link. Physical links may consist of twisted-pair cabling, coaxial cable, fiber optic cabling, wireless radio signals and satellite transmissions.

Data Link Layer

The Data Link Layer covers the transmission of frames and functions in tandem with the physical layer and the network layer. Data Link Layer operations may provide either connectionless transmission that requires no acknowledgement or connection-oriented transmission that requires an acknowledgement of service. The Data Link Layer may provide either connectionless transmission that requires no acknowledgement or connection-oriented transmission that requires an acknowledgement of service. In brief, the Data Link Layer:

- accepts packets of data from the Network Layer,
- divides the packets into frames, and
- passes the frames to the Physical Layer for transmission.

Within this framework, the Data Link Layer becomes active at both the transmitting and the receiving ends of the network. At the transmitting end of the network, the Data Link Layer accepts the address of the node that contains a Physical Layer link so that the network can transmit data to the node. Then, the Data Link Layer accepts data packets from the Network Layer. Once the Data Link Layer accepts the packets, it begins to handshake with the peer to ensure the correct reception of the data. We define handshaking as the initial setup process that occurs between two computers attached to a network and establishes the communication parameters between the two nodes.

Network Layer

The Network Layer sends packets of information. The Network Layer handles any problems associated with delivering a

packet of information form one node of the network to another node. A process found within the Network Layer communicates with processes found at the other ends of all communication links connected to the transmitting node. During the interaction between the Network and Transport Layers, the Network Layer establishes a unified addressing scheme. Each node on the network has a unique address that becomes part of a total, consistent addressing scheme for the network.

Transport Layer

The Transport Layer sees the entire network and uses the Physical, Data Link, and Network Layers to establish end-to-end communications for the higher levels of the model. The Transport Layer has the primary task of moving messages from one end of a network to the other end. In addition, the Transport Layer also provides a set of network services that include addressing, connection management, data flow control, and buffering.

Session Layer

The Session Layer sets a number of parameters that allow actual communication between the nodes to occur. Before the transfer of information takes place, the Session Layer ensures that communication can occur and that the nodes do not attempt to communicate simultaneously. Then, the Session Layer manages the communication by breaking it into usable parts. When the communication ends, the Session Layer provides an orderly method for the break to occur.

Presentation Layer

As data flows from one type of system to another, the Presentation Layer translates the different character codes so that the systems may communicate. The Presentation Layer encrypts, decrypts, and authenticates the data to prevent unauthorized access to information and to confirm the source of the information. In addition, the Presentation Layer also compresses data passed by the Application Layer to save space within the channel during transmission. At the receiving end, the Presentation Layer decompresses the data.

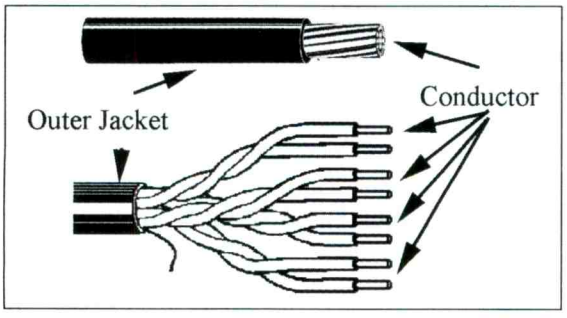


Figure 1a. Unshield Twist

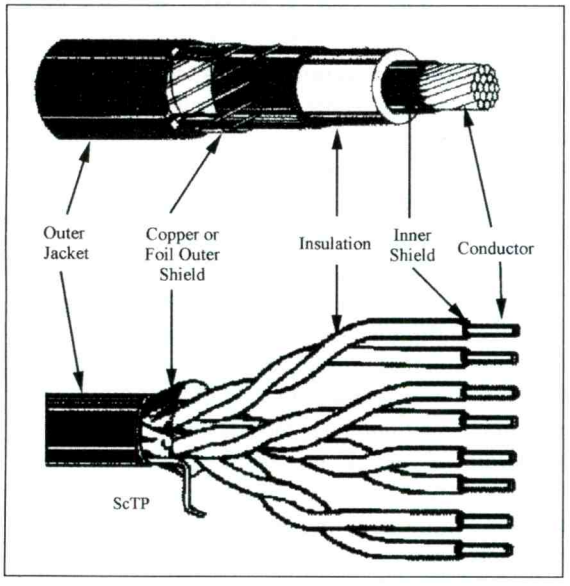


Figure 1b. Shield Twist

Application Layer

The Application Layer contains network applications and passes unmodified messages from the application to the Presentation Layer as a method for accessing services for the other OSI protocols.

Access Methods, Frames, and Packets

An access method defines the set of rules used within networks to arbitrate the use of a common medium. Without access methods, different streams of data would collide as users share a network. All access methods operate at the data-link layer and cover the efficient movement of data rather than content. Examples of access methods include Ethernet and Token Ring.

A frame consists of data placed in a specific sequence and encapsulated by a header and a trailer that contain addressing and messaging information. Networks transmit datagrams or packets as units of information that may consist of a message or a segment of information. Each packet includes a header that contains the address of the destination node.

TABLE 1:
IEEE 802.3 NAMING STANDARDS

Standard	Media/Topology
10Base2	Thinnet
10Base5	Thicknet
1Base5	StarLAN
10Broad36	Broadband — CATV
10BaseT	Twisted-pair
10BaseF	Fiber Optic
100BaseT4	Twisted-pair
100BaseTX	Twisted-pair
100BaseFX	Fiber Optic

The format offers the "s type 1" layout that designates:
- "s" for speed in megabits per second
- "type" for either baseband or broadband communication, and "1" for the maximum segment length in 100 meter intervals.

Logical Link Control

The IEEE 802.2 standard defines the Logical Link Control, or LLC, sublayer of the Data Link Layer as method of link control that remains independent of any specific access method. With this independence, the LLC generates and interprets commands to control the flow of data across Ethernet, Token Bus, and Token Ring local-area networks. In addition, the LLC provides recovery for transmission errors.

Medium Access Control

As with the Logical Link Control sublayer, the Medium Access Control, or MAC, sublayer functions within the Data

Link Layer of the OSI model. The MAC sublayer checks an active channel and the status of the transmitting data or an inactive channel and for the occurrence of a collision. If the MAC sublayer detects a collision, it performs a series of predefined steps and provides the necessary logic to control the network. In addition, the MAC sublayer serves as an interface between user data and the physical placement and retrieval of data on the network.

Ethernet Standards

The Ethernet standard offers a combination of tremendous flexibility and its relative simplicity in terms of implementation and understanding. An Ethernet network operates as a packet-based network built around the Carrier Sense Multiple Access with Collision Detect, or CSMA/CD, protocol. With the use of the CSMA/CD protocol, any Ethernet node determines if it can transmit over a shared medium. The MAC layer enforces the protocol.

In brief, an Ethernet system consists of:

- The physical medium used to carry Ethernet signals between computers,
- A set of medium access control rules embedded in each Ethernet interface that allow multiple computers to fairly arbitrate access to the shared Ethernet channel, and
- an Ethernet frame that consists of a standardized set of bits used to carry data over the system.

In the Ethernet architecture, devices connect to a shared medium and have equal priority access to the medium. All Ethernet nodes have permission to receive network traffic. However, only one device can transmit at any time. Because carrier sensing involves sensing the activity on the medium, the node must wait until activity on the medium has ceased before initiating a transmission. Collision detection occurs if the data transmitted from the first node collides with the data transmitted by a second node.

CSMA/CD Protocol

Ethernet networks use the Carrier Sense Multiple Access/Collision Detect, or CSMA/CD protocol for carrier transmission access. In an Ethernet network, multiple access means any device may attempt to send a frame at any time. Each device senses the condition of the line. If the line has an idle condition, the device begins to transmit its first frame. If another device attempts to transmit data at the same time, a collision occurs. Collision detect occurs and the network discards the frames. In addition, each device waits a random amount of time and retries until successfully transmitting the data.

With the broadcast-based environment found with Ethernet networks, all stations see all frames placed on the network. Following any transmission, each station must examine every frame to determine whether the destination of the frame corresponds with the station. Frames intended for a given station pass to a higher-layer protocol.

The IEEE 802.3 Standard

Although the IEEE 802.3 standard has a basis in the original Ethernet concept, the standard adds support of multiple physical layer options, higher data transmission rates, and different signaling methods. With the support of multiple physical layer options, the 802.3 standard utilizes 50 and 75 ohm coaxial cable, unshielded twisted pair, and fiber optic cable. In addition, the 802.3 standard supports longer maximum cable segment lengths.

Table 2:
Twisted Pair Cabling Categories and Signal Bandwidth Specifications

Category	Maximum Signal Bandwidth
Cat 1	Up to 1MHz (Used only for Analog Voice Transmission)
Cat 2	Up to 4MHz (Used for Low-speed IBM Token Ring Networks)
Cat 3	Up to 16MHz (Widely-used for Digital Voice Transmission and for some 10BaseT Ethernet Networks)
Cat 4	Up to 20MHz (Has Little Existing Uses)
Cat 5	Up to 100MHz
Cat 5e (Category 5 Extended)	(Used for a Wide-range of 10BaseT, 100BaseT, and 1000BaseT Networking Applications)
Cat 6	Up to 250MHz (Intended for High-speed Network Applications)
Cat 7	Up to 600MHz (Intended for High-speed Network Applications)

Note: TIA standards use the term "category" to specify both components and cabling performance. ISO/IEC standards use the term "category" to describe component performance (i.e., cable and connecting hardware. The term "class" describes cabling characteristics such as link and channel performance.

IEEE 802.3 Naming Standards

The 802.3 specification standardizes the type of cabling used for Ethernet networks and sets maximum lengths for cable runs between repeaters. Along with adding support for new Ethernet technologies, the 802.3 standard also establishes a naming standard for Ethernet networks. Table 1 lists the naming standards.

Twisted Pair Cabling

Almost every building in America equipped for telephone services uses twisted pair cabling to carry the telephone and other communications signals. Because the signals have become more complex and because more sources of interference have surfaced, the twisted pair cabling industry has experienced change. Even with the application of fiber optic cabling, twisted pair cabling must now have the capability to carry high data-rate signals and to reject noise interference from industrial and telecommunications

Conference:
July 30
to August 3

Trade Show:
August 1 & 2

NPSC 2002

National Professional Service Convention
and Professional Service Trade Show

The Rosen
Centre Hotel
Orlando, Florida
www.nesda.com
817/921-9061
ext. 16

Get Connected at NPSC 2002 and witness the future of electronics: **Seminars. Certification. Industry Meetings. Sponsored Events. Trade Show. Association Advancement. Networking. They will GET CONNECTED at NPSC 2002. Join us on July 30 to August 3 at the Rosen Centre Hotel in Orlando, Florida. You cannot afford to miss it.**

NPSC 2002, 3608 Pershing Avenue, Fort Worth, TX 76107; Tel: 817/921-9061 ext. 16; Fax: 817/921-3741; Email: judi@nesda.com; For more info. or to register online: www.nesda.com

Circle (29) on Reply Card

sources such as electric motors, power lines, high-power radio and radar signals.

Twisted pair cabling begins with two copper wires encased in color-coded insulation and twisted together to form one twisted pair. Then, the manufacturer packages multiple twisted pairs in an outer jacket to make the twisted pair cable. Varying the length of the twists minimizes the possibility of interference between pairs packaged in the jacket.

Twisted pair cabling used for telephone and local-area network applications provide limited bandwidth and work with the baseband transmission of signals. Unshielded twisted pair (UTP) (Figure 1), has become one of the most popular types of transmission media and originated with the cabling used for telephone connections. Because UTP combines low cost, ease-of-installation, flexibility, and the capability for carrying relatively high data rates, data communications and telecommunications installations continue to use unshielded twisted-pair standard for millions of network connections.

To obtain optimal performance, UTP cable should work as part of a well-engineered structured cabling system. As an example, the installation of UTP cabling requires the use of balance transformers called baluns, or the use of media filters. In either case, the equal induction of noise into the two conductors cancels the noise out at the receiver.

Shielded twisted pair cable (Figure 1B) provides additional protection against noise interference and includes screened twisted pair cable and foil twisted pair cable. While some similarities occur, STP cable has a slightly different design and manufacturing process than UTP cable. STP cable encases the signal-carrying wires within two shields.

The shields act as an antenna and converts received noise into current flowing along the shield. In turn, the current induces an equal and opposite current flowing in the twisted pairs. As long as the two currents remain symmetrical, the currents cancel one another and deliver no net noise to the receiver. Any break in the shield or difference between the quantity of current flowing along the shield and the quantity of the current flowing in the twisted pairs establishes noise.

As a result, the effectiveness of STP at preventing radiation or blocking interference depends on the proper shielding and grounding of the entire end-to-end link. The effectiveness of the shielding becomes more important because of the characteristics of STP cable. For example, the attenuation of STP cabling may increase at high frequencies. In addition, crosstalk and signal noise may increase without compensation for the shield.

Shield effectiveness depends on the shield material and thickness, the type and frequency of the electromagnetic interference, the distance from the noise source to the shield, the continuity of the shield, and the grounding structure. For some applications, STP cables utilize a thick braided shield that increases the weight, thickness, and difficulty of installation for the cable. Other STP cables-called screened twisted pair, or ScTP, and foiled twisted pair, or FTP, rely on a relatively thin overall outer foil shield and have a decreased thickness and cost. In addition, the ScTP and FTP cabling has a maximum pulling tension force intended to prevent the tearing of the shield.

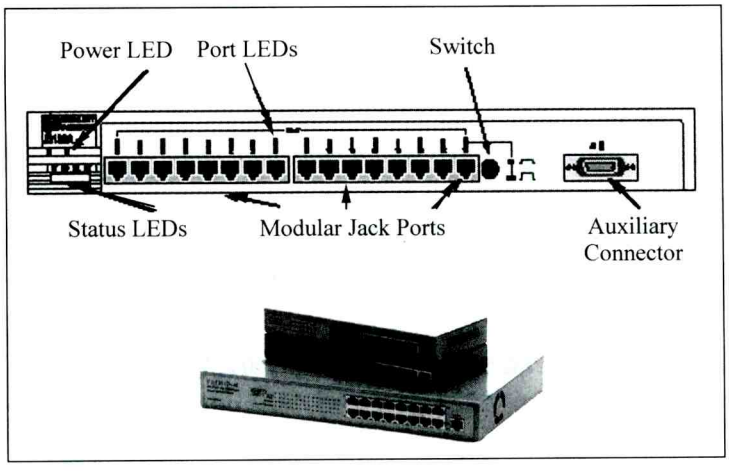


Figure 3. Network Hub

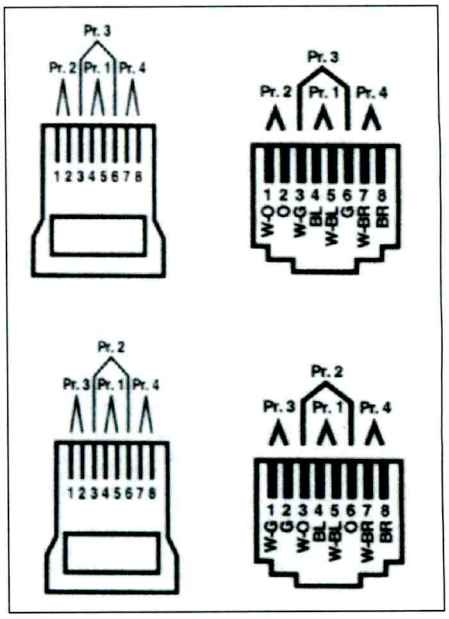


Figure 2. Modular Jack

STP cabling consists of four 24-gauge cables that-in turn-consist of 100 twisted pairs. As mentioned, ScTP and FTP cabling wrap a foil shield around the cable package. Fully shielded twisted pair cabling encloses each of the four cables with an individual foil shield. An overall shield complements the individual shield.

The dependence on proper shielding also carries over to the installation of connectors and other hardware for STP cable. Improperly shielded connectors, connecting hardware, or outlets can cause the degradation of the overall signal quality and noise immunity. A well-installed shielded cabling system requires the full and seamless shielding of every component within the system along with good grounding practices.

Twisted Pair Categories

Because of changing application requirements, UTP and STP cabling has become available in different specifications called categories. Although basic telephone cable—or direct-inside wire-continues to provide value for voice connections, improvements in the manufacture of UTP cabling include variations in the twists, individual wire sheaths, or overall cable jackets. The application requirements and the capability to manufacture improved cabling have led to the development of the

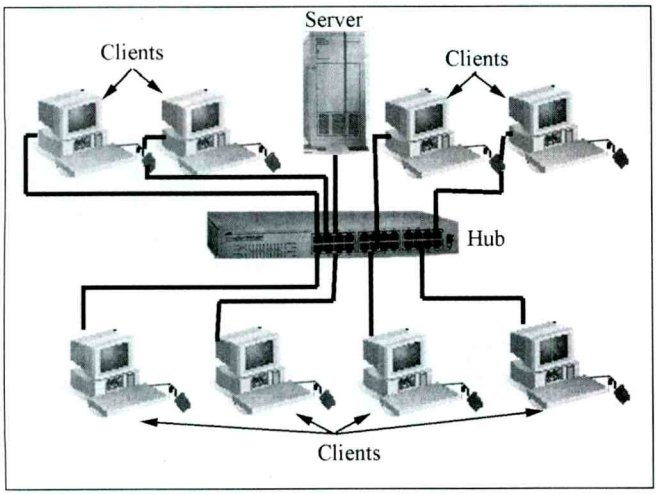


Figure 4. Star Topology

three EIA/TIA-568 standard-compliant categories shown in table 2.

Connectors

Four basic modular jack styles exist in data communications. Rather than refer to the jacks as RJ-45 or a RJ-11 jack, the more correct method refers to the number of cable positions found in the jack. As an example, we refer to the jacks commonly used for UTP cabling as 8-position modular outlets. The letters "RJ" designate the jack as a registered jack and actually refer to specific wiring configurations called Universal Service Wiring Codes. A technician could wire each of the basic jacks discussed in this section for several different types of RJ designations. Figure 2 diagrams an RJ-45 connector.

One application for modular cables involves using the cables as "patches" between modular patch panels. For this application, the modular cables should always have a straight-through configuration. Another application for modular cabling involves the connection of a personal computer, telephone, FAX machine, or other electronic equipment to a modular jack.

Network Interface Cards

The physical connection to the network occurs through the placement of a network interface card, or NIC, inside the computer and connecting the card to the transmission cable. Because the expansion slot connects the NIC to the processor and memory of the computer, it allows the transfer of data to and from the computer to the network. While many computer systems rely on a separate network interface card, some manufacturers have begun to integrate the Ethernet controller functions onto the PC motherboard through the use of a single integrated circuit.

Data transfer methods for a network interface card include programmed input/output transfers where the NIC stores data at the CPU for transfer to RAM. In addition, NICs transfer data by sharing the computer memory and interrupting the processor. Network interface cards arrive configured for the type of network, the speed of the network, and the type of computer bus.

Once the physical connection is in place, the network software manages communications between stations on the network and the server. Network interface cards support network operating systems such as Windows NT, Novell Netware, LAN Manager, VINES, and Appletalk. During the installation of the network operating system, the configuration of the software involves the selection and setup for the installed card.

Repeaters

A repeater functions at the physical layer and interconnects the media segments of an extended network. Repeaters receive signals from one network segment and amplify, retime, and retransmit those signals to another network segment. With this, the repeater allows a series of cable segments to act as a single cable. The amplification gained through the use of repeaters prevents signal deterioration caused by long cable lengths and large numbers of connected devices.

Hubs

Referring to Figure 3, a hub connects multiple user stations through dedicated cables and establishes electrical interconnections. With this, the hub operates much like a multi-port repeater. As shown in Figure 4, a hub creates a physical star network while maintaining the logical bus or ring configuration of the LAN.

Passive hubs concentrate multiple connections into a single device and use electrical relays to connect all users. In some network installations, a number of passive hubs may connect together in a daisy change arrangement. Intelligent hubs add management capabilities to the connections provided by the passive hubs. With this, the hub provides status reports about the connections, compiles statistics about connection usage, and supports the connection of Ethernet and Token Ring cards.

Hubs install in wiring closets centrally located in a building and:

- detect when a node is not responding and "locks it out" so that the ring can continue to operate when a node fails. This happens automatically when the hub senses a node is not responding.
- provide a connection to other rings. With this, the hub sends messages addressed to nodes on other rings across the bridge circuits o those rings and accepts messages from other rings for its nodes.

A stackable hub consists of hubs that stack on top of one another and interconnect through short cables. Even though separate hubs make up the stackable hub, the network "sees" the hub as a single logical device. Stackable hubs offer increased network management capabilities through the use of managed and manageable hubs, flexibility through the availability of more ports, and lower prices per port. The economy and benefits given through the use of stackable hubs occurs because the packets traveling between the devices do not depend on the electronics contained within the repeater.

The repeater units in the hubs connect and form a single device. Each manufacturer of stackable hubs implements the intrahub connections in different ways. In all instances, the patch cables connect repeaters found within the hubs and carry the network data and control information. However, hubs working within the stack

must come from the same manufacturer. Packets moving between the hubs do not depend on the equipment type.

One solution for expanding an Ethernet network involves the cascading, or connecting, of hubs to one another. The cascading of four eight-port hubs can expand the network from the original eight devices to 32 devices. A special type of hub called a concentrator eliminates the need to install cascaded hubs as network requirements grow. Instead, the concentrator consists of a chassis that accepts add-on module boards. Because the backplane of the concentrator serves as a cascaded cable, the installation of the modules easily increases the number of available ports.

An intelligent hub incorporates a microprocessor that can perform pre-programmed functions. The functions may include:

- recognizing commands for turning ports on and off
- obtaining and displaying usage statistics
- displaying diagnostic information, and
- allowing the viewing of network traffic from a console.

Bridges

Available during the early 1980s, bridges originally connected and enabled packet forwarding only between the same type of networks. As technologies have improved, bridges have performed the same tasks between different types of networks. Today, bridges establish LAN-to-LAN connections for similar types of local-area networks. A bridge reads transmitted packets and determines the destination network through a process called filtering.

Bridges interconnect at the Media Access Control sublayer and route data packets using the Logical Link Control sublayer. Although a bridge cannot perform protocol conversion, it can interconnect LANs that rely on different communications protocols. With this, a bridge monitors all traffic on the subnets that it links and reads every packet. During this process, the bridge looks only for the MAC-layer source and destination address for the packet. Therefore, the bridge determines which subnet originated the packet and which subnet should receive the packet. Bridges provide these functions through the use of various Data Link Layer protocols that dictate specific flow control, error handling, addressing, and media-access algorithms.

Bridges provide filtering for frames based on any Layer 2 field or can reject unnecessary broadcast and multicast packets. As an example, a network administrator can program a bridge to reject all frames delivered from a particular network. Because of different types of network support for certain frame fields and the use of different protocol functions within different networks, a bridge may not produce perfect data translation.

TABLE 3:
CABLE TESTER FUNCTIONS

Function	Explanation
Powersum Next	PS-Next measures the signal coupled from all adjacent pairs. New technologies such as gigabit Ethernet use all four pairs.
Propagation Delay	The time required for electrical signals to travel from one end of the cabling link to the other
Delay Skew	The difference in time required for a signal to travel the length of the link over each of the wire pairs
Attenuation-to-Crosstalk Ratio	ACR measures the strength of the signal in relation to the noise on the same pair. A high ACR yields a lower the error rate and a higher quality connection.
PS-ACR	The ratio of attenuation to PS-Next.
Impulse noise	Noise induced by nearby equipment such as light fixtures
Capacitance	Measures the signal distortion caused by the interaction between electrons on two nearby wires.
Impedance	Measures opposition to the flow of electrical current. Impedance is measured for each pair in the cable.
Return Loss	The power of the signal reflections measured at the cable relative to the power of the transmission.
Loop Resistance	Resistance measured in a loop through each pair in the cable
Test to Frequencies as High as 155MHz	Accurately predicts if a cable system can support 155-Mbit/s ATM traffic
Cable Grading	Quantifies link performance against minimum Cat 5 requirements.
Measures Across Multiple Frequencies	Identifies cable that minimally performs beyond required specifications.
Measure Ethernet Traffic	Locates unused ports and measures utilization, collisions, and length of frames
Tone Generation	Traces a particular cable from node to telecommunications closet
Topology Autotest	Conducts tests according to cabling or network type
Auto-Troubleshooting autotest series fails	Gives a detailed analysis when any test in the Mode
Failure Location	Uses crosstalk analysis to pinpoint the location of a failure.
Upgradeability	Upgrades through either software or EPROM

Switches

Like bridges, switches enable the interconnection of multiple physical LAN segments into a single larger network and forward traffic based on MAC addresses. However, switches provide a significant improvement in transaction speed because the operation occurs within hardware rather than through software. Many types of switches exist for different applications such as local-area networking, ATM networks, and internetworking between LANs and WANs.

A LAN switch provides much higher port density at a lower cost than traditional bridges. For this reason, LAN switches can accommodate network designs featuring fewer users per segment. As a result, the use of a switch in a LAN increases the average available bandwidth per user.

Bridges and switches provide several advantages through the division of networks into segments. The forwarding of only given percentage of traffic diminishes the traffic experienced by devices on all connected segments. In addition, a bridge or switch will act as a firewall for some potentially damaging network errors. Bridges and switches also accommodate communication between a larger number of devices than would be supported on any single LAN connected to the bridge. With this, a bridge or switch extends the effective length of a LAN and allows the attachment of distant nodes.

LAN switches provide transparent bridge-like functions in terms of learning a network topology, forwarding, and filtering. In addition, the switches also support dedicated communication between devices, multiple simultaneous conversation, full-duplex communication, and media-rate adaptation. Dedicated collision-free communication between network devices increases the speed of a file-transfer. Multiple simultaneous conversations can occur by either forwarding or switching several packets at the same time. As a result, network capacity increases by the number of supported conversations.

Full-duplex communication effectively doubles the data throughput. Media-rate adaptation refers to the ability of the switch to translate between 10 and 100 Mbps data rates. In addition, media rate adaptation allocates bandwidth on an as needed basis. With this, the installation of a switch requires no change to existing hubs, network interface cards, or cabling.

As we have seen, LAN switches interconnect multiple network segments and provide dedicated, collision-free communication between network devices while supporting multiple simultaneous conversations. In addition, LAN switches provide high-speed switching of data frames.

Routers

Although bridges connect two LANs for the purpose of forming a larger network, a bridge cannot handle the routing and session control functions needed in enterprise-wide networks. A router converts LAN protocols into wide-area network protocols and performs the reverse process at a remote location.

Because routers offer more embedded intelligence than bridges, routers interpret more of the information found in a transmitted frame and support multiple protocols. The use of structured addressing allows routers to effectively use redundant paths and determine optimal routes even in a dynamically changing network. When network congestion or disruption occurs, the router can reroute traffic around the point of congestion or failure. Routers adapt quick to changes in network traffic by balancing the data load over the available routes.

Given these capabilities, many network administrators have replaced bridges with routers. Routers can identify the source and destination of transmitted data and build address tables to define the layout of the interconnected networks. The internetworking information becomes shared among various routing devices connected to the network. Each router on the network maintains a routing table and moves data along the network from one router to the next through the use of routing protocols.

Servers

A computer operating as a server works on a network and facilitates resource sharing. Server computers usually contain larger amounts of random-access memory and higher-capacity disk drives than standard computers on the network. As a result, the server supports concurrent processes and heavy processing tasks. In brief, a server distributes files, messages, and appli-

cations to workgroups and standalone computers in remote locations. The use of a server and the distribution of resources through the server minimize the possibility of a failure in centralized resources.

A server may operate as either a dedicated or shared function microcomputer, a high-powered workstation, minicomputer, or a mainframe. The network operating system controls the functions and operation of the server. Protocols combine with the operating system to establish a framework for communication across the network.

With a dedicated server arrangement, the network operating system runs on a dedicated computer and provides specific tasks for the network such as file sharing, communication, and administration. Because the server centralizes information, a network administrator sets user access policies, defines security rules and measures, establishes data protection, and maintains the operation of the network. Dedicated servers also run multiuser applications that allow many users to access resources and information at a central location. Dedicated server applications include databases, communication services, and electronic mail.

A file server operates as a platform for storing data, applications programs, and files while allowing shared access to the programs or information through network connectivity. All data files contained within the server hard disk drive include access attributes set to read only or read and write. In addition, the server process allows the sharing of network files. A user may transfer an entire file from the file server to a workstation. Attributes associated with file servers include:

- exclusive (the file cannot be shared)
- write access denied (the file can only be read by others), and
- deny none access (the file can be shared, read, and written to).

Database servers divide database processing into a front-end application that runs at the desktop and a back-end processing that runs in the database engine held on the server. During operation, the downloading and uploading of individual records eases locked data and network traffic. Retention of data at the server also facilitates backup and security operations for the database records.

Although a file server offers ease-of-use through the capability to share applications or files, limitations exist. As an example, an operation that requires access to a database may result in the transfer of thousands of records from the file server to the workstation. Transferring the large amount of records over the network can cause a dramatic decrease in network performance.

Database servers solve the problem of passing an entire file over the network by processing the user request on the server and then transferring the results of the operation to the individual workstation. With this, the processing speed and storage capability of the server increase the performance of the network and decrease the time needed to answer the request. Using a database server places greater emphasis on the capabilities of the server rather than the capabilities of the network.

Because processing occurs on the server, one operation may affect the abilities of other users to complete an operation. The server must have the available processing power, memory capacity, and storage capacity needed to not only efficiently complete a requested operation but to also maintain the operations of other users. In addition, an interface must exist between the server and the application software used to make the request. The interface translates the data needs of the application into the language used by the database server.

Print servers use third-party software to control access to network printers. Print servers can affect the performance of the network because the server requires microprocessor cycles from a workstation or file server during operation. As with print servers, communications servers—also referred to as Remote Access Servers—allow the pooling of resources but operate with modems and phone lines. Supporting communication resources requires the installation of multiple serial ports and high interrupt rates at the server.

Hardware Management Tools

Hardware tools for network testing include dedicated equipment such as protocol analyzers, breakout boxes, and servers established for the purposes of network management, testing, and tuning. The implementation and degree of functionality available in test equipment varies from product to product. To develop end-to-end testing capabilities that simulate new applications on an intranet may require a basic toolset that covers protocols, configuration testing, and network mapping.

Using Protocol Analyzers for Network Management

During typical network operation, communications software formats data for transmission according to a particular protocol by adding a header and trailer and forming an envelope for the message. Devices on the network using the same protocol can read the envelope, route it over the appropriate link, deliver the data to the appropriate addressee, and provide an acknowledgement. A protocol violation occurs when the network or device does not follow established procedures. From there, a technician must locate the problem before restoring communications across the network.

A protocol analyzer views and verifies the protocol transfer process and decodes messages. Protocol analyzers exist for all types of communications services including X.25, frame relay, ISDN, token ring, Ethernet, FDDI, and ATM networks. A protocol analyzer connects directly to the network in the same way that a node or communications port connection exists.

In the passive monitoring application, the protocol analyzer displays the protocol activity and user data passing over asynchronous or synchronous transmission links. As a result, the analyzer establishes a window into the message exchange between network nodes. Most protocol analyzers have features such as data capture to RAM or disk, autmatic configuration, counters, timers, traps, masks, and statistics that assist with reducing the time needed for diagnosis.

Trapping provides a method for recording only essential data into the buffer of the protocol analyzer or onto a disk drive. As an example, a trap could capture the first incorrect frame received at the ana-

lyzer. Filtering provides the capability to include or exclude certain types of protocol data such as the destination, source, or bilateral addresses, protocol type, or error packets. Post filtering captures a large number of packets to disk or random-access memory for the purpose of further analysis.

While Bit Error Rate Testing, or BERT, capabilities vary from analyzer to analyzer, the range includes full duplex, half-duplex, and multidrop support. With the generation of packets, a protocol analyzer allows the testing of the impact of additional traffic on the network. Using a group of configuration screens, a network administrator can set parameters such as:

- source address
- destination address
- maximum frame size
- minimum frame size and
- the number of packets sent out with each burst.

Packet generation also allows the customization of the data field section contents to simulate real or potential applications.

Load generation creates varying traffic rates on the network. With the loading the network from lowload to overload conditions, the protocol analyzer stresses network components such as hubs, repeaters, bridges, and transceivers for the purpose of identifying weak links. The timers contained within protocol analyzers measure the time interval between events. By establishing a trap in the transmit path and another in the receive path, the protocol analyzer can verify the handshake procedure time interval.

Mapping automatically documents the physical location of LAN nodes and eliminates the need for rearranging the network map after the addition, deletion, or moving of devices. In addition, mapping software allows the naming of nodes and includes icons for servers and workstations. The icon provides information about the type of adapter used at the node and the location of the node along a cable run.

Analyzer software usually includes a text editor that can run with captured data. With this resource, a network administrator can delete unimportant data, enter comments, print reports, and create files. The text search function allows the tracking of a problem source in data packets through the identification of a known text string.

Along with the more sophisticated troubleshooting and monitoring functions, many protocol analyzers include a mechanism for testing cable breaks or improperly terminated connections. Time Domain Reflectometry, or TDR, sends a signal down the cable, receives and echo, and interprets the information. The analyzer may report that the cable has no fault detected, no carrier sense, an open on coax, a short to coax.

In addition to the monitoring and troubleshooting tests, some protocol analyzers incorporate sophisticated programmability and simulation options. While some analyzers require the use of a programming language, others utilize a set-up screen that allows the definition of a sequence of tests. Once conditions occur that meet pre-determined thresholds, the program automatically initiates a set of tests used for tracking and solving the problem. An automatic configuration capability allows a protocol analyzer to automatically configure itself to the protocols found at the line under test.

With the simulation application, programming of the protocol analyzer allows the device to operate as a gateway, communications controller, or front-end processor. The protocol analyzer replaces the suspect device on the network and allows the isolation of problems. More sophisticated simulation routines verify the conformity of a network device to specific standards.

Using Network Analyzers for Network Management

A network analyzer provides more functionality than a protocol analyzer and offers fault and performance capabilities for maintaining, troubleshooting, and fine tuning networks. To accomplish this, network analyzers provide the capability to oversee the seven network model layers and provide automatic analysis and alarms. The analysis information can transfer to a spreadsheet or database. In addition, the network analyzer can detect problems such as bottlenecks before an interruption to network services occurs. Network analyzers exist for a variety of LANs and WANs applications.

Breakout Boxes

A breakout box monitors the performance of a network without interrupting user traffic. By connecting a breakout box between two devices, a network administrator can check for the proper connection of interface leads. The breakout box allows the opening, closing, or cross connection of the leads for any pattern. Because a breakout box has the capability to cross connect leads, it can connect devices that do not have identical interfaces. In addition, a breakout box can test cable continuity.

Using Cable Testers for Maintaining Network Efficiency

Most-if not all—cable testers offer ease-of-use. Through the use of the tone generator often found in cable testers, a technician can plug the tester into the cable at the PC end, go to the wiring closet, and wave the tone probe over the cables. The ringing sound identifies the terminating end of the cable.

When conducting tests, one member of a two-person team can work from the telecommunications closet, unplug a cable from the hub or patch panel, and attaches the cable to the tester. The other member of the team connects the remote unit of the tester to the terminating end of the cable located at the user's work area. From there, the technicians can run an autotest, or a series of predetermined tests, and grade the system. Test results store within the testing unit. When moving to the next cable, the person at the terminating end moves to the next wall jack to repeat the process.

As we discovered in the opening sections of this chapter, the components and cabling that make up a telecommunications must have uniform impedance values. Faults within the cable can change impedance. Consequently, a load with

one impedance value will reflect or echo part of a signal being carried by a cable with a different impedance level and cause failures. Because of this, both vendors and installers test to ensure that the impedance, resistance, and capacitance values found within the networking cabling comply with standard cable specifications.

Cable testers check for impedance mis-matches during tests for cable faults. For example, a break in a wire creates an open circuit and infinitely high impedance at the break. When a high frequency signal emitted from a cable tester encounters this high impedance, the signal reflects back to the tester. In contrast, a short circuit within a cable displays as a zero impedance value. With this, the impedance mismatch also reflects a high frequency signal. However, the signal reflected by the short circuit will have an inverted polarity.

Most cable testing devices can provide an approximate measurement of the distance to the cable fault. To do this, the tester relies on a cable value called the nominal velocity of propagation. The NVP measures the rate at which a current can flow through the cable and expresses the measure as a percentage of light speed. Then, the cable tester multiplies the speed of light by the NVP and by the total time taken for the pulse to reach the fault and reflect back to the tester. To show the one-way distance, the tester divides the measurement by two.

When checking the electrical length of a cable installation, a tester applies the same concept by using Time Domain Reflectometry to measure length. However, this test requires that one end of the cable not have any termination. During the test, the open end will register as infinite impedance and reflect a pulse back to the tester. Then, the tester factors the response time into the formula used to estimate the overall electrical length of the wire. Cable testers do not have the capability to check the first 20 feet of a cable because a pulse transmitted by the tester reflects back to the device before the signal transmission concludes. As a result, the tester cannot provide an accurate measurement.

Noise stands as one of the biggest problems for a cabling system. A cable tester transmits different frequencies to check the ability of the system to dampen the effects of noise. Due to attenuation, the transmitted signals vary from high strength at the transmission point to lowest strength at the destination point. As a result, the magnetic field of a signal transmitted from a device through one wire may overwhelm a signal arriving at the same device on the wire pair.

Purchasing a Cable Tester

As network technologies have progressed to the high-speed transmission of data, network managers have faced the challenge of knowing whether projected or installed cabling systems will handle the increased data rates. Because of this, test equipment vendors have added a wider range of tests and tools for taking and interpreting measurements. New cable testers provide LCD display screens, cable grading and troubleshooting capabilities, and also work as fault locators, Ethernet monitors, cable toners, and voice sets.

Given the new functionality, selecting the correct cable tester for the application also exists as a challenge. Much of challenge arises from the different test and evaluation philosophies exhibited by test equipment vendors. While some vendors point to the need to certify that a cabling system can handle specific high-speed applications, others emphasize testing to ensure that cabling exceeds current standards. Within this second set, vendors may define specific levels at a specific frequency or recommend the taking of measurements over a range of frequencies.

In addition to capabilities, network managers and technicians must also consider the physical size, portability, and cost of cable test equipment. As an example, hand-held cable testers used for testing Cat 5 cabling range in weight from one to more than three pounds. With and without various options, purchase costs for full-function cable testers range from $2,500 to $5,500. Smaller hand-held units that offer continuity testing rather than total test functionality may sell for as little as $110.

A cable tester has basic functions and may work with various cable types. When purchasing a cable tester, verify whether the cable will accurately test all or only a portion of the cable types discussed in this chapter. In addition, check for the availability of a fiber optic probe attachment and automatic bi-directional NEXT measurement. The tester should have the capability to process and store tests quickly. While some products may run an entire suite of tests within eight seconds, other testers require up to 45 seconds for the same task.

Because networks feature multiple links, the ability to store and manipulate test results has become critical. A given cable tester may store only the last test performed, or it may store as many as 2,000 tests. In addition, some cable testers allow the downloading of results to a personal computer so that installers can provide customers with a printed summary of each test link.

Regardless of the speed, the true measure of tester usefulness is accuracy. Vendors may express accuracy in terms of maximum and typical accuracy levels. If a tester conforms to TSB 67 requirements, the device must provide an indication of a marginal pass or fail. If a cable passes any of the tests by a margin that is lower than the accuracy of the tester, a "marginal" rating occurs.

Manufacturers ship cable that can carry data at frequencies far higher than the 100 MHz defined in the Commercial Building Telecommun-ications Cabling Standard 568A specification. Cables carrying high-frequency signals become more susceptible to noise caused by signal reflections. Many cable testers check the actual bandwidth of the cable and give an indication of how cable will handle high-speed technologies. ■

Tools For Efficient Servicing

Wherever there's a professional performing a diagnosis on a system that's malfunctioning, there's some type of test equipment. Consider a physician trying to find out what's wrong with his patient. He uses a thermometer to check temperature, a sphygmobolometer to check blood pressure, a scale to measure the patient's weight. He takes a blood sample for a lab to perform a number of measurements including: blood gases, sugar level, cholesterol level, etc.

The mechanic working on a car might check engine compression, battery discharge capacity, resistances at a number of critical junctions and more.

The common link in these cases is that when there's a problem with any kind of complex mechanism, whether human, or human-made, a proper diagnosis requires the use of test equipment to record vital operational data.

The same, of course, is true of the consumer electronics service technician trying to perform a diagnosis on a TV, VCR, microwave oven, or other product. If the problem is at all complex, the technician may, in the course of his diagnosis, bring to bear an impressive array of test devices and accessories: DMM, oscilloscope, waveform analyzer, capacitor tester, variable transformer, bench power supply, or even more specialized equipment.

The Test Equipment

Service centers have been forced to change and grow to keep up with changes in the test equipment they use, and to learn to operate new types of test equipment. The basic principles of electronics, however, will never change. Because of these constants, much of the test equipment in use by service centers today will still be useful for years to come. The DMM and the oscilloscope, and other test instruments and accessories such as the variable transformer, the isolation transformer and the bench power supply are just as necessary as they ever were to the serious consumer electronics technician. Therefore, the test equipment required by the technician doesn't so much change, as grow.

But because the consumer equipment serviced by technicians becomes more complex and sophisticated, even as new test equipment is being introduced, the existing items of test equipment are evolving and being improved.

For example, while today's technicians require oscilloscopes and test meters and other old standbys just as much as they did 10 or 20 years ago, in many cases the test equipment they require has to be more sophisticated, perform more precise measurements, than before. The products that the technicians are required to service are so much more sophisticated than they once were, and so the test equipment that the technicians use to analyze them must also be more sophisticated.

Finding Out About the Suppliers

Not all car manufacturers, appliance manufacturers, or homebuilders are alike or equally competent. The same is true of test equipment manufacturers. making a wise decision in the purchase of a new piece of test equipment requires a fair amount of research on the part of the purchaser.

This special advertising section "Test Equipment Showcase," was conceived as a way to help bring more information about test equipment providers to readers. Every advertiser in this section has been given additional space to tell readers something about their company, or to help readers understand the value and use of that company's products.

We invite you to read what these companies that sell test equipment have to say about themselves and their products.

THE CHECKLIST

Before a service center buys a piece of test equipment, it might be useful to check the candidates against a list such as this: (this specifically applies to scopes but the principals apply to most Test Equipment purchases)

- *What products will this equipment be used to test (now and in the near future)?*
- *What bandwidth is needed?*
- *Single-channel, or multi-channel?*
- *Is waveform storage needed?*
- *Will this be used at the bench only, or on site as well?*
- *Does this scope need to have on-screen readout of waveform parameters?*
- *Can this purchase be cost justified as a time and effort saver?*
- *Will the technicians need training to use this test equipment?*
- *Would something less expensive, less sophisticated do the job?*
- *Are the recommendations being made on facts or perceptions?*

Electronic Design Specialists

21621 Reflection Lane
Boca Raton, Florida 33428
Phone: 561-487-6103
Fax: 561-487-6103
www.eds-inc.com

Electronic Design Specialists makes test equipment designed to help servicing electronic technicians troubleshoot problems as quickly and accurately as possible. All test equipment is designed by David T. Miga, CET, who is an electronic engineer and a certified electronic technician.

The EDS corporation was started in 1986 when Dave designed a digital capacitor meter and a semiconductor analyzer to increase his own productivity as a contract technician. When other technicians saw what the EDS-52 capacitor meter and the EDS-59 semiconductor analyzer could do, Dave found himself being asked to build more of these prototypes for them. The production version of the semiconductor analyzer, the SemiAnalyzer 59C, was very successful and was sold from 1987 until 1997. Other unique test equipment followed, such as the Bus Line Tracer, the Micro-Analyzer, the Leak Seeker, and the very popular CapAnalyzer. Although designed for independent service technicians, regular users are the US military, most of the fortune 500 companies, NASA, the TV networks and cable companies, Panasonic, Pioneer and many trade schools and colleges.

Dave designs his test equipment with an entirely different perspective than most test equipment companies. All ideas start with interviewing thousands of independent service technicians for their opinions and special needs. This approach is different from conventional test equipment manufactures, where equipment is designed by engineers that may have never picked up a soldering iron, who wouldn't be able to repair their own television, even with their own test instruments. Their idea of test equipment is to bombard the technician with numbers, to be expensive and to be difficult to use. This is overkill for a servicing technician; check out the "used test equipment" section in the classifieds of this magazine for these products.

For this reason, all EDS equipment is designed to give the technician the tools to tell whether a component is good, poor, or bad, in a circuit, as accurately as possible. A technician doesn't need to know what a capacitor's dissipation factor or dielectric constant is; just is it bad, can I move on? EDS test equipment is designed by technicians, is guaranteed accurate for in circuit tests, and is designed for easy use. Determining the quality of a component in questions done by the test instrument, not the technician.

To design a test instrument to decide whether a component is good or bad, EDS analyzes actual defective components sent in by technicians. Calibrating the test equipment is done by comparing new, old but still working, and known defective components, then programming the test equipment to make the decision, with Dave's 30-year experience as helpful input. Every CapAnalyzer 88A is still tested with the same actual good, poor, and bad electrolytics and tantalums used to design the original prototype, before releasing it to the customer.

EDS was the first on the World Wide Web with animated demonstrations of test equipment products, and has one of the best technical assistance programs on the internet. You can even download replacement owner's manuals and review tech tips, and get self-maintenance help for each product.

As the electronic repair industry moves into the twenty first century, more and more technicians will discover that to be productive, less time must be spent looking at schematics of increasingly complicated circuits. Simply checking components in the circuit with the problem, with the right instruments, is how profitable repairs will be done by surviving technicians in the next millennium.

EDS products are available from your distributor. For international sales contact EDS directly. Check out www.eds-inc.com for a current list of distributors. All products come with a 60 day satisfaction guarantee or money-back policy.

The Standard for checking Capacitors in-circuit

Good enough to be the choice of Panasonic, Pioneer, NBC, ABC, Ford, JVC, NASA and thousands of independent service technicians.

Inexpensive enough to pay for itself in just one day's repairs. At $179, it's affordable.

And with a 60 day trial period, satisfaction guaranteed or money-back policy, the only thing you can lose is all the time you're currently spending on trying to repair all those dogs you've given up on.

Locate shorted or leaky components or conditions to the exact spot *in-circuit*

Still cutting up the pcb, and unsoldering every part trying to guess at where the short is?

$179

Your DVM shows the same shorted reading all along the pcb trace. LeakSeeker 82B has the resolution to find the defective component. Touch pads along the trace, and LeakSeeker beeps highest in pitch at the defect's pad. Now you can locate a shorted part only a quarter of an inch away from a good part. Short can be from 0 to 150 ohms

CapAnalyzer 88A ***LeakSeeker 82B***

***Available at your distributor, or call* 561-487-6103**

Electronic Design Specialists www.eds-inc.com

Circle (4) on Reply Card

SENCORE

3200 Sencore Dirve
Sioux Falls, SD 57107
Phone: 1-800-736-2673
Fax: 605-339-0317
www.sencore.com

For over 50 years, Sencore Electronics has been dedicated to one goal — Making our customers more successful in electronic servicing. Today, Sencore is a leading manufacturer of electronic test equipment because we listen to our customers needs and design them instruments that help them achieve success. Sencore is committed to its customers with an exclusive product line and the absolute best support in the industry. Our obligation and support are just the beginning when a customer says "yes" to Sencore equipment.

Sencore was started in 1951, in downtown Chicago, Illinois, by R.H. (Herb) Bowden. As the business grew, Sencore moved west to Sioux Falls, South Dakota, in 1971, attracted by the area's superb quality of life. The now second generation business remains in Sioux Falls where Sencore is actively involved in community events and charities. Sencore's second generation, represented by co-owners Al and brother Doug Bowden, is committed to adapting to the technical challenges necessary to take Sencore into the 21st century.

Sencore's highly trained employees continually design new equipment based on advances in the electronics industry. With each new product, the company deals with complex issues of marketability, design feasibility, and manufacturability, and brings these together in the shortest time possible. Sencore designs and manufactures test instruments that provide the highest quality and reliability in the entire service industry.

Every Sencore instrument is engineered to provide our customers with exclusive tests and capabilities that will make testing and troubleshooting easier and more efficient. When customers invest in Sencore instruments, they also receive the best after the sale support available in the industry. During the past 48 years plus, Sencore has remained dedicated to one goal-making our customers more successful. And since our success depends on our customers success, were working even harder to be in the industry.

The future looks exciting at Sencore. As technology advances from the broadcast studio to your living room TV receiver, Sencore is preparing itself for new challenges and forming global alliances to stay on top of the industry. We're a forward looking engineering/manufacturing marketing firm with an eye on the future.

Sencore Electronics remains the leading manufacturer of video calibration and service test equipment for the electronics industry.

Over the past few years Sencore's Home Electronics Division has moved into the home and commercial installation/theater market with several new products and training offerings. With over 80,000 new installers needed per year (CEDIA 2001) for the next 5 years this may be a market that you, an electronics servicer may wish to investigate. Our professional staff at Sencore can help educate you on all the opportunities available and provide you with valuable solutions to be successful in this booming field.

Sencore offers dealer and installer package specials that includes everything you need for high quality commercial and residential installations. Ask a Sencore Product Sales Engineer about the "Installers Suite Pro" which includes the VP300 Video Pro Multimedia Generator, the CP291 "Pocket PC" Color Pro 2 Color Analyzer, the SP295 Sound Pro Audio Analyzer, the SL754D Channelizer RF Signal Level Meter, and a heavy duty Travel Case.

Some of our New Installer Tools Include:

Our new VP300 "Video Pro" Multi-media Generator. The VP300 delivers the HDTV, NTSC, PAL, and Computer Display Video Signals you need for accurate alignment of front and rear projectors, monitors, direct view displays and video walls in all operating modes. The VP300 generates all 18 ATSC-HDTV formats including 1080I and 720P in both 4 by 3 and 16 by 9 aspect ratios. The VP300 provides Y PB PR, RGB H/V, Composite, S-Video, and Vesa outputs, and is hand-held, portable, and battery operated! This is also a great generator for in-home HDTV service!

Our new SP295 "Sound Pro" Audio Analyzer. The Sound Pro is a professional quality audio analyzer designed to help you quickly equalize room acoustics, optimize speaker placement, and calibrate system settings for concert quality audio installations. The Sound Pro's standard equipment includes a real time analyzer, sound pressure level meter, energy-time graph, noise criteria test, an integrated audio signal generator and many other features.

The CP291 "ColorPro" is a Pocket PC-based color analyzer that helps you align color tracking and luminance levels on video displays to give you the confidence that the display is aligned to perform its best and to industry specifications. The CP291's easy-to-use graphical interface greatly decreases calibration time with easy to follow measurement screens. The CIE and RGB screens make calibrations simple by illustrating exactly which colors need adjusting. CP291 readings are displayed in xyY, RGB, and color temperature is displayed in degrees Kelvin.

For TV/hdtv service, we just released the HA325 Portable Horizontal Output & Flyback Analyzer. The HA325 is designed to greatly slash servicing time on all types of CRT-based video displays. According to industry estimates, over 250 million CRT-based video displays are currently in use, with sales of another 22 million units this year including 1 million projection systems. Technicians servicing these video displays indicate that over 50% of the failures involve the horizontal output stage. These problems are especially difficult to troubleshoot because of their confusing interaction with other circuits and their potential for dangerous currents and voltages that quickly damage other circuitry and expensive components. Servicing is further complicated by the need to service projection and large screen displays on location.

Who knows where the future will take us next. We do know one thing. Sencore will be at the forefront of new technology with new products and alliances to insure we remain on top of our industry.

See you in the future!

AN ADVERTISING SECTION

T.A. EMERALD

PURETRONICS VALUE DRIVEN LINE HELPS MAINTAIN OPTIMUM SURFACE CLEANLINESS

T.A. Emerald Industries, a company that specializes in high quality cleaning products for advanced applications released the PURETRONICS(r) product line to the electronics industry late last year. PURETRONICS(r) is a new family of environmentally safe precision cleaning products developed specifically for electronic applications with one purpose in mind—-to effectively, safely and affordably clean electronic components and equipment to the point of optimum surface cleanliness.

With extensive research and development in the lab aided of process engineers and service technicians, T.A. Emerald Industries feels confident that they have created a quality line of cleaning products offered at outstanding value. Each individual PURETRONICS(r) product has been subjected to stringent quality and performance standards in order to qualify and be accepted into the line. These standards revolve around qualities they feel essential to an exceptional formulated product: excellent cleaning strength, material compatibility, quick evaporation rate, zero residue, low odor, low toxicity, environmentally safe and reasonable formulation material cost. These product objective qualities are the keys to an effective, safe and affordable cleaning product and are the foundation to the entire PURETRONICS(r) product line. The broad but initially general line consist of different strength contact cleaners, dusters, flux removers, contact cleaner and lubricate, circuit freeze and plastic and glass cleaner. For more information, contact: T.A. Emerald Industries, 1580 East Edinger Avenue Suite O, Santa Ana, CA 92705. 714.972.9200; fax: 714.972.9400. E-mail: info@puretronics.com Web: http://www.puretronics.com

AN ADVERTISING SECTION

COMPUTER & MONITOR MAINT.

Computer & Monitor Maint. Inc was established in 1990 as a monitor service operation. It soon became apparent that the available monitor test equipment was limited. It was also very expensive. Based on that need, we developed our patented line of Checker monitor testers. We then developed a line of television test generators. The next logical step was to blend the two technologies together, resulting in our latest product, the Checker TV-HD. The Checker TV-HD design goal was 1: low cost, 2: ease of use, and 3: versatile. We achieved all of our goals in the Checker TV-HD. It is the lowest cost HDTV test generator available today, yet it provides all the functionality you need to test and evaluate virtually any television, HD or standard. It has Standard video, S-Video, and Component Video outputs, and they can all be used at once.

We also have a small, pocket sized, Video generator, for standard TV, the Checker TV Jr. It has colorbars, full field colors, and cross hatch. Great for setting up and converging projectors. Our TV-Pro has a host of features and RF out. It is also FCC certified to part 15.

Our Checker monitor products are also cost effective and easy to use. From the Checker Jr., to the Checker Pro, they are still the best solutions for today's demanding service business, and that are all manufactured in Duluth Gerorgia. We have sold thousands of our products, all over the world. They work, and keep working.

Please visit our website at www.computermonitor.com for all of the products and details.

Troubleshooting RCA's CTC187 Dead Chassis

by Homer L. Davidson

A TV set that is completely dead is supposed to be the easiest set to troubleshoot. In many cases that is true, but in other cases, a dead set can present some knotty problems. The dead chassis might have a blown fuse with certain leaky components found in the low voltage power supply or horizontal output circuits. Sometimes a leaky regulator transistor or IC can cause the fuse to blow. A leaky flyback or main filter capacitors has caused the fuse to open. Of course a dead chassis symptom with a fuse that's intact might take a little longer to locate (Figure 1).

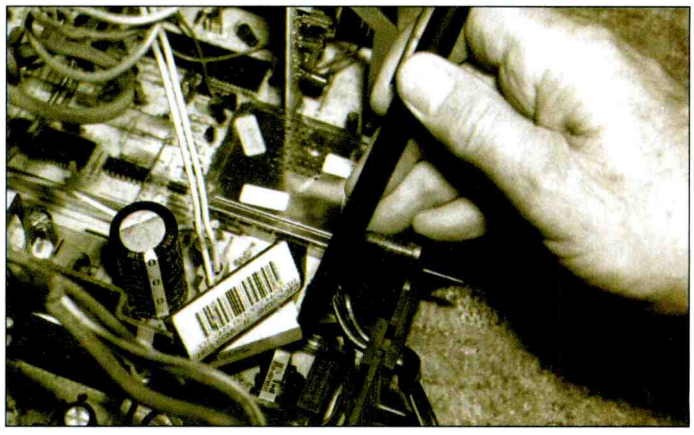


Figure 1. If you have to replace a blown 5A fuse in the RCA CTC187 chassis, you'll find it under some large wattage resistors.

Chassis Dead, Fuse Intact

In an early RCA CTC187 chassis, the fuse was normal but the set didn't operate. A quick voltage test across the main filter capacitor C4007 (680°F, 200 V) revealed that this voltage was as specified. Notice that the low voltage power supply circuits and the IC regulator (U4101) circuits are found in the "hot" chassis ground. Use the negative terminal of the main filter capacitor as the hot ground terminal, when taking voltage measurements in the primary switching circuits.

In these sets, the IC voltage regulator (U4101) can cause several different symptoms in the CTC187 chassis. In fact I have seen a number of different RCA chassis on the service bench that were completely dead, but in which the main fuse was intact, whose problems were caused by problems with this IC regulator. If you encounter one of these sets that exhibit this problem, check resistor R4104 (1.5M©) for an increase in resistance. R4101 can cause a dead chassis symptom with a normal fuse (Figure 2).

A high-pitched squeal when the TV is plugged in and not turned on can be caused by C4103 (0.0033°F) capacitor in series with CR4102 and R4105 (47K©) off of pins 2 and 9 of the regulator U4101. You might find the squealing noise is eliminated when the TV is turned on. Check CR4102 and check to see if R4107 has the correct resistance after replacing defective C4103.

If regulator IC U4101 keeps breaking down or repeated failure occurs, replace transformer T4101. A continuity or resistance measurement of transformer T4101 may not show up a bad transformer, but replace it anyway. T4101 has been known to cause U4101 to fail after replacement in several different CTC187 chassis.

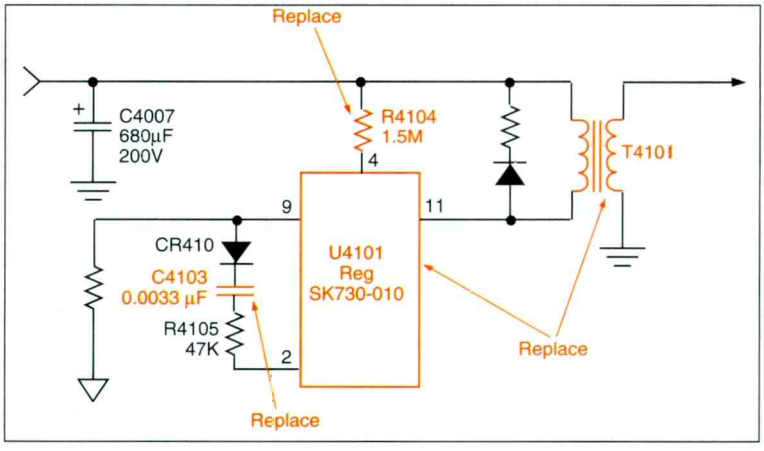


Figure 2. Check for an increase in resistance of R4101 (1.5M©) if the set is dead and the line fuse is intact.

Check R4104, C4103 and U4101 regulator if the set is dead but the fuse is intact. Replace U4101 with an STK730-010 original RCA part number 215530.

If the horizontal output transistor (Q4401) runs hot, the problem may be a shorted U4101 regulator. This problem can ultimately cause the fuse to blow, usually causing the fuse to appear extremely black. Replace IC U1001 if Q4401 fails after a few days of operation.

Dead Chassis, Fuse Intact, No HV

If you encounter one of these sets that has low voltage, or no voltage, on the horizontal output transistor (Q4401), and there is no high voltage, go directly to the secondary winding of the regulator transformer (T4101). The 140V raw voltage source feeds the horizontal output and drive transistor. Check diode CR4106 for open or leakage conditions. CR4106 is a half-wave rectifier feeding a choke filter capacitor network that supplies operating voltage to the horizontal output circuits (Figure 3). CR4106 is located near T4301 and Q4301, ahead of the horizontal output transistor on a separate heat sink.

Check Q4401 and Q4301 with in-circuit transistor tests if you suspect that CR4106 has failed. A faulty Q4401 might arc over and cause CR4106 to be damaged, but in spite of the damage it may test normal with in-circuit tests. If you re quite sure that CR4106 is faulty,

replace it even if it tests good.

Double check filter capacitor C4107 (100°F) and C4105 (10°F) for possible leakage or shorted conditions with the ESR meter. You can assume that CR4106 became damaged by itself if no other component in the 140V source is defective. You might find a damaged U4101 regulator IC after replacing CR4106.

Set Dead, Fuse Intact, No Run Voltage

Defective secondary voltage supply diodes in any TV chassis can cause many service problems in the various circuits. A defective CR4704 diode in the 13.5V and 12V sources in a CTC187 chassis can cause a dead chassis, because proper voltage will not be provided for many different circuits. The 13.5V source feeds the vertical IC (U4501) and vertical deflection yoke circuits (Figure 4).

The 12V source feeds the video, RF switch, and the mixer oscillator (U7301) in the tuner and tuner control IC, while another 12V source feeds the RF AGC, degaussing, tuner, VHF oscillator, IF amp, 5V regulator transistor (Q4106), and stereo decoder (IC1600) circuits. Another 12V source provides voltage for the audio output regulator transistor (Q1406).

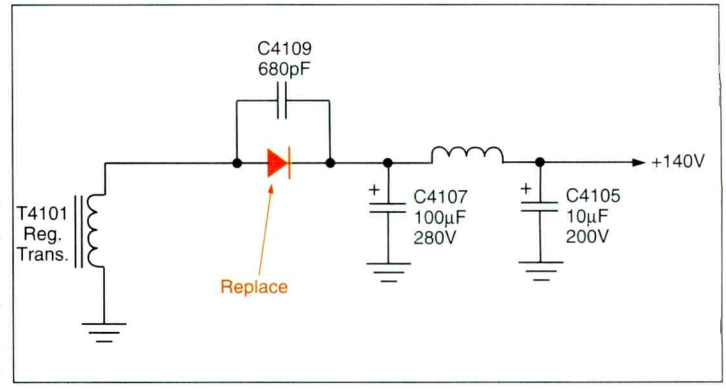


Figure 3. If there s no high voltage but the fuse is intact, suspect a defective CR4106.

The 7.5V regulated transistor (Q4101) in the 12V source feeds the T-chip (U1001), size and ramp circuits, output bias video and vertical supply circuits. Another 7.5V source through choke coil L2704 provides operating voltage to the vertical input, OSD, video buffer, video ABL, black level detector, chroma and beam current circuits of the T-chip (U1001).

Just about any component in the 13.5V, 12V or 7.5V source can cause CR4704 to become leaky or shorted. If diode CR4704 is leaky or shorted, check R4702, R4517 and R4106 to see if any of them is burned or open. A shorted or leaky 7.5V

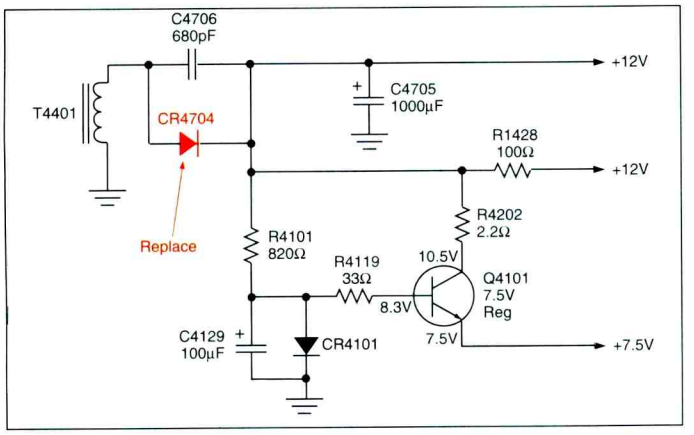


Figure 4. The 12V source supplies many circuits in the CTC187 chassis. If the set is dead, even though the line fuse is intact, the problem may be a defective CR4704.

regulator transistor (Q4101) and overheated diode CR4301 can cause CR4704 to become leaky or open up.

An open or leaky electrolytic capacitor C4705 (1000°F) in the 12V source can destroy CR4704 or cause the 12V source voltage to be low. Check all electrolytics in the 12V, 13.5V, and 7.5V sources with the ESR meter. If CR4704 is defective, replace it with the original part number 207878.

Set is Dead, No Power Up

When the set doesn't power up, the problem is usually in the horizontal or low voltage power supply circuits of the TV chassis. The TV may remain dead with no horizontal sweep, caused by a defective driver transistor, poor soldered driver transformer, or a shorted horizontal output transistor. To quickly determine if the horizontal circuits are functioning, place the scope probe near the flyback and notice if a waveform is present. You do not have to actually touch the flyback circuits.

If there's no sign of a horizontal sweep waveform, the problem might be caused by a defective component between pin 24 of the T-Chip (U1001) and the base terminal of the horizontal output transistor (Q4401). Signal trace the horizontal waveforms from pin 24 of U1001 to the base terminal of horizontal buffer transistor (Q4301). Next check the waveform at the base terminal of driver transistor (Q4301). In one set I encountered, the amplitude of the horizontal drive waveform at the base terminal of Q4301 was very low (Figure 5).

I used the scope to observe the horizontal drive waveform at the emitter terminal of Q4302. The waveform was not present at that point. The driver buffer transistor was tested in-circuit with the diode test of the DMM. It tested normal. A voltage test on the collector terminal indicated very low voltage, where-

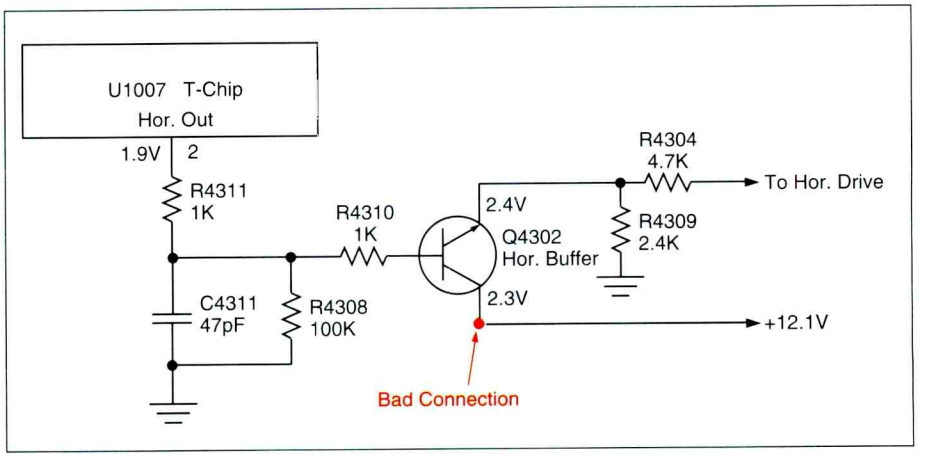


Figure 5. A bad collector terminal connection on the horizontal buffer transistor Q4301 kept

as the voltage at this point should equal the 12Vdc source. As I was making this test, the TV chassis came on. Resoldering the collector terminal of Q4302 solved another dead-no power up service problem.

Dead Set Accompanied By a Whining Noise

The RCA CTC187 TV chassis has been known to experience quite a variety of different service problems. A dead chassis might be caused by a leaky driver transistor with no horizontal sweep waveform, poor soldered driver transformer connections, leaky horizontal output transistor (Q4401), or bad primary soldered connections on the flyback transformer (Figure 6). You might find a combination failure of both horizontal output transistor and bad connections to poor flyback connections in the same chassis.

In another RCA CTC187 chassis, the TV was dead, and a whining noise was coming from the power supply (SMPS). Although the whining noise somewhat sounded like a bad regulator service problem, the noise was caused by a different part. Q4401 was tested with in-circuit transistor tests and was found to be leaky between collector and emitter terminals. A quick diode DMM test between the outside metal case (Collector) of Q4401 and common ground showed a resistance of only 0.17©. Also a shorted Q4401 transistor can be caused by a bad flyback and C4105 in the 140V source.

Q4401 was replaced with a original part number 191142. If that part is not available, this transistor can be replaced with a NTE2331, ECG2331 or a RCA SK10088 universal replacement. After I had replaced Q4401 and turned the set on, the chassis operated for only a few minutes and went dead. When I again checked the horizontal output transistor it tested normal.

The voltage at the primary winding of flyback T4401 was 0V. This voltage should be 140V: the voltage supplied by the 140V source. This anomaly indicated an open primary winding or poor soldered connections. After touching up terminals 1, 2, and 3 of the flyback with the soldering iron, the TV chassis played okay the rest of the day.

A dead symptom and a whining noise

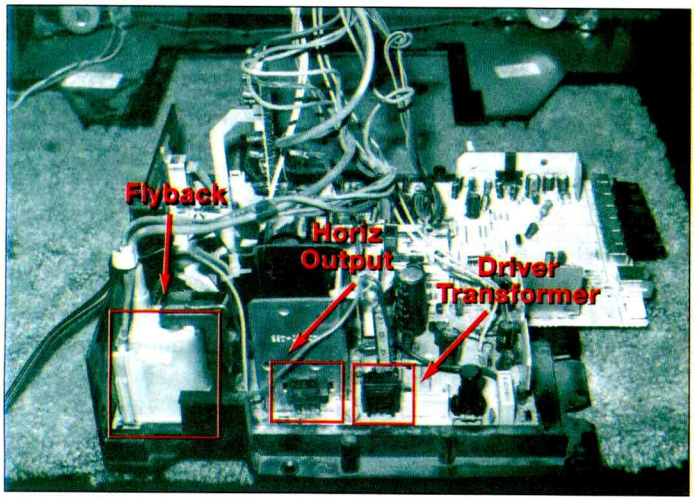


Figure 6. A leaky horizontal output transistor and poor driver transformer (T4301) caused a whining noise in the flyback of one RCA CTC187.

from the power supply can also be caused by a defective yoke assembly. Remember this yoke assembly is attached to the picture tube bell assembly, which means replacing the CRT if it's defective.

I have seen a number of dead RCA CTC187 TV sets in which failure to operate was caused by bad soldered joints or connections on the primary winding of the flyback. When you suspect that this is the problem on a set you're servicing, resolder all flyback connections and check Q4401 for possible leakage or shorted conditions.

A dead set with an intact fuse may be caused by a very bad soldered terminal 2 of the flyback (T4401). Poor soldered terminals on transformer pins 1 and 2 can cause intermittent horizontal sweep, no vertical sweep, a horizontal line down the middle. The chassis might began to cycle off and on. Do not overlook a defective flyback if the chassis is dead and the relay clicks, and there is no a raster or picture.

Dead, No Start Up

If the set is dead and there is no horizontal drive or dered connections on pins 1, 3, 5 and 6 of T4301. Also check the soldered connections of R4305 (6.2 K© tied to pin 1 of T4301 (Figure 7).

Another possible cause of this problem is Q4401. Check this transistor while you re troubleshooting in the horizontal circuits for a dead-no start up symptom. You might find poor soldered T4301 transformer terminals, a leaky horizontal output transistor, and bad contacts on the primary winding of T4401 producing many different service problems. Before testing any other components, proceed with the above repairs for a no-start up symptom.

Another possible cause of a no-start up symptom can be a bad standby voltage source to pin 22 of the T-chip (U1001).

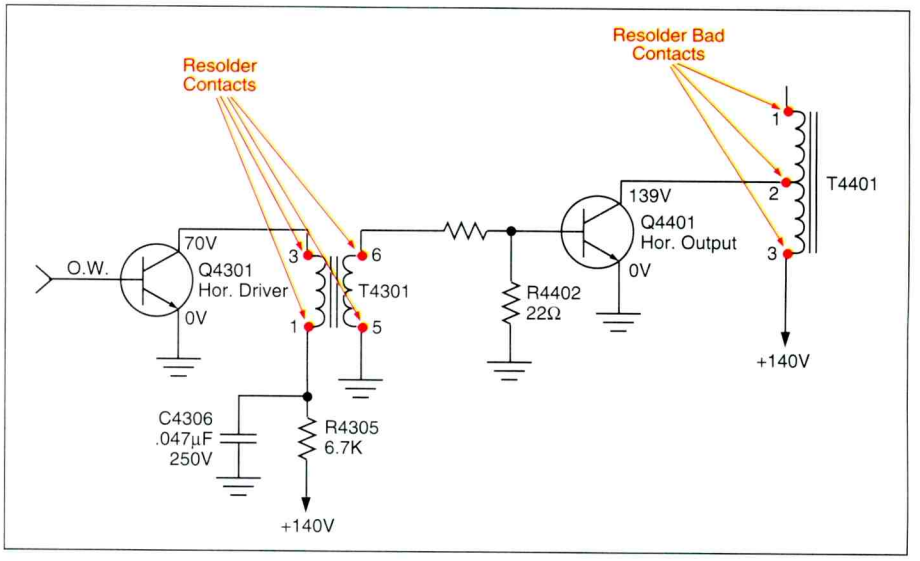


Figure 7. Resolder the driver transformer pin terminals 1, 2, and 3 of flyback (T4401) if the set is dead because it didn't start up.

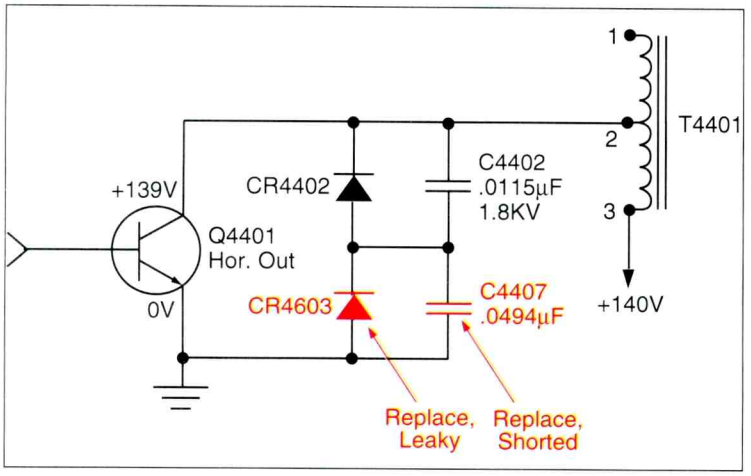


Figure 8. Suspect C4403 in the horizontal output circuits if the picture or raster is narrow.

waveform, or if start up is intermittent, and the chassis might operate for a few hours , then go dead, the problem may be poor horizontal driver transformer connections. In such a case, simply touch up the solder This starts with a bad soldered connection on R4134 (4.7©. Locate pin 22 of the T-chip IC and then find resistor R4134 and solder both sides of this resistor on the PCB terminals. This 7.5V source is fed from the 7.5V regulator Q4101, in the 12V secondary flyback voltage source.

Poor Width

Defective components in the HV, width and yoke circuits can cause poor width and a bowed-in picture. Suspect leaky CR4403 in the horizontal output collector circuit for a narrow picture on both sides of the picture. Be sure to check

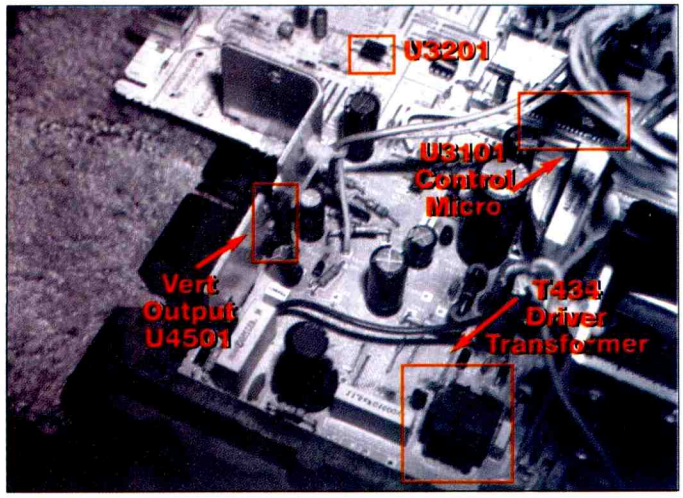


Figure 9. Service literature such as Sams PhotoFacts can help the technician locate the critical components on the CTC187 chassis.

CR4403 after replacing a leaky horizontal output transistor (Q4401). A shorted CR4403 diode can cause a narrow width picture symptom that cannot be adjusted with the horizontal linearity coil (L4401) (Figure 8).

Repeated failure of CR4403 can be caused by an open C4407 (0.047°F, 400v) capacitor that is paralleled with CR4403. Double check diodes CR4402 and C4404 with the ESR meter. C4407 can cause a bowed-in picture symptom.

Poor soldered joints of CR4303 can cause a bowed-in picture on both sides of the raster. A leaky pin cushion output transistor (Q4851) and a shorted CR4403 diode on the main board can cause the picture to be bowed-in on both sides.

Go directly to diode CR4403 and C4407 and check for leaky or shorted conditions if after repairing the horizontal output circuits a width problem exists or the picture is bowed-in on both sides of the raster. Replace both components with original replacements. CR4403 with a 164589 and C4407 with a 204754 part number.

Dead Set, Fuse Intact, Bad Tuner

Another cause of a CTC187 chassis that is dead even though the fuse is intact may be poor soldered grounds in the tuner. If this is the case, you might have observed partial loss of sweep as the chassis went dead. In some cases, the chassis might be intermittent if the tuner grounds aren't securely soldered. An intermittent and snowy picture is another problem that can be caused by poor soldered joints in the tuner.

Besides soldering all ground terminals in the tuner, don't forget to touch up the flyback pin terminals 1, 2, 3 and 10 of the horizontal output transformer for the same results. If the set has a red horizontal line in the center with no vertical sweep and there's no sound from the speakers, the cause might be a bad EEPROM IC, U3201 (Figure 9).

Dead Set Caused by Storm Damage

If lightning strikes the power line or the TV antenna or cable, many different kinds of damage may be caused to the TV circuits. Besides damaging or destroying any of a number of components on the chassis, the large currents that accompany a lightning strike might cause damage to the PC board foil patterns in the low voltage power supply, or in the tuner built right on the PC board. Use the ESR meter to find poor soldered joints and broken foil patterns.

In one CTC187 chassis, storm damage caused havoc with U7401 in the tuner and the control micro IC processor (U3101). The micro control processor (U3101) was replaced with the original part number 223940 and tuner control IC (U7401) with part number 215533. Several PC wire patterns in the tuner circuits were also repaired.

When the chassis was fired up after replacing the storm-damaged components, the tuner was still dead. A quick voltage test on the tuner control IC (U7401) indicated no supply voltage at pin 10. After rechecking the schematic, I found that the tuner control supply source was fed from a + 5V regulator transistor Q4106.

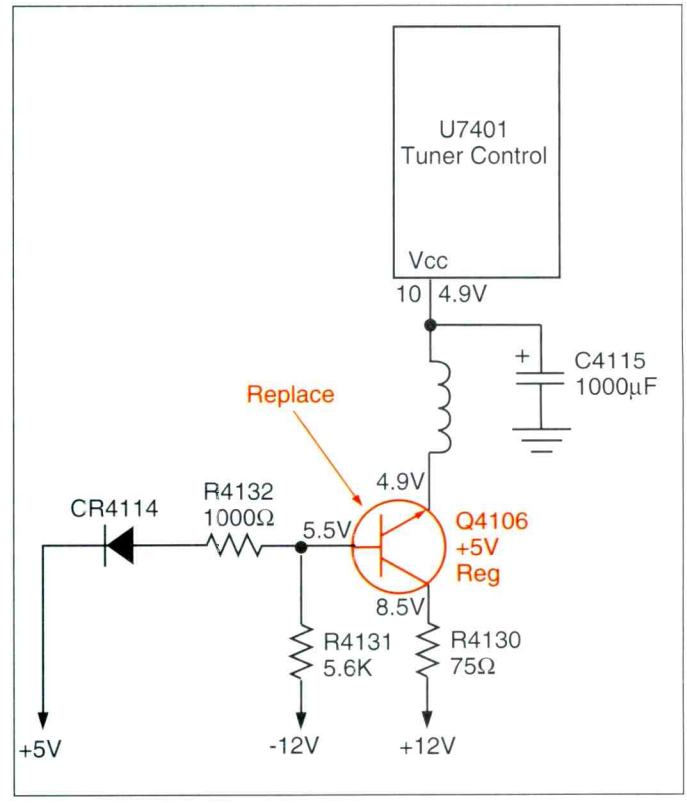


Figure 10. Replace the 5V regulator transistor (Q4106) if there is no tuner control voltage after the set has been damaged by lightning during a storm.

Upon further troubleshooting, a high 12V source was found at the collector terminal of Q4106, buth the voltage at the emitter terminal was 0V. In-circuit transistor tests revealed that this 5V regulator was open (Figure 10), Q4106 was replaced with the original 215495 RCA replacement, finally restoring this storm-ravaged set to operation. ■

Color Printer Service

Prepared with the Assistance of Hewlett Packard

In the short history of personal computers, the technology has been characterized by its propensity to rush ahead at breakneck speed. At first the interface between human and machine consisted of words on a screen. In almost no time, it seemed, graphic user interfaces had been introduced. Once introduced, these interfaces improved quickly.

Mass storage had a similarly quick development. At first there were really no fixed drives. Mass storage was accomplished on floppy disks. Then along came the first fixed disk system, with very small storage capacity. Very quickly larger and larger drives, at smaller and smaller prices, were introduced, until now 60 gigabytes of space on a personal computer is not at all unusual.

Accompanying all of this technological evolution and revolution was the output for permanent media: the printer. Initially the dot matrix printer was the printer of choice: it was inexpensive, could be made to work with just about any computer, and it output marginally acceptable type. In rapid succession, not necessarily in this order, came affordable bubble jet printers, laser printers, ink jet printers, dye-sublimation color printers and color laser printers.

We made the point at the outset that computer technology has has been characterized by rapid improvements. Another characteristic of computer technology has been the tendency for prices of any component of the technology to decline, sometimes precipitously. That has certainly been the case with printers. Initially, dot-matrix printers were the only types of printers affordable by the average personal computer user. In time, other types of printers became affordable: lasers dye sublimation. Today even color laser printers have become affordable, if still somewhat on the expensive side.

It's clear, however, that if consumer electronics technicians who work on personal computers haven't yet seen a color laser printer, they will almost certainly see them in the foreseeable future. This article, presents an overview of the technology of color laser printers.

The Beginning of the Printing Process

When the user is ready to print a document that has been created in an application on the computer, the user can click the printer icon, or choose File and then choose Print from the task bar. The printing interface between the user and the application is uniform and consistent for all Windows-based applications. The interface between the application and the operating system (Windows) is also uniform and consistent.

Application Sends Print Job to Operating System Imaging System

With many applications, the user has the option of interacting with the printer driver at the time the print request is made. This is how the user controls many features of the printer, such as duplexing, input trays, output trays, and media type. As soon as the user selects the print command, the application sends graphical device interface (GDI) information to the Windows imaging system.

Windows Imaging System Processes Print Job

The Windows imaging system processes the GDI information from the application and converts it to device dependent interface (DDI) information. This DDI information is then sent to the printer driver.

Windows Imaging System Sends Print Job to Printer Driver

The Windows imaging system sends the DDI information to the printer driver that was selected when the user clicked Print. It could be the default printer driver or one specifically chosen by the user. That printer driver then translates the DDI information into commands and data that are formatted specifically for the selected printer.

Driver Translates Print Job Into Printer's Language

The printer driver and the Windows imaging system carry on a dialog about the capabilities of the printer and negotiate who will process the print data into a form that is acceptable to the printer. The end result is data that contains printer control commands (usually PJL) and actual image information in the printer's page description language (PDL). The page description language can be delivered in a variety of forms depending on what the printer requires. Most common are PCL or PostScript. Some printers can accept GDI information directly and use it for their PDL. They are often referred to as GDI printers.

Some printers can accept only rasterized binary image data. These are referred to as host-based printers because the host computer creates the final binary image to be printed. In a process called spooling, the control and image information often is written to a hard-disk file before being sent through the hardware interface to the printer.

Driver Sends Print Job to Printer's Input/Output Interface

After the printer driver converts the print job to the printer's control and image format, it sends the resulting data stream to the computer's I/O port (or I/O channel). Here the print job is packaged according to the protocol of the hardware I/O channel selected. The I/O protocol handles the flow of print data from the host to the printer.

Forming a print image on print media involves laser light, electrical charges, heat, media, and toner. Proper operation of all these elements is the key to print quality. It is important to understand the image formation process so that you can diagnose and repair quickly most print quality problems.

Every laser printer follows a basic image formation process that involves six stages. These six stages are:

Cleaning stage
Conditioning stage
Writing stage
Developing stage
Transferring stage
Fusing stage

For color images, some of these stages

are performed up to four times. The color image formation process is described later.

Cleaning Stage

During the cleaning stage, the cleaning blade removes any excess toner from the print drum. This excess toner is stored in the waste toner receptacle within the toner cartridge.

Conditioning Stage

During the conditioning stage, the charging roller or charging corona wire applies a uniform negative charge to the print drum's photoconductive surface. This prepares the print drum to receive an image.

Writing Stage

During the writing stage, the image is written to the print drum:

Before transmitting print data, the printer confirms that the laser diode is working properly.

The laser beam reflects off the surface of the rotating scanning mirror.

The mirror rotation causes the beam to scan directly to the print drum or, depending on the printer model, the beam reflects off the beam-to-drum mirror and then to the print drum.

The areas of the print drum that are exposed by the laser beam discharge create an electrostatic print image. The laser beam turns on and off to create one dot at a time as it sweeps across the print drum. This process repeats until the last scan line of print data is sent.

Developing Stage

During the developing stage, the electrostatic image on the print drum's surface is changed into a visible image by the addition of toner. Negatively charged toner particles on the surface of the developing roller are attracted to the laser-exposed areas of the print drum and repelled from the unexposed areas of the print drum.

Transferring Stage

During the transferring stage, the image on the print drum is transferred to the media:

A positive charge is applied to the back of the media as it passes between the print drum and the transfer assembly.

The positively charged media pulls the negatively charged toner off the print drum and onto the media.

As the media moves past the transfer assembly, the electrically grounded static eliminator removes any remaining charges from the media. This allows the media to separate from the print drum's surface.

Fusing Stage

The fusing stage has two purposes-to melt the toner and to bond the toner to the media.

A heating element heats the fusing roller.

As media passes under the fusing roller, the toner is melted.

The pressure roller holds the media firmly against the fusing roller to ensure that the toner bonds to the media.

The printed media exits the printer into the selected output bin.

Color Printing

Most color laser printers use four colors (cyan, magenta, yellow and black: CMYK) to create an image by performing four passes through the electrophotographic process. During each pass, one color of toner is placed on an intermediate transfer belt. After all the colors are applied, the image is transferred to the print media.

The process described below is representative of most color laser printers. . Some variations of this process occur in other laser printers. The printer service manuals provide printer-specific information.

The formatter separates the image into four color planes.

The conditioning stage charges the entire drum surface.

During the first pass through the writing stage, the laser discharges the drum in the areas of the image where the first color should be applied.

During the first pass through the developing stage, the first layer (color) of toner is developed on the drum.

The first layer of the image is moved to the intermediate transfer belt.

The conditioning, writing, and developing stages are repeated to add each color to the image, in the following order: yellow, magenta, cyan, and black.

After all four colors have been added to the image and moved to the intermediate transfer belt, the transferring stage places the image onto the print media.

Image Defects

An image defect can have several possible causes. Whenever you troubleshoot an image defect problem, check the service manual for information specific to your laser printer. For example, only some printers have a fiber optic cable. An improperly seated or defective fiber optic cable could cause a horizontal or vertical line defect (depending on the media's orientation). Another source of information is the laser printer Quick Reference Service Guide if the company offers one.

Repetitive Defects (Perpendicular to Paper Path)

A repetitive defect has occurred if the lines are perpendicular to the paper path and repeated at consistent intervals. Repetitive defects are usually associated with a specific roller within the printer or the toner cartridge. Laser printers have a repetitive image defect ruler that is contained in the service manual. To use the ruler, align the first occurrence of the defect with the top of the ruler and measure to the next occurrence of the defect. The roller that is causing the defect will be labeled on the ruler. The following are possible causes of repetitive defects:

There is dirt or a defect on a roller. Clean or replace the roller.

The static eliminator teeth are dirty. Clean the printer.

The paper does not meet specifications. The surface of the paper can be too coarse. Try a different media or paper lot (check the laser printer model Paper Specifications Guide).

The toner cartridge is not seated properly or it is defective. Remove the cartridge and reinsert it. If the problem still occurs, check the print drum; if there is a scratch or streak around the print drum, replace the toner cartridge.

Gears are worn, causing slipping or jumping. Inspect the gears that drive the

toner cartridge and the fuser. Replace the main drive assembly.

Black Lines (Parallel to Paper Path)

The following are possible causes of black lines:

The toner cartridge is not seated properly. Remove the cartridge and reinsert it.

The paper does not meet laser printer specifications. Try a different media or paper lot (refer to the printers Paper Specifications Guide).

The static eliminator teeth are contaminated or defective. Clean the printer.

The toner cartridge is defective. Check the print drum; if there is a scratch or streak around the print drum, replace the toner cartridge.

The primary charging roller is dirty, which is caused by a defective toner cartridge. Replace the toner cartridge.

The fuser cleaning pad or fusing assembly is contaminated or damaged. Inspect the fusing assembly for toner buildup or scratches on the fusing rollers. Try cleaning with alcohol. Replace the fusing assembly if it is damaged.

If the lines are perpendicular to the paper path and they are repeated at a consistent interval, this is a repetitive defect (described in the previous topic).

Improperly Sized Image

The following are possible causes of improperly sized images:

Check the paper tray switches (if present).

The paper size selected with the driver and the actual paper size do not match.

The image size is scaled in the printer driver.

Smudged Band with Overprint

The following are possible causes of a smudged band with overprint:

The main motor assembly is not lining up correctly with the toner cartridge drum gears. Replace the main motor assembly.

The gear train assembly is not lining up correctly with the toner cartridge drum gears. Replace the gear train assembly.

The fusing assembly is dirty or defective.

The static eliminator teeth are dirty.

The toner cartridge is defective.

Portion of Blank Page

The following are possible causes of portions of blank page:

The page is too complex. Reduce the complexity of the page or set Page Protect to ON or AUTO.

There is not enough memory available in the printer.

Gray Background

The following are possible causes of a gray background:

The paper does not meet printer specifications or is stored improperly (see the laser printer Paper Specifications Guide).

The printer's operating environment does not meet specifications.

The toner density is set incorrectly.

The toner cartridge is faulty.

Curls and Creases

The following are possible causes of curls and creases:

The paper does not meet printer specifications or is stored improperly (see the manufacturerís Paper Specifications Guide).

The printer's operating environment does not meet specifications.

The paper is loaded incorrectly.

The wrong paper tray is loaded, or the paper tray is sized incorrectly.

The wrong output bin for the paper type is loaded.

There is an obstruction in the paper path.

The fuser temperature is set incorrectly (if controls are present) for the paper type.

Laser Mechanics

The proper operation of the mechanical components of the paper path is very important. It is also important to understand laser printer mechanics and paper movement so that you can quickly diagnose and resolve paper movement problems.

The Pickup Roller

The pickup roller feeds paper from the paper tray into the printer, and the separation pad or roller prevents multiple sheets of paper from entering the printer.

The Registration Rollers

In most printer models, the paper stops momentarily at the registration assembly. This allows the engine controller to synchronize the paper's leading edge with the print image on the print drum and to adjust for paper skew or improper alignment on the printed page.

The Transfer Roller

The paper moves to the transfer assembly, where the print image is transferred from the print drum to the paper.

The Fusing Assembly

The paper moves to the fusing assembly, where the image is fused to the paper.

Photosensors

The leading and trailing edges of the paper activate photosensors that signal the engine controller of paper movement through the printer.

Exiting the Printer

The paper is deposited in the output bin. At this point, additional accessories might staple and collate the printed paper, depending on the printer model.

Duplex Printing

For duplex or two-sided printing, the paper must pass through the printer to receive the first image. The paper is turned over and passes through a second time to receive the second image. The following segments explain the mechanical components of the duplex paper path and how they operate.

Deflection Pawls

As paper exits the fusing assembly, deflection pawls direct the paper to the duplex feed rollers. The rollers then move the paper through the duplexing assembly.

Switchback Area

The duplex feed rollers move the paper to the switchback area. In the switchback area, the paper reverses direction and is directed back to the registration assembly.

Second Pass

The second pass of the paper is printed, and then the deflection pawls direct the paper to the output bin. In duplex printing mode, the back side of the paper is actually printed during the first pass, and the front side of the paper is printed during the second pass.

Photosensors

The leading and trailing edges of the paper activate photosensors that signal the engine controller of paper movement through the duplexing assembly.

Paper jams occur when the printer detects paper that should not be present, or when paper arrives too early or too late at any point on the paper path during the printing stage.

Causes of Paper Jams

Paper jams can occur at any point in the paper path, particularly in the following areas:

Pickup rollers
Registration assembly
Transfer assembly
Fusing assembly
Duplexing assembly

Paper jams usually occur when the paper or other media being used in the printer does not meet specifications. Less frequently, the problem can be mechanical, such as a worn paper movement roller or a defective photosensor, gear, or motor.

Diagnosis of Cause of Paper Jams

Try to verify where the leading edge of the paper stopped to help you narrow down the area of concern.

Use paper that meets printer specifications (refer to the Manualís Paper Specifications Guide).

Ensure that the paper is not damaged. Look for poor edge cut, ream damage, nicks, or creases.

Print on the recommended print side (turn the paper over in the input tray or rotate it from front to rear. Do both if necessary).

Make sure the paper tray is loaded correctly and set to the appropriate paper size.

Do not mix different paper types in a single paper tray.

Do not use paper that has already been printed on.

Do not fan the paper. To separate pages, you should only gently flex the stack of paper.

Replace the paper in the paper tray with a new ream of high-quality paper from a different lot or from a different manufacturer.

Store paper in the proper environment (clean, moderate temperature and humidity, and out of sunlight).

Note: Paper might meet all of the paper specifications but still not perform acceptably in the printer because of the printing environment or other variables over which the printer manufacturer has no control. Always test small amounts of a particular paper before purchasing large quantities.

Prevention of Paper Jams

Remove jammed paper carefully. Try to remove the paper in one piece. Do not leave fragments that could cause additional problems.

Ensure the size of paper matches the driver settings and the settings on the control panel.

Use media that meets the specifications for your printer.

Printer Electronics

Proper operation of printer electronics is very important to print quality. Understanding laser printer electronics allows you to diagnose and resolve printer failures quickly.

The electronic components of a printer follow a specific timing sequence as they function together.

A printer typically goes through five timing stages during normal operation:

Standby stage
Warmup stage
Initial rotation stage
Print stage
Last rotation stage

Warmup Stage

The warmup stage begins when the printer is turned on:

The fusing assembly is energized and begins to warm up.

If present, the cooling fan(s) are energized.

The main motor is energized for 2 to 3 seconds, allowing the print drum to rotate and to be cleaned.

The charging roller is energized momentarily to prepare the print drum's surface for printing.

The engine controller sends a ready message to the formatter.

The formatter sends a ready message to the control panel display.

Standby Stage

During the standby stage the printer is on and waiting for the next print job:

The fusing assembly maintains its standby temperature. Note: A printer with an instant-on fuser does not maintain a standby temperature because it can warm the heating element in less than a second. This reduces power consumption.

The control panel displays a ready message.

Initial Rotation Stage

The formatter receives print data from the host computer. The formatter then processes this data and stores it in the print buffer.

The formatter sends a print signal to the engine controller to notify it of the start of a print job.

The fusing assembly begins to warm up to its printing temperature.

The main motor, scanner motor, and cooling fan (if present) are energized and begin normal operation.

The laser diode power is checked and adjusted. A beam detect signal is sent to the engine controller. This signifies the beginning of a scan line of raster data.

A bias is applied to the charging roller. This enables the charger roller to negatively charge the surface of the print drum.

The transfer roller (or transfer wire on some printers) is negatively charged to repel any toner on its surface.

By the end of this stage, the fusing assembly reaches printing temperature.

Print Stage

During the print stage, all the components of the printer are operating. All the components of the image formation process are energized to take raster data and convert it into an image on the paper. These components include:

The formatter
The engine controller
The laser scanner assembly
The charging roller
The print drum
The developing roller
The transfer roller
The heating element of the fusing assembly

The following mechanical components of the paper path are energized to transport paper through the printer:

The main motor
The pickup roller(s)
The transfer roller
The fusing roller

Last Rotation Stage

When the formatter receives an end-of-job signal from the host computer, the formatter tells the engine controller to begin the last rotation stage.

During the last rotation stage, the printer prepares itself to return to standby mode. These specific procedures vary by printer model.

Media

We wonít go into media in any depth in this article, in order to save space. Suffice it to say that to insure proper operation of a mechanism as complex as that of a laser printer, the paper and toner used should meet the manufacturerís specifications, and should be stored and handled in such a manner that it remains within those specifications until it has been consumed during the printing process.

Troubleshooting

To troubleshoot any problem with a laser printer, you can follow basically the same verification process. This is a process of elimination that will save you time and effort.

The troubleshooting procedures outlined in this section follow a generic systems approach that you can apply to most laser printers. It is very important that you review your service manual for instructions that are specific to your model of printer. To isolate printer problems, your service manual also describes additional tools and resources such as error messages, event or status logs, paper path tests, and high-voltage checks.

Always confirm the following before attempting to isolate any problem:

The printer is plugged in and power is present.

The selected paper tray has media in it.

The toner cartridge is installed properly.

The printer is moved away from direct sunlight and is situated in a well-ventilated area that is not close to heating or cooling vents (temperature, humidity).

Although these suggestions might seem obvious, a quick check of these areas can uncover the solution to your problem.

Procedure

To confirm that power is present in the printer, look for the following:

Do the control panel or LEDs illuminate?
Is the cooling fan operational (if present)?
Can you hear the main motor?

Diagnosis

By confirming the power-up sequence, you know that the printer's power supply is generating the proper voltages.

Potential Problems

Power cord not plugged in
Low line voltage
Defective power supply
Defective ON/OFF switch
Defective engine controller

Procedure

Correct any problem that is indicated by a message on the control panel or LED panel.

Diagnosis

A complete list of printer messages and their corresponding troubleshooting procedures is provided in the troubleshooting section of your service manual. There are also end-user troubleshooting procedures in the user's manual.

Potential Problems

There are four categories of printer messages. Each message category is assigned a priority. If more than one condition occurs at the same time, the highest priority message is displayed. When it has been cleared, the next priority message will be displayed, and so on. Here are the four categories, listed from lowest to highest priority:

Status Messages

Status messages report the current status of the printer during normal operation. Some examples of control panel status messages include READY, INTERNAL TEST, PRINTING FONT LIST, TONER LOW, and LOAD PAPER. Some printer models use a combination of LEDs to indicate these conditions.

Attendance Messages

Attendance messages report that normal printer operation has been suspended and the printer needs operator intervention. Some examples of attendance

messages are MANUAL FEED, LOAD PAPER, and PAPER JAM.

Error Messages

Error messages report printer problems caused by an invalid printer configuration or a defective part. Some error messages can be overridden by pressing the Continue, Select, or Go key. An example of an error message is MEMORY OVERFLOW.

Service Messages

Service messages report printer problems caused by an invalid printer configuration or a defective part, but unlike error messages, you cannot proceed (the printer will not function) until the problem is corrected. Sometimes you can clear a service message by cycling power to the printer. To do this, turn the printer off and then back on. If the message persists, see your service manual. An example of a service message is FUSER ERROR.

Procedure

First, perform an engine test print. A sheet of vertical lines will print. Next, perform a control panel self-test or print a configuration page.

Diagnosis

The engine test bypasses all formatter communications. This allows you to confirm that the print engine is completely functional and able to generate a print image.

If the printer successfully prints the control panel self-test or configuration page, you know that the formatter and the engine controller are communicating correctly. You have confirmed the basic functionality of the formatter. As an added benefit, the self-test or configuration page printout provides valuable information about the printer's configuration, page count, installed options, and installed memory.

Procedure

When troubleshooting an image quality problem, the first priority is to determine whether the toner cartridge is working properly. This should be done before focusing on the fuser or some other component of the image formation process.

Before anything else, try these three basic procedures to confirm that an image is forming properly on the surface of the print drum:

Create a cleaning page.

Depending on your printer model, either perform a half self-test or print a configuration page. These procedures are described in your service manual.

Try a new toner cartridge.

Diagnosis

If the image defect still persists, refer to the image defect summary section in the troubleshooting chapter of your service manual.

Typical Problems

Listed below are some image defects that can occur in all laser printers. For information about the possible causes of these image defects and many others, review the Image Defects topic in the Image Formation Process segment of this article.

Repetitive defects

Vertical black lines

Vertical black lines along the right or left side

Black streaks

Blank pages

Light print, heavy print, or background scatter

Procedure

In addition to the standard serial/parallel interface, many laser printers support a variety of networkable interfaces that require custom installation and configuration.

When printer communication problems exist, first determine whether the printer is working properly when it is disconnected from the host:

Disconnect the interface cable and remove any network interface cards from the printer.

Connect directly from a known working host to the serial I/O or parallel I/O port of the printer. Perform the most basic print job possible to verify printer and system communications.

If you do not have a known working host, type DIR>LPT1 from the DOS prompt (for DOS systems) of the host.

Diagnosis

If you follow this procedure and get a printout, then you have confirmed that the printer (and specifically the formatter assembly) is operating properly. At this point, STOP TROUBLESHOOTING THE PRINTER. The problem is external to the printer.

Typical Problems

If you have confirmed that the problem is external to the printer, redirect your troubleshooting efforts. Check the following typical problems:

Improperly configured software package. Verify that the software is configured correctly.

Incorrect printer driver. Verify that the correct driver is selected. Verify that you have the latest version of the driver.

Conflicting accessory cards (network interface card, MIO, etc.).

Cabling problems.

Improper configuration (host, network interface card, etc.). ■

Circuit Board Rework Opportunities, Solutions and Vendors

by Clay Harrell (cfh@provide.net)

(This article is adapted with permission from a website whose content was originally written to provide information about reworking printed circuit boards in pinball machines. The original complete article may be found at http://marvin3m.com/begin/)

Consumer electronics service centers have a tendency to do it all. When a TV, VCR, receiver, personal computer is brought in for service, the mentality is to do everything from diagnosing the problem to removing the offending circuit board, to removing a faulty component and soldering in a new one. There's nothing wrong with that approach, and many service centers and technicians have the skills in all of those areas so that getting the job done is no problem.

However, that approach is in contrast to the way many other types of companies accomplish the same objectives. In the case of an auto service center, for example, if the problem is a straightforward repair, involving replacement of a component, or components, the establishment will get the job done: for example, replacement of belts, a starter motor or generator, a radiator, etc. If, on the other hand, the work to be done is something that is more within the scope of the expertise of a specialty shop: body shop, radiator repair shop, auto glass specialist, the auto service center will send the car there for that specialty work to be accomplished.

Unfortunately, the tendency to be a jack of all trades can sometimes result in problems. For example, an insufficiently skilled technician working with improper tools can sometimes destroy, or seriously damage the very printed circuit board he had set out to repair. How much better if that circit board had been sent to a specialty shop for repair.

Moreover, the need for such specialists might just be an opportunity for some service centers to develop the expertise, and put in place the specialized tools in order to be able to offer that service to not only other consumer electronics service centers, but any electronics service company that doesn't possess those specialized skills. We present this article with the thought that it might encourage some service centers to specialize in this area.

Figure 1. Good lighting and magnification are essential when reworking PC boards.

Getting Started

Before attempting any Printed Circuit Board (PCB) repair, ask yourself some questions (soldering individual components is one thing, but replacing a soldered-in chip on a circuit board is another):

- Do you have any soldering experience?
- Do you have any PCB soldering experience?
- Do you have the proper tools for PCB soldering?
- Do you have the patience required to go "slow and careful"?

If the answer is "no" to any of these questions, stop! Do not work on circuit boards. Send them out for repair to a professional. In the end, much more money will be saved having the boards fixed professionally, then attempting to repair them yourself. Keep in mind some circuit boards are not replaceable! So if a board is made "non-serviceable" (unusable), a lot more money can be lost than a professional repair would have cost in the first place. In some cases, it is possible to turn a product into junk if a non-replaceable circuit board is ruined.

This is the key point to this document. Don't think because all the procedures here look easy and anyone can do them. Don't become over confident. A "hack" repair can ruin a circuit board. And most repair facilities will not fix circuit boards that have been unsuccessfully repaired ("hacked") by someone else.

How Did You Learn to Solder?

Soldering a new large component in a product is one thing: a sloppy job won't really affect much. Sloppy soldering on a circuit board is another matter however. A circuit board can be totally ruined with bad soldering. Also the equipment and techniques are a bit different on circuit boards than on single components.

I remember when I first learned to solder. My dad taught me with a soldering pencil, some paper clips, and some rosin core solder. I was probably 10 years old,

Figure 2. Proper soldering tools, such as this soldering station, allows the technician to remove solder and make high-quality solder joints while minimizing the danger of damaging the PC board traces.

and I thought it fun. What he had me do first was make a box out of the paper clips. Using needlenose pliers, I constructed one side of the three dimensional box. Then I soldered the points where the paper clips came together. When I was done, it was a

pretty nifty 3-D box, and I was proud. Nostalgia aside, this was a good first experience. It taught me how to solder, at the expense of only some paper clips. If your soldering skills are at the novice level, start small and practice. Sacrifice some paper clips and make a "box".

Practice Makes Perfect

If you have never soldered a PCB before, don't try your first attempt on a (expensive!) PC board. Practice on some junk boards, or some practice circuit boards just made for that purpose, first.

Junk circuit boards are easy to get. Products that have been abandoned by owners, can often provide junk PC boards. Maybe you have an old usless computer (which you couldn't give away!) thats could be used. Practice circuit boards aren't that hard to find. You just gotta look.

Even if you have to pay for some practice boards, it's well worth it. Another alternative is to go to a distributor and buy some cheap resistors (about 50 cents for five), and some "breadboard" print circuit board material with holes. Practice soldering the resistors to the board.

This is not as good practice as using a real printed circuit board though (there's nothing like the real thing). Remember to clean the copper on the board before trying to solder them (unsoldered virgin copper likes to oxidize, making soldering difficult).

Good Lighting and Magnification

Good circuit board repair work requires good light. Good light is not expensive. If there isn't good light in the workshop, go to the hardware store and buy some 4 foot dual fluorescent lamp fixtures (about $10). I personally like fluorescent light for repair work. It's cheap (to buy and run), and it does a good job. Fluorescent light is best because it is "whiter" than incandescent light.

Buy a Good Magnifier

A good magnifier allows examination of circuit boards in great detail, to view repair work quality. There are two types of magnifiers available. One is worn on the head, and it requires an external light source. To focus, move your head to a certain distance from the viewing object. The other (more desirable in my opinion) magnifier is on an adjustable "arm", and has a built in light source (Figure 1). This is what I personally prefer, and I find it extremely useful for finding circuit board defects.

If your resources are seriously limited, a hand-held lighted magnifier reader is also available. This hand-held device works well too, and can fit in a pocket. It has a high intensity bulb with a switch.

Use a Good Soldering Station

When doing PCB repairs, it is important to buy the right tools. Yes, this will cost money. There is no way around that. But do not buy cheap tools. For example, a good soldering station can last a lifetime, and make soldering so much easier and better. Don't be cheap (unless I suggest it!)

Figure 3. A more sophisticated solder station provides good temperature control, and includes a vacuum pump to speed desoldering.

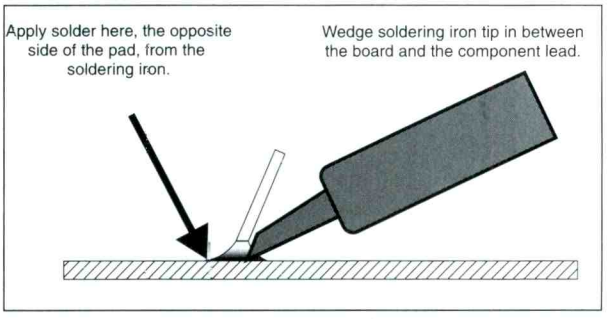


Figure 4. The proper way to solder a component into the circuit is to apply heat to the connection, then apply solder to the heated connection.

Buy a Good Soldering Station

Your dad's old soldering gun isn't going to work for soldering circuit boards. A good soldering station is needed. Melting metal in close proximity to delicate electronic components requires the right tool. When working on printed circuit boards, a precise amount of heat is applied for a short period of time to a very precise area. The best way to do this is with a quality soldering station. Expect to spend up to $50 to $150 for one. Soldering stations are nice because they allow you the soldering temperature to be exact. Also they are grounded nicely, to isolate the iron from its power source (this protects static sensitive chips).

There are soldering stations available for every budget (Figure 2).

Temperature Control is Important, Not Wattage

The important thing to get in a soldering station is temperature control, and not

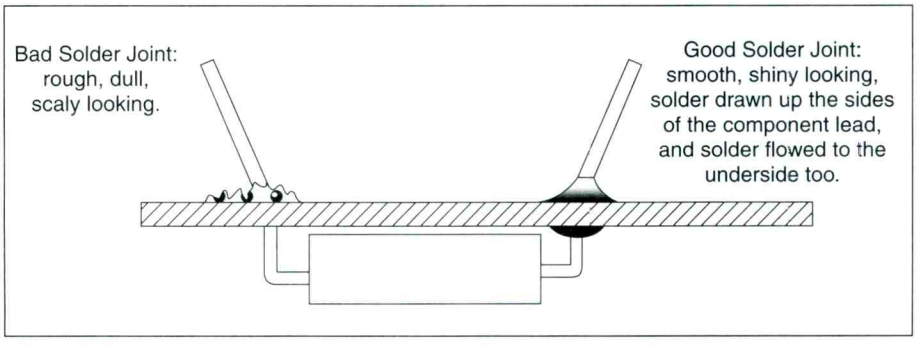


Figure 5. A good joint has a shiny appearance, while a poorly soldered joint appears gray and grainy.

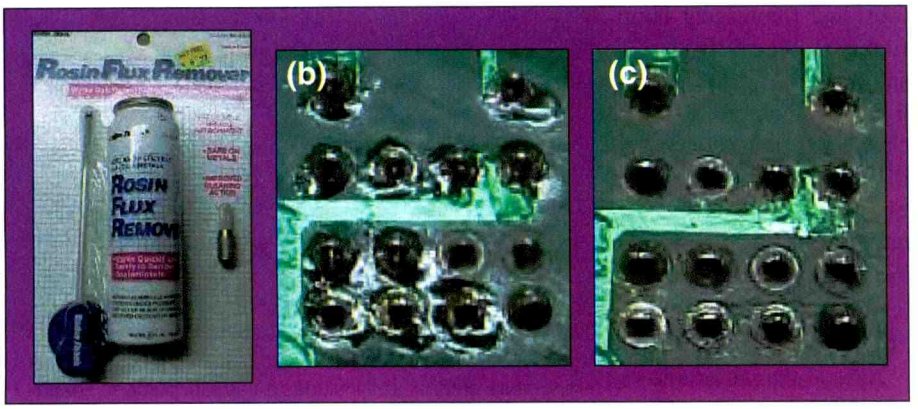


Figure 6. It's good practice to remove excess flux from a soldered board. This graphic shows (a) a container of flux remover, (b) a board that is shiny because of the presence of excess flux, and (c) the same board after the excess flux has been removed.

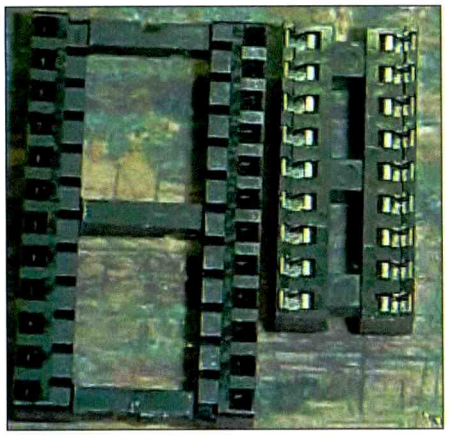


Figure 7. When you replace an integrated circuit, it might be a good idea to solder a socket to the board, then plug the replacement IC into the socket. This keeps the replacement IC from being heated during the soldering process, and eliminates the necessity to use the soldering iron if this IC ever fails again in the future.

some goofy variable rate that has no reference point (like a series of relative digits from 1 to 10). An actual temperature range is important. Soldering is best done at 600 to 700 degrees, but a decent soldering station is usually adjustable from 300 to 900 degrees. A soldering station that doesn't provide a temperature gauge is probably varying the wattage, and not the temperature. This is far less useful.

For lower-cost soldering irons, the wattage of the iron is a measure of the power that is used to heat the iron. So a 25-watt soldering iron is always running at that level of power consumption (like a 25-watt light bulb would), and is always generating heat. The soldering iron's tip absorbs the heat. As long as power is supplied the tip will continue to get hotter until it reaches "equilibrium" (the maximum temperature at which heat will be conducted to the air at the same rate heat is applied to the tip).

As soon as a soldering iron's tip makes contact with metal, heat will transfer from the tip quickly. The higher the wattage orf the iron, the quicker the tip will heat up again. When a cheap soldering iron is idle, it is much hotter than it needs to be for soldering. But the moment you place it on metal for soldering, it cools down. For this reason, if not using a cheap soldering iron for more than 5 minutes, turn it off. Otherwise it will get too hot and ruin the iron's tip (at minimum), or apply too much heat to the solder joint (at worse).

The above is why cheap soldering irons are bad; there is no way to control the actual temperature of the iron! That's why a good soldering station is really a must. The right temperature can be dialed in. Then the station will monitor itself, turning power to the station's soldering tip on and off as needed to maintain the desired temperature. Good soldering stations also provide a level of isolation so static sensitive chips won't be easily ruined by the soldering iron.

Use Good Solder!

Using good solder is very important in circuit board repair. In my opinion, the best solder is made by Kester (USA made). Radio Shack solder is Kester solder (but with the Radio Shack label), and no doubt many other private-branded solders are made by Kester. Here are the solder specs you need:

- Rosin flux core. No other core will suffice.
- 60% tin, 40% lead (60/40) formula; 0.032 inch diameter for circuit boards (0.040 inch or larger for individual components).

Rosin core flux is very important. Any other type of flux will not work for circuit board repair. For example, acid flux is designed for plumbing work, not electronics. The acid residue will damage wires and circuit traces. Most hardware stores only sell 95/5 lead free solder, which won't work for circuit board repair.

Desoldering Tools

When doing circuit board repair, a method of desoldering old parts is also needed. Desoldering braid is a very common and cheap desoldering tool. It's available from a number of distributors and hobby stores. Desoldering braid is simply flexible copper braid, about 1/4" wide. Just put the braid over the joint you are desoldering, then put your hot soldering iron's tip over the braid. As the braid heats up, it will absorb (wick) the melted solder from the joint. When you're done with that joint, move down the braid to a fresh spot (you can not reuse the same area of the braid again). The downside to solder braid is heat. Usually it takes more heat to unsolder using braid. Also it's not very fast. If doing a lot of unsoldering, it will take some time and lots of patience. I personally don't recommend it or use it, but it does work in a pinch.

One other disadvantage of desoldering braid is that if the technician is working on a circuit board with plated-through holes, some solder might remain in the hole, making it impossible to remove the component or IC after it's been desoldered. Even worse, it might result in damage to the circuit board if the technician applies too much force to remove an improperly desoldered device.

The Desoldering Iron

For the average experienced technician, a simple desolding iron is a very good desoldering tool. This is is simply a 45 watt soldering iron with a hollow tip,

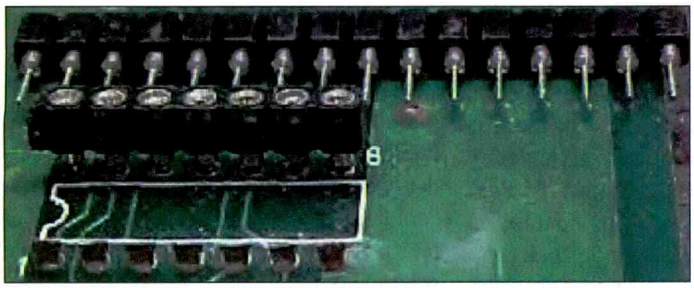


Figure 8. Machine pin sockets are an alternative to IC sockets.

Figure 9. In order to remove the solder from a soldered connection, first heat up the solder joint with the soldering iron.

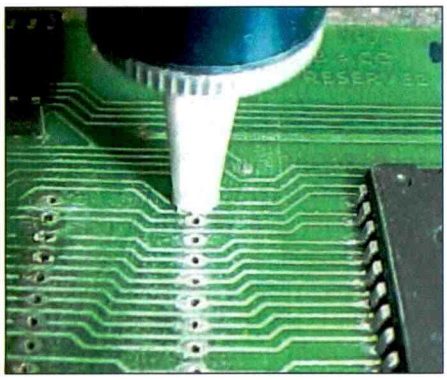


Figure 10. Once the solder has been melted, place the desoldering tool tip over the joint at an angle (trying not to touch the soldering iron's tip), then move the soldering iron away, and quickly position the vacuum tool perpendictular to the board, and quickly press the trigger. This should suck the molten solder from the joint.

and a suction bulb. After letting this iron warm up for about 15 minutes, squeeze and hold the red bulb. Then put the hollow tip over the joint to desolder. After the solder has melted (a couple seconds), release the bulb, and the solder will be sucked from the joint (this theory is how expensive desoldering stations work). An easy one handed operation that requires minimal practice.

But this style of desoldering tool comes with the same warning as non-adjustable temperature soldering irons; the amount of heat applied can not be adjusted. Because of this, the vacuum-bulb desoldering iron can be dangerous. Too much heat, and the traces and solder pads can delaminate from the circuit board. Just keep this in mind. Remember, it is a 45 watt desoldering iron, so it generates lots of heat. With a little practice, this desoldering iron can work well. It's hard to beat for the price, and I personally find it easier to use than most other low-cost desoldering tools. But too much heat can be applied with this tool, making it dangerous for the someone just getting started in printed circuit board rework. Because of this, I would not recommend this tool for first time users.

Also make sure to buy extra tips for this desoldering tool. They sell two styles of tips; get the iron clad version, which costs a little more. A clogged or enlarged tip on this tool will render it useless.

Desoldering Vacuum Pumps

A very common desoldering tool is a large spring action syringe type vacuum desoldering device with a Teflon tip. One example of this is the Soldapullt. Lots of technicians use this desoldering pump because it's inexpensive, and works well. The downside to this tool is it requires two hands (one to hold your soldering iron, and the other to hold the vacuum). A mini version is also available, and works well. The larger product comes in normal and anti-static versions. The anti-static version would be preferred.

The biggest advantage to this tool is that a soldering station can be used to heat the joint being desoldered. This means the desoldering temperature can be controlled via the soldering station. This is probably the single biggest advantage to using this desoldering tool (aside from price). Because of this, I highly recommend the spring action vacuum desoldering tool for less experienced service technicians. But remember, practice is necessary to use it! So find some junk boards and try it out (instructions on how to use this tool are below).

Desoldering Stations

If your service center plans to specialize in this type of work, a real desoldering station should be purchased (Figure 3). These consist of a small suction pump, connected to a soldering iron with a hollow tip. They work much like the desoldering iron that is equipped with a vacuum bulb, except there is an electric vacuum pump instead of a manual suction bulb, and the soldering tip is temperature controlled. These desoldering stations will use the least amount of heat, and do the best job desoldering. Also available are desoldering stations that uses compressed air instead of a dedicated electric air pump. These work the best (since the air source can be a larger 100 psi air compressor), but are obviously not as portable.

Still another type of desoldering system uses hot air to melt the solder. This may be a preferable method of printed circuit board rework. For a company that will specialize in circit board rework, one, or several, of each type of soldering/desoldering station might be required.

How to Solder a Circuit Board

Here are some tips on what to do (and not do) when soldering circuit boards:

A Clean Connection. The connection being soldered must be clean. If the circuit board pad has any corrosion or old flux, clean it off first before soldering. Use a sanding pen (available at automotive paint supply stores) or a small metal brush or even fine grit (400) sandpaper. In some cases, the green "solder mask" may need to be removed from the copper traces to solder. Distributors also sell a cleaner/degreaser solution for this purpose. Alcohol also works well for cleaning parts. Most circuit board connections will be clean, but if they aren't, clean them

first before you try to solder. Flux, which is inside rosin core solder, will vaporize with the heat of the soldering iron, and will remove any remaining oxidation from the metal. This allows the solder to flow easily. But don't think the flux will solve all the dirt problems, because it won't. Dirty surfaces won't allow solder to flow, which means you won't get a good solder joint.

A good mechanical connection first.The components should be secure before attempting to solder them. Solder is not strong, and should not be relied on to "hold" components together. The parts should not be able to move in relation to each other.

Use Care When Installing Components

When installing components, bend (or straighten) the component leads so they go straight into the printed circuit board holes. Components should go in easily; don't jam them in as some components can be damaged easily. Don't pull the leads through the board; instead push the component into the board (pulling leads can damage the component). Double check the component's value before installing it. Make sure that the component is installed in the correct orientation. Transistors, diodes, electrolytic capactitors and ICs must be installed with the leads or pins corresponding to the correct connections on the PC board. Most components should be mounted snug against the board. There are some exceptions though. Any component that could run "hot" should be installed with air clearance below the component. Typically this applies to resistors, diodes and transistors. Before soldering the component, double check the value, orientation and position. It's easier to fix a problem now than after solder has been applied. Examine the Un-Soldered Connection Before Soldering. Inspect the connection. Make sure you know where the new solder is supposed to go. If there is another solder pad very close to the one you are soldering, make a mental note. Make sure no unwanted solder makes a "bridge" from the desired connection to the adjacent one. If a mental note in not made, sometimes it's hard to tell if two solder pads should or should not be connected.

"Tin" Your Soldering Iron

After the soldering iron warms up, apply some solder to all sides of the tip. Then wipe the solder off on a damp sponge made for the purpose. This will "tin" the tip with a nice shiny coating of solder. The solder should not "ball up" and drop off the tip. Do this first right after the soldering iron warms up. This prevents oxides from forming on the tip, and allows heat to be easily transferred from the soldering iron to the joint being soldered. Do this often when soldering to keep the tip clean and heat efficient.

Heat the Joint

The basic principle of soldering is to apply heat to the items being soldered, then apply solder to the heated items (Figure 4). The solder should melt upon contact with the items (do not apply the solder to the soldering iron's tip).

Apply the tapered surface of your soldering iron's tip to the connection being soldered. The tip should not be perpendicular to the solder joint, but at an angle (for greater surface area contact of the tip). It's better to directly heat the circuit board pad, instead of the component leg itself (most electronic components are heat sensitive). Allow the joint to become hot (a second or two), then apply the Rosin core solder to the joint (not to the iron's tip). I usually apply solder to the circuit board pad, and solder will spread across the pad, allowing heat to transfer more efficiently across the joint and to the component's leg. After the solder begins to flow, lift the iron's tip away from the joint carefully, keeping the joint stable until it has cooled.

Cold Solder Joints

There are some important things to remember here. First, let the joint melt the solder, not the iron's tip itself. Second, keep the joint stable until the solder solidifies. If you fail at either of these two point, you may create a "cold" solder joint (a solder joint that fatigues, cracks or becomes nonconductive later; the term "cold" came about because there wasn't enough heat used to solder the connection). A cold solder joint will not provide a good electrical connection. When the solder solidifies, it should be shiny (Figure 5). A gray solder joint indicates either not enough heat was applied, or the joint moved while the solder was solidifying (making an instant "cold" solder joint that will probably fail later). Reapplying heat and re-fusing the solder should cure this problem.

Too Much Heat

Soldering a circuit board with too much heat can "lift" (delaminate) the traces from the circuit board. Traces are the thin metal "wires" that connect the components electrically to each other. These traces are basically epoxied to the circuit board. If you apply too much heat to a solder pad, it will delaminate the pad and its connecting trace. Though a lifted trace can be repaired, the process can be tedious. Applying too much heat is one of the easiest ways to ruin a circuit board.

The Right Amount of Heat

One of the more important thing to remember about soldering on circuit boards is to keep the amount of heat applied at a minimum. Don't overheat the solder joint, as this can lead to traces lifting or breaking, or cause damage to sensitive components. But you also must apply enough heat so the solder joint isn't cold. This is why practice makes perfect. Get the right feel for soldering with enough heat, but not too much, takes some practice (use a scrap circuit board). If the solder joint is clean, and the iron's tip tinned, than there should be no problem soldering with a minimal amount of heat.

The Right Amount of Solder

When soldering, don't apply too much solder, and don't apply too little. If the solder pad appears to be "puckered" when you are finished soldering, too little solder has been applied. If the solder mount is a round mountain, too much solder was added. There should be a small "hill" of solder on the pad, but not an excessive amount of solder. Again, practice will help develop an eye for applying the right amount of solder.

Cut the Component Leads

Use cutting pliers and cut the excess component leads. Cut them at about the point where the solder has risen up the component lead. Do not cut into the solder mound on the circuit board! This can cause the solder joint to crack later, and fail electrically.

Remove the Flux After Soldering

After you have finished soldering, remove any remaining flux (Figure 6). Flux will show up as a shiny area around the joints you have soldered. Some flux is conductive, or it can hold traces of metal inside the flux that can short traces. The best way to remove old flux is to use a rosin flux remover solution.Or you can use 99% rubbing alcohol and a toothbrush, which works quite well too. Don't go crazy doing this though; you can cause problems too by being too aggressive (and breaking traces). Of course let the board dry before you apply power to it.

Inspecting the Solder Joint

When finished, inspect the new solder joint. Use a lighted magnifying lamp, and make sure the connection is good and looks like. Make sure the solder hasn't flowed to any adjacent pads or traces. If it has, apply the soldering iron to he bridge until the bridge melts away. It may be necessary to use a little desoldering braid to remove the solder.

How to Desolder a Circuit Board (Installing/Removing Chips)

Desoldering is an art form. Plenty of practice is needed to perfect the art. So break out some junk PCB boards, and let's try out the new desoldering tool. Important: keep this in mind when desoldering The biggest problem with desoldering is ruining the circuit board itself. Most circuit boards can not take more than one or two desolderings at any particular solder pad. Excessive heat will cause the board traces to lift or crack. Once this happens, it becomes more difficult to repair the board, often because a cracked trace may not be easily seen. A circuit board can easily be ruined with excessive heat from desoldering.

Install a New Socket

When desoldering chips, if the manufacturer doesn't recommend against it, you might consider replacing the chip with a new high quality socket (Figure 7). Again, circuit boards can't take too much desoldering. A good quality socket will solve this problem forever, so no additional soldering/desoldering will ever be needed at that location. An alternative to the socket are machine pin strip sockets (Figure 8). These come in strips that can be cut to the desired length and soldered into the circuit board.

General Desoldering Tool Tips

No matter what desoldering tool is used, here are some general desoldering tips.

If a solder pad just won't desolder cleanly, add some fresh solder. Adding solder assures that there is plenty of solder present to heat up the entire solder joint and distribute the heat. This makes desoldering much easier

Think about using some method to hold the circuit board in place while you desolder. There are special rubber jawed mini vices for this task.

Using a Spring Loaded Desoldering Tool

For first time repair people, the spring action vacuum desoldering tool and a temperature controlled soldering station is the best tool to start with. This way the amount of heat applied can be controlled. The vacuum tool requires using a soldering station too. In one hand have the soldering iron, and in the other hand have the "cocked" tool. First heat up the solder joint to desolder with the soldering iron (Figure 9). Then put the desoldering tool tip over the joint at an angle (trying not to touch the soldering iron's tip). Now move the soldering iron away, and quickly position the vacuum tool perpendictular to the board, and quickly press the trigger. This should suck the molten solder from the joint (Figure 10).

Try not to put the vacuum tool tip right on the soldering iron's tip. This is not always possible if you're in tight quarters, but practice helps. For instance if desoldering a lead on the underside of a board, put the tool right next to the lead you're heating, but not touching it. Then in one motion pull the iron away and put the vacuum tool straight over it and hit the trigger. It's tempting (and easier) to just do that without pulling the iron away. That will eventually wear the Soldapullt's tip. It's up to you whether to learn the technique or just feed new tips to the vacuum desoldering tool over time.

The absolute best technique for removing IC's is to heat against the IC leg on top of the board, while holding the vacuum tool against that lead on the bottom of the board. Gently pushing on the IC leg with the soldering iron to center it in the hole while "sucking" is worth bonus points. Then when the trigger of the vacuum desoldering tool is pressed, it will usually suck all of the solder out cleanly (normal cautions about not overheating an IC leg or circuit pad apply here.) Note: If a lead is being stubborn, or if your first attempt didn't get all the solder out, here's a tip. Resolder the lead with the soldering iron and some solder. This will give the iron more solder to heat, and the vacuum tool more stuff to pull on when sucking it out. Often, on really fragile or older circuit boards, I will just resolder all the points I am about to desolder, before even attempting to use the vacuum tool.

After you have completed removal of solder from a solder joint, cocking the vacuum tool blows most of the old solder back out. It is a good idea to open the tool up from time to time and dump out the bits and pieces that hang out in there. Plus, a cake of solder tends to build up on the face of the piston; peel that off too. ■

New Products

Heavy Duty Crimping Tool Kit

Large diameter coaxial cables such as the LMR®-400, LMR®-600, WBC-400 and WBC-600 require heavy duty crimping tools. The new RFA-4009-20 cushion gripped crimp handle weighs only 1.3 pounds, and is designed to deliver piston-driven compression for installation of crimp ferrules on large diameter cables. For safety and efficiency, the ratchet mechanism is designed to release only after the ferrule is completely crimped. Two die sets are available for use with this crimp handle: the RFA-4009-01 has a 0.610" hex cavity for use with 0.600" diameter cable with a 0.429" hex cavity for ferrules and a 0.118" hex cavity for contacts. The RFA-4009 kit contains the RFA-4009-20 handle and both the RFA-4009-01 and RFA-4009-02 die sets packaged together in a foam lined, sturdy, plastic case with expansion slots to accommodate four additional die sets.

RF Connectors
Circle (10) on Reply Card

Infrared Thermometer

Fluke introduces the Fluke 61 Infrared Thermometer. Created to meet the needs of electrical, process, plant maintenance, facility maintenance, HVAC/R, and automotive professionals, the infrared instrument features a laser beam for easy aiming and is useful for measuring the temperature of rotating, electrically live, dangerously hot, or hard-to-reach objects.

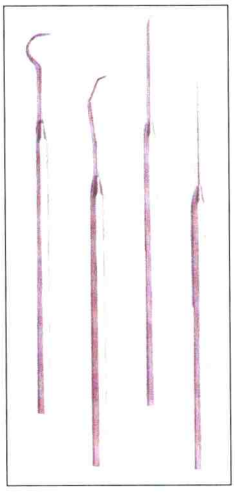
The thermometer has a single front button and sleek ergonomic design. When depressed and held down, the laser illuminates and temperature readings are continuously updated and displayed on the backlit LCD screen.

Fluke Corporation
Circle (11) on Reply Card

Probe Set

Moody Tools announces their new 10 mil precision probes with stainless steel tips and hex-shaped non-roll aluminum handles.

These tools are designed for Fine Pitch applications below 25 mil to allow lead straightening, testing and cleaning of solder joints.



Probes included in this set are also available individually. Individual drivers and sets are provided with tip protectors and are packaged in PVC tubes for product protection.

#55-1784 Set of Four includes 1 each of the following: #55-1780 Straight Tip (#1), #55-1781 Single Bend Tip (#6), #55-1782 Triple Bend Tip (#17), #55-1783 Hook Tip (#23).

Moody Tools, Inc.
Circle (12) on Reply Card

Hex Tool

Wiha Tools introduces the MagicRing, 3 tools in one; standard hex tool, ball end for angle entry and screw holding. A hardened spring steel compression ring holds screws on. The manufacturer achieves this capability by cutting a narrow groove along the major outside diameter of the hex ball and inserting a hardened spring steel compression ring into the groove. When the tool is inserted into the head of hex socket fasteners, the ring will compress just enough for clearance into the fastener, while placing enough outward force to hold up to 3 times the weight of the fastener. Precision machined for exact fit, the product is available in L-keys, SoftFinish grip screwdrivers, T-handles, Fold-ups and Insert/Power bits.

Wiha Quality Tools
Circle (13) on Reply Card

Tool Kits

Aven offers over 25 application specific tool kits for professions that install or maintain computer networks and computers, telecommunications equipment, electronic equipment, CATV, and more.

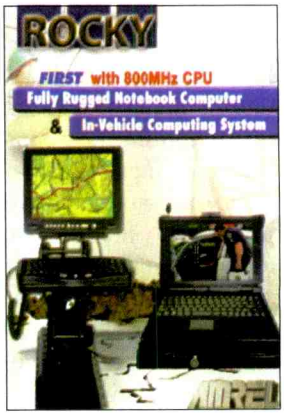
Standard features of all kits include: ergonomically designed screwdrivers for fatigue free work and high torque. The fine textured grip has excellent anti-slip properties, and the blades are made from chrome vanadium steel hardened throughout for long life, lifetime warranty on tools, rugged hard cases or compact and durable soft cases.

Aven
Circle (14) on Reply Card

Mobile Computers

AMREL is an Intel Pentium III based 800 MHz CPU mobile computing systems.

The Pentium III 800 MHz CPU is an optional feature available with all ROCKY Models, including: the Unlimited rugged notebook; the Mobile in-vehicle computing station; the Matrix all in one rugged notebook and



Photofact® Index

SAMS TECHNICAL PUBLISHING HAS JUST RELEASED THE FOLLOWING PHOTOFACT® SETS

GE
CTC203AA5 4582
CTC203AA9 4582
27GT733TX51 4582

JVC
AV-27230/R.....4585
AV-27230/S 4585

MAGNAVOX
MS3250C129 4586
MS3650C129 4586

PANASONIC
CT-2022HCE.....4581
CT-2022HE 4581
CT-2512HCE.....4581
CT-2512HE 4581
DP361 4581
TP360.....4581

PHILIPS
32PS60B121 4579
32PS60B129 4579

RCA
CTC203AA5 4578
CTC203AA9 4578
CTC203CA5 4587
CTC203CA6 4587
CTC203CA9 4587
CTC203CA10 4587
F27667TX51.....4578
F27668TX51.....4578
F32649YX50 4587
F32649YX51 4587
F32649YX53 4587
F32649YX59 4587
F36649YX51 4587

SAMSUNG
TXL2791F..... 4584
TXL2791FX/XAA 4584

SONY
KP-43T70 ..... PF GOLD 11
KP-46C70 ..... PF GOLD 11
KP-48S70 ..... PF GOLD 11
KP-48S72 ..... PF GOLD 11
KP-53N74 ..... PF GOLD 11
KP-53S70 ..... PF GOLD 11
KP-61S70 ..... PF GOLD 11
KV-32FV16.....4580
KV-32FV26.....4580
SCC-P14DA ...PF GOLD 11
SCC-P14EA....PF GOLD 11
SCC-P14FA....PF GOLD 11
SCC-P14GA ...PF GOLD 11
SCC-P14HA ...PF GOLD 11
SCC-P14JA ....PF GOLD 11
SCC-P14KA....PF GOLD 11
SCC-S44E-A 4580
SCC-S44F-A 4580
SCC-S45D-A 4580

TOSHIBA
TAC0112 4583
TAC0113 4583
TAC0114 4577
TAC0115 4577
TAC0116 4577
TAC0116 4588
27AF41 4577
27AF61 4577
32AF41 4588
36A61 4583
36AX61.....4583

Photofact® and Photofact® Gold are available from NESDA Corporate Members: B&D Enterprises, HBF Electronics, MCM Electronics and Pacific Coast Parts. Additionally, Photofact® and Photofact® Gold can be purchased from your local SAMS distributor or directly from Sams Technical Publishing

New Products

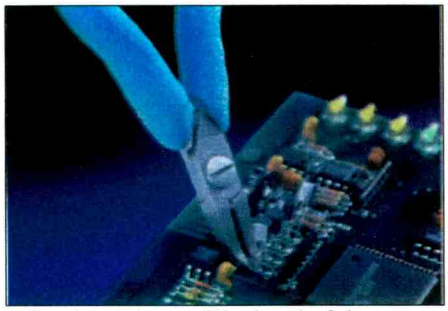
in-vehicle computing stations; as well as the Patriot line of military and government rugged computer products; and the CraftPro line of telecommunication computer products.

AMREL's "Advanced Modular Platform" allows for easy upgrading, device integration and field servicing. Through this platform an array of wireless solutions are available including options for: CDPD, LAN, Bluetooth, Mobitex, GSM, GPRS and Internal v.90 56K fax/modem.

AMREL
Circle (15) on Reply Card

Angle Cutter

Erem, a CooperTools brand, has introduced the 2282E angle cutter designed for surface mount technology (SMT) applications and through-hole component lead trimming.



Product Line — The head of the cutter is angled to allow easy access to components on printed circuit boards. The expertly honed full-flush cutting edges can easily cut copper wire with a diameter as small as 0.1mm and as large as 1.0mm. ESD-safe cushion grips protect sensitive components and the compound curve handle evenly distributes gripping pressure over the palm The cutter is made of extruded 100 percent Eremadium® tool steel for superior durability. The patented internal Magic® spring maintains constant fatigue-free operation for over a million openings. The Erem Maximum Opening Stop (EMOS) limits handles from opening and reduces operator fatigue by preventing excessive hand spread. Surfaces between the two halves are machine-faced to a tolerance of 0.00039", providing smooth, wobble-free operation.

CooperTools
Circle (16) on Reply Card

Video Inspection System

Tool-Vu from Nature Vision, Inc. is a portable, self-contained video inspection system for completing difficult job, home, and hobby tasks in tight-squeeze, hard-to-see, and low light situations.

Most trades experience "can't see" problems in tight places where one's head doesn't fit — on automotive, construction, electrical, heating, plumbing, and many other service jobs. Mirrors might help, but only with adequate lighting.

This product provides the "eyes" and neck for more thorough pre-job inspections and closer scrutiny of completed work in cramped quarters. The miniature CCD camera has a built-in on/off infrared light source.

Its 30-inch flexible gooseneck can snake in and around areas that otherwise are inaccessible. An adjustable-focus lens allows for 10x magnification and small-parts inspection.

See our full line of viewing systems at naturevisioninc.com.

Nature Vision, Inc.
Circle (17) on Reply Card

Digital Self-Contained Solder/Desolder Stations

Weller, a CooperTools brand, has introduced two digital, self-contained, triple

channel, solder/desolder stations for rework and repair of mixed technology boards.

Both units offer 300W of power over three independently controlled channels and a spare channel is available to operate an optional accessory. A built-in pump provides both air and vacuum and a built-in processor with digital read-out provides complete accuracy and reliability. Temperature set-back can be programmed with a built-in timer from five to 60 minutes in five minute intervals. A vacuum gauge on the front panel monitors the flow of air through the desoldering tool. A high reading indicates buildup of solder in the desoldering tool while a low reading indicates the need to change the air filter. A lock-out key is provided to maintain process control for set parameters and the units are ESD-safe to protect sensitive components. Optional accessories for use with the units include the WTA50 thermal tweezer and the HAP1 hot air pencil. The WRS3000V1 model comes with the WSD80 80-watt Silver Series soldering iron and DSV80 in-line desoldering iron. The WRS3000V2 model comes with the DS80 pencil-style desoldering iron.

CooperTools
Circle (18) on Reply Card

Power Analyzer

Brunelle Instruments introduces the Model 1010 Power Analyzer, useful for energy consumption of electrical appliances, measurement of maximum and minimum energy demand, harmonic analysis of power factor correction capacitors, variable speed motor drives and solid-state lighting ballasts, efficiency measurements, measurement of inrush current when power is energized and determining power factor and PF corrections. Measures harmonics, performs power analysis, measures voltage, frequency, crest factor, peak to peak and is true RMS.

Brunelle Instruments
Circle (19) on Reply Card

Books

Newnes Data Communications Pocket Book, Fourth Edition

ISBN: 0-7506-5297-7
2002: 256 pages
Price: $24.99

Newnes Data Communications Pocket Book is a tool kit for engineers, IT professionals, managers and students. The wide ranging coverage is focused firmly on day-to-day information needs, comprising the data, formula and fundamentals that professionals and students really need to hand in work situations.

The scope of this book encompasses networking, on-line services, fibre optics, network protocols, data compression, and the standards that govern these technologies. The new edition has been fully updated to include new material on USB, Firewire, IP version 6, ISDN, ADSL/HDSL, PC video standards and video on demand. The section on LANs has been rewritten with new sections on Cisco, connecting LANs to WANs, and wireless LAN technologies including Bluetooth. There is also a greatly increased emphasis on security, access and administration issues.

Despite the complexity of the subject, this wealth of information is presented succinctly and in such a way, using tables, diagrams and brief explanatory text, as to allow the user to locate information quickly and easily.

CONTENTS: Preface; LAN software; Networking; Operating systems; Bluetooth and wireless LANs; Fault-finding on RS-232 systems; Optical fiber technology and the IEEE interface standard; Multiplexing (TDM and FDM); Data compression; Digital line systems; On-line services; Digital radio systems; Glossary of data communication terms; Index.

Elsevier Science (USA)
Circle (24) on Reply Card

RF Components and Circuits

ISBN: 0-7506-4844-9
2002: 416 pages
Price: $37.99

The RF circuits covered in this book are the heart of the electronic design of TV sets, personal mobile radio, remote control systems, mobile phones, and digital TV and radio.

Joe Carr demystifies the RF design process, presenting real-world design principles, tips and rules-of-thumb with a minimum of mathematics.

Some basic knowledge of electronics is assumed, but the essential features of RF are fully described, including the important topic of receiver dynamics. The theory and circuit descriptions are geared towards genuine design applications rather than the over-simplifications and skeleton circuits of many college texts.

Contents: Preface; Introduction to radio frequencies; Signals and noise; Electronic components at RF; Inductance and inductors; Transformers at RF; Toriod indictor cores; Capacitors; Alternating current circuits at RF; Resonant L-C circuits; Measuring inductance and capacitance values; RF filters; Impedence matching in RF circuits; Transistors for RF circuits; Small-signal amplifiers; RF power amplifiers; RF L-C oscillator circuits; RF crystal oscillator circuits; RF frequency synthesizers; Transmission lines for RF systems; Radio antennas; Attenuators; RF mixer circuits; RF splitters and combiners; RF hybrid coupler transformers; Directional couplers and diplexers; Radio receiver basics; Noise cancellation bridges for receivers; Microwave components; A-1 appendix A: math for radio frequency circuits; A-2 appendix B: decibel notation; A-3 appendix C: the Smith chart; Index.

Newnes
Circle (25) on Reply Card

Optoelectronics and Fiber Optic Technology

ISBN: 0-7506-5370-1
2002: 320 pages
Price: $29.99

Optoelectronics and Fiber Optic Technology is a practical guide to the technology and applications of fiber optics and the wider technologies of optoelectronics. Ray Tricker has managed to demystify this core area of communications technology with a minimum of mathematics, in language that is accessible to a wide range of managers, technician engineers, students and professionals who need to gain an understanding of the available technologies. This is also an introductory text for installation engineers and understanding of available technologies. This is also an introductory text for installation engineers and field service engineers seeking to gain a broad understanding of the field they are working in.

All the key technologies are described: types of cable, transmitters, receivers, couplers, connectors, etc. with emphasis at all times on their selection and application. Key aspects of installation, test techniques, safety and security are also covered in detail.

Topical areas such as optoelectronics in LANs and WANs, cable TV systems, and the global fibre-optic highway make this book essential reading for anyone who needs to keep up with the technology of modern data communications.

CONTENTS: Preface; Introduction Theory; Fibres and cables; Transmitters; Receivers; Waveguides, couplers, connectors and repeaters; Communication systems; Test techniques; Safety and security applications of optoelectronics; Optoelectronics in local and wide area networks; The future; Glossary; Acronyms and abbreviations; Reference; Index.

Newnes
Circle (26) on Reply Card

Newnes Dictionary of Electronics

The Newnes Dictionary of Electronics is in a convenient compact format that makes it useful working dictionary. The definitions are clear and concise, supported by numerous illustrations and circuit diagrams.

The revise edition includes a substantial new section devoted to acronyms and abbreviations. So if you think you know the meaning of ADDER, LAP, FIB, SPICE or WORM, we recommend you check in the Dictionary.

CONTENTS: Listing of electronics terms.

Newnes
Circle (27) on Reply Card

Literature

New Web Site

The Custom Electronic Design and Installation Association (CEDIA) has launched a complementary trade professionals through the complexities of home networking.

The web site, www.cedia.org, serves as a central clearinghouse of information for the 2,000 CEDIA members worldwide, as well as homebuilders, interior designers, architects, and home owners. With links to CEDIA members throughout the world, the new web site is a true global resource.

Following are new features of the CEDIA web site:

- Direct links to CEDIA-sponsored web sites in Australia, Brazil, Canada and Italy
- Information specifically tailored for homebuilders, interior designers and architects, which helps them understand the benefits of partnering with CEDIA in meeting their customers' home networking needs
- A monthly survey to determine consumer preferences and industry trends
- Up-to-date press releases

Custom Electronic Design and Installation Association
Circle (20) on Reply Card

Electrical Connectors and Terminals CD Catalog

A new CD Rom catalog featuring virtually any type of standard connector and terminal, including drawings for each part, and an easy-to-use search engine is being introduced by ETCO.

The catalog features a full range of standard products which can be easily accessed by product type or part number using a convenient search engine. Included are complete product descriptions, approvals, technical drawings, and specifications for thousands of standard items.

Developed to provide users with one source for standard products, the catalog includes automotive electrical system parts, cord products including blades, pins, and female contacts for power cords, and inserts for automated production. Other products include over 1,500 standard connector products such as rings, spades, disconnects, pins, and receptacles.

ETCO
Circle (21) on Reply Card

Customer-Contact Mailer

A ready-to-mail consumer brochure, containing the Top 10 Questions customers should ask themselves when evaluating their communications wiring needs, is available for communications wiring installers and systems integrators from the Copper Development Association Inc. (CDA).

According to Bill Black, CDA vice president for Wire & Cable, the direct-mail piece can play an important role in the marketing of professional services, especially now when consumer spending is slowing and competition is increasing. "The need for upgraded communications wiring has never been greater," he says. "At the same time, Communications installers and systems integrators are looking for new ways to reach and assist consumers with decision-making information. This mailer can help meet that need."

The colorful brochure is designed to attract the attention of home and apartment owners. The headline focuses on areas of critical importance by asking:"Is You Home, Home Office, Phone System Wired for the 21st Century?" The brochure also provides a consumer checklist to help determine individual needs. Questions such as: "Are you an active Internet user?" and "Do you own more than one computer, and are they networked?" help people recognize how communications wiring affects their daily lives and why they should consider wiring or rewiring to meet their needs.

The mailer also lists important questions that consumers can ask their installer to help them make informed purchasing decisions. Customers are instructed to ask for references, discuss installer training and equipment warranties, and inquire about the benefits of structured wiring systems using Category 5 or 5e wiring and RG-6 coaxial cable.

No envelope is necessary if the brochure is to be mailed to potential customers. Blank areas are provided for addresses or mailing labels and for the installer's return address. The installer supplies the postage. These brochures may also be out at home shows and other venues, CDA offers them free to professional installers in quantities up to 200 or at a normal cost for larger amounts.

Copper Development Association
Circle (22) on Reply Card

Brochure on Digital Oscilloscopes

LeCroy has released an 18-page full color brochure on its Waverunner-2™ digital oscilloscopes (DSOs). The brochure, which is available through LeCroy's Web site (www.lecroy.com), outlines all the key specifications, applications, and features of the DSOs.

Among the features of the oscilloscopes outlined in the brochure are the company's exclusive Wavepilot™ and QuickZoom buttons that make it simple to magnify, view, inspect, or measure signal details. The brochure also provides complete information on accessories such as active and current probes, as well as signal measurement and analysis packages for specific applications.

LeCroy
Circle (23) on Reply Card

Association News

CEDIA Management Conference Provides Business Leaders with Growth Management Strategies for Custom Electronic Industry

INDIANAPOLIS - Approximately 125 business leaders from throughout the world recently participated in the Custom Electronic Design and Installation Associationís (CEDIA) 4th Annual Management Conference in Albuquerque, New Mexico. TThe goal of the CEDIA Management Conference was to provide business leaders with the skills to guide their companies successfully into the future. CEDIA brought together experts from various management disciplines to provide thought-provoking ideas and interactive workshops for upper-level managers in the custom electronics industry.

Michael Abrashoff, a former naval commander on the USS Benfold, kicked off the conference by detailing his innovative and grass roots military leadership model to improve morale and productivity aboard his ship. Abrashoff's understanding of issues such as employee retention and setting new standards of communication will help business leaders navigate successfully in today's fluid market.

Attendees participated in a three-day intensive workshop entitled, "Moving from Operational Manager to Strategic Leader." The program, developed exclusively for CEDIA members by the American Management Association, assessed participants' strengths and identified areas for growth in both management and leadership roles.

Said Billilynne Keller, CEDIAís executive director. "In this ever-changing industry and with the continued growth of our membersí businesses, education at the management level is more important than ever."

www.cedia.org or call 1-800-669-5329.

International CES Announces Dates for 2003

The International CES has announced that the 2003 CES will be held Thursday ñ Sunday, January 9-12 in Las Vegas, Nevada.

As your Source for Workstyle and Lifestyle Technology, the International Consumer Electronics Show (CES) is the center stage for the interaction of digital content, technology, media and delivery. More than 100,000 industry professionalsóretailers, manufacturers, content providers, government leaders, corporate buyers, financial analysts and journalistsóare expected to attend the 2003 International CES to experience the latest in wireless, gaming, digital audio and video (including HDTV), digital imaging, mobile electronics, accessories, CE fashion, consumer technology networking, broadband, content media, new business technology, delivery systems, the Internet and home networking and information technologies.

The 2003 CES will include exhibits at the Las Vegas Convention Center, Las Vegas Hilton and Alexis Park Hotel, Las Vegas, Nevada, USA.

mailto: cesinfo@CE.org or http://www.CESweb.org

Walt Herrin to Deliver Keynote at NPSC 2002

Walt Herrin of Hitachi America Ltd./Home Electronics Division, will deliver the Keynote Address at the 2002 National Professional Service Convention in Orlando, Florida. The address is slated for Wednesday, July 31 at 5 p.m. Walt Herrin is Director of National Service for Hitachi America Ltd./Home Electronics Division, located in San Diego, CA. He successfully led Hitachi (and the electronics industry) in paying top rates to servicers through its "Year 2000 Program," and was recognized by NESDA as the National Friend of Service at the 1999 National Professional Service Convention (NPSC). He was honored again as the Person of the Year at NPSC 2000, and with the M. L. Finneburgh Award of Excellence at NPSC 2001. He was honored by the Professional Service Association with its All Industry Award in 2001.

READERS' EXCHANGE

Readers' Exchange is a free service for ES&T paid subscribers only. Please include a copy of a recent address label with your Readers' Exchange Copy. The following restrictions apply to Readers' Exchange:

- Only individual readers may use Readers' Exchange, and items must be restricted to those that are ordinarily associated with consumer electronics as a business or hobby. If you're in business to sell the item(s) you want to offer for sale, the appropriate place for your message is in a paid advertisement, not Readers' Exchange.
- Readers' Exchange items must be restricted to no more than three items each for wanted and for sale.
- All submissions must be typed or printed clearly!

Send your Readers' Exchange submissions to:
Readers' Exchange • Electronic Servicing & Technology • 403 Main Street, 2nd Floor, Port Washington, NY 11050
Tel: 516-883-3382 Fax: 516-883-2162

FOR SALE

Sencore Equipment, TVA92 Video Analyzer ($600), VGA91 Video Generator ($600), HA2500 Horizontal Analyzer ($750), CMA125 Computer Monitor Signal Generator ($750). All units with original boxes, manuals, schematics, and cables. Ken Meier, 2709 Maplewood, Champaign, Il 61821. PH# 217-352-3842 after 5:30 PM cdt. email kmeier1938@aol.com.

Hi-Lo systems Model # Sep-81 AE 8M Quick Eprom Programmer (new) $150.00. Sams Photo Fact #s 4337-4456 (New) $550.00. John A. Farnsworth Jr. 9027 Auditorium St. Lakeview, OH 43331 Ph# 937-935-2493.

EICO Tube Tester Plus RCA Tube Caddie with over 300. Tubes (TV). Some in original cartons. $250.00/Best Offer plus shipping. Picture Tube Sobber Sylvania Model # CK 3000 with Adapters $75/Best offer plus shipping. Contact Jim Annunziata 619-465-3788.

Sam's Photofacts 1-2000 virtually complete. Number above virtually complete. Number above 2000 have many missing. Cabinets included for many. TSM 24-151 complete, AR 8, 37, 51, 73, 90, 98, 138, 160, 175, 275, and 289. Dave Nelson 218-643-6904 423 N. 8th St. Breckenridge, MN 56520, email, djnels@702com.net.

Video Pattern generator Signal Source model 1219 $150.00, Biotek Electro surgical analyzer model RR 301 $75.00, New Static Mat $25.00, Zenith Transoceanic radio $350.00, Stromberg Carlson short-wave radio $325.00, Approx 350 Vacuum Tubes 1980's era $200.00, New Weller Pyropen Jr. not used $60.00, Anatex Model C Iron $10.00, Kenwood 2mtr handy talkie w/accessories $200.00. Will ship COD and add shipping to all prices. E. Leduc, 319 So. Hall St., Manchester, NH 03103 Phone: 603-669-1533, E-mail: edleduc@prodigy.net.

Sencore VA62A Video Analyzer with all manuals and probes, excellent condition $495. Price includes shipping U.P.S. in USA. Leroy Blalock 4728 Devil Tr. Ground Road, Bear Creek, NC, 27207. Phone: 919-837-5632 before 2 pm eastern time.

B&K Model 467 picture tube checker and rejuvenator. Excellent condition, used very little. Also have latest manuals and setup charts. Sockets and universal adapter for checking any picture tube. Price $250. Call Gordon Lane, tel: 615-889-6195, 239 Jacksonian Drive, Hermitoge, TN. 37076.

Retired electronics technician selling all test equipment. 1-SC61 Sencore oscilloscope $450, 1-VC93 Sencore VCR analyzer $650, 1-VA48 Sencore video analyzer $185, 1-PR57 Sencore variac isolation $165, 1-CRT Tester Rejuvenator $85, 1-RF signal generator $65, 1-Transistor Tester $65, 1-laboratory oscilloscope 5" $45, 1-service bench VTVM $45, 1-tube tester portable $45, 2-microfiches 24x and 32x, $85, contact Jose Navarro 305-266-5153 email, jose.m.navarro@worldnet.att.net, Any offer with reasonable prices will be considered.

Sencore HA2500 Horizontal Circuit Analyzer $800, Sencore TF46 cricket Transistor Tester $100, Sencore CM2125 Computer Monitor Analyzer w/EX220x10 Output Expander Module $1,400. All units like new w/original box, manuals, schematics and cables. Joseph Burtzel, 1-800-658-2500 ext. 104, 1240 Oak St. Wabasso, MN. 56293-0217.

Sencore SG165 AM-FM Stereo Analyzer. Owners Manuals and leads, $350. Band K 60 MHz Dual trace oscilloscope #2160. With leads and Manual paid $900 sell for $325. Contact Mark at (541) 267-0628 Audio Video Specialists Coos Bay, OR.

Sencore SC3100, CM2125 with all adapters, HA2500, CR7000, TC100 Advance Monitor Service Course. All in original boxes. Never used. Call Rudy @ (518) 883-3334 or rnb@superior.net.

Photofacts AR9, AR48, AR49 and AR70 each $5.00 plus shipping, Eico model 239 Solid State Fet-TVM meter with leads and manual $40.00 plus shipping, Demodulation Probe for Eico 239 $10.00 plus shipping. T. Walton, 6322 Indian Path, San Angelo, Texas 76901, phone (915) 947-3393.

Small residual of a Radio-TV repair business from the 50's & 60's. 1volt, 6v and 12 volt tubes. Also, 1 Zenith picture tube, type 25vcnp22, BRAND NEW still in the box. Will give a list in detail. Best Offer takes all. Call 215-699-9646 may have to leave message. E-mail krider@bucks.edu.

WANTED

Wanted to buy. Diehl Mark 4 and Diehl Mark 7 Testers. Also parts for Don Bosco Stethatracer. Murray's Repair Service, 561-966-8862. Email-tmgold@bigplanet.com.

Schematic for Motorola model 76T2. (A vintage portable transistor radio.) Mackenzie TV, (480) 946-7270, marjmac@cox.net.

Impedance bridge zm-11/u, phillips scope pm3212, sharp camcorder vll-1250u.need it for parts. Sid 510-357-3788 or sgoldhor@msn.com.

Schematic and Service Manuel for a Mita DC-2254 Copier. Neville W. Young, 214 East Robertson Street, Brandon, FL 33511. 813-685-1900.

Hand held remote control for RCA Model #GLR641TR. George Fogelman, 1201 Idlewilde El Paso, TX 79925, 915-778-0997.

Service Manual or copy for Altec Lansing AM-FM Rcvr. Model 714A. Richard Gilman, P.O. Box 633, King City, CA 93930, 831-385-9248.

Anything associated with the RCA SELECTAVISION CED VIDEODISC PLAYER. The Needle Pickup Video System developed and Marketed in the early 80's. Players, Parts, Remotes, Service Manuals, Advertising Memorabilia, Service Fixtures, Test Jugs, etc. Anything for the following brands: RCA, Zenith, Wards, Realistic and Hitachi. Tell what you have and I will make a offer! Email dj3928@aol.com or write to; Darrell Johnson, 11247 Hardinsburg Road, Cecilia, KY 42724.

Looking for B@K Oscilliscopes Models 1590, 1590A and 1570 working or not. Please call or write if you have one of these to sell. Contact Mike Shelton CET, 2708 May Dr., Burlington, NC 27215 or 336-229-5671 or email ke41gx@netpath.net.

Wanted to buy, Flyback Transformer Zenith projection TV Part #095-04134-13 or 95-4134-13. Also an IC for Emerson TV part #M52039SP. Call at 276-971-2395 or e-mail me at shelbyf@netscope.net.

CLASSIFIED

CLASSIFIED ADVERTISING **By the word.** $1.65 per word, per insertion, pre-paid. Minimum charge is $35 per insertion. Initials and abbreviations count as full words. Indicate free category heading (For Sale, Business Opportunities, Miscellaneous, Wanted). Blind ads (replies sent to ES&T for forwarding) are $40 additional. No agency discounts are allowed for classified advertising. For further information, or to place your order, contact:

Lyndiane Paoletti, Electronic Servicing & Technology
403 Main Street, 2nd Floor, Port Washington, NY 11050
Tel: 516-883-3382 Fax: 516-883-2162

FOR SALE

PHOTOFACT DIAGRAMS for sale. #101-#1103 and 65 newer packages up to #2564. Best offer! Call 605-374-5501.

ANY Tuner we rebuild is $25, YES $25, YES $25, YES $25! Includes FREE Shipping and Handling. *BUY - SELL - TRADE* **Tip Top TV**, 18441 Sherman Way, Reseda, CA 91335. **818-345-1974.** www.tiptoptuner.com.

IN-CIRCUIT CAPACITOR TESTER - Find bad caps FAST and RELIABLY with the Capacitor Wizard in-circuit ESR Tester! Great for monitors, switching power supplies, TV, etc. Still only $179.95 MC/VISA. **Independence Electronics Inc. 800-833-1094. www.awiz.com.**

SENCORE refurbished equipment for sale. (All Models) Like new and fully warrantied! Financing, Visa and M/C. 800-609-0677 ask for Lance Tople.

TV CASE HISTORIES: Volume 9 with 3,500+ histories. Satisfaction assured. Only $63.00 (plus $3.95 shipping). Over 13,700 books and supplements sold with only 1 returned for a refund! **Mike's Repair Service**, P.O. Box 217, Aberdeen Proving Ground, MD 21005. Same mailing address 38+ years. Send SASE for samples. 410-272-4984, 1-800-2-FIX-TVS 11a.m.-9 p.m. (http://mikesrs.no-frills.net).

Circle (32) on Reply Card

DISPLAY CLASSIFIED MARKETPLACE

DISPLAY CLASSIFIED MARKETPLACE Display Classified Marketplace $260.00 per column inch per insertion. Frequency rates available. 2 columns per page, 3 1/2" column width. Minimum size accepted: 1 column inch. Additional sizes billed in 1/4" increments. Maximum height per ad is 4", maximum width per ad is 1 column (3 1/2"). Agency discounts paid to recognized agencies if finished materials are provided. We accept AMEX, MasterCard, VISA and Discover. Optional color (determined by ES&T) $150.00 per insertion. For more information, or to place your order, contact:

Lyndiane Paoletti
Electronic Servicing & Technology
403 Main Street, 2nd Floor, Port Washington, NY 11050
Tel: 516-883-3382 Fax: 516-883-2162

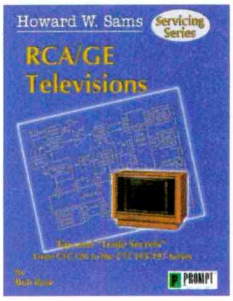
ADVERTISERS INDEX

WE'D LIKE TO SEE YOUR COMPANY LISTED HERE TOO!
CALL: **Joni Jones, 516-944-8068, e-mail: jmjones@ix.netcom.com,**
or
David Allen, *Sales Director*, 516-883-3382,
e-mail: dallen@mainlymarketing.com

TO WORK OUT AN ADVERTISING PROGRAM TAILORED TO SUIT YOUR NEEDS.

ES&T BOOK SHOP

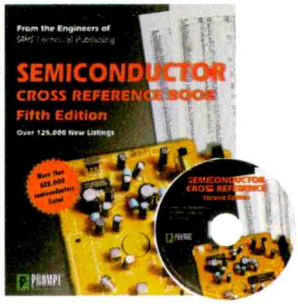
To Order Call Toll Free 800-462-4659



RCA/GE Televisions
(Howard W. Sams)

Expanding on the Sams Servicing Series, author Bob Rose takes an in-depth look at RCA/GE TVs, with coverage of manufacturer hr shop in Fort Dodge, IA for 38 years. He is the author of more than 43 books and more than 1,000 articles printed in 48 different magazines. He currently is the TV servicing consultant for *Electronic Servicing & Technology* magazine.

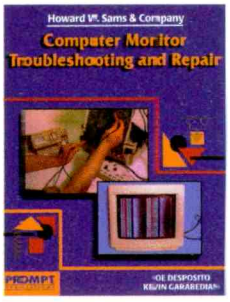
Paperback • 320 pages
ISBN 0790612240 • Sams # 61171
$34.95 US



Semiconductor Cross Reference Book
Paperback or CD-ROM
by Sams Technical Publishing

The perfect companion for anyone involved in electronics! Sams has compiled years of information to help you make the most of your stock of semiconductors. Both paper and CD-ROM versions of this tool contain an additional 128,000 parts listings over the previous editions.

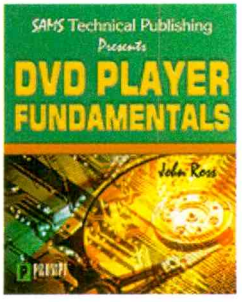
Paperback, 5/E • 876 pages
ISBN 0790611392 • Sams 61139
$39.95 US
CD-ROM, 2/E
ISBN 0790612313 • Sams # 61231
$39.95 US



Computer Monitor Troubleshooting and Repair
By Joe Desposito
Prompt Series from Sams

This can save time and money in monitor repair. Technicians will benefit from this book as it takes the reader through the basics and on to trouble shooting circuits.

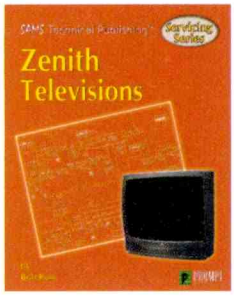
Paperback • 308 pages
ISBN 07906011007 • Sams # 61100
$34.95 US



DVD Player Fundamentals
by John Ross

DVD Player Fundamentals covers every aspect of the Digital Versatile Disc starting with features, specifications, hookup, operation, user error, and more. For the professional, specific technical information includes: DVD track structure and disc construction, optical head and lens features and specifications, video signal processing, MPEG-2 technology, audio signal processing, decoding, audio path and reference signals, switch-mode power supply, tracking servo, transverse servo, system control circuits, etc.

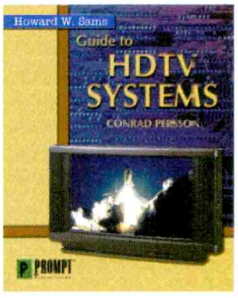
Paperback • 304 pages
ISBN 0790611945 • Sams# 61194
$29.95 US



Servicing Zenith Televisions
(Sams Servicing Series)
by Bob Rose

Expanding on the Sams Servicing Series, author Bob Rose takes an in-depth look at Zenith TVs, with coverage of manufacturer OEM parts versus generic parts.

Paperback • 352 pages
ISBN 0790611716 • Sams# 61216
$34.95 US



Guide to HDTV Systems
by Conrad Persson

As HDTV is developed, refined and becomes more available to the masses, technicians will be required to service them. Up until now, precious little information has been available on the subject. This book provides a detailed background on what HDTV is, the technical standards involved, how HDTV signals are generated and transmitted, and a generalized description of the circuitry an HDTV set consists of.

Paperback • 323 pages
ISBN 079061166X • Sams# 61166
$34.95 US

Servicing TV/VCR Combo Units
(Sams Servicing Series)
by Homer Davidson

Part of Sams Servicing Series, Servicing TV/VCR Combo Units covers the servicing issues surrounding this popular electronic device. TV/VCR combo units have become smaller, more affordable, and functional. They are now used in new ways including applications in autos, campers, kitchens and other non-traditional locations. Homer Davidson uses his vast knowledge to cover this subject in a way no one else can.

Paperback • 320 pages
ISBN 07906 2240 • Sams # 61224
$34.95 US

ORDER TOLL FREE
1-800-462-4659

Make your selections and include your name, address and telephone with order.

Check, Money Order, MC, VISA, AMEX and Discover accepted. Include CC# and Expiration with order. Make checks payable to: ***Electronic Servicing and Technology***.

Shipping: FREE on US orders over $50. Smaller orders = $6.00. Foreign shipping charged at actual cost (less $6.00 for orders over $50).

Call or mail order to:
Customer Service
ES&T
P.O. Box 748
Port Washington, NY 11050
Fax: 516-883-2162
Tel: 800-462-4659

Video Heads

Pick A Number Any Number

When you're looking for a replacement head, SK Series is way ahead of the competition.

SK Series replacement video heads cross over to 4,500 different models and 68 different brands.

And when you're in need of any exact semiconductors, belts, tires, flyback transformers or video replacement parts, we have them too.

But we don't stop there.

Every SK Series product comes with the quality assurance and accuracy you expect from all Thomson products.

For more information on SK Series products, contact your nearest Thomson Distributor.

SK *Series*...The parts you need to do the job. "Trust me!"

Thomson multimedia Inc.

SK *Series*

Circle (43) on Reply Card