

CITIZEN

User's Manual

CONTROL BOARD FOR MLT-288/MLT-289
MODEL BD2-2880/2890

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Japan CBM Corporation

REVISION

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0.00	2000.06.26	Newly authored as a tentative edition for CS products reference.
1.00	2002.08.09	Cover, Page 1, 2, 3, 7, 9 is changed.
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1. OUTLINE

This control boards is designed to be used to control our thermal printer, “MLT-288/289” series through the computer etc.

As being provided with many abundant functions, it can be used widely in various applications. Before you start using it, read this manual thoroughly and understand the content.

1.1 Features

- (1) Ultra compact
- (2) Both interface of Serial and Parallel can be selected by dip switch.
- (3) Input buffer incorporated.
- (4) Bar code printing is available (dedicated command).
- (5) Auto paper cutter control incorporated.
- (6) User-defined character registration function (94 characters)
- (7) Low cost

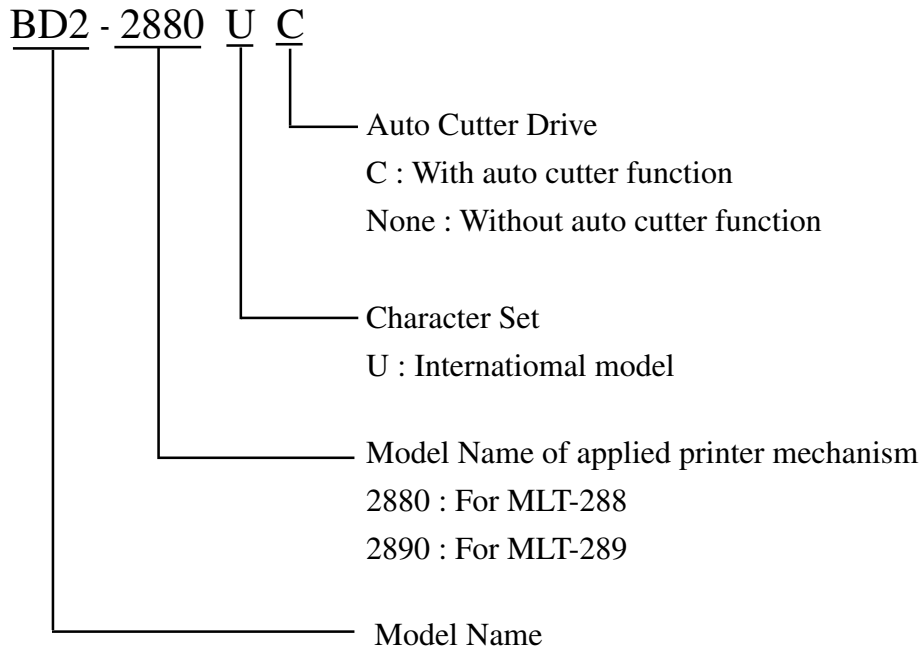
1.2 Precaution

- (1) Make sure to turn OFF the power supply in case of connecting/disconnecting the connectors.
- (2) Absolutely do not make a short circuit between the terminals of connectors.
- (3) Use power supply, LED, interface etc. following their specifications.
- (4) Use the recommended paper shown below.
 - Thermal Paper TF5KS-E2D (Nippon paper)
KF50-HDA (Shin-Oji paper)
F220VP, HP220A (Mitsubishi paper)

2. BASIC SPECIFICATIONS

2.1 Model Classification

Models are identified by the following coding scheme:



2.2 Basic Specifications

Items	Contents
Printing system	Thermosensitive dot-matrix printing
Print width	48 mm
Print Speed	420 dot line/sec
Number of columns	Font A : 32 columns
	Font B : 42 columns
Character dimensions	Font A : 1.25 mm × 3.00 mm
	Font B : 0.88 mm × 3.00 mm
Character types	Alphanumeric, international characters
Bar code type	UPC-A/E, JAN (EAN) 13/8 columns, ITF CODE 39, CODE128, CODABAR
Line pitch	4.23 mm (Can be changed by command)
Interface	Parallel (Conforms to Centronics) or Serial (Conforms to RS-232C) (Selectable by dip switch)
Input buffer	2 K bytes
Supply voltage	VCC: 5V ± 5 % Approx. 130 mA (Self printing) VP : 4.2V ~ 8.5V Approx. 1.5A (Ave) Approx. 4A (Peak) When 7.2V Ordinal voltage is to be 7.2V (Max) 8.5V is a voltage, which is right after charging.
Weight	Approx. 40 g
Outer Dimension	75 mm (W) × 80 mm (D) (For height of component parts, see outer drawing.)
Operating Environment	5 ~ 40°C , 35 ~ 85% RH (with no dew condensation)
Storage Environment	-20 ~ 60°C , 10 ~ 90% RH (with no dew condensation)

3. CONNECTING CONNECTORS

3.1 CN1 Connector for Printer Mechanism (For Print Head)

Pin No.	Signal Name	I/O	Function
1	VH	–	Power for print head
2	VH	–	Power for print head
3	SI	Output	Head data output signal
4	GND	–	GND
5	TM	Input	Thermistor
6	STRB 1	Output	Strobe 1
7	STRB 2	Output	Strobe 2
8	Vdd	–	Thermal head logics power (+5V)
9	LATCH	Output	Latch signal
10	GND	–	GND
11	STRB 6	Output	Strobe 6
12	CP	Output	Clock pulse
13	GND	–	GND
14	STRB 5	Output	Strobe 5
15	STRB 3	Output	Strobe 3
16	GND	–	GND
17	GND	–	GND
18	STRB 4	Output	Strobe 4
19	GND	–	GND
20	GND	–	GND
21	GND	–	GND
22	VH	–	Power for print head
23	VH	–	Power for print head
24	VH	–	Power for print head

Applicable Connector : 52806-2410 (Molex)

3.2 CN2 Connector for Print Mechanism (For Motor & Sensor)

Pin No.	Signal Name	I/O	Function
1	MOTOR B	Output	Operation signal for motor B
2	MOTOR A	Output	Operation signal for motor A
3	MOTOR B	Output	Operation signal for motor B
4	MOTOR A	Output	Operation signal for motor A
5	PE C	Input	Photo-transistor collector (Paper sensor)
6	GND	–	Photointerruptor emitter + cathode
7	PE A	–	Photo-LED anode (Paper sensor)
8	H-UP	Input	Head-up signal
9	GND	–	Head-up sensor GND

Applicable Connector : 53047-0910 (Molex)

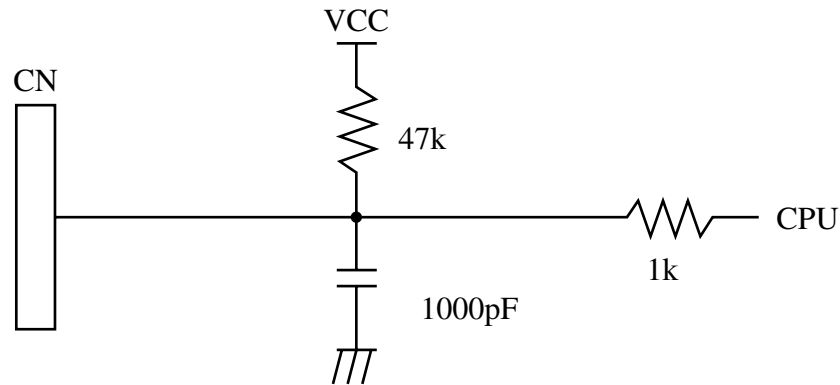
3.3 CN3 Connector for Interface

Pin No.	Signal Name	I/O	Function
1	Vcc	—	Power supply for circuit (5V)
2	Vcc	—	Power supply for circuit (5V)
3	GND	—	GND
4	GND	—	GND
5	Vp	—	Power supply for operation
6	Vp	—	Power supply for operation
7	Vp	—	Power supply for operation
8	Vp	—	Power supply for operation
9	Vp	—	Power supply for operation
10	Vp	—	Power supply for operation
11	P-GND	—	GND for operation
12	P-GND	—	GND for operation
13	P-GND	—	GND for operation
14	P-GND	—	GND for operation
15	P-GND	—	GND for operation
16	P-GND	—	GND for operation
17	LF-SW	Input	LF Switch input
18	ERROR	Output	ERROR LED output (Can be connected directly)
19	PEout	Output	PE LED output (Can be connected directly)
20	DTR	Output	Serial Interface DTR
21	TXD	Output	Serial Interface TXD
22	RXD	Input	Serial Interface RXD
23	DSR	Input	Serial Interface DSR
24	DATA0	Output	Parallel Interface DATA0
25	DATA1	Output	Parallel Interface DATA1
26	DATA2	Output	Parallel Interface DATA2
27	DATA3	Output	Parallel Interface DATA3
28	DATA4	Output	Parallel Interface DATA4
29	DATA5	Output	Parallel Interface DATA5
30	DATA6	Output	Parallel Interface DATA6
31	DATA7	Output	Parallel Interface DATA7
32	STB	Output	Parallel Interface STB
33	BUSY	Output	Parallel Interface BUSY
34	FAULT	Output	Parallel Interface FAULT
35	SELECT	Output	Parallel Interface SELECT
36	PE	Output	Parallel Interface PE
37	NC	Output	Parallel Interface ACK
38	NC	—	No Connection
39	SELECTIN	—	No Connection
40	RESET	Input	Parallel Interface RESET

Applicable Connector : 53313 - 4015 (Molex)

⚠ CAUTION:

1. For LED of $\overline{\text{ERROR}}$ and $\overline{\text{PE}}$, there is a resistor of 330Ω on the circuit side to make current value 10 mA.
Please use LED which its voltage is approx. 2V. LED over 10 mA may break a control board.
2. Control circuit requires power supply only for one pin of each VCC and GND.
However, Operation voltage is to be supplied to all of pin for safety use.
3. Serial interface equips a driver and receiver of RS-232C, make sure to use it at RS-232C level.
4. RESET terminal is pulled up by $3.3K\Omega$. Make sure to make this terminal NC, when this terminal is not used.
5. LF-SW input circuit is as below.



3.4 CN4 Connector for Paper Cutter

Pin No.	Signal Name	I/O	Function
1	M+	Output	Cutter motor operational signal M +
2	M-	Output	Cutter motor operational signal M -
3	GND	—	GND
4	SW	Input	Cutter switch input signal

Using Connector : 5267- 04A-X (Molex)

Note: Use the specified Paper Cutter (Model Name : ACS-220-5V)

4. DIP SWITCH SETTING

(1) DIP SWITCH

Pin No.	Function	ON	OFF	Factory Setting
DS1-1	Auto Cutter	Enable	Disable	OFF
1-2	CR Selection	LF Enable	LF Disable	ON
1-3	Print Density	Combination with J-6 (See next page (5))		OFF
1-4	DTR/XON-XOFF	XON-XOFF	DTR/DSR	OFF
1-5	Baud Rate	See below (3)		OFF
1-6	"			OFF
1-7	"			OFF
1-8	"			OFF

(2) JUMPER

Pin No.	Function	Short	Open	Factory Setting
J1	International Character set	See next page (4)		Short circuit
J2	"			Short circuit
J3	"			Short circuit
J4	Paper Auto Loading	Enable	Disable	Short circuit
J5	Print Drive System	Variable division	Fixed division	Short circuit
J6	Print Density (Supplementary)	Combination with DS1-3 See next page (5)		Short circuit
J7	Not Used	-		Short circuit
J8	Mechanism	MLT-288	MLT-289	Short circuit

*1

*1 : BD2-2890 is set to open circuit.

(3) INTERFACE & BAUD RATE

DS1-8	DS1-7	DS1-6	DS1-5	Input Method	Parity	Baud Rate
OFF	OFF	OFF	OFF	Parallel Input	-	-
OFF	OFF	OFF	ON	Serial Input	None	1200 bps
OFF	OFF	ON	OFF	"	"	2400 bps
OFF	OFF	ON	ON	"	"	4800 bps
OFF	ON	OFF	OFF	"	"	9600 bps
OFF	ON	OFF	ON	"	"	19200 bps
OFF	ON	ON	OFF	"	Odd	1200 bps
OFF	ON	ON	ON	"	"	2400 bps
ON	OFF	OFF	OFF	"	"	4800 bps
ON	OFF	OFF	ON	"	"	9600 bps
ON	OFF	ON	OFF	"	"	19200 bps
ON	OFF	ON	ON	"	Even	1200 bps
ON	ON	OFF	OFF	"	"	2400 bps
ON	ON	OFF	ON	"	"	4800 bps
ON	ON	ON	OFF	"	"	9600 bps
ON	ON	ON	ON	"	"	19200 bps

(4) INTERNATIONAL CHARACTER SET

J-3	J-2	J-1	InternationalCharacter
Open	Open	Open	Japan (JIS)
Open	Open	Short	Japan (Shift-JIS)
Open	Short	Open	Sweden
Open	Short	Short	Denmark 1
Short	Open	Open	U.K.
Short	Open	Short	Germany
Short	Short	Open	France
Short	Short	Short	U.S.A

(5) PRINT DENSITY

DS1-3	J-6	Print Density	Level	Print Density Rate
OFF	Open	Light	0	80%
OFF	Short	Standard	1	100%
ON	Open	Slightly Dark	2	120%
ON	Short	Dark	3	150%

Note:

1. Input Buffer is 2k byte. (Fixed)
 2. Serial data length is 8 bits. (Fixed)
- If print tone is set at 2 or above, printing rate tends to be lowered.

5. POWER SUPPLY

5.1 Specifications

VCC : 5V \pm 5% Approx. 130 mA

VP : 4.2V ~ 8.5V Approx. 1.5A (Peak : Approx. 4A) when 7.2V

Ordinal Voltage is to be 7.2V (Max). 8.5V is a voltage that is right after charging.

8.5V cannot be used for ordinal voltage.

5.2 Precautions

- (1) Design the product to supply power to Vcc before VP when power is supplied to this control board.
- (2) Design the product to turn off the power for Vcc after VP when power is turned off.
- (3) Make sure to turn off the power in case of connecting/disconnecting connectors.
- (4) Make sure to use Vcc and VP following their specifications.
- (5) Make sure to use this control board connecting all of terminals between VP and P-GND.

6. PARALLEL INTERFACE

6.1 Specifications

Data input method : 8 bit parallel signal (DATA0~7)
 Control signals : $\overline{\text{ACK}}$, BUSY, $\overline{\text{STB}}$, $\overline{\text{FAULT}}$, PE, $\overline{\text{RESET}}$

6.2 Explanation of Input/Output Signals

DATA0~7 : 8 bit parallel signal (Positive logic)

$\overline{\text{STB}}$: Strobe signal to read 8 bit data (Negative logic)

$\overline{\text{RESET}}$: Signal to reset control board (Negative logic)

$\overline{\text{ACK}}$: 8 bit data request signal. Pulse signal output at the end of the BUSY signal (Negative logic)

BUSY : Signal to indicate BUSY state of the printer. Input new data for "LOW" (Positive logic)

$\overline{\text{FAULT}}$: Signal which is made "LOW" when printer is in alarm state. (Negative logic)
 In this case all the control logics within the printer stop functioning.

PE : Signal which is output when paper runs out. (Positive logic)

6.3 Electrical Characteristics

(1) Input Signal Level

"HIGH" level : 0.7 Vcc MIN
 "LOW" level : 0.3 Vcc MAX

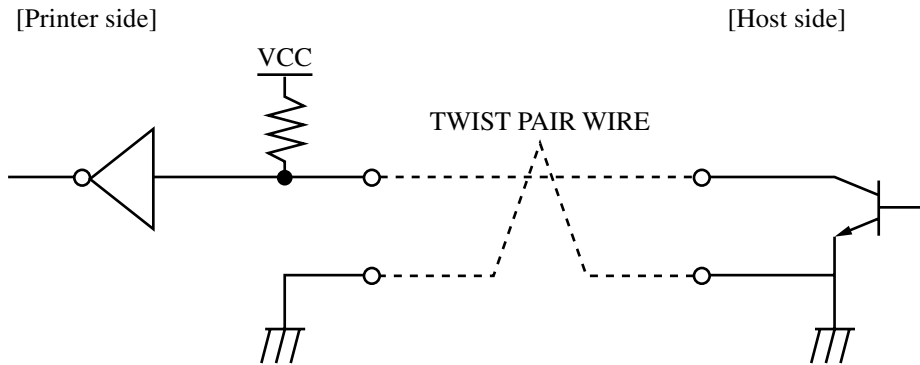
(2) Output Signal Level

"HIGH" level : Vcc - 0.1V MIN
 "LOW" level : 0.1V MAX

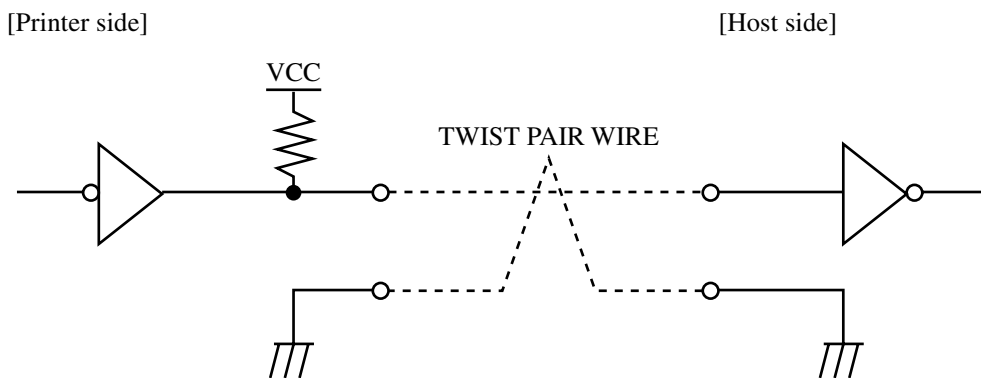
(3) I/O Conditions

$\overline{\text{STB}}$, $\overline{\text{RESET}}$ input signals are pulled up by 3.3K .

Other input signals are pulled up by 50K .

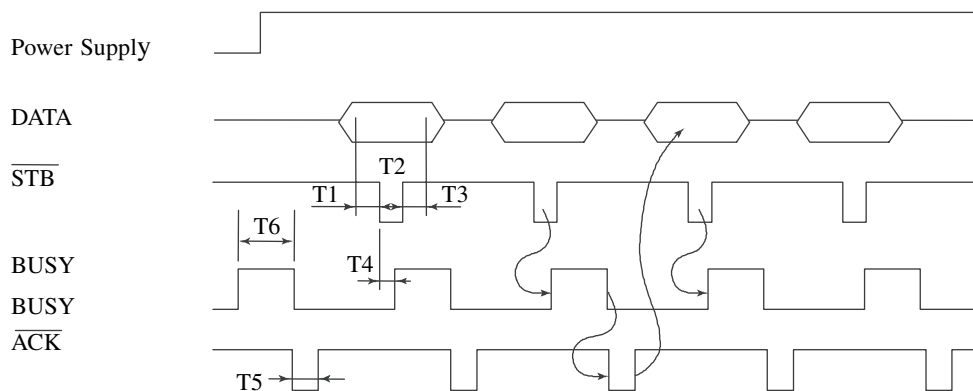


All the output signals are pulled up by 50K



6.4 Timing Chart

(1) Data Input and Printing Timing



- T1, T2, T3 : 0.5 μ s (MIN)
- T4 : 270 ns (MAX)
- T5 : 2.3 μ s (TYP)
- T6 : 500 ms (MIN) *On supplying power

6.5 Data Receiving Control

When BUSY signal is “LOW”, data from the host can be received. When it being “HIGH”, data cannot be received.

6.6 Buffering

This control board incorporates 2K byte buffer.

Therefore, big data can be buffered in input buffer, and the host side can be released immediately.

7. SERIAL INTERFACE

7.1 Specifications

(1) Data transfer system: Asynchronous

(2) Baud rates

1200, 2400, 4800, 9600, 19200 bps (Selectable by user)

(3) Configuration of one word

Start bit	:	1 bit
Data bit	:	8 bits Fixed
Parity bit	:	Odd/Even or No parity (Selectable by user)
Stop bit	:	1 bit or more

(4) Signal polarity

RS-232C		
• Mark	=	logic "1" (-3V ~ -12V)
• Space	=	logic "0" (+3V ~ +12V)

(5) Receiving data (RD signal)

RS-232C		
• Mark	=	1
• Space	=	0

(6) Receiving control (DTR signal)

RS-232C		
• Mark	:	Data transfer is not available
• Space	:	Data transfer is available

(7) Transmission control (TD signal)

DC1 code (11H) X-ON	:	Data reception is available
DC3 code (13H) X-OFF	:	Data reception is not available

7.2 Explanation of Input/Output Signals

(1) RXD

Serial receiving data signal. On occurrence of framing error, overrun error, or parity error, the data is printed as “?”.

(2) DTR

When this signal is READY, write data or a command. When they are written in BUSY, overrun error is occurred and data is ignored. Data can be written into the input buffer even when the printer is busy printing. A BUSY also occurs when the printer is powered on, in test print, in Online mode, or being reset.

(3) TXD

If data remaining in the printer's input buffer is 256 bytes or less, the printer transfers a DC3 (13H: Data Receive Not Ready) signal to the host. If data in the input buffer exceeds 256 bytes, the printer transfers a DC1 (11H: Data Receive Ready) signal to the host.

(4) GND

Common GND on the circuit.

7.3 Error Detection

Parity, framing, and overrun are detected. On detection of any error, the data are stored in the buffer as “?”.

(1) Framing Error

With “space” state having been detected on detection of a stop bit, error takes place. The data are stored in the buffer as “?”.

(2) Parity Error

With an error having been detected under specifying parity check, the data is stored in the buffer as “?”.

(3) Overrun Error

On detection of an overrun error, the data are stored in the buffer as “?”.

7.4 Data Receiving Control

When DTR/DSR control having been selected, with BUSY signal at “LOW”, data from the host side are received. With the signal at “HIGH”, they can not be received.

When DTR/DSR control not having been selected, after X-ON transmission, data is received from the host side. No transmission of data can take place after X-OFF is transmitted.

7.5 Buffering

Data transfer to the input buffer include DTR signals and TD signals as the control signals concerned.

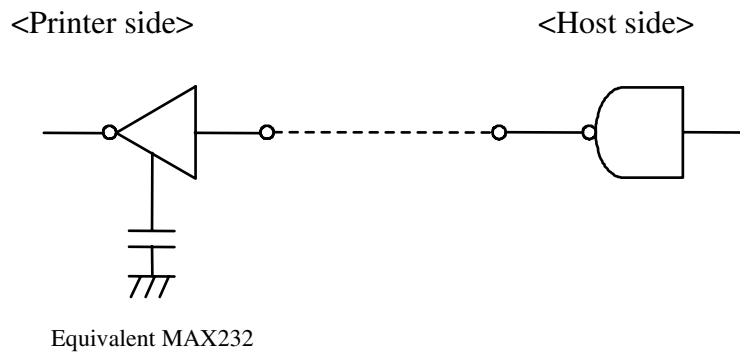
(1) DTR signals (See the page 7.2 (2))

(2) TXD signals (See the page 7.2 (3))

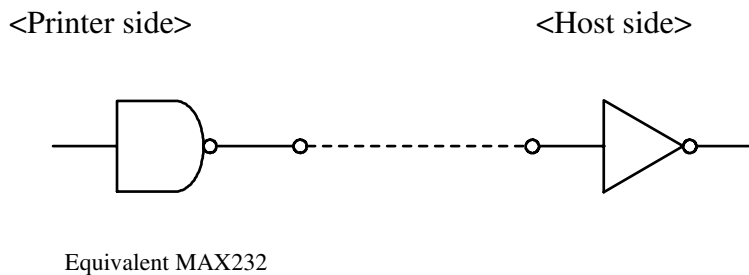
7.6 Electrical Characteristics

(1) RS-232C Circuit

Input (RXD, DSR)



Output (DTR, TXD)



8. ERROR HANDLING

8.1 Peripheral Circuit Errors

These errors are detected at power-on or initialization just after a reset.

(1) Error types

Error	Description
Memory error	The CPU made a self-diagnosis of the circuit and detected an error with the external RAM.
Cutter error	With the auto cutter enabled at the function selection terminal (DS1-1), the auto cutter (ACS-220-5V) is not connected to the cutter connector (CN4).

(2) External signal outputs

Pin No	Signal Name	Remarks
20	$\overline{\text{ERROR}}$	LED output. For a blinking pattern, see 8.3 Error Indication.
22	DTR	Serial interface
27	BUSY	Parallel interface
38	$\overline{\text{FAULT}}$	Parallel interface

(3) Resetting methods

Error	Resetting Method
Memory error	Unrecoverable
Cutter error	After turning off the power, connect the auto cutter (ACS-220-5V) or turn off the function selection terminal (DS1-1) and turn on the power again.

8.2 Operation Errors

(1) Error types

Error	Description
No paper	The printing paper set is not set
Head -up	The head-up lever is at its up position
VH voltage error	A VH voltage is beyond its allowable range (4.2 to 8.5V)
Head temperature error	A head temperature is less than 0°C or 65 °C or higher.
Cutter lock (ACS-220-5V)	When driving the cutter, the cutter is locked due to an external factor (Paper jam, etc.).

⚠Caution: The 8.5V upper-limit voltage for VP voltage error is only an assumptive voltage just after charging the battery when using the battery power. It cannot be normally used. A normal maximum voltage is 7.2V.

(2) External signal outputs

Pin No	Signal Name	Remarks
20	$\overline{\text{ERROR}}$	LED output. For a blinking (Lighting) pattern, see 8.3 Error Indication.
21	$\overline{\text{PE OUT}}$	LED output. This is always output at the time of no paper.
22	DTR	Serial interface
27	BUSY	Parallel interface
37	PE	Parallel interface
38	$\overline{\text{FAULT}}$	Parallel interface

(3) Resetting methods



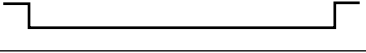
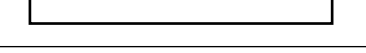
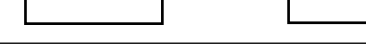
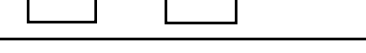
Error	Resetting Method
No paper	Set the paper. See Note 1.
Head -up	Bring down the head-up lever.
VP voltage error	Set to a voltage within the allowable range (4.2 to 8.5V) and turn on the power again. Alternatively, activate the Pin19 (LFSW) of the CN3(interface connector).
Head temperature error	At the lower limit (less than 0 °C), printing becomes operational at 0 °C higher. At the upper limit (65 °C or higher), it become operational at 60 °C or lower.
Cutter lock (ACS-220-5V)	Eliminate paper jam and activate the Pin19(LFSW) of the CN3(Interface Connector) or turn on the power again.

Caution:

1. When auto loading has not been selected with the function selection jumper (J4), set the paper manually. When it has been selected, the auto loading function is enabled to facilitate replacement of the paper.
2. The 8.5V upper-limit voltage for VP voltage error is only an assumptive voltage just after charging the battery when using the battery power. It cannot be normally used. A normal maximum voltage is 7.2V.

8.3 Errors Indication

The errors other than no paper are indicated by a LED output (Illumination or blinking) of the Pin 20 (ERROR) of the CN3 (Interface connector).

Error	Display Pattern	Description
Memory error		Blinking cycle of 200ms
Cutter lock (Cutter error)		Blinking cycle of 150ms(3 times) and 500ms(1 time).
Head -up		Illuminated until reverted
VP voltage error		Illuminated until reverted
Head temperature error		Blinking cycle of 1 sec.
Macro execution wait		Blinking cycle of 500ms.

9. PRINTER MECHANISM CONTROL SYSTEM

9.1 Thermal Head Control System (Division Driving System)

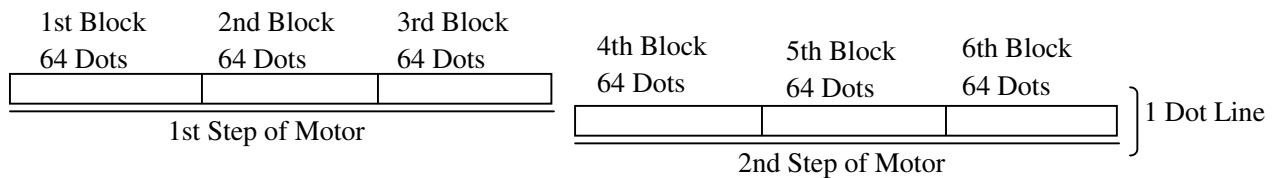
The MLT-288 (Line thermal printer) is driven by this control board has a 384 dots/line head divided into 6 blocks of 64 dots each. When actually driving the head, you can select either Fixed Division Number system, which drives the head, always dividing it into 6 blocks or Variable Division Number system which collectively drives several blocks at the time according to the number of activated head dots.

For selection by function selection, see 4. DIP SWITCH SETTING.

For selection by a command, see 11. PRINT CONTROL FUNCTIONS.

9.1.1 Fixed Division Number System

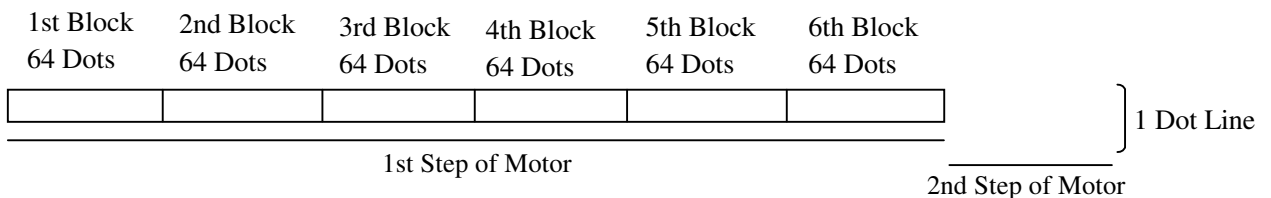
This system always drives each block in the same sequence.



Note: for a stepping motor driving method, see 9.2 Motor Drive.

9.1.2 Variable Division Number System

This system counts the number of printing dots for each block of the printing dot line and drives the blocks collective in such a manner not to exceed the maximum number of driving dots (64 dots).



9.2 Motor Drive

The MLT-288 uses a 4-phase bipolar stepping motor. It feeds the 1 dot line worth of paper in two steps by 2-to-2 phase excitation.

9.2.1 Motor Drive Features

- 1) Drive at an optimum drive speed by the VP voltage.
- 2) Prevents heat generation of the motor by PWM control to restrain current consumption.
- 3) Provides acceleration control at the time of start.

9.2.2 Maximum Motor Drive Speeds at Major Voltage

VH Voltage	Motor Drive Speed
5V	400pps
6V	600pps
7.2V	840pps

Caution: The maximum drive speed depends on the VH voltage.

A printing speed may slightly differ depending on a processing time or voltage detection accuracy. During the course of printing, a motor drive speed may be slower than the maximum drive speed, depending on what is printed or the head divided drive system.

10. MAINTENANCE AND SERVICE

For the information on maintenance and service, please contact our dealer or at the following address.

Northern America

CBM America Corporation

Service Center

363 Van Ness Way Suite 404

Torrance, CA 90501, U.S.A

TEL 310-781-1460

FAX 310-781-9157

Other Areas

Japan CBM Corporation

Information Systems Division

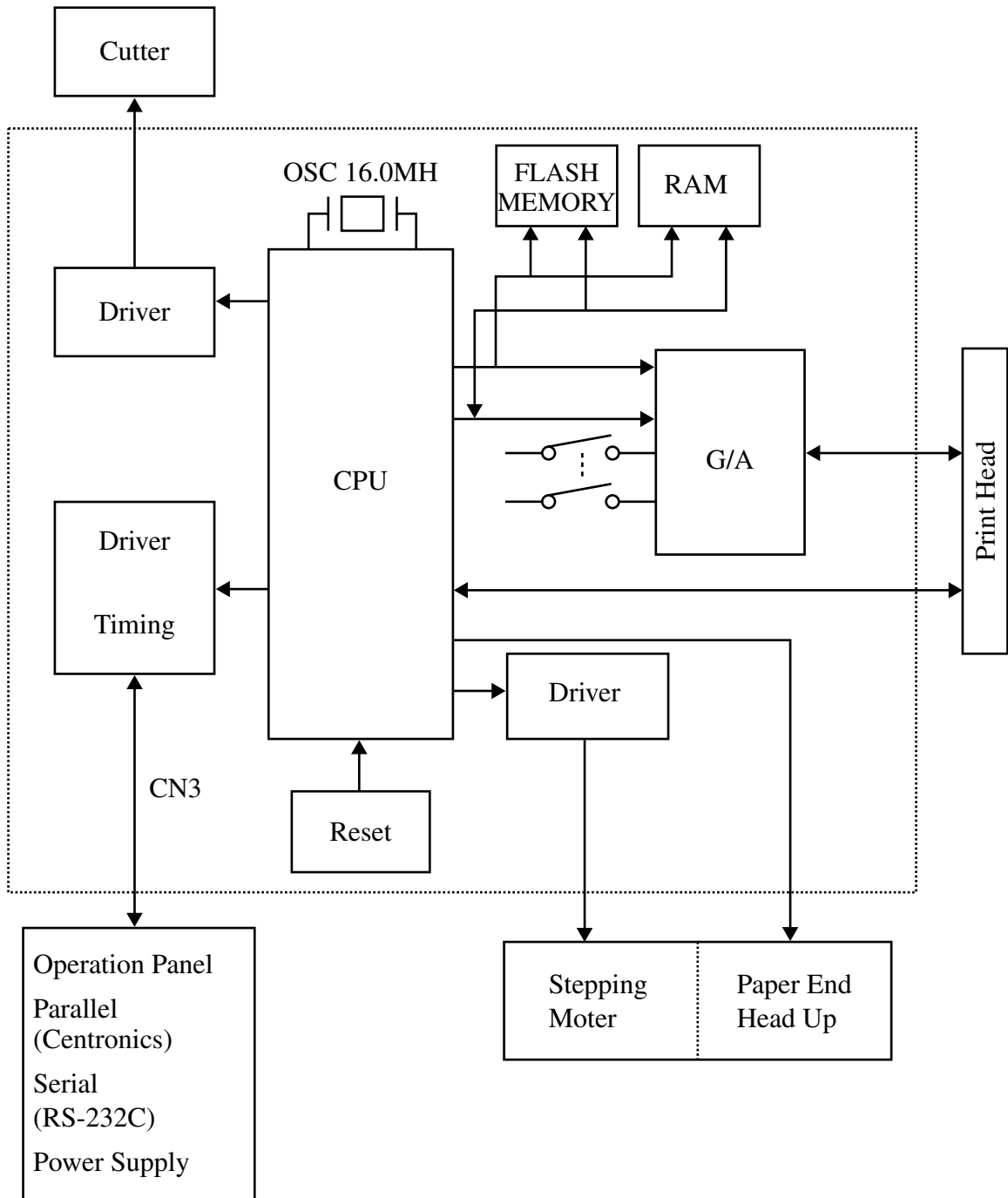
5-68-10, Nakano Nakano-ku,

Tokyo 164-0001 Japan

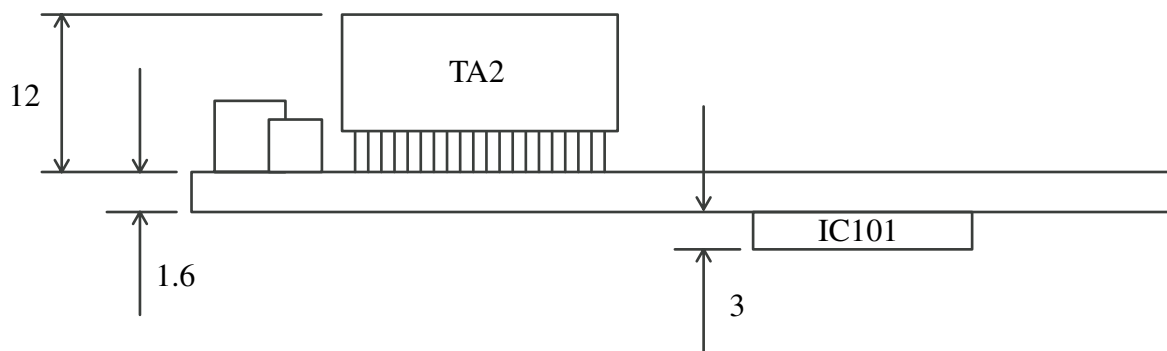
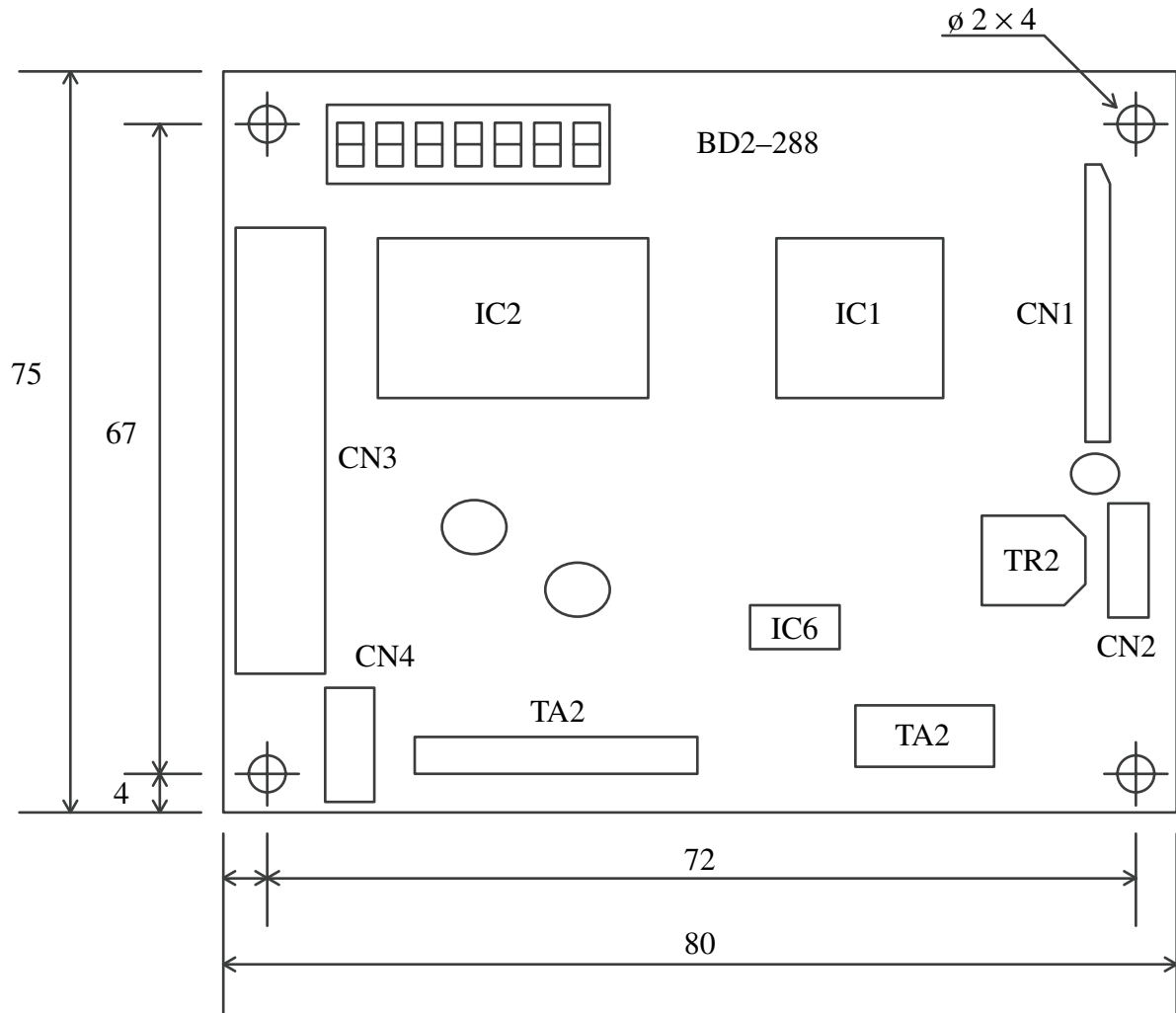
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APPENDIX 1. BLOCK DIAGRAM



APPENDIX 2. OUTER DIMENSION



(Unit : mm)