

GA27-3058-3  
File No. 3872-09

**Systems**

**IBM 3872 Modem  
User's Guide**

**IBM**

## Abbreviations

AA	automatic answering
ACO	automatic call origination
bps	bits per second
BTAM	Basic Telecommunications Access Method
CBS	automatic data coupler (DAAs equivalent to CBS are used on switched network facilities when the 3872 has AA or ACO)
CCITT	International Telephone and Telegraph Consultative Committee
CDT	manual DAA (DAAs equivalent to CDT are used with SNBU when the 3872 does not have AA)
DAA	data access arrangement (a connection, isolation, and coupling arrangement; includes a telephone set on the switched network)
DCE	data communications equipment
DDD	direct distance dialing (USA and Canada)
DPSK	differential phase shift keying
DTE	data terminal equipment (business machine)
EIA	Electronic Industries Association
EON	end of number (with ACO)
OS/DOS	Operating System/Disk Operating System
PTT	Post-Telegraph-Telephone (World Trade countries)
RS	Recommended Standards (used with EIA standards)
SEP	separator (with ACO)
SNBU	switched network backup
TPC	test pattern check
TPG	test pattern generate
WT	World Trade

### *Fourth Edition (Dec. 1974)*

This is a reprint of GA27-3058-2, incorporating changes issued in Technical Newsletter GN27-3124 dated June 7, 1974.

Changes are periodically made to the information herein; before using this publication in connection with the operation of IBM systems or equipment, refer to the latest SRL Newsletter for the editions that are applicable and current.

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## To The Reader

This manual is organized for convenient use and reference by the various persons who will use it for different purposes. There are four main parts:

- Part 1. General Information
- Part 2. Operator Information
- Part 3. Technical Description
- Part 4. Appendixes

Prior knowledge of teleprocessing systems is not a prerequisite for Parts 1 and 2. Part 2 is marked with a black tab on each page, thus making this section, containing operator information, readily visible at the edge of the manual. Problem determination and equalization information formerly contained in Part 2 is now in *IBM 3872 Modem Problem Determination*. Order GA27-3062 for that information.

The information in this manual is intended for system planners, systems engineers, installation planners, operators, and supervisory personnel. Part 1 describes (in general terms) the IBM 3872 Modem, planning considerations, and equipment and facility considerations; Part 2 presents 3872 operating procedures and offline problem determination procedures; Part 3 describes (in detail) the IBM 3872 Modem: interface specifications, installation specifications, communications channel specifications, and special feature descriptions. Considerations in using the 3872 in World Trade countries are included in appropriate places in the manual and are summarized in Part 4, which also contains the Glossary.

This manual contains references to other publications for the convenience of those readers who desire additional information. These publications are:

Electronic Industries Association (EIA) Standards  
RS-232-C, RS-334, and RS-366, available from

EIA Standards Engineering Department  
EIA Standards  
2001 "I" Street, N. W.  
Washington, D. C. 20106 (USA)

International Telephone and Telegraph Consultative Committee (CCITT)

Recommendation V.24 (CCITT Recommendations, White Book, Volume 8), available from

International Telegraph Union (ITU)  
Geneva, Switzerland

or

United Nations Bookstore  
United Nations Plaza  
New York, New York 10017 (USA)

Bell System Data Communications Technical References

PUB41004, *Transmission Specifications for Voice Grade Private Line Data Channels* (March 1969)

PUB41005, *Data Communications Using the Switched Telecommunications Network* (May 1971)

These are available from

American Telephone and Telegraph Co.  
Supervisor-Information Distribution Center  
195 Broadway, Room 208  
New York, N. Y. 10007 (USA)



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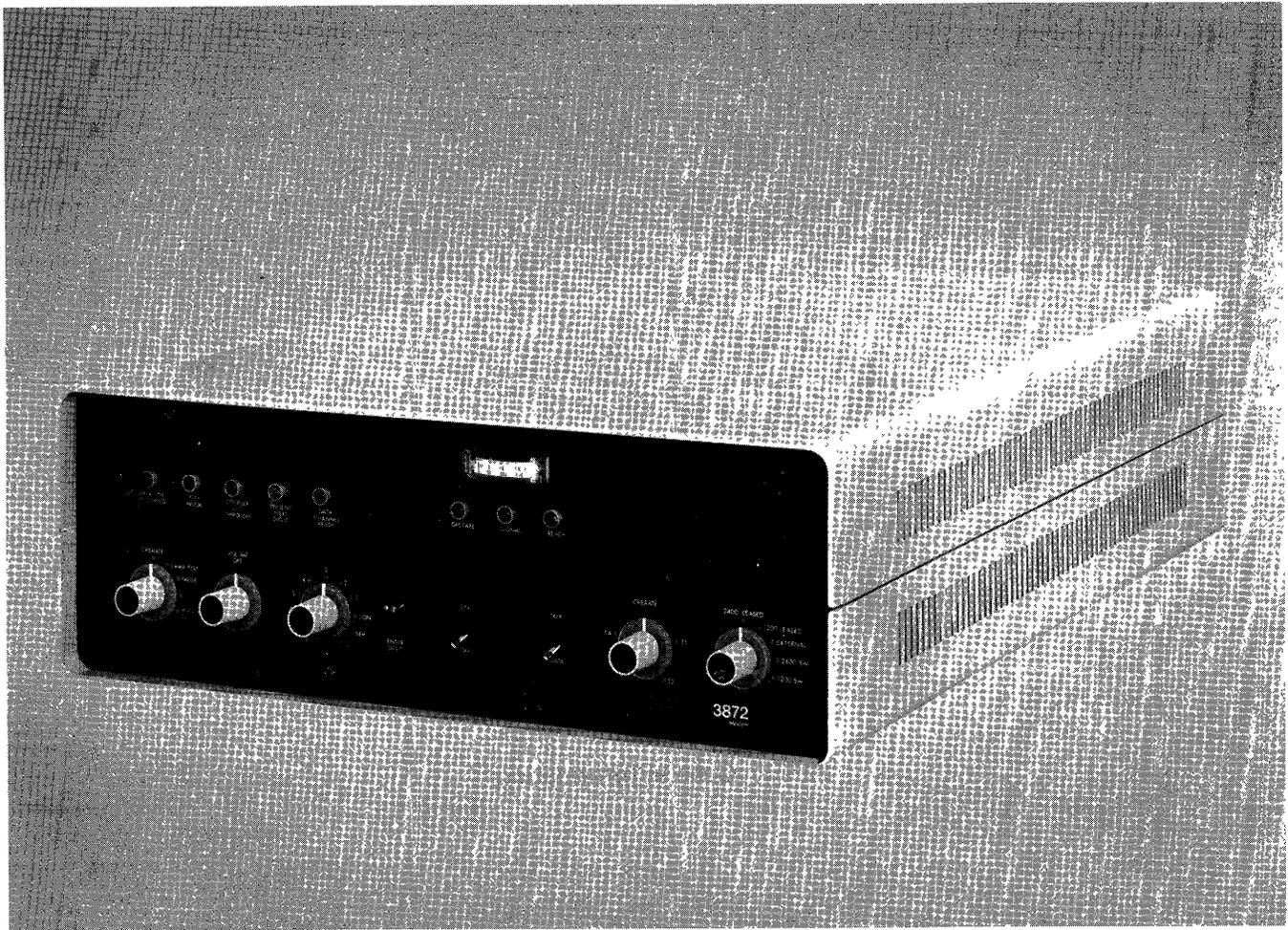
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**Part 1. General Information**



IBM 3872 Modem

In this manual, the IBM 3872 Modem (Frontispiece) is described as an item of equipment in the medium-speed modem field.

**FUNCTION OF A MODEM**

The term modem is a contraction of the terms “modulator” and “demodulator”. The modulator in the modem modifies binary data signals to modulated line signals which can be transmitted over a data communications channel. The demodulator in the modem retrieves data from the modulated line signals, and converts it to binary data.

As described in this manual, a modem is an electronic device that is used when two machines in a data system are located too far apart to be directly connected by a multiwire cable. A communications channel (usually a telephone line) provides the interconnection, and a modem at each end adapts the machine signals to and from the communications channel (Figure 1-1). The transmitting modem modifies binary data for transmission; the receiving modem retrieves the data and converts it back to binary form.

icated voice-grade communications channels and, in the USA and Canada, it operates on public, switched network, voice-grade communications channels.

Using differential phase shift keying (DPSK), it converts business machine serial binary data signals into signals suitable for transmission over the communications channel when transmitting. When receiving, it retrieves data from the channel signals and converts the data back to serial binary form.

**DESIGN FEATURES**

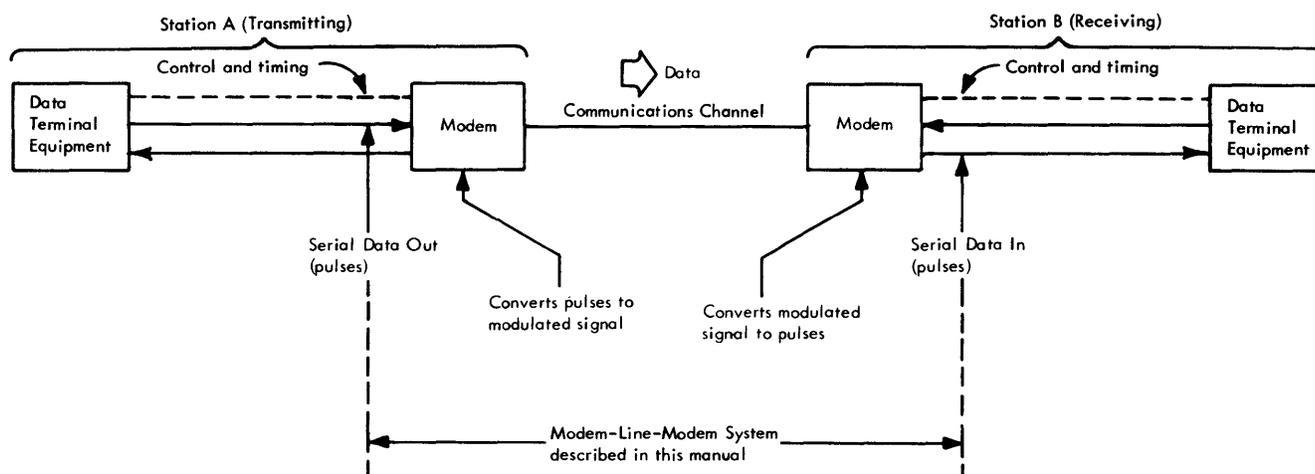
The 3872 has an internal pseudo-random bit-pattern generator that is used to minimize the likelihood of prolonged intervals of sensitive bit patterns on the channel. It is also used for testing purposes.

Equalization provided in the modem compensates for distortion, introduced by the communications channel, that may impair transmission. A 3872 equipped for switched network operation has automatic receiver equalization; a 3872 equipped for point-to-point operation on a dedicated channel has switch-adjustable receiver equalization; a 3872 equipped for multipoint tributary operation has switch-adjustable transmitter and receiver equalization (Figure 1-2).

Every 3872 is capable, under operator or programmed control (and regardless of configuration), of operating at half-speed (1200 bps). Operation may be able to continue at the satisfactory lower rate when a 2400 bps throughput is degraded. All modems on the channel must operate at the

**HIGHLIGHTS**

The IBM 3872 Modem is a synchronous, 2400-bps modem with half-speed (1200 bps) capability. It operates on ded-



Note: Data transfer is shown from Station A to Station B. When the data transfer direction is reversed, the roles of the modems and the data terminal equipment are interchanged.

Figure 1-1. Simplified Teleprocessing System

same rate, and throughput is half that of normal 2400-bps operation. Reliable 1200 bps operation, however, may actually improve throughput, as compared to a degraded 2400 bps operation.

Front panel switches, indicators, and a meter provide much information and control to the 3872 user ( see “Operations” in Part 2). In addition, the call progress monitor allows audible monitoring of automatic call origination.

Testing procedures verify proper transmit and receive operation of the 3872 Modem at either or both ends of the communications channel. Manual operation of automatic switched network functions is provided for by front panel switches: with automatic answering, a call can be answered manually at the common-carrier telephone set; with automatic call origination, a call can be made manually—either at the modem or at the common-carrier telephone set. Refer to “Operations” in Part 2, for operating and testing procedures.

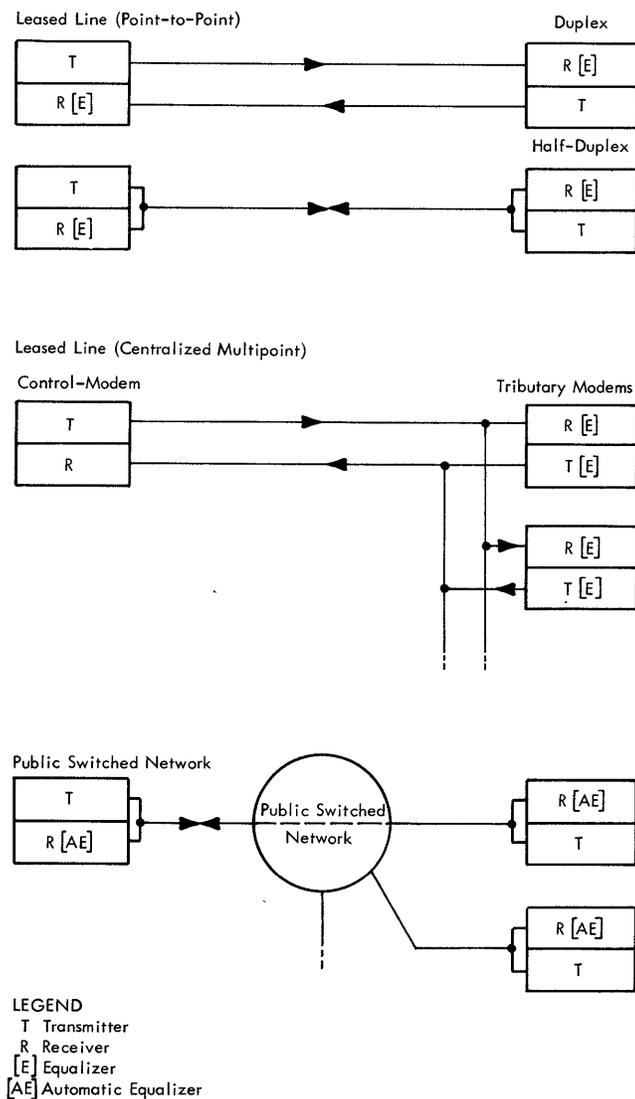


Figure 1-2. Equalizer Location by Configuration

## SPECIAL FEATURES

The basic 3872 Modem, without special features, is a dedicated channel *multipoint control station modem*. Special features (Figure 1-3) equip the 3872 for the following configurations and additional capabilities:

- Two modems in one cabinet (with some exclusions) **Second Modem feature**
- Point-to-point operation **Point-to-Point feature**
- Multipoint tributary operation **Multipoint Tributary feature**
- Switched network operation (with automatic answering) **Switched Network feature**
- Switched network operation of a modem configured for dedicated channel operation **Switched Network Back-up feature**
- Automatic answering when operating on switched network backup **Switched Network Back-up, with Automatic Answering feature**
- Automatic (programmed) call origination on switched network **Automatic Call Origination feature**
- Direct line attachment (in some World Trade countries) **Direct Line Attachment feature**
- Voice communication on dedicated channel facilities **Alternate Voice feature**
- Multiple terminals using one modem **Fan-Out feature**

Refer to “Special Feature Descriptions” in Part 3. Refer to “Operations” in Part 2, for special feature operating and testing procedures. Refer to Appendix C, in Part 4, for switched network backup planning and operating considerations.

## PLANNING A MODEM INSTALLATION

The specific requirements of a modem installation vary from system to system and may change within a system as it expands. Your IBM sales representative can assist in determining the specific requirements for a specific system. This section of the manual describes some of the general considerations.

### Data Terminal Equipment Considerations

Data terminal equipment (DTE) considerations are part of data system characteristics. They include the following items, which bear on the requirements for the modems and the communications channels:

1. Terminal locations. This characteristic can affect the choice of point-to-point, multipoint, or switched network modem and channel configurations. The origins of input data entering the system and the destinations of processed data leaving the system may have a wide and irregular range of geographic locations.

AVAILABLE CONFIGURATIONS	FEATURES									
	Basic Modem	Second <sup>**</sup> Modem	Standard			Optional				
			C1 Equalizer	Auto Equalizer	Auto Answer	Switched <sup>***</sup> Network Backup	Auto Call <sup>**</sup> Origination	Direct Attachment (WT only)	Alternate Voice	Fan-Out <sup>**</sup>
Multipoint (Basic)	1	1	-	-	-	X	-	X	X	X
Multipoint Tributary (Feat.)	1	1	TR	-	-	X	-	X	X	X
Point-to-Point (Feat.)	1	1	R	-	-	X	-	X	X	X
***Switched Network (Feat.)	1	1	-	R	TR*	-	X	-	-	-

\*Not standard with switched network backup.

\*\* Second modem of any configuration is available in same cabinet with basic modem of any configuration.

Neither modem may be equipped with Switched Network Backup, Automatic Call Organization, or Fan-Out.

\*\*\*Switched Network operation in WT is by special arrangement only. Contact your IBM Sales Representative.

Legend:

- X optional
- does not apply
- R receiver
- TR transmitter and receiver

Figure 1-3. Modem Feature Configurations

2. Mode of communicating data. Batched data transfers are often large and may require dedicated channels. Transmitting rates and turnaround times required to accomplish the necessary throughput are important considerations which effect the choices of communications facilities, modems, and modem configurations.

The online (often called conversational) communicating mode imposes more rigorous requirements on the data processor than it does on the data communications facilities. Lower transmitting rates may be suitable; switched network operation may be more economical.

3. Priorities of message. The importance of certain messages or of the traffic between certain stations can affect the choice of communications service and modem configuration.

4. Peak volume of data. This data system characteristic, like the conversational mode of communication, may be more indicative of processor needs than of communications facilities needs. It could, however, affect the choice between point-to-point and multipoint or between dedicated channels and switched network facilities.

**Modem Considerations**

The IBM 3872 Modem has options that contribute to effective use of the selected modem configuration. These options include:

- A range of clear-to-send delays that permits minimizing turnaround time in a given configuration.

- Optional two-wire or four-wire connection to dedicated channels that may permit an economical increase in half-duplex throughput.
- Switch-controlled half-speed operation that may allow continued operation on a marginally performing communications channel. Rated throughput is decreased at half-speed.

Other 3872 considerations include:

- Available special features
- Power supply options
- Dual modem options

**Channel Considerations**

Data system requirements (and the resulting mix of terminal locations and modem configuration selections) determine channel configurations, line access arrangements, and channel specifications. On the switched network, the ability to redial for a better channel is desirable, since switched network channels cannot be individually specified. Dedicated channels that have controlled transmission parameters, however, can be individually specified.

Channel propagation time affects turnaround time and clear-to-send delay. On the switched network, this time varies; on a given dedicated channel, approximate propagation time can be calculated.



### FUNCTION OF DATA TERMINAL EQUIPMENT

A data system that uses modems has functional elements. The functional element that is familiar to users of data processing equipment is called a DTE (data terminal equipment). This element, the DTE, includes the business machine and any conversion necessary for serial-by-bit communication of data between machines. The DTE grouping of system functions excludes only those functions assigned by industry standards to the data communications equipment (DCE) and the communications channel. For information on industry standards, refer to the notice "To The Reader", at the front of this manual.

It is assumed in this manual that the DTE functions required by standards for proper modem operation will be provided. Only modem functions are described here.

### DEFINITION OF TERMS

The following definitions are included in "Appendix B. Glossary" of this manual. They are repeated here for the reader's convenience.

**Communications channel** - A single or dual transmission path, characterized by a particular frequency bandwidth (voiceband in this manual).

**Data System** - An organized collection of methods and interconnected machines that accepts input data, processes the data, and provides output data.

**Duplex operation** - A simultaneous two-way transmission.

**Duplex facilities** - A dual voiceband channel with complete separation of transmit and receive at any station in a system. Any data system which uses the same portion or portions of the voiceband spectrum for simultaneous bidirectional transmission of signals requires duplex facilities. To reduce turnaround time, carrier can be transmitted continuously from both stations of a point-to-point system or from the control station of a centralized multipoint system. Also, four-wire duplex facilities avoid interference between multipoint tributary stations.

**Half-duplex operation** - A two-way transmission of signals, but in only one direction at a time.

**Half-duplex facilities** - A single voiceband channel for bidirectional, non-simultaneous transmission of signals between any two stations in a point-to-point system. Systems that do not require use of the same portion of the voiceband spectrum for simultaneous bidirectional transmission of signals can operate with half-duplex facilities; carrier can be transmitted in only one direction at a time.

*Note:* When the common carrier supplies four-wire duplex facilities for half-duplex mode of operation in a point-to-point system, carrier may be maintained from both stations.

**Service** - The common-carrier function of providing and maintaining a system of facilities to meet customer communications requirements.

**Station** - An input or output point in a communications system.

### MODEM-CHANNEL-MODEM SUBSYSTEM

The communications channel and the modems comprise the subsystem in which modems operate. These two elements of the data system work together to provide long-distance interconnection between machines in the data system (Figure 1-1).

### MODEM FUNCTIONS AND CONFIGURATIONS

The basic modem functions are those illustrated in Figure 1-1: modulation at the transmitting modem and demodulation and data retrieval at the receiving modem. Additional functions that modems perform are as follows:

1. In half-duplex operation, since signals are transmitted in only one direction at a time, a receiving modem must restrain its DTE (data terminal equipment) from beginning to transmit until the channel is ready to carry signals in the opposite direction.
2. System design may require that signals be carried in both directions at the same time. This is duplex (formerly full-duplex) operation, and the modem must be able to transmit and receive signals simultaneously.
3. The modem must be capable of proper channel connection and DTE control. Practical system design may require that several DTEs communicate with a central DTE over the same channel. This arrangement is described as "centralized multipoint". The central DTE is called the control station; the remote DTEs are called tributary stations.
4. Modems operating over public switched network channels must have additional capabilities for connecting and disconnecting calls.

Two types of channels are used for data communications: dedicated channels (privately owned or leased from a common carrier) and switched network channels. Either half-duplex or duplex service is available on dedicated channels; operation is half-duplex on the switched network unless a special arrangement is provided.

### Modem Internal Functions

The internal organization of a modem (Figure 1-4) provides the ability to follow DTE controls and to coordinate with the characteristics of the channel. Internal operation is affected by configuration factors such as: duplex or half-duplex operation, point-to-point (two communicating stations) or multipoint (multiple communicating stations) connection to the channel, and dedicated or switched network channel.

### Modem Configurations

The following configuration descriptions are representative examples of possible modem configurations.

1. Dedicated (leased or privately owned) channels (Figures 1-5 and 1-6).
  - a. Point-to-point on half-duplex communications facilities. Requires complete clearing of the channel and modems before a change of transmitting direction (turnaround).
  - b. Point-to-point on duplex communications facilities. Two channels (or equivalent), one for transmitting in each direction. Turnaround is immediate, since each transmitter sends carrier continuously, allowing each receiver to remain synchronized. Either DTE may transmit data to the other at any time permitted by the data system.

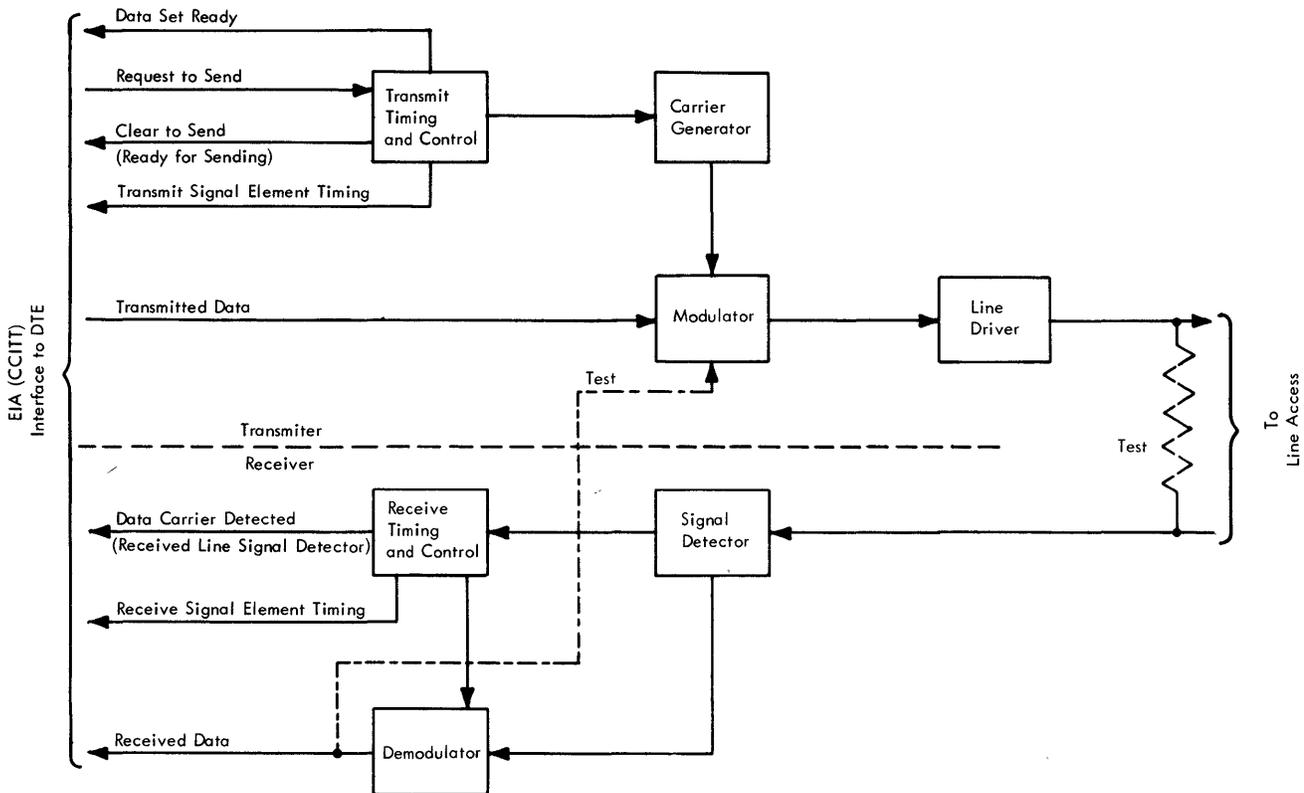
- c. Centralized multipoint on duplex communications facilities. Two channels (or equivalent), one for transmissions *from* the control station and one for transmissions *to* the control station. The control station modem transmitter sends carrier continuously, keeping tributary modem receivers synchronized. Tributary modem transmitters send carrier only to transmit data, and the control station modem receiver synchronizes with any tributary modem transmitter that starts to send. (The control station DTE manages network traffic and invites tributary DTEs to send.)

2. Switched network, Figure 1-7 (public, dialable, voice-grade channels).

*Note:* Half-duplex, public, switched network service is typical in the USA.

- a. Manual call, manual answer. Channel facilities for this configuration (USA and Canada) require a telephone set and a device called a DAA (data access arrangement). The telephone set is used by the DTE operator to dial or to answer a call.

Once the connection is made, each operator raises the data key on the telephone, which transfers the completed connection over to the modems. Modem operation is then point-to-point, in half-duplex.



*Note:* CCITT line designations are shown in parentheses if they differ from EIA standards.

Figure 1-4. Internal Modem Functions (Simplified)

mode. When data transfers are complete, each operator terminates the call at the telephone set. This disconnects the modems from the switched network.

- b. Automatic answering. (See "Special Feature Descriptions" in Part 3.)
- c. Automatic call origination. (See "Special Feature Descriptions" in Part 3.)

### MODEM-CHANNEL INTERFACE AND TYPES OF FACILITIES

Connecting a modem to a common-carrier leased or switched network channel requires compliance with data access arrangements provided by the common carrier. These arrangements are standard with most privately owned lines as well as common-carrier channels. (The type of interface and access connection for the IBM 3872 Modem is specified under "Installation Planning" in Part 3 of this manual.)

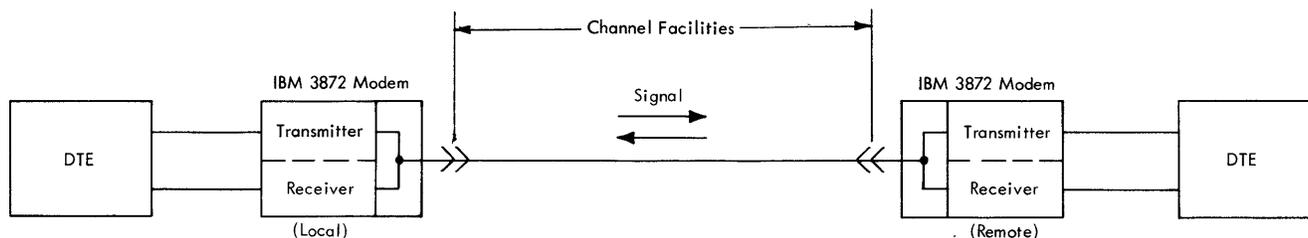
### Dedicated (Leased or Privately Owned Channels)

The interface to dedicated communications facilities consists of two or four wires that are coupled to the modem (that is, for two channels, there is a four-wire connection; for one channel, there is a two-wire connection). Either a two-wire or a four-wire connection may be made by a male connector.

Medium-speed data communications normally require an entire channel to carry the signals in either direction. Thus, in the medium-speed range, a two-wire connection is associated with half-duplex operation, and a four-wire connection, with duplex operation. However, a four-wire connection to half-duplex service may be requested. Multipoint terminal equipment requires four-wire duplex service for satisfactory operation.

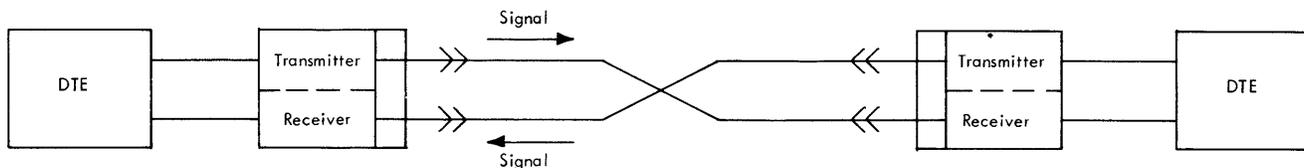
### Switched Network (USA and Canada)

Access to the public switched network requires an access device procured from the common carrier as an additional part of the channel service. (Switched network access for data communications in the medium-speed range is not common in other countries and must be specially arranged.)



Messages are transmitted alternately in each direction.  
 Transmitters are off between message transmissions.  
 The local receiver is clamped when the local transmitter is operating, and vice versa.  
 The local receiver must be synchronized by the remote transmitter before reception of each message, and vice versa.  
 Maximum channel turnaround time.

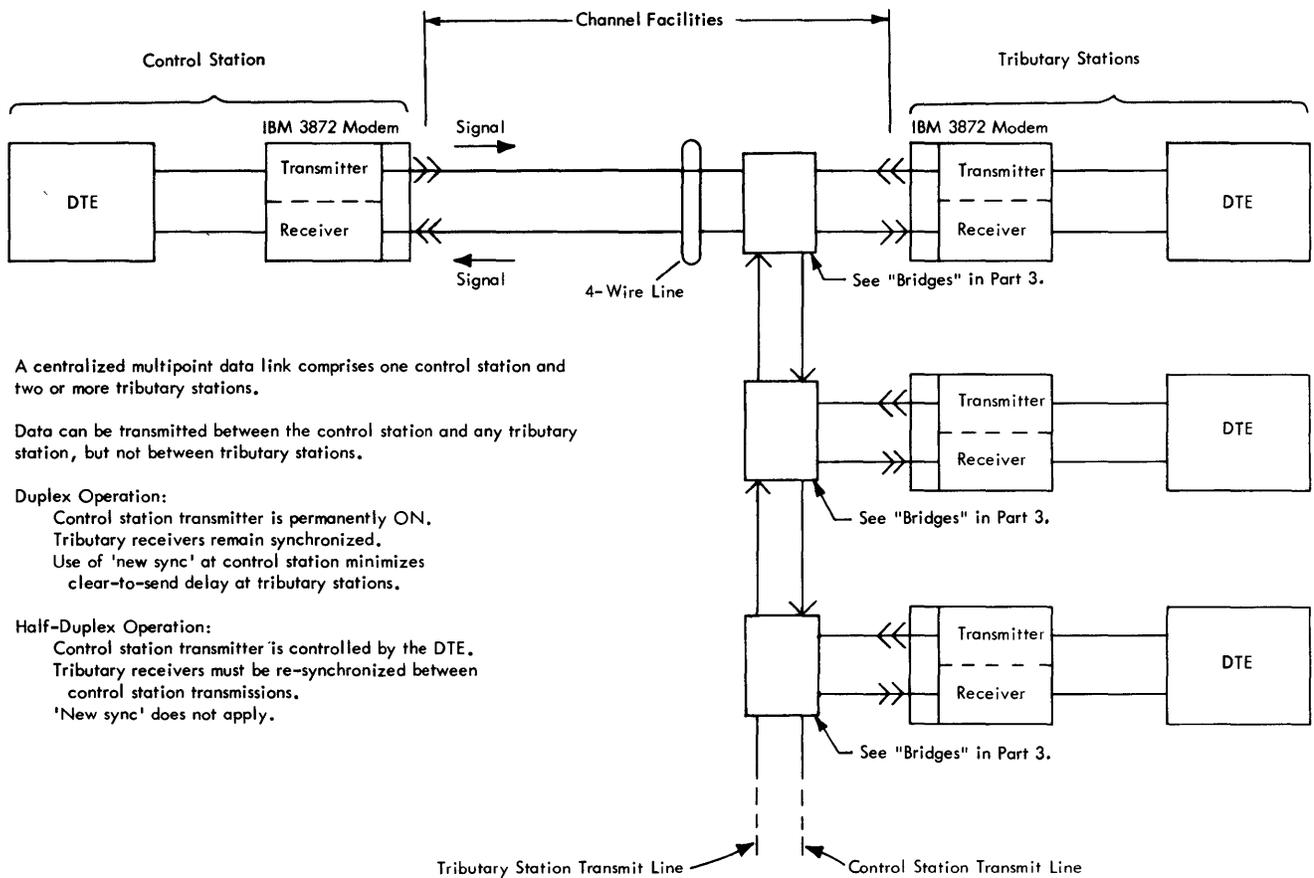
### Two-Wire, Half-Duplex Configuration



1. Duplex or half-duplex operation depends on the DTE.
2. Duplex Operation:  
 Signals may be transmitted simultaneously in both directions.  
 Transmitters and receivers are permanently ON.  
 Each receiver is held continuously synchronized by the transmitter.  
 Turnaround time is modem and DTE turnaround time only.
3. Half-Duplex Operation:  
 Signals are transmitted in one direction at a time.  
 Turnaround time is less than two-wire, half-duplex but more than duplex.

### Duplex Configuration

Figure 1-5. Point-to-Point Data Link Configurations



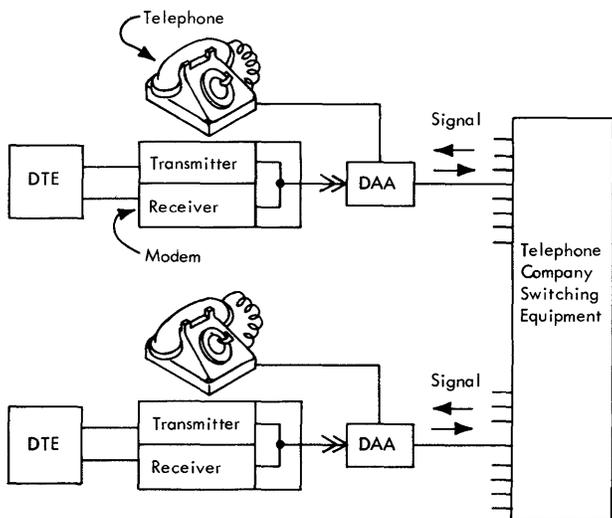
A centralized multipoint data link comprises one control station and two or more tributary stations.

Data can be transmitted between the control station and any tributary station, but not between tributary stations.

**Duplex Operation:**  
 Control station transmitter is permanently ON.  
 Tributary receivers remain synchronized.  
 Use of 'new sync' at control station minimizes clear-to-send delay at tributary stations.

**Half-Duplex Operation:**  
 Control station transmitter is controlled by the DTE.  
 Tributary receivers must be re-synchronized between control station transmissions.  
 'New sync' does not apply.

Figure 1-6. Centralized Multipoint Configuration



A call is dialed and answered manually by DTE operators. Modem communication is point-to-point, half-duplex.

Figure 1-7. Switched Network Configuration, Manual

### OPERATING SEQUENCES

This section of the manual briefly describes the operating sequences of the various modem configurations.

#### Point-to-Point, Two-Wire or Four-Wire, Half-Duplex Sequences

##### Transmit

Refer to Figure 1-5.

1. Sensing 'data set ready' and not 'clear to send' the DTE raises 'request to send'.
2. The modem clamps 'received data' and 'data carrier detected', generates carrier, delays for the receiver to synchronize, and raises 'clear to send (ready for sending)'.
3. The DTE presents serial binary data at the rate of 'transmit signal element timing'.
4. The modem modulates carrier to transmit data.
5. The DTE drops 'request to send' when finished.
6. When all data is sent, the modem stops generating carrier and drops 'clear to send'.

### *Receive*

Refer to Figure 1-5.

1. The modem synchronizes on modulated carrier, raises 'data carrier detected', and presents 'received data' to the DTE.
2. The DTE accepts 'received data' at the rate of 'received signal element timing'.
3. When the modem no longer senses carrier, it drops 'data carrier detected'.

### **Point-to-Point, Four-Wire, Duplex Sequences**

Both DTEs in this configuration (Figure 1-5) hold 'request to send' permanently on. 'Clear to send' is delayed by the modem only when modem power is first turned on. Thereafter, 'clear to send' remains up at both modems, both modems generate and transmit carrier, and both modem receivers remain synchronized. 'Data carrier detected' stays on at both modems. Either DTE can send data at any time allowed by the data system.

### *Transmit*

1. The DTE presents serial binary data at the rate of 'transmit signal element timing'.
2. The modem modulates carrier to transmit data.
3. The DTE stops presenting serial data when it finishes sending.

### *Receive*

1. The modem presents 'received data' to the DTE.
2. The DTE accepts 'received data' at the rate of 'received signal element timing'.

### **Centralized Multipoint, Four-Wire, Duplex Sequences**

The control station DTE in this configuration (Figure 1-6) may hold 'request to send' permanently on. 'Clear to send' is delayed by the control station modem only when modem power is first turned on. 'Clear to send' remains up, and the control station modem continuously generates and transmits carrier.

Tributary station modem receivers are always synchronized and have 'data carrier detected' raised to the tributary DTEs. Tributary DTEs raise 'request to send' only when they have been invited to transmit by the control station DTE. "Control station transmit" and "tributary station receive" are identical to "point-to-point, duplex transmit and receive". Tributary station transmit is identical to "point-to-point, half-duplex transmit". "Control station receive" is described as follows:

1. The control station modem synchronizes on modulated received carrier, raises 'data carrier detected' when data arrives, and presents 'received data' to the control station DTE.
2. The DTE accepts 'received data' at the rate of 'received signal element timing'.

3. When all received data has been presented to the DTE and the modem no longer senses carrier, it drops 'data carrier detected'.
4. The control station DTE, if equipped to control the 'new sync' line, may momentarily raise 'new sync' at this time to reset the modem receiver synchronizing circuits quickly, in expectation of receiving a carrier signal from a different tributary modem.

### **Switched Network, Manual Call, Manual Answer Sequences**

In this configuration (Figure 1-7), it is assumed that the respective DTE operators will arrange by voice who is to transmit first. For this discussion, assume that the calling party transmits first.

*Note:* Once a dialed connection is complete and the channel has been turned over to the modems by the DTE operators, switched network operation is point-to-point, half-duplex. The DTEs have full use of the channel (via the modems) until one or both operators disconnect.

### *Transmit*

1. The DTE operator readies the DTE and, using the telephone set attached to the DAA (data access arrangement), dials the telephone number of the modem that is to receive.
2. The receiving station operator answers, readies the receiving DTE, and activates the exclusion key.
3. The transmitting station operator, hearing a tone, raises the data key on the telephone. The transmitting modem, now connected to the channel, raises 'data set ready'.
4. Sensing 'data set ready' and not 'clear to send', the transmitting DTE raises 'request to send'.
5. The modem clamps 'received data' and 'data carrier detected', generates carrier, delays for the receiving modem to synchronize and equalize, and raises 'clear to send (ready for sending)'.
6. The DTE presents serial binary data to the modem at the rate of 'transmit signal element timing'.
7. The modem modulates carrier to transmit the data.
8. The DTE drops 'request to send' when it has finished sending.
9. When all data has been sent, the modem stops generating carrier and drops 'clear to send'.

### *Receive*

1. The DTE operator answers the ringing of the telephone set attached to the DAA, readies the DTE, and activates the data (exclusion) key on the telephone.
2. The receiving modem synchronizes and equalizes on the received carrier, raises 'data carrier detected' when data arrives, and presents 'received data' to the receiving DTE.
3. The DTE accepts 'received data' at the rate of 'receive signal element timing'.

4. When it no longer senses carrier, the receiving modem drops 'data carrier detected'.

*Disconnect Procedure*

Manual access arrangements require the operator to cradle the handset to disconnect. Automatic access arrangements require a "Not-Ready" condition from the DTE to disconnect.

**Switched Network, Manual Call, Automatic Answer Sequences**

(See "Special Feature Descriptions" in Part 3.)

**Switched Network, Automatic Call Automatic Answer Sequences**

(See "Special Feature Descriptions" in Part 3.)

Test functions of the IBM 3872 Modem are designed to allow the modem user to perform preliminary tests in case of degraded performance. Test results will indicate which supplier's service personnel can best resolve the problem.

In the 3872, test functions include:

1. Attenuated feedback from the modem transmitter to the modem receiver (Figure 1-4), for the purpose of testing the transmit and receive circuits in a local loop.
2. Data received at the local modem is internally looped to the transmitter and automatically retransmitted to the remote modem (Figure 1-4).

*Note:* If DTE-generated data is transmitted in this test, it must be all marks (binary "1").

3. Data test pattern generation and checking can be used to isolate the DTE from modem/channel problems.

### APPLICATION OF TEST FUNCTIONS

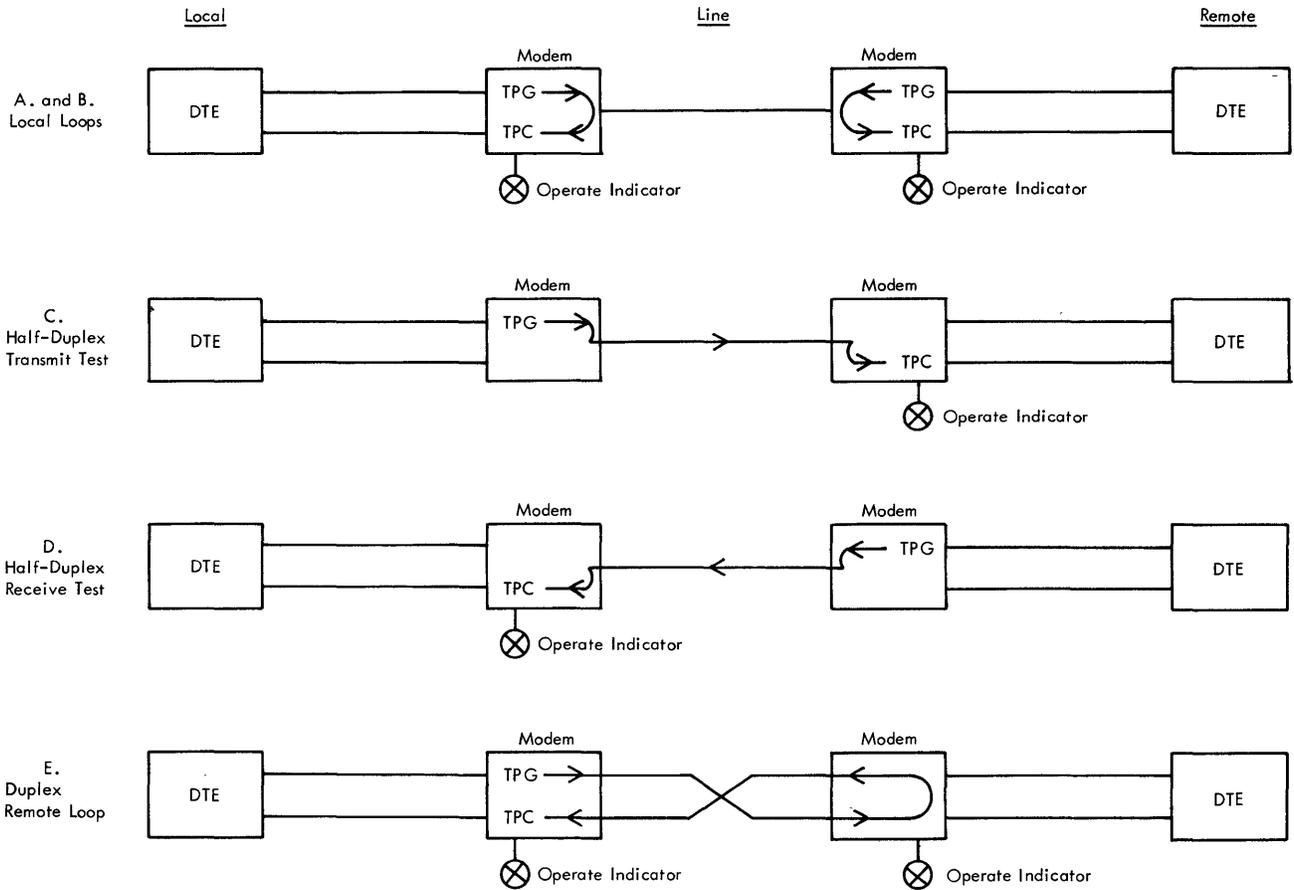
Briefly, test functions may be used as follows (Figure 1-8):

- A. Using the locally generated test pattern, test the local receiver and transmitter in a local loop (3872 Test 1).
- B. Using the remotely generated test pattern, have the remote operator test the remote receiver and transmitter in a local loop at the remote station (3872 Test 1).
- C. In a half-duplex configuration, using the locally generated test pattern, transmit to the remote station and have the pattern checked there (local 3872 Test 3, remote 3872 Test 4).
- D. In a half-duplex configuration, using the remotely generated test pattern, check local reception (remote 3872 Test 3, local 3872 Test 4).
- E. In a duplex configuration, generate the test pattern locally and check it locally. The remote modem receives, checks, and retransmits the pattern, using test circuits. This is called a remote loop (local 3872 Test 3, remote 3872 Test 4).

### INTERPRETATION OF TEST RESULTS

The purpose of the tests (Figure 1-8) is to identify the problem in the modem-channel-modem subsystem. A local loop test that fails indicates a problem in the modem. When both local loop tests are good and either a transmit or receive test fails, a communications channel fault is probable. (The remote loop test allows results to be checked at the transmitting modem and should be used only following fault-free local loop tests).

Problem determination can assist the IBM 3872 Modem user to realize savings in system time and service personnel expense. For testing sequences tailored to each modem configuration, refer to *IBM 3872 Modem Problem Determination*, GA27-3062.



**Note 1:** If the generated test pattern does not check properly at the receiver, the modem momentarily turns off the Operate indicator.

**Note 2:** Tests illustrated here are lettered to correspond with those described and lettered under "Modem Test Concepts" in Part 1 of this manual. Items C and D can be executed simultaneously in a duplex configuration. Item E can be executed by the remote modem as well as by the local modem.

**Note 3:** Refer to IBM 3872 Modem Problem Determination, GA27-3062, for specific switch setting and detailed sequential test procedures.

**Legend** TPG = test pattern generate  
TPC = test pattern check

Figure 1-8. Modem Test Configurations

**Part 2. Operator Information**



This chapter describes the front panel switches and indicators of the IBM 3872 Modem. It also describes the procedures for operating the 3872 under normal conditions. For operating the modem under manual test conditions, see *IBM 3872 Modem Problem Determination*, GA27-3062.

**SWITCHES AND INDICATORS**

Figures 2-1 and 2-2 show the maximum front panel configurations on the 3872 Modem. Refer to these illustrations for the locations of switches and indicators and for a brief description of each.

Refer to Figure 2-3 for the identifying characteristics of various 3872 configurations. Configuration identification is needed to select switch settings and manual operating procedures.

**NORMAL OPERATING AND MONITORING PROCEDURES**

When the modem operation is fully automatic, it is necessary only to turn power on or off. (A 5-second warm-up period is required after power-on.) The lists following in this chapter show switch settings for automatic operation in the applicable configuration.

For 3872 Modems operating on the public switched network, calling is done manually unless the Automatic Call Origination feature is installed; if the Switched Network Backup (SNBU) without Automatic Answering feature is in use, both calling and answering are manual. See "Manual Operations with Switched Network Features", following in this chapter.

**Non-Switched (Leased Line)**

The switch settings listed here apply to point-to-point, multipoint control, and multipoint tributary modems.

1. Power switch set to ON
2. Test/Operate switch set to OPERATE
3. Speed Select switch set to 2400 LEASED or 1200 LEASED (must be the same for all modems on the same channel)
4. Talk/Data switch set to DATA
5. Equalizer switch(es) at optimum setting(s) (See *IBM 3872 Modem Problem Determination*, GA27-3062.)

**Switched Network without ACO**

1. Power switch set to ON
2. Test/Operate switch set to OPERATE
3. Speed Select switch set to 2400 SW or 1200 SW (must

- be the same for any two connected modems)
4. Talk/Data switch set to DATA
5. CBS Data Coupler (or equivalent) test switches in data mode (off) and handset cradled.

**Switched Network with ACO**

1. Power switch set to ON
2. Test/Operate switch set to OPERATE
3. Speed Select switch set to 2400 SW or 1200 SW (must be the same for any two connected modems)
4. Talk/Data switch set to DATA
5. CBS Data Coupler (or equivalent) test switches in data mode (off) and handset cradled
6. ACO Function switch set to OPERATE
7. VOLUME knob rotated clockwise, to monitor calling/answering.

**SNBU Modem on Switched Network**

If automatic answering is not present with the SNBU feature, the 3872 Talk/Data switch is set to TALK when the modem is not actually transferring data. Otherwise, the switch settings are the same as those shown for "Switched Network without ACO."

**Monitoring Automatic Call Origination (ACO)**

This sequence describes the monitoring of a normally completed, automatically placed call. If the system is unable to connect an automatic call (the Data Channel Ready indicator does not come on), the sequence does not end, but, instead, repeats. The point at which the sequence begins to repeat indicates the progress of the call.

<i>Indicator On*</i>	<i>Audible Signal</i>
1. Turn the Volume knob clockwise to increase the volume to a suitable level.	
2. Data Line Occupied*	—
3. Off-Hook*	Click
4. Coupler Cut Through*	—
5. Present Next Digit*	Dial tone
6. Off-Hook* blinks (dialing)	Clicks
7. (dialing complete)	Ringing
8.	Answer tone (2100 Hz)
9. Data Channel Ready* (ACO) and Ready* (modem)	Answer tone ends
10. Operate* dims or blinks	Data

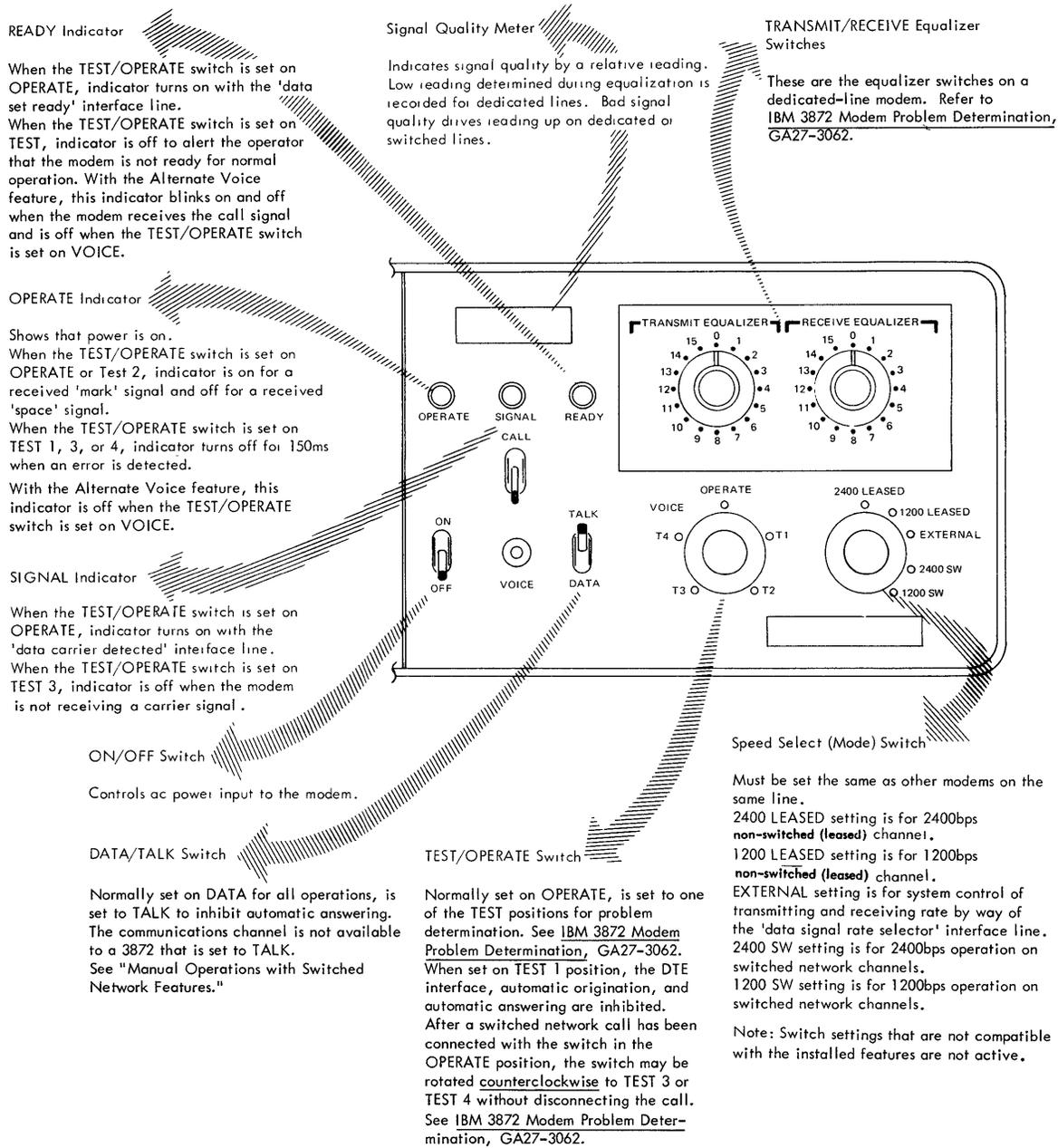


Figure 2-1. Modem Front Panel Switches and Indicators

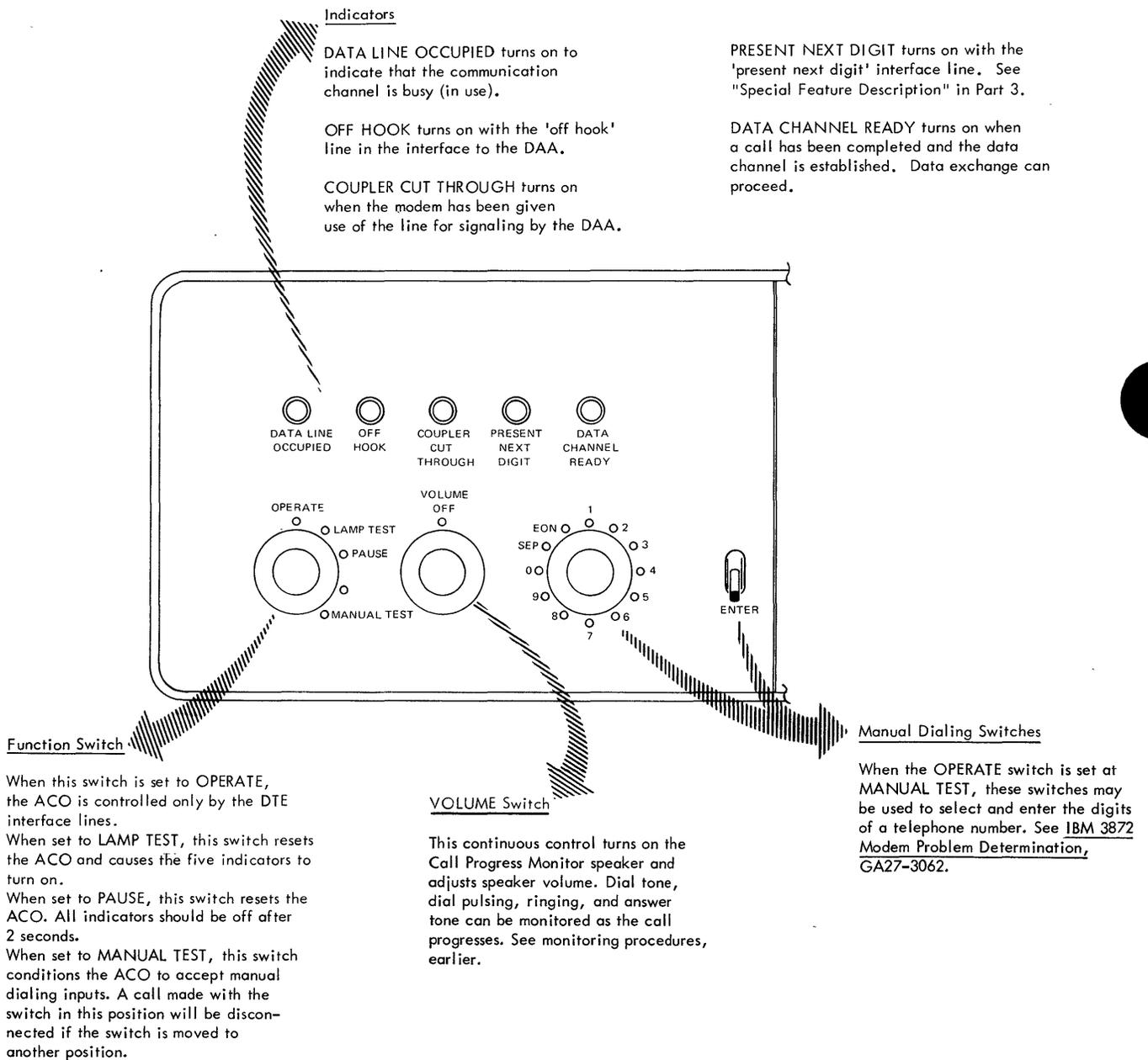
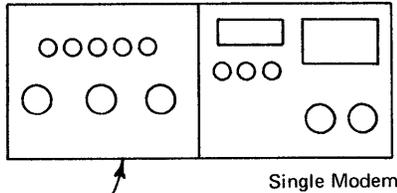


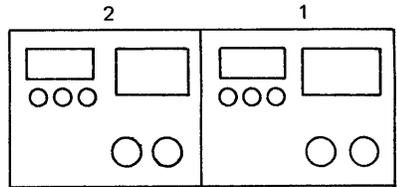
Figure 2-2. Automatic Call Origination Front Panel Switches and Indicators

A. Single or Dual Modem Identification



Single Modem

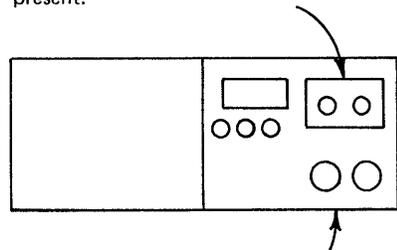
This panel is present on a single modem only if the Switched Network and ACO features are installed.



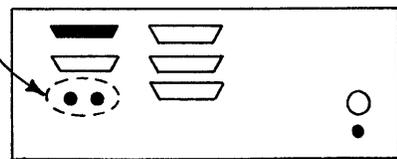
Dual Modem

B. Equipped for Manual Answering, only, on Switched Network

One, both, or neither of these switches may be present.

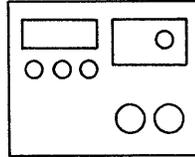


A 3872 single modem with this front panel and cables in both of these locations has the SNBU feature and is equipped for manual answering, only on the switched network. All other 3872 Modems (single or dual) that operate on the switched network are equipped for automatic answering on the switched network.

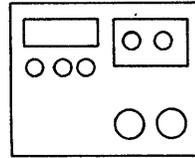


Back Panel

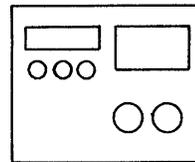
C. Identification of Non-Switched (Leased-Line) Modems



A 3872 Modem (single or dual) with this front panel is a point-to-point, non-switched (leased-line) modem.

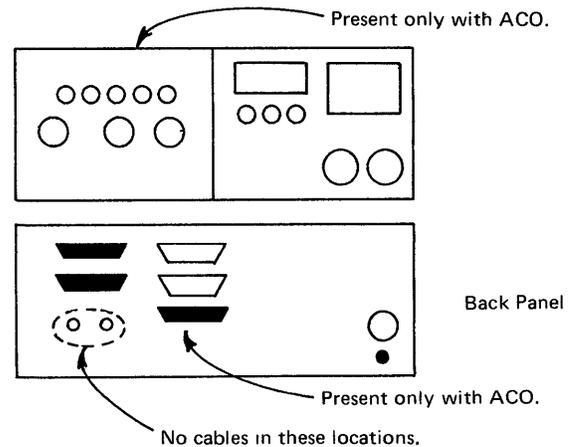


A 3872 Modem (single or dual) with this front panel is a multipoint tributary, non-switched (leased-line) modem.



A non-switched (leased-line) 3872 Modem (single or dual) with this front panel is a multipoint control modem. A 3872 Modem with the Switched Network feature has an identical front panel, but can be identified as shown in C1 and C2, following.

C1. Single Modem with the Switched Network Feature



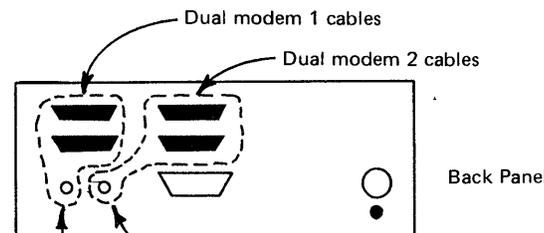
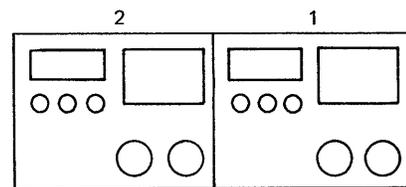
Present only with ACO.

Back Panel

No cables in these locations.

Present only with ACO.

C2. Dual Modems with the Switched Network Feature



Dual modem 1 cables

Dual modem 2 cables

Back Panel

If there is no cable in this location, modem 2 has the Switched Network feature.

If there is no cable in this location, modem 1 has the Switched Network feature.

Figure 2-3. Modem Configuration Identification

### Monitoring Automatic Answering

This sequence describes the normal answering of an automatically answered call. If the call progress monitor (of a modem with ACO) is turned up, audible signals accompany the visual indications.

*Indicator*  
*On\**

1. Ringing on the line
2. Ringing stops and modem sends answer tone
3. Modem Ready\* (answer tone ends)
4. Operate\* dims or blinks (data)

### Programmed Testing

For a DTE that controls the 'test' interface line, the 3872 Modem provides a programmable local loop test. The DTE must provide and check the test data. Refer to the description of the 'test' and 'data set ready' lines under "Using Machine Considerations", in Part 3 of this manual.

### MANUAL OPERATIONS WITH SWITCHED NETWORK FEATURES

To place or answer a switched network call manually, from a telephone at a 3872 Modem installation, it is necessary to know whether the 3872 is equipped for automatic answering (see Figure 2-3B). It is also necessary, in the following procedures, to know if the remote modem is equipped for automatic or for manual-only answering.

Two sets of procedures follow the "Preliminary Setup for Manual Operation"; one set is for use at an auto-answer (CBS Coupler) location, and the other, at a manual-only (CDT DAA) location. Each set contains a calling procedure and an answering procedure. In all procedures, it is assumed that the calling station will transmit first.

*Note:* The handset referred to in the following procedures is the handset of the DAA telephone. The exclusion key for automatic access arrangements (a CBS Data Coupler, or equivalent) or the data key for manual access arrangements (a CDT Data Access Arrangement, or equivalent) is the white key on the left cradle of the DAA handset. When the handset is cradled, tilt it so that the white key is operated first. CDT-equivalent DAAs may have a different arrangement to control talk/data mode; check with the supplier for operating instructions.

### Preliminary Setup for Manual Operation

If an automatic-answer modem is already set up for automatic answering, prepare for manual operation by simply setting the 3872 Talk/Data switch to TALK; otherwise, set the switches as follows:

1. Power switch set to ON
2. Test/Operate switch set to OPERATE
3. Speed Select switch set to agree with the Speed Select switch setting of the remote modem

*Note:* In the following procedures, confirm with the operator of the remote modem that the switch settings are the same.

4. Talk/Data switch set to TALK

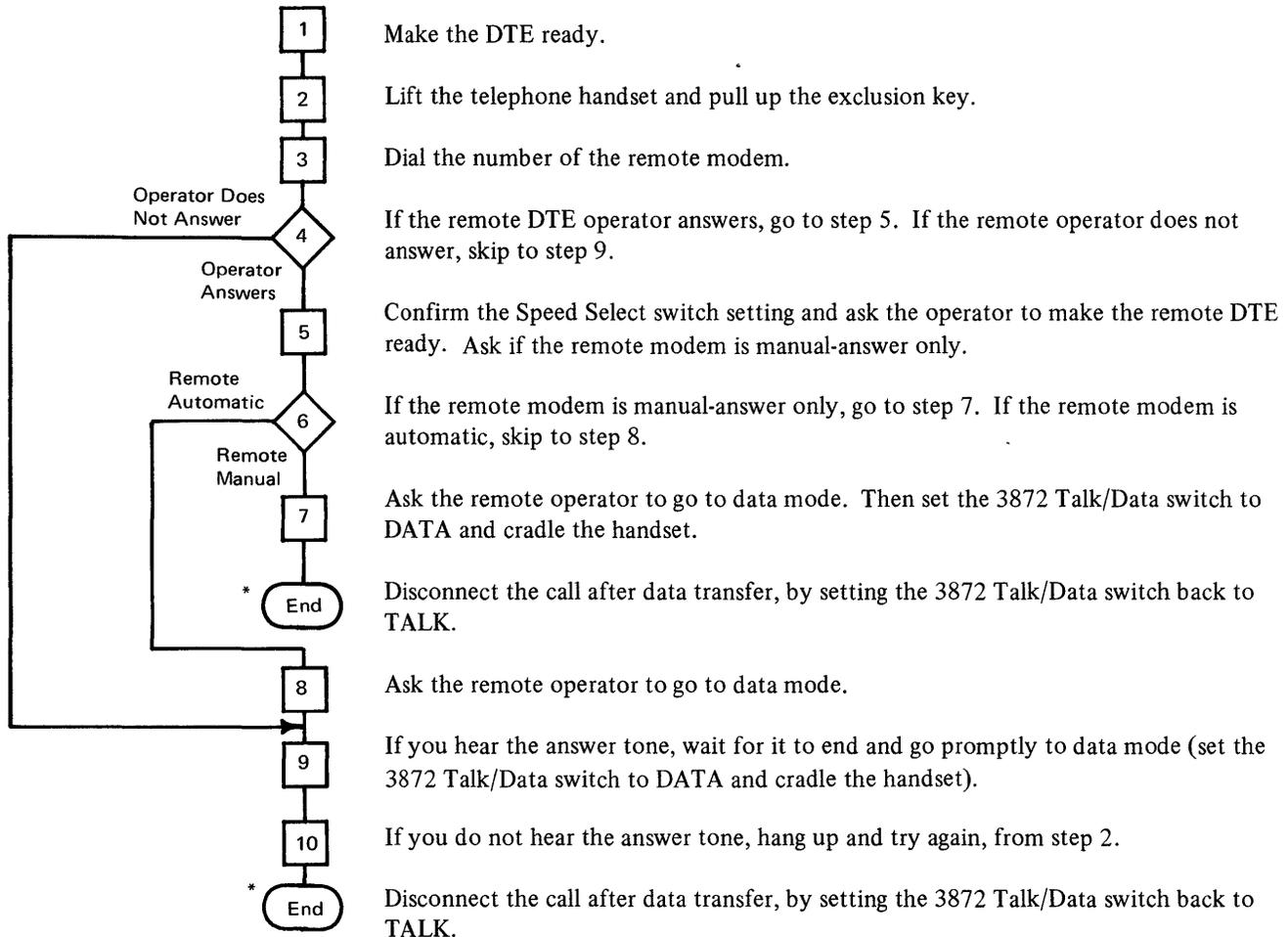
*Note:* Since these are manual procedures, it is assumed that the Talk/Data switch is set to TALK when the modem is not actually engaged in transferring data.

5. For automatic-answer modems, CBS Data Coupler (or equivalent) test switches in data mode (off) and the handset cradled.

## Manual Operation of an Auto-Answer Modem

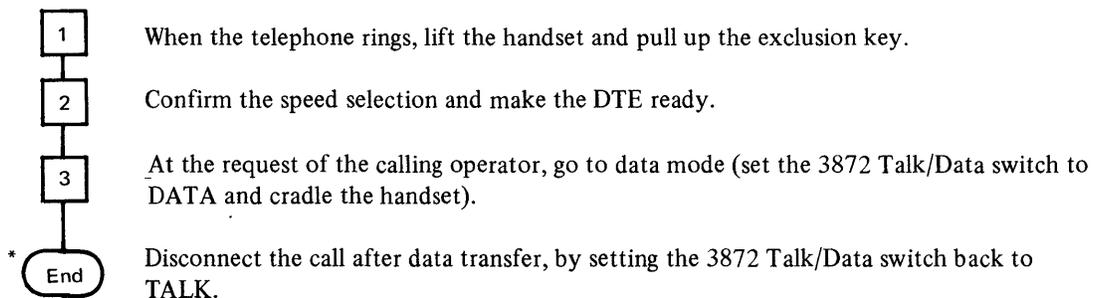
Use these procedures if the modem is connected to a CBS Data Coupler (or equivalent).

### Manual Calling



\*To retain the connection for voice communication, pick up the telephone handset and pull up the exclusion key before switching to TALK. For further data transfer, go back to step 5.

### Manual Answering

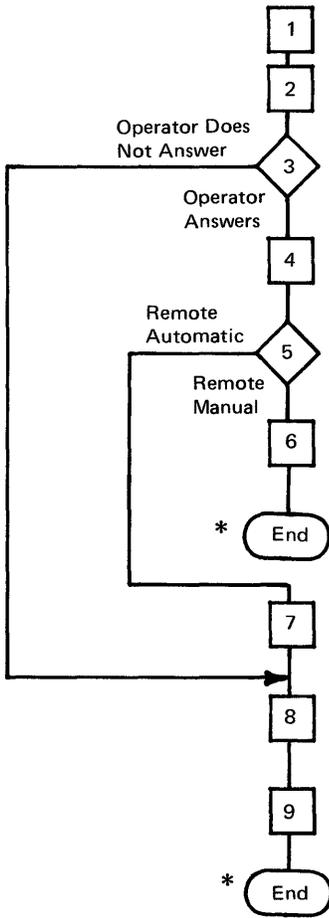


\*To retain the connection for voice communication, pick up the telephone handset and pull up the exclusion key before switching to TALK. Go back to step 2, for further data transfer.

### Manual-Only (SNBU without Automatic Answering) Operation

Use these procedures if the modem is connected to a CDT DAA (or equivalent).

#### Calling



1 Make the DTE ready.

2 Lift the telephone handset and dial the number of the remote modem.

3 If the remote DTE operator answers, go to step 4. If the remote operator does not answer, skip to step 8.

4 Confirm the Speed Select switch setting and ask the operator to make the remote DTE ready. Ask if the remote modem is manual-answer only.

5 If the remote modem is manual-answer only, go to step 6. If the remote modem is automatic, skip to step 7.

6 Ask the remote operator to go to data mode. Then pull up the data key and set the 3872 Talk/Data switch to DATA. Leave the handset out of the cradle.

7 After data transfer, set the 3872 Talk/Data switch back to TALK. Disconnect the call by returning the telephone handset to the cradle.

8 Ask the remote operator to go to data mode.

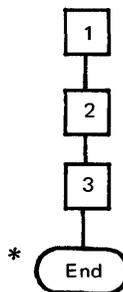
9 If you hear the answer tone, wait for it to end and go promptly to data mode (pull up the data key and set the 3872 Talk/Data switch to DATA). Leave the handset out of the cradle.

10 If you do not hear the answer tone, hang up and try again, from step 2.

11 After data transfer, set the 3872 Talk/Data switch back to TALK. Disconnect the call by returning the telephone handset to the cradle.

\*To retain the connection for voice communication, switch back to TALK but do not disconnect. For further data transfer, go back to step 4.

#### Answering



1 When the telephone rings, pick up the handset. (If there is no response to your greeting, hang up.)

2 Confirm the Speed Select switch setting and make the DTE ready.

3 At the request of the calling operator, go to data mode (pull up the data key and set the 3872 Talk/Data switch to DATA). Leave the handset out of the cradle.

4 After data transfer, set the 3872 Talk/Data switch back to TALK. Disconnect the call by returning the telephone handset to the cradle.

\*To retain the connection for voice communication, set the 3872 Talk/Data switch back to TALK, but do not disconnect. For further data transfer, go back to step 2.

### Disconnecting a Switched Network Call Manually

It may, at times, be necessary to manually disconnect a call that should have been automatically disconnected. Proceed as follows:

With a CBS Data Coupler (or equivalent) (auto-answer)—  
Set the 3872 Talk/Data switch to TALK, with the handset cradled. (If the 3872 has the ACO feature, the ACO function switch must be set at OPERATE.)

With a CDT DAA (or equivalent) (manual-answer-only)—  
Cradle (hang up) the telephone handset attached to the DAA.

### Suspending a Switched Network Connection

A switched network connection can be retained indefinitely, regardless of DTE status, by turning the 3872 Test/Operate switch counterclockwise from OPERATE to the first blank position. (Toll charges accumulate until the call is disconnected.) Reactivate the connection by switching to OPERATE.

## MANUAL OPERATIONS ON NON-SWITCHED (LEASED-LINE) MODEMS

### Equalization

After initial installation, equalization should be done only as required for problem determination. See *IBM 3872 Modem Problem Determination, GA27-3062*.

### Use of the Alternate Voice Feature

The Alternate Voice feature provides for voice communication between the operators of 3872 Modems attached to dedicated communications facilities. This feature, in most cases, eliminates any need for separate toll calls such as would otherwise be required during equalization or re-equalization (see GA27-3062) or when arrangements are being made for half-speed or SNBU operation. See "Alternate Voice Feature" under "Special Feature Descriptions", in Part 3 of this manual. Refer to Figure 2-1 for an illustration of the switch and jack on the 3872 Modem front panel.

*Note:* With the handset plugged into the 3872, line signals (two-wire modems) or receive line signals (four-wire modems) can be heard in the handset receiver, regardless of the Test/Operate switch setting. It is permissible to leave the handset plugged in.

### To Make a Call

1. Plug the telephone handset cord into the VOICE jack on the front panel of the 3872 Modem.
2. Set the Test/Operate switch to VOICE (between OPERATE and T4). Data communication at this modem is interrupted, and the Ready and Signal indicators are off.
3. Operate the CALL switch for about 5 seconds (not less than 2 seconds). At the remote end(s), an audible signal sounds and the Ready indicator flashes on and off while the local CALL switch is active. If there is no response, repeat the operation of the CALL switch.

*Note:* The speed setting of the 3872 Mode Switches (2400 LEASED or 1200 LEASED) affects calling. The modems at both ends of the line should be set the same; if there is no response to repeated calling, switch to 1200 LEASED and try again.

4. Return to data communication, after voice communication, by setting the Test/Operate switch back to OPERATE. The operator whose DTE is to transmit first should return to OPERATE last.

*Note:* Multipoint control station calling signals are received simultaneously by all the tributary stations. (Prearranged patterns of signal duration may be used by the control station operator to identify each tributary station.) Tributary stations cannot call each other; they can call only the control station.

### To Answer a Call

1. When the audible signal is heard and the Ready indicator is flashing on and off, plug the telephone handset cord into the VOICE jack on the front panel of the 3872 Modem.
2. When the audible signal and flashing stop, set the Test/Operate switch to VOICE (between OPERATE and T4). (Data communication at this modem stops, and the Ready and Signal indicators go off.) Respond to the operator who is calling, by speaking into the handset transmitter or by operating the CALL switch. (CALL switch response should be by prearrangement.)
3. Return to data communication, after voice communication, by setting the Mode Switch to agree with the calling station and by setting the Test/Operate switch back to OPERATE. The operator whose DTE is to transmit first should return to OPERATE last.

### Part 3. Technical Description



## CHANNEL CHARACTERISTICS

Telephone lines have varying characteristics, some of which, such as distortion, delay, echo, and noise, are detrimental to data channel operation.

### Noise

#### *Background Noise*

A certain amount of noise on the channel is expected, and IBM modems are designed for efficient operation when it is present. In voice conversation, background noise can be heard as a faint hiss or as an absence of complete silence in quiet periods. Switched network channels tend to have higher noise levels than dedicated channels.

#### *Impulse Noise*

Impulse noise results from occasional electrical disturbances. In voice conversation, impulse noise is heard as "static"; in data communication, impulse noise is destructive, and retransmission is necessary. Some impulse noise is generally present on a communications channel and should be considered in planning system throughput.

### Echo

Single "talker" echo (transmitter to receiver and back) must have a power level below the receiver threshold of the transmitting modem. Double "listener" echo must have a power level considerably lower than the level of the non-reflected signal.

To minimize the impediment to voice conversation caused by echo, common-carrier channels have devices called echo suppressors. An echo suppressor allows signals to pass in the direction of the strongest signal, and it has the ability to change direction when one speaker stops talking and the other starts.

An echo suppressor has the same turnaround capability in a channel used for data communications, but the turnaround time (unnoticed in voice conversation) is objectionable in data communications. Dedicated channels are often specified without echo suppressors, to eliminate the turnaround time allowance; thus echo may be present.

### Distortion and Delay

Distortions and delays are inherent in common-carrier powering and regenerating equipment. Common carriers offer services conditioned for differing specifications with respect to distortions and delays. The tolerable levels are specified by the grade of conditioning when arrangements are made for

the channel. (For example, the 3872 requires a type 3002 channel with C1 conditioning.)

### Equalizers

Modem equalizers can compensate for certain imbalances in common-carrier equipment, which result in delay and amplitude distortion. Equalization in the modem permits satisfactory operation on a less expensive channel. Normally, equalization to the characteristics of a dedicated channel is performed manually at the time of modem installation. In switched network operation, channel characteristics may be different for each call; equalization is performed automatically by the 3872 Modem.

### Bridges

In a duplex centralized multipoint configuration, communication between tributary stations is not allowed. In addition, the tributary stations should not hear each other or themselves as they transmit. In duplex operation, proper insertion of split four-wire or individual two-wire bridges (Figure 1-6) at each drop from the dedicated channel is necessary in the common carrier equipment. This arrangement prevents false signals on the control station transmit line caused by interference between control station carrier and a tributary station transmission.

## MODEM-DATA TERMINAL EQUIPMENT INTERFACE

Portions of the modem-DTE interface have been discussed earlier under "Modem Concepts and Configurations" (Figure 1-4). This interface is standard in the industry (see the notice "To The Reader" at the front of this manual.) The DTE interface of the IBM 3872 Modem is designed to provide proper operation with DTE devices that comply with EIA RS-232-C and CCITT Recommendation V.24. (The DTE interface of the 3872 is specified under "3872-DTE Interface", following.) The following brief descriptions of the interface lines (Figure 3-1) are intended to relate the standards description to the 3872.

### Functional Description of DTE Interface Lines

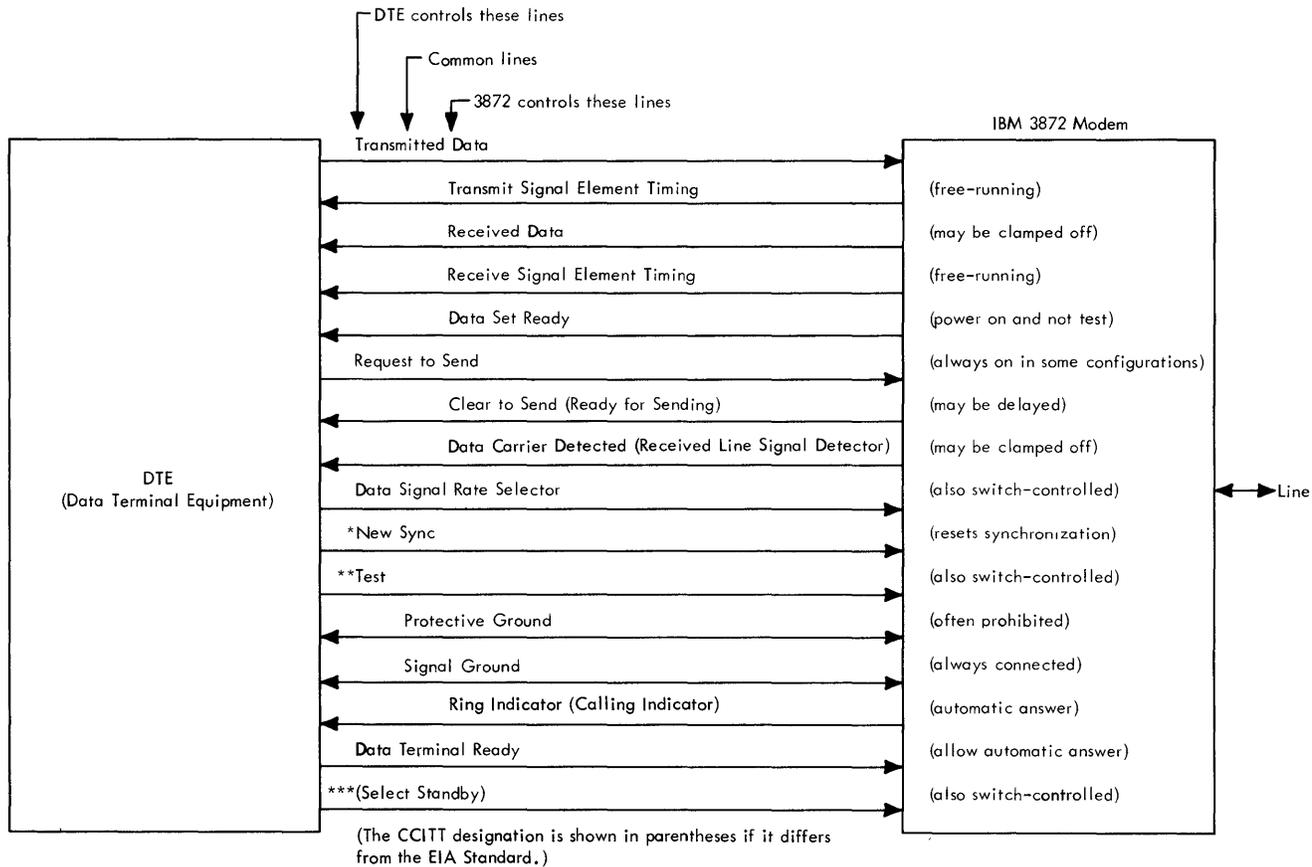
- 'Transmitted data' - The transmitting DTE controls this line to present serial binary data to the modem.
- 'Transmit signal element timing' - The transmitting modem raises (turns on) this line at the optimum time for the DTE to change the binary value (on or 1; off or 0) of the 'trans-

mitted data' line. The 3872 raises (turns on) and drops (turns off) this timing line at the selected bits-per-second rate, whenever it is plugged in and turned on.

- 'Received data' - The receiving modem controls this line to present data to the DTE.
- 'Receive signal element timing' - The receiving modem drops (turns off) this line at the optimum time, when the DTE should sample each bit on the 'received data' line. The bit may be of the same binary value (on or 1; off or 0) as the previous bit, or it may be of the opposite value. The 3872 Modem raises (turns on) and drops (turns off) this timing line at the selected bits-per-second rate, whenever it is plugged in and turned on.
- 'Data set ready' - When the modem is operable, it raises (turns on) this line to the DTE. With the 3872, modem power must be on, and the modem must not be in local test (see "Modem Test Concepts," in Part 1). In addition

in a switched network operation, 'data set ready' indicates a connection to the switched network channel. 'Data set ready' remains on as long as these conditions are met.

- 'Request to send' - The DTE raises (turns on) this line when it wishes to send. 'Data set ready' must be on, and for proper operation, it is necessary that 'clear to send (ready for sending)' be off. When the DTE turns on 'request to send', the IBM 3872 Modem configured for half-duplex operation (Figure 1-5) holds 'data carrier detected' and 'received data' off. This action is known as "clamping". 'Request to send' must be turned off when the DTE has finished sending.
- 'Clear to send (ready for sending)' - After a suitable time interval, known as a "delay", the modem raises (turns on) this line in response to 'request to send'. In half-duplex operation, the delay is needed to perform the clamping, start generating carrier, and allow time for the receiving



\* New Sync is not standardized by EIA or CCITT.

\*\* Test is not standardized by CCITT.

\*\*\* Select Standby is not standardized by EIA.

Note 1: DTE interface lines not controlled by an originating machine are interpreted by the other machine to be down or off (standard).

Note 2: DTE interface standards can be obtained from the sources given in the notice "To The Reader", at the front of this manual.

Figure 3-1. Modem-DTE Interface

modem to synchronize. Following a change of half-duplex transmitting direction, time must also elapse for data to clear from the channel and from the modem. 'Clear to send' stays up (on) until the DTE has turned off 'request to send' and until all data accepted by the transmitting modem has been transmitted.

- 'Data carrier detected' - The modem raises (turns on) this line to signal to the DTE to monitor the 'received data' line. The 3872 turns on this line when the modem is fully synchronized, and clamps off 'received data' in the interim.
- 'Data signal rate selector' - When the 3872 Modem Mode switch is set to EXTERNAL, the modem's ability to transmit and receive at half-speed is controlled by this line from the DTE interface. An up (on) level causes full-speed (2400 bps) operation; a down (off) level causes half-speed (1200 bps) operation. Other positions of the mode switch provide manual control of speed selection. (See "Switches and Indicators" in Part 2.)
- 'New sync' (not standardized by EIA or CCITT) - The control station DTE (Figure 1-6) controls this line to the control station modem. In a centralized multipoint duplex configuration, 'new sync' can reduce the interval required between the end of transmission by one tributary modem and the start of transmission by another tributary modem. As the control station DTE transmits an invitation to the next tributary station to transmit, it momentarily raises (turns on) the 'new sync' line to its modem. This causes the control station modem receiver to reset all receiver synchronization controls. A shorter 'clear to send' delay can then be used at the tributary station, and the control station modem receiver will be waiting to synchronize.
- 'Test' (not standardized by CCITT) - This line from the DTE interface controls the local test loop function of the modem (see "Modem Test Concepts," in Part 1). When this line is up (on), the modem transmit signal (Figure 1-4) is attenuated (reduced in power) and connected to the input of the receiver. This local loop can also be controlled by the 3872 Test Operate switch for manual testing.
- 'Signal ground' and 'protective ground' - These lines connect the electronic ground references and the frames, respectively, of the DTE and the modem. The circuitry must be connected to provide a reference in both devices for up (on) and down (off) levels of the other DTE interface lines. Local restrictions may prohibit the use of the 'protective ground' line. In such case, grounding is accomplished through the ground conductor in the power cords of the respective devices. Power cord ground wires should be connected together through earth or building ground.
- 'Ring indicator (Calling indicator)' - A modem in a switched network configuration raises (turns on) 'ring indicator' to the DTE during the time the ringing signal is being received from the DAA. See "Special Feature Descriptions" in Part 3.

- 'Data terminal ready' - The DTE raises (turns on) this line to a modem in a switched network configuration to allow the modem to be connected to the communications channel. If the modem is equipped for automatic answering or automatic call origination (see "Special Feature Descriptions", following) 'data terminal ready' must be up (on) to answer a call or to automatically originate a call. With either feature, the DTE drops (turns off) 'data terminal ready' to disconnect the channel.
- '(Select standby)' (not standardized by EIA) - The DTE raises (turns on) this line to the IBM 3872 modem in a dedicated channel configuration. (The 3872 Modem requires the Switched Network Backup feature. See "Special Feature Descriptions," following.) When 'select standby' is up (on), the modem disconnects from the dedicated channel and connects to the switched network access (DAA in the USA and Canada). It is then necessary to complete a switched network call before data can be transferred. Modem operation can also be manually transferred to the switched network by the 3872 Mode switch (see "Switches and Indicators" in Part 2).

### 3872-DTE Interface

The digital (binary) interface between the DTE and the IBM 3872 Modem conforms to the specifications of EIA RS-232-C and RS-334 and of CCITT Recommendation V.24, with the considerations described in the following text. Nonstandardized interface lines provided to the DTE interface by the 3872 are also described. In this section of the manual, the following illustrations show the DTE interface:

Figure 3-2 shows the EIA and CCITT designations and names of interface lines, together with the standard pin number of each line.

Figure 3-3 shows the standard interface connector, with pin locations and numbers, and the line that connects to each pin.

Figure 3-4 shows the interface connections for both the 3872-DTE interface and the 3872-DAA interface. The ACO (automatic call origination) interface has a physical arrangement corresponding to that shown in Figure 3-3; the line names and functions are different. (See "Special Feature Descriptions".)

Figure 3-5 shows interface timings.

### USING MACHINE CONSIDERATIONS

The 3872 provides bit synchronization; the using DTE must frame characters. Other considerations are discussed in the following paragraphs.

#### New Sync Line

Use of the 'new sync' interface line by a multipoint control DTE permits the shortest clear-to-send delay (8.5ms) at the

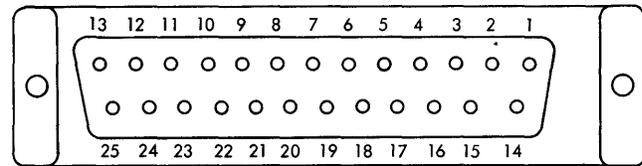
tributary modems. The 'new sync' pulse must be at least 1.0ms in duration. The maximum duration is not critical if it does not last more than 1.8ms after carrier begins to arrive from a tributary modem.

An up (on) level of 'new sync' forces 'data carrier detected' down (off). When 'new sync' returns to the down (off) level, receiving controls return to normal. If a received signal (carrier) is present when 'new sync' drops, the normal 'data carrier detected' delay starts. When the first data transition is sensed after the delay ends, 'data carrier detected' turns on (Figure 3-5), and the modem is synchronized.

When the DTE uses 'new sync', the new carrier and the previous carrier can overlap. The 'new sync' pulse must not end until the old carrier has disappeared at the receiving control station modem; this ensures that the modem will synchronize with the new carrier signal. During the time that two carriers are being received, and until the 'new sync' pulse occurs, there will be spurious transitions on the 'received data' interface line.

When 'new sync' is not provided by the DTE, the modem must recognize the loss of carrier. A high noise level (above threshold) could prevent the modem from synchronizing properly within 8.5 milliseconds. The 25ms clear-to-send delay must be specified at the tributary modems on a multi-point duplex channel, unless the control station DTE waits for 'data carrier detected' to drop, before polling another tributary station. For example, IBM 2845/2848 tributaries require the 8.5-millisecond clear-to-send delay.

Pin Locations



Note: This connection is also used in the ACO/DTE interface, and in the ACO or AA/DAA interface (Figure 3-4.)

Pin No.	NOMENCLATURE
Basic Modem	
1	Protective Ground
2	Transmitted Data
3	Received Data
4	Request-to-Send
5	Clear To Send (Ready for Sending)
6	Data Set Ready
7	Signal Ground
8	Data Carrier Detected (Received Line Signal Detector)
15	Transmitter Signal Element Timing
17	Receiver Signal Element Timing
18	Test
23	Data Signaling Rate Selector with Switched Network or Switched Network Backup Feature
11	Select Standby
20	Data Terminal Ready
22	Calling Indicator (Ring Indicator)

Note: CCITT designations are given in parentheses where they differ from EIA designations.

Figure 3-3. DTE Interface Connector

Connector Pin No.	EIA Designation and Name	CCITT Designation and Name
1	AA Protective Ground	101 Protective Ground
2	BA Transmitted Data	103 Transmitted Data
3	BB Received Data	104 Received Data
4	CA Request-to-Send	105 Request-to-Send
5	CB Clear-to-Send	106 Ready-for-Sending
6	CC Data Set Ready	107 Data Set Ready
7	AB Signal Ground	102 Signal Ground
8	CF Data Carrier Detected	109 Received Line Signal Detector
11	Select Standby*	116 Select Standby
14	New Sync*	
15	DB Transmit Signal Element Timing (DCE)	114 Transmitter Signal Element Timing (DCE)
17	DD Receive Signal Element Timing (DCE)	115 Receive Signal Element Timing (DCE)
18	CX Test (DTE)	Test*
20	CD Data Terminal Ready	108.2 Data Terminal Ready
22	CE Ring Indicator	125 Calling Indicator
23	CH Data Signal Rate Selector (DTE)	111 Data Signaling Rate Selector

\* Not designated by standards.

Figure 3-2. DTE Interface Designations

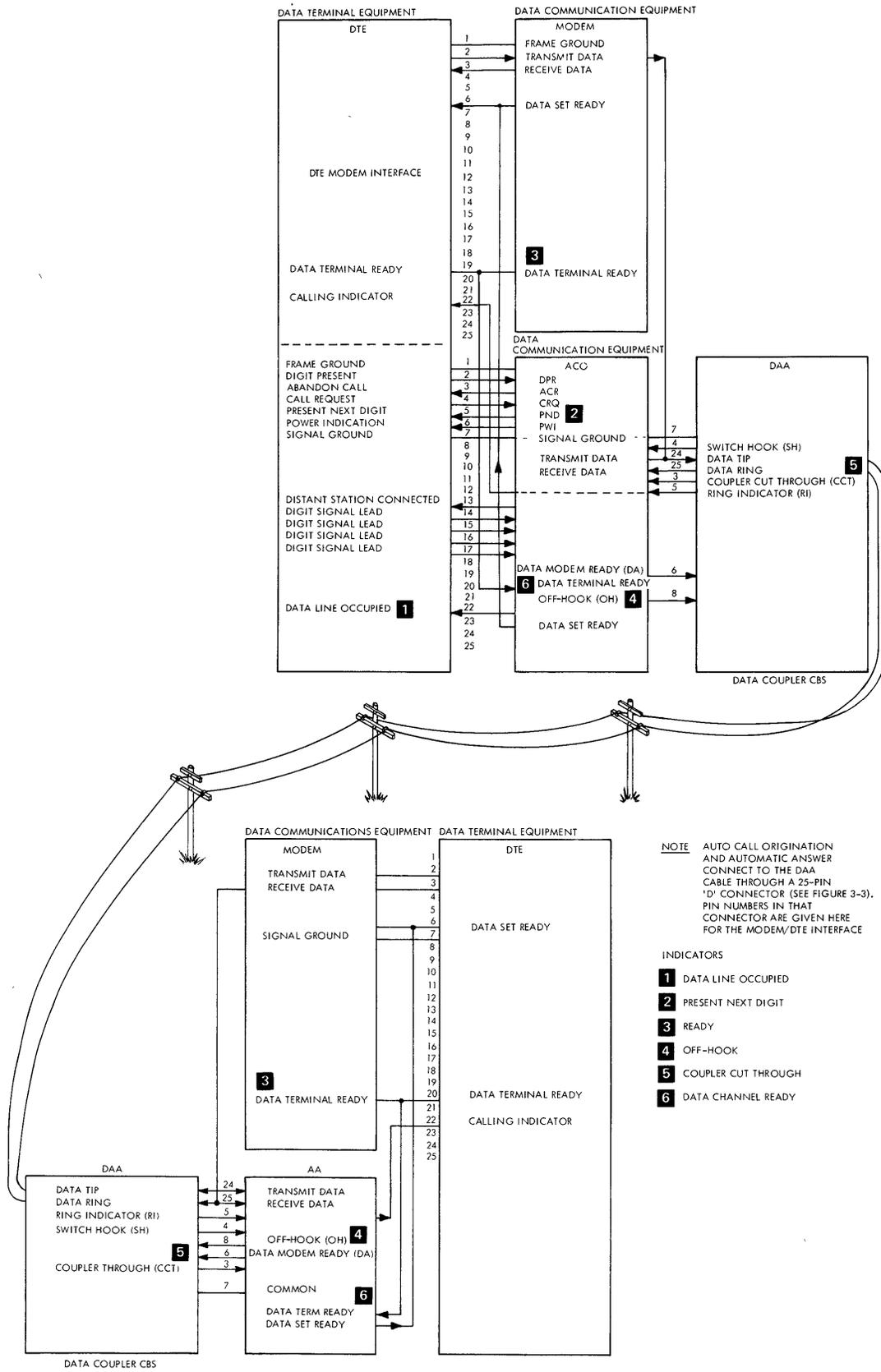


Figure 3-4. Modem and Feature Interface for Transmitting and Receiving Modems

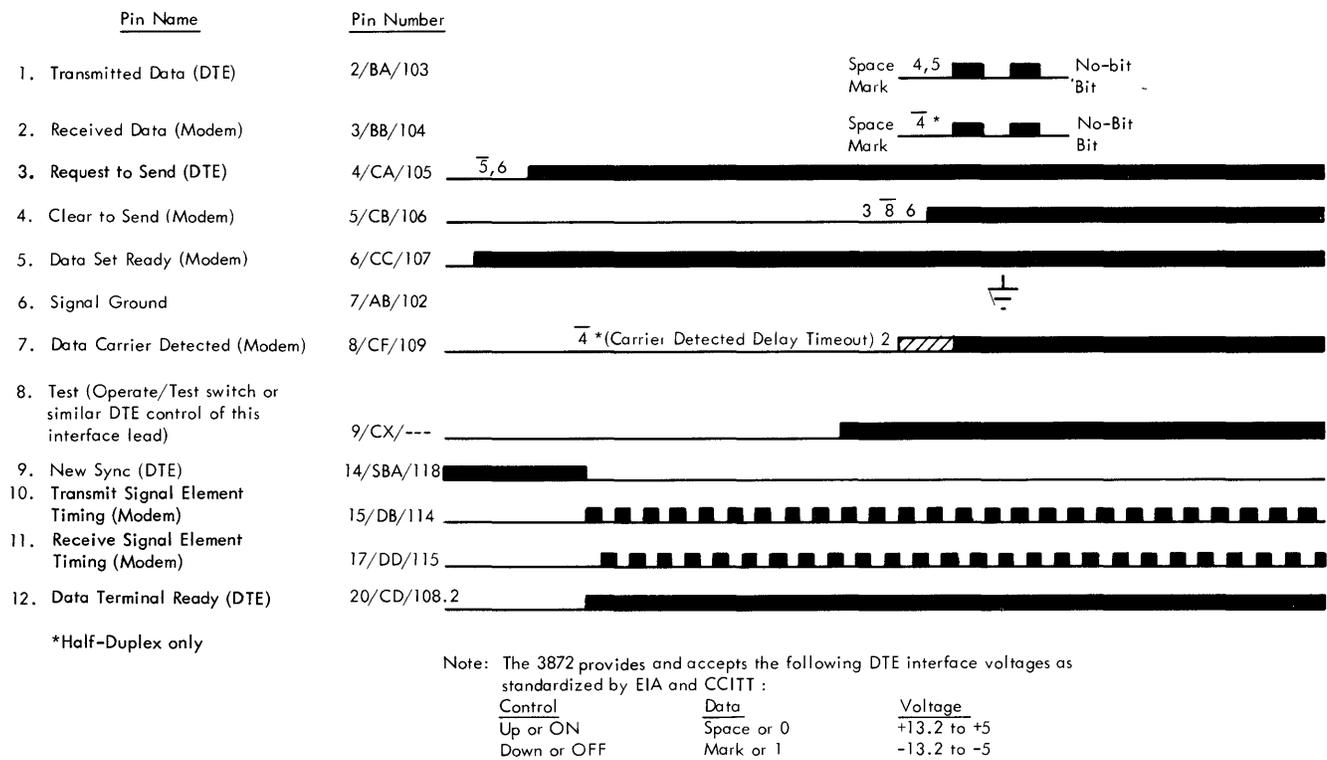


Figure 3-5. DTE-to-Modem Interface

### Test Line

This line from the DTE, when up (on), connects the attenuated modem transmit signal to the modem receiver. No signals are emitted onto the channel, nor are any received from the channel during this time. Data from the DTE on the 'transmitted data' line (after a modem propagation delay of approximately 3ms) appears on the modem 'received data' line. Error detection must be performed by the DTE. An absence of errors indicates that the modem is operating correctly.

### Data Set Ready Line

When the Test Operate switch is set to the TEST 2 position or when the 'test' interface line is up (on), the 3872 turns on (raises) 'data set ready'. This is an exception to EIA RS-232-C.

### Data Signal Rate Selector Line

This line from the DTE to the modem controls the rate of data transmission if the Mode switch is set to EXTERNAL. The speed selection for the transmitting and receiving modems must be the same, whether selected by the Mode switch or by this interface line. When 'data signal rate selector' is up (on), the transmitting rate is 2400 bps; when it is down (off), the rate is 1200 bps.

### Select Standby Line

If the 3872 Mode switch is set to EXTERNAL, the up (on) condition of this interface line from the DTE disconnects the modem from the dedicated facilities and connects it to the switched network facilities. (See "Modem-Data Terminal Equipment Interface", preceding.)

### Propagation through the Modem

Modem propagation time is the delay from the 'transmitted data' input of one modem to the 'received data' output of another modem when they are connected together, back-to-back. It includes propagation time through a transmitter and a receiver, and is about 3.0ms for the 3872 Modem.

### Spurious Bits

Spurious space indications may be experienced at times when 'received data' should be a mark. Abnormally high noise on the transmission line can prevent clamping or cause the modem to unclamp, thus resulting in spurious space indications.

Spurious bits, occurring when the carrier turns off, must be guarded against at the receiver within the DTE. The danger period starts at the time the transmitting modem begins to drop carrier until sometime after carrier disappears from the communications channel.

## USING MACHINE OPTIONS

### Clear-to-Send Delay

The 3872 clear-to-send delay has options of 8.5ms, 25.0ms, 75.0ms, and 150.0ms, nominally. The option is selected by strapping, as follows:

- 8.5ms - Used on multipoint tributary modems, on non-switched (leased) channels, when 'new sync' is used at the control station or when the control station DTE waits for the fall of carrier before polling another tributary. IBM 2845/2848 tributaries use 8.5ms.
- 25.0ms - Used on multipoint tributary modems, on non-switched (leased) channels, when 'new sync' is not used at the control station and polling is immediate.
- 75.0ms (110.0ms with Switched Network feature) - Provided for two-wire, half-duplex short lines in World Trade countries and, in individual cases on two-wire, half-duplex non-switched or switched network channels in the USA or Canada, where turnaround time is critical and communications facilities characteristics are suitable.
- 150.0ms (180.0ms with Switched Network feature) - Used on two-wire, half-duplex non-switched channels and for USA and Canadian switched network operation.

*Note 1:* On a 3872 with the Switched Network feature, or on a 3872 with the Switched Network Backup feature wired to operate with a remote 3872 having the Switched Network feature, the clear-to-send delay for the first transmission of each call in each direction is 1020ms.

*Note 2:* For clear-to-send delays of 25.0ms or longer, carrier is not turned on until 14.5ms after 'request to send' rises (is turned on).

### Data Carrier Detected and Echo Clamp Delays

Echo clamp is provided to prevent the reception of reflected data during turnaround, for operation on two-wire, non-switched channels or on the switched network. The echo clamp at the formerly transmitting modem is shorter than the clear-to-send delay at the newly transmitting modem.

*Note:* The switching of the 'data carrier detected' interface line from down (off) to up (on) does not occur at the expiration of the echo clamp delay. Instead, it occurs at the time of the first space-to-mark transition after the delay expires.

### Loss of Carrier (CD Bridge) Options

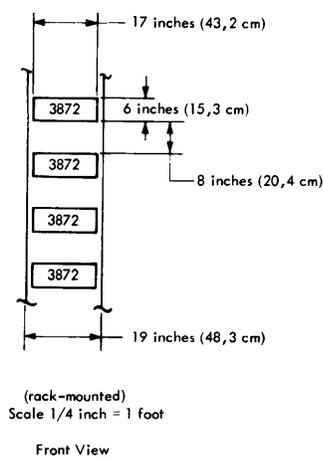
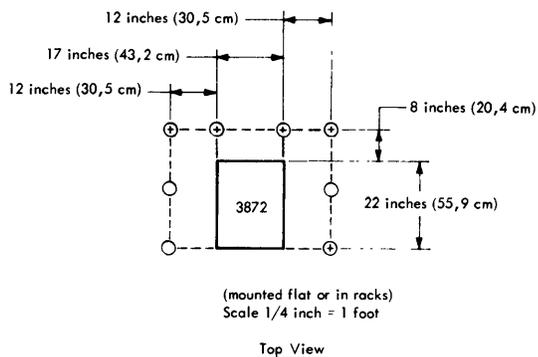
The response (to loss of carrier) of the 'data carrier detected' DTE interface line from a receiving 3872 is optional and is mainly a data system consideration. Option 1 provides maximum data recovery when loss of carrier is less than 8.5ms. Option 2 provides maximum data recovery for systems that may abort the message if 'data carrier detected' falls; this option maintains 'data carrier detected' (but clamps 'received data') when carrier loss is less than 8.5ms. Option 3 assumes that any loss of carrier will abort the message; this option is recommended and is factory-strapped, as it provides maximum accuracy and control of data transfer.

The options, selected by strapping, are as follows:

1. 'Data carrier detected' turns off (drops) 1.8 - 2.3ms after loss of carrier. If carrier resumes within 8.3ms, 'data carrier detected' turns on (rises) within 1.8 - 2.3ms. Otherwise, the normal delay occurs.
2. 'Data carrier detected' turns off (drops) more than 8.5ms after loss of carrier. If carrier resumes, the normal turn-on (rise) delay occurs. 'Received data' clamps to a mark level within 1.8 - 2.3ms after loss of carrier and is unclamped within 1.8 - 2.3ms, if carrier resumes within 8.5ms.
3. 'Data carrier detected' turns off (drops) 1.8 - 2.3ms after loss of carrier. If carrier resumes, the normal turn-on (rise) delay occurs. For 1200 bps operation, this option is automatically selected by the 3872, and the interval is 2.9 - 3.8ms.



IBM 3872 MODEM SPECIFICATIONS



Dimensions:

	Front	Side	Height
Inches	17	22	6
Centimeters	43,2	55,9	15,3

Service Clearances (mounted flat or in racks):

	Right	Left	Rear	Above (mounted in standard racks)
Inches	12	12	8	8
Centimeters	30,5	30,5	20,4	20,4

Weight (maximum): 57 lbs; (26 kg)

Heat Output: 185 Btu/hr (46.6 kcal/hr)

Air Flow: Natural convection only. A clearance of at least 2 inches (5,08 cm) is required at the sides and at the rear, for cooling.

Environment:

	Temperature (dry bulb)	Temperature (wet bulb)	Humidity
Power On	50 <sup>0</sup> –110 <sup>0</sup> F (10 <sup>0</sup> –43.3 <sup>0</sup> C)	85 <sup>0</sup> F (29.4 <sup>0</sup> C) max.	8%–80%
Power Off	50 <sup>0</sup> –125 <sup>0</sup> F (10 <sup>0</sup> –51.6 <sup>0</sup> C)	85 <sup>0</sup> F (29.4 <sup>0</sup> C) max.	8%–80%
Shipment	–40 <sup>0</sup> –140 <sup>0</sup> F (–40 <sup>0</sup> –60 <sup>0</sup> C)		5%–100%*

\*Condensation, not precipitation or immersion

Power Requirements:

	60 Hz	50 Hz
Volts	100, 115, 200, 208, or 230	100, 110, 123.5, 200, 220, or 235
kVA	0.06	0.06
Phase	1	1
Branch Circuit (amperes)	15	15 (maximum)

Nominal current (amperes): 0.67 at 115V

Power cord length: 8 ft. (2,432m) (Power cord only in World Trade countries, "skinned and tinned") (See Figure 3-5.1.)

**Power Cord (World Trade):**

3 AWG No. 18 conductors, 0.04 inches (0.1 cm) in diameter  
 0.374 inches (1.0 cm) outside diameter of the cable

**Power Cord Plug (USA only):**

	Nonlocking		Locking	
	115	208/230	115	208/230
Plug	5266	5666	4720	4570
Connector (in-line)	5269	5669	4730	4580
Connector (single)	5261	5661	4710	4563
Receptacle (duplex)	5262	5662	4700	4550

*Note:* All connectors are Hubbell or Pass & Seymour (or equivalent) except 5666, which is Hubbell (or equivalent).

**Cables and Plugs (see Figure 3-6):**

Cables from DTE are provided by the DTE supplier.

Each modem or ACO has a standard 25-pin receptacle to accept these cables.

Cables to line access are provided with the 3872 Modem Length is 10 ft (3,0m) unless a 15-, 20-, or 25-foot (4,6m, 6,1m, or 7,6m) option is specified.

Non-switched line or CDT Data Access Arrangement (or equivalent manual access arrangement) in USA—terminates in male plug, type 283B or equivalent (user must arrange with the channel supplier for receptacle 549A or 404B surface-mounted or 493A flush-mounted).

Non-switched channel in World Trade countries—terminates in spade lugs.

CBS Data Coupler (or equivalent automatic access arrangement) in USA (with ACO or AA)—terminates in spade lugs at DAA. Connects to 3872 by the standard 25-pin connector and receptacle.

*Note:* It is the customer's responsibility to have the cable to the communications facilities connected to the CBS Data Coupler (or equivalent), when the 3872 has automatic answering or the Automatic Call Origination feature. Figure 3-6 shows the proper connections.

**Exclusions:**

1. The 3872 does not have a convenience outlet.
2. Marginal checking is not provided and should not be attempted.
3. Rack mounting is the customer's responsibility. Mounting hardware is not provided with the 3872.

**COMMUNICATIONS CHANNEL SPECIFICATIONS**

With non-switched voice-grade channel service, the 3872 Modem requires a communications channel of FCC Tariff 260-type 3002 channel with C1 conditioning. In addition, the characteristics of the required channel include those specified in the Bell System administrative guidelines, as described in Bell System Data Communications Technical Reference PUB41004, *Transmission Specifications for Voice Grade Private Line Data Channels* (March 1969). Duplex or half-duplex operation and two-wire or four-wire connection must be stipulated.

The 3872 is also designed to operate on public switched network channels in the USA and Canada. The characteristics of a switched network channel in the USA are described in Bell System Data Communications Technical Reference PUB41005, *Data Communications Using The Switched Telecommunications Network* (May 1971). Refer to the notice "To The Reader", at the front of this manual, for the address from which these publications may be obtained.

*Note:* It is possible that the common carrier will not warrant data communications through PBX (Private Branch Exchange; do not confuse with Centrex) facilities. Check with the facility supplier.

Duplex switched network data channels are available in some parts of the USA, Canada, and France. The 3872 Modem can presently be equipped for this type of channel only in France. See Appendix A for French Caducee facilities.

With conventional switched network facilities, the local drop procured from the common carrier should be specified for greater than 300bps operation. The DAA (data access arrangement) is procured separately; it includes a telephone set and is marked with the proper transmit level.

**MODEM CHARACTERISTICS SIGNIFICANT TO THE COMMUNICATIONS CHANNEL SUPPLIER**

Input or output impedance—600 ohms

Modulation technique—four-phase differential phase shift keying (DPSK).

Receiver sensitivity threshold (strapping option)—On at -40dBm or -27dBm (+1dBm)  
 Off at -43dBm or -30dBm

*Note:* The receive threshold of dedicated-channel machines (except with SNBU) is strapped at -27 dBm at the time of manufacturing. If net line loss may cause the received signal to fall below that level, request the 3872 serviceman to change the threshold to -40 dBm.

Transmit Level—for data, 0dBm, variable by strapping in 1dB steps to -15dBm; for answer tone, 0dBm, variable by strapping in 1dB steps to -15dBm.

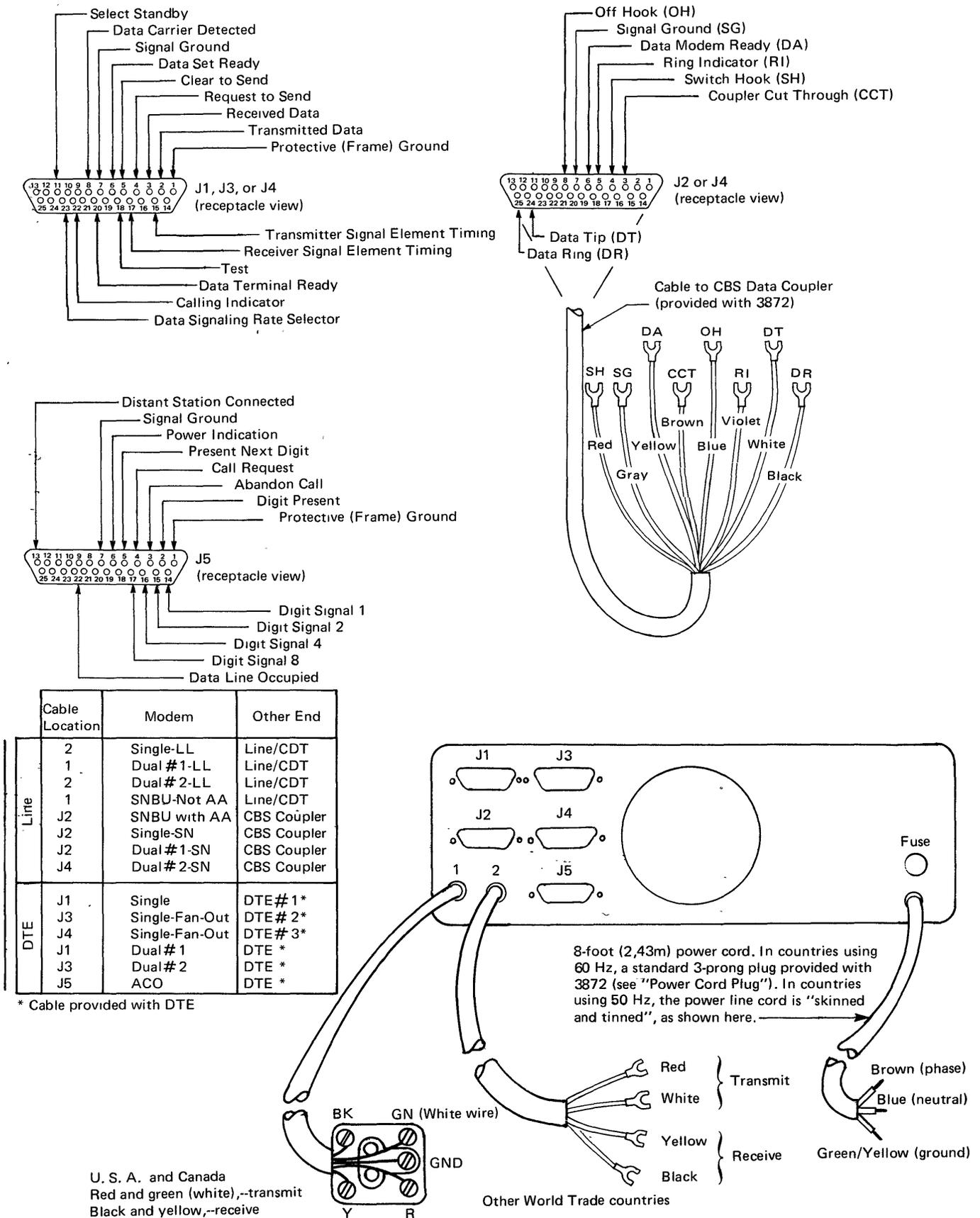


Figure 3-6 External Cables and Cable Receptacles (3872 Rear Panel)

*Note:* Transmit level in the USA and Canada for common-carrier dedicated lines is 0dBm. In other cases, transmit level is specified by the communications facilities supplier. In the USA, switched network transmit level is individually marked on the DAA.

Automatic Coupler - a CBS-type coupler is required with switched facilities when the 3872 has the Switched Network feature, the ACO feature, or the SNBU-AA feature. Among coupler options that may be offered, these are required:

1. Line controlled by coupler, and
2. Ringer on line side.

### **STRAPPING OPTIONS**

Refer to "Modem Characteristics Significant to the Communications Facilities Supplier" and to "Using Machine Options" under "Interface", preceding, for strapping options not described here.

Dialing signals (ACO)—pulse mode; consult the common carrier about applicability.

Automatic Call Delay - strapping provides options of 20, 40 or 60 seconds for an automatically originated call to be answered.

Blind Dial - this strap replaces recognition of dial tone with a 3.2-second delay. Dialing proceeds when the delay times out.

EON - this strap adds recognition of the EON dial character. The use of EON is recommended for reliable operation, but is not supported by IBM programs at this time.

Two-wire/Four-wire - adapts the modem to the selected communications channel service. Switched network is typically two-wire, half-duplex; multipoint is always four-wire duplex. Point-to-point dedicated configurations have three options: two-wire half-duplex, four-wire half-duplex, and four-wire duplex. Each succeeding facilities option has a shorter turnaround and a higher throughput.

This part of the manual describes the special features available with the IBM 3872 Modem (Figure 3-7). The basic modem (without features) is a multipoint control station modem. The features provide different modem configurations and added functions. See "Operations" in Part 2 for 3872 special feature controlling switches and operation procedures.

### SECOND MODEM FEATURE

This feature (not field installable) allows the housing of two modems in the same cabinet and offers savings in space and cost. The two modems share the power supply, cooling, and covers. Neither modem can have automatic call origination or switched network backup.

### POINT-TO-POINT FEATURE

This feature equips the 3872 Modem for point-to-point operation on a dedicated voice-grade channel. A 3872 Modem with this feature is characterized by receiver equalization. The basic modem is otherwise unaltered and can be strapped for duplex or half-duplex operation.

### MULTIPOINT TRIBUTARY FEATURE

This feature equips the 3872 Modem for centralized multipoint tributary operation on a dedicated duplex voice-grade channel. Both the receiver and the transmitter have equalizers.

### SWITCHED NETWORK FEATURE

This feature equips the 3872 Modem to operate with the common-carrier DAA (data access arrangement), and to automatically answer incoming switched network calls (Figure 3-8). The Switched Network feature also provides automatic receiver equalization at the beginning of each switched network connection. (The delay for automatic equalization occurs only on the first transmission, in each direction, after a switched network connection has been established.) The DTE can disconnect an automatically answered call automatically (without operator intervention).

#### Communications Channel Interface (Automatic Access Arrangement)

The interface lines to the DAA (Figure 3-9) are as follows:

- 'Data tip' and 'data ring' - These lines are equivalent to the two-wire connection to a dedicated channel. Modulated carrier is transmitted or received by these two lines,

as is the 3.5-second, 2100Hz tone sent by the modem when it automatically answers an incoming call.

- 'Ring indicator' - The DAA raises (turns on) this line to the modem during the time the ringing signal is present on the line.
- 'Switch hook' - The DAA raises (turns on) this line to the modem when the telephone handset attached to the DAA is not cradled.
- 'Coupler cut through' - The DAA raises (turns on) this line when 'data tip' and 'data ring' can accept signals from the modem.
- 'Data modem ready' - This line is up (on) when the modem and automatic answering circuits have power and are ready to use 'data tip' and 'data ring'.

*Note:* If 'data modem ready' is not up, and an incoming call causes the telephone on the DAA to ring, the call can be answered manually.

- 'Off hook' - The modem raises (turns on) this line to answer an incoming call and to hold a switched network connection. The modem drops (turns off) this line, to disconnect from the switched network.

#### DTE Interface (Automatic Access Arrangement)

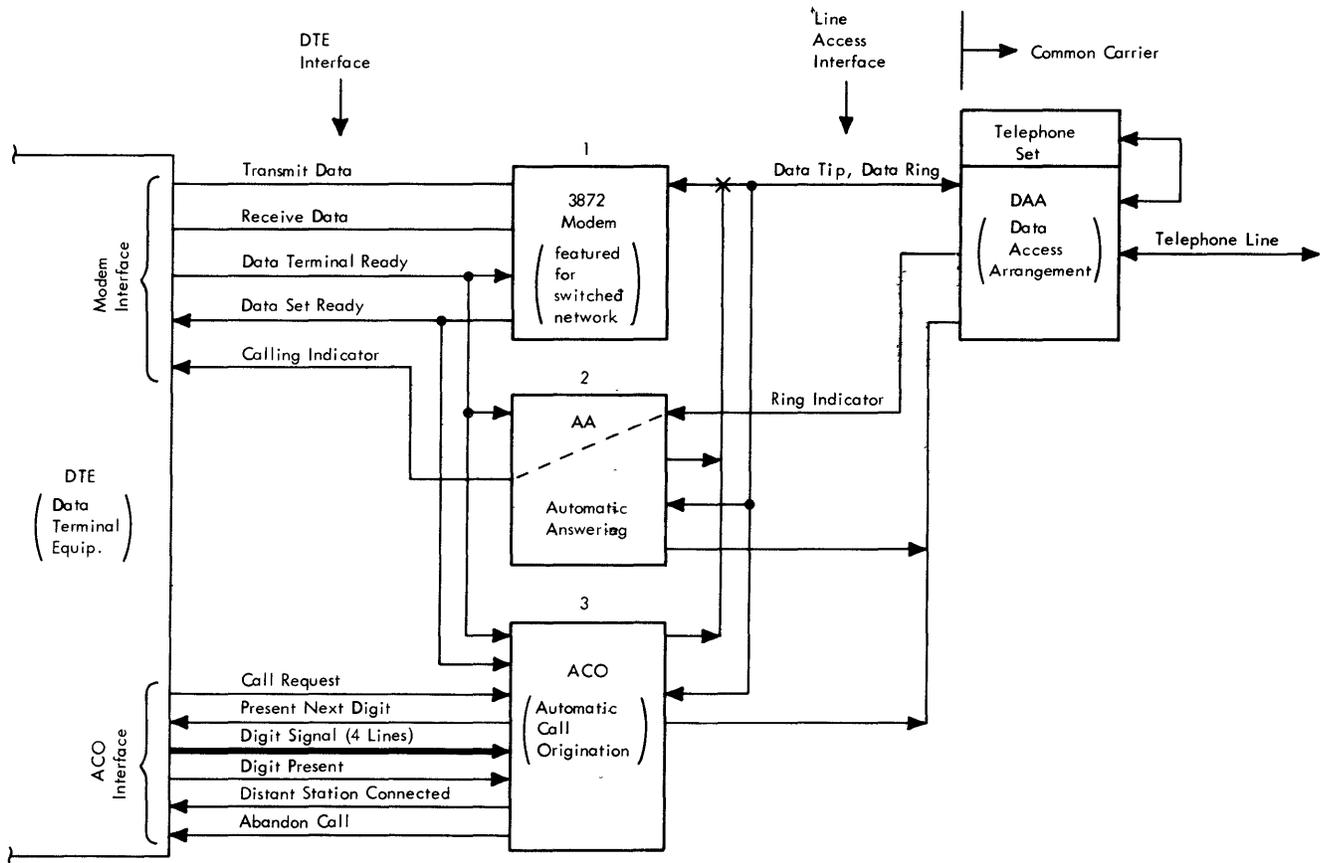
The interface lines between the modem and the DTE operate with the switched network as follows:

- 'Data set ready' - In addition to the conditions of power-on, not local test mode, and not talk mode, the switched network modem requires 'coupler cut through' from the DAA before it raises 'data set ready'. The meaning is the same: the communications channel is ready to use.
- 'Data terminal ready' - The DTE raises (turns on) this interface line to allow the modem to use the communications channel. 'Data terminal ready' up (on) makes it possible for the modem to raise (turn on) 'off hook' to the DAA, and causes the modem to drop 'off hook' when 'data terminal ready' goes down. (*Note:* 'Data terminal ready' must be dropped to terminate toll charges and raised again to allow automatic answering.) When the DTE disconnects, 'data terminal ready' must remain down until 'data set ready' drops.
- 'Calling indicator' - This line, when up (on), alerts the DTE that the modem is receiving a 'ring indicator' signal from the DAA.
- The following DTE interface lines function as described in "Modem-Data Terminal Equipment Interface", preceding: 'transmitted data', 'transmit signal element timing', 'received data', 'receive signal element timing', 'request to send', 'clear to send', 'data carrier detected', 'data signal rate selector', 'test', 'signal ground', and 'protective ground'.

Feature	Feature Characteristics	Feature Qualifications
Second Modem	Two modems (any combination of point-to-point, multipoint, or switched network) in one cabinet.	Excludes switched network backup and automatic call origination on both modems.
Point-To-Point	Receiver equalization.	Dedicated line.
Multipoint Tributary	Transmitter and receiver equalization.	Dedicated line.
Switched Network	Manual calling, automatic answering. Automatic receiver equalization requires 1020 ms clear-to-send delay for first transmission, 185 ms thereafter. Generates 3.5-second 2100 Hz answer tone.	Excludes point-to-point and multipoint. Special arrangement in WT countries.
Switched Network Backup	Manual calling, manual answering. Receiver equalization, requires 150 ms clear-to-send delay.	Excludes Second Modem feature. Special arrangement in WT countries. See Appendix C for planning and operating considerations.
Automatic Answering with Switched Network Backup	Makes unattended operation of DTE possible on switched network. Generates 3.5-second 2100 Hz answer tone.	Special feature only with switched network backup, standard with Switched Network feature.
Automatic Call Origination on Switched Network	Two cables to DTE. Demand--response parallel transfer of dial digits. Calls are programmed by DTE. Includes automatic answering and 3.5-second 2100 Hz answer tone.	Requires switched network, excludes Second Modem feature, requires automatic answering at called stations. EON option is not supported by IBM programs at this time.
Direct Line Attachment	Line isolation transformer, one for 2-wire, two for 4-wire modem.	Presently required in some WT countries.
Alternate Voice	Visual and audible signaling and voice communication.	Requires a dedicated communications channel. Telephone handset is not provided.
Fan-Out	Allows up to three DTEs to use one 3872 Modem (one at a time).	Excludes Second Modem and Switched Network features. Requires multipoint programming for DTE addresses.

Configurations	Special Features							
	Adjustable Equalizer	Automatic Equalizer	Automatic Answering	Switched Network Backup	Automatic Call Origination	Direct Attachment (WT only)	Alternate Voice	Fan-Out
M-P Ctrl (Basic)	-	-	-	X	-	X	X	X
M-P Trib. (Feature)	T/R	-	-	X	-	X	X	X
P-P (Feature)	R	-	-	X	-	X	X	X
Sw. Network (Feature)	-	R	T/R	-	X	-	-	-

Figure 3-7. Special Feature Characteristics and Qualifications



Notes:

- a. Many interface lines are not shown on this diagram. See Figure 3-2.
- b. Item 2 (AA) on a switched network 3872 is a special feature only with switched network backup. However, it is always functionally identifiable.
- c. Items 2 (AA) and 3 (ACO) do not allow the modem use of the line until an incoming call or an automatic outgoing call is answered.

Figure 3-8. Feature Outline, Switched Network Modem

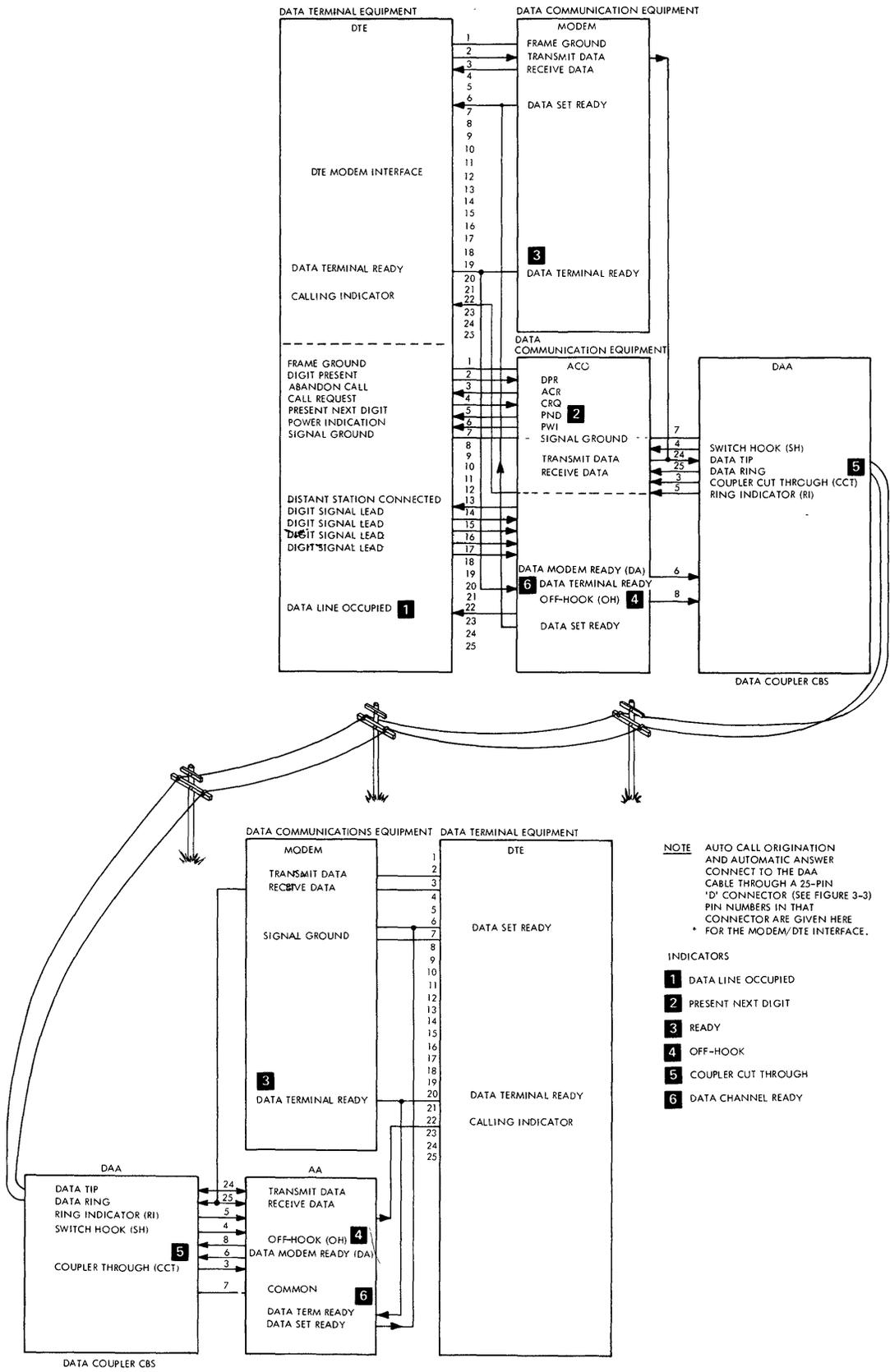


Figure 3-9. Modem Features and Interfaces for Automatic Call Origination and Automatic Answering

**Operation**

When a switched network connection has been made ('coupler cut through' and 'data set ready' are up), modem operation is point-to-point, half-duplex. This section describes procedures used to establish the switched network connection, to transfer the use of the line to the modem, and to disconnect from the switched network.

To manually place a data call on the switched network, the DTE operator uses the telephone set attached to the DAA. Assuming that the called station will answer automatically, the calling operator waits for the answer tone to end and cradles the telephone (thus transferring the line to the modem).

At the called station, the modem senses the ringing on the line, goes off-hook, generates the answer tone and becomes ready, and transfers the channel to the answering modem. The modem receivers are equalized automatically, and the channel then becomes available for use by the DTEs.

After data transfer, both stations "hang up the phone" (go on-hook) to disconnect from the switched network. Going on-hook can be automatic at either or both stations.

Conventionally, the calling station transmits first and the called station receives. Figure 3-10 illustrates the placing of the call, the transfer of the line to the modems, the automatic equalization of the modems, the transfer of data, and the automatic disconnecting of the call. Reversals of trans-

mission are the same as point-to-point, half-duplex. (See "Operating Sequences" in Part 1.)

**SWITCHED NETWORK BACKUP FEATURE**

This feature equips the 3872 Modem configured for dedicated channel operation with a backup switched network data communication capability. Calls are made or answered manually. With this feature, switched network service must be obtained from the common carrier (including an access arrangement with a telephone set) in addition to the dedicated line service. The data system must provide optional switched network access at the remote location, and procedures for standby changeover must be established (see Appendix C). This feature excludes the Second Modem feature.

Compatibility with the Switched Network feature on the remote 3872 requires a 2.5-second delay before the first transmission of each call.

Operation of the Switched Network Backup feature is identical to that described in "Switched Network, Manual Call, Manual Answer Sequences". (See "Operating Sequences" in Part 1.)

**SWITCHED NETWORK BACKUP WITH AUTOMATIC ANSWERING FEATURE**

This feature equips a modem using the Switched Network Backup feature to automatically answer incoming calls. Depending upon the DTE and the data system, unattended

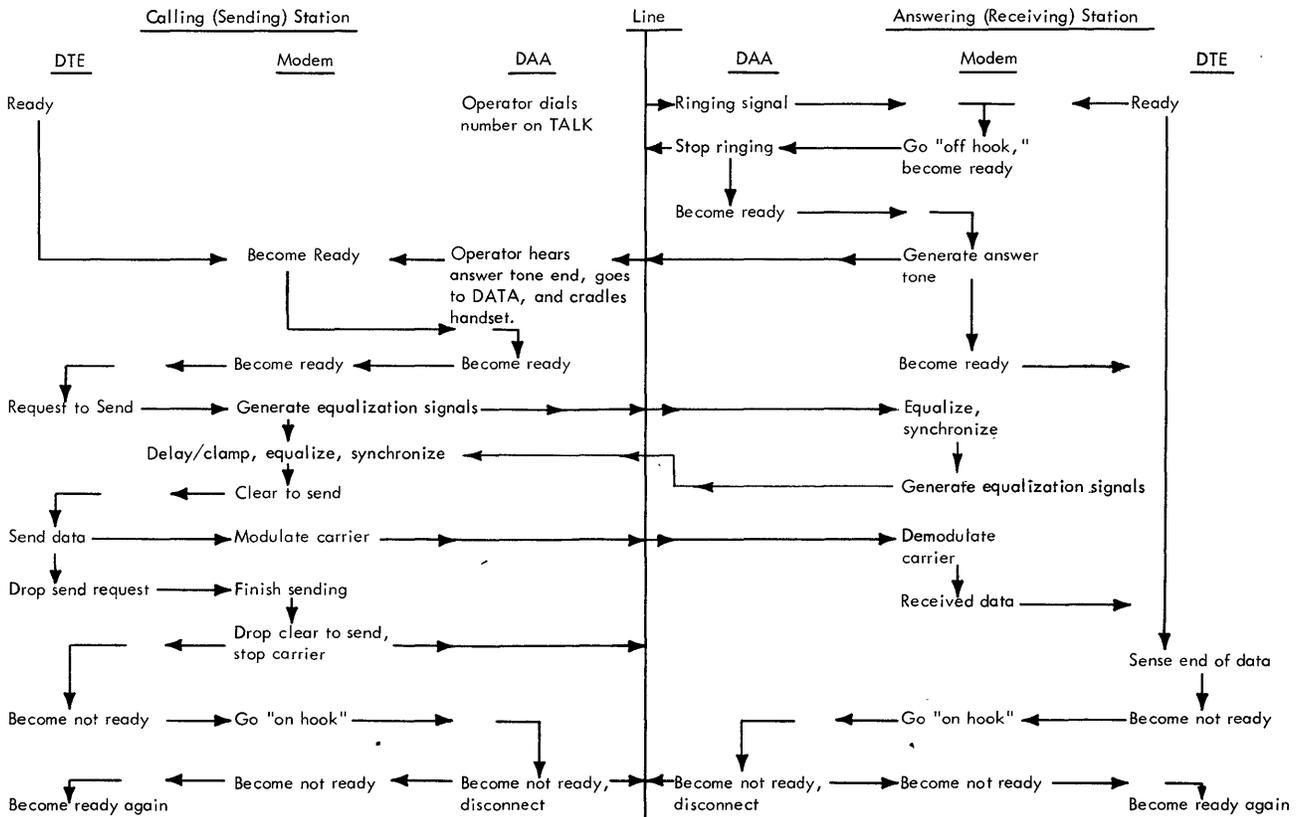


Figure 3-10. Manual Call, Automatic Answering (Switched Network)

operation may be possible. The interface and operation of the Switched Network Backup feature with automatic answering are identical to those of the Switched Network feature (Figures 3-8, 3-9, and 3-10). Refer to “Switched Network Feature”, preceding, and to Appendix C.

### **AUTOMATIC CALL ORIGATION ON SWITCHED NETWORK FEATURE**

This feature, on a switched network modem, makes possible programmed, automatic calling of other stations on the switched network. Called stations must be equipped for automatic answering. The Switched Network feature includes automatic answering, so the addition of the Automatic Call Origination (ACO) feature completely automates the making or answering of routine data calls. The Automatic Call Origination feature excludes the Second Modem feature.

The DTE and the data system deal directly with the ACO feature (Figure 3-8), passing dialing digits to it in parallel, on a demand-response basis. Programming considerations (Figure 3-11) include requesting that a call be made, transferring the dial digits in parallel, re-dialing calls that fail to be completed, and use of the optional SEP and EON dial digits. Data transfer goes from parallel to serial when the call is connected. Excessive error rates must be detected by the DTE and the data system, followed by re-dialing for a better connection.

the same channel access interface as the switched network modem. The DTE interface has two parts with ACO (Figure 3-9); one part is the same as for switched network (see “Switched Network Feature”, preceding). The second part is added for automatic call origination and is described in this section.

#### **Communications Channel Interface (Automatic Access Arrangement)**

- ‘Data tip’ and ‘data ring’ - Modulated carrier is transmitted or received by these two lines, as is the 3.5-second, 2100Hz tone sent by a modem when it automatically answers an incoming call. The ACO feature uses these lines to detect dial tone and to detect the answer tone that indicates completion of an automatically placed call.
- ‘Ring indicator’ - The DAA raises (turns on) this line to the modem during the time that the ringing signal is present on the channel.
- ‘Switch hook’ - The DAA raises (turns on) this line when the telephone handset attached to the DAA is not cradled
- ‘Coupler cut through’ - The DAA raises (turns on) this line when ‘data tip’ and ‘data ring’ are ready to accept signals from the modem. This line is up (on) during a dial tone or answer tone and down (off) during dial pulsing.
- ‘Data modem ready’ - Normally up (on), this line is dropped by the ACO feature during dial pulsing. ‘Data

modem ready’ is raised again in expectation of an answer tone from the called station. This action requests use of the channel for serial data communication.

- ‘Off hook’ - The modem raises (turns on) this line to answer ringing on the channel and to hold a switched network connection. The ACO feature raises (turns on) this line to sense dial tone on ‘data tip’ and ‘data ring’, then pulses this line off and on, repeatedly, to dial each digit. The modem holds ‘off hook’ up to hold a completed connection and drops it (turns it off) to disconnect.

#### **DTE Interface (Automatic Access Arrangement)**

The DTE interface to the ACO feature (Figure 3-9) is described here; the DTE interface to the switched network host modem is described under “Switched Network Feature”

- ‘Power indicator’ - The ACO feature has power on when this line is up (on).
- ‘Data terminal ready’ - The DTE raises (turns on) this line to the modem (and to the ACO feature) to signify that the modem may be allowed to use the channel. When disconnecting a call (by dropping ‘data terminal ready’), the DTE must wait for ‘data set ready’ and ‘data line occupied’ to drop before raising ‘data terminal ready’ again.
- ‘Data set ready’ - The modem does not raise this interface line to the DTE until the DAA gives the modem use of ‘data tip’ and ‘data ring’. An up (on) condition indicates to the DTE that the call is connected and that the modem has use of the channel. ‘Data terminal ready’, dropped to disconnect, must not be raised again until ‘data set ready’ and ‘data line occupied’ have dropped (channel is disconnected).
- ‘Call request’ - The DTE raises (turns on) this line to cause the ACO feature to control the DAA for automatic calling purposes. ‘Call request’ may be dropped (turned off) after ‘data set ready’ rises, and *must* be dropped (turned off) between calls or attempted calls. ‘Call request’ must not be raised (turned on) if ‘data line occupied’ is already up (on).
- ‘Data line occupied’ - The ACO feature raises (turns on) this line in the process of making a call. ‘Data line occupied’ does not drop (turn off) until 1.5 seconds after the call is disconnected by the DTE.
- ‘Present next digit’ - The ACO feature raises (turns on) this line to request a four-bit parallel character on the ‘digit signal’ lines. ‘Present next digit’ drops (turns off) when the ACO feature has completed pulsing the digit to the DAA.
- ‘Digit signal’ and ‘digit present’ (Figures 3-8 and 3-9) - In response to ‘present next digit’, the DTE raises (turns on) the appropriate combination of the four ‘digit signal’ lines (Figure 3-11), then raises (turns on) ‘digit present’ to transfer the dial digit to the ACO feature. When the digit

has been pulsed to the DAA, the ACO feature drops (turns off) 'present next digit'. The DTE must immediately drop (turn off) the 'digit signal' and 'digit present' lines.

*Note:* The use of EON is not supported by IBM programs at this time. If EON (end of number) is not used, 'present next digit' is raised by the modem and remains up after the DTE has transferred the last digit of the telephone number. It drops when the answer tone is received, or when the modem times out.

- 'Distant station connected' - The ACO feature raises (turns on) this line when the distant modem's 3.5-second, 2100Hz answer tone has stopped. 'Data set ready' is up and the calling modem has the use of 'data tip' and 'data ring' when 'distant station connected' is up. 'Distant station connected' stays up until the DTE initiates a disconnect.
- 'Abandon call' - The ACO feature raises (turns on) this line momentarily when dialing fails to result in a switched network connection to an answering station. Only another dial digit within 20 seconds (with EON) or an answered call inhibits this line. Optional time allowances for an answer tone or another dial digit (without EON), or an answered call, are: 20, 40, or 60 seconds. If an invalid digit is transferred from the DTE, or if a call rings in, 'abandon call' rises immediately. 'Call request' should be dropped by the DTE when 'abandon call' drops.

### Operation

An automatically originated switched network connection operates like any other switched network connection (see "Switched Network Feature", preceding), and there is no difference at the automatically answering station. The unique operation with the Automatic Call Origination (ACO) feature is the actual making of the call.

To automatically place a data call on the switched network, the DTE uses the interface to the ACO feature. When the called station answers, the modem uses the channel for serial data communications. At that point, the function of automatic call origination is complete.

The process of automatic call origination (Figure 3-12) modifies the meanings of 'data modem ready' and 'off hook' to the DAA. 'Data modem ready' not on (down) identifies a dialing interval, during which the dropping and raising of 'off hook' is a dialing pulse rather than a disconnect signal.

When the distant station answers, the modem becomes ready to the DTE. The call is connected when the ACO feature raises 'distant station connected' to the DTE and 'data modem ready' to the DAA. 'Call request' can then be dropped and 'request to send' can be raised by the DTE.

### DIRECT LINE ATTACHMENT FEATURE (WORLD TRADE COUNTRIES)

This feature provides a transformer for each channel connected to the modem. Two-wire modems require one trans-

former; four-wire modems require two transformers. The Direct Line Attachment feature must be used in certain World Trade countries (especially the United Kingdom) for isolation of the modem from the communications channel.

### ALTERNATE VOICE FEATURE

The Alternate Voice feature provides facilities for voice communication and audible line monitoring between 3872 Modems equipped for dedicated communications channel operation. This feature, in most cases, eliminates any need for separate toll calls. Voice communication interrupts data communications.

Both modems must have the Alternate Voice feature. This feature is available for single modems and for either or both modems of a dual modem. See Part 2 of this manual for calling and answering procedures.

A telephone handset (user-provided) plugs into the 3872 VOICE jack on the front panel; the CALL switch (momentary) signals the remote end. The telephone handset used with the 3872 Alternate Voice feature may be of any common-carrier or PTT-approved type with the following characteristics: (a) carbon microphone, (b) conventional electromagnetic receiver, and (c) three-wire connection (microphone, receiver, and common).

The following handsets (or equivalents) are suitable:

Automatic Electric, Type 811  
Stromberg-Carlson, Type S-C G-3

*Note:* The transmitter does not discriminate between room noise and voice, nor between talking and listening; locally transmitted room noise can interfere with voice reception on two-wire lines. If it is necessary (because of the room noise level at a station on a two-wire line) to avoid this kind of interference, use a "push-to-talk" handset. The following "push-to-talk" handsets (or equivalent) are suitable:

Automatic Electric, Type 841  
Stromberg-Carlson, Type S-C G-5

These handsets come without plugs; the correct plug is provided with the Alternate Voice feature. Figure 3-13 illustrates the correct connections of the handset cord to the plug.

### FAN-OUT FEATURE

The DTE interface with the Fan-Out feature conforms to the description given earlier. Operation of the two or three attached DTEs as multipoint tributary stations provides the line control discipline necessary for efficient operation; that is:

- All tributary DTEs (maximum of three) are connected to all interface lines, and all must monitor 'received data'.
- Only one tributary DTE may have 'request to send' active. (The 'request to send' lines have no priority order and are not interlocked.)

	1	2	3	4	5	6	7	8	9	0	(Note 1) EON SEP	
Dial Digit (pin 17)	0	0	0	0	0	0	0	1	1	0	1	1
Dial Digit (pin 16)	0	0	0	1	1	1	1	0	0	0	1	1
Dial Digit (pin 15)	0	1	1	0	0	1	1	0	0	0	0	0
Dial Digit (pin 14)	1	0	1	0	1	0	1	0	1	0	0	1

(Note 2)

**Note 1:** The use of EON (end of number), a strapping option, is recommended for reliable operation, but is not supported by IBM programs at this time. When used, EON and SEP are transferred in the same way as dial digits. SEP indicated a pause, such as the wait for a second dial tone when dialing for an outside line. EON indicates that all dial digits have been transferred.

**Note 2:** The pin numbers are in the ACO interface connector to the DTE.

**Note 3:** The digit dialing time ranges from approximately 0.9 seconds to 1.8 seconds.

A. Dial Digit Format

*Call Request	Data Set Ready	Data Line Occupied	Data Terminal Ready	Request to Send	Present Next Digit	Digit Signal	Digit Present	Abandon Call
<u>RAISE</u>	Must be down	Must be down						
<u>DROP</u>	Must be up			<u>RAISE</u>				
	Must be down		<u>RAISE</u>		Rises	Is down	Is down	
					Must be up	Must be up	<u>RAISE</u>	
					Drops	<u>MUST DROP</u>	<u>MUST DROP</u>	
					Is up	Invalid	** Not raised in 20 sec.	Rises
<u>MUST DROP</u>								Drops

\* Call Request must be dropped and raised again between calls or call attempts.

\*\* With EON or with the 20-second answer delay option. Without EON, the inter-digit time allowance is the same as the 20-, 40-, or 60-second answer time allowance.

Note: DTE interface actions are in capital letters and underlined.

B. ACO Interface Restrictions on DTE Actions

Figure 3-11. DTE Considerations for Automatic Call Origination

- 'Clear to send' is returned only to the tributary DTE that raised 'request to send'. 'Transmitted data' is accepted only from that DTE.

Figure 3-14 illustrates some of the potential of the Fan-Out feature. In examples A, B, and C, the throughput expected from multipoint operation requires four-wire, duplex communications channel facilities and appropriate strapping in the 3872 Modems.

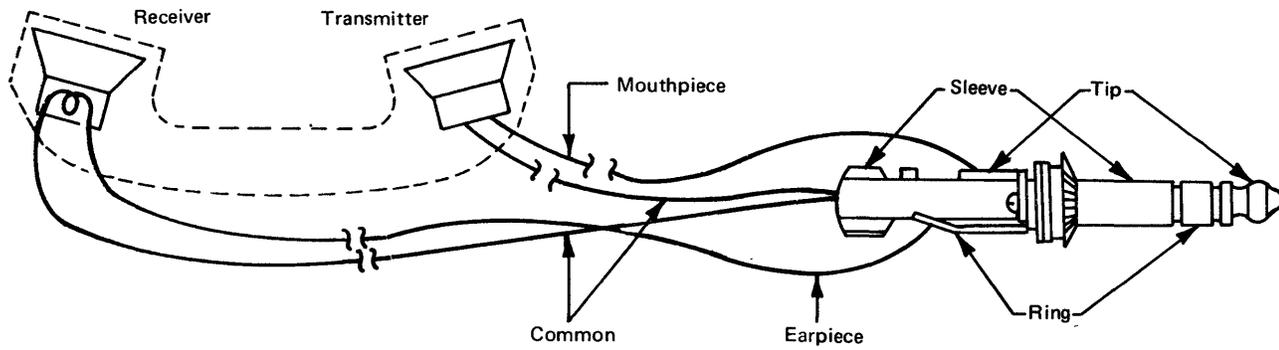
In example D, two-wire, half-duplex, dedicated channel facilities are recommended to simplify the changeover to

SNBU operation (see Appendix C); disconnecting in the SNBU operation must be manual, to prevent interference between the tributary 'data terminal ready' lines. Disconnect SNBU with manual answering by cradling the CDT handset; disconnect SNBU with automatic answering by momentarily setting the Talk/Data switch to TALK.

Only example A is a limiting case. In example C, the remainder of the configuration may be point-to-point or multipoint (with or without Fan-Out features installed at the tributary stations).



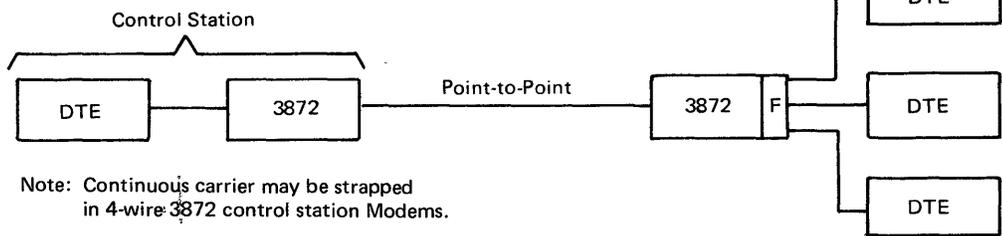
Figure 3-12. Automatic Call, Automatic Answer (Switched Network)



**Note:** Refer to the manufacture's instructions for the color coding of connecting wires.

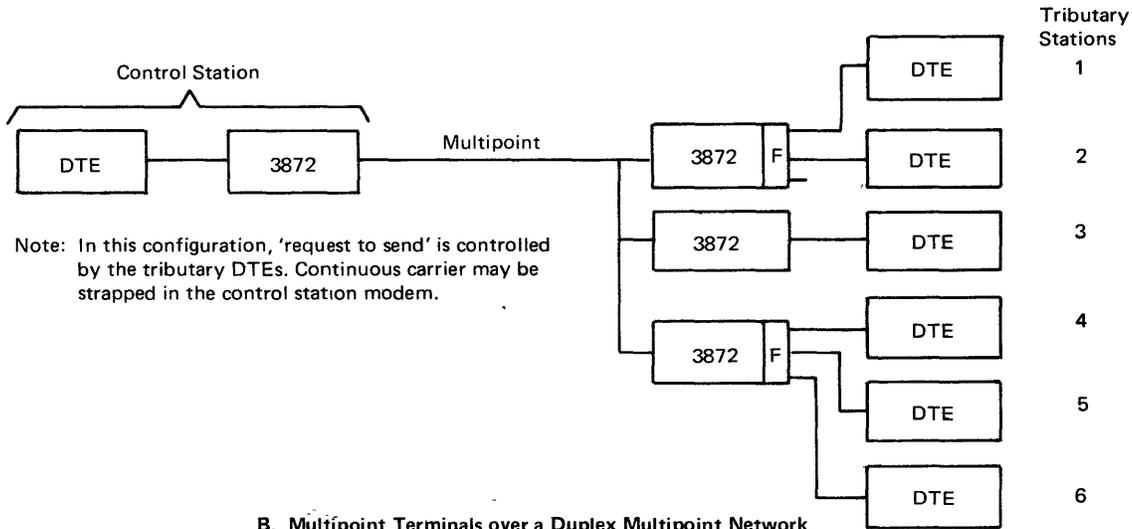
Figure 3-13. Handset Plug Connections

**Legend:** F = Fan-Out Feature  
 --- = SNBU  
 D = Dual Interface



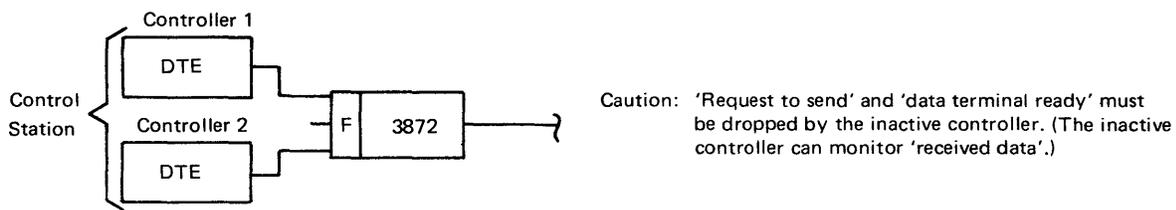
Note: Continuous carrier may be strapped in 4-wire 3872 control station Modems.

**A. Multipoint Terminals over a Point-to-Point Line**

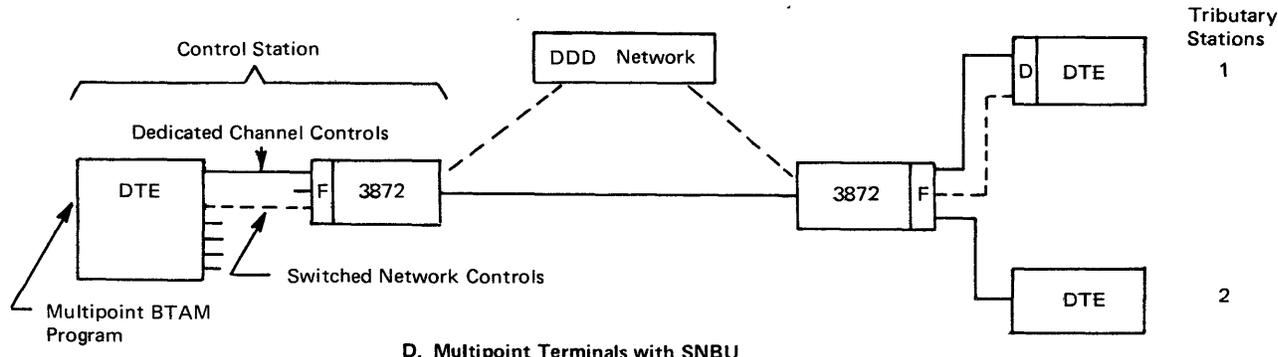


Note: In this configuration, 'request to send' is controlled by the tributary DTEs. Continuous carrier may be strapped in the control station modem.

**B. Multipoint Terminals over a Duplex Multipoint Network**



**C. Fan-Out Feature at Control Station**



**D. Multipoint Terminals with SNBU**

Figure 3-14. Sample Fan-Out Configurations



## Part 4. Appendixes



### CHANNEL SPECIFICATIONS

The 3872 requires a communications channel having characteristics of FCC Tariff 260-type 3002 channel with C1 conditioning. In addition, the specifications implied by Bell System administrative instructions are required. These specifications are described in Bell System Data Communications Technical Reference PUB41004, *Transmission Specifications for Voice Grade Private Line Data Channels* (March 1969). CCITT Recommendation M.102 defines a channel equivalent to a FCC Tariff 260-type 3002 with C2 conditioning. A single M.102 channel or two M.102 channels in tandem provide satisfactory service for 3872 operation. See "Communications Channel Specifications" under "Installation Planning" in Part 3.

Power level and signal-to-noise ratio may vary among World Trade countries. The transmit level and receiver sensitivity threshold of the 3872 are strapped in World Trade applications, to allow for adjustments to the specific situation. See "Strapping Options" under "Installation Planning" in Part 3.

### DIRECT LINE ATTACHMENT

For use on dedicated channels in some World Trade countries (especially the United Kingdom), it may be necessary to provide dc (direct current) isolation from channel access facilities. The Direct Line Attachment feature provides isolation transformers for this purpose. See "Special Feature Descriptions" in Part 3.

### SWITCHED NETWORK OPERATION IN THE USA AND CANADA

The use of the 3872 on switched network lines in the USA and Canada is standard practice, with the proper features. Switched network operation in World Trade countries, however, is by special arrangement. See your IBM sales representative.

### CADUCEE ATTACHMENT FEATURE (FRANCE)

The Caducee Attachment feature for the IBM 3872 Modem equips a basic 3872 (without other features) to operate on the French PTT Caducee Network. It provides an interface and control functions compatible with the Caducee coffret (line coupler and control unit); this feature includes the Talk/Data switch and appropriate equalization. The Caducee Attachment feature is also available with either or both modems of a 3872 dual modem.

### DTE Interface

The 3872-to-DTE interface is the conventional DTE interface described in Part 3; however, 'data terminal ready' must be controlled for switched network mode. The discrete lines illustrated in Figure A-1 are described as follows:

- 'Calling indicator' (CI) - an incoming call from the Caducee Network raises this line for 225ms, only. The signal originates in the coffret and reaches the DTE interface via the 3872 Caducee feature.
- 'Data terminal ready' (DTR) - this line originates in the DTE; it must be up to make or hold a Caducee Network connection, if the 3872 Talk/Data switch is in the DATA position. (Dropping DTR breaks the connection.) If the switch is in the TALK position, an incoming call may be answered manually at the coffret or the coffret may be placed in intervention mode for remote end signaling.
- 'Request to send' (RTS) - this line is raised by the DTE to initiate transmission. Because of the "four-wire," duplex facilities ('transmit' line and 'receive' line) provided by the Caducee Network, 'RTS' may be on continuously, and the 3872 is allowed to control the transmitting of carrier signals.

If the DTE keeps 'RTS' on, or if the 3872 is strapped for continuous carrier, carrier starts when the connection is made and stops when it is broken; the rise of 'clear to send' is delayed 25ms on the first transmission and then remains up until the connection is broken.

If the DTE waits for 'data set ready' before raising RTS, 'clear to send' is delayed 25ms; RTS may then remain up until the connection is broken ('clear to send' remains up, also). If the DTE drops 'RTS' after each transmission (and the 3872 is not strapped for continuous carrier), the 25ms clear-to-send delay recurs with each new transmission.

- 'Data set ready' (DSR) - the Caducee feature raises this line when all of the following conditions are present:
  - (1) a connection is made,
  - (2) 'RTS' is up (or continuous carrier is strapped),
  - (3) the Talk/Data switch is set to DATA, and
  - (4) the communications channel has not been dedicated to the coffret telephone set.When 'DSR' and 'RTS' (or continuous carrier) are up, the 3872 transmits continuous carrier signals; 'clear to send' rises 25ms later.

### Coffret Interface

The coffret interface provides facilities for controlling a Caducee Network connection and for transmitting and

receiving data. The lines in the coffret interface (Figure A-1) are as follows:

- 'Signal ground' (102) - this line provides the reference for the levels of other interface lines.
- 'Protective ground' (101) - this line connects the frame and covers of the 3872 to the frame and covers of the coffret. It may be connected to 'signal ground' in the coffret.
- 'Transmit' line - these two wires make up the transmit path from the 3872 to the Caducee coffret.
- 'Receive' line - these two wires make up the receive path to the 3872 from the Caducee coffret.
- 'Telephone' (T1) - the coffret raises this line to the 3872 when the communications channel has been dedicated to the coffret telephone set.
- 'Data terminal and modem ready' (108) - this line from the 3872 to the coffret is up, under any one of the following conditions:
  - a. The Talk/Data switch is set to DATA with 'DTR' up and the modem ready.
  - b. The Talk/Data switch is set to TALK.
  - c. The 3872 Test/Operate switch is set to T3 or T4.
  - d. The 'telephone' line from the coffret is up.

When 'data terminal and modem ready' is not up, the coffret will not make or hold a Caducee Network connection, and it will break a connection that already exists.

- 'Calling indicator' (A1) - the coffret raises this line to the 3872 for 225ms, once only, when a call is received on the Caducee Network.
- 'Distant station connected' (204) - when a Caducee Network connection has been made, the coffrets at both ends of the communications channel raise this line to signify that the called coffret is connected to the channel.

If disconnect occurs at either end, 'distant station connected' drops at both ends.

### Operation

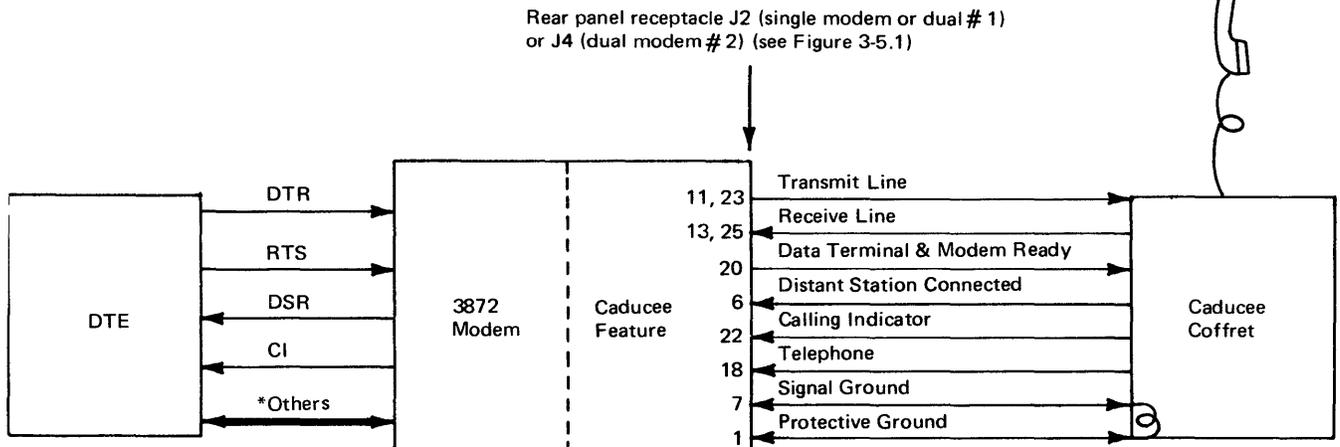
The basic conditions for 3872 Modem (with Caducee Attachment feature) operation on the Caducee Network are given in Figure A-1. The sequence of operation is as follows:

1. A call is dialed manually at a Caducee coffret. If a voice answer is expected, the Talk/Data switch should be set to TALK; if a data connection is expected, the switch should be set to DATA.
2. At the called station, 'calling indicator' rises for 225ms. If the Talk/Data switch is set to DATA and the DTE and modem are ready before the end of the pulse, 'distant station connected' rises at both coffrets, the connection is accomplished, and data transmission takes place as it does on a dedicated communications channel with four-wire, duplex facilities.
3. The connection is broken when either DTE drops 'DTR' and the Talk/Data switch is set to DATA.

*Note 1:* Voice communication may take place between coffret telephone sets if the 3872 Talk/Data switches are set to TALK. The connection between the coffrets depends on the status of 'DTR' only if one or both of the switches is set to DATA. When a connection is transferred from TALK to DATA, both DTEs must be ready; the receiving operator should switch to DATA first.

*Note 2:* All positions of the 3872 Test/Operate switch perform their normal functions with the Caducee Attachment feature installed in the 3872 Modem.

*Note 3:* For further information, and for intervention and dialing procedures, refer to literature on Caducee Network coffret operating procedures, available from the French PTT.



DTE-RTS control options:  
 a. ON continuously  
 b. ON for each transmission  
 c. None

3872 Mode switch set to 2400 SW or 1200 SW  
 3872 strapping:  
 25ms clear-to-send delay  
 -6dBm transmit level  
 Continuous carrier if there is no DTE control of 'RTS'

Cable is provided with 3872; conventional 25-pin male connector on each end. Pin number are shown.

\*See Figure 3-1.

Figure A-1. 3872 Caducee Facilities

## Appendix B. Glossary

*Attenuate:* To lessen the amount, force, or value of.

*Batch Processing:* A system of accumulating and grouping a random number of input items to be processed at one time.

*Carrier:* An oscillation or wave suitable for modulation by the intelligence to be transmitted over the communications system.

*Communications Channel:* A single or dual transmission path, characterized by a particular frequency bandwidth (*voice bandwidth* in this manual).

*Control Station:* On a centralized multipoint communications channel, the station responsible for control of message traffic on that channel.

*Conversation Mode:* Communication between a terminal and a computer, in which each entry from the terminal elicits a response from the computer, and vice versa.

*Data Communications:* The transmission and reception of information by data processing equipment, or communications terminal equipment.

*Data System:* An organized collection of methods and interconnected machines that accepts input data, processes the data, and provides output data.

*Dedicated Line:* A communications channel which is permanently connected between two or more data stations. (Also called "leased" or "private".)

*Delay (group):* The time of propagation between two locations of a certain point of the envelope of a wave (varies with the frequency).

*Demodulation:* The process of retrieving intelligence from a modulated carrier wave.

*Deserialize:* To change from serial-by-bit to parallel-by-bit.

*Distortion:* The unwanted change in waveform that may occur between two points in a transmission system.

*Duplex Facilities:* A dual voiceband channel with complete separation of transmit and receive at any station in a system. Any system which uses the same portion or portions of the voiceband spectrum for simultaneous transmission of signals in both directions requires duplex facilities. To reduce turnaround time, carrier can be transmitted continuously from both stations of a point-to-point system or from the control station for a centralized multipoint system. Four-wire duplex facilities avoid false startups caused by interference between multipoint tributary stations.

*Duplex Operation:* A simultaneous two-way transmission.

*Echo:* A wave that is returned to the point of origin, because of reflection or some other cause.

*Echo Suppressor:* A line device used to prevent energy being reflected back to the transmitter.

*Equalizer:* Any combination of active and/or passive elements inserted in a transmission line or amplifier circuit to improve its frequency response or phase characteristics.

*Half-Duplex Facilities:* A single voiceband channel for bidirectional, non-simultaneous transmission between any two stations in a system. Systems that do not require use of the same portion or portions of the voiceband spectrum for simultaneous transmission of signals in both directions can operate with half-duplex facilities; carrier can be transmitted in only one direction at a time.

*Note:* When the common carrier supplies four-wire duplex facilities for half-duplex mode of operation in a point-to-point system, carrier may be maintained from both stations.

*Half-Duplex Operation:* A two-way transmission of signals, but in only one direction at a time.

*Interface:* A point of demarkation that divides the responsibilities of any two connected pieces of equipment.

*Leased, or Private, Line:* See "dedicated line".

*Mark:* The quiescent or binary 1 data bit condition.

*Modem:* A contraction of "modulator-demodulator". This term may be used when the modulator and demodulator are associated in the same signal conversion equipment.

*Modulation:* A process by which certain characteristics of a wave are modified in accordance with a characteristic of another wave or signal.

*Noise:* Any unwanted disturbance within a useful frequency band, such as undesired electric waves in a transmission channel or device.

*Off-Hook: On-Hook:* Activated/deactivated, in reference to a telephone set; it may also be used in reference to a device attached to a switched network line.

*Parallel Data:* Multiple signal elements, usually a character or byte, transferred simultaneously.

*Propagation Time (delay):* The time necessary for a signal to travel from one point of a circuit to another.

*Serial Transmission:* Transmission, at successive intervals, of signal elements (not transmitted simultaneously).

*Serialize:* To change from parallel-by-bit to serial-by-bit.

*Service:* The common-carrier function of providing and maintaining a system of facilities to meet customer communications requirements.

*Space:* The binary 0 data bit condition.

*Station:* An input or output point in a communications system.

*Strap, Strapping:* Selectable wiring to provide optional variations in the performance of equipment.

*Switched Line (switched network):* A communications channel made up of a number of shorter communications circuits connected through switching facilities provided by a common carrier.

*Teleprocessing:* A form of information handling in which a data processing system uses communications facilities.

*Transmit Level:* A power level of energy introduced onto the communications channel by the transmitter.

*Tributary Station:* On a centralized multipoint communications channel, one of two or more stations that transmits to, and receives from, the control station.

*Turnaround:* The time required to reverse the direction of transmission from send to receive, or vice versa. Time is required for line propagations and line effects, reversal of echo suppressors (where used), modem timing, and DTE reaction.

*Two-wire or Four-wire:* These terms refer to the physical connection to the communications channel. They do not determine half-duplex and duplex communications facilities.



### EXCESSIVE ERRORS AND ALTERNATIVE ACTIONS

The Switched Network Backup (SNBU) feature on the IBM 3872 Modem provides a new level of availability on systems using BTAM under OS/DOS when dedicated line outages occur. A line problem on such a system should cause a console printout, showing that errors on that communications channel (line) have become excessive.

Several alternatives are available:

1. Close the communications channel (line) for a while and try again later.
2. Use the communications channel (line) at half-speed.
3. Use problem determination and/or modem equalization, with the intention of correcting the problem or calling for maintenance.
4. Change over to SNBU (switched network backup) operation. This choice (SNBU operation) may result from the outcome of one of the other alternatives.

This appendix outlines considerations for planning an OS/DOS BTAM system that can use switched network backup to a dedicated channel. Guides to changeover and SNBU operation are included.

*Note:* The 3872 Alternate Voice feature is useful for arranging and/or executing the alternatives listed above. The 3872 Fan-Out feature may also be applicable. See Parts 2 and 3 of this manual.

### STANDBY CONFIGURATION PLANNING

#### General Considerations

Planning a system that will accommodate SNBU operation involves selecting equipment and programming options for normal dedicated communications channel (line) operation. The 3872 Modem Switched Network Backup feature provides for easy changeover from dedicated communications channel access to switched network access. This feature also automatically selects the modem functions strapped at the time of installation for switched network backup operation.

Switched network facilities must be procured and installed. Common-carrier equipment includes the CDT Data Access Arrangement (or equivalent) for manual answering and disconnecting, or the CBS Data Coupler (or equivalent) for automatic answering and disconnecting. A call may be dialed from either manual or automatic facilities. Automatic answering by a 3872 Modem set for switched network backup requires the Switched Network Backup with Automatic Answer feature. See Figure C-1 for guidance in the selection of manual or automatic answering and disconnecting.

The DTE (business machine) programming and equipment options for interface to the 3872 Modem are affected by planning for SNBU operation. Dedicated channel operation is likely to be multipoint and/or duplex, but switched network operation is typically point-to-point, half-duplex (Figures C-2 and C-3).

The DTE (business machine) must be permanently wired for half-duplex control of the 'request to send' interface line. Where appropriate, duplex throughput is maintained by wiring the 3872 for continuous carrier on the dedicated communications facility. On the switched network backup communications facility, the DTE half-duplex control of 'request to send' and the 3872 two-wire configuration provide the necessary half-duplex SNBU operation.

There are special considerations for planning switched network backup to a multipoint channel; see "Backup for Multipoint Dedicated Communications Channels" under "Multiplexer" in the following text.

#### Terminal

A terminal planned and installed for point-to-point, half-duplex operation on the dedicated communications channel requires no change for switched network backup operation. Any terminal planned for switched network backup to duplex dedicated-channel operation (including multipoint) must be wired for half-duplex at the time of installation. Duplex operation on the dedicated communications channel (if appropriate) is achieved by wiring the 3872 for continuous carrier.

A multipoint tributary terminal requires no special consideration for SNBU in respect to half-duplex; however, multipoint tributary terminals require a station address for selection or polling (see "Multiplexer").

A terminal with a dual communications interface (a 2780 with Feature #3401, a 2020 sub-model 2 or 4 with RPQ M58081, or a 2020 sub-model 5 with RPQ E71851) offers the capability of having one interface equipped for dedicated channel operation and the other for switched network (half-duplex point-to-point) operation (Figure C-4). The cable from the appropriate interface must be manually plugged into the 3872 Modem interface cable receptacle (unless the 3872 is equipped with the Fan-Out feature). Automatic answering is available for the second interface, but it is disconnected manually.

A terminal that is program-controlled to provide the appropriate controls (a 5406; a 5410; or a 2020 sub-model 1, 2, 4, 5, or 6) may be reloaded (Figure C-4). Switched network controls, achieved through reprogram-

Terminal or Multiplexer	Request to Send Control	Answer only or Disconnect	ID Mode	Restrictions
<b>Legend</b> IF = Interface H-D = Half-duplex SN = Switched network				
2020 Terminal Basic BSC adapter 2nd IF, dual comm. Re-program for SN 2nd IF & re-program	H-D H-D H-D	Man. Auto <sup>2</sup> Auto <sup>2</sup>	No No Opt.	Re-programmed 2020 is a totally switched network terminal and must communicate with a switched network program.
2701 Multiplexer Same line, same modem SN line, same modem  SN line, SN modem <sup>3</sup>	H-D H-D H-D	Man. Auto <sup>2</sup> Auto <sup>2</sup>	No Opt. Opt.	Requires re-routing data in the program. With ACO, requires an accessible call list in the program and automatic answering at the terminals.
2703 Multiplexer Same line, same modem SN line, same modem  SN line, SN modem <sup>3</sup>	H-D H-D H-D	Man. Auto <sup>2</sup> Auto <sup>2</sup>	No Opt. Opt.	Requires re-routing data in the program. With ACO, requires an accessible call list in the program and automatic answering at the terminals.
2770 Terminal 2780 Terminal Basic 2nd IF, dual comm. 5406 or 5410 Terminal Basic Re-program for SN	H-D H-D H-D H-D H-D	Man. Auto <sup>2</sup> Auto <sup>2</sup> Man. Auto <sup>2</sup>	No No No No Opt.	

- Notes:** 1. At a multipoint control station or at a duplex point-to-point station, the 3872 Modem should be strapped for continuous carrier on the dedicated (leased line) channel.
2. Optional for backup only for point-to-point, dedicated communications channels and only with DTE control of 'data terminal ready'. On 2nd IF (dual communications) terminals not re-programmed for SN, disconnecting is manual. Answers all calls if 3872 power is on and if the modem is set to DATA. With automatic answering and/or disconnecting (using a CBS coupler), the line must be open or the terminal must be ready before the call.
3. ACO is available, but disconnecting at the terminal may be manual.

Figure C-1. Specifications for DTEs in SNBU Systems

ming the second interface, or the same interface make it possible to use automatic answering and disconnecting (by controlling the 'data terminal ready' interface line).

### Multiplexer

Planning for SNBU operation at the multiplexer depends mainly upon the type of dedicated channel configuration (point-to-point or multipoint) and the requirements of the terminals for each configuration. The standby configuration for each dedicated channel configuration is described in the following paragraphs.

### Backup for Point-to-Point Dedicated Communications Channels

As described previously, point-to-point dedicated channels that operate in half-duplex mode require no equipment configuration change for SNBU operation, unless automatic answering is selected. Duplex channels require half-duplex control of 'request to send' for SNBU. The effect of duplex dedicated-channel operation is achieved by wiring the 3872 for continuous carrier on the dedicated channel.

With manual answering and disconnecting on the standby facilities, programming for dedicated channels may be used with SNBU for point-to-point channels. Automatic answering and disconnecting at the multiplexer requires control of the 'data terminal ready' interface line. Alternate programming may be provided by program switching, cable switching, or the addition of another 3872 Modem used solely for the switched network backup operation (Figure C-2).

### Backup for Multipoint Dedicated Communications Channels

Communication via SNBU, with a terminal that is normally on a dedicated multipoint channel, requires multipoint programming at the multiplexer, with a polling or addressing list of one terminal. (The program must provide the terminal with a polling or selection address, but timeouts will occur if the polling list is not reduced to one terminal.) Since multipoint operation does not allow unsolicited communications from a terminal, automatic answering at the multiplexer is not compatible with SNBU operation using multipoint programming.

A conference call might be arranged to avoid reducing the polling list for multipoint SNBU operation, but since it would be prohibitively expensive to maintain a conference connection (which could be used by only one terminal at a time) the conference call technique is not recommended. If the physical proximity of up to three DTE devices permits, all of them may use a 3872 Modem equipped with SNBU and Fan-Out features; multipoint programming can then be used, listing all terminals attached to the 3872 Fan-Out feature.

An alternative to switched network backup at the multiplexer is to use a 3872 Modem solely for communicating with terminals set for SNBU operation. Such an arrangement makes possible using automatic call origination (a modem feature which requires automatic answering). Normal switched network programming at the multiplexer, with provision for a call list that can be modified, applies to this configuration.

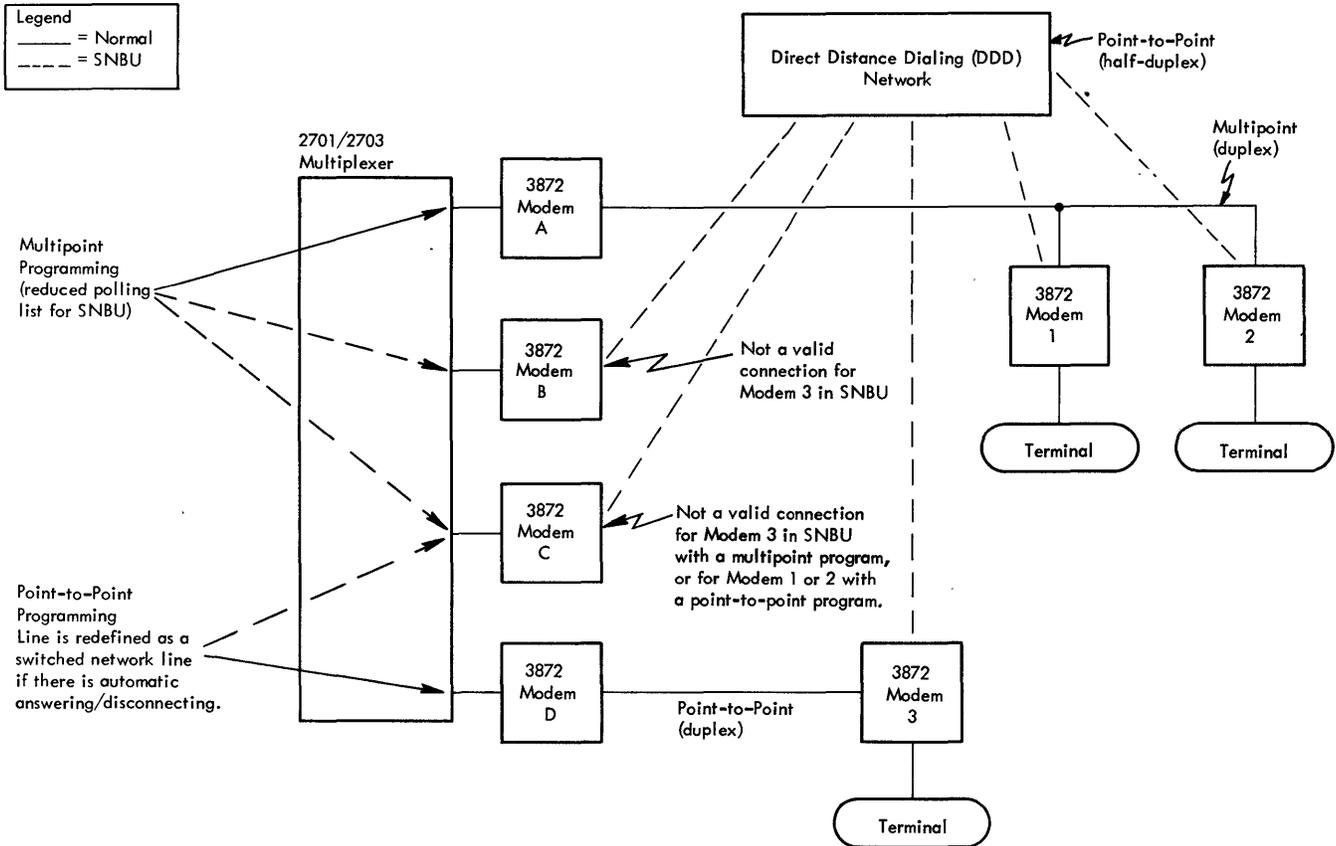
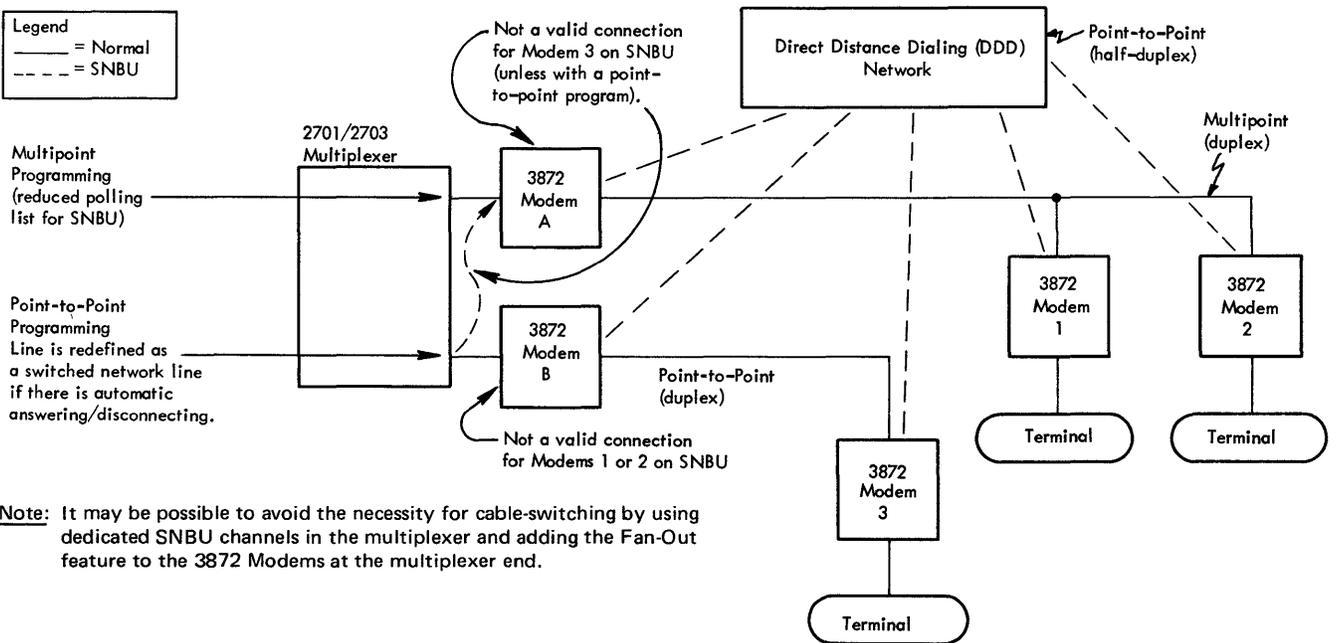


Figure C-2. Sample Multiplexer SNBU Configurations Using Backup Modems



**Note:** It may be possible to avoid the necessity for cable-switching by using dedicated SNBU channels in the multiplexer and adding the Fan-Out feature to the 3872 Modems at the multiplexer end.

Figure C-3. Sample Multiplexer SNBU Configurations Using Same Modem

At the terminal, automatic answering and disconnecting automatically originated calls depends upon the terminal's ability to control the 'data terminal ready' interface line. Such control is available on the second interface of terminals with dual communications interface facilities (a 2780 with Feature #3401, a 2020 sub-model 2 or 4 with RPQ M58081, or a 2020 sub-model 5 with RPQ E71851), except that disconnection is manual. Full switched network capability is available for terminals with reloadable program-controlled communications adapters (a 5406, a 5410, or a 2020 sub-model 2, 4, 5, or 6). Other terminals must answer and be disconnected manually; they cannot answer automatically originated calls.

#### *Program Considerations and Program-Operator Communication*

Switched network backup operation may require additional communication between the operator and the OS/DOS BTAM program. The development of clear, detailed sets of instructions for individual CPU and terminal operators will make apparent the need for additional operator-program communication. See "Standby Changeover and Operation", following, for guidance in developing instructions and procedures.

Messages between the operator and the program may be implemented by using WTOR (OS) or PUTs and GETs to the CPU console (DOS).

*Note:* When using GET, operator response must be prompt to avoid placing the entire "TP partition" in a "wait" for a console reply.

The CPU program should facilitate:

- Recording any error statistics suggesting that SNBU operation might be advantageous. Threshold counters in the LERB macro, user error counters with branching to an operator alert, or a high retry count with the hex '41' return code as the operator alert, may be used.
- Closing and reopening a line that has excessive errors.
- Opening a switched network backup line and rerouting the data.
- Changing the polling or addressing list and providing a delay between the polling or addressing cycles when the list has been reduced to one terminal. The operator must be notified when communications with a terminal have been completed, so that he can place a different terminal on the list.

#### **STANDBY CHANGEOVER AND OPERATION**

System planning and implementation (see "Standby Configuration Planning", previously discussed) may require certain changes in equipment and programming to prepare for an SNBU operation. Aside from these changes, connecting and disconnecting the switched network backup call are the main

operating considerations. Any call placed through a telephone operator should be identified as a data call, to preclude intervention or unexpected disconnection. Connecting and disconnecting procedures for each valid configuration of switched network backup operation are described in the following paragraphs.

*Note:* If SNBU data transfer appears to be unsatisfactory, the operators should disconnect and try again. The 1200 switched mode may be used as an alternative; if it is, both 3872 Modems must be set to 1200 SWITCHED.

#### **Point-to-Point Backup**

In addition to making planned cable or program changes, using the 3872 Modem SNBU feature requires setting both 3872 Modems to 2400 SWITCHED or both to 1200 SWITCHED.

#### *Manual Answering (CDT DAA) at Both Ends*

*To Connect:*

1. CPU operator closes the line in the program.
2. CPU operator switches the 3872 to TALK and calls the terminal CDT/3872 number, using the telephone attached to the CDT DAA at the CPU.
3. Terminal operator switches the 3872 to TALK, answers the telephone, and the operators arrange for SNBU operation and data transfer. The 3872 Modems are both set to 2400 SWITCHED.
4. Terminal operator pulls up the data key on the CDT telephone cradle, makes the terminal ready, and switches the 3872 to DATA.
5. CPU operator pulls up the data key on the CDT telephone cradle, switches the 3872 to DATA, and opens the line in the program.
6. CPU operator enters any CPU console message necessary to initiate data transfer.

*Note:* If the terminal is to transmit first, the sequence of the foregoing steps is: 1, 2, 3, 5, 6, 4.

*To Disconnect:*

1. By prearranged recognition of completed data transfer or by separate phone call, the operators agree to disconnect.
2. CPU operator closes the line in the program.
3. Both operators cradle (hang up) the telephones attached to the CDTs.

#### *Manual Answering (CDT DAA) at Terminal and Automatic Answering (CBS Data Coupler) at CPU*

Control of the 'data terminal ready' interface line must be effected at the CPU. The program data path may have to be changed, and the interface cable to the 3872 Modem may have to be switched (Figure C-3).

*To Connect:*

1. CPU operator closes the dedicated (leased) line in the program, opens the switched network line, and sets the 3872 to 2400 SWITCHED.
2. By prearrangement or by separate phone call, the CPU operator alerts the terminal operator to change to SNBU operation and call the number of the CBS/3872 at the CPU, from the telephone attached to the CDT at the terminal.
3. Terminal operator sets the 3872 to TALK and 2400 SWITCHED, makes the terminal ready, and dials the call.
4. Terminal operator, upon hearing the end of the answer tone, pulls up the data key on the cradle of the CDT telephone, switches the 3872 to DATA, and data transfer begins.

*To Disconnect:*

1. By prearranged recognition of completed data transfer or by separate phone call, the operators agree to disconnect.
2. CPU operator closes the switched network line in the program.

*Note:* Connection of unexpected incoming calls may be avoided by setting the 3872 Modem to TALK.

3. Terminal operator disconnects by cradling (hanging up) the handset of the telephone attached to the CDT.

*Manual Answering (CDT DAA) at CPU and Automatic Answering (CBS Data Coupler) at Terminal*

Control of the 'data terminal ready' interface line must be effected at the terminal. The cable from the second (switched network) interface of the dual communications interface must be plugged into the 3872, or the terminal program must be reloaded for switched network operation. (Figure C-4).

*To Connect:*

1. CPU operator closes the line in the program and, by prearrangement or separate telephone call, alerts the terminal operator that SNBU operation will be used.
2. Terminal operator makes the necessary changes for switched network operation, sets the 3872 to 2400 SWITCHED, and makes the terminal ready.
3. CPU operator sets the 3872 to TALK and 2400 SWITCHED and, using the telephone attached to the CDT, calls the number of the CBS/3872 at the terminal.
4. Upon hearing the end of the answer tone, the CPU operator pulls up the data key on the cradle of the CDT telephone and sets the 3872 to DATA.
5. CPU operator opens the line in the program and enters any CPU console message necessary to start data transfer.

*To Disconnect:*

1. By prearranged recognition of the end of data transfer or by a separate telephone call, the operators agree to disconnect.
2. CPU operator closes the line in the program and cradles (hangs up) the telephone attached to the CDT.
3. Terminal operator disconnects by disabling the terminal or by setting the 3872 to TALK.

*Note:* At a dual interface terminal that has not been re-programmed, the operator must disconnect by setting the 3872 to TALK. Connection of unexpected incoming calls may be avoided by setting the 3872 Modem to TALK.

*Automatic Answer (CBS Data Coupler) at Both Ends*

Control of the 'data terminal ready' interface line must be effected at both ends. At the CPU, the program data path may have to be changed and the cable to the 3872 Modem may have to be changed (Figure C-3). At the terminal, the cable from the second interface of the dual communications interface must be plugged into the 3872 Modem (unless it is already connected to a 3872 with the Fan-Out feature), or the terminal program will have to be reloaded for switched network operation (Figure C-4).

*To Connect:*

1. CPU operator closes the dedicated (leased) line in the program and opens the switched network line.
2. By prearrangement or by separate telephone call, the operators arrange for SNBU operation and for data transfer. The 3872 Modems are both set to 2400 SWITCHED.
3. Terminal operator makes the necessary changes for switched network operation and makes the terminal ready.
4. Calling operator sets the 3872 to TALK, lifts the handset of the telephone attached to the CBS, pulls up the exclusion key on the telephone cradle, and dials the number of the CBS/3872 at the other end.
5. Upon hearing the end of the answer tone, the calling operator sets the 3872 to DATA and cradles (hangs up) the handset when the answer tone ends. Data transfer begins.

*To Disconnect:*

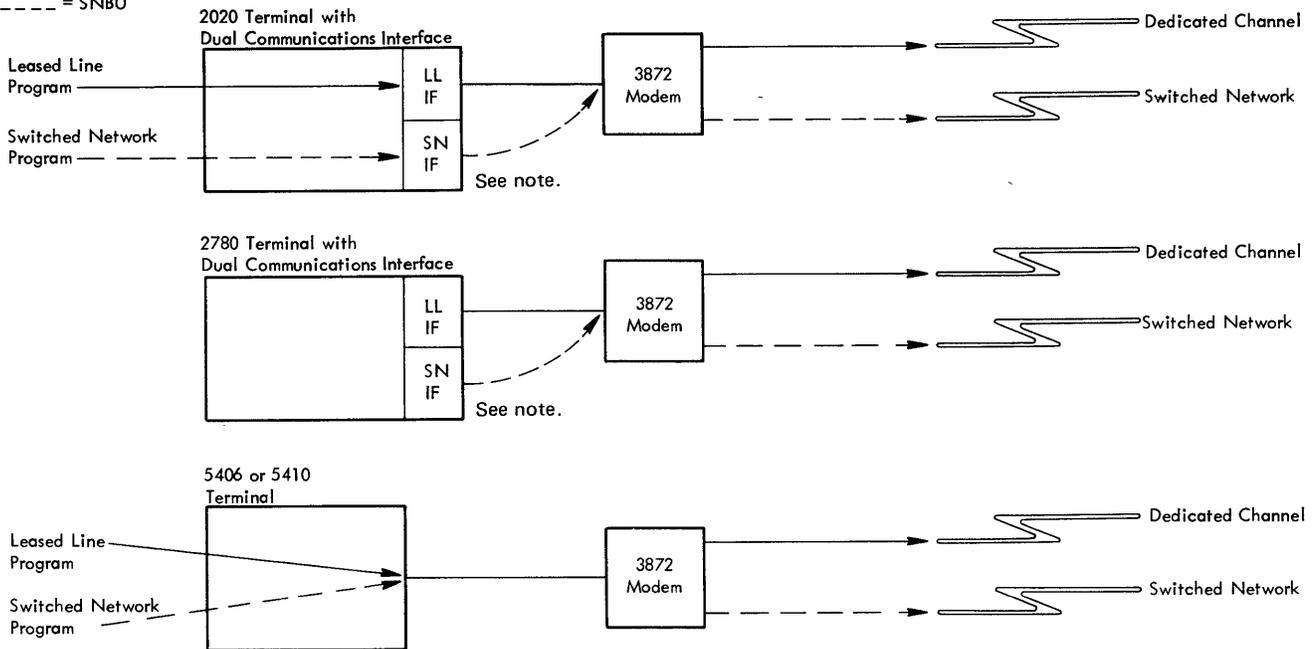
*Note:* Connection of unexpected incoming calls may be precluded by setting the 3872 Modem to TALK.

1. By prearranged recognition of the end of data transfer or by separate telephone call, the operators agree to disconnect.
2. CPU operator closes the switched network line in the program.
3. Terminal operator disconnects by disabling the terminal or by setting the 3872 to TALK.

*Note:* At a dual interface terminal that has not been re-programmed, the operator must disconnect by setting the 3872 to TALK.

**Legend**

LL = Leased line (dedicated channel)  
SN = Switched network  
IF = Interface  
—— = Normal  
---- = SNBU



**Note:** Cable-switching is unnecessary if the 3872 is equipped with the Fan-Out feature. The cable from the dual interface SN connector is permanently connected to the receptacle for DTE #2 (Figure 3-6).

Figure C-4. Sample Terminal SNBU Configurations

**Multipoint Backup**

In addition to making planned cable or program changes, using the 3872 Modem for SNBU operation requires setting both 3872 Modems to 2400 SWITCHED or both 3872 Modems to 1200 SWITCHED. The polling list at the CPU should be reduced to one terminal (or up to three terminals if the Fan-Out feature is in use at the tributary location), to avoid timeouts and interruptions; a delay between polling or addressing cycles should be used to reduce program interference.

Since unsolicited communications are not compatible with multipoint programming, and since the multipoint program must be used in an SNBU operation to provide terminal addresses, automatic answering at the CPU is not a valid configuration.

*Manual Answering (CDT DAA) at Both Ends*

Connecting and disconnecting in this configuration are the same as for point-to-point backup. See "Point-to-Point Backup", previously discussed in this appendix.

*Manual Answering (CDT DAA) at CPU and Automatic Answer (CBS Data Coupler) at Terminal*

Connecting and disconnecting in this configuration are the same as for point-to-point backup. See "Point-to-Point Backup".

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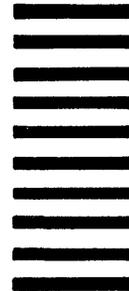
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