

Mr. DeSmet
SUBJECT: PBX Systems - 810A Self Contained Electronic PBX

(GL69-11-128)



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TO: Chief Engineers (copies included for General Plant and Traffic Managers)

FROM: Engineering Director - Customer Telephone Systems

SYNOPSIS: Contains latest planning information on the 810A Electronic PBX, including general description, features, traffic capacities, costs, floor plan data and maintenance features. Limited availability expected in Mid-1971.

* * *

The 810A is a self contained electronic PBX equipped to serve both PBX and Centrex Customers in the range of 80-1200 lines. It will provide Series 100, 200, 300 Centrex I and Centrex II Communications Service Packages as well as the usual Optional Features such as Loudspeaker Paging and TOUCH-TONE Calling. It will also provide most of the newer Custom Calling Services such as Call Transfer-All Calls, and Three Way Calling. It is intended primarily for those customers who would otherwise be served by 757 and 701 type PBX's and in areas not appropriate for No. 101 ESS or Centrex CO.

We expect to have a limited quantity of 810A systems available in Mid-1971 with normal production in 1972. When this PBX is in full production, we will then be in a position to provide all electronic equipment on customers' premises for both PBX and Centrex service as follows:

Type of Equipment

<u>Line Size</u>	<u>PBX Series Service</u>	<u>Centrex Service</u>	<u>Custom Calling</u>
up to 80 L	800A	No. 101 ESS 800A (P)	No. 101 ESS 800A (S)
80-1200 L	810A No. 101 ESS	810A No. 101 ESS	810A No. 101 ESS
1200-4000 L	No. 101 ESS	No. 101 ESS	No. 101 ESS

(P) Planned (S) Under study

Of course, where it is economical to do so, No. 1 ESS and No. 5 Crossbar can be utilized to provide Centrex CO service for any line size.

The estimated installed costs for the 810A are lower than the costs of a comparable 701 PBX for Series 200 and 300 service and slightly higher for Series 100, Centrex I and Centrex II service. However, the 810A will be lower in cost than 701 type equipment for any Series or Centrex service when TOUCH-TONE Calling is provided. Also, in any economic selection study, there are other advantages of the 810A PBX that should be considered, such as, a shorter installation interval, less floor space, lower cost of adding new features such as TOUCH-TONE Calling, lower cost of converting from one Service Package to another, lower maintenance costs and the capability of adding Custom Calling Services. Estimated installed costs of the 810A PBX are shown in more detail in the attached notes.

Bell System Practices and training programs are now being established. You should also be making plans to train your Plant, Engineering, and Traffic people in this new technology so that the 810A can be introduced in an orderly manner. Initial 810A Systems will be factory tested to the extent possible to insure the delivery of trouble-free systems which can be readily installed on customers' premises in the minimum of time.

This system is described in greater detail in the attached notes. If you have further questions on this subject, please call Mr. John Goberis on 212 393-3070.



Engineering Director

JG:MN
Attachments

Features

The 810A Electronic PBX will be arranged for Series 100, 200, 300, Centrex I and Centrex II Services for up to 1200 lines. It will also be arranged for the following PBX Optional Features:

- TOUCH-TONE Calling
- Console Operation with Trunk Group Busy and Incoming Call Indicator Lamps
- Miscellaneous Trunks - Paging, Code Call, Dial Dictation, COAM Interface, Tie Trunks, FX Trunks, WATS Trunks and CCSA Trunks.
- Attendant Control of Dial Access to Trunk Groups
- Call Forwarding - Don't Answer and Busy Line
- Conference Calling
- Call Transfer and Consultation Hold - All Calls
- Call Pickup, Call Hold, Call Forwarding, and Three Way Calling
- Busy Verification, Lockout, and Secrecy
- Hotel Services
- Main Satellite Operation (initially for Series 100 service only)

The following additional features are planned for the 810A PBX and will be furnished later on an optional basis:

- PICTUREPHONE
- AUTOVON
- Speed Calling will not be initially provided as part of this system. We are reviewing other arrangements which will provide this kind of service more economically.

General Description

The basic components of an 810A PBX are: (refer 810A Block Diagram)

1. Common Control
2. Digit Registers
3. Switching Network and Network Control
4. Line and Trunk Select Group
5. Lines
6. Trunks
7. Attendant Position Circuits, Switched Loops, and Attendant Console and
8. Test, Alarm, and Transfer Control Circuit

The 810A System is under the control of the common control circuit which may be duplicated for reliability (generally for systems of greater than 100 lines). The common control connects to the rest of the system through the line group circuits and trunk select group circuits. The test, alarm and transfer control circuit monitors the condition of the two common controls and reverses the status of the common controls periodically and whenever the active common control fails.

The switching network and network control circuit under control of the active common control connects a marked line side circuit to a marked trunk side circuit. Each line group connects up to 100 stations to the PBX and each trunk select group contains about 50 trunks, the type and number depending on the service provided. The line group and trunk select group circuits are not duplicated since a failure in either group will affect service in that group only and, therefore, will affect only a portion of the lines or trunks in the PBX.

The digit registers, intercom trunks, central office trunks, tie trunks, attendant queueing trunks, tone trunks, miscellaneous trunks and switched loops connect to one of the trunk select groups. Digit Registers which have both line and trunk side network appearances are used to provide dial tone and record and store the digits dialed by both trunks and lines. The common control reads out serially the number stored in the register and completes the connection through the switching network.

Attendant position circuits are provided to connect attendant consoles to the switched loops and the common control connect circuits.

Installation and Changes

Installation

The 810A PBX is packaged on a modular basis. A PBX can be engineered in any size and with any service features up to its maximum designed capacity by specifying the proper number and combination of eight functional modular cabinet units. The cabinet modules are field assembled and then interconnected with the plug-in cables provided. The circuit packs required are packaged in the equipment carriers mounted within the cabinet modules. Quick-connect terminals are provided to connect stations and trunks to the PBX. Attendant console cables are terminated on quick-connect fields. Most service features are provided by adding the equipment carriers and circuit packs. Options for hunting, class of service, miscellaneous trunk codes, etc., are made by strapping on quick-connect terminals or inserting plug-in diodes.

Changes

The 810A PBX is arranged to grow from one Series Package to another with a minimum of equipment rearrangement by inserting circuit packs into unequipped equipment carriers, by adding plug-in integrated circuit packages to circuit packs within the system, by replacing circuit packs with different circuit pack codes, and/or by changing wired service options. Series 200 Features can be added to a Series 100 System by plugging in the Camp-On, Attendant Conference circuits and additional common control circuitry. The first four attendant positions would also be expanded to include a DSS field

with busy lamps for up to 200 stations. Studies are under way to determine the practicability of expanding this to 800 stations. Series 300 Features can be added by plugging in the Call Transfer circuits which also provide the Consultation Hold and Add-On Features, the Trunk Answer from Any Station circuits, plus additional common control circuitry.

Centrex I includes all the features provided for Series 100 Service and adds Direct Inward Dialing (DID) and Identified Outward Dialing (IOD). When Centrex II Features are required, Call Transfer and Trunk Answer from Any Station Features will be added similarly as for Series 300.

In addition to the Packaged Features, the Optional PBX Features will be available for use with any of the Series and Centrex systems. The more conventional features such as Dial Dictation, Code Call, etc., will initially be provided by the use of auxiliary 810A circuits which connect to the existing relay type equipment. The newer features such as Call Pick-Up and Call Hold will be provided by plugging in additional 810 type circuits.

Service Options

Service options requiring cross connecting or insertion of diode or shorting type option plugs are as follows:

- (a) Station class of service - insert diode plugs in line modules
- (b) Station hunting - cross connect in line modules
- (c) Dial repeating tie trunk or CCSA trunk class of service - insert diode plugs in trunk modules
- (d) Miscellaneous trunk access code, class, and trunk position assignment - cross connect in common and trunk modules
- (e) Conference Calling, Trunk Answer from Any Station and other access code assignment - cross connect in common modules
- (f) Incoming trunk group assignment for INCOMING CALL INDICATOR lamp assignment - cross connect in common and trunk modules
- (g) TRUNK GROUP BUSY lamp assignment - cross connect in common modules
- (h) Attendant console options for busy verification, attendant conferencing, interposition calling, manual lines, and other features - cross connect in common modules and plug in 810A circuits and equipment as required.

Centrex Arrangements

Centrex I Service provides all the features of Series 100 Service DID and IOD. Night Connections are different from Series 100. With Centrex II, all the features of Centrex I are provided plus Call Transfer - Individual, Consultation Hold, Add-On and Trunk Answer from Any Station.

Initially, only dial pulse DID will be provided as follows:

1. Dial pulse DID with by-link operation for use with step-by-step central offices
2. Dial pulse DID for use with No. 5 Crossbar, No. 1 Crossbar and No. 1 ESS arranged for line link pulsing (LLP) and Crossbar Tandem

Associated with the dial pulse DID, the 810A system will work with the present conventional AIOD systems which utilizes A1 or A2 Station Identification Frame (SIF) at the serving central office.

With dial pulse DID, when an incoming trunk is seized by the central office, the PBX connects a digit register to the trunk. If the central office is step-by-step, the digit register is connected via a bylink and is ready to receive dial pulses immediately. If the central office is Crossbar or ESS, a wink start signal will be sent when the digit register is connected. Depending on the digits received, an appropriate connection to a station or the attendant is made to the incoming central office trunk. Calls to stations not in the extension numbering plan will be routed to fast busy tone.

When automatic number identification is required, the 810A will identify the PBX station number and associated central office trunk on all central office calls. The ANI is an integral part of the 810A system. This information is then transmitted over a data channel to the central office A1 or A2 SIF where it is stored until required for central office charging purposes.

A new method of providing DID for use with No. 5 Crossbar offices over a data link is under study for this system. Associated with this arrangement is a new IOD system which will identify stations making outgoing central office calls only when requested by the central office.

Station Class of Service

A station may have one or more of the following classes of service. All classes of service do not apply to Series 100 service.

- 1) UCO - unrestricted from central office trunks
- 2) RCO - restricted from CO trunks
- 3) TLD - unrestricted from CO trunks but denied toll calls

- 4) RFL - fully restricted (allowed only to originate and terminate intercom calls)
- 5) RIN - inward restricted from incoming CO trunk calls
- 6) NBV - no busy verification provided to this station
- 7) NCO - no camp - on indication tone permitted to this station
- 8) RM (1, 2, 3, 4, 5) - restricted from miscellaneous trunk groups 1, 2, 3, 4, or 5.
- 9) CFA - call forwarding allowed

An unassigned station cannot have the UCO, RCO, TLD or RFL class of service. Assigned stations can have only one of the UCO, RCO, TLD or RFL class of service.

Station class of service will be activated by inserting diode plugs in an associated line module terminal field.

Attendant Consoles

Attendant facilities for this system will be the Universal Console with an optional arrangement for incoming call identity and trunk group busy indications. The attendant can originate calls and incoming calls are completed to her only through switched loop circuits. Up to 12 switch loops are available per attendant and a total of 72 switch loop circuits and 14 consoles can be provided with this system.

In addition to the above, the attendant facilities will include the following features:

- Busy Verification - means for the first attendant to connect to a station even if it is busy. A suitable warning tone is provided.
- Interposition Calling - means to permit attendants in a multi-console installation to transfer incoming special request calls to certain attendants who perform special services, such as busy verification.
- Trunk Group Busy Lamps - up to 24 TGB lamps may be optionally provided on each attendant console to indicate when all the trunks (central office, FX, WATS, etc.) in a trunk group are busy.
- Incoming Call Indicator Lamps - up to 24 ICI lamps may be optionally provided on each attendant console to indicate the type of incoming call such as listed number, FX dial "0", etc.
- Lockout and Secrecy.

- Attendant Control of Dial Access to Trunk Groups - this optional feature enables attendants to control the access to a trunk group which is normally dial selected by stations or trunks.
- Manual Lines - are optionally provided to give manual service for a few stations in the PBX.
- Paging - to give an attendant key access to customer-provided paging system.
- Attendant Supervisory Turret - optionally provided to give an attendant supervisor an indication of the activity of each attendant, the number of calls waiting, supervisor signal, night key and lamp and the alarm indications.

Traffic

The 810A PBX will handle traffic in excess of five CCS per station line of originating and terminating traffic (intercom traffic counted once) on a fully loaded system up to 800 lines as shown in Figure 1. Where necessary, higher traffic carrying capacities than shown in the Figure 1 can be realized by utilizing additional trunk modules and switching network capacity for a given line size capacity. Conversely, lower traffic carrying capacity may be achieved by reducing the number of trunk modules and the switching network.

The system will include provision for connecting trunks, registers, switching network links, attendant circuits, and loop circuits to a traffic usage recorder for traffic measurements.

Traffic Circuit Capabilities

The 810A PBX will be designed for the following maximum trunk capacities. All of these trunks cannot be provided at the same time. Capacities are reduced as follows:

- (a) Tie and auxiliary trunks replace C.O. type trunks on a one-for-one basis.
- (b) Call transfer circuits, conference circuits, and sender circuits replace C.O. type trunks, tie and auxiliary trunks, and intercom trunks.

The maximum number of each type of trunk which can be provided is as follows. The number in parenthesis is the number which cannot be replaced by other circuits.

200 (128) C.O. Type Trunks

72 (24) Tie or Auxiliary Type Trunks

88	(72)	Intercom Trunks
24	(16)	Digit Registers
16	(16)	Tone Trunks
16	(16)	Attendant Queueing Trunks
72	(72)	Switched Loop Circuits
24		Call Transfer Circuits
8		Sender Circuits
14		Attendant Consoles

Floor Space

Attached Figures 2, 3 and 4 show layouts for typical 810A Series 100 Batteryless installations for 100, 400 and 800 line sizes. Data for the minimum floor space requirements is shown in three parts:

1. Space occupied by the 810A cabinets.
2. Space reserved for maintenance of the distributing frame.
3. Space which would be required for withdrawing the slide framework during maintenance, but which could also be used by the customer as aisle space.

Sufficient aisle space for only one opened slide is shown since it will be unnecessary to have two slides open at one time during maintenance.

Although these layouts are designated for Series 100 Service, generally, no additional cabinets would be required for Series 200 and 300 Features and only a few additional cabinets for Centrex I and II Service.

Costs

Figure 5 is a chart showing the estimated installed costs for heavy traffic, 810A PBX's for Series 100, 200, 300, Centrex I and II. The Series 100, 200 and 300 costs are for batteryless operation and Centrex I and II costs include reserve power. The 810A costs are lower than costs for comparable 701 PBX systems for Series 200 and 300 service and slightly higher for Series 100, Centrex I and II Service. However, the 810A PBX is more economical for all services when TOUCH-TONE Calling is provided.

Although first costs will be higher for the 810A for certain installations, there are other offsetting factors which make the 810A the more economical choice, such as shorter installation interval, less floor space, ease and low costs of adding new features such as TOUCH-TONE Calling, ease and low costs of converting from one Series Service to another (e.g., Series

100 to Series 300), lower maintenance costs, capability of providing some of the custom calling features, modern appearance cabinets, solid-state electronic components and capability of adding new features economically as they are developed.

When the new DID-AIOD arrangement described on Page 4 becomes available, we expect Centrex I and II costs to fall well below the costs of equivalent 701 installation using the existing LLP and SIF method.

Maintenance

A Test, Alarm, and Transfer Control Circuit will monitor selected outputs and certain active characteristics of the Line Group, Trunk Select Group, common control, Switching Network and other circuits. This test circuit will give an alarm indication, major or minor, wherever a fault is detected and, depending on the fault, may lock out the defective circuit. The major and minor indications will appear at the attendant's console and may be extended to a central office. If the faulty circuit is in common control in a dual common control system, then the faulty common control will be placed on standby and the other common control will be activated and a major alarm will be generated. Common controls are automatically alternated every 8.5 minutes under normal operation.

PBX Power and Fuse Monitor

Power supply levels from each power module are monitored and if a voltage falls below a predetermined value, or a fuse fails, an alarm indication is generated.

Power Failure Transfer

In the event of commercial power failure up to 50 preassigned stations will be connected directly to central office trunks. These stations can then originate calls to the central office after operating a ground start key on their telephone set. Where 2-way central office trunks are used, these stations can also receive central office calls directly.

Permanent Signal Indication

If any tone trunk is supplying a permanent signal (receiver off-hook tone), a lamp signal alarm will be generated to the attendant. No alarm signal will be sent to the central office for this condition.

Other Maintenance Aids

- (a) A display panel is provided which indicates, by lighted lamps, any fault that is detectable by the system. In many cases, a single fault is indicated by two lamps, one indicating the location of the fault and the other indicating the nature of the fault.

- (b) An alarm buzzer is provided which sounds as a result of a major or minor alarm. This audible signal frees the repairman from having to look frequently at the display panel during trouble shooting procedures.
- (c) Reset, override and control switches are provided which permit a PBX repairman to disable alarms, manually alternate common controls, activate locked-out circuits, override time-outs, and reset various trouble memory circuits.
- (d) A test line is provided which may be used to perform test calls. The PBX repairman can access this test line at a connecting block at each trunk module.
- (e) A test select panel located at each trunk module consists of an array of plugs which permits a craftsman to select any traffic circuit within that trunk module for a test call, from the test line.

Power

The main supply voltages for the 810A PBX are +6v, +24v and -48v. The +4.5v integrated circuit supply voltage is derived with regulators from the +6v supply. Up to about six 810A cabinets or modules will be supplied from a power module via a power module bus for each main supply voltage. There is no electrical connection other than ground between different power modules. The bus module arrangement is the same for battery and batteryless operation.

Batteryless Operation

Each power module contains one rectifier for each of the three main supply voltages. The first power module also contains the 117 volt AC distribution with fuses for each power module. Two arrangements of ferro-resonant rectifiers will be provided. The first arrangement will normally require a line frequency of 60 ± 0.1 Hz. Where operation from a customer supplied auxiliary generator is required, they may be optionally equipped to accept 60 ± 3.0 Hz. The rectifiers will also be equipped to provide for limited voltage holdover in the case of short (about 160 milliseconds) power transients.

Battery Operation

Standard battery plants will be used to supply +24 volts and -48 volts to each power module over individually fused cables. Each power module will also be equipped with a -48v to +6v converter to supply the +6 volt bus.

Ringling

In batteryless operation, -20 Hz ringing is derived from 117 volts 60 Hz AC by a subcycle ringing generator and distributed by the power and signal distribution circuit. In battery operation, an inverter will be used, powered by -48 volts DC.

Tones

The following precise tones will be generated in the ringing and tone circuit:

<u>Tone</u>	<u>Interrupt Rate (ipm)</u>	<u>Frequency (Hz)</u>
Audible ring	15 and continuous	440 + 480
Dial tone	continuous	350 + 440
- Busy tone	60 and 120	480 + 620
High tone (permanent signal)	continuous	480
Miscellaneous tone (camp-on indication, busy verification)	continuous (interrupted by using circuit)	440

810A PBX BLOCK DIAGRAM

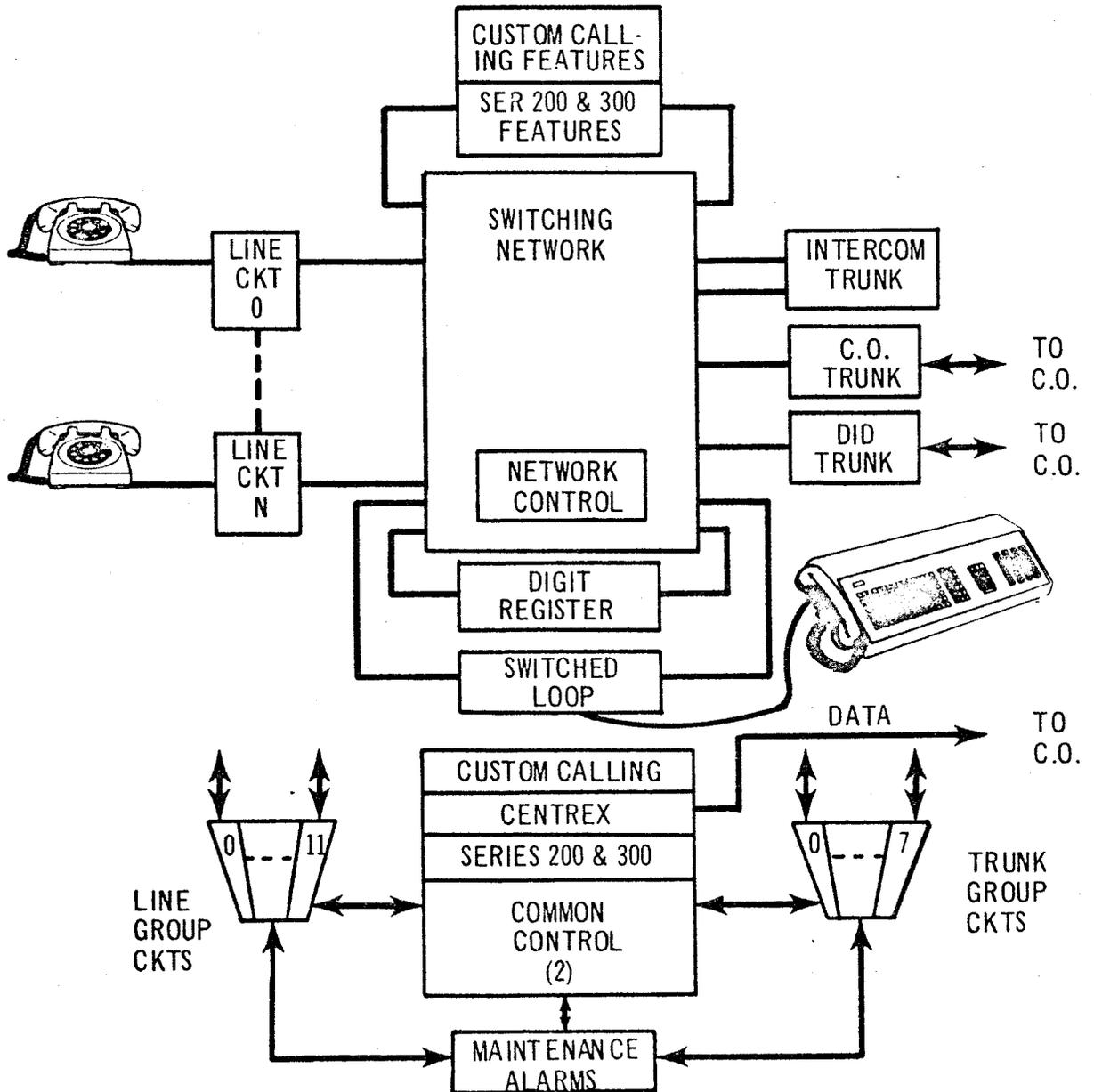


FIG. 1
810A TRAFFIC CARRYING CAPACITY

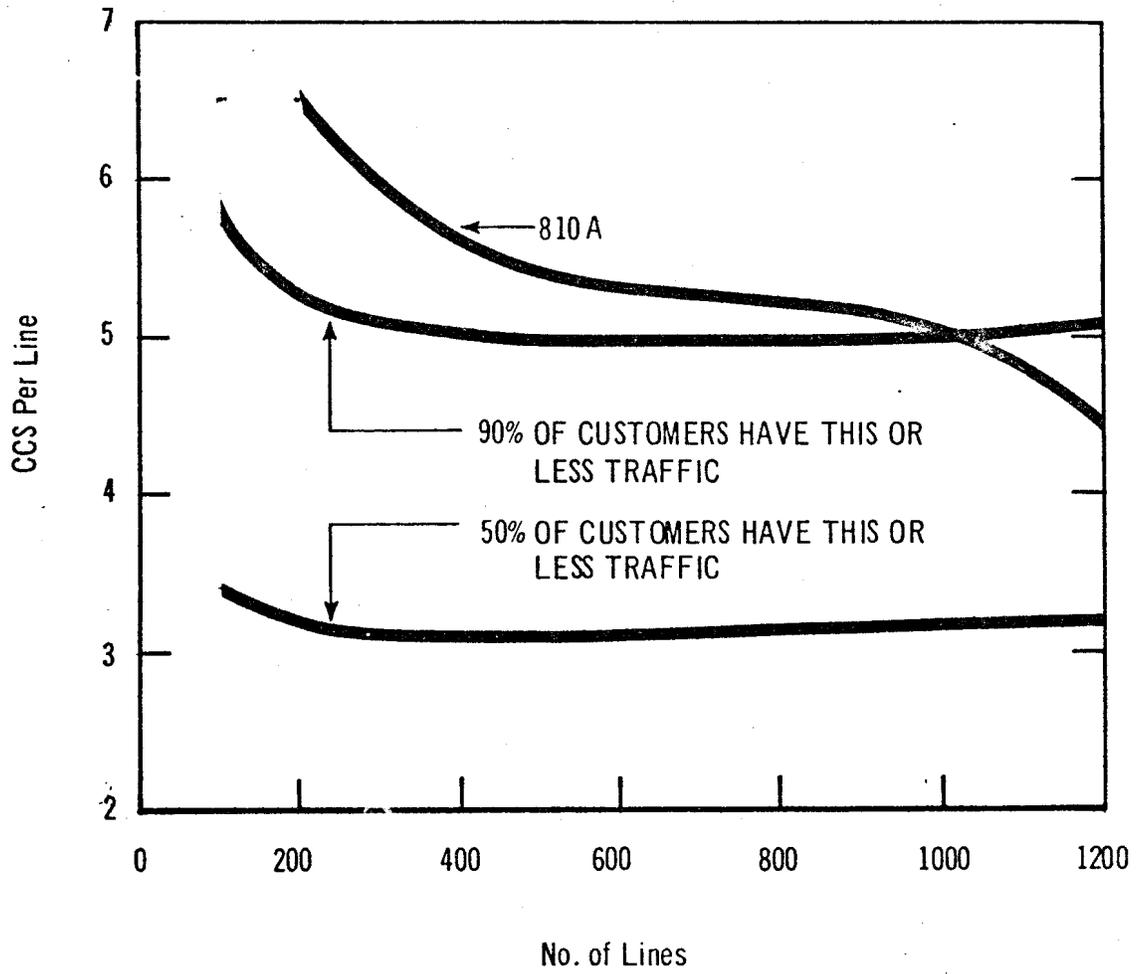
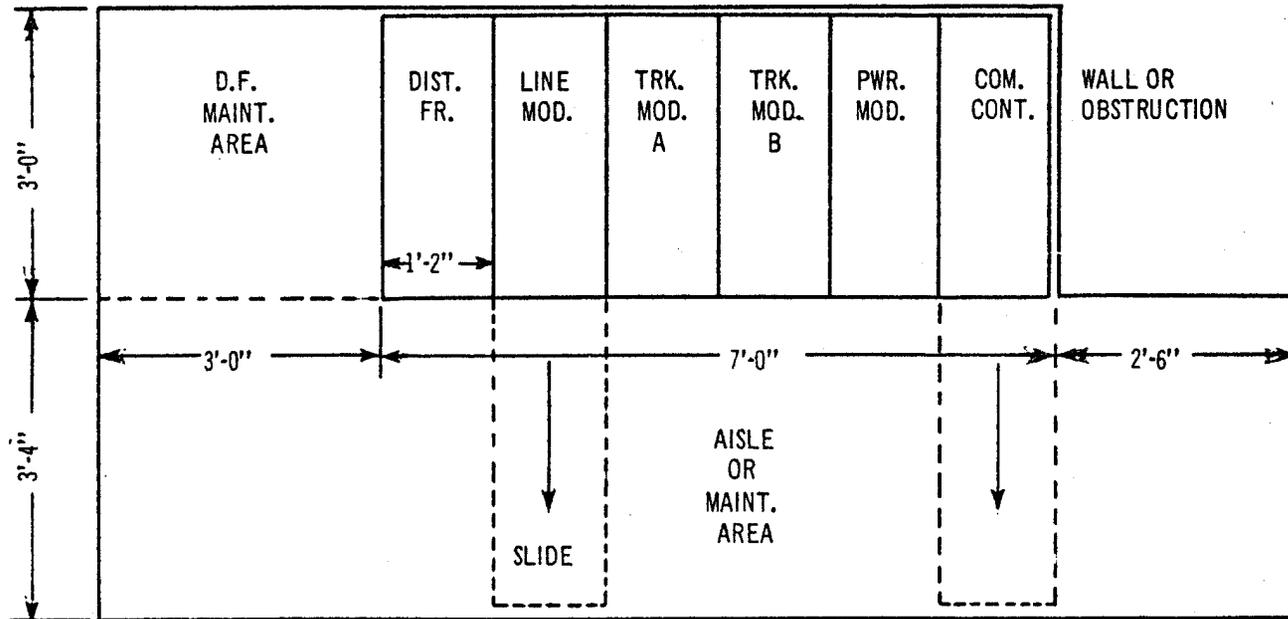


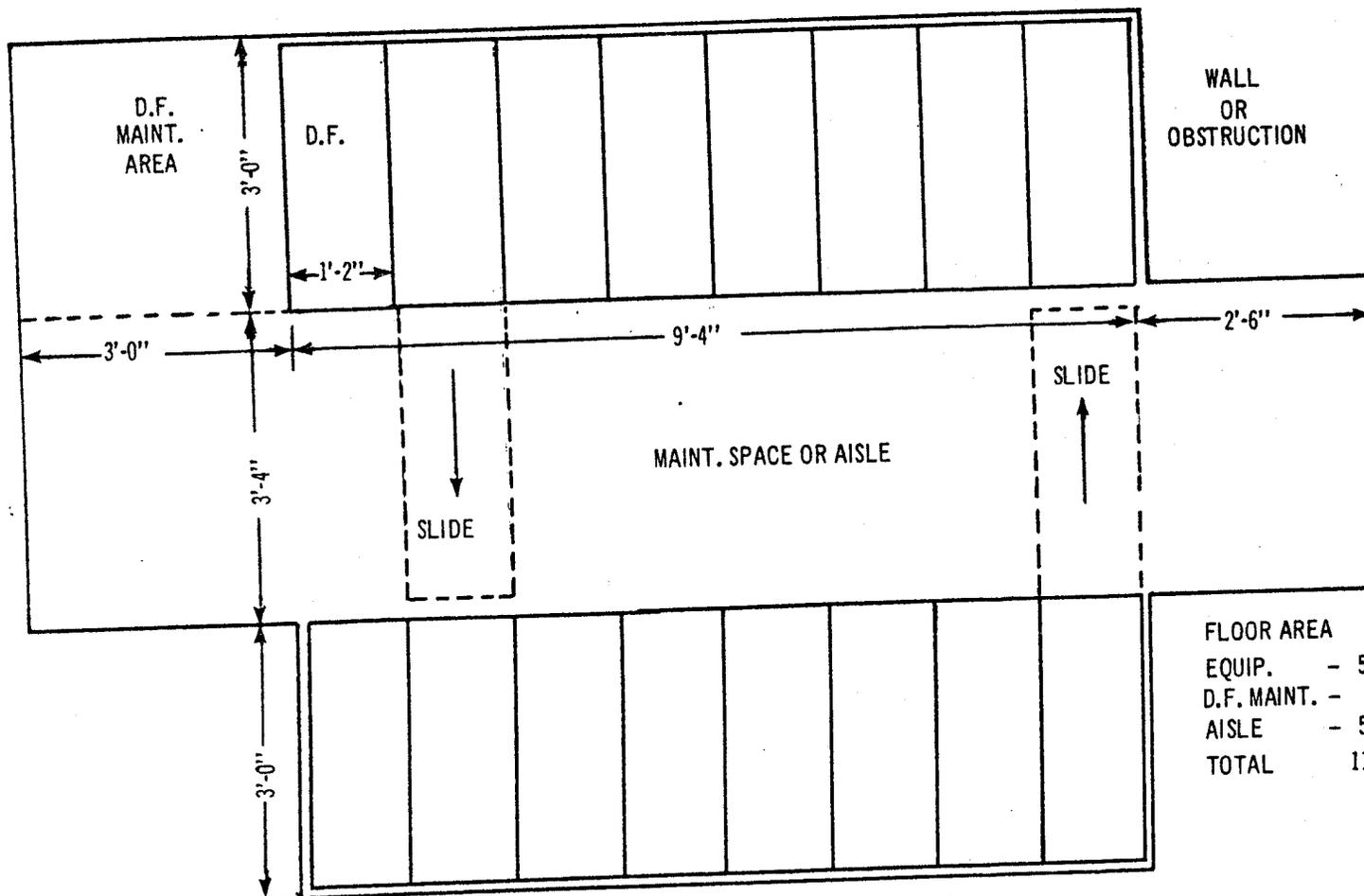
FIG. 2 - 810A FLOOR PLAN



100 LINES - SERIES 100
(6 CABINETS)

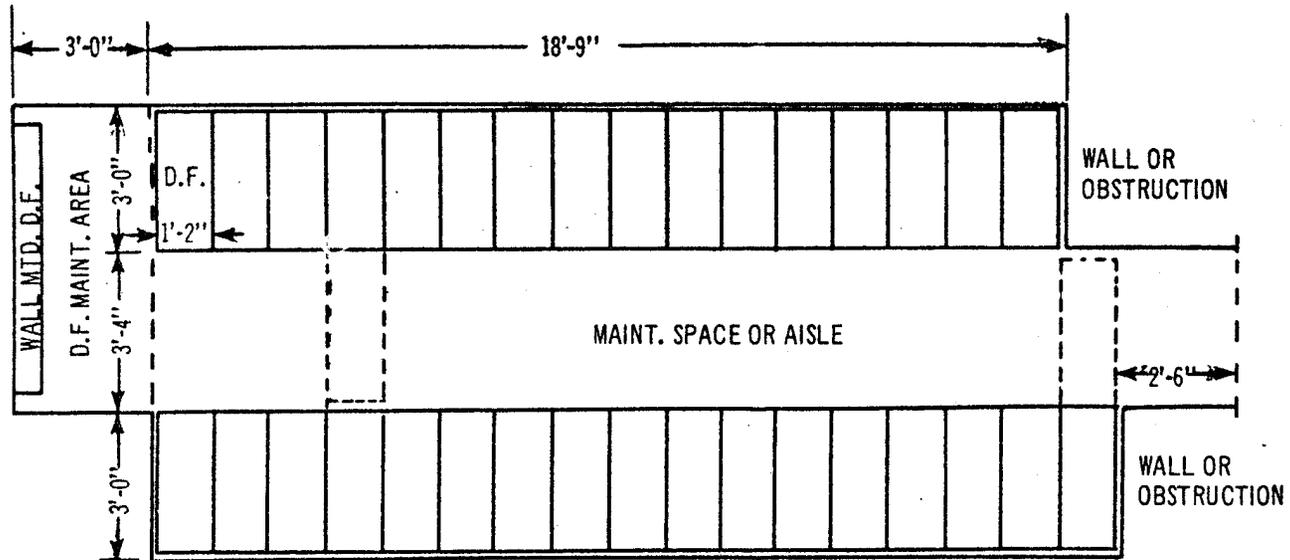
FLOOR AREA	
EQUIP.	- 21
D.F. MAINT.	- 9
AISLE	- 42
TOTAL	72 SQ. FT.

FIG. 3 - 810A FLOOR PLAN



400 LINES - SERIES 100
(16 CABINETS)

FIG. 4 - 810A FLOOR PLAN



800 LINES - SERIES 100
 (33 CABINETS, 1 WALL MTD. D.F.)

FLOOR AREA	
EQUIP.	- 117
D.F. MAINT.	- 18
AISLE	- 74
TOTAL	209 SQ. FT.

FIG. 5
810A PBX- ESTIMATED INSTALLED COSTS

