Hitachi Serial Functions

NPPC Date Code Writer Interface

Contents

Overview

This reference document is designed for the specific functions required by NPPC for serially communicating with and controlling the Hitachi PX series inkjet printer. This document assumes that you already have knowledge & understanding of basic serial communications and working knowledge of the software that you will use to develop the interface.

•More detailed information on Hitachi serial communications can be found in the "Hitachi Instruction Manual" starting on page 6-1.

•Even more information can be found in the SOP-4 "Special Communications" manual for the SOP 4 option that will be used.There is also a document for the features added for NPPC.

•This document is designed to truncate the data from these different sources into a single source in an easy to understand format as it pertains to the NPPC project.

Setting up the Hitachi printer.

To set up the Hitachi printer for communications you must configure the communications settings. These settings can be found by going to "Maint" and then "Environment Setup menu" and then "Communications Environment Setup".There are two screens of settings here that can be toggled between by pressing the "Prev. Screen" and "Next Screen" buttons.You can set the printer up to match your PC or PLC's settings.Below are the optimized settings as the max baud rate for the printer is 19200.

Baud:19200

Data:8 bits

Parity: none

Stop: 1

Communication bytes:1

BCC Code: none

Communications Mode: Overwrite Enabled

Print Contents ACK: Method 1

Condition Character Height: 2 digits

Com signal error: Alarm

Cables

- A standard RS232 cable is used meaning that the transmit & receive pins are crossed between the two ends.This is also called a "null modem" cable.

- A straight serial extension cable may be used if a Null Modem Adapter is present.You can purchase "NULL MODEM" cables or adapters from a computer store if you don't wish to make one.

PinOut

Hitachi		PC
PIN# 2	✕	PIN# 2
3		3
5	——	5
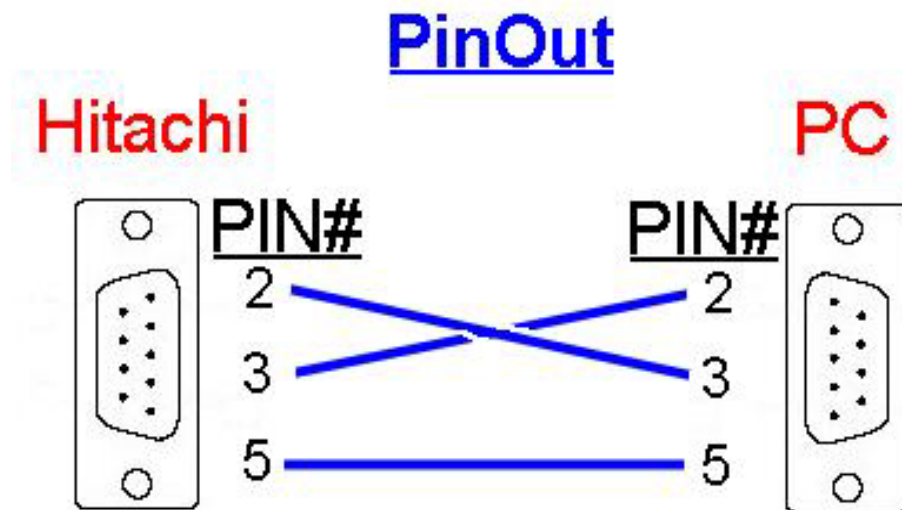
Line Mode

"Line Mode" is the term used to describe who has control of the printer.If "Line Mode" is "On" then the serial port has control of the Hitachi Printer.If "Line Mode" is "Off" then the Operator Interface or touchscreen of the printer is given active control of the unit.The touchscreen can be used to view things while "Line Mode" IS "On" but the "Show Cursor" button is not available so viewed items cannot be changed."Line Mode" status is indicated by [ON] or [OFF] in the top right corner of the screen on the printer.If you are going to communicate with the printer then "Line Mode" must be turned on.If you attempt to serially communicate with the printer and "Line Mode" is not on then you will get a "com 006" error letting you know it is off.The printer can be instructed to turn "Line Mode" on automatically at boot up in the communications configuration.

Communications Errors

Communications errors are noted by a 3 digit number and pop up in a red colored box in the top right hand corner of the screen.The error can be cleared by turning line mode "Off" and back "On" or by a serial reset remotely or they will automatically clear once a good serial transmission is received that contains no errors.

You can configure communications errors to be interpreted by the Hitachi as an "Alarm" which is not serious to the machine or an "Abnormality" which is a serious fault state and will stop printing on the machine.

*A reference chart of these errors is on page 30 of this document and a more detailed list of Communications Errors is listed on page 6-34 of the Hitachi Instruction Manual.

HEX & DECIMAL

Every program is different in how the code looks when serially communicating. Some programmers prefer to use HEX & some prefer DECIMAL. It is all each person's preference. The way the code looks in Qbasic is different from Visual Basic and C+ and etc…I will use decimal in my examples and use Basic type of code.Hex will hereafter be called **HEX** and Decimal will be **DEC**. There is an ASCII chart at the end of this document for your reference.

EX:

If I want to represent sending an "ACK" serially in an example then I will show:

Comm=chr(6)

The word "Comm=" represents whatever com port verbage your program uses to send a serial output and chr(6) represents a DECIMAL character of 6 which is an "ACK"

The exact code to send this out on com 1 in Visual Basic would be :

MSComm1.output=chr(6)

The exact code for Q basic to send this out on com 1 would be:

Open "com1:19200,N,8,1" for output as #1

Print #1,chr$(6)

How the printer communicates.

The Hitachi uses an **ENQ** character to determine whether it is OK to serially communicate or not. The **ENQ** is a HEX 05 which is also a DEC 5. Whoever initiates the communication will begin by sending this character first to see whether it is OK to continue. The ENQ is not required of all communication initiations but is usually required when changing things that may be reflected in the printed message such as font changes or print data changes.

An ENQ will be answered with an "ACK" or a DEC (6) or with a "Nack" which is a DEC (21).

EX:

PLC sends chr(5)

Hitachi replies with chr(6) if all is OK and chr(21) if it is busy and cannot communicate at this time or if it has a problem.

In a situation where the Hitachi will initiate communications you will be required to reply to the ENQ with an ACK before the Hitachi will continue sending the data.

How the printer communicates.

- The format of most of the strings you will send to the printer will be as follows with a few exceptions noted in the examples:

Printer Control:

STX+ESC+Header+Value+ETX

Print data change:

STX+DLE+Item Number in message+Actual Data+ETX

NOTE An item number MUST be specified when sending text or variables to be placed in the printed message.If more than 10 characters are to be placed in a message then the item number must be set for each 10 character set.DLE is the header that tells the printer an item number is coming next.

EX: Item #1   Item #2

comm=STX+DLE+chr(49)+"1234567890"+DLE+chr(50)+

"ABCDEFGHIJ"+chr(3)

Print Format & Specs change:

STX+Header+Item Number in Message+Data+ETX

NOTE When changing Print formats or specifications the item number is sometimes not specified which applies the change to all items in the current message.

Item Numbers

The Hitachi breaks down the printed message into "Item Numbers".A single item contains 10 printed characters.The layout of the item numbers depends on how many lines of text are being printed.A standard message can contain 240 characters which is 24 items of 10 characters each.The following example shows a 30 character message using item numbers 1,2,&3 in single & two line mode.Unused item numbers do not reflect in the printed message so if you put data in item #1 & item #3 and were to leave item #2 blank the printed data would print seamlessly with no gap between the items.

<u>Single Line Mode:</u>

	Item #1	Item #2	Item #3
Line 1	1234567890	ABCDEFGHIJ	abcdefghij

<u>Two Line Mode:</u>

	Item #1	Item #3
Line 1	1234567890	abcdefghij

	Item #2
Line 2	ABCDEFGHIJ

Printer Control

- The following pages on Printer Control show various ways you can serially control the Hitachi Printer itself.The printer must be powered "ON" and serially connected at this point.Line Mode must also be "ON".

To turn "Line Mode" on send:
comm=chr(2)+chr(27)+chr(121)+chr(3)

To turn "Line Mode" off send:
comm=chr(2)+chr(27)+chr(122)+chr(3)

To Start the Printer's Hydraulic circuit:
comm=chr(5)
Receive 'ACK"
Comm=chr(2)+chr(27)+chr(113)+chr(48)+chr(3)
To Stop the Printer's Hydraulic circuit:
comm=chr(5)
Receive 'ACK"
Comm=chr(2)+chr(27)+chr(113)+chr(49)+chr(3)

Printer Control

To set the printer at "Print Ready":

comm=chr(5)

Receive 'ACK"

Comm=chr(2)+chr(27)+chr(113)+chr(50)+chr(3)

To set the printer in "Standby":

comm=chr(5)

Receive 'ACK"

Comm=chr(2)+chr(27)+chr(113)+chr(51)+chr(3)

To reset an Alarm or Abnormality:

comm=chr(5)

Receive 'ACK"

Comm=chr(2)+chr(27)+chr(113)+chr(52)+chr(3)

Retrieve printer status

To get the printer's status send:

Comm=chr(27)+chr(35)

The printer replies:

fixed Header

STX + chr(49) + Data1+Data2+Data3+Data4+ETX

Comm connection
Data1=chr(48)=Line Mode Off

chr(49)=Line Mode On

Reception status
Data2= chr(48)=Able to receive now

chr(49)=Not able to receive now

Operation Status
Data3= chr(48)=Printer Paused

chr(49)=Printer running but not Print Ready

chr(50)=Print Ready

chr(73)=Printer Shutting Down

chr(92)=Maintenance Operation running

chr(51) through chr(98)=Abnormality

(Faults Listed in SOP4 manual page 5-2)

Retrieve printer status cont'd

Alarm Status

Data4= chr(48)=No Alarm

chr(49) through chr(50)=Alarm

(Alarms Listed in SOP4 manual page 5-3)

Retrieve Message contents

To retrieve the contents of the currently printing message send:

Comm=chr(27)+chr(47)

Printer replies:

STX+"Message Contents"+ETX

To retrieve the contents of the previously printing message send:

Comm=chr(27)+chr(46)

Printer replies:

STX+"Message Contents"+ETX

Set Printer's Internal Date & Time

To set the printer's internal clock send:

comm=Chr(5)

Receive "Ack"

comm=STX+chr(114)+ (1st digit of Year)+ (2nd digit of Year)+ (3rd digit of Year)+ (4th digit of Year)+ (1st digit of Month)+ (2nd digit of Month)+ (1st digit of Day)+ (2nd digit of Day)+ (1st digit of Hour)+ (2nd digit of Hour)+ (1st digit of Minute)+ (2nd digit of Minute)+ (1st digit of seconds)+ (2nd digit of Seconds)+ETX

Ex: To set the printer's clock to: "2005/04/25 23:30:00"

comm=Chr(2)+chr(114)+chr(50)+chr(48)+chr(48)+chr(53)+ chr(48)+chr(52)+chr(50)+chr(53)+chr(50)+chr(51)+ chr(51)+chr(48)+chr(48)+chr(48)+chr(3)

Retrieve Printer's current Date & Time

To retrieve the printer's current date & time values send:

Comm=chr(27)+chr(123)

Printer replies:

STX+ESC+chr(124)+YYYYMMDDhhmmss+ETX

Changing Fonts

To change the font matrix for a message you send the desired fonts code as well as the intercharacter space

value which is the space between characters. You will notice that some code identifiers are assigned to more than one font. This is because all possible fonts are placed in the Hitachi as a standard. You may select which algorithm you would like to use for that particular code. In other words you can use a 5x7 or 5x8 algorithm but not both at the same time. The font or font matrix is simply the number of vertical & horizontal dots in a font. It does not change the height of the printed text but simply the number of dots used. You may change the font for a specific item number only if you specify the item number after the header.

Code	Font Matrix	Max IC Space
0	5x5	3
1	5x8(5x7)	3
2	7x10(9x8,9x7)	3 (7)
3	12x16	4
4	18x24	6
5	24x32	8

comm = STX + Chr(27) + Chr(33) + Font Code + IC space + ETX

Ex: change entire message to 5x5 font with an IC space of 2

Comm=chr(5)

Receive ACK.

Comm=chr(2)+chr(27)+chr(33)+chr(48)+chr(50)+chr(3)

Changing Character height

The actual height of the printed message is specified as a value between 1 and 99 with 99 being the maximum height the printer can print.Remember that if you would like to change only a specific item number and not the entire message you simply need to specify it after the header.

To serially change the height of a message you send:

STX+ESC+chr(48)+1st height digit+2nd height digit+ETX

Ex: To set a character height of 90 for the entire message:

Comm=chr(5)

Receive ACK

Comm=chr(2)+chr(27)+chr(48)+chr(57)+chr(48)+chr(3)

Changing character width

Changing the character width is done the same as height but the range is 000 to 199.

To specify a character width:

STX+ESC+chr(49)+1st digit+2nd digit+3rd digit+ETX

Ex: To send a width of 065:

Comm=chr(5)

Receive ACK

Comm=chr(2)+chr(27)+chr(49)+chr(48)+chr(54)+chr(53)+chr(3)

Number of print lines

You can serially set the number of print lines in a message.The maximum number of lines is 4 in a 460 printer and 2 in a 260 printer.The range for the spaces between lines is 0 to 2.To set the print lines send:

STX+ESC+chr(34)+number of lines+line spacing+ETX

EX:Setting the message to 2 lines of text with a line space of 1:

Comm=Chr(5)

Receive ACK

Comm=chr(2)+chr(27)+chr(34)+chr(50)+chr(49)+chr(3)

Sending Literal Text

To send print data to the printer you need to remember that you must specify the item number that the text will be put into and that the maximum number of characters per item number is 10 characters.If you are sending 10 characters or less then they will all fit in item #1.If you are sending 14 characters then you will specify item #1 and send the first 10 characters and then specify item # 2 and send the remaining 4.

STX+DLE+item number+text+ETX

EX:

To Send "1234567890ABCD"

Comm=Chr(5)

Receive ACK

Comm=chr(2)+chr(16)+chr(49)+"1234567890"+chr(50)
+"ABCD"+chr(3)

Also,if you skip an item number and there is no data in it then the data before and after that item number will print seamlessly together.

EX: Data sent to item #1 and Item #3 in single line mode.

Item #1	Item #2	Item #3
1234567890		ABCDEFG

Actual Print on product looks like:

1234567890ABCDEFG

NOTE

To blank or clear the current print data simply send the string to the item numbers with no text in at all in it.

Single & Two Byte Modes

Sending variables is done the same way as far as assigning an item number and having the same 10 character per item number restrictions.Variables such as Date and Time are sent in two byte mode instead of single byte mode.Single byte mode means that a single byte of data is represented by sending 1 byte.Two byte mode means that a single byte of data is represented by sending 2 bytes.There are special characters that let the Hitachi know that you are beginning and ending two byte communications.These characters allow you to mix sending single byte and two byte communication items together in the same string.**SI** tells the printer that you are entering two byte mode and **SO** tells the printer that you are leaving two byte mode.**SI** is a chr(15) and **SO** is a chr(14).

Sending Variables

- **Variables have two byte codes**
- <u>Year</u>   Chr(242)+ Chr(80)
- <u>Month (number)</u>   Chr(242)+ Chr(81)
- <u>Day</u>   Chr(242)+ Chr (82)
- <u>Hour</u>   Chr(242)+ Chr(83)
- <u>Minute</u>   Chr(242)+ Chr (84)
- <u>Seconds</u>   Chr(242)+ Chr(85)
- <u>Julian</u>   Chr(242)+ Chr (86)
- <u>Month (name)</u>   Chr(242)+ Chr(87)
- <u>Week Number</u>   Chr(242)+ Chr(88)
- <u>Day of week</u>   Chr(242)+ Chr(89)

Acceptable formats:

- <u>Year</u>   Y,YY,YYY,YYYY
- <u>Month (number)</u>   M,MM
- <u>Day</u>   D,DD
- <u>Hour</u>   h,hh
- <u>Minute</u>   m,mm
- <u>Seconds</u>   s,ss
- <u>Julian</u>   J,JJ,JJJ
- <u>Month (name)</u>   MMM
- <u>Week Number</u>   W,WW
- <u>Day of week</u>   7

Sending Variables

The formats represent the desired number of printed digits of each variable.

Ex: Year 2005

YYYY=2005 is printed

YYY=005 is printed

YY=05 is printed

 Y=5 is printed

A two byte code is sent for each desired format letter.

Ex: want to print "05" of the year 2005

That is format YY .

Each "Y" is represented by Chr(242)+ Chr(80)

So "YY" would be Chr(242)+ Chr(80)+ Chr(242)+ Chr(80)

The string format for sending variables is the same as sending literal text except that you must specify two byte mode start & stop.

Comm=STX+DLE+Item number+SI+date formats+SO+ETX

EX: Send two digit year to item #1.

Comm=chr(5)

Receive ACK

Comm=chr(2)+chr(16)+chr(49)+chr(15)+ Chr(242)+ Chr(80)+ Chr(242)+ Chr(80)+chr(14)+chr(3)

Sending variables & text together

It is easy to send variables & text together. You must simply remember to turn two byte mode on and off as needed.

EX: send "ABC2005XYZ" to item #1 where 2005 is the variable year.

Comm=chr(5)

Receive ACK

Comm=chr(2)+chr(16)+chr(49)+"ABC"+chr(15)+ Chr(242)+ Chr(80)+ Chr(242)+ Chr(80)+ Chr(242)+ Chr(80)+ Chr(242)+ Chr(80)+ chr(14)+"XYZ"+chr(3)

It is a good practice to put variable dates in separate item numbers when using a postdate or expiration date. This makes it easy to apply Delta offsets serially if you need to change them.

Ex: Place2005 in item #1 and a 2 digit day in item #2 to be used as an expiration date

Comm=chr(5)

Receive ACK

Comm=chr(2)+chr(16)+chr(49)+chr(15)+ Chr(242)+ Chr(80)+ Chr(242)+ Chr(80)+ Chr(242)+ Chr(80)+ Chr(242)+ Chr(80)+ chr(14)+ chr(16)+chr(50)+ chr(15)+Chr(242)+ Chr(81) + Chr(242)+ Chr(81) +chr(14)+chr(3)

Sending offsets

Sometimes you want to offset a date value by a certain amount of time to use it as an expiration code or postdate.To do this you simply insert the date value as described earlier and then apply an offset.The offset is applied to an item number and all date variables in that item number are affected.The "Date Type" refers to whether you are offsetting a date variable by a certain number of minutes,hours,days,months,or years.

Date Type	Date Type Code
Year	chr(48)
Month	chr(49)
Day	chr(50)
Hours	chr(51)
Minutes	chr(52)

Comm=STX+ESC+chr(118)+item number+date offset type+offset 1000's position+ offset 100's position+ offset 10's position+ offset 1's position+ETX

EX: If there is a day date code in item #2 and we wish to offset it by 125 days.

Comm=chr(5)

Receive ACK

Comm=chr(2)+chr(27)+chr(118)+chr(50)+chr(50)+chr(48)+chr(49)+chr(50)+chr(53)+chr(3)

Trigger Delay

The trigger delay is called Write Start position.The orientation of the printhead to the production line determines how this delay is set.It is set the "Normal" way when the product passes under the head from front to back and the "Reverse" way when the product passes under the head from back to front.The difference is the header value.

STX+ESC+Header+1000's position+ 100's position+ 10's position+ 1's position+ETX

Ex:

Delay of 150 in Normal Position:

Comm=chr(5)

Receive ACK

Comm=chr(2)+chr(27)+chr(51)+chr(48)+chr(49)+chr(53)+chr(48)+chr(3)

Ex:

Delay of 150 in Reverse Position:

Comm=chr(5)

Receive ACK

Comm=chr(2)+chr(27)+chr(54)+chr(48)+chr(49)+chr(53)+chr(48)+chr(3)

Registering Messages

You can register messages to the printer if you would like to save the current message that is on the screen to the printer's memory for later use.To do this you must specify a registration number to save the message to from 001 to 150. (1-300 with Optional software)

STX+ESC+chr(85)+registration # 100's position+ registration # 10's position+ registration # 1's position+ETX

Ex: Save message to registration number 105

Comm=Chr(5)

Receive ACK

Comm=chr(2)+chr(27)+chr(85)+chr(49)+chr(48)+chr(53) +chr(3)

Recalling saved messages

To recall a saved message you must know it's registration number from 1 to 150.(1-300 with Optional software)

STX+ESC+chr(86)+registration # 100's position+ registration # 10's position+ registration # 1's position+ETX

Ex:To recall message # 105

Comm=Chr(5)

Receive ACK

Comm=chr(2)+chr(27)+chr(86)+chr(49)+chr(48)+chr(53)+ chr(3)

Serial Communications Errors

001-Transmission code is not a valid string

002-Print Specifications value was illegal

003-More than 10 characters sent to one item number

004-Invalid item number specified

005-Header value not recognized

006-The printer was not ready to receive data (line mode off?)

008-Print specification data out of valid range

009-ETX code position was illegal

010- DLE code position was illegal

011- STX code position was illegal

012- ENQ code position was illegal

013- ESC code position was illegal

014-Parity Error-check baud rate & data format settings

015-Print Format Error-check serial string for invalid data

016-Overrun error - check baud rate & data format settings

017-Framing error- check baud rate & data format settings

019-2 byte code error-(SI & SO used properly? Valid 2 byte code sent?)

020-Print Data code error-(invalid registration number or empty registration number recalled)

021-SI/SO code error-position of SI or SO was illegal

022-Logo code error-font or logo code is invalid

026-Bar Code error- invalid barcode data or format

027-Printing error- character size or grouping illegal/ calendar or count item disrupted

ASCII Chart

DEC	HEX	CHR	DEC	HEX	CHR	DEC	HEX	CHR	DEC	HEX	CHR
0	00	NUL	64	40	@	128	80	€	192	C0	À
1	01	SOH	65	41	A	129	81		193	C1	Á
2	02	STX	66	42	B	130	82	‚	194	C2	Â
3	03	ETX	67	43	C	131	83	ƒ	195	C3	Ã
4	04	EOT	68	44	D	132	84	„	196	C4	Ä
5	05	ENQ	69	45	E	133	85	…	197	C5	Å
6	06	ACK	70	46	F	134	86	†	198	C6	Æ
7	07	BEL	71	47	G	135	87	‡	199	C7	Ç
8	08	BS	72	48	H	136	88	ˆ	200	C8	È
9	09	HT*	73	49	I	137	89	‰	201	C9	É
10	0A	LF	74	4A	J	138	8A	Š	202	CA	Ê
11	0B	VT	75	4B	K	139	8B	‹	203	CB	Ë
12	0C	FF	76	4C	L	140	8C	Œ	204	CC	Ì
13	0D	CR	77	4D	M	141	8D		205	CD	Í
14	0E	SO	78	4E	N	142	8E	Ž	206	CE	Î
15	0F	SI	79	4F	O	143	8F		207	CF	Ï
16	10	DLE	80	50	P	144	90		208	D0	Ð
17	11	DC1	81	51	Q	145	91	`	209	D1	Ñ
18	12	DC2	82	52	R	146	92	’	210	D2	Ò
19	13	DC3	83	53	S	147	93	“	211	D3	Ó
20	14	DC4	84	54	T	148	94	”	212	D4	Ô
21	15	NAK	85	55	U	149	95	•	213	D5	Õ
22	16	SYN	86	56	V	150	96	–	214	D6	Ö
23	17	ETB	87	57	W	151	97	—	215	D7	×
24	18	CAN	88	58	X	152	98	~	216	D8	Ø
25	19	EM	89	59	Y	153	99	™	217	D9	Ù
26	1A	SUB	90	5A	Z	154	9A	š	218	DA	Ú
27	1B	ESC	91	5B	[	155	9B	›	219	DB	Û
28	1C	FS	92	5C	\	156	9C	œ	220	DC	Ü
29	1D	GS	93	5D	]	157	9D		221	DD	Ý
30	1E	RS	94	5E	^	158	9E	ž	222	DE	Þ
31	1F	US	95	5F	_	159	9F	Ÿ	223	DF	ß
32	20	SPC	96	60	`	160	A0		224	E0	à
33	21	!	97	61	a	161	A1	¡	225	E1	á
34	22	"	98	62	b	162	A2	¢	226	E2	â
35	23	#	99	63	c	163	A3	£	227	E3	ã
36	24	$	100	64	d	164	A4	¤	228	E4	ä
37	25	%	101	65	e	165	A5	¥	229	E5	å

ASCII Chart Continued

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
38	26	&	102	66	f	166	A6	¦	230	E6	æ
39	27	'	103	67	g	167	A7	§	231	E7	ç
40	28	(	104	68	h	168	A8	¨	232	E8	è
41	29	)	105	69	i	169	A9	©	233	E9	é
42	2A	*	106	6A	j	170	AA	ª	234	EA	ê
43	2B	+	107	6B	k	171	AB	«	235	EB	ë
44	2C	,	108	6C	l	172	AC	¬	236	EC	ì
45	2D	-	109	6D	m	173	AD		237	ED	í
46	2E	.	110	6E	n	174	AE	®	238	EE	î
47	2F	/	111	6F	o	175	AF	¯	239	EF	ï
48	30	0	112	70	p	176	B0	°	240	F0	ð
49	31	1	113	71	q	177	B1	±	241	F1	ñ
50	32	2	114	72	r	178	B2	²	242	F2	ò
51	33	3	115	73	s	179	B3	³	243	F3	ó
52	34	4	116	74	t	180	B4	´	244	F4	ô
53	35	5	117	75	u	181	B5	µ	245	F5	õ
54	36	6	118	76	v	182	B6	¶	246	F6	ö
55	37	7	119	77	w	183	B7	·	247	F7	÷
56	38	8	120	78	x	184	B8	¸	248	F8	ø
57	39	9	121	79	y	185	B9	¹	249	F9	ù
58	3A	:	122	7A	z	186	BA	º	250	FA	ú
59	3B	;	123	7B	{	187	BB	»	251	FB	û
60	3C	<	124	7C	|	188	BC	¼	252	FC	ü
61	3D	=	125	7D	}	189	BD	½	253	FD	ý
62	3E	>	126	7E	"	190	BE	¾	254	FE	þ
63	3F	?	127	7F	DEL	191	BF	¿	255	FF	ÿ