PROCESSOR MEMORY REQUIREMENTS
NETWORK DESIGN
NO. 3 ELECTRONIC SWITCHING SYSTEM

CONTENTS PAGE

Figures

CONTENTS PAGE

1. GENERAL

1.01 This section covers the Main Store (MAS) memory designed for use in the No. 3 Electronic Switching System (ESS). Included is the application of the network design worksheet used to determine the Main Store (MAS) memory requirements (Section 233-060-840).

1.02 This section is being reissued to include the improvements and added features provided in Issue 4A of the No. 3 ESS generic program SO-2 and to add procedures for the 128K memory module.

1.03 The MAS is functionally designed to include the generic program, the office translations information, and to provide the transient memory for call processing and associated administrative information. This section will be addressed primarily to the office translations area of the MAS.

1.04 The temporary store (call store) of the No. 3 ESS is located in a fixed area of the MAS memory. For the SO-2 issue 4A generic program, the temporary store occupies 20,480 words of memory space (Fig. 1). Since network design engineering of this area is not required, it will not be covered in detail in this section. The temporary store is allocated for various office parameters and a verification is required to determine that the individual and total temporary area capacities have not been exceeded. This procedure will be described in Section 233-060-130 Capacity Determination and System Capacities.

1.05 The MAS is located on the processor frame (Fig. 2). The 3A Central Control (3A CC) accesses the MAS to get program instructions and data to direct and control system actions. A MAS consists of a main store controller and main store memory modules. A single memory module provides the means of storage for 32,768 (32K) 18-bit words

or 131,072 (128K) 18-bit words and is incremented in these amounts as required for growth.

1.06 The MAS is a dynamic, volatile, semiconductor type of storage. Dynamic means that the memory is not permanent and must be automatically refreshed at defined intervals or the stored information will be lost. Volatile means that if power is interrupted, the stored information is destroyed. If a power failure occurs, a "bootstrap" operation is performed to reload and rewrite the stored information into the memory from the backup tape system.

1.07 The memory arrangements, including the tape data facilities, are discussed in Part 2 of this section.

1.08 Part 3 describes the operation and use of the main store memory modules and includes the programs contained on the tape data facilities.

1.09 The method of determining the quantity of main store memory modules required utilizing the Small Office -2 (SO-2) Generic Program is discussed in Part 4. Included are completed network design worksheets from Section 233-060-840 using hypothetical data for the example office, ***Ruraltown.***

1.10 References in this section to methods, planning, data requirements, service levels, and equipment quantities are based on American Telephone and Telegraph Company recommendations.

2. EQUIPMENT ARRANGEMENTS

GENERAL

2.01 The program store, temporary store (call store), and translation store are combined for each 3A CC into a single writable storage area called main store (MAS). This eliminates the need for the additional buses, drivers, buffers, and controls as used in previous systems to interface a separate program store and call store. A backup for the information stored in the main store memory is maintained on a tape cartridge. If the system memory is lost or destroyed, it may be manually restored from the tape and associated tape data controller (TDC) (Fig. 3).

MAIN STORE

2.02 The MAS serves as the storage medium for the generic program, call processing functions, and the office translations required for system operation. The MAS is made up of Insulated Gate Field Effect Transistors (IGFET) electrically alterable (writable) for system instructions. Main stores may have memory modules containing 32K or 128K words per 3A CC. 32K modules are added in 32K word increments to a maximum of five modules and a total of 160K words. A maximum of two 128K memory modules may be provided for 256K words. ***The 32K and 128K memory modules cannot be intermixed in the same office.*** All MAS memory modules are mounted on the processor frame (Fig. 2). The MAS controller serves as the interface between the 3A CC and the memory modules. A retrofit from 32K to 128K memory is not available at this time.

TAPE DATA FACILITIES

2.03 The tape data facilities consist of two tape data controllers and associated tape cartridge units located on the maintenance frame (Fig. 3). Each 3A CC is supported by its own tape cartridge system with accessibility to the other processor tape capacity system for reliability.

2.04 Assembly, equipment, wiring, and apparatus for a complete tape data unit is concentrated on one mounting plate.

3. OPERATION AND USE

GENERAL

3.01 The No. 3 ESS system control is comprised of two 3A processors each having its own dedicated main store (MAS) memory. Each 3A CC is a complete processing system capable of controlling peripheral equipment and all system functions. The two 3A processors normally operate in a duplex configuration with one 3A CC in active control of the system while the other 3A CC is in a standby mode. With the duplex arrangement, all instructions and data are read out of the on-line memory while all writing and updating is done in both memories. The system software is designed to autonomously and automatically transfer processor control if a fault is detected. Reading and writing into the MAS and its associated functions are performed

asynchronously (without timing pulse) from the 3A CC.

3.02 The two means of communication between the 3A CC and the MAS memory are the direct-coupled MAS bus and an input/output subchannel. The MAS bus is the normal means of communication; whereas, the input/output subchannel permits the on-line 3A CC to access the store of the other 3A CC for diagnostic purposes.

MAIN STORE

3.03 The MAS memory is the means of storage for the program instructions and data used by the 3A processor to direct and control the system. A maximum of five 32K MAS memory modules (160K words) or two 128K memory modules (256K words) may be provided per 3A CC. Each word consists of 18 bits, 16 data bits and two parity bits. The MAS memory module is divided into 4K blocks (4096 words—32K module) or 16K blocks (16,384 words—128K module) each of which may be write protected.

3.04 The MAS is divided functionally into temporary store (call store), program store, and translation store (Fig. 1). The temporary store is used by the 3A CC to store transitory data; the program store contains the office generic program; and the translation store provides access to all lines, trunks, and peripheral equipment information. The MAS is electrically alterable (except blocks that are write protected) and the contents of the memory can be changed by accessing it via the teletypewriter (TTY). Recent change (RC) messages are used to alter the memory when there are subscriber changes, trunk additions, addition of new trunk groups, service observing assignments, changes in office code treatment, etc.

TAPE DATA FACILITIES

3.05 Each tape cartridge (Fig. 1) contains a backup image of all the programs, parameters, and translation data residing in the MAS. The tape also contains infrequently used system programs. These programs are referred to as nonresident since they are stored externally to the MAS. Nonresident programs include diagnostics, service order (recent change) programs, etc. These programs are entered into the MAS when required by the system. When the nondedicated teletype arrangement is utilized, traffic data is also stored on the tape until it is printed at a later time on the network administrator's teletypewriter.

3.06 The MAS memory is volatile which means that if power is lost, the stored information is destroyed. If a total power failure occurs (including batteries), a "bootstrap" operation is performed to reload or rewrite the stored information into the MAS memory from the backup tape system.

4. DETERMINATION OF QUANTITIES

GENERAL

4.01 The main store (MAS) memory modules are functionally divided into three separate word memory areas; program store, temporary (call) store, and office translations. Memory space required for the program store and temporary store is identified and fixed by the issue of the generic program provided for the office (Fig. 1). The memory area required for translations is based on the physical size of the office and the associated switching functions and services provided. The quantity of memory modules required for the MAS is determined by the size of the translations area.

4.02 The translations capacities shown on the worksheets are current AT&T recommendations. There is presently an additional 8196 words available, over and above the published translations capacities, Issue 4A, for three and four modules of 32K memory and one module of 128K memory. These capacities, shown on the worksheets, were selected with the expectation that they will last through the next issue of the generic program. The availability of this additional translations space should be taken into account when making the decision to provide an additional module of 32K or 128K memory.

4.03 Section 233-060-840, MAS Modules, contains the worksheets required to calculate the translations area to determine the number of MAS modules required. These worksheets are divided into two parts; Item 1.0, Translation words (unduplicated) and Item 2.0, MAS Module Requirements. Figure 4 is an example of the completed worksheets using hypothetical data for the ***Ruraltown*** office.

TRANSLATION WORDS REQUIRED

4.04 Item D 1.0, Translation Words (Unduplicated), contains four columns: ***Item, Quantity,***

Factor, and ***Words.*** The quantity of each item required should reflect the maximum estimated requirements for the engineering period. For some items, the words to be entered must be converted from the unit quantities per the formula shown. Fractional quantities should be rounded to the next higher integer before entering them in the quantity column. For each quantity entered on the worksheet, multiply the quantity by the factor (words per item) and enter the product in the words column.

4.05 The following is a detailed description of each item used to calculate the Translation Words required (Fig. 4).

(a) ***Fixed (Item D1.1):*** This memory space is required in all No. 3 ESS offices. For the SO-2 generic program, 1600 words are required.

(b) ***Numbers (Item D1.2):*** The following types of translation words are required to define a telephone number served by the No. 3 ESS.

(1) ***Office Codes:*** Each office code (NXX) requires 13 words of memory. Enter the maximum number of office codes required for the engineering interval.

(2) ***Blocks of 1000 Directory Numbers:*** Each thousands group requires ten words of memory. Enter the maximum number of thousands groups required for the engineering interval.

(3) ***Hundreds Groups:*** Each 100-block of 4-digit telephone numbers (NXX-XX00 through NXX-XX99) requires 200 words of memory. The required entry is the total number of hundreds groups of telephone numbers estimated for the engineering interval. If one or more numbers in a hundreds group are used, space for the entire hundred group must be provided. It is not necessary to reserve space for all ten hundreds groups within a thousands group if they are not needed.

(c) ***Network Frames (Item D1.3):*** The number of network frames to be provided may be found in network design worksheet (Section 233-060-830) item C3.0. The factor includes words for each office equipment number (OEN) plus the additional words required to define a network frame. Each network frame requires 928 words of memory.

(d) ***Lines (Item D1.4):*** Additional translation store words are required to define the following types of lines:

(1) ***2-Party:*** Four additional words of memory are required for each 2-party line. Enter the ***maximum*** number of 2-party lines estimated for the engineering period.

(2) ***4-Party:*** Four additional words of memory are required for each 4-party line. Enter the ***maximum*** number of 4-party lines estimated for the engineering period.

(3) ***8-Party:*** Ten additional words of memory are required for each 8-party line. Enter the ***maximum*** number of 8-party lines estimated for the engineering period.

(4) ***Message Registers-Hardware:*** Enter the maximum number of hardware message registers required for the engineering period to determine the word requirements. Include those required for remote operations, such as hotel-motel.

(5) ***Message Registers-Software:*** Enter the maximum number of software message registers estimated for the engineering period. ***Do not*** calculate this requirement if the office is equipped for AMA-AMARC facilities.

(6) ***Coin:*** Enter the maximum number of coin lines forecast for the engineering period into the formula provided to determine the word requirements.

(7) ***Number of PBX and MLH Groups:*** Nine additional words of memory are required for each PBX and MLH group. Enter the maximum number of PBX and MLH groups estimated for the engineering period.

(8) ***Number of PBX and MLH Group Members:*** One additional word of memory is required for each PBX and MLH group member. Enter the maximum number of PBX and MLH group members forecast for the engineering period.

(9) ***WATS:*** Four additional words of memory are required for each outward WATS line. Automatic message accounting (AMA/AMARC) must be available for this service.

(e) ***Custom Calling Lines (Item D1.5):*** Additional translation store words are required to define the following types of custom calling lines: call forwarding, 8-code speed calling lists, and 30-code speed calling lists.

(1) ***Call Forwarding:*** Enter the maximum number of call forwarding lines forecasted for the engineering period.

(2) ***8-Code Speed Calling Lists:*** Twenty-seven words of memory are required for each 8-code speed calling list. Enter the maximum number of 8-code speed calling lists estimated for the engineering period.

(3) ***30-Code Speed Calling Lists:*** Ninety-three words of memory are required for each 30-code speed calling list. Enter the maximum number of 30-code speed calling lists estimated for the engineering period.

(f) ***Trunks and Service Circuits (Item D 1.6):*** Additional translation store words are required to define the following trunk groups and service circuits:

(1) ***Trunk Groups:*** Enter the sum of all universal and miscellaneous ***trunk groups*** estimated for the engineering period. ***Do not include*** trunk groups or circuits that do not require a network termination (ie, applique circuits). Nine words of memory are required for each trunk group.

(2) ***Total Trunks:*** Enter the total universal and miscellaneous trunks expected during the engineering period for those trunk groups specified above. Two words of memory are required for each trunk.

(3) ***Service Circuit Groups:*** Five words of memory are required for each service circuit group. ***Do not include*** tone and announcement service circuit groups. Enter the maximum number of service circuit groups required during the engineering period.

(4) ***Total Service Circuits:*** One and a half words of additional memory are required for each service circuit. Enter the maximum number of service circuits required during the engineering period. ***Do not include*** tone and announcement circuits.

(5) ***Tone and Announcement Groups:*** Five words of memory are required for each tone and announcement trunk group. Enter the maximum required during the engineering period.

(6) ***Total Tone and Announcement Circuits:*** One word of memory is required for each tone and announcement circuit. Enter the maximum number of tone and announcement circuits required during the engineering period.

(7) ***Number of Tandem 2-Way Outgoing Trunk Groups:*** Enter the maximum number of tandem, 2-way, and outgoing trunk groups required for routing and screening purposes during the engineering period. Seven and one-half words of memory are required for each trunk group.

(8) ***Three Way Conference Circuit:*** Two words of memory is required for each 3-way conference circuit. Enter the maximum member of 3-way conference circuits required for the engineering period

(g) ***Three & 6-Digit Translators (Item D1.7):*** Three and 6-digit translators are the starting point for establishing routing and the subsequent treatment for all the 3-digit NXX and NPA codes and 6-digit NPA-NXX codes. The call processing program examines the first three digits dialed by referring to the information placed in memory. These digits identify the call route, ie, intraoffice, interoffice, foreign area, etc, and whether 3- or 6-digit translations are required. Two types of 3- and 6-digit translators are provided for these translations: the complete index type translator and the search type translator. The network administrator must be consulted to determine how the 3- and 6-digit code translations will be handled.

(1) ***Number of Complete Index Translators:*** One complete index type translator is always recommended. In most

cases this translator will be used for 3- digit translations. Another complete index translator is needed for 6-digit translations when more than 127 office codes (the maximum the search type translator can handle) are required. ***A maximum of four complete index translators is allowed (one for 3-digit translations and three for 6-digit translations.*** Enter the numbers of complete index type translators required for the engineering period. Each complete index translator requires 400 words of memory.

(2) ***Search Type Translators:*** This translator will be used primarily for 6-digit translations. It may be used for 3-digit translations where less than 127 codes are required. Translations capacity of the search type translator is 127 codes plus one default value. In addition to the one recommended complete index type translator, three search type translators may be provided for the maximum of four translators per office. Three search type translators will handle a maximum of three foreign area routing codes requiring 6-digit translations. For each NPA requiring 6-digit translations, determine the maximum number of office codes plus one default value. Enter the sum for all NPAs. Each code and default value requires two words of memory.

(h) ***Translation Words (Item D1.8):*** The total translation words for service (Item D 1.8a) is calculated by adding all the word requirements for item D1.1 through item D1.7 This total is divided by the administrative margin (0.95) to determine the total unduplicated translation word requirements (Item D1.8c) for the engineering period. The current translations capacity of the No. 3 ESS is limited by the capacity of the tape backup to 52K (53,248) words. This limitation applies to both types of memory modules and is expected to be increased with the 3E3 generic program.

MAIN STORE MODULE REQUIREMENTS

4.06 Once the total translation word requirement is determined, refer to the table on the worksheet (Fig. 4) for MAS module requirements. The table includes word capacities for all generic program issues presently available or in service. It should be noted that the new 128K module ***is not*** compatible with the existing or new 32K module.

4.07 Issue 4A of generic program SO-2 may be installed with memory modules with two memory capacities; 32,768 (32K) words and 131,072 (128K) words. MASs of unduplicated 32K words memory modules, for issue 4A of the generic, may now be arranged for a minimum of three and a maximum of five modules. A maximum of two unduplicated memory modules is recommended for the MAS utilizing the 128K word memory capacities. The worksheet table (Fig. 4) covers the capacities of the various arrangements and are ***for use with the SO-2 generic program only.***

4.08 The 32K memory module is available ***for additions and maintenance only.***

4.09 The translation word requirements should be carefully evaluated, especially with regards to custom calling forecasts and numbering plan. Consideration should be given to when an additional memory module is required, (ie, the fourth year of a five year job) before it is ordered. Also, available with Issue 4A of SO-2 generic program is ***translation reallocation capabilities*** which may be utilized on a local basis. The reallocation program provides the means of creating, expanding, compressing, and deleting translations as necessary. With this capability, translation areas required for growth may not be necessary.

SO-2 PROGRAM MEMORY ALLOCATION

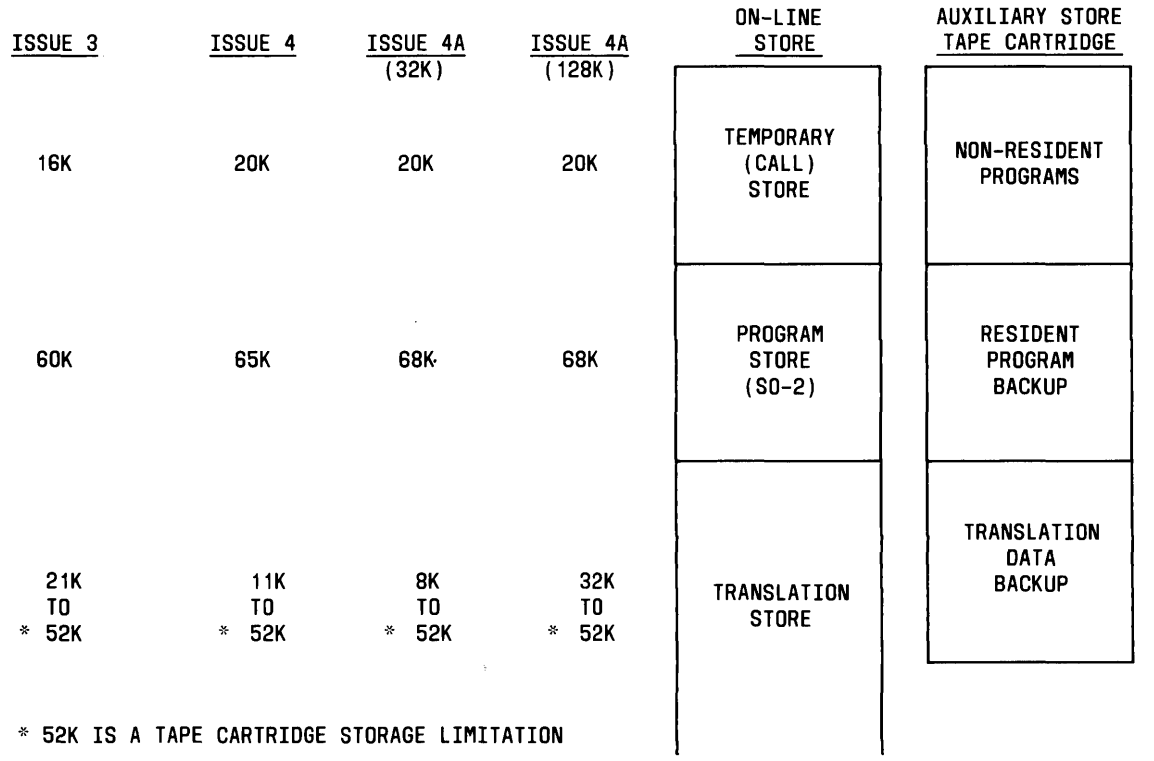

Fig. 1—Memory Allocation

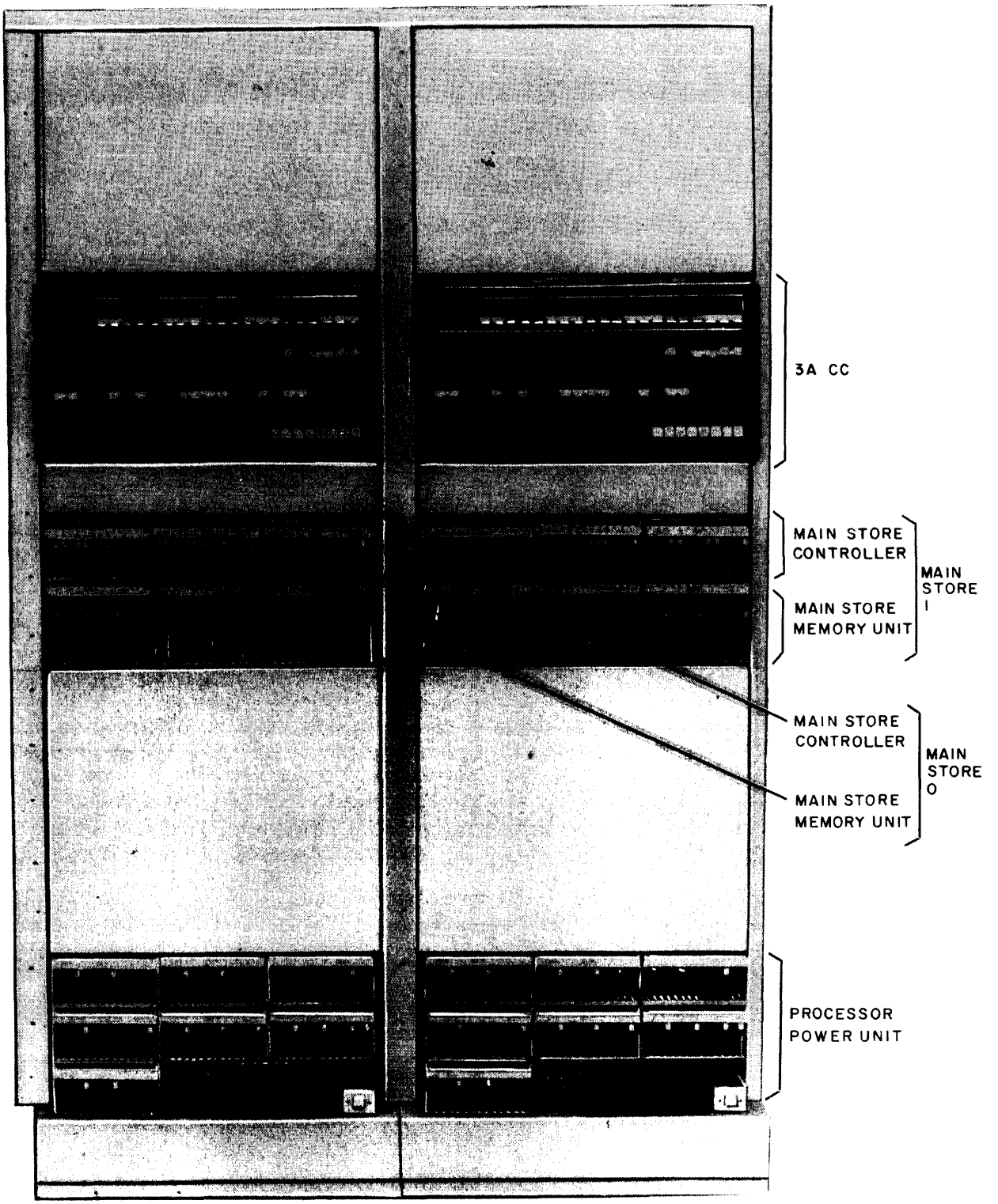

Fig. 2—Processor Frame

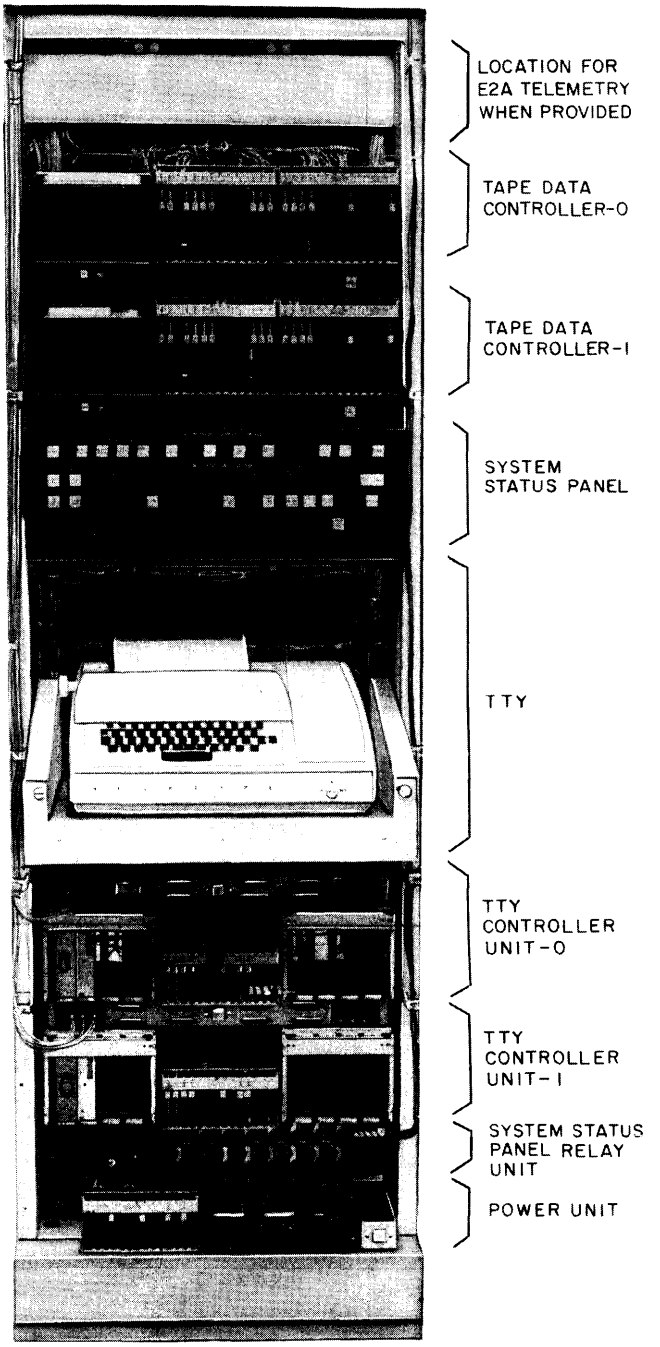

Fig. 3—Maintenance Frame

SECTION 233-060-840, Issue 2
Page 2

Order No. FM 2031
Section A Page
Office RURAL TOWN
Date
Reference – SECTION 233-060-450

NO. 3 ESS
NETWORK DESIGN WORKSHEET

D. MAIN STORE MODULES

1.0 Translation Words (Unduplicated)

ITEM		QUANTITY		FACTOR		WORDS
1.1 Fixed		1600	×	1	=	1600
1.2 Numbers						
a.	Office codes (max. 8)	1	×	13	=	13
b.	Blocks of 1000 directory numbers	5	×	10	=	5
c.	Hundreds groups	50	×	200	=	10,000
1.3 Network Frames		14	×	928	=	12,992
1.4 Lines						
a.	2-Party	273	×	4	=	1092
b.	4-Party	242	×	4	=	968
c.	8-Party	—	×	10	=	—
d.	Message registers - hardware	—	×	2	=	—
e.	Message registers - software (30 × 2) + (30 ÷ 16)	62*	×	1	=	62
f.	Coin (30 × 3)+(30 ÷ 3)=	70*	×	1	=	70
g.	Number of PBX and MLH groups	20	×	9	=	180
h.	Number of PBX and MLH group members	90	×	1	=	90
i.	WATS	—	×	4	=	—
1.5 Custom Calling Lines						
a.	Call forwarding (360 × 2)+(360 ÷ 16)=	743*	×	1	=	743
b.	8-code speed calling lists	100	×	27	=	2700
c.	30-code speed calling lists	6	×	93	=	558
1.6 Trunks and Service Circuits						
a.	Trunk groups (universal and miscellaneous)	70	×	9	=	630
b.	Total trunks (universal and miscellaneous)	590	×	2	=	1180
c.	Service circuit groups	19	×	5	=	95
d.	Total service circuits	138	×	1.5	=	207

* Round to next higher integer

Fig. 4—Network Design Worksheet Completed for Example Office (Sheet 1 of 2)

SECTION 233-060-840, Issue 2
Page 3

Order No. FM 2031
Section A Page
Office RURAL TOWN
Date
Reference – SECTION 233-060-450

NO. 3 ESS
NETWORK DESIGN WORKSHEET

D. MAIN STORE MODULES

1.0 Translation Words (Contd)

ITEM	QUANTITY		FACTOR		WORDS
1.6 Trunks and Service Circuits (Contd)					
e. Tone and announcement groups	12	×	5	=	60
f. Total tone and announcement circuits	36	×	1	=	36
g. Number of tandem + 2-way + outgoing trunk groups (for routing and screening)	12	×	7.5	=	90
h. Three-port conference circuit	5	×	2	=	10
1.7 3 & 6 Digit Translators (Max. 4)					
a. Number of complete index translators	1	×	400	=	400
b. Search type translator (max. 128 codes/trans.) Σ all codes + default values	65	×	2	=	130
1.8 Translation Words					
a. Total translation words for service (total D1.1 through D1.7)				=	33,911
b. Administrative margin				÷	0.95
c. Total translation word requirement (unduplicated)				=	35,696

2.0 Main Store Module Requirements (See Tables Below)

a. Main store modules provided	5
b. Generic program provided	SO-2
c. Issue of generic program provided	4A(32K)

ISSUE OF GENERIC PROGRAM	UNDUPLICATED TRANSLATION WORDS	MAIN STORE MODULES/ SYSTEM CONTROL
Issue 3	22,500 or less	3
	22,501 to 55,500	4
Issue 4	12,288 or less	3
	12,289 to 47,500	4
Issue 4A (32K) †	0	3
	32,768 or less	4
	32,769 to 53,248	5
Issue 4A (128K) †	0	1
	32,768 or less	1
	32,767 to 53,248	2

† See paragraph 4.02 for discussion of Translation Word Capacities.

Fig. 4—Network Design Worksheet Completed for Example Office (Sheet 2 of 2)