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Systems

**Reference Manual for the
IBM 3800 Printing
Subsystem**



Preface

This manual provides information on the functions and features of the IBM 3800 Printing Subsystem relating to channel commands, sense bytes, and error detection, recovery, and recording. In addition, specific information and examples are given of copy modification and control, and graphic character modification.

The manual is intended for use by systems analysts, installation managers, systems programmers, and other personnel requiring 3800 reference information.

RELATED PUBLICATIONS

Programmers should be familiar with the information contained in:

- *IBM System/370 Principles of Operation*, GA22-7000
- *IBM 3800 Printing Subsystem Programmer's Guide (OS/VS1, OS/VS2)*, GC26-3846
- *IBM 3800 Printing Subsystem Programmer's Guide for OS/VS2 SVS*, GC26-3859
- *DOS/VS IBM 3800 Printing Subsystem Programmer's Guide*, GC26-3900

Operators should refer to:

- *IBM System/370 System Summary*, GA22-7001
- *IBM 3800 Printing Subsystem Operator's Guide*, GA26-1634
- *Forms Design Reference Guide for the IBM 3800 Printing Subsystem*, GA26-1633

For offline operation, refer to:

- *Offline IBM 3800 Utility*, SH20-9138
- *Operator/Reference Manual for the IBM 3800 Tape-To-Printing Subsystem Feature*, GA26-1654

For definitions of terms used in connection with data processing and printers, refer to the *Data Processing Glossary*, GC20-1699.

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This publication is a major revision and makes Order No. GA26-1635-1 obsolete. Changes or additions to the text and illustrations are indicated by a vertical line to the left of the change. Changes are continually made to the information herein; before using this publication in connection with the operation of IBM systems, consult the latest *IBM System/370 Bibliography*, GC20-0001, for the editions that are applicable and current.

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Introduction

The IBM 3800 Printing Subsystem is a high-speed, general purpose, nonimpact printer employing electrophotographic technology. The 3800 provides the user with a number of new printing functions including forms overlay and multiple print sizes, and reduces the total cost of printing. The print quality of the 3800 is comparable to that produced by impact printers.

The 3800 has three main assemblies and one optional feature, the burster-trimmer-stacker (see Figure 1). A paper transport feeds, refolds, and stacks the continuous forms paper. An electrophotographic process creates images and transfers those images to the paper forms. A control electronics (microprocessor) controls the operation of the transport and process.

The burster-trimmer-stacker trims the carrier strip from each side of the form, bursts the forms into individual sheets, and stacks them sequentially.

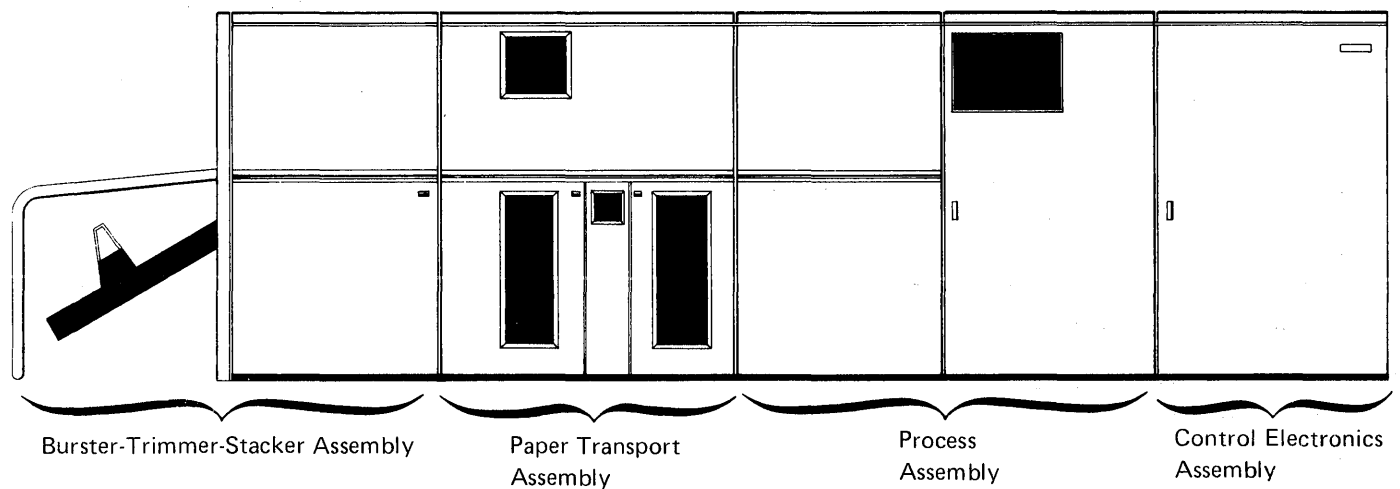


Figure 1. The Four Physical Assemblies of the 3800

Basic System and Features

The 3800 Printing Subsystem can be attached to System/370 Models 145, 148, 155-II, 158, 158-2 (Japan), 158-3, 165-II, 168, and 168-3 standard channel interfaces. The 3800 can be connected to byte multiplexer, selector, or block multiplexer channels.

STANDARD FEATURES

The basic 3800 Printing Subsystem consists of:

- Continuous forms input station and paper transport
- Control electronics with 52K page buffer (42K with the tape-to-printing subsystem feature)
- Electrophotographic process
- Character generation storage for 128 characters
- Twenty character sets, including six underscore sets
- Capability to print 10, 12, and 15-pitch character sets (separately or mixed on a line)
- Vertical line spacing of 6, 8, or 12 lines-per-inch (separately or mixed on a page)
- Graphic character modification
- Forms overlay
- Copy modification
- Job separation marking
- Copy separation marking
- Continuous forms stacker
- Form sizes, either common-use or ISO (International Standards Organization):
 - Common-Use: 5 Discrete lengths (3-1/2 to 11 inches)
10 Discrete widths (6-1/2 to 14-7/8 inches)
Paper weights (15 to 24 pounds)
 - ISO: 6 Discrete lengths (3 to 12 inches)
13 Discrete widths (165 to 378 mm)
Paper weights (56 to 90 grams per square meter)

OPTIONAL FEATURES

The following are optional features for the 3800 Printing Subsystem:

- Additional character generation storage for 127 characters (provides a maximum print capability of 255 different characters for one data set)
- Two-channel switch (allows the 3800 to be accessed by two channels connected to the same or different central processors)
- Burster-trimmer-stacker (removes the carrier strips, separates the continuous pages, and stacks the separate jobs with an offset between each job)
- Tape-to-printing subsystem (allows the 3800 to be connected to a magnetic tape subsystem)

THE PRINTING PROCESS

Figure 2 shows the key elements in the printing process from the continuous forms input station through the continuous forms stacker (CFS) and/or the buster-trimmer stacker (BTS).

Data to be printed is transmitted one line at a time from the central processor to the 3800 where it is translated and stored in an internal page buffer. When a page of data has been transferred from the central processor, it is exposed by modulating the beam of a low-powered laser onto the photoconductor surface of a rotating drum, thereby creating a latent image of the page to be printed. The latent image is coated with toner (a thermoplastic material permeated with lampblack). At the transfer station, the toned image is transferred from the drum to the paper. The paper then passes through the fuser, which fuses the toned image into the paper.

Meanwhile, the drum surface is cleaned and reconditioned for subsequent exposures. If there is sufficient data in the page buffer to print another page after the first, printing continues without stopping the paper motion except when interrupted by the photoconductor gap seal once per revolution. Up to seven 11-inch pages can be printed in a single drum revolution. Forms can be printed simultaneously with the data by flashing the image of a forms overlay negative onto the drum.

Page Identification

The 3800 microcode provides page accounting and configuration information that is used for recovery and status actions. Four two-byte (halfword) counters keep track of the page from the page buffer to the stacker. The first counter is the channel page identifier which counts each page transmitted to the printer. The second and third counters are the transfer page and fuser identifiers which count the last copy of each page as it is processed through the respective transfer or fuser station. The fourth counter is the stacker page identifier which counts the last copy of a page after it is stacked in either the CFS or BTS. When a

mark form sequence (see Mark Form control command) is processed, only one copy of the sequence is counted.

At IML time or power on of the printer, the counters are set to zero. Only the last copy of each page printed and processed through each station is counted. Following an Operator Cancel or Purge Page Buffer order, the channel page identifier is set to the transfer page identifier count. After a system restart, the channel page, transfer page, and fuser page identifiers are set to the stacker page identifier count. (See the following illustration.)

Action	Counter Value			
	Channel Page (CP)	Transfer Page (TP)	Fuser Page (FP)	Stacker Page (SP)
IML or Power On	'0000'	'0000'	'0000'	'0000'
Cancel or Purge	CP set to TP	—	—	—
System Restart	CP set to SP	TP set to SP	FP set to SP	—
Count at 'FFFF', then +1	'0000'	'0000'	'0000'	'0000'
NPRO Generated Pages	Not counted.			
CP = Channel Page FP = Fuser Page TP = Transfer Page SP = Stacker Page				

The counters do not stop at the maximum count of 'FFFF'. If a counter is at 'FFFF', the next page counted increments the counter to '0000' and the subsequent page counts continue to accumulate. This must be considered when determining the number of pages printed. None of the pages generated during a nonprocess run-out (NPRO) are counted.

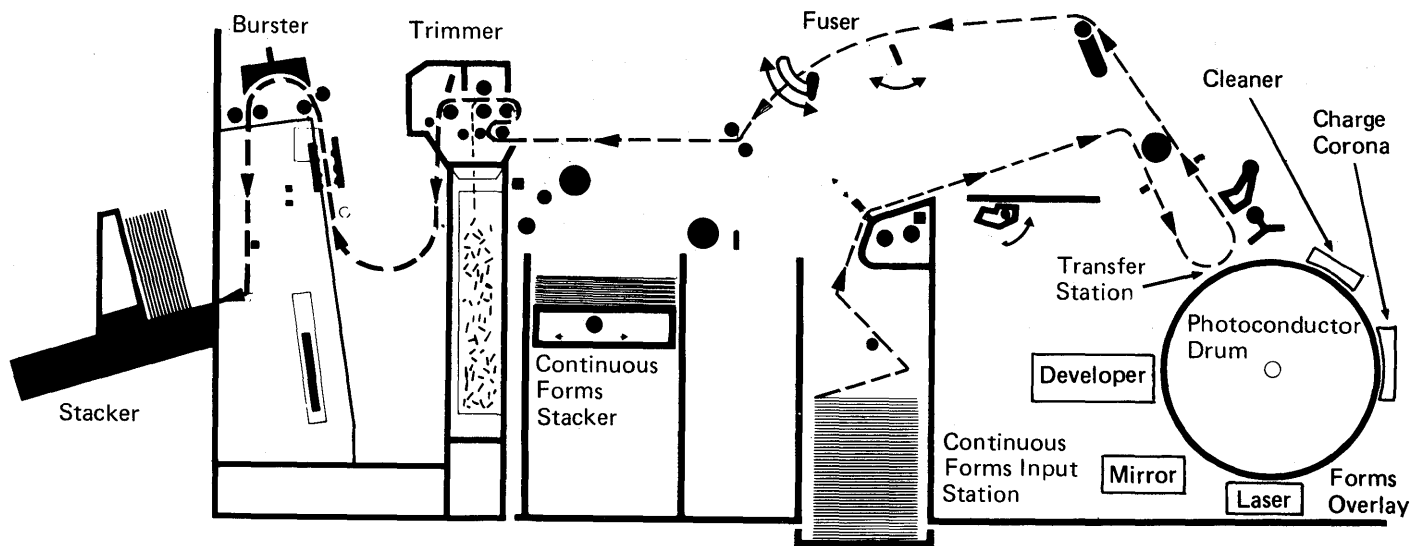


Figure 2. Key Elements of the 3800 Printing Process

FORMS INPUT STATION

The 3800 uses conventional continuous forms. The forms are single-ply (one lamination), perforated horizontally between pages, and have carrier holes punched on both side margins.

The 3800 accepts continuous forms in discrete lengths and widths in either of two sets of sizes: common-use or ISO.

Note: *ISO sizes are not available in the United States and Canada.*

The 3800 accommodates only one of the two size sets, depending on the machine type (common-use or ISO) selected by the user to meet application needs. The following dimensions apply:

Common-Use Sizes

Widths (inches): 6-1/2, 8-1/2, 9-1/2, 9-7/8, 10-5/8, 11, 12, 13-5/8, 14-3/10, 14-7/8
 Lengths (inches): 3-1/2, 5-1/2, 7, 8-1/2, 11
 Weights: 15 to 24 pounds basis weight (56 to 90 grams per square meter)

ISO Sizes

Widths (mm): 165, 180, 215, 235, 250, 270, 280, 305, 322, 340, 363, 375, 378
 Lengths (inches): 3, 4, 6, 8, 10, 12
 Weights: 15 to 24 pounds basis weight (56 to 90 grams per square meter)

Paper Usage

Paper usage for each transmission of a data set can be determined with the following equation:

$$\text{Paper Usage (in feet)} = (\text{Final CPI} - \text{Initial CPI}) \times \text{CGC} \times \text{Forms Length} \div 24$$

where: CPI = Channel Page Identifier
 CGC = Copy Group Copies

Note: *Forms length is maintained in byte 11 of the printer information bytes.*

PAGE BUFFER

Data to be printed is transmitted one line at a time from the host system to the 3800 where it is translated and stored in the page buffer. The normal capacity of the page buffer is 53,248 bytes. When a complete page has been transferred to the buffer, the number of copies specified for the transmission are printed in the specified character style. With the tape-to-printing subsystem feature, the page buffer size is decreased to 43,008 bytes.

CHARACTER GENERATION

The following character sets are stored on an internal disk file and can be selectively loaded into the character generation storage. When more than two character sets are required in simultaneous operation, optional character generation storage must be provided.

Character Style	Characters per Inch		
	10-Pitch	12-Pitch	15-Pitch
Gothic	X	X	X
Gothic (with underscore)	X	X	X
Gothic Condensed			X
Gothic Condensed (with underscore)			X
Text 1	X		
Text 1 (with underscore)	X		
Text 2	X		
Text 2 (with underscore)	X		
OCR A	X		
OCR B	X		
Format	X	X	X
Katakana	X	X	X

Note: An "X" denotes availability.

The character generation storage in the basic 3800 can store 128 graphic characters (two character sets). For operating purposes, the character generation storage is divided into two modules called writable character generation modules (WCGMs). Each WCGM is organized to hold the bit patterns for 64 characters. Once loaded, characters are electronically generated through raster scan techniques.

Two sets of character generation storage (one basic and one optional) can be installed in the control electronics. Therefore, up to four WCGMs can be loaded and program-selected to be active for the printing of any one data set. This provides a maximum graphic capability of 255 characters (including a blank).

The 3800 permits underscoring by either of two methods: (1) using special underscore character sets: Gothic 10-, 12-, and 15-pitch underscore; Gothic Condensed 15-pitch underscore; and Text 1 and Text 2 10-pitch with underscore, or (2) writing a line with no space and then writing a line of underscores (functionally analogous to the impact printer technique).

The number of scan lines in the hardware-generated underscore is determined by the number of lines-per-inch (lpi) that is being printed. An underscore that is one scan line in width is generated for 12 lpi; an underscore that is two scan lines in width is generated for 6 and 8 lpi. See Figure 17 for underscore cell placement.

Note: *When an entire line is underscored, the second method is recommended because only one line needs to be transmitted from the host system.*

In addition, graphic character modification permits either user- or IBM-designed characters to be directly substituted for discrete standard characters in the character generation storage.

EBCDIC or other 8-bit code assignments to graphic characters are implemented through a 256-position translate table. Up to four translate tables can be used. If more than one translate table is used, each additional table requires 256 bytes of page buffer area.

The 3800 can print 10-pitch, 12-pitch, or 15-pitch characters. The maximum number of character positions in a print line is 136, 163, and 204, respectively (see Figure 3). Pitches can be intermixed on any print line. For example, the same information printed using a 10-pitch character line at 6 lines-per-inch (lpi) can be represented on a smaller-size form using 15-pitch characters at 8 lpi. Greater amounts of information can be printed at 12 lpi. Figures 3 and 4 show the number of printable characters per line in relation to form width and character pitch.

Form Width (inches)	10-Pitch	12-Pitch	15-Pitch
6-1/2	55	66	82
8-1/2	75	90	112
9-1/2	85	102	127
9-7/8	89	106	133
10-5/8	96	115	144
11	100	120	150
12	110	132	165
13-5/8	126	151	189
14-3/10	133	159	199
14-7/8	136	163	204

Figure 3. Number of Printable Characters per Line with Common-Use Form Widths

Form Width (mm)	10-Pitch	12-Pitch	15-Pitch
165	55	66	82
180	61	73	91
215	74	89	111
235	82	99	123
250	88	106	132
270	96	115	144
280	100	120	150
305	110	132	165
322	116	139	174
340	123	148	185
363	133	159	199
375 or 378	136	163	204

Figure 4. Number of Printable Characters per Line with ISO Form Widths

COPY MODIFICATION

The 3800 allows customization of selected copies of a data set. This can include legends, explanatory remarks, and column headings, thereby providing the functional equivalent of preprinted forms. For example, report copies can be identified by copy number and the recipient's name to aid distribution.

Copy modification also permits the elimination of selected data on chosen copies, thereby providing the functional equivalent of multiple-part forms having spot carbon, short carbon, short plies, or printed blackout areas.

The storage required for copy modification must be allocated from the page buffer, which reduces page buffer capacity accordingly. The maximum amount of copy modification, including overhead bytes, is 8,192 bytes.

FORMS OVERLAY

The forms overlay function allows the printing of a specific document format, constant data, graph, or design on the paper forms along with the character text information. The operator places a framed overlay negative in a holder and then places the holder in the 3800. The image from the overlay negative may be printed, by program command, on any number of pages starting with the first page.

Alternate methods of forms printing are:

- The Format character sets consist of lines, corners, and intersections.
- The copy modification feature, which prints headings, legends, remarks, and similar data on copies of a report, and suppresses selected data on certain copies.

The forms overlay, copy modification features, and the Format character sets can be used singly or in any combination.

PAPER OUTPUT

Continuous Forms Stacker

For the basic 3800 printers, paper output is in the form of continuous paper fed into the continuous forms stacker. The 3-1/2 and 5-1/2-inch common-use form lengths are stacked two sheets to a fold in lengths of 7 and 11 inches, respectively. Likewise, the 3- and 4-inch ISO lengths are stacked two sheets to a fold in lengths of 6 and 8 inches, respectively. Six-inch ISO length forms may be stacked one or two sheets to a fold (6- or 12-inch length). All other form lengths are stacked individually at their fold lengths.

For paper output handling on machines with the burster-trimmer-stacker (BTS) feature installed, see the description under Optional Features.

Job and Copy Separation

To assist in job separation after processing, identifying marks can be printed on the page perforations between different jobs by the Mark Form command.

When there are several copies of a given document, all part of the same job, separation marks can be printed on the perforation of the left-hand carrier strip on each page at the page perforation. These marks alternate between one and two lines and are changed by the End of Transmission command.

These two types of separation marks are the only type of print allowed within one-half inch of the horizontal page perforations.

OPTIONAL FEATURES

Additional Character Generation Storage

Additional character storage is available to provide more online character capability. This feature permits expansion of the basic 128-character online capacity to 255 characters. The throughput of the subsystem is not impacted by the number of character sets online.

Burster-Trimmed-Stacker

The burster-trimmer-stacker (BTS) adds the optional capability of online bursting, trimming, and sheet stacking for the 3800 printer. The paper is threaded by the operator.

All 3800-listed paper widths, lengths, and weights can be processed by the BTS.

After the sheets are burst and trimmed, they are directed to the stacker, where they are stacked vertically. The pages are stacked so that those printed first may be removed first without stopping the printer. Individual copies can be offset.

Two-Channel Switch

The two-channel switch optional feature allows the 3800 to be attached via two channels to two separate central processors. The switching is done manually by the interface Enable/Disable switches on the usage meter panel of the 3800. Only one channel interface can be enabled at a time. The device address will be the same for both interfaces.

With the two-channel switch feature installed, a dynamic switch feature can be added that allows both channel interfaces to be enabled at the same time. Selection of the interface to be used is determined by programming. The dynamic switch feature allows the 3800 to be attached to two channels of a single central processor and provides alternate path capability.

Note: The alternate path support is not used if the 3800 is connected to byte multiplex channels.

The dynamic switch feature also allows the 3800 to be attached to two processors in a multiprocessor environment, and allows both central processors, one at a time, to access the 3800, thus providing alternate path capability.

Note: For multiprocessor system, this dynamic two-channel switch configuration is recommended because it reduces potential I/O supervisor overhead in accessing the 3800.

Also, with the two-channel switch feature installed, a remote switch feature can be added to permit manual channel selection from a remote console rather than at the printer.

Tape-to-Printing Subsystem

The tape-to-printing subsystem feature allows the 3800 to be used offline by attaching the printer to a magnetic tape subsystem. Online or offline operation is selected by switches on the printer. The printer can be attached to a 3410/3411 or a 3803/3420 Magnetic Tape Subsystem. For further details, see *Introducing the IBM 3800 Tape-to-Printing Subsystem Feature and its Utility*, GA26-1653 and *Operator/Reference Manual for the IBM 3800 Tape-to-Printing Subsystem Feature*, GA26-1654.

ERROR HANDLING

The 3800 Printing Subsystem automatically recovers from certain types of random errors. All successful recovery actions are transparent to the user and are recorded and accessible in the internal error log maintained for the 3800. This log is unloaded and recorded by the programming system. It provides detailed information that aids the CE in diagnosing subsystem operation.

Sense Information

Twenty-four bytes of sense information direct the operating system for appropriate error recovery actions. Sense byte 0 is the standard System/370 sense byte adapted to printers. Sense bytes 1 and 2 provide additional information regarding certain conditions in byte 0. Sense bytes 0, 1, and 2 are intended to be used by the operating systems.

Sense byte 3 reflects dynamic conditions within the printer. Bytes 4 through 23 contain detailed information and are provided for diagnostic evaluation, isolation, and error logging purposes. The 24 sense bytes are transferred to the channel by a Sense command.

METERING

The printer has three meters: a subsystem usage meter, a photoconductor meter, and a developer meter. All meters are located on the subsystem usage meter panel located on the end of the printer control electronics assembly.

Subsystem Usage Meter

The subsystem usage meter indicates how much paper has been processed through the transfer station. It is used for customer billing and by the customer engineer to determine when to schedule preventive maintenance.

The meter increments once for each 100 feet of paper processed. No usage is recorded when the customer engineer is running offline diagnostic programs on the printer. The meter is protected by a tamper-proof box and safeguards similar to those presently in use with standard usage meters.

Photoconductor Meter

The photoconductor meter indicates to the control electronics when an advance of the photoconductor is allowed. The meter count decrements from a preset value until it reaches a zero count (00000).

The meter is decremented once for every 100 feet of paper that moves through the transfer station. The meter is automatically reset to a preset value when the photoconductor is advanced.

Developer Meter

The developer meter indicates to the control electronics when a change of the developer mixture is required. The meter count decrements from a preset value as does the photoconductor meter.

The meter is decremented once for every 60 seconds that the mechanical developer is on. The meter is automatically reset to a preset value when the developer mixture is replaced.

PERFORMANCE CONSIDERATIONS

The 3800 Printing Subsystem operates at a constant rate, moving paper at a nominal speed of 31.8 inches per second (807.72 mm per second). This speed is maintained as long as data to be printed is available in the page buffer and a printing surface on the drum is available for data transfer. While the drum is revolving, the data for each successive page must be in the page buffer in adequate time to maintain the maximum printing speed. A delay in filling the page buffer with a page of data can defer the printing of at least one page to a subsequent portion of the photoconductor.

For example, assume an 11-inch length form is being printed. Seven such forms can be printed per drum revolution. If there is just one instance when all the data for a page to be printed is not in the page buffer when the image is to be generated, only six forms would be printed in that drum revolution. If this occurs often during the printing of a data set, the 3800 would be printing at less than maximum speed.

The approximate formula, $PB \div N$ (where PB is the number of bytes of available page buffer storage, and N is as given in Figure 5), can be used to estimate the maximum data content of a page that can be printed without performance degradation.

Common-Use		
Page Length (inches)	N	N
	Forms Overlay	No Forms Overlay
3-1/2	8	2
5-1/2	6	2
7	5	2
8-1/2	5	2
11	4	2

ISO		
Page Length (inches)	N	N
	Forms Overlay	No Forms Overlay
3	9	2
4	8	2
6	6	2
8	5	2
10	5	2
12	4	2

Figure 5. N Values for Eleven Selected Page Lengths

Whenever the formula is used, the size of the page buffer should be reduced by 256 bytes for each translate table beyond the first and by the amount of data contained in copy modification records. The page buffer storage occupied by the copy modification data can be closely approximated by assuming one byte for every nonrepetitive character (including blanks) in a line, three bytes for every set of four or more repeating characters in a line, and six bytes for each unique segment appearing on one or more copies. When using hardware underscore, an additional byte of storage is required for each underscored character, and there is no consecutive character compression for that line. If the BTS (optional feature) is installed, the page buffer size must be reduced by 768 bytes.

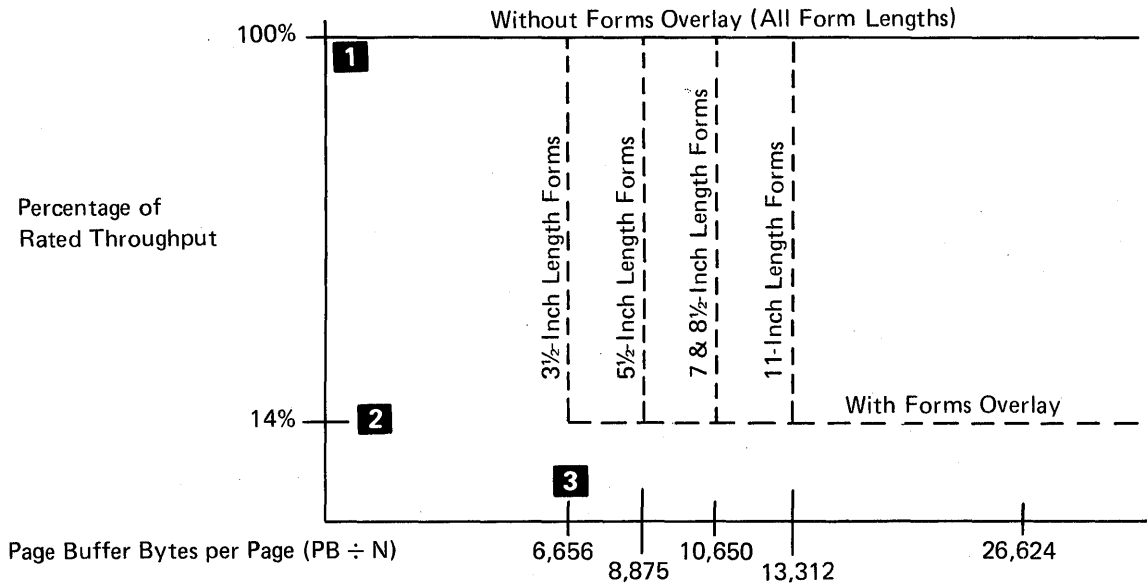
Figure 6 depicts approximate printer throughput for five page lengths with or without use of forms overlay. It shows the percentage of throughput in relation to the number of page buffer bytes required per printed page. The maximum number of characters per line are also shown for comparison purposes.

The application of the data compression algorithm (see the Write Commands section for a description) reduces the number of page buffer bytes required for a specific number of printed characters per page. The following parameters are assumed:

- Page buffer = Nominal 53,248 bytes
- One translate table
- No copy modification
- No hardware underscore
- BTS Feature not installed
- Single copies
- No process sequence delays
- Throughput stabilized (initial conditions excluded)
- No software-imposed delays
- Channel data transfer concurrent with printing
- No retry (on error occurrence)

Considering the parameters listed above, 100% throughput **1** is achieved as long as the average page buffer data for any one page is equal to or less than $PB \div N$. For a page buffer data set that exceeds $PB \div N$, throughput decreases but will not be less than 14% of maximum **2**. For example, if a 3-1/2-inch length form is used that contains the full 20 lines (at 8 lpi), with each line containing 204 15-pitch characters, 4,080 page buffer bytes are required **4**. The printer throughput would be rated at 100% even with forms overlay use because $PB \div N$ of 6,656 has not been exceeded **5**. If hardware underscoring, copy modification, and additional translate tables are added, the nominal page buffer size of 53,248 bytes is reduced accordingly, and the page buffer bytes required for the data set substantially exceed the $PB \div N$ figure of 6,656 bytes **3**. It follows that the rated throughput of the printer is reduced with each additional function. Also affecting throughput, but not considered for this example, is any other previously listed parameter.

At 12 lpi, significant use of copy modification can cause performance degradation due to control electronics internal processing.



Maximum Density of Pages without Data Compression

Page Size (inches)	Characters per Line	Pitch	Lines	LPI	Page Buffer Bytes per Page	PB ÷ N without Forms Overlay	PB ÷ N with Forms Overlay	12 LPI Data Limit for Block Multiplexer Channel**
3-1/2 x 14-7/8	136	10	15	6	2,040	26,624	6,656 5	5,190
	163	12	15	6	2,445			
	204	15	20	8	4,080 4			
	204	15	30	12	6,120#			
5-1/2 x 14-7/8	136	10	27	6	3,672	26,624	8,875	7,770
	163	12	27	6	4,401			
	204	15	36	8	7,344			
	204	15	54	12	11,016*#			
7 x 14-7/8	136	10	36	6	4,896	26,624	10,650	9,720
	163	12	36	6	5,868			
	204	15	48	8	9,792			
	204	15	72	12	14,688*#			
8-1/2 x 14-7/8	136	10	45	6	6,120	26,624	10,650	11,700
	163	12	45	6	7,335			
	204	15	60	8	12,240*			
	204	15	90	12	18,360*#			
11 x 14-7/8	136	10	60	6	8,160	26,624	13,312	14,880
	163	12	60	6	9,780			
	204	15	80	8	16,320*			
	204	15	120	12	24,480*#			

*Will not print at 100% throughput when using forms overlay.

**For byte multiplexer channels, data limits are 28% less.

#Will not print at 100% throughput because of control electronics internal processing limit for 12 lpi only.

Figure 6. Approximate Printer Throughput for Five Selected Page Lengths

Input/Output Operations

The printer is operable from either a selector, block multiplexer, or byte multiplexer channel as provided by the attaching system. The host system initiates all operations by issuing a Start I/O or Start I/O Fast Release instruction with the printer as the addressed device. Independently of the central processor, the channel selects and controls the functions necessary to complete the operation. Refer to Figure 8 for an operational overview of the channel and printer operation. Appendix A contains details on input/output channel instructions.

An operation is specified by the first byte in the channel command word (CCW). The channel transfers the command to the printer where the command is executed. The operation is usually organized into three stages: initial selection, data transfer, and ending sequence.

UNIT SELECTION AND DEVICE ADDRESSING

The I/O address of the 3800 printer is designated by an 8-bit binary number in the I/O instruction. This address is set to hexadecimal 18 ('18') when the printer is shipped, but it can be changed by the customer engineer when the printer is installed. The completed I/O address is specified in bits 16 through 31 of the I/O instruction. See Figure 7 for the address format.

If the printer is not attached, or is disabled or offline, the attempted operation is terminated and the central processor sets a condition code 3.

For the two-channel switch, the same address is used for both interfaces.

0					15					16					23					24					31
						Channel Address						Printer Address													

Bit Position	Field Designation
0 – 15	Not used
16 – 23	Channel Address
24 – 31	Printer Address

Figure 7. Unit Selection and Device Address Format

DATA TRANSFER

Data transfer begins when initial selection is complete and after the channel accepts valid status from the printer. For byte multiplexer channel operation, the printer disconnects from the channel and conditions the channel for the subsequent data transfer. When the printer is attached to a selector channel, it uses all the resource of that channel. Therefore, if another device is attached to the selector channel, that device will be unavailable during each 3800 channel program execution. When the printer is attached to a block multiplexer channel, it uses only one subchannel of that block multiplexer channel. Devices can use the other subchannels and can operate simultaneously with the printer.

The data transfer is determined by whether a write or read command is in process. Since the printer is normally an output device, the write command is used for illustration (see Figure 8). Included in the data transfer to the printer are functions such as selecting translate tables and WCGMs, initializing the forms control buffer, modifying copies or graphics, and sequencing control for the printing of forms overlay and copies. See the individual commands for detailed descriptions of these functions.

Data to be printed is transmitted a line at a time. The line need not be the full-line capacity of the intermediate buffer. The length of the print line is determined by the count in the CCW. When the CCW count exceeds 204 bytes, the printer terminates the transmission at 204 bytes. The command chaining is broken unless the SLI bit is on. Any editing or arranging of the line to be printed must be done in the host system before data transfer by the channel.

During byte multiplexer operations, data transfer may involve a burst of up to eight bytes, limited by the timing of the I/O interface signal sequence. On a byte multiplexer channel, the process is repeated until eight bytes are transferred. The printer then disconnects from the channel. The entire sequence is repeated until the number of characters specified in the CCW have been transferred. For selector or block multiplexer operations, the printer remains connected to the channel until all of the data is transferred. The printer can accept a suppress-data sequence when forced by the channel.

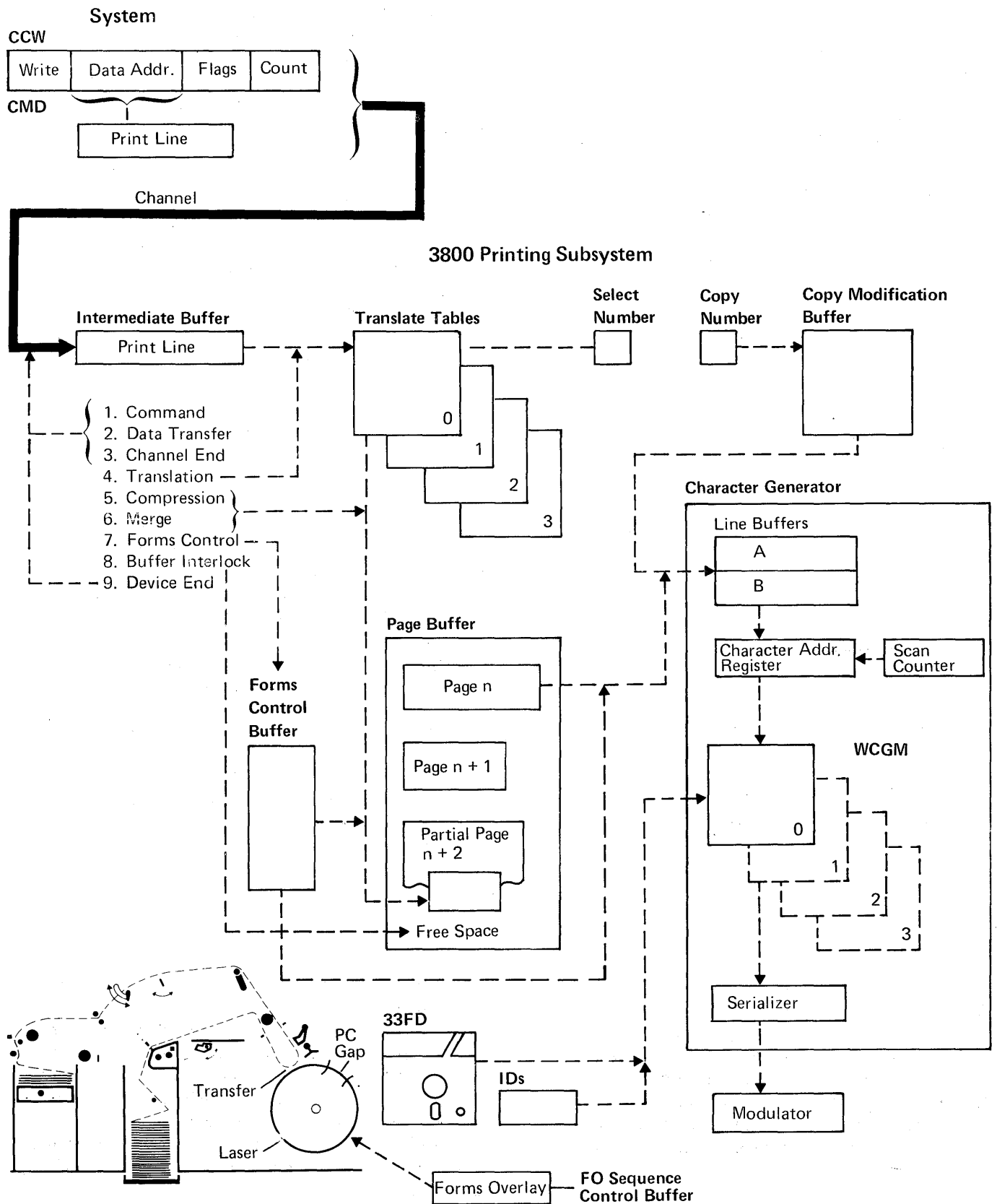


Figure 8. Channel and Printer Operational Overview

DATA TRANSFER (Continued)

The print lines are first placed into an intermediate buffer. After translation, and any compression and merging, the lines are placed into the page buffer where they are assembled into a page. When a complete page is assembled, it is readied for printing. At this time the selected character generation module is used to print the lines. The copy control function determines which copies are to be modified (if any), the number of copies to be printed, and which copies are to be printed with forms overlay. Line spacing and skipping is controlled by the forms control buffer.

ENDING STATUS

In most cases, channel end and device end are presented as the normal ending sequence for an operation with the printer. Channel end is presented at the conclusion of the data transfer and device end is presented after the forms control function. The exceptions are listed for individual command descriptions in the Channel Commands chapter.

CONDITION OF THE DEVICE AFTER RESET

Two types of reset functions are available: system reset and selective reset.

System Reset

System reset is performed when:

- The System Reset key (on the central processor) is pressed.
- System power is turned on.
- Printer subsystem power is turned on.
- The channel is offline (not operational) to the I/O interface.
- The printer control electronic clock is stopped and a selective reset occurs.
- Initial program loading occurs.
- The Reset key on the 3800 operator panel is pressed.
- The initial microprogram load (IMPL) or CE Reset switches on the 3800 CE panel are pressed.

The ready or not-ready status of the printer is generally not changed by a system reset. If there are images on the drum or the paperline has not stopped when the system reset occurs, the printer becomes not-ready. An operator check error condition and new sense and status information is set.

The 3800 printer cannot be reset by the host system when it is disabled. System reset normally resets the printer status and sense information. If the enable/disable state of the printer changes before the reset, but is not yet effective because of required inhibiting conditions, the reset clears these conditions and allows the printer to become disabled.

The channel interface is momentarily "control unit busy" during a system reset. If the reset resulted from an IMPL, the delay is several seconds. If the reset involves turning power on, the delay is several additional seconds. These delays result because of the time needed to load the microprogram and initialize the control electronics.

System reset does not change the contents of the page and control buffers except if associated with an IMPL or turning printer power on. Either sequence clears the buffers of previously stored information.

Selective Reset

Selective reset is issued only as a result of a malfunction detected on some channels. This reset is applicable only when the printer is active on the channel interface. If a selective reset occurs when the printer control electronics are stopped (clock stop), it is processed as a system reset. If the control electronics are not stopped, the reset is processed similarly to an interface disconnect so that the paper-line and drum registration are maintained.

When selective reset occurs, the channel command in progress may be terminated. If the command is terminated before channel end is presented, the channel end and device end status is not presented and the command is ignored. If the command is terminated between the channel end and device end status presentation, the command is executed and device end is presented until accepted by the system.

Interface Disconnect

If the channel discontinues operation with the printer by a Halt I/O or a Halt Device command, the printer recognizes an interface disconnect and attempts to end the operation being performed. If a halt occurs, the operation proceeds as if the channel had stopped data transfer, and the printer fills the remaining print positions with blanks. Channel end and device end are presented normally in ending status as if the halt had not occurred. If the halt occurs during ending status presentation, the printer treats the status as a stacked status condition.

Two-Channel Switch Feature

BASIC FEATURE

The basic two-channel switch appears to the printer as a single channel. The printer only has one of the two channel interfaces enabled at a time. Either interface (A or B) may be enabled or disabled by one of the two toggle switches on the usage meter panel. If both interface switches are enabled, the last interface switched is automatically disabled regardless of the position. When a channel I/O operation is being executed, a Start I/O instruction attempt from the other channel interface causes a not-operational (condition code 3), and select-out to be presented to that channel. Interface A may be enabled at any time the associated switch is in the Enable position and interface B is not already enabled. Likewise, interface B may be enabled at any time the associated switch is in the Enable position and interface A is not already enabled. Once an interface is enabled, it remains enabled until changed by operator action.

The 3800 two-channel switch feature does not adhere to all previous two-channel switch conventions. Those functions not provided are:

- Reserve and release channel commands
- Multitagged and untagged status presentation
- Contingent and reserved connections
- "Control unit busy" or "device busy" status when selection is attempted by the nonswitched interface
- Different addresses for each interface

DYNAMIC FEATURE (OPTIONAL)

The dynamic two-channel switch can have either interface A, B, or both enabled (online). When both interfaces are enabled (both switches on Enable), the printer is selected by the first channel to initiate a selection sequence. Should both channels simultaneously select the printer, the two-channel switch logic breaks the tie. Once an Interface switch is placed at Disable, that interface is disabled (offline). The dynamic switch has three program states: neutral, switched, and partitioned (refer to the discussion of each program state, this page, for details). The transition to or from any state is controlled by the central processor program, but any programmed state can be overridden manually. The only type of connection for the printer

is an implicit connection which lasts until the channel accepts device end status for a command that does not indicate command chaining. Should command chaining be suppressed after channel acceptance of device end status but before reselection occurs, implicit connection is terminated when the command chaining indication is removed. When an I/O operation is terminated by the system with a general reset from the active interface, implicit connection is terminated when the printer responds to the reset condition.

The dynamic two-channel switch appears to the printer as a single channel. The printer can have two channel interfaces simultaneously enabled. However, simultaneous operation with two interfaces is not possible. While an I/O operation with one interface is being executed, a Start I/O instruction attempt from the other interface causes a not-operational (condition code 3) to that interface.

Neutral

In the neutral state, both channel interfaces are enabled and available to the printer for I/O operations. The neutral state exists whenever the printer is operational, not switched to either channel, and not removed from either channel interface by the manual partitioning switches.

Switched

In the switched state, the printer has a connection to one interface. Channel commands are executed only on the selecting interface. Transition from the switched state to the neutral state occurs when the interface connection is terminated.

Partitioned

When an interface of the printer is partitioned (disabled), the printer appears not-operational (condition code 3) to the associated channel. Partitioning is controlled by the manual switches. Each interface may be separately partitioned.

ASYNCHRONOUS STATUS (BASIC AND DYNAMIC)

The only asynchronous status presented by the printer is device end on a not-ready-to-ready transition. This status is presented to the enabled interface or the interface that most recently communicated with the printer. This also allows device end status to be posted to the channel interface that retrieved the sense data after the printer ends the I/O operation with unit check indication. If partitioning switches are switched by the operator between the time a unit check and sense bytes are sent to the channel, and asynchronous device end is also presented, device end is sent to the channel that was switched to. Following an initial power on, an unsolicited device end from a not-ready-to-ready transition is presented to the first interface enabled by the operator. If both interfaces were enabled

at power on, device end is presented to channel A. Device end is discarded by the IBM programming system.

The general reset condition (system or selective) from the active channel is recognized by the printer and the response is the same as that previously described in, Condition of the Device after Reset, except when the switch is in neutral. The two-channel switch responds to a system reset over either interface if the control electronics clock is stopped. For clock-running conditions, the two-channel switch responds to the system reset only from the interface presenting request-in. If request-in is not present and the two-channel switch is in neutral, system reset has no effect from either channel. Figure 9 summarizes the reset conditions for the basic and dynamic two-channel switch.

	Printer Clock Stopped				Printer Clock Running			
	Channel B Issues		Channel A Issues		Channel B Issues		Channel A Issues	
	Selective	System	Selective	System	Selective	System	Selective	System
Channel A Enabled Operational In = Up	N	N	R	R	N	N	r	R
Channel A Enabled Operational In = Down	N -	N	-	R	N -	N	-	R
Channel A Selected	N -	N R	-	R	N -	N	-	R NR
Channel B Selected	-	- R	-	- R	-	- NR	-	- N

Legend

- Not applicable

R Printer Reset

NR No effect if Request-In is down; printer reset if Request-In is up.

N No effect

r Interface Disconnect

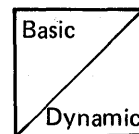


Figure 9. Two-Channel Switch (Basic and Dynamic) Response to General Reset

Channel Commands

The 3800 is designed to be compatible with System/370 and, except for commands controlling functions unique to the 3800, most 3800 commands are compatible in structure

with those for impact printers. The command set for the 3800 is listed in Figure 10.

Command Type	Command Name	Hexadecimal Code	Binary Code
Forms	Space 1 Line Immediately	0B	0000 1011
	Space 2 Lines Immediately	13	0001 0011
	Space 3 Lines Immediately	1B	0001 1011
	Skip to Channel nnnn Immediately	—	1nnn n011
Write	Write with No Space	01	0000 0001
	Write and Space 1 Line	09	0000 1001
	Write and Space 2 Lines	11	0001 0001
	Write and Space 3 Lines	19	0001 1001
	Write and Skip to Channel nnnn	—	1nnn n001
Load	Load Forms Control Buffer	63	0110 0011
	Load WCGM	53	0101 0011
	Load Translate Table	83	1000 0011
	Load Forms Overlay Sequence Control	43	0100 0011
	Load Graphic Character Modification	25	0010 0101
	Load Copy Modification	35	0011 0101
	Load Copy Number	23	0010 0011
Control	No Operation	03	0000 0011
	Initialize Printer	37	0011 0111
	Clear Printer	87	1000 0111
	Block Data Check	73	0111 0011
	Allow Data Check	7B	0111 1011
	Select Translate Table 0	47	0100 0111
	Select Translate Table 1	57	0101 0111
	Select Translate Table 2	67	0110 0111
	Select Translate Table 3	77	0111 0111
	End of Transmission	07	0000 0111
	Mark Form	17	0001 0111
	Execute Order	33	0011 0011
	Status	Sense I/O	04	0000 0100
Sense I/O Type		E4	1110 0100
Sense Error Log		24	0010 0100
Sense Intermediate Buffer		14	0001 0100

Figure 10. 3800 Printing Subsystem Command Set

FORMS COMMANDS

Separate commands are used for the unique spacing and skipping operations required by individual forms. The commands are defined as follows:

Binary Code	Hex	Function
0000 1011	0B	Space 1 Line Immediately
0001 0011	13	Space 2 Lines Immediately
0001 1011	1B	Space 3 Lines Immediately
1000 1011	8B	Skip Immediate to Channel 1
1001 0011	93	Skip Immediate to Channel 2
1001 1011	9B	Skip Immediate to Channel 3
1010 0011	A3	Skip Immediate to Channel 4
1010 1011	AB	Skip Immediate to Channel 5
1011 0011	B3	Skip Immediate to Channel 6
1011 1011	BB	Skip Immediate to Channel 7
1100 0011	C3	Skip Immediate to Channel 8
1100 1011	CB	Skip Immediate to Channel 9
1101 0011	D3	Skip Immediate to Channel 10
1101 1011	DB	Skip Immediate to Channel 11
1110 0011	E3	Skip Immediate to Channel 12

The skip immediate commands are executed any time the form is not at the specified channel. If the form is already at the specified channel, the forms operation is suppressed unless the previous command was a Write With No Space CCW.

The forms control buffer takes the place of the carriage control tape and is analyzed for the number of lines spaced or skipped. If channel 9 or 12 is detected during the space operation, the printer presents the status information as listed in the command summary for each command.

If the space or skip command causes the end of the printable area to be exceeded (1/2-inch/12.7 mm from the bottom edge of the physical form), the page is considered complete and is scheduled for exposure. If the command was a skip, the next form is appropriately positioned. If the command was a space, the next form is positioned to the first print line past the top 1/2-inch (12.7 mm) margin.

Space 1 Line Immediately

0 Command Code	7 8 Data Address	31 Flags	32 37 00	38 39 40	47 48 Count	63
Binary 0000 1011 Hex 0B	Not applicable.	SLI Flag (bit 34). See de- scription below.			Must be nonzero. A zero count causes a program check (bit 42) to be set in the channel status word (CSW).	
CHAINING AND SPECIAL REQUIREMENTS:		The printing area starts 1/2 inch from the top of the form and ends 1/2 inch from the bottom of the form. If this command causes the printer to space past the end of the printable area, the page is considered complete and scheduled for exposure on the photoconductor. The next form is positioned for the starting print line.				

SPACE 1 LINE IMMEDIATELY: Indicates that a blank line should be stored in the page buffer, which produces a line space on the form during the printing of the page.

If a write-with-no-space line was already in the page buffer, the forms position is set to the next line.

INITIAL STATUS: Channel end is presented.

UNIT CHECK: Presented along with device end and the channel 9 sense bit if channel 9 is detected during the space operation.

UNIT EXCEPTION: Presented along with device end if channel 12 is detected during the space operation.

CHANNEL END: Presented as initial status.

DEVICE END (NORMAL): Presented after the line space has been inserted in the page buffer (one byte for each line spaced) and enough room exists in the buffer for the next line.

DEVICE END (ABNORMAL): Presented with unit check and the channel 9 sense bit if channel 9 is detected during the space operation.

Presented with unit exception if channel 12 is detected during the space operation.

SLI BIT: May be on.

Space 2 Lines Immediately

0 Command Code 7	8 Data Address 31	32 Flags 37	38 00 39	40 47	48 Count 63
Binary 0001 0011 Hex 13	Not applicable.	SLI Flag (bit 34). See description below.			Must be nonzero. A zero count causes a program check (bit 42) to be set in the CSW.
CHAINING AND SPECIAL REQUIREMENTS:		The printing area starts 1/2 inch from the top of the form and ends 1/2 inch from the bottom of the form. If this command causes the printer to space past the end of the printable area, the page is considered complete and scheduled for exposure on the photoconductor. The next form is positioned for the starting print line.			

SPACE 2 LINES IMMEDIATELY: Indicates that two blank lines should be stored in the page buffer, which produces two line spaces on the form during the printing of the page.

If a write-with-no-space line was previously transferred, the forms space for that line uses one line space.

INITIAL STATUS: Channel end is presented.

UNIT CHECK: Presented along with device end and the channel 9 sense bit if channel 9 is detected during the space operation.

UNIT EXCEPTION: Presented along with device end if channel 12 is detected during the space operation.

CHANNEL END: Presented as initial status.

DEVICE END (NORMAL): Presented after the blank lines have been inserted in the page buffer (one byte for each line spaced) and enough room exists in the buffer for the next line.

DEVICE END (ABNORMAL): Presented with unit check and the channel 9 sense bit if channel 9 is detected during the space operation.

Presented with unit exception if channel 12 is detected during the space operation.

SLI BIT: May be on.

Space 3 Lines Immediately

0 Command Code 7	8 Data Address 31	32 Flags 37	38 39 00	40 47	48 Count 63
Binary 0001 1011 Hex 1B	Not applicable.	SLI Flag (bit 34). See de- scription below.			Must be nonzero. A zero count causes a program check (bit 42) to be set in the CSW.
<p>CHAINING AND SPECIAL REQUIREMENTS: The printing area starts 1/2 inch from the top of the form and ends 1/2 inch from the bottom of the form. If this command causes the printer to space past the end of the printable area, the page is considered complete and scheduled for exposure on the photoconductor. The next form is positioned for the starting print line.</p>					

SPACE 3 LINES IMMEDIATELY: Indicates that three blank lines should be stored in the page buffer, which produces three line spaces on the form during the printing of the page.

If a write-with-no-space line was previously transferred, the forms space for that line uses one line space.

INITIAL STATUS: Channel end is presented.

UNIT CHECK: Presented along with device end and the channel 9 sense bit if channel 9 is detected during the space operation.

UNIT EXCEPTION: Presented along with device end if channel 12 is detected during the space operation.

CHANNEL END: Presented as initial status.

DEVICE END (NORMAL): Presented after the blank lines have been inserted in the page buffer (one byte for each line spaced) and enough room exists in the buffer for the next line.

DEVICE END (ABNORMAL): Presented with unit check and the channel 9 sense bit if channel 9 is detected during the space operation.

Presented with unit exception if channel 12 is detected during the space operation.

SLI BIT: May be on.

Skip to Channel nnnn* Immediately

0 Command Code	7 8 Data Address	31 32 37 Flags	38 39 00	40 47 Count	48 63
Binary 1nnn n011 Hex XX	Not applicable.	SLI Flag (bit 34). See description below.			Must be nonzero. A zero count causes a program check (bit 42) to be set in the CSW.

CHAINING AND SPECIAL REQUIREMENTS: The printing area starts 1/2 inch from the top of the form and ends 1/2 inch from the bottom of the form. If this command causes the printer to skip past the end of the printable area, the page is considered complete and scheduled for exposure on the photoconductor. The next form is positioned to the appropriate channel.

SKIP TO CHANNEL nnnn* IMMEDIATELY

Indicates that an appropriate number of blank lines should be stored in the page buffer, which causes the form to skip to the channel indicated in the command code bits.

If the print position is currently positioned to the channel then no skipping will take place unless a previous Write with No Space command was performed.

INITIAL STATUS:

Channel end is presented.

UNIT CHECK:

Presented with device end when no matching channel code was found. The forms position is set to the first print position on the next page.

UNIT EXCEPTION:

None

CHANNEL END:

Presented as initial status.

DEVICE END (NORMAL):

Presented after the blank lines have been inserted in the page buffer (one byte for each line spaced) and enough room exists in the buffer for the next line.

DEVICE END (ABNORMAL):

Presented with unit check if no matching channel code is found.

SLI BIT:

May be on.

* Channel (nnnn)	Binary (1nnn n011)	Hex (XX)
1	1000 1011	8B
2	1001 0011	93
3	1001 1011	9B
4	1010 0011	A3
5	1010 1011	AB
6	1011 0011	B3
7	1011 1011	BB
8	1100 0011	C3
9	1100 1011	CB
10	1101 0011	D3
11	1101 1011	DB
12	1110 0011	E3

WRITE COMMANDS

Write commands transfer data from the system to the printer and are normally used for printing. A write command alone does not cause automatic forms control. However, the CCW modifier bits can space 1, 2, or 3 lines or skip to designated channels after the data transfer is complete. The valid write commands are defined as follows:

Binary Code	Hex	Function
0000 0001	01	Write with No Space
0000 1001	09	Write and Space 1 Line
0001 0001	11	Write and Space 2 Lines
0001 1001	19	Write and Space 3 Lines
1000 1001	89	Write and Skip to Channel 1
1001 0001	91	Write and Skip to Channel 2
1001 1001	99	Write and Skip to Channel 3
1010 0001	A1	Write and Skip to Channel 4
1010 1001	A9	Write and Skip to Channel 5
1011 0001	B1	Write and Skip to Channel 6
1011 1001	B9	Write and Skip to Channel 7
1100 0001	C1	Write and Skip to Channel 8
1100 1001	C9	Write and Skip to Channel 9
1101 0001	D1	Write and Skip to Channel 10
1101 1001	D9	Write and Skip to Channel 11
1110 0001	E1	Write and Skip to Channel 12

Each write command transfers only one print line. The printer always accepts up to 204 characters for each write command. However, for 10- or 12-pitch lines, only 136 or 163 characters, respectively, or less, should be transferred for each line to prevent needlessly filling the page buffer.

As each line is transferred from the channel, the printer puts the characters, which make up the line, into an intermediate buffer, and then presents channel end. The characters are then translated by a selected translate table, which replaces each character with a graphic code from the translate table.

When any four or more identical characters occur consecutively within a line, such as fill blanks at the end of the print line, a compression of the line in the page buffer is made (unless a write with no space operation is being performed). Only three bytes are required for each compressed group, and these bytes indicate the compressed character, the number of characters, and the graphic code for that character.

Note: Any translate code of all bits ('FF') indicates an unprintable character. If detected following translation, the character is replaced with a blank ('40') from the currently selected translate table. If upon translating the hex '40' another 'FF' is detected, then a translated code of '00' is placed in the page buffer. A data check occurs unless suppressed by a block data check.

The translated version of the print line is then put into the page buffer. Any remaining print positions in the line are filled with blanks ('40') from the currently selected translate table. The first character in WCGM 0 must have a blank in the first position. Forms control is handled by inserting blank lines for appropriate spacing and skipping operations.

Compression is not performed on a line transferred for a Write With No Space CCW since that line may be merged with the next line. If the forms position must be moved and the line in the page buffer is not compressed, the line is compressed before forms control takes place. Merging characters in two different lines occurs by character position, rather than by physical position in the final print line. The tenth character in a line, for example, is merged with the tenth character in another line regardless of where those characters might otherwise appear (as a result of differences in pitch) on the printed page. When merging two different lines (of the same or different pitches) into one print line, the rules are as shown in the table below.

Caution: A blank is defined in the table as a character from the first location ('00') of any WCGM. If the WCGMs have been altered, merging of lines may have undesired results.

Character in Previous Line	Character in Current Line	Resultant Character	Remarks
Blank-1	Blank-2	Blank-1	Normal
Blank	Character	Character	Normal
Character	Blank	Character	Normal
Character-1	Character-2	Character-1	Data Check (can be suppressed)
Character	Underscore	Character	Hardware Underscore
Underscore	Character	Character	Hardware Underscore
Character-1	Character-1	Character-1	Identical (no data check)

- A printable character in the current line replaces an identical character or a blank.
- A blank in the current line does not replace either a blank or a printable character.
- A printable character in the current line does not replace the character from the previous line if they are different. This condition causes a data check.

The exception to these rules is the underscore, which can be merged with another graphic without a data check.

When merging lines that have characters of different pitch, it is important to understand that:

- When blanks of different pitch are merged, the resulting blank has the pitch of the previous line, not the following line.
- When a printable graphic character is merged with a blank, the resulting character has the pitch of the printable character.

To illustrate, assume that a 10-pitch line, a 12-pitch line, and a 15-pitch line are being merged. Each line contains four positions – three blanks and one graphic in each case. The widths of the 10-, 12-, and 15-pitch characters are proportional to the 18, 15, and 12 bits, respectively, that make up the scan patterns for those pitches (see Figure 17 for details on character cell pitch widths). The three data lines and the resulting print line are illustrated in Figure 11.

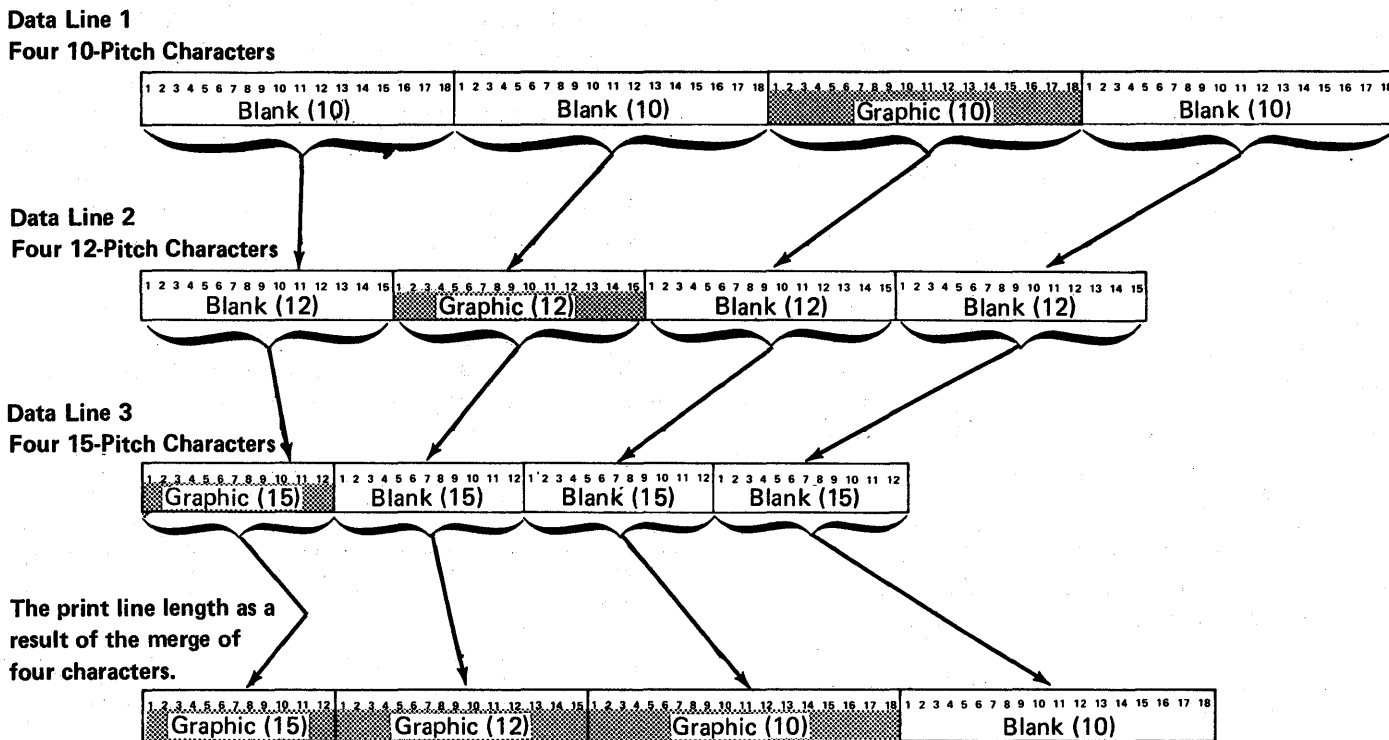


Figure 11. The Result of Merging Characters of Different Pitch Data Lines

Write with No Space

0 Command Code	7 8 Data Address	31 Flags	32 37 00	38 39 40	47 48 Count
Binary 0000 0001 Hex 01	Specifies the main storage location where the data bytes for the print line are stored.	SLI Flag (bit 34). See description below.			1 byte minimum; 204 bytes maximum.
CHAINING AND SPECIAL REQUIREMENTS:		None			

- WRITE WITH NO SPACE:** Transfers one print line to the printer and stores it in the page buffer. The form position is not advanced.
- INITIAL STATUS:** Normally zero.
- UNIT CHECK:** Presented along with device end when a data check occurs.
- CHANNEL END:** Presented after data transfer is completed.
- DEVICE END (NORMAL):** Presented after the print line is translated. No compression is performed and enough room exists in the page buffer for the next print line.
- DEVICE END (ABNORMAL):** Presented along with unit check when a data check occurs.
- SLI BIT:** Must be on if the count is not 204 bytes.

Write and Space 1 Line

0	7	8	31	32	37	38	39	40	47	48	63	
Command Code		Data Address			Flags		00				Count	
Binary 0000 1001 Hex 09		Specifies the main storage location where the data bytes for the print line are stored.			SLI Flag (bit 34). See description below.						1 byte minimum; 204 bytes maximum.	
CHAINING AND SPECIAL REQUIREMENTS: The printing area starts 1/2 inch from the top of the form and ends 1/2 inch from the bottom of the form. If this command causes the printer to space past the end of the printable area, the page is considered complete and scheduled for exposure on the photoconductor. The next form is positioned for the starting print line.												

- WRITE AND SPACE 1 LINE:** Transfers one print line to the printer and stores it in the page buffer. The form position is advanced to the next line.
- INITIAL STATUS:** Normally zero.
- UNIT CHECK:** Presented with device end when a data check occurs.
Presented with device end and the channel 9 sense bit if channel 9 is detected during the space operation.
- UNIT EXCEPTION:** Presented with device end if channel 12 is detected during the space operation.
- CHANNEL END:** Presented after data transfer is completed.
- DEVICE END (NORMAL):** Presented after the print line is translated, compressed, form position is advanced, and enough room exists in the page buffer for the next print line.
- DEVICE END (ABNORMAL):** Presented with unit check when a data check occurs.
Presented with unit check and the channel 9 sense bit if channel 9 is detected during the space operation.
Presented with unit exception if channel 12 is detected during the space operation.
- SLI BIT:** Must be on if the count is not 204 bytes.

Write and Space 2 Lines

0 Command Code 7 8	Data Address 31	32 37 Flags	38 39 00	40 47 48	Count 63
Binary 0001 0001 Hex 11	Specifies the main storage location where the data bytes for the print line are stored.		SLI Flag (bit 34). See description below.		1 byte minimum; 204 bytes maximum.
CHAINING AND SPECIAL REQUIREMENTS: The printing area starts 1/2 inch from the top of the form and ends 1/2 inch from the bottom of the form. If this command causes the printer to space past the end of the printable area, the page is considered complete and scheduled for exposure on the photoconductor. The next form is positioned for the starting print line.					

- WRITE AND SPACE 2 LINES:** Transfers one print line to the printer and stores one blank line following this print line in the page buffer.
- INITIAL STATUS:** Normally zero.
- UNIT CHECK:** Presented with device end when a data check occurs.
Presented with device end and the channel 9 sense bit if channel 9 is detected during the space operation.
- UNIT EXCEPTION:** Presented with device end if channel 12 is detected during the space operation.
- CHANNEL END:** Presented after data transfer is completed.
- DEVICE END (NORMAL):** Presented after the print line is translated, compressed, one blank line is inserted for forms control, and enough room exists in the page buffer for the next print line.
- DEVICE END (ABNORMAL):** Presented with unit check when a data check occurs.
Presented with unit check and the channel 9 sense bit if channel 9 is detected during the space operation.
Presented with unit exception if channel 12 is detected during the space operation.
- SLI BIT:** Must be on if the count is not 204 bytes.

Write and Space 3 Lines

0	7	8	31	32	37	38	39	40	47	48	63
Command Code		Data Address				Flags		00		Count	
Binary 0001 1001 Hex 19		Specifies the main storage location where the data bytes for the print line are stored.				SLI Flag (bit 34). See description below.				1 byte minimum; 204 bytes maximum.	
CHAINING AND SPECIAL REQUIREMENTS: The printing area starts 1/2 inch from the top of the form and ends 1/2 inch from the bottom of the form. If this command causes the printer to space past the end of the printable area, the page is considered complete and scheduled for exposure on the photoconductor. The next form is positioned for the starting print line.											

WRITE AND SPACE 3 LINES: Transfers one print line to the printer and stores two blank lines following this print line in the page buffer.

INITIAL STATUS: Normally zero.

UNIT CHECK: Presented with device end when a data check occurs.
Presented with device end and the channel 9 sense bit if channel 9 is detected during the space operation.

UNIT EXCEPTION: Presented with device end if channel 12 is detected during the space operation.

CHANNEL END: Presented after data transfer is completed.

DEVICE END (NORMAL): Presented after the print line is translated, compressed, two blank lines are inserted for forms control, and enough room exists in the page buffer for the next print line.

DEVICE END (ABNORMAL): Presented with unit check when a data check occurs.
Presented with unit check and the channel 9 sense bit if channel 9 is detected during the space operation.
Presented with unit exception if channel 12 is detected during the space operation.

SLI BIT: Must be on if the count is not 204 bytes.

Write and Skip to Channel (nnnn*)

0 Command Code	7 8 Data Address	31 Flags	32 37 00	38 39 40	47 48 Count	63
Binary 1nnn n001 Hex XX	Specifies the main storage location where the data bytes for the print line are stored.	SLI Flag (bit 34). See description below.			1 byte minimum; 204 bytes maximum.	
CHAINING AND SPECIAL REQUIREMENTS:		The printing area starts 1/2 inch from the top of the form and ends 1/2 inch from the bottom of the form. If this command causes the printer to skip past the end of the printable area, the page is considered complete and scheduled for exposure of the photoconductor. The next form is positioned to the appropriate channel.				

WRITE AND SKIP TO CHANNEL (nnnn*)

Transfers one print line to the 3800 printer and indicates that the form should be skipped to channel nnnn*

INITIAL STATUS:

Normally zero.

UNIT CHECK:

Presented with device end when a data check occurs. Forms position is set to the first print line on the next page.

UNIT EXCEPTION:

None.

CHANNEL END:

Presented after data transfer is completed.

DEVICE END (NORMAL):

Presented after the print line is translated, compressed, blank lines are inserted for the skip-control of forms, and enough room exists in the page buffer for the next print line.

DEVICE END (ABNORMAL):

Presented with unit check if no matching channel code is found or when a data check occurs.

SLI BIT:

Must be on if the count is not 204 bytes.

* Channel nnnn	Binary 1nnn n001	Hex XX
1	1000 1001	89
2	1001 0001	91
3	1001 1001	99
4	1010 0001	A1
5	1010 1001	A9
6	1011 0001	B1
7	1011 1001	B9
8	1100 0001	C1
9	1100 1001	C9
10	1101 0001	D1
11	1101 1001	D9
12	1110 0001	E1

LOAD COMMANDS

Load commands initialize control blocks, buffers, and tables in the control electronics. All load commands result in the completion of any partial page remaining in the page buffer by causing the printer to skip to the beginning of the next page. For Load WCGM, Load Translate Table, Load Graphic Character Modification, and Load Copy Modification commands, the printer waits until all pages currently stored in the page buffer are printed before completing the execution of the load command and presenting channel end and device end to the channel. If the page buffer is full, or many copies of each page are being printed, a wait of several seconds or more could occur until the command is completed and the channel is available to any other connected devices. To eliminate the adverse effect this waiting period can have on system performance, a Clear Printer command should precede any series of load commands that include those with the asterisk below. This ensures that the page buffer will be empty before the load command is issued. The block multiplexer channel will then be disconnected during the time the page buffer is being emptied. The valid load commands are as follows:

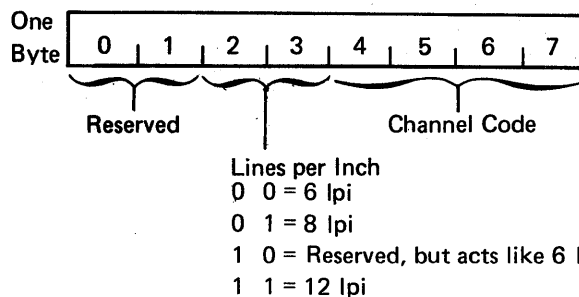
Binary Code	Hex	Function
0110 0011	63	Load Forms Control Buffer
0101 0011	53	*Load WCGM
1000 0011	83	*Load Translate Table
0100 0011	43	Load Forms Overlay Sequence Control
0010 0101	25	*Load Graphic Character Modification
0011 0101	35	*Load Copy Modification
0010 0011	23	Load Copy Number

Normally, the Initialize Printer command or the Load WCGM command clears any control buffers allocated in the page buffer. However, if a subsequent command is issued to a previously loaded control buffer, the buffer is first cleared, then loaded with the new information.

For most load commands, the data is transferred into the intermediate buffer where a validity check is made on the data received. If valid, the data is moved into the actual controlling buffer. If the data is not valid, the original buffer is left unchanged and the printer indicates appropriate status and sense information to the system.

Forms Control Buffer

A forms control buffer (FCB) replaces the paper tape carriage used on some printers such as the 1403. The forms control buffer electronically controls the vertical positioning of lines within the page in addition to the space and skip operations of the forms. The standard line spacings are either 6 lines-per-inch (6 lpi), 8 lines-per-inch (8 lpi), 12 lines-per-inch (12 lpi), or any combination of the three. Each byte transferred to the FCB has the following designations:



The buffer is loaded by the system with the Load Forms Control Buffer command. Any partial page is completed by padding the remainder of the page with blank lines. There is no wait for the page buffer to go empty, nor does a Clear Printer command need to precede the Load Forms Control Buffer command.

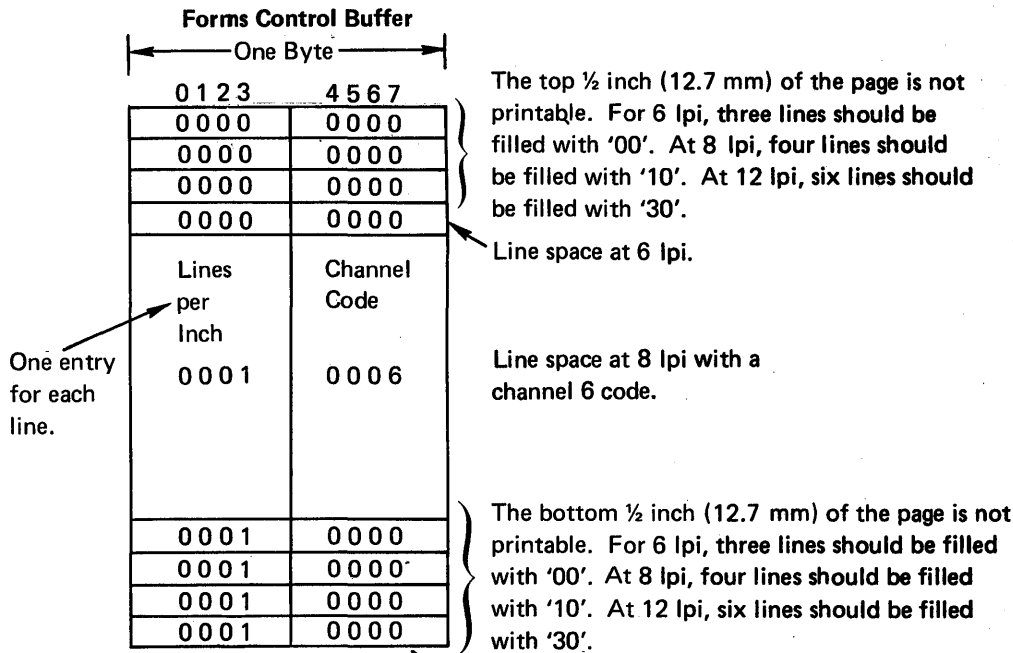
The forms control buffer consists of up to 144 bytes. Each byte corresponds to a physical line position of the form. One of 12 different channel codes may be used in each byte. The number of bytes transferred by the load command determines the length of the FCB. For common-use form sizes, up to 66 bytes can be transferred at 6 lpi, up to 88 bytes at 8 lpi, and up to 132 bytes at 12 lpi. For ISO forms sizes, up to 72 bytes can be transferred at 6 lpi, up to 96 bytes at 8 lpi, and up to 144 bytes at 12 lpi. The printer checks for the following when a load command is received.

- The first or last three bytes are '00' for 6 lpi; the first or last four bytes are '10' for 8 lpi; or the first or last six bytes are '30' for 12 lpi.

Note: This verifies that the unprintable 1/2-inch (12.7 mm) margins at the top and bottom of the page are void of any channel indications.

- Only channel codes 0 through 12 are used.
- The line spacing is an integer multiple of 1/2 inch.
- The length of the FCB matches the length of the paper.

After successful execution of the load command, the printer maintains the proper orientation between the print page and the forms control buffer. Figure 12 associates typical FCB entries with a printed page.



Printed Page	Forms Control
Top ½ inch (12.7 mm) is blank.	00
	00
	00
150,000	6 lpi 00
50,000	6 lpi 00
150,000	6 lpi 00
100,000	6 lpi 00
65,000	6 lpi 00
50,000	6 lpi 00
60,000	6 lpi 00
75,000	6 lpi 00
60,000	6 lpi 00
100,000	6 lpi, channel 2 02
.	
150,000	8 lpi 10
50,000	8 lpi 10
150,000	8 lpi 10
100,000	8 lpi 10
65,000	8 lpi 10
50,000	8 lpi, channel 3 13
60,000	8 lpi 10
75,000	8 lpi 10
60,000	8 lpi 10
100,000	8 lpi 10
Bottom ½ inch (12.7 mm) is blank.	10
	10
	10
	10

Figure 12. Typical Forms Control Buffer Loading

Load Forms Control Buffer

0	7	8	31	32	37	38	39	40	47	48	63	
Command Code		Data Address					Flags		00		Count	
Binary 0110 0011 Hex 63		Specifies the main storage location where forms control buffer information is stored.					SLI Flag (bit 34). See description below.				Specifies the number of bytes to be transferred (maximum 144 bytes).	
CHAINING AND SPECIAL REQUIREMENTS: Should precede space or skip commands for proper forms orientation. The first or last three bytes must be '00' for 6 lpi, the first or last four bytes must be '10' for 8 lpi, and the first or last six bytes must be '30' for 12 lpi.												

LOAD FORMS CONTROL BUFFER: Transfers up to 144 bytes of forms control information to the printer to control space and skip operations for the forms. The forms position is set to the first print line.

Note: *The actual number of bytes transferred depends on the vertical line spacing.*

INITIAL STATUS: Usually zero.

UNIT CHECK/LOAD CHECK: The forms control information is checked for the following:

1. The first or last three bytes are '00' for 6 lpi, the first or last four bytes are '10' for 8 lpi, or the first or last six bytes are '30' for 12 lpi.
2. Only channel codes 0 through 12 are used.
3. The line spacing is a multiple of 1/2-inch.
4. The length of the FCB matches the length of the paper.

Load check is presented if any of the above checks is in error.

CHANNEL END/DEVICE END: Presented after bytes are transferred to the printer and validated, and any partial page is completed.

CHANNEL END/DEVICE END/UNIT CHECK: Presented if a load check is detected in the form control information transferred to the printer. Appropriate sense bits are also set.

SLI BIT: Must be on if count is not 144 bytes.


Notes:

1. *The Initialize Printer command sets the forms control buffer to the IMPL condition. Line spacing is set for 6 lpi with a channel 1 code for the first print line, and the form is positioned to the first print line at the top of the page. If the operator loads a different-length form after the FCB is loaded, the current FCB contents are discarded and the FCB is restored to the IMPL condition.*
2. *A skip to Channel 0 CCW, as issued to a 3211 printer, becomes a load translate table CCW and causes an error to occur.*

Writable Character Generation Modules

There can be four writable character generation modules (WCGMs) in the 3800, two standard and two optional. A WCGM is a storage device holding the bit configurations necessary to print 64 different characters (except for the fourth WCGM where the last position cannot be selected).

The character sets (groups of 64) are stored on a disk in the printer. For use, a character set is read from the disk and loaded into a WCGM. The Load WCGM command transfers four identification (ID) bytes that specify the character sets to be loaded into the WCGMs: byte 0 for WCGM 0, byte 1 for WCGM 1, byte 2 for WCGM 2, and byte 3 for WCGM 3. A nonzero ID code must be specified for the first byte, which loads WCGM 0.

Any odd ID (bit 7 on) is valid and indicates a reserved WCGM. In addition, valid ID codes (bits 1–7) must be an even value from '00' through '40'; that is, even values from '42' through 'FE' are invalid. Any valid code used which does not specify one of the listed ID codes shown in Figure 13 causes the unassigned graphic character  to be loaded into all 64 positions.

Bit 0 of the ID byte is a control flag. If the flag is on, the character in location '2D' is considered to be an underscore for merging purposes when successive lines are written without spacing. When this character is merged with others, the result is an underscored character. The character in location '2D' need not actually be an underscore for this

purpose since the underscore is not overprinted but is generated internally by the 3800.

For example:

1. ID '02' is used to load Gothic 10, but the character in location '2D' cannot be merged with others for underscoring.
2. ID '88' is used to load Format 10. The character at '2D' can be merged with others to provide underscored characters even though it is not an actual underscore.

In the underscored character sets (Gothic, Gothic Condensed, and Text) an underscore is always printed because it is part of the character.

Once loaded, a WCGM remains loaded until the next Load WCGM command is given unless Initialize Printer, IMPL, or power-on sequence occurs. A WCGM is not reloaded if it already contains an unmodified version of the character set to be loaded or if it is reserved. A modified character set is one that has been changed with a user-defined graphic by use of the Load Graphic Character Modification command.

A Load Translate Table command should follow the Load WCGM command since the translate tables are reset during a Load WCGM.

Appendix B contains the character assignments within the various character sets.

Character Sets	Binary Code 0123 4567	Hex Code		Underscore Character Sets	Binary Code 0123 4567	Hex Code
		with under- score	without under- score			
Gothic 10	1000 0010	82	02	Gothic 10	0011 1000	38
Gothic 12	1000 0100	84	04	Gothic 12	0011 1010	3A
Gothic 15	1000 0110	86	06	Gothic 15	0011 1100	3C
Gothic 15 condensed	1001 0010	92	12	Gothic 15 condensed	0011 0110	36
Format 10	0000 1000	88	08	Text 1	0011 1110	3E
Format 12	0000 1010	8A	0A	Text 2	0100 0000	40
Format 15	0000 1100	8C	0C			
Text 1	1000 1110	8E	0E			
Text 2	0001 0000	90	10			
OCR-A	0001 0110	96	16			
OCR-B	0001 1000	98	18			
Katakana 10	0001 1010	9A	1A			
Katakana 12	0001 1100	9C	1C			
Katakana 15	0001 1110	9E	1E			

Note 1: The following identifications (IDs) have special meanings:
 '00' A particular WCGM is not being used. This WCGM ID cannot be referenced by a subsequent translate table CCW.
 Bit 7 = 1 A WCGM is reserved; no loading occurs.
 Bit 0 = 0 The character set does not have an underscore character at location '2D'.
 Bit 0 = 1 The character set has an underscore character ('2D').

Note 2: An attempt to use an ID code greater than '40' (except all odd codes – bit 7 on) in bits 1 through 7 results in a load check.

Figure 13. Character Set ID Codes

Load WCGM

0	7	8	31	32	37	38	39	40	47	48	63
Command Code		Data Address				Flags		00		Count	
Binary 0101 0011 Hex 53		Specifies the main storage location where the four-byte control record is stored.				Used at discretion of programmer.				Four bytes	
<p>CHAINING AND SPECIAL REQUIREMENTS:</p> <ol style="list-style-type: none"> Should precede the Load Translate Table command to ensure that the WCGMs are loaded. Should be chained to a following command (such as a No Operation) for error recovery purposes. Should be preceded by a Clear Printer command to avoid possible system performance degradation. Refer to the Load Commands section for an explanation. 											

LOAD CHARACTER MODULE:

Transfers four bytes from the system to the printer. The four bytes (0, 1, 2, and 3) should contain the character set identification code which will be loaded into the associated WCGM (refer to Figure 13 for a table of the character set ID codes).

A Load Translate Table command should follow a Load WCGM command since the translate tables are reset during a Load WCGM by the control electronics. The printer is set for Translate Table 0 after a load WCGM operation.

INITIAL STATUS:

Initially zero.

UNIT CHECK/LOAD CHECK:

Set in the following cases:

An attempt is made to load a WCGM that is not installed in the printer.

The first WCGM was not specified. (Byte 0 does not contain valid character set ID.)

An incorrect character set ID is used.

The count is less than four.

CHANNEL END:

Presented after the control bytes are transferred and checked for validity.

DEVICE END (NORMAL):

Presented after the WCGMs are loaded with the character set from the internal disk.

DEVICE END (ABNORMAL):

Presented with unit check if a permanent disk error is encountered during the loading of the WCGMs. The printer becomes not ready and appropriate sense bytes are set for equipment check.

Note: Any WCGMs in the process of being loaded probably contain invalid data.

Notes:

- The Initialize Printer command loads the Gothic 10 character set into WCGM 0. The other WCGMs are not changed.
- The load WCGM command disables the copy modification function, frees the storage space previously allocated in the page buffer, and sets the printer for Translate Table 0.

Translate Tables

The four translate tables 0, 1, 2, and 3 can be stored in the page buffer. Each one contains 256 bytes. They are selected by Select Translate Table commands and loaded by Load Translate Table commands. Pages in the page buffer are printed before the tables are loaded, which permits the tables to be loaded at the beginning of the buffer. If an attempt is made to load tables 1, 2, or 3 (after they already contain a table from a previous loading), the previous table will be replaced by the latest table.

Once a translate table is selected, it is used to translate the character codes received from the channel. If a nonexistent table is specified, the printer indicates a data check and the characters are translated with table 0. If no Select Translate Table command is issued, the printer uses the last specified table. The printer is set for table 0 when (1) power is initially turned on, (2) the WCGM is loaded, or (3) an Initialize Printer command is executed.

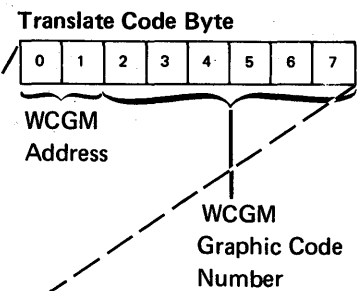
After a translate table is selected, loaded, and stored in the page buffer, each of the data lines transferred by the write commands is translated. Figure 14 shows how an individual byte from the data sent to the printer is transformed into print data. The 8-bit EBCDIC assignment ('C1'), equivalent to the graphic character "A", is used by the printer to address the location in the translate table that contains the value '01'. That value defines a WCGM and a location within the WCGM that contains the scan pattern for printing the "A".

The translate code at location hex '40' should point to a blank character. It is used to pad out a line and to substitute for an unprintable character (translate table code 'FF').

Intermixing multiple character arrangements on a line requires two or more translate tables if a unique EBCDIC code for each graphic does not exist. However, no more translate tables have to be loaded than are needed to print the data set. If a unique EBCDIC-to-graphic assignment exists for the defined multiple character character sets (Text 1 and Text 2 or Gothic and Katakana), then only one translate table is needed. Intermixing within a line using multiple tables is accomplished by first transferring one style of characters to the printer with a Write With No Space command. The second style of characters is then transferred to the printer by a Write And Space command. The printer then merges the two styles into one print line.

Dec.	Hex	Instruction (SS)	Graphics and Controls BCDIC EBCDIC(1) ASCII	7-Track Tape BCDIC(2)	EBCDIC Card Code	Binary
192	C0		? A	B A 8 2	12-0	1100 0000
193	C1		B A	B A 1	12-1	1100 0001
194	C2		B B B	B A 2	12-2	1100 0010
195	C3		C C C	B A 2 1	12-3	1100 0011
196	C4		D D D	B A 4	12-4	1100 0100
197	C5		E E E	B A 4 1	12-5	1100 0101
198	C6		F F F	B A 4 2	12-6	1100 0110
199	C7		G G G	B A 4 2 1	12-7	1100 0111
200	C8		H H H	B A 8	12-8	1100 1000
201	C9		I I I	B A 8 1	12-9	1100 1001
202	CA				12-0-2-8-9	1100 1010
203	CB				12-0-3-8-9	1100
204	CC					
205	CD					
206	CE					
207	CF					

Each byte has the following format:



Translate Table

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0																
1																
2																
3																
4	00										0A	0B	0C	0D	0E	0F
5	10										1A	1B	1C	1D	1E	1F
6	20	21									2B	2C	2D	2E	2F	
7											3A	3B	3C	3D	3E	3F
8																
9												2A				
A																
B																
C		01	02	03	04	05	06	07	08	09						
D		11	12	13	14	15	16	17	18	19						
E			22	23	24	25	26	27	28	29						
F	30	31	32	33	34	35	36	37	38	39						

WCGM 0

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0		A	B	C	D	E	F	G	H	I	␣	.	<	(	+	|
1		&	J	K	L	M	N	O	P	Q	R	!	\$	*)	:
2		-	/	S	T	U	V	W	X	Y	Z	␣	.	%	>	?
3		0	1	2	3	4	5	6	7	8	9	:	#	@	'	=

Figure 14. How a Byte of Data Causes Printing

Load Translate Table

0 Command Code 7	8 Data Address 31	32 Flags 37	38 00 39	40 47	48 Count 63
Binary 1000 0011 Hex 83	Specifies the main storage location where the translate table is stored.	Used at discretion of programmer.			256 bytes
CHAINING AND SPECIAL REQUIREMENTS: <ol style="list-style-type: none"> Should follow a Load WCGM command and a Select Translate Table command. Should be preceded by a Clear Printer command to avoid possible system performance degradation. Refer to the Load Commands section for an explanation. 					

LOAD TRANSLATE TABLE: Transfers 256 bytes of translate table information to the printer. The data is placed into the intermediate buffer where it is checked for validity. If no errors are found, the data is moved to the appropriate buffer. Channel end and device end are presented in ending status. If the data is invalid, unit check, channel end, device end, and appropriate sense bits are set.

INITIAL STATUS: Normally zero.

UNIT CHECK/LOAD CHECK: Presented if any of the following checks occur:

1. A nonexistent WCGM is specified.
2. The count field is less than 256 bytes.
3. A WCGM is not loaded.

Note: If load check occurs, sense bytes 22 and 23 contain the approximate offset from the beginning of the data record to the byte with the error.

CHANNEL END/DEVICE END: Presented to the channel after the translate table is transferred to the printer.

CHANNEL END/DEVICE END/UNIT CHECK: Presented if an error is detected in the translate table information transferred to the printer. Appropriate sense bits are also set.

Note: The Initialize Printer command sets translate table 0 to the IMPL condition and resets the buffer areas allocated for translate tables 1, 2, and 3. This area can be used for page buffer storage or loaded with another translate table with the next Load Translate Table command.

Forms Overlay Sequence Control:

The Load Forms Overlay Sequence Control command controls the printing of the forms overlay image and the number of printed copies. The control information transferred to the printer consists of a maximum of two 2-byte entries. The first byte of each entry defines the number of copies to be printed. The second byte of each entry defines whether to print the forms overlay. If the second byte is zero, the forms overlay is not flashed.

When the control information is transferred, there is no wait for the page buffer to empty nor a need to precede the load command with a Clear Printer command. Any partial page is completed by padding the remainder of the page with blank lines.

The printer checks that an even number of bytes are transferred and that the first byte of each entry (number of copies) is not zero. If either check indicates invalid data, the printer sets the unit check and load check indicator bits in the sense bytes and presents unit check ending status. In addition to printing multiple copies, this command controls the grouping of more than one copy of each page. Retransmission of the data set from the channel is necessary when more than one group is specified or when multiple copies without grouping are specified.

For example, assume that six copies of a data set are to be printed in three groups. The first group contains one copy of the data set with forms overlay printing, the second group contains three copies of the data set (first two copies with forms overlay printing), and the third group contains two copies of the data set without forms overlay printing. The complete data set must be transmitted three times, once for each group. If there are three pages in the data set, the output is as shown in Figure 15.

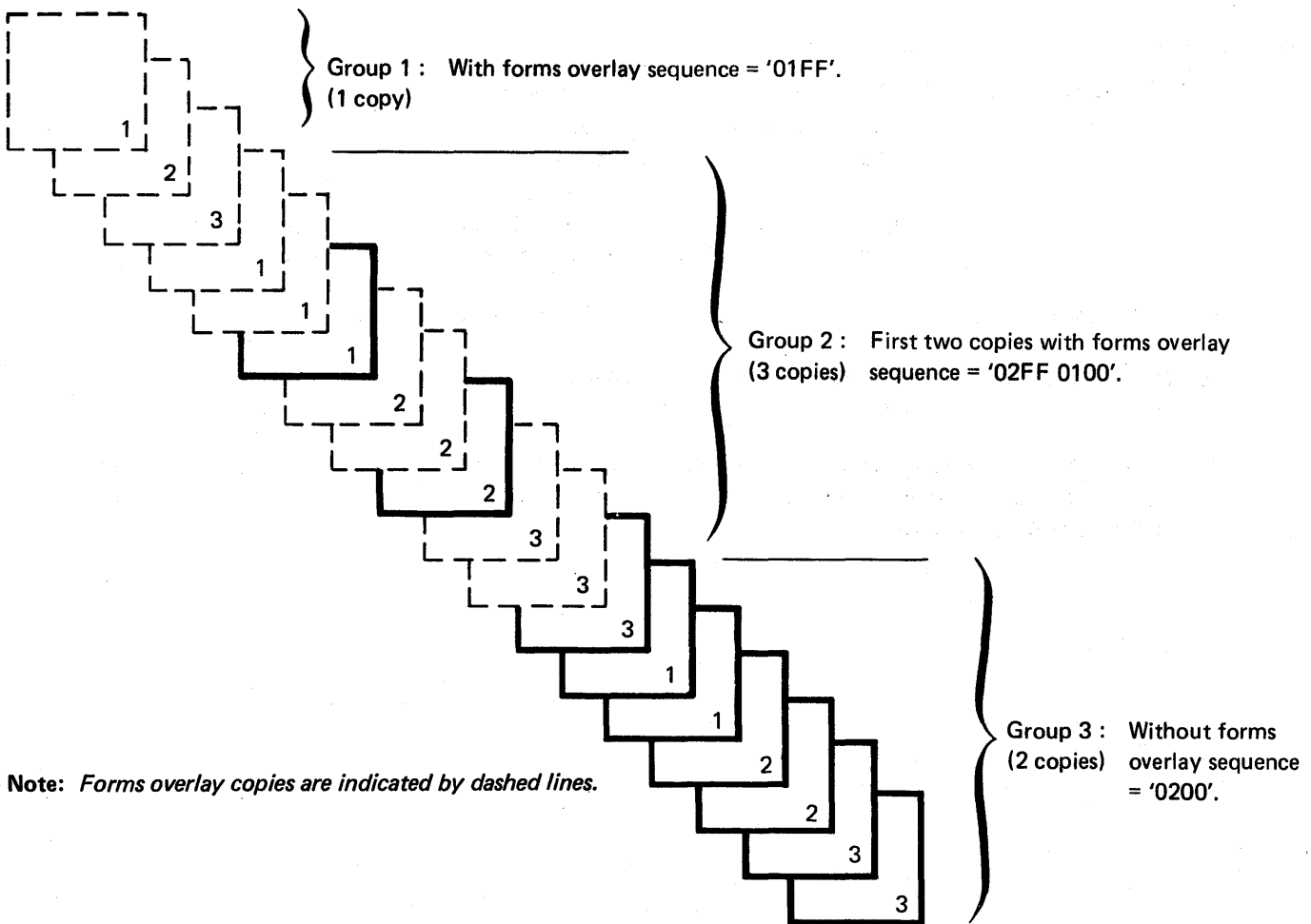


Figure 15. Output Response to a Typical Sequence Control

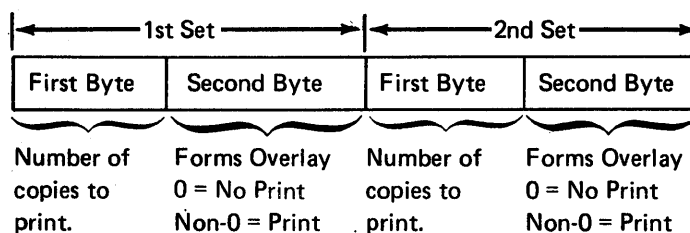
Load Forms Overlay Sequence Control

0	7	8	31	32	37	38	39	40	47	48	63
Command Code		Data Address				Flags		00		Count	
Binary 0100 0011 Hex 43		Specifies the main storage location where the forms overlay control bytes are stored.				SLI Flag (bit 34). See description below.				Two bytes minimum; four bytes maximum.	
CHAINING AND SPECIAL REQUIREMENTS:			None								

LOAD FORMS OVERLAY SEQUENCE CONTROL:

Transfers one or two 2-byte records that define how many copies to print and whether to print the forms overlay.

The bytes have the following format:



Note: *The first byte of each set cannot be zero.*

INITIAL STATUS:

Normally zero.

UNIT CHECK:

The printer checks that the bytes transferred are even in number and that the first byte of each set (number of copies) is not zero.

CHANNEL END/DEVICE END:

Presented after the bytes are transferred to the printer and validated, and any partial page is completed.

SLI BIT:

Must be on if the count is not four bytes.

Note: *The Initialize Printer command sets the sequence control to one copy and designates no forms overlay printing.*

Graphic Character Modification

Substitution or extension of the basic character sets is available through graphic character modification.

The Load Graphic Character Modification command transfers replacement characters to any WCGM in the printer. The modification format (see Figure 16) consists of 1 to 64 segments, 73 bytes per segment. The first byte of each segment contains an EBCDIC character code. The remaining 72 bytes define 24 lines of 3-byte groups that form the character bit patterns. There are 64 possible characters in a WCGM.

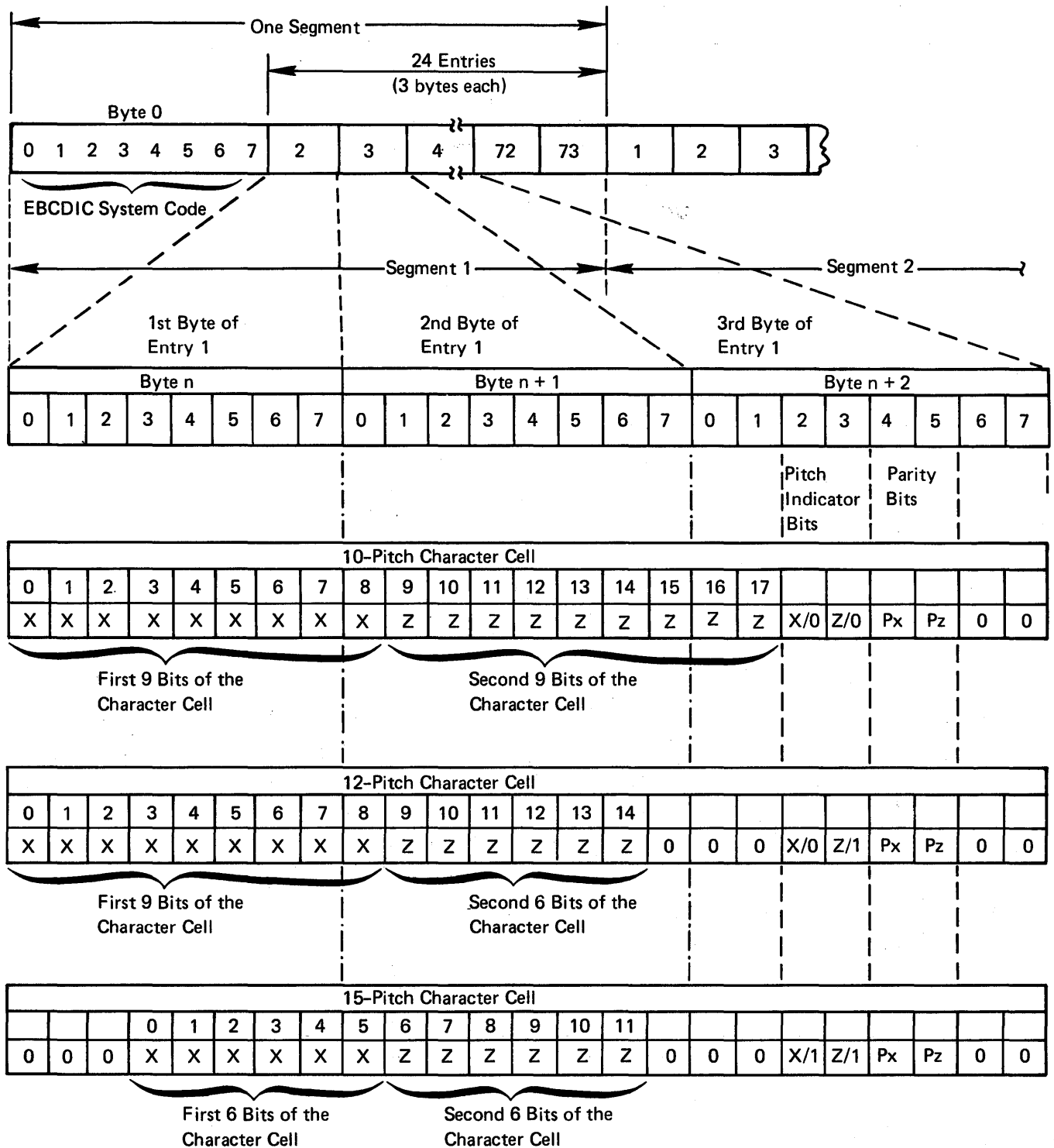
A user-designed replacement character must have a specific format to be compatible with the basic character arrangements. Each character (whether from the basic character set or user-designed) is allotted a 24 x 18-bit matrix (24 lines, 18 bits per line) called a character cell (see Figure 17). Each line entry consists of two 9-bit half-lines. Each half-line has an associated parity bit and pitch specification bit in addition to the nine character bits. The printing of a character requires all 24 line segments at 6 lpi. For 8 lpi printing, the top four (1 through 4) and the last two (23 and 24) line segments are not used, but must be specified. For 12 lpi printing, the top eight (1 through 8) and the last four (21 through 24) are not used, but must be specified.

When designing replacement characters, the user must consider the placement of the character with respect to maximum character cell size, pitch, and line spacing in relation to the other graphic characters. For additional information on designing unique replacement characters, refer to the IBM 3800 Printing Subsystem programmer's guide that applies to the system being used. The pitch specification bits of each line segment determine which character bits are to be used as follows:

Pitch Specification		Bits Used/Entry	
Type	Code	1st Half	2nd Half
10	00	9	9
12	01	9	6
15	11	6	6

The printer checks that the pitch specification bits remain constant throughout each segment and that the length of the data transferred is divisible by 73. If either is incorrect, the printer sets the load check and unit check indicator bits in the sense data and presents unit check ending status. If a translate code selected by the 8-bit character code specifies an 'FF' (unprintable character), the printer also indicates load check and unit check in the sense data.

The Load Translate Table command should precede the Load Graphic Modification command to ensure that the correct table is used. Multiple graphic modification commands can be issued, addressing either the same WCGM or a different one. A WCGM retains the replacement character set graphics until the next Load WCGM command is issued.



Notes:

1. Each segment is 73 bytes.
2. Each command can transfer up to 64 segments.
3. Total number of bytes must be divisible by 73.
4. Those bit positions designated by 0 must be off.
5. Px is odd parity for all "X" bits.
6. Pz is odd parity for all "Z" bits.

Figure 16. Graphic Character Modification Data Format

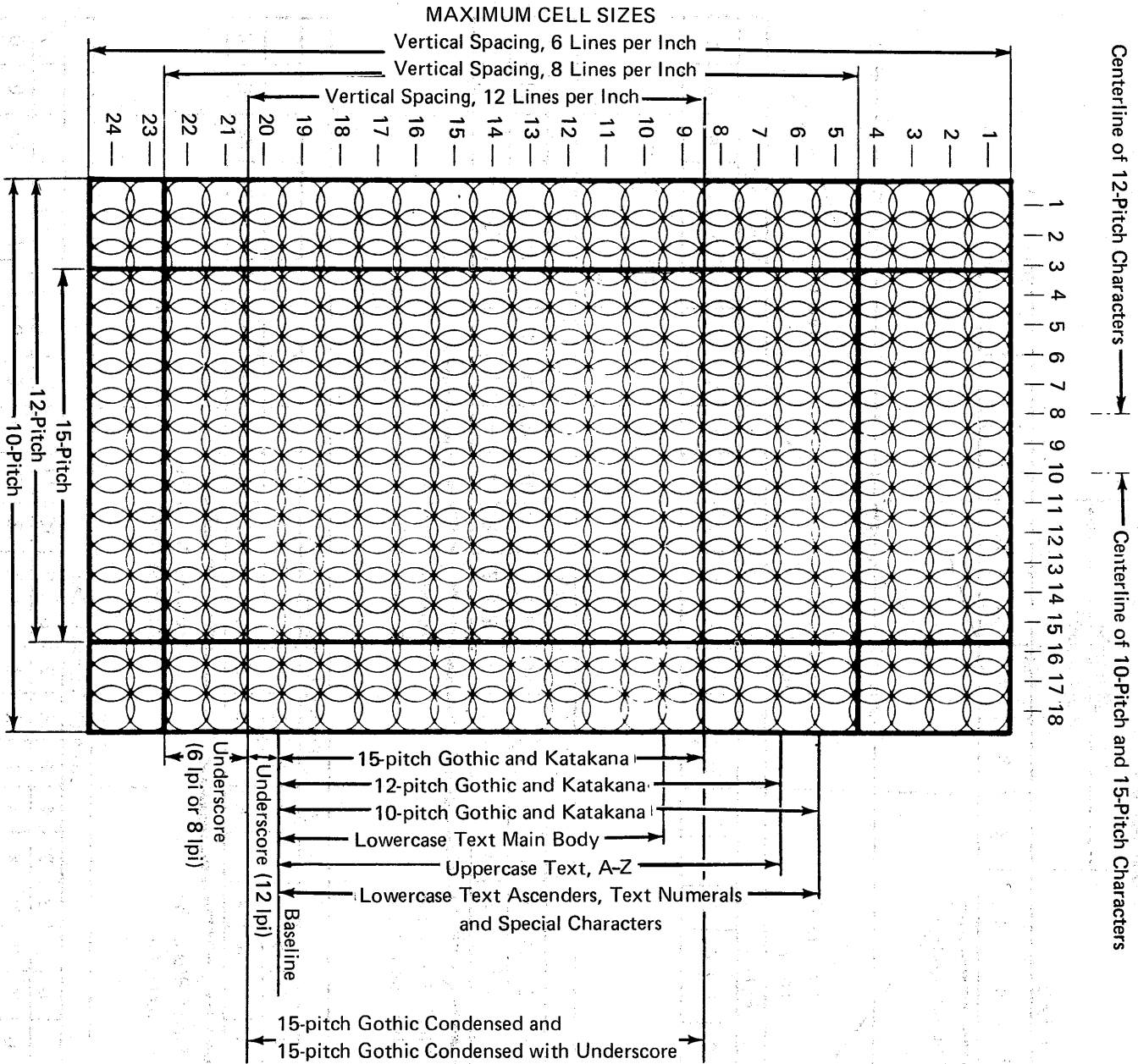


Figure 17. Maximum Cell Sizes

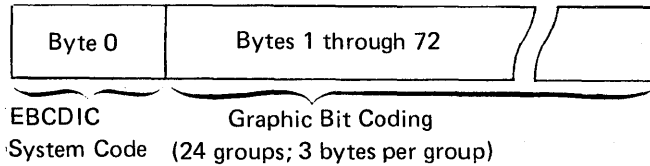
Load Graphic Character Modification

0	7	8	31	32	37	38	39	40	47	48	63
Command Code		Data Address				Flags		00		Count	
Binary 0010 0101 Hex 25		Specifies the main storage location where the graphic character modification bytes are stored.				SLI Flag (bit 34). See description below.				4,672 bytes maximum. Can specify from 1 to 64 segments, each with 73 bytes.	
CHAINING AND SPECIAL REQUIREMENTS:			<ol style="list-style-type: none"> Should be chained from a Load Translate Table CCW to ensure that the correct table is referenced. Should be preceded by a Clear Printer command to avoid possible system performance degradation. Refer to the Load Commands section for an explanation. 								

LOAD GRAPHIC CHARACTER MODIFICATION:

Transfers the bit patterns for substitution or extension of character arrangements in the WCGMs.

The data format consists of from 1 to 64 segments. Each segment has 73 bytes having the following format:



Note: See the *Graphic Character Modification discussion in this chapter for more details.*

INITIAL STATUS:

Normally zero.

UNIT CHECK/LOAD CHECK:

The following checks are made on the bytes transferred to the printer:

- Consistency in each entry for the graphic coding bits that designate character pitch.
- Proper parity of all bytes.
- Data length is an even multiple of 73.
- Byte 0 of each segment specifies a printable character.

If a load check occurs, sense bytes 22 and 23 contain the approximate offset from the beginning data record to the record in error.

CHANNEL END/DEVICE END:

Presented after successful transfer of the graphic character modification data.

CHANNEL END/DEVICE END/UNIT CHECK:

Presented if the data does not meet any one of the checks. Appropriate sense bits are also set.

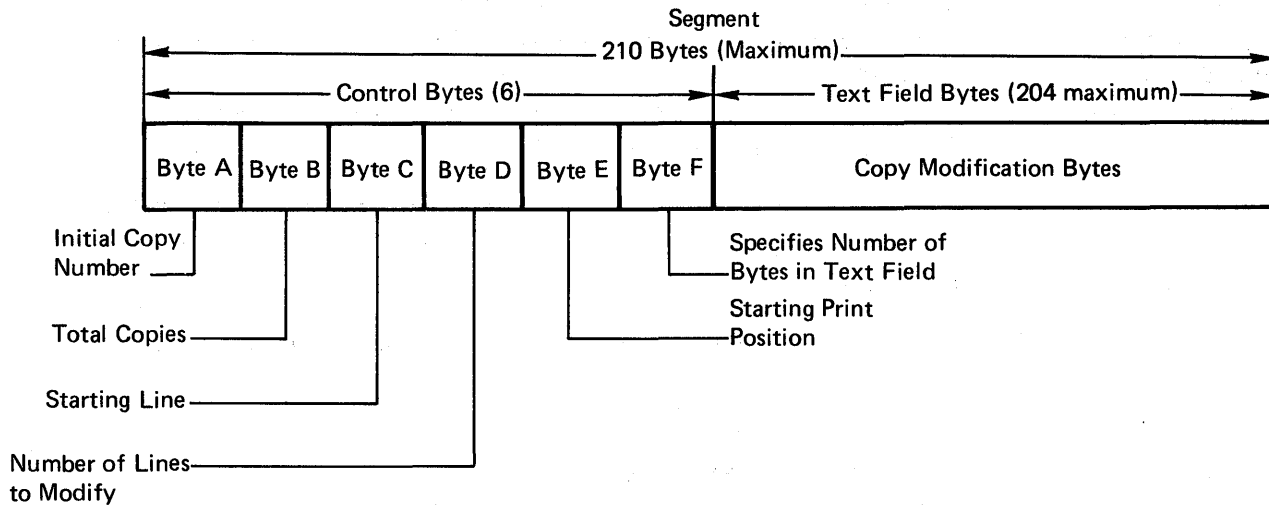
SLI BIT:

Must be on if the count is not 4,672 bytes.

Load Copy Modification

Copy modification information is sent from the system to the printer with the Load Copy Modification command. This channel command transfers control bytes and character text information which the printer loads into an appropriate buffer. The printer combines the text information defining the modified lines with the page information when the page is printed.

The copy modification function is active only after the control-text bytes have been loaded. The control-text bytes are stored in a special buffer allocated from the page buffer. The control-text bytes consist of a series of modification segments. See Figure 18 for an illustration of the typical format of a copy modification segment.



- Byte A — Contains the initial copy number.
- Byte B — Total number of copies for which this control segment applies.
- Byte C — Initial line number: the first line following the top ½ in (12.7 mm).
- Byte D — Total number of lines for which this control segment applies.
- Byte E — Initial print position or character number within the print line.
- Byte F — Total number of bytes in the text field (maximum of 204 bytes). The count reflects any reduction due to compression.
- Text — The characters to be inserted into the print line. Any string of the same characters can be compressed into three bytes. Compression should only be used when four or more adjacent, identical characters appear in the text. The following compression algorithm applies:
 - Byte 1 = 'FF'
 - Byte 2 = Number of compressed characters.
 - Byte 3 = Character being compressed (8-bit code).

All text characters are translated with the selected translate table as the segments are being loaded. The segments are stored in the page buffer. When a compressed field is encountered, only byte 3 is translated. (A code of 'FF' cannot be used for a printable character, since it is reserved for a compression indicator.)

Figure 18. Format of a Copy Modification Segment

Copy modification can place a legend or identification on selected copies of a page. Also, using a field of blanks or some other character, certain text or lines on a selected copy of a page can be deleted or inhibited from printing. Figure 19 illustrates a typical copy modification to a data set. The printer checks that the amount of data transferred is equal to the sum of all the segment lengths in the modification record. For each segment, the printer checks that the sum of the starting position plus the effective length of the text field is less than 206 bytes, but more than 1. The maximum number of copy modification bytes is 8,192. Any error detected in the control record causes load check and unit check bits to be set in the sense bytes by the control electronics. If a load check occurs, sense bytes 22 and 23 contain the approximate offset from the beginning of the data record to the segment in error.

COPY MODIFICATION RESTRICTIONS

- Byte A (copy number) of each segment must be equal to or greater than the previous byte A entry.
- Overlapped text fields are permitted. The last modification takes precedence over preceding modifications.
Note: An initial copy number (byte A) of zero stops the processing of control segments. The previous modification record can be nullified by loading a copy modification record with a copy number of zero.
- A line number of zero or line numbers extending below the last 1/2 inch (12.7 mm) at the bottom of the page do not affect control segment processing.
- 'FF' is reserved for the printer and cannot be used to code a text character.

When the page is printed, copy modification segments for the next print line are scanned by the control electronics during the time the printer is printing the previous line.

This scanning process must be completed prior to the start of the print line. Each modified line of every copy should be analyzed to verify that the modification time does not exceed the allowed times.

The programmer must restrict the number of copy modification segments so that the modification process does not cause a line overrun in the printer. A line overrun condition is detected if the copy modification is not completed in time. When line overrun occurs, the printer sets Unit Check, Intervention Required, and Line Overrun sense bits. The modification time must be less than the following:

- At 6 lpi: 3446 microseconds per line.
- At 8 lpi: 2136 microseconds per line.
- At 12 lpi: 1000 microseconds per line.

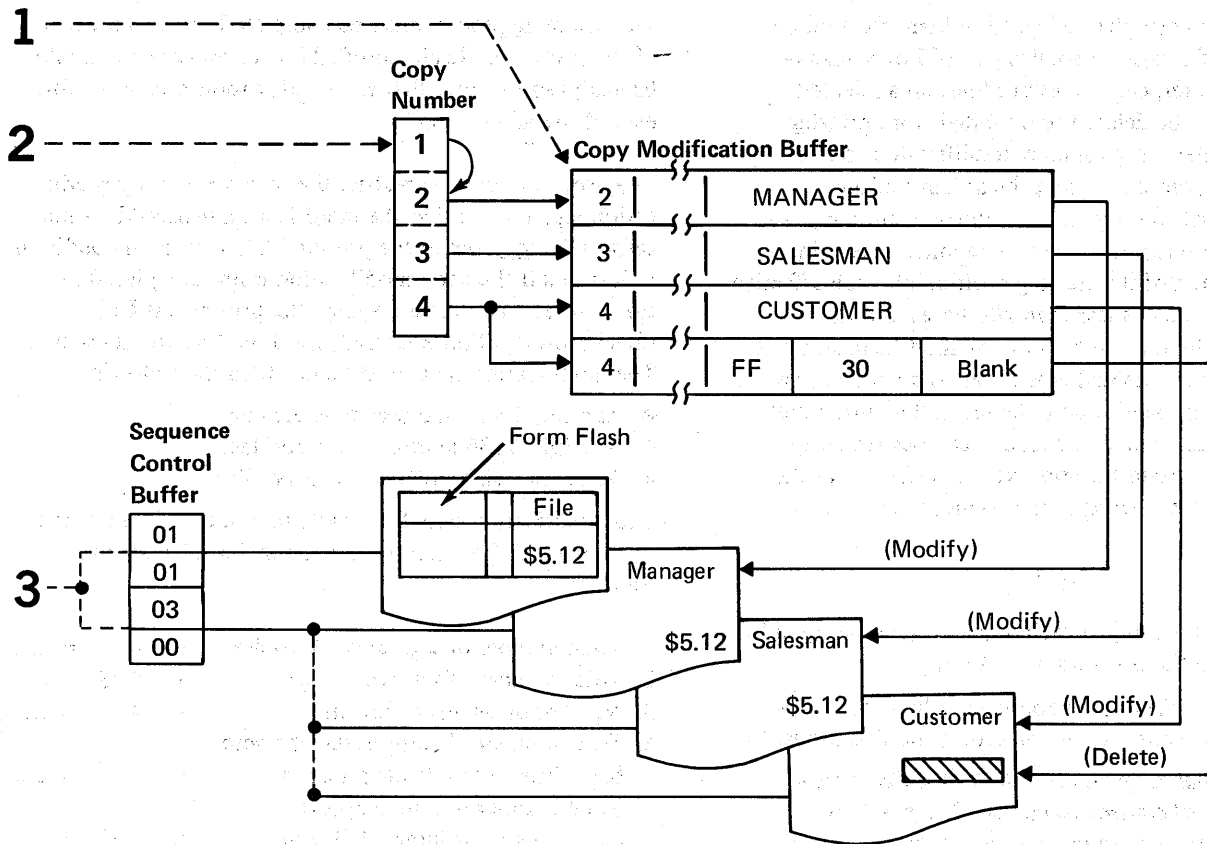
The modification time for a particular line "m" in a particular copy "n" (in microseconds), may be calculated as follows:

- | | | | | |
|--|---|------|---|-------|
| 1. Total number of segments, all copies | x | 9 | = | _____ |
| 2. Total number of segments, copy n | x | 5.75 | = | _____ |
| 3. Number of segments, line m | x | 4 | = | _____ |
| 4. Total number of compressed characters being inserted or deleted, line m | x | 3 | = | _____ |
| 5. Total number of noncompressed characters being inserted, line m | x | 3.25 | = | _____ |

Add the products of steps 1 through 5 for total copy modification time = _____

Note: Copy modification should not exceed allowable times.

The Load Copy Modification command should be preceded by a Select or Load Translate Table command. The Initialize Printer command disables the copy modification function and clears storage previously allocated in the page buffer for use.



4 Transmit a full page to the page buffer.

Note: In this example, copies 2 and 3 have an identification modification. Copy 4 has an identification modification and a money value deletion.

Figure 19. Sample Copy Modification

Load Copy Modification

0	7	8	31	32	37	38	39	40	47	48	63	
Command Code		Data Address					Flags		00		Count	
Binary 0011 0101 Hex 35		Specifies the main storage location where copy modification bytes are stored.					SLI Flag (bit 34). See description below.				7 bytes minimum; 8,192 bytes maximum.	

CHAINING AND SPECIAL REQUIREMENTS:

1. Should be preceded by a Select or Load Translate Table command.
2. Should be preceded by a Clear Printer command to avoid possible system performance degradation. Refer to the Load Commands section for an explanation.
3. Byte A of each entry must be equal to or greater than the previous byte A entry.
4. Overlapped text fields are permitted. The last modification takes precedence over preceding modifications.
5. Line numbers of zero or those extending below the bottom 1/2 inch (12.7 mm) of the page do not effect control entry processing.
6. A bit code of 'FF' is not allowed for characters.

LOAD COPY MODIFICATION: Transfers control bytes and character text bytes from the system to the printer. See Figure 18 for an illustration of the format of one copy modification segment.

INITIAL STATUS: Normally zero.

UNIT CHECK/LOAD CHECK: Any error in the control bytes causes a unit check and a load check. The following checks are also made on the bytes transferred to the printer:

1. The sum of the starting position plus the effective length of the text field is less than 206 bytes, but more than 1 byte.
2. The total number of bytes transferred equals the sum of all segment lengths.

If a load check occurs, sense bytes 22 and 23 contain the approximate offset from the beginning of the data record to the segment in error.

UNIT CHECK/DATA CHECK: Presented if any translate code of all bits ('FF') indicated an unprintable character. If detected following translation, the character is replaced with a blank ('40') from the currently selected translate table. If upon translating the hex '40' another 'FF' is detected, then a translated code of '00' is placed in the page buffer. A data check occurs unless suppressed by a blank data check.

CHANNEL END/DEVICE END: Presented after data transfer is complete.

UNIT CHECK/LINE OVERRUN: Presented along with intervention required if copy modification is not completed in time. See "Copy Modification Restrictions" in this chapter for details.

SLI BIT: Must be on if the count is not 8,192 bytes.

Note: *The Initialize Printer or Load WCGM commands disable the copy modification function and free the storage space previously allocated in the page buffer.*

Load Copy Number

The Load Copy Number command establishes the reference copy number for the first copy of a data set transmission. The copy number is specified in the data byte transferred to the printer by this command. There is no wait for the page buffer to empty nor a need to precede the load command with a Clear Printer command. Any partial page is completed by padding the remainder of the page with blank lines.

As each copy of a page is printed, the copy number increased by one for as many copies as specified by the Forms Overlay Sequence Control command. This provides for matching copies of a data set with the appropriate copy modification entry, which can include all copies of the data set. The Load Copy Number command can be used with each transmission of the data set to select control segments that apply to the particular copy.

Load Copy Number

0	7	8	31	32	37	38	39	40	47	48	63
Command Code		Data Address				Flags		00		Count	
Binary 0010 0011 Hex 23		Specifies the main storage location where the copy number is stored.				SLI Flag (bit 34). See description below.				One	
CHAINING AND SPECIAL REQUIREMENTS:		None									

LOAD COPY NUMBER: Transfers one byte of copy number information from the system to the printer. The copy number sets the reference copy number for the first copy of a data set transmission and is also used to match copies of the data set with appropriate copy modification segments.

INITIAL STATUS: Normally zero.

CHANNEL END/DEVICE END: Presented after the successful transfer of the data byte and the completion of any partial page.

SLI BIT: Must be on if the count is not one.

Note: *The Initialize Printer command or IMPL sets the copy number reference to 1.*

CONTROL COMMANDS

The control commands perform various control functions in the printer. They are immediate commands because channel end is presented as initial status. Device end is presented as ending status after the command (except for No Operation) has been executed. The valid control commands are:

Binary Code	Hex	Function
0000 0011	03	No Operation
0011 0111	37	Initialize Printer
1000 0111	87	Clear Printer
0111 0011	73	Block Data Check
0111 1011	7B	Allow Data Check
0100 0111	47	Select Translate Table 0
0101 0111	57	Select Translate Table 1
0110 0111	67	Select Translate Table 2
0111 0111	77	Select Translate Table 3
0000 0111	07	End of Transmission
0001 0111	17	Mark Form (End of Job)

In general, the control commands condition the printer for the various load, write, and forms control operations. Some of the commands are prerequisites to other commands and others are optional.

No Operation (No-Op)

The No Operation command has no function in the printer. When the printer receives this command, channel end and device end are presented together as initial status. If a constant string of No-Ops are received by the printer (without any intervening channel commands), channel end and device end may be divided between initial status and ending status. This prevents the printer from being overrun with No-Op commands.

Initialize Printer

The Initialize Printer command performs the following functions which effectively function as defaults for the printer:

- Any remaining partial page in the page buffer is printed. Subsequent operations (2 through 7) are not done until the page buffer is empty (does not contain a full page).

- The forms control buffer is set to the IMPL condition and matches the printer forms length adjustments. Line spacing is 6 lpi; the form is positioned to the first print line at the top of the following page.

Note: If the form position was at the top of the page and no printing occurred, the current page is not printed.

- All allocated buffers in the page buffer are cleared. The translate tables 1, 2, and 3, as well as the copy modification buffer, are made available and reassigned to the page buffer.
- Translate table 0 is set to the IMPL condition and is designated for translation use until a subsequent Select Translate Table command is given to the printer.
- WCGM 0 is loaded with the Gothic 10 character set. The other WCGMs are not changed.
- The sequence control is set to 1 copy with no forms overlay printing.
- The copy number reference is set to 1.

Device end is presented to the system as ending status. The Initialize Printer command should be chained to a following command (such as No-Op) for error recovery procedures. If an error occurs, unit check and device end are presented. The Initialize Printer command can then be reissued.

Clear Printer

The Clear Printer command prints any partial page remaining in the page buffer. The form position is set to the first print line of the following page. It should precede and be chained to the first load command in any sequence of load commands. The Clear Printer command disconnects the block multiplex channel while the page buffer is being unloaded. The printer presents channel end as initial status and device end after the page buffer is empty. For error recovery procedures, the Clear Printer command should be chained to a following command. If an error occurs, unit check and device end are presented. The Clear Printer command can then be reissued.

Block Data Check

The Block Data Check command sets the block data check latch in the printer. With this latch set, data checks resulting from unprintable characters or multiple characters are not presented to the system. All other data check error conditions are presented.

Allow Data Check

The Allow Data Check command resets the block data check latch. With this latch reset, error conditions resulting in data checks and unit checks are presented to the system by appropriate sense information.

Select Translate Tables 0, 1, 2, and 3

There are four Select Translate Table commands associated with the four translate tables (0, 1, 2, and 3). Using the proper command, a desired translate table can be selected for loading or for the translation of data lines (assuming the table was previously loaded). These commands should precede the Load Translate Table command when the specific table is being loaded. When selecting the table to be used in the translation, the commands should precede the write commands.

End of Transmission

The End of Transmission command is used with the burster-trimmer-stacker feature (BTS) for copy separation, and to assist post-processing handling. When this command is received prior to completion of the current page, the next page placed in the page buffer and all following pages are "flagged" for separation marking. The perforation edge marking printed in the left-hand carrier strip is changed to either one or two vertical bars. These printed bars aid in copy separation for forms stacked in the CFS. For machines using the BTS, copy separation is accomplished by stacking the sheets offset from the previous pages. The printed marks are not visible since they are trimmed off.

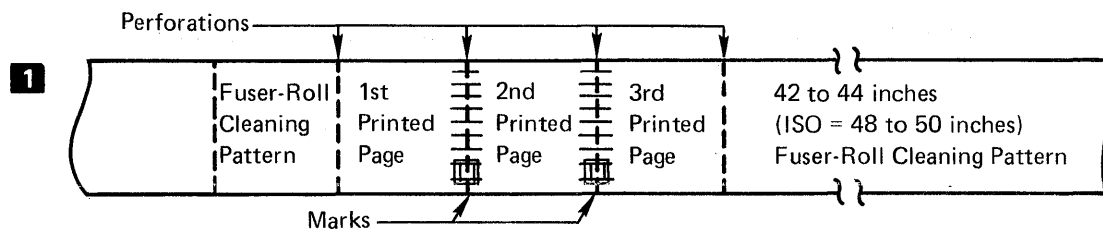
The copy separation marks will be omitted if the paper line is stopped. This condition occurs when the paper stops for the drum PC gap, lack of sufficient data to continue printing, or any condition (maybe momentary) which causes the printer to stop.

Mark Form (End of Job)

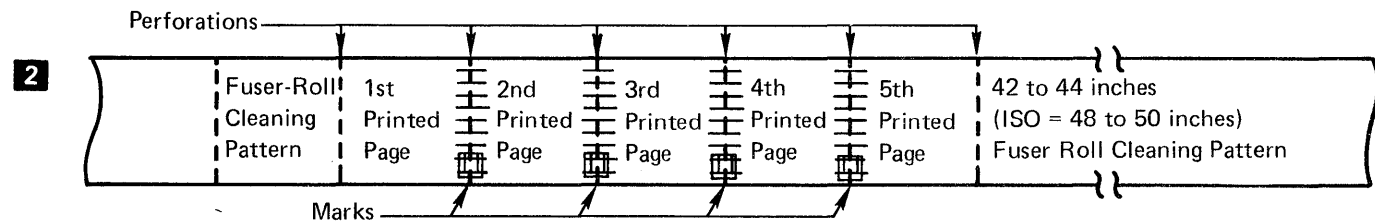
The Mark Form command prints a mark on the perforations which the operator can easily see during postprocessing paper handling. The mark is readily seen on the stack of continuous forms in the CFS or on the burst sheets stacked on the BTS stacker bed.

When the command is received by the printer, the current page in the page buffer is flagged. When the page is ready to be printed, one of the following happens:

- 1 For 7-, 8-1/2-, or 11-inch forms (6-, 8-, 10-, or 12-inch forms for ISO), four pages are processed. The first page contains the fuser-roll cleaning pattern followed by three copies of the page from the page buffer. A mark is printed on the perforations of the three printed pages as follows:



- 2 For 3-1/2- or 5-1/2-inch forms (3- or 4-inch forms for ISO), six pages are processed. The first page contains the fuser-roll cleaning pattern followed by five copies of the page from the page buffer. A mark is printed on the perforations of the five printed pages as follows:



After printing, 42 to 44 inches (48 to 50 inches for ISO) of paper containing the fuser roll cleaning pattern are run. This ensures that once the job identification marks are printed on the perforations, they are not stopped in the transfer station or under the fuser roll. If an error occurs, the sequence is stopped at the first opportunity so that none of the marks are under the fuser roll. When the error has been corrected, the mark form sequence is regenerated. A permanent error stops the sequence immediately and ends the operation.

When the End of Transmission and Mark Form commands are given for the same page, and the BTS is in use, the stacker offsets the pages after the mark form sequence.

No-Op

0 Command Code	7 8 Data Address	31 32 37 Flags	38 39 40 00	47 48 Count	63
Binary 0000 0011 Hex 03	Not applicable.	SLI Flag (bit 34). See de- scription below.		Must be nonzero. A zero count causes a program check (bit 42) to be set in the CSW.	
CHAINING AND SPECIAL REQUIREMENTS:		None			

NO-OP: An immediate command. Causes no action at the addressed device.

CHANNEL END: Presented as initial status.

DEVICE END: Presented as initial status or ending status.

Note: *If a constant string of No-Ops are received by the printer (without intervening channel commands), channel end and device end may be divided between initial status and ending status.*

NO-OP CCW: Count field must not be zero.

SLI FLAG: May be on.

Initialize Printer

0 Command Code	7 8	31	32 37	38 39	40	47	48	63
Data Address		Flags		00			Count	
Binary 0011 0111	Not applicable.		SLI Flag (bit 34). See de- scription below.				Must be nonzero. A zero count causes a program check (bit 42) to be set in the CSW.	
Hex 37								
CHAINING AND SPECIAL REQUIREMENTS:		Should be chained to a following command (such as No-Op) for error recovery procedures.						

INITIALIZE PRINTER:

Performs the following:

1. Prints the remaining partial page in the page buffer. The following operations (2 through 7) are not done until the page buffer is empty.
2. Sets the forms control buffer to the IMPL condition. Line spacing is set to 6 lpi, a channel-1 code is placed at the first print line, and the form is positioned to the first print line at the top of the following page.
3. Clears all allocated buffers in the page buffer. The translate tables 1, 2, and 3 and the copy modification buffers are made available and reassigned to the page buffer.
4. Sets translate table 0 to the IMPL condition and designates it for translation.
5. Loads Gothic 10 character set into WCGM 0. The other WCGMs are left unchanged.
6. Sets the sequence control to 1 copy with no forms overlay flash.
7. Sets the copy number reference to 1.

INITIAL STATUS:

Channel end is presented.

CHANNEL END:

Presented as initial status.

DEVICE END:

Presented as ending status after the command is executed.

SLI BIT:

May be on.

Clear Printer

0 Command Code 7 8	Data Address 31	Flags 32 37 00	38 39 40 47 48	Count 63
Binary 1000 0111 Hex 87	Not checked for validity, but should not exceed addressing capacity.	SLI Flag (bit 34). See description below.		Must be nonzero. A zero count causes a program check (bit 42) to be set in the CSW.

CHAINING AND SPECIAL REQUIREMENTS:

For error recovery procedures, this command should be chained to the first load command in any load command sequence. If an error occurs, Clear Printer can be reissued.

CLEAR PRINTER:

Prints all full pages and any partial page remaining in the page buffer. The form is positioned to the first print line at the top of the following page.

INITIAL STATUS:

Channel end is presented.

CHANNEL END:

Presented as initial status.

DEVICE END:

Presented after the page buffer is empty.

Presented with unit check if an error occurs. The Clear Printer command can then be reissued.

SLI BIT:

May be on.

Block Data Check

0	7	8	31	32	37	38	39	40	47	48	63	
Command Code		Data Address			Flags		00		Count			
Binary 0111 0011 Hex 73		Not applicable.			SLI Flag (bit 34). See de- scription below.							Must be nonzero. A zero count causes a program check (bit 42) to be set in the CSW.
CHAINING AND SPECIAL REQUIREMENTS:		None										

BLOCK DATA CHECK: Sets the block data check latch in the printer which prevents the printer from presenting those data checks resulting from unprintable or multiple characters. All other data checks are still presented to the system as they occur.

INITIAL STATUS: Channel end is presented.

CHANNEL END: Presented as initial status.

DEVICE END: Presented as ending status after the command is executed.

SLI BIT: May be on.

Allow Data Check

0	7	8	31	32	37	38	39	40	47	48	63	
Command Code		Data Address			Flags		00		Count			
Binary 0111 1011 Hex 7B		Not applicable.			SLI Flag (bit 34). See de- scription below.							Must be nonzero. A zero count causes a program check (bit 42) to be set in the CSW.
CHAINING AND SPECIAL REQUIREMENTS:		None										

ALLOW DATA CHECK: Resets the block data check condition in the printer allowing the printer to present all data checks to the system as they occur.

INITIAL STATUS: Channel end is presented.

CHANNEL END: Presented as initial status.

DEVICE END: Presented as ending status after the command is executed.

SLI BIT: May be on.

Select Translate Table 0

0	7	8	31	32	37	38	39	40	47	48	63
Command Code	Data Address						Flags	00			Count
Binary 0100 0111	Not checked for validity, but should not exceed addressing capacity.						SLI Flag (bit 34). See description below.				Must be nonzero. A zero count causes a program check (bit 42) to be set in the CSW.
Hex 47											
CHAINING AND SPECIAL REQUIREMENTS:			Should precede a Load Translate, Load Graphic Character Modification, or Write command.								

SELECT TRANSLATE TABLE 0: Designates translate table 0 for translation of the subsequent print line or designates translate table 0 for loading.

INITIAL STATUS: Channel end is presented.

CHANNEL END: Presented as initial status.

DEVICE END: Presented after the command is executed.

SLI BIT: May be on.

Select Translate Table 1

0	7	8	31	32	37	38	39	40	47	48	63
Command Code	Data Address						Flags	00			Count
Binary 0101 0111	Not applicable.						SLI Flag (bit 34). See description below.				Must be nonzero. A zero count causes a program check (bit 42) to be set in the CSW.
Hex 57											
CHAINING AND SPECIAL REQUIREMENTS:			Must precede a Load Translate, Load Graphic Character Modification, or Write command unless table 1 was the last one used.								

SELECT TRANSLATE TABLE 1: Designates translate table 1 for translation of the subsequent print line or designates translate table 1 for loading.

INITIAL STATUS: Channel end is presented.

CHANNEL END: Presented as initial status.

DEVICE END: Presented after the command is executed.

SLI BIT: May be on.

Select Translate Table 2

0	7	8	31	32	37	38	39	40	47	48	63
Command Code		Data Address			Flags		00				Count
Binary 0110 0111		Not applicable.			SLI Flag (bit 34). See de- scription below.						Must be nonzero. A zero count causes a program check (bit 42) to be set in the CSW.
Hex 67											
CHAINING AND SPECIAL REQUIREMENTS:			Must precede a Load Translate, Load Graphic Character Modification, or Write command unless table 2 was the last one used.								

SELECT TRANSLATE TABLE 2: Designates translate table 2 for translation of the subsequent print line or designates translate table 2 for loading.

INITIAL STATUS: Channel end is presented.

CHANNEL END: Presented as initial status.

DEVICE END: Presented after the command is executed.

SLI BIT: May be on.

Select Translate Table 3

0	7	8	31	32	37	38	39	40	47	48	63
Command Code		Data Address			Flags		00				Count
Binary 0111 0111		Not applicable.			SLI Flag (bit 34). See de- scription below.						Must be nonzero. A zero count causes a program check (bit 42) to be set in the CSW.
Hex 77											
CHAINING AND SPECIAL REQUIREMENTS:			Must precede a Load Translate, Load Graphic Character Modification, or Write command unless table 3 was the last one used.								

SELECT TRANSLATE TABLE 3: Designates translate table 3 for translation of the subsequent print line or designates translate table 3 for loading.

INITIAL STATUS: Channel end is presented.

CHANNEL END: Presented as initial status.

DEVICE END: Presented after the command is executed.

SLI BIT: May be on.

End of Transmission

0	7	8	31	32	37	38	39	40	47	48	63
Command Code		Data Address			Flags		00		Count		
Binary 0000 0111		Not applicable.			SLI Flag (bit 34). See de- scription below.				Must be nonzero. A zero count causes a program check (bit 42) to be set to one in the CSW.		
Hex 07											

CHAINING AND SPECIAL REQUIREMENTS: The order in which the stacker offset and the mark form operations are performed is determined by the order in which the End of Transmission (hex 07) and the Mark Form (hex 17) commands are sent and whether there is data associated with the page being processed. These conditions are summarized in the programming note at the end of this command description. When the End of Transmission command is received by a machine without the BTS feature installed, or not in use, the 3800 changes the left-hand carrier strip, perforation-edge markings to either one or two vertical bars.

- END OF TRANSMISSION:** Initiates stacker offset and changes copy separation lines for the next page in the page buffer and all subsequent pages of the same copy.
- INITIAL STATUS:** Channel end is presented.
- CHANNEL END:** Presented as initial status.
- DEVICE END:** Presented after the command is executed.
- SLI BIT:** May be on.

Programming Note:

When this command is received, the left-hand carrier-strip, perforation-edge marking is changed to either one or two vertical bars. This permits copy separation for machines using the CFS. For machines using the BTS feature, these copy separation marks are trimmed off; the BTS offset is used to serve a similar purpose.

The following table summarizes the printer operation that results from sending the End of Transmission command (hex 07) before or after the Mark Form command (hex 17) when data is or is not associated with the page being processed.

Command Sequence (in hex)	Data or No Data Associated with Page	Resulting Operation
07 before 17	data	Mark forms, then stacker offset
07 before 17	no data	Stacker offset, then mark forms
17 before 07	data	Mark forms, then stacker offset
17 before 07	no data	Mark forms, then stacker offset

Mark Form (End of Job)

0	7	8	31	32	37	38	39	40	47	48	63
Command Code		Data Address				Flags		00		Count	
Binary 0001 0111 Hex 17		Not applicable.				SLI Flag (bit 34). See de- scription below.				Must be nonzero. A zero count causes a program check (bit 42) to be set to one in the CSW.	
CHAINING AND SPECIAL REQUIREMENTS:			The order in which the stacker offset and the mark form operations are performed is determined by the order in which the End of Transmission (hex 07) and the Mark Form (hex 17) commands are sent and whether there is data associated with the page being processed. These conditions are summarized in the programming note at the end of this command description.								

MARK FORM (END OF JOB): Prints one blank page, then three or five additional pages of the page in process. Also, distinguishing marks are printed on the perforations. This is followed by 42 to 44 inches (48 to 50 inches for ISO) of blank pages (depending on the form length being used).

INITIAL STATUS: Channel end is presented after the command is accepted.

ERROR

- If an error is sensed before the marked form reaches the fuser roll, the machine will stop or retry the operation, depending on the error condition.
- If an error code other than hex nE or hex nF is sensed after the marked form reaches the fuser roll, error checking is suspended until the marked form is past the fuser roll.

CHANNEL END: Presented as initial status.

DEVICE END: Presented after the command is executed.

SLI BIT: May be on.

Programming Note:

The following table summarizes the printer operation that results from sending the End of Transmission command (hex 07) before or after the Mark Form command (hex 17) when data is or is not associated with the page being processed.

Command Sequence (in hex)	Data or No Data Associated with Page	Resulting Operation
07 before 17	data	Mark forms, then stacker offset
07 before 17	no data	Stacker offset, then mark forms
17 before 07	data	Mark forms, then stacker offset
17 before 07	no data	Mark forms, then stacker offset

EXECUTE ORDER

The Execute Order command provides four orders for the printer. The command code is hex 33 and there are up to 256 data bytes associated with the command. The data bytes modify the order command by designating one of the following special orders:

- Perform No Operation
- Display Status Code
- Purge Page Buffer
- Request Printer Information

This command is valid only for the online printing subsystem. The printer need not be in ready status for this command to be executed.

Perform No Operation

When byte 0 contains a value other than hex F1, F2, or F3, the Execute Order command does not perform any operation.

Display Status Code

The Display Status Code order allows the user to transmit and display a byte of information at the operator panel display. This parameter byte provides information or instructions for the operator. It is the third byte (byte 2) in the data field and can have any of the hex values between C0 and FE (see the following description for byte 2).

Programming Recommendation: The Display Status Code order drops the printer from the ready status. Therefore, a Clear Printer command should precede the Execute Order command to ensure that all pages in the page buffer get printed. Care should be taken when using this order to avoid losing a significant code that may be displayed at the operator panel.

The significant bytes of this order are:

Byte 0: This byte contains a hex F1 which defines the Display Status Code order.

Byte 1: This byte must contain a hex value of 00.

Byte 2: This byte is the parameter byte and can have any value between hex C0 and FE. Any other values are treated as No Operation orders. To be consistent with previously established procedures, the display codes must be designated as follows:

Status Code	Condition
F1	Thread forms into the CFS
F2	Thread forms into the BTS
F3	Change forms overlay
F8	Check console message

Bytes 3 through 255: These bytes have no significance and are ignored.

Purge Page Buffer

The Purge Page Buffer order eliminates all the pages stored in the printer page buffer and the pages on the drum scheduled for printing. Partial pages in the page buffer are also eliminated. Pages that have been created, or are being created by the laser, are transferred to the paper. The forms control is set to the first print line at the top of a new page.

Note: If a previous Load Forms Overlay Sequence control command specifies copy group printing, the number of printed copies cannot be determined.

The channel page identifier counter is reset to the value of the transfer page identifier counter after the last page on the drum is transferred. The Request Printer Information order can be sent to determine the transfer station page count.

The significant bytes of this order are:

Byte 0: This byte contains hex F2 which identifies the Purge Page Buffer order.

Byte 1: This byte must contain a hex value of 00.

Bytes 2 through 255: These bytes have no significance and are ignored.

Request Printer Information

The Request Printer Information order directs the printer to generate the necessary printer information bytes in the intermediate buffer. These bytes can then be sensed with a Sense Intermediate Buffer command. The significant bytes of this order are:

Byte 0: This byte contains hex F3 which identifies the Request Printer Information order.

Byte 1: This byte must contain a hex value of 00.

Bytes 2 through 255: These bytes have no significance and are ignored.

PRINTER INFORMATION BYTES

The printer information bytes contain accounting and configuration information used for recovery and status actions.

Bytes 1 and 2: These bytes contain a binary number which defines the channel page identifier. This number is associated with the last complete page placed in the page buffer.

Bytes 2 and 3: These bytes contain a binary number which defines the forms control buffer line position. This number is the physical line number of the print position within the page processed.

Note: The first (starting) print line is one-half inch from the perforation and is numbered hex 0001.

Bytes 4 and 5: These bytes contain a binary number which defines the stacker page identifier. This number is associated with the last page put in the CFS or BTS.

Bytes 6 and 7: These bytes contain a binary number which defines the fuser page identifier. This number is associated with the last page processed through the fuser.

Bytes 8 and 9: These bytes contain a binary number which defines the transfer page identifier. This number is associated with the last page processed through the transfer station.

Byte 10: This byte contains a hexadecimal value which defines the forms width of the paper. The hex codes have the following definitions:

Hex Code	Common Use	ISO
01	6-1/2 inch	165 mm
02	Reserved	180 mm
03	Reserved	Reserved
04	8-1/2 inch	215 mm
05	Reserved	Reserved
06	9-1/2 inch	235 mm
07	9-7/8 inch	250 mm
08	10-5/8 inch	270 mm
09	11 inch	280 mm
0A	12 inch	305 mm
0B	Reserved	322 mm
0C	Reserved	Reserved
0D	13-5/8 inch	340 mm
0E	14-3/10 inch	363 mm
0F	14-7/8 inch	378 mm

Byte 11: This byte contains a hexadecimal value which defines the forms length of the paper in 1/2-inch increments. The hex codes have the following definitions:

Hex Code	Common Use	ISO
06	Reserved	3 inch
07	3-1/2 inch	Reserved
08	Reserved	4 inch
0B	5-1/2 inch	Reserved
0C	Reserved	6 inch
0E	7	Reserved
10	Reserved	8 inch
11	8-1/2 inch	Reserved
14	Reserved	10 inch
16	11 inch	Reserved
18	Reserved	12 inch

Bytes 12 through 15: Each byte contains a value which defines a WCGM identification (see Figure 13).

Byte	WCGM Identification
12	WCGM 0
13	WCGM 1
14	WCGM 2
15	WCGM 3

} Refer to character set IDs,
 } Figure 13, for complete details.

Note: *WCGM Identifications are normally even-numbered hex codes. If the contents of a WCGM have been altered (Load Graphic Character Modification), bit 7 of the hex code is turned on to make the identification odd.*

Byte 16: The bits in this byte identify the following conditions:

Bit	Condition
0	Inhibit Mark Copy
1	Forced Error Logging
2	Inhibit Operator Alert
3	Tape-to-Printing Subsystem
4	Additional CGS
5	Burster-Trimmed-Stacker
6	ISO
7	Two-Channel Switch

Byte 17: This byte is reserved.

Execute Order

0 Command Code	7 8 Data Address	31 32 37 Flags	38 39 40 00	47 48 Count	63
Binary 0011 0011 Hex 33	Main storage address where a Perform No Operation, Display Status Code, Purge Page Buffer, or Request Printer Information order is stored.	SLI Flag (bit 34). See description below.			Maximum of 256 bytes.

CHAINING AND SPECIAL REQUIREMENTS:

A Clear Printer command should precede the Display Status Code order if all pages in the page buffer are to be printed before the printer becomes not-ready.

EXECUTE ORDER: Provides one of four orders to be transmitted to the printer.

Perform No Operation

Byte 0	Byte 1	Bytes 2-255	
*XX	00	Ignored	

*XX = Any code other than hex F1, F2, or F3

Display Status Code

Byte 0	Byte 1	Byte 2	Bytes 3-255
F1	00	Parameter Byte	Ignored

Purge Page Buffer

Byte 0	Byte 1	Bytes 2-255	
F2	00	Ignored	

Request Printer Information

Byte 0	Byte 1	Bytes 2-255	
F3	00	Ignored	

INITIAL STATUS: Normally zero.

CHANNEL END/DEVICE END: Presented as ending status after the end of data transfer.

SLI BIT: Must be on, if count is not 256 bytes.

Note: If the first byte (byte 0) of any order specifies a code other than hex F1, F2, or F3, the printer treats it as a No Operation.

STATUS COMMANDS

The status commands – Sense I/O, Test I/O, Sense Error Log, and Sense Intermediate Buffer – can be used to determine the printer status and identify the specific nature of errors or unusual conditions that have occurred. Sense I/O Type is used to sense the printer type and model number.

Sense I/O

The Sense I/O command should be used to transfer the 24 sense bytes from the printer to the channel. Sense byte information is generated and stored in the printer when a unit check status condition occurs.

Sense bytes 0 through 2 are reset when an initial status byte of zero is given to a command other than Test I/O, Sense I/O, or No Operation. A reset signal also resets sense bytes 0 through 2 and 4 through 15.

If the unit check that set the sense bytes caused the printer to become not-ready, then the printer must be made ready by operator or CE intervention before the unit check can be cleared.

Sense I/O Type

The Sense I/O Type command is used to determine the device type and model. Four bytes are transferred from the printer to the channel containing the following information:

Byte 0	=	'FF'	
Byte 1	=	'38'	} —————> Printer Type
Byte 2	=	'00'	
Byte 3	=	'01'	—————> Printer Model

Test I/O

Note: *The Test I/O command is not the result of the channel executing a CCW and the command code (0000 0000) is not written by the programmer. A command code of all 0s is invalid and causes a program check.*

The Test I/O command is generated automatically by the channel when the channel requires status information. The Test I/O command also results from a central processor Test I/O instruction. In either case, it appears to the printer as a command byte of all 0s and is treated as an immediate command. Test I/O requests the printer to send all outstanding status information to the channel and normally presents an all-zero status byte. Stacked or pending status (if any) is presented as initial status.

Sense Error Log

The printer contains an internal error log consisting of 16 eight-byte error records followed by some statistical counters and the machine serial number. Figure 20 shows the error log format. The error log contains internal environmental records. An environmental record, caused by a printer recoverable error, consists of an error identification, the retry count, and detailed status information.

When the log is completely full, the printer sets unit check status along with equipment check and the error log full bits in the sense bytes. The system must issue a Sense Error Log CCW to transfer the log from the printer to main storage. After all 136 bytes have been successfully transferred to the system, the entire log is reset to zeros. The internal error log should be unloaded with a printer-vary-offline procedure or an end-of-day procedure.

Sense Intermediate Buffer

This command transfers up to 256 bytes from the printer intermediate buffer to the channel where it may be analyzed.

Following an Execute Order command specifying Request Printer Information, the printer information bytes are transferred to the channel with the Sense Intermediate Buffer command.

		Log Entry Byte Number							
		0	1	2	3	4	5	6	7
Hex ID		Error-Dependent Data Sense Bytes							
Sense Byte 4		Sense Byte 5	Sense Byte 6	Sense Byte 7	Sense Byte 8	Sense Byte 9	Sense Byte 10	Sense Byte 11	
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
Count	BTS Sheets (x 100)	CFS Folds (x 100)		Paper Processed (x 100)		Serial Number			

Figure 20. Internal Error Log Format

Sense I/O

0 Command Code 7	8 Data Address 31	32 Flags 37	38 00 39	40 47	48 Count 63
Binary 0000 0100 Hex 04	Specifies the storage location where the bytes are to be transferred.	Used at discretion of programmer.			1 byte minimum; 24 bytes maximum.
CHAINING AND SPECIAL REQUIREMENTS:		None			

SENSE I/O: Transfers 24 bytes of sense information from the printer to the channel.

INITIAL STATUS: Normally zero.

DESCRIBES: Current status of the device that performed the operation and system error recovery information.

SLI BIT: Must be on if the count is not 24.

CHANNEL END/DEVICE END: Presented after the sense bytes are transferred.

Note: Refer to *Sense Bytes in the Error Detection, Recovery, and Recording* chapter for a description of the sense information pertaining to printer operations.

Sense I/O Type

0 Command Code	7 8 Data Address	31 Flags	32 37 00	38 39 40 47 48	63 Count
Binary 1110 0100 Hex E4	Specifies the storage location where the bytes are to be transferred.	Used at discretion of programmer.			1 byte minimum; 4 bytes maximum.
CHAINING AND SPECIAL REQUIREMENTS:		None			

SENSE I/O TYPE: Transfers four bytes of device-type information from the printer to the channel. This command is used to sense the type and model number of the printer. The command can be issued even if the printer is not ready.

INITIAL STATUS: Normally zero.

DESCRIBES: **Printer Type and Model**

Byte 0 = 'FF'
 Byte 1 = '38'
 Byte 2 = '00'
 Byte 3 = '01'

} → Printer Type = 3800
 Model = 01

CHANNEL END/DEVICE END: Presented after the sense bytes are transferred.

SLI BIT: Must be on if the count is not four.

Sense Error Log

0 Command Code	7 8 Data Address	31 32 37 Flags	38 39 00	40 47 Count	48 63
Binary 0010 0100 Hex 24	Specifies the main storage location where the error log bytes are to be transferred.	SLI Flag (bit 34). See description below.			1 byte minimum; 136 bytes maximum.
CHAINING AND SPECIAL REQUIREMENTS:		None			

SENSE ERROR LOG: Transfers 136 error log bytes from the printer to the channel.

INITIAL STATUS: Normally zero.

CHANNEL END/DEVICE END: Presented after the error log bytes are transferred. Once the complete log is read, the area is reset (to zeros) so that subsequent entries can be recorded.

SLI BIT: Must be on if the count is not 136.

Note: *The internal error log is reset after 136 bytes are transferred.*

Sense Intermediate Buffer

Caution: This command is intended for maintenance purposes only. Any use other than that provided by IBM diagnostic programs may yield unpredictable results.

0 Command Code 7	8 Data Address 31	32 Flags 37	38 00 39	40 47	48 Count 63
Binary 0001 0100 Hex 14	Specifies the main storage location where the bytes are to be transferred.	SLI Flag (bit 34). See description below.			1 byte minimum; 256 bytes maximum.
CHAINING AND SPECIAL REQUIREMENTS:		None			

SENSE INTERMEDIATE BUFFER: Transfers up to 256 bytes of information from the 3800 intermediate buffer to the channel. Normally used for diagnostic analysis.

INITIAL STATUS: Normally zero.

CHANNEL END/DEVICE END: Presented after the data transfer is completed.

SLI BIT: Must be on if the count is not 256.

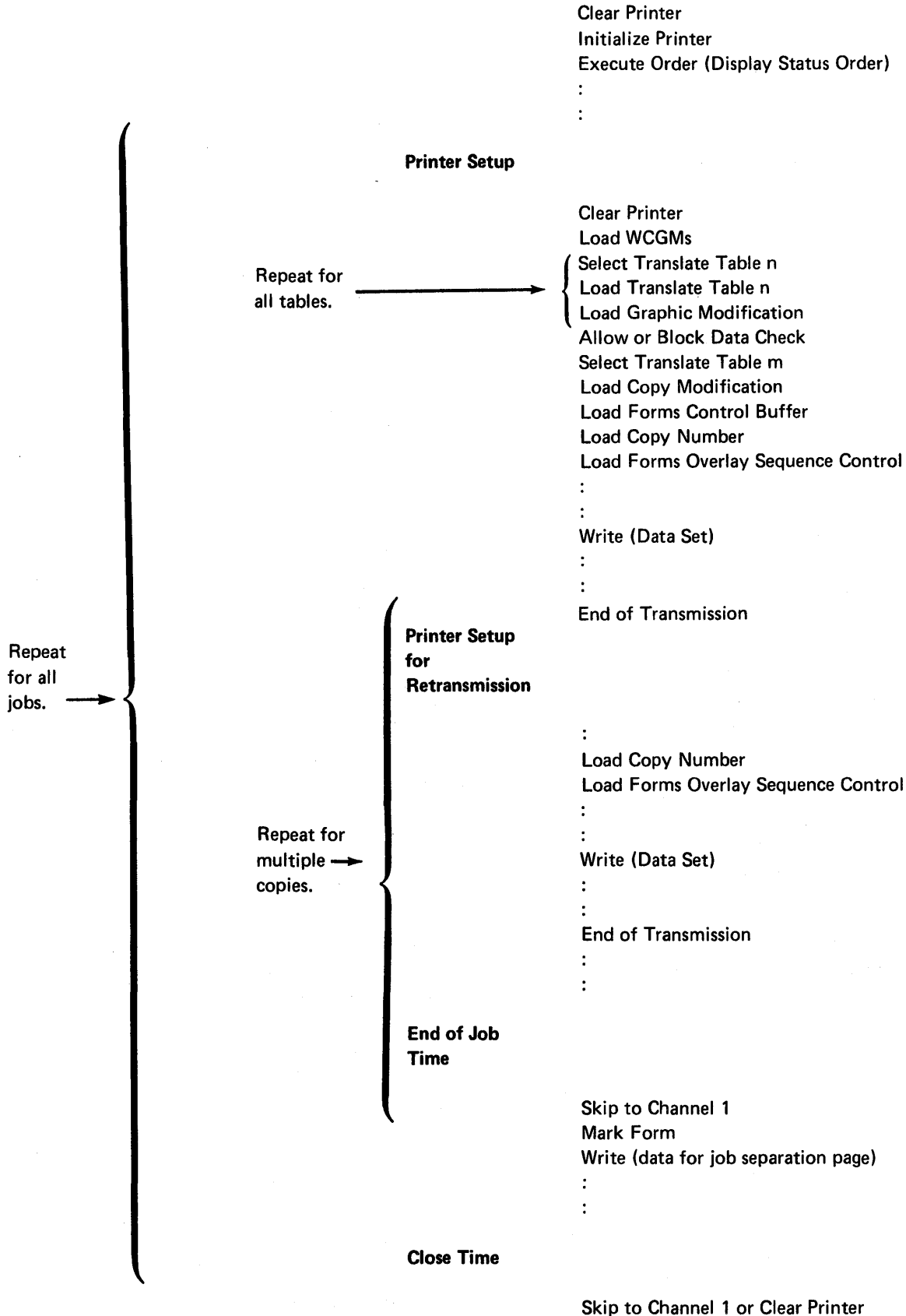


Figure 21. Recommended 3800 Command Sequences for Optimum Operation.
 The central processor program, which initiates the 3800 command sequences, is not shown.

Error Detection, Recovery, and Recording

CHANNEL-DETECTED ERRORS

On some systems, channel-detected errors may be indicated by a machine check interruption in which case a channel status word (CSW) is not stored. For some systems, channel errors can cause the channel to suppress command chaining, set the appropriate bit in the CSW, and request an I/O interrupt immediately or the next time the printer presents status.

Equipment malfunctions detected by the channel may cause the channel to generate an I/O system reset, an I/O selective reset, or an interface disconnect sequence. The error recovery procedure (ERP) depends on the type of operation being executed at the time, the type of error detected, when it is detected, and the subsequent channel response.

If a system reset occurs, the printer stops all current operations and attempts to reinitialize, which results in new status and sense byte data. An error that causes system reset should always be considered permanent.

If selective reset occurs, the printer may continue or stop the current operation. New status and sense byte information may result. An error that causes selective reset may be recoverable.

If an interface disconnect sequence occurs, the printer stops the current operation and proceeds to a normal ending. An error that causes interface disconnect may be recoverable. If the channel issues system reset or selective reset after the printer signals disconnect-in, the printer is set to control-unit-busy during the reset procedure. This allows time for printer restart attempts. If successful, the printer becomes operational, but not-ready. The sense bytes reflect the previous error.

The error recovery procedures, either by retry or after an appropriate delay, should retrieve the sense data to ensure that it is not lost by any subsequent operator action.

For those systems not having programming support for error recovery capability, the recovery method is to stop the operation, print an operator message indicating a permanent error, and exit from the error recovery procedure.

For those systems with channel error recovery, the procedures in the 3800 Error Conditions and Suggested Recovery Actions table (see Figure 22) are recommended.

PRINTER-DETECTED ERRORS

All printer errors cause a unit check to be set in the status byte. The channel accepts the status byte and places it in the CSW. The system should execute a sense command to obtain the detail information about the failure and probable reasons for the unit check. Failure to execute a sense command can cause a loss of the sense bytes. The recovery actions listed in Figure 22 are suggested for the more prominent error conditions.

Before presenting unit check to the host system, the printer attempts to retry some errors through an automatic error retry function.

AUTOMATIC ERROR RETRY

The 3800 printer automatically recovers from certain types of random errors. All successful recovery actions are transparent to the using system. There are four types of error retry: skip transfer, microinstruction, internal disk, and error correction coding.

Channel Status Word	Sense		Name	Description/Action
	Byte	Bit		
Bit 44			Channel Data Check	This bit is set when the channel detects a parity error in the information transferred to or from the CPU main storage. The channel corrects parity on a transfer to main store but not when data is transferred to the printer. Command chaining is suppressed, and the current channel operation proceeds to a normal ending. Data transferred to the printer should still have incorrect parity at the printer which results in a unit check with a bus out parity error. If so, perform the bus out parity recovery procedure. If the indication is a channel data check only, and the check occurred during a write data transfer, the error is most likely permanent. If the check occurred during a read data transfer, try to restart the channel program on the failing CCW. For other possibilities or if the error persists when the failing CCW is restarted, the error is most likely permanent.
Bit 45			Channel Control Check	This bit is set when the central processor or channel malfunctions. If the appropriate CSW fields are valid and the check occurred before the data transfer began, try to restart the channel program on the failing CCW. If the check occurred after the completion of the data transfer, try to restart the channel program on the next CCW. If the check occurred during a read data transfer, try to restart the channel program on the failing CCW. For other possibilities or if the error persists when the failing CCW is restarted, the error is most likely permanent.
Bit 46			Interface Control Check	This bit is set when the channel detects an invalid signal on the I/O interface or when the printer signals disconnect-in. If the printer signals disconnect-in, the error is most likely permanent. If not, follow the recovery procedure for channel control check.
Bit 38	0	0	Command Reject	Caused by a programming error. Provide an operator message indicating an unrecoverable error and exit from this error recovery procedure.
Bit 38	0	1	Intervention Required	Examine sense bytes 1 through 4. If System Restart (byte 3, bit 4) is off, provide an operator message and exit from the error recovery procedure. After the printer is made ready, restart the channel program on the failing CCW. If System Restart is on, pages on the drum or in the page buffer were lost. To recover, the pages must be retransmitted. For spooled or staged output, the control program can back up the number of pages specified by the operator with the information provided in sense bytes 20 and 21. Provide an operator message and exit from this error recovery procedure. After the printer is made ready and the operator has indicated the backup page count, retransmit the lost pages. For direct (not staged) output, provide an operator message indicating an unrecoverable error and exit from this error recovery procedure.
Bit 38	0	2	Bus Out Check	Retry the operation. If the error persists, provide an operator message indicating an unrecoverable error and exit from this error recovery procedure.

Figure 22 (Part 1 of 2). 3800 Error Conditions and Suggested Recovery Actions

Channel Status Word	Sense		Name	Description/Action
	Byte	Bit		
Bit 38	0	3	Equipment Check	<p>Examine sense bytes 1 through 4</p> <p>If System Restart (byte 3, bit 4) is off, provide an operator message and exit from this error recovery procedure. After the printer is made ready, restart the channel program on the failing CCW.</p> <p>If System Restart is on, pages on the drum or in the page buffer were lost. To recover, the pages must be retransmitted. For spooled or staged output, the control program can back up the number of pages specified by the operator with the information provided in sense bytes 20 and 21. Provide an operator message and exit from this error recovery procedure.</p> <p>After the printer is made ready and the operator has indicated the backup page count, retransmit the lost pages.</p> <p>For direct (not staged) output, provide an operator message indicating an unrecoverable error and exit from this error recovery procedure.</p>
	1	0	Hardware Error	
	1	1	Permanent Error	
Bit 38	0	3	Equipment Check	<p>Retrieve the error log information with a Sense Error Log command, generate an environmental record to retain the error log information, and restart the channel program on the failing CCW.</p>
	1	2	Error Log Full	
Bit 38	0	3	Equipment Check	<p>Provide an operator message indicating an unrecoverable error and exit from this error recovery procedure.</p>
	1	3	Cancel Key	
Bit 38	0	1	Intervention Required	<p>Provide an operator message and exit from this error recovery procedure. The operator should press Cancel and Printer Ready. The sense bytes from the cancel condition cause the Cancel recovery procedure to be performed.</p>
	2	7	Line Overrun	
Bit 38	0	4	Data Check	<p>Caused by a programming check. Provide an operator message indicating an unrecoverable error and exit from this error recovery procedure.</p>
Bit 38	0	6	Load Check	<p>Caused by a programming check. Provide an operator message indicating an unrecoverable error and exit from this error recovery procedure.</p>
Bit 38	0	7	Channel 9	<p>Set the channel 9 bit in the status information for indication to the user program. Restart the channel program on the next CCW.</p>
Bit 39			Channel 12	<p>Set channel 12 bit in the status information for indication to the user program. Restart the channel program on the next CCW.</p>

Figure 22 (Part 2 of 2). 3800 Error Conditions and Suggested Recovery Actions

Skip Transfer Retry

The skip transfer retry provides transparent recovery of the following errors:

- Character generation
- Laser
- Mirror servo
- Processing (certain types)
- Forms overlay

When an error is detected during the time the image is being created on the photoconductor, the image is not transferred to the paper. The image is recreated and the error is internally recorded for statistical purposes. The error is retried; if unsuccessful, it is considered permanent. The CE can disable the error detection retry to permit diagnosis.

Microinstruction Retry

The control electronics can retry microinstructions. Should a parity error occur during the execution of the microinstruction, the microprogram automatically enters a diagnostic routine which logs the error internally and initiates an instruction retry. Should the error persist, the microprogram assembles the sense bytes and stops with the contents of the last entry in the internal error log.

The control electronics start the normal sequence on the I/O interface for disconnect-in, and wait for the channel to send a selective reset, which restarts the program. On the next Start I/O or Test I/O, unit check is indicated and 24 sense bytes are presented to the system. Should a second parity error occur during the assembly and/or transmission of the sense bytes, the microprogram stops again with the channel interface disabled. This stop is without the disconnect-in sequence and requires that an operator reset the printer.

Internal Disk Retry

During the initial microprogram load (IMPL), two copies of the functional microprogram are written on the internal disk — one as the primary source and one as an alternative source. Any parity error detected during the loading of the microprogram or character sets is retried. If the error occurs during the microprogram load and is permanent, the loading is automatically switched to an alternate track for completion. If a permanent error occurs on the alternate track, the loading procedure is stopped and the error is posted.

Error Correction Coding Retry

With error correction coding, the writable control storage, the page buffer, and other 3800 buffer areas have single-bit error correction and double-bit detection. This helps to extend the time between permanent failures.

PERMANENT ERRORS

Errors that continue to occur after the printer retry function has been exhausted are permanent errors. These errors should stop the operation and result in the printing of an operator message and an exit from the error recovery procedure.

Operator Message

The following message should be provided by the host system for the 3800 printer:

- Message text
- Channel-device address
- Channel status word
- Sense bytes 0 through 23
- Failing CCW

ERROR LOGGING

In addition to the recovery actions previously noted, the host system error recovery procedures should make the following recordings to document certain specific errors:

- Channel check handler (CCH)
- Statistical data recorder (SDR)
- Outboard recorder (OBR)
- Miscellaneous data recorder (MDR)

Figure 23 associates each of the specific error conditions with the type of error recording required. The SDR recordings in the table consist of seven separate ERP-maintained counters.

Note: *Recording actions are not required for error conditions not listed in the table.*

To assist the CE in analyzing 3800 errors not considered permanent as well as those errors corrected by the automatic retry function, the operating system logs two classes of error information in the system data set: the internal error log and 24 sense bytes.

Channel Status Word	Sense		Description	Channel Check Handler (CCH)	Statistical Data Recorder (SDR)	Outboard Recorder (OBR)	Miscellaneous Data Recorder (MDR)
	Byte	Bit					
Bit 38	0	1	Intervention Required				
			Sense Byte 4 = Not '00' – '0F', not '32, 40, 41, 42'			X	
			Continuous Forms Stacker Mistold (Sense Byte 4 = '32')		4		
			Burster Input Check (Sense Byte 4 = '40')		5		
			No Burst Check (Sense Byte 4 = '41')		6		
			BTS Stacker/Trimmer Check (Sense Byte 4 = '42')		7		
	0	2	Bus Out Parity			X	
	0	3	Equipment Check				
	1	0	Hardware Error			X	
	1	1	Permanent Error			X	
1	2	Error Log Full				X	
Bit 44	–	–	Channel Data Check – Temporary*	X	1		
	–	–	Channel Data Check – Permanent*	X		X	
Bit 45	–	–	Channel Control Check – Temporary	X	2		
	–	–	Channel Control Check – Permanent	X		X	
Bit 46	–	–	Interface Control Check – Temporary	X	3		
	–	–	Interface Control Check – Permanent	X		X	

*Also perform unit check recording action if CSW bit 38 is on.

Figure 23. 3800 Error Recording Actions.

Internal Error Log

A 16-entry internal error log is maintained in the 3800 printer control electronics. Each retryable error is recorded in this log as an eight-byte environmental record consisting of an error identifier, retry count, and other error status depending on the type of error. The Sense Error Log command allows the host system to read this log for the purpose of recording it into the system data set. The log can be read and recorded by the system when one or more of the following conditions occur:

- Internal error log full
- Operator varies the printer offline
- End of day routine

Sense Bytes

The printer provides 24 bytes of sense information to indicate the causes of unit checks. These bytes direct the programming system for appropriate error recovery actions. Sense byte 0 is the standard System/370 sense byte adapted to printers. It contains information resulting from malfunctions in programming or hardware, and is the first level of error indication. Sense bytes 1 and 2 have additional information regarding certain conditions in byte 0. These three bytes, (0, 1, 2) contain initial information about a failure and are intended for the programming system.

COMMAND REJECT (BYTE 0, BIT 0)

This bit is set to one with unit check, channel end, and device end at ending status time when a command other than those defined for the printer is decoded. An invalid command is also indicated in sense byte 1.

Invalid Command (Byte 1, Bit 0): This bit is set to one when a command other than those defined for the printer is decoded.

INTERVENTION REQUIRED (BYTE 0, BIT 1)

This bit is set to one when the printer is not-ready because of any conditions which require operator action. Other bits in sense bytes 1 through 4 indicate the specific reason or action required. Refer to the *IBM 3800 Printing Subsystem Operator's Guide*, GA26-1634, for further details on operator actions. In addition, sense byte 4 gives a summary of all the areas that affect an intervention required condition.

BUS OUT PARITY (BYTE 0, BIT 2)

This bit is set to one when the printer detects incorrect parity in a byte of data or command information received from the channel. If the command byte is invalid, no operation is started by the printer. If the data byte is invalid, the data transfer is terminated with channel end, device end, and unit check. Any data transferred is ignored. The bits in sense byte 1 define which byte was invalid.

Command Byte (Byte 1, Bit 0): This bit is set to one when the printer detects incorrect parity in any command information received from the channel.

Data Byte (Byte 1, Bit 1): This bit is set to one when the printer detects incorrect parity during data transfer from the channel. The actual byte in error is determined from the residual count in the CSW and the data address in the failing CCW.

EQUIPMENT CHECK (BYTE 0, BIT 3)

This bit is set to one to indicate that an unusual hardware condition was detected in the printer. Equipment check also causes unit check to be presented. The bits in sense bytes 1 through 4 define the error condition.

Hardware Error (Byte 1, Bit 0): This bit is set to one when the printer detects an unrecoverable error in the hardware. The printer becomes not-ready and a probable cause is displayed on the operator panel. This condition usually requires customer engineer intervention. Sense bytes 4 through 11 provide additional information on the error.

Permanent Error (Byte 1, Bit 1): This bit is set to one when the printer retry procedures were unsuccessful in recovering from an error. The printer becomes not-ready and a probable cause is displayed in the operator panel status display. This condition usually requires customer engineer intervention. Sense bytes 4 through 11 contain the error log entry describing the permanent error condition.

Error Log Full (Byte 1, Bit 2): This bit is set to one when the error log is full. It indicates that a Sense Error Log command should be given to read and reset the error log so that the equipment check condition can be cleared.

Cancel Key (Byte 1, Bit 3): This bit is set to one when the Cancel key is pressed. A Sense I/O command clears the cancel condition as with all unit checks. When cancel is indicated, sense bytes 20 and 21 contain the number of pages deleted from the page buffer.

DATA CHECK (BYTE 0, BIT 4)

This bit is set to one when the printer detects an error in the print line or channel command just received. The data check conditions caused by unprintable characters or multiple characters can be inhibited by the Block Data Check command. The bits in sense byte 1 define the data check.

Unprintable Character (Byte 1, Bit 0): This bit is set to one when, during translation, the printer detects a character code that cannot be printed. A blank (from the first location in WCGM 0) is substituted for each invalid character encountered.

No Translate Table (Byte 1, Bit 2): This bit is set to one when the table selected for translation does not exist or was not previously loaded. Translate table 0 is then used for the print line.

No FCB Channel Code Match (Byte 1, Bit 3): This bit is set to one when the printer detects that the forms control buffer (FCB) does not contain a channel code to match the skip command. One complete search of the FCB is made. A blank line is inserted in the page buffer for each position checked. Because no match was found, the forms control is set back to the first print line of a new page.

Multiple Characters (Byte 1, Bit 4): This bit is set to one when the printer detects multiple characters in a single print position. When using the Write With No Space command, merging of different print lines can result in attempts to place two different characters in a single print position. Only a blank, underscore, identical character, or a copy modification character may be printed in a position occupied by a nonblank character from a previous Write With No Space command.

LOAD CHECK (BYTE 0, BIT 6)

This bit is set to one when the printer decodes an invalid load command which either did not have the proper prerequisites or the data associated with the command did not pass all the conditional printer tests. The bits in sense bytes 1 and 2 define the load check.

Incorrect Length (Byte 1, Bit 0): This bit is set to one when the record received with the load command fails to have the correct length. The length checks are listed below:

Buffer	Number of Bytes Transferred
Forms Overlay Sequence	Even Number
WCGM	At least 4
Translate Table	At least 256
Copy Modification	Sum of all Segments (Text Segments + 6)
Graphic Character Modification	Multiple of 73

Incorrect Multiple of 6, 8, or 12 lpi (Byte 1, Bit 1): This bit is set to one when the line spacing is not an integer multiple of the 1/2-inch spacing for the entire page.

FCB 1/2-Inch Error (Byte 1, Bit 2): This bit is set to one when there is an incorrect spacing in the top or bottom 1/2-inch areas of the page. For 6 lpi, the first three and/or last three bytes must be '00'. For 8 lpi, the first four and/or last four bytes must be '10'. For 12 lpi, the first six and/or last six bytes must be '30'. Also, no channel codes can be specified in the top or bottom 1/2-inch areas of the page.

Invalid FCB Channel Codes (Byte 1, Bit 3): This bit is set to one if the printer detects a channel code range other than 0 through 12.

FCB Length Error (Byte 1, Bit 4): This bit is set to one if the length of the forms control buffer does not match the length of the forms indicated by the printer controls.

Sense bytes 22 and 23 contain the value of the total length of the FCB data sent to the printer.

WCGM Not Loaded (Byte 1, Bit 5): This bit is set to one if the printer detects that the WCGMs are not loaded. The WCGMs must be loaded before the translate tables.

Unassigned Graphic Character (Byte 1, Bit 6): This bit is set to one if the printer detects an unprintable character when checking each character code in a graphic character modification. The translate table located by the character code must specify valid characters.

Invalid WCGM ID (Byte 2, Bit 0): This bit is set to one if the printer detects that an incorrect character set identification (ID) was specified. The printer checks each character set ID to determine if the character set specified is available and if a WCGM exists for loading the character set.

No ID for WCGM 0 (Byte 2, Bit 1): This bit is set to one if the printer detects that WCGM 0 does not have an ID code specified.

Invalid Copy Modification (Byte 2, Bit 2): This bit is set to one if the printer detects that a copy modification segment contains a starting position plus a number of affected print positions less than 2 or greater than 205. This bit is also set if a text field length is incorrect.

Invalid Forms Overlay Sequence (Byte 2, Bit 3): This bit is set if the forms-overlay, sequence-control bytes specify zero copy counts.

Invalid Graphic Modification (Byte 2, Bit 4): This bit is set to one if the printer detects that the pitch is specified incorrectly within a user-designed graphic or that the pitch is not consistent throughout the character pattern.

WCGM Data Parity Error (Byte 2, Bit 5): This bit is set to one if the printer detects incorrect parity in any graphic data byte transferred from the system to be loaded into a WCGM.

CHANNEL 9 (BYTE 0, BIT 7)

This bit is set to one if the printer detects a channel 9 code in the FCB during a forms space operation. This bit is not set during the forms skip operations.

Sense byte 3 reflects dynamic conditions within the printer. The bits are defined as follows:

PRINTER READY (BYTE 3, BIT 0)

This bit is set to one when the Printer Ready indicator is on.

PAGE BUFFER EMPTY (BYTE 3, BIT 1)

This bit is set to one when the last copy of the last page residing in the page buffer has been printed. There is no full or partial page to be printed in the page buffer.

BLOCK DATA CHECK (BYTE 3, BIT 2)

This bit is set to one when the block data check latch is on. The bit is set to zero when the Allow Data Check command is sent.

BURSTER/STACKER THREADED (BYTE 3, BIT 3)

This bit is set to one when the BTS is threaded for use. The bit is set to zero when the BTS is not being used.

SYSTEM RESTART REQUIRED (BYTE 3, BIT 4)

This bit is set to one if any pages on the drum or in the page buffer were lost or erased because of an error condition which caused intervention required or equipment check condition. The page backup count, which is contained in sense bytes 20 and 21, can be used by the system program to determine how many pages should be sent again to the printer. Pressing Reset on the operator panel sets this bit to zero.

PC ADVANCE ENABLED (BYTE 3, BIT 5)

This bit is set to one when a photoconductor (PC) advance is allowed. The printer is allowed to run until the operator initiates the advance.

SENSE BYTE 4

Sense byte 4 contains a status code which is expressed as a hexadecimal number. This number is a pointer to sense bytes 5 through 11 which provide specific printer information. The bits in sense bytes 5 through 11 indicate various printer conditions depending on the status code given in sense byte 4.

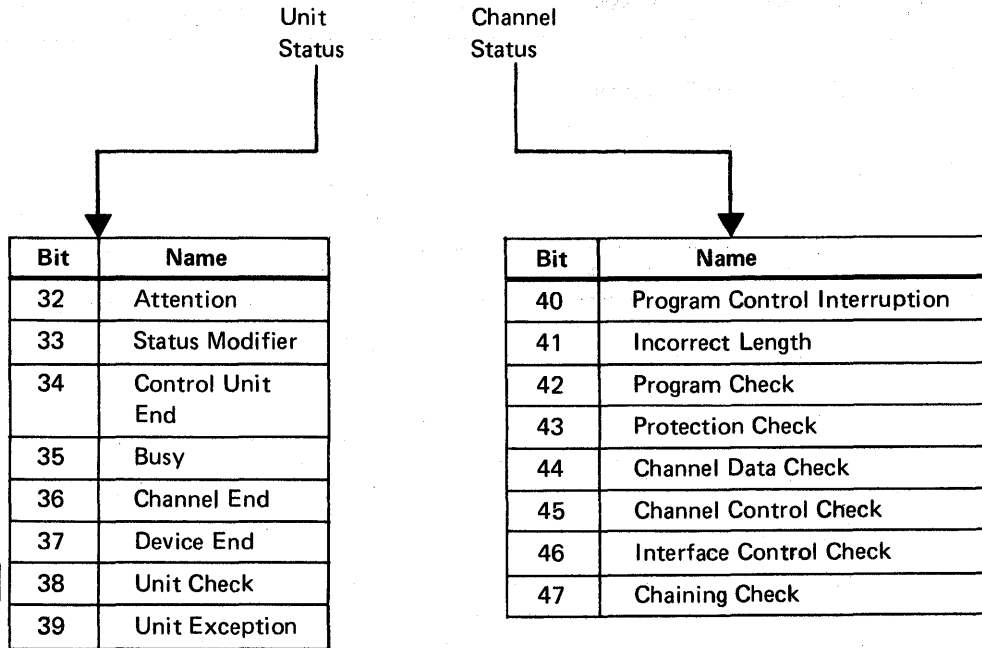
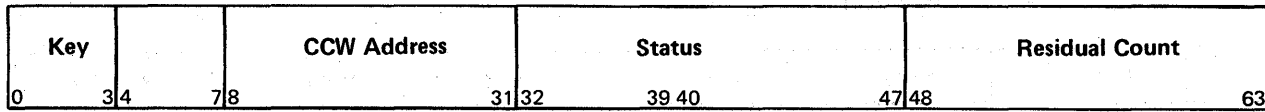
SENSE BYTES 12 THROUGH 23

Sense bytes 12 through 23 contain counter information for the following printer functions:

- Modulo 256 transfer and fuser pulses per-inch (PPI) counters – used by the microcode to track the position of the page
- Fuser page count
- Paper count
- Serial number
- Page backup count or pages cancelled
- PC gap location or load check offset

Figure 24 shows the relationship of the CSW and the printer sense bytes. All of the sense bytes are summarized in Figures 25 through 34.

Channel Status Word



Byte	Contents
0-2	Additional Device Status
3	Printer Dynamic Conitions
4	Status Code
5-11	Error Dependent Data
12	Modulo 256 Transfer 2 ppi
13	Modulo 256 Fuser Predicted 2 ppi
14, 15	Fuser Page Count
16-19	Paper 100 ft. and Serial No.
20, 21	Page Backup Count
22, 23	PC Gap Location/Load Check Offset Pages Cancelled

Byte 4 (Hex)	Functional Area of the Machine
0X	Normal Operator Actions
1X	Transfer Station
2X	Fuser
3X	Continuous Forms Stacker (CFS)
4X	Burster-Trimmed-Stacker (BTS)
5X	Forms Overlay
6X	Drum and Process
7X	Character Generator
8X	Instruction Execution Unit (IEU)
9X	Coronas

Figure 24. Channel Status Word and 3800 Sense Byte Relationship

SENSE BYTES 0 - 2 (Condition defined by byte 0 is further defined by bit(s) turned on in bytes 1 and 2.)

		Byte 0													
		Hex	80	40	20	10	08	04	02	01					
		Bit	0	1	2	3	4	5	6	7					
		Bit ▼	Hex ▼	Command Reject	Interven- tion Required	Bus Out Parity	Equipment Check	Data Check	Reserved 0	Load Check	Channel 9				
Byte 1	0	80	Invalid Command	Not Ready	Command Code	Hardware Error	Unprintable Character	Reserved	Reserved	Reserved	Incorrect Length				
	1	40	Reserved	Operation Check	Data Byte	Permanent Error	Reserved				Incorrect Multiple of 6, 8, or 12 LPI				
	2	20		Toner Collector Full	Reserved	Internal Log Full	No Translate Table				FCB 1/2-Inch Error				
	3	10		Toner Supply Empty		Cancel Key	No FCB Channel Code Match				Invalid FCB Channel Codes				
	4	08		Developer Replacement Required		Reserved	Reserved				Reserved	Multiple Characters	FCB Length Check		
	5	04		End of Forms								Reserved	Reserved	WCGM Not Loaded	
	6	02		Output Full								Reserved	Reserved	Unassigned Graphic Character	
	7	01		Reserved								Reserved	Reserved	Reserved	
Byte 2	0	80		Reserved				Forms Overlay Check	Reserved	Reserved		Reserved	Reserved	Reserved	Reserved	Invalid WCGM ID
	1	40	Transfer Check					No ID for WCGM 00							
	2	20	Fuser Check		Invalid Copy Modification										
	3	10	CFS Check		Invalid Forms Overlay Sequence										
	4	08	Process Check		Invalid Graphic Modification										
	5	04	BTS Check		WCGM Data Parity Error										
	6	02	Reserved		Reserved										
	7	01	Line Overrun		Reserved										

SENSE BYTE 3

Bit	Dynamic Condition
0	Printer Ready
1	Page Buffer Empty
2	Block Data Check
3	Paper Threaded for BTS
4	System Restart Required
5	PC Advance Enabled
6	Reserved
7	Reserved

Figure 25. Sense Bytes 0-3 Summary

STATUS CODES

(SENSE BYTE 4, Internal Error Log Entry Byte 0)

Status Code (Hex)	Description	Internal Log	Sense Byte 5-11 Format
00	Printer Not Ready		
01	End of Forms		
02	Stacker/Trimmer Full		
03	Burster Stacker Not Empty		
04	Toner Supply Empty		
05	Toner Collector Full		
06	Replace Developer		
07	Transfer Check		
08	Fuser Check		
09	CFS Not Ready		
0A	Forms Overlay Check		
0B	PC Advance Allowed		
0C	Developer Check		
0D	Fixed Length Early Termination		
0E	Burster/Trimmer Check		
11	Transfer Not Detented		1 or 2
14	Transfer Start/Stop Check		1 or 2
15	Transfer Misregistration/Jam		1 or 2
16	Transfer Encoder Check		1 or 2
17	Transfer Motor Overload		1 or 2
18	Transfer Print Position Check		1 or 2
1C	Transfer Tractor Cover Check		
1E	Transfer/Fuser Paper Tension Check		1 or 2
21	Fuser Roll Temperature Check		1 or 2
22	Fuser Platen Temperature Check		1 or 2
23	Fuser Roll Closure Check		1 or 2
24	Fuser Roll Open Check		1 or 2
25	Fuser Print Misaligned/Contrast Low		1 or 2
26	Fuser Width Check		1 or 2
27	Fuser Motor Overload		1 or 2
28	Fuser Paper Skew Check		1 or 2
2A	Fuser/Transfer Short Loop Check		1 or 2
2B	Fuser/Transfer Long Loop Check		1 or 2
2E	Fuser Roll Paper Wrap		1 or 2
30	Output Length Check		1 or 2
31	Data Ready/Length Check		1 or 2
32	CFS Misfold		1 or 2

Status Code (Hex)	Description	Internal Log	Sense Byte 5-11 Format
34	Fuser/Output Paper Break/Loop		1 or 2
40	Burster Input Check		1 or 2
41	No Burst Check		1 or 2
42	BTS Stacker/Trimmer Check		1 or 2
43	Early Burst Check		1 or 2
4B	BTS Loop Check		1 or 2
51	Missing Forms Overlay Flash	X	3
52	Extra Forms Overlay Flash	X	3
63	Vacuum System Check	X	3
65	Cleaner Brush Check	X	3
66	Erase Lamp Check	X	3
67	Mark Sensor Check		3
68	Slow Drum Speed		3
69	Fast Drum Speed		3
6A	Drum Motor Overload		3
6C	Toner Overfeed Check		3
71	Character Generator Parity Check	X	3
72	Line Overrun		3
73	Character Generator Line Buffer Check	X	3
74	WCGM Load Check		3
75	Print Synchronization Check	X	3
76	Laser Power Check	X	3
77	Mirror Speed Check	X	3
81-88	Temporary IEU Parity Check	X	5
89	Permanent IEU Parity Check	X	5
8A	Disk File Check	X	6
8B	Subsystem Clock/Sync Check	X	3
8C	Subsystem Thermal/Power Check		4
8E	Subsystem Run Reset		3
8F	IEU Clock Check		3
91	Charge Corona Check	X	3
92	Transfer Corona Check		3
93	Preclean Corona Check	X	3
94	Magnetic Brush Bias Check	X	3
95	Post-Transfer Corona Check		3
C0-FE	Display Status Codes (See Execute Order for details.)		
FF	IEU Clock Stopped		

Figure 26. Sense Byte 4 Summary

FORMAT 1 SENSE BYTES 5–11 (Internal Log Entry Bytes 1–7).
 Status Codes = '1X' – '4X' with output destined for the CFS.

	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11
	Paper Line	Paper Length	CFS	Fuser	Up/Down Counters	Transfer	Paper Width
Bit 0	Paper Loop Switch	Transfer Overload	CFS Active	Backup Roll Open	Fuser Servo Up/Down Counter	Transfer Overflow	Fuser Width Check
Bit 1	Fuser Wrap Switch	Reserved	Reserved	Backup Roll Closed		Transfer Registration Check	Fuser Overload
Bit 2	End of Forms		Reserved	Fuser Setup Check		Extra Transfer Encoder Count	Reserved
Bit 3	Burster Emitter		CFS Not in Auto Mode	Fuser Output Check		Missing Transfer Encoder Count	Reserved
Bit 4	Burster Sheet		CFS Not Ready	Preheat Current Check	Transfer Servo Up/Down Counter	Transfer Detented	Width
Bit 5	Fuser 16 PPI Interrupt	Length	CFS/BTS Table Full	Fuser Roll Current Check		Transfer Tractor Not in Position	
Bit 6	Fuser 2 PPI Interrupt		CFS Jam Light	Preheat Not at Temperature		Corona Paper Guide Up	
Bit 7	Transfer 2 PPI Interrupt		CFS Table Position	Fuser Roll Not at Temperature		Transfer Tractor Cover Check	

Figure 27. Sense Bytes 5–11 (Format 1) Summary

FORMAT 2 SENSE BYTES 5–11 (Internal Log Entry Bytes 1–7).
 Status Codes = '1X' – '4X' with output destined for the BTS.

	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11
	Paper Line	Paper Length	BTS	Fuser	Up/Down Counters	Transfer	Paper Width
Bit 0	Paper Loop Switch	Transfer Overload	BTS Active	Backup Roll Open	Fuser Servo Up/Down Counter	Transfer Overflow	Fuser Width Check
Bit 1	Fuser Wrap Switch	Reserved	Reserved	Backup Roll Closed		Transfer Registration Check	Fuser Overload
Bit 2	End of Forms		BTS Stacker Empty	Fuser Setup Check		Extra Transfer Encoder Count	Reserved
Bit 3	Burster Emitter		BTS Stacker in 2-Inch Area	Fuser Output Check	Missing Transfer Encoder Count		
Bit 4	Burster Sheet	Length	BTS Stacker Jam	Preheat Current Check	Transfer Servo Up/Down Counter	Transfer Detented	Width
Bit 5	Fuser 16 PPI Interrupt		BTS Setup Check	Fuser Roll Current Check		Transfer Tractor Not In Position	
Bit 6	Fuser 2 PPI Interrupt		Paper at PC	Preheat Not at Temperature		Corona Paper Guide Up	
Bit 7	Transfer 2 PPI Interrupt	Reserved	Fuser Roll Not at Temperature	Transfer Tractor Cover Check			

Figure 28. Sense Bytes 5–11 (Format 2) Summary

FORMAT 3 SENSE BYTES 5–11 (Internal Log Entry Bytes 1–7).
 Status Codes = '5X'–'7X' and '8B', '8E', '8F', '9X'.

	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11
	Retry Count	Forms Overlay	Corona	Process	Character Generator	Character Generator	Character Generator
Bit 0	Retry Count	Forms Overlay Flash Occurred	Erase Lamp Off	Mark Sensor Check	Drum/Mirror Drive Thermal	Subsystem Clock Check	Micro-program Ahead
Bit 1		Reserved	Cleaner Not Running	Contrast	Mirror Motor Thermal	Bit Time Clock Check	Print Line Synchronization Check
Bit 2		Reserved	Preclean Corona Off		Mirror Drive Amplifier Check	WCGM Input Parity Error	Line Buffer Interference
Bit 3		Forms Overlay Holder Interlock	Charge Corona Off	Developer Interlock	Mirror Current High	Line Buffer Parity Error	Line Buffer Overrun
Bit 4	Reserved	Reserved	Transfer Corona Off	Toner Hopper Empty	Mirror Not Synchronized	Serializer Parity Error	Under-score Parity Error
Bit 5			Post-Transfer Corona Off	Toner Collector Full	Laser Not Synchronized	Any WCGM Parity Error	Under-score Bit
Bit 6			Drum Servo Off	Cyclone Vacuum Low	Laser Power Low	Character Address Register Bit 0	Laser Bit Counter Overflow
Bit 7			Developer Roll Bias Off	Collector Handle Open	Reserved	Character Address Register Bit 1	Horizontal Delay/Print Width Count = 0

Figure 29. Sense Bytes 5–11 (Format 3) Summary

FORMAT 4 SENSE BYTES 5–11 (Internal Log Entry Bytes 1–7).
Status Code = '8C'.

	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11
	Device 0	Reserved	Paper-line Thermals	Fuser	Process Thermals	Character Generator	Reserved
Bit 0	Reserved	Reserved		Backup Roll Open	Gate and Power Regulator Thermal	Drum/Mirror Thermal	Reserved
Bit 1			Scuff Motor Thermal	Backup Roll Closed	Reserved	Mirror Motor Thermal	
Bit 2			CFS Elevator Motor Thermal	Fuser Setup Check	Process Circuit Protector Open	Mirror Drive Amplifier	
Bit 3			CFS Motor Thermal	Fuser Output Check	Fuser-Platen Link Open	Mirror Current High	
Bit 4			Reserved	Preheat Current Check	Drum Cooling Check	Mirror Not Synchronized	
Bit 5			Reserved	Fuser Roll Current Check	Cyclone Motor Thermal	Laser Not Synchronized	
Bit 6			BTS Motor Thermal	Preheat Not at Temperature	Developer Motor Thermal	Laser Power Low	
Bit 7			Printer Power Not Ready	BTS Motor or Cam Thermal	Fuser Roll Not at Temperature	Cleaner Brush Thermal		Reserved

Figure 30. Sense Bytes 5–11 (Format 4) Summary

FORMAT 5 SENSE BYTES 5–11 (Internal Log Entry Bytes 1–7).
Status Codes = '80'–'89'.

	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11
	Interrupt Required	Micro-instruction Address Register High	Micro-instruction Address Register Low	IEU Register 1	IEU Register 2	Micro-instruction or SO Register High	Micro-instruction or SO Register Low
Bit 0	Storage Operation (SO) Register	Contents of MAR High	Contents of MAR Low	MIR High Parity	Storage Address Register(SAR) Parity	If byte 5, bit 0 = 0, these two bytes contain the failing micro-microinstruction.	
Bit 1	Interrupt Level 1			MIR Low Parity	Local Storage Register(LSR) Parity			If byte 5, bit 0 = 1 (SO or MIR parity error), these two bytes contain the SAR.
Bit 2	Interrupt Level 2			Main Data Register Parity	In Bus Parity	(High Byte)	(Low Byte)
Bit 3	Interrupt Level 3			Writable Control Storage (WCS) Double-bit	No Device Response		
Bit 4	Interrupt Level 4			ALU A Parity	I-Cycle		
Bit 5	Interrupt Level 5			ALU B Parity	E-Cycle		
Bit 6	Interrupt Level 6			Storage Data Register High Parity	Read Only Storage(ROS) High-Speed Loop		
Bit 7	Reserved			SDR Low Parity	Any Error		

Figure 31. Sense Bytes 5–11 (Format 5) Summary

FORMAT 6 SENSE BYTES 5–11 (Internal Log Entry Bytes 1–7).
 Status Code = '8A'.

	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11
	Retry Count	Control Flags	Track Address	Reserved	Reserved	Reserved	Reserved
Bit 0	Retry Count	Interface Routine Required	Track Address	Reserved	Reserved	Reserved	Reserved
Bit 1		Reserved					
Bit 2		Alternate Track Used					
Bit 3		Permanent Error					
Bit 4		No Alternate Available					
Bit 5		Retain Power					
Bit 6		Diagnostic Load Mode					
Bit 7		IMPL Request					

Figure 32. Sense Bytes 5–11 (Format 6) Summary

FORMAT 7 SENSE BYTES 5–11 (Internal Log Entry Bytes 1–7).

Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

Figure 33. Sense Bytes 5-11 (Format 7) Summary

SENSE BYTES 12 – 23

Byte 12	Byte 13	Byte 14	Byte 15	Byte 16	Byte 17
Modulo 256 Transfer 2 PPI Count	Modulo 256 Fuser Predictor 2 PPI Count	Fuser Page Count		Paper 100 ft. Count	
Byte 18	Byte 19	Byte 20	Byte 21 (See Note)	Byte 22 (See Note)	Byte 23 (See Note)
Serial Number		Page Backup Count or Pages Cancelled		PC Gap Location or Load Check Offset	
<p>Note: When load check (bit 6) is on in sense byte 0, these bytes have relative offset instead of PC gap location information. If the load check occurs because of an error during loading of the forms control buffer, bytes 22 and 23 contain the value of the total length of the FCB data sent to the printer. When cancel is indicated, bytes 20 and 21 contain the number of pages deleted from the page buffer.</p>					

Figure 34. Sense Bytes 12-23 Summary

Appendix A. Input/Output Channel Instructions

This appendix provides a brief overview of central processor channel and printer instructions. Refer to *IBM System/370 Principles of Operation*, GA22-7000 for details.

I/O operations, started by I/O instructions in the central processor program, are controlled by commands fetched from main storage by the channel. Arithmetical and logical decision operations are performed while the processing unit is in the problem state; for I/O operations, the processing unit must be in the supervisor state.

The processing unit changes from problem to supervisor state when a supervisor call instruction is executed or when an I/O interrupt occurs and the new program status word (PSW) has a problem state bit off. The status of the system existing at the time of the change is stored in the old PSW.

In the supervisor state, the central processor typically executes the following I/O instructions (see Figure 35 for format):

Start I/O: Starts an I/O operation if the addressed channel and printer are available.

Start I/O Fast Release: Starts an I/O operation if the addressed channel is available. The printer is assumed to be available. If the printer is not available, the channel status word (CSW), bits 6 and 7 (deferred condition code), is set to indicate the appropriate condition.

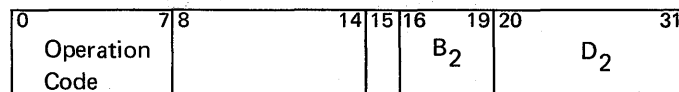
Halt I/O: Stops the operation in progress at the channel, disconnecting the printer from the channel.

Halt Device: Stops the operation in progress at the printer without interfering with other I/O operations at the channel. This instruction should be used instead of Halt I/O to terminate an operation on a device attached to IBM block multiplexer channels.

Clear I/O: Sets the condition code in the PSW to indicate the status of the addressed channel, subchannel, and printer or discontinues the operation. This instruction should be used instead of Test I/O on devices attached to IBM block multiplexer channels.

Test I/O: Sets the condition code in the PSW to indicate the status of the addressed channel, subchannel, and printer.

After the specified instruction is completed, the central processor can return to the problem state and continue the interrupted program by reloading the PSW originally stored when the program entered the supervisor state.



Bit Position	Field Designation	Function
0 - 7	Operation (Op) Code	Designates the operation to be performed: Start I/O, Halt I/O, Test I/O, and others.
8 - 14	Not Used	
15		Set to 1 for Start I/O Fast Release, Halt Device, and Clear I/O.
16 - 19	Base Address Register Location (B ₂)	Designates the address of a register in the central processor. The register is 32 bits in length, but only the low-order 24 bits are used.
20 - 31	Displacement (D ₂)	Bits 16-31 of the sum obtained by the addition of the contents of the register at B ₂ and the contents of the D ₂ field identify the channel and the device addressed by the instruction.

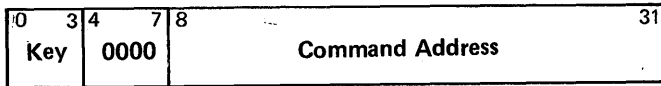
Figure 35. I/O Instruction Format

Channel Address Word

A Start I/O or Start I/O Fast Release instruction causes the channel hardware to fetch the channel address word (CAW) from main storage location 72 prior to issuing the I/O instruction. Bits 0 through 3 of the CAW form the protection key for all commands associated with the I/O instruction. The protection key establishes the right of access (that is, whether data can be stored or fetched) to the particular main storage locations.

The command address in bits 8 through 31 designates the address of the first channel command word (CCW). The three low-order bits of the command address must be zero to specify the CCW on doubleword boundaries.

The format for the CAW is shown in Figure 36.



CAW fields are allocated for the following purposes:

CAW Bit Position	Field Designation	Function
0 - 3	Protection Key	Provides the storage protection key for all commands associated with Start I/O. This key must match the storage key.
4 - 7		Always zero.
8 - 31	Command Address	Designates the location of the first CCW in main storage.

Figure 36. Channel Address Word Format

Channel Command Word

The channel fetches the first channel command word (CCW) from the address specified in the CAW. The CCW specifies the operation to be performed, the main storage locations to be used, and the action to be taken when the operation is completed.

The channel, if available when it receives the CCW, attempts to select the device specified in the I/O instruction by sending the address to all attached control units. If the addressed device is attached to the channel and has power on, the command code portion of the CCW is sent to the printer, which responds with an initial status byte to the channel.

At this point, the Start I/O instruction is finished, releasing the central processor to perform the next instruction. The results of the attempt to initiate execution of the command are indicated by the condition code in the PSW. If the I/O operation was not started, new status information containing the reason for this condition is normally set in the channel status word (CSW).

The format for the CCW is shown in Figure 37.

0	Command Code	7	8	31	32	36	37	38-39	40	47	48	63
		Data Address			Flags	PCI	I A	00				Count

CCW Bit Position	Field Designation	Function
0 - 7	Command Code	Specifies the operation to be performed. The two low-order bits (or when these bits are 00, the four low-order bits) of the command code identify the operation to the channel. The channel distinguishes write, space, load, control, sense, or transfer-in-channel operations. Commands that initiate I/O operations cause all eight bits to be transferred to the printer.
8 - 31	Data Address	Specifies the address of the area associated with data transfer operations.
32	Chain Data (CD)	Specifies chaining of data when set to one. The data rate of the printer permits chaining by the particular system models that can attach the printer.
33	Chain Command (CC) Flag	Specifies chaining of commands when set to one, and when the CD flag is zero. It causes the operation specified by the command code in the next CCW to be initiated upon normal completion of the current operation.
34	Suppress Length Indicator (SLI)	When set to one, specifies suppression of an incorrect length.

CCW Bit Position	Field Designation	Function
35	Skip Flag	When set to one, specifies suppression of a transfer of information to storage during a read, write, or sense operation. Checking takes place as though the information had been placed in storage. When bit 35 is zero, normal transfer of data takes place.
36	Program Control Interruption	When set to one, causes the channel to generate an interruption condition upon fetching the CCW. When bit 36 is zero, normal operation takes place.
37	Indirect Data Addressing	Causes bits 8-31 of the CCW to specify the location of the indirect address list.
38 - 39		Bit positions 38-39 of every CCW except the one specifying transfer-in-channel must contain zeros. Violation of this restriction generates the program check condition.
40 - 47	Not used	
48 - 63	Count	Specifies the number of 8-bit byte locations in the storage area designed by the data address.

Figure 37. Channel Command Word Format

Channel Status Word

The CSW, stored at main storage location 64, informs the program of I/O device status or the conditions under which an I/O operation was terminated. The CSW is formed or changed during I/O interruptions and instruction execution. Status stored in the CSW remains unchanged until a subsequent interrupt occurs or a new I/O instruction is processed. The format for the channel status word is shown in Figure 38.

Status Presentation

The status byte for the 3800 printer is compatible with previous printers attached via System/370 I/O interfaces, and contains the following condition bits:

- Attention
- Status modifier
- Control unit end
- Busy
- Channel end
- Device end
- Unit check
- Unit exception

Status is presented twice for all commands: first, as initial status after initial selection and second, as ending status after the operation is complete. The program only acknowledges status from the printer once or not at all if no error is posted in the initial status byte.

Initial Status: The initial status byte is zero for Test I/O and all nonimmediate commands unless one or more of the following conditions exists:

- The printer is busy.
- A status condition is pending (see Pending Status).
- A unit check occurred.

Ending Status: In most cases, channel end and device end are presented as the normal ending sequence for an operation. The exceptions are noted in the individual command descriptions (see the Channel Commands chapter).

If a programming error occurred during the operation, unit check accompanies the channel end and device end status. If an error causes the printer to become not-ready, unit check will be posted in the next initial status.

Pending Status: A pending status condition may exist for the printer if:

- There is a device end outstanding.
- A disconnect was signalled after the command was issued, but before the device end status was accepted.
- Status was stacked by the channel.

Pending status causes the printer to appear busy. Unless it is busy, the printer requests service to clear the pending status condition. Status is cleared when presented to and accepted by the channel except for the following:

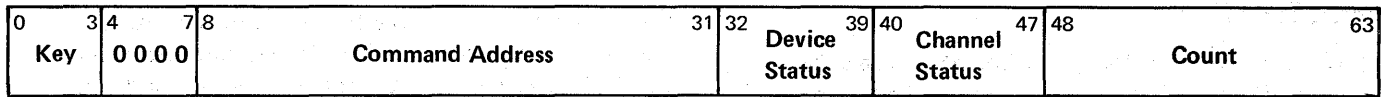
- If the unit check (bit 6) status is not caused by a not-ready condition (unit check is reset only after the printer is made ready).
- The busy status bit is reset only when device end status is accepted by the channel.
- Control unit busy status is reset when the printer becomes available to the channel interface.
- The status byte is reset by a system reset, selective reset, clock stopped condition, CE reset, or a power on reset.

For immediate commands such as the Block/Allow Data Check command, and those commands that do not involve data transfers, channel end is presented as initial status and device end is presented as ending status. For the No Operation command, channel end and device end are presented as initial status.

For load commands, both channel end and device end are presented following the data transfer.

For forms control commands, channel end is presented as initial status and device end is handled as for write commands.

For write commands, either with or without forms control, channel end is presented following the data transfer and device end is not presented until the forms operation is finished and enough room is available in the page buffer for the next print line.



CSW Bit Position	Field Designation	Function
0 - 3	Protection Key	Provides the storage protection key used to chain operations.
4 - 7		Refer to <i>IBM System/370 Principles of Operation, GA22-7000</i> , for details on using these bits.
8 - 31	Command Address	Provides an address eight positions higher than the address of the last CCW used.
32	Attention	Not used by the printer.
33	Status Modifier	Set in conjunction with the busy bit to signify control unit busy. If the control electronics are busy to the channel interface, the printer sets control unit busy status to prevent being overrun with commands (Test I/O) or losing drum images, paperline registration, or reset. When the printer is available, the control unit busy indication is reset.
34	Control Unit End	Set if a control unit busy status has been generated previously and the condition has been terminated.
35	Busy	Indicates that the printer is busy executing a previous command or has an outstanding device end condition in the status byte. Busy status is presented to any command until the outstanding device end is accepted by the channel. Status conditions, if any, accompany the busy indication. Busy is not presented with pending status to a Test I/O command.

CSW Bit Position	Field Designation	Function																		
36	Channel End	Set at the end of each channel command.																		
37	Device End	Indicates that the printer is ready for another command after this status is accepted by the channel. Device end is also set by a change from not-ready to ready.																		
38	Unit Check	Set whenever an unusual or error condition is detected. A Sense I/O command may then be used to identify the condition. If unit check is caused by a not-ready condition, it is presented as initial status until the printer becomes ready.																		
39	Unit Exception	Indicates that channel 12 was detected during a forms space operation. This bit is not set if channel 12 is detected during a forms skip operation.																		
40 - 47	Channel Status	Indicates channel conditions as follows: <table border="1"> <thead> <tr> <th>Bit</th> <th>Designation</th> </tr> </thead> <tbody> <tr> <td>40</td> <td>Program-controlled interruption</td> </tr> <tr> <td>41</td> <td>Incorrect length</td> </tr> <tr> <td>42</td> <td>Program check</td> </tr> <tr> <td>43</td> <td>Protection check</td> </tr> <tr> <td>44</td> <td>Channel data check</td> </tr> <tr> <td>45</td> <td>Channel control check</td> </tr> <tr> <td>46</td> <td>Interface control check</td> </tr> <tr> <td>47</td> <td>Chaining check</td> </tr> </tbody> </table>	Bit	Designation	40	Program-controlled interruption	41	Incorrect length	42	Program check	43	Protection check	44	Channel data check	45	Channel control check	46	Interface control check	47	Chaining check
Bit	Designation																			
40	Program-controlled interruption																			
41	Incorrect length																			
42	Program check																			
43	Protection check																			
44	Channel data check																			
45	Channel control check																			
46	Interface control check																			
47	Chaining check																			
48 - 63	Count	The residual count from the last CCW used.																		

Figure 38. Channel Status Word Format

Command Chaining

The ability to execute a series of channel commands as a result of a single Start I/O instruction is called command chaining, which is indicated by setting bit 33 in the CCW. The printer channel programs normally use command chaining.

Rather than disconnecting after each CCW, the channel fetches the next CCW (specifying a new operation) upon completion of the current CCW. The new I/O operation is automatically executed when the printer has completed the current operation and signaled device end to the channel.

The completion of the current CCW does not cause an I/O interrupt, and the count, indicating the bytes of transferred data, is not available to the program.

Note: *There are no restrictions for command chaining CCWs to the printer because it cannot be overrun by the channel.*

Data Chaining

Data transferred between main storage and the printer may be chained, permitting blocks of data to be transferred to or from noncontiguous areas of main storage.

Data chaining may be used to rearrange information as it is transferred between main storage and the printer. When data chaining is specified (that is, when bit 32 of the channel command word is on), the channel fetches a new CCW (which specifies a new storage location) upon the completion of data transfer for the current channel command. The new CCW command code is ignored.

Data chaining occurs immediately after the last byte of data designated by the current CCW has been transferred to main storage or accepted by the printer.

If both data chaining and command chaining are indicated in the CCW, data chaining takes precedence and command chaining is ignored.

Note: *There are no restrictions for data chaining CCWs to the printer because it cannot be overrun by the channel.*

Appendix B. WCGM Character Assignments

WCGM Position		Gothic and Text 1 (See Note 1)	Text 2	OCR A	OCR B	Format (See Note 2)	Katakana
Hex.	Dec.						
00	00	Blank	Blank	Blank	Blank	Blank	¥
01	01	A	a	A	A	┌ Top left crnr	•
02	02	B	b	B	B	┌ Top left crnr	┌
03	03	C	c	C	C	┌ Top left crnr	┌
04	04	D	d	D	D	┐ Top right crnr	、
05	05	E	e	E	E	┐ Top right crnr	•
06	06	F	f	F	F	┐ Top right crnr	ヲ
07	07	G	g	G	G	└ Bot. left crnr	フ
08	08	H	h	H	H	└ Bot. left crnr	イ
09	09	I	i	I	I	└ Bot. left crnr	ウ
0A	10	¢ Cent	[Bracket	┌ Hook	☒	└ Bot. right crnr	コ
0B	11	. Period	• Bullet	. Period	. Period	└ Bot. right crnr	ケ
0C	12	< Less than	≤ Equal or less	☒	< Less than	└ Bot. right crnr	サ
0D	13	(	{ Brace	- Bot. fiducial	_ Bot. fiducial	└ Left junction	シ
0E	14	+ Plus	± Plus/minus	☒	+ Plus	└ Left junction	ス
0F	15	| Logical OR	■ Histogram	└ Fork	☒	└ Left junction	セ
10	16	& Ampersand	° Degree	& Ampersand	& Ampersand	└ Right junction	ソ
11	17	J	j	J	J	└ Right junction	タ
12	18	K	k	K	K	└ Right junction	チ
13	19	L	l	L	L	└ Top junction	ツ
14	20	M	m	M	M	└ Top junction	テ
15	21	N	n	N	N	└ Top junction	ト
16	22	O	o	O	O	└ Bot. junction	ナ
17	23	P	p	P	P	└ Bot. junction	ニ
18	24	Q	q	Q	Q	└ Bot. junction	ヌ
19	25	R	r	R	R	+ Intersection	ネ
1A	26	! Exclamation	+ DA Cross	┌ Chair	☒	+ Intersection	ノ
1B	27	\$ Dollar	] Bracket	\$ Dollar	\$ Dollar	+ Intersection	ー
1C	28	* Asterisk	- Dash	* Asterisk	* Asterisk	- Horizontal line	ア
1D	29	)	{ Brace	└ Cnr. fiducial	└ Cnr. fiducial	- Horizontal line	ハ
1E	30	; Semicolon	↑ Up arrow	| Rt. fiducial	| Rt. fiducial	- Horizontal line	ヒ
1F	31	┌ Logical NOT	§ Section	| Left fiducial	| Left fiducial	| Vertical line	フ

Notes:

1. The Text 1 capitals are similar to the Gothic except for having small serifs.
2. Format characters are available in three different line weights.

WCGM Position		Gothic and Text 1 (See Note 1)	Text 2	OCR A (See Note 5)	OCR B	Format (See Note 2)	Katakana
Hex.	Dec						
20	32	- Minus	¶ Paragraph	- Minus	- Minus	| Vertical line	イ
21	33	/ Slash	≠ Not equal	/ Slash	/ Slash	|| Vertical line	ウ
22	34	S	s	S	S	! Broken line	フ
23	35	T	t	T	T	!! Broken line	ホ
24	36	U	u	U	U	... Dotted line	マ
25	37	V	v	V	V	☐	ミ
26	38	W	w	W	W	☐	ム
27	39	X	x	X	X	☐	メ
28	40	Y	y	Y	Y	☐	モ
29	41	Z	z	Z	Z	☐	ヤ
2A	42	▣ Lozenge	└ Bot. Lt. Cor.	☐	☐	☐	ヅ
2B	43	, Comma	┐ Top Rt. Cor.	, Comma	, Comma	☐	ヅ
2C	44	% Percent	┌ Top Lt. Cor.	☐	☐	☐	ヨ
2D	45	_ Underscore	└ Bot Rt. Cor.	- Timing Mk.	- Timing Mk.	☐	ラ
2E	46	> Greater than	≥ Equal/Greater	☐	> Greater than	☐	リ
2F	47	? Question	\ Slant	☐	☐	☐	ル
30	48	0 Zero	0	0 Zero	0 Zero	☐	オ
31	49	1	1	1	1	☐	カ
32	50	2	2	2	2	☐	キ
33	51	3	3	3	3	☐	ク
34	52	4	4	4	4	☐	エ
35	53	5	5	5	5	☐	オ
36	54	6	6	6	6	☐	ト
37	55	7	7	7	7	☐	ユ
38	56	8	8	8	8	☐	ヨ
39	57	9	9	9	9	☐	ヲ
3A	58	: Colon	-	☐	☐	☐	レ
3B	59	# Number	+	☐	☐	☐	ロ
3C	60	@ At	‘	| Vertical	| Vertical	☐	ワ
3D	61	' Prime	,	☐	' Prime	☐	ヅ
3E	62	= Equal	† Dagger	☐	= Equal	☐	”
3F	63	“ Quotation	‡ Double Dagger	☐	☐	☐	。

Notes (continued):

- Underscored character sets (Gothic 10, 12, 15, and Text 1, Text 2) are identical to the regular character sets except that an underscore appears under every character except a blank.
- ☐ = Unassigned.
- OCR A character sets should be printing at 6 lpi only. With other line spacing, the extreme top of some characters will not be printed and such characters cannot always be read successfully by optical character reading devices.

Glossary

The following terms are defined as they are used in this manual. If you do not find the term you are looking for, refer to the index or to the *IBM Data Processing Glossary*, GC20-1699.

This glossary includes definitions developed by the American National Standards Institute (ANSI) and the International Organization for Standardization (ISO). This material is reproduced from the *American National Dictionary for Information Processing*, copyright 1977 by the Computer and Business Equipment Manufacturers Association, copies of which may be purchased from the American National Standards Institute, 1430 Broadway, New York, New York 10018.

asynchronous: Without regular time relationship, unexpected or unpredictable with respect to status presentation or service requests.

basis weight: The weight in pounds of a ream (500 sheets) of paper cut to a given standard size for that grade: 25 x 38 inches for book papers, 17 x 22 inches for bond papers, and other sizes for other grades. The basis weight of continuous forms for computer output is based on the size for bond papers.

burster-trimmer-stacker (BTS): An optional feature for the 3800 that permits (1) bursting of the continuous forms into separate sheets, (2) trimming off the 1/2-inch carrier strip from both edges of the forms, and (3) providing single-sheet stacking. The BTS also provides identification of jobs by offsetting the stacking (see job offset).

burst: To separate the continuous forms paper into individual pages.

channel command: An instruction that directs a channel, control unit, or device to perform an operation or set of operations.

chaining: A system of storing commands in which each command belongs to a list or group of commands. Chaining provides consecutive execution until an operation is completed.

character*: A letter, digit, or other symbol that is used as part of the organization, control, or representation of data. A character is often in the form of a spatial arrangement of adjacent or connected strokes.

character arrangement: An arrangement composed of graphic characters from one or more modified or unmodified character sets.

character cell: The maximum physical boundary of a single character. A cell is made up of 24 rows with a total height of 1/6-inch and 18-bit positions having a total width of 1/10 inch.

character compression: When any four or more identical characters occur consecutively within a line, such as blanks at the end of a print line, the printer substitutes a three-byte group instead of the individual characters. The group indicates the graphic code of the character and the number of characters involved.

character generation (or generator): Collectively, the electronics necessary to convert the print line characters into a series of scan patterns which are then used to gate the laser beam modulator, thus producing a latent image on the photoconductor.

character set: The scan patterns for an IBM-supplied set of up to 64 graphic characters, all of one size and style.

character set identifier: A one-byte code identifying the particular character set stored on the internal disk within the 3800.

common-use sizes: A set of paper form sizes used on the 3800 that have been selected as those most commonly used throughout the world.

continuous forms paper: A continuous length of single-ply, fanfolded paper with both edges punched for tractor feeding and perforation between pages. There are various sizes and basis weights.

continuous forms stacker (CFS): The output assembly that refolds and stacks the continuous forms after printing. The assembly is sometimes called a refolder.

copy control: The controls which determine the number of copies to be printed for each data set, as well as which copies will be printed with a forms overlay or have copy modification.

copy modification: A feature that allows the printing of predefined data on all pages of specified copies of a data set.

copy modification segment: The portion of copy modification that contains the control bytes (6) and text bytes (maximum of 204). When transferred to the printer, these bytes modify specific copies of a data set.

* American National Standards Institute definition.

copy separation: The alternation between one or two vertical bars placed in the left carrier strip between pages by the End of Transmission command. In the CFS these marks distinguish between successive copies in a single data set. These marks are trimmed off by the BTS but offset stacking serves a similar purpose.

coronas: Small-diameter wire (or wires, depending on the function) to which a high voltage is applied causing ionization of the air. The ionization creates an electrical charge which performs various functions during the printing process. There are different coronas, each having a unique function such as charge corona, preclean corona, and post-transfer corona.

data *: (1) A representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing by humans or automatic means.
(2) Any representation such as characters or digital quantities to which meaning is or might be assigned.

data set: All of the data that makes up the pages of one complete job.

developer: The assembly that provides a flow of developer mix over the photoconductor to develop the latent image.

drum: A hollow cylinder around which the photoconductor is wrapped. The drum continuously rotates during printing and carries the photoconductor past the various stations in the printing process. The drum also contains the photoconductor supply and takeup spools.

extended binary-coded decimal interchange code (EBCDIC): A set of 256 characters, each represented by eight bits.

electrophotographic: In the 3800 printing process, digital data, which has been converted to raster scan patterns, is scanned onto a photoconductor surface and then electrically charged. (For the forms overlay, a photonegative is projected (flashed) onto the photoconductor.) Next, toner is cascaded over the image and adheres to the charged areas according to the charge potential. Subsequently, the toned image is transferred to the paper and bonded by heat.

format: Character sets (available in 10-, 12-, and 15-pitch) that provide graphics such as lines, corners, and intersections which can be used, for example, to print column lines or boxes around data. Each graphic is available in three line thicknesses.

forms control buffer (FCB): A buffer for controlling the vertical format of printed output. The FCB is analogous to the punched-paper, carriage-control tape used on IBM 1403 printers.

forms overlay: A feature which prints a form, grid, design, or other constant data from a negative as the page buffer data is being printed.

fuser: The assembly that fuses the toned image into the paper by heat and pressure.

Gothic: Character sets (available in 10-, 12-, and 15-pitch) with 63 sans serif graphic characters.

graphic*: A symbol produced by a process such as handwriting, drawing, or printing.

graphic character *: A character normally represented by a graphic.

graphic character modification: A feature that allows the substitution or extension of the graphic characters in an already-defined character arrangement.

host system: The CPU and communication channel which controls the 3800 printer, sometimes called the using system. The printer can have interfaces with several channels between it and the same or different CPUs.

ID: identification

image: The exact likeness or representation of a graphic illustration prepared on a photographic negative. The image is installed into an image holder, inserted into the forms overlay slot, and printed when desired. Image is also defined as the exposed page area on the photoconductor.

impact printer: A printer that mechanically strikes the paper through an impact ribbon.

IMPL: initial microprogram load

ISO: Pertaining to a set of paper sizes selected from those standardized by the ISO group for use in data processing.

job offset: The physical stacking of paper in a "sawtooth" manner so that individual jobs or copies run on the BTS are easy to identify.

* American National Standards Institute definition.

job separation: A series of marks placed on the outside fold of the paper form to indicate the end of the data set. The Mark Form command causes this printing. This method of indicating job termination is used by the CFS. In the BTS, job offset stacking is used to indicate job termination.

Katakana: Character set symbols for writing in one of the two common Japanese phonetic alphabets.

laser: An acronym for light amplification of stimulated emission of radiation. The laser emits a beam of coherent light which forms the image on the photoconductor that is subsequently transferred to the paper.

line overrun: An indication that copy modification was not completed in time for printing the line.

merging: The combining of print lines to highlight or subordinate data within a print line or the printing of different columns of data across a page in different character styles or sizes. See the discussion of Write Commands in the Channel Commands chapter for specific rules for merging.

OCR: optical character recognition; OCR A and B: character set style.

page buffer: Writable control storage in which data to be printed is stored. The data is stored one line at a time until a page is completed and ready to print.

partial page: An incomplete page as compared with a complete page. The host system did not send all of the data required to assemble a complete page in the page buffer.

partitioned: A subdivision of the printer which makes it operate separately and independently from the other attaching channels. This is accomplished by placing the appropriate switch on the usage meter panel to the desired channel.

photoconductor gap: The photoconductor is wrapped from the supply spool (located inside the drum), through an opening on the drum surface, around the drum, and back through the opening on the drum surface to the takeup spool. The opening is referred to as a gap and is sealed after the photoconductor is in place.

pitch: A unit of type width based on the number of times a character can be set in a linear inch. For example, 10-pitch has 10 characters-per-inch.

scan patterns: The bit patterns that make up the individual characters in each character cell (24 rows of 18-bit positions; not all bit positions or rows are used).

scheduling: (1) The preparation time from the completion of the page in the page buffer to the printing of the page, including copy control and copy modification. (2) A line or group of pages waiting within the system to be transferred to the printer.

Text 1 and 2: Character sets of uppercase and lowercase serif graphic characters (63 total).

toner: The material that forms the image on the paper.

transfer station: The assembly where the toned image on the photoconductor is transferred to the paper.

translate table: The 256-byte portion of the character arrangement table that translates the user's data code for a character into the code required by the 3800 control electronics.

two-channel switch: An optional feature for allowing access to the 3800 by two separate channels. The switching is done manually using the Enable/Disable switches on the 3800 usage meter panel. Only one channel interface can be enabled at a time. A Dynamic Switch feature can be added which allows both interfaces to be enabled at the same time with selection determined by programming.

underscore: A line under the individual character. The 3800 provides this capability with either hardware or unique underscore character sets.

writable character generation module (WCGM): A 64-position portion of the 3800 character generation storage which holds the scan elements of one character set. There are two WCGMs in the basic 3800. Optional added storage provides two more WCGMs.

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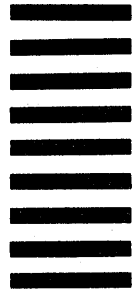
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