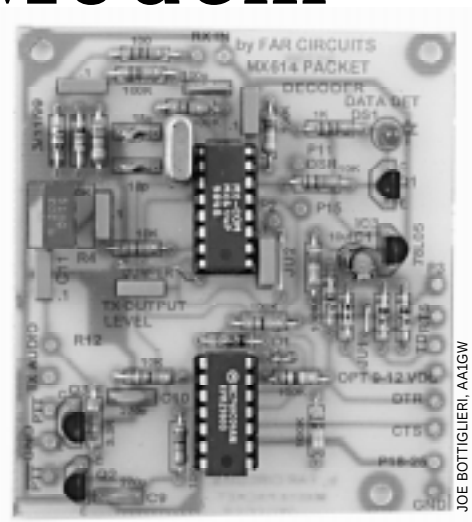
By James A. Mitrenga, N9ART

An MX614 Packet Modem

Can't find a TCM3105 IC for your 1200-bps modem project? Try the MX614!



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Between 1991 and 1998, VHF and UHF packet activity grew steadily, due largely to the availability of inexpensive TNCs and even less-expensive Bell 202 modem ICs for homebrewing. Software such as *Baycom*, *EZPacket* and *Poor Man's Packet*[1] provided the first-time packet operator a means to experience the mode without investing hundreds of dollars in hardware. All you need for these TNCs is the software and an inexpensive modem built around the Texas Instruments (TI) TCM3105 Bell 202 IC. Unfortunately, the TCM3105 chip is no longer available.

A TCM3105 IC Replacement

Several articles in *QST* and *73 Amateur Radio Today* describe projects using the TI TCM3105 as a TNC interface.[2-6] In mid-1998, the source of this IC dried up: TI had canceled production of the part earlier that year. Wide use of the TCM3105 in commercial markets has kept the part from becoming available on the surplus market.

The good news is that a 16-pin DIP IC available from MX-COM (the MX614) performs the same functions as the TI TCM3105.[7] (The two parts are *not*, however, pin-compatible.) Additionally, MX-COM's MX604 is V.23 modem compatible and pin-compatible with the MX614. So you can have a Bell 202 or V.23 modem by simply changing the IC to switch between modes.

These similarities are shared by the TCM3105 and MX614:

Low-power operation (3.3 to 5 V)—This permits powering the IC from a computer's RS-232 port via the RTS, DTR and TXD lines.

1200 bps half-duplex Bell 202-mode operation—Allows compatibility with the 1200-Hz mark and 2200-Hz space-signal conventions.

Low-level analog input—External buffers and low-level amplifiers are not required. Audio taken from a radio's speaker or headphone output is all that is necessary.

TTL level I/O—*Connects directly to computer interface for RXD, TXD, RTS and CTS lines.*

The differences between the MX614 and TCM3105 include:

Reference oscillator—The MX614 uses a standard 3.579545-MHz color-burst oscillator crystal. The TCM3105 uses a not-so-easily-found 4.4336-MHz crystal.

Mode switching—The MX614 has an on-chip buffer stage. It also has a mode-selection input that requires switching between transmit and receive that can be controlled by the PTT line.

Alignment—The MX614 does not require critical receive-bias or carrier-detect threshold alignments as does the TCM3105 circuit.

Serial or parallel-port operation—The MX-COM part does not offer any component reduction with parallel-port operation, as does the TCM3105 Poor Man's Packet design.

Other IC features are available, but as they're not required for Bell 202 operation, they're not identified here.

Circuit Description

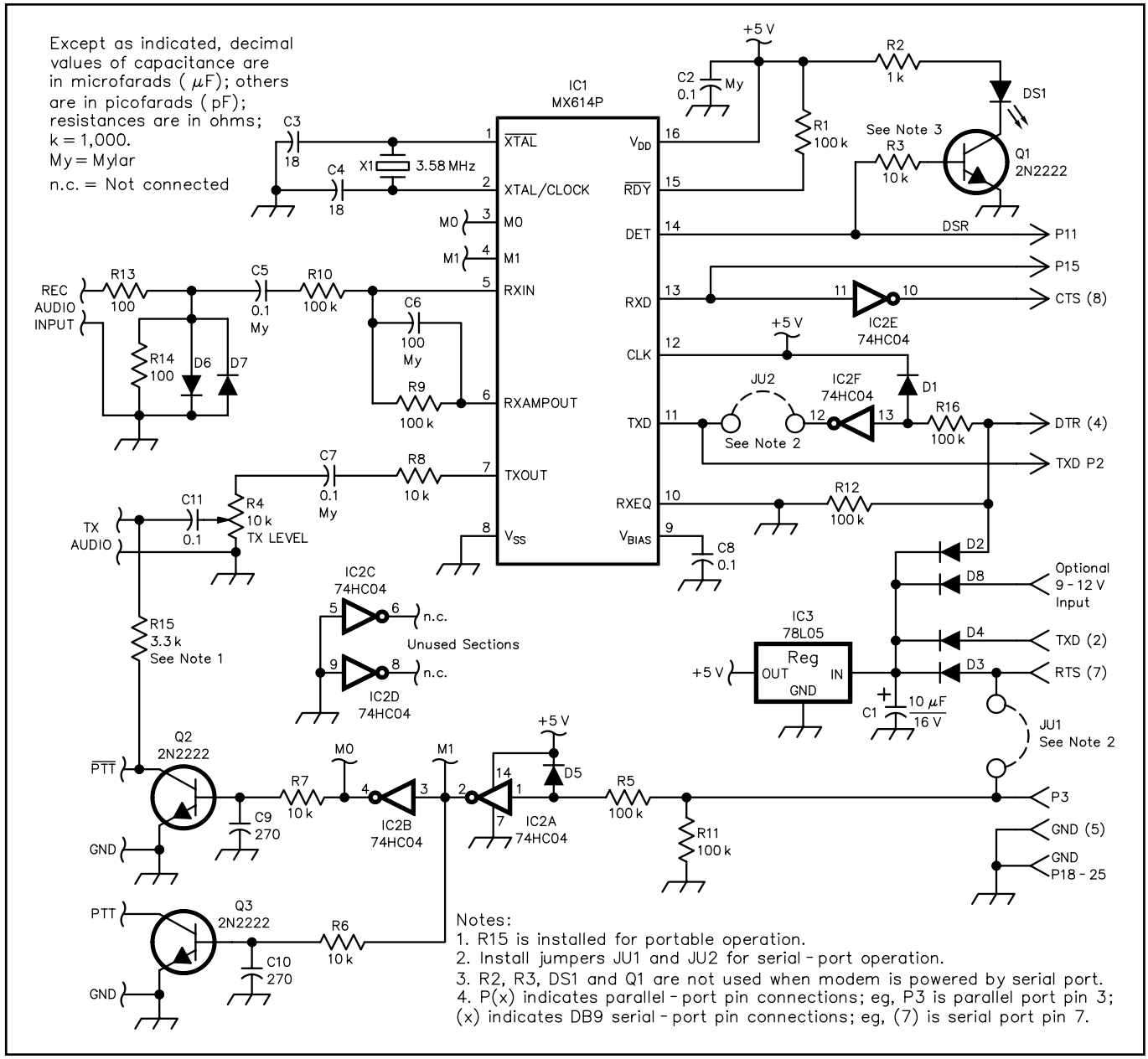
This project (see Figure 1) is patterned after Greg (N3PRT) Cerenzia's Basic Packet Modem (see Note 5). The modem is designed for use with software written to operate Baycom-style modems. PC boards and semi-kits for this project are available.[8]

The interface uses the serial-port DTR line for transmit data (TXD), the CTS line for received data (RXD) and the RTS line for PTT. Cerenzia's circuit uses one section of a hex inverter as a received-signal buffer. The need for that IC section is obviated by the MX614 because it contains a built-in buffer between pins 5 and 6. Two of IC2's inverters are used as translators between the MX-614's TTL levels and the computer's serial-port RS-232 levels. Two more of IC2's inverters interface the computer's RTS line and the radio's PTT line. A normally active-low PTT control is developed with Q2. Q3 handles active-high PTT lines. (Q3, C10 and R6 can be omitted if an active-high PTT control is not required.) Transmit audio level to the radio is controlled by R4. DS1 indicates when the MX614 is decoding a Bell 202 FSK-compatible signal.

Don't install DS1, Q1, R2 and R3 if the modem's power is derived from a computer's serial port. If an external power supply (ie, not a PC's serial port) is used to power the modem, there's no need to install D2, D3 and D4. Also, you can then use a standard TTL 7404 hex inverter in lieu of the CMOS version at IC2; the TTL version requires too much current from a computer's serial port. Mode controls (M0 and M1) for the MX614 are taken from two inverters tied in series (IC2A and IC2B).

Many new portable radios use an unique way to effect push-to-talk through external peripherals (such as remote microphones) without using a separate connection for the PTT line itself. They use the external microphone connector and a switch in series with the fairly low-impedance mike element. A bipolar transistor in the mike's audio path senses the lowered impedance when the external mike is switched in and turns on. When this PTT-switch transistor saturates, it provides the radio a PTT signal via internal connections. The beauty of this design is that only a pair of two-conductor miniature plugs is needed to provide connections for a remote speaker, a remote microphone and a remote microphone PTT.

[1]Notes appear on page 00.



Notes:
1. R15 is installed for portable operation.
2. Install jumpers JU1 and JU2 for serial - port operation.
3. R2, R3, DS1 and Q1 are not used when modem is powered by serial port.
4. P(x) indicates parallel - port pin connections; eg, P3 is parallel port pin 3; (x) indicates DB9 serial - port pin connections; eg, (7) is serial port pin 7.

Figure 1—Schematic of the MX614 packet modem. Unless otherwise specified, resistors are 1/4 W, 5% tolerance carbon-composition or film units. Equivalent parts can be substituted; n.c. indicates no connection. Two sections of IC2 are unused. Some component identifiers deviate from *QST* style to maintain compatibility with the existing PC board. For part numbers in parentheses, RS=RadioShack; DK=Digi-Key Corp, 701 Brooks Ave S, Thief River Falls, MN 56701-0677; tel 800-344-4539, 218-681-6674, fax 218-681-3380; http://www.digikey.com/; MO=Mouser Electronics, 958 N Main St, Mansfield, TX 76063-4827; tel 800-346-6873, 817-483-4422, fax 817-483-0931; sales@mouser.com; http://www.mouser.com/; CDI=Component Distributors, Inc, Ste 108, 710 E Park Blvd, Plano, TX 75074; tel 800-777-7334; http://www.compdist.com/; $25 minimum order.

C1—10 μF, 16 V (RS 272-1025, Mouser 140-XRL16V10)
C2—0.1, 63 V Mylar (RS 272-1069, Mouser 1430-1104)
C3, C4—18 pF disc (Mouser 141-500N5-018J)
C5-C8, C11—0.1 μF, 63 V Mylar (RS 272-1069, Mouser 1430-1104)
C9, C10—270 pF disc (Mouser 141-CD50S6-271)
D1-D8—1N914 RS 276-1620, Mouser 610-1N914
DS1—LED (RS 276-011, panel mount; RS 276-1622, PC-board mount)
IC1—MXCom MX614P (CDI)
IC2—74HC04 CMOS hex inverter (Mouser 511-M74HC04)
R4—10-kΩ, 1/8-W pot (Clarostat 363P or 363M series, Bourns 3386p series)
R15—3.3 kΩ, 1/4 W (RS 271-028, Mouser 271-3.3K); see Note 1 of Figure 1
Q1-Q3—2N2222 (RS 76-2009, Mouser 511-2N2222)
X1—3.579545-MHz crystal, HC-9/U holder (DK X400, Mouser 559-FOX036S)
Misc: PC board (see Note 8); enclosure, connectors and hardware.

The packet-modem design adds low impedance across the mike audio line in the form of a 3.3-kΩ resistor (R15) through the emitter-collector junction of Q2 to ground. This just simulates what would ordinarily be the external mike element in series with an SPST PTT switch. Obviously, the other side of the mike element completes the path to ground. For home-station use, the series resistor is not necessary if you provide a separate PTT connection.

Configurations

If desired, this modem can be operated from the computer's parallel port. Programs such as *EZPacket* and *Poor Man's Packet* are written to use printer ports (LPT1 and/or LPT2). Although *Poor Man's Packet* and

other parallel-port packet programs can be configured to run a Baycom-style modem via the serial port, parallel-port operation is required if a serial port is not available. No parts-reduction advantage is realized using the MX614 circuit as would be seen with the basic *Poor Man's Packet* circuit because hex-inverter sections are employed to effect IC mode selection.

The *Poor Man's Packet* configuration of Figure 1 uses the computer's parallel port for data and control and the computer's serial port to power the modem. Points labeled P(x) indicate connections to a DB25 connector for the parallel-port interface. In the *Poor Man's Packet* configuration, don't install jumpers JU1 and JU2.

The *Baycom* configuration uses the computer's serial port *only*. Serial-port transmit and receive data is routed via the DB9 connector pins 8 (CTS) and 4 (DTR). The modem is powered from the computer's serial port using summing diodes connected to serial-port pins 2 (TXD) and 7 (RTS). Remember to make connection to the serial-port's GND pin (5), too.

If you decide to power the modem from the computer's serial port, do *not* install the **DATA READY** indicator circuit consisting of R2, R3, Q1 and DS1. Install jumpers JU1 and JU2 for serial-port operation.

Construction

My prototype of this project was haywired into an existing box already complete with connectors. Use an enclosure and the connectors and cables that suit your needs. The enclosure size you select will depend primarily on the size and number of the connectors you use. A single DB25 connector could be used for all the I/O lines, but a more-flexible approach might use phono connectors for the **REC AUDIO INPUT, TX AUDIO, OPTIONAL 9-12 V INPUT** and the PTT line and a DB9 connector for the serial- port connections.

Alignment and Operation

The only adjustment this modem requires is setting the transmit modulation level using **TX LEVEL** control R4. If the transmitter's deviation can be measured, setting the tones for about 80% full system deviation (±4 kHz on 2 meters) should be adequate. If no means of measuring the deviation is available, simply adjusting R4 to obtain tones that sound similar to those other packet operators are using should be acceptable.

Summary

The circuit proved to be "build, plug and play" on the FAR Circuits board. We found no surprises with the MX-614 Baycom-style modem. Transmit tones are quite clean and do not exhibit any trailing chirps or squeaks. Give this modem a try!

Notes

[1]All of these programs (*BayCom* V 1.5, *PMP* V 1.1 and *EzPacket* V 1.4) can be found at: **ftp://ftp.funet.fi/pub/ham/Simtel.msdos.packet/**. The BayCom site URL is: **http://www.baycom.org**. An updated version of *EzPacket* (V 2.0) can be found at: **ftp://ftp.hzeeland.nl/pub2/hamradio/funet/packet/terminal/**.

[2]Tony Marchese, N2YMW, "An Easy Path to Packet: the IMP," *QST*, Dec 1995, pp 36-37.

[3]F. Kevin Feeney, WB2EMS, and Andy Payne, N8KEI, "Poor Man's Packet," *73 Amateur Radio Today,* Aug 1991, pp 8-14.

[4]Dexter Francis, KD6CMT, "Packet On The Mac," *73 Amateur Radio Today,* Oct 1992, pp 8-14 and 85.

[5]Craig Rader, N4PLK, John Krohn, KJ4GP, Sam Baine, W4KUM and Mike Zinicola, WD4PUS, "TCM 3105 Modem for the Digicom >64," *73 Amateur Radio,* Feb 1989, pp 42-43.

[6]Greg Cerenzia, N3PRT, "Basic Packet Modem," *73 Amateur Radio Today,* Feb 1996, pp 24-31.

[7]MX-Com, Inc, 4800 Bethania Station Rd, Winston-Salem, NC 27105-1201; tel 800-638-577, 336-744-5050, fax 336-744-5050; **www.mxcom.com**.

[8]PC boards are available from Far Circuits, 18N640 Field Ct, Dundee, IL 60118-9269, tel 847-836-9148 (voice and fax); **www.cl.ais.net/farcir/**. PC Board only, $5, plus $1.50 shipping for up to four boards; semi-kit consisting of the PC board, MX614P IC and crystal, $15, plus shipping for up to two semi-kits. Visa and MasterCard accepted with a $3 service charge.

Jim Mitrenga, N9ART, received his Technician Class license in March of 1979; he upgraded to Amateur Extra Class in 1981. Jim's wife, Sandy, is KB9MXF; their son, Gregor is KG9DF, an Amateur Extra Class licensee who received his Novice ticket on his 10th birthday. They're all active on VHF and UHF FM for family communication. HF CW is Jim's favorite mode, but he's active on AM, FM, SSB, SSTV, RTTY and Packet and enjoys Amateur Radio electronics design. Jim's other interests include fishing, hiking, bicycling, gardening, computers, audio recording and broadcast engineering.

Jim is employed as a program manager at Motorola, Inc, in Schaumburg, IL, where he started as an RF design engineer in 1979. Currently he concentrates on digital communications audio quality. You can contact Jim at 1013 Chippewa Dr, Elgin, IL 60120; **sstv@hotmail.com**.