TRAFFIC MEASUREMENT SYSTEM NO. 1A

DESCRIPTION

1. GENERAL

1.01 The Traffic Measurement System (TMS) No. 1A provides facilities for traffic measurement in private branch exchanges (PBXs) and small central offices.

1.02 This section is reissued for the following reasons:

(a) To include information where applicable for two new features:

● Channel 17 Test

● Zero Print Suppression

(b) To add Fig. 5, 16, and 17

(c) To revise Fig. 6, 7, 8, and 9

(d) To generally update this section.

1.03 The system consists of a portable or frame-mounted remote scanner, an encoder, a transmitter, a centrally located central control unit (CCU), a data set receiver, and a local and/or remote teletypewriter (TTY) which may provide for tape punching on a separate optional tape punch.

1.04 This equipment is arranged to provide usage information directly in a hundred call seconds (CCS) format for rapid analysis.

1.05 This system also provides for the storage of accumulated data into either of two memories located in the CCU. At the end of each half-hour or hour period, the data is cleared from one of the two memories and a TTY printout of the usage information is initiated. During this printout period, one memory is reading information out while the other memory is reading information in.

1.06 A block diagram of the various components and typical facility layouts of the TMS 1A is shown in Fig. 1.

2. EQUIPMENT ELEMENTS

PORTABLE SCANNER AND ENCODER

2.01 The portable scanner functions as part of the TMS 1A. It provides a means of measuring usage on circuits located in a remote section from a CCU. The remote scanner-encoder unit (RSEU) is used in locations where data is to be sampled only occasionally. This portable circuit has the capacity of scanning up to 200 lines which may be divided into a maximum of 20 groups in increments of 5 inputs. As the inputs are scanned, the portable scanner encodes the usage data and controls the transmission of this data to the CCU. The data is transmitted via a portable data set, which sends the information over dedicated or switched voice grade facilities. Scanner-encoders are connected in tandem to one data set to serve those locations where more than 200 usage inputs are to be scanned or where the maximum of 20 groups is exceeded. A maximum of five additional scanners may be operated in tandem with the original scanner sharing its data transmitter, provided that each additional three scanners are fused separately and the 4-foot DTC cord (type M25B) is used. If the 10-foot DTC cord is used, no more than three scanners may be operated in tandem.

2.02 Usage inputs of circuits to be measured are terminated at connectors, or clip-cord access to these usage points is provided. An optional connector panel installed permanently at the location to be measured provides the scanner-encoder access to usage inputs and to a wired group control via plug-ended cords. This panel also provides connections to scanner battery supply (−48 volts and ground) and to a telephone line for the data set. Locations which are not set up for connector panel operation must provide jack access to a −48 volt supply and to the telephone line with the exception of the electronic PBXs. All electronic PBXs will provide −48 volts, +24 volts, and ground to the scanner through three of the first five usage leads of the third connector and a switch arrangement.

2.03 Arrangements for subgrouping the 200 input leads may be accomplished by two methods.

(a) The first method consists of a pin jack arrangement which is an integral part of the portable scanner and which may be rearranged for any location to be measured. In the group
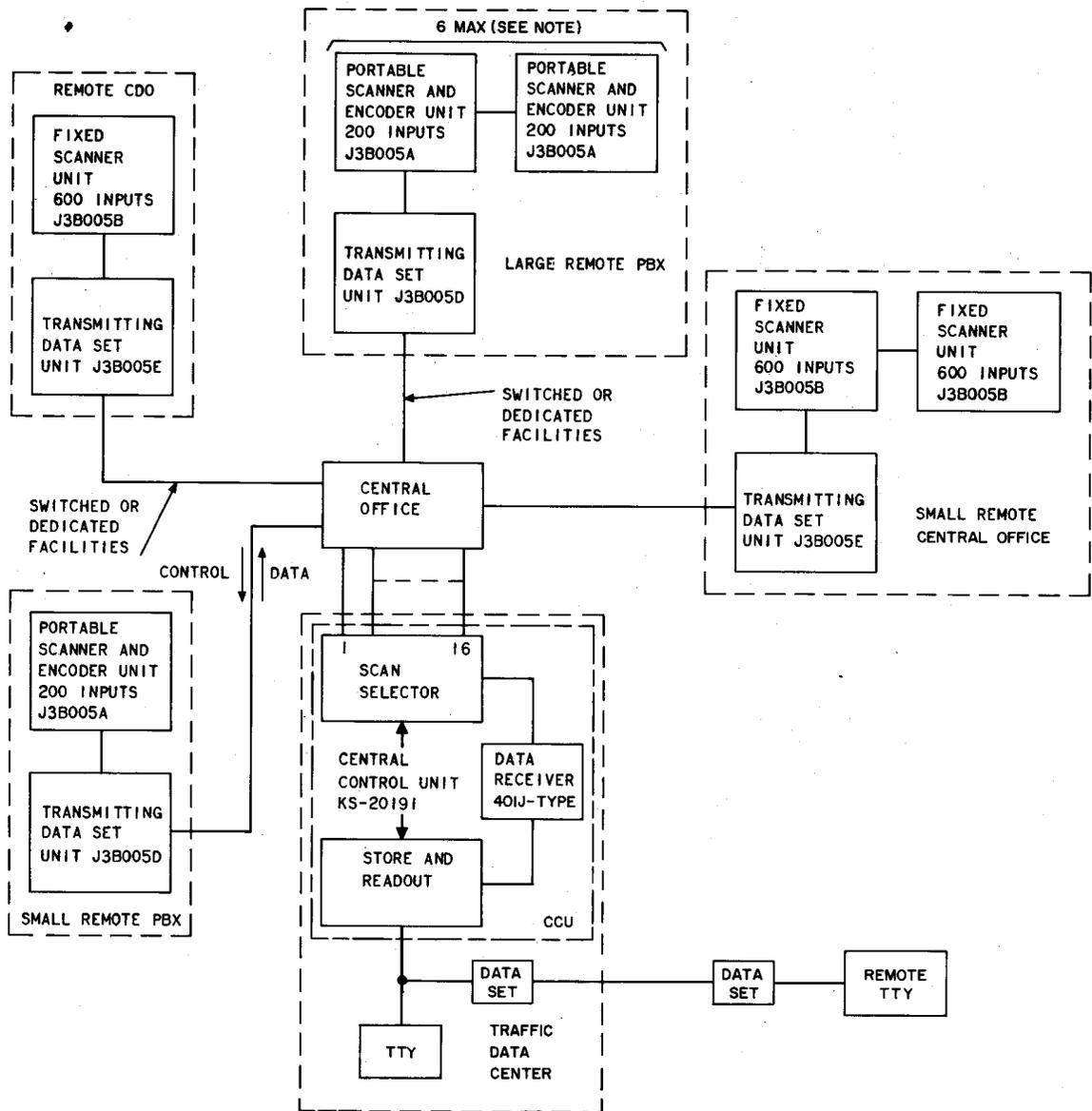
NOTE:
A MAXIMUM OF 6 SCANNER UNITS MAY BE USED PROVIDED EACH 3 UNITS ARE SEPARATELY FUSED.

Fig. 1—Traffic Measurement System No. 1A—Block Diagram

control matrix representation (Fig. 2), a pin is inserted into the N jack (Fig. 3) for groups that are shown in the matrix without the dark area. This pin in the N jack represents a not-end-of-group. A pin inserted into the E jack represents an end-of-group (EOG) and thus is represented by the dark areas. Fig. 3 shows an example layout of the pin jack matrix set up corresponding to the blocked chart shown in Fig. 2. The dark areas represent the presence of a pin jack.

Note: All 40 pins must be inserted for the scanner to operate. A maximum of 20 pins may be placed in the E jacks.

(b) The second method employs the permanently mounted connector panel which is used for input access. This panel contains a prestrapped connector which is accessible to the scanner via a plug-ended cord. A P50B cord ♦or M50N cord♦ is used in this arrangement and is shown

GROUP CONTROL MATRIX

40	30	20	10
39	29	19	9
38	28	18	8
37	27	17	7
36	26	16	6
35	25	15	5
34	24	14	4
33	23	13	3
32	22	12	2
31	21	11	1

◣ EOG

☐ NOT EOG

Fig. 2—Group Control Matrix
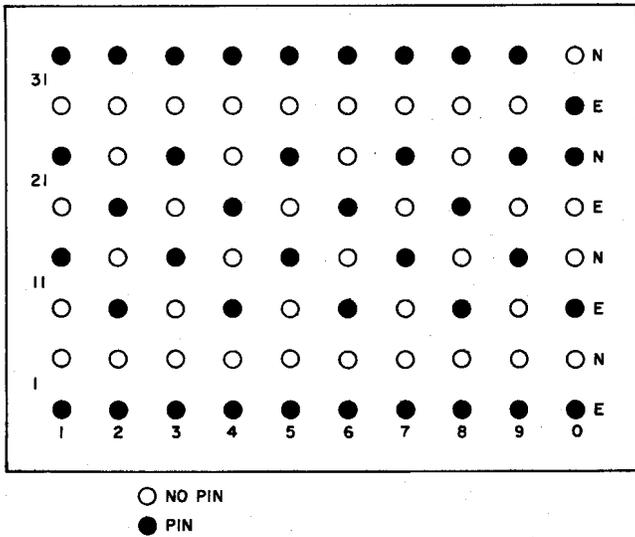
○ NO PIN
● PIN

Fig. 3—Typical Pin Jack Arrangement

in Fig. 4 ▸and Fig. 5 respectively.◂ The group control connector of the connector panel is wired as follows. All terminals (1 through 40) designated as EOG are strapped to terminal 42. The remaining terminals (1 through 40) assigned as

non-EOG are strapped to terminal 41. Terminals 43 through 50 are unused.

KS-19162 L3 PLUG   KS-19163 L25 CONNECTOR

SCANNER END   25'   CONNECTOR PANEL END

Fig. 4—P50B Cord

KS-19162 L3 PLUG   KS-16690 L6 CONNECTOR

SATIN SILVER CORD

5'0"
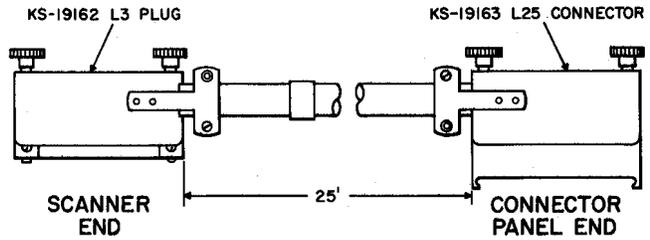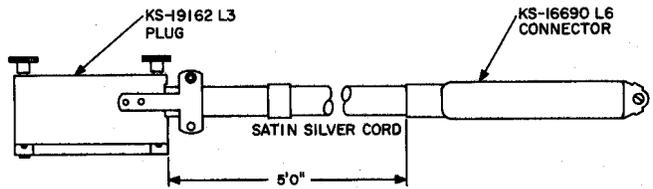
Fig. 5—M50N Cord

2.04 The standard scanner-encoder input impedance detectors may be provided on an optional basis. These detectors are required where the connecting circuit usage lead is unable to tolerate an impedance of 2170 ohms to −48 volts due to the critical busy tests, cross checks, or where high-voltage spikes (+130V) on the usage leads may damage relay contacts in the scanner. Detector impedance is 51,000 ohms to ground for electronic systems operation and 91,000 ohms to −48 volts for electromechanical system operation.

2.05 A level shift arrangement permits the detector to be used for measuring usage in electromechanical and electronic systems. A 3-position switch on the scanner allows selection of the detector modes: position A for electronic systems, position B for electromechanical systems, and position C for no detectors.

2.06 A location which is intended to transmit usage data over a dialed-up connection requires that the telephone number assigned to the data transmitter at this location be dialed from

the CCU to operate the transmitting data set to the off-hook condition.

2.07 Start-scan signals from the CCU, which are received by the data set, are relayed through to the scanner-encoder as ground closures. Scanning starts upon the removal of the start ground.

2.08 The scanner-encoder uses two 206-type selectors to scan 200 inputs in sets of five, making five inputs the minimum group size. Each group of five inputs is identified as an EOG or a not-end-of-group. Group sizes may be increased in increments of five inputs to a maximum group size of 200 inputs. The maximum number of groups is 20 and is governed by the CCU register capacity for each remote scanner.

2.09 The maximum group size of 200 inputs are divided into 40 sets. These sets made up of five inputs each are scanned in sequence, and the five inputs in each set are connected simultaneously to five high-impedance detectors if provided or five detector relays where high-impedance detectors are not provided. Busy indications cause the operation of the detector relays which, in turn, operate translator relays. The translator relays and an EOG relay encode the idle/busy information and the EOG status of the five connected inputs into loop closures which are applied to the data transmitter.

2.10 At the completion of scanning, an end-of-scan (EOS) signal is transmitted to the CCU. If this is the last or only scanner-encoder, the scanner-encoder is restored to normal. During tandem scanner-encoder operation, subsequent start-scan signals are advanced to succeeding scanners until all scanners have been served and restored to normal. The scanner-encoder group control matrix provides a means to program the group sizes when a wired group control is not available. When the matrix is used, each of the 40 sets has a pin inserted in either the E or N jack but not to both jacks. The number of pins in E jacks shall not exceed 20.

FRAME-MOUNTED SCANNER AND ENCODER

2.11 The frame-mounted scanner and encoder function essentially the same as the portable scanner except that the transmitter is provided as part of this circuit. High-impedance detectors are used for the frame-mounted scanner, but it functions with only electromechanical systems. The frame unit for the frame-mounted scanner requires twelve 2-inch by 23-inch mounting plates and accommodates three 200 input scanners. Supplementary units provide for 3 additional 200 input scanners and occupy 11 mounting plate spaces. Input leads, cross-connections, or straps on terminal strips for the connection of the subgroups are contained and considered as part of the frame-mounted scanner. The inputs from the traffic usage circuits may be connected directly from the originating source to the scanner, or they may be connected for cross-connection directly to the distributing frame.

CENTRAL CONTROL UNIT

2.12 The CCU unit is divided into seven major assemblies: front control panel, logic module, rear panel assembly, relay rack, power supply assembly, cable assemblies, and program timer.

(a) The front control panel provides most of the controls and indicators required to operate the CCU. These controls on this panel are located at the top front of the cabinet.

(b) The logic module circuit boards, power regulator circuit boards, and core memory circuit boards are housed in a logic module directly below the writing shelf. Access to the front of this assembly is obtained by opening the cabinet door.

(c) The telephone lines are connected at terminal strips located on the rear panel assembly at the rear of the CCU.

(d) The relay rack contains the CCU relay circuit cards. Access to these cards is gained by opening the hinged logic module.

(e) A 24-hour program timer is mounted adjacent to the 401J-type data set below the control panel.

2.13 The CCU accumulates traffic usage data from a maximum of 16 remote scanner units (RCUs) and controls the printout of this accumulated data on a standard TTY. Data transmission from the remote locations to the CCU is achieved by standard voice-grade telephone circuits, switched or dedicated. A program timer is provided to automatically initiate and terminate the recording interval(s). In addition, a manual control is provided

to initiate a single one-hour (36 cycles) or half-hour (18 cycles) scan and printout. Time-of-day and date circuitry provides complete time orientation for the data printout.

(a) The memory unit provides storage of the traffic data for 20 discrete subgroups for each RSEU. At each half-hour or one-hour interval, the memory unit is automatically read and cleared. The accumulated data is then printed out on a local and/or remote TTY. A maximum of five CCUs may be arranged to feed the same local and/or remote TTY.

(b) The CCU has the capability of performing the following basic functions:

(1) Sequential selection of the 16 remote scanner-encoder (or RSEU) telephone circuits for connection to a 401J-type data set

(2) Generation (via the 401J-type data set) of start-scan interrogate signals to the various RSEUs

(3) Decoding and storage of data received by the 401J-type data set in response to a start-scan signal

(4) Data update, or totalizing, in response to multiple CCU cycles over a one-hour or half-hour data collection interval

(5) Automatic printout of data in CCS units on a standard TTY printer except after one-cycle test scan which requires manual printout start

(6) Simultaneous printout and data collection with no time skew due to printout

(7) Automatic initiation of data collection controlled by a 24-hour program clock.

(c) In addition the CCU provides the following features that are nonessential to the collection of data:

(1) Internal word generator for self-test of CCU logic elements

(2) ◆Internal test logic (channel 17 test) which facilitates verification of a remote scanner installation set up for a new study without

interferring with traffic measurements currently in progress (optional)◆

(3) Manual initiation of 30-minute, 60-minute, and single-cycle scans for test purposes

(4) TTY motor-starting control for reducing TTY maintenance requirements

(5) Standard Electronic Industries Association (EIA) interface output connectors for remote TTY connections through telephone lines and data sets

(6) Priority printing connections to allow a maximum of five CCUs to share local or remote TTY connections

(7) ◆Zero print suppression feature which inhibits the printout of data on all channels not selected for traffic measurements (optional)◆

(8) Front panel controls to allow RSEUs to be connected in tandem to one data set and telephone line. The CCU treats data from each of these RSEUs in tandem as if they were independently connected to the CCU. A simplified block diagram of a CCU is shown in Fig. 10.

SIMPLIFIED CCU BLOCK DIAGRAM

2.14 Sixteen input pairs are connected to the scan selection control logic (Fig. 10). During scanning each input circuit (in sequence) is connected to the 401J2 or J6 data set. For each successive connection, an interrogate signal in the form of a switch closure is transmitted to the data set.

2.15 The data set converts the switch closure interrogate signal into an interrogate tone which is transmitted along the input circuit to the connected scanner. In response to this interrogate tone, the remote scanner transmits data characters representing the status of up to 200 lines being scanned. Each data character consists of a group of three simultaneously transmitted tones that provide information concerning the status of five lines and also whether these are the last five lines of a group. Each data character has a nominal duration of 30 milliseconds.

2.16 The received tone information is converted by the data set into switch closure information

which is supplied to the CCU decoder/adder where it is converted to binary-coded decimal (BCD) format.

2.17 Data received from a remote scanner may be associated with a maximum of 20 groups. All data associated with a particular group from a particular scanner, which is received during the same data accumulation interval, is accumulated in a core memory location associated with that particular group. Each individual scan group may contain any number of lines in multiples of five over a range of 5 to 200. Each time that a scanner is addressed, data from the 20 groups associated with the scanner is received in the same sequence. The EOG information is decoded and used to advance a group counter to address successive locations in core memory as data associated with successive groups is received.

2.18 Each data accumulation interval is either one hour or one-half hour as selected by a manual program control. At the end of each data accumulation interval, accumulated data is transmitted in American Standard Code for Information Interchange (ASCII) format to a TTY unit which generates a printout.

2.19 The CCU employs two identical core memories, used to accumulate data during alternate intervals. While previously accumulated data is being read out of one memory, new data for the current interval is being accumulated into the other memory. Thus, no time skew occurs in printed data and no interference between printing, data scanning, and data accumulation is experienced. Because the memory and adder data-handling rate is greater than either the data printout rate or the data reception rate, the memory control circuitry may be time-shared between the printout control logic (which addresses the off-line memory) and the scanning logic (which addresses the on-line memory).

2.20 The timing for memory is derived from a 4-MHz clock in the memory control logic. Timing signals are continuously generated, but the transfer of data in and out of memory only occurs in response to the reception of data from the addressed scanner or in response to printout commands from the printout logic.

2.21 Data words stored in memory consist of four decimal digits stored in 1-2-4-8 BCD format.

Data is written into memory or read from memory in serial form via the adder register. The data accumulation cycle that occurs in response to the reception of each new data character is as follows.

(a) ◆Fourteen◆ milliseconds after a new data character is sensed the memory control logic is enabled to initiate transfers at the start of the next scan digit cycle.

(b) The least significant digit data is read from the memory into the adder register.

(c) The new data from the decoder is counted into the adder register. If a carry is generated, it is held until the next add time to be added to the digit data for the next higher order digit.

(d) The modified, least significant digit is written into memory.

(e) The three higher order digits pass sequentially (in order of increasing significance) through the adder register to be modified by a carry, if any, from the preceding order.

2.22 During printing times, the digital data to be printed is read from memory into the adder register and is then transferred from the adder register to the output register. It is shifted out of the output register to obtain the serial format required by the TTY.

2.23 Each memory address consists of four bits which designate a scanner number, five bits which designate a group number, two bits which designate a digit number, two bits which designate a bit number, and one bit which designates A or B memory.

2.24 The address bits which designate the digit number and the bit number are always supplied by the scan control counter. Print mode cycles of the scan digit counter alternate with scan mode cycles. During print mode cycles, the address bits designating group number and scanner number are supplied by the print control logic. The status of the address bit designating the A or B memory is such that the off-line memory is addressed.

2.25 During scan mode cycles, the address bits designating group number and scanner number are supplied by the scan control logic.

The status of the address bit designating the A or B memory allows the on-line memory to be addressed. Two complete digit cycles (a print cycle and a scan cycle) are completed in 512 microseconds. Since input characters received from the data set have a duration of 30 milliseconds and since 4.55 milliseconds are available for transferring data from the memory to the output register, the interleaving of print mode and scan mode digit cycles causes no delay in data reception or printing functions.

2.26 Time-of-day, day-of-month, and month-of-year data are required as header information for each data-interval printout. The month-of-year data is manually supplied to the equipment by the operation of the CCU thumbwheel switches. The remaining time data is provided by a digital clock which is initially set to real time by the use of switches and is clocked by the 60-Hz line. Scanner number data is obtained from a print digit scan counter in the printout control logic. End-of-scans-completed data is accumulated for each scanner in an associated location in memory and is read out at the appropriate time in the print cycle. The CCU number is read from a group of gates which have handwired data inputs representing the required number.

2.27 In normal operation, data accumulation and printing are performed under the control of the program timer which is used to establish the required schedule. At the start of each printout time, a scan/print enable signal is required from the program timer to allow the continuation of scanning and the initiation of another printout. When scanning is permitted by the program timer, a scan cycle is initiated every 100 seconds by generation of the start-scan term supplied to the scan control from the printout control. Each of the 16 scanners is addressed for 6 seconds. Thus, an entire scan cycle requires 96 seconds plus a rest period of 4 seconds between successive scans. During this rest period, the scanner number 1 input lines are connected to the data set. However, an interrogate signal is not applied until the start of the next scan cycle.

CONTROL PANEL LAMPS AND SWITCHES

A. Outside Cabinet Controls and Lamps

2.28 The CCU control panel (Fig. 6) is located at the front of the CCU. The lamps, switches, controls, and pushbuttons for the CCU control panel and their meaning and use follow.

RSU CHANNEL SELECT 1 Through 16 Lamps

2.29 Lighting of any one of these 16 lamps indicate which of the 16 RSEU scan channels is being selected for interrogation. If RSU CHANNEL SELECT 1 lamp is continuously lighted, the CCU is in an idle condition.

RSU CHANNEL ACTIVE/ALARM 1 Through 16 Lamps

2.30 When an RSEU is selected for scanning (by activation of its associated LOAD/IDLE/NO LOAD switches), the associated ACTIVE/ALARM lamp lights dimly. If a selected RSEU fails to send an EOS code within an allowable time (5 1/3 seconds) after it receives an interrogate command, the associated ACTIVE/ALARM lamp lights brightly indicating an RSEU failure. This condition will continue until the ALARM RESET or MASTER RESET pushbutton is operated.

LOAD/IDLE/NO LOAD 1 Through 16 Switches

2.31 When any LOAD/IDLE/NO LOAD switch is set to LOAD, the associated RSEU input pair is terminated in a 200-ohm load through normally closed contacts of the associated scan relay. When the associated relay is de-energized, this completes the telephone circuit, thus maintaining a dialed-up connection during periods when the scanner input pair is not connected to the data set. The switch set to LOAD also enables the alarm logic associated with the channel. An alarm indication is activated if the RSEU does not provide an EOS signal within a 5-1/3 second period after the removal of the start-scan command.

2.32 When any LOAD/IDLE/NO LOAD switch is set to NO LOAD, no termination is provided in the associated scanner input pair. The alarm logic associated with the channel is enabled. In addition, setting the switch to NO LOAD causes the nearest lower-numbered scan relay (whose LOAD/IDLE/NO LOAD switch set to LOAD) to be activated in lieu of the scan relay normally associated with the switch. Thus, if the RSEUs are connected in tandem to one telephone pair, the CCU handles the data as if each RSEU were independently connected.
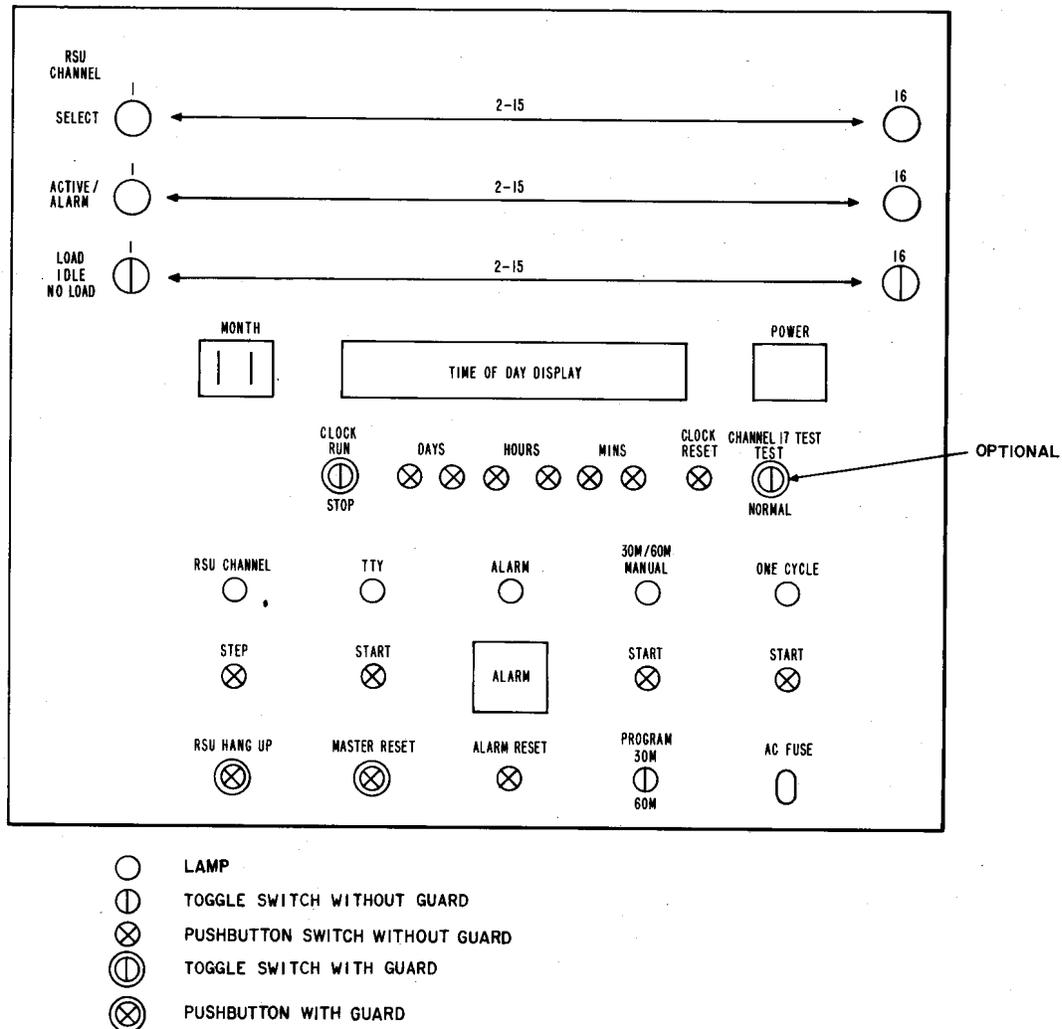
Fig. 6—▶Control Panel Layout◀

2.33 When any LOAD/IDLE/NO LOAD switch is set to IDLE, no termination is provided for the associated telephone line. The alarm logic associated with the channel is disabled, allowing the channel selection circuit to advance (without the generation of an alarm indication) through the selection of a channel that does not return an EOS signal.

MONTH Thumbwheel Digiswitches

2.34 The settings of these two thumbwheel digiswitches from 01 to 12 determine the month data on the printout header for January to December, respectively.

POWER Pushbutton/Lamp

2.35 The alternate-action POWER pushbutton/lamp, when operated and lighted white, connects ac power to the CCU power supplies and to the cabinet fan for the CCU. This switch does not control power to the data set and to the program timer which are connected directly to the line.

Time-Of-Day Display

2.36 The time-of-day display indicates the status of the day, hour, and minute counters that determine the time-of-day data on the printout header. This display must be set to correlate with the program timer.

CLOCK RUN/STOP Switch

2.37 When this switch is set to STOP, the time-of-day logic and the audible alarm are disabled. The switch set to STOP also enables the DAYS, HOURS, MINS, and CLOCK RESET pushbuttons. When the switch is in the RUN position, time-of-day data is updated at a real-time rate.

TIME-OF-DAY DISPLAY and CLOCK RESET Controls

2.38 These controls (DAYS, HOURS, MINS) are provided for the manual preset of days, hours, and minutes. A CLOCK RESET pushbutton is provided for zeroing the time-of-day counters. These controls are disabled when the CLOCK RUN/STOP switch is in the RUN position.

RSU CHANNEL Lamp and STEP Pushbutton

2.39 The STEP pushbutton, when operated, advances the channel selector one channel per operator. This capability is used, for example, when a channel is selected for purposes of dialing an RSEU. When the STEP pushbutton is depressed and the CCU addresses any input channel other than channel 1, the RSU CHANNEL lamp (amber) lights. This lamp remains lighted until channel 1 is again addressed. For dialing an RSEU, the 401J-type data set should be in the talk mode. The PROGRAM 30M/60M switch should be in its center position.

RSU HANG UP Pushbutton

2.40 The RSU HANG UP pushbutton, when operated, initiates generation of the data sets electrical answer-back signal for releasing dialed-up RSEU connections. The data set must be in the data mode. To hang up the CCU end of dialed-up connections, the 401J-type data set is returned to the talk mode and the receiver is hung up. The PROGRAM 30M/60M switch should be operated to 30M or 60M, placing the data set in the data mode.

TTY Lamp and START Pushbutton

2.41 The START pushbutton, when operated, initiates a printout of data collected during one-cycle scans and energizes the TTY lamp. The TTY lamp remains lighted until the printout is complete. This also clears the memory in which data was read out.

MASTER RESET Pushbutton

2.42 Actuation of the MASTER RESET pushbutton resets the printing function, alarm storage flip-flops, one-cycle scan, RSU CHANNEL lamp and STEP pushbutton, 30M/60M MANUAL lamp and START pushbutton, and TTY storage flip-flops, thus extinguishing the RSU CHANNEL lamp, the TTY, and the 30/60 MANUAL lamps, if lighted.

ALARM Lamp and Audible Alarm

2.43 The ALARM lamp and the audible alarm are activated to indicate one or more of the following conditions.

(a) Failure of the scan counter to advance correctly; that is, scanner channels 1 through 16 are not selected in sequence.

(b) Failure to receive an EOS signal from an RSEU within 5 1/3 seconds after a start-scan signal has been transmitted by the CCU.

(c) Receipt of a programmed data-collection start signal from the program timer while a manually actuated scan (one cycle or 30M/60M manual) is in progress.

(d) Receipt of a programmed data-collection start signal from the program timer while the CCU is in the test mode.

(e) Receipt of a programmed data-collection start signal from the program timer after one-cycle scans which have not been printed out by operating the TTY START pushbutton.

(f) Failure of any fuse (F1 through F8).

Note: When the CLOCK RUN/STOP switch is operated to STOP or when the AUDIBLE ALARM INHIBIT switch (inside the cabinet) is operated down, the audible alarm is disabled.

(g) Display clock and program clock more than 1 minute out of sync.

ALARM RESET Pushbutton

2.44 If an alarm indication is caused by an RSEU EOS failure, operating the ALARM RESET pushbutton disables the audible alarm and extinguishes the ALARM lamp. If an ALARM lamp is caused by any other failure, operating the ALARM RESET pushbutton silences the audible alarm. The ALARM lamp remains lighted until the trouble is corrected and the ALARM RESET pushbutton is operated a second time.

30M/60M MANUAL Lamp and START Pushbutton

2.45 Operating the 30M/60M START pushbutton initiates a data accumulation period corresponding to the position of the PROGRAM 30M/60M switch and a printout at the end of this period. The 30M/60M MANUAL lamp remains lighted during the entire data accumulation period.

PROGRAM 30M/60M Switch

2.46 The position of this switch determines the duration of the period over which traffic-usage data is accumulated. When this switch is operated to 60M, data is accumulated for periods of 60 minutes and is printed out at the end of each interval. When this switch is operated to 30M, data is accumulated for intervals of 30 minutes and is printed out at the end of each interval. The enabling function of each successive accumulation and print cycle is provided by the program timer or by the operation of the 30M/60M MANUAL START pushbutton.

2.47 Associated with this switch is a data set function which parallels the data and talk modes on the data set. When the PROGRAM 30M/60M switch is set to the center position, it enables the talk mode on the data set. The switch in any other position places the data set in the data mode to prevent the data set from dropping out of the data mode if an idle channel is selected. The three settings of this switch must be synchronous with the operation of the data set.

ONE CYCLE Lamp and START Pushbutton

2.48 The START pushbutton, when operated, initiates a single, 100-second scan cycle. In response to each operation of the pushbutton, one scan of all 16 RSEU channels is accomplished. By operating the START pushbutton, the ONE CYCLE

lamp lights and remains lighted until a printout is initiated. Any required number of one-cycle scans may be successively made without a printout as long as 100 seconds or more is allowed to elapse between successive actuations of the START pushbutton.

♦CHANNEL 17 TEST Switch (Optional)

2.49 This switch set to the TEST position enables the channel 17 test logic when the system is scanning RSUs. The channel 16 LOAD/IDLE/NO LOAD switch must be in the LOAD position. This will initiate a channel 17 printout at the end of each data scan, except during scheduled printout times when printout will be of previously accumulated data for channel 16. With the switch in the NORMAL position, channel 17 test logic is disabled.♦

B. Inside Cabinet Controls and Lamps

AC FUSE Lamp and Fuse

2.50 This fuse protects the ac line for all parts of the CCU except the 401J-type data set and the program timer. A blown fuse is indicated by the orange AC FUSE lamp.

MEM A/B Switches

2.51 These two switches are manual override switches that when set to either positions A or B select the memory that is first used to store data following the operation of the MASTER RESET, 30M/60M MANUAL START, or ONE CYCLE START pushbuttons. The setting of these switches must always be the same.

AUDIBLE ALARM INHIBIT Switch

2.52 This switch, when in the off position, disables the front panel audible alarm that sounds on a trouble condition.

TEST MODE Switch

2.53 Upon operating this switch to ONES with the MODE switch set to TEST, the first and all other odd-numbered groups contain five busys (0005) per scan; the second and all other even-numbered groups contain five idles (0000) per scan. Upon operating this switch to ZEROS with the MODE switch set to TEST, the first and all other odd-numbered groups contain five idles (0000);

the second and all other even-numbered groups shall contain five busys (0005) per scan.

MODE Switch

2.54 This switch, when operated to RUN, allows the CCU to be operated in a normal manner. When this switch is set to TEST, the CCU disconnects the 401J-type data set and substitutes an internal test data generator.

20 Circuit Pack Lamps

2.55 Fifteen of these 20 lamps mounted on the MSL-20 circuit board indicate the status of various logic elements in the CCU.

PS4, PS3, PS2, and PS1 Lamps

2.56 These lamps, when lighted (as indicated in Table A by an° X), indicate the number of the channel whose information is being sent to the TTY. The channel number is represented by binary bit positions, as shown in Table A.

G5, G4, G3, G2, and G1 Lamps

2.57 These lamps, when lighted (as indicated in Table B by an X), indicate the number of the EOG signals received from each RSEU. These lamps light cyclically for each channel or RSEU scan. The data group number is represented by binary bit positions, as shown in Table B.

WRT B Lamp

2.58 This lamp, when lighted, indicates the status of the CCU memory switching unit. When lighted, the lamp indicates that RSEU data is being read into memory B; therefore, any data being read out is from memory A and vice versa.

TABLE A

STATUS OF PS4, PS3, PS2, AND PS1 LAMPS

LIGHTED LAMP	CHANNEL															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PS4									X	X	X	X	X	X	X	X
PS3					X	X	X	X					X	X	X	X
PS2			X	X			X	X			X	X			X	X
PS1		X		X		X		X		X		X		X		X

TABLE B

STATUS OF G5, G4, G3, G2, AND G1 LAMPS

LIGHTED LAMP	GROUP																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
G5																	X	X	X	X
G4									X	X	X	X	X	X	X	X				
G3					X	X	X	X					X	X	X	X				
G2			X	X			X	X			X	X			X	X			X	X
G1		X		X		X		X		X		X		X		X		X		X

GP5, GP4, GP3, GP2, and GP1 Lamps

2.59 These lamps, when lighted, indicate the character group [including carriage return (CR) and line feeds (LFs)] that is being sent to the TTY. After the printout header, the group counter is reset to zero, after which the counter cycles once for data on each channel. The number of the printout group is represented by binary weights, as shown in Table C. A 1 indicates a lighted lamp; a 0 indicates an extinguished lamp.

DATA TRANSMITTER CIRCUIT

2.60 The data set may be connected over private line or switched facilities to the CCU location. The data set automatically answers incoming calls, responds to control signals initiated at the CCU, and transmits usage data to the CCU. A separate transmitting data set is used along with the portable version of the scanner-encoder while the frame-mounted scanner includes a transmitting data set. This data set responds to control signal frequencies generated by a data receiver associated with the CCU and transmits usage data to the receiver.

2.61 The data set is a basic 401H6 type with external controls added to compensate for loop resistance, to prepare the data set to operate over switched transmission facilities, to originate test scans at a remote location, and to restore a dialed-up data set to the on-hook condition. An installation is equipped with one data set and one or more scanner-encoders. If more than one scanner-encoder is used, the data set is only connected to the first scanner-encoder and to a telephone line.

2.62 Operating power for the 401H6 automatic answer and transmitting circuits is obtained from the telephone line. The necessary power for the 401H6 answer-back receiver is obtained from −48 volt supply of the scanner-encoder through terminals 1 and 2 of the J1 interface connector. The −48 volt battery is transferred to the 401H6 through a 470-ohm dropping resistor. The scanner-encoder must complete a loop closure through terminals 19 and 20 of the interface connector to indicate data terminal ready. While an associated scanner-encoder is not performing its scanning operation, the transmitter is disabled and its answer-back receiver is enabled. During this time, the circuit responds to 1017 Hz and causes its own hang-up. It will respond to 1785 Hz and will

signal a connected scanner-encoder to start scanning. The start-scan signal is transferred to the scanner-encoder through the J1 interface connector.

2.63 During a scanning interval, the 401H6 transmitter is enabled and its answer-back receiver is disabled. At this time data words generated by the scanner-encoder are sent by the transmitting data set to a data receiver associated with the CCU. The block diagram of the remote scanner and data set connected in conjunction with the connector panel is shown in Fig. 7.

3. METHOD OF OPERATION

3.01 The CCU is connected to each remote data transmitter, and all necessary connections have been made and checked between the scanner-encoder units and the usage circuits at the remote locations. If the remote unit is portable, proper connection should have been made between the scanner-encoder and the data transmitter unit. These connections are made through the use of a data set and the individual channel selector keys over a switched or dedicated facility. The channels which are not to be used should be left in the idle position. These channels will be selected just as if they were active channels but will return zeros on the printout for each group of totals.

> *Note:* ◗If zero print suppression feature has been added, zeros will not be printed for channels not selected for traffic measurement.◀

3.02 The CCU has the capacity to receive data from the 3200 inputs transmitted from sixteen 200-input RSEUs (that is, one CCU channel per RSEU). A program timer is provided to automatically initiate the operation and to control the number of hours in the recording interval. A data collection interval of either 18 cycles (30 minutes) or 36 cycles (60 minutes) may be selected. A scanning cycle of 100 seconds is started in either case with each channel sequentially selected at 6-second intervals. Manual controls are provided for initiating 36-, 18-, or 1-cycle programs. Time-of-day and date circuitry provides complete time orientation for the data printout.

3.03 Following channel selection, the CCU executes a 0.5-second loop closure to activate the electrical answer-back start-scan signal (1785 Hz) of the data receivers. This signal is received by the data transmitter at a remote location and is

TABLE C
STATUS OF GP5, GP3, GP2, AND GP1 LAMPS

GP5	GP4	GP3	GP2	GP1	LINE INFORMATION
0	0	0	0	0	(CR) (LF) (ID)
0	0	0	0	1	Note 1—30 (SP) (Time Data)
0	0	0	1	0	(Time Data) (CR)
0	0	0	1	1	(LF) 336 (CR) (LF)
0	0	0	0	0	001 Note 2 (CH 1 Group 21 Data) (CR) (LF)
0	0	0	0	0	(SP x SP) (Ch 1 Group 1 Data)
0	0	0	0	1	(SP x SP) (Ch 1 Group 2 Data)
0	0	0	1	0	(SP x SP) (Ch 1 Group 3 Data)
0	0	0	1	1	(SP x SP) (Ch 1 Group 4 Data)
0	0	1	0	0	(SP x SP) (Ch 1 Group 5 Data)
0	0	1	0	1	(SP x SP) (Ch 1 Group 6 Data)
0	0	1	1	0	(SP x SP) (Ch 1 Group 7 Data)
0	0	1	1	1	(SP x SP) (Ch 1 Group 8 Data)
0	1	0	0	0	(SP x SP) (Ch 1 Group 9 Data)
0	1	0	0	1	(SP x SP) (Ch 1 Group 10 Data) (CR) (LF)
0	1	0	1	0	(SP x SP) (Ch 1 Group 11 Data)
0	1	0	1	1	(SP x SP) (Ch 1 Group 12 Data)
0	1	1	0	0	(SP x SP) (Ch 1 Group 13 Data)
0	1	1	0	1	(SP x SP) (Ch 1 Group 14 Data)
0	1	1	1	0	(SP x SP) (Ch 1 Group 15 Data)
0	1	1	1	1	(SP x SP) (Ch 1 Group 16 Data)
1	0	0	0	0	(SP x SP) (Ch 1 Group 17 Data)
1	0	0	0	1	(SP x SP) (Ch 1 Group 18 Data)
1	0	0	1	0	(SP x SP) (Ch 1 Group 19 Data)
1	0	0	1	1	(SP x SP) (Ch 1 Group 20 Data) (CR) (LF)
0	0	0	0	0	002 Note 2 (CH 2 Group 21 Data) (CR) (LF)
0	0	0	0	0	(SP x SP) (Ch 2 Group 1 Data)
0	0	0	0	1	(SP x SP) (Ch 2 Group 2 Data)
					PATTERN TYPICAL FOR CHANNELS 2 THROUGH 16
1	0	0	1	1	Ch 16 Group 20 Data (CR) (LF)
0	0	0	0	0	> > > (CR) (LF) (LF) (FF)

Note 1: May be 0 (60 minute manual or programmed scan print),
may be 1 (30 minute manual or programmed scan print), or
may be 3 (manually-initiated print cycle).

Note 2: Number of scans completed.

Note 3: CR = Carriage Return

      LF = Line Feed

      ID = CCU Number

      FF = Form Feed

      SP = Space

CROSS-
CONNECTION
PANEL

610
TYPE
1A-TMS
INTERFACE
PANEL

TO PBX
770A
801A
812A

M50N *

M50N (TO GC LEAD)

P86A (MD)

800A
ELECTRONIC
PBX

800A
TRAFFIC
MEASUREMENT
ADAPTER

J1
J2
J3
J4

M50N

—AATR

PC

TO PC
LEADS

ELECTRONIC
PBX

P86

W50B

P50B

PI-P4

ELECTRO-
MECHANICAL
PBX OR
CDO

CONNECTOR
PANEL
WITH OR
WITHOUT
CROSS-
CONNECT

J11-J14

JGC

P50B

GC

BG

W3BG

-48, GND

TEL LINE

TEL

NOT USED
WITH ELECTRONIC
SYSTEMS

REM SCANNER

SEL
1

SEL
2

DETECTORS
(IF
PROVIDED)

EOG
D AND T
RELAYS

J1

DTC

GROUP CONTROL
MATRIX

-48, GND

W2FY CORD OR
DIRECT WIRE

T
DATA
SET
R

J1

M25B CORD

TO CCU
DATA
RCVR

REPEATER

* A P50B CORD MAY BE USED IN
ADDITION FOR ADDED LENGTH.

Fig. 7—▶REM Scanner and Data Set—Block Diagram◀

relayed to the scanner-encoder as a ground closure. Scanning starts on removal of the start ground.

3.04 The 206-type selectors in the scanner unit test for a busy or idle condition on all the 200 usage inputs, five inputs at a time. The status of the inputs as well as an EOG indication for every five inputs are translated into loop closures to a data transmitter which in turn sends back data frequencies shown in Table D. These frequencies along with an EOS signal are received by the data receiver and presented to the CCU as loop closures (minimum 14 milliseconds closed and 14 milliseconds open). This information is translated by the CCU and addressed to the proper storage register in the electronic memory unit. The memory unit provides for storage of the traffic data for 20 discrete subgroups for each RSU. At every half-hour interval or hour interval (or under manual control), the memory unit is automatically read and cleared. The accumulated data is printed out on a local and/or remote TTY in the format illustrated in Fig. 8. A maximum of five CCUs may be arranged to share the same one or two TTYs.

3.05 The CCU selects the succeeding channel, and the process is repeated until the entire 16 channels have been selected and the data recorded from the active channels. Subsequent scanning cycles are made at intervals of every 100 seconds over the period of study.

3.06 A portable scanner and a data transmitter unit are interconnected to the usage inputs to be measured, as shown in Fig. 9.

3.07 At the completion of every half-hour or hour period, the data which has been accumulated from the memory storage unit is cleared, and a TTY printout of the CCS usage, such as that shown in Fig. 8 for a 36- or 18-cycle scan, is initiated. The collection of any new data will not be interferred with by the clearing of the memory storage unit. A second memory storage unit is alternately used with the first to record and store data collected during half-hour or hour intervals. The contents of all the group registers in the memory storage unit along with the scan count unit will be read out and reset during printout operation.

TIME-OF-DAY LOGIC

3.08 The time-of-day logic (Fig. 11) comprises a chain of counters clocked by the 60-Hz line

TABLE D

DATA FREQUENCIES

TRANS. FREQ.	INPUT LEAD		TRANS. FREQ.	INPUT LEAD		TRANS. FREQ.	INPUT LEAD	
	1	2		3	4		5	EOG
A0	—	—	B0	—	—	C0	I	I
A1	I	I	B1	I	I	C1	I	B
A2	I	B	B2	I	B	C2	B	I
A3	B	I	B3	B	I	C3	B	B
A4	B	B	B4	B	B	—	—	—

B—Indicates a busy input lead or end of group.

I—Indicates an idle input lead or not end of group.

Fixed combination of frequencies are also used to designate basic conditions as follows:

      A0/B0/C0 for intercharacter signal.

      A1/B0/C1 for end of scan signal for 200 inputs.

PRINTOUT FORMAT (TYPICAL)

```
<<<
201130  12 20 09 30
336
001036                                                          ⌐CCS/HR
    1234  0345  0456  0567  0678  0789  0890  1987  1876  1654
    0123  0234  0345  0456  0567  0678  0789  0902  0986  0718
002036
    1111  0220  0000  0000  1545  1545  0466  0848  0983  0099
    0203  0303  0066  0180  0000  0000  0000  0000  0000  0000
003005 ◄── RSU CHANNEL 3 RECEIVED 5 CYCLES SUCCESSFULLY ◄──  RSEU NO. 3 WAS CONNECTED
    4256  1351  0000  0000  0000  0000  0000  0000  0000  0000   LATE IN THE STUDY PERIOD
    0000  0000  0000  0000  0000  0000  0000  0000  0000  0000   AND ONLY COMPLETED 5 SCANS.
004000 ◄── CHANNEL 4 NOT SELECTED FOR SCANNING ◄──
    0000  0000  0000  0000  0000  0000  0000  0000  0000  0000   NO SCANNERS ASSOCIATED
    0000  0000  0000  0000  0000  0000  0000  0000  0000  0000   WITH THIS CHANNEL. *
005036
    1234  0345  0456  0678  0789  0890  1987  1890  1765  1654
    0123  0234  0345  0456  0567  0678  0789  0890  0902  0959
    ¦
    ¦
    ¦
    ¦
015036
    1234  0345  0456  0567  0678  0789  0890  1987  1765  1654
    0123  0234  0345  0456  0567  0678  0789  0890  0902  0959
016000 ◄── CHANNEL 16 NOT SELECTED FOR SCANNING ◄──  NO SCANNERS ASSOCIATED
    0000  0000  0000  0000  0000  0000  0000  0000  0000  0000   WITH THIS CHANNEL. *
    0000  0000  0000  0000  0000  0000  0000  0000  0000  0000
>>>
```

RECORD PERIOD FOR CCU NO. 201 (36 CYCLES)

```
<<<
305030  12 20 18 00
336
001018
    5688  2357  2345  3456  4567  5678  6789  7890  0000  0000
    2356  4578  5689  3467  5690  0978  8657  4758  2309  4582
    ¦
    ¦                                                     ⌐CCS/1/2 HR
    ¦
    ¦
016018
    3579  2468  0000  0000  0000  0000  0000  0000  0000  0000
    3692  4812  2574  0000  0000  0000  0000  0000  0000  0000
>>>
```

RECORD PERIOD FOR CCU NO. 305 (18 CYCLES)

* CHANNEL PRINTOUT OMITTED WHERE ZERO PRINT
  SUPPRESSION FEATURE HAS BEEN PROVIDED.

▶ Fig. 8—Printout Format (Typical) ◀

which provides time-of-day data. The counters are presettable to real time by a clock toggle switch and DAYS, HOURS, and MINS pushbutton switches. Parallel BCD data from the counters are supplied to the data multiplexer in the print control logic which formats it for the time-of-day printout. BCD data from the counters is converted to decimal data by BCD-to-decimal decoders which drive the minutes, hours, and days front-panel decoders and nixie time display.

3.09 Decimal minutes data is used to develop the term $00+15+30+45$ which is supplied to the print interval control logic (Fig. 12, sheet 1) where it is used to enable printout initiation on the hour, half-hour, 15 minutes after the hour, or 15 minutes before the hour.

3.10 Rate signals 1 PPS and 2 PPS (Fig. 11) from the counter stages preceding the minutes counter are supplied to the print interval control logic (Fig. 12, sheet 1) and the scan cycle control logic (Fig. 14, sheet 2). The 1 PPS signal is used to clock counters in both of these logic blocks; the 2 PPS signal is used to control timing in the scan cycle control logic.

3.11 The front panel CLOCK RUN/STOP switch, when set to STOP, stops the operation of the time-of-day counters.
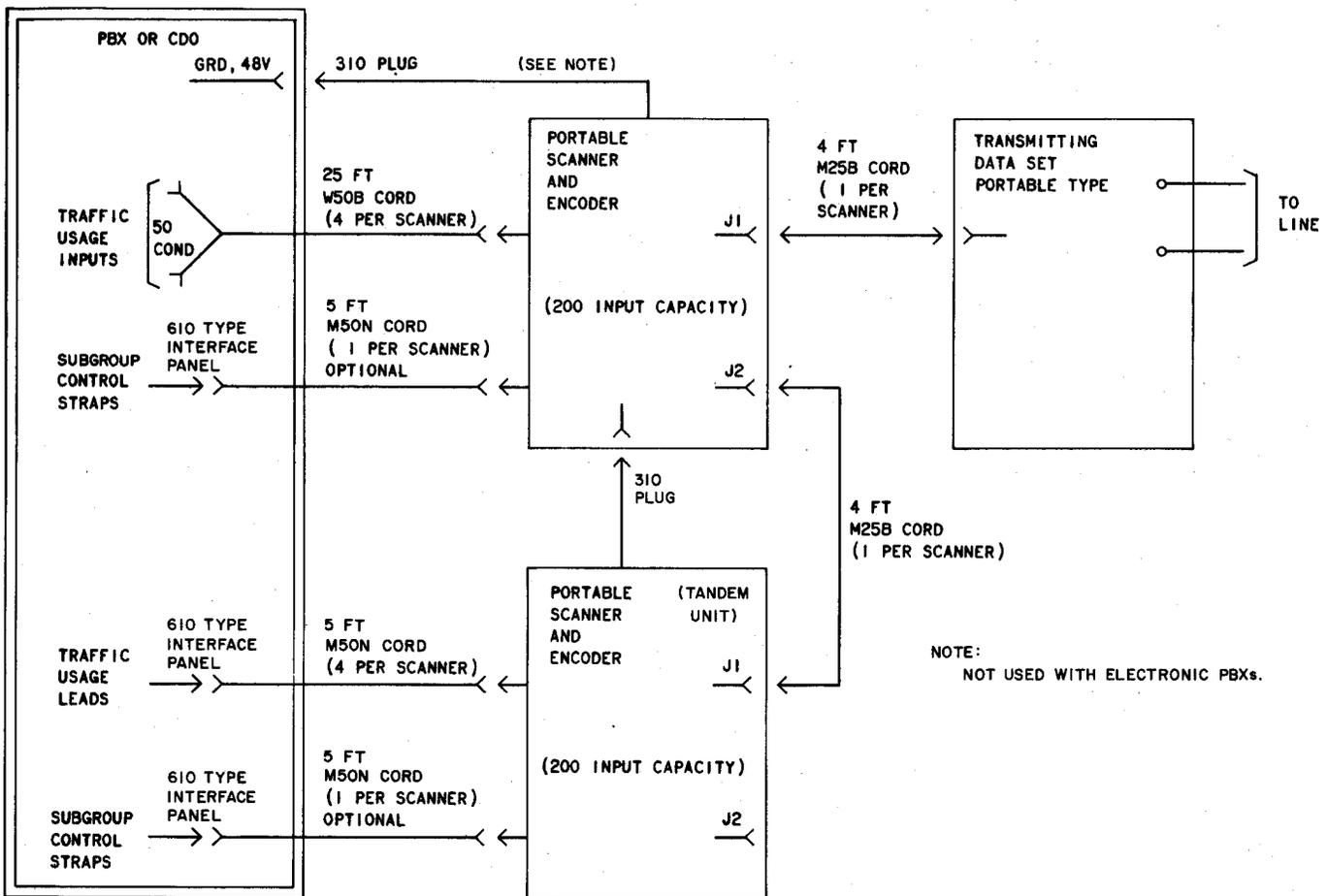
Fig. 9—▶Typical Interconnections for Portable Scanner and Data Transmitter Units◀

PRINT CONTROL AND OUTPUT REGISTER LOGIC

3.12 The print interval control logic, the print counters and decoders, and associated logic are shown in Fig. 12, sheet 1. The print interval control logic includes a logic control counter that is clocked from the time-of-day logic by the 1 PPS signal. When this counter is running, an automatic run signal is transmitted to the scan cycle control logic (Fig. 14, sheet 2) where it is used to enable the initiation of scan cycles each time that the start-scan term is supplied by the print interval control logic. (The start-scan term is transmitted every 100 seconds.)

3.13 If a priority enable signal (Fig. 12, sheet 1) is received from the priority logic, the print interval control logic, under control of the PROGRAM switch, transmits a print control term

to the print clock and shift register control counter and a reset signal to all print timing counters when the selected print interval (60 minutes or 30 minutes) is completed. At this time, a memory-selection flip-flop signal is transmitted to the scan control logic. This places the memory that has just been accumulating data under the control of the print logic and places the memory that has been off-line under the control of the scan logic.

3.14 In the presence of a true print control term from the print interval control logic, the print clock is enabled and print time counting begins.

3.15 The shift register control counter provides an 11-bit print digit period corresponding to the 11-bit ASCII data format shown in Table E. The status of the shift register control counter is

decoded to provide control terms which time the storing of data in the output register and the shifting of data out of the output shift register.

3.16 The shift register control counter clocks the print digit counter although it is often short-cycled by the RESET-TO-PDO term, as shown in Fig. 12, sheet 2. The status of the print digit counter is decoded and supplied to the program code gates. The print digit counter then clocks the print group counter.

3.17 The print group counter is a scale-of-32 counter that supplies 5-bit binary group data to the memory address gates, as shown in Fig. 14, sheet 2. However, after reaching the count of 3, the print group counter is reset at the end of line 3 of the printout; after reaching the count of 19, it is reset at the end of line 5 of the printout. This function is performed under the control of the RESET-TO-PGO gates. The print group counter clocks the two print scan counters.

3.18 The BCD scan counter provides scanner number data in BCD format as required for the printout. This data is applied to the output register via the data multiplexer. The binary scan counter provides the binary-scan-count data required to address the off-line memory. At the end of scan time 16, the print control term is reset and the print clock stops, ending the print cycle.

3.19 During programmed operation, the print interval control logic is enabled by the program timer (Fig. 10). When in synchronism with the time-of-day clock, the print interval is used to establish the scanning schedule. When the print interval control logic is not running under control of the program timer, one data accumulation and print interval may be initiated by actuating the 30M/60M START switch.

3.20 The KDC logic (Fig. 12, sheet 1) receives decoded print digit data from the print digit counter decoder. It also receives decoded scan digit data from the scan digit counter (Fig. 14, sheet 1). The output of this logic is the scan-digit/print-digit coincidence term KDC. This term is gated by the read memory term (Fig. 12, sheet 2). The read memory term restricts the KDC term to the store bit time of print digit times where data from memory is printed out. The KDC term is applied to the memory execute logic (Fig. 14, sheet 2) where it is used in enabling

a memory read cycle during the print mode. Very roughly, the KDC term could be considered a way of synchronizing the print counting chain [that is, the print digit counter and print group counter (Fig. 12, sheet 1)] clocked by 9-milliseoncd pulses with the scan control counter chain (Fig. 14, sheet 1) clocked by 1-microsecond pulses. This is necessary because the scan control counter chain controls digit addressing for printing as well as for scanning (covered in SCAN CONTROL LOGIC).

3.21 Consideration of the print control and output register logic requires a knowledge of the content and format of data that is printed out, as shown in Fig. 8. The line count and program code terms control the format of data to obtain the results shown in Fig. 8. The manner in which the program codes are used to obtain the required sequencing of data on each line is shown in Table F.

3.22 The program terms are obtained by decoding the status of the print digit counter (Fig. 12, sheet 1) and print group counter. The print digit counter determines the status of the units digit of the program code; the print group counter determines the status of the tens and hundreds digits. Since the print digit counter is a scale-of-8 counter, the units digit of the program code has a range of 0 through 7. The print group counter is a scale-of-32 counter, but it is always short-cycled and only the counts of 0 through 9 and 19 are decoded.

3.23 During line 1, line 2, and line 3 printout time, the program advances from 00 through 35. This controls

(a) The printout of three < characters on line 1, CR, and LF at the end of line 1

(b) The printout of the 14 data characters and the four spaces appearing on line 2 and CR and LR at the end of line 2

(c) The printout of the three characters, 336 (total number of groups in printout) on line 3, and CR and LF at the end of line 3.

3.24 At the end of line 3, both the print digit and print group counters are reset so that the program code is reset to 00. The print digit counter and the group counter are reset under the control of the RESET-TO-PGO logic (Fig. 12, sheet 2).

TABLE E

ASCII CODE

CTRL FUNCTIONS, NON-TYPING

| NULL | SOM | EOA | EOM | EOT | WRU | RU | BELL | FE₀ | H.TAB | LINE FEED | V. TAB | FORM | RETURN | SO | SI | DC₀ | X-ON | TAPE AUX ON | X-OFF | TAPE AUX OFF | ERROR | SYNC | LEM | S₀ | S₁ | S₂ | S₃ | S₄ | S₅ | S₆ | S₇ |

SP ! " # $ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ?

@ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [\ ] ↑ ←

LEGEND

⊡ Mark
☐ Space

Note: When parity is used, the characters and functions shown with white background have 8th bit spacing [even parity is used].

CHARACTER ARRANGEMENT

| | Start | No. 1 | No. 2 | No. 3 | No. 4 | No. 5 | No. 6 | No. 7 | No. 8 | Stop |

Mark

Space

1 Unit | 1 Unit | 1 Unit | 1 Unit | 1 Unit | 1 Unit | 1 Unit | 1 Unit | 1 Unit | 2 Units

———— 11 Units of Time ————

CURRENT WAVEFORM FOR LETTER "U"

TABLE F

GENERAL PRINTOUT FORMAT

Letters indicate digits, as required. Insignificant zeros shall be printed. ± indicates a space.

Line 1 <<<

Line 2 AAABCD±EF±GH±JK±LM

Line 3 336

Line 4 NNNPPP

Line 5 ±±XXXX±±XXXX±±XXXX±±XXXX±±XXXX±±XXXX±±XXXX±±XXXX±±XXXX±±XXXX

Line 6 ±±XXXX±±XXXX±±XXXX±±XXXX±±XXXX±±XXXX±±XXXX±±XXXX±±XXXX±±XXXX

Lines 4, 5, and 6 are repeated for each of the fifteen additional central control inputs.

Line 52 >>>

Line 1 is always as indicated (<<<◁.

Line 2 provides:

AAA	Central control number
BCD	030 to indicate 30 minute printout
BCD	130 to indicate 60 minute printout
BCD	330 to indicate printout by TTY key operation
E	month tens
F	month units
G	day tens
H	day units — Date and time of start of printout
J	hour tens
K	hour units
L	minute tens
M	minute units

Line 3 indicates total numbers of groups to follow. This number is always 336.

Line 4 provides: NNN - remote scan unit (001-016)
                     PPP - scan cycles completed (000-036)

Line 5 and 6 each provide ten 4-digit totals.

Line 52 is always as indicated (>>>).

Note 1: Following printout of the last digit of each line, except the last line, carriage return line feed (CRLF) shall be sent to the TTY.

Note 2: Following printout of the last digit of the last line to be printed (> > >), carriage return (CR), line feed (LF), line feed (LF), and form feed (FF) shall be sent to the TTY.

3.25 During line 4, the program code count advances from 00 through 07. Again, at the end of line 4, the print digit counter and the print group counter are reset.

3.26 Starting with the beginning of line 5, the print group counter is allowed to advance without being reset until the end of line 6. During lines 5 and 6, when the accumulated traffic data from each group associated with a particular scanner are being printed, the status of the print group counter determines the group address bits of the off-line memory address. Throughout lines 5 and 6, the print digit counter is reset after the count of 5. This short-cycling of the print digit counter provides the 2-digit periods required for intergroup spaces and the 4-digit periods for each group number.

3.27 Since the last two bits of the ASCII code (the two STOP bits) are always marks (binary 1s in the output register), a 9-stage output register is used to provide the 11-bit ASCII-coded data. Four data bits plus two control bits are required to specify a numerical character. For the scans-completed data printed in line 4 and the traffic usage data printed in lines 5 and 6, the four data bits are obtained from the core memory via the adder register and the memory gate logic (Fig. 12, sheet 2). The time which is available for loading data into the output register is the store bit period of each print digit time.

3.28 For nonnumerical output code bits and for numerical output code bits not supplied by the memory, the store term is used directly to strobe data into the output register. For the four numerical data bits obtained from memory, a shorter strobe time is used due to the higher data-handling rates in the memory. Thus, a gated store term is used to read bits 1, 2, 3, and 4 (the numerical bits) into the output register. This term is supplied by the memory gate logic (Fig. 12, sheet 2). When the read memory (Fig. 12, sheet 2) term is true (indicating that data is to be supplied from the memory), then the gated store term is 0.5-microsecond pulse generated during the store bit time in response to timing terms from the scan cycle control logic, which also gates data from the adder register outputs to the TTY output register input lines (Fig. 12, sheet 2). When the read memory term is false (indicating that data is not being supplied from the memory), then the gated store term is the store term. The read memory term is generated by logic which receives line and print digit data and decodes this data for digit times when data is to be printed out from memory.

3.29 Print control scanner number data from the print control BCD scan counter, time data from the time-of-day logic, and CCU number are applied to the TTY output register (Fig. 12, sheet 2) from the data multiplexer. The CCU number data is handwired to the data inputs of a group of gates in the data multiplexer logic. The data multiplexer sequences the application of data to the TTY output register in accordance with program code and line data which it receives from the program code gates and line counter decoder. The TTY control characters are supplied by gates which receive program code and line data. These include the space, CR, LF, and the form-feed characters. The form-feed character is generated at the end of the printout. This action is initiated by the true level on line 5 which is applied to the TTY control character generator.

SCAN SELECTION CONTROL LOGIC

3.30 The scan selection control receives scan counter data from the scan counter (Fig. 14, sheet 2). This data is decoded and is used to energize one of 16 scan relays, thereby connecting the associated remote scanner input pair to the data set. Control of the scan relays is exercised via driver circuits which also drive the RSU CHANNEL lamps associated with each of the channels. Thus, when a scan relay is energized, the associated RSU CHANNEL lamp is lighted.

3.31 A LOAD/IDLE/NO LOAD switch associated with each channel provides the means of activating the ACTIVE/ALARM lamp associated with that channel when the channel is to be active and also of providing a load for the channel, if required, via normally closed contacts of the associated scan relay. The load is provided only when the switch is set to LOAD. The ACTIVE/ALARM lamp is activated when the switch is operated to either LOAD or NO LOAD. When an ACTIVE/ALARM lamp is activated, it lights dimly as long as the channel response is normal. If the channel fails to respond with an EOS character within 5.83 seconds of being interrogated, then the associated ACTIVE/ALARM lamp lights brightly. Error data is also supplied to the logic causing the ALARM lamp to light and an audible alarm to sound.

3.32 For each scan time during which an EOS signal is not received, the channel status indication logic receives an EOS failure pulse from the scan cycle control logic (Fig. 14, sheet 2). It also receives decoded scan count data which allows it to identify the channel being scanned and the channel active/idle status data from the LOAD/IDLE/NO LOAD switch. An alarm indication (a lighted lamp and error data to the trouble logic) is generated only if an EOS failure signal is received when an active channel is being addressed.

SCAN CONTROL LOGIC

3.33 The scan control counter chain and associated decoders and the scan/print mode flip-flop are shown in Fig. 14, sheet 1. The counter chain is clocked continuously by the 1-MHz clock input from the memory control logic (Fig. 10).

3.34 Each of the four counters shown is a scale-of-4 counter. Three of the four states (t_1, t_2, or t_3) of the t counter are decoded for use in timing events within bit periods. The output of the t counter clocks the bit counter.

3.35 Each of the four states of the bit counter (b_0, b_1, b_2, b_3) are decoded to provide bit timing terms associated with the four BCD bits required to represent a decimal digit. The undecoded outputs of the bit counter (B_1, B_2, B_1, and B_2) are supplied to the memory address gates (Fig. 14, sheet 2). The bit counter clocks the process (P) counter.

3.36 The four states of the P counter are decoded to provide four process terms p_0, p_1, p_2, and p_3 used to control the various sequential transfers required to complete a read-and-write cycle during each digit period. The undecoded P2 and P2 outputs of the P counter are supplied to the memory control logic of Fig. 10 as the read-and-write terms, respectively.

3.37 The P counter clocks the digit counter. The four states of the digit counter (D1 D2, D1 D2, D1 D2, and D1 D2) are decoded to represent the four decimal digits of a stored number. They are supplied to the KDC logic (Fig. 12, sheet 1) as scan digit data. The undecoded outputs of the digit counter (D_1, D_2, D_1, and D_2) are supplied to the memory address gates (Fig. 14, sheet 2).

3.38 The digit counter clocks the scan print mode flip-flop. The ΔM and ΔM terms represent print mode and scan mode cycles, respectively. During print mode cycles, data may be transferred from the off-line memory to the TTY output register. During scan mode cycles, new data is received and is added to previously stored data.

3.39 The scan cycle control logic and scan counters and the control logic associated with these counters and with memory control functions are shown in Fig. 14, sheet 2. The status of the scan counter determines the remote scan unit channel that is addressed (connected to the data set). When the on-line memory is being addressed (during ΔM times), it also determines four bits of the memory address. The scan counter is controlled by the scan cycle control logic. During programmed scanning, the scan cycle control logic is enabled by a true level on the automatic run line from the print interval control logic of Fig. 12, sheet 1.

3.40 In response to a start-scan signal (Fig. 14, sheet 2), which is received every 100 seconds from the print interval control logic (Fig. 12, sheet 1), a scan cycle is begun. At the start of a scan, the scan counter is reset. It is then advanced one count every 6 seconds until the count of 16. At the end of scan time 16 [during which a true S1 S2 S3 S4 term of Fig. 14, sheet 2 is received from the scan count decoder (Fig. 13)], the scan cycle control logic enters a rest period until the next start-scan signal is received. The 6-second scan periods are implemented by a scan cycle counter clocked by the 1 PPS signal from the time-of-day logic. (The 2 PPS rate is used for sequencing of control outputs.)

3.41 When the automatic run signal (Fig. 14, sheet 2) is false, the scanner counter may be advanced one count by actuating the RSU CHANNEL STEP pushbutton. This capability is used to address a particular remote scanner channel which must be dialed or disconnected. When the automatic run signal is false, one complete scan cycle may be initiated by actuation of the ONE CYCLE START switch. This is used to verify that a complete scan cycle may be implemented prior to starting a schedule of programmed scanning and for other test purposes.

3.42 The decoded EOS signal (Fig. 14, sheet 2) from Fig. 15 is received by the scan cycle control logic and is stored. At the end of the 6

seconds allowed for the scan period, if a EOS signal has not been received during the scan period, an EOS failure signal is transmitted to the channel status indication logic (Fig. 13). At the end of the completed scan cycle, an alarm indicator reset signal is transmitted to the channel status indication logic. These signals are used by the channel status indication logic to provide visual indication of EOS failure. The alarm remains until manually cleared.

3.43 To obtain data from each channel as it is addressed, an interrogate signal must be transmitted. This signal originates in the scan cycle control logic from which it is transmitted to the data set.

3.44 The scan cycle control logic resets the group counter when an EOS signal (Fig. 15) is received. If no EOS signal is received, the scan cycle control logic resets the group counter at the beginning of the next 6-second scan period.

3.45 The status of the group counter represents the number of the group for which data is being received. Undecoded group data is supplied to the memory address gates. During scan cycles (ΔM is true), the group data determines five bits of the memory address. The group counter is reset at the EOS period. Thus, the first data received from a newly addressed remote scanner channel is assumed to be from the first group of lines associated with that channel. During the scan period, the group counter is advanced each time that an EOG signal is received along with the line status data. This allows groups of arbitrary sizes. Clocking of the group counter is implemented by the memory execute and group advance control logic. This logic enables the memory for one scan digit cycle each time that a new data character is received, after each time that a new data character is received, and after time has been allowed for the new character data to reach a steady state. The memory execute signal activates the memory for this cycle. At the end of this cycle, if the latest received character included the EOG signal, then the group counter is advanced.

3.46 When data is to be transferred from memory to the output register, the memory execute signal term is also required to activate the off-line memory during print digit cycles. In this case the store term (Fig. 12, sheet 2) and the KDC term received from the print control logic (Fig. 12, sheet 1) enable the generation of the memory

execute term. The store term designates the print bit time during which data is transferred into the output register. The KDC term designates coincidence between the print digit status and the status of the scan digit counter (which provides the digit memory address bits in the print and scan modes).

3.47 The memory read enable term (Fig. 14, sheet 2) is generated during the M digit cycle when a transfer of data from the memory to the output register (via the adder register) is being accomplished. This term is used in generating the strobe term that transfers data from the adder register into the output register.

DECODER AND ADDER LOGIC

3.48 At the start of each P cycle, the adder register is reset by bit and process timing terms (Fig. 15) from the scan cycle control logic (Fig. 14, sheet 2). The first data received by the adder register after it is reset is from the memory. This appears on the data outline from the memory control logic and is applied to appropriate stages of the register under the control of bit and process timing terms from the scan control logic (Fig. 14, sheet 2).

3.49 The second source of data for the adder register is the carry flip-flop (Fig. 15). If the carry flip-flop is set, a clock input pulse is gated to the adder register via transfer gates under the control of bit and process timing terms. At the time that the carry bit is clocked into the adder register, it is also applied to the carry flip-flop via carry reset gates (Fig. 15) which senses the status of the adder register. If the adder register is holding a 9 and receives a carry input, then a new carry must be generated at this time. Thus, under this condition, the resetting of the carry flip-flop is inhibited. Otherwise, the carry flip-flop is reset at the time that the carry bit is clocked into the adder register.

3.50 The third source of data for the adder register are the decoders which receive data from the 14 loop closure inputs from the data set via line filters. During scanning mode cycles when this data is being received, it is applied as the clock input to the adder register via transfer gates that are controlled by digit, bit, and process timing terms (Fig. 14, sheet 1). The digit terms limit the transfer to the least significant digit period since higher-order digit periods are used to

accumulate carry bits from lower orders and new data may only be added to the lowest order digit data from memory.

3.51 During print mode cycles, only the reception of data from the memory is significant. Data from the adder register are continuously presented to gates in the print control logic (Fig. 12, sheet 1). During print mode cycles when data is being transferred from memory to the TTY output register (Fig. 12, sheet 2), the adder register outputs (Fig. 15) are sampled under the control of timing terms (bit and process) from the scan cycle control logic (Fig. 14, sheet 2).

♦CHANNEL 17 TEST LOGIC

3.52 When an RSU has been installed, it can be verified with the CCU by assignment to channel 16. (Channel 16 must not have been in service.) At the CCU location, the newly setup scanner is connected to channel 16 by use of the CALL DIRECTOR®. The channel 16 LOAD/IDLE/NO LOAD switch must then be toggled to the LOAD position. Next, the CHANNEL 17 TEST switch must be set to the TEST position causing the CALL DIRECTOR to disconnect.

> *Note:* The CHANNEL 17 TEST switch is of the locking type preventing accidental toggling of the logic. As the CCU is scanning the channels in normal operation, data will be accumulated for channel 16 from the "test" RSU.

When the CCU reaches channel 16 in the regular sequence, scanning takes place in the normal manner. After completion of the channel 16 data scan, the TTY is activated and only the stored data for channel 16 is transferred for printout since the CHANNEL 17 TEST switch has been operated. The printout format will be as shown in Fig. 16. Lines 1 through 6 and line 52 only are printed. Line 4, however, now indicates fictitious channel "017."

3.53 The "test" RSU may be deactivated by returning the channel 16 LOAD/IDLE/NO LOAD switch to the IDLE position and CHANNEL 17 TEST switch to the NORMAL position. The channel 17 test logic is inhibited from printing of the channel 16 accumulated data during the last scan interval (100 seconds) of every 30-minute interval to avoid interference with the normal

printout (takes place hourly or half-hourly). Channel 17 printout is disabled during the normal printout time (3 1/2 minutes). The normal printout includes data acquired during the scan of channel 16 which occurred during the 100-second "lock-out" period immediately prior to the normal printout.

ZERO PRINT SUPPRESSION LOGIC

3.54 The zero print suppression logic inhibits the printout of data on all channels not selected for traffic measurements (channels in use). The supporting logic is initiated upon receiving PRINT command, while the system is not in MANUAL TTY MODE or TEST MODE. PRINT signal loads a 1 for each channel LOAD/IDLE/NO LOAD switch not set in the IDLE position into a 16-bit shift register.

> *Note:* LOAD or NO LOAD positions are active channel selections.

When the output of the shift register, C19-22, is high (indicating no data for that channel, next one to be printed), gate C20-E is enabled. This enabled condition generates clocks to shift the register until a low indication is found or END OF DATA signal is present at C20-F. END OF DATA indicates that there are no more active channels to be printed. The printer address counters are also incremented by the same clocks which shift the register, thereby the shift register and address counters are in step with one another.

3.55 Another signal EN LINE 3-4-5 (enable lines 3, 4, and 5) enables the logic for the printout format, as shown in Fig. 17.♦

4. MAINTENANCE FEATURES

4.01 Section 252-129-502 covers operational tests for the scanner-encoder and the frame-mounted scanner, while the encoder and transmitter unit are covered in Section 252-129-503.

4.02 Test keys are built into the CCU to facilitate the testing of various components of the unit. Test points, indicators, etc, mounted on the circuit packs are provided to permit the adjustments and the maintenance of the CCU in conjunction with the manufacture's maintenance manual provided with each unit. Section 252-129-501 provides a test procedure for the CCU.
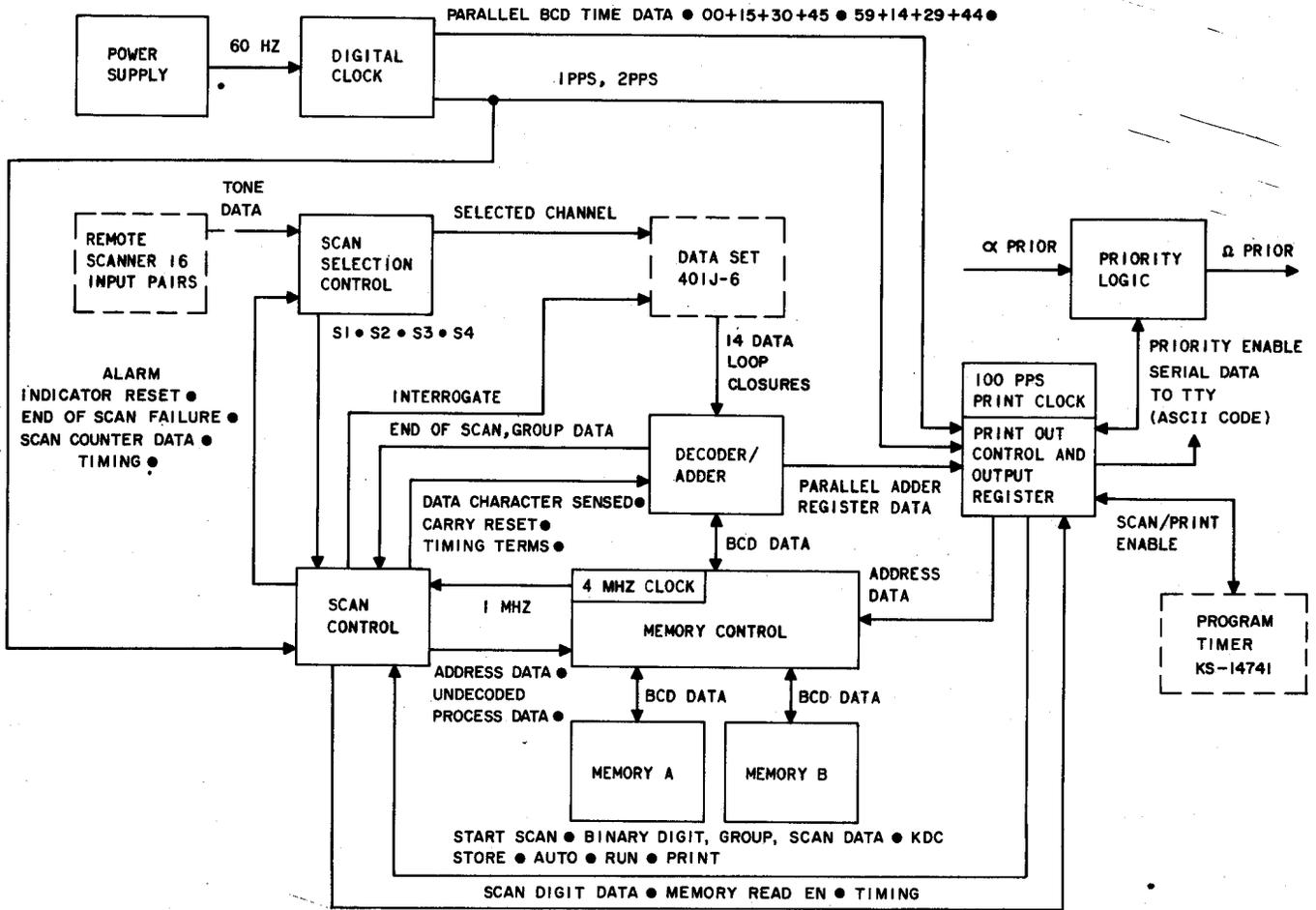
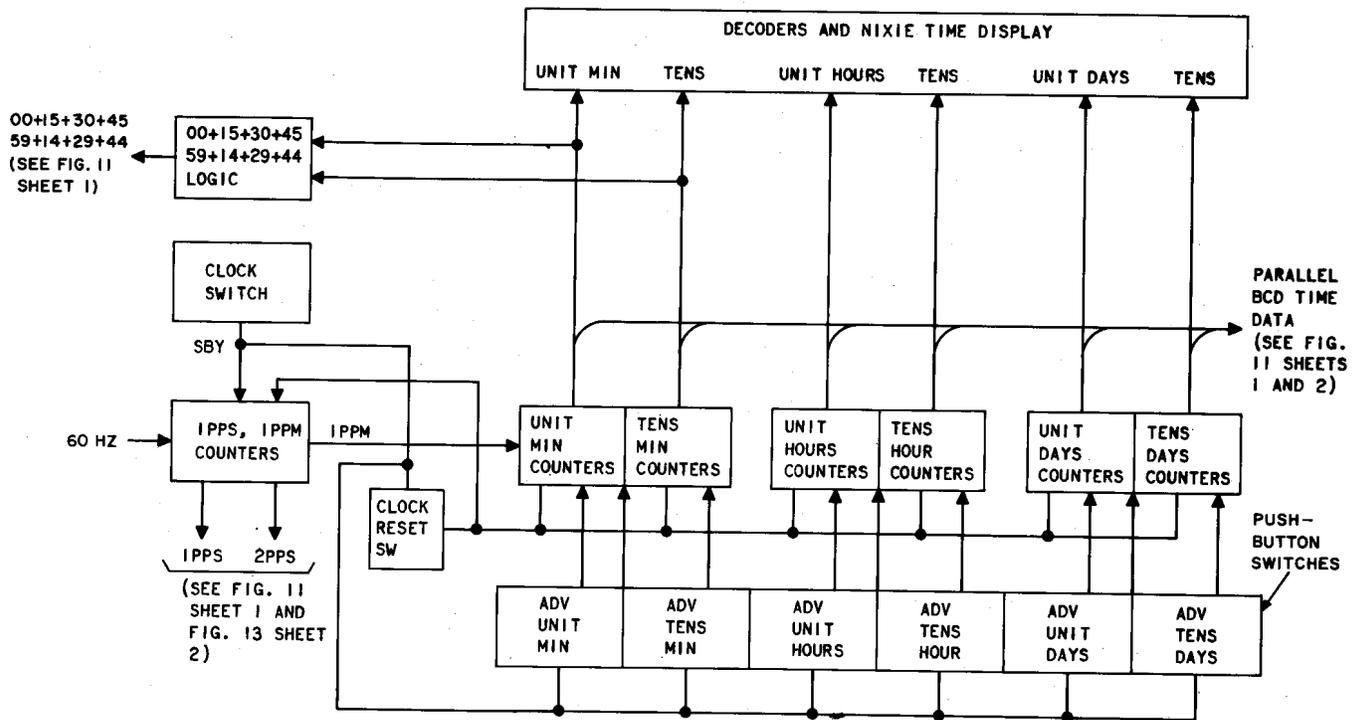**Fig. 10—Central Control Unit—Block Diagram**

DECODERS AND NIXIE TIME DISPLAY

UNIT MIN   TENS   UNIT HOURS   TENS   UNIT DAYS   TENS

00+15+30+45
59+14+29+44
(SEE FIG. 11
SHEET 1)

00+15+30+45
59+14+29+44
LOGIC

CLOCK
SWITCH

SBY

PARALLEL
BCD TIME
DATA
(SEE FIG.
11 SHEETS
1 AND 2)

1PPS, 1PPM
COUNTERS

1PPM

60 HZ

1PPS   2PPS

(SEE FIG. 11
SHEET 1 AND
FIG. 13 SHEET
2)

CLOCK
RESET
SW

UNIT
MIN
COUNTERS

TENS
MIN
COUNTERS

UNIT
HOURS
COUNTERS

TENS
HOUR
COUNTERS

UNIT
DAYS
COUNTERS

TENS
DAYS
COUNTERS

PUSH-
BUTTON
SWITCHES

ADV
UNIT
MIN

ADV
TENS
MIN

ADV
UNIT
HOURS

ADV
TENS
HOUR

ADV
UNIT
DAYS

ADV
TENS
DAYS

Fig. 11—Central Control Unit Time of Day—Block Diagram
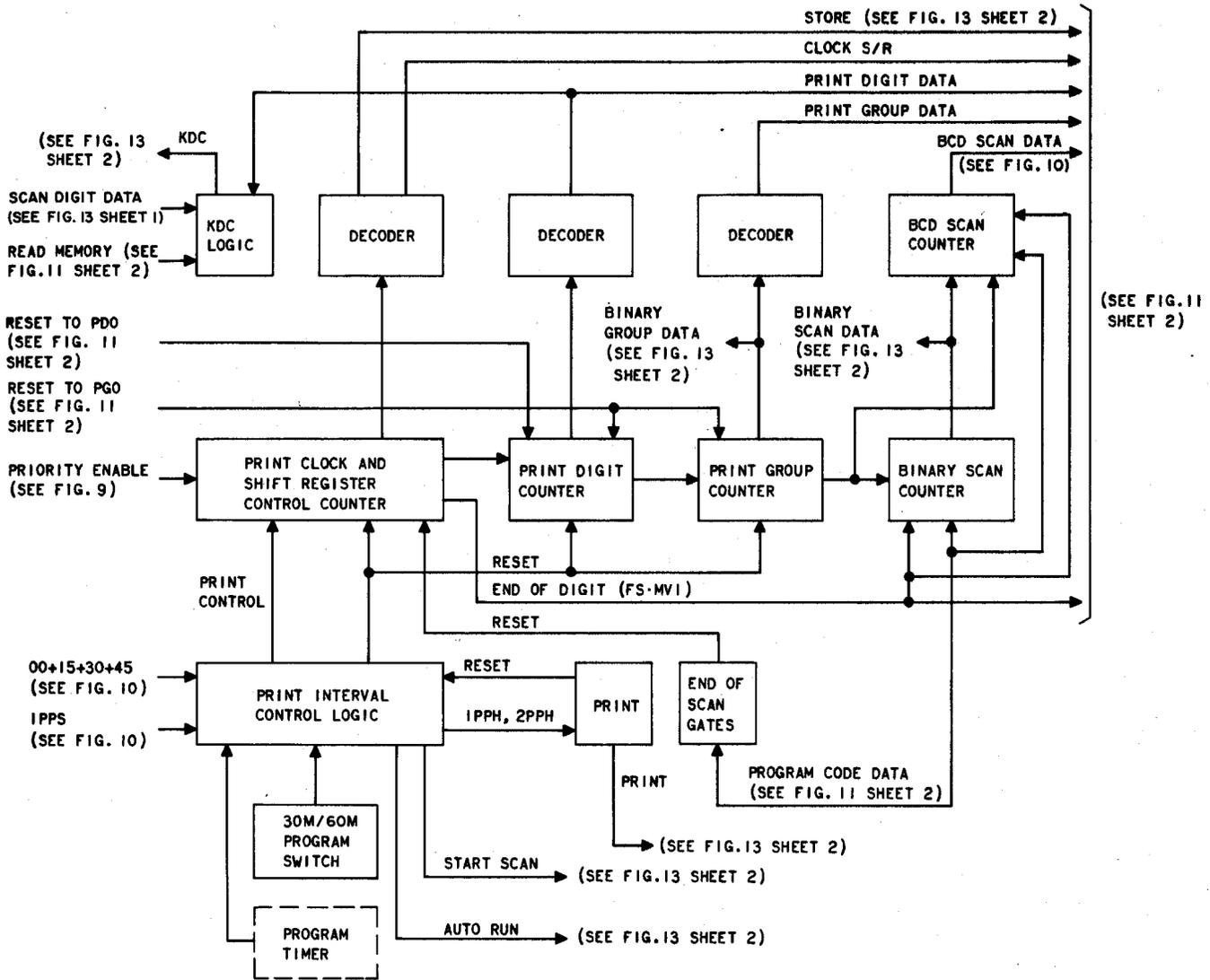
Fig. 12—Central Control Unit Print Control and Output Register—Block Diagram (Sheet 1 of 2)
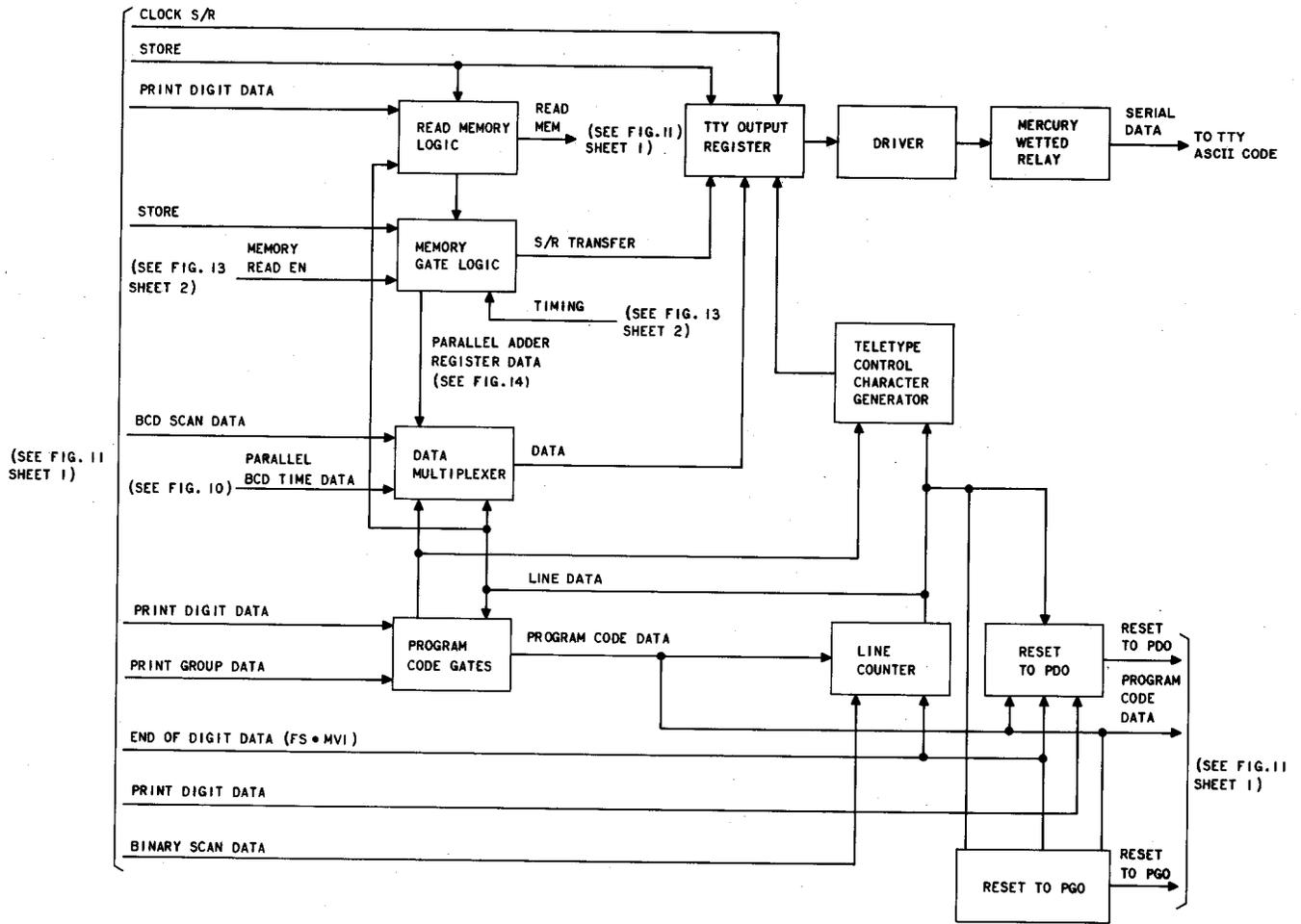
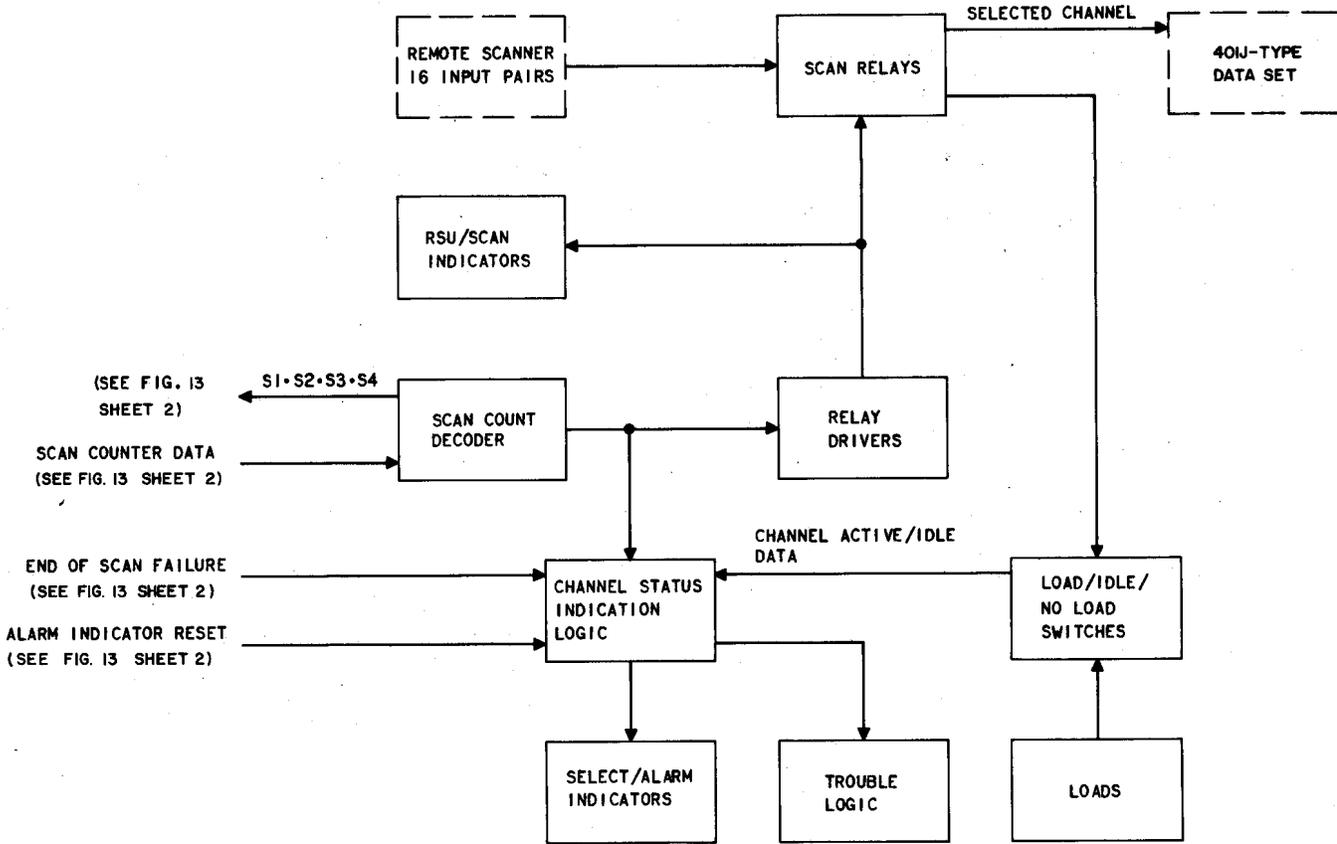**Fig. 12—Central Control Unit Print Control and Output Register—Block Diagram (Sheet 2 of 2)**

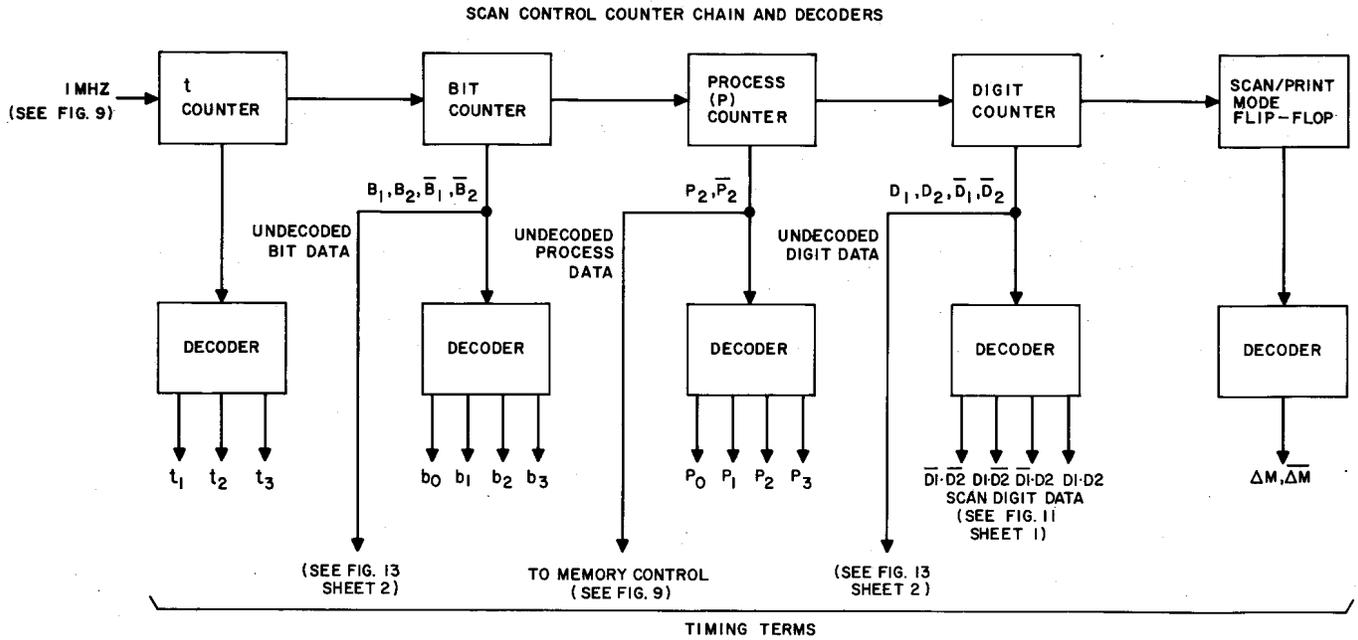Fig. 13—Central Control Unit Scan Selection Control—Block Diagram

SCAN CONTROL COUNTER CHAIN AND DECODERS

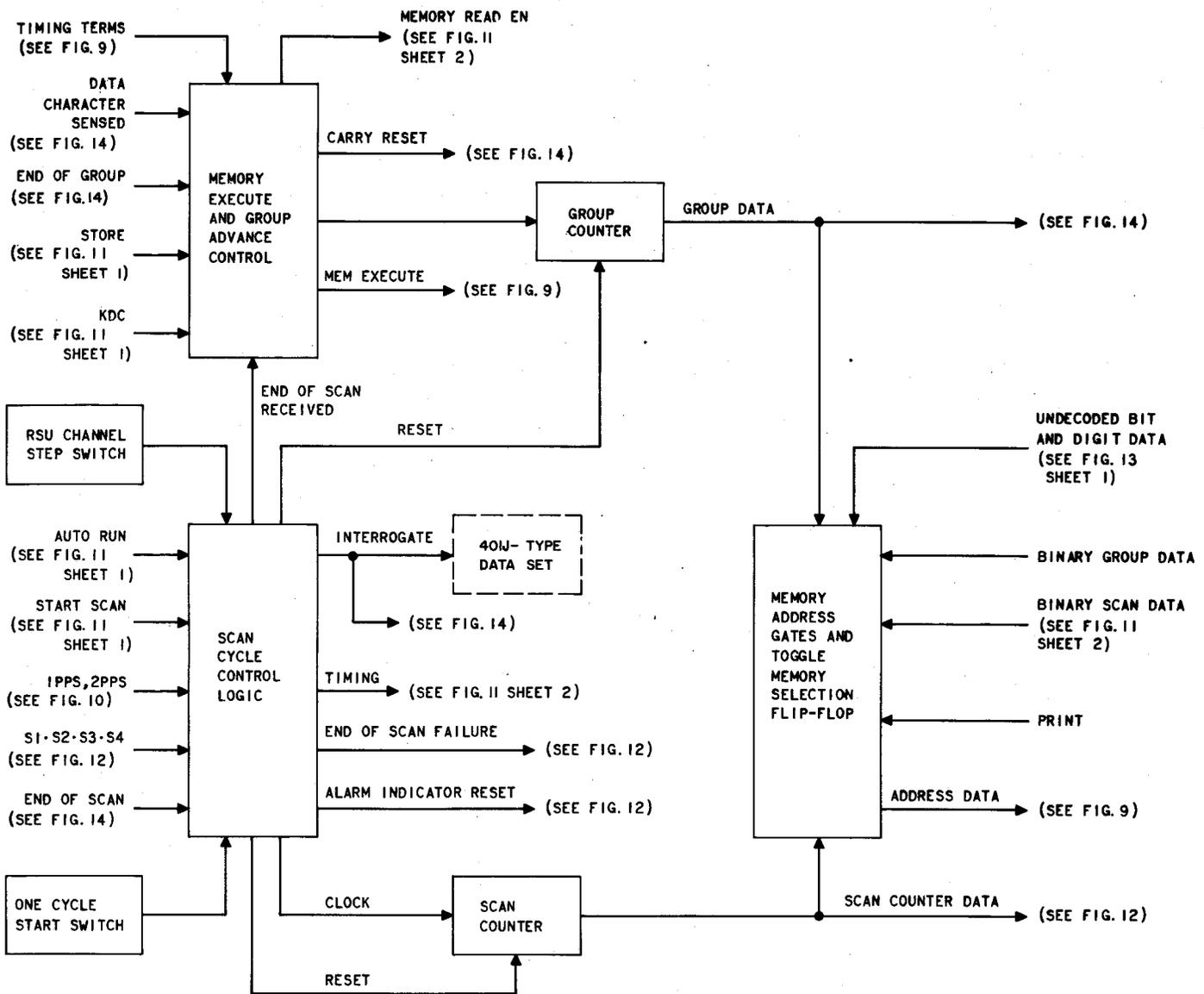**Fig. 14—Central Control Unit Scan Control—Block Diagram (Sheet 1 of 2)**

Fig. 14—Central Control Unit Scan Control—Block Diagram (Sheet 2 of 2)
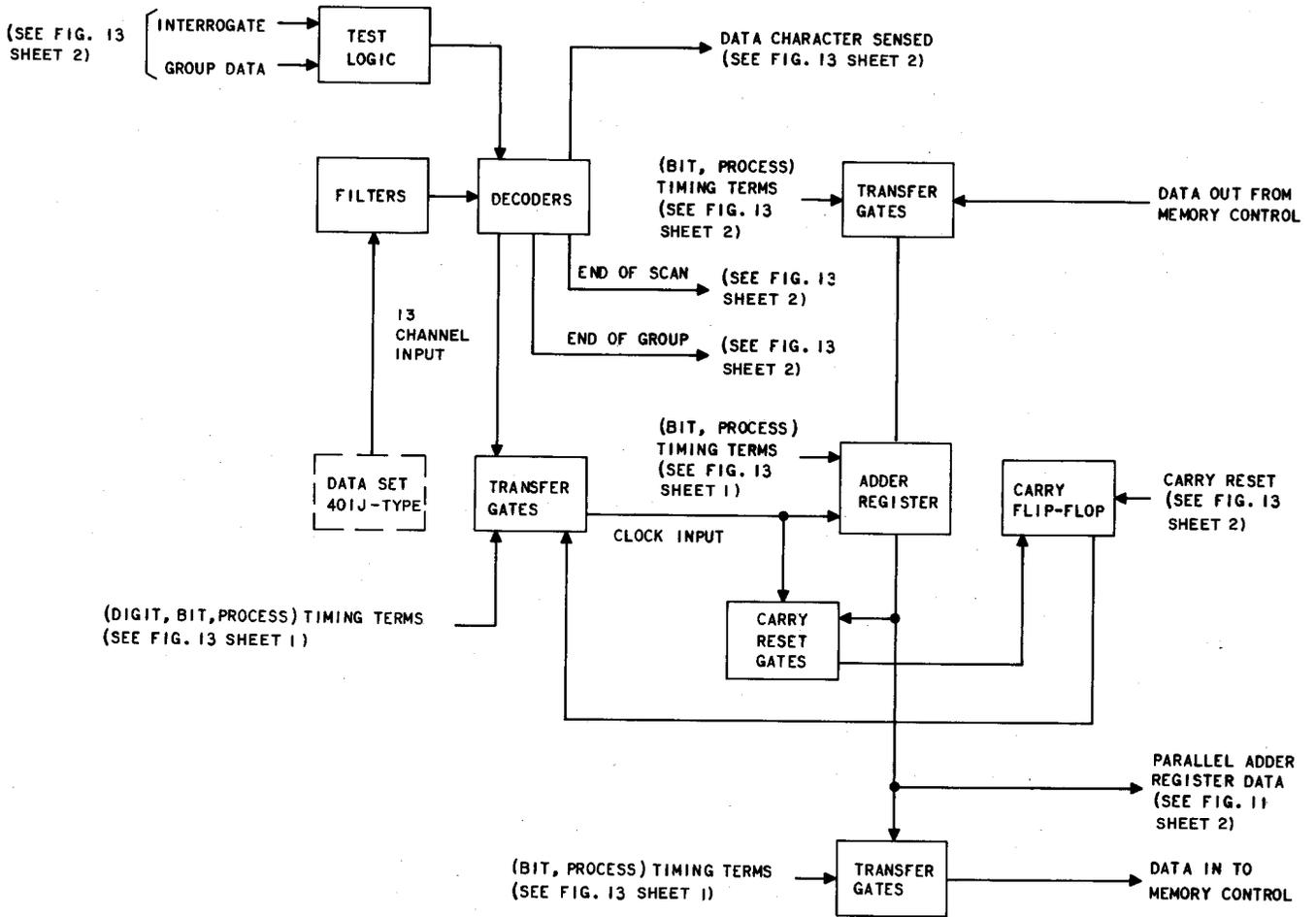
Fig. 15—Central Control Unit Decoder and Adder—Block Diagram

```
<<<
000330 05 00 00 00
336
017001
  0001   0001   0001   0001   0001   0002   0002   0002   0002   0002
  0002   0004   0006   0008   0010   0002   0004   0006   0008   0025
>>>
```

Fig. 16—♦Channel 17 Test Printout◀

```
<<<
000030 05 00 01 00
336
001018
  0018   0018   0018   0018   0018   0036   0036   0036   0036   0036
  0036   0072   0108   0144   0180   0036   0072   0108   0144   0450
>>>
```

Fig. 17—♦Zero Print Suppression Printout◀