SONY®

MSD-560N-1
MSD-560N-2

Instruction Manual

March 1984

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Sony Magnescale Inc.

C A U T I O N F O R U S E

* Before starting to use Sony Magnescale equipment, be sure to check that it works correctly.

* Be sure to provide sufficient safeguard so that extensive damages may be prevented in case of malfunction.

* If the equipment is used neglecting specifications or remodeled by yourself, the functions and performance will not be guaranteed.

* Use of the equipment combined with others than those recommended by us may result in malfunction depending on operating conditions and environments.
  For satisfactory use, therefore, make careful study on the combination beforehand.

C O N T E N T S

1. GENERAL

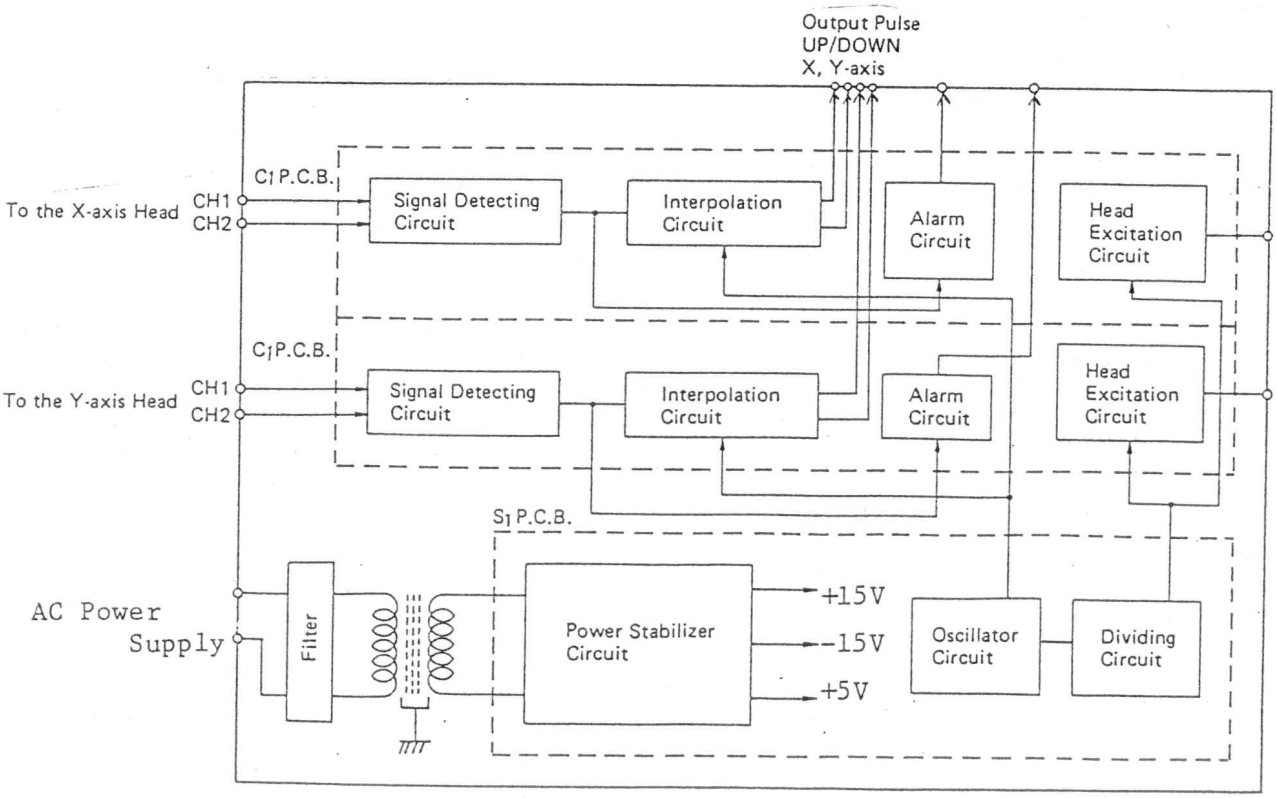
The detector MSD-560N is designed to use Magnescale (usually with water-resistant reading head HA-705LK and scale rod) particularly for rolling mill application to control thickness of strip to be rolled. It outputs pulses corresponding to the displacement and moving direction on the scale.

Main Features:

* The head cable can be extended up to 150m or 500ft.
* Fast response speed, 100m/min. or 330ft/min., max.
* 4 resolutions selectable by internal switches.
  1μm, 2μm, 5μm, 10μm
  (0.00005", 0.0001", 0.00025", 0.0005")
* Alarms for excess speed, scale signal disturbance and power failure.
* Two axes in one box.

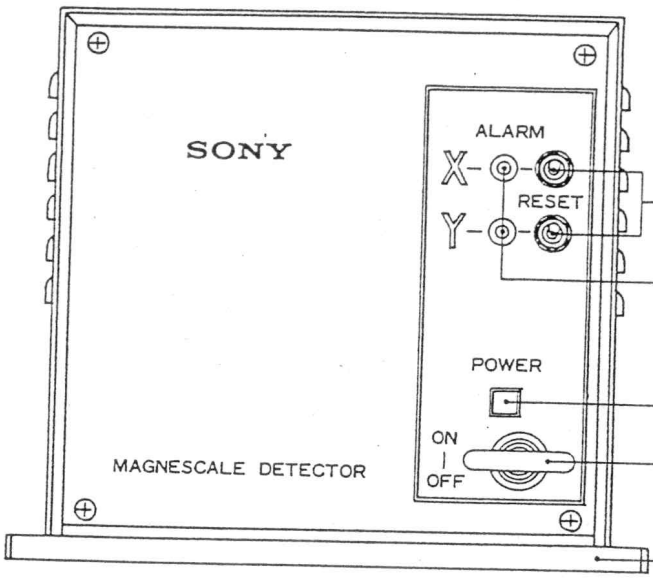
Composition:

MSD-560N is designed for two axes and incorporates three printed circuit boards of which details are shown below.

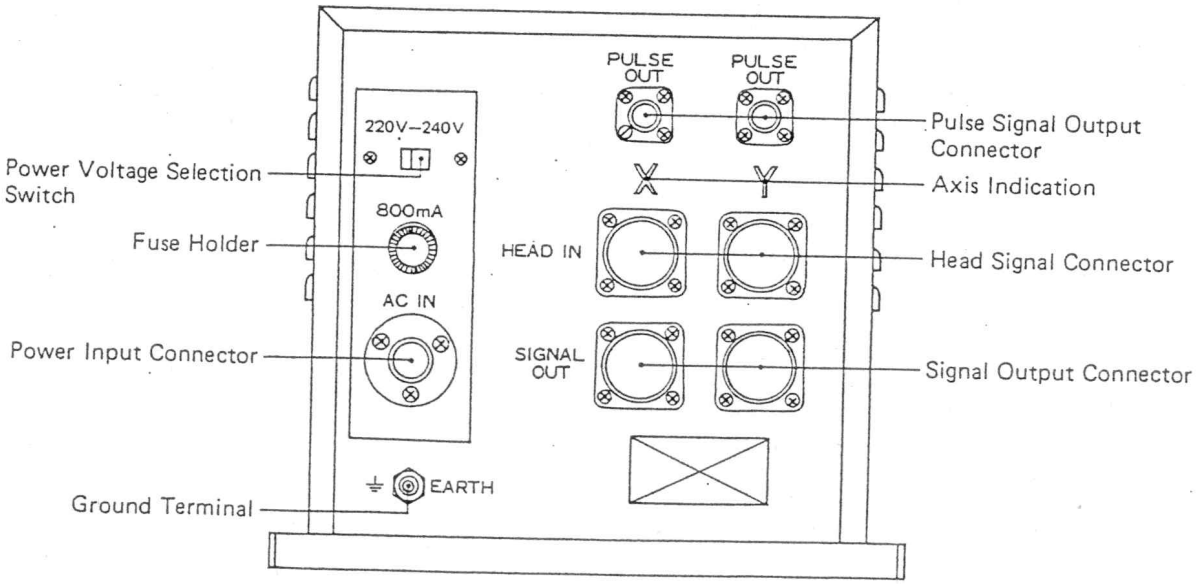


2. EXPLANATION OR PARTS

Front Panel



Rear Panel



Connector and Signal

Connector	Pin No.	Signal	Plug to be Connected
Power Input Connector	1	AC Power Input	16P-3F (TAJIMI)
	3	AC Power Input	
	2	Ground of Casing	
Head Signal Connector	A	Excitation Signal	MS3106B18-8P MS3057-10A (CANNON)
	B	(Vacant)	
	C	Excitation Signal	
	D	Head Signal } Channel 1	
	E	Head Signal } Channel 1	
	F	Head Signal } Channel 2	
	G	Head Signal } Channel 2	
	H	Ground of Casing	
Signal Output Connector	A	Magnescale Signal Output u Ⓨ } UP Direction	MS3106B18-1P MS3057-10A (CANNON)
	B	Magnescale Signal Output u Ⓩ } UP Direction	
	C	Magnescale Signal Output d Ⓨ } DOWN Direction	
	D	Magnescale Signal Output d Ⓩ } DOWN Direction	
	E	Alarm Signal Output ALM	
	F	Alarm Common Terminal ALMcom	
	G	Alarm Reset Input RST	
	H	Ground of Circuits	
	I	Synchronizing Signal Output OSX Y/OSY Y	
	J	Synchronizing Signal Output OSX Z/OSY Z	
Pulse Signal Output Connector	1	Magnescale Signal Output Cu	RM12BPG-5P (HIROSE)
	2	Magnescale Signal Output Cd	
	3	Ground of Circuits	
	4	(Vacant)	
	5	(Vacant)	
		Outputs the same signals as the UP/DOWN signal from the signal output connector. Being TTL output (SN7437), its connecting cable can be extended only up to 2~3 m (6.6~10 ft).	

3. OPERATING INSTRUCTIONS

1) Composition of Scale and Reading Head

1. SZ705: Scale rod retainer
2. MSS-976R: Co-axial linear Magnescale

   Scale pitch: 200μm
   Accuracy: ±5Lμm (L = effective length in meter)
   Coefficient of thermal expansion: (13±1) x 10^{-6}°C
   Operating temperature: -5 ∿ +40°C

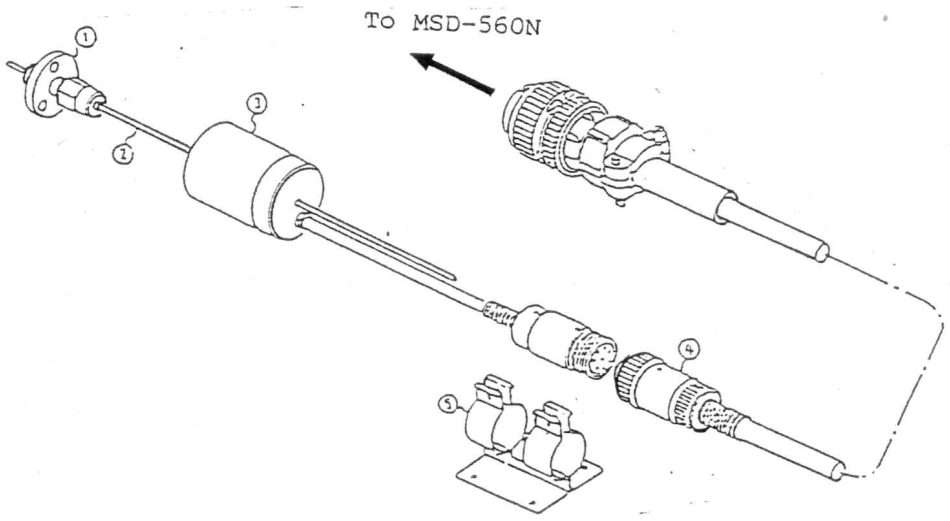
3. HA-705LK: Water-resistant reading head assembly

   Reading head: MSH-705LJ, water-resistant, low-impedance type
   Lead cable: 7-core shielded cable, outer diameter 4.5mm
   Connector: RM15WTJA-8S-(5) made by HIROSE. Water-proof type (proved in water 1.8m deep for 24 hours). Maximum current 5A, maximum voltage AC1500V for 1 min.
   Insulation resistance: 50MΩ or higher, between coils, coil and head, head and housing, shield and housing, shield and head.

4. MK3-100, MK3-150: Connecting cable 100m, 150m, connects HA-705LK and Detector MSD-560N.

   Connector to head: RM-15WTPA-8P-(9) made by HIROSE. Water-proof type (proved in water 1.8m deep for 24 hours). Maximum current 5A, maximum voltage AC1500V for 1 min.
   Connector to detector: MS3106B18-1P, MS3057-10A made by JAL.

5. Connector holder for connecting cable (optional accessory)

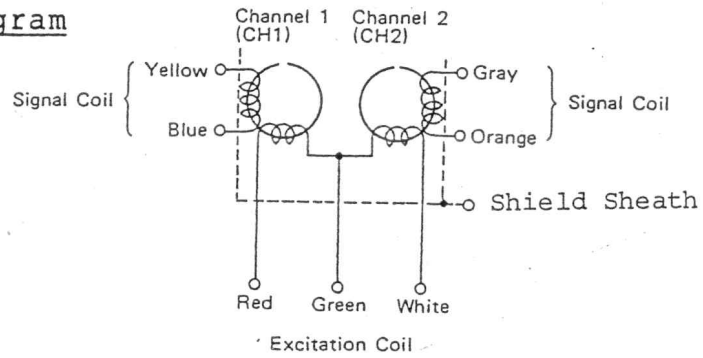


2) Connection of Head Cable

Mount the Magnescale on a machine and connect the head cable to the detector. Use the MK3 cable specified by us as the head cable. In case you use other cable, consult us beforehand. One end of the MK cable is connected to the reading head (usually through water resistant connector) and the other end to the detector.

In case you do not use a connector for connecting the MK3 cable to the head, solder the wires of the MK3 cable and the head lead wires matching them by colour. The head coil connection is as follows:

Head Coil Diagram



Important: Be sure to turn off the power switch before connecting or disconnecting the head cable connector to the detector or the head plug of the scale; otherwise the head may be magnetized and the accuracy may be deteriorated.

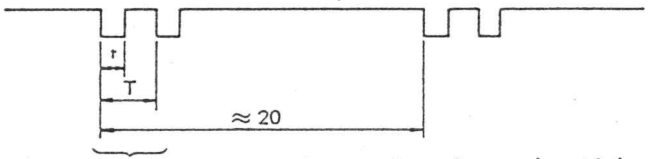
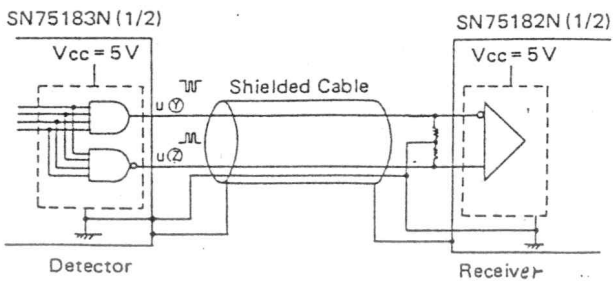
3) Connection of Ground Wire

Firmly connect the ground terminal of the detector to the machine body with the ground wire supplied as standard accessory.

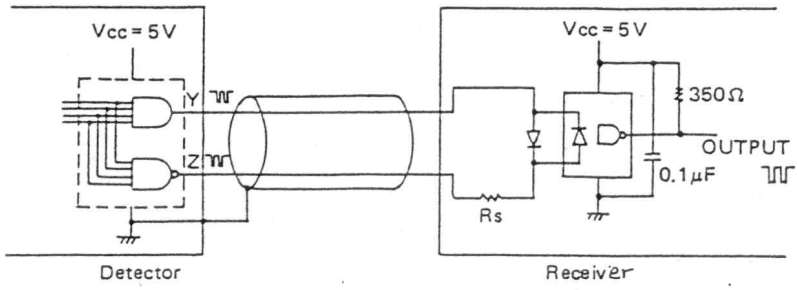
As the head housing is insulated from the head core, loop current does not get into it through the scale. (Head Assembly HA-705LK)

4) Magnescale Signal Output

The scale signal is asynchronous, which is sensitive to external noises. For connection to the detector, therefore, use a shielded cable.
The detector outputs a pulse in every 1μm, 2μm, 5μm or 10μm displacement corresponding to the resolution and the moving direction of the scale.

Pulse Width (t)	1μm (0.00005") 0.2μs ±30% 2μm (0.0001") 0.4μs ±30% 5μm (0.00025") 1.0μs ±30% 10μm (0.0005") 2.0μs ±30%
Maximum Repetition Frequency (T)	1μm (0.00005") 2.5 MHz 2μm (0.0001") 1.25 MHz 5μm (0.00025") 0.5 MHz 10μm (0.0005") 0.25 MHz
Signal Output	When the head signal is received by the line receiver SN75182N (TI), the receiver output is ACTIVE LOW.  The number of pulses in this part increases or decreases according to the reading head velocity and resolution. When the speed is 3m/min. (10ft/min.) at the resolution of 1μm(0.00005"): 1 pulse When the speed is 6m/min. (20ft/min.) at the resolution of 1μm(0.00005"): 2 pulses When the speed is 9m/min. (30ft/min.) at the resolution of 1μm(0.00005"): 3 pulses As the sampling system is employed for reading, there arises a 0 ∿20μs time delay from when the head picks up the scale signal and till when the output pulse is given out from the detector.
Output Circuit	The line driver SN75183N (TI) is used for the output. Prepare such a receiver circuit as shown below. (For details, refer to the DATA BOOK of Texas Instrument.) Example: When the line receiver SN75182N (TI) is used to receive the output. 

When isolating the detector from the receiver circuit



As the Magnescale signal is output at high speed of 2.5 MHz, use a high speed isolator. (For example, 5082-4360 of Hewlett-Packard)

When 5082-4360 is used as an isolator, determine the value Rs in such a way that forward current 7.5mA is fed to the input diode. When using a long connecting cable, consider its resistance also.

- R_S Series Resistance
- V_L Transmission Signal Voltage
- I_L Line Current
- V_D Forward Voltage of Diode

If I_L is set to 7.5 mA, the following equality is obtained:

$$R_S = \frac{V_L - V_D}{I_L} = \frac{3 - 1.5\,(V)}{7.5\,(mA)} = 200\,(\Omega)$$

Confirm the above equality by experiment before use. The maximum output current of SN75183N is 40mA both at high and low output current level.

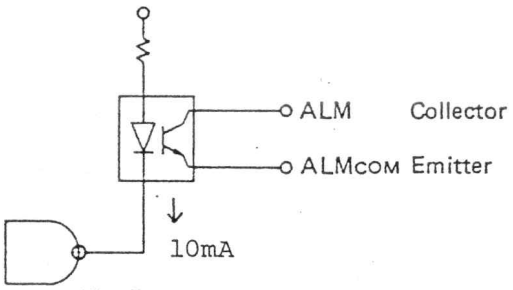
5) Alarm

On the following occassions, alarm works and the alarm lamp on the front panel lights up:

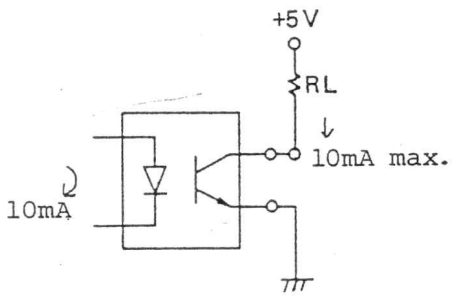
* When the motion of the scale exceeds the maximum response speed.
* When the head cable or head coil is disconnected.'
* When power fails tempolarily. (It does not work, however, at a power failure of less than 10ms.)

  This case is restricted to the mode that the alarm function is instantaneously set ready with power switch turned on. (See 7. MISCELLANEOUS SETTING)

Alarm Output Circuit



This is a transistor output by opto-isolator EE-CM (OMRON).



When resistor is connected as shown, the collector output level is as follows:

* When alarm does not function: Low level
* When alarm functions: High level

The absolute maximum rating (at 25°C or 77°F) of the output transistor is as follows:

* Ic max = 30mA (Actual maximum current Ic max is 10mA, since the primary current is 10mA (conversion efficiency 100%)
* Pc max = 150mW
* Vce max = 30V
* Veb max = 5V

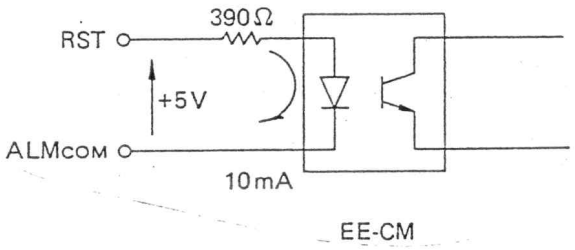
Release of Alarm

Alarm can be released by either of the following operations:

*Flick down the alarm reset switch on the front panel.

* Apply 5V±10% to the G (RST) and F (ALM com) terminals of the signal output connector on the rear panel.

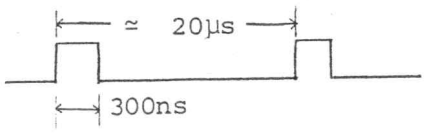
An isolator is used for the alarm reset receiver circuit of the signal output connector.



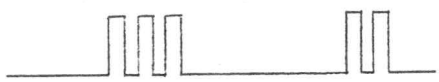
6) Synchronizing Signal Output

As the synchronizing signal is output from the signal output connector, it can be used when it is externally synchronized with the Magnescale signal. Independent synchronizing signal is available for each axis. The output circuit is provided with the line driver SN75183 (TI). Refer to page 7 for its receiver circuit.

Synchronizing signal



UP or DOWN pulse



4. ADJUSTMENT

After installing the scale and detector, make the following electrical adjustment.

[Preparation]
Prepare an oscilloscope and set it according to the table below. Also prepare a slotted head screw driver (3 or 4mm wide) for adjustment of variable trimmer resistors.

> Use an oscilloscope with sensitivity higher than 0.1V and frequency bandwidth higher than 1MHz.

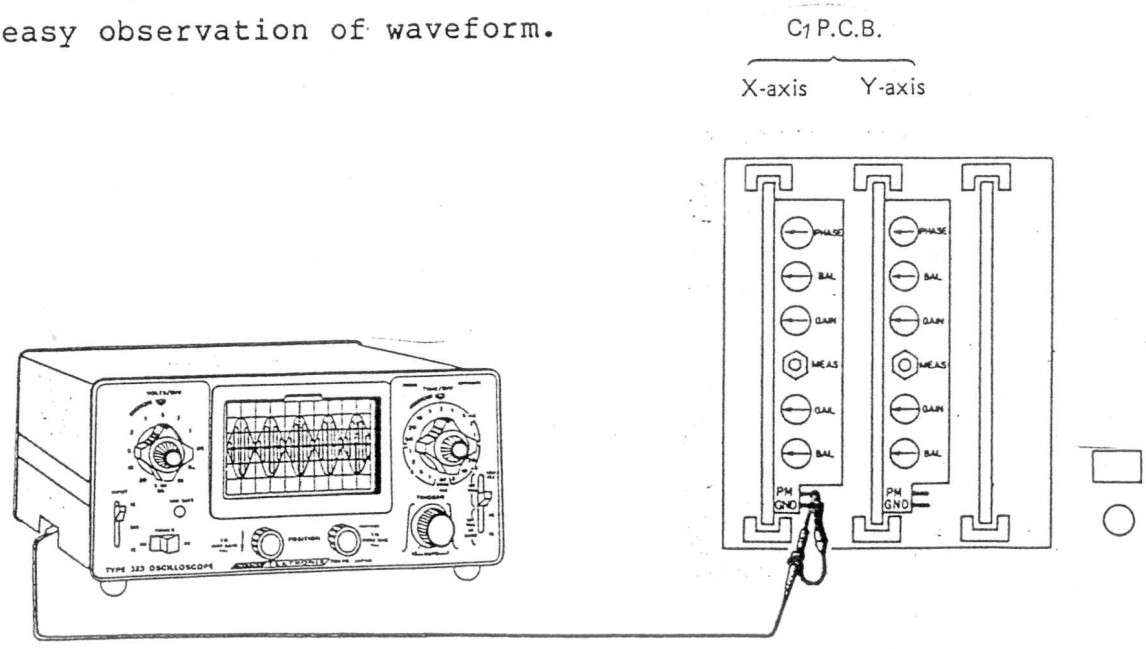
Input Sensitivity	AC0.5V/DIV (use 10:1 probe)
Horizontal Sweep	50 ms/DIV~0.5 ms/DIV
Trigger Source	INT
Trigger Mode	AUTO

Remove 4 setscrews and the front panel of detector.

Connect probes of the oscilloscope to the PM and GND terminals on the C1 P.C.B. and turn on the power switch of the detector.

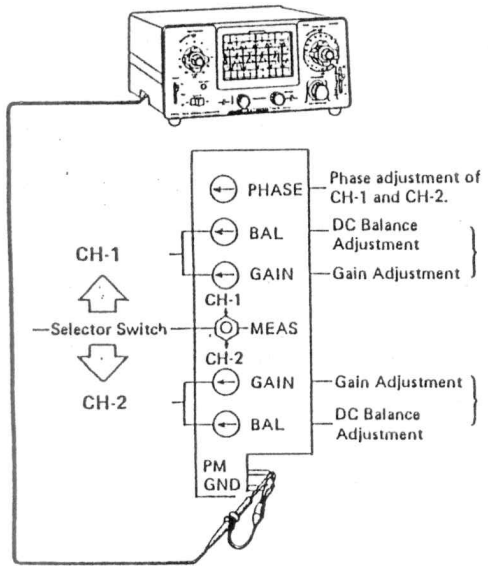
Move the scale at a speed of 0.5 ∿5m/min. (20" ∿200"/min.)

Make appropriate vertical and horizontal adjustment for easy observation of waveform.



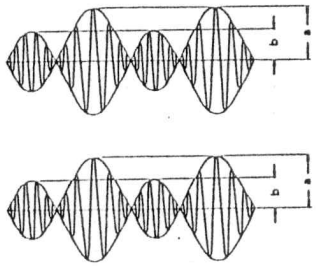
Adjustment

Moving the scale, make the electrical adjustment in the following manner.



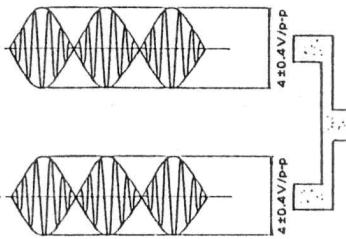
DC Balance Adjustment

Make (a) and (b) equal.



Gain Adjustment

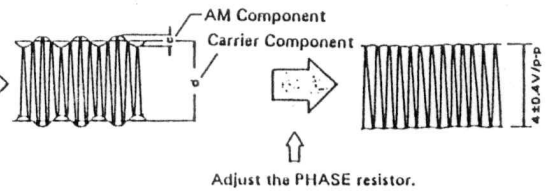
Make the amplitude 4 ± 0.4 V/p-p.



③ Phase Adjustment of CH-1 and CH-2

Make (c) as small as possible.

PM Signal
(Phase Modulated Signal)



(Adjustment finished.)

Adjust the PHASE resistor.

① Adjustment of CH-1

Set the selector switch to the CH-1 side.

You will see such a waveform as shown above. Adjust the BAL resistor of CH-1 to make (a) and (b) equal. Raise the sensitivity of the oscilloscope to make this adjustment as accurately as possible.

In this condition, adjust the GAIN resistor of CH-1 to set the amplitude to 4±0.4V/p-p as shown above.

② Adjustment of CH-2

Set the selector switch to the CH-2 side.

Adjust the BAL resistor of CH-2 in the same way as you did for CH-1.

Adjust the GAIN resistor of CH-2 in the same way as you did for CH-1. Make the amplitude equal to that of CH-1.

Repeat the DC balance and gain adjustments several times to obtain the optimum condition.

Set the selector switch to the center position (MEAS).

Such PM signal as shown above will be observed. Adjust the PHASE resistor to minimise the AM component on the envelope of the waveform. Make this adjustment carefully so that the ratio of (c) and (d) may become as follows:

Resolution	c/d	Carrier Frequency
1μm(0.00005") 2μm(0.0001")	c/d < 0.05 (Less than 5%)	50 kHz
5μm(0.00025") 10μm(0.0005")	c/d < 0.1 (Less than 10%)	

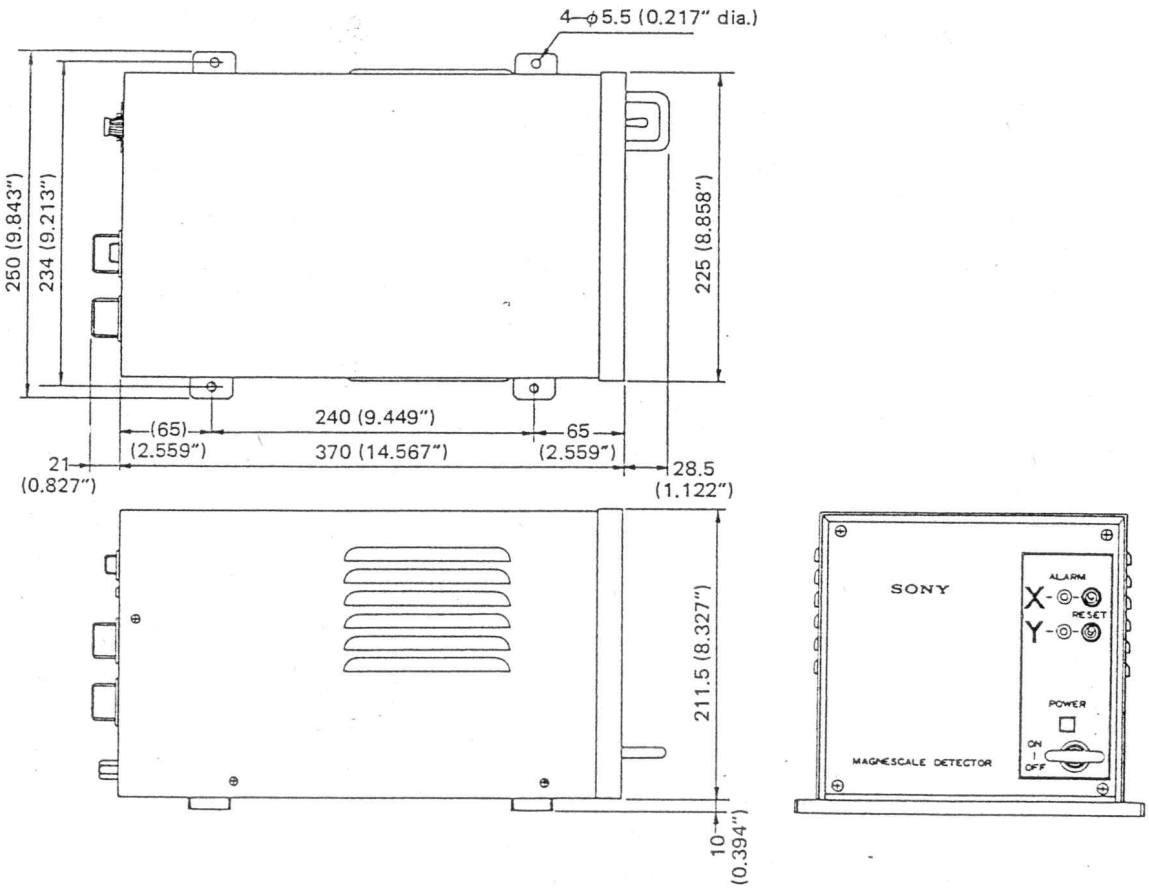
Repeat the above adjustments ① ② ③ several times and minimise the AM component.

* When you cannot reduce the AM component, make sure that hum is not leaking into the oscilloscope, and restart the adjustment.

Accessories

Power Cable 1
Ground Wire 1
Fuse 2
SIGNAL OUT Connector ..... 2 (CANNON MS3106B18-1PX, MS3057-10A)
PULSE OUT Connector ..... 2 (HIROSE RM12BPG-5P)

9. OUTLINE DRAWING

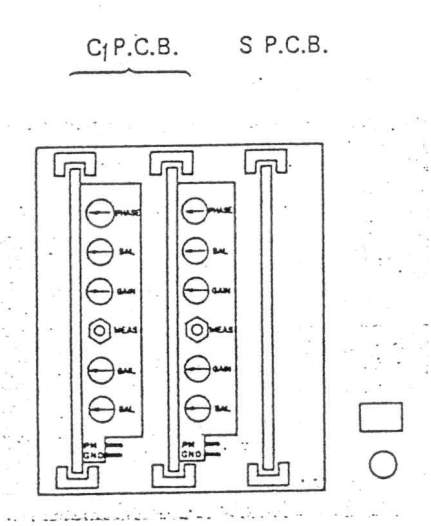


5. SELECTION OF RESOLUTION

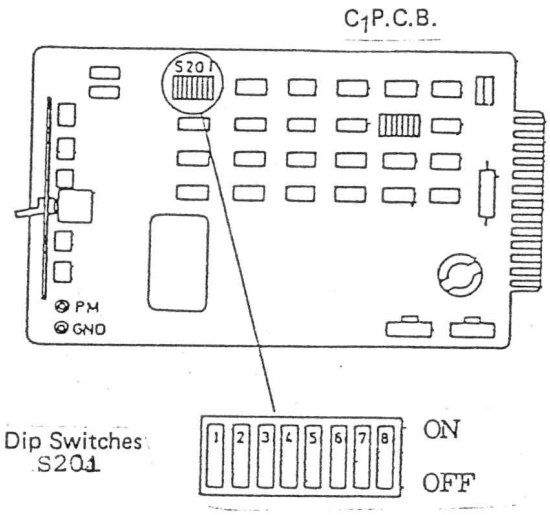
With the resolution selector switches mounted on C1 P.C.B.s and S1 P.C.B., the resolution 1μm, 2μm, 5μm or 10μm (0.00005", 0.0001", 0.00025" or 0.0005") can be selected for X-axis and Y-axis independently.

Selection on the C1 P.C.B.

Pull out the C1 P.C.B. of each axis. Set the dip switches of S201 on the P.C.B. as per table below to the required resolution:



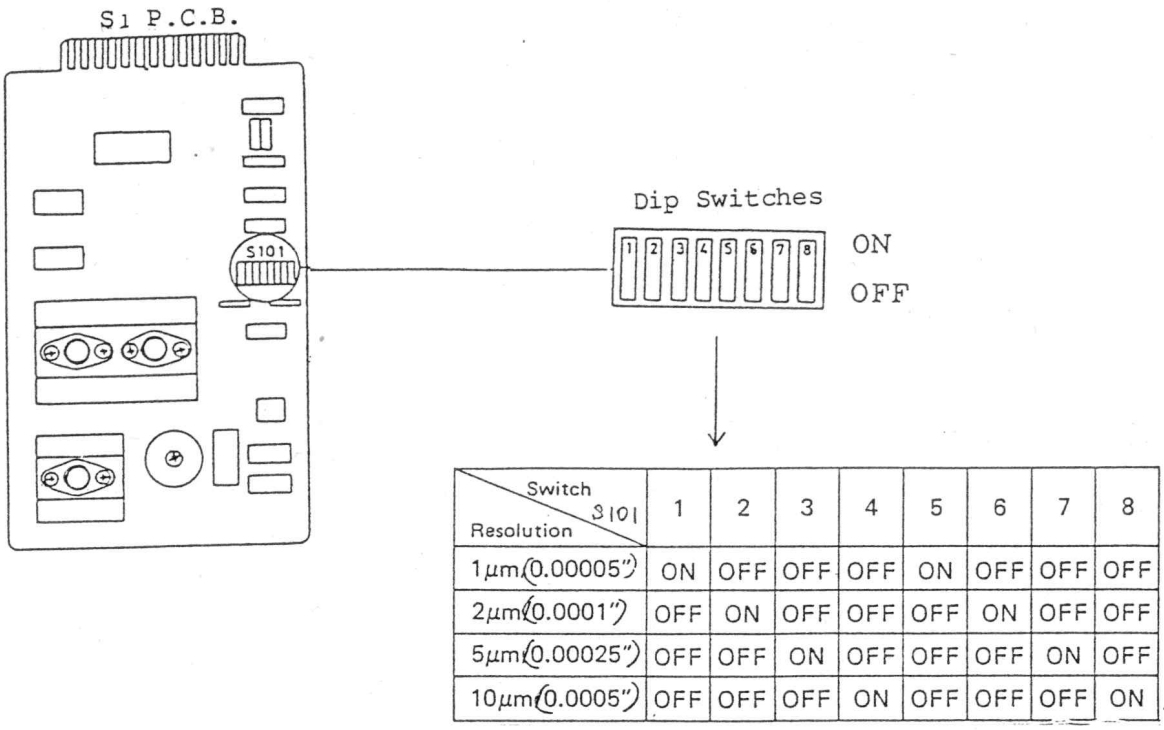
Remove the front panel.



Switch S201 / Resolution	1	2	3	4	5	6	7	8
1μm(0.00005")	OFF	OFF	ON	OFF	OFF	OFF	ON	ON
2μm(0.0001")	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF
5μm(0.00025")	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF
10μm(0.0005")	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF

Selection on the S1 P.C.B.

Pull out the S1 P.C.B. Set the dip switches of S101 on the P.C.B. as per following table to the same resolution as is set on the C1 P.C.B.:

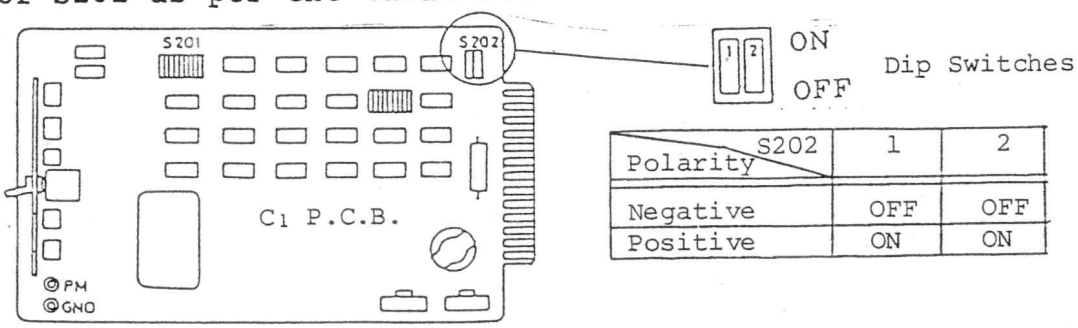


Switch / Resolution S101	1	2	3	4	5	6	7	8
1μm(0.00005")	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF
2μm(0.0001")	OFF	ON	OFF	OFF	OFF	ON	OFF	OFF
5μm(0.00025")	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF
10μm(0.0005")	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON

6. SELECTION OF READING DIRECTION

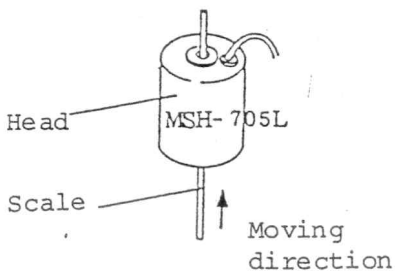
Set the reading direction in conformity to the moving direction of the scale as follows:

Pull out the C1 P.C.B. of the axis whose reading direction you want to change. Set the dip switches of S202 as per the table below.



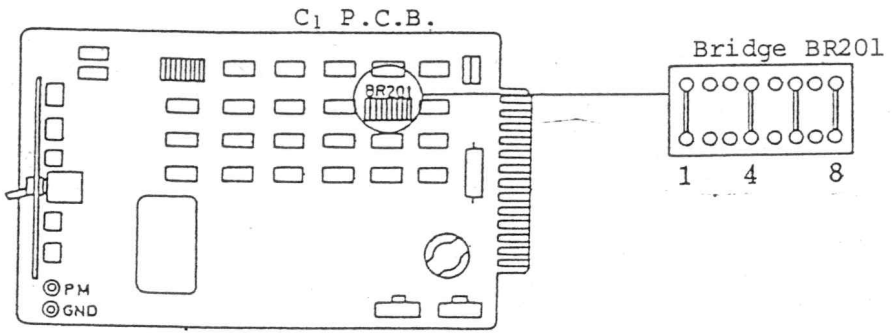
Polarity / S202	1	2
Negative	OFF	OFF
Positive	ON	ON

When the reading direction is set to positive polarity, the pulse starts from UP direction.



7. MISCELLANEOUS SETTING

MSD-560N is designed for various special applications. Settings for them are made with bridges of BR201.



Bridges of BR201 are factory-set as shown below.

BR201	1	2	3	4	5	6	7	8
	SHORT	OPEN	OPEN	SHORT	OPEN	SHORT	OPEN	SHORT

The bridges 3,4,7 and 8, can be used for the following purposes.

[Bridges 3 and 4] Effect of alarm function on power-on

Bridge to be shorted	When power is turned on	When power temporarily fails	Remarks
3	Instantaneously alarm is set ready.	Alarm works.	Alarm is reset every time the power is turned on.
4	Instantaneously alarm function is released.	Alarm does not work.	

[Bridges 7 and 8] Effect of alarm on Magnescale signal output

Bridge to be shorted	Magnescale signal output	Remarks
7	Signal output is prohibited while alarm functions.	
8	Signals are output regardless of the alarm function.	Notice that reliability of the output signal is low while alarm functions.

8. SPECIFICATIONS

Items	MSD-560N-1	MSD-560N-2
Resolution	1μm, 2μm, 5μm, 10μm (0.00005", 0.0001", 0.00025",0.0005") You can set the resolution of X-axis and Y-axis to any one of the above by dip switches on the C_1 P.C.B. and S_1 P.C.B.	
Maximum Response Speed	100m/min. (330ft/min.) (Note)	
Quantization Error	±1 count, max.	
Number of Axes	2 axes in one console	
Length of Connecting Cable	Max. 150m (492'): MK3 type cable specified by us and a low impedance head (HA-705LK) Max. 50m (164') : MK3 type cable specified by us and a standard head	
Scales to be Connected	Linear or rotary Magnescale, or digital gauging probe	
Alarm	Alarm functions on the following occassions: 1. When the motion of the head exceed the maximum response speed (when the level of the PM signal drops to less than 1V/p-p). 2. When the head cable or the head coil is disconnected (when the level of the PM signal drops to less than 1V/p-p). 3. When power fails tempolarily.	
Output Signal	Pulse signal output (Line driver SN75183) Pulse signal output (TTL S 7437) Alarm signal output (OPT isolator EE-CM)	
Input Signal	Alarm reset input (OPT isolator EE-CM)	
Operating Temperature	0°C ∿ +40°C (+32°F ∿ +104°F)	
Storage Temperature	-20°C ∿ +60°C (+14°F ∿ +122°F)	
Power Supply	AC100V,115V±10% 50/60Hz	220V, 240V±10% 50/60Hz
Power Consumption	20W	
Outside Dimensions	250(W)x222(H)x420(D)mm, 9.84(W)x8.74(H)x16.54(D)inch (including brackets)	
Weight	8kg (17.64 lb)	

Note) This maximum response speed is the response threshold of the electronic circuits. If the scale motion exceeds this limit even for a moment, the detector may malfunction Avoid a stick-slip motion on the scale.