Vocal Keyer

Build this stand-alone contesting accessory for your radio and conserve your voice

The June 2008 VHF contest provided a golden opportunity to try my newly assembled Elecraft 222 MHz transverter and homebrew Yagi. The equipment performed well but points for this band were hard to get as repeated CQs over the contest period netted a raspy voice and only five contacts.

After the contest I began looking at commercially available voice keyers to take the brunt of calling CQ. Most keyers are now of the PC soundcard variety but I wanted the ability to operate without a computer. Searching the internet I found an assortment of voice recording chips. The HK828[1] caught my eye with claims of multiple messages and an 8 KHz sample rate. Unlike the popular ChipCorder® devices by ISD, this chip can be easily configured for 2, 4, or 8 fixed duration messages without a microcontroller.

I ordered the required components and bread-boarded the circuit. A printed circuit board was then developed and the assembled board was mounted in a small enclosure. Connection to my Yaesu FT-857 was made using a short CAT-5 cable. The keyer was built with all new parts for about $75 and boasts the following features:

- Two 16-second messages with an 8 KHz sample rate and 4 KHz bandwidth (or four 10-second messages with a 6.4 KHz sample rate and 3.2 KHz bandwidth)
- Built-in audio amplifier and speaker
- Message pushbuttons
- Play/Record switch & LED
- Transmit On/Off switch
- Uses the radio microphone
- Transformer isolated audio output with level control and automatic PTT switching
- Message-1 repeat with 2-25 second delay interval
- Suitable for any radio with appropriate RJ-45 adapters for the microphone and radio

Circuit Description

The HK828 provides high quality, single-chip record and playback for 32-60 second messaging applications. The device includes an oscillator, microphone preamp, automatic gain control, anti-aliasing filter, smoothing filter, speaker amplifier, and a high density multi-level storage array. Recordings are stored in nonvolatile memory which provides zero power message storage.

Controls

All user controls are accessible from the front panel. Audio volume and power is controlled by potentiometer R18 (VOL) with integral switch that turns on DS1 (PWR) when power is applied. The transmit level sent to the radio is set by potentiometer R17 (XMT LVL). Potentiometer R19 (DELAY) sets the time interval between MSG1 repeats. Momentary pushbuttons S1 and S2 provide recording and playback of MSG1 and MSG2, respectively. Locking pushbutton S3 selects between PLAY and REC, and switches the microphone input to U1 or to the radio. Locking pushbutton S4 allows message monitoring without transmitting (XMT ON/OFF). Red LED DS2 flashes when recording or playing messages.

U1, HK828

The sampling rate determines voice quality and is set by the sampling clock oscillator frequency resistor (See Table 1):

OscR (R6)	Sampling Frequency (KHz)	Input Bandwidth (KHz)	Recording Time (Seconds)	Number of Messages	MSEL1 (Pin 24)	MSEL2 (Pin 25)
84K	4.2	2.1	60	8	+5V	+5V
38K	6.4	3.2	40	4	+5V	Ground
24K	8.0	4.0	32	2	Ground	+5V

Table 1

Random access mode can be configured for 2, 4, or 8 fixed length messages by tying the MESL1 and MSEL2 pins high or low. Since most radios have an audio bandwidth of 2.5 to 3 KHz, the two highest sampling rates should be used to ensure good audio fidelity. Each message length is equal to the total recording time divided by the number of messages. For this project R6 is 24K ohms which yields a sampling rate of 8 KHz and 32 seconds of recording time. Random access mode for two 16-second messages is achieved by tying pin 24 (MSEL1) low and pin 25 (MSEL2) high. For slightly less voice quality change R6 to 38K, tie pin 24 high and pin 25 low, resulting in four 10-second messages. Two additional SPST momentary pushbuttons on pins 3 and 4 will then control messages 3 and 4. Solder jumper JP1 across the ON pads to enable the message beep function or across the OFF pads disable the beep.

The addition of a built-in electret microphone is simple and inexpensive and is documented on the HK828 datasheet. However, when a microphone element is soldered to the PC board it picks up *all* noises including pushbutton actuations. For this reason, and to simplify the design, the decision was made to use the radio microphone.

U2, Monostable Multivibrator MC14538B

The MC14538B is a dual monostable multivibrator or one-shot. Triggering can occur from either the rising or falling edge of an input pulse, resulting in an output pulse over a wide range of widths. Pulse duration and accuracy are determined by external timing components on the RxCx pins. The pulse width in seconds is equal to R*C, where R is in ohms and C is in Farads.

The Busy signal from U1 provides a low-going pulse during message recording and playback. This pulse is inverted by U4D and fed to U2A to provide the trigger for the time delay between messages. The end of the delay output pulse from U2A triggers U2B to provide a 0.2 second low-going pulse that restarts MSG1. Diode D3 protects the chip from power-down transients when using large capacitors.

U3, Power Amplifier LM386

The speaker output on U1 provides 12mW into a 16Ω load. I found this power level to be inadequate so U3 was added to boost the level to ½ watt. The amplified audio signal is then sent to an 8Ω speaker.

U4, Quad NOR Gate CD40001

NOR gates U4B and U4C are configured as a Set-Reset latch[2] and control the message repeat in conjunction with the MSG1 pushbutton and microphone PTT switch. When the MSG1 pushbutton is pressed the latch Reset line is pulsed high which forces the $\overline{Q}$ output high and enables the U2 delay interval. The inverted PTT signal from U4A stops message playback (by pulling the CE pin of U1 high) and pulses the latch Set input high. This forces the latch $\overline{Q}$ output low which disables the U2 delay interval.

U5, Voltage Regulator LM7805

13.8 VDC power is supplied via J3. Reverse polarity protection diode D1 then distributes 13.1 VDC to U3, relay K1, and voltage regulator U5. The total load on the 5V voltage regulator is approximately 75 mA.

K1, DPDT Relay

When the signal from U4D goes high during playback, Q1 turns on and actuates relay K1. One set of relay contacts switches the audio from U1 through transformer T1 to the radio and a second set of contacts grounds the PTT line.

T1, Transformer

Transformer T1 provides isolation between the audio output of U1 and the microphone input of the radio. The output ground of T1 is isolated from the PTT ground.

Construction

A PC board layout has been developed and is the preferred method for assembling the circuit, but perf-board construction is feasible for those wishing to cut costs. If enough interest is expressed PC boards will be offered at a nominal cost.

The LMB aluminum enclosure is just large enough to house all components. Print the full-size templates and fasten them to the panels using a glue stick or rubber cement. Next, center-punch and drill all holes. A small half-round file easily cuts the soft aluminum to get the rectangular holes to shape. Use a countersinking bit to improve the appearance of the drilled holes. Labeling can be added using dry transfer letters or a labeling machine. The PC board is mounted inside the

enclosure using ¼-inch hex male/female standoffs and hardware. To minimize RFI, scrape the paint away from the inside of the enclosure around the four standoff holes to allow the PC board ground to make contact with the enclosure. Also, ensure that the top of the enclosure is grounded by scraping the paint away from the outer two enclosure screw holes.

Yaesu FT-817/857/897 owners can plug the standard MH-31 microphone directly into the Vocal Keyer. Connection to the radio is made using a standard CAT-5 cable. Adapters for other microphones and radios can be fabricated with a short CAT-5 cable cut in half and the appropriate connectors attached on each end. This setup reduces the size and complexity of the keyer and allows the Amateur to have separate cables for each radio without the need to reconfigure jumper blocks. A few radio microphone pinouts are shown in Table 2 and connectors are listed in the Parts List.

Pin	Yaesu FT-817/857/897 (8-Pin RJ-45)	Kenwood TS-570/2000 (8-Pin Round)	Icom IC-746PRO (8-Pin Round)
1	Fast	Mic Input	Mic Input
2	Ground	PTT	+8V
3	PTT	Down	Up/Down
4	Mic Input	Up	Squelch
5	Mic Ground	+8V	PTT
6	+5V	NC	Ground
7	Up	Mic Ground	Mic Ground
8	Down	Ground	AF Output

Table 2

Setup

To power the unit, connect 13.8VDC from the radio power supply to a 2.5mm x 5.5mm plug. Initially, set trimpot R16 at 12 o'clock. For recording, set the controls as follows:

1. Set the VOL control to 12'oclock which applies power and lights the green LED
2. Set the XMT LVL to 12 o'clock
3. Set the DELAY control fully clockwise
4. Set the MODE switch to REC
5. Set the XMT switch to OFF

Press and hold the MSG1 pushbutton, speak into the microphone, and then release the pushbutton when finished. The microphone PTT switch does not need to be pressed on most radios. A single beep (if enabled) will signal the start and end of a successful recording. If two beeps are heard before releasing the pushbutton the recording time has been exceeded and the message should be recorded again. Next, set the MODE switch to PLAY, press and release the MSG1 pushbutton, and adjust the VOL control for a comfortable level. Adjust the distance to the microphone or speaking volume if the audio is distorted or weak. When satisfied with the quality of the recording, record the final version. Minimize dead time before and after the message as this will be transmitted each time the message is transmitted.

Press MSG1 and adjust the DELAY for an interval of approximately 2-25 seconds between messages. Press the microphone PTT switch at any time to halt all message playbacks and stop the MSG1 repeat. Resume the auto repeat by pressing MSG1. MSG2 does not have auto repeat and will play one time for each press of its pushbutton. If a message is playing and its respective pushbutton is pressed the message will stop. If a message is playing and a different message pushbutton is pressed the unit will beep, stop playback of the first message, and then play the new message after a short delay.

Operation

With the radio connected to a dummy load, place the XMT switch in the ON position. Press MSG1 or MSG2 to play the message and adjust the XMT LVL control to match the modulation level observed on a live microphone signal. Trimpot R16 may need to be adjusted if the final XMT LVL setting is near the beginning or end of its range. With the radio connected to an antenna, check the quality of the transmitted audio during a QSO and make any refinements as needed. Make a note of the final control settings for future use. For contests I set up MSG1 as a CQ message and reserve MSG2 for common reports such as grid square, QTH, equipment, etc. If a response to your CQ is heard between intervals press the microphone PTT switch (suspending the MSG1 auto repeat) and begin transmitting. At the conclusion of the QSO, press the MSG1 pushbutton to resume the message loop.

Conclusion

The keyer has proven to be a huge success in contest work. This standalone unit gives the user complete control over all parameters with LEDs providing visual feedback. The unit can be built for two or four messages and adapter cables interface to different radios. On-the-air reports have been very favorable with listeners unable to tell any difference between the quality of the recorded and the live voice. For your next contest, take some of the work out of repeated CQs and rest your vocal chords while the Vocal Keyer does the talking.

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Attachments

- Schematic
- PC Board Layout
- Bill of Materials
- Assembly Drawings
- Template
- Pictures

Notes

1. *HK828, Voice Record/Playback IC*, Jaycar Electronics, Part #ZZ8200; (Order 2 chips to meet the $25 minimum order); http://www.jaycar.com/products_uploaded/ZZ-8200.pdf
2. *Simple Set-Reset Latches*, Wikipedia; http://en.wikipedia.org/wiki/Latch_%28electronics%29