

VOLUME 017 MACHINE 4341- -0015871 MODEL M02 SYSTEM 0018167 MODE

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LOGIC TYPE -0- SYSTEMS DIAGRAMS

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Maintenance Information

VOLUME 01	VOLUME 02	VOLUME 03	VOLUME 13/16	VOLUME 17	VOLUME 18
MAINTENANCE ANALYSIS PROCEDURE	MAINTENANCE ANALYSIS PROCEDURE	MAINTENANCE ANALYSIS PROCEDURE	SUPPLEMENT MAINTENANCE INFORMATION	GENERAL INFORMATION	GENERAL INFORMATION
START EXIT UU = 00 02	UU = 1X	UU = 4X 5X EX FX	LOCATIONS TOOLS REMOVAL/ REPLACEMENT ADJUSTMENTS SERVICE AIDS DISKETTE DRIVE PROCESSOR POWER	GENERAL DESCRIPTION FUNCTIONAL UNITS DIAGNOSTIC INFORMATION PROCESSOR LOGS SYSTEM TESTS FEATURES	CONSOLE FUNCTIONS INDEX INSTALLATION

4341

General Information

PREFACE

Volume 17 and 18 provide a high-level description of the 4341 Processor and its functional units. These volumes also provide diagnostic test, log, system test, console function, and feature information.

Technical changes and additions to the text and illustrations are indicated by a line to the left of the change.

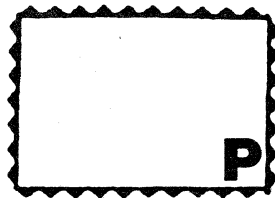
This manual is a supplementary and recall document. It is not intended as a self-study course. It may also be used for a general overview to the 4341, but not for detailed maintenance or how-it-works information.

Related Publications:

- 3278 Model 2A Display Console Maintenance Information, SY27-2546
- 3278 Model 2A Display Console Problem Determination Guide, GA23-0020
- 3279 Display Terminal Maintenance Information, SY33-0069 (Part 1)
- 3279 Display Terminal Maintenance Analysis Procedures (MAPs) SY33-0069 (Part 2)
- 4300 Processors Principles of Operation for ECPS:VSE Mode, GA22-7070
- System/370 Principles of Operation, GA22-7000

LEGIBILITY CONVENTION

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IBM has prepared this maintenance documentation for the use of IBM customer engineers for installation, maintenance, and repair of the specific machines indicated. IBM makes no representations that it is suitable for any other purpose.

Information contained in this documentation is subject to change from time to time. Changes will be reflected in subsequent revisions.

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SAFETY

PERSONAL SAFETY

Personal safety cannot be overemphasized: it is a vital part of customer engineering. To ensure your safety and that of co-workers, always observe the safety precautions given during your safety training and adhere to the following:

Danger Notices

Observe all DANGER notices in this manual.

DANGER

The springs on the console file load arms are compressed. Either ensure that the springs are held safe by the safety rods before separating the items or, if renewing a spring or arm, release the compression of the spring carefully.

General Safety Practices

Observe the general safety practices and the procedure for performing artificial respiration outlined in the *CE Safety Practices* card shown on this page.

Grounding

Ground current may reach dangerous levels. Never operate the system with the grounding conductor removed.

Line-Powered Equipment

Ground all line-powered test equipment through the third-wire grounding conductor in the power cord of the machine being tested.

Machine Warning Labels

Heed the warning labels placed in hazardous areas of the machines.

CE Safety Practices

All Customer Engineers are expected to take every safety precaution possible, and to observe the following safety practices while maintaining IBM equipment:

1. You should not work alone under hazardous conditions or around equipment with dangerous voltage. Always advise your manager if you MUST work alone.
2. Remove all power ac and dc when removing or assembling major components, working in the immediate area of power supplies, performing mechanical inspection of power supplies, and installing changes in machine circuitry.
3. Wall box power switch, when turned off, should be locked or tagged in off position. "Do Not Operate" tags, order number S229-1266, should be affixed when applicable. Pull power supply cord whenever possible.
4. When it is absolutely necessary to work on equipment having exposed operating mechanical parts or exposed live electrical circuitry anywhere in the machine, the following precautions must be followed:
 - a. Another person familiar with power off controls must be in the immediate vicinity.
 - b. Rings, wrist watches, chains, bracelets, and metal cuff links shall not be worn.
 - c. Only insulated pliers and screwdrivers shall be used.
 - d. Keep one hand in pocket.
 - e. When using test equipment, be certain that controls are set correctly and to the proper capacity, and that insulated probes are used.
 - f. Avoid contacting ground potential (metal floor strips, machine frames, etc. - use suitable rubber mats, purchased locally if necessary).
5. Safety glasses must be worn when:
 - a. Using a hammer to drive pins, riveting, staking, etc.
 - b. Power hand drilling, reaming, grinding, etc.
 - c. Using spring hooks, or attaching springs.
 - d. Soldering, wire cutting, or removing steel bands.
 - e. Parts cleaning using solvents, sprays, cleaners, chemicals, etc.
 - f. Exposed to any other condition that may be hazardous to your eyes. REMEMBER, THEY ARE YOUR EYES.
6. Special safety instructions, such as for handling cathode ray tubes and extreme high voltages, must be followed as outlined in CEMs and in the Safety section of the Maintenance Manuals.
7. Do not use solvents, chemicals, greases, or oils that have not been approved by IBM.
8. Avoid using tools or test equipment that has not been approved by IBM.
9. Replace worn or broken tools and test equipment.
10. The maximum load to be lifted is that which, in the opinion of you and of management, does not jeopardize your own health or well-being, or that of other employees.
11. All safety devices, such as guards, shields, signs, ground wires, etc., shall be restored after maintenance.
12. Each Customer Engineer is responsible to be certain that no action on his part renders a product unsafe, or exposes hazards to customer personnel.
13. Place removed covers in an out-of-the-way place where no one can trip over them.
14. All machine covers must be in place before the machine is returned to the customer.
15. Always place CE tool kit away from walk areas (that is, under desk or table) where no one can trip over it.

16. Avoid touching moving mechanical parts (that is, when lubricating, checking for play, etc.).
17. When using stroboscope, do not touch ANYTHING; it may be moving.
18. Avoid wearing loose clothing that may become caught in machinery. Shirt sleeves must be left buttoned, or rolled to above the elbow.
19. Ties must be tucked in shirt or fastened with a tie clasp (preferably non-conductive), approximately 3 inches from the end. Tie chains are not recommended.
20. Before starting equipment, make certain that fellow CEs and customer personnel are not in a hazardous position.
21. Maintain good housekeeping in the area of machines while performing, and after completing, maintenance.

Artificial Respiration

General Considerations

1. Start Immediately. Seconds Count. Do not move victim unless absolutely necessary to remove from danger. Do not wait or look for help or stop to loosen clothing, warm the victim, or apply stimulants.
2. Check Mouth for Obstructions. Remove foreign objects; pull tongue forward.
3. Loosen Clothing; Keep Warm. Take care of these items after victim is breathing by himself, or when help becomes available.
4. Remain in Position. After victim revives, be ready to resume respiration if necessary.
5. Call a Doctor. Have someone summon medical aid.
6. Don't Give Up. Continue without interruption until victim is breathing without help, or until victim is certainly dead.

Rescue Breathing for Adults

Victim on His Back Immediately.

1. Clear throat of water, food, or foreign matter.
2. Tilt head back to open air passage.
3. Lift jaw up to keep tongue out of air passage.
4. Pinch nostrils to prevent air leakage when you blow.
5. Blow until you see the chest rise.
6. Remove your lips and allow the lungs to empty.
7. Listen for snoring and gurgling, signs of throat obstruction.
8. Repeat mouth-to-mouth breathing 10-20 times per minute. Continue rescue breathing until victim breathes for himself.



Thumb and finger position



Final mouth-to-mouth position

Reprint Courtesy Mine Safety Appliance Co.



DOCUMENTATION ORGANIZATION

HOW INFORMATION IS ARRANGED

The Maintenance Information Manual has seven volumes. Each volume has sections identified and separated by tabs. The volumes are organized as shown on the title page.

Volumes 1, 2, and 3 contain maintenance analysis procedures (MAPs). MAPs are step-by-step instructions that direct you in problem determination and correction. Each MAP is identified by title and number.

Volume 13 contains maintenance procedures referred to by the MAPs, plus material needed to support guided maintenance.

Volume 16 contains both guided maintenance and general power information needed to isolate a power problem.

Volume 17 contains a general description of the 4341 Processor functional units, diagnostics, logs, and system test.

Volume 18 contains the console functions, index, and the installation instructions.

SECTION DESCRIPTION

Volume 1 - MAPs

Start MAP is the starting point for all repair action.

Exit MAP is the exit point for all repair action.

System Problem MAP assists you in defining and isolating system-related problems.

Channel I/O MAP assists you in defining and isolating channel or I/O problem.

02 MAPs assists you to analyze the hard wire sequence hardware (01AA1D2) of the maintenance and support subsystem (MSS).

Volume 02 - MAPs

1X MAPs assists you to analyze 4341 power problems indicated on the screen by 1xxxxxx reference codes.

Volume 03 - MAPs

4X MAPs assists you to analyze the main storage and controls logic.

5X, 6X MAPs assists you to analyze the 4341 logic with exception of the maintenance and support subsystem.

EX MAPs assists you to analyze microcode related problems.

FX MAPs assists you to analyze the maintenance and support subsystem (MSS).

Volume 13 - Supplement Maintenance Information

Locations illustrates the locations of the 4341 components within the frames.

Tools contains the list of tools that are required to maintain and service the 4341 hardware.

Removal/Replacements contains procedures to remove or replace components within the 4341 frames.

Adjustments contains adjustment procedures for components of the 4341.

Service Aids contains material that is used with the MAPs to aid in troubleshooting 4341 problems.

Diskette Drive 2D contains the maintenance information needed to service the diskette drive 2D (53FD).

Volume 16 - Processor Power

Power describes the major components of the power system. This includes power screens, sequencing, distribution, adjustments, and hardwire sequence.

Volume 17 - General Information

General Description contains a high-level overview of the 4341 and its maintenance strategy.

Functional Units contains the 4341 data flow, a brief description of the functional units and their working relationship.

Diagnostic Information contains a brief description of the diagnostics available with the 4341.

Processor Logs contains a brief description of the four types of logs available with the 4341, and information on how to display and print the logs.

System Test contains a description of all system test available with the 4341.

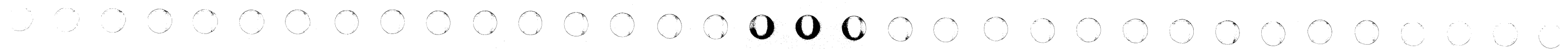
Features gives information on optional features not covered in their related sections.

Volume 18 - General Information

Console Functions contains operating procedures and applications available to you.

Index is common for all 4341 models; it is good for finding information contained in all volumes.

Installation Manual contains the instructions to install the 4341 and all verification tests.



GENERAL DESCRIPTION

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4341 Processor Overview	32 010
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4341 PROCESSOR OVERVIEW

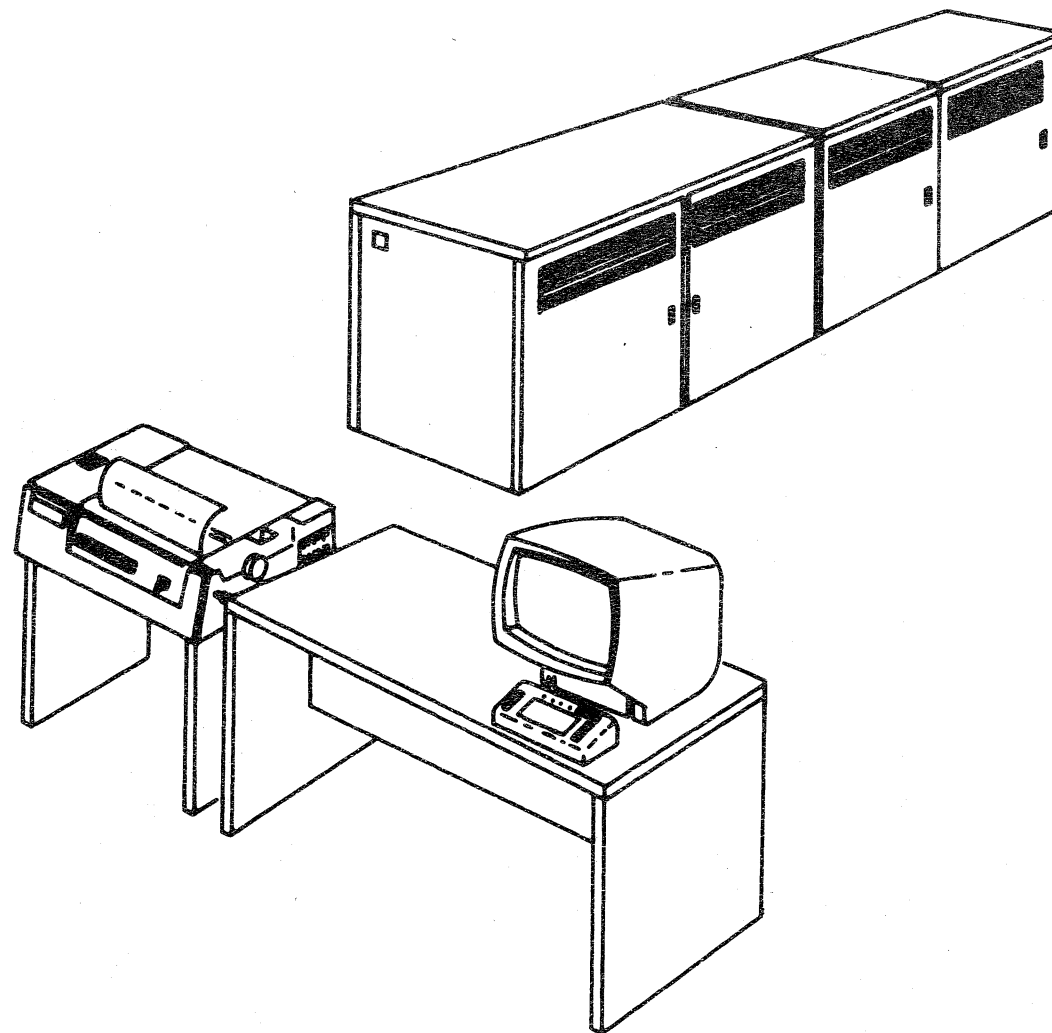
The 4341 Processor is a high-performance data processor with increased reliability through new hardware circuit technology.

The two models of the 4341 Processor are: Model Group 1 and Model Group 2. Some of the differences are shown under "Highlights," page 32 015, and in the "4341 Processor Configuration," page 32 020.

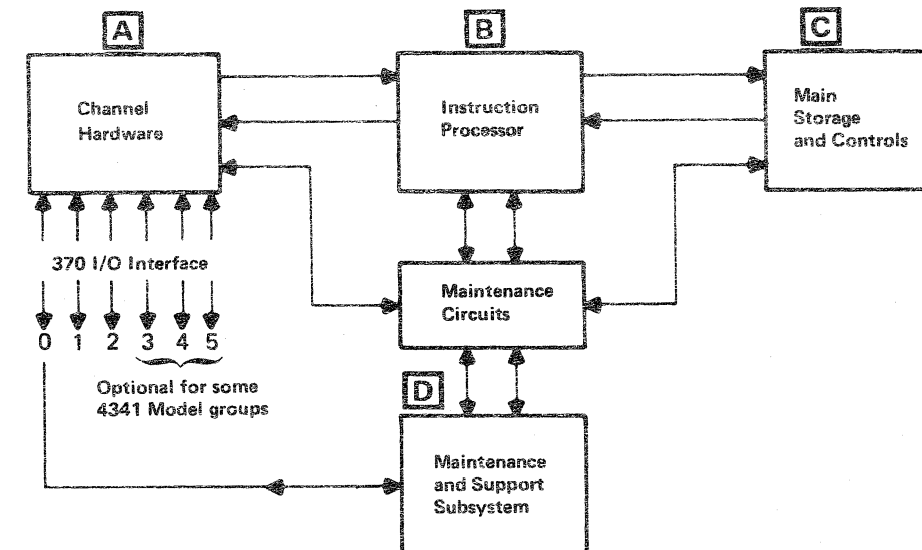
The operation of the 4341 relies on the hardware control circuitry and microcode loaded into control storage. All model groups are compatible with other 4300 processors and can run under current program operating systems. Each processor includes:

- A** Channel Hardware
- B** Instruction Processor
- C** Main Storage and Controls
- D** Maintenance and Support Subsystem

The functional operation of the processor relies on hardware registers, called *external registers*, located throughout the machine. The external registers are data links between the user programs, microcode, and the processor hardware. Each external register has a unique address, and can be accessed by microcode either directly or indirectly. Some external registers are set and reset by the hardware and then tested by microcode. Others are set and reset by microcode.



4341 PROCESSOR BLOCK DIAGRAM



Model Groups 1 and 2

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HIGHLIGHTS

The 4341 offers Virtual Storage System Control Program (SCP) support and System/370 compatibility, enabled by using Large Scale Integrated technology and large processor storage.

The 3278 Display Console Model 2A (or optional 3279 Color Display Console Model 2C) and the Diskette Drive 2D (53FD) are included. The processor provides storage, channel, arithmetic, logic, and control functions.

4341 Model Group 1

- Cycle time: 150 to 300 nanoseconds.
- Two or four megabytes of processor storage per processor.
- Eight-byte wide data path to storage.
- Standard 64K control storage.
- Standard 8K, high-speed buffer storage.
- Six channels in two groups (three standard, three optional) are available:
 - Standard group includes: one byte-multiplexer channel and two block-multiplexer channels.
Channel 1 and/or 2 can be selected as a 3MB channel with data streaming.
 - Optional group includes: three additional block-multiplexer channels. Channel 4 can be selected as a second byte-multiplexer channel.

The channels are capable of multiplexed operation from the instruction execution function of the 4341.

The block-multiplexer channels *appear* as selector channels to I/O devices that do not block-multiplex.

An optional Channel-to-Channel adapter is also available.

4341 Model Group 2

- Cycle time: 120 to 240 nanoseconds.
- Two, four, eight, twelve or sixteen megabytes of processor storage per processor.
- Sixteen-byte wide data path between the basic storage module (BSM) and the high-speed buffer (HSB).
- Standard 64K control storage, with the control storage increment optional feature.
- Standard 16K, high-speed buffer storage.
- Six channels standard: one byte-multiplexer channel (channel 0) and five block-multiplexer channels.

Channel 4 can be selected as a second byte-multiplexer channel.

Channel 1 and/or 2 can be selected as a 3MB channel with data streaming.

The channels are capable of multiplexed operation from the instruction execution function of the 4341.

The block-multiplexer channels *appear* as selector channels to I/O devices that do not block-multiplex.

An optional Channel-to-Channel adapter is also available.

Other significant characteristics are:

- Easy installation, with minimum change of existing input/output configuration.
- Program support available include DOS/VSE, OS/VS1, and VM/370.
- Improved reliability, availability, and serviceability (RAS) is provided, including instruction retry, error checking and correction (ECC) to provide single-bit error correction and double-bit error detection in processor storage. Error recording by the hardware itself and the Remote Support Facility (RSF) for remote maintenance are also provided.
- The required 3278-2A Display Console (or 3279-2C Color Display Console) interacts for both operation and maintenance. The operator control panel (OCP) is included on the operator console keyboard. The console is used for turning power on and off, for initial microcode load (IML), and for starting and stopping 4341 operations.

The console can operate in either Printer-Keyboard Emulation mode or Display mode. In Display mode, the keyboard is used for input and the display is used for the output of up to 20 lines of up to 80 characters each.

In Printer-Keyboard mode, the keyboard is used for input. The display and a recommended 3287 Printer (Model 1, 2, or 2C) are used for output. The display console and the printer appear to the system as a console printer-keyboard. This enables using an operating system that has been generated for a System/360 with a 1052 Printer-Keyboard or a System/370 with a 3210 or 3215 Console Printer/Keyboard. An optional alternate console (with one display/keyboard and one printer) can also be configured.

The console also provides for *normal* versus *instruction step* processing, address compare stopping, for changing certain registers and storage areas, and for displaying hardware status.

For maintenance and service support, the console can display and store the status of the 4341 and other important servicing information. It also provides a means for using diagnostics.

A combination of up to three optional 3278-2A Display Consoles, 3279-2C Color Display Consoles, or 3287 Printers Model 1, 2, or 2C can be configured (for a total of four). The optional printer has a separate address and requires Multiple Console Support (MCS).

Note: *The procedures for configuring 3287 Printers depend upon the operating system being used. For OS/VS1, for example, the 3287 is supported by specifying either a 3286 or 3210 Printer.*

- The Support Processor performs automatic analysis of failure symptoms. The result of this *self-diagnosis* is a processor-generated *reference code* that contains information to guide you to the failing unit. This reference code is logged on the system diskette and displayed to signal the operator to notify the service representative.
- The Diskette Drive 2D (53FD) is used during the IML process and during error recording for later diagnosis. The diskettes contain all microcode required for initializing basic features (and optional features, when ordered), as well as diagnostics to be used by the service representative.
- The Remote Support Facility (RSF) is used by IBM personnel (when authorized by the customer) to improve hardware maintenance.

Modes of Operation

The 4341 executes all of the processing and input/output functions described in the *IBM 4300 Processors Principles of Operation for ECPS:VSE Mode*, GA22-7070, as well as those functions described in the *IBM System/370 Principles of Operation*, GA22-7000. The major difference between the mutually exclusive System/370 and ECPS:VSE modes is the execution of virtual addresses:

- ECPS:VSE mode uses internal address translation for both instruction processor and channel addresses. All storage addresses are virtual addresses.
- System/370 mode uses segment and page tables for processor Dynamic Address Translation (DAT). Channel addresses are real addresses that are translated by the System Control Program (aided by the Channel Indirect Data Addressing facility).

Programming Support

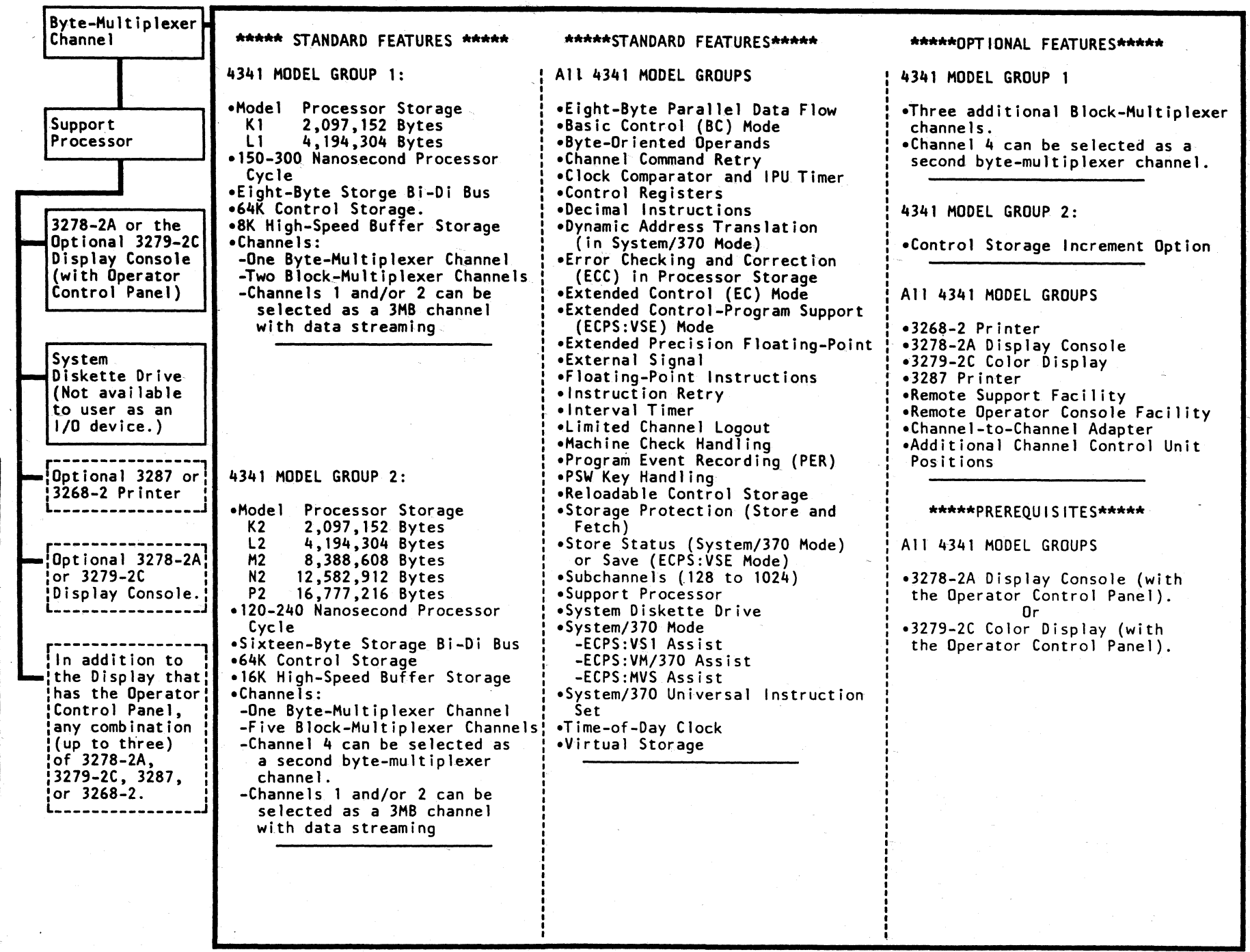
In ECPS:VSE mode, programming support for the 4341 is provided by DOS/VSE. In System/370 mode, programming support is provided by DOS/VSE, OS/VS1, OS/VS2-MVS, and by VM/370.

Brief descriptions of these program support packages (and references to the publications that describe them in detail) are available from your IBM representative. For additional information about 4341 processing, input/output functions, and Basic Control (BC) or Extended Control (EC) modes, see *IBM 4300 Processors Principles of Operation for ECPS:VSE Mode* but when in System/370 mode, see *IBM System/370 Principles of Operation*.

Model Groups 1 and 2

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4341 PROCESSOR CONFIGURATION



***** STANDARD FEATURES *****

- 4341 MODEL GROUP 1:**
- Model Processor Storage
K1 2,097,152 Bytes
L1 4,194,304 Bytes
 - 150-300 Nanosecond Processor Cycle
 - Eight-Byte Storage Bi-Di Bus
 - 64K Control Storage.
 - 8K High-Speed Buffer Storage
 - Channels:
-One Byte-Multiplexer Channel
-Two Block-Multiplexer Channels
-Channels 1 and/or 2 can be selected as a 3MB channel with data streaming
-
- 4341 MODEL GROUP 2:**
- Model Processor Storage
K2 2,097,152 Bytes
L2 4,194,304 Bytes
M2 8,388,608 Bytes
N2 12,582,912 Bytes
P2 16,777,216 Bytes
 - 120-240 Nanosecond Processor Cycle
 - Sixteen-Byte Storage Bi-Di Bus
 - 64K Control Storage
 - 16K High-Speed Buffer Storage
 - Channels:
-One Byte-Multiplexer Channel
-Five Block-Multiplexer Channels
-Channel 4 can be selected as a second byte-multiplexer channel.
-Channels 1 and/or 2 can be selected as a 3MB channel with data streaming

*****STANDARD FEATURES*****

- All 4341 MODEL GROUPS**
- Eight-Byte Parallel Data Flow
 - Basic Control (BC) Mode
 - Byte-Oriented Operands
 - Channel Command Retry
 - Clock Comparator and IPU Timer
 - Control Registers
 - Decimal Instructions
 - Dynamic Address Translation (in System/370 Mode)
 - Error Checking and Correction (ECC) in Processor Storage
 - Extended Control (EC) Mode
 - Extended Control-Program Support (ECPS:VSE) Mode
 - Extended Precision Floating-Point
 - External Signal
 - Floating-Point Instructions
 - Instruction Retry
 - Interval Timer
 - Limited Channel Logout
 - Machine Check Handling
 - Program Event Recording (PER)
 - PSW Key Handling
 - Reloadable Control Storage
 - Storage Protection (Store and Fetch)
 - Store Status (System/370 Mode) or Save (ECPS:VSE Mode)
 - Subchannels (128 to 1024)
 - Support Processor
 - System Diskette Drive
 - System/370 Mode
-ECPS:VS1 Assist
-ECPS:VM/370 Assist
-ECPS:MVS Assist
 - System/370 Universal Instruction Set
 - Time-of-Day Clock
 - Virtual Storage

*****OPTIONAL FEATURES*****

- 4341 MODEL GROUP 1**
- Three additional Block-Multiplexer channels.
 - Channel 4 can be selected as a second byte-multiplexer channel.
-
- 4341 MODEL GROUP 2:**
- Control Storage Increment Option
-
- All 4341 MODEL GROUPS**
- 3268-2 Printer
 - 3278-2A Display Console
 - 3279-2C Color Display
 - 3287 Printer
 - Remote Support Facility
 - Remote Operator Console Facility
 - Channel-to-Channel Adapter
 - Additional Channel Control Unit Positions
-
- *****PREREQUISITES*****
- All 4341 MODEL GROUPS**
- 3278-2A Display Console (with the Operator Control Panel).
Or
 - 3279-2C Color Display (with the Operator Control Panel).

Model Groups 1 and 2

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4341 PROCESSOR MAINTENANCE

MAINTENANCE ANALYSIS PROCEDURES (MAPS)

Repair activities for the 4341 are directed by maintenance analysis procedures (MAPs) as shown in the flowchart on the right side of this page.

Start MAP

Begin all 4341 calls at the Start MAP. Also, begin again at the Start MAP when new failure symptoms are found while using the MAPs and no other instructions are given.

For microcode EC levels **154323** or **866869** or lower:

- The Start MAP directs you to a functional area MAP to repair processor failures.
- If additional problem analysis is required, the Start MAP may direct you to the System or Channel MAP.
- If I/O problem is determined, you are directed to the I/O Maintenance documentation.

For microcode EC levels **154324** or **866870** or **856XXX** or higher:

- The Start MAP directs you to a functional area MAP to repair processor failures.
- If I/O problem is determined, you are directed to the I/O Maintenance documentation.
- You are directed to the Exit MAP if the problem is fixed in the start MAP.

System MAP (Model Group 1 Only)

The System MAP is used on machines with a microcode EC level of **154323** or **866869** or lower. This MAP aids in analyzing system failure symptoms, such as waits and loops.

- When the analysis indicates a processor failure, you are directed to the correct functional area MAP for the repair.
- When the analysis indicates a channel or I/O device failure, but the channel ID or device is not known, you are directed to the Channel MAP for additional analysis.
- When the analysis defines an I/O device failure, you are directed to use device maintenance procedures to repair the problem.

Channel MAP (Model Group 1 Only)

The Channel MAP is used on machines with a microcode EC level of **154323** or **866869** or lower. This MAP aids in defining which channel, channel interface, or attached I/O device is failing.

- When a 4341 channel failure is identified, you are directed to the correct functional area MAP.
- When a channel interface (external to the 4341) or an I/O device failure is identified, you are directed to use device maintenance procedures to repair.

Functional Area MAPs

These MAPs aid in isolating the failure to a field replaceable unit (FRU) and in repairing the problem.

Exit MAP

All 4341 repair activity ends at the Exit MAP. Instructions for completing the call are provided.

REFERENCE CODES

A reference code (RC) is an error message from functional microcode, diagnostics, and error log analysis routines. It is an eight-character (hex) number that contains information about a processor failure, and is displayed when the failure prevents an operation from continuing.

When a reference code is available, repair activity is directed from the Start MAP to a functional area MAP via the processing unit maintenance algorithm (PUMA) or code analysis processor (CAP).

For additional information, go to section 36, *Diagnostic Information*, and see *Reference Codes*.

PROCESSING UNIT MAINTENANCE ALGORITHM (PUMA)

PUMA is a self-prompting microcode routine that runs selected microdiagnostics to isolate a failing FRU. Depending on the results from running PUMA, PUMA provides:

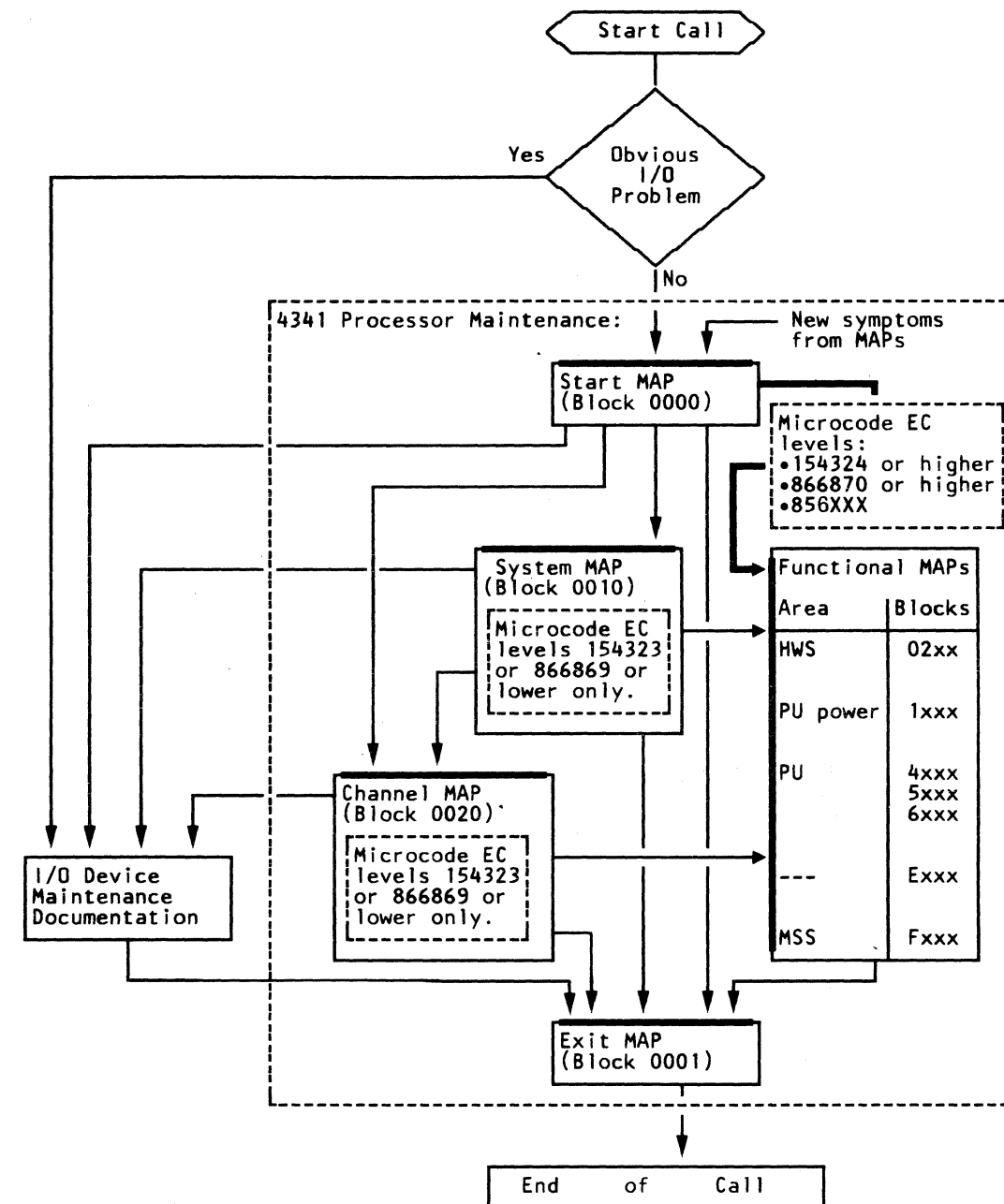
- A list of possible failing FRUs
- A functional area MAP

CODE ANALYSIS PROCESSOR (CAP)

The code analysis processor (CAP) is a microcode routine that analyzes reference codes. Depending on the reference code, the CAP may provide:

- A functional area MAP name
- A list of possible failing FRUs
- A request to run diagnostic tests.

For additional information, go to section 36, *Diagnostic Information*, and see *Code Analysis Processor (CAP)*.



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4341 PROCESSOR MAINTENANCE (Continued)

POWER

The maintenance and support subsystem (MSS) and the processing unit (PU) are powered separately. Power for the MSS is supplied by the hard-wired sequence (HWS) and must be active before power can be applied to the PU via the power controller adapter (PCA).

HWS failures are indicated by lights on the operator control panel (OCP) and on the CE panel (CEP). These lights are analyzed under direction of the MAPs.

PU power is controlled and monitored by microcode via the PCA. Failures result in power error logs that provide a reference code.

PCA diagnostic tests run automatically during SP power-on sequences. Failures are indicated by reference codes.

For additional information, see the "Processor Power" section of this manual.

MAINTENANCE AND SUPPORT SUBSYSTEM (MSS)

Although MSS error logs are available, diagnostic tests are used as the primary method for sensing and isolating failures in the MSS.

- Basic MSS diagnostic tests contained in the support processor read-only storage (SP ROS) and on the functional (FUNCT) diskette run automatically when the MSS is powered on. Failures sensed by these test result in stop words (SP coded stops) that are displayed on the CE panel.
- Extended and optional MSS diagnostic tests provide for more complete testing, and are run when directed by the MAPs. Failures sensed by these tests result in reference codes.

For additional information, see "Maintenance and Support Subsystem Diagnostic Tests" in the "Diagnostic Information" section of this manual. (For information on the MSS logs, see the "Processor Logs" section.)

PROCESSING UNIT (PU)

Automatic error logging and error log analysis (ELA) routines are used as the primary method for isolating failures in the PU. These routines run in the support processor (SP) and provide a reference code that is used as input to the MAPs. For additional information, see the "Processor Logs" section of this manual.

PU diagnostic tests are also available. The tests, consisting of PU basics and machine speed microdiagnostics (MSMDs), are run under direction of the MAPs when ELA was not able to isolate the failing FRU and for PU verification. For additional information, see "Processing Unit Diagnostic Tests" in the "Diagnostic Information" section of this manual.

SPECIAL CHANNEL TESTS

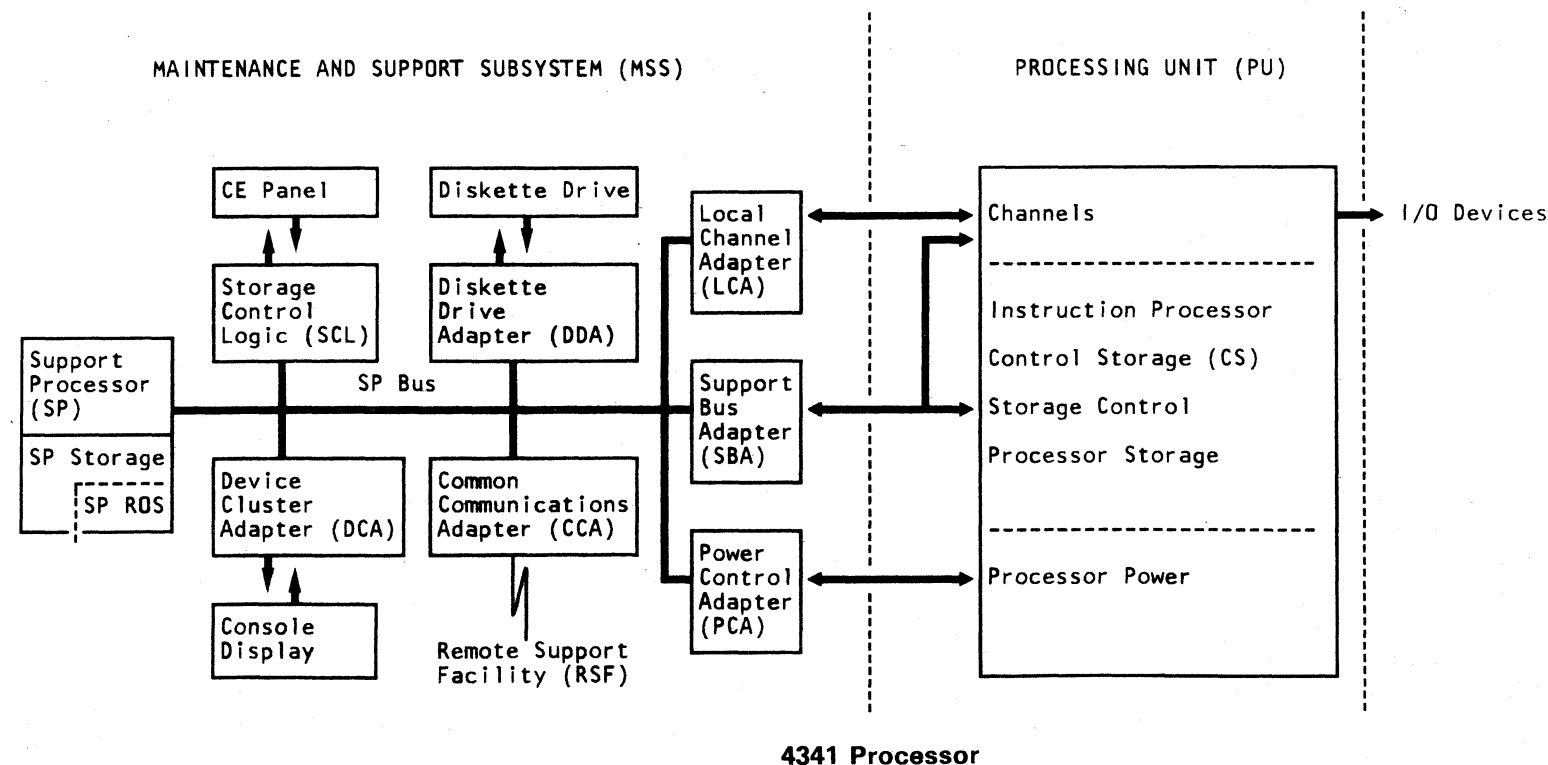
Two special channel tests are available to aid in isolating I/O device and channel interface problems:

- Channel Microcoded Device Exerciser (CMDE). This test issues a TIO and SIO (sense and NOP) to all available devices and displays detailed error information when a failure is sensed.
- Channel Cable Wrap Test (CWT). This test, using special channel cable wrap terminators, aids in isolating failures in the channel interface adapter (IFA) drivers and receivers and in the cables and connectors on the interface.

For additional information, see "Special Channel Tests" in the "Diagnostic Information" section of this manual.

SYSTEM AND I/O TESTS

4300-FRIEND, ST4300, and OLTS are available for testing the processor and attached I/O devices as a system. For information, see the "System Tests" section of this manual. Information (MI) manual.



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Match Circuit	34 045				

**These registers apply to the 4341 Model Group 2 only.

4341 PROCESSOR DATA FLOW

The functional operations of the 4341 Processor use hardware registers called external registers that are located throughout the hardware. The external registers are data links between the user programs, microcode and the hardware. Each external register has a single external address addressable by microcode either directly or indirectly. Some of the external registers are set and reset by the hardware and then tested by microcode. The remainder of the external registers are set and reset by microcode. For detailed description of the external registers, see "Console Functions."

A Channel Hardware

The channel hardware contains the interconnections and controls to communicate with and obtain data from the input/output (I/O) devices. Each channel has a single interface adapter card. The channel data rates are controlled by a slot rotor timing ring. The channel hardware includes:

- Interface Adapters Section
- Interface Controller Section
- Channel Control Section
- Channel Data Buffer Section

B Instruction Processor

The instruction processor is the hardware unit that processes the data and programs. It contains the hardware and microcode to interpret and execute the source programs and to control the channels, the main storage and controls and its own hardware. The instruction processor includes:

- ALU/Local Storage/Data Flow Registers
- Shifter Circuits
- Storage Addressing and Update Registers
- Control Storage

C Main Storage and Controls

Main storage and controls is the unit that contains the processor storage. It also contains the address control circuits to address and control each area of the processor storage. The main storage and controls include:

- Storage Address Control Section
- High-Speed Buffer Section
- Main Storage Section

D Maintenance and Support Subsystem

The maintenance and support subsystem (MSS) is the unit that performs:

- Power control and monitoring
- Initial microcode load (IML)
- Machine check handling
- Manual operations
- Test and diagnostics
- Display console control
- Configuration control
- Error logging
- Error log analysis

The MSS includes:

- *Support Processor* is a hardware controller that controls the functions of the MSS.
- *Support processor storage* is 64K bytes. A 2K-byte section is read-only storage (ROS) for basic MSS diagnostics and bootstrap routines. The remaining 62K bytes are read-write storage, which contains support processor microcode, tables, adapter CACs, and a temporary storage area for application programs that are loaded from the diskette drive 2D (53FD) when called by other programs.
- *Diskette Drive Adapter and Diskette Drive 2D* is used to load the support processor storage with application programs, common adapter codes for adapters, and data needed to initialize the channels, instruction processor, and the main storage and controls hardware.
- *Local channel adapter* is a high-speed data path between the channels, the instruction processor, and the support processor.
- *Support control logic adapter* is a communication path between the CE panel and the support processor.
- *Power controller adapter (PCA)* is a two-way communication path between the maintenance and support subsystem and the all power circuits.
- *Device cluster adapter* is the communication path between the support processor and the console display, operator control panel, console keyboard, and three additional (optional) 3278-2A, 3279-2C, or 3287 devices.

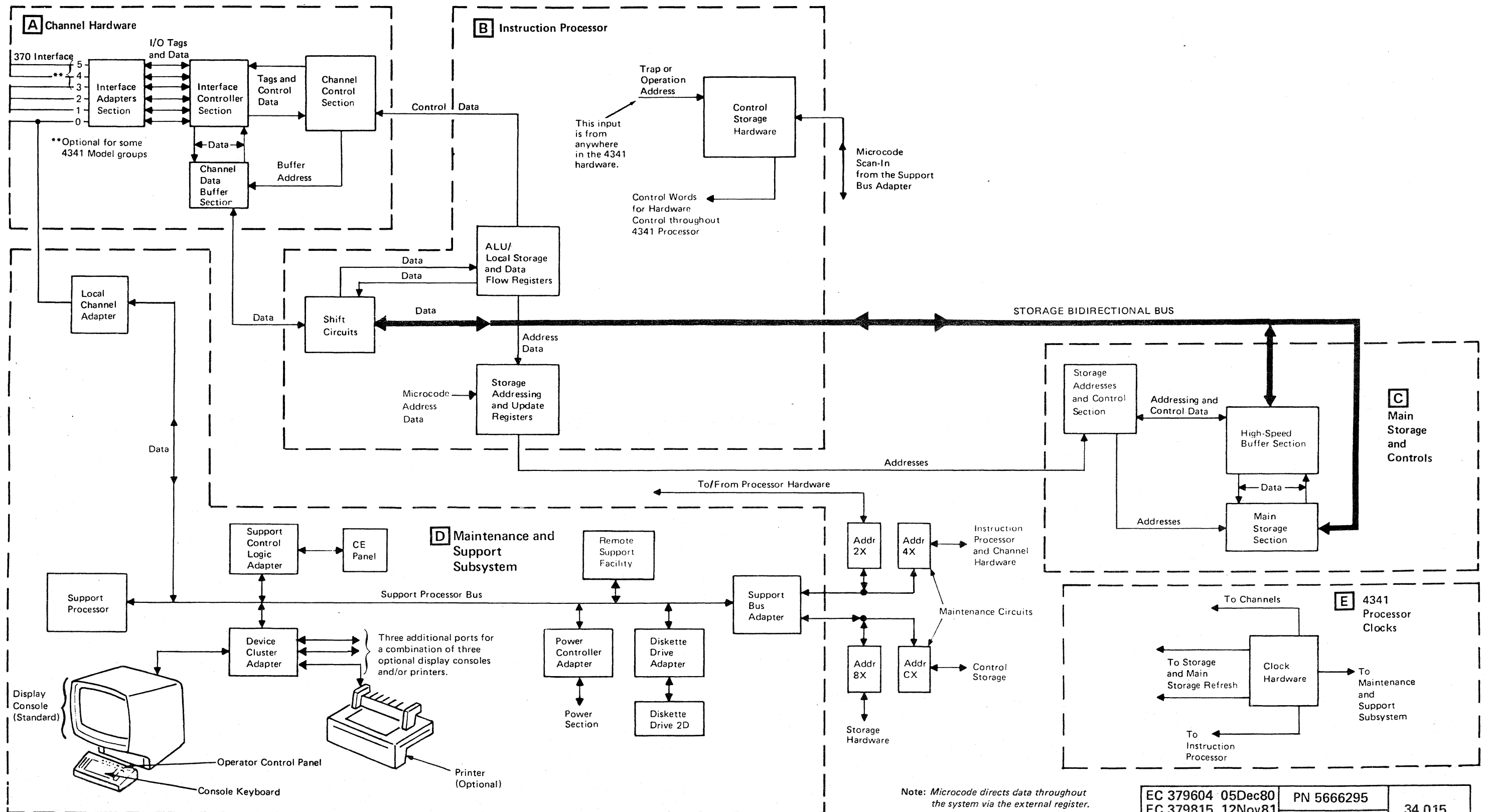
- *Console display and keyboard* is the device to communicate between the operator and the 4341 Processor.
- *Operator control panel (OCP)* contains the switches and indicators to control the power, perform the IML, and monitor the operating status.
- *Console printer* is an optional device to copy information displayed on the console display.

E 4341 Machine Clocks

Machine clocks supply timing pulses that are used to synchronize data and control information. The four machine clocks, (PU clock, storage clock, refresh clock and channel clock), are at card locations 01A-A1G2, K2, and H2. These clock pulses are then distributed throughout the machine. For more information, see "Clock Distribution," page 13 010 of Volume 13.

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4341 PROCESSOR DATA FLOW DIAGRAM



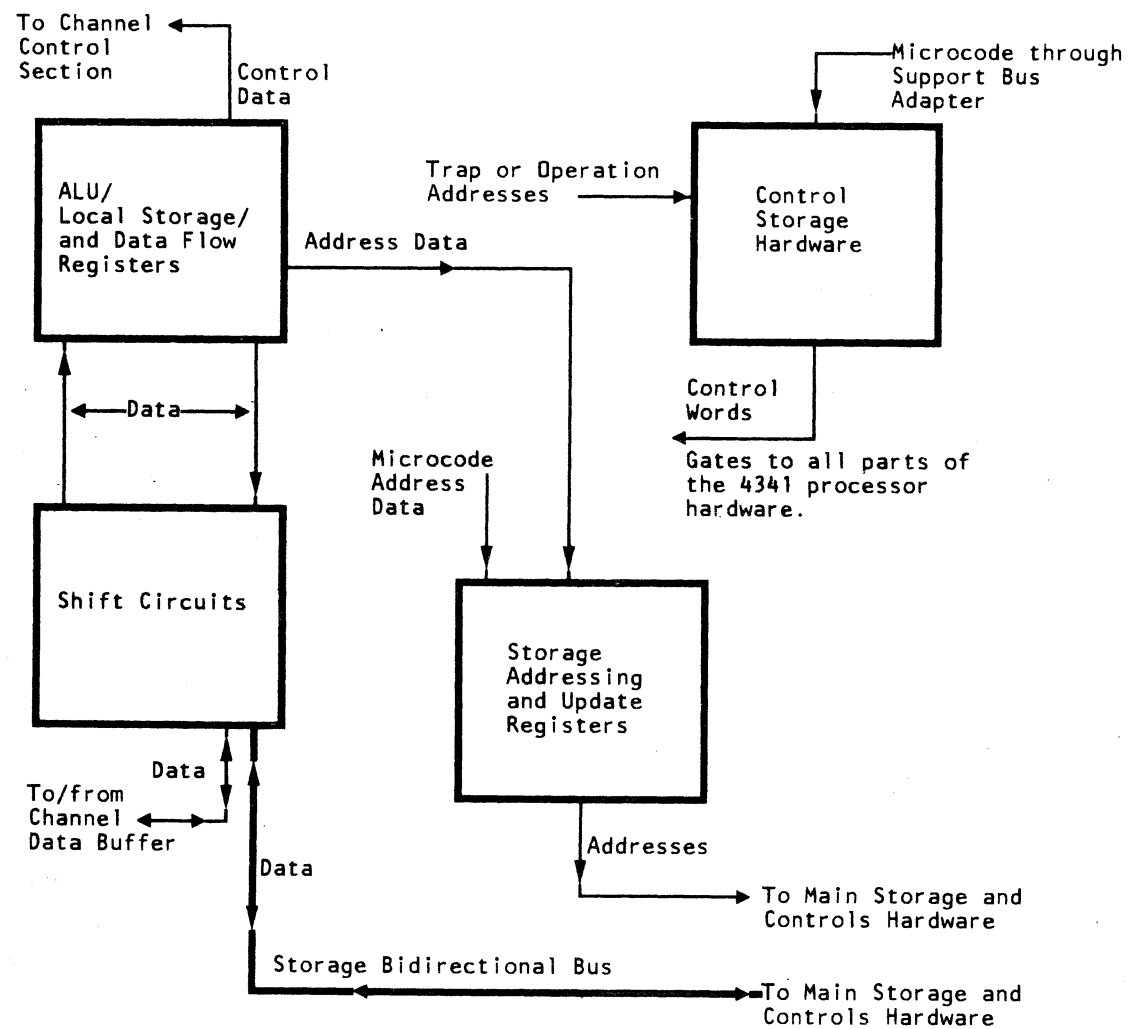


INSTRUCTION PROCESSOR

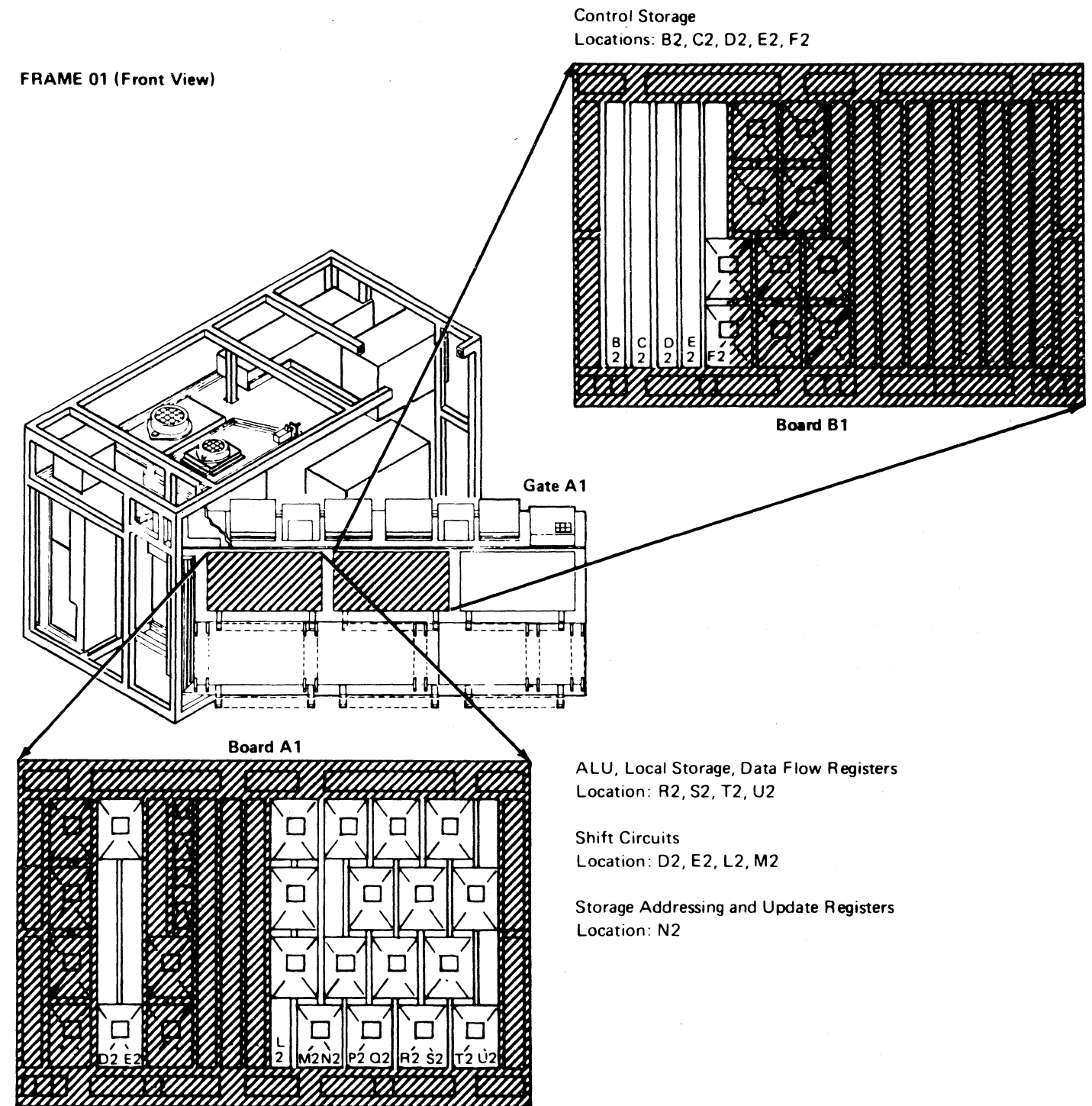
The instruction processor is on 01AA1D2, E2, and L2 through U2 and 01AB1B2 through F2. It includes the following major units:

- Control Storage Hardware
- ALU/Local Storage/Data Flow Registers
- Shift Circuits
- Storage Addressing and Update Registers

INSTRUCTION PROCESSOR BLOCK DIAGRAM



FRAME 01 (Front View)



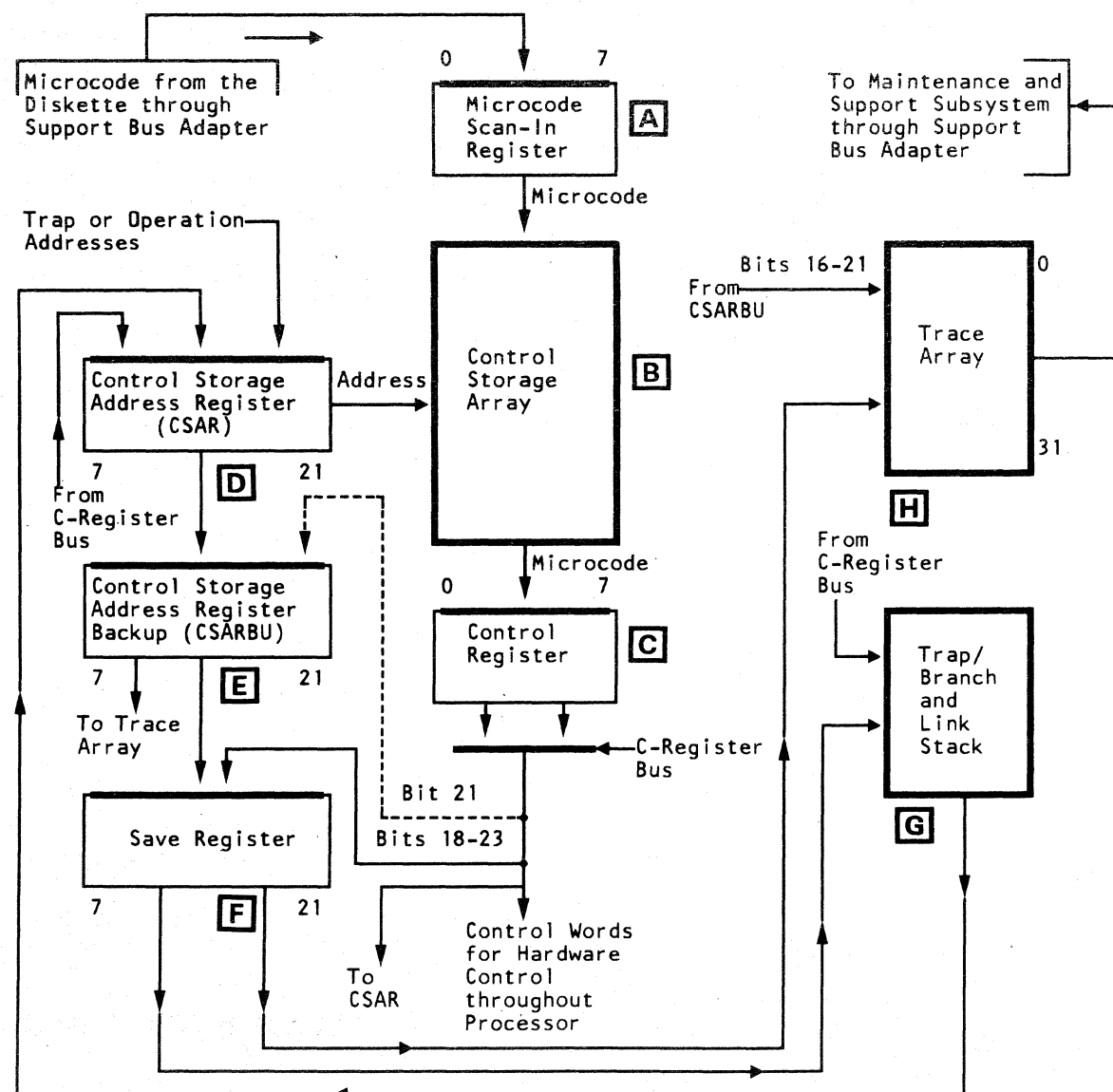
CONTROL STORAGE HARDWARE

Control storage hardware, on 01AB1B2 through F2, stores the microcode and controls (with the aid of external registers), the functional operations of the channels instruction processor, and the main storage and controls hardware. The microcode is loaded into the control storage array at initial microcode load (IML). Trap and operation addresses are transferred from all parts of the processor hardware to obtain the microcode for controlling the hardware functions. The Control storage hardware includes:

- A** Microcode Scan-In Register
- B** Control Storage Array
- C** Control Register
- D** Control Storage Address Register
- E** Control Storage Address Register Backup
- F** Save Register
- G** Trap/Branch and Link Stack
- H** Trace Array

CONTROL STORAGE HARDWARE DATA FLOW DIAGRAM

Locations: 01AB2 through F2



A Microcode Scan-In Register

The microcode scan-in register is an 8-byte register on 01AB1B2 through E2, two bytes per card. This register is used only when you change or initial microcode load (IML) the control storage array. The microcode enters the microcode scan-in register through the support bus adapter of the maintenance and support subsystem.

B Control Storage Array

The control storage array, on 01AB1B2 through E2, is the storage device for the microcode. This storage device can be up to 64K bytes in size. It is loaded by the microcode scan-in register. Two bytes of data from each card of the control storage array are transferred to the control register when called out by the control storage address register.

C Control Register

The control register (C-register) is an 8-byte register on 01AB1B2 through E2, two bytes per card. The C-register reads eight bytes of microcode from the control storage array; four of the eight bytes are transferred to the C-register bus. These bytes are transferred to the C-register bus in the form of a microinstruction that contains control data and an address. The control data controls hardware functions. The address specifies the next microinstruction to be fetched from the control storage array unless an interrupt present.

D Control Storage Address Register

The control storage address register (CSAR), on 01AB1F2, is a 15-bit addressing register. The bits are numbered 7 through 21. This register contains the address of the next 4-byte microinstruction transferred to the control register bus. The address can come from any part of the processor hardware as a result of a trap or operation to be performed. The address can also come from the control register bus and the trap/BAL stack. An image of the addresses in CSAR is stored in CSARBU for later use or to retry a control storage operation.

E Control Storage Address Register Backup

The control storage address register backup (CSARBU), on 01AB1F2, is a 15-bit addressing backup register. The bits are numbered 7 through 21. This register contains the address of the present microinstruction on the control register bus. Bits 7 through 20 of the address transferred to the CSARBU are from the CSAR; bit 21 is from the C-register bus. The total content of CSARBU is passed to the save register, but only the last six bits are passed to the trace array.

F Save Register

The save register, a 15-bit buffer on 01AB1F2, loads the trap/BAL stack and the high-order address byte for the trace array. The bits are numbered 7 through 21. The save register is loaded from the CSARBU. The last six bits are loaded from bits 18-23 of the C-register bus, in the case of a branch and link (BAL) microinstruction.

G Trap/Branch and Link Stack

The trap/branch and link stack, (trap/BAL), on 01AB1F2, is an array that is two bytes wide and has seven address locations. This array contains the return addresses for trap and BAL microinstructions, three locations for trap addresses and four for BAL addresses. The locations are loaded by the save register when a trap or BAL interrupt occurs.

H Trace Array

The trace array, on 01AB1F2, is 18 bits wide by 32 address locations deep. This array can hold a maximum of 32 microinstruction addresses. Each address location is set with bits from the save register and the CSARBU with parity. The trace array is used for error analysis. Its contents can be inspected by the maintenance and support subsystem.

ALU/LOCAL STORAGE/DATA FLOW REGISTERS

This unit, on 01AA1Q2 through U2, moves and processes data as specified by the program. Storage data enters through the shift circuits. Output data goes to the storage addressing and update registers, to the shift circuits, and to the channel control section. The ALU/local storage/data flow registers include:

- A** Local Storage
- B** Retry Array
- C** Local Storage Address Decoder
- D** Arithmetic and Logic Unit
- E** Destination Register
- F** A-Register
- G** Channel A-Register
- H** B-Register
- I** A/B Assembler

A Local Storage

Local storage is an array, eight bytes wide and 128 address locations deep, on 01AA1R2 through U2, two bytes per card. The array has eight sections, each section is 16 address locations deep. Two sections of local storage are for general purpose registers, floating-point registers, trap/BAL save areas, and direct local storage work areas. The other six sections are for channel functions. Local storage is addressed by the local storage address decoder. Input is from the D-register. The output is to the B-register.

B Retry Array

The retry array, 16 bytes wide and 32 address locations deep, is on 01AA1R2 through U2, four bytes per card. This array has two sections, each section is eight bytes wide and 32 address locations deep. The retry array is used alternately by the instruction cycle. It stores the image of local storage used by the instruction being executed. The data in the retry array is used to retry error conditions. Input is from the B-register, and the output is to the Z-bus. The retry array is addressed by the local storage address decoder.

C Local Storage Address Decoder

The local storage address decoder, a set of decoding logic circuits on 01AA1Q2, decodes the addresses read into them by microcode. The addresses are used to specify the address locations in local storage and the retry array.

D Arithmetic and Logic Unit

The arithmetic and logic unit (ALU), the hardware that performs the arithmetic and logical operations is on 01AA1R2 through U2, two bytes per card. Input to ALU is from the A-register, channel A-register, and B-register. The ALU output is to the Z-bus.

The ALU performs binary, decimal, addition, and subtraction operations. It also performs the logical AND, OR, and exclusive OR functions. The ALU also detects bit and byte carry conditions.

DATA FLOW REGISTERS

The data flow registers are 8-byte registers, on 01AA1R2 through U2, two bytes per card. The data flow registers include the D-register, the A-register, the channel A-register, the B-register, and the A/B assembler. The following is a description of their data flow:

E Destination Register

The destination register (D-register) receives data from the ALU and the retry array by the Z-bus. It also receives data from the channel and storage through the byte shifter. The data is transferred to the:

- A-Register
- Channel A-Register
- B-Register
- Local Storage
- Shift Controls
- Channel Control Section

F A-Register

The A-register is loaded from the D-register. The output is to the ALU or A/B assembler.

G Channel A-Register

The channel A-register is used only during channel operations. The input is from the D-register. The output is to the ALU and the A/B assembler.

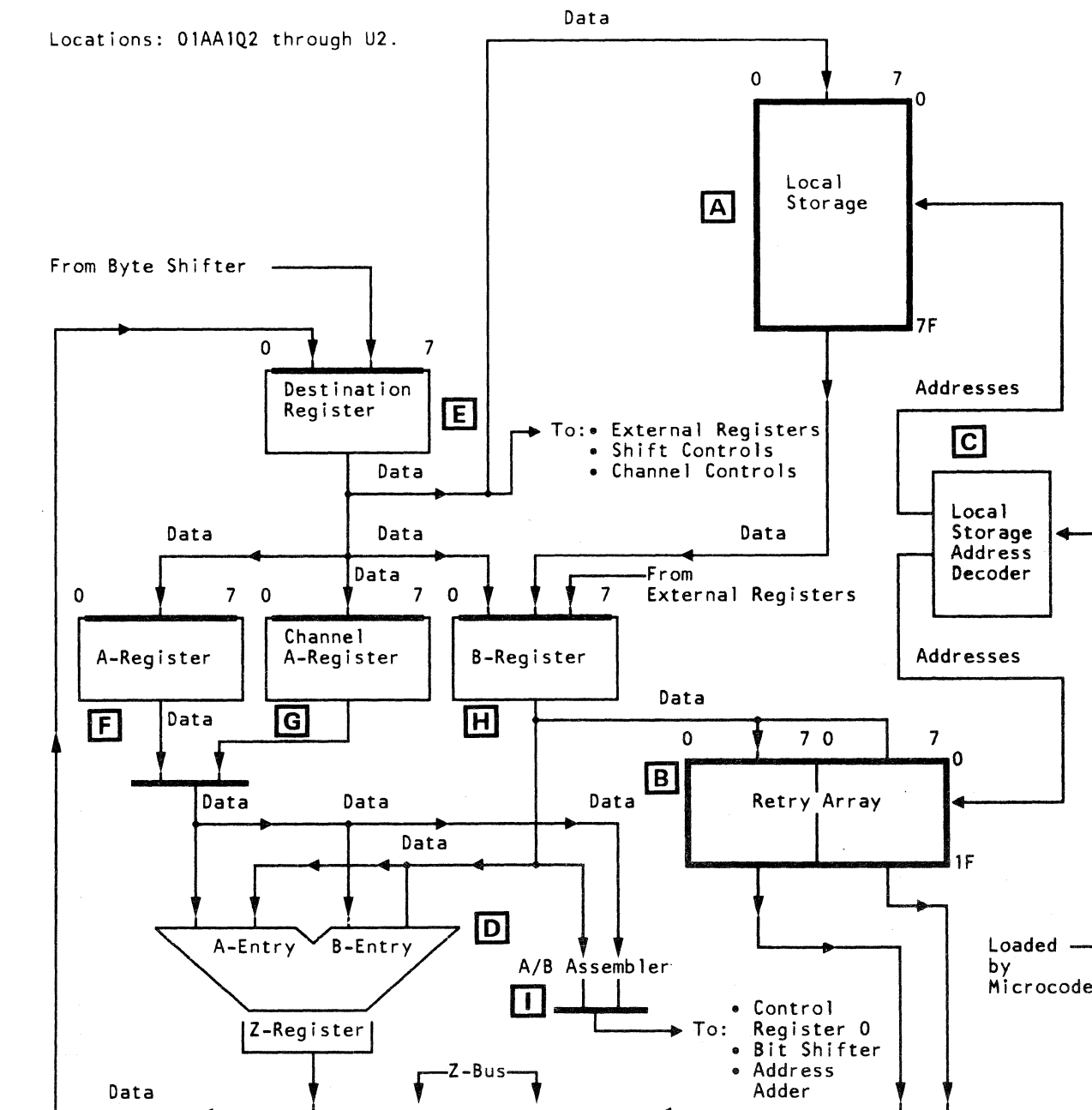
H B-Register

The inputs to the B-register are from local storage, the D-register, and external registers. The output is to the ALU, the A/B assembler, and the retry array.

I A/B Assembler

The A/B assembler assembles the data from the A-register, channel A-register, or B-register. This assembler sends the contents of these registers to external registers, the bit shifter, the control register 0, and the address adder.

ALU/LOCAL STORAGE/DATA FLOW REGISTERS DATA FLOW DIAGRAM



SHIFT CIRCUITS

The shift circuits, on 01AA1D2, E2, L2, and M2, enable the instruction processor to transfer, receive, and shift data among the storage hardware, the channel data buffer section, and the ALU/local storage/data flow registers. It includes:

- A** Bit Shifter
- B** Byte Shifter
- C** Shift Controls
- D** Instruction Buffer
- E** Instruction Buffer Backup
- F** M/Q Register
- G** R4/L1 Shift Circuits

A Bit Shifter

The bit shifter is a shifting network, on 01AA1D2 and E2, four bytes per card. The bit shifter performs the following on data being transferred through it:

- Shifts up to seven bit positions.
- Shifts left or right.
- Wraps or pads data bits.

The operations of the bit shifter are controlled by the shift controls **C**. Data passes from the A/B assembler, through the bit shifter to the byte shifter or to the M/Q register.

B Byte Shifter

The byte shifter is a shifting network, on 01AA1L2, that performs the following functions on data transferred through it:

- Shifts up to seven byte positions.
- Shifts left or right.
- Wraps or pads data bits.

The operations of the byte shifter are controlled by the shift controls **C**. Byte shifter inputs are from the:

- M/Q Register
- Bit Shifter
- Data Register
- Channel Data Buffer Section
- Instruction Buffer

The output of the byte shifter is to the:

- Data Register
- Destination Register (D-Register)
- Instruction Buffer
- Instruction Buffer Backup
- Channel Data Buffer Section
- External Register

C Shift Controls

The shift controls, on 01AA1M2, are three one-byte registers, that include the shift indirect register (SIR), W1 and W2 registers. These registers receive and distribute shift controls and length amounts for the bit shifter, the byte shifter, and the M/Q register. The control data is received from the destination register (D-register).

D Instruction Buffer

The instruction buffer is an 8-byte data buffer on 01AA1L2. It functions with the instruction buffer backup to receive and pass the data and instructions between the storage bidirectional bus and the byte shifter. Input is from the byte shifter, the instruction buffer backup, and the storage bidirectional bus. The output is always through the byte shifter.

E Instruction Buffer Backup

The instruction buffer backup (IBB) is a six-byte data buffer on 01AA1L2. The IBB buffers the last six bytes of each instruction being passed to the instruction buffer. Input to IBB is from the storage bidirectional bus or the byte shifter. The output always goes to the instruction buffer.

F M/Q Register

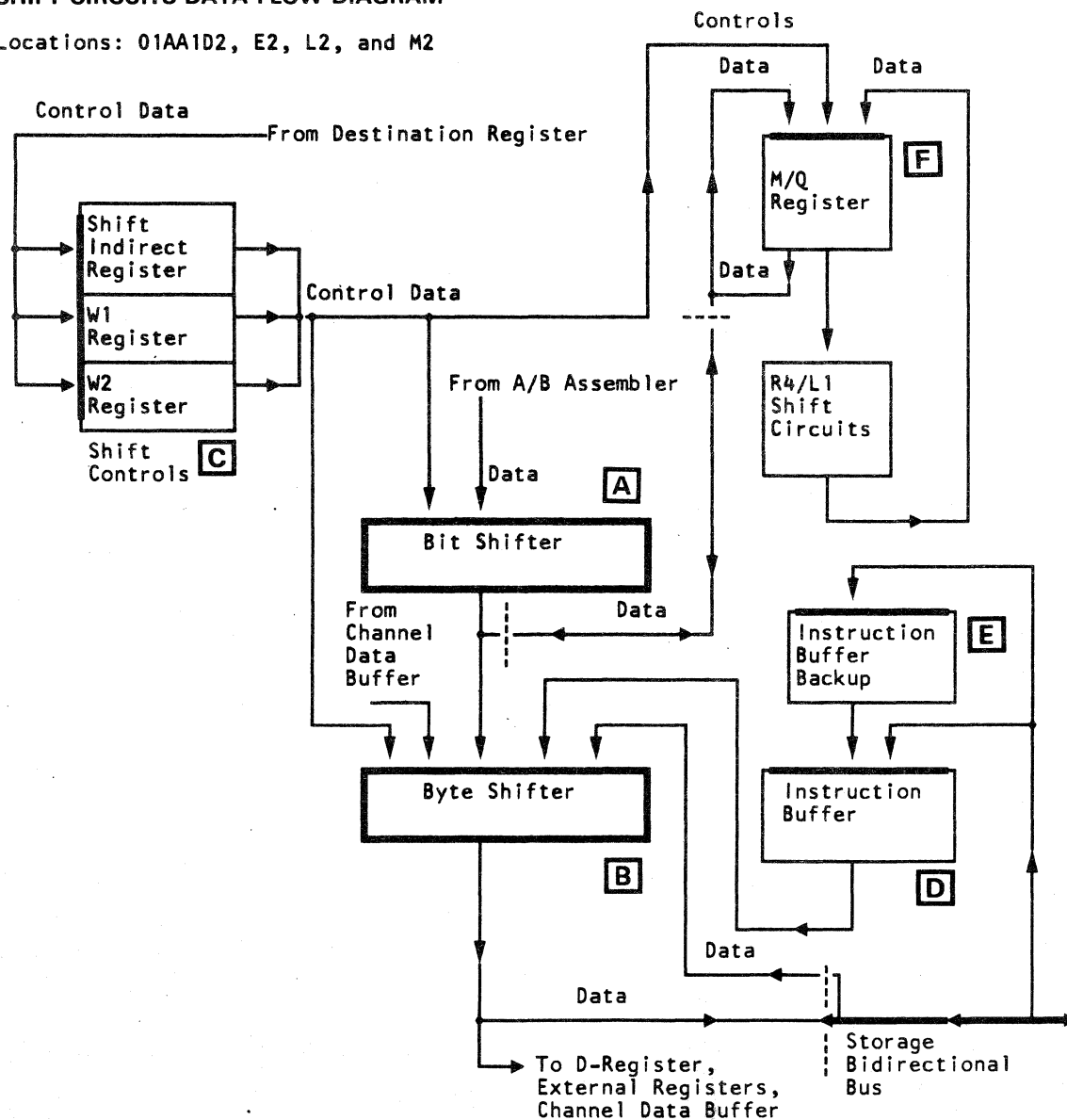
The M/Q register is a 8-byte register used during the multiplying and dividing process. This register is on 01AA1D2 and E2, four bytes per card. The M/Q register receives data from the bit shifter and performs the multiply and divide operations as specified by the shift controls. The data is passed through R4 and/or L1 shift circuits to obtain a desired output. This output is then passed through the byte shifter.

G R4/L1 Shift Circuits

The R4/L1 shift circuits, on 01AA1L2, shift the contents of the M/Q register right four bit positions (R4) and/or left one bit position (L1), as specified by the shift controls. They are used with the M/Q register in multiply and divide operations. The input and output are from and to the M/Q register.

SHIFT CIRCUITS DATA FLOW DIAGRAM

Locations: 01AA1D2, E2, L2, and M2



STORAGE ADDRESSING AND UPDATE REGISTERS

The storage addressing and update registers generate, update, and store addresses for the data and programs in storage. These registers and circuits are on 01AA1N2. Address data to obtain the addresses comes from the A/B assembler and microcode. These addresses are passed to the main storage address register (MSAR) of the storage hardware. The storage addressing and update registers include:

- A** G-Register
- B** Address Adder
- C** Storage Address Register 1
- D** Storage Address Register 2
- E** Channel Storage Address Register
- F** Translate Storage Address Register
- G** Update Circuits +2/4 and +8/16
- H** Instruction Counter
- I** Instruction Counter Backup
- J** Storage Address Backup Register
- K** R9 Shifter
- L** Control Register 0
- M** Match Circuit

A G-Register

The G-register, on 01AA1N2, is a four-byte address register that contains the preceding storage address plus the displacement for the next storage address. The G-register receives input from the storage address bus and microcode. The output is always to the address adder.

B Address Adder

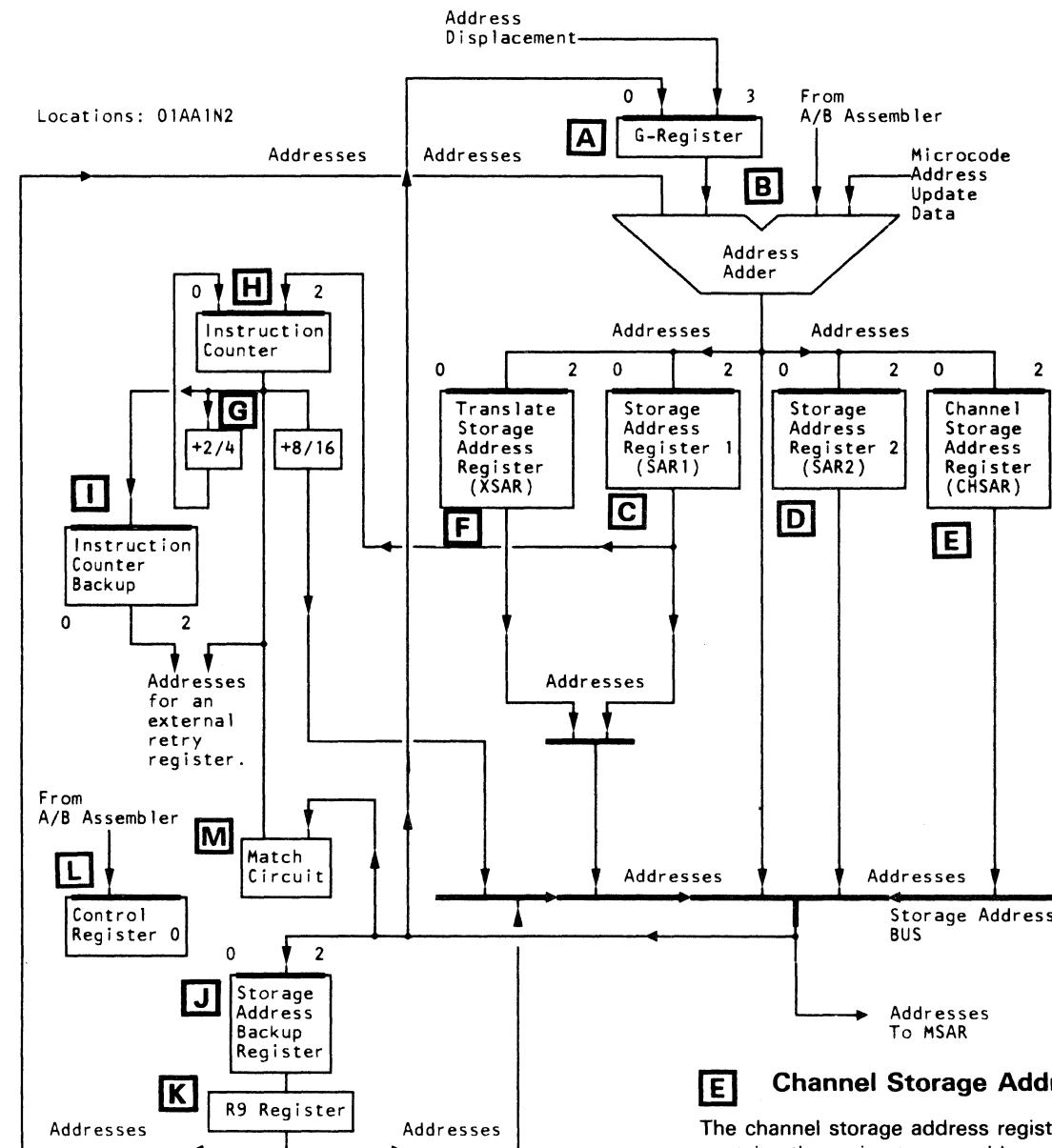
The address adder, on 01AA1N2, is the logic that calculates and updates addresses to form the next storage address.

- Input is from the:
- G-Register
 - A/B Assembler
 - Microcode

The output is to the:

- Storage Address Register 1
- Storage Address Register 2
- Channel Storage Address Register
- Storage Address Bus

STORAGE ADDRESSING AND UPDATE REGISTERS DATA FLOW DIAGRAM



C Storage Address Register 1

The storage address register 1 (SAR1), on 01AA1N2, contains the storage address of the first operand, that is transferred from the address adder. The content of SAR1 is transferred to the main storage address register (MSAR) by the storage address bus. SAR1 also sets the instruction counter.

D Storage Address Register 2

The storage address register 2 (SAR2), on 01AA1N2, contains the storage address of the second operand, that is transferred from the address adder. The content of SAR2 is transferred to the main storage address register (MSAR) by the storage address bus.

E Channel Storage Address Register

The channel storage address register (CHSAR), on 01AA1N2, contains the main storage addresses for use during channel operations. The addresses are received from the address adder. Its content CHSAR is transferred to the main storage address register (MSAR) by the storage address bus.

F Translate Storage Address Register

The translate storage address register (XSAR), on 01AA1N2, aids the address translation process of the channel and instruction processor DLATs when an address translation is not found. XSAR is loaded by the address adder. Its output is transferred to the main storage address register (MSAR) by the storage address bus.

G Update Circuits +2/4 and +8/16

The update circuits +2/4 and +8/16, on 01AA1N2, increment the instruction addresses in the instruction counter. The +8/16 circuits are used during initial selection of a set of

instructions from storage. The +2/4 circuits are used to increase the instruction addresses when in a sequential mode of operation. The address is then put back in the instruction counter. The addresses are also passed to the MSAR by the storage address bus.

H Instruction Counter

The instruction counter, on 01AA1N2, contains the address of the next instruction fetched from storage. It is first set by SAR1 and is then updated by two or four as the instruction sequence continues. The content of the instruction counter is gated to any of the following:

- +2/4 Update Circuit
- +8/16 Update Circuit
- Instruction Counter Backup
- External Registers

I Instruction Counter Backup

The instruction counter backup (ICBU), on 01AA1N2, receives the contents of the instruction counter before the instruction counter is updated. The address in the ICBU can be used for instruction retry. The address is transferred to the external bus for microcode use.

J Storage Address Backup Register

The storage address backup register, on 01AA1N2, contains the address used to obtain a virtual to real address translation after a DLAT miss is received. The content of the storage address backup register is also used during retry mode. The input/output is between the storage address bus.

K R9 Shifter

The R9 shifter, a logical shifting network on 01AA1N2, supports the storage hardware to obtain the translation of an address not found in the DLATs. When a DLAT miss occurs, the R9 shifter shifts the bit positions of the address from the storage address backup register. The address is then transferred to MSAR by the storage address bus.

L Control Register 0

The control register 0 is a three-bit register on 01AA1N2. It specifies the segment and page size of data being transfer from a storage device to the BSM. Control register received input from the A/B assembler. The content is interpreted by microcode.

M Match Circuit

The match circuit, on 01AA1N2, acts on a match of the addresses between the instruction counter and the addresses sent to storage. When a match occurs, the match circuit causes a operator-specified action to occur.

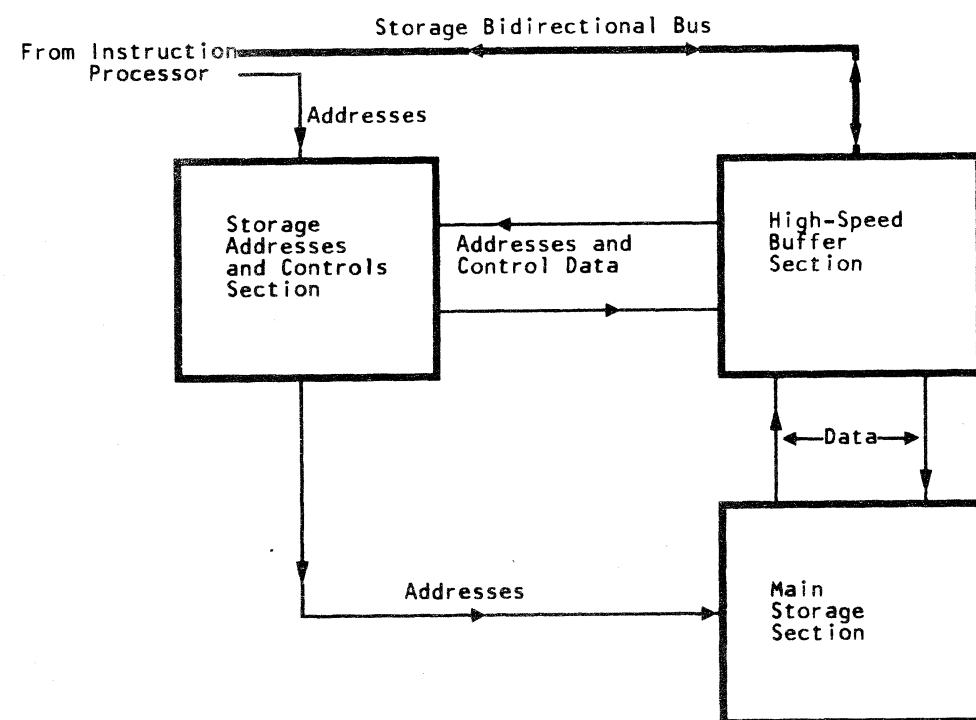


MAIN STORAGE AND CONTROLS

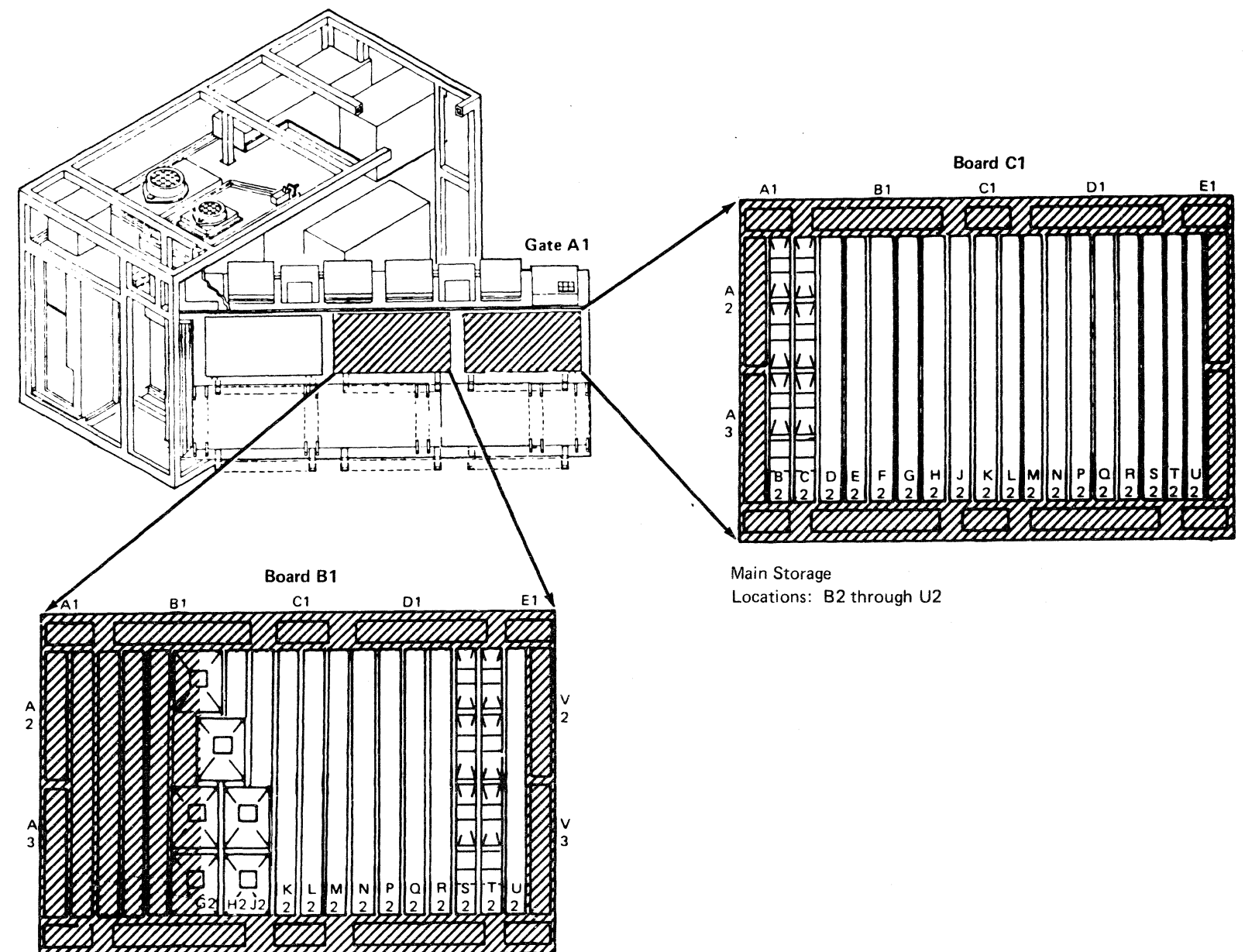
The main storage and controls, on 01AB1G2 through U2, and 01AC1B2 through U2, include:

- High-Speed Buffer Section
- Main Storage Section
- Storage Addresses and Controls Section

MAIN STORAGE AND CONTROLS BLOCK DIAGRAM



FRAME 01 (Front View)



Main Storage
Locations: B2 through U2

High-Speed Buffer
Locations: M2 through Q2
Main Storage
Locations: S2 through U2
Storage Addresses and Controls
Locations: G2 through K2

Model Group 2

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HIGH-SPEED BUFFER SECTION

The high-speed buffer section, on 01AB1M2 through Q2, S2, and T2, decreases the storage access time for programs and data. The output is transferred among the basic storage module (BSM), the instruction processor, or the channel hardware. The addresses and controls are from the storage addresses and controls section. Input is from the BSM and the storage bidirectional bus. The high-speed buffer section includes:

- A** High-Speed Buffer
- B** Data Register
- C** Swap Buffer
- D** Retry Stack

A High-Speed Buffer

The high-speed buffer (HSB), on 01AB1M2 through Q2, is the storage area for the most recently used programs and data. The HSB is 16 bytes wide by 1024 locations deep, (each location contains two doublewords), and has eight sections that contain two 32-block segments. Each block contains eight doublewords.

The eight sections of the HSB are addressed by MSAR bits 13-17, and either MSAR bits 18-20 (during 8- and 64-byte transfers), or MSAR bits 18 and 19 (for 16-byte transfer mode). Data is read out of the HSB at 8-, 16-, or 64-byte transfers to the data register. Data is written to the HSB from the storage bidirectional bus (8-byte transfers) or the data register (8- or 16-byte transfers).

B Data Register

The data register is an 64-byte register that transfers data to/from storage, channel or the instruction processor hardware. The data register is on 01AB1M2 through Q2, 16 bytes per card. The data transferred from the data register is selected by the high-speed buffer directory (HSBD) through the address compare circuit.

Input is from the:

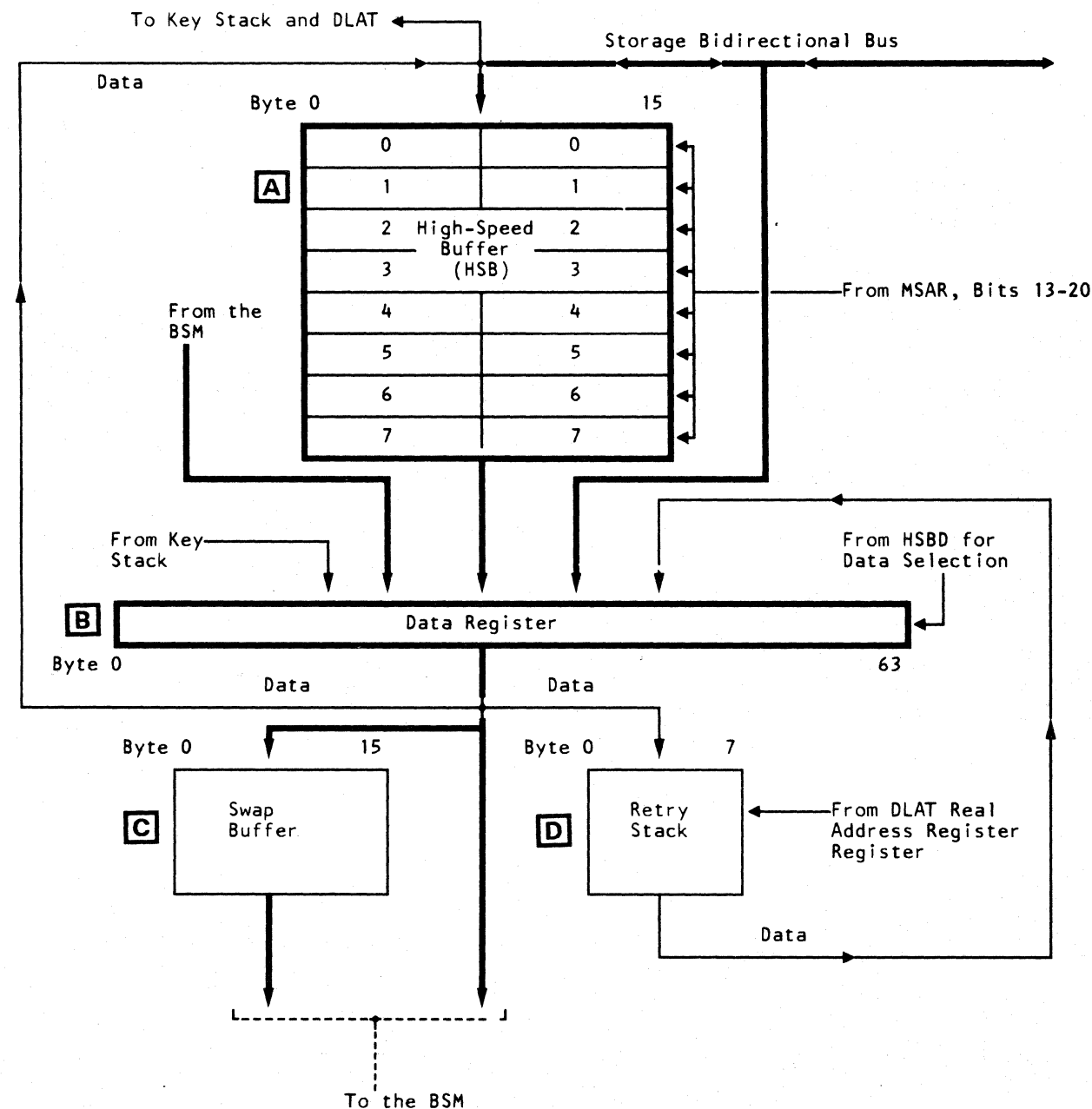
- High-Speed Buffer (64-byte transfers)
- Storage Bidirectional Bus (8-byte transfers)
- BSM (8- or 16-byte transfers)
- Key Stack (2-byte transfers)
- Retry Stack (8-byte transfers)

Output is to the:

- High-Speed Buffer (16-byte transfers)
- Storage Bidirectional Bus (8- or 16-byte transfers)
- Swap Buffer (16-byte transfers)
- Retry Stack (8-byte transfers)
- BSM (16-byte transfers)

HIGH-SPEED BUFFER SECTION DATA FLOW DIAGRAM

Locations: 01AB1M2-Q2, S2 and T2



C Swap Buffer

The swap buffer is a temporary storage device, on 01AB1S2 and T2. When data in a HSB block has changed (and the block location is to be used), the block must be returned to the BSM. The swap buffer holds a HSB block and transfers it to the BSM. The channel hardware can also directly use the swap buffer when storing data in the BSM. All data entering the swap buffer first goes through the data register.

D Retry Stack

The retry stack, on 01AB1M2 through Q2, two bytes per card, is a storage array. It stores the image of HSB doubleword locations before they are changed. The real address and R/W flags, (associated with the doubleword location to be changed), are also stored. Part of the real address is from the DLAT real address register, and the other part is from MSAR. When an error occurs during a storing operation, the retry stack supplies:

- The address associated with the doubleword location that was changed during the error.
- The doubleword as it was before the error occurred.
- The R/W flags for the operation that were in effect when the error occurred.

The above data is used to retry the storage operation. Data enters and leaves the retry stack by the data register.

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MAIN STORAGE SECTION

The main storage section is the area of the storage hardware where programming and customer data is stored. The storage space has auxiliary and user storage. The main storage section is on 01AB1S2, T2, and U2; 01AC1B2 through U2.

Note: Card 01AB1K2, also part of the storage group, contains control logic not described in this section.

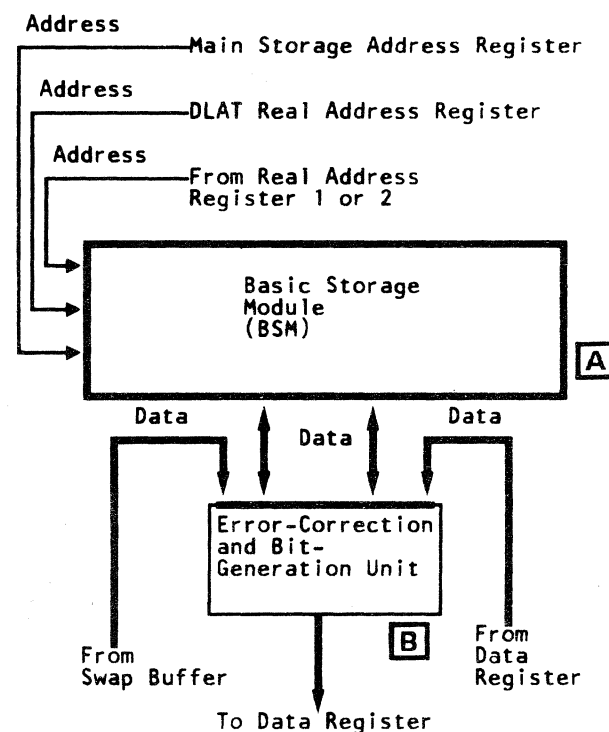
The data is loaded during initial program load (IPL) or an I/O operation. The main storage is addressed by the storage address and controls section and includes:

- A** Basic Storage Module
- B** Error-Correction and Bit-Generation Unit

MAIN STORAGE SECTION DATA FLOW DIAGRAM

Locations: 01AB1S2, T2, and 01AC1B2 through U2.

The number of cards plugged in positions B2 through U2 of the C1 board are affected by storage size and the power group code of the machine.



A Basic Storage Module

The basic storage module (BSM) is machine storage for the 4341 processor. The standard size of storage space is two megabytes. Storage space may be larger depending on the optional sizes available for a particular 4341 model and the customers selection.

Card locations 01AC1D2 through U2 are reserved for the BSM (storage array cards). The number of cards that occupy positions D2 through U2 are affected by the storage size and the power group code of the machine. For specific card locations, go to *Volume 13*, section 14, *Service Aids*, page 14 105, and see "Storage Array Cards Location Chart."

The BSM operates on 16-byte data intervals. All data is transferred to the BSM through the data register before being processed. All data to and from the BSM is transferred through the error-correction and bit-generation unit. The BSM can be addressed by the DLAT real address register, the real address register 1, the real address register 2, or the MSAR bits 13 through 17.

B Error-Correction and Bit-Generation Unit

The error-correction and bit-generation unit, on 01AB1S2 and T2, is the storage hardware that:

- Detects single and double-bit errors.
- Corrects single-bit errors.
- Signals the storage hardware to automatically retry the fetch operation during a HSB load when a double-bit error is detected.
- Causes a machine check on double-bit errors other than a HSB load.
- Causes a machine check on a unsuccessful retry.

All data entering or leaving the BSM must first go through the error-correction and bit-generation unit. The input to the error-correction and bit-generation unit is from the data register, the swap buffer, or the BSM. The output is to the BSM or the data register.

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STORAGE ADDRESSES AND CONTROLS SECTION

The storage addresses and controls section, on 01AB1G2 through K2, is the storage hardware that:

- Addresses the BSM and the HSB
- Translates addresses
- Determines if the requested programs or data is in the HSB
- Compares and stores storage keys.

The storage address and controls section also starts other operations for obtaining addresses, address translations, data, and programs as requested by the instruction processor and channel I/O. The addresses to this section are obtained from the storage address bus of the instruction processor. The storage keys and relative status are obtained on the storage bidirectional bus. The microcode also aids in selecting the correct addresses. This section includes:

- A** Main Storage Address Register
- B** Channel and Instruction Processor DLATs
- C** High-Speed Buffer Directory
- D** Address Compare Circuit
- E** Real Address Registers 1 and 2
- F** DLAT Real Address Register
- G** Key Stack
- H** Key Compare Circuit

A Main Storage Address Register

The main storage address register (MSAR), a 24-bit addressing register on 01AB1H2, is the main addressing component for the storage address control section. This register is loaded with a virtual or real address from the storage address bus. If the MSAR is loaded with a real address, this address is gated to the DLAT real address register, and a part of the address addresses the HSB. If a virtual address is loaded into the MSAR, this address addresses the HSB and the channel/instruction processor DLATs for an address translation. The MSAR addresses the HSB to obtain the correct HSB block and doubleword being requested by the instruction processor or channel hardware. If the page being addressed is not found in the HSB, the main storage address register addresses the BSM.

B Channel and Instruction Processor DLATs

The channel and instruction processor directory lookaside tables (DLATs), on 01AB1J2, are two storage hardware units for virtual-to-real address translation and key checking. The channel DLATs are used in VSE mode for channel operations. The instruction processor DLATs are used in VSE or 370 mode for processor operations. The channel/instruction

processor DLATs are loaded with translated storage addresses, storage keys, and status from MSAR, auxiliary storage and/or the storage bidirectional bus. The DLATs are addressed by MSAR bits 8 through 12. The microcode identifies DLATs to be used. The real address found for a virtual address translation is gated to the DLAT real address register and the address compare circuit. The DLATs are also used for real-to-real address translations where addresses and storage keys are checked. The storage keys for the real or virtual addresses are gated to the key compare circuit and are compared with the PSW key. See "Storage Addresses and Controls Section Data Flow Diagram."

C High-Speed Buffer Directory

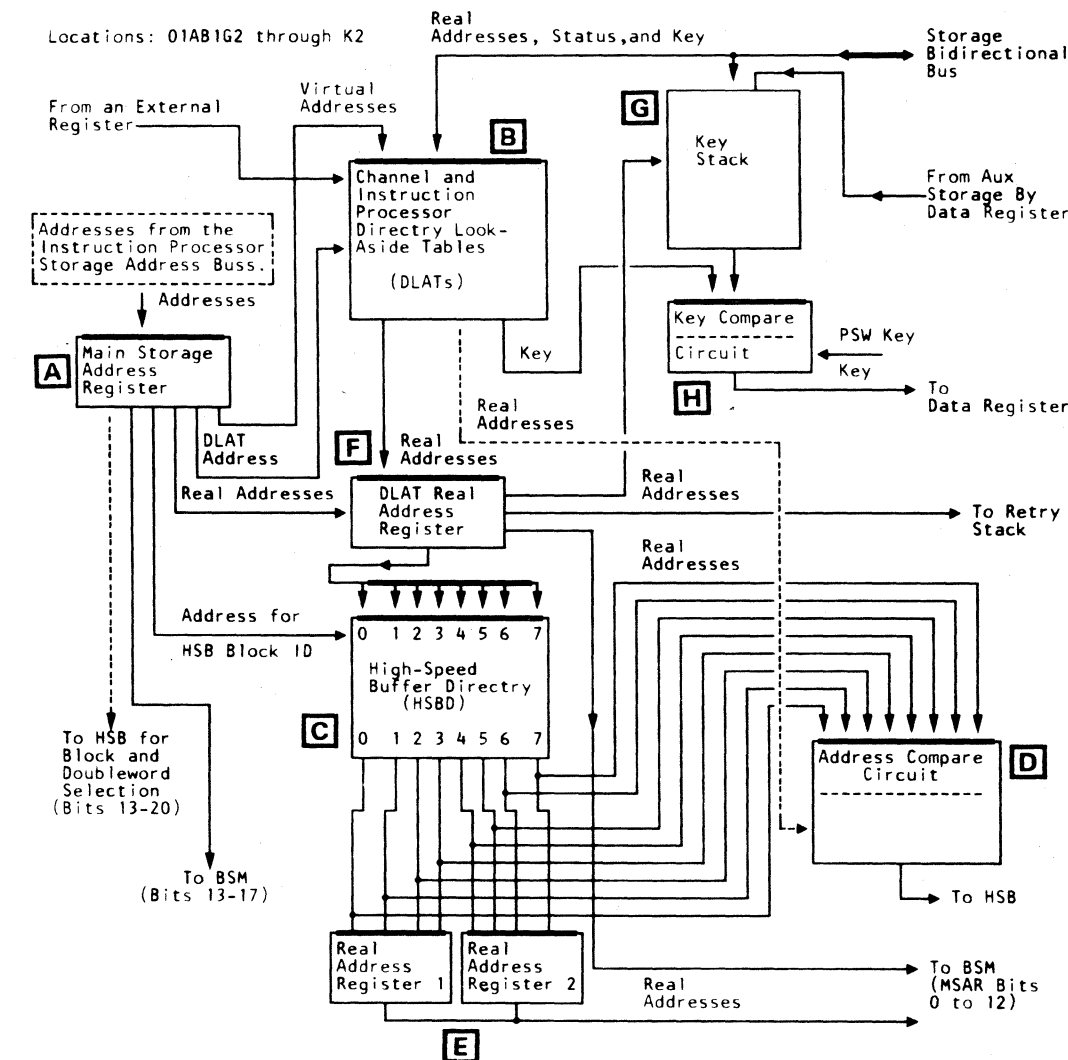
The high-speed buffer directory (HSBD), on 01AB1K2, contains addresses to locate the section of the HSB being

addressed by MSAR. The HSBD has eight sections, one for each section of the HSB. The HSBD contains information to indicate:

- The HSB block that was least recently used (LRU)
- The data in the HSB that has bad parity
- The data in the HSB that was changed
- The section of the HSB that is being addressed by the MSAR.

The HSBD is loaded from the DLAT real address register. It is addressed by MSAR bits 13 through 17, which select a set of eight addresses. Each address points to a different section of the HSB. The eight addresses are gated to the address compare circuit; also four addresses (0-3) are gated to real address register 1, the other four addresses (4-7) are gated to real address register 2. The HSBD address that compares with the address from the DLATs selects the data in the data register being addressed by MSAR.

STORAGE ADDRESSES AND CONTROLS SECTION DATA FLOW DIAGRAM



D Address Compare Circuit

The address compare circuit, on 01AB1K2, is the logical network that compares eight addresses from the HSB with one from the DLATs. If one of the HSB addresses matches the address from the DLATs, the output of the address compare circuits selects the doubleword(s) in the data register being addressed by MSAR. If there is no match, the address compare circuit selects the least recently used (LRU) address of the eight addresses gated from the HSB. This address specifies the section in the HSB to store the needed page of data.

E Real Address Registers 1 and 2

Real address registers 1 and 2, 12-bit address registers on 01AB1K2, specify the BSM location to store a HSB block transferred from the swap buffer. Real address register 1 obtains its input from locations 0-3 of the HSBD; real address register 2 obtains its input from locations 4-7 of the HSBD. The output of both registers addresses the BSM to specify the locations to store data.

F DLAT Real Address Register

The DLAT real address register, a 12-bit address register on 01AB1K2, specifies 2K pages of the BSM data. DLAT real address register is loaded with real addresses by MSAR or the DLATs.

The output is used to:

- Load the HSB.
- Address the key stack for reading or storing a key.
- Load the retry stack with part of the real address for the HSB doubleword stored in the swap buffer.
- Address the BSM for data when the address compare circuit does not obtain a HSB match.

G Key Stack

The key stack is an array, seven-bits wide and up to 4196 locations (depending on the machine storage size). It is on 01AB1G2. The key stack stores the key and key relative status for each 2K page of the BSM storage space. The key stack is loaded by the storage bidirectional bus and is addressed by DLAT real address register. The key gated out is compared in the key compare circuit with the instruction processor PSW key. See "Storage Addresses and Controls Section Data Flow Diagram." On key read instructions, the key is read into the data register.

H Key Compare Circuit

The key compare circuit, on 01AB1G2, is the logical network that compares the instruction processor PSW key with the keys from the DLATs or the key stack. The result of the compare is a control signal used by the storage hardware to determine if it can read from or write to the section of storage being addressed.

Model Group 2

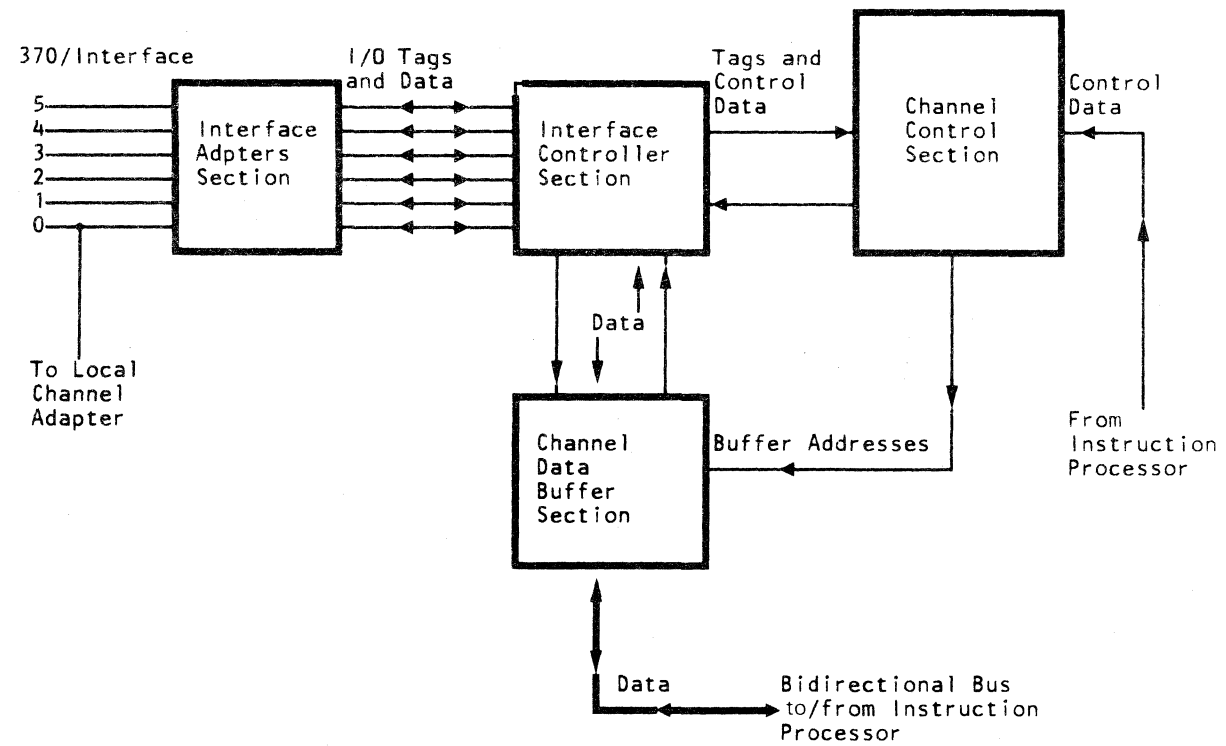
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CHANNEL HARDWARE

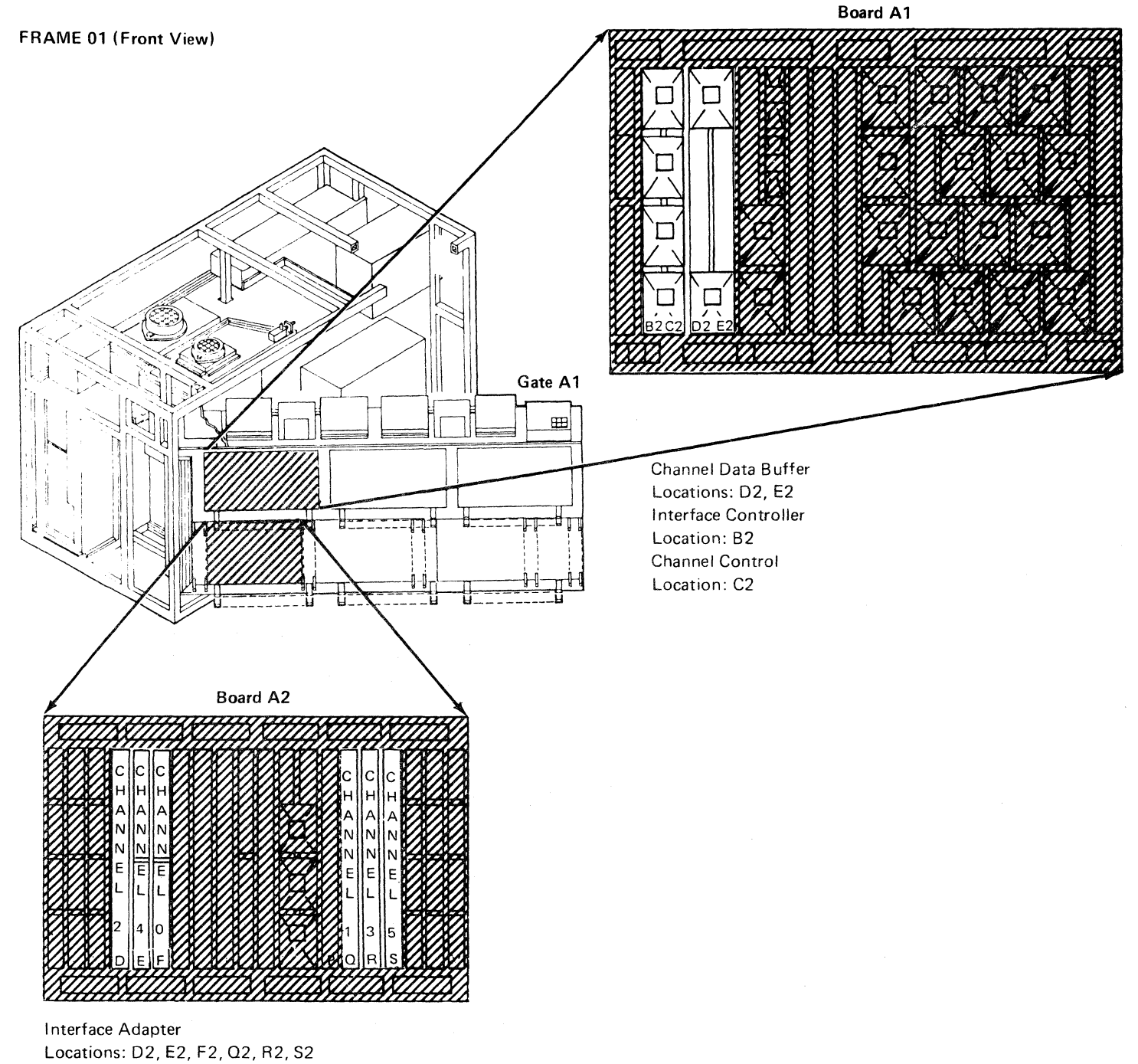
The channel hardware, on 01AA1B2, C2, D2, E2 and 01AA2D2, E2, F2, Q2, R2, and S2, includes:

- Interface Adapter Section
- Interface Controller Section
- Channel Data Buffer Section
- Channel Control Section

CHANNEL HARDWARE BLOCK DIAGRAM



FRAME 01 (Front View)



INTERFACE ADAPTER SECTION

The interface adapter section is the channel hardware that supplies the logic and registers to control the movement of data between the standard 370/Interface and the interface controller section. Each channel has an interface adapter (see the *Interface Adapter Section Data Flow Diagram*). The interface adapters are on 01AA2D2, E2, F2, Q2, R2, and S2. The interface adapters have an interface with the I/O control units and a data/control link to the interface controller section. Each interface adapter includes:

- A** Interface Adapter Control Logic
- B** Tag Control Logic
- C** Data-In Register
- D** Data-Out Register

A Interface Adapter Control Logic

The interface adapter control logic controls, synchronizes, and parity checks all data moved between the standard 370/Interface and the interface controller section. It is on 01AA2D2, E2, F2, Q2, R2, and S2; one set of the logic per card per channel. The control lines to the interface adapter control logic are controlled by the multiple decision maker (MDM) during sequence count mode. During data mode, the control lines are controlled by the interface controller section. All data and controls transferred on the bidirectional data/control bus are parity checked by the interface adapter control logic. The control logic also communicates with the I/O control units through the tag logic circuits. (See *Interface Adapter Section Data Flow Diagram*.)

B Tag Logic

The tag logic handles all inbound and outbound tag lines between the interface adapter control logic and the I/O control unit. This logic is on 01AA2D2, E2, F2, Q2, R2, and S2; one set of the logic per card per channel. In data mode, the control lines are controlled by the interface controller section. In sequence count mode, the outbound tags are controlled by MDM through the interface controller section. The tag control logic is used by the interface controller section to synchronize the flow of data to and from the I/O control units.

C Data-in Register

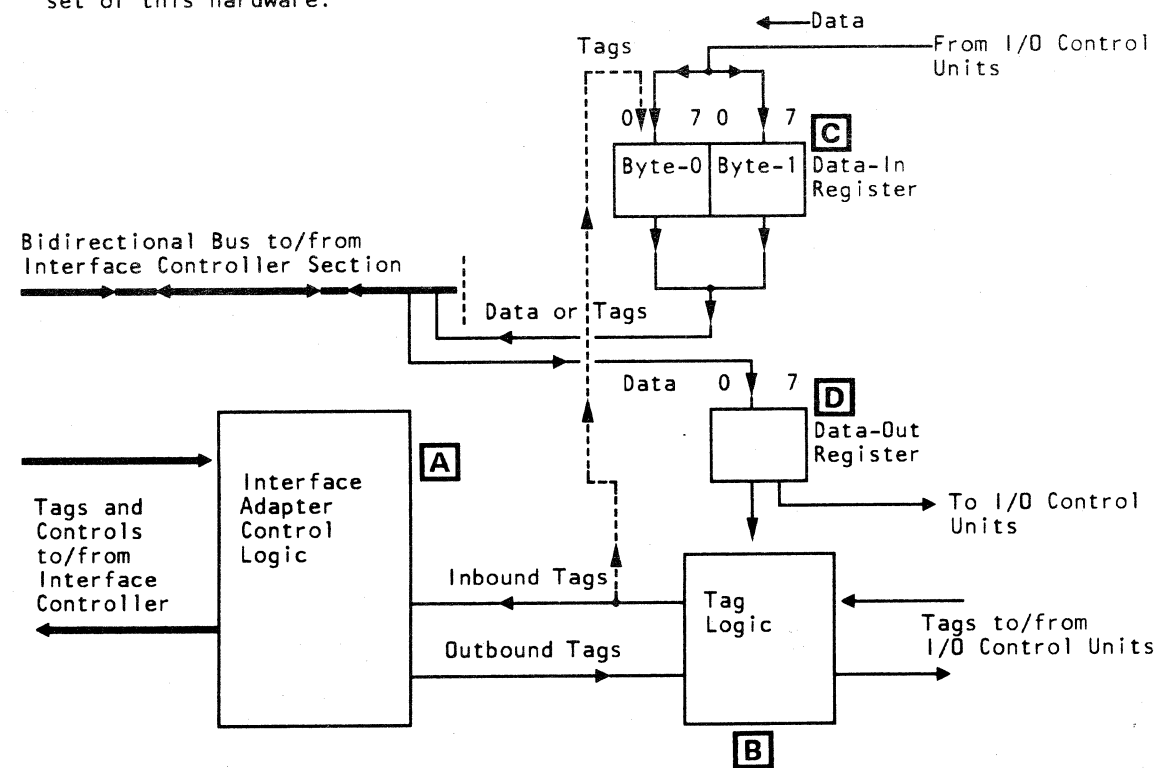
The data-in register is a two-byte buffer that buffers the data and controls gated to the bidirectional data/control bus. It is on 01AA2D2, E2, F2, Q2, R2, and S2; one register per card per channel. The data-in register receives data and tags from the I/O control units. Tags are also received in the byte-0 position from the tag logic circuits. (See *Interface Adapter Section Data Flow Diagram*). The data and tags from the data-in register are transferred to one of the channel data registers located in the interface controller section.

D Data-Out Register

The data-out register is a one-byte buffer that buffers the data from a channel to an I/O control unit. It is located on 01AA2D2, E2, F2, Q2, R2, and S2; one register per card per channel. This register receives data from a channel data register, located in the interface controller section. Data from the data-out register is gated to an I/O control unit.

INTERFACE ADAPTER SECTION DATA FLOW DIAGRAM

Locations: 01AA2, D2, E2, F2, Q2, R2, and S2
 Note: Each channel has a card containing one set of this hardware.



INTERFACE CONTROLLER SECTION

The interface controller section, on 01AA1B2, controls the movement of data between the channel data buffer and the interface adapter (from the I/O devices). It sends and receives control codes between the multiple decision maker (MDM) and the interface adapters. The interface controller section temporarily stores the data for each channel as the data is moved between the channel data buffer and the interface adapters. This section includes:

- A** Channel Interface Control Logic
- B** Channel Data Register

A Channel Interface Control Logic

The channel interface control logic, on 01AA1B2, has a set logic circuits for each channel:

- Supplies the communication link, by control buses, between the interface adapter and MDM.
- Controls data transfers with the channel data buffer (CDB).
- Communicates with the interface adapters through control lines and a bidirectional bus.

The channel interface control logic operates in sequence count mode and in data mode. In sequence count mode the channel interface control logic:

- Interprets the control codes from MDM.
- Passes control data between the interface adapter and MDM.

In data mode, the channel interface control logic:

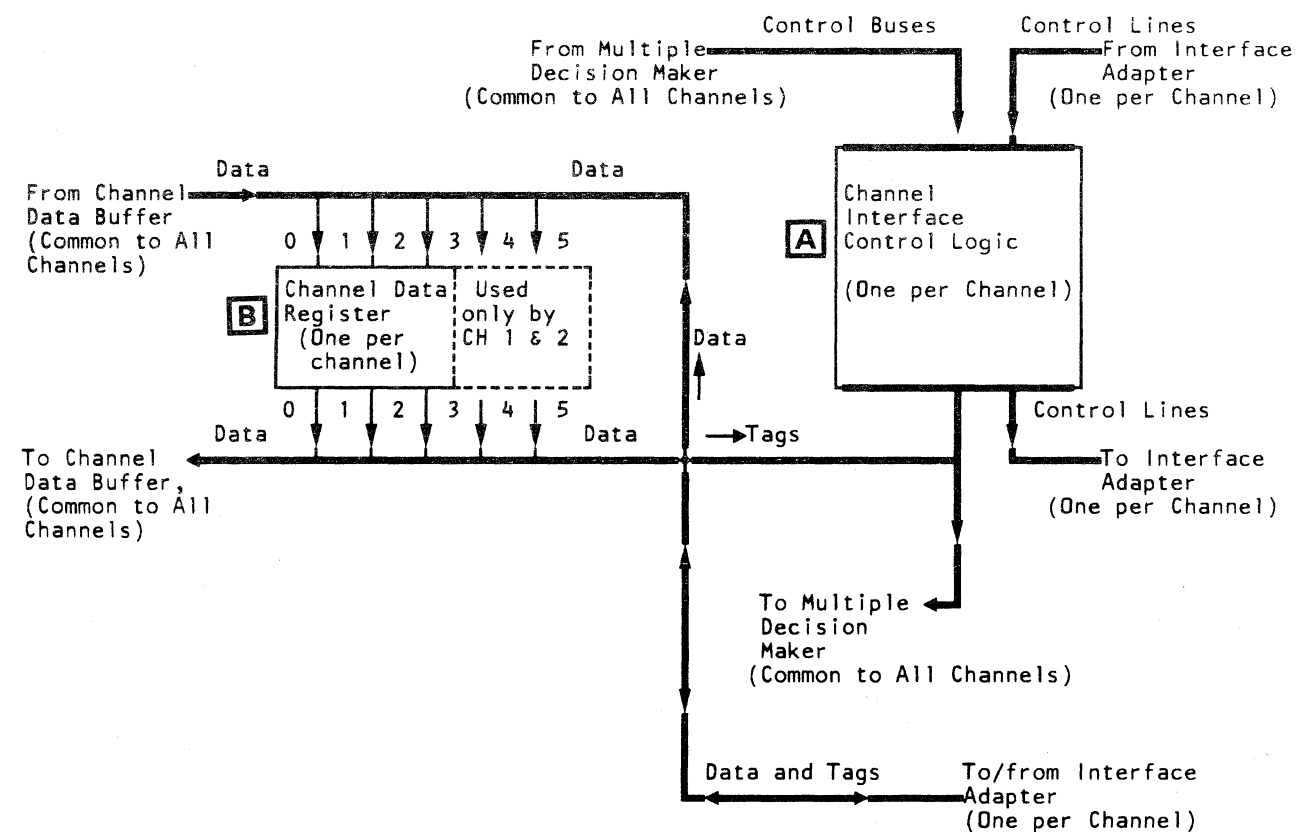
- Makes request to MDM for data transfers with the channel data buffer.
- Controls the communication over the standard 370/Interface.
- Controls the data transfers between the I/O and the channel data buffer through the channel data register.

B Channel Data Register

The channel data register transfers data between the channel data buffer and the interface adapters. There is one channel data register for each channel on 01AA1B2. The channel data register for channels 3, 4, and 5, is four bytes in size; for channels 1 and 2 the channel data register is six bytes in size. Each channel has a bidirectional bus to communicate to/from the interface adapter section for tags and data. Data enters the data register from either the data buffer channel-out register or an interface adapter data-in register. Data leaves the channel data register through either the data buffer channel-in register or an interface adapter data-out register.

INTERFACE CONTROLLER SECTION DATA FLOW DIAGRAM

Location: 01AA1B2



CHANNEL DATA BUFFER SECTION

The channel data buffer section, on 01AA1C2, D2, and E2, transfers data between the main storage section and the I/O devices. The channel data buffer section includes:

- A** Channel Data Buffer
- B** Channel-In and Channel-Out Registers
- C** Data Buffer Data Register
- D** Storage Data Buffer Address Register
- E** Data Length Counter

A Channel Data Buffer

The channel data buffer (CDB) stores the data being transferred between the main storage section and a channel data register located in the interface controller section. CDB has two array cards: one on 01AA1E2 for even bytes and the other on 01AA1D2 for odd bytes. The channel data buffer has six sections, one for each channel. Each section can hold up to 256 bytes. Data enters CDB from either the channel-in register or the data buffer data register. Data leaves CDB by either the channel-out register or the data buffer data register. The CDB is addressed by the storage data buffer address register (SDBAR) for data transfers with the main storage section, and by bytes 3 and 3'(3 prime) of the channel control array register 2 (CCAR 2) for data transfers with a channel data register, located in the interface controller section. See *Channel Data Buffer Section Data Flow Diagram* and the *4341 Processor Data Flow Diagram*.

B Channel-In and Channel-Out Registers

The channel-in and channel-out registers are two-byte registers that transfer data between I/O devices and the channel data buffer. They are on 01AA1D2 and E2, one byte per card. Byte 0 (the even byte) of these registers is on the even array card of the CDB. Byte 1 (the odd byte) is on the odd array card of the CDB. Data enters the channel-in register through the interface controller and is written into the CDB. Data enters the channel-out register from the CDB and is transferred to the interface controller.

C Data Buffer Data Register

The data buffer data register (DBDR), an eight-byte register, transfers data between the main storage section and the channel data buffer (CDB). DBDR is on 01AA1D2 and E2, four bytes per card. It has a direct data path to the byte shifter by a bidirectional bus. Data transferred between DBDR and the main storage section is aligned by the byte shifter if needed.

D Storage Data Buffer Address Register

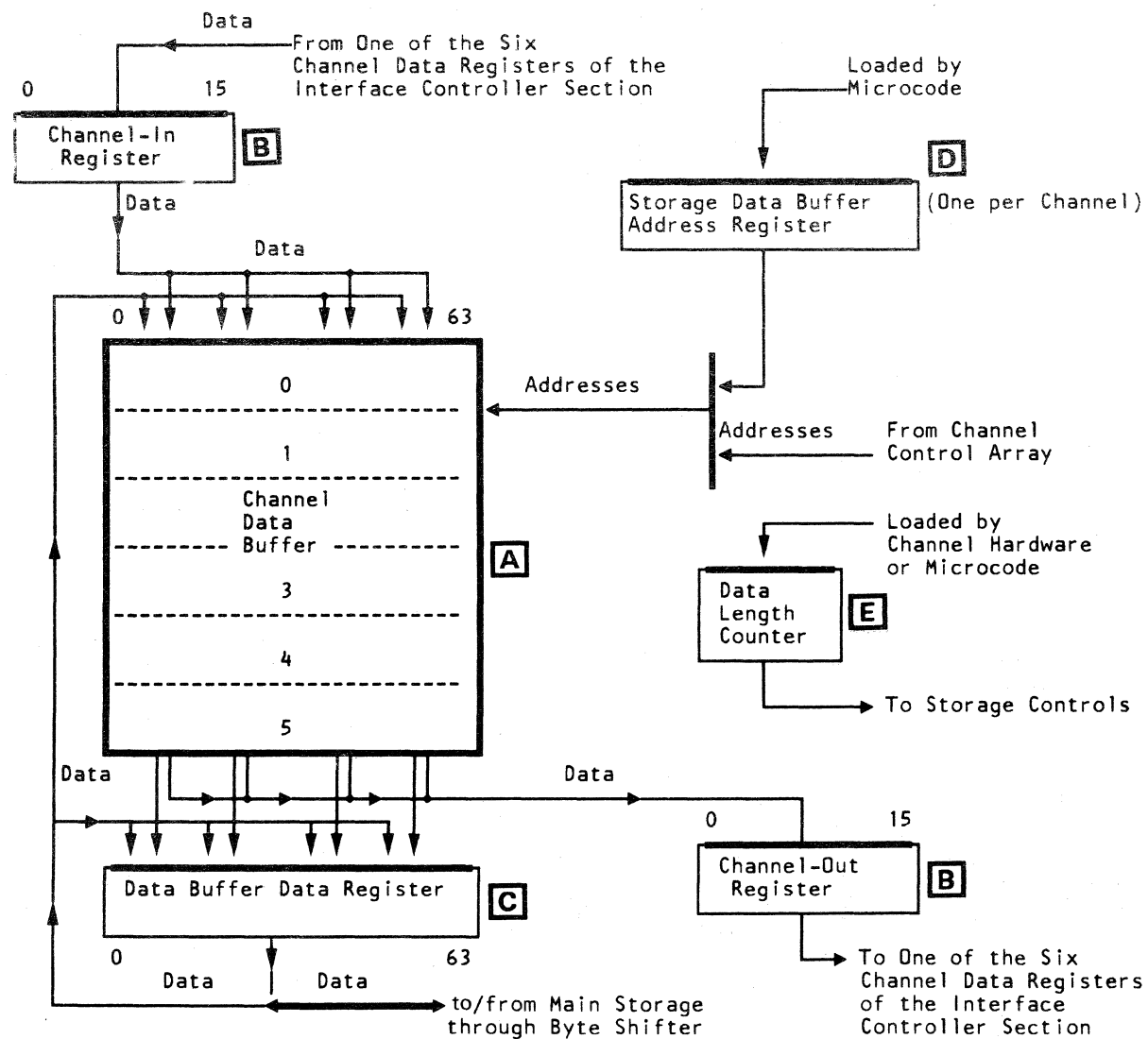
The storage data buffer address register (SDBAR), a one-byte register on 01AA1C2, specifies CDB doubleword locations when making data transfers with storage. Each channel has a SDBAR. Each SDBAR addresses a different section of the CDB. These registers are loaded by microcode through the destination (D) register of the instruction processor.

E Data Length Counter

The data length counter, a one-byte counter on 01AA1C2, keeps track of data transfers between the main storage section and the CDB. It is loaded by microcode or the channel hardware; as determined by the number of bytes to be transferred during a data trap. The count put into the counter is always equal to the number of bytes to be transferred. The storage hardware uses the count in the data length with the address in the channel storage address register to calculate the starting and ending addresses for all data transfers with the channel.

CHANNEL DATA BUFFER SECTION DATA FLOW DIAGRAM

Locations: 01AA1C2, D2, and E2



CHANNEL CONTROL SECTION

The channel control section, on 01AA1C2, controls and keeps track of all channel operations, such as:

- What steps remain in each channel operation.
- The operation done next by each channel.
- The order and frequency each channel is serviced by the CDB.

The control data comes from the channel hardware or microcode through the destination register (D-Register). This section includes:

- A** Channel Control Array
- B** Channel Control Array Register 1
- C** Channel Control Array Register 2
- D** Sync Registers
- E** Slot Rotor
- F** Multiple Decision Maker
- G** Command Register
- H** Asynchronous Command Register

A Channel Control Array

The channel control array (CCA), on 01AA1C2, stores the control data used by the channel hardware and microcode to control the channel operations. CCA operates in data mode and in sequence count mode. In data mode, one halfword combination is addressable. In sequence count mode, several halfword combinations are addressable. The CCA has six sections, one for each channel. The slot rotor determines the section of CCA to be addressed. CCA is first loaded by the channel hardware or microcode through the sync registers. Data entering CCA goes through the channel control array register 2 (CCAR2). Control data from CCA is to the channel control array register 1 (CCAR1).

B Channel Control Array Register 1

The channel control array register 1 (CCAR1), a four-byte register on 01AA1C2, holds CCA control data for inspection by MDM, and then returns the data to CCA. The control data is returned to CCA through CCAR2. Byte 3 of CCAR1 is changed into two bytes (bytes 3 and 3') and the extra byte is placed in the 3' byte position of CCAR2.

C Channel Control Array Register 2

The channel control array register 2 (CCAR2), a four-byte register on 01AA1C2, transfers control data into CCA. The control data in CCAR2 can be updated or changed by the channel hardware or microcode as it is stored in CCA. Microcode loads new control data into CCAR2 through the sync registers. Bytes 3 and 3' of CCAR2 are used as addresses to specify locations in the channel data buffer.

D Sync Registers

The sync registers, one-byte registers on 01AA1C2, transfer control data to CCAR2. These registers supply a control data link between the microcode and the channel hardware. The two sync registers are sync 0 and sync 1; see *Channel Control Section Data Flow Diagram*. They are loaded by microcode or the channel hardware.

E Slot Rotor

The slot rotor is logic circuits, on 01AA1C2, that permit all channels to share, in a set sequence, the circuits that are common to all channels. The slot rotor and the channel clock pulses supply the timing and gating necessary for each channel to use the common circuits and units of the channel hardware. The sequence that each channel may use the common circuits and units is preset in the slot rotor hardware.

F Multiple Decision Maker

The multiple decision maker (MDM), on 01AA1C2, is the channel hardware controller. The MDM inspects the control data transferred from CCA, the command registers, and from the interface controller before directing channel operations. The multiple decision maker also directs the interface adapter to activate or de-activate specific 370/Interface tag lines during initial selection and status handling.

G Command Registers

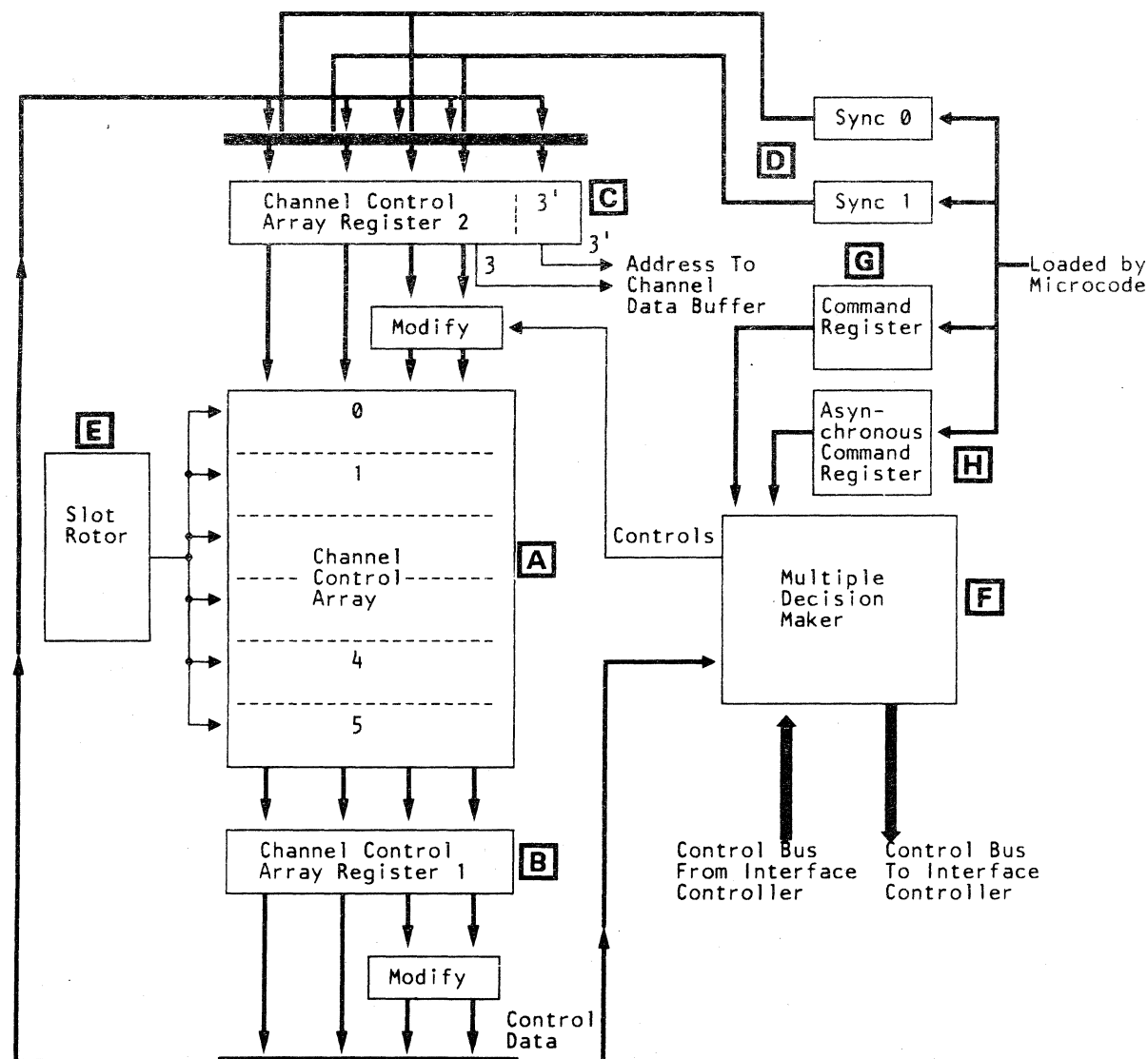
The command registers, one-byte registers on 01AA1C2, transfer channel commands to MDM. Each channel has a separate command register that is loaded by microcode to inform the channel hardware of what the channel should be doing. The contents is inspected by MDM.

H Asynchronous Command Register

The asynchronous command register, a one-byte register on 01AA1C2, transfers channel commands to MDM. The asynchronous command register is shared by all channels. It is loaded by microcode with commands that start, stop, or change an operation for a channel. The content is inspected by MDM.

CHANNEL CONTROL SECTION DATA FLOW DIAGRAM

Locations: 01AA1C2



1957
1958
1959



MAINTENANCE AND SUPPORT SUBSYSTEM

The hardware of the maintenance and support subsystem (MSS) is on 01AA2 K4, L2, M2, N2, P2 and 01AB2 C2 through M2*, R2, S2, T2, U2.

The MSS includes:

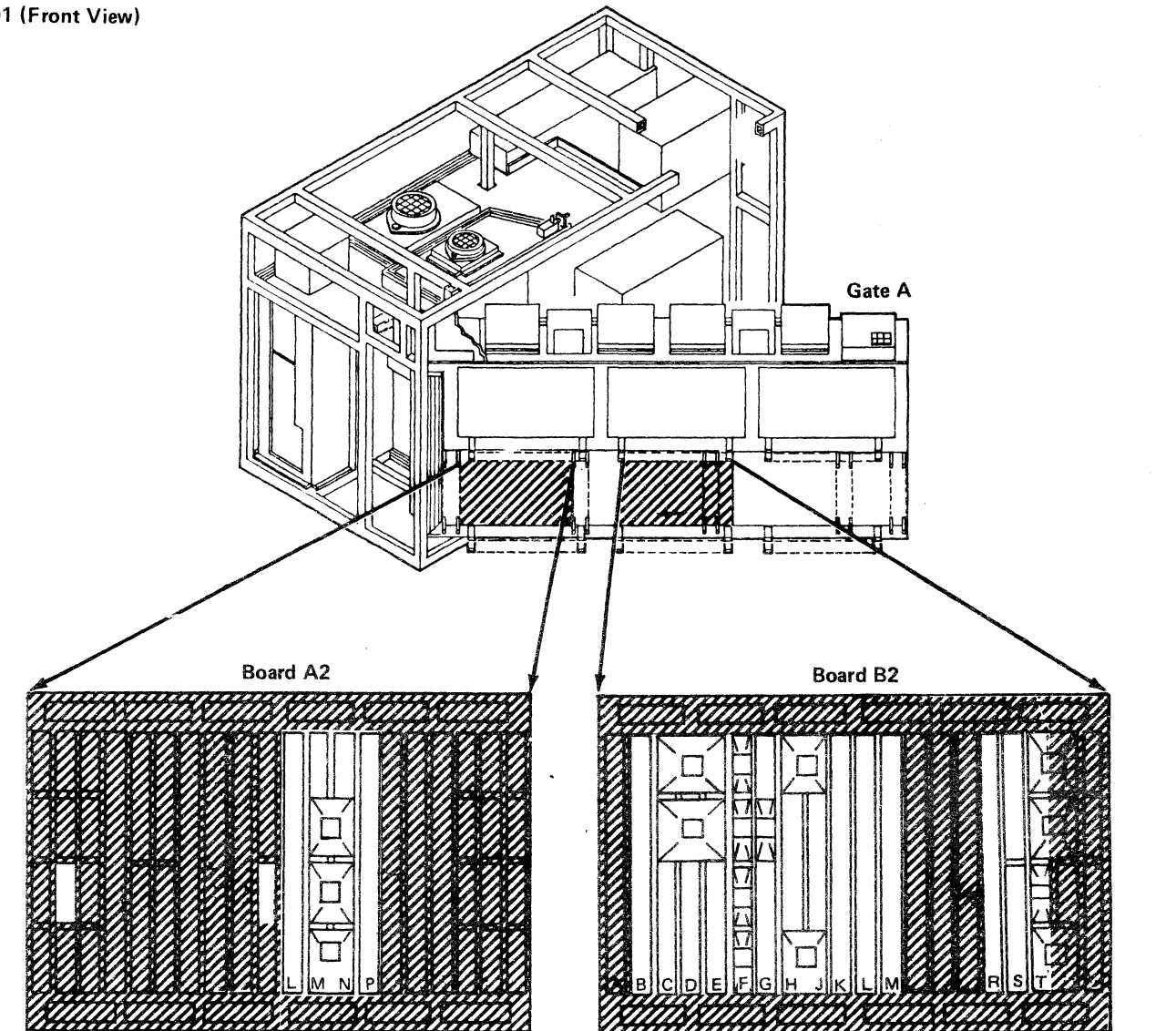
- Support Processor
- Diskette Drive Adapter
- Device Cluster Adapter
- Power Controller Adapter
- Local Channel Adapter
- Support Bus Adapter
- Support Control Logic Adapter
- Remote Support Facility

Maintenance Procedure

- Diagnostic tests detect and isolate 4341 Processor failures:
 - MSS diagnostics contained in the support processor read-only storage (SP ROS) and on the functional diskette are automatically invoked during IML or re-IML sequences, and when you power on the support processor.
 - More tests for the MSS are available on the DIAG4 diagnostic diskette.
- MSS failures that occur during normal customer operations are logged, when possible, for analysis.

* Support Processor Storage
(64-KB card) L2 only
(32-KB card) L2 and M2

FRAME 01 (Front View)



Local Channel Adapter
Locations: M2, N2, P2

RSF Adapter
Locations: B4, K4, L2

Power Controller Adapter
Locations: C2, D2, E2

Support Control Logic Adapter
Location: F2

Support Bus Adapter
Location: G2

Support Processor
Locations: H2, J2, K2

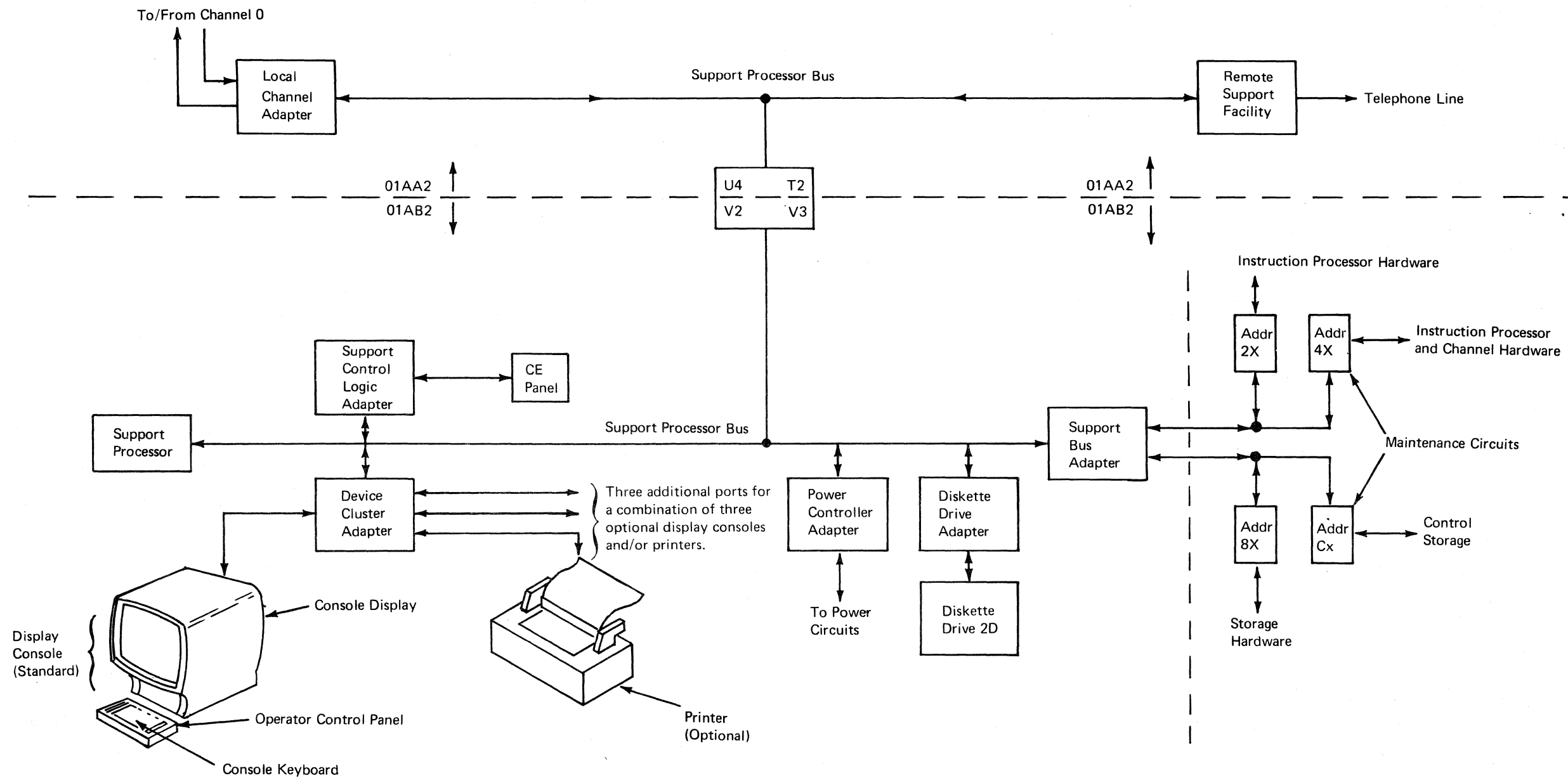
Support Processor Storage
Locations: L2, M2 *

Device Cluster Adapter
Locations: R2, S2

Diskette Drive Adapter
Location: T2, U2

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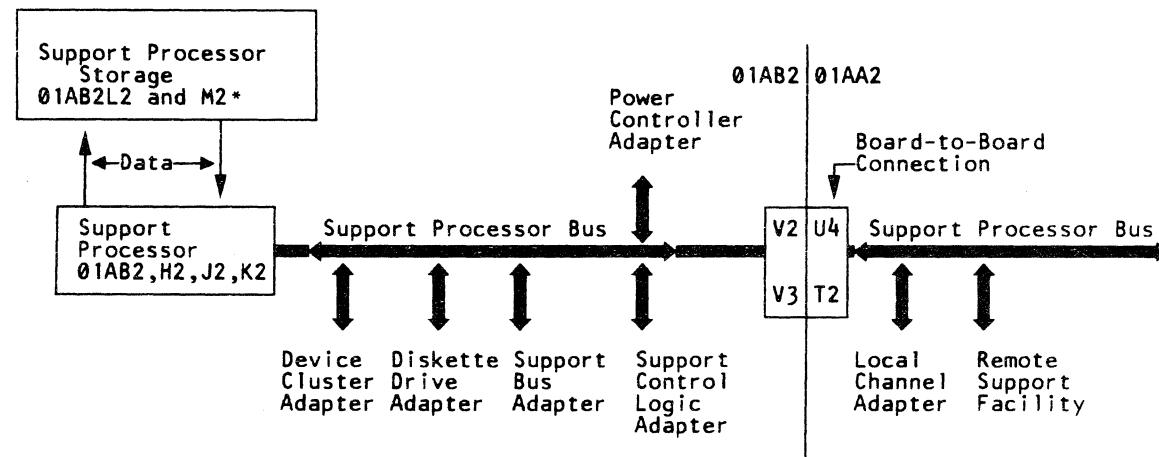
MAINTENANCE AND SUPPORT SUBSYSTEM BLOCK DIAGRAM



SUPPORT PROCESSOR

The support processor (SP) is an interrupt-driven controller, with eight levels of interrupts. For interrupt descriptions, see "Support Processor Interrupts," page 34 120. The SP is on 01AB2H2, J2, and K2. The support processor communicates with devices and the remainder of the 4341 processor through seven adapters. See "Maintenance and Support Subsystem Block Diagram," page 34 110. Data and commands are transferred on the support processor bus between the SP and the adapters. Transfer of data and commands is executed in either normal I/O mode or in burst transfer mode. The data is transferred in either byte mode or halfword mode, depending on the operation.

SUPPORT PROCESSOR DATA FLOW DIAGRAM



Support Processor Storage

The support processor storage is 64K bytes, and is on 01AB2 L2 and M2*. The basic maintenance and support subsystem diagnostics and bootstrap routines are in the support processor, 2KB, read-only storage (ROS) at address locations X'1000' to X'17FF'. The remaining 62 KB of SP storage are read/write storage that contains resident routines, tables, adapter common adapter codes (CACs), and a transient area for application routines. The data in the read/write storage area is loaded from a diskette when called by other routines.

* Support Processor Storage
(64-KB card) L2 only
(32-KB card) L2 and M2

Support Processor Bus

The support processor bus is two bytes wide. The bytes are identified as *byte 0* and *byte 1*. Each byte has eight lines plus parity.

The SP bus enables the support processor to communicate, monitor, and control the functions of the attached adapters and devices. The SP bus also enables the support processor to monitor and respond to conditions of the 4341 Processor environment. The internal prewired address(es) of the adapters attached to the SP bus are:

Adapter	Address(es)	Interrupt Level
DDA	11	5
DCA	02,0A,12,1A	4
SCL	17	0
PCA	85	0
SBA	87	1
LCA	25	2
RSF	24	3

The support processor transfers adapter addresses, adapter commands, burst mode commands, and data on the SP bus to the adapters during I/O operations. The SP bus is controlled by the SP when transferring information and data during operations. The SP bus is controlled by the adapters in read operations for transfers of burst mode commands and data.

Support Processor Interrupts

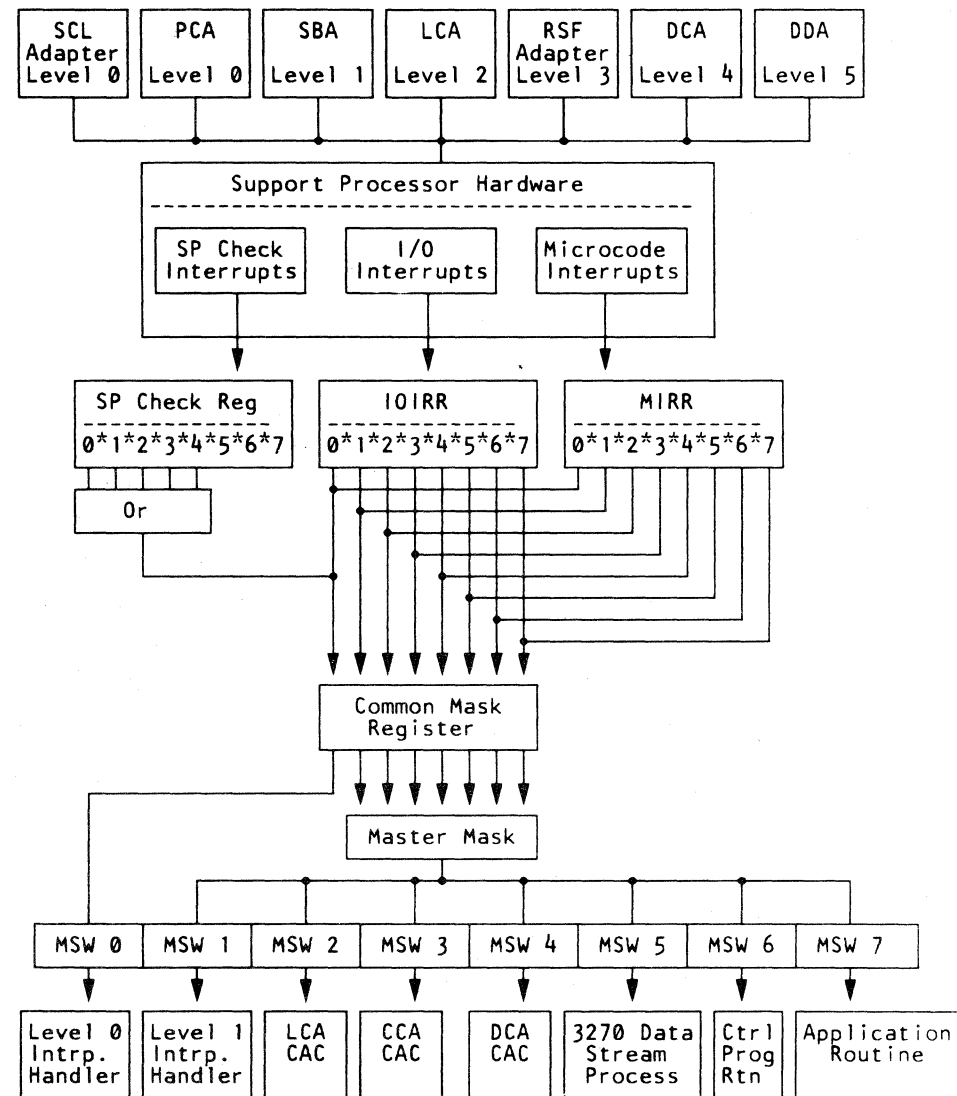
The support processor has eight levels of interrupts (0 to 7). See "Interrupt Table", and "Interrupt Data Flow." Associated with each interrupt level is a microcode status word (MSW). The MSW contains the SP storage address where the instruction processing starts for that interrupt level. The address is in bits 0 through 15 of the MSW.

The adapters use byte 1 of the SP bus during non-I/O operation time. Byte 1 of the SP bus is used to transfer the I/O interrupt requests to the SP.

INTERRUPT TABLE

Interrupt Level	Hardware Interrupt	Program(s) Invoked
Level 0	<ul style="list-style-type: none"> • SP/Check • SCL • PCA 	<ul style="list-style-type: none"> • Power Interrupt Detection • SP Error Handler • SP Trace
Level 1	<ul style="list-style-type: none"> • SBA 	<ul style="list-style-type: none"> • Power Interrupt Handler (Power Monitoring) • Level 1 Interrupt Handler • SBA CAC
Level 2	<ul style="list-style-type: none"> • LCA 	<ul style="list-style-type: none"> • LCA CAC
Level 3	<ul style="list-style-type: none"> • RSF Adapter 	<ul style="list-style-type: none"> • Remote Console Support Program
Level 4	<ul style="list-style-type: none"> • DCA 	<ul style="list-style-type: none"> • DCA CAC
Level 5	<ul style="list-style-type: none"> • Diskette (DDA) 	<ul style="list-style-type: none"> • DCA Data Stream Processing • DDA CAC
Level 6	None	<ul style="list-style-type: none"> • Power Monitoring Program • SP Control Program
Level 7	None	<ul style="list-style-type: none"> • Application Programs

INTERRUPT DATA FLOW DIAGRAM



Support Processor Registers

The support processor registers are used to hold the functional status of the SP. You can display the contents of most these registers on your display console. For more information on how to display these registers, see section 38, "Processor Logs.") The three SP registers are:

- SP Check Register (SPCK)
- Microcode Interrupt Request Register (MIRR)
- I/O Interrupt Request Register (IOIRR)

SP Check Register

The SP check register is eight-bits wide with the following bit definitions:

Inbound Parity Error (Bit-0): An inbound parity error occurred during a read I/O operation, and was detected in the SP.

I/O Timeout (Bit-1): An I/O timeout occurred because a tag response was not received as expected.

Storage Parity (Bit-2): A parity error was detected when data was read from SP storage.

Code Check (Bit-3): An invalid instruction was attempted, or an invalid address was read.

Internal (Bit-4): An error occurred that caused one of the SP check register bits (0, 1, 2, or 3) to be set.

Modifier Latch (Bit-6): If bit-6 is on, the instruction counter contains the address where the error occurred. If bit-6 is off, the error occurred during instruction execution. The instruction counter minus two is the address that points to the instruction error.

Microcode Interrupt Request Register

The microcode interrupt request register (MIRR) has eight latches that are used by the support processor microcode when changing from one interrupt level to another. During SP operations, the MIRR aids the SP microcode to transfer between application routines, SP control routines, or common adapter code functional requests.

I/O Interrupt Request Register

The I/O interrupt request register (IOIRR) identifies the interrupt levels that can be requested by each adapter. The adapter interrupt levels are:

Levels	Adapters
0	Support Control Logic Adapter
0	Power Controller Adapter
1	Support Bus Adapter
2	Local Channel Adapter
3	Common Communications Adapter
4	Device Cluster Adapter
5	Diskette Drive Adapter

DISKETTE DRIVE ADAPTER

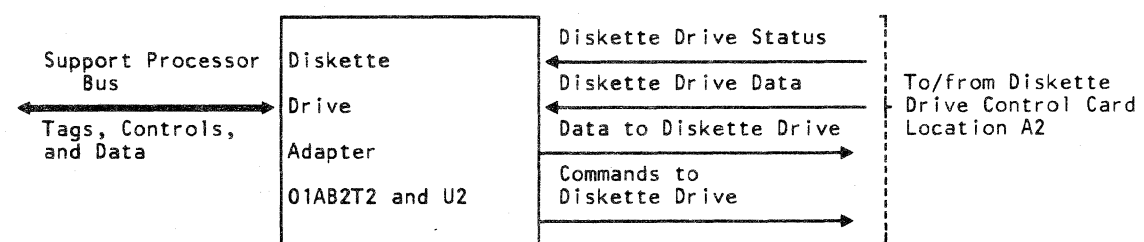
The diskette drive adapter (DDA) is a byte adapter, on 01AB2T2, and U2. The DDA is attached to the SP bus at the prewired address of hex 11 and interrupt level of 5.

The DDA is the communications path between the SP and the diskette drive 2D (53FD). The diskette drive adapter controls the functions of the 53FD. The basic functions performed are:

- Engage the 53FD heads.
- Seek on the diskette tracks.
- Read from the diskette.
- Write to the diskette.

Microcode for initializing the SP and instruction processor is transferred through this adapter. The adapter must activate its interrupt request line to transfer information. Any data, routines, commands, or codes that are requested from a diskette 2D is controlled by, and transferred through, the diskette drive adapter. This adapter also has a temporary storage area for information being transferred between the SP and the 53FD.

DISKETTE DRIVE ADAPTER DATA FLOW DIAGRAM



Note: Cable leaves card T2 at position Y6.

Diskette Drive Adapter Status

The DDA status is in the *Disk* status byte. For information on how to display this status, see section 38, "Processor Logs."

Diskette Drive Adapter Disk Status Byte

The DDA *Disk* status byte contains the error status (bits 0 and 1), the operation status (bits 2, 3, and 4) and the operation condition (bits 5, 6 and 7) of the DDA and the 53FD. See "Disk Status Byte."

DISK STATUS BYTE

Disk Status Byte

0	1	2	3	4	5	6	7
---	---	---	---	---	---	---	---

Error Status (Bits 0 and 1)

Value	Meaning
00	No Error
01	CRC Error
10	Command Reject
11	Hardware Error

Op Status (Bits 2, 3, and 4)

Value	Meaning
000	Op Complete
001	Control Complete
010	Echo Write Check
011	Busy
100	Overrun
101	Timeout
110	Record Not Found
111	Diskette Not Ready

Operating Conditions (Bits 5, 6, and 7)

Value	Meaning
001	Interrupt Pending
010	Adapter Enable
100	SP Check

Error Status (Bits 0,1)

The error status indicates the error type that occurred:

Cyclic Redundancy Check (CRC) Error (error status 01) indicates that the CRC bits that represent a record do not compare with the CRC bits generated for that record.

Command Reject (error status 10) occurs if the support processor attempts to execute an I/O command while the op status indicates a busy condition. This condition also occurs if the SP attempts to execute an invalid I/O command.

Hardware Error (error status 11) indicates that an SP error or a DDA error occurred.

Op Status (Bits 2, 3, 4)

The Op status represents the present condition of the DDA hardware. The OP status is changed at the start of each DDA operation.

If the Op status bits are set other than 000 or 001, the error condition is logged.

Op Complete (Op status 000) indicates that the hardware is not executing op codes.

Control Complete (Op status 001) indicates that a read sector was completed and a control record was read.

Echo Write Check (Op status 010) indicates that, during a write operation to the 53FD, the data transmitted was not received.

Busy (Op status 011) indicates that, while operating with the 53FD, the DDA cannot accept commands from the support processor. Busy remains on until the operation is complete or an error occurs.

Overrun (Op status 100) indicates that, during multisector mode, the SP and SP buffer are busy.

Timeout (Op status 101) indicates that a read/write record, read ID, read-back check, or write track operation was started but not completed in 26 revolutions.

Record Not Found (Op status 110) indicates that the record number register and the record number byte from the ID field of a record did not compare. This condition ends the operation.

Diskette Not Ready (Op status 111) indicates that the hardware detected that the index pulses from the 53FD are not coming on time. This condition ends the 53FD operation.

Operation Condition (Bits 5, 6, and 7)

SP Check (Bit-5), when active, indicates that an error occurred during communication between the SP and the DDA.

Adapter Enable (Bit-6), when active, indicates that channel requests and I/O interrupt signals are accepted by the support processor. If this bit is off, no interrupt signals are accepted by the SP.

Interrupt Pending (Bit-7) is activated when:

- An error status indication is active.
- The op status is out of the busy condition.
- The op status is out of the diskette-not-ready condition.
- The program attempts to execute a seek diskette or data operation in diskette-not-ready condition.
- A *Halt* becomes active while the adapter is communicating with the SP.

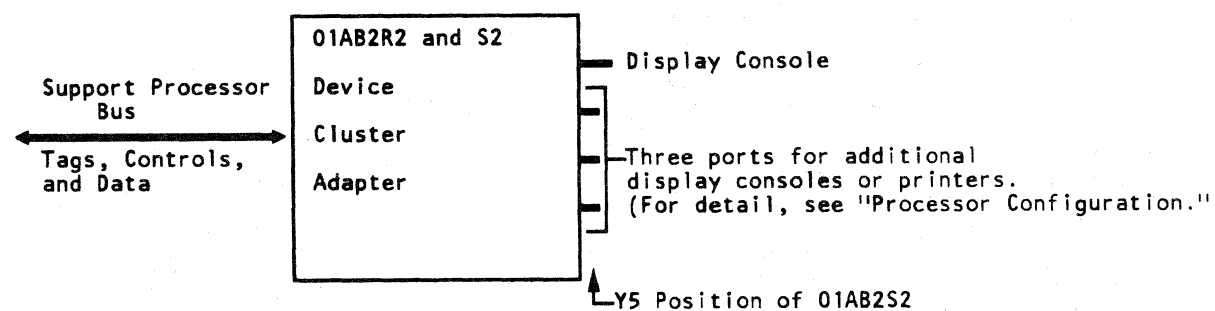
If this bit and the enable adapter bit (bit-6) are on, an interrupt is presented to the SP on the interrupt request line.

DEVICE CLUSTER ADAPTER

The device cluster adapter (DCA) is a halfword burst mode adapter, on 01AB2R2 and S2. The DCA has four ports at the Y5 position of 01AB2S2, to attach four devices (any combination of display consoles and/or printers as outlined in the processor configuration). The DCA has four prewired addresses (02, 0A, 12, and 1A) that are attached to the SP bus.

The DCA is the communication link between the support processor and the display console(s) and printer(s). Communication between the SP and the DCA is on the SP bus either by programmed I/O commands or by burst mode transfers. The DCA hardware automatically polls all attached console displays for data input or errors. The DCA activates its interrupt request level of 4 to byte-1 of the SP bus when it needs the service of the SP. The SP then services the DCA and resets the interrupt level.

DEVICE CLUSTER ADAPTER DATA FLOW DIAGRAM



DCA Operating Conditions

The device cluster adapter has three operating conditions:

1. Enabled nonactive
2. Enabled active
3. Disabled.

Enable Nonactive is the normal operating condition of the device cluster adapter. In this condition the DCA polls its attached devices and transfers their responses to a queue in SP storage.

Enable Active is the operating condition of the DCA when executing commands from the command queue.

Disabled is used by the support processor to set up the 4341 Processor during IML and to recover from a 4341 Processor error. When the disabled operating condition exists, the DCA cannot interrupt the SP or execute burst mode operations, and the DCA devices cannot be serviced by the SP.

Device Cluster Adapter Status

The DCA status is contained in two bytes. Byte 0 contains the extended status, and byte 1 contains the basic status. To display this status, see section 38, "Processor Logs."

Byte 1 (Basic Status)

Ext Stat Set	CMD CPLT	DCA Active	Key Or Stat Entry	Not Used	Mach CHK	ENB/DIS	Intrpt
0	1	2	3	4	5	6	7

Byte 0 (Extended Status)

Over 63	Read Time Out	TTAR Error Or RD LN Parity	Read Data Poll Par Error	Stop Poll	Timer	Error Q Entry	Not Used
0	1	2	3	4	5	6	7

Basic Status Byte

Extended Status Set (Bit-0), when active, indicates that one or more bits of the extended status register have been set. An exception to this is the bit-4 (stop poll).

Command Complete (Bit-1), when active, indicates that a command was just completed.

DCA Active (Bit-2), when active, indicates that the DCA is executing commands.

Keystroke or Status Queue Entry (Bit-3), when active, indicates that a keystroke or status queue entry was transferred to SP storage.

SP Machine Check (Bit-5), when active, indicates that a hardware failure occurred or an invalid command was detected.

Interrupt Enable (Bit-6), when active, indicates that the DCA can cause an I/O interrupt to the SP.

Interrupt (Bit-7), when active, indicates that the DCA is requesting interrupt action from the SP.

Extended Status (Byte 0)

Over 63 (Bit-0) is set by the DCA to indicate that the *over 63* counter has reached a count of 63.

Read Timeout (Bit-1), when active, indicates that no response was received from a Read command.

Read Line Parity (Bit-2), when active, indicates that the DCA detected a bad parity on a device's coax cable resulting from a Read command. It is also set on a bad TTAR response to a DCA Write command.

Read Data Byte Parity (Bit-3), when active, indicates that a data parity error was detected during a coax read response to a Read command.

Stop Poll (Bit-4), when active, indicates that the DCA has stopped polling.

Timer (Bit-5), when active, indicates to the SP that a minimum of one second has passed from the last timer status indication.

Error Queue Entry (Bit-6) indicate that an error status is being transferred to the error queue.

POWER CONTROLLER ADAPTER

The power controller adapter (PCA) is a one-byte asynchronous adapter that operates in single-byte mode. It is on 01AB2C2, D2, and E2. The PCA is attached to the SP bus and has a prewired address of hex 85 and an interrupt level of 0.

The PCA is a two-way communication link between the power and environmental subsystem and the maintenance and support subsystem. It operates in either interrupt or polling mode depending on the type of data being executed. As commanded by the SP, the PCA controls power-on/off sequencing, monitors voltage and current overloading conditions, and monitors thermal, airflow, and electrostatic discharge (ESD) sensors located throughout the 4341 Processor.

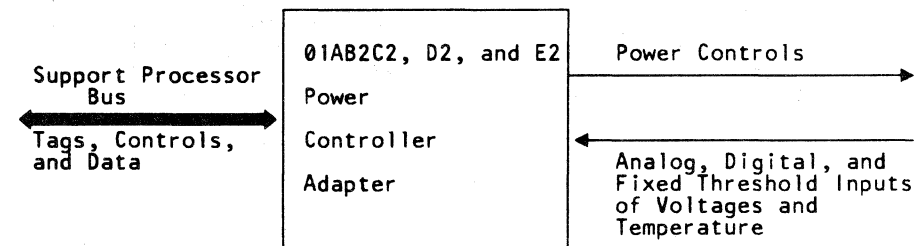
The PCA is checked by diagnostics that are automatically invoked during the IML process.

The PCA contains a card (01AB2E2) that performs SP bus addressing and tag functions, command decodes, interrupt generations, parity generation and checking, and basic status functions.

The PCA contains sensing logic (01AB2C2 and D2) that performs control functions, and digital and analog sensing. The sense cards contain an eight-bit digital-to-analog converter (DAC) that permits voltage and temperature monitoring and measurement with an accuracy of ± 1 percent.

For detailed information on the power controller adapter and its functions, see "4341 Processor Power."

POWER CONTROLLER ADAPTER DATA FLOW DIAGRAM



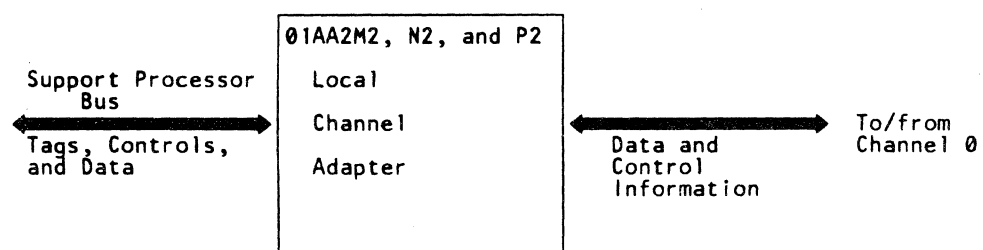
LOCAL CHANNEL ADAPTER

The local channel adapter (LCA) is a burst mode adapter, on 01AA2M2, N2, and P2. The LCA is attached to the SP bus at a prewired address of hex 25 and an interrupt level of 2.

The LCA is a high-speed path between MSS and the channels, instruction processor, and storage hardware, for blocks of data or control information. It connects channel 0 to the SP bus. The LCA takes multiple device addresses and responds to sequences requested by a channel.

LCA functions can be requested by I/O devices attached to an SP adapter or by an application routine using the SIGP and SIGM SPIL commands. A device connected to an SP adapter can request an LCA function when it has data, commands, or status to transfer or to receive between the channels, instruction processor, or storage hardware. Application routines can request an LCA function when a routine transfers or receives data between the channel hardware, instruction processor, or storage.

LOCAL CHANNEL ADAPTER DATA FLOW DIAGRAM



Local Channel Adapter Status

The LCA status is contained in three bytes: the adapter status (byte-0), the basic status (byte-1), and the extended status (byte-2). These bytes indicate the operating conditions of the LCA. When any bit of the three status bytes is set, an I/O interrupt is sent to the SP. For LCA bit definitions and how to display the status, see section 38, "Processor Logs."

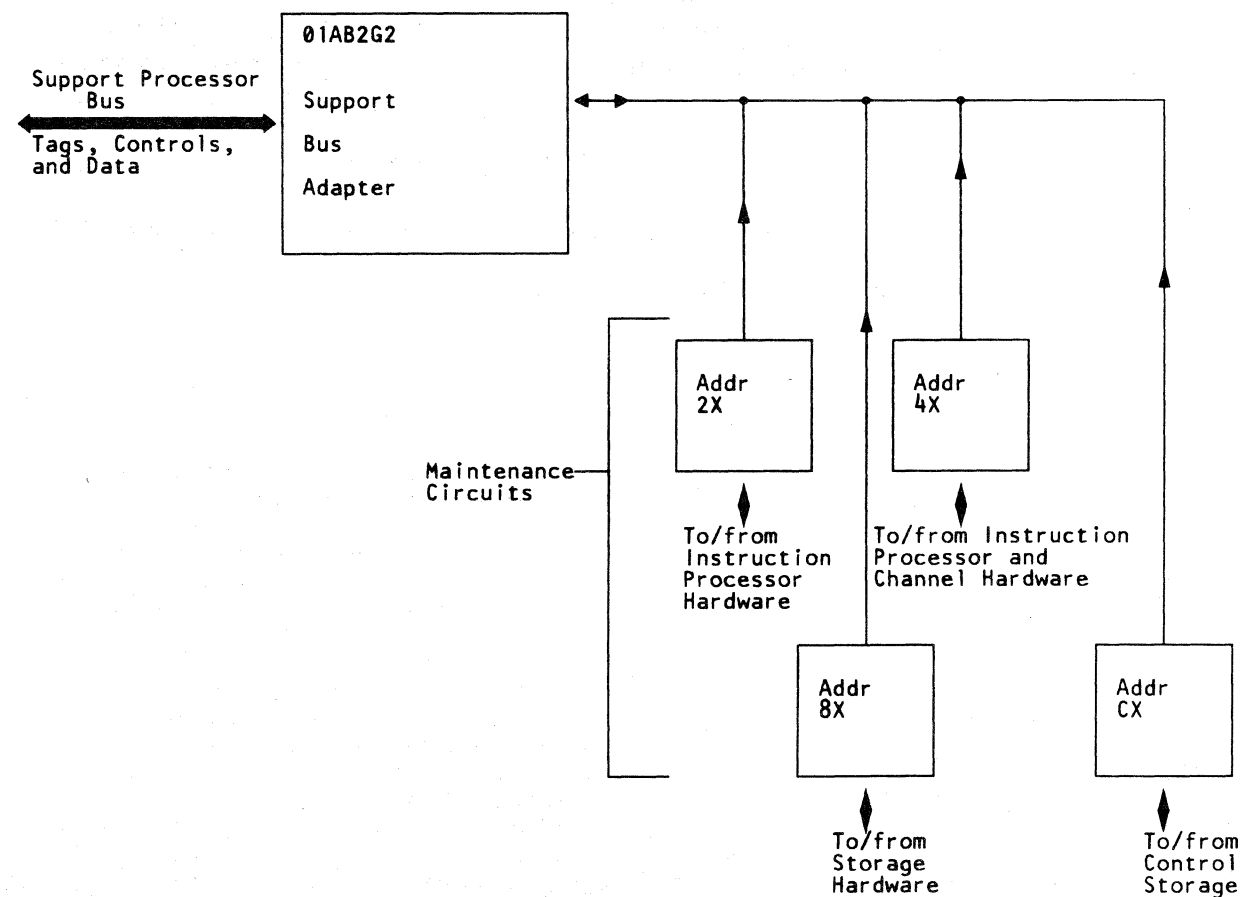
SUPPORT BUS ADAPTER

The support bus adapter (SBA) is a halfword adapter, on 01AB2G2. The SBA is attached to the SP bus at a prewired address of hex 87 and has an interrupt level of 1. The SBA does the read/write functions of the scan rings in the channels, instruction processor, and storage hardware. This is done through the maintenance circuits. See "Support Bus Adapter Data Flow diagram." Other functions of the SBA are:

- Controls hardware communications between the SP and the channels, instruction processor, and storage.
- Transfers an interrupt to the power monitor microcode routine every 256 ms for the microcode to monitor the power environment.
- Controls the following OCP functions:
 - SYSTEM indicator
 - WAIT indicator
 - LAMP TEST switch.

For SBA status bit definitions and how to display the SBA status, see section 38, "Processor Logs."

SUPPORT BUS ADAPTER DATA FLOW DIAGRAM



SUPPORT CONTROL LOGIC ADAPTER

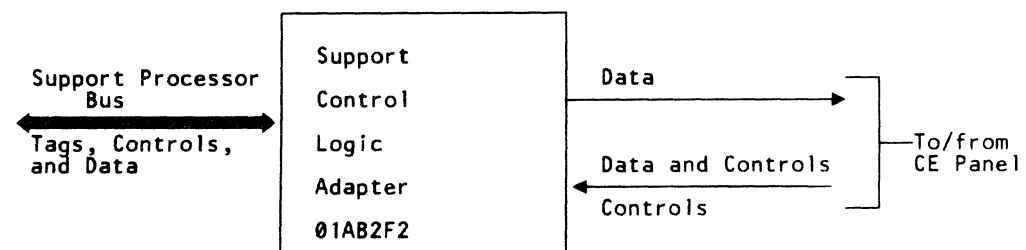
The support control logic adapter (SCL) is a byte adapter, on 01AB2F2. The SCL is attached to the SP bus at a prewired address of hex 17 and interrupt level of 0.

The SCL connects the CE panel to the SP bus. When activated at the CE panel, the SCL adapter performs the following functions:

- Invokes and leaves the SP trace functions.
- Transfers the current SP storage address to the CE panel.
- Transfers the stopword addresses to the CE panel.
- Re-IMLs the processor.
- Transfers the contents of the SCL status register.

For SCL status bit definitions and how to display the SCL status, see section 38, "Processor Logs."

SUPPORT CONTROL LOGIC ADAPTER DATA FLOW DIAGRAM



REMOTE SUPPORT FACILITY

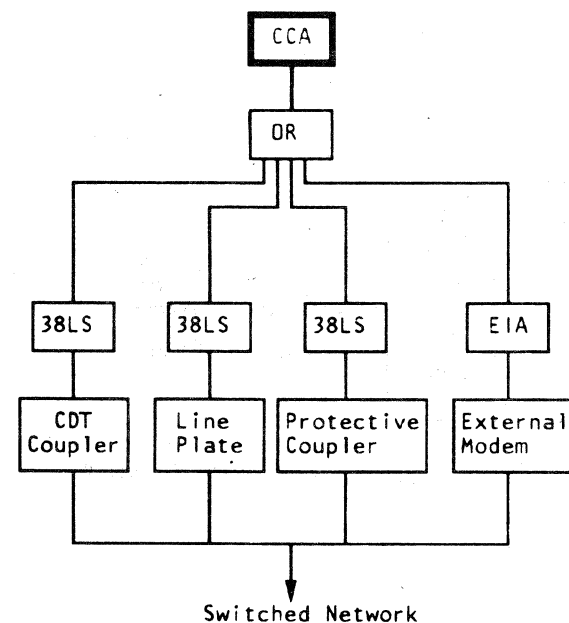
The Remote Support Facility (RSF) includes a Communication Common Adapter (CCA) and either an integrated modem (38LS) or an EIA converter. (See "RSF Configurations Diagram.") The RSF is on 01AA2L2 and K4.

The RSF links the display console to a support center or a data bank system for diagnostic aid. The RSF is for service usage, and is not a teleprocessing port.

The RSF enables a remote specialist to aid you in resolving a problem by observing and controlling all functions of the 4341 Processor except those that must be controlled by hand, such as power on/off, IML, and initial I/O control.

The 4341 has one of the configurations shown in "RSF Configurations Diagram." The configuration depends on the location and the features selected. The operation of the RSF is the same for all configurations.

RSF CONFIGURATIONS DIAGRAM



REMOTE OPERATOR CONSOLE FACILITY

The Remote Operator Console Facility (ROCF) uses the Remote Support Facility to link a remote 4341 Processor to a host console through a standard communication network.

When a remote 4341 system is properly equipped with an auto-answer modem, personnel at a host site can dial-up and take control of the remote 4341 (password checking ensures proper access).

The host console performs most of the 4341 Processor functions, except power on, which is done at the remote 4341.

Communications Common Adapter

The communications common adapter (CCA) is a byte adapter, on 01AA2L2. The CCA is attached to the SP bus at a prewired address of hex 24 and interrupt level of 3. The CCA performs these functions:

- Serialize/deserialize conversion
- Buffers one byte of input or output data
- Controls the bit timing of the data going through it
- Controls the data communications equipment.

Communications Common Adapter Status

The status of the CCA is in three bytes: the basic status, the adapter status, and the modem status. For information on how to display this status see section 38, "Processor Logs."

Basic Status

The bit definitions of the basic status register are:

Input Request (Bit-0), when active, indicates that the CCA has received a byte of data and is ready to send it to the SP.

Output Request (Bit-1), when active, indicates that the CCA is ready to transmit a byte of data.

Data Communications Equipment Interrupt (Bit-2), when active, indicates that the condition of bit-0, 1, or 2 of the data communications equipment (DCE) status register has changed, or that bit-3 of the DCE status register was activated.

Timer Interrupt (Bit-3), when active, indicates that the Interval Timer has returned to zero from its set value.

Exception (Bit-4), when active, indicates that one or more of the adapter status register bits (except bit-7) were set.

SP Machine Check (Bit-5) is set when the CCA detects that the SP is going to interrupt at a level 0.

Interrupt Enabled (Bit-6), when active, permits CCA to cause I/O interrupts.

Interrupt Request (Bit-7), when active, indicates that one or more interrupt request are waiting.

Adapter Status

The bit definitions of the adapter status register are:

Overrun (Bit-0) is set when a new byte of data is received by the CCA before the SP has read the preceding byte.

Underrun (Bit-1) is set when the CCA attempts to transmit a byte of data, but has no data from the SP to transmit.

Receive Clock Running (Bit-2) is always off when the operation is synchronous.

Adapter in Sync (Bit-7), when active, indicates that CCA is synchronized.

Modem Status

The bit definitions of the modem status (which indicates the status of the DCE) are:

Data Set Ready (Bit-0) indicates the 0 or 1 condition of the Data Set Ready line.

Clear to Send (Bit-1) indicates the 0 or 1 condition of the Clear to Send line.

Data Carrier Detect (Bit-2) indicates the 0 or 1 condition of the Data Carrier Detect line.

Ring Indicator (Bit-3) indicates the 0 or 1 condition of the Ring Ind line, which also causes an interrupt request to the SP.

Data Set Ready Transition (Bit-4), when active, causes an interrupt request to the SP.

Data Carrier Detect Transition (Bit-6), when active, causes an interrupt request to the SP.

Clear to Send Transition (Bit-7), when active, causes an interrupt request to the SP.

38LS Modem

The 38LS modem converts a two-level business machine signal into a signal that can be transmitted over a voice grade telephone channel. It is on 01AA2K4 (if the 38LS is specified for the machine configuration). This modem can operate on switched and nonswitched voice grade communications equipment. The modem handles the information serially.

EIA Signal Level Converter

The EIA signal level converter converts business machine signal levels to and from external modem signal levels. It is on 01AA2K4 (if the EIA is specified for the machine configuration). Eight business-machine-to-modem drivers, and eight modem-to-business-machine receivers are included.

SERIAL NUMBER CARD

The serial number card, on 01AB2S4, contains a hardwired representation of the three low-order digits of a six-digit machine serial number.

During initial microcode load (IML), the three digits of this card are compared with the three low-order digits of the machine serial number. The machine serial number is preset on the 4341 diskette.

If the numbers compare, the IML process is continued. If the numbers do not compare, the IML process stops, and a message is posted on the display console.

For more information, see "MSS Service Aids," in Volume 13.

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Model Groups 1 and 2

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INTRODUCTION

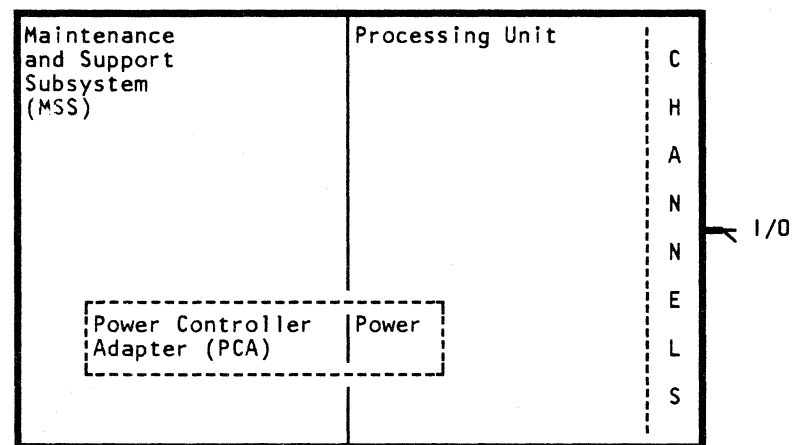
This section contains information on the IBM 4341 Processor diagnostic tests only. For information on ST4300, 4300-FRIEND, the online test system (OLTS), and the online test executive program (OLTEP), see the "System Tests" section. For information on the channel-to-channel adapter (CTCA), see the "Features" section. For information on Problem Analysis, see "Volume 13/16, Section 14, Problem Analysis."

The IBM 4341 Processor has a maintenance and support subsystem (MSS) and a processing unit (see the diagram on this page). Input/output devices are attached to 4341 channels. A power controller adapter (PCA) in the MSS controls processing unit power.

Diagnostic routines and procedures are available for isolating failures in each of these areas. Much of the failure isolation is performed automatically by microcoded error analysis routines that run in both the MSS and in the processing unit. When automatic isolation of failures is not possible, additional diagnostic tests are available.

Repairs in the field are done by the service representative under the direction of Maintenance Analysis Procedures (MAPs). Start all calls at MAP 0000, Entry Point A.

4341 Processor



Maintenance and Support Subsystem (MSS)

- Diagnostic tests are used as the primary method for sensing and isolating failures in the MSS.
 - MSS diagnostic tests contained in the support processor read-only storage (SP ROS) and on the functional (FUNCT) diskette are automatically started during support processor (SP) power-on and re-IML sequences.
 - More complete testing of the MSS is available with tests that are contained on a diagnostic diskette (DIAG4).
- MSS failures that occur during normal customer operations are logged, when possible, for later analysis by the service representative.

Processing Unit Power

- The functional (FUNCT) diskette contains the complete set of power controller adapter (PCA) diagnostic tests. These tests run during normal support processor (SP) power-on sequences. Processing unit power is turned on automatically after the PCA diagnostic tests have run.
- A limited set of PCA diagnostic tests is contained on the DIAG4 diskette.
- Processing unit power is checked automatically by routines that run in the SP. Power log and analysis routines are started when failures are sensed.

Processing Unit

- Automatic error logging and error log analysis (ELA) routines are used as the primary method for isolating failures in the processing unit. These routines run in the support processor (SP) and assume that the MSS is operational.
- Processing unit diagnostics are available when ELA can not isolate the failure.

ERROR LOGGING

Machine status information is collected, formatted, and recorded in a log area on the diskette when a hardware failure or microcode error occurs. The log record is then analyzed automatically by error log analysis routines or manually by the service representative under the direction of MAPs.

Using the logged error data, error log analysis routines attempt to isolate the problem. The result of the analysis is a reference code that directs the service representative to a repair action via MAPs.

If the error analysis routines fail to isolate the problem, MAPs direct the service representative to display the log record for additional analysis.

The four types of logs are:

- Support processor
- Power
- Processing unit
- Reference code history

For information on how to display and print these logs and a description of each, see the "Processor Logs" section.

ERROR LOG ANALYSIS (ELA)

Processing unit error logs are automatically analyzed by error log analysis (ELA) routines. These routines isolate the failure to the smallest possible number of field replaceable units (FRUs). The result of the error log analysis is a reference code.

ELA:

- Is on the FUNCT and DIAG4 diskettes.
- Is requested automatically by error retry routines when a processing unit failure occurs during normal operation.
- Is requested automatically by the test case monitor (TCM) when a machine check occurs while running machine speed microdiagnostics (MSMDs).
- Runs in the support processor (SP).

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REFERENCE CODES

A reference code indicates that an error occurred. It is an eight-character (hex) number with a format of UURRRRIS.

- UU identifies the failing area of the machine.
- RRRR contains specific information about the failure. It is used differently by each of the reference code sources (as identified by the I-field).
- I identifies the source of the reference code.
- S contains status information about the failure.

In addition to the reference code, some reference code sources (identified by the I-field) add an eight-character (hex) reference code extension. This extension has no fixed format and is used to record failure-locating data in the reference code history log.

4341 PROCESSOR REFERENCE CODES

UU RRRR IS

Reference Field
-- No fixed format --

4341 Unit Codes (UU Field)

0x = No reference code on screen

00 = Introduction or entry to MAPs
02 = Hardwired sequence (HWS)
04 = SP IML problems
06 = Operator console failures
08 = MSS failure

1x = Power problem

10 = Hardwired sequence (HWS)
11 = Processing unit power
14 = Channel-to-channel adapter power
17 = I/O power interface
1E = EMC monitoring
1F = Undefined power problem

4x,5x,6x = Processing unit

See the processing unit UU-field definition chart.

For additional information on the processing unit subsystems, see the "General Description" and "Functional Units" sections.

Ex = System problem

EC = SP microcode
ED = LCA or channel 0
EE = Processing unit microcode

Fx = Maintenance and support subsystem (MSS)

F0 = SP bus and adapter interface
F1 = Support processor (SP)
F2 = Local channel adapter (LCA)
F3 = SCL adapter and CE panel
F4 = Diskette drive adapter (DDA)
F5 = Diskette drive
F6 = Power controller adapter (PCA)
F8 = Device cluster adapter (DCA)
F9 = Console display and keyboard
FA = Serial printer
FD = Support bus adapter (SBA)
FE = Common communications adapter (CCA)

Processing unit UU-field definition

A "UU" field of 4x, 5x, or 6x indicates that a failure is suspected in a processing unit subsystem, as shown in the following chart:

UU	CHL	CLK	PU1	PU2	CS	SC	STG
46	-	X	-	-	-	X	X
47	-	X	-	-	-	X	X
48	-	X	-	-	-	X	X
50	-	-	-	-	X	-	-
51	-	X	-	X	-	X	-
52	-	-	X	-	X	-	-
53	-	X	-	-	X	-	-
54	-	-	-	X	X	-	-
55	-	-	X	-	-	-	-
56	-	X	X	-	-	-	-
57	-	-	X	X	-	-	-
58	-	-	X	X	X	-	-
59	-	X	-	X	X	-	-
5A	-	X	-	X	-	-	-
5B	X	-	-	X	-	-	-
5C	-	-	-	X	-	-	-
5D	-	X	-	-	-	-	-
5E	X	-	X	X	-	X	-
5F	-	-	X	X	X	X	-
60	X	-	-	-	-	-	-
61	X	X	-	-	-	-	-
62	X	-	X	-	-	-	-
63	X	-	X	X	-	-	-
64	X	X	-	X	-	-	-
66	-	X	-	-	-	X	-
67	-	-	-	-	-	X	-
68	-	-	X	-	-	X	-
69	-	-	-	-	X	X	-
6A	X	-	-	X	-	X	-
6B	-	-	-	X	-	X	-
6C	X	-	X	-	-	X	-
6D	-	-	X	X	-	X	-
6E	-	-	-	X	X	X	-

The processing unit subsystems are:

CHL - Channel and channel interface adapter (IFA)
CLK - Clock
PU1 - Processing unit data flow
PU2 - Processing unit control
CS - Control storage
SC - Storage control
STG - Storage

Example: A UU of 51 indicates that a failure is suspected in one of the following processing unit subsystems: clock, processing unit data flow, or storage control.

4341 Indicator-Status Byte (IS Field)

Indicator (Bits 0-3 of IS Field)

0 = Power monitor
1 = SP check handler
2 = Any SP CAC or access method
3 = Processing unit IML routine
4 = Error logging or retry routine
5 = Processing unit microcode
6 = Any other SP microcode
8 = Basic diagnostic tests
9 = MSMD diagnostic tests
A = Error log analysis (ELA)
D = MSMD monitor
F = MSS diagnostics

Status (Bits 4-7 of IS Field)

Status	Bit 4 = 1 FRU Identified	Bit 5 = 1 Log Available	Bit 6 = 1 Unre- coverable
0	---	---	---
2	---	---	X
4	---	X	---
6	---	X	X
8	X	---	---
A	X	---	X
C	X	X	---
E	X	X	X

NOTE: Bit 7 is reserved.

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CODE ANALYSIS PROCESSOR (CAP)

The code analysis processor (CAP):

- Analyzes reference codes and displays a field replaceable unit (FRU) list and MAP name, or, may request that the processing unit maintenance algorithm (PUMA) be run. (This information is displayed on the console display as shown in the example to the right.)
- Is on the FUNCT and DIAG1 through DIAG4 diskettes.
- Executes in SP storage.
- Is automatically executed when failures are found by the processing unit diagnostics (Basics and MSMDs).
- Can be manually requested for analyzing other 4341 reference codes.

Manually Requesting CAP

To manually request CAP for analyzing any 4341 reference code:

1. Ensure that the diskette that issued the reference code is mounted. (See "CAP Tables.")
2. Set the CE switch (on the CE panel) ON.
3. Enter: QEI
The CAP INITIATOR screen is displayed.
4. Enter the reference code (and reference code extension, if available) when requested.

Example of screen that is displayed when CAP has been automatically requested while running processing unit diagnostics:

```
REFERENCE CODE = UURRRRIS
FLD = 01 03 09 0D

EXT = 02504400 ISOLATION  COMPLETE  INCOMPLETE  MAP=5040  DIAG EC=123456
                        FAILED      RUN PUMA

FRU LIST SUMMARY = A1B, A1C, A1BW

UURRRRIS 02504400
```

REFERENCE CODE and FLD are outputs of the testcase monitor (TCM) and are the data against which CAP runs.

EXT = Reference code extension supplied by CAP. This is normally used to identify the failing module on the card. However, if a failure occurs while running CAP, the first byte of the EXT field is an error code (see "CAP Error Codes").

ISOLATION COMPLETE = Exchange FRUs in the order given.

ISOLATION INCOMPLETE or FAILED = Run more tests or get aid from the FSC to isolate the problem.

MAP = or RUN PUMA Either identifies MAP to use to complete call, or directs you to run PUMA (see "How to Run PUMA").

DIAG EC = EC level of the CAP table.

FRU LIST = Exchange or check FRUs in the order given. The first two characters indicate the board. The third character indicates the card column location. For FRUs on the A1 and B1 boards, a fourth character indicates a top-card connector (W, X, Y, or Z). For FRUs on other boards, a fourth character indicates card row location (2 or 4).

SUMMARY = The "ISOLATION FAILED" message is displayed or a summary was requested from the CAP INITIATOR screen (UURRRRIS ALL was entered).

Note: When returning a defective processing unit card, provide the following information from the CAP display screen:

- a. Reference code extension (from the EXT field)
- b. EC level of the CAP table (from the DIAG EC field).

How To Run PUMA

To run PUMA:

1. Press and hold the ALT key and press the DIAG key. The diagnostic mode selection screen is displayed.
2. Press only the ENTER key to select PUMA. PUMA requests that the reference code be entered.
3. Enter the reference code and change diskettes when requested by PUMA.

CAP Tables

Reference codes and FRU lists are contained in CAP tables. Because of diskette space limitations, each diskette contains CAP tables for the reference codes that can be issued by the microcode on that diskette only.

CAP tables are identified as CFFx, where x = the I-field in the reference code (UURRRRIS).

Example: Reference code 5D15C088 is in CAP table CFF8.

CAP Error Codes

An "Ex" in the first byte of the CAP reference code extension (shown in the EXT field) indicates that a failure occurred while running CAP.

The error codes used by CAP are:

- E0 = Diskette seek error
- E1 = Diskette read error
- E2 = Correct CAP table not on the diskette
- E3 = Reference code not in the CAP table
- E4 = CAP table length not correct (probably an SP failure)
- E5 = CAP control error (probably an SP failure)
- E6 = CAP table error (probably an SP failure)
- E7 = Increment command issued to diskette drive before seek (probably an SP failure)
- E8 = Invalid reference code

For information about CAP error messages, see "Code Analysis Processor (CAP) Messages."

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4341 PROCESSOR DIAGNOSTIC TEST SUMMARY

	MAINTENANCE AND SUPPORT SUBSYSTEM (MSS)		PROCESSING UNIT	
Test Type	Basic MSS	Extended and Optional MSS	Basics	Machine Speed Microdiagnostics (MSMDs)
Where Located	Support processor read-only storage (SP ROS) FUNCT diskette DIAG4 diskette	DIAG4 diskette	DIAG1 diskette DIAG2 diskette DIAG3 diskette	DIAG4 diskette
Area Tested	Basic SP operations, the first 32K of SP storage, the SP bus, the DDA and diskette drive, and the DCA. Complete PCA tests are on the FUNCT diskette.	Except for the PCA, the extended and optional MSS diagnostic tests check the MSS more completely than the basic MSS diagnostic tests.	Test processing unit hardware via the SBA under control of the test case monitor (TCM).	Tests processing unit hardware at machine speed under control of the MSMD monitor which communicates with the test case monitor (TCM).
Where Tests Execute	Support processor (SP)	Support processor (SP)	Support processor (SP)	Processing unit
How Tests Are Started	Automatically during SP power-on or re-IML sequences.	Automatically after the tests in SP ROS have run.	From the Diagnostic Mode General Selection screen. (To get this screen, press ALT and DIAG together.)	From the Diagnostic Mode General Selection screen. (To get this screen, press ALT and DIAG together.)
How Failures Are Indicated	Stop words: All basic MSS tests <i>except</i> the PCA tests. Reference codes: The PCA tests.	Repair instructions and/or reference codes.	Reference codes. The code analysis processor (CAP) is called automatically.	Reference codes. The code analysis processor (CAP) is called automatically.

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MAINTENANCE AND SUPPORT SUBSYSTEM DIAGNOSTIC TESTS

Diagnostic tests are used as the primary method for isolating failures in the maintenance and support subsystem (MSS).

The two types of MSS diagnostic tests are:

- Basic MSS. These diagnostic tests are in support processor read-only storage (SP ROS), on the FUNCT diskette, and on the DIAG4 diskette.
- Extended and optional MSS. These diagnostic tests are on the DIAG4 diskette.

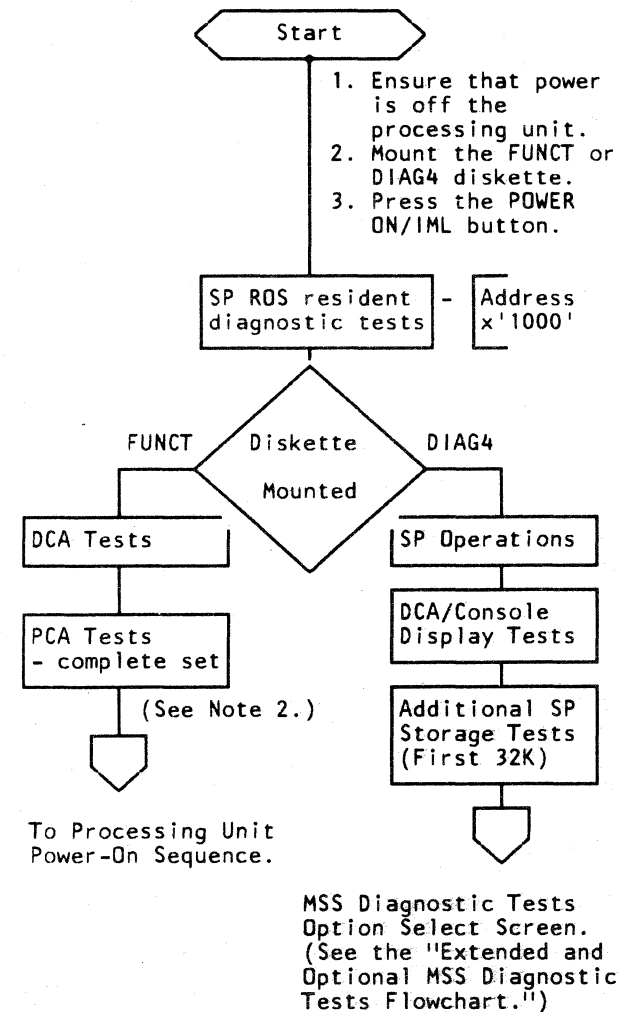
BASIC MSS DIAGNOSTIC TESTS

The basic MSS diagnostic tests verify the operation of the basic MSS and are executed automatically when the SP is powered on or re-IMLd.

Basic MSS Diagnostic Tests (Shown in run sequence)	Where Located	How Failures Are Indicated
SP Basic Operations SP Storage (First 32K) SP Bus DDA and Diskette Drive	SP ROS	Stop Words
DCA PCA (See Note 2)	FUNCT Diskette	See Note 1 Reference Codes
SP Operations DCA and Console Display Additional SP Storage (First 32K)	DIAG4 Diskette	Stop Words

Notes:

1. Failures sensed by the DCA tests on the FUNCT diskette cause the DCA tests to loop. There is no stop word, and the screen remains blank.
2. The two sets of PCA tests are:
 - a. The PCA tests on the FUNCT diskette check all PCA functions. They execute automatically during SP power-on sequences but not during SP re-IML sequences. They also can be manually started (see "Manually Running PCA Diagnostic Tests").
 - b. The PCA tests on the DIAG4 diskette check only the basic communications between the PCA and the SP.



STOP WORDS

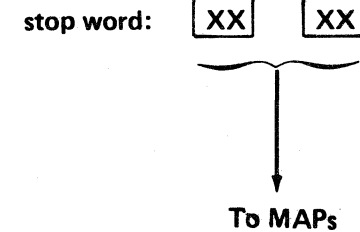
To log errors and display reference codes, the basic MSS must be operational. Until the basic MSS is known to be operational, as verified by the basic MSS diagnostic tests, stop words are used to indicate failures.

A stop word is a two-byte SP storage address that is displayed at the CE panel (see Note) and used as entry to the MAPs.

To display a stop word:

1. Press SP switches A and C together and release. This clears the display.
2. Press and hold SP switch B to display the high-order byte.
3. Press and hold SP switches A and B together to display the low-order byte.

Note: All SP display indicators light when SP power is off. To verify that all indicators turn off, power the SP on and press SP switch C - all SP display indicators should be off.



1. Clear display

2. Display high-order

3. Display low-order

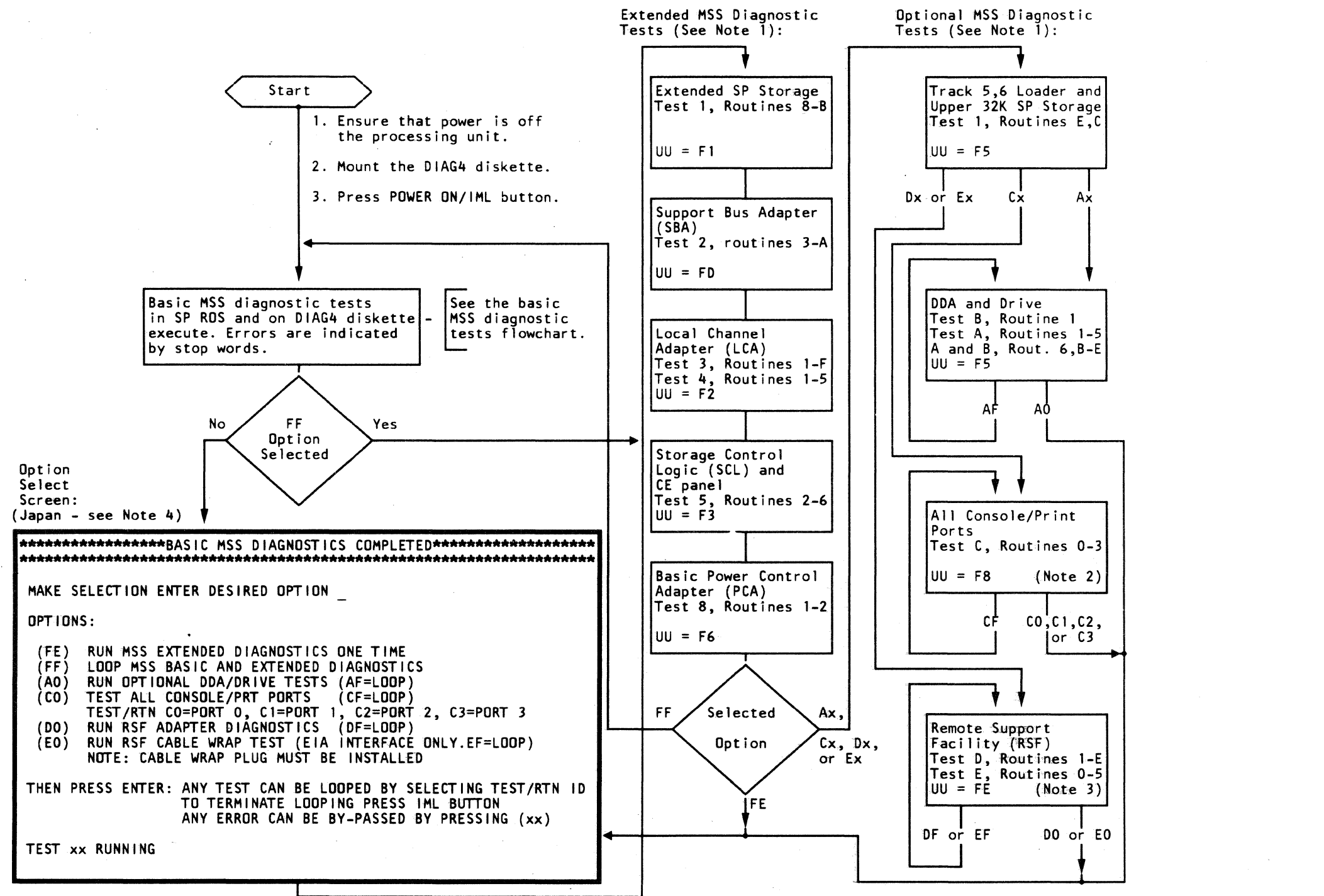
stop word: **XX XX**

To MAPs

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EXTENDED AND OPTIONAL MSS DIAGNOSTIC TESTS

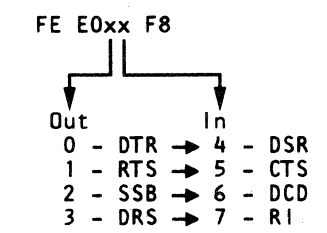


Notes:

- Failures sensed by extended and optional MSS diagnostic tests are indicated by repair instructions and/or reference codes. The UU-field indicates the area of the MSS that failed.
- Four ports, 0 through 3, are available for console displays or printers. When the CO option is selected, all ports are tested. If no device is attached to a port, or if an attached device is not ready, a reference code F8Cx03F8 (x=port ID) is displayed and testing stops.
- Two remote support facility (RSF) test options are available: DO and EO.
 - The DO option is for all RSF configurations. The CCA card at 01AA2L2, and the internal modem (38LS) card or the EIA card at 01AA2K4 are tested. All RSF tests except test E, routine 0 run.
 - The EO option is for the EIA interface only and allows testing the cable to the external modem in wrap mode. All RSF tests run when the EO option is selected, so the CCA card and the EIA card are also tested. Connect the cable wrap plug before selecting the EO option.

Failures sensed by the EIA cable wrap test (EO) are indicated by a reference code FE E0xx F8, where xx indicates the failing line as shown below:

FE E0EE F8 = Transmit or receive data (TD or RD) failure.
 FE E0FF F8 = CCA card failure.



CTS - Clear to send
 DCD - Data carrier detect
 DRS - Data rate select
 DSR - Data set ready
 DTR - Data terminal ready
 RI - Ring indicator
 RTS - Request to send
 SSB - Select standby

For a wiring diagram of the EIA external cable, see the "Service Aids" section of the Maintenance Information (MI) manual.

(Continued)

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4. This note is for the Japan keyboard only.

Some characters on the Japan keyboard are coded differently than the same characters on a U.S. keyboard. There is no microcode on the DIAG4 diskette to translate these characters for running the extended and optional MSS diagnostic tests.

To run the extended and optional MSS diagnostic tests from a Japan keyboard, use the keys shown in the Japan column of the following chart instead of those in the U.S. column.

U. S.		Japan
1 - 0	=	PF1 - PF10
B	=	N
C	=	V

On a Japan keyboard, all other characters used by the MSS diagnostic tests are the same as the U.S. keyboard.

Example: To select option C0 from the MSS Diagnostic Test Option Select screen using a Japan keyboard:

- a. Press the V key (instead of C).
- b. Press the PF10 key (instead of 0).
- c. Press the ENTER key.

MANUALLY RUNNING PCA DIAGNOSTIC TESTS

When the 4341 is not in CE mode, the PCA diagnostic tests on the FUNCT diskette execute automatically during an SP power-on sequence. A reference code is displayed when failures are found.

Additional error information is displayed when the PCA diagnostic tests find an error while executing in CE mode. In addition to the reference code, actual and expected results and error messages are displayed.

Note: Power must be off the processing unit when running the PCA diagnostic tests.

To run the PCA diagnostic tests in CE mode:

1. Ensure that the functional (FUNCT) diskette is mounted.
2. Set the CE MODE switch (on the CE panel) to CE MODE.
3. If 4341 power is off, press POWER ON. Following the basic MSS diagnostic test execution, the Partial Power Up/Down screen is displayed.

If 4341 power is on, key in QMW and press ENTER to display the Partial Power Up/Down screen. Turn off processing unit power from this screen.
4. Key in QMP and press ENTER.

The PCA diagnostic tests run to completion or until a failure is sensed. Press program function (PF) key 9 to restart the PCA diagnostic tests.

To return to normal operation, set the CE MODE switch to NORMAL and press the POWER ON switch.

For additional information and descriptions of the PCA diagnostic tests, see "Diagnostics" in the Processor Power section (Volume 16).

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PROCESSING UNIT DIAGNOSTIC TESTS

Automatically executed error log analysis (ELA) routines are the primary method for isolating failures in the processing unit. These routines are called when a failure occurs in the processing unit during normal operation.

Diagnostic tests are available when ELA does not isolate the failure. The two types of processing unit diagnostic tests are:

- Basics
- Machine speed microdiagnostics (MSMDs)

For information on these tests, see "Basic Diagnostic Tests" and "Machine Speed Microdiagnostics (MSMDs)."

TESTCASE MONITOR (TCM)

The testcase monitor (TCM) is contained on all diskettes (FUNCT and DIAG1 through DIAG4) and is loaded to support processor (SP) storage when processing unit diagnostic tests are requested by the service representative. The TCM then controls loading of the Basics and MSMDs and execution of the Basics. (Execution of the MSMDs is controlled by the MSMD monitor.)

The TCM also permits communication between the tests and the service representative with formatted screens. For information about the messages issued by the TCM, see "Testcase Monitor (TCM) Messages."

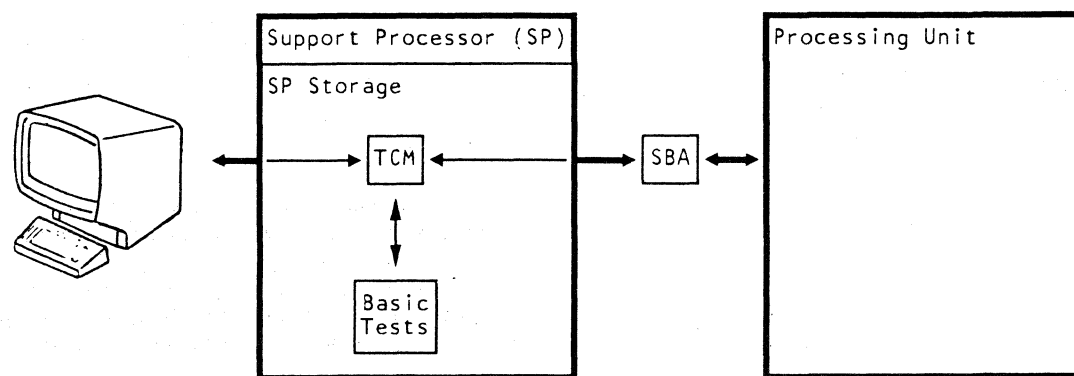
MSMD MONITOR

The MSMD monitor is on the DIAG4 diskette and is loaded by the TCM to control storage (CS) with each MSMD CS load.

The MSMD monitor controls execution of the MSMDs. While the MSMDs are executing, the testcase monitor (TCM) functions as the communications link between the service representative and the MSMD monitor. The TCM sends service representative requests to the MSMD monitor and the MSMD monitor signals the TCM of test failure and test messages.

BASIC DIAGNOSTIC TESTS

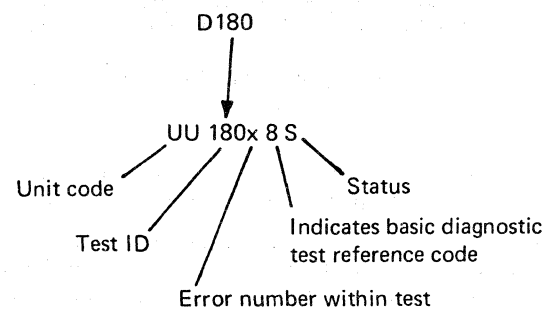
- Test the processing unit via the support bus adapter (SBA).
- Are on diskettes DIAG1, DIAG2, and DIAG3.
- Execute in the support processor (SP) under control of the testcase monitor (TCM).
- Indicate errors by displaying reference codes.



BASIC DIAGNOSTIC TEST IDS

- Are four characters long: D and three hex-characters that indicate run sequence (Dxxx).
- Are displayed in the lower left corner of the screen (module ID field) when the test is executing.
- Appear in the RRRR field of reference codes issued by Basic diagnostic tests (I = 8).

EXAMPLE OF BASIC DIAGNOSTIC TEST ID AND REFERENCE CODE:



BASIC TEST ORGANIZATION: (4341 Model Group 1)

Diskette	Range of Test IDs	Area Tested
DIAG1	D020-D062 D064-D0CC D120-D1F4 D280 D284 D280-D2D4 D2E0-D2EC D2F0-D2F8	SBA and scan rings Error transmission Clocks CREG distribution Maintenance commands Traps Channel slot rotor Channel control
DIAG2	D320-D3E0 D428 D480-D4B1 D520-D538 D580-D5C6 D620-D664 D68E-D6E0 D6F8 D720-D726 D730-D7D0	Data flow ALU error checkers Shifter Late branch IP function Timer I-cycles Retry Byte shifter (See Note) Channel function
DIAG3	D800-D990 DAA4-DAA7 DC20-DD0C	Storage controller Channels - storage Control storage

Note: For additional information on the byte shifter tests, see "Special Purpose Tests."

BASIC TEST ORGANIZATION: (4341 Model Group 2)

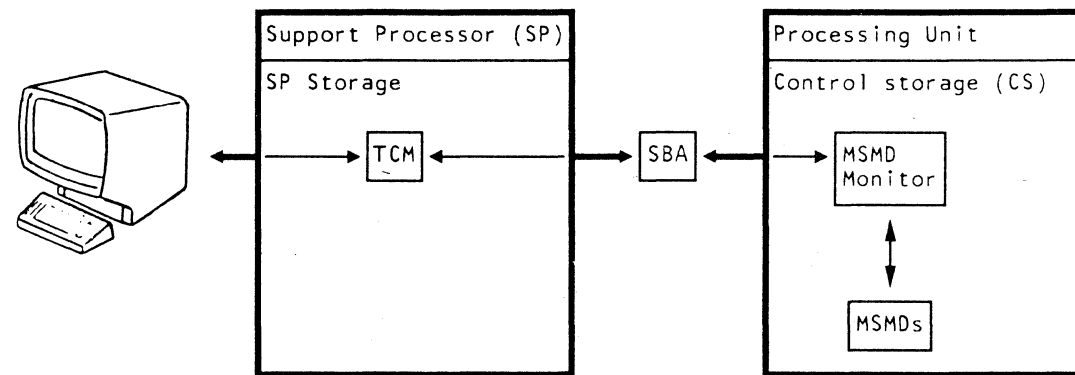
Diskette	Range of Test IDs	Area Tested
DIAG1	D020-D062 D064-D0D4 D100-D1F4 D280 D284 D280-D2D8 D2E0-D2E4 D2F0-D2F8	SBA and scan rings Error transmission Clocks CREG distribution Maintenance commands Traps Slot rotor Channel control
DIAG2	D320-D3E0 D428 D480-D4B1 D520-D538 D580-D5C6 D620-D664 D68E-D6E0 D6F8 D720-D726 D730-D7E0	Data flow ALU error checkers Shifter Late branch IP function Timer I-cycles Retry Byte shifter (See Note) Channel function
DIAG3	D800-D990 DAA4-DAAA DC20-DD0C	Storage controller Channels - storage Control storage

Note: For additional information on the byte shifter tests, see "Special Purpose Tests."

MACHINE SPEED MICRODIAGNOSTICS (MSMDS) (4341 Model Group 1)

- Test the processing unit at machine speed.
- Are contained on diskette DIAG4 in seven control storage loads.

- Execute in the processing unit under control of the MSMD monitor which communicates with the testcase monitor (TCM).
- Indicate errors by displaying reference codes.



MSMD TEST ORGANIZATION

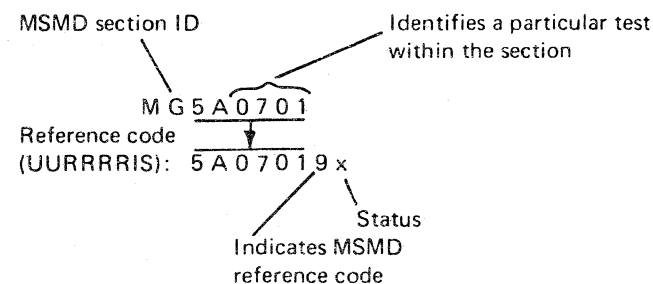
MSMDs are on diskette DIAG4 in seven control storage (CS) loads. Each CS load contains one or more sections and each section contains several tests.

CS Load	Section ID	Section Name	Area Tested
1	A	MADATA00	Data flow
	B	MBDATA00	Data flow
	C	MCBRAN00	Branching
2	D	MDSHFT00	Shifter
	E	MESHFT00	Shifter
	F	MFINTM00	Interrupts and timers
	G	MGSARS00	SARs
3	H	MHSTGC00	Storage controller
	I	MISTGC00	Storage controller
	J	MJSTGC00	Storage controller
4	K	MKBSMT00	Storage (Source 1)
	L	MLBSMT00	Storage (Source 2)
	M	MMIPUA00	Instruction processor
	N	MNIPUA00	Instruction processor
5	O	MOCHAN00	Channel traps
	P	MPCHAN00	Channel data traps
	Q	MQCHAN00	Channel data buffer
	R	MRCHAN00	Channel functions
	S	MSCHAN00	LCA
6	T	MTICYC00	1-cycles
	U	MUTRAP00	Traps
	V	MVRTRY00	Retry
7	W	MWCMDE00	Special channel tests

MSMD TEST IDS

- Are eight characters long starting with an "M."
- Include the MSMD section ID and the UU and RRRR fields of the reference code that is displayed when a failure is sensed.

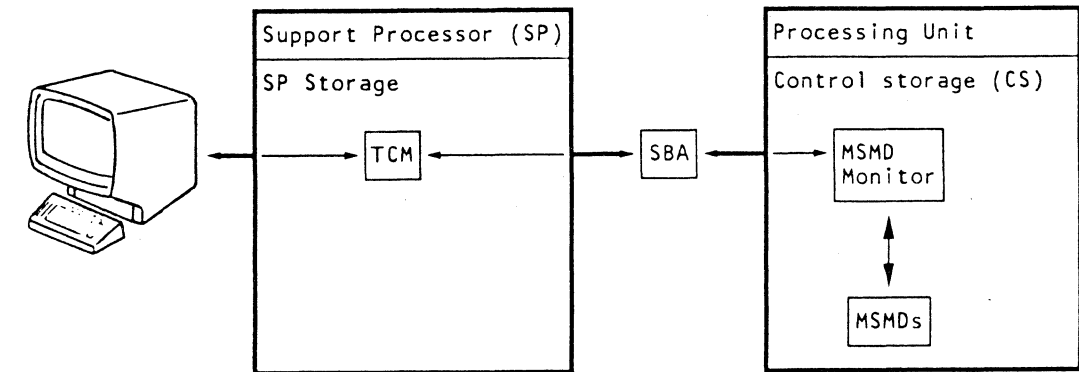
EXAMPLE OF MSMD TEST ID AND REFERENCE CODE



MACHINE SPEED MICRODIAGNOSTICS (MSMDS) (4341 Model Group 2)

- Test the processing unit at machine speed.
- Are contained on diskette DIAG4 in seven control storage loads.

- Execute in the processing unit under control of the MSMD monitor which communicates with the testcase monitor (TCM).
- Indicate errors by displaying reference codes.



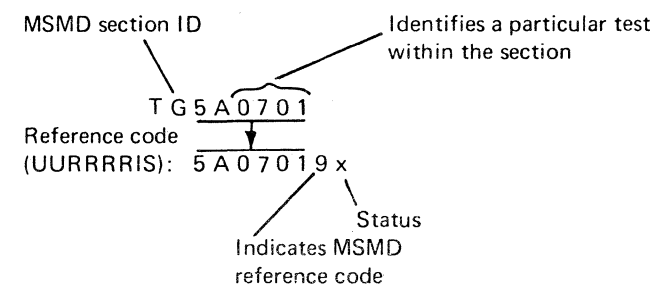
MSMD TEST ORGANIZATION:

MSMDs are on diskette DIAG4 in seven control storage (CS) loads. Each CS load contains one or more sections and each section contains several tests.

MSMD TEST IDS

- Are eight characters long starting with a "T."
- Include the MSMD section ID and the UU and RRRR fields of the reference code that is displayed when a failure is sensed.

EXAMPLE OF MSMD TEST ID AND REFERENCE CODE



CS Load	Section ID	Section Name	Area Tested
1	A	TADATA00	Data flow
	B	TBDATA00	Data flow
	C	TCBRAN00	Branching
	D	TDSHFT00	Shifter
2	E	TESHFT00	Shifter
	F	TFINTM00	Interrupts and timers
	G	TGIPUA00	SARs
3	H	THSTGC00	Storage controller
	I	TISTGC00	Storage controller
	J	TJSTGC00	Storage controller
4	K	TKBSMT00	Storage
	L	TLBSMT00	Storage
	M	TMBSMT00	Storage
	N	TNPAGE00	Storage Controller Op
5	O	TOCHAN00	Channel traps
	P	TPCHAN00	Channel data traps
	Q	TQCHAN00	Channel data buffer
	R	TRCHAN00	Channel functions
	S	TSCHAN00	LCA
6	T	TTICYC00	1-cycles
	U	TUTRAP00	Traps
	V	TVRTRY00	Retry
7	W	TWCMDE00	Special channel tests



HOW TO RUN BASIC AND MSMD TESTS (4341 Model Group 2)

You can initiate the processing unit diagnostic tests (Basics and MSMDs) with any diskette mounted because the test case monitor (TCM) is on all diskettes. If the test to be run is not on the diskette that is mounted, you are prompted to mount the correct diskette.

To run the processing unit diagnostics:

1. Set the CE MODE switch (on the CE panel) ON.
2. Hold the ALT key down and press the DIAG key. The Diagnostic Mode General Selection screen is displayed.
3. Do one of the following:
 - Press ENTER only; in this case PUMA (Processing Unit Maintenance Algorithm) determines what tests need to be run.
Note: PUMA is designed to be used with (and to eliminate) some of the MAPs. It is NOT an independent (stand-alone) option. Therefore, use PUMA only if so directed.
 - Key in one of the listed options (A through G) and press ENTER.

Pressing ENTER only

If you press ENTER only, PUMA displays a prompting message that requests you to enter a reference code (and reference code extension if any). After verifying that the reference code is valid (that is, recorded in the system history file), PUMA runs the appropriate diagnostics. If need be, you will be prompted to mount applicable diskettes. If the reference code you enter is invalid or some action is required by you, PUMA displays a prompting message.

Option A - AUTOMATIC DIAGNOSTIC MODE

Selecting this option starts execution of all Basics and MSMDs except those that are described under "Special Purpose Tests."

- You are prompted when it is necessary to mount another diskette.
- All tests run if no failures are detected.
- If a failure occurs the test run is terminated. CAP is called automatically, and a FRU list and MAP reference are displayed.

```

          DIAGNOSTIC MODE
        GENERAL SELECTION SCREEN
          EC xxxxx

OPTION  DESCRIPTION
A      -  AUTOMATIC DIAGNOSTIC MODE
B      -  SELECTED DIAGNOSTIC(S) MODE
C      -  FIELD SUPPORT CENTER MODE
D      -  FIELD SUPPORT CENTER MODE WITH INTERVENTION
E      -  END OF DIAGNOSTICS
F      -  RUNALL BASICS
G      -  RUNALL MSMD'S

PRESS ENTER TO RUN PROCESSING UNIT MAINTENANCE ALGORITHM
(PUMA) OR SELECT ONE OF THE OPTIONS LISTED ABOVE

SELECTION: _          =====>..... message area .....

OPTIONS IN EFFECT: ____
  
```

Option B - SELECTED DIAGNOSTICS MODE

Selecting this option allows you to run a particular test or group of tests.

- You are prompted to enter test names (IDs) via the Test Case Monitor screen.
- If a failure occurs, the test run is terminated. CAP is called automatically and a FRU list and MAP reference are displayed.

Selecting Basics:

- To run a single Basic test, enter its name (ID).
- To run a group of Basic tests, enter the starting and ending test IDs separated by a hyphen (-) (for example: D020-D060). All tests in the selected group must be on the same diskette.
- To run all Basic tests on a particular diskette, enter: Bx (x = 1, 2, or 3 comparable to DIAG1, 2, or 3).

Selecting MSMDs:

- To run an MSMD section, enter the section name.
- To run a group of MSMD sections, enter the starting and ending section names separated by a hyphen (-) (for example: MOCHAN00-MSCHAN00).
- To run a complete MSMD CS load, enter: Mx (x = CS load number, for example: M3).

Option C - FIELD SUPPORT CENTER MODE

Selecting this option causes the Field Support Center screen to be displayed. See "Diagnostic Mode Field Support Center Screen."

Option D - FIELD SUPPORT CENTER MODE WITH INTERVENTION

Selecting this option causes the Field Support Center screen to be displayed and also allows you to enter console manual functions mode between test steps. See "Diagnostic Mode Field Support Center Screen."

Option E - END OF DIAGNOSTICS

Selecting this option ends diagnostic mode and returns control to console functions. The Q (Console Functions General Selection) screen is displayed.

To return to normal operation:

1. Mount the FUNCT diskette.
2. Set the CE MODE switch to NORMAL.
3. Press the POWER ON/IML switch on the operator control panel (OCP).
4. Enter: QLM
This starts a processing unit IML. Return the machine to the customer when the "IML COMPLETE" message is displayed.

Option F - RUNALL BASICS

Selecting this option starts all Basic diagnostic tests except the byte-shifter tests. For information on the byte-shifter tests, see "Special Purpose Tests."

- You are prompted when it is necessary to mount another diskette.
- If a failure occurs, the test run is terminated. CAP is called automatically, and a FRU list and MAP reference are displayed.

Option G - RUNALL MSMD'S

Selecting this option causes MSMD CS loads 1 through 6 to run. For information on running CS load 7, see "How to Run Special Channel Tests."

- If the DIAG4 diskette is not already mounted, you are prompted to mount it.
- If a failure occurs, the test run is terminated. ELA and CAP are called automatically, and a FRU list and MAP reference are displayed.

OPERATING TIPS

1. When running Basic diagnostic tests, the test ID of the test that is running is displayed in the lower left corner of the screen in the module ID field (line 24, field 22).
2. Processing unit diagnostic test execution is interrupted when the ALT key is pressed and held, and the DIAG key is pressed. The run is cancelled and the diagnostic mode general selection screen is displayed.
3. Pressing ENTER causes the diagnostic mode general selection screen to be displayed when:
 - a. The requested test(s) have run to completion.
 - b. A failure was sensed by a test and the FRU list is displayed.

**HOW TO RUN BASIC AND MSMD TESTS
(4341 Model Group 1)**

You can initiate the processing unit diagnostic tests (Basics and MSMDs) with any diskette mounted because the testcase monitor (TCM) is on all diskettes. If the test to be run is not on the diskette that is mounted, you are prompted to mount the correct diskette. To run the processing unit diagnostics:

1. Set the CE MODE switch (on the CE panel) ON.
2. Hold the ALT key down and press the DIAG key. The Diagnostic Mode General Selection screen is displayed.
3. Do one of the following:
 - Press ENTER only; in this case PUMA (Processing Unit Maintenance Algorithm) determines what tests need to be run (applies to EC 154324/866870 and later). **Note:** PUMA is designed to be used with (and to eliminate) some of the MAPs. It is NOT an independent (stand-alone) option. Therefore, use PUMA only if so directed.
 - Key in one of the listed options (A-G) and press ENTER.

Pressing ENTER only

If you press ENTER only, PUMA displays a prompting message that requests you to enter a reference code (and reference code extension if any). After verifying that the reference code is valid (that is, recorded in the system history file), PUMA runs the appropriate diagnostics. If need be, you are prompted to mount applicable diskettes. If the reference code you enter is invalid or some action is required by you, PUMA displays a prompting message.

Option A - AUTOMATIC DIAGNOSTIC MODE

Selecting this option starts execution of all Basics and MSMDs except those that are described under "Special Purpose Tests."

- You are prompted when it is necessary to mount another diskette.
- All tests run if no failures are detected.
- If a failure occurs, the test run is terminated. CAP is called automatically, and a FRU list and MAP reference are displayed.

Option B - SELECTED DIAGNOSTICS MODE

Selecting this option allows you to run a particular test or group of tests.

- You are prompted to enter test names (IDs) via the Test Case Monitor screen.
- If a failure occurs, the test run is terminated. CAP is called automatically and a FRU list and MAP reference are displayed.

Prior to EC 154324/866870

```

DIAGNOSTIC MODE
GENERAL SELECTION SCREEN
EC xxxxx

OPTION      DESCRIPTION
A -        AUTOMATIC DIAGNOSTIC MODE
B -        SELECTED DIAGNOSTIC(S) MODE
C -        FIELD SUPPORT CENTER MODE
D -        FIELD SUPPORT CENTER MODE WITH INTERVENTION
E -        END OF DIAGNOSTICS
F -        RUNALL BASICS
G -        RUNALL MSMD'S

A VALID SELECTION CONSISTS OF ONE OF THE ABOVE OPTIONS.

SELECTION: _          ====>..... message area .....

OPTIONS IN EFFECT: ____
    
```

Selecting Basics:

- To run a single Basic test, enter its name (ID).
- To run a group of Basic tests, enter the starting and ending test IDs separated by a hyphen (-) (for example: D020-D060). All tests in the selected group must be on the same diskette.
- To run all Basic tests on a particular diskette, enter: Bx (x = 1, 2, or 3 comparable to DIAG1, 2, or 3).

Selecting MSMDs:

- To run an MSMD section, enter the section name.
- To run a group of MSMD sections, enter the starting and ending section names separated by a hyphen (-) (for example: MOCHAN00-MSCHAN00).
- To run a complete MSMD CS load, enter: Mx (x = CS load number, for example: M3).

Option C - FIELD SUPPORT CENTER MODE

Selecting this option causes the Field Support Center screen to be displayed. See "Diagnostic Mode Field Support Center Screen."

Option D - FIELD SUPPORT CENTER MODE WITH INTERVENTION

Selecting this option causes the Field Support Center screen to be displayed and also allows you to enter console manual functions mode between test steps. See "Diagnostic Mode Field Support Center Screen."

Applies to EC 154324/866870 and Later

```

DIAGNOSTIC MODE
GENERAL SELECTION SCREEN
EC xxxxx

OPTION      DESCRIPTION
A -        AUTOMATIC DIAGNOSTIC MODE
B -        SELECTED DIAGNOSTIC(S) MODE
C -        FIELD SUPPORT CENTER MODE
D -        FIELD SUPPORT CENTER MODE WITH INTERVENTION
E -        END OF DIAGNOSTICS
F -        RUNALL BASICS
G -        RUNALL MSMD'S

PRESS ENTER TO RUN PROCESSING UNIT MAINTENANCE ALGORITHM
(PUMA) OR SELECT ONE OF THE OPTIONS LISTED ABOVE

SELECTION: _          ====>..... message area .....

OPTIONS IN EFFECT: ____
    
```

Option E - END OF DIAGNOSTICS

Selecting this option ends diagnostic mode and returns control to console functions. The Q (Console Functions General Selection) screen is displayed. To return to normal operation:

1. Mount the FUNCT diskette.
2. Set the CE MODE switch to NORMAL.
3. Press the POWER ON/IML switch on the operator control panel (OCP).
4. Enter: QLM
This starts a processing unit IML. Return the machine to the customer when the "IML COMPLETE" message is displayed.

Option F - RUNALL BASICS

Selecting this option starts all Basic diagnostic tests except the byte shifter tests. For information on the byte shifter tests, see "Special Purpose Tests."

- You are prompted when it is necessary to mount another diskette.
- If a failure occurs, the test run is terminated. CAP is called automatically, and a FRU list and MAP reference are displayed.

Option G - RUNALL MSMDs

Selecting this option causes MSMD CS loads 1 through 6 to run. For information on running CS load 7, see "How to Run Special Channel Tests."

- If the DIAG4 diskette is not already mounted, you are prompted to mount it.
- If a failure occurs, the test run is terminated. ELA and CAP are called automatically, and a FRU list and MAP reference are displayed.

OPERATING TIPS

1. When running Basic diagnostic tests, the test ID of the test that is running is displayed in the lower left corner of the screen in the module ID field (line 24, field 22).
2. Processing unit diagnostic test execution is interrupted when the ALT key is pressed and held, and the DIAG key is pressed. The run is cancelled and the diagnostic mode general selection screen is displayed.
3. Pressing ENTER causes the Diagnostic Mode General Selection screen to be displayed when:
 - a. The requested test(s) have run to completion.
 - b. A failure was sensed by a test and the FRU list is displayed.

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Diagnostic Mode Field Support Center Screen

This screen is displayed when you select options C or D from the Diagnostic Mode General Selection screen. After you select one of the following options, the Diagnostic Mode Printer and Display Screen is displayed. The options that are available to you are:

Option A - NO OPTION FROM THIS SCREEN REQUIRED

Option B - STOP ON ERROR

This option terminates the test(s) when a failure is detected.

Option C - TEST LOOP

This option loops the selected test or range of tests (see Note).

Option D - TEST LOOP / STOP ON ERROR

This option is the same as C except the test terminates when an error occurs (see Note).

Option E - SECTION LOOP

This option loops an entire MSMD section (see Note).

Option F - SECTION LOOP / STOP ON ERROR

This option is the same as E except the run terminates when an error occurs (see Note).

Option G - RUNALL

This option runs all Basic and MSMD tests.

Option H - RUNALL / STOP ON ERROR

This option is the same as G except the run terminates when an error occurs.

Option I - RUNALL BASIC TESTS

This option runs all Basic tests. If a failure occurs and the display on error option has been selected from the Printer and Display screen, CAP is executed automatically.

Option J - RUNALL MSMD TESTS

This option runs all MSMD tests. See Option I if a failure occurs.

Option R - RE-START DIAGNOSTIC MODE

This option returns you to the Diagnostic Mode General Selection screen.

Note: After selecting options C, D, E, or F, you are prompted to enter a four-digit loop number. Enter in hex the number of times you want to loop the selected test(s). If you press the ENTER key without entering a number, the selected test(s) loop until a failure or interrupt occurs. To end the loop, press the MODE SEL key or the ALT and DIAG keys together.

```

DIAGNOSTIC MODE
FIELD SUPPORT CENTER SCREEN
EC xxxxx

OPTION      DESCRIPTION
A -        NO OPTION FROM THIS SCREEN REQUIRED
B -        STOP ON ERROR
C -        TEST LOOP
D -        TEST LOOP / STOP ON ERROR
E -        SECTION LOOP
F -        SECTION LOOP / STOP ON ERROR
G -        RUNALL
H -        RUNALL / STOP ON ERROR
I -        RUNALL BASIC TESTS
J -        RUNALL MSMD TESTS
R -        RE-START DIAGNOSTIC MODE

A VALID SELECTION CONSISTS OF ONE OF THE ABOVE OPTIONS

SELECTION: _          =====>..... message area .....
OPTIONS IN EFFECT:  _
    
```

Diagnostic Mode Test Case Monitor Screen

This screen is displayed whenever the processing unit diagnostics are running. Prompting and error messages are displayed on this screen. For a description of the messages, see "Messages."

```

DIAGNOSTIC MODE
TEST CASE MONITOR SCREEN
EC xxxxx

SELECTION: _          =====>..... message area .....
OPTIONS IN EFFECT:  _
    
```

Diagnostic Mode Printer and Display Screen

This screen is displayed after you select an option from the Diagnostic Mode Field Support Center screen. You must select one option from each of the two columns (for example, EF = Print all; suppress display).

Option A - PRT/DISPL REF CODE ONLY

This option prints or displays the reference code and failing field when an error occurs.

Option B - PRT/DISPL ALL ON ERROR

This option prints or displays the test ID, expected and actual results, the reference code, and failing data when an error occurs.

Option C - PRT/DISPL TEST ID ONLY

This option prints or displays the test ID as each test is completed. If an asterisk (*) precedes the test ID, this indicates that an error occurred while executing that test.

Option D - PRT/DISPL TEST ID UNLESS ERROR

This option is a combination of options B and C.

Option E - PRT/DISPL ALL

This option prints or displays the test ID and expected and actual results. If an error occurs, the reference code is also printed or displayed.

Option F - SUPPRESS PRT/DISPL

This option suppresses the printing or displaying of data.

Option R - RE-START DIAGNOSTIC MODE

This option returns you to the Diagnostic Mode General Selection screen.

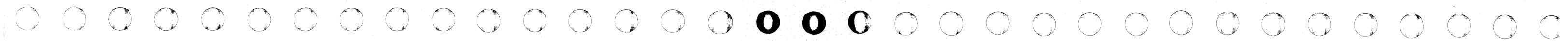
```

DIAGNOSTIC MODE
PRINTER AND DISPLAY SCREEN
EC xxxxx

PRINTER SELECTIONS      DISPLAY SELECTIONS
OPTION DESCRIPTION      OPTION DESCRIPTION
A PRT REF CODE ONLY     A DISPL REF CODE ONLY
B PRT ALL ON ERROR      B DISPL ALL ON ERROR
C PRT TEST ID ONLY      C DISPL TEST ID ONLY
D PRT TEST ID UNLESS ERROR D DISPL TEST ID UNLESS ERROR
E PRT ALL                E DISPL ALL
F SUPPRESS PRT          F SUPPRESS DISPL
R RE-START DIAGNOSTIC MODE R RE-START DIAGNOSTIC MODE

VALID SELECTION CONSISTS OF AN OPTION FROM BOTH THE PRT AND
DISPL SELECTIONS (EXAMPLE: EF=PRINT ALL,SUPPRESS DISPLAY).

SELECTION: _          =====>..... message area .....
OPTIONS IN EFFECT:  _
    
```



SPECIAL CHANNEL TESTS

MSMD control storage (CS) load 7 on the DIAG4 diskette contains special channel tests that display detailed error information if a failure is sensed:

- **Mark In Test**
Use this test to detect a failure to reset an up (active) level of the MARK IN bit (applies to EC 856092 and later).
- **Channel Microcoded Device Exerciser (CMDE)**
Use this test to diagnose channel or I/O device problems.
- **Channel Cable Wrap Test (CWT)**
Use this test to isolate channel interface adapter (IFA) driver and receiver failures.

How to Run Special Channel Tests

1. Mount the DIAG4 diskette and set the CE MODE switch to ON.
2. Press and hold the ALT key and press the DIAG key to display the Diagnostic Mode General Selection screen.
3. Select option G (RUNALL BASICS).
This causes MSMD CS loads 1 through 6 to run which verify 4341 operation up to the drivers and receivers on the channel IFA cards.
4. Select option B (selected diagnostics mode).
5. Enter test ID: M7
After CS load 7 is loaded (takes approximately two minutes), the Special Channel Tests Selection screen is displayed.
6. Make a selection from the screen. Enter:
01 to select CMDE.
02 to select CWT.
03 to select the Mark In Test (applies to EC 856092 and later). (You must first select 02 and run the CWT before selecting 03.)
E to end the special channel tests.

If you select any of these tests, detailed run instructions and available options are displayed to help you run the tests. If you select E, the Diagnostic Mode General Selection screen is displayed.

Mark In Test

The Mark In Test checks for a failure to reset an up (active) level of the MARK IN bit (applies to EC 856092 and later). An open condition is not detected by this test.

For details on how to select the Mark In test, see "How to Run Special Channel Tests." Note that you must run the CWT before running the Mark In test.

Channel Microcoded Device Exerciser (CMDE)

Use the CMDE test to diagnose channel or I/O device problems. If this test detects no failures, run 4300-FRIEND to isolate the problem.

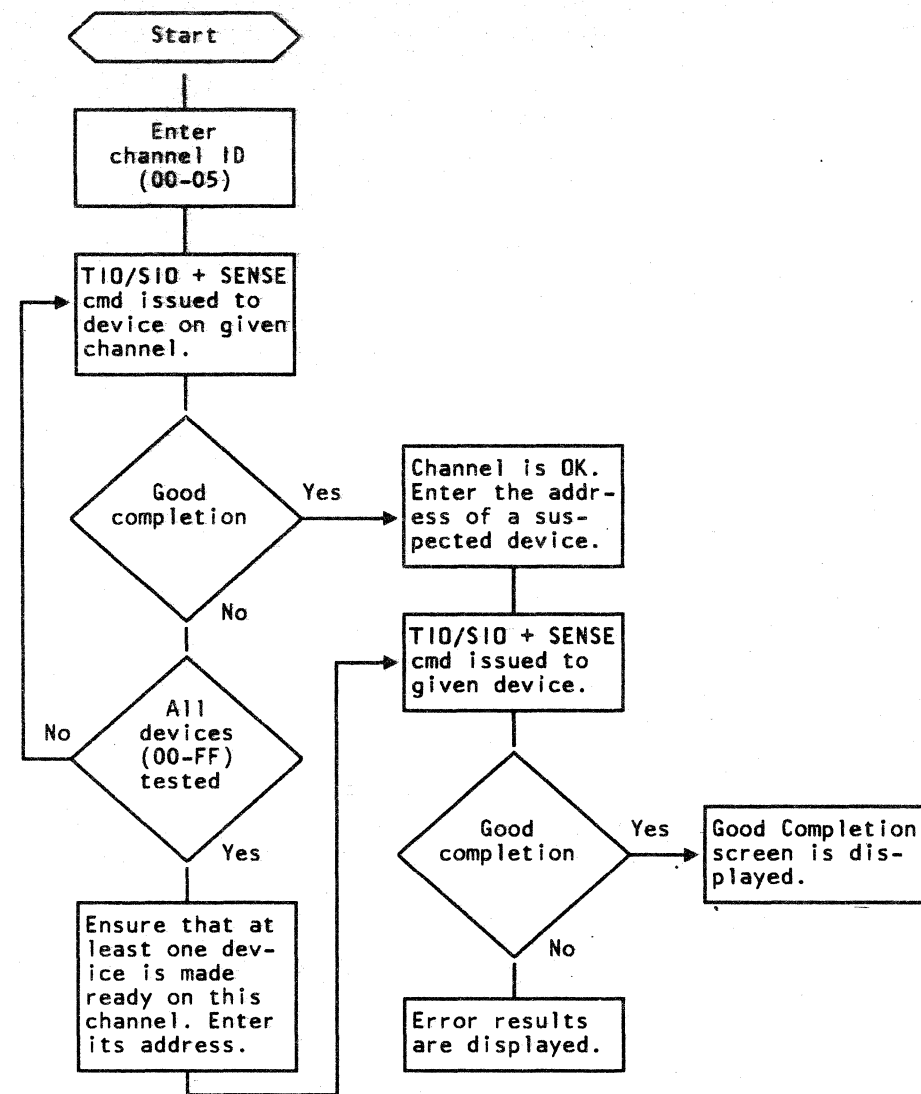
For details on how to select the CMDE test, see "How To Run Special Channel Tests." After you select the CMDE test, detailed run instructions and available options are displayed to help you use the test.

Beginning with EC 856094, the CMDE test is run under the direction of the MAPs (this is the usual way) or independently of the MAPs (this latter method assumes that you have the experience or skills to diagnose channel-related problems). For a high-level description of each method see the two flowcharts on this page. The different bit meanings are also given here for reference purposes.

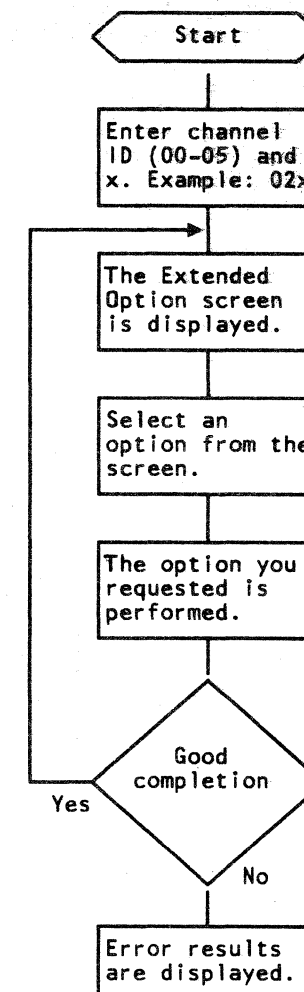
BIT MEANINGS

Device (Unit) Status 80 - Attention 40 - Status modifier 20 - Control unit end 10 - Busy 08 - Channel end 04 - Device end 02 - Unit check 01 - Unit exception
Channel Status 80 - Program-controlled interrupt 40 - Incorrect length 20 - Program check 10 - Protection check 08 - Channel data check 04 - Channel control check 02 - Interface control check 01 - Chaining check
Sense Byte 0 80 - Command reject 40 - Intervention required 20 - Bus-out check 10 - Equipment check 08 - Data check 04 - Overrun
Note: This sense information is not valid for all I/O devices; it is given here as a general guide only. For explicit sense information, see the applicable manual.

CMDE TEST (USING MAPS)



CMDE TEST (NOT USING MAPS)



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Channel Cable Wrap Test (CWT)

Use the Channel Cable Wrap Test (CWT) to isolate (a) channel IFA driver and receiver failures (see note) and (b) channel interface cable and connector failures. The CWT verifies that:

- When each "OUT" line is activated, the corresponding "IN" line is activated (see "CWT Error Example 1").
- The bus and tag lines can be reset (see "CWT Error Example 2").

For details on how to select the CWT, see "How to Run Special Channel Tests." Before running the CWT, you must run CS loads 1 through 6 to verify 4341 operation up to the drivers and receivers on the channel IFA cards.

Note: The Basics and MSMDs verify 4300 operation up to the drivers and receivers on the channel IFA cards.

Channel IFA Card Locations (Board 01AA2)

Channel	IFA Card
0	F2
1	Q2
2	D2
3	R2
4	E2
5	S2

Two terminators (bus wrap and tag wrap) are required to run the CWT. To test a channel IFA card, install the wrap terminators in place of the channel interface cables (on the channel to be tested). To test a channel IFA card and the channel interface cables, install the wrap terminators in place of the channel interface terminators (located on the last I/O control unit of the channel to be tested).

After you have completed the CWT, be sure to remove the wrap terminators and re-install the interface cables or the original terminators.

Bus Wrap Terminator (Part 8483772) Wiring

Bus Bit(Hex)	Bus Out	Bus In
P	B03	G03
0(80)	D04	J04
1(40)	B05	G05
2(20)	D06	J06
3(10)	B08	G08
4(08)	D09	J09
5(04)	B10	G10
6(02)	D11	J11
7(01)	B12	G12
MARK	D13	J13

Tag Wrap Terminator (Part 8483773) Wiring

Tag Bit(Hex)	Tag Out	Pin	Tag In	Pin
0(80)	SUPR OUT	B12	REQ IN	J06
1(40)	OP OUT	J13	OP IN	B03
2(20)	HOLD OUT	G12	DISC IN	J11
3(10)	ADR OUT	B10	ADR IN	B05
4(08)	SEL OUT	D09	SEL IN	B08
5(04)	CMD OUT	D11	STAT IN	D04
6(02)	DATA OUT	G10	DATA IN*	G08
7(01)	SRV OUT	D13	SRV IN*	D06
	MTR OUT**	J04	MTR IN	G05

* DATA IN and SRV IN shorted together are not detected by this test.

** Not tested here — "See Metering Service Procedure."

CWT ERROR EXAMPLE 1 (Dropped Bits)

CABLE WRAP TEST										
CHANNEL: 04										
ERROR DETECTED										
BUS (BIT PATTERN):										
EXPECTED	55	AA	80	40	20	10	08	04	02	01
ACTUAL	15*	AA	80	00*	20	10	08	04	02	01
TAGS (OUT/IN): OP/OP AD/AD HD/DC SE/SE SP/RE SR/SR CD/ST DA/DA										
EXPECTED	40	10	20	08	80	03	07	07	03	03
ACTUAL	40	00*	20	08	80	03	07	07	03	03
==> PRESS ENTER KEY TO RETURN TO CWT OPTION SCREEN										

CWT Error Example 1 shows two instances of dropped bits on channel 4:

1. Dropped bus bit 1. X'55' (bits 1,3,5,7) was sent on bus out and X'15' (bits 3,5,7) was returned on bus in; X'40' (bit 1) was sent on bus out and X'00' (no bits) was returned on bus in.

Note: Suspect a bus parity bit failure if the screen indicates that an error was detected but the "expected" and "actual" bit patterns are the same.

2. Dropped the address (AD) tag. The address out bit (X'10'; tag bit 3) was sent but no bit was returned on the address in line. For the meaning of the tag abbreviations that appear on the screen, see "CWT Tag Abbreviations."

CWT Tag Abbreviations

OP	Operational
AD	Address
HD	Hold
DC	Disconnect
SE	Select
SP	Suppress
RE	Request
SR	Service
CD	Command
ST	Status
DA	Data

CWT ERROR EXAMPLE 2 (Unable to Reset Bits)

CABLE WRAP TEST						
CHANNEL: 04						
ERROR DETECTED		* SPECIAL WRAP TERMINATORS *				
*****		BITS	OUT	IN (TAGS)	OUT	IN (BUS)
UNABLE TO CLEAR		0	SUPR <---->	REQ	0 <---->	0
TAG AND BUS LINES		1	OP <---->	OP	1 <---->	1
		2	HOLD <---->	DISC	2 <---->	2
TAGS: 10		3	ADR <---->	ADR	3 <---->	3
BUS: 40		4	SEL <---->	SEL	4 <---->	4
		5	CMD <---->	STA	5 <---->	5
		6	SRV/DATA <---->	SRV/DATA	6 <---->	6
		7	CMD/SRV/DATA OUT (*)		7 <---->	7
==> PRESS ENTER KEY TO RETURN TO CWT OPTION SCREEN						
(*) FOR MORE INFORMATION ON TAG BIT (7) SEE THE "MAINTENANCE INFORMATION MANUAL" UNDER DIAGNOSTICS: SPECIAL CHANNEL TESTS.						

CWT Error Example 2 shows a failure to reset a tag and bus line on channel 4:

1. TAGS: 10. The address out tag cannot be reset (X'10' = tag bit 3 which is the address tag).
2. BUS 40. Bus bit 1 cannot be reset (X'40' = bus bit 1).

Note: The hardware sets tag bit 7 on whenever tag bit 5 and/or tag bit 6 are set on. Tag bit 7 is not needed to diagnose the failure; therefore, use tag bits 5 and/or 6 to diagnose the failure and ignore tag bit 7.

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MESSAGES

The messages described here are issued by the:

- Code Analysis Processor (CAP)
- Testcase Monitor (TCM)

For additional information on the CAP, see "Code Analysis Processor (CAP)" under "Introduction."

For additional information on the TCM, see "Testcase Monitor (TCM)" under "Processing Unit Diagnostic Tests."

CODE ANALYSIS PROCESSOR (CAP) MESSAGES

Message	Reason for Message	Action Required
uurrrris IS NOT A VALID REFERENCE CODE	This message indicates an MSS failure or a microcode error if the reference code was entered correctly via the QE1 screen, or if CAP was called automatically while running processing unit diagnostic tests. The indicated reference code is not valid.	If an error was made entering the reference code via the QE1 screen, re-enter the reference code.
DISKETTE PROBLEM - CAP CANNOT LOAD TABLE CFFx	This message indicates a diskette failure and is always followed by a message that indicates the failing operation, the diskette drive adapter (DDA) status, and a return code. The return codes are: 01 - Request to increment or read 0 records. 0F - Diskette not ready. 21 - Increment or seek exceeds module length. 41 - Module ID not found. 81 - Diskette read error. 82 - DDA check. 83 - SP check. 8F - Invalid cylinder directory. 9F - No seek was issued before a read or increment.	Repair the diskette problem.
ERROR IN TABLE CFFx FOR REFERENCE CODE uurrrris	This message indicates a diskette drive, DDA, or MSS failure, or a microcode error. CAP found the reference code in the indicated table but could not find a FRU list.	Repair the failure.
MAY BE CHAN x DEVICE PROBLEM	The failure that generated the reference code may be on the indicated channel (if known) or on an attached I/O device. The displayed FRU list may not be valid.	If replacing the FRUs that are indicated does not fix the problem, suspect a channel or I/O device problem. Start again at MAP 0000 with the new symptoms.
REFERENCE CODE uurrrris IS NOT IN TABLE CFFx ON (mounted) DISKETTE	This message indicates that an error was made entering the reference code via the QE1 screen, or, if the indicated table is CFF8, the diskette that contains the Basic test that issued the reference code is not mounted. This message may also be displayed when the diskette is defective, the MSS is failing, there is a microcode error, or the table and the microcode or test that issued the reference code are at different EC levels.	If an entry error was made via the QE1 screen, re-enter the reference code. If the table indicated is CFF8, ensure that the diskette that contains the Basic test that issued the reference code is mounted.
TABLE CFFx IS NOT ON (mounted) DISKETTE	This message is displayed under two conditions: 1. When CAP is started manually (by entering QE1), the message indicates that the reference code was not entered correctly or that the wrong diskette is mounted. 2. When CAP is started automatically (from a diagnostic diskette), the message indicates that there may be a microcode problem.	1. Ensure that the reference code is entered correctly and that the correct diskette is mounted. 2. Go to the indicated MAP if CAP was started automatically.

TESTCASE MONITOR (TCM) MESSAGES

Message:	Reason for message:	User action required:
AN ADDRESS MATCH HAS OCCURRED IF MANUAL INTERVENTION IS REQUIRED: 1. MOUNT THE SYSTEM DISKETTE 2. ENTER YES WHEN READY ELSE, PRESS THE ENTER KEY	Option D (FSC mode with intervention) was selected from the Diagnostic Mode General Selection screen. Execution of basic tests is now at a point where intervention is allowed.	Follow the instructions in the message. If manual intervention is not desired at this point, press the ENTER key.
BASIC DIAGNOSTICS ENDED	A RUNALL BASICS run has completed.	Press ENTER to restart the TCM.
BOTH IDS MUST BE SECTION IDS	An MSMD range consisting of one test ID and one section ID was entered. When selecting an MSMD range, both IDs must be section IDs or both must be test IDs.	Enter a valid range of MSMD test or section IDs.
BUSCI ERROR; SBA COMMAND 33	A BUSCI 33 (source bus control) instruction failed. Possibly caused by an SBA time-out or by an adapter check.	Press ENTER to return to the general selection screen.
CONFIG FAILURE - DEFAULTED TO SUPPRESS PRINT	An error occurred during an attempt to configure a selected printer for TCM use. The print option defaults to suppress print.	Press ENTER to continue.
CONTROL STORE LOAD ERROR - CSLOAD IS IN ERROR	An error occurred while an MSMD CS load was being loaded.	Press ENTER to restart the TCM.
CONTROL STORE LOAD COMPLETE - MSMDS RUNNING	An MSMD CS load has completed and the tests have started.	None.
CONVERSION ERROR EBCDIC TO HEX	An invalid hex character was encountered.	Press ENTER to return to the general selection screen.
DIAGNOSTICS ENDED	An E option was entered.	None. The general selection screen is displayed.
DISPLAY ERROR	A TCM command to the console display has failed, probably because of a microcode error.	Press ENTER to return to the general selection screen.
DUPLICATE IDS NOT ALLOWED	The beginning and ending test IDs of a range were identical.	Re-enter a valid test range.
END OF MSMD TESTS	An MSMD run has completed.	Press ENTER to restart the TCM.

Testcase Monitor (TCM) Messages (Part 1 of 5)

Message:	Reason for Message:	User Action Required:
ENTER 4 DIGIT CYCLE CONTROL NUMBER	A request has been made to run MSMDs under the test or section loop option.	Enter four hex numbers indicating the number of times it is desired to repeat the test or section before continuing.
ENTER 4 DIGIT LOOP CONTROL	The test loop option has been selected.	Enter four hex numbers indicating the number of times it is desired to loop the selected test.
ENTER CHANNEL ID	Basic diagnostic tests have been selected under FSC mode. It is necessary to indicate which channels are to be tested.	Enter the number of the channel to be tested (0-5) or enter ALL for testing all channels. ENTER key only defaults to ch 1.
ENTER ONE BYTE HEX RELIABILITY COUNT	The RUNALL MSMDs option has been selected in FSC mode.	Enter two hex numbers indicating the number of times each MSMD test is to run before proceeding to the next test. The minimum number that can be specified is x'02'.
ENTER TEST ID(S)	An option that requires test id(s) has been selected.	Enter the desired test id(s).
ENTER Y TO BYPASS CONTROL STORE LOAD	The requested MSMD CS load is the same as the CS load that just completed.	Enter Y to allow requesting a different CS load. Press ENTER (with no Y) to run the same CS load again.
ENTER Y TO DISABLE ERRORS WHILE RUNNING MSMDs	MSMD tests have been selected under FSC mode. It is necessary to indicate if errors are to be disabled.	Enter a Y to run MSMDs with errors disabled. A null entry causes the MSMDs to run with errors enabled.
INPUT CONTAINS EXTRA OR INVALID CHARACTERS	The TCM detected an invalid testID format.	Enter a valid testID.
INVALID CHANNEL ID	The requested channel ID is invalid.	Enter a valid channel ID.
INVALID CYCLE CONTROL NUMBERS	A cycle control number containing a non-hex character was entered.	Enter a valid cycle control number.
INVALID ID xxxxxxxx	An invalid test or section ID was entered. (The invalid ID remains in the input area.)	Re-enter test or section ID(s).

Testcase Monitor (TCM) Messages (Part 2 of 5)

Message:	Reason for Message:	User Action Required:
INVALID LOOP CONTROL	A nonhex character was entered in a loop control number.	Re-enter the loop control number.
INVALID OPTION x RE-ENTER OPTION	An invalid option was entered.	Enter a valid option.
INVALID POWER/MEMORY CONFIGURATION CHECK QFS SCREEN	The power group indicated on the DIAG4 diskette does not match the processor.	Copy the configuration data from the FUNCT diskette to the DIAG4 diskette.
INVALID PROCESSOR ID	The serial number on DIAG4 and the hard-wired processor serial number don't match	Use the DIAG4 diskette that matches the processor
INVALID PRINTER - TRY AGAIN	An invalid 3287 printer address was specified.	Enter a valid 3287 printer address.
INVALID SEQUENCE OF TESTS	A segmented test (such as D720-D726) has been selected and the test ID entered is not the ID of the first test.	Press ENTER to return to the diagnostic mode general selection screen.
MOUNT DIAGx → PRESS ENTER WHEN READY	The requested test is not on the diskette that is currently mounted.	Mount the requested diskette and press ENTER.
MSMD CONTROL STORE LOAD: CSLOAD n	To inform the operator that the next MSMD CS load is being loaded. n = the load number, 1 - 7.	None.
MSMD MONITOR ERROR INVALID SECTION (TEST) ID	The MSMD monitor detected an invalid MSMD section or test ID.	Press ENTER to return to the diagnostic mode general selection screen.
MSMD RESET ROUTINE IS EXECUTING	Run status information.	None.
MULTIPLE TESTS MUST BE OF SAME TYPE	A range of tests was selected that included both Basics and MSMDs.	Enter a range of test IDs that includes only Basics or only MSMDs.
NO 3287 PRINTERS ARE AVAILABLE	No 3287 printer is attached to the system.	Select print option F from the print/display screen.
PRESS MODE KEY TO RESTART	An error has occurred that prevents continuing with the test run.	Press MODE SEL to return to the general selection screen.
PRINT ERROR	A TCM command to the console printer failed. This is probably a printer problem.	Press ENTER to return to the general selection screen.
PROCESSING UNIT POWER DOWN. PRESS ENTER. USE POWER SCREENS.	Processing unit power is off.	Press ENTER to return to the general selection screen. Power up the processing unit via the power screens.
RANGE ENTERED NOT ON ONE DISKETTE	The range of tests selected are contained on more than one diskette.	Enter a range of test IDs that is contained on one diskette only.
RANGE ENTERED NOT ON ONE SECTION	The MSMD test range selected is not contained within only one section.	Enter a range of MSMD test IDs that is contained within one section.

Testcase Monitor (TCM) Messages (Part 3 of 5)

Message:	Reason for Message:	User Action Required:
RANGE NOT ALLOWED WITH INTERVENTION	A range of test IDs is not allowed under the FSC mode with intervention option.	Enter a single test ID only.
RDID ERROR: MODID xxxx RTNCODE xx	A diskette error occurred. Some common return codes are: 0F - Diskette not ready 41 - Module not found 81 - Diskette read error	Press ENTER to return to the Diagnostic Mode General Selection screen.
RE-ENTER MESSAGES	An invalid response was entered to a request for information.	Follow the displayed instructions and enter the requested information.
RUN HALTED DUE TO STOP-ON-ERROR OPTION	An error was detected while running under the stop on error option.	Press ENTER to return to the Diagnostic Mode General Selection screen.
SECTION Mxxxxx00 ENDED (STARTED)	Run status information.	None.
SECTION ID NOT VALID FOR TEST LOOP	Only tests (not sections) can run under the test loop option.	Enter a test ID when requested
SECTIONS MUST BE IN SEQUENCE	The selected sections were entered out of sequence.	Enter section IDs in sequence when requested.
SELECT ONE OF THE FOLLOWING 3287 PRINTERS: _ _ _	Select a 3287 printer.	Enter one of the available printer addresses.
SELECTED TESTS xxxx TO xxxx PROCESSED	The selected tests have run to completion.	Press ENTER to return to the Diagnostic Mode General Selection screen.
SELECTED TEST(S) NOT FOUND (OR BYPASSED IN GROUP RUNS)	Either no test exists in the selected range or not all tests in the selected range can be executed.	Press ENTER to return to the Diagnostic Mode General Selection screen.
STATEMENT xxxx HAS JUST FINISHED IF MANUAL INTERVENTION IS REQUIRED: 1. MOUNT THE SYSTEM DISKETTE 2. ENTER YES WHEN READY ELSE, PRESS THE ENTER KEY	Option D (FSC mode with intervention) was selected from the diagnostic mode general selection screen. Execution of basic tests is now at a point where intervention is allowed.	Follow the instructions in the message. If manual intervention is not desired at this point, press the ENTER key.

Testcase Monitor (TCM) Messages (Part 4 of 5)

Message:	Reason for Message:	User Action Required:
SECTION ID AND TEST ID UNPREDICTABLE CS LOAD = Mx	A machine check occurred during an MSMD run. x = the MSMD CS load number (1 - 7), but the TCM can not be certain of which test was running when the check occurred.	Replace the listed FRUs and run the selected tests again.
SERIAL NUMBER ON DIAG4 DISKETTE DOES NOT MATCH MACHINE SERIAL NUMBER	Mismatched serial numbers.	Use the DIAG4 diskette that matches the machine serial number. Also ensure that the machine serial number has been copied onto the diskette.
TEST IDS MUST BE IN SEQUENCE	Selected test IDs were not entered in ascending order.	Enter test IDs in ascending order.
TEST ID: xxxxxxxx PATTERN xx RUNNING	Indicates that the Single-Bit Error test is running.	None.
TEST ID REQUESTED NOT ON ANY DISKETTE	A selected test ID was not found on any diagnostic diskette.	Enter a valid test ID.
UNABLE TO START PU CLOCKS. CHECK CLOCK SKEW DATA ON DIAG4 (QVY22)	Clock delay values may not have been transferred from the FUNCT diskette to the DIAG4 diskette.	See "Diskette Clock Value Update Procedure" in the Adjustments section of the Maintenance Information (MI) manual. Compare the clock delay values on the DIAG4 diskette with the values on the FUNCT diskette. If they are different, transfer the clock delay values from the FUNCT diskette to the DIAG4 diskette.
UNEXPECTED ERROR GO TO MAP 0000 USE REFERENCE CODE BELOW	The support processor has detected an error.	Press ENTER to return to the general selection screen.
VALID MSMD SECTION IS REQUIRED	A section ID (not a test ID) is required when running the section loop option.	Enter an MSMD section ID.

Testcase Monitor (TCM) Messages (Part 5 of 5)

PROCESSOR LOGS

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PROCESSOR LOGS

GENERAL INFORMATION

When a hardware failure or microcode error is sensed, machine status information is collected, formatted, and recorded in a log area on the diskette. The log record is then analyzed either automatically by error log analysis routines or manually by the service representative under the direction of MAPs.

Using the logged error data, error log analysis routines attempt to isolate the problem. The result of the analysis is a reference code that directs the service representative to a repair action via MAPs. For information on reference codes, see the Diagnostic Information section.

The four types of logs are:

- Support processor
- Processing unit
- Reference code history
- Power (for information on the power logs, see the Processor Power section).

Time-of-Day-Clock (TODC) Equivalent

A time-of-day-clock (TODC) equivalent is recorded with each processor log to indicate when the log was taken.

The TODC equivalent is stored in the support processor (SP) and is set initially to 00/001 00:00:00 when the processor is powered on (00/001 is the year and Julian day, respectively). The SP advances the TODC equivalent every 256 milliseconds.

When the time-of-day-clock is enabled, the TODC equivalent is updated to Greenwich mean time (GMT). (See Note.) The TODC equivalent continues to advance every 256 milliseconds, and is corrected to the time-of-day-clock approximately every hour.

Note: When set correctly, the time-of-day-clock reads out in local time and the TODC equivalent reads out in GMT. This is because the operating system stores the local time entered as a GMT value. The difference between these two readings depends on the time zone where the machine is located. There is, for example, a five hour difference between eastern standard time (EST) in the United States and GMT.

How to Display Processor Logs

To display a log:

1. Set the CE MODE switch (on the CE panel) to ON.
2. Press the MODE SEL key. The general selection screen is displayed.

Figure 38-1 shows the selection characters to enter from the general selection screen to display each processor log. To get additional information on the screens listed in Figure 38-1, see the "Description" column.

How to Print Processor Logs

Log screens are printed in the same way that other display screens are printed. For details, see "Screen Copy Options" in the Service Aids section.

Log Type	Screen Name	To display enter:	Summary	Description
Support Processor (SP)	SP Summary	QESA	Contains a summary of the 16 most recent SP error logs.	Figure 38-2
	SP Detail	QESxx	xx = log number (00 - 15) from the SP summary log screen. Displays the complete error log.	Figure 38-3
Power	Power Error	QEL	Contains the four most recent power logs and the eight most recent power reference codes. Each log contains power sensor and control latch status.	Processor Power section
	Temp Trace	QEB	Shows the highest and lowest temperatures sensed at the 01A gate air inlet. Recorded during power-off sequences.	
Processing Unit	Proc Unit Directory	QECD	Contains the last nine processing unit reference codes and a four-character log ID for each. Shows machine and storage error status.	Figure 38-4
	Checks in System	QECDxxxxC	xxxx = log ID from the processing unit directory log screen. Shows the processing unit area that detected the failure.	Figure 38-5
	Scan Rings	QECDxxxxR	xxxx = log ID from the processing unit directory log screen. Shows the status of each scan ring latch at the time of failure.	Figure 38-6
	Proc Unit Summary	QECS	Contains processing unit error statistics.	Figure 38-7
Reference Code	Ref Code History	QERD	Contains the last 31 reference codes.	Figure 38-8

Figure 38-1. 4341 Processor Logs Summary

Model Groups 1 and 2

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Support Processor Logs

All MSS hardware failures and microcode errors are logged if enough of the MSS is operational to permit it.

The two support processor (SP) log screens are:

- SP Summary (Figure 38-2)
- SP Detail (Figure 38-3)

SP Summary (QESA)

The SP summary log:

- Is displayed in CE mode by entering QESA
- Contains a summary of the 16 last SP logs.

For an example of the SP summary log, see Figure 38-2.

Each of the 16 entries has a log number assigned to it and the time that it was recorded. The log numbers range from 00 (the last entry) to 15. To display the detailed information for an entry on this screen, enter QESxx, where xx equals the log number. For additional information, see "SP Detail" and the example shown in Figure 38-3.

To erase the SP summary log:

Enter P. Enter another P when requested.

SP summary log column headings:

LN	Log number. 00 is the last entry.
EVENT	Number of SP logs that have been requested (attempted) since the last SP IML. When the same failure occurs consecutively, all failures are recorded in the event total.
CT	Number of consecutive failures that are the same.
TODC EQUIVALENT	Time of failure. This is the time of the first failure if there have been several failures that are consecutive and the same.
LVL	SP interrupt level. This is the level at which the SP microcode was running at the time of failure.
MM	Master mask.
MC	SP check register contents.
MSW	Microcode status word.
C-IC	Corrected instruction counter value.
INST	Instruction data when error occurred.
ADPT	Adapter address if error occurred during an I/O operation.
SIC	SPIL last instruction address.
LMR	Last module ID read from the diskette.
REF.CODE	Reference code.

SP Detail (QESxx)

The SP detail log:

- Is displayed in CE mode by entering QESxx. xx is a log number, 00 through 15, selected from the SP summary log (QESA).
- Contains detailed error information recorded at the time of failure.

For an example of the SP detail log, see Figure 38-3.

Fields in the SP detail log display:

LEVEL	Level that the SP microcode was running at the time of failure
MMASK	Master mask setting
CMASK	Common mask setting
SPCK	SP check register contents
	0 = I/O parity error
	1 = I/O timeout
	2 = SP storage parity error
	3 = SP microcode check
	4 = Burst mode change
	5 = Zero
	6 = Instruction counter change
	7 = Zero

Note: The microcode sets x'12' into the SP check register to force logging when there is no actual SP check.

IOIRR	I/O interrupt request register
MIRR	Microcode interrupt request register
IC	Instruction counter value
PP	Primary page active at time of error
SP	Secondary page active at time of error
ZHCV	Condition code (bits 0-3)
C-IC	Corrected instruction counter value
INST	Instruction at time of failure
LOADPT	I/O adapter address (if the failure occurred during an I/O operation)
IOCMD	I/O command to a device attached directly to the SP bus
LMR	Last module ID read from the diskette
LMRBASE	Last module ID base program read
REFCODE	Reference code
RC EXTN	Reference code extension

(Continued)

```

***SP LOGOUT SUMMARY***          CURRENT TODC EQUIVALENT: 80/135 10:19:42
=====
LN EVNT CT TODC EQUIVALENT LVL MM MC --MSW--- C-IC INST ADPT SIC- LMR- REF.CODE
00 0008 01 80/115 08:08:48 07 00 20 842C2F2E 842A EE85 0000 2126 96A2 5010C02E
01 0001 07 80/114 04:03:23 07 00 12 7B7E3534 7B7E EE05 0000 5ED0 2020 F5000124
02 000A 07 80/101 02:04:49 07 00 40 79C03534 79BE 671E 0000 5ED0 2020 F5000924
03 0008 02 80/092 09:04:39 07 00 12 0AC23D3C 0AC2 EE15 0000 312A 930B FD000266
04 0007 01 80/090 03:08:08 07 00 12 05722F2E 0572 EE85 0000 317E 930B FD000124
05 0006 01 80/089 02:03:38 07 00 12 792E2F2E 792E EE05 0000 3B1A 3010 F5000224
06 0005 01 80/085 05:03:29 07 00 12 06C02F2E 06C0 EE85 0000 26AC 2025 EC1C0120
07 0004 01 80/075 08:03:30 07 00 12 06C02F2E 06C0 EE85 0000 26AC 2025 EC1C0120
08 0002 02 80/074 06:01:57 07 00 12 792E3534 792E EE05 0000 60C2 1020 F5000124
09 0001 01 80/066 06:01:53 07 00 12 792E3534 792E EE05 0000 60C2 1020 F5000224
10 0018 05 80/056 00:00:49 06 00 12 792E3332 792E EE05 0000 E550 3000 F5000124
11 0011 07 80/043 01:10:43 07 00 12 06C02F2E 06C0 EE85 0000 26AC 2020 EC1C0120
12 000A 07 80/030 03:07:50 07 00 12 06C02F2E 06C0 EE85 0000 26AC 2025 EC1C0120
13 0008 02 80/021 12:03:44 07 00 12 792E2F2E 792E EE05 0000 3B1A 3010 F5000224
14 0007 01 80/021 09:03:34 07 00 12 06C02F2E 06C0 EE85 0000 26AC 2025 EC1C0120
15 0001 06 80/001 03:54:08 07 00 12 85122F2E 8512 EE05 0000 34B0 3070 EC517464

SELECTION: SA          = >

3804 3800
    
```

Figure 38-2. SP Summary Log (QESA)

```

SP LOG 00  TIME: 00/001 00:08:48  ID: 0000004341  EC: 0154312  EVENT 0002
=====
07 LEVEL      842C IC          00 IOADPT      10001000A838B038A238B0390000 CNFG
00 MMASK      2E PP          00 IOCMD      -----MSW'S-----
FF CMASK      2F SP          96A2 LMR      0A18 A120 LVLO      82D0 6362 LVL1
20 SPCK       00 ZHCV       96A6 LMRBASE  456E 2524 LVL2      0000 1514 LVL3
00 IOIRR      842A C-IC      0C5D105D REFCODE  BACA A928 LVL4      C76E AB2A LVL5
01 MIRR       A9CB INST      00000000 RC EXTN  82D0 AD2C LVL6      842C 2F2E LVL7

-----I/O STATUS-----      -----BURST MODE-----      -----PLDA-----
49 DISK       0002 DCA          708A LCA      C8 C1 00 C2 A4 C3
00 SCL        FF1FFF LCA          3F00 74AA DISK  2F AS 20 IM E5 ID
00 PWR        0000000000 CCA      B00E AC80 AD00 AD80 DCA  00 DP C2 CK 70 PG
02 SBA        00000000 PU      B100 AE80 AF00 AF80 DCA  44 TM CO PF 00 BF
                                00 CC 00 CA 00 CT

REGS:2  4  6  8  10  12  14  16  18  20  22  24  26  28  30
0620 5000 0000 842A FA0A 0010 FFFA 8128 216C 2126 8000 86BE 0800 70CB 216C 858C
-----SPIL CURRENT INSTRUCTION-----      -----SPIL LAST INSTRUCTION-----
ADDR:216C  DATA:3600 A000 7061 217C  ADDR:2126  DATA: 5000 243E 216C 04F0
SPIL BRN TABLE:212C 211A 2184 2174 212C 211A 2184 2174 212C 211A 2184 2174 212C

SELECTION: S00          = >

3802 3800
    
```

Figure 38-3. SP Detail Log (QESxx)

Fields in the SP detail log display (continued):

- CNFG Configuration data for the devices attached to the SP bus
- MSW'S Microcode status words for all levels
- I/O STATUS
Status of the I/O devices that are attached directly to the SP bus. (For details, see Figure 38-3.1.)
- BURST MODE
Burst mode register values for each device
- PLDA Program link data area values. (For details, see Figure 38-3.2.)
- REGS Data values in the two active register pages
- SPIL CURRENT/LAST INSTRUCTION
Addresses and data
- SPIL BRN TABLE
Last 13 SPIL instruction branch addresses

<p>DISK - Diskette drive</p> <p>Bit</p> <p>0-1: 00 = Good completion 01 = CRC error 10 = Command error 11 = Hardware error</p> <p>2-4: 001 = Control complete 011 = Busy 100 = Overrun 101 = Timeout 110 = Not found 111 = Not ready</p> <p>5: SP check</p> <p>6: Adapter enable</p> <p>7: Interrupt pending</p>	<p>DCA - Device cluster adapter</p> <p>Extended status (byte 0):</p> <p>Bit</p> <p>0: 63 counter overflow 1: Read timeout 2: Read line parity error 3: Read data parity error 4: Stop polling 5: Timer 6: Error queue entry 7: 0</p> <p>Basic status (byte 1):</p> <p>Bit</p> <p>0: Extended status set 1: Command complete 2: DCA active 3: Key/status Q empty 4: 0 5: SP check 6: Interrupt enable 7: Interrupt request</p>	<p>CCA - Common communications adapter</p> <p>Basic status (byte 0):</p> <p>Bit</p> <p>0: Input request 1: Output request 2: DCE interrupt 3: Timer interrupt 4: Exception 5: SP check 6: Interrupt enable 7: Interrupt request</p> <p>Adapter status (byte 1):</p> <p>Bit</p> <p>0: Overrun 1: Underrun 2: Receive clock running 3: SDLC invalid sequence 4: SDLC frame flag 5: Invalid character 6: Break byte detected 7: Adapter in sync</p> <p>Adapter control (byte 2):</p> <p>Bit</p> <p>0: Receive mode 1: Transmit mode 2: Inhibit zero insertion 3-4: Mode select: auto, EBCDIC, ASCII, SDLC 5-6: Zero 7: NRZI</p> <p>Modem status (byte 3):</p> <p>Bit</p> <p>0: Data set ready 1: Clear to send 2: RLSD 3: Ring indicator 4: DSR transition 5: Reserved 6: RLSD transition 7: CTS transition</p> <p>Modem control (byte 4):</p> <p>Bit</p> <p>0: Terminal ready 1: Request to send 2: Wrap 3: Test 4: Select standby 5: Select half-speed 6: New sync 7: DCE interrupt disable</p>	<p>PU - Processing unit</p> <p>Bit</p> <p>0: Instruction operating bit 1: Microword stop word 2: S/370 mode bit 3: EC/BC mode bit when 370 mode 4: Dynamic address translation 5: PSW wait 6: Channel sequence match 7: CS address match</p> <p>8: Main storage reference match 9: Local storage reference match 10: INDIRO bit 3 11: INDIRO bit 2 12: INDIRO bit 1 13: INDIRO bit 0 14: PU clock run 15: Channel clock run</p> <p>16: Storage refresh clock run 17: Instruction step mode 18: Microword step mode 19: Clock cycle step mode 20: Clock pulse mode 21: Any error disabled 22: Any control storage error 23: Any L1 (stg control) error</p> <p>24: Any channel error 25: Any PU error</p>
<p>SCL - Storage control logic adapter</p> <p>Bit</p> <p>0-1: Unused 2: CE interrupt 0 active 3-4: Unused 5: SP check 6: Level 0 interrupt enable 7: Level 0 interrupt request</p>	<p>LCA - Local channel adapter</p> <p>Adapter status (byte 0):</p> <p>Bit</p> <p>0: S/370 command accepted 1: S/370 status accepted 2: Chaining indicated 3: S/370 stop data transfer 4: Chaining cancelled 5: LCA count=0 6: S/370 interface disconnected 7: LCA status pending</p> <p>Basic status (byte 1):</p> <p>Bit</p> <p>0: SP interface parity error 1: S/370 interface parity error 2: S/370 interface disabled 3: S/370 status pending 4: Adapter busy 5: SP check 6: LCA interrupt enable 7: LCA interrupt request</p> <p>Extended status (byte 2):</p> <p>Bit</p> <p>0: S/370 system reset 1: Stacked status 2: S/370 enable/disable change 3: Reset to selected device 4: CU end sequence error 5: Data abort 6-7: Zero</p>		
<p>PWR - Power</p> <p>Bit</p> <p>0-3: Zero 4: Command check 5: SP check 6: Interrupt enable 7: Interrupt request</p>			
<p>SBA - Support bus adapter</p> <p>Bit</p> <p>0: Control parity error 1: Data parity error 2: Command parity error 3: Address parity error 4: Shift register busy 5: SP check 6: Timer interrupt enable 7: Timer interrupt request</p>			

Figure 38-3.1. I/O Status Field in SP Detail Log

C1: 0 = Processing unit soft stopped 1 = Processing unit hard stopped 2 = 370 PSW; 0=BC, 1=EC 3 = 370 DAT; 0=off, 1=on 4 = Processing unit machine check state 5 = Processing unit check stop state 6,7 - Unused	IM: 0 = Processing unit power up complete 1 = Processing unit IML complete 2 = Mode; 0=VSE, 1=370 3 = Interval timer switch 4 = TODC enable switch 5 = VSE/370 mode swap 6 = Load IPU trace assist 7 = Undefined	CK: 0 - Unused 1 = Stop with double-bit error 2 = Stop key pressed, retry active 3 - Unused 4 = Hardstop on error 5 = No error retry 6 = Disable processing unit error mode 7 = Stop after log	BF: 0 = Block active 1 = Block invoked 2 = Block started 3 = Address compare command 4 = Save variable command 5 - Unused 6 = Verify block 7 = Remove block
C2: 0 = Asynch processing unit stop 1 = Processing unit address compare 2 = MODE or SWAP key pressed 3 = System console request stop 4 = Disable START key 5 - Unused 6 = Disable MODE key 7 = Disable SWAP key	ID: Q = General selection A = Address compare B = Block/patch D = Display/alter E = Error action F = Configuration K = Check control L = Program load M = Power temperature O = Rate control V = Insert/extract Z = Programming system	PG: 0 = E console code loaded when 0 1 = 1052 emulation loaded 2 = Remote console support 3 = LCA CAC loaded 4 = TCM loaded 5 = Retain data bank 6,7 - Unused	CC: 00 = No compare or trace 01 = Equal data compare 11 = Not equal data compare 02 = Trace stop 12 = Trace wrap 22 = Microword/branch trace 42 = 1-counter trace stop 52 = 1-counter trace wrap
C3: 0 = CE MODE switch on 1 = OPER.RATE switch not normal 2 = CHECK switch not normal 3 = ADDR COMPARE not normal 4 = Diagnostic tests active 5 = START key pressed 6 = STOP key pressed 7 = INTR key pressed	DP: 0 = Instruction step mode 1 = Microword step mode 2 = Clock cycle step 3 = Clock pulse step 4 = Repeat microword	TM: 0 = Second timer interrupt 1 = Lvl 6 power monitor complete 2 = Lvl 6 power monitor active 3 = Lvl 6 power monitor scheduled 4 = Power monitor error action 5 = Lvl 1 power monitor complete 6 = Lvl 1 power monitor active 7 = Lvl 1 power monitor scheduled	CA: S = Addr compare softstop T = Trace mode stop W = Trace mode wrap H = Addr compare hardstop Y = Sync pulse only M = Microword trace on B = Microword branch trace
AS: Adapter operational status - 0-1 Zero 4 = Power 2 = DCA 5 = SBA 3 = TP (RSF) 6 = LCA 7 = Diskette		PF: 0 = MSS installed 1 = Processing unit installed 2,3 - Unused 4 = Channel to channel installed 5,6 - Unused 7 = I/O on channels	CT: A = Any storage reference C = Any I/O stg reference D = Any store reference I = 1-fetch reference M = Microword address match L = LS addr dest. match S = LS addr source match

Figure 38-3.2. PLDA Field in SP Detail Log

Processing Unit Logs

The four processing unit log screens are:

- Directory (Figure 38-4)
- Checks in System (Figure 38-5)
- Scan Rings (Figure 38-6)
- Summary (Figure 38-7)

Directory (QECD)

The processing unit directory log:

- Is displayed in CE mode by entering QECD.
- Contains information about the last nine processing unit logs if at least one was caused by an unrecoverable failure. If none of the last nine processing unit logs was caused by an unrecoverable failure, this log contains information about the last eight processing unit logs and the last log that was caused by an unrecoverable failure.

For an example of the processing unit directory log, see Figure 38-4.

Fields in the processing unit directory log display:

ID Log identification number. (assigned sequentially from 0001 through FFFF)

TODC EQUIVALENT Time of failure computed from the current time-of-day clock (TODC) value.

REF CODE Reference code
If the scan ring latch data can not be read, the message "N/A SBA" is displayed instead of a reference code. (N/A means not available.)

STORAGE ERROR Indicates that a storage failure occurred at the address shown. ("ADR N/A" is displayed when the failing storage address is not available.)

Storage error messages:

D Double-bit error
KEY Key error
DK Double-bit error with key
ES Enabled single-bit error
ESK Enabled single-bit error with key

MACHINE STATUS Machine status after the error handling component (EHC) has logged and analyzed the failure. (For additional information, see Figure 38-4.1.)

CHANNEL RESET An "X" indicates that the error handling component (EHC) reset the channel because it was affected by the machine check.

PROCESSING UNIT LOGOUT DIRECTORY MODEL: 4341 SERIAL NUMBER: 000000						
ID	TODC EQUIVALENT	REF CODE	STORAGE ERROR	MACHINE STATUS AND	CHANNEL RESET	
0061	00/001 00:38:13	6E1483AE		CHECK STOP (RESET)		123450
0060	00/001 03:06:08	671805AC	D AT 000100	SUCCESSFUL CC=1 ON I/O	X-----	
005F	00/001 03:02:41	671805AC	D AT 000100	SUCCESSFUL CC=1 ON I/O	X-----	
005E	00/001 00:57:09	EE2756A6		CHECK STOP (FIRST)	XXXXXX	
005D	00/001 08:20:48	553687AE		CHECK STOP (RESET)	-----	
005C	00/001 00:04:59	5E4327A6		CHECK STOP (RESET)	-----	
005B	00/001 00:04:13	5E4327A6		CHECK STOP (RESET)	-----	
				LOGOUT HAS BEEN PURGED		
				LOGOUT HAS BEEN PURGED		
SELECTION: CD ==>						
CSAR: 0000						
3070 3020						

Figure 38-4. Processing Unit Directory Log (QECD)

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Machine Status Messages

Note: (X) Refers to the circled numbers in the flowchart at the right.

- LOGOUT DOES NOT EXIST
There have been less than nine failures or a disk module is damaged and can not be used to save the log data.
- LOGOUT HAS BEEN PURGED
QECP was entered to purge the log.

- 1 SUCCESSFUL RETRY
Processing continues.
- 2 UNSUCCESSFUL RETRY
A second machine check occurred during error retry.
- 3 UNRETRIABLE (NORMAL)
The effect of the failure is too severe to allow retry, or the microcode is unretrieable.
- 4 UNRETRIABLE (NO RETRY)
QKR was entered. Enter QKN to return to normal (retry) mode.
- 5 UNRETRIABLE (EHC)
A machine check occurred during error retry or while trying to isolate the failure to an I/O instruction.
- 6 CHECK STOP (EHC)
A machine check occurred while trying to report a UNRETRIABLE (NORMAL MODE) or UNRETRIABLE (NO RETRY MODE) failure.
- 7 CHECK STOP (FIRST)
The effect of the failure is too severe to allow restart.
- 8 SUCCESSFUL CC=1 ON I/O
The machine check was isolated to an I/O instruction.
- 9 UNSUCCESSFUL CC=1 ON I/O
A machine check occurred while trying to isolate the failure to an I/O instruction.
- 10 CHECK STOP (RESET)
A machine check occurred during a machine reset operation.

Error Handling Component (EHC) Simplified Flowchart

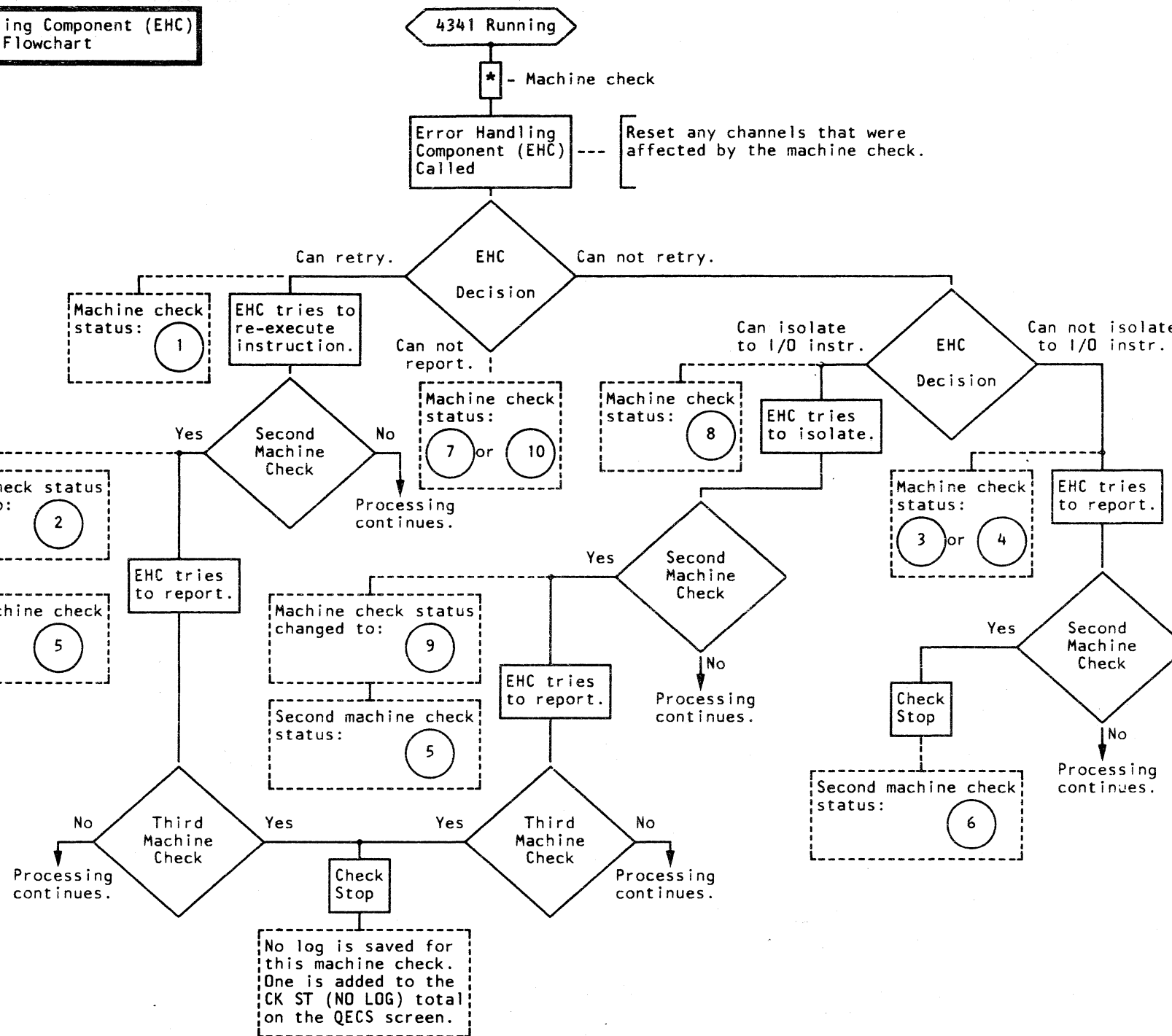


Figure 38-4.1. Directory Log Machine Status Messages

**Checks in System
(QECDxxxxC)**

The processing unit checks in system log:

- Is displayed in CE mode by entering QECDxxxxC. xxxx is the log identification (ID) from the processing unit directory log (QECD).
- Shows the status of the error, disable, and freeze latches at the time of failure. The format and content of this log is the same as the insert/extract checks in system (QVK) screen. For details, see the "Console Functions" section of the Maintenance Information (MI) manual.

For an example of the processing unit checks in system log, see Figure 38-5 (if 4341 Model Group 1) and Figure 38-5.1 (if 4341 Model Group 2).

CHECK AND DISABLE				
SYSCKS	D	F	CARD/AREA	DETAIL LATCHES
1	0		CS CONTROL	0000 0220
0000	0		CS ARRAY	0000 0000 0000 0000
00	0	C	CHN DATA BUFFER	0000 00
0	0	00	CHN CONTROL	0000 00
0	0		CHN INTERFACE	00
0000	0		STG CACHE/DATA	0000 0000 000
00	0		STG CONTROL	0000
00	00		STG SAR/KEY	000
00	00		STG DLAT/DIR	0000 00
00	0	00	PU DATA FLOW	0000 0000 0000 0000 0000
0	0	0	PU SAR	000
0	0	FO	PU DF CONTROL	0000 0000
0	0	4	PU SHIFTER	0000
0	0	F	PU I-CYCLES	0000 0
0	0	C	PU INTERRUPTS	000
0	0	00	PU TIMER	000
0	0		CLK CLOCK	000

SELECTION: CDxxxxC = ▶

Figure 38-5. Processing Unit Checks in System Log (for 4341 Model Group 1)

CHECK AND DISABLE				
SYSCKS	D	F	CARD/AREA	DETAIL LATCHES
1	0		CS CONTROL	0000 0220 0
0000	0		CS ARRAY	0000 0000 0000 0000 00
00	0	C	CHN DATA BUFFER	0000 00
0	0	00	CHN CONTROL	0000 00
0	0		CHN INTERFACE	00
00000000	0		STG CACHE/DATA	0000 0000 0000 00
00	0		STG BSM	0000 0000
00	00		STG SAR/KEY	0000 0000
00	00		STG DLAT/DIR	0000 0000 0000
00	0	00	PU DATA FLOW	0000 0000 0000 0000 0000
0	0	0	PU SAR	0000 0000 00
0	0	FO	PU DF CONTROL	0000 0000
0	0	4	PU SHIFTER	0000
0	0	F	PU I-CYCLES	0000 0
0	0	C	PU INTERRUPTS	000
0	0	00	PU TIMER	000
0	0		CLK CLOCK	000

SELECTION: CDxxxxC = ▶

Figure 38-5.1. Processing Unit Checks in System Log (for 4341 Model Group 2)

**Scan Rings
(QECDxxxxR)**

The processing unit scan rings log:

- Is displayed in CE mode by entering QECDxxxxR. xxxx is the log identification number from the processing unit directory log (QECD).
- Contains the data that was read from the available scan ring latches at the time of failure.

The following scan rings are not logged: 20, 21, 22, 40, 41, 80, 81, 87, C0, and C1. Scanning these rings affects clock operation and would cause the loss of storage data.

Scan ring 25 is read only when a clock error is sensed.

Scan ring 42 is read only when a timer error is sensed.

When QECDxxxxR is entered, the first available scan ring is displayed. The remaining available scan rings are displayed in sequence each time the ENTER key is pressed.

A scan ring can be selected for display by entering QECDxxxxRyy, where yy is the scan ring number. If the selected scan ring is not available, the next available scan ring is displayed.

For an example of the processing unit scan rings log, see Figure 38-6.

PROCESSING UNIT SCAN RING 43			
BYTE	BYTE	BYTE	BYTE
00 1010 0000	01 0000 0000	02 0000 0000	03 1000 0000
04 0100 0010	05 1001 0000	06 0000 0100	07 0000 1111
08 1100 1000	09 0000 0000		

SELECTION: CD0002R44 = ▶

xxxx yyyy

Figure 38-6. Processing Unit Scan Rings Log (QECDxxxxR)

**Summary
(QECS)**

The processing unit summary log:

- Is displayed in CE mode by entering QECS.
- Contains processing unit error statistics.

For an example of the processing unit summary log, see Figure 38-7.

Each entry in this log has two counters:

1. The counters shown on the left can be changed or reset by moving the cursor to the location to be changed and entering the desired value.
2. The counters shown on the right cannot be changed. Error statistics are collected here over the life of the machine.

The group of entries shown in the upper-left part of this screen (SUCCESSFUL RTY through CK ST (MACH RST)) shows the machine status message totals. For information on the machine status messages, see Figure 38-4.1.

Storage error statistics are shown in the lower-left part of the screen:

- DOUBLE (PU) indicates the number of storage failures that were sensed by the processing unit.
- DOUBLE (CHANNEL) indicates the number of storage failures that were sensed by the channel.

The center and right-hand (RH) columns contain error statistics for each area in the processing unit.

PU LOG SUMMARY MODEL: 4341 SERIAL: 000000 CURRENT TODC EQU: 00/001 00:01:12		
0000 0010 SUCCESSFUL RTY	0000 001B CHN CONTROL	0000 001C CLK CLOCK
0000 0001 SUCCESSFUL I/O	0000 0008 CHN DATA BFR H	0000 0000 STG CACHE 0
0000 0023 UNSUCCESSFUL RTY	0000 0007 CHN DATA BFR L	0000 0000 STG CACHE 1
0000 0000 UNSUCCESSFUL I/O	0000 0005 CHN INTERFACE	0000 0001 STG CACHE 2
0000 0000 UNRTY (NORMAL)	0000 0005 CS ARRAY 0	0000 0000 STG CACHE 3
0000 0015 UNRTY (EHC)	0000 0005 CS ARRAY 1	0000 0004 STG CACHE 4
0000 0000 UNRTY (NO RETRY)	0000 0005 CS ARRAY 2	0000 0004 STG CACHE 5
0000 0052 CK ST (FIRST)	0000 0005 CS ARRAY 3	0000 0002 STG CACHE 6
0000 000E CK ST (EHC)	0000 001A CS CONTRDL	0000 0000 STG CACHE 7
0000 0001 CK ST (NO LOG)	0000 000B PU DATA FLOW H	0000 000A STG CONTROL 0
0000 0000 CK ST (MACH RST)	0000 0011 PU DATA FLOW L	0000 001A STG CONTROL 1
	0000 0008 PU I-CYCLES	0000 002F STG DLAT/DIR 0
	0000 0008 PU INTERRUPTS	0000 0016 STG DLAT/DIR 1
0000 0003 KEY	0000 000F PU DF CONTROL	0000 000C STG SAR/KEY 0
0000 0000 ENABLED SINGLE	0000 0008 PU SAR	0000 0002 STG SAR/KEY 1
0000 0000 DOUBLE (PU)	0000 000A PU SHIFTER	
0000 0017 DOUBLE (CHANNEL)	0000 0005 PU TIMER	

SELECTION: CS = ▶

3034 3034

Figure 38-7. Processing Unit Summary Log (QECS)

SYSTEM TESTS

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ST4300

GENERAL INFORMATION

ST4300 is a stand-alone system program that tests the interaction of the 4341 processor and most attached devices. It resides on SOSPC volumes and is self-configuring. ST4300 is received from PID (Program Information Department) with OLTS and is maintained by the hardware CE.

ST4300 also resides on DIAG5. The 3410 and 3420 OLTS are also on DIAG5.

Use the *ST370 User's Guide* (D99-0370A) as the user's guide for ST4300. ST4300 is derived from ST370, and operates the same as ST370 with some exceptions. For the exceptions, see "ST4300 Operational Notes."

Note: *ST4300 does not run in VSE mode; therefore, insert the functional diskette and IML in 370 mode before running ST4300.*

BASIC OPERATING INSTRUCTIONS

1. Clear Storage. (Type in CLEAR when Q screen is displayed on console.)
2. Store X'4300' (if IPLing from OLTSEP tape) in main storage locations 84 and 85 (hex) (QDM84=43).
3. IPL from file-protected OLTSEP tape or system test diskette (DIAG5). If you IPL from the DIAG5 diskette do the following (skip to step 4 if you IPL from OLTSEP tape):
 - a. Set the CE MODE switch ON.
 - b. Enter: QI (using the functional diskette)
This displays the diskette IPL screen.
 - c. Select option S
Message MOUNT PROPER DISK, ENTER appears.
 - d. Insert DIAG5 diskette and press the ENTER key.
ST4300 is loaded (takes approximately 40 seconds).
After loading is completed, the message REMOUNT FUNCTIONAL DISK appears.
 - e. Insert the functional diskette and enter: QRES
 - f. Press the CHG/DPLY key.
 - g. Set the CE MODE switch to NORMAL.

4. After ST4300 is loaded from OLTSEP tape (or the DIAG5 diskette) the system enters wait state (FF01).

Note: *To determine easily the wait code, press the STOP key, and then to continue, press the START key.*

To proceed, make the chosen output device NOT READY, and then READY (a 3287 cannot be used as the output device). A message showing the installed features and a full set of operating instructions is printed (unless you stop the printing by pressing the console INTR key).

Next, ST4300 enters wait state (FF02).

5. You are now instructed to define the input device by causing an attention interrupt on the desired input device (press ENTER if Display Mode; press REQ if PTR/KBD mode).

Next a table of the preconfigured I/O addresses is printed, and the system enters wait state (FF03).

6. You have the option now of removing a device from the table with the DROP command. (If you remove a device via the DROP command, another preconfiguration table is printed.)

If the preconfiguration table is correct, key in CNFG. The unit availability table (UAT) is then printed, and the next wait state is entered (FF04).

7. If the configuration is correct, you are instructed to type GO. After ST4300 loads the tests the system enters wait state (FF05).

At this time, consider the use of additional commands or options (as indicated on the machine instruction printout).

8. ST4300 is now ready to begin testing. Press the INTR key or type GO. ST4300 responds with RUN STARTED, and runs the various tests.

ST4300 OPERATIONAL NOTES

- CE input device 3278-2A or 3278-02 can be used in PRT/KYBD or DISPLAY mode. (When using the 3278-2A in DISPLAY mode, the functional diskette must be at EC 154316 or above.)
- 3278-2A Display Console can be used as the message output device.
- 3278 and 3287 are configured and tested as a 3270.
- 3310, 3340 Natively Attached, 3370, and 8809 are configured and tested.
- 3272-1 and 3277-1 are not supported.

DEVICES SUPPORTED BY THE DIAG5 DISKETTE

1403	Printer
1419	Banking Machine
1442	Reader/Punch
1443	Printer
2311	Direct Access Storage Unit
2314	Direct Access Storage Unit
2321	Direct Access Storage Unit
2400	Magnetic Tape Unit
2415	Magnetic Tape Unit
2420	Magnetic Tape Unit
2501	Reader
2520	Reader/Punch
2540	Reader/Punch
3200	Keyboard
3203	Printer
3211	Printer
3262	Printer
3270	Display
3274	Display
3279	Display
3289	Printer
3310	Direct Access Storage Unit
3330	Direct Access Storage Unit
3340	Direct Access Storage Unit
3344	Direct Access Storage Unit
3350	Direct Access Storage Unit
3370	Direct Access Storage Unit
3375	Direct Access Storage Unit
3380	Direct Access Storage Unit
3410	Magnetic Tape Unit
3420	Magnetic Tape Unit
3505	Reader
3525	Punch
3540	Direct Access Storage Unit
3705	Communication Controller
3800	Printer
3848	Encoder
3890	Banking Machine
8809	Magnetic Tape Unit

Note: *The CTCA Feature is also supported by the DIAG5 diskette.*

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100-100-100-100



ONLINE TESTS (OLTS)

An OLT is a test written for a specific type of I/O device. Most OLTs are able to run in concurrent mode (OLTEP), but some must be run under a stand-alone control program (OLTSEP). These are called *Central Mode* OLTs. Each device is usually supported by a series of OLTs, which contain a complete test for the device.

Some devices, notably older OCR and MICR devices, require time-dependent testing for complete testing. Others, such as two-channel switches, may require precise control of the channels for certain tests. Devices with such requirements usually include some central mode OLTs in the devices OLTs package. These tests should be run under ST4300 and require the customer to give you the system.

OLTEP

OLTEP is a series of programs, one version for each Operating System with OLTEP support. Each OLTEP program supplies a link between the device test (or OLT) and the Operating System chosen by the customer.

LOADING OLT/OLTSEP FROM DIAG5 *

To IPL OLTSEP and tape OLTs from the DIAG5 diskette:

1. Enter: QI
This displays the diskette IPL screen.
2. Enter: Txxxx
xxxx is the device type of the tape drive to be tested.
xxxx can be:
2400 (use for any 2400-type tape drive)
3410
3420
3. The system responds with: MOUNT PROPER DISK,
ENTER.
4. Insert the DIAG5 diskette.
5. Press ENTER key
This loads OLTSEP and the required OLTs.
6. The system responds with: REMOUNT FUNCTIONAL
DISKETTE.
7. Insert the functional diskette.
8. Enter: QRES
This initializes OLTSEP.
9. Press the CHG/DPLY key.
10. Cause an interrupt from the input device (press
ENTER if display mode; press REQ if PTR/KBD
mode).
11. OLTSEP is now functional. For operational
information, see *OLTSEP User's Guide*.

NOTES:

- If wait code FF990A occurs, the console CDS (configuration data set) is incorrect; to continue, press the ENTER key (display mode) or press REQ (PTR/KYD mode) on the desired input device. OLTSEP then autoconfigures that device. If OLTSEP cannot autoconfigure the device, wait code FF990A recurs. (For more information, refer to the *OLTSEP User's Guide*.)

- If the printer CDS is incorrect, you are prompted to enter the address and device type of the output printer.

Sample entry: 00E-1403

After you enter the device address and device type, OLTSEP continues as described in the OLTSEP User's Guide. If a problem occurs, enter blanks in response to the above request (results in wait code FF9906), and then refer to the *OLTSEP User's Guide*. Valid device types are:

1403 3203 3262 3800
1443 3211 3289

- One CDS is available for each of the following types of tape drives:

2400
3410
3420

When you test a tape drive that has standard features, OLTSEP automatically creates a temporary (until the next IPL) CDS for that tape drive (you do *not* have to create a CDS via the CDSGEN function).

Standard Features CDS:

2400 - x'0000 8001 00 000000'
3410 - x'0000 8005 00 000000'
3420 - x'0000 8004 00 000000'

If the tape drive you want to test has nonstandard features, you must use the CDSGEN function. The CDSGEN function gives you the choice of entering CDS information from the operator's console or from a reader. You are prompted to enter Y if you want to use the operator's console to create a temporary CDS. Enter the CDS information as shown below:

ddd mmmm cccc ffff oooo/

ddd = device address
mmmm = model and feature code
cccc = class and type codes
ffff = flags
oooo = optional data (up to 37 bytes)

Example: 181 0000 8004 4400/

For more information, see the *CDSGEN* function in the *OLTSEP User's Guide*.

*Does not apply to EC 154315-154317.



4300-FRIEND for the 4341

INTRODUCTION TO 4300-FRIEND

4300-FRIEND (Fast Running Interpreter Enabling Natural Diagnosis) is a test tool that allows you to analyze complex I/O problems easily and quickly. It is an improvement of the original FRIEND program and is a stand-alone, offline, interpretive, diagnostic program that requires 64K bytes of customer storage and a console display unit. 4300-FRIEND allows you to construct S/370 channel programs in English language along with a formatted data pattern.

4300-FRIEND supports all channel command words (CCWs) for most S/370 files, drums, tapes, card reader/punch units, and teleprocessing devices. You enter each channel command from the console keyboard. Channel programs for up to 99 devices can be entered and run simultaneously. You do not have to learn a strict set of command spellings because several alternatives are provided.

If 4300-FRIEND needs any additional information about the command (such as seek arguments, record numbers, data length, or data) the program asks you for the information.

Several interpreter commands are available for communicating with 4300-FRIEND and for processing CCW chains (4300-FRIEND commands).

- Support of program-controlled interrupt (PCI) and immediate command interrupts.
- Enter the WAIT state after all CCW chains have been started (NO TIME DELAY function).
- Selection of the display console to be used by 4300-FRIEND if the 4341 has multiple display consoles.

4300-FRIEND FUNCTIONS THAT GO BEYOND FRIEND

- Support of S/370 and VSE mode including Indirect Data Addressing.
- Support of CRT-type operator consoles (3277/78, 3279)
- Support of secondary output station (printer) when using 327x.
- I/O instruction trace and I/O interrupt trace.
- Additional 4300-FRIEND commands.
 - Trace of all I/O events (TRACE)
 - System configuration test (CONFIG)
 - Predefined CCW chains (\$\$...)
- Support of new I/O devices.
 - Disks: 3330, 3340, 3350, 3370
 - Printers: 3203-4, 3211, 3262, 3289, 5203
 - Displays: 3277, 3278, 3279

Model Groups 1 and 2

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HOW TO USE 4300-FRIEND

How to Load 4300-FRIEND from Diskette

To load 4300-FRIEND from the DIAG1 diskette:

1. Do a system IML with the functional diskette (either S/370 or VSE mode).
 2. Do a system reset clear (manual operation selection CLEAR).
 3. Place the console in DISPLAY mode.
 4. Set the CE/NORMAL switch to CE mode.
 5. Enter: QI
This displays the diskette IPL screen.
 6. Select option E and press the ENTER key.
Message MOUNT PROPER DISK, ENTER appears.
 7. Insert DIAG1 diskette and press ENTER key.
After 4300-FRIEND is loaded, message REMOUNT FUNCTIONAL DISK appears.
 8. Remove the DIAG1 diskette and insert the functional diskette.
 9. Press the MODE SELECT key on the system display console (the keyboard with the OCP).
 10. Enter: QRES
- Note:** If you are using a single console system, do steps 11 through 13. If you are using a multiple console system, skip steps 11 through 13, and go to step 14.
11. Enter: QZ
 12. Press the ENTER key to start 4300-FRIEND running.
 13. Enter your replies to the 4300-FRIEND requests.
 14. Press the ENTER key on the display console (one without the OCP) that you want to use to control 4300-FRIEND.
 15. Enter your replies to the 4300-FRIEND requests on the display console you selected in step 14. (You can now use the system display console for normal manual system console functions while the display console you selected in step 14 is controlling 4300-FRIEND.)

Overview on Creating a CCW Chain

To create a CCW chain, do the following (as required):

- Respond to 4300-FRIEND requests (see below and "Information Requested by 4300-FRIEND.")
- Respond to 4300-FRIEND messages (see "4300-FRIEND Messages").
- Optionally specify a predefined CCW chain (see "Predefined CCW Chains").
- Specify 4300-FRIEND commands (see below and "4300-FRIEND Commands").
- Specify CCW commands (see "CCW Commands").

The following is a list of the 4300-FRIEND requests. For details about these requests, see "Information Requested by 4300-FRIEND."

ADR=	LOG START=
ATT=	MASK=
BBCCHH=	MASK BYTE=
BL OFFS=	MLCCCBBCCHHRDDS=
BLCK CNT=	MODE (BC/EC)=
CMD=	MODE CMD=
CYL=	MODEL=
DATA=	NUMBER OF TIMES=
DEV=	OP BYTE=
DEV ADDR=	PHY START=
DEV TYPE=	RCD NO=
DL=	REPL CNT=
HARD COPY(Y/N)=	
HD=	SD=
IDAWS IN HEX=	SEC PRINTER ADDR=
KEY=	SECOND SD=
KL=	THIRD SD=
LOG END=	WCC=

The following is a list of the 4300-FRIEND commands. For details about these commands, see "4300-FRIEND Commands."

\$\$?	I
\$\$nnn,*	INCREASE
\$*=hh	INT
? or ??	KEY CAW
ACTIVATE	KEY CCW
ADD	KEY DATA
ALARM	KEY IDA
ALTER KEY	LIST
ALTER nnn	LOOP
BMPX	NO ALARM
BTS	NO BMPX
BUILD	NO COMPARE
CCW	NO DATA DUMP
CHANGE KEYBOARD	NO DECREASE
CHANGE nnn	NO HALT
CLEAR	NO INCREASE
CLEAR\$c	NO INT
COMPARE	NO TEST I/O
CONFIG	NO TIME DELAY
CONNECT	NO WAIT
COPY	POINTER CCW
COUNTER	POINTER DATA
CREATE	POINTER IDA
CSW=xxxx	PRINT SENSE
DATA DUMP	PSW
DECREASE	QUIT
DEVICE=	REMOVE
DISCONNECT	REP
DISPLAY	RESET
DUMP \$	RETURN
DUMP KEY	SCOPE
DUMP	SENSE
DUMP T	SET FB
EX CLRIO	SIZE
EX HDV	START READER
EX HIO	STATUS
EX STIDC	STOP
EX TCH	SUBST
EX TIO	TEST I/O
FLAG	TIME DELAY
GO	TRACE
HALT	WAIT
HELP	

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How to Specify a Single CCW Chain

1. Specify the device address of the unit you want to exercise when 4300-FRIEND asks for it (DEV=).
2. When COMMAND appears on line 20, enter a CCW command and press the ENTER key.
3. Enter any additional information requested by 4300-FRIEND.
4. After you have specified the entire CCW chain, enter GO and press the ENTER key.
The device performs the operation you requested.
5. If you want to specify another CCW chain, press the REQUEST key.
6. When the PROCEED indicator turns on, enter RESET or I.
7. Go to step 1 and specify the new CCW chain.

Examples of a Single CCW Chain

The following example instructs 4300-FRIEND to first seek cylinder 5, head 5 and then cylinder 198, head 9 on device address 260.

```
DEV= DEVICE ADDRESS= 260 (Enter address)
ENTER CCW LIST IN ENGLISH
seek (Enter command)
  CYL=5 (Enter number)
  HD =5 (Enter number)
seek (Enter command)
  CYL=198 (Enter number)
  HD =9 (Enter number)
go
reset
```

The next example instructs 4300-FRIEND to read one block of data from a Fixed Block device (3370).

```
DEV= 240
I/O= 434100-337000
CHAR= 3008210102...
set fb
ENTER CCW LIST IN ENGLISH
def ext
  MASK BYTE= c0
  PHY.START=
  LOG.START=
  LOG. END = 31
locate
  OP. BYTE = 06
  REPL. CNT=
  BLCK. CNT= 32
  BL. OFFS.=
read fb
  DL= 16384
loop 1
go
LOOP IS FINISHED ON UNIT 0240
```

Restrictions

4300-FRIEND inserts TIC *-8 or SET FILE MASK CCWs if it is left out. This can create an invalid CCW chain.

Example of an Invalid CCW Chain:

```
seek
  CYL= 5
  HD= 1
search ha eq
write r0
N 10
SET FILE MASK INSERTED (Placed before the WRITE R0)
  KL= 0
  DL= 100
```

The sequence in the above CCW chain is invalid because the *write r0* command is not directly preceded by a SEARCH CCW. You must specify a Set File Mask before the *search ha* command.

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Advanced Capabilities of 4300-FRIEND

How to Specify Multiple CCW Chains

To enter (and run) multiple CCW chains for the same or different devices, do the following:

1. Do steps 1 through 4 in "How to Specify a Single CCW Chain." (After you enter GO and press the ENTER key, the first CCW chain begins to run).
2. Press the ENTER key again (while the first CCW chain is running).
3. When PROCEED appears on line 20, enter dev= xxx (substitute a hexadecimal device address for xxx). You can enter the previously-specified device address or a different device address.
4. Do not enter RESET.
5. Enter the CCW chain to be overlapped.
6. Type GO.
7. Repeat steps 2 through 6 to enter another CCW chain.

To modify one or more of the CCW chains in a multiple CCW chain, see "Modifying Existing CCW Chains."

Example of a Multiple CCW Chain

This example assumes that you are overlapping a seek operation on devices 160 and 161.

```
DEV= 160
ENTER CCW LIST IN ENGLISH
seek
  CYL= 0
  HD = 1
seek
  CYL= 100
  HD = 2
go      (First CCW chain starts to run)
(Press ENTER)

dev=161  (Enter address for next CCW chain.)
seek
  CYL= 100
  HD = 3
seek
  CYL= 200
  HD = 4
go      (Both CCW chains run)
```

Symbolic I/O Areas

You can reference the data address specified in one CCW from another CCW by using 4300-FRIEND. This allows you to first read and then write the same data or vice versa. Also by using the same area to read into and write from, you can conserve storage space.

For disk files, the symbolic I/O area applies only to the data area of any count-key-data (CKD) or key-data command. 4300-FRIEND uses data chaining to get the data field of these commands.

To use symbolic I/O areas:

1. Enter the normal READ, WRITE, PRINT, etc. commands followed by a comma and *into \$x* if the command is an input command, or *from \$x* if the command is an output command.

x can be any keyboard character, but using characters a to z is recommended for ease of cross-referencing. Characters entered in lowercase are converted to uppercase.
2. If your data is in character and hexadecimal format, use the CREATE/BUILD command. This command builds a symbolic output area that can be used by subsequent write-type CCW commands.
3. If this is your first use of a symbolic character, 4300-FRIEND asks for the normal additional information. If you have already used the symbolic character and no RESET command has been issued, you are not asked for the data length or the data field (the Symbolic Table generated by 4300-FRIEND contains the corresponding data address and the implied length of the data area).

To get a list of the assigned symbolic names use the DUMP\$ command.

Example 1: Writing Disk Records 0 and 1 From Same Area

```
DEV= 160
ENTER CCW LIST IN ENGLISH
seek
  CYL= 5
  HD = 1
set file mask
  MASK= c0
search ha eq
tic *-8
write r0,from$a      ($a points to data area)
  KEY=
  DATA= 500xf0f0    (Data field is 1000 bytes long)
write count key data,from $a
  RCD NO.= 1
  KEY=
go
```

Example 2: Using the CREATE/BUILD Command

```
DEV= 184
create 50,$b      (Create area $b with length 50)
  DATA= x02
  DATA= 4cABCDEF1234
  DATA= x03
  DATA=          (Press ENTER to end requests)
write,from$b
read backwards
read into $a
  DL= 50
1-compare $a,$b  (Specify data compare)
go
  (Press ENTER)
counter          (Print loop counter)
01-UNIT=0184, LOOP= 0000000/0001585 -A
go              (Restart operation)
```

CCW Chain Sequence Control and Delay Between CCW Chains

The WAIT command causes 4300-FRIEND to wait until a CCW chain routine has been completed (device end interrupt) before the next CCW chain is started. You usually use the WAIT command with symbolic I/O areas when you are writing data that was read by a previous CCW chain; this ensures that all the data is read before the write CCW is run. You can also use the WAIT command for a single CCW chain. To use WAIT:

1. Specify WAIT (optional nn milliseconds) anytime during the entry of the CCW chain.
2. After you enter WAIT in the last CCW chain, enter GO.

Example 1: Tape to Printer (80/80 list)

```
DEV= 281
ENTER CCW LIST IN ENGLISH
read,into$a
  DL= 80
wait
DEV= e
print,from$a
csw=01
sns=01
wait
go
```

Example 2: WAIT with Time Delay (Single CCW Chain)

```
reset
DEV= 185
ENTER CCW LIST IN ENGLISH
write
  DATA= 100xf0f0
wait 500 (Causes delay of 500 ms after device end
before starting the next write CCW)
go
```

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Data Compare

Specify the COMPARE command anytime during the entry of a CCW chain. If you are using symbolic I/O areas, you must have already defined them. 4300-FRIEND compares the areas at each completion of the CCW chain.

COMPARE \$r,\$s,nn In this command, \$r and \$s are any previously defined symbolic I/O areas. If you do not specify the optional compare length nn, 4300-FRIEND uses the length of the first operand (r) for the amount of data to be compared.

Example 1: Write & Read Disk Record Zero

```
DEV= 161
ENTER CCW LIST IN ENGLISH
seek
  CYL= xa0
  HD= 7
write ha (Home address is written from seek argument)
SET FILE MASK INSERTED
write r0,from$r
  KEY=
  DATA= 1800xf0f0
read r0,into$s
  KL=
  DL= 3600
compare $r,$s (Length of $r is used)
go
```

COMPARE aa,bb,nn In this command, aa and bb represent the hexadecimal addresses of the areas you want compared (to obtain the addresses, use the CCW command). nn is the number of bytes to be compared in decimal or hexadecimal.

Example 2: Write & Read a Tape Record

```
reset
DEV= 180
ENTER CCW LIST IN ENGLISH
write
  DATA= 1000xff
backspace
read
  DL= 1000
ccw (Display CCW chain)
  1-00A000 01 00D000 6000 03E8
  2-00A008 27 00D3E8 6000 0001
  3-00A010 02 00D3E9 6000 03E8
compare d000,d3e9,1000 (Compare data addresses)
go
```

Increment/Decrement Counter

Use the INCREASE or DECREASE command to increment or decrement a one to four byte field by a specified amount after each running of the CCW chain. You can use this function to modify seek arguments in the data field of a CCW chain or to step a hexadecimal record counter.

Example 1: Record Counter for Tape

```
DEV= 180
write,from $a
  DATA= 100c1234567890
  (See data pointer address in CRT status line
  20 or enter STATUS command.
  ... C= 00A008, 1 D= 00D3E8, 1 !=...
  Subtract 4 from data pointer (D=) to use
  last 4 bytes of write data field as counter.)
increase 4,d3e4,1,0,1
loop 1000 (Write 1000 records)
go
LOOP IS FINISHED ON UNIT 0180
1-stop (Stop first CCW chain)
dev=180 (New UCB)
rewind
loop 1
go
LOOP IS FINISHED ON UNIT 0180
rep1
read,into $b
  DL= 1000
increase 4,d3e4,1,0,1 (Update old $a area)
compare $a,$b (Compare record to expected one)
loop 1000
go
```

Example 2: Modify a device address

The following example shows how you can test a certain range of device addresses for availability (see also CONFIG command).

```
DEV= 0
sense device,into$a
list=1 (Get UCB address)
01-UNIT= 0000, UCB= 0D0000, FL=0019
00A000 E4 00D000 6000 0007
increase 2,d0000,1,xff,0 (Modify device address
  from x'000' to x'0FF')
data dump$a,* (Dump result of sense I/O)
go
```

Data Ripple/Random

RIPPLE and RANDOM are CCW command modifiers that you can specify with a CCW command. If you specify RIPPLE or RANDOM, 4300-FRIEND searches for all CCWs to be rippled or randomized in the CCW chain and either ripples (moves the data pattern one byte to the left) or generates a random data pattern at each completion of the CCW chain. Random data is generated four bytes at a time and data is rippled in blocks of 256 bytes. SEARCH, WRITE HA, and the count field of WRITE COUNT KEY DATA CCWs are bypassed.

Restrictions: Do not use RIPPLE or RANDOM with indirect data addressing (IDA) or with WRITE SPECIAL COUNT KEY DATA CCWs.

Example 1: Write Random Data on Disk

```
DEV= 161
ENTER CCW LIST IN ENGLISH
seek
  CYL= 5
  HD = 1
set mask
  MASK= c0
write ha
write r0,random
  KEY=
  DATA= 3600xff (Data used for first record and
  establishes data length)
read ha (Verify home address)
read r0 (Verify record zero written)
  KL= 0
  DL= 3600
go
```

Example 2: Ripple Data on Printer

```
reset
DEV= e
ENTER CCW LIST IN ENGLISH
space1,ripple
  DATA= 4cABCDEFHGHIJKLMNOPQRSTUVWXYZ1234567
csw=0100
loop
  NUMBER OF TIMES= 500
go
```

Predefined CCW Chains

Specify \$\$xxx to use the predefined CCW chains (and data strings) that are provided by 4300-FRIEND. (Specify \$\$? to display the CCW chains available to you.)

You may need to specify a RESET command or the device address (DEV=cuu) before using a predefined CCW chain. In some cases, the device address is fixed and you must modify it with the n-DEV=cuu or SUBcuu,nnn command. The predefined chains are:

- \$\$001 -Card to Printer (00C/00E)
- \$\$002 -Sets Tape to 1600 BPI (181) and Copies Tape to Tape (180/181)
- \$\$004 -Loads 1403/3203 UCS Buffer with PCS-AN image. (To load the UCS buffer with an image other than the PCS-AN image, see Example 2 below.) You must run routine \$\$010 first to load symbolic data area \$1 with the PCS-AN image (see Example 1 below).
- \$\$010 -Defines four UCS images for symbolic data areas \$A, \$H, \$1, and \$2. \$A = AN-train, \$H = HN-train, \$1 = PCS-AN train, \$2 = PCS-HN train. (Use Examples 1 and 2 below as a guide in the use of \$\$010.)

- \$\$101 -3287 Ripple Print 1 (specify DEV=... before)
- \$\$102 -3287 Ripple Print 2 (specify DEV=... before)
- \$\$110 -327x Display/read (specify DEV=... before)
Two SIOs are used with increments on the screen buffer addresses, and the read data is compared.
- \$\$111 -3278 Display/read (specify DEV=... before)
Same as 110, but with a single SIO.
- \$\$119 -327x Display with Increment (specify DEV=... before)
- \$\$50n -Type RESET before \$\$50n commands, and specify the device address DEV=...
- \$\$510 -3370 - CE Track Initialization
- \$\$520 -3370 - Read FB with Increment

Example 1: Load 1403/3203 With PCS-AN Image

```
DEV= 00e
$$010 (Loads 4 UCS images into symbolic area)
$$004 (Loads UCS buffer with PCS-AN image)
go
LOOP IS FINISHED ON UNIT 000E
```

Example 2: Load 1403/3203 With AN, HN, or PCS-HN Image

```
DEV= 00e
$$010
gtld (Needed for 1403 only)
load ucs,from $x (x is either A (AN), H (HN), or 2 (PCS-HN))
loop 1
go
LOOP IS FINISHED ON UNIT 000E
```

Example 3: Ripple Print Using the AN Image

This example assumes that you have loaded the UCS buffer with the AN image (see Example 2 above).

```
DEV= 2e
$$010 (Gets train data images)
print,from$a,ripple (Ripples AN-train image)
csw=01 (Masks unit exception)
sns=01 (Masks sense x'01')
loop 100 (Do 100 times)
go
LOOP IS FINISHED ON UNIT 002E
```

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Card/Tape CCW Command Input

Use the START READER command to read in the CCW chain(s) from either a card reader or a tape drive. The records must be 80 bytes long and sequential and must contain an exact duplicate of what would have been displayed on the console. This includes the keywords displayed by 4300-FRIEND that request a response from you. Separate the input parameters and operands with a slash (/). The maximum length of a field between two slashes must not exceed 240 characters (the rest is ignored). The data field for EBCDIC data must be immediately terminated by a slash or the blanks between actual end of data and the slash are used as part of the data field. (Do not use slashes within the EBCDIC data fields.) You can use the entire 80 bytes of the record (card) and you can split a parameter between records. If you specify * in the START RDR command (see the examples), 4300-FRIEND displays the input record before any commands are processed (on a CRT only 79 bytes are displayed).

You can group the input records into test cases, each one starting with a QUIT command and a four-digit long test case number in columns three to six of the first record. For example:

```
QT9001 This is test case 9001 /
```

You can end the test case with a RETURN command. You can load the test cases with the START READER,xxx,,nnnn command (nnnn is the number of the test case).

In case of variable hexadecimal digits (for example, SDLC station address), you can use the characters \$ and * in the hexadecimal data fields. These characters are replaced by those specified in a previous \$*=nn command.

You can end the card/tape input mode with the RETURN command or by commands GO, TRACE, SCOPE, or RESET provided in the input record. If syntax errors are detected in the input parameters, the card/tape input mode is ended also.

If a permanent I/O error on the input device causes a program loop, do a program restart or press the external interrupt key twice to return control to the operator's console.

Examples of the START READER Command:

```
DEV= q (Device address not required if specified
       in the input record)
start rdr,c,* (Input device = 00C)
DEV=160 /SEEK/CYL=5/HD=7/SRCH HA/TIC *-8/
       SEEK/CYL=198/HD=9/SRCH HA/TIC *-8/NOP/GO/
```

(Press ENTER; if RESET is not entered, the following CCW chain is overlapped)

```
st rdr,00c.*
DEV=282/WRITE/DATA=1000XF0F0/BSR/RD/
/DL=2000/RETURN/
1-stop (Deactivate first CCW chain)
go (Start to run the last CCW chain)
```

(Press ENTER)

```
s,c.*
DEV=200/DX/MASK BYTE=C6/PHY.START=
/LOG.START=/
LOG.END=31/LC/OP.BYTE=06/REPL.CNT=/
BLCK.CNT=32/BL.OFFS.=/RFB/DL=16384/
INCR3,8805,32,126016,0/TRACE/
```

Storage Protection Key Modification

Use the KEY CAW, KEY CCW, KEY DATA, KEY IDA, DUMP KEY, and ALTER KEY commands to display or modify the storage keys of the different storage areas used for CCW chains. Initially, and after a RESET command, all areas are storage protected with key one (1). The current assignments are displayed on line 20 or after the STATUS command.

You can dump or alter the storage keys of any area with the DUMP KEY or ALTER KEY commands. You can alter the special areas for CCWs, data, and IDAW with the KEY CCW=, KEY DATA=, or KEY IDA= commands. You can display for each CCW chain the key used for the CAW with the CCW=, or LIST= commands in the third flag digit, and you can alter it with the nn-KEY CAW= command.

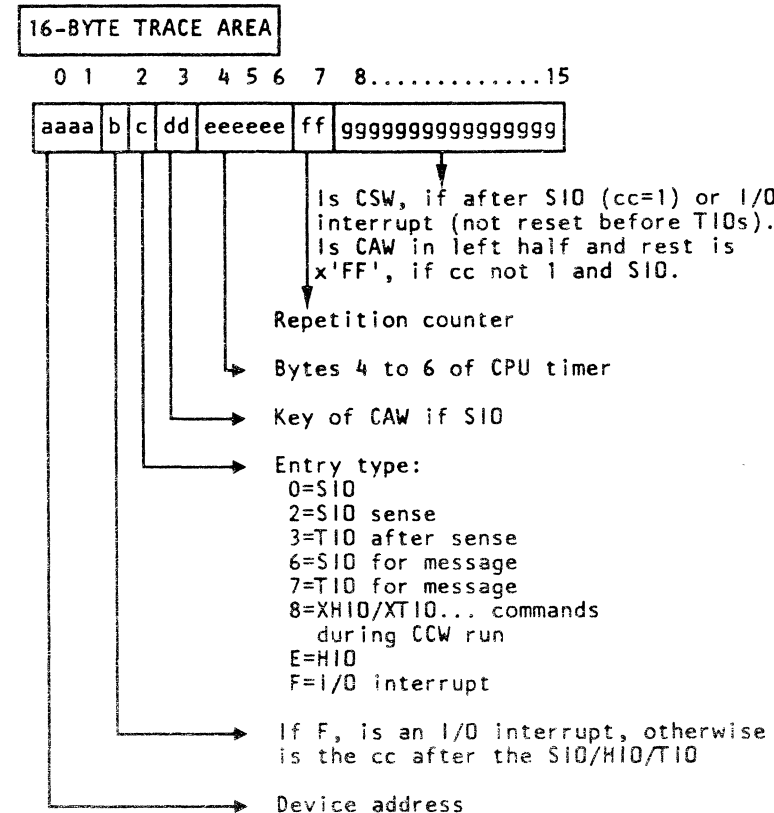
Trace Function

Use the TRACE command to create a trace table in storage of all SIOs issued for, and all interrupts received from, the test devices during the running of the CCW chains. You can use the TRACE command instead of the GO command. If you specify the TRACE,* command, all SIOs, TIOs, and HIOs are traced, including those for the operator console and the secondary printer. You can restrict the trace to one device by specifying a device address with the TRACE command. The trace table start address is stored at location x'040C' and the current trace table pointer at address x'0414'. Use the DUMP function after the trace loop is finished (or the running is stopped).

Example:

```
dump12,40c
00040C 000D2000000D3F70 000D28F0
```

The trace function stores trace information in 16-byte records.



The CPU timer value stored in the trace entry represents bytes 3 to 5 of the doubleword binary counter. The last digit of the stored value is decremented every 16 microseconds.

The one-byte repetition counter is incremented if identical trace entries (except the time value) are stored in sequence. The first entry is stored and all others are ignored.

An entry of 16 bytes containing all x'FF' indicates the end of the current trace area. If the trace reaches the last trace area entry, the trace uses the first entry and all following again. You can display the last trace entries or the complete trace table with the DUMP command, for example, DUMP x300,d20e0. The DUMPT command automatically displays the last trace entries (up to a maximum of 36).

Because the same storage area is used for predefined chains, these chains (command \$\$nnn) are destroyed after a trace run in addition to the HELP command text.

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SPECIAL STORAGE AREAS

- x'0300' Special TIO/SIO loop area.
- x'0400' Four-byte data area address (standard x'D000'). This address should point behind all other FRIEND areas because FRIEND will use the data space up to the end of the storage.
- x'0404' Four-byte CCW area address (standard x'A000' must start on double word boundary).
- x'0408' Four-byte IDA area address (standard x'9F80' must start on word boundary).
- x'040C' Four-byte trace area start address (standard x'4FFF' before storage end).
- x'0410' Four-byte trace area end address (standard x'2FFF' before storage end).
- x'0414' Four-byte current trace entry pointer.
- x'0418' Four-byte address of first unit control block (UCB).
- x'041C' Two-byte internal program version/level (xyyy).
- x'041E' Two-byte secondary output station (printer) address.
- x'0402' Two-byte keyboard device address.
- x'0422' Two-byte printer device address (for internal use).
- x'0424' Two-byte current test device unit address used for TIO.
- x'0426' Two-byte last test device used unit address used for HI0 after 2x external interrupt (INT command).
- x'044C' Control indicator byte (INDBYTE)
 - x'01' = 3277-type console
 - x'10' = Extended control (EC) mode.
- x'044F' SP console control byte x'01' = SP console unit control block area; storage end = x'6FFF'.

To change the area where 4300-FRIEND locates the data area, the CCW area, or the IDA area, include the following patch (REP) card preceding the END (last) card, or alter the storage areas after 4300-FRIEND is loaded by use of the ALTER command. Note that CCWs start on doubleword boundaries and IDAWs on word boundaries and that these areas should not overlap. The data area should be assigned to the last part of the storage.

Patch card format:

```
column
1234 7   17

&REP 000400   XXXX,XXXX (XXXXXXXX is the
2           address of the new data area)
9

ALTER command example:
.
DEV=DEVICE ADDRESS= q   (Any device address)
alter 8,400,xxxxxx (xxxxxx is address of new data area)
0003f8 ..... xxxxxxxx

      (Altered storage displayed)
reset   (Activates changes)
DEV=
```

Unit Control Block (UCB)

For each CCW chain created, 4300-FRIEND uses a special control block called UCB. The address of each UCB can be displayed by using the CCW= or LIST= commands. The length of one UCB entry is 48 bytes.

UNIT CONTROL BLOCK (UCB)

Offset Dec	Hex	Len gth	Contents
00	00	2	Device address
02	02	2	Chain flags: 8000 Wait 4000 Compare 2000 Increase/decrease 1000 Ripple/random/zero (plus indicator in CCW byte 5)
			0800 Data dump 0400 Data dump on operator console 0200 Continue if loop finished 0100 FB device 00x0 CAW key 0008 UCB is used 0004 Device or control unit busy 0002 Chain being executed 0001 Device ready (active)
04	04	4	CCW pointer = address of first CCW
08	08	2	CSW mask bytes set by CSW= command
10	0A	2	Sense bytes mask set by SENSE= command
12	0C	4	Time delay set by WAIT command
16	10	4	Time out counter for missing device end (TIME DELAY)
20	14	4	Operand one address of COMPARE
24	18	4	Operand two address of COMPARE
28	1C	2	Length of compare fields
30	1E	2	Length for DATA DUMP function
32	20	4	Address for DATA DUMP function
36	24	4	Address of the INCREASE/DECREASE table
40	28	2	Loop count; set by LOOP cmd (threshold)
42	2A	2	Number of SIOs run
44	2C	4	Not used

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INFORMATION REQUESTED BY 4300-FRIEND

Listed below are the 4300-FRIEND requests and your replies to them. Enter decimal data with no separation; that is, 123456 (not 123,456 or 123 456). Enter hexadecimal data with a preceding x; for example, x60. If you enter incorrect information, 4300-FRIEND asks you to try again.

If a program loop occurs, enter the character i or perform a program (PSW) restart.

ADR= Specify (in hex) a two-byte 3277 buffer address.

ATT= Specify (in hex) a one-byte 3277 attribute character. The default is x60.

BBCCHH= Specify (in hex) a six-byte 2321 seek argument.

Byte	Function	Range (hex)
0	-----	00
1	Cell	00-09
2	Subcell	00-13
3	Strip	00-09
4	Head position	00-04
5	Head number	00-13

BL. OFFS.= Specify a block offset value for the LOCATE fixed block command. Enter either a decimal value (0 to 4294967295) or a hexadecimal value (x0 to xffffff). The default value is 0.

BLCK. CNT= Specify a block count value for the LOCATE fixed block command. Enter either a decimal value (1 to 65535) or a hexadecimal value (x1 to xffff). The default value is 1.

CMD= Specify a 3277 command.

'SB' = Set buffer address + address
 'SF' = Start field + attribute character.
 'IC' = Insert cursor
 'PT' = Program tabulator
 'RA' = Repeat to address + address and fill character.
 'EU' = Erase unprotected + address
 'EM' = End of message - for printer
 'FF' = Forms feed for printer
 'NL' = New line - for printer
 '.' = ENTER = no command
 '*' = End of data stream (no code generated)

CYL= Specify (in decimal or hex) a cylinder number for a seek command. The default is 0.

DATA= Specify data. 4300-FRIEND repeats the DATA= request until no more data is entered. (You can specify both hexadecimal and decimal data for one symbolic data area by using the CREATE/BUILD command.)

Specify the data in one of the following formats:

nnxhhhhh or nncdddd

nn is an optional decimal duplication factor.
 x indicates hexadecimal data
 hhhhh is the hexadecimal data.
 c indicates EBCDIC data
 ddddd is the EBCDIC data (up to 242 characters). 4300-FRIEND does not convert lowercase characters to uppercase.

Example of DATA=:

DATA= 100xff (100 bytes of x'FF')
 DATA= 1000xf0f0 (1000 groups of x'F0F0')
 DATA= 80c1 (80 bytes of x'F1')
 DATA= 12cab (12 groups of x'818283')
 DATA= 12cABC (12 groups of x'C1C2C3')
 DATA= 12cAaBb (12 groups of x'C181C282')
 DATA= Press ENTER key (indicates all data entered)

DEV=DEVICE ADDRESS= (appears first time only)

DEV= (all other times) Specify a device address in hex. Leading zeros are not required. If you do not specify a device address, 4300-FRIEND uses the last-entered device address or enters the command input mode (if no device address was previously specified). For more details see the DEVICE= command.

DEV. ADDR= Specify the device address of the new operator console or the address of the secondary output station (printer). If the secondary output station address is set to zero, the secondary printer function is inoperative.

DEV. TYPE Specify the type of new console.

1052 = 1052-type console
 3277 = 3277-type console
 3278 = 3278-type console
 3279 = 3279-type console
 SP = 4341 system console with X'83' opcode enabled.
 PRT = Secondary output printer, which must accept a x'09' print command. The PRT function is not used for a 1052 and SP console.

DL= Specify the data length; either a decimal (1 to 32767) or hexadecimal (x0001 to x7fff) value. The default value is 1.

HARD COPY (Y/N)= Specify Y for a copy of all console messages; press the ENTER key if you do not want a copy (4300-FRIEND defaults to the N reply).

HD= Specify (in decimal or hex) a head number. The default is head 0.

IDAWS IN HEX= Specify the real storage addresses for the IDA address list (IDAWs). Enter as many addresses as required, separated by commas (leading zeros are not required). Do not use storage range x'0000' to x'A000' (the 4300-FRIEND program resides there). If data is requested for the CCW, 4300-FRIEND automatically moves the data to the specified real storage area(s).

KEY= Specify the key for the data field. Enter the data as shown for DATA=.

KL= Specify the key length. Enter either a decimal (0 to 255) or hexadecimal (x00 to xff) value. The default value is 0.

LOG. END= Specify the logical end for the DEFINE EXTENT fixed block command. Enter a decimal value (up to 4294967295) or a hexadecimal value (up to xffffff). The default is the value read by the READ DEVICE CHAR fixed block command.

LOG.START= Specify the logical start for the DEFINE EXTENT fixed block command. Enter a decimal value (up to 4294967295) or a hexadecimal value (up to xffffff). The default value is 0.

MASK= Specify (in hex) a one-byte file mask for the SET FILE MASK command (for example, MASK=18). The default is x'CO' (press the ENTER key).

MASK BYTE= Specify (in hex) a one-byte mask for the DEFINE EXTENT fixed block command. If you do not provide a mask, the default mask for the first 12 bytes of the data area is x'00'. 4300-FRIEND sets the last four bytes in the data area to the value read by the READ DEVICE CHAR command (logical end).

MLCCCBBCCHHRDDS= Specify (in hex) 15 bytes of buffer control information for the buffer control record (this is the record transferred to the 2314 on an INIT BUF command).

M = Mode byte; 81 (needs write buffer) or 01
L = Length byte; 6D
CCC = Command 1 (00, 07, 13)
 Command 2 (29, 31, 69, A9, E9)
 Command 3 (05, 06, 0D, 0E, 16, 1A, 35, 3D)
BBCCHH = Seek argument
R = Record number
DD = Data length
S = Search key length

Example:

INIT BUF
MLCCCBBCCHHRDDS= 816d073135000000c3000101005000
WRITE BUF
DATA= 40xf0f0

MODE (BC/EC)= Specify the control mode, BC for Basic Control mode or EC for Extended Control mode. The default is EC.

MODE CMD= Specify (in hex) a MODE SET command code. The default is x93 (7-track tape/800bpi).

MODEL= Specify 41 for the processor model. (This chooses the proper time calculation for the WAIT and TIME DELAY commands).

NUMBER OF TIMES= Specify the number of times you want to run the last entered CCW chain or the CCW chain specified in the LOOP command. Enter 1 to 32767 in decimal.

OP. BYTE= Specify (in hex) the operation byte for the LOCATE fixed block command. The default is x'06'.

PHY.START= Specify the physical start for the DEFINE EXTENT fixed block command. Enter a decimal (up to 4294967295) or hexadecimal value (up to xfffffff). The default is 0.

RCD NO.= Specify the record number to be used in the file identifier field. Enter a decimal (0 to 255) or hexadecimal value (x00 to xff).

REPL. CNT= Specify the replication count for the LOCATE fixed block command. Enter a decimal (0 to 255) or hexadecimal value (x00 to xff). The default is 0.

SD= Specify (in decimal) the defect skip displacement for the 3340/3350 home address.

SEC. PRINTER ADDRESS= Specify the device address of the secondary output printer on which a hard copy of all operator messages are to be printed. You can enter the optional LOG operand after the printer address; for example, OE,LOG (this causes the call of the PRINT LOG function). If you want to modify the secondary printer address later, use the CHANGE KEYBOARD command.

SECOND SD= Specify (in decimal) the second defect skip displacement for the 3340/3350 home address.

THIRD SD= Specify (in decimal) the third defect skip displacement for the 3340/3350 home address.

WCC= Specify (in hex) the 3277 write control character. The default is x'C3'.

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4300-FRIEND MESSAGES

If a message starts with * and the console is a CRT device, 4300-FRIEND waits before displaying the message to allow the use of the ENTER key to stop processing.

If a CRT device is used as the operator console, 4300-FRIEND displays status information on line 20 as shown below:

<...> nn-ccuu-ff C=xxx,kf D=xxx,kf I=xxx,kf mmmm ccc
<...> shows the status as follows:

COMMAND = Enter a 4300-FRIEND command
REPLACE = Enter replace CCW command
RESPOND = Enter requested information
RUNNING = 4300-FRIEND is running CCW chain(s). In case of CPU wait state and stop address x'ODEADO', 4300-FRIEND is waiting for an I/O interrupt from a test device. On a CRT operator console, you can enter 4300-FRIEND commands during this mode without stopping the processing.
TRACING = 4300-FRIEND is tracing CCW chain(s) as they run. See "RUNNING."
SCOPING = 4300-FRIEND is looping on a SIO or TIO command
TIOLOOP = 4300-FRIEND is repeating a TIO command.
PRNTLOG = PRINT LOG function on (copies 4341 console to a line printer).
WORKING = 4300-FRIEND commands are running; no action is required.

The current UCB is displayed together with area pointers. nn = chain number, ccuu = unit address, ff = flag bytes, xxx = area address, k = area key, f = fetch protection on if F, C = CCW area, D = data area, I = IDA area, mmmm = Block multiplexer mode (BMPX) or selector mode (SEL), ccc = card/tape input if CRD.

Status and Operator Messages

\$x aaaaaa llll appears after the DUMP\$ command. x = the symbolic I/O area name, aaaaaa = address (in hex) of the area, llll = length (in hex) of the area.

aaaaaa K=k,F=f,R=r,C=c displays the storage protection keys of a 2k storage area. Address aaaaaa is the first byte of the area, k = storage key in hex, f = fetch protection on if 1, r = reference bit on if 1, c = change bit on if 1.

CHAR= xxx... displays the data received for a READ DEVICE CHAR fixed block command.

COND CODE= n ON UNIT xxxx displays condition code n for device xxxx after an XTIO, XCLRIO, XHIO, XHDV, XTCH, or XSTIDC command. This message is also displayed to indicate the status of the TEST I/O.

Condition code 0 indicates that device xxxx is ready and available.

Condition code 2 indicates that the channel or subchannel, to which the device is attached, is busy.

Condition code 3 indicates that the address is not recognized by a channel or any device on the channel. To enter commands, press ENTER and enter NOTEST. If SCOPE is active, 4300-FRIEND requires a PSW restart to exit from the scope loop.

COND CODE= 1 ON UNIT xxxx

CSW yy yy ... yy yy

SNS zzzzzzzz.zzzzzzzz

displays the condition code, CSW, and sense bytes for device xxxx after an XTIO, XCLRIO, XHIO, XHDV, XTCH, or XSTIDC command.

This message is also displayed to indicate the status of the TEST I/O. Condition code 1 indicates that the channel status word (CSW) was stored.

EC-MODE SET, NO RESET POSSIBLE indicates that the Extended Control Mode was set and no return to Basic Control Mode is possible except by the re-IPL of 4300-FRIEND.

4300-FRIEND STANDARD OPTION SET: displays all the standard options of 4300-FRIEND set during program initialization. If you want to change options, use the BMPX, NO BMPX, TIME DELAY nn, HALT, ALARM, or NO INT commands.

ENTER CCW LIST IN ENGLISH displayed after you enter reply to DEV= at the beginning of a new CCW chain.

EXT-INTRPT BROKE CHAIN indicates that the INT feature was active and that the second EXTERNAL interrupt stopped 4300-FRIEND. The TIO mode and the Card/Tape Input mode are reset.

HALT displayed after 4300-FRIEND detects a condition which requires a program halt. Specify GO to continue.

HALT ON ERROR indicates that an error occurred during the running of a CCW chain. It also indicates a unit check or a permanent CU-busy condition at the device used for the START READER command.

ID = xxxx... displays the ID of the 4341 processor.

I/O= cccctt-ddddtt displays bytes two to seven of the Sense I/O command for the new device specified. This message does not appear if the Sense I/O command is not supported by the device (first byte is not x'FF').

LOOP IS FINISHED ON UNIT xxxx displayed if the CCW chain of unit xxxx has run the number of times specified by the LOOP command. The running of all active CCW chains is discontinued after waiting for outstanding I/O interrupts. If busy devices do not present their interrupt in the time specified by the TIME DELAY command, a Halt I/O is issued.

nn*UNIT=ccuu, LOOP=xxx/yyy - I appears after the COUNTER command. nn = CCW chain number, ccuu = unit address, xxx = loop threshold, yyy = SIO counter. I = active/stopped line indication.

nn*UNIT=ccuu, UCB=aaaaaa, FL=cccc indicates the UCB entry if CCW= or LIST= was specified. nn = CCW chain number, ccuu = unit address, aaaaaa = address, of 34-byte long UCB entry, cccc = active UCB flags.

nn-ccuu-ff C=xxx,kf D=yyy,kf I=zzz,kf mmm appears after the STATUS command. The current UCB is displayed together with area pointers. nn = CCW chain number, ccuu = unit address, ff = flag bytes, xxx = CCW area address, k = area key, f = fetch protection if F, yyy = data area address, zzz = IDA area address, C= CCW area, D= data area, I= IDA area, mmm = block multiplexer mode if BMPX, or selector mode if SEL.

PRINTER NOT READY displayed if the secondary printer is not available or not ready. Make the printer ready or correct the device address.

SET FILE MASK INSERTED indicates that you did not specify a SET FILE MASK command so 4300-FRIEND automatically inserted a Set File Mask CCW preceding the last CCW entered. Because the CCW chain being generated requires a set file mask if you specify a WRITE HA (home address) or WRITE R0 (record zero) command, an invalid CCW chain may result.

START displayed after you start the running of the CCW chain by pressing the ENTER key without input 'GO'.

STORAGE SIZE= xxxxxx displays (in hex) the storage size of the system.

TIC *-8 INSERTED indicates that you did not specify a TIC so 4300-FRIEND automatically inserted a TIC *-8 CCW preceding the last CCW entered. Because the CCW chain being generated requires a TIC if you specify a Search CCW command, an invalid CCW chain may result.

UNIT=xxxx - COUNT=nnn indicates a DATA DUMP print out. xxxx = unit address, nnn = SIO counter.

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Error Messages

-DEVICE QUEUE FULL, LAST CMD IGNORED You have tried to enter more than 99 devices into the device queue. Enter RESET to clear the device queue and start again.

-ENTER 'DEV=' OR 'ADD' BEFORE CCW- You entered a CCW command with an incorrect UCB (device) assignment.

EXT-INTRPT, PSW = xxx/yyy E 4300-FRIEND detected an abnormal external interrupt. xxx is the old PSW for the interrupt.

E at the end of the message indicates an EC mode interrupt. In this case, yyy is the interruption code.

-IDAW POINTS TO PROGRAM AREA Indicates that one of the specified IDA addresses points inside the 4300-FRIEND program. 4300-FRIEND ignores all entered IDAWs and repeats the request for IDAWs.

-INVALID MODEL, USE 31-41 OR 115-168 OR 25-75 Indicates that you specified the wrong model.

I/O-INTRPT, PSW = xxx/yyy E 4300-FRIEND detected an abnormal input/output interrupt (usually from other devices becoming ready). xxx is the old PSW for the interrupt. The CSW and SENSE data are also displayed.

E at the end of the message indicates an EC mode interrupt. In this case, yyy is the interruption code.

-KEYWORD MISMATCH ON INPUT-xxx
4300-FRIEND encountered an error while reading CCW commands from card or tape. The record read must contain all the information that 4300-FRIEND normally requests. The requested information must be in the correct sequence and must be an exact duplicate of the request typeout. xxx is the missing keyword. Enter RESET and then enter START RDR,xxx.

MCK-INTRPT, PSW = xxx/yyy E 4300-FRIEND detected an abnormal machine check interrupt. The log-out area is saved so it can be displayed by the DUMP command. xxx is the old PSW for the interrupt.

E at the end of the message indicates an EC mode interrupt. In this case, yyy is the interruption code.

PGM-INTRPT, PSW = xxx/yyy E 4300-FRIEND detected an abnormal program interrupt. xxx is the old PSW for the interrupt.

E at the end of the message indicates an EC mode interrupt. In this case, yyy is the interruption code.

If PGM interrupts start to be displayed, do a PSW restart. If this does not help, reload 4300-FRIEND. For the DUMP, DISPLAY, or ALTER commands, this error can occur if the specified address is out of storage or the page is disconnected in VSE mode.

SVC-INTRPT, PSW = xxx/yyy E 4300-FRIEND detected an abnormal supervisor call (SVC) interrupt. xxx is the old PSW for the interrupt.

E at the end of the message indicates an EC mode interrupt. In this case, yyy is the interruption code.

-SYMBOL TABLE FULL, LAST CMD IGNORED You tried to enter more than 40 symbolic characters. Type CLEAR\$ to clear the symbol table.

-SYNTAX ERROR- Displayed if the statement or the information was incorrectly spelled, invalid or wrong number of characters was entered, undefined CCW, missing delimiter (comma), unknown verb, etc. Reenter the entire CCW command. (On a CRT-type console, you can enter ? and correct the error).

-SYNTAX ERROR- ON INPUT 4300-FRIEND detected an error in the information entered for a DATA=, KEY=, or BCCCHH= request. Possible data field errors are missing x or c (indicates type of data), or no data after x or c. Reenter the requested information. On a CRT-type console, you can enter ? and correct the error.

-UNDEFINED SYMBOL(S) 4300-FRIEND detected a symbol that was not previously defined. You cannot COMPARE or DUMP from a symbolic I/O area unless it has already been defined by a BUILD or CREATE command, or the FROM or INTO CCW command modifier.

***UNIT=xxxx - CC=1 AFTER SIO**
CSW yyy

SNS zzz
LOOP nnn

Indicates that the Start I/O command is not accepted (condition code = 1). The CSW device status is not control unit busy or device busy or not a single channel end or device end/channel end (immediate commands). Check that the device is ready and online. LOOP counter nnn is not incremented and indicates the number of successfully initiated I/O operations.

***UNIT=xxxx - CC=3 AFTER SIO**
LOOP nnn

Indicates that the Start I/O command is not accepted (condition code = 3). LOOP counter nnn is not incremented.

***UNIT=xxxx - DATA COMPARE ERROR**

BYTE NO.=aaaa \$X=bb \$Y=cc
(one entry for each
byte that failed
to compare)

LOOP nnn

Indicates a data compare error.

xxxx is the hexadecimal device address.
nnn is the loop number that failed.
aaaa is the relative byte number of the two areas compared (first byte = 1).
X represents the first area and is a symbolic character if symbolic I/O areas were used (otherwise = 1).
Y represents the second area (= 2, if no symbolic area).
bb represents the hexadecimal byte in the first area.
cc represents the hexadecimal byte in the second area.

***UNIT=xxxx - INCORRECT CSW**
CSW yyy
LOOP nnn

Indicates any unusual status, for example, attention, unit exception, and any channel status in the CSW.

***UNIT=xxxx - I/O INTRPT,UNIT CHECK**
CSW 00 00D4E0 0E 00 0000
SNS 100020C800 0000000000 ...
LOOP 00662

Indicates that 4300-FRIEND received an I/O interrupt and unit check is on in the CSW. 4300-FRIEND displays the device address that gave the unit check, the actual CSW, and the sense bytes received from the device. If the message ERROR ON SENSE is displayed in front of the sense data, the SIO sense ended with an invalid status.

***UNIT=xxxx - NO DEV-END OR CU-END I/O INTRPT** Indicates that 4300-FRIEND did not receive a device end or control unit end within five to ten seconds after starting a CCW chain or receiving a control unit busy. The delay time depends upon the number of devices running.

You can change the time delay with the TIME DELAY command. If a timeout occurs, 4300-FRIEND issues a HALT I/O to reset the device and then waits another time period for a device interrupt from the HALT I/O.

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4300-FRIEND COMMANDS

In general, all vowels, blanks, periods, and asterisks are ignored in 4300-FRIEND input except in data. You can use a comma to separate a parameter from the command.

For syntax errors or to repeat the previous input, enter a question mark (?). The question mark (?) repeats the last entered 30 characters in the CRT input field. Correct the last command/reply if necessary and press the ENTER key.

If storage addresses are entered for a command, they must be entered in hex with or without leading zeros. Other numeric data (for example, data length) can be entered in either decimal or hex (the hex value must be preceded by an x).

The first line of the commands shows the primary form of the commands; when alternate command forms are allowed, the accepted alternate forms are listed after the primary form.

\$\$?

Use this command to display the first 79 source characters of all predefined CCW chains.

\$\$nnn,*

Use this command to display the source of predefined CCW chain nnn.

\$*=hh

Use this command to assign two hexadecimal digits (hh) for the characters \$ and *. The characters \$ and * in hexadecimal input fields are replaced by the digits assigned. The default value is x'FF'.

? or ??

Use this command (?) to display (and modify) the last input entered on a 3277-type console (up to 30 bytes). If you specify two question marks (??), the next to last input is displayed.

nn-ACTIVATE,*

nn-ACTVT

nn-ACTV

nn-ACT

Use this command to reactivate a CCW chain(s). nn is the UCB number displayed by the LIST= function. If the optional parameter * is specified, all stopped CCW chains are activated (see "LOOP command").

ADD

DD

Use this command to add a CCW to the last CCW chain entered. (4300-FRIEND turns on the command chain bit in the preceding CCW.) For an existing CCW chain, additional CCWs can be added by using the nn-ADD command (see "Modifying Existing CCW Chains").

ALARM

LRM

Use this command to sound an audible alarm after a message appears which requires operator action. To reset ALARM, see the NO ALARM command.

ALTER KEY nnn,addr,k,f

ALTER KEY nnn,\$c,k,f

ALTER KEY \$c,k,f

LTR K ...

ALT K ...

LTK

Use this command to alter the storage key for storage area addr or symbolic I/O area \$c (c can be any alpha character) to the key specified by k. This command also sets fetch protection on if you specify an f as the last operand. The length is nnn bytes.

ALTER nnn,addr,hhhh

ALTER nnn,\$c,hhhh

ALTER \$c,hhhh

LTR

ALT

LT

Use this command to alter up to 80 bytes at address addr or symbolic I/O area \$c (c can be any alphabetic character). Data hhhh is moved to storage. The length nnn of the area to be altered can be specified in decimal or hex. After the alter operation, the changed data is dumped (this includes the preceding and following eight bytes).

BMPX (Enable block-multiplexer mode)

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Use this command to set block-multiplexer mode on (standard if EC mode specified). To disable block-multiplexer mode, see the NO BMPX command.

BTS (Branch to TIO/SIO loop)

Use this command to loop (using a small TIO/SIO loop at address x'300') the last CCW chain entered. Stop the loop by pressing the external interrupt button twice if INT is active. If INT is not active do a PSW restart.

BUILD nnn,\$c

BLD nnn,\$c

CREATE nnn,\$c

CRT nnn,\$c

Use this command to reserve a symbolic data area \$c (c represents any alphabetic value). You can specify the length nnn of the area in decimal or hex. If you specify length zero (0), a data area with length one is created and no data is requested (pointer). The created data area can be used in all following CCWs until you specify the RESET command. (Enter data in response to message DATA=. 4300-FRIEND repeats the DATA= request until you enter no more data or the length count decrements to 0).

CCW or CCW=xxx (List CCWs)

LIST

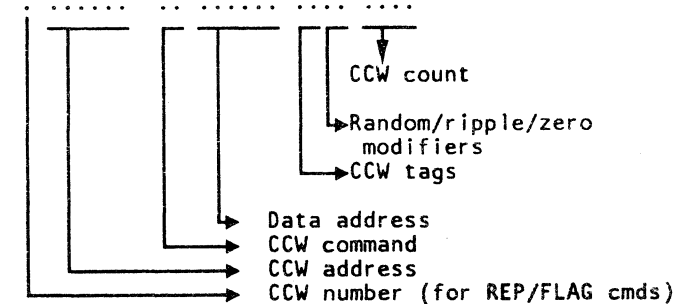
LST

Use this command to display the channel program being generated together with up to 16 data bytes in hex. If you specify a device address, all CCW blocks for this specific device are listed. If you specify a device address of 0 or CCW= alone, 4300-FRIEND displays all CCW blocks of all devices.

If you have not entered GO, the command chain bit is on in the last CCW. If you enter CCW immediately after an I/O error message, the displayed CCW chain is the one that detected the error. The actual failing command is flagged by ** (CCW address in CSW minus 8).

Example:

```
CCW=30
01*UNIT=0030, UCB=0F9000, FL=8009
1-00A000 01 00D000 6010 03E8 RANDOM
2-00A008 27 00D0E8 6000 0001
3-00A010 02 00D0E9 6020 03E8 ZERO
.....
```



UCB= unit control block address for this CCW chain. FL= flag bytes in this UCB. Use the nn-CCW command for one UCB; for example, 2-CCW to display UCB chain two.

**CHANGE KEYBOARD
CHKNGKBRD
CK**

Use this command to request a new keyboard address for command input, or the address of the secondary printer for CRT hard copy.

Note: 4300-FRIEND asks for the device type of the new console/secondary output station. Secondary output station printing produces a hard copy of all messages for the console. If a secondary output station is specified, make sure that it can handle the print CCW x'09'. Reset the secondary output by specifying address = 0 and type = PRT.

**CHANGE nnn,addr,cccc
CHANGE nnn,\$b,cccc
CHANGE \$b,cccc
CHNG**

Use this command to alter up to 80 bytes at address addr or symbolic I/O area \$b (\$b represents any alphabetic character). Data cccc is moved to storage (lowercase characters are accepted). You can specify the length (nnn) of the area in decimal or hexadecimal. After the storage alter operation, the changed area is displayed.

**CLEAR
CLR**

Use this command to clear all CCW execution flags in all active UCBs and to reset the execution counters. You can use this command after an error stop to reinitialize the CCW run sequence.

**CLEAR\$c
CLR\$c
CLR\$**

Use this command to clear the reference to symbolic data area \$c or to all symbolic references if you do not specify a symbolic data area.

**COMPARE \$x,\$y,nnn
COMPARE addr1,addr2,nnn
CMPARE
CMPR
CMP**

Use this command to compare two data areas (addr1 to addr2 or symbolic I/O area \$x to \$y). Specify the length (nnn) of the area in decimal or hexadecimal format (maximum length is 65535 or xfff). If you do not specify a length, the length of the first symbolic I/O area is used. Only two areas can be compared for one CCW chain. The two areas compared can be different in any CCW chain(s).

You can enter COMPARE anytime during the generation of a CCW chain and you can specify it for each CCW chain entered. Any symbolic I/O areas to be used must have been defined before. 4300-FRIEND does the comparison at each completion of the CCW chain.

To reset COMPARE, see the NO COMPARE command.

**CONFIG xxx,yyy
CNFG**

Use this command to test a range of devices (from address xxx to address yyy). If you do not specify device addresses, all device addresses from x'000' to x'FFF' are tested.

4300-FRIEND issues a TIO command, a SIO sense, and SIO sense I/O command to each device. The resulting condition codes, first four sense bytes, and sense I/O information bytes one to seven are displayed. In addition, TCH and STIDC commands are issued for the first device and for all following channel addresses ending with x'00'. The first byte of the channel ID means x'00' = selector channel, x'10' = byte-MPX channel, x'20' = burst-MPX channel. Devices or channels that store condition code 3 after TIO/TCH are not displayed.

All outstanding I/O interrupts are cleared before the CONFIG command. If an I/O interrupt is encountered after one device is tested, a message is displayed.

**CONNECT nnn, addr
CONN nnn, \$c
CNN \$c**

Use this command to connect a storage block of length nnn (full 2K blocks are used).

**COPY xxx
CPY ...
CP ...**

Use this command to copy the last-entered CCW chain for device xxx. The CCW chain is not actually duplicated, instead, the same physical CCW chain is used. This permits the same CCW chain to be run on several devices (of the same type) at the same time.

**COUNTER
CNTR**

Use this command to display the LOOP values and the SIO counters for all active CCW chains/UCBs.

CREATE (see the BUILD command)

CSW=xxxx (CSW status mask)

Use this command to generate a CSW device and channel status mask. The two-byte long hexadecimal xxxx field indicates those bits that you want 4300-FRIEND to ignore. You can enter CSW= anytime during the generation of a CCW chain and you can specify it for each CCW chain entered. The device-end bit cannot be turned off.

**DATA DUMP nnn,addr,*
DATA DUMP nnn,\$c,*
DATA DUMP \$c,*
DTDMP**

Use this command to dump the specified data area (addr or symbolic I/O area \$c) on the secondary printer after running each CCW chain. You do not have to specify the length (nnn) of the area for a symbolic I/O area. If the secondary printer is not specified, the operator console is used for the display. If the optional parameter * is specified, the dump also appears on the operator console.

To reset DATA DUMP, see the NO DATA DUMP command.

**DECREASE n,addr,incr,thr,ini,*
DECREASE
n,addr,incr,thr,ini,n2,addr2,incr2,thr2,ini2,*
DECREMENT
DCR**

Use this command to decrement a counter after each completion of a channel program. Optionally, you can specify a second counter which is updated if the threshold of the first counter is reached. Use this command with the INCREASE command only. See the INCREASE command for the explanation of the parameters.

To reset the DECREASE command, see the NO DECREASE command.

**DEVICE=xxx
DVC=xxx
DEV=xxx
DV=xxx**

Use this command to create a new UCB for the next CCW chain entered with the unit address of xxx (leading zeros are not required). If the device address is *, the address of the operator console is used. The last-entered UCB entry is completed by turning the command chaining bit off in the last CCW.

Note: 4300-FRIEND analyzes the device type at this time. The following commands are run if the device is ready:

For FB device type determination: Sense I/O (x'E4')
2321 determination (if Sense I/O not accepted):
Seek Cylinder (x'0B') - length 4 x'FF.FF'
Seek (x'07') x'000010000000'
After previous checks:
Sense (x'04') - if any error occurred before to clean status.

If the specified device does not handle the above commands, you can specify a dummy device address (for example, 0) and later specify the real device address with the nn-DEVICE= command.

**DISCONNECT nnn, addr
DISC nnn, \$c
DSC \$c**

Use this command to disconnect a storage block of length nnn (full 2K blocks are used). Reconnect the block(s) before using the DUMP/ALTER commands.

**DISPLAY nnn,addr,xxx
DISPLAY nnn,\$c,xxx
DISPLAY \$c,xxx
DSPL**

Use this command to display the contents of storage in character format. Storage is displayed in lines of 64 bytes (maximum) along with the address of the first byte. addr indicates the beginning address; nnn indicates the length (in decimal or hex) of the area to be displayed. You can optionally specify a line printer address xxx for output.

**DUMP \$
DMP\$**

Use this command to dump the names of all assigned symbolic I/O areas along with their storage address and length in hex.

**DUMP KEY nnn,addr
DUMP KEY nnn,\$c
DUMP KEY \$c
DMPK**

Use this command to dump the storage keys of storage area addr for nnn bytes.

**DUMP nnn,addr,xxx
DUMP nnn,\$c,xxx
DUMP \$c,xxx
DMP**

Use this command to dump nnn bytes of storage starting at address addr. You can specify nnn in decimal or hex. Optionally, you can specify a line printer address xxx for output. \$c is any symbolic I/O area specified by a previous BUILD or CREATE command or by the FROM or INTO CCW command modifiers (if you do not specify a length, the one stored for the symbolic field is used). Symbolic address can be offset \$c+a (a = offset 1..F).

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DUMP T
DMPT

Use this command to dump the last entries (36 maximum) of the TRACE area.

EX CLRIO,xxx (Execute Clear I/O)
XC

Use this command to display the condition code received after running the Clear I/O command to device xxx.

EX HDV,xxx (execute Halt Device)
XHD

Use this command to display the condition code received after running the Halt Device command to device xxx.

EX HIO,xxx (Execute Halt I/O)
XH

Use this command to display the condition code received after running the Halt I/O command to device xxx.

EX STIDC,xxx (Execute Store Channel ID)
XS

Use this command to display the condition code received after running the Store Channel ID command for device xxx.

EX TCH,xxx (Execute Test Channel)
XTC

Use this command to display the condition code received after running the Test Channel command for device xxx.

EX TIO,xxx (Execute Test I/O)
XT

Use this command to display the condition code received after running the Test I/O command to device xxx. If you do not specify device address xxx, 4300-FRIEND uses the last device address entered.

FLAG nn,xx (Modify flag byte)
FLGn,xx

Use this command to modify the flag byte in CCW nn to hex value xx. If you specify no value, the flag is set to zero. If you do not specify a CCW number (nn), the last-entered CCW is used.

GO
G
B
EXQ
XQ

Use this command to start running all active CCW chains. After they have started running, the CRT console accepts commands (for example, STOP, ACTIVATE, COUNTER, EXHIO, etc.) without halting the run. You can stop 4300-FRIEND with an I/O interrupt by pressing the ENTER key on the operator's console.

HALT
HLT
H

Use this command to halt processing after an I/O error or false PSW swap occurs. No device is restarted, but additional errors can be indicated. To not halt after an I/O error occurs, see the NO HALT command.

HELP
HLP

Use this command to display operating hints.

I (Initialize)

Use this command to initialize 4300-FRIEND. (This command is the same as RESET except it is accepted in all input fields; for example, in data request.) The device queue, CCW area, data area, and IDA areas are zeroed. All references to symbolic I/O areas (\$a to \$z) are reset. A new device address is requested.

INCREASE n,addr,inc,thr,ini,*
INCREASE n,addr,inc,thr,ini,n2,addr2,inc2,thr2,ini2,*
INCREMENT
INCR

Use this command to increment (advance) a counter after each completion of a channel program. Optionally, you can specify a second counter that is updated if the threshold of the first counter is reached. Use this command with the DECREASE command only.

n = length of the counter (field) 1 to 4.
addr = hexadecimal address of the counter.
inc = optional increment value (in decimal or hex). The default is 1.
thr = optional threshold value (decimal or hex) of the counter at which the counter is initialized. The default = 0.
ini = optional value (decimal or hex) to which the counter is initialized at the beginning and when the threshold is reached. The default is 0.
* = stop processing if threshold of the only or second counter is reached.

To reset the INCREASE function, see the NO INCREASE command.

INT (Interrupt)
NT

Use this command to discontinue the running of CCW chain(s) after the external interrupt button has been pressed twice. A Halt I/O instruction is issued after about five seconds to those I/O devices that are still active. The TIO mode of 4300-FRIEND is reset.

To handle external interruptions normally, see the NO INT command.

KEY CAW=k
KCAW=k
KCW=k

Use this command to specify CAW key k for the running of the CCW chain. k can be any hexadecimal digit 0 to F. The standard key used is 1.

KEY CCW=k,f
KCCW=k,f

Use this command to specify storage key k for the CCW area (for all CCW chains). The standard key is 1 without fetch protection. Specify f to fetch-protect the CCW area.

KEY DATA=k,f
KDATA=k,f
KDT=k,f

Use this command to specify storage key k for the data area (for the next CCW chains to be entered). 4300-FRIEND increments the data area pointer to the next 2K storage boundary and sets the specified key up through the end of storage. The standard key is 1 without fetch protection. Specify f to fetch-protect the data area.

KEY IDA=k,f
KIDA=k,f
KD=k,f

Use this command to specify the storage key k for the IDA area (for all CCW chains). The standard key is 1 without fetch protection. Specify f to fetch-protect the IDA area.

LIST (see the CCW command)

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**LOOP / LOOP nnn,*
LP / LPn,***

Use this command to specify the number of times to loop the entered CCW chain. Specify the loop number nnn in decimal (the maximum number is 65535). The SIO counter is reset to zero.

If the optional parameter * is specified, the CCW chain is stopped when the specified loop count is reached. You can activate the stopped CCW chains again with the ACT,* command. If the parameter * is not specified and the CCW chain has looped the specified number of times, 4300-FRIEND stops the running of all active CCW chains and displays:

LOOP IS FINISHED ON UNIT xxxx
and requests a new command.

Enter GO to repeat the CCW chain(s). You can display the current loop values (thresholds) with the COUNTER command.

**NO ALARM
NLRM**

Use this command to reset the audible alarm on the operator's console.

**NO BMPX
NBMPX
360**

Use this command to set block-multiplexer mode off (standard if BC mode specified).

**NO COMPARE
NCMPR
NCMP**

Use this command to reset the compare indication for the last entered chain, or for the chain specified in the nn-NOCOMPARE format.

**NO DATA DUMP
NDTDMP**

Use this command to reset the Data Dump command.

**NO DECREASE
NDCR**

Use this command to reset the Decrease command.

**NO HALT
NHLT
NH**

Use this command to not halt after an I/O error occurs.

**NO INCREASE
NINCR**

Use this command to reset the increase function.

**NO INT
NNT**

Use this command to instruct 4300-FRIEND to handle the external interruptions normally (no interrupt).

**NO TEST I/O
NTST**

Use this command to reset the TIO mode.

**NO TIME DELAY
NTMDL
NTD**

Use this command to instruct 4300-FRIEND to go to WAIT state after all active UCB devices are started until an I/O interrupt occurs. Devices that do not return a device-end interrupt are not restarted. This mode is recommended, in order to save processor time, if 4300-FRIEND is used in the "Virtual Machine" (VM) environment.

**NO WAIT
NWT**

Use this command to reset the WAIT indication for the last entered chain, or for the chain specified in the nn-NOWAIT format.

**POINTER CCW=xxx
PNTRCCW=...
PTRCCW=...**

Use this command to specify the next CCW's address (xxx) (must be on double-word boundary).

**POINTER DATA=xxx
PNTRDT=...
PTRDT=...**

Use this command to specify the next CCW's data area address (xxx).

**POINTER IDA=xxx
PNTRD=...
PTRD=...**

Use this command to specify the next IDAW's address (xxx) (must be on word boundary).

**PRINT SENSE
PRNTSNS
PRTSNS**

Use this command to display the 32-byte long standard sense area. The TIO mode of 4300-FRIEND is reset.

**Program (PSW) Restart
PSW**

In execution mode, use this command to request a Clear function without counter reset.

**QUIT
QT
Q**

Use this command to quit (cancel) a 4300-FRIEND request for console input (for example, DATA=). The whole last command is ignored, and a new command is requested. The REPLACE function is reset.

**REMOVE=xxx
RMV=xxx**

Use this command to remove all CCW chains for device xxx from the device queue. If you are running several different devices in overlap mode, the complete CCW chain(s) of a device can be removed with this command. If you want to remove a single CCW chain, you must use the STOP command.

REP nn (Replace CCW)

RPn

Use this command to replace CCW nn in the last CCW chain entered with the next CCW that is entered. Use the nn-REP command to modify a specific CCW chain. When you are entering a CCW chain, specifying REP alone, replaces the last entered CCW with the next one.

**RESET
RST
RQT
F**

Use this command to reinitialize 4300-FRIEND. The device queue, CCW area, data area, and IDA areas are zeroed out. All references to symbolic I/O areas (\$a to \$z) are reset. A new device address is requested.

**RETURN
RTRN**

Use this command to change from card/tape input to operator console input. Otherwise, use the GO or TRACE command.

**SCOPE
SCP**

Use this command to loop on a Start I/O or Test I/O instruction. SCOPE can only be used in single CCW chain mode. If you specify SCOPE after a TEST I/O, do a PSW RESTART to exit SCOPE mode. If you specify SCOPE after a START I/O, use the console REQUEST to exit.

**SENSE=xxxx
SNS=xxxx**

Use this command to create a sense byte status mask. The two-byte long, hexadecimal xxxx field indicates those bits to be ignored by 4300-FRIEND in the first two bytes of the sense field. You can enter this command anytime during generation of a CCW chain and you can specify it for each CCW chain entered.

**SET FB (Set fixed-block device)
STFB**

Use this command if a device does not store the correct FB ID after a sense I/O.

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**SIZE
SZ**

Use this command to display the storage size in hexadecimal.

**START READER,xxx,*,nnnn,B
STRTRDR,xxx
STRDR,xxx
S,xxx**

Use this command to read the CCW chain(s) from either a card reader or a tape drive with address xxx. If the second parameter is * all records read are displayed. As an optional third parameter, a four-digit test case number can be specified. This number must be located in columns 3 to 6 of the first record of a test case. If a tape is used and a desired test case has been passed, a fourth parameter B for backward read can be used. 4300-FRIEND skips all test cases up to the one specified.

**STATUS
STTS**

Use this command to print all the program indicators normally displayed on line 20.

**nn-STOP
n-STOP**

Use this command to deactivate CCW chain nn. nn is the UCB number displayed by the LIST= function.

**SUBST xxx,yyy (Substitute)
SBST ...
SB ...**

Use this command to search all channel programs for device address yyy and then change the device address to xxx. If you want to change the device address in a specific CCW chain, use the nn-DEV=xxx CCW chain control command.

**TEST I/O
T
TEST
TST**

Use this command to repeatedly run the TIO instruction (using the last-entered device address only) and display its results, that is, condition code, CSW, and sense bytes. If you specify a loop count for the last entered UCB, the TIO loop can be restricted. To execute the TIO only once, use the EX TIO command. By entering SCOPE instead of GO the display of the result is skipped.

Reset TIO mode by pressing the ENTER key twice (if INT feature is active) or by commands NO TEST I/O, PRINT SENSE, or RESET.

**TIME DELAY nn
TMDL nn**

Use this command to set the timeout counter (for the running of all CCW chains) to decimal nn seconds. An error message is displayed if 4300-FRIEND does not receive a device end for a CCW chain within the specified time period. Also use this command if an operator console or secondary printer is used as a test device. For no time delay, see the NO TIME DELAY command.

**TRACE xxx
TRC**

Use this command to start the running of all active CCW chains and to build up a trace area that contains information about all SIOs and I/O interrupts of all test devices. If you specify an asterisk (*) for device address xxx, the SIOs and TIOs for the operator console and the secondary printer are also traced. If you specify device address xxx, only trace entries for this device are stored in the trace area. You can dump the last entries in the trace area with the DUMPT command.

**WAIT nn,n
WT nn**

Use this command to instruct 4300-FRIEND to wait until the current CCW chain has been completed (device end interrupt) before the next CCW chain is started. If you do not specify nn, 4300-FRIEND starts the next CCW chain immediately upon the receipt of the device end interrupt; otherwise, it waits for nn milliseconds before starting the next CCW chain. The second parameter (n) is optional and specifies 1/10 milliseconds.

To reset the wait function, see the NO WAIT command.

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Modifying Existing CCW Chains

During the creation of a CCW chain, all entered commands are related to the current UCB (the number of the current UCB is displayed on line 20 or after the STATUS command). To modify an existing CCW chain (UCB), specify the UCB/CCW chain number (get the UCB/CCW chain number by using the CCW= or LIST= commands), a dash, and then the command (see below).

Example:

This command modifies the loop count for CCW chain 12:
12-loop 5000

Example:

This command copies CCW chain number 2 to the current UCB by using the same CCWs and data:

2-copy

nn-ACTIVATE Activates UCB/CCW chain number nn.

nn-ADD Adds a command after CCW chain number nn (also see nn-SETFB).

nn-CCW Lists the CCWs of UCB/chain number nn.

nn-COMPARE ... Specifies/modifies COMPARE values.

nn-NO COMPARE Deactivates COMPARE for CCW chain number nn.

nn-COPY Copies CCW chain number nn to the current UCB.

nn-COUNTER Lists the counters of UCB/CCW chain number nn.

nn-CSW=xxxx Specifies/modifies the CSW bits to be ignored.

nn-DATA DUMP Specifies/modifies the DATA DUMP values.

nn-NO DATA DUMP Deactivates DATA DUMP for CCW chain number nn.

nn-DECREASE .. Specifies/modifies the DECREASE values.

nn-NO DECREASE Deactivates DECREASE for CCW chain number nn.

nn-DEVICE= Changes the device address for CCW chain number nn.

nn-FLAG nn,xx Modifies the flag byte in CCW chain number nn.

nn-INCREASE .. Specifies/modifies the INCREASE values.

nn-NO INCREASE Deactivates INCREASE for CCW chain number nn.

nn-KEY CAW= Specifies/modifies the CAW key.

nn-LIST Lists the CCWs of UCB/CCW chain number nn.

nn-LOOP Specifies/modifies the LOOP count.

nn-REP nn Replaces a CCW in CCW chain number nn (also see nn-SETFB).

nn-SENSE=nnnn Specifies/modifies the SENSE bits to be ignored.

nn-SETFB Sets FB type for device (required before nn-REP and nn-ADD commands for 3370).

nn-STOP Stops/deactivates UCB/CCW chain number nn.

nn-WAIT nnnn Specifies/modifies WAIT for CCW chain number nn.

nn-NO WAIT Deactivates WAIT for CCW chain number nn.

For a detailed description of the above commands, see "4300-FRIEND Commands."

CCW Chain Execution Control

Before a SIO is issued, 4300-FRIEND checks the CCW chain and zeros all input areas indicated by the ZERO flag in the CCW.

In case of an I/O interrupt or condition code 1 or 3 after a start I/O instruction, 4300-FRIEND analyzes the CSW and issues the specified UCB control commands in the following sequence:

- Successful completion of a CCW chain (either no error detected or error was masked out by CSW=/SENSE= commands).
 - Data compare.
 - Data dump.
 - Data ripple or random.
 - Increment or decrement storage field.
 - Compare loop count.
- Unsuccessful execution of a CCW chain (error in CSW after I/O interrupt and CSW status not masked).
 - Issue sense command in case of unit check in CSW.
 - In case of all sense bytes being masked and no other error in CSW, handle it as normal interrupt.
 - Display error message.
 - Data dump.
 - Data ripple or random.
 - Increment or decrement storage field.
 - Compare loop count.
- Condition Code 1 (CSW stored) after Start I/O with unexpected CSW status.
 - In case of all CSW status error bits being masked, handle it as immediate interrupt.
 - Issue sense command in case of unit check in CSW.
 - In case of all sense bytes being masked and no other error in CSW, handle it as immediate interrupt.
 - Display error message.
 - Increment or decrement storage field.
 - Retry Start I/O (SIO counter is not incremented). The SIO is not retried if the loop count is one.
- Condition Code 3 after Start I/O.
 - Display error message.
 - Increment or decrement storage field.
 - Retry Start I/O (SIO counter is not incremented). The SIO is not retried if the loop count is one.
- Condition Code 2 (busy) after Start I/O.
 - if WAIT specified, wait until device end is signaled by device, or stop execution if interrupt not received after about five seconds.
 - if WAIT was not specified, start next device (if specified).
- Test I/O Loop (last entered device address at storage location x'420').
 - Print out condition code.
 - Increment or decrement storage field.
 - Compare Loop Count.

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CCW COMMANDS

In general, all vowels, blanks, periods, and asterisks are ignored in 4300-FRIEND input except in requested data. All commands can be entered in either uppercase or lowercase characters.

An underline () after a command indicates that no other character (except a comma or space) should follow it. If you enter other characters after the command, it might be misinterpreted or a syntax error could occur.

Following the CCW command, a CCW flag or CCW command modifier can be entered, separated by a comma.

The CCWs that have an *S* following the command are automatically generated with the Suppress Incorrect Length Indicator (SILI) set on. If you do not want the SILI bit set on, specify NOSILI after the CCW command.

For a detailed description of the device CCWs, refer to the Component Description manual for that device.

General CCWs

CMD HH *S* (Command Code in hex)

Enter any hexadecimal command code. If the last hex digit is odd, data is requested.

HEX HHHHHHHHHHHHHHHHH (Complete CCW in hex) HX HHHHHHHHHHHHHHHHH X HHHHHHHHHHHHHHHHH

Enter a complete CCW in hex. Sixteen hex characters are packed into an 8-byte CCW and inserted into the CCW chain. The data address in the CCW is changed to point to the next available data area location of 4300-FRIEND (if SKIP bit is not on in CCW flag). Blanks can be inserted to separate fields. No CCW flag or CCW command modifier can be specified.

NOP (x'03') *S* (No-operation) NP

READ (x'02') *S* (Read) RD R

SENSE (x'04') *S* (Sense) - (length always 32 bytes) SNS

Standard sense bits are (byte zero):

- x'80' = Command reject
- x'40' = Intervention required
- x'20' = Bus-out check
- x'10' = Equipment check
- x'08' = Data check
- x'04' = Overrun

SENSE I/O DEVICE (x'E4') *S* (Sense I/O Device) SENSE DEVICE SNSDVC SNSN

TIC *-n..n or -n..n (x'08') (Transfer in channel) TIC *+n..n or +n..n TC

n..n is the decimal number of bytes for the channel to transfer to (displacement) the * and + or - are optional. If only TIC is entered, *-8 is assumed. If X is the first character of n..n, the following characters are taken as hexadecimal displacement.

WRITE (x'01') *S* (Write) WRT WR W

Disk CCWs

DIAGNOSTIC LOAD (x'53') (Diagnostic Load) DGNTSTCLD DGLD DGL

DIAGNOSTIC WRITE (x'73') (Diagnostic Write) DGNSTCWRT DGWRT DWR DW

ERASE (x'11') *S* (Erase Record) ERAS RS

INIT BUF (x'E3') (Initialize Buffer - 2314) NTBF

M/T + CCW (Set multi-track bit for specified CCW)

MT + CCW

READ BUF (x'E2') (Read Buffer - 2314) RDBF RBF

READ BUFFERED LOG (x'A4') RDBFLG RBFLG RBL (Read Buffered Log - 33XX)

READ COUNT (x'12') (Read Count) RDCNT RCNT RC

READ COUNT KEY DATA (x'1E') *S* (Read CKD) RDCNTKDT RDCKD RCKD

READ DATA (x'06') *S* (Read Data) RDDT RDD

READ DIAGNOSTIC STATUS (x'44') (Rd Diag Stat) RDDGNSTCSTTS RDDGS RDDS

READ HA (x'1A') (Read Home Address) RDH RH

READ IPL (x'02') *S* (Read Initial Program Load) RDPL RD

READ KEY DATA (x'0E') *S* (Read Key and Data) RDKDT RKDT RKD

READ R0 (x'16') *S* (Read Record Zero) RDR0 RRO RR

READ SECTOR (x'22') (Read Sector) RDSCTR RDSC RSC

RECALIBRATE (x'13') *S* (Recalibrate) RCL

RELEASE (x'94') (Device Release - string switch) RLS RL

RESERVE (x'B4') (Device Reserve - string switch) RSV

RESET BUF (x'C3') *S* (Reset Buffer - 2314) RSTBF

RESTORE (x'17') *S* (Restore) RSTR

SEARCH HA EQ (x'39') (Search Home Address Equal) SRCHEQHA SQH SHQ SH

SEARCH ID EQ (x'31') (Search Identifier Equal) SRCHEQID SRCHQD SCHQD SQD

SEARCH ID HI (x'51') (Search Identifier High) SRCHDH SCHDH SDH

SEARCH ID HI EQ (x'71') (Search Id Equal or High) SRCHDQH SCHDQH SDQH

SEARCH KD EQ (x'2D') *S* (Search Key & Data Equal) SRCHQDT SCHQDT SQDT SDT

SEARCH KD EQ HI (x'6D') *S* (Search Key/Data Eq/Hi) SRCHKDQH SCHKDQH SKDQH

SEARCH KD HI (x'4D') *S* (Search Key and Data High) SRCHKDH SCHKDH

SEARCH KEY EQ (x'29') *S* (Search Key Equal) SRCHQK SCHQK SQK

SEARCH KEY EQ HI (x'69') *S* SRCHKQH SCHKQH SKQH

SEARCH KEY HI (x'49') *S* (Search Key High) SRCHKH SCHKH SKH

SEEK (x'07') (Seek) SK

SEEK CYL (x'0B') (Seek Cylinder) SKCL SKCC

SEEK HEAD (x'1B') (Seek Head) SKHD SKHH

SET FILE MASK (x'1F') (Set File Mask) STFLMK STMK SFM

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SET SECTOR (x'23') (Set Sector)

STSCTR
STSC
STS
SS

SPACE COUNT (x'0F') *S* (Space Count)

SPCCNT
SPCNT

WRITE BUF (x'E1') (Write Buffer - 2314)

WRTBF
WRBF
WBF

WRITE COUNT KEY DATA (x'1D') (Write CKD)

WRTCKD
WRCKD
WCKD

WRITE DATA (x'05') (Write Data)

WRTDT
WRD
WD

WRITE HA (x'19') (Write Home Address)

WRTHA
WRH
WH

WRITE H40 (x'19') (Write 3340 Home Address)

WRH40
WH40
WRWH
WWH

WRITE H50 (x'19') (Write 3350 Home Address)

WRH50
WH50
WRMH
WMH

WRITE KEY DATA (x'0D') (Write Key and Data)

WRTKD
WRKD
WKD

WRITE R0 (x'15') (Write Record Zero)

WRTR0
WRR0

WRITE SPECIAL COUNT KEY DATA (x'01')

WRTSPCKD
WRSPCKD
WSPCKD

Fixed Block (FB) Commands - 3370

Fixed block (FB) devices are identified during device address specification time (DEV=...). If the device handles FB (depends on SENSE I/O bytes 4 and 5 which must be x'3370'), the DEVICE CHARACTERISTIC is read and saved for later use. If the device does not store the correct FB ID after the sense I/O command, the SET FB command can be used after DEV=.

DEFINE EXTENT (x'63') (Define Extent - 16 bytes)

DFNXT
DFNX
DX

Requested parameters are:

MASK BYTE= (two hex digits)

PHY.START= (decimal value or up to 8 hex digits preceded by "x")

LOG.START= (decimal value or up to 8 hex digits preceded by "x")

LOG.END= (decimal value or up to 8 hex digits preceded by "x")

If nothing is entered, defaults are: first three parameters all 0. LOG.END is the value read by the READ DEVICE CHAR command (reduced by 1).

DIAGNOSTIC CONTROL (x'F3') (Diagnostic Control)

DGCNTRL
DGCNT
DCNT
DC__

DIAGNOSTIC SENSE (x'C4') *S* (Diagnostic Sense)

DGNSTCS__
DGSNS
DS__

LOCATE (x'43') (Locate - 8 bytes)

LCT
LC
L__

Requested parameters are:

OP. BYTE = (two hex digits)

REPL. CNT= (decimal value or up to 2 hex digits preceded by "x")

BLCK. CNT= (decimal value or up to 4 hex digits preceded by "x")

BL. OFFS.= (decimal value or up to 8 hex digits preceded by "x")

If nothing is entered the defaults are:

OP. BYTE = x'06'

REPL. CNT= x'00'

BLCK. CNT= x'0001'

BL. OFFS.= x'00000000'

READ BUFFERED LOG (x'A4') *S* (Rd & Reset)

RDBFLG
RDBL
RBFLG
RBL

READ DEVICE CHAR (x'64') (Read Dev Char)

RDDVCC
RDDVCC
RDDVC

READ FB (x'42') *S* (Read Fixed Block)

RDFB
RDF__
RFB__
RF__

READ IPL (x'02') *S* (Read IPL)

RDPL

RELEASE (x'94') *S* (Device Release - string switch)

RLS
RL

RESERVE (x'B4') *S* (Device Reserve - string switch)

RSRV
RSV

SENSE EXTENDED (x'84') *S* (Sense Extended)

SNSXT
SNSX
SX__

WRITE FB (x'41') (Write Fixed Block)

WRTFB
WRFB
WFB

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Tape CCWs

BACKSPACE (x'27') *S* (Backspace Record)

BKSP
BK
BSR

BSF (x'2F') *S* (Backspace File)

ERG (x'17') *S* (Erase Record Gap)
RG

FSF (x'3F') *S* (Forward Space File)

FSR (x'37') *S* (Forward Space Record)

MODE SET (x'93') *S* (Mode Set 7-track 800 bpi)
MDST

MODE SET 800 (x'CB') *S* (Mode Set 9-track 800 bpi)
MDST 8

MODE SET 1600 (x'C3') *S* (Mode Set 9-track 1600 bpi)
MDST 1

MODE SET 6250 (x'D3') *S* (Mode Set 9-track 6250 bpi)
MDST 6

READ (x'02') *S* (Read)
RD
R__

READ BACKWARDS (x'0C') *S* (Read Backwards)

RDBCK
RDBK
RDB__
RB__

REWIND (x'07') *S* (Rewind)

RWD
REW

UNLOAD (x'0F') *S* (Rewind Unload)

RUN

WRITE (x'01') *S* (Write)

WRT
WR__
W__

WTM__ (x'1F') *S* (Write Tape Mark)

Card Reader/Punch CCWs

PUNCH (x'01') *S* (2540 punch, fd, sel stacker)

PNCH
PCH

PUNCH BINARY (x'21') *S* (2540 pch bin, fd, sel stkr)
PNCHBNR

PUNCH 42 (x'C1') *S* (1442 pch, eject, sel stacker 2)
PNCH42

PUNCH 42 BINARY (x'E1') *S*
PNCH42BNR (1442 pch binary/eject/sel stkr)

READ CARD (x'02') *S* (Read Card)
RDCD
RCRD
RCD

Printer CCWs

ALLOW DC (x'7B') *S* (Allow Data Check)
LLWDC

BLOCK DC (x'73') *S* (Block Data Check)
BLCKDC

FOLD (x'43') *S* (Fold -3211 + 3203-4)
FLD

GATE LOAD (x'EB') *S* (Gate Load - 1403)
GTLD

IMM + CCW command
MM (Immediate -use with SPACE/SKIP cmds)

LOAD FCB (x'63') *S* (Load Forms Control Buffer)
LDFCB

LOAD UCS (x'FB') *S* (Load UCS Buffer without Folding)
LD UCS
LDCS

For 1403, a GATE LOAD command must be executed before a LOAD UCS.

LOAD UCS F (x'F3') *S*
LDCSF (Load UCS Bufr & Fold -not for 3211)

PRINT (x'09') *S* (Print with one Space after)
PRNT
PRT

RAISE COVER (x'6B') *S* (Raise Cover 3211)
RSCVR

READ FCB (x'12') *S* (Read FCB 3211)
RDFCB
RFCB

READ PLB (x'02') *S* (Read PLB 3211)
RDPLB

READ UCSB (x'0A') *S* (Read UCSB 3211)
RCSB

SKIP n *S* (Skip to Chnl n - n is 1 to 12)
SKPn

SKIP 0 (x'83') *S* (Skip to Channel 0 immediate - 3211)
SKP0

SPACE n (x'cc') *S* (Print with n Space(s) After)
SPCn
n is 1, 2, or 3; command is x'09', x'11', or x'19';
immediate x'0B', x'13', or x'1B'.

UNFOLD (x'23') *S* (Unfold (3211 + 3203-4))

NFLD

WRITE (x'01') *S* (Write without Space)

WRT__
WR__
W__

CAUTION:
This can destroy printer ribbons.

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**CRT and Hard-Copy Printer CCWs
(3277/3278-3287)**

ERASE ALL U (x'0F') *S* (Erase All Unprotected)
RSLL

ERASE/WRITE (x'05') *S* (Erase/Write)
RSWRT
RSW

ERASE WRITE CRT (x'05') *S* (Erase Write 3277 Data)
RSWRTCRT
RSW3277

Instead of DATA= 3277 specific requests are typed.
To end them, enter * after CMD= is typed.
See command table below. *
Do not specify indirect addressing (IDA).

READ BUFFER (x'02') *S* (Read Buffer)
RDBFFR
RBFFR
RBFF

READ MODIFIED (x'06') *S* (Read Modified)
RDMD
RMD

SELECT (x'0B') *S* (Select)
SLCT

WRITE (x'01') *S* (Write)
WRT__
WR__
W__

WRITE CRT (x'01') *S* (Write 3277 Data Stream)
WRTCRT
WR3277
W3277

Instead of DATA= 3277 specific requests are typed.
To end them, enter * after CMD= is typed.
See command table below.
Do not specify indirect addressing (IDA).

Command Table

If you specify WRITE CRT or ERASE WRITE CRT, 4300-FRIEND asks for the 3277 command (buffer control order).

'SB' = Set Buffer Address (x'11') + address
'Sf' = Start Field (x'1D') + attribute character
'IC' = Insert Cursor (x'13')
'Pt' = Program Tabulator (x'05')
'Ra' = Repeat to Address (x'3C') + address and 'fill' character (DATA=)
'Eu' = Erase Unprotected (x'12') + address
'EM' = End of Message (x'19') - for printer
'FF' = Forms Feed (x'0C') - for printer
'NI' = New Line (x'15') - for printer
' ' = ENTER key = no command
'*' = end of data stream (no code generated)

Teleprocessing CCWs (270x, 370x)

ADPREP (x'1E') *S* (Address Prepare)
ADPRP
DPRP
ADP
DP

BREAK (x'0D') *S* (Break)
BRK

CONTROL SCB (x'0B') *S* (Ctl SCB SDLC -16 bytes)
CNTRLS
CS

Address aligned on fullword boundary.
OFS= Enter buffer offset in decimal (default= 2).
ADR= Enter SDLC station address.
FLG= Enter control flag byte in hex;
x'80'= Inactive station (0= active).
x'40'= Datapoll station (0= contact).
x'20'= Send rnr poll (0= rr).
x'10'= Reply rnr to poll (0= rr).
NSC= Enter ns current.
NSA= Enter ns acknowledged.
NRA= Enter nr of next frame to be received.
IDT= Enter four byte identification field in hex.

DIAL (x'29') *S* (Dial, switched line with autocal)
DL

DISABLE (x'2F') *S* (Disable Line)
DSBL

ENABLE (x'27') *S* (Enable Line)
NBL

INHIBIT (x'0A') *S* (Inhibit)
INHBT
NHBT
NH

POLL (x'09') *S* (Poll/Autopoll)
AUTOPOLL
TPLL

POLL SCB (x'09') *S* (Poll SCB -SDLC Autopoll)
PLLSCB
PLLS
Enter SCBs as for Control SCB command.
End command with answer 'n' after Y-N=.

POLL SDLC (x'0F') *S* (Poll SDLC)
PLLS DLC
PLLS D

PREPARE (x'06') *S* (Prepare)
PRPR
PP

READ (x'02') *S* (Read)
RD__
R__

READ PIU (x'06') *S* (Read PIU (SDLC))
RDP

SADn *S* (SAD n -270x n is 0, 1, 2, or 3)
SDn

SENSE SCB (x'14') *S* (Sense SCB SDLC - 24 bytes)
SNSSCB
SNSS
Address aligned on fullword boundary.

WRAP (x'05') (Wrap)
WRP

WRITE (x'01') *S* (Write)
WRT__
WR__
W__

WRITE PIU (x'05') *S* (Write PIU (SDLC))
WRTP
WPIU
WP

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CCW FLAGS

You can enter a CCW flag after a CCW command, a CCW modifier, or another CCW flag (separated by a comma). Note that some CCW flags are automatically set by 4300-FRIEND (after the CCW has been specified, you can change these flags with the 4300-FRIEND FLAG command).

DC (x'80') (Data Chaining)
CD

Causes use of address portion of next CCW (command chaining is not turned on)

IDA (x'04') (Indirect Data Addressing)
D

Note: This parameter must be the last one entered in the CCW command. 4300-FRIEND requests IDA areas for IDAW. Do not specify a CCW command modifier with IDA.

NOSILI (resets x'20')

NSL (Reset Suppress Incorrect Length Indicator)

PCI (x'08') (Program Controlled Interrupt)
PC

Causes a channel controlled interruption. 4300-FRIEND ignores all interrupts with PCI on in the CSW until device end is posted in the CSW.

SILI (x'20') (Suppress Incorrect Length Indicator)
SL

Causes suppression of possible incorrect length indication in CSW.

SKIP (x'10') (Skip transfer)
SKP

Suppress transfer of information to storage.

CCW COMMAND MODIFIERS

Add the following CCW command modifiers to a CCW command for the indicated reasons. You can combine these modifiers where applicable.

CRT or 3277

Requests a special 3277 data stream after WRITE and ERASE WRITE.

FROM
FRM

Specifies a symbolic I/O area is to be used.

INTO
NT

Specifies a symbolic I/O area is to be used.

LENGTH (Data Length)
LN

4300-FRIEND requests key length and data field length for the file count instead of using the amount of data entered from KEY= and DATA= . For commands which have a fixed data length assigned by 4300-FRIEND, use LENGTH to change the fixed data length.

NEW (Reset CCW indicators.)
NW

This modifier resets the disk indicators for:
- TIC required
- Seek argument not required
- Set File Mask required

RANDOM (Random)
RNDM
RN

Generates random data (bypasses 'home address' and 'count fields')

RIPPLE (Ripple data)
RPPL
RP

Moves the data area one byte to the left for all write CCWs.

ZERO
ZR

Clears input area of CCW before execution of Start I/O.

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CHANNEL-TO-CHANNEL ADAPTER

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INTRODUCTION

The channel-to-channel adapter (CTCA) moves data between channels of the 4341 and System/370, or System/360 channels. The connected channels are called channel X and channel Y. The CTCA is located in, and is powered by, the channel X system.

The primary application of the CTCA is to move data between main storage of two processors. The adapter can also be used to connect two channels of the same system for moving blocks of main storage data. (Do not connect to byte multiplex channels in wrap mode.)

The adapter has an X-side and a Y-side that connect as control units to channel X and channel Y. Each side communicates with its channel on tag lines in the same method as any other I/O control unit.

DATA FLOW

The data path through the adapter is one byte wide (eight bits plus a parity bit). Entry is from the channel bus-out lines, and exit is by the channel bus-in lines. The Y-side of the adapter is the same as the X-side. The logic and data path are the same if X and Y are reversed. The descriptions and diagrams are in terms of channel X.

INPUT

Channel X puts three types of information on its bus-out lines during the interface sequence:

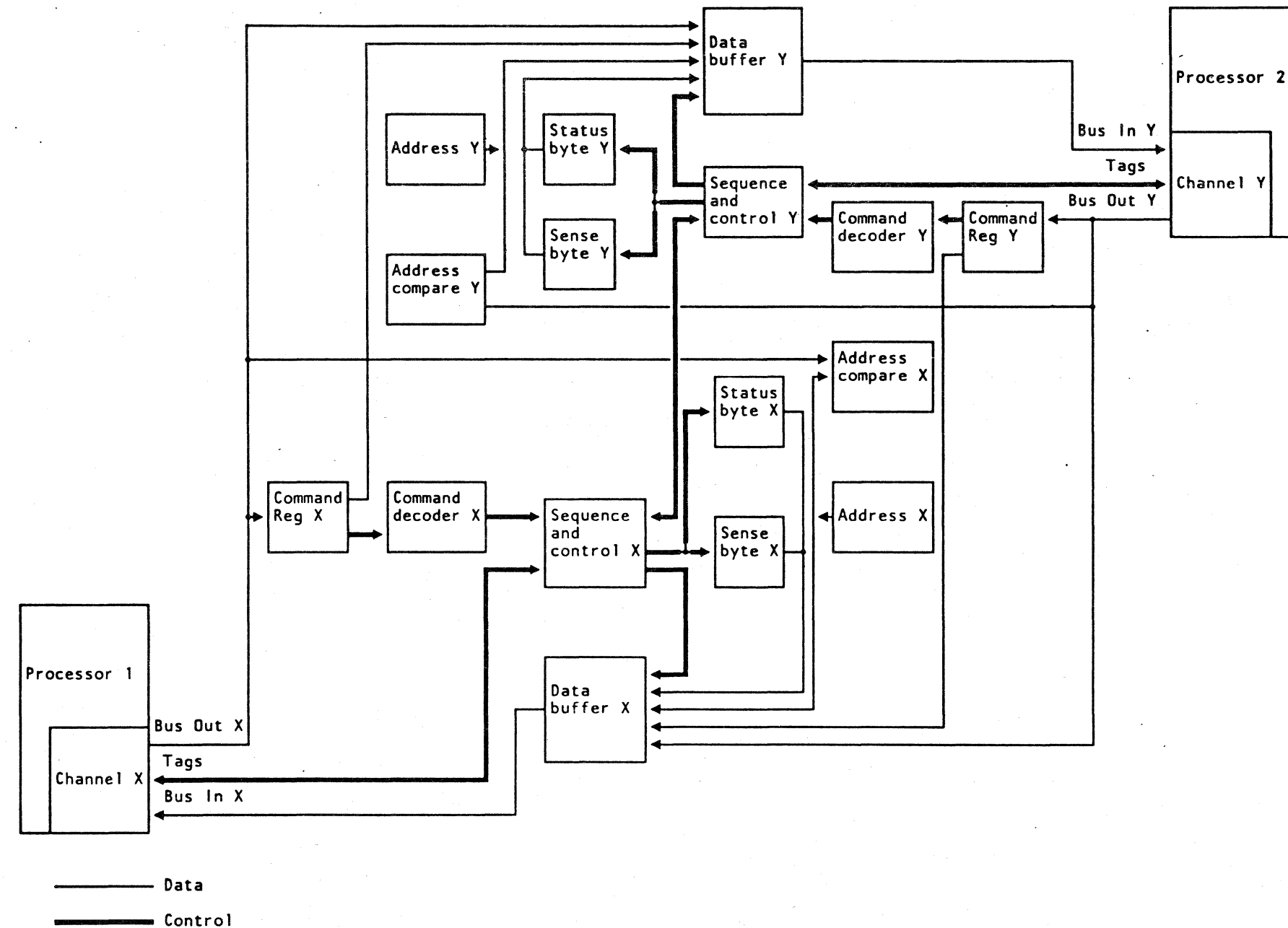
1. At address-out time, the address of the X-side of the adapter goes to the address compare X-circuit.
2. At command-out time, the command byte goes to the command register.
3. At service-out time, the data byte goes to data buffer Y.

OUTPUT

Data buffer Y is the output buffer for the data byte moved from channel X to channel Y. The buffer also sends four other types of information to channel Y on the bus-in Y lines:

1. Address Y, the address plugged on the card, is sent at address-in time.
2. The command register output is sent in response to "sense command byte".
3. The status byte is sent at status-in time.
4. The sense byte is sent in response to sense adapter state.

CTCA DATA FLOW AND OPERATION



OPERATIONAL SUMMARY

Two channels communicate through the CTCA using pairs of operations. For example, a read command from channel X is handled by a write command from channel Y. The adapter responds to the channels with status information that lets the operation continue or indicates the condition that stops the operation.

The CTCA has two nine-bit data buffer registers. Each register of the adapter feeds its associated interface bus-in drivers. These buffers have no common input and an error on one side does not make the adapter unavailable to both channels.

The buffers are loaded from five sources under control of the adapter during different interface sequences.

X Data Buffer Loaded From	Sequence
X Address Generation Bits	Address-In
X Status Information	Status-In
X Sense Information	Sense Status Data
Y Command Register	Sense Command Data
Y Bus-Out	Y Read Data

A command register for each side of the adapter is loaded from its associated bus-out at command-out time, during the initial selection sequence. The contents of the command register is sent to the main storage of the other processor in response to a sense command byte. Therefore, the programmer can see what command was issued by the other channel and also use the modifier bits.

The following operations are described in terms of channel X and/or channel Y. The operations occur in pairs. Therefore, a control command issued by channel Y can only be terminated by a sense command byte from channel X, although a sense command byte from one channel does not need an acknowledgment from the other channel. A Read from channel X can only be handled by a Write from channel Y, although a sense command byte from Y shows the command byte as issued by channel X.

A Start I/O (other than a Sense, Write End-of-File, or a No-Op) generates an attention interrupt on the opposite side of the adapter if no command is already on the opposite side. This attention interrupt signals the program that, on the other side, the adapter has an active I/O operation waiting for a response. After the attention is recognized by the channel, this side can issue a sense command byte command to determine what command is active. This is a typical sequence of events. If two systems are operating so that a SIO is active on channel X and a second SIO (matched command) is issued to channel Y before the attention is received by channel Y, the following occurs as instructed by the mode:

1. For compatibility mode (360), the attention interrupt is not sent but is reset because of the matched commands, and the operation continues.
2. For extended mode (370), the attention interrupt to channel Y, if not cleared earlier by channel Y, is given in response to the channel Y SIO, even if the commands match. If the channel Y SIO is issued again (assuming a matching command), the operation continues.

NOT-READY ABILITY

The CTCA also has the ability of being made not ready; that is, not available to one or both channels for command execution. An interface disconnect, selective reset, or equipment check from channel X generates a not-ready condition on the adapter side. While the X-side is not ready, any command issued by the channel Y (except Sense Adapt State) is rejected with a unit check in the initial status. Any command from channel X (except Test I/O or Sense Adapter State) makes the X-side adapter ready. The not-ready-to-ready change causes a device-end interrupt to be sent to the channel Y to indicate that the X-side has been made ready and is now available for operation.

SPEED

Because the CTCA operates in burst mode, the operational-in line of the adapter is held up from the time of selection to ending status. Transmitting data across the interface is at the speed of the slower channel.

ADDRESSING

The CTCA has two eight-bit addresses. One address for each side of the adapter is plugged at the time of installation. For plugging information, see ALD XX942.

SELECTION

To select the adapter, channel X places an address byte on bus-out at address-out time. The address byte must match the X-side plugged address. The plugged address is then returned to the channel at address-in time.

COMMANDS

The CTCA decodes and executes eleven commands. Bit positions 4-7 indicate the basic operation, and positions 0-3 indicate the modified code. This code extends the basic operation for programmer use. In the commands listed below, X = do not care, and M = modifier bits.

Command	Bus-Out Bit Positions
	0 1 2 3 4 5 6 7
Test I/O (Note 1)	X X X X 0 0 0 0
Write	0 M M M M 0 1
Write End-of-File (Note 2)	1 X X X X 0 1
Read	M M M M M 1 0
No Operation	0 X X X X 0 1 1
Control	M M M M M 1 1 1
Sense Adapter State (Note 3)	X X X 0 0 1 0 0
Modified No-Op (Disable Compt)	1 1 X X X 0 1 1
(Enable Compt)	0 1 X X X 0 1 1
Sense Command Byte	X X X 1 0 1 0 0
Read Backward	M M M M 1 1 0 0

Notes:

1. The Test I/O is a command to the adapter.
2. In compatibility mode, this command decodes as a normal Write command.
3. In compatibility mode, this command decodes as a Sense Command byte command.

CONTROL

The Control command sends control information between the channels. To do this, the five modifier bits are coded as desired. Using the Control command can prevent conditions in which a channel is kept busy with a command issued to the adapter, while waiting for the correct command response (for example, an X-read waiting for a Y-write). The Control command, as used in the CTCA, is always an immediate command. This means that channel-end is sent to the channel during the initial selection sequence. This frees the channel during the SIO operation.

Control Command Issued to an Idler Adapter

Channel X started the control. The complete Command byte is set into the X-command register, and channel-end is sent with initial status. This frees channel X. A control immediate latch is set in the X-side, and an attention interrupt is sent to channel Y. Channel Y, when free, can take the attention (as defined by the *IBM System/360 Principles of Operation, GA22-6821*).

To free the adapter, a Sense Command Byte command must be issued by channel Y. At the end of the sense command byte from channel Y, a device end for channel X is generated.

Control Command Issued to a Busy Adapter

A Control Command issued by channel X receives busy status for the following reasons:

1. A Control Command issued earlier by X has not been cleared. This response is the busy bit alone.
2. A Control Command issued earlier by channel X was cleared with a channel Y sense command byte, but before the device end was taken by X. The response is busy and device end. This clears the device end and leaves the adapter idle.
3. The Control Command is issued by X after Y has issued a command. The response is busy and attention. The attention after being sent no longer sets the request-in tag and attempts to interrupt the processor. However if any other command, such as a Control, is issued, the response is still busy and attention.

Control Command Issued to a Not-Ready Adapter

A Control Command from channel X to the adapter with the Y-side not ready receives unit check.

SENSE ADAPTER STATE

This command tests the condition of the adapter to determine the cause of a unit check. The adapter does not change by the execution of this command. The unit-check status bit is ignored, and the initial status is all zeros. Then the sense byte is sent as data to the channel. Channel end and device end are sent as the end status. Any status other than unit check is sent to the channel as initial status, and the adapter disconnects after initial selection. This command receives a busy response if a Control Command was at the adapter.

Sense Adapter State Bits

The combination of bits indicates:

1. All bits off indicate that the other side is ready. This is the normal condition.
2. Bit 1 on (intervention required) and bit 7 off (interface disconnect or selective reset) indicate that the other side is not ready because of a system reset on that side.
3. Bits 1 and 7 both on indicate that the other side is not ready because of a Halt I/O, Halt Device, or selective reset.
4. Bit 2 on (buffer data check) indicates that the data buffer used on this side of the adapter has sensed bad parity. The operation is not stopped, but a unit check is sent with the end status.
5. Bit 3 on (equipment check) indicates that a hardware failure has occurred on this side of the adapter.

Bits 4, 5, and 6 must be decoded to determine if the other side of the adapter was also in error. If all are zero, the side doing the sense had the only error.

SENSE COMMAND BYTE

The Sense Command Byte command is used by one system to test the command byte of the other system. If the adapter is idle when the Sense is performed, the data byte is all zeros. For the data byte to contain the command byte of the other system, the commands issued by the other channel are:

Channel Y Earlier Issued	Sense Data
	0 1 2 3 4 5 6 7
Adapter Idle	0 0 0 0 0 0 0 0
Control	X X X X X 1 1 1
Read Backward	X X X X 1 1 0 0
Read	X X X X X X 1 0
Write	0 X X X X X 0 1

The only exception is when channel X issues a Sense Command Byte to the adapter before a preceding Control from channel X has been cleared. If the Control has not been answered by a Sense from channel Y the Sense receives a busy response. If the X-Control had been answered, but the device end had not been received or had been stacked by channel X the Sense receives both busy and device end in the initial status byte. This clears the device end.

READ OR READ BACKWARD

The CTCA does not recognize the difference between a Read and a Read Backward command. In both cases, the primary function of the adapter is to transmit data bytes to the starting channel. The function of the channel is to place the data bytes in main storage in the correct order.

Read to an Idle Adapter

When a Read or Read Backward command is issued to an idle adapter, the issuing channel receives an all-zero initial status and then is held up until the other channel responds with a Write. An attention is immediately set up to signal the nonissuing channel that an operation is waiting. The complete Read command is stored in the command register and is available to the Y-side by a Sense Command Byte command.

If a preceding Write command had been issued by the channel Y before the Read, the attention on the X-side is reset and both operations are performed. A service-in requests a byte of data from the writing (Y) channel, and it is passed through the adapter to the channel X. The operation continues until either channel responds with a Stop (Cmd-0 to Srv-1). After receiving the Stop, a status containing channel end is sent to both channels. If neither channel is chaining, receiving the status by both channels frees the adapter.

Read to a Busy Adapter

The three responses to a Read issued by a channel X are:

1. If an X-Control command issued earlier has not been cleared (the X-Control command still valid), the adapter responds to initial selection with a busy status.
2. If the status information stored in the X-side of the adapter is waiting, the response is busy plus the status. This status, channel end and device end from a earlier operation that was stopped with a Halt I/O; or device end from a earlier (X) Sense Command Byte that had been received by the channel, or a device-end generated by the Y-side going from the not-ready-to-ready status.
3. Busy and attention status are the response to an X-read command, if a channel Y had earlier issued a Read, Read Backward, or Control.

If the attention had not been received by channel X, the Read command clears it as an interruption condition. However, it still appears as a response to another Read until the earlier issued command by channel Y is completed. A Y-write is completed only by an X-read, and a Y-control is completed only by an X-Sense command.

Read When EOF was Issued

If the X-adapter side End-of-File has been set by a earlier issued Y-Write End-of-File command, the X-Read is rejected, and the unit-exception bit is set in the initial status byte.

WRITE

The Write command in the CTCA takes data from the writing (starting) channel and sends the data to the reading (nonstarting) channel. The response to a Write command issued to either an idle or a busy adapter is the same as that for a Read command.

If a Y-Read command has been issued before the X-Write, and if the attention on the X-side has been received, both operations are performed. Channel X receives a zero status in response to its command if attention is received or not. Service-in requests a data byte from channel X and sends it to channel Y. This operation continues until either channel signals Stop. If the operation is stopped by the reading channel, one more byte of data than is needed is sent to the adapter by the writing channel.

WRITE END-OF-FILE

The Write End-of-File (WEOF) command is used to signal a Read or Read Backward on the other side of the adapter when no more data is to be sent. This command is especially useful in attempting to stop an operation where single Writes are being issued to chained Reads. The Write End-of-File sets an EOF latch in the other side of the adapter. This indicates that no more data is to be given and that Read chaining is broken.

When channel X issues a Write End-of-File, a waiting Read on channel Y receives channel end, device end, and unit exception as ending status. This occurs before any data has been sent, but after zero initial status is sent to the channel. If the Write End-of-File is issued before the Read and initial status is sent, the unit-exception bit is sent alone and the Read command is rejected.

The Write End-of-File is the same as a No-Op on the writing side. Channel end and device end are returned in the initial selection status and the adapter is available for more commands.

Because a Write End-of-File is only meant to terminate a Read (or Read Backward), the EOF condition is reset if any command other than Read is issued on the other side. In this case, the EOF condition is never indicated and is lost.

If, after a Write End-of-File is issued, another command, such as Control, is given on the same channel before a Read is issued on the other channel, the attention interrupt condition is kept waiting until after the unit exception is sent in response to a Read command.

Write end-of-file commands can not be stacked; that is, if three WEOF commands are issued by channel X, then channel Y issues the Read command only. The first Read command receives a unit exception.

A Halt I/O or a selective or system reset on either side of the adapter resets the EOF condition.

NO OPERATION

No Operation (No-Op) command in the CTCA is always a command immediate. The contents of the adapter latches are not affected by this command. The response sent to the channel, if this command is issued to an adapter that is busy or has waiting status, is the same as for the Read command.

TEST I/O

A Test I/O command in the CTCA can be used by the programmer to determine the status of the adapter any time the channel is free. The status received indicates the condition of the adapter as follows:

1. Zero status indicates that the adapter is idle.
2. A busy bit indicates that the control unit is busy with an X-Control command that has not been cleared.

If the channel Y had a Read, Read Backward, Write, or Control that was still in the adapter, and an X-Test I/O command is issued, the adapter responds with attention status.

A device-end status response to an X-Test I/O indicates that the X-Control has been cleared or that the other side went from not-ready-to-ready state. This clears the device-end status.

A channel-end and device-end response indicates that a command was stopped by a Halt I/O. Any status condition sent to the channel as an interruption has the same response.

HALT I/O OR HALT DEVICE

The execution of a HIO (Halt I/O) or HDV (Halt Device) instruction causes an interface disconnect. The interface disconnect condition stops the adapter data transfer and makes the adapter not ready. When the CTCA senses the interface disconnect condition, its response to the halting channel is immediate. The adapter drops all tag-in lines, sets channel end and device end (if the reset occurs after initial status time), and waits to send the status to the halting channel. If the channel not starting the Halt is operating with the adapter, it receives channel end, device end, and unit check. If this channel issues a Sense Adapter State command to determine the cause of the unit check, it receives a data byte with bits 1 and 7 on. Bit 1 indicates that an interface disconnect or selective reset caused the not-ready condition. The interface disconnect sequence in compatibility mode causes a channel-end or device-end interrupt to the channel that issued the HIO, even if the Halt occurs before the adapter has an active command. A HIO or HDV stops any operation in effect on either side of the adapter.

SYSTEM OR SELECTIVE RESET

A System or Selective Reset is handled as an interface disconnect except that no channel end or device end is sent to the issuing channel. When the adapter has power on, both the X- and Y-sides receive an automatic reset that puts the adapter in compatibility mode.

A System or Selective Reset causes the adapter to become not-ready only if one inhibit compatibility latch is still on. In this case, the adapter is held in extended mode. To make the adapter ready issue a Read, Read Backward, Write, Write End-of-File, Control, or No-Operation command to the adapter. For example, if channel X issues a System Reset, the X-side is not ready until channel X issues one of the above commands. All of the channel Y commands except Sense Adapter State are rejected with unit check as long as the X-side remains not ready. When an X command makes the X-side ready, a device-end interruption occurs on channel Y to indicate that the adapter is ready.

When a device end is waiting or stacked and the adapter is made ready on the other side, the ready device end is stored. After the waiting device end is cleared, the adapter interrupts with the ready device end. When the adapter has a waiting or stacked device end, a stored ready device-end interrupt, and the adapter is made not-ready, the stored device end is reset and only the waiting or stacked device-end interrupt occurs. The state of the X-side ready latch has no effect on commands issued by channel X. The X-ready latch affects only channel Y commands.

Status Byte

Each side of the adapter has a status byte register where six of the eight available status bits are stored. The status bits appear on bus-in to the channel as follows:

Bus-In Bit Position	Status
0	Attention
1	Not Used
2	Not Used
3	Busy
4	Channel End
5	Device End
6	*Unit Check
7	*Unit Exception**

*Not used in compatibility mode.

**See "Write End-of-File command."

STATUS SUMMARY

The following chart is a summary of the important status information described in the other sections.

Channel X issues:	Resulting status when channel Y has previously issued:				
	X Ctrl and Y sns Cmd	Y read	Y write	Y control	Y Wr EOF
X read	Busy, DE clear Adpt	Busy and Attn	Y-go-X reset Attn	Busy and Attn	Unit Exc
X write	Busy, DE clear Adpt	X-go-Y reset Attn	Busy and Attn	Busy and Attn	Reset X EOF Attn to Y
X control	Busy, DE clear Adpt	Busy and Attn	Busy and Attn	Busy and Attn	Reset X EOF Attn to Y CE to X
X Wr EOF	Busy, DE clear Adpt	CE, DE to both sides unit Exc to Y	Busy and Attn	Busy and Attn	Reset X EOF set Y EOF CE, DE to X
X test I/O	DE, clear Adpt	Attn	Attn	Attn	Reset X EOF Adpt idle zero status to X
X No-op	Busy, DE clear Adpt	Busy and Attn	Busy and Attn	Busy and Attn	Reset X EOF CE, DE to X
X Sns Cmd	Busy, DE	Force 0 status Y Cmd byte to X	Force 0 status Y Cmd byte to X	Y Cmd byte to X, Rst Attn DE Intr to Y	Reset X EOF zero Cmd byte to X
X sns state	Busy, DE clear Adpt	Busy and Attn	Busy and Attn	Busy and Attn	Reset X EOF Sns bits to X

When the adapter has a waiting control (no Y-Sense command to X-Control), the response given to the channel is the busy bit sent as initial status.

SENSE BYTE

The CTCA uses seven bits to indicate to the channel the cause of a unit check set in the status byte. The sense bits are reset by all commands except Test I/O. The sense bits are not available in compatibility mode because the Sense Adapter State command cannot be executed in this mode.

The bits appear on bus-in to the channel as:

Bus-In Bit Position	Sense Indication
0	Not used
1	Intervention required
2	Buffer data check (other side of adapter)
3	Equipment check
4	Selection check (other side of adapter)
5	Control sequence check (other side of adapter)
6	Status generation check (other side of adapter)
7	Halt I/O or selective reset

SENSE BIT DEFINITION

Intervention Required: This bit indicates that the other side of the adapter is not ready because of one of the following three conditions:

1. System reset
2. Selective reset
3. Interface disconnect.

Buffer Data Check: This bit indicates that bad parity was sensed at the output of the data buffer that feeds the bus-in interface for the other side of the adapter. This bit can be turned on only during data service.

Equipment Check: This bit indicates that this side of the adapter has a hardware error condition. Four error conditions can occur on either side of the adapter:

1. Command check (invalid command decode or parity error)
2. Selection check
3. Invalid sequence check
4. Status generation check.

These error indications are available via the console display on the host processor.

Selection Check: This bit indicates a failure in the adapter selection logic. A check is indicated if the adapter is selected and the select-out tag is propagated at the same time.

Invalid Sequence Check: This bit indicates that the control sequence latches did not come on or did not go off in the correct order. These latches control the interface tags-in and other adapter timings.

Status Generation Check: This bit indicates that a not valid status was generated. The parity-predict logic for the status byte determines if the status is not correct.

Interface Disconnect or Selective Reset: This bit indicates that an interface disconnect (HIO or HDV) or selective reset has been issued on the other side of the adapter.

COMPATIBILITY MODE

To operate the System/370 CTCA with programs written for System/360 CTCA, some of the functions of the System/370 CTCA adapter must be disabled. They are two inhibit compatibility latches, one for each side of the adapter. An inhibit compatibility latch is set by a Modified No-Op Command (11xxx011). When either or both inhibit compatibility latches are set, the adapter is in the extended mode (370). An inhibit compatibility latch is reset by System Reset, Selective reset, or by another Modified No-Op command (01xx x011). When both inhibit compatibility latches are reset, the adapter is in compatibility mode and can operate with System/360 programs. The following are affected:

1. The Write End-of-File command is not usable. This command (1xxx xx01) sent to the adapter is decoded as a standard Write (0xxx xx01).
2. The Sense Adapter State command is not usable. This command (xxx0 100) sent to the adapter is decoded as a Sense Command Byte command (xxx1 0100).
3. The unit check and unit exception status bits are deleted. The latches used to present these bits are inhibited.
4. Ready latches for both sides of the adapter are forced on and are not permitted to reset. This means that the not-ready-to-ready device-end is sent.
5. The sense bits are not sent to the channel because there is no longer a Sense Adapter State command. The sense bits do stop the adapter operation, but they come on and are available to be displayed in the host processor.
6. Channel-end and device-end bits are sent to the channel even when the halt occurs during initial status time.
7. A read-write match is always performed. The attention status does not have to be cleared before the match is performed.

Note: *The enable compatibility latch is reset to the enable compatibility mode by a power-on reset, or a Modified No-Op command (01xx x011). The enable compatibility latch is set to the expanded function mode by a Modified No-Op command (11xxx011).*

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ONLINE-OFFLINE MODES

The CTCA has an I/O interface switch on the operator console of the X-processor. This switch permits the CTCA to be logically removed from the X- and Y-systems. When the adapter has been removed (disabled), it is not available to either the X- or Y-sides. A not available adapter does not respond to its address if selection is attempted (the adapter propagates select-out).

An indicator, labeled Chan-Chan Disabled, indicates that the adapter is offline. This indicator is lit only if the following conditions are met.

1. Neither interface is operating with a channel (both op-in tags are down).
2. Neither interface is chaining commands.
3. Neither interface has waiting or stacked status of any type.
4. Neither adapter side has a control command waiting.

With the I/O interface switch in the disable position and all of the four conditions are met, the indicator is on to indicate that the adapter is then not available to the X- and Y-systems. The adapter remains in this condition until the switch is moved to the enable position.

I/O INTERFACE ISOLATION

The CTCA has added circuits to permit the power to be turned off and on without affecting the operation of the Y-channel. This permits maintenance of the (host) system and the CTCA without affecting the operation of the Y-system.

SELECT-OUT BYPASS

Because the adapter receives its power from channel X, it is not necessary to propagate the channel X select-out tag when power is off. A select-out bypass circuit is supplied to enable channel Y to operate with other control units when power is off for channel X.

Select-out and select-in tag lines can be swapped between sides. A jumper arrangement permits this swapping. For plugging information, see ALD XX941.

The X-side of the adapter goes to tailgates and, therefore, can be placed in any position on the interface. However it must always be connected to one of the channels of the host system.

POWER-ON/OFF SEQUENCE

In order to ensure isolation, the host (X) system must supply the following hardware and controls when powering up or down:

1. An I/O Interface switch
2. An I/O interface disabled indicator
3. Automatic control of the power sequencing of the +6V supply used for the interface driver circuits. This inhibits transients on the signal lines.
4. A relay-controlled pick for the ground side of the 6V circuit for the select-out bypass relay.

The sequencing of the functions in items 3 and 4 is done as follows.

To turn off power:

1. Send operator messages to both systems, specifying removal of the adapter from use.
2. Press the Channel To Channel switch.
3. Wait for the Chan-Chan Disabled indicator (green) to light.
4. Press Power Off.

To turn power on:

1. Press Power On.
2. Wait for Chan-Chan Disabled indicator to turn on.
3. Press the Channel To Channel switch. The Chan-Chan Disabled indicator goes out.
4. Adapter is not ready, but is available to the program.

PROGRAMMING NOTES

The following information describes operations that are special for the adapter.

INITIAL PROGRAM LOAD (IPL)

During the initial program loading operation, a system reset pulse, before the selection of the adapter, causes the adapter to become not ready. Any operation waiting on the other side of the adapter is terminated with channel end and device end sent to a Read or Write command and with device end sent to a control command. Another device end is sent because the adapter on the IPL side went from not ready to ready. Attention status is then sent because of the IPL Read command. After the ready device end is received, the Y-side of the adapter must respond with a write command to complete the IPL.

COMMAND CHAINING

Command chaining can be performed by channel X and channel Y and/or both at the same time; however, all operations performed by the CTCA occur in pairs. Therefore, a illogical sequence of commands sends a status of busy and attention to the last channel issuing a command. For example, if both channels are chaining and a Read command is issued by channel Y followed by a Control command from channel X, channel X receives an attention that causes channel X to disconnect from the adapter. Channel Y remains connected to the adapter until a correct response is received from channel X (in this case, a Write or a Write End-of-File command). Because the sense commands do not need an acknowledgment, they should not be chained in answer to a chain of control commands.

When channel X issues a Write, Read, or chained Control command to the adapter, the busy condition remains active until a correct response is received from channel Y or until either channel issues a Halt I/O or reset.

HALT I/O

If initial status was received before the adapter was halted, the Halt I/O instruction causes a channel end and device end to be sent to the channel that issued the halt. The channel-end and device-end status is sent to the channel as an interruption or in response to a Test I/O or Start I/O instruction.

HALT DEVICE

The Halt Device instruction causes an interface disconnect to the device specified.

ATTENTION

If the adapter has a waiting attention interruption, a Test I/O clears the attention as an interruption condition although it does not reset the attention status bit. The next Test I/O receives attention until a match between the channel command occurs; for example, a Write on one channel to a Read on the other.

When a device has the attention bit on in the status byte and receives Start I/O, the attention bit is reset if a match occurs, and the adapter executes the operation. Under the same condition, if no match occurs, the Start I/O receives a condition code 1 with the busy and attention bits stored in the unit status position of the CSW.

A waiting attention or a stacked attention on one side of the adapter is reset by an interface disconnect issued to either side of the adapter. Zero status is sent to the channel.

WRONG LENGTH RECORD

A wrong length record indication can occur at the end of the operation under these conditions:

Read on Channel X to Write on Channel Y	Wrong Length Record Indicated on Channels:	
	Channel X	Channel Y
X Count equal to Y count.	No	Yes
X count more than Y	Yes	Yes
X count less than Y	Yes	Yes
*X count=Y count-1	Yes	No
**X count=Y count-2	Yes	No

*Compatibility Mode
**Data-In/Data-Out Mode

Note: When running with data-in/data-out mode plugged, the adapter prefetches two bytes of data from the writing channels before the reading channel can stop data movement.

SUPPRESS DATA

The Suppress-Out tag is used in the CTCA to keep the channel from being overrun during data chaining operations. It is also used at any time a channel needs to stop the operation to permit servicing of one of its other channels. The CTCA does not request service (service-in tag) from a channel while its suppress-out tag is up.

FUNCTIONAL UNITS

A complete logical function is done by one MST card. The X cards are the same PNs as the Y cards.

ADDRESS COMPARE AND DATA FLOW X

- The card location is 03AA1R2 (X-side). The ALDs are XX001-051. (Y-side is 03AA1N2. ALDs are XX101-151.)

The five functions shown on the diagram "CTCA Data Flow and Operation" are on this card. They are address X, address compare X, data buffer Y, command register X, and command decoder X.

For channel X to select the adapter, the bus-out X at address-out time must compare with the plugged address X. Plugged address X is sent to the data buffer X at address-in time.

Bus-out has three types of information (data, control, sense). Each is identified and selected at the correct time by the channel tags-out.

The address compare circuit is enabled by address-out.

The command register receives bus-out data at command-out time.

Data buffer Y receives bus-out data at service-out time.

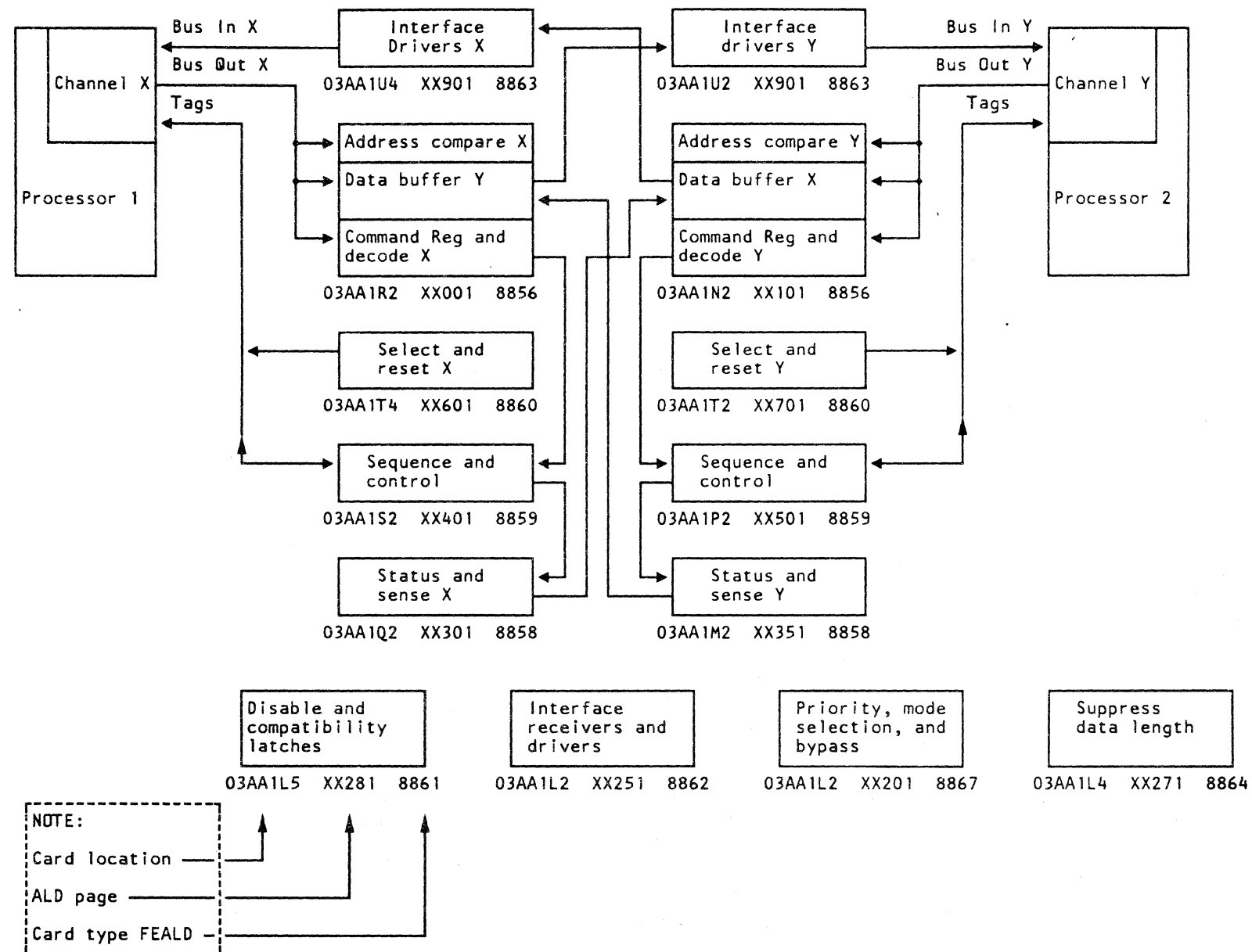
The three-way selector gates the command-register output, the data byte, and the Y-side address. The two-way selector gates the output of the three-way selector and the input B bus-in lines. Input B is the sense byte or the status byte.

The eleven commands from channel X are decoded from the X-command register output into nine adapter commands. Read Backward is interpreted as the Read command.

The output of the command register and command decoder are checked for parity; either one in error turns on X command check.

The command register output generates a new parity bit that goes to data buffer Y with bits 0-7. The output of the data buffer is parity-checked. An error causes a buffer data check.

LOCATIONS



SELECTION AND RESET X

- The card location is 03AAIT4 (X-side). The ALDs are XX601-621. (Y-side is 03AAIT2. ALDs are XX701-721.)

Selection

To select the adapter, the channel must address the adapter, send select-out, and receive operational-in.

The channel X hold-out and select-out tags set the select-out latch.

With an address compare, 'Address Matched X', resets the select propagate latch. The select-out latch may then set the X-side selected latch.

X-side selected sets sequence 1 X which generates the operational-in tag.

Reset

Power-on reset causes both sides of the adapter to receive an automatic reset.

The suppress-out tag and the operational-out tag control system-reset and selective-reset latches.

SEQUENCE AND CONTROL X

- The card location is 03AA1S2 (X-side). The ALDs are XX401-451. (Y-side is 03AA1P2. ALDs are XX501-551.)

Interface tags and adapter commands enter this card to generate the gates and controls needed to move data through the adapter.

Sequence

A series of latches from sequence 1 to sequence 5 keeps the adapter in step with the channels.

Control

The decoded commands, sequence latches, and interface tags set a series of latches that control data movement.

The gate selector selects the sense byte, data byte, command byte, and status byte.

'Start data service sequence' or 'sense command or status' sets the first byte latch before the go latch is set.

'Bus-in set' is activated for each kind of byte set into the data buffer. Notice that control lines from both sides of the adapter generate the 'bus-in set' pulse.

The adapter check register is set by buffer check, sequence check, and status check errors.

DISABLE AND COMPATIBILITY

- The card location is 03AA1L5. The ALD is XX281.

Disable

The Chan-Chan Disable switch on the console lets channel Y operate when channel X is powered up or down. The 'set disable latch' line is controlled by the switch. Other input lines prevent setting the latch during an operation.

Compatibility

System/360 channel-to-channel programs can be used if the CTCA is in compatibility mode. The compatibility latch must be reset for compatibility mode. Bit 0 of the modified no-op command gives the set and reset of the latch.

SELECT PRIORITY, MODE SELECTION, AND BYPASS

- The card location is 03AA1L2. The ALDs are XX201-211.

Select Priority

Each side of the adapter can be logically on select-out or select-in. The chart shows plugging for high or low priority for both sides.

	High Priority	Low Priority
Y-side	BC-BB BA-CA CB-CC	BC-CC BA-BB CB-CA
X-side	CG-CH AG-BG BH-AH	CG-BG AG-AH BH-CH

Mode Selection

If the adapter is operating to a System/360 channel, 03AA1L2 must be plugged for 'no Data-In'. If the adapter is operating to a System/370, plug channel 'Data-In mode'.

- Data-In/Data-Out mode is selected by plugging DE to DD.
- No Data-In mode is selected by plugging DE to DF.

Select-Out Bypass

With power off, the relay is normal to let the channel Y select-out line to take the following path: pin BC to pin BB, through the normally closed relay point, through the Dot OR to pin CB, to pin CC and select-out tag Y.

STATUS, SENSE, AND INPUT B BUS-IN X

- Card location 03AA1Q2 (X-side). (Y-side is 03AA1M2.)
- ALDs are XX301-321, XX325-345 (X-side). (Y-side is XX351-371, XX375-395.)

This card analyzes the condition of the X-side of the adapter to generate the six status bits and three of the eight sense bits. The other five sense bits are generated with the function they represent on the other side of the adapter.

The circuits shown on ALD XX301-321 include:

STATUS BITS

0	Attention
3	Busy
4	Channel end
5	Device end
6	Unit check
7	Unit exception

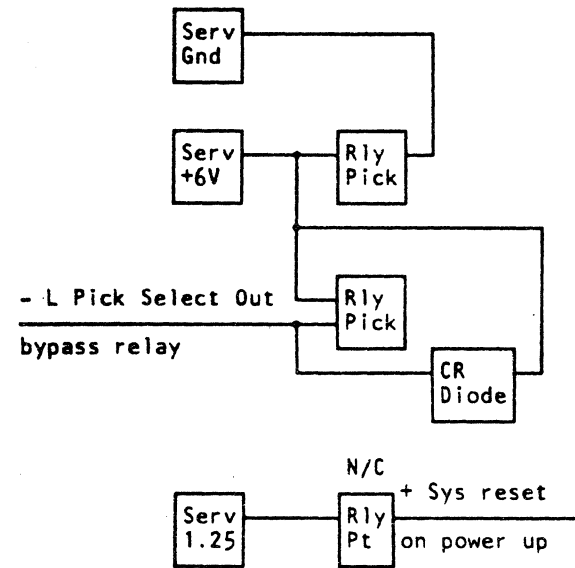
SENSE BITS

1	Intervention required
3	Equipment check
7	Halt I/O or selective reset.

Input B Bus-in: Status and sense bits 1, 3-6, and parity are selected by 'gate status X' and 'gate sense byte X' to become part of the 'input B bus-in X' byte that goes to the data buffer Y. The remaining three bits of the 'input B bus-in X' are selected on the address compare and data flow card.

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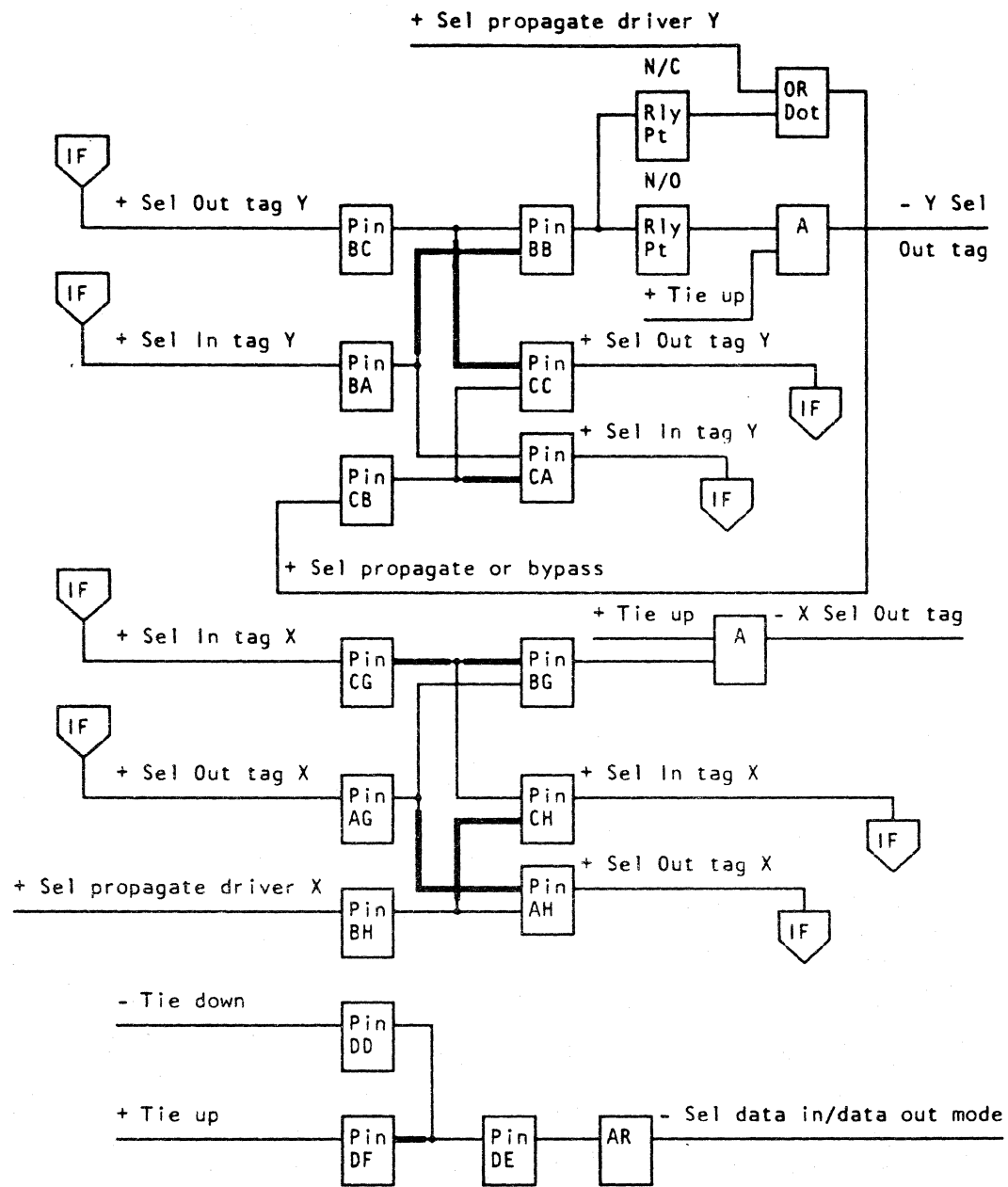
SELECT PRIORITY, MODE SELECTION AND BYPASS



IF = Interface

— = Alternate Plugging

— = Both X and Y plugged high priority and data in mode





CHANNEL-TO-CHANNEL ADAPTER TEST

The channel-to-channel (CTCA) test:

- Resides on the DIAG1 diskette
- Executes as a stand-alone program in processing unit storage
- Tests the CTCA between two channels on the same 4341 Processor
- Provides field replaceable unit (FRU) isolation.

TEST DESCRIPTION

The channel-to-channel adapter (CTCA) is tested between two channels on the same 4341 Processor. If the Y-side of the CTCA is normally cabled to another processor, it must be recabled to an available 4341 channel.

Note: It may be necessary to make a channel available. Any channel except channel 0 can be connected to the CTCA. For an example of CTCA cabling, see "Channel-to-Channel Adapter (CTCA) Test Cabling."

The CTCA test requires that the channels connected to the CTCA are operational. The operation of these channels must be verified by running the channel machine speed microdiagnostics (MSMDs) and channel wrap test as directed by the START MAP.

For a simplified flowchart of the CTCA test run procedures, see "Simplified Channel-to-Channel Adapter (CTCA) Test Flowchart." For detailed information, refer to "CTCA Test Run Procedure."

As shown in the flowchart, a UCW must be assigned to the Y-side of the CTCA after the CTCA is cabled for testing.

Next, the test must be loaded and an operational mode selected. The CTCA operates in either of two operational modes:

1. Compatibility mode. In this mode, the CTCA accepts S/360 commands.
2. Extended mode. In this mode, the CTCA accepts S/370 and 4341 Processor commands.

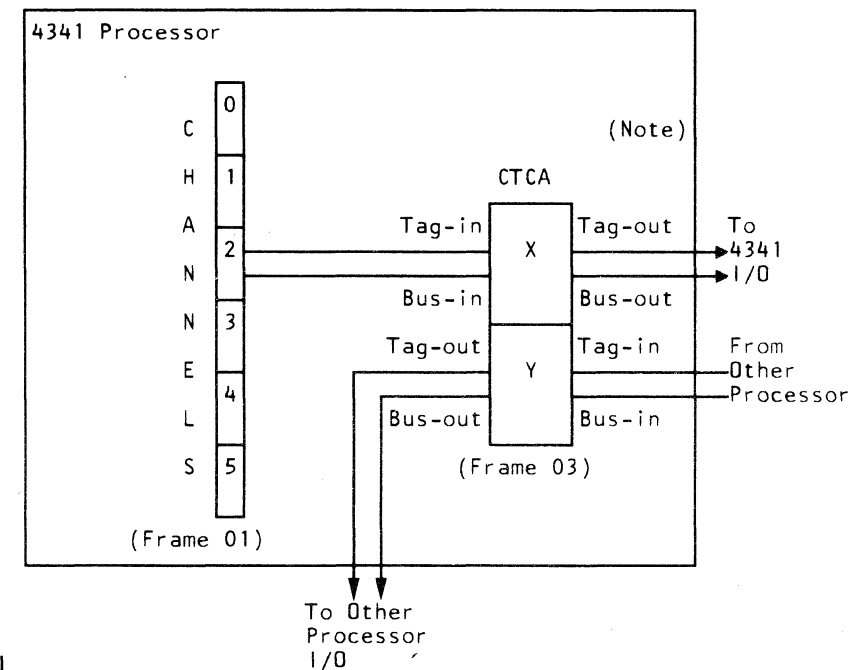
Test options allow for selecting the mode of operation. Select compatibility mode the first time through the test run sequence.

Run and display options must be selected after selecting the operational mode. The test then begins execution. A TIO is issued to both the X-side and the Y-side of the CTCA. If successful, a message is displayed that indicates that both sides of the adapter are operational. An error message is displayed if the TIO operation fails.

All valid commands are attempted. Various data counts and patterns are used. After a command that expects an interrupt from the adapter is issued, a timeout loop (approximately one minute) is entered. If no interrupt is received within the timeout period, an error message and FRU list is displayed.

CHANNEL-TO-CHANNEL ADAPTER (CTCA) TEST CABLING

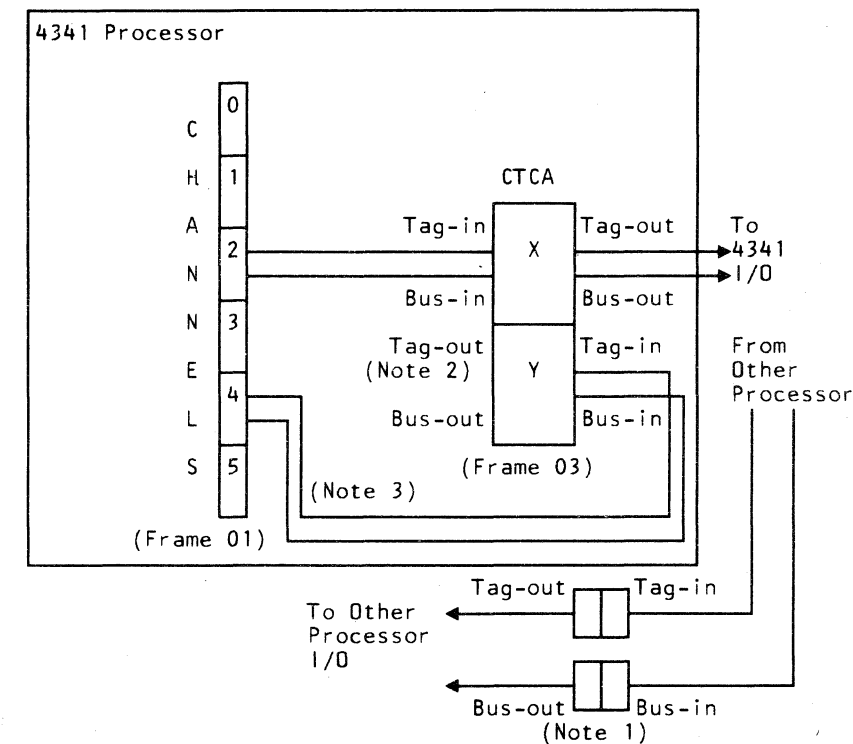
EXAMPLE 1: Channel-to-channel adapter (CTCA) cabled to 4341 and another processor for normal operation. (The CTCA can be cabled to any 4341 channel except channel 0.)



Note:

To operate the I/O attached to the X-side of the CTCA, power must be on the CTCA. If it is necessary to run without power on the CTCA, the channel interface cables must be connected together (Tag-in to Tag-out and Bus-in to Bus-out) to bypass the X-side.

EXAMPLE 2: Channel-to-channel adapter (CTCA) cabled for running CTCA test. (The CTCA can be cabled to any 4341 channel except channel 0.)

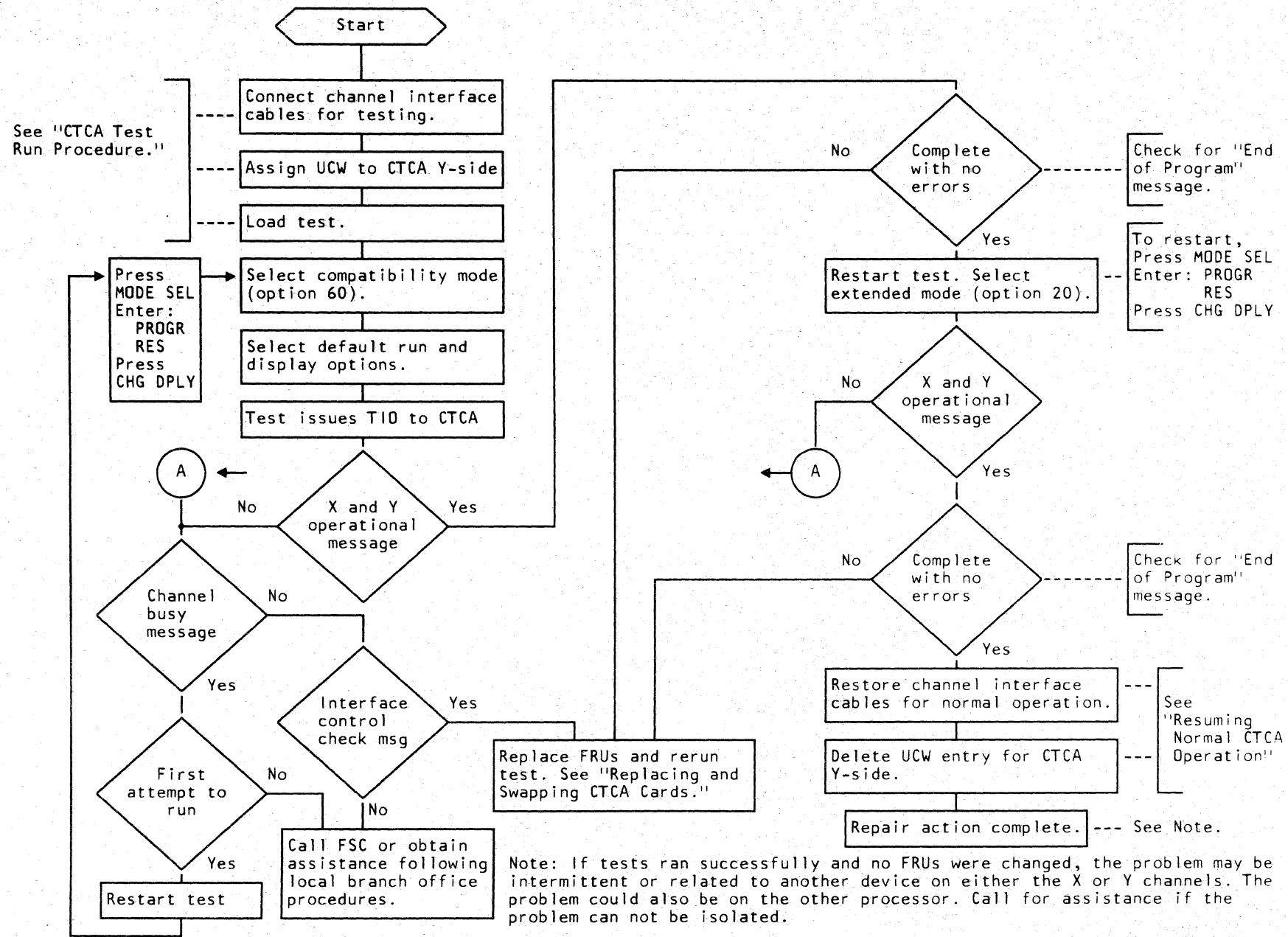


Notes:

1. Disconnect cables from the Y-side of the CTCA and connect (butt) together.
2. Install terminators on the Y-side Tag/Bus-Out connectors.
3. Connect channel interface cables from the Y-side Tag/Bus-In connectors to any available 4341 channel except channel 0.

SIMPLIFIED CHANNEL-TO-CHANNEL ADAPTER (CTCA) TEST FLOWCHART

Important: Before running the CTCA test, verify that the channels to be used for testing are operational as directed by the START MAP.



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CTCA TEST RUN PROCEDURE

To run the channel-to-channel adapter (CTCA) test, both sides of the CTCA (X and Y) must be cabled to channels on the 4341 on which the test is to be run. See example 2 of "Channel-to-Channel Adapter (CTCA) Test Cabling."

Note: Before running the CTCA test, verify that the channels that will be used for testing are operational as directed by the START MAP.

For a simplified flowchart showing the CTCA test set-up and run sequence, see "Simplified Channel-to-Channel Adapter (CTCA) Test Flowchart."

To run the channel-to-channel adapter (CTCA) test:

1. Connect channel interface cables for testing the adapter.
 - a. Ensure that the other processor connected to the CTCA is stopped.
 - b. Disconnect both pairs of channel interface cables at the CTCA Y-side and connect (butt) the cable connectors together (tag-out to tag-in and bus-out to bus-in).
 - c. Restart the other processor if desired.
 - d. Connect a pair of channel interface cables from the Y-side tag/bus-in connectors to any available 4341 channel. (Make a channel available if necessary. Use any channel *except* channel 0.)
 - e. Install terminators on the Y-side tag/bus-out connectors.
2. Use the operator console display/keyboard in the following steps. Ensure that it is in 'PRT KEYBOARD' mode. (Check the Program Load screen (QL) and change if necessary.)
3. Assign a UCW to the CTCA Y-side.
 - a. Ensure that the FUNCT diskette is mounted and that power is on the 4341.
 - b. Set the CE MODE switch (on the CE panel) ON.
 - c. Enter: QDUUxxx
(xxx = address of the CTCA Y-side.)
 - d. Enter: QDUC
Verify that the CTCA Y-side address just entered is included in the list of devices attached to the 4341 channels.
4. Load the CTCA diagnostic test.
 - a. If system not in 370 mode, do a system IML in 370 mode.
 - b. Enter: QI
This displays the diskette IPL screen.
 - c. Select option C and press the ENTER key.
Message 'MOUNT PROPER DISK, ENTER' appears.
 - d. Insert the DIAG1 diskette and press the ENTER key.
After loading is completed, message 'REMOUNT FUNCTIONAL DISK' appears.

5. Select options and begin test execution:

- a. Mount the FUNCT diskette and press the MODE SEL key.
- b. Enter: QRES
- c. Enter: QZ
- d. Press the REQ key.
- e. Ensure that the interval timer is ON.

Note: If the timer is OFF, a message is displayed requesting that it be turned on. To turn the timer on:

- 1) Press MOD SEL
- 2) Enter: QJ
- 3) Press CHG DPLY.

- f. Select an operational mode option when requested.

Note: Run the test in compatibility mode (option 60) first. If no failures are detected, then select extended mode (option 20).

- g. Enter the CTCA X- and Y-side addresses when requested.
- h. Select the test run and error message display options when requested. These options are:

H - Halt on error
NH - No halt on error
P - Display error messages
NP - No error message display
R - Loop the routine that detected the error
NR - No looping of the error routine
S - Program loop
NS - No program loop

The default run options are: halt on error (H) and display error messages (P).

- i. Perform manual operations as requested by messages on the operator's console display.

RESTARTING THE CTCA TEST

Successful completion of the CTCA test is indicated by the message: "PROGRAM END." To restart:

1. Press the MODE SEL key.
2. Enter:
 - a. PROGR
 - b. RES
3. Press the CHG DPLY key.
4. Start again at step 5f (above).

REPLACING AND SWAPPING CTCA CARDS

When the CTCA test detects a failure, it displays an error message (under the default display option) and a list of suspected FRUs. These FRUs are CTCA cards located on the A1 board in frame 03 (03A1).

Replace the listed cards one at a time beginning with the first card listed. Rerun the test after replacing each card. If the CTCA test still detects the failure after a card has been replaced, put the original card back in the machine, replace the next card on the list, and run the test again. Continue with this procedure until the trouble is found. Call for help if the trouble remains after all cards listed have been replaced.
Note: If a defective CTCA card halts processor operation and a new card is not readily available, you can bypass the CTCA by connecting together the channel interface cables. See the note in Example 1 under CTCA Test Cabling.

Several CTCA cards are interchangeable and can be swapped (exchanged) to aid in isolating the failure when replacement cards are not available. The following chart shows which cards are interchangeable between the X and Y-sides of the adapter:

X	Y
Q2	M2
S2	P2
R2	N2
T4	T2
U4	U2

The cards at L2, L3, L4, and L5 are not interchangeable.

To swap or replace CTCA cards—

1. Remove power from the CTCA:
 - a. Enter: QOM
 - b. Enter: MW
The partial power up/down screen is displayed.
 - c. Enter: O1 O4
2. Swap or replace CTCA cards.
3. Restore power to the CTCA:
 - a. From the partial power up/down screen, enter: 44
This reinitializes the partial power up/down screen.
 - b. Enter: O0 O4
4. Restart the test:
 - a. Press the MODE SEL key.
The general selection (Q) screen is displayed.
 - b. Enter: QOI
 - c. Press the START key.
 - d. Enter: QON
 - e. Enter: PROGR
 - f. Enter: RES

RESUMING NORMAL CTCA OPERATION

When the CTCA test runs error-free in both compatibility mode (option 60) and extended mode (option 20), the channel cables and 4341 UCWs can be restored and the machine returned to the customer.

Follow this procedure—

1. Restore channel cables for customer operation:
 - a. Remove the terminators from the Y-side tag/bus-out connectors.
 - b. Remove the channel interface cables from the Y-side tag/bus-in connectors to the 4341 channel.
 - c. Ensure that the other processor is stopped.
 - d. Reconnect the other processor's channel interface cables to the Y-side of the CTCA.
 - e. Restart the other processor if desired.
2. Delete the UCW entry for the CTCA Y-side:
 - a. Enter: QDUUxxxX
(xxx = address of the CTCA Y-side. Example: QDUU450X)
 - b. Enter: QDUC
Verify that the UCW for the CTCA Y-side is not listed.
3. Run the channel MSMDs:
 - a. Mount the DIAG4 diskette.
 - b. Press and hold the ALT key and press the DIAG key.
 - c. Select option B (selected diagnostics mode) from the Diagnostics Mode General Selection screen.
 - d. Enter test ID: M5
 - e. If a failure is detected by these tests, go to the MAPs. If no failure is detected by these tests, go to the next step.
4. Re-IML the processing unit:
 - a. Mount the FUNCT diskette.
 - b. Set the CE MODE switch (on the CE panel) to NORMAL.
 - c. Enter: QLMFollowing the "IML COMPLETE" message, the machine can be returned to the customer.

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