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IBM SYSTEM/3

IBM 5203 Printer: Original Equipment Manufacturers' Information

The IBM 5203 Printer Models 1 and 2 are designed as output devices for the IBM System/3. This publication provides information, as a design guide, for the manufacturers of other data processing systems who intend to use the 5203 Printer in their system.

The following topics are dealt with:

1. The operating principles (both mechanical and electronic) of the 5203.
2. The function and timing of all interface signals.
3. The tracing operations that are required to be made by the system to which the 5203 will be attached.
4. The power requirements of the 5203, and electronic information about the interface drivers and receivers.
5. Electrical cabling requirements, and the physical locations of the interface signal connectors.
6. Physical planning data on the 5203, for installation purposes.

Preface

The IBM 5203 Printer is designed exclusively for connection to the IBM System/3, which controls the machine through an integrated attachment that is located in the central processing unit. The 5203 Printer alone has no logic capabilities and, therefore, it requires precisely timed 'ready-made' signals from an external source in order to perform its functions. Other manufacturers who intend to use the 5203 in their data processing systems are, consequently, obliged to design a control unit that is capable of delivering the required control signals.

This manual provides information of interest to designers and manufacturers of equipment that is to be attached to the 5203. IBM's responsibilities, resulting from such an attachment, are defined in the *IBM Multiple Supplier System Bulletin,* Order No. G120-6648.

To assist manufacturers in the designing of a control unit, the manual describes the operating principles of the 5203 and explains the use, function, timing, and physical details of all interface signals that the printer requires from, and/or sends to, the using system. All timing information pertains to both the 5203 Model 1 (100-lines-per-minute machine) and the Model 2 (200-lines-per-minute machine). The logic of the System/3 printer attachment is, however, not described.

The reader is assumed to be familiar with logical design and with solving such problems as the synchronizing of electronic circuits with electromechanical events.

First Edition (May, 1970)

Changes are periodically made to the information herein; before using this publication in connection with the operation of IBM equipment, refer to the latest SRL Newsletter, for the editions that are applicable and current. The data contained herein is current as of March, 1970.

Text for this manual has been prepared with the IBM SELECTRIC® Composer.

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A form for reader's comments is provided at the back of this publication. If the form has been removed, comments may be addressed to IBM Laboratories, Product Publications, Dept 3179, 703 Boeblingen/Wuertt, P.O. Box 210, Germany.

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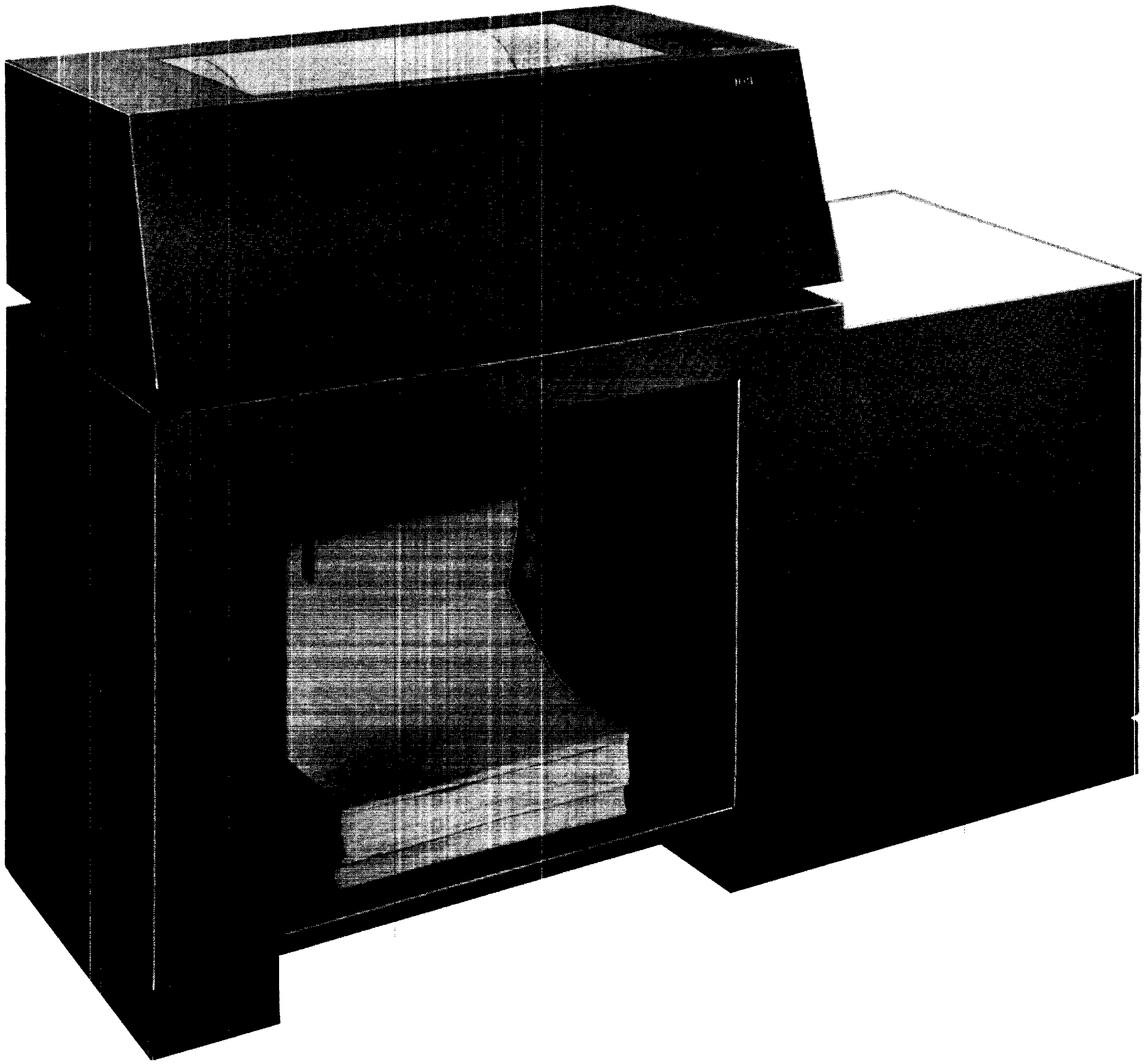
Illustrations

Note: The illustrations in this manual have a code number to the right of the caption. This is a publishing control number and is unrelated to the subject matter.

Abbreviations

A	Ampere
AC,ac	Alternating Current
Carr	Carriage
Char	Character
cm	Centimeter
DC,dc	Direct Current
Dr	Driver
Gnd	Ground
Hmr	Hammer
Hz	Hertz
in.	Inch
Intf	Interface
I/O	Input/Output
kΩ	Kiloohm
lpm	Lines per Minute
Lt	Left
m	Meter (dimension)
mA	Milliampere
mm	Millimeter
ms	Millisecond
N/C	Normally Closed
N/O	Normally Open
ns	Nanosecond
PCB	Printer Control Box
PEB	Printer Electronics Board
Posn	Position
Ptr	Printer
rev	Revolution
rpm	Revolutions per Minute
Rt	Right
s	Second (of time)
SLT	Solid Logic Technology
Sw	Switch
TB	Terminal Block
UCS	Universal Character Set
V	Volt
Ω	Ohm
μA	Microampere
μs	Microsecond



Frontispiece. IBM 5203 Printer [07363]

The IBM 5203 Printer (Frontispiece) is an electromechanical impact-printing device known as a *back printer*. In a back printer, electromagnetically operated print hammers (Figure 1) strike the paper form from behind, thereby pushing a small area of the form against a print element that is located in front of the form.

In the 5203 Printer, the print element is a type carrier (chain), composed of 240 characters that are mounted on a moving, endless band; this arrangement permits all of these characters to be offered to every print hammer repeatedly as the type carrier travels. The type carrier is motor driven at a constant speed, and is housed in a removable cartridge.

The 5203 is available in two models; Model 1 prints at a rate of 100 lines per minute (lpm), and Model 2 prints at 200 lpm.

The printing of a word is a serial-assembly process. To ensure the faithful reproduction of a particular text that is to be printed, therefore, the type characters that become aligned with the various print hammers must be continuously monitored for comparison with the text characters; a print hammer can fire only when a comparison shows that the aligned type character is identical to the text character in a given position.

These monitoring operations must adhere to precise timing conditions, which are based on the construction of the printer. Because the monitoring operations are controlled from the system to which the 5203 is attached, the operating principles of the machine are explained in this manual. The explanations are supported by appendixes which give specific timing, interface, character set, and electrical details.

Detailed timing conditions and tolerances are given in the section "Signal Interfaces" in this manual.

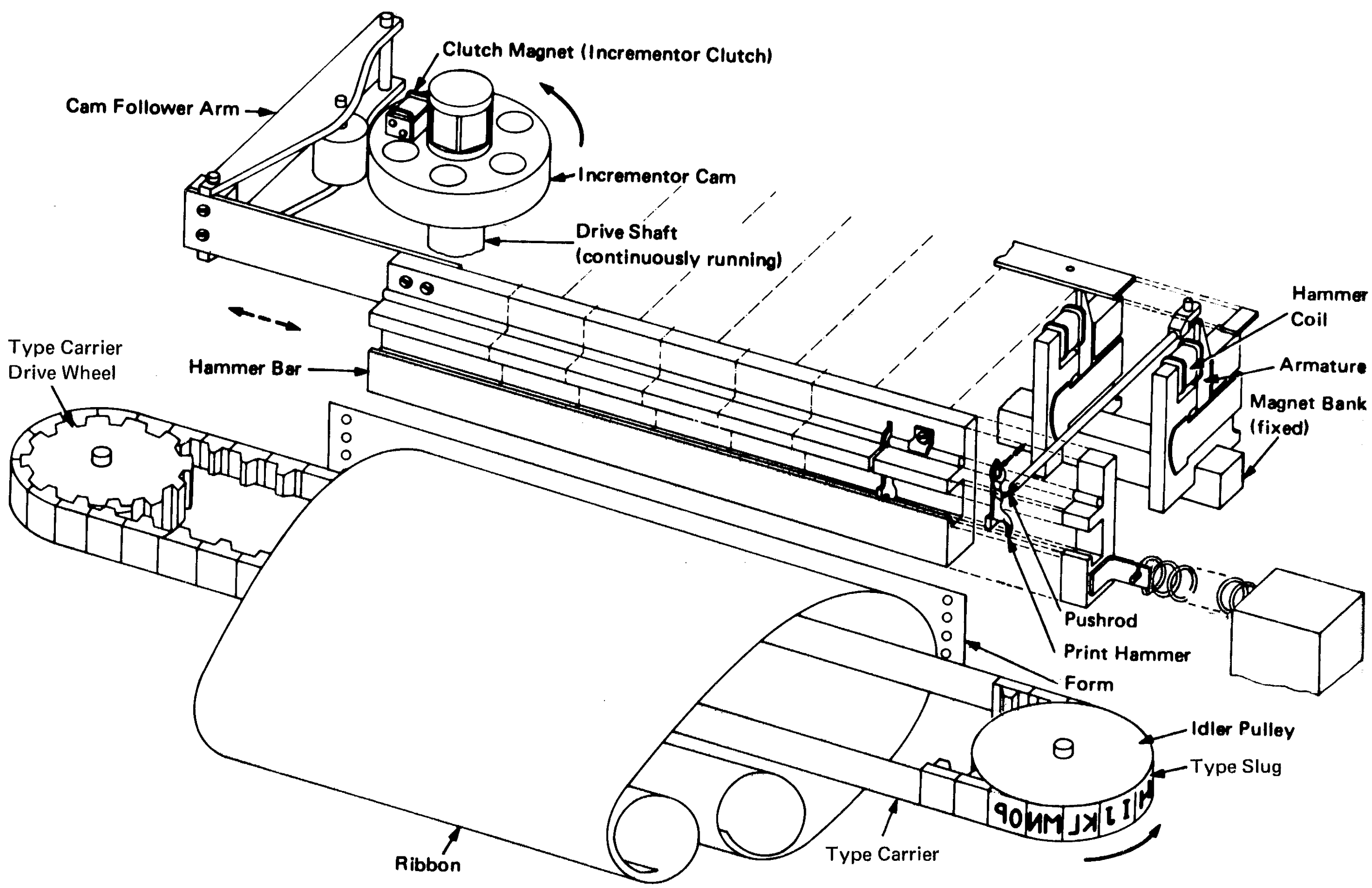


Figure 1. Mechanism of the 5203 Printer [06959]

OPERATING PRINCIPLES OF 5203

Print Positions and Principles of Scanning

The print line is composed of 96, 120, or 132 individual print positions that are located side by side in a horizontal plane. The term *print position* defines the space in which a character is to appear on paper. For this initial description, assume that one print position is identical with one print hammer. (On the 5203, in practice four print positions are served by one print hammer, through a clutch-controlled shift mechanism.)

The spacing of the print positions is 0.1 in. (2,54 millimeters [mm]) from the beginning of one character area to the next, which includes the gap between the adjacent characters (Figure 2); this spacing is termed the *print span.* The distance from one type character to the next is 0.1505 in. (3,823 mm), which is about 50% wider than the print span; this distance is termed the *type span*. The type carrier travels at a constant speed of 129.0 inches (327,7 centimeters) per second, from right to left, and the relationship of print span to type span thus causes a sequential alignment of every second type character with every third print position.

When type character 1 is in perfect (dead-center) alignment with print position 1, the type span allows no other type characters and print positions to be equally *fully* aligned. Figure 2 shows that, at the same instant, type character 3 is *almost* aligned with print position 4, and type characters 5, 7, and 9 (and so on) are progressively further away from dead-center alignment, that is, in increments of an *additional* 0.001 inch each.

It is clear that an alignment scan proceeds from left to right as the type carrier moves from right to left. This alignment scan presents some type character to one-third of all print positions, such as (in Figure 2) characters 1, 3, 5, 7, and 9 to print positions 1, 4, 7, 10, and 13. This means that one character each is offered to 44 print positions of a 132-position print line during the particular scan.

The scan that starts at the instant when type character 1 is in perfect alignment with print position 1 is defined as *subscan 1.* At the end of subscan 1, the type carrier has progressed just far enough to perfectly align type character 2 with print position 2 (Figure 3); this instant is the starting point of *subscan 2.*

During subscan 2, every second type character is aligned with every third print position, except that, now, the entire alignment scheme is advanced by one. This means that type characters 2, 4, 6, 8, 10, and so on are offered to print positions 2, 5, 8, 11, 14, and so on. At the end of subscan 2, type character 3 is in perfect alignment with print position 3 (Figure 4); this instant is the starting point of *subscan 3.* The foregoing scanning proceeds through all positions.

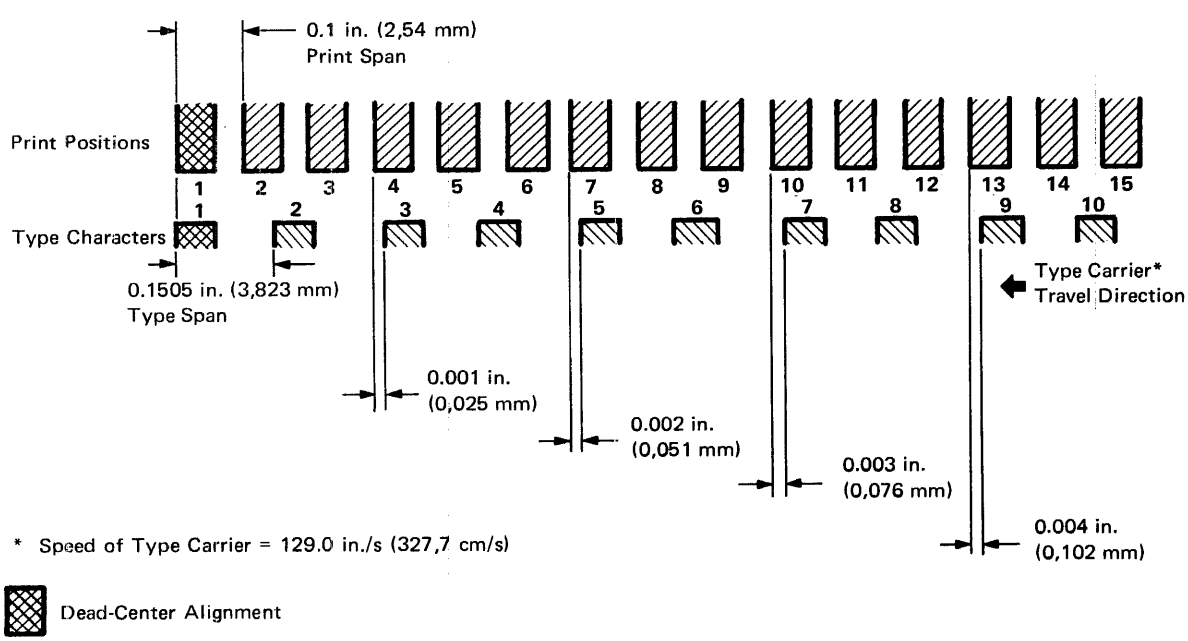


Figure 2. Print-Span to Type-Span Relationship [07323]

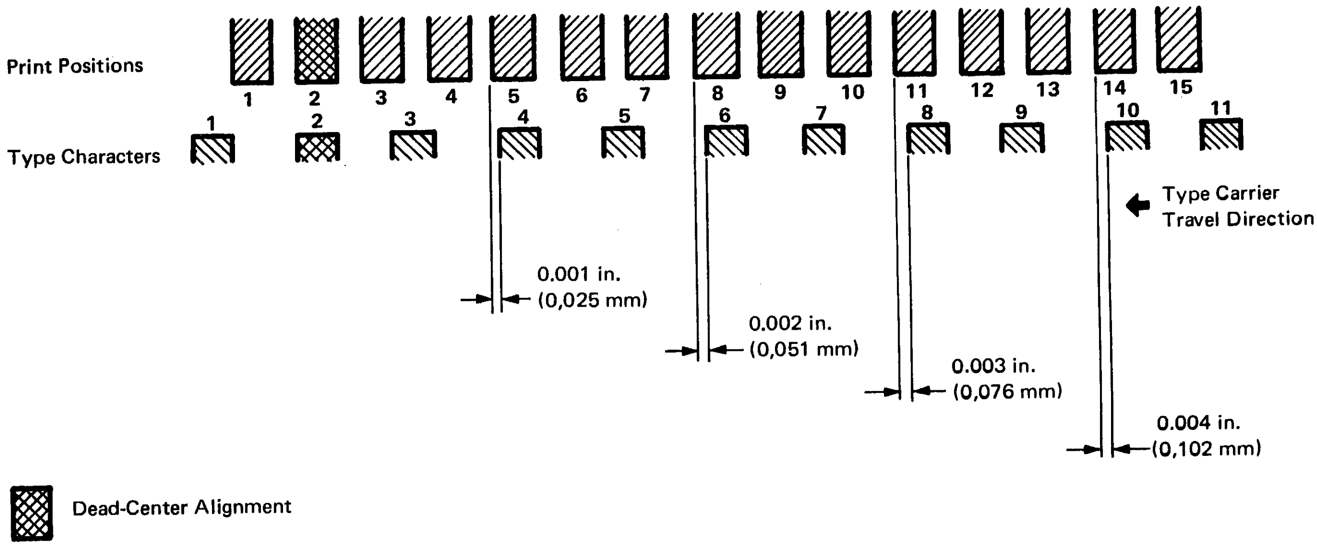


Figure 3. Subscan 2 Alignment Sequence [07324]

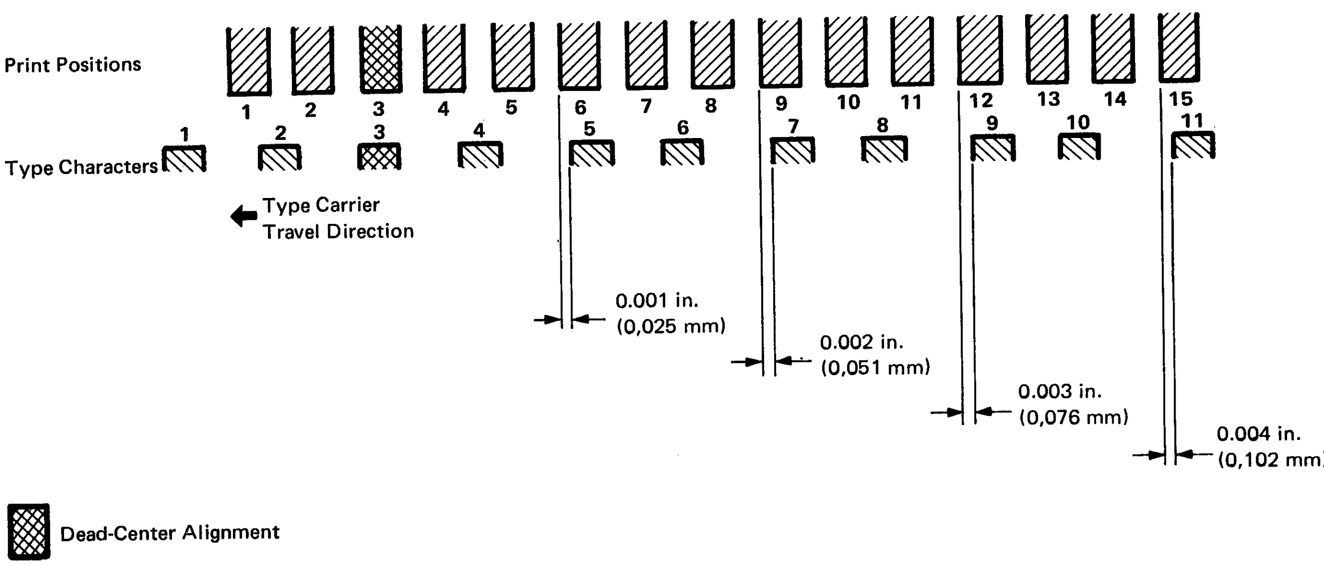


Figure 4. Subscan 3 Alignment Sequence [07325]

Because every subscan offers a type character to one third of all print positions, a "run" of three successive subscans is termed one *print scan.* This term is used because such a scan-series is required to offer *one* character to *every* print position in the print line. Every print position receives a different character, which is not necessarily the one that is to be printed there; the number of print scans that are required to offer the entire set of characters to every print position therefore depends on the number of different characters available. Figure 5 demonstrates this relationship by means of a 20-position printer with 14 different characters (numerals 1 through 14); the circles, squares, and triangles show the characters that become aligned during a particular subscan, and the vertical lines show that every character is offered to every print position in the course of 14 print scans.

Timing of Scans

The 5203 indicates the first alignment of every subscan, but not the alignments that occur during the subscans. These first alignment pulses (subscan pulses) are generated by a timing drum (Figure 6), which has 144 evenly spaced slots and a 145th slot midway between the 144th and 1st slots. The 145th slot represents the "chain" home pulse, which is

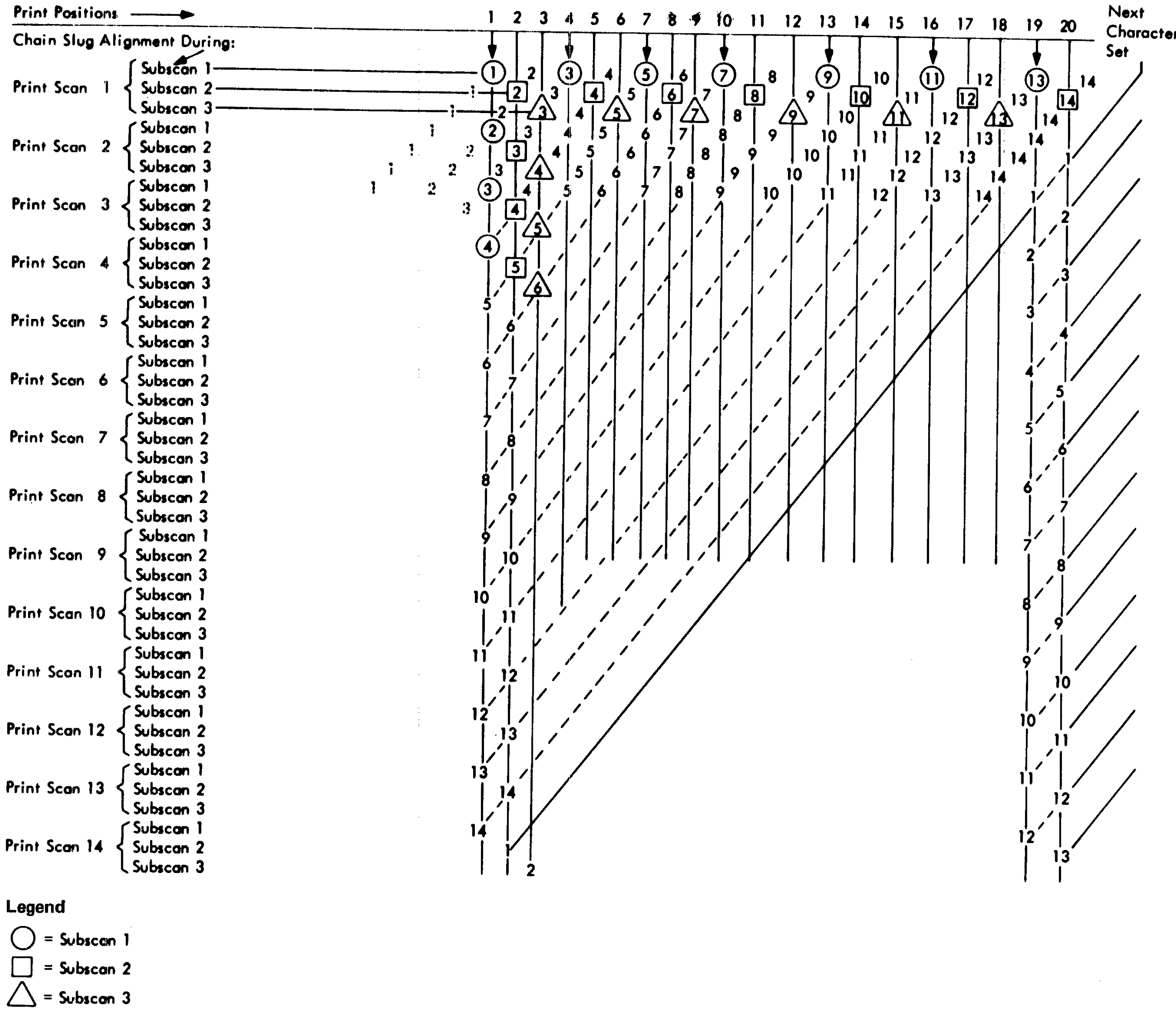
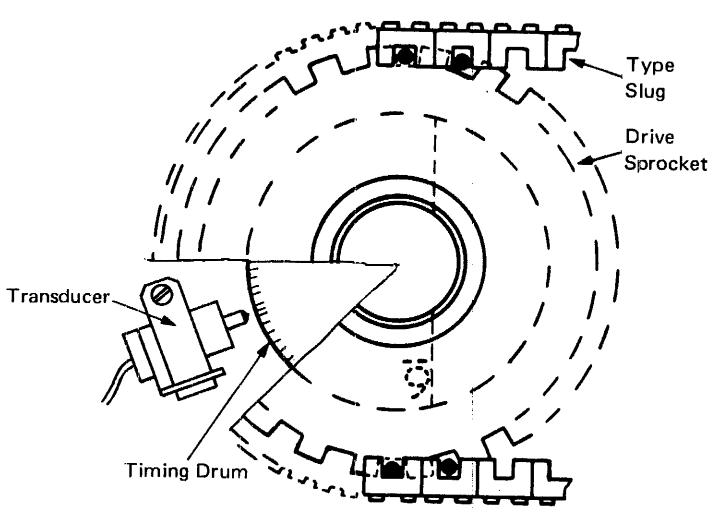


Figure 5. Basic Scanning Sequence [07326]



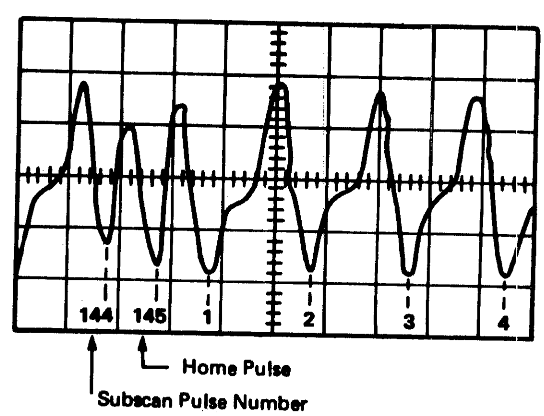


Figure 6. Printer Timing Mechanism [07327]

the primary synchronization pulse for the tracing logic in the using system. The slots are sensed by a transducer, the output of which is amplified and shaped in the printer.

The pulse scheme is based on the standard 48-character set. Because the type carrier has 240 character positions, five identical sets of 48 characters each are distributed along the type carrier. The timing drum rotates five times in every "revolution" of the type-carrier, which means that the "chain" home pulse appears prior to each character set and is followed by 144 subscan pulses for each character set. These 144 subscan pulses, divided by 3, produce 48 print scans as required for the 48 different characters.

The "chain" home pulse may be used to start the tracing logic in the using system. It is assumed in this manual that the tracing logic consists of two counters, one of which points to every second type character while the other points simultaneously to every third print position; in this way, both counters can be compared, in order to derive the "yes" or "no" hammer-firing decision. In addition, a propagation device (such as an oscillator, a trigger ring, or a similar circuit) is required for updating these counters in synchronism with every alignment, because the printer indicates only the *start* of every subscan. Thus the time available between two subscan pulses may be divided into the appropriate number of alignment steps, as required for a given number of print positions. ("Appropriate" means basically one-third of all print positions, although another subdivision may be chosen. See "Control Considerations" for details.)

When the 5203 is equipped with the Interchangeable Chain Cartridge, Add'l feature (which has a so-called universal character set [UCS] of either 60 or 120 different characters), the five home pulses in every revolution of the type carrier are used in an AND function with an additional emitter pulse that occurs six times per revolution. A pulse coincidence occurs only once per revolution, and this coincidence is recognized as the home pulse for UCS operations. The subscan sequence is the same as for a basic machine.

The scanning principles and timing explained previously are modified in actual operation of the 5203 because one print hammer serves four print positions, through a sequential allocation mechanism that is described in "Print-Hammer Allocation".

Print-Hammer Allocation

The print hammers (Figure 7) are located in a hammer bar that is suspended by leaf springs so that it can be moved in a horizontal direction. Each hammer is operated by its own magnet, through a pushrod that transfers the armature stroke to the hammer. The magnets are located in a fixed magnet bank (see Figure 1) in such a manner that every magnet is centered behind four print positions. A 96-position printer is thus equipped with 24 magnets (and 24 hammers), a 120-position printer has 30 magnets, and a 132-position printer has 33 magnets.

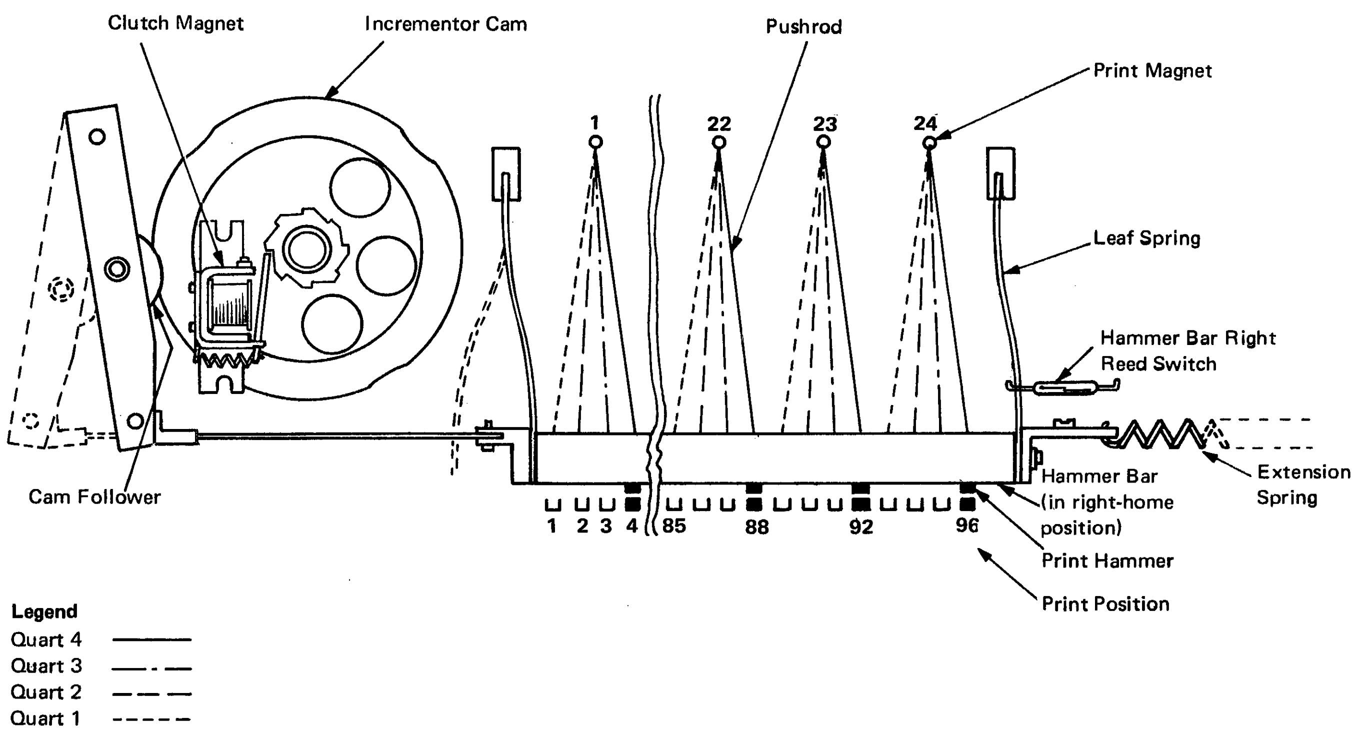


Figure 7. Hammer Allocation Mechanism [07328]

A clutch-operated incrementor cam mechanism positions the hammer bar in such a way that all hammers are allocated to one quarter of all print positions at a given instant. During initial power on, the incrementor (hammer shift) clutch must be picked to move the hammer bar to the right-home position, which is indicated by a magnet-operated reed switch. In the right-home position, the hammers are allocated to the fourth quarter (quart 4) of all print positions, as shown in Figure 7; for a 96-position printer, "right home" means that hammer 24 is allocated to print position 96, hammer 23 is allocated to print position 92, and so on, ending with hammer 1 being in front of print position 4.

The hammer bar remains in the fourth-quarter position until every character in the set has been offered to every print hammer; for a 48-character set, 48 print scans therefore elapse before the hammer bar moves. When the incrementor cam clutch is picked, the hammer bar performs a one-position shift to the left, thus allocating the hammers to the third quarter (quart 3) of all print positions. An emitter on the cam issues a print start pulse (Figures 8 and 9) when the shift motion is completed, and the pulse informs the using system of the beginning of a new print quart. During this print quart, the cam rotates and presents an even dwell (a circular segment) that keeps the hammer bar motionless for the duration of 48 print scans (that is, 144 subscans). For larger character sets (UCS), the even-dwell time of the cam is actually too short. The missing time is, therefore, provided by stopping the cam before the next shift ramp reaches the follower arm (see UCS latchpoints in Figures 8 and 9). A print line is thus built up in four hammer increments by the right-home position and three successive shift motions.

After completion of one print line, the 5203 Model 1 (100-lpm printer) restores the hammer bar to the right-home position, whereas the Model 2 (200-lpm printer) keeps the hammer bar at the left-home position to build up the next print line in reverse order. This operational difference is achieved by different cam contours, as shown in Figures 8 and 9.

Before the start of the next print line, the form (or forms, in the case of dual feeding*) must be advanced. On the 100-lpm printer, forms advancement takes place concurrently with the hammer bar restore cycle, which provides sufficient time for a 31-line space movement; if the form needs to move more than 31 spaces, the incrementor cam must be stopped until the form has settled. On the 200-lpm printer, the cam design provides a time allotment for forms advancement by one single space; if the form needs to move more than one single space, the cam must be stopped until the form has settled.

The hammer allocation alters the print alignment scheme, described previously in this section, in that only one-fourth of the alignments that occur during a subscan actually yield *useful* print options. (The term *print option* describes the situation in which a type character is aligned with a print position, and may thus be printed if it happens to be the

* On machines equipped with the Dual Feed Carriage feature, a second carriage is provided so that two forms may be printed side by side. Each form is under a separate forms control.

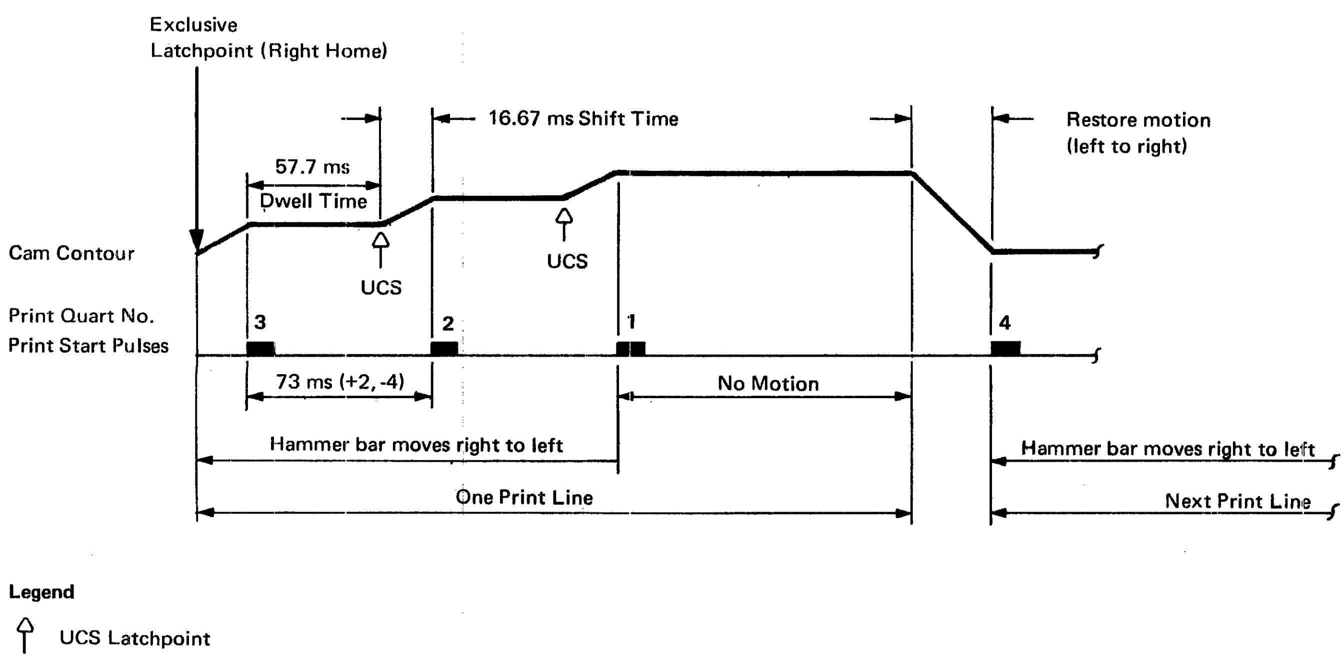


Figure 8. Cam Contour with Latchpoints (5203 Model 1) [07329]

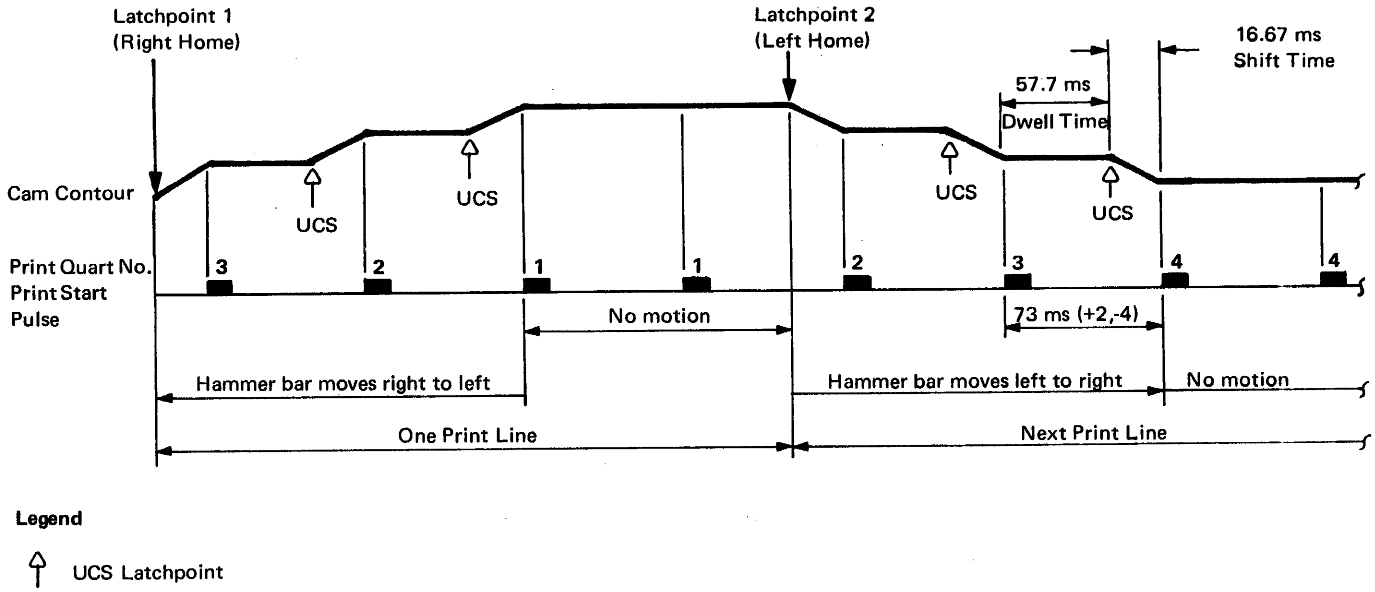


Figure 9. Cam Contour with Latchpoints (5203 Model 2) [07330]

character that is to appear in that print position.) Figure 10 shows the useful alignments during the first three subscans, based on a 132-position print line. Instead of the normal sequence of every second type character/every third print position, the useful sequence is as shown, that is, every eighth type character/every twelfth print position. Consequently, most of the subscan pulses do not necessarily indicate the first useful alignment of a scan (as they would do if every print position had its own hammer). This situation requires an additional control, the principle of which is described in "Control Considerations".

CONTROL CONSIDERATIONS

The print-hammer allocation may be incorporated into the tracing logic of a using system in several ways. The designer of the tracing logic has considerable freedom of action, and his ultimate decision will depend on various technical and economic factors which cannot be evaluated in this manual. Two basic methods of tracing are, however, described in this section as a design guide and for familiarization purposes.

The assumptions made in the following text do not imply that the tracing logic of a using system must be designed exactly as described or that circuits must be used where, for example, a control program can handle the task equally well. All explanations are limited to basic facts so as to avoid any influence on a potential design. The section "Signal Interfaces" in this manual does, however, contain detailed timing requirements which any tracing logic must meet. Recommendations are given where the designer has a choice of methods or implementation.

Assumptions

It is assumed that the text for one print line is set into a reserved area (such as an output field, a print buffer, or a line register) in an edited form, so that this text can be compared with the type characters. The term *edited* means that all print positions in which no printing is to appear are occupied by some "unprintable" character, such as a filler character or a blank; it is then possible for all print positions to be compared systematically, so that any unprintable characters inhibit firing of the print hammers because of the unequal-compare results.

It is further assumed that the tracing logic contains devices that, in effect, represent the following three basic counters:

1. A *subscan counter,* that counts the subscans either accumulatively in chronological order or in a repetitive 1-2-3 pattern.
2. A *print scan counter,* that is increased by 1 each time that three subscans have elapsed.
3. A *print compare counter,* that consists of two subcounters that count simultaneously; one subcounter traces every optioned type character, and the other traces every optioned print position.

If the text is encoded in numeric form (for example, from 1 through 48), the type characters can be identified by a simple counting procedure and the comparison thus consists of the ANDing or EXCLUSIVE ORing of two binary values. This form of encoding also simplifies counting. Because the 5203 indicates only the beginning of every subscan but not the print options within a subscan, the tracing logic operates independently of the printer, that is, under control of an oscillator that steps the print compare counter. The actual tracing may be achieved by various methods, two of which are described.

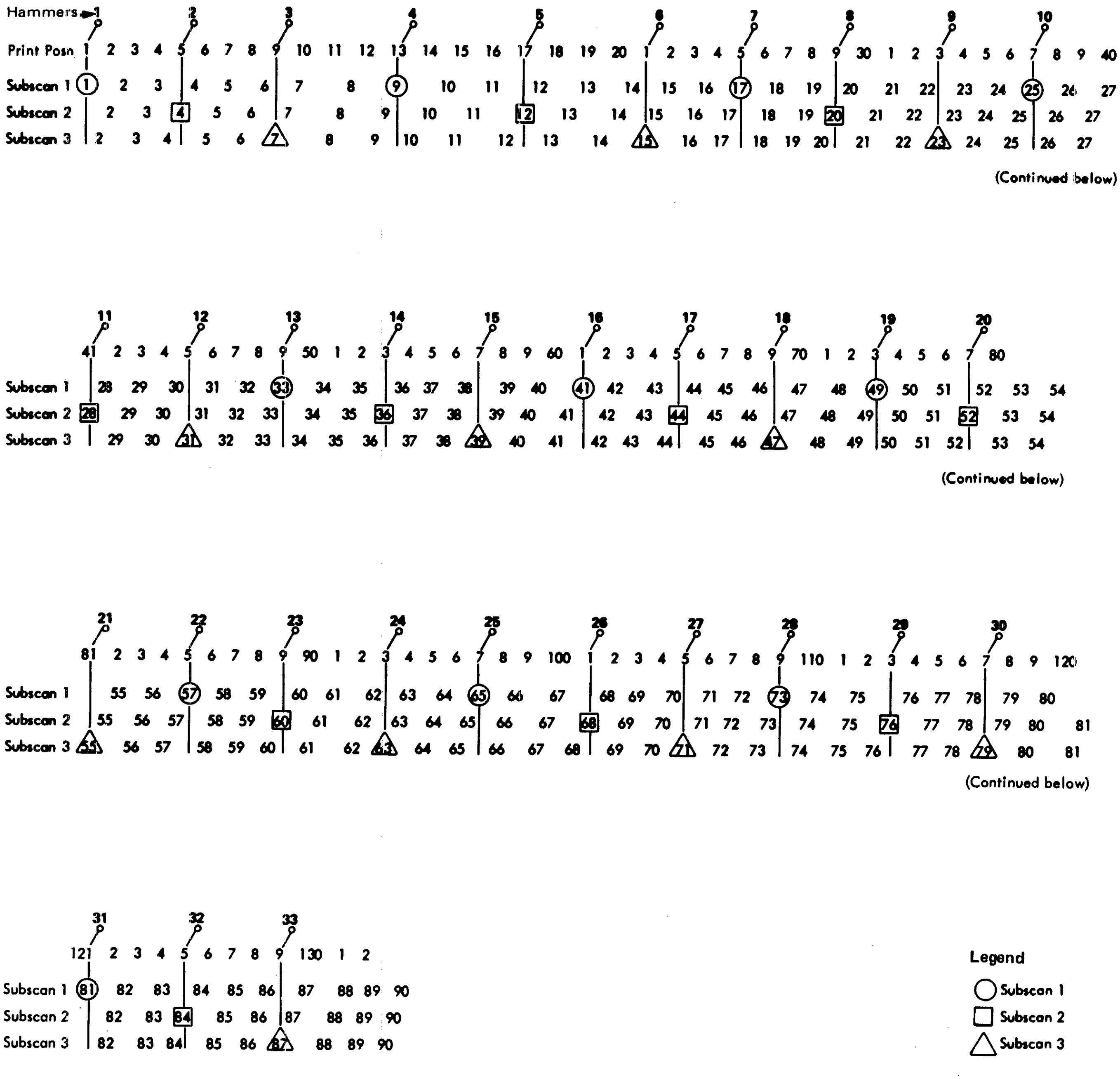


Figure 10. Useful Print Alignments [06961A]

Tracing Method 1

The first method of tracing is based on a tracing sequence that is limited exclusively to the *useful* print options. This means that the print compare counter skips all print positions that are void of a hammer, by comparing every 8th type character with the contents of every 12th print position. When this method is used, the subscan pulses are periodically asynchronous to the first print option in certain subscans.

The tracing oscillator must, therefore, start with the appropriate delay (Figure 11). The delay ensures that the first useful option in a given subscan is found, after which the 8-to-12 stepping sequence may begin. Depending on the subscan and on the hammer allocation, three different start delays or none may be required (Figure 12). The start delays and the presetting of the print compare subcounters vary both with every subscan and with the hammer allocation in every quart.

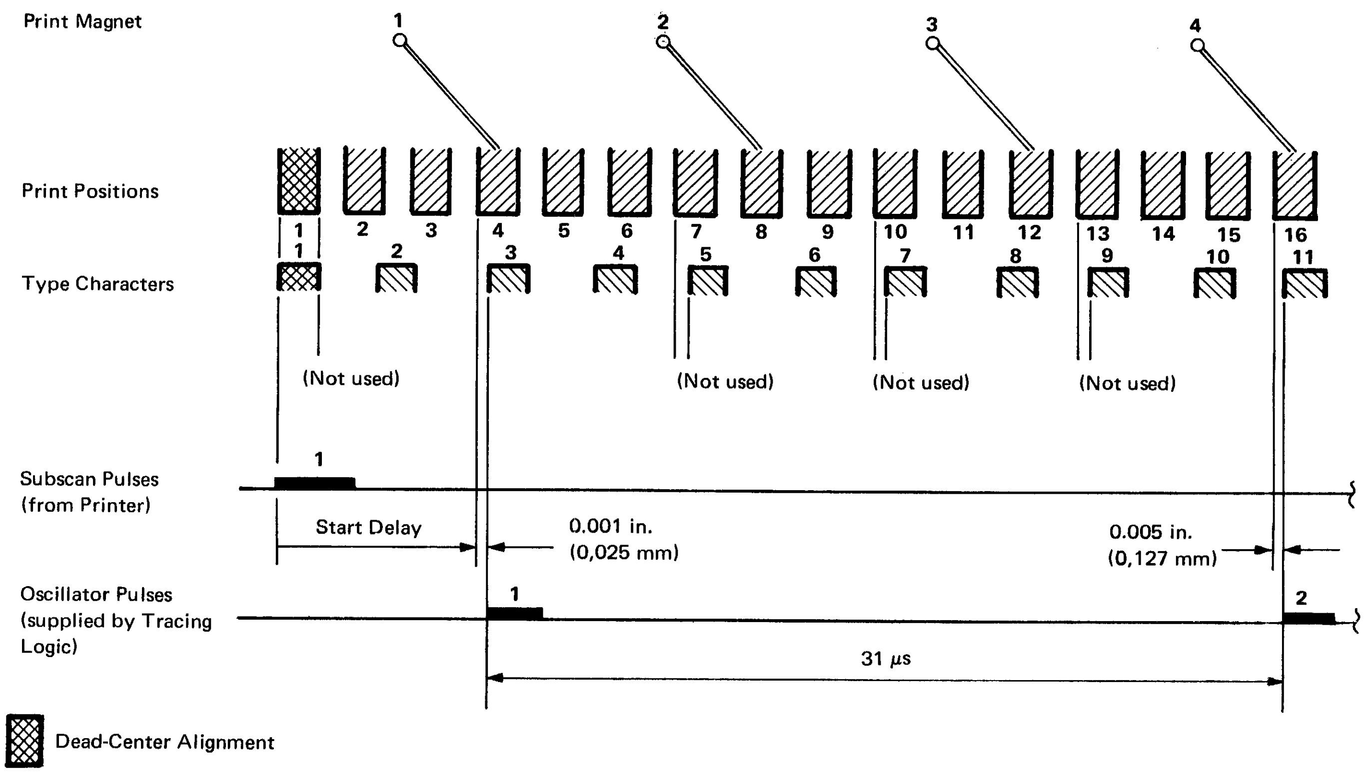


Figure 11. Start Delay of Tracing Oscillator [07331]

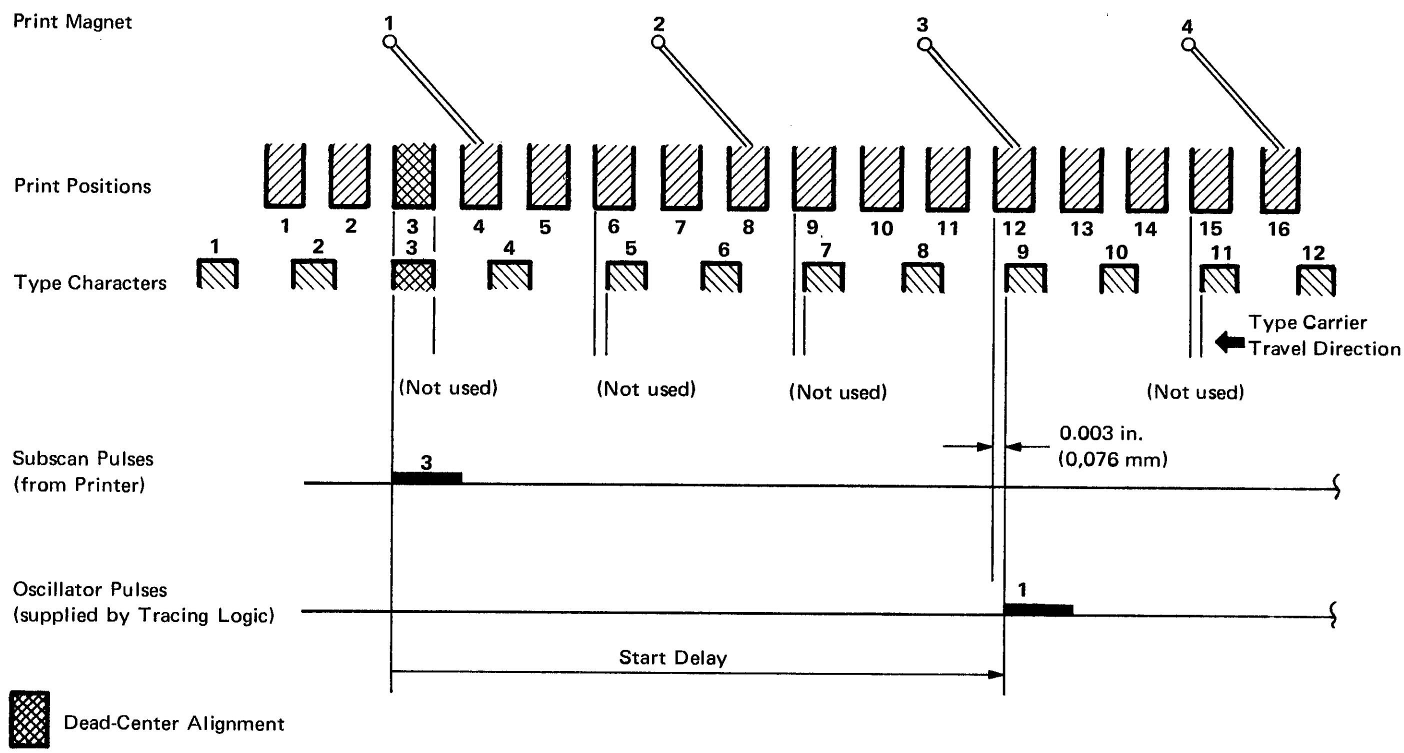


Figure 12. Worst-Case Start Delay [07332]

The 8-to-12 tracing sequence provides 11 print options per subscan. The type carrier speed, in conjunction with the print and type spans, causes a time spacing of 31 microseconds (μs) between adjacent print options. The subscan pulses must, consequently, lead the actual dead-center alignments by a hammer flight time of 1425 μs (Figure 13), plus the 31 μs provided for comparison and stepping. The pulse lead time is given by the position of the chain transducer in relation to the timing drum. A vernier setting allows the lead time to be adjusted within a range of 750 μs, but the adjustment cannot reduce the lead time to less than 1167 μs.

Tracing Method 2

The second method of tracing is based on a tracing sequence that compares *every* optioned print position, irrespective of whether a hammer is present. A separate hammer allocation mask must then suppress the result of the comparison in all positions that are void of a hammer at a given time (Figure 14). The print compare counter systematically compares every second type character with every third print position (just as if every print position had its own hammer).

This method avoids the various start delays and intricate presetting patterns of method 1, but requires a faster oscillator because 44 print options occur within one subscan. The time spacing between adjacent print options must be 7.7 μs, and the subscan pulses then lead the true dead-center alignments by the hammer flight time (1425 μs), plus the 7.7 μs provided for comparison and stepping. The subscan pulses are always in synchronism with the first print option of a subscan.

The hammer allocation mask must be designed to shift in synchronism with the hammer bar. Each mask position is retained for the duration of one print quart.

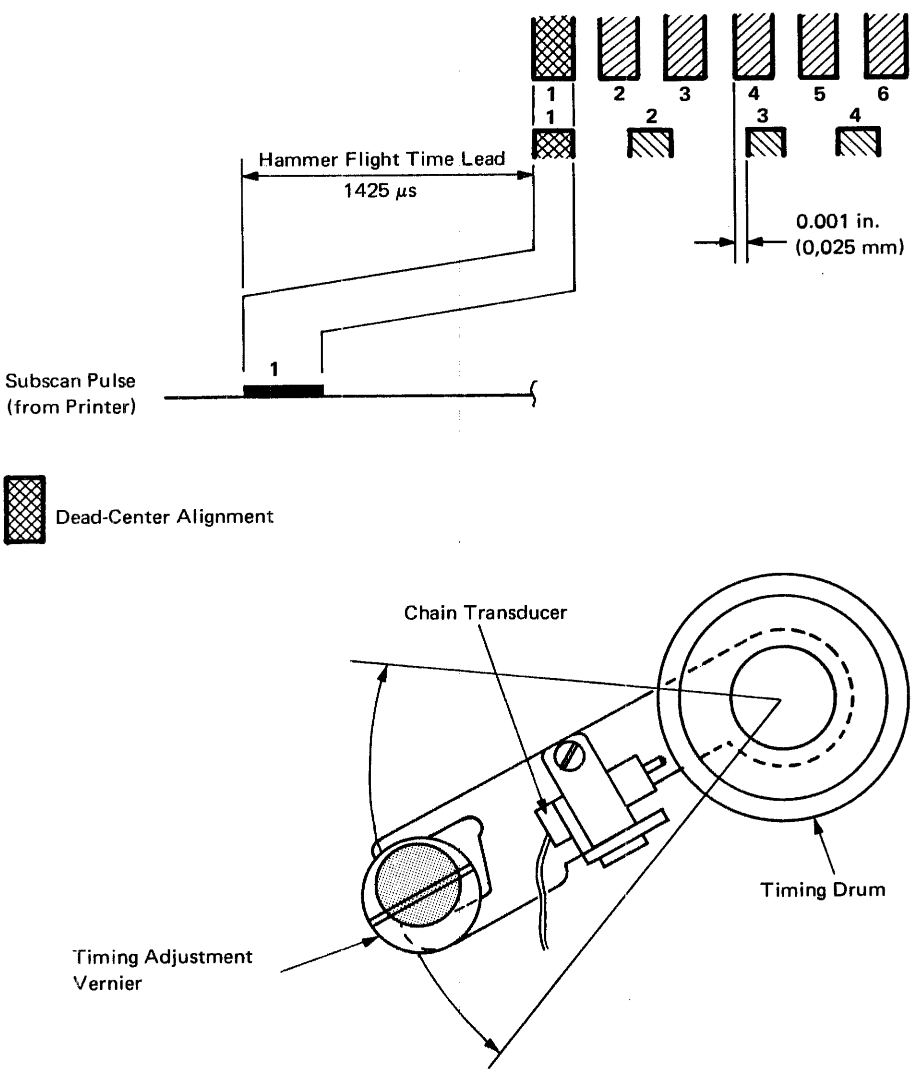


Figure 13. Pulse Lead Time vs Physical Alignment [07333]

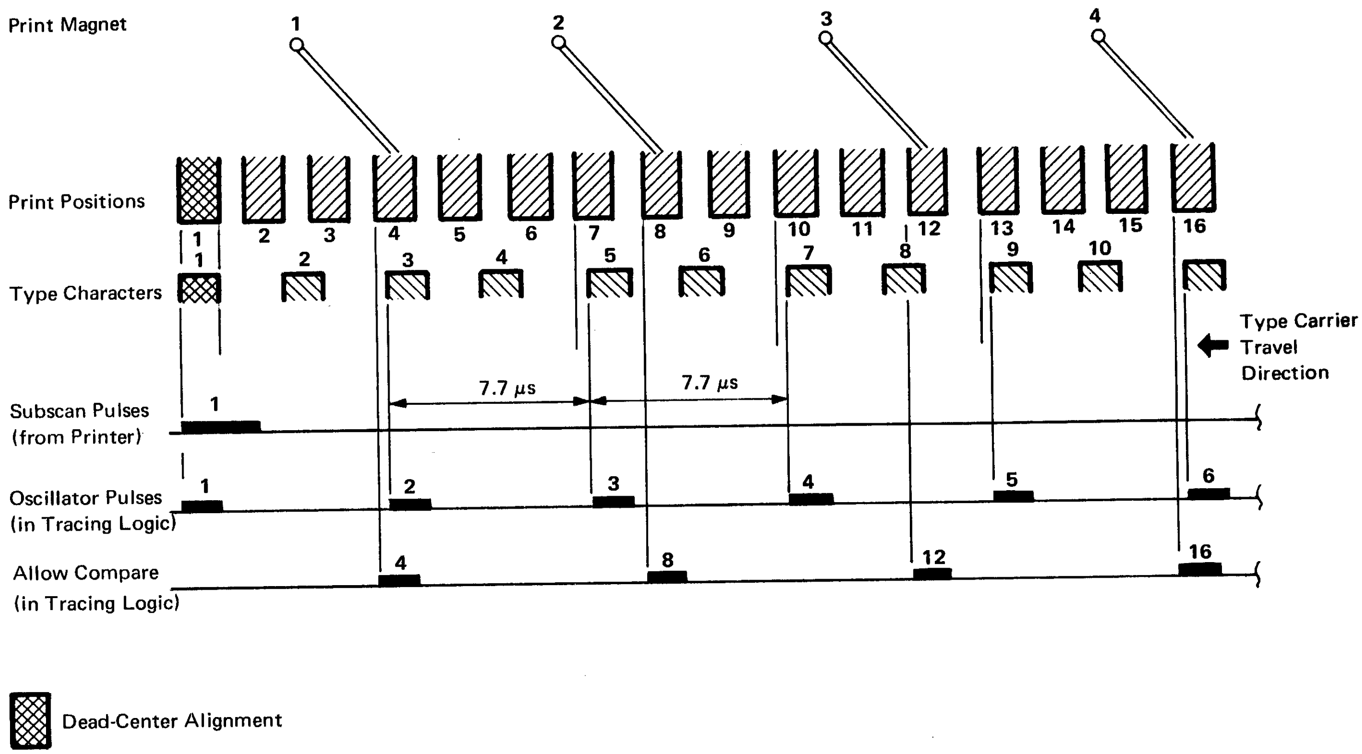


Figure 14. Compare-Suppression Method of Tracing [07334]

Invalid Character Test

Because the hammer-firing decision is based on an equal comparison between the required character and the aligned character, all text should be checked for validity either before editing or before its delivery to the tracing logic. All characters other than those available on the type carrier should be recognized as invalid or unprintable before a print operation is started. A validity check of this type is recommended in order to avoid the confusion created by a "missing" character (which cannot possibly be printed).

It is also recommended that the same filler character is always used in those positions that are to remain intentionally blank.

UCS Tracing

Universal character sets* may be ordered from IBM by customers who need to print more characters than those offered by the standard (48) character set. The characters may usually be selected by the customer, and the sequence of these characters on the type carrier may be determined according to statistical needs.

Because the contents of the UCS are variable, and customers may use several different UCS's, special tracing efforts are required. Every UCS cartridge is accompanied by a chain image card deck that may be loaded into the tracing logic. The tracing logic should, therefore, contain an image buffer of 120 positions (the largest UCS set offered has 110 different characters, some of which may be repeated). The tracing method is the same as that required for standard sets, except that more characters must be compared. Therefore, the print compare counter (or its equivalent) must be expanded, and the incrementor clutch must be controlled so as to expand the cam dwells (which allow for 48 print scans) to the enlarged number of print scans. Control of the incrementor clutch is described in the section "Signal Interfaces" under "Intf Hmr Shift Clutch" and "Intf Print Start Pulse".

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* Interchangeable Chain Cartridge, Add'l feature

This section describes the purpose and timing conditions of every incoming or outgoing signal that the 5203 requires and/or gives in response. The signal descriptions are divided into *logical signals* (associated with printing), *interlock signals* (required for event control), and *manual signals* (from console keys). The console lights interface is also described in this section.

The location that is given with the text heading for each signal refers to the connector and pin identification; for example, "location A5 B2" means that the interface for the signal is located at connector A5, pin B2. These locations are also given in Appendix C (see Figure 43). Abbreviated words in the signal names are explained in a list at the beginning of the manual.

The terms "chain" and "type carrier", used in this section, have the same meaning.

LOGICAL SIGNALS INTERFACE

The logical signals are described in approximately the order that they are required by the 5203 or are returned to the using system during print operations. The voltage level of the signals is given under "Interface Drivers and Receivers" in the section "Power Interfaces".

Intf Drop +60V (Direction: To Printer)

Location: A5 B2

The 'intf drop +60V' signal must be activated by the using system in all cases where unsafe conditions or errors require that the 5203 be made nonoperational; conversely, this signal must be absent for the printer to become operational. 'Intf drop +60V' controls the dc contactor in the printer control box (PCB). An up level on the signal causes the internal +60V dc supply of the 5203 and the type-carrier drive motor to be cut off, and a down level automatically picks the dc contactor (and the type-carrier drive motor relay if the common interlock is off).

Intf Device Ready (Direction: From Printer)

Location: A5 D5

The 'intf device ready' signal turns on (down level) 5 seconds, ±50%, after the start or restart of the type-carrier drive motor. The signal indicates to the using system that the type carrier is up to speed, which is a prerequisite for printing. The printer motors are started when ac power is turned on, although the type-carrier drive motor is also controlled by a common interlock (two switches), which allows this motor to start only when rear unit and forms chute are closed. 'Intf device ready' goes off (up level) immediately the using system activates the 'drop +60V' signal.

Note: The device-ready indication is not to be used as a start-printing command. Print operations must not begin before the operator has pushed the start key on the 5203 console and a print instruction has been issued by the program.

Intf Print Time (Direction: To Printer)

Location: A5 B5

The 'intf print time' signal provides the using system with a means of controlling the ribbon drive of the printer. The ribbon drive runs as long as 'intf print time' is on (down level) and stops 1 second, +60%, –40%, after 'intf print time' goes off (up level).

The exact time for turning on 'intf print time' is a matter of designer's choice. The signal must be on before the first print command is executed. It is recommended that the signal is always turned off after every print line, to avoid unnecessary ribbon transport (for example, during long processing periods between result printouts). During continuous printing, the ribbon runs continuously because the 1-second runout delay covers the restart gap (Figure 15).

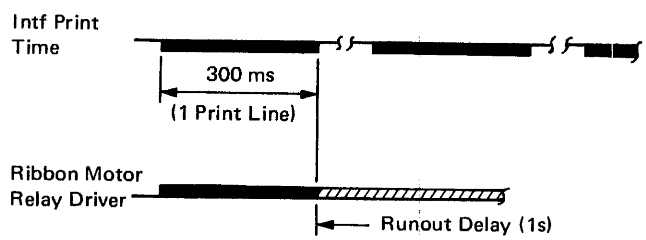


Figure 15. Example of Ribbon Control [07335]

Intf Chain Emitter (Direction: From Printer)

Location: A5 D3

The 'intf chain emitter' output line sends the subscan pulses and the home pulse. The width (up level) of subscan pulses 1 through 143, and the time from the leading edge of subscan pulse 1 to the leading edge of subscan pulse 2 are shown in Figure 16. All subsequent pulses up to subscan pulse 144 have the same spacing and do not vary by more than 8 μs. The width of, and spacing between, subscan pulses 144 and 145 (home pulse) are also shown in Figure 16.

The home pulse defines the next following pulse as "subscan 1 start", provided a standard 48-character set is used.

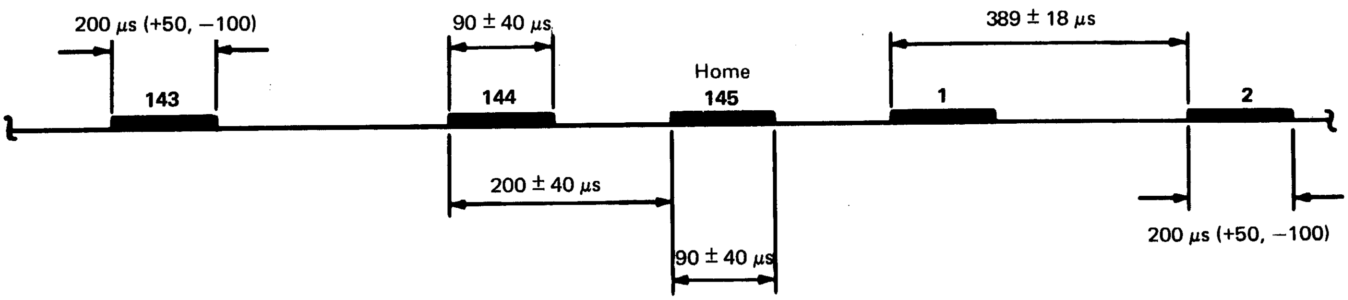


Figure 16. Chain Emitter Timing [06604A]

The home pulse may be used for checking synchronization between chain and the tracing logic; an asynchronous condition should be recognized when chain and tracing logic differ by more than 200 μs.

Intf UCS Chain Home Emitter (Direction: From Printer)

Location: A5 D10

The 'intf UCS chain home emitter' signal must be used only if the Interchangeable Chain Cartridge, Add'l feature is installed on the printer. The signal appears six times per chain revolution whereas the standard chain home pulse appears five times per chain revolution. A near coincidence of both pulses thus occurs once per chain revolution and constitutes "valid home". A true coincidence occurs when the time between the leading edge of the UCS-home pulse and the leading edge of the chain home pulse is 6 milliseconds (ms) or less (Figure 17). The width of the UCS-home pulse is between 0.3 and 0.8 ms.

The UCS-home pulse must be ignored unless a UCS-chain cartridge is installed on the printer.

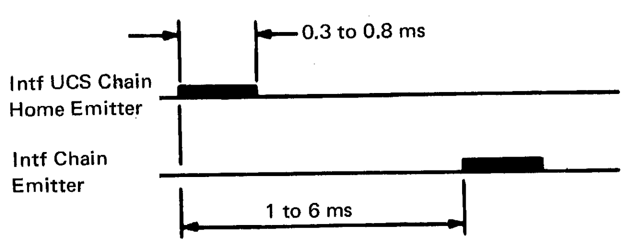


Figure 17. UCS to 'Chain Home' Pulse Relationship [06605]

Intf 48 Char Set (Direction: From Printer)

Location: A5 D9

The 'intf 48 char set' signal is on (down level) when either a standard character set type carrier or no type carrier is installed on the printer. The signal is off (up level) when a UCS-chain cartridge is installed on a printer equipped with the Interchangeable Chain Cartridge, Add'l feature. 'Intf 48 char set' originates from a microswitch that is operated by a stud provided only on UCS-chain cartridges. The signal thus tells the tracing logic if the UCS-home pulse is to be ignored.

Intf Hmr Shift Clutch (Direction: To Printer)

Location: A5 B4

Down level must be applied to the 'intf hmr shift clutch' line when, and for as long as, the magnet of the incrementor clutch is to be energized (clutch engaged); up level must be applied for as long as the clutch is to be disengaged. The incrementor clutch controls the movement of the hammer bar, through the incrementor cam. With down level applied, the clutch magnet is picked for 3.2 to 5.0 ms, after which the current is automatically limited to hold current. The duration of 'intf hmr shift clutch' is unlimited.

Clutch Operation

The incrementor clutch is operated under the following circumstances. Before a print operation is started, the hammer bar must be brought to the right-home position by engagement of the incrementor clutch until the hammer-bar-right condition is indicated to the using system (see "Intf Hmr Bar Right"). The initial quart of a first print line (quart 4) is then printed with the hammer bar locked at right home (clutch disengaged).

For maximum efficiency, it is recommended that the incrementor clutch magnet is picked at the start of the last three print scans for the initial quart (Figure 18). For a 48-character set, this means that 'intf hmr shift clutch' should go on at the beginning of print scan 45; for a 60- or 120-character set (UCS), the clutch magnet should be picked whenever the print buffer is empty, unless this instant coincides with the clutch-inhibit time (48 to 65 ms after the 'intf print start pulse' signal is raised). The print-buffer-empty condition occurs when the last character of a given print line has been printed, which may be so early that there is no need to stop the incrementor cam; should this moment coincide with the clutch-inhibit time, the clutch magnet must be picked only after the inhibit time has elapsed.

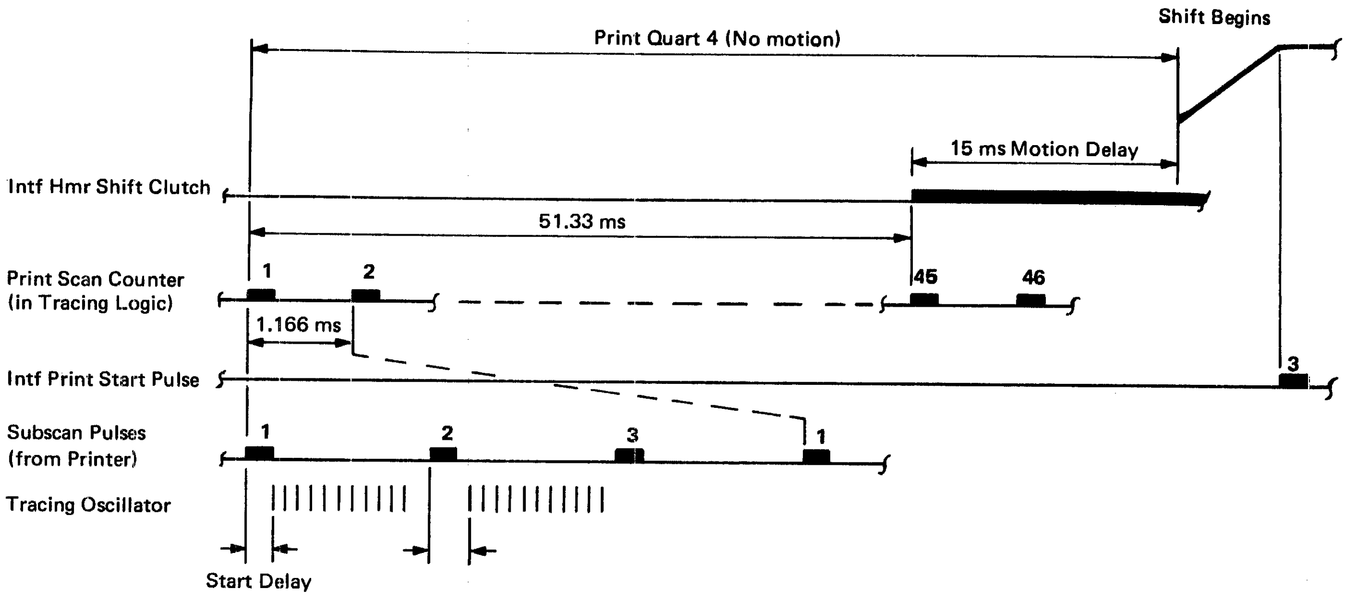


Figure 18. Example of Hammer Shift Clutch Control [07336]

The exact moment for releasing the incrementor clutch is described under "Intf Print Start Pulse". Clutch release depends mainly on the type of print operation in progress and on the number of carriage spaces (forms movement) taken after print line completion. For a standard print operation (48-character set), the clutch may be kept engaged until the print line is completed. It must then be disengaged only if the carriage limits (31 spaces for the 5203 Model 1, 1 space for the Model 2) are exceeded. If these limits are not exceeded, and if printing is to be continued, the clutch may remain engaged until the print job ends.

During UCS operations, the incrementor clutch must be disengaged during every print quart, because the cam dwells must be extended beyond the mechanically given 48-print-scan allotment.

Intf Print Start Pulse (Direction: From Printer)

Location: A5 B6

The 'intf print start pulse' signal originates from a timing device on the incrementor cam. The signal appears 20 to 40 ms after the incrementor clutch starts to engage. Up level on the 'intf print start pulse' line means on, and down level means off. The rising flank of the pulse marks the exact moment that the hammer bar comes to rest in a new print quart (Figure 19). The hammer bar is then on an even dwell of the cam (motionless) for the duration of 48 print scans.

The print start pulse indicates to the tracing logic that the compare operations (which have been suppressed after completion of the previous print quart) may now continue. The tracing logic has, for re-orientation, 1.16 ms of elapsed time after recognition of the print start pulse. It is recommended that the subscan pulses are counted throughout the shift motion and that the subscan pulse that follows after the print start pulse is "seized" for resynchronization. The dwells of the incrementor cam are designed with a 3-subscan safety margin and, therefore, resynchronization must be established not later than after 3 subscans have elapsed.

In addition, the print start pulse may be used to supervise correct operation of the incrementor clutch. For example, an error may be recognized whenever the print start pulse fails to appear within 45 ms after the incrementor clutch magnet has been picked. Supervision, as described, is a matter of designer's choice.

For UCS operations, the print start pulse also indicates the instant that the incrementor clutch is to be disengaged. The clutch magnet may be dropped 5 ms after it has been picked but not later than 5 ms after 'intf print start pulse' has risen.

Note: The subsequent re-engagement of the incrementor

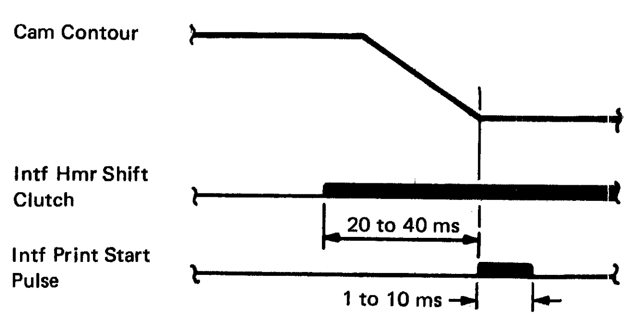
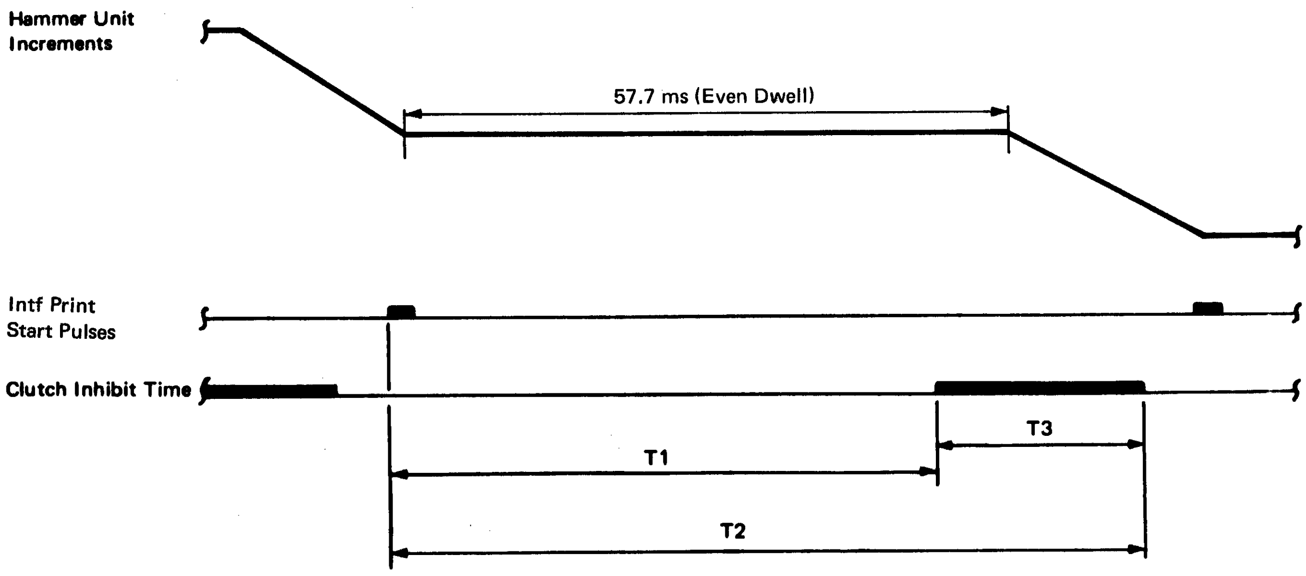


Figure 19. Print Start Pulse Timing [07337]



Legend

T1 = 48 ms
T2 = 65 ms
} Clutch may pick during T1 and after T2, but not during T3

T3 = 17 ms (inhibit time)

Figure 20. Hammer Shift Clutch Restriction [07338]

clutch (during UCS operations) must occur either *within* 48 ms after the rise of 'intf print start pulse' or *after* a total period of 65 ms has elapsed (Figure 20). The clutch magnet must not be picked during the intermediate period of 17 ms because, during that time, the clutch armature is about to engage the clutch sleeve (maximum impact).

The print start pulse may also be used as the indication for disengaging the *carriage* clutch when carriage advancing operations in excess of the limits are to be performed. The print start pulse for the last quart prior to print line completion should be used for this indication. Details on clutch re-engagement after carriage operations are given under "Intf Left Carr Emitter".

Intf Left Carr Clutch (Direction: To Printer)

Location: A5 B13

Down level must be applied to the 'intf left carr clutch' line when, and for as long as, the carriage clutch is to be engaged. The earliest moment for picking the carriage clutch magnet is at the start of the last three print scans (in the last quart prior to print line completion). For a 48-character set, this means that the clutch should be started at print scan 45 for the last print quart, to avoid throughput losses.

The duration of the 'intf left carr clutch' pulse depends on the number of line spaces by which the form is to be advanced. The carriage indicates, through the carriage emitter pulse, the start of every carriage space motion. This pulse may be used as the clutch disengagement signal as described under "Intf Left Carr Emitter".

Intf Left Carr Emitter (Direction: From Printer)

Location: A6 B13

The 'intf left carr emitter' signal is on (up level) 7 to 10.5 ms after the leading edge of the 'intf left carr clutch' pulse (Figure 21). The 'intf left carr emitter' pulse has a width of 0.5 to 2 ms. The rising flank of the emitter pulse indicates the exact moment for disengaging the carriage clutch. If, for example, a single space is to be performed, the clutch magnet must be dropped when the first emitter pulse is recognized;

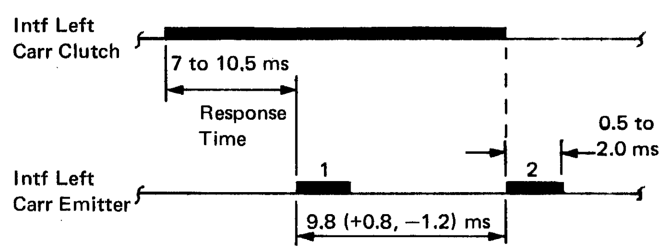


Figure 21. Carriage Timing Relationship [07339]

if eight spaces are desired, the clutch must disengage when the eighth emitter pulse is sensed. The distance from the leading edge of one emitter pulse to the leading edge of the next one is 9.8 ms, +0.8, −1.2 ms. It is up to the designer to provide a format counter or similar device for carriage control. The designer may, likewise, arrange supervision of the carriage emitter pulses for recognizing clutch failures.

The earliest moment at which printing may be started again is 12 ms after recognition of the carriage emitter pulse for the last line space. This 12-ms delay ensures that the carriage clutch is properly disengaged and that the form has settled (Figure 22). The tracing logic may then synchronize with the chain by recognizing the next subscan pulse that starts a new print scan (whichever this may be). The print scan counter should continue counting, otherwise orientation would be lost.

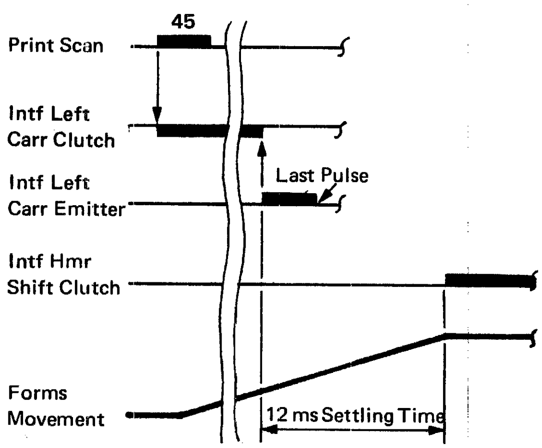


Figure 22. Paper Settling Time [07340]

Intf Right Carr Clutch, and Intf Right Carr Emitter

Locations: A5 D2, A6 D2

The signal input and output lines 'intf right carr clutch' and 'intf right carr emitter' are used only if the 5203 is equipped with the Dual Feed Carriage feature. The use and function of these signals are identical to those described previously for the left carriage.

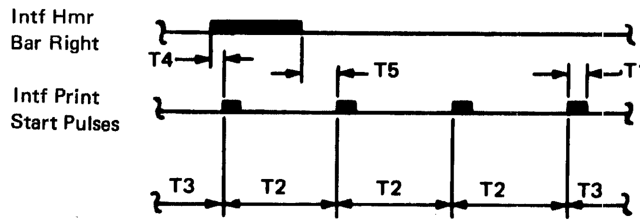
Both carriages operate independently of each other. Either carriage may, however, influence the control of the incrementor clutch. With a dual feed carriage, resumption of print operations depends on the carriage that exceeds the spacing limit.

Intf Hmr Bar Right (Direction: From Printer)

Location: A5 B8

The 'intf hmr bar right' signal originates from a reed switch that is operated by a permanent magnet on the hammer bar. The signal goes on (up level) 0.6 to 8.0 ms prior to the print start pulse for quart 4 when the hammer bar moves left to right. The signal goes off (down level) 0.6 to 16 ms prior to the print start pulse for quart 3 when the hammer bar moves left. The 'intf hmr bar right' signal is on when the hammer bar is at the right-home position. Figures 23 and 24 show the signal in relation to the print start pulses for, respectively, the 5203 Model 1 and Model 2.

The 'intf hmr bar right' signal is provided for orientation or re-orientation of the tracing logic. It is recommended that a calibration movement of the hammer bar is started whenever power is applied or re-applied to the printer. Thus, the 'intf hmr bar right' signal can be sensed periodically, whenever the hammer bar should be at the right-home position; appropriate action (of designer's choice) may then be taken if the hammer bar is not in this position.



Legend
T1 = 1 ms min, 10 ms max
T2 = 73 ms (+2, −4). Increases during UCS printing
T3 = 372 ms (+2.5, −5.0). Increases if more than 31 spaces occur
T4 = 0.6 to 8 ms } During actual printing
T5 = 0.6 to 16 ms }

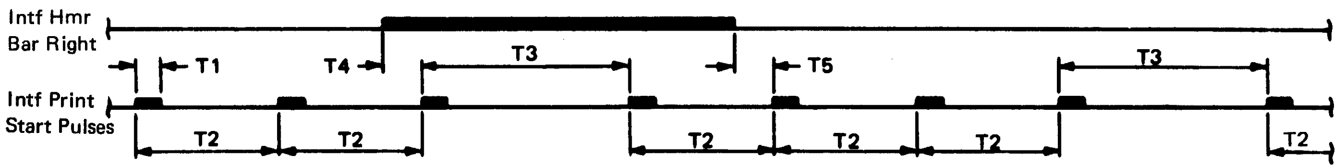
Figure 23. Hammer Bar Right (5203 Model 1) [07341]

Intf Hammer Address (Direction: To Printer)

Locations: Connector A6. (For pins, see Figure 43)

The hammer drivers, which supply current to the print hammer magnets, are addressed by nine X-address lines and four Y-address lines that form a 4 X 9 matrix (Figure 25). Down level must be applied for addressing, and up level for nonaddressing. An individual print hammer is fired only when a specific X-address line, a specific Y-address line, and the common hammer set line are at down level coincidentally (ANDed function). This coincidence must last for at least 0.3 μs (Figure 26).

Any hammer driver that has been turned on (fired) must be turned off 1167 μs, ±54 μs, later. The reset is accomplished by activating the same X-address and Y-address lines (previously used for firing) in coincidence with the common hammer *reset* line. The resetting coincidence must last for at least 0.3 μs, but should be 300 μs if a valid hammer off echo pulse is to be obtained. See also "Intf Hammer Off Echo".



Legend

T1 = 1 ms min, 10 ms max
T2 = 73 ms (+2, −4). Increases during UCS operations
T3 = 79 ms (±4) with single space. Increases with extra spaces
T4 = 0.6 to 8 ms } During actual printing
T5 = 0.6 to 16 ms } During actual printing

Figure 24. Hammer Bar Right (5203 Model 2) [07342]

On-Level	Signal Name
− (Minus)	Intf Hammer Address X 7
− (Minus)	Intf Hammer Address X 8
− (Minus)	Intf Hammer Address X 9
− (Minus)	Intf Hammer Address X A
− (Minus)	Intf Hammer Address X B
− (Minus)	Intf Hammer Address X C
− (Minus)	Intf Hammer Address X D
− (Minus)	Intf Hammer Address X E
− (Minus)	Intf Hammer Address X F
− (Minus)	Intf Hammer Address Y 0-3
− (Minus)	Intf Hammer Address Y 4-7
− (Minus)	Intf Hammer Address Y 8-B
− (Minus)	Intf Hammer Address Y C-F
− (Minus)	Intf Hammer Set
− (Minus)	Intf Hammer Reset
+	Intf Reset Ptr Electronics

X-Address

Y-Address	7	8	9	A	B	C	D	E	F
Y 0-3		31	3	7	11	15	19	23	27
Y 4-7		32	4	8	12	16	20	24	28
Y 8-B		1	5	9	13	17	21	25	29
Y C-F	33	2	6	10	14	18	22	26	30

Hammer Driver Number

Figure 25. Hammer Address Lines and Matrix [07343]

The hammer drivers supply maximum firing currrent to the magnet coils for as long as the drivers are set (the drivers are latch circuits). A reset after 1167 μs (±54 μs) is mandatory because of the limited duty cycle of the hammer magnet coil. The accuracy of the firing duration influences the print quality, because the chain keeps moving; an excessive firing time may cause image blurr. If a hammer driver does not reset because of a malfunction, the tracing logic may apply up level to the 'intf reset ptr electronics' line for at least 0.3 μs; this action resets all hammer drivers.

Note: The chain emitter pulses lead the actual (physical) alignments by the hammer flight-time factor. The timing adjustment vernier (see Figure 13), which can move the chain transducer radially around the timing drum, provides a means for advancing or retarding the subscan pulses. This vernier is used to center the hammer impact exactly on the character slug. Final adjustment must be made while the printer is operating.

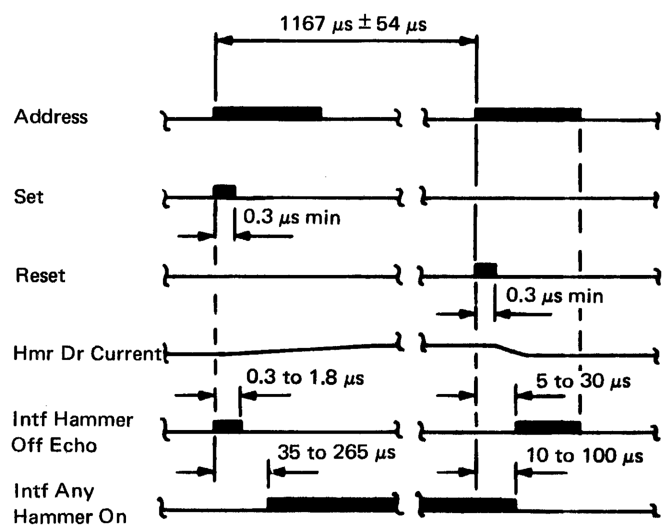


Figure 26. Hammer Fire Timing and Checking [07344]

Intf Hammer Off Echo (Direction: From Printer)

Location: A5 B9

The 'intf hammer off echo' signal is generated by a check circuit that emits a pulse (up level) each time a hammer driver is set or reset. The width of the setting echo pulse is 0.3 to 1.8 μs whereas that for the resetting echo pulse is 10 to 100 μs; the wider pulse represents the actual "off echo" (see Figure 26).

Note: Hammer set and hammer reset coincidence need not be more than 0.3 μs. To obtain proper hammer off echo response, the address and reset lines must, however, be activated for at least 300 μs.

'Intf hammer off echo' may be used for detailed checking of print operations. For example, a hammer-fire check bit may be stored into the print buffer to replace the character that has just been printed. The off echo may, likewise, be used for blanking or deleting the text character that has been printed.

The actual use of this signal (if used at all) is the choice of the designer. It is recommended, however, that print operations are supervised, because the accidental loss of a character or digit in lists or bills may be difficult to diagnose.

Intf Any Hammer On (Direction: From Printer)

Location: A5 B10

The 'intf any hammer on' signal is generated by a circuit that senses the current in the common hammer return line. The signal turns on (up level) 35 to 265 μs after the first hammer fires, and remains on for as long as one (at least) of the hammer coils draws current.

It is recommended that the hammer current is supervised, because the hammer coils have a limited cycle of duty owing to their high ampere-per-turn ratio. 'Intf any hammer on' should, therefore, be monitored, preferably at the completion of every print quart because no hammer should be on at that time.

The signal may also be sampled, in conjunction with 'intf hammer off echo', to directly identify a reset failure; the earliest time for sampling is 100 μs after reset of the last hammer driver in a print quart. If 'intf any hammer on' is indicated after the completion of one print quart, the 'intf reset ptr electronics' signal should be activated. If this action does not turn off 'intf any hammer on', the 'intf drop +60V' signal should be activated so that all hammer power will be turned off.

INTERLOCK SIGNALS INTERFACE

The 5203 contains a number of interlock switches that ensure operator safety and functional prerequisites as described in the following paragraphs. The interlock circuits are feed-through lines, that is, they are supplied with +24 volts (V) as the common source, and they return individual signals as up level (no interlock condition) or down level (interlock condition). All interlock signals (Figure 27) are conditioned by integrators (in the printer) so that the signals are free from bounce.

It is the responsibility of the using system to initiate the required action because the printer contains no logic circuits for interlock handling.

The interface location for each signal is given in Appendix C (see Figure 43).

On-Level	Signal Name
– (Minus)	Intf Common Interlock
– (Minus)	Intf Hmr Unit Thermo Overl
– (Minus)	Intf Forms Jam
– (Minus)	Intf End of Forms

Figure 27. Interlock Signals [07345]

Intf Common Interlock (Direction: From Printer)

Location: A5 D7

The 'intf common interlock' signal is on (down level) when, and for as long as, either the rear unit is open (tilted back) or the forms chute is in the loading position (pivoted up). The signal originates from two normally-open (N/O) microswitches that are connected in series.

With 'intf common interlock' on, the using system must energize the 'intf drop +60V' line to cut off the 60V supply and the chain motor; the printer then loses its device-ready state. The using system must also turn on the interlock light on the printer console and turn off the ready light.

The 'intf drop +60V' signal must go off when 'intf common interlock' turns off (up level).

Intf Hmr Unit Thermo Overl (Direction: From Printer)

Location: A5 D6

The 'intf hmr unit thermo overl' signal turns on (down level) when the hammer unit thermoswitch senses a temperature of more than 134°F (57°C). The normally closed (N/C) thermoswitch opens when the temperature limit is exceeded, and closes only when the hammer unit has cooled.

When a thermal overload condition arises, the using system must activate the 'intf drop +60V' signal to cut off the 60V supply. The using system must also turn on the check light on the printer console to inform the operator of the unusual condition; the light should go out only when the hammer unit has cooled. See also "PEB Thermoswitch" under "DC Power Interface" in the section "Power Interfaces".

Intf Forms Jam (Direction: From Printer)

Location: A5 D11

The 'intf forms jam' signal turns on (down level) when, and for as long as, a forms jam occurs in any of the forms tractors. The signal originates from a normally closed microswitch that opens when a tractor door is forced open by a jam. The tracing logic should complete any print line that happens to be in progress when the jam occurs, and should then stop any further print operations.

The using system must turn off the ready light on the printer console and turn on the forms light, to inform the operator of the unusual condition.

Intf End of Forms (Direction: From Printer)

Location: A5 B12

The 'intf end of forms' signal is on (down level) when the forms have progressed to a point where they are about to leave the forms chute. When an end-of-forms condition is present, the using system must turn on the forms light on the printer console and turn off the ready light. Any print line that is currently in progress must be completed, after which printing must stop.

When 'intf end of forms' is on, about 14 in. (35,5 cm) of paper, equaling at least 80 print lines, are available below the current print line. This remaining paper may be printed by several continuation methods of designer's choice, such as:

1. One (*but only one*) line may be printed for each operation of the start key on the console. This restriction reminds the operator that an end-of-forms condition exists each time that the start key is depressed for an additional print line.
2. Continuous printing of a fixed or predetermined number of lines may be resumed after a single start-key operation. This method requires a stepdown counter to be set for limit recognition, because the printer issues no further signal after 'intf end of forms'.

   Note: Irrespective of the print-continuation method chosen, the using system should provide a final print stop before the forms leave the tractors. This action is necessary to prevent the print hammers from striking the ribbon. The final stop should be initiated 85 print lines after 'intf end of forms' is raised.

MANUAL SIGNALS (CONSOLE KEYS) INTERFACE

The keys on the console of the 5203 are pushbutton switches with normally closed and normally open contacts. The keys provide the means for manual control and intervention, but no logic circuits for these operations are provided in the printer. The keys are supplied by their respective common grounds (from the using system), and return these grounds to the system through the N/C or N/O contacts of the switches. The N/O interface lines are floating, whereas the N/C contacts provide permanent ground when a switch is idle. The N/O interface lines have ground potential when, and for as long as, physical pressure is applied to a switch (Figure 28).

Any logic action that is caused by contact transfer must take place in the tracing logic of the using system. The using system must also provide integrators or other bounce-elimination networks if these are required.

The following paragraphs describe the principal use of each key and the results that are expected from its operation. The interface location for each signal is given in Appendix C (see Figure 43).

Intf Printer Start Key (N/C, N/O)

Location: A2 B6, A2 B7

The printer start key is used by the operator to indicate his readiness for a print operation. The using system must not act upon a print command (received from the program) until the start key has been operated. When the key has been operated, the using system must render the printer carriage keys inoperative, and must turn on the ready light. The start status should be retained either until a printer interlock or check condition arises or until the printer stop key is operated.

The start key must be inoperative when the printer indicates "common interlock" (rear unit open or forms chute pivoted up). Start key signals must also be ignored for as

Level	Signal Name
–	Intf Printer Start Key N/C
+	Intf Printer Start Key N/O
–	Intf Printer Stop Key N/C
–	Intf Lt Carr Space Key N/C
+	Intf Lt Carr Space Key N/O
–	Intf Rt Carr Space Key N/C
+	Intf Rt Carr Space Key N/O
–	Intf Lt Carr Restore Key N/C
+	Intf Lt Carr Restore Key N/O
–	Intf Rt Carr Restore Key N/C
+	Intf Rt Carr Restore Key N/O
	Intf Sw Gnd for Start + Stop Key
	Intf Sw Gnd for Lt Carr
	Intf Sw Gnd for Rt Carr

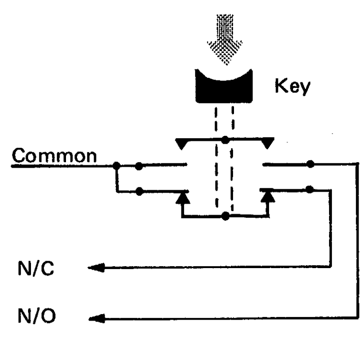


Figure 28. Manual Signals [07346]

long as a thermal overload condition exists or when the printer fails to indicate "device-ready" (chain up to speed).

The necessary preparatory actions in the tracing logic depend on the design of this equipment. It is recommended that the 'intf hmr bar right' signal be sensed whenever the start key is operated for the first time after power on, and that the hammer bar be moved to the right-home position if it is not already there. The start key must not override any interlocks except the end-of-forms interlock.

Intf Printer Stop Key (N/C)

Location: A2 D5

The printer stop key is normally closed and may thus be incorporated into a series circuit. The stop key line is open (floating) when, and for as long as, the key is pushed. The stop key must override the start key (for example, when start and stop keys are operated simultaneously).

The stop key is used by the operator to indicate that he wishes to discontinue printing. Any print line that is in progress when the stop key is operated must continue to completion before the stop status becomes effective. Once the stop status is in effect, the printer carriage keys must become operational and the ready light must go out. The stop status must not affect the printer motors, and these should keep running. The stop status must be retained until the start key is operated. The stop key must be operational whenever power is on.

Intf Lt (or Rt) Carr Space Key (N/C, N/O)

Locations: Connector A2. (For pins, see Figure 43)

The left- and right-carriage space keys have identical functions but act upon the respective carriage only. Both keys each present a normally open and a normally closed interface line. The signals from both keys must be accepted only when, and for as long as, the printer is in stop status. The space keys must lose their functions when the printer start key is operated.

A carriage space key is used by the operator to advance the respective form by one single space for each time that the key is depressed. The operator must thus be able to advance the form by an unlimited number of single spaces. The space key functions must not be inhibited by any of the interlocks (except start status).

Intf Lt (or Rt) Carr Restore Key (N/C, N/O)

Locations: Connector A2. (For pins, see Figure 43)

The left- and right-carriage restore keys have identical functions but act upon the respective carriage only. Both keys each present a normally open and a normally closed interface line. The signals from both keys must be accepted only when, and for as long as, the printer is in stop status. The carriage restore keys must lose their functions when the printer start key is operated.

A carriage restore key is used by the operator to advance the respective form to a predetermined point that represents the first print line for a sheet of the form. The restore operation is based on the manual forms-adjustment procedure. The operator disengages the tractors from the carriage clutch (6-line/8-line selection lever to neutral position), and positions the form vertically, using the forms advance/retard knob. He may thus align a specific frame or date line, etc. (which may be printed on the form) with the lower of two scribed lines on the 5203 that indicate where the characters for the first print line will appear on the form. The operator then presses the carriage restore key to synchronize the carriage and the format counter (in the tracing logic) with the "new" beginning of the form. The tractors are finally linked with the carriage drive when the 6-line/8-line selection lever is again operated.

Once the carriage has been set up as described, operation of the carriage restore key always advances the form to the first line of the next sheet (if the printer is in stop status).

The designer of the tracing logic should provide the means for loading format information into the carriage counter so that the skip length of the restore operation can be adjusted to the actual sheet length of a given form. The maximum sheet length for the 5203 is recommended to be 14 in. (35,5 cm) from fold to fold; the minimum length is 3 in. (7,62 cm).

The designer should also prevent a carriage runaway, in case *no* format information was introduced prior to restore key operation. For example, the restore key may initiate a single space if no format information is available.

It is recommended that the *left* carriage restore key is associated with the 'intf print time' signal, so that the operator can run the ribbon drive for one second whenever the left carriage restore key is operated. This run allows a ribbon 'flowcheck', which is desirable after installation of a new ribbon, to be made.

The carriage restore keys need not be inhibited by any interlocks (except start status).

CONSOLE LIGHTS INTERFACE

The lights on the console of the 5203 (Figure 29) are connected to a common ground from the using system and require a driver in the using system for each indicator light line that is to be driven. The lights are driven by 7.25V ac.

The following paragraphs describe the conditions that require a specific indicator to come on or go out. The interface location for each indicator is given in Appendix C (see Figure 43).

Intf Ready Light Driver (Direction: To Printer)

Location: A2 D2

The 'intf ready light driver' line must be turned on when the printer start key has been operated and the printer has no

Level	Signal Name
AC	Intf Ready Light Driver
AC	Intf Interlock Light Driver
AC	Intf Forms Light Driver
AC	Intf Check Light Driver
AC	AC Lamp Common
—	Intf Run Use Meter

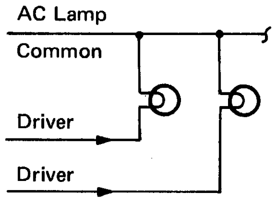


Figure 29. Printer Lights and Use Meter Control [07347]

interlock or check condition and indicates "device ready" to the using system. 'Intf ready light driver' must remain on until either the printer stop key is operated or any one of the interlock or check conditions arises. The removal or resetting of an interlock or check condition must not automatically turn on the ready light; the light must come on, instead, only when the printer start key is operated after the condition has been rectified.

Intf Interlock Light Driver (Direction: To Printer)

Location: A2 B5

The 'intf interlock light driver' line must turn on when the 'intf common interlock' signal turns on. These signals indicate that the rear unit is open and/or the forms chute is in the load position. The interlock light must go out when the 'intf common interlock' signal turns off.

Intf Forms Light Driver (Direction: To Printer)

Location: A2 B2

The forms light must come on when either the end-of-forms condition or a forms jam occurs. The forms light should go out only when new forms are loaded or the forms jam is removed, as appropriate.

Intf Check Light Driver (Direction: To Printer)

Location: A2 D4

The 'intf check light driver' signal must turn on (and the check light must come on) when the hammer unit thermoswitch operates (overtemperature condition). The check light should also come on if the following occur:

1. The 'intf any hammer on' signal is indicated when no hammer should be on.
2. Any checks (such as chain synchronization errors, carriage failures, no print start pulse) occur in the printer tracing logic.

The guideline for check-light operation should be the operator's need for information about adverse conditions that affect the printer. The check light should go out when the respective check condition has been rectified.

METERING

Intf Run Use Meter (Direction: To Printer)

Location: A5 D13

The 'intf run use meter' line controls the elapsed-time use meter that is installed in the printer. The meter records the operating time in hours and minutes. The exact criteria for starting the meter are a matter of designer's choice; for example, the meter may be started with every print command. Down level must be applied to the 'intf run use meter' line when, and for as long as, the meter is to record time. The minimum signal length required to start the meter is 400 ms. The meter stops within 20 to 40 ms after up level is applied to the interface line.

This section contains information on the alternating current (ac) power interface, the direct current (dc) power interface, and the interface drivers and receivers. Details of the printer electrical system are given in Appendix C.

AC POWER INTERFACE

AC Mainline Power

The 5203 requires 3-phase ac power for its motors and for its internal 60V dc power supply. The printer may be ordered either for 50-hertz (Hz) or 60-Hz power and may be set up for the following line voltages (phase-to-phase):

50-Hz Machines	*60-Hz Machines*
220 to 235V	208V
380 to 408V	230V

The voltage setup can be changed by means of internal jumpers that select the appropriate coil tap and/or connect the motor coils in either delta (Δ) or wye (Y) configuration.

The 5203 is equipped with an ac power cable that contains the phase leads and a protective ground lead (Figure 30); the cable on 50-Hz machines also contains a neutral lead. The power cable should be connected to the ac distribution of the using system or to a similar source that is under system control.

The ac power rating is 2.5 kilovolt-amperes (kVA).

Appropriate fuse or circuit breaker protection must be provided; fuses should be of the slow-blow (time-lag) type, because all motors start up together. The voltage that is supplied should be within ±10% of its nominal rating and the frequency should be accurate to within ±0.5 Hz.

Phase Rotation

Phase rotation must be in the order of the phase lead numbers, that is, in 1-2-3 sequence. This sequence corresponds with the power plug pin identification X-Y-Z (see Figure 30).

CAUTION
The phase rotation sequence must at no time be in any other sequence, otherwise the helical spring clutches and the print chain may be damaged.

To facilitate correct phase-rotation setup, the installation instructions supplied with the printer must be followed. All motors carry arrows that indicate the direction of rotation.

Console Lights Power

The using system must supply 7.25V ac (±8%) to the printer console lights via individual drivers that are controlled by logic circuits. The lights operate on a common return. The maximum current requirement is 500 milliamperes (mA).

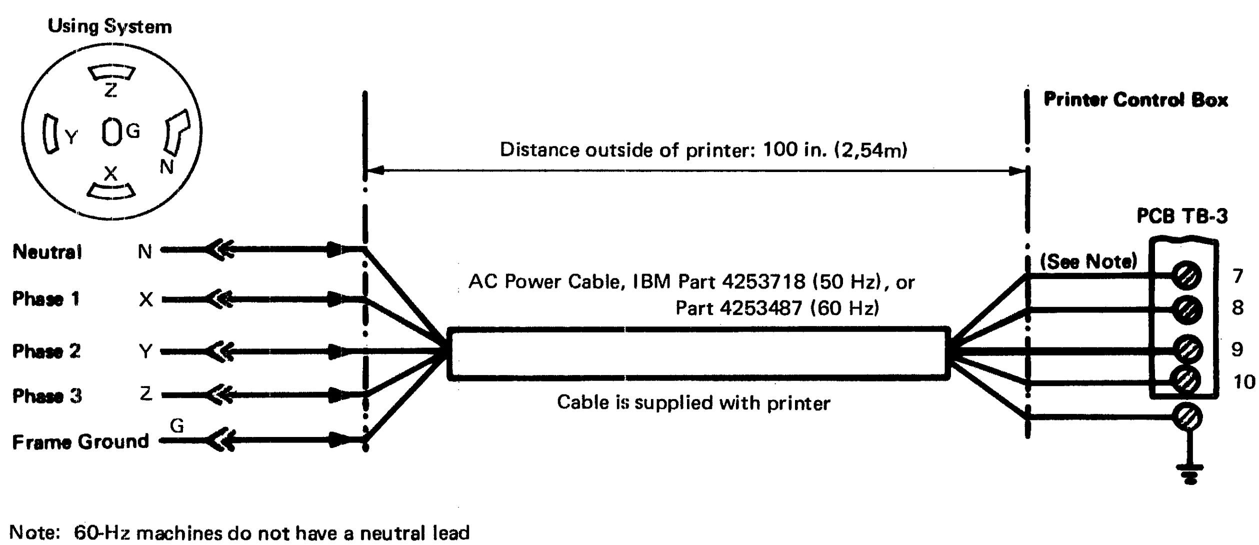


Figure 30. AC Power Interface [07348]

DC POWER INTERFACE

DC Potentials

The using system must supply three different dc potentials (Figure 31) for the logic circuits of the printer and for the relay drivers. The three dc potentials must operate against a dc common ground and must meet the following requirements:

Volts	*Tolerance*	*Steady Load*	*Absolute Peak*
−4V dc	±2%	0.6 ampere (A)	None
+6V dc	±2%	1.6A	7.5A
+24V dc	±5%	1.4A	11.0A

Note: Absolute peak loads may occur for less than 1 ms. Half of the absolute peak loads may be expected for 8.3 ms (maximum).

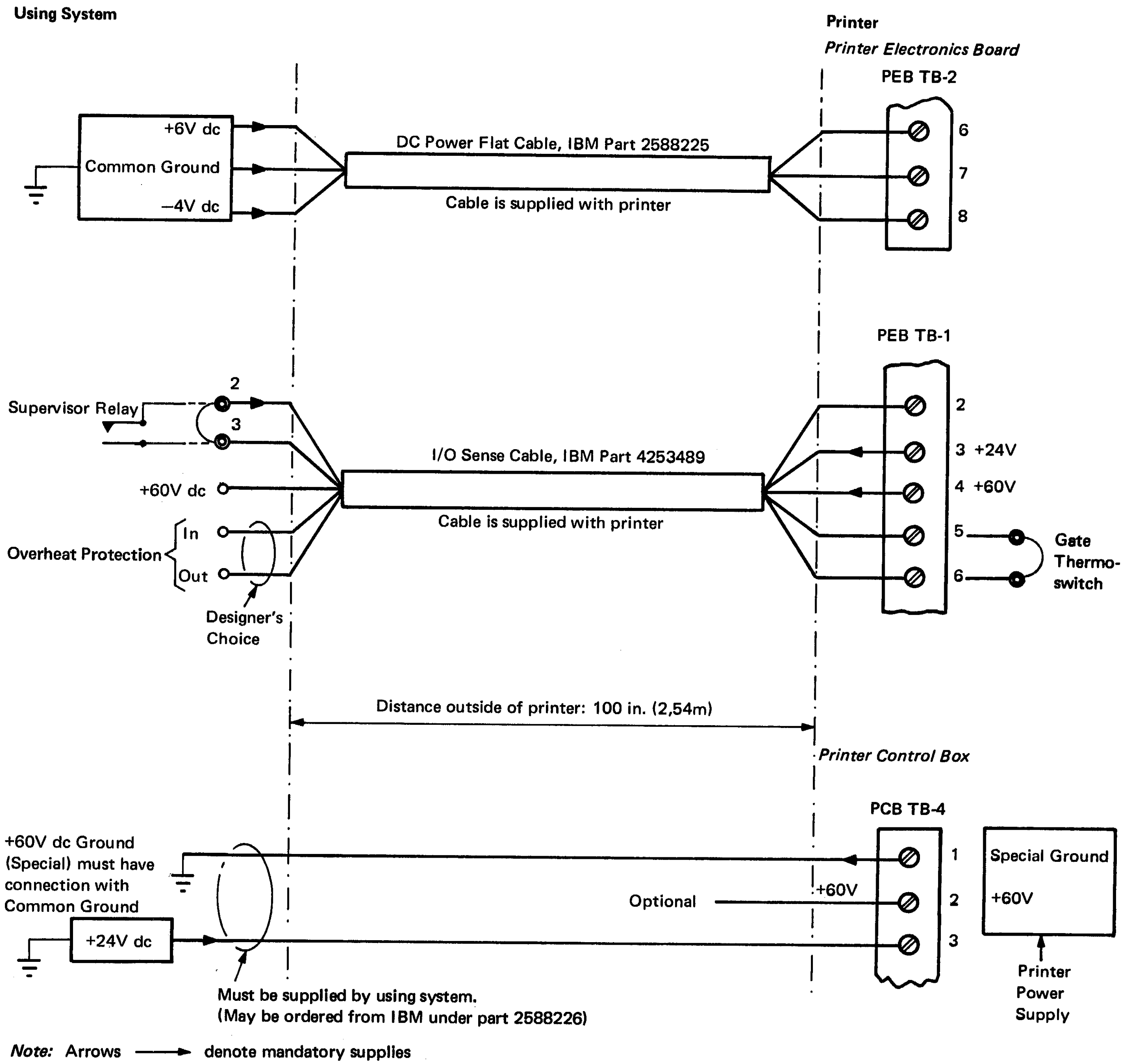


Figure 31. DC Power Interface [07349]

DC Common Ground

The dc common ground for the –4V, +6V, and +24V potentials must be connected to the +60V dc ground (ground special) of the printer, in order to avoid ground shifts.

Power Sequencing

The dc potentials should be sequenced in order to avoid undefined actions during transient periods. The sequence steps should be spaced 20 to 50 ms apart as follows.

Power-On Sequence

1. Minus 4V dc applied (simultaneously with ac power).
2. Plus 6V dc applied.
3. Plus 24V dc applied.
4. Down level applied to the 'intf drop +60V' line (which turns on the internal power supply of the printer).

Power-Off Sequence

1. Up level applied to the 'intf drop +60V' line.
2. Plus 24V dc cut off.
3. Plus 6V dc cut off.
4. Minus 4V dc cut off.

Power Supervision

The printer is equipped with a supervision cable, termed the *I/O sense* cable (see Figure 31), that allows the using system to check the +60V dc supply of the printer. In the event of a +60V dc failure, the using system must disengage all printer clutches and drop all relays by opening a normally closed contact that connects the +24V line of the I/O sense cable with the +24V sequence line of this cable.

PEB Thermoswitch

An input line and an output line that are void of potential represent a current path through the thermoswitch on the printer electronics board (PEB) when, and for as long as, the cooling air is below the temperature limit. The thermoswitch may thus be made part of an overheat protection loop (see Figure 31) in which all other thermosensor elements of the system are in series connection. It is recommended that the PEB thermoswitch is used in the power control circuits of all supplies that feed the printer.

INTERFACE DRIVERS AND RECEIVERS

The 5203 interface is designed to meet the requirements of IBM System/3 explicitly and may not necessarily suit another system unless the same drivers, receivers, and cables are used. It is up to the designer of the using system to evaluate the measures that will achieve compatibility. It may be necessary to convert or redrive the signals if cable lengths other than those described are used.

Interface Driver

The interface driver (Figure 32) consists of an NPN transistor that is used as a direct coupled inverter when the input signal is driven into the base of the transistor. Two configurations are used, one with a 5.5 kiloohm (kΩ) resistor as a return from the base to +6V, and the other without this base return. The output drive is increased on those drivers that are equipped with the base return.

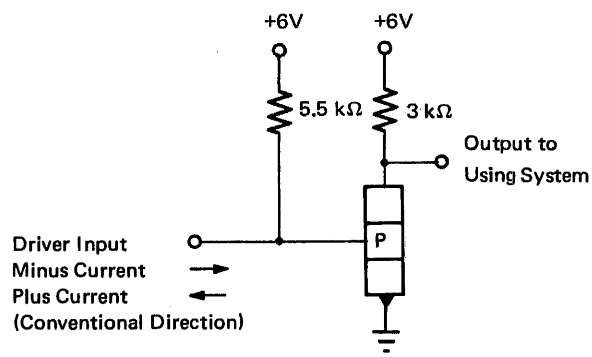


Figure 32. Interface Driver [07350]

Output Voltages and Current Levels: These are shown in Figure 33.

Line Drive Capability: The interface driver is capable of driving an interface receiver over a flat cable that has characteristic impedance of 92 ohms and a maximum length of 14 feet (7,25 meters). For details, see "Cable Considerations".

Interface Receiver

The interface receiver (Figure 34) consists of an NPN transistor with appropriate resistors that present the proper termination impedance to the driver at the other end. The diode protects the base-emitter junction from reverse breakdown.

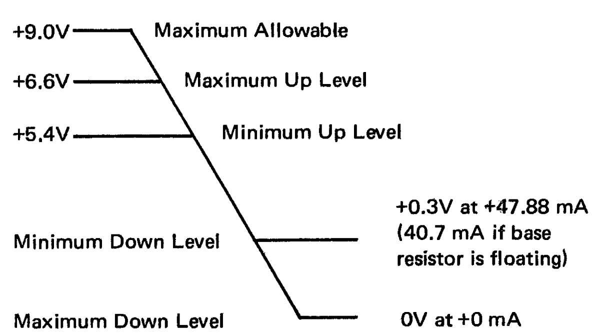


Figure 33. Interface Driver Output Voltages and Currents [07351]

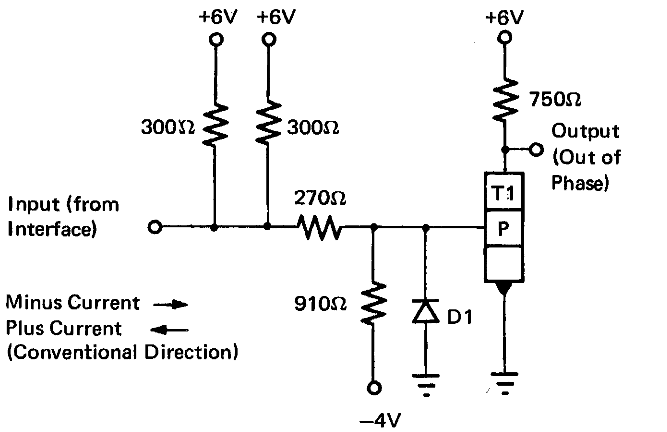


Figure 34. Interface Receiver [07352]

Input Voltages and Current Requirements: These are shown in Figure 35.

Equivalent Circuit: This is shown in Figure 36.

Output Voltages and Currents: These are shown in Figure 37.

Transitions and Delays: These are shown in Figure 38.

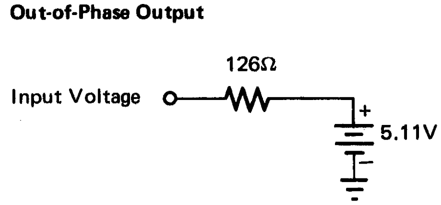


Figure 36. Interface Receiver Equivalent Circuit [07354]

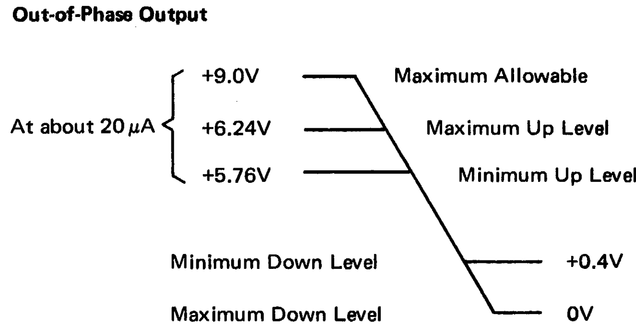


Figure 37. Interface Receiver Output Voltages and Currents [07355]

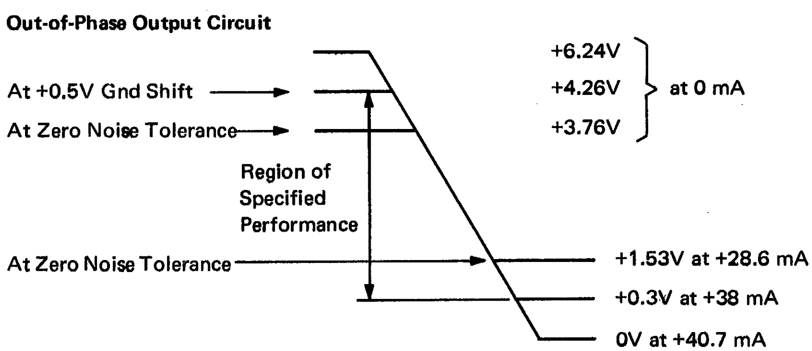
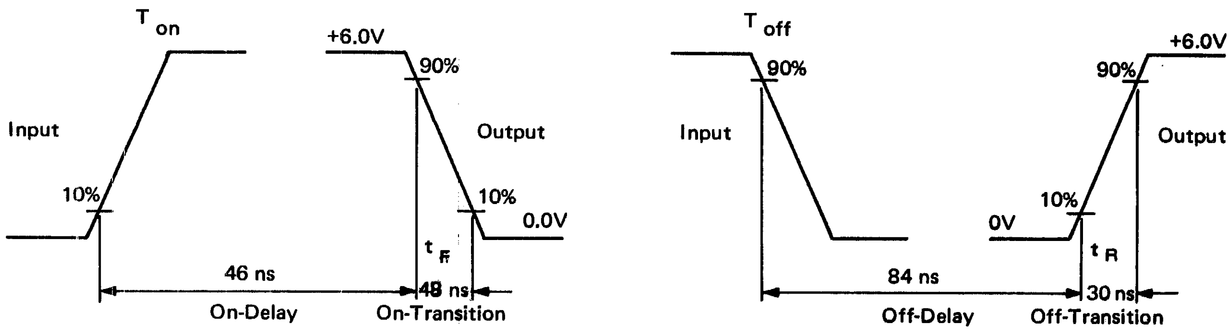


Figure 35. Interface Receiver Input Voltages and Currents [07353]

Out-of-Phase Output



Legend

T_{on} = On-Transition
T_{off} = Off-Transition
t_F = Fall Transition
t_R = Rise Transition

Figure 38. Interface Receiver Transitions and Delays [07356]

Console Key Termination

The printer console keys are logically independent of the printer; the using system may supply any suitable voltage, up to 30V, to these keys. Terminating resistors should limit the current in each key circuit to 30 mA or less.

CABLE CONSIDERATIONS

The 5203 provides the ac power cable, one dc power flat cable, and the I/O sense cable (see Figures 30, 31, and 44). The dc power flat cable will probably be impracticable to use (because of its customized shape and its special tab distribution) and, therefore, a conventional cable with spade lugs may have to be used in place of it.

The using system must supply one dc power cable, and also the three logical interface cables (with paddle cards). It is recommended that IBM SLT* flat cables are used for the logical interface; these cables present a characteristic impedance of 92 ohms to drivers and receivers, and are already equipped with paddle cards. The three logical interface cables may be ordered under the following part numbers:

One cable, part 2588023, for board position A5.
Two cables, part 2588024, for board positions A2 and A6.

The proper impedance can also be achieved if coaxial cables are used; coaxial cables must, however, be equipped with IBM paddle cards (or equivalent) because the board connection cannot be made in any other way. Paddle card assemblies can be ordered under the following part numbers:

Part 5800634, paddle card (1)
Part 5352958, strain relief clamp (1)
Part 595720, rivet (2).
Part 811802, card guide (1)

The routing of cables within the 5203 is shown in Appendix C (see Figure 44).

Note: When SLT flat cables are used, the length that is outside of the machine must be enclosed in a grounded metal raceway for noise protection. Cables for logical signals must not exceed the maximum allowable length of 14 feet (7,25 meters); about 88 inches (2,24 meters) will be used within the 5203.

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* Solid Logic Technology

Appendix A. Printer Consolidated Timings

Consolidated timings for the 5203 Model 1 are shown in Figure 39 and those for the Model 2 are shown in Figure 40.

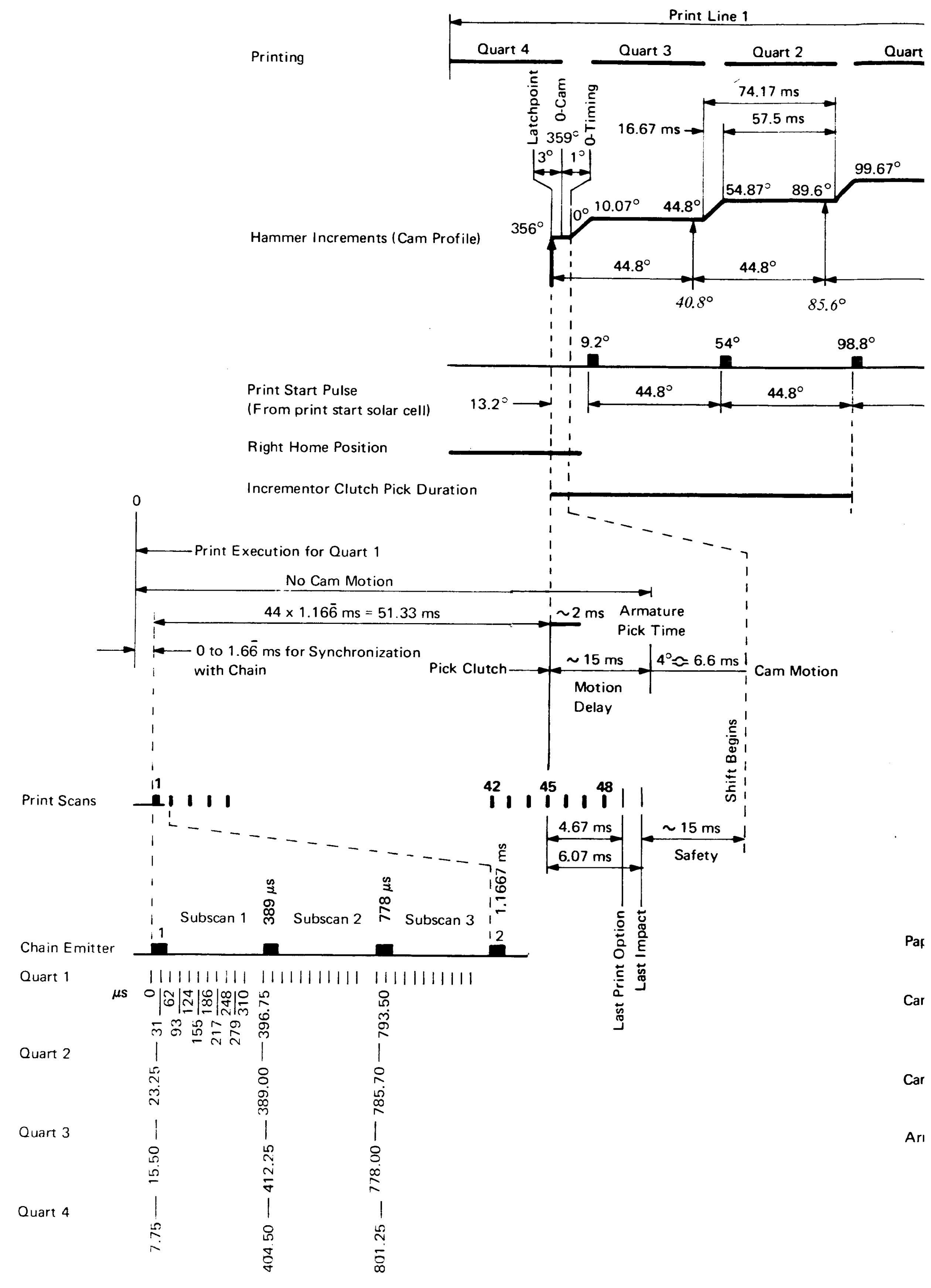


Figure 39. Consolidated Timing for 5203 Model 1 [06995A]

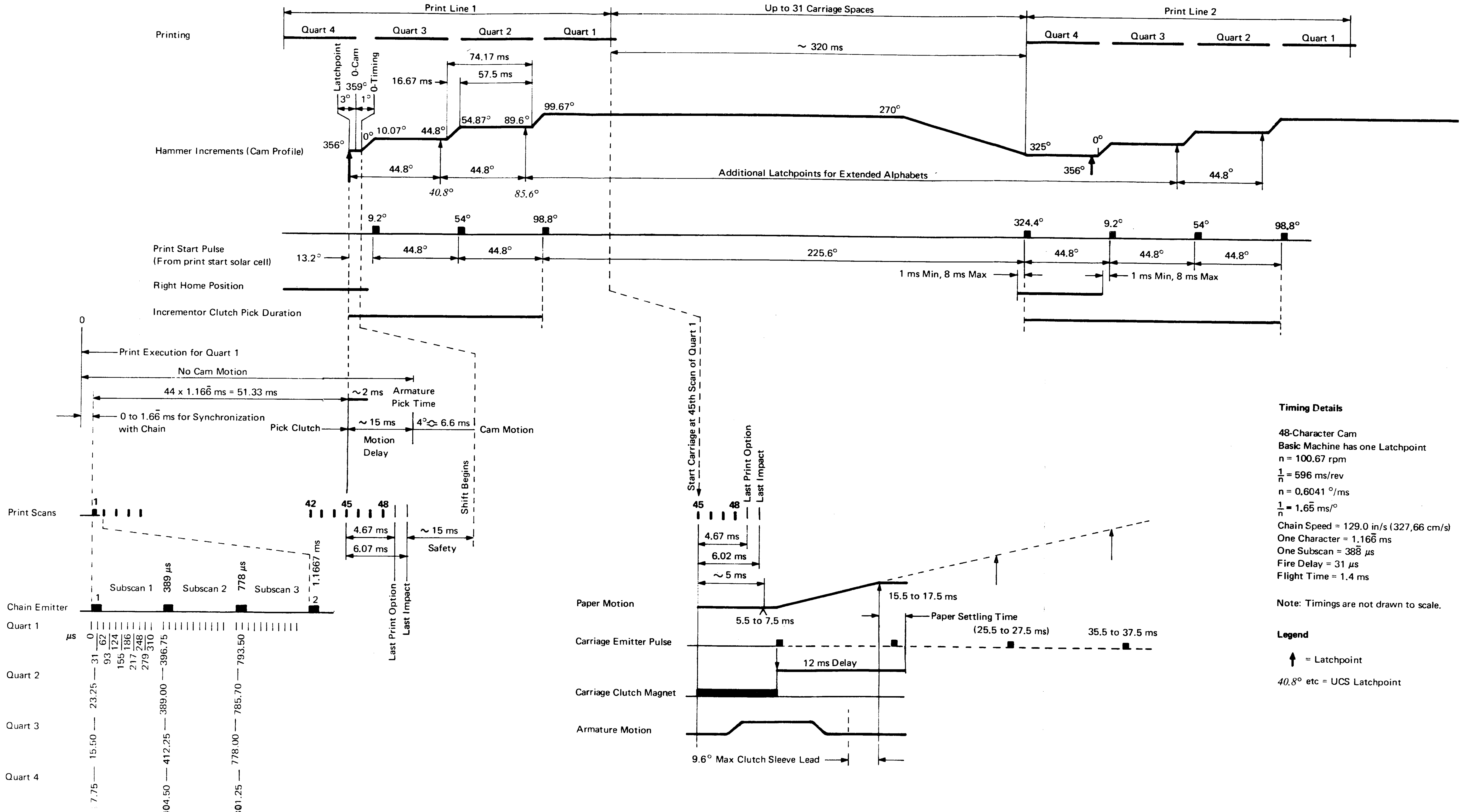


Figure 39. Consolidated Timing for 5203 Model 1 [06995A]

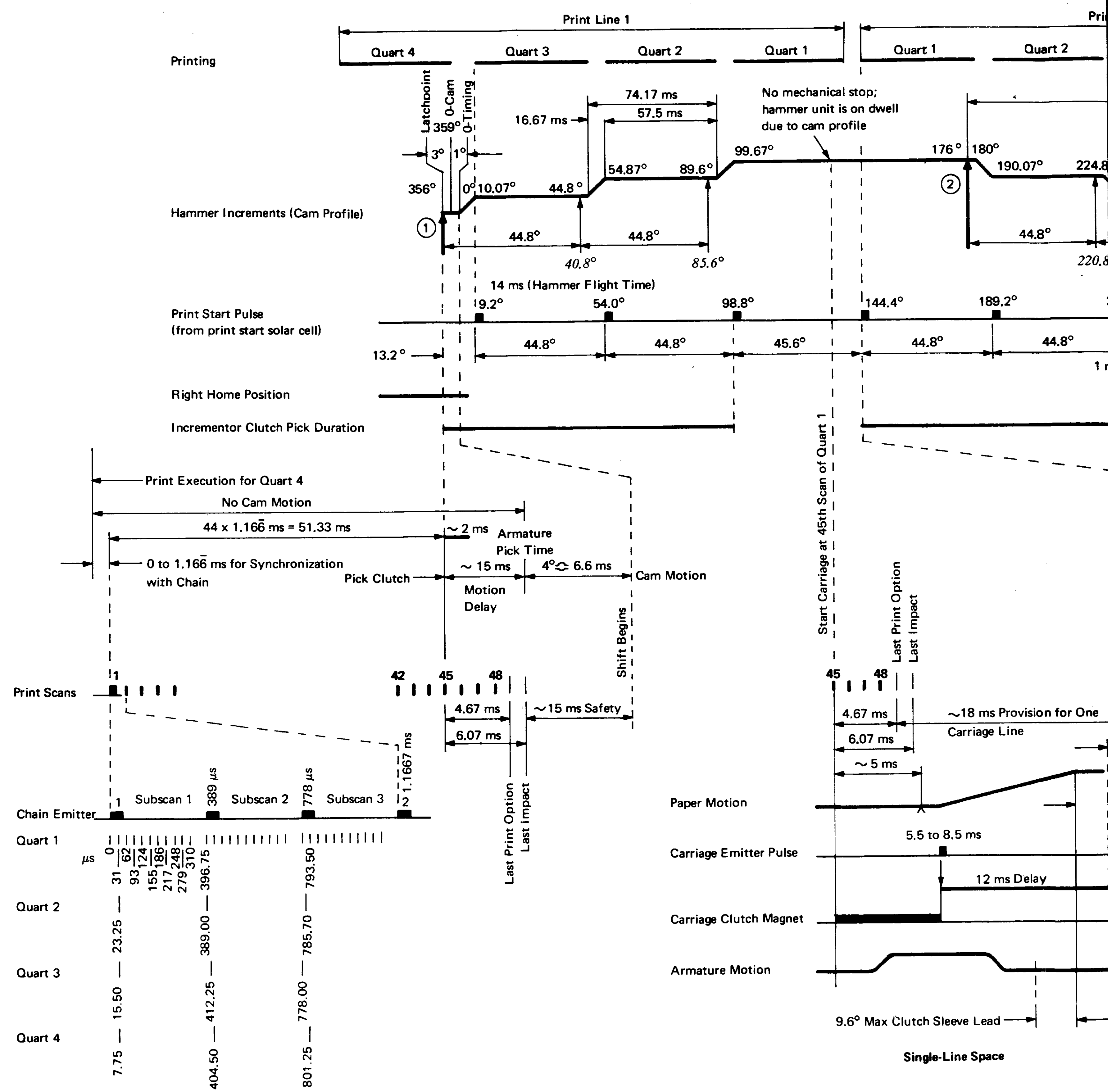
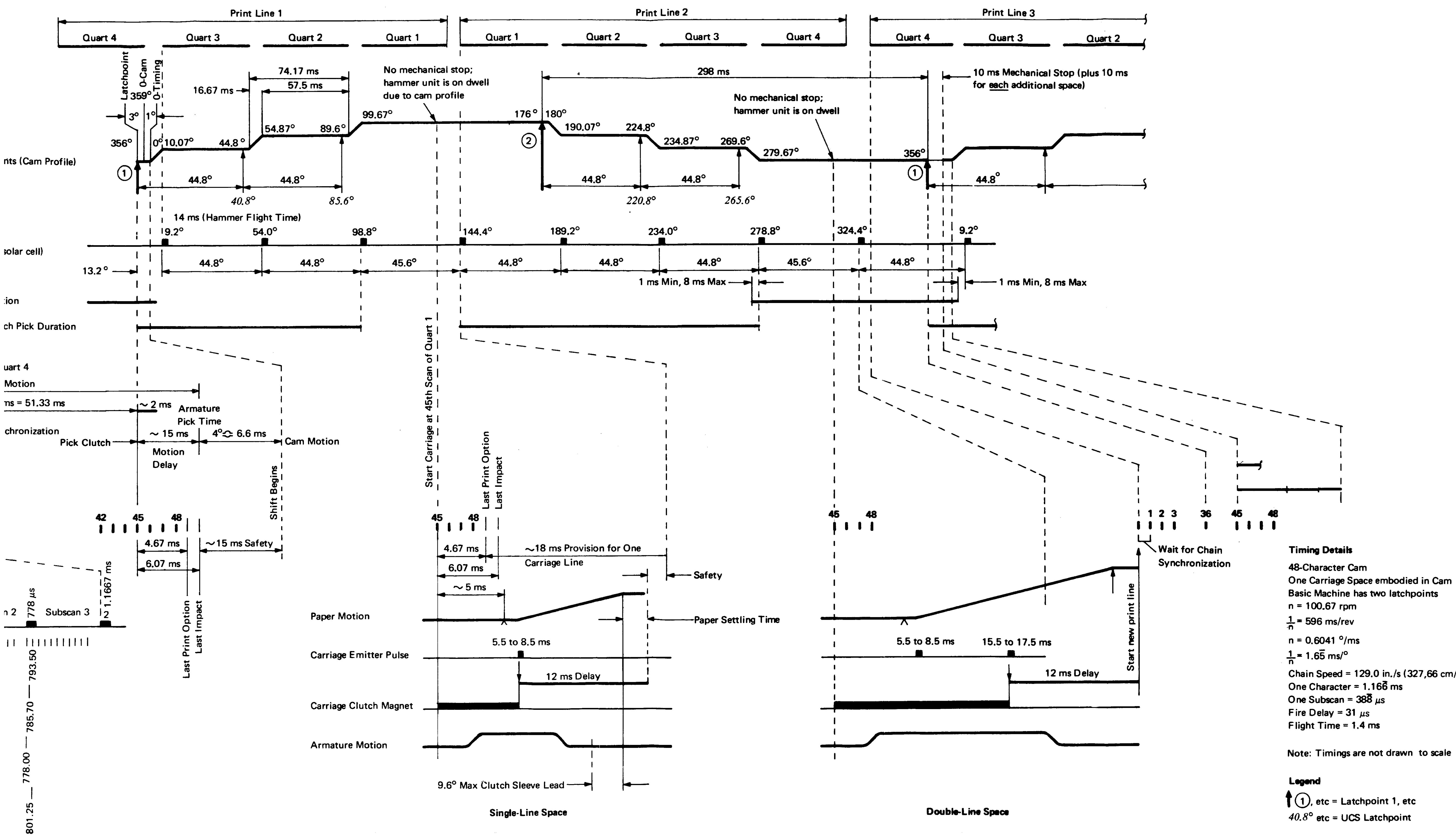


Figure 40. Consolidated Timing for 5203 Model 2 [06996A]

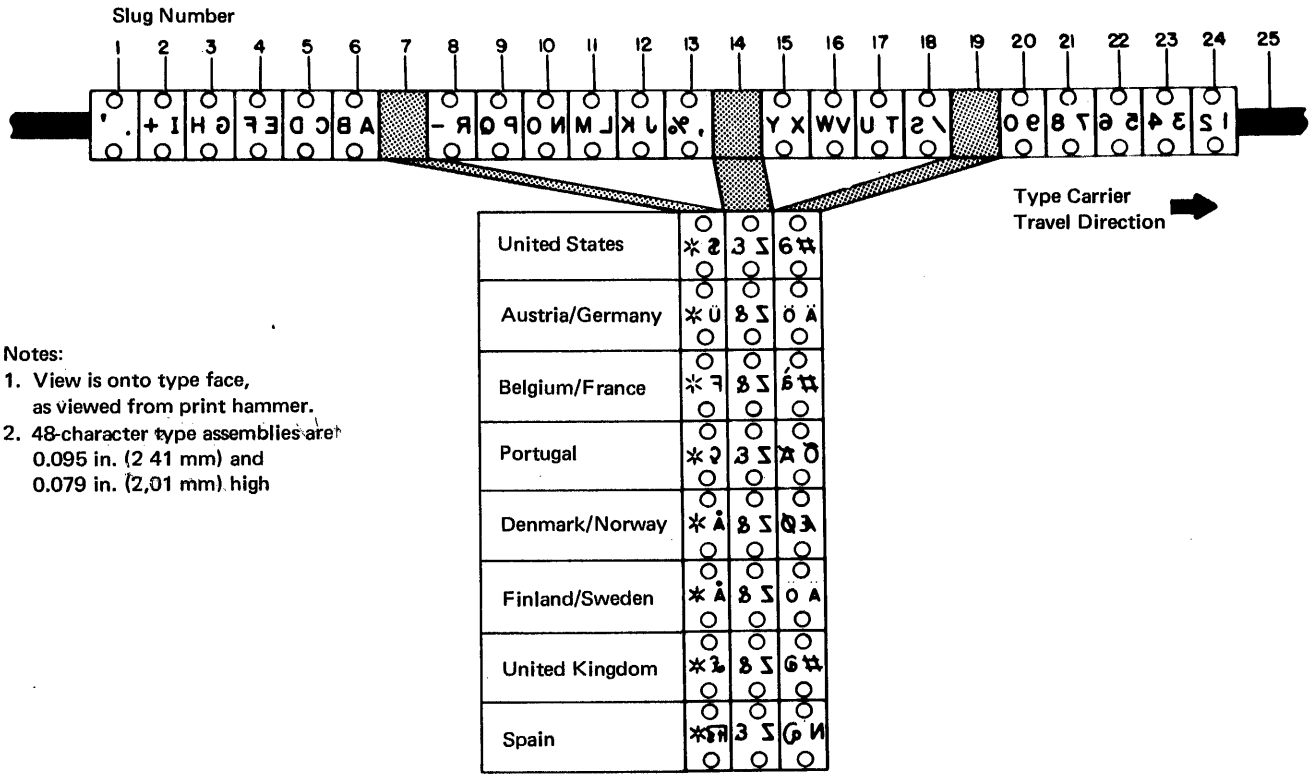


Print Line 1
Print Line 2
Print Line 3
Quart 4
Quart 3
Quart 2
Quart 1
Quart 1
Quart 2
Quart 3
Quart 4
Quart 4
Quart 3
Quart 2
Latchpoint
0-Cam
0-Timing
359°
16.67 ms
74.17 ms
57.5 ms
No mechanical stop; hammer unit is on dwell due to cam profile
298 ms
10 ms Mechanical Stop (plus 10 ms for each additional space)
No mechanical stop; hammer unit is on dwell
3°
1°
356°
0°
10.07°
44.8°
54.87°
89.6°
99.67°
176°
180°
190.07°
224.8°
234.87°
269.6°
279.67°
356°
nts (Cam Profile)
40.8°
85.6°
220.8°
265.6°
14 ms (Hammer Flight Time)
9.2°
54.0°
98.8°
144.4°
189.2°
234.0°
278.8°
324.4°
9.2°
solar cell)
13.2°
45.6°
1 ms Min, 8 ms Max
ion
ch Pick Duration
uart 4
Motion
ns = 51.33 ms
~2 ms
Armature Pick Time
chronization
Pick Clutch
~15 ms
Motion Delay
4° ≈ 6.6 ms
Cam Motion
Shift Begins
Start Carriage at 45th Scan of Quart 1
Last Print Option
Last Impact
42
45
48
4.67 ms
6.07 ms
~15 ms Safety
~18 ms Provision for One Carriage Line
~5 ms
Safety
Paper Settling Time
1 2 3
36
Wait for Chain Synchronization
Start new print line
1.1667 ms
778 µs
Subscan 3
n 2
2
Last Print Option
Last Impact
801.25 — 778.00 — 785.70 — 793.50
Paper Motion
Carriage Emitter Pulse
Carriage Clutch Magnet
Armature Motion
5.5 to 8.5 ms
15.5 to 17.5 ms
12 ms Delay
9.6° Max Clutch Sleeve Lead
Single-Line Space
Double-Line Space
Timing Details
48-Character Cam
One Carriage Space embodied in Cam
Basic Machine has two latchpoints
n = 100.67 rpm
1/n = 596 ms/rev
n = 0.6041 °/ms
1/n = 1.65 ms/°
Chain Speed = 129.0 in./s (327,66 cm/s)
One Character = 1.166 ms
One Subscan = 388 µs
Fire Delay = 31 µs
Flight Time = 1.4 ms
Note: Timings are not drawn to scale
Legend
①, etc = Latchpoint 1, etc
40.8° etc = UCS Latchpoint

del 2 [06996A]

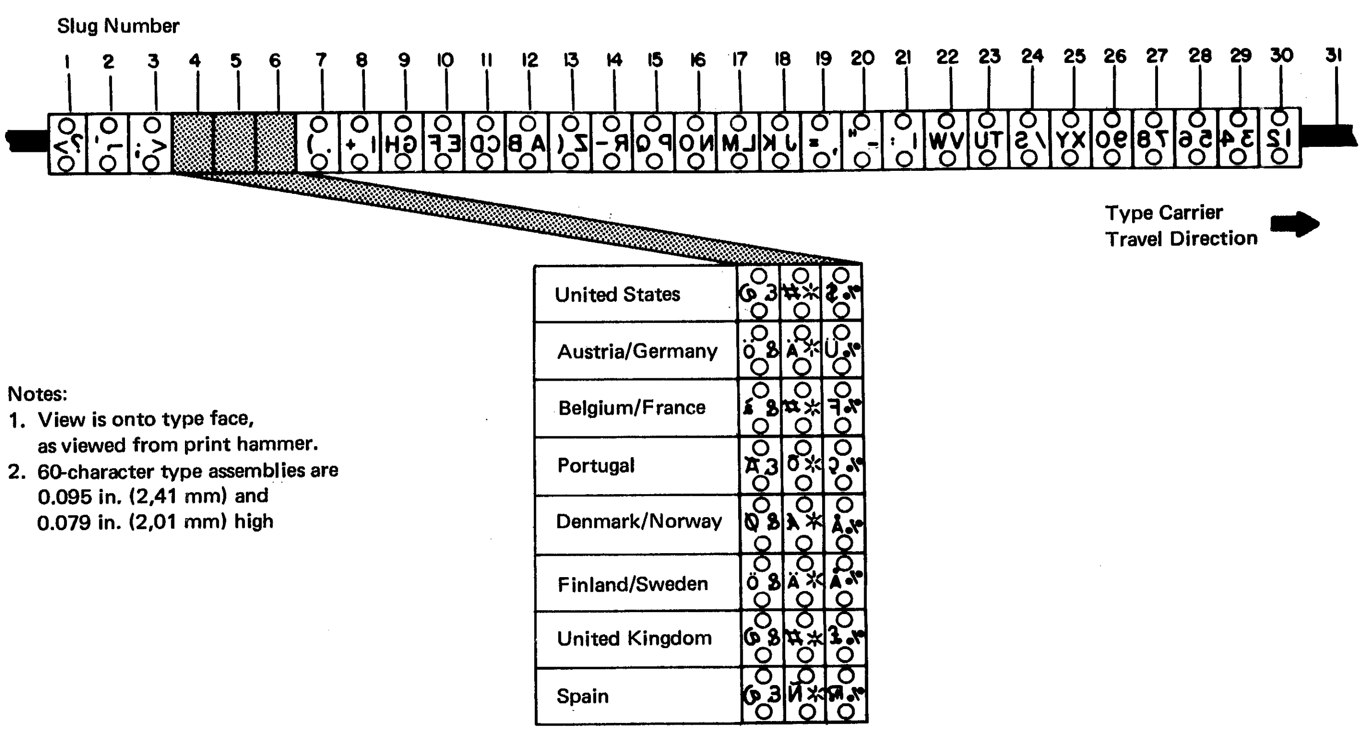
Figure 41 shows the sequence of characters and alternative national graphics for the 48- and 60-character sets.

48-Character Set Sequence



Notes:
1. View is onto type face, as viewed from print hammer.
2. 48-character type assemblies are 0.095 in. (2,41 mm) and 0.079 in. (2,01 mm) high

60-Character Set Sequence

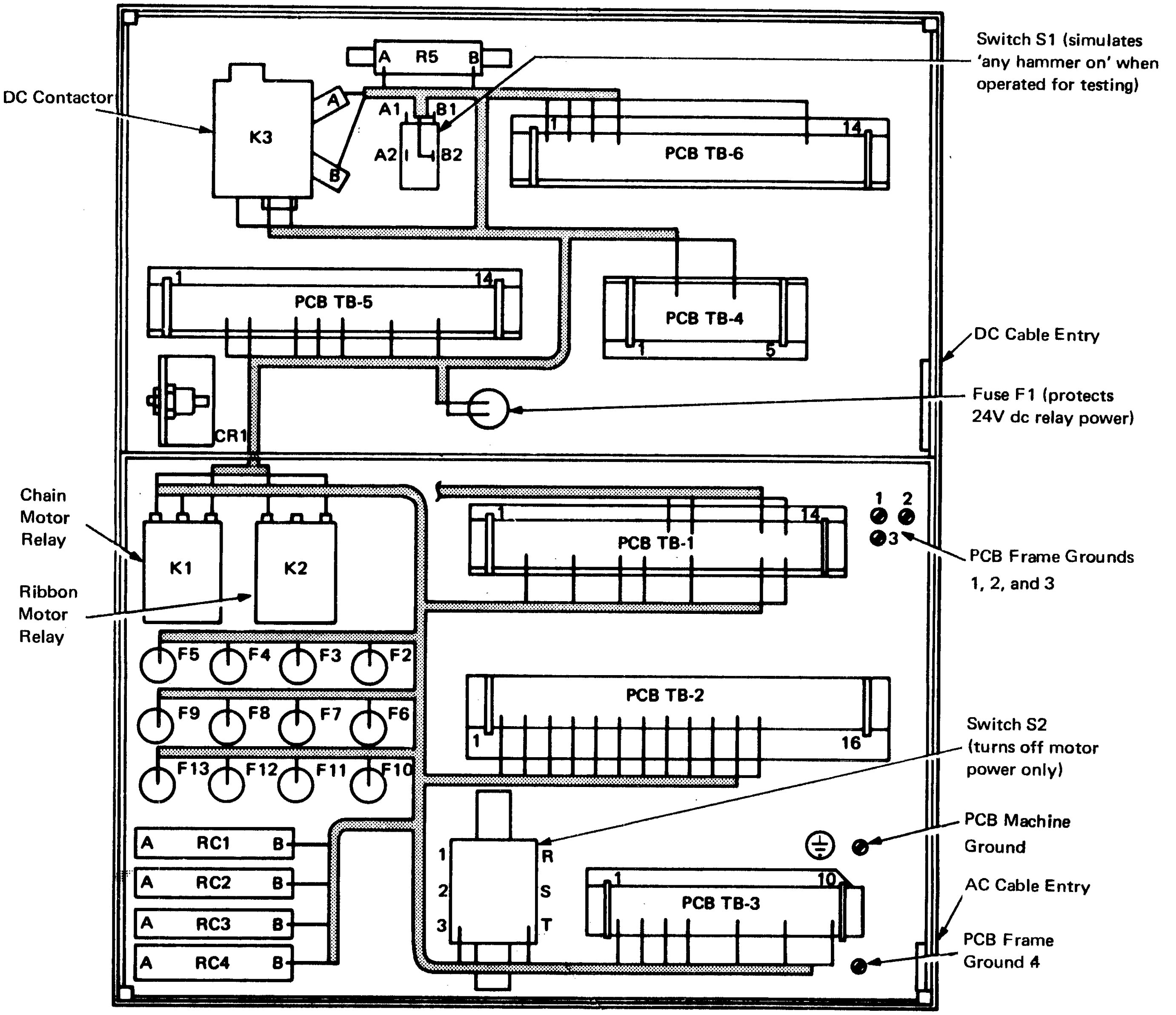


Notes:
1. View is onto type face, as viewed from print hammer.
2. 60-character type assemblies are 0.095 in. (2,41 mm) and 0.079 in. (2,01 mm) high

Figure 41. Character Sequences for 48- and 60-Character Sets [07360]

The locations of components within the printer control box and on the printer electronics board are shown in Figures 42 and 43 respectively. A list of signal interface locations is given also in Figure 43.

The routing of cables within the 5203 is shown in Figure 44, and details of cable plugs are shown in Figure 45.

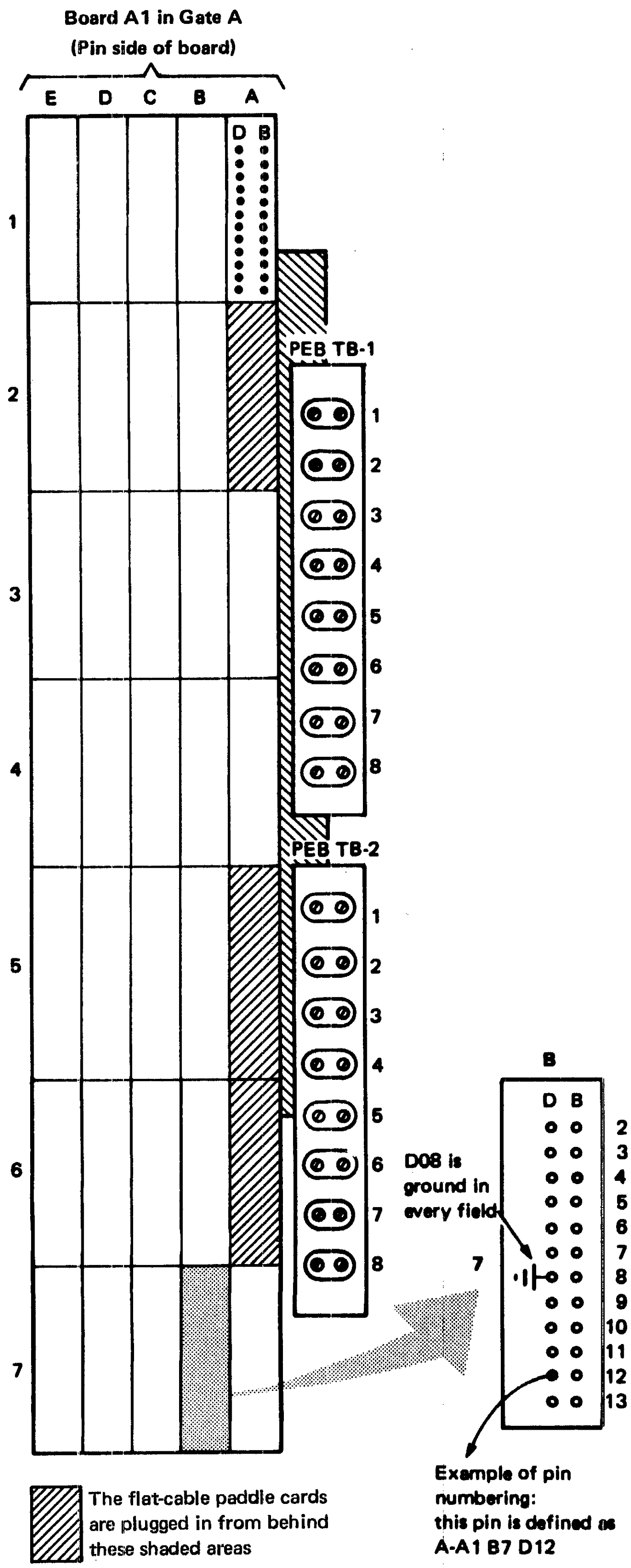


Fuse Details

Fuse	50-Hz Machines		60-Hz Machines	
	Rating	IBM Part	Rating	IBM Part
F2, F3, F4	0.8A	78952	1.5A	1176668
F5, F6, F7	0.5A	78999	1.0A	303549
F8 through F13	0.175A	111260	0.3A	78998

Note: All fuses and the switches S1 and S2 are accessible from the outer side of the PCB

Figure 42. Printer Control Box Locations [07357]



Signal Interface Locations

Connector A2

Pin	Signal Name	Level
B 2	Intf Forms Light Driver	AC
D 2	Intf Ready Light Driver	AC
B 3	Intf AC Lamp Common	AC ⏚
D 4	Intf Check Light Driver	AC
B 5	Intf Interlock Light Driver	AC
D 5	Intf Stop Key N/C	–
B 6	Intf Printer Start Key N/C	+
D 6	Intf Sw Gnd for Start & Stop Key	–
B 7	Intf Printer Start Key N/O	+
B 8	Intf Lt Carr Restore Key N/C	–
B 9	Intf Lt Carr Restore Key N/O	+
D 9	Intf Sw Gnd for Lt Carr	–
B10	Intf Lt Carr Space Key N/C	–
D10	Intf Lt Carr Space Key N/O	+
B11	Intf Rt Carr Restore Key N/C	–
D11	Intf Rt Carr Restore Key N/O	+
D12	Intf Sw Gnd for Rt Carr	–
B13	Intf Rt Carr Space Key N/C	–
D13	Intf Rt Carr Space Key N/O	+

Connector A5

Pin	Signal Name	On-Level
B 2	Intf Drop +60V	+
D 2	Intf Right Carr Clutch	–
D 3	Intf Chain Emitter	+
B 4	Intf Hmr Shift Clutch	–
B 5	Intf Print Time	–
D 5	Intf Device Ready	–
B 6	Intf Print Start Pulse	+
D 6	Intf Hmr Unit Thermo Overl	–
D 7	Intf Common Interlock	–
B 8	Intf Hmr Bar Right	+
B 9	Intf Hammer Off Echo	+
D 9	Intf 48 Char Set	–
B10	Intf Any Hammer On	+
D10	Intf UCS Chain Home Emitter	+
D11	Intf Forms Jam	–
B13	Intf Left Carr Clutch	–
D13	Intf Run Use Meter	–
B12	Intf End of Forms	–

Connector A6

Pin	Signal Name	On-Level	
B 2	Intf Hammer Address X7	–	
D 2	Intf Right Carr Emitter	+	
D 3	Intf Hammer Address XF	–	Minus
B 4	Intf Hammer Address X8	–	Minus
B 5	Intf Hammer Address X9	–	Minus
D 5	Intf Hammer Address Y0-3	–	Minus
B 6	Intf Hammer Address XA	–	Minus
D 6	Intf Hammer Address Y4-7	–	Minus
D 7	Intf Hammer Address Y8-B	–	Minus
B 8	Intf Hammer Address XB	–	Minus
B 9	Intf Hammer Address XC	–	Minus
D 9	Intf Hammer Address YC-F	–	Minus
B10	Intf Hammer Address XD	–	Minus
D10	Intf Hammer Set	–	Minus
D11	Intf Hammer Reset	–	Minus
B12	Intf Hammer Address XE	–	Minus
B13	Intf Left Carr Emitter	+	
D13	Intf Reset Ptr Electronics	+	

Figure 43. Printer Electronics Board Locations [07358]

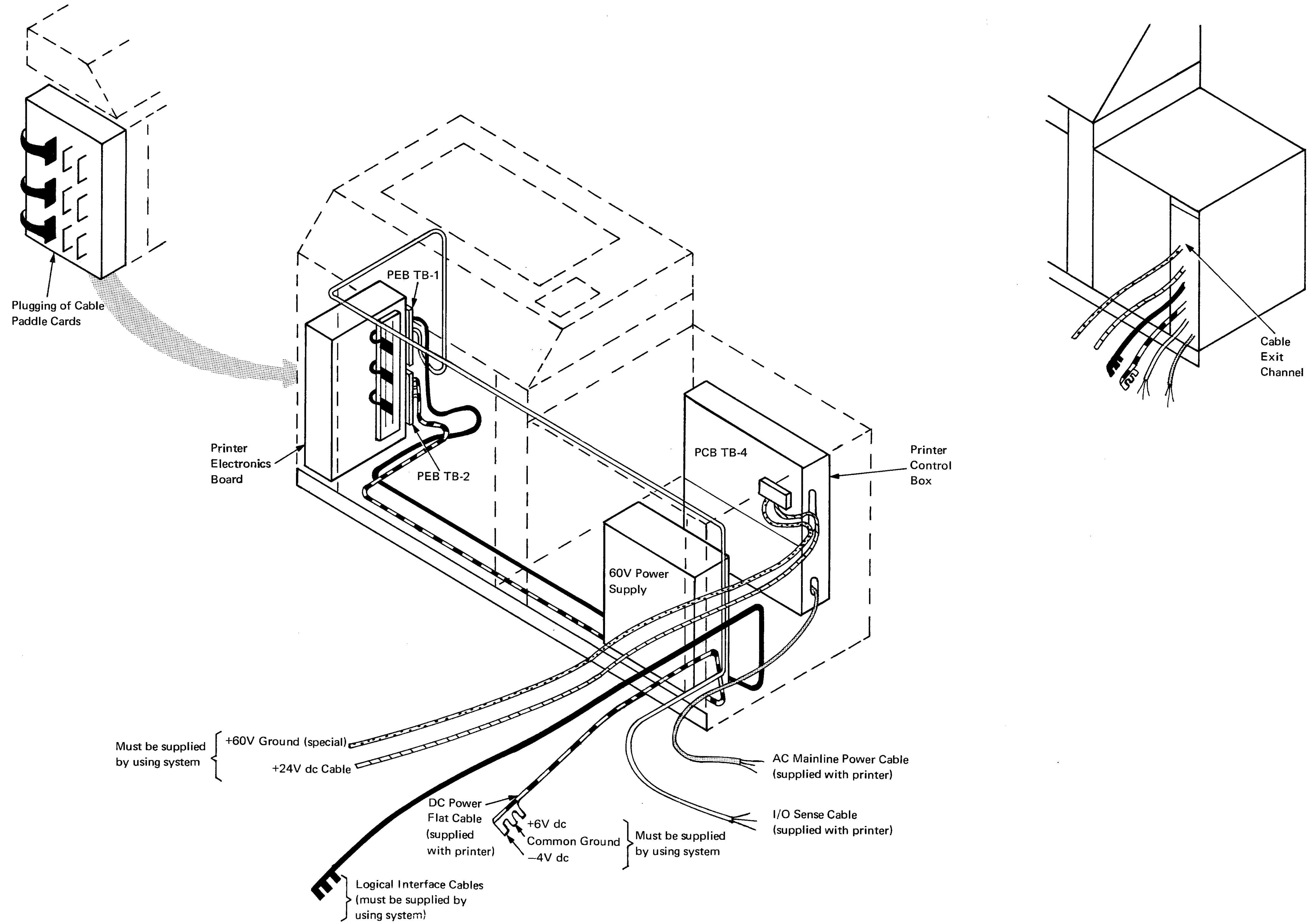
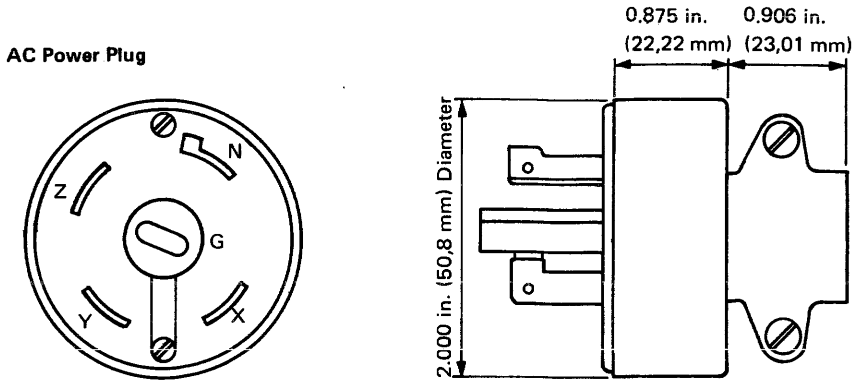


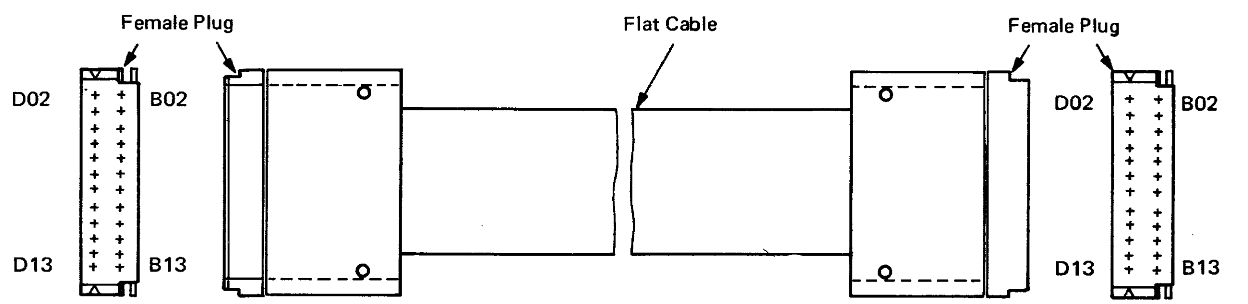
Figure 44. Printer Cable Routing [07359]

AC Power Plug



Rating: 30A, 600V max
Plug: IBM Part 5213831
Mating Part: IBM Part 5213830

Flat Cable with Plugs



Flat Cable Female Plug with Mating Pin

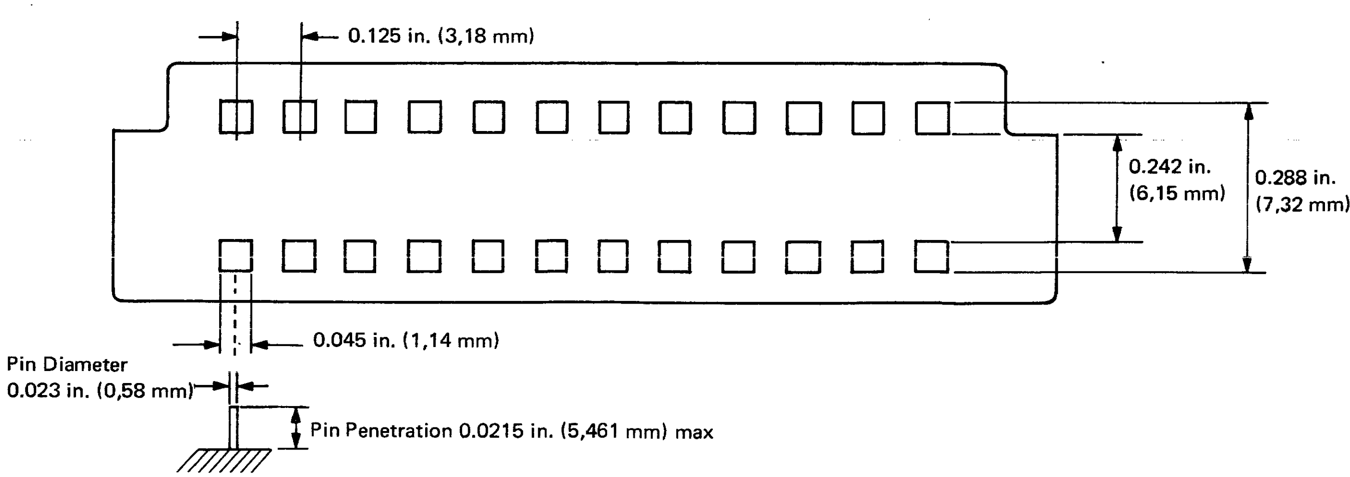
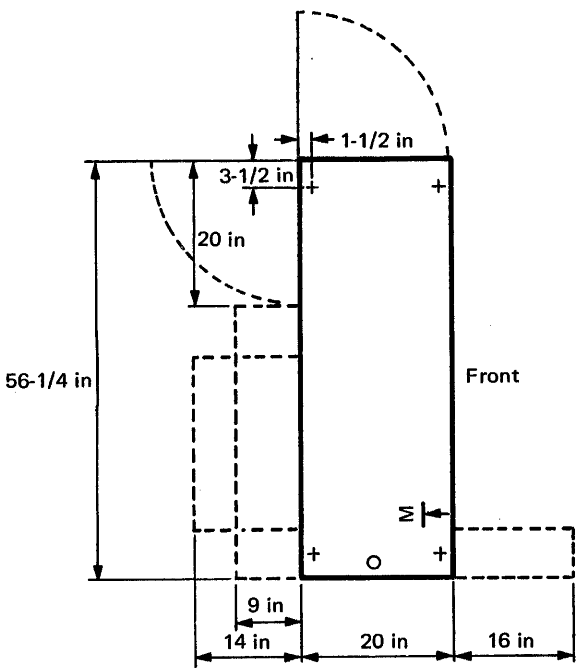


Figure 45. Cable Plug Details [07361]

PLAN VIEW



Inches	Centimeters
1-1/2	4
3-1/2	9
9	23
14	36
16	41
20	51
56-1/4	143

Legend

+ Casters (adjustable for leveling)

O Leveling Pad

M Use Meter Location

Figure 46. Plan View of 5203 [07362]

UNIT SPECIFICATION

Dimensions

	Width	*Depth*	*Height*
Inches	56-1/4	20	41-1/2
Centimeters	143	50,8	104

Weight

475 lb (215 kg)

Heat Output

912 BTU/h (230 kcal/h)

Power Requirements (without Logical Voltages)

kVA	2.5
Phase	Three phases
Voltage tolerance	±10%
Frequency tolerance	±0.5 Hz

Operating Environment

Temperature	61-100°F (16-38°C)
Relative humidity	8-80%
Maximum wet bulb	78°F (26°C)

Nonoperating Environment

Temperature	50-109°F (10-43°C)
Relative humidity	8-80%
Maximum wet bulb	80°F (27°C)

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Original Equipment Manufacturers' Information

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