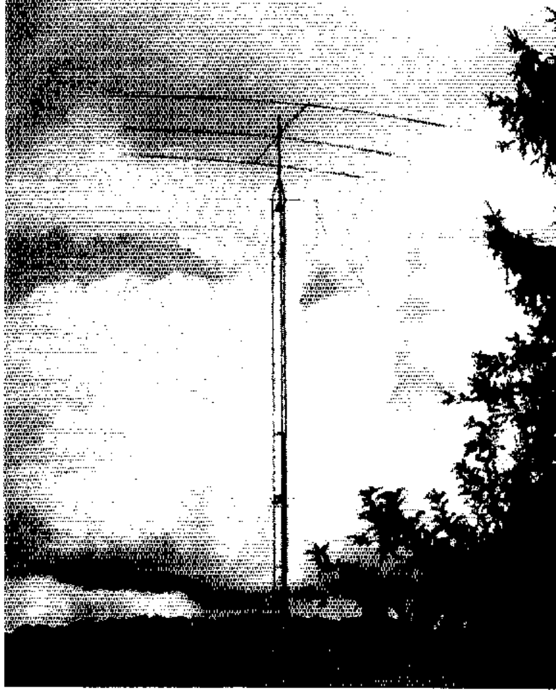
Antenna Hardware You Can Build



There are some generic items that most of us need for home-station antenna projects. These tips may help you to save money by building your own hardware.

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Are you weary of tower climbing, or perhaps too old to risk climbing that steel pinnacle in your back yard? If so, I share your outlook! Wouldn't a yardarm and halyard be a nice addition to your tower—especially if you like to experiment with wire antennas, as I do? There's also the matter of combining numerous radial wires at a common point near the base of a shunt-fed tower or metal mast. Looking for a convenient way to do this? If you are, you'll find these specialty hardware items and others that pertain to routine antenna projects treated in this article. I doubt that I have "invented a better mouse trap" with the gadgets I want to describe, but they work satisfactorily for me. I'm convinced that some of you will have better solutions to the common hardware problems we will consider here. If you do, send them to the Hints and Kinks editor, thereby sharing your innovative ideas with the other *QST* readers.

A Tower Yardarm

Although I own a 50-foot tilt-over tower, I find it time-consuming to disconnect my wire antennas and winch the top section up and down each time I want to hoist a new wire antenna. I decided to eliminate that tedious routine by installing a yardarm with a pulley and halyard near the top of my tower. Fig 1 shows a photograph of the yardarm after I installed it. Presently it supports one corner of a full-wave rectangular loop antenna for 80 meters. The far end of the loop is held aloft by a 50-foot telescoping mast.

Nothing could be more ordinary than a homemade yardarm, but there are some pointers I want to offer with regard to making them strong and lasting. A yardarm made solely from a mere piece of steel pipe will bend and sag from stress during high winds and periods of icing. Fig 2 shows details for the yardarm of Fig 1. Note that two methods are used to increase the load limit of the unit: (1) A wooden dowel is contained within the pipe. The dowel is the same length as the pipe section. (2) A small eye bolt is added at the outer end of the yardarm. The eye bolt allows the addition of a nylon guy line that attaches to a tower leg. This helps prevent the yardarm from sagging or bending because of undue stress. Apart from those two features, the yardarm follows typical lines. The wooden dowel insert serves another purpose: It prevents the pipe from compressing at the points where the U bolts and eye bolts are located, thereby keeping the related hardware tight over a period of time. I painted my dowel rod with two coats of spar varnish before inserting it into the pipe. This extends the life of the wood by sealing it against moisture.

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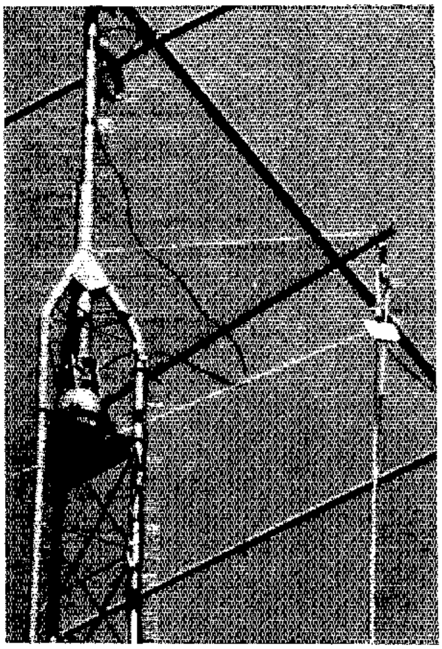

Fig 1—Photograph of a tower that is equipped with the yardarm of Fig 2.

You may want to eliminate the pulley for the halyard and use the large screw eye as a guide for your halyard. But when the eye bolt becomes rusty, it will cause undue wear and tear on the halyard. For a slight additional expense you can add a pulley.

I prefer to use ¼-inch-diameter nylon rope as halyard material. This type of cord is widely available at marinas that stock boat accessories. I also have had good luck with heavy-duty fabric clothesline. A yearly coating of silicone waterproofing liquid (such as that used for boots and shoes) extends the life span of fabric rope. I do not recommend the use of stranded polypropylene clothesline; it deteriorates rapidly from ultraviolet rays and airborne pollutants.

My yardarm is made from 1-inch-OD electrical conduit. The wooden dowel rod is ¾-inch OD. The metal pipe was cleaned, then sprayed with two coatings of automotive undercoating paint. The eye bolts and U bolts were obtained at a hardware store.

Ground Radial Connection Plate

I've seen some very fancy metal plates used to join numerous ground-radial wires. I have also observed some dreadful rat's nests where radial wires were connected.

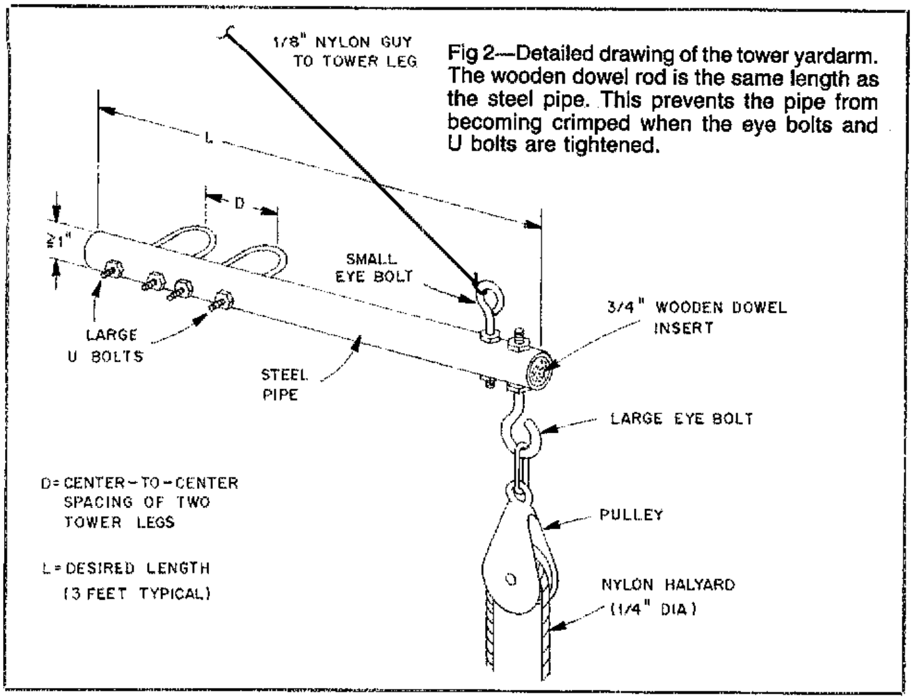

Fig 2—Detailed drawing of the tower yardarm. The wooden dowel rod is the same length as the steel pipe. This prevents the pipe from becoming crimped when the eye bolts and U bolts are tightened.

No doubt either method is suitable if all of the wires are well bonded electrically. But, it is nice to have an orderly arrangement that ensures positive electrical contact between the base of the vertical antenna and its radial system. To that end, I gravitated toward a technique that calls for each radial wire being soldered to a common junction block near the antenna feed point. A sketch of this unit is presented in Fig 3.

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Form a U-shaped aluminum channel from 14- or 16-gauge stock. Use two U bolts to affix the channel on a tower leg or metal mast. Three no. 14 copper bus bars provide conductors to which the radial wires may be soldered. Drill six ¼-inch-diameter bolts at their ends to accommodate the no. 14 bus wire. A propane torch or 500-W soldering iron is suitable for soldering the wires to the bolts. On completion of the assembly, coat the bolts and nuts with nonacidic sealant such as that sold in tubes by Dow Chemical or GE. This coating retards oxidation to ensure good electrical contact between the bolts and the junction-block plate. I find that a thin coating of silicone grease between the U bolts and the tower leg (renewed yearly) helps to minimize oxidation at the points where the U bolts contact the tower.

The occasion for unwanted oxidation may be reduced considerably if you can locate some iron sheet metal from which to form the U-shaped channel. If iron is used, you will eliminate the mating of dissimilar metals. However, the formation of rust will still be a consideration, and this suggests frequent maintenance. If the iron sheeting can be galvanized at a nearby plating shop, it is worth considering.

Half-Sloper Fixture

Good electrical connections are as important to the quarter-wave or half-sloper antenna, as is the case with the ground radials discussed previously. We need to be aware that the tower is a working part of the quarter-wave sloper antenna. This means that the shield braid of the coaxial feed line must have a positive connection to the tower at the point of antenna attachment (usually near the top of the tower). I have seen some inferior arrangements for half slopers, wherein the amateur simply wrapped the coaxial-cable braid around a tower leg, then taped it in place. This may seem acceptable at first, but in no time the copper-to-steel mating surfaces (dissimilar metals again!) will begin to oxidize. The result is a resistive connection and possible TVI from rectification. This can also cause reception of spurious responses in the station receiver.

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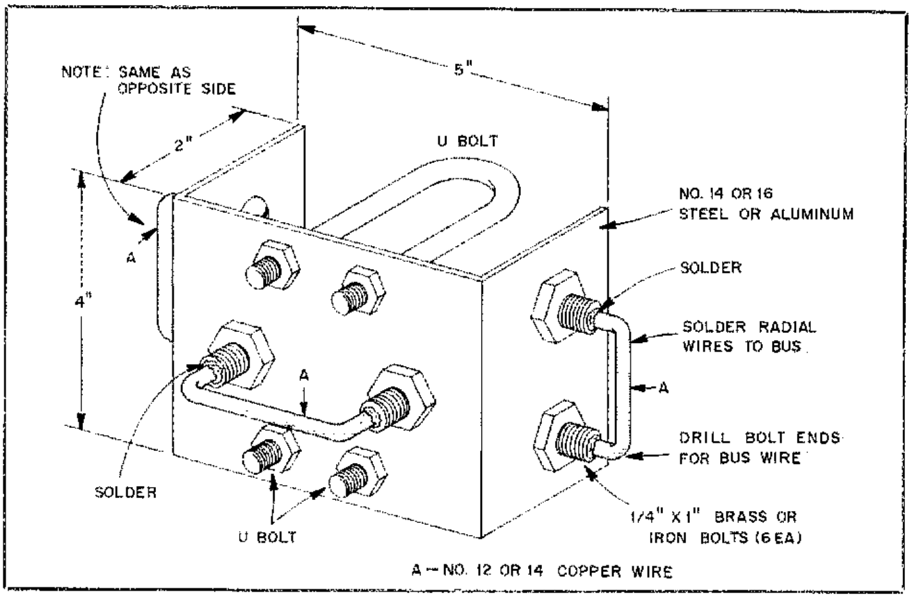

Fig 3—Details for the ground-radial block. The radial wires are soldered to the U-shaped bus-wire loops on the front and sides of the bracket. The ends of the ¼-inch-diameter bolts are drilled to accommodate the bus wires, which are soldered to the bolts.

My solution to the problem is shown in Fig 4. An L-shaped steel or aluminum bracket is attached to a tower leg by means of U bolts. The metal stock should be fairly thick in order to prevent bending from the weight of the antenna wire. No. 14 gauge sheet metal is recommended. You may use no. 16 gauge sheet metal if diagonal braces (two) of the same stock (about ½ inch wide) are used across the inside part of the L at the top and bottom of the fixture.

A ¼-inch hole is drilled in the lower, outer corner of the L bracket. This is used to attach the top insulator for the wire portion of the half sloper. A small loop of wire (to relieve strain on the upper end of the antenna) is soldered between the antenna

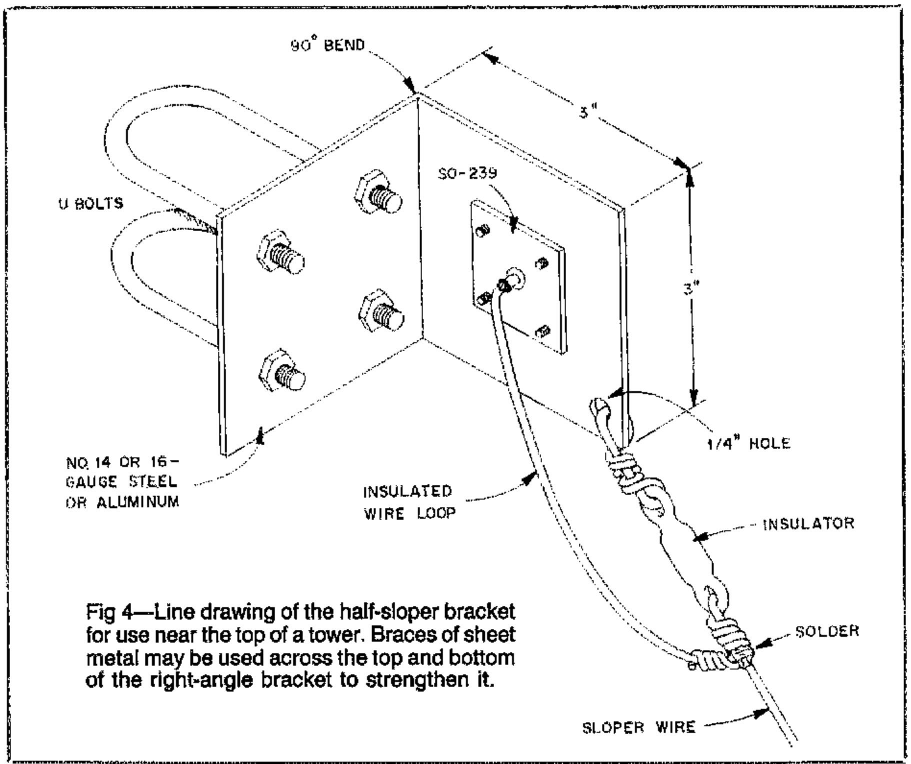

Fig 4—Line drawing of the half-sloper bracket for use near the top of a tower. Braces of sheet metal may be used across the top and bottom of the right-angle bracket to strengthen it.

and the coaxial connector center lug on the fixture. The wire loop should be insulated to prevent it from shorting to the metal L bracket. A short length of easy-to-get automotive high-tension wire (don't use resistance wire that has a carbon core) or Teflon-insulated no. 16 or 18 hookup wire will work nicely. Once more, a thin coating of silicone grease is helpful in minimizing corrosion where the U bolts mate with the tower leg. If you have an elbow adaptor for your coaxial jack, it will reduce the strain on the cable where it attaches to the L-shaped fixture. Vinyl electrical tape may be used around the coaxial connector and the elbow to keep moisture out, after the cable has been attached. Coax Seal® may be used instead of the tape, and can be applied also to the base end of the SO-239 connector to protect it from the effects of weather.

Although I do not recall seeing it mentioned in articles about half slopers, it is wise to ground the coaxial cable shield braid also at the bottom of the tower. This is helpful when the integrity of the tower-section joints is in doubt. The base of the tower or mast should be well grounded in order for the half sloper to work properly.

Homemade Ladder Line

Although manufactured 300-ohm 1-kW twin-lead and 450-ohm molded ladder lines are available for use as tuned, balanced feeders, it is often faster and less costly to make your own balanced, open-wire line. Not only is the monetary consideration worthwhile, but we can design the feed line for a specific impedance. Fig 5A shows a section of balanced line. The characteristic impedance of the feeder (Z_0) may be obtained from the accompanying equation. You will experience difficulty when trying to design very low-impedance lines, such as 150 or 300 ohms. This is because the spacing (S), if it is close, may be hard to realize from a practical point of view. The smaller the conductor diameter, the less difficult becomes the task of building low-impedance lines. Unfortunately, the wire size may be so small that the line will not accommodate the power of your transmitter.

We will have no difficulty when working with no. 14 wire (0.064-inch-diameter) provided we build line that has a 450-ohm or greater impedance. Fig 5B shows the correct spacing (S) for no. 14 wire when designing the line for 450 or 600 ohms.

Open-wire feed line of the type in Fig 5 is superior to the commercial 300- and

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450-ohm feeders that have polyethylene insulation. The 450-ohm ladder line is better than the 300-ohm TV line, at least when it comes to losses and temporary impedance changes from rain and ice. This is because rectangular sections of the polyethylene insulation are removed from the 450-ohm ladder line at approximately 1-inch intervals. This reduces losses and weather-related impedance changes. On the other hand, the solid-insulation, 300-ohm line is highly subject to impedance changes and increased loss when it is wet.

If we build open-wire line, we can greatly reduce losses in general and should experience very little impedance change when there is water, snow or ice on the line. I use

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70 feet of homemade 600-ohm open-wire line to feed an 80-meter full-wave loop. Despite the line having been encrusted with snow and ice last winter, the system im-

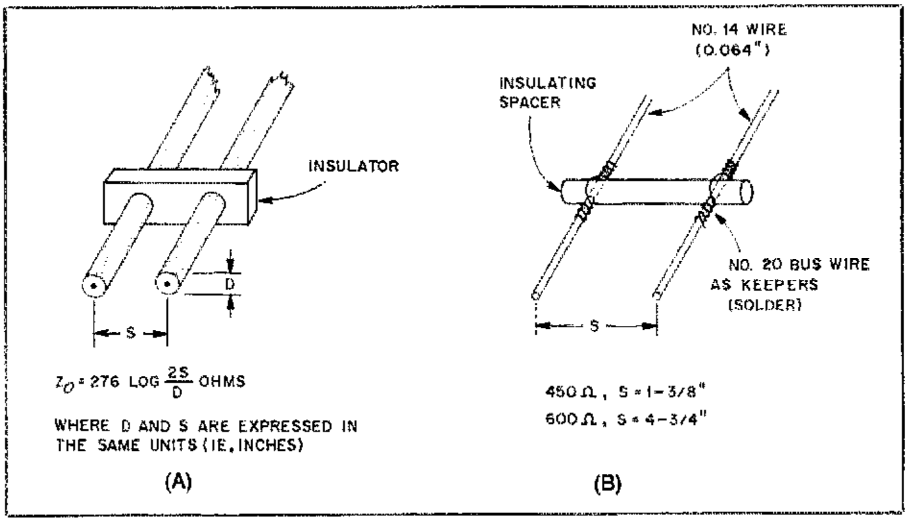

Fig 5—Illustration A shows a section of balanced feeder with the equation for determining the impedance. At B is an example of open-wire line with dimensions for 450- and 600-ohms impedance.

pedance, as checked at the transmitter end of the line, remained relatively close to that during dry conditions. The SWR only changed from 1.3:1 to 1.7:1 when there was ice on the feeders. Another antenna that has 450-ohm polyethylene ladder line changed from 1.12:1 to 3.5:1 when the line was covered with ice.

Feed-Line Insulators

We may use a variety of materials for the spacers in our open-wire line. Perhaps the least expensive stock is that of variety store plastic coat hangers. The material is 3/8-inch-diameter, and several insulators may be cut from one hanger. I use a spacing of approximately 8 inches between insulators. Fewer spacers may be used if you are able to affix the open-wire line to posts with insulators at 15- to 20-foot intervals. I use polyethylene electric-fence insulators for this purpose.

Various kinds of plastic tubing and rod may be used for feed-line spreaders. I have seen some homemade feed line that contained small, plastic hair curlers. The handles from throw-away razors or the bodies of plastic pens can be used. If there is an industrial plastics dealer in your area, check the odd-lot materials that most of them sell. It is possible to buy odd lengths of plastic rod or tubing at attractive prices. Tubing is best in terms of reduced overall weight for the feed line.

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Insulator Anchoring

Fig 5B illustrates one method for affixing the insulators to the wire conductors of open-wire line. A short jumper of no. 20 or 22 bare bus wire (strip the insulation from some bell or hookup wire) is soldered to the feed line on each side of each insulator as shown. This prevents the insulating spacers from slipping on the two feed-line wires. Another scheme I find quick and easy is to use thin-wall spacers (no. 4 hole) over the wires at each side of the spacer. A crimping tool allows me to lock the spacers in place on the wire. If you can't find some thin-wall spacers, try cutting 3/8-inch sections from small-diameter copper tubing. They may be crimped on the wires by means of diagonal cutters or a crimping tool.

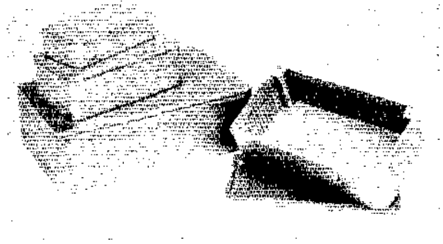
Closing Comments

There is nothing spectacular about any of the ideas presented here. Perhaps some kinks found in these pages will aid you in shortening the job when you are in need of antenna hardware. Innovation on your part will no doubt yield better hardware than I have described. The items seen here have worked nicely for me over a couple of decades, and none of them require special tooling to produce.

New Products

DICK SMITH ELECTRONICS PROJECT BOXES

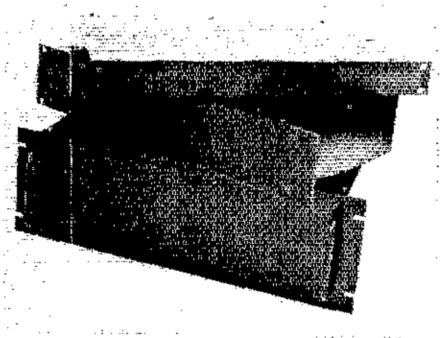
☐ Dick Smith Electronics has several series of low-cost project boxes in a variety of styles and sizes. The die-cast aluminum series (A) are built in England and Australia, and feature interior channelled walls for PC-board mounting. They come complete with die-cast cover and screws.



(A)

Cat No.	*Size (inches)*	*Price*
H-2221	3.9 × 1.0 × 2.0	$3.95
H-2211	4.7 × 1.6 × 2.4	4.95
H-2206	6.0 × 2.0 × 3.2	5.95
H-2201	7.5 × 2.4 × 4.3	8.95

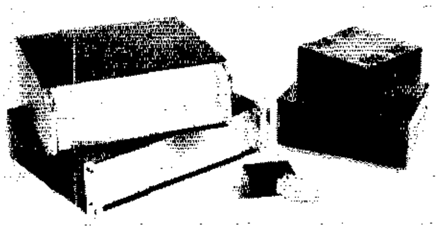
The standard 19-inch rack-mount black instrument cases (B) feature a heavy gauge (1/8-in) front panel and ventilated top and bottom panels. They are supplied flat and assemble in just minutes.



(B)

Cat No.	*Size (inches)*	*Price*
H-2483 Slim	16.75 × 9.8 × 1.5	$24.95
H-2482 Medium	16.75 × 9.8 × 3.25	27.50
H-2481 Large	16.75 × 9.8 × 5.5	29.95

The "Pro" look instrument cases, at (C) left, feature front and rear aluminum panels and handles. The plastic power supply case and air vent case, at right, include front and rear plastic panels and slots for cooling. The mini-project case, center, comes complete with mini-circuit board and a lid with flange mounts.



(C)

	Cat No.	*Size (inches)*	*Price*
Inst Case	H-2455	8 × 4 × 10	$17.95
Inst Case	H-2465	9 × 3 × 12	19.95
P S Case	H-2516	5.1 × 5.1 × 2.9	5.50
Vent Case	H-2504	7.9 × 5.7 × 2.9	6.95
Mini Case	H-2765	2.6 × 1.8 × 1.2	2.25

Available from Dick Smith Electronics, Inc, PO Box 8021, Redwood City, CA 94063, tel 415-368-8844. Send $1 postage and handling for the DSE catalog. The DSE catalog has 15 pages filled with hard-to-get information on pin connections for ICs, Zener diode data, circuit ideas, transistor interchangeability data and much more. —*Bruce O. Williams, WA6IVC*

Strays

I would like to get in touch with...

☐ anyone for exchanging information and circuits of gadgets (microelectrode preamplifiers, transducers, thermostats, impedance pneumographs and osmometers) for improving teaching of biological sciences. Carlos Peres da Costa, PY7CPC, Rua dos Navegantes 541, Apt 602, Boa Viagem PE 51021, Brazil.