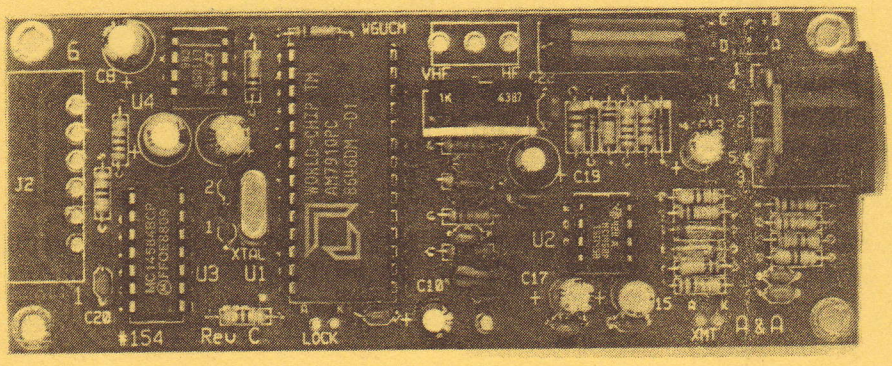
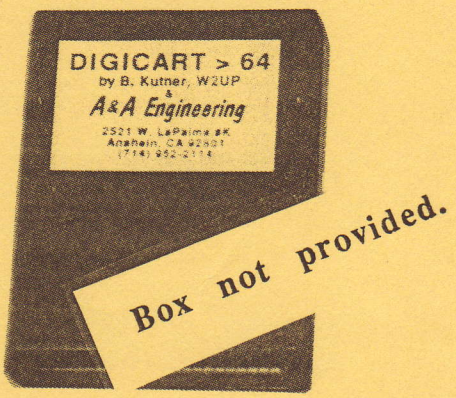
A&A Engineering
2521 W. LaPalma, Unit K, Anaheim, CA 92801
Phone (714) 952-2114 FAX (714) 952-3280

DigiCom>64 & DigiCart





Packet for the Commodore 64 or 128

DigiCom>64 (ITEM #154) is a software-based **PACKET** radio system for the Commodore 64 or 128. The software makes your Commodore 64 or 128 emulate a TNC. The software requires a modem interface between your transceiver and the cassette port. The A & A version of the modem can be plugged directly into the cassette port or remote mounted via a cable. A watchdog timer and reed relay PTT are standard. Operating power is derived from the computer so no external power is required.

The modem circuit is built around the popular **AM7910 WORLD MODEM CHIP ™** which is **crystal controlled so no alignment is required.** A single, three position mode switch allows HF, VHF normal or VHF with equalizer operation. The VHF equalizer mode boosts the high end of the incoming audio, it does not alter the transmit function. Equalizer mode is required with some hand helds.

REVISION "C" of the circuit provides improved HF receive operation. Although not a true squelch, if the volume is set within range, about 100mV p-p, the circuit will only respond to the incoming tones and ignore most of the HF background noise. Other modems are fooled into thinking the channel is busy

A & A Engineering offers blank boards, kit of parts and assembled and tested circuit boards. Should you choose to, you may use the board connector and plug the circuit directly into the computer, or you may remote mount the unit in an enclosure and cable over to the computer. Both connectors are included with every kit or assembly. Also included are; three position mode switch, TRANSMIT and LOCK LED indicators.

Each kit or assembly includes a free disk. Version 2.03 is the most popular version of the software (best documentation) and that is the version that we normally ship. We also have versions 3.51 (BB), 4.01 (EM), 5.00, C128-1 drive and C128-2 drive. Additional disks are just $5.00 each.

ORDER #154-KIT @ $49.95 or Assembled Board #154-ASY @ $69.95

DigiCart (ITEM #167) is the DigiCom>64 Packet Program in a cartridge - **NO DISC DRIVE REQUIRED.** This is ideal for Commodore users without a disc drive or for those occasions where lugging a drive around is inconvenient. The cartridge is autobooting, ideal for unattended operations such as hilltop digipeater or emergency operating. Should power be interrupted and then restored, the program and parameters will automatically re-boot in 2-3 seconds.

A unique feature of this cartridge is the ability to re-write and save parameters and stored text. This is achieved by using **EEPROM** for storage. Unlike RAM, **no battery backup** is needed to maintain data. You (the user) can write to cartridge using the computer keyboard **without the need of an EPROM burner.** Move the cartridge from one computer to another and all parameters and stored text will move with you.

The Cartridge contains software version 2.03 plus cartridge read and write utilities. Enhancements over version 2.0 include additional password control of remote access features, extended ranges of several parameters and additional CTRL codes. **This is a cartridge version of the software.** A modem interface between transceiver and C64 cassette port is also required. Each cartridge comes with a 25 page instruction book. **Box pictured is no longer sold with the KIT or ASSEMBLY.**

ORDER #167-KIT @ $20.00 Assemblies #167-ASY @ $30.00

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HOW TO USE THIS DISC

Enclosed is the Digicom >64 packet radio TNC emulator program for the Commodore 64 computer. Please **make a back up copy** and store the original in a safe place.

Below is an example of what the disc directory may look like:

```
0  "DIGICOM DE W2UP "     73 2A
17    "READ THIS FIRST"       SEQ
1     "---------------"       USR
4     "SEQ FILE READER"       PRG
49    "DIGICOM.DOC.I"         SEQ
39    "DIGICOM.DOC.II"        SEQ
41    "DIGICOM.DOC.III"       SEQ
17    "DIGICOM.DOC.IV"        SEQ
1     "---------------"       USR
2     "BOOT"                  PRG
8     "FSTLTD"                PRG
113   "DIGICOM>64 V2.03"      PRG
5     "DC.PAR.0"              PRG
1     "+---------------"      USR
49    "OVERVIEW.DOC"          SEQ
22    "SYSTEM HELP"           SEQ
7     "HF TUNING INFO"        SEQ
288 BLOCKS FREE.
```

To view the directory of your disc, type
LOAD"$",8 <CR> note: **<CR>** means you type a carriage return
the computer will respond with:
SEARCHING FOR $
LOADING
READY.
You then type: **LIST <CR>**

ALL documentation and program instructions are contained in sequential files, all files labeled "SEQ" in the directory.

To view or print any of the sequential files, use the program named "SEQ FILE READER". To load and run the sequential file reader program, type:
LOAD"SEQ FILE READER",8 <CR>
the computer responds with:
SEARCHING FOR SEQ FILE READER
LOADING
READY.

You then type: **RUN <CR>**
The following message will appear:
name of file to print ? **(NOTE: lower case letters)**

You then enter the name of any of the SQE file listed in the directory. **Notice:** The program has switched to lower case lettering, leave this as is, do not try to switch back.

Try typing **"read this first" <CR>** **(NOTE: lower case letters)**

The program will respond with"

(S)screen or (P)rinter ?

At this point you may print the file or you may view the file on the screen. If you decide to view the file on the screen, it will automatically scroll quickly. You may hold down the "CTRL" key to slow down the scrolling. Also the format of the text is set-up for the printer so some messages will wrap around, but you can still read them.

At this point we strongly encourage you to PRINT out all sequential files, then carefully READ them ! ! ! !

Since Digicom is a large program, it takes a very long time to load. To speed things up a bit, a FASTLOADER program has been included. Access to this FASTLOADER is obtained thru the program named "BOOT". To load and run the actual DIGICOM program, you type:

LOAD"BOOT",8,1 <CR> **(NOTE: the ,8,1)**

The ,8,1 is required because you are now dealing with a machine language program.

The computer will respond with:
SEARCHING FOR BOOT
LOADING
READY.
You then type: **RUN <CR>**

The name DIGICOM > 64 will appear in reverse print, flash a few times, then the disc drive will whril, and in about 30 seconds you will be greeted with the DIGICOM split screen.

You are now up and running the famous Digicom 64 program. From here on, **YOU** have to refer to the printed instructions that **YOU** obtained when **YOU** printed all of the SEQ files.

Please take the time to read all of the instruction that are in the SEQ FILES.

IF YOU WANT TO STAY UP TO DATE CONCERNING ALL ASPECTS OF DIGICOM, DOWN LOAD - READ - AND SAVE ALL COPIES OF:

THE DIGICOM EXCHANGE BY KB2BBW

A monthly newsletter with real questions, answers and timely tips. Search your local Packet BBS by typing L> DIGICM or L< KB2BBW

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ORDER FORM

DATE _____

SOLD TO:

_____

_____

_____

_____

SHIP TO:

_____

_____

_____

_____

QTY	ORDER NO.	DESCRIPTION	UNIT COST	AMOUNT

(check one)

Check or M.O. Enclosed ___ Credit Card ___

Sorry NO COD's

(Personal or company checks may be held for check to clear)

CREDIT CARD ORDERS $20.00 MINIMUM

SUB TOTAL _____

CA RESIDENTS ADD
7 3/4 % SALES TAX _____

SHIPPING _____

TOTAL _____

VISA ___ MASTERCARD ___

CARD NO. _____

EXP. DATE _____

DAYTIME PHONE (____) _____

SIGNATURE _____

1-27-93

DIGICOM > 64

A software-based packet radio system for the Commodore 64

by Barry N. Kutner, MD W2UP

Cheap n' Easy Packet!

Packet radio is a relatively new and exciting mode of communications. Unfortunately, there's still often considerable expense to get on packet. A personal computer (or ASCII terminal) and a terminal node controller (TNC) are required for packet operation. Fortunately, the former is already in many ham shacks today. The TNC consists of two main parts: the packet software (in ROM), and a modem circuit for tone encoding and decoding. Together, they produce and decode the packet signal.

I'd often wondered why no one has written a program to emulate the functions of a TNC that would eliminate the need for a somewhat expensive and mode-specific piece of equipment. Well, it *has* been done! Several German hams wrote the system I describe below for the Commodore 64 (or C128 in the 64 mode). It is public domain! While popular in Europe for several years, it remains relatively unknown in the United States. I and others have been providing copies of this software for the ham community.[1]

Why take this approach to packet radio? Personally, I don't like being an "appliance operator." I like to build, modify, and troubleshoot my own equipment. The miniaturization of solid state gear, however, has made this difficult for the non-engineer. I am an eye surgeon who operates through a microscope, and the compactness and complexity of my own equipment intimidates me! Further, with the number of Commodore 64s out there, this system provides inexpensive and easy access to packet radio for many.

The program is written entirely in machine language and is about 30K long. Unfortunately, the authors will not release the documented source code (I have asked), so there is no program listing available. Since the program is machine language and data is transferred through the cassette port of the C-64 or C-128, it is machine-specific and will not function with other computers, including the VICs and the SX64.

The Interface

Since the computer takes care of all our packet housekeeping functions, the interface between the computer and the radio needs only act as a modem. It must take the voltage levels from the computer and turn them into audio tones for transmission, and must turn the incoming AFSK into voltage levels the computer can interpret. There must also be control of receive-transmit switching.

The interface circuit (Figure 1) uses the AM7910 chip, a complete asynchronous FSK modem in a 28-pin DIP package. Signal modulation, demodulation, and filtering functions are performed by digital signal processing (DSP) techniques. Analog-to-digital and digital-to-analog converters are included on the chip. It is used in several of the higher priced commercial TNCs. This circuit permits both VHF and HF operation, and no alignment is required (other than setting the audio output level).

Circuit Description

The mode control pins are 17–21. S1 is used to select one of three modes: HF, VHF, or VHF with Equalizer. All three operate in "loopback" mode so that receive and transmit frequencies are the same (half-duplex operation).

The HF mode makes use of the Bell 103 Answer protocol. Tones are 2025 and 2225 Hz keyed at 300 baud. This mode has been chosen to make the switch as simple as possible (SPDT center-off). Many commercial modems use the CCITT V.21 Answer mode, which has different tone frequencies (more on the significance of this later).

VHF mode uses the Bell 202 protocol with 1200 baud operation and tones of 1200 and 2200 Hz. The Equalizer mode accentuates the 2200 Hz tone for use with those transceivers with a rapid roll-off of the higher frequencies.

The analog audio output from the receiver passes through an op amp, used for buffering, into pin 5 of the 7910 and is then processed by the modem chip. The TTL level output appears at pin 26. It is buffered by a switching transistor before going into the computer for "decoding." Similarly, the transmit data from the computer is presented to pin 10 after passing through a buffer transistor. After being processed by the 7910, its analog tones (at pin 8) pass through an op amp before going into the audio input of the transmitter.

Transmit/receive switching is software controlled and occurs at pin 5 of the C64 cassette port. As this output is 6–7 volts, it is divided in half by a resistor network before being presented to the chip. When the PTT goes low, pin 12 goes low. This instructs the modem to enter transmit mode. A high level on pin 12 turns off transmission of data.

The power requirements are +5 volts at 150 mA and −5 volts at 15 mA.

A few other comments are in order concerning the AM7910 modem. The circuit does not have a tuning indicator. No tuning is needed for VHF. Just set your transceiver to a packet frequency (e.g., 145.01 MHz) and it's all set. For HF operation, tuning is critical and must be within 50 Hz for proper operation. Since the tones generated and decoded are 375 Hz higher in frequency than some commercial TNCs (using the CCITT V.21 protocol), on 20 meters, for example, tune to about 14103.4 kHz, 14105.4 kHz (lower sideband), and so on.

Watchdog Timer

This circuit provides a timeout of the PTT line after about nine seconds key down. This time constant may be altered by changing the values of R6 or C3 in the 555 circuit. It's not necessary to always be present during packet operation. Should the computer crash, or if a power failure occurs during unattended operation, it's possible for the transmitter to remain in the key-down state. This is unhealthy for the transmitter and causes unnecessary interference. This simple safeguard prevents any problems.

Since I received so many requests, I made a printed circuit board available. The PC board is configured to plug directly into the cassette port, and all power comes from this port. (To obtain the −5 VDC, use an ICL7660 voltage inverter chip.) As an alternative, use a 6-conductor cable to mount the unit remotely. Both mountings that use the PC board eliminate the need for an external power supply. Complete parts kits and assembled units containing the watchdog timer and reed relay output options (both containing cassette port connectors and the PC board) are also available.[5]

Overall, the AM7910 interface should cost less than $50 in parts, assuming no junk box parts. Not bad to get on packet!

Software

As with any packet system, there is a command mode and a converse mode. Digicom>64 recognizes a colon (:) as the first character of all commands. Any line not beginning with a colon is transmitted. Commands may be abbreviated to the least number of characters that make it unique. For example, this is the command string to connect to me via the WD3IGI digipeater:

:C W2UP V WD3IGI (carriage return)

Several parameters must be set prior to initial operation. While most parameters have default values, users will probably want to set many of them for their personal preferences (for example, screen color, 40 or 80 character screen, etc.). On the disk, I have included a "PERM file" that boots with the program. It's set for VHF operation at 1200 baud, while using 60 Hz AC. One parameter the user needs to set is MYCALL, which enters his callsign, and is transmitted in every packet. The system won't allow transmissions when this isn't set. It's set individually for each user port as follows:

:MYCALL W3XYZ (carriage return)

Full documentation is contained on the program disk.

Hardware

The modem requires connections to the receiver's audio output, the transmitter's microphone (or accessory audio) input, the PTT line, and ground. All connections to the computer are via the cassette port. Once this is done, it's a simple matter of selecting the correct mode of operation. Experiment with the Equalize mode on VHF to determine whether or not it's needed. Once that is done, just flick on the switch and it's ready to go!

Final Comments

As of early 1988, I have sent out to five continents about 900 copies of Digicom>64 with associated circuit diagrams. A warning: I have heard rumors that both the software and interface diagrams have appeared on some "commercial" telephone access bulletin board services with incorrect information.

Before initial testing, recheck the wiring and make sure there are no solder bridges between connections. NEVER plug or unplug the cassette port connector with power applied to either the computer or modem.

This project provides an inexpensive and easy way to join the many hams already on packet. It also gives the builder a sense of accomplishment and the satisfaction of "rolling his own."

I would like to thank the authors of Digicom>64, DL2MDL, DL3RDB, and DL8MBT for writing such a superb program, and releasing it into the public domain. I thank Frank DL1SBR for providing the English translation of the documentation.

Willy YV1AQE provided the basic AM7910 circuit, which I have modified. I also thank the many hams to whom I have sent copies of the program over the last year, and who provided me with valuable feedback and tips concerning both the software and the interface, which have culminated in this article.

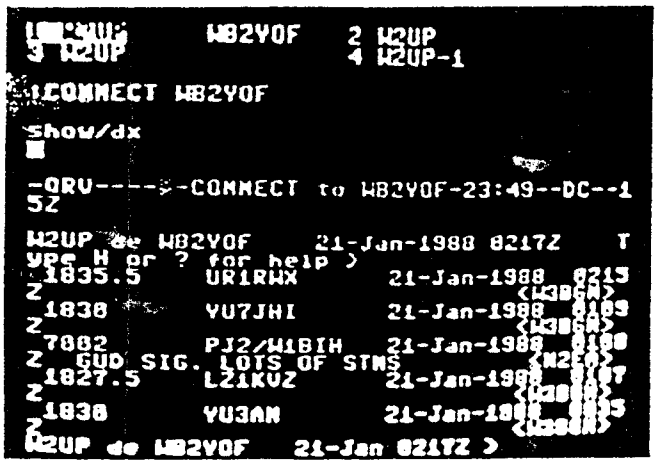

Photo A. The main screen illustrates a connection between port 1 and the Frankford Radio Club's DX spotting Packet Bulletin Board. Split screen operation allows viewing of both transmitted and received data simultaneously.}

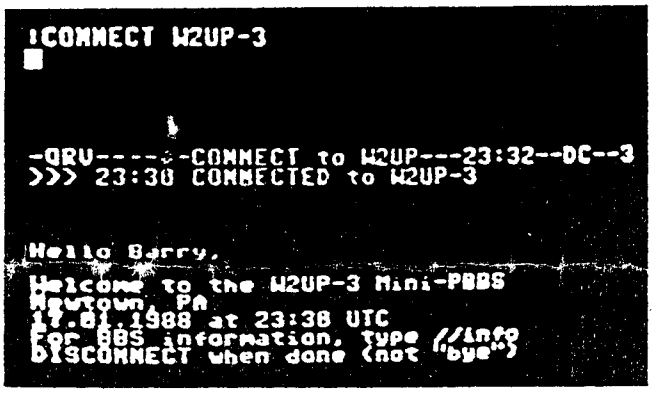

Photo B. Digicom>64 can perform unattended BBS operation. The bulletin board can be used for file transfers or as a personal mail drop.

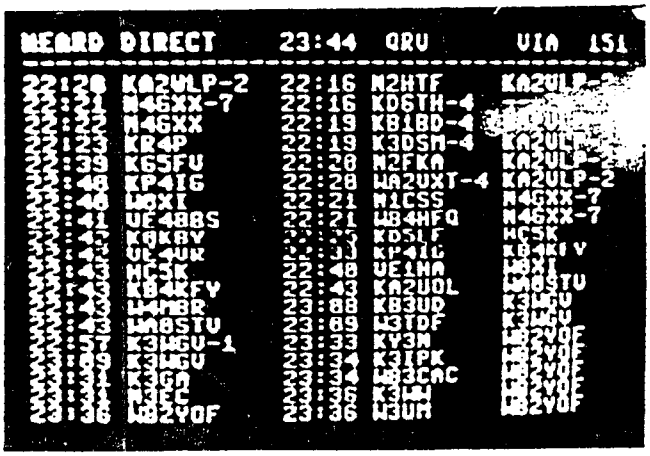

Photo C. The MHEARD screen (displayed by hitting the F7 key) shows recent packet activity. This screen is from actual operation on 20 and 2 meters. Other stations can retrieve this information to see what signals have been heard recently.

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DigiCom >64 Revision C Modem - Additional Information

1) The circuit requires **only 100 mV p-p audio input.** If driven from a speaker output, if will copy signals almost too low for you to hear. It will accept as much as 2 V p-p without damage. Preformance is better if you **DO NOT OVERDRIVE** the input.
2) There is one pot on the circuit board, it is the Audio Out Volume control. With the pot set straight up, the circuit outputs 25 mV p-p, which is what 99.44% of most rigs require. Yours may be different. The full adjustment range allows for 0 to 50 mV output.
3) You cannot transmit a signal until you enter a valid call sign into the software. Read the instruction contained in the SEQ files concerning the parameter "MYCALL". You cannot use all four ports until you set the parameter "USER" equal to four in the software. Read the instruction contained in the SEQ files.
4) Revision "C" circuit has improved HF receive characteristics. If you set the incoming volume within range, (about 100 mV p-p) the circuit will ignore most of the background noise and respond only to the packet tones. Although not a true HF squelch circuit, it operates like one.
5) Three modes are available: HF, VHF Normal and VHF Equalized. The VHF Equalized boosts the high frequency components of the received incoming audio only. **It does not alter the transmit characteristics.** This mode is useful when the audio response of the VHF rig falls off sharply above 2 KHz. Some HT's will not work unless you use this mode.
6) Two LED's are provided. The TX LED (RED) is lit when the modem is in the transmit mode. The LOCK LED (YEL) is lit when the modem is processing data within the carrier passband. **Please note that the LOCK LED will light EVERYTIME it is presented with data that has frequency components within the carrier passband. Although it may be INVALID DATA,** the processor does not know that, and it does't care. The software decides what constitues valid packet data. The modem processor just process the data and therefore the LOCK LED could be lit on noise or even if the incoming data is invalid.

General Information: **Unless otherwise noted,** most kits are board level kits and *do not* include enclosure, interconnect cables etc. All circuit boards are FR-4 epoxy, etched, drilled, plated and ready for use. Everything you purchase from us must be satisfactory or we will replace the item or refund your money. We cannot be responsible for *incorrect assembly, bad workmanship* or items *damaged by the builder.*

Technical Assistance: Need help with one of our kits, we will be glad to help. But please call
between the hours of 2 PM and 5 PM PST ONLY

Return Policy: Customers wishing to return merchandise for a refund must do so within 30 days from the date of order. Returns must be shipped prepaid. There is a **15% restocking charge on all returns.**

Repair Information: If you wish to return a kit that you assembled, please include your name, address and a daytime phone number. For all **board level kits, return only the board. DO NOT SEND your** cables, enclosure, connectors etc. **We processe all repairs in the order we receive them.** Your repair may not take 4 - 6 weeks but **you will face this long of a delay** if the person(s) before you send in a **"repairman's nightmare".** Allow 4 - 6 weeks and include the following amounts for service and shipping;

KIT COST		
	less than $ 50	include $ 25.00
	$ 50 to $ 100	include $ 35.00
	$ 100 to $ 250	include $ 55.00
	over $ 250	include $ 75.00

If you built a BOARD LEVEL KIT, please send in only the board. If you send in a board level KIT with your cables, box etc, we have to remove all of this before we can test the board. Kits sent in for repair without pre-payment or credit card authorization, will not be repaired. Instead we will send you an invoice. After payment is received, we will repair the unit.

For full kits that include an enclosure, send the FULL unit back.

If repair costs exceed the above amounts, we will mail you an estimate before we proceed.

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HF Packet - Additional Information

Our packet modems utilize the AM7910 chip which we opearte in the Bell 103 Answer Back mode. On HF the tones used are 2025 Hz and 2225 Hz. On VHF the tones used are 1200 Hz and 2200 Hz. Other modems may use different tone pairs.

To receive valid packets on HF, you must tune your receiver such that the tone pair of 2025 Hz and 2225 Hz are coming out of your speaker and are going into our modem. Please note that this represents only a 200 Hz shift in audio frequencies.

One very inportant aspect of packet is that the data must be received 100% correct before it will appear on the receive screen. You cannot spin the dial while a packet is coming in, changing the tones mid-packet will surely result in an invalid packet. When tuning HF packet, move the receive frequency in the smallest increment possible, 10 Hz or 1 Hz if possible. Then **take you hand off the tuning dial and let some packets come in.** Repeat this process until you have packets appearing on your receive screen.

Present regulations allow 300 baud below 28 MHz and 1200 baud above 28 MHz.

NOTE: Some items you should keep in mind while running HF packet:

1) Depending on your receiver bandpass, you may hear many packet stations on the air at the same time and they may appear to be on the same frequency. Keep in mind we are talking about a 200 Hz shift. They may in fact not all be on the same frequency. This means that although you may hear more than one station, usually you can only tune in one or maybe two at a time. Don't be surprised if you hear many stations but are only able to copy just one of them. Careful tuning will reveal that you probably can copy all of them, but only one at a time because they are a few hundred Hertz apart. To your ear the tones may sound the same but the modem detects tones precisely.
2) Different modems or TNC's use different tone pairs. Some use 1600 Hz and 1800 Hz. If a station is transmitting using the 1600-1800 tone pair, where do you have to tune your receiver to get 2025-2225 Hz out of your speaker for this modem to receive properly. Likewise what is his transmitter carrier frequency? If you have RIT, you could match his transmitting carrier and adjust the RIT as required for the proper tone pair. Note that two stations, operating without RIT can operate on different carrier frequencies such that their resepctive tones at their receivers are proper. You may hear both, but you cannot copy both.
3) For DigiCom (Packet for the Commodore), you have to flip the modem switch to the HF position and set the parameter HBAUD to 300 to operate HF packet.
4) For BayCom (Packet for the IBM/Clones), you have to flip the modem switch to the HF position and set the parameter HBAUD to 300 **and then transmit something in order for the actual baud rate change to take effect** to operate HF packet.

dc W6UCM

4/11/92

TYPICAL MODEM INTERCONNECTIONS

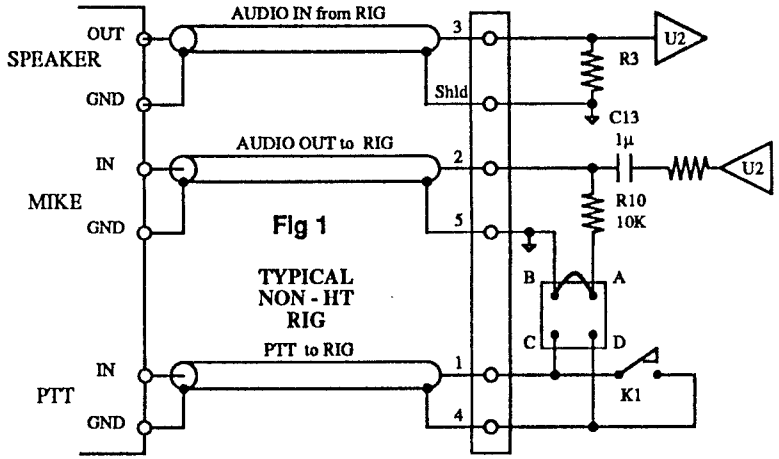
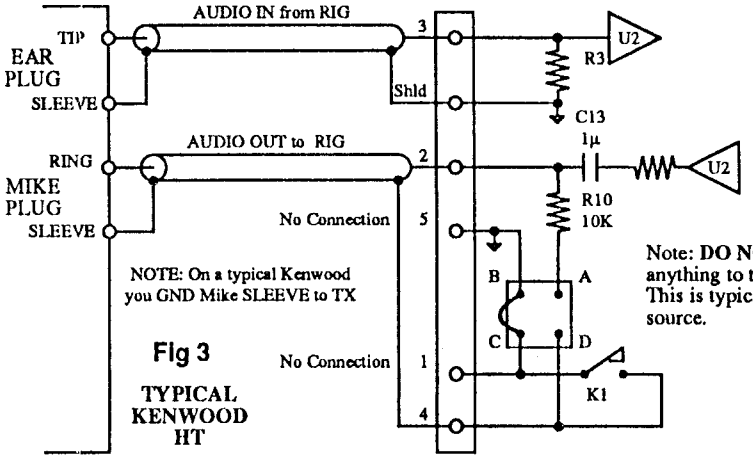


Fig 1

TYPICAL NON - HT RIG

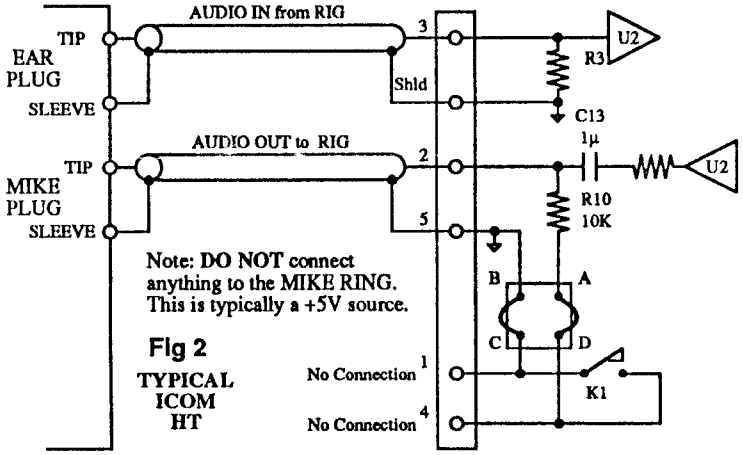


NOTE: On a typical Kenwood you GND Mike SLEEVE to TX

Fig 3

TYPICAL KENWOOD HT

Note: DO NOT connect anything to the MIKE TIP. This is typically a +5V source.



Note: DO NOT connect anything to the MIKE RING. This is typically a +5V source.

Fig 2

TYPICAL ICOM HT

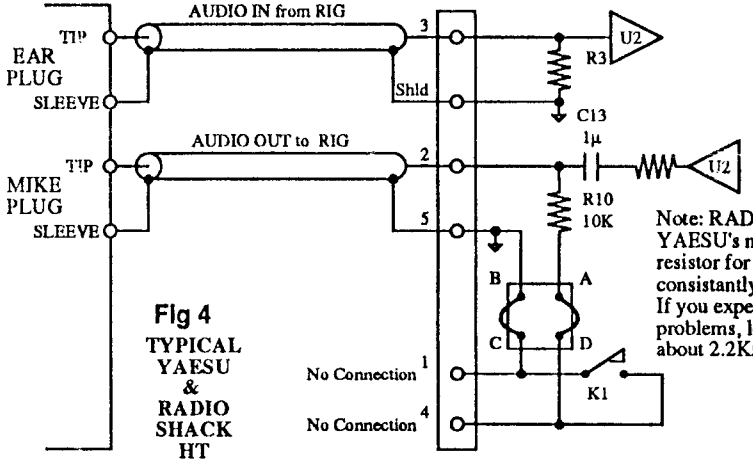


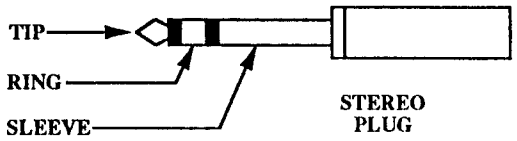
Fig 4

TYPICAL YAESU & RADIO SHACK HT

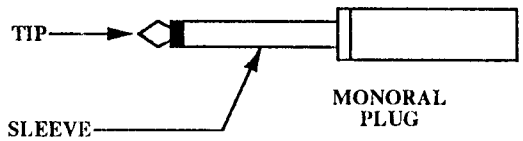
Note: RADIO SHACK & YAESU's needa lower value resistor for R10 to key consistantly. If you experience keying problems, lower R10 to about 2.2KΩ

Notes:

1) Figure 1 shows a typical, Non - Handi -Talky interconnection. Three separate shielded cables are recommended. If your rig does not supply three separate grounds, you may **combine the sheilds at the rig.** Minature michrophone cable (lapel mike cable) is recommend.
2) Figures 2, 3 and 4 show interconnections for **typical HT's**. Most Handi-Talkies don't have a separate PTT line. They are put into the transmit mode by applying a DC load from the MIKE HOT to GROUND, then super-imposing (AC coupling) the audio onto this same line. R10 applies the DC load and C13 does the AC coupling. These HT interconnection diagrams were submitted to us by various manufacturer's, these interconnections do work and are in wide use. (SOME KENWOOD's ARE DIFFERENT)
3) **NOT ALL of a certain manufacturer's rigs are the same.**
   YOUR RIG MAY BE DIFFERENT. CHECK YOU OPERATORS MANUAL IF YOU HAVE PROBLEMS.



STEREO PLUG



MONORAL PLUG

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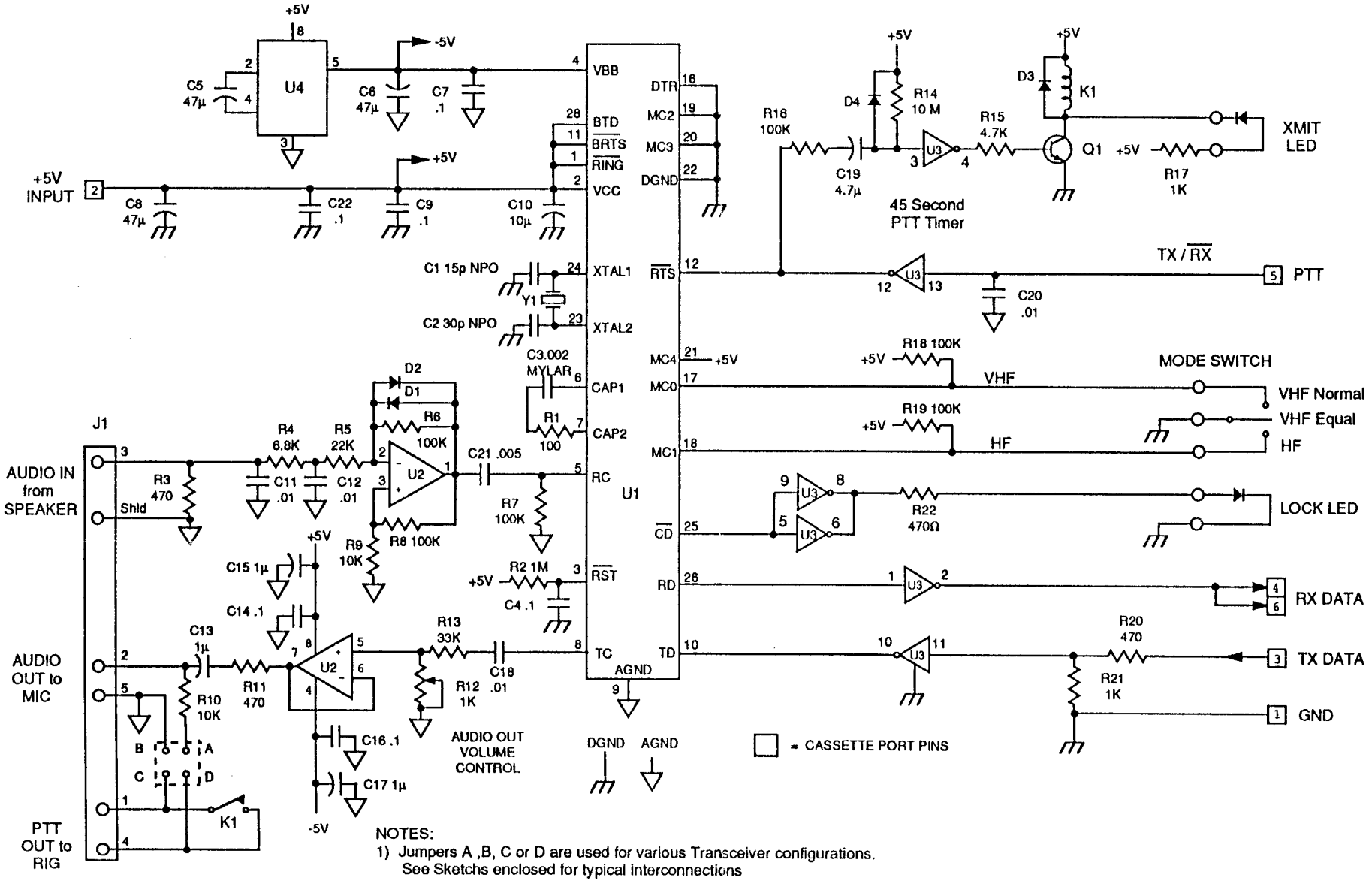
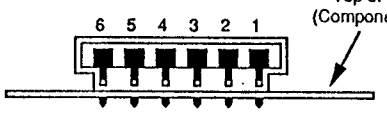


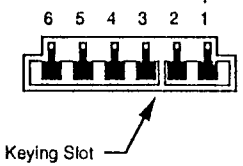
NOTES:

1) Jumpers A ,B, C or D are used for various Transceiver configurations. See Sketchs enclosed for typical interconnections
3) Audio out to RIG is 25 mv if R12 is set to center. Range is 0 to 50 mv.

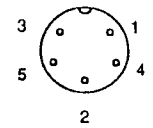
Modem PCB Connector
as viewed from the computer



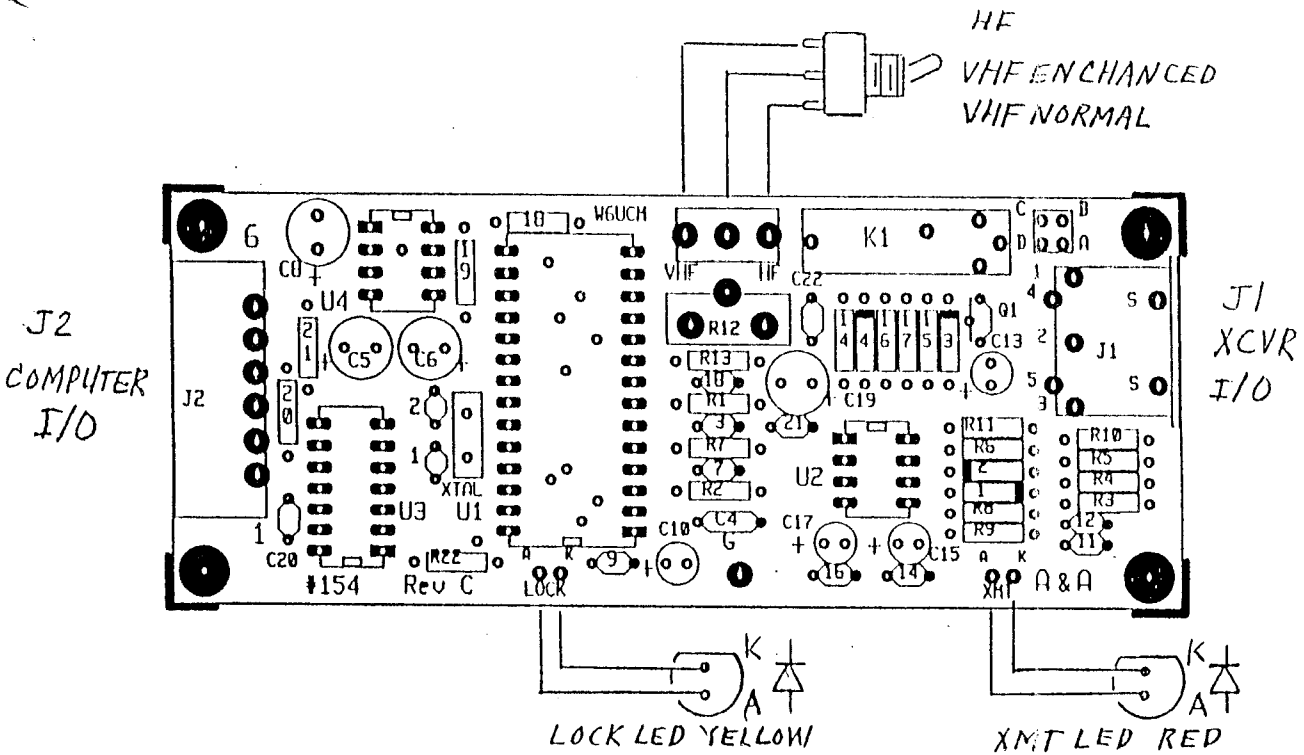
Modem Cable Connector
as viewed from the computer



Mating 5 pin DIN
as viewed from the wiring side



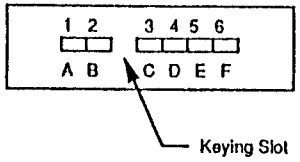
A & A Engineering	2521 W. La Palma, Unit K Anaheim, CA. 92801 USA	
SCALE n/a DATE 13 MAR 88		DRN BY STAS A REV 13 JAN 92
DIGICOM >64 MODEM		
SCHEMATIC	DRAWING NUMBER 492-154	REV C



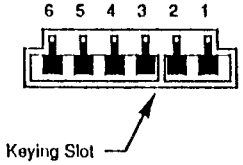
NOTE: Every DigiCom comes supplied with two seperate computer connectors. A board connector and a cable connector. You can use either one.

1) You may choose to mount the board connector and plug the modem into the computer and have it hang out the rear of the computer as would a cartridge. In this case the ferrite beads are not used.
2) Or you may choose to box up the modem and make a computer cable. In this case, the ferrite beads are put on the cable at the computer end.

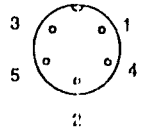
Commodore Cassette Port
as viewed from the outside



Modem Cable Connector
as viewed from the computer



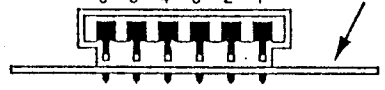
Mating 5 pin DIN
as viewed from the wiring side



Commodore Cassette Port

Pin	Function
A - 1	Ground
B - 2	+ 5V Supply
C - 3	Cassette Motor
D - 4	Cassette Read
E - 5	Cassette Write
F - 6	Cassette Sense

Modem PCB Connector
as viewed from the computer



REF DES	QTY	DESCRIPTION	
R1	1	100 Ω 1/4 W 5%	BN-BK-BN
R2	1	1 MΩ 1/4 W 5%	BN-BK-GN
R3,11,20,22	4	470 Ω 1/4 W 5%	YL-VI-BN
R4	1	6.8 KΩ 1/4 W 5%	BL-GY-RD
R5	1	22 KΩ 1/4 W 5%	RD-RD-OR
R6,7,8,16 18,19	6	100 KΩ 1/4 W 5%	BN-BK-YL
R9,10	2	10 KΩ 1/4 W 5%	BN-BK-OR
R12	1	1 KΩ 1 Turn Vert Pot	
R13	1	33 KΩ 1/4 W 5%	OR-OR-OR
R14	1	10 MΩ 1/4 W 5%	BN-BK-BL
R15	1	4.7 KΩ 1/4 W 5%	YL-VI-RD
R17,21	2	1 KΩ 1/4 W 5%	BN-BK-RD
C1	1	15 pF NPO Disc	
C2	1	30 pF NPO Disc	
C3	1	.002 µF Mylar	(202)
C4	1	.1 µF Mylar	(104)
C5,6,8	3	47 µF Radial	
C7,9 14,16,22	5	.1 µF Disc/Mono	(104)
C10	1	10 µF Radial	
C13,15,17	3	1 µF Radial	
C19	1	4.7 µF Radial	
C11,12,18,20	4	.01 µF Disc/Mono	(103)
C21	1	.005 µF Mylar	(502)
D1,2	2	1N60/270 Ge Diode	
D3,4	2	1N4148 Si Diode	
Q1	1	PN2222A Transistor	
U1	1	AM7910 IC	
U2	1	LM1458 IC	
U3	1	74HCH IC	
U4	1	ICL7660 IC	
SOC	2	8 pin IC socket	
SOC	1	14 pin IC socket	
SOC	1	20 pin IC socket	
K1	1	5V Reed Relay	
Y1	1	2.4576 Mhz Crystal	
J1 (card)	1	5 pin DIN	PCB Connector Radio I/O
J1 (cable)	1	5 pin DIN	Cable Connector Radio I/O
J2 (card)	1	Edge Conn	09-03-1061 Cassette Port
J2 (cable)	1	Cable Conn	09-01-6061 Cassette Port
J2 (pins)	6		.156 Cable Conn Pins
Ferrite Bead	6		FB-43-1501
SW1	1		SP3T toggle switch
LED	1		RED LED w/ mntg clip (XMT)
LED	1		YEL LED w/ mntg clip (LOCK)
HRDW	1	4 pin	.100 header
HRDW	2		Shorting Bars
PCB	1		#154 Rev "C" Circuit Board

A & A Engineering	2521 W. La Palma, Unit K Anaheim, CA. 92801 USA	
SCALE n/a DATE 18 MAR 88		DRN BY STAS A REV 13 JAN 92
DIGICOM >64 MODEM		
COMPONENT LAYOUT	DRAWING NUMBER 492-154	REV C

A&A Engineering
2521 W. LaPalma, Unit K, Anaheim, CA 92801
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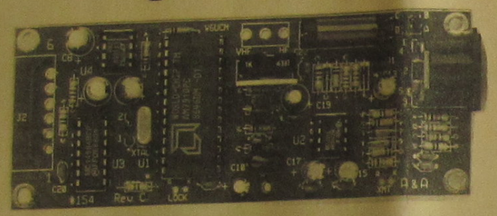
DigiCom>64 & DigiCart



Packet for the Commodore 64 or 128

DigiCom>64 (ITEM #154) is a software-based **PACKET** radio system for the Commodore 64 or 128. The software makes your Commodore 64 or 128 emulate a TNC. The software requires a modem interface between your transceiver and the cassette port. The A & A version of the modem can be plugged directly into the cassette port or remote mounted via a cable. A watchdog timer and reed relay PTT are standard. Operating power is derived from the computer so no external power is required.

The modem circuit is built around the popular **AM7910 WORLD MODEM CHIP ™** which is **crystal controlled so no alignment is required**. A single, three position mode switch allows HF, VHF normal or VHF with equalizer operation. The VHF equalizer mode boosts the high end of the incoming audio, it does not alter the transmit function. Equalizer mode is required with some hand helds.

REVISION "C" of the circuit provides improved HF receive operation. Although not a true squelch, if the volume is set within range, about 100mV p-p, the circuit will only respond to the incoming tones and ignore most of the HF background noise. Other modems are fooled into thinking the channel is busy

A & A Engineering offers blank boards, kit of parts and assembled and tested circuit boards. Should you choose to, you may use the board connector and plug the circuit directly into the computer, or you may remote mount the unit in an enclosure and cable over to the computer. Both connectors are included with every kit or assembly. Also included are; three position mode switch, TRANSMIT and LOCK LED indicators.

Each kit or assembly includes a free disk. Version 2.03 is the most popular version of the software (best documentation) and that is the version that we normally ship. We also have versions 3.51 (BB), 4.01 (EM), 5.00, C128-1 drive and C128-2 drive. Additional disks are just $5.00 each.

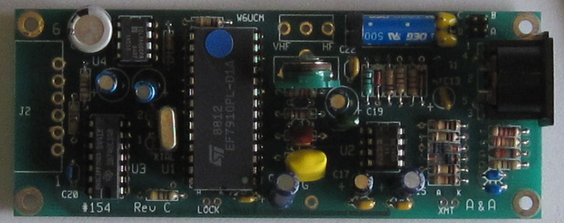
ORDER #154-KIT @ $49.95 or Assembled Board #154-ASY @ $69.95

DigiCart (ITEM #167) is the DigiCom>64 Packet Program in a cartridge - **NO DISC DRIVE REQUIRED.** This is ideal for Commodore users without a disc drive or for those occasions where lugging a drive around is inconvenient. The cartridge is autobooting, ideal for unattended operations such as hilltop digipeater or emergency operating. Should power be interrupted and then restored, the program and parameters will automatically re-boot in 2-3 seconds.

A unique feature of this cartridge is the ability to re-write and save parameters and stored text. This is achieved by using **EEPROM** for storage. Unlike RAM, **no battery backup** is needed to maintain data. You (the user) can write to cartridge using the computer keyboard **without the need of an EPROM burner.** Move the cartridge from one computer to another and all parameters and stored text will move with you.

The Cartridge contains software version 2.03 plus cartridge read and write utilities. Enhancements over version 2.0 include additional password control of remote access features, extended ranges of several parameters and additional CTRL codes. **This is a cartridge version of the software.** A modem interface between transceiver and C64 cassette port is also required. Each cartridge comes with a 25 page instruction book. **Box pictured is no longer sold with the KIT or ASSEMBLY.**

ORDER #167-KIT @ $20.00 Assemblies #167-ASY @ $30.00



DIGICOM>64

A software-based packet radio system for the Commodore 64

by Barry N. Kutner, MD W2UP

Cheap n' Easy Packet!

Packet radio is a relatively new and exciting mode of communications. Unfortunately, there's still often considerable expense to get on packet. A personal computer (or ASCII terminal) and a terminal node controller (TNC) are required for packet operation. Fortunately, the former is already in many ham shacks today. The TNC consists of two main parts: the packet software (in ROM), and a modem circuit for tone encoding and decoding. Together, they produce and decode the packet signal.

I'd often wondered why no one has written a program to emulate the functions of a TNC that would eliminate the need for a somewhat expensive and mode-specific piece of equipment. Well, it *has* been done! Several German hams wrote the system I describe below for the Commodore 64 (or C128 in the 64 mode). It is public domain! While popular in Europe for several years, it remains relatively unknown in the United States. I and others have been providing copies of this software for the ham community.[1]

Why take this approach to packet radio? Personally, I don't like being an "appliance operator." I like to build, modify, and troubleshoot my own equipment. The miniaturization of solid state gear, however, has made this difficult for the non-engineer. I am an eye surgeon who operates through a microscope, and the compactness and complexity of my own equipment intimidates me! Further, with the number of Commodore 64s out there, this system provides inexpensive and easy access to packet radio for many.

The program is written entirely in machine language and is about 30K long. Unfortunately, the authors will not release the documented source code (I have asked), so there is no program listing available. Since the program is machine language and data is transferred through the cassette port of the C-64 or C-128, it is machine-specific and will not function with other computers, including the VICs and the SX64.

The Interface

Since the computer takes care of all our packet housekeeping functions, the interface between the computer and the radio needs only act as a modem. It must take the voltage levels from the computer and turn them into audio tones for transmission, and must turn the incoming AFSK into voltage levels the computer can interpret. There must also be control of receive-transmit switching.

The interface circuit (Figure 1) uses the AM7910 chip, a complete asynchronous FSK modem in a 28-pin DIP package. Signal modulation, demodulation, and filtering functions are performed by digital signal processing (DSP) techniques. Analog-to-digital and digital-to-analog converters are included on the chip. It is used in several of the higher priced commercial TNCs. This circuit permits both VHF and HF operation, and no alignment is required (other than setting the audio output level).

Circuit Description

The mode control pins are 17–21. S1 is used to select one of three modes: HF, VHF, or VHF with Equalizer. All three operate in "loopback" mode so that receive and transmit frequencies are the same (half-duplex operation).

The HF mode makes use of the Bell 103 Answer protocol. Tones are 2025 and 2225 Hz keyed at 300 baud. This mode has been chosen to make the switch as simple as possible (SPDT center-off). Many commercial modems use the CCITT V.21 Answer mode, which has different tone frequencies (more on the significance of this later).

VHF mode uses the Bell 202 protocol with 1200 baud operation and tones of 1200 and 2200 Hz. The Equalizer mode accentuates the 2200 Hz tone for use with those transceivers with a rapid roll-off of the higher frequencies.

The analog audio output from the receiver passes through an op amp, used for buffering, into pin 5 of the 7910 and is then processed by the modem chip. The TTL level output appears at pin 26. It is buffered by a switching transistor before going into the computer for "decoding." Similarly, the transmit data from the computer is presented to pin 10 after passing through a buffer transistor. After being processed by the 7910, its analog tones (at pin 8) pass through an op amp before going into the audio input of the transmitter.

Transmit/receive switching is software controlled and occurs at pin 5 of the C64 cassette port. As this output is 6–7 volts, it is divided in half by a resistor network before being presented to the chip. When the PTT goes low, pin 12 goes low. This instructs the modem to enter transmit mode. A high level on pin 12 turns off transmission of data.

The power requirements are +5 volts at 150 mA and −5 volts at 15 mA.

A few other comments are in order concerning the AM7910 modem. The circuit does not have a tuning indicator. No tuning is needed for VHF. Just set your transceiver to a packet frequency (e.g., 145.01 MHz) and it's all set. For HF operation, tuning is critical and must be within 50 Hz for proper operation. Since the tones generated and decoded are 375 Hz higher in frequency than some commercial TNCs (using the CCITT V.21 protocol), on 20 meters, for example, tune to about 14103.4 kHz, 14105.4 kHz (lower sideband), and so on.

Watchdog Timer

This circuit provides a timeout of the PTT line after about nine seconds key down. This time constant may be altered by changing the values of R6 or C3 in the 555 circuit. It's not necessary to always be present during packet operation. Should the computer crash, or if a power failure occurs during unattended operation, it's possible for the transmitter to remain in the key-down state. This is unhealthy for the transmitter and causes unnecessary interference. This simple safeguard prevents any problems.

Since I received so many requests, I made a printed circuit board available. The PC board is configured to plug directly into the cassette port, and all power comes from this port. (To obtain the −5 VDC, use an ICL7660 voltage inverter chip.) As an alternative, use a 6-conductor cable to mount the unit remotely. Both mountings that use the PC board eliminate the need for an external power supply. Complete parts kits and assembled units containing the watchdog timer and reed relay output options (both containing cassette port connectors and the PC board) are also available.[3]

Overall, the AM7910 interface should cost less than $50 in parts, assuming no junk box parts. Not bad to get on packet!