University of Waterloo

RESEARCH ON DATA TERMINALS AND NETWORK COUPLING ARRANGEMENTS (Part 2)

Final Report

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I Introduction

The Terminal Attachment Program (T.A.P.) sponsored by the Federal Department of Communications (Department of Communications) was initiated in recognition of the growing number of foreign devices attached to the various communications networks throughout the country. The devices ranged from telephone amplifiers to computer data links. Carriers, users and manufacturers have all agreed that such devices will continue to be developed and used. There is agreement on the need for uniform standards to apply to the use and design of foreign devices. Department of Communications has, over the last few years, provided a non-partisian forum to debate and generate a set of standards applicable to all. To this end Department of Communications has issued two major (and a host of minor) standards documents related to the T.A.P. program. (CS-01 Voice Non-Addressing Equipment, March 1978, and CS-02 Data Non-Addressing Equipment, September 1978.)

It is now apparent that the T.A.P. program is facing the very difficult task of adapting to rapidly changing technology. This means new requirements for standards with new emphasis. New technology and an ever increasingly sophisticated user community will pressure the adaption of new standards.

The program has an ongoing need to educate its participants. Manufacturers, especially those small companies typ-

ical of Canadian industry need assistance in interpreting and adapting to the standards established by T.A.P..

II Scope

Coverage in this report is restricted to data non-addressing devices (CS-Ø2). It covers computer modems, facsimile, and medical data links.

This contract provides for the expansion and transfer of a data base of CS-Ø2 ced hardware. This move was made with a minimum of problems in November 1978 to the Department of Communications computer center at Shirley Bay.

Digital data is a large part of many customers' communication requirements. The introduction of two new technologies is likely to dramatically increase this type of data. Packet switching computer networks for commercial users and Videotex type services for the consumers. The latter is likely to have a profound impact on industry with the need for new low cost terminals.

The use of a standard interface which will account for all of the static electrical parameters has been favored for some time. In this contract the design of a standard interface was investigated.

Longitudinal Balance has long been an outstanding problem in the interfacing to the common carrier networks. In this contract the problems associated with longitudinal balance were examined and recommendations made.

III Data Base Transfer to Department of Communications's Computer System at Shirley Bay

A data base of Data Non-Addressing Equipment has been compiled throughout the duration of both Terminal Attachment Program contracts with the University of Waterloo. The data base management software was written in APL and run on the Honeywell 66/60 computer owned by the Math Faculty at the University of Waterloo.

The data base was separated into three parts: modems, medical, and facsimile. Modems, which tend to be used in a wide variety of applications, are the largest part of the data base. Medical and facsimile data are more specialized in nature and are not as common.

The data base and the data base management program were moved to the Department of Communications computer facility at Shirley Bay in November of 1978. The data base management program was modified to function on the Department of Communications computer.

A seminar on the use of the data base was presented in January to Department of Communications personnel to introduce them to the data base system, its commands, and contents.

IV Data Base Observations

It is clear from the data base that most manufacturers requiring the use of the common carriers utilize existing modems developed for general purpose data transmission.

In almost all cases where modems are contained within a piece of equipment the manufacturer chose to utilize a prebuilt modem rather than develop his own. This demonstrates the fear that most specialized equipment manufacturers have of the connections to the common carriers.

The manufacturers' concerns stem from two areas. First, they have a natural fear of the unknown technical standards that they must meet. Second, they fear the carriers themselves in the sense that the carriers might employ the full force of the law on them for accidental regulation violations.

The manufacturer utilization of the prebuilt modem recognizes their concern for proper interface standards and in some ways shows their lack of understanding in the interface parameters. In short, the manufacturer of a new "strange device" requiring data communication wants to busy himself with his "strange device" and wants to remain unconcerned with the data communication problems. Data communication is a problem, "long solved by others", and it is a, "problem he should not be concerned with".

The average small Canadian company is not vertically integrated in structure. The small Canadian company is, in effect, a specialty house in one technical area. The corporate decision to restrict the expertise to one area is motivated by the financial resources available for product support. It is for this reason that the problems of data communications have been left to a few companies prepared to develop expertise in that area. The remaining users of data communication rely on the expertise in the field.

This general observation led me to propose the need for a standard network interface in the first contract on Data Terminals and Network Coupling Arrangements.

Facsimile and some aspects of medical electronics are data transmission intensive by their nature. It was found that their use of built-in data couplers was extremely limited.

V Digital Devices

As noted before the general rule seems to be for manufacturers of unique devices to incorporate manufactured modems for use in their data communication. Commercial data retrieval systems such as Teledon proposed by Department of Communications, and other systems proposed by Bell Canada, and TORSTAR, are areas in the future which may very well prove to be an exception to this general rule. In these systems the demand for high volume cheap terminals will force manufacturers to cut all unnecessary costs to a minimum. This relatively new use of high technology devices utilizing common carriers is likely to have a significant impact on data communications over common carriers. For the first time data communications will be available to the general public in a cheap, readily available form. It will no longer be a race (relative to voice communications) use of the existing networks. New industries are likely to get quickly on the bandwagon and a very competitive marketplace is likely to emerge. At this time, Canada is taking a lead in data retrieval type commercial systems. The success of technology trials here is being watched carefully by other countries.

The rapid growth of the new Videotex technology suggests the need for separate kinds of regulation. The terminals in this new area are simple user produced consumer terminals. There is serious question whether such terminals

should be regulated on electrical characteristics alone or if the digital protocol should be tested as well.

A second consumer related product likely to spin-off from the emerging nigh technology in both terminals and data communications is electronic mail systems. There already exists many systems associated with time-share computer systems. For example, when I access the time-snare system of the University of Waterloo, I get an indication of the total number of memos sent to me by other time-share users. It has provided a method of contact to me that is reliable and quick. I can, at my leisure, answer or act on the messages (usually once a day) and what is better, I can access the time-share system from almost any place in North America with a local telephone call. This is accomplished via the newly developed data communication networks (DATAPAC in Canada and Telenet and TYMNET in the U.S.A.). The establishment of centers for message nandling is likely only to occur in the near future. Such centers are likely to be used initially by manufacturers to process sales orders from sales representatives and by other groups as a common low cost communications system to keep track of employees who are travelling extensively.

VI Standard Terminal Interface

In the first T.A.P. contract it was found that a definite need existed to have a standard terminal interface. There nas been a long term reluctance by manufacturers to deal directly with the common carrier networks if it could be avoided.

Appendix 5 includes a schematic and a description of a standard interface circuit. It is designed to meet all of the necessary interface parameters except spectral content and signal levels. The use of a standard interface will minimize the need of a manufacturer to develop common carrier interfaces. The manufactucer will have to make only level adjustments to the interface and ensure his data meets the spectrum content requirements outlined in the CS-02 Certification Standards.

It is anticipated that the design of a Standard Terminal Interface will be placed in the public domain. It is expected that the Standard Terminal Interface could be used by manufacturers to summarize the amount of design time required to interface to the common carrier networks.

VII Longitudinal Balance

> "Telephone companies and equipment manufacturers have generally agreed on a definition for longitudinal balance for many years. This agreement extends also to the basic approach followed when measuring balance. Testing for balance involves the application of a longitudinal voltage. Then any resulting metallic voltage is measured, and the ratio of the two voltages is used to develop a balance number. Unfortunately, agreement has ended at about this point." (IEEE Std. 455-1976.)

Longitudinal balance is defined to be good when the input impedance of two terminals is very nearly identical with reference to some external point, usually ground.

Most of the problems related to Longitudinal Balance has centered on two items 1) How is longitudinal balance measured? 2) What constitutes acceptable longitudinal balance?

My examination of the longitudinal balance problem has yielded several cost-wise questions. It is generally acknowledged that improving the longitudinal balance of a terminal device will improve the overall quality of the net-

work. It can also be stated that the effects of poor longitudinal balance accumulate and when the longitudinal balance of a terminal is measured we examine its contribution to overall network imbalance. The effect of imbalance is line cross-talk which often can actually be heard on standard telephone lines.

The question of measurement technique has been answered by the publication of an IEEE document entitled, "IEEE Standard TEST Procedure for Measuring Longitudinal Balance of Telephone Equipment Operating in the Voice Band". (IEEE Std. 455-1976). This short document contains a great deal of useful information related to longitudinal balance, its meaning, and its measurement. It is also referred to in the CS-02 Certification Standard in the section on Longitudinal Balance.

At least in part, the Certification Standard CS-02 fails to leave the reader with a clear idea about the expected results in measuring Longitudinal Balance. CS-02 refers to IEEE Standard 455-1976 as source both as its measurement and as the configuration of the test environment. I would recommend that more information regarding the IEEE Std. 455-1976 test set be published as part of the CS-02 Standard. This would give a better indication to manufacturers (especially small ones) about the required technical specification of terminals attaching themselves to the common carrier networks.

This is important for a second reason as well. A well meaning manufacturer purchases the required Department of Communication documents relating to the Terminal Attachment Program only to find that information essential to compliance with the program is lacking.

The numerical evaluation of terminal equipment for longitudinal balance poses several serious problems. The figure of merit assigned to a terminal specifies the longitudinal imbalance to the network of a specific terminal. Imbalance is an accumulative effect of many different network components. The common carriers equipment contributes to the overall effect of increased noise and cross-talk between lines. The Canadian approach through T.A.P. has been to establish values of imbalance to the point where a properly designed terminal can meet the requirements. These values are somewhat higher than those generally suggested in the U.S.A. (Petition to F.C.C. from Charles D. Hansell, Chairman IEEE Susceptability Subcommittee, April 1978.) At this point in time, I believe that these values should be retained. The balance values as they exist assure Canadian product acceptance in the United States.

The standards as they exist will assume Canadian consumers of a high product standard. The high quality Canadian carrier networks will not be adversely affected by the addition of new foreign devices. This assurance is important for all users in the years to come.

VIII Summary

The growth of the Terminal Attachment Program at Department of Communications has focussed the interests of users and manufactucers of terminal equipment to the interface standards sought by the common carriers. Department of Communications through the T.A.P. program has served as an unbiased forum to debate and establish standards. As tecnnology cnanges, new and different standards will likely be sought.

Computer networks, for example, already require that terminals have both electrical standardization and standardization of the data formats. This type of terminal standard will likely be eventually required for use with the new information retrieval type of consumer services. Although it is not clear at this time exactly in which direction these services will go, a number of common items seem to be emerging. Mass use of specialized terminals will likely generate keen competition between Canadian companies for the market place. Department of Communications has been studying such services throughout its Videotex program. It is my opinion that regulations pertaining to Videotex related services should be examined now for implementation at some future time.

The use of common carrier networks for data transmission is now a common place occurrence. The variable nature of the user applications has tended to encourage manufactur-

ers to treat the actual interface to the common carrier networks as a separate problem. It has been usual for a manufacturer to use a standard interface (modem) manufactured by someone else.

In many respects manufacturers (especially small ones) are afraid of the common carrier networks. The interface terms and conditions are foreign to them and they rationalize this fear by observing that they are able to buy a solution to their interface problems. The need for a standard interface exists. The use of a standard network interface will encourage product development by small companies.

The publication of a standard network interface will give insight to manufacturers of the requirements of the network interface. It will also provide a badly needed example to enhance the CS-02 test specification.

The longitudinal balance of a terminal device has long been an outstanding problem; both the measurement of the longitudinal balance and the evaluation of balance. I would recommend that the IEEE Standard 455-1976 continue to be used in measuring longitudinal balance. This standard is simple and has achieved almost universal acceptance. I would like to add, however, that CS-02 certification standards be altered to more fully explain both the nature of longitudinal balance and to illustrate the mechanics of the actual tests.

On a quantitative basis the present values of acceptable longitudinal balance should be left as they are. I believe the current limits will encourage the maintenance of a high communication standard.

The future will have many more data terminals especially related to interactive consumer data base retrieval equipment. It is my belief that terminal equipment of this type will likely require certification for both data protocol and electrical standards. On the bright side I would expect such equipment to be simple, reliable, and well engineered.

IX Appendices:

(1) USER Manual for the Data Base

(2) MODULAR Data Base Entries

(3) FACSIMILE Data Base Entries

(4) MODEM Data Base Entries

(5) STANDARD Network Interface

(6) SAMPLE Terminal Session

Appendix 1

USER MANUAL FOR THE DATA BASE

The Terminal Attachment Program (T.A.P.) database contains information on items which use the telephone network to send data. These items are in three categories: modems, facsimile equipment, and medical equipment. By far the largest area is modems with over 300 entries. Each entry in each category has several "attributes" associated with it. For example, in the modems, attributes include manufacturer's name, the modem's model number, its baud rate, cost, and so on. In this database, these are referred to as "headings".

There are commands which allow the user to manipulate the data to suit his requirements. Unwanted data can be discarded (temporarily), data can be sorted, and data can be printed in a variety of ways.

When first signing on to the database, one has access to the whole pool of data. However, one seldom wants to print out all of the data -- so the database includes commands to remove the unwanted pieces of data from the pool. One can think of it as looking at the whole subject at first, and then narrowing down the view until you see only those things which are of interest. At that time, these remaining items can be printed on the terminal.

The following is a detailed description of how to use the commands to manipulate the database information. Note that in the examples which are given, text which would be typed by the user of the database is indented six spaces from the left, just as it would be when the user typed it. The database program's replies start at the left margin.

Getting to the Database

To use the database, one must first tell the computer to enter the APL subsystem. This is because all the commands to manipulate the database are written in the APL language. Assuming that one is signed on, and has just received a prompt from TEL (the exclamation mark), the following will enter APL:

```
!APL<cr>                    <---user types "APL" and hits return
```

Now, the user must load the programs into his workspace. This is done by typing:

```
    )LOAD DATABASE
```

The right parenthesis tells APL that this is a command. The database program will now be loaded and will commence execution automatically.

The first thing you will be asked is to specify which of the three areas you are interested in: modems, facsimile, or medical equipment. Each is stored in a separate file, and

so only one can be accessed at a time. After you have specified, the appropriate files will be opened, and control is given to the user. Note that the prompt for the user is six blanks, i.e. the typewheel (or cursor) will move in six spaces from the margin and wait.

General Command Information

Any of the system commands can be invoked simply by typing a single command name and hitting return. If more information is required, the program will prompt the user for it.

Help and Explain

There is a command which will introduce the user to all of the other commands: it is "HELP". When the user types "HELP", he will be given a list of all of the commands available, and a short note on each. One of the commands is a supplement to "HELP", and that is "EXPLAIN". If a user types "EXPLAIN", and hits return, he will be asked to enter the name of a command he wants explained. This will give him a more detailed description of that command than "HELP" could give.

The following is a list of commands, similar to the one given by the "HELP" command:

BYE to sign off

ENTRIES to find out how many entries there are

EXPLAIN	to find out how to use the commands correctly
SELECT	to select entries which contain specific data
HEADINGS	to get a list of valid headings
HELP	to see this list of commands
LINES	to set the maximum number of lines per page
PRINT	to print the selected entries
RESTART	to 'unget' the entries and start over
SORT	to sort the entries into alphabetical order
WIDTH	to set the maximum number of characters per line

The "EXPLAIN" command will give the user more detailed information on each of these commands. The following is similar to information given by the "EXPLAIN" command:

```
      EXPLAIN
WHICH COMMAND? BYE
TO SIGN OFF OF THE SYSTEM JUST TYPE THE WORD BYE.
      EXPLAIN
WHICH COMMAND? ENTRIES
TO FIND OUT HOW MANY ENTRIES ARE CURRENTLY AVAILABLE,
JUST TYPE THE WORD ENTRIES.
      EXPLAIN
WHICH COMMAND? EXPLAIN
TO GET AN EXPLANATION OF THE COMMANDS IN THIS SYSTEM,
JUST TYPE THE WORD EXPLAIN.
TO SEE A LIST OF VALID COMMANDS, TYPE THE WORD HELP.
```

Entries

The entries command tells the user how many pieces of data remain in the available data pool at any time. As the user removes more and more unwanted pieces of data from the pool by using the "SELECT" command, the number returned by the "ENTRIES" command will be reduced to reflect this. In addition, this command is automatically invoked at the end of the "SELECT" command. Example:

```
      ENTRIES
112 ENTRIES
```

Headings

The "HEADINGS" command tells the user the names of the headings currently in use. These headings will change, depending on which section of the database is being used: modems, facsimile, or medical equipment. They may also change as the database information is updated. This information is necessary to use the "SELECT" command correctly. Example:

```
      HEADINGS
THE FOLLOWING ARE VALID HEADINGS:
MANUFACTURER,MODEL,SPEED,COST,COMMENTS
```

Restart

The "RESTART" command reverses the effects of the "SELECT" command. All of the data which was discarded becomes available again. This allows the user to start over.

Example:

```
      ENTRIES
23 ENTRIES
      RESTART
309 ENTRIES
```

Sort

The "SORT" command will sort the selected data alphabetically. After the command name is entered, the user will be prompted to enter the names of the headings he wishes the sort to be done on. That is to say, if he wants the data in order of manufacturer's name, he would enter "MANUFACTURER". Note that more than one name may be entered at once, separated by commas. This allows the user to have all the items of one manufacturer (for example) further sorted by model number. Example:

```
      SORT
WHICH HEADINGS? MANUFACTURER,MODEL
```

Select

When using the database, one can select entries which are of interest by using the "SELECT" command. The rest of the data is discarded. In this way, the user can cut down the amount of data to be printed. Then, the information which remains can be printed on the user's terminal. In this manner, one extracts only the pertinent information

from among all of that which is contained in the database. To use the select command, type the word "SELECT". The program will then ask for three pieces of information, one at a time. It will want to know what heading you want to use, what data you are looking for in that heading, and the match you want made (equality, inequality, etc.) It will ask "WHICH HEADING?", to which you should answer one of "MANUFACTURER", "MODEL", or the like. This indicates which heading you want to use as the basis for keeping or discarding the data. The second question will be "WHAT RELATIONSHIP?". Answers to this will include "EQ" for equal, "NE" for not equal, etc. This is further explained below. The third question is "WHAT VALUE?". Here one types the name of the company, or type of modem, or cost, or whatever one is searching for. See the following examples:

```
      SELECT
WHICH HEADING? MANUFACTURER
WHAT RELATIONSHIP? EQ
WHAT VALUE? DATAMEX
```

In this example the user wants to select all the entries where the manufacturer is equal to "DATAMEX".

```
      SELECT
WHICH HEADING? SPEED
WHAT RELATIONSHIP? LE
WHAT VALUE? 300
```

This example demonstrates how to select the modems whose speed is less than or equal to 300 bps.

This is the complete list of relationships:

EQ equal

NE not equal

LE less than or equal to

LT less than

GE greater than or equal to

GT greater than

NE not equal

CO contains

The "CO" relationship can be used where the exact name of a company, for example, is not known. If the user answers the three questions as "MANUFACTURER", "CO", and "DATA", all companies whose name contains the phrase "DATA" will be selected.

Print

The "PRINT" command, of course, is used to print the remaining data on the users terminal. All that's necessary is to enter the word "PRINT". The format of the output is controlled by the "LINES" and "WIDTH" commands, which the user should use before printing (see below). The "PRINT" command will ask the user to enter the names of the headings he wants printed. These headings will be printed out in the order that the user enters them. Therefore, if you're in-

terested in the model number, and the cost, it would make sense to enter "MODEL,COST". A person interested in the manufacturer's name, and any comments would enter "MANUFACTURER,COMMENTS" instead. Example:

```
      PRINT
WHICH HEADINGS? MODEL,COST

-3023                          -$ 249

-103A                          -$ 153
```

Lines and Width

The "LINES" and "WIDTH" commands are used to tell the programs the size of the user's page or terminal screen. As before, just enter the command name, and you will be prompted for data. The number you give to the "LINES" command indicates the maximum number of lines which will be printed per page. After this many lines, output will be suspended until the user hits the "return" key on his terminal. The number given to "WIDTH" determines the length of the lines that will be printed. If the line would have been too long, it is chopped in an appropriate place, and the remainder is shifted to the next line.

Bye

The "BYE" command gets the user out of the database, and back to TEL, the normal level on the computer. Just enter the word "BYE".

A Typical Session

A typical user's session with the database might go as follows:

1. User signs on and accesses database.
2. User specifies area of interest; modems, fax, or medical.
3. User finds out how many pieces of data are available with "ENTRIES" command.
4. User decides to cut down number of entries by judicious use of "SELECT".
5. User tells programs size of page with "LINES" and "WIDTH" commands.
6. User has data printed on terminal by "PRINT" command.
7. User signs off via "BYE" command.

Final Notes

Because of the method used in the construction of the commands for the database, it is possible to get unexpected error messages. This would happen if the user typed invalid commands or garbage where a command name was expected. These messages are generated by APL directly, and do not indicate a problem with the database, only that the user should stick with the proper commands.

Appendix 2

MEDICAL DATA BASE ENTRIES

manufacturer	-model	-line type
	-line connection	-frequencies
	-comments	
Hewlett Packard	-1517A	-voice grade
	-internal daa	-1075,1935,2365 Hz
	-internal auto dialer	
Cambridge Instrument	-3038	-voice grade
	-internal daa	-1375,1935,2365 Hz
	-internal auto dialer	

Appendix 3

FACSIMILE DATA BASE ENTRIES

manufacturer	-model	-speed
	-line connection	-modulation
	-line type	-comments
Infolink	-Scanatron	-3 min./page
	-daa	-fsk/fm
	-voice grade	-
Infolink	-Electrowriter	-na
	-daa	-fm
	-voice grade	-transmits handwriting
Graphic Sciences	-dex 4100	-2 to 12 min./page
	-daa	-fm
	-voice grade	-
Graphic Sciences	-dex 700	-2 to 6 min./page
	-acoustic coupler	-am/fm
	-voice grade	-uses reverse channel
Graphic Sciences	-dex I	-6 min./page
	-acoustic coupler	-fm
	-voice grade	-uses reverse channel
Graphic Sciences	-dex VI	-6 min./page
	-daa	-fm
	-voice grade	-uses reverse channel

Graphic Sciences	-dex VII	-6 min./page
	-automatic daa	-fm
	-voice grade	-uses reverse channel
Graphic Sciences	-dex IX	-4 min./page
	-acoustic coupler	-fm
	-voice grade	-uses reverse channel
Graphic Sciences	-dex 180	-3 or 6 min./page
	-acoustic coupler	-fm
	-voice grade	-uses reverse channel
Graphic Sciences	-dex 181	-3 or 6 min./page
	-daa	-fm
	-voice grade	-uses reverse channel
Graphic Sciences	-dex 182	-3 or 6 min./page
	-automatic daa	-fm
	-voice grade	-uses reverse channel
Graphic Sciences	-dex 120	-2 min./page
	-acoustic coupler	-fm
	-voice grade	-uses reverse channel
3M	-VRC II	-4 or 6 min./page
	-acoustic or daa	-fm
	-voice grade	-output 3dbm adjustabl
3M	-VRC 593	-3 to 6 min./page
	-acoustic coupler	-fm
	-voice grade	-output -15 to 3dbm adjustable

34	-VRC	-4 or 6 min./page
	-acoustic coupler or daa	-fm
	-voice grade	-output 0dbm adjustabl
34	-9600	-35 sec./page
	-daa	-fsk
	-voice grade	-digitally encodes dat

Appendix 4

MODEM DATA BASE ENTRIES

manufacturer	-model	-equivalent
	-speed	-modulation method
	-asynch/synch	-half/full duplex
	-line type	-line conditioning
	-connection signal	-equalisation
	-reverse channel	-voice/data
	-originate/answer	-loopback
	-comments	-price
Acrodyne	-VTC1	-103A
	-300	-fsk
	-a	-half/full
	-acoustic;2 wire	-
	-RS2323/C;contact	-
	-	-
	-orig	-
	-	-$ 325
Acrodyne	-VTC2	-103A
	-300	-fsk
	-a	-half/full
	-acoustic;2 wire	-
	-RS2323/C	-
	-	-
	-auto ans	-
	-	-$ 625

American Systems	-34033	-4033D/E
	-10	-fsk
	-a	-simplex
	-2 wire	-
	-RS232C;contact	-fixed
	-	-
	-orig/auto ans	-
	-receives Touch Tones	-not available
Anderson Jacobson	-A242	-103A
	-450	-fsk
	-a	-half/full
	-acoustic	-
	-RS232B;teletype	-
	-	-
	-orig	-
	-	-$ 365
Anderson Jacobson	-A246	-103A
	-450	-fsk
	-a	-full
	-acoustic	-
	-RS232C;TTL	-
	-	-
	-orig	-
	-OEM only	-$ 210

Anderson Jacobson	-AD342	-103A
	-300	-fsk
	-a	-half/full
	-acoustic;2 wire	-
	-RS2323;teletype	-
	-	-
	-orig/ans	-
	-	-$ 435
Anderson Jacobson	-ADAC1200	-202C
	-1200	-fsk
	-a	-simplex/half
	-acoustic	-
	-RS2323	-
	-	-
	-	-
	-	-$ 935
Anderson Jacobson	-ADC212	-
	-300	-fsk
	-a	-full
	-acoustic	-
	-CCITT	-
	-	-
	-	-
	-U.K. version	-$ 495

Anderson Jacobson	-AJ211	-
	-300	-fsk
	-a	-half/full
	-acoustic;2 wire	-
	-CCITT	-
	-	-
	-	-
	-fits European handset	-$ 495
Anderson Jacobson	-DCM151	-
	-150	-fsk
	-a	-half/full
	-2/4 wire	-
	-I3M type	-
	-	-
	-orig/ans	-
	-limited distance	-$ 165
Anderson Jacobson	-L142	-103F
	-300	-fsk
	-a	-half/full
	-2/4 wire	-
	-	-
	-	-
	-	-
	-	-$ 240

Anderson Jacobson	-L145	-103F
	-300	-fsk
	-a	-half/full
	-2/4 wire	-
	-	-
	-	-
	-auto ans	-
	-	-$ 240
Anderson Jacobson	-L150/12 series	-
	-600	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232C	-
	-	-
	-orig/ans	-rem/loc
	-	-$ 155 to $ 230
Anderson Jacobson	-L184/12	-103F
	-450	-fsk
	-a	-half/full
	-2 wire	-
	-RS232C	-
	-	-
	-ans	-rem/loc
	-	-$ 130

Anderson Jacobson	-MJ1291/12	-202C/D
	-1200	-fsk
	-a	-simplex/half
	-DAA;2/4 wire	-
	-RS232C	-man
	-rev	-
	-orig/auto ans	-rem/loc
	-	-$ 350
Anderson Jacobson	-MJ293/12 series	-103A/E
	-450	-fsk
	-a	-full
	-DAA	-
	-RS232C	-
	-	-
	-orig/auto ans	-rem/loc
	-	-$ 210
Anderson Jacobson	-TMJ330K	-103A
	-150	-fsk
	-a	-half/full
	-2/4 wire	-
	-teletype	-
	-	-
	-orig/ans	-
	-mounted in teleprinter	-$ 320

Astrocom	-110	-103;113
	-300	-fsk
	-a	-simplex/half/full
	-acoustic;2 wire	-
	-RS2323/C;teletype	-
	-	-
	-orig	-
	-	-$ 295
Astrocom	-110\	-103;113
	-300	-fsk
	-a	-half/full
	-acoustic;2 wire	-
	-RS232C;teletype	-
	-	-
	-orig/ans	-loc
	-	-$ 345
Astrocom	-120 series	-202
	-1200/1300	-fsk
	-a	-simplex/half
	-2/4 wire	-C2
	-RS2323/C	-fixed
	-rev	-
	-orig/auto ans	-
	-has indicators	-$ 245 to $ 500

Astrocom	-133 series	-103
	-300	-fsk
	-a	-full
	-2 wire	-
	-RS232B/C	-
	-	-
	-orig/auto ans	-
	-has indicators	-$ 145 to $ 415
Astrocom	-140	-
	-1200	-fsk
	-a	-half/full
	-2 wire	-
	-RS232B/C	-
	-dev	-
	-orig/auto ans	-
	-signal status indicator	-$ 430
Astrocom	-320	-201A/B/C
	-300	-pm
	-s	-simplex/half/full
	-2/4 wire	-
	-RS232B/C	-fixed
	-	-
	-orig/ans	-loc
	-self test	-$1200

Astrocom	-103/2	-
	-2400 to 19200	-pm
	-s	-half/full
	-2/4 wire	-
	-RS232B/C	-
	-	-
	-orig/ans	-rem/loc
	-limited distance	-$ 725
Astrocom	-SC200	-
	-2000 to 19200	-pm
	-s	-simplex/half/full
	-2/4 wire private	-
	-RS232B/C	-
	-	-
	-orig/ans	-rem
	-self test;limited dist.	-$ 920 to $1525
Astrocom	-SC400	-
	-10000 to 100000	-pm
	-s	-simplex/half/full
	-2/4 wire private	-
	-RS232B/C	-
	-	-
	-orig/ans	-
	-limited distance	-$1825

Bell System	-103A	-101;103;113
	-300	-fsk
	-a	-half/full
	-2 wire	-
	-RS232C	-fixed
	-	-v/d
	-orig/auto ans	-
	-integral handset	-not available
Bell System	-103J	-101;103;113
	-300	-fsk
	-a	-half/full
	-2 wire	-
	-RS232C	-fixed
	-	-v/d
	-orig/auto ans	-rem/loc
	-	-not available
Bell System	-113A	-101;103;1133
	-300	-fsk
	-a	-half/full
	-2 wire	-
	-RS232C	-fixed
	-	-v/d
	-orig	-
	-integral handset	-$ 12/mo

Bell System	-1133	-101;103;113A
	-300	-fsk
	-a	-half/full
	-2 wire	-
	-RS232C	-fixed
	-	-v/d
	-auto ans	-
	-integral handset	-$ 10.50/mo
Bell System	-113D	-101;103;107
	-300	-fsk
	-a	-half full
	-2 wire	-
	-RS232C	-fixed
	-	-v/d
	-auto ans	-rem digital
	-	-not available
Bell System	-201A	-201A
	-2000	-4 phase pm
	-s	-half/full
	-2/4 wire	-C2
	-RS232C;contact	-fixed
	-	-v/d
	-orig/auto ans	-
	-integral handset	-$ 55 to $ 70 /mo.

Bell System	-2013	-2013/C
	-2400	-4 phase pm
	-s	-half/full
	-2/4 wire	-C2
	-RS232C;contact	-fixed
	-	-v/d
	-orig/auto ans	-
	-integral handset	-$ 55 /mo.
Bell System	-201C	-2013/C
	-2400	-4 phase pm
	-s	-half/full
	-2/4 wire	-
	-RS232C	-fixed
	-	-
	-orig/auto ans	-rem/loc
	-self test	-$ 59.55 /mo.
Bell System	-201LSI	-
	-2000/2400	-pfk
	-s	-
	-2/4 wire	-
	-RS232C	-adaptive
	-150 bps	-v/d
	-	-rem/loc
	-	-not available

Bell System	-202C	-202A/D/E/R/S
	-1200/1800	-fsk
	-a	-half/full
	-2/4 wire	-C1/C2
	-RS232C	-fixed
	-rev	-v/d
	-orig/auto ans	-
	-	-$ 30 to $ 35 /mo.
Bell System	-202D	-202A/C/E/T
	-1800	-fsk
	-a	-half/full
	-2/4 wire	-C1/C2
	-RS232C;contact	-fixed
	-rev	-v/d
	-orig/auto ans	-
	-	-$ 30 to $ 40 /mo.
Bell System	-202E	-202A/C/D/S
	-1800	-fsk
	-a	-half
	-2/4 wire	-C1/C2
	-RS232C	-fixed
	-rev	-v/d
	-orig/auto ans	-
	-	-$ 14 /mo.

Bell System	-202R	-202A/C/D/E
	-1300	-fsk
	-a	-half/full
	-2/4 wire	-C1/C2
	-R3232C	-fixed
	-	-v/d
	-orig/ans	-
	-	-$ 13 to $ 20 /mo.
Bell System	-202S	-202C
	-1200	-fsk
	-a	-half
	-2 wire	-
	-R3232C	-fixed
	-rev	-v/d
	-orig/auto ans	-rem/loc
	-self test	-$ 32.50 /mo.
Bell System	-202T	-202D/R
	-1300	-fsk
	-a	-half/full
	-2/4 wire	-C2
	-R3232C	-fixed
	-rev	-v/d
	-orig/ans	-rem/loc
	-	-$ 24.85 /mo.

Bell System	-203A	-
	-4300	-3 phase pm
	-s	-half/full
	-4 wire	-
	-RS232C	-auto
	-	-v/d
	-orig/ans	-rem/loc
	-self test	-$ 135 /mo.
Bell System	-2033	-
	-4300	-3 phase pm
	-s	-half
	-2 wire	-
	-RS232C	-auto
	-	-v/d
	-orig/auto ans	-rem/loc
	-self test	-$ 135 /mo.
Bell System	-209A	-
	-9600	-quam
	-s	-half/full
	-4 wire	-D1
	-RS232C	-auto
	-	-v/d
	-orig/ans	-rem/loc
	-self test	-$ 249 /mo.

Bell System	-212A	-101;103;113
	-300	-fsk
	-a	-half/full
	-2 wire	-
	-RS232C	-fixed
	-	-v/d
	-orig/auto ans	-rem/loc
	-	-not available
Bell System	-212A	-212A
	-1200	-fsk
	-s	-full
	-2 wire	-
	-RS232C	-fixed
	-	-v/d
	-orig/auto ans	-rem/loc
	-	-not available
Bell System	-300 series	-
	-19200 to 230400	-
	-s	-
	-5000/3000 common chan'l	-
	-	-
	-	-
	-	-
	-built into terminals	-not avail

Bell System	-300/1200	-101;103;113
	-300	-fsk
	-a	-half/full
	-2 wire	-
	-RS232C	-fixed
	-	-v/d
	-orig/auto ans	-rem/loc
	-	-not available
Bell System	-407A	-401
	-10	-fsk
	-a	-simplex
	-2 wire	-
	-voltage;contact	-fixed
	-	-v/d
	-auto ans	-
	-receives Touch Tones	-not available
Bell System	-4073	-401
	-10	-fsk
	-a	-simplex
	-2 wire	-
	-voltage;contact	-fixed
	-	-v/d
	-auto ans	-
	-receives Touch Tones	-not available

Bell System	-407C	-491
	-110 to 300	-fsk
	-a	-half
	-2 wire	-
	-RS232C;contact	-
	-	-v/d
	-auto ans	-
	-uses Touch Tones	-not available
Bell System	-Codex 9600	-
	-9600	-phase ampl.
	-s	-
	-4 wire	-
	-RS232C	-auto
	-	-v/d
	-	-digital
	-	-not available
Bell System	-GDC202T	-
	-1200/1800	-fsic
	-a	-
	-2/4 wire	-
	-RS232C	-line
	-rev	-
	-	-loc
	-	-not available

Bell System	-4103	-
	-2400/4800	-qam
	-s	-
	-4 wire	-
	-RS232C	-adaptive
	-	-
	-	-loc
	-	-not available
Burroughs	-TA2400 series	-2013
	-2400	-psk
	-s	-half/full
	-2/4 wire	-
	-RS232C	-fixed
	-	-
	-orig/ans	-rem/loc
	-2400 has auto ans	-$1600
Burroughs	-TA713	-202D
	-1300	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232C	-man
	-	-
	-orig/ans	-rem/loc
	-	-$ 700

Burroughs	-TA714	-2020
	-1200/1300	-fsk
	-a	-half/full
	-2/4 wire	-C2 (at 1200)
	-RS232C	-fixed
	-	-
	-orig/auto ans	-rem/loc
	-auto call	-$1000
Burroughs	-TA714-1	-
	-1300	-fsk
	-a	-
	-2/4 wire	-
	-RS232	-EIA
	-	-
	-	-yes
	-	-$1700
Burroughs	-TA733-48	-
	-4800	-3 phase psk
	-s	-half/full
	-4 wire	-C1
	-RS232C;CCITT	-
	-	-
	-orig/ans	-rem/loc
	-	-$5000

Burroughs	-TA733	-202D
	-1300	-fsk
	-a	-half/full
	-4 wire	-
	-RS232C	-
	-	-
	-orig/ans	-rem/loc
	-	-$ 950
Carterfone	-403D	-403D
	-10	-fsk
	-a	-half
	-2 wire	-
	-2-of-8;3C4;voltage	-
	-	-
	-auto ans	-
	-busy out diagnostic	-$ 495
Carterfone	-D3103A	-103A
	-440	-fsk
	-a	-full
	-2/4 wire	-
	-RS232B/C;teletype	-
	-rev	-v/d
	-orig/auto ans	-rem
	-integral handset	-$ 425

Carterfone	-FNX/DDD model	-1010
	-440	-fsk
	-a	-half/full
	-2/4 wire;DAA	-
	-RS232C;teletype	-
	-	-v/d
	-orig/auto ans	-rem
	-	-$ 425 to $ 550
Carterfone	-Telex model	-
	-75	-telex
	-a	-half
	-telex	-
	-telex	-
	-	-
	-orig/ans	-loc
	-	-$ 330
Codex	-4300	-
	-4800	-qam
	-s	-
	-4 wire	-
	-RS232C;MIL188C;CCITT	-auto
	-150 bps	-v/d
	-auto ans	-
	-	-$4300

Codex	-4800 dial	-
	-4800	-qam
	-s	-half
	-2/4 wire	-
	-RS232C;CCITT	-auto
	-rev	-v/d
	-orig/auto ans	-rem/loc
	-	-$5575
Codex	-48001	-
	-4800	-qam
	-s	-
	-4 wire	-
	-RS232C	-auto
	-75/150 bps	-v/d
	-	-
	-	-$4800
Codex	-4800C	-
	-3200/4800	-qam
	-s	-simplex/half/full
	-4 wire	-
	-RS232C;CCITT;MIL188	-auto
	-150 bps	-v/d
	-orig/ans	-rem/loc
	-multiplexing	-$4500

Codex	-4300I	-
	-4300	-8 phase psk
	-s	-half/full
	-4 wire	-M102
	-CCITT	-auto
	-rev	-v/d
	-orig/ans	-rem/loc
	-multiplexing	-$4500
Codex	-4300MP	-
	-4800	-psk
	-s	-full
	-4 wire	-C1
	-RS232C;CCITT	-auto
	-rev	-v/d
	-orig/ans	-rem/loc
	-	-$4500
Codex	-7200	-
	-7200	-qam
	-s	-
	-4 wire	-
	-RS232C;MIL133;CCITT	-auto
	-	-v/d
	-	-
	-	-$7200

Codex	-7200C	-
	-4800/7200	-qam
	-s	-half/full
	-4 wire	-C2
	-RS232C;CCITT;MIL188	-auto
	-	-v/d
	-orig/ans	-rem/loc
	-multiplexing	-$6350
Codex	-3200LDSU	-
	-2400 to 19200	-pm
	-a/s	-half/full
	-2/4 wire	-
	-RS232C;MIL188	-fixed
	-	-
	-orig/ans	-rem/loc
	-limited distance	-$ 995
Codex	-8300G3M	-
	-48000 to 64000	-psk
	-	-full
	-4 wire wide band	-
	-CCITT V.35	-fixed
	-	-v/d
	-orig/ans	-rem/loc
	-	-$6450

Codex	-9600	-
	-9600	-qam
	-s	-
	-4 wire	-
	-RS232C;4ILL33C;CCITT	-auto
	-	-v/d
	-	-
	-	-$9750
Codex	-9600C	-
	-4800/7200/9600	-qam
	-s	-half/full
	-4 wire	-C2
	-RS232C;CCITT;4ILL33C	-auto
	-	-v/d
	-orig/ans	-rem/loc
	-multiplexing	-$3900
Codex	-CF6	-
	-19200	-qam
	-	-full
	-4 wire	-C2
	-RS232C;Bell 303	-auto
	-	-v/d
	-orig/ans	-rem/loc
	-	-$2400

Codex	-LSI4800	-
	-2400/4800	-qam
	-s	-half/full
	-4 wire	-
	-RS232C;CCITT;MIL188C	-auto
	-150	-v/d
	-orig/ans	-rem/loc
	-multiplexing	-$4325
Codex	-LSI481	-
	-2400/4800	-8 phase dpsk
	-s	-half/full
	-4 wire	-M102
	-RS232C;CCITT	-auto
	-150 bps	-v/d
	-orig/ans	-rem/loc
	-multiplexing	-$4325
Codex	-LSI48FP	-
	-2400/4800	-qam
	-s	-half/full
	-4 wire	-C1
	-RS232C;CCITT;MIL188C	-auto
	-150 bps	-v/d
	-orig/ans	-rem/loc
	-	-$4500

Codex	-LSI72J0	-
	-4300/7200	-qam
	-s	-half/full
	-4 wire	-C2
	-RS232C;CCITT;MIL188C	-auto
	-	-v/d
	-orig/ans	-rem/loc
	-multiplexing	-$5500
Codex	-LSI72FP	-
	-4300/7200	-qam
	-s	-half/full
	-4 wire	-C2
	-RS232C;CCITT;MIL188C	-auto
	-	-v/d
	-orig/ans	-rem/loc
	-	-$6725
Codex	-LSI96/V29	-
	-9600	-qam
	-s	-half/full
	-4 wire	-M102
	-RS232C;CCITT	-fixed
	-rev	-v/d
	-orig/ans	-rem/loc
	-multiplexing	-$9350

Codex	-LSI9600	-
	-4800/7200/9600	-qam
	-s	-half/full
	-4 wire	-C2
	-RS232C;CCITT;MIL188C	-auto
	-	-v/d
	-orig/ans	-rem/loc
	-multiplexing	-$3500
Codex	-LSI96FP	-
	-4800/7200/9600	-qam
	-s	-half/full
	-4 wire	-C2
	-RS232C;CCITT;MIL188C	-auto
	-	-v/d
	-orig/ans	-rem/loc
	-	-$3750
Coherent	-DAM1	-
	-600	-fsk
	-asynch	-simplex/half/full
	-2/4 wire	-
	-RS232C;MIL1888;contact	-
	-rev	-v/d
	-orig/ans	-
	-multiplexing	-$ 600

Coherent	-DA44	-
	-600/1200	-fsk
	-async	-half/full
	-2/4 wire	-
	-CCITT	-
	-75 bps	-v/d
	-orig/ans	-rem/loc
	-output -12 to 3 dbm	-$ 500
Coherent	-DA443	-
	-1200	-fsk
	-a	-
	-2/4 wire	-
	-RS232C;CCITT V-24	-man
	-75 bps	-
	-	-
	-	-$ 499
Coherent	-DA453	-2020
	-1300	-fsk
	-a	-simplex/half/full
	-2/4 wire	-
	-RS232C;CCITT;MIL1833	-
	-rev	-v/d
	-orig/ans	-loc
	-	-$ 325 to $ 375

Coherent	-DA153	-
	-1800	-fsk
	-a	-
	-2/4 wire	-
	-RS232C;CCITT V-24	-man
	-75 bps	-
	-	-
	-	-$ 375
Coherent	-DA150	-
	-1300	-fsk
	-asynch	-half/full
	-2/4 wire	-none/C1/C2
	-RS232C	-
	-	-
	-	-loc
	-	-
Coherent	-TYM1	-
	-150	-fsk
	-a	-simplex/half/full
	-2/4 wire	-
	-RS232C;MIL1333;contact	-
	-rev	-v/d
	-orig/ans	-
	-multiplexing	-$ 525

Collins	-FD4	-
	-75 to 600	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232C	-
	-	-
	-	-
	-	-$ 600 to $ 750
Collins	-TE110	-
	-110	-fsk
	-asynch	-half/full
	-2/4 wire	-
	-RS232C;TTL;CCITT	-
	-	-
	-orig/ans	-
	-output 0 to -12 Dbm	-$ 600 to $ 750
Collins	-TE1200	-202D
	-1800	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232C	-
	-rev	-
	-orig/auto ans	-loc
	-self test	-$ 475

Collins	-TE150	-
	-150	-fsk
	-asynch	-half/full
	-2/4 wire	-
	-RS232C;TTL;CCITT	-
	-	-
	-orig/ans	-loc
	-output 0 to -12 Dbm	-$ 600 to $ 750
Collins	-TE2400	-2013
	-1200/2400	-4 phase pm
	-s	-simplex/half/full
	-2/4 wire	-
	-RS232C;CCITT	-compromise
	-	-v/d
	-orig/auto ans	-rem/loc
	-self test	-$ 900 to $1300
Collins	-TE2400A	-
	-1200/2400	-psk
	-synch	-
	-	-
	-RS232C;CCITT	-
	-	-
	-	-
	-output 0 to -15 Dbm	-

Collins	-TE300	-
	-300	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232C	-
	-	-
	-orig/ans	-loc
	-output 0 to -12 dbm	-$ 600 to $ 750
Collins	-TE500	-
	-500	-fsk
	-asynch	-half/full
	-2/4 wire	-
	-RS232C;TTL;CCITT	-
	-	-
	-	-
	-output 0 to -12 Dbm	-
Collins	-TE75	-
	-75	-fsk
	-asynch	-half/fell
	-2/4 wire	-
	-RS232C;TTL;CCITT	-
	-	-
	-	-
	-output 0 to -12 Dbm	-

Comdata	-150 series	-
	-300	-fsk
	-a	-full
	-acoustic;2/4 wire	-
	-RS232C;CCITT	-
	-	-
	-	-
	-carrier indicator	-$ 147 to $ 175
Comdata	-201	-201
	-2000/2400	-pm
	-s	-half/full
	-2/4 wire	-C2
	-RS232C	-man
	-	-v/d
	-orig/auto ans	-loc
	-	-$ 395
Comdata	-202	-202
	-1300	-fsk
	-a	-full
	-2/4 wire	-
	-RS232C	-man
	-rev	-v/d
	-orig/auto ans	-loc
	-	-$ 425

Comdata	-330 series	-103;113
	-300	-fsk
	-a	-full
	-2 wire;DAA	-
	-RS232C;MIL188;teletype	-
	-	-
	-orig/auto ans	-loc
	-	-$ 150 to $ 170
Datapoint	-3400	-103
	-300	-fsk
	-a	-full
	-acoustic	-
	-RS232C	-
	-	-
	-orig	-loc
	-	-$ 350
Datapoint	-9401	-103
	-300 to 440	-fsk
	-a	-full
	-2 wire;CBT DAA	-
	-RS232C	-man
	-	-
	-orig/auto ans	-loc
	-	-$1500

Datapoint	-9402	-202
	-1200/1300	-fsk
	-a	-half/full
	-2/4 wire	-C2
	-Datapoint I/O	-man
	-rev	-
	-orig/auto ans	-loc
	-	-$1500
Develcon	-DS2020	-
	-1300	-fsk
	-asynch	-half/full
	-2/4 wire;ddd	-
	-	-
	-150	-
	-orig/ans	-loc/rem
	-	-
ESE	-43QM	-
	-4800	-qam
	-s	-
	-3002	-
	-R3232C;1IL133	-auto
	-rev	-
	-	-
	-	-not available

ESE	-43Q4P	-
	-4800	-qam
	-s	-
	-3002/DDD	-
	-RS232C;MIL188	-adaptive
	-dev	-v/d
	-	-
	-	-not available
ESE	-96Q4P	-
	-9600	-qam
	-s	-
	-3002	-
	-RS232C;MIL188	-adaptive
	-dev	-v/d
	-	-
	-	-not available
Edmunds Newhall	-2018	-
	-2401	-dpsk
	-s	-
	-2/4 wire	-
	-RS232C	-fixed
	-	-v/d
	-	-
	-	-$1350

Edmunde Newnall	-201L	-
	-2400	-dpsk
	-s	-
	-1/2 wire	-
	-RS232C	-fixed
	-	-v/d
	-	-
	-	-$1350
GTE Lenkurt	-25C	-
	-600	-fsk
	-a	-simplex;half;full
	-2/4 wire	-
	-RS232C	-
	-	-
	-orig/ans	-VF digital
	-multiplexing	-$ 450
GTE Lenkurt	-25D	-
	-200	-fsk
	-a	-simplex/half/full
	-2/4 wire	-
	-teletype	-
	-	-
	-orig/ans	-VF
	-	-$ 550

GTE Lenkurt	-261A	-
	-2400	-duobinary fm
	-s	-half/full
	-2/4 wire	-
	-RS232C;RS334	-man
	-rev	-v/d
	-orig/ans	-back-to-back
	-	-$ 325
GTE Lenkurt	-262A	-203A
	-4300	-dps
	-s	-half/full
	-2/4 wire	-
	-RS232C;CCITT	-auto
	-rev	-v/d
	-orig/ans	-back-to-back/loopback
	-	-$3500
GTE Lenkurt	-2623	-2033
	-4800	-8 phase pm
	-s	-half
	-2 wire	-
	-RS232C	-auto
	-	-
	-orig/auto ans	-rem/loc
	-	-not available

GTE Lenkurt	-26C	-
	-1300/2400	-duobinary fm
	-a/s	-simplex/half/full
	-2/4 wire	-none/C1/C2
	-RS232C;MIL1333	-man
	-rev	-v/d
	-orig/ans	-rem/loc
	-	-$1700 to $2200
GTE Lenkurt	-26C40.3	-
	-20400/49300	-duobinary fm
	-	-simplex/half/full
	-4 wire wide band	-
	-current switching	-man
	-	-
	-orig/ans	-vf loop
	-	-$1750 to $2300
Gandalf	-DNT300 series	-
	-2400 to 19200	-pm
	-s	-simplex/half/full
	-2/4 wire	-
	-RS232C;CCITT	-man
	-rev	-
	-auto ans	-rem
	-limited distance	-$1000

Gandalf	-LD3110	-
	-4800	-fsk
	-a	-
	-2/4 wire	-
	-RS232C	-auto
	-	-
	-	-
	-	-$ 230
Gandalf	-LD3120	-
	-9600	-
	-a	-half/full
	-2/4 wire	-
	-RS232C;teletype	-
	-	-
	-	-
	-limited distance	-$ 230
Gandalf	-LD3200 series	-
	-2400 to 9600	-pm
	-s	-simplex/half/full
	-2/4 wire	-
	-RS232C;CCITT	-man
	-	-
	-	-rem/loc
	-	-$ 560

Gandalf	-LDS2000	-
	-9600	-delay encoded
	-s	-
	-4 wire	-
	-RS232C	-man
	-	-
	-	-
	-	-$ 560
Gandalf	-LDS250	-
	-9600	-pm
	-s	-half/full
	-2/4 wire	-
	-RS232C;CCITT	-man
	-	-
	-	-rem/loc
	-limited distance	-$ 734
Gandalf	-LDS250/2	-
	-56000	-delay encoded
	-s	-
	-4 wire	-
	-RS232C	-man
	-	-
	-	-
	-	-$1400

Gandalf	-DDS300	-
	-1300 to 19200	-pm
	-s	-half/full
	-2/4 wire	-
	-RS232C;CCITT	-man
	-rev	-
	-	-rem/loc
	-limited distance	-$ 784
General Datacomm	-100 series	-103;113
	-300	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232C;teletype;TTL	-
	-	-
	-orig/ans	-rem
	-	-$ 215 to $ 440
General Datacomm	-201 series	-201A/B/C
	-2000/2400	-pm
	-s	-half/full
	-2/4 wire	-C2
	-RS232C	-
	-	-
	-auto ans	-rem/loc
	-	-$ 700 to $1100

General Datacomm	-212 series	-212C/D/E
	-1200/1300	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232C	-
	-rev	-
	-orig and/or answer	-rem
	-	-$ 365 to $ 420
General Datacomm	-208 series	-208A
	-4800	-fsk
	-a	-half/full
	-4 wire	-
	-RS232C	-auto
	-	-v/d
	-orig/auto ans	-rem/loc
	-	-$3200 to $3600
General Datacomm	-402 series	-402D
	-75	-fsk
	-a	-simplex
	-2/4 wire	-
	-contact	-
	-rev	-
	-orig	-
	-transmit only	-$ 485 to $ 540

General Datacomm	-9601	-
	-4800/7200/9600	-am-vsb
	-s	-full
	-	-Dl
	-RS232C	-auto
	-	-v/d
	-orig/ans	-rem/loc
	-	-$6500
Hycom	-5823	-
	-4800	-qam
	-a/s	-
	-2/4 wire	-
	-RS232C	-auto
	-1300 bps	-v/d
	-	-
	-	-$2995
IBM	-3872	-
	-1200/2400	-dpsk
	-s	-half/full
	-2/4 wire	-Cl
	-RS232C	-man/auto
	-	-v/d
	-orig/auto ans	-
	-line self test	-$2575

IBM	-3874	-
	-2400/4800	-cpsk
	-s	-half/full
	-2/4 wire	-C1
	-RS232C	-auto
	-	-v/d
	-orig/auto ans	-
	-line- and self-test	-$3570
IBM	-3875	-
	-3600/7200	-pm-am
	-s	-half/full
	-4 wire	-C2
	-RS232C	-man
	-	-v/d
	-orig/auto ans	-
	-line- and self-test	-$7275
IBM	-Line Adapters	-
	-134/600	-fsk
	-a	-half/full
	-2/4 wire	-
	-IBM	-
	-	-
	-orig/ans	-
	-limited distance	-$ 432 to $ 365

ICC	-2JLSI	-2J1A/3/C
	-2J00/2400	-4 phase pm
	-s	-half/full
	-2/4 wire	-
	-RS232C;CCITT;MIL1833	-fixed
	-rev	-
	-orig/auto ans	-rem/loc
	-self test	-$1585
ICC	-24L3I	-2J1A/3/C
	-2J00/2400	-4 phase pm
	-s	-half/full
	-2/4 wire	-
	-RS232C;CCITT;MIL1833	-fixed
	-rev	-
	-orig/auto ans	-rem/loc
	-self test	-$1585
ICC	-4500/48	-
	-4800	-am-vsb
	-s	-full
	-4 wire	-
	-RS2323/C;CCITT;MIL1933	-auto
	-	-v/d
	-orig/ans	-
	-multiplexing;self test	-$4980

ICC	-4800/72	-
	-4800/7200	-am-vsb
	-s	-full
	-4 wire	-C1/D1
	-RS232C/CCITT;4IL1333	-auto
	-	-v/d
	-orig/ans	-
	-multiplexing;self test	-$5900
ICC	-5500/96	-
	-9600	-am-vsb
	-s	-full
	-4 wire	-C2/D1
	-RS232C/CCITT;4IL1333	-auto
	-	-v/d
	-orig/ans	-
	-self test;multiplexing	-$7900
ICC	-96	-
	-9600	-
	-s	-full
	-4 wire	-C2/D1
	-RS232C;CCITT;4IL133C	-auto
	-	-v/d
	-	-rem/loc
	-multiplexing	-$3750

ICC	-Com-Link II	-
	-2400 to 19200	-pm
	-s	-half/full
	-2/4 wire	-
	-RS232C;CCITT;teletype	-man
	-	-
	-	-
	-self test;ltd. distance	-$ 975
ICC	-Lineplexer II	-
	-4800 to 19200	-
	-	-full
	-4 wire	-C2/D1
	-RS232C;CCITT;MIL188C	-
	-	-
	-	-rem/loc
	-for biplexing 2 modems	-$5250
ICC	-MP848	-
	-4800	-pm
	-s	-half/full
	-2/4 wire	-
	-RS232C;CCITT;MIL1888	-auto
	-rev	-v/3
	-orig/auto ans	-rem/loc
	-	-$4475

ICC/Milgo	-4700/43	-
	-4800	-vsb
	-	-
	-	-
	-RS232C;MIL133	-
	-	-
	-	-
	-auto call	-
Intertel	-MCS1200	-2020/0
	-1300	-fsk
	-s/a	-half/full
	-2/4 wire	-
	-RS232B/C;CCITT	-statistical
	-rev	-v/d
	-orig/auto ans	-rem/loc
	-	-$ 950
Intertel	-MCS2400	-2013
	-2400	-4 phase pm
	-s	-half/full
	-2/4 wire	-
	-RS232B/C;CCITT	-statistical
	-rev	-v/d
	-orig/auto ans	-rem/loc
	-	-$1750

Intertel	-MCS4300	-
	-4300	-qam
	-s	-half/full
	-2/4 wire	-
	-RS232C;CCITT	-auto
	-rev	-v/d
	-orig/auto ans	-rem/loc
	-	-$4400
Intertel	-MCS7200	-
	-7200	-qam
	-s	-
	-2/4 wire	-
	-CDT/CBS for DDD	-auto
	-150 bps	-
	-	-
	-	-$7100
Intertel	-MCS9600	-
	-4800/7200/9600	-qam
	-s	-half/full
	-2/4 wire	-
	-RS232C;CCITT	-auto
	-rev	-v/d
	-orig/auto ans	-rem/loc
	-multiplexing	-$3700

Livermore Data Systems	-412	-2023/1
	-1200	-fsk
	-a	-simplex/half/full
	-2/4 wire	-
	-RS232C;CCITT;MIL188	-
	-rev	-
	-orig/auto ans	-rem
	-	-$ 725
Livermore Data Systems	-424	-2013/C
	-2400	-4 phase pm
	-s	-simplex/half/full
	-2/4 wire	-
	-RS232C;CCITT;MIL188	-auto
	-rev	-
	-orig/auto ans	-rem
	-	-$ 875
Livermore Data Systems	-440/43	-
	-2400/4800	-dc-am
	-s	-full
	-4 wire	-
	-RS232C;CCITT	-auto
	-	-
	-orig/ans	-rem/loc
	-	-$1995

Livermore Data Systems	-76 series	-103;113A
	-600	-fsk
	-a	-half/full
	-acoustic;2/4 wire	-
	-RS232C/C;teletype	-
	-	-
	-orig	-
	-	-$ 300 to $ 325
Livermore Data Systems	-AD3448	-
	-1200 to 4800	-am-pm
	-a/s	-simplex/half/full
	-2/4 wire	-C2/C4
	-RS232C;MIL1333;contact	-
	-rev	-v/d
	-orig/auto ans	-
	-integral handset	-$1495
Livermore Data Systems	-Classic series	-103A2
	-300	-fsk
	-a	-half/full
	-acoustic	-
	-RS232C/C;teletype	-
	-	-
	-orig/ans	-
	-	-$ 325

MI2 Corporation	-RCU-1	-
	-50	-fsk
	-a	-half
	-2 wire	-
	-teletype	-
	-	-
	-orig/auto ans	-
	-	-$ 350
MI2 Data Systems	-Design 1200	-
	-1300	-fsk
	-a	-
	-2/4 wire	-
	-RS232C	-auto
	-rev	-
	-	-
	-	-$ 500 to $1200
Multi-Tech	-300	-103/113A
	-450	-fsk
	-a	-half/full
	-acoustic/2 wire	-
	-RS2323/C;teletype	-
	-	-
	-auto ans	-
	-	-$ 210

Multi-Tech	-310	-103/113A
	-450	-fsk
	-a	-half/full
	-acoustic/2 wire	-
	-RS2323/C;teletype	-
	-	-
	-auto ans	-loc
	-	-$ 390
Multi-Tech	-320	-103/1133
	-300	-fsk
	-a	-half/full
	-2 wire	-
	-RS2323/C	-
	-	-
	-auto ans	-rem
	-	-$ 230 to $ 325
Multi-Tech	-FM1200	-202
	-1200	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS2323/C	-man
	-	-
	-orig/auto ans	-rem/loc
	-	-$ 225 to $ 460

Multi-Tech	-FM30 series	-103;113A
	-300	-fsk
	-a	-half/full
	-acoustic	-
	-RS232C;teletype;TTL	-
	-	-
	-orig	-
	-	-$ 190 to $ 270
Multi-Tech	-FM300	-103;113A
	-450	-fsk
	-a	-half/full
	-acoustic;2 wire	-
	-RS232C;teletype	-
	-	-
	-orig	-
	-	-$ 210
Multi-Tech	-FM310	-103;113A
	-450	-fsk
	-a	-half/full
	-acoustic;2 wire	-
	-RS232C;teletype	-
	-	-
	-orig/auto ans	-loc
	-	-$ 390

Novation	-212	-212C/D/E
	-1200/1300	-fsk
	-a	-half/full
	-2/4 wire	-C2 at 1300
	-RS232C/CTL	-fixed
	-rev	-v/d
	-orig/auto ans	-rem
	-	-$ 365
Novation	-36	-103
	-300	-fsk
	-a	-half/full
	-acoustic	-
	-RS232C;teletype;DAA	-
	-	-
	-	-
	-designed for DECwriter	-$ 235
Novation	-ATM1330	-101C
	-300	-fsk
	-a	-half/full
	-2 wire	-
	-RS232C	-
	-	-v/d
	-auto ans	-rem/loc
	-integral handset	-$ 350 to $ 520

Novation	-DC3100 series	-103
	-300	-fsk
	-a	-half/full
	-acoustic/2 wire	-
	-RS232C;teletype;DAA	-
	-	-
	-orig/ans	-rem/loc
	-	-$ 295 to $ 330
Novation	-EC100 series	-103
	-440	-fsk
	-a	-full
	-acoustic/2 wire	-
	-TTL	-
	-	-
	-orig and/or ans	-
	-self test	-$ 100
Omnitec	-103	-103
	-450	-fsk
	-a	-half/full
	-acoustic	-
	-RS232	-
	-rev	-
	-orig	-
	-	-$1595

Omnitec	-1103	-103
	-300	-fsk
	-a	-half
	-private line	-
	-RS232	-fixed
	-	-v/3
	-orig/ans	-
	-integral handset	-$ 844
Omnitec	-1200A	-202C
	-1200	-fsk
	-a	-half
	-acoustic;2 wire	-
	-RS232	-
	-rev	-
	-orig/ans	-
	-	-$ 975
Omnitec	-1202	-202C
	-1200	-fsk
	-a	-half
	-DAA;4 wire	-
	-RS232	-
	-rev	-
	-orig/auto ans	-loc
	-	-$ 325

Omnitec	-202	-202
	-1200	-fsk
	-a	-half/full
	-acoustic	-
	-RS232	-
	-rev	-
	-orig	-
	-	-$1693
Omnitec	-401A	-103
	-450/600	-fsk
	-a	-half/full
	-acoustic/2 wire	-
	-RS232B	-
	-	-
	-orig	-rem/loc
	-	-$ 300
Omnitec	-4013	-103
	-450/600	-fsk
	-a	-half/full
	-acoustic/2 wire	-
	-RS232B	-
	-	-
	-orig	-rem/loc
	-	-$ 300

Omnitec	-101C	-103
	-450/500	-fsk
	-a	-half/full
	-acoustic/2 wire	-
	-RS2323	-
	-	-
	-orig	-rem/loc
	-	-$ 300
Omnitec	-4500	-101C
	-110	-fsk
	-a	-half
	-2 wire	-
	-RS232;teletype	-
	-	-
	-orig/auto ans	-rem/loc
	-	-$ 550 to $ 750
Omnitec	-4700	-101C
	-300	-fsk
	-a	-half
	-2 wire	-
	-RS232;teletype	-
	-	-
	-orig/auto ans	-rem/loc
	-	-$ 550 to $ 750

Omnitec	-4000	-1010
	-300	-fsk
	-a	-half
	-2 wire	-
	-RS232;teletype	-
	-	-
	-orig/auto ans	-rem/loc
	-	-$ 550 to $ 760
Omnitec	-501A	-103
	-110	-fsk
	-a	-half/full
	-acoustic	-
	-teletype	-
	-	-
	-orig	-rem/loc
	-	-$ 154
Omnitec	-503\	-103
	-450	-fsk
	-a	-half/full
	-	-
	-	-
	-	-
	-orig	-rem/loc
	-designed for DECwriter	-not available

Omnitec	-700 series	-103
	-300/450/500	-fsk
	-a	-simplex/half/full
	-acoustic;2 wire	-
	-RS2323/teletype	-
	-	-
	-orig and/or ans	-rem/loc
	-	-$ 341 to $ 590
Omnitec	-91133	-103
	-450	-fsk
	-a	-half;full
	-2 wire	-
	-RS232;teletype	-
	-	-
	-orig/ans	-
	-remote LED diagnostics	-$ 342
Omnitec	-Bawdy 12	-
	-1200	-fsk
	-a	-
	-2 wire	-
	-RS232C	-none
	-rev	-
	-	-
	-	-$ 975

Paradyne	-Bisync 43	-
	-4800	-pam
	-s	-half/full
	-2/4 wire	-
	-RS232C;MIL188C	-auto
	-	-v/d
	-orig/auto ans	-rem/loc
	-IBM 3SC compatible	-$4500
Paradyne	-LSD19200	-
	-19200	-
	-	-full
	-4 wire	-
	-RS232C;CCITT	-auto
	-	-v/d
	-orig/auto ans	-rem/loc
	-for biplexing 2 modems	-$5150
Paradyne	-LSI-43	-
	-4800	-pam-vsb
	-s	-full
	-4 wire	-
	-RS232C;MIL188C	-auto
	-	-v/d
	-orig/auto ans	-rem/loc
	-	-$3000

Paradyne	-LSI-72	-
	-4800/7200	-pam-vsb
	-s	-full
	-4 wire	-
	-RS232C;IIL188C	-auto
	-	-v/d
	-orig/auto ans	-rem/loc
	-	-$4000
Paradyne	-LSI-96	-
	-4800 to 9600	-pam-vsb
	-s	-full
	-4 wire	-
	-RS232C;IIL188C	-auto
	-	-v/d
	-orig/auto ans	-rem/loc
	-	-$1500
Paradyne	-M48	-
	-4800	-pam-vsb
	-s	-half/full
	-2/4 wire	-
	-RS232C	-auto
	-150 bps	-v/d
	-orig/auto ans	-rem/loc
	-multiplexing	-$3000

Paradyne	-4400	-
	-4800/7200	-dpsk
	-s	-half/full
	-2/4 wire	-
	-RS232C;CCITT	-auto
	-rev	-v/d
	-orig/auto ans	-
	-network analyzer	-$3000
Paradyne	-496	-
	-4800 to 9600	-pam-vsb
	-s	-full
	-4 wire	-
	-RS232C;MIL188C	-auto
	-	-v/d
	-orig/auto ans	-rem/loc
	-multiplexing	-$6500
Penril	-1200/150	-2022/D
	-1200	-fsk
	-a	-half/full
	-2 wire	-
	-RS2323/C;CCITT	-fixed
	-rev	-v/d
	-orig/auto ans	-rem/loc
	-integral handset	-$ 300 to $ 400

Pencil	-1200/5	-2020/0
	-1200	-fsk
	-a	-half/full
	-2 wire	-
	-RS232B/C;CCITT	-fixed
	-rev	-v/d
	-orig/auto ans	-rem/loc
	-integral handset	-$ 300 to $ 400
Pencil	-1300	-2020
	-1300	-fsk
	-a	-half/full
	-2/4 wire	-C2 (1300)
	-RS232B/C;CCITT	-fixed
	-	-
	-orig/auto ans	-rem/loc
	-	-$ 320
Pencil	-2400/300	-
	-1200/2400	-4 phase pm
	-s	-simplex/half/full
	-2/4 wire	-
	-RS232C;MIL1333	-fixed
	-75 to 300 bps	-
	-orig/auto ans	-rem/loc
	-	-$1920

Pencil	-2400B1	-2013/C
	-1200/2400	-4 phase pm
	-s	-half/full
	-2/4 wire	-
	-RS232B/C;CCITT	-switch
	-	-v/d
	-orig/auto ans	-rem/loc
	-self test;handset	-$1375
Pencil	-300 series	-103/113
	-300	-fsk
	-a	-half/full
	-2 wire	-
	-RS232B/C	-fixed
	-rev	-v/d
	-orig/auto ans	-rem/loc
	-integral handset	-$ 200 to $ 250
Pencil	-48/Micro	-
	-2400/4800	-qam
	-a/s	-half/full
	-2/4 wire	-
	-RS232C;CCITT;MIL188C	-auto
	-110 bps	-v/d
	-orig/auto ans	-rem/loc
	-integral handset	-not available

Pencil	-48/Multi	-
	-4800	-dpsk
	-s	-half/full
	-2/4 wire	-
	-RS232C/C	-man
	-	-v/d
	-orig/ans	-rem/loc
	-integral handset;self test -$2300	
Pencil	-PSH 24/48/72/96	-
	-2400 to 19200	-encoded fsk
	-s	-half/full
	-2/4 wire	-
	-RS232C;CCITT	-man
	-	-
	-orig/ans	-rem/loc
	-limited distance	-not available
Pencil	-PSH hi-speed	-
	-19200 to 1Mbps	-pm
	-s	-half/full
	-2/4 wire	-
	-Bell 301/303	-man
	-	-
	-orig/ans	-rem/loc
	-limited distance	-not available

Prentice	-Line Adaptors	-
	-500	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232C;teletype	-
	-	-
	-orig/ans	-rem/loc
	-	-$ 135 to $ 200
Prentice	-P103	-103
	-300	-fsk
	-a	-half/full
	-2 wire	-
	-RS232C;teletype	-
	-	-
	-orig/ans	-rem/loc
	-	-$ 135
Prentice	-P113	-113
	-300	-fsk
	-a	-half/full
	-2 wire	-
	-RS232C;teletype	-
	-	-
	-orig/ans	-rem/loc
	-	-$ 195

Prentice	-P1200	-
	-1200	-fsk
	-a	-full
	-2 wire	-
	-RS232C;teletype	-auto
	-150 bps	-
	-orig/auto ans	-rem/loc
	-	-$ 400
Prentice	-P2013/C	-2013/C
	-2400	-pm
	-s	-half/full
	-2/4 wire	-
	-RS232C	-auto
	-	-
	-orig/ans	-rem/loc
	-	-$ 355
Prentice	-P202	-202C/D/R/T
	-1200	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232C;teletype	-
	-rev	-
	-orig/auto ans	-rem/loc
	-	-$ 300 to $ 350

Prentice	-asynch line driver	-
	-9600	-baseband
	-a	-half/full
	-2/4 wire	-
	-RS232C;teletype	-
	-	-
	-orig/ans	-loc
	-limited distance	-$ 230
Prentice	-limited range adapters	-
	-600 to 150000	-pm
	-s	-full
	-2/4 wire	-
	-RS232C;Bell 300	-auto
	-	-
	-orig/ans	-rem/loc
	-limited distance	-$ 300 to $1200
Prentice	-synch line driver	-
	-1200 to 23000	-delay
	-s	-half/full
	-2/4 wire	-
	-RS232C;Bell 300	-auto
	-	-
	-	-rem/loc
	-limited distance	-$ 350

Pulsecom	-4000 series	-103
	-300	-fsk
	-a	-half/full
	-2 wire	-
	-RS232C;teletype	-fixed
	-	-v/d
	-orig/auto ans	-rem/loc
	-	-$ 225 to $ 300
Pulsecom	-4321	-434/B
	-300	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232C;teletype	-
	-	-
	-orig/ans	-loc
	-	-not available
Pye TMC	-424	-
	-2400	-phase
	-s	-
	-2 wire	-
	-RS232;CCITT	-auto
	-rev	-
	-	-
	-	-not available

QEI	-Q70	-
	-1200	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232B/C;CCITT	-
	-rev	-v/d
	-orig/ans	-loc
	-	-$1000
QEI	-Q700	-
	-1200	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232B/C;CCITT	-
	-rev	-v/d
	-orig/ans	-loc
	-	-$ 515
QEI	-Q701	-
	-300	-fsk
	-asynch	-
	-2 wire	-
	-teletype	-
	-	-
	-	-
	-output level -30 to 0 dbm -	

RFL	-320r	-
	-1200	-fsk
	-a	-full
	-2 wire	-Cl
	-RS232C	-compromise
	-rev	-
	-orig/auto ans	-rem
	-	-$ 940 to $1160
RFL	-5135	-101;103;113
	-300	-fsk
	-a	-half/full
	-acoustic;2/4 wire	-
	-RS232C;teletype	-
	-	-
	-orig	-rem/loc
	-	-$ 130
RFL	-5220	-101;103;113
	-300	-fsk
	-a	-half/full
	-acoustic;2/4 wire	-
	-RS232C;teletype	-
	-	-
	-auto ans	-rem/loc
	-	-$ 275

RFL	-6335	-202C
	-1300	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232C	-
	-	-
	-orig	-
	-	-$ 235
Rixon	-D31300	-202
	-1300	-fsk
	-a	-half/full
	-2/4 wire	-C1/C2
	-RS2323/C	-fixed
	-rev	-v/d
	-orig/auto ans	-rem/loc
	-	-$ 500
Rixon	-D32401	-2013/C
	-1200/2400	-4 phase pm
	-s	-simplex/half/full
	-2/4 wire	-
	-RS2323;TTL	-man
	-	-v/d
	-orig/auto ans	-rem/loc
	-	-$ 795

Rixon	-D3300	-103A/E/113
	-300	-fsk
	-a	-full
	-2 wire	-
	-RS232C;MIL188	-
	-	-v/d
	-orig/auto ans	-cem
	-	-$ 345
Rixon	-DS9631	-
	-3600 to 9600	-am-vsb
	-s	-full
	-4 wire	-C2
	-RS232B/C;MIL188	-auto
	-	-v/d
	-orig/ans	-cem/loc
	-	-$3200
Rixon	-R103A2/3	-103A
	-300	-fsk
	-a	-full
	-2 wire	-
	-RS232	-
	-	-
	-orig;auto ans	-
	-	-$ 600

Rixon	-T103A2/3/F	-103/113
	-300	-fsk
	-a	-full
	-2 wire	-
	-RS232B/C	-
	-	-v/d
	-orig/auto ans	-loc
	-remote test	-$ 435 to $ 439
Rixon	-T103333	-103/113
	-300	-fsk
	-a	-full
	-DAA	-
	-RS232B;teletype	-
	-	-v/d
	-orig/auto ans	-
	-remote test	-$ 500
Rixon	-T113 series	-103A2/E/1133
	-300	-fsk
	-a	-full
	-2 wire	-
	-RS232B;teletype	-
	-	-v/d
	-orig and/or ans	-
	-remote test	-$ 195

Rixon	-T113A	-101C;1033;103E
	-300	-fsk
	-a	-full
	-2 wire	-
	-RS232C	-
	-	-
	-orig	-
	-connects via modified 502 set -$ 410	
Rixon	-T1133D5	-103E;113A
	-300	-fsk
	-asynch	-full
	-2 wire	-
	-RS232C	-
	-	-
	-auto ans	-
	-	-$1100
Rixon	-T201C	-2313
	-2400	-phase
	-synch	-half/full
	-2/4 wire	-
	-RS232C	-compromise
	-	-
	-orig/auto ans	-
	-	-$1430

Rixon	-T202B	-202B
	-1200	-fsk
	-a	-transmit only
	-2 wire	-
	-RS232B	-
	-dev	-v/d
	-auto ans	-
	-remote test	-$ 475 to $ 570
Rixon	-T202B	-202
	-1200	-fsk
	-asynch	-full
	-2 wire	-
	-RS232C	-fixed
	-5 bps	-v/d
	-orig/auto ans	-loc
	-	-$ 500
Rixon	-T202T	-202
	-1800	-fsk
	-a	-half/full
	-2/4 wire	-C2
	-RS232C	-fixed
	-5 bps	-v/d
	-orig	-loc/rem
	-	-$ 525

Rixon	-T233A	-233A
	-4330	-dc
	-s	-full
	-4 wire	-none/C2
	-RS232C	-auto
	-	-v/d
	-orig/ans	-rem/loc
	-	-$3750
Rixon	-T2033	-2033
	-4330	-pm
	-s	-half
	-2 wire	-
	-RS232C	-auto
	-	-v/d
	-orig/auto ans	-rem/loc
	-	-$3750
Rixon	-PA201A/3	-201A
	-2000/2400	-pm
	-s	-half/full
	-2/4 wire	-
	-RS232B;contact	-fixed
	-	-v/d
	-auto ans	-
	-remote test	-$1075 to $1300

Sonex	-2133	-103
	-300/600	-fsk
	-a	-full
	-2/4 wire	-
	-RS232C;teletype;TTL	-auto
	-	-
	-orig/auto ans	-rem/loc
	-	-$ 195
Sonex	-2113	-113
	-300/600	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232C;teletype;TTL	-auto
	-	-
	-orig/ans	-
	-multiplexing	-$ 115
Sonex	-2202	-202C/D/E
	-1800	-fsk
	-a	-half/full
	-2/4 wire	-C2
	-RS232C	-auto
	-5 bps	-
	-orig/auto ans	-rem/loc
	-multiplexing	-$ 435

Sonex	-2404	-
	-12	-Touch Tones
	-a	-half
	-2 wire	-
	-user-specified	-auto
	-	-
	-ans	-
	-	-$ 175
Sonex	-300	-103
	-300	-fsk
	-a	-half/full
	-2 wire	-
	-RS232C;teletype	-
	-	-
	-auto ans	-loc
	-	-$2645
Sonex	-31	-103
	-300	-fsk
	-a	-half/full
	-2 wire	-
	-RS232C;teletype	-
	-	-
	-orig	-
	-	-$ 252

Sonex	-Autotone	-401J/403D/E/407
	-10 to 20	-Touch Tones
	-a	-half
	-2 wire	-
	-RS232C;FFD;contact	-auto
	-	-v/d
	-auto ans	-
	-multiplexing	-$ 325 to $ 550
Spectron	-DF401	-
	-1200 to 19200	-
	-a/s	-full
	-4 wire	-
	-RS232C	-
	-	-
	-orig/ans	-rem/loc
	-limited distance	-$ 400
Stelma	-202 Plus	-
	-1900	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232C	-
	-	-
	-	-rem/loc
	-1900 150 bps channels	-$1255 to $1450

Stelma	-202R	-202R
	-1200/1300	-fsk
	-a/s	-half/full
	-2/4 wire	-
	-RS232C	-
	-	-
	-	-rem/loc
	-	-$ 422 to $ 710
Stelma	-703\C	-103A
	-300	-fsk
	-a	-half/full
	-acoustic	-
	-RS232C	-
	-	-
	-orig/ans	-
	-	-$ 330
Stelma	-Datapak	-
	-75 to 1300	-fsk
	-a/s	-simplex/half/full
	-2/4 wire	-
	-RS232C;CCITT;MIL188;teletype	-
	-	-
	-orig/ans	-
	-multiplexing	-$ 350 /channel end

Stelma	-Datapak 103	-103E/F
	-300	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232C	-
	-	-
	-ans	-rem/loc
	-	-$ 272 to $ 550
Stelma	-Datapak 1133	-1133
	-300	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232C	-
	-	-
	-ans	-rem/loc
	-	-$ 272 to $ 550
Syntech	-ESP201	-201A/B/C
	-2300/2400	-4 phase pm
	-s	-half/full
	-2/4 wire	-
	-RS232C	-fixed
	-	-v/d
	-orig/auto ans	-rem/loc
	-self test	-$1350

Syntech	-LDA series	-
	-19200	-fsk
	-a/s	-half/full
	-2/4 wire	-
	-RS232C	-man
	-	-v/d
	-orig/ans	-rem/loc
	-limited distance	-$ 693 to $ 795
Syntech	-TTL03	-102/113
	-300	-fsk
	-a	-full
	-2 wire	-
	-RS232C;TTL	-
	-	-v/d
	-orig/auto ans	-rem
	-	-$ 375
Syntech	-TT2Jl	-201A/B/C
	-2000/2400	-4 phase pm
	-s	-half/full
	-2/4 wire	-
	-RS232C;TTL	-fixed
	-	-v/d
	-orig/auto ans	-rem/loc
	-	-$1095

Syntech	-FF202	-202
	-1333	-fsk
	-a/s	-half/full
	-2/4 wire	-
	-RS232C;TTL	-fixed
	-rev	-v/d
	-orig/auto ans	-rem/loc
	-	-$ 450
Tele-Dynamics	-7102A/D	-103/113
	-300	-fsk
	-a	-full
	-acoustic;2 wire	-
	-RS232C;CCITT;teletype;TTL	-
	-	-
	-orig/ans	-rem/loc
	-	-$ 202
Tele-Dynamics	-7103LC	-103/113
	-300	-fsk
	-a	-half/full
	-2 wire	-
	-RS232C;MIL1333;CCITT	-
	-	-v/d
	-orig/ans	-rem/loc
	-voice via Bell 304A	-$ 292

Tele-Dynamics	-7113LC4	-133A/3
	-300	-fsk
	-a	-full
	-2 wire	-
	-RS232C;teletype;CCITT;TTL	-
	-	-
	-orig/auto ans	-
	-	-$ 207
Tele-Dynamics	-7201A/3	-201A/B
	-2000/2400	-4 phase pm
	-s	-half/full
	-2/4 wire	-
	-RS232C;CCITT	-fixed
	-	-
	-orig/auto ans	-rem/loc
	-	-$ 395
Tele-Dynamics	-7202D/E	-202D/E
	-1300	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232C;CCITT	-fixed
	-rev	-
	-orig/auto ans	-rem/loc
	-	-$ 440

Tele-Dynamics	-7233A	-203A
	-4300	-pm
	-s	-half/full
	-2/4 wire	-
	-RS232C;CCITT	-auto
	-	-
	-orig/ans	-rem/loc
	-	-$2750
Tele-Dynamics	-7300	-
	-1800 to 19200	-
	-s	-simplex/half/full
	-2/4 wire	-
	-RS232C	-fixed
	-	-
	-orig/ans	-rem/loc
	-limited distance	-not available
Timeplex	-103	-103
	-300	-fsk
	-a	-full
	-2/4 wire	-
	-RS232C;CCITT;contact	-
	-	-v/d
	-orig/auto ans	-rem/loc
	-	-$ 185 to $ 325

Timeplex	-202	-202
	-2000	-fsk
	-a/s	-simplex/half/full
	-2/4 wire	-C2
	-RS232C;CCITT;MIL1888	-statistical
	-rev	-v/d
	-orig/auto ans	-rem/loc
	-	-$ 295 to $ 425
Tran	-Connectran 550	-
	-9600	-baseband
	-a	-half/full
	-4 wire	-
	-RS232C	-
	-	-
	-	-
	-limited distance	-$ 295
Tran	-Directran	-103/113/202
	-9600	-baseband
	-a	-half/full
	-4 wire	-
	-RS232C	-
	-	-
	-orig/ans	-rem/loc
	-limited distance	-$ 325 to $ 520

Tran	-Intertran 911/931 series -	
	-1200 to 19200	-pcm
	-s	-half/full
	-4 wire	-
	-R3232C	-
	-	-
	-	-rem/loc
	-limited distance	-$1150 to $1250
Tran	-Intertran 916/936 series -	
	-19200 to 250000	-pcm
	-s	-half/full
	-4 wire	-
	-Bell 300	-
	-	-
	-	-rem/loc
	-limited distance	-$1300 to $1550
Tran	-Intertran 913/933 series -	
	-48000 to 64000	-pcm
	-s	-half/full
	-4 wire	-
	-CCITT	-
	-	-
	-	-rem/loc
	-limited distance	-$1250 to $1500

Tran	-Intertran 951/961	-
	-2400 to 19200	-baseband
	-s	-half/full
	-4 wire	-
	-RS232C	-
	-	-
	-orig/ans	-rem/loc
	-limited distance	-$ 745 to $ 900
Tran	-Intertran 956/966	-
	-19200 to 250000	-ppm
	-s	-half/full
	-4 wire	-
	-Bell 300	-
	-	-
	-orig/ans	-rem/loc
	-limited distance	-$1050 to $1200
Tran	-Intertran 981	-
	-2400 to 9600	-baseband
	-s	-half/full
	-4 wire	-
	-RS232C	-
	-	-
	-orig/ans	-rem/loc
	-limited distance	-$ 435

Tuck	-1630 series	-202
	-1200	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232C;TTL	-fixed
	-5 bps	-v/d
	-orig/auto ans	-rem
	-	-$ 122 to $ 375
Tuck	-1652	-
	-2400	-fsk
	-a	-half/full
	-2/4 wire	-
	-RS232C	-fixed
	-	-
	-orig/ans	-rem
	-limited distance	-$ 325
Tuck	-1310/1330/1331	-491A/B/H/J/433
	-20	-am
	-	-half
	-2 wire	-
	-acoustic;contact	-
	-	-v/d
	-orig/auto ans	-
	-front panel LED	-$ 225 to $ 595

Universal	-103/113	-103/113
	-300	-fsk
	-a	-full
	-2 wire	-
	-RS232C;CCITT	-
	-	-
	-auto ans	-
	-answer via CBS DAA	-not available
Universal	-12-12	-
	-1200	-psk
	-a/s	-full
	-2 wire	-
	-RS232C;CCITT	-
	-	-
	-	-rem/loc
	-	-not available
Universal	-201A/B/C	-201A/B/C
	-2400	-psk
	-s	-half/full
	-2/4 wir	-
	-RS232C;CCITT	-
	-	-
	-auto ans	-
	-five diagnostic LED's	-not available

Universal	-2020/0	-202
	-1200/1300	-fsk
	-s	-half/full
	-2/4 wire	-
	-RS232B/C	-
	-5/150 bps	-
	-orig/auto ans	-rem/loc
	-	-$ 445 to $ 495
Universal	-20245	-
	-1300	-fsk
	-a	-half/full
	-2/4 wire	-C2
	-RS232C	-
	-	-
	-orig/ans	-rem/loc
	-	-$ 575
Universal	-20253	-
	-1200	-fsk
	-s	-half/full
	-2/4 wire	-
	-RS232C	-
	-	-
	-orig/ans	-rem/loc
	-	-$ 550

Universal	-R415	-103/113/201/212
	-2400	-fsk psk
	-a/s	-half/full
	-2/4 wire	-
	-RS232C	-
	-rev	-
	-orig/auto ans	-rem/loc
	-	-not available
Vadic	-LDA	-
	-134/500	-fsk
	-a	-half
	-2/4 wire	-
	-RS232C	-
	-	-
	-orig/ans	-rem/loc
	-	-$ 200
Vadic	-LLA	-
	-134/500	-fsk
	-a	-half
	-2/4 wire	-
	-RS232C	-
	-	-
	-orig/ans	-rem/loc
	-	-$ 200

Vadic	-SLA	-
	-600/1200	-fsk
	-a	-half
	-2/4 wire	-
	-RS232C	-
	-	-
	-orig/ans	-rem/loc
	-	-$ 200
Vadic	-VA1200	-202
	-1300	-fsk
	-a	-half
	-2/4 wire	-C2
	-RS232B/C	-
	-rev	-
	-orig/auto ans	-rem/loc
	-	-$ 235
Vadic	-VA21	-
	-300	-fsk
	-	-
	-2 wire	-
	-CCITT V.24/V.23	-
	-	-
	-orig/auto ans	-rem/loc
	-I34 compatible	-$ 600

Vadic	-VA23	-
	-1200	-fsk
	-a/s	-half/full
	-2/4 wire	-
	-CCITT	-compromise
	-rev	-v/d
	-orig/auto ans	-rem/loc
	-integral handset	-$ 600
Vadic	-VA2435	-2013/C
	-2400	-dpsk
	-s	-half
	-2/4 wire	-
	-RS232C	-compromise
	-	-
	-orig/auto ans	-rem/loc
	-	-$ 600
Vadic	-VA300 series	-103/113
	-300	-fsk
	-a	-full
	-2 wire	-
	-RS232C	-
	-	-
	-orig/auto ans	-rem/loc
	-	-$ 215

Vadic	-VA3400	-
	-1200	-
	-a	-full
	-2 wire	-
	-RS2323/C	-compromise
	-	-
	-orig/auto ans	-rem/loc
	-	-$ 715
Ven-Tel	-AC103	-103/113
	-300	-fsk
	-s	-full
	-acoustic;2 wire	-
	-RS232;CCITT;teletype	-
	-	-
	-orig/ans	-
	-	-$ 265
Ven-Tel	-AC1212	-
	-1200	-fsk
	-a	-full
	-acoustic	-
	-RS232;CCITT;teletype	-
	-	-
	-orig/ans	-rem
	-has indicators	-$ 530

Ven-Tel	-DCI120	-103/113
	-300	-fsk
	-a	-full
	-acoustic;2 wire	-
	-RS232;CCITT;teletype	-
	-	-
	-orig/ans	-
	-designed for DECwriter	-$ 325
Ven-Tel	-MD103	-103
	-300	-fsk
	-a	-full
	-2 wire	-
	-RS232;CCITT	-
	-	-
	-orig/ans	-rem/loc
	-	-$ 220
Ven-Tel	-MD113	-113
	-300	-fsk
	-a	-full
	-2 wire	-
	-RS232;CCITT	-
	-	-
	-orig/auto ans	-rem/loc
	-	-$ 200

Ven-Tel	-401212	-
	-1200	-fsk
	-a	-full
	-2 wire	-
	-RS232;CCITT;current logic	-
	-	-
	-orig/auto ans	-rem
	-indicators	-$ 450

Appendix 5

STANDARD NETWORK INTERFACE

The standard terminal interface was designed to meet all of the static parameters. It was designed to interface the common services standard phone line with terminal device. The standard interface was designed with the following characteristics.

- input and output signal isolation
- gain controls on input and output
- TTL level compatable ring detection
- TTL level compatable answer control
- The whole circuit to operate off a single supply of 5 volts.

With reference to the schematic IC1b is a simple variable gain operational amplifier used to take the terminal signal and apply it to the bridge composed of an isolation transformer, pot, and two 320 ohm resistors. The gain control on IC1b is used to establish the transmit signal level.

The bridge circuit issued to isolate the transmitted signal from the terminal and the received signal to the terminal. The Null pot is used to offset the effective line impedance observed by the transformer T1. Cx is the bridge circuit is to make the transformer exhibit pure resistance impendance. The null pot is adjusted to maximize the isolation between input and output.

IC1b is an operational amplifier used to amplify line levels to the level required by the terminal device. It's gain control is adjusted to provide proper levels required by the terminal device.

IC1a is used to observe ringing voltages on the line and report them to the terminal device. OC1 is an optimal isolator which will isolate the line from the rest of the terminal software circuitry. OC1 detects ringing if the differential line voltage exceeds 50 volts in either direction. The operational amplifier is used to convert the detected ringing voltage to TTL levels for the terminal device.

IC1a is used to change TTL levels to provide sufficient current to drive RY1 used to answer the line. This can also be controlled by the terminal device.

Appendix 5

```
HONEYWELL CP-V AT YOUR SERVICE - CRC
09:10 MAR 30,'79     IO# 55    LINE# 11   USERS= 13    STAT= 1
LOGON PLEASE: 535V,TAPIAY
!APL
APL 005
CLEAR WS
      )LOAD DATABASE
 DATABASE    SAVED  17:00 JAN 20,'79
WAS 3
ENTER A NUMBER TO INDICATE YOUR AREA OF INTEREST:
0.  SIGN OFF THE COMPUTER
1.  MODELS
2.  MEDICAL EQUIPMENT
3.  FACSIMILE EQUIPMENT
YOUR NUMBER
3
TO SEE A LIST OF COMMANDS TYPE THE WORD 'HELP'.
      HELP
THE FOLLOWING IS A LIST OF VALID COMMANDS. TO USE ANY COMMAND
JUST TYPE ITS NAME. IF MORE INFORMATION IS REQUIRED, THE
FUNCTION WILL PROMPT YOU FOR IT.
BYE         TO SIGN OFF
ENTRIES     TO FIND THE NUMBER OF ENTRIES IN THE AVAILABLE DATA POOL
EXPLAIN     TO GET AN EXPLANATION OF ANY OF THE COMMANDS
HEADINGS    TO GET A LIST OF VALID HEADINGS
HELP        TO SEE THIS LIST OF COMMANDS
```

```
LINES       TO SET THE MAXIMUM NUMBER OF LINES PRINTED PER PAGE
PRINT       TO PRINT THE SELECTED ENTRIES
RESTART     TO RETURN ALL ENTRIES TO THE AVAILABLE POOL
SELECT      TO SELECT ENTRIES WHICH CONTAIN SPECIFIC DATA
SORT        TO SORT THE ENTRIES INTO ALPHABETICAL OR NUMERICAL ORDER
WIDTH       TO SET THE MAXIMUM NUMBER OF CHARACTERS PRINTED PER LINE
      ENTRIES
16 ENTRIES
      HEADINGS
THE FOLLOWING ARE VALID HEADINGS:
MANUFACTURER,MODEL,SPEED,COUPLING,MODULATION,LINETYPE,COMMENTS,DATE
      SORT
WHICH HEADINGS?
#:
      SPEED
      PRINT
WHICH HEADINGS?
#:
      SPEED,MANUFACTURER
-2 MIN./PAGE                    -GRAPHIC SCIENCES
-2 TO 12 MIN./PAGE              -GRAPHIC SCIENCES
-2 TO 6 MIN./PAGE               -GRAPHIC SCIENCES
-3 MIN./PAGE                    -INFOLINK
-3 OR 6 MIN./PAGE               -GRAPHIC SCIENCES
-3 OR 6 MIN./PAGE               -GRAPHIC SCIENCES
-3 OR 6 MIN./PAGE               -GRAPHIC SCIENCES
-3 TO 6 MIN./PAGE               -3M
```

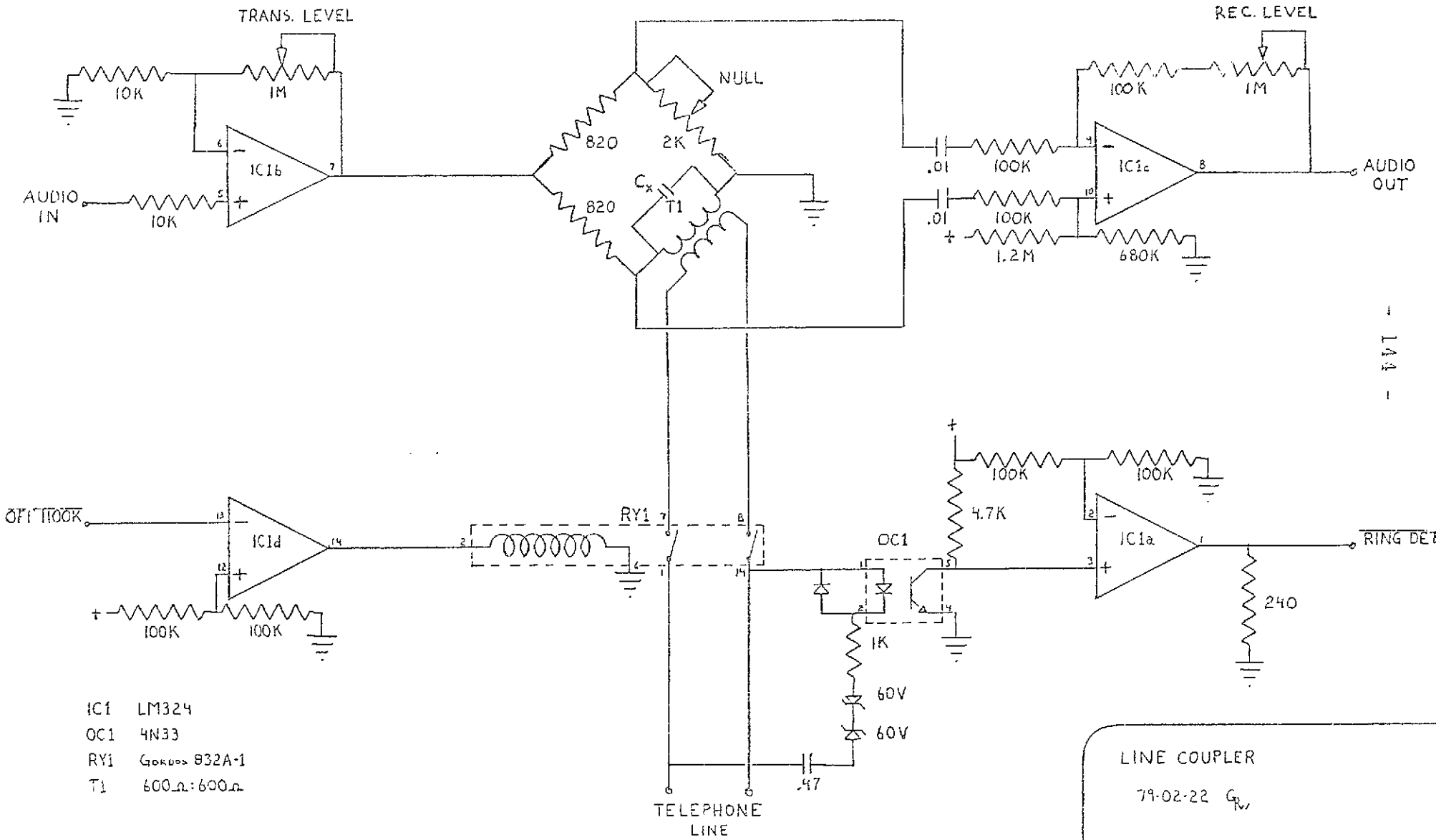
```
-35 SEC./PAGE                    -34
-4 MIN./PAGE                     -GRAPHIC SCIENCES
-4 OR 6 MIN./PAGE                -34
-4 OR 6 MIN./PAGE                -34
-5 MIN./PAGE                     -GRAPHIC SCIENCES
-5 MIN./PAGE                     -GRAPHIC SCIENCES
-6 MIN./PAGE                     -GRAPHIC SCIENCES
-NA                              -INFOLINK
      SORT
WHICH HEADINGS?
#:
      LINETYPE
      PRINT
WHICH HEADINGS?
#:
      MODEL,LINETYPE
-DEX 120                         -VOICE GRADE
-DEX 4100                        -VOICE GRADE
-DEX 700                         -VOICE GRADE
-SCANAFRON                       -VOICE GRADE
-DEX 130                         -VOICE GRADE
-DEX 101                         -VOICE GRADE
-DEX 102                         -VOICE GRADE
-VRC 500                         -VOICE GRADE
-9600                            -VOICE GRADE
-DEX IX                          -VOICE GRADE
-VRC                             -VOICE GRADE
```

```
-VRC II                         -VOICE GRADE
-DEX I                          -VOICE GRADE
-DEX VI                         -VOICE GRADE
-DEX VII                        -VOICE GRADE
-ELECTROWRITER                  -VOICE GRADE
      SORT
WHICH HEADINGS?
#:
      MODEL
      PRINT
WHICH HEADINGS?
#:
      MODEL,COMMENTS
-9600                           -DIGITALLY ENCODES DATA
-DEX 120                        -USES REVERSE CHANNEL
-DEX 130                        -USES REVERSE CHANNEL
-DEX 131                        -USES REVERSE CHANNEL
-DEX 132                        -USES REVERSE CHANNEL
-DEX 4100                       -
-DEX 700                        -USES REVERSE CHANNEL
-DEX I                          -USES REVERSE CHANNEL
-DEX IX                         -USES REVERSE CHANNEL
-DEX VI                         -USES REVERSE CHANNEL
-DEX VII                        -USES REVERSE CHANNEL
-ELECTROWRITER                  -TRANSMITS HANDWRITING
-SCANATRON                      -
-VRC                            -OUTPUT DB1 ADJUSTABLE
```

```
-VRC 503                        -OUTPUT -15 TO 0DBM ADJUSTABLE
-VRC II                         -OUTPUT 0DBM ADJUSTABLE
      EXPLAIN
WHICH COMMAND?
EXPLAIN
  TO GET AN EXPLANATION OF THE COMMANDS IN THIS SYSTEM,
  JUST TYPE THE WORD EXPLAIN.
  TO SEE A LIST OF VALID COMMANDS, TYPE THE WORD HELP.
      EXPLAIN
WHICH COMMAND?
SORT
  THE SORT COMMAND IS USED TO ARRANGE THE REMAINING ENTRIES
  INTO NUMERICAL OR ALPHABETICAL ORDER. AFTER TYPING THE
  WORD SORT, YOU WILL BE ASKED WHICH HEADINGS YOU WISH THE
  SORT TO BE DONE ON. YOU MAY ENTER ANY OF THE VALID HEADINGS
  SEPARATED BY COMMAS. IF MORE THAN ONE IS ENTERED THE FIRST
  ONE TAKES PRECEDENCE OVER THE SECOND, AND THE SECOND OVER
  THE THIRD, ETC. THIS MEANS THAT IF YOU WANT, FOR EXAMPLE,
  THE DATA ARRANGED IN ORDER OF MANUFACTURER, AND THE ONES
  OF THE SAME MANUFACTURER ARRANGED IN ORDER OF SPEED YOU
  WOULD ENTER 'MANUFACTURER,SPEED'.
  TO GET A LIST OF THE VALID HEADINGS SEE THE COMMAND HEADINGS.
      SELECT
WHICH HEADING?
*:
      MANUFACTURER
WHAT RELATIONSHIP?
```

```
#:
CD
WHAT VALUE?
#:
34
4 ENTRIES
      PRINT
WHICH HEADINGS?
#:
      MANUFACTURER,MODEL
-34                              -VRC II
-34                              -VRC 603
-34                              -VRC
-34                              -9600
      ENTRIES
4 ENTRIES
      RESTART
16 ENTRIES
      BYE
!OFF

CPU = .3356 CON= 00:17:00 INT = 32 CHG = $ 1.62
```



IC1 LM324
OC1 4N33
RY1 Gordos 832A-1
T1 600Ω:600Ω

LINE COUPLER

79-02-22 GR