THE MAGAZINE FOR PROFESSIONAL ELECTRONIC AND COMPUTER SERVICERS

ELECTRONIC™

Servicing & Technology

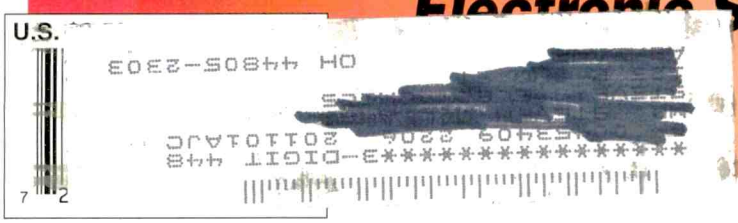
November 2000

Troubleshooting SMD Components

Circuit Board and Parts Handling

SOLDERING & DESOLDERING UPDATE

- **Servicing Audio Equipment**
- **Automotive Electronic Systems**



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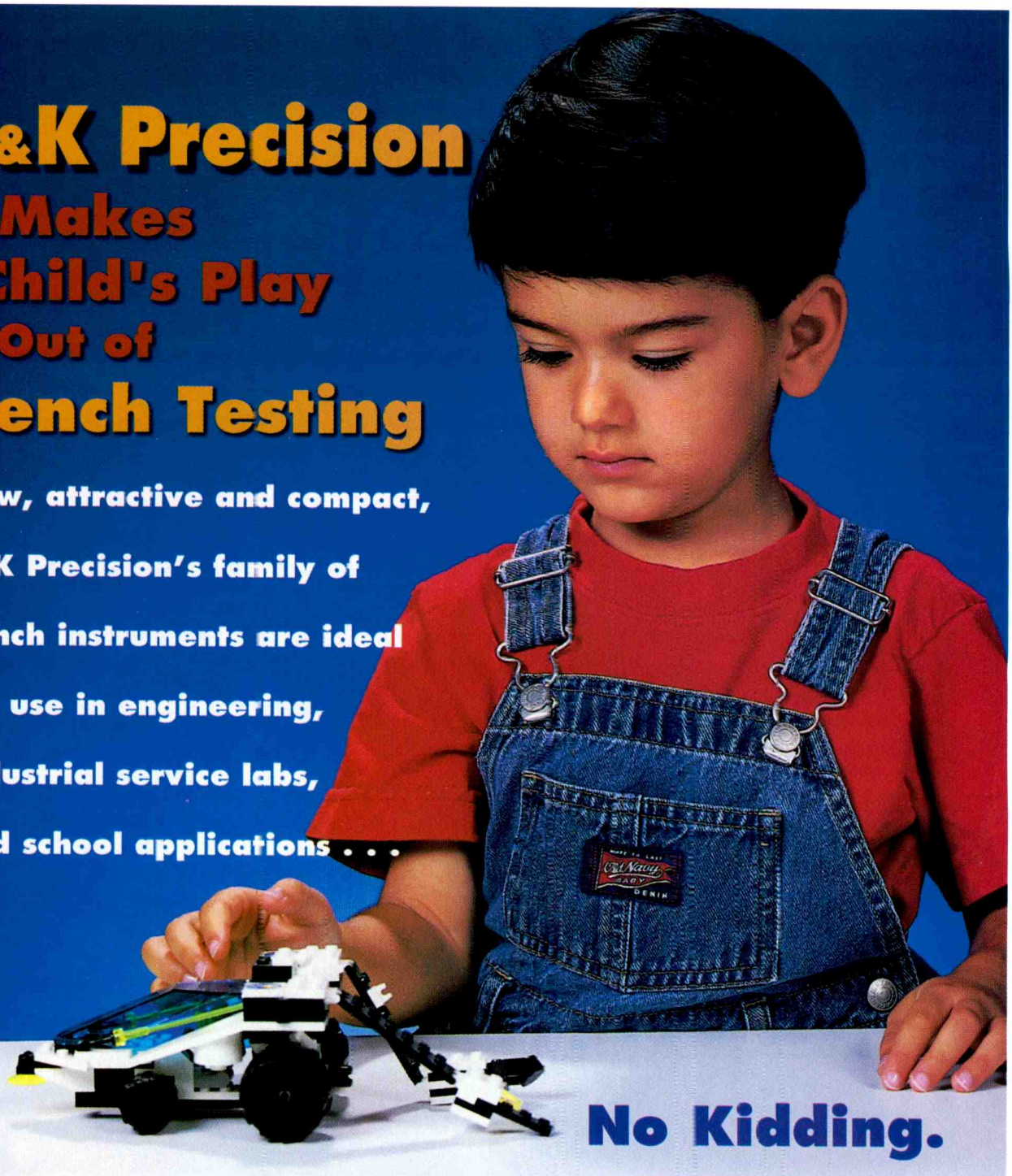

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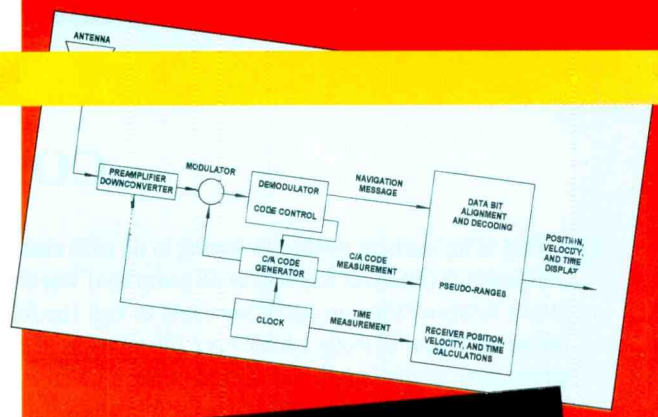
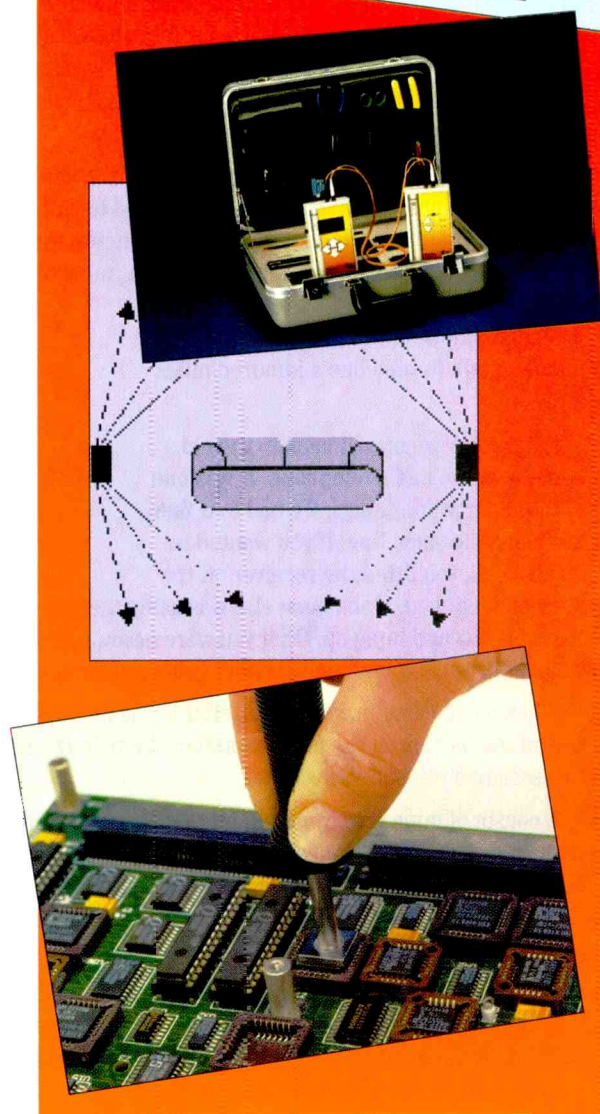
THE MAGAZINE FOR PROFESSIONAL ELECTRONIC AND COMPUTER SERVICERS
ELECTRONIC Servicing & Technology
Volume 20, No. 11 November 2000

contents

FEATURES





Cover Photos Courtesy of Metcal.

DEPARTMENTS

Editorial

by Nils Conrad Persson

CONNECTEDNESS

One of my earliest memories having to do with electronic communications (and this was maybe 50 years ago) was the time my family returned from an out of town trip to visit the relatives. My folks had moved to a city a little over 100 miles from the town where most of the family had settled down. My Dad wanted to let his mother know that we had arrived safely, and we didn't have a telephone in the apartment where we lived, so we stopped at a drugstore near home and I went in with my Dad while he made the call.

I was in awe. My Dad lifted the receiver off the hook, dialed O and told the operator what number he wanted to call. He fished in his pocket for some coins and slipped them into the slot. Soon he started talking to his mother. Being still a young child, I remember wondering if I'd ever learn enough to know how to use one the telephone to talk to someone a hundred miles away.

Later, after we moved back to the old hometown, we had a telephone. It was one of those party line things. We had four families using the same line. If you wanted to make a call, you lifted the receiver off the hook and listened. If someone else was using the line you heard them talking and hung up. Or, if you were nosey, you could continue to listen and learn a little about your neighbor's affairs.

When a call came in, you could tell if it was for you by the ring. One of the parties on the line was assigned one long ring, another was assigned two short rings, etc.

A cousin of mine who lived in a more rural community had an even more primitive arrangement. It was one of those crank telephones. To dial out, you cranked the telephone, which caused a ring at the central office. Then you told the operator where you wanted to call to, and she made the appropriate connections via patch cords.

My cousin was also on a party line as well, so if you wanted to call him, you would tell the operator where you were calling from to "call Centralville 555-3333 ring two, please."

My how things have changed in just 50 years, or so.

Nowadays, it seems, everyone is connected to everyone. You can't drive down the street, shop at the mall, eat in a restaurant, or go to the grocery store without seeing someone, or more likely several someones, talking away on the cell phone. But it's not just cell phones. Many of the people without cell phones, and even many who do, have their pagers. If someone needs to talk to them, they dial the pager number, and the pager beeps or vibrates and tells them someone wants to talk to them. In the case of the pagers that have a digital readout, the caller can even send a message to be read by the person paged.

And of course, there are the palmtop computers that are set up to connect to the internet.

Speaking of the internet, only a scant few years old, the internet has provided a way for people to be even more connected. Today, individuals can use the internet to communicate either in real time, or e-mail, via type or voice. Moreover, they can access information on companies, visit the local library, or connect to thousands of websites. They can listen to or download music, read the news. The internet provides a whole new level of connectedness.

"The internet provides a whole new level of connectedness."

But so far we have only seen the beginning of connectedness via the internet. Most internet users are connected to the internet via dial-up lines. That is, most of the time they're not connected. When they want to use the internet, they key in a telephone number that connects them to a local node of a network that then connects them to the internet provider's computer. A few subscribers today have either a cable connection or a digital subscriber line (DSL) that allows them to be connected to the internet 24 hours a day.

A number of companies, notably Cisco, the manufacturer of internet routers, are working to make full-time internet connection a reality for most users. Under the scheme envisioned by these companies, members of the newly-formed Internet Home Alliance, internet subscribers would be connected to the internet at all times, and be able to communicate, receive radio and television programming, send instructions to their intelligent appliances, and much more via the internet.

The implications for consumer electronics service are staggering. There is opportunity for service centers to help homeowners get connected. There is the need to learn how reception of digital audio and video via the internet differs from reception of radio and television over the air, via cable or via satellite. It's a whole new world that we're all going to have to learn about.

Just 50 years later, the communications surrounding that trip could be entirely different. Instead of waiting to get to the destination, I could chat the entire way with the folks at home on the cell phone. Or a passenger in the car could keep in touch with the family via a laptop computer connected to the internet via a cell phone connection. Considering the dramatic way connectedness has changed in a mere 50 years, does anyone care to venture a guess as to where we'll be 50 years hence?

Conrad Persson

THE MAGAZINE FOR PROFESSIONAL ELECTRONIC AND COMPUTER SERVICERS

ELECTRONIC Servicing & Technology

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.

A publication of
MAINLY MARKETING ENTERPRISES INC.
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Port Washington, NY 11050 USA
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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. Subscription prices (payable in US dollars only): Domestic—one year $26.95, two years $49.95. Canadian—one year $36.95, two years $69.95. Foreign Air Post—one year $44.95, two years $85.95. 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, Circulation Department, Suite 405, 25 Newbridge Road, Hicksville, NY 11801.

ETA Electronics Technicians Association

National Electronics Service NESDA Dealers Association, Inc. Member, Electronic Servicing Dealers Association

News

In-orbit testing of radio broadcast satellite performed

Sirius Satellite Radio, the satellite radio broadcaster, today announced that in-orbit testing of the company's first satellite, Sirius-1, was successfully completed on July 31. Payload and signal testing showed all systems performing to specification. The company is scheduled to begin broadcasting its 100 channel audio entertainment service at the end of this year.

From its three orbiting satellites, Sirius (www.siriusradio.com) will directly broadcast up to 100 channels of digital-quality programming to motorists throughout the continental United States for a monthly subscription fee of $9.95. Sirius will deliver 50 channels of commercial-free music in virtually every genre, and up to 50 channels of news, sports and information such as CNBC, NPR, SCI FI Channel, Classic Radio and the BBC. Sirius' broad and deep range of virtually every music format as well as its news, sports and entertainment programming is not available on conventional radio in any market in the United States.

Sirius has alliances to install three-band (AM/FM/SAT) radios in Ford, Chrysler, BMW, Mercedes, Mazda, Jaguar and Volvo vehicles as well as Freightliner and Sterling heavy trucks. In addition, Sirius has alliances with numerous electronics manufacturers to furnish radios to automakers, as well as adapters to electronics retailers that will allow radios in existing vehicles to receive Sirius broadcasts.

Semiconductor chips readied for satellite radio receivers

XM Satellite Radio Inc., the satellite radio broadcaster, and STMicroelectronics, a semiconductor vendors, have successfully completed fabrication and initial testing of XM's first pass custom chips; these chips are now being delivered to XM radio partners for integration into the manufacturing process of XM satellite-capable radios. Delivery of these custom integrated circuits is a major technical milestone in the production of XM's radios.

The XM chipset consists of two custom integrated circuits designed by STMicroelectronics for XM Satellite Radio, which are capable of processing XM's digital satellite signal transmitted by its two high-powered satellites as well as the signal transmitted from XM's terrestrial repeater network. The signal contains up to 100 channels of digital audio programming in addition to text information relating to the song title, artist and genre of music that will be shown on the radio display. Custom integrated circuits enable radio manufacturers to mass-produce XM radios at attractive retail price points.

According to Hugh Panero, XM President and CEO, "We are extremely happy that these highly complex chips have been delivered by ST on time and fully functional at the first silicon. As a result we have been able to deliver them to our radio manufacturing partners in a time frame that is consistent with achieving our second quarter 2001 XM service launch date."

Last month, XM demonstrated its first working prototype radio developed by XM as well as a radio developed by Delphi-Delco. The XM chipsets are being delivered to the company's radio manufacturing partners, which include Delphi-Delco, Sony, Alpine, Pioneer Electronics Corporation and Clarion among others.

XM Satellite Radio is developing a new band of radio. It will create and package up to 100 national channels of digital-quality music, news, sports, talk, comedy and children's programming in its state-of-the-art, all-digital 82-studio broadcast center in Washington, DC. The service will be uplinked to XM's two powerful satellites and transmitted directly to vehicle, home and portable radios across the country. The company's first satellite is scheduled to launch in December. XM's consumer service is slated to begin during the first half of 2001 for a monthly subscription fee of $9.95. XM ready radios will be sold by automotive and retail outlets such as Best Buy and Circuit City. The company has a long-term distribution agreement with General Motors to integrate XM-Ready radios into its vehicles commencing in 2001. XM's strategic investors include America's leading car, radio and satellite TV companies - General Motors, American Honda Motor Co. Inc., Clear Channel Communications, DIRECTV and Motient Corporation (Nasdaq: MTNT). For more information, visit XM's new website: www.xmradio.com.

Sales of Audio Products Remain Hot in August

The steamy month of August showed no sluggishness in the factory sales of audio products to dealers according to the Consumer Electronics Association (CEA). Sales for this month rose six percent compared to the same period last year, resulting in year-to-date sales of $5.3 billion, an 11.2 percent rise over last year.

The warm weather saw portable audio revenues post a nine percent increase in August, generating $235 million in sales. This increase contributes to the 22 percent increase in sales of portable audio products so far this year, up to $1.6 billion. Within this sector, headset CD players jumped up 25 percent to $85 million, helping this category achieve year-to-date sales of $511 million - 37 percent ahead of the first eight months of 1999

Factory sales of audio systems also experienced double-digit growth, climbing 16 percent to revenues of $192 million in August. For the year so far, audio system revenues rose nine percent over 1999, surpassing $1.2 billion in revenue. Helping drive this tremendous growth are the compact systems category, increasing 15 percent, and the convenient and affordable home-theater-in-a-box category, increasing a phenomenal 45 percent in August, demonstrating the desire of consumers for easy, one-stop solutions to great sound.

"Consumers are increasingly experiencing the immersive aspects of surround sound," commented Gary Shapiro, president and CEO of CEA. "Whether it is a family enjoying a home theater experience or a college student listening to digital music files from their PC, clearly digital audio products are changing the way people listen. This trend will only continue when new formats, such as DVD-Audio and Super Audio CD, bring us new exciting aural experiences and music as we've never heard it before."

Even though sales of home receivers dipped slightly in August (six percent), other categories within separate home audio components also experienced double-digit growth. Within this sec-

tor, CD equipment revenues were up by 27 percent (largely due to the growing popularity of CD recorders), and separate home speakers increased ten percent. Year-to-date numbers show that home audio component sales are up 13 percent, equaling $965 million in sales dollars. The aftermarket autosound sector is running par with last year's figures with $1.5 billion in revenue generated thus far this year.

Fostering the internet lifestyle

Cisco Systems, a leader in networking for the Internet, has announced its involvement in a new industry alliance: Internet Home Alliance, dedicated to enhancing consumers' understanding, appreciation and adoption of the Internet lifestyle. Through its relationship with the Alliance, Cisco will work to fuel the market by promoting industry collaboration and assisting in the development of the entire ecosystem, from device manufacturers to retailers.

As a founding member of Internet Home Alliance, Cisco will be able to build on its vision to provide consumers anywhere, anytime Internet access in the home. The Internet Home Alliance is the ecosystem enabler that will help to make the Internet lifestyle a reality. As Internet lifestyle solutions become mainstream and the availability of broadband increases, Cisco will benefit from the need to distribute broadband throughout the home to connect computers, telephones, home subsystems, such as HVAC and security, and smart appliances.

"Cisco initiated the Internet Home Alliance in order to build the ecosystem necessary to support the Internet lifestyle," said Mike Moone, group vice president and general manager, Cisco's Consumer Line of Business. "The Alliance will work with all members of the industry, from service and content providers to home integrators and developers, to accelerate parallel industry growth. This will allow the industry to quickly deliver Internet lifestyle solutions that add value to consumers' lives."

Cisco believes the Internet is the next essential home utility where high-speed, always-on Internet access is available throughout the home.

Internet Home Alliance members include 3Com, Best Buy, Cisco Systems, CompUSA, General Motors, Honeywell, Invensys, Motorola, New Power Company, Panasonic, Reliant Energy, Sears, Roebuck and Co., Sun Microsystems and Texas Instruments. This group of well-established consumer and high-technology companies will work together to define critical industry building blocks and minimize barriers currently inhibiting the mass adoption of Internet lifestyle solutions. The Alliance recognizes the following issues currently affecting the adoption rate of Internet lifestyle solutions: market fragmentation, consumer and industry confusion, and availability and complexity of home technology solutions. Internet Home Alliance will work with industry associations and ecosystem partners to further enable the creation, distribution and adoption of Internet solutions that add value to consumers' lives.

For more information on Internet Home Alliance, visit www.internethomealliance.com. ■

DTV Stations in Operation

According to figures released by the National Association of Broadcasters (NAB), as of October 19, 2000, there were 159 DTV stations operating in 55 markets in the United States. Following is a list by major city of the call letters of the station, the analog channel number, and the DTV channel number. *(See table below).*

NEW YORK (1)
WCBS 2 56
WNYW 5 44

LOS ANGELES (2)
KABC 7 53
KCBS 2 60
KCAL 9 43
KNBC 4 36
KTLA 5 31
KCOP 13 66
KTTV 11 65
KCET 28 59
KWHY 22 42

CHICAGO (3)
WFLD 32 31
WCPX 38 43
WSNS 44 45

PHILADELPHIA (4)
WPV I6 64
KYW 3 26
WTXF 29 42
WCAU 10 67
WFMZ 69 46
WNJT 52 43
WHYY 12 55
WLVT 39 62

SAN FRANCISCO (5)
KGO 7 24
KRON 4 57
KTVU 2 56
KPIX 5 29
KBHK 44 45
KNTV 11 12
KQED 9 30
KICU3 6 52
KBWB 20 19

BOSTON (6)
WBZ 4 30
WCVB 5 20
WMUR 9 59
WHSH 66 23
WFXT 25 31
WHDH 7 42
WENH 11 57

DALLAS (7)
WFAA 8 9
KDFW 4 35
KXAS 5 41
KTVT 11 19

WASHINGTON (8)
WJLA 7 39
WUSA 9 34
WRC 4 48
WETA 26 27
WTTG 5 36

DETROIT (9)
WXYZ 7 41
WJBK 2 58
WDIV 4 45
WWJ 62 44
WTVS 56 43

ATLANTA (10)
WSB 2 39
WXIA 11 10
WGCL 46 19
WAGA 5 27

HOUSTON (11)
KHOU 11 31
KPRC 2 35
KRIV 26 27
KTRK 13 32

SEATTLE (12)
KOMO 4 38
KCTS 9 41
KING 5 48
KIRO 7 39
KCPQ 13 18

CLEVELAND (13)
WMFD 68 12
WKYC 3 2
WEWS 5 15
WOIO 19 10
WJW 8 31

TAMPA (14)
WTVT 13 12
WFTS 28 29
WFLA 8 7
WTSP 10 24

MINNEAPOLIS/ST. PAUL (15)
KTCI 17 16
KSTP 5 50
KMSP 9 26

MIAMI (16)
WSVN 7 8
WPLG 10 9

PHOENIX (17)
KPHO 5 17
KSAZ 10 31
KNXV 15 56
KUTP 4 526
KPNX 12 36

DENVER (18)
KMGH 7 17
KDVR 31 32
KRMA 6 18

PITTSBURGH (19)
WTAE 4 51
WPXI 11 48
KDKA 2 25

SACRAMENTO (20)
KCRA 3 35
KXTV 10 61
KTXL 40 55
KOVR 13 25

ST. LOUIS (21)
KTVI 2 43
KMOV 4 56
KSDK 5 35

ORLANDO/DAYTONA BEACH/

MELBOURNE (22)
WOFL 35 22

PORTLAND, OR (23)
KOPB 10 27
KATU 2 43
KPDX 49 48
KOIN 6 40
KGW 8 46
KPTV 12 30

BALTIMORE (24)
WBAL 11 59
WMAR 2 52
WMPT 22 42
WBFF 45 46
WJZ 13 38

INDIANAPOLIS (25)
WTHR 13 46
WISH 8 9
WRTV 6 25
WXIN 59 45

SAN DIEGO (26)
KGTV 10 25
KNSD 39 40
KFMB 8 55
KSWB 5 19

HARTFORD/NEW HAVEN (27)
WTNH 8 10
WFSB 3 33

CHARLOTTE (28)
WBTV 3 23
WCNC 36 22
WSOC 9 34
WCCB 18 27

RALEIGH (29)
WRAL 5 53
WTVD 11 52
WRAZ 50 49

MILWAUKEE (31)
WMVS 10 8

CINCINNATI (32)
WLWT 5 35
WKRC 12 31
WCPO9 10
WXIX19 29

KANSAS CITY, MO (33)
KCPT 19 18

COLUMBUS (34)
WBNS 10 21

GREENVILLE-SPARTANBURG (35)
WSPA 7 53

SALT LAKE CITY, UT (36)
KSL 5 38
KTVX 4 40

GRAND RAPIDS (38)
WOOD 8 7

OKLAHOMA CITY, OK (45)
KFOR 4 27

HARRISBURG (46)
WITF 33 36

LOUISVILLE (48)
WKPC 15 17

LAS VEGAS (53)
KLAS 87

HONOLULU (71)
KITV 4 40
KMAU 12 29
KHVO 13 18

SPOKANE (72)
KXLY 4 13

OMAHA (73)
KMTV 3 45

PORTLAND/AUBURN (80)
WCBB 10 17

MADISON (84)
WKOW 27 26

SOUTH BEND (85)
WNDU 16 42

COLUMBIA (86)
WRLK 35 32

JACKSON (89)
WMPN 29 20

TRI-CITIES, TN-VA (92)
WCYB 5 28
WKPT 19 27

BATON ROUGE (97)
WLPB 27 25

SPRINGFIELD (105)
WGBY 57 58

RENO (111)
KNPB 5 15

AUGUSTA (115)
WRDW 12 31

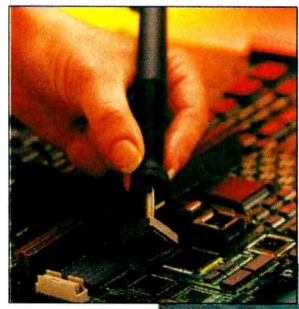
ROCHESTER-MASON CITY-AUSTIN (153)
KTTC 10 36

QUINCY-HANNIBAL-KEOKUK (161)
WGEM 10 54

Soldering and Desoldering Update

Adapted from information provided by Metcal

In order to provide consumers with electronics products that are compact, loaded with features, and capable of high quality of output, engineers and manufacturers have made components smaller, made circuit traces on PC boards thinner, and found ways to pack more components on each board, including the use of surface mount technology (SMT). That has presented a number of new challenges to service technicians: the people who have to repair those products.



Fortunately, other manufacturers have responded by providing technicians with an arsenal of advanced tools that can help the technician make those repairs quickly, with a minimum of potential for damaging of components or boards.

The existence of both conduction and convection tools give technicians a choice of methods to repair and rework SMT. Conduction rework tools transfer heat to solder joints via contact with a heated metal tip or head. Convection (hot air) tools transfer heat via a directed hot gas or air stream.

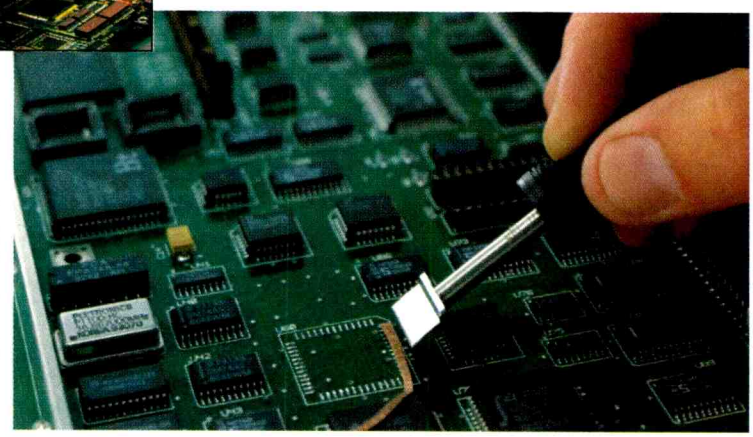
No rework technology is ideal for all situations. In choosing a rework tool, the service center manager must evaluate not just the tool itself, but the total interplay between operator, tool, and task requirements. The key evaluation criteria are product damage, speed, application flexibility, user friendliness, and cost.

To illustrate this, two cases, the removal of an SOIC-24 and PLCC-84 using both conduction and hot air tools, are presented.

The repair processes

For any rework or repair process, obtaining high quality, cost effective results requires optimizing the interaction between operator and equipment. Equipment choices that make sense for high-volume rework may be inappropriate for mid- or low-volume rework. Because consumer electronics service is by definition a low-volume situation, this article will focus exclusively on low-volume, manual rework equipment for SMDs.

There are three primary rework technologies available for low-volume SMT rework. They are:



Conduction
Convection (or "hot air")
IR (infra-red) Reflow

Conduction tools operate by transferring heat to solder joints via contact with a heated metal tip. This tip can vary widely in shape from fine point needles to four sided socket heads. Examples of these include soldering irons, fixed sockets heads and tweezer grips. Convection tools transfer heat to solder joints via a directed hot gas/air stream. The gas/air flow pattern is shaped by nozzle selection. IR reflow tools transfer heat via radiation. Conduction and convection technologies are by far the most prevalent for low volume rework. They will be the focus of discussion. IR reflow will not be dealt with here.

Evaluation criteria

No rework technology is ideal for all situations. The best option is one that most closely approaches the ideal from a total process perspective. In order to determine the best method, the service center has to consider the interaction between operator, equipment, and the given rework task, and not just equipment selection.

Evaluation criteria can be grouped into five categories, all of which interact with each other. For example, an easy-to-use tool will probably increase speed and reduce the risk of product damage. The five categories with defining factors and ideals are:

Product damage

The ideal in terms of product damage is to cause no damage. This consideration can be divided into two subcategories: component-related and PCB-related damage. Component-related damage includes thermal stress of the IC, thermal shock/fracture to the packaging, mechanical shock, lead deformation, unintentional reflow of adjacent leads (same component), and induced solder bridging. PCB-related damage includes lifted pads and traces, delamination, blistering, measling, and unintentional reflow of adjacent component leads. Product damage requirements define the baseline performance parameters for rework.

Speed

The ideal is to get the process done quickly. This is defined by rework task complexity and volume. Total task time, including preparation and start-up, actual operation, and clean-up must be considered. Speed defines throughput, which directly impacts economic costs.

Application range

In terms of application range, the ideal is that the process is flexible, so that the chosen method will work in all

instances. The application range is defined by the number of process steps within a rework task, the nature of these steps, and the number of component types being reworked. It determines how flexible, as opposed to how dedicated, a tool must be, which influences equipment costs. Because flexibility and complexity are often linked, it also influences ease of use.

User friendliness

The ideal is that the tools and the process should be easy to use. This includes ergonomics, comfort, complexity of set-up and operation, intuitiveness of operation, and operator safety. Because it defines the interaction between operator and equipment, it heavily influences speed, product damage potential, and quality of total rework. Complexity and intuitiveness directly affects operator training costs. Operator safety is also important because of the elevated temperatures (250C to 350C) of both conduction and hot air rework tools.

Economic cost

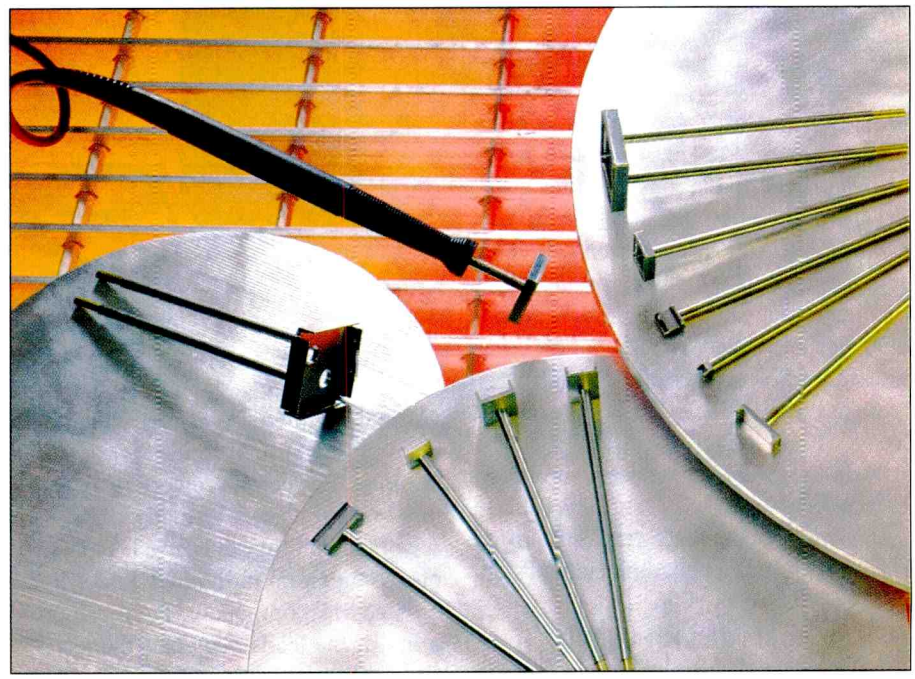
Especially for a consumer electronics service center, the ideal is that the soldering tools and materials be inexpensive. This includes costs related to equipment (acquisition, operating, consumable, calibration, maintenance, and repair), operator training, labor, and product damage. It is netted against revenue, which is influenced by throughput and product value. Of course, for repair to be economically viable the net cost of rework must be less than the cost of simply scrapping the product. The relevance of each defining factor within each category depends on the rework task objective.

SMT rework tasks

To restate: the type of rework task defines the stringency and priority of the evaluative factors discussed above. The six most common tasks are:

- Solder joint touch-up
- Correction of misaligned, but good components
- Removal of defective components
- Attachment of new components (after defective component removal)
- Removal of components for post-mortem analysis
- Design induced changes to the PCB

Requirements for equipment and process performance can be quite different depending on the task. For example, highly focused heat, no damage to the component and speed are important factors in selecting a method for solder joint touch-up. But because of the repetitive nature of the task, high flexibility probably is not. Cn the other hand for defective component removal, damage to the component is irrelevant but no PCB damage is key. Component flexibility is likely to be important as well.



SMT repair (rework) considerations

A given rework task involves a number of discrete process steps. The performance requirements for a given process step can vary widely, even for the same type of rework task. So in addition to evaluating rework technologies from a task standpoint, they must also be evaluated for how well they perform for a given process step. In some cases, different rework technologies may be warranted for different process steps within a single rework task.

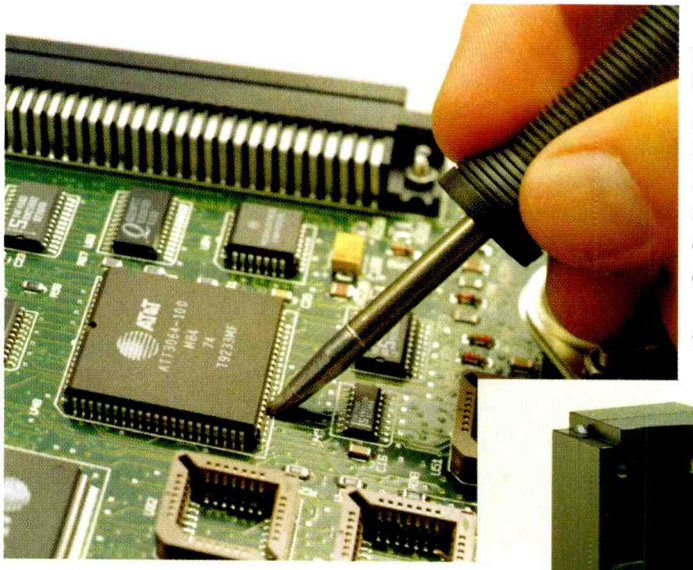
Take two cases where the rework task for both is to remove a defective fine pitch component. In the first case, the components are tightly packed on a densely populated board. Precise, focused heat delivery may be the key to avoiding product damage. This would favor a conduction tool. In the second case, components are spaced wide enough so that adjacent reflow is not an issue, but lead coplanarity is poor. This would favor the use of a convection tool.

The steps involved in SMT repair

Problem identification: This involves identifying the nature and location of the problem, whether it is in the component or on the PCB. It also involves identifying the desired end result (e.g., if the problem is solder bridging, the desired end result is the removal of that bridging.)

Component removal: This involves effecting multiple lead reflow and separation of the component leads from the pads. Key performance parameters driven by product damage constraints are dwell time, temperature, and pressure.

PCB preparation: This involves preparation of the PCB to accept reattachment of a component. It includes pad preparation (e.g. removal of old solder), cleaning



(e.g., flux removal), and surface leveling (e.g., coplanarity). The stringency of this step is driven by the manufacturer's solder quality requirements.

Component replacement: This involves application of new solder, alignment and placement of the new component, anchoring and soldering of the component, and cleaning of the PCB.

Inspection: This will not be discussed here.

For solder joint touch up and correction of misalignments, solder reflow/multiple lead reflow can be considered simplified cases of the component replacement step.

Conduction vs. hot air

In selecting between a conduction method of repair vs. a hot air method for SMT repair in the service center, it is useful to understand the strengths and limitations of each. To highlight these we will focus on the component removal and replacement steps.

Strengths and limitations are of two types: inherent and design based. The two are not independent; the inherent nature of the technique dictates the design parameters. Inherent strengths and limitations have their basis in physics whereas design based limits are dictated by tool construction. Inherent properties establish the realm of possible application for the specific rework technology.

The inherent differences between conduction and hot air rework methods are as follows:

Conduction rework tools: capable of both highly precise and distributed heat delivery. Heat transfer requires physical contact with the solder joint.

Hot air rework tools: heat transfer is via indirect media (gas/air) which does not require physical contact with the solder joint. For certain rework tasks, these inherent properties virtually dictate the rework technology to be used. For example, to touch-up individual solder joints on an SMT component, the close proximity of the leads mandates the use of a fine point conduction tool. However, to attach a multi-leaded component on a surface with coplanarity problems, a hot air tool would be favored.

But for most rework tasks, tool design is the deciding factor and has the greatest impact on rework performance with respect to product damage, speed, application range, user friendliness, and economic cost.

We'll look at two important areas in more detail: thermal stress on components and adjacent leads and removal speed (dwell time).

Thermal stress

The key parameters in determining thermal stress are dwell time and tool temperature. The higher the temperature, the higher the potential thermal damage, but also the shorter the dwell time needed for reflow. On the other hand, shorter dwell time restricts the amount of energy that can be transferred, which limits how high a temperature the component will actually reach. In addition, both affect the rate of increase in temperature (engineers at companies that manufacture soldering tools call this the temperature ramp rate) of the component, which is what can cause thermal shock damage. Both dwell time and temperature must be optimized to minimize thermal stress.

Removal of an SOIC-24

A 24 pin SOIC (plastic body, gull wing leads) was removed using both conduction and hot air tools. The conductive tool used was a solder system fitted with an tunnel tip designed for the SOIC-24. Tip temperature was measured at 390 degrees C. Leads were fluxed and the removal tip tinned prior to rework for maximum heat transfer efficiency. In the case of the hot air tool used, the manufacturer's recommended settings were used with a resultant air stream temperature measured at 340 degrees C. No shielding was used. The thermocouples fed data directly to a computer data acquisition system.

For experimental reasons, several components were removed with each tool. An average rework time was determined. To measure temperatures, each tool was applied to a common fixtured SOIC-24 for the previously measured dwell time. This way, the thermal load variations were avoided. Type K thermocouples were embedded in the body of the components and attached to one of the component leads. An additional thermocouple was attached to an adjacent 1210 chip lead 0.100" away from the SOIC-24's leads. Thermocouples were inserted through the PCB to shield the thermocouples as much as possible from extraneous convective and radiative effects

from both rework tools.

In the case of the conduction tool. Average time required for removal was 5.5 seconds. The tip was then applied to the fixtured component for this time. Measurements show that the component lead reached reflow almost instantaneously. The peak temperature reached by the component body was only 84 degrees C, well below the point where the components would have experienced damage. As could be expected for a conduction tool, adjacent lead temperatures remained well below 150 degrees C, peaking at 53 degrees C.

During removal with hot air, average removal time was 8.8 seconds. Hot air was then applied to the fixtured component. Unlike the conduction tool, the leads ramped up to reflow temperature. (Because an average removal time was used, the peak lead temperature for the convection tool was slightly lower than expected.) The peak temperature reached by the component body was 120 degrees C. While this temperature was higher than for the conduction tool due to the longer dwell time required, it was still below the level at which the component would have been damaged. This data is similar to that reported elsewhere.

The most significant difference from conduction was the temperature of the adjacent leads. In the absence of shielding, adjacent lead temperature peaked at the 150 degrees C maximum. This, however, would not reflow adjacent components or cause damage.

What these and additional runs show is that, when used properly for this component and components of comparable pin count, size, and type, neither conduction or hot air places significant thermal stress on the component itself. Component peak body temperatures reached during rework are comparable for both tools. Because of the method of heat transfer, conduction results in less adjacent lead heating than hot air. Conduction is also faster than hot air.

Removal of a PLCC-84

An 84 pin PLCC was also studied. There were three reasons for including this device in the study. First, the component is subject to longer dwell times during rework because of the higher pin count (total thermal load). Second, the four-sided lead placement requires either a socket conduction tip or four-sided air nozzle that exposes the component itself to more direct heating. Third, the J-lead configuration makes it more difficult for both conduction and hot air tools to effectively heat the leads than a more open gull wing configuration.

The conductive tool used was a solder system with a quad tip designed for the PLCC-84. Tip temperature was measured at 370 degrees. By not fluxing the leads, removal times were increased, also increasing the thermal stress on the component. The hot air tool used an appropriate nozzle. The manufacturer's recommended settings were used with an air stream temperature of 340 degrees. No shielding was used.

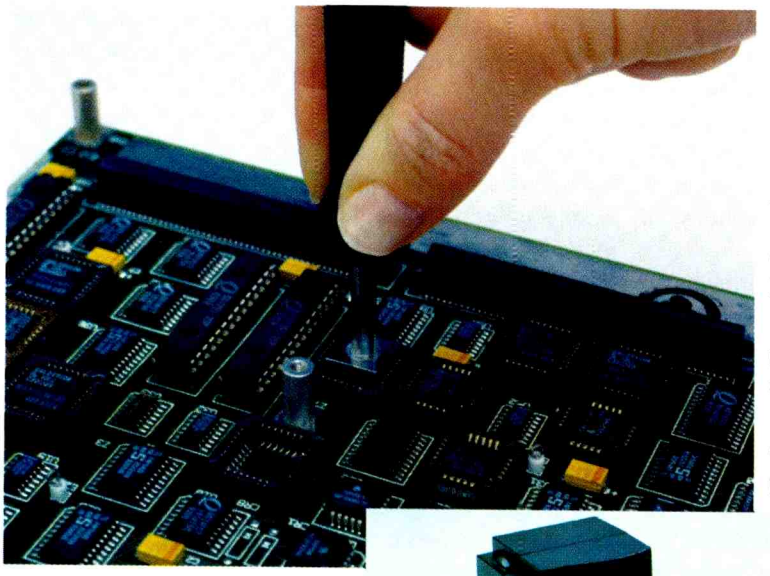
Again, for experimental reasons, several components were removed with each tool. An average rework time was determined. Then, to measure temperatures, each tool was applied to a common fixtured PLCC-84 for the previously measured dwell time. This way, the problem of thermal load variation was avoided. The same thermocouple arrangement used for the SOIC-24 case was used.

Average time required for removal was 18 seconds. The tip was then applied to the fixtured component for this time. Again, measurements show that the component lead reached reflow almost instantaneously. (The apparent temperature rise in component body temperature after removal of the tip is the conduction lag through the plastic to the thermocouple.). The peak temperature reached by the component body was 116 degrees, still below the temperature at which the device might have been damaged. As might be expected. this higher peak temperature is due to the

longer dwell. Adjacent leads peaked at 72 degrees, well below the 150 degrees Celsius maximum.

Average removal time using the hot air system was 60 seconds. Applying hot air to the fixtured component, we again see the leads ramping up to reflow temperature. (Because an average removal time was used, the peak lead temperature for the convection tool was slightly lower than expected.) Peak temperature in the component body of 167 degrees which is below the maximum body temperature for standard packages. Unshielded adjacent leads reached peak temperatures of up to 155 degrees.

Surprisingly, component peak body temperatures were about 50 degrees lower for the conduction tool than for the hot air.



Operator interface

As stated earlier, the interaction between tool and operator must be considered, not just the capability of the tool alone. While the previous cases show the potential performance of the tools, the actual performance depends on the operator.

Conduction tools are highly intuitive to use with high precision. Because contact is required to transfer heat, direction of the heat is "self-locating." Since some pressure is required to contact all leads simultaneously, it is possible for the operator to apply too much pressure, which can cause damage to pads or leads. Because the tool to component linkage is mechanical, there is a risk that the operator might attempt to remove the component before the solder of all leads has reflowed (melted), resulting in lifted pads. Visual identification of reflow can be difficult because the tool obscures the view of the joints.

However, this is easily corrected by a few minutes practice and training. Training consists primarily of teaching operators not to apply excess pressure during reflow and waiting until full reflow is achieved. It is possible to train operators from scratch in under five minutes to successfully remove components without damage to the PCB.

Hot air Tools are fairly intuitive to use but are incapable of high precision direction. Because there is no direct contact between tool and joint, heat direction is not "self-locating." But, non-contact means the risk of pad damage is minimal. The need to set air flow rates and temperature (and not just temperature) makes optimizing the tool in operation more difficult. High air flow rates can cause solder balls to be blown across the PCB. Reflow of adjacent components must be guarded against.

Training operators to use hot air effectively is more difficult than for conduction tools. Operators must be trained and must develop skill in balancing temperature and air flow rates, aiming the air stream, and shielding components. Safety training must also be given due to the emission of a hot gas/air stream during use (and often during idle).

Summary

In summary, the choice between conduction vs. hot air rework for SMT depends on the nature of the rework task and process step. From the above, some general selection rules can be stated.

- Conduction rework is generally favored when:
- Doing simple solder joint touch up
- Removing defective component to prepare the PCB for a new one
- Working on densely populated PCBs or other access restricted areas
- Reattaching lower pin count and larger pitch components
- Rework must be more widely distributed among operators or operator turnover is higher.
- Hot Air rework is generally favored when:
- Reattaching small chips where solder surface tension will self-align them
- Reattaching high pin count components
- Rework involves a few, highly skilled, centralized operators.
- Removing SOICs for post-mortem analysis or for re-use. ■

Automotive Electronics Systems: What's New Global Positioning Systems

By John A. Ross

There was a time, and not so long ago, in the history of the automobile when "automotive electronics" meant a radio. Just as with the definition of "consumer electronics," the definition of "automotive electronics has changed to encompass much more than it originally meant. Today automotive electronics includes electronic ignition, sensors and mechanisms for deploying air bags, sensors and actuators for operating antilock brakes, sophisticated auto audio systems and even TV for the RV.

One of the most intriguing electronics systems in cars today is the global positioning system (GPS). With one of these systems, the traveler need never get lost again, and with any luck, they may even be able to avoid traffic jams.

GPS

As an intelligent link between travelers, vehicles, and infrastructure, Intelligent Transportation Systems, or ITS, combine information processing, communications, control and electronics. Given this combination, manufacturers have used ITS to:

- assist drivers in reaching a desired destination
- collect and transmit information about traffic conditions and transit schedules.
- decrease congestion by rerouting traffic flow during an accident or road construction
- improve the productivity of commercial, transit, and public safety fleets by using automated tracking and dispatch systems.

Implementing intelligent transportation systems

Current Intelligent Transportation Systems offer a wide range of services for motorists. As an example, the General Motors OnStar system uses a hands-free, voice-activated cellular phone and Global Positioning System satellite technology to link the driver to the OnStar Center. In the event of an accident or other problem, operators can instantly locate the car, check on the occupantsí condition, notify the nearest emergency service, or dispatch an ambulance or towing truck to the scene of the accident. OnStar estimates that over four million vehicles nationwide will contain its vehicle communications services within the next three years.

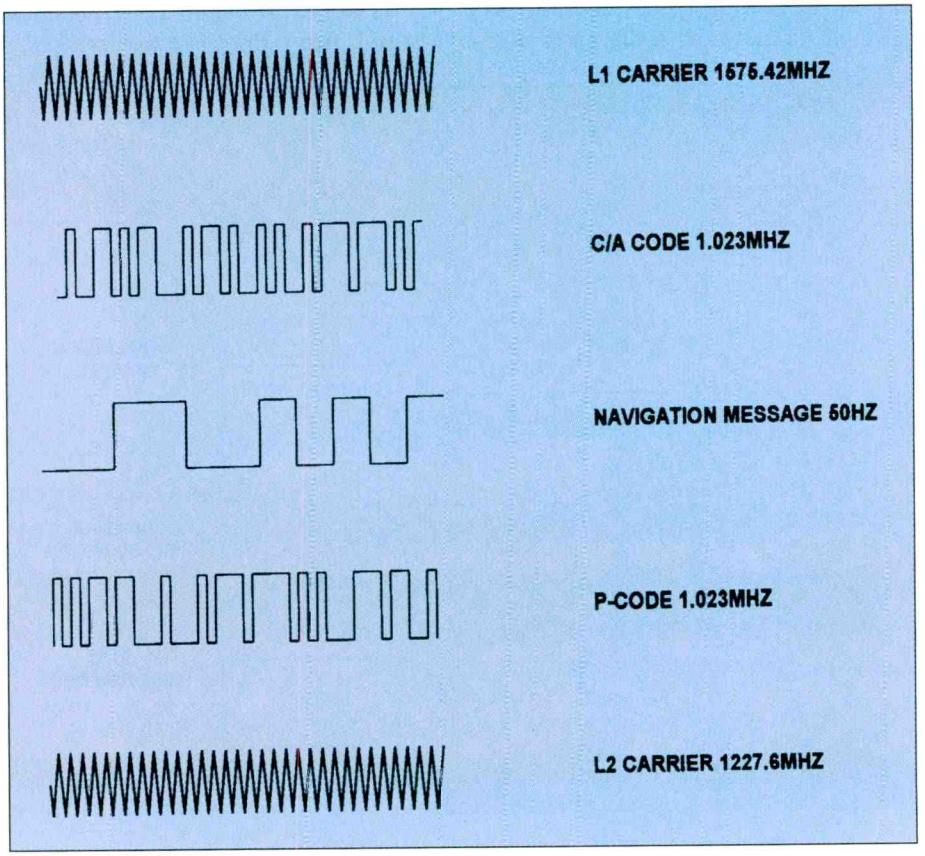


Figure 1. The satellites transmit two microwave carrier signals called L1 and L2. While the 1575.42 MHz L1 signal carries the navigation message and the SPS code signals, the 1227.60 MHz L2 frequency measures ionospheric delay.

For just under $400, you can purchase an in-car navigation system that combines a portable computer with GPS technology and operates in any car and at any location. In addition to GPS, most navigation systems also use "dead reckoning" to pinpoint your location. A built in sensor measures the carís movement and records driven distance. An electronic signal from the speedometer, a gyroscope that measures turns, and software in the car translate the location information into maps and routes. Two-way voice activated technology allows hands-free operation and provides spoken directions on request for each turn.

Maps display in real-time so youíll always know exactly where you are and where you're headed. The map databases arrive on a compact disc and provide up-to-date travel information. Every road segment may have a maximum of 150 attached information sets that include street names, address ranges and turn restrictions. In addition, map databases contain hundreds of thousands of Points of Interest information in more than 40

categories that include restaurants, gas stations, police stations and hospitals.

Global positioning systems

Developed and maintained by the Department of Defense, the Global Positioning System consists of more than 24 active satellites that track in predictable orbits around the earth every twelve hours. Because the satellites orbit at an altitude of approximately 10,900 miles, each satellite repeats a designated track and configuration over any point on the Earth each day. Six orbital planes with at least four satellites maintain 60 degree spacing and an inclination of 55 degrees with respect to the equatorial plane. A pseudo-random-noise code, or PRN number, provides a unique 32-position identifier for each satellite.

As a result of the track and configuration, five to eight satellites remain visible from any point on the Earth. The Global Positioning System provides specially-coded satellite signals for processing by a GPS receiver and operates through triangulation. Processing the GPS signals allows the receiver to compute position, velocity and time. The receiver uses signals from four GPS satellites to find positions according to Earth-centered, Earth-fixed X, Y, and Z position coordinates, velocity, and the time offset in the receiver clock.

Defining the GPS signals

As shown in Figure 1, the satellites transmit two microwave carrier signals called L1 and L2. While the 1575.42 MHz L1 signal carries the navigation message and the SPS code signals, the 1227.60 MHz L2 frequency measures ionospheric delay. During operation, the Coarse Acquisition, or C/A code consisting of a repeating 1MHz PRN code modulates the L1 carrier phase and spreads the spectrum over a 1MHz bandwidth. Repeated every 1023 bits, a different C/A code exists for each satellite. The Precise, or P-Code, modulates both the L1 and L2 carrier phases and occurs as a seven-day-long 10 MHz PRN code.

Consisting of data bits that describe the satellite orbits, clock corrections, and system parameters, the 50Hz GPS Navigation Message also modulates the L1-C/A code signal. Twenty-five frames that include 125 sub-frames send from the satellite over a 12.5-minute period make up the Navigation Message. Time-tagged data bits mark the time of transmission of each subframe at the time of transmission by the satellite.

Transmitted every 30 seconds, each data bit frame contains 1500 bits divided into five 300-bit subframes that contain orbital and clock data. While subframe one contains satellite clock corrections, subframes two and three contain precise satellite orbital data sets. Subframes four and five transmit different pages of system data. 1500 bit data frames occur every thirty seconds and contain five subframes. The 300 bit data bit subframes contain parity bits that allow for data checking and limited error correction. Clock data parameters describe the relationship of the satellite clock to GPS time.

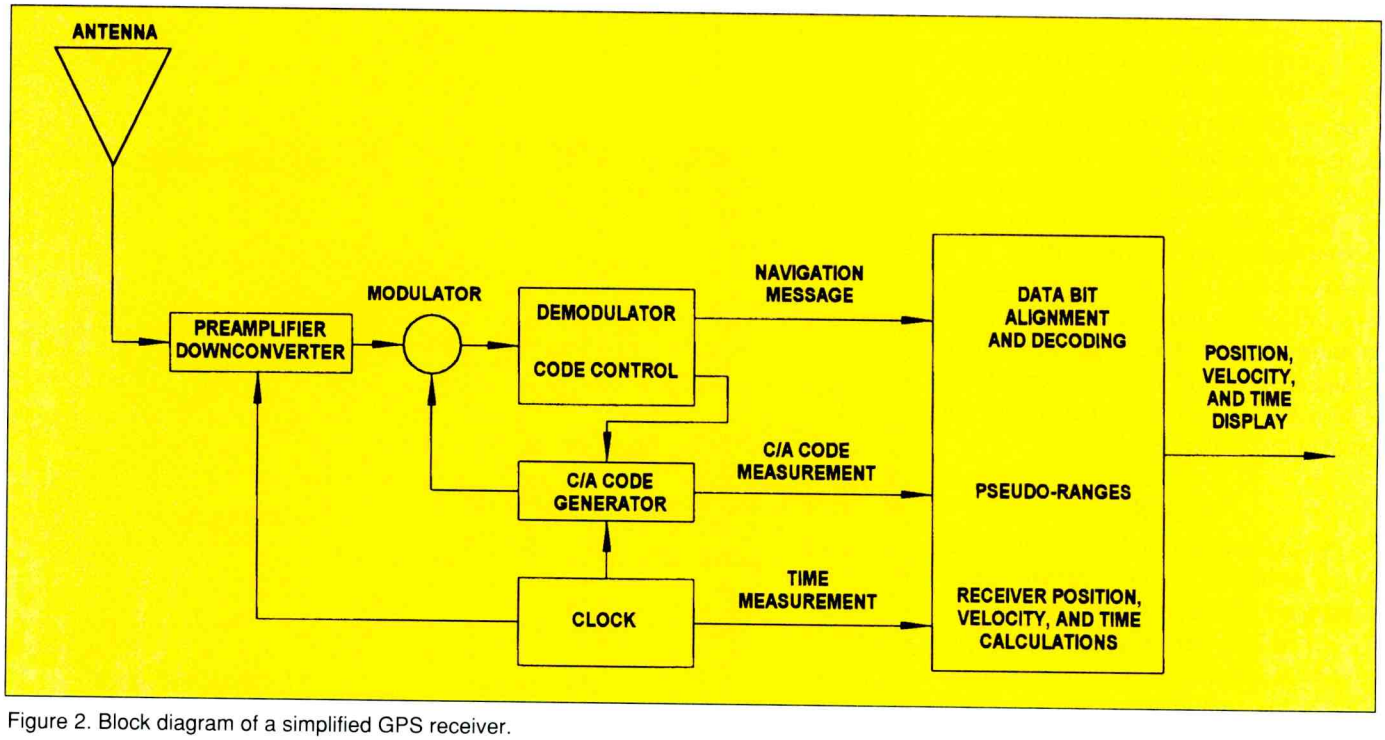


Figure 2. Block diagram of a simplified GPS receiver.

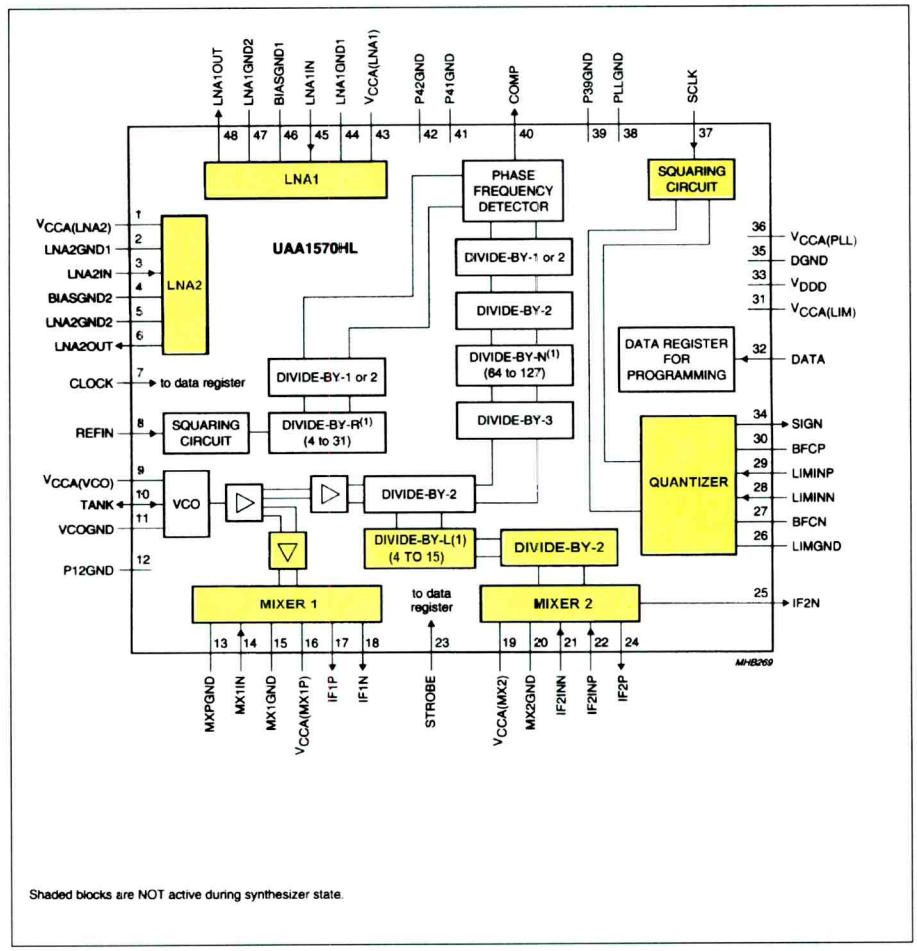
Ephemeris data

Ephemeris data parameters describe short sections of the satellite orbit. During typical operation, a GPS receiver gathers new ephemeris data each hour and may retain old data for a maximum of four hours. Combined with an algorithm, the ephemeris parameters describe the satel-

lite position for any time within the period of the orbit described by the ephemeris parameter set. Latitude and longitude measurements match the shape, area, and curvature of the GPS receiver location and provide precise mapping according to specific points. Velocity represents a change in the position of the GPS receiver over time, the satellite Doppler frequencies, or a combination of the time and the Doppler frequencies.

Satellite time

The Time signal involves calculations of satellite time, GPS time, and Universal Coordinated Time, or UTC. Each satellite contains four atomic clocks monitored by ground control stations and reset to maintain time to within one-millisecond of GPS time. Clock correction data bits reflect the offset of each satellite from GPS time. At the receiver, GPS signals set the satellite time as data bit subframes occur every six seconds and contain bits that resolve the Time of Week to within six seconds. Representing a combination of the Master Control Clock and the satellite clock times, GPS Time measures in weeks and seconds from 24:00:00, January 5, 1980. Universal Coordinated Time calculates from GPS Time using UTC correction parameters sent as part of the navigation data bit stream.



Shaded blocks are NOT active during synthesizer state.

Figure 3. The Philips Semiconductor UAA1570HL provides complete single-chip double-superheterodyne receiver front-end that operates with signals from GPS and GLONASS navigation systems. The IC integrates a programmable DPLL synthesizer, VCO with external varactor and resonator, a 1-bit amplitude quantizer and a time sampled TTL/CMOS compatible SIGN output bit driver.

GPS Control Segment

Along with a Master Control Facility located in Colorado, tracking stations located around the world make up the GPS Control Segment and monitor signals from the satellites. Using the signals, the tracking stations establish orbital models for each satellite that provide precise orbital data called the ephemeris and clock corrections for each satellite. While the Master Control Facility uploads ephemeris and clock data to the satellites, radio signals transmitted from the satellites to GPS receivers contain the orbital data and clock information.

GPS User Segment

Consumers and the GPS receivers make up the GPS User Segment. When requested by the consumer, a GPS receiver converts the satellite signals into Earth-centered, Earth-fixed X, Y, Z position coordinates, velocity, and time estimates. The receiver may work as a handheld unit or within an automobile, ship, or aircraft. GPS receivers intended for civilian-use rely on an SPS signal that has an accuracy intentionally degraded by the Department of Defense.

Figure 2 represents the block diagram of a simplified GPS receiver. Within the diagram, a PLL locks to either a positive or negative half-cycle and demodulates the 50HZ navigation message from the GPS carrier signal. In addition, the PLL provides a method for measuring and tracking the carrier frequency. Tracking changes to the numerically controlled oscillator also allows the tracking and measuring of the carrier frequency phase.

At the receiver, the PRN Code Start Position occurs when the receiver and satellite align. The PRN Code Start Position represents the time that the satellite PRN arrives at the receiver. In addition, the code measures the range to satellite offset by the amount that the receiver clock offsets from GPS time and represents the pseudo-range. The receiver locates the position of the satellite in Earth-centered, Earth-fixed XYZ coordinates through the use of four satellite pseudo-ranges, the clock correction data, and ephemeris data.

In addition, a GPS receiver produces replicas of the C/A code and the P-Code found at the satellite. Using the satellite PRN, the receiver produces the C/A code sequence for a specific satellite through the use of a C/A code generator. As the

receiver attempts to align with the satellite, the C/A code generator repeats the same 1023-chip PRN-code sequence every millisecond. If the receiver applies a different PRN code to a satellite signal, alignment does not occur.

When the receiver uses the same code as the satellite and alignment occurs, the receiver displays detected signal power levels. As the satellite and receiver codes align completely, the spread-spectrum carrier signal compresses and the receiver detects full signal power. The receiver uses the detected signal power to align the C/A code in the receiver with the code in the satellite signal. In most instances, the receiver compares a late version of the code with an early version to ensure the tracking of the correlation peak.

Receiver position derives from the satellite positions, measured pseudo-ranges and the last computed receiver position. XYZ position coordinates convert to latitude, longitude and height above the receiver location. Circuitry within the receiver provides methods for calculating the effects of upper atmospheric conditions and solar disturbances on signal reception and measurement accuracy.

UNIT	AMOUNT OF ACCURACY
Vertical	160 Meters
Horizontal	100 Meters
Time	340 nanoseconds

Table 1. Civilian GPS predictable accuracy

Civilian GPS Accuracy

Table 1 lists the horizontal, vertical, and time accuracies as specified by the 1999 Federal Radionavigation Plan. Each accuracy rating expresses a value of two standard deviations of radial error from the actual antenna position to a group of position estimates given through satellite elevation angles.

In addition to the accuracies listed in Table 1, receiver manufacturers may use other accuracy measures such as Root-Mean-Square and Circular Error Probable. While Root-Mean-Square, or RMS error represents the value of one standard deviation of the error in one, two or three dimensions, Circular Error Probable, or CEP, represents the value of the radius of a circle centered at the actual position that contains 50% of the position estimates. Spherical Error Probable, or SEP, represents the spherical equivalent of CEP, or the radius of a sphere centered at the actual position that contains 50% of the three dimension position estimates.

The Philips Semiconductor UAA1570HL front-end receiver circuit

The Philips Semiconductor UAA1570HL provides complete single-chip double-superheterodyne receiver front-end that operates with signals from GPS and GLONASS navigation systems. As Figure 3 shows, the IC integrates a programmable DPLL synthesizer, VCO with external varactor and resonator, a 1-bit amplitude quantizer and a time sampled TTL/CMOS compatible SIGN output bit driver. Programmable prescaler controls establish flexibility through the use of different frequency schemes.

The design of the UAA1570HL incorporates two identical low-noise amplifiers but also allows the disabling of the internal LNAs and connection to an external LNA. An unbalanced common emitter and a cascode stage operate at the input stage of each amplifier. The AC-coupled output stage consists of a compound feedback bootstrap amplifier. Each LNA can supply a power-matched gain of approximately 15.5 dB with an associated noise figure of 3.7 decibels.

The first mixer includes an RF preamplifier consisting of an unbalanced common emitter and cascode stage followed by a Gilbert cell mixer. The cascode output AC-couples to one side of the Gilbert cell mixer. The other side of the cell mixer AC-couples to mixer ground through a 20pF decoupling capacitor. Low-loss inductive emitter feedback decreases the input signal to the Gilbert mixer RF input. With this, the signal levels at the compression and intercept points increase.

A single transistor configured as a Colpitts circuit operates as a negative impedance VCO with an external inductive resonator. The gain of the VCO depends on the use of series or parallel resonators; tuning occurs through an external varactor diode. A differential buffer stage with emitter follower inputs splitting the signal to the divider and LO driver stage path follows the VCO and increases isolation between mixer and synthesizer signals.

The first IF filter provides selectivity to protect the 2nd mixer from high level spurious RF signals which pass through the wide band-pass envelope of the RF filters. In addition, the filter attenuates thermal noise and spurious signals in the 2nd mixer image band. Moreover, the filter provides impedance matching/transformation from the RF mixer output to the IF mixer input and rejects spurious common mode and differential signals generated by high level local sources such as harmonics of the reference clock or sample clock.

The second IF filter provides selectivity to protect the limiter input from spurious signals which pass through the 5MHz wide first IF bandpass filter envelope and attenuates undesired second mixer output signals. In addition, the filter defines and shapes the noise bandwidth prepared for amplitude quantization and provides impedance matching from the IF mixer output to the limiter input while maintaining stability. Finally, the second IF filter rejects spurious common mode and differential signals generated as harmonics of the reference clock or sample clock and digital processing noise from associated devices.

After frequency conversion and filtering to approximately a 2MHz bandwidth in the second IF filter, the UAA1570HL converts the frequency-translated thermal noise from the GPS pass-band around the L1 carrier to a digital signal for processing. To accomplish the conversion, the IC determines the sign of the thermal noise through amplitude quantization in a 1-bit hard limiter. From there, the asynchronous information becomes time quantized by latching in a master/slave D-flip-flop to complete the analog-to-digital conversion process. The ECL digital SIGN bit data then translates to TTL levels before moving to the processor.

The Philips Semiconductor SAA1575HL GPS baseband processor

Another IC, the SAA1575HL GPS Baseband Processor integrates a 16-bit Philips 80C51 Extended Architecture microcontroller, eight GPS channel correlators, a real-time GPS clock, a power-down/reset controller, timer/counters, and UARTs into one device. The SAA1575HL contains two-kbyte words of internal data memory but must access an additional 32-kbyte words of external data memory for correct firmware operation. Along with the internal memory, the SAA1575HL contains two standard 16-bit timer/counters and a third 16-bit up/down timer/counter. The timers can measure time intervals and pulse duration, count external interrupts, generate interrupt requests, and generate Pulse Width Modulation or timed output waveforms. The watchdog timer protects the system from incorrect code execution by causing a processor reset if the firmware does not feed the timer before it reaches its terminal count.

The SAA1575HL synchronously samples the one or two-bit sampled IF data stream from the front-end IC with the front-end reference clock, or SCLK, signal. With the operation of the digital sampling circuit, the device prevents digital noise from causing incorrect timekeeping and operates correctly for the entire range of specified system frequencies. In addition, the SAA1575HL uses a digital under-sampling system to ensure that ground bounce does not affect real-time clock accuracy. Then, the processor follows instructions from firmware on an external ROM to calculate the full GPS position and time information.

The GPS firmware processes the GPS signals from up to 8 satellites, generates GPS information, and controls the hardware configuration of the integrated circuit. From there, the device communicates with a host through a standard serial port. A 16-bit data bus and a 19-bit address bus extend to external pins and allow the accessing of external data and program memory.

The optional Real-Time Clock, or RTC, requires a separate 32.768kHz crystal and enables fast re-acquisition of satellites after the switching off of power. Dividing the crystal frequency down with a fixed divider provides the 1Hz timebase for the RTC block. A separate power supply for the RTC maintains the low power RTC function. Omitting the crystal disables the RTC.

Each of the eight GPS channel correlators includes a Numerically Controlled

Oscillator, PRN code generator, phase rotator and low-pass filter. The identical correlators share the two-bit IF input and the sample clock signals given by the front-end processor. The input signal consists of the 50 bits-per-second GPS data spread by the 1.023 Mbits/s PN code and modulated by the residual carrier. The residual carrier frequency consists of the Doppler frequency and the receiver local oscillator frequency offset.

In part, the parallel correlators decode data from the IF input stream. Then, the correlators align the local PRN sequence with the digitized input GPS spread spectrum signal and generate the filtered correlation result for the microcontroller. The firmware generates a navigation message and provides standard GPS data outputs to the user. To recover the GPS data and find the accurate timing of the received data for GPS navigation from the low-level GPS signal, the IC uses a PLL to find the residual carrier frequency and phase with minimum tracking phase error. A Delay-Locked Loop determines the PRN Code Start Position within the received signal.

And yet more

But with all that already exists, the revolution in automotive electronics technology continues. No doubt most readers have already seen commercials for the night vision enhancement system that projects a display of the road ahead as seen by infrared sensors well beyond the range of the car's headlights. And in the works is the Intelligent Transportation Systems Data Bus (IDB) that will formalize a working relationship between the Consumer Electronics Association (CEA) and the Society of Automotive Engineers (SAE) to standardize the way consumer electronics products connect and communicate in Automobiles.

Given the ingenuity of consumer electronics and automotive engineers, and the rapid developments in electronics today, we can expect the definition of "automotive electronics" to just keep expanding to encompass more and more products and concepts. ■

Servicing Audio Equipment

By Steve Lindemann

Lindemann is owner of Fred's Sound Of Music, Inc., 3760 SE Hawthorne Blvd., Portland, OR 97214 (503)234-5341, www.fredsoundofmusic.com.

There was a time when only audiophiles were very concerned about sound systems. They'd spend a great deal of time and money buying just the right preamp, amp, tuner and speakers. In general, the most time and effort went into finding the best combination of turntable, tone arm and cartridge to bring out all the beauty of the music recorded as groves on a vinyl LP. And those systems generally could put out a lot of acoustic power. Most other people were content to buy a decent system that could put out music of reasonable fidelity with decent power output.

Things have changed. For one thing, good, high fidelity, powerful, sound is everywhere, especially on the sound tracks of movies. Television stations are broadcasting better sound than the thin monophonic stuff they used to send out over the airwaves. Moreover, more people want the movie theater/concert hall sound experience in their homes, so they are buying higher quality audio systems.

All of this is making it more likely that a consumer electronics service technician will encounter an audio system of high fidelity, and significant acoustic power, when they answer an on-site television service call. This article presents some information about these systems that technicians should be aware of before beginning to service one of these systems.

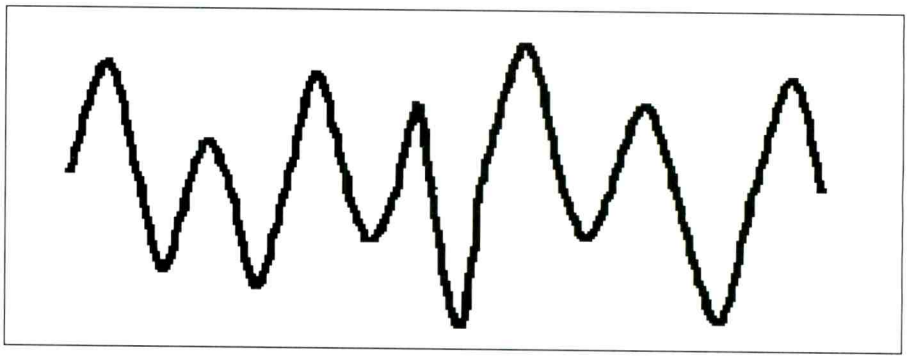


Figure 1. This sinusoidal signal represents what an audio signal might look like as it enters the speaker.

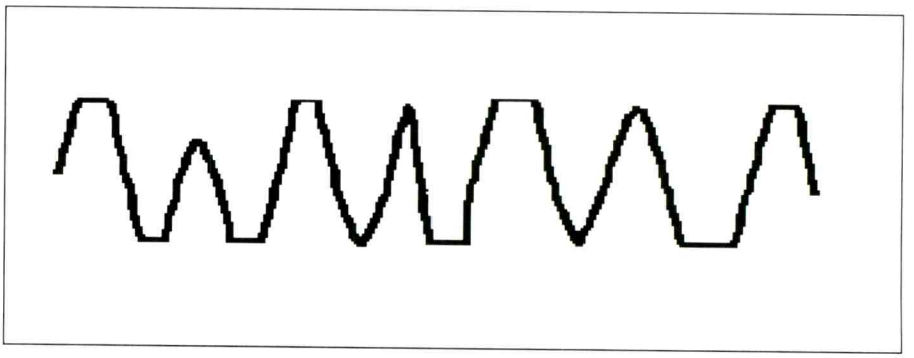


Figure 2. If we take the same music as that represented in Figure 1 and try to reproduce it at a level greater than the amplifier is capable of (clipping), we get something like this waveform, which looks more like a group of square waves than a sinusoid. Square waves contain large amounts of high frequency information, which can destroy tweeters.

Speakers

Despite the best of engineering, the selection of the best drivers and the most careful production and quality control techniques, loudspeakers can still fail. The purpose of this segment is to identify some of the causes of such problems so that the technician can recommend ways in which they can be avoided in the future so that the client's loudspeaker system can continue to deliver the quality sonic performance that was intended.

Less than 1% of high-end speakers in the field ever fail or cause trouble for their owners. There are two reasons for this excellent record. Quality loudspeakers have always used relatively "high-order" crossovers. This improves the crossover's control over the drivers' performance within each operating range, turning each driver off quickly outside of its band. This control keeps a tweeter from attempting to reproduce midrange frequencies, and a midrange from trying to handle lower frequencies (tasks which neither driver is designed to perform).

Gentle or "low order" crossovers, a current audio fad, place extreme demands on the power handling capabilities of drivers, and sharply increase distortion, a sign of protest from the drivers. Consequently, these two deficiencies sharply increase the prospect of the driver eventually degrading or failing. Most high quality speakers protect against these problems even further through the very careful choice of crossover frequencies, and the use of only the highest quality drivers.

Speaker misuse #1: too much power

The first reason for speaker failure is the most obvious: playing any speaker at excessive levels can damage it. If any distortion is audible, the volume is too loud and likely to cause damage. But in some

cases distortion may not be noticeable before damage occurs. For example, home loudspeakers can easily reproduce the real dynamic range of live acoustic music; but no high quality speakers can reproduce the brutal levels of a rock concert. Low fidelity PA (public address) speakers should be used if that's the type of music the client listens to.

Caution: prolonged exposure to high sound pressure levels can permanently damage a listener's hearing. Moreover, hearing "adapts" to high volumes, allowing the listener to incorrectly feel that potentially damaging volumes are "normal." Recommend that your clients protect their hearing as well as their investment in high quality loudspeakers by avoiding excessive playback levels.

The average audiophile mistakenly believes that the position of the volume control provides some indication of the percentage of output power the amplifier is delivering at the time. This is not true; in fact, most systems are clipping with the volume control set around the one o'clock position. Preamp/receiver designers probably set these levels so that less sophisticated buyers will be impressed by their product's power ("Look everybody, I've only got the control set half-way and it plays this loud.")

Moreover, and not surprising, many audiophiles believe that the "power meters" on their amplifiers or receivers can be used to avoid clipping. Unfortunately this is not so. The meters used on amps are only decorative and cannot show actual power levels since they can only be calibrated to one impedance. Actual speaker impedance varies with frequency: it might be 20ohm at 40Hz and 4ohm at 150Hz, and yet the speakers are rated at 8ohm. A very small number of power amplifiers have clipping indicators that actually do what they say. If an amplifier has this capacity, it will be made clear in the instruction manual. To guard against clipping, ask the supplier for guidance, or advise the client to keep the volume control below "twelve o'clock" on the dial.

The effects of too much power

The effect of too much power is one of these problems: burned voice coils, deformed voice coil formers, loose voice coil windings, or lead-in wire fatigue. The first three effects are the result of excessive heat. More than 95% of the amplifier's power is converted to heat in the voice coils. A burned voice coil results when the wire has actually melted. Most voice coils are wound on aluminum bobbins to improve heat dissipation and cooling.

Unfortunately, when aluminum is heated to the point of deforming, it does not return to exactly its original shape. The result can be a "rubbing driver" a situation in which the former touches the pole piece during its operation. (The pole piece is a cylindrical piece of metal, which, together with the magnet of the speaker, forms the magnetic gap in which the voice coil moves). While most high-end drivers use high temperature adhesives, excessive heat can still melt the adhesive enough to free turns of the coil. This results in a rattling sound as these loose turns hit the pole piece.

We are all familiar with the concept of metal fatigue. This occurs when a piece of metal is bent back and forth so far and so many times that it eventually breaks. This can also occur in drivers that are overpowered. Since woofers and midranges use "tinsel leads" or special heavy-duty wires attached to the voice coil, they don't fail this way. But tweeters use a very thin voice coil wire to attach the voice coil to the terminals. Excessive power can break those leads. This is one of the causes of "after-the-party syndrome:" the speaker was working at high volume levels at night, and then quit the next day at low levels. The actual damage was done at the high levels, but then the wire finally broke at levels that would not normally cause any damage.

Speaker misuse #2: too little power

The second cause of speaker failure may be surprising: too little power can destroy drivers, especially tweeters. To see why, we can look at a musical waveform in Figure 1.

Notice that it looks like a combination of various sine waves. If we take the same music and reproduce it at a level greater than the amplifier is capable of (clipping), we get something like the waveform in Figure 2. Now the signal is looking more like a group of square waves rather than sine waves. Square waves contain large amounts of high frequency information, and can destroy tweeters. In this situation, clipping in the midrange creates large amounts of high frequency energy, which damages the tweeter. This is one of the reasons we look for high maximum amplifier power ratings: they will assure that musical peaks are not clipped and so turned into potentially damaging square waves.

Speaker misuse #3: defective sources

Some tweeter failures are also caused by defective associated components. CD players, tuners, tape decks, preamps,

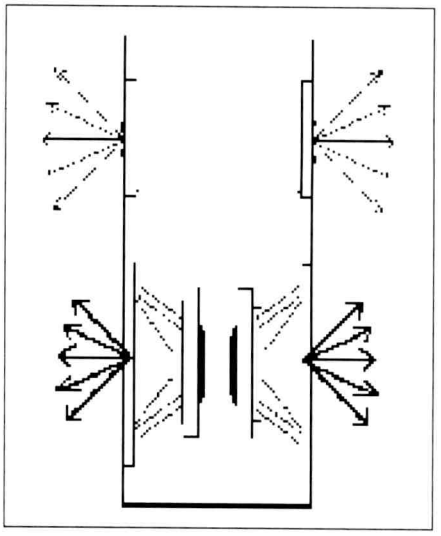


Figure 3. The front and back drivers in a bipolar speaker move at the same time with the music. These speakers are used as the main speakers in stereo and the front right/left speakers in a home theater system. The front output sound provides direct information that is crucial to detail, focus and localization.

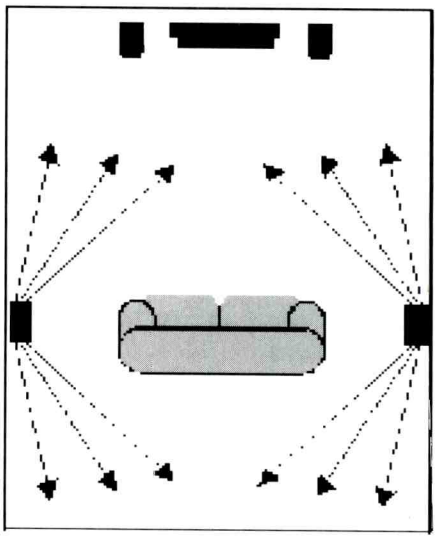


Figure 4. Dipolar speakers have come into existence primarily within the home theater realm, where they are generally located directly on the sides of the listener. Since the front and back of this speaker are out of phase with each other, the surround speaker has a null or cancellation zone within the movie viewing area. Thus, the focus of sound transcends forward to the movie screen with the surround speakers enveloping the listening area.

receivers, or power amplifiers can "oscillate," or produce inaudible high frequency signals that can destroy tweeters These same components can also produce direct current (dc), which is especially damaging to woofers. Not even the most expensive and exotic components are immune to these potential defects. If a speaker has become damaged for no apparent reason, it may be that a piece of associated equipment is at fault.

Home theater surrounds — bipolar and dipolar

Emerging recently to the forefront of speaker technology have been two diverse designs of speaker systems called bipolar (Figure 3) and dipolar (Figure 4). These speakers look similar from the outside with two complete sets of drivers, one set on the front and the other set on the rear. But each speaker system functions differently.

The bipolar speakers front and back drivers move at the same time with the music and are used as the main speakers in stereo and the front right/left speakers in a home theater system. The front output sound provides direct information that is crucial to detail, focus and localization. The radiated output from the rear of the speaker provides reflected information that creates added spatial realism. A well-designed bipolar speaker will give a 3-D sound without losing the main focus of exact placement of the sound of instruments, singing, dialogue and movie sound track pinpointing.

The dipolar speakers on the other hand have come into existence primarily within the home theater realm. Surround speakers have slowly moved from the back or rear of the seating area to directly on the sides of the listener. At the same time, the sound of the surround speakers has been diffused and non-focused using dipolar speakers. Unlike the bipolar speaker, the dipole surround speaker fires information both to the front and back at opposing times of each other, reflecting off the walls and into the room. Since the front and back of this speaker are out of phase of each other, the surround speaker has a null or cancellation zone within the movie viewing area. Thus, the focus of sound transcends forward to the movie screen with the surround speakers enveloping the listening area.

Tweak the system

Here are a few easy and inexpensive ways to improve the performance of your client's stereo and home theater system.

1. Update speaker wire and inter-connect cables. Remember, thicker is not always better. Quality not quantity. Also, bi-wire speakers whenever possible. (Editor's note: Recently some manufacturers have begun constructing speakers with a second pair of connections terminals, which allows the speaker to be split into two independent sections. Generally, the split is such that one set of terminals connects to the mid and high frequency speakers, and the other set connects to the low-frequency speaker [woofer]. As the speakers come from the factory, there is a connecting link between the terminals so they can be wired normally [Figure 5], or the link can be removed so the speaker can be bi-wired [Figure 6]).

2. Spike the speakers (that is, put them on stands that penetrate the carpet and couple the speaker to the floor acoustically), it will tighten the bass and improve imaging. Use of speaker stands for small speakers to position them closer to ear level will greatly improve clarity.

3. Test the stereo or home theater system for proper phasing. A test disc is most helpful.

4. Cushion those components that react to vibration such as CD players and turntables.

5. To many of us our favorite component is the ever lasting turntable and with a little attention your client's turntable can remain the favorite component in the system. So check the tonearm for proper weight. Check the needle for wear. Keep the needle and records clean.

6. Advise your client to clean his compact discs. The optical system in the CD

player will not make up for dirt and scratches so take care of those CD's. Soft cloth and mild non-abrasive liquid cleaner should do the job.

CD disc review

Every owner of a stereo or home theater must have in their arsenal an audio test CD such as the one from Stereophile (110 Fifth Avenue, New York NY 10011, 718-745-5025, Fax: 718-745-5076, www.stereophile.com). This CD features a battery of short exams to fine-tune any stereo or home theater system and includes thirteen musical selections with subtle detail that will caress the listener's ears.

The examination and testing portion of the CD has these tests:

- home theater and stereo channel identification tests for right, left, center, subwoofer and surround channels,
- stereo channel phasing both in-phase and out-of-phase,
- sounds for testing loudspeakers and rooms with warble tones and burn-in noise,
- signals for testing electronics components, amplifiers and CD players including test tones in squarewave, multitone and sinewave.

The music portion of the CD has the best recordings found and some of the cuts provide information on such things as sound stage mapping and microphone techniques. Playing a musical number is not enough on this CD, the handy booklet that comes with each CD will step you through each nuance of music and testing.

Sound pressure level meter

A sound pressure level meter is an inexpensive and invaluable tool for measuring sound levels in a listening room. It is an indispensable aid when optimizing loudspeaker and listening positions and it allows audiophiles to quickly measure sound levels to ensure they are within safe levels. It is truly an essential audiophile accessory. Check your distributor for availability, or they are available at Radio Shack.

The sound pressure level meter is a small hand-held device for measuring the pressure level of a sound wave in an acoustic environment such as a listening room. As an example, the meter sold by Radio Shack can be used to measure sound pressures in the range 50dB to126dB. This is accomplished through the use of an analog display which ranges from -10dB to +6dB and a rotary dial that allows you to select one of seven ranges centered at 60dB, 70dB, 80dB, 90dB, 100dB, 110dB and 120dB. The dial also has a setting called 'BATT' that can be used for testing the meter's internal 9V battery.

Aside from a dial for range selection and an analog display, the meter consists of a front-mounted microphone and two switches for changing the meter's frequency response or "weighting," and the speed of its response to sound pressure changes.

The weighting switch allows for switching between the standard 'A' and 'C' weightings. Choosing the 'C' weighting will make the meter respond more-or-less uniformly over the frequency range from 32Hz to 10,000Hz, and the 'A' weighting will make the meter more sensitive to frequencies in the range 500Hz to 10,000Hz.

The response switch allows for changing the speed of the meter's response from 'SLOW' to 'FAST'. Finally, the meter is equipped with a phono-type output jack for connection to other measuring equipment, and a standard threaded socket for tripod mounting. Mounting the meter atop a tripod is recommended in order to avoid reflections off of your body, which can alter measurements, by more than 2dB.

Setting up speakers using the sound pressure meter

When setting up loudspeakers in a listening room, the ultimate goal is to choose loudspeaker and listener positions such that sound pressure levels are fairly constant over the audible frequency range. To effectively use the sound pressure level meter for this purpose, a test CD containing a pink noise track and tracks containing test tones over a wide frequency range is required. Such CD's are available from several sources, but I typically use either Stereophile's Test CD 2 or Test CD 3, and each containing tracks which fit the bill nicely.

The first step in using the meter for loudspeaker placement is to pick a starting location for the loudspeakers and lis-

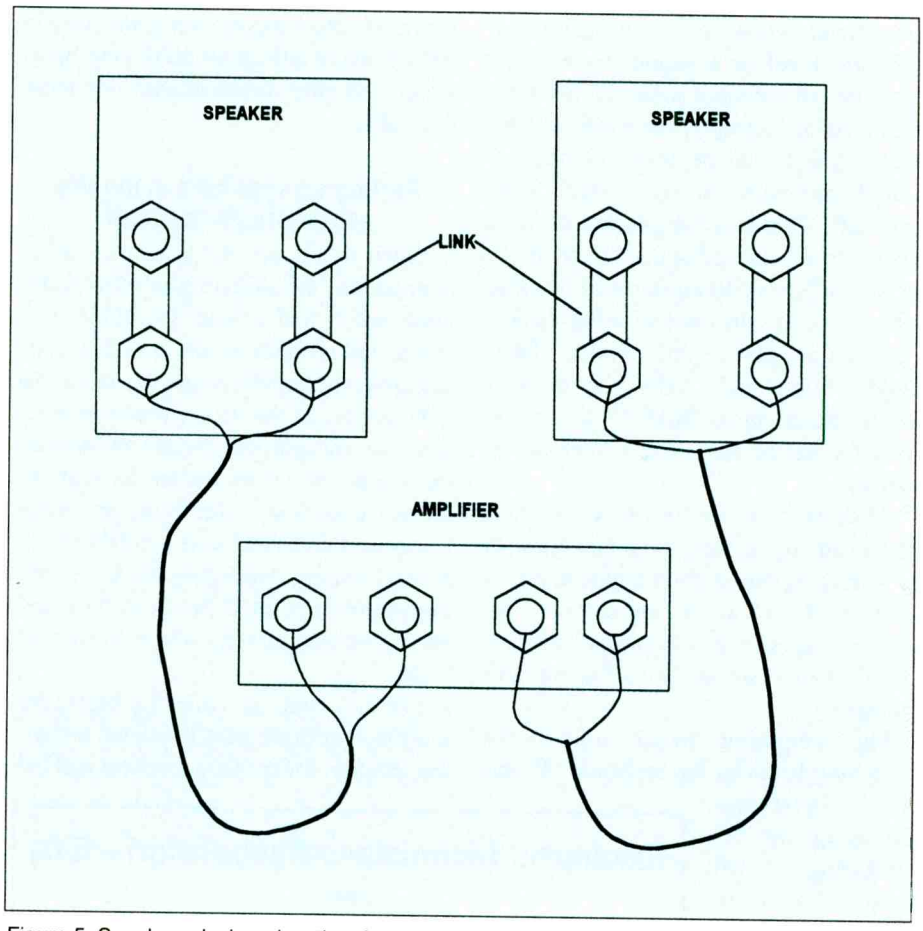


Figure 5. Speakers designed so that they can be connected in a bi-wire arrangement come from the factory with a connecting link between the terminals so they can be wired normally, as shown here.

tening seat. Don't worry about the initial placement too much since you'll most likely be changing it radically once you start measuring. Pick initial locations such that the speakers are equidistant from the side walls, and the listening position is centered between the loudspeakers. If you're not using a tripod, try to stand to the side of the meter to reduce reflections from your body that might affect your measurements.

Play the pink noise track on the test CD (track 15 on Stereophile's Test CD 2) and adjust the volume of the system so that the meter reads 0dB (which means that the sound pressure level at the meter's location is 80dB since the meter's dial is set to 80dB). Be sure to leave the volume control at this level so that subsequent measurements can be meaningfully compared to the pressure at this volume level. Ensure that the meter is at the same location as when making the pink noise measurement, and play the test tone tracks from your test CD (tracks 16-18 on Stereophile's Test CD 2). For each test tone, jot down the tone's frequency and the meter's reading at that frequency. When you're done measuring the sound pressure level for each test tone, you will have a set of measurements of frequency vs. sound pressure level. In other words, you will have the data for a frequency response graph of the room, given the current loudspeaker and listener locations.

How to set up a stereo system

Buying the correct components for your individual needs is just the first step in reaching your client's goal of owning a fine stereo system. It is amazing to see quality components set up in such a way that it is impossible to get maximum sound quality from them. A two-channel (stereo) system consists of one pair of speakers, one or more source components, and amplification.

Speaker placement

This is probably the most important aspect of setup. Without optimizing the speaker's position in relation to the room and the seating area, it will never perform to its full potential. Both speakers should be placed along the same wall, facing the listening position. Ideally, they should be separated from one another by at least six feet, and probably no more than ten. Speakers too close together can sound "cramped." If the speakers are too far apart, they lose a tight center image.

If the floor is carpeted and spikes were included with the floorstanding speakers, they should most definitely be used. The spikes (points go down) will couple the speakers to the floor, making them more stable and generally improve the quality of bass. This is one of the easiest ways to improve the sound of any speaker. Smaller speakers need to be elevated so that the top of the speaker is 30 to 40 inches from the floor. Solid speaker stands (with spikes) are recommended. The room boundaries are an important consideration. The speakers should be positioned out from the rear and side walls at least 12 to 18 inches. If the speakers are too close to the side walls, imaging will suffer. Moving a speaker closer to the rear wall reinforces bass, but soundstage depth will probably be hindered. Speakers like to have some breathing room around them . If you stuff the speakers into a tight spot between pieces of furniture, their imaging and sound quality will suffer. The optimum position for a speaker's placement is rarely in the first spot they're placed. Trial and error is the only way to determine where the speakers will sound the best, but the rewards are well worth the effort.

Component placement

The equipment stand is a surprising-

ly important part of any home stereo system. Beyond aesthetics alone, there is performance and convenience to consider. "Open-air" cabinets with no doors, sides, or backs are generally the best choice. Because there are no sides to interfere with the sound waves these cabinets are nearly "invisible" to the speakers. The open-air design lets the equipment run cooler and allows very easy access to the rear of components. Metal stands, with their weight and density, tend to perform better than wooden stands. Large wood entertainment centers look good and are very popular but they severely compromise the system. These wall-units reflect a large portion of the speakers sound, restrict ventilation and cable access, and totally ignore vibration. Remember, vibration is detrimental to sound reproduction. The more vibration you can control, the better. Many of the open-air cabinets use floor spikes and shelf spikes to reduce vibration.

Home theater speaker assemblage

A home theater needs at least six speakers: left front, right front, center front, two surrounds, and a subwoofer or bass module (Figure 7). For a Dolby Digital system, all speakers except the subwoofer should be capable of a full range of sound and be fairly equal in quality and performance.

The left front, right front and center speakers carry the bulk of the music and sound effects in a home theater. These speakers should be high quality and able to handle a wide range of sounds.

The center speaker is the primary carrier of dialogue and should therefore be the same quality as the left and right front speakers. Ideally, it should be the exact same speaker, or at least matched in quality and power. Placement of this speaker may be best right on top or directly below the video screen.

For some home theater systems, the surround speakers can be smaller in size because they do not need to carry the booming bass. The surround speakers should be as close as possible in sound quality and balance as the front speakers for an even sound. We do recommend the same speaker driver ensemble as the fronts for Dolby Digital.

Subwoofers reproduce the low bass sounds that make movie effects like explosions, sonic booms, crashes, and dinosaur footsteps seem realistic. These are the sounds that really pull the listener into the experience. A good subwoofer, preferably a powered subwoofer, is needed for a full effect.

Any speaker placed within 2 feet of the

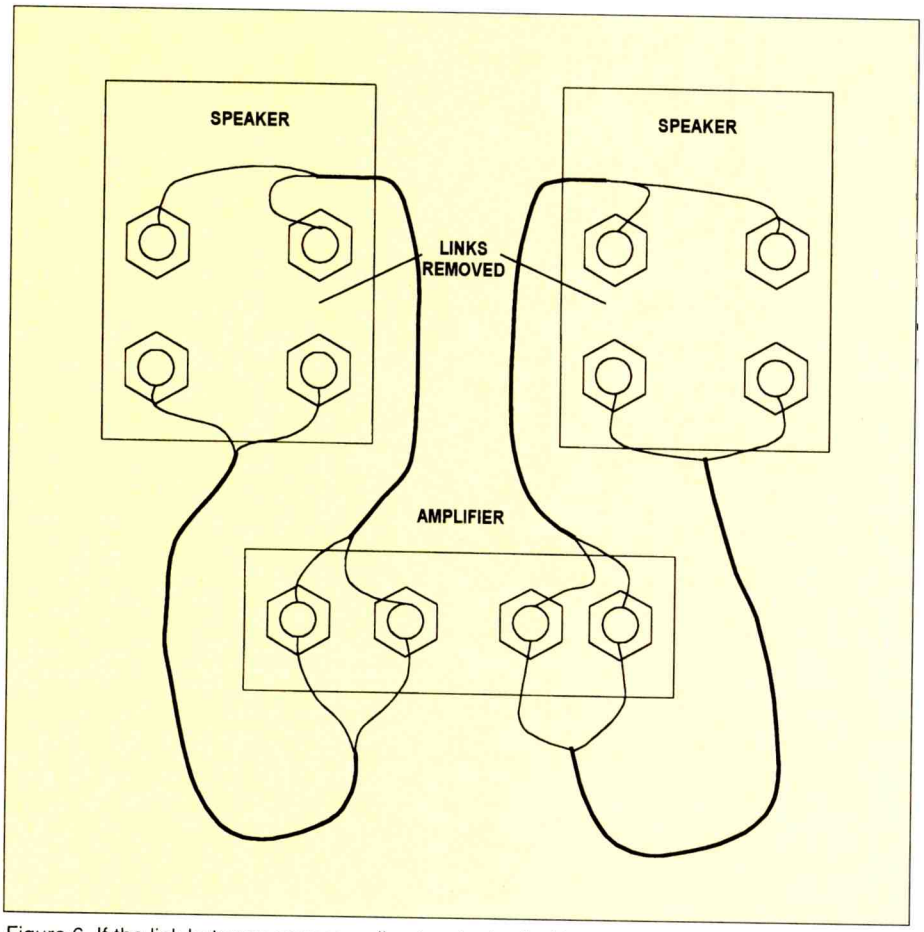


Figure 6. If the link between corresponding terminals of a bi-wire type speaker is removed, the speaker can be bi-wired.

television needs to be magnetically shielded to avoid video signal breakups and picture distortion not to mention picture tube damage. Most speakers marketed toward home theater are shielded, but it is an important item to verify.

We do recommend the same surround speaker driver ensemble as the fronts for Dolby Digital.

The speaker break-in

There's really only one piece of gear in a home theater system that almost every audio/video expert agrees can benefit from "break-in:" speakers. Dynamic speaker drivers (the cone woofers and dome tweeters found in almost all speakers) have moving parts that are generally rather stiff when they come out of the factory. One of these parts is called the surround; it's the rounded piece of rubber or foam that connects the outer edge of the cone or dome to the speaker basket. The other is called the spider; it's the part that connects the center of a woofer cone to the back part of the speaker basket, and that keeps the woofer's voice coil centered in the voice-coil gap.

The surround is the rounded piece of rubber or foam that connects the outer edge of the cone or dome to the speaker basket

Surrounds and spiders are kind of like shoes, they're not very flexible at first but with use, they become much more flexible. And as the surrounds and spiders in the speakers become more flexible, the speakers will sound better. Some speakers sound just a little better after break-in. Some go from sounding horrible out of the box to sounding glorious after 24 hours of break-in.

Should your client break in speakers? Absolutely, if they want to get great sound from them right away. There are a couple of easy ways to do it. If the receiver or preamp has a test tone that automatically circulates from speaker to speaker, the owner can just leave the test tone on for a day or two while at work.

You could also find a particularly brutal action scene on a DVD or laserdisc, such as the canal chase scene from Terminator 2, and set the player for chapter repeat, then crank up the system (not too high) and leave the house for several hours.

Dvd video players

All DVD-Video players deliver composite-video and S-video signals playable on a conventional TV. All provide such video features as fast-scan, freeze-frame, and stop-frame motion (a kind of incremental slow-mo). All have a built-in menu system that lets the user set up and control the player, and all let the user navigate the menus on DVDs that provide access to the contents, including special features like storyboards and directors' comments.

All players also put out analog stereo signals as well as a digital audio bitstream from CDs and DVDs. The digital signal can carry Dolby Digital surround sound or standard PCM stereo, depending on how the disc is encoded or which audio track is selected. Most newer players can also pass a DTS-encoded digital signal from those few discs with DTS soundtracks. To play it safe, make sure the player is DTS-compatible so that if DTS's popularity takes off, your client will at least have the option of passing the signal to an external processor or receiver with a DTS decoder. Receivers increasingly offer this because they contain digital signal processing (DSP) chips that can handle both Dolby Digital and DTS decoding - the processor simply senses the signal format and switches in the appropriate decoding software. DTS compatibility isn't absolutely necessary, however, because DTS discs must also carry PCM or Dolby Digital soundtracks for play-

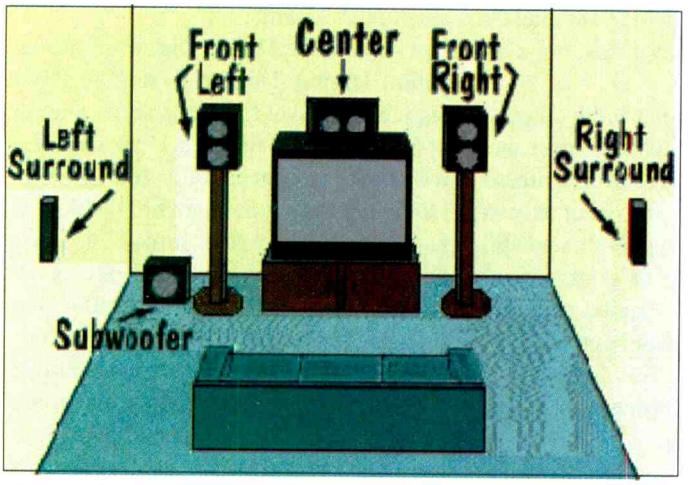


Figure 7. A home theater needs at least six speakers: left front, right front, center front, two surrounds, and a subwoofer or bass module.

back in stereo or Dolby Surround.

The current home theater setup largely determines the features and price level the client should be looking for. If the system is modest, then a budget player should do fine. Picture quality doesn't differ dramatically from one player to another (they all use similar MPEG-2 video decoding chips), and a budget player's picture will look fine, particularly on smaller TV screens.

More expensive players will provide somewhat better picture quality, smoother fast and slow picture scanning (particularly during reverse scanning), and various fun features - picture zoom, for example. These players will integrate nicely with average home theaters. Top-price players provide uncompromised video and audio quality and a full set of features. In addition, their typically superior construction quality and styling can add to pride of ownership. These models are appropriate for deluxe home theaters where cost is no object.

Dolby digital decoding: onboard or outboard?

One of the most exciting aspects of home theater and DVD is surround sound. Many discs contain 5.1-channel Dolby Digital (DD) soundtracks which are five discrete audio channels plus a dedicated low-frequency-effects (LFE) or ".1" channel for deep bass. To hear this surround sound, your client will need a DD decoder, which can reside either inside the DVD player or in the A/V receiver (or surround processor).

In general, it's better if the decoder is in the receiver. There

it is accessible to other components that output signals that need decoding, such as a satellite receiver, and it reduces the wiring between the player and the receiver: the undecoded DD signal requires only one cable to carry it, whereas a decoded 5.1-channel analog signal requires six. Also, receivers are usually better equipped than a DVD player with onboard decoding to handle the bass-only low-frequency-effects (or ".1") channel.

A DD decoder in the player really makes sense only if the receiver lacks one. And in the worst case, the listener can get along without Dolby Digital at all. The analog stereo signal in most DVDs is Dolby Surround-encoded, and any A/V receiver will be able to decode that into surround sound.

Compatibility with 96/24

When people think of DVD-Video, they rightly think of its awesome picture quality. But DVD also offers awesome sound quality. In particular, it accommodates stereo sound sampled at 96 kHz and with a resolution of 24 bits; far above the CD standard in terms of frequency response and dynamic range. A few record labels (most notably Chesky) are offering music-only DVD-Video discs with 96/24 specs. Some players won't play these discs. Some do play them, but at lower fidelity, downsampling the signal from 96 kHz to a lower sampling rate such as 48 kHz, or reducing the resolution to 20 bits or less, or both. Finally, some players play the full signal. Yet again, read the fine print!

Outputs

Some folks buy a component based on its flashing-light count. Smarter folks look at the back panel, because the number of inputs and outputs largely determines how useful the component is and how "future-proof" it might be. Most DVD players don't have any inputs, but look carefully at the outputs. As mentioned previously, all models have both composite-video and S-video outputs. More and more DVD players also have a component-video output, the highest-quality video signal. Even if your client's current TV doesn't accept this, his next TV might.

When it comes to digital audio outputs, make sure the player at least has the same kind of output as the receiver's digital input. Some have only a coaxial or only an optical output, others have both, and still others have two of each. Of course, players with built-in Dolby Digital decoders also have a set of six analog outputs.

Special features

All DVD players let you play discs straight through, select among their contents, and amuse friends with fast and slow playback. A few players add other useful features. For example, top-end players provide comprehensive video controls to tweak the picture and to reduce video noise. Some players automatically select the 5.1-channel soundtracks (if available), while other players require manual selection. If the system has a big laserdisc collection, combi-players play both laserdiscs and DVDs as well as CDs. Theta and Pioneer seem to be the leaders in the combi-player arena.

Surround history

Dolby is one of the best-known names on the planet. For starters, it appears on about a zillion cassettes. And Dolby has long been a benchmark for high-quality sound in movie theaters. Dolby Digital (DD), with its five discrete audio channels plus a dedicated low-frequency-effects (LFE) or ".1" channel for deep bass, hit the big screen in 1992 with the action/adventure flick Batman Returns. More than 9,000 movie theaters in North America are now equipped for Dolby Digital playback, which delivers more realistic and engaging sound than the Dolby Stereo system that was introduced to theaters in 1976 (it wasn't until the following year that Star Wars really turned moviegoers on to surround sound). On the domestic scene, most DVDs have Dolby Digital 5.1-channel soundtracks, and literally millions of decoders - mostly built into A/V receivers - are in consumers' hands.

A year after Dolby Digital made its debut, Digital Theater Systems (DTS) launched its rival format with the release of Jurassic Park. Also a 5.1-channel system, DTS is conceptually the same as Dolby Digital yet incompatible with it. It has made impressive inroads against Dolby's lock on cinema sound. Thanks to backing by Hollywood moguls like Steven Spielberg, DTS playback equipment is installed in close to 9,000 movie theaters in North America. On the home side, DTS decoders are appearing in more and more components, including a number of A/V receivers, and the first batch of DTS-encoded DVDs became available sometime ago.

When the consumer-electronics industry's DVD Working Group sought the best audio coding technology for the new format back in 1995, Dolby Labs was fast out of the blocks. Dolby argued that its name recognition, its familiarity with the movie industry, and the choice of its system for audio coding in the new digital TV (DTV) standard made it a natural for DVD as well. The DVD group agreed, and Dolby Digital was selected as one of the two "mandatory" soundtrack formats for DVDs released in the U.S., meaning that at least one of them has to be on each disc. A two-channel PCM soundtrack like those found on CDs is the other mandatory format.

Late to the party, DTS argued that its coding method sounds better than Dolby Digital because it uses a higher bit rate and therefore that the DVD standard should be changed. The DVD Working Group was not moved, and DTS was relegated to the dreaded "optional" status, meaning that any DVD carrying a DTS soundtrack must also have either a PCM or a DD soundtrack. (Note, however, that a DD soundtrack is not necessarily 5.1-channel - it can range from mono to 5.1 channels, and can also be a two-channel stereo track carrying Dolby Surround information.) Because the decision to add DTS as an optional format was made after the DVD format was officially launched, first-generation DVD players are incompatible with DTS. ■

Circuit Board and Parts Handling

The function of the consumer electronics servicing technician is to repair products that have malfunctioned. It doesn't happen very often, but a cardinal sin on the part of the technician is to cause damage to the very product that he's endeavoring to repair. Given the delicate nature of many of the assemblies and components in today's electronics products, such incidents will occur from time to time, but proper handling of components, and the circuit boards they're installed on during the service procedure can reduce such situations to a minimum.

The nature of the problem

In recent years, electronics manufacturers have continually packed more circuit functions in a single package, worked to reduce size and weight of products while increasing their functionality, packed more and more components more closely on printed circuit boards. The result of all of this has been improved operation for the consumer, but at a cost of increasing service difficulty for the technician.

For example, integrated circuits that have become increasingly sensitive to heat, static electricity, and electrical overstress. So if the technician doesn't take proper precautions when handling a replacement IC, or uses soldering equipment that is not static electricity safe, or uses too much heat in soldering a new IC into the circuit, he might damage or destroy that replacement before the repair job is done.

In fact, heat is such an enemy to today's ICs that it is a truism today that if you remove a multileaded package, you should not replace it in the circuit even if it tests out good because you have probably damaged it such that even if it operates now, it will probably fail long before it should.

More heat related problems

But heat damage to the component being desoldered is not the only heat-related problem a technician can cause. Carelessness or overzealousness in the use of a soldering iron or hot air handpiece can cause damage to heat-sensitive components in the vicinity of the component being worked on. Moreover, the damage done may be such that the damaged component doesn't immediately fail, but only after some weeks or months gives up the ghost. This type of damage may be the cause of mysterious callbacks.

Heat can cause other problems that will cause chagrin to the technician. Those circuit traces and soldering lands on today's tightly packed printed circuit boards are quite delicate. If the technician applies too much heat during the desoldering, or soldering, process, he may cause the lands to lift off the board. Now he has to repair the PC board before he can complete the product service.

The way to avoid such a contretemps is to follow the manufacturer's instructions, use soldering/desoldering equipment of the proper wattage/heat delivery, and exercise appropriate care.

Other handling precautions

But it's not only components and PC Boards that are delicate. Mechanical assemblies in today's media players, such as VCRs, CD players and DVDs may be delicate. For example, the optical pickup assemblies in CD and DVD players require extreme care in handling. For example, following is the description of handling precautions in the training manual for a DVD player from a major manufacturer.

Optical assembly replacement checklist

The DVD laser is much more sensitive to static damage than is a CD laser assembly. Here is the description of one manufacturer on replacement of a DVD laser.

1. Remove the tray to access the optical assembly rail.
2. The metal rail the assembly rides on is held down with only one screw
3. The tooth rack gear must be transplanted from the old optical assembly to the new one or the sled will not move the assembly.

4. The connector at the optical assembly flips up to release the cable. The cable at the other end mates with a conventional connector on the mb75 board that unlocks by pulling toward the cable.
5. Connect the new optical block.
6. Plug in the cable from the new laser assembly.
7. Remove the 2 solder shorts across the CD and DVD lands on the assembly.

Avoid bending PC boards

Avoid overheating lands.

Follow manufacturer's instructions

It's easy to just dive right in and fix a problem. But failure to read the manufacturer's directions can result in serious damage. For example, here's a procedure from a Hitachi service bulletin to correct a symptom of a one-inch wide light vertical band in the video at the center of the screen in a PTV 99-01.

The bulletin says that the correction for this symptom is to replace jumper K761 with an inductor, a 0.8uH ferrite bead.

Procedure:

Remove back cover and gain access to main Power/Deflection PWB.

Warning: When removing the center ground strap, bend it down and cover with electrical tape to prevent any possibility of accidental shorting (See Service Bulletin PTV 99-04).

From the bottom side of the chassis, unsolder the jumper K761, located next to C658 and C659 in the position marked L761.

Remove the Jumper K761 from the top side of Power/Deflection PWB.

From top side of Power/Deflection PWB, insert new coil part #2123461, into position labeled L761.

Solder leads to PWB from bottom side of Power/Deflection PWB. Cut any excess leads.

Replace chassis securely into cabinet. (Be sure to properly assemble the Power/Deflection Cabinet *ground strap, stapled to cabinet beneath Power/Deflection PWB, to chassis rail or shorting may result).

*Warning, when removing screw securing ground strap to chassis: The ground strap must be bent down and away from chassis before applying power to tile chassis, use electrical tape to isolate. Severe damage to chassis can result if contact of the ground strap is made with a hot chassis. Remember to remove tape before reattaching to chassis assembly.

Record critical information before making changes

It's a fact of life for technicians today that modern TV sets employ microprocessors. The instructions that operate those microprocessors are stored in EEPROMs. Any time a technician works in this critical area of a TV set, he must be cognizant that he could make changes in the software that might adversely affect the set's operation.

Here's an example of a Hitachi service bulletin that emphasizes the importance of recording all adjustment data before replacing the microprocessor. In this case, the problem symptom is that the brightness of a PTV 99-02 flickers when "AI" mode is turned on.

Procedure: Replace microprocessor with updated microprocessor

If a set with the above symptom is encountered and it falls within the listed serial numbers (in this case, V8K000001 to V9A001350), please perform the following:

With set OFF, press and hold the INPUT button on the front panel, then press POWER to turn TV on. The 12C adjustment menu should appear. Write down the data for EVERY adjustment item.

Turn set OFF, unplug the set and remove the back cover.

Remove the two screws securing the main chassis to the cabinet and the center GROUND screw.

Loosen the wire harness retainers to provide enough slack allowing the chassis to be pulled back and rotated upward exposing the underside (printed copper side).

Carefully unsolder and remove the metal shields protecting the Microprocessor (1001).

Remove Microprocessor (1001), pay attention to orientation. IC may be soldered directly into PWB or inserted into IC socket. Note: If Microprocessor is installed in a socket, unsoldering isn't necessary.

Replace with Hitachi part number CP06342U, make sure not to create any solder bridges. When installing the new Microprocessor, be careful not to bend any pins.

Reinstall shield assembly, cleaning any solder excess from PC board. Be sure to check for solder bridges.

Install chassis back into cabinet, make sure to attach GROUND strap* to chassis.

Reassemble the set. Pay special attention to wire harness routing, must be same as original.

Press and hold INPUT button on the front panel, then press power to turn TV on. The 12C adjustment menu should appear. Select MEMORY RESET from first page of 12C menu and press Cursor right to initialize.

Check that all 12C data matches the data you wrote down in step 1. If it does not, please adjust data to match that found in step I.

Verify unit operation.

*WARNING. when removing screw securing ground strap to chassis: The GROUND strap must be bent down I and away from chassis before applying power to the chassis, use electrical tape to isolate. Severe damage to chassis can result if contact of the ground strap is made with a hot chassis. Remember to remove tape before reattaching to chassis assembly.

Smaller, closer, more delicate

The device handling situation for consumer electronics technicians is not likely to improve. More likely, it will continue to become more difficult, more challenging. As electronics technology progresses, no doubt ICs will feature more and more functions, and therefore, most likely, more leads. And they will be more delicate. Components will continue to be spaced more closely on circuit boards with finer lead spacing. But, no doubt, makers of tools and handling equipment will continue to offer tools more suited to the advanced boards and components. And technicians will continue to find ways to deal with these new challenges. ■

Troubleshooting SMD Components

By Homer L. Davidson

Today, SMDs, and leadless chips are found throughout most modern consumer electronic products. Transistors, resistors and capacitors are frequently manufactured as SMDs. These devices may be found anywhere in a TV chassis (Figure 1), or any other electronic product. SMT (surface mount technology) components, and SMD (surface mount devices) are usually located in the low voltage, low current and low wattage circuits. You will find SMT parts in the system control, control microprocessors, tuners, flyback return, X-ray protection and video circuits of the TV set. SMD chips are found in both the TV and VCR sections of the TV/VCR combo.

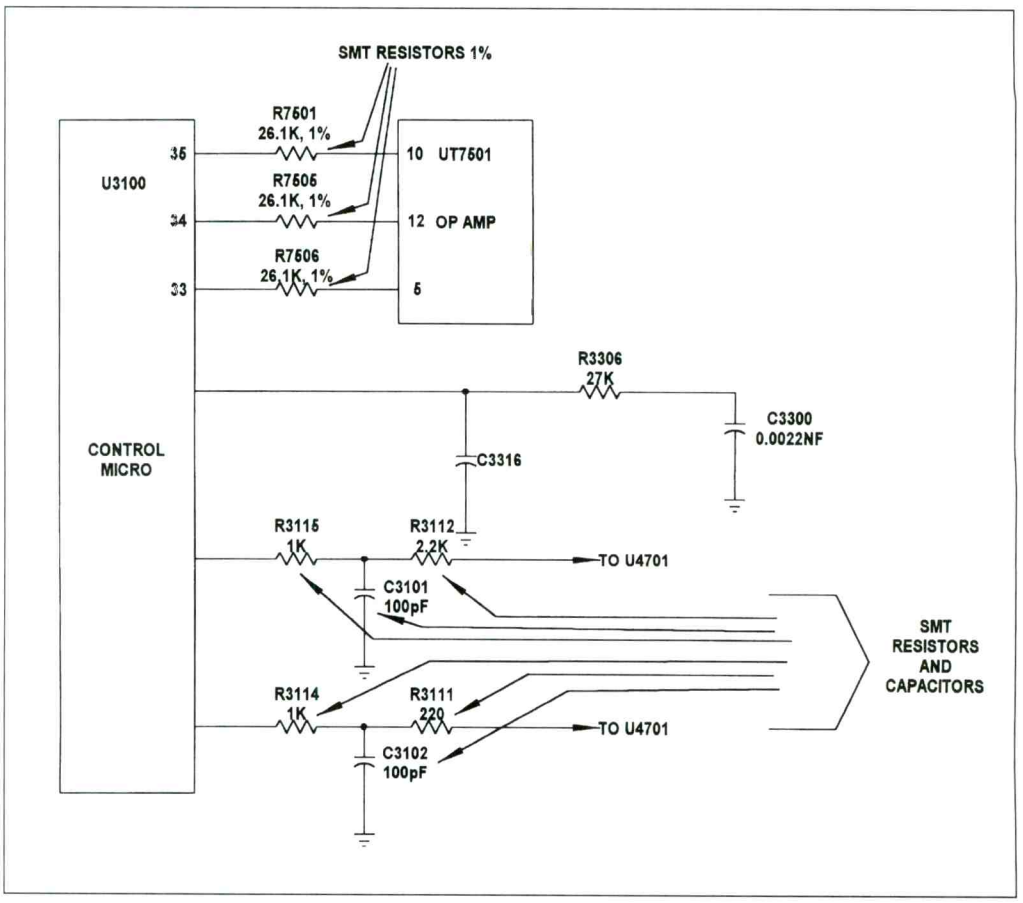


Figure 1. These are some of the critical SMT resistor chips found in the system control circuits.

Using the ESR meter

In troubleshooting, the ESR meter is frequently a good choice for testing the condition of SMDs. Always remember to discharge that capacitor before taking any measurements with the ESR meter.

Although the ESR meter was designed to check the ESR (equivalent series resistance) of a capacitor, the meter can make accurate tests of small inductors and can measure the actual capacitance of a bypass or electrolytic capacitator in the circuit. When you perform an ESR test on a capacitator, its condition will be indicated by the position of the meter needle in relation to the scale: Bad, Compare and Good. Small bypass capacitors can be identified by the correct capacitance measured on the resistance scale. Likewise small inductors can be identified by the correct inductance using resistance measurements. A resistance chart is enclosed for capacitators and coils in the ESR meter operating manual.

A leaky electrolytic capacitor will show some resistance on the ESR meter. Double check the capacitor if the capac-

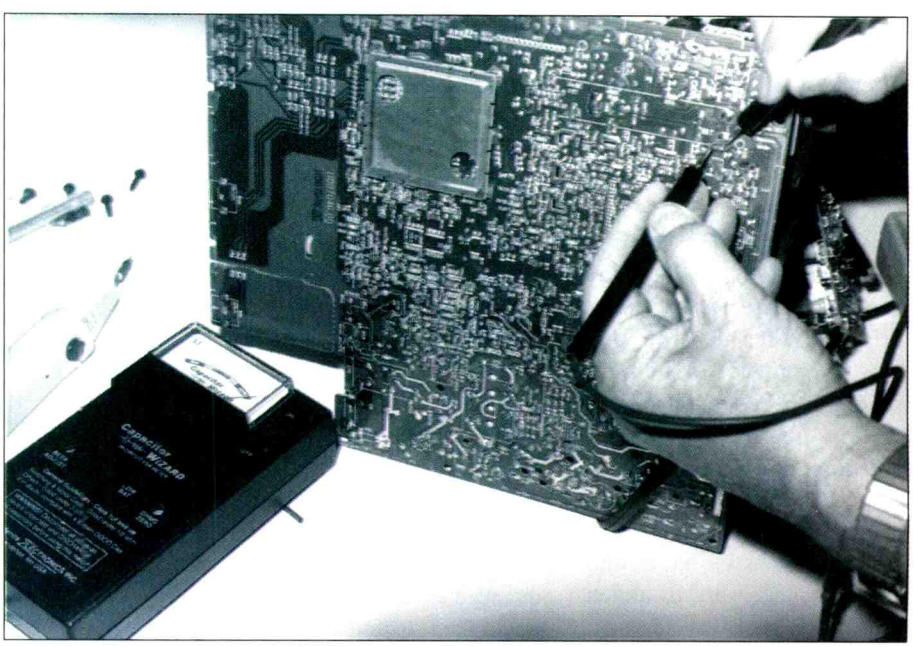


Figure 2. Modern consumer electronic products often contain significant numbers of SMT chips of capacitors, resistors, transistor and ICs.

itance measured by the meter is not the same as the value printed on the capacitor. A defective capacitor will most likely show both a bad ESR reading and an incorrect capacitance.

The ESR meter can make accurate in-circuit tests while the component being tested is still soldered to the PCB. It isn't necessary to remove one end of the component for normal tests; this can save a lot of time on the service bench.

In the case of an electrolytic that has leakage, you might encounter some misleading readings using the ESR meter that will require that you check them with a capacitance meter. For example, let's say you suspect a 10µF capacitor and check it with the ESR meter. A 10Ω leakage across the suspected 10µF electrolytic might give a reading of a little less than 1 on the ESR meter scale. A normal electrolytic of the same capacitance will give the same measurement. If the electrolytic capacitor has a dead short across it, the meter indicator will hit the end peg of the ESR meter.

After making several capacitor tests with the ESR meter, you can quickly locate the defective capacitor in any circuit and sort them out. Remember, the electrolytic capacitor might test good on a regular capacitor checker and still have ESR problems. You can quickly check all capacitors in a given circuit, in minutes, and weed out the defective capacitor.

Chip breakdown

SMT or leadless components can break down like any standard part in the TV chassis. The SMT capacitor can become leaky, open, lose capacitance, or become shorted. A defective bypass chip capacitor can be easily located without removing it from the circuit by pressing the sharp ESR probe tips into the connections on each sides of the capacitor. Small bypass chip capacitors can be measured and compared using the resistance scale of the ESR meter. Compare the reading given by the defective capacitor with the reading given by a known good capacitor of the same value.

For example, a reading of 30 on the ESR meter measurement indicates a capacitor around 0.047µF capacitance. A 0.01µF chip will give a reading of 15 on the meter scale, while a 0.47µF bypass has a measurement of 1 on the meter. An SMT chip capacitor with capacitance of 0.01µF might only nudge the infinity line on the ESR meter. Capacitors of less than 0.01µF capacitance cannot be successfully measured by the ESR meter. A 4700 pF NPO capacitor will not deflect the pointer of the ESR meter whatsoever.

SMT electrolytics found in the TV chassis can easily be tested with the ESR meter. The radial or upright electrolytic is usually an aluminum type capacitor. Miniature capacitors of lower capacitance are found in flat ceramic chips. These electrolytics have end-to-end soldered contacts. Both ceramic and radial electrolytics are found mounted on the PC wiring (Figure 2)

Determining capacitance with an ESR meter

In addition to checking the suspected capacitor for ESR problems, the ESR meter can display its capacitance by the number that the meter pointer indicates. A normal 1.5µF SMD electrolytic capacitor indicates around number 8 on the ESR

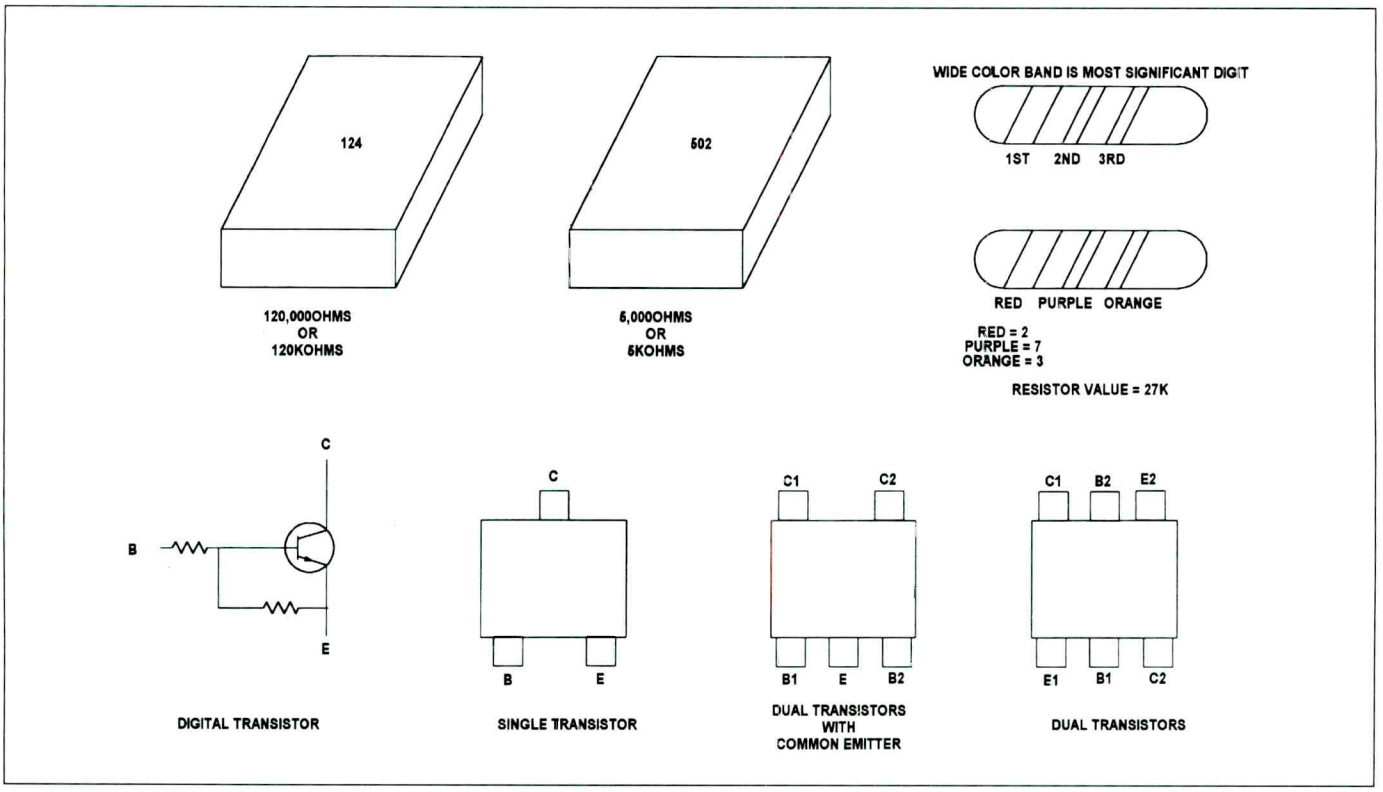


Figure 3. The values of SMD capacitors and resistor chips are marked on top with numbers and letters.

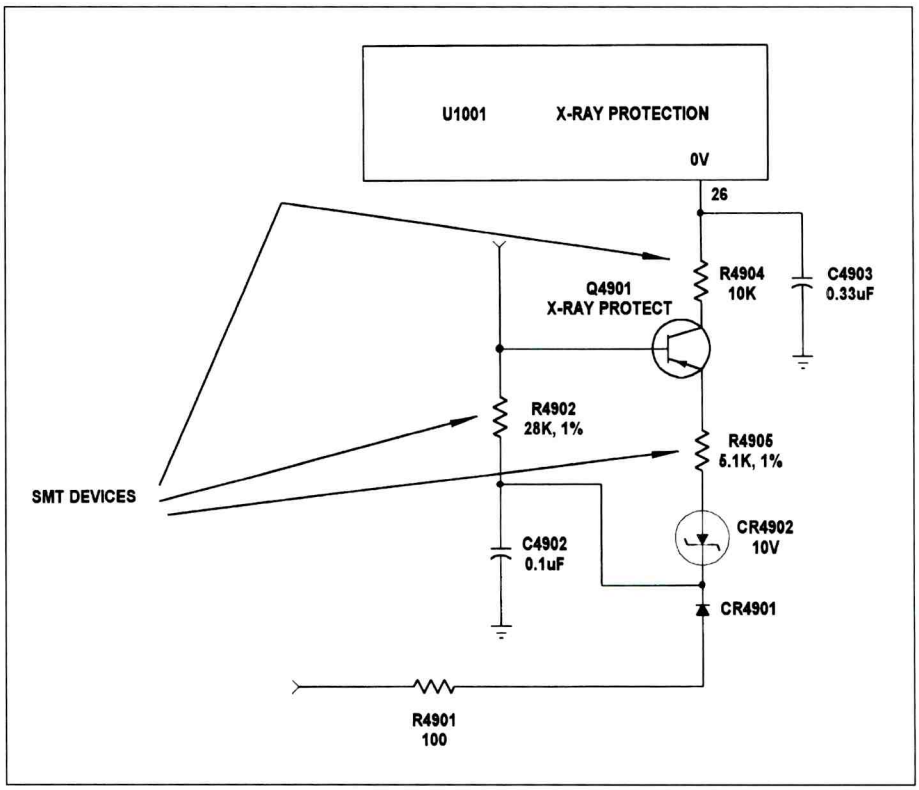


Figure 4. Critical SMT resistor chips are also located in the X-Ray protection circuits of an RCA CTC187 chassis.

meter. A normal 10µF electrolytic will give a reading in the yellow range of the meter display. A normal ceramic 0.1µF chip should read around 15 on the ESR meter. Likewise a normal 220µF 350V standard electrolytic will indicate in the green section, around 0.1 on the meter scale. Large electrolytics of, say, 10,000µF might cause the meter to peg in the green area of the scale.

If you're faced with an unknown capacitor because the numbers are smudged or missing, you can measure its capacitance using the ESR meter. Once you've determined the value of the unknown device, double check the accuracy of the meter reading by measuring the value of another, known good, capacitor of the same value. Another way to determine the specified value of any capacitor is to check for the correct capacitance on the schematic, if one is available.

If an electrolytic capacitor changes value, dries up, or becomes open, the capacitance value shown on the ESR meter will be different from the specified value. If you measure a capacitor that gives a reading on the ESR meter that is significantly different from the specified value, replace it. If a ceramic chip capacitor reads open when checked with the ESR meter, it might have a cracked chip, or poor end soldered connections. Replace the ceramic chip capacitor if the ESR meter shows that its capacitance has changed significantly, or if the meter pointer hits the peg (a shorted capacitor), or if its shows no measurement at all. Double check the suspected shorted capacitor on the capacitor checker.

You can compare the suspected capacitor measurement with another capacitor of the same value. Notice if the capacity measurement is the same as indicated by the numbers of the ESR meter as marked on the chip. Whenever you must replace a defective capacitor, check the replacement to be sure that it is of the correct capacitance and working voltage before soldering it into the PC board.

Chip identification

Surface mounted chips such as capacitors, resistors, diodes and transistors have numbers and letters stamped on the top side of the component. A chip resistor with the number 124 stamped on top has a resistance value of 120,000Ω. The first two numbers equal the resistance value, with the last number indicating the numbers of zeros. The number 4 indicates four (0000) zeros. For instance, the numbers 502 found stamped on top equals 5000Ω or 5KΩ (Figure 3).

The cylindrical or round type chip

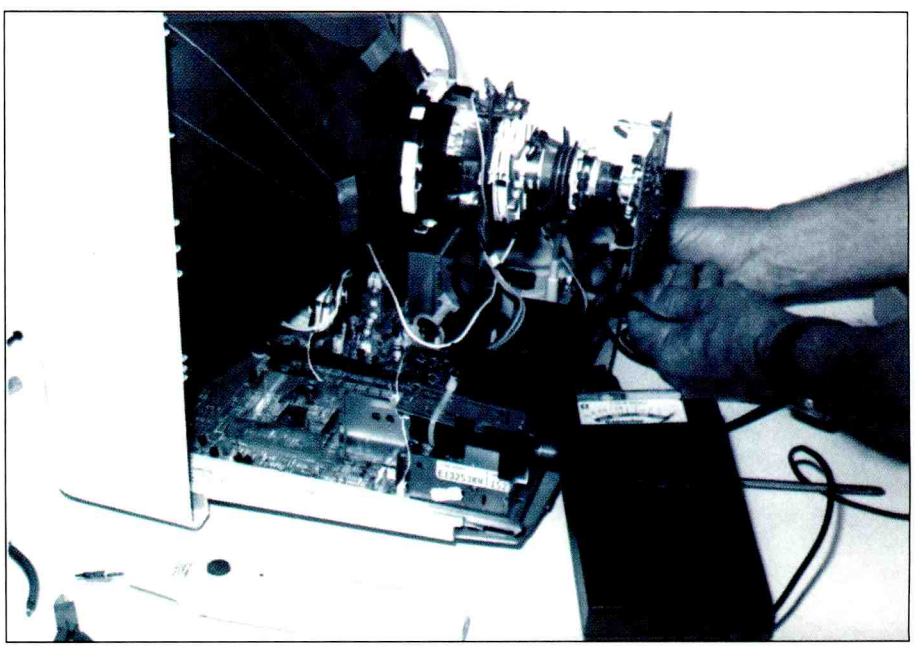


Figure 5. Making a continuity test of a normal fuse with the ESR meter.

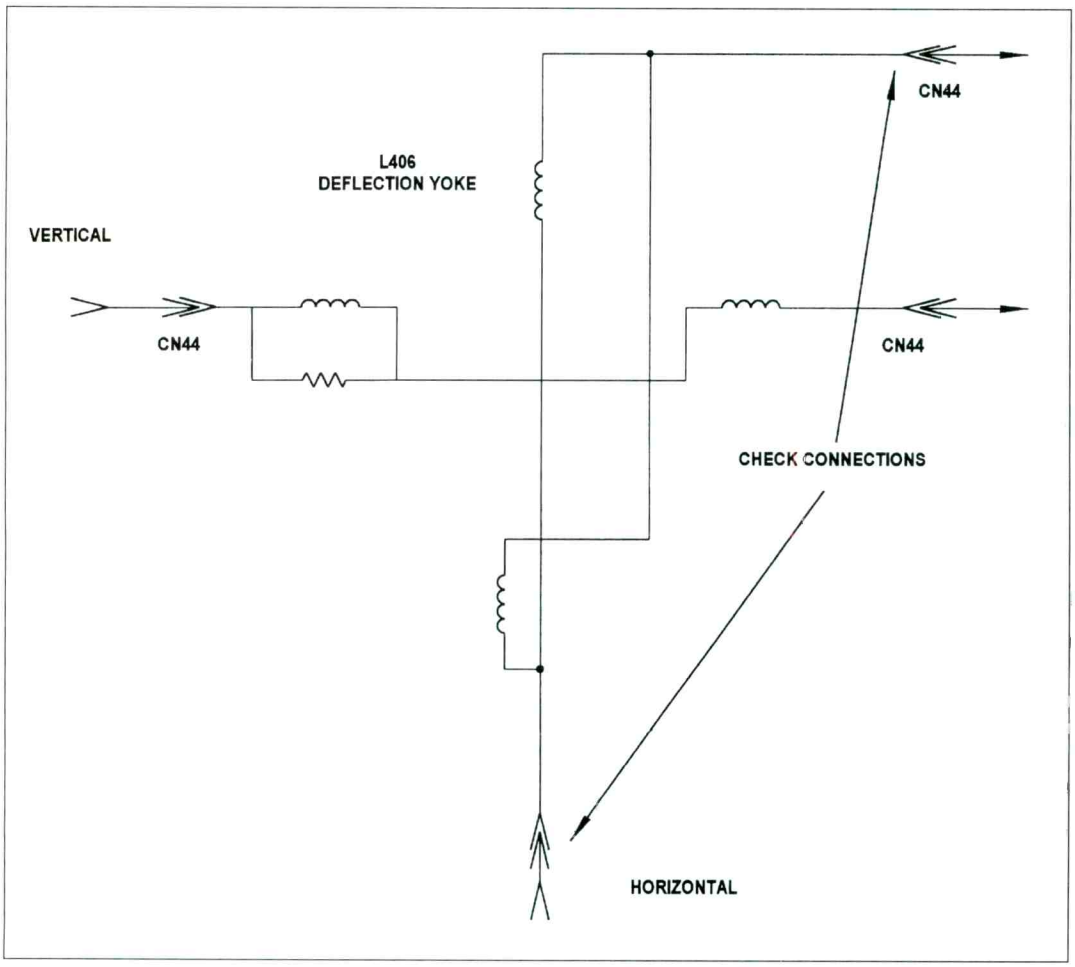


Figure 6. Improperly soldered connections of CN44 caused horizontal foldover in a Samsung K20 chassis.

ble check the schematic to see if this is a shorted component, or a circuit connection.

Never reuse a removed chip for a replacement. Throw the part away. Often the end connection of the chip becomes damaged, too much heat has been applied and the chip can be damaged. Replace it with a new chip component.

An SMD digital transistor might have base and emitter resistors inside the chip component. These transistors might test as transistors with bad junctions. Double check the transistor against the correct schematic. A leadless transistor might have more than one transistor fabricated in one chip or component. Notice that the collector terminal of the transistor is at the top side in a single component. Double check the transistor chip terminals on the manufacturers schematic or in the service

resistors or capacitors have three color bands around the component. Start with the widest color band for the starting number. A resistor chip with a wide red color indicates number 2. The second color (purple) around the chip indicates number 7, while the last color (orange) is 3 and the total chip resistance is 27,000 ohms or 27KΩ. Remember to start with the largest width color as the most significant digit.

Fixed chip capacitors and transistors have stamped letters and numbers on the top side of the component. Note that some chips that show a short or zero resistance are tie-through, wire jumpers that might tie two or more circuits together. Some SMD resistors might have a resistance marked as a "wire" under the resistance symbol number on the schematic. If you encounter what appears to be a shorted component, dou-

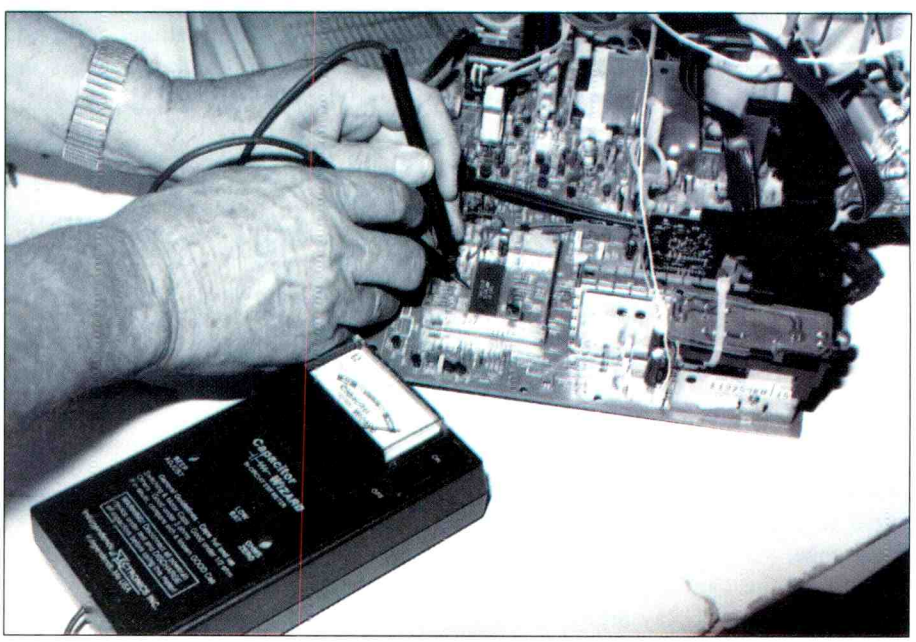


Figure 7. Check each pin terminal of IC or microprocessor with the ESR meter to insure a good soldered connection.

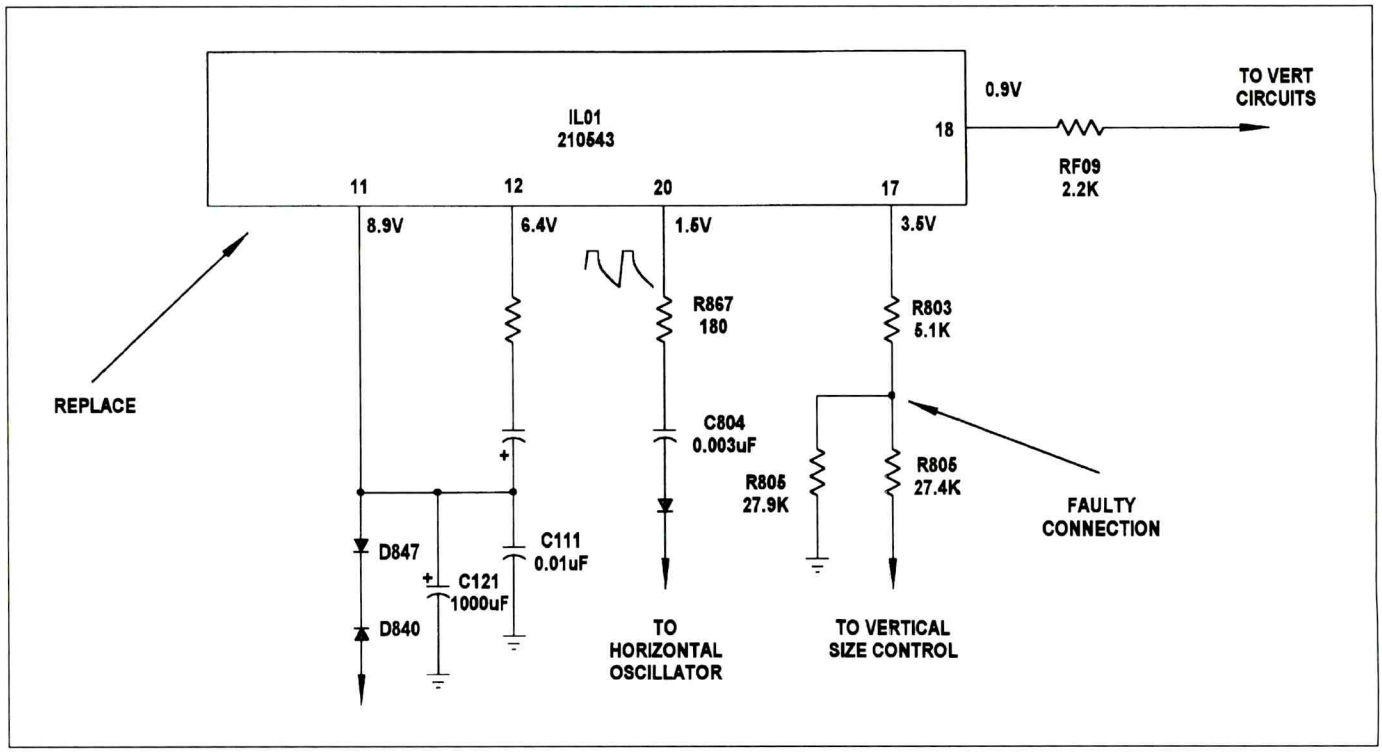


Figure 8. Faulty soldered connections of RP03 and RP05 caused poor vertical sweep in a RCA TX82 chassis.

literature for dual or digital transistors.

Chip resistors

SMT resistors on the PC wiring of the TV chassis might be flat or round components. Defects that you may encounter in SMT resistors include open-circuited devices, cracked devices, or resistors that have increased in resistance. Often very high-value resistors have a tendency to increase in resistance. If a component in the circuit tied to an SMD resistor becomes short-circuited, the SMD resistor may overheat and become burned. Poorly soldered end connections are the cause of most service problems with SMD chips. Most SMD resistors, by the way, are of the 1/10W variety.

The ESR meter can accurately measure resistance up to 35Ω. Extremely low ohmic value SMT resistors can be measured very accurately using the 0 to 30 ohm range.

Most of the capacitors, diodes and transistors in the X-Ray protection circuit of a TV chassis (Figure 4) can be checked using an ESR meter. Although none of the resistors in this circuit can be checked using the ESR meter, all of the bypass and electrolytic capacitors can be accurately tested. Notice that these SMT resistors are of the 1% type. The only components that cannot be tested by the ESR meter are resistors and U1001. The ESR meter has its limitations. After all, it was designed to check capacitors for ESR problems.

Continuity tests

Low resistance, PC foil wiring, soldered connections, transistor terminal connections, and continuity tests can all be made with the ESR meter. The ESR meter can check the resistance or continuity of a foil trace and PC wiring. The ESR meter should read zero resistance or hit the meter peg at zero when used to measure normal PC wiring. Long PC wiring can show some fractions of resistance. A break or a poor connection of the foil should show some signs of resistance or open (infinity) measurement of the ESR meter. Always discharge the circuits or capacitors before taking ESR meter tests.

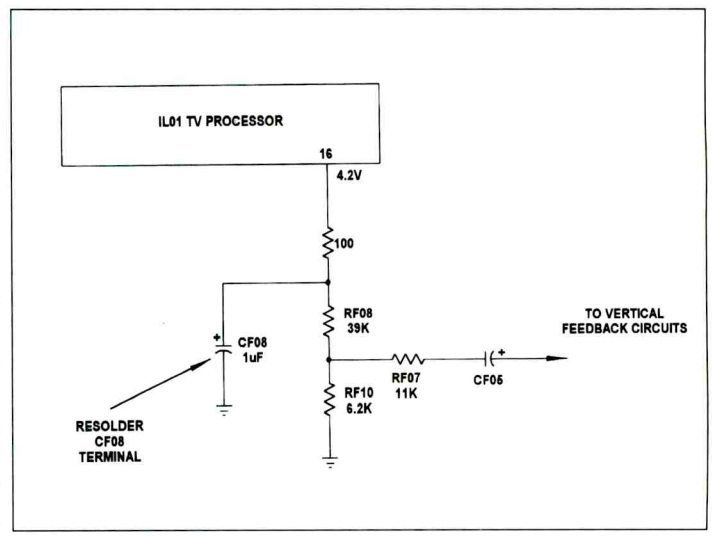


Figure 9. A faulty soldered terminal of CF08 produced insufficient vertical sweep symptom in the RCA TX82 chassis.

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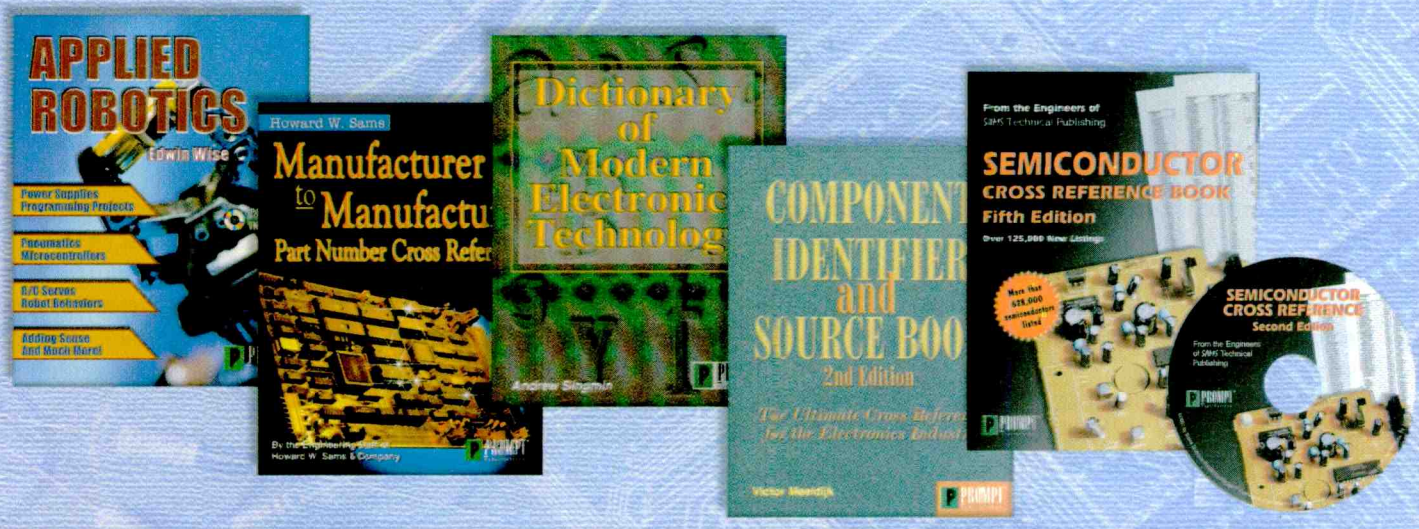

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A poorly soldered connection of a transistor terminal to the PC wiring joint might show a resistance less than 0.5Ω in the good scale, indicating a poor soldered joint. Another indication of an intermittent or cold soldered joint is an interrupted tone from the ESR meter. Although this intermittent or poor soldered connection cannot be seen with the naked eye, the ESR meter indicates a poor soldered connection.The ESR meter sensitive enough that long PC wiring may indicate some foil resistance.

The continuity measurement of a small coil, resistor, or fuses will hit the peg or zero on the meter (Figure 5). You can identify different small inductors with the ESR meter. A 2.5µH coil should show measure 1Ω on the meter. A resistance of 4Ω across the coil or inductor equals 7.6µH inductance, while a 30Ω measurement indicates a coil inductance of 48µH with the ESR meter. Check the small inductor chart in the ESR meter operating manual for different coil measurements.

Intermittent horizontal foldover

The ESR meter is useful for locating open connections, bad foil joints and poor socket connections. A customer brought in a Samsung K20 chassis that had an intermittent horizontal foldover symptom. Sometimes when the chassis was moved or jarred, the intermittent acted up. The ESR meter was used to make continuity checks on the coils and socket connections.

By checking continuity of wire breaks, wire wraps and socket connections, the intermittent problem was traced to a poor socket connection. A couple of CN44 connections on the horizontal winding indicated poor socket connections (Figure 6). Soldering a loop of wire around the poor socket connection solved the intermittent foldover problem. Sometimes poor soldered connections at sockets, wire jumpers and SMD tie-through can easily be located with the ESR meter.

Bad soldered joints or connections

Improperly soldered connections on component terminals can produce an intermittent or dead chassis. Improperly soldered terminal connections between resistors, capacitors, transistors and IC components to foil traces can cause intermittent and shutdown symptoms. Broken foil traces in the TV chassis are very difficult to locate in the TV chassis. The ESR meter can quickly indicate if the foil is broken or a poor soldered connection is at hand.

An RCA TX82N chassis that had the problem of no vertical sweep turned out to be a tougher service problem than first expected. I replaced IC IL01, but when I observed waveforms with the oscilloscope, I found that the horizontal waveform at pin 20 was normal but that there was no vertical waveform at pin 18 of IL01. Using the ESR meter, I checked for continuity of the printed circuit traces from the top of each pin of the IC to a corresponding component. No broken traces or connections were found (Figure 7).

A quick voltage test on each terminal of IL01 did not turn up any different voltage measurements than those on the schematic. All resistors and capacitors on all pins 11,12,16,17,18, and 20 were checked with no useful results. Again critical voltage measurements were made on all IC terminals. The voltage at pin 17 was higher than the specified value. Was this pin missed during the continuity checks?

The supply voltage terminal was discharged and the ESR meter was used again to check the IC terminals to ground. When RP03 (5.1K ohm) resistor was checked between terminal and foil connection, a poor soldered connection was located. In fact two different soldered connections, on RP03 and RP05, were almost completely open circuited, according to the display on the ESR meter (Figure 8). Resoldering of both terminal connections of each resistor to the PC wiring solved the no vertical sweep problem.

Component or poor soldered connections

The ESR meter can quickly locate a poor soldered connection on a SMT chip or bad end joints. When you find resistance between a chip component terminal and the soldered foil trace, however small, you have located a poor connection. A soft interrupted tone from the meter can also indicate a bad or intermittent connection.

A loss of vertical sweep at the bottom of the picture was noted in a RCA TX82 chassis. All capacitors were quickly eliminated with a quick ESR meter test in the vertical output circuit. When a voltage measurement was made on each terminal of the output IC, CF108 (1µF) was accidentally disturbed, whereupon the picture filled out the screen. CF108 tested normal with the ESR meter (Figure 9).

Initially, CF108 was suspected of being defective (small capacitors of 1µF to 4.7µF have a tendency to become reduced in capacitance) but it checked normal in the circuit. When the end terminal of the 1µF electrolytic was checked to common ground, the connection was found to be bad. Also the ESR meter indicated that the junction of RF108 was a poor connection. The picture returned to normal when both terminals of RF108 and CF108 were resoldered.

Conclusion

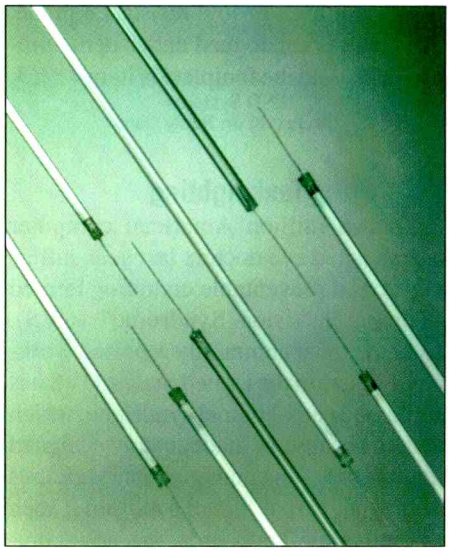
The ESR meter is useful when testing for unknown or known capacity and locating the defective capacitor with in-circuit tests. Besides checking capacitors on the good and bad scale, the ESR meter can locate the capacitor with ESR problems. Poor board connections can quickly be located with the ESR meter. Broken foil traces and SMD connections can be located with the erratic beep of the meter buzzer. Defective capacitors may check normal on a regular capacitor checker and still have a ESR service problem.

One big advantage of the ESR meter is that you can check many capacitors in the TV chassis in minutes and locate the defective capacitor, with in circuit tests. Always remember to discharge each capacitor before attaching the ESR meter probes across the suspected capacitor terminals so you don't damage the meter. ■

New Products

Cold cathode lamps

A new series of cold cathode fluorescent lamps that come in bright white and UV types for use in hand-held instrumentation, purification systems, optical readers or scanners, LCD illumination, and other applications is being introduced by Gilway Technical Lamp. These lamps feature <3.5 mm dia. sizes and come in bright white and ultra violet types for applications requiring a compact source.



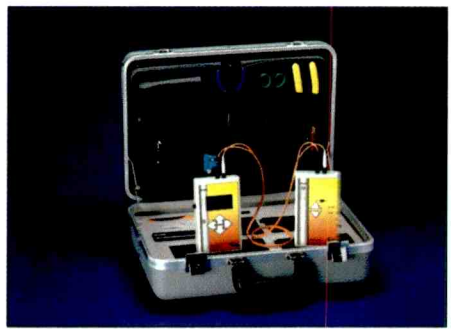
The bright white lamps incorporate special phosphors which enhance visible illumination to 26,000 cd/m2 levels and the UV lamps have a spectral distribution ranging from 300 nm to 400 nm with a peak wavelength of 350 nm.

Providing uniform linear illumination and life ratings >10,000 hrs, the fluorescent Lamps draw only 5mA and are designed to endure shock and vibration in applications such as optical readers or scanners, LCDs, and area illumination of CCD cameras. UV lamps are ideal for use as a UV source in industrial, lapidary, and gem fluorescence testing and medical/dermatological examination. Inverters are required.

Gilway Technical Lamp
Circle (11) on Reply Card

Fiber optic toolbox

A new fiber optic "toolbox" from Fotec offers both the tools needed for fiber optic premises cabling installation and an automated cable tester that tests the cables and



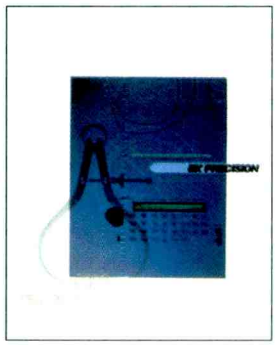
stores data for certification and customer reports.

According to the company, their fiber optic toolboxes contain practically everything an installer needs for installation, test, maintenance and troubleshooting fiber optic networks. The toolboxes include tools for cable preparation, pulling, terminating and splicing, plus a complete set of test equipment. The ACT2 tester included in this toolbox offers automated testing of two fiber links, data storage for certification reports and a built-in fiber optic talkset. The toolbox is available in either hard or soft carrying cases as a no-cost option.

Fotec
Circle (12) on Reply Card

New Product Line Catalog for 2001

B & K Precision Corporation announces its new Product Line Catalog for 2001. The 96-page, full-color catalog can be downloaded from the firm's Web site, bkprecision.com, or is available free of charge by contacting any authorized distributor.



The new catalog features over 50 new and best selling products, including IC Testers, Programmable Power Supplies, Cable Testers, Environmental Instruments, and Video Monitor Testers, as well as a full line an accessories. For use by by electrical and electronic field service, depot service, and engineering/R&D personnel.

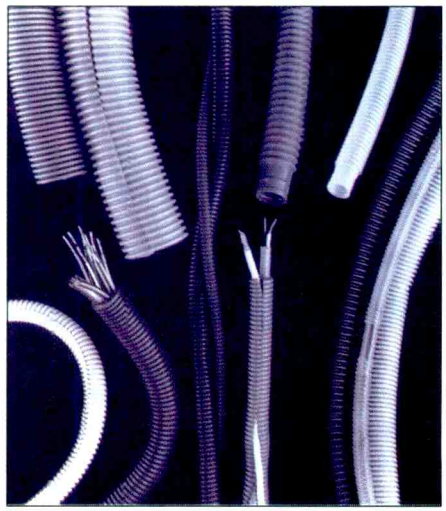
For additional information or the name and location of an authorized distributor near you.

B&K Precision
Circle (13) on Reply Card

Corrugated tubing

A new line of flexible corrugated tubing that bends without restriction for concealing and protecting hose, tubing, and cabling or can be slit to allow easy installation over existing wiring or plumbing is being introduced by Nelco Products.

The NewAge Corrugated Tubing is a lightweight, flexible, covering that can protect contents from abrasion, puncturing, UV, weather, heat, and other elements. Suitable for a variety of functional and decorative applications, this durable



tubing comes in several materials, sizes, and in many standard colors including beige to match hi-tech requirements.

Useful as decorative cover or conduit, the tubing can also be supplied slit to allow easy installation over existing plumbing or wiring. Available in low, medium, and high density- and flame-retardant polyethylene, and heat stabilized or flame-retardant polypropylene, it comes in 17 sizes ranging from 1/4" to 2" dia.

Nelco Products, Inc.
Circle (14) on Reply Card

Mat cleaner

Techspray introduces Mat Cleaner XT, an extra-strength, work surface cleaner. The cleaner is designed for removing hand oils, flux resins and other soils from all types of work surfaces, including ESD-safe mats, ant-static tables, floor mats, hard laminates

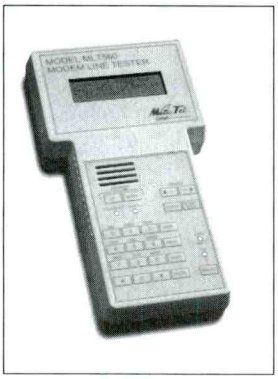
New Products

and bench-tops. This water-based cleaner, will not streak or leave any residue, and is, according to the company, safe and effective for all anti-static surfaces.

Techspray
Circle (15) on Reply Card

Modem Line Tester

The MLT650 from Jensen Tools handheld portable Modem Line Tester allows local service providers and network installers to qualify POTS lines for modem use. Simply dial any dial-up modem on the tester, and it will negotiate the fastest rate up to 56kbps V.90 standard. Bandwidth problems on the talk path are quickly identified. It operates on rechargeable internal batteries with 3 hour operation time. The adapter/charger is included. The unit measures 7.5" x 4" x 2.7", and weighs 1.5 lbs.



Jensen Tools
Circle (16) on Reply Card

ESD area warning sign

The Desco Area Warning Sign, item 06739, is a bright yellow, highly visible poster-size sign. When posted in work areas where ESD control is required, the sign draws immediate attention. The sign is 17" x 22" and is printed on heavy stock and laminated for durability. It also helps meet the requirement of ANSI/ESD S20.20-1999, section 6.2.3.1. This states that "Handling of ESDS (ESO sensitive) parts, assemblies and equipment without ESD protective covering or packaging shall be performed in a Protected Area. Caution signs indicating the existence of the Protected Area shall be posted and clearly visible to personnel prior to entry to the Protected Area."

ESD Systems
Circle (17) on Reply Card

Personal grounding tester

The Pilgrim PGT-1 Personal Grounding Tester from ESD systems.com tests wrist straps and coil cords. An optional footplate provides for testing foot straps and for ESD shoes per ANSI-Z41. The tester has a fast response to detect intermittent wrist strap and coil cord connections. The tester is compatible with international power: 120/240Vac, 50/60Hz. In addition, the unit will verify the polarity and ground integrity of an electrical outlet. Audible and visual indicators tell the operator whether their wrist strap, foot strap, or shoe has passed or failed in a high or low resistance mode. The tester is catalogued under Item number 41220 and the footplate is Item 41213.

ESD Systems
Circle (18) on Reply Card

Task lighting

Sixteen million American computer users visited eye doctors last year suffering from a preventable condition termed "Computer Vision Syndrome" (CVS). Now the most commonly reported workplace injury in the United States, CVS has surpassed carpal tunnel syndrome, which occurs because of inadequately designed input devices and poor posture. Measures to prevent carpal tunnel syndrome, such as ergonomic keyboards, are now commonplace. But what most computer users still don't know that a new lighting technology, which brings natural daylight indoors, can stop the symptoms of CVS (headaches, eyestrain, blurred vision) before they begin.

OTT-LITE VisionSavers, from Environmental Lighting Concepts are specially designed to replicate specific wavelengths of natural daylight, which are needed by all computer users. Graphic artists, who frequently need Northern Daylight or PMS swatches, can now color match Video Display Terminals (VDT's) and output devices without resorting to a window. Workers who are disturbed by glare from ambient lighting (some of whom suffer from CVS) can now quickly and easily solve the problem. These lights use a special blend of rare earth phosphors that owe their existence to the work almost a half - century ago of a photographer who simply wanted plants to blossom in his cellar.

Environmental Lighting Concepts
Circle (19) on Reply Card

Literature

Terminal, connector, application equipment catalog

A new comprehensive catalog featuring virtually any product or special application equipment involved with the termination of wire is being offered by ETCO Inc. The catalog features 180 pages describing standard and custom product offerings which include automotive products such as spark plug and distributor terminals, and various types of boot insulators; cord products including blades, pins, and female contacts for 110/220V power supply cords, and male and female inserts for automated production; engineered products including over 1,500 standard connector products such as rings, spades, disconnects, pins, and receptacles; a wide range of insulated quick connectors; and a broad line of application equipment.

ETCO Incorporated
Circle (20) on Reply Card

Cross-reference update

Philips ECG announces the addition of Relays and update of Semiconductors to the on-line Cross-Reference.

The company's website, www.ecg products.com, on-line cross-reference now has the capability of cross-referencing popular U.S., Asian and European relay part numbers.

Visiting the website at and clicking on the "On-line cross-reference" link can access this program. Select either "Relay Cross-Reference", or "Semiconductor Cross-Reference" and enter the number for which you are looking for a replacement.

Philips ECG
Circle (21) on Reply Card

ESD control products catalog

ESD systems.com has a new 68-page catalog with over 1,000 items for electrostatic discharge (ESD) control. The catalog lists wrist straps, foot grounders, grounding devices, floor and table mats, floor finish, smocks, ionizers, monitors and testers, shielding bags, tape, educational materials, and more. A full-service web site offers quick access to a comprehensive site on ESD control.

ESD Systems
Circle (22) on Reply Card

Light measurement catalog

A 36-page catalog that features a new fully automated spectral analysis system, various other instruments and systems, along with an expanded metrology laboratory that provides NIST traceable calibrations is being offered by International Light, Inc.

The IL Light Measurements Catalog 2001 is a complete source of portable and benchtop instruments and components for performing light measurements from the UV through near IR, in virtually any environment. Featuring the new fully automated IL2000 SpectroCube Spectroradiometer with a built-in modem for remote operation, this catalog also describes the firm's calibrations lab, which meets ANSI.Z540-1 and ISO.10012-1 requirements.

Describing thousands of modular system combinations for manufacturing, quality control, and research applications, the 36-page catalog includes standard systems for performing photoresist and photoexposure measurements, UV curing, photostability testing, LED and flash measurement, photodynamic therapy and photobiology, optical radiation hazard testing, laser power measurements, and more.

International Light, Inc.
Circle (23) on Reply Card

Test instruments catalog

B&K Precision announces the availability of its new product line catalog for 2001. The 96-page, full-color catalog can be downloaded from the firm's website, www.bkprecision.com, or is available free of charge by contacting any authorized distributor.

The new catalog features over 50 new and best selling products. These include IC testers, programmable power supplies, cable testers, environmental instruments and video monitor testers, as well as a full line of accessories. The catalog is expected to be a useful source document for use by electrical and electronic field service, depot service and engineering R&D personnel.

B&K Precision
Circle (24) on Reply Card

NEW WEBSITE

WEBSITE FOR TOOL CASES

Jensen Tools has launched www.jensencases.com. This new site focuses on Jensen's selection of cases, including shipping cases, foam-filled cases, computer and business cases and tool cases. In addition to this, the site offers carts and trucks, tools and lighting and electrical products. Other features include tips on selecting the right case and a glossary of case terms.

The site offers free technical support, online technical documents, a 24 hour/7 day FaxBack service, secure online ordering, and flexible shipping options, plus a UPS tracking feature that allows customers to check the status of shipments.

Jensen Tools Inc.
Circle (25) on Reply Card

Books

Semiconductor Cross Reference on CD-ROM: 2nd Edition

By the Engineering Staff of
Sams Technical Publishing
ISBN #0-7906-1231-3
CD-ROM $39.95

From the Engineering staff of Sams Technical Publishing comes an enhanced, completely updated, electronic version of their best selling semiconductor cross reference guide. Semiconductor Cross Reference on CD-ROM: 2nd Edition contains over 628,000 part numbers, type numbers and other identifying numbers all cross referenced to completely update ECG, NTE, TCE and Radio Shack replacement number database. More than 125,000 new devices have been added.

This enhanced version gives the user an OEM-to-OEM part number cross reference. Just type in the part number of the device to be replaced, and the cross reference will not only give you the suitable replacement numbers for the original device, it will also list any of the 628,000+ OEM or device type numbers that have the same replacements as the original number.

System Requirements: Windows 95 or higher; 68 MB of free disk space; will work directly from the CD or will load completely to your hard drive.

Sams Technical Publishing
5436 West 78th Street
Indianapolis, IN 46268
800-428-7267
Fax: 800-552-3910

Semiconductor Cross Reference Book -Fifth Edition

By the Engineering Staff of
Sams Technical Publishing
ISBN #0-7906-1139-2
864 Pages $39.95

Sams Technical Publishing, the company that produces PHOTOFACT service documentation, has added thousands of new semiconductors to the all new, completely updated, fifth edition of the Semiconductor Cross Reference Book, a comprehensive cross reference available for engineers, technicians, and all those who work with semiconductors. Over 628,000 Manufacturer's part numbers are crossed to ECG, NTE, TCE, and Radio Shack replacement part numbers to provide complete coverage of all major semiconductor types: bipolar transistors, FETs, diodes, rectifiers, ICs, SCRs, LEDs, modules, and thermal devices.

Key Features include:

- More than 628,000 semiconductors listed.
- Used with Prompt's Manufacturer-to-Manufacturer Part Number Cross Reference, this becomes the best repair tool you have.
- Complete, up-to-date replacement listings for ECG, NTE, TCE and Radio Shack cross references.
- An excellent tool for technicians of any experience level.
- Up-to-date list of original equipment manufacturers.

Semiconductor Cross Reference Book is divided into two sections:

- Section 1: Original Device Types

This section lists device types in alphanumeric order by manufacturers' part number, type number, or other identification. Next to the part number is a replacement code that you will use to look up replacements in Section 2.

- Section 2: Replacements

This section provides substitutions and replacements for the semiconductors listed in Section 1.

This book lists part numbers from the United States, Europe, and the Far East. All major types of semiconductors are covered: bipolar transistors, FETs, diodes, rectifiers, ICs, SCRs, LEDs,modules, and thermal devices. The Semiconductor Cross Reference Book is

four cross references in one, showing the most up-to-date replacements part numbers from NTE, ECG, Radio Shack, and TCE, with an up-to-date list of original equipment manufacturers.

Sams Technical Publishing
5436 West 78th Street
Indianapolis, IN 46268
800-428-7267
Fax: 800-552-3910

Is This Thing On?

By: Gordon McComb
ISBN #: 0-7906-1081-7
136 Pages $19.95

Is This Thing On? is a useful guide written principally for those responsible for sound systems in churches, schools, city offices, hotels, and auditoriums. The book takes readers through each step of selecting components, installing, adjusting, and maintaining a sound system for small meeting rooms, churches, lecture halls, public-address systems for schools or offices, or any other large room that requires sound system equipment.

It explains in easy-to-understand terms, with drawings and illustrations, the exact procedures behind connections and troubleshooting diagnostics. With the help of this book, hobbyists and technicians will be able to avoid the problems that often arise in setting up sound systems for events and lectures that rely on sound technology.

Is This Thing On? covers basic components of sound systems, the science of acoustics, sound system specifications, wiring sound systems, and installing wireless mikes, CD players, portable public-address systems and more. The book begins by explaining different types of sound systems, basic components, and general information on tools and safety. It then deals with the basics of acoustics, discusses how sound is affected by an enclosed room, explains acoustic feedback, and reviews common sound system terminology.

- Chapter 1: Introducing Sound Systems
- Chapter 2: Learning the Science of Acoustics
- Chapter 3: Understanding Sound System Specifications
- Chapter 4: Installing Sound System Components
- Chapter 5: Wiring Sound Systems
- Chapter 6: Testing, Adjusting, and Operating Sound Systems
- Chapter 7: Maintaining and Troubleshooting Sound Systems
- Chapter 8: Installing and Using Sound System Add-Ons

About the Author:

Gordon McComb has written more than 45 books, including Speakers for Your Home and Automobile and Security Systems for Your Home and Automobile, both published by PROMPT Publications. In addition, he has written numerous books on computers, robotics, and lasers. McComb is an avid experimenter, and likes to spend his free time working in his home electronic music studio.

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5436 West 78th Street
Indianapolis, IN 46268
800-428-7267
Fax: 800-552-3910

Making Sense of Sound

By: Alvis J. Evans
ISBN #: 0-7906-1026-4
112 Pages $14.95

How is sound electronically reproduced? What are pitch, fidelity, and distortion? How do today's electronic components work together to produce quality sound? These questions and many more are answered in the book "Making Sense of Sound, The Basics of Audio Theory and Technology."

Through easy-to-understand and clearly-illustrated text, Making Sense of Sound will teach you the basics of audio theory and its relationship to today's audio technology.

- Chapter 1: Fundamentals of Stereo Sound Systems
- Chapter 2: About Amplifiers
- Chapter 3: Kinds of Distortion
- Chapter 4: Sound Transducers
- Chapter 5: New Sound Concepts
- Chapter 6: Recording and Playback
- Chapter 7: System Noise
- Chapter 8: AM/FM Tuners and Receivers
- Chapter 9: Video and TV Stereo

About the Author:

The author of Making Sense of Sound, Alvis J. Evans, is an associate professor of electronics at Tarrant County Junior College in Ft. Worth, Texas. The author of many book on the subjects of electricity and electronics for both beginning hobbyists and advanced technicians, Mr. Evans is in demand to teach seminars and workshops nationwide to members of the trade. Five other books by Alvis Evans are available from PROMPT Publications: The Multitester Guide, The Right Antenna, 2/E, Sound Systems for Your Automobile, Speakers for Your Home and Automobile, 2/E, and VOM and DVM Multitesters for the Hobbyist and Technician.

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Indianapolis, IN 46268
800-428-7267
Fax: 800-552-3910

Self on Audio

Douglas Self
ISBN: 0 7506 4765 5 Paperback
Pages: 416pp
Price: $37.95

This book is a collection of the essential Electronics World articles, covering twenty years of amplifier technology but with a very strong bias towards more recent material. The articles include self-build projects as well as design ideas and guidance for the professional audio designer. The result is a unique collection of design insights and projects - essential for all audio designers, whether amateur or professional.

Douglas Self has dedicated himself to demystifying amplifier design and establishing empirical design techniques based on electronic design principles and experimental data. His rigorous and thoroughly practical approach has established him as a leading authority on amplifier design.

Contents: Introduction; PRE-AMPLIFIERS: An advanced preamplifier MRPI; High-performance preamp MRP4; Precision preamp MRP10; Moving-coil head amp; Preamp '96 I; Preamp '96 II; "Overload Matters" (RIAA overload); Balanced line inputs and outputs, part 1; Balanced line inputs and outputs, part 2; POWER AMPLIFIERS: FETs less linear than BJTs; Distortion in power amplifiers 1-8; Distortion residuals; Trimodal part 1, 2; Load-invariant power amp INVAR.DOC; Common-emitter amps; Two-stage amplifiers; SPEAKERS: Excess speaker currents; Class distinction (amp classification); Relay control; Power

Books

partition diagrams; Audio power analysis.

Butterworth-Heinemann
225 Wildwood Avenue
Woburn, MA 01801
800-366-2665
Fax: 800-446-6520

Assembling and Repairing Personal Computers, 2/e

Dan L. Beeson,
Pima Community College
Copyright 2000, 458 pp.
Paper Bound with Disk format
ISBN 0-13-081949-2

For courses in PC Assembly, Troubleshooting and Repair.

This text divides the personal computer system into subsystems, giving brief theory of operations, installation instructions, and testing procedures. The material is presented in practical, manageable sections to be easily assimilated by the beginning user and easily referenced by the practicing technician.

Features

- NEW-Information on newest microprocessors.
- NEW-The latest technology-e.g., new ATX motherboards, new AGP video graphics ports, new USB Universal Serial Bus, new DIMM memory, and Windows 98.
- Parenthetical "notes" sections.
- Alerts students that sections are intended for the beginner or technician to save time in finding information.
- Troubleshooting sections.
- Guides students to clear and easy diagnosing.
- Special sections-On CD-ROMs, sound cards, optical scanners, and modems/faxes.
- Provides students with an exposure to various ancillary devices they will encounter in their professional careers.
- Photos, drawings, and tables.
- Provides visual representations of topics under discussion.
- Easy-reference lists.
- Offers students quick reference to the text's tables, figures, chip pin outs, connector pin outs and programs.
- Review and Quiz problems.
- Provides students with reinforcement at the end of each chapter.
- Valuable appendices.
- Provides students with access to additional related materials and rationalization.
- Evaluation copy of The Troubleshooter.
- Provides students with opportunity to become familiar with the industry's best diagnostic software.

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One Lake Street
Upper Saddle River, NJ 07458
973-236-7825

A+ Certification and Lab Manual Pkg., 2/e

Charles J. Brooks
Copyright 1999, 370 pp.
Paper format
ISBN 1-58076-007-4
Summary

For courses in A+ Certification,

Calendar of Events

CONSUMER ELECTRONICS SHOW (CES)
JANUARY 6 — 9, 2001
Las Vegas Convention and Las Vegas Hilton
Alexis Park and Riviera
Las Vegas, NV
Consumer Electronics Association
2500 Wilson Boulevard
Arlington, VA 22201-3834
703-907-7605
www.ce.org

COMDEX/Chicago 2001
(Formerly COMDEX/Spring)
APRIL 3 — 5, 2001
McCormick Place, Chicago
Key Media
300 First Avenue
Needham, MA 02494-2722
781-433-1500
www.comdex.com

NATIONAL ALL SERVICE CONVENTION (NASC)
FEBRUARY 7 — 11, 2001
Delta Resort
Orlando, Florida
Professional Service Assoc.
71 Columbia Street
Cohoes, NY 12047
518-237-7777
www.psaworld.com

CABLE-TEC EXPO 2001
MAY 8 — 11, 2001
Orlando, FL
Society of Cable Telecommunications Engineers
140 Philips Road
Exton, PA 19341
610-363-6888
www.EXPO2001info@scte.org

ELECTRONIC DISTRIBUTION SHOW & CONFERENCE (EDS)
MAY 15 — 17, 2001
Educational Programs
May 14
Las Vegas Hilton
Las Vegas, NV
Electronic Distribution Show Corp
222 South Riverside Plaza
Suite 2160
Chicago, IL 60606
312-648-1140
www.edsc.org

NATIONAL PROFESSIONAL SERVICE CONFERENCE (NPSC)
JULY 30 — AUGUST 4, 2001
Riviera Hotel,
Las Vegas, NV
National Electronics Service Dealers Association (NESDA)
2708 Berry Street,
Fort Worth, TX 76109
817-921-9061
www.nesda.com

NPSC 2001
National Professional Service Convention and Professional Service Trade Show

CUSTOM ELECTRONICS DESIGN AND INSTALLATION ASSOCIATION (CEDIA)
SEPTEMBER 5 — 9, 2001
Indianapolis Convention Center
Indianapolis, IN
CEDIA Headquarters
9802 N Meridian Street,
Suite 200
Indianapolis, IN 46260
800-669-5329
www.cedia.org

CEDIA EXPO 2001
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Computer Architecture, Computer Repair and Service, Advanced Electronics, PC Troubleshooting, Basic Software Troubleshooting and Computer Science at two- year schools and vocational and technical colleges.

Designed to prepare students for the A+ Certification exam sponsored by the Computing Technology Industry Association for computer service technicians, this text and lab guide provides students with conceptual information and hands-on practice to provide a fundamental knowledge base.

Features

- NEW-Information added on all of the new A+ objectives established in 1998.
- Reflects for students the new A+ standards in every chapter.
- NEW-Original chapter on System Software has been split into two chapters: chapter 4, Operating Systems and chapter 5, Microsoft Windows.
- Provides students with greater coverage of the bootup process, DOS troubleshooting, and Windows 95 organization and troubleshooting information.
- NEW-Troubleshooting coverage has been reorganized.
- Integrates Symptoms sections to the chapters where each components troubleshooting sequence is discussed instead of in one separate chapter.
- NEW-Coverage of Microsoft Windows 3.x and Windows 95 Theory.
- Provides students with the most current coverage.
- NEW-Additional OS troubleshooting information.
- Prepares students with hands-on practice.
- NEW-A+ Core Exam Margin Icon.
- Directs readers to focus on key content related to the Core exam. Appendix A provides a complete list of A+ objectives that links directly to the margin icons in each chapter.
- NEW-A+ DOS/Windows Margin Icon.
- Directs readers to focus on key content related to the DOS/Windows exam.
- NEW-New multiple choice questions.
- Tests students knowledge of basic questions.
- NEW-New boxed content.
- Provides a visual break for students and highlights important information and definitions.
- Learning objectives at beginning of each chapter.
- Enables the student to preview the content of the chapter and obtain a framework for study.
- Key terms in boldfaced type when terms are first introduced and defined in the chapter.
- Reinforces important terms for student to remember.
- Extensive and varied end-of-chapter material.
- Provides students with multiple-choice questions, open-ended review questions, and lab manual exercises, all designed to test and reinforce knowledge and to provide hands-on lab work.
- Accompanying MCP Test Prep A+ CD-ROM shrink-wrapped to the back of each book.
- Allows students to complete mock tests, determine their weak points, and study more strategically with three styles of testing: flash card style, study card style, and full assessment.
- Detailed diagrams and screen shots in each chapter.
- Provides students with constant visual reinforcement of the concepts discussed.
- Key Points section at the end of each chapter.
- Summarizes chapter concepts for students.

Prentice Hall Publishing Company
One Lake Street
Upper Saddle River, NJ 07458
973-236-7825

Microcomputer Repair, 3/e

James L. Antonakos, Broome Community College
Tom Adamson
Copyright 1999, 693 pp.
Paper format
ISBN 0-13-893454-1

Summary

For Microcomputer Repair/Servicing and Computer Architecture courses at the senior level. Requires no prior knowledge of electronics, and minimal acumen in math and theory. Emphasizing the development of essential troubleshooting and repair skills, this combinatory text/lab manual offers a clearly written and highly organized approach to teaching beginning technology students the fundamental skills required for hardware and software servicing of microcomputer systems. Expanded and updated, it now consists of 59 exercises (vs. 48 in the previous edition) which are divided into seven (vs. five) units, with each unit addressing a specific range of topics.

What are your thoughts on using a text/lab manual combination for the microcomputer repair course?

Features

- Offers a well-designed, "self-contained module" exercise format, enabling instructor's to tailor their courses to their students' technical backgrounds and employment preparation goals.
- Starts off with a sound introduction to the use of the text, the lab, safety requirements, and basic tool usage.
- Familiarizes students with the fundamentals of electronic hardware, basic soldering skills, and integrated circuit identification.
- Instructs students on the rudiments of DOS.
- Gives students hands-on experience in the teardown and assembly of microcomputer systems.
- Covers a wide range of microcomputer-related topics, from assembly language to computer networks and software viruses.
- Includes exercises on CD-ROM drives and sound cards, memories, the advanced Intel processors, assembly language, computer viruses, and computer networks.
- Offers a strong pedagogical framework to support each exercise:
  - Performance Objectives.
  - Required Materials.
  - Background Information.
  - Troubleshooting Techniques.
  - Self-Tests.
  - Familiarization Activities.
  - Questions/Activities.
  - Review Quiz.

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Tel: 516-883-3382 Fax: 516-883-2162

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ES&T Readers Speakout

READER OPINION SURVEY/COMMENTS

The September issue Reader Opinion Card asked our readers to:

- **Indicate key business or technology topics ES&T should cover, or continue to cover.**
- **Share thoughts about market happenings, events, directions, difficulties and/or opportunities you believe we should address.**
- **And, make comments on this first issue published by Mainly Marketing.**

The October card asked more on profax.

Hope change in management is for the best. Technology moves fast — you guys started to lag. New focus on trends and keep up dates each issue.
R.M.M. – Dolton, IL

I think the articles by Jim Wilson were intended for Engineering students in their junior year at college, not for a technician. The articles by Bob Rose are printed without anyone verifying his methods of trouble shooting.
S.G. – San Leandro, CA

Service on TV/VCR combos: high cost of service info. Very good issue.
C.P. – Cambria, CA

I would like to see more computer hardware related articles, with in depth troubleshooting and repair Sections. I would like to see an Employment section where CET's are offered jobs around the country or even around the world. I enjoy ES&T magazine and believe it is a great benefit to all technicians that read it, especially aspiring technicians/students.
G.E.F. – Vacaville, CA

ES&T: Employment Section begins in January 2001.

I liked the article on 21st Century TV. Since we only repair TVs and are a one man shop, articles that address our situation are the greatest interest.
W.S. – Grass Valley, CA

Would like more articles like repairing 21st Century TVs.
B.D. – Torrance, CA

Telecom Test Equipment.
P.M. – Roseville, CA

I must have been on Mars...This is the first I have heard of NPSC. Are they part of NESDA?
F.T.S. – Philadelphia, MS

ES&T: Yes, contact NESDA at ???-???-???? for full information.

New product reviews. Keep the Free Reader Service Card.
N.B. – Waxhaw, NC

This is a good issue, but the August issue was even more interesting. Also, very important to me is the change in color of the Profax. Now in white I can read it much easier. I hope you continue with white.
O.L. – Reno, NV

Print quality of schematics was poor. Compare the print quality of September's Profax schematics with those of previous issues printed on special paper.
T.G. – Sunnyvale, CA

TV, VCR Repairs DVD, CD, HDTV and computers.
C.G. – Fremont, CA

Enjoyed tools of trade and 21st Century TV repair. Preferred centerfold on non-glossy paper. Liked idea of comments and request for literature on same card.
J.C. – Elgin, Ontario, Canada

ES&T: Profax paper and color will be determined by the October issue comment cards and the change will take place with the January issue.

What a Pleasant surprise!!!!!!!!!! We need you!!!!!!!!!! Love the 1st Issue!!!! P.S. KEEP YOUR ADVERTISING SALES TEAM HOPPING!!!!
R.J.E.

ES&T: Thanks! You can help defray our costs by telling your vendors you read ES&T.

From one who started reading PF Reporter 50 years ago-the September issue looks great.
K.K.

Laser-Printers, HDTV-DTV.
F.V. – Las Vegas, NV

CCTV - Closed Circuit Television (video) provides a need for service and we have the know-how now would like more exposure.
H.L.J. – Garfield Heights, OH

Continue the excellent articles on different consumer electronics repair TV, VCR, microwave, etc.
T.S. – Only, TN

TV & VCR Servicing. PC test and servicing. Your isolation transformers on page 48, very informative. We need more on this.
G.H. – Bayamon, PR

This is, as usual, an informing issue. Please cover servicing tips on Magnavox TV sets. Also, servicing information on washers, dryers and microwave ovens I.G., GE and Samsung products.
P.O.T. – Orlando, FL

ES&T: Is there more interest in large white goods electronic servicing? Let us know.

Power supplies of consumer sets. Theory and Practical schematics. Ownership of consumer products. "Manufacturing."
D.H. – Christiansted, USVI

Test equipment. Troubleshooting. Product evaluations.
R.J.P. – Raleigh, NC

More updates on new and up-coming technology.
R.H. – Saye, OK

Bob Rose's articles are very good. Would like to see more articles on other brands such as: Sony, Sanyo, Symphonic, Samsung. Maybe Bob Rose could write an article on AC/DC combination TV VCR units. Especially Symphonic combo.
R.R. – Nutly, NJ

Excellent. Why not use a variety of TV/VCR manufactures for Profax? Are you stuck with RCA? How about Samsung, JVC, Sony, Toshiba, etc.? Here in Canada, we also have Electrohome, Magnasonic, Sansui and others. (Sears) Why not talk about cassette mechanisms and Aiwa's CD mechanical systems? Printing Calculators? Phones and related equipment? Music eyboards/organs? Sony Playstations?
S.B.B – Grandfalls, NB, Canada

Would like to read more on CD servicing. I don't see enough of it in ES&T.
J.A.B. – Chicago, IL

Invite more reader input on problems with products that are common and suggest fixes. We need more info on getting parts for monitors/phones and other products. Why is it so hard to get info from computer manufactures? How about a section on repair tips, possibly from manufacture field input? By the way I did not receive my July 2000 issue, and I just got my Sept. 2000 issue on Oct. 18, 2000.
M.J.W.J.– Dartmouth, NS, Canada

TV servicing, HDTV updates, and service websites.
J.A.F Jr. – Lakeview, OH

Keep the updates coming.
M.C – Des Plaines, IL

Great article "Repairing 21st Century TVs". How about articles on "CHIPPERCHECK" and the same for other manufactures especially for Computer Monitors SGI and DEC Sony converts.
A.H. – Gatco, CA

More articles on CD players, repairing, parts, diagrams and where to get. Go back to putting an at end of article this way we know it ends. Also on SMD remove and replace How to - Help.
M.G. – W. Palm Beach, FL

ES&T: See page 38 in this issue.

Would like to see more articles on test equipment, auto electronics testing and schematics, articles covering actual theory and servicing of TV, VCR, Auto Electronics, New Products, etc. I appreciate you printing my comments on the first ES&T issue. Thanks.
R.P.A – Sissonville, WV

This is a very interesting and informative professional magazine. Keep up the excellent work.
A.H. — Brooklyn, NY

More How to Learn Tech. on New Technology.
J.E. — New Rochelle, NY

Thank you very much for the attention you gave to project. Thank you also for being so kind as to publish my entire work in the October issue of Electronic Servicing and Technology. I have gotten a great deal of replies in the past few days. I will keep in touch, and let you know how my entries fare. This paper will be going into Long Island Science Congress, Intel Science and Engineering, Intel Talent Search, as well as St. Johns Symposium. If its not too much trouble, could you be so kind as to tell me where I could purchase a copy of the October issue of ES&T.
L.G. – Bethpage, NY

Send your comments, questions, suggestions, complaints and kudos to:

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403 Main Street, 2nd Floor
Port Washington, NY 11050
dallen@mainlymarketing.com
Fax: 516-883-2162

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ELECTRONIC Servicing & Technology

2001 EDITORIAL SCHEDULE

As of 11/7/00

Watch for these Features, Special Reports, Technical Updates and other articles designed to help Consumer Electronics Service and Maintenance Professionals stay current and grow.

ISSUE		SPECIALS	COMPUTERS/ NETWORKING/ AUTOMOBILE ELECTRONICS	CONSUMER ELECTRONICS	TOOLS/ EQUIPMENT COMPONENTS	HOME THEATER	50TH ANNIVERSARY	SHOWS/ CONFERENCES
JAN	CES SHOW ISSUE NASC PREVIEW	2000 ANNUAL INDEX OF ARTICLES AND PROFAX SCHEMATICS	DVD	Playstations	Materials Handling: ESD to Moving Equipment		50th Anniversary – History Part 1	CONSUMER ELECTRONICS SHOW (CES) 2001 January 6-9, Las Vegas Convention Center, Alexis Park & Riviera, Las Vegas NV
FEB	NASC SHOW ISSUE	REFERENCE ISSUE on Service Tips: CD's, Webs and OEM contacts	Scanners	VCR/TV Combos	Service Management Software	Phone Systems	Service Center Management Trends	NATIONAL ALL SERVICE CONVENTION (NASC), February 7-11, Delta Resort, Orlando, FL
MAR	COMDEX PREVIEW NASC REVIEW	TOOLS AND TOOLCASE SHOWCASE and Review	Printers	VCRs	Test Equipment Update	Designing Your Showcase Site	Circuit Board Rework Opportunities, Solutions	
APR	COMDEX SHOW ISSUE EDS PREVIEW	DISTRIBUTION SHOWCASE and Review	Rewritable Disk Systems	CCTV	Test Probes/ Accessories Update	Antennas/ Top Boxes for HDTV	50th Anniversary – History Part 2	COMDEX/CHICAGO 2001 (Formerly COMDEX-Spring) April 3-5, McCormick Place, Chicago, IL
MAY	COMDEX REVIEW, CABLE-TEC SHOW ISSUE, EDS SHOW ISSUE, NETWORLD+INTEROP SHOW ISSUE	15th ANNUAL WEB and BUYER'S GUIDE. Includes multiple manufacturer/ distributor listings in the Product Directory and a Company Contact Directory, including Web and Email addresses	Monitors	Marine Electronics	Electronic Servicing Supplies	Audio/Sound Installation and Maintenance	Cost of Service Today	CABLE-TEC EXPO 2001, May 8-11, Orlando, FL. ELECTRONIC DISTRIBUTION SHOW & CONFERENCE (EDS), May 15-17 (May 14 Educ.), Las Vegas Hilton, Las Vegas, NV. NETWORLD+INTEROP, May 6-11, Las Vegas Conv. Center, Las Vegas, NV
JUN	EDS, COMDEX, CABLE-TEC & NETWORLD REVIEWS		GPS/Auto, Marine, etc.	Camcorders	Soldering Desoldering	Network Installation and Maintenance	Learning Programs	
JUL	NPSC PREVIEW		Auto Computer Systems	Microwave Ovens	Oscilloscope Update	Servers	50th Anniversary – History Part 3	
AUG	NPSC SHOW ISSUE CEDIA PREVIEW	REPLACEMENT PARTS SHOWCASE and Review	Firewire	Digital TV	Multimeter Update	Lighting	Complying with Environmental Considerations	NPSC (NESDA/ISCET) Conference, July 30-Aug. 4, Riviera Hotel, Las Vegas, NV
SEP	CEDIA SHOW, NETWORLD+INTEROP SHOW ISSUE	HOME THEATRE SHOWCASE and Review	Telecom Test Equipment	HDTV	Transformers	Power Management	Home Theatre Opportunities	CEDIA, Sept 5-9, Indianapolis Convention Center, Indianapolis, IN. NETWORLD+INTEROP, Sept. 9-14, Atlanta, GA
OCT	CEDIA, NETWORLD REVIEW, COMDEX PREVIEW	MANUFACTURERS PRODUCT BRAND Directory	PC Testing Tips	Keyboards/ Organs	SMD	Servicing $10,000+ TVs	50th Anniversary – History Part 4	
NOV	COMDEX SHOW ISSUE		Computer Software Diagnostics	Cassette Mechanisms	Power Supplies	Rear Projection	Servicing TVs Today	COMDEX-FALL 2001, Nov. 12-15, Las Vegas Convention Center, Las Vegas, NV
DEC	COMDEX REVIEW	TEST EQUIPMENT SHOWCASE and Review	Internet Access	CD Players	MPU's	Security	New Technology Update	

IN EVERY ISSUE: New Products, New Literature, News, Book Reviews, Photofacts and Profax.

To be scheduled or added as available: Test Your Electronics Knowledge (TYEK), Troubleshooting Tips, Video Corner, Computer Corner, Audio Corner, Business Corner, Communications Corner, The Smart Building, Successful Servicing, What Do You Know About Electronics (WDYKAE), Service Organization Profiles.

READERS' EXCHANGE

Readers' Exchange is a free service. 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.
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- All submissions must be typed or printed clearly!

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B&K Transistor checker model 510. Excellent Condition. $95.00 with case. Sencore Touch Tone Cricket Transistor Checker, Model TF26. Will also test jets and leakage in or out of circuit. Excellent Condition. $125.00. B&K Sweep Function Generator Model 3017. Good for Audio & Circuit Tracing $75.00. Contact Gordon Lane, 239 Jacksonion Dr., Hermitage, IN 37076., 615-889-6195.

Sencore Technical training tape no. TV 300, Understanding Horizontal Stages, with workbook in binder (used one time) $30 plus freight, The Servicer's Advantage by Sencore Tech Tips no. 101 through 230 in binder $30 plus freight. Also, ES&T magazines years 1983 through 1992 (120 issues) and years 1994 thru 1999 (49 issues, 11 missing) $50 plus freight. Will send everything for $100 plus freight. T.T. Walton, 3403 Crestmont Dr., Midland, TX 79707, Phone 915-520-6553.

Sencore VC93 Video Analyzer, like new, all probes, manual, video tapes, $825.00. Contact James Wajid 914-831-5981.

Radio Shack 3-Meter CB Tester $15. NRI Signal Tracer $25. Fluke 806DA True RMS Multimeter $200. Microwave Oven Leakage Tester $40. Contact Leonard Duschenchuk 561-871-5831.

Sencore SC 3100 Waveform Analyzer $2,300.00. Sencore VC93 VCR Analyzer $1,100.00. Both in mint condition. Please contact Steve Berry at 734-586-4137 or email scberry5401@aol.com.

B&K 545 component analyzer. $1950 612-866-6183.

Wavetek Signal Analysis Sams 450-$250 and Sams Digital Model III at $350. Both in soft cases like new. Alex Minelli, 718 Michigan Street, Hubling, MN 55746, 218-263-3598.

Due to medical bills necessary to sell new-old stock radio tubes-no TV's no trash-100 large tubes or 200 small tubes $93 each. When sold all tubes gone, add shipping. Also must sell old radio books and catalogs. Maurer Television, 29 South 4th Street, Lebanon, PA 17042, 717-272-2481. Waiting for return call.

Sencore, New SC3100, Scope Meter, Frequency Counter $1,995; New Sencore, PRS570, Digital AC Isolation Transformer $595; Many other pieces of test equipment priced to sell. Email: sdcalal@att.net for complete list and prices. Contact Alex, 858-274-6935 (work) 9-5 Pacific Time.

WANTED

Mitsubishi 35" TV model #CS-3504R – need front door part #702C757030. Contact Todd in Felton, PA at 717-993-5164.

SCREAN for Lap-Top, Toshiba Satellite 335 CDT or 330. 718-477-1385, email jkmny@aol.com.

Marantz FC #LC-6554-4151 or Marantz AMP Model IA2232SB. For parts, Mackenzie TV Service, 1800 N. Scottsdale Rd., Scottsdale, AZ 85257, Phone: 480-946-7270, Fax: 480-946-2549, Email: marjmac@home.com.

CRT's for NEC 6PG+ or 9PG+ Projectors PT# E8508A – RP, GP, BP or copy of service manual. Fax: 562-924-9626.

Need service manual, Schmetic, for a NEC-Model CD-510-CD player. Will copy and return or buy. Murray's Repair Service 561-966-8862.

Manual for EPROM programmer. Model DATA I/O 990-1902 system 19. jkmny@aol.com, tel 718-447-1385.

Sencore HA2500 sweep analyzer. Call Skip 631-363-6910.

SONY OBSOLETE PARTS: Part #1-809-120-21 (5 pin) Regulator module I.C. #DM 43. Part #1-808-979-11 (10 pin) High voltage protect module. I.C. #PM 501. Will accept good (used) or new part. Needed to complete repair job—HELP!!!! Contact: Appliance Service, 121 E. 5th Avenue, Tallahassee, FL 32303, phone and fax 850-224-4710.

Yoke: YS-53929K for 19" Spectricon TV M9C2-1K3, SAW filter for Wards 19" TV JSA-12646, Schematic for Toshiba 26" TV 289 X 4M. Worley, 305 Hickory Bend Rds., Enterprise, AL 36330, email: worley@snowhill.com, 334-347-5281.

Adapter Socket #CR-31 for B&K Picture Tube Tester Rejuvenator #470. Ed Herbert, 410 N. Third Street, Minersville, PA 17954.

Service manual and schematics for JVC-VCR Mod. HR-D960U. Will pay for copying or copy and return. BRS Electronics, 1329 Twining Road, Dresher, PA 19025, 215-659-2349.

95-4170 Zenith Fly or 9-848-02R Board. Write David Lehmann at R2 Box 104, Mansfield, MO 65704 or call 417-924-3350.

Sharp Camcorder VL-L250U, Philips O Scope PM 3212, Navy Impedance Bridge ZM 11 A/U Sidney 510 357 3788 working or not. S. Geldhor, 2147 Troubas, San Leandre, CA 94577.

Service manual for KOSS-model HG335-Cd, AM/FM Radio, Cassette Player. Will buy or copy and return. Also, still need ICDEC 00 15B or C. Murrays Repair Service 561-966-8862.

JVC, TV Model AV-3171S — service manual/schematic. Buy or rent, print is out of publication. Contact: Steve Bavis, 1144 Riverview Drive., Annapolis, MD 21401. 410-757-2592, esteve @flashcom.net.

Hickok tube tester, Technics SP-10MK3 or MK2 turntables, SME or Technics tonearms, studio limiters and processors. 612-869-4963.

Garrard Stereo Receiver Amp. Model# GRX665 Operator and Schematic Manuals buy or copy. T. Wilson 13123 Sevres Street, New Orleans, LA 70129, Phone: 504-254-0890.

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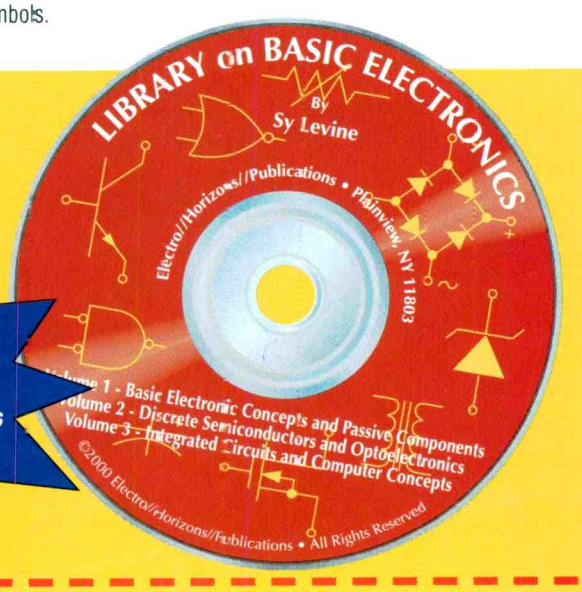

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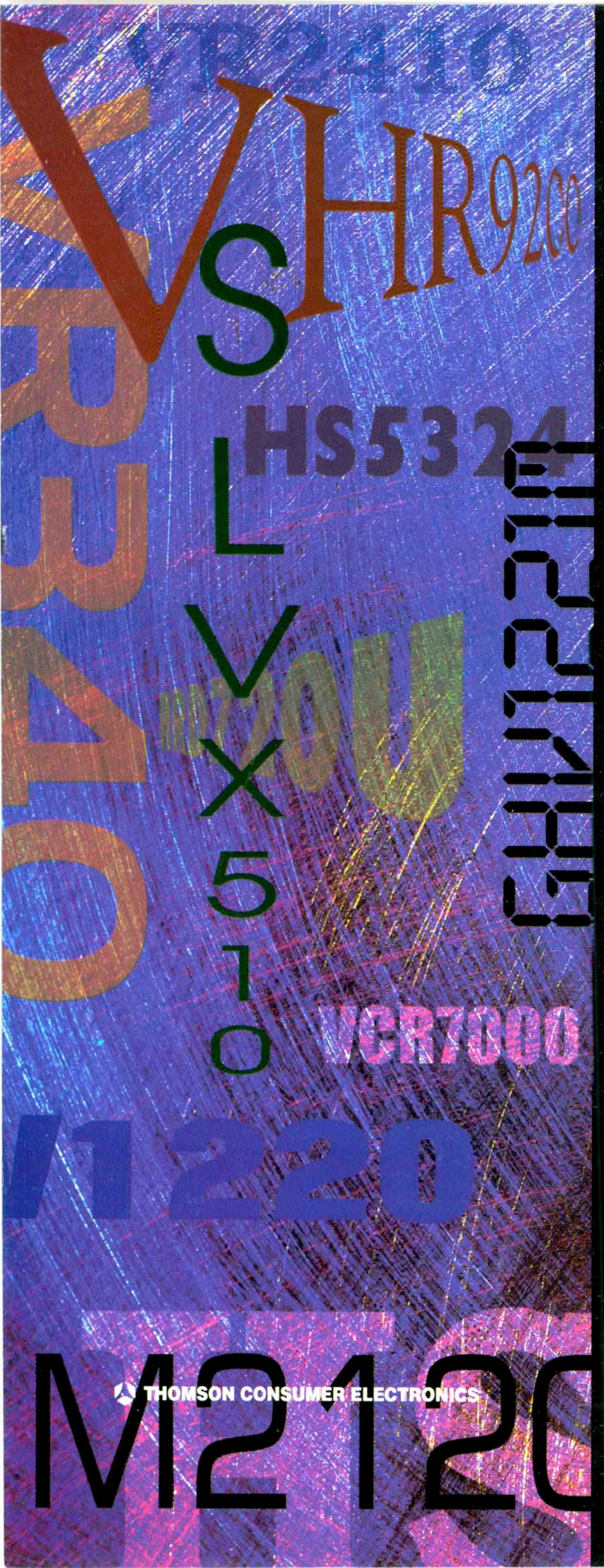

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