Ultimate-II MPS Printer Emulation

User's Guide

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1. Introduction

1.1. Context

The printer emulation is a new feature on 3.0 firmware. With this functionality you can print from your Commodore 64/128 using an emulated IEC device #4 or #5.

This emulation simulates a Commodore MPS-1230 printer with all the commands that this printer can understand. Not all commands are executed as some of them are hardware related and cannot obviously be implemented. The results are printed to PNG image files, one file per page. You can also choose to bypass the printer emulation and to send the raw data from #4 or #5 IEC device to a file.

MPS-1230 was a mid-range black ink ribbon 9 dot matrix printer sold by Commodore in the late 80's.

This printer is compatible with nearly all the usual programs that have been edited for C64/C128

1.2. Purpose of this document

This document describes how to use and configure the Ultimate-II embedded printer emulation.

You will also find all the commands and charsets supported by the printer. Then you can add printer facility to your own BASIC programs!

2. Configuration

2.1. Overview

You will find all the configuration items for the printer in the IEC configuration menu.

2.2. Enable the printer

To enable the printer, you need to enable the software IEC feature in the Ultimate-II:

- Use the F2 Menu to enter Ultimate-II configuration and then select "**Software IEC Settings**"
- Then on item "**IEC Drive and Printer**" select "**Enabled**"

2.3. Printer configuration items

- **Printer Bus ID** : 4 or 5 (default is 4)
  This will assign device ID 4 or 5 to the printer.
- **Printer output file** : default is */SD/printer*
  You can select file base name that the printer emulation will use to create the PNG files. If you choose to generate PNG files they will be named */SD/printer-001.png*, */SD/printer-002.png*, and so on. If you chose the bypass the emulation and write raw data to disk the file will be named */SD/printer* with no extension.
- **Printer output type** : PNG or RAW (default is PNG)
  PNG are images created by the printer emulator each time a page is ejected from the printer. Caution, if a file with the same name already exists, it will not be overwritten and the page is lost. RAW is the data directly sent by the C64/128 to the IEC port and recorded to a file. If the file already exists, the new data will be appended to it.
- **Printer ink density** : Low, Medium or High (default is Medium)
  You can consider this as "how strong is the pin impact on the paper". *Low* will only print very small dots and *High* larger dots. As a consequence, this will change the resulting contrast. *High* gives the best result for DRAFT character mode. *Medium* may be well suited for NLQ character mode. Just test and see what match your needs.

3. Using the printer

3.1. Printing from the C64/C128

Just use your program and tell it that you have a connected printer compatible with MPS Commodore series (e.g.: MPS-801/MPS-803 are the most frequently supported commodore printers).

3.2. Flushing the printer spool

The printer has a very small buffer (128 bytes) and some data may still be in the buffer waiting to be printed when your print job is finished. The printer doesn't know that your job is finished and waits for more data to print until the end of the page.

You need to tell the printer that you want all the buffered data to be printed and to eject the current page. This works as the *Form Feed* button on the real MPS-1230 to eject the page.

Go to F5 Menu and select "**Flush printer/Eject Page**". In PNG mode, this will make the current page to be written to a file. Next print job will start on a blank page. In RAW mode this will write the buffered data to the file.

3.3. Resetting the printer

You may need to reset printer to go back to an initial state. Go to F5 Menu and select "**Reset IEC and Printer**". Current data in printer buffer is lost. Current page that was being printed is also lost.

3.4. Performances

Composing a page full of text and creating the PNG file will need approximatively 15 seconds on the Ultimate-II (28 seconds using NLQ mode). You may think it's slow but this is much faster than a real MPS-1230 printer (1 min in DRAFT mode, 4 min in NLQ mode) !

At this time, with firmware 3.0 beta, the Ultimate-II middle button becomes unresponsive while composing a page. Be patient and look the storage LED activity. You will see the file written to disk. There may be more than one page to compose.

RAW mode is nearly immediate. There is no process time to wait.

4. Commodore printer commands

This chapter describes the commands the printer can understand. You will find Commodore BASIC sample to explain you how to use them.

4.1. Simple example

This will print a first line with HELLO WORLD! on it and a second line with HELLO printed with double width characters.

```
10 OPEN1,4
20 PRINT#1,"HELLO WORLD!"
30 PRINT#1,CHR$(14)"HELLO"
40 CLOSE1
```

```
HELLO WORLD!
HELLO
```

4.2. Secondary address

When you use the OPEN basic command you can specify an optional secondary address:

- **0** : Select PETASCII charset with uppercases and graphic chars
- **7** : Select PETASCII charset with lowercases and uppercases

If no secondary address is specified, 0 is the default.

4.3. Commands

4.3.1. Graphical operations

ESC g
27 71
1Bh 47h

Select the **Double Strike** print mode. Characters are printed twice and paper is lifted 1/216" between the two passes.

```
10 OPEN1,4,7
20 PRINT#1,CHR$(27);chr$(71);"DOUBLE STRIKE"
30 CLOSE1
```

```
double strike
```

ESC h
27 72
1Bh 48h

Disable **Double Strike** print mode

```
10 OPEN1,4,7
20 PRINT#1,CHR$(27);chr$(72);
30 CLOSE1
```

EN ON
14
0Eh

Select the **Double Width** print mode (Enhanced ON)

```
10 OPEN1,4
20 PRINT#1,CHR$(14);"DOUBLE WIDTH"
30 CLOSE1
```

```
DOUBLE WIDTH
```

EN OFF
15
0Fh

Disable the **Double Width** print mode (Enhanced OFF)

```
10 OPEN1,4
20 PRINT#1,CHR$(15);
30 CLOSE1
```

RVS ON
18
12h

Select the **Reverse** print mode. Each character is printed in negative.

```
10 OPEN1,4
20 PRINT#1,CHR$(18);"REVERSE"
30 CLOSE1
```

REVERSE

RVS OFF
146
92h

Disable the **reverse** print mode

```
10 OPEN1,4
20 PRINT#1,CHR$(146);
30 CLOSE1
```

ESC - 1
27 45 49
1Bh 2Dh 31h

Select the **Underline** print mode for all characters and spaces that follow.

```
10 OPEN1,4
20 PRINT#1,CHR$(27);CHR$(45);CHR$(49);"UNDERLINE"
30 CLOSE1
```

UNDERLINE

ESC - 0
27 45 48
1Bh 2Dh 30h

Disable the Underline print mode.

```
10 OPEN1,4
20 PRINT#1,CHR$(27);CHR$(45);CHR$(48);
30 CLOSE1
```

ESC e
27 69
1Bh 45h

Select the **Bold** print mode.

```
10 OPEN1,4
20 PRINT#1,CHR$(27);CHR$(69);"BOLD"
30 CLOSE1
```

BOLD

ESC f
27 70
1Bh 46h

Disable the Bold print mode.

```
10 OPEN1,4
20 PRINT#1,CHR$(27);CHR$(70);
30 CLOSE1
```

ESC 4
27 52
1Bh 34h

Select the **Italic** print mode.

```
10 OPEN1,4
20 PRINT#1,CHR$(27);CHR$(52);"ITALIC"
30 CLOSE1
```

ITALIC

ESC 5
27 53
1Bh 35h

Disable the **Italic** print mode.

```
10 OPEN1,4
20 PRINT#1,CHR$(27);CHR$(53);
30 CLOSE1
```

ESC [n
27 91 n
1Bh 5Bh n

Select the spacing mode depending on parameter "n" as described on this table:

n	SPACING	
0	PICA	10 chars/inch
1	ELITE	12 chars/inch
2	MICRO	15 chars/inch
3	CONDENSED	17.1 chars/inch
4	PICA COMPRESSED	20 chars/inch
5	ELITE COMPRESSED	24 chars/inch
6	MICRO COMPRESSED	30 chars/inch

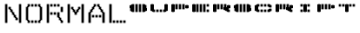
```
10 OPEN1,4
20 PRINT#1,CHR$(27);CHR$(91);CHR$(n);
30 CLOSE1
```

```
PICA                    Draft Regular
ELITE                   Draft Regular
MICRO                   Draft Regular
CONDENSED               Draft Regular
PICA COMPRESSED         Draft Regular
ELITE COMPRESSED        Draft Regular
MICRO COMPRESSED        Draft Regular
```

ESC s 0
27 83 48
1Bh 53h 30h

Select the **Superscript** print mode. Characters are half high than the normal height and are printer on the upper half interline.

```
10 OPEN1,4
20
PRINT#1,"NORMAL";CHR$(27);CHR$(83);CHR$(48);"SUPERSCRIPT"
30 CLOSE1
```



ESC s 1
27 83 49
1Bh 53h 31h

Select the **Subscript** print mode. Characters are half high than the normal height and are printer on the lower half interline.

```
10 OPEN1,4
20 PRINT#1,"NORMAL";CHR$(27);CHR$(83);CHR$(49);"SUBSCRIPT"
30 CLOSE1
```

ESC t
27 84
1Bh 54h

Disable Superscript and Subscript print mode.

```
10 OPEN1,4
20 PRINT#1,CHR$(27);CHR$(84);
30 CLOSE1
```

ESC X n
27 120 n
1Bh 78h n

If n=0, select standard quality mode (Draft)
If n=1, select near letter quality mode (NLQ)

```
10 OPEN1,4
20 PRINT#1,CHR$(27);CHR$(120);CHR$(n);
30 CLOSE1
```

NLQ ON
31
1Fh

Select the Near Letter Quality print mode (NLQ)

```
10 OPEN1,4
20 PRINT#1,CHR$(31);
30 CLOSE1
```

```
DRAFT QUALITY
NEAR LETTER QUALITY
```

NLQ OFF
159
9Fh

Disable the Near Letter Quality print mode (NLQ)

```
10 OPEN1,4
20 PRINT#1,CHR$(159);
30 CLOSE1
```

CRSR DWN
17
11h

Select PETASCII charset for uppercases/lowercases characters. With this charset, a limited number of graphical characters are available.

```
10 OPEN1,4
20 PRINT#1,CHR$(17);
30 CLOSE1
```

CRSR UP
145
91h

Select PETASCII charset for uppercases only characters. With this charset, all graphical characters are available.

```
10 OPEN1,4
20 PRINT#1,CHR$(145);
30 CLOSE1
```

4.3.2. Paper feeding

LF
10
0Ah

A **Line Feed** returns the print head to le left margin and advances the paper to the next line (behavior is LF+CR).

```
10 OPEN1,4,7
20 PRINT#1,CHR$(10);
30 CLOSE1
```

CR
13
0Dh

A **Carriage Return** returns the print head to le left margin and advances the paper to the next line (behavior is CR+LF).

```
10 OPEN1,4,7
20 PRINT#1,CHR$(13);
30 CLOSE1
```

FF
12
0Ch

A **Form Feed** prints the current page to a PNG file and then continue printing on the first line of a new blank page.

```
10 OPEN1,4,7
20 PRINT#1,CHR$(12);
30 CLOSE1
```

CS
141
8Dh

Returns the print head to le left margin but stays in the same line (behavior is CR).

```
10 OPEN1,4,7
20 PRINT#1,CHR$(141);
30 CLOSE1
```

4.3.3. Format control

ESC c n
27 67 n
1Bh 43h n

Defines the page length in number of interlines (range 1-127).
This command is ignored by Ultimate-II MPS Printer Emulation.

```
10 OPEN1,4,7
20 PRINT#1,CHR$(27);CHR$(67);CHR$(1-127);
30 CLOSE1
```

ESC c NUL n
27 67 0 n
1Bh 43h 00h n

Defines the page length in inches (range 1-22).
This command is ignored by Ultimate-II MPS Printer Emulation.

```
10 OPEN1,4,7
20 PRINT#1,CHR$(27);CHR$(67);CHR$(0);CHR$(1-22);
30 CLOSE1
```

ESC n m
27 78 m
1Bh 4Eh m

Define the **Bottom of Form** (BOF) in number "m" of interlines at the end of the page that are not used to print and are automatically skipped.
This command is ignored by Ultimate-II MPS Printer Emulation.

```
10 OPEN1,4,7
20 PRINT#1,CHR$(27);CHR$(78);CHR$(m);
30 CLOSE1
```

ESC o
27 79
1Bh 4Fh

Disable the **Bottom of Form** (BOF).
This command is ignored by Ultimate-II MPS Printer Emulation.

```
10 OPEN1,4,7
20 PRINT#1,CHR$(27);CHR$(79);
30 CLOSE1
```

ESC 8
27 56
1Bh 38h

Disable the end of paper detector to be able to print until the end of the paper.
This command is ignored by Ultimate-II MPS Printer Emulation.

```
10 OPEN1,4,7
20 PRINT#1,CHR$(27);CHR$(56);
30 CLOSE1
```

ESC 9
27 57
1Bh 39h

Enable the end of paper detector.
This command is ignored by Ultimate-II MPS Printer Emulation.

```
10 OPEN1,4,7
20 PRINT#1,CHR$(27);CHR$(57);
30 CLOSE1
```

HTAB
9
09h

This is the traditional horizontal tabulation. Head jumps to the next tabulation stop. Stops are located every 8 PICA character position since the beginning of a line. This is fixed, not configurable.

```
10 OPEN1,4
20 PRINT#1,CHR$(9);"THIS IS THE PRINT POSITION 8"
30 CLOSE1
```

POS n_1 n_2
16 n_1 n_2
10h n_1 n_2

On the current line, jump to the horizontal position corresponding to the n_1n_2 decimal number of PICA characters since the beginning of the line. Each parameter is a value between 0 and 9. 00 is the position of the first character. n_1n_2 can range from 00 to 79. Does nothing is current position is already over the n_1n_2 position.

```
10 OPEN1,4
20 PRINT#1,CHR$(16);CHR$(2);CHR$(6);"THIS IS THE PRINT
POSITION 26"
30 CLOSE1
```

ESC POS n_1 n_2
27 16 n_1 n_2
1Bh 10h n_1 n_2

On the current line, jump to the horizontal position corresponding to the dot position given by parameters n_1 and n_2 from the beginning of the line. Parameter is calculated using the formula n_1x256+n_2. Value range is 0 to 480

Examples:

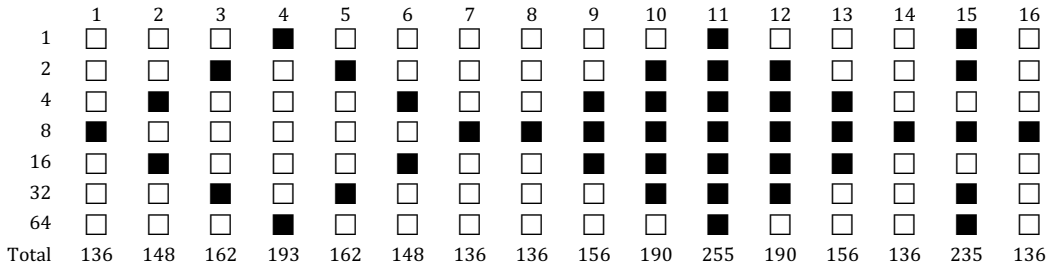
n_1	n_2	POSITION
CHR$(0)	CHR$(20)	0 + 20 = 20
CHR$(1)	CHR$(0)	256 + 0 = 256
CHR$(1)	CHR$(224)	256 + 224 = 480

```
10 OPEN1,4
20 PRINT#1,CHR$(27);CHR$(16);CHR$(1);CHR$(6);"THIS IS THE
PRINT POSITION 262"
30 CLOSE1
```

4.3.4. Graphic Bitmap

Printer can print graphic data using the Bit Image Mode (BIM). An image is defined by a bit array of 7 rows. Each column is encoded in a byte, LSB is up, MSB is not printed and always set to 1.

Example for a 16 columns array:



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	□	□	□	■	□	□	□	□	□	□	■	□	□	□	■	□
2	□	□	■	□	■	□	□	□	□	■	■	■	□	□	■	□
4	□	■	□	□	□	■	□	□	■	■	■	■	■	□	□	□
8	■	□	□	□	□	□	■	■	■	■	■	■	■	■	■	■
16	□	■	□	□	□	■	□	□	■	■	■	■	■	□	□	□
32	□	□	■	□	■	□	□	□	□	■	■	■	□	□	■	□
64	□	□	□	■	□	□	□	□	□	□	■	□	□	□	■	□
Total	136	148	162	193	162	148	136	136	156	190	255	190	156	136	235	136

Don't forget that bit 2^7 is always set, this adds 128 to each value.

First byte with 2^7 bit not set means that BIM data has ended. As BIM is always printed using the double width mode, you can use code **EN OFF** (15 0Fh) to tell the printer that BIM data has ended.

When in BIM, interline is automatically set to 7 dot height.

BIT IMG
8
08h

Select the **Bit Image Mode**. Provided data is printed as an array of dots as described above. Maximum BIM data width that can be printed on printable area is 480 dots.

```
10 OPEN1,4,7
20 A$=""
30 FOR I=1 TO 16
40 READ A:A$=A$+CHR$(A)
50 NEXT I
60 FOR J=1 TO 3
70 PRINT#1,CHR$(8);A$
80 NEXT J
90 CLOSE1
100 END
110 DATA 136,148,162,193,162,148,136,136
120 DATA 156,186,255,186,156,136,235,136
```

BIT IMG SUB n
8 26 n
08h 1Ah n

Select the repeated Bit Image Mode. The BIM data is printed n times on the same row. If n=0 data will be repeated 256 times. If you need more than 256 repetitions, you will have to call BIT IMG SUB with the data several times.
BIM data size must be less than 255 bytes, extra data is ignored.

```
10 OPEN1,4,7
20 A$=""
30 FOR I=1 TO 16
40 READ A:A$=A$+CHR$(A)
50 NEXT I
60 FOR J=1 TO 3
```

```
70 PRINT#1,CHR$(8);CHR$(26);CHR$(10);A$
80 NEXT J
90 CLOSE1
100 END
110 DATA 136,148,162,193,162,148,136,136
120 DATA 156,186,255,186,156,136,235,136
```

4.3.5. Character creation, Down Line Loading (DLL)

On a MPS-1230 user can create from 1 to 94 custom characters to replace normal characters. These characters are loaded in RAM. Consecutive characters can be defined in a single sequence beginning by the first character. DLL has to be enabled in the configuration of a real MPS-1230 printer and RAM buffer is smaller as a part of the RAM is reserved for DLL.

On Ultimate-II MPS Printer Emulation, DLL is not available but commands are correctly recognized and skipped with all their data.

ESC =
27 61
1Bh 3Dh

This code has to be followed by parameters **m n c s a** $\mathbf{p_1}$ $\mathbf{p_2}$...$\mathbf{p_{11}}$ which represents decimal byte codes to describe characters to load.

m and **n** are the number of bytes to load. Use the formula
t = (number of chars x 13) +2
then calculate m and n in order to have m + (n x 256) = t using formulas
n = t / 256 (keep entire part only)
m = t – (n x 256)

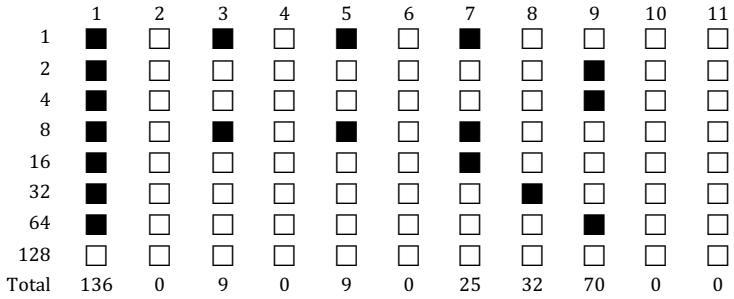
E.g.: for 94 characters,
t = (94 x 13) +2 = 1224
n = 1224 / 256 = 4
m = 1224 – (4 x 256) = 200

c Is the decimal ASCII code of the first character of the sequence. Only decimal codes from 33 to 126 can be used for DDL. Code 65 is "A"

s Is a constant value 20 (14h) (missing from official documentation but present in all examples)

a This parameter tells if character has to be printed using the upper 8 dots of the printer head or the 8 lower dots.
a = 0 : use the 8 upper dots of the 9 dot printer head
a = 1 : use the 9 lower dots of the 9 dot printer head

$\mathbf{p_1}$ $\mathbf{p_2}$...$\mathbf{p_{11}}$ Represents the 11 columns defining the dots printed for the character.



	1	2	3	4	5	6	7	8	9	10	11
1	■	□	■	□	■	□	■	□	□	□	□
2	■	□	□	□	□	□	□	□	■	□	□
4	■	□	□	□	□	□	□	□	■	□	□
8	■	□	■	□	■	□	■	□	□	□	□
16	■	□	□	□	□	□	■	□	□	□	□
32	■	□	□	□	□	□	□	■	□	□	□
64	■	□	□	□	□	□	□	□	■	□	□
128	□	□	□	□	□	□	□	□	□	□	□
Total	136	0	9	0	9	0	25	32	70	0	0

This represents the real R character in DRAFT quality.
In the 8x11 matrix you have to remind that a dot active in a column cannot be active in the next column to let the head recycle. Ultimate-II MPS Printer emulator does not suffer from this limitation.

*Note from the author: I tested this command on a real MPS-1230 because explanations given by Commodore seems to be false. I can't make it work, example in the MPS-1230 manual prints nothing. Where are the 13 bytes by character? I only count 12 (**a** p_1 p_2...p_{11})*

ESC i n
27 73 n
1Bh 49h n

Select the print quality depending on parameter "n"

n=0 standard quality (draft) and normal characters

n=2 near letter quality (NLQ) and normal characters

n=4 standard quality (draft) and special characters created with Down Line Loading (DLL). Not supported on Ultimate-II MPS Printer Emulation, same behavior as n=0.

n=6 near letter quality (NLQ) and special characters created with Down Line Loading (DLL). Not supported on Ultimate-II MPS Printer Emulation, same behavior as n=2.

```
10 OPEN1,4
20 PRINT#1,CHR$(27);CHR$(73);CHR$(n);
30 CLOSE1
```

```
DRAFT QUALITY
NEAR LETTER QUALITY
```

5. PETASCII character table

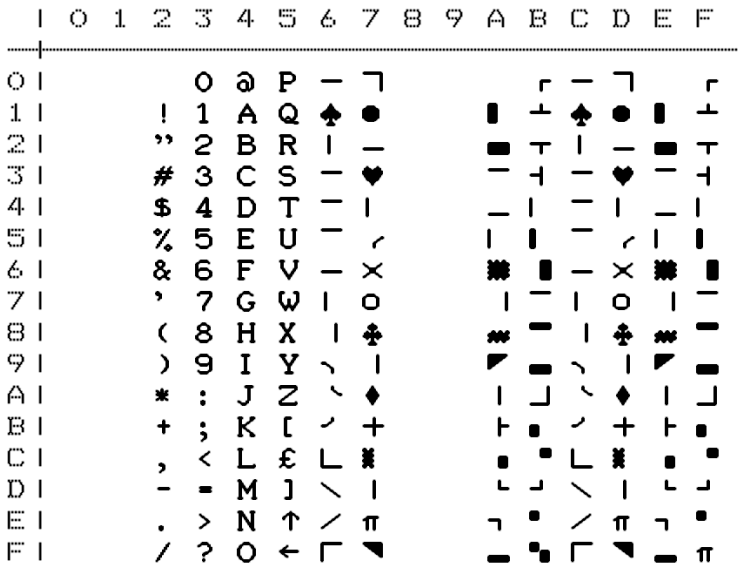


Table 1 : USA/UK Charset in Uppercase/Graphic Mode (Secondary address = 0)

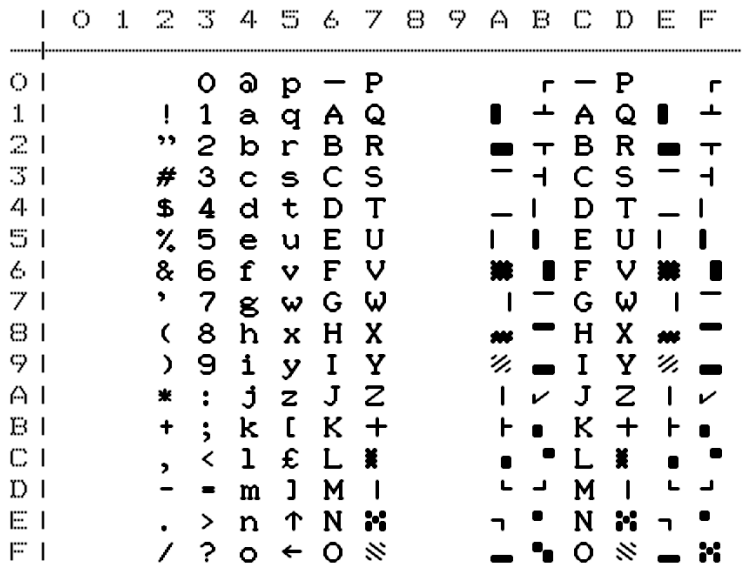


Table 2 USA/UK Charset in Lowercase/Uppercase Mode (Secondary address = 7)

6. Commodore commands reference

CODE ASCII	DEC	HEX	DESCRIPTION	PAGE
BIT IMG	8	08	Select graphic Bit Image Mode	12
BIM IMG SUB	8 26	08 1A	Select repeated graphic Bit Image Mode	12
HTAB	9	09	Horizontal tabulation	11
LF	10	0A	Line Feed	10
FF	12	0C	Form Feed	10
CR	13	0D	Carriage Return	10
EN ON	14	0E	Double width character ON	6
EN OFF	15	0F	Double width character OFF	7
POS	16	10	Jump to horizontal position in number of characters	11
CRSR DWN	17	11	Select Commodore charset with lowercases and uppercases	9
RVS ON	18	12	Negative character ON	7
ESC	27	1B	ASCII code for the Escape character	
NLQ ON	31	1F	Near Letter Quality ON	9
ESC POS	16	10	Jump to horizontal position in number of dots	11
ESC -	45	2D	Underline ON/OFF	7
ESC 4	52	34	Italic ON	8
ESC 5	53	35	Italic OFF	8
ESC 8*	57	38	Disable paper end sensor	11
ESC 9*	58	39	Enable paper end sensor	11
ESC =*	61	3D	Custom character definition using Down Line Loading (DLL)	13
ESC c*	67	43	Set paper height in number of interlines	10
ESC c NUL*	67 0	43 00	Set paper height in inches	10
ESC e	69	45	Bold character ON	7
ESC f	70	46	Bold character OFF	7
ESC g	71	47	Double Strike ON	6
ESC h	72	48	Double Strike OFF	6
ESC i	73	49	Select character print definition	14
ESC n*	78	4E	Define Bottom of Page (BOF)	10
ESC o*	79	4F	Disable Bottom of Page (BOF)	11
ESC s	83	53	Select Superscript or Subscript character mode	8
ESC t	84	54	Disable Superscript and Subscript character mode	9
ESC [	91	5B	Select character spacing (PICA, ELITE, …)	8
ESC X	120	78	Select NLQ or DRAFT	9
CS	141	8D	Carriage Return with no Line Feed	10
CRSR UP	145	91	Select Commodore charset with uppercases and graphics	9
RVS OFF	146	92	Negative character OFF	7
NLQ OFF	159	9F	Near Letter Quality OFF	9

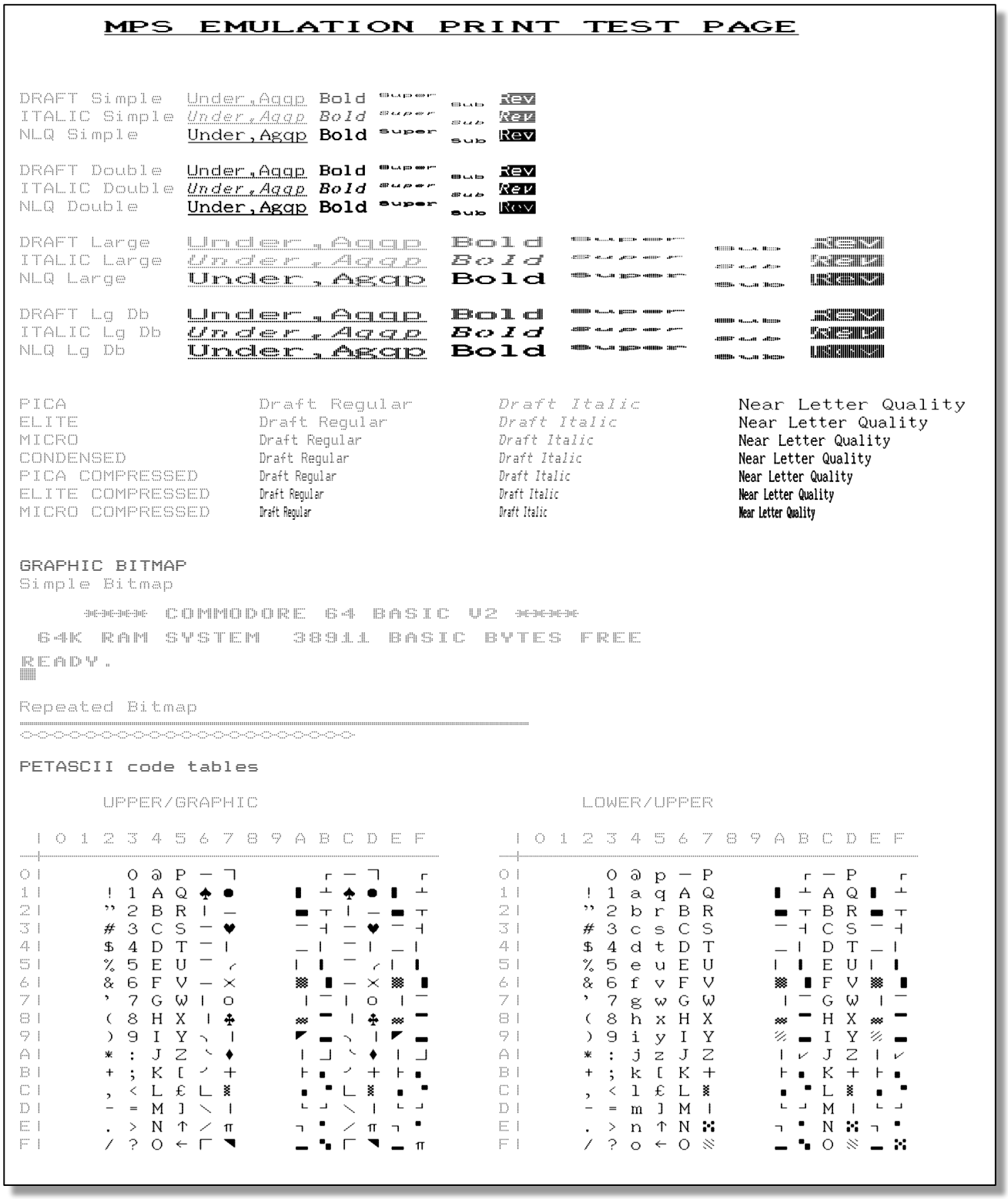
* Ignored in the Ultimate-II MPS Printer Emulation

7. Technical Specifications

Output Type	PNG file 2-bit depth (4 grey levels) with lossless compression typical file size range is 30kB - 140kB
Page size	1984 x 2580
Printable area size	1920 x 2516 (80 x 71 PICA characters)
Horizontal Resolution	240 dpi
Vertical Resolution	216 dpi
Physical ratio	A4 (21cm x 29,7cm)
Character matrix	8V x 11H in draft mode 16V x 11H in NLQ mode
Print pitches	Pica, 10 char/in, 80 char/line Elite, 12 char/in, 96 char/line Micro, 15 char/in, 120 char/line Condensed, 17.1 char/in, 137 char/line Pica Compressed, 20 char/in, 160 char/line Elite Compressed, 24 char/in, 192 char/line Micro Compressed, 30 char/in, 240 char/line
Printing styles	Boldface Double width Superscript Subscript Double strike Underlined Italic Reversed

8. Print Sample

With Printer Ink Density set to Medium



9. Document Revisions

Revision	Date	Author	Description
1.0	May 11, 2016	René Garcia	Initial release