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IBM System/370 Model 115 Functional Characteristics

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This Technical Newsletter provides replacement pages for the subject publication. Pages to be inserted and/or removed are:

v through vii
135, 136
136.1, 136.2 (added)
139 through 142

A change to the text or to an illustration is indicated by a vertical line to the left of the change.

Summary of Amendments

Information about the Universal Character Set feature has been revised and additional information is given about dualing on the IBM 5203 Printer Model 3.

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IBM 5203 Printer Model 3

This section describes the character sets, commands, status reports, sense information, and error recovery procedures for the 5203 Printer Model 3, when operating under control of the integrated printer attachment.

5203 CHARACTER SETS

The AN and HN trains, equipped with five sets of 48 characters, are standard. Whether the AN or HN set is printed depends solely on the train mounted on the printer. Other trains may be used if the Universal Character Set (UCS) optional feature is installed. The LC train cannot be installed.

Dualing

The AN and HN trains are identical except for four character positions. On the AN train these four positions contain:

▣ % @ #

whereas the HN train has:

) (' =

This means, for example, that the HN train has the graphic) where the AN train has ▣. This graphic) is printed if the corresponding EBCDIC code 01001100 (see Figure 70.1) is sent to a printer equipped with the HN train. Graphic) would also be printed on a similarly equipped printer from code 01001100 — which is primarily assigned to the graphic ▣ on the AN train. This relationship is called dualing (pairing). All possible combinations are shown in Figures 70.1 and 70.2.

AN Train

EBCDIC Code	Primary Assignment on AN Train	Assignment for Dualing on HN Train
01001100	▣)
01101100	%	(
01111100	@	'
01111011	#	=

HN Train

EBCDIC Code	Primary Assignment on HN Train	Assignment for Dualing on AN Train
01011101)	▣
01001101	(%
01111101	'	@
01111110	=	#

Figure 70.1. EBCDIC Codes of Graphics Dualing on the 5203

Apart from the exception stated in Figure 70.2, the codes outside the bold lines of Figure 70.2 are considered to be undefined. Undefined codes generally cause an unspecified

graphic to be printed. This graphic may be different from the one printed, displayed or otherwise recorded by another output device. IBM reserve the right to change such undefined graphics printed by the 5203 from an undefined code.

5203 COMMANDS

Write Commands

Write commands cause data to be transferred from main storage to the print line buffer; the data transfer is followed by the electro-mechanical print operation, including any carriage motion. The data transfer begins at the storage location designated by the data address (CCW bits 8 to 31) and proceeds in ascending order of address. The data transfer ends either when the print line buffer is filled or when the length count (CCW bits 48 to 63) has been reduced to zero, whichever occurs first. The count should be decimal 96, 120 or 132, depending on the print line width. If the output area contains more characters than appropriate for the print line width or if the count is less than the print line width, incorrect length (bit 41 in the CSW) is indicated unless the SLI flag is on and the CD flag is off in the current CCW. Channel end (bit 36 in the CSW) is indicated when the data transfer from main storage to the print line buffer has been completed. Device end (bit 37 in the CSW) is indicated when the mechanical print operation and any carriage operations have been carried out. Channel end and device end are interruption conditions (but only for the last command if chaining is in progress).

The printer attachment accepts the write commands shown in Figure 71.

Carriage Control Commands

Carriage control commands consist of space and skip commands and the 'load carriage control buffer' command. For space and skip commands, the command code is transferred to the printer attachment, then channel end is indicated in the initial status and the carriage operation is started. Device end is indicated when the mechanical operation is completed at the 5203. Device end is an interruption condition for space and skip commands, unless command chaining is in progress.

Figure 72 shows the space and skip commands available for the 5203.

Carriage Control Buffer Structure

The 5203's carriage is not controlled by paper tape (the method used in the IBM 1403 Printer and other IBM high-speed line printers). Instead, the 5203 employs a 112-byte carriage control buffer.

Each carriage control buffer byte represents one line on

For example: A 12-inch sheet multiplied by eight lines per inch results in 96 printable lines per sheet. The end-of-sheet code must be assigned to line 96 (buffer byte 96). A 12-inch sheet used with six lines per inch spacing results in 72 printable lines per sheet, so the end-of-sheet code must be assigned to line 72. Correct end-of-sheet code assignment ensures that the carriage control buffer remains in synchronism with the form. If the end-of-sheet code is not assigned to the last printable line of a sheet, the control counter wraps around to zero too early (or too late), causing information for the next sheet to be printed on the last lines of the previous sheet. There is no error indication to show that the counter is not synchronised with the form.

Load Carriage Control Buffer

The 'load carriage control buffer' command code is:

Hex	CCW Bits
	0 1 2 3 4 5 6 7
63	0 1 1 0 0 0 1 1

Data is transferred from main storage to the carriage control buffer, starting at the main storage location specified in bits 8 to 31 of the CCW and proceeding in ascending order of address. The buffer is loaded in ascending order of position and this continues until the end-of-sheet code is detected, the buffer is filled, or the CCW count is reduced to zero, whichever occurs first.

The 5203 requires a channel 1 code and an end-of-sheet

code in each pattern loaded into the forms control buffer. If either, or both, code is missing, the command is terminated and unit check is set at channel end time. Sense byte 0, bit 6 (no channel found) is also set. Subsequent carriage control will follow the pattern defined in the last valid forms buffer load command.

Note: The end-of-sheet code is required to avoid loss of synchronization between the forms and the forms control. The channel 1 code is required to support the CARRIAGE RESTORE key (which advances the forms to channel 1), and the end-of-forms indication (which is set when the internal forms switch is operated, and channel 1 is detected afterwards).

If the count in the 'load carriage control buffer' CCW is either greater than 112 or less than 112 (decimal), incorrect length is indicated unless the SLI flag bit is on and the CD flag bit is off in the CCW.

Channel end is presented when the data transfer from main storage is completed. Device end is presented when the new data has been stored on the diskette.

UCS Commands

Universal character set (UCS) commands are only valid when the UCS feature is installed in the 5203 attachment. If these commands are given in the absence of a UCS feature, the commands are rejected and bit 0 is set in sense byte 0.

5203 SENSE INFORMATION

Sense Byte 0

The bits in sense byte 0 have the following meanings assigned:

Bit	Designation
0	Command reject
1	Intervention required
2	Bus out check (not used)
3	Equipment check
4	Data check
5	Chain buffer parity check
6	No channel found
7	Channel 9

Command Reject (Bit 0)

The command reject bit, when set, indicates that the current command was rejected because it was not assigned to the 5203 or the respective feature is not installed. A read command being issued causes command rejection. The fact that the current command has been rejected is indicated by *unit check* being set in the initial status. Setting of unit check causes chaining (if specified) to be suppressed.

Intervention Required (Bit 1)

The intervention required bit, when set, indicates that operator intervention is necessary because the 5203 has lost the ready state. The ready state is lost in the following situations:

1. The 5203's STOP key is pressed.
2. The train cartridge is not properly seated or has been removed.
3. The rear unit is open or the forms chute points upward (in the load position).
4. A forms jam has occurred (switching on the CHECK light).
5. The forms have run out (switching on the FORMS light).
6. A carriage sync check has occurred (switching on the CHECK light).
7. A chain sync check has occurred (switching on the CHECK light).
8. An overheat condition (thermal overload) occurred in the hammer unit or the 5203's electronics gate.
9. A hammer driver could not be reset, or the CE hammer-on check switch was accidentally operated, causing the coil protect bit (bit 2, sense byte 2) to be set.
10. The hammer bar right home position could not be detected or the shift clutch failed.
11. The check circuitry is defective, setting the any-hammer-on check bit, and also forcing the coil protect check bit, in sense byte 2.
12. An error occurred in the subscan counter, setting the

subscan ring check bit in sense byte 2.

13. A chain buffer address register check has occurred.

The setting of the intervention required bit causes *unit check* to be set in the CSW at the initiation of a 'start I/O' or 'test I/O' instruction or at device end time, depending on when the condition arises. Intervention required is reset when the printer is restored to the ready state.

Bus Out Check (Bit 2)

The bus out check bit is not used.

Equipment Check (Bit 3)

This bit indicates a program-correctable error that occurred in the 5203 or the front end logic. The error is corrected the next time the printer is selected for a 'start I/O', 'halt I/O', or 'halt device' instruction.

The equipment check bit is set by one or more of the nine error conditions which are represented by the bits of sense bytes 4 and 5. For details of these conditions, see "Sense Byte 4" and "Sense Byte 5" in this section.

The detection of an equipment check causes unit check to be set at the time device end (with or without channel end) is set.

Note: Setting of the equipment check bit does not cause the 5203 to lose the ready state.

Data Check (Bit 4)

The data check bit can only be set when data checks are not prevented by a 'block data check' command. Data check will then be set if the print line buffer contains a character pattern for which no matching pattern is found in the UCS buffer during a UCS print operation. This is usually due to a wrong program being used.

The fact that data check is set is indicated by unit check being set in the CSW at device end time.

Chain Buffer Parity Check (Bit 5)

The chain buffer parity check bit is set to indicate a chain buffer parity error. The presence of a chain buffer parity check causes unit check to be set at channel end time.

No Channel Found (Bit 6)

The no channel found bit is set when a skip command or a write and skip command did not find the channel code (in the carriage control buffer) to which the carriage was to advance. The setting of the no channel found bit causes unit check to be set at device end time.

Channel 9 (Bit 7)

The channel 9 bit, when set, indicates that a channel 9 code was detected in the carriage control buffer during the execution of a space command or a write and space command. The same situation when caused by a manual space or any of the skip commands does not set the channel 9 bit. The setting of the channel 9 bit causes unit check to be set at device end time.

Sense Byte 1

Sense byte 1 is not used.

Sense Byte 2

The bits in sense byte 2 represent eight conditions, any of which can cause the 5203 to lose its ready state. The setting of one of these bits causes the intervention required bit to be set in sense byte 0. The bits in sense byte 2 have the following meanings assigned:

<i>Bit</i>	<i>Designation</i>
0	Interlock (chain gate open)
1	Forms check (jam)
2	Coil protect check
3	Subscan ring check
4	Chain buffer address register check
5	Hammer unit shift check
6	Any-hammer-on check
7	Thermal overload

Interlock (Bit 0)

The interlock bit is set to indicate that the 5203's rear unit is open, a train cartridge is removed or not properly seated, or the forms chute is in the load position.

Forms Check (Bit 1)

The forms check bit, when set, indicates a paper jam.

Coil Protect Check (Bit 2)

The coil protect check bit, when set, indicates that power was removed from the hammer circuits to prevent damage to the hammer coils.

Subscan Ring Check (Bit 3)

The subscan ring check bit is set if there is an error in the subscan ring counter (hardware) or a drum emitter failure.

Chain Buffer Address Register Check (Bit 4)

This bit is set to indicate that there is a loss of synchronism between the chain position and chain buffer addressing at home pulse time (at this time, both should be in step).

Hammer Unit Shift Check (Bit 5)

The hammer unit shift check bit, when set, indicates a failure in a shift clutch, clutch photo emitter, or hammer bar right home switch.

Any-Hammer-On Check (Bit 6)

The any-hammer-on check bit is set to show that protection of the hammer coils is no longer possible because of a failure in the coil protect monitoring circuits or because the CE any-hammer-on test switch was operated. This bit can also mean that the 'any-hammer-on' latch was not turned off, because a hammer failed to fire.

Thermal Overload (Bit 7)

The thermal overload bit, when set, shows that hammer power was removed due to overheating in the hammer unit or the 5203's electronics gate.

Sense Byte 3

Sense byte 3 is not used.

Sense Byte 4

The bits in sense byte 4 represent eight error conditions, any one of which can cause the equipment check bit to be set in sense byte 0. An equipment check caused by a condition in sense byte 4 is a program-correctable error.

<i>Bit</i>	<i>Designation</i>
0	Hammer reset failure check
1	No fire check
2	Misfire check
3	Print data buffer parity check
4	Check bit buffer parity check
5	Chain buffer parity check
6	Buffer address register check
7	Clock check

Hammer Reset Failure Check (Bit 0)

This bit, when set, indicates that a hammer driver failed to reset when addressed for resetting.

No Fire Check (Bit 1)

The no fire check bit, when set, indicates that a hammer failed to fire when addressed for firing.

Misfire Check (Bit 2)

The misfire check bit, when set, indicates that a hammer fired without being addressed.

Buffer Parity Checks (Bits 3, 4, and 5)

The buffer parity check bits for the print data buffer, check bit buffer and chain buffer are set to indicate parity errors in the buffers concerned.

Buffer Address Register Check (Bit 6)

The buffer address register check bit is set when an addressing error causes a subscan to seem excessively long.

Clock Check (Bit 7)

The clock check bit is set when extra clock steps (possibly due to "noise") are detected.

Sense Byte 5

Bit 0 in sense byte 5 represents one further error condition (in addition to those in sense byte 4) which, when set, causes the equipment check bit to be set in sense byte 0. This equipment check is a program-correctable error.

<i>Bit</i>	<i>Designation</i>
0	Open coil check
1	(Not used)
2	(Not used)
3	(Not used)
4	(Not used)
5	(Not used)
6	(Not used)
7	(Not used)

Open Coil Check (Bit 0)

The open coil check bit, when set, indicates that a hammer coil has burnt out.

5203 ERROR RECOVERY

The following text describes the minimum action the operating system should take to deal with errors or other unusual conditions that may occur. Errors and other unusual conditions are usually indicated by the setting of unit check or any of the other status bits (except an end condition or busy) in the CSW.

Unit Check in CSW

When a command ends with unit check set in the CSW, the operating system should issue a 'sense' command and subsequently inspect at least sense byte 0 to find the reason for the unit check. The following text describes the suggested error recovery procedures for errors shown by bits set in sense byte 0.

Command Reject (Sense Byte 0, Bit 0)

The most likely cause of command reject being set is that a command not assigned to the 5203, such as a 'read' command, has been issued. The most likely causes of a command being rejected are that it requires the UCS feature, which is not installed, or that an unassigned command, such as a read command, has been issued. In the first case, the operating system should issue a message advising the operator to run the program on a printer with the UCS feature. In the second case, the operating system should trace back the program and provide a message advising the system programmer to correct the error.

Intervention Required (Sense Byte 0, Bit 1)

If the intervention required bit is set, the printer has lost its ready state and manual intervention is required. The operating system should analyze sense bytes 2 and 3 because these bytes contain error information not indicated by the 5203's indicator lights. If sense bytes 2 and 3 show the cause of the error, an appropriate message should then be issued to the operator advising him of the error and requesting him to press the printer's START key (to restore the ready state).

If the error is not obvious from the information in sense

bytes 2 and 3, the message should advise the operator to check the indicator lights on the 5203 operator panel. These lights, as described below, can suggest the reason for the printer losing its ready state.

INTERLOCK Light On: The operator should make certain that the train cartridge is properly mounted, the rear unit is closed, and the forms chute is in the feed position (downward).

FORMS Light On: The operator should check whether new forms must be inserted. In case of end-of-forms, the printer continues printing and the FORMS light is switched on when the channel 1 code is found in the buffer. The operator must then insert new forms and press the 5203's START key. (The end-of-forms feelers must be set into their cutouts, otherwise the FORMS light remains on.)

CHECK Light On: An error has occurred either in the 5203 or in the front end. Errors in the printer can be conditions such as a forms jam, a thermal overload (hammer unit or electronics gate), a chain sync check, any-hammer-on check, a carriage sync check, and so on.

Hardware malfunctions of this type may be overcome by pressing the 5203's START key. However, in case of repeated hardware errors, CE attention is required.

Equipment Check (Sense Byte 0, Bit 3)

If the equipment check bit is set, the operating system should analyze the data provided by sense bytes 4 and 5, and issue a message to the operator advising him of the condition. The program should then retry the last command or display the last print line on the video display. Equipment check conditions are not usually so severe that a retry would be ineffective. However, if equipment check persists, the CE should be notified.

Data Check (Sense Byte 0, Bit 4)

If the data check bit is set, the print pattern sent to the 5203 cannot be printed with the train cartridge currently fitted. In this case, the train cartridge should be changed and the job should be repeated.

Chain Buffer Parity Check (Sense Byte 0, Bit 5)

If the chain buffer parity check bit is set, the operating system should display the last line to be printed and repeat the operation. If the error persists, the CE should be notified. Reloading of the UCS buffer is not required because the hardware reloads the buffer automatically.

No Channel Found (Sense Byte 0, Bit 6)

If the no channel found bit is set, the carriage control buffer has been loaded with information that is not appropriate for the current program. The operating system should either reload the carriage buffer or issue a message that indicates what type of control information should be

loaded. The operator may also be advised to check the forms on the printer to determine which control program is required.

Channel 9 (Sense Byte 0, Bit 7)

If the channel 9 bit is set, the operating system should take the appropriate action, depending on the use and meaning of channel 9. Setting of the channel 9 bit may indicate a programming error such as the wrong carriage control information for the current program.

Unit Exception in CSW

If the unit exception bit is set, a channel 12 code was detected during spacing and interpretation depends on the meaning which the programmer has assigned to channel 12.

Channel Data Check in CSW

The channel data check bit is usually set as a result of a parity error in the data transferred (such as in a buffer load operation) between main storage and the printer attachment. The error is not severe because the parity has been

corrected. The output at the printer is, however, unreliable and the operating system should either retry the operation or use the video screen to display the contents of the output area as it should have been printed. Retry should in any case be attempted. Repeated channel data checks require CE attention.

Note: If channel data check is set, the operating system should analyze storage location 176, which contains the limited channel logout. This logout shows how far the operation progressed and/or how it was terminated.

Channel Control Check in CSW

If the channel control check bit is set, the operation was either terminated or not started due to a severe error in the Model 115's main storage controller or internal bus system. Retry should be attempted and, if unsuccessful, the CE should be notified.

Note: If channel control check is set, the operating system should analyze storage location 176, which contains the limited channel logout. This logout shows how far the operation progressed and/or how it was terminated.