nri journal

NOVEMBER 1963

35 Cents

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BUILD AN ENVIRONMENT MONITOR

ZENER DIODE METER PROTECTION

CHANGER CHECKOUT

NEW TWIN-TRANSISTOR SUPER POWERMATE

BREAKS THE GAIN/OVERLOAD BARRIER

Servicemen and the public long wanted it, but were told they couldn't have it—a transistorized TV antenna preamplifier with the overload capacity to handle local signals without sacrificing the gain that brings in distant stations.

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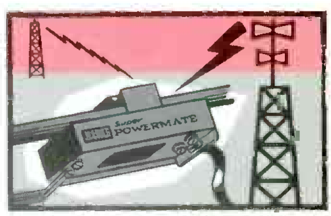

GAIN to reach far-distant stations. OVERLOAD capability to prevent local-signal interference.

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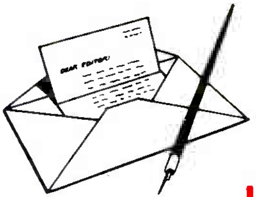

Letters

■ In order to facilitate our work, would you please publish articles covering the trouble-shooting of auto radio receivers of the hybrid and all transistor types.

By this we mean to say publish articles on how to localize various types of receiver defects such as dead set, hum, noise, oscillation, weak receiver, etc., by using the VTVM and signal generator.

Many NRI graduates in this vicinity specialize in auto radio receiver repair and they would appreciate such articles.

Armand Landry
St. Romuald, Levis,
Quebec, Canada

We have received several requests for this topic. Joe Griffin is doing the writing and it is scheduled for next issue.

■ I enjoyed all the articles in the June/July issue especially the "Mag Amp".

I like the cover, color, print size, paper quality, clear picture, advertisements, etc., in the NRI Journal. I also like the way each article is being divided into subtitles and the subtitles in color stand out. This gives the reader a preview of what is being written, and also serves as a fast index for future references about each piece of equipment.

If economical and by popular request, I would like to see a small index picture of the unknown author of each article, as was sometimes shown in the previous NRI News. This will give the reader a view of the people in the NRI organization.

Charles Cook
Broussard, Louisiana

It's economical, Charles, but no longer practical with many new feature and monthly department writers.

■ I have one complaint about the new NRI Journal; it is 1/2 inch too long. The extra 5/8 inch width is all right but with the extra length, it will not fit the NRI book binders. Can't you cut the size down to fit the binders or do we have to buy a set of new binders?

Benjamin R. Duncan
APO, San Francisco, Calif.

Our new page size now conforms with other magazines and permits larger type. It also meets the requirements of the advertisers.

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■ If you have any students in San Antonio, Texas who are High Fidelity Stereo enthusiasts, and might be interested in part time servicing of sound components, tape recorders and assembly of kits, it would be appreciated if you would put us in touch with them.

Bill Case Sound
3522 Broadway,
San Antonio 9, Texas

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On Our Cover

An $816,000 contract for a 425-mile microwave radio system for telephone communications has been awarded by the New Zealand Post Office to General Telephone and Electronics International Incorporated, a subsidiary of General Telephone and Electronics Corporation.

Microwave radio signals can be focused like a beam of light and transmitted from point to point over great distances and all types of terrain. Hundreds of telephone conversations are transmitted simultaneously by the ultra-high frequency radio signals which are received and transmitted from one microwave relay tower to another until the desired terminal is reached.

A microwave relay tower similar to those which will be utilized in the New Zealand system is shown on the cover. The station is part of a 275-mile microwave chain operated between Vancouver, B. C., and Port Hardy on Vancouver Island by the British Columbia Telephone Company, and GT and E telephone operating subsidiary.

nri journal

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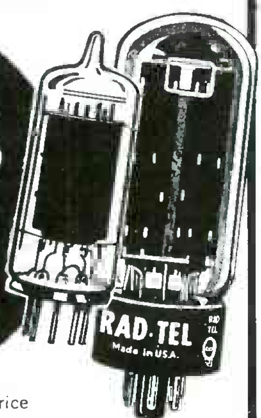

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1G3	.79	6AX5	.74	6SJ7	.88	12DE8	.83
1J3	.79	6BA6	.50	6SK7GT	.95	12DL8	.88
1K3	.79	6BC5	.61	6SL7GT	.84	12DQ6	1.04
1R5	.77	6BC8	1.04	6SN7	.65	12DS7	.84
1S5	.75	6BE6	.55	6SQ7GT	.94	12DT5	.76
1T4	.72	6BF5	.90	6T4	.99	12DT7	.79
1U5	.65	6BF6	.44	6T8	.85	12DT8	.78
1X2B	.82	6BG6	1.70	6U8	.83	12DW8	.89
2AF4	.96	6BH8	.98	6V6GT	.54	12DZ6	.62
3AL5	.46	6BJ6	.65	6W4	.61	12ED5	.62
3AU6	.54	6BJ7	.79	6W6	.71	12EG6	.62
3AV6	.42	6BK7	.85	6X4	.41	12EK6	.62
3BC5	.63	6BL7	1.09	6X8	.80	12EL6	.50
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3CS6	.58	6BZ6	.55	8AW8	.93	12FX8	.90
3DG4	.85	6BZ7	1.03	8BQ5	.60	12GC6	1.06
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3GK5	.99	6CD6	1.51	8CN7	.97	12L6	.73
3Q4	.63	6CG7	.61	8CS7	.74	12SF7	.69
3S4	.75	6CG8	.80	8EB8	.94	12SK7GT	.95
3V4	.63	6CL8	.79	8FQ7	.56	12SL7	.80
4BQ7	1.01	6CM7	.69	9CL8	.79	12SN7	.67
4CS6	.61	6CN7	.70	11CY7	.75	12SQ7GT	.91
4DT6	.55	6CQ8	.92	12A4	.60	12U7	.62
4GM6	.60	6CR6	.60	12AB5	.60	12V6	.63
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5BR8	.83	6DA4	.68	12AJ6	.62	18FY6	.50
5CG8	.81	6DE6	.61	12AL5	.47	19AU4	.87
5CL8	.76	6DG6	.62	12AL8	.95	19BG6	1.39
5CQ8	.84	6DJ8	1.21	12AQ5	.60	19EA8	.79
5EA8	.80	6DK6	.59	12AT6	.50	19T8	.85
5EU8	.80	6DN6	1.55	12AT7	.76	21EX6	1.49
5J6	.72	6DQ6	1.10	12AU6	.51	25AX4	.70
5T8	.86	6DT5	.81	12AU7	.61	25C5	.53
5U4	.60	6DT6	.53	12AV6	.41	25CA5	.59
5U8	.84	6DT8	.94	12AV7	.82	25CD6	1.52
5V6	.56	6EA8	.79	12AX4	.67	25CU6	1.11
5X8	.82	6EB5	.73	12AX7	.63	25DN6	1.42
5Y3	.46	6EB8	.94	12AY7	1.44	25EH5	.55
6AB4	.46	6EM5	.77	12AZ7	.86	25L6	.57
6AC7	.96	6EM7	.82	12B4	.68	25W4	.68
6AF4	1.01	6EU8	.79	12BD6	.50	32ET5	.55
6AG5	.70	6EV5	.75	12BE6	.53	35C5	.51
6AH4	.81	6EW6	.57	12BF6	.60	35L6	.60
6AH6	1.10	6EY6	.75	12BH7	.77	35W4	.42
6AK5	.95	6FG7	.69	12BK5	1.00	35Z5	.60
6AL5	.47	6FV8	.79	12BL6	.56	36AM3	.36
6AM8	.78	6GH8	.80	12BQ6	1.16	50B5	.69
6AQ5	.53	6GK5	.61	12BR7	.74	50C5	.53
6AS5	.60	6GK6	.79	12BV7	.76	50EH5	.55
6AT6	.49	6GN8	.94	12BY7	.77	50L6	.61
6AT8	.86	6H6	.58	12BZ7	.86	70L7	.97
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SOLID STATE FILTERS REPLACE CONVENTIONAL TUNED CIRCUITS

BY JOHN SHELDON

A line of interesting piezoelectric ceramic filters manufactured by the Piezoelectric Division, Clevite Corporation, are replacing conventional tuned circuits in many types of new communications equipment ranging from pocket transistor radios to single sideband equipment.

These piezoelectric ceramic filters are available in a number of configurations with various electrical characteristics for maximum circuit adaptability. The single-disc Transfilters are perhaps of the most interest to the technician as they are currently being used by several "domestic" receiver and CB gear manufacturers. This article describes the basic operation of the Transfilter as used in its application to familiar receiver and oscillator circuits.

The heart of the Transfilters is a small piezoelectric ceramic disc, which as in the case of a quartz crystal, has characteristics similar to a conventional L-C tuned circuit. Fig. 1 shows the equivalent electrical circuit for a "fundamental resonator" ceramic disc, while a ring and dot "first overtone resonator" is illustrated in Fig. 2. Notice that the equiva-

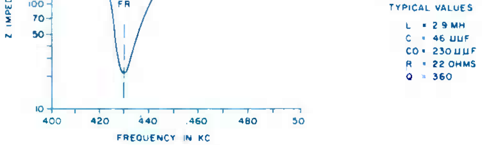


FIG. 1. Electrical circuit for a "fundamental resonator" ceramic disc.

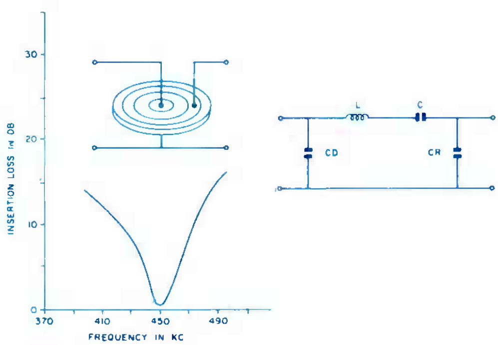


FIG. 2. A ring and dot "first overtone resonator".

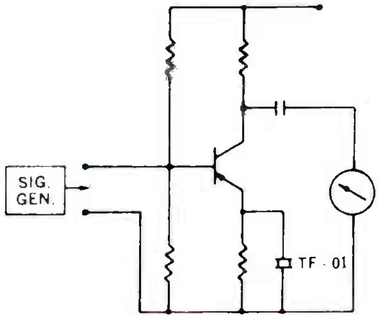


FIG. 3. A typical i-f amplifier stage with TF-02 Transfilter substituted for the usual emitter bypass capacitor.

lent circuit for the fundamental resonator is essentially a series resonant circuit, while the overtone resonator displays the characteristics of a pi-section network.

The value of these piezoelectric ceramic discs as tuned circuit elements lies in their extreme time and temperature stability. For example, the resonant frequency of a typical disc will change by not more than 0.2% in the next ten years, and not more than 0.19% over the temperature range of from -40°C to +85°C. Also, when once packaged, the discs require no adjustment or alignment.

The series Transfilter is designed as a replacement for the conventional emitter bypass capacitor in transistorized i-f amplifier circuitry, and its effect is to considerably improve the selectivity of the stage. Fig. 3 shows a typical i-f amplifier stage with a TF-02 Transfilter substituted for the usual emitter bypass capacitor, while Fig. 4 gives the stage's frequency response. Assume for a moment that the signal generator connected to the amplifier's input is set at 200 kc. At this frequency, the TF-01A will appear as a high impedance across the transistor's emitter resistor as 200 kc is well below its resonant frequency of 455 kc. As the signal generator's frequency is increased toward the resonant frequency of the TF-01A, it will decrease, allowing the amplifier's gain to increase due to improved bypassing. The amplifier gain will increase to a maximum at the resonant frequency of the TF-01A, and again

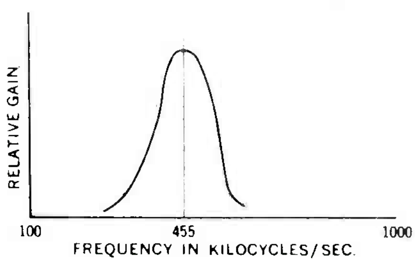


FIG. 4. I-F stage's frequency response.

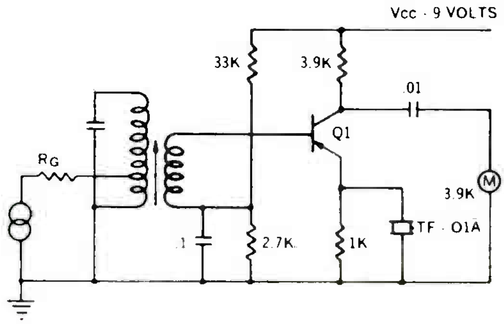


FIG. 5. A transistorized i-f amplifier with TF-01A substituted for the usual emitter bypass capacitor.

fall as the signal generator's frequency is raised still further. Thus, the TF-01A, acts as a true series resonant circuit....exhibiting high impedance at all frequencies other than resonance and very low impedance at resonance.

Fig. 5 shows a typical transistorized i-f amplifier with a TF-01A substituted for the usual emitter bypass capacitor. Curve A, in Fig. 6, shows the amplifier's frequency response with a regular emitter bypass capacitor. Notice the considerably improved selectivity achieved by use of the TF-01A Transfilter.

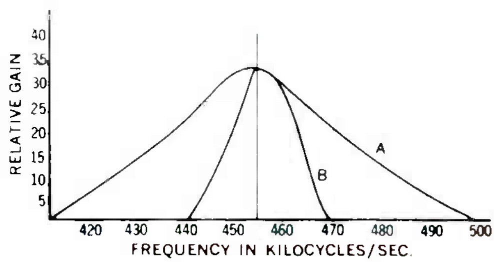


FIG. 6. A comparison of the amplifier's frequency response with a regular emitter bypass capacitor (A) and with the TF-01A substituted (B).

The TO-01 and TO-02 Transfilter series are designed as replacements for conventional i-f transformers in transistor i-f amplifier circuitry. The TO-01 series is intended for use with transistors having an effective input impedance of 300 ohms or less. while TO-02

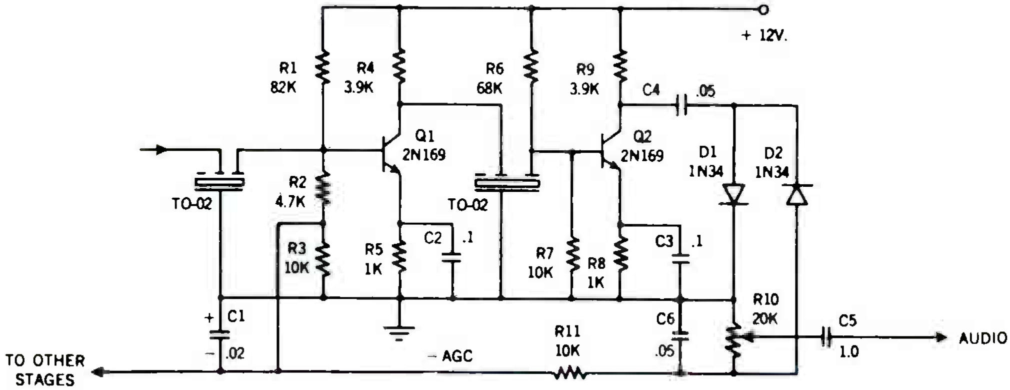


FIG. 7. A two stage transistorized i-f amplifier using TO-02 Transfilters.

series will properly match transistor input impedances between 600 ohms and 3K ohms.

One of the useful characteristics of the TO-01 and TO-02 is that, being electrically similar to a pi-section network, they offer an impedance transformation between input and output terminals. Thus, they will provide a good impedance match, minimizing insertion loss, when connected between the relatively high collector impedance of the preceeding transistor stage to the low base input impedance of the following transistor stage.

Fig. 7 illustrates a typical two stage transistorized i-f amplifier-detector using TO-02 Transfilters.

Both the TO series transfilter series are available in the common i-f center frequencies. In the case of the TO and TF units, suffixes A, B, and C, indicate center frequencies of 455, 465, and 500 kc respectively.

An interesting application for the TO-01 Transfilter is the oscillator shown in Fig. 8. The use of transfilters as circuit elements include:

1. small physical size.
2. oscillator frequency may be varied by means of an inexpensive potentiometer as compared with a variable capacitor in the case of a conventional L-C oscillator.
3. tuning element may be located at a point remote from the oscillator circuitry.

In the circuit of Fig. 8, advantage is taken of the 180° phase reversal between the Transfilter's input and output terminals to provide oscillator action.

The operating frequency of this circuit may be varied over a limited range by changing Q1's forward base bias resistor, R1. This effectively varies Q1's internal impedance, hence the impedance "seen" by the Transfilter's dot electrode. Since the load impedance affects the Transfilter's operating frequency, changing the transistor's impedance will shift the oscillator frequency. With the circuit constants shown in Fig. 8, the approximate frequency shift that can be achieved is 5 kc. By adjusting the value of the padding capacitor, C1, this frequency spread can be chosen so as to obtain an equal frequency shift above and below the Transfilter's center frequency.

That's pretty much the story on these intriguing little gadgets. Keep your eyes peeled; you'll probably be seeing them before you know it.

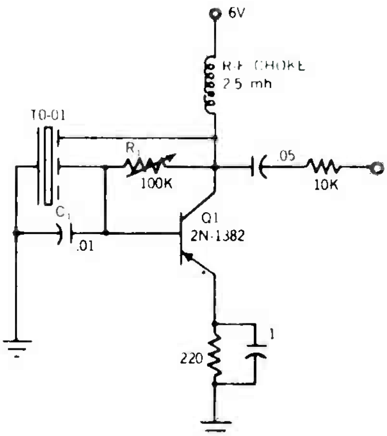


FIG. 8. An oscillator circuit using the TO-01 Transfilter.

ENVIRONMENT MONITOR

CONSTRUCTION DETAILS ON A VERSATILE SENSING DEVICE FOR ACCURATE REMOTE CONTROL OF TEMPERATURE DATA

BY SILOM HORWITZ

Out on the high seas there's a ship that's completely automated, operating without benefit of crew. There is, however, an "engineer," who sits in his easy chair and watches all the instruments to make sure everything is working correctly. Because of location, all the instruments are remote-reading.

You, too, can read the temperature at remote points from your easy chair! You probably now have a thermometer outside a window, and one or more inside to keep you informed of what the weather's like and whether your air conditioner, furnace, and refrigerator are doing their jobs. This is good, except for one thing: you have to travel to each one to get all the readings.

In the automatic ship, as well as in the automated processes in industry today, distant-reading thermometers are the rule. These normally use two types of sensing devices: thermocouples, which generate a minute voltage according to temperature, and resistance-type transducers, which change in resistance depending on the temperature.

Thermocouples are very critical, comparatively expensive, and require special leads because the voltage is so low that even a tiny resistance introduces a reading error. Thermocouples will work at very high temperatures, which makes them important for that application. Resistance transducers are either very fine wire (usually platinum or nickel) which increases the resistance as the temperature increases ("positive temperature coefficient") or thermistors, made of a ceramic material which decreases in resistance as the temperature rises ("negative temperature coefficient"). Thermistors are especially easy to use, as the change in resistance is high even for small changes in temperature.

Though not technically thermistors, reverse biased germanium signal diodes (such as the 1N34), as well as most transistors, likewise exhibit a considerable change in resistance with changes in temperature (a bad feature in most applications!) and can be effectively used for temperatures up to about 120° F. With germanium diodes selling for only a few cents each at "surplus" stores, the cost is much less than for thermistors.

Add a source of voltage, and a meter to read current, and the varying resistance of the transducer is an analog of (directly proportional to) the temperature. A straight circuit like Fig. 1 is fine, if you only want to read one input, but there is neither a way to compensate for different sensors, nor can the zero point be set readily. The simplest way to add these two features is to set up a DC bridge. Fig. 2 shows the basic circuit, with RT the transducer and R1 the meter setting potentiometer. With R1 and proper voltage you can set the meter so that the minimum temperature you want will appear at meter zero, and maximum at full scale. By making Rx variable, you can compensate for differences in transducers, so you now have all the ingredients for a multi-location distant-reading monitor.

Fig. 3 is the final schematic, showing a 6 input instrument, though, of course, it can be made with as many inputs as you want. R1 is still the meter set pot, but Rx has been replaced by six pots -- one for each input. In addition, there are two added features: a voltage control, to compensate for changing battery voltage due to age, and a voltmeter circuit to check and set the battery voltage. With diodes used as transducers (or using 100,000-ohm thermistors) and a single mercury cell, temperatures from about 20°F to 110°F can be read accurately. As current drain is less than 600 microamperes (0.0006 amperes!) the single mercury cell will have a life of over 1000 hours; if you take readings for two hours a day, it will last more than a year!

CONSTRUCTION

The instrument shown in Figs. 4 and 5 was designed as a part of a monitoring panel, but it can just as easily be built into a cabinet or mini-box. Construction is straight-forward, with lead lengths of no importance, though

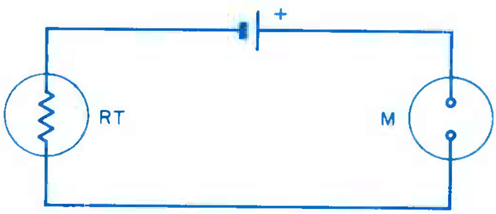


FIG. 1. Basic circuit of uncompensated input.

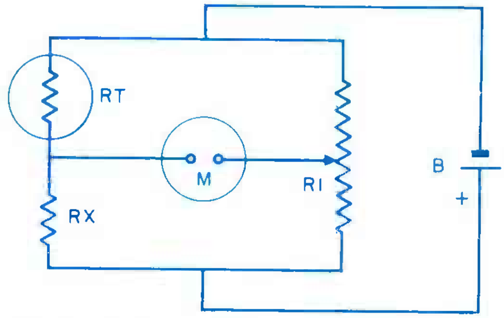


FIG. 2. Simple method for compensating for different sensors.

neat workmanship will simplify troubleshooting and later maintenance. Screw terminal strips are recommended to fasten input wires. Jacks, binding posts, or sockets can be used, but are more expensive and not necessary. The mercury battery is soldered into the circuit; it is difficult to see in Fig. 4 because it was wrapped with black insulating tape and then taped to the meter case for convenience. It is possible to buy a battery holder, but with the long battery life, a holder is not only unnecessary, but the contacts can oxidize, affecting accuracy.

The sensors (or transducers -- both terms are interchangeable as used here) can be germanium diodes, transistors, or thermistors. The thermistors are most accurate, and cost about $3 each for the standard types. For accuracies of 1%, "YSI Precision Thermistors" are available; their part number 44011. They sell for $4.90 each in quantities less than ten, and can be obtained from Newark Electronics Corp., 223 West Madison St., Chicago 6, Illinois. Germanium diodes, though a little more delicate and less linear, are still very satisfactory, and will give readings that have an accuracy greater than most household-type thermometers. To find out whether or not a diode is suitable, connect the leads to an ohmmeter (reverse biased -- that is, ohmmeter positive lead to anode and negative lead to cathode. If you're not sure which is which, connect the leads to get the highest resistance reading.) The reverse resistance should be about 100,000 to 300,000 ohms on the "10,000X" scale at 70°F room temperature. Now warm the diode by pressing it between your thumb and forefinger -- the resistance should drop by at least 100,000 ohms. Remove your fingers and the resistance should rise. Some diodes are very sensitive, while others are not; if you buy the ten or twenty for a dollar surplus types, you

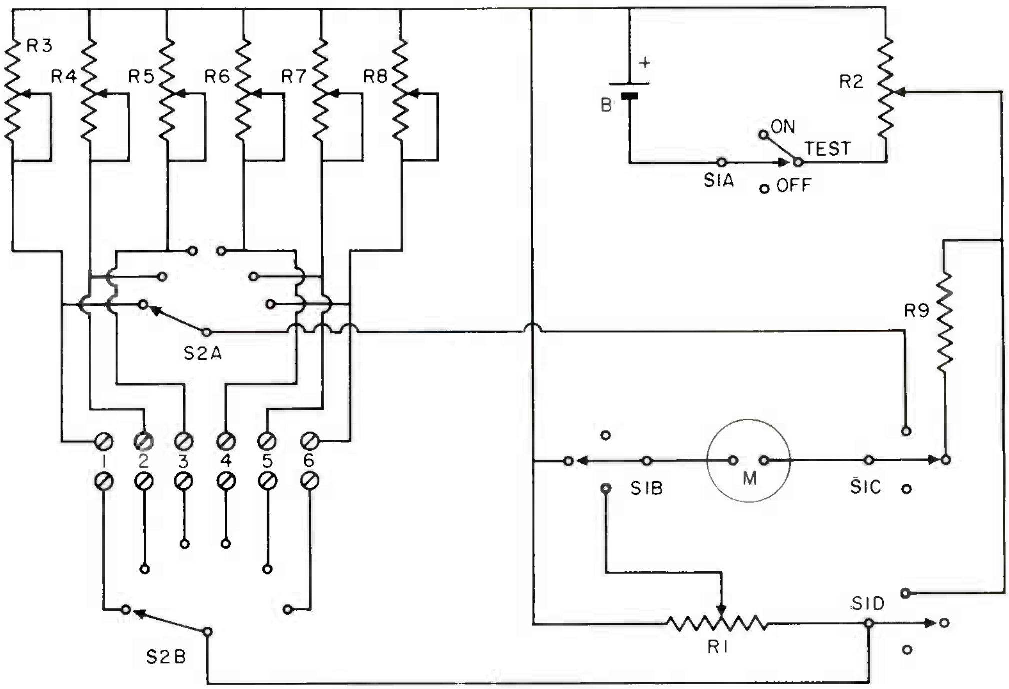


FIG. 3. Final schematic for environment "Monitor".

PARTS LIST

R1 -- 10,000 ohm pot	M -- Microammeter (0-50)
R2 -- 5000 ohm pot	B -- Mercury cell, 1.4 volts (Mallory RM-1R)
R3 through R8 -- 10,000 or 20,000 ohm pots	S1 -- Rotary switch, 4 pole, 3 position
R9 -- 27,000 ohm, 1/2 watt resistor	S2 -- Rotary switch, 2 pole, 6 position

Transducers (see text)
Terminal screw strip, hardware, panel, etc.

should find at least half of them perfect as temperature sensors.

The diodes (or thermistors) need protection and moisture-proofing, as moisture will lower the resistance, giving incorrect readings. In Fig. 5 you will see one method of constructing the transducer. First, to identify the cathode end, a red (or other distinctive color) piece of insulating tubing ("spaghetti") is slipped over its lead, with a piece of black or clear tubing over the other. The leads are then bent as shown, and the proper length of 2-conductor cable soldered to them, with the joint insulated with tubing or tape. The entire assembly is then completely coated with cement (household, rubber insulating, model, or epoxy), after which it is inserted into a length of metal tubing - metal, because you want quick heat conduction for fast response. You can usually find small metal tubing at model and hobby shops. When the cement is dry, an additional amount of cement is applied to both ends to make sure the tube is sealed. Now you can leave it out in the rain, or even immerse it in water!

You can, by the way, use other sensing devices with this monitor. A photoconductive cell, for example, can be connected to an input to show how light it is outside, or to show whether or not a light is on at a remote location (such as a closed garage). Similarly, a humidity sensor can be connected to show relative humidity. Any transducer which changes resistance from about 50,000 ohms to 300,000 ohms can be used; for other ranges, changes will be necessary in voltage, setting pots, or both.

CALIBRATION

CAUTION: do not operate the monitor without an input device connected, as an open circuit will place too great a load on the meter and possibly damage it!

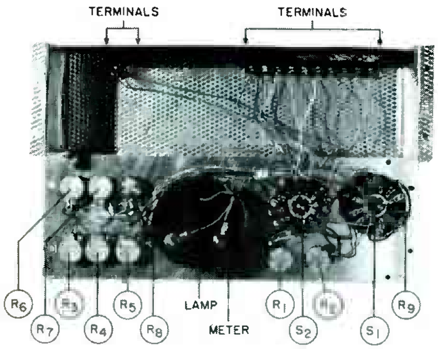


FIG. 4. Rear of panel view of "Monitor."

To calibrate, first switch S1 to "test," and turn R2 until the meter reads 30. Then, switch S1 to "on" with S2 on No. 1 position (transducer connected to No. 1 terminals). With R3 at about the halfway point, rotate R1 until a meter reading of 25 is obtained. Now prepare a glass of water by adding ice until the temperature is exactly 40° F. (You will need a good thermometer -- if you don't have one, perhaps you can borrow one from a photographer friend.) Immerse the transducer in the water, and adjust R1 so the meter stabilizes at a reading of 10. Now, prepare a glass of hot water at exactly 110° F. Immerse the transducer, and the reading should go to 45. If it does not, adjust R3 until it does, and repeat the 40° F immersion, adjusting R1 again to obtain the reading of 10. Repeat until you have the readings on scale. Now prepare another glass of water at 70° F -- the meter reading should be 25 when the transducer is placed in it. You can now prepare a scale like this:

°F	30	40	50	60	70	80	90	100	110	120
Meter	5	10	15	20	25	30	35	40	45	50

Note that each microampere equals 2° F. Some diodes will not be this linear, but you can compensate by showing the exact readings on your scale.

Repeat with each transducer, but this time adjust only the transducer pot (R3 to R8) to bring the reading to the proper scale position.

If you use the YSI precision thermistors, incidentally, you can calibrate temperature directly from the resistance table furnished with them, and you will need only one transducer pot, as these devices are of guaranteed accuracy from unit to unit.

USES

In addition to temperature monitoring around the house to take the place of thermometers, this instrument can have a multitude of uses. On a boat (cabin cruiser!), it can tell you water temperature, above and below decks air temperature, and engine temperature. In a fallout shelter (or other hideaway), it can tell you not only temperature, but (with suitable transducers) whether it's day or night, dry or humid, radioactive or clear. In the photo lab, a transducer can be immerced in each solution and wash water to monitor proper temperatures, but make sure the transducer tube is stainless steel!

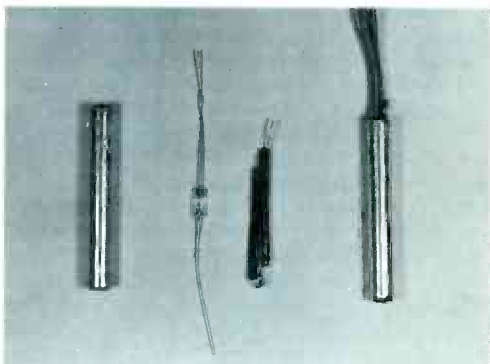


FIG. 5. Transducer Assembly. Metal tube, germanium diode as purchased, diode with insulating tubing bent for insertion in tubing, and completed transducer.

And, of course, in the electronics repair shop, transducers can be taped to critical components in a TV or radio receiver, transmitter, or other device, to signal if any are overheating. To do this, you will need to reset R1 to read the higher temperatures.

In other words, like the engineer on the automatic ship, with this monitor you can tell what the conditions are around you while you sit in your easy chair!

RADIO IN A COFFEE MILL LAMP

FIG. 1. Two views of the radio in the coffee mill lamp.

A radio in a coffee mill is a conversation piece in more ways than one -- it brings back memories of the old days, and it lets you hear the latest news. To make this outfit even more useful you can easily convert the mill into a table lamp (Fig. 1).

This authentic coffee mill, shown in Fig. 2, is a Colonial No. 1147, made by Wrightsville Hardware Company, Wrightsville, Pa., and sells in hardware and department stores for under $5. A pocket transistor radio is mounted in the drawer of the mill in such a way that it can be removed easily for battery replacement, or repairs.

You can use the coffee mill as it comes from the store, Fig. 2, or you can improve its appearance by soaking off the paper label; giving the wood a coat of walnut stain, or enamel and replacing the wood knob with an ornamental black iron knob to match the iron on the mill.

Fig. 3 shows how to mount the panel in the drawer for the radio. The radio should fit the panel cut-out loosely enough so the radio can be removed easily.

If you want a lamp also, proceed as in Fig. 4. You can have the metal pipe threaded at a machine shop, or electrical repair shop, or do it yourself with a dime store 1/8-NPT die and a 1/4"-20 tap. Use plastic tape, or spaghetti tubing, over the lamp-cord inside the pipe; or you can bring the lampcord out of the socket cap through a rubber grommet. Use a 40-to-60 watt bulb, and a "clip-on" lamp shade.

SOMETHING NOVEL

FOR YOUR STUDY DESK

BY ART TRAUFFER

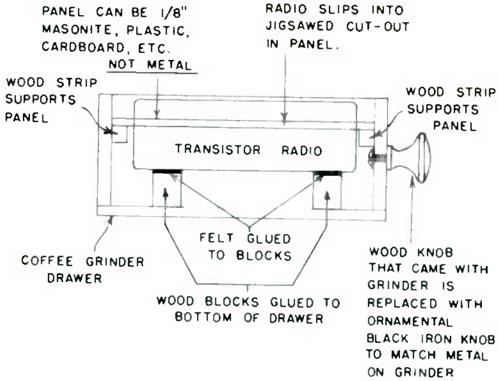


FIG. 3. "X-ray view" of radio mounting.

1	Pocket transistor radio.
1	1/8"-thick panel to fit in drawer
	Wood for making strips and blocks for supporting panel and radio.
	Small pieces of felt or rubber.
1	Ornamental black iron knob.

FIG. 2. The coffee mill as it comes from the store.

1	Colonial No. 1147 Coffee Mill (made by Wrightsville Hardware Company, Wrightsville, Pennsylvania. Sold in hardware and department stores for under $5).

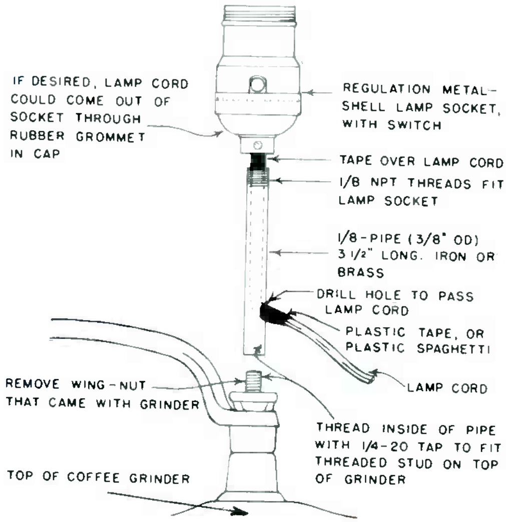


FIG. 4. How lamp socket is mounted and wired.

1	Standard metal-shell lamp socket, with switch.
1	9' length lampcord with plug.
1	3-1/2"-length 1/8-pipe (3/8" OD).
	Plastic tape; or spaghetti to pass lampcord.
1	Lamp bulb (40 to 60 watt).
1	"Clip-on" lamp shade.

What Would You Have Done?

BY GEORGE D. PHILPOTT

"This must be our lucky day," Lucky Lytle announced heartily, as he stepped in through the back doorway of his TV shop, arms loaded with antenna gear.

At the workbench his helper, Super-Sonic Smith, turned to greet the boss.

Lucky dropped his load of aluminum elements, lead-in wire, and several bags filled with hardware on the floor and faced his protege. "Remember Mrs. Fife, the Elms Apartments?" he asked.

"Do I! Man, who could forget her ... her TV, anyhow. She's the woman who tried to tell me that her Channel 35 faded out every afternoon exactly at 4:10 P. M. What a story - as if a TV set knew what time it was, or that her favorite program would be next. Don't tell me she called again?"

Lucky replied, "Yep. I just came from her place and her station DID fade nearly out - at approximately 4:10, all but the snow. The picture reminded me of a blizzard at dawn."

"So what's so lucky about that?" queried Super-Sonic; he hadn't forgotten his last trip to the Elms and the way Mrs. Fife had raked him over the coals for doing "next to nothing" to repair her set.

Lucky said, "I hate to admit it but the trouble she is having would have fooled Yogi Bear. She lives in one of the inside apartments and the UHF antenna, a small bow-tie array, works best only when her set is in front of the window. But guess why?"

Super-Sonic scratched his crew-cut and blinked, "Because the signal comes in the window, I figure," he replied.

"Right." Lucky grinned. "In through the window comes Channel 35, all day long, too, up until 4:10 in the afternoon. Then, get this, Mrs. Jones in the apartment across the window well from Mrs. Fife arrives home from work, unlocks her door, walks into her apartment, and the first thing she does then is step over to the side window and pulls up the Venetian blinds."

"You don't mean ..."

"I do," said Lucky, "those aluminum slats were reflecting the signal at precisely the right angle into Mrs. Fife's window."

Lucky selected a carton labeled UHF ultra X Antenna and examined the contents. "I promised the lady a roof-top job before quitting time, so grab our walkie-talkies, a spool of 300-ohm tubular and some chimney straps. I've got permission to drop her a lead."

The lad scowled to show he didn't care much for jobs around quitting time. Then he announced glumly that one of the walkie-talkies had developed a bad cold or something and wouldn't talk and the batteries were missing from the other one.

"We need those hand-jobs on most of these UHF deals," Lucky reminded the lad. "Orientation is important in our signal area ... even critical. Get them operating, tomorrow, if possible. In the meantime, bring a pocket ohmmeter. We'll have to get by with it, this time."

Super-Sonic groaned in mortal anguish, "Boss, how am I going to tell what you mean by a lot of dots-and-dashes on a meter ... me up there on the chimney and you down in the room. Remember the mess we always got into before we got the walkie-talkies?"

"I certainly do remember," said Lucky, sternly, "perhaps next time you will see to it that our tranceivers are working."

On the way to the Elms, Lucky explained to his helper how he intended to substitute an ohmmeter to take the place of the walkie-talkies in this instance. "On the roof, you'll be able to tell exactly which direction I want you to turn the antenna, clockwise, or counter," he said. "I've got a new idea that's so simple even you can understand it."

Super-Sonic grinned. "Maybe - just maybe, I will," he replied. "But you still haven't explained what a 1 meg control has to do with the setup."

" ... and two capacitors," added Lucky Lytle.

How did Lucky use the ohmmeter to substitute for the walkie-talkies?

(Answer on page 32)

Measuring Small DC Voltages

STUDENTS AND PRACTICING TECHNICIANS SHOULD BECOME FAMILIAR WITH CHOPPER CIRCUITRY

BY STEPHEN HAHN

Electronic experimenters often find it necessary to measure small DC voltages developed by devices which have very low power delivering capabilities. A typical example would be the DC signal generated by a photo electric cell. Some photo cells are, of course, capable of delivering half a volt under bright illumination. However, this signal will drop considerably if the photo cell is loaded down with a low resistance. Consequently, it is often impossible to measure photo cell output by placing a low resistance DC voltmeter across the cell.

Another case would be measuring the strength of an unmodulated carrier as it is received by a simple tuned circuit followed by a crystal detector. Unless the transmitter is high powered or nearby, the DC voltage developed across the detector is small (a few millivolts or microvolts) and any circuit loading would completely deteriorate the signal to such a low level that it would become virtually unmeasurable.

These low level DC signals can be measured with two types of circuits. The first employs a DC amplifier using transistors or vacuum tubes. Such an amplifier presents a nonloading high resistance to the signal and then amplifies it through a number of stages. The output is displayed on a meter. DC amplifiers of this kind, especially for the measurement of low level DC signals, are usually complex and difficult to construct, due to the fact that they are troubled by drift which occurs both over time and as a result of changes in the temperature of the environment. Such drift is caused by small changes in the amplifier's B+ voltages and in the filament voltages. These voltage changes are amplified by the DC amplifier and become indistinguishable from the signal which is being measured, unless the DC amplifier is very carefully designed. Therefore, its drift over a few minutes or over a few degrees of Centigrade may be larger than the very signal which one is attempting to measure.

Low level DC voltages can also be measured by immediately converting them into an AC signal. Such a technique is called "chopping". This AC signal is then fed into a standard AC vacuum tube voltmeter having a high input impedance. (This is not to be confused with the standard service type VTVM which will not measure voltages in the order of millivolts.) The difficulty of DC amplifier drift is overcome while the requirements of high input impedance and high sensitivity are also met by the AC vacuum tube voltmeter.

Chopping devices fall into three general categories:

- purely electronic
- a combination of mechanical and electronic
- purely mechanical.

In electronic chopping, the DC signal is fed into a multivibrator switch which transforms the DC signal into an AC signal of some predetermined frequency. The circuit is similar to the electronic switch used with oscilloscopes for viewing two signals simultaneously.

Another type of chopper uses a photoelectric cell and a light source working in conjunction with a rotating windowed shutter. The chopping frequency is determined by the rpm shutter whose window allows the photo cell to produce a voltage when illuminated and zero voltage when dark. A number of choppers of this kind are commercially available but here again the complexity of the design makes them quite beyond the means of the home experimenter. Photoelectric choppers also do not turn themselves on and off in a pure "square wave" manner. Thus, the speed at which they can chop, as well as their response time, has a practical limit.

The most commonly used chopper employs a reed which vibrates back and forth between two contact points, thereby chopping the DC

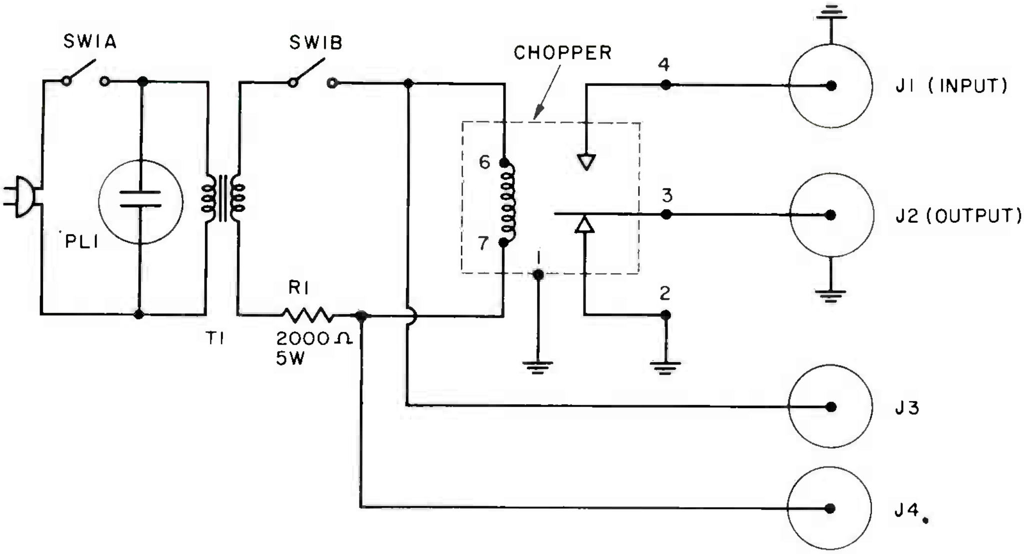


FIG. 1. Chopper system.

PARTS LIST

PL1 - 110 volt neon pilot light	CHOPPER: 18 volt coil, 50 to 400 cycles, SPDT, available from Round Hill Associates Inc., 665 5th Ave., New York 22, N. Y. ($6.50) or equivalent.
T1 - 110 volt isolation transformer Lafayette TR 91	Chassis: aluminum utility box 4" x 5" x 6"
SW1 - DPST toggle switch	
R1 - 2000Ω, 5 watt wirewound	
J1 and J2 phone jacks	
J3 and J4 5-way binding posts (Red)	

signal into an AC signal of some frequency (usually between 50 and 1,000 cycles). This vibrating reed may be energized by a small DC motor in instances where stray AC fields cannot be permitted in the vicinity of the chopping system. In most instances, however, the chopping reed is energized by an AC coil. The reed is positioned in the center of this coil and the chopping frequency is determined by the frequency of the coil voltage. As the reed moves back and forth in the coil field, it makes and breaks contacts, thereby chopping the input DC signal into an AC signal. Mechanical choppers of this kind have the advantage that their chopping signal is virtually a pure square wave. On the other hand, they have the disadvantage of periodic contact corrosion, even though the switched signals are very minute.

Many types of mechanical choppers are currently available. They range in price from a few dollars to well over fifty dollars. Coil voltages are as low as a few volts to over sixty volts AC. Chopping frequencies may vary from fifty cycles to as high as 1,000 cycles. Generally speaking, mechanical choppers cannot be used on DC signals higher than 1-1/2 volts or in circuits which draw more than one milliampere.

An excellent chopper may be constructed around a very reasonably priced unit available from Round Hill Associates, 665 Fifth Avenue, New York 22, N. Y., for $6.50. This particular chopper utilizes an 18-volt coil which can be operated at any frequency from 50 to 400 cycles. (Other choppers can, of course, be used with appropriate change in the chopping coil power supply system.) The chopping element consists of a single pole double throw reed. The entire chopper is mounted in a shielded, hermetically sealed can and all connections are made through a standard octal socket. The maximum DC input to this chopper is 1-1/2 volts at 1 milliampere.

The entire system is mounted in a small utility aluminum cabinet and a 110-volt isolation transformer with dropping resistor is used to drive the reed. See Fig. 1. The chopper itself is placed on a small bracket at the very front of the cabinet while the power supply section is located at the rear, to make certain that AC fields will not interfere with the operation of the system. The chopper's contacts are wired in such a manner that when the chopper is not in operation, the output circuitry is shorted to ground. Chopper input leads as well as chopper output leads should be kept as short as possible in order to avoid possible hum pickup. Two binding posts are brought out at the rear of the cabinet and these binding posts are connected directly across the chopper coil. This feature is useful when the chopper is to be driven with frequencies other than the 60 cycles furnished by the power supply. When the main chopper switch is turned off, it not only opens the primary of the power transformer, but also the secondary, leaving the chopper coil circuitry floating. Thus, the chopper can be driven with any 18-volt AC signal from 50 to 400 cycles.

In actual use, the DC signal which is to be measured is fed into the input jack. (Bear in mind that for this chopper, the signal must never exceed 1-1/2 volts and the current flowing through the circuit must never exceed one milliampere.) The chopper output is taken across the output jack and fed into any high impedance AC vacuum tube voltmeter whose sensitivity is adjusted to the proper range to take care of the DC signal which is being fed into the chopper. It must be remembered that choppers of this kind generate some noise themselves and consequently there is a limit to the sensitivity which such a system has.

The particular chopper described in this article is used in conjunction with Knight AC VTVM which has a sensitivity down to -50 db or 3 millivolts full scale. This meter has an input resistance of 10 megohms making it ideally suited for voltage measurements requiring negligible loading. With this meter set to its most sensitive scale (.003 volts) and the chopper operating without a signal, the noise level produced by the chopper is virtually unmeasurable, causing only a very slight deflection of the needle on the order of a few microvolts. In making measurements with this system, remember that the chopper converts the DC signal into a square wave having a frequency of 60 cycles. The AC vacuum tube voltmeter is calibrated in pure sine wave RMS volts. Consequently, if a signal other than a sine wave is fed into the AC vacuum tube

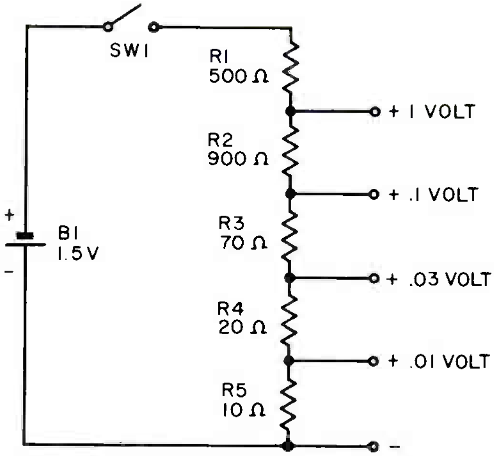


FIG. 2. DC test rig.

PARTS LIST

R1	1/2W	500Ω	All 1% Aerovox Carbofilm
R2	"	900Ω	or
R3	"	70Ω	Dale RS Series
R4	"	20Ω	or
R5	"	10Ω	Equivalent

B1 Any 1-1/2 volt battery (Eveready 915 or equiv.)

SW1 - SPST toggle switch (optional)

voltmeter, the voltage reading indicated will not be exactly correct, due to the harmonic content of the non sine wave input, as well as the harmonic distortion generated within the vacuum tube voltmeter itself.

Most AC vacuum tube voltmeters utilize a high gain wide band amplifier whose output is applied to a bridge rectifier driving a meter. Since the vacuum tube voltmeter reads RMS volts, application of a non sine wave signal may result in a small error. Consequently, it is a good idea to calibrate the chopper to the AC vacuum tube voltmeter which you are going to use, since the chopper produces square waves. This can easily be done by developing a highly accurate synthetic DC voltage through the use of a standard dry cell and a 1% precision resistor dividing network, as shown in Fig. 2. A fresh dry cell will deliver 1.5 volts and a resistor voltage dividing network will offer highly accurate DC signals of 10, 30, and 100 millivolts and one volt. The entire synthetic reference source draws only one milliampere and consequently may be left connected for long periods of time.

(Continued on page 32)

DEVICE OF THE MONTH

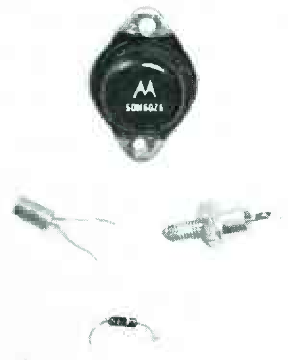
The Zener Diode

BY R. C. APPERSON, JR.

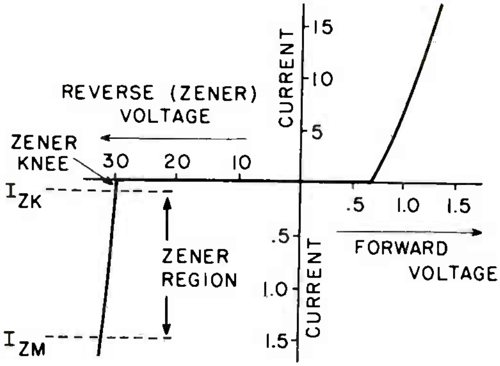
Solid state electronics brought an avalanche of new phrases and terms to our field, each new device having a name of its own even though the function performed was similiar to an existing device. This is the case with the Zener diode, which functions much like the voltage regulator (VR) tube that has been with us for some time. But, like all new things, the Zener has added features which make it a much more versatile device than the VR tube. As we discuss the applications of this special diode, let's keep in mind the VR tube and its limited functions and we will become more aware of the yoke that solid state devices lifted from the neck of the electronic engineer.

Since we've pointed out that the Zener and the VR tube are similiar in function, we know that the Zener is used as a voltage regulator. Here the VR tube applications end and the Zener's just begin. It is a much used constant voltage reference and is available in Zener voltage ratings of around 2 volts to 200 volts and up to 50 watts in power dissipation capability. Whenever you want a DC voltage you can depend on to remain constant, use the Zener. It is also used as a coupling device between stages, a biasing element, constant amplitude clipper (which we will discuss in the circuit of the month), constant intensity light by Zener controlled voltage, light dimming elements and many other diverse applications. Anywhere a voltage is to be controlled to within a narrow range, the Zener should be considered.

How do you spot one physically? Good question, because they range in appearance from a power transistor in a TO-3 case to a regular silicon diode. Some are stud mounted like rectifiers and some are similar to the solder in top hat diodes. The best way to identify a Zener is by its number. You may need a Zener manual or a catalog if the number is not familiar. On an ohmmeter check, you'll think you have a regular diode as we will see later. A few Zeners are shown here to depict the likeness to other components.



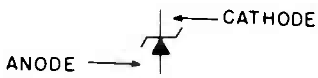
Any diode will Zener. The difference between the regular diode and the Zener diode is that the Zener voltage is specified and manufactured to Zener at a given voltage and the Zener region is greater. You're wondering what the Zener voltage is, aren't you? It is the voltage required, in the reverse direction, to break the diode down. In the regular diode we try not to exceed the peak inverse voltage - here we are interested in this voltage. Look at the graph and you will see that we have a regular diode in the forward direction - about 0.7 volt and the diode conducts. Let's turn the diode around.



No conduction until we reach around 30 volts, then - zoom - the current takes off and holds the voltage at 30 volts. A certain current must be drawn (I_{ZK}) to keep the diode in the Zener plateau or flat portion of the curve. The diode can be operated between I_{ZK} and I_{ZM}, which is the maximum current the diode can conduct without damage. Another point of interest on the curve is the Zener Knee. A good diode has a very sharp knee, the point where the diode goes abruptly from a state of non-conduction to one of conduction. After we cross the knee, the drop across the Zener is relatively constant over a wide range of currents. Here we have control or regulation.

If we are going to increase a voltage and have the current increase, yet have the voltage across the Zener remain constant - what will we do with the additional voltage? This points to one of the essentials in the Zener circuit, a ballast resistance. The ballast can either be a resistor, an active resistance element such as a transistor or a capacitive or inductive reactance. This is a point to remember when servicing a circuit using a Zener. If the Zener failed, it is very possible the ballast element failed. This can occur in the form of shorted transistors or capacitors, so check these elements before you sacrifice a new Zener!

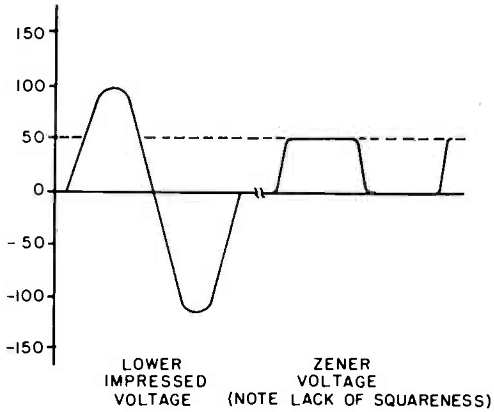
On a schematic, the Zener appears like this:

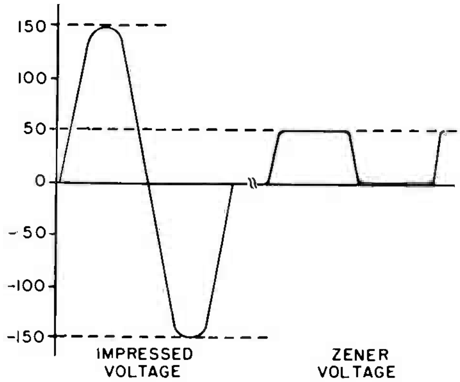


and is inserted in the circuit in a manner such that the diode is essentially back biased. That is, if the voltage to be controlled is positive, place the positive voltage on the cathode and vice versa.

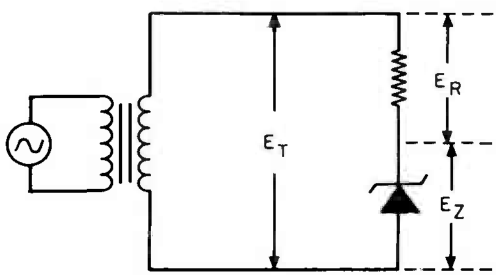
Since we can readily see how an increasing DC voltage can break down the Zener, let's connect a Zener in an AC circuit and examine its behavior. We'll build a square wave calibrator.

We'll take a transformer with a slight step-up ratio so that we not only get isolation from the AC line but also more voltage across the circuit. The increased voltage will enable us to get a more nearly squared waveform, since the point where the Zener conducts is down lower on the waveform, like this:





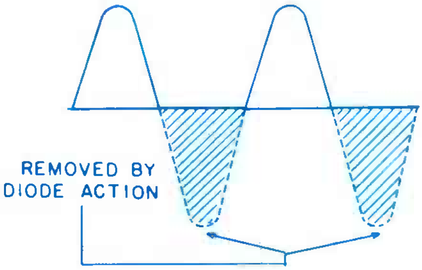
The 60 cycle sine wave will be impressed across the circuit as shown here:



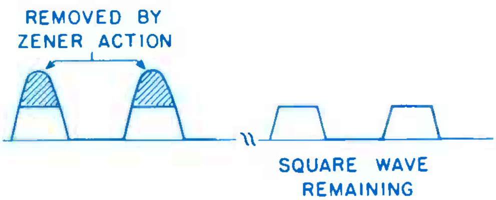
and we have said that as the reverse voltage increases across the Zener, it will conduct at a given voltage. The sine wave is clipped by the Zener action on the positive swing and as it tries to go negative the diode conducts after the voltage reaches about 0.7 volts. This is regular diode action. We can see by this that we can obtain a clipped and clamped waveform of any amplitude within the value range of the Zener diode.

The amplitude can be doubled by using two Zeners back to back. This also gives a symmetrical square wave around the zero volt reference level. In other words, the positive and negative alternations are clipped equally.

An easier way to see what takes place in forming a square wave with one Zener is to first consider the Zener as a regular diode, a half wave rectifier. Note that the diode has removed the negative alternation.



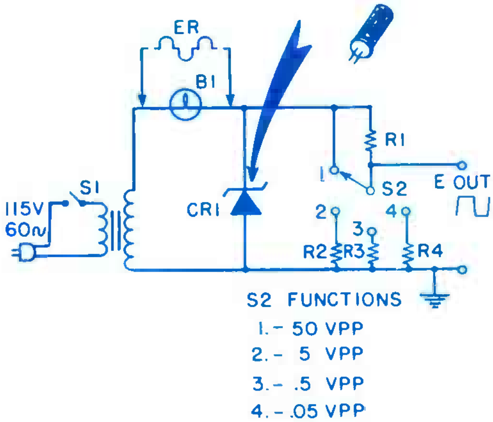
Now - let the diode break down at a certain voltage when the waveform goes positive. The rest of the alternation is shorted, so to speak, and we get the desired square wave.



One thing to keep in mind is that a Zener which is to dissipate much power should have an adequate heat sink. Usually a nomagraph is included in the Zener diode manual for easy heat sink computation.

CIRCUIT OF THE MONTH

The circuit of the month this issue grew of necessity. We just got a new oscilloscope and needed an accurate way of calibrating the vertical amplifier. Seeking the cheapest method to obtain the desired accuracy, we chose the Zener calibrator.



THE ZENER CALIBRATOR

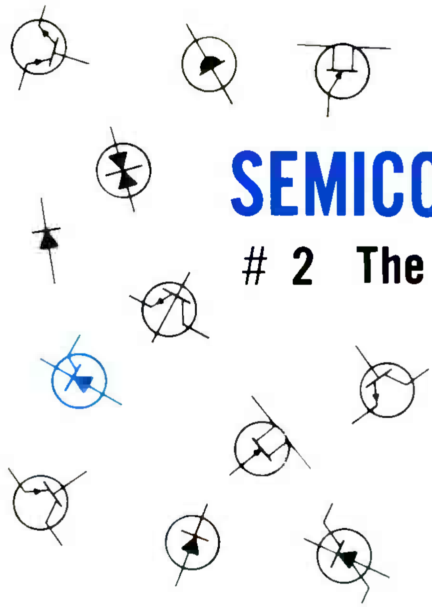
PARTS LIST

R1	2.15 K 1/2W 1%
R2	2150Ω 1/2W 1%
R3	215Ω 1/2W 1%
R4	21.5Ω 1/2W 1%
CR1	1.5Z50D Zener diode (Dickson, available from Lafayette Radio)
B1	115-125V, 6W bulb (6S6)
T1	150V transformer, Merit P3046
S1	SPST switch
S2	rotary, 1 pole- 5 position (Mallory 3215J or equiv.)

It functions in the manner described earlier in the discussion of the AC operation of the Zener. B1 is the ballast resistance. A small light bulb is used for economy since wattage is a consideration. It is also an "on" indicator. It can be positioned behind an indicator jewel and made to serve a double function.

R1 through R4 make up a voltage divider. One percent resistors are recommended for accuracy. Precaution should be exercised when soldering close tolerance resistors, since heat will change the resistance. To be on the safe side, grasp the lead being soldered with your longnose pliers.

The selection of voltage is achieved with S2 while S1 functions as the on-off control. The voltage ranges are 50, 5, .5 and .05 volts peak to peak. This is convenient for a scope which has an attenuator of 1000:1 to 1:1 in four steps. -10-



SEMICONDUCTOR REVIEW

2 The Silicon Controlled Rectifier

BY

JOHN POTTER SHIELDS

This month, our main topic of discussion is a semiconductor device which is enjoying greatly increasing popularity - to the point of finding its way into our home workshop power tools and lamp switches. In case you haven't already guessed....what we are talking about is the silicon controlled rectifier (SCR). This device combines the control ability of a transistor with the high current carrying capacity of the silicon rectifier. It is now being produced in large volume and in a myriad of current ratings and configurations by several of the leading semiconductor manufacturers, including General Electric, Texas Instruments, and Westinghouse. The SCR should not be considered "just another power transistor." While it will perform many of the functions of a power transistor, it is an entirely different breed of cat in its basic operation, as you will shortly see.

For most practical purposes, the SCR may be considered analogous to the thyratron tube. As in the case of the thyratron, the SCR is a "go-no-go" device which is switched to its "On", or conducting state, by a signal applied to its control electrode. Like the thyratron, the SCR's control electrode loses all control over the anode current, which can only be interrupted by reducing the anode voltage below a certain value. Although similar to the thyratron in many of its characteristics the SCR offers many advantages over the thyratron. For example, the SCR does not depend upon the ionizing time of a gas (which takes many microseconds) for its operation, and thus can be switched on and off much more rapidly than a thyratron. Also, the SCR has a much lower internal voltage drop than the thyratron when switched to the "on" state, resulting in much less internal power dissipation and hence greater efficiency. The SCR will operate at voltage levels much lower than a thyratron as it does not depend upon the ionizing of a gas, which occurs at a minimum of about 75 volts.

Now, let's take a look at how the SCR operates. Fig. 1A illustrates the SCR's physical configuration; Fig. 1B is its corresponding electrical symbol. Fig. 2A is a plot of the voltage-current characteristics of a typical SCR. Examining the forward conduction characteristics, we see that as voltage is applied so as to bias the SCR in its forward direction, only a

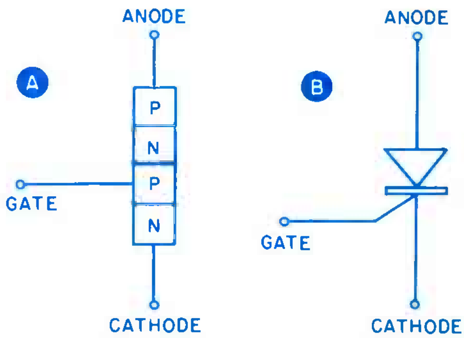


FIG. 1. The physical configuration of the SCR (A), and its corresponding electrical symbol (B).

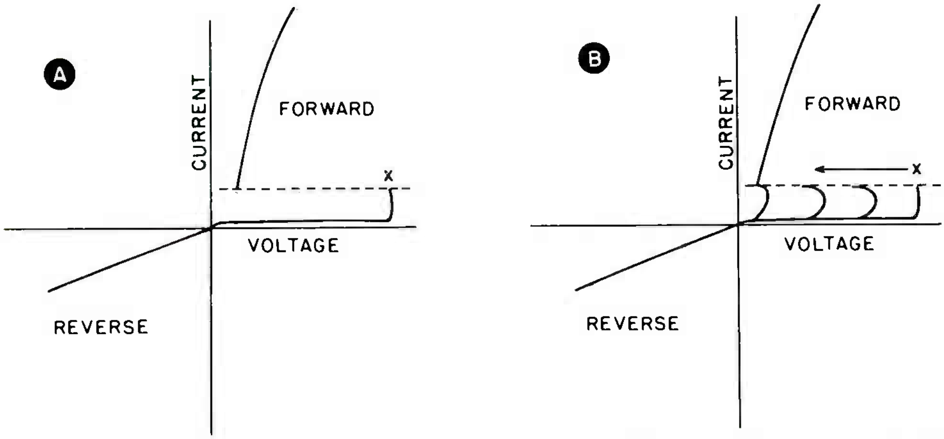


FIG. 2 (A) a plot of the voltage-current characteristics of a typical SCR and, (B) the action of the SCR's "gate" electrode in controlling the flow of anode current.

small leakage current will flow until the applied forward voltage has been increased to point X. Up to this point, the SCR is in its "off" condition. At point X, the device suddenly switches to its "on" state as evidenced by the sudden increase in forward current which is limited only by the impedance of the external circuit to which the SCR is connected.

Fig. 2B shows the action of the SCR's "gate" electrode in controlling the flow of anode current. As you can see, the effect of a signal voltage applied to the gate reduces the value of forward voltage required to switch the SCR to its "on" state. As the gate current is increased, point X "moves to the left" of its original point of conduction until, with sufficient gate current, the SCR's forward current characteristics are just about the same as a conventional P-N diode. As mentioned earlier, once the SCR is switched to its "on" state, the gate electrode loses all control until the anode current is reduced below a minimum value, known as the "holding current".

Fig. 3 shows one example where the high efficiency of the SCR is utilized in a high current phase-controlled voltage regulated power supply. In operation, a portion of the power supply's output voltage is sampled by the voltage divider, R, and fed to the "error amplifier" where it is amplified and compared with the "voltage reference". The resultant correction signal is applied to a voltage-controlled phase shift network which carries the relative phase shift between the gates of

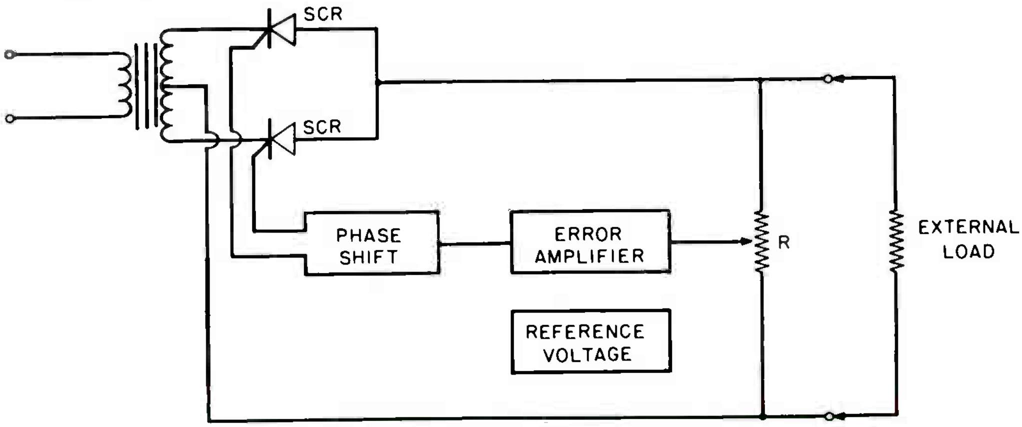


FIG. 3. An example of the use of the SCR in a high current phase-controlled voltage regulated power supply.

SCR's with respect to their anodes in proportion to the correction signal, and thus control the average power which they will deliver to the load.

Other SCR applications include electric motor speed and reversing controls, power inverters and converters, automatic safety devices, and so on. It is a certainty that you will be hearing and seeing more of the SCR as it continues to invade the industrial and domestic fields.

NOTEWORTHY CIRCUITS

Before trotting forth this month's circuits, I want first to extend an invitation to all of you to submit your favorite semiconductor circuit for publication in this department of the column. The only "rules" are that you have actually successfully assembled the circuit... no "arm-chair designs" please, and that the circuit be of simple design. By this, I mean don't submit a complete transistorized TV schematic or the like. A good rule of thumb is to keep the number of transistors to a maximum of 5 or 6. And of course, the circuit should be of general interest. Okay, now let's see what you have to show us. Now, on to this month's crop of circuits.

ELECTRONIC FILTER

The large number of transistor radios and general transistorized equipment that is coming in for service necessitates a source of well-filtered low voltage power for test purposes. While batteries may be used, they are uneconomical ...especially when servicing transistorized auto receivers. Most technicians have a variable voltage battery eliminator on hand. Unfortunately, the output voltage of most of these units contains excessive ripple voltage, rendering them unsuitable for the servicing of transistor equipment.

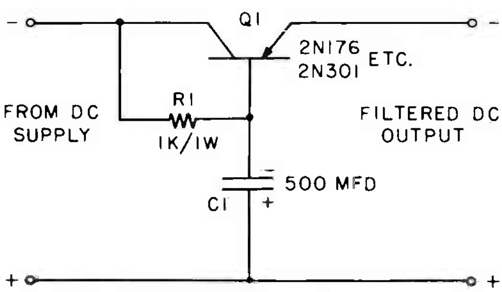


FIG. 4. An "electronic" or "capacitance multiplication" filter.

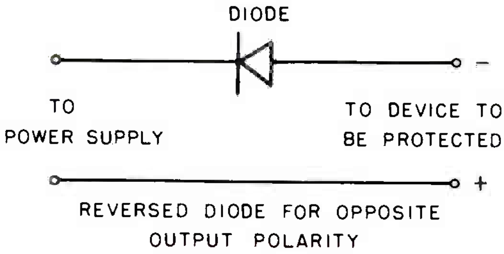


FIG. 5. A germanium diode placed in series with the power supply input terminal of the unit being tested.

Fig. 4 shows one solution to the problem. What we have here can be considered to be an "electronic" or "capacitance multiplication" filter. In operation, Q1 is connected as an emitter-follower in series with the DC power supply's negative output lead. Q1's base is supplied via the dropping resistor R1, with C1 being connected from base to ground. With this arrangement, the effective filtering is equal to the base capacitance (mfd) X the beta of Q1. Thus, if a 500 mfd capacitor is connected into the base circuit of a transistor having a beta of 40, the effective filter capacitance would be 500x40 or 20,000 mfd...quite effective. Naturally the current drawn through the filter should not exceed the maximum collector current rating of the transistor. A 2N176 is a good transistor choice for currents up to 2 amperes at 12 volts. Don't forget to use a heat sink with the transistor if it is going to be operated continuously at anywhere near its maximum current rating. One solution to this is to mount the whole "works" inside a standard 3"x4"x5" minibox, the top of which serves nicely as the transistor's heat sink.

REVERSE POLARITY PROTECTION

One of the peculiarities of many semiconductors is that they are most unhappy, often to the point of destruction, if supplied with current of the wrong polarity. One very simple way of avoiding this is to place a germanium diode in series with the power supply input terminal of the unit under test or development as illustrated in Fig. 5. Since the diode will pass current in only one direction, it will automatically prevent current of the wrong polarity from reaching the unit. Naturally, the diode should have a forward current rating at least equal to the current drawn by the unit with which it is used.

See you next month.

METER MATCHING QUIZ

By ROBERT K. RE

Most "meters" in electronics are used to measure electrical parameters, but a few are used as circuit components. From the list below match up each "meter" with its definition or description, and then check your answers with those on page 32.

A. Accelerometer	I. Ohmmeter
B. Ammeter	J. Permeameter
C. Audiometer	K. Potentiometer
D. Bolometer	L. Reflectometer
E. Galvanometer	M. Variometer
F. Goniometer	N. Voltmeter
G. Hydrometer	O. Wattmeter
H. Magnetometer	P. Wavemeter

___1. Applied originally to a device that measured voltages, this term is now used to describe variable resistors.

___2. Rechargeable batteries require the use of this instrument to measure the electrolyte's condition and the general situation of each cell.

___3. This special meter, in its many forms, measures the ease with which magnetic flux passes through materials.

___4. Using two coils, temperature-sensitive resistors, or other means, this meter measures the product of voltage and current in a circuit.

___5. Highly sensitive, this meter is often found in the null-detecting branch of very accurate bridges and other balancing circuits.

___6. Composed of specially-arranged coils, this device is used in radio direction finders to determine the direction or angle of incoming radio waves.

___7. For measuring and indicating the magnitude and polarity of electric potentials, this meter, in some form or other, is found on most electronic workbenches.

___8. This electro-mechanical instrument is used extensively in navigation and guidance equipment to measure changes in velocity.

___9. Widely used by Hams, this meter, by absorption, reaction, or other means, measures the frequencies present in a circuit. It is particularly useful above those frequencies where signal generators are unstable.

___10. Used with transmission lines, this meter utilizes directional couplers to detect and measure such things as the power flowing in both directions in the main line, power to the load, and SWR.

___11. With special test records or tone signals, this meter measures various characteristics of a person's ear such as sensitivity and frequency response.

___12. Named after a pioneer in electronics, this meter is used to measure the ease with which electrons pass through circuit elements.

___13. Found often in transmitter circuits, this adjustable inductor, composed of two coils in series and mounted one inside the other, has a wide tuning range.

___14. Measuring the intensity and direction of magnetic fields is the prime purpose of this special meter. The name is often applied to devices that measure only one component of the field such as horizontal or vertical.

___15. Measuring and indicating the number of electrons (or holes) that pass a given point in a circuit is the function of this common meter.

___16. Normally used in a bridge circuit, this energy-sensitive device utilizes the change in resistance of an element (when exposed to microwave power) to measure power. Barretters and thermistors are typical examples.

ZENER DIODE METER PROTECTION

ZENER PROVIDES CHEAP METER INSURANCE

BY

RONALD L. IVES

Multimeters very seldom wear out. Most of them are damaged beyond economical repair by the accidental connection of a high voltage across a low voltage range. This commonly wraps the pointer around the upper stop pin, and may also burn out some of the series resistors, or even the moving coil.

So common is this trouble that some test instruments (such as the Triplett Model 630) are equipped with an internal fuse, and a clip for a spare. This is a step in the right direction, as the fuse prevents much instrument cremation, and reduces, but does not always eliminate, serious pointer-slamming. If fuses were truly instantaneous in their action, an instrument fuse would supply all the needed protection.

What we really need is a shunt across the instrument coil, which has infinite resistance when the range in use is not overvolted, and substantially zero resistance when the voltage is too high for the range in use.

ZENER DIODE CHARACTERISTICS

Within the last five years, a semiconductor device has appeared on the market which, as the voltage applied across its terminals is raised, is substantially nonconducting up to a specific value, and then acts as a very low resistance above that value. This device is called a Zener diode. It is available with critical voltages from about 3.9 up to more than 200; and in wattages from 50 milliwatts to 50 watts. Its chief use is as voltage regulators.

APPLICATION

If, in a multimeter, we connect a Zener diode (correctly polarized) across the meter movement and a part of the multiplier string, with the Zener voltage slightly higher than the normal full-scale voltage at the point of connection, serious pointer-slamming and overheating of the meter coil and series resistors will be virtually eliminated.

As should be obvious, there are a number of alternative connections and Zener voltages which are workable. General circuit and constants for one combination are shown in Fig. 1. Here, the Zener diode is connected from the 3-volt tap to common side of the instrument. If the instrument is connected backwards, the Zener diode forms a shunt of very low resistance across the instrument movement, so that it will read very slightly

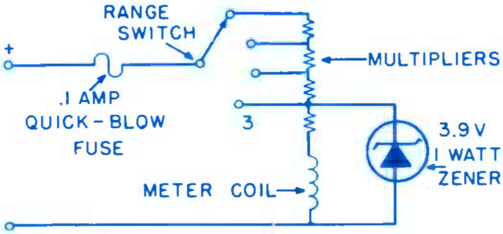


FIG. 1. Zener diode meter protection circuit.

below zero. If normal voltage is applied to the instrument, with the correct polarity, potential at the 3-volt tap will not exceed 3 volts, and the Zener diode (3.9 volts) will act as an open circuit. If, however, an excessive voltage is applied to any tap, the voltage at the 3-volt point will rise above 3 volts. As soon as this voltage reaches 3.9 volts (the Zener voltage), the Zener diode will conduct, and voltage across the 3-volt range will never exceed 3.9. This will drive the instrument pointer off scale, but will not slam it, and the movement of the well-built multimeter will not be damaged.

To prevent destruction of the Zener diode in the event that a high voltage is connected to the 3-volt tap of the instrument, a fuse rated at considerably less than the Zener carrying capacity is connected in series with the positive instrument lead. For a 1-watt, 3.9-volt Zener diode, which has a carrying capacity of about 250 milliamperes, a 0.1-ampere quick-blow fuse is ideal.

Note that this method of protection is effective on AC also. If a high alternating voltage is connected across the meter, when it is switched for a low DC voltage, the positive half wave will be depeaked at 3.9 volts by the Zener diode just as if it were DC. The negative half wave will be shunted around the meter movement by the Zener diode, which functions as an ordinary diode in this polarity.

ALTERNATIVES

Many multimeters have their lowest DC voltage range at some value other than 3. When this is the case, substitution of a Zener diode of a voltage slightly higher than the designated value of the range is in order, and will provide excellent protection.

Additional protection can be provided for the higher ranges by connecting a small neon lamp (NE-2) from the +60-volt tap (if there is one) to system negative. This will conduct at some voltage above 60 (approximately 65), and reduce to prevent pointer-slamming in the higher voltage ranges. This, like the Zener diode, protects from both AC and DC overvolting of the DC meter ranges.

LIMITATIONS

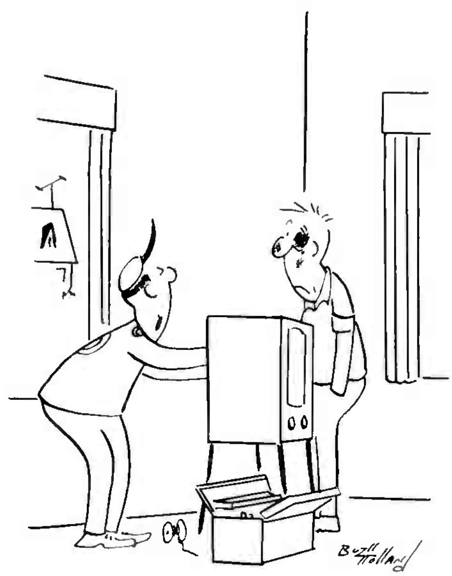
Because Zener diodes are not perfect, but have a slight leakage resistance when they are not conducting (several megohms, usually), their use as meter protectors will impair the accuracy of very high resistance multimeters, as they are shunted across the meter movement and part of the multiplier string.

In general terms, their use is limited to instruments having a resistance of 5,000 ohms per volt and less. If used with a 20,000-ohm per volt instrument, it will tend to "read low" on all ranges, unless either a "premium" Zener diode, having a very high leakage resistance, is used or the meter calibration is adjusted to compensate for the leakage resistance of the Zener diode used.

CONCLUSIONS

For ordinary bench multimeters, having sensitivities up to about 5,000 ohms per volt, Zener diode protection is very effective, and does not impair accuracy detectably.

For high-sensitivity multimeters (10,000 ohms per volt and up), the protection provided by a Zener diode is obtained at a cost of impairment of accuracy. Although this can be offset by several methods, all costly, the best method, for high sensitivity meters, seems to be to install a normally-closed push button in series with the Zener diode. This button is pressed, opening the Zener circuit, when the exact value of the voltage is to be determined.



"When you told him he was doing it wrong, what did the other TV repairman do?"

Tubes CAN Be Checked Without A Tube Tester

A COMMON SENSE APPROACH TO TUBE CHECKING USING IN-CIRCUIT TECHNIQUES

BY THOMAS B. HASKETT

You don't need a tube tester to determine how tubes in your amplifier or transmitter are doing. While testers are desirable and useful in most situations, there are times when you don't have one on hand. And they are artificial, anyway — tubes are made to operate in amplifiers, not in testers — and no tester exactly duplicates the conditions of service of an in-use tube. Furthermore, you can test used spares by the methods outlined here.

GAIN TEST

What do you test for? To see how well a tube can do its intended job. Amplifiers must have gain, and rf amplifiers must have rf gain. In a radio receiver, this includes the rf amplifier, converter, and i-f stages. The simplest test consists of hanging a VTVM across the AVC line and tuning in a fairly weak but steady signal. (Use a signal generator if you like, but a distant station will do as well. Don't try this at night, however, or skywave fluctuation will disrupt your readings.) Now you can try several tubes in each socket, allowing for warmup, and comparing AVC voltage with each. If you adopt the same station for these tests you will soon be able to recognize weak tubes by the resultant AVC voltage. (Note: If the radio uses a loop antenna, be sure it's oriented the same way in each test, for similar signal pickup.)

AF amplifiers can be tested the same way—by feeding them a fairly-pure 400- or 1000-cycle tone and measuring and listening critically to the output. Fig. 1A shows the hookup for the AF section of a radio receiver, while 1B shows the procedure for a hi-fi or stereo rig (check each channel separately). Don't omit blocking capacitor C, as the meter may not have one in the AC function. The signal source can be any AF oscillator with reasonably clean output in the range of 400 to 1000 cps or so. If you can't get an oscillator, try to have a friend make a tape recording of one. If you haven't tape gear, you can buy LP's with test tones on them. If you're really desperate, ask friends in electronics what the local tone phone number is. In most communities the telephone company keeps a tone generator working 24 hours a day. Linemen dial it all the time to check out new installations; once you get the number, you can use it, too. A microphone by the telephone receiver will work, but a pickup coil is better.

You can make one easily by hooking up the plate winding (high-impedance side) of an old output transformer to the input of your amplifier. (Don't connect the other side of the transformer to anything.) Once you get the tone into the amplifier under test, you can switch tubes and read signal output on the VTVM, thus gauging the relative performance of various tubes. Be sure to use the same amount of signal into the amplifier each time. If you use the telephone oscillator, put the output transformer/pickup coil in a cigar box and place the telephone cradle on top. Then turn the phone for maximum pickup and leave the speaker connected to the amplifier.

OSCILLATORS

You can check the local oscillator in a radio or TV by measuring AVC voltage and switching tubes. Without the oscillator signal, there'd be no i-f, hence no DC from the 2nd detector.

A tape recorder's bias oscillator can be checked several ways. If you have an audio VTVM (AC VTVM) you can monitor erase-head current. There may be a test point for this purpose on the chassis. If not, use the hookup of Fig. 2A: insert a 100-ohm resistor in series with the grounded head lead. Hang the meter across the resistor, load a reel of blank or used tape on the machine, and start the "record" function, but with no input signal to the recording amplifier. You can figure the head current with Ohm's Law by the drop across the resistor, and you can try various tubes to see which one(s) give the proper value as recommended in the manufacturer's instructions.

If you have no audio VTVM, but do have an ordinary VTVM or VOM, or if the tape recorder has a VU meter (not an indicator light), you can still get an accurate picture of bias-oscillator operation. Fig. 2B shows the hookup. Feed a steady signal (400 to 1000 cycles) to the recording input, adjusting the recording gain for proper level on the tape. Do this

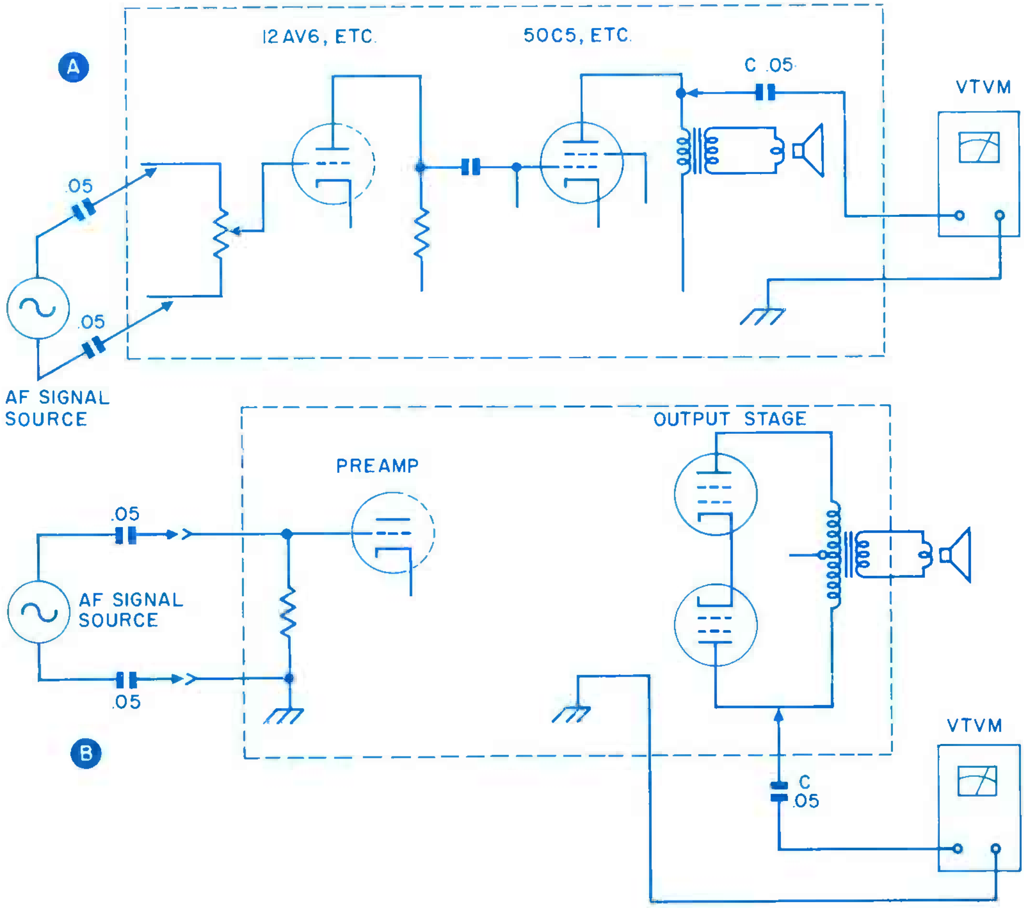
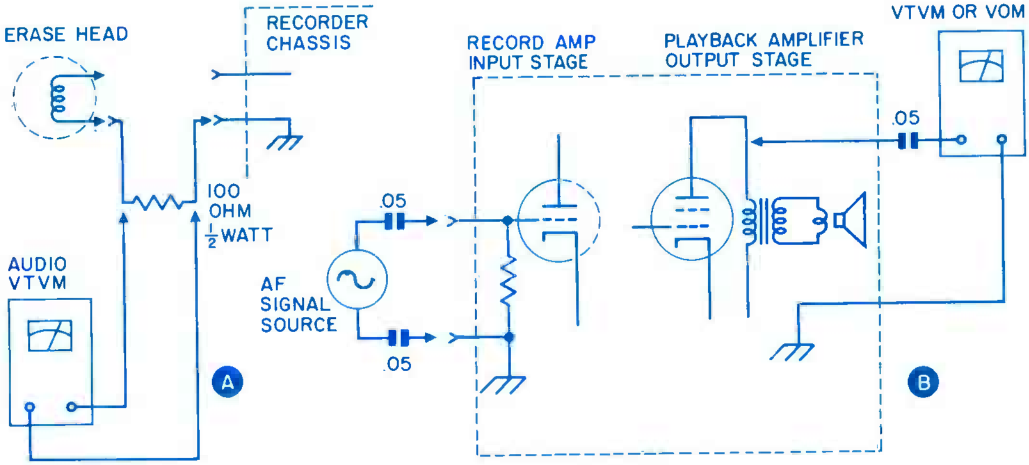


FIG. 1. AF Gain Test. (A) AF section of radio; (B) Hi-Fi or stereo amplifier.



(A) Monitoring bias-oscillator current; (B) measuring recorded signal output.

for one minute with a new or "reference" tube; then stop the machine and change oscillators. After warmup, record another minute, leaving the gain unchanged. Repeat this as often as you have different tubes. Then play back the tape, observing audio output on the VTVM, VOM, or recorder VU meter. You can compare various tubes as oscillators, and the weaker ones won't give as much signal output as the good one.

POWER TUBES

These tubes can often be checked better in their intended service than in a tube tester. For example, rf power tubes in transmitters usually give ample indication of their condition by the way they tune up, as observed on the plate milliammeter, multimeter, or your own VOM. Fig. 3A is a graph of plate current vs. frequency, showing the dip at resonance. A new or good tube will show a sharp dip, but since emission decreases with age, an old tube will show only a broad, shallow dip as you tune the plate tank across resonance. While you're at it, you may want to make a record of the readings on each tube, since power rf tubes are often expensive. You will then be able to judge the life of each bottle as you go along.

If your transmitter has no meter, a VOM on the current range will do nicely, as at Fig. 3B. Break the cathode lead to ground below the cathode resistor or rf choke, if there is one. Then insert meter leads from this point to ground (chassis). Caution: Make connections with all power off. Refer to transmitter manual for normal current and set VOM on next higher range. (If current value is unknown, start on highest range.) Then apply power to transmitter and carefully switch downrange until a reading is applied. Be sure to kill power and discharge B+ line to chassis carefully before changing tubes.

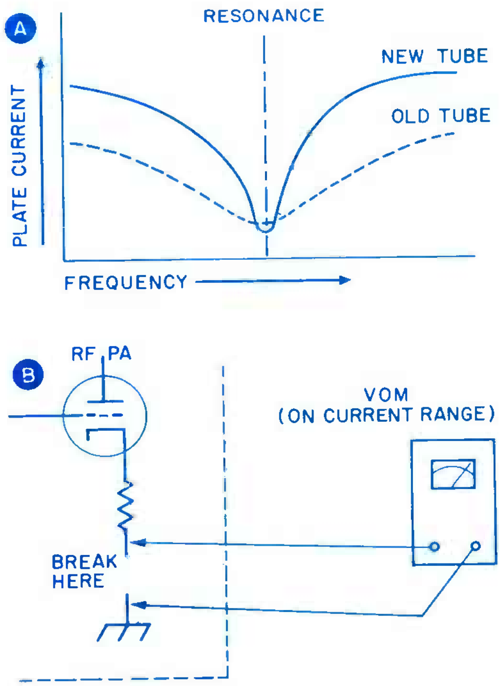


FIG. 3. Testing of rf power tubes: (A) dip at resonance; (B) monitoring plate current.

TV scanning tubes—horizontal and vertical output stages—are also best checked in the TV receiver itself. The test indicator is built in—it's the screen. Raster size depends on tube capability, and if the screen is easily filled, with overlap on all sides, the tube is probably OK. You can check for proper amount of overscan by rolling picture vertically with the hold control. Sometimes the horizontal hold will do the same for horizontal overscan, but you may have to try horizontal linearity and drive controls to evaluate this stage. If the picture shows a drive line easily or blanking bars on both sides, either the horizontal output or the damper may be weak.

RECTIFIERS

The easiest way to check a rectifier is to simply measure its output voltage under load. This can be compared with the schematic, or you can try a new tube. Old rectifiers can be run through a power socket one at a time, with your meter across the input filter capacitor as a monitor. The B+ will be low with old or weak tubes. In a TV set, the raster size and brightness will drop, too.

The same technique will work with high-voltage rectifiers in TV sets. CAUTION: Be very careful with HV circuits -- use a HV probe on the meter, and make all connections before power is applied. Discharge HV lead carefully after test, before unhooking test leads. If you have no HV probe or meter, you can still get an approximate picture of the 1B3's condition. Provided that the horizontal oscillator, output, and damper tubes are in good shape, raster brightness will depend on the HV rectifier's condition. Tune in an unused channel, but leave the brightness control set normally.

Sometimes the sound of a tube will betray its condition. For instance, in sets with full-wave rectifiers, AC ripple in the B+ line has a frequency of 120 cps; therefore 60-cycle hum usually comes from heater-to-cathode leakage in low-level tubes. This occurs, as Fig. 4 shows, because the heater line is often grounded while the cathode resistor places the cathode above ground, due to the tube's plate current. In this case, it's easy for electrons to flow from the heater to the cathode.

When a tube exhibits this defect in a hi-fi or stereo set, it must be replaced. You can identify the source of hum by touching your finger to the first stage's grid and turning up the gain. The hum you hear is 60-cycle; if the other hum matches it, heater-to-cathode leakage is probably the cause. If the other hum doesn't match, it's probably a power-supply filter.

Mushy-sounding output from an AF amplifier is often caused by an unbalanced push-pull output stage, or by a partially-shorted output tube, whether single-ended or push-pull. It's also important to remember that in high-fidelity work, preamp tubes are more prone to hum troubles than distortion, while in later stages -- from the second tube to the output -- it's the other way around. Low-level stages seldom cause distortion, as the signal isn't that high. Later stages, however, handle high-amplitude signals, and they will show distortion much sooner than low-level stages.

Older and more-nearly defective tubes will overload and show distortion at less drive than new, good tubes. Although you can always substitute with new tubes, it's also possible to get a fair picture of distortion conditions by feeding a steady tone (400 or 1000 cps) into the amplifier at a higher-than-normal level. With a new or good tube in the output socket, no clipping or distorting should be heard. Older tubes will betray their defect by clipping at lower levels.

The same principle can be applied to TV: watch the picture carefully -- if it lacks sparkle and fine detail, or if it smears or shows trailing edges, a new video amplifier or video detector may clear up the trouble.

MAKE IT A HABIT

You should, by all means, have and use a tube tester, for it's often faster to test a number of different tubes this way than by plugging them in amplifiers. But form the habit of looking at the TV picture, listening to the sound,

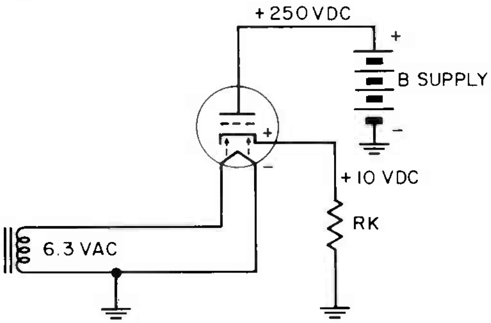


FIG. 4. Heater-to-cathode leakage.

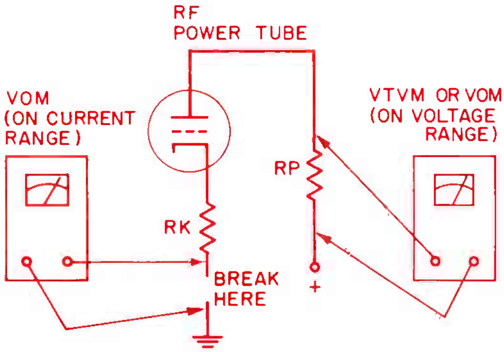


FIG. 5. Two ways to meter tube current.

reading the plate milliameter, etc., as you go along. Often you may not need to use the tube tester. You can also make a perfectly-adjusted amplifier, TV, or radio, and deliberately plug in defective tubes, just to see what evidence will show up.

Many old-time professional PA or broadcast amplifiers included meters to measure cathode current of tubes. When a tube ages, it's current drops off. To put it another way, its plate resistance increases. The result is the same. If you have some gear you'd like to keep close tabs on, you can provide this feature by installing a meter which can be switched into the cathodes of the various stages. However, if you don't wish to go to all this trouble, simply do as Fig. 5 illustrates -- measure and make a note of the drop across the plate resistor (with no signal through the unit). Older tubes will show less drop as their plate current lessens. (This is what many tube testers show, by the way.)

Finally, don't forget that you can check a VR tube by measuring its terminal voltage in use with a high-impedance VTVM. The value should be within a few volts of the tube's number -- i. e., near 150 volts for a VR-150.

And if an AC-DC radio goes dead on you, use your ohmmeter (or any continuity checker) across the filaments of each tube, in turn, to track down the culprit.

Above all, always ask yourself these questions: What is the tube supposed to do? How can I measure this?

DC Voltages (Cont. from P. 17)

By taking a few calibration points a voltage conversion multiplier can be developed. In the case of this particular chopper, used in conjunction with the Knight AC vacuum tube voltmeter, it was found that the voltage reading on the meter had to be doubled to obtain the true DC input to the chopper. Thus, if we are working on the 3 millivolt scale of the AC vacuum tube voltmeter and read a voltage of 2 millivolts AC, the actual DC voltage appearing across the chopper input circuitry is 4 millivolts.

In making low level AC measurements from a high impedance voltage source, fully shielded test cables must be used. This same technique holds true for making low level DC measurements from a high impedance source -- for example, a photo cell. If this precaution is not observed, hum will be picked up by the test leads and chopped along with the DC signal resulting in an erroneous reading.

Once this system has been calibrated, it will give many, many thousands of hours of trouble-free service without drift or instability, making it possible to measure very minute DC signals without loading the circuits involved.

ANSWER TO LUCKY'S PROBLEM

(What Would You Have Done? - Page 14)

After installing the antenna and dropping the lead-in, Lucky installed two small (250 mmfd.) capacitors in series with the 300-ohm line to the receiver antenna terminals, temporarily. He then connected a 1 meg control across the line-end of the lead-in. On the roof, Super-Sonic connected his pocket instrument across the line at the antenna.

Center scale on the meter was the dividing line between left or right, clockwise or counterclockwise, to the man turning the antenna. Lucky had already checked this control setting with the meter before attaching it to the line. When he wanted Super-Sonic to adjust the antenna counter-to-clockwise, he merely backed-off slightly on the control. When the antenna was finally properly orientated, he notified the man on the roof by re-setting his control for another CENTER reading.

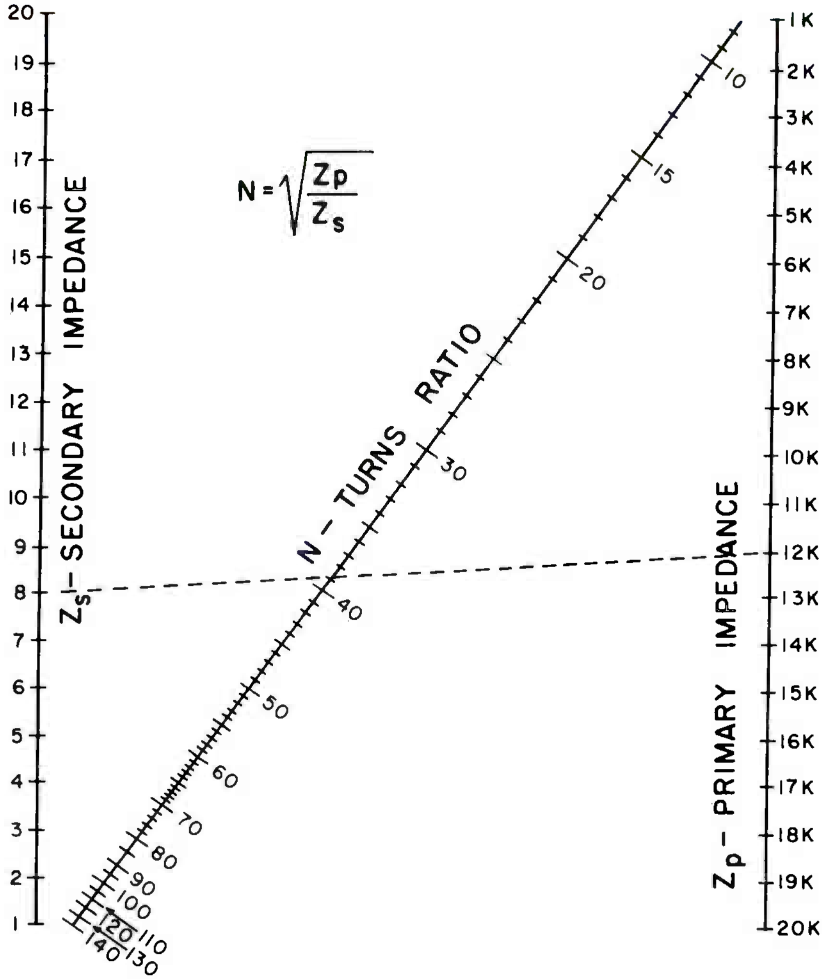
METER MATCHING ANSWERS

(Quiz - Page 24)

1. K	2. G	3. J	4. O
5. E	6. F	7. N	8. A
9. P	10. L	11. C	12. I
13. M	14. H	15. B	16. D

IMPEDANCE TRANSFORMATION NOMAGRAPH

BY ALAN L. TEUBNER



This chart reduces the problem of choosing audio transformer turns ratios to a matter of drawing a single straight line. The values are especially chosen for matching amplifier power output stages to speaker systems.

An example has been drawn on the chart to illustrate its use. Assume that you want to match an eight-ohm speaker voice coil to a Class AB push-pull output stage using two beam power tubes which require 12,000 ohms plate-to-plate load resistance. Simply draw a line between 8 on the Secondary Impedance scale and 12K on the Primary Impedance Scale. The point where this line crosses the Turns Ratio scale gives the answer, in this case 38.7 to 1. Naturally, you must use the nearest available value, and you can use the nomogram again with the actual turns ratio to check the reflected impedance.

The nomogram will give results of approximately the accuracy of a slide rule. Of course, the formula must be used with the same care and knowledge of its limitations as any other simple formula in electronics.

CHANGER

TIPS ON TURNTABLE SERVICING

A square hole was made in the top of this portable work table so that the working mechanism of a defective changer could be studied in a mirror while it was in operation.

To simplify the work of checking out automatic changers and making necessary repairs or adjustments it helps to assemble a low wattage amplifier in combination with a small matching speaker. The two units can be combined in a table radio case similar to one shown in the photograph. The controls are front mounted and included on the panel is a phono input receptacle. Additional provisions in the same "box" may include a preamplifier for checking changers equipped with magnetic pick-ups. An extra output receptacle for another speaker can be installed at the back of the case. Such a unit makes the work of testing any type of changer quite easy. A double 110-v socket can be attached to the rear panel so that the changer or tape deck can be plugged in at this point thus making the assembly a complete, compact power unit for use anywhere. Efficient compact 3-tube amplifiers which are ideal for this purpose are available at any radio supply house for a few dollars.

Faulty operation of the mechanical part

A preamplifier such as shown here is needed in addition to a standard amplifier for checking out changers with magnetic cartridges.

This handy portable, low-powered amplifier was installed in the wooden case that once housed a small table radio. The same speaker was used and a screen covers the hole once used for the station dial. Controls are front mounted as is the phono input socket.

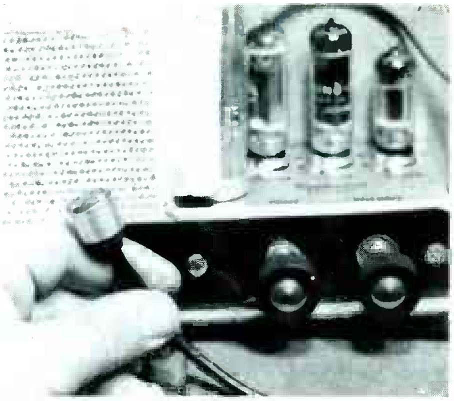
CHECK-OUT

. . . . . By Glen F. Stillwell

of any changer can be checked by mounting the unit on two supports made from inverted empty coffee tins. To keep the changer from creeping off these supports provide each of them with a spring type clothespin wired to the bottom of the can as shown in the photograph. These supports are positioned so that they clear all working parts of the changer mechanism so that it can be studied under actual operating conditions.

To check the underside part of the changer for faulty operation cut a square hole a little smaller than the unit in the top of a work bench or portable service table. Place the changer over this hole and study its operation by holding a mirror under it as demonstrated in the photograph. In this way the cause of the faulty operation can be quickly determined and corrected. The hole can be covered with a sliding plastic or wooden panel when not in use. If the bench, or table, is high enough and sufficiently large the technician can observe changer action by sitting under the bench and the mirror will not be needed.

This support made from an empty pound coffee can is one of a pair used to hold the changer being checked in a normal operating position. Spring type clothespin attached to the can keeps the changer from creeping.



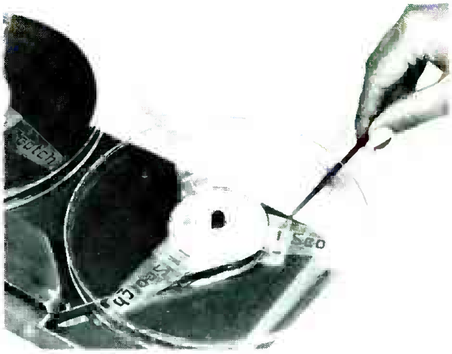
This is a low-wattage amplifier with an attached speaker and an input connection. It is very handy for checking out changers.

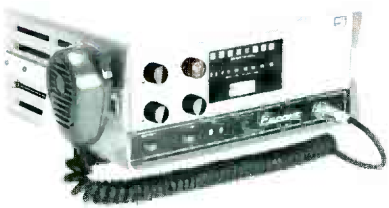
Shown above is another device to study record changer action conveniently. Basically, it is a shelf bracket made from light tubing, U-shaped with ends bent at right angles. Pipe straps were used to fasten the bracket in place, but not permanently. The bracket itself may be removed easily by simply lifting it away from the pipe straps, the latter being loosely fastened to the shop wall.

New Products

The all-thumbs method of threading tape recording reels has been outmoded by the 3M Company, the producer of "Scotch" brand recording tapes. This new self-threading reel automatically winds the tape after it has been placed between the flanges near the hub.

The new tape recording reel, which is threaded simply by laying the tape against the hub, has been hailed as the "most revolutionary in the history of reel design." The self-threading reel has solid flanges and when sealed with a plastic collar is a dust-proof, self-storing unit.





The "Escort" new multi-purpose two-way radiotelephone delivers superior talk-power, range and general performance on both land and water. This transceiver, which has an extended range, operates on Citizens Band Service channels, class D license required. The rugged compact radiotelephone (15 lbs.) has all built in features. Transistorized dual power supply of 12 volts DC and 115 volts AC. Easy to install and operate.

A new 1-1/2 inch model, in both DC and AC rectifier ratings, has been added to General Electric's BIG LOOK* line of 2-1/2 inch, 3-1/2 inch, and 4-1/2 inch panel meters. This tiny instrument is designed to save panel and control board space yet afford excellent readability.

*Trademark of General Electric Co.

Johns-Manville's Plastic Electrical Tape is now available in a pocket-size dispenser that adds new ease and convenience to applications of this product. The refillable dispenser offers all the advantages of the larger unit, yet holds only 20 feet of 3/4-in. wide tape, as opposed to the 66-feet long roll of the large dispenser.

The small unit, fits easily in the pocket, has no moving parts and allows applying and cutting the tape with only one hand if necessary in awkward locations.

ALUMNI NEWS

John Berka	President
Howard Tate	Vice President
James Kelley	Vice President
Eugene DeCaussin	Vice President
David Spitzer	Vice President
Theodore E. Rose	Executive Sect.

Visits To Local Chapters

Last year J. B. Straughn, Chief of NRI Consultation Service, accompanied Executive Secretary Ted Rose on his annual visit to the various local chapters. Mr. Straughn's lectures and demonstrations on Radio-TV Electronics were so enthusiastically received that he is repeating his visits this season. Below is a tentative schedule of the visits yet to be made. This schedule will be confirmed or modified in subsequent issues of the Journal.

CHAPTER	DATE
Hagerstown	November 14
Springfield, (Mass.)	November 20
New York	November 21
New Orleans	January 14
Minneapolis-St. Paul	April 9
Pittsburgh	May 7
Hackensack	May 29

All NRI students and graduates are welcome at the mettings whether they are chapter members or not. Take advantage of this chance to meet Mr. Straughn and to hear him lecture on Electronics. See "Directory of Local Chapters" on page 39 for information on time and place of meetings.

Visitors

Sylvester (Pete) Carter of the New York City Chapter and his brother Bill were in Washington on a recent trip and dropped in at the Institute for a visit. Sorry your Executive Secretary was out to lunch, fellows, and when he returned you had only enough time to say hello.

CHAPTER CHATTER

DETROIT CHAPTER Chairman James Kelley has received numerous calls from recent NRI graduates who are interested in joining the Chapter. It will bear repetition here that membership in a local Chapter of the Alumni Association is not limited to Graduates. All NRI men, both students and graduates, will receive a hearty welcome at all the local chapters as guests and prospective members.

HACKENSACK CHAPTER has been enjoying some lively group discussions on particular problems some of its members have had with TV sets. The chapter is fortunate in having Cres Gomez who on several occasions has lectured on the various methods of TV fault analysis and repair.

Ever since the Chapter was organized last May, every report has contained the name of at least one new member. The newest is Ed Halvey, Montvale. Glad to number you among the membership, Ed.

The Chapter is expecting many more NRI students and graduates in this area to join. Luckily the meetings are held in an area where there is no problem in parking; there is plenty of space convenient for everyone.

The Chapter has had word from both Motorola and Zenith in regard to programs in which they will participate in the near future.

LOS ANGELES CHAPTER felt it necessary to devote an entire meeting to consider the possibility of holding its meetings in a new location. After a lengthy discussion and weighing all the pros and cons, it was finally

Three of the officers of the Los Angeles Chapter. L. to R. Eugene DeCaussin, Chairman, Jim Law, Secretary; and William Edwards, Vice Chairman.

A Los Angeles chapter group discussing tube testers owned by various members.

decided to continue to meet in Chairman Gene DeCaussin's Radio-TV Shop.

When the business part of the meeting was brought to a close, Mrs. DeCaussin sprang a surprise: a cake for Earl Dycus. Mrs. Tevis did the same for Mrs. DeCaussin, Earl's and Mrs. DeCaussin's birthdays being only one day apart.

The Chapter owes a debt of gratitude to Mrs. DeCaussin and Mrs. Tevis for their regular attendance and providing the tasty refreshments at the metting. This contributes greatly to the good fellowship at the meetings.

NEW YORK CITY CHAPTER in its initial meetings of the new season welcomed back a large group from their summer vacations, plus a brand new member, Ellsworth Steininger. Congratulations to you Ellsworth.

Jim Eaddy brought in the first one of the transistor radios that his firm (Bulova) is generously supplying the Chapter members to work on, and he demonstrated servicing techniques. As a change of pace, Secretary Joe Bradley said a few words on the subject of TV alignment, pointing out what could be done with an ordinary signal generator and a VTVM as against a sweep generator and crystal calibrated marker.

All in all, these first meetings constituted an auspicious beginning for the season.

PHILADELPHIA - CAMDEN CHAPTER'S newest members are Harry Pinkerson and Jacob Ehrgott, Jr., both of Philadelphia. Welcome to the chapter, gentlemen!

representative of Motorola was scheduled guest speaker at one meeting but Russ Mauger, Service Manager for Motorola, informed the chapter that their field man couldn't make it and his presentation ought to be postponed to a later meeting. Fortunately, Harvey Morris pinch-hit for him with a talk and demonstration on troubleshooting with the scope. The chapter provided Harvey with a good TV receiver to use during the demonstration and Harvey tuned in his usual excellent job.

It was pointed out in the October issue of the NRI Journal that Secretary Jules Cohen had been trying to work out a deal with the Philco Corporation to allow members of the chapter to tour one of their plants and see how printed circuits are made. Jules reports that he believes this tour is finally all set.

Bill Heath of Westinghouse also offered to arrange for chapter members to go through the Westinghouse plant at Metuchen, N. J. It would have to be an all day affair, the chapter members would furnish their own transportation and Westinghouse would treat them to a luncheon. They would then be taken on a tour of the entire plant. A large number of the members were definitely interested. Both of these trips may have been held by the time this issue of the Journal goes to press. If not, any other members who might be interested in either one or both should contact Jules Cohen or Chairman John Pirrung.

SAN ANTONIO (ALAMO) CHAPTER'S Sam Bentler, who is Electronic Control Inspector at Kelly AFB, San Antonio, delivered a fine, highly informative talk on the use of a scope in TV troubleshooting.

J. B. (Blan) Straughn, Chief, NRI Consultation Service, conducting a demonstration at a meeting of the Philadelphia-Camden Chapter. At left, holding up the doorwary, is Ted Rose, Executive Secretary of the NRI Alumni Association.

The following meeting was scheduled to be held as "service night", to which members bring their tough dogs or other equipment to see what the group can do with them.

The Chapter was pleased to have James Quinn join its membership. A warm welcome to you, Jim.

SAN FRANCISCO CHAPTER members showed considerable enthusiasm for and greatly enjoyed learning some new service techniques from a demonstration conducted by Andy Royal and Ed Persau. Their use of a bar generator for linearity adjustments and signal injection in the rf-if stages of a TV receiver were the highlights of the demonstration. Various part defects were simulated and the signal generator was used to localize the trouble to a section and a stage. The members were properly appreciative to Andy and Ed for this excellent program.

Congratulations to John F. Cullen as the latest member to join the Chapter.

Directory of Local Chapters

Local chapters of the NRI Alumni Association cordially welcome visits from all NRI students and graduates as guests or prospective members. For more information contact the Chairman of the chapter you would like to visit or consider joining.

CHICAGO CHAPTER meets 8:00 P. M., 2nd and 4th Wednesday of each month, 666 Lake Shore Dr., West Entrance, 33rd Floor, Chicago. Chairman: Frank Dominski, 2646 W. Potomac, Chicago, Ill.

DETROIT CHAPTER meets 8:00 P. M., 2nd and 4th Friday of each month. St. Andrews Hall, 431 E. Congress St., Detroit. Chairman: James Kelley, 1140 Livernois, Detroit, Mich., VI-1-4972.

FLINT (SAGINAW VALLEY) CHAPTER meets 8:00 P. M., 2nd Wednesday of each month at Chairman Andrew Jobbagy's Shop G-5507 S. Saginaw Rd., Flint Mich. OW 46773.

HACKENSACK CHAPTER meets 8:00 P. M., last Friday of each month, Hackensack YMCA, 360 Main St., Hackensack, N. J. Chairman: George Schalk, 471 Saddle River Rd., Ridgewood, N. J.

HAGERSTOWN (CUMBERLAND VALLEY) CHAPTER meets 7:30 P. M., 2nd Thursday of each month at the YMCA in Hagerstown, Md. Chairman: Francis Lyons, 2239 Beverly Dr., Hagerstown, Md. Reg 9-8280.

LOS ANGELES CHAPTER meets 8:00 P. M., 2nd and last Saturday of each month, 5938 Sunset Blvd., L. A. Chairman: Eugene DeCaussin, 5870 Franklin Ave., Apt. 203, Hollywood, Calif., HO 5-2356.

MINNEAPOLIS-ST. PAUL (TWIN CITIES) CHAPTER meets 8:00 P. M., 2nd Thursday of each month, Walt Berbee's Radio-TV Shop 915 St. Clair St., St. Paul. Chairman: Paul Donatell, 1645 Sherwood Ave., St. Paul, Minn., PR 4-6495.

NEW ORLEANS CHAPTER meets 8:00 P. M., 2nd Tuesday of each month at Galjour's TV, 809 N. Broad St., New Orleans, La. Chairman: Herman Blackford, 5301 Tchoupitoulas St., New Orleans, La.

NEW YORK CITY CHAPTER meets 8:30 P. M., 1st and 3rd Thursday of each month, St. Marks Community Center, 12 St. Marks Pl., New York City. Chairman: David Spitzer, 2052 81st St., Brooklyn, N. Y., CL 6-6564.

PHILADELPHIA-CAMDEN CHAPTER meets 8:00 P. M., 2nd and 4th Monday of each month, K of C Hall, Tulip and Tyson Sts., Philadelphia. Chairman: John Pirrung, 2923 Longshore Ave., Philadelphia, Pa.

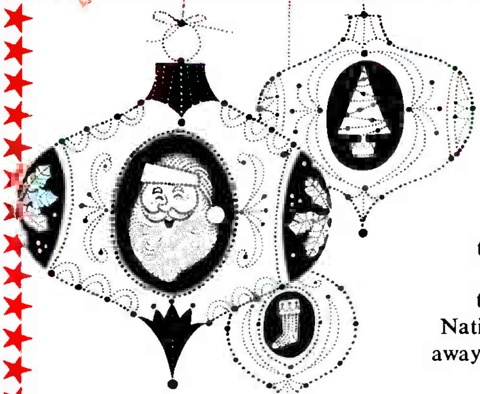
PITTSBURGH CHAPTER meets 8:00 P. M., 1st Thursday of each month, 436 Forbes Ave., Pittsburgh. Chairman: Thomas Schnader, RD 3, Irwin, Pa., 731-8327.

SAN ANTONIO ALAMO CHAPTER meets 7:30 P. M., 3rd Wednesday of each month, Beethoven Hall, 422 Pereida, San Antonio. Chairman: Jesse De Lao, 606 Knotty Knott, San Antonio, Texas.

SAN FRANCISCO CHAPTER meets 8:00 P.M., 1st Wednesday of each month, 147 Albion St., San Francisco. Chairman: Peter Salvotti, 2543 Great Hwy., San Francisco, Calif.

SOUTHEASTERN MASSACHUSETTS CHAPTER meets 8:00 P. M., last Wednesday of each month, home of John Alves, 57 Allen Blvd., Swansea, Mass. Chairman: James Donnelly, 30 Lyon St., Fall River, Mass. OS 2-5371.

SPRINGFIELD (MASS.) CHAPTER meets 7:00 P. M., last Saturday of each month at shop of Norman Charest, 74 Redfern St., Springfield, Mass. Chairman Steven Chomyn, Powder Mill Rd., Southwich, Mass.



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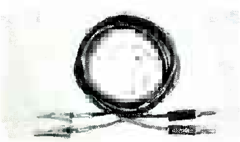

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