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Down East Microwave 3333LY 33-cm Loop Yagi

SSB Electronics LT 33S 902-MHz Transverter

Tono '777 Communications Terminal

Tono θ-777 Communications Terminal

The heart of a modern computerized Amateur Radio station is the modem. Connected between the transmitting and receiving equipment and the computer, the modem modulates and demodulates RTTY and CW signals for display by the computer. Modern communication terminals have come a long way from the first simple one- or two-chip modems connected to the computer. Today's terminals handle most of the decoding chores "on board," and most use their own microprocessor and memory. The Tono θ-777 is an excellent example of a state-of-the-art communications terminal.

The '777 receives and transmits RTTY (Baudot and ASCII), AMTOR and CW. All coding and decoding is handled by the terminal; a computer is used for display and keyboarding. The Tono '777 incorporates an RS-232-C interface, and may even be used with an ASCII or Baudot teleprinter machine.

First Impressions

The first thing you notice about the θ-777 is the lack of front-panel controls. The POWER switch, RESET button and variable SHIFT potentiometer are the only breaks in an otherwise smooth front panel. These are the only operating controls on the unit—all functions of the '777 are controlled from the computer.

A 28-LED display tells you everything you need to know about operating MODE and STATUS, PTT, KEY line and BUFfer status, AMTOR MASter or SLave station, phase, traffic and idle indications, and FIGures and LETTERs case in RTTY. A 10-LED bar-graph tuning indicator is used for tuning both RTTY and CW signals.

All connections to the terminal are made from the rear panel; RS-232-C connector, DC12V input cable, INPUT TTL and AF jacks, a PHONE jack for headphones or an external monitor speaker, PTT jack, POSItive and NEGative keying jacks, a REMOTE jack for keying accessory equipment, and an AFSK output with a GAIN control. The INPUT jacks provide for both audio and TTL signals. The TTL input is provided so that a high-speed modem can be connected to the '777.

Connections

The '777 comes equipped with a standard cable with a DIN plug on one end to mate with the RS-232-C jack on the rear panel, and a DB25P plug on the other end. The manual includes detailed instructions for connecting the Tono to different types of terminals, including ASCII and Baudot teleprinter machines. An internal DIP switch selects the code and speed used to communicate with the '777. I used a Radio Shack TRS-80® Model 4P with the '777—my Western Union Model 100 teleprinter machine has been in the attic since I moved to Connecticut three years ago. It is interesting, however, to note that a Baudot terminal *can* be used with the '777, if you are so inclined.

The '777 requires 12 V dc at approximately 1 A. A 12-V power supply is not provided with the unit. All keying and input/output lines are terminated with phono jacks on the rear panel. For the simplest RTTY and CW installation, the AFSK and PTT lines are connected to a microphone connector, the keying line is connected to the radio's key jack, and the AF input on the Tono is connected to the external speaker output of the radio. This is how I connected the '777 to a Kenwood TS-820 for testing at W1INF, the ARRL HQ club station.

On the Air

When you first turn on the '777, it responds with what the manual calls the "status line." This is a display on the terminal screen informing you of the current operating mode, which set of tones and shift is in use, the sense (normal or reverse), speed and PTT status (manual or automatic). The '777 starts up in Baudot mode at 45.5 bauds, normal sense and manual PTT.

All functions of the '777 are controlled from the terminal keyboard. While this is a bit confusing at first, it becomes quite natural very quickly, and is really convenient. ESCAPE sequences (typing the ESCAPE key, followed by another key or keys) are used to control the various modes and operating parameters. For example, after power on, you change to CW mode by typing ESCAPE M 7 to select mode 7 (CW). To change the speed to 20 WPM, you type ESCAPE S 20.0. If you need to see the status line, you type ESCAPE ?

The dual bar-graph display is used as a tuning indicator. Five LEDs on each side of center show the relative strengths of the MARK and SPACE tones. The MARK side of the indicator is also used as a CW tuning indicator.

CW Operation

The '777 sends beautiful CW. The weighting (dot:dash ratio) is adjustable from 1:3 to 1:7. The '777 automatically tracks the receive speed; no operator adjustment is required. The unit receives strong signals well, and even copies poor "fists" if the signal is strong enough. Like most computerized CW-receive devices, however, weak-signal receive performance leaves something to be desired. A "random code generator" function is also included, so that you can use the unit to improve your code speed.

The "Green Keys"

The '777 really shines on RTTY. With the PTT set to "automatic," the unit keys the transmitter as soon as you start typing; ESCAPE D unkeys the transmitter. With manual PTT selected, you must also type ESCAPE D to key the transmitter. Transmitted text may be formatted automatically into 64, 72 or 80-character lines. The '777 inserts a carriage return/line feed sequence when the end of the line is reached. Unshift-on-space and a "diddle" feature are also available; with diddle on, the '777 sends continuous LETTERS characters when there is no text to be sent. The AFSK tones are crystal controlled for accuracy.

The unit has a 768-character input buffer; to activate the buffer, you type ESCAPE P and start typing. When you type ESCAPE P again, the buffered text is transmitted. There are also four 64-character message memories, seven 32-character memories, and four 16-character memories for SELCAL data. Memory data is not retained if the unit is switched off.

The terminal software I use does not support split-screen operation. Most terminal programs written for use with a modem do not—you may be able to find some written specifically for your computer. This is not really a problem, but a split-screen display makes RTTY operation a bit easier and more pleasant.

An interesting feature is "mode 0" RTTY. While tuning around the RTTY subband, you can set MODE 0 (ESCAPE M 0) and the '777 will automatically select Baudot or ASCII and set the speed by tracking the incoming signal. This feature works reasonably well, but if you have a good "ear" for RTTY, you can often recognize the type of signal being received and manually set the parameters before the Tono can figure out the signal.

The LED tuning indicator is adequate for use in the amateur bands, but trying to tune in a commercial RTTY signal with an oddball shift is difficult without an oscilloscope display. The '777 incorporates outputs for a tuning oscilloscope, but the phono jacks for vertical and horizontal outputs are inside the

case on the PC board, and *under* the monitor speaker! The speaker must be removed (unplugged from the PC board and lifted out of its mounting bracket) to *use* the scope outputs.

With the internal modem, operating speeds between 12 and 200 bauds can be selected. The internal software will handle speeds up to 600 bauds if an external TTL-output modem is connected to the TTL input of the '777.

The input-filter shift is continuously variable from a little less than 170 Hz to a little more than 850 Hz. Markings for 170, 425 and 850 Hz shifts are provided around the SHIFT control for easy reference. The SHIFT control selects the receive shift only; transmit AFSK tones are selected from the terminal keyboard, with the MARK tone either 1275 Hz or 2125 Hz, and the shift 170, 425 or 850 Hz.

Monitoring Commercial RTTY

Commercial RTTY signals are a real challenge for any modem. An addendum sheet packed with the '777 states, "Due to the proliferation of 'communications terminals,' *most* if not *all* of the major Commercial Press Services are now 'playing games' with shift, tone, phasing, and speed in order to discourage unauthorized use of their services." I tried the unit with the Kenwood TS-440S in W1INF and found only a few readable transmissions. The US Information Agency transmits "in the clear," as do some foreign press services. If you plan to use the Tono to monitor commercial traffic, it will help if you speak Spanish or French, and a book such as the Klingenfuss *Guide to Utility Stations* will be extremely helpful.

AMTOR

Even AMTOR operation is simple; here, again, the software adds some "automation." In mode 5 (what Tono calls Mode L AMTOR), you can monitor ARQ, FEC AMTOR and SITOR (commercial ship traffic) signals. To switch to the "wait state" common to both Mode A and Mode B AMTOR, you type ESCAPE M 4. To transmit in Mode B, you type ESCAPE B, and the '777 begins transmitting. In the "wait" mode, if the '777 hears your station being called in Mode A, it will automatically switch over and synchronize with the transmitting station. In operation, you can call CQ in Mode B, and when you get an ARQ call, the '777 automatically switches over and the radio starts to chirp away.

If you hear a Mode B CQ call and want to call the station in Mode A, you type ESCAPE A followed by the selcal of the station you want to call. The Tono switches to Mode A and calls the station. This all may sound complicated, but in actual operation it is quite simple. I had never operated AMTOR before I reviewed the '777, and it only took me 5 minutes or so to get the hang of operating with the terminal.

Problems

Very few problems appeared during my Product Review operation. The main complaint I have is that the manual is a bit lacking for such a complex piece of hardware. The table of contents is quite detailed, but there is no index. A few of the features are not fully documented, such as the adjustable CW weight feature. The manual states that to change the weight you type ESCAPE followed by a number from 0 to 9, corresponding to

CW weights between 1:3 and 1:7. There is no indication of which weights correspond to which numbers, which weight is the default value or how to return to the default after you set a different weight.

Finally

I am impressed by the Tono θ-777. It does everything I'd want a communications terminal to do, and does it all very well and with a minimum of knob tweaking and software fiddling. The control functions seem quite logical, once I got used to them, and I found it very easy to switch from mode to mode as I tuned around the band. If there were no AMTOR stations to work, I could quickly tune up the band and work Baudot, or tune down to the low end of 20 and work CW. If the ham bands were lifeless, I went hunting for commercial RTTY stations. In short, I was sorry to see the end of my Product Review testing.

Exclusive distributor: Amateur-Wholesale Electronics, 8817 SW 129th Terr, Miami, FL 33176, tel 305-233-3631. Suggested price: $249.—*Bruce S. Hale, KB1MW*

SSB ELECTRONICS LT 33S 902-MHz TRANSVERTER

Times sure have changed for the UHF/microwave enthusiast. In the old days, there was no commercial equipment available for these frequencies, and everything had to be built piece-by-piece at home (or at work during "free" time). Now, there is a wealth of compact commercial equipment available if you know where to look. SSB Electronics is
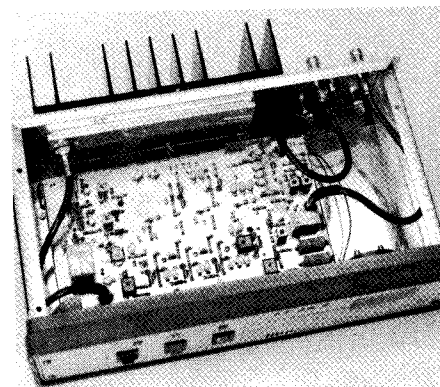
an established West German manufacturer of high-quality VHF and UHF equipment, including transverters and preamplifiers. The subject of this review, a new transverter for the new 902-MHz (33-cm) amateur band, is based on the popular LT 23S 1296-MHz transverter. Anxious to get on 33 cm for the summer, I purchased the LT 33S in May 1986, about 9 months after 902 MHz became available for use in the US. The review unit was from the first production run.

Circuit Highlights

The LT 33S is a linear transverter that converts signals in the 902-904 MHz range to 144-146 MHz. It is meant to be used with a 2-meter transceiver as a tunable IF, and works on all modes. Weak-signal activity (on the East Coast, at least) centers around 903.1 MHz, so the 2-meter rig must be able to tune to 145.1 MHz. Don't despair if your 2-meter rig won't cover that frequency. The

LT 33S is equipped with two crystal-controlled oscillators, selectable from the front panel. Order an additional crystal and you're all set.

The receiver section of the LT 33S is equipped with a modern Mitsubishi MGF1202 GaAsFET front end. Another MGF1202 acts as a low-loss active mixer. Conversion gain is about 20 dB, and the converter noise figure is 1.6 dB (measured with an HP8970A Automatic Noise Figure Meter and an HP346A Noise Source).

On the transmit side, the 2-meter signal enters the mixer through an adjustable 30- to 50-dB attenuator. Although the correct mixer drive level is about -10 dBm (100 μW), the attenuator allows the transverter to be used with 2-meter drive levels ranging from 100 mW to 10 W. Following the mixer, a 3-pole filter eliminates the image and other spurious signals. The signal is then amplified to the final output level through six stages. The review LT 33S transverter was rated at 6-W output. Higher powered units are planned for the future.

The LT 33S is built in two modules. The receiver, local oscillator, low-level transmitter stages and control circuitry are contained on one large circuit board that takes up most of the cabinet interior. The final amplifier is enclosed as a separate unit that is attached to a heat sink on the rear panel.

Connections

The front panel contains the POWER OUTPUT meter, three control switches and some LED indicators. The L.O.1/ L.O.2 switch allows selection of local oscillator frequencies. L.O.2 is the standard position, while L.O.1 is for an optional crystal. Manual PTT operation is afforded by the TX switch. The third switch is for power ON/off.

The rear panel is equally simple. BNC connectors are used for the 902-MHz transmitter output, 902-MHz receiver input and for the RF connection to the 2-meter transceiver. There are binding posts for power and ground, as well as for control of an external TR relay. Finally, a phono jack is provided for PTT control.

The LT 33S contains internal switching to connect the 2-meter IF rig to the transmitter attenuator in transmit, and to the output of the receiver in receive. There is, however, no internal antenna relay. SSB Electronics did this to make it easier to connect additional power amplifiers or an external preamplifier. You'll have to supply your own relay rated for use at 900 MHz. Suitable relays are often available at flea markets or through ham ads. If you wish to purchase a new relay, the SSB Electronics distributor listed at the end of this review can help. I used a CX-600N relay purchased from RadioKit, Box 973H, Pelham, NH 03076.

Connections between the LT 33S and the rest of the station are easy to make. First, you'll need a power supply capable of providing 14 V at about 2.5 A. You can use the LT 33S at 12 V, but the power output will be down by a watt or two. If your antenna relay has a 12- to 14-V coil, you can power it from the rear panel. The control circuit is set up to supply 12-14 V to the +REALAIS terminal during receive periods and remove this voltage when the LT 33S switches to transmit. If you use RG-58 cable to connect the antenna relay to the 902-MHz input and output jacks, make the runs as short as possible—RG-58 is very lossy at 900 MHz. A single cable runs between the 144-MHz

IN/OUT jack on the transverter and the antenna jack on the 2-meter rig. To control the LT 33S TR switching from the 2-meter rig, you must connect the PTT jack on the transverter to a line from the transceiver that is grounded in transmit and open in receive. Note that the LT 33S does not contain any RF switching. You must ground the PTT jack or manually operate the front-panel TX switch to transmit.

I used the LT 33S with a Yaesu FT-726R as the IF transceiver. Following the suggestion in the operator's manual that the 2-meter transmitter be operated at the lowest possible power output, I adjusted the internal attenuator in the LT 33S for full 33-cm power output at 1 W of 2-meter drive power.

Operation

The antenna I used with the LT 33S was a Down East Microwave 33-element loop Yagi on a 100-foot tower. I installed the antenna with a 130-foot feed line of Belden 9913 as a "temporary" measure a few days before the June 1986 VHF QSO Party. This feed line has a measured loss of 6 dB at 902 MHz, so I would not recommend using it on a permanent basis. Unfortunately, I still haven't gotten around to replacing it... With this feed line, only 1.5 W from the LT 33S reaches the antenna and the receiver noise figure is increased by 6 dB.

Despite the poor feed line, I worked 10 stations in 6 grid squares during the June VHF QSO Party. During June, July and August, I worked a number of other stations, to bring my grid total to 15. In September, I added a 20-W amplifier to boost my power at the antenna to 5 W. In October, I added an 80-W amplifier. By mid-October, I had worked 25 different grid squares and 12 states. My best DX was W3HQT/4 in FM27, about 300 miles.

I am very pleased with the LT 33S. Since it is a linear transverter that works in all modes, I was able to make CW, SSB and FM QSOs. The transmitter has a clean-sounding signal, and you can work a lot of good DX with 6 W. The receiver hears very well, even with a lousy feed line ahead of it. Of minor concern is the stability of the local oscillator—it tends to drift slowly until the transverter has warmed up for a half hour or so.

The LT 33S proved to be a reliable piece of equipment. The only problem I had was when I accidently connected the 2-meter transmitter to the 902-MHz receiver input. This resulted in a blown MGF1202 in the front end. I replaced that device with a Mitsubishi MGF1402 I had available. The replacement device worked fine! Without making any adjustments, the conversion gain rose to 21.25 dB and the noise figure decreased to 1.25 dB.

This transverter is a fine way to gear up for our newest UHF band. Distributed by Transverters Unlimited, Box 6286 Station A, Toronto, ON M5W 1P3, Canada, tel 416-759-5562. Price class: $500.—*Mark Wilson, AA2Z*

DOWN EAST MICROWAVE 3333LY 33-CM LOOP YAGI

Loop Yagis have been popular for many years among amateurs operating at 1296 and 2304 MHz. These antennas have proved to be good performers in wet weather as well as dry. Many amateurs have had good luck building loop Yagis from various construc-

Table 1
SSB Electronics LT 33S 902-MHz Transverter

Manufacturer's Claimed Specifications	Measured in the ARRL Lab
Transmitting Converter	
Input frequency: 144-146 MHz.	As specified.
Output frequency: 902-904 MHz.	As specified.
2-m drive power: 0.1 to 10 W.	As specified.
Output power: 6 W.	Maximum saturated output 7.3 W.
Receiving Converter	
Input frequency: 902-904 MHz.	As specified.
Output frequency: 144-146 MHz.	As specified.
Overall noise figure: 1.4 dB, typical.	1.6 dB.
Overall gain: 20 dB, typical.	20.7 dB.
Power supply requirements: 14.5 V dc at 2.5 A transmit, 0.2 A receive.	13.8 V at 2.3 A during transmit (6 W output) and 0.2 A during receive.
Dimensions: 3 × 11.8 × 8.7 in (HWD).	
Weight: 5.5 lb.	
Color: Green.	
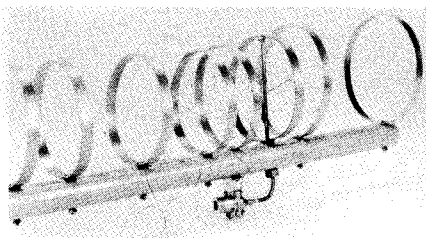
tion articles in the amateur literature.

Down East Microwave supplies commercially constructed loop Yagis for popular frequencies in the 900- to 2500-MHz range. The 3333LY reviewed here is designed for use on the 33-cm (902-MHz) amateur band. It has 33 elements, including 30 directors, two reflectors and a driven element. The boom is 12 feet long.

For ease in shipping, the 1-inch-OD boom is fabricated in two sections that are spliced together with a 7-inch length of smaller tubing. Boom material is high-quality 6061-T6 for high strength and long life. The loop elements are 5/16 inches wide and made from 0.032-inch-thick 5052-H32 alloy aluminum. The loop element material was chosen for strength and corrosion resistance. The largest loop is about 4½ inches in diameter. All hardware is stainless steel. A Type-N connector is supplied, but other types are available upon request. The machine work on the review antenna was excellent, and everything lined up well.

Down East Microwave loop Yagis are available assembled, and also in kit form at a lower price. The review antenna was assembled. To get it ready for installation, I just had to unpack the antenna, remove one director, slide the boom sections together and fasten them, and replace the director. Kit assembly is only slightly more involved, and

takes about an hour. All kit parts are well marked, and the elements come preformed into loops, so putting one of these antennas together is not too much different from assembling a conventional Yagi. The only tools required are a screwdriver and small wrench, as well as a soldering iron for making two easy connections to the driven element.

I installed the 3333LY on a 100-foot tower as described in the SSB Electronics 33-cm transverter review in this column. It's worth noting that the loop Yagi must be mounted at the top of the mast so that the mast does not pass through the plane of the elements. I wanted to place the antenna at the bottom of the mast to minimize feed-line loss, so I bolted the review antenna to a cross boom along with a similar Yagi for 1296 MHz.

A common criticism of loop-Yagi antennas is that the elements are fragile and easily deformed. That is not the case with the Down East products because of the size and quality of the loop materials. I mounted my antenna with the loops pointing down and have not experienced damage from birds or ice.

The home-station antenna worked so well that I purchased another for friends to take to rare grid squares on expeditions. The portable antenna survived some 3000 miles of travel during the summer and fall. It was carried on (and in) vehicles as diverse as Ed Hare's (KA1CV) Subaru Brat, Bart Jahnke's (KB9NM) Ford Bronco and Clarke Greene's (K1JX) Audi Quattro with no damage, save a missing nut on one element. That's one sturdy antenna!

If you're planning to get on 33 cm, this antenna is worth serious consideration. If you need more gain, stacking kits are available. Manufacturer: Down East Microwave, Box 1655A, RFD 1, Burnham, ME 04922, tel 207-948-3741. Price class: $93 assembled, $77 for the kit.—*Mark Wilson, AA2Z*

Table 2
Down East Microwave 3333LY 33-Element, 33-cm Loop Yagi

Manufacturer's Claimed Specifications	Measured in the ARRL Lab
Frequency range: 880-910 MHz.	Tested only at 902-904 MHz.
Boom length: 144 in.	As specified.
Boom diameter: 1 in.	As specified.
Mast diameter: Up to 1 in.	As specified.
Weight: 5 lb.	As specified.
Maximum power handling: 550 W, average.	Tested only up to 80 W.
Connector: Type N female.	As specified.
Typical SWR: Less than 1.2:1.	1.3:1 at 903 MHz.