



Color Display & Touch pad

Max 16 Channels Input



Multi channel electronic micrometer

ML-LP-Sx

User's Guide (Ver. 5.24R3)

The contents of this manual could be different according to the software version and it can be changed without notice.

Please use this good after reading the manual thoroughly.

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Introduction

Thanks for buying our product.

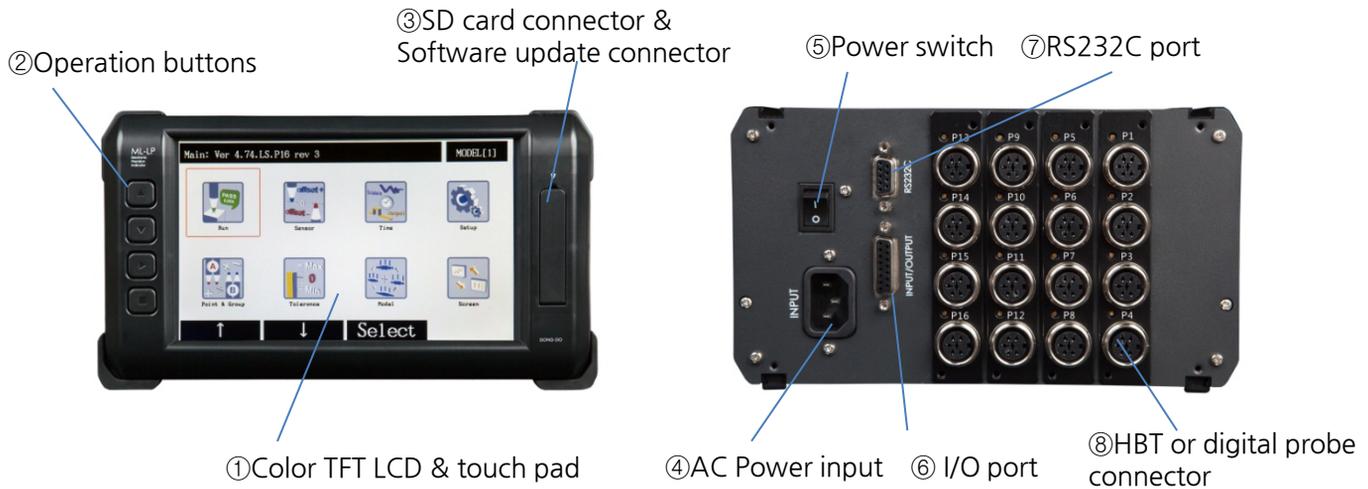
ML-LP is a high precision multi-channels electronic micrometer with a wide color TFT LCD and touch pad. ML-LP must be your various solutions for your inspection systems.

Specialty of ML-LP

1. Maximum 16 channels HBT(LVDT option) or digital probe inputting is supported.
2. Maximum 6 channels of air gauge inputting is supported.
3. Various calculation modes(+, -, x, /, avg, max, min, Max-min, sin, cos, and even user's unique functions).
4. Intuitively confirm production status by various histograms and flow chart.
5. High resolution & reliability.
6. Easy operation with 7" color TFT LCD and touch pad.
7. RS232C communication. Serial commands are supported.
8. I/O interface.
9. Micro SD card data backup.(*.CSV or *.TXT).
- 10.PC screen editor is supported.

Product features & composition

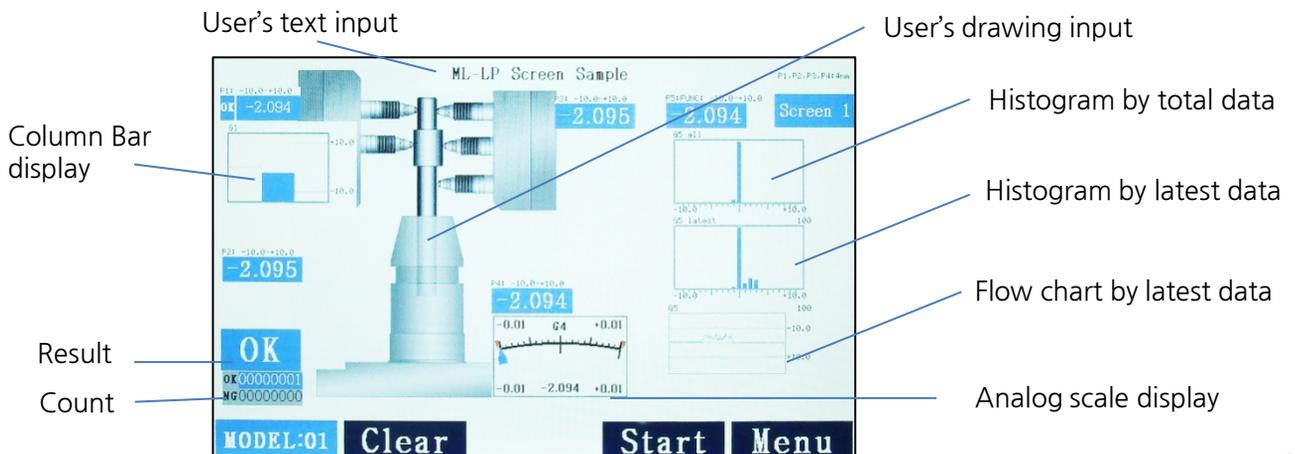
1. Features



- ① LCD & Touch pad : To display the measuring data and show variable menu for data setting. Operating by touch pad is possible.
- ② Operation buttons : To select menu & change values instead of touch pad.
 UP▲ : Move up the cursor or increase values.
 DOWN ▼: Move down the cursor or decrease values. / Runout measuring start.
 SELECT ►: Make a choice of the cursor position. / Static measuring start.
 MODE ■ : Escape the menu. / Enter the main menu from measuring screen.
- ③ SD card connector & Software update connector : To save the measuring data by micro SD card or to upload a software for ML-LP.
- ④ AC power input socket : AC110~220V, 50Hz/60Hz power input.
- ⑤ Power switch : power ON/OFF switch.
- ⑥ I/O port : To communicate with external PLC or controller.
- ⑦ RS232C port : To do serial communication with PC or PLC.
- ⑧ HBT or digital probe connector : Maximum 16 probes can be connected.

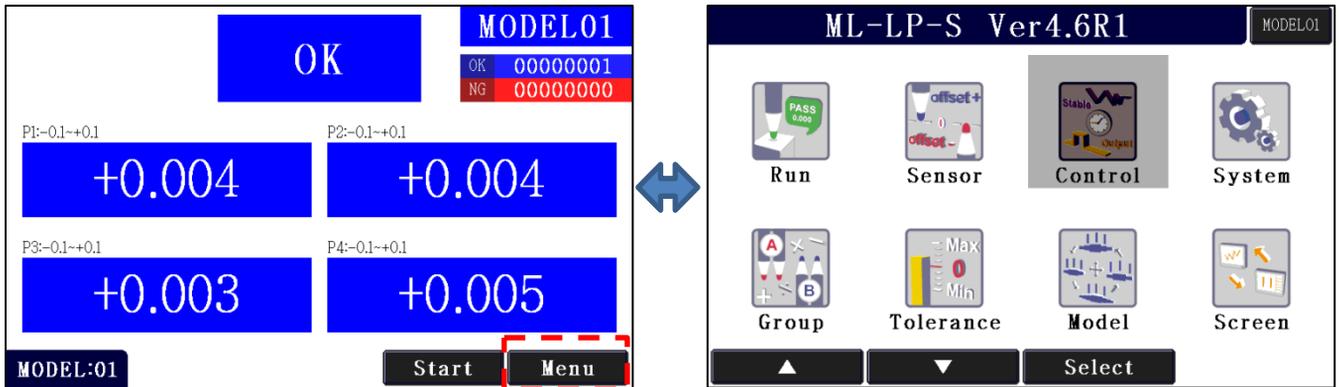
2. Measuring screen

ML-LP is supported user friendly various functions and display as like below picture. The screen is edited by 'ML-LP Screen Editor' on PC.



Functions

1. Main Menu



If the 'Menu' on the screen or the mode button(■) is pressed, the main menu is appeared. The main menu is reached in the any other menu by pressing the Mode button(■) several times. The menus shown on the screen can be entered by touching the screen or moving the cursor by Up(▲) /Down(▼) buttons and pressing Select(▶) button on it.

- 1) RUN : To go to the measuring screen
- 2) Group : To set the items to display on the measuring screen.
Various functions can be set in this menu.
- 3) Sensor : To check the raw sensor values. Setting master zero, offset, direction, etc.
- 4) Tolerance : To set the tolerances for each points and groups. And setting nominal values, too.
- 5) Control: To change the settings about runout, start method, I/O, RS232, etc.
- 6) Model : Memory space to save the current settings. And the setting can be recalled.
- 7) System : To change the settings about system as like sensor type, unit, language, etc.
- 8) Screen : To change the measuring screen settings by micro SD card.

2. Run

- To go to the measuring screen.

Functions

3. Group

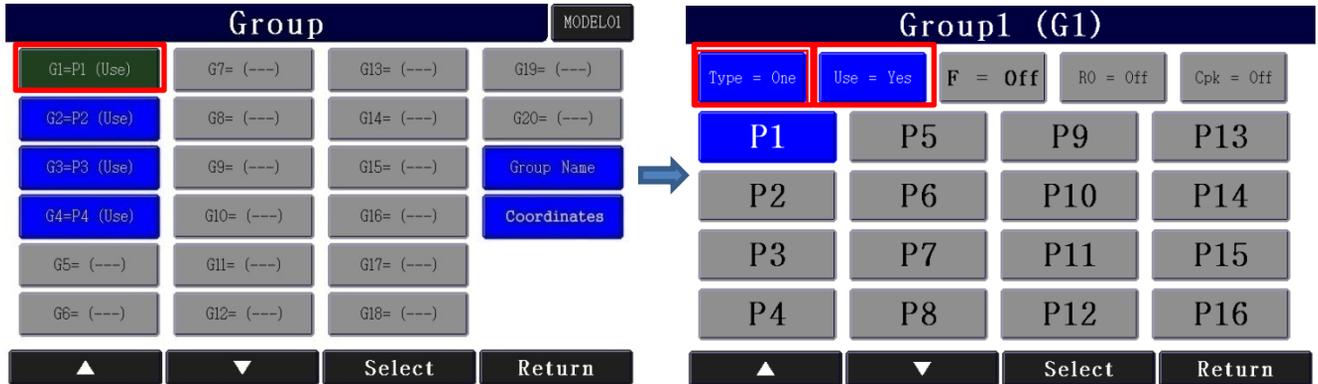
- To set the items to display on the measuring screen. Various functions can be set in this menu.
- Maximum 20 groups are possible to display on the screen.

*****Please use PC screen editor to add the groups, if not, there should be a display errors.**

The calculation of the existed group is possible.

*****If 'text mode' = on, it's possible to add & edit the groups without PC screen editor.**

Please see page Please see the 9.Screen at 12th page.



① Choose the group to set
(Touch screen)

② Setting the type of the group, points or groups to use in this group function, and the decision of use this group or not.

- There are the types of the group, None, One, Peak, R.Peak, Plan, Max, Min, Avg, Sum, M-m, Plus, Minus, and Func. If the type is selected, the display is changed along the type.

1) None: No used

2) One: 1 point

3) Peak: High peak data hold.

To clear the peak data, press ▲up button or give clear signal to I/O port.

4) R.Peak: Low peak data hold.

To clear the peak data, press ▲up button or give clear signal to I/O port.

5) Plane: To get the height from the virtual plane by the selected 3 points. check next page.

6) CP: To get the Process Capability. Detail description on page 19.

7) CPK: To get the Process Capability Index. Detail description on page 19.

8) Max: Maximum value in the selected points or groups.

9) Min: Minimum value in the selected points or groups.

10) Avg: Average value in the selected points or groups.

11) Sum: Addition value of the selected points or groups.

12) M-m: (Maximum value - minimum value) in the selected points or groups.

13) Dia: To get a diameter by 3 points.

*Need to check only 3 points. The master's diameter should be set at 'Preset'.

Main menu → Tolerance → Preset(for the 'Dia' type group).

14) Plus: Addition between two values.

15) Minus: Subtraction between two values.

16) Func: User's functions as like $=(G1+G2) \times 3.14 + 10$. So, user can calculate anything with it.

Functions

-If USE = Yes, the group is displayed on the measuring screen(except type is set by 'None').

-If F is not 'Off' as like $F = \sin(\text{or } \cos \dots \text{etc.})$, the group is calculated as like $\sin(\text{the group value})$. So, you can use the trigonometric functions with the group.

Ex) $F = \sin$, Type = Avg(P1, P2, P3) → Result = $\sin(\text{avg}(P1, P2, P3))$

-If R0 is not 'Off' as like $R0 = rM - m$, etc., the group becomes a runout group.

Runout group measuring setting is on the 'Control' → 'Runout' menu. Look at the page 9.

-If Cpk button is pushed, a menu comes out to select 'Cp' or 'Cpk'. To display and serial out the Cp or Cpk, please on this tap.

Ex) Type = one, Use = Yes, Cp = On(or Cpk = On), choose P1 (any point or group for it)

Set the UL & LL at the 'Tolerance' menu.

→ Then Cp or Cpk value for P1 will be on the screen & value goes out to RS232C port.

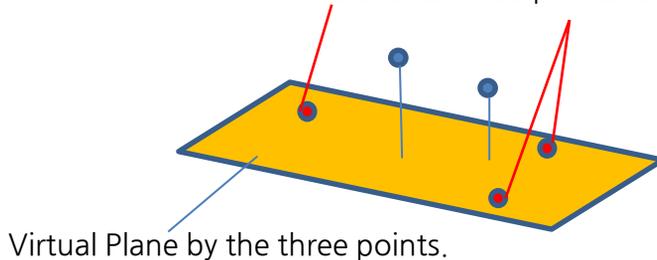
Plane function:

User can calculate the heights from a virtual plane.

Group				MODEL01
G1=P1 (Use)	G7= (---)	G13= (---)	G19= (---)	
G2=P2 (Use)	G8= (---)	G14= (---)	G20= (---)	
G3=P3 (Use)	G9= (---)	G15= (---)	Group Name	
G4=P4 (Use)	G10= (---)	G16= (---)	Coordinates	
G5= (---)	G11= (---)	G17= (---)		
G6= (---)	G12= (---)	G18= (---)		

Coordinates						MODEL01	
	POS X	POS Y	SET		POS X	POS Y	SET
P1	1.000	0.000		P9	0.000	0.000	
P2	2.000	0.000	*	P10	0.000	0.000	
P3	3.000	0.000		P11	0.000	0.000	
P4	0.000	2.000	*	P12	0.000	0.000	
P5	2.000	2.000	*	P13	0.000	0.000	
P6	3.000	3.000		P14	0.000	0.000	
P7	0.000	0.000		P15	0.000	0.000	
P8	0.000	0.000		P16	0.000	0.000	

The reference three points for the virtual plane.



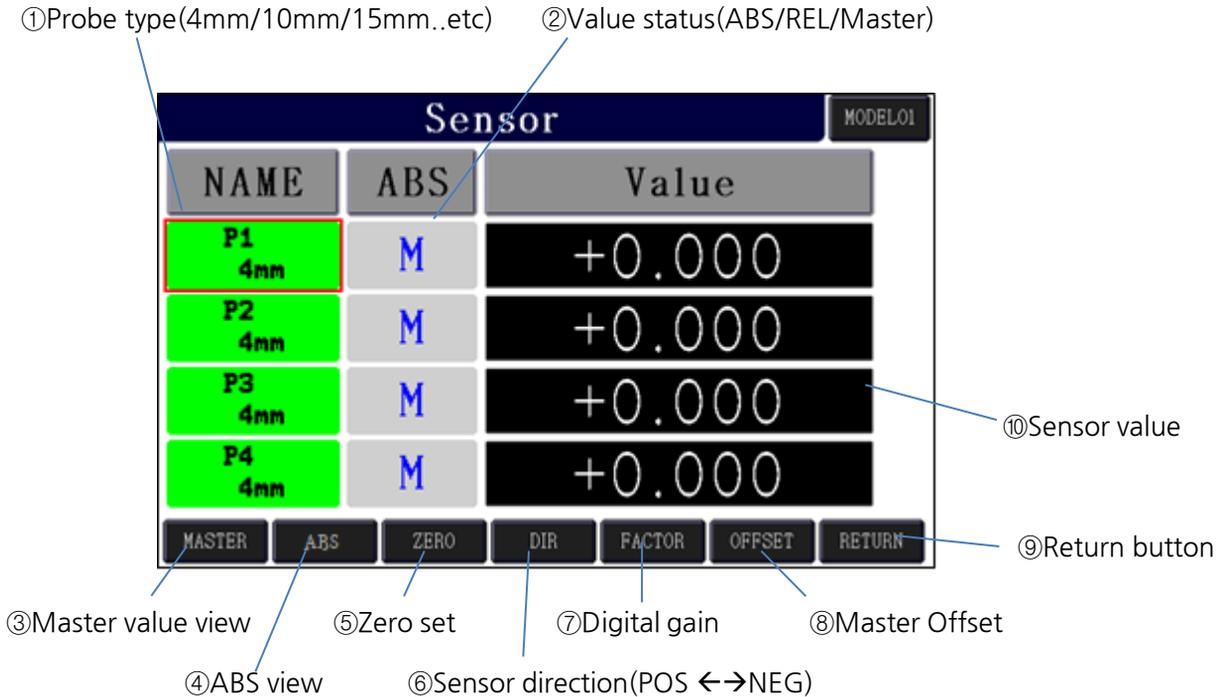
1. User puts in the right (X, Y) coordinates of the probes.
2. Choose the 3 points at the 'Coordinates' menu for the virtual plane.
3. Set the type of group to 'Plane' if the height from the virtual plane is necessary.
4. Set 'Master Zero' with master part.
5. Done.

* If the type of group is set to 'Plane', ML-LP gives the height from the virtual plane. But for other type, it gives the value from the 'Master Zero'.

Functions

4. Sensor

- To check the raw sensor values. Setting master zero, offset, direction, etc. All of the values about the current sensors are shown in this menu.



①Probe type: Current probe type. Right stroke probes should be connected on right channels (e.g. P1 4mm : Less than 4mm stroke probes. P1 10mm : 10mm stroke probe, ...etc.)

****Cautions: if the probe type is not correct, the measuring data should be not correct!!**

②Value status: Current value's status. M: master view(Current master's setting values view), A: absolute value view(Raw probe's value), R: relative zero(Mater zeroing).

③Master: To see master set values.

④ABS: To see the absolute value of the probe(raw value of it).

⑤Zero: To set the current value to master zero.

⑥Dir: Direction of the sensor, normally POS. Sensor value is increase if probe is pressed when the 'Dir' is set by POS. Touch the screen to change it, POS \leftrightarrow NEG.

⑦Factor: Digital gain. Normally set by 1.000. Final value = raw value * Factor.

⑧Master Offset: The offset value would be added on the real measured data. Normally set by 0.000

$$\begin{array}{rcll} \text{Measured result} & - & \text{Target(Drawing)} & = \text{Input data in offset} \\ 9.900 & - & 10.000 & = -0.100 \end{array}$$

⑨Return: To return to the main menu with saving the setting.

⑩Sensor value: The sensor's value depends on the value status.

Functions

5. Tolerance

- To set the tolerances for each points and groups. And setting nominal values, too.
- Each items can be selected by touching the item.

①Group name ②Hi/Low tolerance ③Preset(Nominal value)

④Offset for group

⑤Digital gain for group

⑥Return button

	Lo	Hi	Preset	Offset	Factor
P1	-0.100	+0.100	0.000	+0.000	1.000
P2	-0.100	+0.100	0.000	+0.000	1.000
P3	-0.100	+0.100	0.000	+0.000	1.000
P4	-0.100	+0.100	0.000	+0.000	1.000
F5:FUNC	-0.100	+0.100	0.000	+0.000	1.000

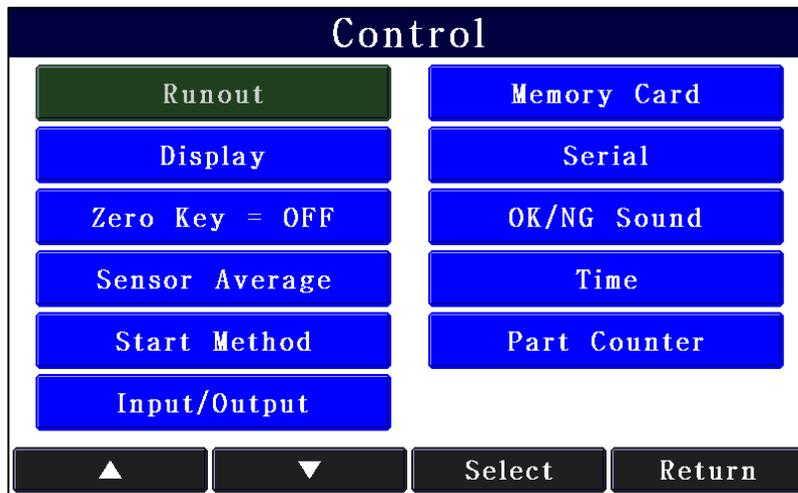
▲ ▼ Select Return

- ①Group name: User can change the name of the 'points and groups' here for the measuring screen.
- ②Hi/Low tolerance: Hi and Low tolerance to make the OK/NG decision. If the tolerance to change is selected, the number entering menu is come out.
- ③Preset: A nominal value for measuring screen. The real value is added on this value but not affected on the result.
- ④Offset: Offset values for groups. Normally set by 0.000.
- ⑤Factor: Digital gain for groups. Normally set by 1.000.
Final value = raw value * Factor(at 'Sensor' menu) * Factor(at 'Tolerance' menu).
- ⑥Return: To return to the main menu with saving the setting.

Functions

6. Control

- To change the settings about runout, start method, I/O, RS232, etc.



- ① Runout: Simple runout is supported with ML-LP-S or ML-LP-A models.
Under 40Hz to 100Hz data gathering is possible to gather the data for runout mode.
For higher speed runout, there're special model(ML-LP-R).
- 1) Stopping method : There're 3 kinds of method of stopping 1 cycle of runout.
- Stop by stop: stop the cycle by the stop signal on input port.
- Stop by start off : stop the cycle when start signal is off.
- Stop by time out: stop the cycle by time out.
** Starting the runout cycle is always by the 'runout start' signal on the input port.
- 2) Time : The time to gather the data. Only available when 'Stop by timeout' is set.
- 3) Auto Zero : To set auto master zero before start runout function. Normally, set No.
- 4) RO with Flatness: If NO is set, only runout set groups are measured.
If Yes is set, static set groups are also measured with RO start signal.
If 'RO with Flatness = YES', static groups are measured after runout groups are measured.
** Runout function works if there're any runout Groups. Please check page 6, about 'Group'.
- ② Display :
- 1) LCD: LCD on/off is possible to increase RS232C data output speed.
- 2) Clear Graph Data: Histogram data is cleared by this menu.
- 3) Value conversion: Value conversion setting.
Method to choose round/raise/cut for last digit.
Digit to choose the numbers below decimal point. 0.00 or 0.000.
- 4) OK/NG counter: on/off the OK or NG counter.
- ③ Zero Key: To allow to set master zero on the measuring screen. If the UP▲ button is pressed for over 2 sec., the master zero is set.
- ④ Sensor average: : To set how many raw data is used to average them for one measuring sequence. -The one measuring sequence time could be different by this setting.
- Measure average: average count for measuring / Zero average: for master zeroing.

Functions

⑤ Start Method: To choose the start method of measurement.

- 1) Auto: measurement is doing continuously.
- 2) Manual: measurement is done just when start signal is input.
- 3) Semi-Auto: data changes are shown continuously, but measurement is done with only start signal.
- 4) Wait start off: If On is set, the measurement is waited until the start signal is off.

⑥ Input/Output: To set input / output pins' purpose.

⑦ Memory card: To set if the SD memory card is used to save data. The data format is the same as serial output. And the file formats are .txt or .csv. The data is saved in the date folder in SD card automatically.

⑧ Serial: To set the serial format. Please check serial communication section for details.

⑨ OK/NG sound: Beep sound setting for OK/NG.

⑩ Time: To set the stable time for probe and data output signal holding time on the I/O port.

⑪ Sensor Limit: To set the working area for each of the sensors. If a raw value of probe is out of the limit, the color of the box to be grey with red color text. If 'Lo' and 'Hi' limit values are the same, this function is not working. Default is off.

⑫ Part Counter: Part number counting On/Off. Max count is 9999 and after that it goes to 0000.

7. Model

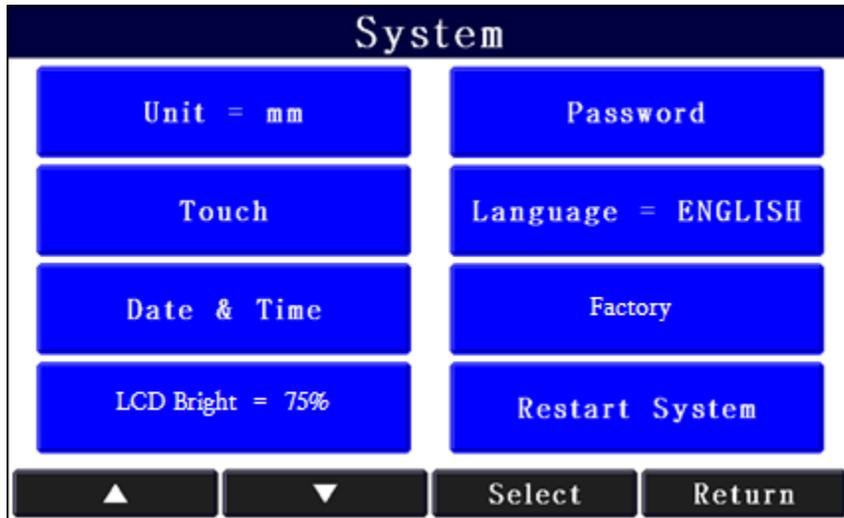
- Memory space to save the current settings. And the setting can be recalled.

There're 16 memory spaces in ML-LP. If the model is set by 99 or External, the model can be changed by external I/O input.

Functions

8. System

To change the settings about system as like sensor type, unit, language, etc.



- ① Unit: unit is changed mm \leftrightarrow mil(1/1000 inch).
- ② Touch : To check or calibrate the touch pad. To calibrate it, just follow the 5 cross in order. You should press it until a beep is on.
- ③ Date & time : To set current date and time.
- ④ LCD Bright : To set the brightness of the screen.
- ⑤ Password : User can set the password to enter the 'Main' menu from measuring screen. Password ON -> Password Change -> enter Password.
- ⑥ Lang : Menu language selection. English / Korean.
- ⑦ Factory : To change a factory setting(secured).
- ⑧ Restart system : To restart the system(Turn off the power and on again).

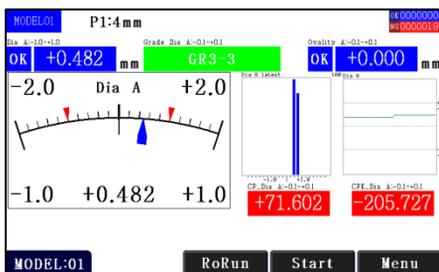
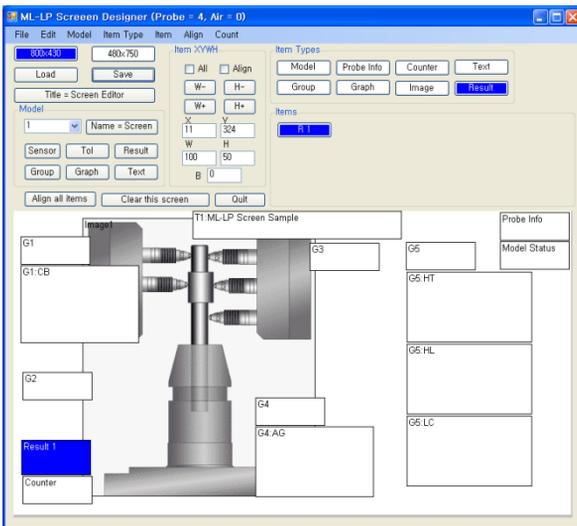
Functions

9. Screen

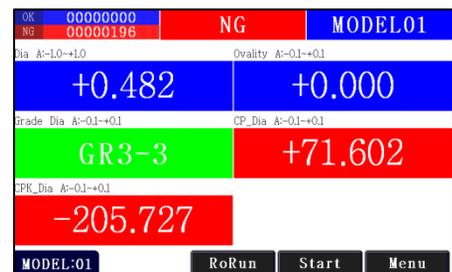
- To change the edited settings for measuring screen. It is edited by 'PC Screen Editor for ML-LP' on PC. The software is loaded by micro SD card.

- To use 'PC Screen Editor' for ML-LP, please see the manual, 'PC screen editor for ML-LP'.

- ① Load from Card: To install the edited files on PC. And it becomes a default setting.
*Caution: if the probe type and channel number is not correct, ML-LP shouldn't work right.
- ② Save to Card: To save the settings to SD card. It can be loaded on PC.
- ③ Load Default : To load the configuration settings from default memory on ML-LP.
- ④ Save Default : To save the configuration settings to default memory on ML-LP.
- ⑤ Screen Direction : The screen direction is turning by 90°.
- ⑥ Text Mode : To display only text on the measuring screen. No pictures, no graphs.
On the text mode, user doesn't have to use PC editor to add groups.



<Text Mode : Off>



<Text Mode : On>

Serial communications



Serial format viewer :

Whenever the settings are changed, the serial format is shown on this viewer.

① Items (At the Main menu → Control → Serial)

- **Send(use)** : To set the use of the RS232C serial output or not.
- **Speed** : Communication speed from 9600 bps to 115200 bps.
- **Type** : ASCII or HEX
- **POS1, POS2** : User can choose one.
 - a start number(StartNb), result(OK/NG), a number of data(DataNb), model number(Mdl.Nb), or model name(Mdl.name).
- **Data Format** :
 - 1)Point On/Off : To put the decimal point on the data or not.
 - 2)Preset On/Off : To add the 'preset' values for the serial data or not.
 - 3)Int.Length : To set how many digits are at the front of the decimal point. (Only used if 'Point' = ON) ex) In.Length = 4 & Point On/Off = On → +0000.000
 - 4)Group OK/NG : To send individual 'Group' OK/NG result on each data.
- Send All** : To send all groups' data even if user doesn't set some groups. i.e. max data output.
- Commands** : To give several commands by RS232C.
 - 1) Commands On/Off: To use the serial commands or not(**Default : Off**).
 - 2) Use Device ID On/Off: To use the serial command ID when several units connected the line together.
 - 3) Device ID : The device ID for serial communication. (01 ~ 99, '00' for all unit).

*Serial Commands :

- START: Start command for static group, measure once & return the measured data.
- ROSTART: Start command for runout group, measure once & return the measured data.
- MZERO : Master Zero. No use for Air type.
- MCLEAR : Master Zero clear. No use for Air type.
- RESET : Initialize the measuring screen (Clear OK/NG counter, Clear graph, ..etc.)
- RECALL: Return the current data once without new measurement.

*Serial Commands Format:

-If no use ID:

[COMMAND] [CR] [LF] → [ACK] returns after 5msec

([ACK] returns only for MZERO, MCLEAR, RESET. For START, RECALL, it just gives the data.)

-If use ID:

[ID] [,] [COMMAND] [CR] [LF] → [ACK] return after 5msec

-[CR] : 0x0D, [LF]: 0x0A, [ACK] : A [CR] [LF] (= A#wr#wn)

Serial communications

② Cable setting

Elec' micrometer		Direction of signal	Computer	
Signal	Pin No.		Pin No.	Signal
N.C	1		1	DC
RD	2	←	2	RD
TD	3	→	3	TD
N.C	4		4	DTR
SG	5	●	5	SG
N.C	6		6	DSR
N.C	7		7	RTS
N.C	8		8	CTS
N.C	9		9	RI

- Cable of computer serial working terminal - Connect 4Pin and 6Pin / Connect 7Pin and 8Pin

Serial communications

③ Examples of the serial communication

- Hex Format

STX (1 Byte)	STATUS (1 Byte)	MEASURING DATA (n Byte)					ETX (1 Byte)
-------------------	----------------------	------------------------------	--	--	--	--	-----------------

(n = Transmit Data Q'ty x 2)

- ASCII Format

Byte	1	2	1	2	1	5*n+(n-1)	1	1	2	1	1
Char	ENQ (0x05)	Start Point	,	End Point	,	Data	,	ETX (0x03)	@@	CR	LF

Ex) In case of No. of Data is 2.

1	2	1	2	1	5	1	5	1	1	2	1	1
ENQ	01	,	02	,	+0043	,	-0025	,	ETX	@@	CR	LF

- ASCII Format with Part counter.(A special request is required at the Purchased Order.)

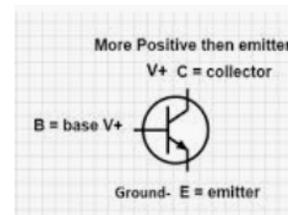
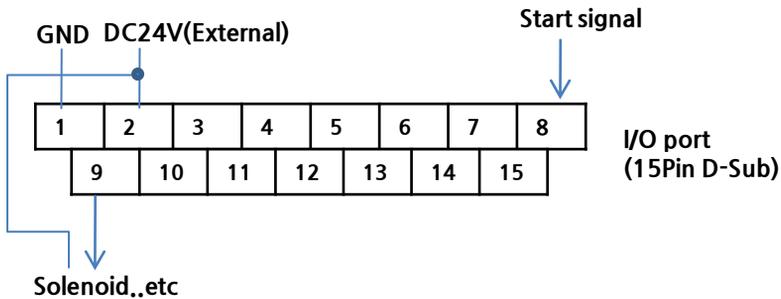
Byte	1	2	1	2	1	2	1	5*n+(n-1)	1	1	2	1	1
Char	ENQ (0x05)	Part No.	,	Start Point	,	End Point	,	Data	,	ETX (0x03)	@@	CR	LF

I/O port & operating sequence

1) I/O pin description

Pin	Name	In/Out		Description	Circuit
1	NCOMMON		0 V	GROUND	
2	PCOMMON		+24V		
3	IN6	in	H/L		
4	IN5	in	H/L		
5	IN4	in	H/L		
6	IN3	in	H/L		
7	IN2	in	H/L		
8	IN1	in	H/L		
9	OUT6	out	H/L		
10	OUT5	out	H/L		
11	OUT4	out	H/L		
12	OUT3	out	H/L		
13	OUT2	out	H/L		
14	OUT1	out	H/L		

* User should set how to use the IN/OUT pins at the 'Setup' → 'Input/output'.



Standard: NPN

- Pin 1: GND**
- Pin 2: DC24V** (Just for ML-CP/MP/LP)
- Pin 3~8: Input port**
- Pin 9~14: Output port**

I/O port & operating sequence

2) Extended I/O pin map (Option, 37 pin connector)

OUTPUT (GroupA)		
Pin	Dir.	Function
7	OUT	OUT A0
8	OUT	OUT A1
9	OUT	OUT A2
10	OUT	OUT A3
11	OUT	OUT A4
12	OUT	OUT A5
13	OUT	OUT A6
14	OUT	OUT A7

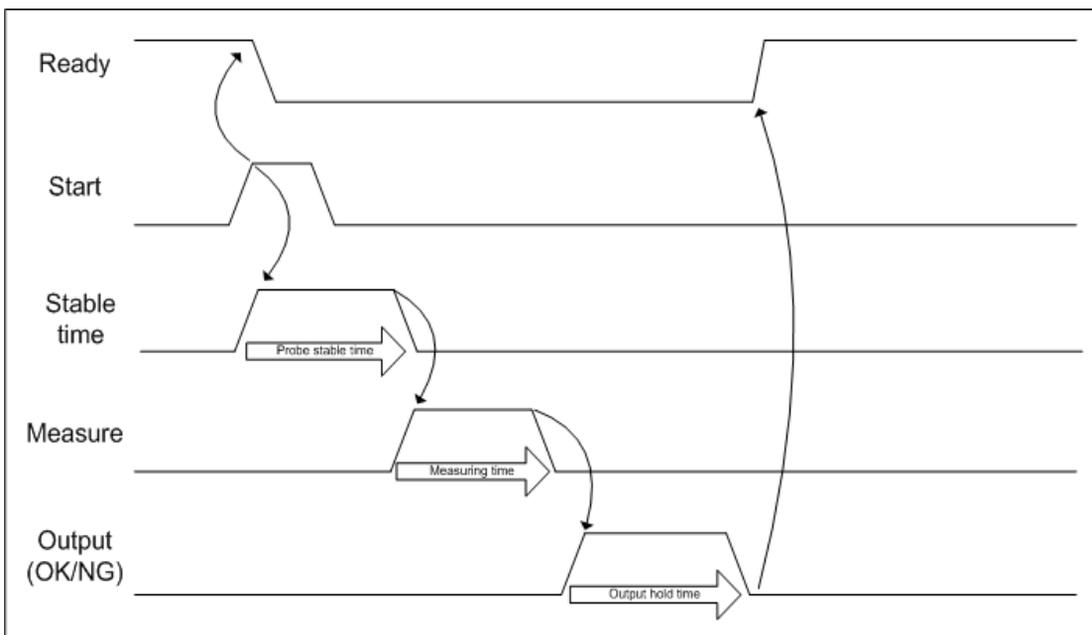
OUTPUT (GroupB)		
Pin	Dir.	Function
15	OUT	OUT B0
16	OUT	OUT B1
17	OUT	OUT B2
18	OUT	OUT B3
25	OUT	OUT B4
26	OUT	OUT B5
27	OUT	OUT B6
28	OUT	OUT B7

OUTPUT (GroupC)		
Pin	Dir.	Function
29	OUT	OUT C0
30	OUT	OUT C1
31	OUT	OUT C2
32	OUT	OUT C3
33	OUT	OUT C4
34	OUT	OUT C5
35	OUT	OUT C6
36	OUT	OUT C7

INPUT		
Pin	Dir.	Function
3	IN	INPUT 2
4	IN	INPUT 1
5	IN	INPUT 0
22	IN	INPUT 5
23	IN	INPUT 4
24	IN	INPUT 3

ETC		
Pin	Dir.	Function
1	POWER	NCOM (0V)
2	POWER	PCOM (+24V)
6	POWER	NCOM (0V)
19	N.C.	NOT USED
20	N.C.	NOT USED
21	POWER	PCOM (+24V)
37	N.C.	NOT USED

3) Timing diagram



Specifications

1. Operation condition

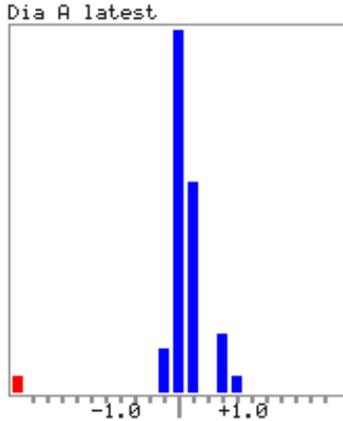
DIVISION	GENERAL
MAIN SUPPLY	AC100-220V, 50/60Hz
OPERATING TEMPERATURE	5 ~ 40℃
RELATIVE HUMIDITY	Up To 70%
SUPPORTING OUTAGE	DATA BACK UP BY INNER FLASH MEMORY

2. Specifications

DIVISION		SPECIFICATION
HBT/LVDT Sensor	CHANNELS	1ch~16ch(HBT sensors) 1ch~6ch(Air sensors)
	RESOLUTION	1um for HBT probes(0.1um option) 0.1um for air sensor
DISPLAY	Color TFT LCD	7" TFT COLOR LCD
DIMENSION		W220×D184×H120 (mm)
WEIGHT		Approx. 2.2kg
OUTER INTERFACE		RS232C, 9600 ~ 115200bps
		I/O port (IN:6, OUT:6) Option: Extented IO (IN:6, OUT:24)

SPC functions

1. Histogram



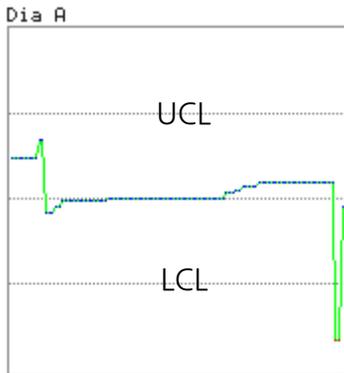
Histogram shows the representation of the distribution of numerical data.

It is very intuitive and powerful to know the production flow.

ML-LP histogram spec:

1. 23 bars are shown.
2. Blue color bars are between Hi/Low tolerance, Red color bars are outside of the tolerance.
3. If too high or low measurement is occurred, the first or last bar is increased.
4. Two type histograms are on ML-LP
 - 1) Total histogram: update the histogram from first to last until power is off.
 - 2) Latest histogram: draw the histogram with latest 100 data.

2. Control chart(Flow chart)



Control chart shows the process is currently under control.

ML-LP control chart spec:

1. Mark a spot with current measurement.
2. Blue spots are between UCL and LCL, Red spots are outside of the control limits.
3. Draw the control chart with latest 100 data.

3. CP/CPK (Process capability Index)

To report process capability and process performance with Cp, Cpk.

Cp= Process Capability. A simple and straightforward indicator of process capability.

Cpk= Process Capability Index. Adjustment of Cp for the effect of non-centered distribution.

μ = Average

σ = Standard deviation

$Cp = (USL - LSL) / (6 \times \sigma)$

$Cpk = \min((USL - \mu) / (3 \times \sigma), (\mu - LSL) / (3 \times \sigma))$

ML-LP cp/cpk spec:

-Maximum number of data is 100, after that it is updated with latest 100 data.

*Make groups for Cp or Cpk to display or send it out to RS232C port.

Please see page 5 for it.

