

CP 290 MRS

CP 324 MRS

CP 424 MRS



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<http://www.aps-printers.com/>

This manual provides complete information about A.P.S CP290MRS, CP324MRS and CP424MRS printers.

A.P.S reserves the right to make changes without notice to the product to improve reliability, function or design.
A.P.S does not assume any liability arising out of the application or use of the product or circuit described herein.

2. GENERAL FEATURES

The CP290MRS, CP324MRS and CP424MRS are the world's first 2 inch, 3 inch and 4 inch, 24Volts thermal printer mechanisms with an integrated control board using serial and parallel communications. The height of the mechanisms plus board is less than 27 mm, which makes them the most compact 2 inch, 3 inch and 4 inch, 24Volts thermal line printing solution available today.

- **Power supply voltage ranges from 18V to 27V**
- **Ultra-compact printers**
 - CP290MRS* Total size W91 x H20 x D55
 - CP324MRS* Total size W121 x H20 x D55
 - CP424MRS* Total size W156 x H27 x D55
- No wire or connector exiting this volume
- **Software programmable consumption**
 - Dynamic division, and high speed (up to 90mm/s)
- **Full control over printing quality/speed**
 - Speed clamping via control code
- **External pluggable switches and LED for easy integration**
- **Fully hot plug printers**
- **2 Communication ports**
 - RS232 (speed up to 115 200 Bds)
 - Centronics
- **Three internal fonts**
 - Easy font update
- **Powerful Text Printing Modes**
 - Horizontal
 - 180 degree
 - Double and Quadruple width and height printing
 - Inverse video
- **Powerful Graphic Modes**
 - Variable width and offset
 - Double width and height
- **Hole / Mark Detection**
- **Cutter driving**
 - Guillotine cutter type
- **10 Barcodes**
 - Normal and 90 degrees
- **Supports reflective and transmissive optocouplers**
- **Single sheet introduction/ejection support**
 - Pause between detection of paper and printer beginning to load
- **Printing parameters saved in flash are recovered at next power-up**
 - One simple command saves all important parameters
- **Optional near end of paper optosensor**
- **Windows® drivers available**
- **Easy firmware upgrades**

3. REVISION HISTORY

REV.	DATE	PAGE	REVISION ITEM
A	08/Jul/99	-	First issue
B	20/Jan/01	-	1.35, 1.36 firmware revision : No black mark detection, No rotative cutter
C	01/Mar/01	-	1.37 firmware revision : Black mark detection supported, No rotative cutter.
D	18/Mar/02	-	5.0 firmware revision : Three internal fonts, inverse video, different widths mixed on same line, text justification, rotated barcodes, support for both reflective and transmissive optocouplers.
E	01/Sep/02	-	5.1 firmware revision: enhanced opto support with calibration.
F	17/Feb/03	-	5.2 / 5.3 firmware revisions: setup and printing parameters can be saved in flash memory, near end of paper detection optosensor support, single sheet loading / ejection support.
G	15/Apr/03	-	5.40 / 5.50 firmware revisions: minor enhancements.
H	19/May/03	-	5.41 / 5.51 firmware revisions: linear optosensor enhancement.
I	27/May/03	-	5.42 / 5.52 firmware revisions: near end of paper default threshold defined.
J	04/Jun/04	-	5.43 / 5.53, 5.44 / 5.54 firmware revisions: Updated RS232 parameters saving. Near end of paper hardware update.
K	20/Sep/05	-	Minor corrections in control codes description.
L	04/Sep/06	-	5.45 / 5.55 firmware revisions: Stepper motor management: retight phase becomes a parameter.
M	04/Dec/06	5 39 to 45	General size with cutter Drawings

4. GENERAL SPECIFICATIONS

ITEM	SPECIFICATION
Print method	Thermal dot-line printing
Dimension WxDxH (mm)	<i>CP290MRS</i> 91 x 55 x 20 <i>CP324MRS</i> 121 x 55 x 20 <i>CP424MRS</i> 156 x 55 x 27
Dimension with Cutter WxDxH (mm)	<i>CP290MRS-C</i> 98 x 63 x 42 <i>CP324MRS-C</i> 121 x 71 x 40 <i>CP424MRS-C</i> 156 x 71 x 48
Total dots	<i>CP290MRS</i> 432 <i>CP324MRS</i> 576 <i>CP424MRS</i> 864
Dot density	8 dots/mm
Paper width	<i>CP290MRS</i> * 60 mm (FL) or 66 mm +/-0.5 (BL) <i>CP324MRS</i> 80 mm +/-1 <i>CP424MRS</i> 114 mm
Print width (centered on paper)	<i>CP290MRS</i> 54 mm <i>CP324MRS</i> 72 mm <i>CP424MRS</i> 104 mm
Heat element pitch	0.125 mm
Paper feed pitch	0.125 mm
Paper feed tension	50g or more
Paper hold tension	80g or more
Recommended Paper	KF50-HDA or equivalent
Voltage range	<i>Logic</i> 5Volts +/- 5% <i>Power</i> From 18Volts to 27Volts
Current consumption	From 1 to 9 Amps (@24V)
Operating temperature	From -10°C to +60°C
Operating humidity (RH%)	20-85 (no condensation)
Storage temperature (°C)	From -40°C to +90°C
Storage humidity (RH%)	10-90 (no condensation)
EMC standard	Designed to comply with Level B – FCC - CE

* FL = Front loading
BL = Bottom loading

5. PRINTER DEVICE INTERCONNECTION

Please refer to the drawing attached to back of this specification for connect or positions. These printers are fully hot plug: any connector hereafter can be connected or disconnected without damaging the printer.

5.1 Power supply connector

Connector J1: MOLEX, 53048 Series 9 contacts. Female 51021 Series contacts 50079/50058. Power supply (V bat) is from 18V to 27V DC. No power up sequence is required between the 5Volts and the 24Volts.

PIN NUMBER	SIGNAL NAME
1	GND
2	GND
3	GND
4	GND
5	GND
6	V bat
7	V bat
8	V bat
9	5 VL

IMPORTANT NOTE:

Wires AWG28 must be used in order to avoid current losses

5.2 Serial communication connector

Connector J2: MOLEX, 53048 Series 5 contacts. Female 51021 Series contacts 50079/50058.

PIN NUMBER	SIGNAL NAME
1	Gnd
2	Transmit data (Txd, printer output)
3	Receive data (Rxd, printer input)
4	CTS/DSR (printer input)
5	RTS/DTR (printer output)

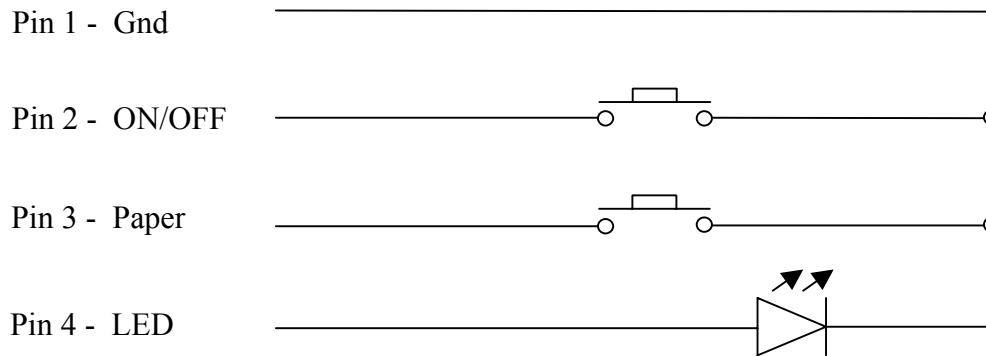
5.3 Switch/Led connector

Connector J3: MOLEX, 53048 Series 4 contacts. Female 51021 Series contacts 50079/50058.

PIN NUMBER	SIGNAL NAME
1	Gnd
2	ON/OFF line
3	Paper FEED
4	LED (cathode)

This connector allows you to design an external paper feed button, on-line off-line button, and status LED.

External circuitry is as follows:



(*) A serial resistor (470 Ohms) is on the printer, setting the LED current at about 7 mA.

The Switches and LED functions are defined in the following table:

Printer Status	OFF	OFF Line	On Line	Head-up	End of Paper	Over/Under Voltage or Temperature
On/Off Line SW	Execute self-test if pressed during Power-On	On Line	Off Line	N/A		
Paper Feed Switch	N/A	Feeds Paper	Feeds Paper if not already printing	N/A		
LED	OFF	1 Flash "ON"	Always "ON"	2 Flash "ON"	3 Flash "ON"	4 Flash "ON"

5.4 Parallel communication connector

Connector J4: MOLEX, 53048 Series 15 contacts. Female 51021 Series contacts 50079/50058.

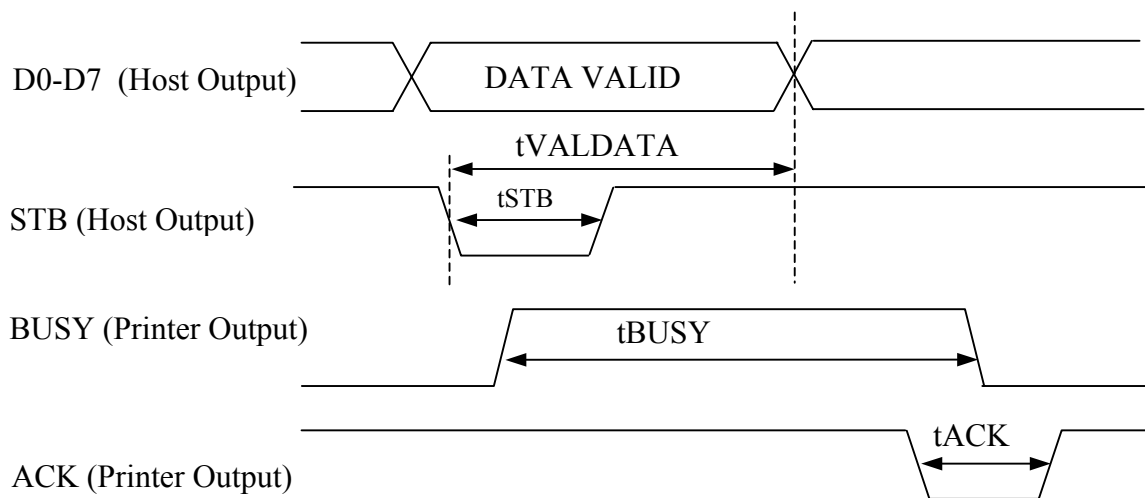
PIN NUMBER	SIGNAL NAME
1	\AUTOFEED
2	BUSY
3	D7
4	D6
5	D5
6	D4
7	D3
8	D2
9	D1
10	D0
11	PE
12	\INIT
13	GND
14	\STB
15	\ACK

Note: When the printer is not powered, all lines of the parallel port are driven to ground through 220 Ohms except \INIT. In order to keep the power consumption on these lines as low as possible, it is recommended to keep all these lines to a logic 0, and keep \INIT to a logic one. In any case, when the printer is not powered and the parallel port is connected, \INIT must be left to one, to ensure a proper printer initialization at power up.

5.5 Timing for parallel communication

The communication protocol is Centronics compatible, and has the ability to handle the “Compatibility Mode” (Write from the Host to the Printer), and also the “Byte Mode”, for the host to read internal data from the printer. The “Byte Mode” is used to receive printer status back from the printer.

5.5.1 Compatibility mode timing (host writes to the printer)

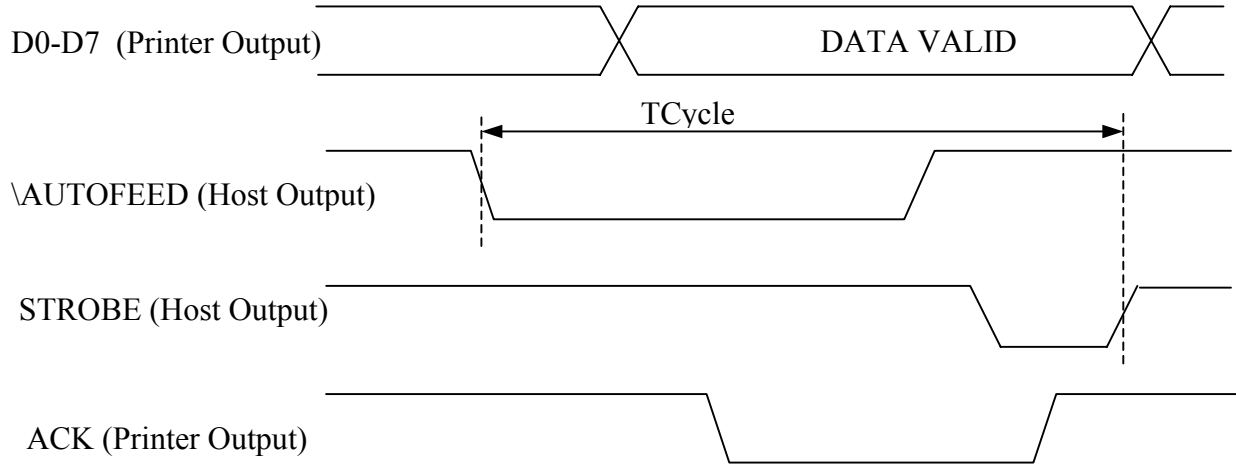


PARAMETER	MIN	TYP	MAX	COMMENTS
Time STB (t_{STB})	5 μ s	-	-	This time is given by the host
Time BUSY (t_{BUSY})	25 μ s	90 μ s	250 μ s	This hold time is controlled by GS b control code
Time $t_{VALDATA}$	25 μ s	-	-	Time in while the data must be stable. This time is fixed by the host.
Time ACK (t_{ACK})	-	3 μ s	-	

IMPORTANT NOTE:

The data (D0-D7) must be stable for $t_{VALDATA}$. If not, please contact APS for additional cabling.

5.5.2 Byte Mode timing (host reads data from printer)



In this mode, the data transfer controlled is given by the host, but tCycle must not exceed 0.5 seconds

5.6 Serial / Parallel mode selection

Serial or Parallel mode will be chosen via software automatically after the first character is received. At power-up, both serial and parallel communications are active. If the first character is received on the serial port, the communication will be serial, and vice versa for parallel. This first character will be interpreted like any other incoming byte into the printer.

5.7 Near end of paper sensor

It is possible to add a near end of paper detection feature to all printers. The near end of paper is an extension available on the parallel communication connector. The usage of this extension disables the parallel communication feature.

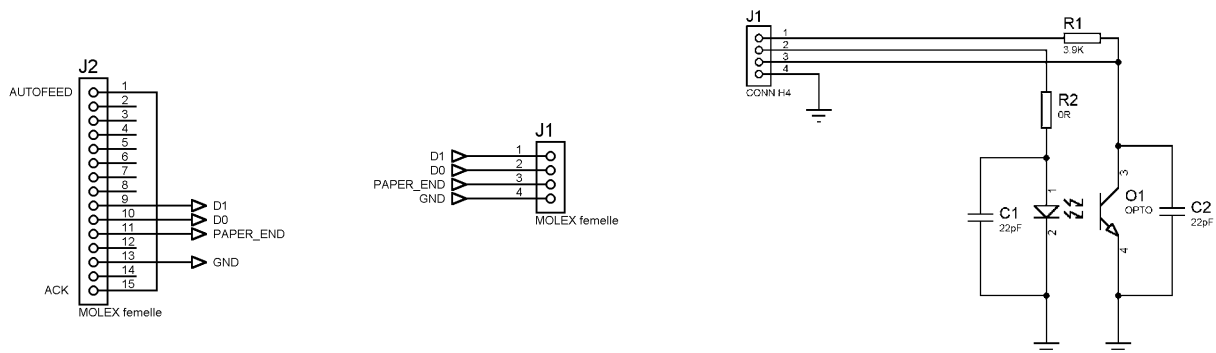
This extension is available for purchase from A.P.S as a small board with mounting holes and a four point connector. See photo below.



The actual size can be seen on the photo. The dark rectangle is the optosensor. The connector and passive components are on the other side for easier mounting.

It uses a reflective optosensor placed near the end of the paper roll, and will preventively detect the fact that the roll will soon have to be changed.

A cable with the corresponding 4 points on one end and 15 points on the other will connect to appropriate signals on the parallel port. A loopback on the 15 points side will allow the firmware to detect the presence of the extension and configure the required pins correctly for operation of the optosensor. See cabling and optosensor board schematics below.



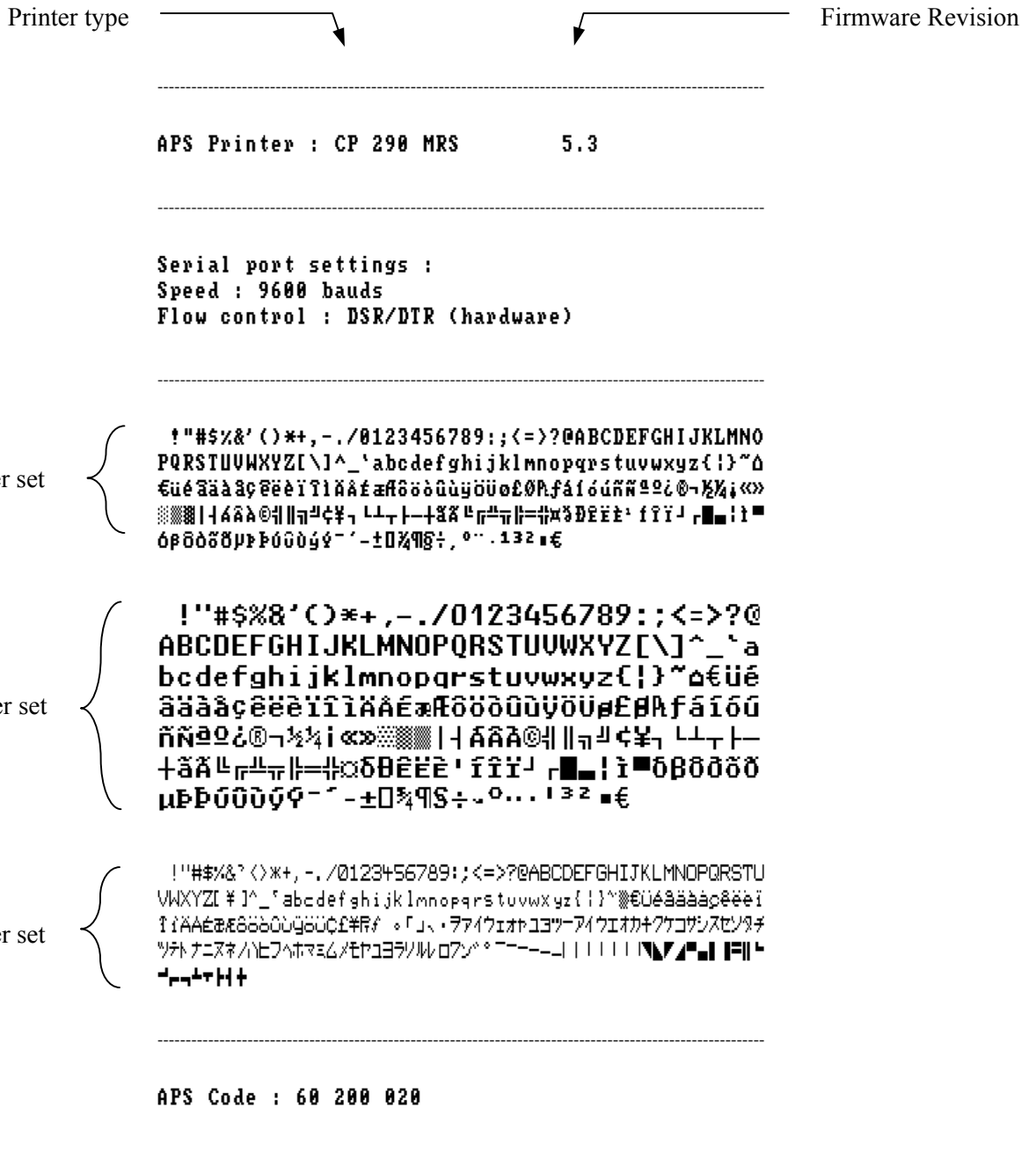
When this feature is used, the parallel port functionality is disabled. Due to variations in optosensor specifications, and different mounting positions, it will generally be necessary to perform a calibration procedure. This is very straightforward, as the firmware has a command that will automatically perform a reflection measurement, determine an appropriate threshold, and permanently store it in the flash memory of the microcontroller. This is normally done only once in production. The application software can query for the near end of paper status, and the firmware will respond with a single yes/no answer.

Please refer to the “Near end of paper” control codes (“ESC n” commands set) in section 6.4.2 for more information.

6. PRINTER DEVICE OPERATIONS

6.1 Self test Mode

This mode is done by the combination of the 2 external switches (see section 5.3). It prints the printer type, the revision of the printer firmware, the serial port settings, all internal character sets, and product code.



6.2 Paper loading

Paper loading can be achieved by two different methods:

- **Automatic paper loading:** With the green head-up lever in the down position, insert the paper inside the printer, and then the roller will automatically feed the paper for about 40 mm. If the printer has a cutter, the cutter will cut the paper after the loading. The printer is then ready to print. This function can be achieved only if power supply is more than 18 volts. In mark detection mode, the paper is fed forward to the TOF position.
- **Manual paper loading:** Put the green head-up lever in the up position. Manually feed the paper into the printer until it exits between the thermal head and the roller. Turn the green lever to the head-down position. Now the printer is ready to print.

6.3 Text Printing Format

The controller board has three resident sets of 224 characters : 8x16, 12x20, and 7x16.

The 8x16 and 12x10 fonts include the *Euro currency symbol (Position 128, 80h)*.

12 characters are selectable from the international character set : refer to ESC “R” command for more information.

All character bitmaps will be shown with their hexadecimal code (row being the most significant nibble, and column the least significant nibble). Example : ascii code for ‘A’ is 41 hex (or 65 decimal).

- **8x16 Character set:** Character size is 9 pixels (8 “active dots” plus one inter-character) x 20 pixels (16 “active” dots plus 4 interlines including underline), or 1.125mm x 2.5mm.

With double and quadruple height and width, maximum character size can go up to 4.5mm width x 10mm height.

Horizontal character spacing and line spacing may be adjusted via the software. Character per line is up to 64 in standard text, 32 in double width, and 16 in quadruple width.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
2		!	"	#	\$	%	&	'	()	*	+	,	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[\]	^	_
6	'	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{		}	~	Δ
8	€	ü	é	ä	ä	à	ç	ë	è	ï	ï	l	ä	ä		
9	é	æ	ff	ô	ö	ò	û	ù	ÿ	ö	ü	ø	ø	Æ	f	
A	á	í	ó	ú	ñ	ñ	º	º	¿	¿	½	¼	¿	«	»	
B	⌘	⌘	⌘			Á	À	À	©	¶	¶	¶	¶	¶	¶	¶
C	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
D	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð
E	ó	β	ö	ö	ö	ö	ö	ö	ö	ö	ö	ö	ö	ö	ö	ö
F	-	±	∏	¼	¶	§	÷	,	°	°	°	°	°	°	°	°

- **12x20 Character set:** Character size is 13 pixels (12 “active dots” plus one inter-character) x 24 pixels (20 “active” dots plus 4 interlines including underline), or 1.625 mm x 3 mm.

With double and quadruple height and width, maximum character size can go up to 6.5mm width x 12mm height.

Horizontal character spacing and line spacing may be adjusted via the software. Character per line is up to 44 in standard text, 22 in double width, and 11 in quadruple width.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
2		!	"	#	\$	%	&	'	()	*	+	,	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[\]	^	_
6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{		}	~	␣
8	€	ü	é	ä	ä	ä	ä	ç	è	ë	è	ï	î	ï	Ä	Å
9	É	æ	Æ	ô	ö	ö	ö	û	ÿ	ö	ü	ß	£	¢	ℳ	ƒ
A	á	í	ó	ú	ñ	ñ	ñ	ñ	ñ	ñ	ñ	ñ	ñ	ñ	ñ	ñ
B	⌘	⌘	⌘	⌘	⌘	⌘	⌘	⌘	⌘	⌘	⌘	⌘	⌘	⌘	⌘	⌘
C	L	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
D	δ	θ	ê	ë	è	'	í	î	ï	↓	r	■	■	■	■	■
E	ö	β	ö	ö	ö	ö	μ	β	β	ö	ö	ö	ö	ö	ö	ö
F	-	±	□	¼	½	¾	÷	·	°	..	.	!	3	2	■	€

- **7x16 Character set :** Character size is 8 pixels (7 “active dots” plus one intercharacter) x 20 pixels (16 “active” dots plus 4 interlines including underline), 1 mm by 2,5mm.

With double and quadruple height and width, maximum character size can go up to 4 mm width by 10mm height.

Horizontal character spacing and line spacing may be adjusted via the software. Character per line is up to 48 in standard text, 24 in double width, and 12 in quadruple width.

This font includes the Katakana characters set.

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
2		!	"	#	\$	%	&	'	()	*	+	,	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[\]	^	_
6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{		}	~	␣
8	€	ü	é	ä	ä	ä	ä	ç	è	ë	è	ï	î	ï	Ä	Å
9	É	æ	Æ	ô	ö	ö	ö	û	ÿ	ö	ü	ß	£	¢	ℳ	ƒ
A	。	「	」	、	・	ヲ	イ	ウ	エ	オ	カ	キ	ク	ケ	コ	サ
B	-	ア	イ	ウ	エ	オ	カ	キ	ク	ケ	コ	サ	シ	ス	セ	ソ
C	タ	チ	ツ	テ	ト	ナ	ニ	ノ	ネ	ヘ	ニ	フ	フ	フ	フ	フ
D	ミ	メ	ム	モ	ヨ	リ	ル	レ	ロ	ワ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ
E	ー	ー	ー	ー	ー	ー	ー	ー	ー	ー	ー	ー	ー	ー	ー	ー
F	▲	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

6.4 Operating Control codes

Control codes are non-printable characters or sequences of characters that control the operation of the printer. Within the following description, a control code causes the printer to interpret the following byte as part of a command and not as a printable character.

6.4.1 Control codes cross reference

Setup and Hardware control

COMMAND	DESCRIPTION
GS / n	Set printing speed / maximum peak current
GS s n1 n2	Set maximum print out speed
GS D n	Set print intensity
ESC @	Reset printer
ESC v	Send printer status
ESC I	Send printer identity
GS B n	Serial communication settings
GS b n	Set parallel port busy line hold time
ESC o n	Set optocoupler type
GS O n1 n2	Start optocoupler calibration
ESC O	Send optocoupler parameters
GS o	Send optocoupler level
ESC s	Save setup parameters
ESC d	Default setup parameters
GS p n	Set paper loading pause
GS P n1 n2	Set paper loading length
GS e n	Eject paper
GS M n1 n2	Set paper loading speed
GS r n	Sets retight phase of stepper motor
ESC n p	Near end of paper presence
ESC n c	Near end of paper calibration
ESC n s	Near end of paper status
ESC n l	Near end of paper level

Text and General commands

COMMAND	DESCRIPTION
ESC % n	Select internal font
ESC R n	Select international character set
ESC 2 n	Set line pre-spacing
ESC 3 n	Set line spacing
ESC SP n	Set character spacing
ESC b n	Set inverse video printing
ESC c n	Set maximum number of columns
ESC C n	Set text justification
ESC ! n	Set print mode
ESC { n	Set/reset rotated characters
LF	Line feed
CR	Carriage return
ESC J n	Feed paper (n dot lines) forward
ESC j n	Feed paper (n dot lines) backward
CAN	Cancel print data buffer (text mode)

Graphics commands

COMMAND	DESCRIPTION
ESC * n1 n2 n3 n4 n5 n6, data	Print graphics
ESC \$ n1,n2	Horizontal dot positioning
ESC V n1,n2,n3 data	Horizontal bit image

Cutter commands

COMMAND	DESCRIPTION
ESC m	Partial cut
ESC i	Full cut

Bar code commands

COMMAND	DESCRIPTION
GS k n [Start] <data> NUL	Print bar code
GS h n	Barcode height
GS w n	Barcode magnification
GS H n	Text position in barcode
GS R n	Set/reset rotated barcode

Hole and black mark detection commands

COMMAND	DESCRIPTION
GS L n	Set mark length
GS T n1 n2	Set TOF position
GS E	TOF feed paper
GS X n1 n2	Set mark to cut position
GS x n1 n2	Set cut line to head dot line length
GS Y n1 n2	Set opto to head dot line length

6.4.2 Setup and Hardware control

GS / n

Description: Set printing speed / Maximum peak current/ Dynamic division

Format: <1Dh> <2Fh> <n>

Comments: n = 0 : Set at maximum printing speed (maximum peak current on power supply, and maximum speed).

n = 1 to 32 : Software programmable consumption (Dynamic division). The maximum number of black dots which are simultaneously heated is (n+1) x 8.

Example : n = 5 (Default): Maximum black dots heated : (5+1)*8 = 48.

Printer Peak consumption @24V:

$(0.3A \text{ (Stepper Motor)} + 24*48/1500) = 1.068A$

1500 Ohms is the dot resistance.

GS s n1 n2

Description: Sets the maximum print speed

Format: <1Dh> <73h> <n1> <n2>

Comments: This control code may be used to reduce the print speed. Maximum print speed may be reduced in case of paper roll diameter above 60mm and/or if rewinding mechanism is connected to the printer.

Bytes n1, n2, set the time T (in μs) between each step :

$T = (256*n1) + n2.$

Default : T = 1152 : n1 = 4, n2 = 128.

Example : T = 1152 μs

Maximum print out speed : $(1/(8 * 1152e-6)) = 100 \text{ mm/s}$

8 dots/mm is the dot density.

Note : if parameter T is zero, the speed is reset at its default power-on value.

GS D n

Description: Set print Intensity

Format: <1Dh> <44h> <n>

Comments: n=80h (128d) : (Default). Nominal print intensity

n>80h (128d) : Printout becomes darker

n<80h (128d) : Printout becomes lighter

(n from 0 to 255 (FFh)).

ESC @

Description: Resets printer

Format: <1Bh> <40h>

Comments: Resets the printer device. This command is executed immediately after being received, even in case of a full buffer (DTR/RTS or Xoff active). Host must disable the handshaking controls to send the ESC @ command.

ESC v

Description: Send printer status

Format: <1Bh> <76h>

Comments: The printer returns a single byte that reflects the status of the printer in accordance with the following table:

BIT	FUNCTION	BIT = 0	BIT = 1
0	Head temperature	OK	Too high or too low
1	Head-up	No	Yes
2	Paper out	No	Yes
3	Power supply	OK	Too high or too low
4	Printer in use	Ready	Action in progress
5	On/Off line	Off	On
6	Hole/Mark detection Error	No	Too short, too long or not found
7	Cutter failure	Yes	No

This command is executed immediately after being received, even in case of a full buffer (DTR/RTS, Xoff or Busy active). Host must disable the handshaking controls to send the ESC v command.

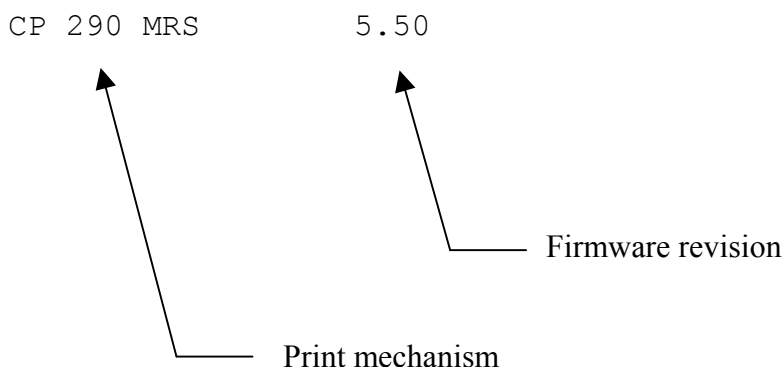
When using the parallel port, PE signal is continuously updated by the software. To read the status byte, use the Byte Mode (Parallel communication) as described in section 5.5.2, after having sent the ESC v command.

ESC I

Description: Send printer identity

Format: <1Bh> <49h>

Comments: The printer returns a string ended by zero (00h) that reflects the printer identity. The string is formed by the concatenation of print mechanism name and firmware revision, like the following example:



Note : The string always has a fixed format, that is : the print mechanism name padded to 16 bytes, a space, then 5 bytes for the firmware revision (the dot being in the middle), ended with zero.

GS B n

Description: Serial communication and mode settings
Format: <1Dh> <42h> <n>
Comments: Sets serial communication speed and mode
 Bit 7: B7 = 0: Xon-Xoff mode (software control),
 B7 = 1: DSR/DTR mode (hardware control)
 Bit 6: Not used
 Bit 5: Not used
 Bit 4: Not used
 Bit 3: Not used
 Bit 2, 1, 0: Speed.

n	SPEED
0	1200
1	2400
2	4800
3	9600
4	19200
5	38400
6	57600
7	115200

(Default n = 83h : DSR/DTR; Normal mode, 1 Stopbit, 9600 Bds, No Parity)

GS b n

Description: Parallel port busy line hold time setting
Format: <1Dh> <62h> <n>
Comments: Sets the minimum tBUSY hold time on the parallel busy line. See "Compatibility mode timing" (refer to section 5.5.1) for an example of the waveform.

The 'n' value may be changed to avoid erratic character reception from the host's automatic character repeat feature. This command repeats sending the latest byte sent when the printer hold time tBUSY is too short (from 20µs to 100µs depending on the host's parallel port firmware). To avoid the repeating, the minimum time of tBUSY must be increased. Please note that increasing the tBUSY hold time will reduce the communication speed.

If the host firmware correctly controls the timing per the waveforms given in "Compatibility mode timing" (see section 5.5.1) and has no automatic repeat feature, n can equal 0, thereby minimizing time of tBUSY (around 25µs) and maximizing communication speed.

By default n = 50 which gives 80µs for the minimum duration of tBUSY.
 The time is given by the formula: (n * 1µs) + 30µs. (n from 00h to FFh).

ESC o n

Description: Sets the optocoupler type.
Format: <1Bh> <6Fh> <n>
Comments: n = 0 : support for reflective optocoupler activated (default).
n = 1 : support for transmissive optocoupler activated.

If the default optocoupler is replaced by the user, the distance between the opto and the printing line can be adusted by a control code – see “Hole / Black mark detection commands” section.

GS O n1 n2

Description: Starts the optocoupler calibration procedure.
Format: <1Dh> <4Fh> <n1> <n2>
Comments: n1 specifies the length of paper loading before the actual calibration is done.
n2 specifies the length of paper used to calibrate the opto.
Length is in centimeters.
For details, please contact A.P.S for opto calibration application note.

ESC O

Description: Sends optocoupler parameters.
Format: <1Bh> <4Fh>
Comments: The printer responds by sending 6 bytes :

- opto type (0 for reflective, 1 for transmissive)
- black level
- mark/backing level
- paper level
- paper presence threshold
- mark detection threshold

All these parameters are determined automatically by the opto calibration procedure and should provide correct operation for most applications. This command is intended for test purposes.

GS o

Description: Sends the current level of the opto.
Format: <1Dh> <6Fh>
Comments: The printer responds with a byte representing the opto level.

ESC s

Description: Save the setup parameters. (Applies to version 5.2 and higher)

Format: <1Bh> <73h>

Comments: The setup parameters are saved in the internal flash memory of the controller. They are not lost when power is removed or printer reset, and are recalled when power is applied again.
The following parameters are saved by this command:

- internal font
- pre line spacing
- line spacing
- character spacing
- print mode
- rotated
- maximum number of columns
- text justification
- maximum peak current
- intensity
- serial mode
- busy hold time
- barcode height
- barcode magnification
- barcode text position
- barcode orientation
- paper loading length
- paper loading speed
- paper loading pause
- speed limitation
- top of form position
- mark to cut position
- head to cut length
- opto to head length

ESC d

Description: Default setup parameters. (Applies to version 5.2 and higher)

Format: <1Bh> <64h>

Comments: Revert all parameters of the 'Save setup parameters' command to their factory default values. This action is temporary. If the printer is reset or power is cycled, the parameters will be initialized with the last set saved by the 'ESC s' command. If you want to permanently set the parameters to the factory defaults, you must send an 'ESC d' 'ESC s' sequence. Combining the use of these command and the 'reset printer' command enables you to compare the effects of the default and saved values without altering the saved values.

GS p n

Description: Sets paper loading pause

Format: <1Dh> <70h> <n>

Comments: n = 0 to 255. Software programmable pause between the moment the printer detects the insertion of paper and the moment the roller starts turning. This allows accurate manual positioning of the paper. The value n is in 125 milliseconds units.

Default: n = 0.

Example: n = 16. The printer waits 2 seconds.

GS P n1 n2

Description: Sets paper feeding length in automatic paper loading

Format: <1Dh> <50h> <n1> <n2>

Comments: Sets the length of the paper fed during the automatic paper loading.

Bytes n1, n2, set the length L (in dot lines) of the feeding.

$L = (256 * n1) + n2$

Default: L = 40 mm : n1 = 1, n2 = 64.

GS e n

Description: Ejects paper

Format: <1Dh> <65h> <n>

Comments: n = 0 to 255. The printer will feed the paper until an end of paper condition is detected. It will then feed an extra n millimeters, usefull for ejecting sheets totally.

GS M n1 n2

Description: Sets paper loading speed

Format: <1Dh> <4Dh> <n1> <n2>

Comments: This control code may be used to adapt the loading speed to various conditions.

Bytes n1, n2, set the time T (in μ s) between each step:

$T = (256 * n1) + n2$. $1500 < T < 32000$.

Default: T = 11520: n1 = 45, n2 = 0. Speed: $(1 / (8 * 11520e-6)) = 10.8$ mm/s.

GS r n

Description: Sets retight phase of stepper motor.

Format: <1Dh> <72h> <n>

Comments: This control code may be used to customize retight phase of stepper motor.

Indeed, after a stepper motor OFF phase, beginning of a new printout may be compressed due to mechanical play inside printer gear box. To avoid that, a retight phase may be required: additional steps are performed just before printing so as to absorb this play. Retight phase is mainly required when feeding changes of sense or following power up/reset. In these cases, 20 extra steps are suitable and performed automatically. But, it may be also required when feeding sense doesn't change depending of application. In this case, a parameter is available to define how many steps to be done before printing.

n = 0 to 255.

n = 0 indicates that no retight phase is required.

Otherwise, n indicates number of extra steps to be done before new printing.

This parameter is not saved in flash memory; so, it has to be set at every power up/reset if default value is not suitable.

Default : n =20 steps.

Note: A.P.S has designed an extension that plugs to an existing printer and allows the addition of a near end of paper detection feature by mounting an optosensor near the end of the paper roll. The following codes are available to support operation of this feature. Please contact A.P.S for ordering information.

ESC n p

Description: Checks near end of paper extension presence

Format: <1Bh> <6Eh> <70h>

Comments: This command returns a single byte. The printer will check for the presence of the near end of paper detection extension and report if it was found (byte = 1) or not (byte = 0).

ESC n c

Description: Starts an automatic calibration of the near end of paper sensor

Format: <1Bh> <6Eh> <63h>

Comments: Due to variations in optosensor mounting and sensitivity, it is possible to calibrate the threshold at which a near end of paper condition will be detected. This command will automatically determine an appropriate threshold and report it as a single byte. The value is also saved in flash memory and will be recalled at next power-on. However, the default value provided by the firmware should make the calibration optional for most applications.

Note: Near end of paper calibration application note and Calibration tools are available. Please contact APS for more details.

ESC n s

Description: Gets the near end of paper status

Format: <1Bh> <6Eh> <73h>

Comments: This command will send a single byte representing the near end of paper status, that is, if the current optosensor level is under or above the calibrated threshold. The byte value is either 0 (ok, enough paper still present) or 1 (near end of paper condition).

ESC n l

Description: Gets the near end of paper level

Format: <1Bh> <6Eh> <6Ch>

Comments: This command returns a single byte representing the current reflection level seen by the optosensor. Smaller values mean more reflection (paper is closer). This command should not be needed in normal applications and is intended mostly for test purposes.

6.4.3 Text and General commands

ESC % n

Description: Select internal font
 Format: <1Bh> <25h> <n>
 Comments: n = 0: **8x16** Font is selected.
 n = 1: **12x20** Font is selected.
 n = 2: **7x16** Font is selected.
 For custom fonts support, please contact A.P.S

ESC R n

Description: Select international character set
 Format: <1Bh> <52h> <n>
 Comments: Modify the set of printable characters in accordance with the table below:

n	COUNTRY	23	24	40	5B	5C	5D	5E	60	7B	7C	7D	7E
0	USA	#	\$	@	[\]	^	'	{		}	~
1	France	#	\$	à	°	ç	§	^	'	é	ù	è	“
2	Germany	#	\$	§	Ä	Ö	Ü	^	'	å	ö	ü	ß
3	UK	£	\$	@	[\]	^	'	{		}	~
4	Denmark 1	#	\$	@	Æ	φ	Å	^	'	æ	Φ	å	~
5	Sweden	#	α	É	Ä	Ö	Å	Ü	é	ä	ö	å	ü
6	Italy	#	\$	@	°	\	é	^	ù	à	ò	è	ì
7	Spain 1	Pt	\$	@	ı	Ñ	¿	^	'	"	ñ	ı	~
8	Japan	#	\$	@	[¥]	^	'	{		}	~
9	Norway	#	α	É	Æ	φ	Å	Ü	é	æ	Φ	å	ü
10	Denmark 2	#	\$	É	Æ	φ	Å	Ü	é	æ	Φ	å	ü
11	Spain 2	#	\$	à	ı	Ñ	¿	é	'	ı	ñ	ó	ú
12	Latin Amer.	#	\$	à	ı	Ñ	¿	é	û	ı	ñ	ó	ú

ESC 2 n

Description: Set line pre-spacing

Format: <1Bh> <32h> <n>

Comments: Sets the line pre-spacing. (Default n = 0). n may vary from 0 to 15. The line spacing pitch is 1/8mm. Note: This is useful when printing in inverse video if some character pixels are on the first dotline.

ESC 3 n

Description: Set line spacing

Format: <1Bh> <33h> <n>

Comments: Sets the character line spacing. (Default n = 3). n may vary from 3 to 15. The character line spacing pitch is n/16mm.

ESC SP n

Description: Set character spacing

Format: <1Bh> <20h> <n>

Comments: Sets the right character spacing. (Default n = 2). n may vary from 1 to 16. The right character spacing pitch is n/8mm. This spacing is proportional to double width (nx2) and quadruple width (nx4) commands.

ESC b n

Description: Set inverse video printing

Format: <1Bh> <62h> <n>

Comments: The value of n (default 0) can be 1 (inverse video) or 0 (normal video). This setting is valid for the whole printing line. Spaces at the beginning of a line will be printed as a dark rectangle. In order to shift the black printing from the left margin, one can send the TAB (ascii 0x09) instead. This enables an accurate control of the placement of the edges of the inverted portion.

ESC c n

Description: Set maximum number of columns

Format: <1Bh> <63h> <n>

Comments: The value of n (default 255) is the maximum number of printable characters the printer accepts before automatically going to the next line.

ESC C n

Description: Set text justification
 Format: <1Bh> <43h> <n>
 Comments: The value of n specifies how text will be justified.
 n = 0: text will be centered.
 n = 1: text will be right justified.
 n = 2: text will be left justified.
 Default is left justification.

ESC ! n

Description: Set print mode
 Format: <1Bh> <21h> <n>
 Comments: The value of n (default 0) selects the various modes of printing as described in the table on the next page:

Bit	Function	Bit = 0	Bit = 1
0	Not used	-	-
1	Quadruple Height	Cancelled	Set
2	Quadruple Width	Cancelled	Set
3	Not used	-	-
4	Double Height	Cancelled	Set
5	Double Width	Cancelled	Set
6	Not used	-	-
7	Underlined	Cancelled	Set

Note: Different print widths can be mixed on the same line (8 changes per line maximum).

ESC { n

Description: Set/Cancel Rotated characters
 Format: <1Bh> <7Bh> <n>
 Comments: This command rotates text by 180°.
 n = 0 (default) : Printout is normal.
 n = 1 : Printout is rotated 180°.

LF

Description: Line feed
 Format: <0Ah>
 Comments: Move the print position to the beginning of the next line.

CR

Description: Carriage return

Format: <0Dh>

Comments: Move the print position to the beginning of the next line. Note: if CR is followed by LF, the printer will ignore the LF after CR. So, CR = LF = CR+LF.

ESC J n

Description: Feed paper (n dot lines) forward

Format: <1Bh> <4Ah> <n>

Comments: Paper is fed for n (n<256) dot lines (n times 0.125 mm). The print position is at the beginning of the next line.

ESC j n

Description: Feed paper (n dot lines) backward

Format: <1Bh> <6Ah> <n>

Comments: Paper is fed for n (n<256) dot lines (n times 0.125 mm) backward. The print position is at the beginning of the next line.

CAN

Description: Cancel print data buffer (text mode)

Format: <18h>

Comments: The print buffer is cancelled and print position is set to the beginning of the next line.

6.4.4 Graphic commands

ESC * n1 n2 n3 n4 n5 n6 <data>

Description: Print graphics

Format: <1Bh><2Ah><n1><n2><n3><n4><n5><n6><data>

Comments: Bytes n1, n2 and n3 sets the number of byte N to be printed out:

$$N = (65536 * n3) + (256 * n2) + n1$$

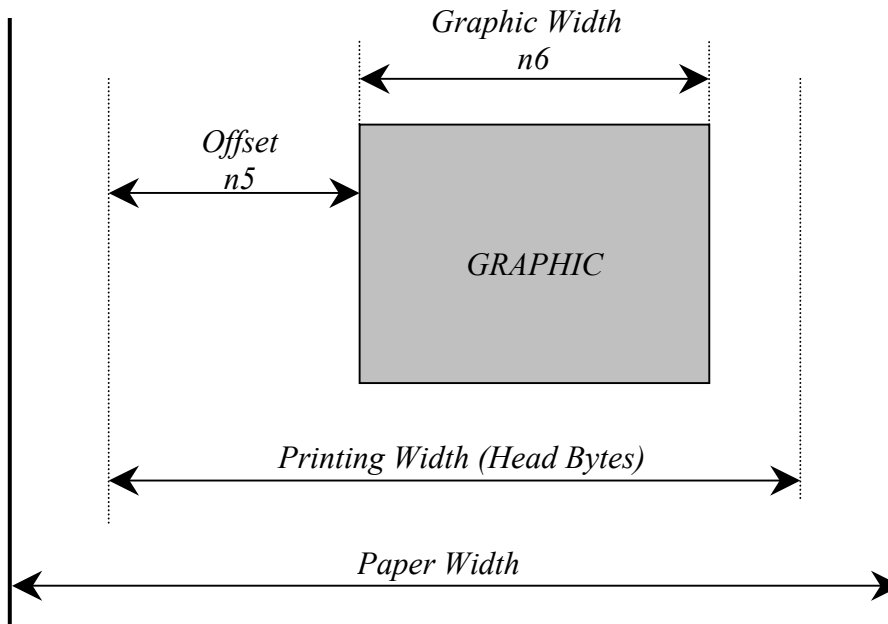
Byte n4 sets graphic operators on data byte and has the following meaning:

- n4=0 : print normal size data byte (full printer resolution)
- n4=1 : double width
- n4=2 : double height
- n4=3 : expanded (double width, double height)

Byte n5 sets the number of byte to be skipped before printing out the first graphic bit:

- 00 H : first graphic bit to be printed out is dot one on the head
- 01 to FF H : 1 to 255 bytes skipped (to be less than total number of head's bytes)

Byte n6 sets the width of the graphic to be printed out:



- 01 to FF H : width is 1 to 255 bytes (to be less than total number of head's bytes)

Example : With the following bitmap :



Black and white, 1 dot per pixel, 368 pixels width and 242 pixels height, printed in full resolution, and centered,
Size = $368 * 242 / 8 = 11\ 132$ bytes :

$n1 = 124d, n2 = 43d, n3 = 0d, n4 = 0d, n5 = 1d, n6 = 46d$

or $n1 = 7Ch, n2 = 2Bh, n3 = 0h, n4 = 0h, n5 = 1h, n6 = 2Eh$

ESC \$ n1 n2

Description: Horizontal dot positioning

Format: <1Bh><24h><n1><n2>

Comments: Dot positioning command in bytes (to be used with ESC V). Dot position equals $(n1 + 256*n2)$. n1 must be less than the total number of the head bytes, given by the total number of dots divided by 8 (for instance CP324MRS is $576/8 = 72$), and n2 is always 0.

ESC V n1 n2 n3 <data>

Description: Horizontal bit image

Format: <1Bh><56h><n1><n2><n3><datas>

Comments: The number of bytes to be printed is equal to $(n2+256*n3)$. n2 must be less than the total number of the head bytes, given by the total number of dots divided by 8 (for instance CP324MRS is $576/8 = 72$), and n3 is always 0. n1 is the resolution: 0 is standard size, 1 is double width, 2 double height, 3 is expanded.

IMPORTANT NOTES FOR GRAPHICS:

- Please note that n5 (offset) + n6 (graphic width) needs to be less than the number of head's bytes (printing width). If it is greater, control code will be ignored.
- One dot line must be performed in less than 2s. If not, the current into stepper will be removed resulting in poor print quality.
- It is recommended for all graphics sequences to set up the communication speed at the maximum value.

6.4.5 *Cutter commands*

ESC m

Description: Partial cut

Format: <1Bh> <6Dh>

Comments: In continuous paper feed mode, this command performs a partial cut (if cutter is present) at the current paper position.

In hole/mark detection mode, the paper is fed forward to the Cut position (GS X) and then cut.

ESC i

Description: Full cut

Format: <1Bh> <69h>

Comments: In continuous paper feed mode, this command performs a full cut (if cutter is present) at the current paper position.

In hole/mark detection mode, the paper is fed forward to the Cut position (GS X) and then cut.

6.4.6 Bar code commands

GS k n [Start] <data> NUL

Description: Print bar code

Format: <1Dh> <6Bh> <n> [Start] <data> <00h>

Comments: n is barcode standard selection, as described in the following table. [Start] is an optional byte used only by Code 128.

n	START BYTE	BAR CODE TYPE
0	No Start	UPC-A
1	No Start	UPC-E
2	No Start	EAN 13
3	No Start	EAN 8
4	No Start	Code 39
5	No Start	Interleaved 2/5 (ITF)
6	No Start	Codabar
7	135	Code 128A
	136	Code 128B
	137	Code 128C

GS h n

Description: Select vertical height of bar code

Format: <1Dh> <68h> <n>

Comments: n ranges from 1 to 255 in multiple of 1/8 mm (default is 128).

GS w n

Description: Select horizontal magnification of bar code

Format: <1Dh> <77h> <n>

Comments: n defines the number of 0.125mm units used to define the module of each barcode symbol. The thick lines are set to twice n value (n ranges from 2 to 6, default is 3).

GS H n

Description: Select printing position of barcode text

Format: <1Dh> <48h> <n>

Comments: n is used to define the position of the characters which are printed with the bar code:

n	PRINTING POSITION
0	Not printed (Default)
1	Above barcode
2	Under barcode
3	Above and under bar code

Note : If the barcode width exceeds the printing width, it will be ignored.
The barcode text is printed out with the latest selected font (ESC %)

GS R n

Description: Set/reset rotated barcode

Format: <1Dh> <52h> <n>

n = 0: barcode is printed horizontally.

n = 1: barcode is printed vertically.

6.4.7 Hole / Black mark detection commands

GS L n

Description: Set Mark length
Format: <1Dh> <4Ch> <n>
Comments: Set Mark length and switch from continuous paper feed to mark detection.
 n specifies the length of the mark in dot lines at 0.125mm. If n = 0 (Default) then the printer switches into continuous paper feed mode.
 Example: If n = 24 the length of the mark is equal to 3mm, and the printer enters the mark detection mode.
 The minimum mark length is 2.5 mm and the maximum is 7 mm.

Note: Sending this command clears the hole/mark detection error bit in the printer status.

GS T n1 n2

Description: Sets top of form (TOF) position
Format: <1Dh> <54h> <n>
Comments: Defines the number of dot lines N between the end of the mark and the first printable line (TOF).
 $N = (256 * n1) + n2$. By default, N = 0 dot lines.

Note: It is possible to define a negative top of form distance. The value is represented with the two's complement of the absolute value of the distance.
 For example, to specify a - 5 mm distance, $N = - 40 = 65536 - 40 = 65496$. n1 = 255, n2 = 216.

GS E

Description: TOF feed paper
Format: <1Dh> <45h>
Comments: Makes paper feed to the next TOF position. The hole/mark detection error bit in the printer status is automatically cleared when the black mark is found.

GS Y n1 n2

Description: Set opto to head dot line length
 This code is to be used only if the opto position is different from that set on the printer by default.
Format: <1Dh> <59h> <n1> <n2>
Comments: Defines the number of dot lines N between the opto position and the head dot line.
 $N = (256 * n1) + n2$.
Values are a function of printer mechanism.

6.4.8 Cutter settings Commands

When executing partial or full cut, the ticket is fed to the next cut position and then cut.

To avoid advancing and losing one ticket during power Off/On sequence, please do the following :

- Turn the printer off in top of form position.
- Turn the printer on and reconfigure the Hole / Mark detection by sending all parameters (GS L, GS T, GS X and if necessary GS x).

GS X n1 n2

Description: Set mark to cut position length

Format: <1Dh> <58h> <n1> <n2>

Comments: Defines the number of dot lines N between the end of the mark and the Cut position.
 $N = (n1 * 256) + n2$ (Default: $N = 0$).

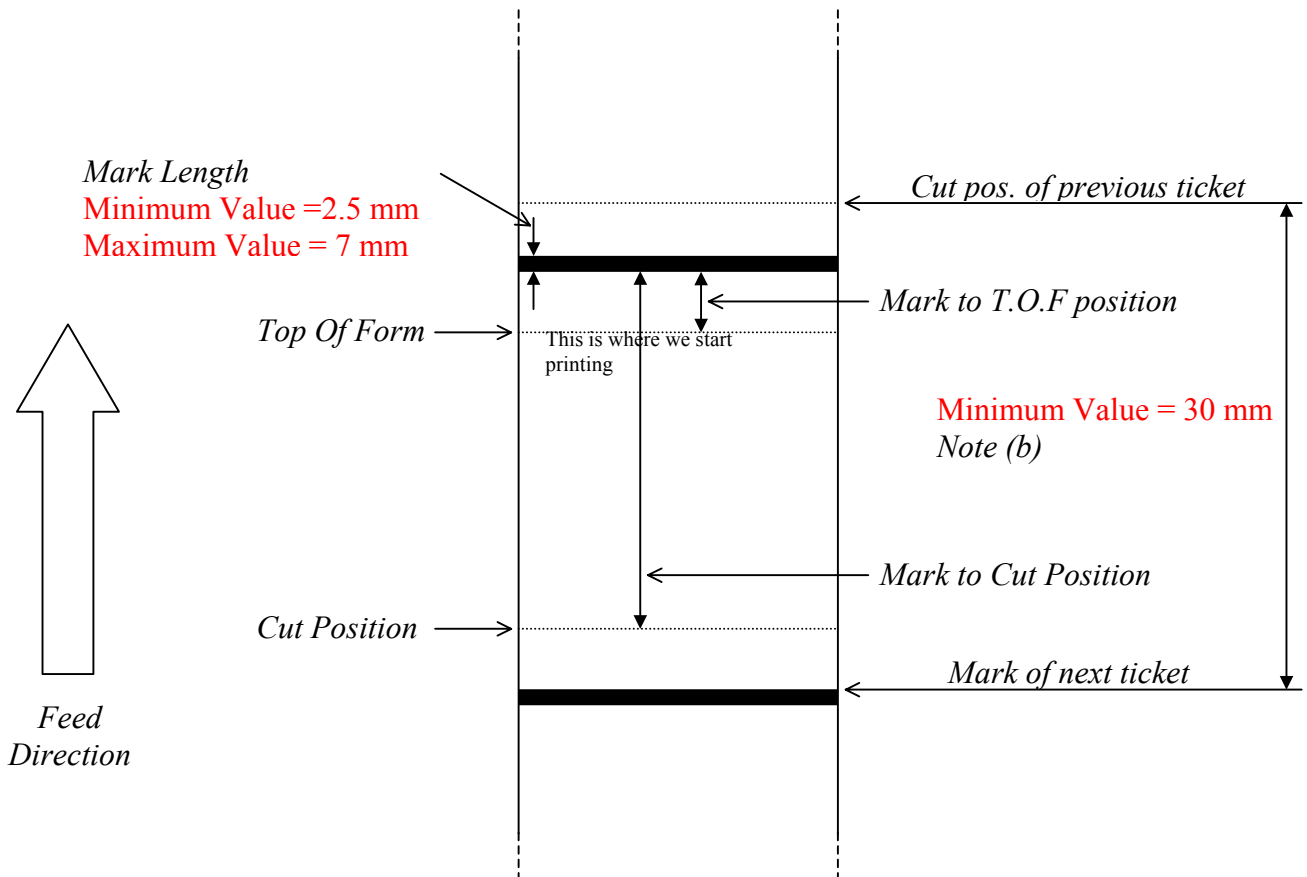
GS x n1 n2

Description: Set cut line to head dot line length

This code is to be used only if the cutter's blade position is different from that set on the printer by default.

Format: <1Dh> <78h> <n1> <n2>

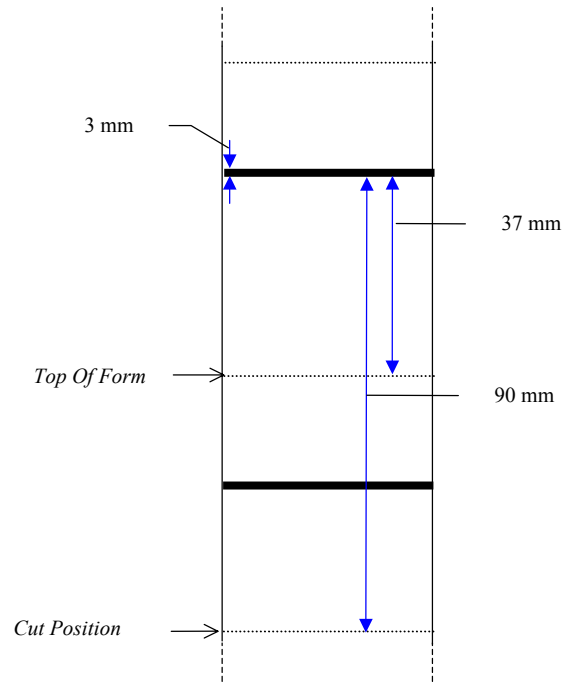
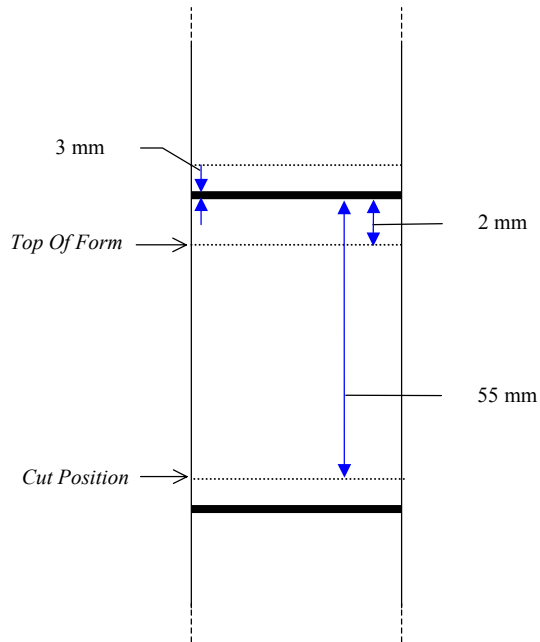
Comments: Defines the number of dot lines N between the cut position and the head dot line.
 $N = (256 * n1) + n2$. By default, $N = 88$ dot lines.



NOTES :

- (a) Make sure that Hole/Black mark fully covers the opto sensor window, according to the paper path chosen (front or bottom).
- (b) The distance between the cut position of the previous ticket and the mark of the next ticket should be superior to the distance (in terms of paper path) between the cutter and the opto (default : 24.5mm). A minimum distance of 30mm should provide reasonable margin.
- (c) For optimum performance, the paper should be guided, and in particular, the distance between the paper and the opto should be kept as constant as possible.

6.4.9 Hole / Black mark detection examples



7. ORDERING CODES

CP290MRS without cutter and bracket:

Bottom loading

CP 290-MRS - BL

Front loading

CP 290-MRS - FL

CP290MRS with Guillotine cutter and bracket:

CP 290-MRS - xx - C

CP290MRS with Rotative cutter and bracket:

CP 290-MRS - xx - RC

CP324MRS without cutter and bracket:

CP 324-MRS

Bottom loading

CP 324-MRS - BL

Front loading

CP 324-MRS - FL

CP324MRS with Guillotine cutter and bracket:

CP 324-MRS - xx - C

CP324MRS with Rotative cutter and bracket:

CP 324-MRS - xx - RC

CP424MRS without cutter and bracket:

CP 424-MRS

Bottom loading

CP 424-MRS - BL

Front loading

CP 424-MRS - FL

CP424MRS with Guillotine cutter and bracket:

CP 424-MRS - xx - C

CP424MRS with Rotative cutter and bracket:

CP 424-MRS - xx - RC

8. DRAWINGS

