CENTRALIZED STATUS, ALARM AND CONTROL SYSTEM DESCRIPTION

CONTENTS PAGE

1. GENERAL

1.01 This section contains the physical and functional description of the Centralized Status, Alarm and Control System (CSACS).

1.02 Whenever this section is reissued, the reason for reissue will be listed in this paragraph.

1.03 The Centralized Status, Alarm and Control System (CSACS) is a real-time alarm monitoring system which allows the centralization of alarms from remote electromechanical wire centers. The

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system also provides a number of controls for centralized operation of wire center equipment such as to make equipment busy, reset alarms and other operations to reduce the need for immediate dispatch and protect service.

1.04 The system objective is to provide operator personnel at the central location with sufficient information to determine an optimal course of action. This action may be to monitor further, exercise a remote control, or dispatch maintenance personnel to the wire center.

1.05 The system coverage can range from an option containing only those points which are needed to provide minimal coverage for a wire center (primary) to other much more detailed coverages which can be tailored to the particular wire center (secondary). Circuit modifications have been engineered on a standard basis for the equipment on which coverage is recommended. Where local conditions require the monitoring of additional equipment not covered by the standard options, provision has been made for TELCO to define additional coverages engineered to its own needs.

2. SYSTEM HARDWARE DESCRIPTION

2.01 CSACS is composed of the central processing alarm and control equipment, an E2A remote unit connected to status and control points at each remote wire center, and a 4-wire private line multipoint data network interconnecting the central to the remote wire centers.

2.02 The CSACS central consists of three major groups of equipment (Fig. 1)—the CSACS central unit (J1P003A), the CSACS telemetry and control unit interface (J1P003B), and the input/output devices, such as TTYs and audible and visual alarms. The visual alarms consist of optional critical wall indicator(s) (J1C016D).

2.03 The remote wire centers consist of an E2A remote telemetry unit (J1P003D, No. 5 Crossbar; J1P003E, Step-by-Step) with its 202T data set, an interface unit, status and control point modifications, an optional building terminal strip, and the interconnecting leads from the status and control points to the E2A or interface unit. The interface unit, E2A, and the data set are frame mounted at the wire centers.

2.04 The data network is the communication link between the central and the remote wire center. The data network is TELCO engineered and maintained to the requirements detailed in EL1700. As a practical limitation, up to 16 remote wire centers may be connected to a data network.

3. EQUIPMENT ELEMENTS

CSACS CENTRAL UNIT—SD-1P024-01 (See System Block Diagram)

3.01 The CSACS central unit is housed in Cabinet A consisting of a stored program data processor, 28K 16-bit words of usable core memory, a tape cassette drive unit, an optional ROM (Read Only Memory) bootstrap loader and the associated UNIBUS interface circuits. The processor executes control of all peripheral devices within the central unit over the UNIBUS, which is a common high speed data path interconnecting all processor controlled peripherals and memory. The interface circuits provide the logic and buffer registers necessary for program-controlled parallel transfers of data between the central unit and external equipment. The interface circuits also include status and control bits that may be controlled by either the program or the external device. A detailed discussion of the central unit hardware follows.

A. PDP 11/10 Processor (Fig. 2)

3.02 The central processor, manufactured by Digital Equipment Corporation, is a 16-bit data word, byte-oriented general purpose computer. The processor, which is connected to the UNIBUS, controls the time allocation of the UNIBUS for peripherals, and performs arithmetic and logic operations and instruction decoding. It has eight high-speed general-purpose registers and a capacity of 32,768 directly addressable word locations. The upper 4,096 word locations are designated as peripheral device addresses leaving a maximum of 28,672 word addresses for core memory. The processor is slide mounted in a H960 type cabinet (cabinet A) and includes a real-time clock, the master TTY interface, the first 8,192 words of core memory and slots for four UNIBUS to processor interface modules. (Fig. 3).

B. UNIBUS

3.03 The UNIBUS is a single common set of signal wires that connect the processor,

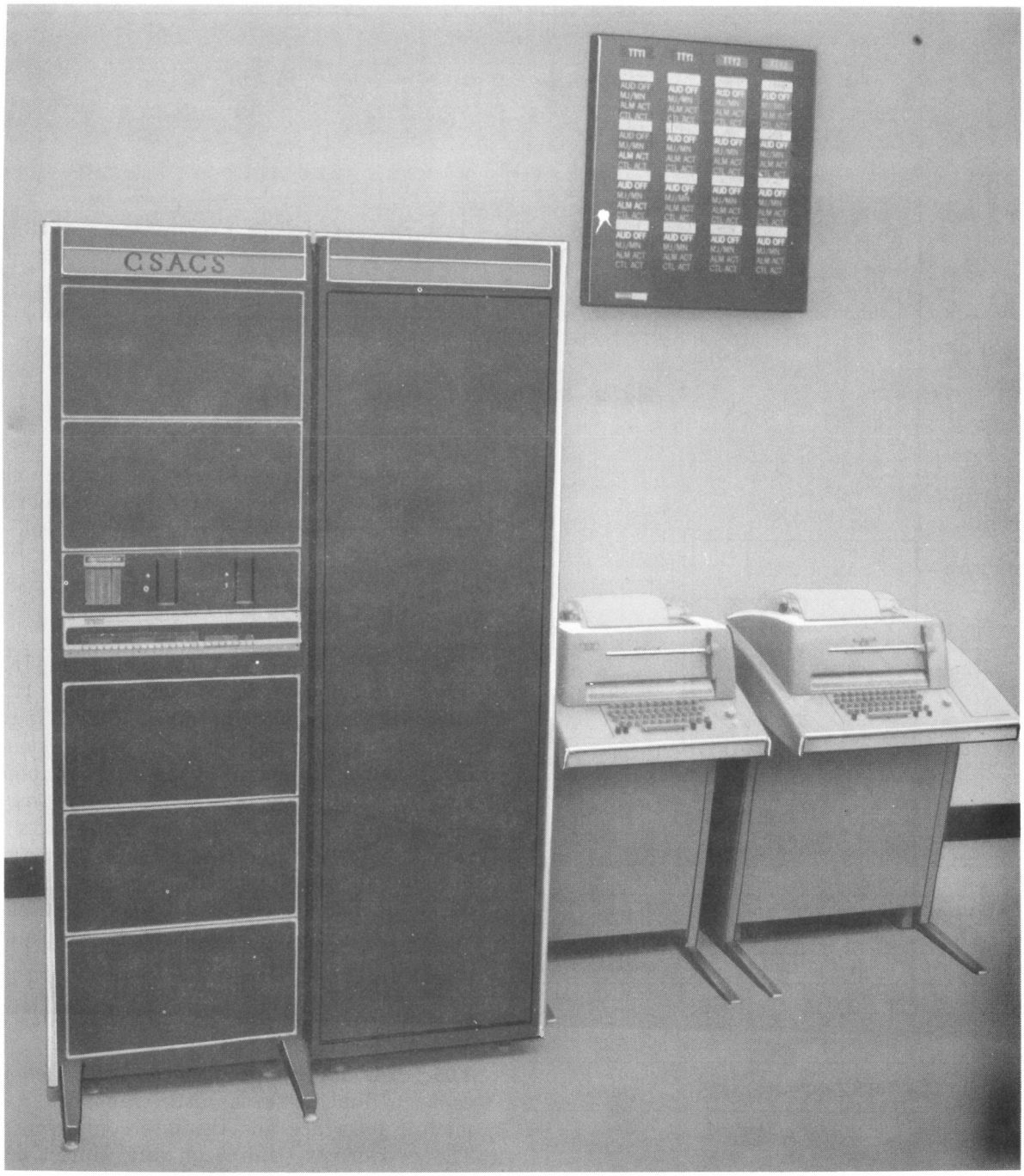
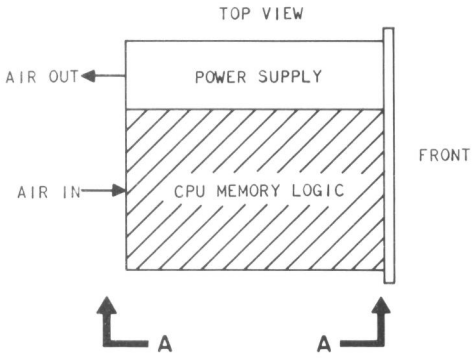


Fig. 1—CSACS Central Equipment

Fig. 2—PDP 11/10 Processor



	DLII-E FOR 1ST TTY
MAINTENANCE	DRII-C FOR 1ST TCT
UNIBUS CONNECTOR SLOT	DRII-C FOR ALARM AND CI
	TAII-AA FOR TAPE CASSETTE
UNIBUS TERMINATOR	
CORE MEMORY (8K)	
CENTRAL PROCESSOR UNIT	

VIEW A-A

Fig. 3—Processor Equipment Arrangement

memory, and all peripheral interfaces. Each device, including memory location, processor registers, and peripheral device registers, is assigned an address on the UNIBUS. The UNIBUS consists of 120 conductors in the form of ribbon-cable—fifty-six conductors for signals and 64 for grounds. Signals and grounds are alternated to minimize crosstalk. All devices are connected to these lines in parallel. Fifty-one of the signal lines are bidirectional, and the remaining five signal lines are undirectional and are used for priority bus grant control.

C. LT35-CC KSR 35 TTY Master TTY

3.04 The master TTY is a modified KSR 35 supplied with the processor. It is not interchangeable with the other TTYs. It provides for full-duplex eight-level ASCII asychronous serial data over a standard 20 Ma current loop. The interface, built into the processor, has the control and monitoring functions and the data buffer registers for data storage prior to transfer. The master TTY is the only TTY that can be used for computer diagnostics, off-line utilities and entering data when performing system data generation.

D. TA11-AA Magnetic Tape Cassette System (Fig. 4)

3.05 The TA11 tape cassette system consists of a dual drive cassette transport, a control module interface and the interconnecting cables. The two drives (Unit 0 on left, Unit 1 on right) do not run simultaneously. The cassette tape is special digital quality "Phillips-Type". It is 1 mil thick by 150 feet long. The cassette system is used to perform system generation of the generic software and to provide a storage medium for diagnostic and off-line utilities. The on-line function of the cassette tape unit is loading the generic into core memory and dumping the core image in case of system failure. The tape transport is slide mounted in cabinet A above the processor. The control module interface is mounted in the processor.

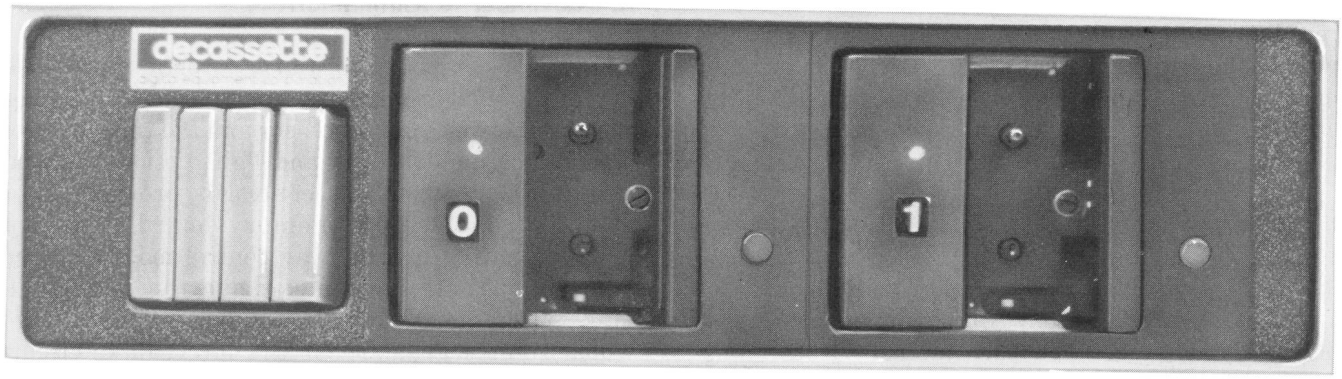


Fig. 4—TA11-AA Cassette Drive

E. DR11-C General Purpose Interface

3.06 The DR11-C is a general purpose interface between the processor UNIBUS and an external peripheral. The DR11-C provides the logic and buffer registers necessary for program-controlled parallel transfers of 16-bit data between the processor and the external devices. The interface also includes status and control bits that may be controlled by either the program or the external device for command, monitor, and interrupt functions. In CSACS the DR11-C has two applications. The first is the computer to alarm and critical indicator interface. The connecting external circuit is always equipped for alarm control and optionally equipped to drive critical indicator display panels. The connecting cable in this application uses only the output connector of the DR11-C. The DR11-C for alarms and critical indicators is mounted in the processor box. The second application of the DR11-C is the telemetry computer translator interface. Each DR11-C connected to a telemetry computer translator (TCT) allows the processor to communicate to a 202T data set in E2A format. The system can support up to eight DR11-C-to-TCT interface units with the first (DR1) being mounted in the processor box and the additional (DR2-9), as required, mounted in the extension mounting box located below the processor in cabinet A.

F. DL11-E Asynchronous Line Interface

3.07 The DL11-E is a character-buffered communication interface designed to assemble or disassemble the serial information required by a communications device for parallel transfer to or from the processor UNIBUS. The circuit includes the serial transmitter and receiver and the status and control bits necessary for command, monitor, and interrupt functions. The EIA data set control bits are included for control of 103-, 108-, or 202-type data sets. The DL11-E is used as a serial interface for the local or remote TTYs. The local TTYs are equipped with EIA interfaces and are connected through a null modem cable. The DL11-E controls a 108-type data set when used with a remote TTY. The processor can support up to five DL11-E interface modules. The first is mounted in the processor and the additional, as required, are mounted in the extension mounting box.

G. H960-DA—Central Unit Cabinet

3.08 The H960-DA cabinet is 72 inches high by 21 inches wide, by 30 inches deep, with a 861C-type power controller. The cabinet can mount equipment 19 inches wide. The power controller provides both switched and unswitched ac outlets. The unswitched power is provided through a circuit breaker for operating equipment requiring continuous power. The switched power is applied through a power relay in the power controller. The power controller is connected to the processor OFF-ON-PANEL LOCK switch. When the processor switch is placed to ON or PANEL LOCK position, the power relay operates and applies power to the switched outlets. The H960-DA comes equipped with BA11-FD Extension Mounting Box.

H. BA11-FD Extension Mounting Box (Fig. 5)

3.09 The BA11-FD comes installed in the H960-DA cabinet. It provides mounting space for core memory and interface modules. It includes a

bulk power supply which provides the necessary regulators to provide dc power to the units installed within the mounting box. The BA11-FD is slide mounted and occupies the bottom half of the H960-DA cabinet.

I. Core Memory

3.10 The core memory provided with the system is magnetic read/write core memory with a 900-ns cycle time. The core memory is the only on-line storage for the system and provides 28,672 (28K) word locations. The first 8 K words are located in the processor. Two units, a MF11-L (8 K memory) and a MM11-LF (12 K memory) provide the last 20K of memory. The MF11-L is mounted in the extension mounting box and provides the mounting assembly and cables necessary to mount the MM11-LF.

J. B792-YH Cassette Tape Bootstrap Loader

3.11 The B792-YH ROM contains a 32-word program which allows the system to be bootstrapped from cassette tape. The program rewinds the cassette tape, skips the first block, reads a 128 word block into the first 128 locations of memory, and then jumps to location 0 of memory. The block which is read into low core contains the actual bootstrap loader program. The cassette tape bootstrap loader reduces the amount of work required by the craft in system generation, reading in diagnostics, running off-line utilities, and loading the operational programs. The bootstrap loader is mounted in the extension box.

CSACS TELEMETRY AND CENTRAL UNIT INTERFACE (SD-1P023-01) (See System Block Diagram)

3.12 The CSACS telemetry and central unit interface is a configuration of Western Electric assembled equipment units designed to provide the necessary interface between the central unit and the alarms, critical indicators, telemetry and teletypewriters required by the system. The equipment is housed in its own 6-foot high by 21-inch wide by 30-inch deep cabinet (cabinet B) adjacent and attached to the central unit cabinet A. The units are mounted in both the front and back of the cabinet. A detailed discussion of the units and their functions follow. (See Fig. 6.)

A. Computer to Alarm Interface

3.14 The computer to alarm interface provides the synchronization, control, and buffering required between the processor and the relay control circuits to sound alarms and light optional critical indicator displays. This control is provided by a primary computer to memory board interface module for the first 16 relay control modules. The first relay control modules drive the major and minor alarm and provide a watch-dog-timer control which sounds an alarm if the interrupter circuit fails to operate. The remaining 15 relay modules are used to drive critical indicator displays. If the optional critical indicators are provided and the system is displaying more than 60 wire centers, a secondary computer to alarm interface unit is required. The secondary interface operates similar to the primary to control an additional 16 relay control modules to display the additional wire centers. The computer to alarm interface units (J1P003BA-1) are mounted on the rear of cabinet B.

Primary Computer to Memory Board Module AR718

3.14 The primary computer to memory board module AR718 provides the synchronization, control, and buffering between its input and up to 16 memory and relay control modules (AR700). The AR718 will also provide the control for a secondary computer to alarm interface unit if more than 16 AR700 are required. The input to the AR718 is from connector No. 1 of the first general purpose interface DR11-C (DR0) on the central unit processor. No electrical feedback is provided from the AR718 other than control information. Fault detection is performed by the maintenance personnel through programmed audio and visual tests. The design and length of cable between the processor and this circuit is quite critical and is restricted to 15 feet. All data signals are run on tight-twisted pairs with grounds. The grounds are to be spliced as close to the two connectors as possible to obtain maximum benefit of the tight-twisted pair cable. The AR718 and the AR700s it controls are mounted on the primary computer to alarm interface.

Secondary Computer To Memory Board Module AR719

3.15 The secondary computer to memory board module AR719 provides the synchronization, control, and buffering between its input and the

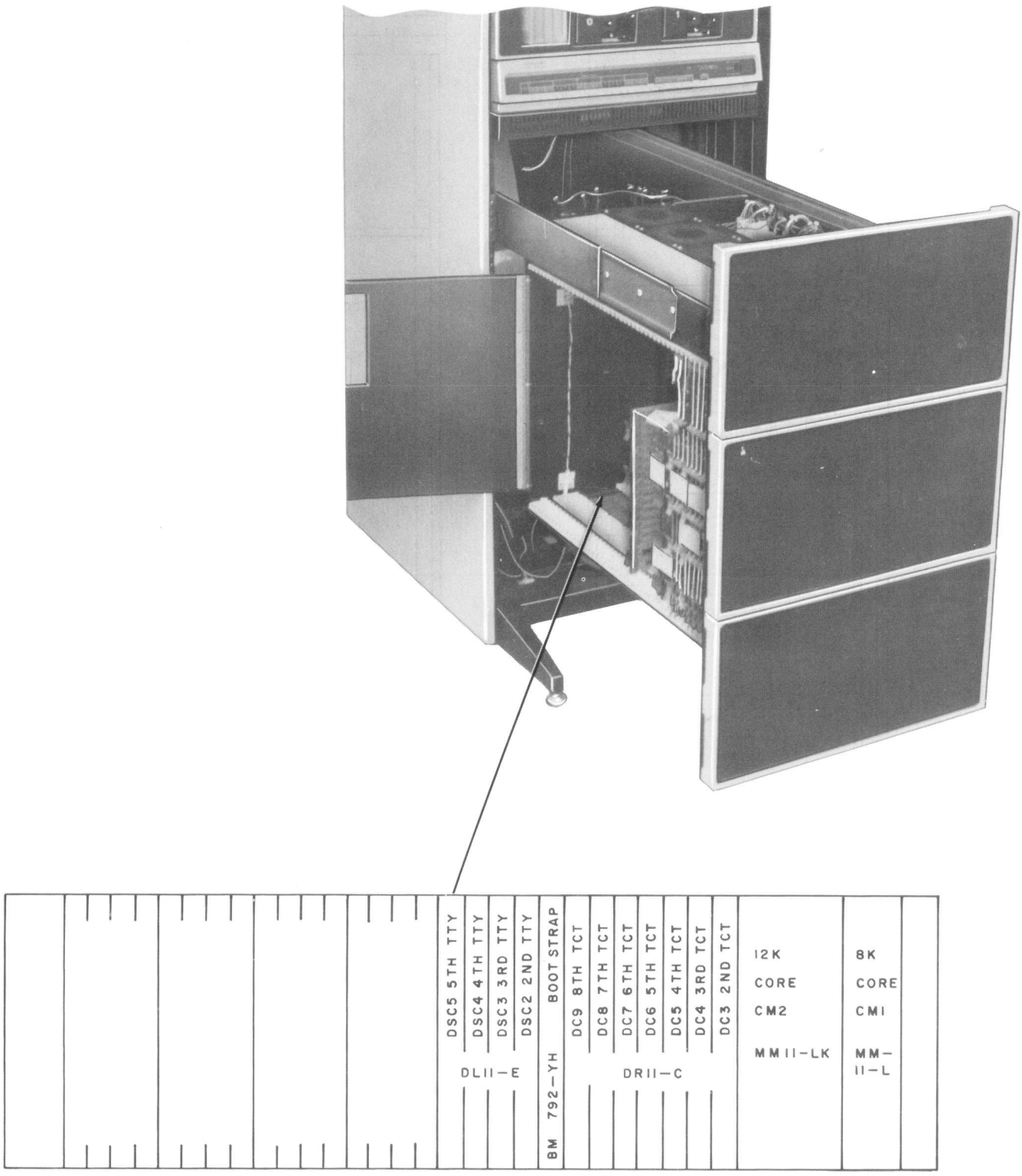


Fig. 5—BA11-FD Extension Mounting Box

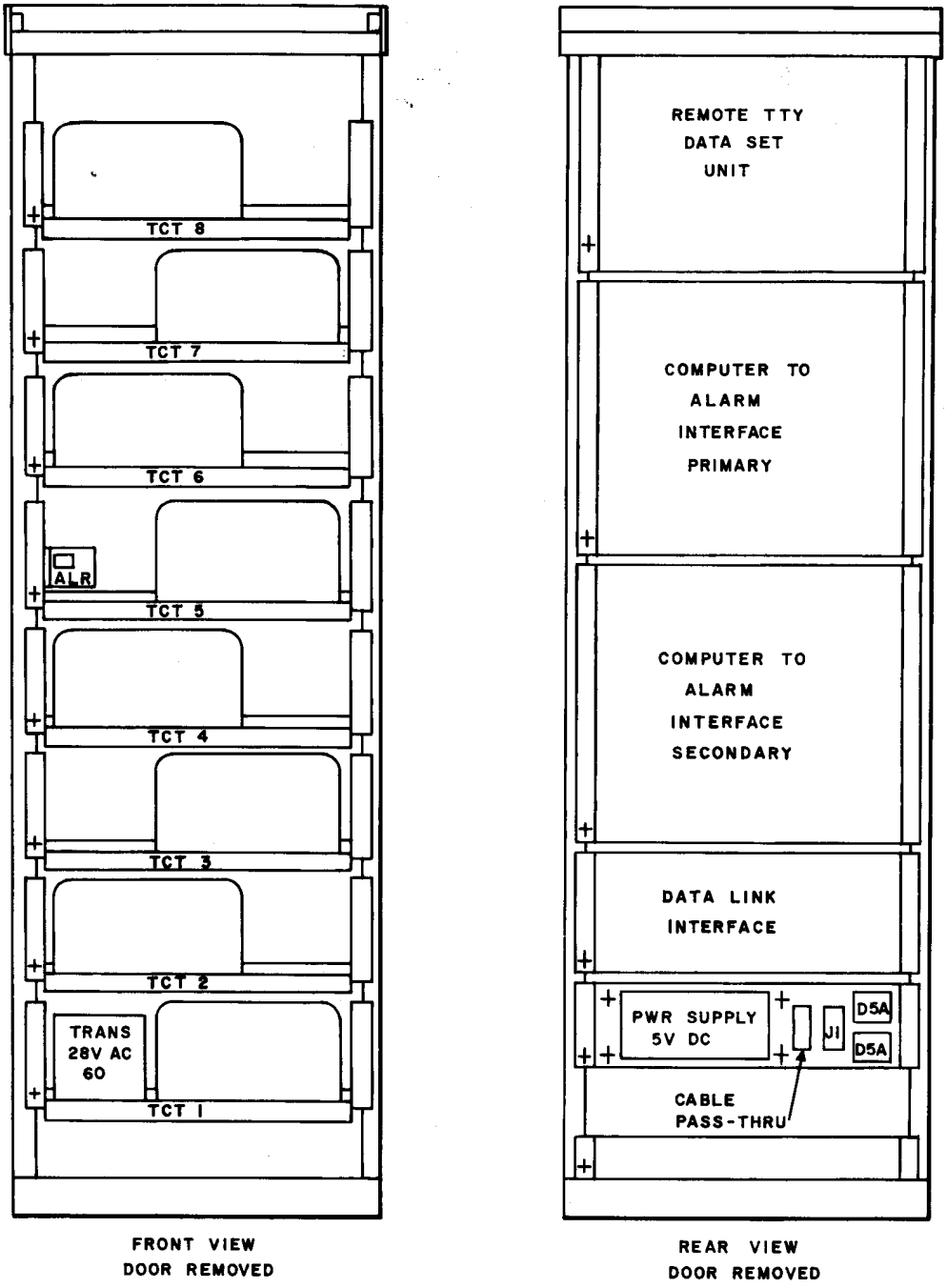


Fig. 6—Telemetry and Central Unit Interface Cabinet

memory and relay control modules (AR700) under its control. The input to the AR719 is physically a secondary connector from the primary interface unit. The inputs are logically from both the general purpose interface (DR0) and the primary interface AR718. The input control and timing is supplied by the AR718 and the data is from the general purpose interface. The AR719 and the AR700 modules under its control are mounted on the secondary computer to alarm interface unit.

Memory and Relay Control Module AR700

3.16 The AR700 memory and relay control module provides the means of storing data from the data bus, which connects all AR700s to the AR718 or AR719, and presents the data as relay contact closures. The module has a clock and 16 data input terminals. The data lines are shared by the other modules but each has its own clock lead. When, the AR718 or AR719 module selects an AR700 module, it strobes the clock lead which inputs the 16 data bits from the bus. The 16 data bits are then stored in memory. The output of memory is connected to 16 buffer drivers which drives the output relays. The AR700 modules mounted on the primary computer to alarm interface unit, as required, are designated MEM (1-16). The AR700 modules mounted on the secondary interface unit, as required, are designated MEM (17-32).

3.17 The first AR700 module, MEM 1, is used to control the alarm circuitry. The first 4 relays are assigned to continuous interrupters. The first relay is operated at 120 ipm, 50 percent duty cycle. The make and break contacts of this relay are used to control the watch-dog-timer.

3.18 The watch-dog-timer is a dual channel RC circuit with a transistorized buffer and relay driver. The output drivers are tied together so that the timer output is grounded if either half of the circuit times out. If either input fails to be grounded within approximately 3.5 seconds, the output will be grounded and operate the watch-dog-timer relay in the alarm control circuit and sound the ringing alarm. A nonlocking alarm release key, mounted on the front of cabinet B, is provided to silence the alarm. Relays 2—4 are not presently used.

3.19 The remaining relays of MEM 1 relay module that have assigned function at this time are as follows.

- Relay 5, 120 ipm data interrupter which drives the tone ringer. This relay operates when the processor wishes to signal a telemetry alarm.
- Relay 6, 3-second timed alarm which drives the tone ringer for 3 seconds. This relay operates only when the processor wishes to signal a minor alarm.
- Relay 7, 60 ipm controlled interrupter which drives a chime buffer relay. This relay operates when the processor wishes to signal a major alarm.

3.20 The relay modules AR700 MEM 2-32, as required, are used to drive the lamps on the critical indicator display panels—one module per vertical column on the indicator, four relays to an office with four offices per vertical.

B. Telemetry Computer Translator (TCT)

3.21 The TCT is an asynchronous data set controller that provides the processor with the means of communicating with the E2A remote units. It take parallel data from its general purpose interface unit and converts it into serial E2A formatted data. The serial data is sent via the 202T data set and multipoint data network to the remote units. The TCT also takes the serial data from the data network and converts it into parallel data for use in the processor. The output of the TCT to the 202T data set is standard EIA data set control signals. One additional nonstandard EIA data set control lead is used by the TCT for carrier restoral to facilitate fast polling. Each 202T data set associated with a TCT is optioned to accommodate fast polling in a 4-wire multiparty environment. The TCTs are shelf-mounted on the front of cabinet B, and the data sets are mounted on the back of cabinet B.

C. Local/Remote Teletypewriter Interface

3.22 The central unit can support up to five TTYs in addition to the master TTY. Each of the additional TTYs may be local or remote to the central unit. If the TTY is to be a local TTY (less than 100 cable feet), a null modem cable is required. The null modem cable allows the EIA cable from the processor DL11-E interface to be connected to the EIA cable from the TTY. Since the interfaces of the processor and the TTY EIA are designed to work into a data set and not into another terminal, the null modem cable allows each terminal to look like a data set to the other terminal.

3.23 If the TTY is to be a remote TTY, the EIA cable from the processor is connected to a 27B1 data unit which provides the termination of the EIA cable, test switches for maintenance, and required strapping and cabling to the 108E type

data set. The 108E data set is optioned for 2-wire operation, mark-hold condition on TL lead during loss of carrier detection, and full duplex operation. At the remote TTY, a 108D is used and optioned the same as to 108E at the central. The 27B1 data unit and the data sets are mounted on the back of cabinet B.

D. Audible Alarms

3.24 There are two audible alarms provided with CSACS. The alarms are provided to signal the operator personnel when an off normal condition exists. The alarms will represent a major, minor, telemetry or watch-dog-timer alarm. The audible for a major alarm is produced by a KS-5594-L5 chime. The minor, telemetry and watch-dog-timer alarms are produced by a S1B tone ringer. The audible alarms are to be mounted external to the equipment cabinets. They may be wall or panel mounted so that they are easily heard in the local work area.

E. Critical Indicator Display (Fig. 7)

3.25 The critical indicator display is an optional wall-mounted panel 33 inches high, 29 inches wide by 4 inches deep. Each critical indicator display panel contains four vertical columns of 16 light indicators each. A vertical column displays the critical indications for four wire centers, each having four indications. Each vertical column on a critical indicator display panel is driven by a relay control module AR700 (MEM_) located in cabinet B. The lamps will provide a summary display of the wire center status and quickly identify the associated wire center with some degree of urgency when a audible alarm is received. The lamps associated with each wire center and their function are as follows.

- AUD OFF: This (audible off) lamp is lighted when the audible alarms for the particular wire center are not to sound at the central unit location. This is a result of the wire center being placed in the manned or local mode.

- MJ/MN: This (major/minor) lamp is lighted when the audible alarm sounds at the central location. It will persist until released by personnel at the central location.

- ALM ACT: This (alarm active) lamp is lighted as long as an alarm condition for the wire center exists, even if the alarms have been inhibited by an input message.

- CTL ACT: This (control active) lamp is lighted as long as any of certain remote controls of the wire center are operated.

3.26 The critical indicator displays shall be wall mounted so that they are easily viewed from the local work area, and the cable from the relay control module to the panels shall not exceed 200 cable feet.

F. Local/Remote Teletypewriter

3.27 The local/remote TTYs are 35-type KSR USOC code HOPPF or functional equivalent. They are not interchangeable with the master TTY, connected to the processor. The local/remote TTY is an on-line operation TTY and has no off-line function. The TTYs are assigned various administrative functions and input authorization. The assignments (covered in Part 4 of this Section) are via the software.

REMOTE WIRE CENTER (See System Block Diagram)

A. E2A Telemetry Status and Command Remote Unit

3.28 The E2A telemetry status and command remote unit (SD-1C543-01) is designed for general applications, but its features have been tailored to suit the CSACS requirements (No. 5 Crossbar remote—SD1P027-01, J1P003D; Step-by-Step remote—SD1P025-01, J1P003E). The maximum capability of the E2A remote unit is 1024 status points monitored with limited output command points or 256 output command points with limited status points. The CSACS applications will utilize a combination of these points. The E2A remote unit provides a rigid set of lead designations, SS for status input points and CC for command output points. The status points are divided into status groups. The status group is a logical entity that governs the order in which the information is sent from the remote unit to the central unit. The structure of the status group is not dependent upon the physical arrangement of the E2A remote unit but rather a function of the cross-connections in the unit. There are four status groups, numbered from 1 to 4, containing up to 256 status points each. The status group is divided into 16 subgroups,

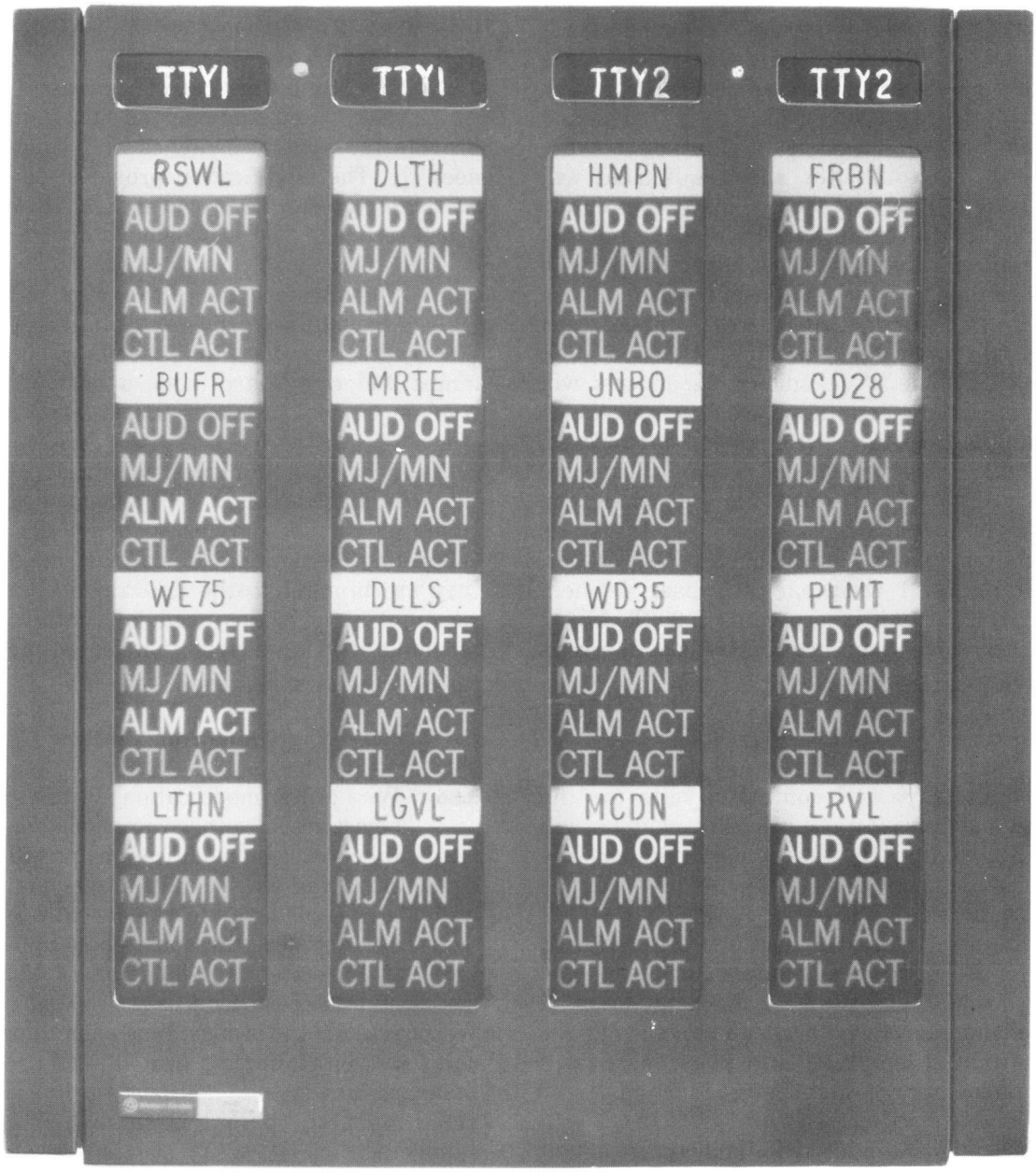


Fig. 7—Critical Indicator Display

numbered from 1 to 16, with 16 status points each. The status points within the remote unit are numbered, by the generic software, from 1 to 1024 with points 1 through 256 being in status group 1. The points of the second status group start at 257 regardless of the number of points actually used in the first status group. Similarly, the third status group starts with point 513 and the fourth with 769. Each point is dedicated for a particular function (status, special, reserved, or user definable), the particular function being dependent upon the type of wire center being served.

3.29 The E2A remote unit consists of a basic remote unit and up to four expander units. A basic remote unit contains common control logic along with 4 combined status and command cards. Each of the combined cards has 16 status input

points and 8 command output points for a total of 64 status/32 command points. An expander unit has provision for mounting eight cards. The cards may be any combination of two types; cards with 32 status input points or cards with 16 command output points. Depending upon the size of the wire center being monitored, the basic equipment will grow to provide coverage by adding up to four expander units and cards as required. A number of cross-connects are required to adapt the general E2A remote unit to the CSACS application. These cross-connects are made on a cross-connect card (CP34) in the basic unit and one (CP8) in each expander unit. The basic unit cross-connects will establish operating conditions, assign the status address, and identify the last equipped circuit card. The expander cross-connect will assign status and command card positions to status group and subgroup numbers and command block numbers. The types of CSACS remote offices will be No. 5 Crossbar, Step-by-Step, No. 1 Crossbar, and user defined. Each E2A remote unit incorporates a 202T private line data set for communication with a like data set at the CSACS central unit.

B. Interface and Control Circuits

3.30 The interface and control circuits for the various types of remote wire centers will function approximately the same; however, the hardware and office modification to perform the functions will differ. The No. 5 Crossbar Office will have an interface and control unit (SD-28075-01) to provide the interface function between the switching machine and the E2A telemetry unit. It extends sensing and control leads to selected circuits of the switching machine and provides usage counters, pulse storage, and control functions.

3.31 The Step-by-Step interface and control circuit (SD-35025-01) is much simpler than the No. 5 Crossbar. Unlike the No. 5 Crossbar, no sensing wires are extended from this circuit to the equipment and the only control leads extended are for alarm release, and office alarm cutoff in the unmanned mode.

3.32 The control switches and indicator lamps for the Step-by-Step office are mounted on a lamp and key cabinet (ED 35041) to be mounted on a wall or column per telephone company instructions. The lamps and keys on the cabinet are: 4 lamps—LOC (Local), REM (remote), CAL (call central), COL (control active)—and 3 keys—LOC (transfer to local control), REM (transfer control to central), RLS (release active CSACS controls).

3.33 The No. 5 Crossbar office master test frame jack, lamp and key circuit is modified to provide the control switches and indicator lamps needed. The modification provides, in addition to what Step-by-Step is provided, a MAR key (master alarm release). The LOC lamp is not provided.

3.34 The interface and control circuits for a No. 1 Crossbar Office are similar to that of Step-by-Step; however, the control switches, indicator lamps and relays are made a part of the alarm transfer circuits (SD-25885-01) as a feature.

3.35 A building terminal strip cabinet (ED 1P117-01) is available as a recommended option to all types of remote offices to provide a point for connecting the multiple building alarm points before they are brought to the E2A remote unit. If this terminal strip is not used, a locally engineered terminal strip or distribution frame may be used for that purpose.

C. Remote Wire Center Modifications

3.36 Wire center modifications to meet the system objectives have been provided for each wire center function. The modifications provide interface connections for alarm, status and control points which are needed at the remote wire centers for switching functions, transmission equipment, power and building status indications. Most of the modifications and connections are covered by standard Western Electric drawings, thus minimizing telephone company engineering and installation effort. Standard drawings do not exist for building alarms, since most equipment is furnished by outside suppliers.

3.37 The points in the E2A are grouped into categories or options for the purpose of simplifying TELCO ordering. There are four classes of options, ie, switching, transmission, power, and building. Each class is broken down into a primary option and one or more secondary options. The primary options are the minimum set of points deemed necessary to monitor the functions in a wire center. The secondary options are additional points judged to be desirable in order to more efficiently and accurately monitor and control the wire center operation. In addition to the points available under each of the options,

other points exist in each of the remote types. Many of these points are "user definable" allowing TELCO to engineer them as they see fit and to assign one message to each block of 8 points from the following set of predefined messages: special major (SPL MJ), special minor (SPL MN), special status (SPL), switch (SW), power (PWR), and transmission (TRMSN). User-definable status point uses, such as the per point monitoring of analog and digital carrier, are covered by standard drawings for the equipment modifications; however, the particular user-definable point assignment is left up to TELCO.

4. PRINCIPLES OF OPERATION

A. System Operations

4.01 CSACS, in an on-line operating state, will poll each remote wire center approximately every 10 seconds. The polling or scan is a group report request command generated by the software. Upon receipt of the request command, the remote unit will access and determine the status of the various alarm and status points in the office. This information is returned to the central unit for further processing. The central unit will process the data received from the remote wire center alarm and status points to determine if a reportable condition is present. To minimize the amount of information to which the operator must respond, conditions are only reported on an exception basis. Due to the different characteristics of the points being monitored, four processing types are used to determine the reportability of the conditions. The processing types are as follows:

- Type A—Threshold processing—based upon trouble rate—output message and audible alarm each time a threshold is exceeded.

- Type B—Verified change of state processing—output message and audible alarm when the point is off normal on the second consecutive scan and an output message when the indication releases.

- Type C—Hit processing—output message and audible alarm for each off normal indication received.

- Type D—Change of state processing—output message and audible alarm when an off normal indication is received for the first time and an output message when the indication releases.

When the processor determines that a reportable alarm condition exists, an English-like message is printed out, an audible alarm will sound the appropriate condition, and if critical wall indicators are used, appropriate lamps will light. The operator at the central unit will retire the audible alarm by typing an input message on the TTY. The output message is then examined to determine what course of action should be taken. One decision may be to remove a faulty piece of equipment from service (make-busy). The operator would then type in the appropriate input command. The remote unit, upon receipt of the command, will operate the addressed relay and then send a verification "quick reply" back to the central unit. The central unit, upon receipt of the quick reply, in most cases will initiate a scan to determine the state of the associated verify-status point. If the status point indicates proper operation of the command, the central unit prints "OK" after the command request; if not, an error message is printed. When a remote wire center control is operated by the central unit, a control active lamp (CTL) at the wire center and on the critical indicator display will be lighted. At this point, as determined by the nature of the condition, amount of equipment in the remote office, and local procedures, the operator may dispatch maintenance personnel.

4.02 The system will, in addition to the condition reports, generate an hourly summary report. The summary report is an instantaneous look at each wire center and contains the date, time, wire center names, the status (manned or unmanned) and a list of alarms active, command points active, and points which have been inhibited. The summary report can be generated for any wire center at any time the system is on line by a "OP:wcid.SUM!" input message.

4.03 The wire centers may operate in a manned or unmanned mode. In the unmanned mode it is assumed, as above, that complete responsibility for alarm administration of the wire center function is at the CSACS central. The alarm and status information will be monitored by the central; and audible alarms should sound only at the central. The central can operate all commands that have been provided at the remote wire center. The wire center can take control from the central by operating at LOC key. When the LOC key is

operated, the wire center is placed in the manned mode and the responsibility for alarms is transferred to the wire center. In the manned mode the only command that can be operated by the central is to transfer control back to the central; however, all controls that were active before transfer will remain active. A release key is provided to release all controls activated by the central unit. In the manned mode, point processing will continue unless an inhibit office (INH:OFC) command is typed in. The INH:OFC command will discontinue scanning of an office. The processing in the manned mode is different from the unmanned mode. In the manned mode all data is processed by type "D" change-of-state, except threshold points, which remain the same. This is necessary as the automatic alarm release feature of the remote wire centers is disabled in the manned mode. For transferring control back to the central, a REM key is provided. If the office is left unattended without operating the REM key, an UPD:MODE command will cause the wire center to transfer the unmanned mode.

B. Output Messages

4.04 The standard output message format consists of seven fields which indicate the time, location, and nature of the report. The first field indicates the priority of the report in terms of the audible alarm sounded. This field is 2 characters and may either consist of star-star (**)—major, star-blank (*)—minor, or blank-blank—status. The next field is the 2 digit minutes after the hour. This is followed by the wire center name. The point identification field is the fourth field and is used to indicate the type of problem encountered. The next field is the mode field which is used to indicate if the wire center is manned (MON) or, if not, receiving an alarm (ALM) or alarm release (STAT). The state of the point is indicated by ON or OFF in the next field. The final field is the point number within the wire center.

4.05 When interpreting a message, the most important field to consider is the priority field. If it has star-star or star-blank, a major or minor alarm condition, respectively, is indicated for an unmanned office. Next, the identification field should be used to determine the equipment which causes the alarm. Appropriate action should then be taken. The possible actions which may be taken include further monitoring, dispatching the appropriate maintenance personnel, and sending a command to the wire center to help alleviate the problem. If the priority field is blank, the mode field should next be considered. If the field is ALM, a status level alarm has occurred in an unmanned office, and the equipment involved should be determined. If the mode field is STAT, an alarm release in an unmanned office has taken place. This message can be paired with the associated alarm message to determine the duration of the alarm condition and consider whether further action is needed. The other indication the mode field may have is MON. If the mode field is MON, and the state field is ON, an alarm condition in a manned office was detected while an OFF state indicates the release of an alarm condition. The actions to be taken on the output message depends upon local practices. For the description of the various output messages, the Output Message Manual can be used. The Output Message Manual is in alphabetic order on the identification field and entries will provide information about the cause of the problem, explain the interpretation of the variable portion of the identification field, if any, and give guidelines for actions to be taken. Local procedures will have to provide the interpretation of special and user-defined points, if used, which are TELCO assigned.

4.06 There are several types of output messages which do not correspond completely with the standard format. These messages indicate the failure of some component of the CSACS equipment to operate properly. These failures may be either software, hardware, or telemetry problems. The interpretation and actions to be taken can be found in the Output Manual and in the trouble sectionalization procedures section of the PA document.

C. Input Command Messages

4.07 There are two basic types of commands—the remote affecting commands and the CSACS internal commands. CSACS internal commands are those commands that do not affect the remotes, but instead control processes in the CSACS central itself. Remote affecting commands, however, are those that actually cause an action to be taken in the wire center, such as the REMOVE:MARKER command. Remote affecting commands may exert latching or momentary control. Latching control commands are remote affecting commands that operate the appropriate E2A relay and leave it operated. Latching control commands usually exist in complementary pairs, one to operate and one to

release the relay. Momentary control commands are remote affecting commands that operate the appropriate E2A relay and then release under program control.

4.08 The input commands consist of up to four fields. These fields are the verb, wire center identification, keyword and data. The verb or action field specifies the type of action to be taken. Examples are RMV (remove), RST (restore), OPR (operate) and OP (output). The verb field is terminated by a colon (:). The wire center identification (wcid) field is used to specify the particular office for which the command is intended. The "wcid" field is required on all remote office commands but is optional on some of the central processing commands. The "wcid" field is terminated by a period (.). The keyword or equipment field is used to identify the type of equipment on which the action is to be performed. Examples of keywords are DT (dial tone marker), PT (status point), and TUR (traffic usage recorder). Where a keyword longer than four characters is specified in the Input Message Manual, only the first four characters need to be entered. The data field is used to further specify the equipment to be acted upon when necessary. For example, the dial tone marker number must be specified when removing a dial tone marker. The data field may contain subfield for commands requiring additional information. When the data field requires additional information, punctuations as specified in the Input Message Manual will separate the subfields. A message is terminated by an exclamation point (!) causing the command to be executed.

4.09 A system verification procedure is performed on all input messages. First the message is checked for proper form. This includes the entry of valid values for the action, wire center identification, keyword and data fields. Proper punctuation is also required. Once the command is determined to be proper in form, a check is made to see that the TTY which entered the message is an authorized source of this input. Next a check is made to determine if the command is consistent with the current state of the wire center (manned or unmanned). In order to execute a command in a wire center, the wire center must be in the unmanned state. A check is then made to insure that more than one element of a group of equipment is not removed from service unknowingly. Finally, when the command is sent to the remote wire center, a check is made to verify that the proper action did take place. The standard verification responses are given in the Input Message Manual.

D. Program Loading—BOOT

4.10 The cassette boot procedure allows the loading of bootable CSACS programs directly from cassette tape. This is accomplished by the use of the loader program, BOOT, that appears as the first program file recorded on all bootable cassettes and either the BM792-YH/ROM (bootstrap loader) or its software equivalent. Several different programs (files) may appear on one physical cassette, and the user is able to select the program he desires to boot.

4.11 If the BM792-YH ROM is not available, then it is necessary to enter the ROM software equivalent into core memory, using the key switches on the computer console, prior to initiating the boot procedure. The software equivalent may be loaded anywhere above memory location 200 (octal) with this starting address referred to as SOFTSTRT.

4.12 There are two basic foot procedures available, the normal procedure which under error-free operation will halt only once to allow the user to select the program to be booted and the check procedure that halts two additional times to allow the user to verify that the boot routine itself is operating correctly. The normal procedure is recommended for most users, with the check procedure used only if there is doubt that either the BOOT or the ROM is functioning properly.

E. Data Generation

4.13 On site data generation is designed to configure the standard CSACS generic software package for the individual TELCO installation. This configuration includes the specification of the number of interface units in the central unit (DR11-C and DL11-E units), the specification of the E2A remote units which are installed and their network configuration. The data generation package will require a minimum of man/machine dialogue over the TTY to configure the system and provide for growth updating with the minimum of "down" time. This "down" or "off-line" time is to be less than 15 minutes.

4.14 For each remote wire center to be connected to a CSACS central unit, there are two types of information which must be available at

the central location—First, the CSACS configuration data as to the network, address, and type of remote office being served; and second, an E2A remote profile which specifies the E2A telemetry cards which are installed in the remote is required.

4.15 The required configuration data which must be supplied at the central unit consists of:

- REMOTE NAME—1 to 11 characters containing no blanks, periods (.), colons (:), semicolons (;), commas (,), exclamation points (!), or slashes (/).
- NETWORK (OR TCT) NUMBER—This is a number from 1 to 8 which indicates on which telemetry network the remote wire center is found.
- REMOTE ADDRESS—This is a number between 1 and 254 which indicates the address to which the remote wire center has been wired to respond.
- CRITICAL INDICATOR NUMBER—This is a number between 1 and 124 which indicates the critical indicator slot in which indications for the remote should appear.
- TYPE OF REMOTE—This is to indicate which type of pre-engineered processing the remote office is to receive, such as No. 5 Crossbar, Step-by-Step, or user defined.

4.16 The E2A remote profile consists of a list of those E1A telemetry cards which are installed in the remote unit. This information should be arranged in status group order to facilitate verification of the profile generated by the installation procedure.

4.17 The initial start-up procedure for a new system will consist of loading the data generation program tape, answering the configuration questions asked by the computer, creating a load tape and booting the system with the newly created load tape. The question and answer dialogue requires the configuration data and the profile information for the remote wire centers. After the name, type, network number, remote address and critical indicator number has been entered for each remote wire center, a size option has to be determined. The determination will be in response to the question "AUTO OR MANUAL SIZE?" for each wire center. The AUTO size option will cause the remote to be scanned to determine the equipment profile. The MANUAL size option will require response to the questions related to the profile (status groups and cards equipped). The MANUAL option should be selected when the wire center modification is incomplete and not on-line. Data generation is complete when a load tape containing the CSACS on-line programs and data areas has been generated. At this point, CSACS may be put into service by using the created load tape to "boot" the system.

4.18 During the life of CSACS, it will be necessary to change the configuration originally specified for a number of reasons. This can include remote wire centers added or removed, central equipment in the form of DR11-C and DL11-E interface cards added, additional telemetry cards within a remote unit, and major reorganization of the telemetry networks. These same procedures will be used for the installation of a new generic software issue after the initial installation. The limited memory size of the processor requires that in order to maximize the memory usage in the on-line system, all the data areas are reassembled when a change is made. However, in order to avoid long off-line periods, features are provided which require only the inputting of any information which has changed. Also saved is any information which may have been entered in the on-line mode which affects processing and message routing so that this information need not be supplied again.

F. Teletypewriter Administration

4.19 Efficient operation of a CSACS central will require a thoughtful mapping of the information delivered at each TTY workstation to the expertise and authority of the operator manning that station. Wrong or inadequate information presented to an operator, who is without authority or the knowledge to act on that information, will negate much of the effectiveness CSACS can offer as a centralized surveillance and control system. The term "Teletypewriter Administration" describes the activity of planning, maintaining and changing the operator TTY workstation-to-computer interface. The manner in which the central is administered is entirely at the discretion of the TELCO management with the CSACS software system providing great flexibility. TTY messages may be distributed and

input commands authorized on many premises, several of which are outlined below:

- By Message Type—all switching related messages to one TTY, all transmission messages to another, etc.
- By Office—all messages from one wire center to TTY0, all messages from second wire center to TTY1, etc.
- By Office Type—all No. 5 Crossbar wire centers to TTY1, all Step-by-Step messages to TTY2, etc.
- By District or Area—all wire centers in district A to TTY1, all wire centers in district B to TTY2, etc.
- By Work Shift—messages are routed to remote or different TTYs for night shift monitoring.
- Hybrid of the above—all switching messages from No. 5 Crossbar wire centers to TTY1, all messages to TTY0 on a "copy to" basis during the first shift, all message to TTY2 on the second shift, all messages from district A on TTY3, and all messages from district B on TTY4, etc.

4.20 Three message distribution levels have been provided to enable flexibility in the TTY message routing and monitoring schemes. They are the TTY message type designation assigned to each output message, the message group assignment made for each message type, and the physical TTY assignment made for each message group. Using these provisions, messages may be selected for viewing at a particular TTY work station by message type, wire center type on by geographical or administrative area.

4.21 All output messages have been designated as one or more of the five TTY message types: Power, Building, Transmission, Switching or Special. These TTY message types do not necessarily correspond to a physical TTY work station. They are functional groupings of messages by types. If desired, all messages of a functional type may be assigned to a particular TTY work stations, thus retaining the identity throughout the routing scheme. The CSACS Output Message Manual documents the TTY message type(s) assigned to each output message. This assignment is not changeable in the field.

4.22 Up to eight message groups (numbered MG0 to MG7) may be initialized as distribution points for messages from a particular TTY message type. Message groups may be thought of as "bins" that are set up to collect all messages that are to be treated as a group. For each wire center, each of the five TTY message types are independently routed to a particular message group. This message group is called the primary message group for that type of message. In addition, copies of messages from a particular message type may also be routed to additional message groups on a "copy to" basis. Messages routed on a "copy to" basis may be abandoned if the physical TTY buffers monitoring the message group are full. However, messages routed to the primary message group will always be printed. This level of the distribution mechanism, the TTY message type to message group mapping, sets up the basic distribution of the messages. The routing scheme is set up and altered by use of the RTE:MSG (ROUTE:MESSAGE) input command.

4.23 CSACS centrals may have up to six TTY work stations (numbered TTY0 to TTY5) either all colocated at the central or with several remotely located. Any TTY work station may monitor the messages assigned to a particular message group or those of several message groups. The message group to physical TTY assignment, the third and final phase in the message routing and monitoring scheme, is expected to be the most fluid, with a maximum of eight commands necessary to completely alter it. In most cases it is expected that a switch to night-time surveillance will take four or less commands. The monitoring scheme is set up and may be altered by the use of the MON:MG (MONITOR:MESSAGE GROUP) command.

4.24 CSACS provides an input authorization mechanism for checking the validity of input command requisition. If the input command has a associated status point that allows verification of command operation, input permission is granted if the requesting TTY serves the primary message group for the function the command affects. It will also be granted to "copy to" message groups if they have been granted input authorization by use of the RTE:MSG command. Thus, commands can only be operated from work stations receiving

information concerning the functional type that will be affected by the command.

4.25 After the initial data generation of an installation, the message distribution and input authorization will be found in a default state with all messages routed to and inputs authorized from the master TTY (TTY0). That is, all primary, copy to, and input routings are assigned to message group 0; and TTY0 is assigned to each message group. The TELCO administration will then have to alter this default state by using both the RTE:MSG and MON:MG input commands.

4.26 The message routing, monitoring, and input authorization information will be automatically saved when the system is dumped, eliminating the need to respecify this information for subsequent reboots.

4.27 The status of the message routing and input authorization scheme implemented may be checked at any time by using the VER:TTY (VERIFY:TELETYPEWRITER) command. This command returns the status all routing, monitoring and input authorization for the system.

G. Threshold Administration

4.28 Threshold processing (Type A) was designed to allow the reporting of a condition only when its failure rate exceeds a specification. The method used to determine such a condition makes use of a thresholding cell which consists of four fields, two targets and two counters. The two target fields contain integer constants between 1 and 255. The target fields specify the time or usage base to be used and the number of failures during the base period needed to cause an alarm condition. The target field can be set and changed with a TTY input message. The two counters are used to record the passage of the base period and the number of failures detected. The base period may be on a per scan on usage basis. The per scan is a close approximation to time as the interscan interval is to be about a constant 10 seconds. At the end of each base period (per scan or usage) the usage counter is pegged and a failure pegs the failure counter. When the failure counter is greater than failure target, a message is outputted and the usage and failure counters are set to zero. When the usage counter is greater than the usage target the usage counter is set to zero and the failure counter is divided into two. This gives a type of exponential decay of the data.

4.29 After the initial data generation of an installation, the target fields of the threshold cells are left in a default state. The default state, as determined by the generic program, is 10 usages for the usage target and 3 failures for the failure target. The target values can be changed via an (UPD:THR) message. However, the change must be as a class. There are ten classes at the present time as follows:

MKR2—DT and CM Marker 2nd try

TV2—Transverter 2nd try

DT1—DT 1st try

CM1—Completing/Combined Marker 1st try

LD—Transverter 1st try

PRT1—Pretranslator 1st try

LD—Load alarms

OP1—ANIB Outpulsers 1st try

OP2—ANIB outpulsers 2nd try

PRT2—Pretranslator 2nd try

5. MAINTENANCE

5.01 For the most part, maintenance of CSACS will be accomplished by isolating the problem to one or more circuit modules or circuit packs and replacing those with spares. Spare circuit packs and modules are to be provided for replacement purposes. A DR11-C and a TCT may be installed and maintained as hot spares.

5.02 In the event of a failure of the E2A remote unit, it is expected that the problem can be isolated to a circuit pack using the E-telemetry station test set (KS-20937). The defective circuit pack can then be replaced using the spares provided. The station test set can also be used to test the TCT at the central unit.

5.03 Off-line diagnostic programs are provided for maintenance and testing of the CSACS facility. These diagnostics are most useful in the

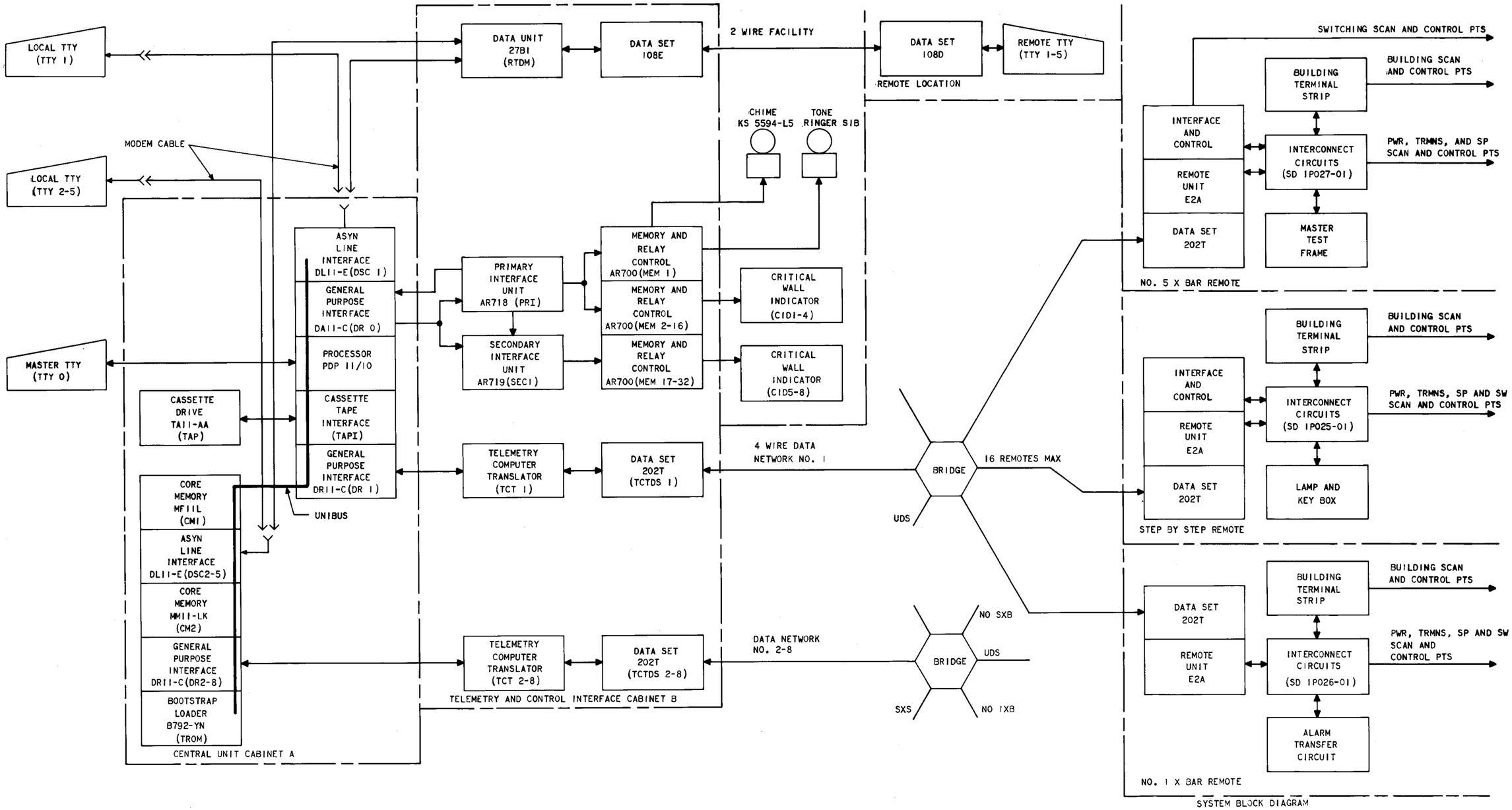
initial phases of installation and test of facility and for isolation of failures.

5.04 A maintenance contract can be negotiated from the Digital Equipment Corporation (DEC) ® to perform the necessary preventive and corrective maintenance on the equipment they manufacture.

6. REFERENCES

6.01 The following is a list of references associated with CSACS.

DOCUMENT	TITLE
201-653-104	E2A Status Reporting and Control Telemetry Description (CSACS)
201-653-504	E2A Telemetry—CSACS TCT and E2A Remote Tests
592-031-100	Data Set 202T-Description
CD/SD - 1P023-01	Telemetry and Central Unit Interface
CD/SD - 1P024-01	CSACS Central Unit
CD/SD - 1P025-01	Interconnection Circuit for Step-by-Step Office
CD/SD - 1P026-01	Interconnection Circuit for No. 1 Crossbar Office
CD/SD - 1P027-01	Interconnection Circuit for No. 5 Crossbar Office
CD/SD - 1P030-01	Interconnection Circuit for Use in Special Remote Applications
CD/SD - 1C535-01	Telemetry Computer Translator CSACS Application
CD/SD - 1C543-01	E2A Telemetry Status and Command Remote CSACS
CD/SD - 28075-01	CSACS Interface and Control Circuits for No. 5 Crossbar Office
CD/SD - 35025-01	CSACS Interface and Control Circuits for Step-by-Step Office
IM-1P300-01	Input Message Manual
OM-1P300-01	Output Message Manual
PA-1P300-01	Program Application
PD-1P300-01	Program Description
PG-1P300-01	Generic Program



SYSTEM BLOCK DIAGRAM

System Block Diagram