You Can Do This!

More About Constructing the Slider E100 Loopstick

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October 2008

Introduction The Slider antenna is an unusually effective AM loopstick based on an innovative but simple concept: maximize DX reception by *tuning the loopstick itself*, before the signal reaches the radio's front end. Developed by Ultralight experimenters to greatly improve the E100's wide-band sensitivity, the Slider loopstick has not only exceeded the original design objective, but has solved the general challenge of creating a loopstick with the maximum possible DX performance for its size. The Slider-equipped E100 greatly outperforms the stock unit on all frequencies, and has repeatedly proven its DXing effectiveness with weak-signal reception of Trans-Pacific stations throughout the AM band. As one of the major portable antenna breakthroughs in recent experimentation, the Slider provides the E100 owner with an inexpensive (under $30) but extremely effective performance boost, making his E100 competitive in sensitivity with any portable on the planet. *It is also one of the easiest radio modifications that any of us have ever seen.* It requires the DXer to open the back of the case of the E100 and make two simple solder connections on the circuit board immediately exposed. That is it!!!

The Challenge Although the stock E100 is an excellent AM DXing portable, it has one unfortunate weakness that seriously compromises its ability to receive weak low-band DX signals: a mediocre small loopstick antenna. Fortunately the E100's stock loopstick is not only easily removed, but has the simplest possible two-lead coil design, making its complete replacement one of the easiest ways for an E100 owner to radically improve the sensitivity of this otherwise impressive radio.

Like most digital Ultralight radios, the E100's front end also suffers from a tendency to drop off in sensitivity on either high or low band, even when an effective loopstick is transplanted directly into its circuitry and peaked at the standard 600 kHz alignment point. In the case of the E100, the 600 kHz peak alignment caused the new Amidon 7.5" loopstick's sensitivity to drop off rapidly on the high-band, while on the X-band it was little better than the tiny stock loopstick. While puzzling over this problem, an inspiration finally came: instead of securing the loopstick coil at the 600 kHz peak point (i.e. the standard alignment procedure), *why not slide the coil to peak every incoming DX signal from 530-1700 kHz while DXing in real time ?* A few quick tests were run on the upper part of the band using a moveable coil sliding directly on the ferrite bar: there was a huge difference in the E100's sensitivity!

The "Slider" was born, and has become the tool to boost the E100's sensitivity past that of any stock portable

We both constructed our Slider E100s simultaneously. John's is mounted on a thin plywood mounting board and base and uses 5/8" O.D. vinyl tubing for the coil form. Gary used his normal T-shaped mounting system that is more amenable to hand-held DXing, and used a coil form of weatherproof tape, wound mastic-side out. Electrically, our two Slider E100s are identical. In either case, there are only three simple operations to construct what is, *pound-for-pound, the best portable DX receiver on the planet*. First, you need to wind the sliding coil on its form on a new Amidon 7.5" x .5" ferrite rod loopstick. Secondly, you need to connect the antenna and coil to the E100 and test everything. Lastly, you need to construct a mounting system to secure the new Slider Loopstick to the radio. DXers who are used to working under the hood of modern electronics can just skim the rest of the article. But for those less used to modifying their rigs, we are going to take this project step-by-step: because *YOU CAN DO THIS!*

STEP ONE: Building the Slider Loopstick Itself This step is quite easy: it is simply the winding of a single coil on a movable form, which will slide along a ferrite bar to peak DX signals as they are received. Your first design choice is the material for the sliding coil form. Some care needs to be taken to choose a material which will not absorb moisture or in any other way interact with the magnetic lines of force at work here. Hobbyists have used a number of materials for Slider coil forms:

1. 5/8" thin walled vinyl tubing from the hardware store
2. A tube made from wrapping a rectangle of clear vinyl (from a sheet protector) loosely around the rod and securing with clear packing tape
3. A tube made from waterproof tape, wrapped around the ferrite rod mastic-side out with temporary cardboard spacers between the two to make the tube *slightly* larger than the rod
4. A tube of Styrofoam cup material wrapped and secured with clear packing tape

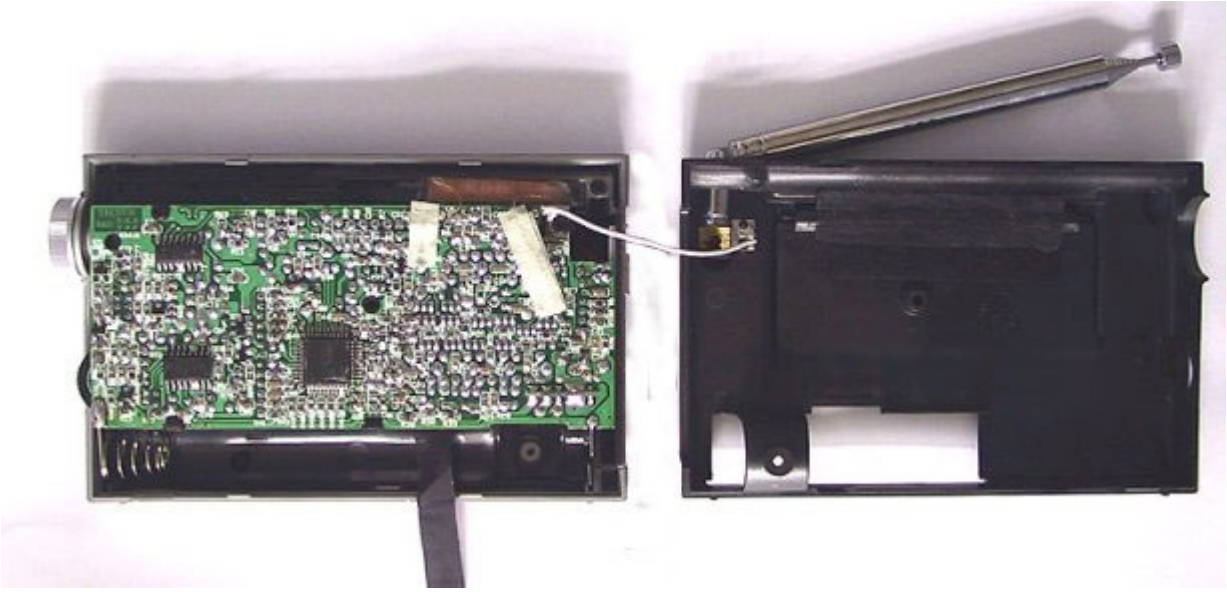
The point is to create a tube about 2" long that will slide *easily but not loosely* on the ferrite rod.

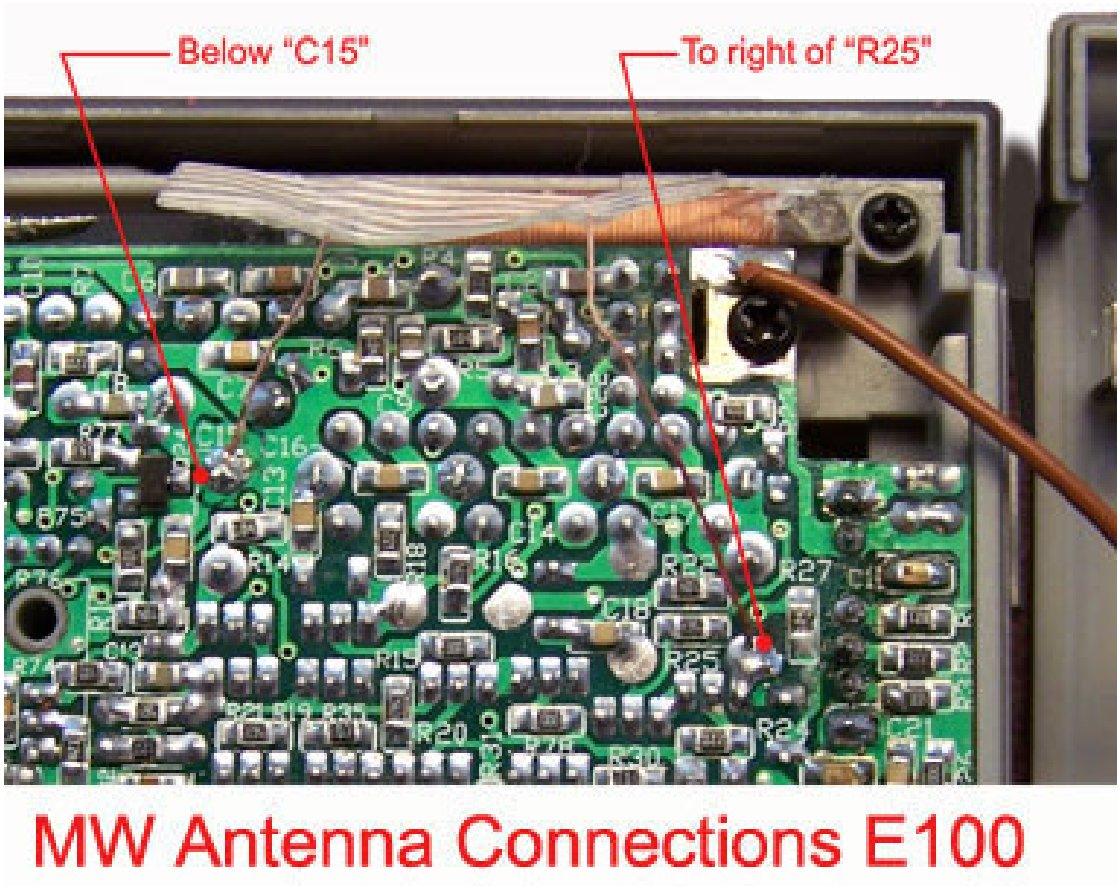
The second part of this step is winding the coil of special 40/44 Litz wire (refer to "Materials and Supplies" near the end of the article.) Litz wire is a very special cabled wire constructed from near microscopic insulated copper strands that was developed especially for this use. It is possible to construct a Slider coil with other thin wire. However, the RF sensitivity of your Slider E100 will not be nearly as great as that of a Litz-equipped Slider. Initially, you should wind your Slider coil to the full 63-turns. You may choose to remove a few of these coils during the testing phase later, but for now, 63 is your number. You should leave at least 4" pigtail wires on your completed coil…. and if you remove a few coils as you test later, even longer pigtails are OK at that stage.

So, now you take your Slider Coil form, place it on the ferrite bar and wind the coil. We generally work with small pieces of masking tape or even electricians tape to temporarily secure the coil form to the rod and also to pin the loose end of the Litz wire as we begin to wind the coil. Hobbyists using black vinyl tubing as a movable form will eventually need to apply adhesive to the coil turns to keep them in place (Superglue works well); this is unnecessary for the sticky waterproof tape, of course. On the other hand, users of waterproof tape will need to have a temporary cardboard form under the tape (with a very slippery surface facing the ferrite bar) that will be pulled out and discarded after the coil is wound. This ensures that a small space will exist between the waterproof tape form and the ferrite bar, to allow an easy sliding

With the Slider Coil wound and free to slide on its ferrite bar, its time to open up the E100 and proceed with Step 2.

STEP TWO: Attaching and Testing the New Slider Bar: To open the E100 for access to the circuit board, you place the E100 face down and simply remove two rear screws: one is in the very middle of the back, under the moveable radio stand; one is in the bottom of the battery compartment. The screw visible immediately beneath the whip antenna only holds it to the back and may b left in place, at least for now. You then gently lever the cabinet apart, *starting on the right-hand side.* Raise the right hand side, gently, to about a 30 degree angle until you feel the constraint of the wire connecting the circuit board to the whip antenna (the white wire below.) Now, free the left-hand side of the cabinet around the switches and volume control and then open the radio "like a book," as shown immediately below.

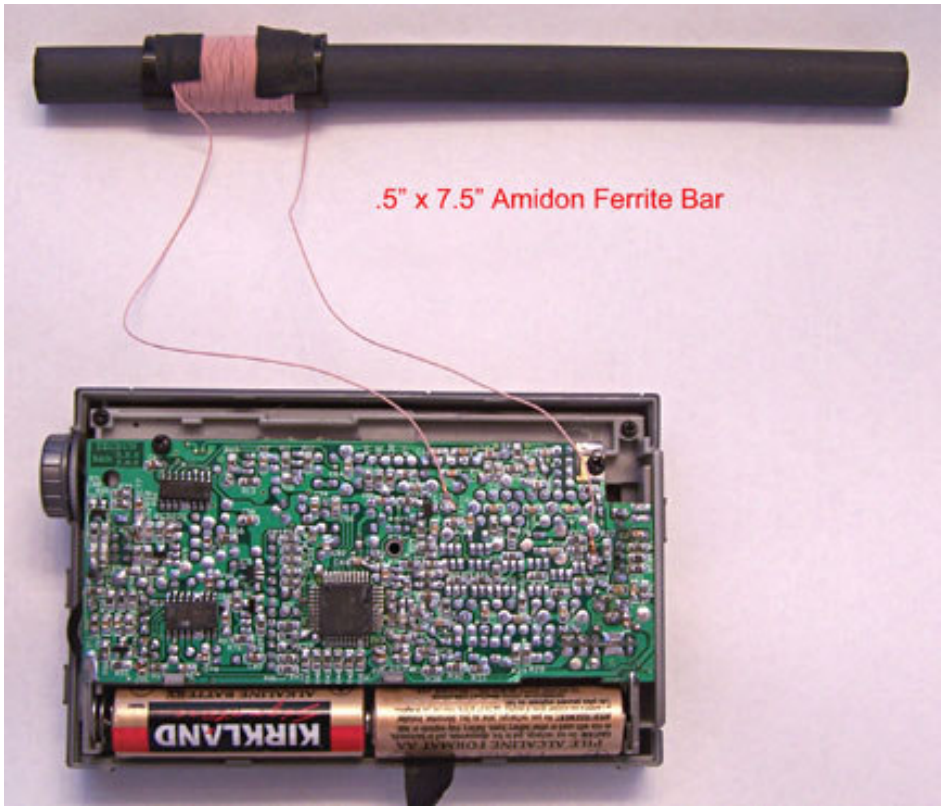




MW Antenna Connections E100

To install the new Slider, carefully note the position of the two connection leads for the existing loopstick. Using a small (30w or less) soldering iron with a fairly sharp point, remove the stock loopstick wires. The tiny stock loopstick can be easily removed from the case by scoring its glued borders with a small knife, and lifting it out. If you want the option of returning the E100 to stock condition later, you should save the little ferrite bar, of course. Providing adequate slack in the new connecting wires to your new Slider for the chosen mounting method, solder the two leads into the E100's back circuit board at the same locations observed previously (refer to the second picture on the previous page.)

There are several choices at this point. One choice is whether or not to retain the whip antenna for use on Shortwave and FM. Some of us believe in getting all of the ferrous metal away from the new Slider Bar. In that case, unscrew the whip antenna screw now and remove the antenna. Others of us have used a Slider with the whip in place and found that it worked fine. You choose. If you remove the whip, the remaining hole is the perfect place to bring the two Litz connecting wires out of the case. If you choose to leave the whip in place, you might enlarge the access hole previously occupied by the lanyard or cut a small slot in the edge of the back panel, to accommodate these wires.



Now, with the Slider Bar properly attached to the radio, it ought to appear about like the picture to the left, with the coil turns temporarily taped in place; it is time to test the peaking ability of your 63-turn Slider coil. First, though, you probably need to tape those batteries in place, since they tend to fall out when you turn the radio over to turn it on for testing. Now, flip radio over, fire it up and set it on a frequency near the bottom of the dial that contains a local station. Unless you have wound your coil too tightly, the Slider coil ought to slide fairly freely. Move it from the end toward the center of the bar. At some point, you should hit a real peak very near the end of the bar. Now do the same thing with the radio tuned to a local station near the top of the dial. You should hit a real peak for that end of the dial, too; this second peak should be just a little way farther toward the center of the bar.

If things work great and they should, you are ready make final decisions on the number of turns on the coil. The full 63 turn coil tends to have only small movement between the rather abrupt peaks at the high and low end. Taking a few turns off the coil tends to widen the amount of movement (up to ¾") between peaks at 540 and 1700 and create a bit gentler peak (though just as high.) The final number of turns is a matter of personal preference. In any case, for maximum performance, both peaks should occur in the outer 25% of the length of the bar. The lowest number of turns that we have found to work properly is 51.

After the final turns count of the coil has been determined, the coil will need to be permanently attached to the coil form, except in the instance of Gary's waterproof tape approach, where the outward-facing mastic holds the coil firmly in place. Some DXers use Superglue to fix the coil in place, others "airplane" glue and still others wrap the coil with a layer of clear packing tape. Each of these methods seems to work well.

STEP THREE: Creating the Final Support Structure There are probably about as many ways of connecting the Bar and the radio as there are DXers doing this modification. As examples we'll take you through two methods: the first is an all-plastic system, constructed by Gary, from parts of an inexpensive builders' level and tubing, the second by John is an all-plywood affair.

The Plastic Slider Frame: Fortunately, hobbyists can use a quick, easy and effective method of mounting the Slider loopstick, provided they are willing to create a small plastic frame glued to the top of the front section of the E100 cabinet.. A 48" plastic level (such as the orange-colored model offered by Ace hardware for $10) offers sufficient material for two standard one-post mounting frames (see photos), plus two more with two posts. These plastic levels typically have a very smooth and flat lower surface, which is ideal for making a strong glue bond with the "rubberized finish" on the top front section of the E100 cabinet.

Use a hacksaw to cut the top flat section (without the measuring scale) to a length of 8", with the single post centered in the cutout. Cut the bottom flat section (with the measuring scale, that will be glued to the top of the E100's front cabinet section) to a length of 4 3/8", with the post centered in the middle. If a mounting post for an external antenna BNC connector is desired, cut the bottom flat section to a length of 6", with the post centered 2 ¼" from the left side. This will leave an extension of 1 5/8" past the right side of the E100's top surface, suitable for attaching a BNC connector. Trim away the back flat section of the plastic frame's bottom surface with a hacksaw, to provide space for the E100's whip antenna (see photo). Completely sand all cut surfaces with 150 grit sandpaper, to smooth the edges.

Thoroughly clean the bottom flat surface of the plastic frame and the top surface of the E100's front cabinet section with water and soap as necessary, to provide clean, flat mating surfaces for a strong glue bond. Rinse off all soap, and let both surfaces dry completely. Apply epoxy cement or Superglue to the flat top surface of the E100's front cabinet section ONLY, and attach the plastic frame's bottom flat surface flush with the E100's front cabinet edge (see photo). Hold both surfaces securely together for several minutes, to provide an extremely strong glue bond. Set the assembly aside, to allow time for strong bonding. The plastic frame provides an ideal curved slot for the rubber air hose shock mounts to protect the loopstick, as well as providing plastic bumpers to protect the ends of the loopstick. As a completely waterproof and insulated system, the plastic frame allows the Slider loopstick to perform with top sensitivity and nulling ability, and should last indefinitely. Attach the Slider loopstick to the plastic frame with two 1 ½" lengths of ½" inner-diameter rubber air hose shock mounts (see photo), secured by large plastic tie wraps.

Gary's design was initially intended for hand-held use. However, it works quite well as a desk unit and may be placed either on a plastic turntable or one of those nice plastic stands for portable radios that are sold by Universal Radio and others.

The Plywood Slider Mount: If you are used to doing even minor wood working, it is also easy to create a plywood mounting board and removable base like that shown above. This approach was first conceived largely as a desktop unit. However, lifted out of the base, the mounting board fits handily on a plastic turntable or may be hand-held. The mounting board, in this case, is fabricated from ¼" "Baltic Birch" plywood and measures 9" x 9" as does the ¾" thick Baltic Birch base. The two boards are not permanently connected, but simply fit together with the ¼" mounting board slipping into a 3/8" x1/2" deep rabbet (groove) cut in the base. The Slider rod is secured to the mounting board with cable ties and the rod (in these photos) is supported about 1/8" above the mounting board with a double layer of the 5/8" tubing used for the coil form. PLEASE NOTE: Tests by Steve Ratzlaff have recently shown that overall sensitivity will be maximized in this design by blocking the ferrite bar up above the board so that there is at least 3/8" clear between the Slider coil and the mounting board. Photos of the most recent version of this Slider design will be posted on dxer.ca by the end of October 2008.

The E100 is attached to the mounting board with patches of Velcro and sits on a ¾" plywood block that is permanently attached to the board. Naturally, the mounting board could be fabricated from masonite or sheet plastic, or possibly other non-metallic sheet materials. In the case of plywood or fiberboard, however, the mounting board should be sealed with a couple of coats of polyurethane to prevent the absorption of moisture.

Materials and Supplies: For maximum sensitivity in the new Slider loopstick, it is really important to use frequency-optimized Litz wire which is readily available. Believe us, we have tried it both ways; the Litz wire gives a noticeable increase in sensitivity over thin normal copper hook-up wire. Litz wire of the optimum 40/44 type may be obtained from Dave Schmarder at thefiercerabbit@1n34a.com; Dave will sell small amounts of wire to individuals. For one slider you need 12 feet of 40/44 wire. Dave prefers an email at the above address stating the type of wire and quantity desired, after which he will quote the material and shipping cost. The 7.5" x .5" frequency-optimized ferrite bars are available from the Amidon Corporation and are *by far the best* that we have found. The best of the Amidon bars for our use is the **Type 61, 7.5" x .5"** bar (part # R61-050-750) at $20 plus shipping. (https://www.amidoncorp.com/items/10)

Even larger ferrite bars are available from the Stormwise Company, which sells 1" diameter plastic-coated ferrite rods from 4.5" long all the way up to 27" long. Both Guy and John have constructed Slider loopsticks with these monster bars, and their work will be soon be documented in a dxer.ca article.

THE SLIDER IN ACTION: Although the two of us originally developed the Slider E100 to hunt for Trans-Pacific MW DX signals from the Pacific Northwest, in our opinion the Slider is equally useful as a domestic DX tool anywhere and is of special usefulness to those in situations where directional outdoor antennas are not possible. Tune in any DX signal from 530-1700 kHz, and simply slide the coil to peak the signal--simplicity itself! The Slider loopstick's function is similar to a preselector, providing a huge frequency-optimized boost in sensitivity wherever the coil is peaked. The E100 with its substandard low-band sensitivity is suddenly transformed into an ultra-sensitive DXing tiger, with wideband AM weak-signal performance at legendary levels.

A 7.5" x ..5" Amidon ferrite-bar based Slider loopstick was used in combination with a Murata CFJ455K5 IF filter for astonishing E100 receptions throughout the summer DU season at Grayland, Washington. Prior to the development of the Slider loopstick, no stand-alone portable had ever been successful in solidly receiving any DU's (South Pacific DX stations) at Grayland. The twin challenges of relatively weak DU signals and in-line domestic QRM created a very tough task for portables. The E100's stock loopstick was clearly inadequate. Serious experimental breakthroughs were required. Fortunately, the Slider loopstick provided the major sensitivity boost needed for competitive DU reception on the E100's, and Guy Atkins' Murata IF filter modification provided the major selectivity boost. The cumulative effect of extreme sensitivity and extreme selectivity creates a true portable DXing sensation, for the ultimate in very compact AM-DX performance. The "full package" modified E100 immediately made a huge difference in South Pacific DXing at Grayland, finishing the summer season with five Australian stations, three from New Zealand, plus Tonga-1017, Fiji-639 and two Hawaiians. This same fully modified E100 has continued its astonishing performance at the very modest DXing location of Puyallup, Washington, adding multiple TP's for a current season total of 49 stations from Asia and the South Pacific. The innovative Slider loopstick is the sensitivity "engine" that makes it all possible, and is the perfect overachieving antenna for the most DX-capable Ultralight!

We both wonder at the cost-effectiveness of the Murata filter modification for use in domestic DXing, where the E100's already relatively good sensitivity may be sufficient. Certainly of the two modifications, for domestic DXing, you should do the Slider first.

ADDING A PICK-UP COIL FOR AN EXTERNAL ANTENNA

We have really been surprised at the effectiveness an external antenna port to the E100 with the Slider modification. It is very simple and inexpensive to add this capability to your Slider E100 and really rewarding if you have access to good external antennas at home or on DXpeditions. Essentially, you add a pick-up coil (we use 4 or 5 turns of 28 or 30 ga. Kynar wire wrap wire from Radio Shack) and connect that in some fashion to the coaxial lead-in from the external antenna. You do not need to be concerned about impedance mismatches in this situation.

Steve Ratzlaff and John have both noticed that using the Slider Coil and Bar to tune the relationship between the radio and the external antennas really improves the performance of the E100 with the strong RF from outside antennas. Steve has also found that the Slider coil can tune out unwanted IMD and image reception from external antennas. There is no noticeable loss of stand-alone performance of the Slider E100 with this pick-up coil attached.

The photo below shows the external pick-up coil in place and a miniature connector between the coil leads and the coax. It is also possible to connect the leads directly to the coax of a patch cord.