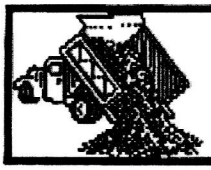
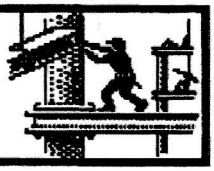


Modifying the Coleco Internal Modem INTO A Serial Card

by Syd Carter



I always wondered what a serial card was all about, sure the signal lines were understood awhile back, but the mystery of getting everything to work was still unanswered. A bit of experimentation provided those answers and now I am a proud owner of a serial card which cost me next to nothing to build. I should clarify that I has to canibalize an original 300 baud modem (Which I didn't use anymore anyway) then there was a chip which I had to purchase. This chip is called the Max232. It's function is to convert the normal computer TTL level signals to standard RS232 levels. This changes the computers +5 & 0 volts into +10 (normally +12v) and -10 (normally -12). These levels are allowable to RS232 standards.

WHY DO I WANT A SERIAL CARD?

Hear is the reason for wanting a serial card. This card is used to interface the computer to a host of standard RS232 type devices. Typical example would be an external modem, however there is a multitude of devices available. My personal preference for designing the serial card was to interface to another computer with serial capabilities, however an RS232 terminal can be interfaced to thereby obtain an 80 column display on the ADAM.

WHAT IS THE PURPOSE?

This article is being released so that others have access to the design details to build their own serial card. A card which is capable of speeds from 9600 baud up to 56K baud. Sure enough, these speeds are to spec, the limitation of the modem is 300 baud as it is configured, however after connecting it as indicated, you bypass the 300 baud limitation and can progress upwards.

START AT THE BEGINNING

A few stats are in order, first off, the serial card will operate at 300 and 1200 baud by just adding the MAX232 chip and cables. No other circuit modification is required. This is due to an internal multiply register. To achieve the 9600 baud upper limit would require some jumpers and crystal interchanging. It is for this reason that the circuit diagram enclosed with this article is so detailed. It shows the clocking circuitry responsible for the speed output. 9600 baud is the upper limit if your going to communicate asynchronously. You will encounter this type most often. When you operate in synchronous mode, the upper 56K baud rate is achievable.

EXPERT APPROACH TO CONSTRUCTION

Withholding the technical details, observe the circuit diagram labeled "Adamlink Modem converted to Serial Card". The lower half of the diagram is where the modification parts are located. Essentially, you must cut 2 traces on your modem card which go to pins 3 and 5 of the U7 chip. This should be the 74HC943 300 baud modem chip. You then connect the MAX232 chip to the INS8251 (U6) chip. After that there is a Db25 connector. If you want to save the modem, then install switches where you cut the traces.

PARTS REQUIRED

1 MAX232 chip, 1 16 pin socket, 4 22uf 16v Electrolytic capacitors, 1 DB25 male type connector, 2 1/2 feet of 4 conductor cable 22 AWG, 1 breadboard to solder everything on plus some connecting wire.

CONSTRUCTION CONSIDERATIONS

Be sure to ground yourself while handling the modem board. A sure way to destroy the modem is by static electricity. The modem circuit board can be removed from it's case be peeling off the Coleco sticker on case top. Then pry apart. The largest chip on the board is the INS8251 chip which should be labeled U6. The MAX232 capacitors are flexible and can be lower than 22uf if so desired. The trade off is in output impedance thereby limiting cable length and increasing the chance of device errors.

DESIGN DETAILS

The configuration shown will provide a 300/1200 baud serial card in the DTE format. This will interface to modems and other DCE type devices. It will not interface to a terminal since a terminal is a DTE type device also. Changing between DTE and DCE is rather simple, just switch the TXD and RXD lines and connect the MAX232 DTR output to pin 6 on the DB25 connector (DSR). Faster baud rates will involve changing the crystal. Observe the reasoning here. The incoming frequency is 3.579545/188 MHz. The divider from Xtal to TXC in order is /2, /47, /2 for a total ratio divide of 188. therefore, the incoming baud rate (clock frequency) is 3.579545/188 = 19040.13 baud. The chip however, is software configured to a multiply of 64, therefore 19040.13/64 = 297.5 baud. yes, your modem is actually running slow. Now consider that another interbal multiply selection is X16. So dividing 19040.13/16 yields 1190 baud. As you see, we are starting to exceed the allowable limits. The last internal multiply is X1. Now consider replacing the crystal with one that divides down to 9600 baud in the X1 multiply. This would yield 9600 baud, yet no other useable baud rates. This is a limitation. You can fiddle around some and obtain 9600/2400. Your main concern is with the chip requirements. The specs state that the incoming clock signal on pin 20 must be greater or equal to 4.5 times the transmit / receive clock. If using synchronous mode, observe 30 times factor. Therefore, if you operate at 9600 baud in the X1 mode, the incoming clock signal must be 9600*4.5 = 43200 Hz. This is not achievable though since the minimum clock signal allowed is 740740 Hz while the maximum incoming clock signal is 2.380952 MHz. My personal preference is to replace the crystal with a 1.8432 MHz value. The first flip flop will have to (Note iagram shows a divide / 47) be placed after the inverter. The end result is to achieve 9600 baud in the X1 mode. By bypassing the two flip/flops and configuring to X16 mode gives you 2400 baud. If your really gung ho, then try wiring the programmable divider to a port address with an 8-bit latch thereby giving you full 9600/4800/2400/1200/300 baud rates. My suggestion here is to gain the spec sheet on the MC14569 Divide by N chip for further details.

SOFTWARE IMPLEMENTATION

A hardware design is only as good as the software behind it. Fortunately, the USART chip is understood by a variety of programmers already. The problem arises since these programmers restricted their software to operate at 300 baud only (X64 mode). This is identified as a multiplier of 3 programmed in the initialization overlay. X16 is number 2 and X1 is number 1. I personally will have software available for the configuration of yet undetermined nature and you may wish to consult me for details when my final configuration is completed. In the meantime, I am operating the base circuit at 300/1200 baud and have ADAMlink II operating. This software operates at 300 baud only since it uses the 60 Hz interrupt vector to read data from the USART. 1200

baud is operational, but you miss some characters. I will most likely be pursuing the programmable baud rate via a port address and an 8-bit latch connected to the MC14569 chip with an 1.8432 MHz crystal. This configuration will be utilized via a terminal program to allow high speed transfers between two computers. 80 column terminal software will be a secondary priority, however the software implementation is rather rudimentary.

IN CLOSING

I make no warrants to the information discussed in this article. I have built and tested my own version as described with exception to the programmable baud rate mod. To my knowledge, this information is accurate to the circuit construction that I prepared. Special thanks to Joe Magner for his initial assistance with understanding the modem circuitry.

FOR FURTHER ASSISTANCE

You can call me by voice between the hours of 8:30pm - 10:30pm at (416) 769-6446. I will provide circuit mods to those who desire it.

REVISION: May 2, 1990.... After hearing that this file and associated schematic diagram was not made readily available, I have posted this to CompuServe for distribution. Since this article was written, a few updates have occured. First, you will notice the diagram shows the one chip having a divide of 47. It should show 48. I corrected the original above article especially in the calculation of baud rate. Second, I have tried the programmable baud rate mod and still encountered an unsucessful operation above 1200 baud. I've also written 80 column software which allows control to pass to a serial terminal with or without a keyboard. These files will be made available as a means of obtaining remission for the work involved to create this project. For a $5.00 fee, I will send you a configured 80 column patch along with source code plus a configured MEX communications software package. Please note that the configuration is for use with original CP/M or at least that which contains the original video drivers. I have no idea if TDOS is compatible.

This project should only cost you around $15.00 to build, but if you wish, then send your working modem (some non working ones may still work) to me along with a check in the amount of $35 payable to:

Trisyd Video Games
26 Florence Cres.
Toronto, ONT., CAN. M6N-4E4

I will construct it and send you the currently configured software. The associated diagram (showing required modifications) is located below. Now, put that unused modem to use!