PERIPHERAL DIAGNOSTICS
SOFTWARE SUBSYSTEM DESCRIPTION
EXTENDED OPERATING SYSTEM
3A PROCESSOR

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1. GENERAL

1.01 This section describes the peripheral diagnostic control functions provided by the Extended Operating System (EOS) for any EOS furnished peripherals and those peripheral devices which the application may designate to be controlled by the EOS diagnostic monitor. The diagnostics performed on the standard EOS peripherals are also described.

1.02 This section is being reissued to reflect changes and improvements to peripheral diagnostics, provide additional reference documents, new text in paragraph 3.04 and changes in Table A, B, and C. Since this reissue is a general revision, no arrows have been used to denote significant changes.

1.03 The following Bell System Practices provide background information related to the EOS peripheral diagnostics.

SECTION	TITLE
254-300-130	Input/Output Interfaces, Description and Theory of Operation, 3A Processor
254-300-190	Teletypewriter and Teletypewriter Controller, Description and Theory of Operation, Common Systems
254-300-200	Programmed Magnetic Tape System, Description and Theory of Operation, Common Systems
254-340-030	Processor/Process Management, Creation, Event and Communication Control, Software Subsystem Description, Extended Operating System, 3A Processor
254-340-032	Interrupt Handling, Software Subsystem Description, Extended Operating System, 3A Processor
254-340-040	Data Administration, Software Subsystem Description, Extended Operating System, 3A Processor
254-340-080	Maintenance Overview, Software Subsystem Description, Extended Operating System, 3A Processor
254-340-084	Duplex Processor Operation, Software Subsystem Description, Extended Operating System, 3A Processor
254-340-086	Initialization and Recovery, Software Subsystem Description, Extended Operating System, 3A Processor
254-340-088	Processor Diagnostics, Software Subsystem Description, Extended Operating System, 3A Processor
254-340-130	Input/Output Interface, Description and Theory of Operation, Common Systems
254-340-190	Teletypewriter and Teletypewriter Controller, Description and Theory of Operation, Common Systems
254-340-200	Programmed Magnetic Tape System, Description and Theory of Operation, Common Systems
1C-900	Trouble Locating Manual, 3A Processor

1.04 The following programs contain the codes and comments that detail the peripheral diagnostic functions in the EOS.

(a) The EOS diagnostic monitor program (AUTOMN), PR-4C626, provides the monitor and control functions for performing peripheral diagnostics.

(b) The operating system tables (OSTABS), PR-4C120, provide the various parameters which define system hardware and software configuration as specified by the application.

(c) The return control to the interrupted routine program (PRCGWG), PR-4C122, portion of the dispatcher will return control to an interrupted task.

(d) The common base level monitor program (CBLM), PR-4C617, provides access to the multiscan function subroutines.

(e) The common tape paging monitor (CPAGM) PR-4C619, pages nonresident programs from the cartridge tape into the paging buffer.

(f) The maintenance subroutines programs (MAISUB), PR-4C608, provide various maintenance support subroutines.

(g) The EOS maintenance task (MAINT), PR-4C 607, provides the task control for resident maintenance and diagnostics.

(h) The programmed magnetic tape system (PROMATS), PR-4C707, provides a series of 20 diagnostic tests.

(i) Remote serial interface (RSI) diagnostic program (DGNRSI), PR-4C708, provides a series of 20 diagnostic tests.

(j) Teletypewriter controller (TTYC) diagnostic program (DGNTC), PR-4C709, provides a series of three diagnostic tests.

(k) Common Tape Maintenance Program (CTAPM), PR-4C706, provides tape data controller and cartridge tape maintenance functions.

A. EOS Diagnostics

1.05 The EOS provides and supports two different categories of diagnostic programs.

(a) Processor diagnostics, which test the 3A CC, memory, direct memory access (DMA), and the parallel channel (PCH). These diagnostics require the use of the off-line 3A CC to run diagnostic tests as administered by the on-line machine. Control for 3A CC diagnostics is provided by the common diagnostic monitor program (CDGNM). Control for DMA and PCH diagnostics is furnished by AUTOMN. These diagnostic functions are described in Section 254-340-088.

(b) Peripheral diagnostics, which test the programmable magnetic tape system (PROMATS), remote serial interface (RSI), the teletypewriter controller (TTYC), the tape data controller (TDC), and any application- specified peripherals designated to utilize the EOS monitor. These diagnostics do not require the use of the off-line 3A CC. They are monitored and controlled by AUTOMN and performed as subroutines. AUTOMN and the peripheral diagnostics it controls are described in subsequent paragraphs.

1.06 The peripheral units are normally assigned as file system devices, eg, those serviced by the EOS file system task, and may be interfaced with the processor via a duplex bus selector (DBS). (TTYs and RSIs do not use a DBS.) The DBS is diagnosed in conjunction with a particular peripheral device, and the diagnostic is designed as a system call from the peripheral device assigned to the DBS. This is accomplished by use of an EOS system macro in the diagnostic program which will access the DBS diagnostic. The DBS diagnostic program diagnoses the bus interface portion of the DBS for the on-line processor.

1.07 The peripheral diagnostic programs are defined by EOS or the application by use of the DEFDIAG macro. The diagnostic parameters and all acceptable TTY messages are specified in the EOS system tables, OSTABS, by the diagnostic vector table (DGTAB). The peripheral diagnostic programs defined by the EOS are the same as those listed in paragraph 1.04 (h), (i), and (j).

B. Diagnostic Philosophy

1.08 All diagnostics are based on a stop-on-first-failure approach. Each diagnostic test depends on the fact that all previous tests in a sequence have passed. However, the tests do not use any data from a previous test, and running an individual test is not precluded.

1.09 Faults are reported via a trouble number that is directly related to the failing test number. Trouble Locating Manual (TLM) information is contained in each diagnostic. Failing circuit pack numbers for a given trouble number are listed in order of probability of causing the fault.

1.10 Diagnostics are never used during reconfiguration or for any reason which requires that they be immediately available. Therefore, all diagnostics are nonresident and paged in from the tape cartridge as required (except DBS diagnostics). Diagnostics can be performed automatically and can also accommodate manual requests in the form of TTY input messages or specific requests from other tasks.

C. Diagnostic Teletype Interface

1.11 The EOS furnishes an ESS-type of TTY interface for maintenance purposes (Fig. 1), which allows all diagnostic messages to be input in a standard ESS format. The interface is controlled by two EOS tasks. The first is the terminal administrator task (DADMAD) and the second is the maintenance task (MAINT). DADMAD accomplishes its functions at a priority level, which is one level higher than that assigned to the medium priority level of MAINT (eg, when MAINT is assigned priority 10, DADMAD is assigned priority 11). This assignment convention is necessary to ensure that a diagnostic program running at medium priority level of MAINT does not block TTY messages.

1.12 Input messages requesting peripheral diagnostics follow a standard ESS message format consisting of an action verb, keyword, and action option parameters as shown in the message format:

DGN: DEVICE,SUBDEVICE,ACTION OPTIONS,TEST NUMBER

(a) DGN is the action verb for all diagnostic input commands.

(b) Device is the keyword specifying a device by assigned name, eg, PROMATS, RSI, TTYC, etc.

(c) Subdevice is identified by an assigned unit number. When no number is entered, the number is assumed to represent zero.

(d) Action options may be any of the defined options.

- The step (STP) option provides manual control through use of the EXEC pushbutton on the system status panel. Control is maintained over individual tests by running only one test at a time.

- The repeat (RPT) option provides the capability to perform the same test repeatedly while the EXEC pushbutton is depressed.

- The unconditional (UCL) option provides the capability to perform all tests in sequence regardless of error conditions. All errors are reported but the sequence continues.

(e) The test number is used to select a specific test. The test must be specified with either the STP or RPT options. When no test is specified and one of the options is not selected, all diagnostic tests pertaining to the selected device are run in sequence starting at test 1, stopping on the first error.

1.13 Each character of a TTY input message generates a demand interrupt which causes interrupt processing through the kernel. An event is enabled to indicate that an ESS-type message has been received requesting a diagnostic, and the input message will be processed by the task. The terminal administrator functions and interrupt handling are described in Sections 254-340-040 and 254-340-032, respectively.

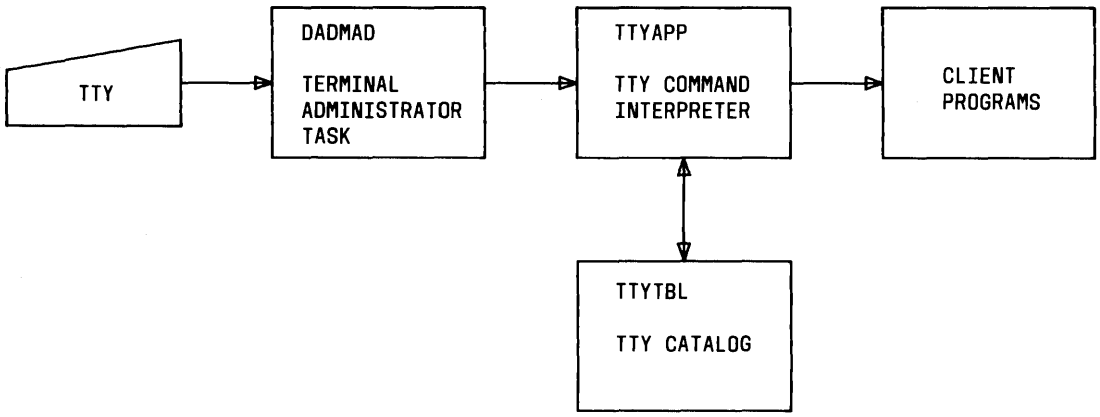


Fig. 1—TTY Input Functional Block Diagram

D. Peripheral Diagnostic Functional Overview

1.14 When the EOS initializes, all defined tasks designated to be initialized in the ready state are structured into a ready list in order of descending priority. The EOS diagnostic task (DGCTSK) is initialized into the ready state and is placed on the ready list in the specified priority position. The specific priority, type of initialization, and initial state are defined by the application user in the system tables (OSTABS). The priority level is normally low; a typical value is one. The main element of the diagnostic task is AUTOMN.

1.15 When DGCTSK is initialized, it performs some preliminary processing, eg, clears leftover messages, enables event 3 to receive additional messages, etc, and then places itself into the wait state and goes off the ready list until a diagnostic request is received via event 3. Since event 3 has been enabled, the input of an ESS-type message will cause event 3 of DGCTSK to be set. This will result in DGCTSK being moved from the wait state to the ready state and placed on the ready list. When the priority of DGCTSK becomes the highest on the ready list, it will be dispatched and will take control of the processor. Processor management is described in Section 254-340-030.

1.16 The AUTOMN accepts either a TTY (manual) input message or a message from an EOS task (automatic), initiates and controls the performance of the requested diagnostic program, and provides the necessary output messages. When the diagnostic has completed, DGCTSK returns to the wait state until another diagnostic request is received.

2. EOS DIAGNOSTIC MONITOR (AUTOMN)

A. General

2.01 The AUTOMN administers two classes of diagnostic programs:

(a) Diagnostics for all standard 3A Processor peripheral units which are supported by EOS. These include file system devices (ie, those with an entry in the file system tables) and channel units (ie, those that interface on the normal I/O interface registers R9, R10, and R11).

(b) Diagnostics for application supplied peripherals. These peripherals may or may not be assigned through the file system but must be accessible by any diagnostic furnished by the application user.

2.02 The AUTOMN is part of the low priority (typically 1) diagnostic task DGCTSK. Once initialization is completed, it is placed in the wait state until activated by a diagnostic request message on event 3, by an intertask message such as a REQ-PAGE SVC sent from another EOS task (Fig. 2), or by a request from an EOS task to automatically invoke a diagnostic. Once activated, two types of diagnostics may be administered:

(a) Those that require the off-line 3A CC (channel unit diagnostics). For these diagnostic programs, the monitor copies the diagnostic into the off-line store and then administers the execution in the off-line machine. Details concerning this type of diagnostic procedure are in Section 254-340-088.

(b) Those diagnostics that utilize the on-line 3A CC are called as subroutines by AUTOMN, actually becoming an extension of the diagnostic monitor task. All diagnostic routines are nonresident and are paged into the paging buffer as required. The data base organization and the paging function are described in Section 254-340-064.

2.03 The basic functional sequence (Fig. 2) of DGCTSK is:

- Input message processing which identifies the device for which the diagnostic is requested and provides the required information with which to build the diagnostic control block (DGN_CB) (Fig. 3)
- Identification and location of the proper diagnostic programs (resident or nonresident)
- Reservation of the off-line 3A CC, if required, and initiating the paging function to page in the nonresident programs
- Invocation of the selected diagnostic program
- Interpretation of returns and producing appropriate output messages
- Handles abort requests.

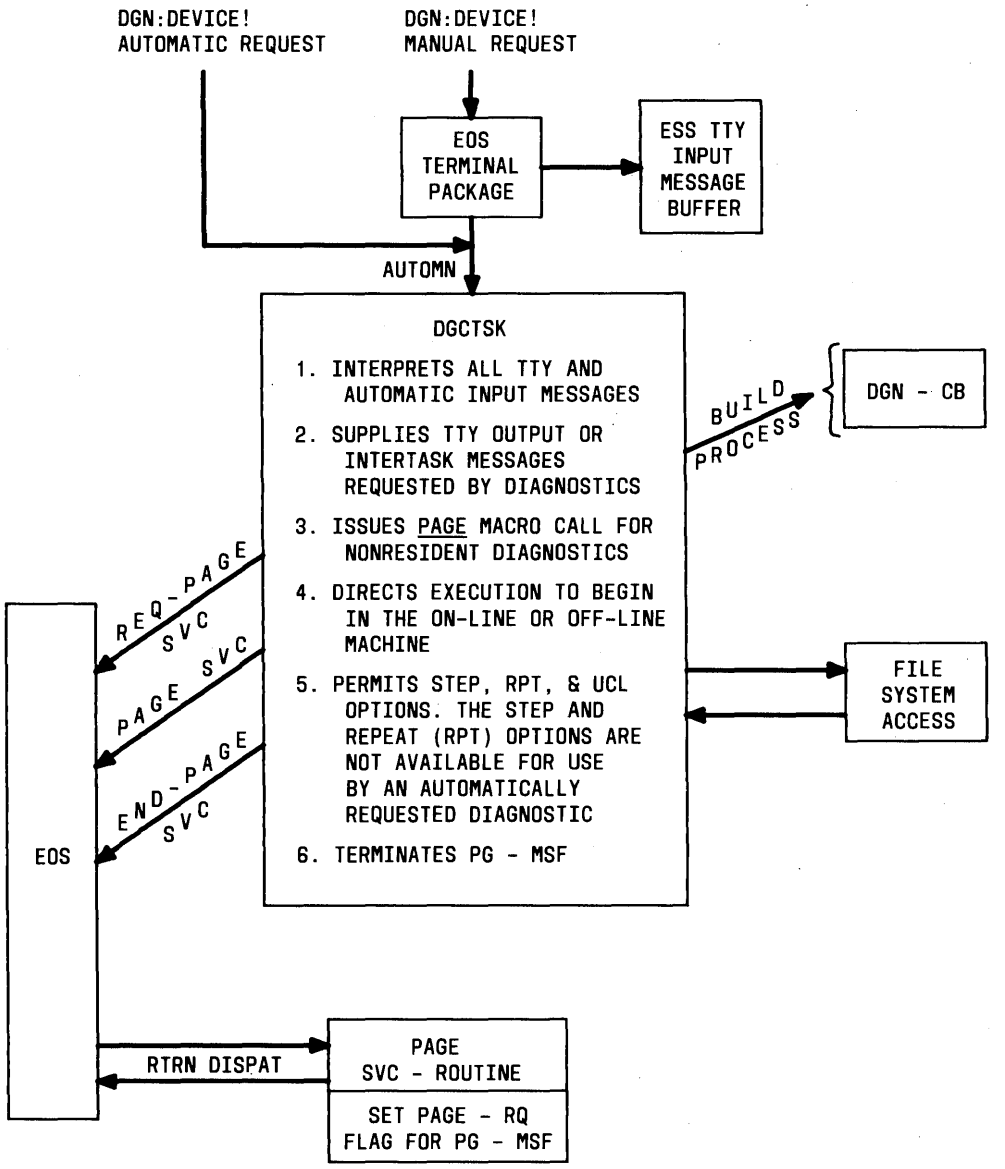


Fig. 2—Invocation of a Peripheral Diagnostic

B. Input Message Processing

2.04 The AUTOMN is entered via the event routine 3 entry point DCT_TTYIN. The message buffer is tested and determination is made as to whether the message is requesting an abort of a previously requested diagnostic or if the requested diagnostic was previously invoked. Once these tests are complete, a test for a valid device is made. The appropriate 2-character response (eg, PF, NG, etc) is then returned either to the TTY (manual mode) or to the requesting EOS task (automatic mode). All manual diagnostic requests are processed prior to processing any automatic diagnostic requests. Control is then passed to the dispatcher to notify other tasks that a diagnostic has been requested.

2.05 Event 3 is again enabled to allow input of additional diagnostic messages. The current message is then tested for any requested options:

(a) UCL—Unconditional automatic execution which reports all errors but continues to perform the diagnostic until completed

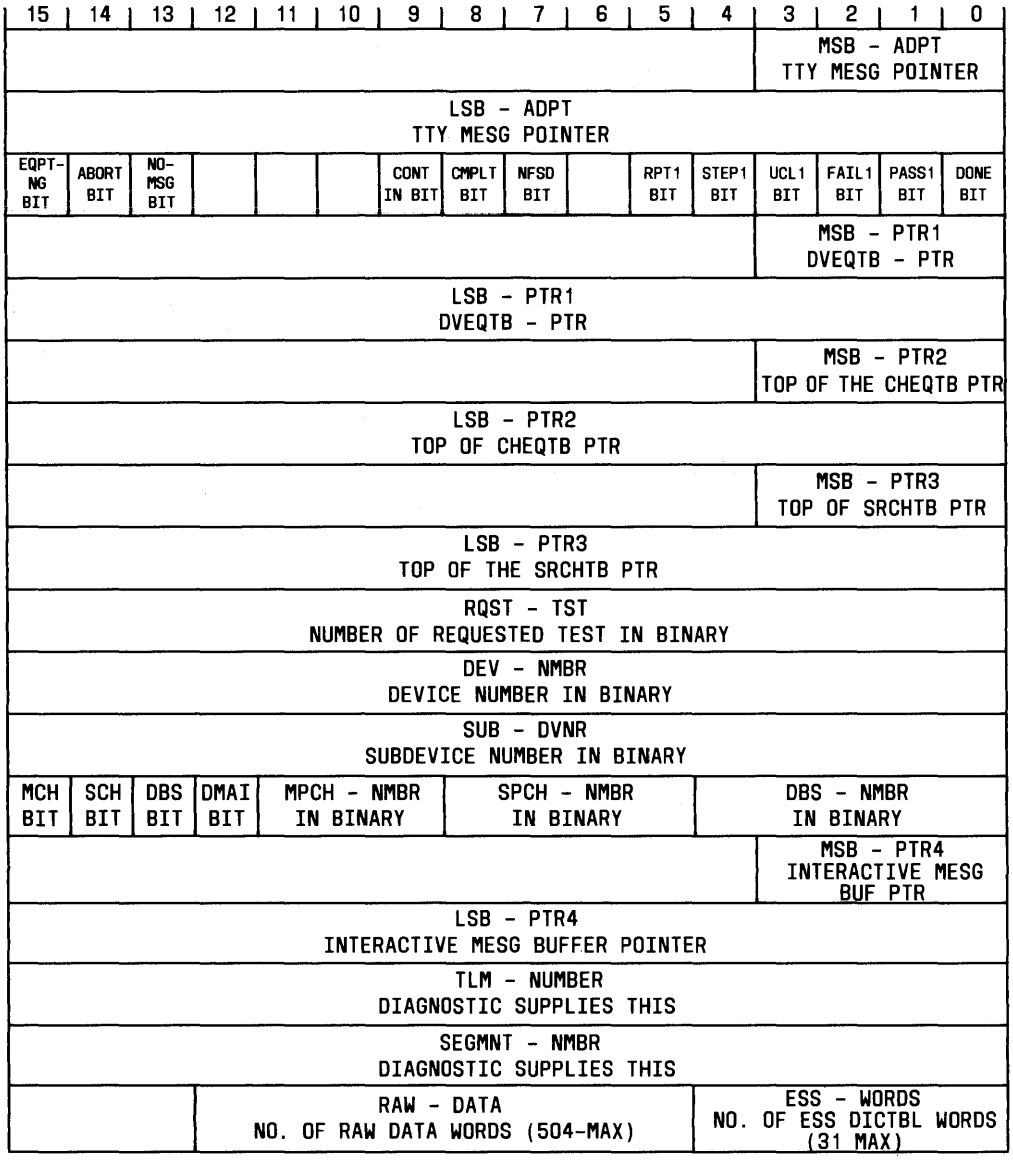


Fig. 3—Layout of Diagnostic Control Block (DGN_CB)

(b) RPT—Repeat the diagnostic under manual control (not available in automatic mode)

(c) STP—Step through all diagnostics under manual control (not available in automatic mode).

When an option is identified, the appropriate bit is set in DGN_CB. Selected pointers are then set in DGN_CB which locate the TTY input message buffer, the channel equipment table, the serial channel table, and the interactive message buffer. The specific test number (when one is requested) and the device and subdevice (when required) are identified and placed in the appropriate locations in DGN_CB. At this point, construction of DGN_CB is complete with information that is common to any device whose diagnostics are monitored by AUTOMN.

C. Diagnostic Program Identification

2.06 AUTOMN must determine the device category in order to determine which diagnostic

program must be called. The message number will specify the category of the device:

(a) A channel unit

(b) A file system device

(c) Neither of the above.

This section pertains to the diagnostic functions for file system devices. Section 254-340-088 describes those functions pertaining to the channel devices. When the device to be diagnosed is a standard peripheral device, it must be removed from service and defined as a unit under the EOS file system.

2.07 To manually remove the device from service, the following message is entered:

RMV:DEVICE (File system device name)

The system will respond with a message that the device has been removed from service. When the device cannot be removed from service, it cannot be accessed by the diagnostic. In this case, AUTOMN will abort the diagnostic request and furnish the following message:

IN SERVICE (File system device name)

2.08 To determine that the device is listed as a unit under the EOS file system, the device equipment table (DEV_EQP) in the application system tables (OSTABS) is accessed. When the search is unsuccessful, the following message is printed:

FILE SYSTEM ACCESSING

When the search is successful and the unit is out of service, AUTOMN completes building the DGN_CB and sets a flag indicating that the unit requested is in a maintenance state. When DGN_CB is successfully constructed for any peripheral device, a search of DGTAB in OSTABS is started to locate the diagnostic program to be run.

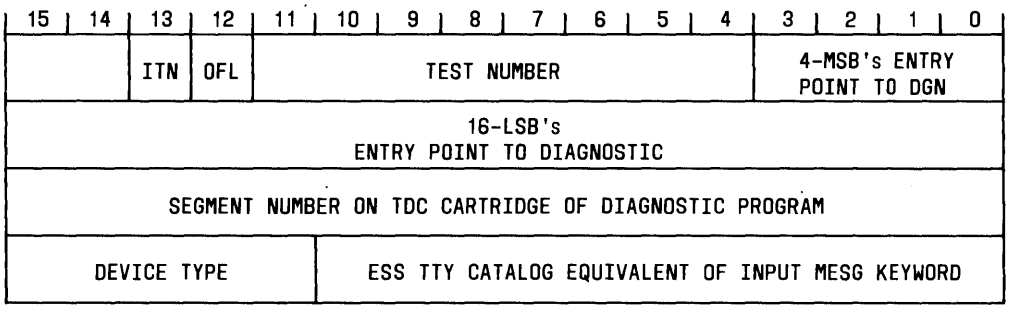
2.09 The basis of the search is the keyword [1.12 (b)] specifying the device name. AUTOMN begins checking each consecutive 4-word entry in DGTAB (Fig. 4), first for a match on the keyword and then for a match of the test number when one is specified. When a test number is not specified, the tests will start with number one. When a match of the keyword is obtained but no match of a required test number can be found, then the requested test was never entered in DGTAB and the following message will be printed:

TEST NUMBER NG

This condition occurs when the repeat option is requested and no test is specified.

D. Determination of Off-Line and Nonresident Diagnostic Programs

2.10 Once the required 4-word entry in DGTAB is located, AUTOMN can determine if the



NOTES:
1. ITN = 1 IF THE TEST NUMBER IS TO BE IGNORED BY PDGM.
   THE DEFAULT VALUE IS ITN = 0.
2. OFL = 1 IF THE DIAGNOSTIC TEST IS TO RUN IN THE OFF-LINE CC.
   THE DEFAULT VALUE IS OFL = 0.

Fig. 4—Layout of 4-Word Entry in Diagnostic Vector Table (DGTAB)

diagnostic requires the off-line 3A CC and whether the required program is resident or nonresident. In the case of file system devices furnished as part of EOS, none of the diagnostics require the off-line 3A CC, and all programs are nonresident. Application diagnostics utilizing the diagnostic monitor may be structured differently. When the program is nonresident, AUTOMN invokes the paging mechanism to page the program into the paging buffer. When paging is complete, control is passed to the diagnostic program.

E. Interpretation of Diagnostic Returns

2.11 When diagnostics are in control, they make various returns to the diagnostic monitor (AUTOMN). The monitor uses the returns to determine what action must be taken to perform further monitor functions. The diagnostic returns information by setting the appropriate bits in DGN_CB. AUTOMN also initiates action to enable the printing of the diagnostic messages.

2.12 The DONE bit (Fig. 3) in DGN_CB is set by the diagnostic when it has completed execution. This notifies the monitor that further execution of the diagnostic is not required; but it does require that the monitor cause the results of the diagnostic to be printed and certain termination processing to be performed. The setting of the ABORT bit will override the DONE bit; however, the only difference between the two is that printing of the test information is suppressed for the abort. The DGN (device) ABORTED message is printed, where (device) represents the device being diagnosed.

2.13 The diagnostic notifies AUTOMN of the success or failure of the diagnostic by setting either the PASS1 bit or the FAIL1 bit. It may also set the CMPLT bit which indicates that one pass of the test has been completed, but the diagnostic is not ready to terminate. The decision to terminate in this case is left to DGNMON. When the CMPLT bit is set, either the PASS1 or FAIL1 bit must be set; the DONE bit is not set.

2.14 The UCL1 bit is set by AUTOMN when the UCL action option is requested by the input message. This option prevents termination of a diagnostic when a failure occurs. Under this option, when a failure is detected by the diagnostic, a failure message is generated and the next sequential test is started. When all tests have been run, the DGN (device) COMPLETE message is printed. Without this option, diagnostics are terminated on detection of the first failure.

2.15 When the action-option STEP is specified in the input message, AUTOMN sets the STEP1 bit in DGN_CB. This option permits the test to be run once and a message printed. Thereafter, the test is run when the PF EXECUTE button on the system status panel is depressed. When this option is in effect, the task MAINT monitors status changes of the PF EXECUTE button and, when a change of state is detected, AUTOMN is reentered via event routine 9 entry point EXEC_STP. A message is generated on the first run; thereafter, a message will be generated only when the results change. The status of the test is also displayed on the PASS/FAIL lamps on the system status panel.

2.16 When the action-option RPT is specified in the input message, AUTOMN sets the RPT1 bit in DGN_CB. This option permits a specifically requested test to run repetitively until test execution is halted by a TTY input message. AUTOMN generates an output message after the first cycle of the test. After the first cycle, a message is printed only when the results of the test change. The repetition may be stopped by depressing the EXECUTE button. The MAINT task monitors the status of the EXECUTE button and, when depressed, MAINT will sense the state change and report it. AUTOMN responds to event 10 routine (STRT_RPT) to start the diagnostic in the repeat mode and to event 11 routine (ACT_RPT) to restart the diagnostic.

2.17 Both the STEP and RPT options may be invoked only by an input message from the maintenance TTY; ie, they cannot be requested by an intertask message from another EOS task. The STEP and RPT options are terminated by the standard peripheral diagnostic abort message:

ABT:PGDN!

2.18 AUTOMN may be used to invoke an executive program such as an application-defined interpretive monitor used to administer table-driven diagnostics. In this case, AUTOMN uses the appropriate entry in DGTAB in OSTABS to direct execution to begin at the entry address of the application-defined monitor. It will use the output message facility of AUTOMN to produce failure information when an error occurs.

2.19 The NO_MSG bit in DGN_CB is set by the diagnostic to suppress all output messages from AUTOMN that result when the requested test has completed execution on the selected peripheral. In effect, this flag suppresses all the trouble location information normally supplied by the diagnostic for AUTOMN to output on the maintenance TTY.

2.20 The ABORT bit in DGB_CB is set by the diagnostic to indicate to AUTOMN that a conditon has been detected which requires the diagnostic to abort itself. The diagnostic cleans up after itself and then returns control to AUTOMN with the ABORT bit set. AUTOMN performs the necessary termination functions for the abort and generates the message:

DGN (device) ABORTED

where (device) is the keyword originally specified by the input message.

2.21 The diagnostic sets the EQPT_NG bit in DGN_CB and returns control to AUTOMN when the equipment device number in the input message is incorrect. This could represent an input error, or unequipped channel, etc. The diagnostic must also set the DONE bit in this case. AUTOMN generates the response message:

EQUIPMENT NUMBER NG

F. Return of Failure Information

2.22 The executing diagnostic furnishes AUTOMN appropriate failure information in DGN_CB. The standard failure message routine reproduces the original diagnostic message and then follows it with failure data:

DGN (device) nnnn

where (device) is the device name (keyword) specified in the original message and nnnn represents the specific device identity. This is followed by data in the form:

FAULT XXXX SEGMENT YYYY

where XXXX is a hexadecimal quantity placed in the TLM_NUMBER word of the DGN_CB by the diagnostic, and YYYY is another hexadecimal number reflecting the segment number of the program which detected the failure.

2.23 AUTOMN checks two fields of a word in DGN_CB. The first, ESS_WORDS, may specify that up to 32 ESS dictionary words are to be printed in connection with the error. When these words are dictionary table words, AUTOMN will output these standard ESS words, eight to a line, up to a maximum of four lines. AUTOMN next examines the RAW_DATA field. The diagnostic may specify up to 248 hexadecimal words to be provided as output. These words are printed, 8 to a line, up to 31 lines. Thus, the diagnostic may furnish a prologue for the raw-data dump by using the ESS words. This could be in the form of headings, explanations, etc.

3. DIAGNOSTIC PROGRAMS

A. General

3.01 The EOS furnishes standard diagnostic programs for all system peripheral devices included as part of the 3A Processor. These devices are the PROMATS, RSI, and TTYC. (See paragraph 1.05.) Other application diagnostic programs are covered in paragraph 3.05.

B. PROMATS Diagnostics

3.02 The PROMATS diagnostics (DGNPRO) consist of a series of 20 tests. The tests can be run in sequence or one at a time as specified by the input message. The diagnostic tests PROMATS and the interconnecting channel devices by initializing each element of the system and checking the required responses. When all responses are correct, the primary functions of PROMATS are tested by performing controlled read and write operations and verifying correct performance. A list of all tests and a brief description of each is contained in Table A. PROMATS theory of operation is described in Section 254-300-200.

C. RSI Diagnostics

3.03 The RSI diagnostics (DGNRSI) consist of 20 tests. The tests can be run in sequence or one at a time as specified by the input message. The tests are structured to check the serial channel assigned to the RSI, then initialize and perform checks on the interfaces, decoders, control elements, receivers and transmitters, and ensure that the

TABLE A

PROMATS DIAGNOSTIC (DGNPRO) TESTS

TEST NO.	FUNCTION
01	Tests interfacing channels including DBS, parallel subchannel (SPCH), direct memory access (DMA), and main parallel channel between PROMATS and the 3A CC. The interrupt and DMA request (DMAR) paths are included.
02	Tests initialization by placing a command present (CP) signal on the parallel bus interface and checking for required responses, eg, SYNC, ER, and BUSY from the bus interface unit (BIU).
03	Tests all interface signals again, the address portion of status word 0 (SW0), and the BIU address decoder by a series of send status (SST) commands to verify that PROMATS can recognize the proper address and can respond to the CP and SST commands.
04	Tests the information (INF) leads (16 data bits plus 2 parity bits) between the PROMATS BIU and the DBS. The BIU data registers are then tested.
05	Switches the DMA request (DMAR) off and on and then uses the DBS maintenance status word to perform a direct check to determine that the DMAR is not stuck open or closed.
06	Uses a BIU loop-around to test INF leads. The leads are first cleared, then all leads are set to "1" one at a time. The leads are then set to "0" one at a time. Checks for crossed leads.
07	Tests channel and BIU for sensitivity to noise and bit drops by looping around different bit patterns.
08	This test sends an emergency stop (ESTP) command and verifies that the CONFORM program is sane enough to respond by returning the command complete (CMDC) signal.
09	This test sends an INIT command to PROMATS and verifies all return responses.
10	This test verifies the interrupt system by first disabling it and verifying that no interrupts are received. The system is then enabled and verifies that an interrupt can be recognized. The ability of the PROMATS to generate interrupts is also tested.
11	This test verifies the capability to access status words 0, 1, 2, and 3, which are normally invisible in CONFORM. The test verifies portions of the microcode, internal bus bits, and several gates and flip-flops.
12	This test exercises the built-in microcode diagnostic sequences (maintenance steps).
13	This test performs a direct tape command by writing a string of zeros (ID burst) onto tape and verifying the results.
14	This test confirms the write command by writing data, consisting of a block of 256 words, onto tape. This provides an actual test of a DMA data transfer to PROMATS.
15	This test verifies the Backspace command by backspacing to the beginning of a block of data entered in test 14. No data is transferred.
16	This test verifies the Read Forward command. The test reads the block of data written in test 14 and backspaced in test 15 and compares the data array with that written in test 14.

TABLE A (Contd)

PROMATS DIAGNOSTIC (DGNPRO) TESTS

TEST NO.	FUNCTION
17	This test performs a statistical read/write check of the tape by writing, then reading back 50 test blocks of 256 words per block.
18	This test checks the command repertoire and time-out detection. It sends a series of commands: Read, Fast-Forward, Emergency-Stop, Rewind, Preempt, and verifies beginning of tape (BOT) markers.
19	This test writes an ID burst to isolate read system errors. The test is run only when an earlier test indicates read system errors.
20	This test is a continuation of test 19 to isolate read system errors indicated from other tests. This test can, if necessary, direct the replacement of every circuit pack in every group of the read system.

data set can receive and send data as required. A list of all tests and a brief description of each is contained in Table B. RSI theory of operation is described in Section 254-300-130.

D. Teletypewriter Controller (TTYC) Diagnostics

3.04 The TTYC diagnostics are supervised by the AUTOMN. The TTYC to be diagnosed is placed in the maintenance state and the diagnostics are invoked by a request on the maintenance TTY. The diagnostics communicate with AUTOMN via the DGN_CB. The diagnostics assume that the CC is functioning properly, the TTYC has been initialized and is in the maintenance state, and AUTOMN has ascertained that a valid test and device number have been selected.

3.05 The TTYC diagnostic (DGNTC) consists of a series of three tests. The tests can be run individually or in a sequence, depending on the input message, and cannot be requested from the TTY being diagnosed. The tests check the basic timing, status reporting, and parity capability of the controller. A list and brief description of each test are in Table C. For detailed theory of operation of the TTY controller, refer to Section 254-300-190.

E. Application Diagnostics

3.06 In addition to the diagnostics previously described, any application user may specify application peripheral diagnostics as required. All diagnostics of this type must be defined by the DEFDIAG macro, and the 4-word format (Fig. 4) must be listed in OSTABS in order to define all TTY message verbs and keywords for construction of DGTAB.

TABLE B

RSI DIAGNOSTIC (DGNRSI) TESTS

TEST	FUNCTION
01	This test verifies the serial channel utilized by the RSI.
02	This test sends an acknowledge (ACKII) command to the serial peripheral interface and checks for responses.
03	This test first sends all zeros and then all ones to the bus terminator (BT) and checks for proper responses.
04	This test sets the BT to all ones then switches to all zeros one bit at a time. The test is repeated by setting all zeros to ones a bit at a time and checking for proper response in each case.
05	This test checks the address decoders on the serial peripheral interface (SPI), the BT, and four RSI ports.
06	This test verifies communication with the RSI port. It also verifies the sanity of the PBI interface and basic command decoders.
07	This test exercises all the mode flip-flops of the RSI. It also verifies operation of the command decoders.
08	This test verifies the basic send and receive capabilities of the universal asynchronous receiver transmitter (UART).
09	This test checks the first-in/first-out (FIFO) and both sides of the UART by transmitting 256 unique characters at the maximum baud (information bids per second) rate.
10	This test is similar to test 09 except that all four electronic industry association (EIA) voltage level outputs (R2S, DTR, RCT, CDR) are switched off and on as rapidly as possible during the conduct of the test.
11	This test checks the majority of the interrupt logic in the RSI port, with the exception of the EIA change interrupt circuits.
12	This test exercises a modulator/demodulator (MODEM) when the port is equipped. When the test is run, it is assumed that the analog loopback (AL) test button on the MODEM has been depressed. The EIC detector is also tested.
13	This test verifies that the RSI port can run at the baud rate specified in the device control block (DVCB).
14	This test verifies that a character ready, send (CRS) bit is returned during a write-data operation when the send buffer is not full.
15-19	Vacant
20	This test verifies that a data set/modem with dial-up capability can respond to the switched telephone network.

TABLE C

TTYC DIAGNOSTIC (DGNTC) TESTS

TEST NO.	FUNCTION
01	This test (TIME_TST) tests the communication channel interface, timing accuracy of the clock and sequencers, TTYC state transition, and TTYC loop-around capability.
02	This test (STAT_TST) confirms that port status alarm status can be altered, and that "Who Are You" (WRU) circuitry is operative.
03	This test (PAR_TST) confirms the capability of the controller to check the parity on TTY messages, either odd or even.

F. Miscellaneous Diagnostic Commands

3.07 The command:

OP:QUEUE!

will output the diagnostic request list (queue) as well as the currently active diagnostic. The output from this command is formatted as follows:

OP QUEUE DGN XXX CUR ACT

(currently active diagnostic)

DGN XXX MAN

(next up, was manually requested)

DGN XXX MAN

(2nd next up, was manually requested)

DGN XXX AUTO

(3rd next up, was automatically requested)

The requests are listed from top to bottom, in the order they will be executed. The currently active diagnostic will be followed by "CUR ACT". Manual and automatic requests are followed with "MAN" and "AUTO", respectively. The response to this command is "PF".

3.08 The command:

ABT:PDGN

aborts the currently executing peripheral diagnostic.

3.09 The command:

STOP:DGN:XXX! (XXX is the requested diagnostic)

removes all occurrences of diagnostic XXX from the EOS diagnostic queue. The response to this command is "OK".

Note: This command will not abort diagnostic XXX if it is currently active.

4. TAPE DATA CONTROLLER DIAGNOSTICS

4.01 The TDC diagnostics are incorporated in the common tape maintenance program (CTAPM), which also contains an input message processing routine (entry point CTAPM) that is always resident and a common monitor (TAPEDGN) that controls diagnostic test execution.

A. Initiating TDC Diagnostic Tests

4.02 The TDC diagnostic tests can also be initiated by a TTY input message:

DGN:TDC X!

where x is the unit number of the TDC to be tested. The diagnostics can be run in any one of seven modes depending on the message form.

(a) ***DGN:TDC x!***—All tests (1 through 6, paragraph 4.05) are requested and run in sequence. Testing is terminated at the first failure.

(b) ***DGN:TDC x;UCL!***—All tests are requested and run in sequence. All failures are reported, but do not terminate the testing.

(c) ***DGN:TDC x;RPT!***—The same as (a) except the sequence is restarted at the failure.

(d) ***DGN:TDC x,TST Y!***—Run a specified test Y times. (Y ranges from 1 to 6.)

(e) ***DGN:TDC x,TST Y;RPT!***—Run a specified test (Y) repeatedly.

(f) ***DGN:TDC x,STP!***—Run all tests under stop mode. Testing is terminated at the first failure.

(g) ***DGN:TDC x,TST Y:STP!***—Run a specific test under the step mode. Stepped by activation of the EXECUTE switch.

4.03 The common tape maintenance program (CTAPM) is identified as the client program by the TTY input message processing software. Entry is at the tape diagnostic TTY message handler program unit, which is always resident. This program unit checks the message options and determines if the requested TDC is available. When the requested unit is available, the message handler makes a request to the multiscan function controller (MSFC) in the common base level monitor assembly unit (CBLM) to initiate a multiscan function. When the request is denied, a retry later message (RL) is returned. When the request is accepted, a successful indication (IP) is returned to CTAPM, which will continue processing to set up the diagnostic control block with the test information contained in the input message. When this is complete, an in-progress message is returned to the TTY.

B. Execution Of TDC Diagnostic Tests

4.04 The multiscan function controller (MSFC), which runs as part of the medium priority level maintenance task (MAINT), controls the actual execution of the TDC diagnostics. MSFC makes all program identifications and controls the paging mechanism for the diagnostics. Entry to CTAPM from MSFC is at the diagnostic monitor program entry point (TAPEDGN). TAPEDGN is responsible for calling all tests in the proper sequence and printing out resultant diagnostic messages. The tests return flags to the monitor pertaining to pass, fail, or need-to-run status.

4.05 The TDC diagnostics consist of six distinct tests. Each test serves as a building block to the next test, eg, no test can be executed successfully until all previous tests are successfully executed. Therefore, no test should be run individually until all previous tests of the sequence report all tests passed. The six (in sequence) tests are:

(1) The serial peripheral interface (SPI) test

(2) The buffer unit test

(3) The cartrigde tape transport controller test

(4) The minirecorder read test

(5) The minirecorder miscellaneous function test

(6) The minirecorder write test.

Details pertaining to the multiscan function controller and the medium priority maintenance tasks are in Section 254-340-084. Descriptions of the major functions performed by each TDC test are contained in Table D.

5. GLOSSARY

5.01 The following terms and definitions are used in this section.

3A CC—3A Central Control

AUTOMN—The peripheral diagnostic monitor program run by the EOS as an EOS system task.

Baud Rate—The number of information bits that can be transmitted in one second.

BIU—Interface unit of the PROMATS.

BOT—Beginning of tape.

BT—Bus termination in the RSI equipment.

TABLE D

COMMON TAPE MAINTENANCE (CTAPM) TESTS

TEST	FUNCTION
01	This test verifies that bad parity in the serial sequence will be detected. An initialization of the entire device is then requested and verified. Sends an all 0s word and all 1s word and then checks that each is correctly returned. A series of 16 orders is sent to shift a 1 through a field of 0s. Verifies that data can be transferred through the interface to the bus terminator (BT) and returned.
02	Initializes and sets the buffers states to known levels. Sends a load state order to the buffer. It then tests the capability of the 1024-bit shift registers to shift data accurately. The ready flag, clear flag, overflow conditions, and shift register bit count are all tested and verified.
03	This test is performed by issuing and verifying 15 of the 18 cartridge tape transport controller orders.
04	For this test the cartridge must be in place and write-enabled. A read-a-block command is issued for each track. Each block selected will require a backspace action in order to complete correctly. A continuous read command is issued for one track; when complete, the unit should return to the idle state.
05	This test verifies all non-read/write functions of the unit. Tests include fast forward, fast reverse, stop, beginning of tape (BOT), and end of tape (EOT) sensors and the backspace function.
06	This test requires that the other unit be in service. A block is read from the other unit, modified, and then written on the unit being tested. The test block is then read back and verified.

CBLM—Common base level monitor

DADMAD—The EOS terminal administration task.

DBS—Duplex bus selector.

DEFDIAG—The system macro by which peripheral diagnostics are defined.

DEV_EQP—The set of tables in OSTABS which define the devices attached to the EOS via the file system.

DGTAB—The peripheral diagnostic transfer vector in OSTABS generated by use of the DEFDIAG macro.

DGCTSK—The task name assigned to the peripheral diagnostic monitor DGNMON. Runs at a low priority.

DMA—Direct memory access.

DVCB—The device control block in OSTABS. Used to define attributes of file system devices.

EIA—Electronic Industry Association standard voltage levels for signaling.

EOS—Extended Operating System.

EOT—End of tape

ESS—Electronic Switching System.

FIFO—First in/first out.

File System—A software interface between the user and peripheral devices.

INF—Information leads between the DBS and PROMATS BIU.

MAINT—The main system maintenance task run as an EOS system task.

MSFC—Multiscan Function Controller

MODEM—Modulator-demodulator used to make machine signals compatible with communications facilities, eg, digital to analog and vice versa.

OSTABS—Operating system tables which contain the parameters and configuration information pertaining to an application which is utilizing the EOS.

Paging Buffer—A designated area in writable store which is used for loading nonresident programs and data in resident store during the time they are in use. Size is specified by the application.

PBI—Parallel bus interface; the interface circuitry between a parallel channel and PROMATS.

PCH—Parallel channel.

PROMATS—Programmable magnetic tape system. A nine-track tape system furnished as standard with the 3A Processor.

RSI—Remote serial interface equipment. Equipment utilized to interface remote terminals with the 3A Processor to allow data transmission.

SCH—Serial channel.

SPCH—Parallel subchannel.

SPI—Serial peripheral interface. Equipment used to interface peripheral devices to the serial channels of the 3A Processor.

SVC—Extended instruction utilized for system (supervisor) calls.

TDC—Tape Data Controller.

TLM—Trouble Locating Manual.

TTYC—Teletypewriter controller.

UART—Universal asynchronous receiver transmitter. Part of the RSI equipment.

WRU—"Who are you" circuitry in the TTYC.