BOUNDARY SCAN (BS02) MODULE

Overview

Introduction

T4 - 1
T16 - 1
T32 - 2

There is one boundary scan (BS) module in each CRAY T94 and CRAY T916 system, and there are two BS modules in a CRAY T932 system.

In a CRAY T932 system, each BS module is located in one half of the system's physical boundary and connects only to the components within that half of the system. Therefore, each BS module supports only one-half of the system, or up to 44 system modules.

Functions

The BS module performs the following functions:

- Serves as an interface for all boundary scan operations
- Serves as the system interface for continuity-line information and control between the continuity-line sensors and the monitoring system
- Acts as a substitute maintenance interface (in place of an IO module) in the CPU tester only.

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Overview: The Boundary Scan Operation

Boundary Scan Testing Overview

Integrated circuits in the CRAY T90 series mainframes have the capability to drive test data from their output pins and capture data on their input pins. Because this logic is associated with the option boundary (or periphery) and because the data can be scanned into and out of the system, this capability is known as boundary scan.

Boundary scan allows testing of any interconnection in the machine (between boundary scan output and input cells) for proper connection. Boundary scan has the capability to detect shorts between option interconnections, to detect shorts between interconnections and power/ground grids, or to detect open foils in the interconnections. The interconnections connected directly to the memory stacks and the I/O channels cannot be tested with boundary scan. These interconnections cannot be tested because there are no boundary scan capabilities built into the memory chips or the I/O channels.

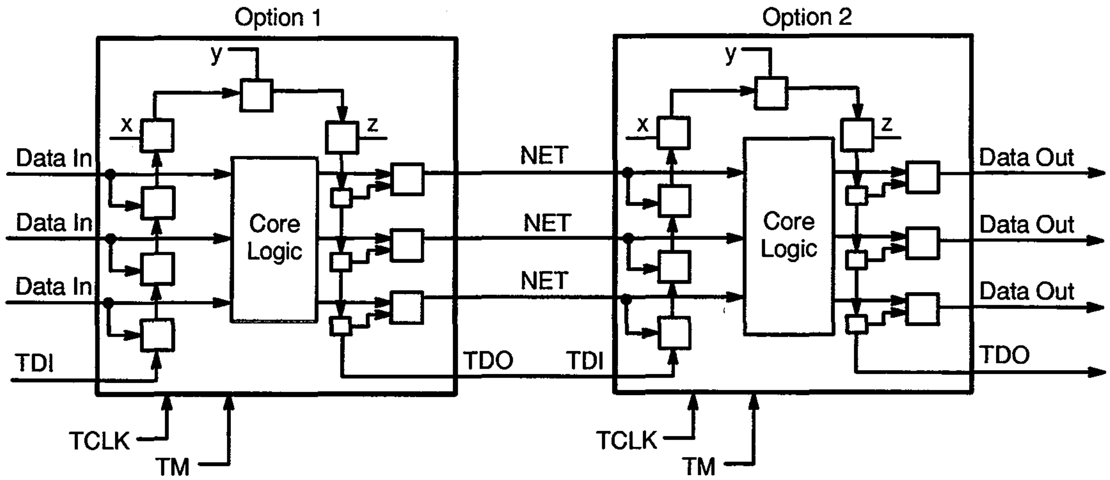
Boundary scan also has a module and an option identification function that identifies the module and option type. For more information on how this feature works, refer to "Module Identification" on page 22 and "Option Identification" on page 24 of this document.

The boundary scan system test enables the boundary scan operation. This test includes the `bscan`, `breport`, `bsb`, and `runbscan` programs. Refer to *The Boundary Scan System Test* document, publication number HDM-xxx-x, for more information on these programs. Boundary scan takes between 2 minutes (in a CRAY T94 system) to 10 minutes (in a CRAY T932 system) to run. Run boundary scan to verify the integrity of the system after a failure that causes the operating system to fail, or after you complete a repair procedure. Boundary scan requires control of the system; therefore, you cannot run a boundary scan test simultaneously with the operating system. CRAY T932 systems can be degraded, allowing you to run boundary scan tests on one half of the system while the operating system is running on the other half of the system.

The Boundary Scan Register

Each option in CRAY T90 series mainframes contains a chain of shift-register-based cells around the periphery of the option. These cells are the boundary scan register (BSR). There is one BSR location (or bit) for each input/output pad on the option. In addition, there are 16 additional bits used to store an option identification number.

Figure 1 shows an example of how boundary scan data is shifted through the BSRs on each option.



x, y, z = Fixed logic levels for the identification (ID) register. Nets are foils that run between options.

Figure 1. Boundary Scan Operation

In normal system operation, data passes between option pins and logic as if the BSR were not there. When boundary scan is run, test data is shifted along the BSR shift register path, which includes each option on a module and all the interconnections between the options. Each option has a connection or pin for test data in (TDI) and test data out (TDO). Test data is shifted through the BSR path from TDI to TDO on each option by two control signals: Test Clock (TCLK) and Test Mode (TM).

TCLK and TM Control Signals

The TCLK signal is a pulse that causes data to be latched in the BSR. The TM signal determines the operating mode of the BSR. When TM is 0, the BSR is in serial mode. Each pulse of TCLK advances the data one position in the boundary scan chain. When TM is 1, the BSR is in parallel mode, and boundary scan data is placed on the output pins. A TCLK pulse latches the data on the input pins.

Boundary Scan Test Sequence

Table 1 describes the boundary scan sequence.

Table 1. Boundary Scan Test Sequence

Stage	TM Value	Description
1	0	BSR is loaded with test data using multiple TCLK pulses.
2	1	Parallel data is sent across the nets with a single TCLK pulse.
3	0	Serial data is read from the BSR using multiple TCLK pulses.

Overview: Continuity-line Sensing

Continuity Line

Every module in a CRAY T90 series system has a long, continuous metal line that runs near all of the options on the module. This metal line is called the continuity line (or is sometimes referred to as the C-line or burnline). The continuity line connects to the maintenance connector on each module. If an area of a module overheats, a segment of the continuity line opens and the BS module sends error information to the control system.

Continuity-line Sense Signal

The continuity-line sense signal is a 1-MHz square wave (refer to Figure 2). A square wave is used instead of a ground reference so that if the continuity wire shorts to ground, the short can be detected.

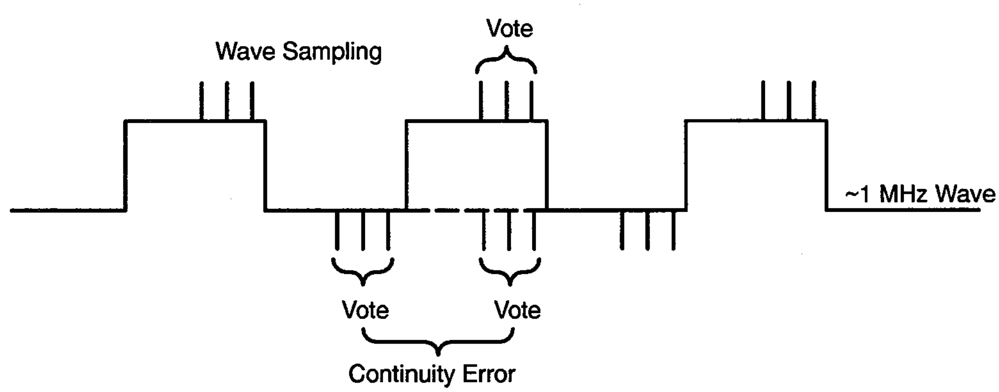


Figure 2. Continuity-line Sense Wave

The continuity-line sense signal is continuously sent through the continuity lines on each module and is sampled by the BS options three times near the end of every half period (512 KHz). A *vote* is taken from the three samples and the majority vote is used as the sensed value. This voting system removes glitches and prevents noise from causing an unnecessary shutdown of the system.

Continuity-line Errors

If the BS module fails to receive a toggle of the continuity-line sense signal every half period, the BS module notifies the control system that a continuity-line error occurred. When the control system receives the signal indicating a continuity-line failure, it starts a countdown timer. If the error indication goes away before the timer times out, the timer is reset and nothing happens. If the timer times out, the system performs a shutdown sequence. In CRAY T932 systems, only the physical half of the system receiving the continuity-line error shuts down.

Mask Bits

Control registers in the BS options enable and disable continuity-line sensing. These registers function as mask bits. There are 49 mask bits in the BS module: 1 bit for each BS option port that enables/disables continuity-line sensing on the system modules and 1 bit to enable/disable continuity-line sensing on the BS module.

In MME environment 0 (compose mode) you can enable and disable these mask bits. MME refers to these mask bits as burn mask bits. Refer to the *MME User Guide*, publication number HDM-xxx-xx, for information on how to enable/disable system modules from continuity-line sensing.

BS Module Component Layout

Module Map

Figure 3 shows the components on a BS module. The clock receiver, clock testpoint (clock TP), and termination resistor modules are common with all mainframe modules.

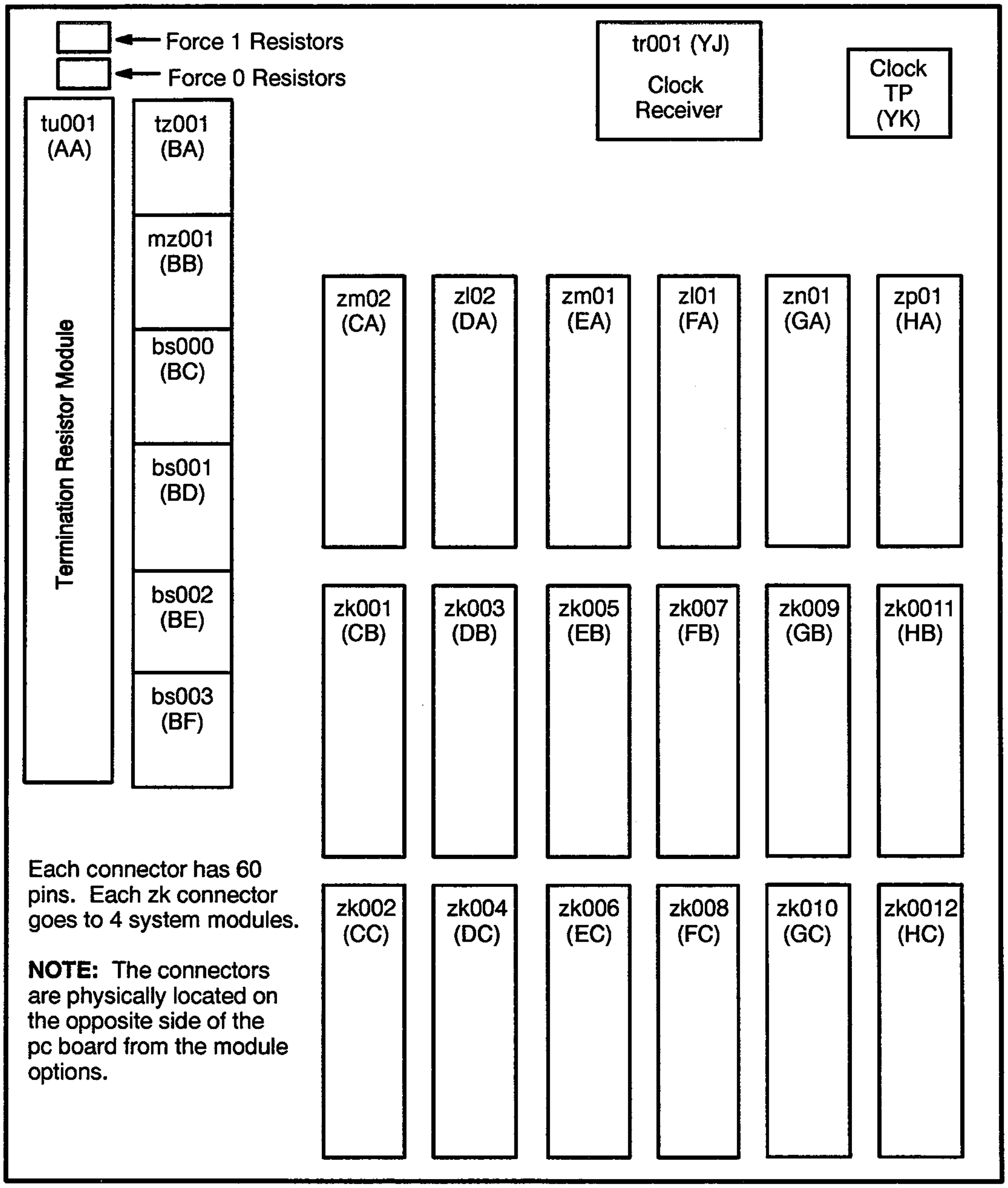


Figure 3. Boundary Scan Module Map

BS Module Connectors

Table 2 lists the boundary scan module connectors.

Table 2. Boundary Scan Module Connectors

Connector Name	Connector Quantity	Connector Function
ZK	12	60-pin module interface connectors associated with the 12 BS option ports. Each BS option sends data or test signals to three ZK connectors. Each ZK connector can pass data to four different system modules.
ZL01	1	Input connector for the boundary scan channel from the support system.
ZL02	1	Not used.
ZM01	1	Output connector for the boundary scan channel to the support system.
ZM02	1	Not used.
ZN01	1	Connector to the control system for continuity-line sensing information.
ZP01	1	Maintenance connector. The source for boundary scan test signals to the MZ option for running the boundary scan test on the BS module (from a tester only). In a CRAY T90 series system, this connector is biased off.

BS Module Options

Table 3 lists the BS module options and describes their functions. The four BS options are assigned a 2-bit hard-wired identification number or Array ID (11, 10, 01, 00). The MZ and TZ options are common to all modules.

Table 3. Boundary Scan Module Options

Option Name	Option Quantity	Option Description
BS †	4	Each BS option receives 4 data bits, 1 parity bit and one of four control signals (ready, resume, disconnect, or master clear) for the boundary scan test feature. Each BS option drives 12 ports for boundary scan testing and continuity-line sensing. BS000 generates a 1-MHz square wave for continuity-line sensing.
MZ	1	A fanout and relay option for boundary scan and continuity-line test signals for testing the BS module. The MZ option is the first option on system modules to receive boundary scan test information from the BS options.
TZ	1	System Clock. The TZ option generates module identification information that is sent back to the BS options with the boundary scan test data.

† In the Boolean, BS options BS000, BS001, BS002, and BS003 are referred to as Array NOE, Array UNE, Array DUE, and Array TRE, respectively.

BS Option Ports Each BS option has 12 logical ports for a total of 48 ports on each BS module. These ports are assigned by the nibble (4 bits) within each 16-bit parcel of the Array ID. Table 4 shows the port assignments for each BS option.

Table 4. BS Option Port Assignments

Option Name	Boolean Notation (Array ID)	Port Assignment (Nibble) †			
		Parcel 0	Parcel 1	Parcel 2	Parcel 3
BS003	11	Not Used	47 – 44	31 – 28	15 – 12
BS002	10	Not Used	43 – 40	27 – 24	11 – 8
BS001	01	Not Used	39 – 36	23 – 20	7 – 4
BS000	00	Not Used	35 – 32	19 – 16	3 – 0

† A nibble is equal to 4 bits.

The BS option ports route boundary scan or continuity-line data to the boundary scan/continuity-line port on each system module through 1 of 12 ZK connectors. Each ZK connector can direct the data to 4 different system modules that have the same function and that are near each other. Because there is only a maximum of 43 system modules (not including the BS module) in each physical boundary of a CRAY T90 series system, not all of the ZK connectors are needed to direct the data. Therefore, spare ZK connectors exist on the BS module that can be used as backup connectors if the primary connector is defective.

Table 5 through Table 7 show the port maps for the CRAY T90 series systems. The port maps show which ZK connector is associated with each BS option port and the chassis location to which the BS option directs data. The spare destination in the table indicates which ZK connector to use if the primary connector is defective.

Table 5. CRAY T94 Chassis Boundary Scan Module Port Map

Port Numbers	ZK Connector Number	Connector Location	BS Option Source	Chassis Location
36 – 39	9	GB	01	B1, B2, B3, B4
20 – 23	5	EB	01	C5, C4, C3, C2
5	1	CB	01	A1
4	1	CB	01	C1

Table 6. CRAY T916 and CRAY T932 (Quadrants 1 and 2) BS Module Port Map

Port Numbers	ZK Connector Number	Connector Location	BS Option Source	Chassis Location	
				Stack	Number
44 – 47	11	HB	03	H	1 – 4
40 – 43	10	HC	02	L	1 – 4
36 – 39	9	GB	01	H	5 – 8
32 – 35	8	GC	00	L	5 – 8
28 – 31	7	FB	03	G5, E, I	
24 – 27	6	FC	02	Spare	
20 – 23	5	EB	01	G	1 – 4
16 – 19	4	ED	00	K	1 – 4
12 – 15	3	CC	03	F	1 – 4
8 – 11	2	DC	02	J	1 – 4
4 – 7	1	CB	01	F	5 – 8
0 – 3	0	DB	00	J	5 – 8

Table 7. CRAY T932 (Quadrants 0 and 3) BS Module Port Map

Port Numbers	ZK Connector Number	Connector Location	BS Option Source	Chassis Location	
				Stack	Number
44 – 47	11	HB	03	P	1 – 4
40 – 43	10	HC	02	D	1 – 4
36 – 39	9	GB	01	P	5 – 8
32 – 35	8	GC	00	D	5 – 8
28 – 31	7	FB	03	G5, A, M	
24 – 27	6	FC	02	Spare	
20 – 23	5	EB	01	O	1 – 4
16 – 19	4	ED	00	C	1 – 4
12 – 15	3	CC	03	N	1 – 4
8 – 11	2	DC	02	B	1 – 4
4 – 7	1	CB	01	N	5 – 8
0 – 3	0	DB	00	B	5 – 8

Logical Connections: How the BS Module Works

Introduction

Figure 4 shows the logical connections between the BS module and the mainframe. The BS module has two maintenance ports: the passon port and the serial interface port. The passon port is not used. The serial interface port is a bit serial interface that provides direct maintenance control within the BS module. The serial interface port directs data and control information to the serial maintenance channel (SMC), to the boundary scan/continuity-line maintenance port on each system module, or between the continuity-line wires on each system module and the monitoring system. The SMC is used only in a manufacturing environment when modules are being tested.

The serial maintenance interface port also ensures that no more data arrives after a source disconnect signal has been sent. If data does arrive, then lost data flags are set in the status word.

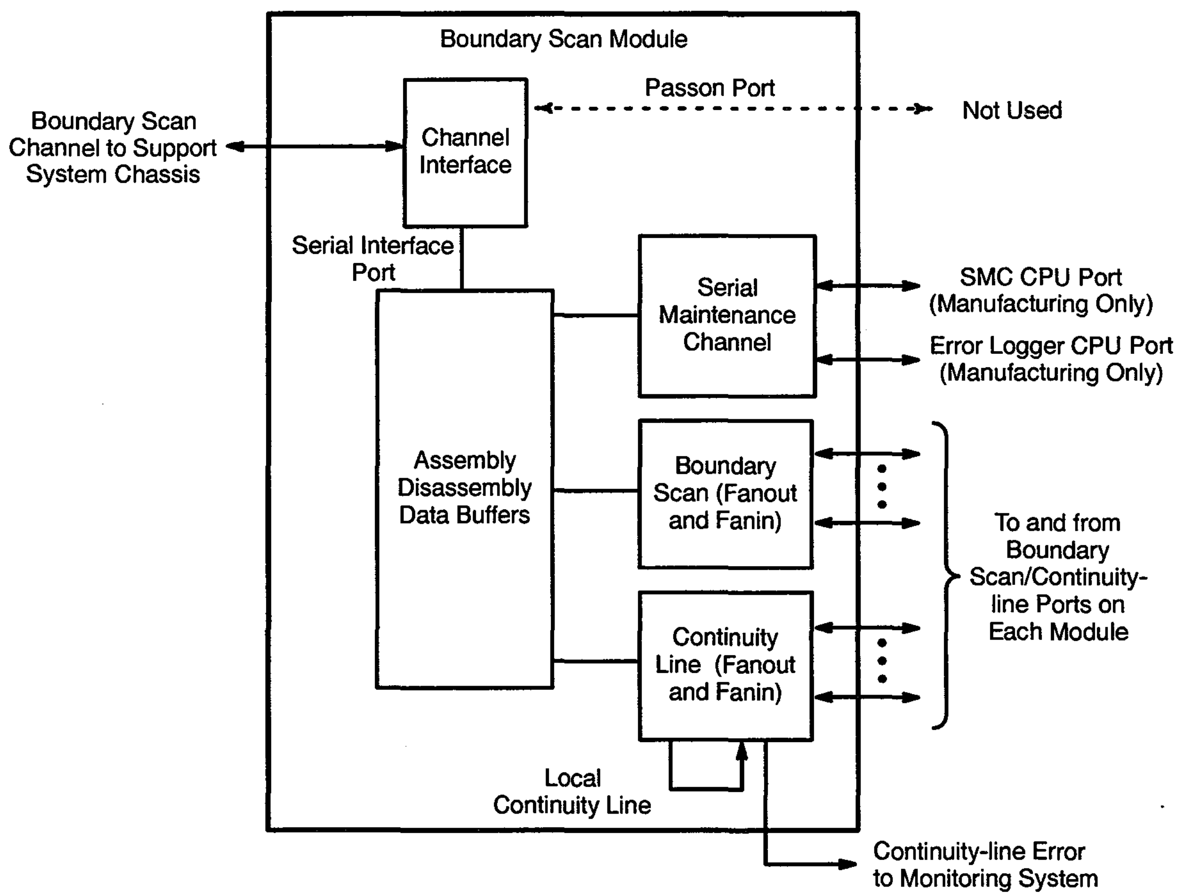


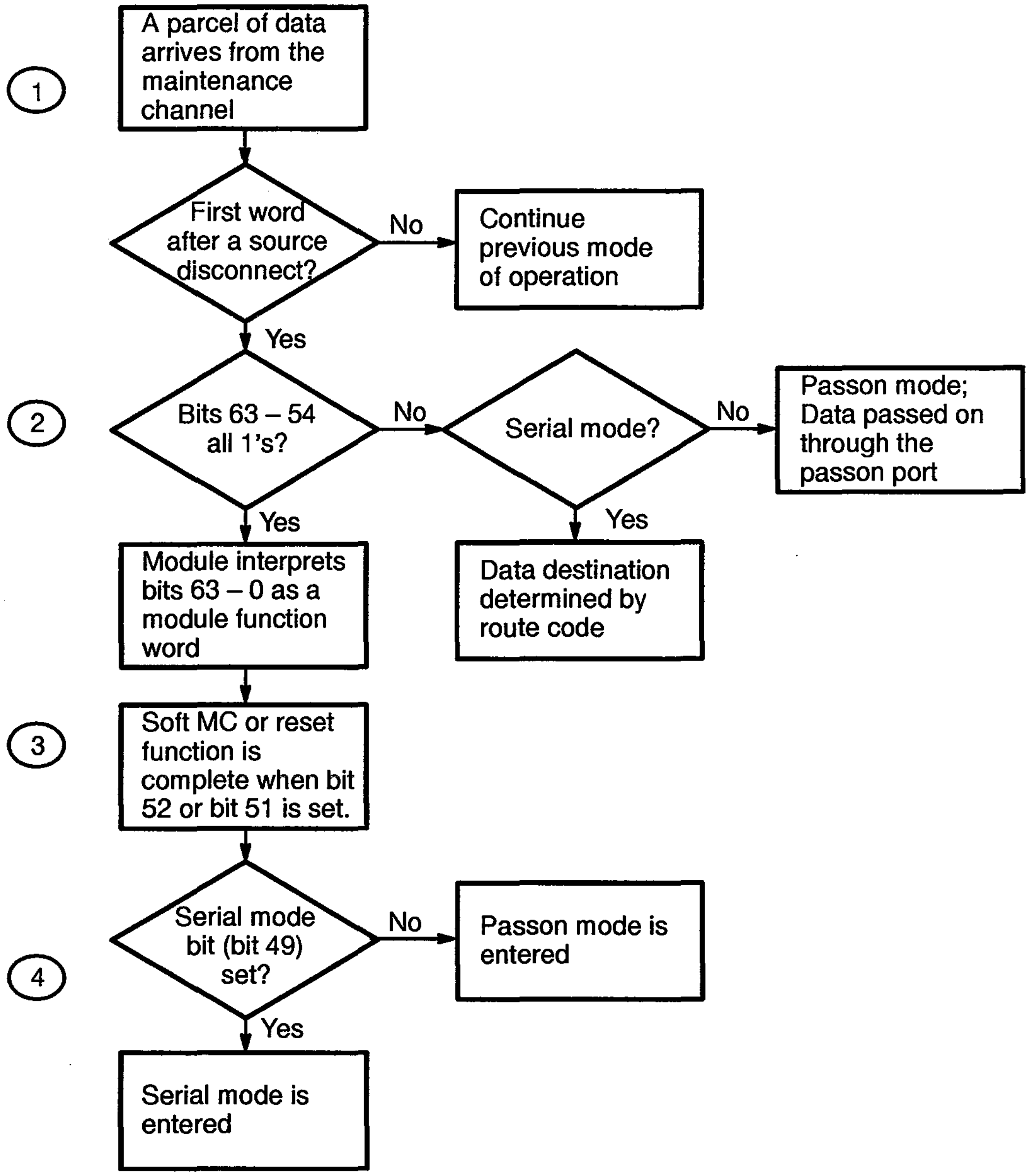
Figure 4. BS Module Logical Connections

Mode of Operation: Serial or Passon

The BS module has two modes of operation: serial mode and passon mode. In serial mode, the BS module routes data to the serial interface port for boundary scan and continuity-line operations. Passon mode is not used.

The BS module determines the mode of operation by examining the contents of the first data parcel following a source disconnect signal. If the upper 10 bits of this parcel are all 1's, the BS module interprets the word as a module function word. The first parcel of the module function word (module function parcel) determines whether the BS module operates in serial mode or passon mode and then directs the data to the appropriate maintenance interface port. If data is directed to the passon port (which is not used), unpredictable results will occur.

If the upper 10 bits are not all 1's, the module continues to send data to the previously selected maintenance interface port determined by the state of the control register bit. The BS module continues to operate in either serial or passon mode until it receives a new module function word from the control channel. Figure 5 summarizes how the BS module determines operation mode. The table defines the numbered phases within the figure.



Phase	What Happens
1	A source disconnect signal indicates the end of an operation and defines the next word as the first word of a new transfer.
2	The state of the parcel is determined.
3	Initializes the BS module and forces the module into a known state if the function is for the BS module.
4	Determines the mode of operation (serial or passon mode) and routes data to the appropriate maintenance interface port.

Figure 5. How the BS Module Determines the Mode of Operation

Module Function Word

When bits 54 through 63 of the first parcel of the word following a source disconnect signal are all 1's (for example, 177700 000000 000000 000000), the BS module interprets the word as a module function. A module function word determines the BS module mode of operation. Figure 6 shows the contents of a module function word.

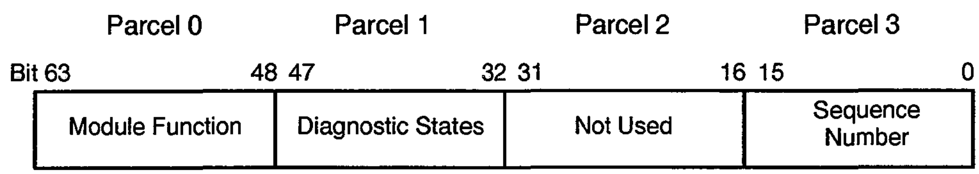


Figure 6. Module Function Word

Parcel 0: Module Function

Parcel 0 defines a module function and contains the switch pattern, soft master clear, reset read status clear error, enter serial mode, and internal loop bits. Figure 7 shows the module function parcel and the bits within.

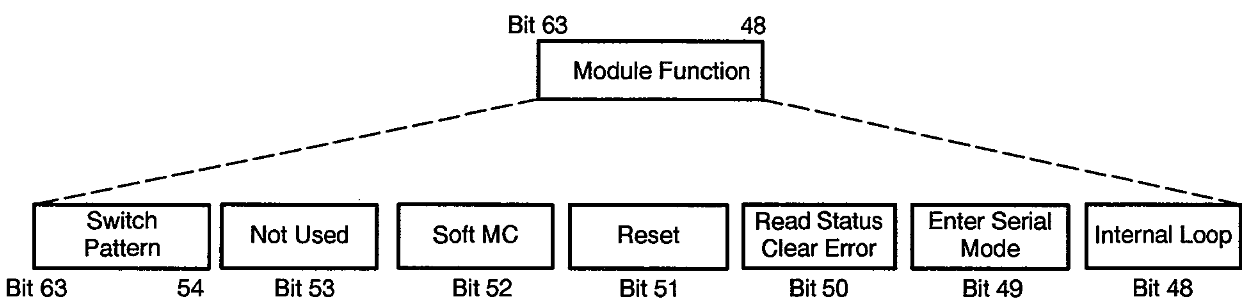


Figure 7. Module Function Parcel

The switch pattern field (bits 54 through 63) determines whether the remainder of the word is a module function. When this field is all 1's, the remaining word is a module function. When this field is not all 1's, the data is sent unchanged to one of the two maintenance ports.

The soft master clear and reset bits (bit 52 and bit 51) enable the BS module to be initialized with either a soft master clear function or a reset function. If either bit is set, the corresponding function is completed as soon as the parcel is detected. All operations in process at the time the signal is received are aborted and reset. When either bit is set and received, a return disconnect signal is sent to the return channel to place the module and the return channel into a known state. In addition to initializing the BS module, a soft master clear function also turns off the local sanity code generator, clears any entry in the error logger, and disables the SMC by ignoring SMC and error logger inputs.

When the read status clear error bit (bit 50) is set, the BS module performs a read status function and a clear error status function. A read status function returns 4 parcels of the module status word from the BS module. Table 8 shows the module status word. A clear error status function clears the error status accumulated across all operations in the system.

NOTE: The return channel and source channel are paths defined by the structure of the sanity tree. When a signal is sent to the return channel, the signal follows the sanity tree path to its source location.

The enter serial mode bit (bit 49) determines the operation mode of the BS module. If this bit is set, the module operates in serial mode and can perform boundary scan, continuity-line sensing, and SMC functions. If this bit is not set, the BS module operates in passon mode and unpredictable results occur.

If the internal loop bit (bit 48) is set, no more functions are performed, and all parcels of data (including parcels from the module function word) are looped back to the return channel.

NOTE: The only way to exit from the internal loop mode is to send a soft master clear signal or a reset signal to the BS module.

Table 8. Module Status Word

Bits	Name	Definition
63 – 48	Read Function	Module function or channel function doing the read status.
47 – 32	DS_IMAGE	Diagnostic states from the last module function word. A soft master clear or a reset signal does not affect the DS image field.
31	Error Status	CS_nibblePE for nibble THREE
30	ERROR STATUS	CS_SeqERR (CS_rdy overflow)
29	ERROR STATUS	Zero
28	ERROR STATUS	Zero
27	ERROR STATUS	CS_nibblePE for nibble TWO
26	ERROR STATUS	LostData on Serial Out
25	ERROR STATUS	LostData on Serial In
24	ERROR STATUS	CS_IncompleteWord ERROR
23	ERROR STATUS	CS_nibblePE for nibble One
22	ERROR STATUS	Zero
21	ERROR STATUS	CR_SeqERR (CR_rsm underflow)
20	ERROR STATUS	PORT_REQUEST_ERROR (PORTdata and noREQUEST_OUTPUT)
19	ERROR STATUS	CS_nibblePE for nibble ZERO
18	ERROR STATUS	Zero
17	ERROR STATUS	Zero
16	ERROR STATUS	Any ERROR
15	SERIAL STATUS	Logger Input Reg Full
14	SERIAL STATUS	Logger On
13	SERIAL STATUS	Primary Input Sanity Valid
12	SERIAL STATUS	Primary Output Sanity On
11	SERIAL STATUS	SMC_ENABLE On
10	SERIAL STATUS	Zero
09	SERIAL STATUS	Secondary Input Sanity Valid
08	SERIAL STATUS	Secondary Output Sanity On
07 – 00	SEQUENCE NUMBER	From the last module function word

Parcel 1: Diagnostics States

Parcel 1 of the module function word contains the diagnostic states field (bits 32 through bits 47). When the BS module is in serial mode, these bits are stored in the diagnostic states register on the BS module. Once the fourth parcel of data from the module function word (sequence number field) is received and the function is executed, the diagnostic states register and the DS image register are loaded with these bits. When set, these bits force error conditions that set the error status bits in the module status word. Table 9 summarizes the diagnostic states bits and what they can test when they are set. Bits 38, 40, 44, and 45 are not used.

Table 9. Diagnostic States Bits

Bits	Description
47, 43, 39, 35	Toggle the incoming parity bit for the respective nibble.
46	Force a source channel sequence error for each channel source ready signal received.
42, 41	Force the data mode prepend to route codes 34, 35, or 36 to cause lost data when the SMC channel is looped back on itself.
37	Force a return channel sequence error for each channel return resume signal received.
36	Force TM = TDO on all selected ports. This allows TM to be tested with a special cable that loops the port signals back on themselves.
32	Toggle all return channel parity bits.

The diagnostic states bits remain active until a soft master clear signal or a reset signal is received or until a new module function command is executed. A soft master clear or reset signal will not clear the DS image field in the module status word.

Parcel 3: Sequence Number

Bits 0 through 7 in parcel 3 are the sequence number field and are used by the programmer to tag a specific function. Bits 8 through 15 of this parcel are not used.

Serial Mode: Boundary Scan, Continuity Line, and SMC Functions

Overview

When bit 49 (enter serial mode) of a module function word is set, the BS module operates in serial mode; that is, data entering or leaving the BS module is directed to the serial interface port.

In serial mode, the BS module performs one of the following functions:

- Performs a channel function that is used to control continuity lines and boundary scan operations
- Performs a port function that selects input and output ports for boundary scan operations
- Performs a loop controller function that selects sanity code and error logger control functions
- Sends data to the SMC

Route Code

Each word following a module function word has a route code in parcel 0 (bits 48 to 63). The route code defines the destination or function of each word. The route code is defined as 5 bits starting with the first nonzero bit in the word. Figure 8 shows how the route code is defined.

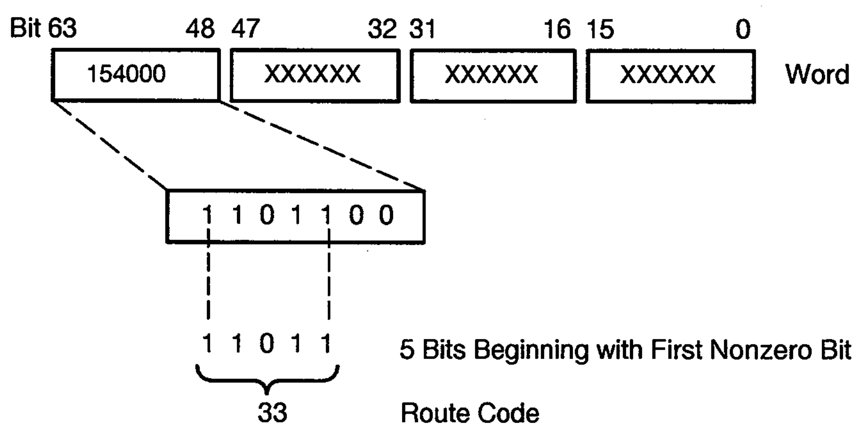


Figure 8. Route Code Definition

Table 10 lists the route codes and the destination of the word on the BS module. When a route code is received (unless if it is 37), it is stored in the route code register. If the BS module receives a route code of 37, the module continues to send data to the location indicated by the route code previously stored in the route code register.

Table 10. Route Codes

Route Code (Octal)	BS Module Destination
20 – 27	Data is sent to and from the Serial Maintenance Channel (SMC) used only for module test.
30	Loop controller function for selecting sanity code and error logger control functions on the BS module.
31 – 32	Undefined.
33	Channel function (route code must be in bits 63 – 59) which enables/disables the continuity-line transmitters, loads the burn mask register, and enables/disables detection of continuity-line errors to the monitoring system.
34 – 36	Undefined.
37	Continuation/data mode/port function (route code must be in bits 63 – 59). With any function, a route code of 37 will continue sending data to the location indicated by the contents of the route code register. A port function enables/disables the boundary scan operations by activating TM and TCLK signals and directing data to specific system module ports. Data mode sends data to the SMC until a source disconnect signal is received.

Example: Flow of Serial Mode Operation

Figure 9 shows the flow of data through the BS module when a boundary scan operation command is initiated. The first word following the module function word (that selects serial mode) is a channel function word with a route code of 33. The route code is placed in the route code register, and the BS module enters the boundary scan port operation.

The word following the channel function word is a port function word with a route code of 37. A port function word enables boundary scan operations and generates the TM and TCLK control signals. A route code of 37 puts the BS module in continuation mode, which enables the BS module to continue the operation defined by the contents of the route code register. Therefore, the boundary scan operation continues until the BS module receives a source disconnect signal.

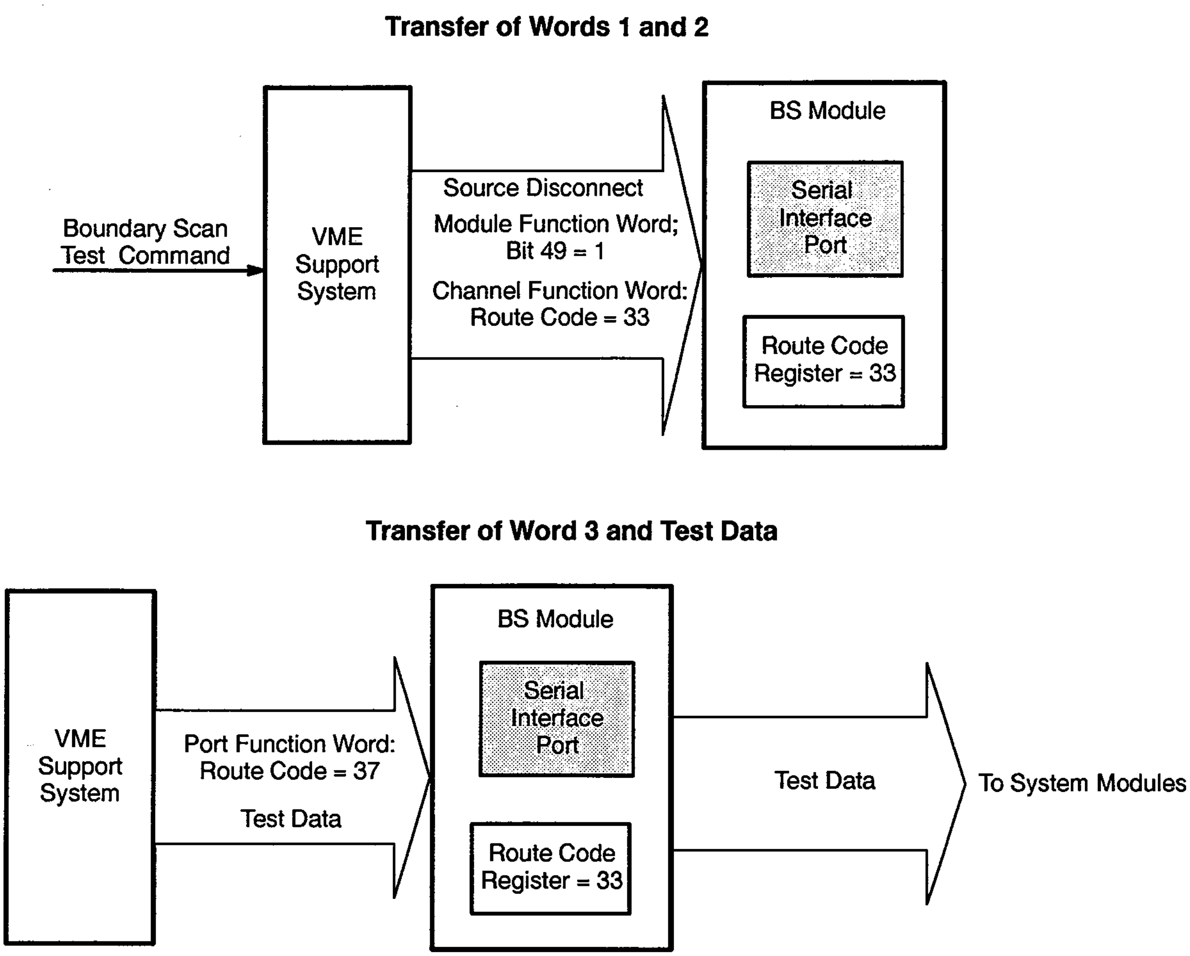


Figure 9. Boundary Scan Test Data Flow with BS Module Operating in Serial Mode

Block Diagram: How Boundary Scan Works

Channel Interface

When the boundary scan test is initiated, the maintenance workstation (MWS) sends control signals and data patterns through the LOSP boundary scan channel (via the ZM connector) to the BS module. This channel interface handles 16 data bits, 4 parity bits, and 3 control signals (**Ready**, **Resume**, and **Disconnect**) in parallel. Communication through the interface uses 64-bit words consisting of four 16-bit parcels. Refer to Figure 12.

BS Option Functions

Each BS option receives 4 data bits, 1 parity bit, and a control signal from the LOSP channel. Common connections between the four BS options distribute this data and control information to all BS options to ensure that they perform operations in sequence.

When the BS options receive boundary scan data and control information, they perform the following three functions:

- Disassemble the parallel data (64-bit words in four 16-bit parcels) coming from the LOSP channel into serial data (test data out).
- Generate the **TCLK Test Clock** signal
- Generate the **Test Mode (TM)** signal

Each BS option then sends the **Test Data Out**, **Test Mode**, and **TCLK Test Clock Out** signals through its 12 ports out to 3 ZK connectors. Each ZK connector directs the boundary scan test signals to 4 different modules; therefore, boundary scan test information can be sent to 48 different modules (12 connectors x 4 modules).

The test results are assembled into 64-bit words and transmitted as 4 parcels on the control channel output. Because of the serial nature of boundary scan, a word is returned on the channel for each word accepted. Data streams must be adjusted so that they end on 64-bit boundaries.

Boundary Scan Operation on System Modules

Boundary scan data and control signals enter the MZ option on the CP, CM, shared, or IO modules through one of the connectors listed in Table 11. The data and control signals enter the MZ option as **TDI, TDO, TM,** and **TCLK**. Refer to Figure 10.

NOTE: The boundary scan signals named in the BS option Boolean are **Test Data Out, Test Data In, Test Mode, TCLK Test Clock Out**, and **RKLK Klock Return In**. These signals going into the MZ option and all other system options are called **TDO, TDI, TM**, and **TCLK** or **RCLK**.

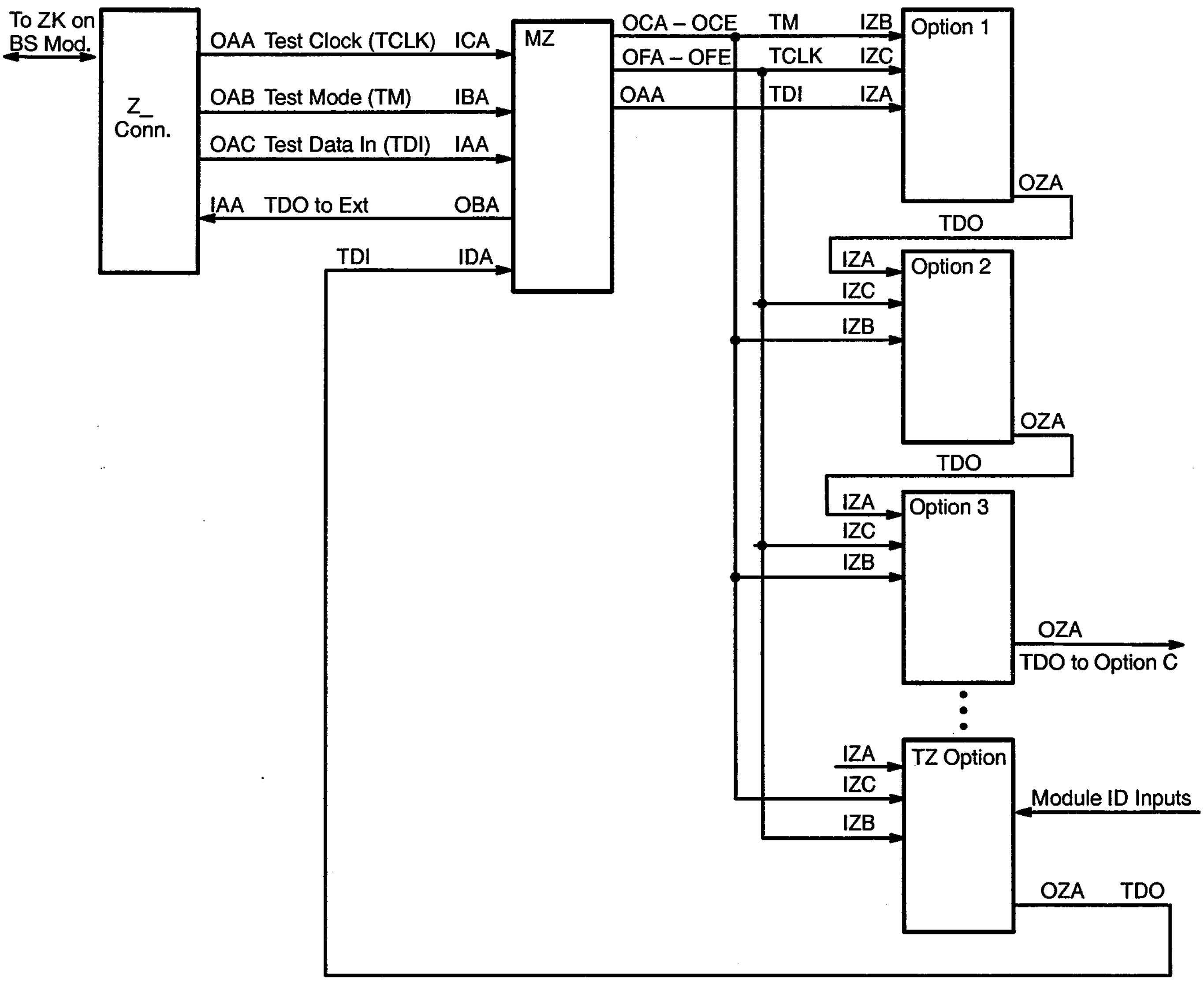


Figure 10. Boundary Scan Test Operation on System Modules

The MZ option fans out the **TM** and **TCLK** signals to all options on the module and sends **Test Data In** to one option to begin a daisy chain of the test data through all the circuitry on that module. The TZ option on each module is the last option to receive test data and the first option to return its boundary scan test data to the MZ option. The TZ option test data includes module identification information. Data leaves the module through the connectors listed in Table 11.

Table 11. Connector Input for Boundary Scan Test Signals

Module Type	Connector
CP	ZR
CM	ZE
SR	ZR
NW	ZE
IO	ZR
BS †	ZP

† Testing the options and interconnections of a BS module is done only in Systems Test and Checkout (STCO). Test signals are generated on the tester.

Return Path of Boundary Scan Test Data on BS Module

The **Test Data In** and the **RKLK Klock Return In** signals pass through the ZK connectors to the BS options. The BS options reassemble the serial data into parallel data and send the data to the LOSP channel via a ZL connector. Each BS option sends 4 data bits, 1 parity bit, and a control signal back to the LOSP channel.

Module Identification

Each TZ option has 23 input pins that encode module identification information. The module identification information is divided into two fields: the module type and the module serial number.

The module type field is a 10-bit field consisting of two 5-bit subfields: A and B. The A subfield contains the first letter of the module type. An *A* is encoded as 00001, a *B* is encoded as 00010, and so on up through *Z*, which is encoded as 11010. The B subfield contains the second letter of the module type and is encoded the same way as the A subfield. The module type is hard-wired into each module using forced 0's and forced 1's.

The module serial number field is a 13-bit field consisting of a binary number ranging from 0 through 8191. During the manufacturing process, the serial number input pins are connected to forced 0's, setting the serial number to 0. The serial number is set to the desired number by cutting some of the input pin interconnects. Each open pin *floats* to a logical 1.

Table 12 shows the module identification bits, their input pins on the TZ option, and their location in the boundary scan chain. Scan location 0 in the TZ option is the first bit read out of the boundary scan chain. Location 315 is the last bit of the chain to be read. The last column of the table is an example showing the value of each bit for BS module serial number 5.

Table 12. Module Identification Bits

Field	Subfield	Bit	Pin	Scan Position	Value for BS Module S/N 5
Module Type	A (1st Letter)	A0	327	48	0
		A1	332	44	1
		A2	335	41	0
		A3	342	36	0
		A4	346	32	0
	B (2nd Letter)	B0	10	307	1
		B1	11	306	1
		B2	140	203	0
		B3	143	200	0
		B4	150	196	1
Serial Number		S0	37	287	1
		S1	47	279	0
		S2	62	269	1
		S3	138	205	0
		S4	153	192	0
		S5	209	142	0
		S6	229	129	0
		S7	239	121	0
		S8	249	114	0
		S9	259	106	0
		S10	330	45	0
		S11	340	37	0
		S12	345	33	0

Option Identification

The option identification (chip ID) is a 16-bit number that identifies the option type. When this 16-bit number is expressed as a decimal, the least significant (decimal) digit can have up to ten different chip IDs for logically equivalent parts. For example, the least significant digit of the chip ID can vary from 0 to 9 with no logic changes to the option.

Block Diagram: How Continuity-Line Sensing Works

Continuity-line Sense Signal Generation

Figure 13 is a block diagram of continuity-line sensing. Each BS option generates the square wave continuity-line signal and sends it through the 12 BS option ports to the system modules that it supports (refer to the port maps in Table 5, Table 6, and Table 7). This continuity-line signal leaves the BS options as the **Burn Line Source** signal and returns to the BS options as the **Burn Line Return** signal. If there are no continuity-line errors, the **Burn Line Return** signal is identical to the **Burn Line Source** signal. However, if a continuity-line error occurs, the continuity-line signal looks like the signal in the wave shown in the lower half of Figure 11.

NOTE: The continuity line is also referred to as a burnline or a C-line. Signal names in Figure 13 and the supporting text are consistent with the Boolean comments for the BS module options.

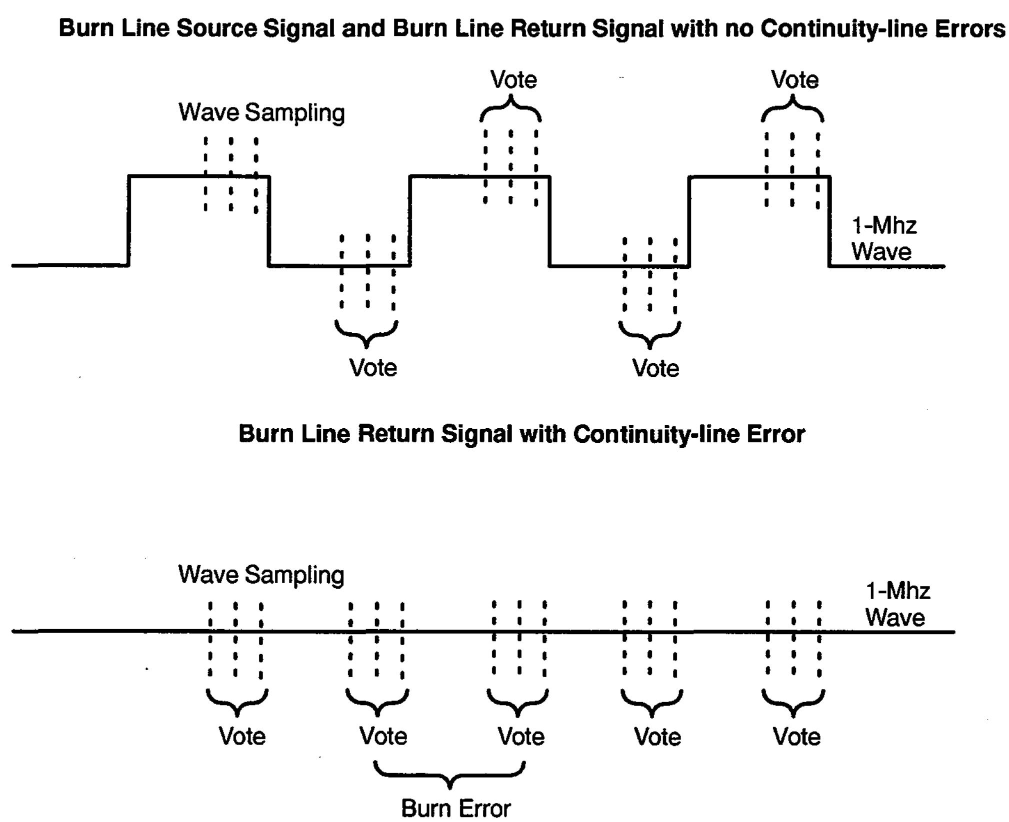


Figure 11. Continuity-line Sense Wave with a Continuity-line Error

Continuity-line Error Summation

Continuity-line information from all of the system modules is ORed and sent to the control system. Option BS001 generates the **Burnerr Sum to**

Next Chip signal for the local continuity line or BS module continuity line. This signal goes to option BS000 where it is ORed with the sum of the 12 **Burn Line Return** signals for option BS000. The sum of these 13 signals goes to option BS001 and is ORed with the sum of the 12 **Burn Line Return** signals for option BS001 (25). This summation continues for option BS003 (37) and option BS002 (49). The final sum of all of the **Burn Line Return** signals ORed is sent to the control system from two different BS options. BS002 sends one **Burnerr to WACS** signal to the control system, and BS000 sends a copy of the **Burnerr to WACS** signal to the control system. Two **Burnerr to WACS** signals are sent for redundancy.

If a continuity-line error occurs in any of the system modules, the final sum that is equal to 1 will be sent to the control system, which will shut down the CRAY T90 series system. on a T32, only 1/2 of system shuts down

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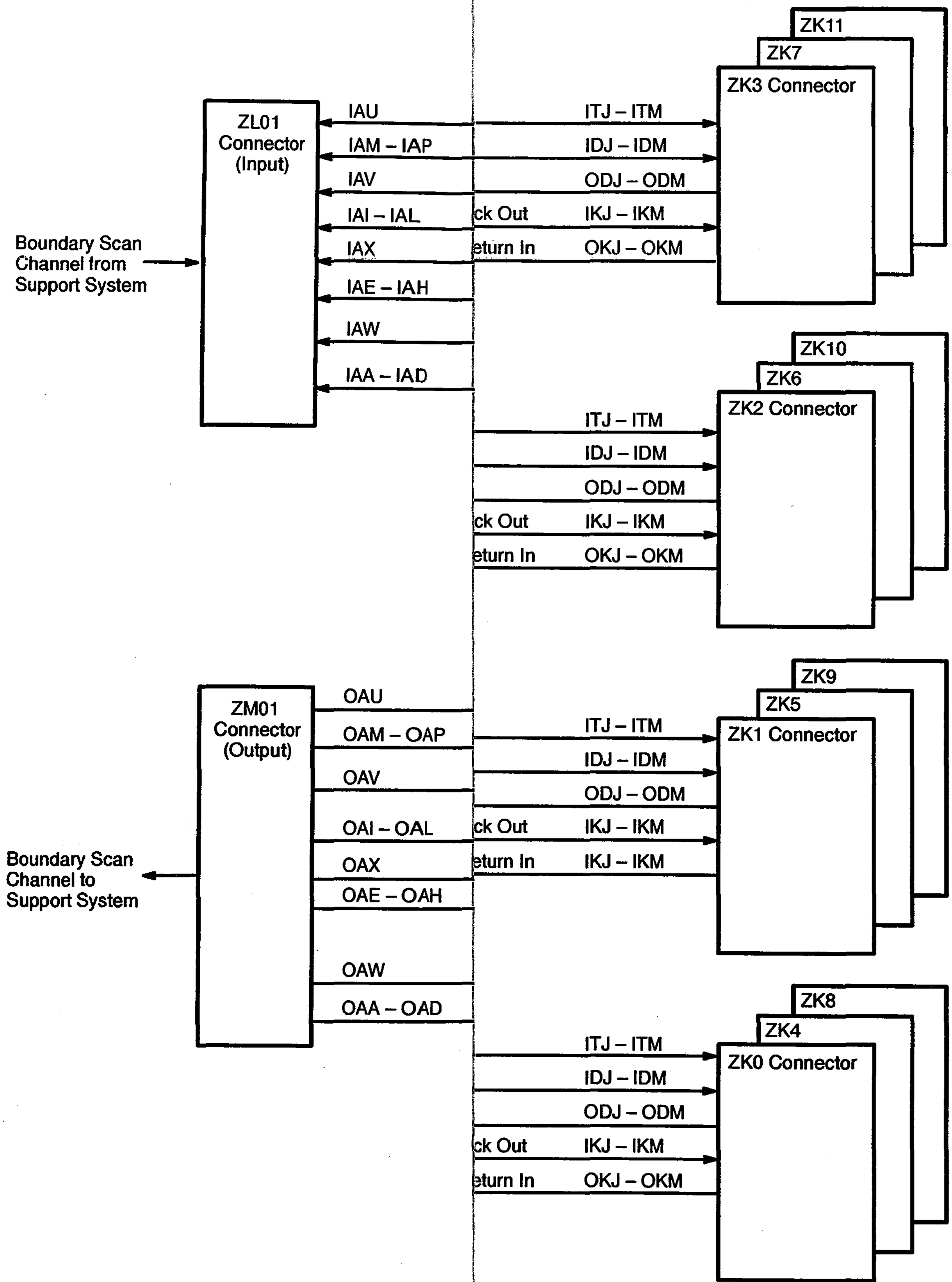
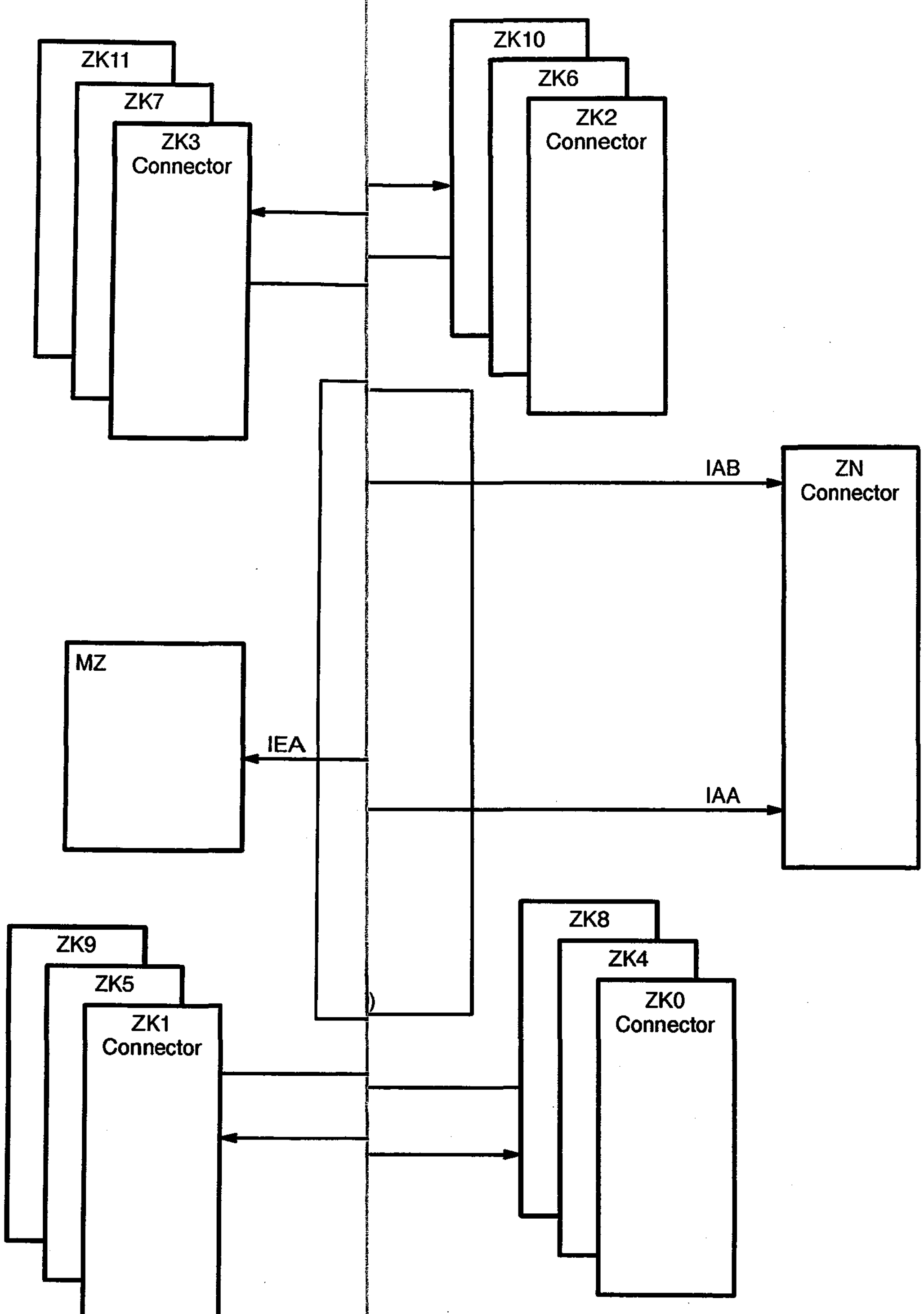

ZK11
ZK7
ZK3 Connector
ZL01
Connector
(Input)
IAU
IAM – IAP
IAV
IAI – IAL
IAX
IAE – IAH
IAW
IAA – IAD
ITJ – ITM
IDJ – IDM
ODJ – ODM
ck Out
IKJ – IKM
eturn In
OKJ – OKM
Boundary Scan
Channel from
Support System
ZK10
ZK6
ZK2 Connector
ZK9
ZK5
ZK1 Connector
ZM01
Connector
(Output)
OAU
OAM – OAP
OAV
OAI – OAL
OAX
OAE – OAH
OAW
OAA – OAD
Boundary Scan
Channel to
Support System
ZK8
ZK4
ZK0 Connector



Note: The signal names are con

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Preliminary Information

Number: **HTM-xxx-x**
December 1994

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