Mitutoyo

High-resolution Digimatic Measuring Unit
LITEMATIC VL-50-B/50S-B

Low and constant measuring force of 0.01N, 0.15N, or 1N

Providing low and constant measuring force for high-accuracy inspection of delicate workpieces

LITEMATIC VL-50-B/50S-B

FEATURES · VL-50-B/50S-B

• Patent registered (Japan), Patent pending (Japan)

Ideal for measuring the thickness or height of a workpiece that can be easily affected by the measuring force

• With a measuring force of only 0.01 N, the Litematic is ideal for measuring easily deformed workpieces or high-accuracy components.
• For workpieces for which 0.01 N is insufficient, either the 0.15 N or 1 N model is recommended.
• The spindle is motor-driven and stops when the contact point touches the workpiece. From then on, the maximum, minimum, or difference value can be measured using a constant measuring force.

High-accuracy measurement

• High resolution of 0.01 μm, and wide measuring range of 50 mm.
• The measuring table supplied with **VL-50-B** is ceramic, which is corrosion free, for easier maintenance and storage.
• The spindle is made of low thermal expansion material.

Litematic VL-50-B

Litematic Head VL-50S-B

Note: The stand (**957460**) is sold as an option.

Separate type VL-50S-B

Because the measuring unit and the display unit are separate, they can be integrated into the user's measurement system. An optional dedicated stand is also available.

Constant measuring force principle

An unbalanced, parallel-link structure enables the Litematic to offer a low and constant measuring force.

The Litematic's measuring force is not provided by a spring but comes from a structure resembling a balance scale. We call this a "parallel linkage." A motorized slider carrying the linked spindle moves down its guideway while the linkage is supported on a stop, as shown in Fig 1. When the spindle contacts the workpiece (Fig. 2) it moves the linkage up off the stop and the motor is halted. At this point the linkage is now supported by the workpiece, and thus a constant measuring force is applied.

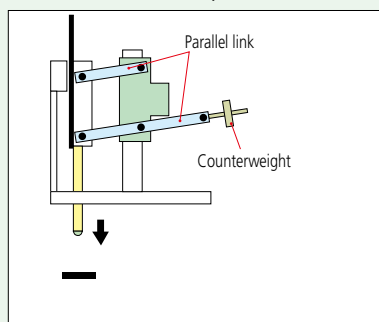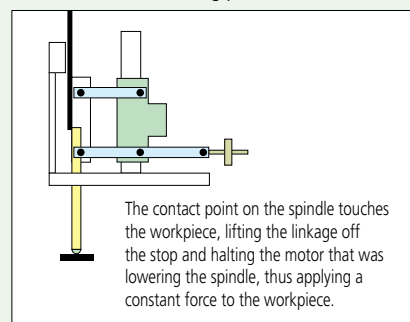Fig. 1. The spindle moves downwards towards the workpiece.

Parallel link

Counterweight

Fig. 2. The spindle lifts the linkage off the stop into the measuring position.

The contact point on the spindle touches the workpiece, lifting the linkage off the stop and halting the motor that was lowering the spindle, thus applying a constant force to the workpiece.

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Example Measurement Applications

Rubber and plastic

If the workpiece is soft the risk of indentation may be reduced by replacing the standard contact point with one of larger radius, such as an optional carbide-ball type.

- ▶ Plastic
- ▶ Rubber
- ▶ Keypad

Glass

For this type of workpiece the smallest measuring force available is recommended.

- ▶ Blue plate glass
- ▶ Lenses
- ▶ Contact lenses

Film and sheet

If the workpiece flexes, making accurate measurement impossible, using a type with a larger measuring force or adding a weight to the spindle may be effective.

- ▶ Film
- ▶ Flexible substrates
- ▶ Various types of sheet

Precision components

The Litematic can be used as a high-precision displacement gage.

- ▶ Bearing
- ▶ Shaft

Thin sheet metal

Because the measuring force is small, deformation of the workpiece can be minimized.

- ▶ Chassis
- ▶ Shimming materials
- ▶ Blade springs
- ▶ Beverage can materials

Media discs

For this type of workpiece the smallest measuring force available is recommended.

- ▶ Media tape
- ▶ Hard disks
- ▶ Various types of disks

Medical and pharmaceutical products

If the workpiece is soft the risk of indentation may be reduced by replacing the standard contact point with one of larger radius, such as an optional carbide-ball type.

- ▶ Injection needles
- ▶ Pills
- ▶ Patches and ointments

Semiconductors

If the workpiece flexes, making accurate measurement impossible, using a type with a larger measuring force or adding a weight to the spindle may be effective.

- ▶ Chips
- ▶ Wafers
- ▶ Lead frames

Electronic components

For this type of workpiece the smallest measuring force available is recommended.

- ▶ Printed circuit boards
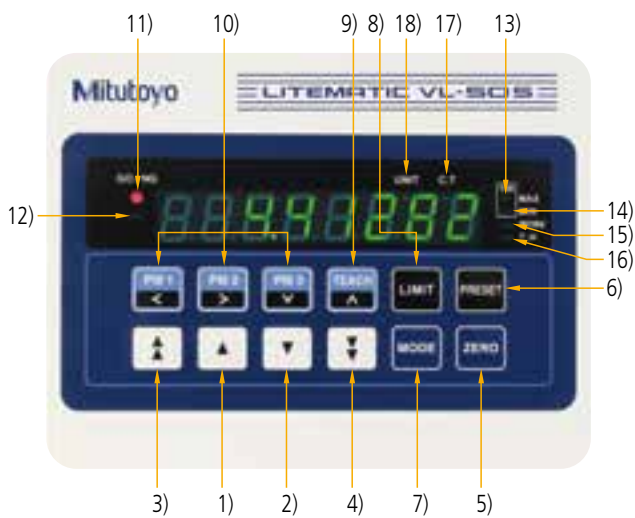- ▶ Connectors
- ▶ Battery components

LITEMATIC VL-50-B/50S-B

## FUNCTIONS — VL-50-B/50S-B

Control panel/Display Unit

Key function

| Key	Function
1) Up	Moves the spindle up only while the key is pressed.
2) Down	Moves the spindle down only while the key is pressed. Used to touch the contact point on a workpiece to make a measurement.
3) Rapid Up	Moves the spindle up quickly only while the key is pressed.
4) Rapid Down	Moves the spindle down quickly only while the key is pressed.
5) ZERO	Sets the origin at any position of the spindle. Also, it zero-sets all display values for difference measurements. This key can be used to clear an error.
6) PRESET	Allows the currently displayed value to be set from the keyboard, irrespective of spindle position. Often used in conjunction with gauge blocks.
7) MODE	Selects and sets one of various measurement modes such as MAX/MIN measurement.
8) LIMIT	Enters tolerance limits for tolerance judgment.
9) TEACH	Sets up the position memory.
10) PM1 to PM3	Moves the spindle to a previously stored position with a single keystroke.

Indicator (LED)

Indicator	Function	
11) GO/NG	Displays the result of a GO/NG judgment.	
12) Sign	Lights to display a minus value.	
13) MAX	Lights in the maximum value mode.	Both light when the measurement is the difference type (MAX - MIN).
14) MIN	Lights in the minimum value mode.	
15) WORK	Lights while a workpiece is being measured.	
16) T.H.	Lights when a measurement value is held after measurement has been completed.	
17) C.T.	Lights when the user compensation is set to ON. (Lights while the position memory is active.)	
18) UNIT	Lights while the unit of display values is inch. (Lights in the external HOLD mode.)	

Rear panel (switches and connectors)

VL-50-B
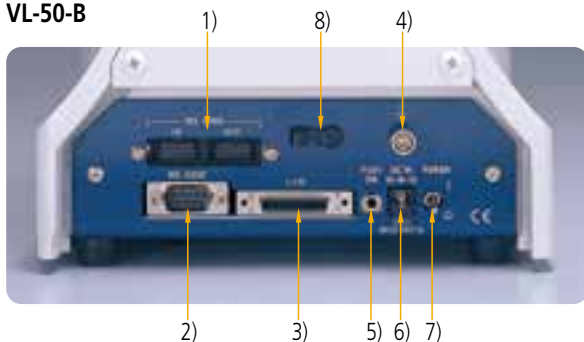
VL-50S-B
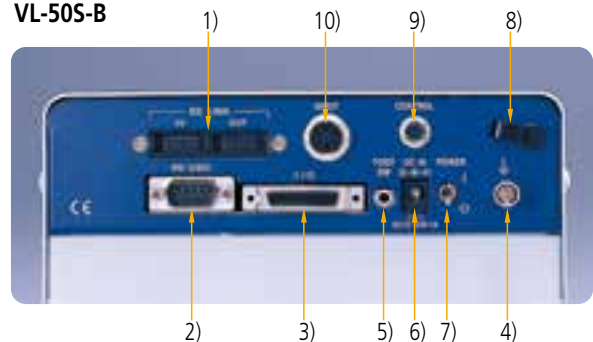
1) Measurement data output connector (OUT)	Outputs measurement data to a Digimatic mini-processor, etc.
RS-LINK connector (IN/OUT)	Connects multiple devices and can output measurement data from one RS-232 port.
2) RS-232C connector	For communication with a PC, etc.
3) External control connector	Used to connect this instrument to an external device for remote control.
4) GND terminal	—
5) Foot switch	Foot switch (optional) for controlling measurement operation is connected here.
6) DC IN	Input connector to receive power from the AC mains adapter.
7) Power switch	—
8) AC adapter cord clamp	Prevents AC adapter cord from pulling out.
9) CONTROL connector: for VL-50S-B only	Gage head connector.
10) INPUT connector: for VL-50S-B only	Gage head connector.

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SPECIFICATIONS VL-50-B/50S-B

Order No.	318-221*[4]	318-222*[4]	318-223*[4]	318-226*[4]	318-227*[4]	318-228*[4]
Model	**VL-50-B**	**VL-50-15-B**	**VL-50-100-B**	**VL-50S-B**	**VL-50S-15-B**	**VL-50S-100-B**
Measuring range*[1]	0 to 50 mm (0 to 2 in)					
Resolution	0.01/0.1/1.0 µm (0.0000005 in/0.000005 in/0.00005 in)					
Display unit	8 digits/14 mm (0.6 in) character height (without signs)					
Scale type	Reflection type linear encoder					
Stroke	51.5 mm (2 in) (when using a standard contact point)					
Measuring accuracy (20 °C)*[1]	$(0.5+L/100)$ µm L=arbitrary measuring length (mm)					
Accuracy guaranteed temperature*[2]	20 ± 1 °C					
Repeatability*[1]	$\sigma = 0.05$ µm					
Measuring force*[1]	0.01 N	0.15 N*[3]	1 N*[3]	0.01 N	0.15 N*[3]	1 N*[3]
Feed speed — Measurement	Approx. 2 mm/s (0.08 in/s) or 4 mm/s (0.16 in/s) (changeable by parameter)					
Feed speed — Fast feed	Approx. 8 mm/s (0.3 in/s)					
Contact point	ø3 mm carbide tipped (fixing screw: M2.5 (P=0.45)×5), standard contact point: **901312**					
Measuring table	ø100 (ceramic, grooved, removable)			—		
Input	Foot switch input (when optional foot switch is used), External Control					
Output	Digimatic output/RS-232C output (changeable by parameter)					
Rating — Power supply	85 to 264 V AC (depends on AC adapter)					
Rating — Power consumption	Max. 12 W (12 V, 1 A)					
EU Directive	Standard: EN61326-1:2013, Immunity test requirement: Clause 6.2 Table 2, Emission limit: Class B					
Main unit mass	19 kg (35.2 lbs)			6 kg (11 lbs)		
Standard Accessories	AC adapter: **357651**, Power cable: **02ZAA000**, Grounding wire: **09CAA985**, AC cable (Japan): **02ZAA000**, AC cable (USA): **02ZAA010**, AC cable (EU): **02ZAA020**, AC cable (UK): **02ZAA030**, AC cable (China): **02ZAA040**, AC cable (Korea): **02ZAA050** Hex wrench (2 pcs, for fixing contact point and for removing fixing bracket)					
Optional accessories	Foot switch: **937179T**					
	—			Dedicated stand: **957460**		
	Output connector (with cover): **02ADB440** (for external control)					
	RS-LINK/Digimatic connecting cable: **936937** (1 m) **965014** (2 m)					
	Recommended interchangeable contact points*[5] (Measuring force when each interchangeable contact point is used.) Shell type: **101118** (**Approx. 0.02 N**) Carbide tipped spherical contact point, ø7: **120059** (**Approx. 0.03 N**) Carbide tipped spherical contact point, ø10.5: **120060** (**Approx. 0.06 N**) Carbide tipped needle contact point, ø0.45: **120066** (**Approx. 0.01 N**)					
	VL weight parts: **02AZE375** Measuring force: Approx 0.01 N to 0.96 N Note: The above VL weights are not applicable to **VL-50-100-B**, **VL-50S-100-B**.					

*1 Normal measurement using standard contact point (with smoothing set as "weak").
*2 Under less temperature change, and hot or cold direct air flow should be avoided.
*3 0.15 N and 1 N types are factory-installed option.
*4 To denote your AC power cable add the following suffixes to the order No.: A for UL / CSA, D for CEE, DC for CCC, E for BS, F for SAA, K for KC, and No suffix are required for PSE.
*5 When another contact point that has a flat measuring face is mounted, the contact point requires parallelism adjustment with respect to the table surface.
    Mounting this contact point should be custom-ordered from Mitutoyo.
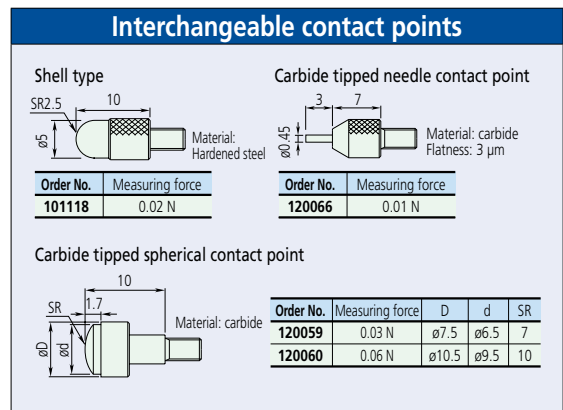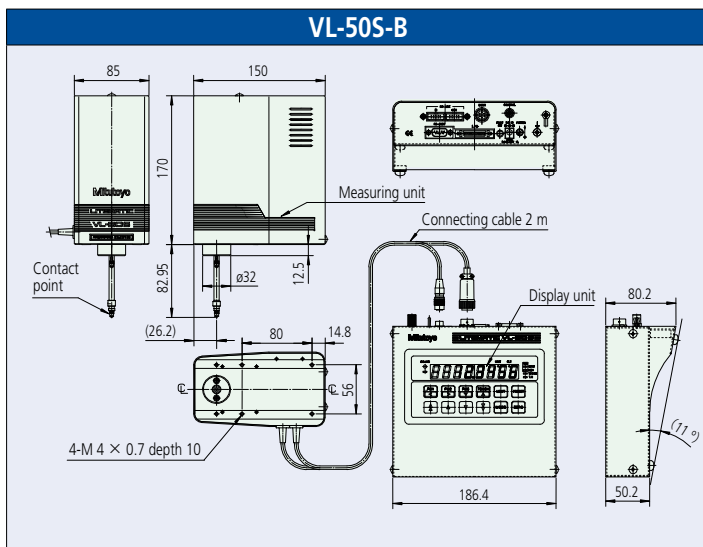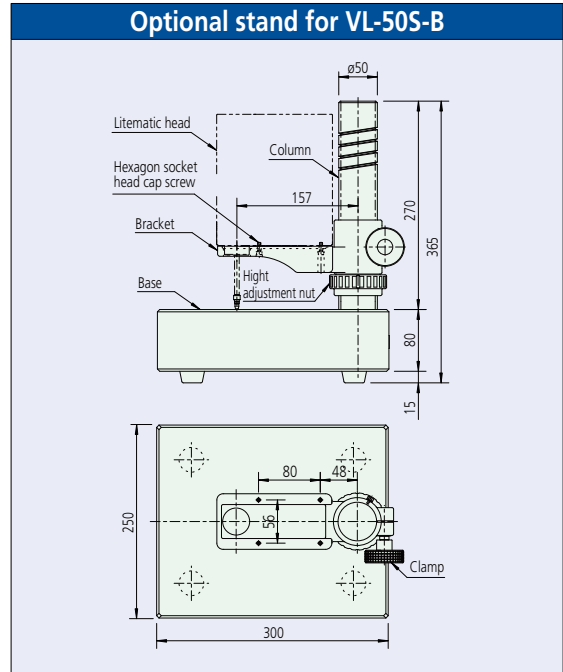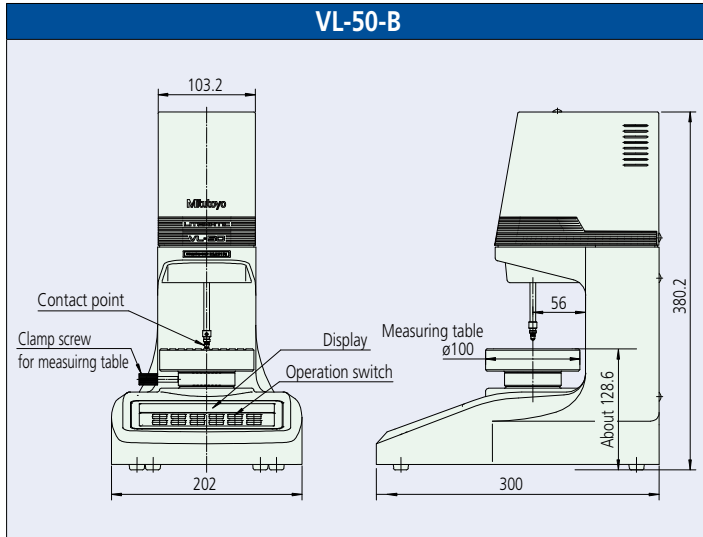Note: Motor life is approximately 100,000 operations, after which replacement is advisable.
    This maintenance factor is particularly important to bear in mind when the machine is used frequently, such as on a production line.

LITEMATIC VL-50-B/50S-B

DIMENSIONS

VL-50-B

Contact point
Clamp screw for measuirng table
Display
Operation switch
Measuring table ø100
103.2
380.2
56
About 128.6
202
300

VL-50S-B

Measuring unit
Connecting cable 2 m
Display unit
Contact point
85
150
170
82.95
ø32
12.5
(26.2)
80
14.8
56
4-M 4 × 0.7 depth 10
186.4
80.2
50.2
(11 °)

Optional stand for VL-50S-B

Litematic head
Hexagon socket head cap screw
Bracket
Base
Column
Hight adjustment nut
Clamp
ø50
157
270
365
80
15
80
48
56
250
300

Interchangeable contact points

Shell type

SR2.5
10
ø5
Material: Hardened steel

Order No.	Measuring force
101118	0.02 N

Carbide tipped needle contact point

3
7
ø0.45
Material: carbide
Flatness: 3 µm

Order No.	Measuring force
120066	0.01 N

Carbide tipped spherical contact point

10
SR
1.7
øD
ød
Material: carbide

Order No.	Measuring force	D	d	SR
120059	0.03 N	ø7.5	ø6.5	7
120060	0.06 N	ø10.5	ø9.5	10

Note: When a contact point having a flat measuring surface, other than those described above, is installed, the measuring surface must be adjusted for parallelism with the table surface. This requires a special order.

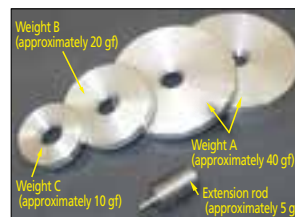## Optional weights for the Litematic (02AZE375)

One of the notable characteristics of the Litematic is its small measuring force (0.01 N or 0.15 N models). However, depending on the characteristics of the workpiece, it may not be possible to transmit a sufficient measuring force and the contact point may appear suspended. To solve such a problem, optional weights are available that attach to the spindle to achieve the appropriate measuring force without damaging the workpiece.

Note: Cannot be used with **VL-50-100-B**, or **VL-50S-100-B**

Spindle with an optional weight installed


External appearance of optional weights

Weight B (approximately 20 gf)
Weight A (approximately 40 gf)
Weight C (approximately 10 gf)
Extension rod (approximately 5 gf)

Measuring forces generated by weight combinations for 0.01/0.15 N models

Measuring force (N)		Extension rod	A	B	C
0.01	0.15				
0.06	0.21	1			
0.16	0.31	1			1
0.26	0.41	1		1	
0.36	0.51	1		1	1
0.46	0.61	1	1		
0.56	0.71	1	1		1
0.66	0.81	1	1	1	
0.76	0.91	1	1	1	1
0.86	—	1	2		
0.96	—	1	2		1

Connector terminal Function

(1) Applicable plugNo.02ADB440
No.02ADB440 (with cover) Optional accessory

Receptacle
10236-52A2
(3M) or equivalent
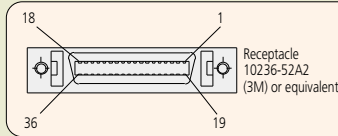
Applicable plug specification
10136-3000VE	(3M: Plug)
10336-52AO-008	(3M: Cover)
DX40M-36P	(Hirose: Plug)
DX30M-36-CV	(Hirose: Cover)

(2) Pin assignment

| Pin No.	Signal name	Input/Output	Description (purpose)
1	COM	—	Common terminal to input and output circuits (internally connected to GND)
2	COM	—	
3	L1	OUT	Tolerance judgment output terminal A related judgment terminal only outputs "L" At error occurrence L1, L5 = Outputs "L" L2, L3, L4 = Outputs "H"
4	L2	OUT	
5	L3	OUT	
6	L4	OUT	
7	L5	OUT	
10	NOM	OUT	Outputs "L" in the count mode.
21	ULIMIT	OUT	Outputs "L" at the top dead point of the spindle.
22	WORK	OUT	Outputs "L" upon detection of a workpiece.
25	SET1	IN	Specifies peak selection/motor speed in combination with SET.
26	SET2	IN	
28	MODE	IN	Peak selection: In combination with SET Peak mode / SET2 / SET1: Current value H H MAX H L MIN L H TIR L L
30	UP	IN	Motor control: Specifies a spindle ascent speed along with SET. Speed VL-50B/50-SB / VL-50AH / SET2 / SET1: 8 mm/s 5 mm/s H H 4 mm/s 3 mm/s H L 2 mm/s 2 mm/s L H 1 mm/s 1 mm/s L L When changing the spindle speed, stops the spindle once and allows 50 ms or more before change.
31	DN	IN	Motor control: Specifies a spindle ascent speed along with SET. Speed VL-50B/50-SB / VL-50AH / SET2 / SET1: 8 mm/s 5 mm/s H H 4 mm/s 3 mm/s H L 2 mm/s 2 mm/s L H 1 mm/s 1 mm/s L L When changing the spindle speed, stops the spindle once and allows 50 ms or more before change.
32	FSW	IN	Motor control: Same function as that of foot switch.
34	HOLD	IN	The display value is held during input. At error occurrence the error is cleared at the leading edge of this signal.
35	P.SET	IN	Executes presetting. Peak clear: The peak value is cleared upon input of the signal during the HOLD signal input in the Peak mode.
	N.C.	—	Unconnected terminals (8, 9, 11-20, 23, 24, 27, 29, 33 and 36 pin terminals)

(3) Input/output circuit

1. Output circuit: When the signal goes to "Low," the transistor turns on.
(Open collector output)
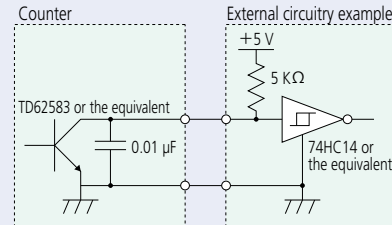
Maximum output voltage：24 V
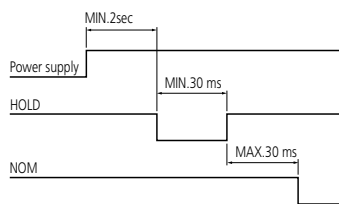Maximum output current：20 mA
Maximum saturation voltage：0.7 V

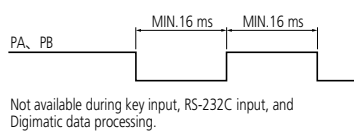2. Input circuit: When the signal goes to "Low," the input is enabled.
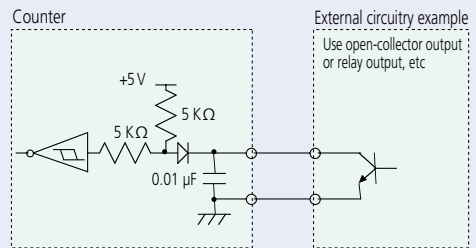
Maximum input current：1 mA
Inout volutage (H)：H＝4〜24 V
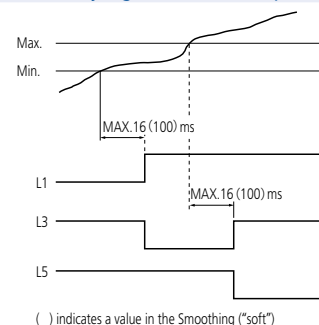Inout volutage (L)：＝1 V max.
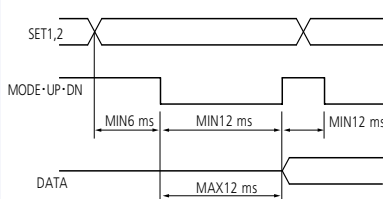
(4) Timing Chart

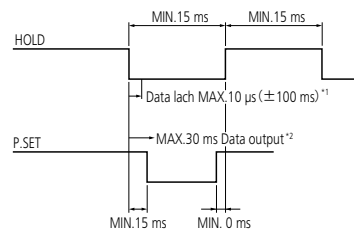### 1. Power On characteristics

2. External presetting

Not available during key input, RS-232C input, and Digimatic data processing.

3. Tolerance judgment result output timing

（　） indicates a value in the Smoothing ("soft")

4. Mode/Up/DN timing

5. HOLD, Error clear

* Peak clear input (following HOLD input, preset input)
*1:The value in ( ) is that at the time of smoothing.
*2:In case of parametere 28 and HOLD selection 1.

RS-232C Communication Function

(1) List of commands

Command format	Response output	Operation content
GA＊＊CRLF	G#＊＊, +01234.567CRLF	A display value is output via RS-232C. "＊＊" indicates gage channel numbers 01 to 99 (all channel number to 01 "#" indicates the type of data (N: current value, X: maximum value, M: minimum value, and W: TIR) CRLF stands for carriage return (CR) and line feed (LF).
CN＊＊CRLF	CH＊＊CRLF	The display is switched to the current value.
CX＊＊CRLF	CH＊＊CRLF	The display is switched to the maximum value.
CM＊＊CRLF	CH＊＊CRLF	The display is switched to the minimum value.
CW＊＊CRLF	CH＊＊CRLF	The display is switched to the TIR value.
CR＊＊CRLF	CH＊＊CRLF	The display is zero-set.
CL＊＊CRLF	CH＊＊CRLF	The peak value is cleared.
CP＊＊,+01234567CRLF	CH＊＊CRLF	The preset value is input. Input a preset value and a tolerance limit with a sign and a numeric value of 8 digits without appending a decimal point.
CD＊＊,+01234567CRLF	CH＊＊CRLF	Input tolerance limit S1. Perform tolerance setup in the order of CD and CG for 3-step tolerance judgment, and in the order of CD, CE, CF, and CG for 5-step tolerance judgment. An error messege is output if there is a difference in tolerance limit order, or in the number of steps between the setting and data to be sent, or if incorrect data exists. If this is the case, repeat setup from the beginning of the CD command.
CE＊＊,+01234567CRLF	CH＊＊CRLF	Input tolerance limit S2.
CF＊＊,+01234567CRLF	CH＊＊CRLF	Input tolerance limit S3.
CG＊＊,+01234567CRLF	CH＊＊CRLF	Input tolerance limit S4.
CS＊＊CRLF	CH＊＊CRLF	An error is canceled.
VS＊＊,+$CRLF	CH＊＊CRLF	Spindle control Sign +: Moves up the spindle., -:Moves down the spindle. $: Speed specification 0: Stop 1: 2 mm/s 2: 4 mm 3: 8 mm/s approx.
VT＊＊,+$CRLF	CH＊＊,#CRLF	Status of spindle condition In place of #, 0: Normal 1: Upper dead point limit 2: WORK ON Channel number 00 cannot be used.

(2) Pin assignment

```
1       5
  o o o o o
   o o o o
6       9
```
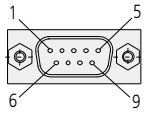
- Receptacle specification: D-sub 9-pin (male), inch thread spec.
- Applicable plug specification: D-sub 9-pin (female), inch thread spec.
- Commercial cable examples:
  For DOS/V: KRS-403XF1K (1.5 m), Sanwa Supply Corp.
 For PC-98 series: KRS-423XF1K (1.5 m), Sanwa Supply Corp.

Pin No.	Signal name	Input/Output	Definition
2	RXD	IN	Receive data
3	TXD	OUT	Transmit data
4	DTR	OUT	Data terminal ready
5	GND	—	Ground
6	DSR	IN	Data set ready
7	RTS	OUT	Request to send
8	CTS	IN	Clear to send
1, 9	N.C.	—	Unconnected

(3) Communication protocol (EIA RS-232C compatible)

Home position	DTE (terminal) and cross cable are to be used.
Communication method	half-duplex, non-procedural
Baud rate	4800, 9600, 19200 bps
Bit configuration	Start bit: 1 Data bits: (7 or 8) ASCII, uppercase Parity bit: None, even or odd Stop bits: 2
Communication condition setup	Set with parameters.

(4) Timing Chart

RS-232C command input and response output

MAX.20 ms*   MIN.10 ms

*The RS-232C output is put on hold during key operations.
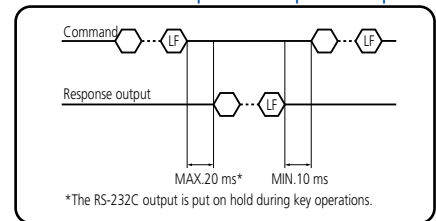
RS-232C data output time

The maximum output time when the all-data-output command (GA00CRLF) is used can be calculated using the following formula:

**Maximum output time [ms] =
counter connection count X 20 + connected channel X 17 (8.5) + 6 (3)**

*At a transfer speed of 9,600 bps; figures inside ( ) indicate values [in ms] when the speed is 19,200 bps. (Calculation example) 1 VL unit = MAX43 (31.5) ms (Note: The processing time by the personal computer is not included.)

Printer

**Digimatic mini processor
DP-1VA LOGGER
264-505**

Prints the Digimatic output up to 8 digits from Litematic.

Connecting cable (**936937**)

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