HSP3100-FC

Technical reference

Preface

- This manual provides a complete technical information reference about **HSP3100-FC** mechanism.
- If not specified, the data of the present specification are valid for all the types of printers, when the specification of the printer is different, according to the type, its specification is described with annotation.
- The present specification is valid also for customized types, where the different condition has not effects for common data (eg. different length of elec. cables).
- More information is available upon request such as high speed printing applications and reliability figures.

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Revision History

Rev.	Date	Page/Sec.	Description	Author
A	02/08/05	-	Preliminary.	MR/EV/NT

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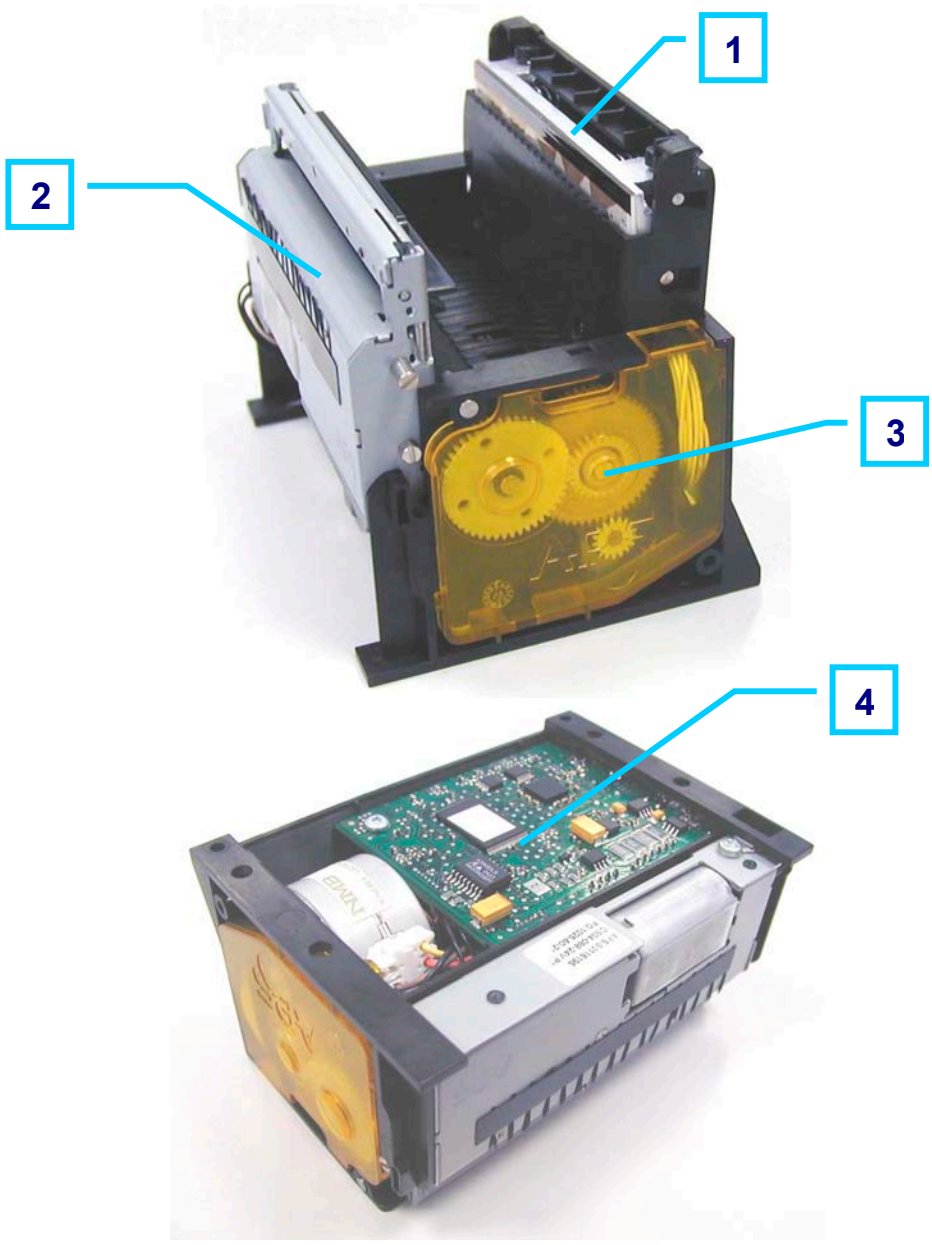
1. INTRODUCTION

The **HSP3100-FC** is a 8 dots thermal line 3" printer, it has been designed for POS application as high speed printing mechanism with an integrated guillotine cutter.
An overview of the mechanism is shown below.



2. removable print-head (for easy cleaning operations)
3. removable guillotine cutter
4. robust gearing using metallic pins
5. fast controller board

1.1 HSP3100-FC features

The main features of HSP3100-FC are:

- **High-speed printing (up to 220mm/s)**
  Historic control printing (enhances printing quality and lowers power consumption)
- **100 km of mechanical life**
- **High resolution printing (8dots/line)**
- **Integrated guillotine cutter**
- **Full control over printing quality/speed**
  User-definable maximum speed and acceleration
  User-definable printing intensity
- **Powerful text printing modes**
  Double, quadruple width and height
  Underlined, inverse video
  90 and 180° rotated printing
  … all these may be mixed on the same text line
- **Powerful graphic mode**
  Double, quadruple width and height
  One download, multiple prints facility for images
  Raster graphics printing (FAX-style)
- **Page mode printing**
  Powerful yet easy to use placing, rotating and stretching commands to prepare complex tickets and print them at maximum speed
- **Macro support**
  Up to 2Kbytes of mixed data/command may be stored in memory and played back at any time (useful for static ticket headers, etc)
- **Cutter driving**
  DC motor cutter
- **Barcode support**
  Support for UPC-A, UPC-E, EAN13, CODE39, ITF and CODABAR
- **End of paper detection**
- **Easy removable thermal head (for replacement and cleaning)**
- **Head-up detection (IR opto-sensor)**
- **Cover-open detection support through external user switch**
- **Dedicated user non-volatile (NV) memory**
  Available for the user to read and write any data
  Images (such as logos) may be stored in NV memory and printed on request
- **USB communication interface**
  Complies with the *Universal Serial Bus specification Rev. 2.0 (basic speed)*
- **Two resident characters fonts, easy font upgrades**
  Font A is 12x24 pixels, font B is 9x17 pixels
  User fonts may be of any width and height
- **Easy firmware upgrades**

2. GENERAL SPECIFICATIONS

Item		Specification	
Dimensions W x D x H		112x81x57.5 (mm)	
Weight		Approx. 450 g	
Paper width		82.5mm +0/-0.5 mm	
Paper thickness		Max 100 g/m^2	
Print method		Thermal dot-line printing	
Paper path		Straight	
Number of dots		640	
Dot density		8 dots/mm	
Printing width		80 ± 0.2 mm (centred on paper)	
Paper feed pitch		0.125 mm	
Cutter type		Guillotine	
Cut types		Full and partial	
Paper loading		Automatic	
Thermal side winding		Inside or outside	
Recommended Paper		JUJO-AF50KS-E (standard grade) JUJO-AF50KS-E3 (high sensitivity) Equivalent types can be used	
Voltage range		24 V ± 10%	
Current consumption		Average 5A Max peak 12A (@24V, max black printout)	
Operating temperature		From 0°C to +50°C	
Operating humidity (RH%)		20-85 (no condensation)	
Storage temperature (°C)		From -40°C to +90°C	
Storage humidity (RH%)		10-90 (no condensation)	
Printer life	**Durability**	**Basic conditions**	**Maximum variations**
Printhead pulse life	50 million pulses	Room temp.: 20 ÷ 25 °C Mounting plane: parallel to the ground plane	Max. 15% in resistance value (Ω) of any dot, from its initial value
Printhead abrasion life	50 km		
Transmission chain life	100 km		--
Cutter	500.000 cuts		--

3. THERMAL HEAD

3.1 Thermal head

Heat element structure:	2 heaters/dot
Number of heat elements:	640 dots
Heat element (dot) pitch:	0.125 mm
Printing width	80 mm
Average resistance:	800 Ω ±3%

3.1.1 *Thermal head electrical characteristics*

Item	Symbol	Min.	Typ.	Max.	Unit
Print voltage	VH	-	24	26.4	V
Logic voltage	Vdd	4.75	5.00	5.25	V
Logic current	Idd	-	-	80	mA
Input voltage (High)	V_{IH}	0.8 Vdd	-	Vdd	V
Input voltage (Low)	V_{IL}	0	-	0.2 Vdd	V
Data input current (DI) High	I_{IH} DI	-	-	0.5	µA
Data input current (DI) Low	I_{IL} DI	-	-	-0.5	mA
STB 1 to 6 input current (High)	I_{IH} STB	-	-	60	µA
STB 1 to 6 input current (Low)	I_{IL} STB	-	-	-1	µA
Clock input current (High)	I_{IH} CLK	-	-	5	µA
Clock input current (Low)	I_{IL} CLK	-	-	5	µA
Latch input current (High)	I_{IH} LAT	-	-	5	µA
Latch input current (Low)	I_{IL} LAT	-	-	5	µA
Data out output voltage (High)	V_{DOH}	4.45	-	-	V
Data out output voltage (Low)	V_{DOL}	-	-	0.05	V
Output voltage (driver out)	V_{OL}	-	1.0	-	V
Clock frequency	f CLK	-	-	8	MHz
Clock width	tw CLK	30	-	-	ns
Data setup time	tsetup DI	30	-	-	ns
Data hold time	thold DI	10	-	-	ns
Data out delay time	td DO	-	-	120	ns
Latch width	tw LAT	100	-	-	ns
Latch setup time	tsetup LAT	200	-	-	ns
Latch hold time	thold LAT	50	-	-	ns
STB setup time	tsetup STB	300	-	-	ns
Driver out delay time	tdo	-	-	10	µs

4. SENSORS

The **HSP3100-FC** has two sensors:

Function	Type
Paper detection	Photo interrupter/opto sensor
Head up detection	Photo interrupter

The paper detection sensor is intended to be used to monitor the presence/absence of the paper. If there is no paper or the paper roll is near to its end the printing is enabled.

The **HSP3100-FC** has a head up and down function that separates the head from the rubber roller to allow TPH cleaning and paper jamming removal. If the TPH is not in the correct position (hooked on body pins) the printing is enabled

5. CUTTER

5.1 General characteristics

	CGA8824
Cutting method	Guillotine
Paper weight	100g/m² MAX
Paper width (max)	85 mm
Cut type	Total and partial
Cut frequency (max)	20 cuts/min
Cutter life	> 500 000 cuts
Operating temperature range	-10 to +50°C
Operating humidity range	10-80% (non condensing)
Full cut time	430ms
Partial cut time	560ms
Size (HxDxW)	15.4 x 53 x 100.4

5.2 Cutter installation

The cutter is placed in vertical position in the front part of printer body. The assembly is made by two slides that keep in position the pin screwed on cutter frame.

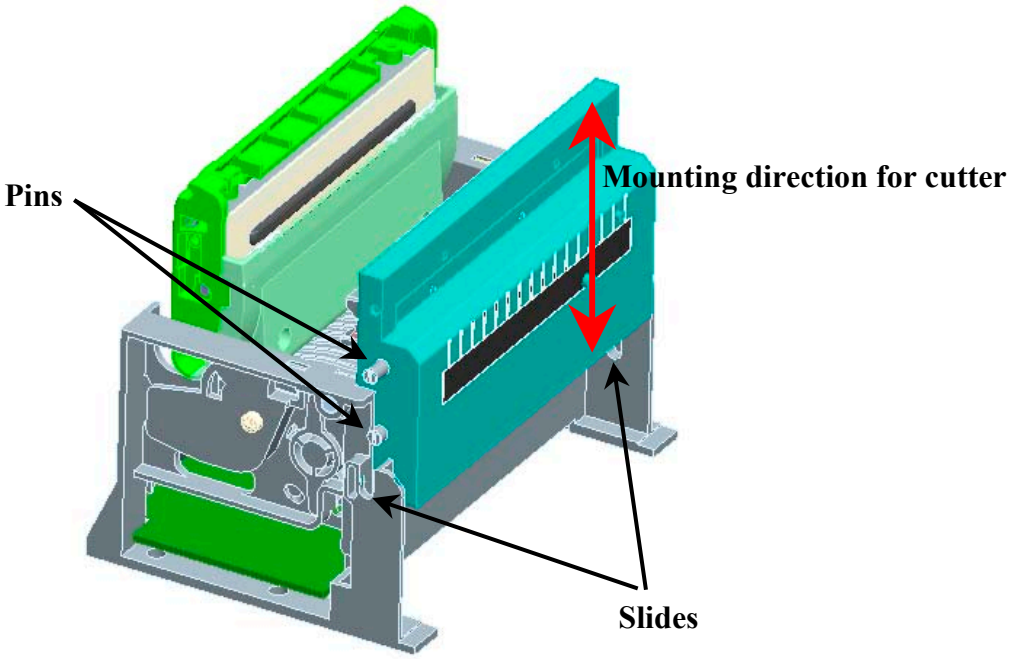


Fig. 1 – cutter installation

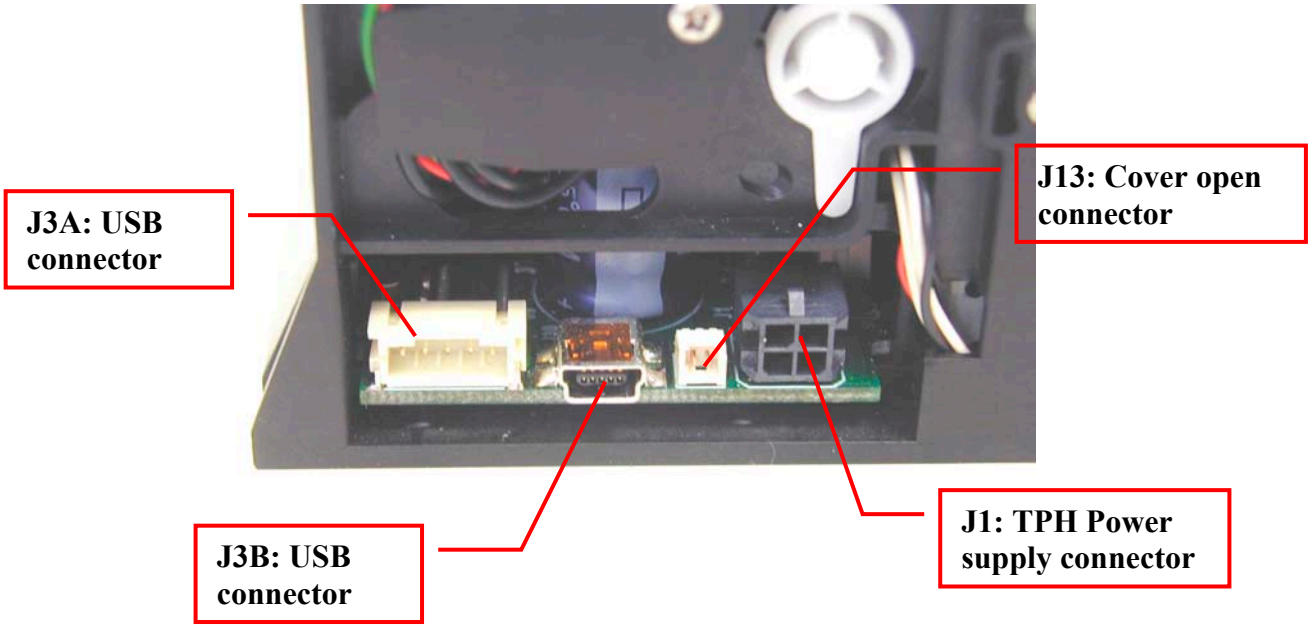
6. PRINTER DEVICE INTERCONNECTION

This device is fully hot-plug : any connector hereafter can be connected or disconnected without damaging the printer.

The HSP3100-FC control board offers the following types of connections:

- Main power supply;
- USB communication interface;
- Printer cover-open switch sensing.

Refer to the attached overall dimensions drawing for location and pin 1 identification of each connector.



6.1 TPH power supply connector

Connector J1: Molex 43045-0406, 4 contacts, right angle, pitch 3.00mm Micro-Fit
Mates with Molex plug 43025-0400

Pin number	Signal name	Signal direction	Description
1	VIN	Power	TPH supply voltage
2	VIN	Power	
3	GND	Ground	TPH supply ground
4	GND	Ground	

Table 1: TPH power supply connector pinout.

Nominal supply voltage: 24V +/-10%
Power supply failure is detected when supply voltage drops below 16V (default value, may be adjusted *via* an escape command)

Average current: 5A
Peak current: 12A (when printing whole black dotlines at maximum printing speed)

Current consumption may vary according to required printing speed and printing quality settings. Values shown are absolute maximum values.

6.2 USB communication connectors

Two connectors (J3A and J3B) are available for USB communication. Connectors J3A and J3B are bound to the same USB interface; the HSP3100-FC control board has only one USB interface. Connector J3B is wired in parallel to connector J3A. . Consequently, both connectors cannot be used at the same time.

Connector J3A: JST type S5B-PH-SM3-TB, 5 contacts, right angle, pitch 2.00mm

Pin number	Signal name	Signal direction	Description
1	VBUS	Power	USB bus power +5V
2	D-	I/O	Differential data signal
3	D+	I/O	Differential data signal
4	ID	Ground	Printer connect signal
5	GND	Ground	USB interface ground

Table 2: USB connector pinout.

Connector J3B: Molex type 54819-0571 standard mini-B USB connector

Pinout of connector J3B is similar to connector J3A and is also described by Table 2.

6.3 Cover open connector

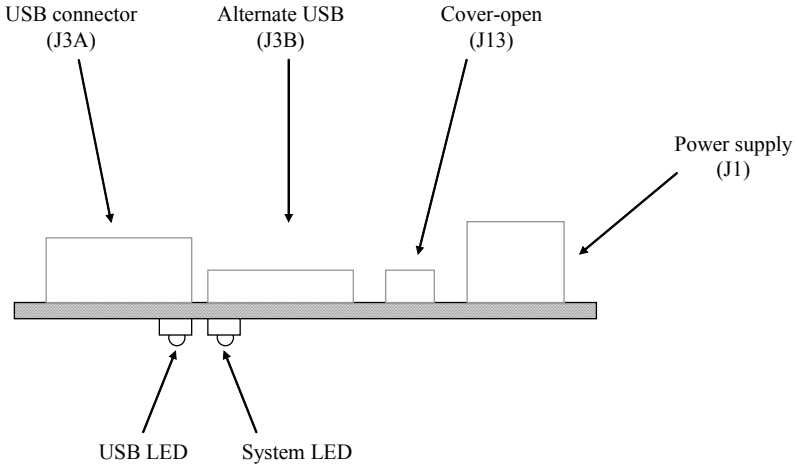
This connector is intended to give the possibility to connect a custom external switch to detect if any cover of the complete system is open. Generally speaking it can be used to detect any system condition where the printing must be disabled.
Connector J13: Molex 53047-0210, 2 contacts, straight, pitch 1.25mm
Mates with Molex plug 51021-0200

Pin number	Signal name	Signal direction	Description
1	CO_SW	N.A.	Cover open sensor switch
2	GND	N.A.	Ground

Table 3: Cover open connector pinout.

6.4 System and USB LED

The control board has two LED showing current system and communication status. Figure 1 shows position of the two LED inside the connector window.



(connectors window viewed from the outside of the mechanism)

Figure 1: Connectors window and LED position.

The system LED indicates the current state of the printer.
Table 4 shows the relationship between printer states and LED blinking patterns.

Printer state	System LED blink pattern
Online	Always ON
Offline	One flash
Paper stop – printer head up or cover is open	Two flashes
Paper stop – end of paper	Three flashes
Error condition detected	Fast blinking
Boot mode	Slow blinking
Monitor mode	Intermittent blinking

Table 4: System LED blinking patterns versus printer states.

The USB LED indicates the state the USB communication interface is in. Once initialized, the USB LED also indicates the activity on the USB communication link.

7. OPERATING CONTROL CODES

7.1 Control codes in alphabetical order

The following legend is used throughout Table 5: Control codes in alphabetical order. Table 5 to indicate the effect of each command in either standard or page modes.

- **X** = command is executed in either mode
- **(X)** = command is executed only when received at the beginning of a line
- **I** = command is ignored
- **D** = command is disabled, received data is processed as normal data

- **S** = received value is set, but does not affect processing in current printing mode

The whole set of commands supported by the HSP3100-FC control board is 100% ESC/POS compatible. Commands printed in *italic* are enhancements brought by APS; whenever possible, it has been verified that these enhanced commands were not interfering with the present ESC/POS command set.

Note 1: commands printed in italic on a grey background are APS-specific commands. As such, they are not part of the standard ESC/POS command set. However, the APS-specific commands try to follow the ESC/POS commands layout, and to date do not conflict with the standard ESC/POS command set

Note 2: commands printed on a hashed background are standard ESC/POS commands that are not implemented in this design for some reason. Please refer to the description of each specific command for more information.

Command	Description	Standard mode	Page mode	Page
HT	Horizontal tab	X	X	28
LF	Print and line feed	X	X	28
FF	Print and return to standard mode (in page mode)	I	X	46
CR	Print and carriage return	X	X	29
CAN	Cancel print data in page mode	I	X	46
DLE EOT	Real-time status transmission	X	X	20
DLE ENQ	Real-time recover from error	X	X	22
ESC FF	Print data in page mode	I	X	47
ESC SP	Set right-side character spacing	X	X	29
ESC !	Select printing options	X	X	29
ESC $	Set absolute print position	X	X	30
ESC %	Select/cancel user-defined character set	X	X	38
ESC &	Download user-defined character set	X	X	39
ESC *	Print bit image	X	X	34
ESC -	Turn underline mode on/off	X	X	30
ESC 2	Set default line spacing	X	X	31
ESC 3	Set line spacing	X	X	31
ESC =	Enable/disable printer	X	X	22
ESC ?	Cancel user-defined character	X	X	41
ESC @	Reset printer	X	X	23
ESC D	Set horizontal tab positions	X	X	31
ESC J	Print and feed paper	X	X	32
ESC L	Select page mode	(X)	I	47
ESC M	Select character font	X	X	41
ESC R	Select an international character set	X	X	42
ESC S	Select standard mode	I	X	44
ESC T	Set print direction in page mode	S	X	47
ESC V	Turn 90° clockwise rotation mode on/off	X	S	44
ESC W	Set printing area in page mode	S	X	48
ESC \	Set relative print position	X	X	32
ESC a	Set justification	(X)	S	44
ESC c 3	Select paper sensor(s) to signal paper end	X	X	23

ESC c 4	Select paper sensor(s) to stop printing	X	X	23
ESC c 5	Enable/disable panel buttons	X	X	23
ESC d	Print and feed n lines	X	X	33
ESC t	Set character code table	X	X	43
ESC {	Turn upside-down printing mode on/off	(X)	S	45
FS g 1	Write to NV user memory	X	D	55
FS g 2	Read from NV user memory	X	X	56
FS p	Print NV bit image	X	D	57
FS q	Download NV bit image	(X)	D	57
FS r	*Upload NV bit image*	*(X)*	*D*	*59*
GS !	Set character size	X	X	33
GS $	Set absolute vertical print position in page mode	I	X	49
GS *	Download bit image	X	X	36
GS (A	Execute self test	X	D	23
GS /	Print downloaded bit image	(X)	X	37
GS :	Start/end macro recording	X	X	60
GS B	Turn white/black reverse printing mode on/off	X	X	33
GS H	Select print position of HRI characters	X	X	50
GS I	Transmit printer ID	X	X	24
GS J 0	*Get number of available dot lines in print buffer*	*(X)*	*X*	*61*
GS J 1	*Get number of available text lines in print buffer*	*(X)*	*X*	*62*
GS J 2	*Set printing intensity*	*(X)*	*X*	*62*
GS L	Set left margin	(X)	S	45
GS M 0	*Set stepper motor acceleration*	*X*	*X*	*62*
GS M 1	*Set minimum printing speed*	*(X)*	*X*	*62*
GS M 2	*Set maximum printing speed*	*(X)*	*X*	*63*
GS P	Set horizontal and vertical motion units	X	X	34
GS T 0	*Get printing head temperature*	*(X)*	*X*	*63*
GS T 1	*Get printing head voltage*	*(X)*	*X*	*64*
GS T 2	*Set power failure voltage*	*(X)*	*X*	*65*
GS V	Select cut mode and cut paper	(X)	X	61
GS W	Set printing area width	(X)	S	46
GS \	Set relative vertical print position in page mode	I	X	50
GS ^	Playback macro	X	X	60
GS a	Enable/disable Automatic Status Back (ASB)	X	X	25
GS f	Set font for HRI characters	X	X	34
GS h	Set barcode height	X	X	51
GS k	Print barcode	(X)	X	52
GS r	Transmit sensors status	X	X	27
GS v 0	Print raster bit image	(X)	D	37
GS w	Set barcode width	X	X	54

Table 5: Control codes in alphabetical order.

7.2 Control codes grouped by functionality

The following sections split the various commands different categories. The same legend as in 7.1 is used throughout the following tables.

7.2.1 Printer status and configuration commands

Command	Description	Standard mode	Page mode	Page
DLE EOT	Real-time status transmission	X	X	20
DLE ENQ	Real-time recover from error	X	X	22
ESC =	Enable/disable printer	X	X	22
ESC @	Reset printer	X	X	23
ESC c 3	Select paper sensor(s) to signal paper end	X	X	23
ESC c 4	Select paper sensor(s) to stop printing	X	X	23
ESC c 5	Enable/disable panel buttons	X	X	23
GS (A	Execute self test	X	D	23
GS I	Transmit printer ID	X	X	24
GS a	Enable/disable Automatic Status Back (ASB)	X	X	25
GS r	Transmit sensors status	X	X	27

Table 6: Printer status and configuration command set.

7.2.2 Text printing commands

Command	Description	Standard mode	Page mode	Page
HT	Horizontal tab	X	X	28
LF	Print and line feed	X	X	28
CR	Print and carriage return	X	X	29
ESC SP	Set right-side character spacing	X	X	29
ESC !	Select printing options	X	X	29
ESC $	Set absolute print position	X	X	30
ESC -	Turn underline mode on/off	X	X	30
ESC 2	Set default line spacing	X	X	31
ESC 3	Set line spacing	X	X	31
ESC D	Set horizontal tab positions	X	X	31
ESC J	Print and feed paper	X	X	32
ESC \	Set relative print position	X	X	32
ESC d	Print and feed n lines	X	X	33
GS !	Set character size	X	X	33
GS B	Turn white/black reverse printing mode on/off	X	X	33
GS P	Set horizontal and vertical motion units	X	X	34

Table 7: Text printing command set.

7.2.3 *Graphics printing commands*

Command	Description	Standard mode	Page mode	Page
ESC *	Print bit image	X	X	29
GS *	Download bit image	X	X	36
GS /	Print downloaded bit image	(X)	X	37
GS v 0	Print raster bit image	(X)	D	37

Table 8: Graphics printing command set.

7.2.4 *Character set commands*

Command	Description	Standard mode	Page mode	Page
ESC %	Select/cancel user-defined character set	X	X	38
ESC &	Download user-defined character set	X	X	39
ESC ?	Cancel user-defined character	X	X	41
ESC M	Select character font	X	X	41
ESC R	Select an international character set	X	X	42
ESC t	Select character code table	X	X	43

Table 9: Character set command set.

7.2.5 *Standard mode specific commands*

Command	Description	Standard mode	Page mode	Page
ESC S	Select standard mode	I	X	44
ESC V	Turn 90° clockwise rotation mode on/off	X	S	44
ESC a	Set justification	(X)	S	44
ESC {	Turn upside-down printing mode on/off	(X)	S	45
GS L	Set left margin	(X)	S	45
GS W	Set printing area width	(X)	S	46

Table 10: Commands specific to standard mode printing.

7.2.6 *Page mode specific commands*

Command	Description	Standard mode	Page mode	Page
FF	Print and return to standard mode (in page mode)	I	X	46
CAN	Cancel print data in page mode	I	X	46
ESC FF	Print data in page mode	I	X	47
ESC L	Select page mode	(X)	I	47
ESC T	Set print direction in page mode	S	X	47
ESC W	Set printing area in page mode	S	X	48
GS $	Set absolute vertical print position in page mode	I	X	49
GS \	Set relative vertical print position in page mode	I	X	50

Table 11: Commands specific to page mode printing.

7.2.7 *Barcode commands*

Command	Description	Standard mode	Page mode	Page
GS H	Select print position of HRI characters	X	X	50
GS f	Select font for HRI characters	X	X	51
GS h	Set barcode height	X	X	52
GS k	Print barcode	(X)	X	52
GS w	Set barcode width	X	X	54

Table 12: Barcode command set.

7.2.8 *NV user memory commands*

Command	Description	Standard mode	Page mode	Page
FS g 1	Write to NV user memory	X	D	55
FS g 2	Read from NV user memory	X	X	56
FS p	Print NV bit image	X	D	57
FS q	Download NV bit image	(X)	D	57
FS r	*Upload NV bit image*	*(X)*	*D*	*59*

Table 13: Non-volatile user memory command set.

7.2.9 *Macro commands*

Command	Description	Standard mode	Page mode	Page
GS :	Start/end macro recording	X	X	60
GS ^	Playback macro	X	X	60

Table 14: Macro definition and playback command set.

7.2.10 *Cutter commands*

Command	Description	Standard mode	Page mode	Page
GS V	Select cut mode and cut paper	(X)	X	61

Table 15: Cutter command set.

7.2.11 *APS specific commands*

Command	Description	Standard mode	Page mode	Page
GS J 0	*Get number of available dot lines in print buffer*	*(X)*	*X*	*61*
GS J 1	*Get number of available text lines in print buffer*	*(X)*	*X*	*62*
GS J 2	*Set printing intensity*	*(X)*	*X*	*62*
GS M 0	*Set stepper motor acceleration*	*(X)*	*X*	*62*
GS M 1	*Set minimum printing speed*	*(X)*	*X*	*62*
GS M 2	*Set maximum printing speed*	*(X)*	*X*	*63*
GS T 0	*Get printing head temperature*	*(X)*	*X*	*63*
GS T 1	*Get printing head voltage*	*(X)*	*X*	*64*
GS T 2	*Set power failure voltage*	*(X)*	*X*	*65*

Table 16: APS specific command set.

8. CONTROL CODES DESCRIPTION

8.1 Printer status and configuration commands description

DLE EOT n

Description	Real-time status transmission			
Format	ASCII	DLE	EOT	n
	Hex	10	04	n
	Decimal	16	4	n
Range	$1 \leq n \leq 4$			

This command transmits the status information specified by n. Each status is represented by a one byte data. Table 17 shows a list of information that may be gathered using this command. Please refer to the following tables for detailed explanation of each status byte.

This command is executed upon reception, regardless of the commands and data currently waiting in the reception queue. It is not possible to issue this command in the middle of a multi-byte command. If all the same this command shall be received in the middle of a multi-byte command, it would be automatically answered, and the result should then be discarded by the HOST software.

n	Status information
1	Printer status
2	Offline status
3	Error status
4	Sensors status

Table 17: Status information list.

- n = 1, printer status

Bit	Description
0	Unused. Should read 0.
1	Unused. Should read 1.
2	Cash drawer switch is open when set to 0. Cash drawer switch is closed when set to 1. *This functionality is not implemented in this design.*
3	Printer is offline when 1, otherwise online.
4	Unused. Should read 1.
5	Undefined.
6	Undefined.
7	Unused. Should read 0.

Table 18: Printer status bits description.

- n = 2, offline status

Bit	Description
0	Unused. Should read 0.
1	Unused. Should read 1.
2	Printer cover is open when set to 1, otherwise closed.
3	Paper is being fed using PAPER FEED when set to 1. *This functionality is not implemented in this design.*
4	Unused. Should read 1.
5	Printing is being stopped when set to 1.
6	An error has occurred when set to 1.
7	Unused. Should read 0.

Table 19: Offline status bits description.

- n = 3, error status

Bit	Description
0	Unused. Should read 0.
1	Unused. Should read 1.
2	Undefined.
3	A cutter error has occurred when set to 1.
4	Unused. Should read 1.
5	An unrecoverable error has occurred when set to 1.
6	An auto-recoverable error has occurred when set to 1.
7	Unused. Should read 0.

Table 20: Error status bits description.

- n = 4, sensors status

Bit	Description
0	Unused. Should read 0.
1	Unused. Should read 1.
2,3	If “11”, near end of paper has been detected by sensor. If “00”, no near end of paper has been detected. *This functionality is not implemented in this design.*
4	Unused. Should read 1.
5,6	If “11”, end of paper has been detected by sensor. If “00”, no end of paper has been detected.
7	Unused. Should read 0.

Table 21: Sensors status bits description.

Status byte is only transmitted if the communication interface is not busy sending data. For example, status byte will not be transmitted if the USB transmit buffers are full or if the printer is already sending data in response to a HOST command. In this case, this command will be ignored.

DLE ENQ n

Description	Real-time recover from error			
Format	ASCII	DLE	ENQ	n
	Hex	10	05	n
	Decimal	16	5	n
Range	$1 \leq n \leq 2$			

This command instructs the printer to try and recover from an error condition. This command is only useful in case of cutter errors; all other errors (end of paper, TPH voltage and/or temperature out of range) are automatically recovered as soon as the error condition disappears.

Parameter n indicates what the printer should do right after the error is recovered:

n	Description
1	Recover from error and restart printing from the line where error occurred
2	Recover from error and clear receive and print buffers

Table 22: Out of error actions.

This command is executed upon reception, regardless of the commands and data currently waiting in the reception queue. This command is processed even if the reception buffer is full.

This command is ignored if the printer is not in an error condition.

ESC = n

Description	Enable/disable printer			
Format	ASCII	ESC	=	n
	Hex	1B	3D	n
	Decimal	27	61	n
Range	$0 \leq n \leq 255$			
Default	n = 1			

This command puts the printer in online or offline mode, depending on the value of n.

Bit	Description
0	1=printer enabled (online), 0=printer disabled (offline)
1-7	Undefined

Table 23: On/off line mode selection.

Printing is disabled when the printer is in offline mode.

ESC @

Description	Reset printer		
Format	ASCII	ESC	@
	Hex	1B	40
	Decimal	27	64

This command resets the printer and places the printer firmware in the default state. Please note that the printer will not be able to answer nor to accept commands during the reset period. A small delay has then to be inserted after issuing the reset command, and before sending commands or data again.

This command does not clear the receive buffer.

ESC c 3 n

Description	Select paper sensor(s) to signal paper end				
Format	ASCII	ESC	c	3	n
	Hex	1B	63	33	n
	Decimal	27	99	51	n
Range	$0 \leq n \leq 255$				
Default	n = 15				

This command is not implemented in this design, since there is only one sensor to signal the end of paper roll.

ESC c 4 n

Description	Select paper sensor(s) to stop printing				
Format	ASCII	ESC	c	4	n
	Hex	1B	63	34	n
	Decimal	27	99	52	n
Range	$0 \leq n \leq 255$				
Default	n = 0				

This command is not implemented in this design, since there is only one sensor to signal the end of paper roll.

ESC c 5 n

Description	Enable/disable panel buttons				
Format	ASCII	ESC	c	5	n
	Hex	1B	63	45	n
	Decimal	27	99	53	n
Range	$0 \leq n \leq 255$				
Default	n = 0				

This command is not implemented in this design, since there is no panel buttons.

GS (A pL pH n m

Description	Execute self test							
Format	ASCII	GS	(	A	pL	pH	n	m
	Hex	1D	28	41	pL	pH	n	m
	Decimal	29	40	65	pL	pH	n	m
Range	(pL + (pH x 256)) = 2 (pL = 2, pH = 0)							
	n = 0, 48							
	2 ≤ m ≤ 3, 50 ≤ m ≤ 51							

This command instructs the printer to print the test pattern specified by m using the paper roll number n. The 16-bit parameter (pL+pH*256) indicates the number of parameter bytes such as n, m. Since there are two parameter bytes (bytes n and m), pL should be 2 and pH should be 0.

Moreover, there is only one paper roll in this system, so n should be 0.
Table 24 indicates the various test patterns available.

m	Test pattern
2, 50	Printer self-test ticket
3, 51	Roller test ticket

Table 24: Self-test test patterns.

The roller test ticket is a simple 40cm long test ticket which aims at demonstrating the correctness of the roller.

Once the test print is over, the printer automatically resets as if the ESC @ command had been transmitted.

GS I n

Description	Transmit printer ID			
Format	ASCII	GS	I	n
	Hex	1D	49	n
	Decimal	29	73	n
Range	1 ≤ n ≤ 3, 49 ≤ n ≤ 51, 65 ≤ n ≤ 69			

This command transmits the printer ID specified by n. Table 25 shows the various printer ID that can be retrieved.

n	Printer ID	Type	Value
1, 49	Printer model ID	Byte	*Undefined*
2, 50	Printer type ID	Byte	0x02 (see below)
3, 51	Monitor version ID	Byte	0
65	Firmware version	ASCII string	0
66	Manufacturer	ASCII string	APS
67	Printer name	ASCII string	HRS
68	Serial number	ASCII string	*Undefined*
69	Printer type	ASCII string	HSP3100-FC

Table 25: Printer ID description.

Table 26 shows the bits description of the printer type ID byte.

Bit	Description
0	1=Two-byte character code supported. 0=Two-byte character code not supported.
1	1=Cutter mounted. 0=Cutter not mounted.
2	Unused. Should read 0.
3	Unused. Should read 0.
4	Unused. Should read 0.
5	Undefined
6	Undefined
7	Unused. Should read 0.

Table 26: Printer type ID bits description.

Printers ID which numbers range from 65 to 69 are transmitted as ASCII null-terminated strings. They are prefixed with an underscore ("_", ASCII code 0x5F) character, and always end with a zero (NUL, ASCII code 0x00).

For example, the printer will respond to the GS I <65> command with the following bytes:

ASCII	_	A	P	S	NUL
Hex	5F	41	50	53	00
Decimal	95	65	80	83	0

GS a n

Description	Enable/disable Automatic Status Back (ASB)			
Format	ASCII	GS	a	n
	Hex	1D	61	n
	Decimal	29	97	n
Range	$0 \leq n \leq 255$			

This command enables or disables the transmission of Automatic Status Back (ASB) information. The principle of this command is to let the printer inform the host on its own initiative that an event has occurred on one or several of the specified items described in Table 27.

Bit	Description
0	1=Transmit ASB on drawer kick-out connector pin 3 event
1	1=Transmit ASB on online/offline change event
2	1=Transmit ASB on error event
3	1=Transmit ASB on paper roll sensor event
4-7	Undefined

Table 27: Automatic Status Back monitoring request bits.

If, for example, the ASB functionality is configured with n = 6 (0b00000110), the printer will transmit its status to the host whenever it switches from online to offline or vice-versa, and/or when an error condition is detected. The status consists of four bytes, described in Table 28, Table 29, Table 30 and Table 31. The status is also transmitted upon the reception of the command.

- First status byte

Bit	Description
0	Unused. Should read 0.
1	Unused. Should read 0.
2	0 = Cash drawer switch is open, 1 = Cash drawer switch is closed *This functionality is not implemented in this design.*
3	0 = printer is online, 1 = printer is offline
4	Unused. Should read 1.
5	0 = printer cover is closed, 1 = printer cover is open
6	0 = paper is not being fed using PAPER FEED, 1 = paper is being fed *This functionality is not implemented in this design.*
7	Unused. Should read 0.

Table 28: First ASB byte bits description.

- Second status byte

Bit	Description
0	Undefined
1	Undefined
2	Undefined
3	1 = Cutter error occurred, 0 = no error
4	Unused. Should read 0.
5	1 = Unrecoverable error occurred, 0 = no error
6	1 = Automatically recoverable error occurred, 0 = no error
7	Unused. Should read 0.

Table 29: Second ASB byte bits description.

- Third status byte

Bit	Description
0,1	"11" = Sensors detected near end of paper "00" = No near end of paper detected *This functionality is not implemented in this design.*
2,3	"11" = Sensors detected end of paper "00" = No end of paper detected
4	Unused. Should read 0.
5	Undefined
6	Undefined
7	Unused. Should read 0.

Table 30: Third ASB byte bits description.

- Fourth and last status byte

Bit	Description
0-3	Undefined
4	Unused. Should read 0.
5-6	Undefined
7	Unused. Should read 0.

Table 31: Forth ASB byte bits description.

ASB bytes are only transmitted if the communication interface is not busy sending data. For example, ASB bytes will not be transmitted if the USB transmit buffers are full or if the printer is already sending data in response to a HOST command. However, ASB event will not be lost and status will be transmitted as soon as the communication interface is ready.

GS r n

Description	Transmit sensors status			
Format	ASCII	GS	r	n
	Hex	1D	72	n
	Decimal	29	114	n
Range	n = 1, 2, 49, 50			

This command transmits the sensors status byte number n.
Table 32 and Table 33show the bits layout of each sensors status byte.

Bit	Description
0,1	"11" = Sensors detected near end of paper "00" = Paper roll is not near the end of the paper *This functionality is not implemented in this design.*
2,3	"11" = Sensors detected end of paper "00" = Paper roll is not finished
4	Unused. Should read 0.
5	Undefined.
6	Undefined.
7	Unused. Should read 0.

Table 32: First sensors status byte (n=1 or n=49).

Bit	Description
0	1 = Cash drawer switch is closed 0 = Cash drawer switch is open *This functionality is not implemented in this design.*
1	Undefined
2	Undefined
3	Undefined
4	Unused. Should read 0.
5	Undefined.
6	Undefined.
7	Unused. Should read 0.

Table 33: Second sensors status byte (n=2 or n=50).

8.2 Text printing commands description

HT

Description
Format ASCII HT
Hex 9
Decimal 9

This command jumps to the next tab position.
This command has no effect if the cursor is beyond the last tab position.
See ESC D command for more information and setting about tab positions.

LF

Description Print and line feed
Format ASCII LF
Hex 0A
Decimal 10

This command makes the print cursor go to the next line. In standard mode, the current text line is also immediately printed.

CR

Description	Print and carriage return	
Format	ASCII	CR
	Hex	0D
	Decimal	13

This command is ignored. To go to the next line and/or to print the current text line, use the LF command instead.

ESC SP n

Description	Set right-side character spacing			
Format	ASCII	ESC	SP	n
	Hex	1B	20	n
	Decimal	27	32	n
Range	$0 \leq n \leq 255$			
Default	n = 0			

This command sets the right-side spacing of characters. This command sets the spacing value independently in standard and page modes.

This command sets the spacing of the right side of the character to n x horizontal or vertical motion unit, depending on the current mode and printing direction:

- In standard mode, horizontal motion unit is used;
- In page mode, horizontal motion unit is used when printing direction is set to horizontal (starting either from left or right); vertical motion unit is used when printing direction is set to vertical (starting either from top or bottom).

Changing the horizontal or vertical motion units does not affect the current right-side spacing.

When using characters magnified horizontally, the right-side character spacing is modified accordingly (for example, right-side character spacing is twice as set when using double-width).

The maximum right-side spacing is 35.983 mm (255/180” or approximately 288 dots). Any setting higher than this value is automatically clipped to the maximum.

ESC ! n

Description	Set printing options			
Format	ASCII	ESC	!	n
	Hex	1B	21	n
	Decimal	27	33	n
Range	$0 \leq n \leq 255$			
Default	n = 0			

This command sets the current printing options using n as follows:

Bit	Description
0	0=Character font A (12x24), 1=Character font B (9x17)
1	Undefined
2	Undefined
3	Unsupported
4	Double-height enabled when set to 1
5	Double-width enabled when set to 1
6	Undefined
7	Underline mode enabled when set to 1

Table 34: Printing options details.

Double-height, double-width and underline may also respectively be selected using functions GS ! and ESC -. However, the last setting is the one that is currently effective.

ESC $ nL nH

Description	Set absolute print position				
Format	ASCII	ESC	$	nL	nH
	Hex	1B	24	nL	nH
	Decimal	27	36	nL	nH
Range	$0 \leq nL \leq 255$				
	$0 \leq nH \leq 255$				

This command sets the absolute position of the printing cursor from the beginning of the line. The distance from the beginning of the line to the print position is (nL+256*nH) x horizontal or vertical motion unit.

- In standard mode, horizontal motion unit is used;
- In page mode, horizontal motion unit is used when printing direction is set to horizontal (starting either from left or right); vertical motion unit is used when printing direction is set to vertical (starting either from top or bottom).

Settings outside the specified printable area are ignored. Please refer to commands GS L, GS W and ESC W for more information about the printable area in standard and page modes.

ESC - n

Description	Turn underline mode on/off			
Format	ASCII	ESC	-	n
	Hex	1B	2D	n
	Decimal	27	45	n
Range	$0 \leq n \leq 2, 48 \leq n \leq 50$			
Default	$n = 0$			

This command enables or disables the underlining of characters. The parameter given is also used to setup the thickness of the underline, as described in table below.

n	Description
0, 48	Disable underline mode
1 ,49	Enable underline mode, set thickness to 1 dotline
2 ,50	Enable underline mode, set thickness to 2 dotlines

Table 35: Underline options details.

Note that underline mode may also be selected using command ESC !. However, the last setting is the one that is currently effective. Moreover, the underline thickness set using ESC - is used when underlining characters using ESC !.

ESC 2

Description	Set default line spacing			
Format	ASCII	ESC	2	
	Hex	1B	32	
	Decimal	27	50	

Revert to the default line spacing, which is approximately 4.23 mm (1/6”).

ESC 3 n

Description	Set line spacing			
Format	ASCII	ESC	3	n
	Hex	1B	33	n
	Decimal	27	51	n
Range	$0 \leq n \leq 255$			
Default	Line spacing is approximately 4.23mm (1/6”).			

This command sets the line spacing independently in standard and page modes.

This command sets the line spacing to n x vertical or horizontal motion unit, depending on the current mode and printing direction: line spacing should be set so that total text line height does not exceed 1016mm (40”).

- In standard mode, vertical motion unit is used;
- In page mode, vertical motion unit is used when printing direction is set to horizontal (starting either from left or right); horizontal motion unit is used when printing direction is set to vertical (starting either from top or bottom).

Changing the horizontal or vertical motion units does not affect the current line spacing.

ESC D n1 … nk NUL

Description	Set horizontal tab positions				
Format	ASCII	ESC	D	n1 … nk	NUL

	Hex	1B	44	n1 … nk	00
	Decimal	27	68	n1 … nk	0
Range	$1 \leq n \leq 255$				
	$0 \leq k \leq 32$				
Default	Tab positions are set every 8 characters (columns 9, 17, 25, and so on).				

This command sets the tab positions used by the HT command. Positions n1 … nk are column numbers. Tab positions must be ordered in ascendant order, i.e. $n_i < n_j$ for i<j.

The horizontal tab position is stored as a value of (total character width x n) dots, measured from the beginning of the line. Changing character width (by changing font or magnification options) does not affect previously configured tab positions.

ESC J n

Description	Print and feed paper			
Format	ASCII	ESC	J	n
	Hex	1B	4A	n
	Decimal	27	74	n
Range	$0 \leq n \leq 255$			

This command flushes the print buffer (i.e. immediately starts printing all data waiting in the print buffer) and feeds the paper by n x (vertical or horizontal motion unit).

In standard mode, the vertical motion unit is always used to calculate the feed amount.
In page mode, the selected unit depends on the current printing direction:

- If the printing direction is set to either “left to right” or “right to left”, the vertical motion unit is used;
- If the printing direction is set to either “top to bottom” or “bottom to top”, the horizontal motion unit is used.

ESC \ nL nH

Description	Set relative print position				
Format	ASCII	ESC	\	nL	nH
	Hex	1B	5C	nL	nH
	Decimal	27	92	nL	nH
Range	$-640 \leq nL+256*nH \leq 640$				

This command moves the position of the printing cursor by the specified amount (positive or negative). The distance from the current position to the target print position is (nL+256*nH) x horizontal or vertical motion unit. (nL+256*nH) should be considered as a signed 16-bit word.

- In standard mode, horizontal motion unit is used;
- In page mode, horizontal motion unit is used when printing direction is set to horizontal (starting either from left or right); vertical motion unit is used when printing direction is set to vertical (starting either from top or bottom).

Settings outside the specified printable area are ignored. Please refer to commands GS L, GS W and ESC W for more information about the printable area in standard and page modes.

ESC d n

Description	Print and feed n lines			
Format	ASCII	ESC	d	n
	Hex	1B	64	n
	Decimal	27	100	n
Range	0 ≤ n ≤ 255			

This command flushes the print buffer (i.e. immediately starts printing all data waiting in the print buffer) and feeds the paper by an amount of n x (current line spacing).

GS ! n

Description	Set character size			
Format	ASCII	GS	!	n
	Hex	1D	21	n
	Decimal	29	33	n
Range	0 ≤ n ≤ 255			
Default	n = 0			

This command sets the magnification factor of characters. Horizontal and vertical scaling ratios may be defined independently. Scaling ratio may range from x1 to x8.

Bit	Description
0-3	Vertical scaling ratio : - a value of 0 sets normal height, - a value of 1 sets double-height, - a value of y sets scaling ratio (y+1)
4-7	Horizontal scaling ratio: - a value of 0 sets normal width, - a value of 1 sets double-width, - a value of x sets scaling ratio (x+1)

Table 36: Character size setting options.

Note that horizontal and vertical magnification factors may also be defined using ESC ! command. However, the last setting is the one that is currently effective.

GS B n

Description	Turn white/black reverse printing mode on/off			
Format	ASCII	GS	B	n
	Hex	1D	42	n
	Decimal	29	66	n
Range	0 ≤ n ≤ 255			
Default	n = 0			

This command enables or disables the printing of characters and images in inverse mode. Only the LSB of n is used in this command:

- When the LSB of n is 0, white/black reverse printing mode is disabled;
- When the LSB of n is 1, white/black reverse printing mode is enabled.

GS P x y

Description	Set horizontal and vertical motion units				
Format	ASCII	GS	P	x	y
	Hex	1D	50	x	y
	Decimal	29	80	x	y
Range	$0 \leq x \leq 203$				
	$0 \leq y \leq 203$				
Default	x = 203, y =203				

The horizontal motion unit is set to approximately 25.4/x mm (1/x inches).
The vertical motion unit is set to approximately 25.4/y mm (1/y inches).

The default values select a horizontal motion unit of 1 dot, and a vertical motion unit of 1 dot.
When x or y are set to 0, default values are used.

8.3 Graphics printing commands description

ESC * m nL nH d1…dk

Description	Print bit image						
Format	ASCII	ESC	*	m	nL	nH	d1…dk
	Hex	1B	2A	m	nL	nH	d1…dk
	Decimal	27	42	m	nL	nH	d1…dk
Range	m = 0, 1, 32, 33						
	$0 \leq nL+256*nH \leq 640$						
	$0 \leq d \leq 255$						

This command immediately prints the transmitted image using the mode specified by m. See Table 37 for information about printing mode.

Print mode	Horizontal direction		Vertical direction	
	Number of dots	Density	Number of dots	Density
0	nL+256*nH	100 dpi	8	66 dpi
1	nL+256*nH	200 dpi	8	66 dpi
32	nL+256*nH	100 dpi	24	200 dpi
33	nL+256*nH	200 dpi	24	200 dpi

Table 37: Immediate image printing modes.

When double vertical density (200 dpi) is selected, there are three times as many data to be transferred than when single vertical density (66 dpi) is selected. Therefore, depending on the selected print mode the host should transfer an amount of nL+256*nH bytes (print modes 0 and 1) or 3*(nL+256*nH) bytes (print modes 32 and 33).

Image is transmitted from the host to the printer by **columns**. Figure 2 shows an example image and the order in which bytes are to be transmitted to the host.

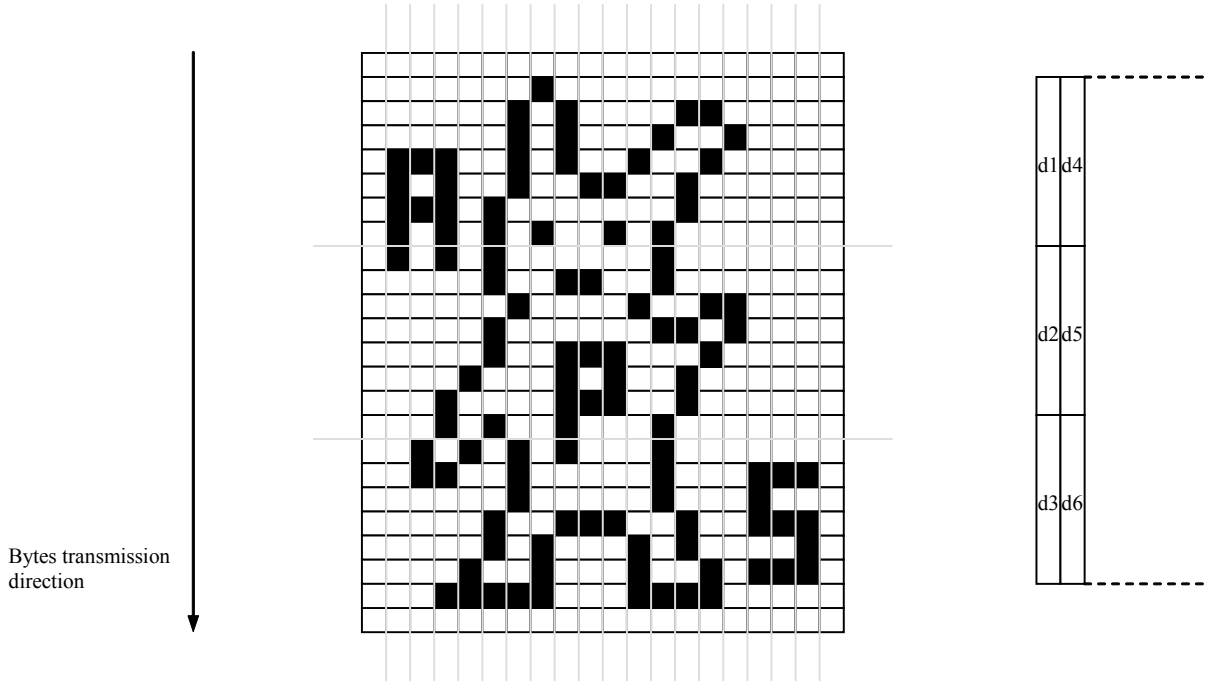


Figure 2: Example image demonstrating the transmission by columns.

The above example shows a 20x24 pixels image, suitable for printing in double vertical density (200 dpi) modes 32 and 33.

Byte d1 will be the first byte transmitted, then d2, d3 and then transmission of the next column begins: d4, then d5, d6 and so on. Within each byte, pixel at the top is placed in the MSB, while pixel at the bottom is placed in the LSB. Table 38 shows the byte representation of the first 6 columns of the above sample image.

Column	First byte of column	Second byte of column	Third byte of column
1	0x00	0x00	0x00
2	0x0F	0x80	0x00
3	0x0A	0x00	0xC0
4	0x0F	0x83	0x42
5	0x00	0x04	0x86
6	0x03	0xD9	0x1A

Table 38: Byte representation of example bit image.

GS * x y d1…d(x*y*8)

Description	Download bit image					
Format	ASCII	GS	*	x	y	d(x*y*8)
	Hex	1D	2A	x	y	d(x*y*8)
	Decimal	29	42	x	y	d(x*y*8)
Range	$1 \leq x \leq 255$					
	$1 \leq y \leq 48$					
	$x*y \leq 1600$					
	$0 \leq d \leq 255$					

This command downloads a bitmap image to the printer for subsequent printing using the GS / command. Once downloaded, the image may be printed as many times as required using different printing options without the need to download it again.

The bitmap image is transmitted by **columns**, just like the ESC * command. Please refer to Figure 3 and to the ESC * command description for information about bytes ordering.

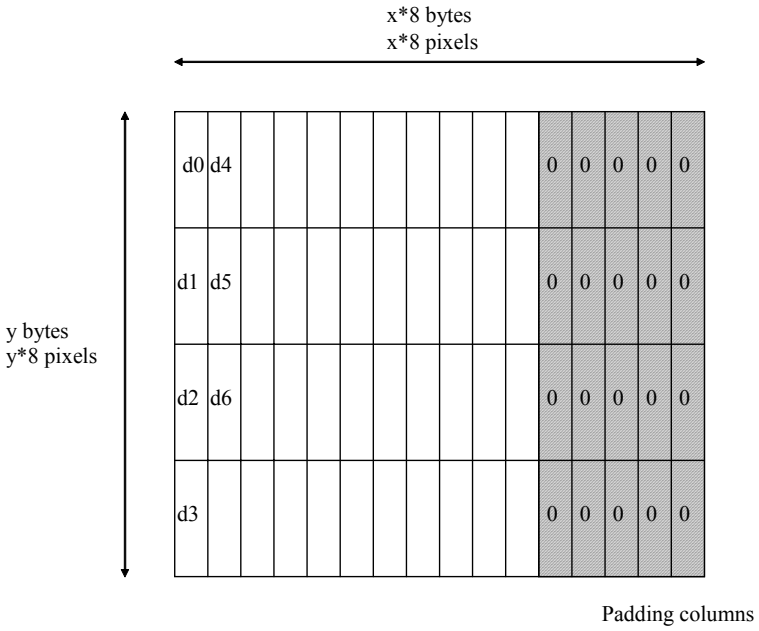


Figure 3: Downloaded bit image dimensions and bytes ordering.

Image width should be a multiple of 8 pixels. If the actual image width is not an exact multiple of 8 pixels, the host is required to insert blank padding columns at the right of the image in order to reach a total width that is multiple of 8 pixels.

Figure 3 shows an example bit image which width is 13 pixels, and which height is 32 pixels. The width of this image (13) is not a multiple of 8, so the host has to insert 5 padding columns (set to 0 in the example) at the right of the bit image to be able to download it successfully. The resulting dimensions of the downloaded bit image are then 16 pixels width by 32 pixels height. Command parameters will then be, in this case, x = 2 and y = 4.

If the total size of the image is larger than the specified amount, command processing stops right after the y parameter and the following bytes are treated as normal data.

GS / m

Description	Print downloaded bit image			
Format	ASCII	GS	/	m
	Hex	1D	2F	m
	Decimal	29	47	m
Range	$0 \leq m \leq 3$, $48 \leq m \leq 51$			

This command prints the image downloaded in RAM by command GS *, using the specified printing mode. Table 39 shows the various printing modes available.

Mode	Horizontal scaling	Vertical scaling
0, 48	Normal	Normal
1, 49	Double width	Normal
2, 50	Normal	Double height
3, 51	Double width	Double height

Table 39: Available printing modes while printing downloaded bit image.

This command is ignored if no bit image has been downloaded using the GS * command.
If a portion of the bit image lies outside the current printing area, this command is ignored.

GS v 0 m xL xH yL yH d1…dk

Description	Print raster bit image				
Format	ASCII	GS	v	0	m xL xH yL yH d1…dk
	Hex	1D	76	30	m xL xH yL yH d1…dk
	Decimal	29	118	48	m xL xH yL yH d1…dk
Range	$0 \leq m \leq 3$, $48 \leq m \leq 51$				
	$0 \leq xL \leq 80$, $xH = 0$				
	$0 \leq yL \leq 255$, $0 \leq yH \leq 8$				
	$0 \leq d \leq 255$				
	$k = (xL + xH*256) * (yL + yH*256)$				

This command prints the transmitted image dotline by dotline using the mode specified by m. The following table shows the various printing modes used with this command.

Mode	Horizontal scaling	Vertical scaling
0, 48	Normal	Normal
1, 49	Double width	Normal
2, 50	Normal	Double height
3, 51	Double width	Double height

Table 40: Raster bit image printing modes.

The width of the raster image is (xL+256*xH) x 8 dots.

The height of the raster image is (yL+256*yH) dotlines.

Unlike ESC * and GS * commands, the image data is transmitted on a dotline basis. See Figure 4 for an illustration of the bytes ordering.

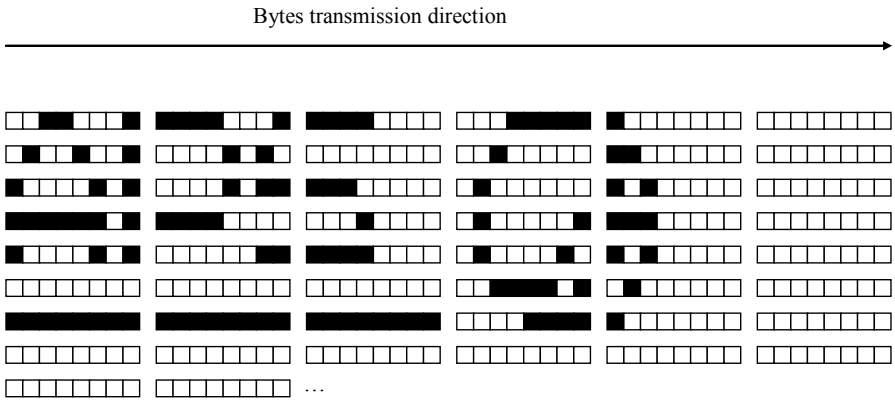


Figure 4: Raster image example and bytes ordering.

Table 41 shows the bytes representation of the above example image.

	Column 0	Column 1	Column 2	Column 3	Column 4	Column 5
Row 0	0x31	0xF1	0xF0	0x1F	0x80	0x00
Row 1	0x49	0x0A	0x00	0x20	0xC0	0x00
Row 2	0x85	0x0B	0xE0	0x40	0xA0	0x00
Row 3	0xFD	0xF0	0x10	0x41	0xE0	0x00
Row 4	0x85	0x03	0xF0	0x42	0xA0	0x00
Row 5	0x00	0x00	0x00	0x3D	0x40	0x00
Row 6	0xFF	0xFF	0xFF	0x0F	0x80	0x00
Row 7	0x00	0x00	0x00	0x00	0x00	0x00

Table 41: Bytes representation of example raster image.

8.4 Character set commands description

ESC % n

Description	Select/cancel user-defined character set			
Format	ASCII	ESC	%	n
	Hex	1B	25	n
	Decimal	27	37	n
Range	$0 \leq n \leq 255$			
Default	n = 0			

This command selects or deselects the user-defined character set. When the user-defined character set is selected, any characters that have been defined by user using the ESC & command replace the ones of the current active font.

There are two sets of user-defined characters. The first set corresponds to the ESC/POS font A in which characters are 12 pixels wide and 24 pixels high. The second set corresponds to the ESC/POS font B in which characters are 9 pixels wide and 17 pixels high. Use the ESC ! command to select the current set. See the ESC & command description for more information.

Only the LSB of n is used by this command:

- When the LSB of n is 0, the user-defined character set is deselected;
- When the LSB of n is 1, the user-defined character set is selected.

ESC & y c1 c2 [x1 d1…d(y*x1)]…[xk d1…d(y*xk)]

Description	Download user-defined character set			
Format	ASCII	ESC	&	…
	Hex	1B	26	…
	Decimal	27	38	…
Range	y = 3			
	32 ≤ c1 ≤ c2 ≤ 126			
	0 ≤ x ≤ 12 (when font A (12x24) is selected)			
	0 ≤ x ≤ 9 (when font B (9x17) is selected)			
	0 ≤ d1…d(y*xk) ≤ 255			

This command defines the bitmap for one or more user-defined characters of the currently selected set.

There are two sets of user-defined characters. Each user-defined set is made of 95 characters which ASCII codes range from 32 to 126.
The two sets have different bitmap sizes. The first set corresponds to the ESC/POS font A in which characters are 12 pixels wide and 24 pixels high. The second set corresponds to the ESC/POS font B in which characters are 9 pixels wide and 17 pixels high. Use the ESC ! command to select the current set.

It is possible to define characters for user-defined set A and user-defined set B independently. Moreover, it is possible to define multiple characters at once within the same set using this command. If only one character needs to be defined, use c1=c2. If several characters need to be defined, use c1<c2.

Character bitmaps are transmitted by columns. ‘y’ represents the number of bytes that form a column. Then for each character, ‘x’ represents the width of each character in pixels. For each character, ‘x*y’ bytes are transmitted that form the character bitmap. Figure 5 shows the bits organization of a character bitmap in either font A or font B.

See also below for examples of character bitmaps for both user font A and user font B.

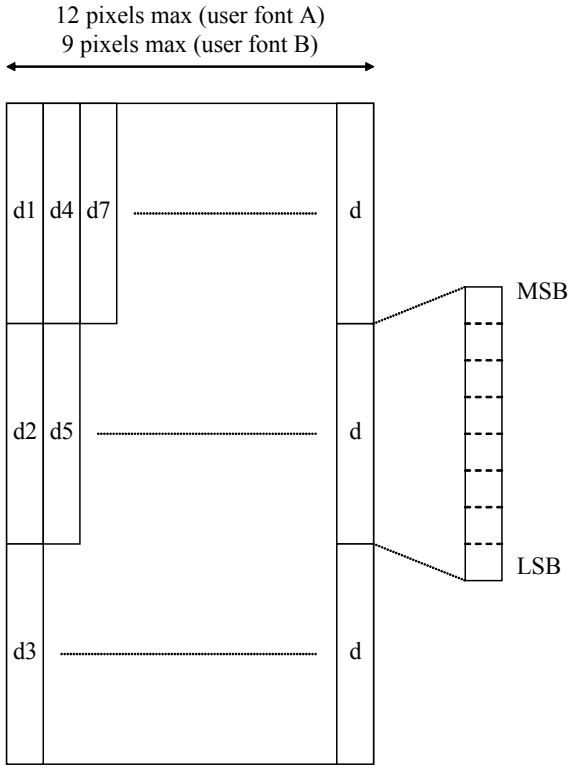


Figure 5: Bits organization of a user-defined character bitmap.

'y' should always be equal to 3. 'x' should be no greater than 12 when user font A is selected, and no greater than 9 if user font B is selected. If any of these conditions is not respected, the definition of characters stops immediately and the remaining character data is processed as normal printing data.

Character bitmap example for character font A

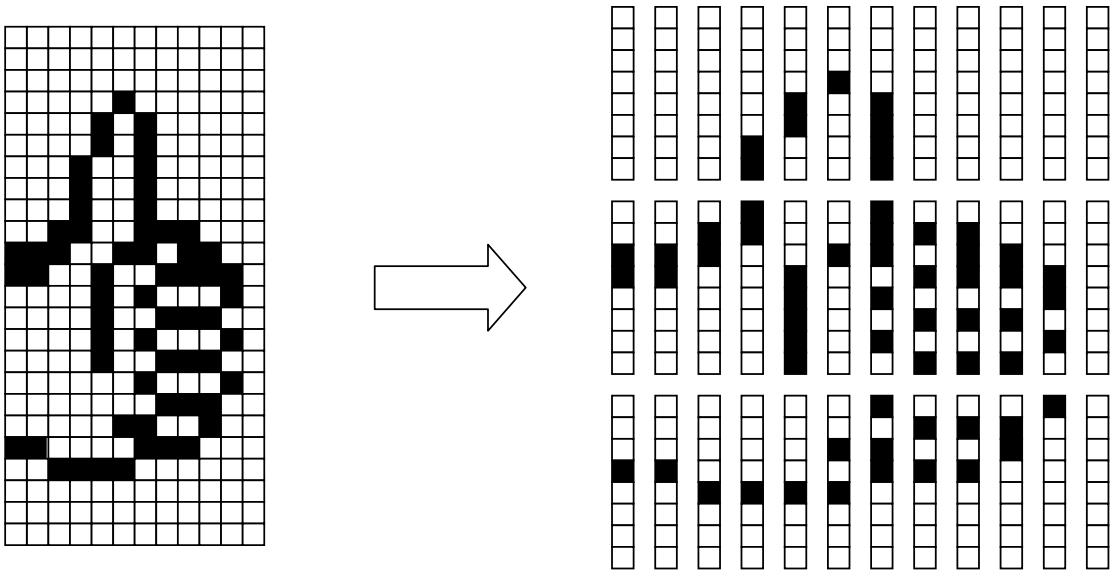


Figure 6: User-defined character bitmap (font A).

The bytes stream defining this character bitmap would begin with:

```
0x00, 0x30, 0x10,
0x00, 0x30, 0x10,
0x00, 0x60, 0x08,
0x03, 0xC0, 0x08,
0x0C, 0x3F, 0x08 …
```

Character bitmap example for character font B

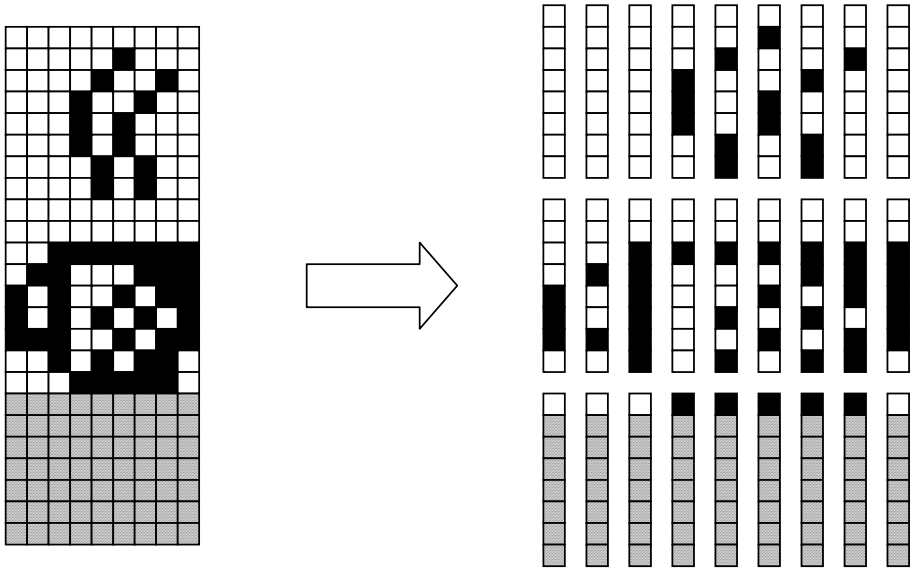


Figure 7: User-defined character bitmap (font B).

The bytes stream defining this character bitmap would begin with:

```
0x00, 0x0E, 0x00,
0x00, 0x12, 0x00,
0x00, 0x3F, 0x00,
0x1C, 0x20, 0x80,
0x23, 0x25, 0x80 …
```

ESC ? n

Description	Cancel user-defined character			
Format	ASCII	ESC	?	n
	Hex	1B	3F	n
	Decimal	27	63	n
Range	$32 \leq n \leq 126$			

This command cancels the bitmap defined for user character n. After deletion, the user-defined bitmap is replaced by the bitmap of the corresponding internal character, if it exists. If no bitmap is defined for character n in the internal character set, then the corresponding user-defined character is blanked.

ESC M n

Description	Select character font			
Format	ASCII	ESC	M	n
	Hex	1B	4D	n
	Decimal	27	77	n
Range	0 ≤ n ≤ 255			
Default	n= 0			

This command selects the current active character font, as shown in table below:

n	Description
0, 48	Select character font A (12x24)
1 ,49	Select character font B (9x17)
i, 48+i	Select character font number i (for i ≥ 2)

Table 42: Character font selection details.

This command is used to select ESC/POS fonts or other user fonts downloaded to the external FLASH using an APS specific utility. Fonts number 0 and 1 are reserved for ESC/POS standard fonts, while fonts with numbers greater than or equal to 2 are user fonts.

There are two ways of selecting a font, either by number or *by digit*. Thus, if one wants to select the font number 2, both commands ESC M <2> and ESC M 2 may be issued.
There is, however, only one way to select fonts with numbers above 9. For these fonts, only the "selection by number" form of the command is valid. Example: to select font number 10 (if present), the command ESC M <10> should be issued.

This command is ignored if font number n does not exist.

Note that command ESC ! may also be used to select active character font. However, the last setting is the one that is currently effective.

ESC R n

Description	Select an international character set			
Format	ASCII	ESC	R	n
	Hex	1B	52	n
	Decimal	27	82	n
Range	0 ≤ n ≤ 13			
Default	n = 0			

This command selects the translation table for the international character set, as shown in table below:

n	Character set
0	U.S.A.
1	France
2	Germany
3	U.K.
4	Denmark I

5	Sweden
6	Italy
7	Spain I
8	Japan
9	Norway
10	Denmark II
11	Spain II
12	Latin America
13	Korea

Table 43: International character sets.

ESC t n

Description	Select character code table			
Format	ASCII	ESC	t	n
	Hex	1B	74	n
	Decimal	27	114	n
Range	$0 \leq n \leq 5$, $16 \leq n \leq 19$, $n = 255$			
Default	$n = 0$			

This command selects a character code table (character set for ASCII code above and including 128), from the table below.

n	Character code table
0	PC437 [U.S.A., Standard Europe]
1	Katakana
2	PC850 [Multilingual Latin I]
3	PC860 [Portuguese]
4	PC863 [Canadian-French]
5	PC865 [Nordic]
6	PC737 [Greek]
16	WPC1252 [Windows Latin I]
17	PC866 [Cyrillic]
18	PC852 [Latin II]
19	PC858 [Multilingual Latin I + Euro]
255	Space page (*unsupported*)

Table 44: Character code tables.

8.5 Standard mode specific commands description

ESC S

Description	Select standard mode		
Format	ASCII	ESC	S
	Hex	1B	53
	Decimal	27	83

This command switches from page to standard mode. This command has no effect if the printer is already in standard mode.

ESC V n

Description	Turn 90° clockwise rotation mode on/off			
Format	ASCII	ESC	V	n
	Hex	1B	56	n
	Decimal	27	86	n
Range	$0 \leq n \leq 1, 48 \leq n \leq 49$			
Default	n = 0			

This command enables 90° clockwise rotation of characters in standard printing mode. Characters will be rotated 90° clockwise before being printed but will still be ordered from left to right, or from right to left if upside-down printing mode if enabled (see ESC { command for more information about upside-down printing).

ESC a n

Description	Set justification			
Format	ASCII	ESC	a	n
	Hex	1B	61	n
	Decimal	27	97	n
Range	$0 \leq n \leq 2, 48 \leq n \leq 50$			
Default	n = 0			

This command sets the justification mode used in standard mode printing. In page mode, this command performs only internal flags operations. See table below for details on justification options.

n	Description
0, 48	Left justify text lines
1, 49	Center text lines
2, 50	Right justify text lines

Table 45: Standard mode justification details.

ESC { n

Description	Turn upside-down printing mode on/off			
Format	ASCII	ESC	{	n
	Hex	1B	7B	n
	Decimal	27	123	n
Range	0 ≤ n ≤ 255			
Default	n = 0			

This command enables or disables the upside-down printing mode in standard mode. When upside-down printing mode is selected, text lines are rotated 180° before being printed, i.e. text is printed from right to left and characters are rotated 180°.

Only the LSB of n is used in this command:

- When the LSB of n is 0, upside-down printing mode is disabled;
- When the LSB of n is 1, upside-down printing mode is enabled.

In page mode, this command performs only internal flags operations.

GS L nL nH

Description	Set left margin				
Format	ASCII	GS	L	nL	nH
	Hex	1D	4C	nL	nH
	Decimal	29	76	nL	nH
Range	0 ≤ nL ≤ 255				
	0 ≤ nH ≤ 2				
Default	nL = 0, nH = 0				

This command sets the size of the left margin of the current printable area in standard mode. The width of the left margin is set to (nL+256*nH) x (horizontal motion unit). The setting will only be effective at the beginning of a line. When issued in the middle of a line, the setting will be effective starting at the beginning of the next line.

Figure 8 shows an illustration of the various areas of a text line in standard mode.

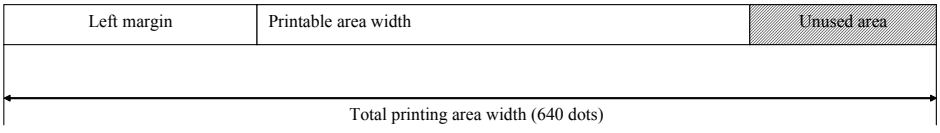


Figure 8: Standard mode line areas.

In page mode, this command only performs internal flags operation. The settings will be effective when the printer returns to standard mode.

The maximum size of the left margin equals the printable area width minus the width of a character in the current font using the current printing options. Any settings greater than this value will be clipped. After

setting the left margin, the printable area will be adjusted if necessary in order to accommodate to the new left margin.

GS W nL nH

Description	Set printing area width				
Format	ASCII	GS	W	nL	nH
	Hex	1D	57	nL	nH
	Decimal	29	87	nL	nH
Range	$0 \leq$ nL $\leq$ 255				
	$0 \leq$ nH $\leq$ 2				
Default	nL = 128, nH = 2, (nL+256*nH) = 640				

This command sets the width of the printing area in standard mode. After issuing this command, the width of the printing area will be set to (nL+256*nH) x (horizontal motion unit). The setting will only be effective at the beginning of a line. When issued in the middle of a line, the setting will be effective starting at the beginning of the next line.

In page mode, this command only performs internal flags operation. The settings will be effective when the printer returns to standard mode.

Figure 8 (see GS L command) shows an illustration of the various areas of a text line in standard mode.

The maximum width of the printing area is 640 dots. Any setting greater than this will be clipped to 640 dots. After setting the printing area width, the left margin will be adjusted if necessary, in order to accommodate to the new printing area width. Hence, if the printing area width is set to a value equal to or greater than 640 dots, the left margin will be reduced to 0 (see GS L command for more information about the left margin).

8.6 Page mode specific commands

FF

Description	Print and return to standard mode (in page mode)	
Format	ASCII	FF
	Hex	0C
	Decimal	12

This command prints the current page data and returns to standard mode.
This command has no effect in standard mode.

CAN

Description	Cancel print data in page mode	
Format	ASCII	CAN
	Hex	18
	Decimal	24

This command cancels the print buffer in page mode. After the execution of this command, the print buffer will be cleared and the print cursor placed at the starting position, which depends on the specified print direction (see ESC T command) and the current print area (see ESC W command).

ESC FF

Description	Print data in page mode		
Format	ASCII	ESC	FF
	Hex	1B	0C
	Decimal	27	12

This command prints the current page data. The page buffer is not cleared, which implies that:

- The same page may printed another time using the ESC FF command;
- The page has to be cleared using the CAN command in order to start with a new blank page.

ESC L

Description	Select page mode		
Format	ASCII	ESC	L
	Hex	1B	4C
	Decimal	27	76

This command switches from standard mode to page mode.
Print buffer is cleared upon entering page mode. This command is ignored in page mode.

This command switches the settings for the following commands:
- ESC SP (set right-side character spacing);
- ESC 2, ESC 3 (set line spacing).

The printer leaves page mode for standard mode after printing by FF is completed or the ESC S command is issued. The printer returns to standard mode when power is turned on, printer is reset or ESC @ is issued.

ESC T n

Description	Select print direction in page mode			
Format	ASCII	ESC	T	n
	Hex	1B	54	n
	Decimal	27	84	n
Range	$0 \leq n \leq 3, 48 \leq n1 \leq 51$			
Default	$n = 0$			

This command sets the direction of printing in page mode. Cursor position is also reset within the printing area set by the ESC W command, according to the following table.

n	Printing direction	Starting cursor position
0, 48	Left to right	Upper left corner
1, 49	Bottom to top	Lower left corner
2, 50	Right to left	Lower right corner
3, 51	Top to bottom	Upper right corner

Table 46: Printing direction settings.

Figure 9 illustrates the various direction options and cursor starting positions.

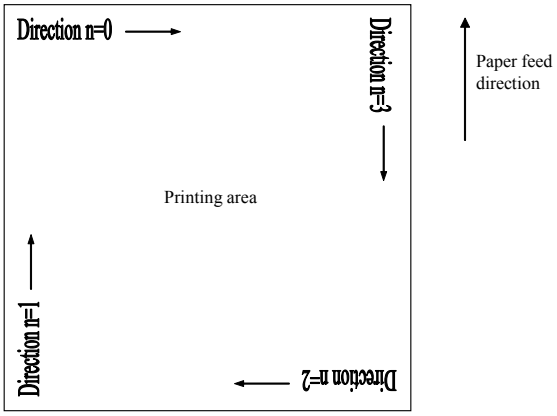


Figure 9: Printing directions within printing area.

ESC W xL xH yL yH dxL dxH dyL dyH

Description	Select printing area in page mode			
Format	ASCII	ESC	W	xL xH yL yH dxL dxH dyL dyH
	Hex	1B	57	xL xH yL yH dxL dxH dyL dyH
	Decimal	27	87	xL xH yL yH dxL dxH dyL dyH
Range	$0 \leq$ xL+256*xH $\leq$ 639			
	$0 \leq$ yL+256*yH $\leq$ 1199			
	$0 \leq$ dxL+256*dxH $\leq$ 640			
	$0 \leq$ dyL+256*dyH $\leq$ 1200			
Default	x = y = 0			
	dx = 640 (80mm)			
	dy = 1200 (150mm)			

This command selects the rectangle area within the current page in which characters and images are to be printed. The printing cursor is reset within this area as specified by the ESC T command.

Figure 10 shows an example of printing area selection.

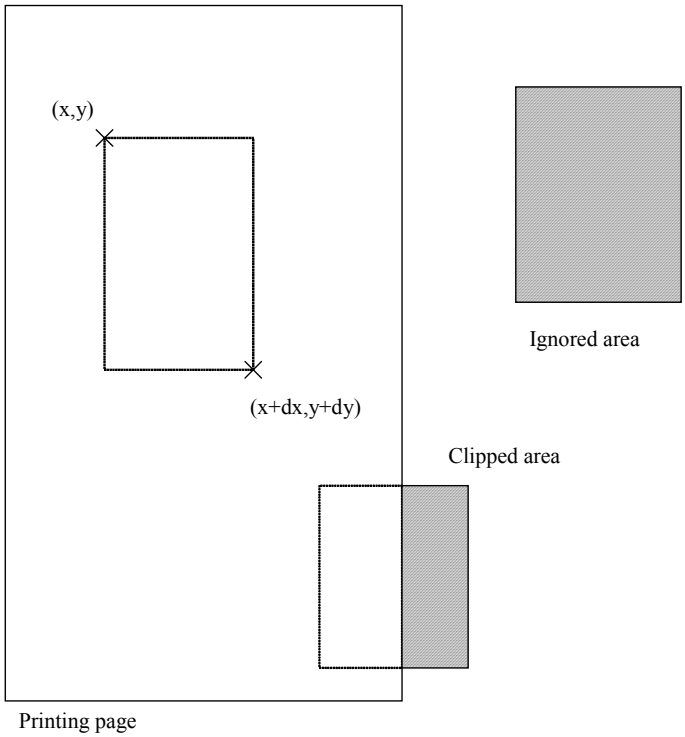


Figure 10: Printing area selection example.

If a portion of the specified area lies outside the printing page, the dimensions (either width or height) of the rectangle area are clipped against the borders of the whole printing page.

Moreover, if the specified area totally lies outside the printing page, the command is ignored and the current printing area is not updated. The printing cursor is not reset.

GS $ nL nH

Description	Set absolute vertical print position in page mode				
Format	ASCII	GS	$	nL	nH
	Hex	1D	24	nL	nH
	Decimal	29	36	nL	nH
Range	0 ≤ nL+256*nH ≤ 1199				

This command sets the current absolute vertical print position in page mode, depending on the current printing direction.

- If the current printing direction is either “left to right” or “right to left”, this command sets the absolute print position in the vertical direction (feeding direction). The actual print position is set to (nL+256*nH) x (vertical motion unit);
- If the current printing direction is either “top to bottom” or “bottom to top”, this command sets the absolute print position in the horizontal direction (perpendicular to the feeding direction). The actual print position is set to (nL+256*nH) x (horizontal motion unit).

In either case, the printing cursor is reset at the beginning of the line according to the printing direction specified by the ESC T command.

Any settings outside the current printing area are ignored.
This command is ignored in standard mode.

GS \ nL nH

Description	Set relative vertical print position in page mode				
Format	ASCII	GS	\	nL	nH
	Hex	1D	5C	nL	nH
	Decimal	29	92	nL	nH
Range	$-1200 \leq nL+256*nH \leq 1200$				

This command moves the position of the printing cursor by the specified vertical amount (positive or negative). The distance from the current position to the target print position is (nL+256*nH) x horizontal or vertical motion unit, depending on the current printing direction. (nL+256*nH) should be considered as a signed 16-bit word.

- If the printing direction is set to either “left to right” or “right to left”, the cursor is shifted vertically by an amount of (nL+256*nH) x vertical motion unit;
- If the printing direction is set to either “top to bottom” or “bottom to top”, the cursor is shifted horizontally by an amount of (nL+256*nH) x horizontal motion unit.

In either case, the printing cursor is reset at the beginning of the line according to the printing direction specified by the ESC T command.

Any settings outside the current printing area are ignored.
This command is ignored in standard mode.

8.7 Barcode commands description

GS H n

Description	Select print position of Human Readable Interpretation (HRI) characters			
Format	ASCII	GS	H	n
	Hex	1D	48	n
	Decimal	29	72	n
Range	$0 \leq n \leq 3, 48 \leq n1 \leq 51$			
Default	n = 0			

This command defines whether Human Readable Interpretation (HRI) of barcodes should be printed or not. Moreover, this command defines the position of HRI characters (above, below or both above and below the barcode).

Table 47 shows the various settings available.

n	Description
0, 48	HRI characters are not printed
1, 49	HRI characters printed above the barcode
2, 50	HRI characters printed below the barcode
3, 51	HRI characters printed above and below the barcode

Table 47: HRI print position settings.

Figure 11, Figure 12 and Figure 13 show sample barcodes printed using the various HRI print position settings.

Figure 11: Barcode with HRI characters printed above (n=1).

Figure 12: Barcode with HRI characters printed below (n=2).

Figure 13: Barcode with HRI characters printed above and below (n=3).

GS f n

Description	Select font for Human Readable Interpretation (HRI) characters			
Format	ASCII	GS	f	n
	Hex	1D	66	n
	Decimal	29	102	n
Range	$0 \leq n \leq 255$			
Default	n= 1			

This command selects the font used to print HRI characters, as shown in table below:

n	Description
0, 48	Select character font A (12x24)
1 ,49	Select character font B (9x17)
i, 48+i	Select character font number i (for i ≥ 2)

Table 48: HRI character font selection details.

This command is used to select ESC/POS fonts or other user fonts downloaded to the external FLASH using an APS specific utility. Fonts number 0 and 1 are reserved for ESC/POS standard fonts, while fonts with numbers greater than or equal to 2 are user fonts.

There are two ways of selecting a font, either by number or *by digit*. Thus, if one wants to select the font number 2, both commands GS f <2> and GS f 2 may be issued.
There is, however, only one way to select fonts with numbers above 9. For these fonts, only the "selection by number" form of the command is valid. Example: to select font number 10 (if present), the command GS f <10> should be issued.

This command is ignored if font number n does not exist.

GS h n

Description	Set barcode height			
Format	ASCII	GS	h	n
	Hex	1D	68	n
	Decimal	29	104	n
Range	1 ≤ n ≤ 255			
Default	n = 185 (23.1mm)			

This command sets the height of printed barcodes in dotlines. Since a dotline is 0.125mm high, the physical height of a barcode on paper is set to (n x 0.125) millimeters.

GS k m d1…dk NUL [(1)] | GS k m n d1…dn [(2)]

Description	Print barcode						
Format 1	ASCII	GS	k	m	d1…dk		NUL
	Hex	1D	6B	m	d1…dk		NUL
	Decimal	29	107	m	d1…dk		NUL
Format 2	ASCII	GS	k	m	n	d1…dn	
	Hex	1D	6B	m	n	d1…dn	
	Decimal	29	107	m	n	d1…dn	
Range	Format 1: 0 ≤ m ≤ 6 (k and d depend on the type of barcode used)						
	Format 2: 65 ≤ m ≤ 71 (n and d depend on the type of barcode used)						

This command prints a barcode using barcode format m and barcode data d1…dk or d1…dn. There are two methods for transmitting barcode data to the printer:

1. The first method uses command format 1: the HOST terminates barcode data transmission by sending a NUL character at the end of the command. Note that barcode data reading may stop before the reception of the NUL character if too many characters have been transmitted;

2. The second method uses command format 2: before sending actual barcode data, the HOST sends the size of barcode data, which is represented by n. Then the HOST sends n barcode data characters.

Table 49 shows the various barcode formats supported by the printer. This table also shows the correct barcode data range for each barcode format.

Format	m	Barcode format	Barcode data size	Barcode data range
1	0	UPC-A	$11 \leq k \leq 12$	$48 \leq d \leq 57$
	1	UPC-E	$11 \leq k \leq 12$	$48 \leq d \leq 57$
	2	EAN13	$12 \leq k \leq 13$	$48 \leq d \leq 57$
	4	CODE39	$1 \leq k$	$48 \leq d \leq 57$ $65 \leq d \leq 90$ d = 32,36,37,43,45,46,47
	5	ITF2-5	$1 \leq k$ (even)	$48 \leq d \leq 57$
	6	CODABAR	$1 \leq k$	$48 \leq d \leq 57$ $65 \leq d \leq 68$ d = 36,43,45,46,47,58
2	65	UPC-A	$11 \leq n \leq 12$	$48 \leq d \leq 57$
	66	UPC-E	$11 \leq n \leq 12$	$48 \leq d \leq 57$
	67	EAN13	$12 \leq n \leq 13$	$48 \leq d \leq 57$
	69	CODE39	$1 \leq n \leq 255$	$48 \leq d \leq 57$ $65 \leq d \leq 90$ d = 32,36,37,43,45,46,47
	70	ITF2-5	$1 \leq n \leq 255$ (even)	$48 \leq d \leq 57$
	71	CODABAR	$1 \leq n \leq 255$	$48 \leq d \leq 57$ $65 \leq d \leq 68$ d = 36,43,45,46,47,58

Table 49: Barcode format settings and limits.

When using command format 1, the printer may stop accepting characters as barcode data before the trailing NUL character if the total number of characters exceeds the barcode data size (k) shown in Table 49. Remaining characters are processed as normal printing data. If the size of barcode data is less than the requested minimum, barcode printing is aborted and barcode data is ignored.

The barcode data size n will be clipped to the maximum barcode data size shown in Table 49 when using command format 2. Moreover, barcode printing will be aborted if the size of barcode data is less than the requested minimum. In this case barcode data is ignored.

When ITF2-5 barcode format the total number of barcode data characters should be even. If an odd number of characters is transmitted as barcode data, the last character is ignored so as to make the total length an even number.

Table 50 shows examples of each barcode format and the associated printing commands.

Barcode sample	Printing command
UPC-A 	GS k <0> 07567816412 <0> *(format 1)* GS k <0> <11> 07567816412 *(format 2)*
UPC-E 	GS k <1> 04210000526 <0> *(format 1)* GS k <1> <11> 04210000526 *(format 2)*
EAN-13 	GS k <2> 750103131130 <0> *(format 1)* GS k <2> <12> 750103131130 *(format 2)*
CODE39 	GS k <4> CODE39 <0> *(format 1)* GS k <4> <6> CODE39 *(format 2)*
ITF 	GS k <5> 12345670 <0> *(format 1)* GS k <5> <8> 12345670 *(format 2)*
CODABAR 	GS k <6> A9876543210B <0> *(format 1)* GS k <6> <12> A9876543210B *(format 2)*

Table 50: Barcode printing samples.

GS w n

Description	Set barcode width			
Format	ASCII	GS	w	n
	Hex	1D	77	n
	Decimal	29	119	n
Range	$2 \leq n \leq 6$			
Default	n = 3			

This command sets the horizontal size of printed barcode according to n. Parameter n sets the barcode module width as shown in Table 51.

n	Multi-level barcode module width (mm)	Binary-level barcode	
		Narrow width (mm)	Wide width (mm)
2	0.250	0.250	0.625
3	0.375	0.375	1.000
4	0.625	0.625	1.625
5	0.750	0.750	1.875
6	0.875	0.875	2.250

Table 51: Barcode module width settings.

There are two kinds of barcodes:

- In the first barcode type, bars and spaces can be as wide as required by the barcode format. However, the width of bars and spaces is always a multiple of an elementary width, which is called the module. This type of barcode is called *multi-level barcode*;
- In the second barcode type, bars and spaces widths may be one of two predefined values: either narrow or wide. This type of barcode is called *binary-level barcode*.

Barcodes UPC-A, UPC-E and EAN13 are of multi-level barcode type.
Barcodes CODABAR, CODE39 and ITF2-5 are of binary-level barcode type.

8.8 NV user memory commands description

FS g 1 m a1 a2 a3 a4 nL nH d1…dk

Description	Write to NV user memory						
Format	ASCII	FS	g	1	m	a1 a2 a3 a4 nL nH	d1…dk
	Hex	1C	67	31	m	a1 a2 a3 a4 nL nH	d1…dk
	Decimal	28	103	49	m	a1 a2 a3 a4 nL nH	d1…dk
Range	m = 0						
	$0 \leq (a1 + a2*256 + a3*65536 + a4*16777216) \leq 65535$						
	$1 \leq (nL + nH*256) \leq 65535$						
	$0 \leq d \leq 255$						
	$k = (nL + nH*256)$						

This command writes the transmitted data bytes into user non volatile (NV) memory. Contents of the NV memory are not lost when the power is turned off.

A portion of the on-board FLASH memory is reserved as a random storage space for user data. The user may write any kind of information relevant to the application inside this memory space, and read this information back as desired. Since the contents of this NV memory are not lost when the power is turned off, this memory area is ideally suited for storing things like user serial number, ticket counter, etc.

Available memory addresses range from 0 to 65535. If the specified memory range [start, end] (see Equation 1) is not located within these bounds, command aborts and the following data is processed as normal data.

$$\begin{cases} start = a_1 + 256 \cdot a_2 + 65536 \cdot a_3 + 16777216 \cdot a_4 \\ end = start + (n_L + 256 \cdot n_H - 1) \end{cases}$$

Equation 1: Start and end addresses of specified NV user memory region.

Notes:

- Allow a little delay after issuing this command to account for the programming time of the on-board FLASH memory. The printer will be unavailable during this time, however incoming characters will still be received and queued in the reception buffer;
- If configured, Automatic Status Back (ASB) is not sent during the execution of this command. However, status change information is not lost and is transmitted as soon as the command has completed execution;
- Modification of the user NV memory involves an erasure and programming of the on-board FLASH memory. This can only be done a limited number of times, which is typically the minimum number of write cycles guaranteed for the FLASH component (around 1,000,000 times). Do not use that command too often (several times a day is fine);
- Moreover, to maximize the life of the memory, prefer an update of large chunks of data in one go (one FS g 1 command) to an update of several small chunks of data (several FS g 1 commands). This minimizes the number of erase/program cycles of the FLASH.

Use command FS g 2 to read data from NV user memory.

FS g 2 m a1 a2 a3 a4 nL nH

Description	Read from NV user memory						
Format	ASCII	FS	g	2	m	a1 a2 a3 a4	nL nH
	Hex	1C	67	32	m	a1 a2 a3 a4	nL nH
	Decimal	29	103	50	m	a1 a2 a3 a4	nL nH
Range	m = 0						
	0 ≤ (a1 + a2*256 + a3*65536 + a4*16777216) ≤ 65535						
	1 ≤ (nL + nH*256) ≤ 65535						

This command transmits data from user non volatile (NV) memory to the HOST.

A portion of the on-board FLASH memory is reserved as a random storage space for user data. The user may write any kind of information relevant to the application inside this memory space, and read this information back as desired. Since the contents of this NV memory are not lost when the power is turned off, this memory area is ideally suited for storing things like user serial number, ticket counter, etc.

Available memory addresses range from 0 to 65535. If the specified memory range [start, end] (see Equation 1) is not located within these bounds, command aborts and the following data is processed as normal data.

During transmission, user data is surrounded by beginning and end synchronization bytes. The format of transmitted data is as follows:

ASCII	_	d1…dk	NUL
Hex	5F	d1…dk	00
Decimal	95	d1…dk	0

Where d1…dk are bytes programmed using command FS g 1.

FS p n m

Description	Print NV bit image				
Format	ASCII	FS	p	n	m
	Hex	1C	70	n	m
	Decimal	28	112	n	m
Range	1 ≤ n ≤ 255				
	0 ≤ m ≤ 3, 48 ≤ m ≤ 51				

This command prints the non-volatile (NV) bit image number n using mode m. NV bit images are stored in on-board FLASH memory and are not lost when the power is turned off.

Mode	Horizontal scaling	Vertical scaling
0, 48	Normal	Normal
1, 49	Double width	Normal
2, 50	Normal	Double height
3, 51	Double width	Double height

Table 52: NV bit image printing options.

The first image defined is NV image number 1. This command aborts if NV bit image number n has not been defined. This command does nothing if the resulting scaled image does not fit within the defined page.

Use FS q command to download bit images.
Use FS r command to retrieve downloaded bit images.

FS q n [xL xH yL yH d1…dk]1…[xL xH yL yH d1…dk]n

Description	Download NV bit image				
Format	ASCII	FS	q	n	[xL xH yL yH d1…dk][1…n]
	Hex	1C	71	n	[xL xH yL yH d1…dk][1…n]
	Decimal	28	113	n	[xL xH yL yH d1…dk][1…n]
Range	1 ≤ n ≤ 255				
	0 ≤ xL ≤ 255, 0 ≤ xH ≤ 2 (1 ≤ xL + 256*xH ≤ 640)				
	0 ≤ yL ≤ 255, 0 ≤ yH ≤ 3 (1 ≤ yL + 256*yH ≤ 800)				
	0 ≤ d ≤ 255				
	k = (xL + xH*256) * (yL + yH*256) * 8				

This command receives and stores images in non-volatile (NV) image memory. NV image memory contents are not lost when power is turned off. NV image memory may be used to store logos or any frequently used graphics.

This command retrieves and stores n images in NV memory. Before reception of any image, the entire NV image memory is cleared, previously defined images are then lost. Use FS r command to retrieve previous bit images and send them back along with new images while updating NV image memory.

If n is out of bounds, command aborts immediately and the following data is processed as normal data. Moreover, if any xL, xH, yL and/or yH combination is out of bounds for any image, command aborts and the following data is processed as normal data. In this case, however, NV image memory is still cleared, and all images transmitted up to the faulty image are defined.

NV images are transmitted by columns. Image width is 'xL+256*xH' bytes, image height is 'yL+256*yH' bytes. One byte is 8 pixels wide. For each image, k bytes are transmitted that form the image bitmap. Figure 14 shows the bits organization of a NV image.

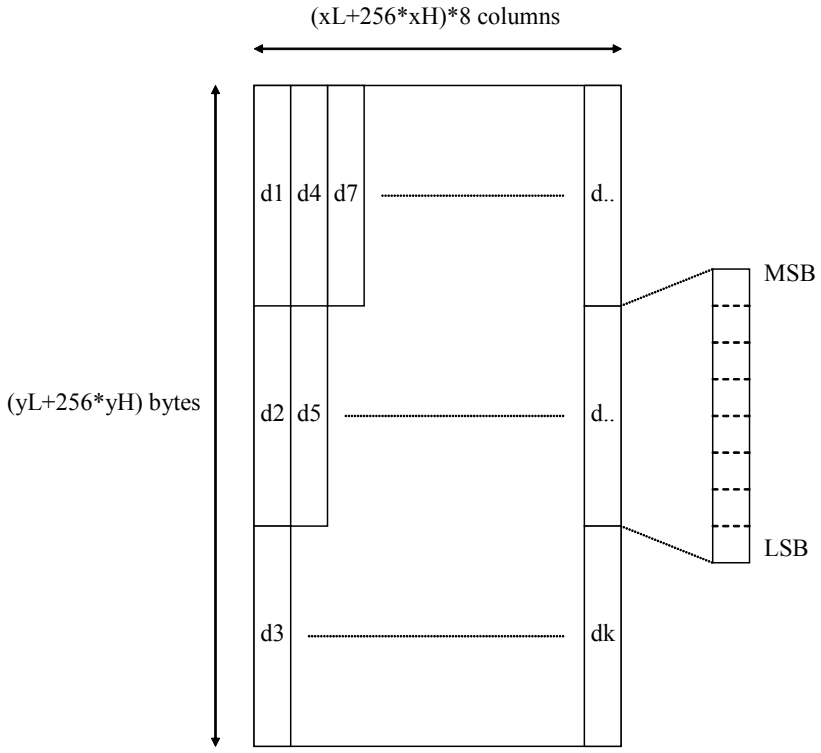


Figure 14: Bits organization of a user-defined NV bit image.

Figure 15 illustrates how typical NV image pixels would be broken out in bytes as required by this command.

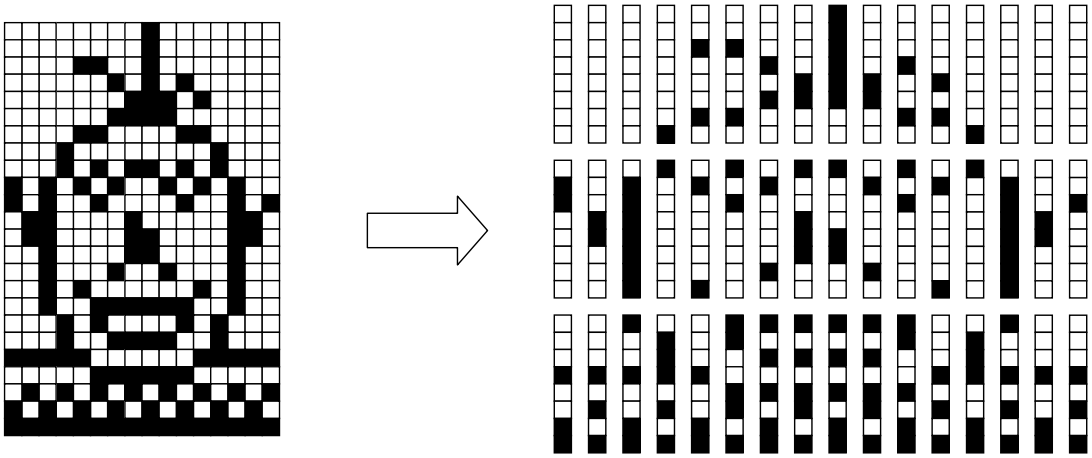


Figure 15: NV bit image sample.

The bytes stream defining this NV bit image would begin with:

```
0x00, 0x60, 0x13,
0x00, 0x18, 0x15,
0x00, 0x7F, 0x93,
0x01, 0x80, 0x75,
0x22, 0x41, 0x13 …
```

FS r n *APS specific*

Description	Upload NV bit image			
Format	ASCII	FS	r	n
	Hex	1C	72	n
	Decimal	28	113	n
Range	1 ≤ n ≤ 255			

This command allows the HOST to retrieve bitmap data of NV image number n, as it has been defined by FS q command.

The first image defined is image number 1. This command aborts and does not transmit anything if NV image number n has not been defined.

Image data is transmitted using exactly the same format as the one used by command FS q, surrounded by an underscore ("_", ASCII code 0x5F) character and a zero (NUL, ASCII code 0x00) character:

ASCII	_	xL xH yL yH d1…dk	NUL
Hex	5F	xL xH yL yH d1…dk	00
Decimal	95	xL xH yL yH d1…dk	0

Where:

- xL+256*xH = width of the image in bytes;
- yL+256*yH = height of the image in bytes;

- d1…dk are the actual bitmap data bytes, as transmitted during NV bit image download (see FS q command).

8.9 Macro commands description

GS :

Description	Start/end macro recording		
Format	ASCII	GS	:
	Hex	1D	3A
	Decimal	29	58

When first received, this command starts macro recording and places the printer in the macro recording state. In the macro recording state, the printer stores incoming commands and data bytes into a macro buffer as it interprets them. This command places the printer back into normal state and stop macro recording when it is received while in macro recording state.

During macro recording, the printer copies the bytes received in the reception FIFO directly into the macro buffer after having interpreted them. The maximum size of the macro buffer is 2048 bytes, so a mix of 2048 command/data bytes may be recorded into the macro buffer. Bytes received after the first 2048 bytes are not recorded, but yet interpreted and the printer does not leave macro recording state.

The host may transmit any command during macro definition except the following:

- GS ^ (playback macro). If the printer receives the GS ^ command while in macro recording state, macro recording stops immediately and clears the macro buffer;
- GS (A (execute self-test). If the printer receives this command during macro recording, macro recording is stopped immediately and the printer begins executing the GS (A command.

The ESC @ command (reset printer) does not stop macro recording, so this command may be included in a macro sequence.

GS ^ r t m

Description	Playback macro					
Format	ASCII	GS	^	r	t	m
	Hex	1D	5E	r	t	m
	Decimal	29	94	r	t	m
Range	$0 \leq r \leq 255$					
	$0 \leq t \leq 255$					
	m = 0, 1					

This command plays the sequence back of bytes recorded in the macro buffer as if they were transmitted over the communication link by the host. The macro sequence is replayed r times with an optional delay of (t x 100ms) between each execution. Byte m defines the execution mode:

- When the LSB of m is 0, the macro is executed r times with pauses of (t x 100ms) in-between;

- When the LSB of m is 1, the macro is executed r times. After each execution, the printer waits for (t x 100ms), then waits until the user presses the PAPER FEED button. The printer repeats the "print/wait delay/wait button" sequence r times.

Note: mode LSB(m)=1 is not implemented in this design, because there is no PAPER FEED button.

If no macro has been defined, this command does not do anything.

8.10 Cutter commands description

GS V m [1] | GS V m n [2]

Description	Select cut mode and cut paper				
Format 1	ASCII	GS	V	m	
	Hex	1D	56	m	
	Decimal	29	86	m	
Format 2	ASCII	GS	V	m	n
	Hex	1D	56	m	n
	Decimal	29	86	m	n
Range	Format 1: m = 1, 49				
	Format 2: m = 66, 0 ≤ n ≤ 255				

This command performs a paper cut in either full or partial cut mode. Partial cut leaves a small bridge area uncut on the paper.

The type of cut requested depends on the value of m, as described in the following table.

m	Description
1, 49	Partial cut
66	Feed the paper by a distance (n x vertical motion unit), then perform a full cut

Table 53: Paper cut modes details.

8.11 APS specific commands description

GS J 0 ***APS specific***

Description	Get number of available dot lines in the print buffer			
Format	ASCII	GS	J	0
	Hex	1D	4A	30
	Decimal	29	74	48

This command returns the number of dot lines currently available in the print buffer as a byte.

If more than 255 dot lines are available in the print buffer, then the actual value is clamped to 255. If the byte returned is 255, then it should be interpreted that there are *at least* 255 dot lines (about 31.8mm) available in the print buffer.

GS J 1 ***APS specific***

Description	Get number of available text lines in the print buffer				
Format	ASCII	GS	J	1	
	Hex	1D	4A	31	
	Decimal	29	74	49	

This command returns the number of text lines currently available in the print buffer as a byte.

If more than 255 text lines are available in the print buffer, then the actual value is clamped to 255. If the byte returned is 255, then it should be interpreted that there are *at least* 255 text lines available in the print buffer.

GS J 2 n ***APS specific***

Description	Set printing intensity				
Format	ASCII	GS	J	2	n
	Hex	1D	4A	32	n
	Decimal	29	74	50	n
Range	$52 \leq n \leq 205$				
Default	n = 128				

This command sets the printing intensity to the value specified by n.
Printing intensity can be varied from -60% (n=52) to +60% (n=205).

GS M 0 n ***APS specific***

Description	Set stepper motor acceleration				
Format	ASCII	GS	M	0	n
	Hex	1D	4D	30	n
	Decimal	29	77	48	n
Range	$62 \leq n \leq 250$				
Default	n = 125 (4000mm/s²)				

This command sets the acceleration of the stepper motor, which is used during ramping up and ramping down the printing speed between minimum and maximum speeds. Equation 2 gives a formula to compute n from a given acceleration in mm/s².

$$n = 31.25 \cdot 10^{-3} \cdot acceleration\ in\ mm/s^2$$

Equation 2: Acceleration calculation formula.

GS M 1 n ***APS specific***

Description Set minimum printing speed

Format	ASCII	GS	M	1	n
	Hex	1D	4D	31	n
	Decimal	29	77	49	n
Range	$5 \leq n \leq 110$				
Default	n = 25 (50mm/s)				

This command sets the minimum printing speed that is used to calculate the trapezoidal profile of the stepper motor speed. Use Equation 3 to compute byte n for any desired printing speed in mm/s.

$$n = 0.5 \cdot speed\ in\ mm/s$$

Equation 3: Minimum printing speed calculation formula.

The minimum printing speed must be less than or equal to the maximum printing speed set via command GS M 2 otherwise setting will be ignored by the printer.

GS M 2 n ***APS specific***

Description	Set maximum printing speed				
Format	ASCII	GS	M	2	n
	Hex	1D	4D	32	n
	Decimal	29	77	50	n
Range	$5 \leq n \leq 110$				
Default	n = 110 (220mm/s)				

This command sets the maximum printing speed that is used to calculate the trapezoidal profile of the stepper motor speed. Use Equation 4 to compute byte n for any desired printing speed in mm/s.

$$n = 0.5 \cdot speed\ in\ mm/s$$

Equation 4: Maximum printing speed calculation formula.

The maximum printing speed should be greater than or equal to the minimum printing speed set via command GS M 1 otherwise setting will be ignored by the printer.

GS T 0 ***APS specific***

Description	Get printing head temperature			
Format	ASCII	GS	T	0
	Hex	1D	54	30
	Decimal	29	84	48

This command returns the actual printing head temperature as a byte.

Byte n is the value returned when issuing this command. This byte is the result of an ADC conversion of the head temperature. Equation 5 and Equation 6 give a two-step process to retrieve the actual head temperature in degrees.

$$R_T\ (Kohms) = 33 \cdot \frac{n}{255 - n}$$

Equation 5: Thermistor resistance calculation formula.

$$T(°C) = \left(\frac{1}{298} + \frac{1}{B} \cdot \ln\left(\frac{R_T}{R_{25}} \right) \right)^{-1} - 273$$

Equation 6: Head temperature conversion formula.

With:

- B = 3950K;
- R_{25} = 30Kohm.

Table 54 shows various example byte values returned by this command, for various typical head temperatures.

Head temperature (°C)	ADC value
10	165
25	121
50	63
70	35

Table 54: ADC values for various typical head temperatures.

GS T 1 ***APS specific***

Description	Get printing head voltage			
Format	ASCII	GS	T	1
	Hex	1D	54	31
	Decimal	29	84	49

This command returns the actual printing head voltage as a byte.

Byte n is the value returned when issuing this command. This byte is the result of an ADC conversion of the head voltage. Equation 7 may be used in order to retrieve the actual head voltage in volts.

$$V_{Head}\ (volts) = 0.142 \cdot n$$

Equation 7: Head voltage conversion formula.

Table 55 shows various example byte values returned by this command, for various typical printing head voltages.

Printing head voltage (V)	ADC value
16	112
20	141
24	169
26	183

Table 55: ADC values for various typical head voltages.

The nominal head voltage is 24V; hence, the value returned by this command should be around 169 when the TPH power supply is at nominal voltage.

GS T 2 n ***APS specific***

Description	Set power failure voltage				
Format	ASCII	GS	T	2	n
	Hex	1D	54	32	n
	Decimal	29	84	50	n
Range	$0 \leq n \leq 152$				
Default	n = 112 (16V)				

This command sets the printing head supply voltage limit that triggers power failure mode.

If power supply voltage drops below the limit set by this function, the control board assumes that a power supply failure has occurred. In this case, the control board stops all printing jobs, motor and cutter, and puts the board in a low power state. Printing may later be resumed by the HOST if the power supply failure has proven to be temporary.

Byte n is compared to ADC conversions of the head voltage. Equation 8 may be used to calculate this value from a given limit in volts.

$$n = 7.025 \cdot V_{Head} \ (volts)$$

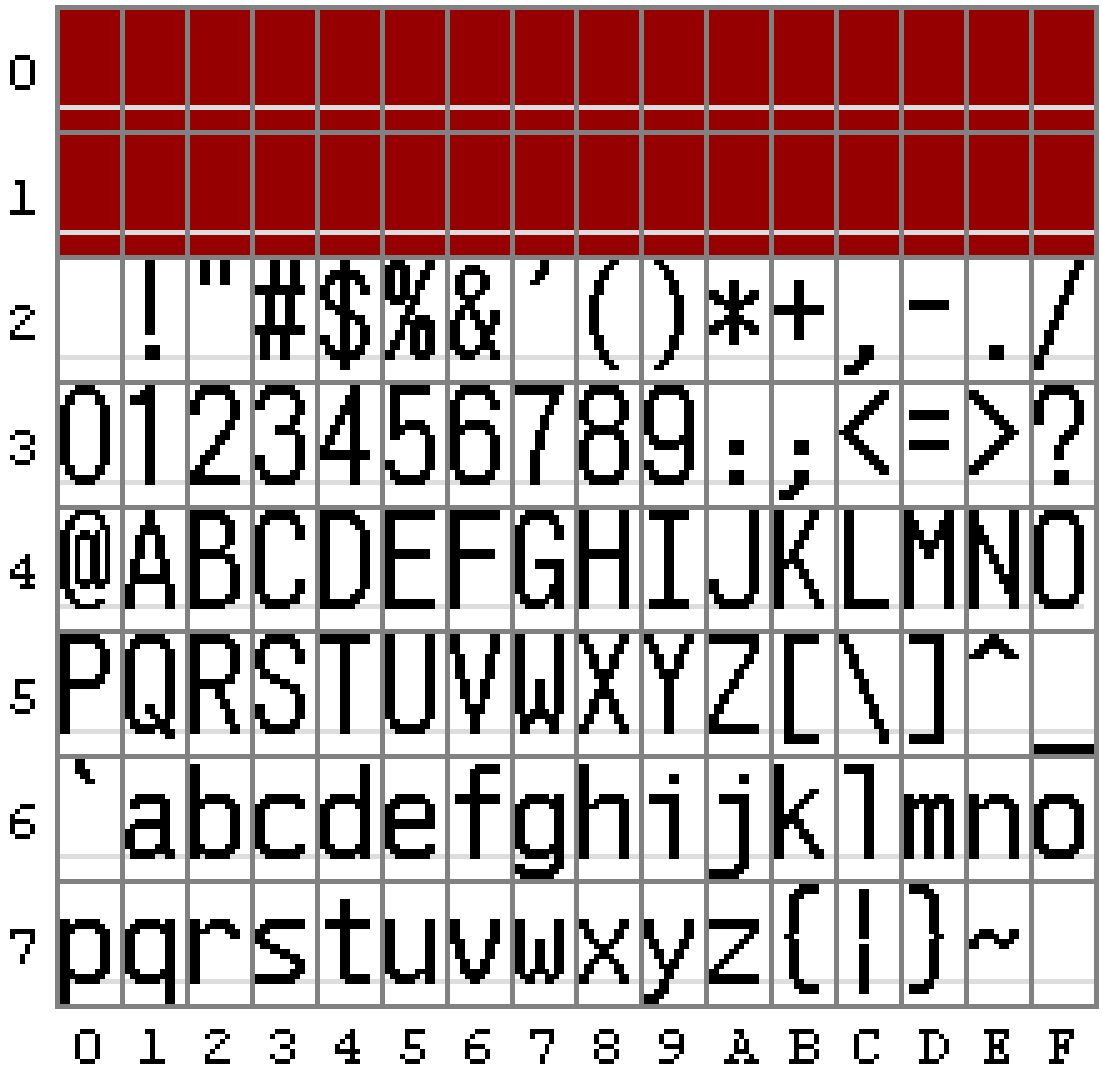
Equation 8: Power failure voltage calculation formula.

Setting power supply threshold to zero (n = 0) disables power supply failure checking.

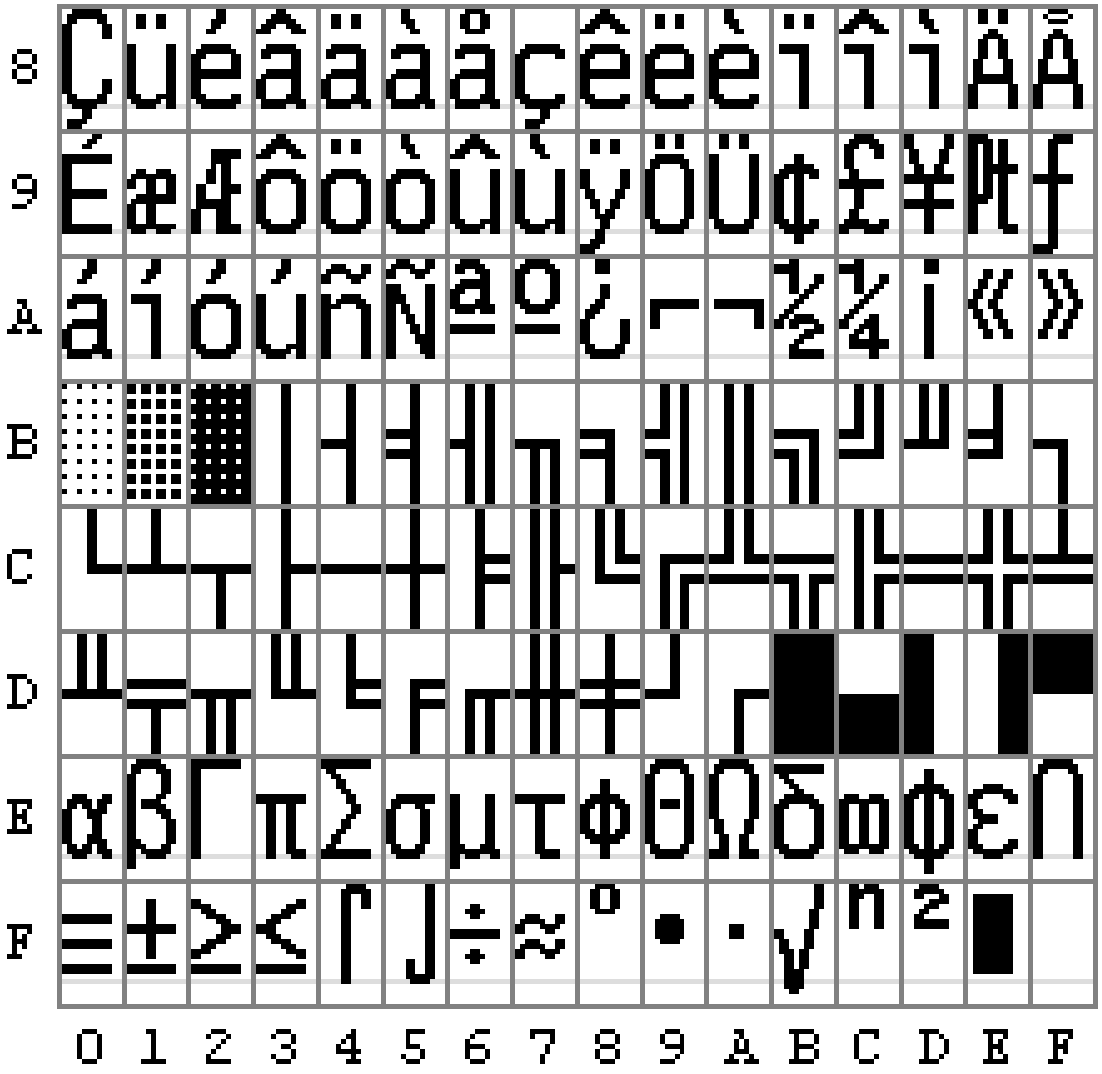
9. CHARACTER CODE TABLES

This section shows the character bitmaps associated with each character code for supported code pages. Bitmaps shown are those of font A (12x24). Other fonts use the characters design but with different bitmap sizes.

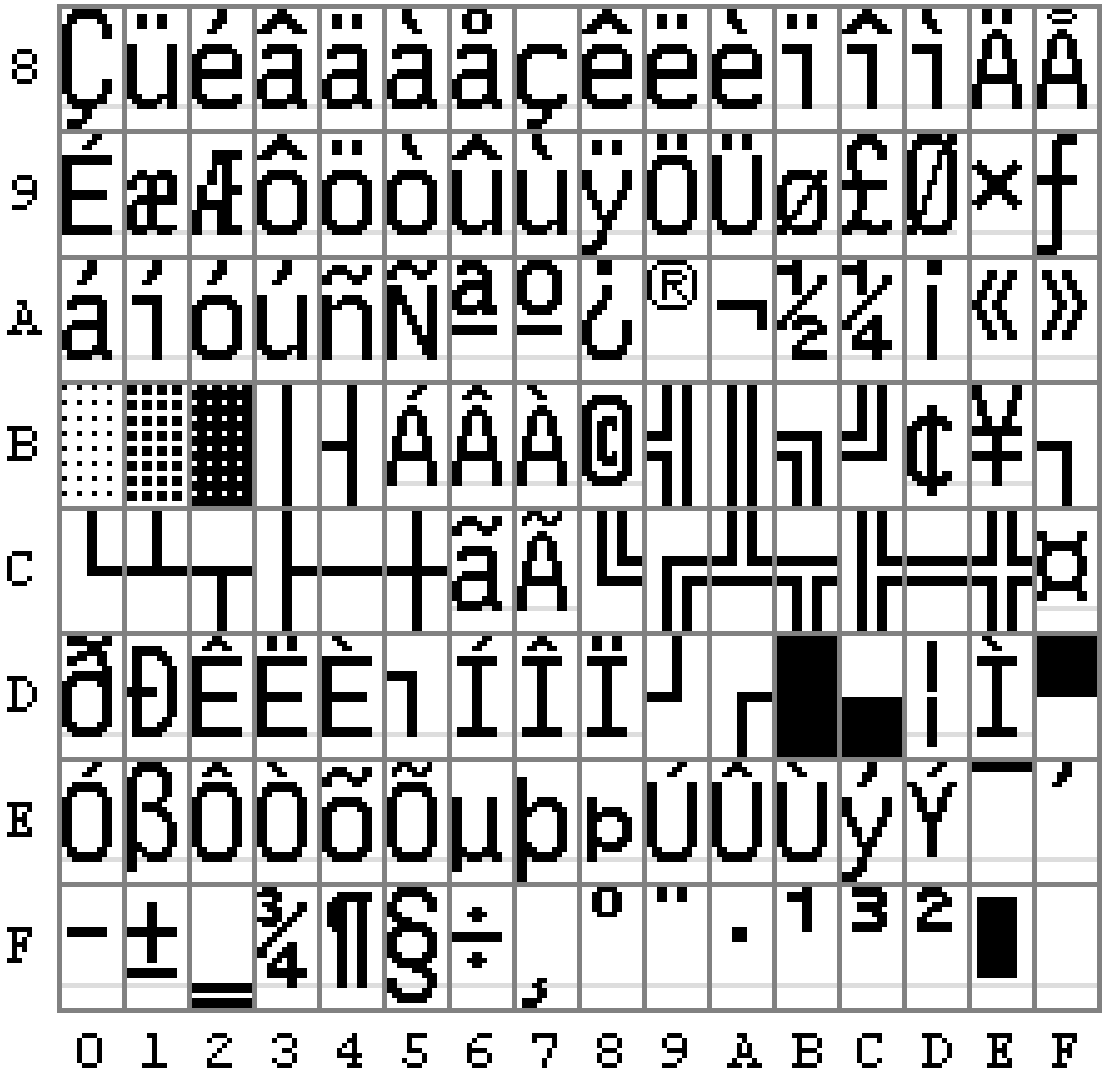
9.1 ASCII set (character codes 0-127)



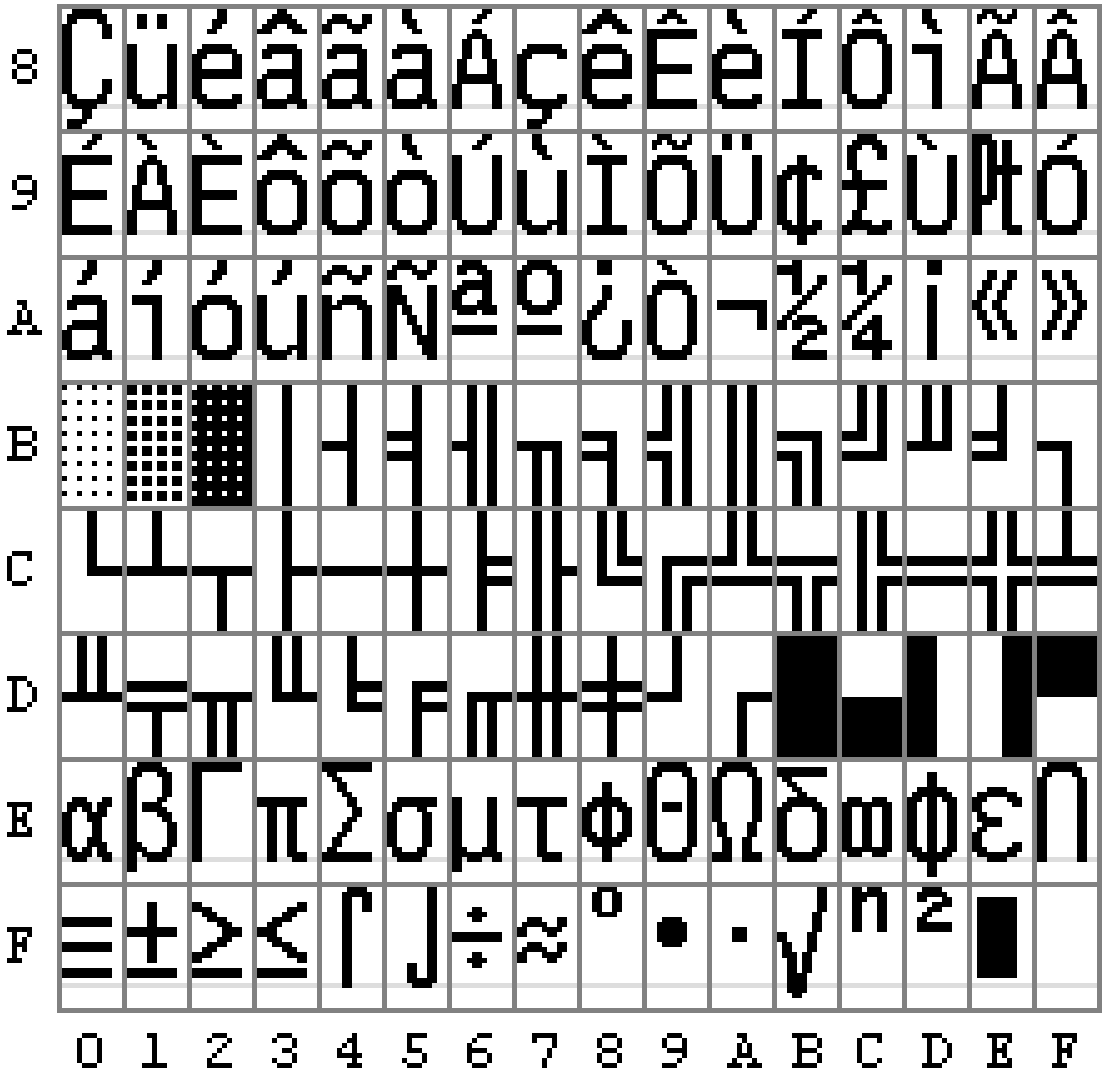
9.2 Page 0 (PC437 ; U.S.A., Standard Europe)



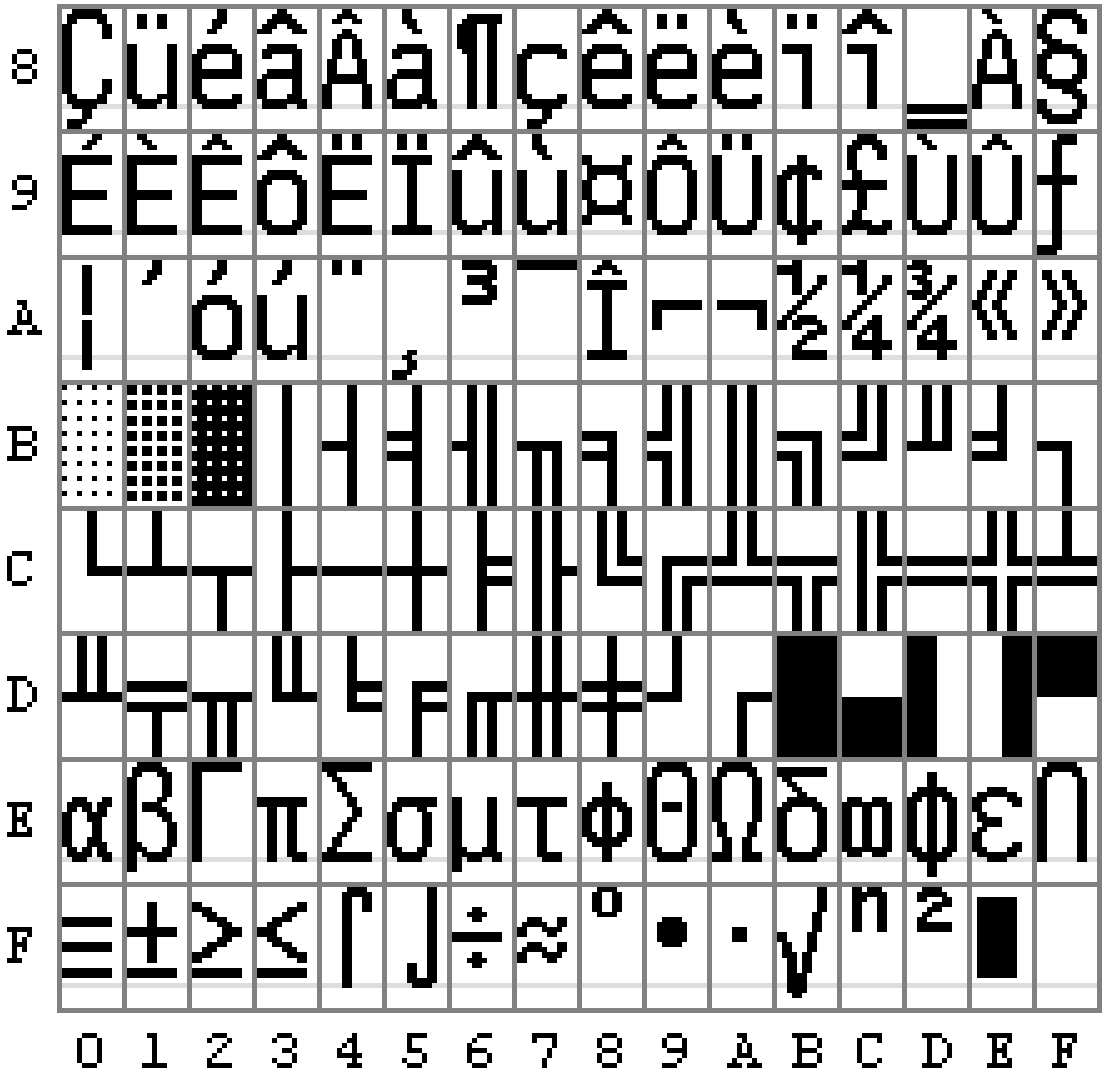
9.3 Page 2 (PC850 ; Multilingual Latin I)



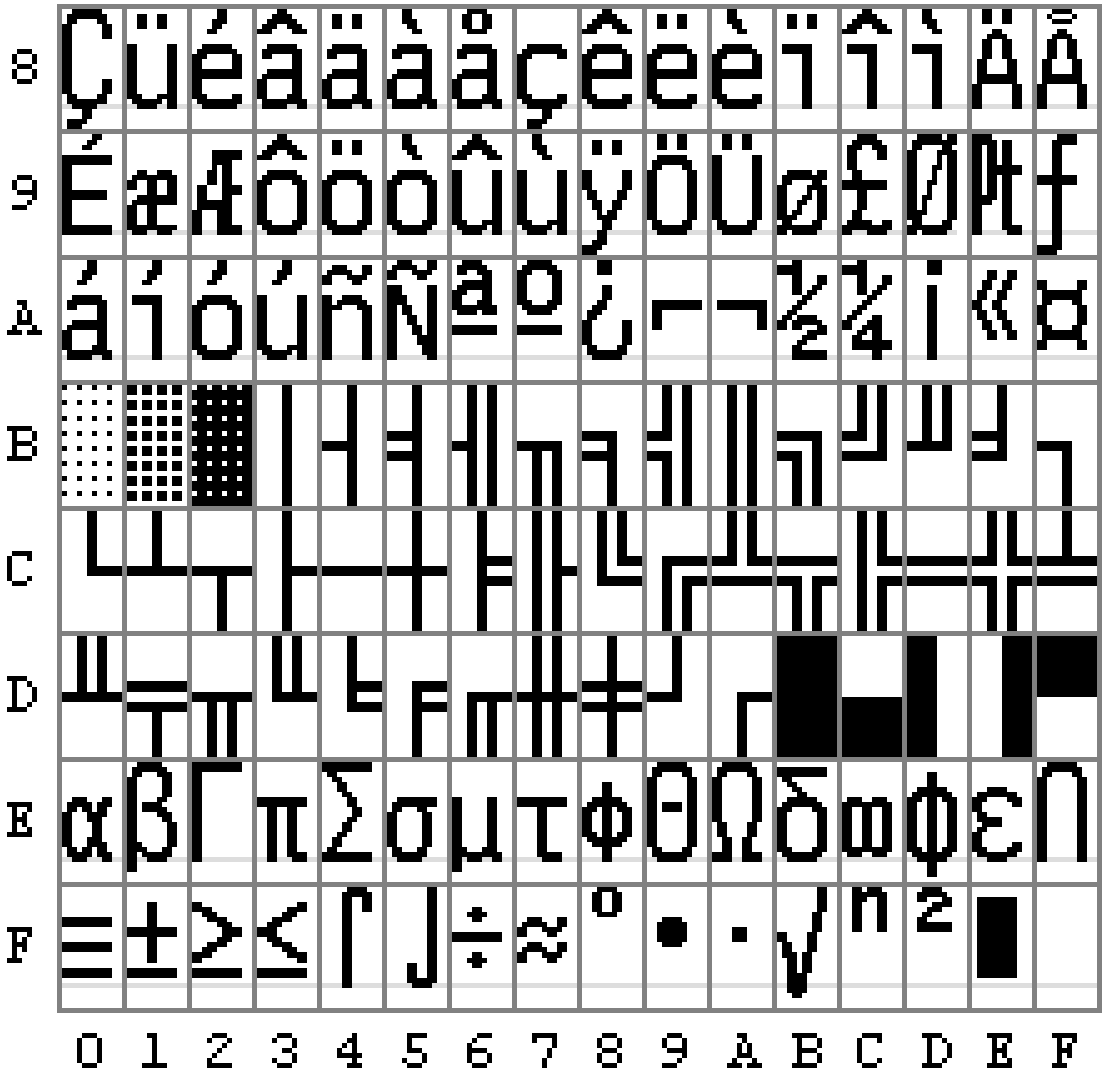
9.4 Page 3 (PC860 ; Portuguese)



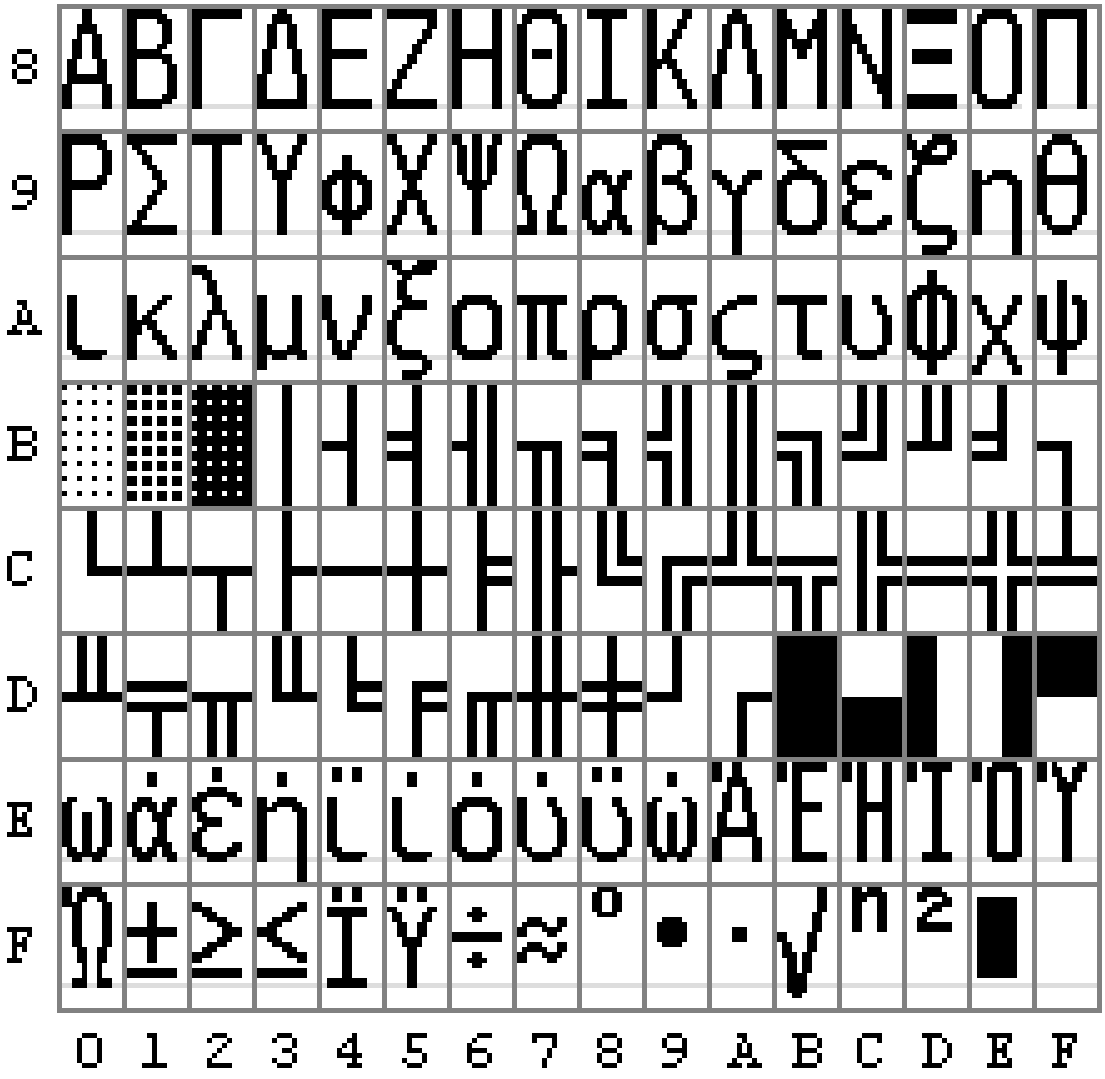
9.5 Page 4 (PC863 ; Canadian-French)



9.6 Page 5 (PC865 ; Nordic)

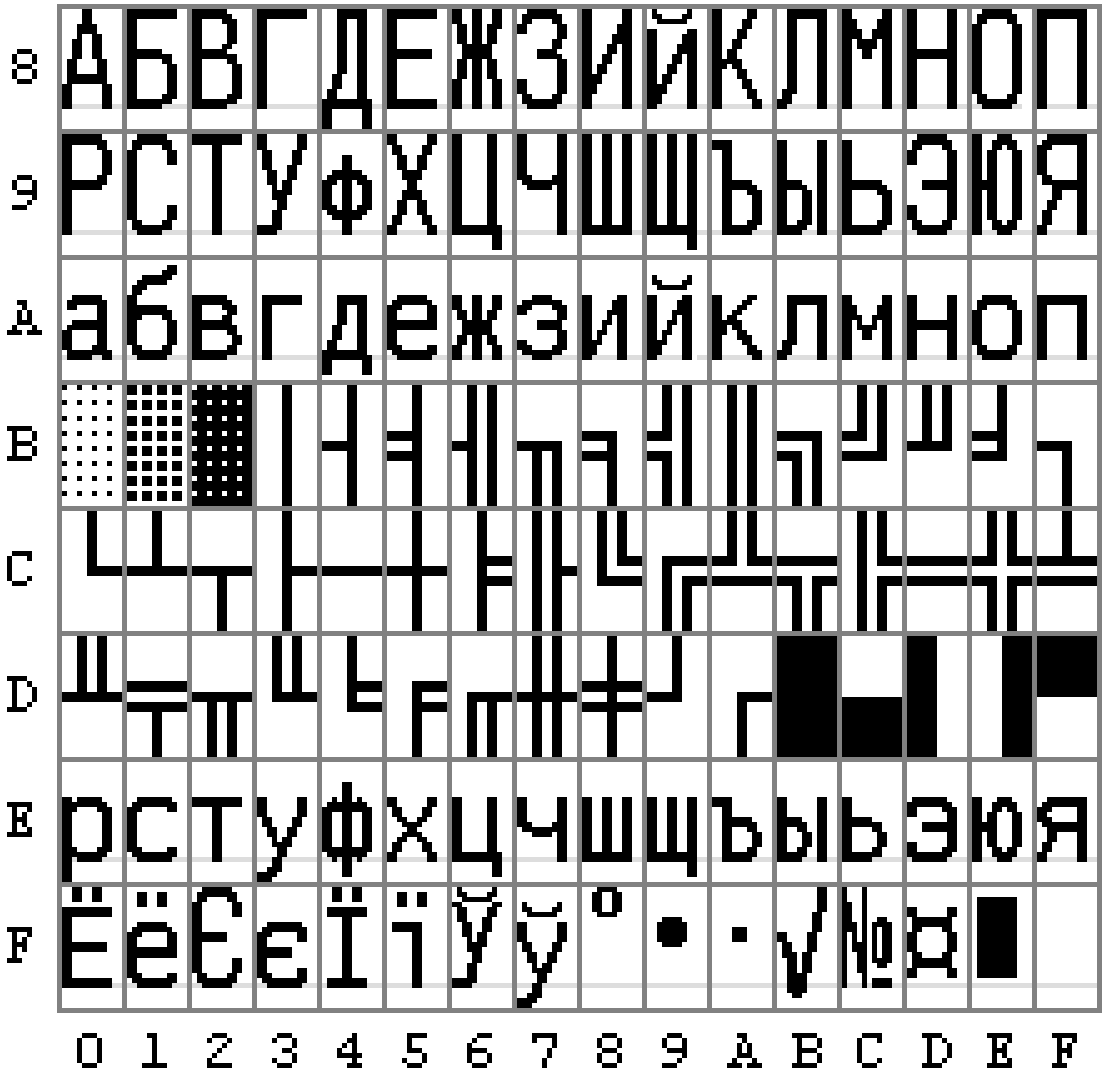


9.7 Page 6 (PC737 ; Greek)

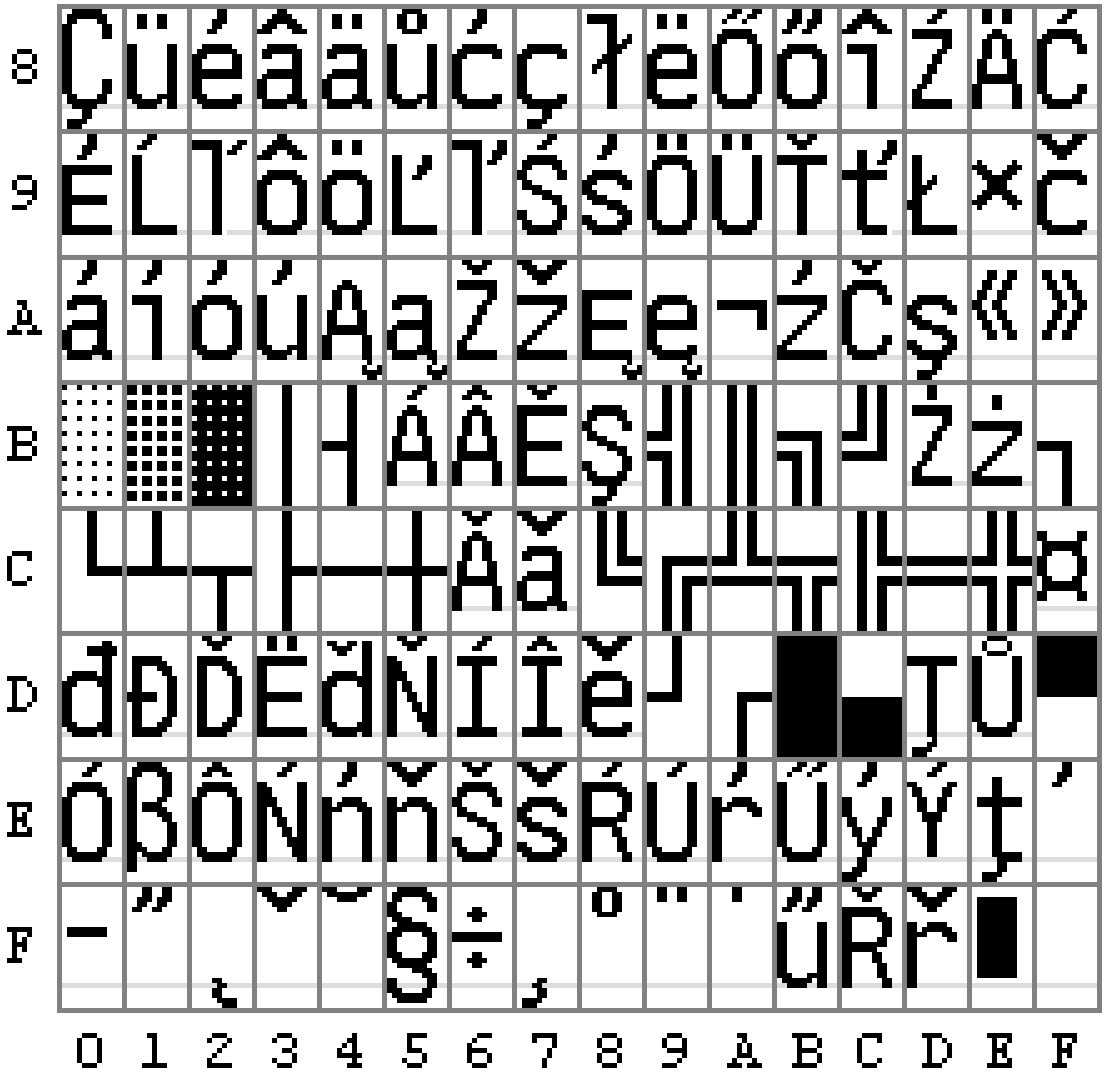


9.8 Page 16 (Windows WPC1252 Latin I)

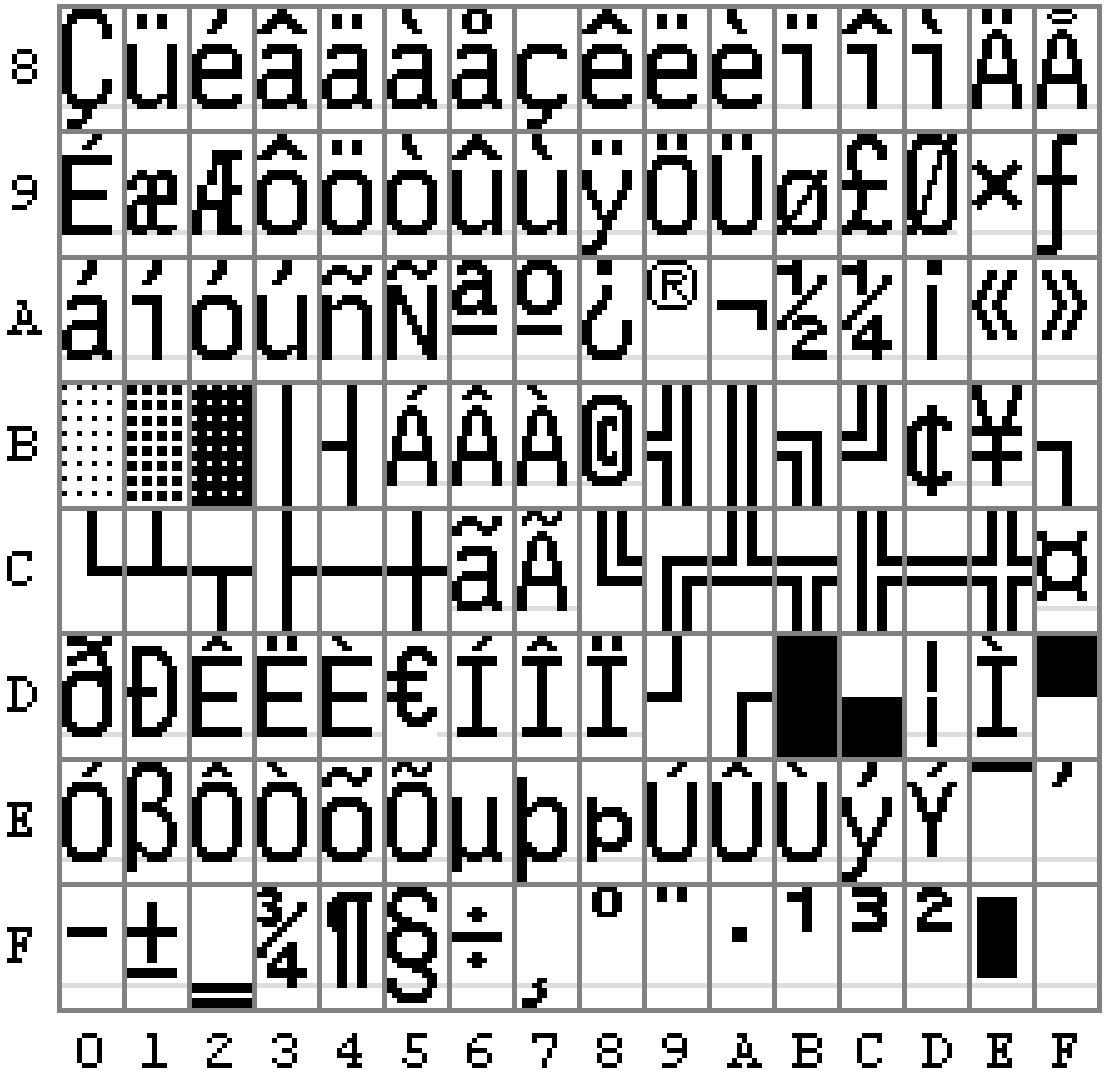
9.9 Page 17 (PC866 ; Cyrillic)



9.10 Page 18 (PC852 ; Latin II)



9.11 Page 19 (PC858 ; Multilingual Latin I + Euro)



10. OPERATING PRECAUTIONS

1 When performing continuous printing, the supply energy should be reduced so that the substrate temperature, monitored through the thermistor, will remain below 65°C.
2 All strobes signals must be disabled during the power and logic voltage ON/OFF sequence.
3 Do not touch the connector pins with naked hands.
4 The print-head substrate surface is coated with glass, for this reason, mechanical stresses, shocks, dust and scratches should be avoided to prevent damage.
5 When the print-head operation is completed, print supply voltage (including the charged voltage with capacitor) should be reduced to the ground level and maintained until next print-head operation.
6 Avoid condensation, if condensation occurs, do not switch ON the print-head power, until condensation has disappeared.
7 Print quality would become degraded if paper or ink residue were stuck on the heat element area. In this case, clean the print-head with an applicator and alcohol. Do not use the sandpaper as this will destroy the heating elements.
8 If sticking sound, is heard while printing, please check and adjust the paper feed mechanism and the electrical pulse program to eliminate the sound.
9 Make sure the paper does not have high abrasion factor, low sensitivity or abnormal chemicals.

Important precautions

To prevent any dot element damage:
At power up make sure that logic voltage Vdd is present simultaneously or before VH.
At power down make sure that VH is at 0 V before removing logic voltage Vdd.

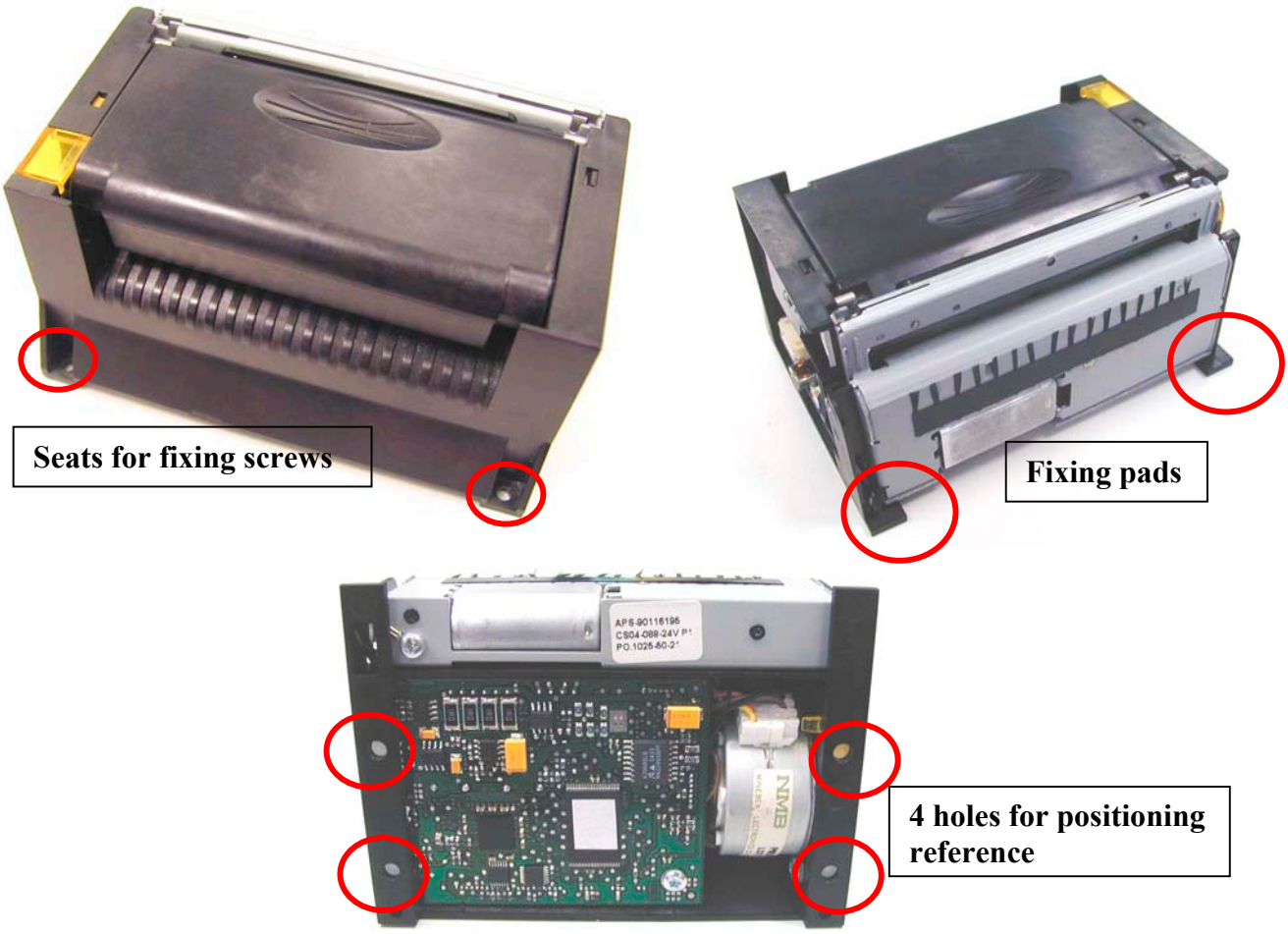
11. MECHANICAL AND HOUSING

11.1 Overall dimensions

See attached drawings for overall dimensions. 3D models (IGES or STEP format) are available at APS upon request.

11.2 Fixing points and mounting precautions

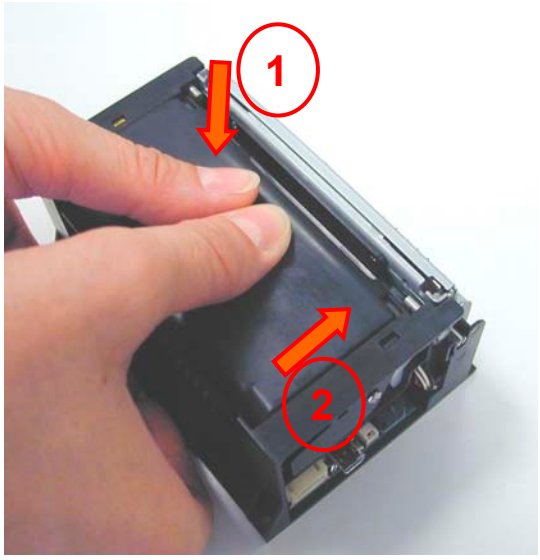
The printer is intended to be mounted in horizontal position (with head parallel to ground), placed on a flat roof, fixed by 2 pads and 2 screw. 4 holes in the bottom of the printer are available as positioning references. See attached drawings for detailed dimensions and recommended screws.



12. HANDLING HSP3100-FC

12.1 Print-head group opening and closing

To close the thermal head push slightly downwards with 2 fingers and, keeping pushed downwards, push forwards until the metallic pins are correctly positioned in their seats. If the print-head group is not correctly close, paper loading and printing is disabled.



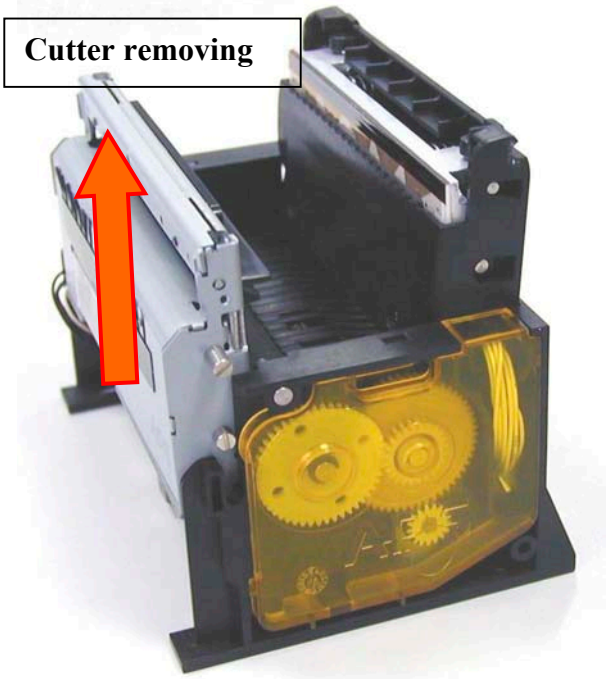
To open the thermal head push slightly downwards with 2 fingers and, keeping pushed downwards, pull backwards. The group can be rotated up to 90°.

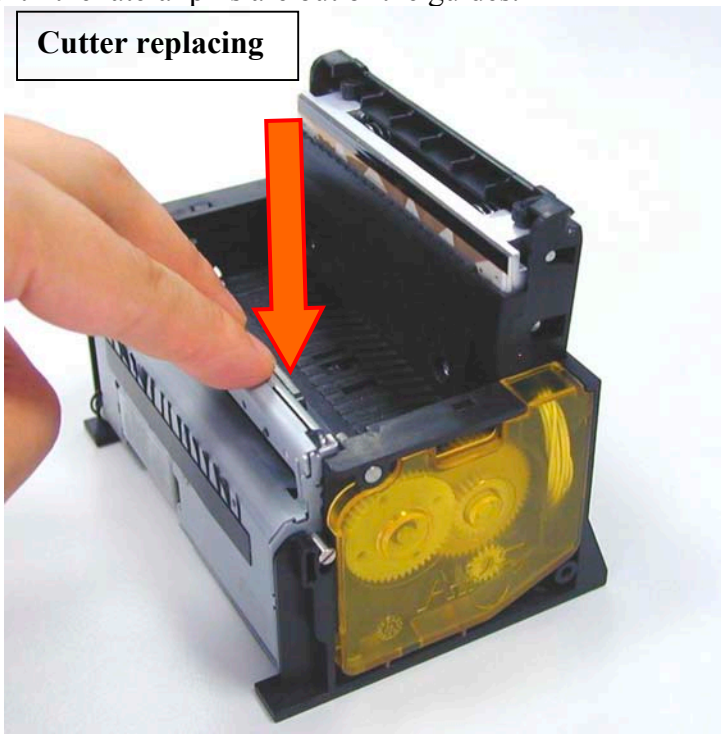
12.2 Paper loading

To load the paper insert the paper in the paper inlet slot with the thermal side upward, push slightly the paper until the paper start being pulled by roller.

12.3 Cutter handling

To remove the cutter from its seat pull upwards until the lateral pins are out of the guides.



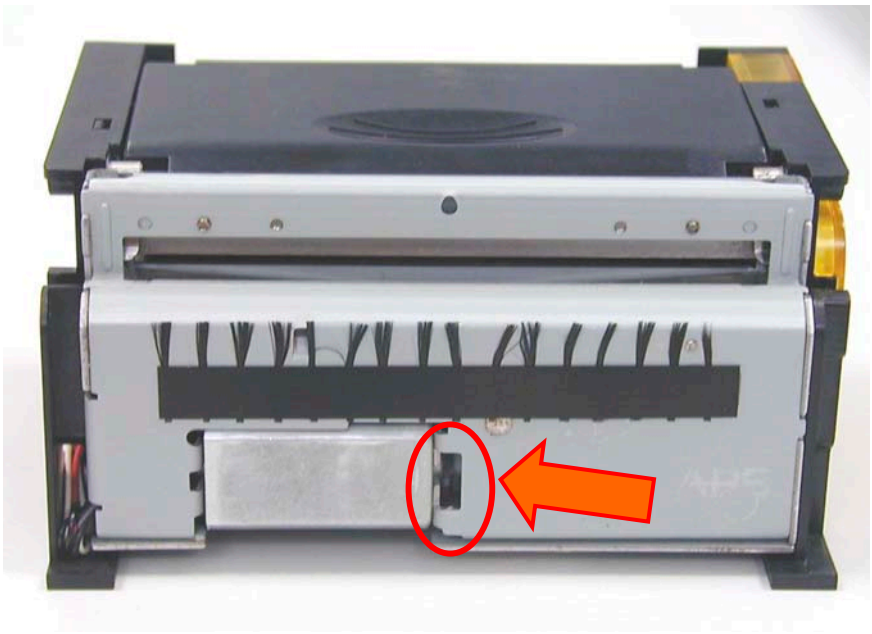


To replace the cutter in position, align the metallic pins with the lateral guide and push downwards until the cutter is in position.

During these operations the printhead group must be open and pay attention not to damage the cutter wires.

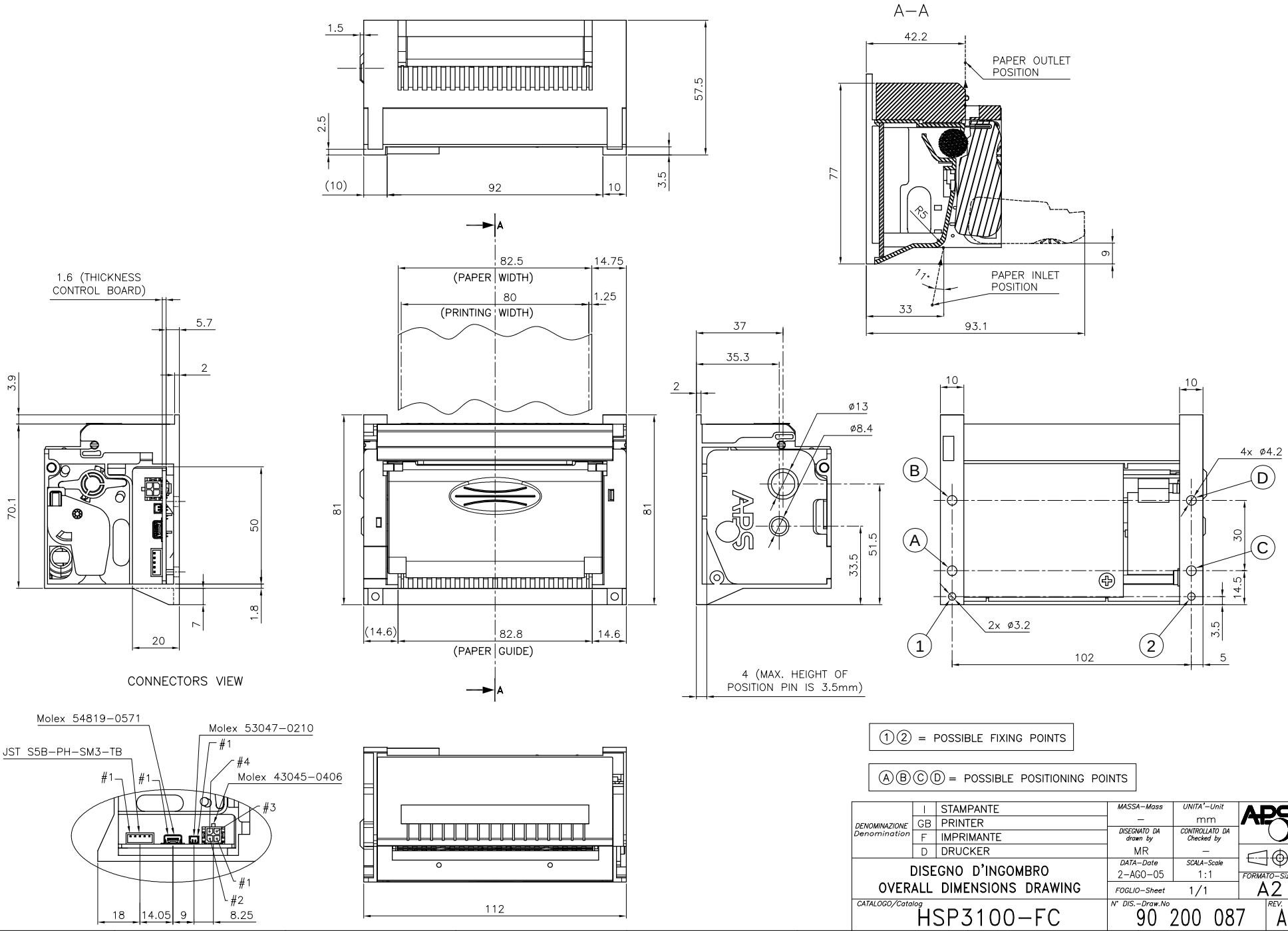
12.4 Cutter jam removing

In case of paper jam inside the cutter it's possible to take the cutter moving blade back to home position by auctioning the black gear inside the cavity shown in picture below.



13. ORDERING CODE

Type	Ordering code
Standard	**HSP3100-FC**



① ② = POSSIBLE FIXING POINTS

Ⓐ Ⓑ Ⓒ Ⓓ = POSSIBLE POSITIONING POINTS

DENOMINAZIONE Denomination	I	STAMPANTE	MASSA–Mass: –	UNITA'–Unit: mm
	GB	PRINTER	DISEGNATO DA drawn by: MR	CONTROLLATO DA Checked by: –
	F	IMPRIMANTE		
	D	DRUCKER		
DISEGNO D'INGOMBRO OVERALL DIMENSIONS DRAWING			DATA–Date: 2–AGO–05	SCALA–Scale: 1:1
			FOGLIO–Sheet: 1/1	FORMATO–Size: A2
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