SPECIFICATION

KSCOM

Microprocessor Commands and Messages

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1.0 MICROPROCESSOR CONSOLE PROGRAM

The DECSYSTEM-2020 consists of the following hardware and software:

1. The console program, which runs in the microprocessor
2. The TOPS-10 operating system, which runs in the KS10 central processor
3. The console terminal (CTY), which is connected directly to the microprocessor. The CTY operates in either of two modes:
   a. Console mode, which is used for the boot procedure, diagnostics, and error recovery
   b. User mode, which runs TOPS-10 operator programs and allows the operator to communicate with timesharing users

The console program runs automatically when you power up the DECSYSTEM-2020. Therefore, when you type on the CTY immediately after powering up, you are communicating with the console program running in the microprocessor. In this case, the CTY is in console mode.

To communicate with the TOPS-10 operating system running in the KS10 central processor, the CTY must be in user mode. To switch the CTY from console mode to user mode, you must do one of the following:

1. Boot the system with either the BT or the MT command.
2. Continue execution with either the CO or the ST command.
3. Type a CTRL/Z.

When the CTY enters user mode, the message USR MOD prints on the CTY.

To switch the CTY to console mode from user mode, you must perform the following steps:

1. Make sure the LOCK switch on the front panel is unlocked.
2. Type CTRL/backslash.

When the CTY enters console mode, the message ENABLED prints on the CTY.

The following format rules apply to console mode:

1. Do not type more than 80 characters on one line.
2. Separate commands with a comma when you type more than one command on a line.
3. Use only octal numbers.

2.0 COMMON MICROPROCESSOR COMMANDS AND SPECIAL CHARACTERS

This section lists the most common commands and special characters. Note that these commands are executed only in console mode.

Command	Function
BT (Boot)	Boots the system from the last disk drive selected. Loads and starts the microcode and the monitor bootstrap from unit 0 on UBA1 (default address) or from the drive selected with the last DS command. The KS10 starts at memory address 1000. The bootstrap program prompts with BTS>. This command switches the CTY from console mode to user mode.
CO (Continue)	Continues execution. This command switches the CTY from console mode to user mode.
DM xx (Deposit Memory)	Deposits xx (36 bits) into KS10 memory. The address was previousy loaded by the LA command.
DS (Disk Select)	Selects a disk drive other than unit 0. Use this command with the BT command.
EM (Examine Memory)	Examines the contents of KS10 memory. The address was previously loaded by the LA command.
EM xx (Examine Memory)	Examines the contents of KS10 memory address xx.
HA (Halt)	Halts the KS10.
LA xx	Sets KS10 memory address to xx, where xx = 0000000 to 1777777.
MS (Magnetic Tape Select)	Selects a magnetic tape drive other than unit 0. Use this command with the MT command.
MT (Magnetic Tape Boot)	Boots the system from magnetic tape using either the last drive selected or unit 0, the default.
RP (Repeat)	Repeats last command (or last command string) until you press any CTY key.
SH (Shutdown)	Shuts down the monitor after completing the last instruction. When you give this command, the microprocessor stops monitoring the keep-alive count.
ST xx (Start)	Starts the KS10 program at memory address xx. This command switches the CTY from console mode to user mode.

Special Character	Function
CTRL/backslash	Switches the CTY from user mode to console mode.
CTRL/O	Suppresses printing at the terminal or resumes printing if it is the second CTRL/O.

Special Character	Function
CTRL/Q	Resumes printing at the terminal after a CTRL/S has stopped it.
CTRL/S	Stops printing at the terminal and hangs the microprocessor.
CTRL/U	Deletes the current line.
CTRL/Z	Switches the CTY from console mode to user mode.
DELETE Key (or RUBOUT)	Deletes the last character typed.

3.0 GLOSSARY OF MICROPROCESSOR COMMANDS

Sections 3.1 through 3.11 list the microprocessor commands alphabetically within functional groups. The functional groups are:

1. Boot Commands (See Section 3.1.)
2. Enable/Disable Commands (See Section 3.2.)
3. Examine Commands (See Section 3.3.)
4. Mark/Unmark Microcode Commands (See Section 3.4.)
5. Miscellaneous Commands (See Section 3.5.)
6. Read CRAM Commands (See Section 3.6.)
7. Select Device Commands (See Section 3.7.)
8. Set and Deposit Commands (See Section 3.8.)
9. Start/Stop Clock Commands (See Section 3.9.)
10. Start/Stop Microcode Commands (See Section 3.10.)
11. Start/Stop Program Commands (See Section 3.11.)

3.1 Boot Commands

Command	Function
B2	Loads a modified preboot program, which loads and runs a special sequence of modified functional diagnostics.
BC	Performs a rudimentary test of some KS10 hardware. The test includes: 1. Floating all 1's and all 0's across the KS10 bus 2. Checking page 1 of the KS10 MOS memory in an addressing sequence

Command	Function
BC (Cont.)	3. Checking page 1 of the KS10 MOS memory for its ability to hold all 1's and all 0's 4. Using an addressing sequence for testing CRAM addressing to check the KS10 control store and to check each location for its ability to hold all 1's and all 0's
BT	Boots the KS10 from disk. This command loads and starts the microcode and the monitor boot program from drive 0 on UBA1 (the default address), or on the drive selected with the last DS command. The KS10 starts at memory address 1000.
BT 1	Same as the BT command, except that the diagnostic boot program is loaded and started rather than the monitor boot program.
LB	Loads the monitor boot program from the last disk selected. This command does not load the microcode. The program must start at memory address 1000.
LB 1	Same as the LB command, except that the diagnostic boot program is loaded rather than the monitor boot program. The program must start at memory address 1000.
MB	Loads the monitor boot program from the last magnetic tape selected. This command does not load the microcode. The program must start at memory address 1000.
MT	Boots the KS10 from magnetic tape. This command loads and starts the microcode and the monitor boot program from tape unit 0, from slave unit 0 on UBA3 (default), or from the drive selected by the last MS command.
MT 1	Same as the MT command, except that the diagnostic boot program is loaded and started rather than the monitor boot program.

3.2 Enable/Disable Commands

If you press RETURN after the following commands, the current value prints on your CTY.

Command	Function
CE xx	Enables (xx = 1) or disables (xx = 0) cache.
PE xx	Enables or disables parity detection: PE 0 Disables all parity detection. PE 4 Enables KS10 bus parity detection. PE 5 Enables DPE/DPM parity detection. PE 6 Enables CRA/CRM parity detection. PE 7 Enables all parity detection.

Command	Function
SC xx	Enables (xx = 1) or disables (xx = 0) soft CRAM error recovery.
TE xx	Enables (xx = 1) or disables (xx = 0) CPU interval timer interrupts.
TP xx	Enables (xx = 1) or disables (xx = 0) CPU traps.

3.3 Examine Commands

Command	Function
EB	Examines the KS10 bus. This command prints the contents of console registers 100 through 103 and 300 through 303.
EC	Examines the current contents of the CRAM control register. The CPU clock must be stopped to execute this command.
EC xx	Examines the contents of CRAM address xx. The CPU clock must be stopped to execute this command.
EI	Examines the contents of the I/O register. The address was previously loaded by the LI command.
EI xx	Examines the contents of the I/O address xx.
EJ	Examines the current CRAM address, the next CRAM address, the jump address, and the subroutine return address. The CPU clock must be stopped to execute this command.
EK	Examines the contents of the microprocessor memory. The address was previously loaded by the LK command.
EK xx	Examines the contents of the microprocessor memory address xx.
EM	Examines the contents of KS10 memory. The address was previously loaded by the LA command.
EM xx	Examines the contents of KS10 memory address xx.
EN	Examines the contents of the next KS10, microprocessor, or I/O address.
ER	Examines the contents of an internal microprocessor I/O register. The address was previously loaded by the LR command.
ER xx	Examines the contents of the internal microprocessor I/O register xx.

3.4 Mark/Unmark Microcode Commands

To execute the following commands, the CPU clock must be stopped.

Command	Function
MK xx	Marks the microcode word (set bit 95) at CRAM address xx.
UM xx	Unmarks microcode word (clear bit 95) at CRAM address xx.

3.5 Miscellaneous Commands

Command	Function
EX xx	Executes the single KS10 systems-level instruction xx.
KL xx (KLINIK)	Enables the KLINIK remote diagnosis link when used with the REMOTE DIAGNOSIS key switch. See Section 5.0 for detailed information on this command.
LT (Lamp test)	Turns the STATE, FAULT, and REMOTE lights on for 1 to 2 seconds, and then turns them off for 1 to 2 seconds. The lights then return to their original state.
MR (Master reset)	Resets the KS10 processor.
PW xx	Sets the KLINIK access password to xx, where xx = maximum of 6 alphanumeric characters. To clear the password storage area, type PW and then press RETURN.
RP	Repeats last command (or last command string) until you press any CTY key.
ZM	Zeroes memory in 1 to 6 minutes. This command deposits 0s into all KS10 memory locations.

3.6 Read CRAM Commands

Command	Function
RC	Performs diagnostic read functions from 0 to 17 to read the CRAM addresses and the contents of the current address as follows:

```
RC 0   CRAM bits 00 to 11
RC 1   Next CRAM address
RC 2   CRAM subroutine return address
RC 3   Current CRAM address
RC 4   CRAM bits 12 to 23
RC 5   CRAM bits 24 to 35 (Copy A)
RC 6   CRAM bits 24 to 35 (Copy B)
```

Command	Function
RC (Cont.)	RC 7 0s RC 10 Parity bits A to F RC 11 KS10 bus bits 24 to 35 RC 12 CRAM bits 36 to 47 (Copy A) RC 13 CRAM bits 36 to 47 (Copy B) RC 14 CRAM bits 48 to 59 RC 15 CRAM bits 60 to 71 RC 16 CRAM bits 72 to 83 RC 17 CRAM bits 84 to 95

3.7 Select Device Commands

Command	Function
DS	Selects the disk for bootstrap. The console program asks the following questions. The default answers are underlined. >>UBA?1 UBA number? >>RHBASE?776700 RH11 base address? >>UNIT?0 Disk drive unit number? The default value for the RH11 base address is currently the only value permitted. Also, if you press RETURN to respond to any question, the current value is retained.
MS	Selects the magnetic tape for bootstrap. The console program asks the following questions. The default answers are underlined. >>UBA?3 UBA number? >>RHBASE?772440 RH11 base address? >>TCU?0 Tape controller unit number? >>DENS?1600 Tape density? >>SLV?0 Slave number? The default value for the RH11 base address is currently the only value permitted. Also, if you press RETURN to respond to any question, the current value is retained.

3.8 Set And Deposit Commands

Command	Function
DB xx	Deposits xx (36 bits) onto the KS10 bus.
DC xx	Deposits xx (96 bits) into CRAM. The address was previously loaded by the LC command. The CPU clock must be stopped to execute this command.
DI xx	Deposits xx (16, 18, or 36 bits) into an I/O register. The address was previously loaded by the LI command.

Command	Function
DK xx	Deposits xx (8 bits) into the microprocessor memory. The address was previously loaded by the LK command. Note that data cannot be deposited in PROM addresses; only in RAM addresses.
DM xx	Deposits xx (36 bits) into KS10 memory. The address was previously loaded by the LA command.
DN xx	Deposits xx into the next KS10, microprocessor, or I/O address.
DR xx	Deposits xx (8 bits) into internal microprocessor registers. The address was previously loaded by the LR command.
LA xx	Sets KS10 memory address to xx, where xx is 0000000 to 1777777.
LC xx	Sets CRAM address to xx, where xx = 0000 to 3777.
LF xx	Loads diagnostic write function xx, where xx = 0 to 7. The function specifies a 12-bit group within a CRAM address.

LF	CRAM Bits
0	00 to 11
1	12 to 23
2	24 to 35
3	36 to 47
4	48 to 59
5	60 to 71
6	72 to 83
7	84 to 95

LI xx — Loads I/O address. The address is a control number and a register address. I/O addresses that are accessible from the console are listed below. The address of the console instruction register is not included in this list. If the console tries to access its own instruction register, there is no response.

CTL	Address	Register
0	100000	Memory status register
1,3	763000-77	UBA paging RAM
1,3	763100	UBA status register
1,3	763101	UBA maintenance register
1,3	7xxxxx	UNIBUS device registers

LK xx	Sets microprocessor memory address to xx (PROM address = 00000 to 17777; RAM address = 20000 to 21777).
LR xx	Sets internal microprocessor I/O register address to xx.

3.9 Start/Stop Clock Commands

Command	Function
CH	Halts the CPU clock.
CP	Pulses the CPU clock. The CPU clock must be stopped to execute this command.
CP xx	Pulses the CPU clock xx times (up to 376 octal). The CPU clock must be stopped to execute this command.
CS	Starts the CPU clock.

3.10 Start/Stop Microcode Commands

To execute the following commands, the CPU clock must be stopped.

Command	Function
PM	Pulses the microcode. This command performs a CP command to execute a microinstruction followed by an EJ command to print the current CRAM address, the next CRAM address, the jump address, and the subroutine return address.
SM	Resets and starts the microcode at CRAM address 0.
SM xx	Resets and starts the microcode at CRAM address xx. SM 1 causes a dump of the KS10 processor status into the halt-status block.
TR	Repeats the PM command until you press any CTY key.
TR xx	Repeats the PM command until it reaches CRAM address xx or until you press any CTY key.

3.11 Start/Stop Program Commands

Command	Function
CO	Continues KS10 program execution. This command switches the CTY from console mode to user mode.
HA	Halts the KS10 program. The KS10 microcode enters a halt loop.
SH	Shuts down the monitor by depositing nonzero data into KS10 memory location 30.
SI	Executes the next KS10 instruction.
ST xx	Starts the KS10 program at address xx. This command switches the CTY from console mode to user mode.

4.0 ERROR MESSAGES

Unless otherwise noted, you will receive the following error messages only when TOPS-10 is not running and the CTY is in console mode.

?A/B

A and B copies of a microcode field did not match. Call your field service representative.

?BC n

Bootcheck error. n is the error number. Call your field service representative.

?BFO

Buffer overflow. You typed more than 80 characters on a single line while in user mode.

?BN

Bad number. The console program accepts only octal numbers.

?BT xxxyyy

Boot error where xxxyyy is an octal code representing the error. You may have tried to boot from a nonexistent device, or from a device that is not in the proper format, or from a device that does not have the KS10 microcode on it. Try again with a select command for the desired boot device (MS or DS) and then repeat the boot command that failed. xxxyyy represents the following octal codes when the microprocessor is trying to access either a disk or a magnetic tape.

xxx	Explanation
001	**Accessing Disk** - The microprocessor encountered an error while it was trying to read the home blocks. This error can be caused by selecting the wrong unit, having no disk pack in the drive, specifying the wrong RHBASE, selecting the wrong UNIBUS adapter, or using a bad disk drive. This error can also occur if the microprocessor can read both the home block and the alternate home blocks, but neither has the home block identifier (HOM) in SIXBIT. **Accessing Magnetic Tape** - The microprocessor encountered an error while it was trying to read the first page of the microcode from magnetic tape. This error can be caused by selecting the wrong unit, specifying the wrong RHBASE address, selecting the wrong UNIBUS adapter, selecting the wrong slave, specifying the wrong density, using a bad tape drive, using a bad magnetic tape, or using an improperly formatted magnetic tape. Any microprocessor command or process that accesses a disk or magnetic tape can cause you to receive this message.

?BT xxxyyy (Cont.)

xxx	Explanation
002	The microprocessor encountered an error while it was trying to read the page of pointers that makes up the microprocessor file system. This error can be caused by using an improperly formatted disk pack, by trying to read home blocks that contain errors, by using a bad disk drive, or by using a bad disk pack. Any microprocessor command or process that accesses a disk or magnetic tape can cause you to receive this message.
003	The microprocessor encountered an error while it was trying to read a page of microcode. This error can be caused by using an improperly formatted disk pack or by using a bad disk drive or pack.
004	The microcode did not start running successfully after a BT or an MT command.
010	The microprocessor encountered an error while it was trying to read the preboot program. This error can be caused by using an improperly formatted disk pack or magnetic tape, or by using a bad disk drive or pack.
yyy	This represents the lower eight bits of the microprocessor address of the channel-command-list operation that failed.

?BUS

Bad KS10 bus. This may occur on power up. Call your field service representative.

?C CYC

Command cycle failed. Call your field service representative.

?CHK n

Microprocessor checksum error. n is the error number. This may occur on power up. Call your field service representative.

?D CYC

Data cycle failed. Call your field service representative.

?DNC

Did not complete. This message usually occurs if you have bad KS10 microcode, no KS10 microcode, or the KS10 microcode has not been loaded. If the message occurs in response to an HA command, the KS10 microcode may not be running (for example, when you have pressed RESET). Try reloading the microcode. If the error persists, call your software contact.

?DNF

Did not finish. This message may occur during a CO, ST, or EX command. Usually, this error occurs if you have bad KS10 microcode, no KS10 microcode, or the KS10 microcode has not been started. Call your software contact.

?FRC

Forced reload. This message means that an automatic reload is in progress. When it is complete, the message BOOTS or the monitor startup messages will print on the CTY. This error occurs during timesharing.

?IA

Illegal address. The address you typed was out of range. Repeat the command with a legal address.

?IL

Illegal command. The console program did not recognize the sequence of characters that you typed as a legal command.

?KA

Keep-alive error. This error occurs only during timesharing. The monitor has not updated the keep-alive count for 15 seconds. The monitor will resume operation and immediately print a keep-alive stopcode (KAF).

?MRE

Memory refresh error. Follow the steps in Section 6.4.1 of the TOPS-10 Operator's Guide for the DECSYSTEM-2020. Call your field service representative. This error occurs during timesharing.

?NBR

No bus response. Call your field service representative.

?NDA

No data acknowledge. Call your software contact.

?NR-SCE

Nonrecoverable soft CRAM error. Reload the system.

?NXM

Nonexistent memory. This error can occur during an EM or DM command. The command referenced a nonexistent memory location. Try again with a smaller address.

?PAR ERR xxx yyy zzz

The KS10 CPU clock has been frozen because of a detected system parity error. xxx yyy zzz represents the contents of microprocessor registers 100, 103, and 303. Follow the steps in Section 6.4.1 of the TOPS-10 Operator's Guide for the DECSYSTEM-2020. This error occurs during timesharing.

?RA

Requires argument. Repeat the command and provide the argument required.

?RUNNING

Clock running. Stop the CPU clock so that the microprocessor can execute the command that you typed.

%SCE xxxxxx

Soft CRAM error. xxxxxx represents the address at which the microprocessor encountered the error. This is an informational message, ignore it.

?UI

Unknown interrupt. The console program received an internal interrupt and found no character on either the CTY input line or the KLINIK input line. Call your field service representative. This error occurs during timesharing.

5.0 KLINIK

The KLINIK link allows DIGITAL personnel to collect and analyze performance data, and to diagnose a problem in a user's system without traveling to his installation.

The KLINIK link can be in one of four states, depending on the position of the REMOTE DIAGNOSIS switch on the front panel, the commands you type, and the commands the KLINIK user types. The four states are:

1. State 1 - Unavailable
2. State 2 - Awaiting Password
3. State 3 - Timesharing User
4. State 4 - Remote CTY

To use KLINIK, the link must be in State 4.

State 1 - Unavailable

In State 1, only you (the operator) can use KLINIK.

The two ways to set the KLINIK link to State 1 are:

1. If there is a password, set the REMOTE DIAGNOSIS switch to DISABLE.

2. If there is no password, set the REMOTE DIAGNOSIS switch to PROTECT.

If a remote-site user tries to use KLINIK while the link is in State 1, ?NA (Not Available) prints on his terminal.

State 2 - Awaiting Password and State 3 - Timesharing User

I State 2, a remote-site user must give the correct password to set the KLINIK link to State 3, Timesharing User. State 3 allows field service personnel to examine SYSERR files and crash dumps.

To set the KLINIK link to State 2, perform the following steps:

1. Type PW[password]<ret> to enter a password into memory.

2. Set the REMOTE DIAGNOSIS switch to PROTECT.

To use the KLINIK link for timesharing (State 3), the remote-site user must type everything that is underlined in the following sample dialogue where the correct password is psswrd:

PW:pssdrw (RET)	The password is wrong. Try again.
?IL PW:psswdr (RET)	The password is still wrong. Try again. The console program hangs up the line after three tries.
?IL PW:psswrd (RET)	The password is right.
OK	The KLINIK link is now in State 3.

In State 3, the KLINIK link behaves as if it were a normal timesharing line.

State 4 - Remote CTY

In State 4, the KLINIK link is a remote CTY. The console program cannot differentiate between the CTY and the remote CTY. For example, if you type an S at the CTY and the remote-site user types a Y and presses RETURN, the console program runs a SYSTAT. Therefore, you ust be careful not to type on the CTY while the remote-site user is typing on the remote CTY.

The two ways to set the KLINIK link to State 4 are:

1. Make sure the KLINIK link is in State 3 and then type KL 1.

To use the KLINIK link as a remote CTY (State 4), the remote-site user must type everything that is underlined in the following sample dialogue:

PW:psswrd (RET)	Type the password.
OK^\	Type CTRL/backslash. The KLINIK link is now in State 4.

2. Set the REMOTE DIAGNOSIS switch to ENABLE and then type KL 1. In this case, the remote-site user must type only CTRL/backslash. No password is necessary.

   Although the KLINIK link is less secure when you use this method to enter State 4, it is convenient when there is no operator coverage.

Table 1 is a summary of the various states of the KLINIK link.

Table 1
KLINIK States

Position of Switch	Operator Commands	KLINIK User	State
DISABLE	-	-	1
PROTECT	-	-	1
PROTECT	PW password	password	2
ENABLE	-	-	3
PROTECT	PW password KL 1	password CTRL/backslash	4
ENABLE	KL 1	CTRL/backslash	4

If you turn the REMOTE DIAGNOSIS switch to DISABLE while in any state, you switch the KLINIK link to State 1, unavailable.

You need not enter a password into memory with the PW command nor turn the KL command on with the KL 1 command every time it is necessary to enable the KLINIK link. They are retained in memory until one of the following occurs:

1. You press the POWER switch.

2. You press the RESET switch.

3. You type PW followed by a carriage return. This removes the password from memory. If this happens during States 2 or 4, the KLINIK link returns to State 1. In this case, type KL 0. When you type the KL 0 command, the KLINIK link switches from State 4 to State 2.

The following commands to the console program allow you to enable or disable the KLINIK facility:

Command	Function
KL	Gives the status of the KL command.
KL 0	Turns off the KL command so that State 4 is disabled.
KL 1	Turns on the KL command so that State 4 can be entered.
PW password	Allows you to enter a 1- to 6-character password into memory. The password remains in the memory until you type PW followed by a carriage return, or until you press the POWER or the RESET switch.

6.0 CONSOLE STATUS REGISTERS

The console program reads and prints (at the CTY) the contents of certain microprocessor registers in response to the EB (examine bus) command and a system parity error (?PAR ERR). The EB command prints registers 100 through 103 and 300 through 303. Registers 100, 303, and 103 print when the system parity error is detected. Figure 1 shows the register bit format.

7.0 KS10 HALT STATUS CODES

When the KS10 halts, the microprocessor prints a halt status code in the following form on the console terminal:

```
%HLTD/nnnnnn  PC/000000,,xxxxxx
```

where n = the halt status code. (See Table 2.)

x = the program counter when the halt occurred. Note that the halt status code tells you why the KS10 processor halted.

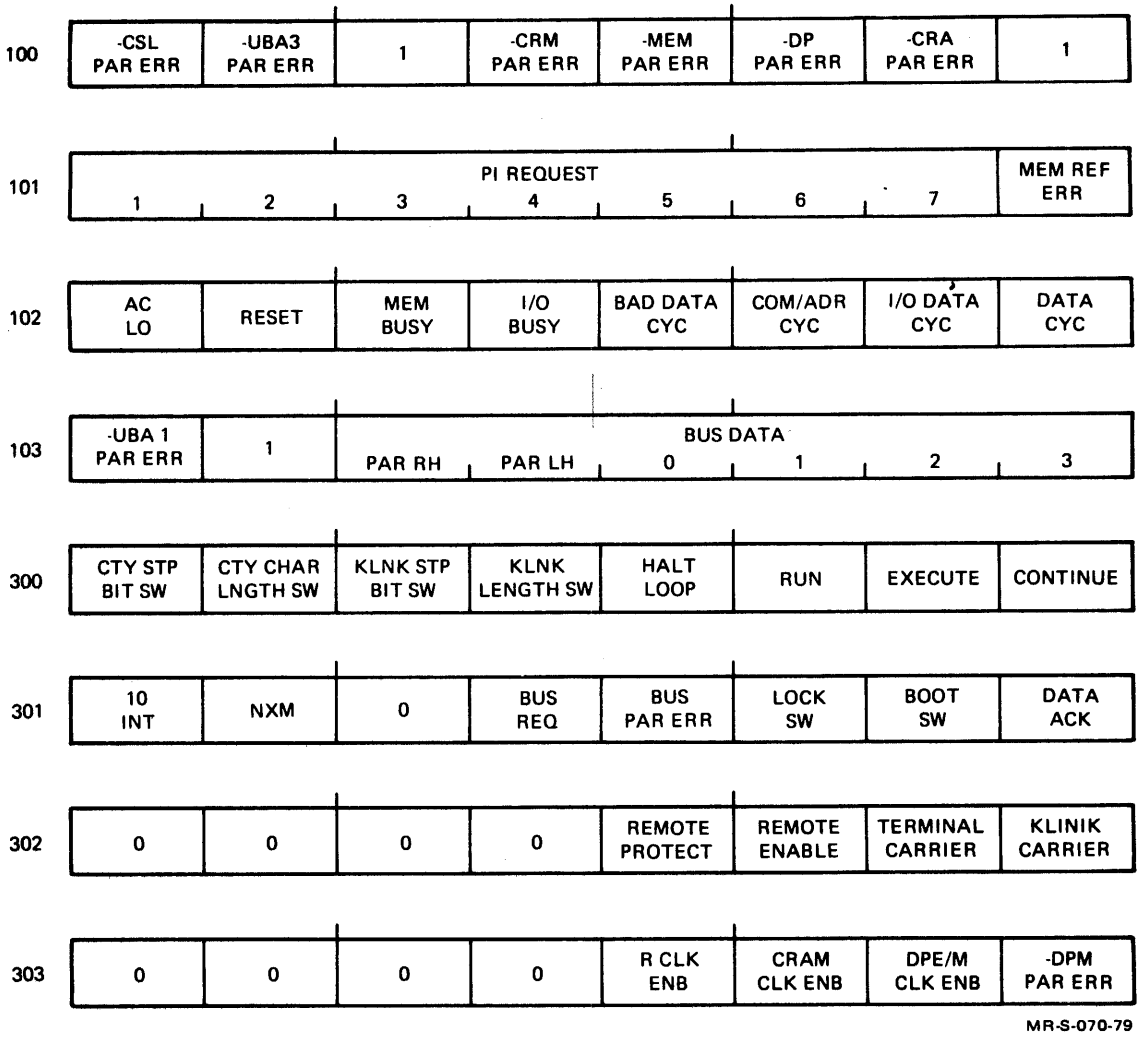

Figure 1 Register Bit Format

Table 2
KS10 Halt Status Codes

Halt Code	Definition
000001	A halt instruction has been executed.
000002	The console program (microprocessor) halted the CPU. That is, an HA command was typed at the console.
000100	An illegal interrupt instruction occurred. Call your field service representative.
000102	The pointer to the UNIBUS vector is zero. Call your field service representative.
001000	An illegal microcode dispatch occurred. Call your field service representative.
001005	The microcode startup check failed. Call your field service representative.

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