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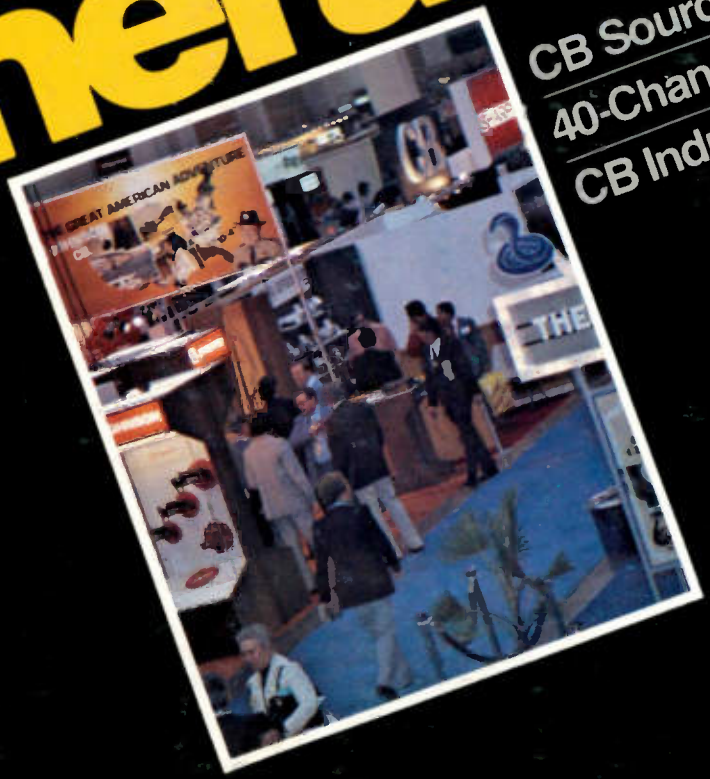
PC-77: kicking off CB's 2nd generation

CB Source Guide
40-Channel Freq. Chart
CB Industry Report



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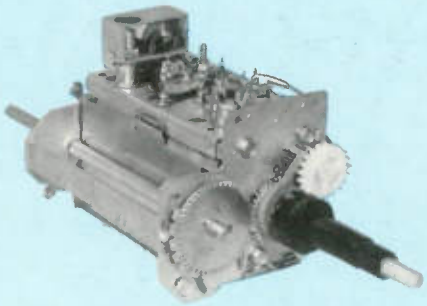

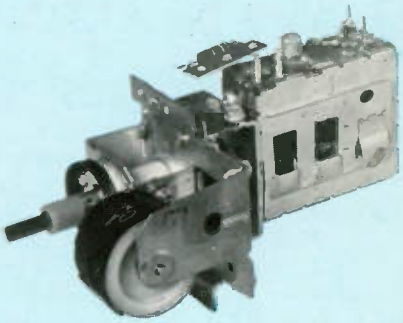

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EDITOR'S MEMO

CB: the sales/ service slack taker upper?

There were about 10 million CB sets sold in this country in 1976, according to data released recently by the Electronics Industries Association (EIA).

And, according to the FCC, the EIA and various other sources 'close to the electronics industry,' there were somewhere between 15-20 million CB sets in use in the U.S. as of January 1.

It's no secret that about 70-80% of these CB sets have reached consumers' hands through what traditionally are called 'mass-merchandising' outlets—department store, 'discount' and electronic specialty store chains, etc.

The remaining 20-30% of the 15-20 million CB sets in use have reached consumers through 'independent' retail outlets, including consumer electronic sales/service dealers.

To get a 'firmer feel' of the degree to which independent electronic sales/service dealers have become involved in the CB market, we recently asked Infometrics, the mail/phone research division of our company, to query by phone 49 randomly selected owners of independent electronic sales/service businesses. Following is a synopsis of their findings:

Among the total number of owners surveyed:

- 55% are now *selling* CB and CB-related products or definitely plan to by mid-year. (39% are already selling CB.)
- 57% are now *servicing and installing* CB and CB-related products or definitely plan to by mid-year. (35% are already servicing and installing CB.)
- 75% sell *and* service home entertainment electronic products (TV, radio, etc.).

Among the 39% who already are selling CB and CB-related products:

- The median total annual gross income is $70,000, with a range from $18,000-$800,000. (42% of those now selling CB are grossing over $100,000 annually.)
- The median percentage of total gross income which comes directly from CB-related sales is 15%, with a range from 3%-80%. (26% of those now selling CB receive 25% or more of their total annual gross income from CB-related sales.)
- The median number of CB transceivers sold per month is 14, with a range from 2-100 units. (26% of those who now sell CB average between 20 and 100 units per month.)
- The median number of brands handled by each dealer is 3.6. (A total of 24 brands were mentioned.)
- 84% buy from a distributor. (The remaining 16% buy CB products from both distributors and manufacturers.)
- Half install 80% or more of the CB transceivers they sell, and only 33% install less than a quarter of the units they sell. Of those dealers who now sell CB, only one does not offer installation.)

Among the 35% who already are servicing and installing CB:

- The median percentage of total annual gross income which they receive from CB service/installation is 10%, with a range from 2%-40%. (Of those who now sell/install CB, a third receive 20% or more of their total annual gross income from CB service/installation.)
- 82% offer service/installation on all brands of CB, and the remaining 18% specialize in specific brands (typically 2-3 brands).
- 88% are authorized warranty service centers for one or more brands of CB.
- 41% service/install CB for other retail outlets such as department and discount stores.
- 70% employ 1 or more FCC-licensed service technicians.

Because of the relatively small sample employed in our survey, the preceeding findings might not indicate the *precise* degree to which the independent electronics sales/service industry is involved in CB. However, they do seem to provide further evidence that a significant number of traditional 'TV sales/service' dealers are successfully diversifying into other consumer electronic markets. Which, in turn, means that the number of independent dealers who have all of their sales and/or service eggs in one basket is becoming increasingly smaller. ■

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THE COVER: This photo from last year's PC-76 symbolizes the presentation of the 2nd annual Personal Communications show, PC-77, Feb. 15-17, in Las Vegas. Billed as the largest trade show of two-way radio equipment ever held, PC-77 will showcase for the first time the new 40-channel CB radios and associated accessories.

DEPARTMENTS

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NEWS OF THE INDUSTRY

NEWCOM '77 Will Feature A CB/Communications Seminar

A discussion of 40-channel CB radios, their sales potentials and prospect and a product display will be the main feature of a CB/Communications seminar to be staged during NEWCOM '77 in Las Vegas, May 3, 4 and 5. The seminar theme will be "The Rules Have Changed But The Fight's The Same," and will take a look at the evolution of the communications market since the end of the CB boom, and opportunities that lie ahead.

The first half of the seminar will be conducted by Richard Horner, president, E. F. Johnson Co. and will be titled "The Second Revolution—40 Channels." Jon Passini, marketing manager for Cobra Communications Products, will lead the second part with a discussion on "Expanding Our Communications Future."

Survey Shows Average Hourly Wages Earned By TV Technicians In the U.S.

A recent survey of 4,093 journeymen TV technicians across the country conducted by NESDA shows that the average servicer is paid $5.19 per hour. The lowest hourly wage reported by those surveyed was $2.63 and the highest was $7.39. A breakdown of 25 selected metropolitan areas in descending order of the weighted average rate is as follows:

Selected Metropolitan Areas	Number of Journeymen Surveyed	Lowest Paid Rate	Weighted Average Rate	Highest Paid Rate
St. Louis	19	$4.50	$6.11	$7.16
Milwaukee	33	5.12	6.10	6.45
Los Angeles	525	3.25	5.92	7.00
Orlando	13	5.20	5.80	5.85
Detroit	46	4.50	5.65	6.36
Sacramento	14	5.00	5.60	6.40
Minneapolis	24	4.85	5.47	6.00
Chicago	226	4.50	5.39	7.39
North Jersey	72	3.75	5.36	6.50
Phoenix	25	5.15	5.35	5.50
New York	423	3.85	5.32	6.88
San Diego	70	3.75	5.26	5.95
Washington, D.C.	189	3.95	5.19	7.00
Cleveland	80	4.90	5.17	5.50
Boston	81	4.00	5.08	6.20
Salt Lake City	27	5.00	5.05	5.50
Philadelphia	92	3.80	5.04	5.90
Cincinnati	55	3.87	5.04	5.75
Denver	72	4.70	5.00	5.98
Pittsburgh	44	4.58	4.98	5.40
Kansas City	72	3.90	4.95	5.50
Dallas	129	4.55	4.94	5.50
Baltimore	148	3.75	4.94	5.05
New Orleans	31	4.75	4.93	5.90
Atlanta	41	4.44	4.83	6.75

FTC Investigates TV Game Effect On CRT—Game Manufacturers Say 'No Problem'

The Federal Trade Commission's Bureau of Consumer Protection (FTC/BCP) is conducting an inquiry into whether or not the newest electronic consumer product, the TV Game, does any harm to the home TV picture tube. TV game manufacturers, however, say there should be no problems as they have yet to receive any complaints from the millions of TV game buyers about damage under normal usage.

The FTC inquiry is said to have been prompted by damage caused to CRTs in TV sets used for demonstration purposes in retail stores. There have been some reports that these demonstration sets received what is called "ion beam burn" or "phosphorous exhaustion", or in other words, an image burned onto the surface of the tube.

Producers of the TV games say that the problem encountered with the demonstration sets will not occur with home sets under normal use.

TV Set Sales—Color & B&W—Expected To Improve Very, Very Slightly

Two forecasts of what 1977 will produce in TV set sales—both close to each other—indicate that there won't be much difference between 1976 and 1977. The first forecast is one from the TV industry itself. It calls for color sales to dealer in 1977 of 8.05 million and black & white sales of 5 million. (See EIA figures for the end of 1976, below)

The second forecast is one made by *TV Digest,* calling for 8.25 million new color sets and 5.2 million black & whites. Other parts of the *TV Digest* 1977 forecast include: "Color TV prices will rise slightly as cost pressures continue"; "It seems more likely than not that Sony will buy former Westinghouse picture tube plant"; and "At least one more TV maker will follow GE into VIR-controlled color, and there'll be more emphasis on digital tuning." ■

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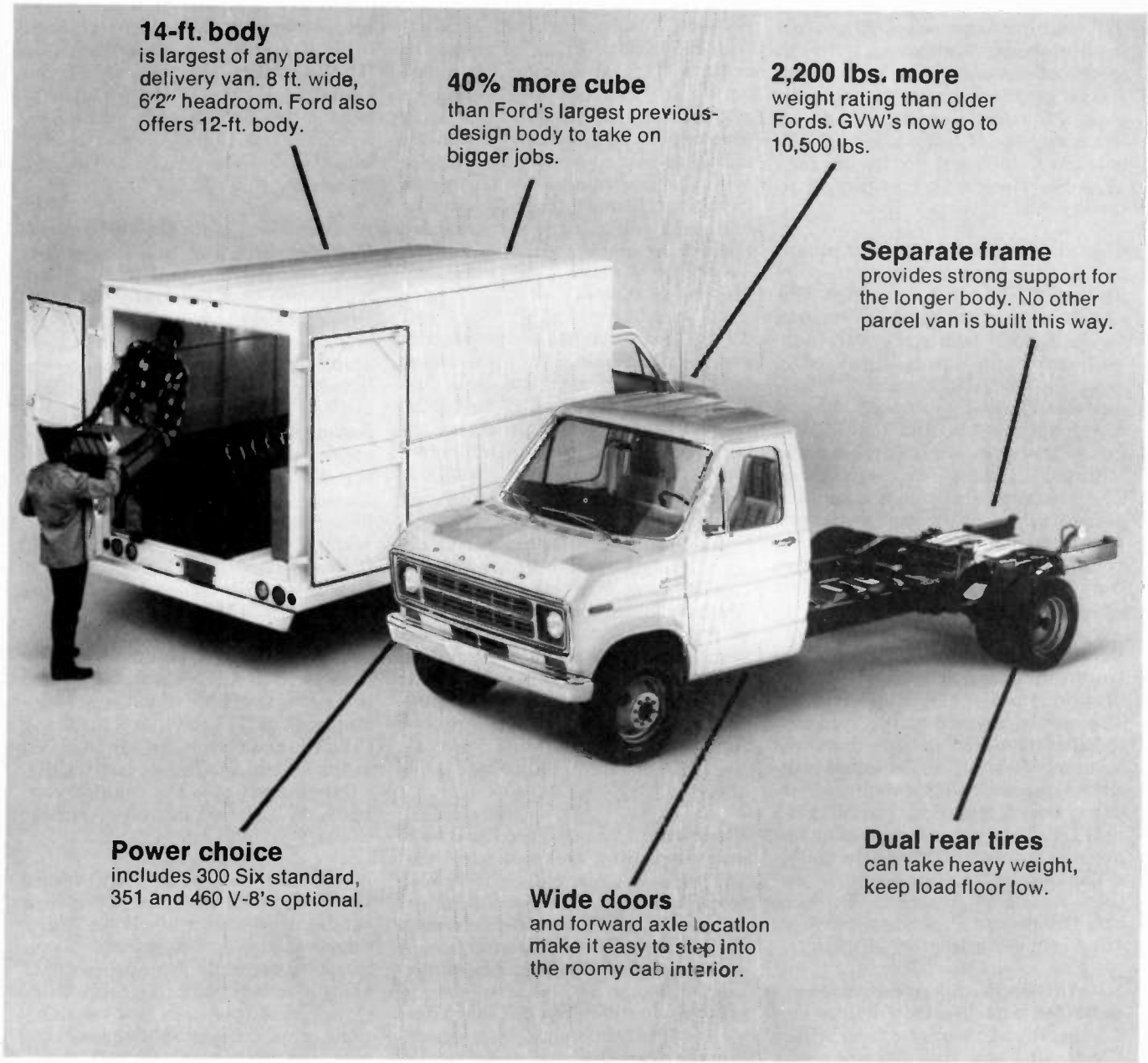

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TECHNICAL LITERATURE

Industrial Electronic Tools and Supplies are featured in a new catalog just released by Joseph Electronics. The new 328 page catalog, No. 077, features more than 70 product lines providing descriptions, technical specifications and pricing. It places special emphasis on test equipment, tools, PC supplies and products for laboratory and R & D markets. Available free from *Joseph Electronics, Inc.*, 1733 No. Harlem Ave., Chicago, Illinois 60635.

Closed Circuit Video Equipment are highlighted in a new 8-page brochure, CCV-118B, from RCA. The new literature presents information on the TC1000 family of general surveillance and lower light level cameras; the TC1005 camera family for demanding CCTV applications and lower light levels; and the TC1030 family of very low-light-level cameras with silicon intensifier target tubes. The brochure also covers monitors, alarm call-up sequential switchers, date and time recorders and a time-lapse video recorder. Available free from *RCA Solid State Division*, Box 3200, Somerville, N.J. 08876.

Semiconductor Replacements are cross referenced and described in a new guide and catalog from Raytheon. The newly revised guide contains specifications and outline drawings for nearly 300 "RE" replacement transistors, diodes, SCR's, integrated circuits, and accessories, including 45 new types not previously listed. The guide also cross references thousands of domestic and foreign set part numbers. Available free from *Raytheon Co.*, Distributor Products Operation, 4th Avenue, Burlington, MA 01803.

CB Antennas and Accessories are described and illustrated in a new 4-color, 12 page brochure from Wilson Electronic Corp. Included are photographs, sectional details, specification, and descriptions of CB base antennas, mobile antennas, crank-up towers and rotors. The new literature features a description of "Dual Parasitic Excitation," a principle found in the firm's antennas. Available free from Consumer Product Division, *Wilson Electronics Corp.*, 4288 So. Polaris Avenue, Las Vegas, Nevada 89103.

Citizens Band Accessories are covered in a new folder from RMS Electronics. The literature describes and illustrates such products as: CB window antenna mount for base station, a detachable antenna trunk mount, slide lock mounts, horn and extension speakers, hook-up cables with reusable connectors, co-phasing CB harness, dummy loads, microphones and microphone connectors, interference filters and adaptors for all CB equipment. Available free from *RMS Electronics*, Inc., Bronx, N.Y. 10462.

Service Technician Tool Kits are featured in Catalog 22, the newest literature from Techni-Tool. Included are 25 new tool kits for the engineer and service technician, and such unique tools as a diamond wafer saw and a "no-nik" co-axial cable stripper. With this new catalog, the technician can design his own tool kit, selecting and specifying only the items that are needed. Available free from *Techni-Tool, Inc.*, Apollo Road, Plymouth Meeting, PA 19462.

Digital Instruments and accessories are described fully, with prices in the latest booklet from Data Precision. The catalog lists and pictures the firm's line of digital multimeters and counter-timers. It's available free from *Data Precision Corp.*, Audubon Rd., Wakefield, Mass. 01880.

Semi-Conductor Replacements are completely covered in the newest catalog from Workman Electronics. The new literature lists replacements of over 75,000 manufacturer's numbers to over 200 Workman models. The guide also features a cross-reference to other major semi-conductor manufacturers. The catalog is available free from *Workman Electronic Products, Inc.*, P.O. Box 3828, Sarasota, Florida 33578.

Electronic Connectors, Hardware and Fastening Devices are listed and priced in a new catalog from Waldom Electronics. The new literature, catalog No. 2C-76, lists a wide variety of Hollingsworth solderless terminals, connectors and crimping tools, connector housings and pin terminals, printed circuit hardware, hand and air-powered crimping tools, designer's kits for crimp and nylon connectors, terminals, handles, spacers and electronic hardware. Available free from *Waldom Electronics*, Dept. PR, 4625 West 53rd St., Chicago, Ill. 60632.

TV Test Rigs, Brighteners, and Substitute Tuners are some of the items included in the latest catalog from TeleMatic. The new literature, Catalog 76-2, lists a universal TV test rig, yoke & convergence adaptors, extension tools, brighteners cross-referenced to tubes, crystal checkers, CRT testers, high voltage probes, curve tracers and power supplies. Also included are TV high voltage repair parts and kits. Available free from *TeleMatic*, 2245 Pitkin Avenue, Brooklyn, N.Y. 11207.

Test Instruments for industry, education and service are fully described and pictured in the 1977 catalog from Leader. Included, complete with specifications, illustrations and prices, is the firm's complete line of oscilloscopes/vectorscopes, multimeters, color bar and pattern generators, DVM's, millivolt meters, signal generators, wattmeters, sweep/marker generators and accessories. Available free to the service industry from *Leader Instruments Corp.*, 151 Dupon St., Plainview, N.Y. 11803

A Technical and Do-It-Yourself Catalog, from Tab Books, describes over 400 current and forthcoming books, plus 14 of the firm's Electronic Book/Kits. The 44-page catalog includes books in a wide range of subject areas from: Amateur Radio License Study Guides to Communications—2-Way, Shortwave and CB Radio. Among new and forthcoming titles described are: "Build Your Own Working Robot", "Modern Electronics Math", VHF/UHF Fire, Police, Ham Scanners—Schematic Servicing Manual", and "The Electronic Musical Instrument Manual." The catalog is free from *Tab Books*, Blue Ridge Summit, Pa. 17214.

AM and SSB CB Radios are fully illustrated in full color and described in a folder available from Cobra Communications. The full line of the firm's CB units and accessories are included in the folder. Available free from distributors and *Cobra Communications*, 1801 W. Belle Plaine Avenue, Chicago, IL 60613.

Alarm and Security Equipment now available is described in the latest catalog from Mountain West Alarm Supply Company. The guide lists over 900 intrusion and fire alarm products, along with information on application, principle of operation and specifications, plus connection diagrams and pictures of typical installations. Available free from *Mountain West Alarm Supply Co.*, 4215 North 16th St., Phoenix, Arizona 85016.

CB, Automotive and Appliance Noise Filters are described in the new selector guide from Cornell-Dubilier. Basic definitions and applications are presented plus descriptions of the complete CDE line of alternator/generator filters, co-axial feed-thrus, L-C tuned filters, appliance filters, and low pass TV filters. Also described are the firm's heavy duty rotors for base station. Free from Mr. William Carlson, *Cornell-Dubilier*, 150 Avenue L, Newark, N.J. 07101. ■

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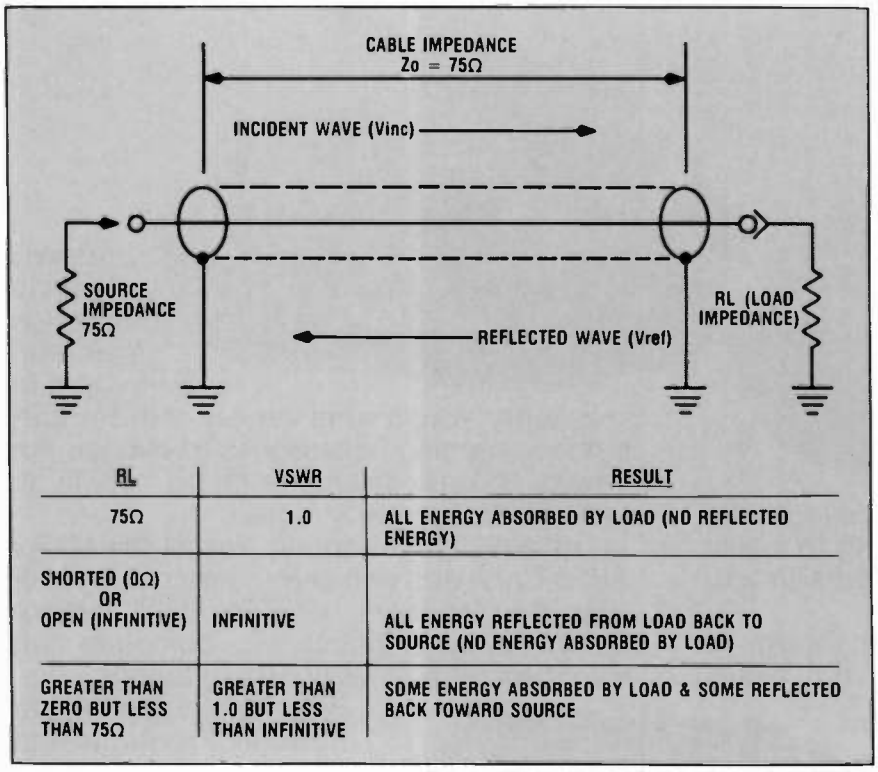
ABC's Of VSWR In MATV

By James E. Kluge*

What it is, what causes it, and how to minimize or eliminate it



RL	VSWR	RESULT
75Ω	1.0	ALL ENERGY ABSORBED BY LOAD (NO REFLECTED ENERGY)
SHORTED (0Ω) OR OPEN (INFINITIVE)	INFINITIVE	ALL ENERGY REFLECTED FROM LOAD BACK TO SOURCE (NO ENERGY ABSORBED BY LOAD)
GREATER THAN ZERO BUT LESS THAN 75Ω	GREATER THAN 1.0 BUT LESS THAN INFINITIVE	SOME ENERGY ABSORBED BY LOAD & SOME REFLECTED BACK TOWARD SOURCE

Fig. 1—Effects of impedance mismatch on VSWR.

■ VSWR means *Voltage Standing-Wave Ratio*. The more general term is simply 'standing-wave ratio' (SWR), and can be either a voltage or current ratio. However, because most measurements involve voltage, 'VSWR' is the more popular term.

VSWR is a measure of how efficiently high-frequency (RF) power is transmitted over an RF transmission line. In an MATV system, for example, an excessive VSWR will cause excessive signal loss and spoil otherwise good TV pictures.

VSWR IS A RATIO

Any impedance mismatch between the transmission line and any device connected to it will cause *standing waves*. The ratio of actual source or load resistance (R_L) and transmission-line impedance (Z_o) equals VSWR (R_L/Z_o or Z_o/R_L, whichever ratio is greater than 1). For example, when using 75-ohm cable, a load resistance of either 50 ohms or 112.5 ohms produces a VSWR of 1.5.

VSWR always has a value greater than 1 and in case of an open (R_L = infinitive) or short circuit (R_L = 0) VSWR becomes infinite (see Fig. 1).

VSWR also equals the *ratio* of maximum to minimum amplitude of the standing wave on the transmission line or cable.

REFLECTIONS CAUSE STANDING WAVES

Standing waves occur when part of the energy propagated down a transmission line (termed *incident energy*) is reflected back up the line in a reverse direction. Reflected energy is caused by impedance discontinuities in the line, in the connectors or from an improper load termination.

An open or short circuit at the load end of a transmission line reflects *all* the incident energy back toward the source because there is nowhere else for it to go. Where the line is terminated in a pure load resistance exactly equal to the characteristic impedance of the line, *all* the incident energy is absorbed by the load resistor—none is reflected. This is the ideal case representing maximum transfer of energy from source to the load via the transmission line. We call this a *matched* condition (VSWR = 1)

TRAVELING WAVES

On a matched transmission line, all electromagnetic waves travel along the transmission line from source to load as *traveling waves*. This may be visualized as a train of sine waves moving along the

*The author is a technical editor for the Winegard Company

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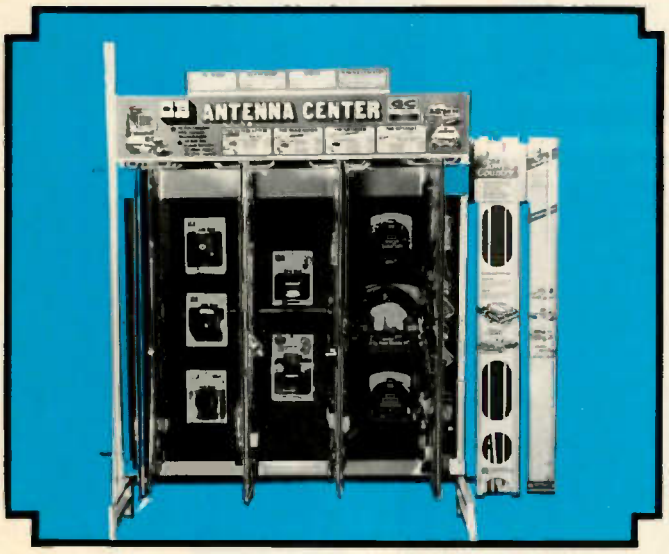

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2. Large cargo capacity.
Tradesman's a trim compact size with an engine that is far forward. So you can carry king-sized loads. Even our 109-inch-wheelbase model, the shortest in the business, has more than nine feet of loadspace behind the engine.

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For extra-big jobs, there's Maxivan, the biggest van in the business... with 18 extra inches of load length over the standard Tradesman.

5. Good gas mileage.
In EPA estimates, Dodge B100 Tradesman with a standard 225 Six and manual transmission* got 24 MPG, highway; 18 MPG, city. Your actual mileage may differ depending on your driving habits, condition of your van, and optional equipment. But Tradesman offers a Fuel Pacer option that can help you get maximum mileage.

Dodge Tradesman: A whole lot more.
The reasons for buying a Dodge Tradesman van don't stop there. They're as numerous as Tradesman's other great features: small Six and V8 engines. Big 22-gallon gas tank. Or an optional 36-gallon tank. Options like a sliding side door (127-inch-wheelbase models only) for easy loading. Automatic speed control. Air conditioning that's available as an option on every eight-cylinder model Tradesman. A KaryVan model that gives you the maneuverability and convenience of a Tradesman van... plus the loadspace of a bigger truck.

See for yourself at your Dodge Dealer's. There are a lot of great reasons to buy or lease from America's number one maker of compact van-type vehicles.

*Not available in California or with high altitude certification. Available on B100 only.

Dodge Trucks

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transmission line. If you could fix your eyes on an imagined vertical line located at any fixed point along the transmission line, at the point where the sine wave intersects your imagined vertical line, the voltage would 'appear" to alternately swing first positive and then negative as the sine waves pass on their way from the generator to the load (see Fig. 2).

EFFECT OF STANDING WAVES

Any reflected waves traveling in the opposite direction (i.e., from load to source) will either reinforce or cancel the voltage of the incident wave. At half-wave intervals the reinforcement and/or cancellation is maximum. The result is a pure standing wave that appears to remain stationary while its amplitude or height increases and decreases as a function of time.

If the load end of the line is open or shorted (100-percent reflected energy), the standing-wave amplitude will vary from zero to twice the maximum amplitude of the incident wave.

If the line is properly terminated, or matched, in a pure resistance equal to its characteristic impedance (no reflected wave) there will be no standing wave, just a pure traveling wave.

If the line is terminated in a finite impedance of more or less than the characteristic impedance of the transmission line (the most common case), the maximum standing-wave amplitude results in some value between once and twice the maximum amplitude of the traveling incident wave.

VSWR & 'RETURN LOSS'

Expressed mathematically, the *maximum* amplitude of a standing wave will equal the peak value of the incident wave plus the peak value of the reflected wave (Vinc + Vref), producing maximum voltage reinforcement, or voltage addition.

The *minimum* amplitude of a standing wave will equal the difference between the peak values of the incident and reflected waves, producing maximum voltage cancellation.

Because VSWR equals the ratio of maximum to minimum, then:

$$\text{VSWR} = \frac{\text{Vinc} + \text{Vref}}{\text{Vinc} - \text{Vref}}$$ and

$$\text{RETURN LOSS} = \frac{\text{Vinc}}{\text{Vref}} = \frac{1}{r}$$

Therefore, the higher the return loss, the lower the VSWR, as shown in Table 1.

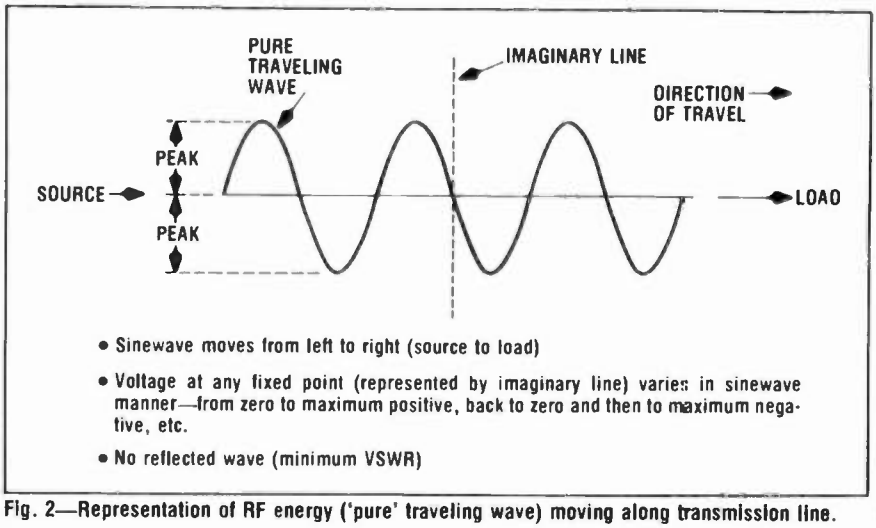

Fig. 2—Representation of RF energy ('pure' traveling wave) moving along transmission line.

EFFECT OF LINE LOSS

In the interest of simplicity, the previous remarks dealt with a *lossless* transmission line and generally would hold true for short lengths less than 10 ft. However, for lengths of tens to hundreds of feet, cable loss has a definite effect. As a traveling wave travels down a 'lossy' line, it diminishes in amplitude until it reaches the load end. At the load end, a portion of the arriving energy is reflected

and begins its journey back toward the source. Again, because of cable loss, the reflected energy also diminishes in amplitude as it returns back toward the source, where a portion of it is absorbed.

At the source, the incident energy is maximum and the reflected energy is minimum; *thus, you can expect the VSWR to be small and nearest a value of unity at the source.*

VSWR & 'BACK MATCH'

Any mismatch at the source will cause a portion of the signal that is reflected back from the load to be 're-reflected' back again in the direction of the load. However, if the source is properly matched to the line, any reflected wave arriving from the load will be absorbed by the source resistance. For this reason, it is important that the source, or 'signal generator' be matched to the line. This is commonly referred to as *backmatch*, i.e., looking backwards from the load along the line to the source. It should be evident that a proper resistive backmatch will absorb reflections emanating from the load end. In this case the resistance of the source absorbs the reflected energy.

In low-energy circuits such as MATV and CATV, the amount of energy absorption by the source resistance is of little concern. However, in high-energy circuits such as broadcast transmitters or similar 'high-power generators', serious damage could result from appreciable reflected power being absorbed by the transmitter (source) circuits.

VSWR & 'IMPEDANCE DISCONTINUITIES'

Standing waves are also caused by impedance discontinuities in a transmission line. Any change in the physical dimensions of the transmission line and/or its connectors will cause impedance discontinuity. Discontinuities occur when the cable is crushed or flattened by staples, clamps, window sashes, or when the center conductor is nicked or the cable is bent too sharply, or if the insulation contains foreign material.

Cable-manufacturing machinery also can produce slight physical distortions at evenly spaced points along the length of the cable. This can cause signal "suck-

outs" at certain frequencies depending on the distance between distortions relative to a quarter wavelength. For this reason, we advise that you buy quality, namebrand coaxial cable (preferably sweep tested) for MATV.

Staples placed at evenly spaced points along a line also can cause "suckouts" of certain channels. Which channel is affected will depend on the relationship between wavelength and the distance between staples or between two adjacent periodic distortions of the cable geometry.

ELIMINATING HIGH VSWR IN MATV

Standing waves on an MATV cable can cause smeared pictures, multiple ghosts, snowy pictures (as a result of excessive signal loss) and possible loss of color.

Standing waves can be avoided or significantly reduced by employing the following installation and design techniques:

- Terminate the end of every MATV cable run with a 75-ohm resistor
- Terminate every unused splitter output with a 75-ohm resistor
- Terminate the line-out jack on the last tap of a trunkline
- Use quality, name-brand coaxial cable, preferably a type which is certified by the manufacturer as having been sweep-tested
- Do not install staples or clamps in a manner which causes impressions in the cable. Use staples to *support* the cable, not to fasten it tightly to a structure
- Randomly space staples or clamps so that the effects of any slight impressions in the cable do not 'accumulate' at some specific wave-length (channel frequency) or fraction thereof
- Buy antennas, preamps, line amps, splitters, taps, etc., which provide a *low VSWR* for both input and backmatch
- Avoid sharp bends when routing cable
- Avoid routing under or through areas where the cable might be crushed
- Use extreme care and the correct tools when installing connectors on the cable with care. Next to improper terminations, this is probably the most common installer-caused fault which causes poor VSWR and resulting poor pictures. ■

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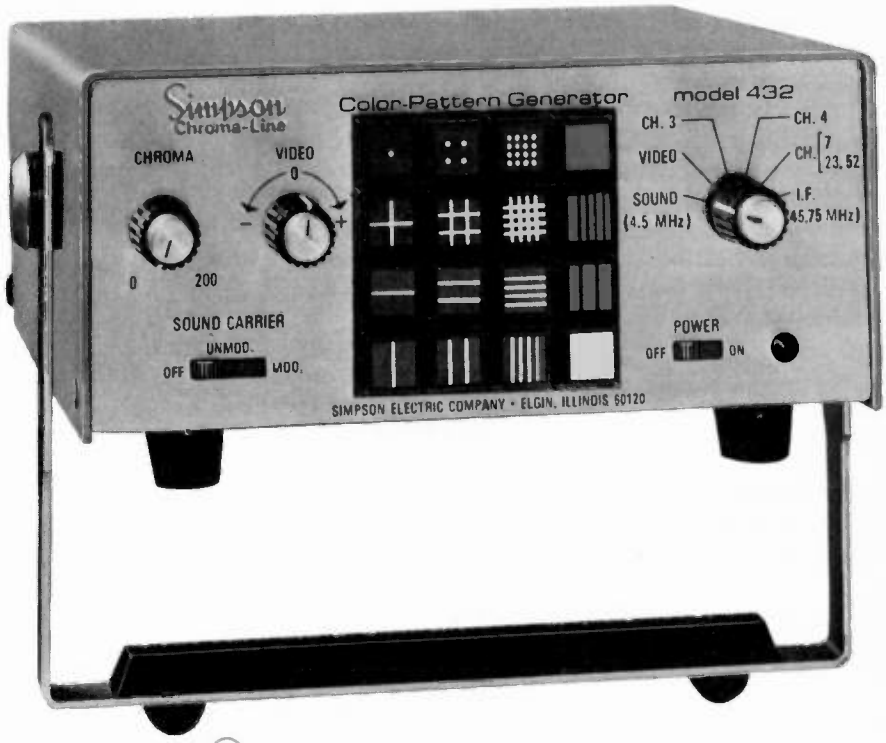

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CB Sales & Service 1976-1977

By Don W. Mason

■ Less than one year ago the CB industry staged its first national trade show—PC-76—in Las Vegas. It was a signal that Citizens Band Radio had arrived—and was about to become a major factor in the electronics industry. This month—on February 15, and again in Las Vegas—the doors will be open on PC-77. It is being billed as the "largest trade show of two-way radio equipment ever held, with over 75,000 square feet of exhibit space reserved by over 300 exhibitors."

In the ten months between PC-76 and PC-77, what has developed with the users, the producers, and the regulators of CB? And what's ahead for 1977? To find out, we talked with a number of major CB manufacturers, and to officials of the FCC and the Electronic Industries Association.

FROM PC-76 TO PC-77

Throughout 1976, the CB boom continued—first, as supply tried to catch up with demand, and then, after the expansion to 40 channels was announced by the FCC, to clear the warehouses of 23-channel models. All previous sales records for CB transceivers were broken, several major electronic manufacturers entered the market, the FCC developed new methods to break the log-jam of license applications, and the CB antenna became almost as commonplace as the car's radio antenna.

CB Sales Volume Breaks All Records

More citizens band radios were sold in 1976 than in all of the previous 28 years since the birth of CB. In fact, according to John Sodolski, vice president of the communications division of the Electronic Industries Association (EIA), close to 10 million CB radios were sold in 1976, which is more than double that of the record volume set in 1975. And when you add antenna and accessories sales to CB radios sold, Sodolski said, you wind up with retail sales which topped $2 billion in 1976.

During the first seven months of 1976, the zooming CB sales record was attributed to the new awareness of the public to the benefits of CB and to demand racing ahead of supply. From August through September, Sodolski points out, there was a sales slowdown brought on mainly by "supply finally catching up with demand, a traditional summer selling slump, and confusion in the marketplace surrounding the FCC's July announcement of the 40-channel expansion."

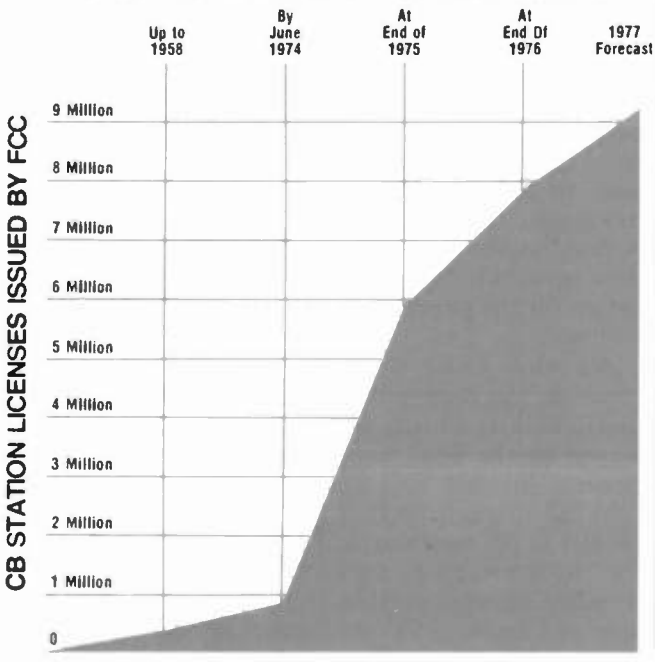
There was a sharp upturn, according to the EIA, in November and December because of favorable pricing, stepped up advertising, Christmas gift-buying, and a growing awareness of the public that the 23-channel models are not obsolete and will be completely adequate for most areas of the country. As Sodolski put it, "More and more people are realizing that 23 channels are adequate in less congested areas; the existing 23 channels will be increasingly easier to use and less crowded after the additional channels are made available; and the 23-channel unit prices are lower."

Sodolski added the fact that he thinks Channel 9 will remain as the national emergency channel and Channel 19 will likely remain the trucker's channel for some time to come.

Shortly after the FCC announced the expansion to 40 channels a number of CB manufacturers came up with conversion programs for consumers who bought 23-channel transceivers after the FCC announcement. A certificate was issued with each 23-channel unit purchased which would allow the buyer to trade his radio in for a 40-channel unit, or send it back to the factory for conversion to 40-channels. The cost to the consumer for such trade-in or conversion varied from $25 to $50.

However, much in line with Sodolski's comments, several of the manufacturers we talked with feel that few 23-channel customers, in the end, will have taken advantage of the conversion privileges. As Paul Davis, vice president and general manager for Cobra Consumer Products put it, "We have a conversion program and, of course, we will convert for anyone wanting it, but we don't honestly expect to find many people wanting conversion. We think, in most cases, they'll realize that the 23-channel model they bought is plenty adequate for their purposes, and that they

GROWTH OF FCC-LICENSED CB STATIONS



won't want to give up their unit for the one to three month period conversion takes."

Although Motorola does not have a conversion program for their retail customers, according to Mike Boyle, CB sales manager for Motorola, they will take back any 23-channel products their distributors want to turn in. "After all," Boyle said, "we don't want them tying up their money holding our stock. We'll hold the 23-channel models probably until the second quarter. If there is a price difference between the 23-channel and the 40-channel models, which there will be, the 23-channel radios will still be attractive, and as the smoke clears, we may enter the 23-channel market again."

That at least some CB manufacturers were not ready to say goodbye forever to the 23-channel models was apparent when we talked to RCA's Dennis Burke, manager of sound products merchandise. Just this past fall, RCA announced the addition of two new 23-channel mobile transceivers, Models 14T300 and 14T301, to their line because, as Burke said, "We believe most CB activity will remain on 23 channels for a long time and for many areas of the country, 23 channels will be sufficient for normal operation. We'll, of course, have a full line of 40-channel CB for 1977," Burke added, "but we'll have 23-channel radios priced differently to make them attractive."

With 10 million CB radios sold just in the past year, industry and government leaders estimate that somewhere between 15 and 25 million CB transceivers are currently in use. This is based on the fact that FCC licenses are issued for each station and many "stations" utilize more than one transceiver. Also included in the estimates are an unknown number of CB radios being operated illegally without a license.

Richard Everett, assistant chief of the amateur and citizens band division of the FCC, estimates that there is an average of 2½ to 3½ radios per station license, and that the total number of CB radios in the country is now between 15 and 25 million. John Sodolski, EIA, estimates a total of around 20 million radios in use.

FCC CB License Methods Are Streamlined In 1976

In January, 1976, the FCC was receiving Class D CB license applications at the rate of about 550,000 a month. They were issuing licenses at the rate of about 250,000 a month, and in January of 1976 had a backlog of licenses yet to be issued of 750,000.

In April, to speed up processing, and to eliminate the long delay of about two months that new CB purchasers had to wait for their licenses, the FCC initiated a new temporary licensing program. The CB purchaser then received his temporary license with the unit from the dealer and was able to legally operate his radio for a 60-day period, beginning on the date he sent in his application for the permanent license.

As the year progressed, the number of applications being received by the FCC went down a bit but still up over the number received in 1975. By the end of 1976, the average number of applications received by the FCC per month had come down to about 368,000.

Among the reasons suspected for the slight decline in application rate occurring in midsummer was the 40-channel expansion announcement which might have caused some would-be purchasers to wait until 1977, the beginning signs of supply catching up with demand, and the possibility that some CB purchasers, after getting their temporary 60-day license with the transceiver, neglected to mail in the permanent license application.

At any rate, when all of the 1976 figures were finally in, the total number of Class D licensed CB stations in the country was just about 7.8 million.

The other FCC move relating to CB was the elimination of the four dollar fee for licenses. The announcement was made in December, but didn't become effective until January 1st.

The move eliminating the fee was caused by a ruling from the U.S. Court of Appeals that license fees charged by the FCC since 1970 had been excessive. Because of the court ruling, the FCC suspended all license fees, including those for CB, while it studied the implications of the ruling. It is unknown at this point whether the elimination of the $4 fee will have any effect on the number of CB license applications to be received at the FCC in the future. Even without the fee, CB purchasers will still have to apply for a permanent license.

Looking Ahead Through 1977

"Cautious optimism," among the representatives of the industry and government we talked to, probably best describes the 1977 attitude toward the CB market. It's just possible that the exciting, but unstable, days of the CB boom are starting to wind down a little.

There are a lot of CB transceivers and accessories yet to be sold before the American public is anywhere near being oversupplied; or in other words, before we'll be talking about a replacement market as the big goal. As Richard Horner, president, E.F. Johnson, told *Sales & Marketing* magazine at the end of last year, "Even with the amazing growth of the past several years, there are still no more than 15 million CB radios in use in this country, compared with a potential market of 250 million, if you figure that every car, truck, recreational vehicle, and home could eventually have an installation."

Perhaps the best indication that there is still a huge market for CB radios yet to be satisfied, was the entrance this past year of the communications industry giants—GE, RCA, and Motorola. While the three large companies seem to be entering the field with a full effort, representatives of the three companies we talked with all exhibited a cautious type of optimism.

RCA's Dennis Burke said, "Although it's hard to be definite right now, we have been forecasting sales to be very good in 1977—probably somewhere in the vicinity of 1976 volume, perhaps a little bit less. The reason I say a little bit less," Burke explained, "is that an awful lot of 4th quarter sales in 1976 were generated by the tre-

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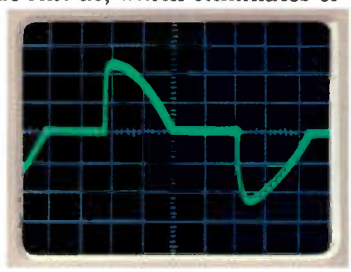

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mendous price advantages offered on 23-channel models and perhaps we took a little bit out of 1977." And Burke added, "We're looking for a little more realistic approach to forecasting production cycles and gearing up properly for what is forecast. This will contribute to more balance between supply and demand in 1977."

"In terms of total CB units," John Dullmeyer, manager, personal communication products, General Electric, said, "we think 1977 will be almost even with 1976, possibly down a little bit. But, in terms of dollars, 1977 will be better than 1976." As to General Electric's approach to CB specifically, Dullmeyer said, "We went into the market on a very limited basis in 1976. We knew changes were coming with the FCC's 40-channel expansion so we played 1976 on a very controlled basis." As for 1977, Dullmeyer said, "We will participate very actively in 1977 and intend to be a significant factor in the market. In fact, we would eventually like to be in the top 3 to 5 manufacturers in the industry sometime in the near future."

Also cautious about the 1977 market was Mike Boyle of Motorola. "We expect 1977 to be a good year for the industry and for us, but we don't know yet, how good. We do feel that what we manufacture this year we will be able to sell because there's always a need for a good quality product. And perhaps," Boyle continued, "we have an advantage because we manufacture our product here in this country. In other words, we don't have to watch for, or worry about, boats arriving loaded down with product. We don't consider ourselves as one of the big factors in the market, quantity-wise. I'm sure our production will be able to keep up or down with whatever demand there is."

A little more optimistic note was struck by representatives of two companies that have been in the CB market for a longer time than RCA, GE and Motorola. John Magnusson, national service manager for Hy-Gain, said that 1977 "is going to be almost like two years ago, but not with the same sharply rising curve we had before. Also, the expansion to 40 channels caused problems in the last few months of 1976, but we think as the consumer learns the difference between 23 channel and 40 channel models and the benefits of each, things will settle down. We're fairly optimistic about 1977 and, in fact, I think there could possibly be a shortage of both kinds of CB in 1977."

"I think '77 is going to be a fantastic year," was the opinion of Paul Davis of Cobra, "in fact it may be bigger than 1976 because of the carryover of 23-channel jobs. There are a lot of carryovers, and those are going to fly out, and in 1977 we're going to sell a tremendous amount of 40 channels. I've booked enough orders already for the first several months of the year," Davis continued, "to force us to go out and buy more merchandise."

On an industry-wide basis, John Sodolski, EIA, said "I believe CB sales will continue to climb in 1977, largely due to the public's firsthand exposure to the nearly 20 million CBs in the field." Sodolski expects that there will be a 2-tier market for CB's in 1977. "Twenty-three channel models will continue to be big sellers," Sodolski said, "particularly during the first quarter, before supply of new 40-channel units catches up with demand."

The Opportunity For CB Servicers

Finally, we asked what CB manufacturers are doing about in-warranty and out-of-warranty servicing. Indications are, with all of them, that they are still in the process of building their "authorized service" networks. RCA's Dennis Burke said, "We have about 150 authorized service centers around the country now and we expect to have a lot more in the future. Competent servicers are a key ingredient to our future success. Anyone getting into CB service will have the luxury of being in an industry where the volume is great enough to make the effort worthwhile. After all, with over 10 million units or more being sold each year, you're talking about a nice piece of change for those aggressive servicers who want to get in and do the job." When asked about RCA's source for authorized servicers, Burke replied that "probably most of them are now coming from the communications field, but we're happy and willing to talk to anyone about RCA authorized service if they have the knowledge, the equipment and the necessary license."

Hy-Gain, according to John Magnusson, now has about 1000 warranty stations under contract, "but we're always interested to talk to anyone who is qualified and interested," he said. When asked about the possibility of more TV/radio servicers getting into CB service, Magnusson said, "We have some TV servicers now, but the license and test equipment are necessary. Those TV servicers who have made that transition are doing well, but they are a cut above the 'ma and pa' servicers."

Mike Boyle, Motorola, said that his firm now has about 300 authorized service stations and hopes to add another 200 by the end of 1977's second quarter. "Some of our regular Motorola two-way shops are doing CB servicing, but we're looking first for shops that are now equipped properly with the right equipment and licensed, trained technicians."

There are now 600 franchised warranty service stations for Cobra products around the country, and Cobra's Paul Davis says they plan to add more in the next year or so. "We have the best warranty stations in the business," Davis stated, "because we pay our bills, we have the parts and our factory backs them up, and we're fussy. We only approve 1 out of every 3 who apply."

IN SUMMARY

So—as PC-77, "the largest two-way radio trade show in history" gets ready to open its doors in Las Vegas—and as we look to Citizens Band Radio for 1977—things look good. This time the "good" is not a wild, uncontrolled boom-type market. It just may be that sales won't be as good as 1976—but it looks as though a certain amount of stability is moving into the marketplace. There's still a lot of optimism on the part of CB's producers, regulators and users for 1977, but there's caution, too. And that isn't a bad way to go. ■

CB Servicers' Source Guide

An alphabetical listing of CB transceiver brand names cross-referenced to manufacturer and/or marketer, plus an alphabetical listing of CB transceiver manufacturers and/or marketers and addresses and phone numbers where service literature and/or parts may be ordered, if so indicated by 'YES' in 'PARTS' and 'SERV. LIT.' columns. (Asterisk * in 'PARTS' column indicates manufacturer/marketer has regional parts centers—contact manufacturer/marketer for address/phone number of parts center nearest you. Notation 'C.O.D.' in 'PARTS' column indicates manufacturer/marketer will send parts C.O.D.—for all others, payment must accompany order unless you have an established account with that manufacturer/marketer.)

BRAND NAME - MANUF./MARKETER CROSS-REFERENCE

BRAND NAME	MANUFACTURER/MARKETER
Aimor	Aimor Corp.
Aircommand	Superscope
Alaron	B & B Import-Export
American Electronics	American Electronics, Inc.
Astro Line	Boman Industries
Astrosonix	Boman Industries
Audiovox	Audiovox Corp.
Automatic Radio	Automatic Radio
Avon	Avon Electronics
Bay City	Fried Trading Co.
Beltek	Beltek Corp.
Blue Streak	CPD Industries
Browning Labs	Browning Laboratories
CB-27	Fried Trading Co.
CB-40	Fried Trading Co.
Challenger	TRS International
Channel Master	Channel Master
Clarion	Clarion Corp.
Cobra	Dynascan Corp.
Colt	Directional International
Commando	Commando Communications
Courier	Fanon/Courier Corp.
Coyote	PAL Electronics
CP300	Communications Power
CP400	Communications Power
CP4000B	Communications Power
CPI	Cyclops Products
Craig	Craig Corp.
Crystal	Trans-Comm Manufacturing
Dolthone	Unimetrics
Eagle	Eagle Electronics
Ebersonic	Mason Camera & Electronics
Echo	Echo Communications
Eico	Eico Electronic Instrument
Ever-Sonic	Avon Electronics
Eversonic	Mercury Radio & Battery
Fanon	Fanon/Courier Corp.
Fieldmaster	Fieldmaster Radio
Gemtronics	Gemtronics
General Electric	General Electric Co.
Globe	GC Electronics
Granada	Fried Trading Co.
Hallicrafters	Hallicrafters Co.
Handic	Handic-USA
Hanimex	International Merchandising
Hitachi	Hitachi Sales Corp.
Horizon	Standard Communications
Hy-Gain	Hy-Gain Electronics
IDI	Inland Dynatronics
Inland Dynatronics	Inland Dynatronics
J. C. Penney	J. C. Penney Co.
JIL	J.I.L. Corp.
Kraco	Kraco Enterprises
Kris	Kris, Inc.
Lafayette	Lafayette Electronic Sales
Lake	Lake Communications
Mako-1	Unimetrics
Marlin-1	Unimetrics
Merc	Mercury Radio & Battery
Messenger	E. F. Johnson Co.
Metro Sound	Metro Sound
Midland	Midland International
MOCAT	Motorola
Mongoose	Cerwin Vega
Motorola	Motorola
Nuvox	Nuvox Electronics
Pace	Pathcom Inc.
Palomar	Palomar Electronics
Panasonic	Panasonic
Pearce-Simpson	Pearce-Simpson
Porpoise-1	Unimetrics
Power	GEM'S Enterprises
President	President Electronics
Prominent	Mason Camera & Equipment

BRAND NAME	MANUFACTURER/MARKETER
Ram	CPD Industries
Ranger	Tenna Corp.
Ray Jefferson	Ray Jefferson
RCA CoPilot	RCA
Realistic	Radio Shack
Regency	Regency Electronics
Rice	Airway Citizens Band Radio
Road Runner	PAL Electronics
Robert Electronic	Dyn Electronics
Robyn	Robyn International
Royal Sound	Royal Sound
Royce	Royce Electronics
R-T-40	Emergency Beacon Corp.
R Thomas 23	Emergency Beacon Corp.
Rystl	Rysti Electronics
Samsonic	Samsonic Trading Co.
SBE	SBE, Inc.
Sears	Sears, Roebuck & Co.
Shakespeare	Shakespeare Co.
Shark	Shark Electronics
Sharp	Sharp Electronics
Sidewinder	Sidewinder International
Siltronix	Siltronix
Smokey	Enterprise Co., USA
Sonar	Sonar Radio
Soundmusic	Soundmusic Products
Sound Trax	International Antex
Sparkomatic	Sparkomatic
Stingray	Unimetrics
Summer Camp	Welchtronic Distributor Corp.
Surveyor	Surveyor Manufacturing
Teaberry	Teaberry Electronics
Tenna	Tenna Corp.
Tram	Tram/Diamond
Tran-Sonic	Tran-Sonic Industries
TRS Challenger	TRS International
Unimetrics	Unimetrics
Universal	Universal Machine
Universe	Fortune Star Products
Utac	I. A. Sales Corp.
Viking	E. F. Johnson Co.
Waner	Waner Electronics
Welchtronic	Welchtronic Distributor Corp.
Windsor	Windsor Industries
XTAL	Far Eastern Research Lab.
Zodiac	Trans-Comm Manufacturing

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Airway Citizens Band Radio 1159 S. Harlem Worth, IL 60482 312-448-3680	YES	YES (C.O.D.)
American Electronics, Inc. 91 N. McKinley Greenwood, IN 46142 317-888-7265	YES	YES (C.O.D.)
Audiovox Corp. 150 Marcus Blvd. Hauppauge, NY 11787 516-231-7750	YES	YES*
Automatic Radio 2 Main St. Melrose, MA 02176 617-321-2300	YES	YES
Avon Electronics Co. 1201 Broadway New York, N.Y. 10001 212-889-4980	YES	YES (C.O.D.)
B & B Import-Export, Inc. 185 Park St. Troy, MI 48084 313-585-8400	YES	YES
Beltek Corp. Of America 1093 Bedmar Carson, CA 90746 213-537-6180	YES	YES (C.O.D.)
Boman Industries 9300 Hall Rd. Downey, CA 90241 213-869-4041	YES	YES
Browning Laboratories, Inc. P.O. Box 310 Laconia, NH 03246 603-524-5454	YES	YES* (C.O.D.)
Cerwin Vega (HED) 12250 Montague Pacima, CA 91331 213-896-0777	YES	YES
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Clarion Corp. Of America 5500 Rosecrans Ave. Lawndale, CA 90260 213-973-1100	YES	YES
Commando Communications Corp. 1524 Elm Ave. South Pittsburg, TN 37380 615-837-8681	YES	YES (C.O.D.)
Communications Power, Inc. 2407 Charleston Rd. Mountain View, CA 94043 415-965-2623	YES	YES (C.O.D.)
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Cyclops Products, Inc. 815 Elm St. Manchester, NH 03101 603-668-8826	YES	YES C.O.D.)
Directional International, LTD. Colt Comm. Div. 5725 N. Central Ave. Chicago, IL 60646 312-763-8440	YES	YES
Dynascan Corp. **Cobra Communications Products Grp.** 6460 W. Cortland St. Chicago, IL 60635 312-889-8870 (Serv. Lit.) Parts: 2815 W. Irving Park Chicago, IL 60635 312-583-4360	YES	YES*
Dyn Electronics, Inc. 3095 N.W. 77th Ave. Miami, FL 33122 305-592-6710	YES	YES* (C.O.D.)
Eagle Electronics 6400 W. Park Dr. Houston, TX 77057 713-780-3990	YES	YES
Echo Communications, Inc. Cedarburg, WI 53012 414-377-5050	YES	YES
E. F. Johnson Co. 299 10th Ave. S.W. Waseca, MN 56093 507-835-6222	YES	YES C.O.D.)
Eico Electronics Instruments Co. 283 Malta St. Brooklyn, NY 11207 212-272-1100	YES	YES
Emergency Beacon Corp. 15 River St. New Rochelle, NY 10801 914-235-9400	NO	YES
Enterprise Co. U.S.A. 7037 Hayvenhurst Ave. Van Nuys, CA 91406 213-781-7330	YES	YES
Fanon/Courier Corp. 990 S. Fair Oaks Ave. Pasadena, CA 91105 213-799-9164	YES	YES (C.O.D.)
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Fortune Star Products Corp. 1207 Broadway New York, NY 10001 212-684-7140	NO	YES
Fried Trading Co., Inc. 167 Clymer St. Brooklyn, NY 11211 212-384-3519	YES	YES
GC Electronics Globe Electronics Div. 400 S. Wyman Rockford, IL 61101 815-968-9661	YES	YES
Gemtronics 356 South Blvd. Lake City, SC 29560 803-394-3565	YES	YES*
Gem's Enterprises Co., Inc. 1382 Jarvis Ave. Elk Grove Village, IL 60007 312-640-8727	NO	NO
General Electric Co. Personal Comm. Div. Bldg. #5, Electronics Park Syracuse, NY 13201	YES	YES* (C.O.D.)

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Hitachi Sales Corp. Of America 401 W. Artesia Blvd. Compton, CA 90220 213-537-8383	YES	YES (C.O.D.)
Handic-USA, Inc. 14560 N.W. 60 Ave. Miami Lakes, FL 33014 305-558-1522	YES	NO
Hy-Gain Electronics Corp. 4900 Superior Lincoln, NB 68505 402-466-8111	YES	YES (C.O.D.)
I. A. Sales Corp. of Calif., Inc. 766 Lakefield Rd. Westlake Village, CA 91361 805-497-3966	NO	YES (C.O.D.)
Inland Dynatronics, Inc. 10 Horizon Blvd. South Hackensack, NJ 07606 201-641-3600	YES	YES

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J. C. Penney Co., Inc. 1301 Ave. Of The Americas New York, NY 10019 212-957-4292	YES	YES
J. I. L. Corp. Of America, Inc. 1000 E. DelAmo Blvd. Carson, CA 90746 213-537-7310 Serv Lit & Parts: 737 W. Artisa Blvd. Compton, CA 90220	YES	YES (C.O.D.)
Kraco Enterprises, Inc. 505 E. Euclid Ave. Compton, CA 90224 213-774-2550	YES	YES (C.O.D.)
Kris, Inc. Pioneer Rd. Cedarburg, WI 53012 414-375-1000	YES	YES C.O.D.)
Lafayette Electronics Sales, Inc. 111 Jericho Turnpike Syosset, NY 11791 516-921-7700	YES	YES (C.O.D.)
Lake Communications, Inc. 1948-E Leigh Ave. Glenview, IL 60025 312-729-6767	YES	YES
Mason Camera & Electronics Corp. 1170 Broadway New York, NY 10001 212-689-6289	YES	YES
Mercury Radio & Battery Corp. 1269 Genesee St. Buffalo, NY 14211 716-896-5253	YES	YES (C.O.D.)
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PAL Electronics Co. 2962 W. Weldon Phoenix, AZ 85017 602-264-0214	NO	YES
Palomar Electronics P.O. Box 2403 Escondido, CA 92025 714-746-2666	YES	YES
Panasonic Co. P.O. Box 1457 Syracuse, NY 07094 201-348-7000	YES	YES*
Pathcom Inc. **Pace Two-Way Radio Prods.** 24049 S. Frampton Ave. Harbor City, CA 90710 213-325-1290	YES	YES*
Pearce-Simpson 4701 N.W. 77th Ave. Miami, FL 33166 305-592-5550	YES	YES
President Electronics, Inc. 16691 Hale Ave. Irvine, CA 92714 714-556-7355	YES	YES
Radio Shack 2617 W. 7th St. Fort Worth, TX 76107 817-390-3011	YES	YES*
Ray Jefferson Main & Cotton Sts. Philadelphia, PA 19127 215-487-2800	YES	YES
RCA Distributor & Special Prods. Div. 2000 Clemens Bridge Rd. Deptford, NJ 08096 609-963-8000	YES	YES*
Regency Electronics, Inc. 7707 Records St. Indianapolis, IN 46226 317-545-4281	YES	YES (C.O.D.)
Robyn International, Inc. P.O. Box 478 Rockford, MI 49341 616-866-1557	YES	YES (C.O.D.)
Royal Sound Co., Inc. 248 Buffalo Ave. Freeport, NY 11520 516-868-2880	YES	YES (C.O.D.)
Royce Electronics Corp. 1746 Levee Rd. North Kansas City, MO 64116 816-842-7505	YES	YES (C.O.D.)
Rysti Electronics Corp. 328 N.W. 170th St. North Miami Beach, FL 33169 305-652-3838	YES	YES (C.O.D.)

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SBE, Inc. 1045 Main St. Watsonville, CA 95076 408-722-4177 Parts (east): 5280 W. 161st St. Brook Park, OH 44142	YES	YES (C.O.D.)
Sears, Roebuck & Co. 925 S. Homan Ave. Chicago, IL 60607 312-265-2500	YES	YES
Shakespeare Co. **Electronics Div.** P.O. Box 246 Columbia, SC 29202 803-779-5800	YES	YES
Shark Electronics, LTD. 19 W. 44th St. New York, NY 10036 212-499-4005	YES	YES
Sharp Electronics Corp. #2 Keystone Place Paramus, NJ 97652 201-265-5600 Parts: (west): 21580 Wilmington Ave. Long Beach, CA 90810 213-830-4470	YES	YES
Sidewinder International **USA, Inc.** 3570 7th St. Wayland, MI 49348 616-792-2205	YES	YES (C.O.D.)
Siltronix 330 Via El Centro Oceanside, CA 92054 714-757-8860	NO	YES (C.O.D.)
Sonar Radio Corp. 1928 Tiger Tail Blvd. Dania, FL 33004 305-920-5510 Parts (east): 212-649-8000	YES	YES (C.O.D.)
Soundmusic Products 303 Fifth Ave. (Suite 1815) New York, N.Y. 10016 212-532-8254	YES	YES
Sparkomatic Milford, PA 18337 717-296-6444	NO	NO
Standard Communications Corp. 108 W. Victoria Carson, CA 90746 213-532-5300 Serv. Lit. & Parts: P.O. Box 92151 Los Angeles, CA 90009	YES	YES (C.O.D.)

continued on page 49

CLASS-D CITIZENS BAND CHANNEL CARRIER FREQUENCIES AND PERMISSIBLE DEVIATION

CHANNEL	SPECIFIED FREQ. (MHz)	.005% UPPER FREQ. LIMIT (Hz)	.005% LOWER FREQ. LIMIT (Hz)
1	26.965	26,966,348	26,963,652
2	26.975	26,976,348	26,973,652
3	26.985	26,986,349	26,983,651
4	27.005	27,006,350	27,003,650
5	27.015	27,016,350	27,016,351
6	27.025	27,026,351	27,013,649
7	27.035	27,036,352	27,033,648
8	27.055	27,056,353	27,053,647
9	27.065	27,066,353	27,063,647
10	27.075	27,076,354	27,073,646
11	27.085	27,086,354	27,083,646
12	27.105	27,106,355	27,103,645
13	27.115	27,116,356	27,113,644
14	27.125	27,126,356	27,123,644
15	27.135	27,136,357	27,133,643
16	27.155	27,156,358	27,153,642
17	27.165	27,166,358	27,163,642
18	27.175	27,176,359	27,173,641
19	27.185	27,186,359	27,183,641
20	27.205	27,206,360	27,203,640
21	27.215	27,216,361	27,213,639
22	27.225	27,226,361	27,223,638
23	27.255	27,256,363	27,253,639
24	27.235	27,236,362	27,233,638
25	27.245	27,246,362	27,243,638
26	27.265	27,266,363	27,263,637
27	27.275	27,276,364	27,273,638
28	27.285	27,286,364	27,283,636
29	27.295	27,296,365	27,293,635
30	27.305	27,306,365	27,303,634
31	27.315	27,316,366	27,313,634
32	27.325	27,326,366	27,323,634
33	27.335	27,336,367	27,333,633
34	27.345	27,346,367	27,343,633
35	27.355	27,356,368	27,353,632
36	27.365	27,366,368	27,363,632
37	27.375	27,376,369	27,373,631
38	27.385	27,386,369	27,383,631
39	27.395	27,396,370	27,393,630
40	27.405	27,406,370	27,403,630

Here's a miniature 3½ digit portable multimeter that delivers extraordinary performance and value for only $189.

Data Precision proudly presents a 0.1% accuracy multimeter that brings the same high performance and value to 3½ digit portable instruments that our Model 245 brought to 4½ digit multimeters. The same levels of reliability, the same small size, the same great convenience and flexibility. The Model 175 has it all... and more for just $189.00.*

High performance

The Model 175 gives you 32 ranges of measurement capability, six functions, 0.1% DCV accuracy guaranteed for one year, and 100 microvolts resolution. You can measure DCV from ±100 microvolts to ±1000V, ACV from 100 microvolts to 500V with a frequency response of 30Hz to 50kHz, DC Current from ±100 nanoAmps to ±2A, AC Current from 100 nanoAmps to 2A with a frequency response of 30Hz to 50kHz, Resistance from 100 milliohms to 20 Megohms **in two excitation voltages.**

Real miniature portability

Here is true miniature portability that delivers lab performance wherever you take it. And you can take it **anywhere.** The 175 operates from AC line, or rechargeable NiCad batteries for 6 hours of in-spec operation. Add this to the remarkably small size 1¾"H x 5½"W x 3½"D, 34 cu. in., weight 22 oz. (4.45 x 13.97 x 8.89cm, 552cc, .63kg.) exceptional operating temperature characteristics, rugged construction... and you can see that this is **real** portability.

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Connect the 175 to an AC line and you have a great bench instrument. It's always recharging when line connected and ready to go into the field whenever you need it.

And the Model 175 gives you a lot more.

- **Easy to Read, Big, Bright Display:** 0.43" LED display for easy reading in dim light or bright light.

- **Hi/Lo Resistance Measurement:** Measure resistance in **two modes.** Hi excitation 2.5V (exceeds semiconductor forward threshold) and Lo excitation 300mV (below silicon junction threshold), for in-circuit resistance measurement without turning on semiconductor junction. **No need to unsolder resistor.**
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- **Overload Protected**
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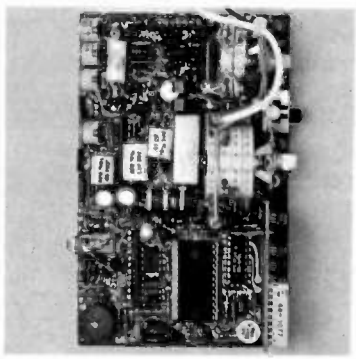

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Actual size, front view.

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Fig. 1—The 1977 Delco digital AM/FM radio and FM stereo unit shown in the elapsed-time-mode.

Delco Goes Digital In 1977

A penetrating look at a new AM/FM radio and FM-stereo auto unit that features digital readout of frequency, time, day and elapsed time

By Joseph J. Carr, C.E.T.

■ One of the new auto electronic products you'll see, and possibly work on, in 1977 is Delco's new digital AM/FM radio and FM-stereo model. Shown in Fig. 1, the new unit uses a "3½-digit", yellow LED, seven-segment digital read-out that displays AM and FM frequency, the time-of-day, day-of-the-month and elapsed time.

The time-of-day is continuously displayed on the digital read-out except when the radio is first turned on, the station-frequency is changed, or the user pushes a special frequency recall button. The AM or FM frequency is displayed for about five seconds, and then the readout automatically reverts to the time-of-day. The time-of-day and calendar are set by a screwdriver adjustment behind the removable front bezel, or cover.

The radio portion of the 1977 Delco digital radio is basically the same IC design as reported in 1976. However, there is a difference in the audio section. In this new model, a DM-84 "bridge audio" power IC module is used. This means that only *ungrounded* loudspeakers can be used with this model. And any extra speakers that might be installed later should also be of the ungrounded type. The somewhat standard practice in car radio installation of grounding one speaker terminal so that only one wire need be run could possibly destroy the bridge audio IC.

CMOS IC's Call For Careful Handling

In addition to the need for ungrounded speakers, the CMOS integrated circuits used in the new model require very special handling. These complimentary metal oxide semiconductor chips

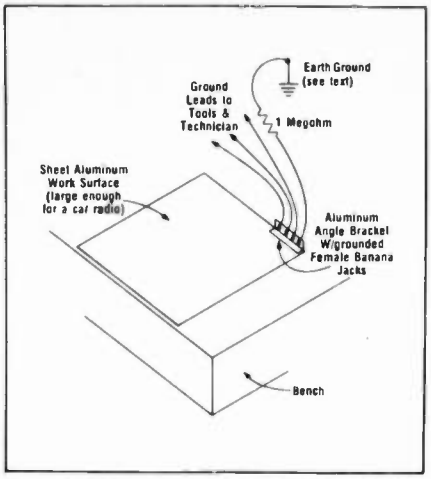

Fig. 2—Diagram of a grounded work surface required for safe handling of CMOS IC devices used in Delco's new digital radio.

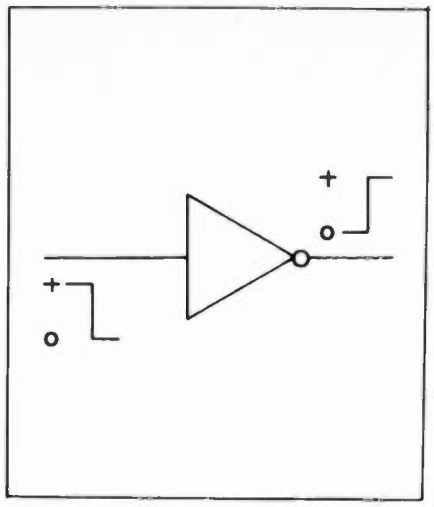

Fig. 4—Diagram of a typical inverter element with an output that is opposite of the input.

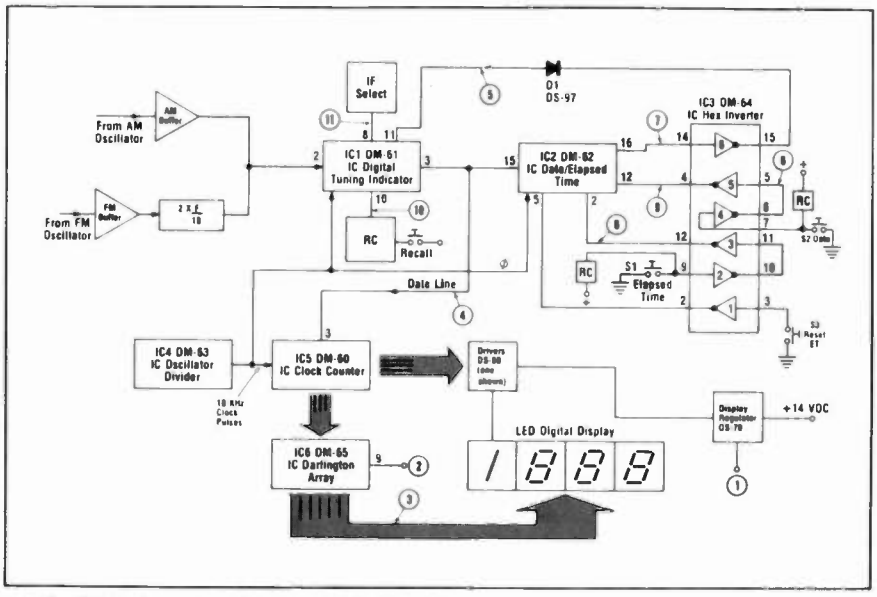

Fig. 3—Block diagram of the digital subassembly.

(CMOS) require the same precautions used when working with unprotected metal oxide semiconductor field effect transistors (MOSFET's). *Everything* that could possibly come in contact with the device must be grounded.

For proper grounding, Delco recommends a cookie sheet as a temporary work surface. For those who want a more permanent fixture, we suggest a sheet of aluminum mounted on the service bench. (See Fig. 2). A ground bracket, made of right-angle aluminum stock, is fitted with several ground banana jacks (either uninsulated, or insulated with the center connector grounded).

The banana jacks are then used to connect ground wires to all of your tools. This includes the soldering iron tip, a pair of tweezers for chip-handling, and even a wrist band for the technician.

To prepare the wrist-band, simply solder one end of test probe wire (because it's flexible) to the flat surface of a regular metal watchband. Of course, be sure to file away the chrome plating before soldering.

The aluminum ground plate then must be connected to earth ground through a 1 megohm resistor. For earth ground, you can use either a real ground rod, clamp it to a *cold* water pipe, or to the screw on any properly wired AC outlet cover plate. One grounding method I've found convenient is with the use of model G3 "Groundlets". These devices, made by Instrutek, Inc., 15 Lincoln Park Center, Annapolis, Md., 21401, provide three binding posts bonded directly to the duplex outlet box cover plate.

Replacement CMOS chips are packed with the pins embedded in a black foam, rubber-like material that is electrically conductive. Do *NOT* take the IC out of the black foam until you are ready to use it—and then only if you are properly grounded. As you know, these chips are expensive, and careless handling to satisfy curiosity will cost you money, and lots of it.

A block diagram of the digital portion of the radio is shown in Fig. 3. As you can see, the heart of the digital subassembly is a set of special CMOS IC modules. These include: the DM-61 *digital tuning indicator* (ICDTI), DM-62 *date-elapsed time* (ICDET), DM-63 *oscillator-divider* (ICOD), DM-60 *clock counter* (ICC), and the DM-65 *Darlington array* (ICDA). In addition, several special transistors are used, including the DS-513, used as a voltage regulator, and the DS-60 Darlington transistors used as display switches.

Frequency Display

As mentioned, the AM or FM frequency is displayed for five seconds after turn-on, when the frequency changes, and when the recall button is depressed.

The recall condition in the frequency mode is manually selected, but the other two methods for obtaining frequency display are automatic. The circuits contain an internal memory and a comparator. If the frequency changes more than 10 KHz on AM or 100 KHz on FM the comparator issues an output command that turns on the frequency display for the five second period.

The five-second display period at set turn-on is due to the memory of the circuit being 'empty', which is interpreted by the comparator as a large frequency difference. After the five second period, the memory circuit has new data from the time circuit to operate on and it will not display frequency again until the station is changed or the recall switch is depressed.

The digital readout is determined by data from either the digital tuning indicator (ICDTI) or the date-elapsed-time (ICDET), which is passed along a common bus to the clock counter (ICC), where it is processed and decoded for multiplexed display.

The complex nature of these cir-

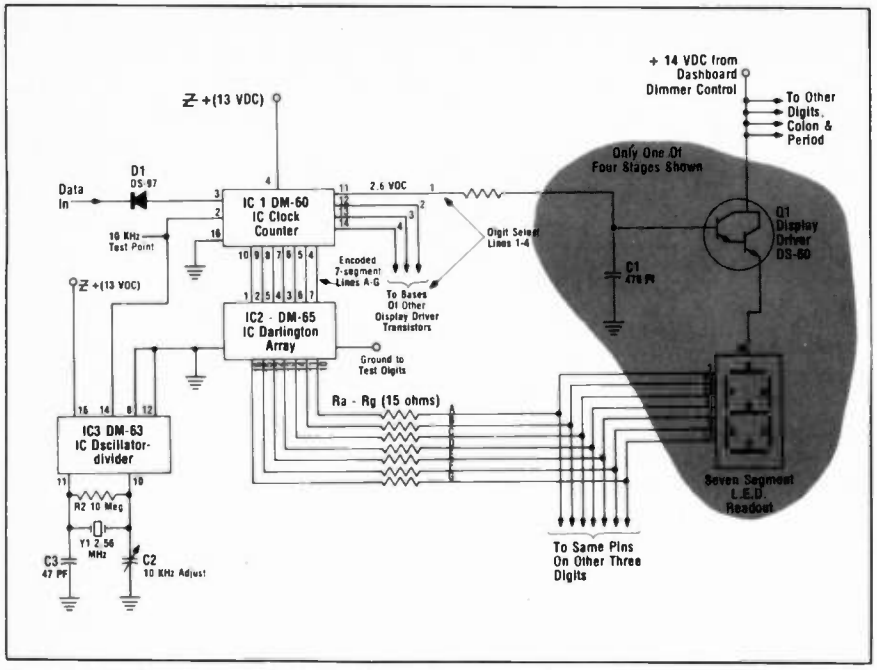

Fig. 5—Block diagram of the multiplexed display circuit with only one of the four DS-60 display driver transistors shown.

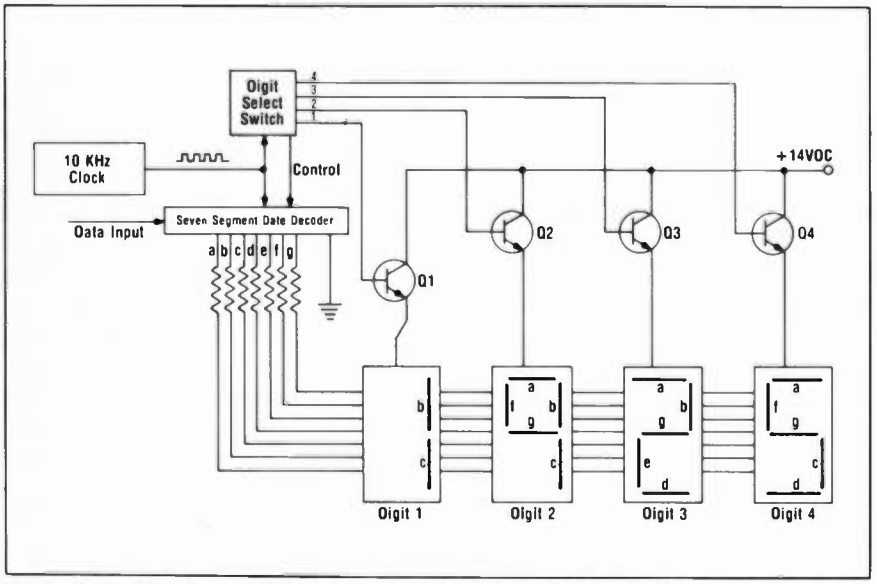

Fig. 6—A simplified diagram of a display multiplex circuit showing how the ICC turns on just one digit at a time.

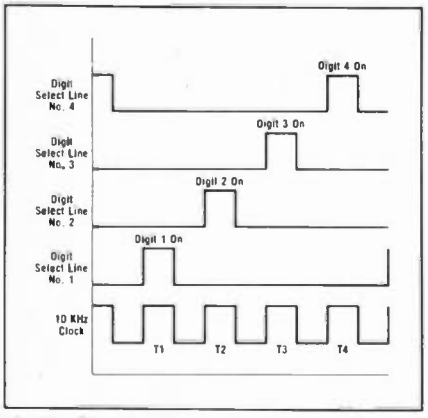

Fig. 7—Diagram showing the timing of the multiplex circuit, with all electronic switching controlled by 10 KHz clock pulses.

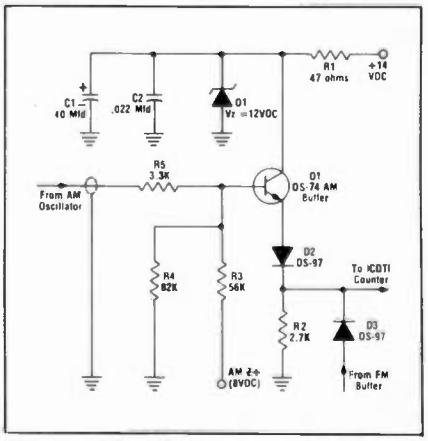

Fig. 8A—Schematic drawing of the AM buffer section.

cuits requires a 10 KHz synchronization signal, also used as the time-base for the counter. The 10 KHz signal can be set with a small variable capacitor, but care must be used when doing so. Be sure to use an accurate frequency meter such as a digital counter. Any counter suitable for CB service will do for this job. Do not depend on your oscilloscope's time base, or some ancient 10 KHz audio oscillator.

Date and Elapsed Time Control

The date-of-the-month and elapsed-time display is controlled by IC 3, (DM-64) which is a "hex inverter." For those unfamiliar with the world of digital electronics, an inverter is a digital circuit element that gives an output signal that is the opposite of its input signal. In diagrams, it is represented by a triangle, most often with a circle at its apex (Fig. 4).

In digital electronics we have only two possible signal states, or levels: *high* and *low*. In the high condition, called logic level "1", the voltage will have some positive value. In the older IC devices, level "1" was +5 VDC, but in the CMOS, "1" might be represented by any voltage level between +4 VDC and +18 VDC. The logical "0" is the low stage and that usually means the point is grounded, or very near ground (i.e., less than 1 volt).

The rules for inverter operation are simple:

1. A high input (1) gives a low (0) output.
2. A low input (0) gives a high output (1).

DM-64 in Fig. 3, is a hex inverter with six (hex) independent inverter circuits that control the Date and Elapsed Time IC, DM-62, by making certain pins either high or low. For example, switch S3, when depressed, grounds the input of hex inverter (HI) No. 1. This causes the output of HI No. 1 to go high for an instant and resets the elapsed time counter (DM-62).

Similarly, when switch S2 is closed, it grounds the input of hex inverter No. 4, making its output (pin 6) high. Because the output of hex inverter No. 4 is connected to

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the input of hex inverter No. 5, the output of hex inverter No. 5 goes low, grounding pin No. 12 on the date and elapsed time IC (DM-62). This causes the date to display. An RC network keeps the date turned on for a short time, after which the display reverts to time-of-day.

How The Display Circuit Works

In order to reduce current requirements and circuit complexity, the new Delco digital radio uses a method of "display multiplexing." Although only one of the LED readouts is turned on at any one time, the rate at which the circuit switches through the four separate readouts is so high (10 KHz) that one gets the illusion of a steady, continuous display.

In the Delco readout system, there are seven individual LED bars arranged in a figure 8 pattern, for each of the four readouts. Circuitry for one of the four readout stages is shown in Fig. 5. The arabic numeral, or digit, that is displayed is determined by which of these segments is turned on and producing light. For example, if segments a, b, and c are turned on, a "7" will be displayed. On the other hand, if f, g, b, and c segments are turned on, we will see a "4".

A total of eleven Darlington transistors are used as switches to control the four LED readouts. Seven of these Darlington transistors, operating as segment drivers, are located inside the Darlington Array (DM-65). The other four are type DS-60 display drivers, used to sequentially supply +14 VDC to the LED readouts. These four are mounted outside DM-65. (See Fig. 3).

The proper seven-segment code for each of the four readouts is determined by the DM-60 IC Clock Counter (ICC) as it examines the input data. It operates in this case, then, as a decoder. The ICC also sequentially activates the four *digit select* lines, pins 11 through 14. When a new line is selected, power is applied through a DS-60 display driver transistor to the appropriate digit. At this same time, the DM-60 also passes the seven-segment code through the Darlington Array IC (ICDA) to the segment lines, a through g. Each of these lines will take on a "1" or "0" value as needed for the par-

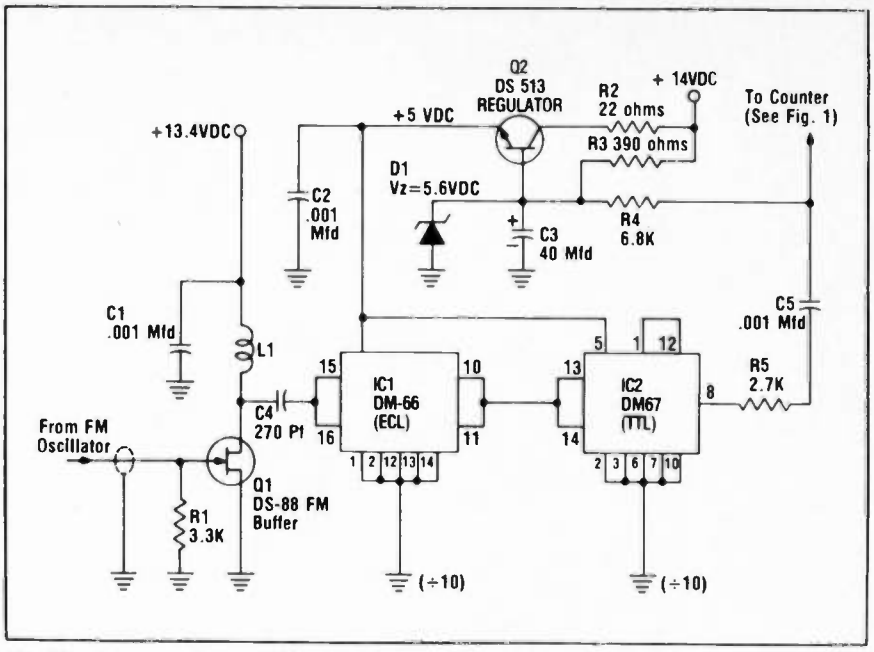

Fig. 8B—Schematic drawing of the FM buffer section and the divide-by-100 stages.

Digital Radio Troubleshooting Procedure

Table I

STEP & TEST POINT	NAME/DESIGNATION	TEST	COMMENTS/RESULTS
1	display regulator	measure voltage	Should be +5 to +9. Do not proceed until this voltage is present
2	lamp test	ground "2"	All L.E.D. segments should light up and read "18:8.8"
3	segment control	ground pins 10 -16 on DM-65 one at a time	See table II for results to expect
4	data line input	ground DM-60 pin 3	clock overrides all other functions
5	ICDTI status	ground DM-61 pin 11	Frequency display locked out
6	status control	voltage on DM-64 pin 15	Depress "date", "elapsed time" or "reset". Voltage should go *low*
7	status control	voltage on DM-64 pin 14	Depress "date", "elapsed time", or "reset". Voltage goes *high*
8	"ET select"	voltage on DM-62 pin 2	Depress "reset" or "elapsed time," voltage goes low. Depress "recall" or "date", voltage goes high
9	date select	voltage on DM-62 pin 12	depress "date", voltage goes low. depress "recall", "ET", or "reset." voltage goes high
10	Frequency display gate	Voltage on DM-61 pin 10	depress "freq". Voltage goes high. Depress ET or reset. voltage goes low
11	I.F. select	Voltage on DM-61 pin 8	Place bandswitch in FM. Voltage should be high. Place bandswitch in AM. Voltage should be low

ticular number to be displayed. An "0" on a line will provide a path to ground for the segment to which it is connected, and this allows the LED bar to light up.

Display Multiplexing

In the case of display multiplexing, not to be confused with stereo multiplexing, we are using the process described earlier where only one of the four digits is turned on at any one time. This is the way that electronic calculator displays also operate. In Fig. 6, we show a simplified diagram to illustrate how display multiplexing works in the new Delco unit.

As shown, all similar pins on each of the four readouts are tied together. In other words, all segment "a" pins are connected together, as are all of the other six pins, "b" through "g". Thus, the seven-segment code appearing on lines a through g is applied simultaneously to all four digits.

However, the particular digit that is activated at any instant in time is the only one that will turn on. This occurs because the four digit select lines from the clock counter IC are sequentially activated so that when a high appears on a digit select line, the DS-60 associated with it will become forward biased and will pass power to the next digit to be lighted.

For example, suppose we want to display the number "1925" on multiplexed display as shown in Fig. 6. Also, let us assume that the display is scanned left to right so that the left-most digit turns on first and the right-most digit turns on last.

As we proceed, refer to Fig. 6, and Fig. 7, which shows the timing diagram for the multiplexer. As you'll notice in both diagrams, the 10 KHz clock synchronizes the whole sequence of events.

For purposes of explanation, we assume in Fig. 7 that pulse time one (t1) occurs at a time when digit No. 1 is to be lighted. At t1, the line select switch causes select line No. 1 to go high, and at the same time, it tells the decoder to place the proper code on lines a through g. In our example, we want a "1" on the display, so the decoder grounds segment lines b and c and leaves the other high.

The high condition of line No. 1 forward-biases transistor Q1, and

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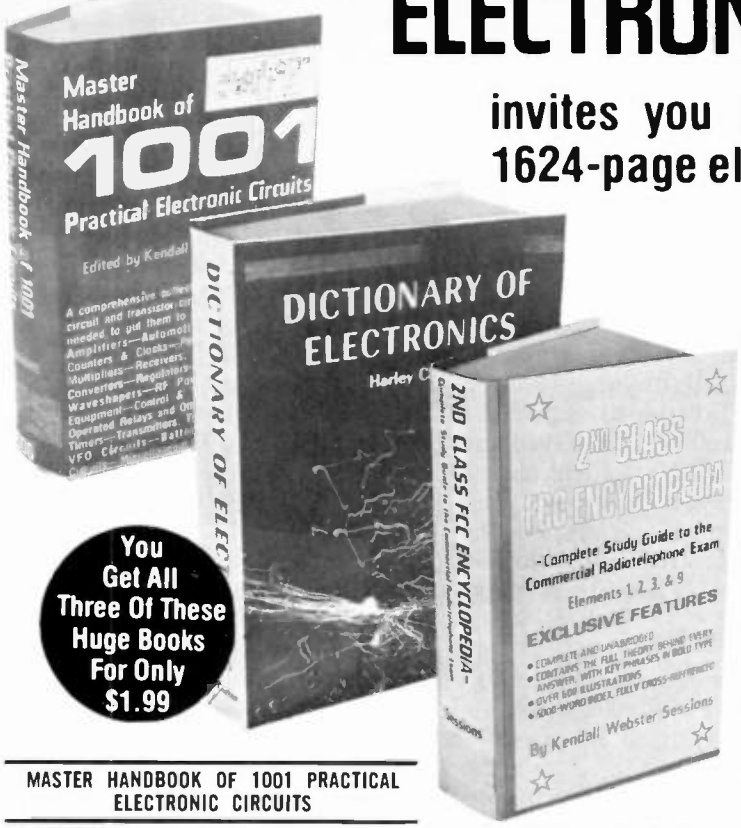

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The section on test equipment includes circuits for almost any instrument you can imagine, from simple range multipliers for your VOM to sophisticated frequency counters. Build even one of these practical devices and you've saved far more than you've paid for the book. The Section on receivers and RF preamplifiers gives you a rich choice of circuits from which to choose in order to improve reception of any type of signal in any part of the radio frequency spectrum: it's an extremely simple and effective way to get "metropolitan" performance from a "fringe area" TV installation. If you're in the business of servicing/repairing commercially built electronic equipment (TV receivers, stereo amplifiers, CB transmitters and receivers), you're going to especially appreciate the comprehensive Appendix of IC substitutions, which includes base diagrams for most popular ICs, and gives you all the info you need to adapt the IC packages of one manufacturer to the circuit applications of another. Another Appendix is a pictorial listing of common electronic symbols.

DICTIONARY OF ELECTRONICS

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Appendix material provides you with still more information—an extensive list of units and abbreviations, graphic symbols used in schematics, component color codes, db conversion tables, data on the electromagnetic spectrum, tube base diagrams, etc.

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allows power to be applied to the common anode connection of digit 1. Current then flows from ground, through the decoder, and segment lines b and c, through LED cathodes b and c (this turns on bars b and c), then to Q1 and back to the +14 VDC supply.

At time t2, line No. 2 goes high, activating digit No. 2. At the same time, the decoder is told to supply the code to turn on segments a, b, c, f, and g. This lights up a "9".

Similarly, at time t3, digit No. 3 turns on and a "2" is displayed and at time t4, digit No. 4 turns on and a "5" is displayed. Only one digit is activated at any one time, but the 10 KHz switching rate is so fast that you perceive a steady display.

Other Circuits Of Note

Most of the remaining circuitry in the Delco 1977 digital radio is of the same sort used in previous models. There is one noteworthy difference, however, in the buffering circuits between AM and FM local oscillators and the frequency counter input. The buffer amplifiers between the frequency counter and AM and FM local oscillators are shown in Figs. 8A and 8B.

The AM buffer is simply an emitter-follower feeding a diode rectifier. The buffer is needed to prevent loading of the AM local oscillator by the counter. The diode is used to convert sinewaves from the local oscillator to pulses required by the counter.

The FM buffer is a little different because the digital tuning indicator IC (DM-61 or ICDTI) cannot handle signals in the 100 MHz range directly. The FM buffer uses a DS-88 JFET to amplify signals from the FM local oscillator and to pass them on to a two-stage divide-by-100 (f/100) section.

This f/100 stage is actually two f/10 stages in cascade (10 x 10 = 100). The first f/10 stage (IC1) is a decade divider of the emitter coupled logic (ECL) family. This family of digital logic IC's can operate to at least 120 MHz, so they'll easily handle the FM local oscillator signal.

The next stage (IC2) is a more common TTL decade divider that is good only to 20 to 30 MHz. It is satisfactory in this case, though, because the ECL stage reduces the FM local oscillator signal to a range less than 12 MHz.

The two dividers, IC1 and IC2, require a supply voltage that is within 5% of +5VDC in order to operate properly. Overvoltage will damage them.

Transistor Q2 in Fig. 8B, a type DS-513, combines with Zener diode D1 to form a voltage regulator that drops the +14 VDC to +5 VDC.

If you ever find excessive voltage on the +5VDC line, be sure to check not only for a leaky DS-513 or an open D1, but also the DM-67 and DM-66. If you ever find either a DM-67 or DM-66 defective, do not install a replacement until the regulated power supply is checked and determined to be in good condition.

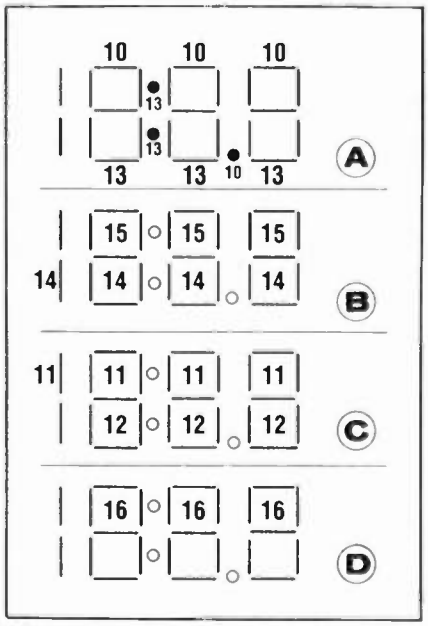


Table II—Pin grounding procedure for segment control. Ground pins 10 to 16 on DM-65, one by one. Figures in table indicate which segments will light up for each DM-65 pin. *Caution*: If you use an alligator clip or screw driver for grounding, make the ground-end connection first, then the connection to the DM-65 pin.

Troubleshooting the Digital Section

To aid in troubleshooting the Delco digital radio, we've prepared a chart of logical steps as shown in Table I. The troubleshooting steps on the chart correspond to circled numbers in Fig. 3. For efficient, safe diagnosis, we recommend a review of the procedures for handling CMOS devices and the construction of the grounded work area described. In addition, you'll find it worthwhile to acquire the 1977 Delco service manual (publication No. 6D-1977-1, dated Sept., 1976) from a Delco wholesale parts distributor. ■

PC-77 SHOW AGENDA

A schedule of the activities planned during the second annual Personal Communication Two-way Radio Show to be held at the Las Vegas Convention Center in Las Vegas, Nevada, Tuesday, Wednesday and Thursday, February 15, 16 and 17, 1977—sponsored by the Citizens Radio Section, Communications Division, of the Electronic Industries Association (EIA).

MONDAY, FEBRUARY 14, 1977

- 7 to 10 P.M.—(Cocktail Reception, 7 to 8 P.M.; Banquet, 8 to 10 P.M.)

The Opening Banquet—Ballroom of the MGM-Grand Hotel

With: Special Guest Star, Impersonator Mel Blanc, "the man with a thousand voices"

Opening Addresses by:

- Congressman Lionel Van Deerlin, Representative from California's 42nd Congressional District
- FCC Commissioner Benjamin L. Hooks

TUESDAY, FEBRUARY 15, 1977

- 9:30 to 11:30 A.M.—First session of PC-77 Seminar Program, *UPDATE 1977*, with John Sodolski, Vice President, Communications Division, EIA, as Moderator:

- 9:30 A.M.—Government Regulations:

The New FCC Rules, Licensing, Trends, and a Look at the Future—with Charles Higginbotham, Chief, Safety & Special Radio Services Bureau, FCC

The New Technical Requirements and Standards—with Raymond Spence, Chief Engineer, FCC

Interpreting Regulations—with Ray Hall, Executive Vice President, Electronic Representatives Association

- 10:45 A.M.—Public Safety—Challenges and Opportunities:

Personal Communications and Highway Safety—with Gerald Reese, Managing Director, REACT International, Inc.

Law Enforcement Involvement in CB Radio—with Colonel S.S. Smith, Superintendent, Missouri State Highway Patrol

- 10 A.M. to 6 P.M.—Exhibit Hall Open

WEDNESDAY, FEBRUARY 16, 1977

- 9:30 to 11:30 A.M.—Second Session of PC-77 Seminar program
- 9:30 A.M.—*The New Marketplace*—with William I. Thomas, Chairman, Citizens Radio Section, Communications Division, EIA, as Moderator

Market Penetration–What We've Done and Where We're Going—with Ted Andros, Executive Vice President, Hy-Gain Electronics Corp.

How to Promote Personal Communications in Your Marketplace—with David Bradley, Executive Vice President, Kris, Inc.

Handling Interference Complaints—with John Chass, Vice President, Sales and Engineering, Royce Electronics

How to Sell Antennas and Accessories—with James Rice, President, The Antenna Specialists Company

How to Maximize Your Return from the Rep Who Calls On You—with Bert Moore, Partner, Bassett & Moore

- 10 A.M. to 6 P.M.—Exhibit Hall Open

THURSDAY, FEBRUARY 17, 1977

- 10 A.M. to 6 P.M.—Exhibit Hall Open

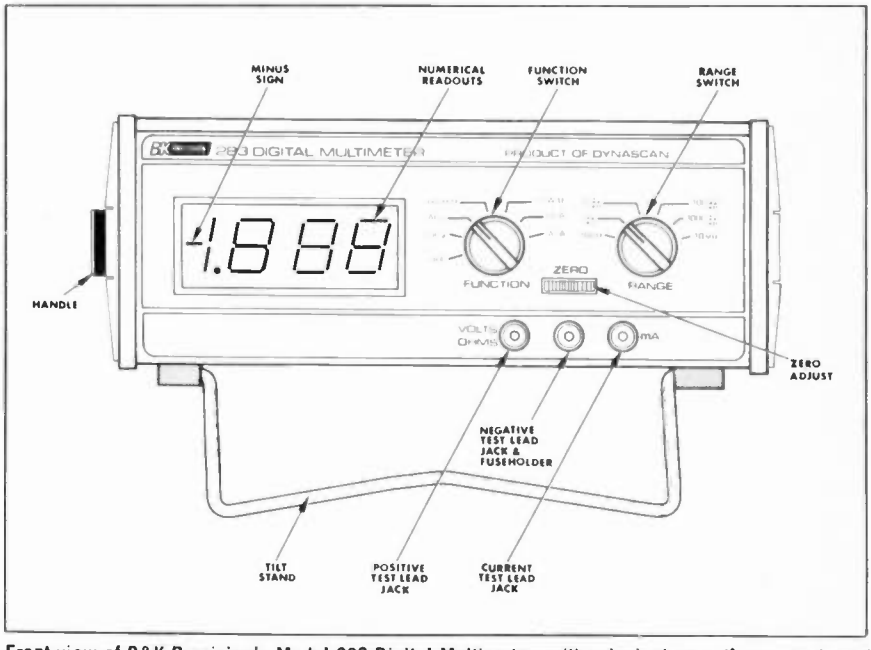
TEST INSTRUMENT REPORT

Features & specifications of recently introduced test instruments designed for servicing applications

For more information about this test instrument, circle No. 131 on Reader Service Card in this issue.

B&K's Model 283 DMM

A 3½ digit, servicer-oriented, digital multimeter with 'high/low power' resistance measuring ranges



Front view of B&K Precision's Model 283 Digital Multimeter, with principal operating controls and features pointed out.

■ B&K Precision's newest digital multimeter, the Model 283, is a 3½ digit, 100% overranging type capable of measuring DC voltages from .001 to 1500 volts, AC voltages from .001 to 1000 volts RMS, DC and AC current from 1 μamp to 1.999 amps, and resistances from .1 to 19.99 megohms. (Ranges, accuracies, input impedances and other measurement characteristics are detailed in the accompanying Table Of Specifications.)

Although the 283's size (3⅝" X 7" X 9") and weight (6 Lbs.) make it particularly suited for bench use, a built-in carrying handle, stow-away tilt stand and an optional rechargeable battery power pack—which fits inside the instrument's case and provides in excess of eight hours of continuous operation before overnight recharging is required—also make it portable.

Another—and perhaps the most significant—servicer-oriented feature of the 283 is its *two* resistance measuring modes, one of which, called 'LOW Ω', produces relatively low levels of test current (.1mA or less), which are particularly useful for in-circuit reisistance measurements in semiconductor-equipped circuits. The other mode, called 'HIGH Ω', produces significantly higher test currents (up to 1mA), which are especially useful for out-of-circuit resistance measurements, including front-to-back resistance-ration testing of semiconductor junctions.

Although all six ohms ranges of the 283 can be used in both resistance measuring modes, the current through—and consequently the voltage developed across—a resistance measured in a given range with the 283 in the LOW Ω mode is only *one-tenth* that for the same resistance measured in the same range in the HIGH Ω mode.

With the FUNCTION switch of the 283 in the 'LOW Ω' position, the *maximum* voltage which will be developed across a measured resistance in any ohms position of the RANGE switch is *.2 volt*. This 'maximum' level of voltage is developed only when the value of the measured resistance is equal to the 100% overrange capability of the particular range selected. If the value of the resistance is less than the 100% overrange capability of the range, the voltage developed across the resistance will be proportionately less than .2 volt.

For example, the '100% overrange' capability of the 283 with the RANGE switch in the '10K Ω' position is 19.99 K ohms. If a 19.99K ohm resistance is measured with the RANGE switch in this position and the FUNCTION switch in the 'LOW Ω' position, .2 volt will be developed across the measured resistance. However, if the measured resistance is only 10K ohms (the 'full-scale' measurement capability of the '10K Ω' range) only .1 volt will be devel-

Close-up view of right-hand side of the 283's front panel showing input protection fuse removed. (Fuse is installed in 'common' input jack. Twisting spring-loaded jack with tip of finger releases it, causing fuse to pop out.)

oped across it—and proportionately less for lower values of resistance.

Because the voltage levels (.2 volt or less) developed across measured resistances in the LOW Ω mode are less than the levels required to forward bias semiconductor junctions (about .6 volt for silicons and slightly over .2 volt for germaniums), the misleading errors caused by forward biased junctions that shunt measured circuit resistances are avoided when in-circuit resistance measurements are performed with the 283 in this mode.

On the other hand, because the 283's HIGH Ω mode furnishes up to 1 mA of test current through measured resistances, it is especially useful for out-of-circuit resistance measurements—including testing the front-to-back resistance ratios of semiconductor junctions—as well as for in-circuit testing in circuits not equipped with semiconductors.

The procedure for front-to-back resistance-ratio testing of diode and bipolar transistor junctions with the 283 in the HIGH Ω mode is as follows:

1) Remove the device from the circuit

2) Place the RANGE switch of the 283 in the '1K Ω' position (maximum test current in this position is 1 mA)

3) Connect the test leads across the junction and observe the read-

continued on page 49

TABLE OF SPECIFICATIONS

B&K Precision Model 283 Digital Multimeter

DC VOLTAGE FUNCTION
Ranges: 0-1.000, 0-10.00, 0-100.0, 0-1000 volts (±)
Overrange: 100%, to 1.999, 19.99, 199.9, 1500 volts (±)
Max. Input: 1500 volts DC, or DC + AC (Protected to this level on all ranges)
Accuracy:
1, 10, 100 volt ranges:
±.5% of reading, ±1 digit
1000 volt range: ±1.0% of reading, ±1 digit
Input Impedance: 10 megohms
Polarity Indication: Minus sign displayed automatically; plus sign implied
Overrange Indication: When input exceeds 100% of full range, top and bottom segments of first digit on left flash while display indicates '000'

AC VOLTAGE FUNCTION
Type: Average reading calibrated to readout RMS value of pure sine wave
Ranges: Same as for DC function
Overrange: 100%, to 1.999, 19.99, 199.9, 1000 volts AC RMS
Max. Input: 1000 volts RMS, or 1500 volts PEAK (Protected to this level on all ranges)
Accuracy:
1, 10, 100 volt ranges: ±1% of reading, ±1 digit
1000 volt range: ±1.5% of reading, ±1 digit
Freq. Response:
1, 10, 100 volt ranges: ±1% from 40HZ-400HZ
100 volt range: ±1.5% from 40Hz-400Hz
Input Impedance: 10 megohms
Overrange Indication: Same as for DC function

DC CURRENT FUNCTION
Ranges: 0-1.000, 0-10.00, 0-100.0, 0-1000mA (±)
Overrange: 100%, to 1.999, 19.99, 199.9, 1999mA
Max. Volt. Across Input Terminals: 250mV (650mV on 1000 mA range)
Accurracy:
1, 10, 100mA ranges: 1% of reading, ±1 digit
1000mA range: 1.5% of reading, ±1 digit
Polarity Indication: Same as for DC voltage function
Overrange Indication: Same as for DC voltage function
Input Protection: Internal diodes and externally accessible fuse

AC CURRENT FUNCTION
Ranges: Same as for DC current function
Overrange: Same as for DC current function
Max. Volt. Across Input Terminals: 250 mV RMS (650mV RMS on 1000 mA range)
Accuracy:
1, 10, 100mA ranges: ±1.5% of reading, ±1 digit
1000mA range: ±2% of reading, ±1 digit
Freq. Response: 40-400 Hz at stated accuracy
Overrange Indication: Same as for DC voltage function
Input Protection: Same as for DC current function

RESISTANCE MEASURING FUNCTION
Ranges: 0-100, 0-1K, 0-10K, 0-100K, 0-1000K, 0-10 megohm
Overrange: 100%, to 199.9 ohms, 1.999K, 19.99K, 199.9K, 1999K, 19.99 megohms
Accuracy:
HIGH Ω Function: ±1% of reading, ±1 digit all ranges except 10 megohm (which is ±2% of reading, ±1 digit)
LOW Ω Function: ±2% of reading, ±1 digit for 100 ohm through 1000K ohm ranges
Max. Volt. With Full-Scale Reading: HIGH Ω Function: 2 volts; LOW Ω Function: .2 volt

Max. Test Currents: (HIGH Ω mode):

RANGE:	CURRENT:
100 ohm	1mA
1K ohm	1mA
10K ohm	100uA
100K ohm	10uA
1000K ohm	1uA
10 megohm	100nA

Max. Open-Circuit Volt.: 8 volts
Polarity Of Input Terminals: 'VOLT/OHM' jack (red) is positive on all ranges
Input Protection: −500 volts to +1000 volts AC PEAK, continuous. (Will withstand momentary overloads to +1000 volts DC + AC PEAK)

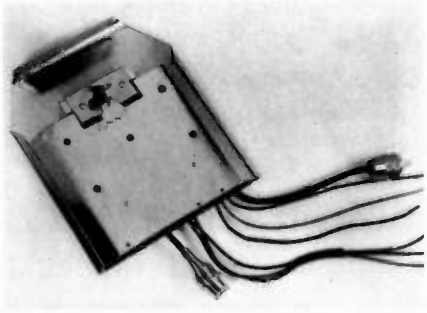
GENERAL SPECS
Power Source: 117 volts AC, 50/60 Hz delivered from factory. (User can change to operate from 100 to 234 volts AC by changing tap on power transformer.) Internal rechargeable battery power pack available on optional basis.
Dimensions: 3⅝" high x 7" wide x 9" deep
Weight: 6 lbs.
Accessories Included: 2 test leads
Optional Accessories:
BP-83 Rechargeable Battery Pack
PR-21 Isolation/Direct Probe
PR-23 RF Detector/Demodulator Probe (15KHz-250MHz)
HV-28 High-Voltage Probe
Price: $170.00

NEW PRODUCTS

Descriptions and specifications of the products included in this department are provided by the manufacturers. For additional information, circle the corresponding numbers on the Reader Service Card in this issue.

KEY-LOCK CB SLIDE MOUNT 134

A new universal key lock slide mounting bracket for CB radios that helps to prevent theft has been introduced by *RMS Electronics*. The mount is designed for use with all automobile CB transceivers, and mounts easily under the dashboard or on the floor.



Both the mount and CB radio can be easily unlocked and removed from the vehicle when radio is not in use. The mount, model no. CBLM-520, comes complete with male and female coaxial cable connectors, 3-wires, mounting hardware, screws and key. List price is $14.50.

HIGH PASS FILTER FOR CB 135

A new high pass filter to reduce interference with TV and FM reception caused by CB and other high frequency radio transmission has been introduced by *Avanti Research*. The new filter is installed on the TV lead-in, as close to the set as possible. Designated the Model AV-811, the device lets the TV signal come through the line unhindered, while choking off the incoming CB signal. It has an impedance of 300 ohms, VSWR of 1.1:1, negligible line loss, and cutoff frequency of 54 MHz.

OSCILLOSCOPE PROBE 136

A new oscilloscope probe that features a slim-body construction and 10:1/direct capability is available now from *B & K-Precision*. Designated Model PR-35, the probe is designed for any oscilloscope using a BNC connector, having a bandwidth up to 15MHz and an input capacitance of 10-35 pF. The probe is constructed with a steel inner structure, encapsulated by a rugged plastic shell. The "pull-apart" hidden switch design prevents accidental position switching of the 10:1/direct switch. The PR-35 has an impedance of 10 megohms/18 pF (10:1) and 1 megohm/120 pF (1:1). Maximum voltage is 500 Vp-p. It is priced at $30.

TRIPLE BANANA PLUGS 137

A new cable with a triple banana plug on one end and single banana plugs on the other end is now available from *ITT Pomona Electronics*. Called Model 1701, the cable comes in 18 inch and 24 inch lengths. The triple banana plug has a spring of one-piece treated beryllium copper alloy. The plug body is brass with a nickel-plated finish and polyethylene thermoplastic insulation. The single banana plugs are made of the same material as the triple-plug. As a patch cord, Model 1701 is said to fit many European banana jacks and is ideal for balanced line. Priced at $24.95.

CORDLESS SOLDERING GUN 138

A new, heavy-duty, cordless solder-

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Hickok CB Test Instruments

MODEL 334 DIGITAL MULTIMETER

Lab quality, all-function workhorse gives 5 ranges of AC and DC voltage and current plus 6 ranges of ohms. All with 3½ digit resolution plus automatic decimal point, automatic polarity and automatic overrange indication.

MODEL 388 CB IN-LINE TESTER

Provides digital read-out of the four prime operational checks required in transmitter service. One hook-up operation and front panel control. One compact package. Frequency. Power output. Standing-wave ratio. And percent of modulation. Cable matching and coupling circuits are internal and automatic. Also model 388X with TCXO.

MODEL 270 FUNCTION GENERATOR

For all CB transceiver audio circuits. Doubles as a 455 KHz IF generator. Calibrated, sine, square and triangle waveforms from 1Hz to 500 KHz. With external connections produces logic pulses, sweeps and ramps; amplitude and frequency modulated outputs; tone bursts; and a host of mixed signal outputs.

MODEL 380 SERIES FREQUENCY COUNTERS

Easy-to-use with simplified controls and hands-off operation provided by autoranging and auto-decimal circuits. Model 380 offers guaranteed range of 1 to 80 MHz. Model 385 is for communications and UHF with a range of 10 to 512 MHz. Stability to 1ppm available in 380X and 385X models.

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ing gun that is said to solder everything from No. 12 electrical connections to micro circuitry has been introduced by *Wahl Clipper Corporation*. Called Iso-Tip, the new gun contains a built-in refillable .062 solder spool and self-feeding mechanism that operates by fully depressing the trigger. Solder feeds through a tube at the tip, which positions it for one-hand soldering. Iso-Tip is also available without the automatic feed. Sixteen snap-in tips are available for adaptation to different types of jobs. A plug-in battery charge is standard equipment with the gun and will bring the nickel-cadmium batteries from dead to full-

charge overnight. When fully charged the gun will make up to 400 electronic joints. The isolated-tip design eliminates electrical leakage and the need for grounding.

VARIABLE GAIN CB MIKES 139

A new variable gain CB microphone is being introduced by *GTE Sylvania* as part of their new line of CB accessories. The new variable gain mike, Model SDX-100, (pictured) for mobile use, features a thumb-controlled slide switch for gain control. A base station model, SDX-200, has a similar slide

switch and push-to-talk and lock switches which permit "hands-off" communication. Both models have a patented speech processing circuit which increases average modulation power by more than 4 db and minimizes audible distortion. The new SDX models are part of Sylvania's newly introduced line of five CB microphones, wired for use with transceivers requiring either relay or electronic switching. All are equipped with a standard, factory pre-wired PP-50 plug.

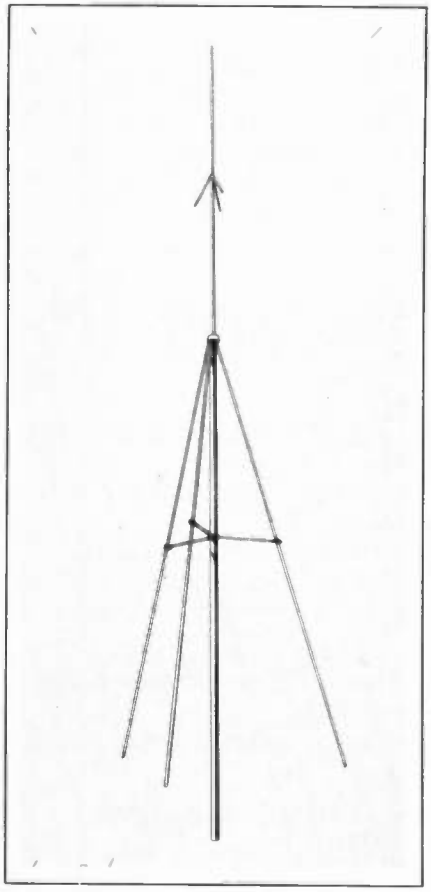
FIVE-AND-A-HALF DIGIT DVM 140

A new 5½ digit DVM that measures ACV, DCV and ohms, and features a built-in frequency counter, is now available from *Dana Laboratories*. The instrument, Dana 5100, has .43 yellow LEDS for reduced eye fatigue and a switchable filter which provides inherent noise rejection at multiples of 10Hz. DC settling time (filter out) is only 30m Sec. A high accuracy averaging AC converter is standard equipment with Dana 5100. The combination of DVM and frequency counter allows the operator to calibrate the function generator at the same time

an AC voltage measurement is being made. Optional accessories include current shunts, high voltage probe 5 to 50KV, RF probe, true RMS AC converter and input cable.

CB BASE STATION ANTENNA 141

A new base station antenna which features base-loading, full aperture, half-wave dipole design is being introduced by *GTE Sylvania*. The new antenna Model SYL-BS. has a typical VSWR of from 1.5 to 1 or better on all



channels and an average power gain which is 12 db above typical quarter-wave base station antennas. Model SYL-BS is constructed of lightweight aluminum tubing with an overall height of 17 feet and base width of less than six feet. The new antenna is part of a complete line of mobile and base station CB antennas recently introduced by Sylvania.

FREQUENCY COUNTER 142

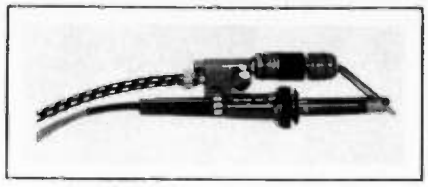
A new 10 MHz frequency counter with a measuring range of from 20 Hz to 10 MHz is now available from *Systron-Donner*. All solid-state, the new counter has a complete set of adjustable input controls, including a 3-position (x1, x10, x100) attenuator switch, and an offset control. Designated the Model 6202B, the new unit can make high-accuracy measurements of complex, non-sinusoidal waveforms. The variable offset control also has a fixed preset trigger position. Four selectable gate times from 0.1 Hz to 100 Hz allow readouts of measure-

ments to appear at a convenient resolution. Minimum sensitivity is 25 mV RMS for inputs to 1 MHz; 50 mV RMS for inputs from 1 to 5 MHz; and 100 mV RMS for all inputs above 5 MHz. A crystal oscillator with an aging rate of ± 2 parts in 10^6 per year is standard. A temperature controlled crystal oscil-

lator is available at extra cost. The new counter is priced at $295.

SOLDER REMOVAL SYSTEM 143

A new solder removal system with a miniature, air-operated vacuum pump, is now available from *Air-Vac Engineering*. Constructed of molded plastic the pump is mounted on a desoldering iron handle. It provides instant on/off vacuum less than four inches from the joint to be desoldered. High vacuum flow is not restricted by vacuum tubing. These PVSG model vacuum removal systems are available on American Beauty, Esico, Hexacon, Ungar and Zeva irons. They provide a maximum desoldering tip temperature of from 77°-95° F. Compressed air is used only when vacuum is on, so consumption is less than 1.5 scfm. These systems are priced as low as $80.



CB NOISE SUPPRESSION FILTER 144

The new EMI-80A CB noise suppression filter from *Marine Technology* is designed to eliminate alternator or generator interference.

This three-element, pi-type filter provides over 35 dB of noise attenuation throughout the entire 40-channel CB band and is rated for 80 amps of continuous current. It also provides effective noise attenuation on Amateur bands 40 to 2 meters and on the Marine VHF band.

Physical design features include all brass terminals and epoxy-encased

network elements, to insure long life when the unit is mounted in the engine compartment.

Suggested retail price of the EMI-80 is $9.95.

DC POWER SUPPLY FOR CB SERVICE 145

A new dc power supply designed for CB service application has been announced by Hickok Electrical Instrument Company. Designated Model 244 Mobile/Comm Power Supply, the new unit is a compatible, rack-mountable addition to the Hickok CB service system. The unit has a fully-adjustable voltage range of 10.5 to

14.5 volts, metered on a large 2½ inch meter with a calibrated standard 13.8 volt setting clearly indicated. The full adjustability and 0.5% regulation permits duplication of actual storage-battery operating conditions such as low-voltage and over-voltage operation. Continuous-duty three amp output is protected against short circuits by fold-back current limiting, so that even dead shorts will do no damage. All overload conditions are indicated by a front-panel OVERLOAD light. Priced at $125.

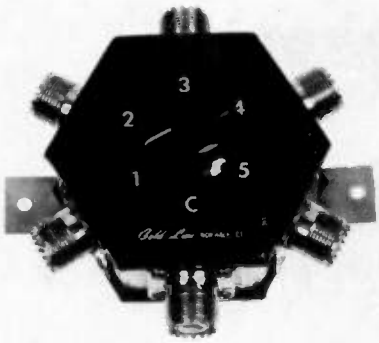
DISTORTION MEASUREMENT SYSTEM 146

A new measurement system for audio work that combines a distortion analyzer and an oscillator simultaneously tuned for fast, easy-to-use operation has been introduced by *Sound Technology*. Called Model 1700B, the new system features a .001% distortion oscillator for testing from 10 Hz to 110 kHz, fully automatic nulling that eliminates balance controls, and a differential input that measures floating or balanced sources, reducing ground

loop and noise pickup. Model 1700B will measure distortion down to .002% in less than 5 seconds, will measure ac voltage 30 uV full scale to 300V full scale with 2% accuracy, will measure voltage or signal-to-noise ratios with 100 dB dynamic range, and will measure power across 8 ohms. Priced at $1775.

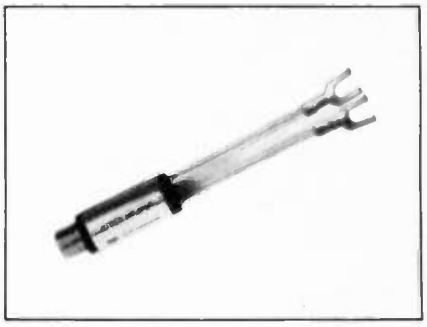
CB DUMMY ANTENNA LOAD 147

A new coax switch and dummy load, designed for use by CB dealers, has been introduced by *Gold Line Connector*. Called "The Big Dummy," the new device will protect up to five demonstrator CB radios on one antenna from damage by accidental keying. With one of up to five CB radios connected to the antenna, the new device will automatically protect the other four sets with a load termination of 50 ohms.



MATCHING TRANSFORMER 148

A new 100 to 75-ohm antenna or downlead matching transformer for home TV, MATV and CATV systems has been introduced by *Blonder-Tongue Laboratories*. The transformer, called the Setmatch, provides the proper impedance match between a 300-ohm and a 75-ohm antenna or TV receiver input terminals. It can be connected between the TV antenna



and the downlead and/or between the downlead and the receiver. A coax fitting is used at one end of the transformer and twinlead connections are at the other end. The transformer provides an accurate impedance match with low losses over the entire 10 to 900-MHz band. Suggested distributor net price is about $1.40.

TEST INSTRUMENT RPT.

continued from page 41

out; reverse the leads and again observe the readout

Following are possible combinations of readouts and the junction conditions they indicate:

a) Overrange indication (display consists of zeroes and flashing dual minus signs on left of display) regardless of 'polarity' of test lead connections—indicates the junction is *open*

b) Zero or almost zero resistance regardless of test lead 'polarity'—indicates the junction is *shorted*

c) Overrange indication with test leads connected one way, but in-range readout when test leads reversed—indicates the junction is *probably good*. (In addition, the in-range readout can be used to identify the type of semiconductor being tested—a readout between 400 and 700 indicates a silicon type, and a readout between 100 and 300 indicates a germanium.)

Price of the B&K Precision Model 283 Digital Multimeter is $170.00, complete with operating manual and a set of test leads. ■

continued from page 25

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Superscope, Inc., Automotive Prods. Div. 20525 Nordhoff St. Chatsworth, CA 91311 213-998-9333	YES	YES*
Surveyor Manufacturing Corp. 7 Electronics Court Madison Heights, MI 48071 313-544-9110	YES	YES (C.O.D.)
Teaberry Electronics Corp. 6330 Castleplace Dr. Indianapolis, IN 46250 317-842-0280	YES	YES (C.O.D.)
Tenna Corp. 19201 Cranwood Parkway Warrensville Heights, OH 44128 216-475-1400	YES	YES (C.O.D.)
Tram/Diamond Corp. P.O. Box 187 Lower Bay Rd. Winnisquaw, NH 03289 603-524-0622	YES	YES (C.O.D.)
Tran-Sonic Industries, Inc. 12 Farview Terrace Paramus, NJ 07652 201-845-0370	NO	YES
Trans-Comm Manufacturing Co. 8885 Bond St. Overland Park, KA 66214 913-381-5310	YES	NO
TRS International LTD. 4825 N. Scott St. Schiller Park, IL 60176 312-678-5227	YES	YES (C.O.D.)
Unimetrics, Inc. 123 Jericho Turnpike Syosset, NY 11791 516-364-8100	YES	YES
Universal Machine Co., Inc. 2300 Reagan Dallas, TX 75219 214-521-8750	YES	YES
Waner Electronics Corp. P.O. Box 777 Tulsa, OK 74101 918-245-2501	YES	YES (C.O.D.)
Welchtronic Distributor Corp. 3022 S. Cedar St. Lansing, MI 48910 517-393-8002	YES	YES (C.O.D.)
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