SII

PTD00P01-E (CPU)
PTJCGG2-E (CG ROM)
LTPDx47/CAPDx47 SERIES CONTROL CHIP SET
TECHNICAL REFERENCE

U00113266101

Seiko Instruments Inc.

PTD00P01-E (CPU) PTJCGG2-E (CG ROM) LTPDx47/CAPDx47 SERIES CONTROL CHIP SET TECHICAL REFERENCE

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PREFACE

This reference manual contains the specifications and functional descriptions of the Chip set that controls the LTPDx47/CAPDx47 series printer.   It is recommended that the user thoroughly read this manual to become familiar with the equipment prior to use.

- PTD00P01-E(CPU): PTD00P01(omitted "-E") or CPU.

- PTJCGG2-E(CG ROM): PTJCGG2(omitted "-E") or CG ROM.

The PTD00P01 can print various character codes such as JIS 1st and 2nd level Kanji or Katakana character set 1 and Katakana character set 2 by connecting a CG ROM (PTJCGG2-E, Japanese Gothic font). The CG ROM can register downloaded character, optional font, user-defined character, downloaded bit image, NV bit image and macro.

Fully investigate the intellectual proprietary rights of the sample circuits described in this manual before using.

The Chip set complies with EU RoHS Directive (2002/95/EC). Moreover, the Chip set does not contain the hazardous substances controlled by China RoHS (Management Methods for Controlling Pollution by Electronic Information Products).

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CHAPTER 1
OVERVIEW

1.1 FEATURES

The CPU has features as shown below:

- Drives LTPDx47 and CAPDx47 series printer.

- Drives winder unit, drawer or presenter.

- Supports parallel input/output, serial input/output and USB input/output.

- Achieves printing with less current by using division control according to the number of dots to be activated.

- Automatically measures the thermal head resistance and adjusts the energy used for printing.

- Provides high quality printing by automatically adjusting the print density according to the temperature and voltage.

- Detects problems with hardware, thermal head resistance, voltage, temperature, out-of-paper, platen block position, etc.

- Provides various character functions, including double-width/double-height, reverse printing, underlining, character spacing control and inversion.

- Permits superimposing of character data and bit image data.

- Provides a ruler line function which allows ruler lines and characters to be easily overlaid.

- Prints both 16- and 24-dot size characters.

- Prints Japanese Kanji characters by connecting the CG ROM.

- By connecting the CG ROM, CG ROM can store the function settings that set by Function Setting command, and not deleted by POWER OFF.

- Below functions are available by connecting the CG ROM. These are stored in User area of CG ROM, and not deleted by turning off the power.

  - Downloaded characters function: Registers and prints any font.
  - Optional font: Registers and prints characters of any size 127x127 or smaller.
  - User-defined character: Registers and prints any font.
  - Downloaded bit image and NV bit image: Prints rectangular images repeatedly.
  - Macro: Significantly reduces transmission data volume.

- Prints two-dimensional bar codes or page mode function by connecting the external RAM.

- Prints barcodes using the barcode print function.

1.2 TERMINOLOGY

- **Dot**

  A character or graphic image is composed of picture elements called dots. A dot corresponds to one of the thermal head heat elements.

- **Dot line**

  A line of dots arranged in the direction perpendicularly to the paper feed direction. The dot line corresponds to the line of the thermal head heat elements.

- **Character spacing**

  The space between two characters.

A   B
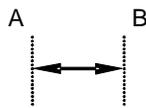
Character spacing

- **Space between lines**

  The space between two lines.

ABC

Space between lines

ABC
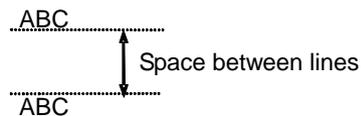
- **Line spacing**

  Distance from the bottom of character in upper line to the bottom of character in lower line.

ABC

Line spacing

ABC
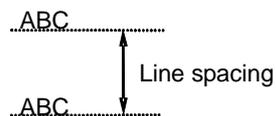
- **Input buffer**

  The memory for storing the data (characters and commands) received from the host device. The command is executed at the time the characters are fetched from the input buffer. After this is done, the characters are stored in the line buffer. The capacity of the input buffer is 4096 bytes.

- **Line buffer**

  The memory for storing one line of character data fetched from the input buffer. When the line buffer is filled with character data or the printing conditions are made valid through a command, the data in the input buffer is printed.

  The system configuration is shown in Figure 1-1.
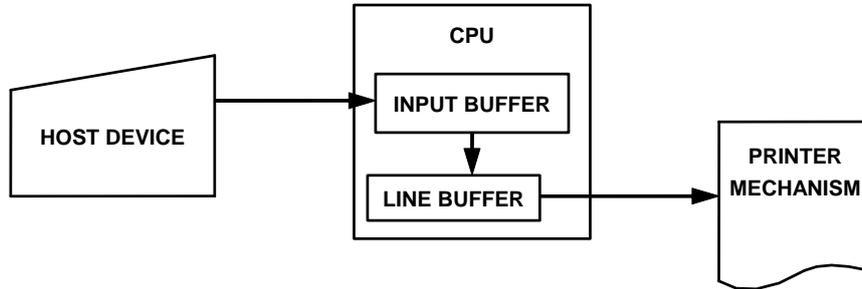
Figure 1-1 System Configuration

- **One line full print**

  The printing executed when the data in the line buffer exceeds one line. The data for one line is stored in the line bufer. When the next data exceeds the number of characters which can be printed, the data in the line buffer is printed. The overflowing data is stored at the beginning of the next line.

- **2-byte characters**

  Kanji and User-defined characters. The CG ROM is essential to print Kanji and user-defined characters.

- **1-byte characters**

  Extended graphics characters, Katakana character set 1 and Katakana character set 2, and downloaded characters. The CG ROM is essential to print Katakana character set 1 and Katakana character set 2 and downloaded characters.

- **Font**

  The form of a character. A character is composed of dots in a group. The user can define a font using the downloaded font, etc.

- **Font size**

  The size of a character. There are 2 sizes of fonts, 16-dot font size and 24-dot font size.

	16-dot (height x width)	**24-dot (height x width)**
Standard size characters	16 x 8	24 x 12
2-byte characters	16 x 16	24 x 24

- **1-byte characters/2-byte characters**

  Classification by character codes.
  1-byte characters are specified with the 1-byte character code.
  2-byte characters are specified with the 2-byte character codes.
  2-byte characters can be used only when specifying the Kanji mode.

  1-byte characters
    Katakana character set 1
    Katakana character set 2
    Extended graphics characters
    Downloaded characters
    Optional fonts
    Codepage 1252

  2-byte characters
    Kanji
    User-defined characters
    Kanji quarter size characters

1.3 NOTATION IN THE TECHNICAL REFERENCE

The notation in the technical reference is described below;

- **Character string**

  A character string is showing as follows;
  Example: 'G' (a character string 'G' is enclosed with a single quotation mark.)

- **Negative logic**

  The negative logic signals have '!' before the signal name. See Chapter3 "PIN DESCRIPTION" for the input/output direction.

- **Level of a Digital signal**

  "High" indicates 1 of a digital signal, "Low" indicates 0 of the digital signal.

- **Hexadecimal**

  Hexadecimal is showing as follows;
  Example: 0AH (a hexadecimal unit 'H' is added behind a hexadecimal number.)

CHAPTER 2

SPECIFICATIONS

This chapter describes general specifications for the CPU and the CG ROM.

See Chapter 5 "HARDWARE SPECIFICATIONS" or Chapter 9 "SOFTWARE SPECIFICATIONS" for details of hardware and software.

2.1 TYPE AND DIMENSIONS

Table 2-1 Type and Dimensions

	CPU	CG ROM
Name	PTD00P01-E	PTJCGG2-E
Package type	120-pin QFP	48-pin TSOP (Type I)
Dimensions (W)×(D)×(H) mm	16.0×16.0×1.7	20.0×12.0×1.2
Type	C-MOS LSI	C-MOS LSI

Table 2-2 lists the specifications of the CPU in a combination of the LTPDx47/CAPDx47 series printer.

Table 2-2 Specifications for CPU

Item	Specifications	
Applicable model	LTPD247 CAPD247	LTPD347 CAPD347
Printing method	Thermal dot line printing	
Character type	Extended graphics character set Katakana character set 1 [*1] Katakana character set 2 [*1] Codepage 1252 JIS 1st and 2nd level Kanji [*1] Downloaded character User-defined character Optional font [*1]	

Character configuration
    1-byte character
    2-byte character
	16-dot 24-dot
	16×8 24×12 [*2]
	16×16 24×24 [*2]	

Input control method	Parallel input/output Serial input/output USB input/output	
Printable dot number	432 dots	576 dots
Number of characters per line (Condition 1)	36	48
Line spacing	34 dots [*2]	
Character spacing	0 dot [*2]	
Maximum print speed (Condition 2)	200 mm/s	150 mm/s

Operating voltage range
    Vdd
    Vp
	
	3.0 to 3.6V
	21.6 to 26.4V	

Operating frequency	12 MHz±0.01%	
Current consumption (Idd) (Condition 3) Printing	 150 mA max.	
Operating temperature	-10 to 50°C	
Storage temperature	-30 to 80°C	

*1 : CG ROM is required.
*2 : The default value which can be changed by commands.

Condition 1:   24-dot 1-byte character, 0-dot character spacing.
Condition 2:   25°C, 144 dots dynamic division, 24-dot line spacing, 0-dot character spacing,
                   24-dot 1-byte character (Extended graphics character set・character code B2H), 12 characters or less.
Condition 3:   In the sample circuit, Vdd=3.3V, 25°C, no error, and when input/output pin is not connected.

Table2-3 lists the function which becomes usable by connecting CG ROM, and Table2-4 lists the function which becomes usable by connecting External RAM.

Table 2-3 CG ROM Functions

Item	Without CG ROM	With CG ROM
Usable Character type	Extended graphics character set Codepage 1252	Extended graphics character set Codepage 1252 Katakana character set 1 Katakana character set 2 JIS 1st and 2nd level Kanji
Storage of Function setting	Impossibility	Possible
Storage of Maintenance counter	Impossibility	Possible
Registration function which uses CG ROM	-	Downloaded character Optional font User-defined character Downloaded bit image NV bit image Macro

Table 2-4 External RAM Functions

Item	Without External RAM	With External RAM
Page mode function use	Impossibility	Possible
Two dimensional bar code use	Impossibility	Possible

CHAPTER 3
PIN DESCRIPTION

Figure 3-1 and Figure 3-2 show the pin configurations of the CPU and CG ROM.   This figures are top view of the CPU or CG ROM.   Table 3-1 and Table 3-2 list the pin definitions for the CPU and CG ROM.

3.1 CPU (PTD00P01) TERMINALS

In the tables for each terminal, the negative logic signals have '!' before the signal name.
The mark of I/O in the table means that: I: Input, O: Output (Viewed from the CPU).

```
              Pin 91          Pin 61
                │               │
        ┌───────┴───────────────┴───────┐
Pin 92 ─┤                                ├─ Pin 60
        │                                │
        │          PTD00P01-E            │
        │                                │
        │                                │
        │                                │
Pin 120 ┤                                ├─ Pin 31
        │                                │
        └───────┬───────────────┬───────┘
                │               │
              Pin 1           Pin 30
```
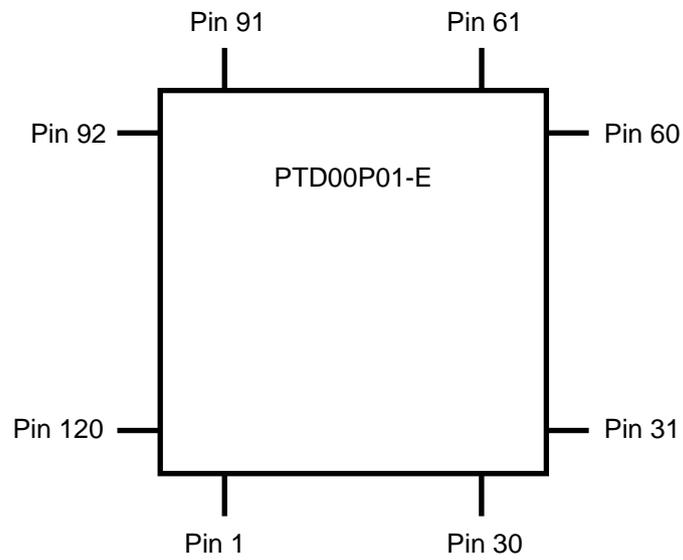
Figure 3-1 CPU Pin Configuration

Table 3-1 CPU Pin Definitions

Pin No	Signal Name	I/O	Function	Reamrks
1	!CS1	O	External RAM selection	
2	!CS2	O	CG selection	
3	DRS	I	Drawer sensor	
4	MD2	I	Mode selection 2	
5	ST1	O	Status signal 1	
6	ST2	O	Status signal 2	
7	ST3	O	Status signal 3	
8	A20	O	A20	
9	A19	O	A19	
10	Vss	—	GND	
11	A18	O	A18	
12	A17	O	A17	
13	A16	O	A16	
14	A15	O	A15	
15	A14	O	A14	
16	A13	O	A13	
17	Vss	—	GND	
18	A12	O	A12	
19	Vdd	—	+3.3V	
20	A11	O	A11	
21	A10	O	A10	
22	A9	O	A9	
23	A8	O	A8	
24	A7	O	A7	
25	A6	O	A6	
26	Vss	—	GND	
27	A5	O	A5	
28	A4	O	A4	
29	A3	O	A3	
30	A2	O	A2	

Table 3-1 CPU Pin Definitions

Pin No	Signal Name	I/O	Function	Reamrks
31	A1	O	A1	
32	A0	O	A0	
33	RESERVED	－	Reserved	Connect to GND
34	ST4	O	Status signal 4	
35	USB_PULLUP	O	USB pull up control	
36	DrVdd	－	Vdd for USB transceiver	
37	USBD+	I/O	USB data signal D+	
38	USBD-	I/O	USB data signal D-	
39	DrVss	－	GND	
40	Vbus	I	USB detection in	
41	MDCLK	I	Mode selection	
42	Vss	－	GND	
43	!CTS/SELECTIN	I	Serial CTS signal/ Parallel selection in	
44	Vdd	－	+3.3V	
45	!DSR/PINIT	I	Serial DSR signal/ Parallel INIT	
46	PRS2	I	Presenter sensor 2	
47	WD1/PR1	O	Winder drive 1/ Presenter drive 1	
48	WD2/PR2	O	Winder drive 2/ Presenter drive 2	
49	!PACK	O	Parallel acknowledge	
50	PBUSY	O	Parallel BUSY	
51	IF2/!RTS(SBUSY)	I/O	Interface selection/ Serial RTS signal	
52	HTE	I	Head temperature error interrupt	
53	D0	I/O	D0	
54	D1	I/O	D1	
55	D2	I/O	D2	
56	D3	I/O	D3	
57	Vss	－	GND	
58	D4	I/O	D4	
59	D5	I/O	D5	
60	D6	I/O	D6	

Table 3-1 CPU Pin Definitions

Pin No	Signal Name	I/O	Function	Reamrks
61	D7	I/O	D7	
62	Vdd	—	+3.3V	
63	!HSTB1	O	Head strobe 1	
64	!HSTB2	O	Head strobe 2	
65	!HSTB3	O	Head strobe 3	
66	!HSTB4	O	Head strobe 4	
67	Vss	—	GND	
68	!HSTB5	O	Reserved	Be open
69	!HSTB6	O	Reserved	Be open
70	NS	I	Paper-near-end sensor	
71	HS	I	Platen block positioning detection	
72	HDATA	O	Head data	
73	!HLATCH	O	Head data LATCH	
74	HCLK	O	Head data CLK	
75	PRS1	I	Presenter sensor 1	
76	Vss	—	GND	
77	!RES	I	RESET	
78	VCL	—	Power terminal	Connect to GND via the capacitor of 0.1uF
79	TxD	O	Serial data output	
80	RxD/AUTOFEED	I	Serial data input/ Parallel auto feed	
81	RESERVED	—	Reserved	Be open
82	Vss	—	GND	
83	XTAL	I	oscillation input	
84	EXTAL	I	oscillation input	
85	Vdd	—	+3.3V	
86	PSTB	I	Parallel strobe	
87	!DTR	O	Serial DTR signal	
88	!STBY	I	Reserved	Pull up
89	MPH1	O	Motor drive signal 1	
90	MPH2	O	Motor drive signal 2	

Table 3-1 CPU Pin Definitions

Pin No	Signal Name	I/O	Function	Reamrks
91	MI1	O	Motor current setting signal 1	
92	PLL_Vdd	—	Vdd for PLL circuit	Connect to Vdd via the resistor of 100Ω
93	MCL1	O	Motor control signal 1	
94	PLL_Vss	—	GND	
95	MI2	O	Motor current setting signal 2	
96	MCL2	O	Motor control signal 2	
97	MD0	I	Mode selection 0	
98	SVdd	I	Reference voltage	
99	OPS	I	Option mark sensor	
100	SHT	I	Head temperature detection	
101	AVdd	—	Vdd for A/D converter	
102	EVNT	I	Reserved	Pull up
103	AVss	—	GND	
104	SVp	I	VP voltage detection	
105	Vref	—	Reference voltage for A/D	Connect to Vdd
106	SHR	I	Thermal head resistance detection	
107	PS	I	Out-of-paper sensor	
108	MREF	O	Motor reference voltage	
109	MD1	I	Mode selection 1	
110	HVPSW	O	Thermal head Vp switch	
111	!HVDDSW	O	Thermal head Vdd switch	
112	MSSW	O	Sensor switch	
113	!LWR	O	Lower byte write signal	
114	!FEED	I	FEED signal	
115	!RD	O	Read signal	
116	DR	O	Drawer drive	
117	Vss	—	GND	
118	!CUTS	I	Cutter sensor	
119	Vdd	—	+3.3V	
120	IF1/!PDCS	I/O	Interface selection/ Parallel data chip select	

3.2 CG ROM (PTJCGG2) TERMINALS

In the tables for each terminal, the negative logic signals have '!' before the signal name.
The mark of I/O in the table means that: I: Input, O: Output (Viewed from the CG ROM).

```
          Pin 1  ┌──────────────────┐  Pin 48
                 ┤                  ├
                 │                  │
                 │   PTJCGG2-E      │
                 │                  │
          Pin 24 ┤                  ├  Pin 25
                 └──────────────────┘
```
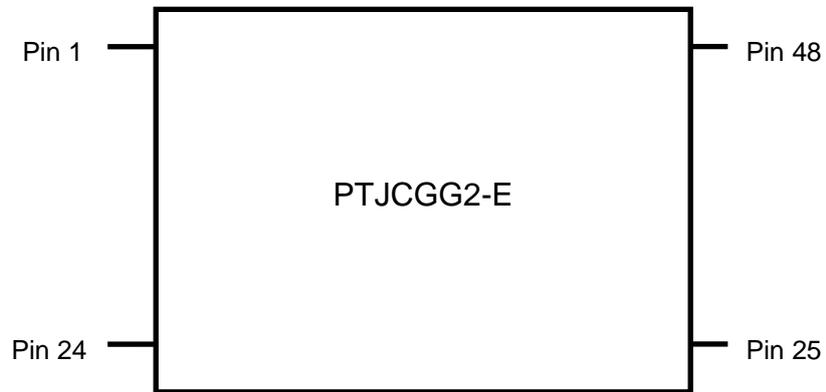
Figure 3-2 CG ROM Pin Configuration

Table 3-2 CG ROM Pin Definitions

Pin No	Signal Name	I/O	Function	Reamrks
1	A15	I	A15	
2	A14	I	A14	
3	A13	I	A13	
4	A12	I	A12	
5	A11	I	A11	
6	A10	I	A10	
7	A9	I	A9	
8	A8	I	A8	
9	A19	I	A19	
10	NC	─	No connection	Be open
11	!WE	I	Write Enable	
12	!RES	I	RESET	
13	NC	─	No connection	Be open
14	NC	─	No connection	Be open
15	NC	─	No connection	Be open
16	A18	I	A18	
17	A17	I	A17	
18	A7	I	A7	
19	A6	I	A6	
20	A5	I	A5	
21	A4	I	A4	
22	A3	I	A3	
23	A2	I	A2	
24	A1	I	A1	
25	A0	I	A0	
26	!CE	I	Chip enable	
27	Vss	─	GND	
28	!OE	I	Output enable	
29	D0	I/O	D0	
30	NC	─	No connection	Be open
31	D1	I/O	D1	
32	NC	─	No connection	Be open
33	D2	I/O	D2	
34	NC	─	No connection	Be open
35	D3	I/O	D3	
36	NC	─	No connection	Be open
37	Vdd	─	+3.3V	

Table 3-2 CG ROM Pin Definitions

Pin No	Signal Name	I/O	Function	Reamrks
38	D4	I/O	D4	
39	NC	—	No connection	Be open
40	D5	I/O	D5	
41	NC	—	No connection	Be open
42	D6	I/O	D6	
43	NC	—	No connection	Be open
44	D7	I/0	D7	
45	A-1	I	A-1	
46	Vss	—	GND	
47	!BHE	I	Data Bus Width Selection	Connect to GND
48	A16	I	A16	

CHAPTER 4

OPERATION PRINCIPLES

4.1 THERMAL HEAD CONTROL

4.1.1 Data Transfer to the Thermal Head

The CPU transfers one dot line of data at 6M bps, synchronized with the HCLK signal.
The data is transferred in order to the shift register inside the thermal head from the left (when facing the paper feed direction).
The transferred data is then transferred by the head latch signal to the latch register inside the thermal head.
Turning on the head strobe signal initiates printing of one dot line of data on the thermal paper.

4.1.2 Thermal Head Drive Operation

The line thermal head can be driven dividing a one-line upper head into several blocks.

In the LTPDx47/CAPDx47 series printer, a one-line head is divided into 3 (LTPD247/CAPD247) blocks and 4 (LTPD347/CAPD347) blocks, which are called physical blocks. Head strobe signals (!HSTB1 to 4) are connected to each physical block to activate it. To actually drive the head, several physical blocks are activated simultaneously.
A group of physical blocks that is driven simultaneously is called a logical block.

One of two methods of division for logical blocks can be selected: dynamic division and fixed division. This selection is made by performing function settings or through a command.
For the function settings or the selection by the commands, see Chapter 9"Auxiliary Functions".

(1) Dynamic division

The CPU counts the number of dots activated in each physical block and divides each physical block by software to print a single dot line so that the number does not exceed the specified maximum number of activated dots. The CPU determines logical blocks each time it prints a single dot line.
In dynamic division, since the order of the printing blocks and printing speed are changed in each dot line according to the content of the print data, the print quality may be lower than that in fixed division. If print quality is regarded as important, printing in fixed division is recommended.

The maximum number of activated dots in the initialization status is specified by performing function settings. 72 to 288 dots can be set using the command for setting the number of dynamic division dots (DC2 '%').

When the maximum number of activated dots is 144 dots, and all of the dots are driven, as shown in Figure 4-1, the CPU activates the six logical blocks groups of physical blocks in order, so that the number does not exceed 144 dots.

(NOTE) **If a number of dots between 72 and 144 is specified with the dynamic division specify command, messy, unclear printing or abnormal sound etc., may occur depending on the environmental and printing conditions, and the print quality may deteriorate remarkably. Therefore be sure to check in advance that the number of dots is not set within the above range.**
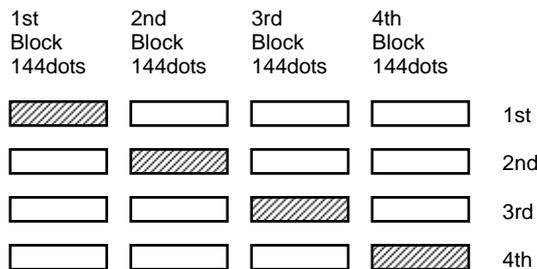
Shaded Area = Activated Dots

Figure 4-1 Dynamic Division When All Dots are Activated
(Maximum Number of Activated Dots =144 : LTPD347/CAPD347)

The advantage of dynamic division is that the maximum number of activated dots can be specified according to the capacity of the power supply used. The printer can be operated with a small capacity power supply when a small number is specified for the maximum number of activated dots. However, this process may increase the number of divisions and may lower print speed for printing at a high print ratio. On the other hand, printing speed becomes faster when the maximum number of activated dots is larger, requiring, however, a larger power supply.

(2) Fixed division

In the fixed division method, a group of physical blocks that are driven simultaneously, i.e. a logical block, is determined beforehand. The fixed division method always drives physical blocks in the same order, resulting in higher printing quality.

The default status of the fixed division method can be specified by function setting. Alternatively, the fixed division select command (DC2 '>') can be used to specify.

Table 4-1 Head Logical Blocks When Fixed Division is Selected

Printer mechanism	Order	Physical block number				Maximum number of activated dots
		1	**2**	**3**	**4**	
LTPD247	1st	○	×	○	-	288dots
CAPD247	2nd	×	○	×	-	144dots
LTPD347	1st	○	×	×	○	288dots
CAPD347	2nd	×	○	○	×	288dots

4.1.3 Adjustment of Applied Energy

The CPU automatically controls the energy applied to the thermal head according to the resistance, temperature of the thermal head, the Vp voltage and the thermal paper.
The default setting of the print density in the CPU is set to TF50KS-E2D (Nippon Paper Industries). If the thermal paper in use is different from present value of the print density, be sure to adjust the print density according to the thermal paper in use.

The print density can be adjusted from 60% to 140% of the rated energy using the Print Density Specify command. See Chapter 9 "FUNCTION CODE DESCRIPTION" for more details.

4.2 MOTOR DRIVE PRINTER MECHANISM CONTROL

4.2.1 Motor Drive Method

The paper feed motor of the LTPDx47/CAPDx47 series printer are a two-phase, bipolar type stepping motor. The LTPDx47/CAPDx47 series printer drive the motor through 2-2 phase excitation. Thermal Paper is fed for one dot line by two steps.

The maximum drive speed of motor depends on Vp voltage by the followings:

LTPD247/CAPD247: 3200pps
LTPD347/CAPD347: 2400pps

However, acceleration control is executed to prevent the printing pitch from being too small and assure the needed paper feed at the start. Acceleration is automatically executed to the drive speed and then normal-speed operation starts.
When the drive time of the head is longer than one step of the motor, the CPU slows down the motor drive speed to have enough head drive time. Therefore, the motor drive speed decreases during printing according to the division method of the head and the head temperature.

The CPU uses a constant current chopper type driver IC for constant current control. Use the circuit recommended Chapter 5 "Motor Control Circuit" to fully utilize the performance of the printer mechanism. If other circuits are used, the performance of the printer decreases, besides the motor may overheat and may be damaged.

> **(NOTE)** **If excessive load is applied to the Thermal paper during paper feed and printing, the printer may step out and cannot return to the normal status. The paper supply load to the printer must be 0.98N (100 gf) or less.**

4.2.2 The Timing for Driving the Head and Motor

Printing is executed by driving the motor while driving the head. Figure 4-2 shows the timing for driving the head in fixed division for LTPD247/CAPD247 series printer.
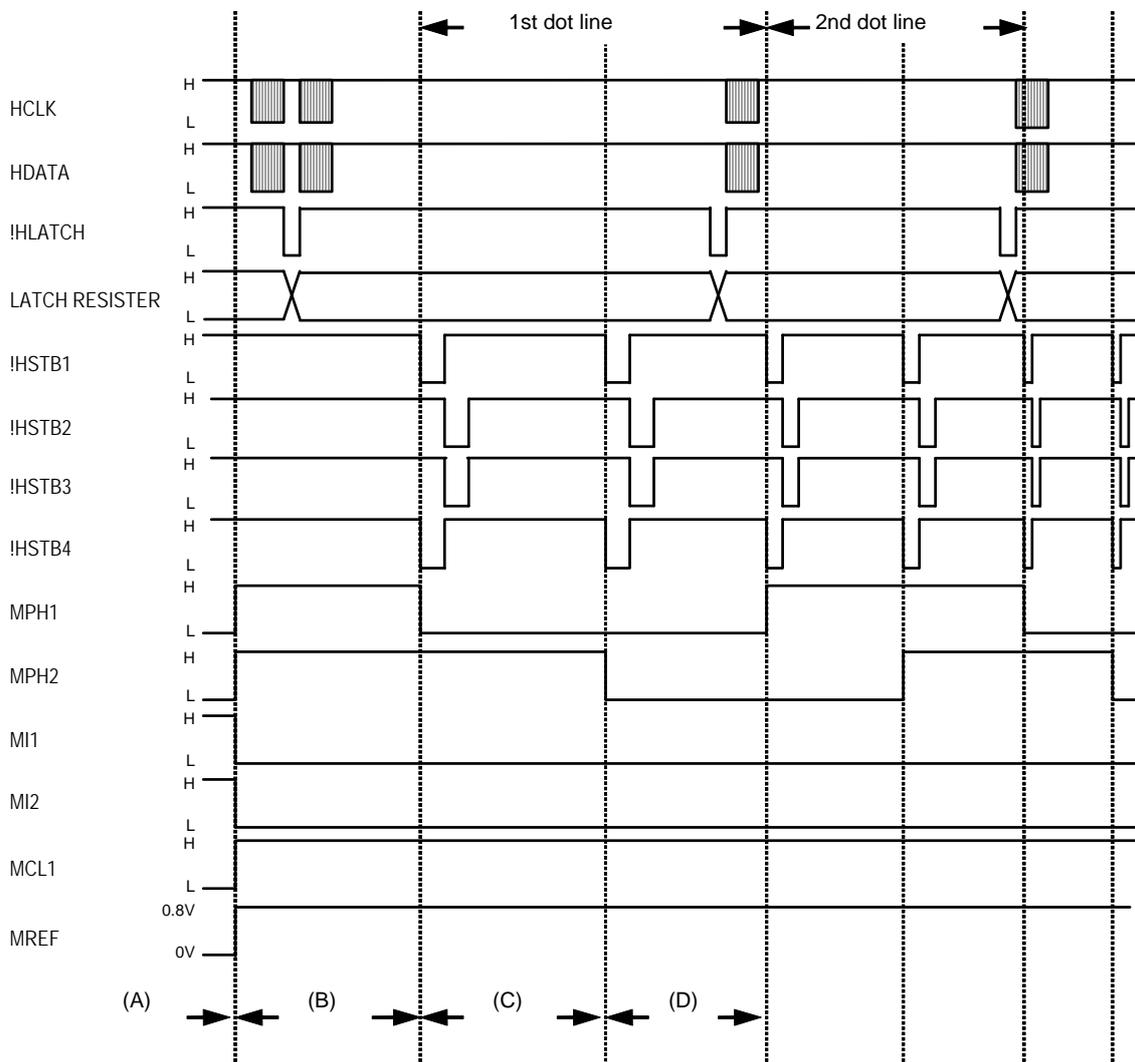
Figure 4-2 The Timing for Driving the Head and the Motor (Fixed division: LTPD347/CAPD347)

(A)	Pause state:	The CPU turns off the output of the motor.
(B)	Start step output:	The CPU outputs the same phase as the one which was output just before the printer had paused. The CPU transfers and latches 1st dot line data into the thermal head. After that, the CPU transfers and latches 2nd dot line data into the thermal head.
(C)	First step output:	The CPU prints latched data in blocks 1 to 4 in order. The motor outputs the phase 1st step, which are synchronizing with !HSTB1.
(D)	Second step output:	The motor and thermal head are same operated in step (C). When output !HSTB4 is completed, the CPU latches data of 2nd dot line and then transfers data of 3rd dot line into the thermal head.

The CPU executes the remaining steps in the same manner: activates the head synchronized with the motor driving, to transfer the data to the head every two steps.

4.3 ERROR PROCESSING

Errors are classified into following types. Thermal head error, Vp voltage initialization error, out-of-paper error, platen block open error Vp voltage error, thermal head temperature error, autocutter error, paper jam error while detecting mark, paper feed error in presenter and presenter paper jam error.
The type of operation errors can be judged from the status output port. Moreover, that can be judged using the Error Status Response command (see Chapter 9 "Auxiliary Functions").

See Chapter 5 "PARALLEL INPUT/OUTPUT CONTROL CIRCUIT", "SERIAL INPUT/OUTPUT CONTROL CIRCUIT" and "USB INPUT/OUTPUT CONTROL CIRCUIT" for reception of error code.

The thermal paper can be fed by !FEED even if the CPU is in error status of thermal head temperature error and out-of-paper error. See Chapter 5 "SWITCH CIRCUIT" for !FEED.
Input data is stored into the buffer except when thermal head error and Vp voltage initialization error occur. If the error is cleared, the CPU resumes the printing operation.

The causes of each operation error and the corresponding recovery are listed below:

- **Thermal head error**

  The thermal head error is detected just after initialization or turn the power on.
  The average resistance of the thermal head is lower than rated value, or the dot resistance is especially low.
  The average resistance of the thermal head is higher than rated value, or some of the physical blocks are damaged.
  This means that the printer mechanism is damaged, or not correctly connected.
  -> Nonrecoverable error

- **Vp voltage initialization error**

  When the power is switched on, or during the initialization just after reset, Vp voltage is not over 20V within 5 seconds.
  That cause of abnormal power supply or circuit.
  -> Nonrecoverable error

- **Out-of-paper error**

  No paper
  -> Load paper. The CPU goes to print-ready status.

- **Platen block position error**

  The platen block is not positioned correctly.
  -> Set the platen block to the normal position.
  The CPU goes to print-ready status in about a second.

- **Vp voltage error**

  Vp voltage is out of the allowable range.
  -> Return Vp voltage within the allowable range. The CPU goes to print-ready status.

- **Thermal head temperature error**

  The temperature of the thermal head is $-25°C$ or lower, or $85°C$ or higher.
  -> If it ranges from $-20°C$ to $80°C$, the CPU goes to print-ready status.

- **Autocutter error**

  There are two kinds of autocutter errors:

  1. An error occurs during operation of the cutter; the movable blade is in the home position.
  -> The CPU outputs the autocutter error and then goes to print-ready status one second later.
  The CPU enters the print-ready status after the cutter stops operation.

  2.An error occurs during operation of the cutter; the movable blade is not in the home position (the movable blade is locked).
  -> The CPU outputs the autocutter error. Remove the cause of the locking of the movable blade (such as paper jamming) and return the movable blade to the home position. If so, the CPU goes to print-ready status.

  See Section 4.4.3 "Unlocking of the Movable Blade" for unlocking the movable blade,.

- **Paper jam error while detecting mark**

  The end of mark is not detected after beginning to detect the mark.
  -> Remove the thermal paper or release the platen block once.
  Set the thermal paper or the platen block again, the CPU goes to print-ready status one second later.

- **Presenter paper jam error**

  A presenter sensor PRS1 does not detect the thermal paper although the printer mechanism starts printing and feeds the thermal paper with specified paper length.
  -> Remove the thermal paper or release the platen block once.
  Set the thermal paper or the platen block again, the CPU goes to print-ready status one second later.

- **Paper feed error in presenter**

  An error is detected by the sensor of PRS1 or PRS2 while the presenter feeds the thermal paper.
  -> Remove the thermal paper or release the platen block once.
  Set the thermal paper or the platen block again, the CPU goes to print-ready status one second later.

> **(NOTE)** The Vp voltage allowable range is programmed to be from 20 to 28V in consideration of detection errors and instantaneous changes.

4.4 MECHANISM STATUS OUTPUT

The following four signals indicate the printer mechanism status:

    ST1 (pin 5)
    ST2 (pin 6)
    ST3 (pin 7)
    ST4 (pin34)

For the error status and the solution for each error, see Section 4.3 "ERROR PROCESSING". Mechanism status other than error status are as follows:

- **Initializing**

    Initializing status.

- **Rewriting flash memory**

    Downloading 1-byte or 2-byte characters into the flash memory.

- **Paper-near-end status**

    The CPU is in paper-near-end status when NS (CPU: pin 70) is "High".
    The function setting or Print Stop Capable Paper Detector Selection command can be set so that the CPU stops to print after detecting paper-near-end status.
    When paper-near-end sensor error is set to disable in the function setting, this status does not affect any operation of printer mechanism such as data reception and printing. Only the status is output.

- **Printing**

    The CPU performs the operations such as printing or feeding the thermal paper by command. The CPU does not consider the operation such as feeding the thermal paper by !FEED (pin 114) as printing status.

- **Print-ready status**

    Normal data input and printing are ready in this status.

The status of the signals for each status is listed in Table 4-2.

Table 4-2 Mechanism Status Display

Status	ST1	ST2	ST3	ST4
Initializing	High	High	High	Low
Rewriting flash memory	High	Low	High	High
Thermal head error	Low	Low	Low	Low
Thermal head temperature error	Low	High	Low	Low
Vp voltage error / Vp voltage initialization error	Low	Low	High	Low
Presenter paper jam error / Paper jam error while detecting mark	Low	High	High	Low
Paper feed error in presenter	Low	Low	Low	High
Autocutter error	Low	High	Low	High
Platen block position error	Low	Low	High	High
Out-of-paper error	Low	High	High	High
Paper-near-end	High	Low	High	Low
Printing	High	Low	Low	High
Print-ready	High	Low	Low	Low

If more than one error are overlapped at the same time, the CPU outputs upper status of Table 4-2.

The printing operation is available when the printer mechanism is the Paper-near-end status or lower in Table 4-2.

4.5 AUTO-LOADING

The CPU has an auto-loading function for replacing thermal paper easily. Auto-loading function supporting printer mechanism depends on the model. See CAPDx47 series printer technical reference in advance.

Auto-loading function is that the thermal paper is loaded automatically when the condition of the thermal paper no existence in the printer mechanism and the platen block is set.
The default setting of auto-loading paper length is 640 dots (8cm approximately). The paper feed drive speed is 320 pps.
The settings of auto-loading enable/disable or auto-loading paper feeding length setting can be changed by the function setting command (See Chapter 9 "Auxiliary Functions").
The operation of auto-loading is as follows:
Cut the edge of the thermal paper so that the corners of the thermal paper are square (90°).

1) The printer mechanism should have no thermal paper.
    If the thermal paper exists in the printer mechanism, remove the thermal paper by feed forward or backward.

2) Insert the thermal paper to the paper inlet of the CAPDx47 series printer after the platen block is set. At this time, insert the thermal paper to end of the paper inlet until the auto-loading operation is started.

3) The CPU goes to print-ready status automatically after auto-loading function is completed. However, if the mark mode is enabled by the function setting, the CPU goes to print-ready status after performing the mark detection.
    Printing operation resumes if printing data is stored in the buffer.

4.6 AUTOCUTTER FUNCTION

4.6.1 Autocutter Operation

The CPU has a function to operate the printer mechanism with the autocutter CAPDx47. This function can be selected by function setting.

If this autocutter function is selected, operation of the autocutter can be easily checked as the CPU executes cutting after test printing is completed on printer mechanism. See Section 4.9 "TEST PRINTING" for test printing. See Chapter 9 "Auxiliary Function" for the selection using the function pins.

When connecting the LTPDx47 series printer mechanism, set the SWDIP1-1 to 1 to prevent from initialization error. However, note that setting of SWDIP1-1 as 1 disables autocutter drive command even if the CAPDx47 series printer unit is connected.

4.6.2 Autocutter Initialization

The autocutter is initialized either through power on or through reset by hardware or software if the autocutter is connected and the autocutter function is enabled by the function setting. Moreover, the autocutter is also initialized when the autocutter is set to enable by executing the command.

When the movable blade of the cutter is outside the paper-through window, the cutter-drive motor automatically rotates, returning the movable blade to the home position.

4.6.3 Unlocking of Movable Blade

If the movable blade is locked due to a paper jam or other error and the cutter does not operate, unlock the movable blade by following the procedure below:

(1) When the movable cutter is at the home position

Remove the cause of the lock (such as paper jam). The CPU returns to print-ready status.

(2) When the movable cutter is not at the home position

Autocutter error occurs.
Remove the cause of the lock and release and set the platen block.
The movable cutter returns to the home position automatically after releasing the platen block.

4.6.4 Autocutter Control Timing

The control timing when CAPDx47 series printer unit is connected to the CPU is shown in Figure 4-3.
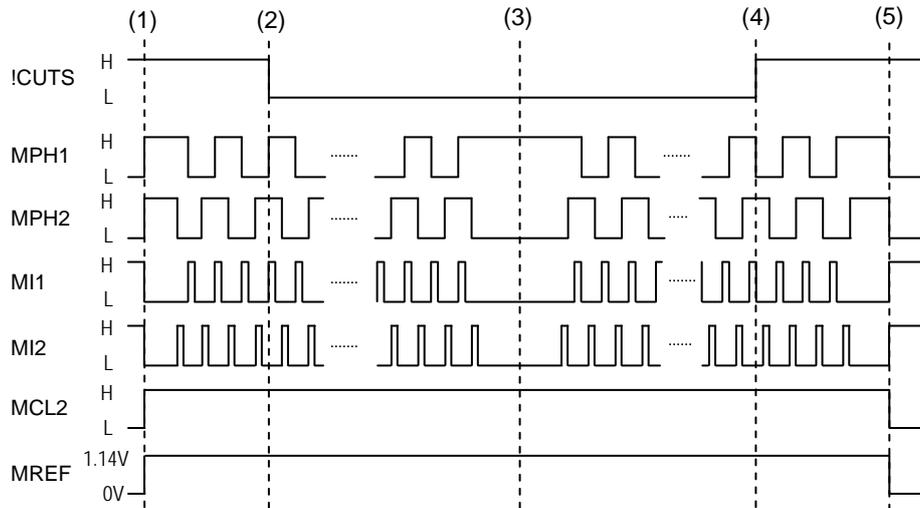
(1) Normarl rotation starts   (2) Sensor OFF   (2) to (3) Normal rotation   (3) to (4) Reverse rotation
(4) Sensor ON   (5) Pause

Full cutting   (2) to (3): 600 steps   (4) to (5): 30 steps
Partial cutting   (2) to (3): 520 steps   (4) to (5): 30 steps

Figure 4-3   Autocutter Control Timing

4.7 PAPER REWIND FUNCTION

The control timing when winder unit is connected to the CPU is shown in Figure 4-4.

To prevent the paper jam, printing is started after performing normal rotation of 8 steps.

(1) Pause   (2) Start step
(3) Normal rotation (8 steps)   (4) Printing
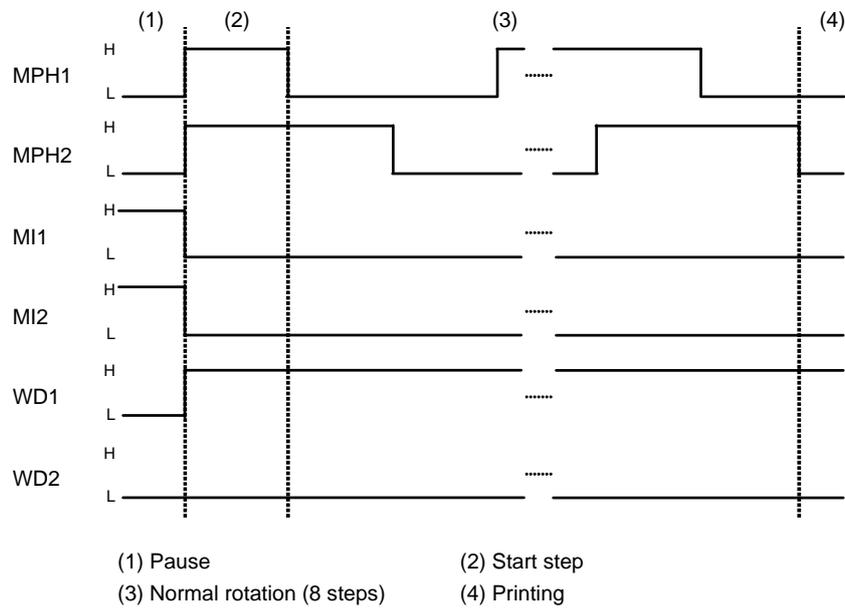
Figure 4-4 Winder Unit Control Timing

4.8 FUNCTION SETTINGS

The following functions can be set with the CPU.

Table 4-3 Function settings

SWDIP No.	Function
1-1	Autocutter selection
1-2,3	Drawer, Winder and Presenter selection
1-4	Auto-loading selection
1-5	Mark sensor selection
1-6	Paper-near-end sensor selection
2-1	Thermal head drive settings
2-2,3	Number of dots selection for dynamic division drive
3-1	Mark mode selection
3-2 to 6	Thermal paper selection
4	Print density selection
5-1	Automatic status response selection
5-2	Print data handling when an error occurs
5-3	CR mode selection in parallel communication
5-4	Paper-near-end sensor error selection
5-5	Initialization performance selection after paper setting
6, 7	Auto-loading paper feeding length setting
8, 9	Mark position correction
10, 11	Mark detection maximum feeding length setting

There are two ways for function settings: the function settings are executed by the command after turn on the printer or initialization (not stored in CG ROM), or the function settings are stored into the CG ROM by the command. When the function settings are stored into the CG ROM, the Chip set rereads the function settings during initialization. Thus, do not need to execute the command for function settings after turn on the printer or initialization.
See Chapter 9 "Auxiliary Function" for the details of function settings and the shipping value.

4.9 TEST PRINT

The CPU has a test print function. The current settings of the function settings and 1-byte characters are printed when a test print is performed.
Through this function, confirming simply the current settings of the function settings and whether or not the circuit and the printer mechanism are connected correctly.
To perform test printing, turn on the power while set the !FEED (CPU: pin114) to "Low", or cancel the reset. The test printing procedure is as follows:

(1) Test printing by turning the POWER ON

Set the !FEED to "Low", and turn on the power. The test print will then start.
When turning the power on, turn on either Vdd and Vp simultaneously, or Vdd first and then Vp.

(2) Test printing by resetting

Turn on both Vdd and Vp (simultaneously, or Vdd first and then Vp).
Set the !RES (CPU: pin 77) to "Low".
Set the !FEED for the printer mechanism to be tested to "Low", and the !RES to "High".
The test print will then start.

(NOTE)   **Test printing can only check SWDIP1 to 4 of the function settings. If want to check after SWDIP5, it is possible to check by Function Set Response command. (9.4.10 Auxiliary Functions DC2 'I')**

```
LTPD-24V series Interface
PTD00P01 [ Ver X.XX ]
  DD.MMM.YYYY
Copyright(C):SII

Mechanism:LTPD247
          58mm,24V,8dot/mm

* SWDIP1 *
1)  Autocutter:Disable
2-3)Peripheral device:Disable
4)  (Reserved)
5)  Mark sensor:Option sensor
6)  Near end sensor:Disable
7-8)(Reserved)

* SWDIP2 *
1)  Head drive:
            Dynamic division
2-3)Division method:144[dot]
5-8)(Reserved)

* SWDIP3 *
1)  Mark mode:Disable
2-6)Thermal paper:TF50KS-E2D
7-8)(Reserved)

* SWDIP4 *
 Print density:100[%]

* Communication type *
 USB communication
 Control model:PTD00

* Font infomation *
 漢字文字の使用可
 外字の使用可
 Down-load Font enable

* Memory infomation *
 User area:880K[byte]
 Check sum 1:XXXX
 Check sum 2:XXXX
 Check sum 3:XXXX
 Check sum 4:XXXX
```

[HEX DUMP MODE]

Figure 4-5 Test Print Sample

4.10   HEX DUMP PRINT

The CPU has a hex dump function which allows data to be printed in hexadecimal code.
Through this function, confirming simply whether or not the data sent from the host device is received correctly or the correct data from the host device has been sent.
A hex dump print is performed after test printing with !FEED.

The hex dump print procedure is as follows:

(1)   A hex dump print by turning the power on

Set the !FEED to "Low", and turn on the power supply. Keep holding !FEED to "Low" until the test printing is completed, a hex dump print will then start.
When turning the power on, turn either Vdd and Vp simultaneously, or Vdd first and then Vp.

(2)   A hex dump print by resetting

Turn on the power supply, turn on Vdd and Vp (simultaneously, or Vdd first and then Vp).
Set the !RES signal (CPU: pin 77) to "Low". Set the !FEED to "Low", and the !RES must be "High". Keep holding !FEED to "Low" until the test printing is completed, the hex dump will then start.

When '[HEX DUMP MODE]' is printed, return the !FEED to "High".
The data after the !FEED returned to "High" is printed all in hexadecimal code.
The data is printed eight bytes each. Data less than eight bytes is printed when the !FEED is switched to "Low".

```
                [ HEX DUMP MODE ]

                20 21 22 23 24 25 26 27
                28 29 2A 2B 2C 2D 2E 2F
                30 31 32 33 34 35 36 37
                38 39 3A 3B 3C 3D 3E 3F
                40 41 42 43 44 45 46 47
                48 49 4A 4B 4C 4D 4E 4F
                50 51 52 53 54 55 56 57
                58 59 5A 5B 5C 5D 5E 5F
                60 61 62 63 64 65 66 67
                68 69 6A 6B 6C 6D 6E 6F
                70 71 72 73 74 75 76 77
                78 79 7A 7B 7C 7D 7E 7F
```

Figure 4-6 Hex Dump Print Sample

4.11   SELECTING THE POWER SUPPLY

To determine the power supply for driving the CPU, see Chapter 5 "ELECTRICAL CHARACTERISITICS".
Vp and Vdd must be connected to the same ground.
Vdd must satisfy the conditions given below. The electric current means the required amount when using the recommended circuit. When changing or extending the circuit, determine the power supply according to the circuit used.

> Vdd (for circuit): 3.0 to 3.6V   0.35A min.

The maximum current consumption of Vp changes depending on the voltage and the print method. Select the power supply according to the print method and the voltage used.

> Vp (for thermal head and motor): 21.6 to 26.4V

When the maximum number of activated dots is N, the maximum current consumption of Vp is:

> $Ip(max.) = Vp \times N/1455 + 0.6$ (A)

- **When driving the printer mechanism with fixed division**

  When selecting the fixed division mode, substitute the value in Table 4-4 to N.

Table 4-4 Maximum Number of Activated Dots (fixed division mode)

Printer	Maximum number of activated dots (N)
LTPD247/CAP247	288
LTPD347/CAP347	288

- **When driving the printer mechanism with dynamic division**

  When selecting the dynamic division mode, set N as the value specified by the function setting or command (DC2 '%'). the default value is N=144.

Be careful that voltage drops due to the wiring resistance because a large current flows to Vp.
Narrow and/or long wiring for the power supply line may cause pale or uneven printing due to the voltage drop when the thermal head is activated.

CHAPTER 5

HARDWARE SPECIFICATIONS

Chapter 5 describes the pin functions and connection circuit sample. Unless particularly stated otherwise in a sentence, the terminal number shows the CPU terminal.

5.1 ELECTRICAL CHARACTERISTICS

If the CPU and CG ROM exceed the absolute maximum ratings because that is the C-MOS devices, there is a possibility of breaking the chip by voltage, heat, latch-up, etc.
Also, malfunctions may occur if the operating range is exceeded. Pay attention to the absolute maximum ratings, the operating ranges, and the electrical characteristics, when designing the peripheral circuits.
Latch-up means that when a voltage of Vdd + 0.3 V or more, or GND − 0.3 V or less, is applied to the signal pin, the IC is damaged by the flow of excessive current in the IC.

5.1.1   Absolute Maximum Ratings

Table 5-1 and Table 5-2 list the absolute maximum ratings of the CPU and CG ROM.

Table 5-1 CPU Absolute Maximum Ratings

Item	Symbol	Conditions	Rating
Power supply voltage	Vdd	—	−0.3 to 4.6V
Analog power voltage	AVdd	—	−0.3 to 4.6V
Input voltage	Vi	—	−0.3 to Vdd+0.3V
Output voltage	Vo	—	−0.3 to Vdd+0.3V
Operating temperature	Topr	—	−20 to 75°C
Storage temperature	Tstg	—	−55 to 125°C

Table 5-2 CG ROM Absolute Maximum Ratings

Item	Symbol	Conditions	Rating
Power supply voltage	Vdd		−0.6 to 4.0V
Input voltage	Vi	For Vss	−0.6 to Vdd +0.6V
Output voltage	Vo		−0.6 to Vdd +0.6V
Operating temperature	Topr	—	−50 to 125°C
Storage temperature	Tstg	—	−55 to 125°C

5.1.2 Operating Ranges

Table 5-3 and Table 5-4 list the operating ranges of the CPU and CG ROM.
The range of operating temperature means the operating range of IC itself and does not mean the range for printing using the printer mechanism.

Table 5-3 CPU Operating Range Characteristics

Item	Symbol	Conditions	MIN	STD	MAX
Power supply voltage	Vdd	—	3.0 V	3.3 V	3.6 V
High input voltage	Vih	!RES, !STBY, HTE, MD0 to 2	0.9Vdd	—	Vdd+0.3 V
		Other than the above	0.7Vdd	—	Vdd+0.3 V
Low input voltage	Vil	!RES, !STBY, MD0 to 2	−0.3 V	—	0.1Vdd
		Other than the above	−0.3 V		0.2Vdd
Threshold voltage	VT$^+$	!CTS/SELECTIN, PSTB, !DSR/PINIT, PRS2	—	—	0.7Vdd
	VT$^-$	!CTS/SELECTIN, PSTB, !DSR/PINIT, PRS2	0.2Vdd	—	—
Operating temperature	Topr	—	−20ºC	—	75ºC
Operating frequency	Fop	—	11.9988 MHz	12 MHz	12.0012 MHz
Operating cycle	tcyc	—	83.325 ns	83.333 ns	83.341 ns

Table 5-4 CG ROM Operating Range Characteristics

Item	Symbol	Conditions	MIN	STD	MAX
Power supply voltage	Vdd	—	3.0 V	3.3 V	3.6 V
	Vss	—	0.0 V	0.0 V	0.0 V
High input voltage	Vih	—	0.7Vdd	—	Vdd+0.3 V
Low input voltage	Vil	—	−0.5 V	—	0.8 V
Operating temperature	Topr	—	−40ºC	—	85ºC

5.1.3 DC Characteristics

Table 5-5 and Table 5-6 list the DC characteristics of the CPU and CG ROM.

Table 5-5 CPU DC Characteristics

(Unless otherwise specified, Vdd = 3.3 V, Topr = 25°C, Fop = 12 MHz)

Item	Symbol	Conditions		MIN	STD	MAX
High output voltage	Voh	Ioh=−200 μA		Vdd−0.5 V	—	—
		Ioh=−1 mA		Vdd−1.0 V	—	—
Low output voltage	Vol	Iol=1.6 mA		—	—	0.4 V
Hysteresis	ΔV	!CTS/SELECTIN, PSTB, !DSR/PINIT, PRS2		0.06 Vdd	—	—
Input leakage current	Iih	Vi=0.5 to Vdd−0.5 V	!RES	—	—	10.0 μA
			Other than !RES	—	—	1.0 μA
Current consumption	Icc	Vih=Vdd−0.5 V Vil=0.5 V Unloaded condition		—	50 mA	85 mA

Table 5-6 CG ROM DC Characteristics

Item	Symbol	Conditions	MIN	STD	MAX
High output voltage	Voh	Ioh=−100 μA	Vdd−0.4 V	—	—
Low output voltage	Vol	Iol=1.8 mA	—	—	0.45 V
Input leakage current	Iih	Vi=0 to Vdd	−1.0 μA	—	1.0 μA
Output leakage current	Ioh	Vo=0 to Vdd	−1.0 μA	—	1.0 μA
Power current (Reading)	Icc	Cycle= 6 MHz, all output open !CE=Vil, !OE=Vih	—	—	20.0 mA
Power current (Writing or Erasing)	Iccw	Writing or Erasing	—	—	30.0 mA
Power current (Stand-by)	Iccs	all output open !CE=!RESET=Vdd	—	—	150 μA

5.1.4 AC Characteristics

(1) CPU AC Characteristics

Table 5-7 and Figure 5-1 show the AC characteristics of CPU.

Table 5-7 CPU Access Timing Characteristics

(Vdd= 3.3 V, Topr = 25°C)

Item	Symbol	MIN	MAX
Address delay time	t_{AD}	—	15 ns
!CS delay time 1	t_{CSD1}	—	15 ns
Read strobe delay time 1	t_{RSD1}	—	15 ns
Read strobe delay time 2	t_{RSD2}	—	15 ns
Data setup time for read	t_{RDS}	15 ns	—
Data hold time for read	t_{RDH}	0 ns	—
Data access time for read	t_{ACC}	—	83 ns
Access time from read strobe	t_{OE}	—	73 ns
Write strobe delay time 1	t_{WRD1}	—	15 ns
Write strobe delay time 2	t_{WRD2}	—	15 ns
Write data delay time	t_{WDD}	—	20 ns
Write strobe time	t_{WSW}	59 ns	
Data setup time for write	t_{WDS}	0 ns	—
Data hold time for write	t_{WDH}	3 ns	—
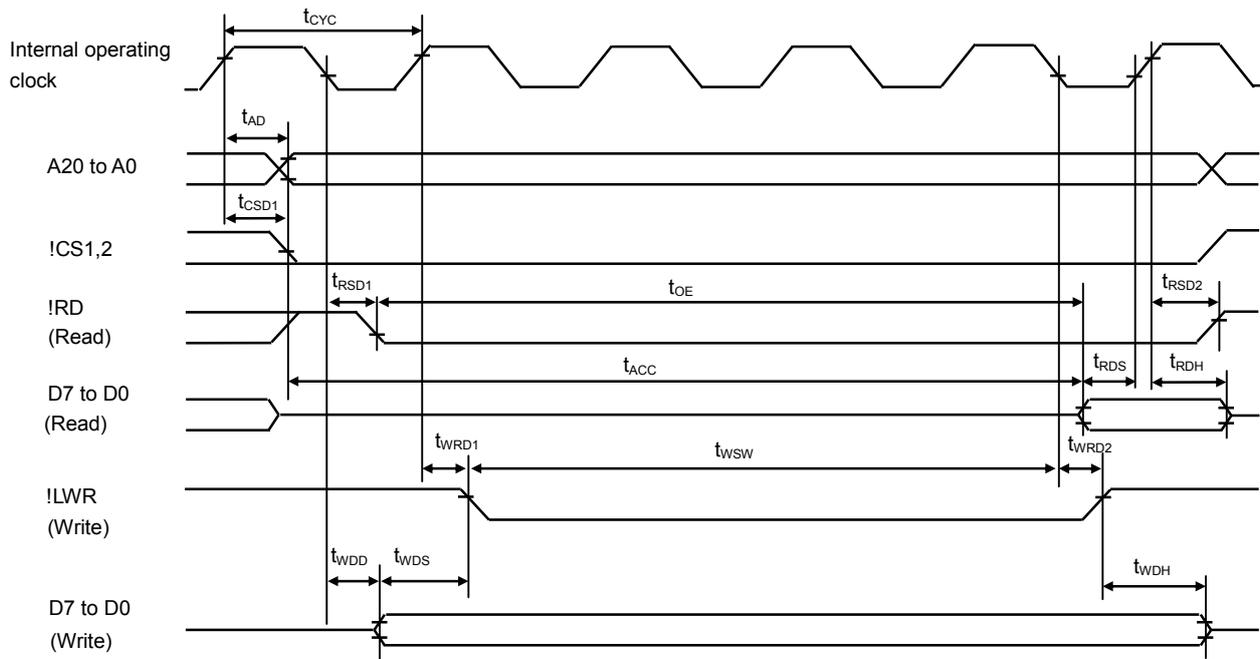
Figure 5-1 CPU Access Timing

(2) CG ROM AC Characteristics

Table 5-8 and Figure 5-2 show the AC characteristics of CG ROM.

Table 5-8 CG ROM Access Timing Characteristics

- **Read Cycle**

Item	Symbol	MIN	MAX
Read cycle time	t_{RC}	70 ns	—
Address access time	t_{AA}	—	70 ns
!CE access time	t_{ACE}	—	70 ns
!OE access time	t_{OE}	—	30 ns
!CE, !OE output disable time	t_{DF}	—	25 ns
Output holding time	t_{OH1} t_{OH2}	0 ns	—

Timing conditions:
    Time of input rising and falling: 10 ns
    Voltage of timing measurement point: Vdd/2
    Load condition: CL =30pF+ 25kΩ pull-up resistance+ 25kΩ pull-down resistance

- **Write Cycle**

Item	Symbol	MIN	MAX
Write cycle time	t_{WC}	70 ns	—
Address access time	t_{AS}	0 ns	—
Address holding time	t_{AH}	45 ns	—
!CE setup time	t_{CS}	0 ns	—
!CE holding time	t_{CH}	0 ns	—
Write pulse time	t_{WP}	45 ns	—
Data setup time	t_{DS}	45 ns	—
Data holding time	t_{DH}	0 ns	—
Vdd setup time	t_{VDS}	50 µs	—

Timing conditions same as read cycle.

- **Read Cycle**
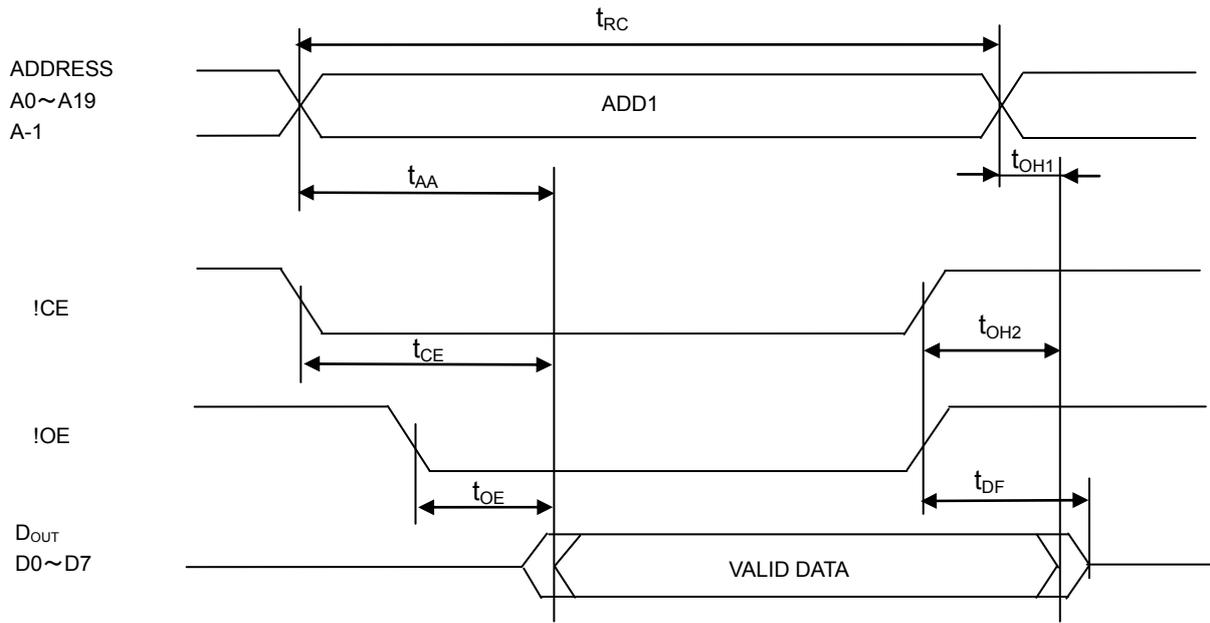
- **Write Cycle**
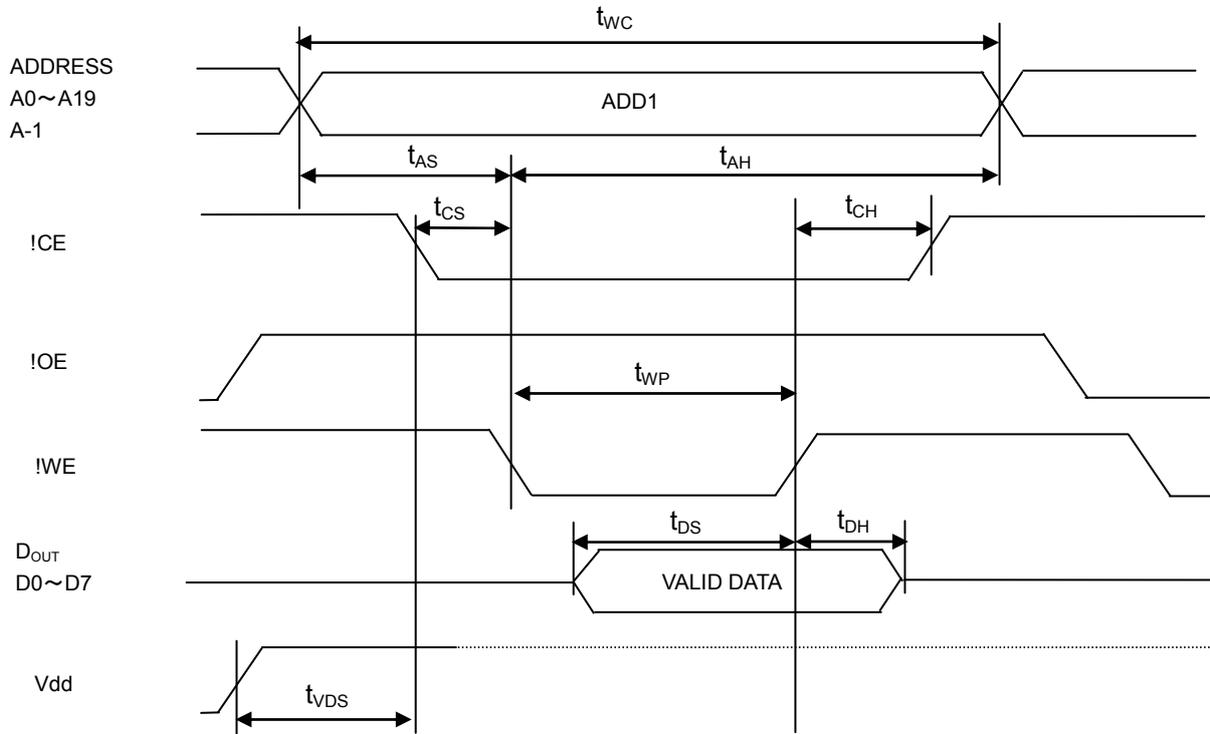
Figure 5-2 CG ROM Access Timing

5.2 POWER CONNECTION

The CPU and CG ROM power pins must be connected as listed in Table 5-9 and Table 5-10.
Use the bypass capacitor from 0.01 µF to 0.1 µF between the following pins, which should be mounted in as close contact as possible with the chip.

- Between the pins of Vdd and Vss
- Between the pins of AVdd and AVss
- Between the pins of Vref and AVss
- Between the pins of DrVdd and DrVss

Table 5-9 CPU Power Pin Connection

Pin No.	Symbol	Connection
10, 17, 26, 42, 57, 67, 76, 82, 117	Vss	Connected to GND
19, 44, 62, 85, 119	Vdd	Connected to Vdd
101	AVdd	Connected to Vdd
105	Vref	Connected to Vdd
103	AVss	Connected to GND
36	DrVdd	Connected to Vdd
39	DrVss	Connected to GND

Table 5-10 CG ROM Power Pin Connection

Pin No.	Symbol	Connection
37	Vdd	Connected to Vdd
27, 46	Vss	Connected to GND

5.3 RESET CIRCUIT

When the !RES pin (pin 77) is reset to "Low", the CPU will be in reset status.
Figure 5-5 shows a sample reset circuit.

Table 5-11 CPU Reset Timing Characteristics

Symbol	Item	MIN	MAX
tosc	!RES oscillation stabilizing time	10 ms	—
tresw	!RES pulse width	20 tcyc	—
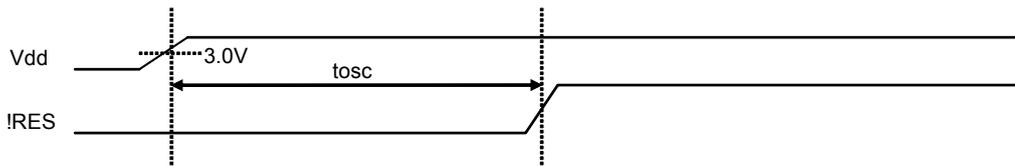
Figure 5-3 Oscillation Stabilizing Time
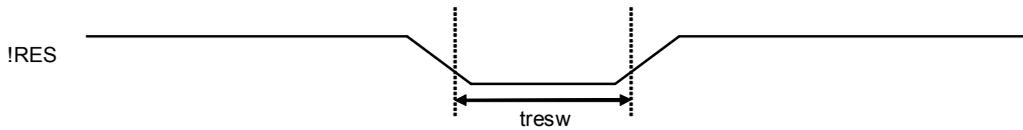
Figure 5-4 Reset Input Timing

*   Recommended IC: S-80927CNNB-G8XT2G (Seiko Instruments Inc.)
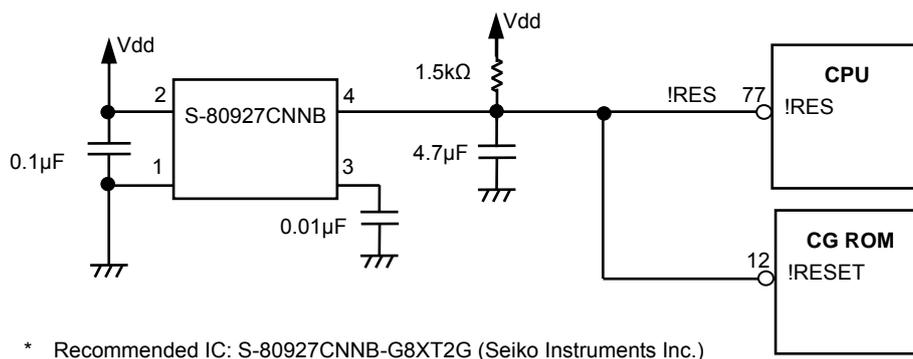
Figure 5-5 Sample Reset Circuit

5.4 OSCILLATOR CIRCUIT

5.4.1 Clock Input Circuit

Input a clock signal to the EXTAL pin (pin 84) so that the internal clock is set to 12 ± 0.0012 MHz.

Make XTAL pin (pin 83) open when inputting the external clock.
Figure 5-6 shows a sample external crystal oscillator circuit.
Figure 5-7 shows a sample external clock input circuit.

Table 5-12 Clock Timing

Symbol	Item	MIN	MAX
Fop	EXTAL clock input frequency	11.9988 MHz	12.0012 MHz
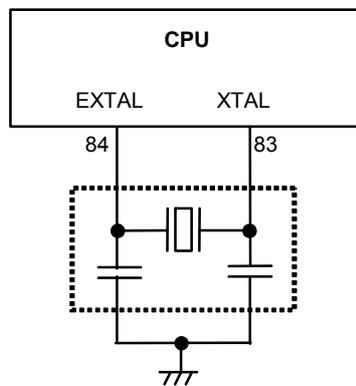
Recommended crystal oscillator: CX5032GB12000H0PHSZZ (KYOCERA)

Figure 5-6 Sample External Crystal Oscillator Circuit
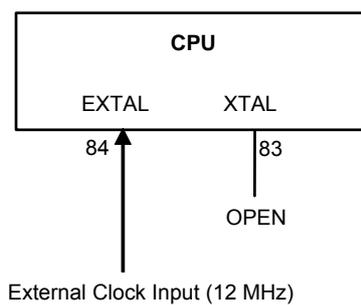
Figure 5-7 Sample External Clock Input Circuit

5.5 SWITCH CIRCUIT

The CPU has !FEED (pin 114) for feeding paper forward on printer mechanism. If pin is set to "Low", the thermal paper is fed forward on respective printer mechanism.
Chattering prevention processing for !FEED is performed by software. For normal operation, set the pins to low for at least 30 ms.

When each switch is set to "Low", the CPU operates as follows:

(1) In the mark mode

1) The CPU feeds the thermal paper to the mark.

2) After feeding the thermal paper to the mark, position correction is performed according with the function setting.

3) After this, paper cutting is performed when the autocutter is enabled.

(2) In other than the mark mode

1) The CPU feeds the thermal paper for one line in the forward direction.

2) After feeding the first line, operation is suspended for 0.5 second.

3) After this, the CPU continues to feed thermal paper one line at a time until the signal input returns to "High".

The amount of paper feed just after initialization is 34 dot lines (approximately 4 mm).

(NOTE)   !FEED pin must be pulled up to Vdd when it is not used.
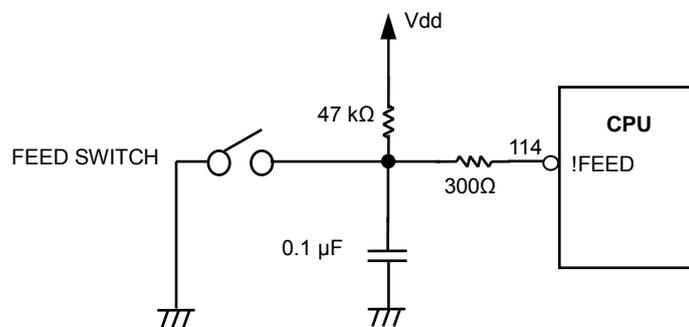
Figure 5-8 Sample Switch Circuit

5.6 DISPLAY CIRCUIT

The status of the printer mechanism can be determined according to the status of ST1 pin (pin 5), ST2 pin (pin 6), ST3 pin (pin7) and ST4 pin (pin 34). If the circuit shown in Figure 5-9 is connected to these pins, the status of the mechanism can be displayed as listed in Table 5-13.

(NOTE) **ST1 to ST4 must be open when they are not used.**

Table 5-13 Mechanism Status Display

Status	ST1	ST2	ST3	ST4
Initializing	High	High	High	Low
Rewriting flash memory	High	Low	High	High
Thermal head error	Low	Low	Low	Low
Thermal head temperature error	Low	High	Low	Low
Vp voltage error / Vp voltage initialization error	Low	Low	High	Low
Presenter paper jam error / Paper jam error while detecting mark	Low	High	High	Low
Paper feed error in presenter	Low	Low	Low	High
Autocutter error	Low	High	Low	High
Platen block position error	Low	Low	High	High
Out-of-paper error	Low	High	High	High
Paper-near-end	High	Low	High	Low
Printing	High	Low	Low	High
Print-ready	High	Low	Low	Low

If more than one error are overlapped at the same time, the CPU outputs upper status.
For example, when platen position error and Vp voltage error have occurted at the same time, CPU outputs Vp voltage error only. When Vp voltage error and thermal head temperature error have occured at the same time, CPU outputs thermal head temperature error only.
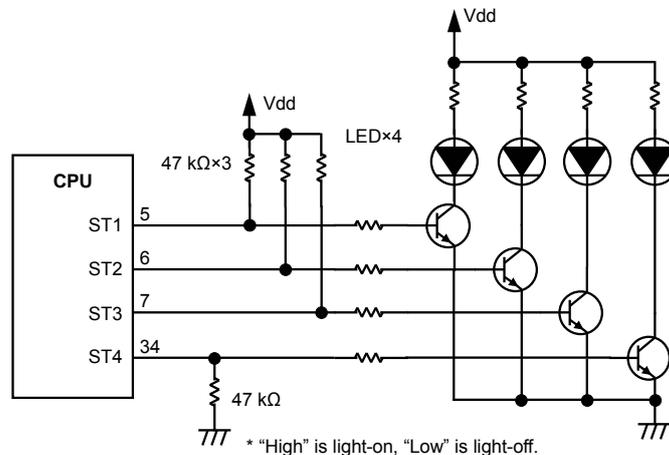
Figure 5-9 Sample Display Circuit

5.7 INTERFACE SELECTION CIRCUIT

The CPU has two pins IF1 (pin 120) and IF2 (pin 51) for selecting interface. The CPU reads these status just after POWER ON. Pull up or down these pins according to interface used.
IF1 is shared with !PDCS for parallel communication. When using paralell communication, see 5.8 "PARALLEL INPUT/OUTPUT CONTROL CIRCUIT".
IF2 is shared with !RTS for serial communication. When using serial communication, see 5.9 "SERIAL INPUT/OUTPUT CONTROL CIRCUIT".

Table 5-14 Interface Selection Pins

Interface	IF2	IF1
USB	Low	Low
Parallel	Low	High
Serial	High	Low
No selection	High	High
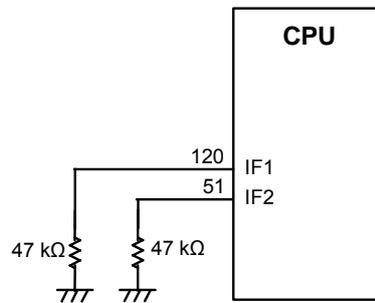
Figure 5-10 Sample Interface Selection Circuit (USB use)

5.8 PARALLEL INPUT/OUTPUT CONTROL CIRCUIT

The parallel input/output control circuit supports data reception according to the ordinary, simplified Centronics mode and data transmission according to IEEE1284 nibble mode. The CPU processes data at the input/output voltage level of 3.3 V. Be sure to use a level conversion when connecting to the interface which applies 5.0 V

5.8.1 Input/output Port

The following pins are used for parallel input/output.

- **PSTB (pin 86): Input**

  The PSTB signal is a strobe signal to read data.
  The rising edge of this signal generates an interrupt signal to the CPU and starts reading the data after shifting !PDCS (pin 120) to "Low".
  This signal is ignored when PBUSY is "High".

- **PBUSY (pin 50): Output**

  The PBUSY signal indicates that the CPU is ready to receive data.
  When the PBUSY signal is "Low", data can be input.
  This signal remains "High" until the input processing of one byte of data is complete.
  The PBUSY signal outputs "High" after inputting one byte of data when an error occurred.

- **!PACK (pin 49): Output**

  The !PACK signal indicates that the data receiving is complete.
  The !PACK signal is normaly "High" and outputs "Low" pulse when the input processing of one byte of data is complete.
  The next data can be received after outputting !PACK signal.

- **SELECTIN (pin 43): Input**

  The SELECTIN signal changes two modes nibble mode and Centronics mode.
  When detecting "High", the mode begins to change to nibble mode.

- **AUTOFEED (pin 80): Input**

  The AUTOFEED signal ignores during data receiving.
  In the nibble mode, the AUTOFEED is used hand-shake method as HostBusy.

- **PINIT (pin 45): Input**

  The PINIT signal is used for the printer initialization.
  When detecting "High", the CPU begins to initialize the printer mechanism.

(NOTE) **When parallel input/output is not be used, deal with the pins as follows:**
PSTB, SELECTIN and PINIT must be pulled down to GND.
AUTOFEED must be pulled down to GND when the serial communication is also not used.
PBUSY and !PACK must be open.
Those pins of PSTB, SELECTIN and AUTOFEED for the parallel communication and !CTS, !DSR and RxD for the serial communication are used by same assignments respectively, use selected interface communication according to section "5.7 INTERFACE SELECTION CIRCIT".

5.8.2 Data Reception

The CPU receives parallel data using an 8-bit parallel hand-shake method.

Data reception can be executed during printing. The PBUSY and !PACK signals are output every byte. When the remaining capacity of the input buffer is 4096 bytes, PBUSY continues to be "High" until the remaining capacity of the input buffer becomes 4095 bytes or lower.

Figure 5-11 shows input/output timing of the data in the CPU pins.
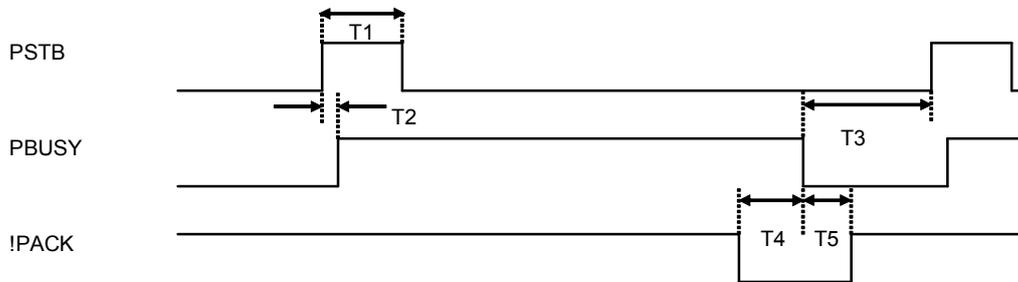
Figure 5-11 Parallel Data Receiving Timing

Table 5-15 Parallel Data Receiving Timing Characteristics

(Vdd = 3.3 V $\pm$ 10%, Topr = -20 to 75$\degree$C)

Symbol	Item	MIN	MAX
T1	PSTB Pulse Width	2tcyc	—
T2	PSTB$\uparrow$ to PBUSY$\uparrow$	—	65ns + 2tcyc
T3	PBUSY$\downarrow$ to PSTB$\uparrow$	0 ns	—
T4	!PACK$\downarrow$ to PBUSY$\downarrow$	1.8 μs	—
T5	PBUSY$\downarrow$ to !PACK$\uparrow$	1.8 μs	—

5.8.3 Data Transmission

The CPU transmits parallel data such as following using an IEEE1284 nibble mode.

A response data by response function commands

The response data is stored in the output buffer. When the host device requires the nibble mode, the response data is transferred. The capacity of output buffer is 256bytes. The CPU does not perform printing processing and so on until the output buffer full is cleared.

5.8.4 Sample Circuit

Figure 5-12 shows a sample parallel input/output control circuit.
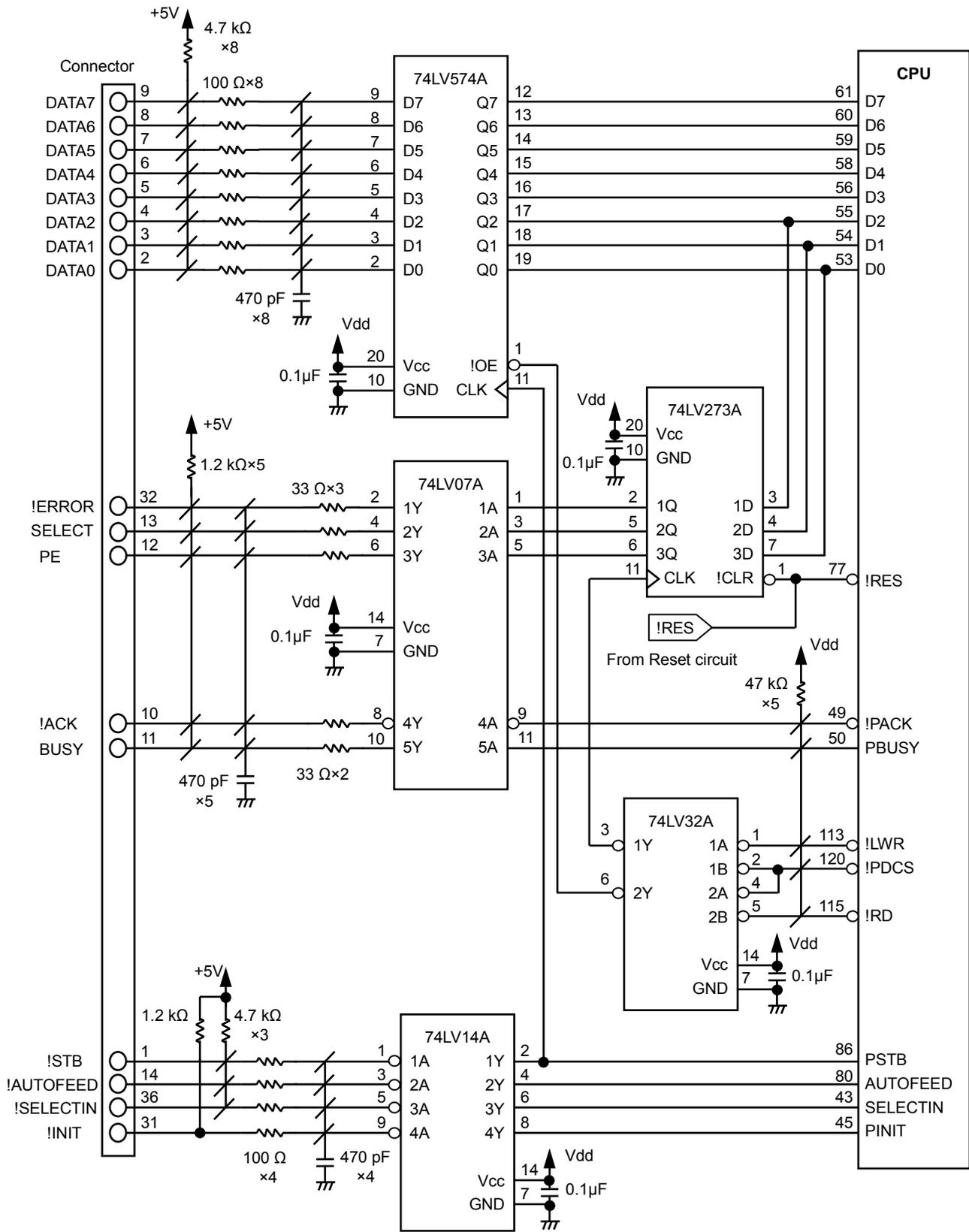
Figure 5-12 Sample Parallel Input/Output Control Circuit

5.9 SERIAL INPUT/OUTPUT CONTROL CIRCUIT

The input and output of serial data is performed using asynchronous serial communication.
The CPU processes data at the input/output voltage level of 3.3 V.

5.9.1 Input/output Port

The following pins are used for seial input/output.

- **TxD (pin 79): Output**

  Data output port.
  When Xon/Xoff control is selected, the Xon/Xoff signal is output.

- **RxD (pin 80): Input**

  Data input port.
  Break processing (hardware reset) is performed by inputting "Low" into RxD 20ms or longer.

- **!RTS (pin 51): Output**

  Indicates whether or not the printer is ready to receive data.
  When the !RTS is "Low", data can be input.
  !RTS is a pin for interface selection, which requires its status to be pulled up with Vdd during serial communication.

- **!CTS (pin 43): Input**

  Reserved pin.
  Must be pulled down to GND.

- **!DTR (pin 87): Output**

  Reserved pin.
  Must be opened.

- **!DSR (pin 45): Input**

  Reserved pin.
  Must be pulled down to GND.

(NOTE) When serial input/output is not used, deal with these pins as follows:
TxD and !DTR must be open.
RxD must be pulled up to Vdd when the parallel communication is also not used.
!CTS and !DSR must be pulled down to GND when the parallel communication is also not used.
!RTS is common use with the interface selection (IF2). Set !RTS according to the interface in use.
Those pins of PSTB, SELECTIN and AUTOFEED for the parallel communication and !CTS, !DSR and RxD for the serial communication are used by same assignments respectively, use selected interface communication according to section "5.7 INTERFACE SELECTION CIRCIT".

5.9.2 Data Reception

The printer receives data during the printer printing. However, when the input buffer becomes 4032 bytes or more, the printer performs the following and requires the host device to temporarily stop transferring data.

- Switches the !RTS to "High"
- Outputs Xoff (13H) from the TxD

After that, when the input buffer becomes 3968 bytes or less, the printer performs the following and requires the host device to resume data transferring.

- Switches the !RTS to "Low"
- Outputs Xon (11H) from the TxD

Up to 64 bytes of input data are guaranteed after the !RTS signal has become "High".

5.9.3 Data Transmission

CPU transmits various data such as response data by the response command other than the Xon and Xoff codes which are output when controlling Xon and Xoff, through TxD.

5.9.4 Transmission Conditions

When selecting serial input, the transmission conditions are fixed as follows. However, when transferring data, data control by !CTS and Xon/Xoff is not executed, and the data is freely transferred.

Baud rate: 115200 bps
Parity: None
Data control: Busy, Xon/Xoff (simultaneous output)
Data bit length: 8 bits
Stop bit length: 1 bit

5.9.5 Sample Circuit

Figure 5-13 shows a sample serial Input/output control circuit.
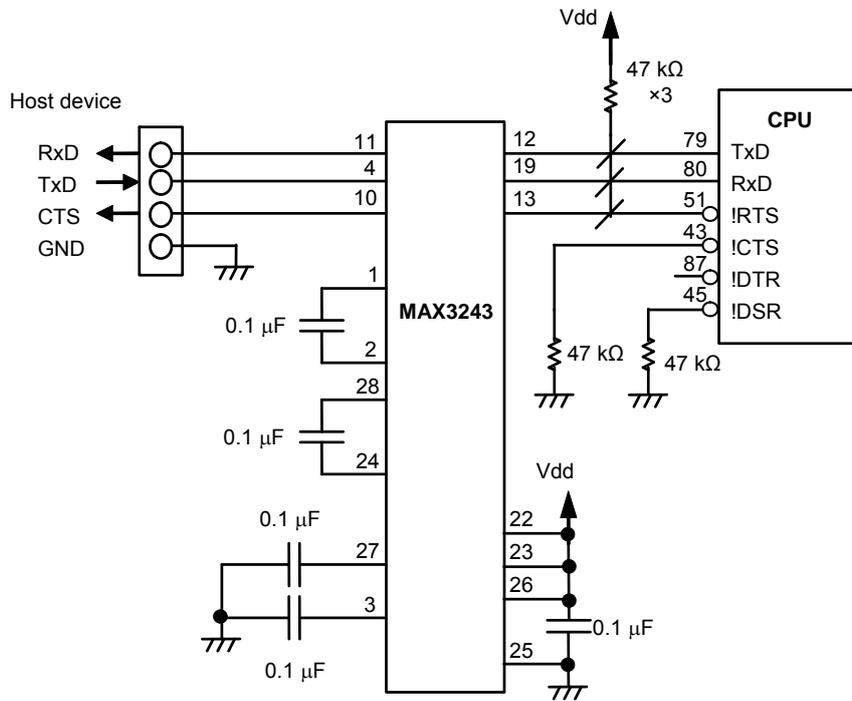
*: IC used: MAX3243(Texas Instruments)

Figure 5-13 Sample Serial Input/output Circuit

5.10   USB INPUT/OUTPUT CONTROL CIRCUIT

The USB transmission control supports bidirectional communication by bulk transfer that is based on USB standard. This CPU has the circuit configuration that uses the Philips USB controller to realize the USB communication.

5.10.1 Input/output Port

In the control with the USB controller, the following pins are used for the USB input/output.

- **USBD+ (pin37), USBD- (pin 38): Input/Output**

  Uses data transmission to input/output.

- **Vbus (pin 40): Input**

  Detects USB cable condition whether connecting or disconnecting.

- **USB_PULLUP (pin 35): Output**

  Controls USBD+ for pull up.

> **(NOTE)   When USB input/output is not used, deal with these pins as follows:**
> **USBD+ and USBD- must be open.**
> **Vbus and USB_PULLUP must be pulled down to GND.**

5.10.2 Data Reception

This CPU uses a bulk-out transfer method for the USB data input.
The data are received even during the printing operation, and when the data accumulate in the input buffer by the amount of 4032 bytes + 2 packets, the NAK response continues until the data processing progresses to 3968 bytes or less.
The number of bytes that can be received with one packet is maximum 64 bytes.

5.10.3 Data Transmission

This CPU uses a bulk-in transfer method for the USB data output.

The response data are stored temporarily in the output buffer, and a response is made to the bulk-in packet request from the host device. If no transmission data exist, the zero length data is returned when the bulk-in request is received. The number of bytes that can be transmitted with one packet is maximum 64 bytes. The output buffer size for USB data output is 256 bytes, and when this output buffer becomes full, the print processing, etc. are disabled until a space is made in the output buffer, thus requiring the care.

5.10.4 Sample Circuit

Figure 5-14 shows a sample USB data input/output circuit.
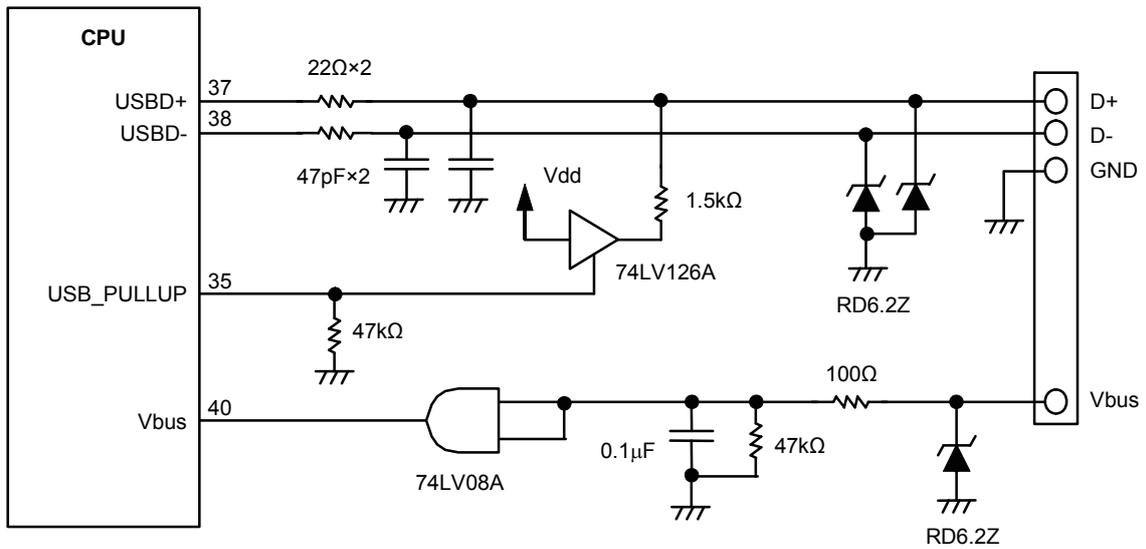
∗ IC used: HD74LV08A(Renesas Technology) HD74LV126A(Renesas Technology)

* Change the circuit constant or add filters according to the noise condition in your operating environment.
* Make sure a product conforms to a USB standard because that is affected by a circuit design or a pattern design etc.

Figure 5-14 Sample USB Circuit

5.11 OUT-OF-PAPER SENSOR, OPTION MARK SENSOR CIRCUIT

The CPU uses the input signal from the photo-interrupter mounted in the printer mechanism to check for thermal paper.
The CPU determines that thermal paper exists when PS (pin 107) is "Low", and determines the printer mechanism is out of paper when "High".
When PS goes "High", the CPU enters the out-of-paper error status after printing stops. If the thermal paper is installed to the printer mechanism, the CPU goes to print-ready status one second later.
When the CPU is in the standard mode, stopped data is resumed to print from the line beginning in error occurred.
When the CPU is in the page mode, the print is begun from the top of page.
Moreover, out-of-paper sensor also can be used as the mark sensor.
In this case, the CPU determines as the mark when PS is "High".

In addition to use as paper sensor, the CPU can feed the thermal paper to the mark detection using option mark sensor.
The CPU determines as the mark when OPS (pin 99) is "High".
CPU performs status output or status response, only if Paper jam error while detecting mark occurred.

One of the out-of-paper sensor or the option sensor can be set as the mark sensor by the function setting. See Chapter 9 "Auxiliary Function" for setting.

Figure 5-15 shows a sample out-of-paper sensor, option mark sensor circuit.
The CPU outputs the sensor switching signal (MSSW). MSSW (pin 112) becomes "High" when the sensor is detecting.

> **(NOTE)** MSSW must be opened when it is not used.
> OPS must be connect to the GND when it is not used.
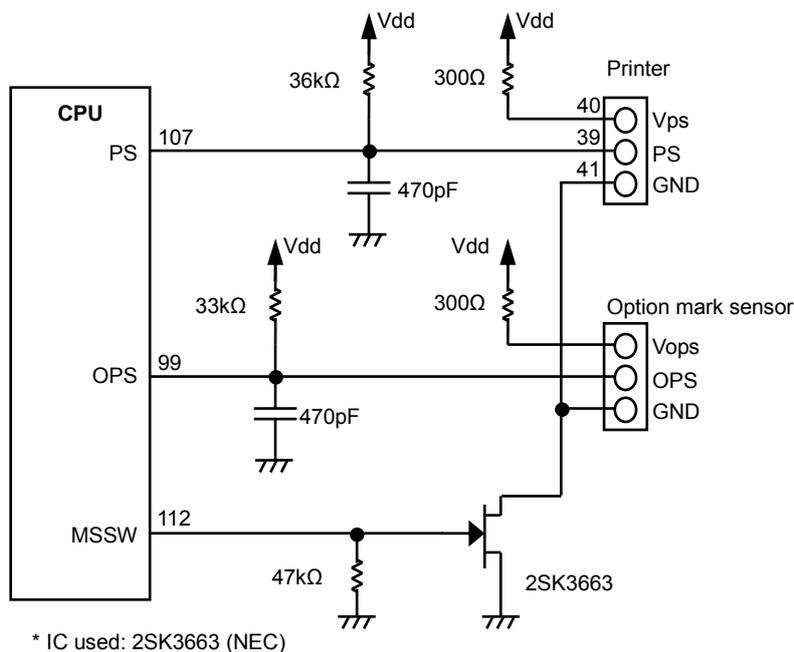
Figure 5-15 Sample Out-of-paper Sensor, Option Mark Sensor Circuit

5.12   PLATEN POSITION DETECTION CIRCUIT

The CPU uses the signal from the mechanical switch mounted in the printer mechanism to check the platen status, released or set.
The CPU interprets the platen block is released when HS (pin 71) is "High" and the platen block is set when HS is "Low".
When HS is "High" (platen block released), the CPU enters the platen block position error status after printing present dot line. When the platen block is set, the CPU goes to the print-ready status one second later. In the standard mode, the CPU resumes printing from the beginning of the interrupted line. In the page mode, the CPU resumes printing from the top of the page.

Figure 5-16 shows a sample platen position sensor circuit.

The CPU outputs the sensor switching signal (MSSW). MSSW (pin 112) becomes "High" when the sensor is detecting.
Avoid platen release rever operation during printing as this may deteriorate the thermal head.
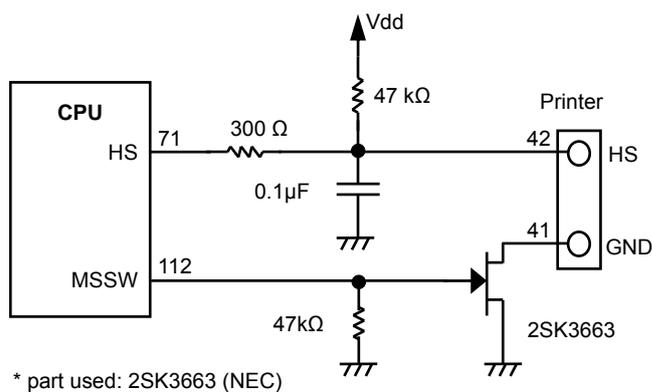
Figure 5-16 Sample Platen Position Sensor Circuit

5.13 PAPER-NEAR-END DETECTION CIRCUIT

The CPU detects paper-near-end status using a mechanical switch or photo interrupter aside from the out-of-paper sensor of the printer mechanism.
The CPU determines that paper-near-end occurs when NS (pin 70) is "High", and determines the thermal paper exists in the printer mechanism when "Low".
When paper-near-end is detected, a bit at paper-near-end of status response becomes 1.

Select the paper-near-end sensor is enable/disable through the function setting. See Chapter 9 "Auxiliary Function".
The function setting or Print Stop Capable Paper Detector Selection command can be set so that the CPU stops to print after detecting paper-near-end status. See Chapter 9 "Auxiliary Function" for the command.

Figure 5-17 shows a sample paper-near-end detection circuit.

Use the following part of the reflection type photo interrupter or the equivalent as the paper-near-end sensor to detect paper-near-end status.

Type: NJL5902RB

Manifacturer: New Japan Radio Co.,Ltd

(NOTE) If NS is not used, it must be pulled down to GND.

---

* part used: 2SK3663 (NEC)
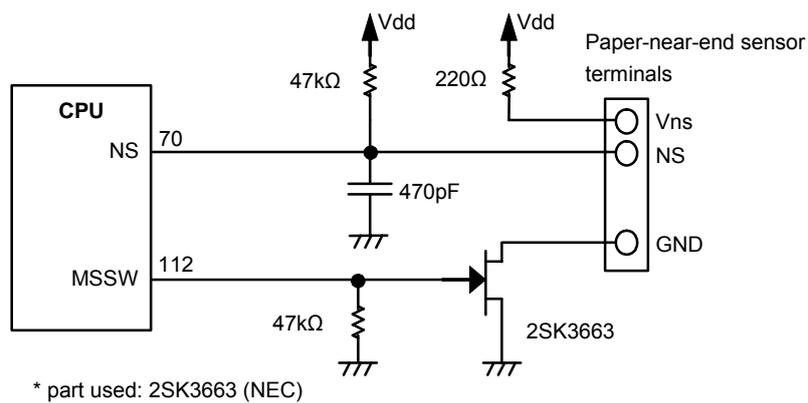
Figure 5-17 Sample Paper-near-end Detection Circuit

5.14   VOLTAGE MEASUREMENT CIRCUIT

The CPU has the capability to measure Vp and reference voltages for detecting the thermal head apply energy or various errors. The CPU does not work without the Vp voltage measurement circuits.

(1)   Reference Voltage Detection Circuit

A reference voltage of 2.495 V must be input to SVdd (pin 98).
This voltage uses as the reference voltage for measuring the Vp or thermistor voltages. Figure 5-18 (A) shows a sample reference voltage sensing circuit.

This circuit may be omitted if Vdd is stabilized at 3.3 V±1%. If the circuit is omitted, connect SVdd to GND, as shown in Figure 5-18 (B). Process it with Vdd at 3.3 V and the reference voltage at 2.495 V.

(A)

(B)   Processing SVdd pin without reference voltage
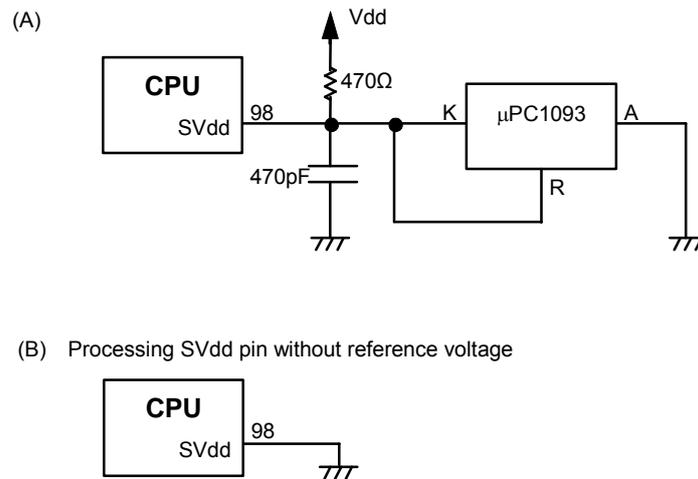
Part used: µPC1093 (NEC)

Figure 5-18 Sample Reference Voltage Detection Circuit

(2)   Vp Voltage Measurement Circuit

The Vp voltage is measured using SVp (pin 104).
The measured Vp voltage is used for checking for Vp voltage response and Vp voltage errors.
If the measured Vp voltage is not within the allowable range, the CPU stops the thermal head drive and goes to the printer mechanism in Vp voltage error status. If the voltage is returned to the allowable range, the printer goes to return-waiting status one second later.
The Vp voltage is detected at initialization (immediately following reset). The CPU goes to Vp voltage initialization error when Initialization is not completed until the Vp voltage is 20V or higher within 5 seconds.

Figure 5-19 shows a sample Vp voltage measurement circuit.
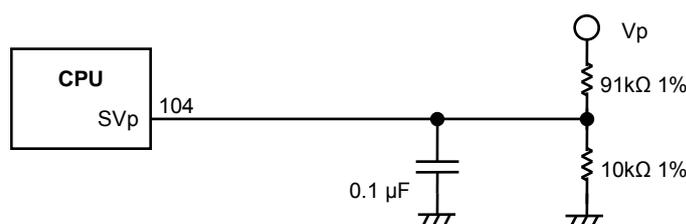
Figure 5-19 Sample V$_P$ Voltage Measurement Circuit

5.15   MOTOR CONTROL CIRCUIT

The CPU uses a constant-current chopper type driver IC to drive the motor. The following six signals are used for controlling the driver IC.

- **MPH1 and MPH2 (pins 89 and 90): Output**

  Outputs phase for driving the motor on the printer mechanism.

- **MI1 and MI2 (pins 91 and 95): Output**

  Outputs current control signal for driving the motor on the printer mechanism.

- **MCL1 (pin 93): Output**

  Selection signal for the motor driver.

- **MREF (pin 108): Output**

  Outputs voltage to set the motor current.

Motor current is controlled between 0 and approximately 220mA.

Figure 5-20 shows a motor drive signal timing chart and Figure 5-21 shows a sample motor control circuit.
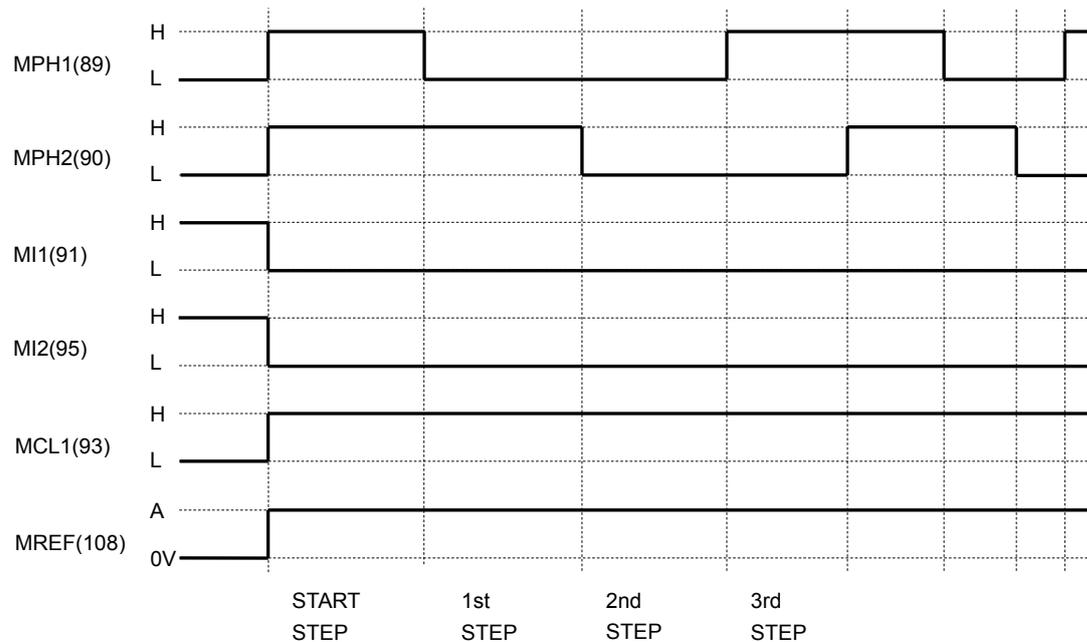
MREF A: 0.88V(LTPD247/CAPD247)
            0.80V(LTPD347/CAPD347)

Figure 5-20 Motor Drive Signal Timing Chart
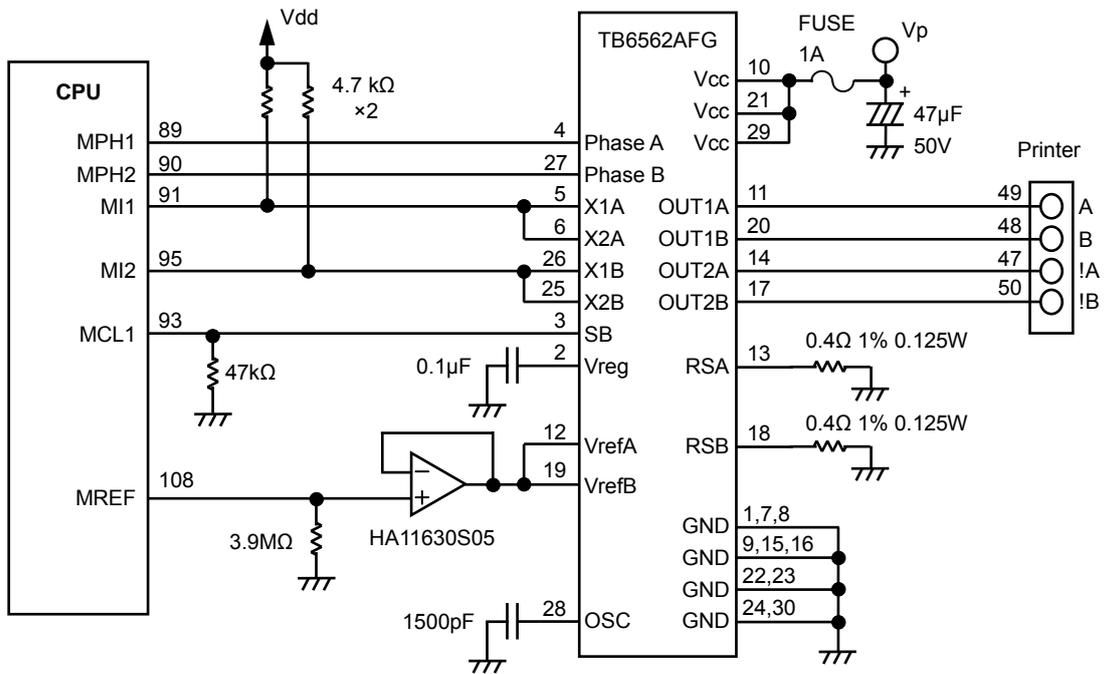
* Parts used: TB6562AFG (TOSHIBA)、HA11630S05 (Renesas Technology)

Figure 5-21 Sample Motor Control Circuit

5.16   HEAD CONTROL CIRCUIT

(1)   Resistance measurement circuit

The CPU has a function for measuring the resistance of the thermal head. Based on the measurement, the CPU determines how much energy is to be applied and detects problems. To use this function, the resistance measurement circuit and the Vp interrupt circuit are necessary.

The following three pins are used for the resistance measurement circuit.

- **HVPSW (pin 110): Output**

  Interrupts Vp applied to the common pin of the thermal head.
  Input the HVPSW (pin 110) via the thermal head drive circuit in Figure 5-24 to Vp interrpt circuit for interrupting Vp by hardware if the thermal head temperature error occurs.

- **!HVDDSW (pin 111): Output**

  Sends a small amount of current to the thermal head to measure the resistance of the head.

- **SHR (pin 106): Input**

  Measures the resistance of the thermal head.

In Figure 5-22, the resistance measurement circuit is surrounded by a dotted line. The resistance measurement circuit can be omitted. In this case, the resistance of the thermal head is set to 1500 Ω.

(NOTE)   **When the resistance measurement circuit is omitted, deal with these pins as follows:**
!HVDDSW must be pulled up to Vdd when connecting LTPD247/CAPD247 series printer
!HVDDSW must be pulled down to GND when connecting LTPD347/CAPD347 series printer

---

(2)   Vp interrupt circuit

This circuit interrupts Vp to prevent electrolytic corrosion of the thermal head and to enable the detection of the resistance mentioned above.
Electrolytic corrosion may significantly shorten the life of the thermal head. Thermal paper ordinarily contains electrolytic material to prevent sheets from sticking to each other due to static electricity. If there is too much of this electrolytic material, high temperatures and humidity cause the material to ionize, resulting in electrolytic corrosion of the thermal head.

Input the HVPSW (pin 110) via the head drive circuit in Figure 5-24 to Vp interrpt circuit for interrupting Vp by hardware if head temperature error occurs.

Figure 5-22 shows sample resistance measuring and Vp interrupt circuits.

The Vp interrupt circuit is controlled as follows:

1)   Set HVPSW (pin 110) to "High", turning FET on.

2)   When the print conditions are not met after printing is completed, set HVPSW to "Low" to turn FET off.
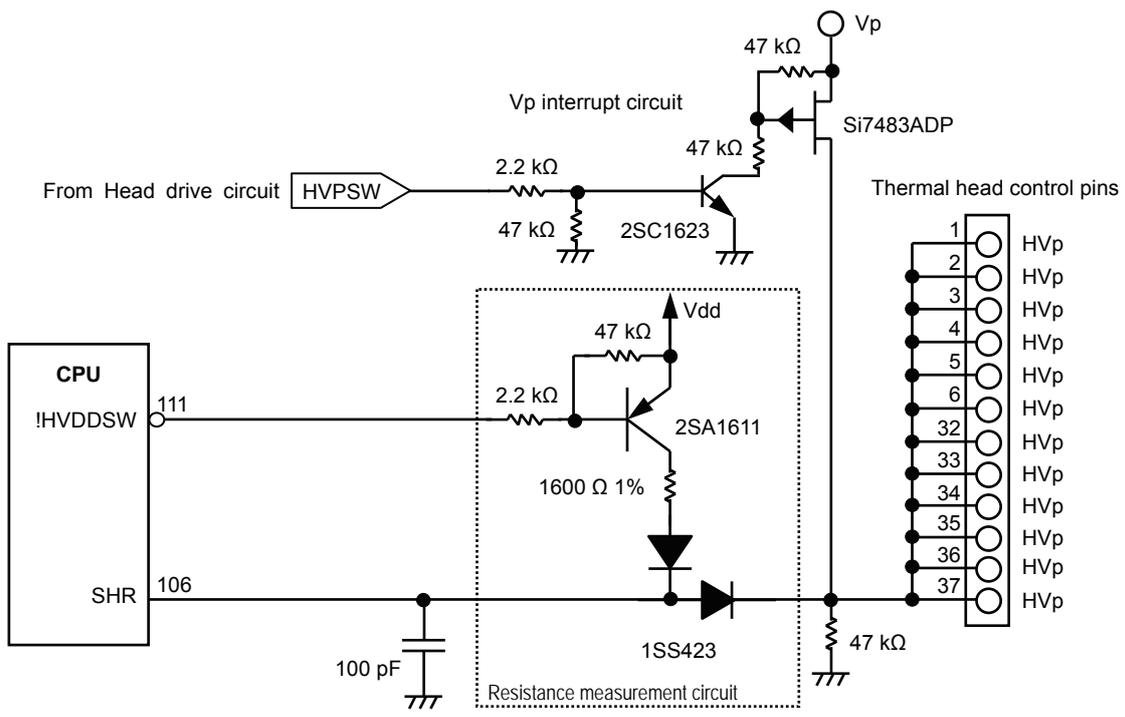
* Parts used: Si7483ADP(VISHAY)、2SC1623(NEC)、2SA1611(NEC)、1SS423(TOSHIBA)

Figure 5-22 Sample Resistance Measuring and Vp Interrupt Circuits

(3) Head temperature measurement circuit

The thermistor is mounted on the LTPD247/CAPD247 series pirnter to measure the temperature of the thermal head.

The CPU measures the temperature of the thermal head by receiving the signal of the thermistor from SHT (pin 100).

The CPU determines the energy to be applied to the head and also checks for the thermal head temperature errors.

If the temperature of the thermal head is -25°C or lower, or 85°C or higher, the CPU stops driving and puts the printer in head temperature error status. If the temperature of the thermal head is returned from −20 to 80°C, the printer goes to printable status.

Although the temperature of the thermal head is monitored by the CPU, the hardware also can stop thermal head output by sending a strobe signal from the comparator, such as in the case when the CPU loses operational control.

The head off signal from the comparator is input to HTE (pin 52). Use the head off signal to turn the HVPSW of the head drive circuit and Vp intrrupt circuit off when head temperature error (when HTE becomes "High") occurs.

Figure 5-23 shows a sample head temperature detection circuit.
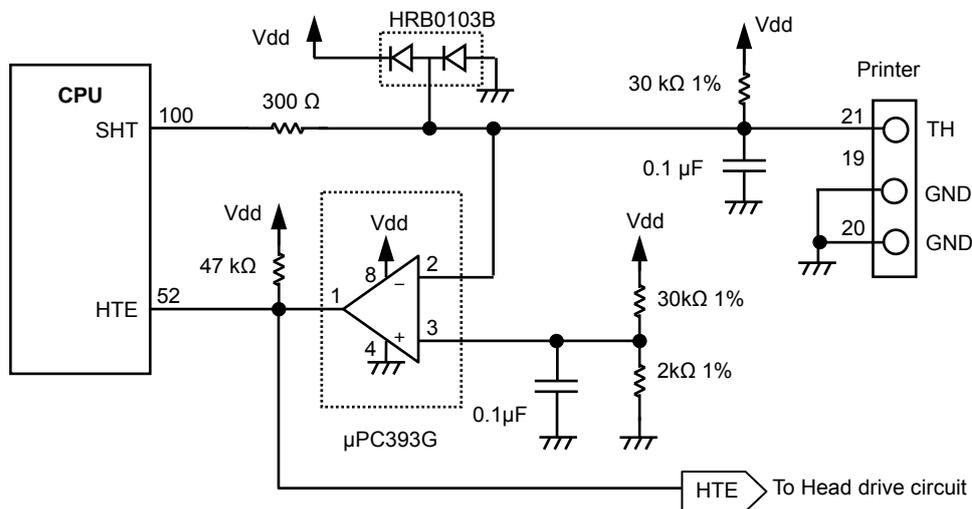
*: Part used: µPC393G (NEC)、HRB0103B(Renesas Technology)

Figure 5-23 Sample Head Temperature Detection Circuit

(4) Thermal head drive circuit

The thermal head pins of the printer mechanism, DAT, !LATCH, and CLK, are connected in parallel to thermal head driver ICs in the thermal head.
Input the comparator outputs of the head temperature detection circuit in Figure 5-23 to the !OE1 (74LV541: pin11) of the thermal head drive circuit for turning the thermal head drive circuit off when head temperature error occurs. Moreover, input the HVPSW (pin 110) via the head drive circuit in Figure 5-22 to Vp interrpt circuit for interrupting Vp.

Figure 5-24 shows a sample head drive circuit.
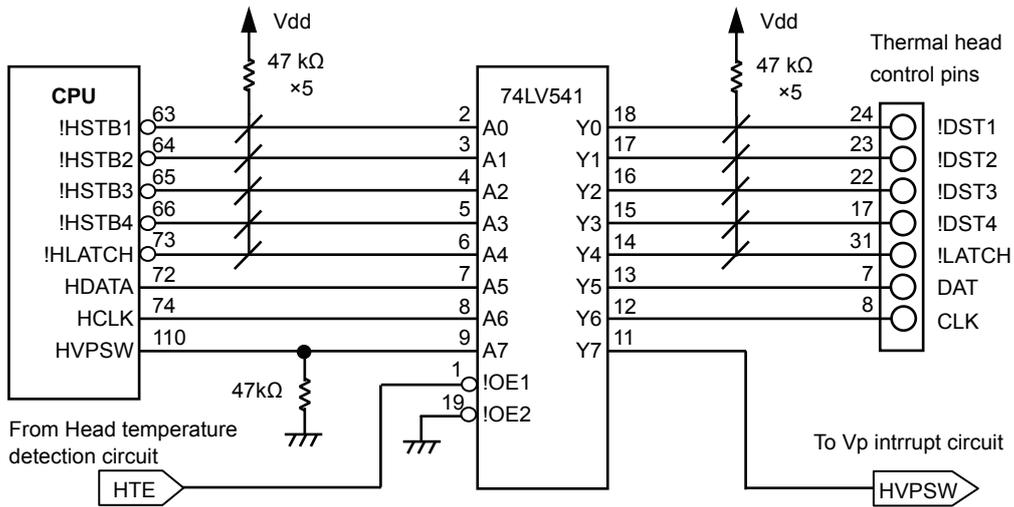
Figure 5-24 Sample Head Drive Circuit

5.17   CG ROM INTERFACE

When the CG ROM (PTJCGG2: Gothic font, Seiko Instruments Inc.) is connected, the CPU can process the followings:

- **Prints JIS 1st and 2nd level Kanji and Katakana character set1 and Katakana character set2.**
- **Prints downloaded characters, user-defined characters, optional fonts, macro, NV bit image and downloaded bit image.**
- **Stores the function settings.**
- **Maintenance counter function**

The CPU prints a test printing so that to confirm CG ROM is connected or not.

Figure 5-25 shows a sample CG ROM connection curcuit.

(NOTE)   When the CG ROM is not connected, !CS2 (pin 2) must be open.
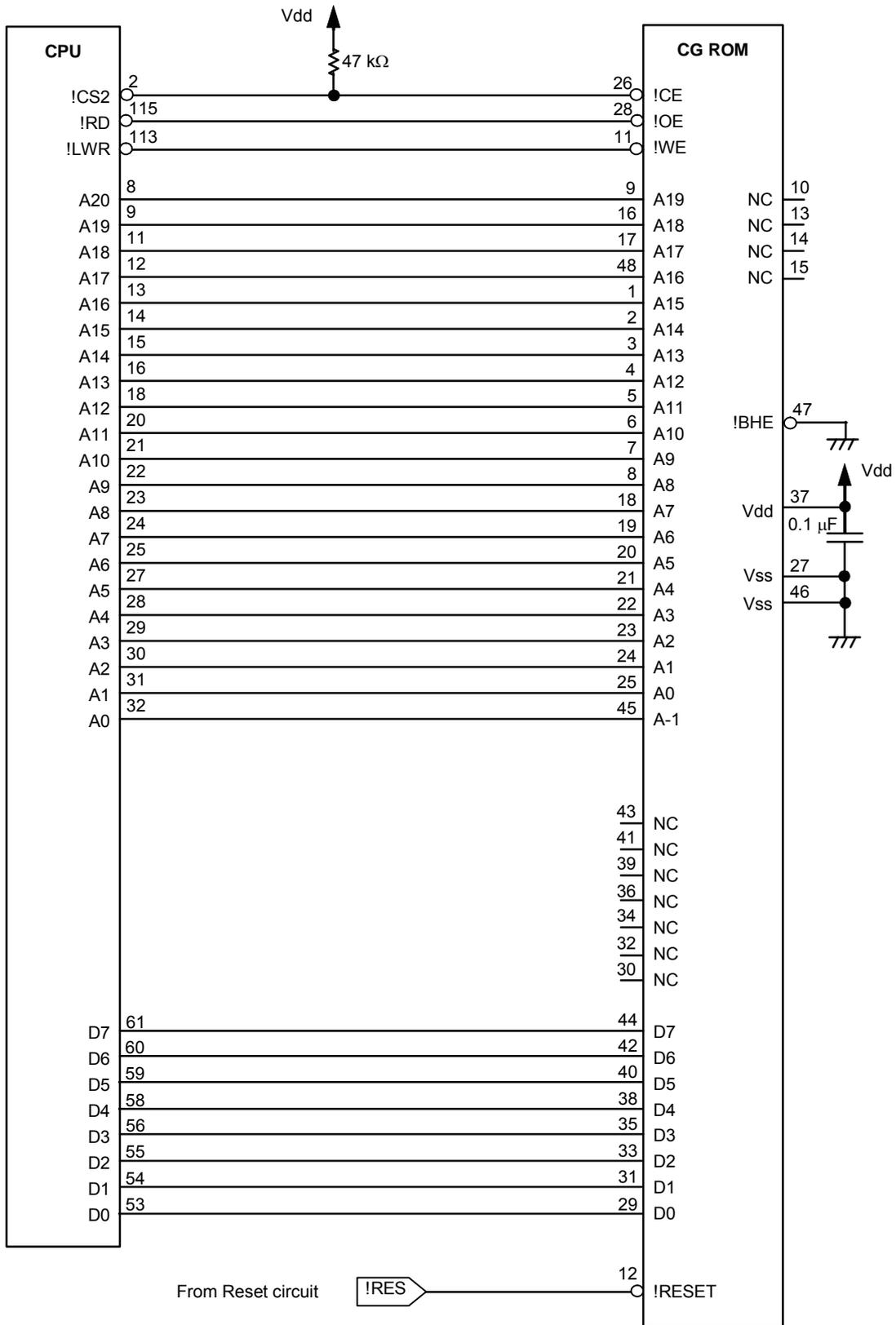
Figure 5-25 CG ROM Connection Circuit

5.18   EXTERNAL RAM INTERFACE

The CPU can use the following functions with an external RAM connected:

- **Page mode**

- **Two-dimensional bar code**

At least 128K bytes (1M bits) of RAM is required. See Chapter 9 "STANDARD MODE AND PAGE MODE" for page mode.

If the RAM satisfies the external memory access timing characteristics shown in Table 5-7 and Figure 5-1, up to 2M bytes may be connected.

Figure 5-26 shows a sample circuit with 256K bytes of SRAM (8-bit bus) connected as external RAM.

The CPU outputs the signal of chip select of the external RAM from !CS1 (pin 1).

Address bus should be connected to contiguous address using A0 to A17 of the CPU.

Capacity of memory, remaining memory and check sum of the external RAM is possible to confirm by test printing.

(NOTE)   When the external RAM is not connected, !CS4 (pin 66) must be open.

---
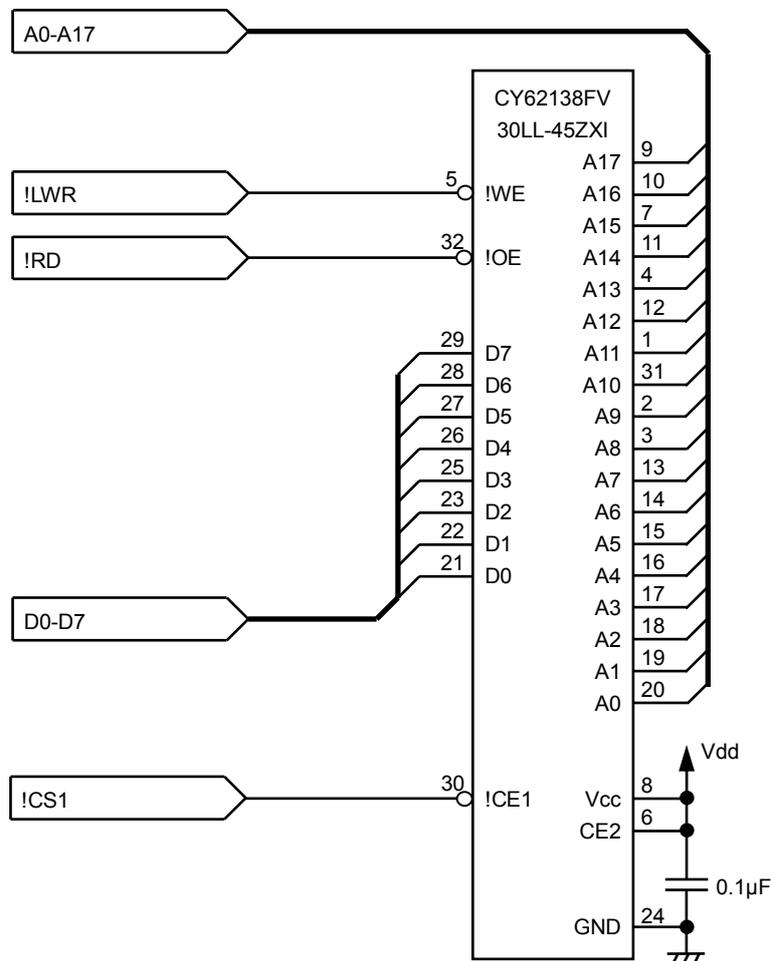
*: Part used: CY62138FV30LL-45ZXI（Cypress）

Figure 5-26 Sample External RAM (256K bytes, SRAM) Connection Circuit

5.19 AUTOCUTTER DRIVE CIRCUIT

The CPU cuts thermal paper automatically when connecting the CAPD247. Full and partial cutting is available by the commands.

The following pins are used to drive the autocutter.

- **MPH1 and MPH2 (pins 89 and 90): Output**

  Outputs phase to drive autocutter.

- **MI1 and MI2 (pins 91 and 95): Output**

  Outputs current control signal to drive autocutter.

- **MCL2 (pin 96): Output**

  Selection signal for the motor driver.

- **MREF (pin 108): Output**

  Outputs voltage to set the motor current.

- **!CUTS (pin 118): Input**

  Sensor switch signal of the movable blade of the cutter.
  The CPU determines that the cutter is in error status if !CUTS is "Low" when the cutter is not in operation or if the input signal does not change for a certain time during operation.

See CAPDx47 AUTOCUTTER UNIT TECHNICAL REFERENCE for the details.

Figure 5-27 shows a sample autocutter control circuit.

(NOTE) **When an autocutter is not connected, deal with these pins as follows:**
MCL2 must be opened.
!CUTS must be pulled up to Vdd.

---
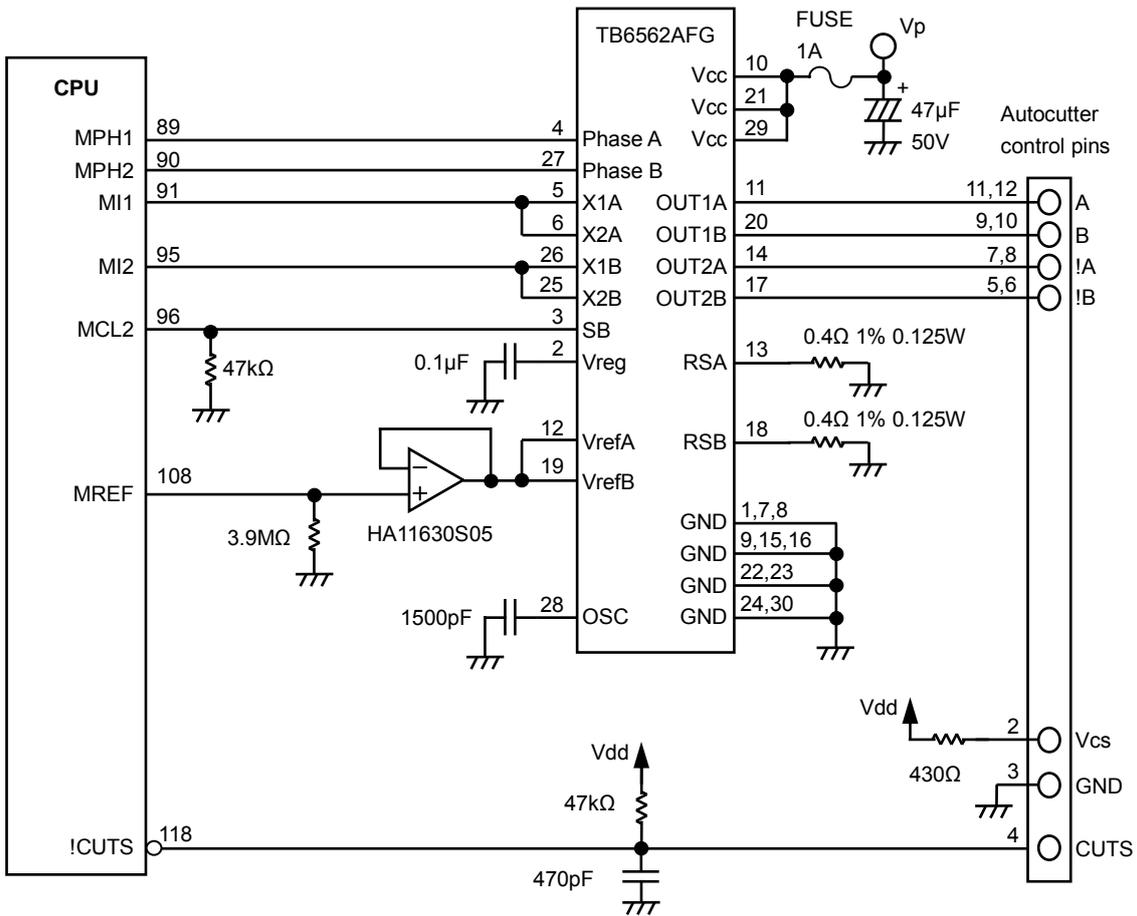
* Parts used: TB6562AFG (TOSHIBA)、 HA11630S05 (Renesas Technology)

Figure 5-27 Sample Autocutter Control Circuit

5.20 WINDER UNIT DRIVE CIRCUIT

The CPU can drive either a winder unit or a drawer.
The following pins are used to drive the winder unit:

- **WD1 and WD2 (pins 47 and 48): Output**

  Controls the winder unit.

Figure 5-28 shows a sample winder unit control circuit.

(NOTE)   If a winder unit and a drawer are not connected, WD1 and WD2 must be opened.

---
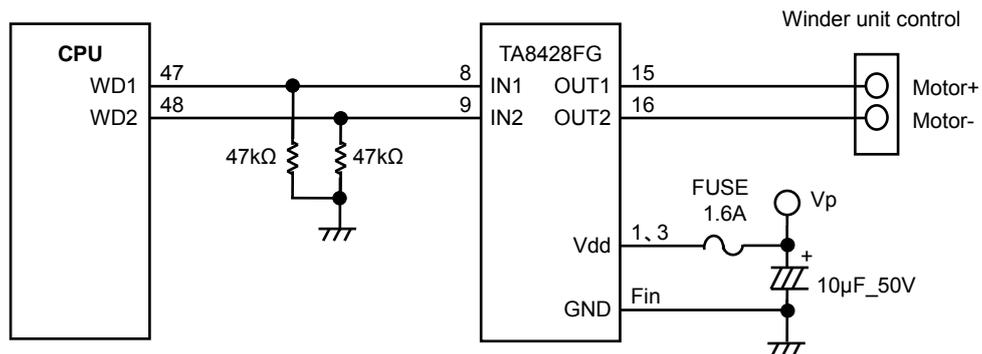
* Parts used: TA8428FG (TOSHIBA)

Figure 5-28 Sample Winder Unit Control Circuit

5.21 DRAWER DRIVE CIRCUIT

The CPU can drive either a drawer or a presenter.
The following pins are used to drive the drawer:

- **DR (pin 116): Output**

  Controls the drawer.

- **DRS (pin 3): Input**

  Sensor switch signal of the drawer.
  The CPU determines the DRS state by the command.

Figure 5-29 shows a sample drawer drive circuit.

(NOTE)   When a drawer is not connected, deal with these pins as follows: **DRS must be pulled up to Vdd.** **DR must be opened.**
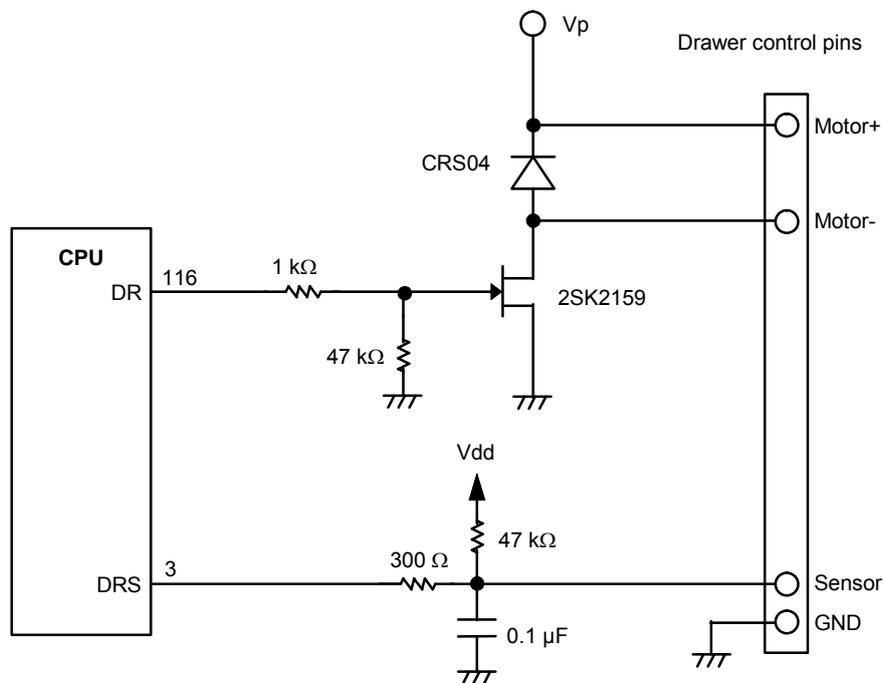
*Parts used: 2SK2159(NEC)、CRS04(TOSHIBA)

Figure 5-29 Sample Drawer Drive Circuit

5.22 PRESENTER DRIVE CIRCUIT

The CPU can drive a presenter. When using the presenter, a drawer and a winder cannot be connected. The following pins are used to drive the presenter:

- **PR1 (pin 47), PR2 (pin 48): Output**

  Outputs the signal to drive the presenter.

- **PRS1 (pin 75): Input**

  Sensor signal to detect the thermal paper in the presenter.

- **PRS2 (pin 46): Input**

  Sensor signal to detect the thermal paper in the outlet of presenter.

Figure 5-30 shows a sample presenter drive circuit.

> **(NOTE)** **When a drawer is not connected, deal with these pins as follows:**
> **PRS1 and PRS2 must be pulled up to Vdd.**
> **PR1 and PR2 must be opened if the winder is not used.**

*Parts used: TA8428FG (TOSHIBA), 2SK3663 (NEC)
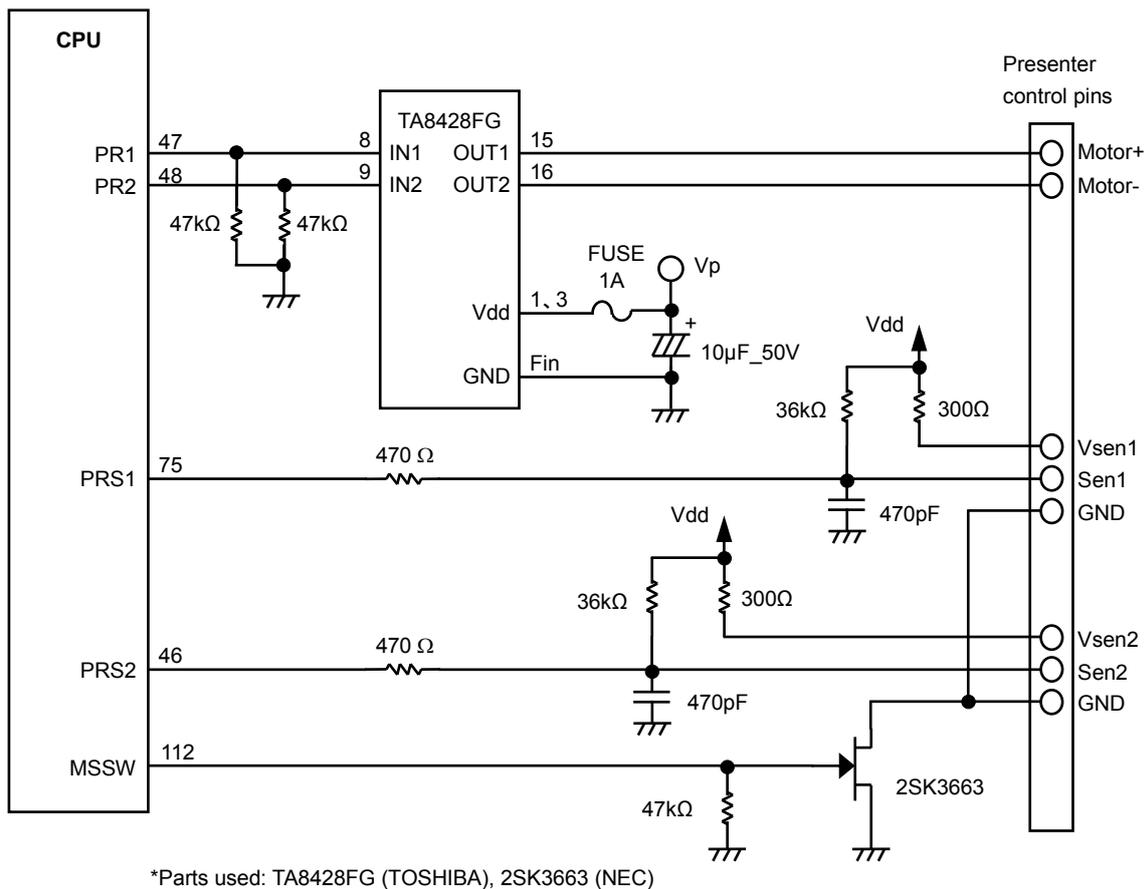
Figure 5-30 Sample Presenter Unit Drive Circuit

5.23 PROCESSING OF OTHER PINS

Pins not explained in this reference manual must be processed as listed in Table 5-16. If these pins are not processed correctly, the CPU may not work correctly.

| (NOTE) | The unused pins of the address pins (A0 to A20) or the data bus pins (D0 to D7) must be open. |

Table 5-16 Processing of Other CPU Pins

Pin No.	Signal Name	I/O	Processing Method
4	MD2	O	Must be pulled up to Vdd.
33	RESERVED	-	Must be connected to GND
41	MDCLK	I	Must be connected to GND
68	!HSTB5	I	Must not be connected to anything.
69	!HSTB6	I	Must not be connected to anything.
78	VCL	-	Must be connected to GND via a capacitor of 0.1uF which added near VCL.
81	RESERVED	-	Must not be connected to anything.
88	!STBY	I	Must be pulled up to Vdd.
92	PLL_Vdd	-	Must be connected to Vdd via a resistor of 100Ω, and be connected to PLL_Vss via a capacitor of 0.1uF which added near PLL_Vdd.
94	PLL_Vss	-	Must be connected to GND
97	MD0	I	Must be pulled up to Vdd.
102	EVNT	I	Must be pulled up to Vdd.
109	MD1	I	Must be pulled up to Vdd.

5.24   POST-RESET TIMING

Figure 5-31 shows the operation timing immediately following CPU reset.
Time T1 for initialization after canceling reset depends on the following conditions.

- **Detects value of the thermal head resistance.**

- **The presence of external RAM and its capacity.**

Time T1 is approximately 50ms if the resistance is not being measured and for the external RAM is not exist.
T1 takes approximately 105ms longer if the resistance is being measured with the resistance measurement
circuit. If 8-bit bus 256K bytes of external RAM are connected, T1 takes approximately 125ms longer.
For example, if the resistance is measured and 8-bit bus 256K bytes of external RAM is connected, T1 is as
follows:

T1 = 50+105+125 = approximately 280ms

T1:	typ. 280ms (See the above)	T5:	typ. 12µs
T2:	Max. 300µs	T6:	typ. 15µs + Data 1 byte[1]
T3:	typ. 2.0µs		
T4:	typ. 2.0µs		
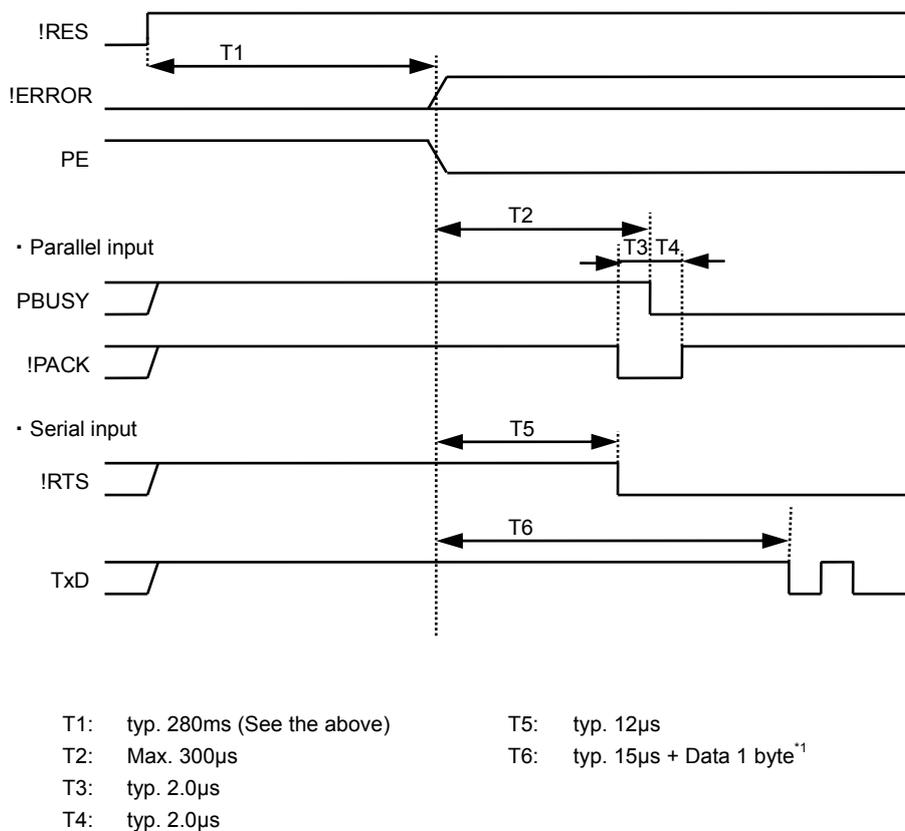
*1 : Time between start bit transmission and the end of stop bit transmission when selecting serial input.

Figure 5-31 Operation Timing Immediately Following Reset

- **During parallel input**

  The !RTS and TxD signals remain "High" and do not change. Regardless of an error occuring just
  after initialization completes, the PBUSY signal becomes"Low", and "Low" pulse is output from
  the !PACK signal.

- **During serial input**

  The PBUSY, !PACK, and TxD signals remain "High" and do not change. Regardless of an error
  occuring just after initialization completes, the !RTS signal becomes "Low" and outputs Xon.

CHAPTER 6
PACKAGING

Figure 6-1 and Figure 6-2 show the dimensions of the CPU and the CG ROM.
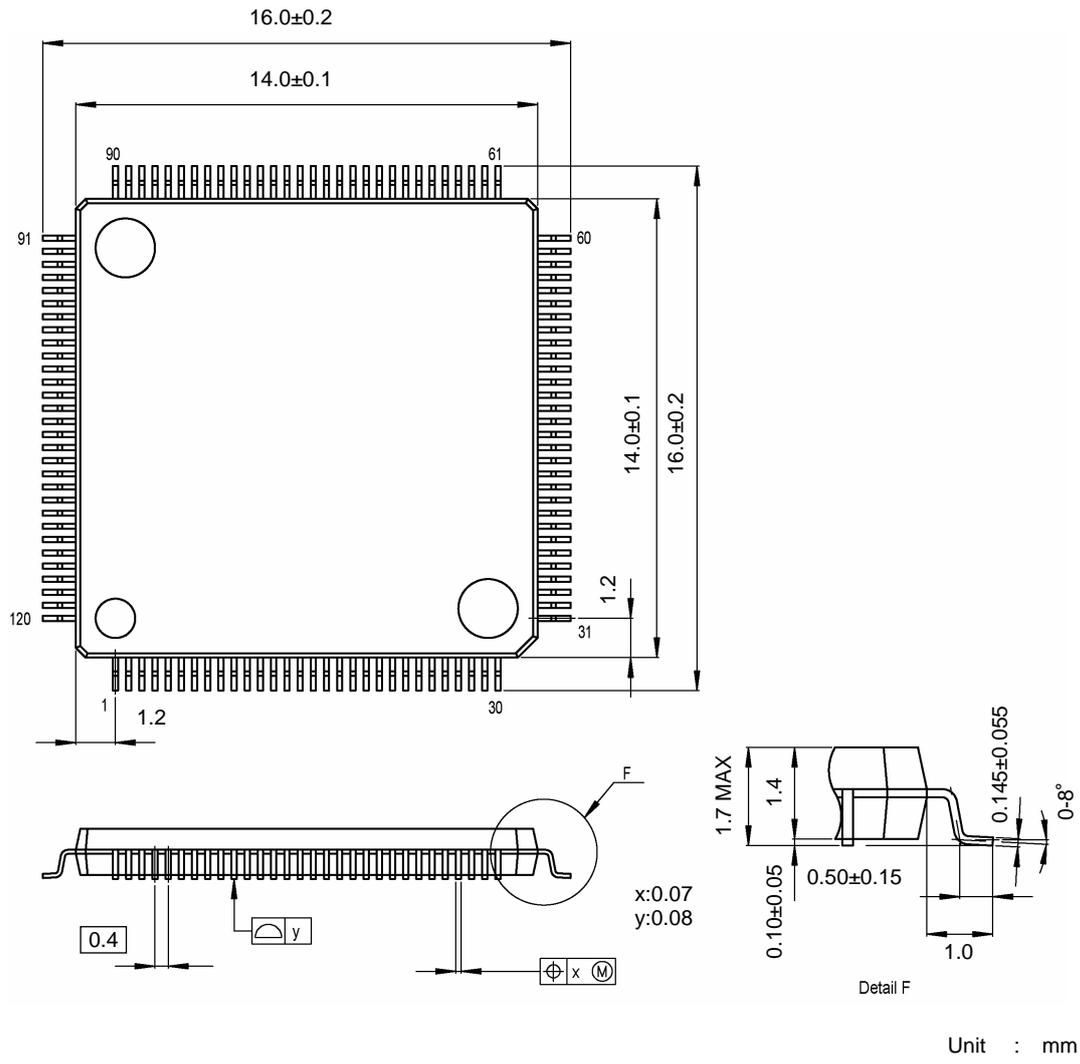
Unit : mm

Figure 6-1 CPU Dimensions

1. 00±0. 05

0. 5

0. 22±0. 05

1. 2 (max.)

12. 0±0. 1

18. 4±0. 1

20. 0±0. 2

0. 1 $^{+0.11}_{-0}$

0. 6±0. 1

0. 10±0. 05
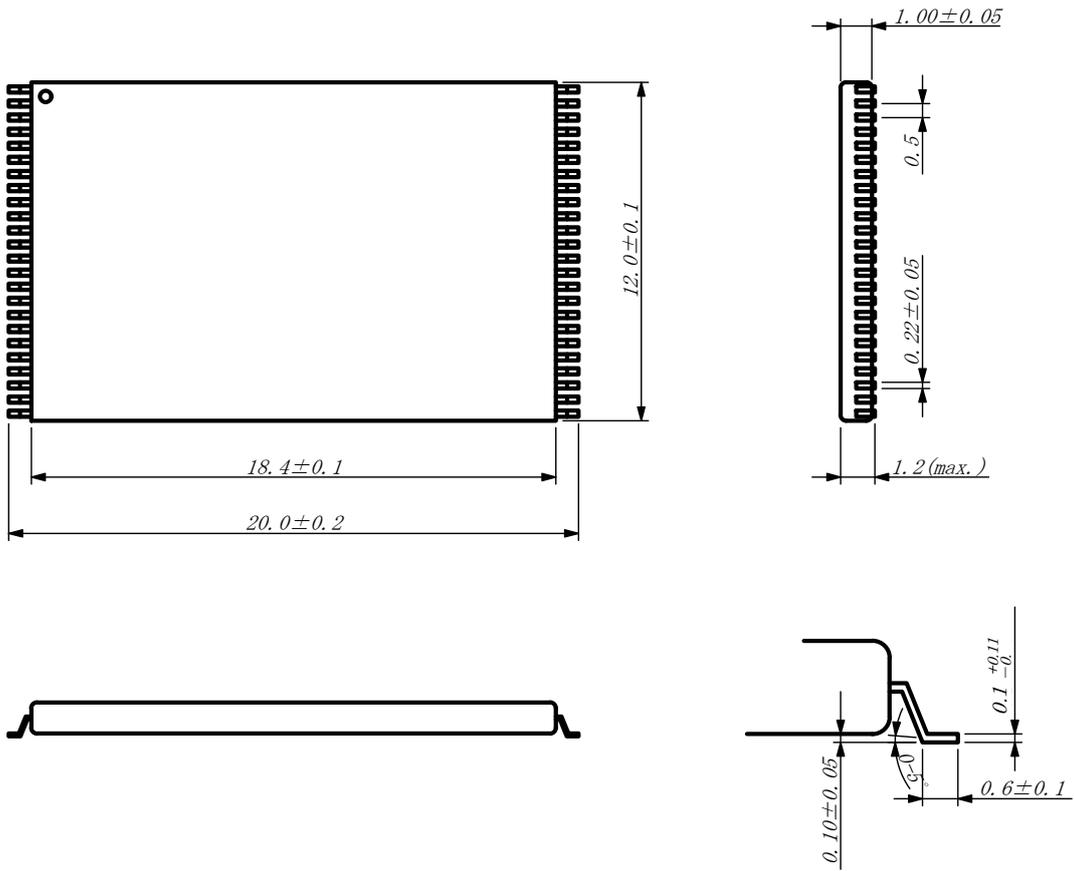
Unit : mm

Figure 6-2 CG ROM Dimensions

CHAPTER 7
SAMPLE CIRCUIT DIAGRAM

Figure 7-1 to Figure 7-8 show sample circuits for the Chip set. Table 7-1 lists the major parts used in the sample circuits.
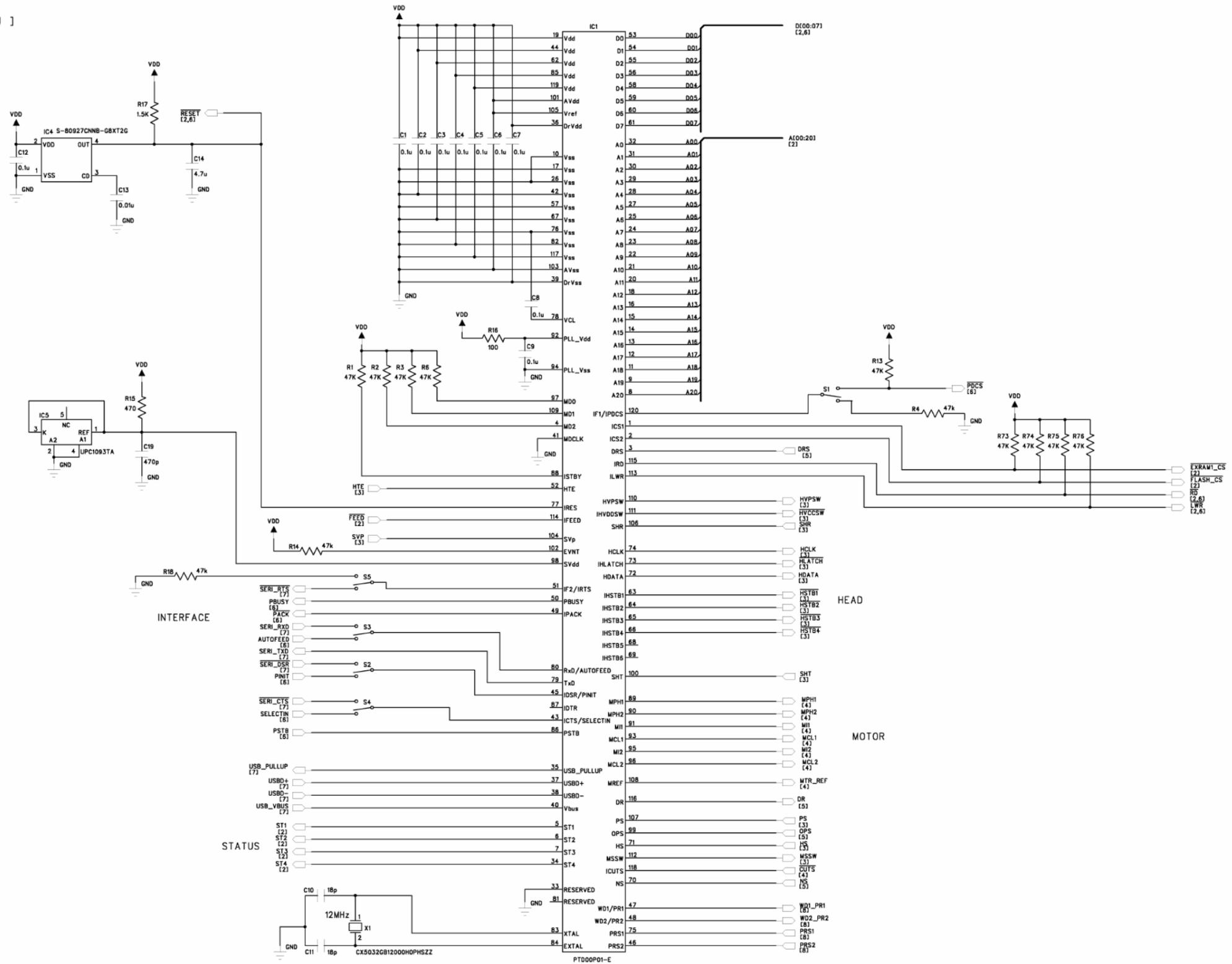
Figure 7-1 Sample Circuit 1

[CG , SRAM , STATUS , RESET , FEED]
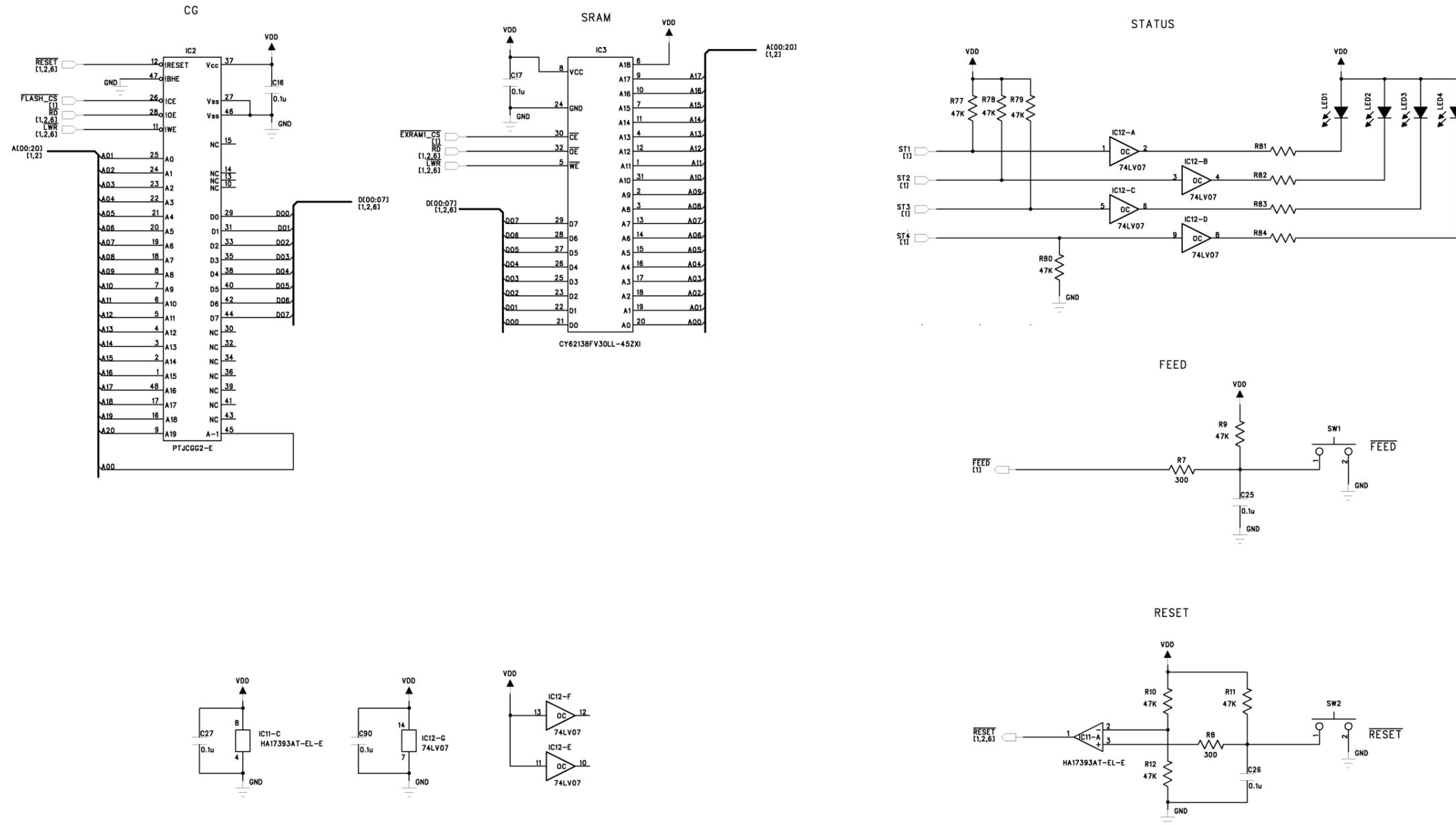
Figure 7-2 Sample Circuit 2

[HEAD]
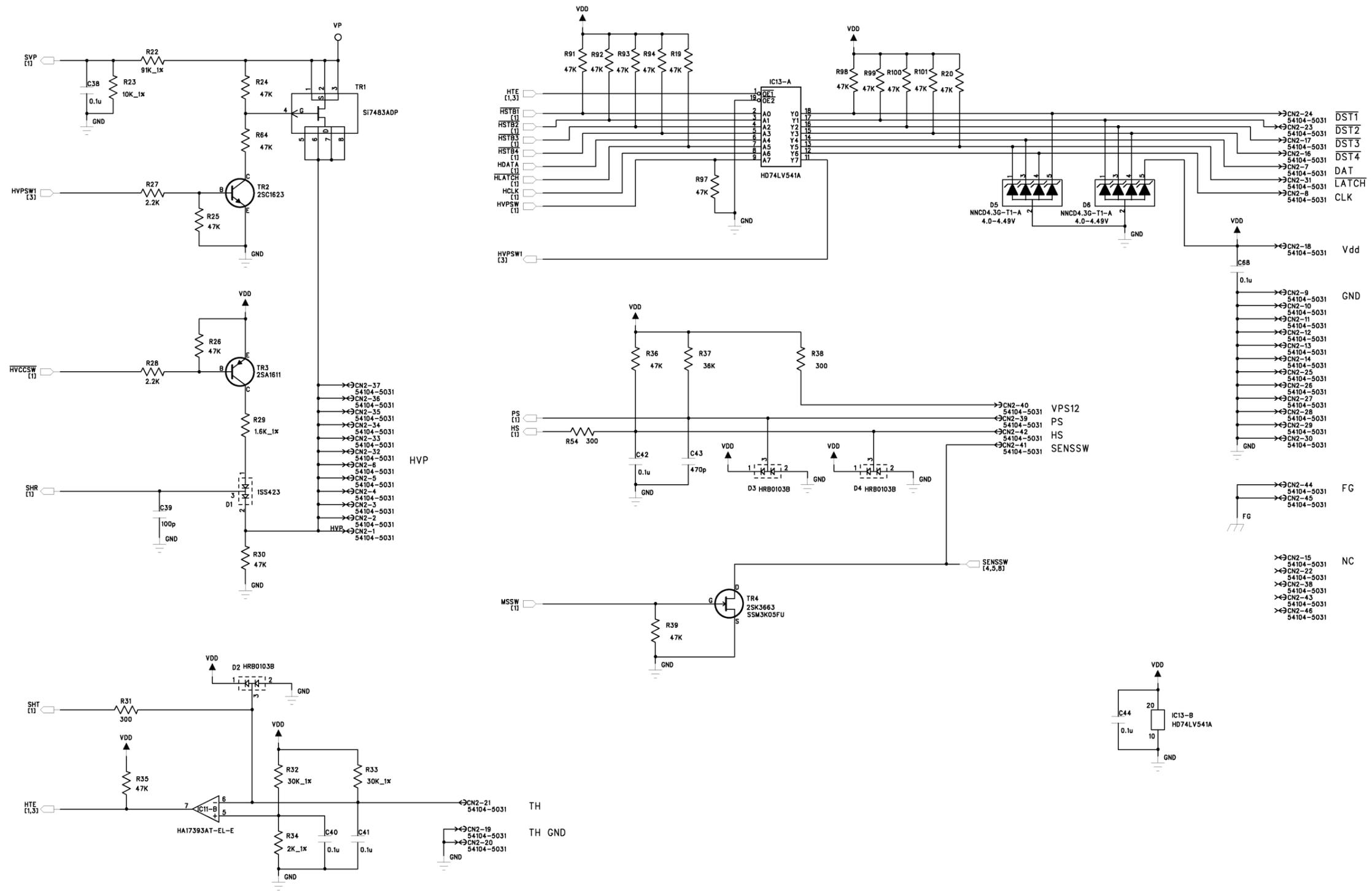
Figure 7-3 Sample Circuit 3

[MOTOR , CUTTER]
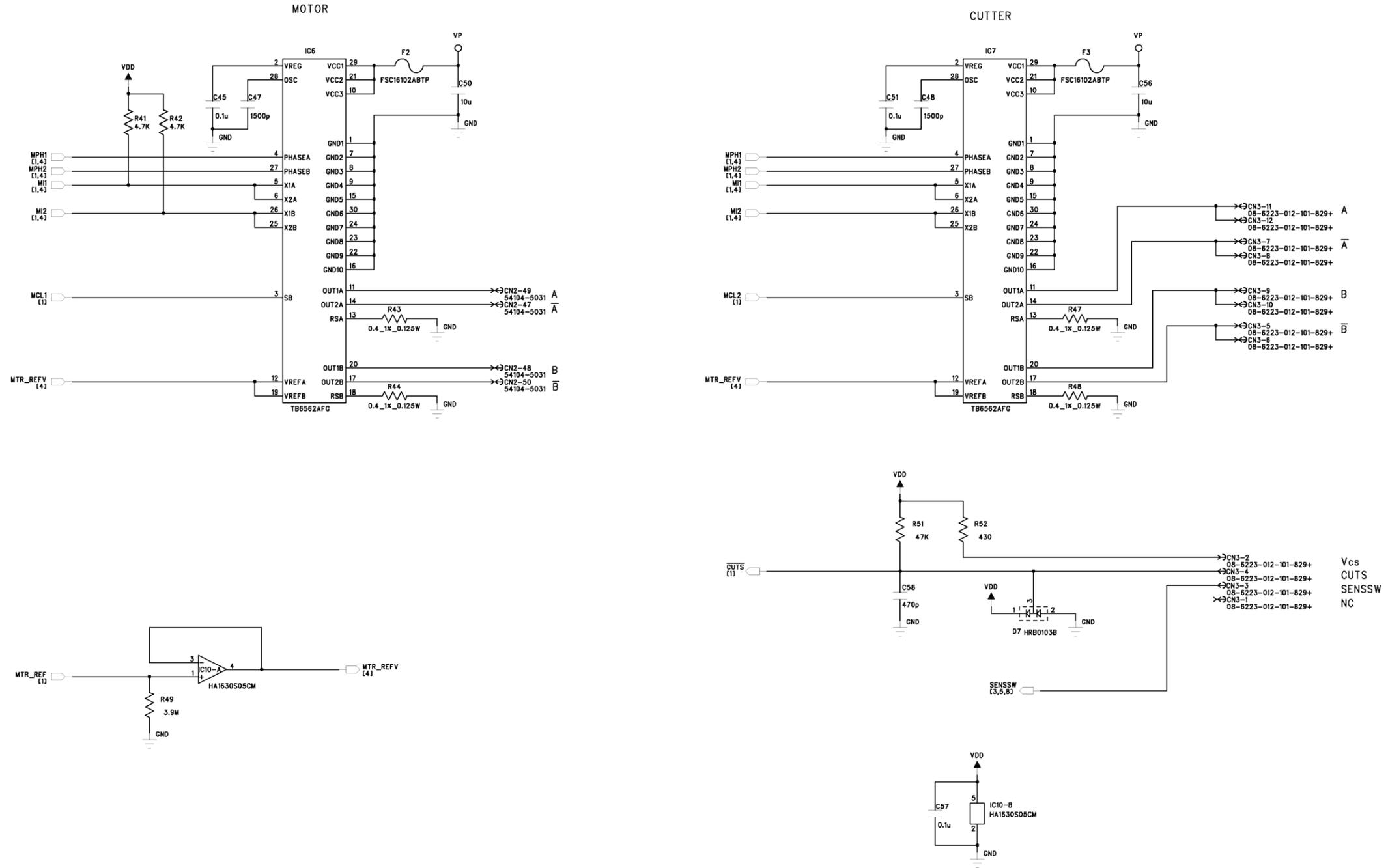
Figure 7-4 Sample Circuit 4

[DRAWER , N/S , MARK]

DRAWER

VP

F4
FSC16162ABTP

IC59

D10
CRS04

0.1u

CN10-1
SM04B-SRSS-TB(LF)(SN)   Vdr

CN10-2
SM04B-SRSS-TB(LF)(SN)   GNDdr

DR
[1]

R90
1k

G
D
TR5
2SK2159
S

R57
47K

GND

DRS
[1]

R58
300

VDD

R59
47K

C60
0.1u

GND

CN10-3
SM04B-SRSS-TB(LF)(SN)   DS
CN10-4
SM04B-SRSS-TB(LF)(SN)   GND

GND

NEAR END

VDD

R62
47K

R63
220

NS
[1]

C62
470p

GND

VDD

1   2

GND

D8 HRB0103B

CN6-1
SM03B-SRSS-TB(LF)(SN)   Vns
CN6-2
SM03B-SRSS-TB(LF)(SN)   NS
CN6-3
SM03B-SRSS-TB(LF)(SN)   SEMSSW

SENSSW
[3,4,5,8]

MARK

VDD

R65
33K

R66
300

OPS
[1]

C63
470p

GND

VDD

1   2

GND

D9 HRB0103B

CN4-1
04FMN-SMT-A-TF(LF)(SN)   Vms
CN4-2
04FMN-SMT-A-TF(LF)(SN)   MS
CN4-3
04FMN-SMT-A-TF(LF)(SN)   SENSSW
CN4-4
04FMN-SMT-A-TF(LF)(SN)   NC

SENSSW
[3,4,5,8]

Figure 7-5 Sample Circuit 5

[PARALLEL]
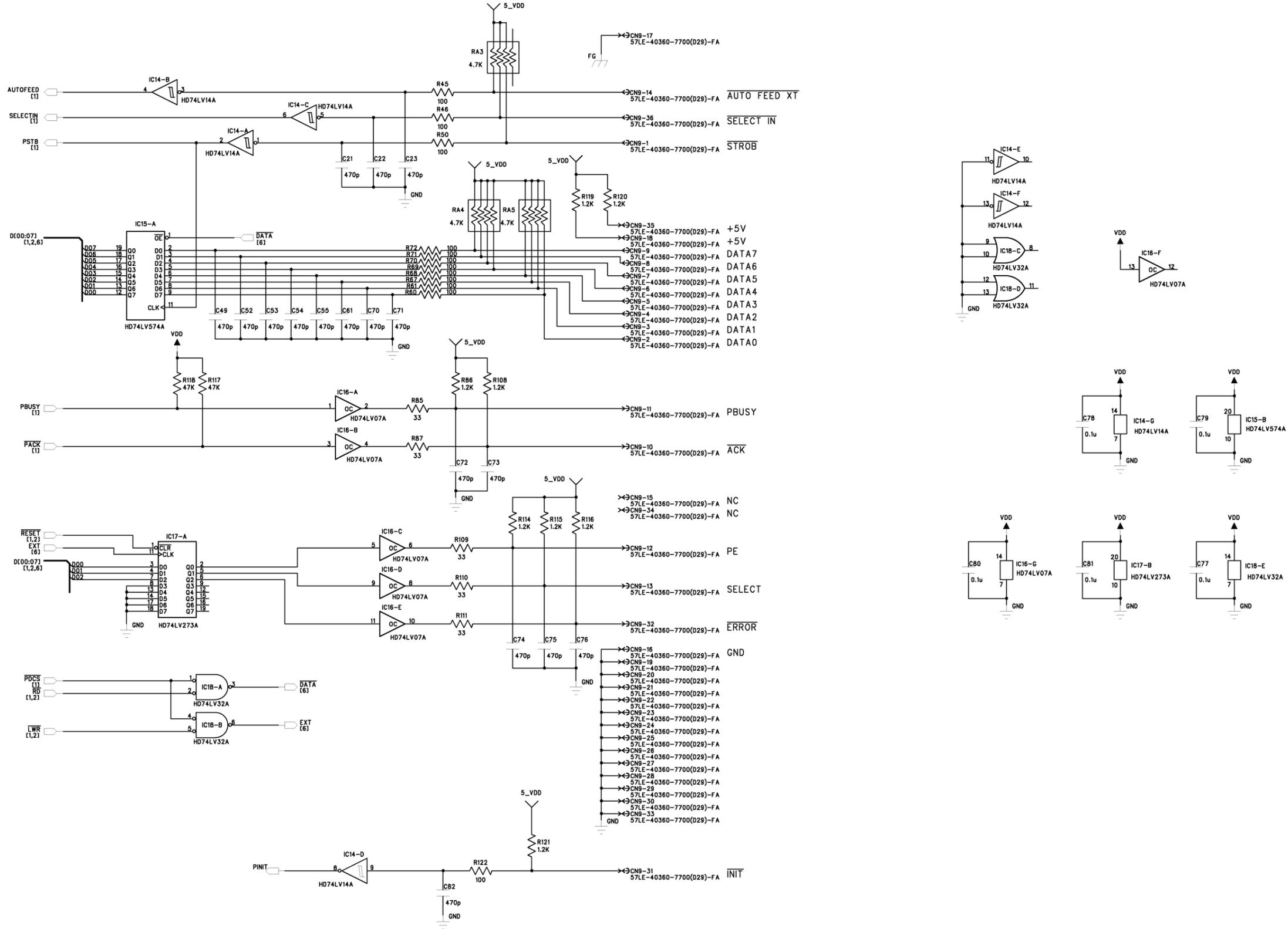
Figure 7-6 Sample Circuit 6

[SERIAL , USB]
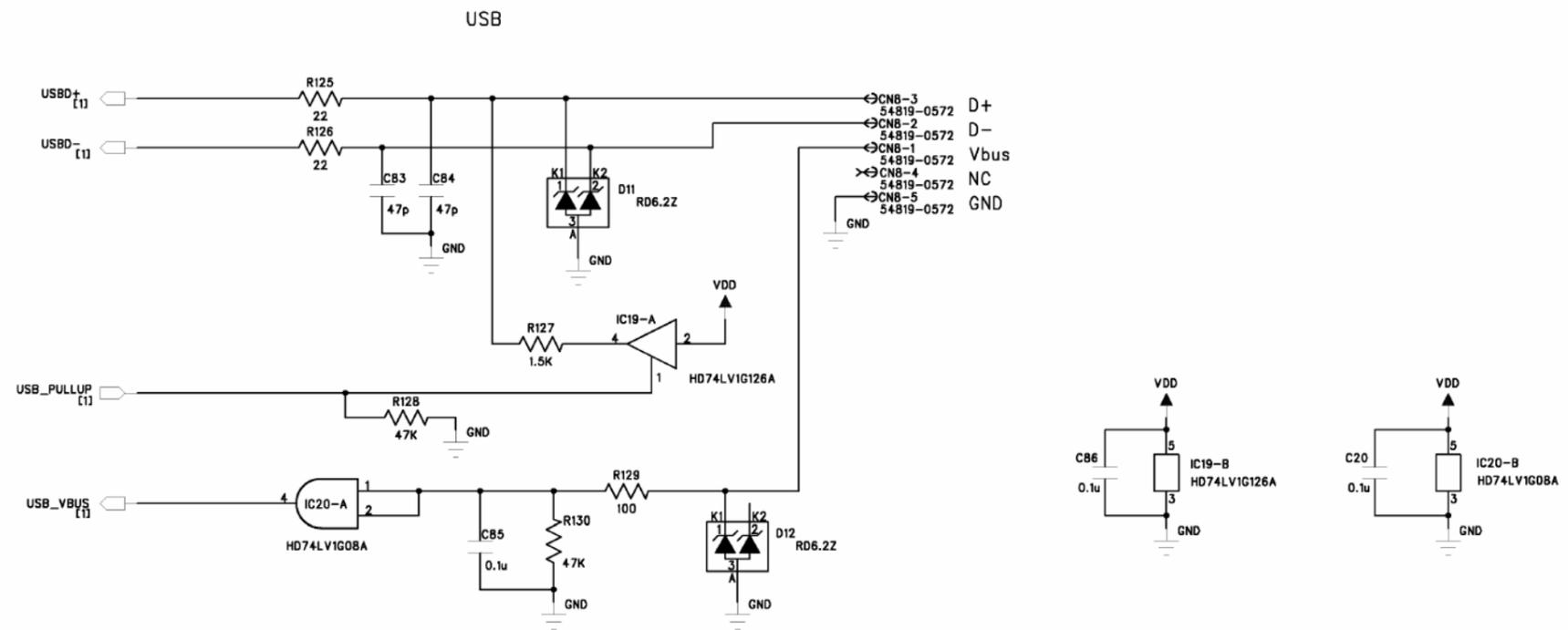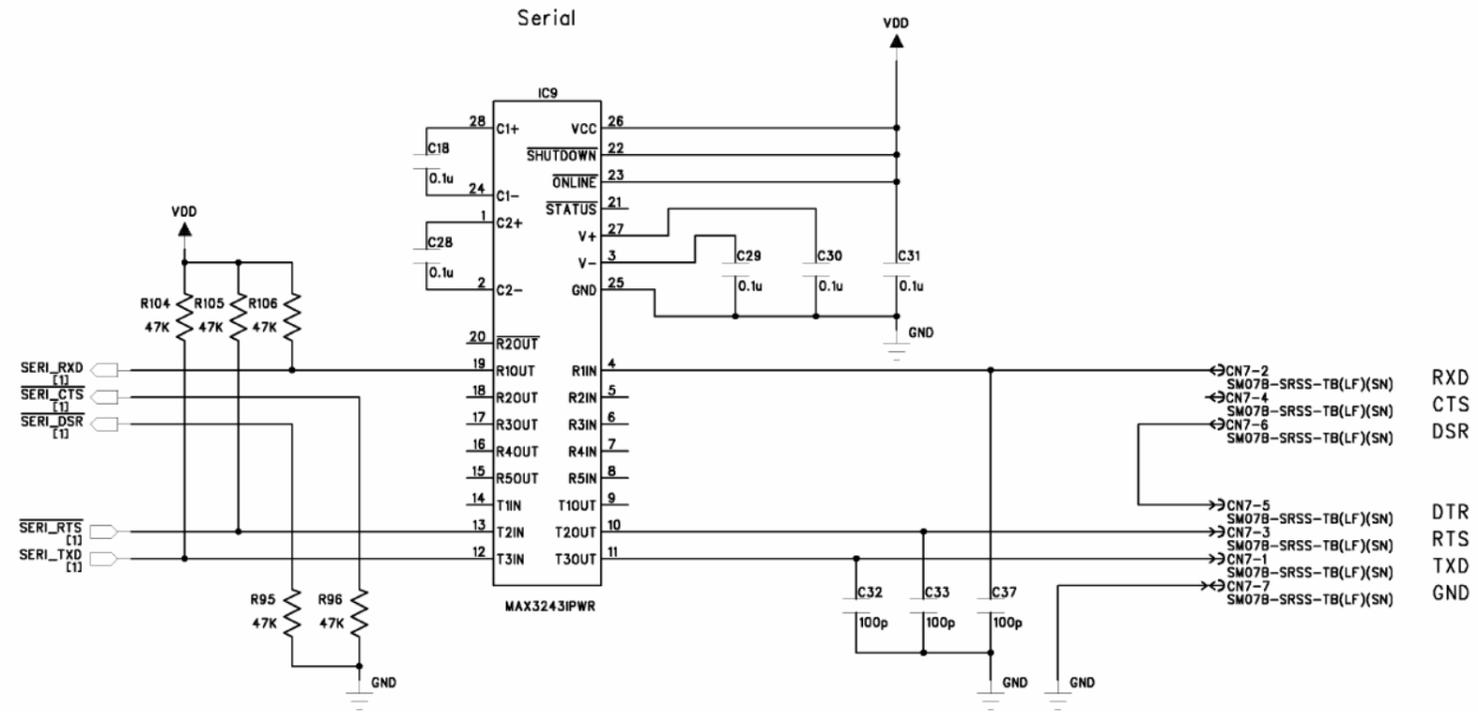
Figure 7-7 Sample Circuit 7

[PRESENTOR , WINDER , POWER]

PRESENTOR/WINDER

POWER
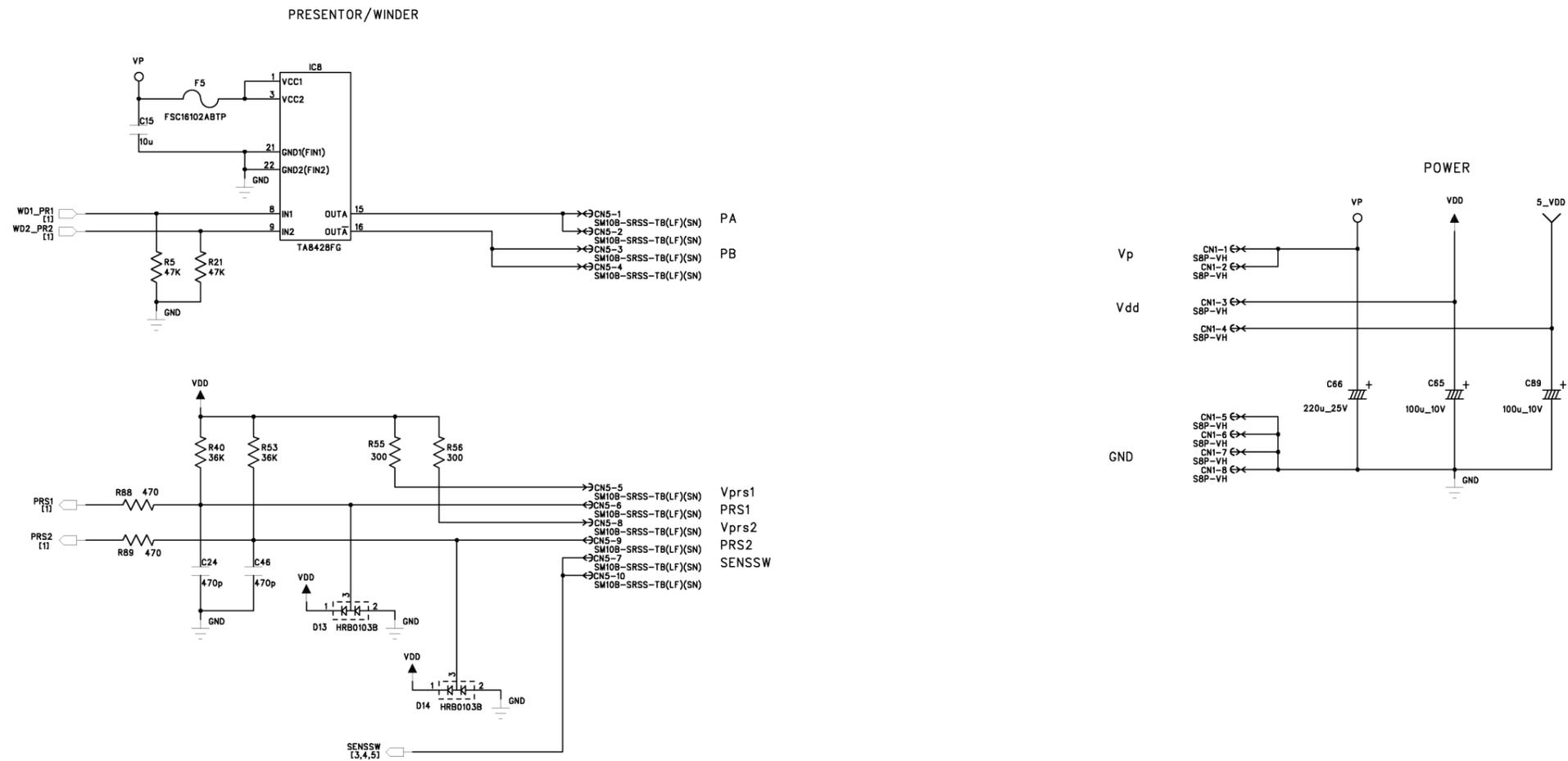
Figure 7-8 Sample Circuit 8

Table 7-1 Major Parts Used in the Sample Circuits

Part	Type Number	Manufacturer	Remarks
IC1	PTD00P01-E	SII	CPU
IC2	PTJCGG2-E	SII	CG
IC3	CY62138FV30LL-45ZXI	CYPRESS	SRAM
IC4	S-80927CNNB-G8XT2G	SII	Reset IC
IC5	uPC1093TA	NEC	Reference voltage IC
IC6,7	TB6562AFG	TOSHIBA	Motor driver
IC8	TA8428FG	TOSHIBA	Motor driver
IC9	MAX3243IPWR	TEXAS INSTRUMENTS	IC for RS232C
IC10	HA1630S05CMEL-E	RENESAS	Operational Amplifier
IC11	HA17393AT-EL-E	RENESAS	Comparator
IC12,16	HD74LV07ATELL-E	RENESAS	Logic IC
IC13	HD74LV541ATELL-E	RENESAS	Logic IC
IC14	HD74LV14ATELL-E	RENESAS	Logic IC
IC15	HD74LV574ATELL-E	RENESAS	Logic IC
IC17	HD74LV273ATELL	RENESAS	Logic IC
IC18	HD74LV32ATELL	RENESAS	Logic IC
IC19	HD74LV1G126AVSE-E	RENESAS	Logic IC
IC20	HD74LV1G08AVSE-E	RENESAS	Logic IC
X1	CX5032GB12000H0PHSZZ	KYOCERA-KINSEKI	Crystal oscillator
TR1	Si7483ADP	VISHAY	FET
TR2	2SC1623-T1B-L5-A	NEC	Transistor
TR3	2SA1611-T1-A	NEC	Transistor
TR4	2SK3663-T1-A	TOSHIBA	FET
TR5	2SK2159-T1-AZ	NEC	FET
D1	1SS423(TE85L,F)	TOSHIBA	Diode
D2-4,7-9,13,14	HRB0103BTL-E	RENESAS	Diode
D5, 6	NNCD4.3G-T1-A	NEC	Diode
D10	CRS04(TE85L,Q)	TOSHIBA	Diode
D11,12	RD6.2Z	TOSHIBA	Diode

CHAPTER 8

IMPLEMENTATION CONSIDERATIONS

When mounting the Chip set using air reflow or N2 reflow, keep the following conditions.
Also, the number of resoldering must be within 3 times.

8.1 SOLDERING TEMPERATURE CONDITIONS

Figure 8-1 shows a recommended temperature profile.
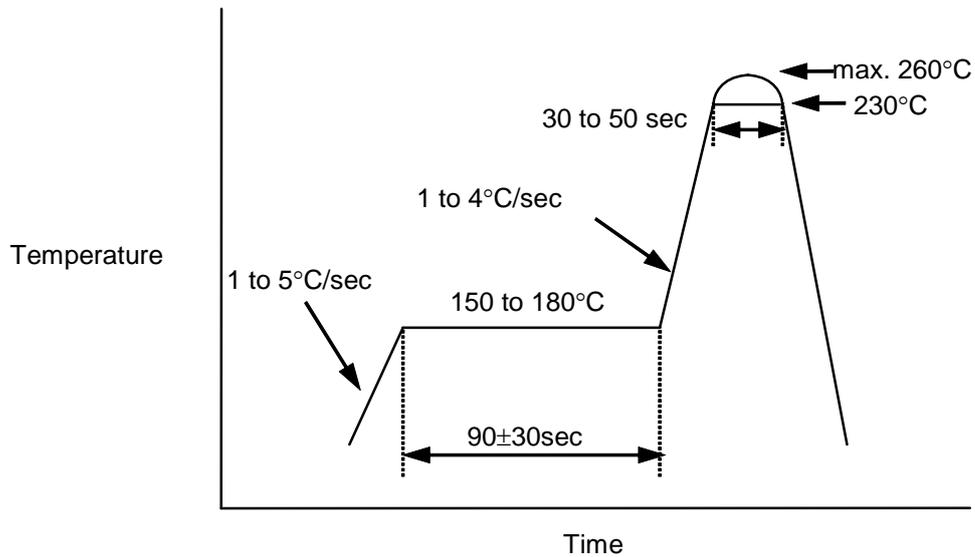
Prevent to cool the board compulsory after reflowing.

Figure 8-1   Temperature Profile at Reflow

8.2 SOLDERING CAUTIONS

Keep the following conditions for setting the high-temperature peak as temperature profile at reflow when mounting the plated lead-free products:

- **The surface temperature of product should be allowable temperature limit or lower.**

- **The temperature of lead pin should be no lower than melting point of the soldering equipment.**

Because the temperature for melting point of the film plated with Sn-Bi is the range of 220 to 230ºC, the soldering temperature requires 230ºC or higher.

8.3 STORAGE CONDITIONS

(1) Storage with a damp proof package

The product with a damp proof package must be stored in 5 to 35°C and 85%RH or less.

(2) Storage without a damp proof package

Table 8-1 shows storage conditions of the product without a damp proof package.
Using a damp proof chamber (30%RH or less) on the market is recommended to store the product without a damp proof package for long hours.
When opening the damp proof package for such checking delivery goods, seal up the package within 60 minutes. When heating a product by several times soldering, complete a work within the specified time of storage shown in Table 8-1.

Table 8-1 Storage Conditions After Unpacking the Damp Proof Package

Item	Conditions	Reference
Temperature	5 to 30°C	
Humidity	60%RH or less	
Time	168 hours or less	Time between opening the package and final soldering

(3) Baking

Do a baking treatment under the conditions listed in Table 8-2 when the color of the 30% spot on the humidity indicator card enclosed changes to pink, or the condition stored of the product exceeds the condition specified in Table 8-1.

Table 8-2 Baking Conditions

Item	Conditions	Reference
Temperature	125 ± 5°C	Within 96 hours totally
Time	16 to 24 hours	

8.4 CLEANING CONDITIONS

Although it is essential to clean flux off of the solder to ensure high system quality, improper cleaning may cause the device to be affected by the solvent, thus reducing device quality. Use of solvents that contain chlorine ions (e.g., CHLOROCEN) will result in adverse effects on device reliability.

The cleaning conditions given below are recommended. It may be necessary to perform vapor blasting before and after the main cleaning.

Detergent:Clean through 750 H, Pine alpha ST-100S, EC-7, Technocare FPW/FPV

Ultrasonic cleaning conditions: Frequency:28 to 29 kHz
Time: 30 sec or less
Power: 15 W/liter maximum

> **(NOTE)   Do not put the printed circuit board or device in direct contact with the vibration source. Select an appropriate frequency so that the device does not resonate.**

8.5 MECHANICAL AND THERMAL STRESS

External lead fractures, moisture resistance deterioration, or internal lead pin disconnections may occur while the packages or external lead pins are being cut out or bent. Care must be taken so that excessive mechanical stress is not applied to the printed circuit board and the external leads of the IC device after the device is installed on the board.

Since the IC devices are made of various materials having different thermal expansion coefficients, quality deterioration or internal lead disconnections may occur if the devices are exposed to high temperatures for a long period or to sudden temperature changes during the soldering process. Try to keep any mechanical or thermal stress on the IC devices at a minimum.

CHAPTER 9

SOFTWARE SPECIFICATIONS

9.1 CHARACTER CODES AND COMMANDS

The character code range and user-defined character codes when the Kanji Specification/Cancel mode is selected are different from those when the Shift Kanji mode is selected with the Kanji Code System Select command.

9.1.1 Kanji Specification/Cancel Mode

When the Kanji Specification/Cancel mode is selected with the Kanji Code System Select command, Kanji characters can be printed using second byte character codes after Kanji mode is selected with the Kanji Mode Specify command.

The command functions as 1-byte character code or the first or second byte of 2-byte character code.
If a command is input in 2-byte character codes, the next data is always processed as the first byte. However, the next data is 1-byte character code for FS '.'.
If a command is input as the second byte of 2-byte character code, the first byte is ignored.

(1) 1-byte character codes

    00H - 1FH: The codes listed below are processed as commands. The other codes are ignored.

        09H (HT), 0AH (LF), 0CH (FF), 0DH (CR), 12H (DC2), 13H (DC3), 18H (CAN),
        1BH (ESC), 1CH (FS), 1DH (GS)

    20H - 7EH: The codes are processed as 1-byte character.
    7FH: Ignored
    80H - FEH: The codes are processed as 1-byte character.
    FFH: It different each character set.
          If the extended graphics character set or the Katakana character set1 or Katakana character set2
          are selected, they are ignored.
          If the Codepage 1252 is selected, it is processed as character code.

(2) 2-byte character codes when selecting Japanese

    2-byte character codes specify Kanji characters or User-defined characters.

    (a) First byte

    00H: The 1-byte character area. Specify the 1-byte character code with the second byte.
    21H - 76H: 2-byte character area
    77H: User-defined character area
    78H - 7EH: 2-byte character area

    If the codes other than the above are not commands, these codes are ignored.
    The next data to be received is processed as the first byte.

(b)   Second byte

(If the first byte is 00H)

20H - 7EH: The codes are processed as the 1-byte character.
80H - FEH: The codes are processed as the 1-byte character.
FFH : It different each character set.
    If the extended graphics character set or the Katakana character set1 or Katakana character set2
    are selected, they are ignored with the first byte.
    If the Codepage 1252 is selected, it is processed as the 1-byte character.

(If the first byte is not 00H)
21H - 7EH: The codes are processed as the second byte of a Kanji character or user-defined character.

If the codes other than the above are not commands, these codes are ignored with the first byte. The next
data to be received is processed as the first byte.

The codes not defined as JIS or special characters in the 2-byte character area are processed as 2-byte
character spaces.

(3)   2-byte character codes when selecting Korean.

It specify Korean and user-defined character by 2-byte character codes

(a)   First byte

00H : 1-byte character area. Specify the 1-byte character code at second byte.
77H : Area for user-defined characters.
A1H - FDH : Area for Korean characters when selecting Korean.

If the other codes except above are not command, they are ignored. The next received data processed as
first byte.

(b)   Second byte

(If the first byte is 00H)
20H - 7EH : Processed as the 1-byte characters.
80H - FEH : Processed as the 1-byte characters.
FFH : It differ depend on the character set.
    If the extended graphics or Katakana character set1 or Katakana character set2, are selected, they
    are ignored with first byte.
    If the Codepage1252 character set, it processed as the first byte character set.

(If the first byte is 77H)
21H - 7EH : Processed as the second byte of user-defined characters.

(If the first byte is A1H to FDH)
A1H - FEH : Processed as the second byte of Korean characters.

If the other codes except above are not command, they are ignored with first byte. The next received data
processed as first byte.

In the 2-byte character area, the code are not defined by Korean processed as the 2-byte character
space.

9.1.2 Shift Kanji Mode

If the shift Kanji mode is selected with the Kanji Code System Select command, Kanji characters can be printed with 2-byte character codes without entering the Kanji Mode Specify command.

The command functions as 1-byte character code or the second byte of 2-byte character code.
If a command is input for the second byte of 2-byte character code, the first byte is ignored.

(1) 1-byte character codes

   00H - 1FH: The codes listed below are processed as commands. The other codes are ignored because they are 1-byte.

      09H (HT), 0AH (LF), 0CH (FF), 0DH (CR), 12H (DC2), 13H (DC3), 18H (CAN),
      1BH (ESC), 1CH (FS), 1DH (GS)

   20H - 7EH: The codes are processed as the 1-byte character
   7FH: Ignored
   80H - FEH: See (2).
   FFH: It different each character set.
         If the extended graphics character set or the Katakana character set1 or Katakana character set2 are selected, they are ignored.
         If the Codepage 1252 is selected, it is processed as the 1-byte character.

(2) 2-byte character codes

   2-byte character codes specify Kanji and user-defined characters.

   (a) First byte

   81H - 9FH: 2-byte character area
   E0H - EBH: 2-byte character area
   ECH: User-defined character area
   EDH - EFH: 2-byte character area

   The other codes 80H - FEH are processed as 1-byte characters.

   (b) Second byte

   40H - 7EH: The codes are processed as the second byte of a shift JIS code.
   80H - FCH: The codes are processed as the second byte of a shift JIS code.

   If the codes other than the above are not commands, these codes are ignored with the first byte.

   The codes not defined as Shift JIS or special characters in the 2-byte character area are processed as 2-byte character spaces.

(3) 2-byte character codes when selecting Korean.

(a) First byte

A0H : Area for user-defined characters.
A1H - FDH : Area for Korean characters when selecting Korean.

If the other codes except above are not command, they are ignored. The next received data processed as first byte.

(b) Second byte

(If the first byte is A0H)
A1H - FEH : Processed as the second byte of user-defined characters.

(If the first byte is A1H to FDH)
A1H - FEH : Processed as the second byte of Korean characters.

If the other codes except above are not command, they are ignored with first byte. The next received data processed as first byte.

In the 2-byte character area, the code are not defined by Korean processed as the 2-byte character space.

9.2 CG ROM

Using a CG ROM is possible to use user-defined characters, downloaded characters, optional fonts, macro, NV bit image, downloaded bit image. A CG ROM is nonvolatility (FLASH memory) and that consists of the following area.

- System area
  stores data for controlling system, the value of function settings and maintenance counter.

- Font area
  stores font data such as Kanji and so on.

- User area
  stores downloaded characters, user-defined characters, optional fonts, macro, NV bit image, and downloaded bit image.

System area is rewritten using the commands such as Function Setting (DC2 'k') or Maintenance Counter Preservation (GS 'S'). Font area can not be rewritten. User area can be rewritten using registration commands of user-defined characters, downloaded characters, optional fonts, macro, NV bit image, and downloaded bit image.
Amount of memory other than system area and font area is 917504 bytes. When using optional fonts, macro, NV bit image, and downloaded bit image, it is necessary to know the remaining amount of memory beforehand. Read this section before using these functions.

(1) Memory area

Chip set allocates or frees memory area in order to change uses of the user area and its capacity. Allocating the memory area means that the memory is divided into the specified capacity (the number of bytes) so as to be exclusively used for a certain function.

Freeing the memory area means that the division of the memory for the exclusive use of a certain function is abolished so that the other functions become usable. The freed memory area is not reused until CPU executes the commands User Area Initializaton (DC2 'R') or User Area Reduction (DC2 '*' '1').

However, when using user-defined characters, downloaded characters, optional fonts, macro, NV bit image, and downloaded bit image, the user must be sure not to exceed the remaining memory area. The capacity of one memory area is limited to 65536 bytes for optional fonts, 2060 bytes for macro, 262144 bytes for NV bit image, and 65536 bytes for downloaded bit image. Do not exceed this limit when using these functions.

How to calculate the amount of using memory, see the description of each command.

Table 9-1 Memory Area after Initialization

Use	Bytes	Release memory area
User-defined characters	9784	Enable
Downloaded characters	6184	Enable
Optional font	0	Enable
Macro definition	0	Enable
NV bit image	0	Disable
Downloaded bit image	0	Disable

For user-defined characters and downloaded characters, the memory in the User area is allocated beforehand at initialization and shipment. This area can be freed using commands, and its empty area increased for optional font, macro, NV bit image, and downloaded bit image.
When defining and registering optional font, macro, NV bit image, and downloaded bit image, it is necessary to calculate the remaining memory area constantly. Be aware that all of the data which exceeds the remaining memory area is ignored.
For definition optional font, macro, NV bit image, and downloaded bit image, the area is automatically allocated when the corresponding command is input. These commands operate as follows:

- When the parameter of the command is outside the range:
  CPU ignores the part outside and processes the remaining data as character codes.

- When the command is normal but memory area has not been allocated (memory shortage):
  All of the data, including the successive data, is ignored.

- When the command is normal and memory area has been allocated:
  The data is registered.
  The remaining memory is confirmed by using the Remaining User Area Response command (DC2 '*' '2').

(2) Memory control information

After allocating the area, the memory control information is added at the beginning of the allocated area. The number of bytes for memory control information differs depending on each function. The number of bytes for memory control information of each function is listed in Table 9-2.

Table 9-2 Number of Bytes of Memory Control Information (User Area)

Function	Number of Bytes
User-defined characters	8
Downloaded characters	104
Optional font	12
Macro	12
NV bit image	2048
Downloaded bit image	12

[Example]

For user-defined character, the 24×24 dot character takes 72 bytes and the 16×16 character takes 32 bytes. Therefore, there can be up to 94 characters, with 8 bytes of memory control information, as shown below:

$(72+32) \times 94 + 8 = 9784$ bytes

When calculating the remaining memory, include the number of bytes for memory control information. Since one memory area is limited to 65536 bytes, the maximum number of bytes which can be registered, is as follows:

Optional font $= 65536 - 12 = 65524$ bytes

(3) Precautions for the macro

Macro can not include the commands for allocating or freeing (up) the memory area listed in Table 9-3.

Table 9-3 Commands for Allocating or Freeing Memory Area

Command	Command Name
DC2 'P'	Optional Font Define
DC2 'Q'	Optional Font Invalidation
GS ':'	Macro Define Start/Stop
ESC '&	Downloaded Character Define
DC2 'D'	Downloaded Character Area Operation
FS '2'	User-Defined Character Define
DC2 'G'	User-Defined Character Area Operation
FS 'q'	NV Bit Image Define
GS '*'	Downloaded Bit Image Define
GS 'v'	Raster Bit Image Printing
DC2 '*' '1'	User Area Reduction
DC2 'R'	Extension Memory Initialize

If the commands listed in Table 9-3 are input during selection of macro, macro selection is canceled.

(4) Memory management

1) About Memory in the User area of CG ROM

Memory in the User area of CG ROM has the following three kinds of conditions:

- In use state
- Used state
- Unused state
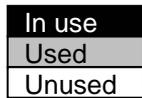
| In use |
| Used |
| Unused |

The user area other than exclusive use for user-defined character and downloaded character is in Unused state at shipping.

When some data is saved in the user area, the user area turns to In use state as explained in the figure below.
When the data in use state is invalidated, the invalidated area turns to Used state. The invalidated area cannot be returned to its original state again.

[1] Shipping

| Allocated memory area for user defined |
| Allocated memory area for downloaded character |
| Unused state |

[2] State that some data are registered.

| Allocated memory area for user defined |
| Allocated memory area for downloaded character |
| Data (1) In use state |
| Unused state |

[3] State that the registered data is invalidated.

| Allocated memory area for user defined |
| Allocated memory area for downloaded characte |
| Data (1) Used state |
| Unused state |

[4] State that the registration and invalidation are repeated.

| Allocated memory area for user defined |
| Allocated memory area for downloaded character |
| Data (1) Used state |
| Data (2) In use state |
| Data (3) In use state |
| Data (4) Used state |
| Data (5) In use state |
| Unused state |

[5] State that the User Area Reduction command (**DC2 '*' '1'**) is executed.

| Allocated memory area for user defined |
| Allocated memory area for downloaded character |
| Data (2) In use state |
| Data (3) In use state |
| Data (5) In use state |
| Unused state |

In the example:

*'Some data' means other than user defined character and downloaded character.

When data registration and invalidation are repeated, the memory state turns to the [4] state. To use the Used state area again, execute the User Area Reduction command (DC2 '*' '1'). The [5] shows the memory state after the command is executed.

Execute Remaining User Area Response command to be sure the current memory empty capacity.
By Remaining User Area Response command, the current memory empty capacity is respond.

2) Precaution of the CG ROM area rewriting, release and ensure

When define and register the command (user-defined character, downloaded character, optional font, macro, NV bit image and downloaded bit image), the data are registered in the area already, compare the registered data and newly registered data. If all data are equal, does not process the overwritten.

The remaining memory amount is checked by the response command of Remaining User Area Response. (DC2'*''2').

The CG ROM is configured with the FLASH memory.
The maximum rewritable number of the FLASH memory is approximately 100000 times.
Execute the User Area Reduction command (DC2 '*' '1') after getting low memory for restraining the numbers of the memory rewriting.

Do not turn off the printer while the command on writing or invalidation into the CG ROM executes. If doing so, operational malfunctioning may occur. To prevent destruction of the CG ROM, transfer the Execution Response Request command (DC2 'q' n) after command on writing or invalidation, and check a response code.

9.3 STANDARD MODE AND PAGE MODE

There are two ways for print mode: the standard mode that CPU prints the received data each time or the page mode that CPU prints the page data after received one page data can be selected.

9.3.1 Standard Mode

In the standard mode, CPU prints the received data each time.
When one line buffer is filled up with the character data (one line full print) or the print condition is established by the Line Feed command or the Printer return command, CPU prints.

9.3.2 Page Mode

In the page mode, CPU prints at each one page.
The printer enters to the page mode by the Page Mode Select command.
When CPU enters to the page mode, the printer develops the received data in the print area of the memory.
When CPU receives the Page Mode Print and Recovery or Page Mode Data Print commands, CPU prints the print data developed on the memory collectively.

In the page mode, there are two methods, the method that CPU prints only one page and the method that CPU prints the save data for multiple numbers.

(1) Page mode operational procedures

Table 9-4 and Table 9-5 show how to print the data.

Table 9-4 When Only One Page Print is Desired

Procedure	Command	Description	Remark
1	ESC 'L'	Selects the page mode.	The standard mode and there is no data in the line buffer are required.
2	ESC 'W'	Specifies print area.	When the print area is not specified, all print area is specified.
3	ESC 'T'	Specifies the print start point and print direction.	When the print start point and print direction are not specified; Print start point: upper left; Print direction: left to right
4	Various	Develops the data in the specified print area.	
5	FF	Prints all data of the page mode correctively and returns to the standard mode.	

Table 9-5 When Multiple Prints are Desired

Procedure	Command	Description	Remark
1	ESC 'L'	Selects the page mode.	The standard mode and the top of the line are required.
2	ESC 'W'	Specifies print area.	When the print areas are not specified, all print areas are specified.
3	ESC 'T'	Specifies the print start point and print direction.	When the print start point and print direction are not specified; Print start point: upper left; Print direction: left to right
4	Various	Develops the data in the specified print area.	
5	ESC FF	Prints all data of the page mode correctively.	The data of the page mode is held.
6		Repeats procedure 5 for [A number to Reprinted-1] times.	When changing a part of the print data, execute procedure 2 to 5.
7	ESC 'S'	Returns to the standard mode.	

(2) Data processing of the page mode

1) Preset of the print start position

A character, a bit image, and a bar code are developed with the reference of the print start position.

Preset the print start position by the Vertical Absolute Position Specify in Page Mode command before transmitting the print contents.

When the printer starts developing characters and bit images, the print start position will be shifted automatically.

2) Developing position of characters and image data

- Characters

The reference point of characters is lower left.
The developing position is the position that is matched the lower left of characters with the print start position.
After developing, the print start position shifts horizontally for character width plus right space.

- Bit image

The reference point of the bit image is lower left.
The developing position is the position that is matched to the lower left of the bit image with the print start position. After developing, the print start position shifts horizontally for image width.

- Downloaded bit image

The reference point of the downloaded bit image is lower left.
The developing position is the position that is matched the lower left of the downloaded bit image with the print start position. After developing, the print start position shifts horizontally for the image width.

- Barcode

The reference point of the barcode is lower left.
The developing position is the position that is matched the lower left of the image with the print start position.

Therefore, HRI characters are developed at the under position of the print start position.
After developing, the print start position shifts horizontally for the barcode width.

- Raster bit image

The reference point of the raster bit image is upper left.
The developing position is the position that is matched the upper left of the image with the print start position.
After developing, the print start position shifts horizontally for the image width.
The developing positions of the character and the image data are shown in Figure 9-1.
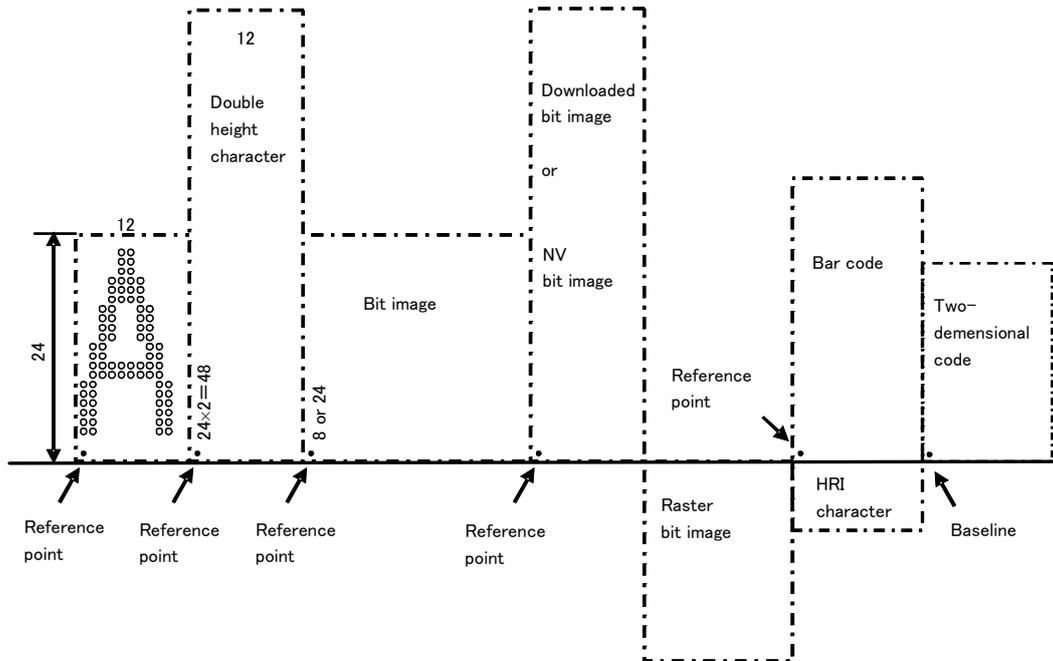
Figure 9-1 Deployment Positions of Characters and Image Data

- HINT

Transmit print data after executing Page Mode Select command or Print Area Set in Page Mode command then specifying developing position. If developing position is not specified, CPU does not print data correctly.

3) Direction of Developing position

CPU prints data according to specified direction. Refer to Character Print Direction Specify in Page Mode command.

4) Print command processing

The commands that involve a print operation in the page mode are FF and ESC FF. Print commands in the standard mode (LF, ESC 'J', etc) do not result in actual printing, but only moving of the print deployment position.

5) Buffer full processing

Buffer full processing in the horizontal character direction is performed when all the character data cannot be deployed in the print area like in the standard mode, and the subsequent data is deployed from the beginning of the next line.

Buffer full processing in the vertical character direction is performed when there is no deployment reference position within the area, and the subsequent data is discarded.

6) Setting of printing area in page mode

CPU prints all printable area in page mode except two-dimensional bar code area from extended RAM area. The all printable area is different depend on the connecting mechanism and the capacity of SRAM.

Table 9-6 Page Mode Maximum Print Range

Printer	Maximum width (X direction)	Maximum length (Y direction)				
		128k bytes	256k bytes	512k bytes	1M byte	2M bytes
LTPD247/CAPD247	432dots	1737dots	4110dots	8854dots	16000dots	16000dots
LTPD347/CAPD347	576dots	1310dots	3100dots	6678dots	13836dots	16000dots

9.4 FUNCTION CODE DESCRIPTION

This chapter describes the commands in each function.

```
┌──────────────────────────────────────────────────────────────┐
│                                                              │
│  ▂▂▂                                              x  x  x  x │
│  X X                                              │         │
│   │                                   The name of the command│
│   └── Command                                                │
│                                                              │
│  ┌─────────┐                                                 │
│  │  Code   │   Indicates hexadecimal codes. (  H)            │
│  └─────────┘                                                 │
│  ┌─────────┐                                                 │
│  │Definition│  Indicates parameter and setting data area     │
│  │ Range   │                                                 │
│  └─────────┘                                                 │
│  ┌─────────┐                                                 │
│  │ Default │   Describes default for the command with parameter│
│  └─────────┘                                                 │
│  ┌─────────┐                                                 │
│  │Function │    Indicates the function of the commands.       │
│  └─────────┘                                                 │
│  ┌─────────┐                                                 │
│  │ Notes   │    Describes the notes of the commands as needed.│
│  └─────────┘                                                 │
│  ┌─────────┐                                                 │
│  │ Related │    Describes the commands related to this command operation.│
│  │Commands │                                                 │
│  └─────────┘                                                 │
└──────────────────────────────────────────────────────────────┘
```

- Buffer full

  The line buffer is full status. In the standard mode, CPU prints data in line buffer and feeds Thermal paper one dot line after receiving new data. That performance is same as LF. In the page mode, CPU shifts the print position to beginning of line and develops the data after receiving new data.

- Beginning of line

  The beginning of a line signifies satisfaction of the following conditions.
  No print data (including space and skip portion caused by HT) exists in the current line buffer.
  No specification of the print position by ESC '$', ESC '¥'.

- Printable area

  X direction maximum width that can be printed, as specified by the print width specification.
  See 9.3.2 Page Mode for the print width setting. The print width shows the printable area.
  In the page mode, the print length is defined by Character Print Direction Specify in Page Mode command.

- Print area

  Print area set with the Print Area Width Set command (GS 'W') and Print Area Set in Page Mode (ESC 'W'). Must always (Print area≤Printable area).

- Ignore

  This is the state of discarding all the code including the parameter and not doing anything.

- Inch

  Unit of length. 1 inch = 25.4 mm approx.

- LSB / MSB

  LSB is the least significant bit and MSB is the most significant bit.

9.4.1 Printing Command

LF   Line Feed

| Code | 0AH |

| Function | [When the standard mode is selected] |

Prints the data in the line buffer and performs line feed based on the set number of lines.

[When the page mode is selected]
Moves the print start position to the top of the next line based on the set number of lines.

| Related Commands | ESC '2', ESC '3' |

FF   (1) Page Mode Print and Recovery (when the page mode is selected)
(2) Marked Paper Print and Form Feed (when the standard mode is selected)

| Code | 0CH |

| Function | Differs depending on the mode selected. |

[When the page mode is selected]
Prints data, which is entirely developed over all the printable area, in block and returns it to the standard mode.

[When the standard mode is selected]
When Mark is selected in the function setting, the printer prints data in the line buffer and executes the paper form feed.

| Notes | [When the page mode is selected] |

All the developed print data is erased after having been printed.
The paper form feed is not executed.
The next print position is the beginning of the line.
The print area set by ESC 'W' is initialized.

[When the standard mode is selected]
The next print position is the beginning of the line.

| Related Commands | [When the page mode is selected] |

ESC FF, ESC 'L', ESC 'S'

[When the standard mode is selected]
GS FF, GS '<'

CR   Carriage Return

| Code | 0DH |

| Function | When CR mode selection in parallel communication is set to enable with function setting, CPU provides the same function as LF. |

| Notes | This command is ignored the followings: |

CR mode selection in parallel communication is set to disable, in serial communication and in USB communication.
The next print position is the beginning of the line.

| Related Commands | LF, DC2 'w', DC2 'l' |

Code	1BH 0CH

Function	In the page mode, batch prints the data deployed in the entire page buffer.

Notes	Only valid when the page mode is selected. When the standard mode is selected, this command is ignored. Following printout, the deployed data, ESC 'W', ESC 'T' setting values, and print start positions are held. The paper form feed is not executed.

Related Commands	FF, ESC 'L', ESC 'S'

Code	1BH 4AH n

Definition Range	0≤n≤255

Function	[When the standard mode is selected] Feeding the Thermal paper for a predefined distance. When data exist in the line buffer, the Thermal paper is feed after printing one line. The paper feed distance is [n × basic calculation pitch] inches. The vertical basic calculation pitch (y) is used. [When the page mode is selected] Shifts the print start position for predefined distance. Distance is [n × basic calculation pitch] inches. The basic calculation pitch differs depending on the start position. When the starting point is specified as "upper left" or "lower right" by ESC 'T', the basic calculation pitch (y) in the paper feed direction (characters' vertical direction) is used. When the starting point is specified as "upper right" or "lower left" with ESC 'T', the basic calculation pitch (x) in the direction perpendicular to paper feed (characters' vertical direction) is used.

Notes	The beginning of the line following print completion is the next print position. This command does not affect the line spacing set by ESC '2' or ESC '3'. The basic calculation pitch is set by GS 'P'. If the calculation result is a fractional figure, it is compensated using the mechanism minimum pitch, and the remainder is discarded.

Related Commands	GS 'P'

ESC 'd' n   Print and n Lines Feed Forward

Code	1BH 64H n

Definition Range	0≤n≤255

Function	[When the standard mode is selected]

Feeding the Thermal paper for n lines.
The paper feed distance is [n × the specified line space × basic calculation pitch] inches.
The vertical basic calculation pitch (y) is used.

[When the page mode is selected]
Moves the print start position for n lines.
Moving distance is [n × specified line space × basic calculation pitch] inches.
The basic calculation pitch differs depending on the start position.

When the starting point is specified as "upper left" or "lower right" by ESC 'T', the basic calculation pitch (y) in the paper feed direction (characters' vertical direction) is used.

When the starting point is specified as "upper right" or "lower left" by ESC 'T', the basic calculation pitch (x) in the direction perpendicular to paper feed (characters' vertical direction) is used.

Notes	The next print position is the beginning of the line.

CAN   Print Data Cancel in Page Mode

Code	18H

Function	Deletes all the data in the latest print area in the page mode.

Notes	Only valid when the page mode is selected. When the standard mode is selected, this command is ignored. Data out of print area that is set currently cannot be deleted.

Related Commands	ESC 'L', ESC 'W' 9.3.2 Page Mode

9.4.2 Line Spacing

ESC '2'   1/6 Inch Line Feed Set

Code	1BH 32H
Function	Specifies the line spacing per line as 1/6 inch (34 dots).
Notes	The line spacing can be set independently in the standard mode and the page mode.
Related Commands	ESC '3'

ESC '3' n   Line Spacing Set

Code	1BH 33H n
Definition Range	$0 \leq n \leq 255$
Default	The line spacing per line as 1/6 inch (34 dots).
Function	Sets the line spacing per line. The line spacing is [n × basic calculation pitch] inches.
Notes	The line spacing can be independently set in the standard mode and the page mode. The basic calculation pitch is set by GS 'P'. Moreover, once set, the line spacing is not changed even when the basic calculation pitch is changed by GS 'P'. If the calculation result is a fractional number, it is compensated using the mechanism's minimum pitch, and the remainder is discarded. In the standard mode, the vertical basic calculation pitch (y) is used. When the printer unit is used in the page mode, the operations are as follows depending on the starting point. When the starting point is specified as "upper left" or "lower right" by ESC 'T', the basic calculation pitch (y) in the paper feed direction (characters' vertical direction) is used. When the starting point is specified as "upper right" or "lower left" by ESC 'T', the basic calculation pitch (x) in the direction perpendicular to paper feed (characters' vertical direction) is used.
Related Commands	ESC '2', GS 'P'

9.4.3 Character Set

Code	1BH 20H n

Definition Range	0≤n≤255

Default	n=0

Function	Sets the amount of space to the right of the character. The right space amount is [n × basic calculation pitch] inches.

Notes	This command does not affect Kanji. The amount of right space of double width becomes double against the amount of the setting value. The Character Right Space Amount Set command can be independently set for the standard mode and the page mode. The basic calculation pitch is set by GS 'P'. Furthermore, the set right space amount is not changed even if the basic calculation pitch is changed with GS 'P' after the right space amount has been set. If the calculation result is a fractional figure, it is compensated using the mechanism's minimum pitch, and the remainder is discarded. In the standard mode, the horizontal direction basic calculation pitch (x) is used. In the page mode, the basic calculation pitch used here is as follows depending on the starting point. When the starting point is specified as "upper left" or "lower right" by ESC 'T', the horizontal direction basic calculation pitch (x) is used. When the starting point is specified as "upper right" or "lower left" by ESC 'T', the vertical direction basic calculation pitch (y) is used.

Related Commands	GS 'P'

Character width

A Character height

Right space
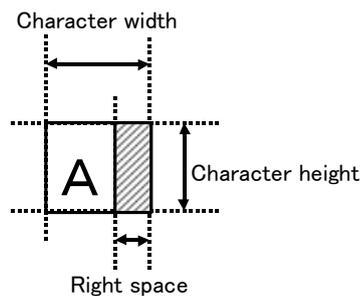
Code | 1BH 21H n

Definition Range | 0≤n≤255

Default | n=0

Function | Selects the print mode.

Bit	Function	Value	
		0	**1**
0	Character font	Font A selected (24× 12)	Font B selected (16 × 8)
1	Undefined	–	–
2	Undefined	–	–
3	Bold print	Cancel	Specify
4	Double height	Cancel	Specify
5	Double width	Cancel	Specify
6	Undefined	–	–
7	Underline	Cancel	Specify

Notes | When both the double height and double width are specified, the character size is double height and width.
Underlines are used along the entire character width including the space to the right of the character. However, no underline is used for the portion skipped through the use of HT and for 90° right rotated characters.

The underline width is the thickness set by Underline Specify/Cancel command (ESC '–'), and is independent of the character size. If not restricted by ESC '–', the underline width is 1 dot.

This command does not affect Kanji, except bit 3 (bold characters).

If characters with different vertical direction extension factors exist in mix on the same line, extension is executed based on the character's bottom edge (the characters' bottom edges are aligned).

If extending characters in the horizontal direction, they are extended in the right direction using the left edge of the character as reference.

In case of print modes for which bold print, underline, etc., can be set and cancelled as with other commands, the command processed last is valid. Therefore, if bold print is cancelled with ESC '!' n the following specification of bold print with Bold Print Specify/Cancel command (ESC 'E'), specification with ESC 'E' is cancelled.

The last specified command by this command (ESC '!' n) or Character Size Specify command affects double width and double height.

Related Commands | ESC '–', ESC 'E'

ESC 'M' n — Character Font Select

| Code | 1BH 4DH n |

| Definition Range | n=0, 1, 2, 3, 48, 49, 50, 51, |

| Default | n=0 |

| Function | Selects a character font. |

n	Function
0, 48	Select font A (24 × 12).
1, 49	Select font B (16 × 8).

| Notes | Character fonts can also be selected with Print Mode Select command (ESC '!'), but the last executed command becomes effective. |

| Related Commands | ESC '!' |

GS '!' n — Character Size Specify

| Code | 1DH 21H n |

| Definition Range | 0≤n≤255 |
| | 1≤vertical scale≤8, 1≤horizontal scale≤8 |

| Default | n=0 |

| Function | Specifies a character size (vertical scale/horizontal scale). |

Bit	Function	Value	
		Hexadecimal	Decimal
0 to 3	Vertical scale	See table 1 [Vertical Scale]	
4 to 7	Horizontal scale	See table 2 [Horizontal Scale]	

1 Vertical Scale

Hexadecimal	Decimal	Scale
00H	0	×1 (default)
01H	1	×2 (double)
02H	2	×3
03H	3	×4
04H	4	×5
05H	5	×6
06H	6	×7
07H	7	×8

2 Horizontal Scale

Hexadecimal	Decimal	Scale
00H	0	×1 (default)
10H	16	×2 (double)
20H	21	×3
30H	48	×4
40H	64	×5
50H	80	×6
60H	96	×7
70H	112	×8

| Notes | The setting applies to all characters (including Kanji) except HRI characters. However, as for the character size of optional font, the scale is specified up to double width or double height. If the command specifies the scale to three or larger, optional font is modified with double width or double height. |

When either vertical scale or horizontal scale is out of definition, this command is ignored.

In the standard mode, vertical direction shows the paper feed direction and horizontal direction shows the vertical direction for the paper feed direction.
Therefore, when specifying "Character 90° Right Rotate Specify/Cancel," the relationship between the length and breadth becomes reverse.

In the page mode, vertical direction shows the vertical direction for the character and horizontal direction shows the horizontal direction for the character.

ESC '−' n   Underline Settings

| Code | 1BH 2DH n |

| Definition Range | 0≤n≤2, 48≤n≤50 |

| Default | n=0 |

| Function | Defines or cancels underline. |

n	Function
0, 48	Cancel underline
1, 49	Set 1-dot height underline and specify underline
2, 50	Set 2-dot height underline and specify underline

| Notes | Underlines are used along the entire character width including the space to the right of the character. However, no underline is used for the portion skipped through the use of HT and for 90° right rotated characters.

When underline is canceled with n=0, no underline is added to the subsequent data, but the underline height setting immediately before underline cancel is retained. Moreover, in the initial state, underline cancel (n=0) is selected.

Regardless of the size of characters, underline height is constant

Even if the underline height changes in the middle of a line, the last specified height becomes effective.

This command does not affect Kanji.

Underline specification/cancellation is also possible with ESC '!', but the command that was last processed becomes valid. Therefore, if the following specification of underline with ESC '!', underline is canceled with ESC '−', the ESC '!' specification is canceled

| Related Commands | ESC '!' |

ESC 'E' n — Bold Print Specify/Cancel

Code	1BH 45H n

Definition Range	0≤n≤255

Default	n=0

Function | Specifies or cancels bold printing.
If n=<*******0>B, cancels bold printing.
If n=<*******1>B, specifies bold printing.

Notes | Only the LSB is valid for n.
This command affects both 1-byte character and Kanji.

Related Commands | ESC '!'

ESC 'G' n — Double Strike Printing Specify/Cancel

Code	1BH 47H n

Definition Range	0≤n≤255

Default	n=0

Function | Specifies or cancels double strike printing.
If n=<*******0>B, cancels double strike printing.
If n=<*******1>B, specifies double strike printing.

Notes | Only the LSB is valid for n.
Print result is exactly the same as bold printing.
This command affects both 1-byte character and Kanji.

Related Commands | ESC 'E'

Code | 1BH 56H n

Definition Range | n=0, 1, 48, 49

Defaults | n=0

Function | Specifies or cancels 90° character rotation to the right.

n	Function
0, 48	Cancel 90° character rotation to right
1, 49	Specify 90° character rotation to right (1 dot interval in horizontal direction)

Notes | Even when underline is specified, underline is not done for characters that are rotated 90° to the right.
If 90° right rotation is specified, the relation between horizontal scaling and vertical scaling in relation to the character direction is opposite when 90° right rotation is canceled.
This command does not affect the page mode.
When the page mode is selected, only the printer unit's internal flag operation is performed when this command is input.

Related Commands | ESC '!', ESC '−', FS '!', FS '−'

Code | 1BH 7BH n

Definition Range | 0≤n≤255

Default | n=0

Function | Specifies or cancels inversion (flip) printing.
If n=<*******0>B, cancels inversion (flip) printing.
If n=<*******1>B, specifies inversion (flip) printing.

Notes | Only the LSB is significant for n.
This command is valid only when it is input at the beginning of a line.
When the page mode is selected, only the printer unit's internal flag operation is performed when this command is input.
This command does not affect the page mode.
Inversion (flip) printing rotates the data of the line 180°.
This command affects both 1-byte character and Kanji.

Code	1DH 42H n

Definition Range	0≤n≤255

Default	n=0

Function	Specifies or cancels reverse printing of characters. If n=<*******0>B, cancels reverse printing. If n=<*******1>B, specifies reverse printing.

Notes	Only the LSB is significant for n. The characters that can be reverse printed are internal characters and downloaded characters. The right space defined with ESC SP is also subject to reverse printing.

In the following cases, reverse printing is not performed.

Bit image (ESC '*')
Downloaded bit image (GS '/')
Barcode (GS 'k')
HRI character (GS 'H')
Portion skipped by horizontal tab (HT)
Portion skipped by Absolute Position Specify (ESC '$')
Portion skipped by Relative Position Specify (ESC '\')
NV bit image (FS 'p')
Two-dimensional code (GS 'p')

This command does not affect the space between lines.

Reverse print takes precedence over underline. Therefore, even when underline is specified, no underline is applied to reverse print characters. However, the underline setting status does not change.

Code	1BH 52H n

Definition Range	0≤n≤10

Default	n=0

Function	Selects the international character sets listed in the following table.

n	Country	n	Country
0	USA	6	Italy
1	France	7	Spain
2	Germany	8	Japan
3	United Kingdom	9	Norway
4	Denmark I	10	Denmark II
5	Sweden		

Related Commands	See CHAPTER 10 CHARACTER CODES.

Code | 1BH 74H n

Definition Range | n=0, 1, 16, 254, 255

Default | n = 0

Function | Selects page n in the character code table as follows.
If Katakana Character Set 1 and Katakana Character Set 2 are selected without CG ROM, the command is ignored.

n	Character set
0	Extended graphics
1	Katakana character set 1
16	Codepage1252
254	Katakana character set 2
255	Blank page

Related Commands | See CHAPTER 10 CHARACTER CODES.

ESC '&' y s e [x [d]k]n   Downloaded Character Registration

Code | 1BH 26H y s e [x [d]k]n

Definition Range | y=3 (when font A (24 × 12) is selected)
y=2 (when font B (16 × 8) is selected)
$20H \leq s \leq e \leq 7EH$
$0 \leq x \leq 12$(when font A (24 × 12) is selected)
$0 \leq x \leq 8$ (when font B (16 × 8) is selected)
$0 \leq d \leq 255$

Default | Unregistered

Function | Registers downloaded character pattern to the specified character code.
y defines the number of bytes in the vertical direction.
s defines the registration start character code, and e defines the registration end character code.
x specifies the horizontal dot count to be registered.

Notes | The character codes that can be registered are ASCII code in the range of 20H to 7EH.
Multiple continuous character codes can be registered per registration. To specify only one character, specify s=e.

d is registration data and indicates the pattern the number of dots in direction x from the left end. If at this time x is less than the character configuration dot count, the remaining dots on the right side become spaces.

The number of data bytes required for downloaded character registration of one character k is $k=y \times x$ bytes.

The number of data bytes required for downloaded character registration of total data n is $n=k \times (e–s+1)$.

Registration data bit is 1 in case of corresponding to a dot to be printed, or is 0 in case of corresponding to a dot not to be printed.

The memory usage is m=6184 bytes. (includes information amount)

| Related Commands | ESC '%', ESC '?' |
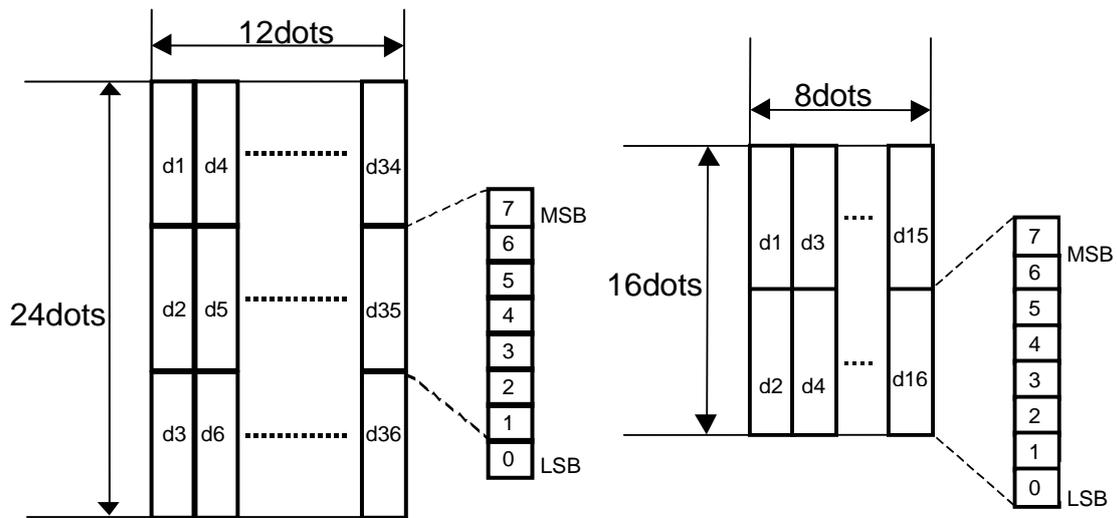
ESC '%' n   Downloaded Character Set Specify/Cancel

| Code | 1BH 25H n |

| Definition Range | 0≤n≤255 |

| Default | n=0 |

| Function | Specifies or cancels downloaded character set.
If n=<*******0>B, cancels downloaded character set.
If n=<*******1>B, specifies downloaded character set. |

| Notes | Only the LSB is significant for n.
If downloaded character set was canceled, the internal character set is automatically specified. |

| Related Commands | ESC '&', ESC '?' |

ESC '?' n   Downloaded Character Release

| Code | 1BH 3FH n |

| Definition Range | 20H≤n≤FEH |

| Function | Releases downloaded character corresponding to the specified code. |

| Notes | n indicates the character code for releasing the registration pattern. After releasing, CPU prints the internal character.
Releases the selected character font code by ESC '!'.
If the specified character code is undefined, this command is ignored. |

| Related Commands | ESC '&', ESC '%' |

DC2 'D' n   Downloaded Character All Release

Code	12H 44H n

Definition Range	0≤n≤255

Function	Releases downloaded character area.
	If n=<*******0>B, releases downloaded character area.
	If n=<*******1>B, allocates downloaded character area.

Notes	Only the LSB is significant for n.
	When downloaded character area is released, downloaded characters are deleted, and downloaded character specification is canceled. Moreover, Downloaded Character Registration (ESC '&') command and Downloaded Character Set Specify/Cancel (ESC '%') command are ignored.
	To allocate again downloaded character area that has been freed, a remaining memory capacity of 6184 bytes or more is required. If the remaining memory capacity is insufficient, downloaded character area is not allocated and DC2 'D' 1 is ignored.

DC2 'O' n   Optional Font Select

Code	12H 4FH n

Definition Range	0≤n≤255

Default	n=0 (Optional font cancel)

Function	Performs optional font selection and cancellation.
	If n=<*******0>B, cancels optional font.
	If n=<*******1>B, selects optional font.

Notes	Only the LSB is significant for n.
	When optional font is selected, the subsequent character codes are printed using this optional font when optional font has been registered previously.
	Optional font has priority over download font in printing

DC2 'P' s e y x [d]k   Optional Font Registration

Code	12H 50H s e y x [d]k

Definition Range	20H≤s≤e≤7EH
	1≤y≤127, 1≤x≤127

Default	Undefined

Function	Allocates memory area of optional font and registers it.

Notes	When optional font is already registered, if it is not as same as the registered content, allocate the area again and register it.
	The registration start character code is specified with s, and the registration end character code with e.
	Optional font vertical dot count is specified with y. If y falls outside the domain, the subsequent data is processed as character code.
	Optional font horizontal dot count is specified with x. If x falls outside the domain, the subsequent data is processed as character code.
	The data count per character is INT $((y+7)/8) \times x$ bytes.

Therefore, the total data count
$k = INT((y+7)/8) \times x \times (e-s+1)$.

Regarding the font data of one character, 8 vertical dots are input as 1-byte data in the order shown in the following figure. The following figure is based on x=y=20.
The calculating method of the total data is different from the calculating method of the total data count k. Because register the memory, the font image is explicate by the low scan style.

The memory usage amount $m=INT((x+7)/8 \times (e-s+1) + (information amount of the memory)$

ex. 20dots×20dots

※A gray area is disregarded.
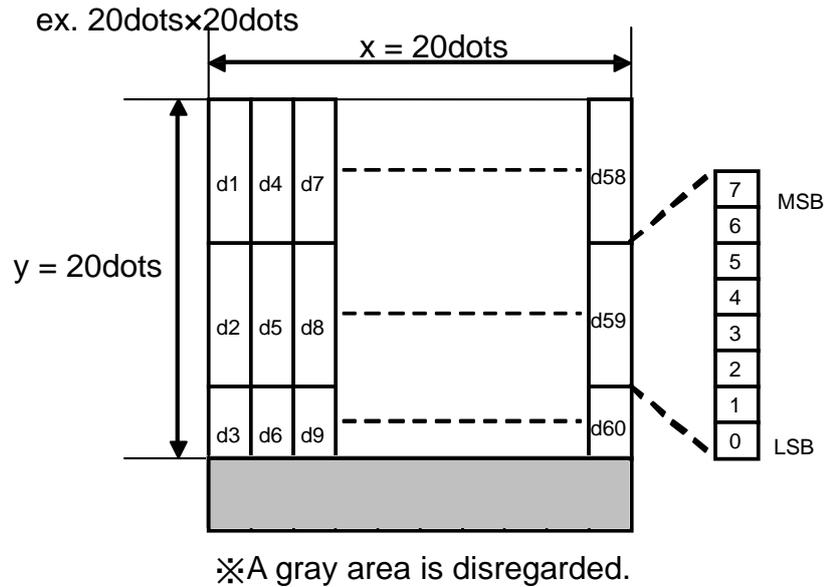
DC2 'Q'   Optional Font Release

Code	12H 51H

Definition Range	Undefined

Function	Releases all the registered optional fonts and frees the memory that was used for these optional fonts. Thus, the registered optional fonts are not printed after executing Optional Font Release command.

Notes	Line buffer is also cleared.
	The remaining memory capacity is not increased.
	It is possible to use again as the user area by the reduction command of the extended memory area (DC2'*'1').

9.4.4 Character Position

ESC 'L'   Page Mode Select

Code	1BH 4CH

Function   Switches the mode from the standard mode to the page mode.

Notes   This command is effective only when input is executed at the beginning of a line.
This command is not effective when input is executed in the page mode.
The printer unit returns to the standard mode after processing the print with FF or executing the command of ESC 'S'.
In the page mode, the received data is deployed in the print area specified with ESC 'W', and it is batch printed with the FF or ESC FF commands. Print/line feed commands such as LF, ESC 'J', and ESC 'd' just move the pointer to the next data and do not actually cause printing.
The character deployment position is the starting point specified with ESC 'T' in the print area specified with ESC 'W'.

The setting values of the following commands, which have independent values in the page mode and standard mode. The Page Mode Select command is switched to the setting values of the page mode.

ESC SP	Character Right Space Amount Set
FS 'S'	Kanji Space Amount Set
ESC '2'	Line Spacing Set
ESC '3'	1/6 Inch Line Feed Set

Although the following commands are set in page mode, the actual printing is not performed.

ESC 'V'	Character 90° Right Rotate Specify/Cancel
ESC 'a'	Alignment
ESC '{'	Inversion Printing Specify/Cancel
GS 'L'	Left Margin Set
GS 'W'	Print Area Width Set

Related Commands   FF, CAN, ESC FF, ESC 'S', ESC 'T', ESC 'W', GS '$', GS '\'
See 9.3.2 Page Mode.

ESC 'S'   Standard Mode Select

Code	1BH 53H

Function   Switches the printer unit from the page mode to the standard mode.

Notes   This command is effective only when it is input in the page mode.
The data used in the page mode is deleted.
The print area set through the Print Area Set in Page Mode (ESC 'W') is initialized.

The setting values of the following commands, which have independent values in the page mode and standard mode, are switched to the setting values of the standard mode.

ESC SP	Character Right Space Amount Set
FS 'S'	Kanji Space Amount Set
ESC '2'	Line Spacing Set
ESC '3'	1/6 Inch Line Feed Set

Related Commands   ESC 'L'

Code	1DH 50H x y

Definition Range	0≤x≤255
	0≤y≤255

Default	x=203, y=203 (Minimum pitches of the printer mechanism)

Function	Sets the horizontal basic calculation pitch to 1/x inches, and the vertical basic calculation pitch to 1/y inches.

Returns to the initial value when x=0, y=0.

Notes	The horizontal direction means the direction perpendicular to paper feed, and the vertical direction means the paper feed direction.

In the standard mode, the following parameters are used regardless of the character orientation (inversion (flip), 90° right rotated, etc.).

Commands that use x: ESC SP, ESC '$', FS 'S', GS 'L', GS 'W'
Commands that use y: ESC '3', ESC 'J' , GS ' $ ', GS 'A' , GS '\'

In the page mode, the following parameters are used depending on the character orientation.

When starting point is "top left" or "bottom right" through ESC 'T' (characters deployed in direction perpendicular to paper feed)
Commands that use x: ESC SP, ESC '$', ESC 'W', ESC '\', FS 'S'
Commands that use y: ESC '3', ESC 'J', ESC 'W', GS '$', GS 'A', GS '\'

When starting point is "top right" or "bottom left" through ESC 'T' (characters deployed in paper feed direction)
Commands that use x: ESC '3', ESC 'J', ESC 'W', GS '$', GS 'A', GS '\'
Commands that use y: ESC SP, ESC '$', ESC 'W', ESC '\', FS 'S'

This command does not affect existing settings.

If the calculation result combined with other commands is a fractional figure, it is compensated using the mechanism's minimum pitch, and the remainder is discarded

Related Commands	ESC SP, ESC '$', ESC '3', ESC 'J', ESC 'W', ESC '\', FS 'S', GS '$', GS 'A', GS 'L', GS 'W', GS '\'

HT   Horizontal Tab

Code	09H

Function	Shifts the print position to the next horizontal tab position.

Notes This command is ignored if the next horizontal tab position has not been set.
The print position is shifted to [print area + 1] if the next horizontal tab position is beyond the print area.
The horizontal tab position is set with ESC 'D'.
The initial horizontal tab position value is every 8 characters for the characters selected in the initial state.
Upon reception of this command when the print position is at [print area + 1] and the standard mode is selected, the current line buffer full print and horizontal tab processing from the beginning of the next line are executed.
Upon reception of this command when the print position is at [print area + 1] and the page mode is selected, the current line buffer full processing and horizontal tab processing from the beginning of the next line are executed.

Related Commands	ESC 'D'

ESC 'D' [n]k NUL   Horizontal Tab Position Set

Code	1BH 44H [n]k 00H

Definition Range	1≤n≤255, 0≤k≤32

Default	Every eight characters selected in the initial state

Function Sets the horizontal tab positions.
n indicates the number of columns from the left margin or the beginning of the line up to the setting position.
k indicates the number of horizontal tab position data to be set.

Notes The horizontal tab position is set as [n × character width] from the left margin or the beginning of the line.
Character width here means the entire character width including the space to the right of the character, and when double width is specified, this width is doubled.
This command cancels already set horizontal tab positions.
If n=8 is set as the horizontal tab position, the next print position shifts to the 9th column as the result of HT execution.
A maximum of 32 horizontal tabs can be set (k=32). If the number of tabs exceeds this number, the data after the last tab is processed as regular data.
The n that specifies the setting position is input in ascending order and then input 00H finally.
When n is not input in ascending order, the printer exits the process of Horizontal Tab Position Set command and the subsequent data is processed as normal data.
The values of n must be in ascending order and end with 00H. If n is a value equal to or smaller than the immediately preceding n, tab setting ends the moment this n is input, and the subsequent data is processed as normal data.
Send the ESC 'D' NUL command to cancel all tab settings.
If n exceeds the printable area for one line, a horizontal tab is set in the [maximum print column number + 1] position.
Even if the character width is changed after setting the horizontal tab positions, the set horizontal tab positions remain unchanged.

Related Commands	HT

Code	1BH 61H n

Definition Range	0≤n≤2, 48≤n≤50

Default	n=0

Function	Selects the type of justification for the print data on each line.

n	Alignment
0, 48	Align left
1, 49	Centered
2, 50	Align right

Notes	This command is effective only when it is input at the beginning of a line. When the page mode is selected, only the printer unit's internal flag operation is performed when this command is input. This command does not affect the page mode. Alignment is performed within the print area's width. Even portions skipped through the use of HT, ESC '$', ESC '\', etc., are subject to alignment.

Code	1DH 4CH nl nh

Definition Range	0≤nl≤255, 0≤nh≤255

Default	nl=0, nh=0

Function	Sets the left margin set with nl and nh. The left margin is [(nh×256+nl) × basic calculation pitch] inches.

Notes	This command is effective only when input at the beginning of a line. When the page mode is selected, only the internal flag operation of the printer unit is performed when this command is input. This command does not affect the page mode.

If a value that exceeds the printable area for 1 line is input, the maximum value of the printable area is set as the left margin.
The basic calculation pitch is set with GS 'P'. The set left margin does not change even if the basic calculation pitch is changed with GS 'P' after the left margin has been set.
The GS 'P' horizontal basic calculation pitch (x) is used for calculating the left margin. Moreover, if the calculation result is a fractional number, it is compensated using the mechanism's minimum pitch, and the remainder is discarded.

If, during character data deployment, the set print area width is less than one character of the currently specified type, the following processing is performed only for that line.

(1) In the range that does not exceed the printable area, the print area corresponding to one character of the specified type is extended toward the right side.

(2) If an area corresponding to one character cannot be secured even when processing (1) is performed, the print area is extended to the left side (the left margin is reduced).

If, during deployment of non-character data (bit image, etc.), the set print area width is less than the minimum width of one internal character, the following processing is performed only for that line.

(1) In the range that does not exceed the printable area, the print area up to one character of the minimum width among the internal characters is extended toward the right side.

(2) If an area corresponding to one character cannot be secured even when processing (1) is performed, the print area is extended to the left side (the left margin is reduced).

Ruled line data specified with ruled line command (DC3) is not shifted or masked by Left Margin Set. (Ruled line data is always valid in printable area.)

| Related Commands | GS 'P', GS 'W' |

GS 'W' nl nh   Print Area Width Set

| Code | 1DH 57H nl nh |

| Definition Range | $0 \leq nl \leq 255$, $0 \leq nh \leq 255$ |

| Default | Printable area |

| Function | Sets the print area width specified with nl and nh.
The print area width is $[(nh \times 256 + nl) \times$ basic calculation pitch] inches. |

| Notes | This command is effective only when input is executed at the beginning of a line.
When the page mode is selected, only the internal flag operation of the printer unit is performed when this command is input.
This command does not affect the page mode. |

If a value that exceeds the printable area for 1 line is input, the entire area except the left margin is set as the print area width.
The basic calculation pitch is set with GS 'P'. Moreover, the set print area width does not change even if the basic calculation pitch is changed with GS 'P' after the print area width has been set.

The GS 'P' horizontal basic calculation pitch (x) is used for calculating the print area width. Moreover, if the calculation result is a fractional number, it is compensated using the mechanism's minimum pitch, and the remainder is discarded.

If, during character data deployment, the set print area width is less than one character of the currently specified type, the following processing is performed only for that line.

(1) In the range that does not exceed the printable area, the print area corresponding to one character of the specified type is extended toward the right side.

(2) If an area corresponding to one character cannot be secured even when processing (1) is performed, the print area is extended to the left side (the left margin is reduced).

If, during deployment of non-character data (bit image, etc.), the set print area width is less than the minimum width of one internal character, the following processing is performed only for that line.

(1) In the range that does not exceed the printable area, the print area up to one character of the minimum width among the internal characters is extended toward the right side.

(2) If an area corresponding to one character cannot be secured even when processing (1) is performed, the print area is extended to the left side (the left margin is reduced).

Ruled line data specified with ruled line command (DC3) is not shifted or masked by Left Margin Set. (Ruled line data is always valid in maximum printable area.

| Related Commands | GS 'L', GS 'P' |

Code | 1BH 54H n

Definition Range | 0≤n≤3, 48≤n≤51

Default | n=0

Function | Specifies the character print direction and starting point in the page mode.

n	Print direction	Starting point
0, 48	Left → Right	Top left (A in Figure below)
1, 49	Bottom → Top	Lower left (B in Figure at below)
2, 50	Right → Left	Bottom right (C in Figure at below)
3, 51	Top → Bottom	Top right (D in Figure at below)

Notes | When the standard mode is selected, only the printer unit's internal flag operation is performed when this command is input.
This command does not affect the standard mode.
The character deployment position is the starting point specified with ESC 'W'.
The basic calculation pitch parameters (x or y) used for the following commands differ depending on the starting point.

When the starting point is "Top Left" or "Bottom Right" (character arranged in direction perpendicular to paper feed)
Commands that use x: ESC SP, ESC '$', ESC 't', FS 'S', ESC '$'
Commands that use y: ESC '3', ESC 'J', GS '$', GS 'A', GS '\'

When the starting point is "Top Right" or "Bottom Left" (character arranged in paper feed direction)
Command that use x: ESC '3', ESC 'J', GS '$', GS 'A', GS '\'
Commands that use y: ESC SP, ESC '$', ESC '\', FS 'S'

Related Commands | ESC '$', ESC 'L', ESC 'W', ESC ' \', GS '$', GS 'P', GS '\'
See 9.3.2 Page Mode.
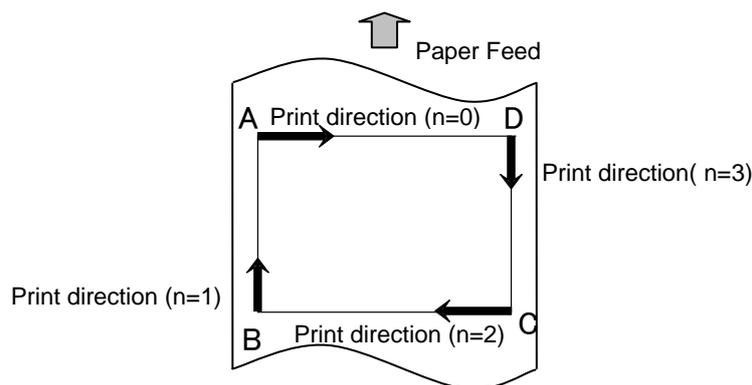
Code | 1BH 57H xL xH yL yH dxL dxH dyL dyH

Definition Range | 0≤xL, xH, yL, yH, dxL, dxH, dyL, dyH≤255

Default | Printable area of print paper

Function | Sets the print area position and size.
The settings are as follows.

Horizontal starting point=[(xH×256+xL) × basic calculation pitch] inches
Vertical starting point=[(yH×256+yL) × basic calculation pitch] inches
Horizontal length=[(dxH×256+dxL) × basic calculation pitch] inches
Vertical length=[(dyH×256+dyL) × basic calculation pitch] inches

Notes | When the standard mode is selected, only the printer unit's internal flag operation is performed when this command is input.
This command does not affect the standard mode.
This command is ignored when the horizontal or vertical starting point falls outside the printable area. Refer to 9.3.2 Page Mode for page mode printable area.

The character deployment position is the starting point specified with ESC 'T' in the print area.

If either the (horizontal starting point + horizontal length) or (vertical starting point + vertical length) falls outside the printable area, the maximum value of the print area becomes the printable area.

The basic calculation pitch is set with GS 'P'. Moreover, the set print area does not change even if the basic calculation pitch is changed with GS 'P' after the print area has been set.

If the calculation result is a fractional figure, it is compensated using the mechanism's minimum pitch, and the remainder is discarded.

Basic calculation pitch (x) is used to calculate the horizontal starting point and horizontal length, and basic calculation pitch (y) is used to calculate the vertical starting point and vertical length.

Using X as the horizontal starting point, Y as the vertical starting point, Dx as the horizontal length, and Dy as the vertical length, the print area appears as follows.
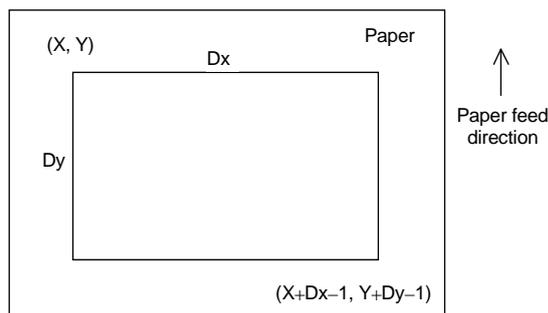
When the page mode is selected, the ruled line data specified by the ruled line command (DC3) is effected by the print area specified by this command. The ruled line is not printed outside the print area.

Related Commands | CAN, ESC 'L', ESC 'T', GS 'P'
See 9.3.2 Page Mode.

Code   1BH 24H nl nh

Definition Range   0≤nl≤255
                        0≤nh≤255

Function   Specifies the print position using the left margin position as reference.
            The next print position is [(nH×256+nL) × basic calculation pitch] inches from the left margin
            position.

Notes   Specified values that fall outside the print area are ignored.
            In the case of a printer unit with no left margin setting, the absolute position of the print position is
            specified using the beginning of the line as reference.

            The basic calculation pitch is set with GS 'P'.
            If the calculation result is a fractional figure, it is compensated using the mechanism's minimum
            pitch, and the remainder is discarded.
            In case of a printer unit that supports this command, the horizontal basic calculation pitch (x) is
            used in the standard mode.

            In the page mode, the following operations are executed, depending on the starting point.

            (1) When the starting point is specified as "upper left" or "lower right" with
            ESC 'T', the absolute position in the perpendicular direction (horizontal direction of character) is
            specified for paper feed. At this time, the horizontal direction basic calculation value (x) is used
            for calculation in case of printer units that support GS 'P'.

            (2) When the starting point is specified as "upper right" or "lower left" with
            ESC 'T', the absolute position in the paper feed direction (horizontal direction of character) is
            specified. At this time, the vertical direction basic calculation value (y) is used for calculation in
            the case of printer units that support GS 'P'.

Related Commands   ESC '\', GS 'P'

Code   1BH 5CH nl nh

Definition Range   0≤nl≤255, 0≤nh≤255

Function   Specifies the print position using the current position as reference.
            The next print position is [(nh×256+nl) × basic calculation pitch] inches from the current position.

Notes   Specified values that exceed the print area are ignored.
            In relation to the character direction, to specify a position right of the current position, specify a
            positive number, and to specify a position left of the current position, specify a negative number.
            The negative number is in 2's complement.

            The basic calculation pitch is set with GS 'P'.
            If the calculation result is a fractional figure, it is compensated using the mechanism's minimum
            pitch, and the remainder is discarded.

            In the standard mode, the horizontal basic calculation pitch is used (x).

            When the printer unit is used in the page mode, the operations are as follows depending on the
            starting point.

            (1) When the starting point is specified as "upper left" or "lower right" with ESC 'T', the relative
            position of the direction perpendicular to the paper feed direction (character's horizontal
            direction) specified. At this time, the horizontal basic calculation pitch (x) is used.

(2) When the starting point is specified as "upper right" or "lower left" with ESC 'T', the relative position of the paper feed direction (character's horizontal direction) is used. At this time, the vertical basic calculation pitch (y) is used

| Related Commands | ESC '$', GS 'P' |

| GS '$' nl nh | Vertical Absolute Position Specify in Page Mode |

| Code | 1DH 24H nl nh |

| Definition Range | $0 \leq nl \leq 255$, $0 \leq nh \leq 255$ |

| Function | The absolute vertical data deployment start position of the character is specified on the basis of the starting point, when the page mode is specified.
The absolute position is [(nh$\times$256+nl) $\times$ basic calculation pitch] inches. |

| Notes | This command is effective only when input at the beginning of a line.
This command is ignored other than when the page mode is selected.
The reference starting point refers to the position specified with ESC 'T'.
Absolute position specification that exceeds the specified print area is ignored.

The operations are as follows depending on the starting point for ESC 'T'.

(1) When the starting point is specified as "upper left" or "lower right", the absolute position in the paper feed direction (vertical direction of the character) is specified. At this time, the vertical basic calculation pitch (y) is used.

(2) When the starting point is specified as "upper right" or "lower left", the absolute position in the direction perpendicular to paper feed (vertical direction of the character) is used. At this time, the horizontal basic calculation pitch (x) is used.

The basic calculation pitch is set with GS 'P'.
If the calculation result is a fractional figure, it is compensated using the mechanism's minimum pitch, and the remainder is discarded.
If characters with different vertical direction extension factors exist in mix on the same line, extension is performed based on the bottom edge of the character.

The base line is set at 0 dot.

The references for data to the specified print position are as follows.

Character data: Bottom edge of character
Bit image: Bottom edge of bit image
Downloaded bit image: Bottom edge of downloaded bit image
Raster bit image: Upper edge of raster bit image.
NV bit image: Bottom edge of NV bit image
Barcode: Bottom edge of barcode (except HRI character) |

| Related Commands | ESC '$', ESC 'T', ESC 'W', ESC '\', GS 'P', GS '\'
See 9.3.2 Page Mode. |

Code	1DH 5CH nl nh

Definition Range	$0 \leq nl \leq 255$, $0 \leq nh \leq 255$

Function	Specifies the relative vertical data deployment start position using the current position as reference, when the page mode is specified. The relative position is [(nh$\times$256+nl) $\times$ basic calculation pitch] inches.

Notes	This command is effective only when the page mode is selected. The current position used as reference means the deployment reference position for the next data.

In relation to the character, to specify a position lower than the current position, specify a positive number, and to specify a position higher than the current position, specify a negative number. The negative number is in 2's complement.

Relative position specifications that exceed the specified print area are ignored.

The basic calculation pitch is set with GS 'P'.

If the calculation result of a model that supports GS 'P' is a fractional figure, it is compensated using the mechanism's minimum pitch, and the remainder is discarded.

The following operations are performed depending on the starting point of ESC 'T'.

When the starting point is specified as "top left" or "bottom right", the relative position of paper feed (Vertical character direction) is specified. At this time, the vertical basic calculation pitch (y) is used for calculation by printer models that support GS 'P'.

When the starting point is specified as "bottom left" or "top right", the relative position perpendicular to paper feed (vertical character direction) is specified. At this time, the horizontal basic calculation pitch (x) is used for calculation by printer models that support GS 'P'.

The references for the deployment of data to the specified print position are as follows.

Character data: Bottom edge of character
Bit image: Bottom edge of bit image
Downloaded bit image: Bottom edge of downloaded bit image
Raster bit image: Upper edge of raster bit image
NV bit image: Bottom edge of NV bit image
Barcode: Bottom edge of barcode (except HRI characters)

Related Commands	ESC 'T', GS '$', GS 'P'

9.4.5　Image

ESC '∗' m nl nh [d]k   Bit Image Mode Print

| Code | 1BH 2AH m nl nh [d]k |

| Definition Range | m=0, 1, 32, 33 |
| | $0 \leq nl \leq 255$, $0 \leq nh \leq 3$, $0 \leq d \leq 255$ |

| Function | Specifies the bit image in mode m for the dot count specified with nl and nh. |

m	Mode	Vertical dot density	Horizontal dot density	Data count (k)
0	8-dot single density	8	Single density	$nh \times 256 + nl$
1	8-dot double density	8	Double density	$nh \times 256 + nl$
32	24-dot single density	24	Single density	$(nh \times 256 + nl) \times 3$
33	24-dot double density	24	Double density	$(nh \times 256 + nl) \times 3$

| Notes | If m falls outside the parameter range, the data past nl is processed as normal data.
nl and nh indicate the horizontal dots of the bit image to be printed, and are [$nh \times 256 + nl$].
If bit image data exceeds the printable dot count for one line, the exceeding portion is discarded.
d indicates the bit image data. Bits that correspond to dots to be printed are 1, and bits that correspond to dots that are not printed are 0.

If print width of deployed character data by setting GS 'L' or GS 'W' is less than internal one-character, CPU processes only for that line as follows.

(1) In the range that does not exceed the printable area, the print area corresponding to one character of the specified type is extended toward the right side.

(2) If an area corresponding to one character cannot be secured even when processing (1) is performed, the print area is extended to the left side (the left margin is reduced).

CPU returns to usual data processing after executing image data.
The commands for Bold Print Specify, Double Strike Printing Specify, Underline Specify and Character Font Select other than Inversion printing do not affect this command.

<Data input order>

8dot image

24dot image

7 MSB
6
5
d1 d2 d3 d4 d5 d6 4
3
2
1
0 LSB

d1 d4 d7 ....
7 MSB
6
5
d2 d5 d8 4
3
2
1
d3 d6 d9 .... 0 LSB
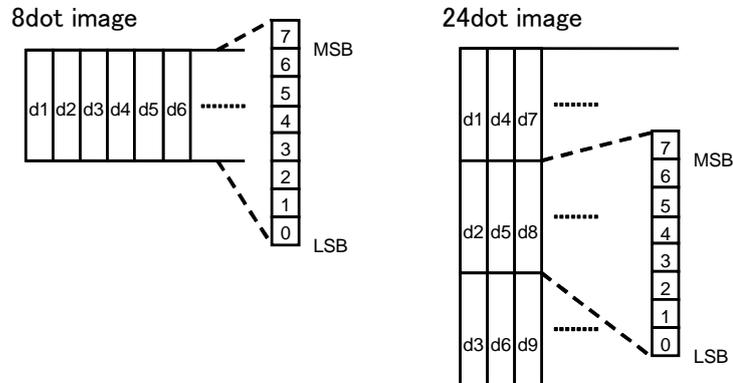
GS '∗' x y [d]k   Downloaded Bit Image Registration

Code   1DH 2AH x y [d]k

Definition Range   1≤x≤255, 1≤y≤255, 0≤d≤255
(However, delete in case of x=0 or y=0)

Function   Registers downloaded bit image with bit count defined with x and y.
x × 8 specifies the horizontal bit count.
y × 8 specifies the vertical bit count.

Notes   A horizontal dot count of (x × 8) dots, and a vertical dot count of (y × 8)dots is used.
d indicates the bit image data of downloaded bit image. 1 is used for bits corresponding to dots to be printed, and 0 for bits corresponding to dots that are not printed.
Cannot register more than the image data of 65524 bytes.
Whether to use the column scan mode or the row scan mode for transfer data can be selected with the DC2 'l' command.
The relation between downloaded bit image and image data is as follows.
The memory usage amount m=k+(amount of the information of the memory) bytes.
If there is the data in the line buffer at the standard mode, this command is ignored.

Related Commands   GS '/'

Column scan mode

X = x × 8

Y = y×8

d1 d(y+1) d(y*2+1)
d2
7 MSB
6
5
4
3
2
1
0 LSB
dy d(y*2) d(y*x*8)

Row scan mode

X = x × 8

| d1 | d2 | .... | dx |
| d(x+1) | d(x+2) | | d(x*2) |

Y = y × 8

d(x*y*8)

7 6 5 4 3 2 1 0
MSB   LSB
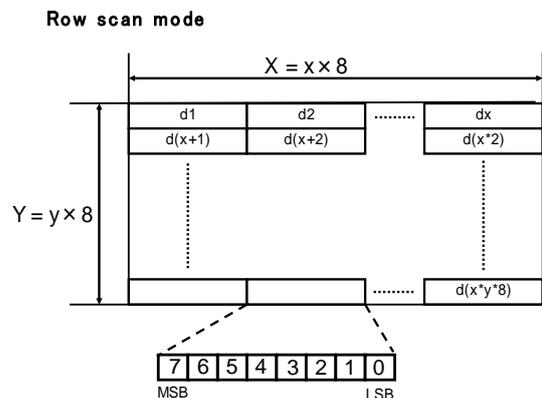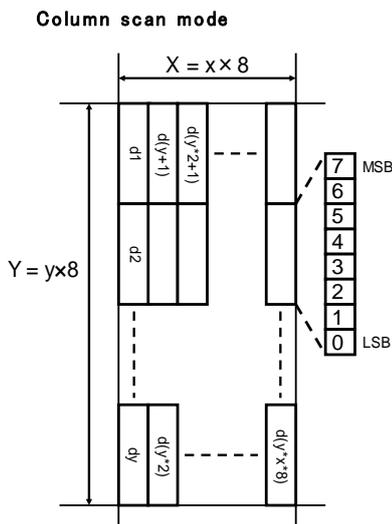
Code	(1) 1DH 2FH m
	(2) 1DH 2FH m n

Definition Range	(1) $0 \leq m \leq 3$, $48 \leq m \leq 51$
	(2) $4 \leq m \leq 7$, $52 \leq m \leq 55$, $0 \leq n \leq 255$

Function   Prints the specified downloaded bit image data in mode m.
When m is in the range $4 \leq m \leq 7$ or $52 \leq m \leq 55$, print position in horizontal direction of downloaded bit image can be specified with n.
(The print position is specified with nx8-dot from the left edge of the Thermal paper.)

m	Position
0, 48	Normal mode printing
1, 49	Double width mode printing
2, 50	Double height mode printing
3, 51	Double height and width mode printing
4, 52	Normal mode selection
5, 53	Double width mode selection
6, 54	Double height mode selection
7, 55	Double height and width mode selection

Notes   This command is not effective if downloaded bit image data is not defined.
When the standard mode is selected, this command is effective only when there is no data in the line buffer.
Except for inversion (flip) printing, this command does not affect the print mode (bold print, double strike printing, underline, character size, etc.).
If the registered downloaded bit image data count exceeds the print area, the data that exceeds the print area is not printed.

When downloaded bit image, character data, bit image and barcodes mix and exist in the same line in page mode, the bottom of downloaded bit image and the others are aligned as follows;

Character data: Bottom edge of the character are aligned.
Bit image: The bottom edges of bit images are aligned.
Barcode: The bottom edges of barcodes are aligned. At this time, HRI characters is not included.

If the print area width set with GS 'L' and GS 'W' is less than one character of the minimum width among the internal characters, the following processing is performed only for that line.

(1) In the range that does not exceed the printable area, the print area up to one character of the minimum width among the internal characters is extended toward the right side.

(2) If an area corresponding to one character cannot be secured even when processing (1) is performed, the print area is extended to the left side (the left margin is reduced).

When this command is received with m in the range $0 \leq m \leq 3$ or $48 \leq m \leq 51$, printing starts immediately.
When m is in the range $4 \leq m \leq 7$ or $52 \leq m \leq 55$, the selected downloaded bit image is printed in the character print area and the space between lines. Printing is also done in the paper feed area with ESC 'J' and ESC 'd'.

When downloaded bit image is selected, specifying m outside the range 4≤m≤7 or 52≤m≤55 cancels downloaded bit image selection.
In the page mode, downloaded bit image selection is invalid.

| Related Commands | GS '∗'

GS 'v' '0' m xL xH yL yH [d]k   Raster Bit Image Print

| Code | 1DH 76H 30H m xL xH yL yH [d]k

| Definition Range |
$$0 \leq m \leq 3, 48 \leq m \leq 51$$
$$0 \leq xL \leq 255, 0 \leq xH \leq 255$$
$$0 \leq yL \leq 255, 0 \leq yH \leq 15, 0 \leq d \leq 255$$
$$k = (xH \times 256 + xL) \times (yH \times 256 + yL), \text{ however } k \neq 0$$

| Function | Prints raster format dot images in mode m.

m	Mode	Vertical dot density	Horizontal dot density
0, 48	Normal mode	203dpi	203dpi
1, 49	Double width mode	203dpi	101dpi
2, 50	Double height mode	101dpi	203dpi
3, 51	Double height and width mode	101dpi	101dpi

xL and xH specify the horizontal data count of bit images as (xH×256+xL) bytes.
yL and yH specify the vertical data count of bit images as (yH×256+yL) bits.

| Notes | When the standard mode is selected, this command is effective only when there is no print data in the line buffer.
None of the printing modes (character size, bold print, double strike printing, inversion (flip) printing, underline, reverse print, etc.) affect raster bit images.

If the print area set with GS 'L' or GS 'W' is less than the minimum width, the print area width is extended to the minimum width for that line only. The minimum width is 1 dot irrespective of the mode.
The data that cannot fit in the print area is discarded by dots.

The raster bit image print start position can be freely set with HT (Horizontal Tab), ESC '$' (Absolute Position Specify), ESC '\' (Relative Position Specify), or GS 'L' (Left Margin Set).

The ESC 'a' (Alignment) setting is also effective for raster bit images.

If this command is executed during macro definition, macro definition is stopped and processing of this command starts. At this time, macro becomes undefined.

d indicates the definition data. Bits that correspond to dots to be printed are 1, and bits that correspond to dots that are not printed are 0.

When executing this command, reduced printing speed due to communication speed may cause poor print quality or abnormal noise. Therefore, this command should be used under the environment which can maintain with a constant speed, for example the Page mode and so on.

Code	(1) 1CH 70H n m
	(2) 1CH 70H n m o

Definition Range	1≤n≤255, 0≤m≤3, 48≤m≤51
	1≤n≤255, 4≤m≤7, 52≤m≤55, 0≤o≤255

Default	Canceled

Function	Prints NV bit image specified with n in mode m.

In the ranges 4≤m≤7 and 52≤m≤55, the print position in the horizontal direction of NV bit image can be specified with o.
(The print position is specified with 8-dot boundary.)

m	Position
0, 48	Normal mode printing
1, 49	Double width mode printing
2, 50	Double height mode printing
3, 51	Double height and width printing
4, 52	Normal mode selection
5, 53	Double width mode selection
6, 54	Double height mode selection
7, 55	Double height and width selection

Notes	NV bit image refers to a bit image that can be printed using this command according to the definition of NV bit image in the nonvolatile memory.

If specified NV bit image n is undefined, this command is invalid.

When the standard mode is selected, this command is valid only when there is no data in the line buffer.
Except for inversion (flip) printing, this command does not affect the print mode (bold print, double strike printing, underline, character size, reverse print, character 90° right rotate).

If the print area set by GS 'L' and GS 'W' is less than width of one internal character (width of the font size selected by the font size), the following processing actions are executed only for this line.

(1) In a range that does not exceed the printable area, the print area is expanded to the right side to a size where one vertical column of NV bit image can be printed.

(2) If a sufficient area cannot be secured even when processing (1) is performed, the print area is expanded to the left side (the left margin is reduced).

If a bit image of a size exceeding the print area is specified, the data in the print area becomes the target for printing, but data beyond the print area is not printed.
Regardless of the line spacing set with the initial lines spacing setting (ESC '2') or the line spacing setting (ESC '3'), paper feed is performed (height of NV bit image n) dots when the normal mode and double width mode are specified, and (height of NV bit image n × 2) dots when the double height mode and the double height and double width mode are specified.

Upon the completion of printing of the bit image, the beginning of the line becomes the next print position and normal data processing is executed.

When this command is received with m in the range 0≤m≤3 or 48≤m≤51, printing starts automatically.

When m is in the range 4≤m≤7 or 52≤m≤55, the selected NV bit image is printed in the character print area and the space between lines. Printing is also done in the paper feed area with ESC 'J' and ESC 'd'.

When NV bit image is selected, specifying m outside the range 4≤m≤7 or 52≤m≤55 cancels NV bit image selection.

Multiple NV bit images cannot be selected. Only the last selection is valid.

In the page mode, NV bit image selection is invalid.

In the page mode, when printing of NV bit image is specified, NV bit image is allocated in the image memory inside the printer unit. Actual printing is not performed until page mode printing with the FF or ESC FF command.

| Related Commands | ESC '*', FS 'q', GS '/', GS 'v' '0' |

FS 'q' n [xL xH yL yH [d]k]1 to [xL xH yL yH [d]k]n — NV Bit Image Define

| Code | 1CH 71H n [xL xH yL yH [d]k]1 to [xL xH yL yH [d]k]n |

| Definition Range |
1≤n≤255
0≤xL≤255
0≤xH≤3, however, 1≤(xH×256+xL)≤1023
0≤yL≤255
0≤yH≤1, however 1≤ (yH×256+yL) ≤288
0≤d≤255
k=(xH×256+xL) × (yH×256+yL) × 8
Entire definition area=(260096 bytes)

| Defaults | Undefined |

| Function | Defines NV bit image. |

| Notes | NV bit images refers to items defined with this command in nonvolatile memory, which can be printed with NV Bit Image Print (FS 'p') command.

b n specifies the number of NV bit images to be defined.

xL and xH specify the horizontal direction of NV bit image as (xH×256+xL) × 8 bits.
yL and yH specify the vertical direction of NV bit image as (yH×256+yL) × 8 bits.

One NV bit image definition data consists of [xL xH yL yH d1 ... dk].

Defines n number of NV bit images in ascending order from NV bit image number 01H. Therefore, the first data group [xL xH yL yH d1 ... dk] becomes NV bit image number 01H, and the last data group [xL xH yL yH d1 ... dk] becomes NV bit image number n. This corresponds to NV bit image number specified with NV Bit Image Print (FS 'p') command.

d indicates the definition data. Bits that correspond to dots to be printed are 1, and bits that correspond to dots that are not printed are 0.

This command becomes valid when the 7 bytes from FS to yH are processed as normal values.

All the already defined NV bit images are deleted when this command is executed. Therefore, it is not possible to redefine only one NV bit image among multiple already defined NV bit images. In this case, all the data must be resent.

After writing to nonvolatile memory is completed, the printer unit resets the hardware.

The definition area in this printer unit is a maximum of 260096 bytes. Multiple NV bit images can be defined, but bit image data whose total capacity (bit image data + header) exceeds 260096 bytes cannot be defined.

If parameters that exceed the total capacity are specified in the first NV bit image data group, this command is invalid. The data following the parameter is processed as character code or a command. In this case, deletion of nonvolatile memory and writing to the nonvolatile memory are not performed.

If a parameter that exceeds the remaining capacity of the definition area in the second and subsequent NV bit image data group is specified with xL, xH, yL and yH, execution of this command is interrupted and writing to nonvolatile memory starts. At this time, NV bit image in the process of being defined becomes invalid (undefined), but NV bit images before that are valid.

When this command is processed during macro definition, macro definition is interrupted, processing of this command is started, and the contents of macro definition are cleared.

This command defines only NV bit images without printing them. NV bit image printing is executed with NV Bit Image Print (FS 'p') command.

Do not turn the printer off during executing the command.

Whether to use the column scan mode or the row scan mode for transfer data can be selected with the DC2 'I' command.

The relation between NV bit images and print data in the column scan mode is as follows.
The memory usage m is
m=(xH×256+xL)×(yH×256+yL)×8+(amount of the information of the memory) bytes.

xH×256+xL=256 dots

(yH×256+yL)×8 dots=384 dots
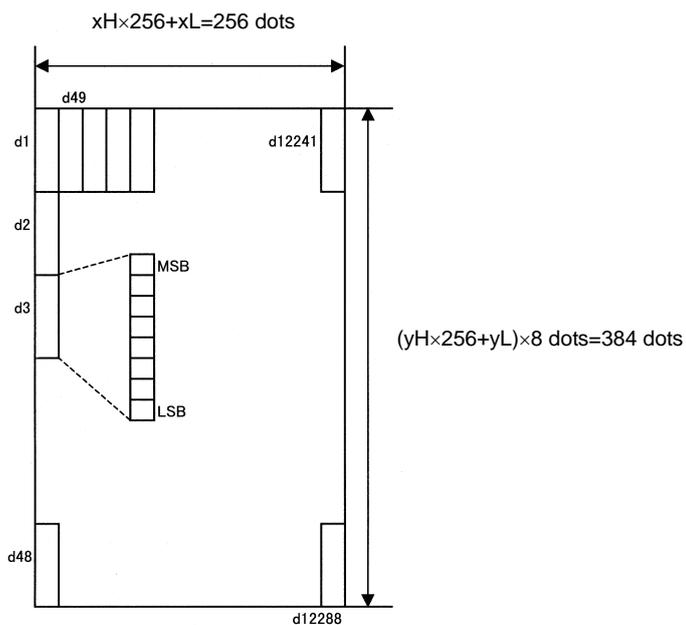
Example: Using the column scan mode, with xL=32, xH=0, yL=48, yH=0

Related Commands   FS 'p'

| Code | 12H 49H n |

| Definition Range | 0≤n≤255 |

| Default | n=0 (Column scan) |

| Function | Specifies whether to perform bit image registration transfer data with column scan or row scan. |

If n=<*******0>B, column scan is performed.
If n=<*******1>B, row scan is performed.

| Notes | Only the LSB is significant for n. |

The commands that are affected by this command are as follows.
NV Bit Image Define (FS 'q')
Downloaded Bit Image Registration (GS '∗')

| Code | 12H 3DH n |

| Definition Range | 0≤n≤255 |

| Default | n=1 |

| Function | When the row scan method is selected as the bit image scan method, selects whether the left edge of the print image is the LSB or MSB. |

If n=<*******0>B, the LSB is the left edge.
If n=<*******1>B, the MSB is the left edge.

| Notes | Only the LSB is significant for n. |

The commands that are affected by this setting are as follows.

NV bit image Mode Define (FS 'q')
Downloaded Bit Image Registration (GS '∗')
Raster Bit Image Print (GS 'v' '0')
Ruled Line Image Write (DC3 'v')
Ruled Line Pattern Fill (DC3 'F')

When the column scan method is selected, only the internal flag operation is performed when this command is input.

| Related Commands | DC2 'I', |

9.4.6 Macro

Code	IDH 3AH

Function	Starts and stops macro definition.

Notes	When this command is input during normal operation, macro definition start is specified. Moreover, when this command is input during macro definition, macro definition stop is specified.

When the following items are input during macro definition, macro definition is stopped and the definition contents are cleared.

Macro Execution (GS '^')
Downloaded Character All Release (DC2 'D')
User Defined Character All Release (DC2 'G')
Optional Font Registration (DC2 'P')
Optional Font Release (DC2 'Q')
Extension Memory Initialize (DC2 'R')
NV Bit Image Define (FS 'q')
Downloaded Bit Image Print (GS '*')
Raster Bit Image Print (GS 'v')
User Area Reduction (DC2 '*' '1')

Macro initialization status is undefined.
The definition contents are not cleared by ESC '@'.
When GS ':' is input immediately following input of GS ':', macro status changes to the undefined status.
A maximum of 2048bytes of data can be macro defined.

The formula is below shows the memory usage m byte.
m=(number of the data)+(amount of the information of the memory)

Related Commands	GS '^'

Code	1DH 5EH r t m

Definition Range	$0 \leq r \leq 255$, $0 \leq t \leq 255$, m=0

Function	Executes macro definition contents. r specifies macro execution count. t specifies the wait time during macro execution. m specifies macro execution mode. Performs continuous execution r number of times, at time intervals specified by m = 0: t.

Notes	Waits approx. (t×100ms) following one macro execution as a result of t specification. When this command is input during macro definition, macro definition is stopped and the definition contents are cleared. When no macro is defined, r=0, and m≠0, this command is ignored.

Related Commands	GS ':'

9.4.7 Bar Code

GS 'H' n   HRI Character Print Position Selection

| Code | 1DH 48H n |

| Definition Range | 0≤n≤3, 48≤n≤51 |

| Default | n=0 |

| Function | Selects the HRI character print position during barcode printing. |

n	Character position
0, 48	Do not print
1, 49	Over barcode
2, 50	Under barcode
3, 51	Over and under barcode (both)

| Notes | HRI is an acronym that stands for Human Readable Interpretation. HRI characters are printed in the typeface selected with GS 'f'. |

| Related Commands | GS 'f', GS 'k', ESC 'M' |

GS 'f' n   HRI Character Typeface Selection

| Code | 1DH 66H n |

| Definition Range | n=0, 1, 48, 49 |

| Default | n=0 |

| Function | Selects the HRI character typeface to be used to print barcodes. |

n	Typeface
0, 48	Font A (24× 12)
1, 49	Font B (16 × 8)

| Notes | HRI is an acronym that stands for Human Readable Interpretation. n=0 HRI characters are printed to the position specified by GS 'H'. HRI characters are printed as the base position that is downed for the specified characters height from the base line of the barcode print. Change to default setting in case of hardware reset or initialization. |

| Related Commands | GS 'H' |

GS 'h' n   Barcode Height Set

Code 1DH 68H n

Definition Range $1 \leq n \leq 255$

Default n=162

Function Sets the barcode height to n dots.

Related Commands GS 'k'

GS 'w' n   Barcode Horizontal Size Set

Code 1DH 77H n

Definition Range $2 \leq n \leq 6$

Default n=3

Function Sets the barcode's horizontal size.

N	Multilevel barcode module width (mm)	Binary level barcode	
		Fine element (mm)	Thick element (mm)
2	0.250	0.250 (2 dots)	0.625 (5 dots)
3	0.375	0.375 (3 dots)	1.000 (8 dots)
4	0.500	0.500 (4 dots)	1.250 (10 dots)
5	0.625	0.625 (5 dots)	1.625 (13 dots)
6	0.750	0.750 (6 dots)	1.875 (15 dots)

Notes Multilevel barcode refer to the following barcode systems.
UPC-A, UPC-E, JAN13(EAN13), JAN8(EAN8), CODE93, CODE128 and JAN 13 Add-on

Binary barcode refer to the following barcode systems.
CODE39, ITF and CODABAR

Specify a value of 3 or greater to n to print a ladder barcode (barcode printed horizontally when viewed in the paper feed direction).
When 2 is specified to n, read out accuracy may be downed.

In LTPD247/CAPD247 printer, set the parameter n as 2 if a barcode which printed vertically in paper feed direction is printed using JAN 13 Add-on. Value of 3 in default setting cannot print that barcode.

Related Commands GS 'k'

Code | 12H 3Ah n

Definition Range | $0 \leq n \leq 2$

Default | n=1

Function | Changes the barcode N:W ratio (Narrow width: wide width).

N	N:W
0	1:2
1	1:2.5
2	1:3

Notes | Some barcode readers may not read the barcode depending on the setting of the narrow width and the setting value of this command.
Use this command after confirming that there is no problem.

Related Commands | ESC '@'

| Code | 1DH 6BH m [d]k 00H   (m≦6)
1DH 6BH m n [d]n   (m≧65)
1DH 6BH m [d]k 00H [d2]s 00H (JAN13 add-on)   (m=22)
1DH 6BH m n [d]n s [d2]s (JAN13 add-on)   (m=87) |

| Definition Range | 0≦m≦6, m=22, 32≦d≦126, 1≦k≦255
65≦m≦73, m=87, 1≦n≦255, 0≦d≦127
s=2,5
48≦d2≦57 (JAN13 add-on) |

| Function | Selects the barcode typeface and prints the barcode. |

m	Barcode system	Barcode data count	Remark
0	UPC-A	Fixed (11≦k≦12)	Same barcode system as m = 65
1	UPC-E	Fixed (11≦k≦12)	Same barcode system as m = 66
2	JAN13 (EAN)	Fixed (12≦k≦13)	Same barcode system as m = 67
3	JAN8 (EAN)	Fixed (7≦k≦8)	Same barcode system as m = 68
4	CODE39	Variable	Same barcode system as m = 69
5	ITF	Variable (Always even number)	Same barcode system as m = 70
6	CODABAR	Variable	Same barcode system as m = 71
22	JAN13 add-on	Variable (Add-on 2:14≦k≦15) (Add-on 5:17≦k≦18)	Same barcode system as m = 87
65	UPC-A	Fixed (11≦k≦12)	Same barcode system as m = 0
66	UPC-E	Fixed (11≦n≦12)	Same barcode system as m = 1
67	JAN13 (EAN)	Fixed (12≦n≦13)	Same barcode system as m = 2
68	JAN8 (EAN)	Fixed (7≦n≦8)	Same barcode system as m = 3
69	CODE39	Variable	Same barcode system as m = 4
70	ITF	Variable (Always even number)	Same barcode system as m = 5
71	CODABAR	Variable	Same barcode system as m = 6
72	CODE93	Variable	-
73	CODE128	Variable	-
87	JAN13 add-on	Variable (Add-on 2:14≦k≦15) (Add-on 5:17≦k≦18)	Same barcode system as m = 22

| Notes | The command configuration, code, domain, and some notes differ depending on the value of m. When m=0 to 6 and m=65 to 71, and, m=1022 and m=7587, the same barcode system is selected and the print result is also the same.

d indicates the characters to be printed. In all the barcode systems, if d is a character that cannot be printed, the barcode until then is printed and normal data processing is resumed from the next data.

If specifying a UPC-A barcode data and a UPC-E barcode data by 12 bytes including the check digit, the printer ignores the 12th byte and automatically calculates the check digit. |

If specifying a JAN13 (EAN) barcode data by 13 bytes including the check digit, the printer ignores the 13th byte and automatically calculates the check digit.

If specifying a JAN8 (EAN) barcode data by 8 bytes including the check digit, the printer ignores the 8th byte and automatically calculates the check digit.

The printer unit performs paper feed a distance equivalent to the barcode height (including HRI characters when HRI character printing is specified), regardless of the line spacing set with ESC '2' or ESC '3'.

When the standard mode is selected and the horizontal direction exceeds the print area for one line, the printer unit does not print the barcode and performs only paper feed.

When the standard mode is selected, this command is effective only when there is no data in the line buffer. If data exists in the line buffer, data past m is processed as normal data. Moreover, the beginning of the line following barcode operation completion becomes the next print position.

Selecting the standard mode does not affect the print modes other than the inversion (flip) printing (bold printing, double strike printing, underline, character size, etc.)

For the concept of the barcode printing in the standard mode, refer to the figure [Barcode print in the standard mode].

When the page mode is selected, the printer unit performs only barcode data deployment and does not print. After completion of barcode deployment, the next dot following the last barcode data becomes the next print position.

In page mode, if barcodes, character data, bit images, and downloaded bit images exist together on the same line, the bottom edge of the barcode and the following positions of the character data, bit image and downloaded bit image are aligned. At this time, HRI characters are not included. (See the figure [Barcode print in the page mode].)

Character data: Bottom edge of character
Bit image: Bottom edge of bit image
Downloaded bit image: Bottom edge of downloaded bit image

In page mode, after completion of barcode deployment, the next dot following the last barcode data becomes the next print position.

When the barcode width exceeds the print area in page mode, barcode printing is not performed, and the position for data deployment shifts to the left side outside the print area.

In page mode, barcode layout includes horizontal tab.

In page mode, inversion (flip) printing, bold line, under line and character size do not affect barcode printing.

In page mode, when the print start position is specified to lower left or upper right by Character Print Direction Specify in Page Mode (ESC 'T'), the direction of bars is perpendicular to the paper feed direction (ladder barcodes).

When printing using ladder barcodes, height of the barcode should be 10 mm or higher and ambient temperature should be 0 to 40 °C (32 to 104 °F).

If not, print may be unstable and read out accuracy may be worsened.

In page mode, when the print start position is specified to lower left or upper right by Character Print Direction Specify in Page Mode (ESC 'T'), width of the barcode should be 30 cm or shorter. CPU can not print correctly if long width bar code is printed.

[1 Notes regarding: GS 'k' m[d]k NUL]

This command ends with NUL code.

k indicates the barcode data count. If a barcode system with fixed data count is selected, be sure to make k match this character count. If the data count is insufficient, data processing is performed up to the NUL code. Moreover, if the data count is excessive, a fixed length of data is processed and any excess data is processed as normal data.

Always make the data count for ITF barcodes with m=5 an even number. If the data count is an odd number, the last data is ignored.

[2 Notes regarding: GS 'k' m n [d]n]

n indicates the data count, and n bytes are processed as barcode data from the next data. If n falls outside the domain or the data count when the ITF barcode with m=70 is selected is an odd number, command processing is stopped and data from the next data is processed as normal data.

[Barcode print in the standard mode]
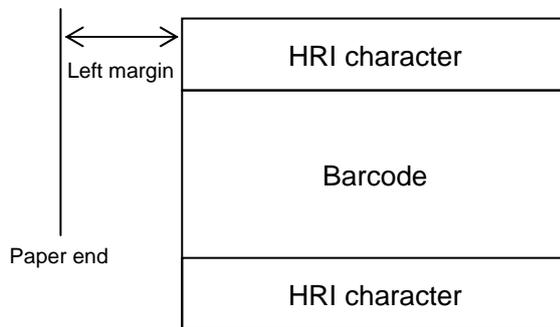
[Barcode print in the page mode]
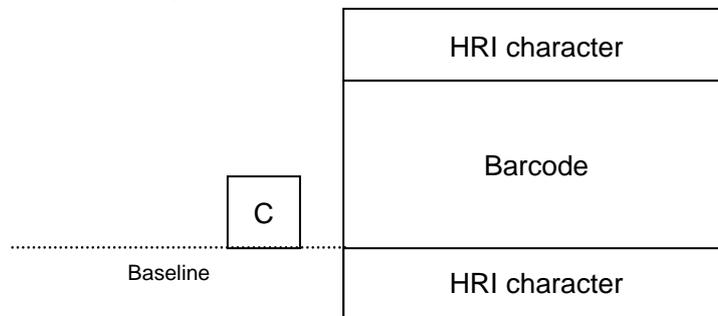
| Related Commands | GS 'H', GS 'f', GS 'h', GS 'W', DC2 'z'

9.4.8 Two-dimensional Barcode

GS 'n' n   Nominal Fine Element Width

Code	1DH 6EH n

Definition Range	2≤n≤4 (dot count)

Function	Sets the nominal fine element width.

Default	n=3

Related Commands	GS 'p'

GS 'o' n   PDF Module Height Set

Code	1DH 6FH n

Definition Range	2≤n≤127

Default	n=10

Function	Sets the PDF module height by dot.

Notes	If the module height is set too low, the barcode reader may not be able to read barcodes. Min. height should be specified more than 3 dots in case of the normal use.

GS 'p' 0 m2 e r c nl nh [d]k   PDF417 Print

Code	IDH 70H 00H m2 e r c nl nh [d]k

Definition Range	0≤m2≤255 0≤e≤8 0, 3≤r≤90 0,1≤c≤30 0≤d≤255 0≤nl, nh≤255 1≤k(=nh×256+nl)≤499

Function	PDF417 is printed from the specified contents. m2=<*******0>B : Normal mode m2=<*******1>B : Simple mode (Macro PDF is not supported) e: Error correction level r: Module (0 is automatically set) c: Number of columns in data area (0 is automatically set) d: Data k: Data count

Related Commands	GS 'n', GS 'o'

Code	12h 3BH n

Definition Range	2≤n≤11

Default	n=6

Function	Specifies a module size of QR Code and Data Matrix.

n: The number of dots for one side of the module size.

Related Commands	GS 'p' 1, GS 'p' 2

GS 'p' 1 model e v mode nl nh data   QR Code Print

Code	1DH 70H 01H model e v mode nl nh [data]

Definition Range	model=01H, 02H

e=4CH, 4DH, 51H, 48H
0,1≤v≤40
mode=4EH, 41H, 42H, 4BH, 4DH
1≤nh×256+nl≤7089

Function	Prints QRCode data based on the specified contents.

model: Specifies a model

e: Selects an error correction level.
        'L' (4CH), 'M' (4DH), 'Q' (51H), 'H' (48H)

v:=0:   Automatic selection (A version is automatically selected depending
        on the number of input data.)
        1≤v≤40 Fixed version (up to 14 for model-1)

mode: Specifies a mode of data.

mode	Hexadecimal	Mode
N	4E	Numerical mode
A	41	Alphanumeric mode
B	42	8-bit byte mode
K	4B	Kanji mode
M	4D	Mixed mode

nl, nh: Specifies the number of data.

Data: Kanji data of the QRCode data should be set by Shift JIS code.

Notes	When specifying any value out of the defined range, this command is ignored, and the

subsequent data is processed as the normal data.
When specifying any value of 7090 or more bytes, the subsequent data is processed as the
normal data.
The maximum value should be 7089 or less bytes depending on the model, the mode, and the
error revision level.
When specifying any value exceeding the maximum value, the value is read out.

When the horizontal width (includes a quiet zone) of the QRCode exceeds the print area, this command is ignored.
In the standard mode, when data exists in the line buffer, this command is ignored.
In the standard mode, Alignment and Inversion (Flip) Printing are enable.
The width of the quiet zone is fixed 4 modules.

Related Commands   ESC 'a', ESC '{'

GS 'p' 2 ecc row col nl nh data   Data Matrix Print

Code | 1DH 70H 02H ecc row col nl nh [data]

Definition Range   ecc=00H
8≤row≤144
10≤col≤144
1≤nh×256+nl≤3116

Function   Prints the Data Matrix code base on the specified contents.

ecc: 00H (ECC 200) (for future extensional function)

row: Specifies the number of the modules for the vertical direction.
When '0' is specified, this is defined automatically.

col: Specifies the number of the modules for the horizontal direction.
When '0' is specified, this is defined automatically.

nl, nh: Specifies the number of the data.
The maximum number of the data is 3116 bytes.
When specifying any value of more than 3117 bytes, the subsequent data is processed as the normal data.

Notes   When specifying any value other than the number of the modules for horizontal and vertical directions in ECC 200, this command is ignored.
When specifying any value exceeding 3116 bytes, the subsequent data is processed as the normal print data.
The maximum value varies depending on the number of the modules for horizontal and vertical directions and storage data. When specifying any data exceeding the maximum value, it is discarded.
When the barcode size (includes a quiet zone) exceeds the print area, this command is ignored.
In the standard mode, when the data exists in the line buffer, this command is ignored.
In the standard mode, Alignment and Inversion (Flip) Printing are enable.
The width of the quiet zone is fixed to 1 value.
The Structured Append is not supported.

Only the following combinations between vertical line (Column) and horizontal line (Row) are enable.

Squares (Column × Row)
10×10, 12×12, 14×14, 16×16, 18×18, 20×20, 22×22, 24×24, 26×26, 32×32, 36×36, 40×40, 44×44, 48×48, 52×52, 64×64, 72×72, 80×80, 88×88, 96×96, 104×104, 120×120, 132×132, 144×144

Rectangles (Column × Row)
18×8, 32×8, 26×12, 36×12, 36×16, 48×16

Related Commands   ESC 'a', ESC '{'

Code	1DH 70H 03H 02H sc cc pc n [data] (mode2)
	1DH 70H 03H 03H sc cc pc n [data] (mode3)
	1DH 70H 03H 04H n [data] (mode4)
	1DH 70H 03H 05H n [data] (mode5)

Definition Range $1 \leq n \leq 138$

Function   Prints the Maxi Code data based on the specified contents.

sc: Specifies a service class.
        In mode 2, and mode 3, sc should be 3-digit numerals.

cc: Specifies a country code.
        In mode 2, and mode 3, cc should be 3-digit numerals.

pc: Specifies a postal code.
        In mode 2, the postal code should be specified in 9-digit numerals.
        If less than 9-digit numerals is desired, specify data except numerals for the remainder.
        In mode 3, the postal code should be specified in 6 alpha numerals.

n: Specifies the number of the data.

Notes   When specifying any value of 139 or more bytes, the subsequent data is processed as the
        normal print data.
        The maximum data value will be 138 or less bytes depending on the mode. When specifying
        any data exceeding the maximum value, it is discarded.

        When the barcode size (includes a quiet zone) exceeds the print area, this command is ignored.
        In the standard mode, when data exists in the line buffer memory, this command is ignored.
        In the standard mode, Alignment and Inversion (Flip) Printing are enable.
        The print size of the barcode is fixed to vertical 213 dots $\times$ horizontal 225 dots.
        The right and left width of the quiet zone is 8 dots.
        The bottom and top width of the quiet zone is 7 dots.
        The Structured Append is not supported.

Related Commands   ESC 'a', ESC '{'

9.4.9 Kanji

FS '&' — Kanji Mode Specify

Code	1CH 26H

Function	Specifies the Kanji mode.

Notes	When the Kanji code system is Shift JIS, only the internal flag operation of the printer unit is performed when this command is input. In this case, printing is not affected. The initial state is the Kanji mode cancel status. The Kanji code is processed 1st byte first, then 2nd byte.

Related Commands	FS '.', FS 'C'

FS '.' — Kanji Mode Cancel

Code	1CH 2EH

Function	Cancels the Kanji mode.

Notes	If the Kanji code system is Shift JIS, only the internal flag operation of the printer unit is performed when this command is input. In this case, printing is not affected. The initial state is the Kanji mode cancel status.

Related Commands	FS '&', FS 'C'

FS '!' n — Kanji Print Mode Specify

Code	1CH 21H n

Define Range	$0 \leq n \leq 255$

Default	n=0

Function	Specifies the Kanji print mode.

Bit	Function	Value 0	Value 1
0	Kanji font	Font A (24×24)	Font B (16×16)
1	Undefined	–	–
2	Double width	Cancel	Specify
3	Double height	Cancel	Specify
4	Undefined	–	–
5	Undefined	–	–
6	Undefined	–	–
7	Underlined	Cancel	Specify

Notes: When both double width and double height are specified, the character size becomes double height and double width.

Underline is applied to the entire character width including the spaces to the left and right of the character. However, underline is not applied to the portion skipped by HT, etc., and to 90° rotated characters.

The underline width is the thickness set with FS '−', regardless of the character size. If the underline width is not set with FS '−', it is set to 1 dot.

If characters with different vertical extension rates exist on the same line, the characters are extended using the bottom edge of the characters as reference (bottom edges of characters are aligned).

When characters are extended horizontally, extension is done in the right direction using the bottom edge of the characters as reference.

In case of print modes that enable specification/cancellation of the same parameters, such as character size and underline, as other commands, the command that is processed last is the one that is effective. Therefore, if, after double height and double width are specified with FS 'W', double height and double width are canceled with FS '!', the FS 'W' specification is canceled.

Related Commands: FS '−', FS 'W'

FS '−' n   Kanji Underline Specify

Code: 1CH 2DH n

Define Range: 0≤n≤2, 48≤n≤50

Default: n=0

Function: Specifies and cancels Kanji underline.

n	Function
0, 48	Cancel Kanji underline
1, 49	Set 1-dot height Kanji underline and specify Kanji underline
2, 50	Set 2-dot height Kanji underline and specify Kanji underline

Notes: Underline is applied to the entire character width including the spaces to the left and right of the character. However, underline is not applied to the portion skipped by HT, etc., and to 90° rotated characters.

If Kanji underline is canceled with n=0, underline is not applied to the subsequent Kanji data, but the underline width setting in effect until immediately before is retained. Moreover, in the initial state, the default width of Kanji is 2 dots.

The Kanji underline width is the specified thickness (and thus is constant), regardless of the character size.

Underline specification/cancellation is also possible with FS '!', but the command that was processed last is valid. Therefore, if following specification of underline with FS '!', underline is canceled with FS '−', the FS '!' specification is canceled.

Related Commands: FS '!'

| Code | 1CH 43H n |

| Definition Range | n=0, 1, 48, 49 |

| Default | n=0 |

| Function | Selects the Kanji code system. |

n	Function
0, 48	JIS code system
1, 49	Shift JIS code system

| Notes | The Kanji code valid in the JIS code system is as follows. |

1st byte: 21H to 7EH
2nd byte: 21H to 7EH

The Kanji code valid in the Shift JIS code system is as follows.
1st byte: 81H to 9FH and E0H to EFH
2nd byte: 40H to 7EH and 80H to FCH

| Code | 1CH 53H n1 n2 |

| Definition Range | 0≤n1≤255, 0≤n2≤255 |

| Default | n1=0, n2=0 |

| Function | Sets the Kanji's left space (n1) and the Kanji's right space (n2). |

The left space is [n1 × basic calculation pitch] inches, and the right space is [n2 × basic calculation pitch] inches.

| Notes | When specify the expand width as double, the space of the left and the right is double as the setting amount. The basic calculation pitch is set with GS 'P'. Moreover, the set space does not change even if the basic calculation pitch is changed with GS 'P' after the Kanji space settings have been performed. |

If the result calculated with GS 'P' is a fractional figure, it is compensated using the mechanism's minimum pitch with the remainder discarded.

In standard mode, the horizontal basic calculation pitch (x) is used.

In the page mode, the basic calculation pitch is as follows, depending on the starting point.

(1) When the starting point is specified as "top left" or "bottom right" with ESC 'T', the horizontal basic calculation pitch (x) is used.

(2) When the starting point is specified as "top right" or "bottom left" with ESC 'T', the vertical basic calculation pitch (y) is used.

| Related Commands | GS 'P' |

Width

Height

Left space   Right space
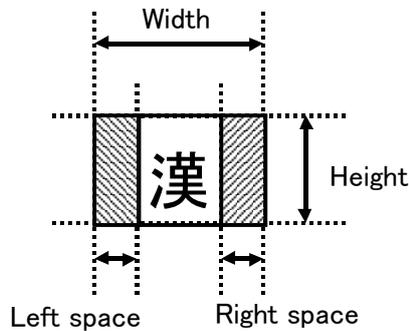
FS 'W' n   Kanji Double Height and Double Width Specify/Cancel

Code	1CH 57H n

Define Range	0≤n≤255

Default	n=0

Function	Specifies or cancels double height and double width for Kanji.

When n=<*******0>B, double height and double width is canceled.
When n=<*******1>B, double height and double width is specified.

Notes	Only the LSB is significant for n.

Double height and double width characters are characters for which double height and double width are specified simultaneously.

When double height and double width are canceled using this command, the printer unit prints the subsequent data starting from the next character in the normal size.

If characters with different vertical extension rates exist on the same line, they are extended using the characters' bottom edge as reference (the characters' bottom edges are aligned).

If extending characters in the horizontal direction, they are extended in the right direction using the left edge of the character as reference.

It is possible to specify/cancel double height and double width characters by simultaneously specifying double width extension and double height extension with FS '!', but the command that is processed last is valid. Therefore, if double height and double width are canceled with FS 'W' following specification of double height and double width, the specification with FS '!' is cancelled.

Related Commands	FS '!'

DC2 '.' n   Kanji Font Selection

Code	12H 2EH n

Definition Range	n=0, 1, 48, 49

Default	n=0

Function	Selects the Kanji font.

n	Function
0, 48	Select Kanji font A (24X24)
1, 49	Select Kanji font B (16X16)

Notes	It is possible to select the Kanji font with FS !, but the command that is processed last is valid.

Related Commands	FS !

FS '2' c1 c2 [d]k   User-Defined Character Registration

Code	32H c1 c2 [d]k

Definition Range	The domain differs depending on the Kanji code system.

When JIS code system is specified
c1=77H
$21H \leq c2 \leq 7EH$
$0 \leq d \leq 255$

When Shift JIS code system is specified
c1=ECH
$40H \leq c2 \leq 7EH$ and $80H \leq c2 \leq 9EH$
$0 \leq d \leq 255$

k=72 (when 24 × 24 font is selected)
k=32(when 16 × 16 font is selected)

Default	Undefined

Function	Resisters the Kanji user-defined character pattern as the character code specified with c1, c2. Rewriting to already registered external character is over written.

Notes	c1, c2 indicate the Kanji code for defining user-defined characters, c1 indicating the 1st byte, and c2 the 2nd byte. d indicates the definition data. Bits that correspond to dots to be printed are 1, and bits that correspond to dots that are not printed are 0. k indicates the definition data count. This count differs depending on the selected font size. The memory usage m=9784 bytes.(included the information amount of memory)

Related Commands	FS'C'
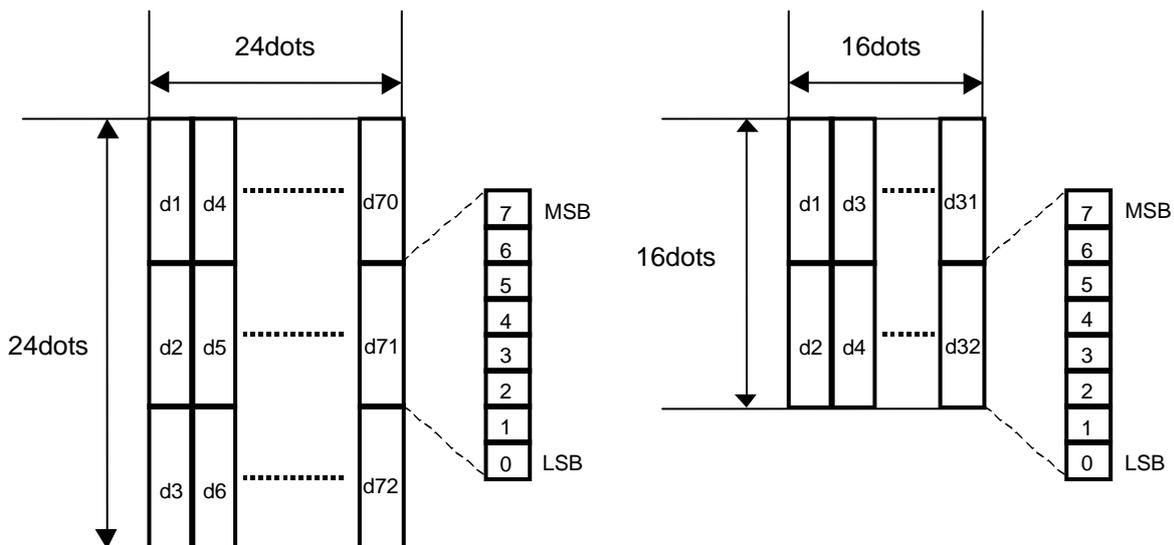
Code	12H 47H n

Definition Range	0≤n≤255

Function	Releases user-defined character area.
	If n=<*******0>B, releases user-defined character area.
	If n=<*******1>B, allocates user-defined character area.

Notes	Only the LSB is significant for n.
	User-defined characters are not printed when user-defined character area is released.
	User-defined character area is 9784 bytes. If this area is released, the remaining memory capacity is not increase.
	The user area is allocated again by the reduction command of extended memory area (DC2'*"1').
	To allocate again user-defined character area that has been freed, a remaining memory capacity of 9784 bytes or more is required. If the remaining memory capacity is insufficient, user-defined character area is not allocated and DC2 'G' 1 is ignored.

9.4.10 Auxiliary Functions

ESC '=' n   Peripheral Equipment Selection

| Code | 1BH 3DH n |

| Definition Range | 0≤n≤255 |

| Default | n=1 |

| Function | Selects peripheral equipment for which data from the host computer is valid. |

Bit	Peripheral	Value	
		0	**1**
0	Printer unit	Disable	Enable
1	Undefined	–	–
2	Undefined	–	–
3	Undefined	–	–
4	Undefined	–	–
5	Undefined	–	–
6	Undefined	–	–
7	Undefined	–	–

| Notes | If the printer disable setting is selected, the printer unit discards all the data except the error recover command, until the printer enable setting is again selected. |

ESC '@'   Printer Initialize

| Code | 1BH 40H |

| Function | Clears the data in the line buffer and initializes the settings. |

| Notes | The function settings reread is not performed.
The data in the input buffer is held. |

| Related Commands | 9.5 LIST OF INITIAL VALUES |

DC2 '@'   Hardware Reset

| Code | 12H 40H |

| Function | Performs hardware reset. |

| Notes | Performs the same operation as during power ON. |

GS FF   Marked Paper Form Feed

| Code | 1DH 0CH |

| Function | Executes the marked paper form feed (form feed to the cut position). |

| Notes | This command is enabled only when entered at the top of the line. Otherwise it is ignored. Executing this command at the print start position does not have the paper form feed to the next print start position. |

Code	1DH 3CH

Function	Performs the marked paper form feed.

Notes	This command is effective only when marked paper is selected. Executes the paper form feed to the cutting position after initialization.

Code	1DH 41H m n

Definition Range	0≤m≤1, 48≤m≤49 0≤n≤255

Function	Sets the amount of correction for the marked paper form feed position in relation to the initial position. m specifies the correction direction.

m	Print Position
0, 48	Forward
1, 49	Reverse
2, 50	Forward, FLASH memory
3, 51	Reverse, FLASH memory

n specifies the amount of correction.
The absolute position is [n × basic calculation pitch] inches.

Notes	This command is effective only when the marked paper have been selected. This command is ignored unless it is input immediately the following marked paper form feed (FF, GS FF, GS '<', paper feed switch operation, etc.). The edge of next mark cannot go beyond the mark sensor. If a correction amount that exceeds the marked paper edge is set, the paper form feed position is set at the end of mark. The basic calculation pitch is set with GS 'P'. The vertical basic calculation pitch (y) is used for calculating the correction amount. If the calculation result is a fractional figure, it is compensated using the mechanism's minimum pitch, and the remainder is discarded. Paper feed is performed to compensate during command execution. The paper feed distance depends on the set correction amount. If choose the writing to FLASH memory, initialize the printer after writing to FLASH memory. When adjusting the paper form feed position, set the distance from the paper edge to the print start position with an enough margin. The print start position for the Thermal paper may change depending on the temperature and humidity. If setting with no margin, unprinted area or paper jam may occur. Set a margin of 3 mm or more from the paper edge. When the paper form feed position is corrected forward, note that the next mark does not overlap with the sensor. A printing defect may occur when the paper form feed performs paper reverse.

Related Commands	FF, GS 'FF', GS '<', GS 'P'

Code | 1DH 43H 30H n m

Definition Range | 0≤n≤5
0≤m≤2, 48≤m≤50

Default | n=0, m=0

Function | Sets the continuous counter print mode.

n specifies the number of print columns.
When n=0, only the number of columns corresponding to the counter value is printed.
When n≠0, the number of print columns is set.

m specifies the print position of the continuous counter print position within the set number of columns.

m	Print Position	Processing when counter value is lower than the set number of columns
0, 48	Align right	Add space(s) to left side
1, 49	Align right	Add '0' to left side
2, 50	Align left	Add space(s) to right side

Notes | When the counter value is higher than the n set number of columns, the printer unit prints n columns below the counter value.
When n=0, the value of m is meaningless.
When n or m falls outside the domain, the setting value does not change.

Related Commands | GS 'C' '1', GS 'C' '2', GS 'c'

GS 'C' '1' aL aH bL bH n r   Count Mode Set

Code	1DH 43H 31H aL aH bL bH n r

Definition Range	$0 \le aL \le 255$
	$0 \le aH \le 255$
	$0 \le bL \le 255$
	$0 \le bH \le 255$
	$0 \le n \le 255$
	$0 \le r \le 255$

Default	aL=1, aH=0, bL=255, bH=255, n=1, r=1

Function	Sets the count mode of the continuous counter.
	n specifies the step magnitude during count-up or count-down.
	r specifies the number of repetitions with the counter value fixed.

Notes	When [aH×256+aL < bH×256+bL and n≠0 and r≠0], the count-up mode is set.
	When [aH×256+aL > bH×256+bL and n≠0 and r≠0], the count-down mode is set.
	When [aH×256+aL = bH×256+bL or n=/0 or r=/0], count stop is set.

When the count-up mode is set, [aH×256+aL] becomes the minimum counter value, and [bH×256+bL] becomes the maximum counter value. Moreover, when the counter exceeds the maximum value, count-up from the minimum value starts again.

When the count-down mode is set, [aH×256+aL] becomes the maximum counter value, and [bH×256+bL] becomes the minimum counter value. Moreover, when the counter is smaller than the minimum value, count-down from the maximum value starts again.

Related Commands	GS 'C' '0', GS 'C' '2', GS 'c'

GS 'C' '2' nl nh   Counter Value Set

Code	1DH 43H 32H nl nh

Definition Code	$0 \le nl \le 255$
	$0 \le nh \le 255$

Default	nl=1, nh=0

Function	Sets the continuous counter value.

Notes	nl and nh indicate the continuous counter value, and the counter value is [nh×256+nl].

When the count-up mode is specified, if the counter value set with this counter falls outside the counter range set with GS 'C' '1', the counter value is forcibly changed to the minimum value upon execution of the next GS 'c' command.

When the count-down mode is specified, if the counter value set with this command falls outside the counter range set with GS 'C' '1', the counter value is forcibly changed to the maximum value upon execution of the GS 'c' command.

Related Commands	GS 'C' '0', GS 'C' '1', GS 'c'

Code	1DH 63H

Function	Sets the continuous counter value to the line buffer and updates the counter.

Notes	After setting the current continuous counter value as print data (character string) to the line buffer, performs counter count-up or count-down according to the set count mode. The counter value set to the line buffer is printed through a print command or buffer full.

When the count-up mode is specified, if the counter value exceeds the counter range set with GS 'C' '1', the counter value is forcibly changed to the minimum value through execution of this command.

When the count-down mode is specified, if the counter value exceeds the counter range specified with GS 'C' '1', the counter value is forcibly changed to the maximum value through execution of this command

Related Commands	GS 'C' '0', GS 'C' '1', GS 'C' '2'

Code	1DH 49H n

Definition Range	$1 \leq n \leq 3$, $49 \leq n \leq 51$

Function	Sends the specified printer ID.

n	Printer ID type	Specification
1, 49	Printer model ID	0BH
2, 50	Type ID	See Table [Type ID]
3, 51	ROM version ID	Depends on ROM version

Table [Type ID]

Bit	Detector	Value	
		0	1
0	Extended CG	No	Yes
1	Autocutter	No	Yes
2	Printer	LTPD247/ CAPD247	LTPD347/ CAPD347
3	Undefined(Reserved)	Fixed to 0	
4	Identifier	Fixed to 0	
5	Presenter	No	Yes
6	Undefined(Reserved)	Fixed to 0	
7	Identifier	Fixed to 0	

Notes	Each printer ID is responded by 1-byte.

Since this command is executed during input buffer deployment, a delay may occur between command reception and printer ID transmission, depending on the input buffer status.
ROM version ID is needed when CPU F/W is uploaded.

(1) GS 'V' m
(2) GS 'V' m n

Paper Cut Position Feed

Code   (1) 1DH 56H m
       (2) 1DH 56H m n

Definition Range   (1) m=0, 1, 48, 49
       (2) m=65, 66, 0≤n≤255

Function   Feeds the Thermal paper to the specified paper cut position.

m	Function
0, 48	Full cut
1, 49	Partial cut
65	Cut position + [n × basic calculation pitch] feed forward and full cut
66	Cut position + [n × basic calculation pitch] feed forward and partial cut

Notes   The command configuration, code, domain, and some notes differ depending on the value of m. In the standard mode, this command is effective only when input is executed at the beginning of a line.

[1 Note regarding: GS 'V' m]
If no autocutter is selected in the function settings, only paper feed is performed.

[2Notes regarding: GS 'V' m n]
When n=0, the printer unit feeds the paper to the cut position.
When n≠0, the printer feeds [n × basic calculation pitch] inches beyond the cut position.

The basic calculation pitch is set with GS 'P'.

The vertical basic calculation pitch (y) is used as the paper feed distance. Moreover, if the calculation result is a fractional figure, it is compensated using the mechanism's minimum pitch, and the remainder is discarded.

Related Commands   DC2 'k' and DC2 'w'.

ESC 'p' m n1 n2

Specification Pulse

Code   1BH 70H m n1 n2

Function   Drive the drawer.

Operating   Only the LSB is significant for m.
       m=0 : Drive the drawer.
       m=1 : Ignore

Related Commands   DC2 'k' and DC2 'w'.

Code | 1DH 67H 30H m nl nh

Definition Range | m = 0
(nh×256+nl)=20, 21, 50, 61, 62, 70

Function | Sets the values of the specified maintenance counter and the maintenance counter saved in the non-volatile memory to '0'.
Specifies the maintenance number as nh×256+nl.

nh×256+nl		Counter type
Hexadecimal	**Decimal**	
14H	20	Line number of paper feed (in 100-dot line)
15H	21	Number of head activation times (in 100-dot line)
32H	50	Number of autocutter drive times
3DH	61	Number of printed sheets (only in printer unit with presenter)
46H	70	Drive time of printer unit (in minutes)

Notes | It may cause a breakage in the non-volatile memory because this command is frequently used. It is recommended that this command be used less than 10 times/day.

The printer turns BUSY status during writing data to the non-volatile memory for this command. Do not transmit data from the host computer while the printer is in BUSY status. The printer stops data receiving.

Do not turn the printer off during executing the command.

Related Commands | GS 'g' '1', GS 'g' '2'

Code | 1DH 67H 31H m

Definition Range | m = 0

Function | Saves all maintenance counter values in the non-volatile memory.

Notes | The paper feed line number and head activation count are returned in 1/100 unit.

It may cause a break down of the non-volatile memory because this command is frequently used. It is recommended that this command be used less than 1000 times/day.

Do not turn the printer off during executing the command.

Related Commands | GS 'g' '0', GS 'g' '2'

| Code | 1DH 67H 32H m nl nh |

| Definition Range | m = 0 |

(nh×256+nl)=20, 21, 50, 61, 62, 70, 148, 149, 178, 189, 190, 198

| Function | Transmits the maintenance counter value. The initial value of the maintenance counter becomes the value saved in the non-volatile memory. Specifies the maintenance number as nh×256+nl. |

nh×256+nl		Counter type
Hexadecimal	**Decimal**	
14H	20	Line number of paper feed (in 100-dot line)
15H	21	Number of head activation times (in 100-dot line)
32H	50	Number of autocutter drive times
3DH	61	Number of printed sheets (only in printer unit with presenter)
3EH	62	Number of collection times (only in printer unit with presenter)
46H	70	Drive time of printer unit (in minutes)
94H	148	Line number of paper feed (in 100-dot line)*
95H	149	Number of head activation times (every 100-dot line)*
B2H	178	Number of autocutter drive times*
BDH	189	Number of printed sheets (only in printer unit with presenter)*
BEH	190	Number of collection times (only in printer unit with presenter)*
C6H	198	Product drive time (in minutes)*

* The value is accumulated without being reset.

Configuration of the maintenance counter data listed below.

	Hexadecimal	**Decimal**	**Number of data**
Header	5FH	95	1 byte
Data	30H to 39H	48 to 57	1 to 10 bytes
NUL	00H	0	1 byte

| Notes | Note that the automatic status may be transmitted during transmitting the maintenance counter value.

The head activation time is not counted up for paper feed with the feed swtich and paper feed by the command. The head activation time is counted up for the paper feed or line feed with print action and paper feed for the page print with the command. |

| Related Commands | GS g '0', GS 'g' '1', GS 'a' |

DC2 '*' '1' — User Area Reduction

Code   12H 2AH 31H

Function   Set the user area (FLASH memory) again, remaining memory capacity is allocated.

Notes   If release the user area, not increase the available memory.
When execute this command, released memory become reusable.
Pay attention to use this command often, the life of FLASH memory will be shorter.
The life of FLASH memory is 100000 times approx. using.

DC2 '*' '2' — Remaining User Area Response

Code   12H 2AH 32H

Function   Sends the remaining memory capacity at the user area (FLASH memory).

Notes   The remaining memory capacity except the released area is notified.
The remaining memory capacity is notified as 12 bytes in the following format.
The following example assumes a remaining memory capacity of 4864 bytes.

Remaining memory capacity rewritten as 6-digit hexadecimal. (4864 -> 00H 13H 00H)
Expressed as ASCII code starting from the highest of the 6 digits. (See below.)
Each item expressed as ASCII code is divided into the low order 4 bits and high order 4 bits, which are operated OR with 00H. (See below.)
This is transmitted in the following sequence: Low order value and high order value of 1st digit of code, 2nd digit of code, . . . 6th digit of code.

	ASCII	High Order	Low Order
0	30H	03H	00H
0	30H	03H	00H
1	31H	03H	01H
3	33H	03H	03H
0	30H	03H	00H
0	30H	03H	00H

Response data transmission sequence (12 bytes):
00H, 03H, 00H, 03H, 01H, 03H, 03H, 03H, 00H, 03H, 00H, 03H

DC2 'R' n — Extension Memory Initialize

Code   12H 52H n

Definition Range   n=1

Function   Initializes extension memory (FLASH memory).

Notes   All user-defined characters, downloaded characters, optional fonts, macros, and downloaded bit images are cleared and returned to the initial state. (User-defined characters and downloaded characters area are allocated.)
Function settings and maintenance counter are not initialized.
When the status is except n=1, ignores this command.

Code   12H 6BH f [d] k

Definition Range   0≤f≤254
                                  f=255: Prohibition
                                  0≤d≤255
                                  k=40

Function   Sets all of SWDIP switch.

Sets the functions below. The setting value is valid when the command is executed.
f=00H : Does not write at the system area in the CG ROM at the same time as the setting.
f=80H : Writing at the system area in the CG ROM at the same time as the setting.

Specify continuously SWDIP1 to 40 the total is 40 bytes.

Does not set f=FFH. It cause not operate properly.

Notes   For the SWDIP switch meanings, see Function Settings command.
              Do not turn the printer off during executing the command.

Code   12H 77H f [d] k 00H

Definition Range   0≤d≤255
                                  0≤f≤255 (See the following SWDIP switch setting table)
                                  k=40 (f=00H, f=80H), k=1 (except left value)

Function   Sets the SWDIP switch.

The MSB has mean below.
f=00H : Does not write at the system area in the CG ROM at the same time as the setting.
f=80H : Writing at the system area in the CG ROM at the same time as the setting.

SW DIP No.	f		Function
All SW DIP	00H	80H	40 byte all writing
1	01H	81H	General setting 1
2	02H	82H	General setting 2
3	03H	83H	General setting 3
4	04H	84H	General setting 4
5	05H	85H	General setting 5
6,7	06H,07H	86H,87H	Auto-loading paper feeding length setting
8,9	08H,09H	88H,89H	Mark position correction
10,11	0AH,0BH	8AH,8BH	Mark detection maximum feeding length setting
After 12	0CH to 28H	8CH to A8H	(Reserved)
-	7FH	FFH	(Prohibit)

Notes   The printer performs hardware reset after completion of writing.
              Do not turn the printer off during executing the command.

Details for settings of SWDIP1 to DIP 12 are described below. The value that is indicated by boldface shows a default setting value. The words in brackets are printed at test print.

> **(NOTE)   Be sure to set the directed value as "Fixed" according to 0 or 1 in list so that CPU works correctly.**

(1)   General Settings 1 (SWDIP1)

Setting the printer mechanism or selecting the peripheral.

- Autocutter selection (SWDIP1-1)
  Enable/disable of the Autocutter is selected.

- Drawer, winder or presenter selection (SWDIP1-2 or 3)
  Enable/disable of the drawer, the winder or the presenter is selected.
  When driving the winder, select the function setting as Drawer/Winder Enable and do not connect the drawer pin to anything..

- Auto-loading selection (SWDIP1-4)
  Enable/disable of the auto loading in the printer mechanism is selected.

- Mark sensor selection (SWDIP1-5)
  The photo sensor used as a mark sensor is selected.

- Paper-near-end sensor selection (SWDIP1-6)
  Enable/disable of paper-near-end sensor is selected.

Table 9-7 General Settings 1 (SWDIP1)

SWDIP	Function	Value	
		0	**1**
1-1	Autocutter selection	Enable	**Disable**
1-2 to 3	Drawer, winder or presenter selection (Peripheral Device)	Refer to Table 9-8	
1-4	Auto-loading selection	Disable	**Disable**
1-5	Mark sensor	Paper sensor	**Option sensor**
1-6	Paper-near-end sensor (Near end sensor)	Enable	**Disable**
1-7	Reserved	-	**Fixed**
1-8	Reserved	-	**Fixed**

Table 9-8 Drawer, Winder or Presenter Selection (SWDIP1-2 to 3)

SWDIP 1-3	SWDIP 1-2	Drawer, Winder or Presenter Selection
0	0	Presenter Enable
0	1	Drawer/Winder Enable (Drawer/Winder)
1	0	Drawer Enable (Drawer)
1	**1**	**Disable**

(2) General Settings 2 (SWDIP2)

Selecting the drive method of the printer mechanism.

- Division drive method selection (SWDIP2-1)
  Select the thermal head drive method from dynamic division or fixed division.

- Number of dots selection for dynamic division drive (SWDIP2-2 or 3)
  When selecting the dynamic division, the maximum number of the drive dot can be set.

Table 9-9 General Settings 2 (SWDIP2)

SWDIP	Function	Value	
		0	**1**
2-1	Division drive method selection (Head drive)	Fixed div.	**Dynamic div.**
2-2 to 3	Number of dots selection for dynamic drive (Division method)	Refer to Table 9-10	
2-4	Reserved	-	**Fixed**
2-5	Reserved	-	**Fixed**
2-6	Reserved	-	**Fixed**
2-7	Reserved	-	**Fixed**
2-8	Reserved	-	**Fixed**

Table 9-10 Number of Dots Selection for Dynamic Drive (SWDIP2-2 to 3)

SWDIP 2-3	SWDIP 2-2	Number of dots selection for dynamic drive
0	0	72
0	1	**144**
1	0	288
1	1	144

(3) General Settings 3 (SWDIP3)

Selecting the mark mode and the thermal paper.

- Mark mode selection (SWDIP3-1)
  Enable/disable of the mark detection is selected.

- Thermal paper selection (SWDIP3-1)
  Selecting the thermal paper to use.

Table 9-11 General Settings 3 (SWDIP3)

SWDIP	Function	Value	
		0	**1**
3-1	Mark mode selection	Enable	**Disable**
3-2 to 6	Thermal paper selection	Refer to Table 9-12	
7	Reserved	-	**Fixed**
8	Reserved	-	**Fixed**

Table 9-12 Thermal Paper Selection (SWDIP3-2 to 6)

SWDIP 3-6	SWDIP 3-5	SWDIP 3-4	SWDIP 3-3	SWDIP 3-2	Thermal paper selection
0	**0**	**0**	**0**	**0**	**TF50KS-E2D**
0	0	0	0	1	TP50KJ-R
0	0	0	1	0	Prohibition
0	0	0	1	1	PD160R-63
0	0	1	0	0	TL69KS-LH
0	0	1	0	1	P220VBB-1
0	0	1	1	0	P300
0	0	1	1	1	P350
0	1	0	0	0	KIP370
0	1	0	0	1	KIP470
0	1	0	1	0	PD160R-N
0	1	0	1	1	AF50KS-E
0	1	1	0	0	Alpha900-3.4
0	1	1	0	1	KT55F20
0	1	1	1	0	F5041
0	1	1	1	1	KF50
1	0	0	0	0	AP50KS-D
1	0	0	0	1	KPR440
1	0	0	1	0	AP50KS-FZ
1	0	0	1	1	P5045
Except above data					Prohibition

> **(NOTE)** **If too much energy is applied to the thermal head, it would shorten its life span and cause the paper feed problem. Set an accurate thermal paper selection and print density. If selecting the thermal paper that is different from the one specified in the thermal paper selection or in case of not setting the print density in 100%, the specified life span would not be guaranteed of the product specification in this technical reference. Verify the performance with your actual device before printing.**

(4) General Settings 4 (SWDIP4)

Setting the print density by 1%.

Table 9-13 Setting the Print Density (SWDIP4)

SWDIP	Function	Number of byte	Definition range	Default
4	Print density selection	1 byte	60 to 140 (%)	**100 (%)**

> **(NOTE)** **If too much energy is applied to the thermal head, it would shorten its life span and cause the paper feed problem. Set an accurate thermal paper selection and print density. If selecting the thermal paper that is different from the one specified in the thermal paper selection or in case of not setting the print density in 100%, the specified life span would not be guaranteed of the product specification in this technical reference. Verify the performance with your actual device before printing.**

(5) General Settings 5 (SWDIP5)

Setting the function of status response and print data handling when the errors occur.

- Automatic status response selection (SWDIP5-1)
  Selecting the automatic status response function whether to be enable or not.

- Print data handling when an error occurs (SWDIP5-2)
  Select printing data whether to discard or not when the errors occur. If selecting the printing data discard when the errors occur, discard the command below:
  -> Printing data, feeding, cut the thermal paper, execution response request.

> **(NOTE)** **If selecting the printing data discard when the errors occur, get errors during processing the command, the command processing does not exit till receive the all remaining data. When the errors occur if there is the data during processing, send the all remaining data and enter the next command.**

- CR mode selection in parallel communication (SWDIP5-3)
  Selecting CR command in parallel communication whether to be enable or not.

- Paper-near-end sensor error selection (SWDIP5-4)
  Select the function to stop the print as the error whether enable or disable, when the paper-nearend sensor detects out-of-paper.

- Initialization performance selection after paper setting (SWDIP5-5)
  When selecting this function to enable, CPU operates the printer mechanism as the following:
  Paper setting -> paper feed forward approximately 20mm -> paper cutting -> initialization
  performance to feed the Thermal paper forward approximately 3mm.
  If the autocutter function is disabled or the thermal paper is inserted during turning on the power or
  resetting, CPU does not operate the initialization performance after set the thermal paper even if
  setting this function as Enable.

Table 9-14 General Settings 5 (SWDIP5)

SWDIP	Function	Value	
		0	1
5-1	Automatic status response selection	Enable	**Disable**
5-2	Print data handling when an error occurs	Enable	**Disable**
5-3	CR mode selection in parallel communication	Enable	**Disable**
5-4	Paper-near-end sensor error selection	Enable	**Disable**
5-5	Initialization performance selection after paper setting	Enable	**Disable**
5-6	Reserved	-	**Fixed**
5-7	Reserved	-	**Fixed**
5-8	Reserved	-	**Fixed**

(6) Auto-loading paper feeding length setting (SWDIP6 to 7)

When the setting of auto-loading is enabled, setting the paper feeding length by 1mm.

Table 9-15 Auto-Loading Paper Feeding Length Setting (SWDIP6 to 7)

SWDIP	Function	Numbers of bytes	Definition range	Default value
6 to 7	Auto-loading paper feeding length setting	2 bytes	20 to 300 (mm)	**80 (mm)**

(7) Mark position correction (SWDIP8 to 9)

Preset the correct direction and length of mark position correction in the SWDIP8 to 9 by 1 dot line.
When setting the parameter as 1(1H) to 8000 (1F40H), the correcting direction is forward.
When setting the parameter as -1(FFFFH) to -72 (FFB8H), the correcting direction is reverse. Set a minus
number by twos complement.

Table 9-16 Mark Position Correction (SWDIP8 to 9)

SWDIP	Function	Numbers of bytes	Definition range	Default value
8 to 9	Mark position correction	2 bytes	-72 to 8000 (dot line)	**0**

(8) Mark detection maximum feeding length setting (SWDIP10 to 11)

CPU feeds the thermal paper until detecting the mark by the mm.
If the out-of-paper sensor does not detect the mark after feeding specified length of Thermal paper, CPU stops feeding the thermal paper by specified length. Moreover, when autocutter selection is set to enable, paper cutting operation is performed.

Table 9-17 Mark Detection Maximum Feeding Length Setting (SWDIP10 to 11)

SWDIP	Function	Numbers of bytes	Definition range	Default value
10 to 11	Mark detection maximum feeding length setting	2 bytes	0 to 4000 (mm)	**500 (mm)**

DC2 'l' n   Function Set Response

Code	12H 6CH n

Definition Range	n=0

Function Reads the SWDIP switch setting.

Notes The value of all the SWDIP switches written in the FLASH memory is responded.
For the SWDIP switch meanings, see Function Settings command.

Responses are sent as 80 bytes in the following format.

1st response byte:	Indicates number that is logical sum of low 4 bits of SWDIP1 and 00H

2nd response byte:	Indicates number that is logical sum of high 4 bits of SWDIP1 and 00H 4 bits right shift

:

77th response byte:	Indicates number that is logical sum of low 4 bits of SWDIP39 and 00H

78th response byte:	Indicates number that is logical sum of high 4 bits of SWDIP39 and 00H 4 bits right shift

79th response byte:	Indicates number that is logical sum of low 4 bits of SWDIP40 and 00H

80th response byte:	Indicates number that is logical sum of high 4 bits of SWDIP40 and 00H 4 bits right shift

When Automatic Status Back Enable/Disable command is set to valid, 4 bytes of automatic status may be inserted into the function setting response according to timings.

To disable automatic status response, set all of bits to '0' with Automatic Status Back Enable/Disable command before executing Function Set Response command

Distinguish the status using identifiers whether that is the response of executed Function Set Response command or automatic status response.

DC2 'q' n   Execution Response Request

Code	12H 71H n

Definition Range	0≤n≤255

Function Sends n.

Notes CPU has 4-kbyte input buffer, and command and data input, execution, and printing are not synchronized. Therefore, it is not possible to confirm command execution completion and character printing completion from external. By inputting this command following a command or character print command, upon return of the response to that command, it is possible to confirm whether the command or printing prior to when the command was issued has been completed.

Specify the response code with n. The low order 4 bits are valid for n. The transmitted code, which is the logical sum of the specified 4 low-order bit of n and 80H, consists of the code from 80H to 8FH.

DC2 't'   Test Print

Code	12H 74H

Function Performs test print.

Notes All setting values using commands are initialized.
The printer cannot communicate during test print.
The input buffer is cleared when executing the test print.
Do not input commands and print data subsequently to the test print command.
Input commands in the communication ready state after completion of the test print.

ESC 'c' '3' n   Paper-out Signal Output Capable Paper Detector Selection

Code	1BH 63H 33H n

Definition Range	0≤n≤255

Default	n=15

Function Selects a paper sensor that outputs the signal as out-of-paper status when out-of-paper occurs.

Bit No.	Detector	Value	
		0	**1**
0	Paper-near-end sensor	Disable	Enable
1			
2	Out-of-paper sensor	Disable	Enable
3			
4	Undefined	–	–
5	Undefined	–	–
6	Undefined	–	–
7	Undefined	–	–

More than one sensor can be selected at the same time. If several sensor are set to enable, out-of-paper status is output after detecting that status by one of those.
This command is valid for the parallel communication. However, CPU ignores this command in serial or USB communications.

ESC 'c' '4' n   Print Stop Capable Paper Detector Selection

Code   1BH 63H 34H n

Definition Range $0 \leq n \leq 255$

Default   Depends on function setting

Function   Selects a paper sensor that stops printing when out-of-paper occurs.

Bit No.	Detector	Value	
		0	1
0	Paper-near-end sensor	Disable	Enable
1			
2	Undefined	–	–
3	Undefined	–	–
4	Undefined	–	–
5	Undefined	–	–
6	Undefined	–	–
7	Undefined	–	–

Notes   Printing actually stops when the line that is currently being printed completes printing and paper feed has been executed.

When the SWDIP1-6 is invalid, this command is ignored.

A default setting depends on SWDIP5-4, which is invalid as '0' and is valid as '3'.

Code   1DH 72H n

Definition Range   1≤n≤3, 49≤n≤51

Function   Sends the specified status data.
            n=1, 49: Send status data of the paper sensor.
            n=3, 50: Send status data of the presenter.

Paper sensor status (n=1, 49)

Bit No.	Function	Value	
		0	**1**
0	Paper-near-end sensor	Paper	No paper
1	Undefined	Fixed to '0'	
2	Paper end sensor	Paper	No paper
3	Undefined	Fixed to '0'	
4	Identifier	Fixed to '0'	
5	Undefined	Fixed to '0'	
6	Undefined	Fixed to '0'	
7	Identifier	Fixed to '0'	

Undefined status (n=2, 50)

Bit No.	Function	Value	
		0	**1**
0	Undefined	Fixed to '1'	
1	Undefined	Fixed to '0'	
2	Undefined	Fixed to '0'	
3	Undefined	Fixed to '0'	
4	Identifier	Fixed to '0'	
5	Undefined	Fixed to '0'	
6	Undefined	Fixed to '0'	
7	Identifier	Fixed to '0'	

Presenter status (n=3, 51)

Bit No.	Function	Value	
		0	**1**
0	Paper detected by presenter	No paper	Paper
1	Undefined	Fixed to '0'	
2	Paper feed error in presenter	No	Yes
3	Undefined	Fixed to '0'	
4	Identifier	Fixed to '0'	
5	Presenter paper jam error	No	Yes
6	Undefined	Fixed to '0'	
7	Identifier	Fixed to '0'	

Notes   Since this command is executed during input buffer deployment, a delay may occur between command reception and status data transmission, depending on the input buffer status.

Related Commands   GS 'a'

Code | 1DH 61H n

Definition Range | 0≤n≤255

When the Automatic status response function (SWDIP5-1) is invalid: n=00H
When the Automatic status response function (SWDIP5-1) is valid: n=1FH

Function | Selects a status for ASB (Automatic Status Back).

Bit No.	Function	Value	
		0	1
0	Changing drawer sensor status	Disable	Enable
1	Printer information	Disable	Enable
2	Error status	Disable	Enable
3	Continuous paper sensor	Disable	Enable
4	Other status	Disable	Enable
5	Undefined	–	–
6	Undefined	–	–
7	Undefined	–	–

Notes | When either status becomes enable, the status at the time of executing this command is sent. Hereafter, whenever the enable status condition changes, the status data is sent. At this time, in even the status where the ASB is not enabled, any change may occur because each status data indicates the current state.

When all status become disable, the ASB function becomes disable.

When the ASB function is enable in the default, the status at the 1st communicable time after powering on the printer is sent.

4-byte status except Xoff code always continues.

Because this command is executed at line buffer development, a delay between command receiving and status data sending may occur depending on the line buffer state.

The printer responds only to the interface being selected.

When the cable is connected, the status data is sent right after connecting.

Bits 0, 4 and 7 of the 1st byte are identifiers to distinguish from other responses. When bits 0, 4, and 7 are responded as 0, 1, 0 respectively from the printer, proceed the subsequent 4 bytes included that response (except Xoff) as statuses by ASB function.

Paper-near-end sensor and mark sensor are responded when enable by the function settings.

(1) The 1st byte (printer mechanism information)

Bit No.	Function	Value	
		0	**1**
0	Identifier	Fixed to '0'	
1	Motor drive	Stop	Work
2	Drawer sensor status	Low	High
3	Undefined	Fixed to '0'	
4	Identifier	Fixed to '1'	
5	Platen sensor status	Closed	Opened
6	Paper feed switch	OFF	ON
7	Identifier	Fixed to '0'	

(2) The 2nd byte (error information)

Bit No.	Function	Value	
		0	**1**
0	Undefined	Fixed to '0'	
1	Undefined	Fixed to '0'	
2	Paper jam error while detecting mark	No	Yes
3	Autocutter error	No	Yes
4	Identifier	Fixed to '0'	
5	Thermal head error Vp voltage error Vp voltage initialization error	No	Yes
6	Automatic recovery error	No	Yes
7	Identifier	Fixed to '0'	

Bit 0 to 3: When the errors occur other than the bit 5=0 and 6=0 other bit is 1, CPU performs automatically reset after errors are cleared.

Bit 5: When any one of the Thermal head error/Vp voltage error/Vp voltage initialization error occurs, bit 5 is as '1'.

Bit 6: When the thermal head temperature error occurs, bit 6 is as '1'.

(3) The 3rd byte (paper detector information)

Bit No.	Function	Value	
		0	**1**
0	Paper-near-end sensor	Paper	No paper
1	Undefined	Fixed to '0'	
2	Out-of-paper sensor	Paper	No paper
3	Undefined	Fixed to '0'	
4	Identifier	Fixed to '0'	
5	Undefined	Fixed to '0'	
6	Mark sensor	No	Yes
7	Identifier	Fixed to '0'	

(4) The 4th byte (presenter information)

Bit No.	Function	Value	
		0	**1**
0	Paper detected by presenter	No paper	Paper
1	Undefined	Fixed to '0'	
2	Paper feed error in presenter	No	Yes
3	Undefined	Fixed to '0'	
4	Identifier	Fixed to '0'	
5	Presenter paper jam error	No	Yes
6	Undefined	Fixed to '0'	
7	Identifier	Fixed to '0'	

| Related Commands | GS 'r', DC2 'k' and DC2 'w'

Code   12H 30H 61H n

Function   The CPU records the error history when an error occurs, even if an error is cleared.
This command can call the error history whenever it is needed.
The error history is cleared when the command or hardware reset is executed.

Specifies if an error history is cleared or not by upper bit of n.
If n=<0*******>B, responds an error history and a history data is not cleared.
If n=<1*******>B, responds an error history and a history data is cleared.

Specifies errors responded/cleared by lower 7 bit of n.
n=0: All history   (8-byte) response
n=1: First byte   (1-byte) response
n=2: Second-byte (1-byte) response
n=3: Third byte   (1-byte) response
n=4: Forth byte   (1-byte) response
n=5: Fifth byte   (1-byte) response
n=6: Sixth byte   (1-byte) response
n=7: Seventh byte (1-byte) response
n=8: Eighth byte   (1-byte) response
The command other than the above is ignored.

(1) First byte

Bit	Function	Value	
		0	1
0	Discarding history of Error data	Invalid	Valid
1～3	Reserved	Fixed to 0	
4～7	Identifier	Fixed to 0	

(2) Second-byte

Bit	Function	Value	
		0	1
0	Hardware error history	Invalid	Valid
1	Vp error history	Invalid	Valid
2	Head-temperature error history	Invalid	Valid
3	External Flash writing error history	Invalid	Valid
4～7	Identifier	Fixed to 0	

(3) Third byte

Bit	Function	Value	
		0	**1**
0	Presenter paper jam error history	Invalid	Valid
1	Paper feed error in presenter history	Invalid	Valid
2	Paper jam error history while detecting mark	Invalid	Valid
3	Reserved	Fixed to 0	
4~7	Identifier	Fixed to 0	

(4) Forth byte

Bit	Function	Value	
		0	**1**
0	Head-up error history	Invalid	Valid
1	Autocutter error history	Invalid	Valid
2	Out-of-paper error history	Invalid	Valid
3	Near-end error history	Invalid	Valid
4~7	Identifier	Fixed to 0	

(5) Fifth to Eighth byte

Bit	Function	Value	
		0	**1**
0~3	Reserved	Fixed to 0	
4~7	Identifier	Fixed to 0	

DC2 '>' n   Fixed Division Selection

| Code | 12H 3EH n |

| Function | Sets the thermal head driving method to fixed division mode.
n specify the number of the division. |

n	Number of the Division	
	LTPD247/CAPD247	**LTPD347/CAPD347**
0	Fixed 2-division	Fixed 2-division

| Notes | CPU performs the fixed division drive mode with this command.
See Chapter 4 "Fixed division" for more information on fixed division method,.
The default status can be determined using SWDIP2-1. |

DC2 '%' n   Dynamic Division, Number of Dots Specify

Code   12H 25H n

Function Sets the head driving method to dynamic division mode and specifies the maximum number of activated dots.

n: Specifies maximum number of activated dots to n × 8. the range of n is 9 through 36, the others are specified as follows:
n<09H (9): n=09H (9×8=72 dots)
n>24H (36): n=24H (36×8=288 dots)

Notes   Set this command, the head is dynamic division driving method.
The range of n is between 9 and 36. Specify the maximum number of activated dots as n × 8 dots.

See chapter 4 "Dynamic division" for more information on dynamic division method.
When CPU prints the data that is high density by the dynamic division mode using low-capacity power supply, the printing defect or voltage error may occur. Make sure that when the number of dots is specified by this command, do not exceed its voltage capacity.

The default status can be determined using SWDIP 2-1 through 3.

DC2 '~' n   Print Density Specify

Code   12H 7EH n

Function Sets print density.
n: 60≦n≦140

Notes   A Print density can be adjusted by setting the energy applied to the head to a value from 60% to 140% of the rated energy. However, when the print density is set as more than 100%, a life span of the head may be shorter than that specification.

If n is specified less than 60 or more than 140, this command is ignored.
The default status can be determined using SWDIP 4 (60% to 140%).

(NOTE) **If too much energy is applied to the thermal head, it would shorten its life span and cause the paper feed problem. Set an accurate thermal paper selection and print density.**
If selecting the thermal paper that is different from the one specified in the thermal paper selection or in case of not setting the print density in 100%, the specified life span would not be guaranteed of the product specification in this technical reference. Verify the performance with your actual device before printing.

DC3 '#' n — Overlapping Mode Selection

Code	13H 23H n

Definition Range	0≦n≦255

Default	Ruled line OR overlapping mode

Function	Specifies OR or XOR for the overlapping mode of ruled line, character and image data. n=<*******0>B: OR overlapping mode n=<*******1>B: XOR overlapping mode

Notes	When the page mode is selected, only the printer unit's internal flag operation is performed when this command is input. This command does not affect the page mode. If the OR overlapping mode is specified, either the part where dots exist in the ruled line, image or character is print out in black. If the XOR overlapping mode is specified, the part where image is overlapped with character is printed out in white and the non-overlapped part is print out in black.

DC3 '(' — Ruled Line Continuous Command

Code	13H 28H

Function	Following input of this command, the printer unit receives ruled line commands without DC3 code until it receives 29H.

Notes	All commands other than ruled line commands are ignored.

DC3 '+' — Ruled Line ON

Code	13H 2BH

Definition Range	Ruled line OFF

Function	Sets the ruled line ON.

Notes	Following input of this command, the selected ruled line is printed at paper feed caused by character printing and the space between lines, LF, ESC 'J', and ESC 'd', and ruled line dot line printing, DC3 'P' and DC3 'p'. This command is effective until the Ruled Line OFF command (DC3 '−') is executed. The dots whose bits on the selected ruled line buffer is '1', printed out. However, ruled line beyond the specified printing area with ESC 'W' is not printed (In the standard mode, the ruled line data is always printed in the printable area width.)

Related Commands	DC3 '−', ESC '#'

DC3 '−'   Ruled Line OFF

Code	13H 2DH

Default	Ruled line OFF

Function	Sets the ruled line to OFF.

Notes	After this command is executed, ruled line is not applied.

Related Commands	DC3 '+'

DC3 'A'   Ruled Line A Selection

Code	13H 41H

Default	Ruled line buffer A is selected

Function	Selects ruled line buffer A.

Notes	Following this, ruled line data set is performed for ruled line buffer A, and the image of ruled line buffer A is printed out.

Related Commands	DC3 'B'

DC3 'B'   Ruled Line B Selection

Code	13H 42H

Default	Ruled line buffer B is selected

Function	Selects ruled buffer B.

Notes	Following this, ruled line data set is performed for ruled line buffer B, and the image of ruled line buffer B is printed out.

Related Commands	DC3 'A'

DC3 'C'   Ruled Line Buffer Clear

Code	13H 43H

Default	All the data of ruled line buffers A and B cleared

Function	Clears all the bits of the selected ruled line buffer to '0'.

DC3 'D' nl nh   Ruled Line Dot Set

Code	13H 44H nl nh

Definition Range	$0 \leq nl \leq 255$, $0 \leq nh \leq 255$

Function	Sets to '1' the bit of the [$nh \times 256 + nl$] dot of the selected ruled line buffer.

Notes	The position of the dot is counted by regarding the dot on the left edge of the screen as position '0'. When dots have been specified outside the printable area, they are ignored. A printable area means that the data is printed with maximum range of Y direction in the page mode.

DC3 'F' n1 n2   Ruled Line Pattern Fill

Code	13H 46H n1 n2

Definition Range	0≤n1≤255, 0≤n2≤255

Default	Ruled lines all cleared

Function	Fills the selected ruled line buffer with 2-byte data specified with n1, n2.

Notes Fills the ruled line buffer with a 16-dot repetitive image pattern consisting of n1 (8 dots on left side) and n2 (8 dots on right side).

The correspondence of n1 and n2 bits and dots can be changed through Image LSB/MSB Select (DC2 '='). (The initial state is MSB on the left side.)

When dots have been specified outside the printable area, they are ignored. A printable area means that the data is printed with maximum range of Y direction in the page mode.

Related Commands	DC2 '='

DC3 'L' ml mh nl nh   Ruled Line Line Set

Code	13H 4CH ml mh nL nh

Definition Range	0≤ml≤255, 0≤mh≤255
	0≤nl≤255, 0≤nh≤255

Default	Ruled lines all cleared

Function Sets to '1' the bits in the range from the [mh×256+ml] dot to the [nh×256+nl] dot of the selected ruled line buffer.

Notes The position of the dot is counted by regarding the dots on the left edge of the screen as position '0'.
When dots have been specified outside the printable area, the dots are ignored. A printable area means that the data is printed with maximum range of Y direction in the page mode.

DC3 'P'   Ruled Line 1 Dot Line Print

Code	13H 50H

Function	Prints as a 1-dot line the selected ruled line buffer image when ruler line is ON.

Notes When there is data in the line buffer, after this data is printed and paper feed equivalent to the space between lines is performed, the ruled line is printed as a 1-dot line. (A ruled line is also printed on the printed characters and the space between lines.)

When the ruled line is OFF, no ruled line is printed and 1-dot line paper feed is performed.

Configure the ruled line by 2 dots or more. The 1-dot ruled line may be invisible.

DC3 'p' nl nh   Ruled Line n Dots Line Print

Code	13H 70H nl nh

Definition Range	$0 \leq nl \leq 255$, $0 \leq nh \leq 255$

Function   Prints as n-dot line the selected ruler line buffer image when ruled line is ON.

Notes   When there is data in the line buffer, after this data is printed and paper feed equivalent to the space between lines is performed, the ruled line is printed as [nh$\times$256+nl]-dot line. (A ruled line is also printed on the printed characters and the space between lines.)

When the ruled line is OFF, no ruled line is printed and [nh$\times$256+nl]-dot line paper feed is performed.

DC3 'v' nl nh [d] k   Ruled Line Image Writing

Code	13H 76H nl nh [d]k

Definition Range	$0 \leq d \leq 255$, $1 \leq nh \times 256+nl \leq$ (Maximum page length)

Default   Ruled lines all cleared (d=all 0)

Function   Writes image data to the selected ruler line buffer.

Notes   As for image data, input data corresponding to '1' dot line amount.
The correspondence between image data bits and dots can be changed with Image LSB/MSB Select (DC2 '='). (The initial state is MSB on the left side.)

When dots have been specified outside the printable area, they are ignored. A printable area means that the data is printed with maximum range of Y direction in the page mode.

Related Commands	DC2 '='

9.5 LIST OF INITIAL VALUES

Settings	Initial Value	Command
Character right space amount set	0	ESC SP
Bold printing	Cancel	ESC '!', ESC 'E'
Double strike printing	Cancel	ESC 'G'
Underline	Cancel/ 1 dot width	ESC '! ', ESC '−'
90° right rotated character printing	Cancel	ESC 'V'
Inversion (flip) printing	Cancel	ESC '{'
Character font	Font A (24 × 12)	ESC '!'
Double height	Cancel	ESC '!', FS '!', FS 'W'
Double width	Cancel	ESC '!', FS '!', FS 'W'
Reverse printing	Cancel	GS 'B'
International character set	USA	ESC 'R'
Character code table	Extended graphics	ESC 't'
Downloaded characters	Undefined	ESC '&'
Kanji mode	Cancel	FS '&', FS '.'
Kanji font	24 × 24	FS '!'
Kanji underline	Cancel/ 1 dot width	FS '!', FS '−'
Kanji code system	JIS code system	FS 'C'
Kanji space amount set	Right=0, Left=0	FS 'S'
User-defined characters	Undefined	FS '2'
Line spacing	1/6 inch	ESC '2', ESC '3'
Peripheral equipment selection	Printer enabled	ESC '='
Horizontal tab position	Every 8 characters	ESC 'D'
Page mode	Not selected	ESC 'L', ESC 'S'
Print direction in page mode	Left → Right	ESC 'T'
Starting point in page mode	Top left	ESC 'T'
Print area in page mode	Entire printable area	ESC 'W'
Alignment	Left	ESC 'a'
Paper-out Signal Output Capable Paper Detector Select	Valid	ESC 'c' '3'
Print stop capable paper detector	Depends on function setting	ESC 'c' '4'
Downloaded bit image	Undefined	GS '*'
Macro	Undefined	GS ': '
Counter print mode	Digit number = 0/Align right	GS 'C' '0'
Counter mode	Count-up	GS 'C' '1'
Counter range	1 to 65535	GS 'C' '1'
Counter value	1	GS 'C' '2'
Counter step	1	GS 'C' '1'
Number of repetitions	1	GS 'C' '1'

Settings	Initial Value	Command
HRI character print position	Do not print	GS 'H'
HRI character typeface	Font A	GS 'f'
Barcode height	162 dots	GS 'h'
Barcode width	0.375mm, 0.375/1.000mm	GS 'w'
Barcode N:W ratio	1:2.5	DC2 ':'
Nominal Fine Element Width	3 dots	GS 'n'
PDF Module Height Set	10 dots	GS 'o'
QRCode, DataMatrix module size specify	6 dots	DC2 ';'
Left margin	0 (beginning of line)	GS 'L'
Print area	Entire printable area	GS 'W'
Basic calculation pitch	x direction: 1/203inch y direction: 1/203inch	GS 'P'
Sending of automatic status	Depends on function setting	GS 'a'
Image LSB/MSB	MSB	DC2 '='
Downloaded character area	Secured	DC2 'D'
User-defined character area	Secured	DC2 'G'
Bit image scan method	Column scan method	DC2 'I'
Optional font	Undefined	DC2 'P'
Ruled line	OFF	DC3 '+', DC3 '−'
Ruled line buffer	Clear	DC3 'C'
Ruled line overlapping	OR	DC3 '#'
Downloaded Character Set Specify	Cancel	ESC '%'
Optional Font Select	Cancel	DC2 'O'

CHAPTER 10
CHARACTER CODES

10.1   STANDARD SIZE CHARACTERS

Extended graphics character and Codepage 1252 can be printed without CG ROM.
A Katakana character set1 and Katakana character set2 can be printed with the CG ROM.
When 1-byte character is printed using Kanji Mode Select command, assign the first byte to 00H and 1-byte character code to second byte.

```
     0 1 2 3 4 5 6 7 8 9 A B C D E F
20     ! " # $ % & ' ( ) * + , - . /
30   0 1 2 3 4 5 6 7 8 9 : ; < = > ?
40   @ A B C D E F G H I J K L M N O
50   P Q R S T U V W X Y Z [ \ ] ^ _
60   ' a b c d e f g h i j k l m n o
70   p q r s t u v w x y z { ¦ } ~
80   Ç ü é â ä à å ç ê ë è ï î ì Ä Å
90   É æ Æ ô ö ò û ù ÿ Ö Ü ¢ £ ¥ € ƒ
A0   á í ó ú ñ Ñ ª º ¿ ⌐ ¬ ½ ¼ ¡ « »
B0   ▒ ░ ▓ │ ┤ ╡ ╢ ╖ ╕ ╣ ║ ╗ ╝ ╜ ╛ ┐
C0   └ ┴ ┬ ├ ─ ┼ ╞ ╟ ╚ ╔ ╩ ╦ ╠ ═ ╬ ╧
D0   ╨ ╤ ╥ ╙ ╘ ╒ ╓ ╫ ╪ ┘ ┌ █ ▄ ▌ ▐ ▀
E0   α ß Γ π Σ σ µ τ Φ θ Ω δ ∞ φ ∈ ∩
F0   ≡ ± ≥ ≤ ⌠ ⌡ ÷ ≈ ° ∙ · √ ⁿ ² ■
```

Figure 10-1 Extended Graphics Character Set
(International code is set as USA)

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
20		!	"	#	$	%	&	'	(	)	*	+	,	−	.	/
30	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
40	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
50	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
60	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
70	p	q	r	s	t	u	v	w	x	y	z	{	¦	}	~	
80	▁	▂	▃	▄	▅	▆	▇	█	▏	▎	▍	▌	▋	▊	▉	+
90	⊥	⊤	⊣	⊢	￣	─	│	│	┌	┐	└	┘	╭	╮	╲	╱
A0		。	「	」	、	・	ヲ	ア	イ	ウ	エ	オ	ヤ	ユ	ヨ	ツ
B0	ー	ア	イ	ウ	エ	オ	カ	キ	ク	ケ	コ	サ	シ	ス	セ	ソ
C0	タ	チ	ツ	テ	ト	ナ	ニ	ヌ	ネ	ノ	ハ	ヒ	フ	ヘ	ホ	マ
D0	ミ	ム	メ	モ	ヤ	ユ	ヨ	ラ	リ	ル	レ	ロ	ワ	ン	゛	゜
E0	=	╞	╪	╡	◢	◣	◥	◤	♠	♥	♦	♣	●	○	╱	╲
F0	╳	円	年	月	日	時	分	秒	〒	市	区	町	村	人	▦	

Figure 10-2 Katakana Character Set 1
(International code is set as USA)

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
20		!	"	#	$	%	&	'	(	)	*	+	,	−	.	/
30	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
40	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
50	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
60	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
70	p	q	r	s	t	u	v	w	x	y	z	{	¦	}	~	
80	▁	▂	▃	▄	▅	▆	▇	█	▏	▎	▍	▌	▋	▊	▉	+
90	⊥	⊤	⊣	⊢	￣	─	│	│	┌	┐	└	┘	╭	╮	╲	╱
A0		。	「	」	、	・	ヲ	ア	イ	ウ	エ	オ	ヤ	ユ	ヨ	ツ
B0	ー	ア	イ	ウ	エ	オ	カ	キ	ク	ケ	コ	サ	シ	ス	セ	ソ
C0	タ	チ	ツ	テ	ト	ナ	ニ	ヌ	ネ	ノ	ハ	ヒ	フ	ヘ	ホ	マ
D0	ミ	ム	メ	モ	ヤ	ユ	ヨ	ラ	リ	ル	レ	ロ	ワ	ン	゛	゜
E0	=	╞	╪	╡	◢	◣	◥	◤	♠	♥	♦	♣	●	○	╱	╲
F0	╳	円	年	月	日	時	分	秒	〒	市	区	町	村	人	▦	

Figure 10-3 Katakana Character Set 2
(International code is set as USA)

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
20		!	"	#	$	%	&	'	(	)	*	+	,	−	.	/
30	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
40	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
50	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
60	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
70	p	q	r	s	t	u	v	w	x	y	z	{	¦	}	~	
80	€		‚	ƒ	„	…	†	‡	ˆ	‰	Š	‹	Œ		Ž	
90		'	'	"	"	•	–	—	˜	™	š	›	œ		ž	Ÿ
A0		¡	¢	£	¤	¥	¦	§	¨	©	ª	«	¬	-	®	¯
B0	°	±	²	³	´	µ	¶	·	¸	¹	º	»	¼	½	¾	¿
C0	À	Á	Â	Ã	Ä	Å	Æ	Ç	È	É	Ê	Ë	Ì	Í	Î	Ï
D0	Ð	Ñ	Ò	Ó	Ô	Õ	Ö	×	Ø	Ù	Ú	Û	Ü	Ý	Þ	ß
E0	à	á	â	ã	ä	å	æ	ç	è	é	ê	ë	ì	í	î	ï
F0	ð	ñ	ò	ó	ô	õ	ö	÷	ø	ú	ù	û	ü	ý	þ	ÿ

Figure 10-4 Codepage 1252
(International code is set as USA)

Table 10-1 International Character Set

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	^	`	ä	ö	ü	ß
3	United Kingdom	£	$	@	[	\	]	^	`	{	¦	}	~
4	Denmark I	#	$	@	Æ	Ø	Å	^	`	æ	ø	å	~
5	Sweden	#	¤	É	Ä	Ö	Å	Ü	é	ä	ö	å	ü
6	Italy	#	$	@	°	\	é	^	ù	à	ò	è	ì
7	Spain	Pt	$	@	¡	Ñ	¿	^	`	¨	ñ	}	~
8	Japan	#	$	@	[	¥	]	^	`	{	¦	}	~
9	Norway	#	¤	É	Æ	Ø	Å	Ü	é	æ	ø	å	ü
10	Denmark II	#	$	É	Æ	Ø	Å	Ü	é	æ	ø	å	ü

10.2 2-BYTE CHARACTERS

The 1990 JIS first- and second- level Kanji can be printed with the CG ROM.
In addition, special characters are assigned to the Kanji code in non-Kanji character area.

```
        0 1 2 3 4 5 6 7 8 9 A B C D E F
2820    ─ │ ┌ ┐ ┘ └ ├ ┬ ┤ ┴ ┼ ━ ┃ ┏ ┓
2830    ┛ ┗ ┣ ┳ ┫ ┻ ╋ ┠ ┯ ┨ ┷ ┿ ┝ ┰ ┥ ┸
2840    ╂ ─ │ ┌ ┐ ┘ └ ├ ┬ ┤ ┴ ┼ ┆ ┆ ┆ ′
2850    ″ ‴ ： ⊕ ⊖ 干 ≃ ≲ ≳ ħ ℧ ⊗
2860
2870
```

```
        0 1 2 3 4 5 6 7 8 9 A B C D E F
2920      ` ° ' ' │ あ い う え お や ゆ よ っ わ
2930    ア イ ウ エ オ ヤ ユ ヨ ツ ワ カ ケ
2940    ‖ ∫ ＝ ─ ： ： ‖          ⌒ ⌣ ⌒ ⌐
2950    ⌒ ⌣ ∧ ∨ ⋀ ⋎ ⌐ └ ⌐ ⌐ ⌒ ⌐      │ ′
2960
2970
```

```
        0 1 2 3 4 5 6 7 8 9 A B C D E F
2020       I II III IV V VI VII VIII IX X ⅰ ⅱ ⅲ ⅳ ⅴ
2030    ⅵ ⅶ ⅷ ⅸ ⅹ 0 1 2 3 4 5 6 7 8 9 g
2040    m mm cm km cm² m² km² cm³ m³ mg kg cc dℓ ℓ kℓ ms
2050    μs ns ㎐ € Hz ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩
2060    Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ ㈹ ㈱ ㈰ ㈭ ㊞ ▦ ▦ ▨ ▦ ▨
2070    ▧ ▨ ▦ ▦ ▨ ▧ ▧ ▨ ▨ ▨ ▨ ▨ ▨ ▨
```

Figure 10-5 Special Character Set

APPENDIX A
COMMAND INDEX