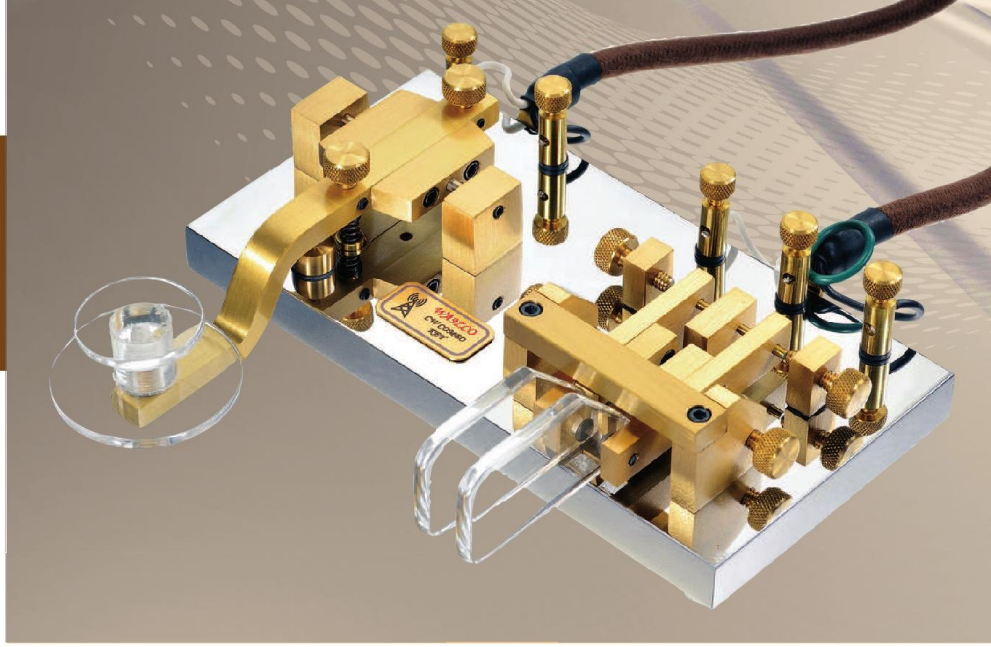
Fabricate this dual-key design in your home workshop.



CW Combo Key

Marc Alan Winzenried, WA9ZCO

This Combo Key (dual-key) design is suitable for operating transceivers like the Icom IC-7610, with a straight key plugged into the rear key port and a paddle plugged into the front port, allowing on-the-fly operation of both keys without the need for transceiver reconfiguration (see the lead image). The design is compact, and maximizes key stability in a small size.

The key features dual-key functionality, compact size, and heavy base weight for operational stability. It has single-hand adjustments without the need to adjust locking nuts, has minimal adjustment backlash, and adjustable tension holding. Only a summary and safety precautions appear here. Detailed construction information, mechanical drawings, a materials list, and additional images can be found on the **www.arrl.org/QST-in-Depth** web page, as can the design drawings and *Design CAD* files.

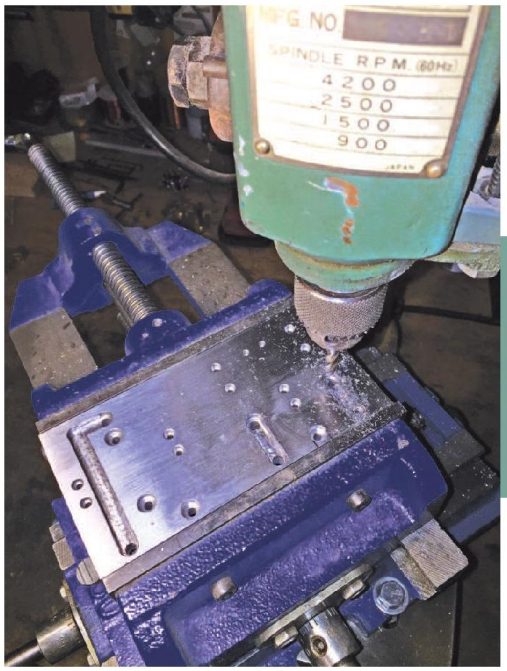


Figure 1 — A drill press used as a milling fixture.

Although there is some milling used for fabrication of some components, I did not use a milling machine.

Tools

You will need a multispeed drill press (see Figure 1, shown milling the base), a belt sander with a fixed stand, and a right angle grinder with thin ferrous metal cutting disk. You will also need an X/Y table with a vise (**www.harborfreight.com**), and a table saw with an aluminum metal cutting blade.

Also needed are a small hobby metal chop saw, a Dremel tool with metal cutting discs, a router with wood-type router bits, and a small hydraulic jack — shown in use bending the key arm in Figure 2. A half-inch variable speed drill, wire gauge drill set, modified wire gauge drills for brass cutting, a quarter-inch ferrous metal end mill, and a quarter-inch non-ferrous metal end mill are also useful.

Key Design

I designed components using a very early version of *Design CAD*, starting with the functional components first and then the mounting components. I then fabricated parts. I first assembled the key on the unfinished steel base to check the design concept, and then disassembled it for final finishing. Although there is some milling used for fabrication of some components, I did not use a milling machine. To stay with the concept of using commonly available and affordable tools, I mounted an X/Y table vise to the base of the drill press and installed a quarter-inch end mill in the drill press chuck (see Figure 1).

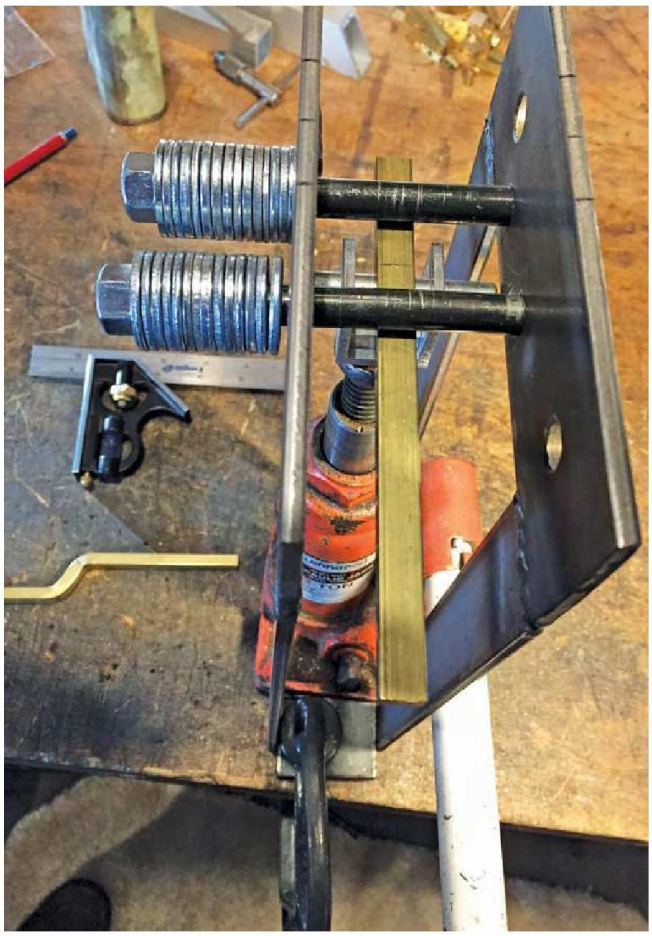


Figure 2 — A hydraulic jack mounted in a fixture for armature bending.

Steel Material Fabrication

Cut the steel key base using a right angle grinder with a thin metal cutting disk. Follow all safety precautions, including safety glasses, hearing protection, heavy clothing, and appropriate gloves. Cutting steel with a grinder and a cutting disk produces sparks that can ignite combustible materials, so do this process in a safe area, free of all combustibles. Use a belt sander mounted in a rigid stand, and a heavy-duty metal cutting belt in the sizing and prepolishing steps. The threaded holes were hand tapped using a tap with the appropriate lubrication cutting fluid.

Brass Material Fabrication

I cut all of the brass components on a table saw with an aluminum-cutting blade installed. I used a 7½-inch Milwaukee aluminum cutting blade, as shown in Figure 3, but other non-ferrous metal cutting blades are available. Cutting brass at the slowest speed possible did not produce any sparks.

Figure 3 — A brass sawing table with an aluminum saw blade at right.

Figure 4 — A rough sanding fixture.

I used a double-fluted end mill intended for aluminum, but it works well on brass. Drilling brass is different than drilling steel, so I used modified drill bits specific to brass drilling.

Finish the brass components using the belt sander (see Figure 4) and a hand-sanding block. Hand tap the threaded holes using standard taps with the appropriate tap lubrication cutting fluid. I made a tap alignment block from a small scrap block of brass with the appropriate tap clearance hole drilled.

Plastic Material Fabrication

I cut most of the acrylic plastic parts using the table saw with an aluminum cutting blade. Cut circular parts using hole saws with a wood guide block. Cut the paddle handles using the table saw, and the front radius corners using a table-mounted wood router and a wood radius cutter bit with a bearing guide. Radius-cut the edges of the paddle handles using a 1/16-inch wood radius cutting bit that also has a bearing guide.

Sand all plastic edges in steps using sanding paper from 180 grit to 3,000 grit. Once you've finished sanding the edges of the plastic, polish the edges using the Novus #2 and 3 plastic scratch remover products. Holes drilled in the plastic are best done using the brass modified drill bits. Thread the holes with a hand tap without using any cutting fluid. Align the tap using an alignment block.

Combo Key Base Fabrication

Cut the base from a 12 × ½ × 3 inch rectangular cold rolled steel bar stock using a right angle grinder with a metal cutoff wheel. Sand and pre-polish the cut base to the finished size using the belt sander mounted in a fixed stand. Mark and drill all holes using a standard drill press. Counter-sink all socket head screws on the base bottom side to recess the screw heads (see Figure 1). Mill the conductor slots on the key base bottom side using the tooling, as described on the *QST* in Depth page.

Assemble the complete key and test for operation. Once the key is fully operational, disassemble the base and have it chrome plated by a local plating shop. Then re-assemble the key and add the four self-adhesive rubber pads to the base bottom corners.

Straight Key Fabrication and Assembly

For the bending process, I built a jig from steel straps to hold a small common hydraulic jack (see Figure 2). My jig was welded, but the jig can be fabricated without a welder. Use safety glasses during the bending process. I used a full-scale print of the armature as a template to confirm the correct bends of the armature. The armature could be inserted in the jig backwards to correct an over-bent armature. Roughly sand the armature sides with a belt sander to remove the side bend-outs so the armature can sit square for drilling the holes for the tension screws, axle, and side supports. Trim the armature to the finished length using the table saw. Details of the straight key assembly are on the *QST* in Depth page.

Once the key is fully operational, disassemble the base and have it chrome plated by a local plating shop.

Paddle Key Fabrication and Assembly

The paddle armatures are an assembly of four parts that include the main support, axle support, axle, and the contact pin. Cut the two main paddle armatures from 3/16 × 3/8 inch brass bar stock using the table saw, and roughly sand using the fix-mounted belt sander. Both left and right main paddle armatures are symmetrically identical, so the same operations apply to both pieces. Again, specific detailed instructions are on the *QST* in Depth web page.

Cut two axle supports from brass bar stock, and roughly sand. Both left and right axle supports are symmetrically identical. Cut two brass contact rods from round brass rod stock. Cut the armature axle to length from a stainless-steel standard stock rod using a Dremel-mounted metal cut-off disk, and polish each end using the drill press.

Cut two base side supports from brass bar stock. Both base side supports are symmetrically identical, so the same operations apply to both pieces. Mill the top bearing support bar notches and the back angle using the X/Y table vise on the drill press.

Cut two base contact supports from brass bar stock using the table saw and roughly sand. Both base contact supports are symmetrically identical. Cut the main support center stop from brass bar stock and roughly sand.

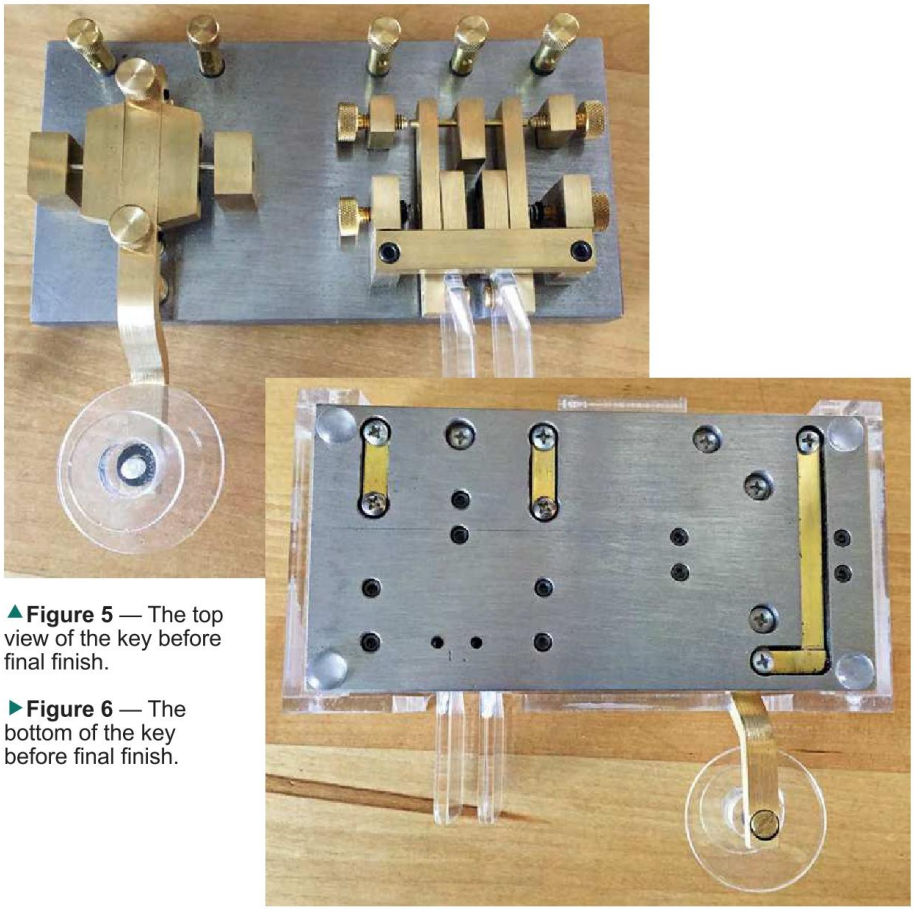
Cut the upper bearing support bar from brass bar stock, and roughly sand. Cut three brass terminal posts from a standard round tube brass stock. Cut two brass contact rods from round brass rod stock. Drill one end of each piece with a small dimple using a drill-centering jig. Fill the dimple hole with rosin flux, and silver solder the end. Place the part in the drill press chuck for finish sizing and polishing. Install the completed contacts in the end of the two paddle armatures and hold in place with locking setscrews.

Fabricate the two contact strips from the brass strips that were cut using the hobby metal chop saw. Radius grind both ends, remove burrs using the belt sander, and drill clearance holes in each end. Cover the non-contact part of the strip with heat insulating tape.

Install the three terminal brass thumbscrews. Modify the two spring adjustment thumbscrews to accommodate shoulder washers used to center the spring. The two nuts on each thumbscrew are locked to each other exposing 1/16 inch of the thread. Insert this into a portable drill chuck, and turn while filing until the shoulder washer fits to the end of the thumbscrew. Remove the nuts on the thumbscrew, and realign the thumbscrew threads after filing.

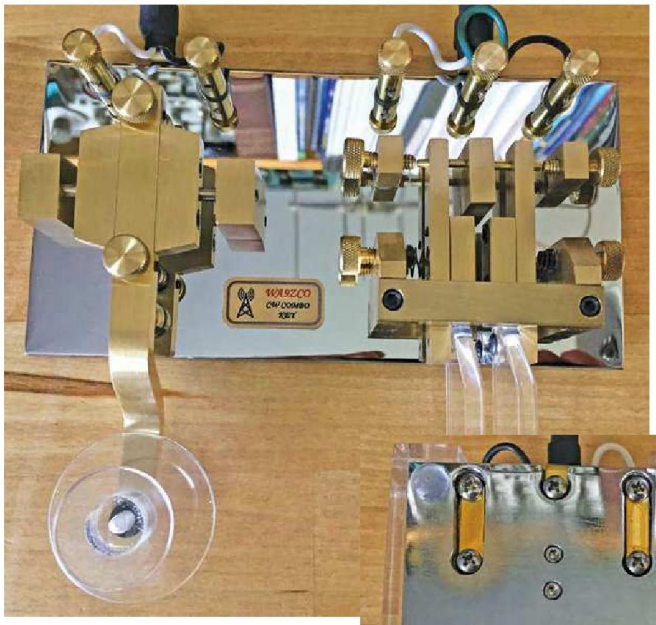
Paddle Key Assembly

Both paddle armature assemblies are symmetrically identical with the exception of the axle orientation, which is adjusted after installation. Mount the axle supports to the main paddle armature supports using two socket head steel screws in each axle support. Do not tighten yet. Clamp the assembly in a vise with pads, and tighten the socket head screws. Drill the

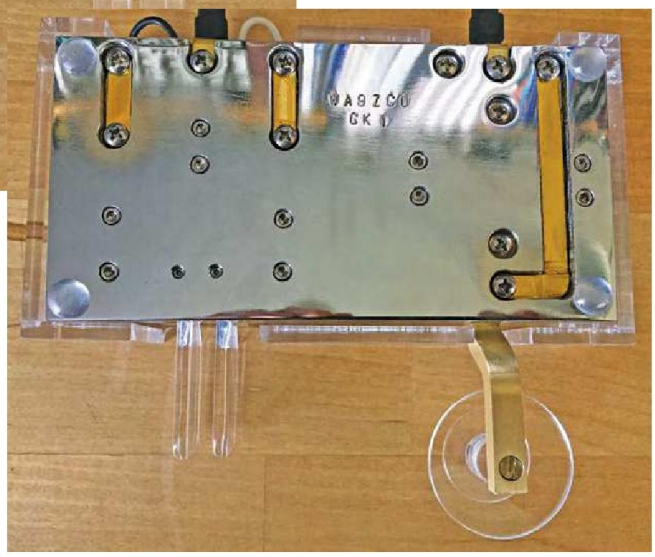


▲ **Figure 5** — The top view of the key before final finish.

▶ **Figure 6** — The bottom of the key before final finish.



◀ **Figure 7** — The top view of the key after final finish.



▼ **Figure 8** — The bottom of the key after final finish.

I cut most of the acrylic plastic parts using the table saw with an aluminum cutting blade.

spring blind hole in the axle supports using the main paddle armature spring clearance hole as a guide. This assures the axle support block spring blind hole is aligned with the main paddle armature spring clearance hole. Install the axles, and install and lightly tighten the locking setscrew. Setscrews will be fully tightened once the armature assembly height adjustments are completed. Install the contacts with the silver soldered end facing the same direction as the spring open hole. Install and lightly tighten the contact locking setscrew. Fully tighten the setscrews once the armature assembly horizontal position adjustments are completed.

Install the spring adjustment thumbscrew in each of the base side supports. Cut two 1⁄16-inch nylon pieces from 1⁄16-inch weed cutter line, and insert each piece in the rear tapped hole of each side support tension adjustment hole. Install two tension adjustment setscrews in the rear of each side support tension adjustment hole, and adjust for best tension control.

The assembled side supports are installed on the base using four socket head screws. These screws are not tightened until final assembly.

Install the assembled contact supports on the base. Install a thumbscrew in each of the three terminal posts. Install 1⁄16-inch nylon and setscrews in both contact supports like in the side supports. Install the other two non-grounded terminal posts. Align the terminal wire holes and tighten the screws. Align the base contact supports and tighten the screws. Install the base center stop support on the base using socket head screws and tighten.

Install two setscrews on the base from the bottom. These are used for adjusting the paddle axle vertical play. Insert a single roller bearing in each of the axle base top holes. Install the shoulder washer on each spring adjust thumbscrew. Insert a single roller bearing in each of the axle upper bearing support bar blind holes. Insert the springs in the paddle's

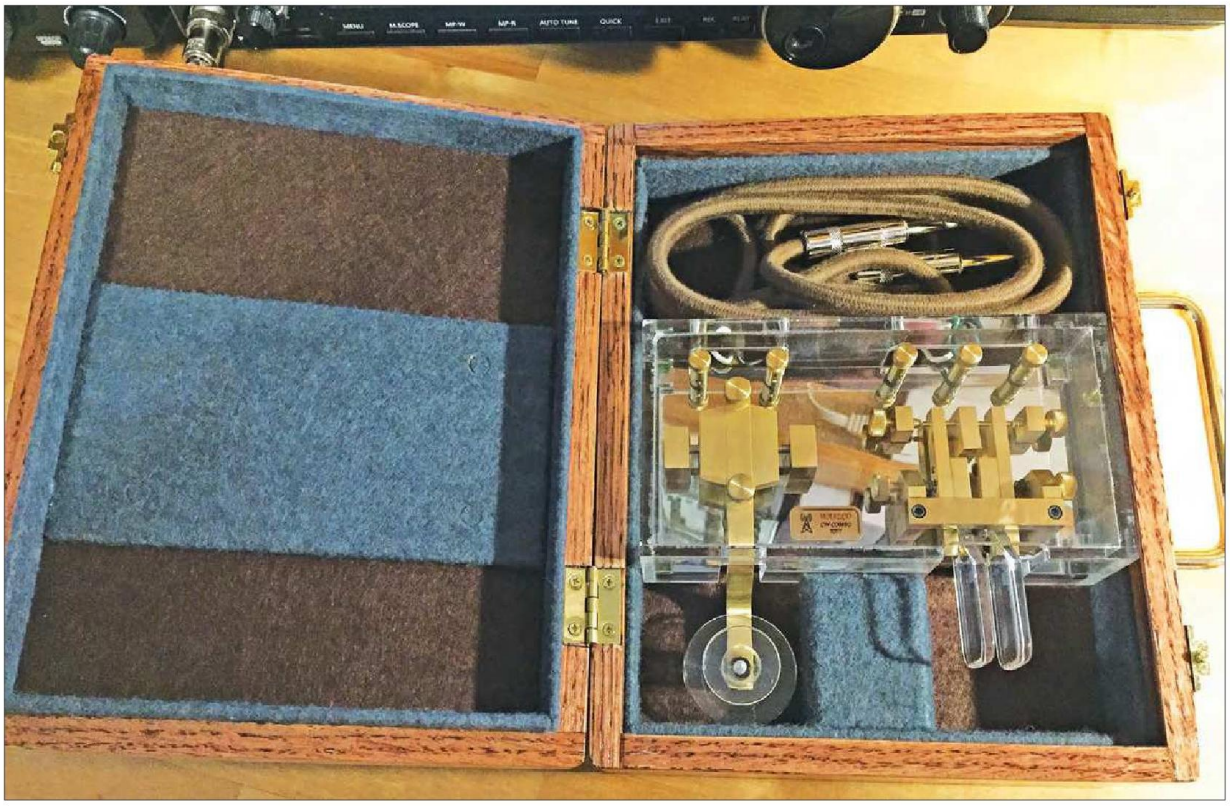


Figure 9 — The Combo Key in its wooden box.

main armature assemblies and install the assemblies with the lower axle inserted into the base axle holes and the spring aligned into the thumbscrew shoulder washers.

Install the upper bearing bar with the two socket head screws and tighten. Tighten the four side support socket head screws. Adjust the lower paddle free play with the axle setscrews located under the base. Once adjusted, install another setscrew on the underside of the base to lock the free play adjustment setscrew. Adjust the paddle's main assembly for alignment to the contact thumbscrews by the axle-locking setscrew. This adjustment requires removal of the upper bearing support bar and removal of the paddle assembly. The paddle assembly contact rods are adjusted to provide best alignment of the front paddles.

Testing and Finishing

Figure 5 shows a top view of the unfinished key, and Figure 6 shows a bottom view. Adjust and test both the straight key and the paddle key to confirm operation. Then disassemble the keys so all parts can receive final finishing. Final finishing includes hand sanding and clear coating of all brass components.

After final finishing, re-assemble and re-adjust the keys. Figure 7 shows the top, and Figure 8 shows the bottom of the finished and polished Combo Key. I also fabricated a wooden case to store the Combo Key (see Figure 9).

Marc Alan Winzenried, WA9ZCO, was first licensed in 1968 and now holds an Amateur Advanced-class license. He retired from a career in industrial machine control design, writing control system software and managing projects. Marc graduated with an associate's degree in electronics. He has designed and home-built most of his equipment, including QRP transceivers, panels, antennas, Arduino projects, and solar systems. A recent project includes an NEC-compliant amateur radio station off-grid solar backup power system. You can reach Marc at **wa9zco@bayland.net**.

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Feedback

■ The article "Comparing Mobile/Portable Antennas of 20 Meters" by Ulrich Rohde, N1UL, published in the January 2020 *QST* contained a few typographical errors. The company name should be spelled Rohde & Schwarz in the caption of the lead image; the call sign mentioned on page 41 should be S51DX, and the author's email address should have been listed as **dr.ulrich.l.rohde@gmail.com**.