CITIZEN

User's Manual

CONTROL BOARD FOR MLT-388/MLT-389

MODEL BD2-3880/3890

Rev. 1.00 Newly Issued on October 22, 2004

Japan CBM Corporation

REVISION

Rev. No.	Date	Content
1.00	2003.06.23	Issued as first edition.
1.00	2004.10.22	“3.3 CN3 Connector for Interface” changed

CONTENTS

1. OUTLINE

This control boards is designed to be used to control our thermal printer, "MLT-388/389" 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 (option).
(6) User-defined character registration function (94 characters)
(7) Low cost

1.2 Precaution

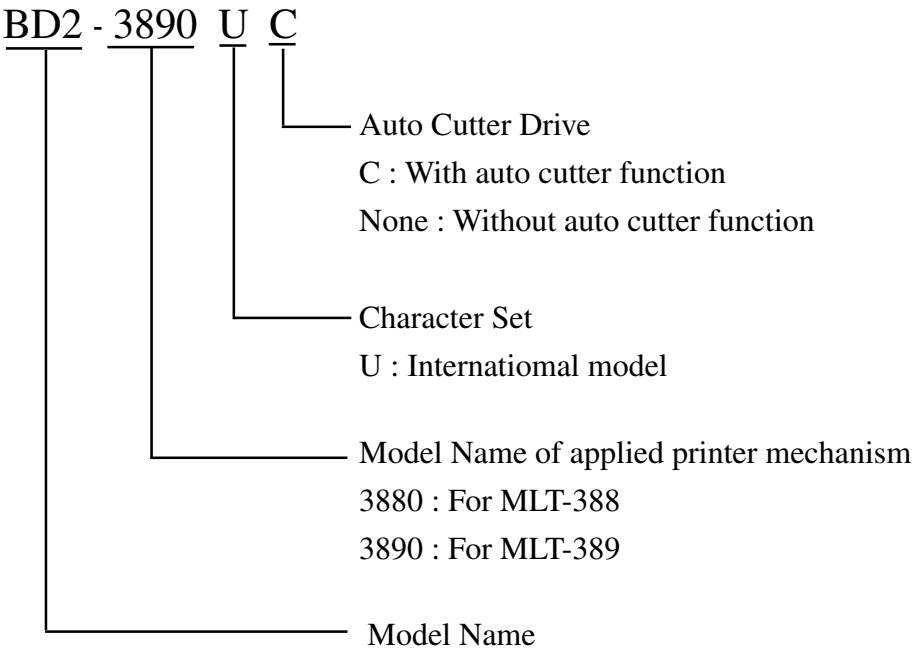
(1) Make sure to turn OFF the power supply in case of connecting/disconnecting the connectors.
(2) Absolutely do not make a short circuit between the terminals of connectors.
(3) Use power supply, LED, interface, etc. following their specifications.
(4) Use the recommended paper shown below.

- Thermal Paper TF50KS-E2D (Nippon paper)
  KF50-HDA (Shin-Oji paper)
  F220VP (Mitsubishi paper) or the equivalent

2. BASIC SPECIFICATIONS

2.1 Model Classification

Models are identified by the following coding scheme:



* Printer model is specified by J8 (jumper).

2.2 Basic Specifications

Items	Contents
Printing system	Thermosensitive dot-matrix printing
Print width	72 mm/576 dots
Print Speed	7.2V: Approx. 60 mm/s within 64 dots, at 35°C or more 5V: Approx. 30 mm/s within 64 dots, at 63°C or more
Number of columns	Font A : 48 columns
	Font B : 64 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	Serial (Conforms to RS-232C) or Parallel (Conforms to Centronics) (Selectable by dip switch)
Input buffer	2 K bytes
Supply voltage	Logic part: 5V ±5% Approx. 130 mA (At ANK slide printing) Drive unit: 4.2V ~ 8.5V Average: 1.5A (Peak: Approx. 4A) → Operating votage is 7.2 V (Max) 8.5 V is a voltage only right after charging. 8.5V cannnot be used for normal voltage.
Weight	Approx. 40 g
Outer Dimension	80 mm (W) × 90 mm (D) (For height of component parts, see outer drawing.)
Operating temperature and humidity	5 ~ 40˚C , 35 ~ 85% RH (with no dew condensation)
Storage temperature and humidity	–20 ~ 60˚C , 10 ~ 90% RH (with no dew condensation)

3. CONNECTING CONNECTORS

3.1 CN1 Connector for Printer Mechanism

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	nSTRB 1	Output	Strobe 1
7	nSTRB 2	Output	Strobe 2
8	nSTRB 3	Output	Strobe 3
9	VDD	—	Thermal head logics power (+5V)
10	nLATCH	Output	Latch signal
11	GND	—	GND
12	nSTRB 9	Output	Strobe 9
13	CP	Output	Clock pulse
14	GND	—	GND
15	nSTRB 8	Output	Strobe 8
16	nSTRB 4	Output	Strobe 4
17	nSTRB 5	Output	Strobe 5
18	nSTRB 6	Output	Strobe 6
19	GND	—	GND
20	nSTRB 7	Output	Strobe 7
21	GND	—	GND
22	GND	—	GND
23	GND	—	GND
24	VH	—	Power for print head
25	VH	—	Power for print head
26	VH	—	Power for print head
27	VH	—	Power for print head
28	VH	—	Power for print head

Applicable Connector: 52806-2810 (Molex)

* First "n" of signal name indicates "L" active signal.

3.2 CN2 Connector for Print Mechanism

Pin No.	Signal Name	I/O	Function
1	MOTOR $\overline{B}$	Output	Operation signal for motor $\overline{B}$
2	MOTOR A	Output	Operation signal for motor A
3	MOTOR B	Output	Operation signal for motor B
4	MOTOR $\overline{A}$	Output	Operation signal for motor $\overline{A}$
5	PE C	Input	Photointerruptor collector (Paper sensor)
6	GND	—	Photointerruptor emitter + cathode
7	PE A	—	Photointerruptor anode (Paper sensor)
8	H-UP	Input	Platen not mounted signal (MLT-389) Head-up signal (MLT-388)
9	GND	—	Head-up sensor GND

Applicable Connector: 53047-0910 (Molex)

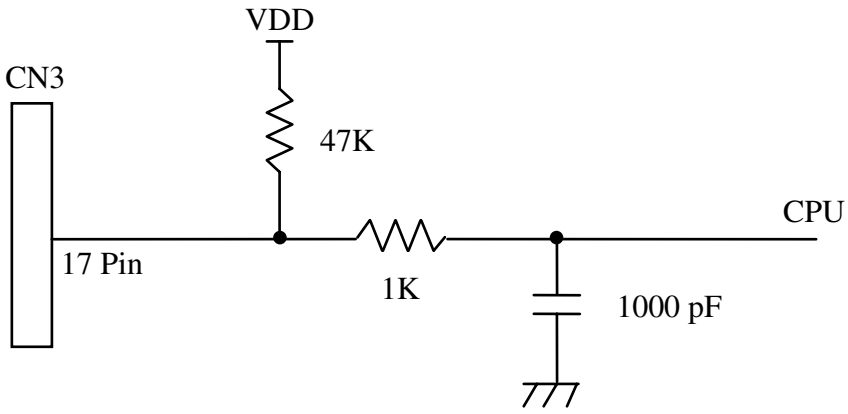
3.3 CN3 Connector for Interface

Pin No.	Signal Name	I/O	Function
1	VDD	—	Power supply for circuit (5V)
2	VDD	—	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	Input	Parallel Interface DATA0
25	DATA1	Input	Parallel Interface DATA1
26	DATA2	Input	Parallel Interface DATA2
27	DATA3	Input	Parallel Interface DATA3
28	DATA4	Input	Parallel Interface DATA4
29	DATA5	Input	Parallel Interface DATA5
30	DATA6	Input	Parallel Interface DATA6
31	DATA7	Input	Parallel Interface DATA7
32	nSTB	Input	Parallel Interface nSTB
33	BUSY	Output	Parallel Interface BUSY
34	nFAULT	Output	Parallel Interface nFAULT
35	SELECT	Output	Parallel Interface SELECT
36	PE	Output	Parallel Interface PE
37	nACK	Output	Parallel Interface nACK
38	NC	—	No Connection
39	NC	—	No Connection
40	nRESET	Input	Parallel Interface nRESET

Applicable Connector: 53313 - 4015 (Molex)
* First "n" of signal name indicates "L" active signal.

⚠**CAUTION**:

1. For LED of ERROR and PE, there is a resister of 330 Ω on the circuit side to make the current value 10 mA. Please use LED with a forward voltage of approx. 2V. LED exceeding 10 mA may break a control board.
2. Power supply for circuit (VDD and GND) requires feeding to only one pin. However, power supply for driver circuit (VP and P-GND) requires feeding to all pins to secure the capacity.
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 47 KΩ. Make sure to make this terminal NC, when this terminal is not used.
5. LF-SW input circuit is as below.



3.4 CN201 Connector for Paper Cutter (Option)

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

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

⚠**CAUTION**: Use the specified Paper Cutter (Model Name: ACS-230-5V).

4. SELECTING FUNCTIONS

DIP SWITCH

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

JUMPER

Pin No.	Function	Short	Open	Factory Setting
J1	Font Selection	See Table (2)		Open (*1)
J2				Open (*1)
J3				Open (*1)
J4	Paper Auto Loading	Enable	Disable	Short
J5	Print Drive System	Variable division	Fixed division	Short
J6	Print Density (Supplementary)	Combination with DS1-3 See Table (3)		Short
J7	Not Used	—		Short
J8	Mechanism	MLT-388	MLT-389	Short

*1: All are short circuited for overseas type (BD2-38XX U).
*2: When MLT-389 is used, J-4 is left unused and no auto loading occurs regardless of whether the jumper is short circuited or open.

(1) 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

(2) Font Selection

J-3	J-2	J-1	International Character
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

(3) Print Density

DS3	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%

⚠**CAUTION**:

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

5. POWER SUPPLY

5.1 Specifications

VDD : 5V ±5% Approx. 130 mA

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

Operating votage is 7.2V (Max)

8.5V is a voltage only right after charging. 8.5V cannot be used for normal voltage.

5.2 Precautions

(1) Design the product to supply power to VDD before VP when power is supplied to this control board.

(2) Design the product to turn off the power for VDD 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 VDD 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 : nACK, BUSY, nSTB, nFAULT, PE, nRESET

6.2 Explanation of Input/Output Signals

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

nSTB : Strobe signal to read 8 bit data (Negative logic)

nRESET : Signal to reset control board (Negative logic)

nACK : 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)

nFAULT : 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 VDD MIN

"LOW" level : 0.3 VDD MAX

(2) Output Signal Level

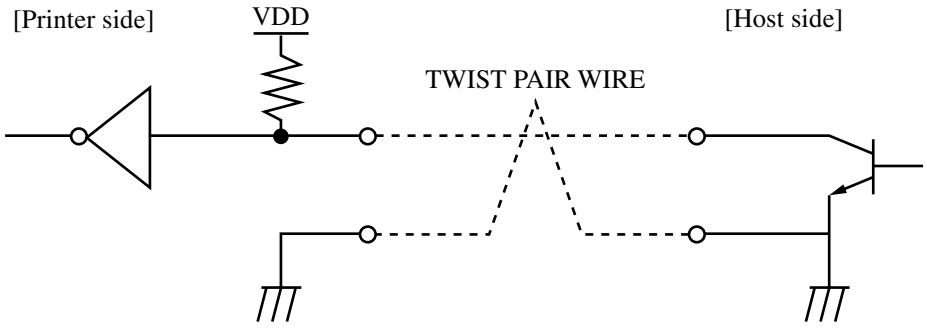
"HIGH" level : VDD - 0.1V MIN

"LOW" level : 0.1V MAX

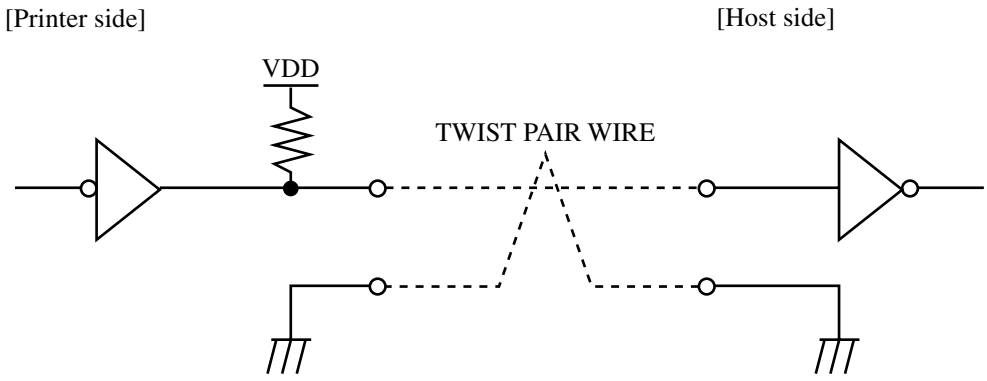
(3) I/O Conditions

nSTB, nRESET input signals are pulled up by 47 KΩ.

Other input signals are pulled up by 50 KΩ.



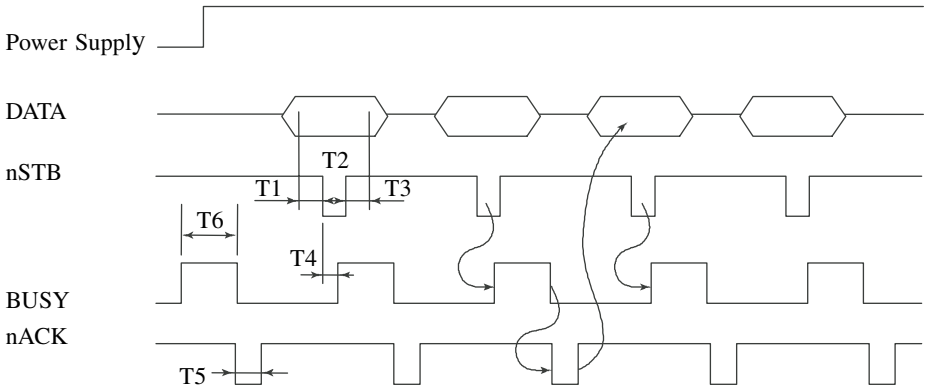
* First "n" of signal name indicates "L" active signal.



All the output signals are pulled up by 50 KΩ.

6.4 Timing Chart (Compatibility Mode)

(1) Data Input and Printing Timing



T1, T2, T3 : 0.5 μs (MIN)
T4 : 270 ns (MAX)
T5 : 2.3 μs (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 is selected, data from the host is received with DTR signal at "space" but not received with DTR signal at "Mark". When XON/XOFF control is selected, data from the host is received after sending XON but cannot be received after sending XOFF.

7.5 Buffering

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

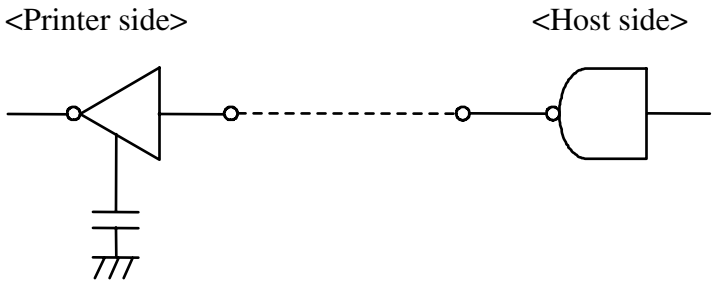
(1) DTR signals [See 7.2 (2)]

(2) TXD signals [See 7.2 (3)]

7.6 Electrical Characteristics

(1) RS-232C Circuit

Input (RXD, DSR)



Equivalent MAX232

Output (DTR, TXD)

Equivalent MAX232

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-230-5V) is not connected to the cutter connector (CN201).

(2) External signal outputs

Connector for interface (CN3)

Pin No.	Signal Name	Remarks
18	ERROR	LED output. For a blinking pattern, see "8.3 Error Indication".
20	DTR	Serial interface
33	BUSY	Parallel interface
34	nFAULT	Parallel interface

* First "n" of signal name indicates "L" active signal.

(3) Resetting methods

Error	Resetting Method
Memory error	Unrecoverable
Cutter error	After turning off the power, connect the auto cutter (ACS-230-5V) 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. * When MLT-388 is used.
Platen not mounted	Platen is not mounted. * When MLT-389 is used.
VP voltage error	A VP 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-230-5V)	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

Connector for interface (CN3)

Pin No.	Signal Name	Remarks
18	ERROR	LED output. For a blinking pattern, see "8.3 Error Indication". Output at error other than No-paper.
19	PE out	LED output. This is always output at the time of no paper.
20	DTR	Serial interface
33	BUSY	Parallel interface
36	PE	Parallel interface
34	nFAULT	Parallel interface

(3) Resetting methods

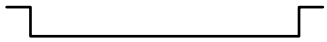
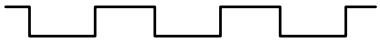
Error	Resetting Method
No paper	Set the paper. See Note 1.
Head-up	Bring down the head-up lever. * When MLT-388 is used.
Platen not mounted	Mount the platen. * When MLT-389 is used.
VP voltage error	Set to a voltage within the allowable range (4.2 to 8.5V) and turn on the power again. Alternatively, activate the Pin 17 (LF-SW) 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 Pin 17 (LF-SW) 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 Error Indication

The errors other than no paper are indicated by a LED output (Illumination or blinking) of the Pin 18 (ERROR) of the CN3 (interface connector).

Error	Display Pattern	Description
Memory error		Blinking cycle of 200 ms
Cutter lock (Cutter error)		Blinking cycle of 150 ms (3 times) and 500 ms (1 time).
Head-up *MLT-388 Platen not mounted *MLT-389		Illuminated until reverted
VP voltage error		Illuminated until reverted
Head temperature error		Blinking cycle of 1 sec.
Macro execution wait		Blinking cycle of 500 ms.

9. PRINTER MECHANISM CONTROL SYSTEM

9.1 Thermal Head Control System

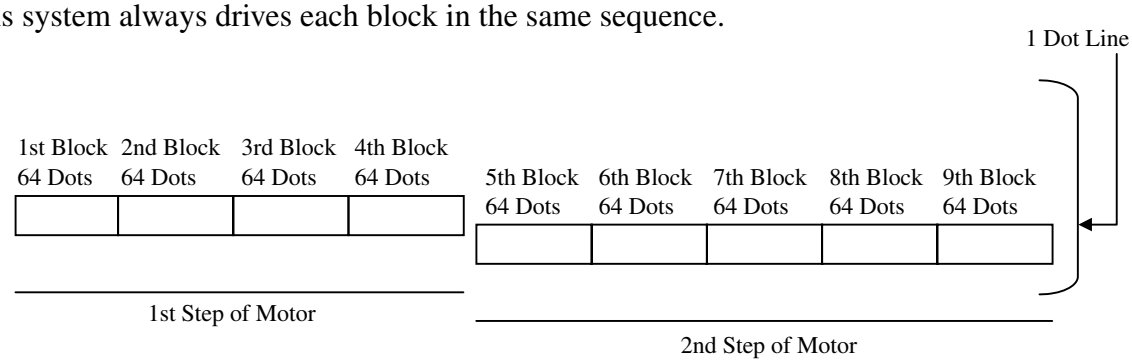
The MLT-388/MLT-389 (Line thermal printer) to be driven by this control board has a 576 dots/ line head divided into 9 blocks of 64 dots each. When actually driving the head, you can select either Fixed Division Number system, which drives the head, always dividing it into 9 blocks or Variable Division Number system which collectively drives several blocks at the time according to the number of activated head dots.

For selection by function selection, refer to "4. Function Selection".

For selection by command, refer to attached "BD2-38XX Command Reference".

9.1.1 Fixed Division Number System

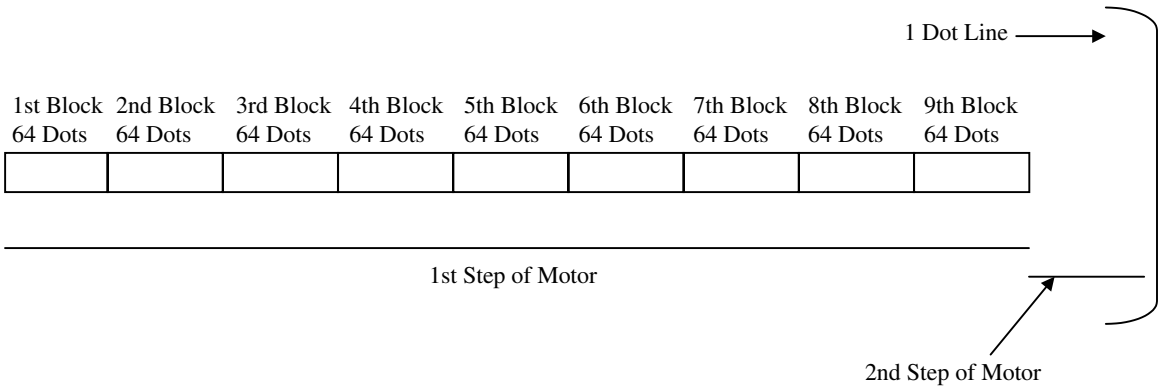
This system always drives each block in the same sequence.



⚠ **CAUTION**: 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-388 and MLT-389 use a 4-phase bipolar stepping motor, which feeds paper by one dot line 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 Speed at Major Voltage

VP Voltage	Motor Drive Speed
5V	487 pps
6V	702 pps
7.2V	960 pps

⚠ **CAUTION**: The maximum drive speed depends on the VP 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.

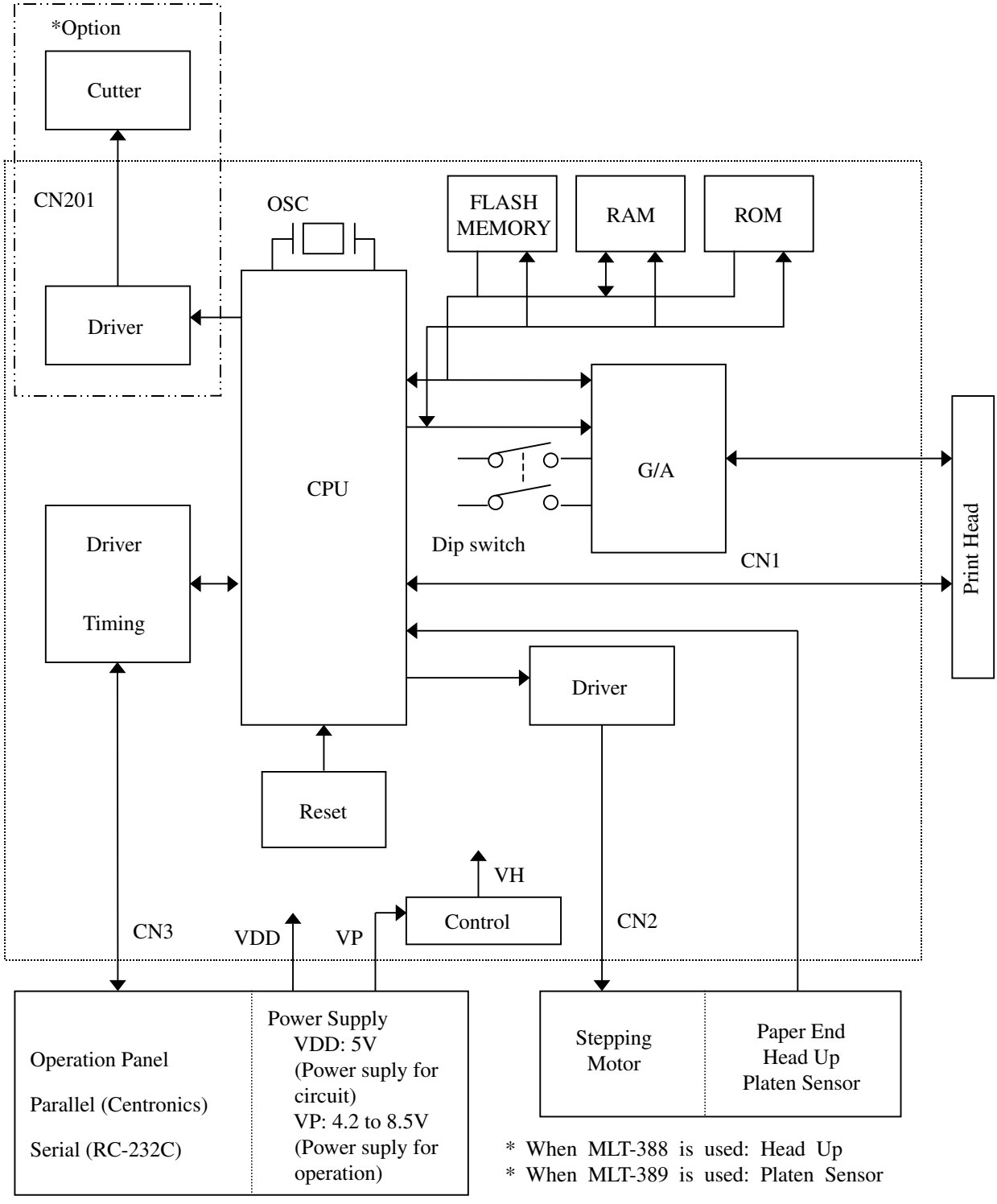
Northern America
CBM America Corporation
Service Center
363 Van Ness Way Suite 404
Torrance, CA 90501, U.S.A

TEL 310-781-1460
FAX 310-781-9157

Other Areas
Japan CBM Corporation
Information Systems Division
CBM Bldg., 5-68-10, Nakano
Nakano-ku, Tokyo, 164-0001, Japan

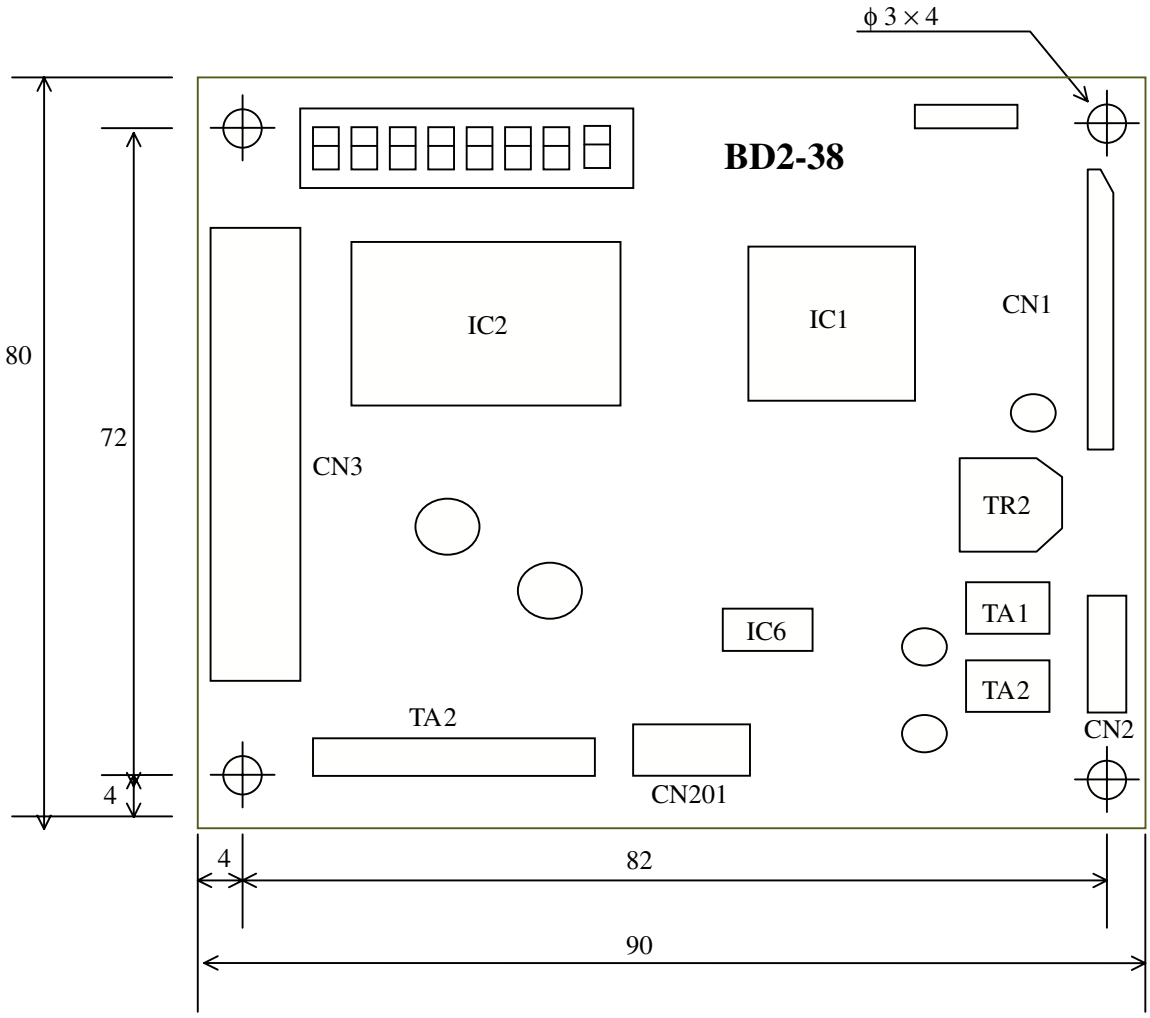
TEL 03-5345-7440
FAX 03-5345-7441

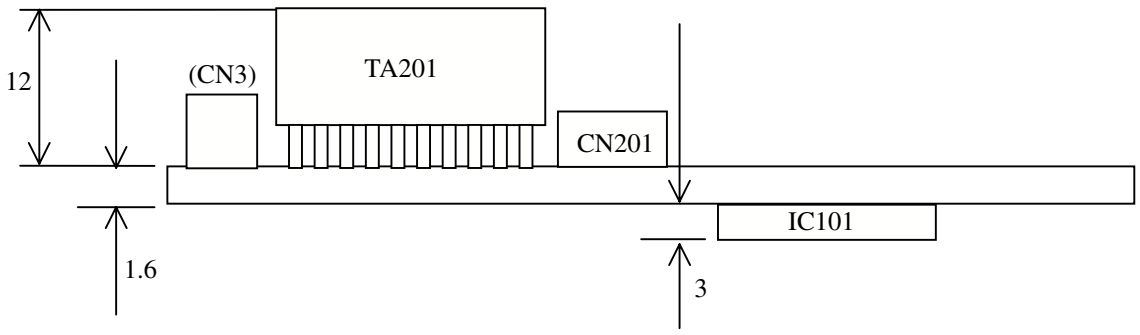
APPENDIX 1. BLOCK DIAGRAM



*1: Only for Japan

APPENDIX 2. OUTER DIMENSION





(Unit: mm)