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If you're active on 160 meters, there's a good chance you've worked Mark, ON4WW, in Belgium. One of his station's biggest assets is his array of Beverage receiving antennas. But switching between those antennas was slow and inefficient, until ON5UK came up with a higher tech solution.

The ON4WW Ultimate Beverage Switchbox

BY LUC SMET,* ON5UK

In past years, I have had the opportunity to participate in several low-band contests from different well-known Belgian contest stations. The excellent results yielded by those stations on the low bands are closely related to the use of extensive receive-antenna systems. You can't work them if you can't hear them. Mark Demeuleneere, ON4WW, uses eight Beverage antennas, one every 45 degrees, which is adequate, if not perfect, for contesting purposes. The only catch in his setup was the switching part. How can you move instantly from any one heading to another without having to rotate through all interlaying headings? This question led to the development of a new switching unit, and the details follow.

The Initial Switchbox

Until recently, the switching from one Beverage heading to another was done with an 8-position rotary switch. Not only

is this a way of switching that is physically fatiguing when done over a long contesting period, it is also inefficient. To switch from east to west, three intermediate positions have to be passed, which means switching four times. Valuable time can also be lost when trying to find the correct heading for an unknown weak station.

Fig. 1 shows the schematic of the old switchbox. The rotary switch (two layers, eight positions) switches two relays—REL1 and REL2 (outside relays on the Beverage field)—through a diode matrix, and also switches the polarity of the voltage (positive, negative, or none) that is fed through the inner conductor of the coaxial cable, which also transports the received radio signal. The combination of the position of REL1, REL2, and the voltage on the inner conductor of the coax allows you to select one of the eight Beverages through circuits A, B and C (which are also physically outside on the Beverage field).

The table in this article provides an overview of the combinations of the voltages controlling the relays, the voltage on the inner conductor of the coax, and the resulting heading of the Beverage antenna.

The New Switching System: Version 1

The objectives of the new system were clear:

- One push on a button would effectively select any of eight Beverages.
- The existing outside switching arrangement should stay as is.
- When a defect occurs at the new switching system, the old rotary switch must be able to be put back in action instantaneously.
- The operational characteristics of the new circuitry must be able to be altered in a simple way.

The new switching circuitry is built around a 16F877A. This PIC (Programmable IC) offers an advantage: You don't have to take it out of the circuit in order to reprogram it. The choice of antenna heading is made through selection of any of eight pushbutton switches.

With two additional pushbutton switches, you can rotate clockwise or counter-clockwise through all headings. This comes in handy when trying to figure out from which heading a weak signal is coming in. Photo A shows the new switchbox. The schematic is shown in fig. 2.

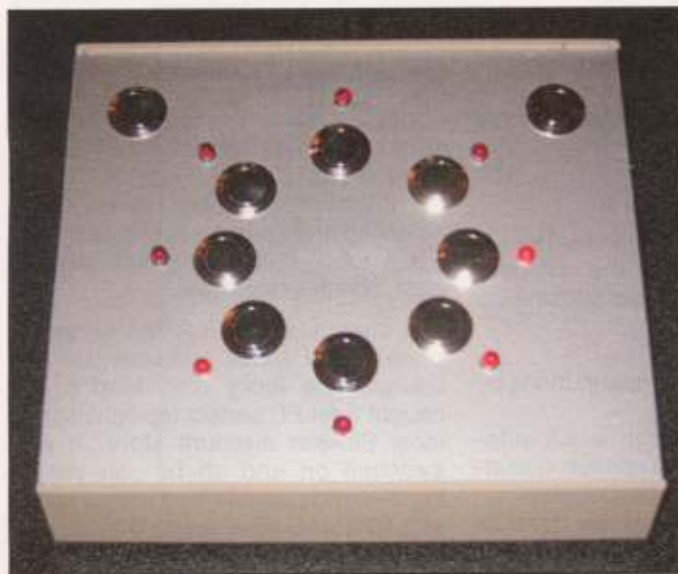


Photo A— The new pushbutton switchbox.

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A version of this article in Dutch and French was published in the July/August 2011 issue of CQ-QSO, the magazine of UBA, the Belgian national amateur radio association. This English version is published by permission.

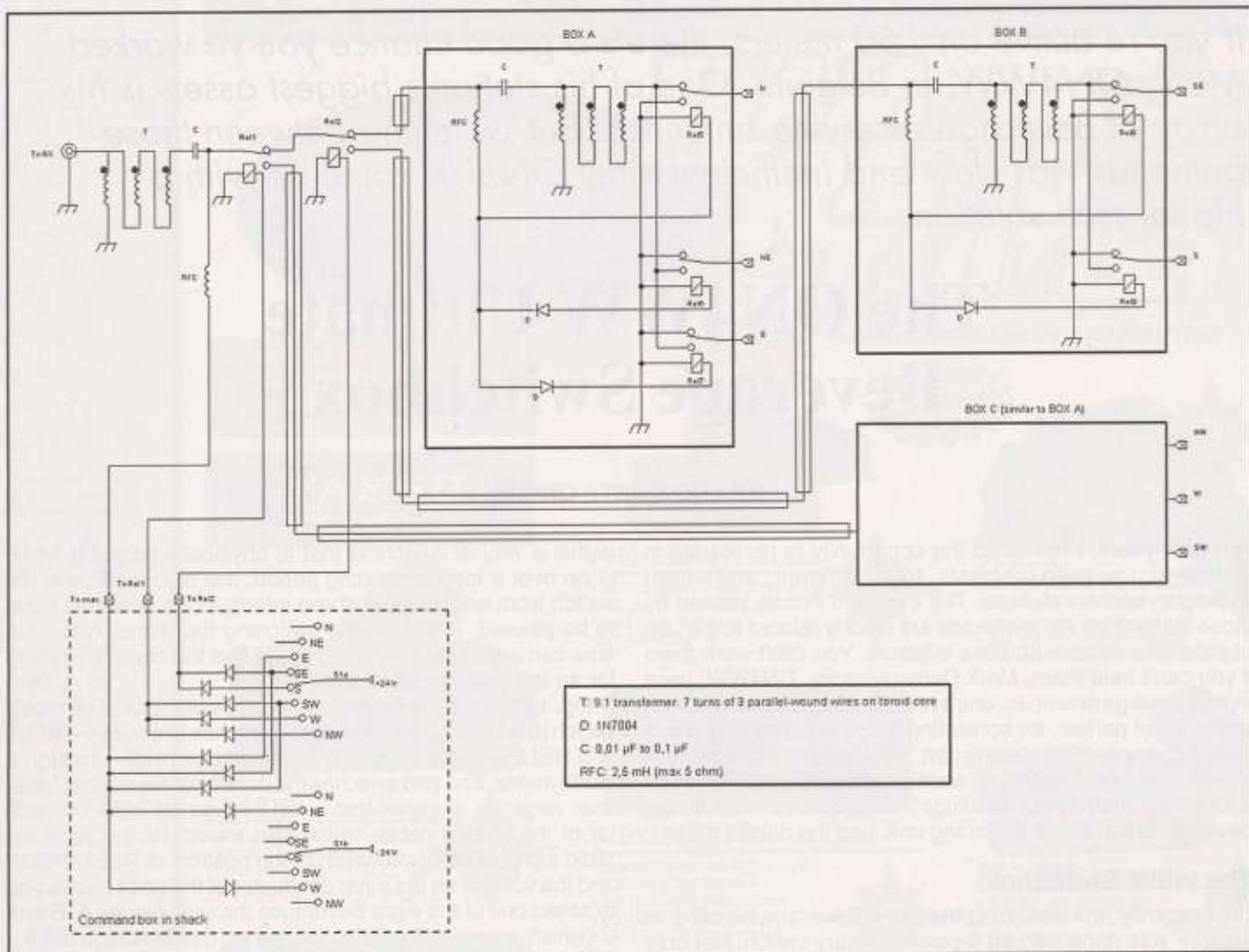


Fig. 1— Through relays REL1, REL2, and the voltage on the center conductor of the coax, we select the correct Beverage antenna through the circuits A, B, and C.

The new switching unit was connected to the existing rotary switchbox. Some minor adjustments were inevitable. The existing arrangement is expanded with switch S2 (2 positions, 3 circuits) and relays REL3 and REL4. S2 gives the option of using the old rotary switch or the new system with pushbuttons. Relays REL3 and REL4 provide the choice of voltage polarity on the coax, within the new switching system. See fig. 3 for the altered schematic of the existing switchbox.

The operation of the PIC program is simple. The state of the inputs of the PIC (inputs connected to the pushbuttons) is constantly monitored/probed. When the PIC notices that one of the inputs gets momentarily "high" (+5V), it chooses the correct antenna by driving transistors T1 through T4, which in turn steer relays REL1, REL2, REL3, and REL4.

The PIC is programmed with JAL (Just Another Language), a programming language resembling Pascal.

Information on this language is widely available on the internet.

Here Comes Version 2

This new switching arrangement was a vast improvement over the old one. Enthused by it, Mark quickly came up with some further ideas:

- Replacement of the pushbuttons by touch-button switches.
- A touch-button switch which automatically makes one full revolution east-to-east heading, counter-clockwise.
- This revolution must be done in

about 2.2 seconds, the approximate time in between two CQs on the 160-meter band.

- Interruption of this revolution by selecting any heading of choice;
- A touch-button to switch step by step, counter-clockwise.

A search on the internet revealed, professional touch switches are not cheap! One lucky day, Mark's eye caught a 4-LED sensor tap lighting in a local Blokker discount store. It was switched on and off by...oh yes, a touch-switch, and all for a cheapo price of 2.49 Euros! (See photo B.)

	N	NE	E	SE	S	SW	W	NW
REL1	0	0	0	0	0	+	+	+
REL2	0	0	0	+	+	0	0	0
Coax	0	-	+	0	+	+	-	0

Table 1— The polarity of the chosen voltages and the corresponding heading of the selected Beverage antenna. Mark and I agreed it was time to develop a more comfortable and efficient switching system.

Would this touch switch be practical for our project? It appeared the switching circuitry was built around a bistable multivibrator. With some programming, we thought, it should be possible to steer the PIC.

Because the local Blokker discounter had an insufficient number of these units in stock, Mark went on a touch-lamp hunt in all Blokker stores over a wide area—successfully! The printed circuit boards of these units (see photo C) were shortened with a small hacksaw and could then be used in the new version of the switching device. Nothing much changed from the schematic of fig. 2. The pushbutton switches were replaced by the touch-button switches. See fig. 4 for the connections of the touch-button switches.

The programming of the PIC was adjusted. Now it constantly monitors whether the status of the PIC inputs “changes” (from low to high and vice versa). All of Mark’s lat-

est wishes were incorporated within this new version (photo D). A video demo with all options can be seen on YouTube (see references). All three versions—the original rotary switch and the two new electronic switches—are within reach at ON4WW (photo E) and are interchangeable if necessary.

The LA4HIA Version

Shortly after publication of the video demo on Youtube, Rune, LA4HIA, asked if it would be possible to build a similar switching arrangement tailored to his specific environment. Rune uses several Beverages that are switched through a RATPAK 8 from Array Solutions. The RATPAK uses a command box that is connected to a central switchbox through a nine-conductor cable (of which one conductor serves as common “return”), which commands eight relays to choose one out of

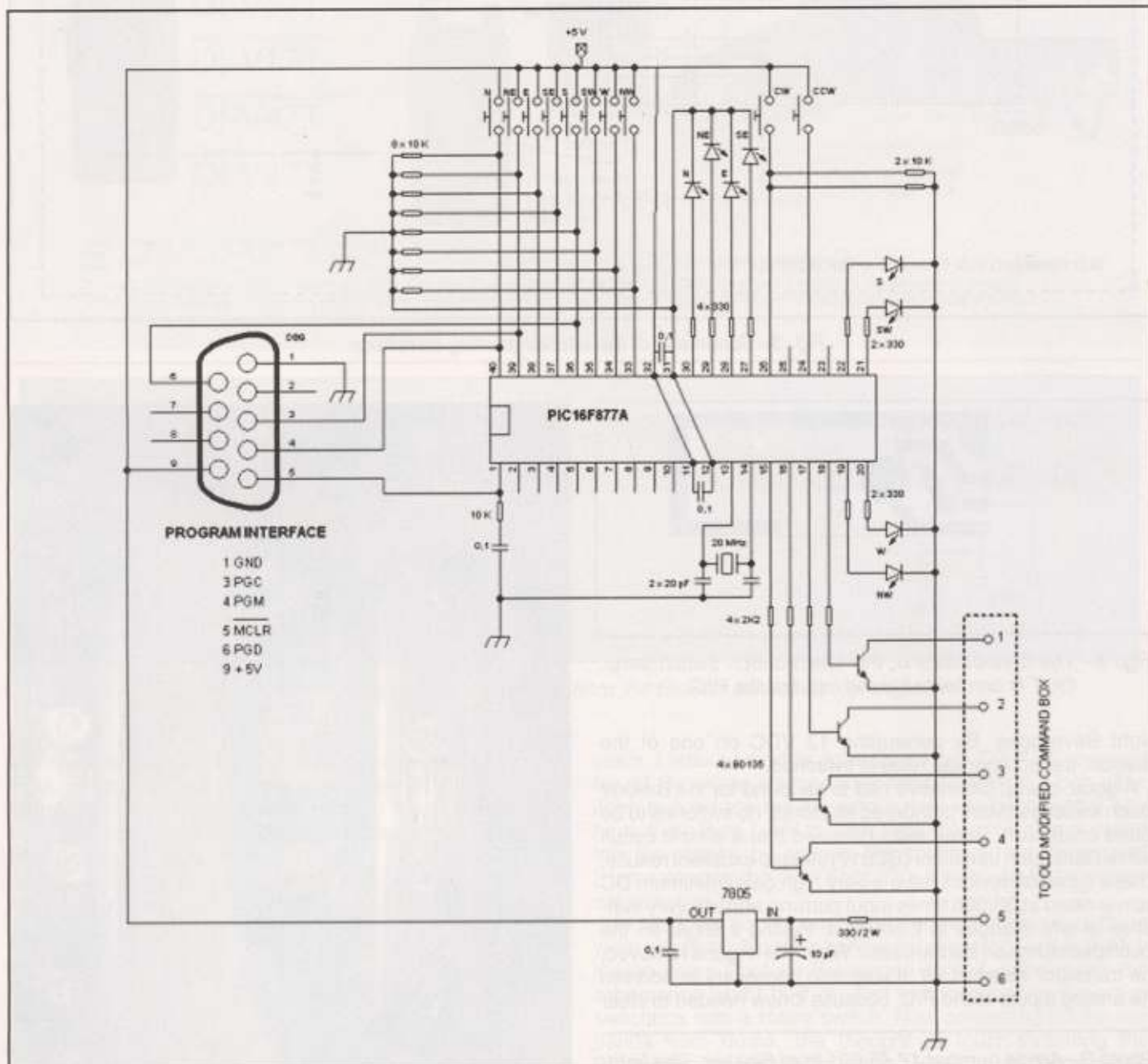


Fig. 2— The schematic for the 16F877A configuration.

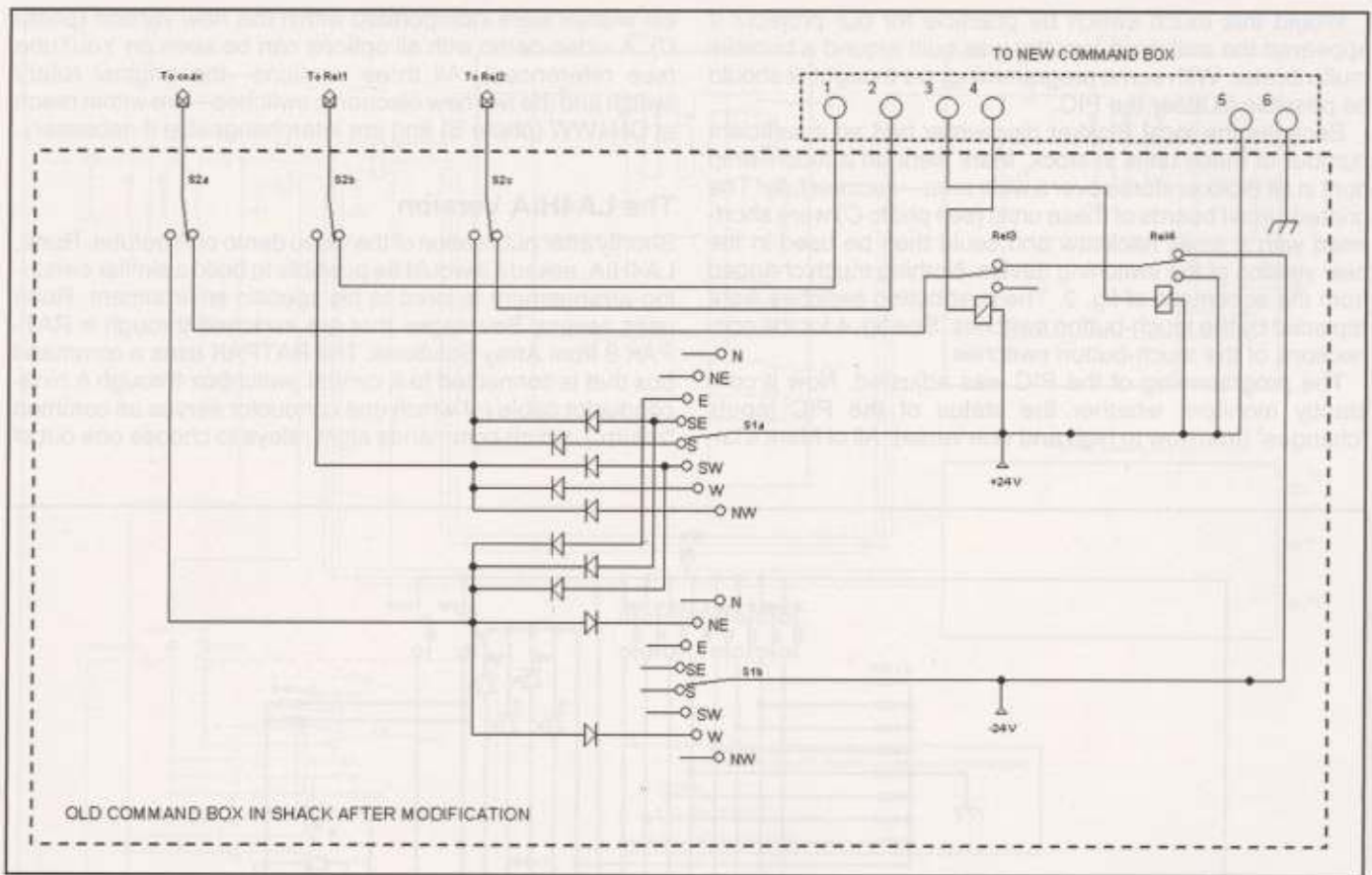


Fig. 3— Schematic of the altered existing switchbox.

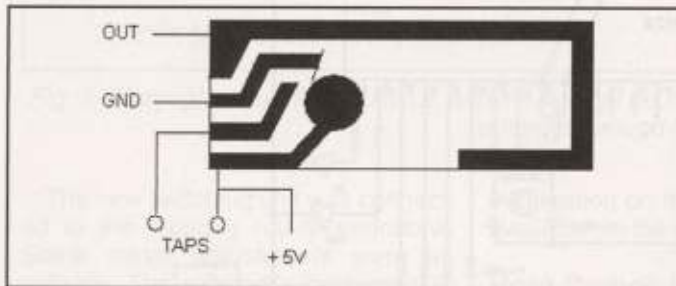


Fig. 4— The connections of the touch-button switch lamp. OUT is connected to the input of the PIC.

eight Beverages. By generating 12 VDC on one of the strands, the appropriate relay is switched.

A good, cheap alternative had to be found for the Blokker touch switches (Mark plundered all stores; no switches to be found anymore!). Some tests revealed that a simple circuit with a Darlington transistor (BC517) yielded excellent results. These types of devices have a very high gain (minimum DC gain is rated at 30,000 times input current) and are very sensitive to any changes at their input. Putting a finger on the touch pads turns on the transistor. When the finger is removed, the transistor switches off. It was also necessary to address the analog inputs of the PIC, because it now needed to steer

Photo B— Article number 17.45.001 from Blokker. This lighting module is for portable use in a tent or camping car and is activated by a touch switch. →



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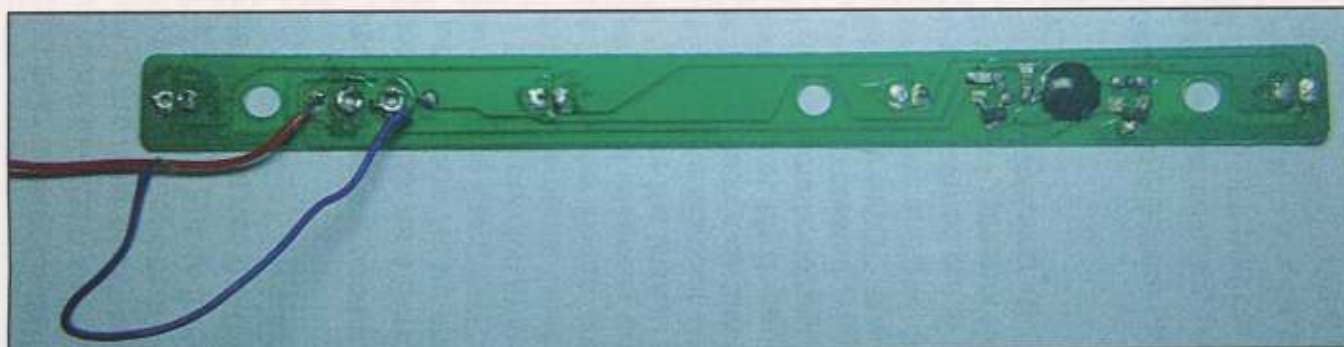


Photo C— The printed circuit board from the Blokker sensor tap lighting.

eight relays. The PIC-program also needed some modifications. Photos and a schematic of the LA4HIA switchbox are linked to this issue's highlights page on the CQ website at <http://www.cq-amateur-radio.com>. Readers of our digital edition may simply click on the link.

The Next Step

Rag, LA6FJA, recently asked me if it would be possible to build a version suitable for steering two Ameritron RCS-4 units. That will be the next challenge and project.

A Closing Note by ON4WW

Contest experiences with the new switch unit:

My first low-band contest experiences go back some 20

years. I listened in while John Devoldere, ON4UN, operated his 12-Beverage station to win time after time. Soon after, John handed me the key and a new low-band addict was born. Even then, I said to John, "We should be able to switch the Beverages by merely the touch of our fingertips." (Remembering the '80s Acec TVs with touch-button channel selection.)

In 1993, we bought our current home (making sure there were plenty of meadows behind the property), and in the following years I put up Beverages myself. John made the schematics, and I built my first and long-lasting Beverage switchbox with a rotary switch. Now contesting on the low bands from home, the thought of touch-switching the Beverages lingered in my mind. It wasn't until I noticed one of my guest operators struggling with the rotary switch on my Beverage control box that I picked up the thread and talked

about it to Luc, ON5UK. The end result of that conversation is this article.

It is just fantastic to be able to switch instantaneously from one heading to another. However, the icing on the cake is the automatic rotation of a full revolution. When things on 160 meters start to get slow during a contest (and that happens quite often), it is pure luxury to just touch a button and the "dial" takes a spin over all the Beverages in between CQs. Previously it was easy to miss a very weak caller, but with this feature it is hard to miss such a station. Also very handy is the ability to interrupt this automatic rotation and pick any desired heading. In short, this magical box rocks!

References

Hex files: The hex files of the JAL programs are available at: <www.tls.uba.be/Projecten.html>

YouTube: <<http://www.youtube.com/watch?v=D9IVU-p3f0I>>

Blokker: <<http://www.blokker.be>>

ON4WW: <<http://www.on4ww.be/ON4WWPresent.html>>

LA4HIA: <<http://www.la4hia.com>>

Devoldere, John, ON4UN, *ON4UN's Low Band DXing*, Fifth edition, American Radio Relay League, Newington, CT <<http://www.arrl.org>>

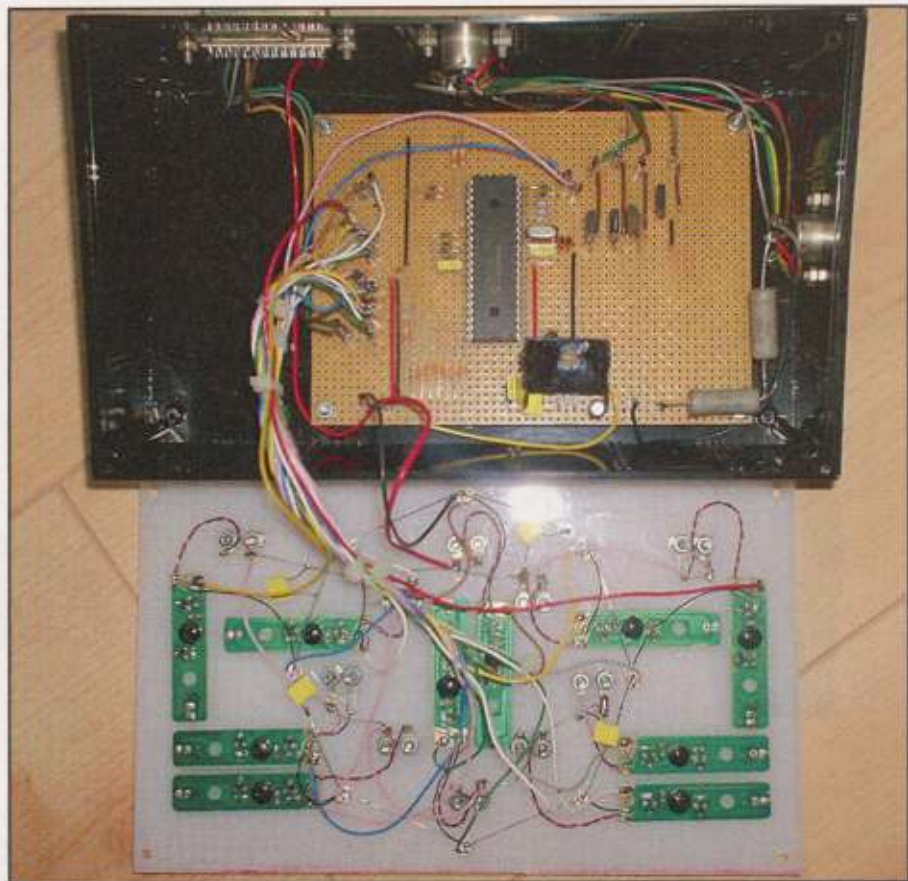


Photo D— Inside the new touch-control switchbox.



Photo E— Overview of the different switchboxes. On top (middle) of the FT-1000MP radio is the old rotary switch version (to the left of that is the homebrew K9AY control box). To the right-hand side of the speaker are the two new versions: first the pushbutton version, followed by the touch-button switchbox.