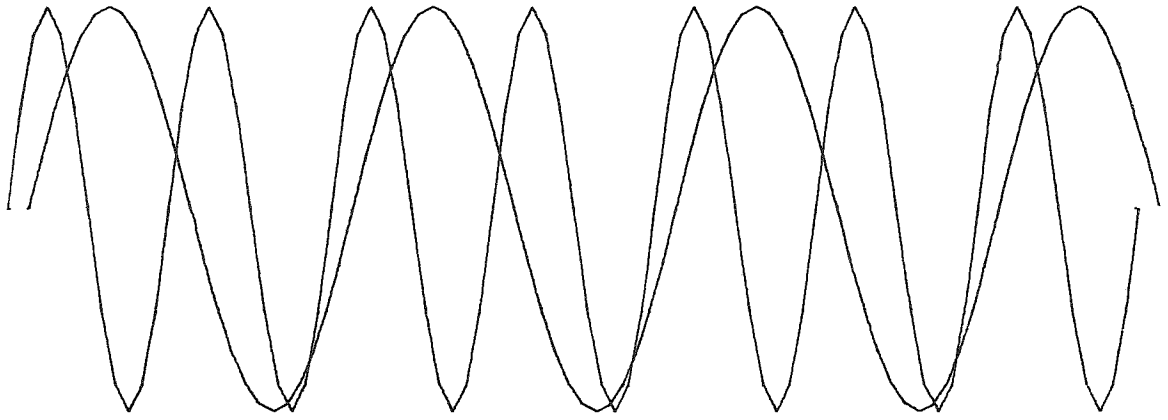
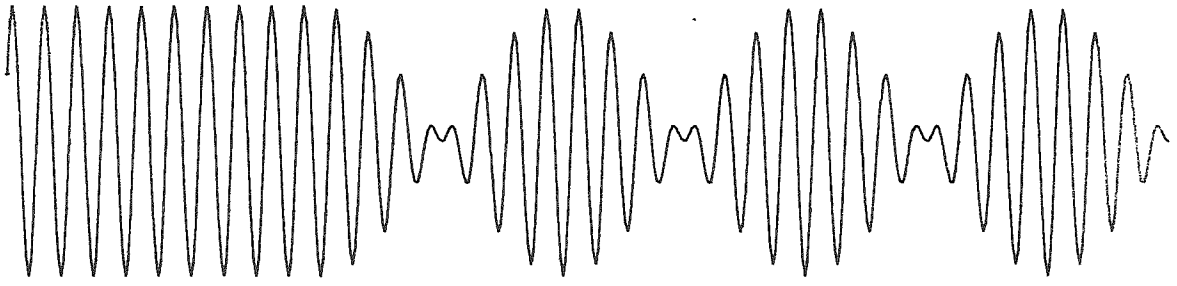
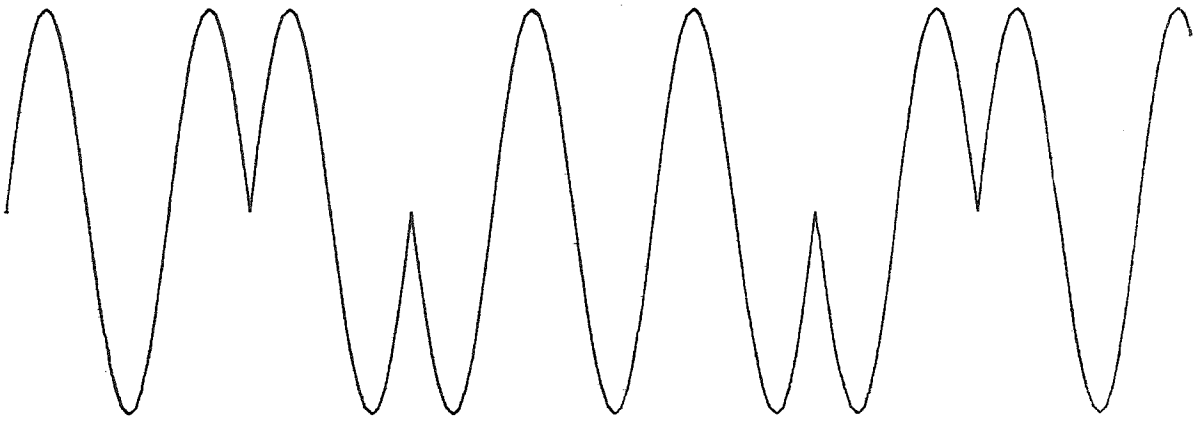
COMMUNICATIONS HANDBOOK







REVISION RECORD

REVISION	DESCRIPTION
A	Manual released.
(10-27-72)	

Publication No.
60405100

Address comments concerning this manual to:

Control Data Corporation
Headquarters Support Engineering
Box 0
Bloomington, Minnesota 55400

or use Comment Sheet in the back of this manual.

INDEX

ABBREVIATIONS

ASCII	American Standard Codes for Information Interchange
DAA	Data Access Arrangement
DDN	Direct Dial Network
DL	Dedicated Line
DSA	Data Set Adapter
HDX	Half Duplex
FDX	Full Duplex
MILGO	International Communications Corporation
MOD	Model
MODEM	Modulator/Demodulator (Data Set)
N/A	Not Applicable
PVT	Private Line
RIXON	United Business Communications Inc.
RTS	Request to Send
TTY	Teletype
UNI	Universal
WBL	Wide Band Line
WE	Western Electric (Bell System)

I. TROUBLESHOOTING HINTS

Introduction

This pamphlet is designed to assist in troubleshooting communications problems. It is not a tutorial on communications but will assist the trained communications CE in gaining practical experience.

To get maximum benefit from this manual, the reader should first become familiar with the following publications:

1. Introduction to Data Communications
   CDC, Pub. No. 13798900

2. Control Data 3000L Communications Systems and Equipment
   CDC, Pub. No. 41606600

3. Communications Systems Division Terminal Unit and Data Set Customer Engineering Technical Information Manual
   CDC, Pub. No. 41605200

These manuals give a background in transmission theory and will aid in providing a basic understanding of communications system problems.

Two areas will be covered starting at the point at which signals leave the CDC digital equipment. These will include the interface equipment (data set) and the telephone line itself. A sample data set (WE201) will be described and method of troubleshooting a problem with a WE201 will be outlined.

A. Data Sets

The telephone communications network, which we will be dealing with, was designed primarily to carry voice communications which is an analog signal. Data, however, is digital and therefore incompatible with the present telephone network. To make the digital data compatible with the telephone network, a device is needed which can change data to an analog representation. This device is a data set and it accomplishes compatibility by modulating digital data on to an analog carrier. The data set also furnishes the timing signals necessary to talk to terminal equipment.

The point at which the CDC digital equipment connects to the data set is called the interface (See Figure 1 A). Because of the large number of data terminal and data set manufacturers, this point has been standardized by the Electronic Industries Association and is defined by Document Number RS232C. A detailed explanation of RS232C can be obtained by writing to:

Director, Center for Computer Sciences and Technology
National Bureau of Standards
Washington, D.C. 20234

The voltage levels used in RS232C are defined as:

Control On	+3 to +25 Volts	Logical	"0"
Control Off	-3 to -25 Volts	Logical	"1"
Data Mark	-3 to -25 Volts	Logical	"1"
Data Space	+3 to +25 Volts	Logical	"0"

For pin assignments, see Table 1.

A very common data set is the WE201 (Western Electric). A description of this data set will be given with an outline to troubleshoot a problem in a system using this data set.

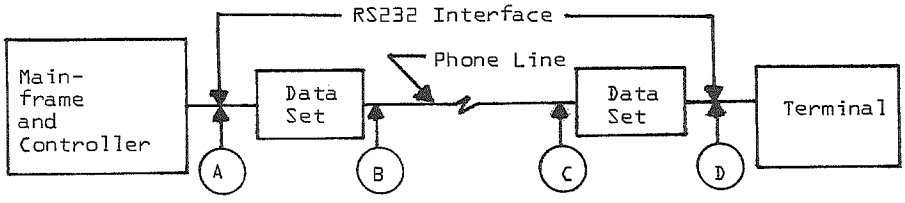


FIGURE 1
COMMUNICATIONS SYSTEM

Description

The 201 Series data sets are used to transmit synchronous serial data over a telephone transmission facility. The serial data applied to the send data lead is phase modulated onto a carrier and filtered to limit the band width to 2800 Hz. The receive portion of the data set detects the difference in phase of the incoming carrier and regenerates the digital data stream. The rate at which the phase changes is used to generate the receive clock.

The 201 A and B are the same except the 201A transmits data at 2000 bits/second and is used on dial up lines. The 201B transmits at 2400 bits/second and must have conditioned private lines.

Trouble Location

The following procedure assumes that the data set strapping options have been checked and are correct. {See Strapping Option Section} Also, it is assumed that the appropriate diagnostic has been run on the data terminal equipment and that it is working properly.

To use this procedure, access must be gained to the interface pins. A device has been designed by Maintenance Equipment Engineering for this purpose. It is a Data Terminal Junction Box and is obtainable through CEM under P/N 122111999.

Trouble Location Procedure {Refer to Figure 1}

Data not getting to remote site

1. Data present on send data lead at interface {Point A}
   Yes: Go to 7

   No: ↓

2. Data terminal ready on {Point A}
   No: Check data set adapter

   Yes: ↓

3. Data set ready on {Point A}
   No: Check data set:
   a. Power on
   b. In data mode or test mode

   Yes: ↓

4. Request to send on {Point A}
   No: Check data terminal equipment

   Yes: ↓

5. Clear to send on {Point A}
   No: Replace data set

   Yes: Trouble is in data terminal or the cable between the data set and data terminal equipment is bad.

6. Transmit clock on {Point A}
   No: Replace data set

   Yes: ↓

7. Data leaving the data set on the telephone lines o.k. {Point B}
   No: Replace data set

   Yes: ↓

8. Data being received at the line side of the receive modem and the level is proper {Point C}
   {See section on telephone line measurements using an oscilloscope.}
   No: Call phone company and report trouble. {Have line number handy.}

   Yes: ↓

9. Data set ready lead is on {Point D}
   No: Replace modem

   Yes: ↓

10. Carrier is on {Point D}
    No: Replace modem

    Yes: ↓

11. Data is being received {Point D}
    No: Replace modem

    Yes: ↓

12. Check receive clock {Point D}. Make sure it is stable. If receive clock jitters, trouble is most likely bad phone line. However, trouble could be bad modem. If replacing the modem does not cure the problem, call the phone company to report a faulty line {Have line number handy}.

B. Telephone Lines

The telephone line characteristics that adversely affect data transmission are:

1. Amplitude/Frequency Distortion
2. Delay Distortion
3. Intermodulation
4. Improper Termination
5. Improper Signal Levels
6. Impulse Noise

It is possible for the customer engineer to measure the last two of these parameters with the aid of an oscilloscope. The first four require more specialized equipment.

To measure noise or signal levels, your oscilloscope must have dual input vertical amplifiers with an algebraic add capability.

Signal Levels {In decibels, DB}

Procedure:

A. Make sure the scope is grounded to a good common ground. {The modem chassis makes good ground.}

B. Connect the "A" input of the scope to one side of the line and "B" input to the other side.

C. Invert the "B" input. {Make sure both vertical attenuaters are set to the same value and that they are calibrated.}

D. Set the display switch to A+B {Algebraic Add}.

E. The scope trace may contain longitudinal noise {A.C. Hum}. This can be phased out by adjusting either the "A" or "B" amplitude vernier adjustment.

F. The peak-to-peak voltage reading obtained from the scope can then be referenced to the chart on Table 2. The formula $DB = 20 \text{ Log } \frac{E}{2.2}$ may also be used where E is the peak-to-peak voltage reading from the scope. Check individual modem tables in Section III to determine optimum signal levels.

Impulse Noise

Procedure:

A. Connect oscilloscope to the phone lines the same way as measuring signal levels.

B. Set the trigger source to internal and sweep mode to single.

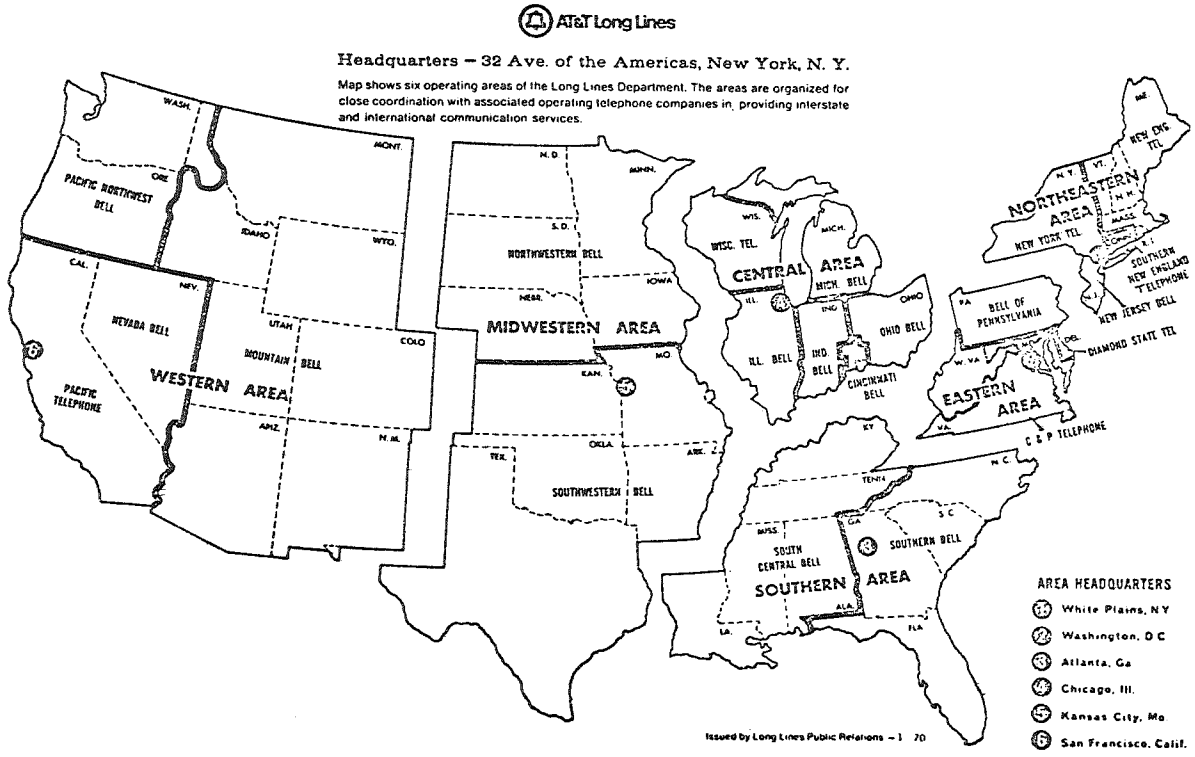
C. Adjust the trigger level to trigger at a level just above the signal level of the receive data.

D. Remove the signal from the line and reset the sweep. Any triggering of the sweep will be a result of impulse noise at a level greater than signal level.

▽Everything you▽ve always wanted to know about the Telephone Company....▽

▽Telephone Company▽ is a general term used when discussing ▽communications common carriers. The business of a telephone company is to supply communications facilities to the general public. Since these companies serve the public, they must comply with regulations set up by the Federal Communications Commission (FCC) at the Federal level and many state regulatory agencies. These agencies regulate the companies by setting rates which may be charged and generally regulating all phases of their business.

There are many ▽telephone companies▽ in the United States. By far the largest is the ▽Bell System▽ companies operated by American Telephone and Telegraph Company (AT&T) and its subsidaries. A map of the ▽Bell System▽ is shown below.



As you can see, the ▽Bell System▽ is a system of local companies (Northwestern Bell, Mountain Bell, etc.) which serve the various geographic areas. The U.S. is also broken into geographic areas known as ▽Long Lines▽ areas. ▽Long Lines▽ is a division of AT&T which provides interstate service between territories of the various associated companies and the many independent companies in the U.S. Therefore, if your line goes interstate or connects to an independent company, ▽Long Lines▽ has responsibility for that line in the ▽Bell System▽.

The independent phone companies noted above consists of some 2500 companies owned and operated outside of the ▽Bell System▽. These companies all connect to the ▽Bell System▽ giving the capability to communicate with anyone on the ▽Bell System▽ or with other independents. It might be noted here that Bell has more experience with data lines than many of the independents. Therefore, problem solving with the independents will require patience and perserverance.

Problem Solving

If a problem develops on your data line, there is certain information that is necessary to help isolate the problem. Therefore, you should take time to find and record this information so that it is readily available when a problem arises.

Information required when requesting help for the Telephone Company:

1. Line Type
   a. Dedicated (sometimes called "private" or "leased line")
   b. Dial up

2. Circuit Number (On Dedicated Lines)
   This number identifies the line to the phone company and should be kept at some location (besides the site log) where it is readily accessible. A good place is the demarcation strip. ⋈ Placement of the number on the modem is not recommended because it would be removed if the data set is replaced.

3. Strapping Options
   If your data set becomes inoperable and has to be replaced, the replacement may not have the correct strapping options. Therefore, you should keep a list of strapping options for future reference. This list should be kept in the site log and a copy in the terminal cabinet if convenient.

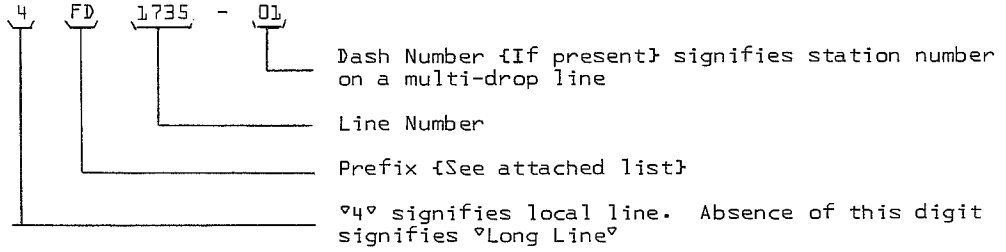
4. Emergency Service Phone Number
   An "emergency service" phone number should be available on your modem or near the demarcation strip. ⋈ If a number is not posted there, it will have to be obtained from your local sales representative. This number should be obtained and kept handy. This number will put you in contact with the "Private Line Service Board". For "Long Lines", this board is manned 24 hours a day, 7 days a week.

Now that you have all the necessary information, you can start checking your phone line problem.

If your phone line is a dial-up line, you can try "hanging-up" and dialing again. This may give you a different line of better quality. If re-dialing does not solve your problem or if re-dialing is necessary too often, your customer may have to work with his account representative to resolve the problem.

Dedicated lines present unique problems which may prove difficult to define and correct. After you are reasonably sure that the problem is in the phone line, you should proceed as follows:

1. Call the "emergency service" number.
2. Identify yourself and your line number.
   A typical line number would be:



The test board man will then check your line to see if it is properly terminated. If the problem cannot be resolved by talking to the test board man, it is advisable to call Regional Tech Support. They will have the test equipment and experience necessary to check further into the problem.

⋈ A demarcation strip is the point at which the telephone line terminates. This point is then connected to the modem.

PREFIXES

The following prefixes are used to identify various types of lines and service:

PREFIX	
FAD	Alternate full period telephone/foreign exchange/data phone Series 2000 Type 2001
FD	Data circuit - telephone grade and higher grade channels Series 3000 Type 3002 Series 4000 Type 4001
FDA	Alternate telephone - data Series 3000 Type 3002
FH	Multi-purpose wide band, base capacity 48KC Series 8000
FPA	Alternate full period telephone metering up to 150 BAUD Series 2000
FPD	Full period data phone Series 2000 Type 2001
FW	Service terminals for use as a wide band channel Series 8000, 5000
FXD	Foreign exchange data phone Series 2000 Type 2006
TB	Data up to 55 BAUD Series 1000 Type 1002
TBA	Alternate teletypewriter. Data up to 150 BAUD Series 1000
TC	Metering channel 30 BAUD Series 1000 Type 1001
TFA	Alternate telephotograph telephone Series 1000
TTA	Alternate teletypewriter Morse Series 1000
VM	Metering channel voice grade Series 3000 Type 3001
VMA	Alternate telephone voice grade metering Series 3000 Type 3001

TABLE 1
RS232 Pin Assignment
For WE201 Type Data Sets

Circuit	Pin	Explanation
AA	1	Frame ground. The frame ground and the ground wire of the power cord are all connected together within the data set.
BA	2	Send data
BB	3	Receive data
CA	4	Request to send
CB	5	Clear to send
CC	6	Interlock {Data set ready}
AB	7	Signal ground
CF	8	Carrier detected
Not Defined	9	+12 volts for testing
Not Defined	10	-12 volts for testing
DB	15	Serial clock transmit
Not Defined	16	Dibit clock transmit
DD	17	Serial clock receive
Not Defined	18	Dibit clock receive
Not Defined	19	Remote release {See Note 1}
CD	20	Remote control {Data terminal ready} {See Note 2}
Not Defined	21	Ready {See Note 1}
CE	22	Ring Indicator 1 {See Note 1}
Not Defined	23	Ring Indicator 2 {See Note 1}
DA	24	Serial Clock Transmit, External

Note 1

For contact option, operates on a contact closure basis. Not used with EIA option.

Note 2

For contact option, operates on a contact closure basis. For EIA option, +6 volts or -6 volts.

Note 3

Specification RS232C states that data set cables cannot exceed 50 feet. This may vary with the type of cable used.

TABLE 2
DBM QUICK CONVERSION CHART
(Table of Equivalence (dbm) for 1Khz into a 600 ohm line)

	DBM	PEAK-TO-PEAK VOLTAGE (E)		DBM	PEAK-TO-PEAK VOLTAGE (E)
+	10	6.90		13	0.49
	9	6.18		14	0.44
	8	5.51		15	0.39
	7	4.91		16	0.35
	6	4.38		17	0.31
	5	3.90		18	0.28
	4	3.48		19	0.25
	3	3.10		20	0.22
	2	2.76		21	0.20
	1	2.46		22	0.17
				23	0.16
	0	2.19	—	24	0.14
	1	1.96		25	0.12
	2	1.74		26	0.11
	3	1.55		27	0.10
	4	1.38		28	0.09
	5	1.23		29	0.08
—	6	1.10		30	0.07
	7	0.98		35	0.04
	8	0.87		40	0.02
	9	0.78		45	0.01
	10	0.69		50	0.007
	11	0.62			
	12	0.55			

TABLE 3
MODEM COMPARISON

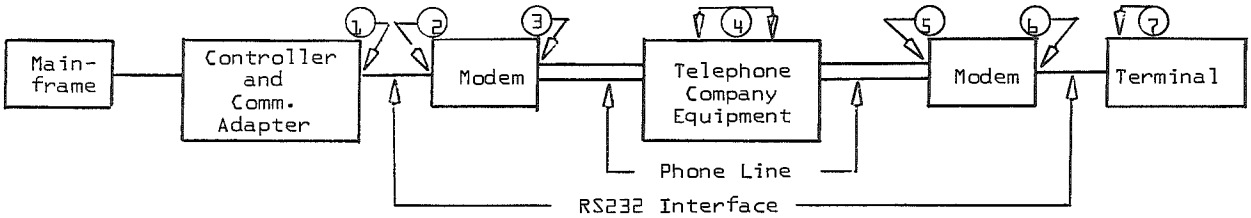
MODEM	SPEED BPS MIN	SPEED BPS MAX	MODU-LATION	DUPLEX MODE	LINE CONDITIONING REQUIRED	SYNCH OR ASYNCH	EQUALI-ZATION
WE103	-	300	FSK	HDX/FDX	None	A	None
WE201A	-	2000	PSK	HDX/FDX	None	S	None
WE201B	-	2400	PSK	HDX/FDX	None	S	None
WE203	2400	7200	AM/VSB	HDX/FDX	C2	S	Auto
WE301	18K	40.8K	PM/VSB	FDX	Wideband	S	None
WE303	18K	230.4K	PM/VSB	FDX	Wideband	S	None
CDC358-1	0	9600	FSK	HDX/FDX	Pvt Line	A	None
CDC358-2	1200	9600	FSK	HDX/FDX	Pvt Line	S	None
CDC358-3	40.8K	163.2K	FSK	HDX/FDX	Pvt Line	S	None
CDC358-4	50K	200K	FSK	HDX/FDX	Pvt Line	S	None
CDC124-1	-	2400	FSK	HDX/FDX	Pvt Line	S	None
Milgo 22/2400*	2000	2400	PSK	HDX/FDX	None	S	Statistical
Milgo 44/4800	-	4800	PSK	FDX	None	S	Manual
Milgo 45/4800	-	4800	PSK	FDX	None	S	Adaptive
Milgo 46/4800	-	4800	PSK/AM	PDX	None	S	Manual
Rixon DS1800	-	1800	FSK	FDX	C1	A	Delay
Rixon DS2400**	1200	2400	PSK	HDX/FDX	C1	S	

* Bell 201 Compatible
** Bell 201B Compatible

C. Looping Data

Many data sets and data set adapters have looping (echo) capabilities designed into the hardware.

This function is very useful in isolating failing hardware. Data can be looped back (echoed) to the originating equipment for comparison. This can be done on successive portions of the communications link until the faulty component is discovered.



LOOP BACK (ECHO) POINTS

Common loop back areas are shown in the figure above. Communications systems usually have some (but not all) of the possible loop back areas shown above. Loop back capabilities which exist in CDC equipments will be outlined in this section. Capabilities existing in specific modems can be found in the individual modem manuals.

8XXX TTU's, Patch Boards, Communication Adapters

Loop back (echo) procedures for these types of equipments can be found in the "Communications Systems Division Terminal Unit and Data Set Customer Engineering Technical Information Manual", Publication Number 41605200. The procedure is quite lengthy and therefore will not be repeated here.

361-X Communication Adapters (CA)

All 361 CA's are equipped with a Test Mode feature. Test mode is enabled by either a switch or a function command. When in test mode, data is looped back prior to the data set interface. Therefore, neither the data set nor the data set interface is checked out.

For the 361-1---

1. Put the CA in Test Mode by placing the test switch (S1 on 1ERM board) in the TEST position.
2. If the CA is in Half Duplex Mode, move the HDX/FDX shorting block to the FDX position (on 1 EPM board).
3. Run echo diagnostic.

Looping logic for the 361-4, 5, 6 is selected by program control. Therefore, it is only necessary to run the echo section of applicable diagnostics to loop back data. Note that the data set must be cabled to the CA being tested. This is because "Serial Clock Transmit" from the data set is used for timing.

6671/6671-2

Test Cable: P/N 18886710

For 103 mode testing:

1. Determine channel to be tested.
2. Select channel for 103 mode by placing channel mode switch in the front center of cabinet in the up position.
3. Connect test cable between selected channel and test connector T17 which is located on a panel in the lower left portion of the back of the cabinet.
4. Load the diagnostic RT5 and set parameters and channel selection. Test will run only those sections applicable to 103 mode.

For 201 mode testing:

1. Determine channel to be tested.
2. Select channel for 201 mode by placing channel mode switch in the front center of cabinet in the down position.
3. Connect test cable between selected channel and test connector T16 which is located on a panel in the lower left portion of the back of the cabinet.
4. Load the diagnostic RT5 and set parameters and channel selection. Test will run only those sections applicable to 201 mode. If 4800 Baud capability is installed set appropriate parameter.

6673/74/75

Test Cables: P/N 38614900 - Two Needed
P/N 38615000

1. Select data set controllers to be tested.
2. Remove data set cables and attach test cables as shown on Page 2-13 of the 6673/74 CE Manual (Pub. No. 60201500).
3. Load the diagnostic RT3 and select receiving and transmitting data set controller. Enter all other necessary parameters. Test Sections 1 and 2 are the only sections that will run in loop mode.

6676-A/B/C

Test Cables: 6676-A/B P/N 18834800
6676-C P/N 18685000

1. Select channels to be tested.
2. Connect appropriate test cable between the two channels.
3. Load the diagnostic TT3 and set parameters including transmitting and receiving channels. Only test sections 1-5 should be selected for loop mode.

791

1. Determine which data set adapters are to be tested.
2. Place test switches on connector panel in test position for selected DSA's.
3. Load diagnostic LCC from 6000/CDC Cyber SMM tape or from paper tape on the maintenance console.
4. Set applicable parameters for selected DSA's.
5. For internal loop, run sections 1-3 only.
6. Section 4 is for external loop and requires a test cable (not yet available).

D. TEST EQUIPMENT

PAR Meter

The PAR Meter currently being recommended for field use is the Marconi TF2809.

What does it accomplish?

The PAR Meter reading is a reading of "fidelity" of the telephone line. By "fidelity" we mean a single reading, the result of which is made up of many distortion factors. The PAR Meter uses a meter scale with graduations from Zero (0) to one hundred (100), with 100 being a perfect reading. This, of course, is not possible over an actual phone line. If in theory, however, you had a 100 reading, it would mean that your line facility has: (1) no phase distortion, (2) no amplitude distortion, (3) no Gaussian noise (steady state noise).

The minimum acceptable PAR Meter readings for digitally conditioned lines are as follows:

3002	(Unconditioned)	Min	45
C-1	(Conditioned)	Min	48
C-2	(Conditioned)	Min	78
C-4	(Conditioned)	Min	87
C-5	(Conditioned)	Min	95

The circuit length in miles should not affect the line conditioning; however, since one of the three parameters used to indicate PAR is noise, the PAR readings will be lower as circuit length increases. This can be seen in Appendix A, Table II, of this handbook. You will note that the Gaussian noise level increases as circuit length increases.

What is the PAR signal?

The PAR Meter transmits a bi-polar pulse train. This test signal train is weighed (filtered) to within the voice band, and most importantly, all components are in phase within the signal.

When all the components of the signal are in phase, the signal has the highest ratio of peak-to-average power. Thus the name P.A.R. (Peak-to-Average Ratio). Calibration of the instrument should be done periodically to assure that the signal transmitted is clean and undistorted. Thus when connected to the phone line pair, if the signal is distorted during its trip to the other end by delay (phase) distortion or amplitude distortion (no longer at flat frequency response) and/or noise, the peak-to-average ratio will be degraded.

This distorted signal is fed into the receiver of another PAR Meter, (in the case of straight-away measurements) or looped back to your own PAR receiver, (in the case of 4 wire loop-back arrangements). This received signal is fed into an Automatic Gain Control (AGC) circuit which clamps the average input signal level to a pre-set level and the peak-to-average ratio is read out on the 0 to 100 percent of PAR Meter.

It is a good rule of thumb on loop-back tests to avoid making PAR tests on circuits which have an overall loss in excess of 32 dbm. The PAR Meter is an extremely useful tool and should be used to validate all new circuit installations, particularly multi-point dedicated (private) line circuits.

Remote Terminal Tester TS001-A04

The Remote Terminal Tester (RTT) was designed to drive remote display equipment. However, it is possible to drive other equipments in half duplex mode, if that equipment interface conforms to EIA Standard RS-232B.

Remote Terminal Tester TS001-A04 - Continued

Test sequences are switch selectable and allow either automatic or manual message formats. These formats allow the terminal to be tested off-line at 2.4 or 4.8 KHz.

Some of the more common functions that can be exercised include ALERT, POLL, WRITE, WRITE RE-SET, CLEAR WRITE, and DIAGNOSTIC WRITE.

For a complete description of the tester and its operation, refer to Customer Engineering Manual 58031300.

Dual Mode Remote Terminal Tester TD102-A01

The Dual Mode Remote Terminal Tester (DMRTT) was designed to allow local and remote off-line testing of display terminals. Remote refers to operating terminals across a telephone line.

The DMRTT simulates data and signals coming from a data set when operating in the LOCAL mode and simulates data and signals going to the data set when operating in the REMOTE mode. This eliminates the need for using the main computer to troubleshoot problems. By using fixed or variable messages, derived from hardware, the DMRTT is able to simulate all message patterns which the main computer would normally transmit. The DMRTT also has the ability to ignore incorrect responses or the absence of responses and loop on a chosen pattern, allowing the operator to troubleshoot a malfunction.

For further information concerning the operation and theory of this tester, refer to Customer Engineering Manual 59302600A.

Programmable Terminal Exerciser (TD103A01

The TD103A01 is a programmable exerciser that will be used to troubleshoot remote communications equipment. The tester can be programmed to exercise asynchronous or synchronous type equipment. It can communicate through two data sets and phone lines, one data set and phone line or directly attached to the failing terminal. Due to programming capabilities, the tester may even be made to act like a terminal and communicate with the data source. It is mainly designed with Large Sclae Integration and utilizes a memory with 512 8-bit word locations. The complete tester is compactly packaged in an easy-to-carry aluminum suitcase.

Some of the tester's main features are as follows:

1)	Baud Rate	- Easily adjustable from 10 Hz to 12 KHz
2)	Asynchronous Mode	- One start bit one stop bit, or one start bit two stop bit
3)	Parity	- Odd, even or none
4)	Word Length	- 5, 6, 7, or 8 bit words
5)	Mode	- Half or full duplex
6)	Modem	- Has a built-in modem
7)	Diagnostics	- A complete self testing diagnostic will be available
8)	Keyboard	- Program may be easily loaded with use of keyboard
9)	Magnetic Card Reader	- Utilizes a magnetic card reader to load available programs

The programmable tester will not be available to the field until the first quarter of 1973.

APPENDIX A
TABLE I
SPECIFICATIONS FOR THE
VOICE BANDWIDTH DATA CHANNEL AND C-TYPE CONDITIONING

		3002 Channel	C1 Conditioning	C2 Conditioning	C4 Conditioning
I	Circuit Designation Use (Note D+G) Interstate Tariff FCC No. 260	Alternate Voice/Data or Data only	Alternate Voice/Data or Data only	Alternate Voice/Data or Data only	Alternate Voice/Data or Data only
II	General Characteristics Type of Service Mode of Operation Method of Termination Imped.-Source & Load Maximum Signal Power (Note H)	2-Point or Multipoint Half-or Full-Duplex 2-Wire or 4-Wire 600-ohm-Resistive-Bal. 0 dBm for Composite Data Signal, OVU for Voice	2-Point or Multipoint Half-or Full-Duplex 2-Wire or 4-Wire 600-ohm-Resistive-Bal. 0 dBm for Composite Data Signal, OVU for Voice	2-Point or Multipoint Half-or Full-Duplex 2-Wire or 4-Wire 600-ohm-Resistive-Bal. 0 dBm for Composite Data Signal, OVU for Voice	2-Point or 3-Point (Note F) Half-or Full-Duplex 2-Wire or 4-Wire 600-ohm-Resistive-Bal. 0 dBm for Composite Data Signal, OVU for Voice
III	Attenuation Char. Meas. betw. 600-ohm Impedances at Lineup (Recommended) Expected Max, Var. of (L) (Note A) Frequency Response (Ref. 1000 H_z) (Note B) Frequency Error	16 dB ± 1 @ 1000 Hz Short-term ± 3 dB Long-term ± 4 dB Freq. Range Var.-dB 300-3000, -3 to + 12 500-2500, -2 to + 8 ± 5 Hz	16 db ± 1 @ 1000 Hz Short-term ± 3 dB Long-term ± 4 dB Freq. Range Var.-dB * 300-2700, -2 to + 6 * 1000-2400, -1 to + 3 2700-3000, -3 to + 12 ± 5 Hz	16 dB ± 1 dB @ 1000 Hz Short-term ± 3 dB Long-term ± 4 dB Freq. Range Var.-dB * 300-3000, -2 to + 6 * 500-2800, -1 to + 3 ± 5 Hz	16 dB ± 1 dB @ 1000 Hz Short-term ± 3 dB Long-term ± 4 dB Freq. Range Var.-dB * 300-3200, -2 to + 6 * 500-3000, -2 to + 3 ± 5 Hz
IV	Delay Characteristics Absolute delay (Note C) Envelope delay distortion	Not Specified Less than 1750 Micro-seconds over band from 800 to 2600 Hz	Not Specified *Less than 1000 Micro-seconds over band from 1000 to 2400 Hz Less than 1750 Micro-seconds over band from 800 to 2600 Hz	Not Specified *Less than 500 Micro-seconds 1000 - 2600 Hz *Less than 1500 Micro-seconds 600 - 2600 Hz *Less than 3000 Micro-seconds 500 - 2800 Hz	Not Specified *Less than 300 Micro-seconds 1000-2600 Hz *Less than 500 Micro-seconds 800-2800 Hz *Less than 1500 Micro-second 600-3000 Hz *Less than 3000 Micro-seconds 500-3000 Hz
V	Noise Characteristics Message Circuit Noise Impulse Noise (Note E & H)	See Table II 15 counts in 15 minutes @ 69 dBmVB (69 dBm C)	See Table II 15 counts in 15 minutes @69 dBm VB (69 dBm C)	See Table II 15 counts in 15 minutes @ 69 dBmVB (69 dBm C)	See Table II 15 counts in 15 minutes @ 69 dBmVB (69 dBm C)

* These specifications are tariffed items. All others are the current administrative instructions of A.T.&T. Co.

TABLE I (CONTINUED)

SPECIFICATIONS FOR THE VOICE BANDWIDTH DATA CHANNEL
AND C TYPE CONDITIONING

NOTES:

A. (L) is the net loss as measured at 1000 Hz. Short term variations are those likely to be observed during a measurement interval. They are caused by amplitude and phase hits, dropouts, and maintenance activities. Long term variations include seasonal changes, tube aging, etc.

B. DC continuity is not provided on any of these offerings.

C. Absolute delay and propagation times are not specified. Where satellite channels are employed, the delay may be several tenths of a second and telemetry and retransmission schemes may be either unusable or limited.

D. If alternate voice data operation is desired and the data modulation does not allow the use of compandors (such as many AM systems where instantaneous power varies rapidly), the voice mode may be degraded by excessive noise. If signaling is required, the data modulation must not interfere with 2600 Hz S.F. Signaling units and response is not specified between 2450 and 2750 Hz.

E. These impulse noise limits are primarily Plant maintenance limits. In cases where they are exceeded, Engineering will evaluate the performance on impulse noise distribution; i.e., how rapidly the counts (impulses) fall off as counting level (impulse noise peak voltage) is raised, and the effect on the data system performance.

F. Third-point operation describes the conditioning where Point A (Master) can transmit to B and C (slaves) simultaneously and both B and C can respond to A. Transmissions between B and C are possible, but the characteristics are not specified.

G. C3 conditioning, not included in this table, describes conditioning of access lines and trunks in central office switching applications. An end-to-end connection consisting of four trunks and two access lines with C3 will approximate C2 conditioning overall.

H. The "vb" in the objectives refers to the voiceband filter in the measuring set. This approximates the "C" message filter and the typical response of the voice grade channel.

TABLE II

MESSAGE CIRCUIT NOISE CHARACTERISTICS
PRIVATE LINE OPERATION

The basic objective for data operation is that the rms data level should be 24 dB above the message circuit noise reading with a "C message weighted filter" during the data signal on condition. Since the data level can be -16 dBm at the terminal, the following objective is given:

** rms data signal	-16	dBm	74	dBrnC
Signal-to-Noise Requirement	24		24	
Allowable Noise	-40	dBm	50	dBrnC

If readings are made in the idle or "no signal" condition, as is most common, the following objectives are typically used. These readings are caused by a masking of noise, due to idle circuit loss in the expandor in compandored carrier systems, and other effects.

Circuit Length (Miles)		Expected Noise Reading C Message Weighting Not Exceeding
0-	50	28 dBrnC
50-	100	31 dBrnC
100-	400	34 dBrnC
400-	1000	38 dBrnC
1000-	1500	40 dBrnC
1500-	2500	42 dBrnC
2500-	4000	44 dBrnC
4000-	8000	** 47 dBrnC
8000-	16000	** 50 dBrnC

TABLE II (Continued)

* Assume a random spectrum of the data signal.

** Voice operation may be degraded.

NOTE: All readings are expected values. While the noise characteristics are fairly stable, variations due to facility activity or troubles will be experienced.

TABLE III

C3 CONDITIONING

For access lines and trunks associated with a Switched Circuit Automatic Network or Common Control Switching Arrangement.

Access Lines

- The envelope delay distortion shall not exceed:
  between 1000 and 2600 Hertz, a maximum difference of 110 microseconds
  between 600 and 2600 Hertz, a maximum difference of 300 microseconds
  between 500 and 2800 Hertz, a maximum difference of 650 microseconds
- The loss of the data loop shall be less than 10 dB at 1000 Hertz and the loss deviation from 1000 Hertz reference shall not exceed:
  between 500 and 2800, -0.5db to +1.5db
  between 300 and 3000, -0.8db to +3db
  (+ means more loss)

Trunks

- The envelope delay distortion shall not exceed:
  between 1000 and 2600 Hertz, a maximum difference of 80 microseconds
  between 100 and 2600 Hertz, a maximum difference of 260 microseconds
  between 500 and 2800 Hertz, a maximum difference of 500 microseconds
- The loss deviation with frequency (from 1000 Hertz reference) shall not exceed:
  between 500 and 2800 -0.5db to +1db
  between 300 and 3000 -0.8db to +2db

Impulse Noise *

No more than 15 counts in 15 minutes at 59 dBrnc referred to the local central office.

Message Circuit Noise *

No more than 20 dBrnc

* Requirements for both access lines and trunks.

These requirements are given to define minimum design objectives for loops used for either Data Access Arrangements or DATA-PHONE service.

II. SYSTEMS

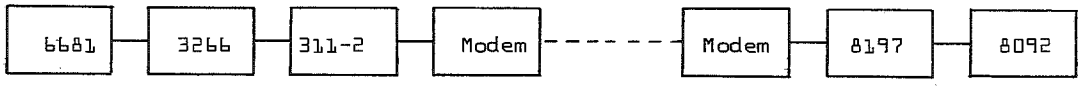
In order to accommodate a wide variety of equipments, modem vendors have built many options into their gear. These options are usually installed by straps and give flexibility in accommodating such things as level changes, voltage or current interface, two or four-wire phone lines, etc. In using this section, it will be necessary to have a copy of the technical manual for the particular modem you are interested in. The tables in Section III contain a brief description of the necessary options for the particular hardware and software configuration. However, to accomplish (or verify) the point-to-point wiring, the technical manual should be on hand.

NOTE: IT IS ILLEGAL TO REMOVE THE COVER FROM OR OTHERWISE TAMPER WITH BELL (WESTERN ELECTRIC) MODEMS. THE INFORMATION CONTAINED IN THIS BOOK IS GIVEN FOR REFERENCE WHEN TALKING TO BELL EMPLOYEES OR ORDERING SPECIFIC SERVICE TO BE INSTALLED.

Also in this section are options contained in the CDC transceivers and data set adapters. In this case, options are selected with shorting blocks or decoding plugs.

SYSTEM: 6000

SOFTWARE: Operating System: Scope 3.X
Software Product: Export/Import 8130

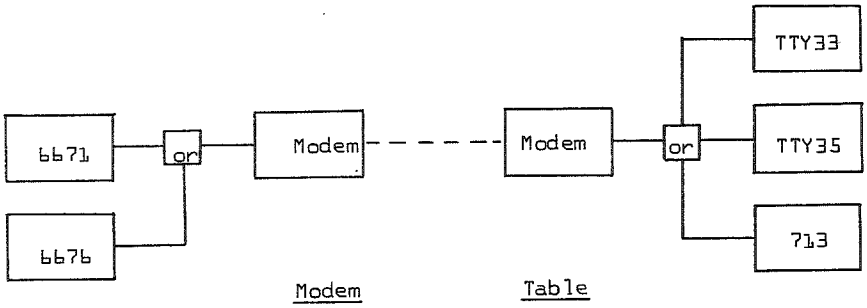


Modem	Table
WE201A3/B3	1.2
CDC358-2	2.1
CDC124-1	2.9
MILGO 2200/24	3.1
MILGO 4400/48	3.2
MILGO 4500/48	3.3
MILGO 4600/48	3.4

See Note 3

SYSTEM: 6000

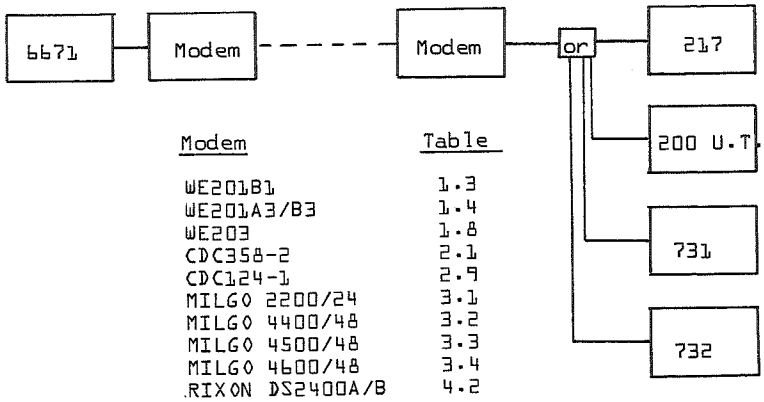
SOFTWARE: Operating System: Scope 3.X
Software Product: TTY RESPOND
RESPOND II
INTERCOM 3



Modem	Table
WE103	1.1
CDC 358-1	No Options Available
Rixon DS1800	4.1

SYSTEM: 6000

SOFTWARE: Operating System: Scope 3.X
Software Product: INTERCOM 3

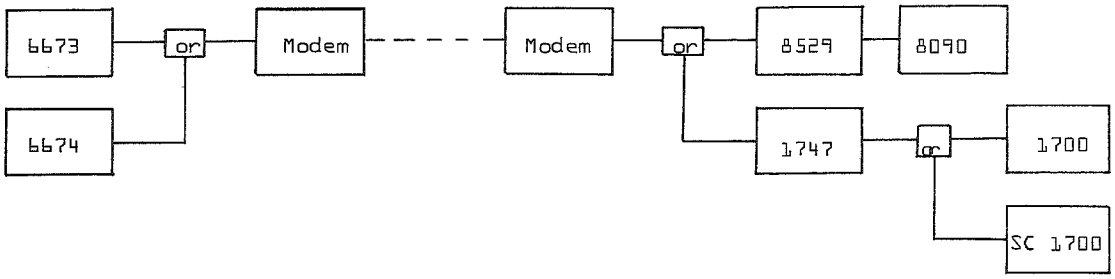


Modem	Table
WE201B1	1.3
WE201A3/B3	1.4
WE203	1.8
CDC358-2	2.1
CDC124-1	2.9
MILGO 2200/24	3.1
MILGO 4400/48	3.2
MILGO 4500/48	3.3
MILGO 4600/48	3.4
RIXON DS2400A/B	4.2

See Note 1,2,3

SYSTEM: 6000

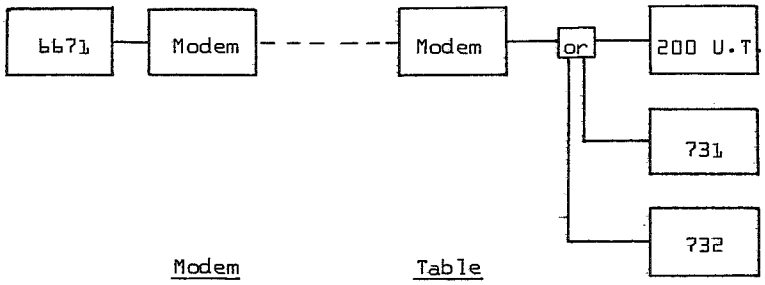
SOFTWARE: Operating System: Scope 3.X
Software Product: EXPORT HIGH SPEED



Modem	Table
WE301	1.6
WE303	1.7
CDC 358-3	2.2
CDC 358-4	2.2

SYSTEM: 6000

SOFTWARE: Operating System: Scope 3.X
Software Product: EXPORT/IMPORT 200

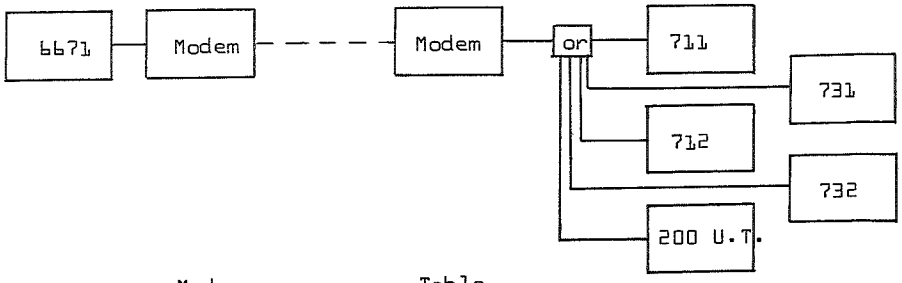


Modem	Table
WE201B1	1.3
WE201A3/B3	1.4
WE203	1.8
CDC358-2	2.1
CDC124-1	2.9
MILGO 2200/24	3.1
MILGO 4400/48	3.2
MILGO 4500/48	3.3
MILGO 4600/48	3.4
RIXON DS2400A/B	4.2

See Note 1.3

SYSTEM: 6000/CYBER 70-72, 73, 74

SOFTWARE: Operating System: Scope 3.4, 3.4.1
Software Product: INTERCOM 4

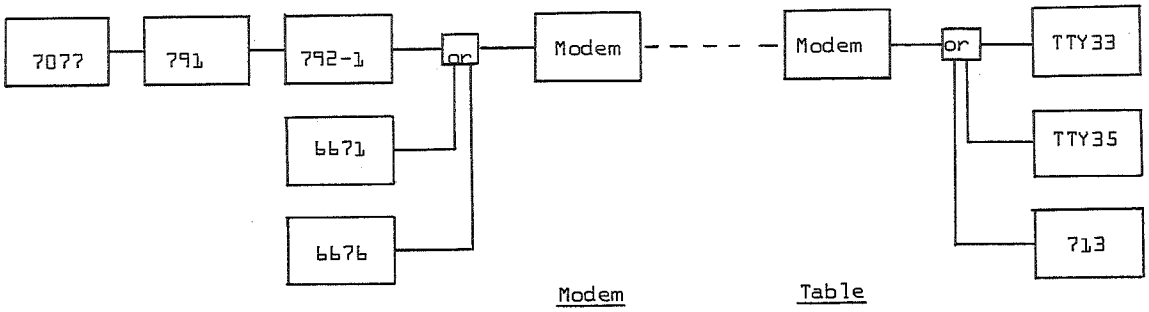


Modem	Table
WE201B1	1.3
WE201A3/B3	1.4
WE203	1.8
CDC358-2	2.1
CDC124-1	2.9
MILGO 2200/24	3.1
MILGO 4400/48	3.2
MILGO 4500/48	3.3
MILGO 4600/48	3.4
RIXON DS2400A/B	4.2

See Note 1.3

SYSTEM: 6000/CYBER 70-72, 73, 74

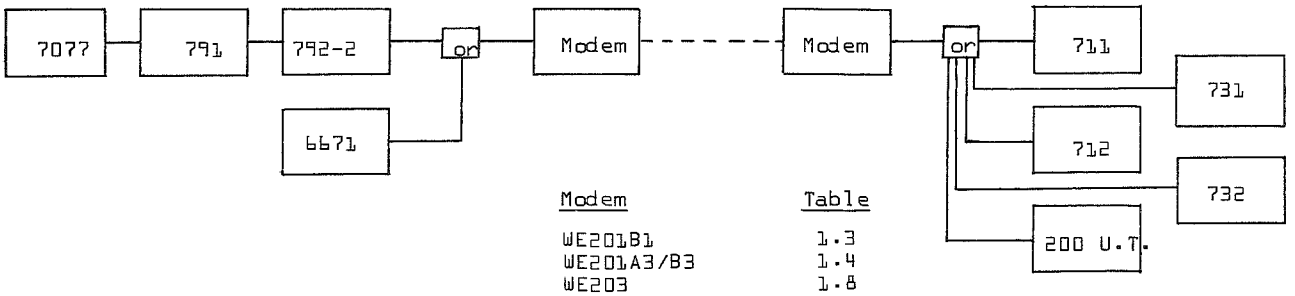
SOFTWARE: Operating System: Scope 3.4, 3.4.1
Software Product: INTERCOM 4, 4.1



Modem	Table
WE103	1.1
CDC 358-1	No Options Available
Rixon DS1800	4.1

SYSTEM: 6000/CYBER 70-72, 73, 74

SOFTWARE: Operating System: Scope 3.4.1
Software Product: INTERCOM 4.1

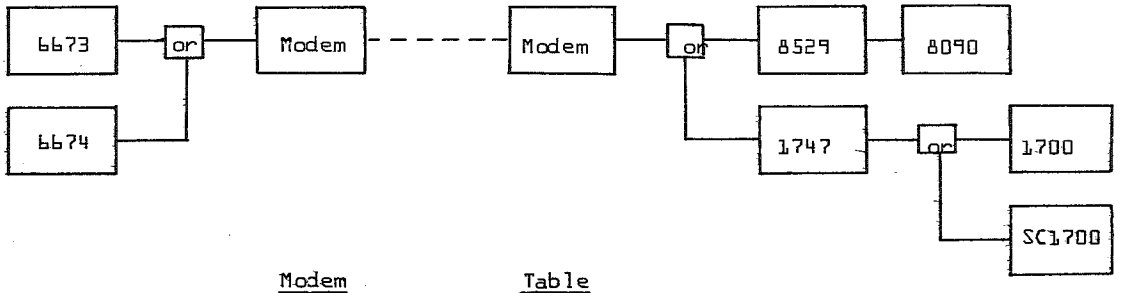


Modem	Table
WE201B1	1.3
WE201A3/B3	1.4
WE203	1.8
CDC358-2	2.1
CDC124-1	2.9
MILGO 2200/24	3.1
MILGO 4400/48	3.2
MILGO 4500/48	3.3
MILGO 4600/48	3.4
RIXON DS2400A/B	4.2

See Note 1.3

SYSTEM: 6000/CYBER 70-72, 73, 74

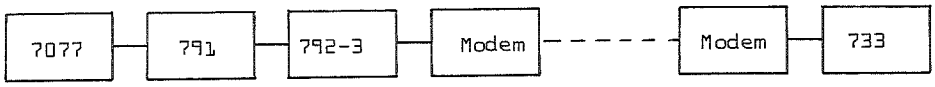
SOFTWARE: Operating System: Scope 3.4, 3.4.1
Software Product: INTERCOM 4, 4.1



Modem	Table
WE301	1.6
WE303	1.7
CDC 358-3	2.2
CDC 358-4	2.2

SYSTEM: 6000/CYBER 70-72, 73, 74

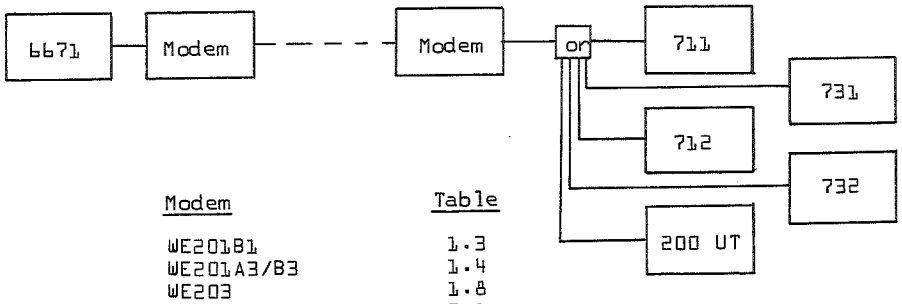
SOFTWARE: Operating System: Scope 3.4.1
Software Product: INTERCOM 4.1



Modem	Table
WE303C	1.7
CDC 358-3	2.2
CDC 358-4	2.2

SYSTEM: 6000/CYBER 70-72, 73, 74

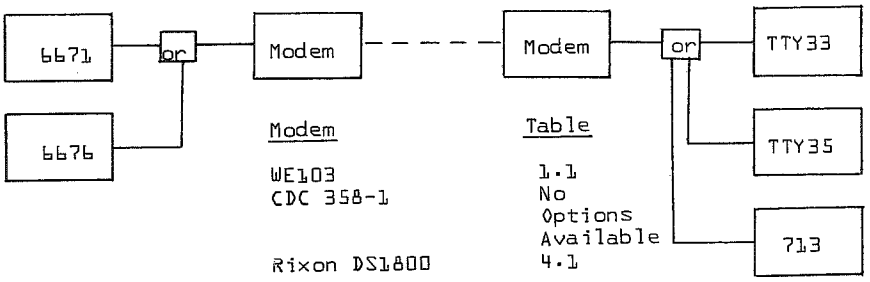
SOFTWARE: Operating System: KRONOS 2.0
Software Product: EXPORT/IMPORT 200



Modem	Table
WE201B1	1.3
WE201A3/B3	1.4
WE203	1.8
CDC358-2	2.1
CDC124-1	2.9
MILGO 2200/24	3.1
MILGO 4400/48	3.2
MILGO 4500/48	3.3
MILGO 4600/48	3.4
RIXON DS2400A/B	4.2

SYSTEM: 6000/CYBER 70-72, 73, 74

SOFTWARE: Operating System: KRONOS 2.0
Software Product: Interactive Basic



Modem

WE103
CDC 358-1

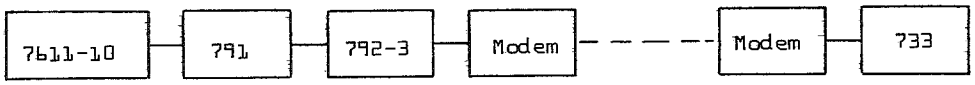
Rixon DS1800

Table

1.1
No
Options
Available
4.1

SYSTEM: 7000

SOFTWARE: Operating System: Scope 2.0
Software Product: Scope 2.0



Modem

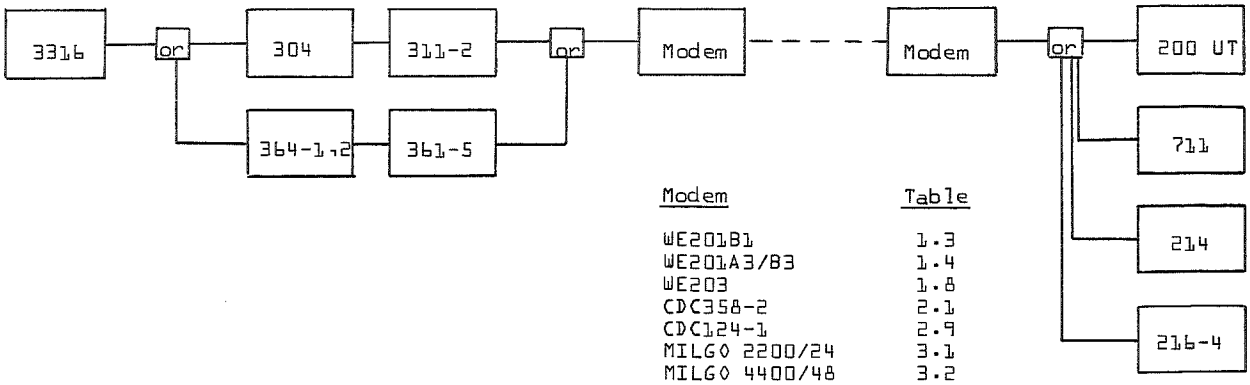
WE303C
CDC 358-3
CDC 358-4

Table

1.7
2.2
2.2

SYSTEM: 3000L

SOFTWARE: Operating System: MASTER 3.3
Software Product: RESPOND
EXPORT/IMPORT

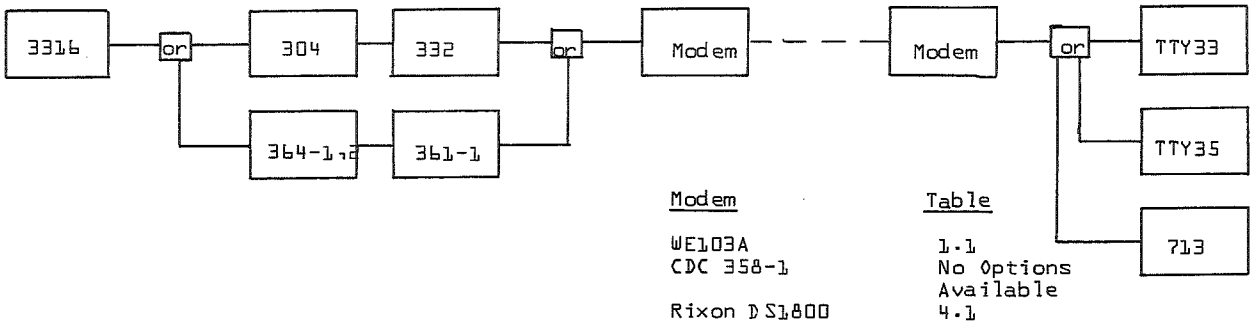


Modem	Table
WE201B1	1.3
WE201A3/B3	1.4
WE203	1.8
CDC358-2	2.1
CDC124-1	2.9
MILGO 2200/24	3.1
MILGO 4400/48	3.2
MILGO 4500/48	3.3
MILGO 4600/48	3.4
RIXON DS2400A/B	4.2

See Note 3,4,5

SYSTEM: 3000L

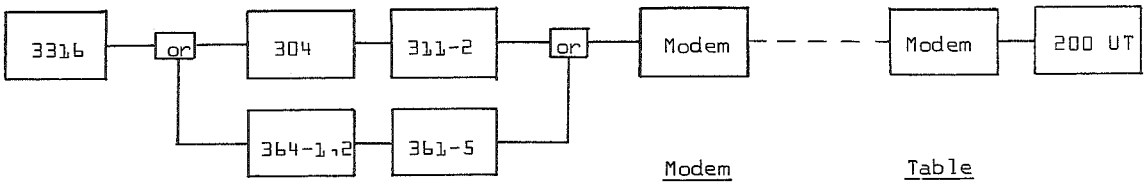
SOFTWARE: Operating System: MASTER 3.3
Software Product: RESPOND



Modem	Table
WE103A	1.1
CDC 358-1	No Options Available
Rixon DS1800	4.1

SYSTEM: 3000L

SOFTWARE: Operating System: MASTER 3.3
Software Product: MCS III

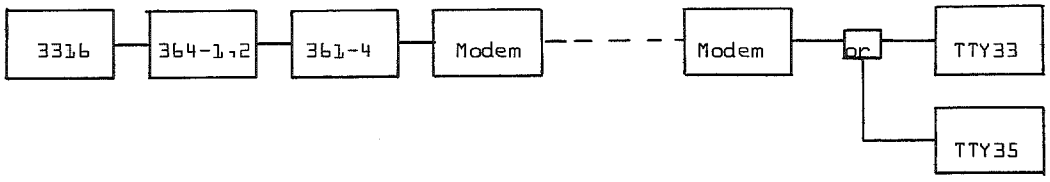


Modem	Table
WE201B1	1.3
WE201A3/B3	1.4
WE203	1.8
CDC358-2	2.1
CDC124-1	2.9
MILGO 2200/24	3.1
MILGO 4400/48	3.2
MILGO 4500/48	3.3
MILGO 4600/48	3.4
RIXON DS2400A/B	4.2

See Note 3.4

SYSTEM: 3000L

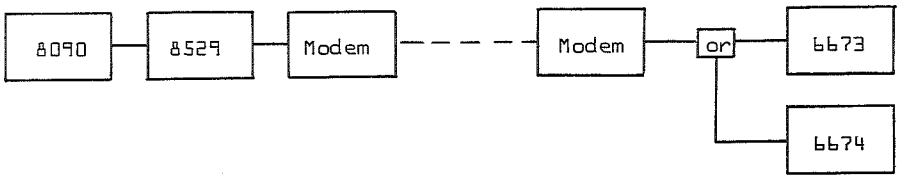
SOFTWARE: Operating System: KRONOS III



Modem	Table
WE103A	1.1
WE202	1.9
CDC 358-1	No Options Available
Rixon DS1800	4.1

SYSTEM: 8000

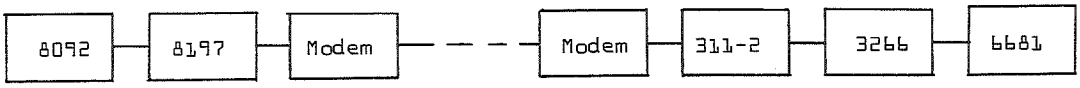
SOFTWARE: Software Product: Export High Speed



Modem	Table
WE301	1.6
WE303	1.7
CDC 358-3	2.2
CDC 358-4	2.2

SYSTEM: 8130

SOFTWARE: Software Product: IMPORT/EXPORT

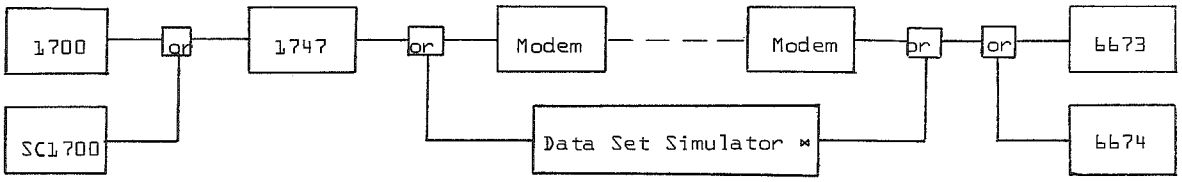


Modem	Table
WE201B1	1.3
WE201A3/B3	1.4
WE203	1.8
CDC358-2	2.1
CDC124-1	2.9
MILGO 2200/24	3.1
MILGO 4400/48	3.2
MILGO 45/4800	3.3
MILGO 46/4800	3.4
RIXON DS2400A/B	4.2

See Note 3

SYSTEM: 1700/SC1700

SOFTWARE: Operating System: MSOS
Software Product: 1700 Import High Speed
(May Also Stand Alone)

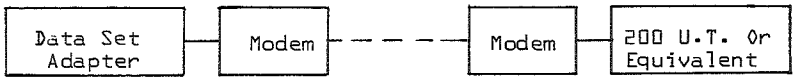


Modem	Table
WE301	1.6
WE303	1.7
CDC 358-3	2.2
CDC 358-4	2.2
No Modem ⋈	2.3

SYSTEM: 3L00

SOFTWARE: All Standard 3L00 Communications Software

MODEMS: Any WE201 Compatible Modem in Two-Wire Half-Duplex Mode



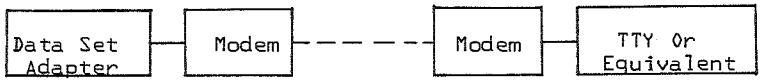
DSA	Table
CDC 311-2	2.4*
CDC 361-5	2.5

* When using 358-2 data sets, the data sets should be wired in four-wire mode. This is to eliminate the 15ms turn-around delay. (Also true for CDC124-1.)
---For 311-2, use decoder plug on J04, P/N 36937938, (ASCII FD or UNI FD) Blk, Yel, Yel.

SYSTEM: 3L00

SOFTWARE: All Standard 3L00 Communications Software

MODEMS: Any WE103, WE202, or Equivalent Modem



DSA	Table
CDC 8536 C,D	2.6
CDC 8537 C,D	2.7
CDC 361-1,2,3	2.8

NOTES ON ADDITIONS

1. When operating at 4800 Baud, the 6671-2 or 6671-1 with Standard Option 10258-1 must be used.

2. To run 4800 Baud, the 217 must have one of two 4800 Baud QSE's intalled. They are: a) 4800 Baud Controlled Carrier and b) 4800 Baud Constant Carrier. (DT501 for Constant Carrier, DT500 for Controlled Carrier.)

3. When using a WE203 or Milgo 45/4800 modem, they must be strapped for no automatic equalization and RTS must be held on. (WE203 requires a Bell Modification to hold RTS on.)

4. To run the 200 UT at 4800 Baud, Option DT500 or DT501 is necessary. DT500 has carrier controlled by RTS. DT501 has a constant carrier.

5. To run the 216-4 at 4800 Baud, Option DU102 is necessary.

III. MODEM TABLES

This section contains strapping options necessary for modems to work with specific CDC software and hardware.

NOTE: It is illegal to remove the cover from or otherwise tamper with Bell (Western Electric) modems. The information contained in these tables is given for reference when talking to Bell employees or ordering specific service to be installed.

Strapping options for non-Bell modems may be checked or verified if CDC has maintenance responsibility for the modems. If CDC does not have maintenance responsibility, check with an authorized serviceman before removing the covers from modems.

TABLE 1.1 WE103 STRAPPING OPTIONS

WE103A
(Also Applies to 101C)

OPTION	YES/NO
Auto Answer Key Controlled	Yes
Initiate Disconnect	Yes
Respond to Disconnect	Yes

WE103F

FREQUENCY MODE
1. Put local modem in ANSWER mode if remote modem is in ORIGINATE mode. 2. Put local modem in ORIGINATE mode if remote modem is in ANSWER mode. 3. Mode may be controlled by CY lead # (on RS232 interface).

In a multi-point network, it is often necessary to change the data set from operation in one frequency mode to another in the course of operation. The CY lead controls the frequency mode. If it is desired to operate in the "OR" mode, the CY lead should be held "ON" (+ voltage). To transfer to the "AN" mode, the CY lead should be held "OFF" (- voltage).

TABLE 1.2 WE201A3/B3
STRAPPING OPTIONS

Feature	Option	HDX Private Line	HDX Dial Up	FDX Private Line
1. Automatic Answer with 804A Handset	Z	No	Yes	No
without 804A Handset	ZJ	Yes	No	Yes
2. New Synch. Not Used	W	Yes	Yes	Yes
3. Terminal Impedance 600 OHMS	Y	⋇	No	Yes
900 OHMS	X	⋇	Yes	No
4. Line 2-Wire (Half Duplex)	ZC	Yes	Yes	No
4-Wire (Carrier Controlled by RTS)	ZB	No	No	Yes
5. Echo Delay Used	V	Yes	Yes	No
Not Used	T	No	No	Yes
6. Transmitter 0 DBM	G	Normally strapped with "A" option, but common carrier requirements should be checked.		
Line Signal -2 DBM	F			
-4 DBM	E			
-6 DBM	B			
-8 DBM	A			
7. Control Lead Interface				
Contact Closure Interlock	ZE	Yes	Yes	Yes
Ring Indicator	ZG	Yes	Yes	Yes
8. Receiver Signal Level		See Table 1.5		
9. Wire Connections		See Table 1.5.1		

⋇ Either option may be utilized. Contact Bell Telephone for correct impedance.

TABLE 1.3 WE201B1
STRAPPING OPTIONS

Feature	Option	HDX Private Line	HDX Dial Up	FDX Private Line
1. Automatic Answer (With Two Wire Key Tel. Set) Selective	W	No	⋇	No
Permanent	X	No	⋇	No
2. New Synch. Not Used	A	Yes	Yes	Yes
3. Terminal Impedance 600 OHMS	G	⋇	No	⋇
900 OHMS	F	⋇	Yes	⋇
4. Line 2-Wire (Half-Duplex)	ZP	Yes	Yes	No
4-Wire (Carrier Controlled by RTS)	ZO	No	No	Yes
5. Echo Delay Used	E	Yes	Yes	No
Not Used	B	No	No	Yes
6. Transmitter 0 DBM	ZI	Normally strapped with "ZM" option but common carrier requirements should be checked.		
Line Signal -2 DBM	ZJ			
-4 DBM	ZK			
-6 DBM	ZL			
-8 DBM	ZM			
7. Receive Signal Level		See Table 1.5		
8. Wire Connections		See Table 1.5.2		

⋇ Either option may be utilized. Contact Bell Telephone for correct impedance.

TABLE 1.4 WE201A3/B3
STRAPPING OPTIONS

Feature	Option	HDX Private Line	HDX Dial Up	FDX Private Line
1. Automatic Answer with 804A Handset	Z	No	Yes	No
without 804A Handset	ZJ	Yes	No	Yes
2. New Synch Not Used	W	Yes	Yes	Yes
3. Terminal Impedance 600 OHMS	Y	⋈	No	Yes
900 OHMS	X	⋈	Yes	No
4. Line 2-Wire (Half-Duplex)	ZC	Yes	Yes	No
4-Wire (Carrier Controlled by RTS)	ZB	No	No	Yes
5. Echo Delay Used	V	Yes	Yes	No
Not Used	T	No	No	Yes
6. Transmitter 0 DBM	G	Normally strapped with "A" option, but common carrier requirements should be checked.		
Line Signal -2 DBM	F			
-4 DBM	E			
-6 DBM	B			
-8 DBM	A			
7. Control Lead Interface				
EIA RS232 Voltage/Interface Interlock Corresponds to Data Set Ready Function and Ring Indicator	ZD	Yes	Yes	Yes
	ZF	Yes	Yes	Yes
8. Receiver Signal Level		See Table 1.5		
9. Wire Connections		See Table 1.5.1		

⋈ Either option may be utilized. Contact Bell Telephone for correct impedance.

TABLE 1.5
RECEIVER SIGNAL LEVELS

201 A3/B3 Option	201 B1 Option	Compromise Equalizer Out: Receiver Signal (DBM)	Compromise Equalizer Out: Max Line Noise
S	ZA	-50 to -20	-60⋈
R	ZB	-44 to -14	-54
Q	ZC	-38 to -8	-48
N	ZD	-32 to -2	-42
		Compromise Equalizer In	
M	ZE	-42 to -12	-52⋈
K	ZF	-36 to -6	-46
J	ZG	-30 to 0	-40
H	ZH	-24 to +6	-34

⋈ Decibel reference to noise weighing 500 telephone frequency response

NOTE: Normally on short distance lines, the compromise equalizer is out and on long lines, the compromise is in. Also, the least sensitive option is normally required, such as option N or option H. Common carrier circuit requirements should be checked prior to strapping.

Table 1.5.1

WE201A3, B3 Wire Connections

FEATURE	CIRCUIT PACK	OPTION	TYPE OF OPERATION		CONNECTION
AUTOMATIC ANSWER	T10 (CP AN4)	ZJ	Without 804A		(1,2)
		Z*	With 804A (Requires Y Option. See TERMINAL IMPEDANCE)		Remove (1,2)
NEW SYNC	L1 (CP AN6)	ZK	New Sync Used		None
		W*	New Sync Not Used		(7,15)
ECHO DELAY	L1 (CP AN6)	V**	Echo Delay Used		(1,5) (11,12)
		T***	Echo Delay Not Used		(11,16)
TERMINAL IMPEDANCE	L1 (CP AN6)		IMPEDANCE (OHMS)		
		Y*	600		(6,10) (3,8)
		X	900		(2,10) (3,4)
2-OR 4-WIRE	L2 (CP AN7)		TYPE OF OPERATION		
		ZA***	4-Wire Private Line (Full-Duplex)	Continuous Carrier	(22,24,25) (20,21,23) (13,16) (11,12)
		ZB		Carrier Controlled by Request to Send or Multiparty	(18,22) (19,20) (24,25) (14,17) (21,23) (13,16) (11,12)
		ZC**	2-Wire Private Line or DDD (Half-Duplex)		(22,24) (20,23) (15,25) (10,21) (9,14,17)
TRANSMITTER LINE SIGNAL	L2 (CP AN7)		LINE SIGNAL (DBM)		
		G	0		(26,30)
		F	-2		(27,30)
		E	-4		(28,30)
		B	-6		(29,30)
		A*	-8		(30,31)
RECEIVER SIGNAL LEVEL (See Notes)	L2 (CP AN7)		RECEIVER SIGNAL (DBM)	MAXIMUM LINE NOISE (DBRNC)	
			COMPROMISE EQUALIZER OUT		
		S	-50 to -20	28	(5,7)
		R	-44 to -14	34	(1,7) (3,5)
		Q	-38 to -8	40	(6,7) (4,5)
		N***	-32 to -2	46	(1,7) (3,6) (4,5)
			COMPROMISE EQUALIZER IN		
		M	-42 to -12	36	(2,7) (5,8)
		K	-36 to -6	42	(1,7) (2,3) (5,8)
		J	-30 to 0	48	(2,4) (5,8) (6,7)
		H**	-24 to +6	54	(1,7) (3,6) (2,4) (5,8)
CONTROL LEAD INTERFACE	L4 (CP AP11) EIA RS-232-A Voltage Interface	ZD*	Interlock (IT) (Corresponds to Data Set Ready Function of RS-232-A)		(1,3) (5,6) (11,13) (21,24)
		ZF*	Ring Indicator 1 (RG1) (Corresponds to Ring Indicator Function of RS-232-A)		(9,10) (17,18) (19,20) (21,22) (8,14,15)
			Remote Control RC (Corresponds to Data Terminal Ready Function of RS-232-A)		
	L4 (CP AP11) Contact Closure Interface	ZE	Interlock (IT)		(1,2) (4,5,7) (11,12,24)
		ZG	Ring Indicator 1 (RG1) Ring Indicator 2 (RG2) Remote Control (RC) Remote Release (RR) Ready (RDY)		(8,9) (15,16) (18,20) (22,23)

* Indicates factory-wired option for 201A3, A4, and 201B3, B4.
** Indicates factory-wired option for 201A3, A4 only.
*** Indicates factory-wired option for 201B3, B4 only.

Table 1.5.2

WE201B1 Wire Connections

FEATURE		TERMINAL STRIP	OPTION	TYPE OF OPERATION	CONNECTIONS
AUTOMATIC ANSWER (WITH TWO-WIRE KEY TELEPHONE SET)			W	Selective Automatic Answering	Will Vary With Tel. Set
			X	Permanent Automatic Answering	Will Vary With Tel. Set
TERMINAL IMPEDANCE				IMPEDANCE (OHMS)	
		L1	G*	600	(6,10) (3,8)
		L1	F	900	(2,10) (3,4)
NEW SYNC		L1	A*	New Sync Not Used	(7,15)
		L1		New Sync Used	None
ECHO DELAY (See Note 1)		L1	E	2-Wire	(1,5) (11,12)
		L1	B*	4-Wire	(11,16)
TRANSMITTER OUTPUT LEVEL				LINE SIGNAL (DBM)	
		L2	ZI	0	(26,30)
		L2	ZJ	-2	(27,30)
		L2	ZK	-4	(28,30)
		L2	ZL	-6	(29,30)
		L2	ZM*	-8	None
TYPE OF OPERATION				TYPE OF OPERATION	
		L2	ZN*	Continuous Carrier	(22,24,25) (20,21,23) (13,16) (11,12)
	4-WIRE PRIVATE LINE	L2	Z0	Carrier Controlled by Request-To-Send	(18,22) (19,20) (24,25) (14,17) (21,23) (13,16) (11,12)
	2-WIRE PRIVATE LINE	L2	ZP	Carrier Controlled by Request-to-Send	(22,24) (20,23) (15,25) (10,21) (9,14,17)
RECEIVE SIGNAL LEVEL (See Note 1)				RECEIVER SIGNAL (DBM) / MAXIMUM LINE NOISE (DBRNC)	
				COMPROMISE EQUALIZER OUT	
		L2	ZA	-50 to -20 / -36	(5,7)
		L2	ZB	-44 to -14 / -42	(1,7) (3,5)
		L2	ZC	-38 to -8 / -48	(6,7) (4,5)
		L2	ZD*	-32 to -2 / -54	(1,7) (3,6) (4,5)
				COMPROMISE EQUALIZER IN	
		L2	ZE	-42 to -12 / -40	(2,7) (5,8)
		L2	ZF	-36 to -6 / -46	(1,7) (2,3) (5,8)
		L2	ZG	-30 to 0 / -52	(6,7) (2,4) (5,8)
		L2	ZH	-24 to +6 / -58	(1,7) (3,6) (2,4) (5,8)

* Indicates factory-wired option

TABLE 1.6 WE301
STRAPPING OPTIONS

OPTION
1. Always used on FDX, Private Line.
2. Strap for Internal Timing (Clock supplied by modem)

TABLE 1.7 WE303
STRAPPING OPTIONS

OPTION
1. Use synchronous plug.
2. Modem supplies timing.
3. Strap for 50% roll off if "N" or "L" carrier facility is used.
4. Strap for 100% roll off if "T" carrier facility is used.

TABLE 2.1 CDC 358-2
STRAPPING OPTIONS

Internal Connections, Transmit/Receive Card Assembly (1)

	Line Attenuating Jumper/Resistor				Optional Circuit Jumpers			Carrier		Line Terminating Resistors		External Jumpers (XCEIVER)
Transmission Line Type	W1	W2	W6	W7	W3	W4	W5	W12 (3)	W13 (4)	R20 (X_o) Receive	R21 (Z_o) Send	At TB1
Twisted Pair 4-Wire	○—○	○—○	○—○	○—○	OP	•—•	•—•	○—○	○—○	120	120	None Required
Twisted Pair 2-Wire	○—○	○—○	○—○	○—○	OP	•—•	•—•	○—○	○—○	120	OP	TB1-1→TB1-3 TB1-2→TB1-4
Coaxial Cables (TWO)	○—○	○—○	○—○	○—○	•—•	•—•	•—•	○—○	○—○	4 Z_o (2)	4 Z_o (2)	None Required
Coaxial Cables (One)	○—○	○—○	○—○	○—○	OP	•—•	•—•	○—○	○—○	4 Z_o (2)	OP	TB1-1→TB1-3 TB1-2→TB1-4

(1) T/R card assy supplied with transceiver is wired for twisted pair 4-wire application.

(2) To be determined at installation. See CE Manual.

(3) Carrier Controlled by RTS

(4) Carrier Controlled by CTS

○—○ Pin Jacks

○∿∿○ Pin Jacks with Resistor Jumper

•—• Wire Jumper, Soldered

OP Open

TABLE 1.8 WE203
STRAPPING OPTIONS
USED ON FOUR-WIRE FULL DUPLEX
(DEDICATED LINE) FACILITIES

FEATURE	OPTION	STRAPS ON AR335 CARD
1. Four-Wire Without Auxiliary Channel	Z	7, 12, 15, 17, 27, 34
2. 0 to 150 Bit Auxiliary Channel Not Provided	YD	28, 30
3. 600 OHM Line Impedance	S	21, 24
4. 0 dbm/0 db Transmit Line Signal Level	ZP	1, 2, 3, 4 (Transmit Level Set By Phone Line Parameters)
5. 10 db Receive Pad	B	11
6. 804 Auxiliary Set Used	YA	5, 20
7. 804 Auxiliary Set Not Used	N	Remove 5, 20
8. Initiate Start-Up of High Speed Channel CTS Inhibited by Carrier On Delayed	J	25, 38
9. Receive Data Never Clamped	F	31

NOTE: When ordering a 203 Data Set, be sure to specify a "List 2" model. This will allow operation at 2400 Baud using 2 level modulation, 4800 Baud using 4 level modulation, and 7200 Baud using 8 level modulation. Also specify "List 8" which is the EIA interface.

TABLE 2.2 CDC 358-3,4
STRAPPING OPTIONS

Internal Connections, Transmit/Receive Card Assembly (1)

Transmission Line Type	Line Attenuating Jumper/Resistor W1	W2	W6	W7	Optional Circuit Jumpers W3	W4	W5	Carrier W12 (3)	W13 (4)	Line Terminating Resistors R20 {X_O} Receive	R21 {Z_O} Send	External Jumpers {XCEIVER} At TB1
Twisted Pair 4-Wire	○—○	○—○	○—○	○—○	OP	•—•	•—•	OP	OP	120	120	None Required
Twisted Pair 2-Wire	○—○	○—○	○—○	○—○	OP	•—•	•—•	OP	OP	120	OP	TB1-1 → TB1-3 TB1-2 → TB1-4
Coaxial Cables {TWO}	○—○	○—○	○—○	○—○	•—•	•—•	•—•	OP	OP	4 Z_O (2)	4 Z_O (2)	None Required
Coaxial Cables {ONE}	○—○	○—○	○—○	○—○	OP	•—•	•—•	OP	OP	4 Z_O (2)	OP	TB1-1 → TB1-3 TB1-2 → TB1-4

(1) T/R card assy supplied with transceiver is wired for twisted pair 4-wire application.

(2) To be determined at installation. See CE Manual.

(3) Constant Carrier

(4) Constant Carrier

○—○ Pin Jacks

○~○ Pin Jacks with Resistor Jumper

•—• Wire Jumper, Soldered

OP Open

TABLE 2.3 NO MODEM

The two controllers {1747, 6673/74} must be within 200 feet of each other to operate in this manner. The two controllers may be up to 1000 feet apart if the transmitters and receivers are changed to long line drivers and receivers.

TABLE 2.4 DECODER PLUG OPTIONS
CDC 311-2 {DJ110/DJ111} Data Set Adapter

DECODER PLUG	PART NUMBER	FUNCTION	COLOR CODE
J00	---	Not Needed	---
J01	---	Not Needed	---
J02	---	Not Needed	---
J03	---	Not Needed	---
J04	36937936	ACSII HDX or Universal HDX	Blk,Yel,Org
J05	36937941	WE200 Series ASCII Synch {026}	Blk,Grn,Red
J06	36937946	WE200 Series Data Set Timing	Blk,Blu,Red
J07	36937948	WE200 Series Data Set Timing	Blk,Vio,Brn
J20	13680807	MASTER 2.0 HDX	Red,Blk,Gry
J21	36937958	ASCII Synch	Red,Brn,Red
J22	36937961	ASCII Synch	Red,Red,Red
J23	36937966	Data Set Timing RS232 Interface	Red,Org,Yel
J24	36937969	WE200 Series Data Set	Red,Yel,Brn

TABLE 2.5 SHORTING BLOCK OPTIONS

CDC 361-5 (DJ144) Data Set Adapter

UNIT AND BOARD TYPE	ABBREVIATION ON BOARD	SELECT THIS FUNCTION WITH SHORTING BLOCKS
1. Send Unit 1 (9CSM)	OFF/ON	ON - Selects USASCII
2. Send Unit 2 (9CTM)	Bit 0-7	026 - Selects Synch. Character
3. Send Control Unit 1 (9CUM)	BREAK	Insert a Shorting Block in the Two Middle Tip Jacks
	Rev. Channel	
	ON/OFF	OFF - Selects Restraint
	ODD/EVEN	ODD - Selects Parity
	FDX/HDX	HDX - Selects Half Duplex Operation
	ACA/SCA	SCA - Select Synchronous Operation
4. Send Control Unit 2 (9DAM)	CRC/LRC	LRC - Selects Longitudinal Redundancy Check
	LRC/CRC	
	300S/200S	200S - Selects Interface with WE200 Series Data Set
5. Receive Unit 1 (9CPM)	OFF/ON (Top)	ON - Selects USACII Mode
	OFF/ON (Bottom)	ON - Selects End-Of-Message Detection
6. Receive Unit 2 (9CRM)	P9 ON/OFF	ON - Parity Strip
	Bit 0-7	026 - Synch Character
7. Receive Control Unit 1 (9CZM)	200/300	200 - Selects WE200 Series Data Set Interface
8. Receive Control Unit 2 (9DBM)	200/300	200 - Selects WE200 Series Data Set Interface

TABLE 2.6* DECODER PLUG OPTIONS

CDC 8536 C,D DATA SET ADAPTER

DECODER PLUG	PART NUMBER	FUNCTION	COLOR CODE
J01	36691600	Character Length - 8 Bits	Yel
J02	36691614	8 Bit ASCII Lower Order Bit First	Brn, Yel
J03	36691620	Rub-Out Character Detect	Brn, Wht

* This table is for typical ASCII teletypes. For other teletypes, (BAUDOT, etc) refer to the 8536/8537 Customer Engineering Manual.

TABLE 2.7* DECODER PLUG OPTIONS

CDC 8537 C,D DATA SET ADAPTER

DECODER PLUG	PART NUMBER	FUNCTION	COLOR CODE
J01	36691614	8 Bit ASCII Lower Order Bit First	Brn, Yel
J02	36691605	Total Character Length 10 Bits	Yel, Blk

* This table is for typical ASCII teletypes. For other teletypes (BAUDOT, etc) refer to the 8536/8537 Customer Engineering Manual.

TABLE 2.8* SHORTING BLOCK OPTIONS

CDC 361-1,2,3 (DJ142/DJ143 DATA SET ADAPTER

UNIT AND BOARD TYPE	ABBREVIATION USED ON BOARD	SELECT THIS FUNCTION WITH SHORTING BLOCKS	
1. Send 1 (9EPM)	EnBrk/Dis Brk HDX/FDX	Dis Brk HDX	- Disable Break - Selects Half Duplex
2. Send 2 (9EQM)	EN/DIS 5 Bit/6 Bit/ 7 Bit/8 Bit 1 SP/1.5 SP/ 2 SP W1/W2	DIS 8 Bit 1 SP W2	- Disable Restraint Feature - Select 8 Bit Character Length - Select 1 Character Time Stop Pulse - Select Operating Speed 0-300 BPS
3. Receive 2 (9ESM)	5/6/7/8 W1/W2	8 W2	- Select 8 Bit Character Length - Select Operating Speed 0-300 BPS

* This table is for a typical ASCII teletype. For other teletypes, (BAUDOT, etc), refer to the DJ142/DJ143 Customer Engineering Manual and 361-1/2/3 Reference Manual.

TABLE 2.9 CDC124-1
Strapping Options

1. Select 2 or 4 wire operation at TB1 (same as 358-2 in Table 2.1)

2. Strap for internal timing. Shorting block sockets 1 & 2 of P1 on board 1 (9EJM).

Table 3.1 MILGO 2200/24

Strapping Options

	FEATURE	HDX PRIVATE LINE	HDX DIAL UP	FDX PRIVATE LINE
1)	New Sync	No	No	No
2)	Output Line Level Control	See Note 1	See Note 1	See Note 1
3)	Input Line Level Control	See Instruction Manual	See Instruction Manual	See Instruction Manual
4)	Transmit Timing Select	Strap For External Timing (G to F)	Strap For External Timing (G to F)	Strap For External Timing (G to F)
5)	Data Rate Select	Strap For 2400 BPS Modulation "B" (Open Straps)	Strap For 2400 BPS Modulation "B" (Open Straps)	Strap For 2400 BPS Modulation "B" (Open Straps)
6)	Receive Data Carrier Detector Time Constant	70 MS Delay (Open Straps)	70 MS Delay (Open Straps)	7 MS Delay Strap A to B
7)	Receive Data Carrier Detect Function Select	Place Mark Hold On Receive Data Strap A to D And A to E	Place Mark Hold On Receive Data Strap A to D And A to E	Place Mark Hold On Receive Data Strap A to D And A to E
8)	Carrier Control Select	Strap H to J And H to K	Strap H to J And H to K	See Note 2
9)	Request-To-Send Select	Strap A to B	Strap A to B	Strap A to B
10)	Clear-To-Send Delay	Strap D to F And F to G	Strap D to F And F to G	See Note 3

NOTE 1

Normally strapped for 0 dB but common carrier requirements should be checked. See Modem Instruction Manual for strapping procedure.

NOTE 2

Normally send carrier is left on and receive carrier clamp is removed. (No Straps) However, for multi-point operation, send carrier is controlled. (Strap H to J) Also, when working with a 200 UT, strap H to J.

NOTE 3

Normally the Clear-To-Send delay is 8.5 MS on four-wire (strap D to G and G to E). See Modem Instruction Manual for other options.

TABLE 3.2 Milgo 4400/48

Strapping Options

FULL DUPLEX PRIVATE LINE OPTIONS	CARD	STRAPS	COMMENTS
Send Level	N12	Strap in 4 db	Normally set for "0" db. Circuit line-up should be checked for actual level required
Modem Supplied Clock	N13	1 to 2	
Request to Send - Clear to Send Routine	N13	6 to 7	RTS - CTS Delay is 50 MS
Data Modulation Detector	N13	3 to 4	
Send Carrier Controlled by Request to Send	N13	10 to 11	For continuous carrier, strap 5 to 6 (See Note 1)
New Sync Option	N13	16 to 9 Remove strap 16 to 17 and 12 to 13	The new sync option is not used.
Data Carrier Detector	N13	19 to 20	
Carrier Detector Time Delay	N5	A to B	
Mark Hold On Receive Data	N5	F to G	
Data Carrier	N6	Strapped for 5 db	

NOTE 1

Most terminals operating at 4800 Baud can be used with continous carrier. When operating in a multipoint environment, carrier will have to be controlled by Request to Send.

TABLE 3.3 Milgo 4500/48

Strapping Options

FULL DUPLEX PRIVATE LINE OPTIONS	CARD	STRAPS	COMMENTS
Transmit Line Level	N10	Strap for "0" db {See Manual}	Normally set for "0" db. Circuit line-up should be checked for actual level required.
Receive Line Level	N1	Strap for -16 db {See Manual}	
Automatic Equalize Initiate	N21	A to B	
Modem Supplied Clock	N22	D to E	
Request to Send	N22	A to B	If data terminal equipment has to be operated with carrier dropping, strap A to C.

Table 3.4 MILGO 4600/48

Strapping Options

{This data is preliminary and may differ slightly with new units}

FULL DUPLEX PRIVATE LINE OPTIONS	CARD	BACK-TO-BACK TEST	NORMAL OPERATION
1} Receive Level Adj. {Thumbwheel Switch}	N2	N/A	See Instruction Manual
2} Non-Sync Option	N3	Open Strap 1 to 2	Open Strap 1 to 2
3} Two-wire Operation {This unit is normally not used on 2-wire}	N5	Open Strap A to B Open Strap C to D	Open Strap A to B Open Strap C to D
4} Output Line Level	N9	N/A	See Note 1
5} Send Clock	N10	Strap 2 to 3	Strap 2 to 3
6} Special Case	N10	Strap 4 to 5	Strap 4 to 5
7} Request-To-Send Select	N10	Strap 7 to 8	Strap 7 to 8
8} Special Case {2-Wire Operation}	N10	Open Strap 9 to 10	Open Strap 9 to 10
9} Regeneration	N10	Strap 11 to 12	Strap 11 to 12
10} Special Case	N11	Open Strap 1 to 2	Open Strap 1 to 2

NOTE 1

Normally strapped for 0 dB but common carrier requirements should be checked. See Modem Instruction Manual for strapping procedure.

EQUALIZING THE MILGO 4600/48 MODEM

There are two pairs of telephone lines to be equalized--the receive lines and the transmit lines. Line compensation in both directions (receive and transmit) from only one site, can be accomplished with a modem equipped with two equalizers. Therefore, during equalization, two different switch settings are needed--one for equalizing the receive lines and the other for equalizing the transmit lines.

For receive equalization, the different switch positions are:

- ...RECEIVE EQUALIZER IN/OUT switch in the IN position.
- ...TRANSMIT EQUALIZER IN/OUT switch in the IN position.
- ...MODE switch in the RCV EQL position.
- ...BUSS-BACK switch in the NORMAL position.
- ...DATA switch in the NORMAL position.
- ...LEVEL switch is not actuated.
- ...POWER indicator is ON.
- ...TEST MODE is ON.
- ...SIG LOST indicator is OFF.

When the MODE switch is set to the RCV EQL position, the meter monitors receive equalization information. Set all Equalizer knobs to maximum counter-clockwise position. Rotate each knob 90° clockwise from this position. Start with the left hand knob in the upper row. The knob to its right is adjusted second, etc., with the right hand knob in the upper row adjusted fourth. The right hand knob in the bottom row is adjusted fifth, etc., with the left hand knob in the bottom row adjusted last.

Each knob is adjusted to give a minimum meter indication. If any knob has little effect the first time through the 8 knobs, return it to its starting (90° from maximum counter-clockwise) position and go on to the next knob.

When proper equalization is achieved, the meter will indicate less than 5% of maximum scale deflection. Several passes through the 8 knobs may be required to obtain proper equalization.

For transmit equalization, the different positions are:

- ...RECEIVE EQUALIZER IN/OUT switch in the IN position.
- ...TRANSMIT EQUALIZER IN/OUT switch in the IN position.
- ...MODE switch in the XMT EQL position.
- ...BUSS-BACK switch in the NORMAL position.
- ...DATA switch in the NORMAL position.
- ...LEVEL switch is not actuated.
- ...POWER indicator is ON.
- ...TEST MODE indicator is ON.
- ...SIG LOST indicator is OFF.

When the mode switch is placed in the XMT EQL position, the meter monitors equalization of the transmit line through a loop which includes the remote modem. The procedures for initially setting and then adjusting the 8 knobs of the transmit equalizer is the same as given above. Again, a meter indication less than 5% of maximum scale deflection should be obtained.

NORMAL TRANSMISSION

During normal data transmission, the position of the switches are as follows:

- ...RECEIVE EQUALIZER IN/OUT switch in the IN position.
- ...TRANSMIT EQUALIZER IN/OUT switch in the IN position.
- ...MODE switch in the SIG QUAL position.
- ...BUSS-BACK switch in the NORMAL position.
- ...DATA switch in the NORMAL position.
- ...LEVEL switch is not actuated.
- ...POWER indicator is ON.
- ...SIG LOST indicator is OFF, if the received carrier is at the proper level.

TABLE 4.1 RIXON DS1800
(Replaces RIXON FM18B)
STRAPPING OPTIONS

FEATURE	HDX PRIVATE LINE	FDX PRIVATE LINE	HDX DIAL UP
1. 2-Wire/4-Wire	2-Wire or 4-Wire	4-Wire	2-Wire
2. Request-To-Send/Clear-To-Send Delay	200 MS for 2-Wire; 60 MS for 4-Wire	60 MS	200 MS
3. Data Clamp	Yes	Yes	Yes
4. Soft Turn Off	Yes	Yes	Yes
5. Local Copy Inhibit	Yes	Yes	Yes
6. Receive Squelch	Yes	Yes	Yes
7. Compromise Equalizer	No	No	Yes
8. Output Level	0 db	0 db	-9 db
9. Carrier Control	Controlled by RTS	Controlled by RTS	Controlled by RTS

TABLE 4.2 RIXON DS2400A/B
STRAPPING OPTIONS

This modem is designed to operate in 4-Wire Full Duplex only and therefore should not require any change in the internal strapping. It is possible to operate this modem on a 2-Wire Private Line; however, this requires special circuit changes and the maintenance manual should be consulted. Generally these are factory modifications.

COMMENT SHEET

MANUAL TITLE CONTROL DATA® COMMUNICATIONS HANDBOOK

PUBLICATION NO. 60405100 REVISION A

FROM: NAME: _____

BUSINESS ADDRESS: _____

COMMENTS:

This form is not intended to be used as an order blank. Your evaluation of this manual will be welcomed by Control Data Corporation. Any errors, suggested additions or deletions, or general comments may be made below. Please include page number references and fill in publication revision level as shown by the last entry on the Record of Revision page at the front of the manual. Customer engineers are urged to use the TAR.

CUT ALONG LINE

AA3419 REV. 11/69 PRINTED IN U.S.A.

NO POSTAGE STAMP NECESSARY IF MAILED IN U. S. A.

FOLD ON DOTTED LINES AND STAPLE

STAPLE

STAPLE

FOLD

FOLD

FIRST CLASS
PERMIT NO. 8241

MINNEAPOLIS, MINN.

BUSINESS REPLY MAIL
NO POSTAGE STAMP NECESSARY IF MAILED IN U.S.A.

POSTAGE WILL BE PAID BY

CONTROL DATA CORPORATION
Headquarters Support Engineering
Box 0
Bloomington, Minnesota 55400

Attn: J. J. Daml - HQN04S

FOLD

FOLD

CUT ALONG LINE

CONTROL DATA

>>> CUT OUT FOR USE AS LOOSE-LEAF BINDER TITLE TAB

CONTROL DATA
CORPORATION

8100 34th AVE. SO., MINNEAPOLIS, MINN. 55440

LITHO IN U.S.A.