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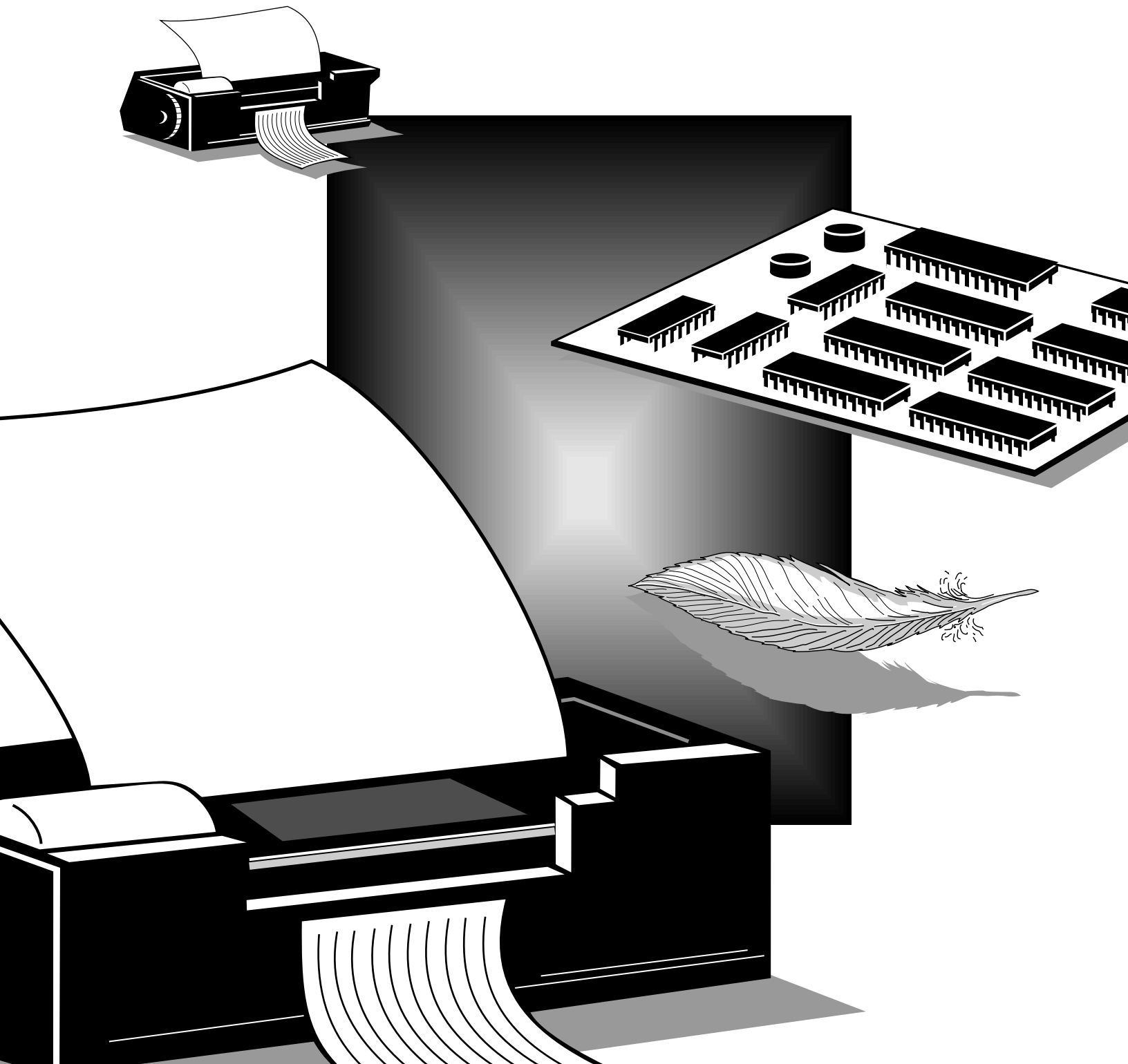
IFM001-01B/B-C/BM/BM-C

Technical Reference



SII
Seiko Instruments Inc.

IFM001-01B/IFM001-01BM
INTERFACE BOARD
TECHNICAL REFERENCE

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Seiko Instruments Inc.

IFM001-01B/IFM001-01BM TECHNICAL REFERENCE

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PREFACE

This reference manual describes the specifications, functions and operating procedures for the IFM001-01 interface board.
The IFM001-01 is an interface board for the MTP series microthermal printers. The following two models are prepared according to whether or not EEPROM is used.

- IFM001-01B: EEPROM is not used.
- IFM001-01BM: EEPROM is used.

In this reference manual, the IFM001-01 is used when referring to functions common to both. Either the IFM001-01B or the IFM001-01BM is used when referring to functions indigenous to each.
This manual also describes the print operation of this printer. Read this reference manual thoroughly before using the interface.

SII has not investigated the intellectual property rights of the sample circuits included in this manual. Fully investigate the intellectual property rights of these circuits before using.

TABLE OF CONTENTS

CHAPTER 5 OPERATION PRINCIPLES

CHAPTER 6 SETUP

CHAPTER 7 COMMAND DESCRIPTION

CHAPTER 8 CHARACTER CODES

CHAPTER 9 ELECTRICAL CHARACTERISTICS

APPENDIX A COMMAND INDEX

APPENDIX B DIMENSIONS AND BOARD AFTER MOUNTING

APPENDIX C CIRCUIT DIAGRAM AND PARTS LIST

TABLES

FIGURES

Figure Page

CHAPTER 1

OVERVIEW

1.1 FEATURES

The IFM001-01 is an interface board used with the MTP series printer for printing data sent from a host device. The IFM001-01 processes the data input from a host device and also outputs internal test patterns.
The IFM001-01:

- Supports all twelve models of the MTP series character and graphic printers.
- Has software modes compatible with those of earlier models (MTPI-CN, CC, GNP, GNS).
- Accepts both parallel and serial input.
- Provides double-width printing, character spacing control, and inverse printing.
- Provides various fonts including alphanumeric and Japanese *kana* characters, an extended graphics character set, international characters, and special characters.
- Can print all input data as bit image data.
- The IFM001-01BM can print downloaded characters.

1.2 PRECAUTIONS

1.2.1 Power Supply Precautions

- Use a power supply voltage within the range specified in general specifications.
- When switching the power supply ON, turn Vcc on followed by V_p within a second.
- When switching the power supply OFF, turn V_p off followed by Vcc within a second.
- When two power supplies are used, prepare a common ground for both power lines.
- When a common power line is used, take care that the deviation in the V_{cc} voltage does not exceed 5 ± 0.5 V.
- Use a power supply which provides stable voltage output even when the current fluctuates.
- The IFM001-01 incorporates a reset circuit to prevent malfunction of the circuit due to a reduction in Vcc voltage.

1.2.2 Connecting Precautions

- Be sure that terminals are not shorted.
- Be sure to turn the power off before you connect or disconnect any cables to or from the IFM001-01.
- Make the connecting cable (CN1) to the printer mechanism as thick and as short as possible.
- Make the connecting cable (CN3) to the host device as short as possible.
- When connecting to a power supply (CN2), use all power supply terminals (V_{cc}, V_p, and GND).

- Since the signal terminal of the connecting cable (CN2) to the host device is CMOS input / output, configure the connecting circuit so as not to cause latch-up: when a voltage of V_{cc} +0.3 V or more or GND-0.3 V or less is on the signal terminal, the IC is shorted by the flow of overcurrent in the IC.
  Latch-up will happen in the following cases:

  - The output signal voltage of the power supply on the host device side and V_{cc} are different.
  - The power-on of the IFM001-01 and the host device are not executed simultaneously.
  - GND impedance is high: the power cable is too long or too thin, or the number of the cables is too few.

  For the connection method in order to avoid latch-up, refer to Section 6.3, Connection to the Host Device and the Power Supply.

- The solder jumper (PSSW) must be connected or PS of CN2 fixed at low when the paper sensor function is not used under Mode 0 specifications.
- The solder jumper (DSR) must be connected or DSR of CN2 fixed at low when the DSR function is not used under serial communication setting.
- Do not connect the RSW solder jumper.

1.2.3 Handling Precautions

- Before using the IFM001-01, be sure to adjust the volume according to Section 5.4.2, Head Pulse Width Setting.
- Never modify the IFM001-01.
- Do not install the IFM001-01 in a location that is subject to intensive static electricity, high vibration, electromagnetic fields, corrosive gas, rain, fog, or direct sunlight.

1.3 TERMINOLOGY

- Dot
  A character or bit image is composed of picture elements called dots. A dot corresponds to one of the serial thermal head elements.

- Character spacing
  The space between two characters in the direction perpendicular to the paper feed direction.

- Input buffer
  The memory inside the interface for storing the data (characters and commands) received from the host device. The command is executed at the time when fetching from the input buffer. The characters are fetched from the input buffer and stored in the line buffer. The capacity of the input buffer is 120 bytes.

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

- Line buffer full print
  The printing executed when the data in the line buffer exceeds on line. The overflowing data is stored at the beginning of the next line.

- Font
  The form of a character. A character is composed of dots in a group. The user can define a font using a downloaded font, etc., if using the IFM001-01BM.

- EEPROM
  Non-volatile semiconductor memory (memory information is retained even if the power is turned off). Using this memory, you can write and erase electrically. CMOS type serial EEPROM is mounted on the IFM001-01BM.

CHAPTER 2

GENERAL SPECIFICATIONS

2.1 SPECIFICATIONS

2.1.1 Common Specifications

The common specifications of the IFM001-01 are listed in Table 2-1.

Table 2-1 Common Specifications

Item	Specifications
Print method	Thermal serial dot printing
Print direction	left to right in relation to the paper feed direction
Operating voltage range	V_{CC} 5.0 V ± 0.5 V V_P 5.0 V ± 1.0 V
Current consumption (I_{CC})	During standby mode 17.0 mA max. During standby 27.0 mA max. During printing 30.0 mA max.
Operating temperature range	32 °F to 122 °F (0 °C to 50 °C)
Storage temperature range	-4 °F to 140 °F (-20 °C to 60 °C)
Dimensions (W × D × H)	2.81 in. × 2.32 in. × 0.45 in. (71.5 mm × 59 mm × 11.5 mm)
Wight	0.04 lbs (Approximately 20 g)

The following command modes can be selected using SW3.

Mode 0: Contains the most functions. Downloaded characters can be used with the IFM001-01BM.
Mode 1: MTPI-GNP, GNS compatible mode
Mode 2: MTPI-CN, CC compatible mode

2.1.2 Mode 0 Specifications

The mode 0 specifications of the IFM001-01 are listed in Table 2-2.

Table 2-2 Mode 0 Specifications

Item	Specifications
Applicable mode	MTP series character and graphics printers, 12 models
Available character type	Alphanumeric and Japanese *kana* characters Extended graphics character set (default settings available through SW1-7.) Special characters International characters EEPROM downloaded characters (IFM001-01BM)
Font size	Character printer (7 × 6 dot matrix) Graphics printer (8 × 6 dot matrix)
Character spacing	Character printer (one dot space) Graphics printer (no space) Space is changeable according to the command.
Input/output control method	Centronics (STROBE, BUSY hand shaking) RS-232C (BUSY control, Xon/Xoff control)

2.1.3 Mode 1 Specifications

The mode 1 specifications of the IFM001-01 are listed in Table 2-3.

Table 2-3 Mode 1 Specifications

Item	Specifications
Applicable mode	MTP series character and graphics printers, 12 models
Available character type	Alphanumeric and Japanese *kana* characters Special characters International characters
Font size	Character printer (7 × 6 dot matrix) Graphics printer (8 × 6 dot matrix)
Character spacing	Character printer (one dot space) Graphics printer (no space)
Input/output control method	Centronics (STROBE, BUSY hand shaking) RS-232C (BUSY control)

2.1.4 Mode 2 Specifications

The mode 2 specifications of the IFM001-01 are listed in Table 2-4.

Table 2-4 Mode 2 Specifications

Item	Specifications
Applicable mode	MTP series character printers, 6 models
Available character type	Alphanumeric and Japanese *kana* characters
Font size	Character printer (7 × 5 dot matrix)
Character spacing	Character printer (two dot space)
Input/output control method	Centronics (STROBE, BUSY hand shaking)

2.2 THERMAL PAPER

Use the recommended thermal paper as in Table 2-5.

Table 2-5 Recommended Thermal Paper

Maker	Normal thermal paper	High-sensitivity thermal paper
Nippon Paper Industries	TP50KS-A	TP50KS-E2C
Honshu Paper Co., Ltd.	FH65BX-14N	FH65BU-2
Mitsubishi Paper Co., Ltd.	F-200U7N5	F-200U9W3

* High-sensitivity thermal paper reacts with less applied energy than with normal paper. For a more detailed explanation refer to section 5.4.2, Head Pulse Width Setting.

CHAPTER 3

PIN DESCRIPTION

The IFM001-01, the MTP series, and the host device are connected using two connectors.
In the tables for each terminal, negative logic signals have ! at the beginning of the signal name.
Input/output directions as viewed from the IFM001-01 are indicated by the following.

I: Input
O: Output

3.1 PRINTER MECHANISM CONNECTING TERMINAL BLOCK

CN1 connects to the printer mechanism and has 16 pins.
Connector used: A1-16PA-2.54DSA (Hirose).

Table 3-1 CN1 Terminal Assignments

Pin No.	Signal Name	I/O	Function
1	M+	—	V_P (Motor common power)
2	M -	O	Motor drive output
3	TG	I	Tachogenerator signal
4	TGGND	—	GND
5	HP	I	Home position signal
6	HPGND	—	GND
7	HDADA1	O	Head data 1
8	HDADA2	O	Head data 2
9	HDADA3	O	Head data 3
10	HDADA4	O	Head data 4
11	HDADA5	O	Head data 5
12	HDADA6	O	Head data 6
13	HDADA7	O	Head data 7
14	HDADA8	O	Head data 8
15	HCOM	—	V_P (Head common power)
16	HCOM	—	V_P (Head common power)

3.2 HOST DEVICE CONNECTING TERMINAL BLOCK

CN2 carries the following signals:

- V_{CC} and V_P power supplies, GND
- Parallel input/output terminal
- Serial input/output terminal
- Error output terminal
- Feed, software standby mode release, reset input terminal
- Paper sensor input terminal

Connector used: A3B-28PA-2DSA (Hirose)

Table 3-2 CN2 Terminal Assignments

Pin No.	Signal Name	I/O	Function
1	V_{CC}	I	Logic power (5 V)
2	V_P	I	Printer mechanism power (5 V)
3	V_P	I	Printer mechanism power (5 V)
4	V_P	I	Printer mechanism power (5 V)
5	GND	—	GND
6	GND	—	GND
7	!STROBE	I	Parallel strobe
8	DATA0	I	Parallel data 0
9	DATA1	I	Parallel data 1
10	DATA2	I	Parallel data 2
11	DATA3	I	Parallel data 3
12	DATA4	I	Parallel data 4
13	DATA5	I	Parallel data 5
14	DATA6	I	Parallel data 6
15	DATA7	I	Parallel data 7
16	!ACK	O	Parallel acknowledge
17	PBUSY	O	Parallel busy
18	PE	O	Paper end
19	!ERROR	O	Error
20	GND	—	GND
21	!FEED	I	Feed
22	!SSBY	I	Software standby mode release
23	PS	I	Paper sensor
24	!INIT	I	Reset
25	TxD	O	Serial transmission data
26	RxD	I	Serial reception data
27	DSR	I	Interface use enable/disable
28	SBUSY	O	Serial busy

CHAPTER 4

BASIC OPERATION

4.1 BASIC STRUCTURE

The IFM001-01 consists of a single circuit board. The circuit block diagram for the IFM001-01B is shown in Figure 4-1.

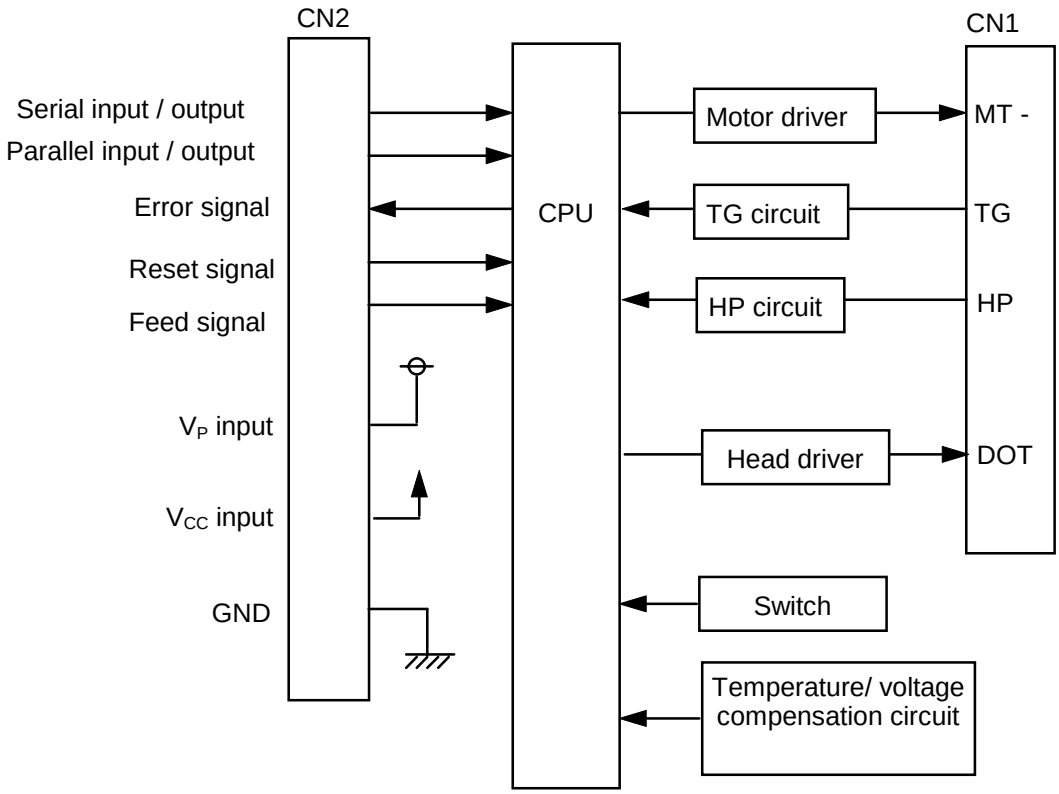


Figure 4-1 IFM001-01B Circuit Block Diagram

The data processing block consists of a CPU. It also includes a function pin, a reset circuit, a motor control circuit, a tachogenerator circuit, a home switch circuit, and a temperature/voltage compensation circuit.
EEPROM is connected to the IFM001-01BM.

4.2 BASIC PRINT OPERATION

4.2.1 Initialization

The CPU is initialized following power-on reset release and following reset release using !INIT and also following hardware reset release. During initialization, the following operations are conducted:

(1) Each port and register initialized

(2) RAM cleared

(3) Function pin setting (see Section 6.1) read

(4) IFM001-01BM: font and character spacing set to EEPROM.
IFM001-01B: font and character spacing are set according to SW1.

(5) Mechanism initialized
① If the thermal print head is not already in the home position when initialization is executed, it is returned to the home position.
② One line of paper is fed if the setting is set accordingly. SW1 pin 8 can be used to determine whether or not paper is fed.

(6) Test printing (if !FEED is low)

4.2.2 Operation Timing Immediately Following Initializaion

The operation timing immediately following reset is given in Figure 4-2. However, the timing given in Figure 4-2 is for when none of the following conditions exist. The time needed for initialization immediately following reset varies according to which of the following conditions exists.

- Test printing is executed.
- The thermal print head is not in the home position.
- An error has occured.
- There is no paper.
- DSR is high when using serial input.

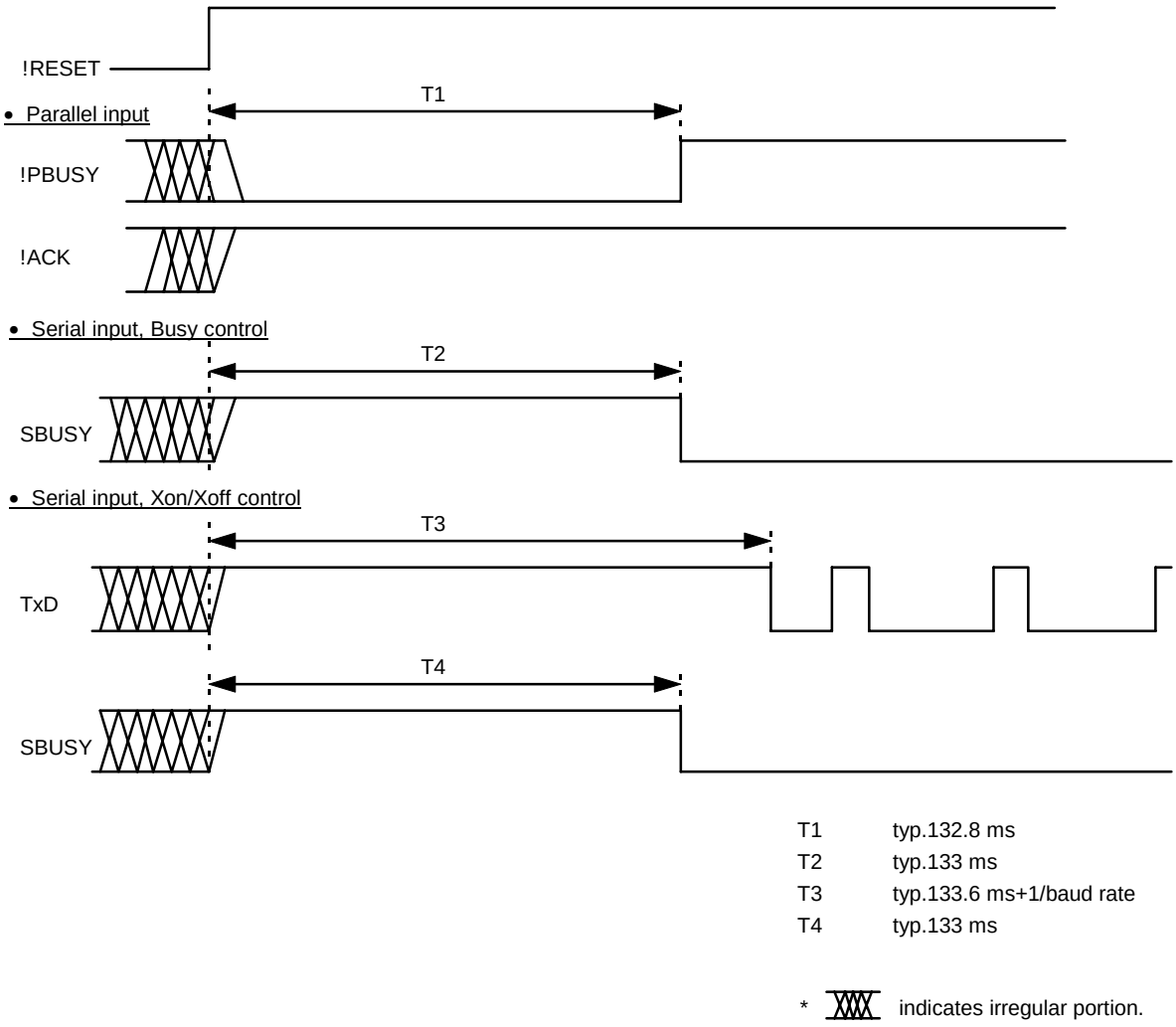


FIgure 4-2 Operation Timing Immediately Following Reset

NOTE

- In parallel input, the low pulse of !ACK is not output following reset release.
- During initialization immediately following reset, !ERROR does not go low.

4.2.3 Basic Operation for Printing One Line

(1) The data sent from the host device is stored in the input buffer.
Since the storage to the input buffer is processed using interrupts, it is possible to receive data during printing.

(2) The data is read from the input buffer.
If it is character data, step (3) is executed .
If it is not character data but a command, the function specified by the command is executed.

(3) The character data is stored in the line buffer.
When the character data exceeds one line or contains the print command, printing starts.

(4) The character codes of the line buffer are changed into the image data of a dot line.

(5) The image data is transferred to the print head.

(6) The motor and the print head are driven.

(7) The IFM001-01 feeds one line of paper and returns to step (2).

4.2.4 Reset by External Signal

!INIT (CN2-24) goes low, all processing in progress is terminated, and the printer enters ready-reset status.

Initialization occurs when !INIT goes from low to high.

For the input voltage to !INIT, see Table 9-3.

CHAPTER 5

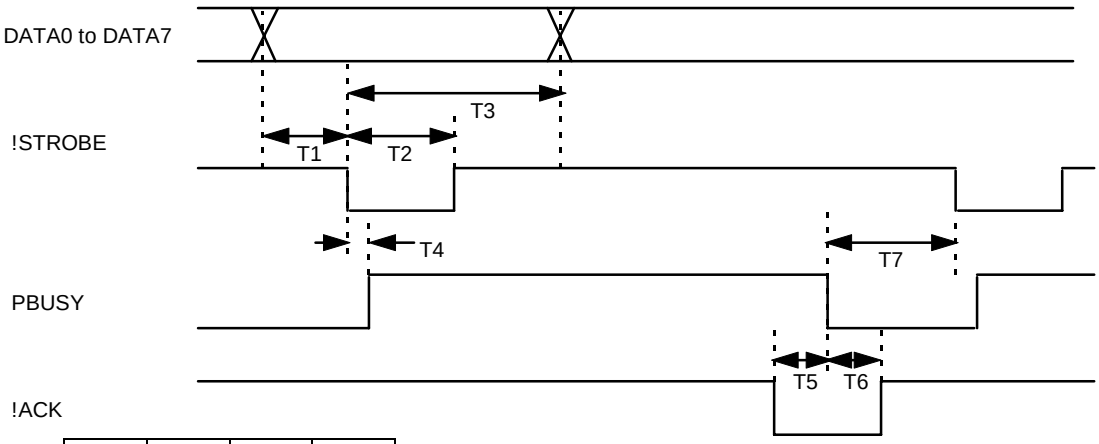
OPERATION PRINCIPLES

5.1 DATA INPUT/OUTPUT

5.1.1 Parallel Input/Output

(1) Timing for input/output parallel data

Data input/output between the host device and the IFM001-01 is controlled as shown in Figure 5-1. The CPU receives parallel data using 8-bit parallel handshake method. Data reception can be executed during printing. PBUSY and !ACK are output every byte. The busy status continues as long as the number of bytes of data stored in the input buffer exceeds 120.



	MIN	MAX	UNIT
T1	0.5	—	µs
T2	0.5	—	µs
T3	0.5	—	µs
T4	—	0.5	µs
T5	3.25	3.26	µs
T6	3.25	3.26	µs
T7	0	—	ns

T1: Data setup time for !STROBE.
T2: !STROBE pulse width.
T3: Data hold time for trailing edge of !STROBE.
T4: Time between trailing edge of !STROBE and point at which PBUSY becomes high.
T5: Time between trailing edge of !ACK and leading edge of PBUSY.
T6: Time between leading edge of PBUSY and leading edge of !ACK.
T7: Time from leading edge of PBUSY during which next !STROBE can be input.

Figure 5-1 Parallel Data Input/Output Timing

(2) Parallel input/output port

① Parallel strobe
!STROBE (CN2-7): Input

- Strobe signal for reading data.
- Data is read at the transition of this signal to low.
- This signal is ignored when PBUSY is high.

② Parallel data n
DATAn (CN2-8 through CN2-15): Input

- 8-bit parallel data signal.
- The data is read by !STROBE.
- High is 1 and Low is 0.

③ Parallel busy
PBUSY (CN2-17): Output

- BUSY indicates that data can be input.
- When PBUSY is low, data can be input.
- This signal remains high until the input processing of one byte of data is complete.
- This signal goes to high if an error occurs.
- This signal is high when serial input/output is selected.

④ Parallel acknowledge
!ACK (CN2-16): Output

- !ACK indicates that data reception is complete.
- !ACK is normally high. A low pulse is generated when one-byte of data has been input.
- Further data can be input after !ACK has been output.
- This signal is high when serial input/output is selected.

5.1.2 Serial Input/Output

(1) Timing for receiving serial data

The data input/output between the computer and the IFM001-01 is controlled as shown in Figure 5-2. The input and output of serial data is performed using asynchronous serial communication.
The IFM001-01 continues to receive data during printing.

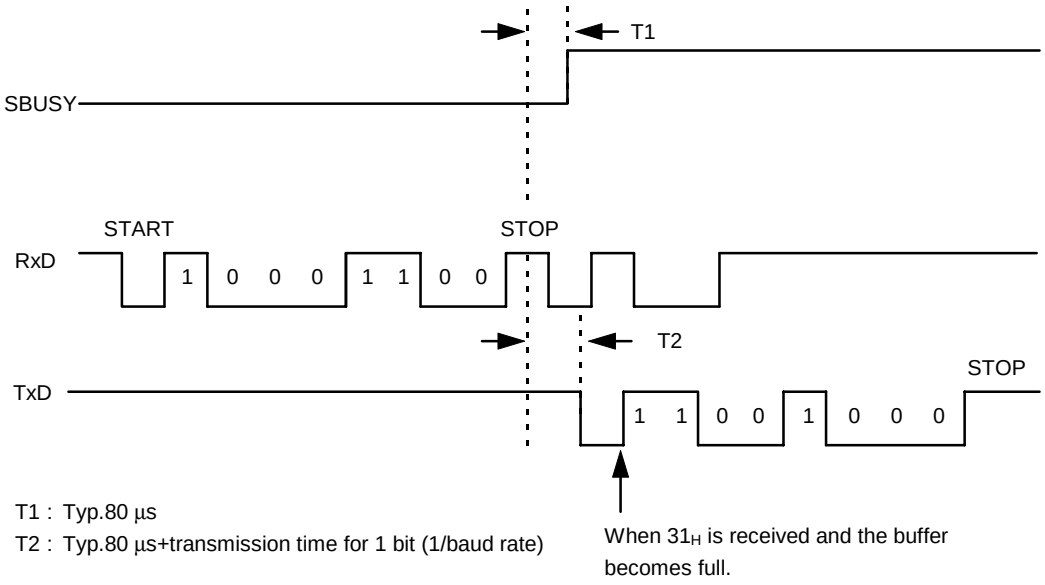


Figure 5-2 Serial Data Input/Output Timing

(2) Serial input/output port

Serial input/output signals (SBUSY, TxD, RxD, and DSR) of the IFM001-01 are sent and received at the TTL level. A level conversion circuit is required when using with an RS-232C. For a sample level conversion circuit, see Figure 6-3.

① Serial busy
SBUSY (CN2-28) : output

- Indicates whether or not data can be received.
- When SBUSY is low, data can be input.
- When Xon/Xoff control is selected, SBUSY is always low.

② Serial transmission data
TxD (CN2-25) : output

- When Xon/Xoff control is selected, Xon/Xoff is output.
- Data is output according to the transmission conditions which are set by the function pins.
- Always high when BUSY control has been selected.

③ Serial reception data
RxD (CN2-26) : input

- Data input port
- Data is input according to the transmission conditions which are set by the function pins.

④ I/F use
DSR (CN2-27) : input

- This signal determines whether or not the interface board will be used.
- If low is input, reception is possible.
  If high is input, neither reception or feed input is possible.
  This pin should ordinarily be fixed at low.
  Can be fixed at low by using DSR switch of the solder jumper.

(3) Setting the transmission conditions

The IFM001-01 can set the serial input/output transmission conditions using the function pin (SW2). However, stop bit length are fixed at 1 bit and can not be changed.
For the setting method for the transmission conditions, see Section 6.1.4.

(4) Error processing when receiving

The IFM001-01 receives and checks serial data according to the transmission conditions.
When the IFM001-01 has received one byte of data without errors, the data is stored in the input buffer. If there are any errors, the following data is stored in the input buffer according to the type of error.

	Error type	Error code
①	Parity error	'!': 21_{16}
②	Framing error	'?': $3F_{16}$

If the input data cannot be printed correctly and instead "!" or "?" is printed, the transmission conditions between the host device and the IFM001-01 most likely does not match.

5.2 MOTOR DRIVE AND PRINTING

5.2.1 Motor Terminal

① Motor drive output
M- (CN1-2) : output

- Outputs the signal that drives the motor.

② Tachogenerator signal input
TG (CN1-3) : input

- Inputs the tachogenerator signal. The tachogenerator signal is the output from a signal output device directly coupled to the motor. Two cycles of simulated sine wave are generated for each revolution of the motor.

③ Home position signal input
HP (CN1-5) : input

- The printer's home position status is detected from the home position terminal (HP). If the home position signal is off, the print head is in the home position. If the home position signal is on, the print head is not in the home position.

- Synchronization with print start is obtained by detection of the home switch changing from high to low.

5.2.2 Motor Drive Operation

Motor drive and printing are conducted according to the following procedures.

(1) The motor comes on when the print conditions given in Section 5.3 have been met during data input standby.

(2) When home switch ON is detected, the first dot line of the first character or bit image data is printed in synchronization with the first leading edge of the tachogenerator's print timing signal.
Home position is detected every 1 ms. ON is judged to have been detected after it is detected four times.

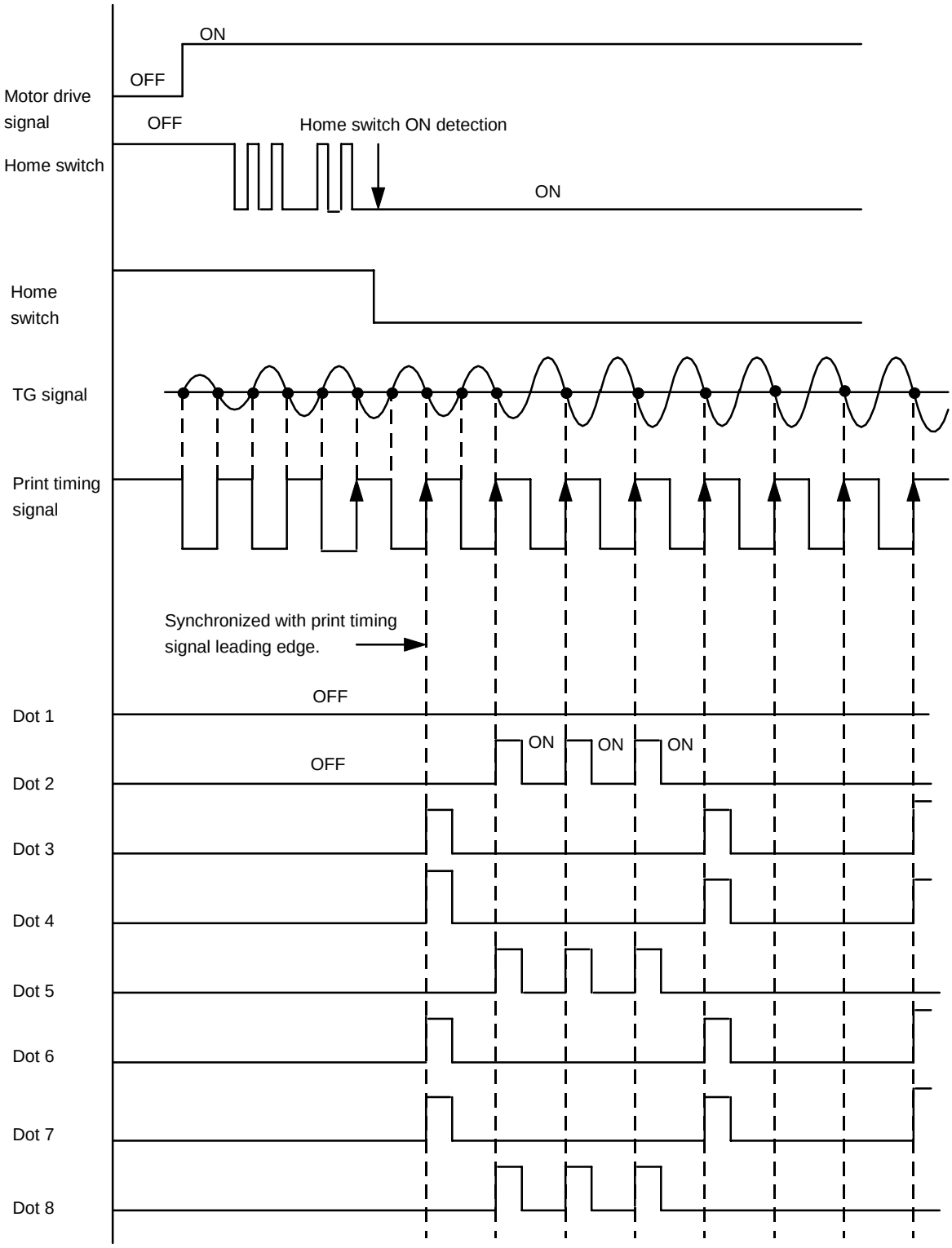
(3) Printing is carried out in synchronization with the leading edge of the signal from the tachogenerator.

(4) Printing ends and paper is fed mechanically.

(5) If print conditions have not been met by the time the print head comes near the home position, the motor stops at the home position.
If the motor stops, set the home position (print start position determination) again.

(6) If print conditions have been met by the time the print head comes near the home position, the motor does not stop but continues printing.
Once the home position has been set to the start of printing, the print position is determined according to the tachogenerator count, making it unnecessary to set the home position again until the motor stops.
During continuous printing, the tachogenerator count is initialized each time the count has completed one full cycle (see N in Tables 6-3 and 6-4).

A print start timing and character print timing chart is given in Figure 5-3.



Example of printing the number “8”. The character generator has an 8×6 configuration. Dots 2 through 8 are used with a character printer.

Figure 5-3 Print Start Timing and Character Print Timing Chart

The continuous printing timing chart is given in Figure 5-4.

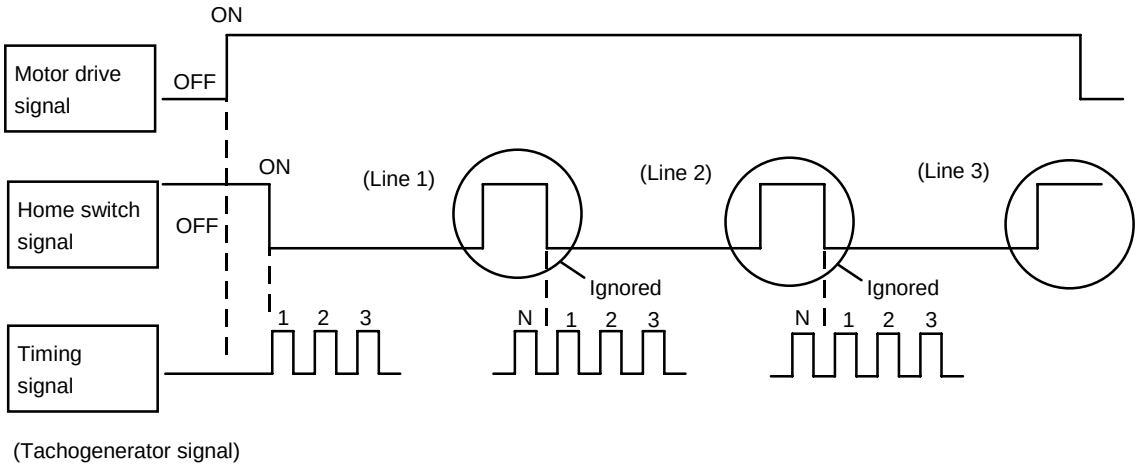


Figure 5-4 Continuous Printing Timing Chart

5.3 PRINT CONDITIONS

The IFM001-01 starts printing of one line under any of the following conditions:

(1) When a CR code is processed within the CPU, the data in the line buffer is printed.

(2) When a LF code is processed within the CPU, the data in the line buffer is printed. (Excluding Mode 2.)

(3) When the line buffer becomes full, printing is executed.
Conditions for printing when the line buffer becomes full differ according to the mode as indicated below.

<Mode 0>

① When printing normal characters:
If the total dot count of the data in the line buffer is greater than (right margin dot count - 6) dots, and character data is input to the line buffer, printing is executed.

② When printing characters in the double-width mode:
If the total dot count of the data in the line buffer is greater than (right margin dot count - 12) dots, and character data is input to the line buffer, printing is executed.

Printing is also executed when the line buffer becomes full in the hard graphic mode.

<Mode 1>
Character printer: X=7
Graphic printer: X=6

① When printing normal characters:
If the total dot count of the data in the line buffer is greater than (maximum dot count - X) dots, and the CPU enters the bit image mode or character data is input to the line buffer, printing is executed.

② When the last character in a line is in the double-width mode or when the double-width mode is used immediately preceeding the line:
If the total dot count of the data in the line buffer is greater than (maximum dot count - 2X) dots, and the CPU enters the bit image mode or character data is input to the line buffer, printing is executed.

Printing is also executed when the line buffer becomes full in the bit image mode.

<Mode 2>

If the number of places in the character data in the line buffer is at the maximum amount, and character data is input to the line buffer, printing is executed.

5.4 THERMAL PRINT HEAD DRIVE

5.4.1 Control Method

Head data
HDATA1 through HDATA8 (CN1-7 through CN1-14) : output
- The head signal is output from the head data terminal (HDATA1 to HDATA8).

Thermal print head activation is performed through historical control based on the temperature voltage compensation oscillation circuit pulse which is input from the head pulse width clock input pin.
A 20-pulse count is used for dots for which the previous dot was not driven, and a 16-pulse count for dots for which the previous dot was driven. For a 16-pulse count, drive is not conducted for the first four pulses of the 20-pulse count. Drive begins immediately after the fourth pulse.

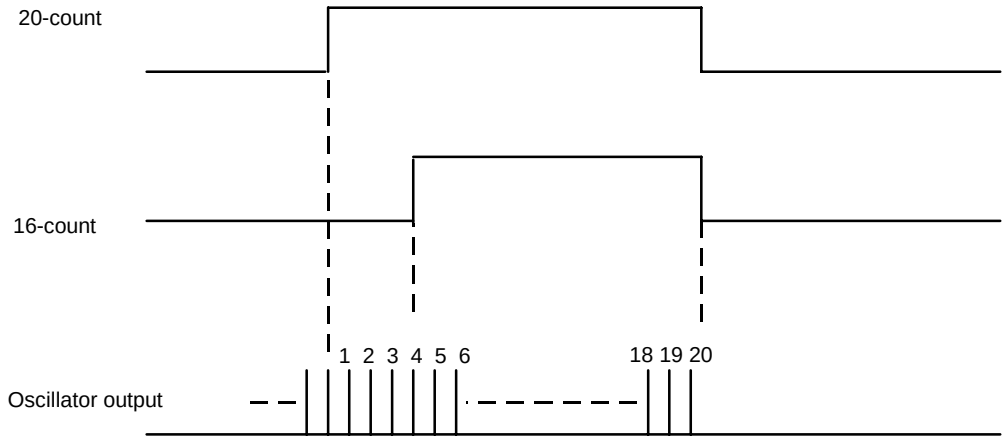


Figure 5-5 Thermal Print Head Pulse Width and Oscillator Output

NOTE

If a tachogenerator signal is received before the twenty pulses end, thermal print head excitation is terminated, any remaining print for the current line is ignored, and printing resumes from the next line. Be aware that an error signal is not output in this situation.

If this problem occurs, the following are possible causes:
- Head pulse width increased due to abnormally low temperature or low voltage.
- Noise was included with the tachogenerator signal.

5.4.2 Head Pulse Width Setting

- Head Pulse Width adjustment

Before printing from the printer to which the IFM001-01 has been connected, the head pulse width of the IFM001-01 must be adjusted with the VR1 variable resistor.
The oscillation circuit output frequency to adjust varies depending on the mechanism type (character or graphic printer), the head resistance rank (A, B, or C), and the thermal paper type (high sensitivity or normal).
Adjust the oscillation circuit output frequency to the value listed in Table 5-1, with Vcc=5V and and the temperature=24 °C.
The IFM001-01 can be adjusted the the oscillation circuit output frequency to the value listed in Table 5-1 by turining the VR1 variable resistor using a phillips screw driver while measuring the output waveform frequency of TP2 using an oscilloscope or frequency counter. (Refer to Figure 6-1, Position of Function Switch, for the positions of the TP2 and VR1.)
Adjust the volume appropriately within the range listed in Table 5-1 according to the print output, because the oscillation circuit output frequency in each resistance rank is uneven.
While printing, do not adjust the head pulse width.
If excessive energy is applied to the thermal head, the head may be damaged.

Table 5-1 Oscillation Circuit Output Frequency Adjustment
(Vp=5 V, T=24°C, VCE (SAT)=0.2 V)

Resistance Rank		**A**	**B**	**C**
High sensitivity thermal paper	Character printer	12.8 ± 0.9kHz	14.0 ± 1.1kHz	15.5 ± 1.3kHz
	Graphic printer	11.2 ± 0.7kHz	12.3 ± 0.8kHz	13.6 ± 1.0kHz
Normal thermal paper	Character printer	11.8 ± 0.8kHz	12.9 ± 1.0kHz	14.2 ± 1.2kHz
	Graphic printer	10.3 ± 0.6kHz	11.3 ± 0.8kHz	12.5 ± 0.9kHz

- Temperature Voltage Compensation Characteristic

The temperature voltage compensation oscillation circuit makes the oscillation circuit output frequency change to maintain that constant energy is applied to the print head despite changes in temperature or voltage. Through the counting of this output pulse, the printer is able to maintain stable print quality regardless of changes in temperature and voltage.

Temperature compensation range: 0 °C to 40 °C
Voltage compensation range: 4.0 V to 6.0 V

The temperature voltage compensation oscillation circuit outputs the frequency for the V voltage and T temperature using the following compensation formulas.

Applied energy compensation

$$E = \frac{V_0+V}{2V} E_0 \left(1+ \frac{T_0 - T}{100}\right)$$

Head pulse width calculation

$$t = \frac{R \times E}{V^2}$$

Oscillation circuit output frequency

$$f = \frac{20}{t}$$

E0: Rated energy (mJ) (See Table 5-2.)
E: Applied energy (mJ)
V0: Rated voltage (5.0 V)
V: FPC terminal voltage (V) (Vp minus head driver V_{CE} (sat))
T0: Room temperature (24 °C)
T: Operation temperature (°C)
t: Pulse width (ms) for rated energy application
R: Head resistance (Ω)
f: Frequency (kHz) of pulse output from oscillator

Table 5-2 Energy Applied to Thermal Print Head

(Environmental temperature: 24°C)

Thermal print head applied voltage (V)		4.0 V	5.0 V	6.0 V
Rated applied	High sensitivity paper	2.59	2.30	2.11
energy (mJ)	Normal paper	2.81	2.50	2.29
Maximum applied energy (mJ)		3.37	3.00	2.75

Table 5-3 Head Resistance Ranking

Rank	A	B	C
Character printer	15.3 ± 1 Ω	14.0 ± 1 Ω	12.7 ± 1 Ω
Graphic printer	17.6 ± 1 Ω	16.0 ± 1 Ω	14.4 ± 1 Ω

- There is a ± 5% dispersion in resistance between dots on the same print head. Ranking is made according to average values.
- The rank is indicated on the FPC.

5.5 PAPER DETECTION

The IFM001-01 checks for paper when Mode 0 is selected.

① Paper sensor input
PS (CN2-23) : input

- If PS is high, there is no paper. If PS is low, there is paper.
- Detected during data input standby, and after completion of one line of printing (after exceeding the print area).
- If there is no paper, data input is prohibited after the first data input.
- Even if there is no paper when the !FEED pin goes low, it feeds one line.
- DSR is also detected when there is no paper.
- If the IFM001-01 does not detect any paper immediately following reset, it will wait until after it detects paper to return the print head to the home position and to feed one line of paper.

② Paper end output signal
PE (CN2-18) : output

- If the PE output terminal is high, there is no paper. If the PE output terminal is low, there is paper.
- There is no error signal output when there is no paper.

5.6 ERROR

5.6.1 Error Terminal

!ERROR (CN2-19) : output

- !ERROR is normally high. It goes to low when an error occurs.

5.6.2 Error Conditions

(1) The home switch is off for too long.

<Causes>
- The function pins are set to a different type of mechanism than that which is connected.
- The home switch is damaged.

(2) Motor tachogenerator signal spacing exceeds the specified values.

Specified value

Motor startup: 1 second
Motor drive: 100 ms

<Causes>
- A paper jam occured.
- Vp power is not on.

(3) A ± 10 tachogenerator count shift from the set tachogenerator position has occured during continuous printing.

<Causes>
- The function pins are set to a different type of mechanism than that which is connected.
- The tachogenerator signal includes noise.

5.6.3 Error Processing

The following processing is performed when an error occurs.

(1) All printer output (M-, HDATA1 through HDATA8) goes off.
(2) !ERROR goes low.
(3) Data input is prohibited.

5.6.4 Error Status Elimination

To eliminate the error status, remove the cause of the error, then set !INIT to low or turn the power off then on again (power-on reset).

5.7 SOFTWARE STANDBY MODE

The software standby mode can be entered using the DC2+"stp" command in mode 0.
After transition to the software standby mode, TP1 output (ϕ) becomes high.

Software standby mode release
!SSBY (CN2-22) : input

- To release the software standby mode, set !SSBY to low in the software standby mode.
  See Section 7.2.2 for details.

(1) If the DC2+"stp" code is processed internally while the motor is driven, driving of the motor is completed and transition is made to software standby mode after T1 has elapsed. T1 is typically 106.5 ms.

The timing of transition to the software standby mode is given in Figure 5-6.

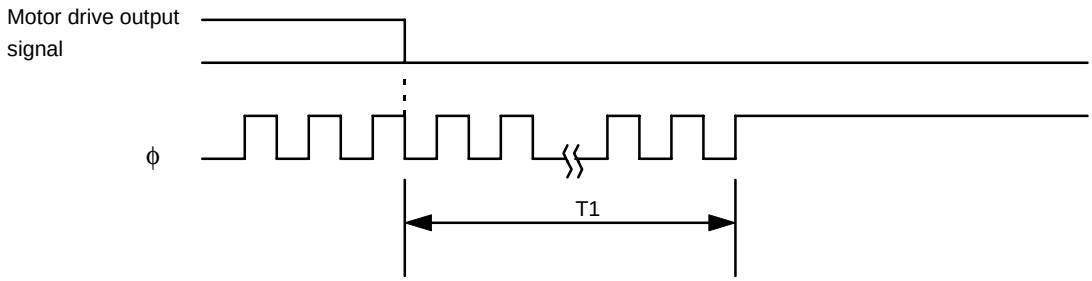


Figure 5-6 Software Standby Mode Transition Timing

(2) Processing is restarted after T2 has elapsed following the trailing edge of each release signal. T2 is typically 26.0 ms.

The timing of return from the software standby mode is given in Figure 5-7.

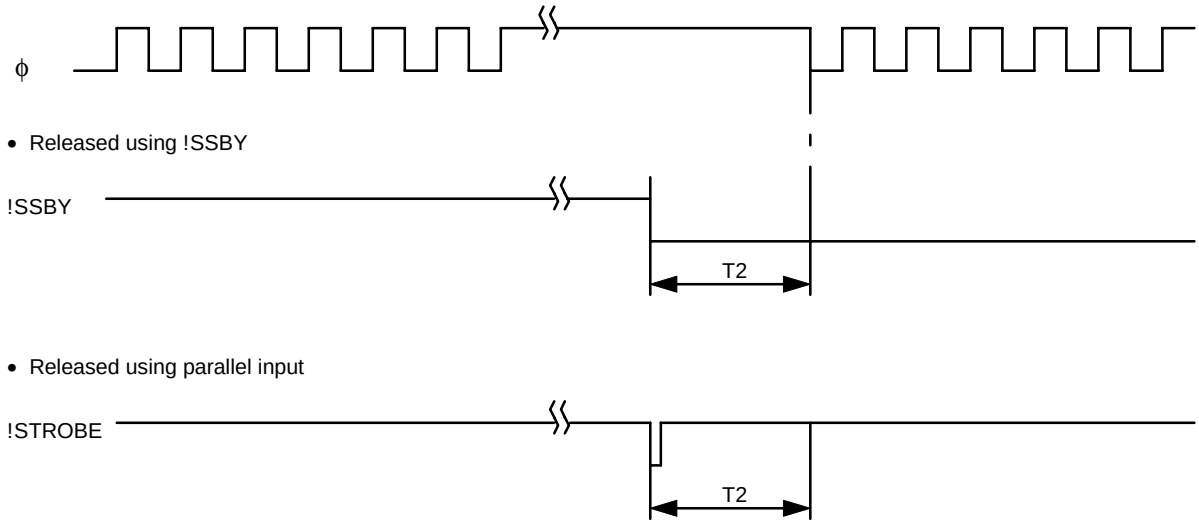


Figure 5-7 Software Standby Mode Return Timing

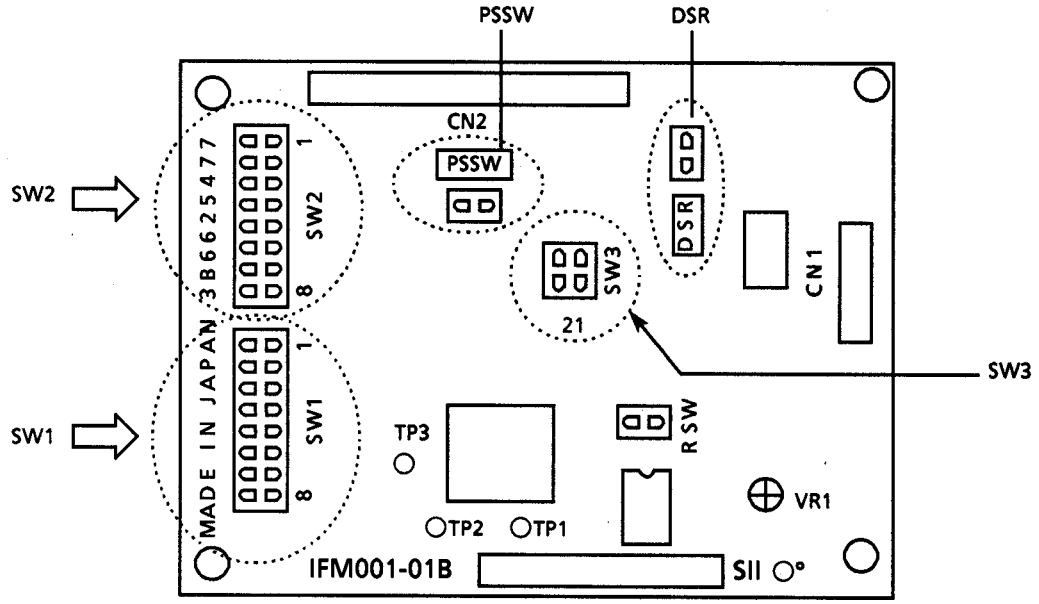
CHAPTER 6

SETUP

This section describes how to set up the IFM001-01.
Always turn the power off when setting up the IFM001-01.

6.1 SETTING FUNCTION SWITCHES

The position of the function switches on the IFM001-01 is shown in Figure 6-1.



Recommended header for SW1 and SW2 : DIC152-16P (Honda Tsushin)
Recommended short-circuit plug for SW1 and SW2 : DIC-128 (Honda Tsushin)

Figure 6-1 Position of Function Switches on the IFM001-01

NOTE

The solder jumper of PSSW and DSR must be on or PS and DSR of CN2 fixed at low when not used.
The solder jumper of RSW must be always off.
Before using, adjust the energy using the VR1.

It is necessary to either connect jumpers, or to mount the header connector on the IFM001-01. When shipped, all of the jumpers on the soldered side of the board are open. The short-circuit status of the header connector or the jumpers indicates “ON” and the open status indicates “OFF”. The function switches are read at initialization just after power-on or resetting. When changing the setting, turn the power from off to on.

The IFM001-01 has 18 function switches (hereinafter called “SW”). The functions are given in Table 6-1.

Table 6-1 Function Pin Assignment

Pin	Function
SW1 pins 1 through 4	Mechanism type selection
SW1 pins 5 through 8	Initial function selection
SW2 pins 1 through 8	Communication function selection
SW3 pins 1 and 2	Command mode selection

6.1.1 Command Mode Selection

SW3 is used to select the command mode.
When making the selection, be aware that the availability of SW1 and SW2 depends on the command mode.
When the switch is unavailable, it is considered OFF, but it should be set to OFF regardless of its actual position.

Table 6-2 Command Mode Selection

Command mode	SW3-1	SW3-2	Valid/Invalid
Mode 0	OFF	OFF	All pins are valid.
Mode 1 (MTPI-GNP, GNS compatible mode)	ON	OFF	SW1 pins 7 and 8 and SW2 pin 8 are invalid.
Mode 2 (MTPI-CN, CC compatible mode)	ON	ON	SW1 pins 1, 2, and 3 are valid. All other pins are in**v**a**l**id.
Prohibit Mode	OFF	ON	**NEVER USE THIS MODE**

NOTE

Always select Mode 0 when using the IFM001-01BM.

6.1.2 Mechanism Type Selection

SW1 pins 1 through 4 are used to select the mechanism type.

Table 6-3 Mechanism Type Selection (Character Printer)

MTP type	Dots	Digits	* N	SW1-1	SW1-2	SW1-3	SW1-4
MTP102-13B	91	13	160	OFF	OFF	OFF	OFF
MTP102-16B	112	16	200	ON	OFF	OFF	OFF
MTP102-18A-K	126	18	240	OFF	ON	OFF	OFF
MTP201-20B	140	20	230	ON	ON	OFF	OFF
MTP201-24B	168	24	276	OFF	OFF	ON	OFF
MTP401-40B	280	40	450	ON	OFF	ON	OFF

* The total number of TG pulses in one round trip of the print head.

NOTE

- The number of digits is calculated at one dot space.
- If SW1 pin 4 is off and the settings for the other pins differ from those indicated above, MTP401-40B will be selected. However, you should always use the settings given in Table 6-3 to select MTP401-40B.

Table 6-4 Mechanism Type Selection (Graphic Printer)

MTP type	Dots	Digits	* N	SW1-1	SW1-2	SW1-3	SW1-4
MTP201-G128	128	21	276	OFF	OFF	OFF	ON
MTP201-G128-B	138	23	230	ON	OFF	OFF	ON
MTP201-G166	166	27	276	OFF	ON	OFF	ON
MTP401-G192	192	32	360	ON	ON	OFF	ON
MTP401-G256	256	42	450	OFF	OFF	ON	ON
MTP401-G280	280	46	450	ON	OFF	ON	ON

* The total number of TG pulses in one round trip of the print head.

NOTE

- The number of digits is calculated at no space.
- If SW1 pin 4 is on and the settings for the other pins differ from those indicated above, MTP401-G280 will be selected. However, you should always use the settings given in Table 6-4 to select MTP401-G280.

6.1.3 Initial Function Selection

SW1 pins 5 through 8 are used to select the initial functions.
Always set SW1 pin 7 to off when SW1 pin 5 is set to the hard graphic mode.

Table 6-5 Initial Function Selection

Pin No.	Function	Low	High
SW1-5	Graphic mode	Hard	Soft
SW1-6	Inverse printing selection	Inverse printing	Normal printing
SW1-7	Character type selection	Extended graphics character set	Alphanumeric and Japanese *kana* characters
SW1-8	Initial paper feed	No paper feed	One line paper feed

NOTE

If the hard graphic mode is selected:

- All received data is printed as bit image data.
- Printing is executed only when the line buffer becomes full. All the function codes (for example, CR, LF) are processed as bit image data.
- The LSB (the lowest bit) of image data is the uppermost first dot. Please refer to section 8.1.2, Font Structure 2.

6.1.4 Communication Function Selection

Communication functions are selected using SW2 pins 1 through 8.
If pin 1 is set to parallel, pins 2 through 8 are ignored. However, you should set pins 1 through 8 all to off.
If pin 5 is set to no parity, be sure to set pin 6 to off.

Table 6-6 Communication Function Selection

Pin No.	Function	Low	High
SW2-1	Communication method	Serial	Parallel
SW2-2 to 4	Baud rate	See Table 6-7.	
SW2-5	Parity (yes/no)	No	Yes
SW2-6	Parity (odd/even)	Odd	Even
SW2-7	Serial data bit length	7 bits	8 bits
SW2-8	Serial data control	Xon/Xoff	BUSY

Table 6-7 Baud Rate Selection

Note: Baud rates differ between Mode 0 and Mode 1.

Mode 0	Mode 1	SW2-2	SW2-3	SW2-4
150 bps	75 bps	OFF	OFF	OFF
300 bps	150 bps	ON	OFF	OFF
600 bps	300 bps	OFF	ON	OFF
1200 bps	600 bps	ON	ON	OFF
2400 bps	1200 bps	OFF	OFF	ON
4800 bps	2400 bps	ON	OFF	ON
9600 bps	4800 bps	OFF	ON	ON
19200 bps	9600 bps	ON	ON	ON

6.2 CONNECTING TO THE PRINTER MECHANISM

The IFM001-01 connects to the printer mechanism through CN1.
Table 6-8 shows CN1 and the corresponding connectors of the printer mechanism.
Since the print head of the printer mechanism is connected by a flexible cable, connect the printer mechanism to the IFM001-01 via a printed circuit board mounted the flexible connector between them.
For the board connection, refer to Section 6.6, Board Connection Sample.

Table 6-8 CN1 and Corresponding Connector of Printer Mechanism

CN1Terminal No.	CN1 Terminal Name	Input/Output Direction	Printer Mechanism Connector*
1	M+		M+
2	M-	→	M-
3	TG	←	TG
4	TGGND		COM
5	HP	←	HM
6	HPGND		COM
7	HDATA1	→	(1)DOT1 (2)NC
8	HDATA2	→	(1)DOT2 (2)DOT1
9	HDATA3	→	(1)DOT3 (2)DOT2
10	HDATA4	→	(1)DOT4 (2)DOT3
11	HDATA5	→	(1)DOT5 (2)DOT4
12	HDATA6	→	(1)DOT6 (2)DOT5
13	HDATA7	→	(1)DOT7 (2)DOT6
14	HDATA8	→	(1)DOT8 (2)DOT7
15	HCOM		HEAD COMMON
16	HCOM		HEAD COMMON

* (1) = graphic printer; (2)= character printer.

6.3 CONNECTING TO THE HOST DEVICE AND THE POWER SUPPLY

The IFM001-01 connects to the host device and the power supply through CN2.

- Power supply (V_{cc}, V_p, and GND)
- Parallel input/output
- Serial input/output
- Error output
- Feed, software standby mode release, and reset input
- Paper sensor input

The connection method for each function is described below.

6.3.1 Connecting to the Power Supply

Connect the power supply to the terminals listed in Table 6-9.
The power supply is divided into V_{cc} and V_p, however, GND should be common to all.
Make the cable connecting to the power supply less than 30 cm long.
The power supply should be connected to all the power supply terminals of the IFM001-01.
A high voltage current passes through V_p. When using V_{cc} and V_p, connect three V_p terminals and at least two GND terminals to the V_p power supply. Connect one V_{cc} terminals and at least one GND terminals to the V_{cc} power supply.

Table 6-9 Power Supply Terminal Connection (CN3)

Terminal No.	Signal Name	Function
1	V_{cc}	Logic power supply (4.5 V to 5.5 V)
2, 3, 4	V_p	Printer power supply (4 V to 6 V)
5, 6, 20	GND	GND

Use a power supply having the following specifications.

Logic power supply (V_{cc})	5 V ± 0.5 V	30 mA or higher
Printer power supply (V_P)	5 V ± 1.0 V	Peak current consumption or higher.

* The average current consumption of Vcc is 11.3 mA.

Use the following formula to calculate the peak current consumption of Vp when all dots are energized.

Character Printer	$Ipeak = \frac{Vp-Vsat}{R} \times 7 + 0.2$	(A)
Graphic Printer	$Ipeak = \frac{Vp-Vsat}{R} \times 8 + 0.2$	(A)

Vsat is the saturation voltage of the head driver. It is typ 0.2 V when using the LB1256, and R is the head resistance.

6.3.2 Connecting for Parallel Input/Output

Use CN2 terminals 7 to 17 and GND for parallel input/output.

Table 6-10 Parallel Input/Output Terminals Connection (CN2)

Terminal No.	Signal Name	I/O	Function
7	!STROBE	I	Parallel strobe signal
8	DATA0	I	Parallel data signal0
9	DATA1	I	Parallel data signal1
10	DATA2	I	Parallel data signal2
11	DATA3	I	Parallel data signal3
12	DATA4	I	Parallel data signal4
13	DATA5	I	Parallel data signal5
14	DATA6	I	Parallel data signal6
15	DATA7	I	Parallel data signal7
16	!ACK	O	Parallel, Acknowledge signal
17	PBUSY	O	Parallel, Busy signal

"High" is 1
"Low" is 0

Handshaking is performed using !STROBE, DATA0 to 7 and BUSY, or !ACK.

These signals are CMOS input/output. When the V_{cc} power supply voltage and the voltage on the host device side are not the same or the power-on of these voltages is not performed at the same time, connect through the protection resistance and the buffer as shown in Figure 6-2 in order to prevent latch-up.
For the latch-up phenomenon, refer to Section 1.2.

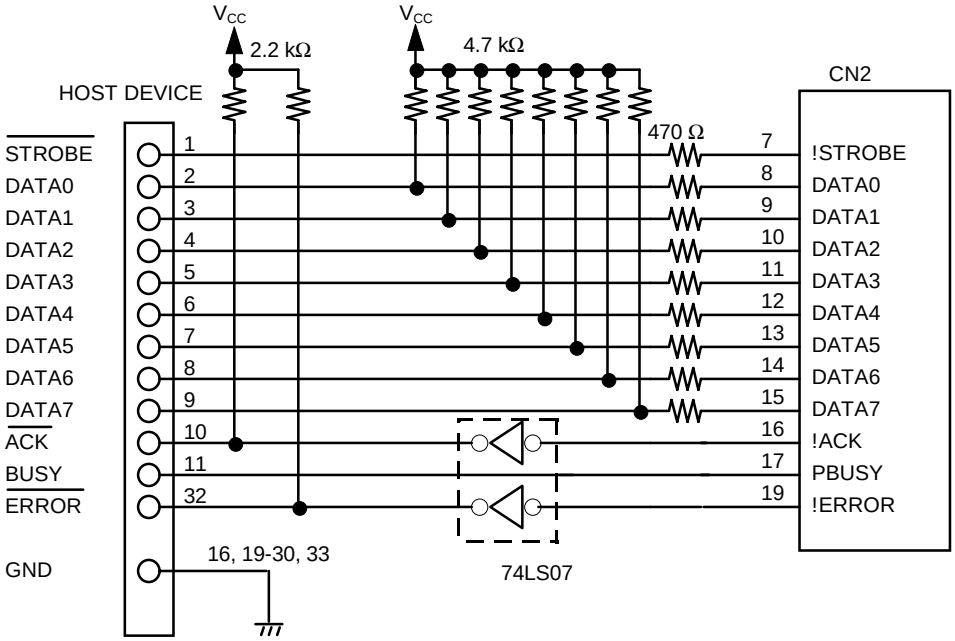


Figure 6-2 Sample Parallel Input/Output Circuit

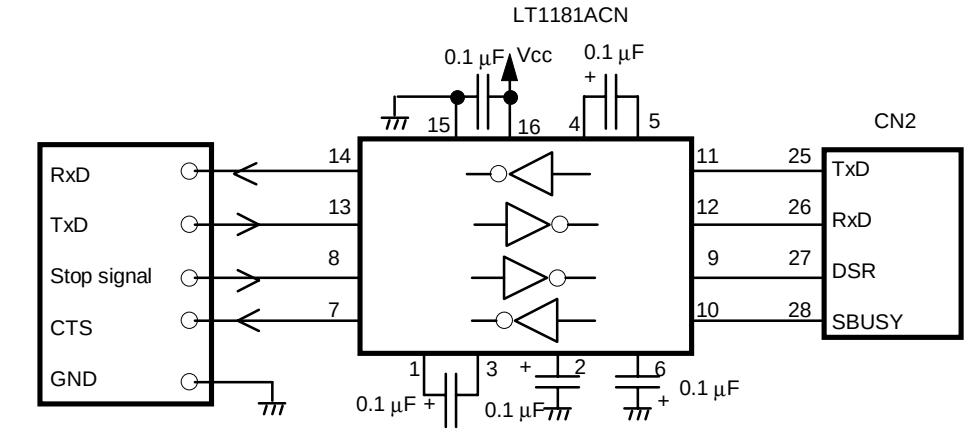
6.3.3 Connecting for Serial Input/Output

Use CN2 terminals 25 to 28 and GND for serial input/output.

Table 6-11 Input/Output Terminals Connection (CN2)

Terminal No.	Signal Name	I/O	Function
25	TxD	O	Serial sending data
26	RxD	I	Serial receiving signal
27	DSR	I	Interface use enable/disable
28	SBUSY	O	Serial busy

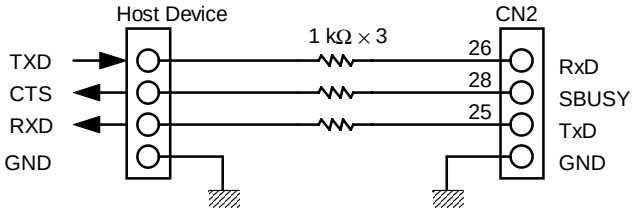
Handshaking is performed using SBUSY, or the Xon/Xoff signal which is output from TxD. These signals are TTL level. When using with RS-232C, level convert is required. The sample level convert circuit when using with RS-232C is shown in Figure 6-3.



Part used: LT1181ACN (Linear Technology)

Figure 6-3 Sample RS-232C Level Conversion Circuit

In the case of connecting directly to the host device without level convert, when the V_{cc} power supply voltage and the voltage on the host device side are not same or the power-on is not performed at the same time, connect using the protection resistance of 1 kΩ as shown in Figure 6-4 in order to prevent latch-up.
For the latch-up phenomenon, refer to Section 1.2.



Connection to the TTL level signal with another power supply

Figure 6-4 Sample Serial Input/Output Circuit

NOTE

DSR must be fixed at low when DSR is not used under serial communication setting. The IFM001-01 can be fixed at low by using DSR switch of the solder jumper.
For the position of the IFM001-01, see Figure 6-1.

6.3.4 Connecting to Switches and LEDs

To connect to the feed, standby mode switch release, and reset switches, use CN2 terminals 21, 22, and 24.
To connect to the LEDs for displaying the printer status, use CN2 terminals 18 and 19.

Table 6-12 Switch and Error Terminals Connection (CN2)

Terminal No.	Signal name	I/O	Function
18	PE	O	Paper end
19	!ERROR	O	Error
21	!FEED	I	Feed
22	!SSBY	I	Software standby mode release
24	!INIT	I	Reset

In case of connecting these terminals directly to the host device, when the V_{cc} power supply voltage and that on the host device side are not same or the power-on of these voltages is not performed at the same time, connect using a protection resistance of 1 kΩ in order to prevent latch-up.

For the latch-up phenomenon, refer to Section 1.2.

!FEED, !SSBY, and !INIT are pulled up. When connecting the switch externally, it is possible to operate the IFM001-01 only if the switches are connected between the signals and GND, as shown in Figure 6-5.

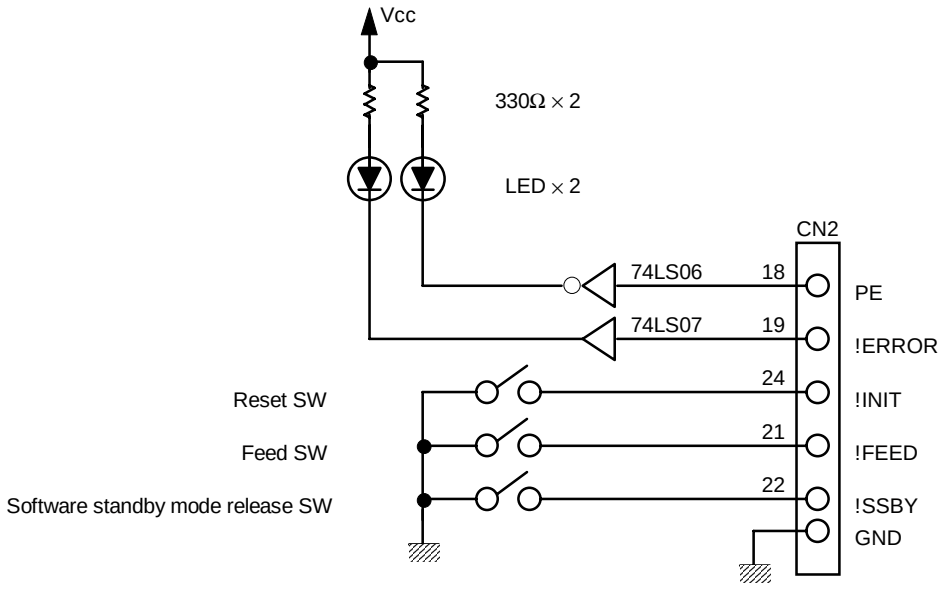


Figure 6-5 Sample Switch and Display Circuit

6.3.5 Connecting to Paper Sensor

To connect the paper sensor (optional), use CN2 terminal 23 (PS).

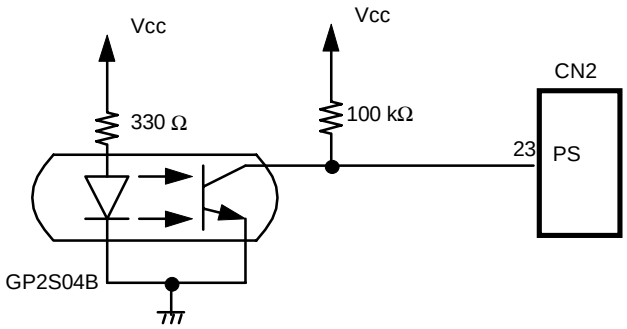
Table 6-13 Paper Sensor Terminal Connection (CN2)

Terminal No.	Signal Name	I/O	Function
23	PS	I	Paper sensor

When the V_{cc} power supply voltage and the voltage for optional sensor are not the same or the power-on of these voltages is not performed at the same time, connect using a protection resistance of 1 kΩ or more in order to prevent latch-up.

For the latch-up phenomenon, refer to Section 1.2.

A sample paper sensor circuit is given in Figure 6-6.



Part used: GP2S04B (Sharp)

Figure 6-6 Sample Paper Sensor Circuit

NOTE

In Mode 0, PS must be fixed low when it is not used.
The IFM001-01 can be fixed low using the PSSW switch of the solder jumper.
For the position of the IFM001-01, see Figure 6-1.

6.4 OPERATING

6.4.1 Loading Paper

Insert the thermal paper into the paper inlet of the printer mechanism.
Always use one of the recommended thermal papers listed in Table 2-5.

6.4.2 Paper Feed

The IFM001-01 can feed paper in the forward direction through input from external signals.
Use the pin listed in Table 6-14 for sending !FEED.

Table 6-14 Paper Feed Terminal (CN2)

Terminal No.	Signal Name	I/O	Function
21	!FEED	I	Paper feed input

- If !FEED goes low during data input standby, one line of paper is fed. Pin status is detected when the thermal print head comes near the home position and paper feed is conducted if it is low.
- Chattering prevention processing for !FEED is performed in the software. Low must be maintained for at least 30 ms to ensure proper function.

6.4.3 Test Print Flow

There are two methods of test print execution.

(1) With !FEED set to low, switch the power on.
(2) Set !RESET to low.
Set !FEED to low, then set !RESET to high.

Test print items are printed in the following order:

(1) Firmware version

(2) CPU ROM checksum

(3) All characters

When using the IFM001-01B, codes 20_H to FE_H are printed according to the settings of SW1. If alphanumeric and Japanese *kana* characters have been selected, $7F_H$ is excluded (See Figure 6-8).

When using the IFM001-01BM, the codes from 0_H to FE_H that have been registered in EEPROM are printed (See Figure 6-9).

(4) 10 lines of zigzag pattern (every other dot is printed)

(5) Items (3) and (4) are repeated while !FEED remains low.

NOTE

Under Mode 2 specifications, the codes within the range of 20_H through $7F_H$ and $A0_H$ through DF_H are printed. Item (4) above is not printed.

<IFM001-01B>
Mode 0
MTP201-G128
Alphanumeric and Japanese *kana* characters selected
Normal printing

Figure 6-7 Test Print Sample 1

<IFM001-01BM>
Mode 0
MTP201-G128
Normal printing

Figure 6-8 Test Print Sample 2

6.5 TEST PIN INSTALLATION

The IFM001-01 has the test pins listed in Table 6-15. The signal outputs listed in Table 6-15 can be examined by installing the test pins.

Table 6-15 Test Pin Terminal

Pin Name	Function	Normal Output
TP1	CPU system clock output	Frequency is within 2.44 MHz to 2.48 MHz.
TP2	Head applied pulse output	Pulse width according to Section 5.4.2.
TP3	Reset signal output	Reset voltage in Table 9-1. Switches from high to low.

* For the position of the test pin terminals, see Figure 6-1.

6.6 BOARD CONNECTION SAMPLE

The IFM001-01 and relay board connection and recommended parts are shown below.
Figure 6-9 shows the overhead view of the IFM001-01 and printer mechanism. The IFM001-01 and the printer mechanism are mounted on a relay board. The control input/output signals travel along the following path from the IFM001-01:

IFM001-01 → CN1 Cable → Relay Board → Head Flexible Connector and Motor Drive Signal Connector → Print Mechanism

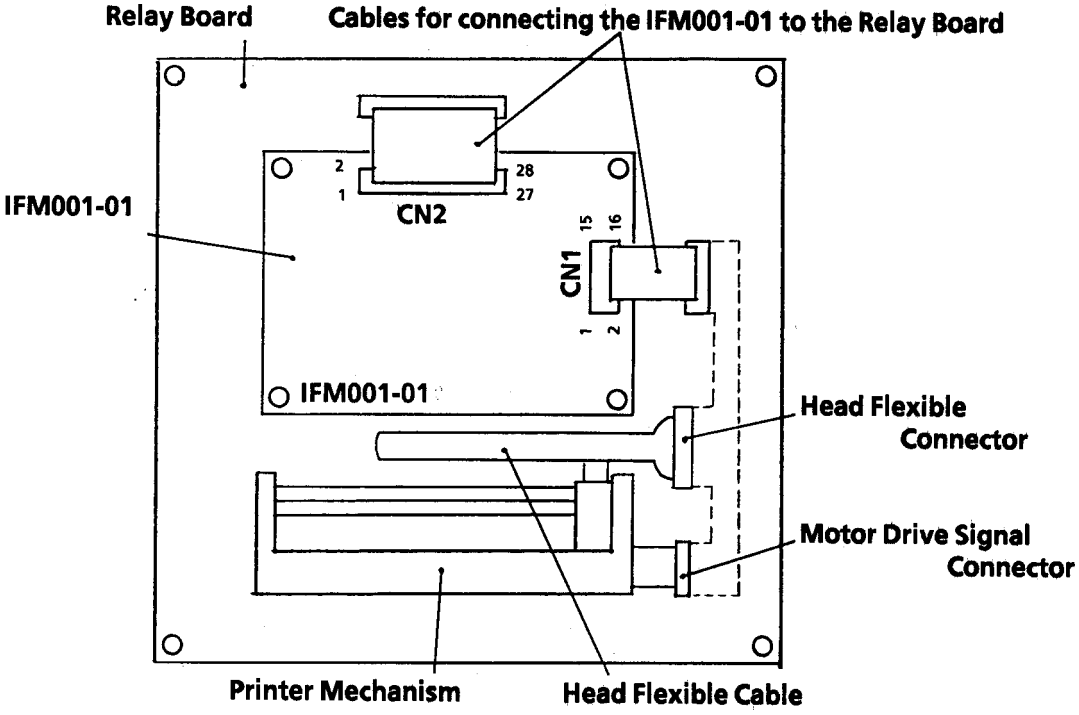


Figure 6-9 Board Connection Sample

Recommended Parts

- CN1 Mounting connector: A1-16PA-2.54DSA (Hirose Electric Co., Ltd.)
  Crimp socket: A1-8D-2.54C (Hirose Electric Co., Ltd.)
  (Use two sockets.)
  Crimp terminal: A1-2630SC (Hirose Electric Co., Ltd.)

- CN2 Mounting connector: A3B-28PA-2DSA (Hirose Electric Co., Ltd.)
  Crimp socket: A3B-28D-2C (Hirose Electric Co., Ltd.)
  Crimp terminal: A3B-2630SC (Hirose Electric Co., Ltd.)

- Head flexible connector: HBLB series (Burndy Japan, Ltd.)

CHAPTER 7

COMMAND DESCRIPTION

7.1 EEPROM

EEPROM is installed only on the IFM001-01BM and can be used only when the command mode is Mode 0. Installation of EEPROM enables the configuration of font and character spacing.
X24C16 (16 Kbit, XICOR) is used for EEPROM.

(1) Font

Both the alphanumeric and Japanese *kana* character set and the extended graphics character set are installed in ROM.
The fonts to be used differ according to the interfaces as follows:

- When using the IFM001-01B:
  The internal fonts in ROM within the CPU are used while printing.

- When using the IFM001-01BM:
  The downloaded characters registered in EEPROM are used while printing.
  The fonts can be downloaded and switched with the internal fonts in ROM with commands by using EEPROM.
  The internal fonts in ROM are switched on commands.
  When shipped, the alphanumeric and Japanese *kana* character set in Table 8-1 is built in EEPROM.

(2) Character spacing

The default settings of character spacing differ according to the printed circuit boards (whether there is EEPROM or not).

- When using the IFM001-01B:
  Character spacing is set to 1 dot when character printers are used, and 0 when graphic printers are used.

- When using the IFM001-01BM:
  The character spacing written in EEPROM is applied.
  The character spacing can be written to EEPROM on commands.
  Writing the character spacing to EEPROM makes the character spacing immediately following initialization changeable.
  When shipped, the character spacing is set to 0.

7.2 MODE 0

7.2.1 Character Codes and Commands

When using the IFM001-01BM, the character fonts in EEPROM and internal ROM are selectable using the **ESC+"%"** command.
When using the IFM001-01B, the character fonts in internal ROM are read.

(1) When EEPROM character font is selected:

Mode 0 function codes are processed as commands.
For codes other than the mode 0 function codes, if the character fonts are registered, the character fonts are read.

(2) When internal ROM character font is selected:

① When the alphanumeric and Japanese *kana* characters are selected:
0 through $1F_H$: Mode 0 function codes are processed as commands. For codes other than mode 0 function codes, 1 byte is taken in then the code is ignored when recognized as a non-Mode 0 code.
20_H through FE_H: Character codes.
FF_H: Ignored.
* For the contents of the character fonts, see Table 8-1.

② When extended graphics character set is selected:
0 through $1F_H$: Mode 0 function codes are processed as commands. For codes other than mode 0 function codes, 1 byte is taken in then the code is ignored when recognized as a non-Mode 0 code. 03_H to 06_H, and 15_H are character codes.
20_H through FF_H: Character codes.
* For the contents of the character fonts, see Table 8-2.

<Mode 0 function code>
09_H (**HT**), $0A_H$ (**LF**), $0D_H$ (**CR**), $0E_H$ (**SO**), 12_H (**DC2**), 14_H (**DC4**), 18_H (**CAN**), $1B_H$ (**ESC**)

7.2.2 Command Description

(1) 1 byte function codes

HT

[Name] Horizontal tabulation

[Code] 09_{16} or 9_{10}

[Function] Moves the printing position to the next tabulation position.

[Operation]
- The tabulation position is set from the left margin every eight characters (9th line, 17th line, and so on) regarded the following number of dots as one character.

  Character printer: 7 dots
  Graphic printer: 6 dots

- The tabulation position is not changed according to the print mode setting.
- If **HT** exceeds the right margin position, line buffer full print is not executed.

LF

[Name] Line Feed

[Code] $0A_{16}$ or 10_{10}

[Function] Prints the data in the line buffer, then feeds paper one line.

[Operation] Only line feed is performed when the line buffer is empty.

CR

[Name] Carriage Return

[Code] $0D_{16}$ or 13_{10}

[Function] Prints the contents of the line buffer, then feeds paper one line.

[Operation]
- Only line feed is performed when the line buffer is empty.
- **LF** received immediately following **CR** is ignored.

SO

[Name] Double-Width (with automatic reset) ON

[Code] $0E_{16}$ or 14_{10}

[Function] Sets double-width mode.

[Operation]
- Characters following this command are printed at twice their normal width.
- Character spacing is also doubled.
- Double-width mode is cleared by input of **DC4**, **LF**, **CR**, **ESC+"W"+0** or line buffer full print.

DC4

[Name] Double-Width (with automatic reset) OFF

[Code] 14_{16} or 20_{10}

[Function] Resets double-width mode with automatic reset. The CPU is placed in this mode when initialized.

CAN

[Name] Cancel

[Code] 18_{16} or 24_{10}

[Function] Cancels the data in the line buffer that has been received before this code.

[Operation] HT is also canceled and the print start position is from the left margin.

(2) Escape Sequences

if codes other than the specified command are input following **ESC** codes, the command is ignored. For example, if **ESC+"F"** is input, **ESC+"F"** is ignored.

ESC + SP + n

[Name] Character Spacing

[Code] $1B_{16} + 20_{16} + n$, or $27_{10} + 32_{10} + n$

[Definition range] $0 \leq n \leq 15$ (n is an integer)

(The highest four bits are ignored.)

[Default status] IFM001-01BM: the value set in EEPROM
IFM001-01B: the value below
Character printer: 1 dot
Graphic printer: None

[Function] Sets the character spacing to n dots.

[Operation]
- n indicates the number of dots.
- The character spacing is twice the number of dots in the double-width mode.

ESC + "@"

[Name] Reset

[Code] $1B_{16} + 40_{16}$, or $27_{10} + 64_{10}$

[Function] Initializes the interface.

[Operation]
- The contents of the line and input buffers are cleared.
- After reset command is input, the data input before resetting is cleared.

ESC + “I” + n

[Name] Inverse Print

[Code] $1B_{16}+49_{16}+n$ or $27_{10}+73_{10}+n$

[Definition range] n=0 Normal
n=1 Inverse
(The highest seven bits are ignored.)

[Default status] The value set by SW1 pin 6.

[Function] Turns on/off inverse print for each individual line.

[Operation]
- The mode selected last in each line becomes effective.
- In the inverse print mode, each of the characters is printed upside down. The sequence of characters in a line is also reversed.
  The character sent first is printed at the right margin and subsequent characters are printed from right to left.

ESC + “K” + n1 + n2 + image data

[Name] Bit Image

[Code] $1B_{16}+4B_{16}+n1+n2+$image data, or
$27_{10}+75_{10}+n1+n2+$image data

[Definition range] $0_H \leq (n2 \times 100_H+n1) \leq 1FF_H$
(The highest seven bits of n2 are ignored.)

[Function] Prints the data following **ESC+”K”+n1+n2** as bit images.

[Operation]
- n2 (higher-order bytes) and n1 (lower-order bytes) specify the number of dot lines of the bit image.
- Data exceeding the line is discarded. In this case, line buffer full print is not executed.
- MSB of image data is the uppermost first dot (Refer to section 8.1.3, Font Structure 3).

ESC + ”Q” + n

[Name] Right Margin

[Code] $1B_{16}+51_{16}+n$ or $27_{10}+81_{10}+n$

[Definition range] $2 \leq n \leq X$ (n is an integer)
X: Maximum number of characters for each printer indicated in Tables 6-3 and 6-4.
(Ignores **ESC+”Q”+n** when exceeding the definition range.)

[Default status] n=X

[Function] Sets the right margin.

[Operation]
- The printable area extends to n characters.
- The data in the line buffer is discarded.
- Ignored if the right margin is set less than (left margin+1). At this time, data in the line buffer is discarded.
- In inverse mode, the printable area extends n characters from the right end of the line.
- If the right margin is set to X, the margin is automatically set to the maximum number of dots of the printer.

ESC + ”W” + n

[Name] Double-Width

[Code] $1B_{16}+57_{16}+$ n, or $27_{10}+87_{10}+n$

[Definition range] n = 1: Turns the double-width mode on.
n = 0: Turns the double-width mode off.
(The highest seven bits are ignored.)

[Default status] n=0

[Function] Turns on/off the double-width mode.

[Operation]
- Characters following this command are printed at twice their normal width.
- Character spacing is also doubled.
- Double-width mode set by this code is not released by **DC4** codes or line feed.

ESC + “l” + n

[Name] Left Margin

[Code] $1B_{16}+6C_{16}+n$ or $27_{10}+108_{10}+n$

[Definition range] $0 \leq n \leq X-2$ (n is an integer)
X: Maximum number of characters for each printer indicated in Tables 6-3 and 6-4.
(Ignores **ESC+”l”+n** when exceeding the definition range.)

[Default status] n=0

[Function] Sets the left margin.

[Operation]
- The non-printable area extends to n characters.
- The data in the line buffer is discarded.
- The right margin value is automatically set to the maximum number of dots of the printer if it is set larger than (right margin-1).
  At this time, the left margin is set to the specified value. The contents of the line buffer are discarded.
- In the inverse mode, the non-printable area extends n characters from the right end of the line.

(3) Font extended function codes

ESC + “R” + n

[Name] International character set

[Code] $1B_{16}+52_{16}+n$, or $27_{10}+82_{10}+n$

[Definition range] $0_H \leq n \leq 0C_H$ (n is a integer)
(The highest four bits are ignored.)
(Ignores **ESC+”R”+n** when exceeding the definition range.)

n
0: USA
1: FRANCE
2: GERMANY
3: U.K.
4: DENMARK1
5: SWEDEN
6: ITALY
7: SPAIN1
8: JAPAN
9: NORWAY
A: DENMARK2
B: SPAIN2
C: LATIN

[Default status] Set to JAPAN for alphanumeric and Japanese *kana* characters, and to USA for the extended graphic character set.

[Function] Changes the type of international character set.

[Operation]

- Selects the following characters from the 13 types of characters: 23_H, 24_H, 40_H, $5B_H$, $5C_H$, $5D_H$, $5E_H$, 60_H, $7B_H$, $7C_H$, $7D_H$, $7E_H$.
  For the contents of the character fonts, see Table 8-3.

- When using the EEPROM font, the international character of the fonts for which the character set is copied can be specified.

ESC + “c” + n

[Name] Special character

[Code] $1B_{16}+63_{16}+n$, or $27_{10}+99_{10}+n$

[Definition range] n=0 Normal character
n=1 Special character
(The highest seven bits are ignored)

[Default status] n=0

[Function] Specify characters $E0_H$ to FE_H in the character codes table as normal characters or special characters.

[Operation]
- Normal characters and the special characters can be printed in the same line.
- The modes switch at the time **ESC+“c”+n** is processed in the CPU.
- When using the EEPROM font, the fonts for which the character set is copied can be specified as either normal characters or special characters.
- For the contents of the character fonts, see Table 8-4.

ESC+“t”+n

[Name] Character code table

[Code] $1B_{16}+74_{16}+n$, or $27_{10}+116_{10}+n$

[Definition range] n=0 Ignores **ESC+“t”+0**
n=1 Extended graphics character set
n=2 Ignores **ESC+“t”+2**
n=3 Alphanumeric and Japanese *kana* character
(The highest six bits are ignored)

[Default status] Set in the character code table specified using SW1 pin 7.

[Function] Selects the character code table.

[Operation]
- The international character remains unchanged.
- The modes switch at the time **ESC+“t”+n** is processed in the CPU.
- When using the EEPROM font, the type of font for which the character set is copied can be specified.

ESC + “z” + n

[Name] Zero font

[Code] $1B_{16}+7A_{16}+n$, or $27_{10}+122_{10}+n$

[Definition range] n=0 with slash
n=1 without slash
(The highest seven bits are ignored)

[Default status] n=0

[Function] Selects the zero font.

[Operation]
- The modes switch at the time **ESC+”z”+n** is processed in the CPU.
- When using the EEPROM font, the zero font of the font for which the character set is copied can be specified.
- For the contents of the character font, see Table 8-5.

(4) EEPROM function codes

These commands are valid only when EEPROM is used. ESC+(1 byte code) is ignored when EEPROM is not used.

ESC + “%” + n

[Name] Font

[Code] $1B_{16}+25_{16}+n$, or $27_{10}+37_{10}+n$

[Definition range] n=0 Internal ROM font select
n=1 EEPROM font select
(The highest seven bits are ignored.)

[Default status] When using the IFM001-01BM, the EEPROM font is read.

[Function] Selects the EEPROM font or the internal ROM font.

ESC + “&” + n + m + font data

[Name] Download 8 × 6 font

[Code] $1B_{16}$+26_{16}+n+m+font data, or 27_{10}+38_{10}+n+m+font data

[Definition range] $00_H \leq n \leq m \leq FF_H$
(if n>m, or n and m are specified out of the definition range, the download character registration is invalidated and the character pattern data is processed as normal character codes.)

[Function] Registers the download character.

[Operation]

- n represents the beginning of the registration codes and m represents the end; download characters are registered in the codes from n to m. If n=m, only one character can be registered.
- Following the registration codes (n,m), input the pattern data of the character to be defined. One character is composed of 6 bytes. Therefore, the number of pattern data is (6 × number of registration code<m - n+1>[bytes]).
- Even if a one-byte function code is specified for n and m, it is not printed as a font. To register immediately following the previous registration, specify the number of registration characters, ignoring the function codes. For example, to register in 08_H to $0C_H$, number of data is 6 × 3=18 because 09_H and $0A_H$ are the function codes.
- If you specify a new download character in one previously defined, the previously defined download character is cleared, then the new one defined.
- Character codes for which download characters are not registered are ignored and not printed.
- MSB of the font data is the uppermost first dot (Refer to section 8.1.3, Font Structure 3).

ESC + ":" + s + n + m

[Name] Character Set Copy

[Code] $1B_{16}+3A_{16}+s+n+m$, or $27_{10}+58_{10}+s+n+m$

[Definition range] s=0, n=0, m=0
(Ignores **ESC+":"+s** when s is not 0.)
(Ignores **ESC+":"+s+n** when n is not 0.)
(Ignores **ESC+":"+s+n+m** when m is not 0.)

[Function] Download and copy the internal ROM font.

[Operation] The currently selected type of font, international characters, special characters, and zero font are valid.
Before inputting this code, specify the character set to be copied.

ESC + ":" + s + SP + SP

[Name] Download Character Clear

[Code] $1B_{16}+3A_{16}+s+A0_{16}+A0_{16}$, or $27_{10}+58_{10}+s+160_{10}+160_{10}$

[Definition range] s=0
(Ignores **ESC+":"+s** when s is not 0.)
(Ignores **ESC+":"+s+SP** when the first SP is not $A0_H$.)
(Ignores **ESC+":"+s+SP+SP** when the second SP is not $A0_H$.)

[Function] Clears all download characters registered in EEPROM.

[Operation] If this command is executed, characters can not be printed until the font is downloaded or the character set is copied.

ESC + ":" + SP + n

[Name] Change Default Value of Character Spacing

[Code] $1B_{16}$ + $3A_{16}$ +20_{16}+ n, or 27_{10}+58_{10}+32_{10}+n

[Definition range] $0 \leq n \leq 15$ (n is an integer)
(The highest four bits are ignored.)
(Ignores **ESC+":"+SP+n** when n is specified out of the definition range.)

[Function] Changes the default value of character spacing following initialization.

[Operation] The currently selected character spacing is not changed.

(5) Other codes

DC2 + “stp”

[Name] Set to Software Standby Mode

[Code] 12_{16} + 73_{16} +74_{16}+70_{16}, or 18_{10}+115_{10}+116_{10}+112_{10}

[Function] The IFM001-01 is transferred to the software standby mode.

[Operation]

- Current consumption can be significantly reduced by switching to the software standby mode in the following ways:
  ① The CPU and the clock stop.
  ② The peripheral function stops and resets.
  ③ As long as the specified voltage is given, the status of the CPU, the register, the RAM, and the I/O port is maintained.

- Enters the software standby mode after printing one line and returning to the home position.

- The software standby mode can be cleared by any of the following procedures:

  ① Set !INIT to low. The CPU is tranferred to reset status.
  ② Set !SSBY to low level.
  ③ Input data normaly in the parallel input mode. However, even if you input the trailing signal to !STROBE to clear the software standby mode before transferring to the standby mode internally after inputting this command, the data is only stored in the input buffer, but the standby mode is not cleared. To control the standby mode surely, do not input data from the time this command is input to the time of transition to the standby mode.

- In the serial input mode, the software standby mode can not be cleared by data input through the serial signal, and data input in the standby mode is ignored.
  Use method ① or ② to clear the standby mode in the serial input mode.

7.3 MODE 1

7.3.1 Character Codes and Commands

0 through $1F_H$: Mode 1 function codes are processed as commands.
For codes other than mode 1 function codes, 1 byte is taken in then the code is ignored when recognized as a non-Mode 1 code.

[Mode 1 function code]
$0A_H$ (**LF**), $0D_H$ (**CR**), $0E_H$ (**SO**), $0F_H$ (**SI**), 18_H (**CAN**), $1B_H$ (**ESC**)

20_H through FE_H: Character codes.
FF_H: Ignored.

* For the contents of the character fonts, see Table 8-6.

7.3.2 Command Description

(1) 1 Byte function code

LF

[Name] Line Feed

[Code] $0A_{16}$ or 10_{10}

[Function] Prints the data in the line buffer, then feeds paper one line.

[Operation]

- Only one line feed is performed when the line buffer is empty.
- Under the following conditions, the data in the line buffer is printed, then a carriage return is executed; and then, 1 line is fed:

  Character printer: X=7
  Graphic printer: X=6

  ① When printing normal characters:
  When the number of dots of data in the line buffer is more than (maximum number of dots - X), if LF code or data+CR+LF are input, the data in the line buffer is printed, then a carriage return is executed; and then, 1 line is fed.

  ② When the rightmost character of the line is a double-width character or the double-width mode was selected immediately before printing one line:
  When the number of dots of data in the line buffer is more than (maximum number of dots - 2X), if LF code or data+CR+LF are input, the data in the line buffer is printed, then a carriage return is executed; and then, 1 line is fed.

CR

[Name] Carriage Return

[Code] $0D_{16}$ or 13_{10}

[Function] Prints the contents of the line buffer, then feeds paper one line.

[Operation]
- Nothing is performed when the line buffer is empty.
- **LF** received immediately following **CR** is ignored.

Only **CR**	None
Data+**CR**	Printing+one line feed
Data+**CR**+**LF**	Printing+one line feed

SO

[Name] Double-Width ON

[Code] $0E_{16}$ or 14_{10}

[Function] Selects the double-width mode.

[Operation]
- This command is cleared by input of the **SI** code.
- The spaces between characters are not doubled.

SI

[Name] Double-Width OFF

[Code] $0F_{16}$ or 15_{10}

[Function] Releases the double-width mode.

CAN

[Name] Cancel

[Code] 18_{16} or 24_{10}

[Function] Cancels line buffer data that has been received before this code.

(2) Escape Sequences

If codes other than the specified command are input following **ESC** codes, the command is ignored. For example, if **ESC+"F"** is input, items up to **ESC+"F"** are ignored.

ESC + "S" + "n1n2n3n4" + image data

[Name] Bit Image (software graphic mode)

[Code] $1B_{16}$+53_{16}+"n1n2n3n4"+image data, or
27_{10}+83_{10}+"n1n2n3n4"+image data

[Definition range] "0" (30_H) ≤ n1n2n3n4 ≤ "9" (39_H)
("n1n2n3n4", a four-digit decimal number, represents the number of bytes of bit image data to be printed. If data which does not meet the format is input, this command is not executed and **ESC+"S"+"n1n2n3n4"** is ignored.
In this case, image data input following this command is valid, however, it is printed as characters.)

[Function] Prints the data following **ESC+"S"+"n1n2n3n4"** as bit images.

[Operation]
- Data exceeding the maximum number of dots is printed in the next line.
- LSB of image data is the uppermost first dot (Refer to section 8.1.2, Font Structure 2).
- When the line buffer is full, if **LF** or **CR** codes are input, the data in the line buffer is printed, then a carriage return is executed; and then, 1 line is fed.

ESC + “c”

[Name] Special character

[Code] $1B_{16}+63_{16}$, or $27_{10}+99_{10}$

[Function] Specifies characters $F9_H$ to FD_H in the character codes table as normal characters or special characters.

[Operation]

- Normal characters and special characters are switched following this command.
- Normal characters and special characters can be printed in the same line. For example, and Ω can be printed in one line.
- The modes switch at the time **ESC+”c”** is processed in the CPU.
- For the contents of the character fonts, see Table 8-8.

NOTE

In MTPI-GNP and GNS (earlier SII products), the special character selection status was selected at the end of the line, preventing normal characters and special characters from being contained in the same line.
For example, using BASIC in normal character selection status, executing:

```
LPRINT CHR$(&H1B); ”c”;CHR$(&HF9);CHR$(&H1B);”c”;CHR$(&HFA),
```

will result in “市区“ with the MTPI-GNP and GNS, and “Σ 区“ with the IFM001-01B.

ESC + “R” + n

[Name] International character set

[Code] $1B_{16}+52_{16}+n$, or $27_{10}+82_{10}+n$

[Definition range] $0_H \leq n \leq 06_H$ (n is a integer)
(Ignores **ESC+”R”+n** when exceeding the definition range.)

n
0: JAPAN
1: FRANCE
2: GERMANY
3: U.K.
4: SWEDEN
5: ITALY
6: USA

[Default status] Set to JAPAN.

[Function] Changes the type of international character set.

[Operation]
- Selects the following characters from 7 types of characters: 23_H, 24_H, 40_H, $5B_H$, $5C_H$, $5D_H$, $5E_H$, 60_H, $7B_H$, $7C_H$, $7D_H$, $7E_H$.
  For the contents of the character fonts, see Table 8-7.

7.4 MODE 2

7.4.1 Character Codes and Commands

0 through $1F_H$: Mode 2 function codes are processed as commands. For codes other than mode 2 function codes, 1 byte is taken in then the code is ignored when recognized as a non-Mode 2 code.

[Mode 2 function code]
$0D_H$ (**CR**), 18_H (**CAN**)

20_H through $7F_H$: Character codes.
80_H through $9F_H$: Ignored.
$A0_H$ through DF_H: Character codes.
$E0_H$ through FF_H: Ignored.

* For the contents of the character fonts, see Table 8-9.

7.4.2 Command Description

CR

[Name] Carriage Return

[Code] $0D_{16}$ or 13_{10}

[Function] Prints the contents of the line buffer, then feeds paper one line.

[Operation]
- One line of feed is performed when the line buffer is empty.
- If **CR** is input at the maximum place, the data in the line buffer is printed, then a carriage return is executed; and then, 1 line is fed.

CAN

[Name] Cancel

[Code] 18_{16} or 24_{10}

[Function] Cancels line buffer data that has been received before this code.

CHAPTER 8

CHARACTER CODES

8.1 FONT STRUCTURE

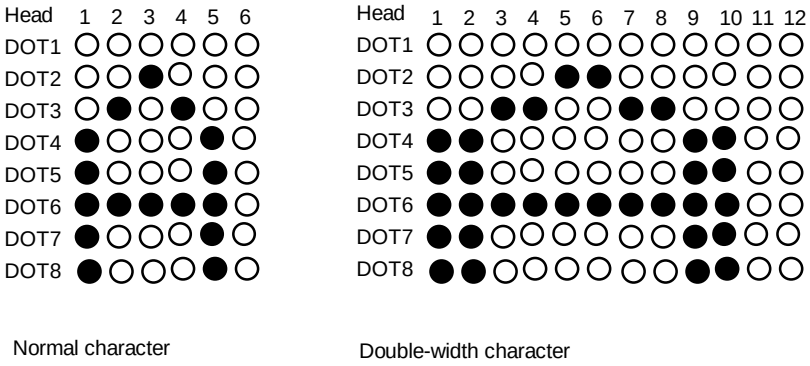
8.1.1 Font Structure 1

Graphic printer 8×6 font

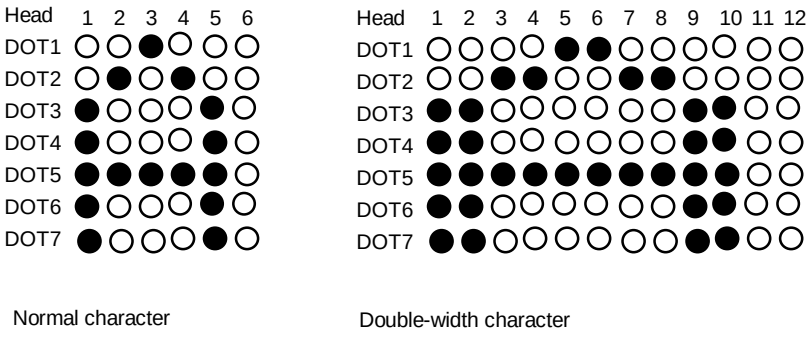
Character printer 7×6 font (One dot at the top is not printed.)

* When Mode 2 is selected, the font structure becomes 7×5 and the uppermost dot and the dot on the right are not printed.

Example 1) Printing the letter “A” on a graphic printer:



Example 2) Printing the letter “A” on a character printer:



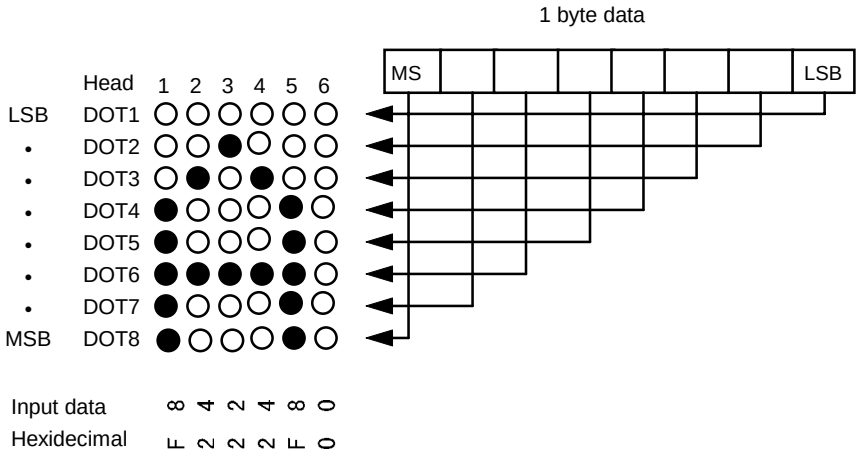
8.1.2 Font Structure 2

Pattern data is input by bytes where 1 represents a dot that will print, and 0 represents that will not.

When the following is input, DOT 1 of the head becomes the LSB of the input data:

- Data in Hard Graphic Mode
- Bit image data in Mode 1
  (ESC+"S"+"n1n2n3n4"+bit image data)

Example) When inputting data for an "A", and printing it on a graphic printer:



In order to print the above data as bit image data after "ESC+"S"+"n1n2n3n4" " in BASIC, execute the following:

```
LPRINT CHR$(&H1B);"S";"0006";
LPRINT CHR$(&HF8);CHR$(&H24);CHR$(&H22);CHR$(&H24);CHR$(&HF8);CHR$(&H0)
```

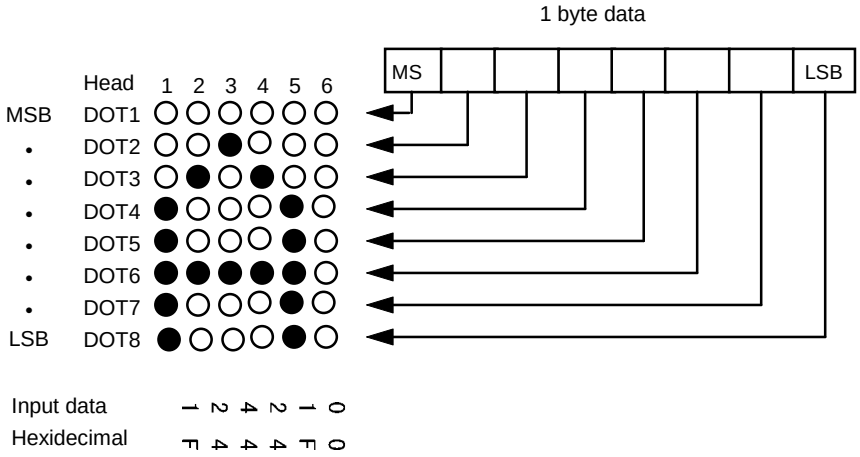
8.1.3 Font Structure 3

Pattern data is input by bytes where 1 represents a dot that will print, and 0 represents that will not.

When the following is input, DOT 1 of the head becomes the MSB of the input data:

- Bit Image data in Mode 0
  (ESC+"K"+n1+n2+bit image data)
- Down Loaded Characters
  (ESC+"&"+n+m+down loaded characters)

Example) When inputting data for an "A", and printing it on a graphic printer:



In order to print the above data as bit image data after "ESC+"K"+n1+n2" in BASIC, execute the following:

```
LPRINT CHR$(&H1B);"K";CHR$(&H6);CHR$(&H0);
LPRINT CHR$(&H1F);CHR$(&H24);CHR$(&H44);CHR$(&H24);CHR$(&H1F);CHR$(&H0)
```

8.2 TYPE OF CHARACTER

8.2.1 Mode 0

(1) Character codes

The character code tables for the alphanumeric and Japanese *kana* character and extended graphic character sets are stored in the internal ROM of the CPU.
The default status can be selected using SW1 pin 7. The character code tables can be changed using commands.
Table 8-1 lists the alphanumeric and Japanese *kana* character codes and Table 8-2 lists the extended graphic character set codes.

Table 8-1 Alphanumeric and Japanese *kana* Character Codes

Lower bits \ Higher bits		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
		0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0	0000			SP	ø	@	P	`	p	—	┴	SP	ー	タ	ミ	=	×
1	0001			!	1	A	Q	a	q	—	┬	。	ア	チ	ム	⊨	円
2	0010		DC2	"	2	B	R	b	r	━	┤	「	イ	ツ	メ	≠	年
3	0011			#	3	C	S	c	s	▬	├	」	ウ	テ	モ	≡	月
4	0100		DC4	$	4	D	T	d	t	▬	─	、	エ	ト	ヤ	◢	日
5	0101			%	5	E	U	e	u	▬	─	・	オ	ナ	ユ	◣	時
6	0110			&	6	F	V	f	v	■	│	ヲ	カ	ニ	ヨ	◥	分
7	0111			'	7	G	W	g	w	■	│	ァ	キ	ヌ	ラ	◤	秒
8	1000		CAN	(	8	H	X	h	x	▌	┌	ィ	ク	ネ	リ	♠	〒
9	1001	HT		)	9	I	Y	i	y	▌	┐	ゥ	ケ	ノ	ル	♥	市
A	1010	LF		*	:	J	Z	j	z	▌	└	ェ	コ	ハ	レ	♦	区
B	1011		ESC	+	;	K	[	k	{	▌	┘	ォ	サ	ヒ	ロ	♣	町
C	1100			,	<	L	¥	l	¦	▌	┌	ャ	シ	フ	ワ	●	村
D	1101	CR		−	=	M	]	m	}	▌	┐	ュ	ス	ヘ	ン	○	人
E	1110	SO		.	>	N	^	n	~	■	└	ョ	セ	ホ	゛	／	▩
F	1111			/	?	O	−	o	SP	+	┘	ッ	ソ	マ	°	＼	

- SP means space.
- Codes for blanks are ignored.
- Thick bordered cells indicates function codes.

Table 8-2 Extended Graphics Character Set Codes

Lower bits \ Hgiher bits		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
		0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0	0000			SP	0	@	P	`	p	Ç	É	á	⣿	└	╨	α	≡
1	0001			!	1	A	Q	a	q	ü	æ	í	▒	┴	╤	β	±
2	0010		DC2	"	2	B	R	b	r	é	Æ	ó	▓	┬	╥	Γ	≥
3	0011	♠		#	3	C	S	c	s	â	ô	ú	│	├	╙	π	≤
4	0100	♥	DC4	$	4	D	T	d	t	ä	ö	ñ	┤	─	╘	Σ	⌠
5	0101	♦	§	%	5	E	U	e	u	à	ò	Ñ	╡	┼	╒	σ	⌡
6	0110	♣		&	6	F	V	f	v	å	û	ª	╢	╞	╓	μ	÷
7	0111			'	7	G	W	g	w	ç	ù	º	╖	╟	╫	τ	≈
8	1000		CAN	(	8	H	X	h	x	ê	ÿ	¿	╕	╚	╪	Φ	°
9	1001	HT		)	9	I	Y	i	y	ë	Ö	⌐	╣	╔	┘	θ	∎
A	1010	LF		*	:	J	Z	j	z	è	Ü	¬	║	╩	┌	Ω	·
B	1011		ESC	+	;	K	[	k	{	ï	¢	½	╗	╦	■	δ	√
C	1100			,	<	L	\	l	¦	î	£	¼	╝	╠	▄	∞	n
D	1101	CR		–	=	M	]	m	}	ì	¥	¡	╜	═	▌	φ	2
E	1110	SO		.	>	N	^	n	~	Ä	Pt	«	╛	╬	▐	∈	■
F	1111			/	?	O	_	o	⌂	Å	ƒ	»	┐	╧	▀	∩	SP

- SP means space.
- Codes for blanks are ignored.
- Thick bordered cells indicates function codes.

(2) International characters

The following character codes of the internal ROM can be replaced with the characters of each country, by using commands.

23_H, 24_H, 40_H, $5B_H$, $5C_H$, $5D_H$, $5E_H$, 60_H, $7B_H$, $7C_H$, $7D_H$, $7E_H$

Table 8-3 International Character Codes

n	Hexadicimal / Character set	23	24	40	5B	5C	5D	5E	60	7B	7C	7D	7E
0	America	#	$	@	[	\	]	^	`	{	¦	}	~
1	France	#	$	à	°	Ç	§	^	`	é	ù	è	¨
2	Germany	#	$	§	Ä	Ö	Ü	^	`	ä	ö	ü	ß
3	U.K.	£	$	@	[	\	]	^	`	{	¦	}	~
4	Denmark I	#	$	@	Æ	Ø	Å	^	`	æ	∅	å	~
5	Sweden	#	¤	É	Ä	Ö	Å	Ü	é	ä	ö	å	ü
6	Italy	#	$	@	°	\	é	^	ù	à	ò	è	ì
7	Spain I	Pt	$	@	¡	Ñ	¿	^	`	¨	ñ	}	~
8	Japan	#	$	@	[	¥	]	^	`	{	¦	}	~
9	Norway	#	¤	É	Æ	Ø	Å	Ü	é	æ	∅	å	ü
10	Denmark II	#	$	É	Æ	Ø	Å	Ü	é	æ	∅	å	ü
11	Spain II	#	$	á	¡	Ñ	¿	é	`	í	ñ	ó	ú
12	Latin	#	$	á	¡	Ñ	¿	é	ü	í	ñ	ó	ú

(3) Special characters

The following character codes of the internal ROM can be replaced with the characters of each special character, by using commands.

$E0_H$ to FE_H

Table 8-4 Special Character Codes

Alphanumeric and Japanese *kana* character

	E	F
0	火	⇨
1	水	⇦
2	木	⇧
3	金	⇩
4	土	
5	◧	☎
6	◨	♪
7	「	♬
8	」	÷
9	△	Σ
A	♀	μ
B	♂	Ω
C	ℓ	π
D	∪	σ
E	⊂	°C
F	⊃	

Extended garaphics character set

	E	F
0	∅	→
1	ϕ	←
2	IJ	↑
3	ij	↓
4	Œ	|
5	œ	¶
6	3	†
7	ħ	‡
8	¢	✳
9	₱	▷
A	₲	▶
B	≠	◆
C	∧	⌐
D	∨	⌡
E	∨	√
F	∵	

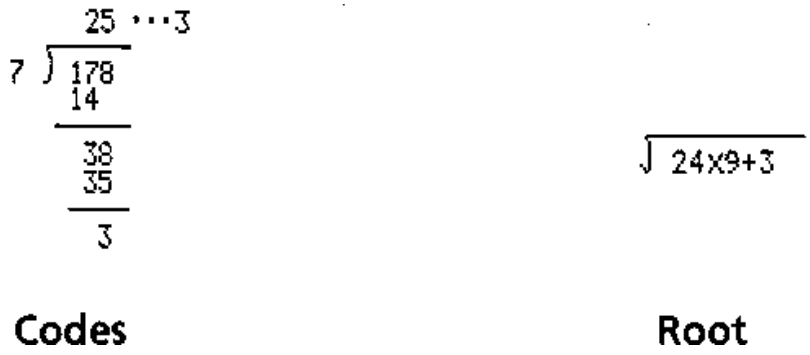


Figure 8-1 Print Sample

(4) Zero font

The zero font (character code 30_H) of the internal ROM can be selected using commands.

Table 8-5 Zero Font Code

ESC+"z"+0 with slash	Ø
ESC+"z"+1 without slash	0

(5) EEPROM internal characters

If using the IFM001-01BM, font characters contained in EEPROM can be selected.

8.2.2 Mode 1

(1) Character font table

In Mode 1, only alphanumeric and Japanese *kana* characters can be used.
Table 8-6 lists the alphanumeric and Japanese *kana* character codes.

Table 8-6 Alphanumeric and Japanese *kana* Character Codes

Lower bits \ Higher bits		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
		0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0	0000			SP	∅	@	P	`	p	—	丄	SP	ー	タ	ミ	=	×
1	0001			!	1	A	Q	a	q	—	丅	。	ア	チ	ム	⊨	円
2	0010			"	2	B	R	b	r	━	⊣	「	イ	ツ	メ	≠	年
3	0011			#	3	C	S	c	s	━	⊢	」	ウ	テ	モ	≡	月
4	0100			$	4	D	T	d	t	▬	—	、	エ	ト	ヤ	◢	日
5	0101			%	5	E	U	e	u	▬	—	・	オ	ナ	ユ	◣	時
6	0110			&	6	F	V	f	v	▬	｜	ヲ	カ	ニ	ヨ	◥	分
7	0111			'	7	G	W	g	w	■	｜	ァ	キ	ヌ	ラ	◤	秒
8	1000		CAN	(	8	H	X	h	x	▏	⌜	ィ	ク	ネ	リ	♠	〒
9	1001			)	9	I	Y	i	y	▏	⌝	ゥ	ケ	ノ	ル	♥	市
A	1010	LF		*	:	J	Z	j	z	▌	⌞	ェ	コ	ハ	レ	♦	区
B	1011		ESC	+	;	K	[	k	{	▌	⌟	ォ	サ	ヒ	ロ	♣	町
C	1100			,	<	L	¥	l	¦	▌	⌜	ャ	シ	フ	ワ	●	村
D	1101	CR		−	=	M	]	m	}	▌	⌝	ュ	ス	ヘ	ン	○	人
E	1110	SO		.	>	N	^	n	~	■	⌞	ョ	セ	ホ	ミ	／	▩
F	1111	SI		/	?	O	−	o	SP	+	゜	ッ	ソ	マ	°	＼	

- SP means space.
- Codes for blanks are ignored.
- Thick bordered cells indicates function codes.

(2) International characters

The following character codes of the internal ROM can be replaced with the characters of each international character, by using commands.

23_H, 24_H, 40_H, $5B_H$, $5C_H$, $5D_H$, $5E_H$, 60_H, $7B_H$, $7C_H$, $7D_H$, $7E_H$

Table 8-7 International Character Codes

n	Hexadicimal / Character set	23	24	40	5B	5C	5D	5E	60	7B	7C	7D	7E
0	Japan	#	$	@	[	¥	]	^	`	{	¦	}	~
1	France	#	$	à	°	Ç	§	^	`	é	ù	è	¨
2	Germany	#	$	§	Ä	Ö	Ü	^	`	ä	ö	ü	ß
3	U.K.	£	$	@	[	\	]	^	`	{	¦	}	~
4	Sweden	#	¤	É	Ä	Ö	Å	Ü	é	ä	ö	å	ü
5	Italy	#	$	@	°	\	é	^	ù	à	ò	è	ì
6	America	#	$	@	[	\	]	^	`	{	¦	}	~

(3) Special characters

The following character codes of the internal ROM can be replaced with the characters of each special character, by using commands.

$F9_H$ to FD_H

Table 8-8 Special Character Codes

Codes	F9H	FAH	FBH	FCH	FDH
Characters at initialization	市	区	町	村	人
ESC"c"	Σ	μ	Ω	π	σ

8.2.3 Mode 2

(1) Character font table

In Mode 2, only alphanumeric and Japanese *kana* characters can be used.
Table 8-9 lists the alphanumeric and Japanese *kana* character codes.

Table 8-9 Alphanumeric and Japanese *kana* Character Codes

Higher bits / Lower bits		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
		0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0	0000			SP	℘	@	P	`	p			SP	ー	タ	ミ		
1	0001			!	1	A	Q	a	q			。	ア	チ	ム		
2	0010			"	2	B	R	b	r			「	イ	ツ	メ		
3	0011			#	3	C	S	c	s			」	ウ	テ	モ		
4	0100			$	4	D	T	d	t			、	エ	ト	ヤ		
5	0101			%	5	E	U	e	u			・	オ	ナ	ユ		
6	0110			&	6	F	V	f	v			ヲ	カ	ニ	ヨ		
7	0111			'	7	G	W	g	w			ァ	キ	ヌ	ラ		
8	1000		CAN	(	8	H	X	h	x			ィ	ク	ネ	リ		
9	1001			)	9	I	Y	i	y			ゥ	ケ	ノ	ル		
A	1010			*	:	J	Z	j	z			ェ	コ	ハ	レ		
B	1011			+	;	K	[	k	{			ォ	サ	ヒ	ロ		
C	1100			,	<	L	¥	l	¦			ャ	シ	フ	ワ		
D	1101	CR		−	=	M	]	m	}			ュ	ス	ヘ	ン		
E	1110			.	>	N	^	n	~			ョ	セ	ホ	ミ		
F	1111			/	?	O	−	o	SP			ッ	ソ	マ	°		

- SP means space.
- Codes for blanks are ignored.
- Thick bordered cells indicates function codes.

CHAPTER 9

ELECTRICAL CHARACTERISTICS

9.1 GENERAL CHRARACTERISTICS

Table 9-1 General Characteristics

Item	Symbol	Condition	Specification			Unit
			MIN	TYP	MAX	
Logic power voltage	Vcc		4.5	5.0	5.5	V
Reset voltage	VR	Vcc: high → low	3.5	3.6	3.7	V
Printer mechanism voltage	V_p		4.0	5.0	6.0	V
Circuit current consumption	Icc1	In standby mode	—	4.6	17.0	mA
	Icc2	During standby	—	11.3	27.0	mA
	Icc3	During printing	—	13.3	30.0	mA
Printer mechanism current consumption	Ip1	Duringstandby	—	6.0	9.0	mA
	Ip2	During feeding paper (Vp=5V)	—	125.0	250.0	mA
	Ip3	During feeding paper (Vp=6V)	—	135.0	270.0	mA

9.2 PRINTER INTERFACE CONDITIONS

Table 9-2 Printer Interface Conditions (CN1)

(Vcc=5.0 V, Ta=0 °C to 50 °C)

Item		Symbol	MIN	TYP	MAX	Unit	Measuring Condition
Head drive output	output voltage	VHCE (sat)	—	—	0.6	V	Iout=450mA
Motor drive output	output voltage	VMCE (sat)	—	—	0.4	V	Iout=500mA
Home switch input	Switch current		—	—	0.25	mA	
	ON detection resistance		—	—	1.0	KΩ	
TG signal input High/Low detection level		TGV	—	0.6	—	V	

9.3 INPUT / OUTPUT SIGNAL CONDITIONS

Table 9-3 Input/Output Signal Conditions (CN2)

(Vcc=5.0 V, Ta=0 °C to 50 °C)

Item		Symbol	MIN	TYP	MAX	Unit
Schmitt trigger input voltage *1 PS,!FEED,!SSBY,!STROBE		Vt- Vt+ (Vt+)-(Vt-)	1.0 — 0.4	— — —	— Vcc × 0.7 —	V V V
High input voltage	!INIT input	Vih	3.5	—	Vcc	V
	*1, input terminals other than !INIT	Vih	2.0	—	Vcc+0.3	V
Low input voltage	!INIT input	Vil	0	—	1.0	V
	*1, input terminals other than !INIT	Vil	-0.3	—	0.8	V

Table 9-4 Output Signal Coditions (CN2)

(Vcc=5.0 V, Ta=0 °C to 50 °C)

Item		Symbol	MIN	TYP	MAX	Unit	Measuring Condition
High output voltage	All output terminals	Voh	Vcc-0.5	—	—	V	Ioh=-200µA
		Voh	3.5	—	—	V	Ioh=-1.0mA
Low output voltage	All output terminals	Vol	—	—	0.4	V	Iol=1.6mA
Input pull-up MOS current		-Ip	30	—	250	µA	Vin=0V

9.4 CONNECTOR LIST

Table 9-5 Connector List

Connector No.	Maker	Model Name
CN1	Hirose	A1-16PA-2.54DSA
CN2	Hirose	A3B-28PA-2DSA

* Refer to section 6.6, Interface Board Connection Sample, for a list of recommended crimp sockets and crimp terminals.

APPENDIX A

COMMAND INDEX

<Mode 0>

(1) Byte function codes

Function Code	Name	Page
HT	Horizontal tabulation	7-3
LF	Line feed	7-3
CR	Carriage return	7-3
SO	Double-width (with automatic reset) ON	7-4
DC4	Double-width (with automatic reset) OFF	7-4
CAN	Cancel	7-4

(2) Escape sequences

Function Code	Name	Page
ESC+SP+n	Character spacing	7-5
ESC+”@”	Reset	7-5
ESC+”I”+n	Inverse print	7-6
ESC+”K”+n1+n2+image data	Bit image	7-6
ESC+”Q”+n	Right margin	7-7
ESC+”W”+n	Double-width	7-7
ESC+”l”+n	Left margin	7-8

(3) Font extended function codes

Function Code	Name	Page
ESC+”R”+n	International character set	7-9
ESC+”c”+n	Special character	7-10
ESC+”t”+n	Character table select	7-10
ESC+”z”+n	Zero font	7-11

(4) EEPROM function codes

Function Code	Name	Page
ESC+”%”+n	Font	7-12
ESC+”&”+n+m+font data	Download 8 × 6 font	7-13
ESC+”:”+s+n+m	Character set copy	7-14
ESC+”:”+s+SP+SP	Download character clear	7-14
ESC+”:”+SP+n	Change default value of character spacing	7-15

(5) Other codes

Function Code	Name	Page
DC2+”stp”	Set to software standby mode	7-16

<Mode 1>

(1) Byte function codes

Function Code	Name	Page
LF	Line feed	7-18
CR	Carriage return	7-19
SO	Double-width ON	7-19
SI	Double-width OFF	7-19
CAN	Cancel	7-19

(2) Escape sequences

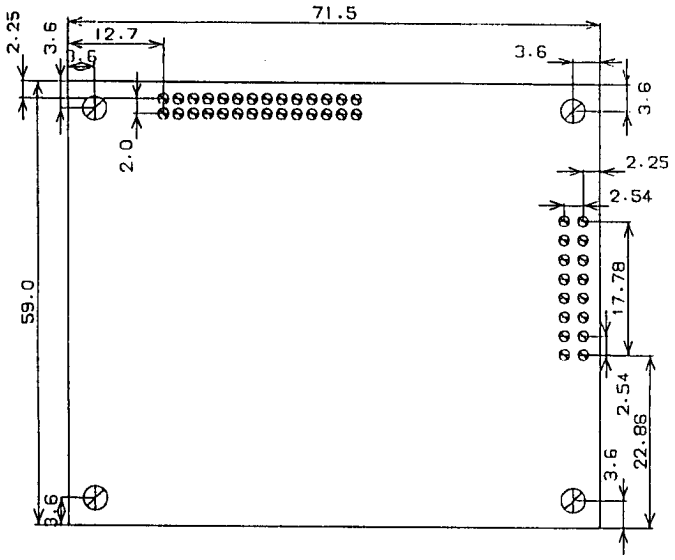
Function Code	Name	Page
ESC+”S”+”n1n2n3n4”+image data	Bit image (software graphic mode)	7-20
ESC+”c”	Special character	7-21
ESC+”R”+n	International character set	7-22

<Mode 2>

Function Code	Name	Page
CR	Carriage return	7-23
CAN	Cancel	7-23

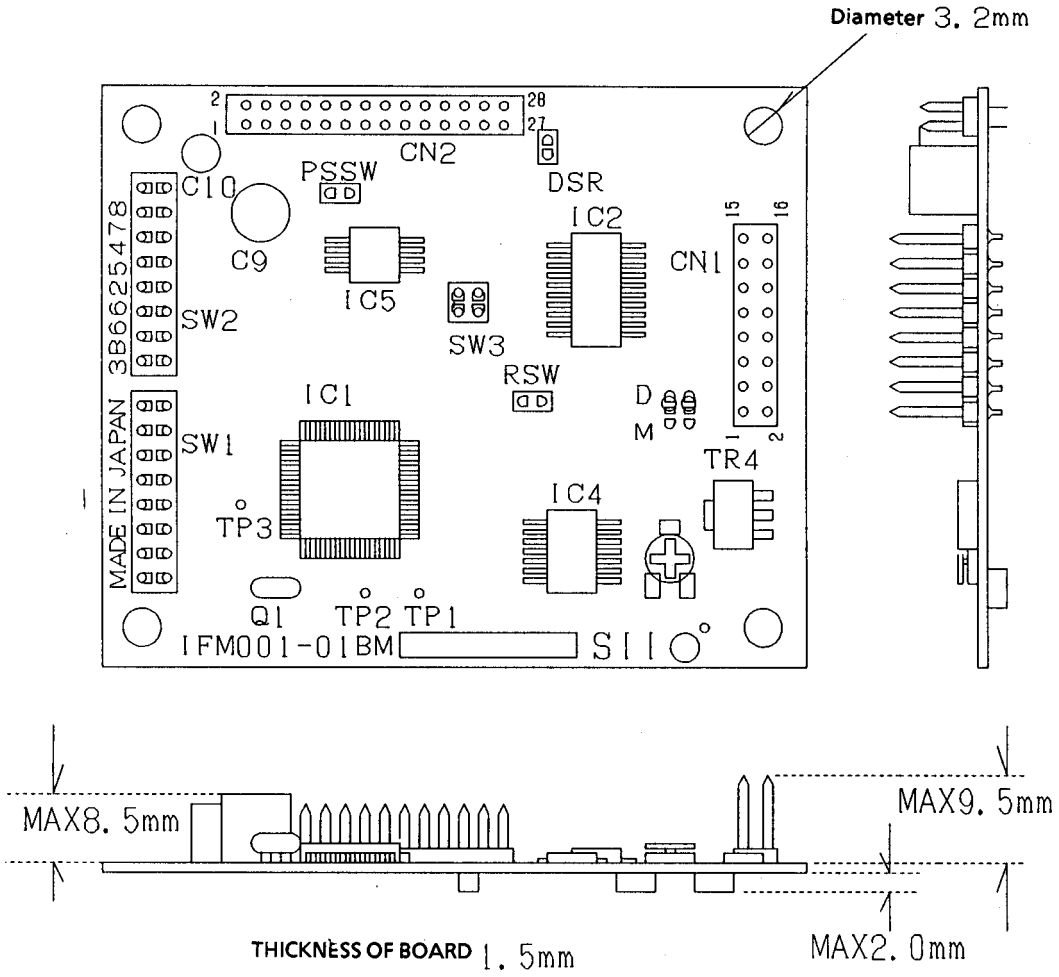
APPENDIX B

DIMENSIONS AND BOARD AFTER MOUNTING



[Unit : mm]

Figure B-1 Dimensions



[Unit : mm]

Figure B-2 Board After Mounting

APPENDIX C

CIRCUIT DIAGRAM AND PARTS LIST

Table C-1 lists the parts used in the IFM001-01BM circuit and Figure C-1 shows the IFM001-01BM circuit. The part surrounded by the dotted line in Figure C-1 is not included on the IFM001-01B.

Table C-1 Parts List

Part Name	Type Number	Vendor	Remarks
CPU	HD6433238R43F	Hitachi, Ltd.	IC1
Driver	LB1256M	Sanyo	IC2
Reset IC	S-80736AN-D0	SII	IC3
IC	TC4069UBF	Toshiba	IC4
EEPROM	X24C16S8	Xicor	IC5
Transistor	2SC2462LC	Hitachi, Ltd.	TR1, TR2
Transistor	DTC123EK	Rohm	TR3, TR6
Transistor	2SD1699	NEC	TR4
Transistor	2SD999	NEC	TR5
Diode	HSM221C	Hitachi, Ltd.	D1
Diode	HSM123	Hitachi, Ltd.	D2
Ceramic Oscillator	CST4.91MGW	Murata	Q1
Variable resistance	RH03A3CS4J01A	Alps	VR1 (47K)
Carbon film resistor	RMC1/10 472JAB	Kamaya	R1 (4.7K)
Carbon film resistor	RMC1/10 222JAB	Kamaya	R2, R8 (2.2K)
Carbon film resistor	RMC1/10 104JAB	Kamaya	R3, R7, R14 (100K)
Carbon film resistor	RMC1/10 102JAB	Kamaya	R4, R15 (1K)
Carbon film resistor	RMC1/10 103JAB	Kamaya	R5, R6, (10K)
Carbon film resistor	RMC1/10 164JAB	Kamaya	R9 (160K)
Carbon film resistor	RMC1/10 123JAB	Kamaya	R10 (12K)
Carbon film resistor	RMC1/10 223JAB	Kamaya	R11, R12, (22K)
Carbon film resistor	RMC1/10 271JAB	Kamaya	R16 (270)
Ceramic condenser	GRM40F104Z25PB	Murata	C1 to C6, C11 (0.1μF)
Ceramic condenser	GRM40CH821J50PB	Murata	C7, C8 (820pF)
Electrolytic capacitor	25MS7100M	Rubikon	C9 (100μF/25V)
Electrolytic capacitor	25MS7A4R7M	Rubikon	C10 (4.7μF/25V)
Connector	A1-16PA-2.54DSA	Hirose	CN1
Connector	A3B-28PA-2DSA	Hirose	CN2

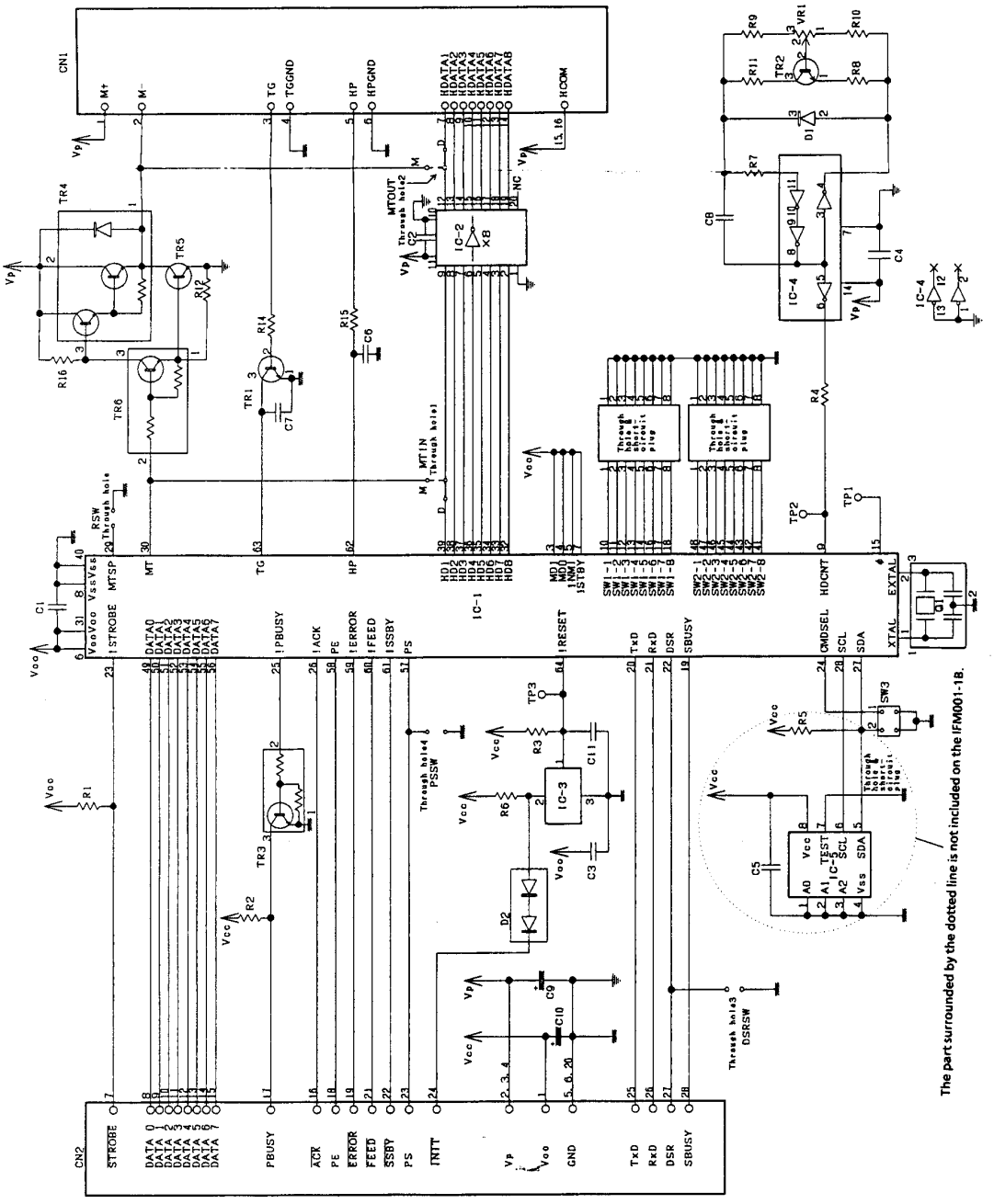


Figure C-1 IFM001-01BM Circuit