WIRE-WRAPPING TECHNIQUES FOR COMPUTER HOBBYISTS

Modern techniques save assembly time for
*more complex electronic projects*

BY ADOLPH MANGIERI

TRADITIONALLY, electronics hobbyists and experimenters have relied on point-to-point wiring and printed circuits in assembling their projects. This was fine when projects were relatively simple and had few IC component counts. With the coming of home computers, however, traditional wiring methods left much to be desired.

Now, an A/D converter, an I/O port, or a complete microcomputer can be assembled without preparing artwork or etching a complex double-sided pc board. In addition, the circuit can be enlarged or revised with ease. Best of all, a soldering iron is never required. Particularly advantageous for computer projects where wiring flexibility is a must,

Wire Wrapping can be used with almost any type of electronic construction.

Propelled by the growing numbers of microcomputer enthusiasts, hobbyist Wire Wrapping has come into its own,

(A)

Standard Wrap

spawning a broad range of inexpensive tools and accessories. Owners of Altair 8800 and IMSAI 8080 microcomputers, for example, can obtain commercial Wire Wrap plug boards that are compatible with their bus systems. In addition, you can choose between or combine conventional tip-loaded wrapping, bare-wire bus strapping, and speedy insulated-wire bus strapping with a new multimode tool from Vector Electronic.
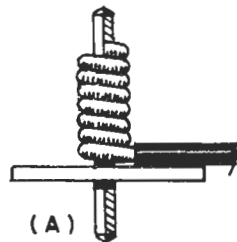
The Connection. A Wire Wrap connection consists of a minimum of six closely wound turns of wire applied under tension to a post with a special square cross section. The standard Wire Wrap connection is shown in drawing A.

The modified wrap shown in drawing B includes an additional half-turn or so of insulated wire. This wrap can be used when extreme mechanical vibrations might otherwise cause wire breakage. (The modified wrap also precludes short circuits to a ground plane.)

As shown in drawing C, the tip of the Wire Wrap tool includes a centrally located hole that accommodates the wrap post. An off-center hole, or "wire tunnel," accepts the end of the wire. As the tool is rotated, wire coming from the wire tunnel negotiates a sharp 90° bend that results in drag and tension on the wire. Under tension, the wire becomes firmly imbedded against the sharp edges of the post to form a gas-tight contact.

Bus strapping, shown in drawing D, permits rapid interconnection of many posts with a single unbroken length of wire, avoiding repeated insertion of the wire end into the tunnel. Conventionally, continuous bus strapping requires the use of bare wire, which imposes some wiring limitations.

Typical Wire Wrap tools, including power wrapper.
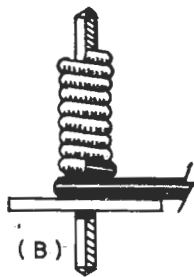
Modified Wrap

Wire Wrapping tools for conventional wrapping are available from Vector Electronic (12460 Gladstone Ave., Sylmar, CA 91342) and OK Machine and Tool Corp., (3455 Conner St., Bronx, NY 10475). Both companies also offer electrically powered automatic tools that greatly reduce operator fatigue and vastly speed up the wiring.

Slit-N-Wrap Tool. A new and rather unique tool, the Vector Electronic Model P180 "Slit-N-Wrap" tool, is a spool-fed insulated-wire bus strapping device that eliminates the need to cut wire and strip away insulation. This high-speed wrapping tool permits a bus to be strapped to the ground plane without the usual danger of causing short circuits.

A 100' (30.5-m) spool of No. 28 polyurethane-nylon insulated wire fastens to the top of the Slit-N-Wrap tool handle. The wire is then fed down through a hole in the body of the tool and exits through the wire tunnel. As the tool is rotated clockwise, a sharp slitting edge at the
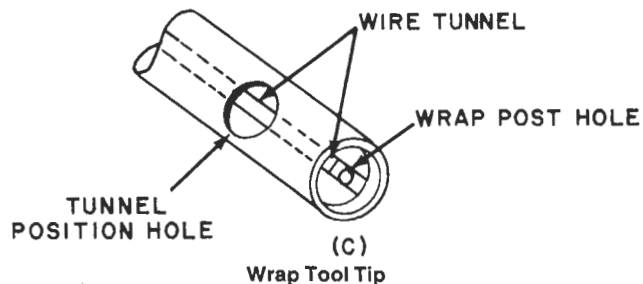
tool's tip splits the insulation on the wire lengthwise. As wiring proceeds, the tension on the wire and pressure at the contact points force the insulation aside to allow the wire to become firmly imbedded against the post. The tool provides at least 10,000 perfect wraps before replacement of the slitting tip becomes necessary. The tool itself is designed to be used on standard 0.025" (0.64-mm) square Wire Wrap posts.

You can "pencil wire" the solder-through insulated wire used with the Slit-N-Wrap tool around any size lug or terminal and solder directly through the insulation, which vaporizes when soldering heat is applied. The Slit-N-Wrap tool

Wrap Tool Tip

also conventionally wraps or straps No. 26 through No. 30 bare and Kynar-insulated wire.

The Slit-N-Wrap tool comes with two spools and the Model P138 chisel knife and wire-forming tool. Replacement spools of wire are available in different colored insulation.

Wrap-N-Strap Tools. For conven-

tional wrapping of bare and Kynar-insulated wire, the Vector Dual-Way Wrap-N-Strap tools operate in either direction. These are highly efficient tools, with slim handles that can be twirled rapidly between the fingers. The tip of the tool is cross-slotted and recessed to permit insertion of the wire ends without having to upend the tool.

The Model P160 Wrap-N-Strap tool wraps No. 26 through No. 30 wire onto 0.025" square wrap posts. The tool can be used for bus strapping by passing bare wire down through its hollow handle. Similar, but with the wire spool and bracket located atop the handle, the Vector Model P160-2A-1 wrap tool is

more convenient for strapping. With the spool-fed wire retracted, this tool is also used for tip-loaded wrapping of bare and insulated wire.

For unwrapping No. 26 through No. 30 wire, the Model P160-1A Dual-Way unwrap tool has a self-adjusting sleeve that contains the unravelled wire for easy removal from the wrap post. The Model P160-9 Wrap-N-Unwrap tool is

double-ended. It can wrap and unwrap wire but it cannot be used for strapping. Tools for wrapping No. 22 through No. 26 wire onto large 0.045" (1.14-mm) square posts and 0.031" × 0.062" (0.79 × 1.57 mm) posts include the Model P160-6 Wrap-N-Strap tool, the Model P160-6-1 Spool Wrap-N-Strap tool with top-mounted wire spool, and Model P160-7 unwrap tool. These dual-way tools have larger grips for greater torque to wrap heavier wire.
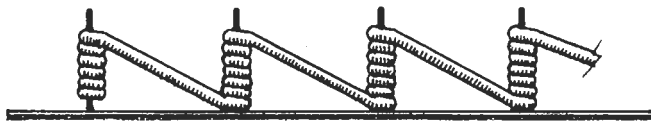
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Bus Strapping

Another good wrap/unwrap tool for standard 0.025" Wire Wrap posts is the Model WSU-30 from OK Machine and Tool Corp. Built into the side of this tool is a hardened-steel cutter that neatly and quickly removes Kynar insulation from the wrap wire.

With the extensive Wire Wrapped microcomputer system, powered wrapping, strapping, and unwrapping is advantageous. These tasks are performed almost instantaneously by The Vector Model P160-4R and the OK Model BW 630 cordless power wrapping tools. Both tools wrap in the clockwise direction. The Vector tool has a chuck that accepts the Models P160-2A wrap, P160-9 double-ended, and P180 Slit-N-Wrap tools. It can also be used for strapping when the Model P160-5 spool strapping adapter is used. The OK Model BW 630 power tool comes with wrapping bit and sleeve.

For powered unwrapping, the Model P160-4L cordless power tool from Vector rotates in the counterclockwise direction and accepts the bits of the Models P160-1A and P160-7 unwrap tools. Vector's Model P160-4T power tool kit consists of the Model P160-4R power driver and the Model P180 Slit-N-Wrap tool already installed.

Accessories. A variety of accessories and hardware that ease the task of the Wire Wrap user are available. Vector, for example, has a number of circuit boards, circuit card connectors, and wrap posts. Both Vector and OK offer a variety of dual-in-line (DIP) Wire Wrap sockets for IC's, numeric LED displays, and DIP switches.

The Vector No. 8800V universal microcomputer/processor plugboard is bus-compatible with the Altair 8800 and IMSAI 8080 microcomputers. The P-pattern, double-clad etched and drilled board provides separate ground and wiring planes that assure effective noise suppression. The board measures 10" × 5.3" (25.4 × 13.5 cm) and has 100 edge contacts, arranged 50 contacts to a side. This board accommodates two 40-pin, eight 24-pin, or 36 16- or 14-pin DIP IC's. It also has two finned heat sinks to accommodate voltage regula-tors. Mating sockets for this board include the Vector No. R681 solder-tail socket with Altair coding and the No. R681-1 wrap-post connector. The Vector No. 4350 logic and interface board that measures 9" × 7" (22.9 × 17.8 cm) can accommodate a medium-sized microcomputer on one or two boards; it provides 80 edge contacts, arranged 40 per side.

A single-clad, etched board that measures 8" × 4.5" (20.3 × 11.4 cm) can be used to assemble a microcomputer trainer with limited memory. For Wire Wrapping, the Vector No. 3677-7 ground-plane board has a continuous grid with copper etched back from the holes to form a relieved ground plane that clears the wrap posts. Power buses can be assembled topside on this board with Vector's No. T107 punched copper bus strips. To ground a wrap post, a self-gripping No. T112 bus link can be slipped onto the post before wrapping the wire; its tab is then soldered to the ground plane.

The Vector No. 3677-6 padboard has interdigitized power and ground bus arrays of oval pads that accept all DIP sockets for either Wire Wrapping or soldered wiring.

Wrap-post board pins can be pushed into P-pattern board holes with inexpensive pin-insertion tools For soldered installations of discrete components, the rugged and versatile Vector No. T49 Klipwrap post can be used, inserted with a No. P156 insertion tool. It has a stepped fork at one end, allowing temporary snap-in connections. The No. T44 Miniwrap pin, installed with a No. A13 insertion tool, has a small solder slot at one end and can be used for terminating diodes, transistors, etc. Soldered to a foil trace or crimped to insulated board, the No. K32 J pin has many uses.

Perhaps the most useful of the double-ended wrap posts is the Vector No. T46-3 pin, inserted with a No. P133B tool; it accommodates three or four wraps at each end. The No. T46-5 is a similar but slightly shorter wrap post. Fitted into edge contact pads of the No. 8800V board, the single-ended No. T46-4 pin affords two wrapping levels. Where one wrap level will suffice, the short single-ended No. T51 pin can be used to pass a circuit trace from one to the other side of a circuit board.

The No. R32 gold-plated socket pin from Vector can be used to assemble transistor and DIP IC sockets. When installing these or any of the other Vector wrap pins, the No. MB45-20-062 P-pat-

Vector 8800V Wire Wrap Board for 8080 microcomputers.
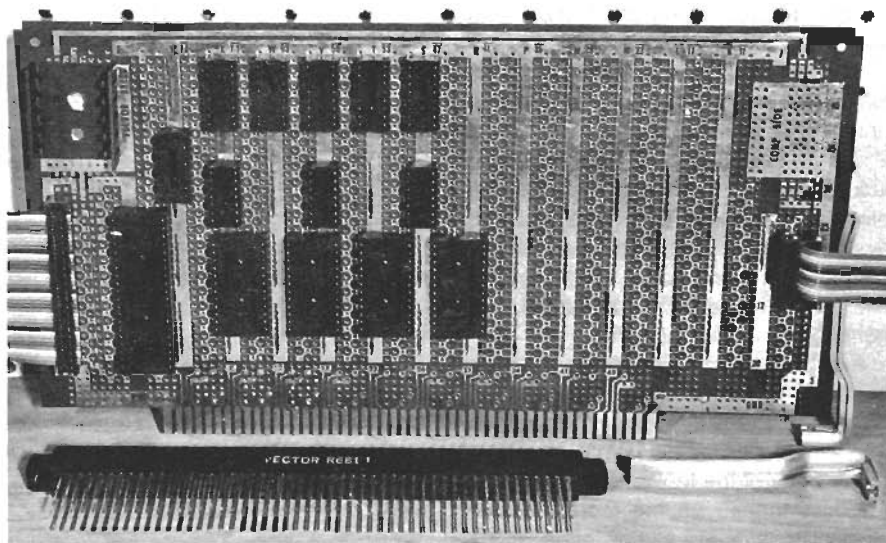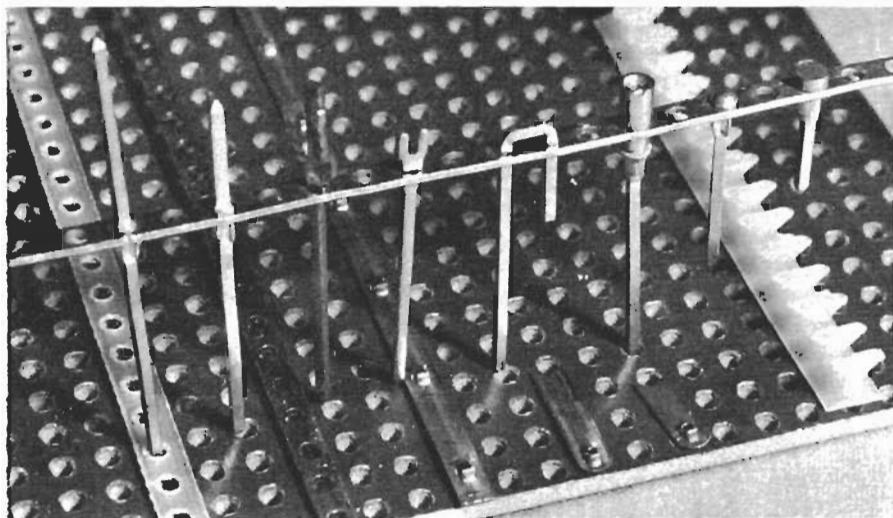
Assortment of terminal-pin hardware for Wire Wrapping.

tern perforated alignment block should be used to assure perpendicular alignment of the posts.

A handy item to have around when Wire Wrapping a project is the Model WD-30-B wire dispenser from OK. It holds a 100′ spool of wire that feeds out through a hole in the side of the case to any length required. Built into the dispenser are a wire cutter and an insulation stripper.

Working With Wire Wrap. Rapid bus strapping with the Slit-N-Wrap tool requires very little practice. First, pull out 1″ (2.54 cm) of wire, position the tool on the post, and hold the free end of the wire. Rotate the tool clockwise only and wrap seven or eight closely wound turns. You can keep track of the number of turns by counting the number of times the tunnel position marker passes a given point. Lift the tool off the post and form a loose strain relief loop by circling the post with the wrap tool. Form the wire down beside the post and hold it against the board with the plastic end of the No. P183 knife and forming tool.

With the wire tunnel marker up and the wire and tool in a nearly straight line, pull the tool to the next post and wrap as above. At the last post, add an extra turn and omit the strain relief loop. Either snip or break the wire by swinging the tool back and forth. Then use the chisel knife to cut off the excess wire at the first wrap post. To avoid snarling the wire, arrange your work so that you can complete the entire run without setting down the wrap tool.

Tip-loaded wrapping of Slit-N-Wrap wire with the Model P180 tool comes in handy at times. (You should use a heat sink when soldering a pencil-wired

Slit-N-Wrap connection.) The pencil-wired strain relief loop can be omitted, using simpler methods of strain relief, which preclude bending of wrap posts when installing a direct taut connection. As you wrap the first turn, observe the preceding wrap post for evidence of strain or pulling. If pulling is evident, reverse the direction of tool rotation part way once or twice as you slowly form the initial turn.

Another useful method is to position the wire tunnel marker to the far side of the post before anchoring and prior to wrapping the wire. Also, it is very useful to direct the wire tunnel marker and, hence, the direction of the wire as you prefer before lifting the strapping tool from the post. Wire coming off the posts at higher levels creates a "Sawtooth" effect than can interfere with other wiring. One way to avoid this problem is to pencil wire a spiralling turn down the post before removing the tool from the post and, similarly, to reach a higher wrap level on another post.

Conventional tip-loaded wrapping of bare and Kynar-insulated wire proceeds rapidly with the easy-to-load wrap tools. To wrap efficiently, roll the handle of the tool fully as far as you can between your thumb and fingers. When using insulated wire, strip away 1″ of the insulation, taking care to avoid wire nicks. (A special Wire Wrap insulation stripper here will obviate nicks.) Then run the wire insulation right up to or around the post to preclude short circuits. You can easily form the modified wrap with the insulated turn by inserting a bit of the insulated portion of the wire into the wire tunnel. Where it can be used, bare-wire strapping and wrapping saves time. Spool-fed strapping avoids wire snarls

and more readily permits pencil wiring of connections around any size terminal or lug. Do not forget: Pencil-wired connections *must* be soldered.

You will discover that wire size plays a part in Wire Wrapping. Commonly used No. 30 bare and insulated wire is readily available in economical bulk spools and in assorted lengths of precut and prestripped wire with a variety of insulation colors. The use of prestripped wire affords convenience, but the resulting slack wire can impair high-frequency circuit performance.

Easily wrapped and routed No. 30 wire has little or no tendency to place wrap posts under strain with the taut connection. However, the wire kinks or bends easily if you miss the wire tunnel when tip-loading the wrap tool.

Excellent for power and ground busing, No. 26 wire is much less easily formed and routed on the crowded Wire Wrapped board. The wire has a pronounced tendency to place posts under strain and requires strain relief with taut connections. As a compromise, No. 28 wire is easily tip-loaded and routed and easily strain relieved when required.

Powered wrapping with cordless power tools is ideal for large assembly projects. You will quickly develop proper timing of the motor to achieve efficient wrapping techniques. Very forceful in action, the power tool pulls the wire around the wrap post a half turn or so if you loosely anchor the wire. You can use this to your advantage to make the modified wrap connection.

At first, you may tend to under-wrap connections, leaving a flying end, when using a power tool. You can compensate for this by lifting the power tool partway to examine the wrap and then lowering the tool to complete the job.

With the heavier wire sizes, powered wrapping places even more strain and tension on wrap posts when installing a taut connection. One remedy is to leave some slack wire and pin the wire to the board before wrapping. Alternatively, you can manually advance the rotor one turn before starting the power tool.

In Conclusion. As you become familiar with the Wire Wrap approach to circuit assembly, you will discover that this scheme is much more efficient than the traditional approaches used in project wiring. With a little practice, you will soon master the proper tool-handling techniques to use to produce perfect Wire Wrapped joints every time. It may not be long before you retire your soldering iron for good. ◇