SONY®

Rajan
16/10/19

INSTRUCTION MANUAL
FOR
DETECTOR
MSD 9050 and MSD 9550

March, 1978

Sony Magnescale Inc.

CONTENTS

1. General

This detector is designed to increase the range of applications of the Magnescale, and it has a number of features which are improvements on previous models produced by Sony Magnescale:

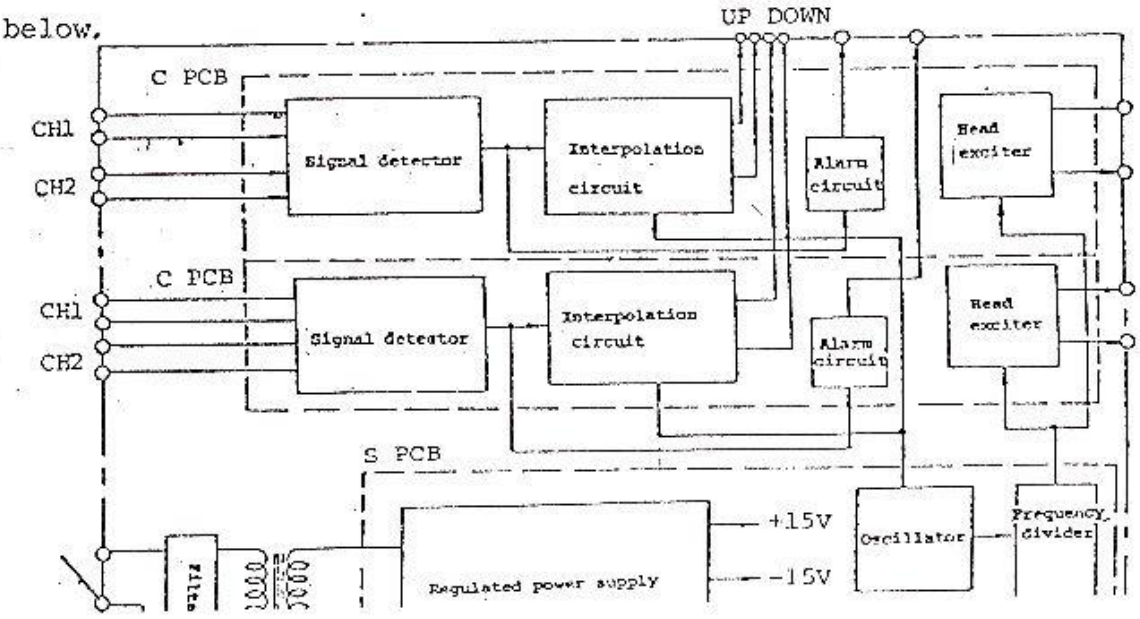
(1) The head cable can be extended (up to a maximum of 150m)
(2) The response speed is faster (max. 100m/min.)
(3) Two axes are provided in one housing.
(4) An AC input is employed for the power supply.
(5) There are two alarm circuits.

Use a low impedance head when connecting an MSK cable over 100m long to the detector. For operation, refer to the instructions in this manual and they will insure that you use the detector in the best possible working conditions.

Failure to follow the instructions in this manual or failure to take note of the precautions may result in an accident or breakdown. Kindly note that the guarantee will not be valid in cases where the detector breaks down due to mishandling.

2. Configuration

Two axes are provided in a sigle housing, and a total of three printed circuit boards are incorporated. The circuit configuration of each of the printed circuit boards is shown below.



*	S PCB (1)	Regulated power supply (±15V, +5V)
		Oscillator
		Frequency divider
*	C PCB (2)	Same for both X and Y axes
(one for		Signal detectors
each axis)		Interpolation circuits
		Alarm circuit

3. Specifications

Item	Specification
Resolution	5μm/10μm Selectable by replacing C and S PCB sockets. Resolution same for X and Y axes.
Maximum response speed	100m/min. (See Note 3-1)
Quantization axes	± 1 count (See Note 3-2)
Number of axes	2 axes in one housing
Maximum length of head cable	With low impedance head and MSK type cable designed by Sony Magnescale. 150m
Maximum legth of signal output cable	When received with circuitry and cable designated by Sony Magnescale 100m
Alarm circuit	Detector's alarm circuit are actuated When : (1) PM signal level falls to about one-half that of specified level (4Vp-p) This happens when maximum response speed of head is exceeded, and the cause may be traced to disconnected wire in the head or cable, or head wear. (2) Power fails.
Output signals	The following are available as output signals : (1) Pulse signal output ..... SN75183 (line driver) (2) Pulse signal output ..... SU7437 (TTL) (3) Alarm signal output ..... EE-CM$_2$ (Optoisolator)
Input signal	The following is available as an input signal : (1) Alarm reset input ..... EE-CM$_2$ (Optoisolator)
Usable temperature range	0°C - +40°C
Storage temperature range	-20°C - +60°C
Power requirements	AC 100/115V ± 10%, 50/60Hz AC 220/240V ± 10%, 50/60Hz (See Note 3-3)

Power consumption	20W
Dimensions	250(W) x 221.5(H) x 419.5(D) mm Inclusive of mounting feet
Weight	8kg

(Note 3-1) This maximum speed is the value limited by the electronic circuitry. If exceeded, even for an instant, this may result in a malfunction. When using the detector, take care that there is no stick-slip motion on the transducer.

(Note 3-2) The quantization error is inherent to the digital system.

(Note 3-3) AC 100/115V for Japan and the United States
AC 220/240V for Europe
(All values are selectable)

Accessories

* Power cable (1)
* Cables for connecting head and detector (2) (See Note 3-4)
* Ground wire (1)
* Fuses (2)
* Plugs for SIGNAL OUT connector (2) (See Note 3-5)
* Plug for PULSE OUT connector (1) (See Note 3-6)
* Instruction Manual

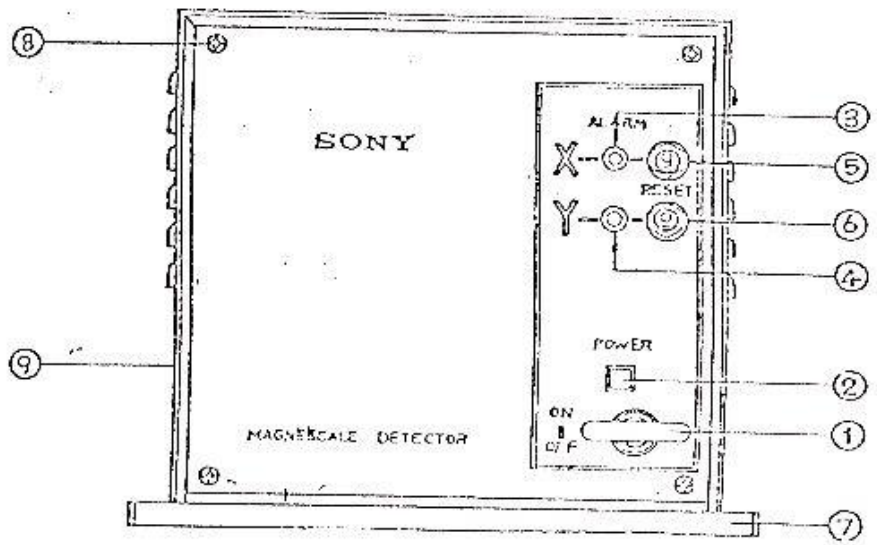
(Note 3-4) Order this separately, bearing in mind the designated cable length, since this is treated separately from the detector.

(Note 3-5) MS33106B18-1PX manufactured by Japan Aviation Electronics MS3057-10A manufactured by Japan Aviation Electronics

(Note 3-6) RM12BPG-5P manufactured by Hirose Electric

4. Description of Parts

4-1. Front panel



(1) POWER SW — Power switch
Power is supplied to the detector when this switch is set to ON.

(2) POWER LAMP — Power indicator lamp
This lights up when power is supplied to the detector.

(3) ALARM LAMP (X axis) — This lamp lights up when the alarm circuit is actuated.

(4) ALARM LAMP (Y axis) — This lamp lights up when the alarm circuit is actuated.

alarm when the alarm circuit has been actuated.

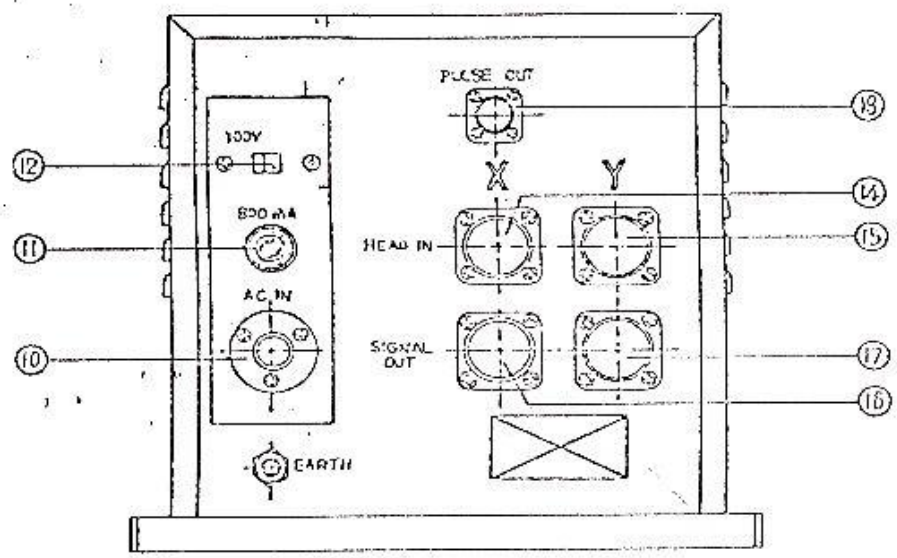
(6) ALARM RESET (Y axis) — Alarm release switch
Setting this switch to ON releases the alarm when the alarm circuit has been actuated.

(7) MOUNT — The detector is secured to the mount whose insulating material insulates the mount and the detector.

(8) Setscrews — These are the front panel's setscrews.

(9) Front panel — Remove this panel before adjusting the detector.

4-2. Rear panel



(10) AC IN — Power input connector
This is for supplying power to the detector from an external source.

(11) Fuse holder — Use a specified fuse.

input connector.

(13) Ground terminal (EARTH)
Use this terminal to ground the detector and the machine body.
The detector's GND circuit is connected to the case.

(14) HEAD IN (X axis)
Head cable connector
Use this to connect the designated MSK-type cable.

(15) HEAD IN (Y axis)
Head cable connector
Use this to connect the designated MSK-type cable.

(16) SIGNAL OUT (X axis)
Signal output connector
Use this to feed out UP/DOWN signal output (line driver output), alarm signal output, alarm reset input, and the clock signal output.
For other application, read through the operating instructions.

(17) SIGNAL OUT (Y axis)
Signal output connector
Use this to feed out the UP/DOWN signal output (line driver output), alarm signal output, alarm reset input, and the clock signal output.
For other applications, read through the operating instructions.

(18) PULSE OUT
Use this to feed out a signal which is the same as the UP/DOWN signal fed

However, the cable only be extended 2-3m since a TTL output is fed out with the SN7437.
Therefore, use this as an auxiliary output connector.

4-3. Type of Signals, Connector Pin Positions

Connector No.	Pin No.	Signal	Remarks
AC IN	1 2 3	) AC Power input GND	Compatible plug 16p-3F (TAJIMI)
HEAD IN (X axis)	A B C D E F G H	Excitation signal EX(A) No connection Excitation signal EX(C) Head signal CH1(D) Head signal CH1(E) Head signal CH2(F) Head signal CH2(G) GND	Compatible plug MS3106B18-8P MS3057-10A (Japan Aviation Electronics)
HEAD IN (Y axis)	A B C D E F G H	Excitation signal EX(A) No connection Excitation signal EX(C) Head signal CH1(D) Head signal CH1(E) Head signal CH2(F) Head signal CH2(G) GND	Compatible plug MS3106B18-8P MS3057-10A (Japan Aviation Electronics)
SIGNAL OUT (X axis)	A B C D E F G H I J	Magnescale signal output u(Z) Magnescale signal output u(Y) Magnescale signal output d(Z) Magnescale signal output d(Y) Alarm signal output ALM(+) Alarm signal output ALM(-) Alarm reset input INAL(+) Alarm reset input INAL(-) Clock signal output CKO(Z) Clock signal output CKO(Y)	) UP) DOWN Compatible plug MS3106B18-1P MS3057-10A (Japan Aviation Elec-

SIGNAL OUT (Y axis)	A B C D E F G H I J	Magnescale signal output u (Z))UP Magnescale signal output u (Y) Magnescale signal output d (Z))DOWN Magnescale signal output d (Y) Alarm signal output ALM (+) Alarm signal output ALM (-) Alarm reset input INAL (+) Alarm reset input INAL (-) No connection No connection	Compatible plug MS3106B18-1P MS3057-10A (Japan Aviation Electronics)
PULSE OUT	1 2 3 4 5	Magnescale signal output Cu (X) Magnescale signal output Cd (X) Magnescale signal output Cu (Y) Magnescale signal output Cd (Y) GND	Compatible plug RM12BPG-5P (Hirose Electric)

5. Instructions for Operation

5-1. Instructions for Installation

5-1-1. Connecting the head cable

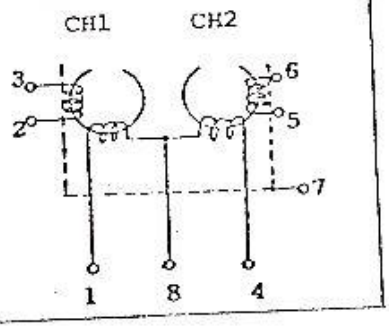
* Connect the head cable after connecting the scale to the machine. (Refer to separate instruction manual of scale for actual mounting of scale).

  Use an MSK-type cable designated by Sony Magnescale for the head cable. Contact Sony Magnescale if you want to employ a different cable.

* If you use one of Sony Magnescale's standard scales, both the detector and the scale can be plug-connected with a designated MSK-type cable.

* If you plan to use a bare scale for special applications, solder the head cable and the MSK-type cable.

Refer to the table below for the head's internal wiring.

No.	Lead wire (color)	Part wired	Internal wiring diagram
1	Red	CH1 exciter coil	
2	Blue	) CH1 signal coil	
3	Yellow		
4	White	CH2 exciter coil	
5		) CH2 signal coil	
6	Gray		
7	Shield wire	Casing	
8	Green	CH1, CH2 common mode choke coil	

* Pair off the color-coded wires with those at the end of the Sony Magnescale-designated MSK-type cable, and solder.

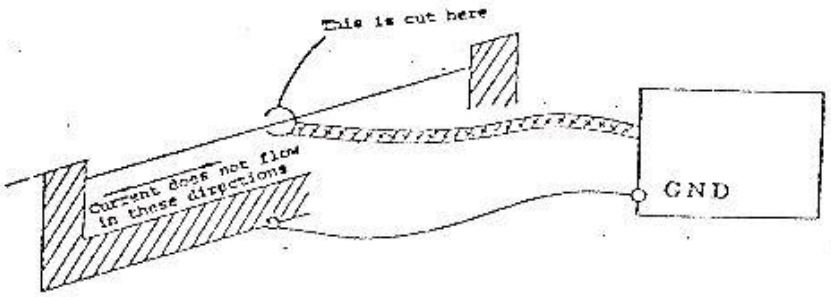
(Note)

Make absolutely sure that you turn the power off before plugging and unplugging the connector which connects the head to the detector and the connectors at the scale side. Otherwise, you may magnetize the head.

5-1-2. Connecting the ground wire

* Using the accessory ground wire, connect the machine body securely to the detector's ground terminal (EARTH).

* The head case is insulated from the head core and so there is no need to worry about ripple current flowing through the scale.



5-2. Input/output signals

The input and output signals are available at the SIGNAL OUT connectors. The signals are asynchronous and so every provision is made against noise, although be sure to use the shield wire.

5-2-1. Magnescale signal output

The Magnescale signal output is distinguished according to whether the resolution is 5μm or 10μm and to the direction the pulse is moving. It is then fed out.

(a)	Pulse width	0.25μs	±30% with 5μm resolution
	(t)	0.5μs	±20% with 10μm resolution

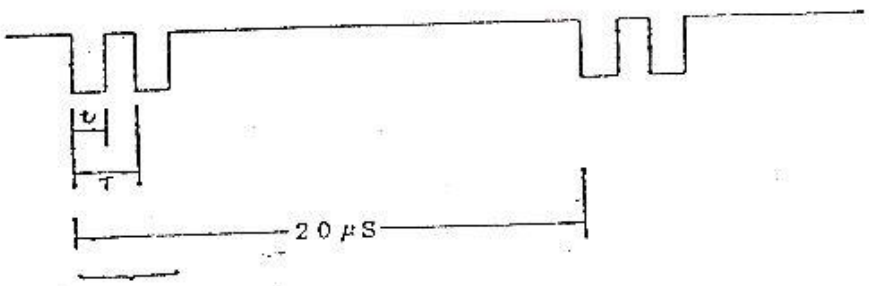
(b) Maximum repetition frequency (T)

With 5μm resolution : 2MHz

With 10μm resolution : 1MHz

(c) Signal output

The pulse form is ACTIVE LOW at the output when received



The number of pulses of this part increases or decreases according to the reaponse speed.

1 pulse at speed of 30m/min.

2 pulses at speed of 60m/min.

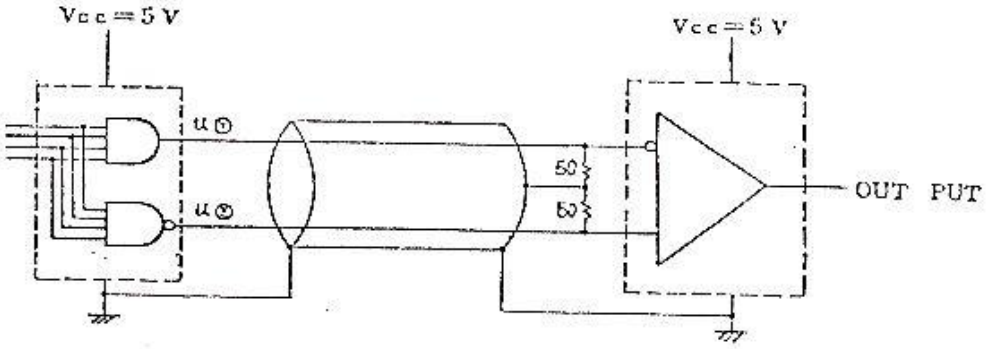
3 pulses at speed of 90m/min.

Since the sampling method is adopted for readout, there is a time lag from the time the scale signal is picked up by the head until the time the head generates an output pulse. This time lag is usually 0 - 20μs with this detector.

(d) Output circuit

Use the line driver SN75183N (made by Texas Instruments). It can be employed in the receiving circuit as follows :

d-1. When received by the line receiver SN75182N(made by Texas Instruments).

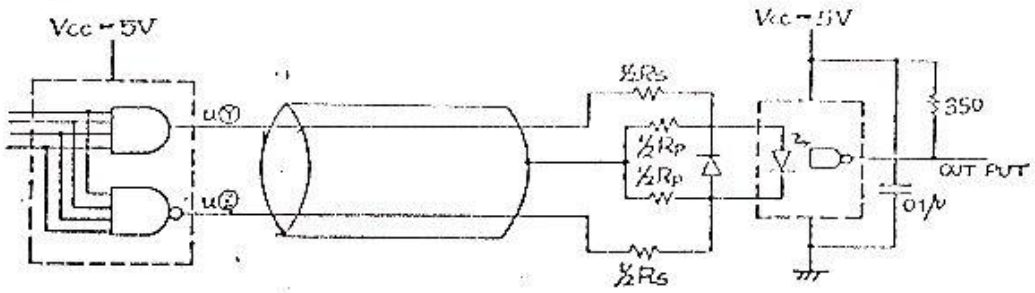


SN75183N(1/2) SN75182N(1/2)

The output can be transmitted up to 100 meters with a transmission line impedance of 100 ohms.

For further details, refer to Texas Instruments' Data Book.

(c) When isolating the detector output circuit from the receiver input circuit



Use a high-speed isolator since the Magnescale signal output has a high speed at 2MHz. (For example, the 5082-4360 made by Hewlett Packard).

When employing the 5082-4360 as the isolator, determine the values of Rs and Rp so that a forward current of 7.5mA may flow in the isolator input diodes. Adjust the resistance of the resistors when the cable is lengthened.

For example : Line termination resistance Ro

Transmission signal voltage VL

To reduce the reflection to the minimum, adjust the terminal resistance Ro and divide into Rs and Rp.

$$Rs = \frac{Vl - VD}{IL} \qquad Rp = \frac{VD}{IL - ID}$$

Where VD and ID are the voltage and current of the isolator's input diode.

If Ro = 100 ohms, VL = 3V, VD = 1.5V and ID = 5mA,

then $IL = \frac{3V}{100 \text{ ohms}} = 0.03A$

And $Rs = \frac{3V - 1.5V}{0.03} = 50$ ohms, $Rp = \frac{1.5V}{0.03A - 0.005A} = 60$ ohms

Furthermore, the maximum output current of SN75183N is:

10H = -40mA; 10L = 40mA

The length of the cable depends on its capacitance and so feel free to experiment, and adjust.

5-2-2. Alarm signal output

(a) Actuation

As listed in the specifications, the alarm is actuated under the following conditions:

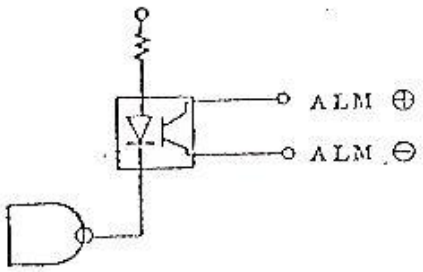
(1) When the PM signal level falls to about one-half of the specified level (4Vp-p)

(2) When the power fails and when the power suddenly drops for an instant (the alarm will not be actuated under less than 5ms power off conditions), and when the power constantly drops.

Possible causes of (1) are the head exceeding the maximum response speed of the detector, a disconnection in

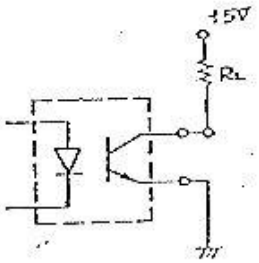
(b) Output circuit

The EE-CM2 optoisolator made by Omron Tateisi is used for the transistor output.



Collector

Emitter



The collector output when the resistor is connected as shown in the diagram on left is:

HIGH level when the alarm is not actuate

LOW level when the alarm is actuated

The absolute maximum values (at 25°C) of the output transistor are:

Ic max. = 30mA

Pc max. =150mA

Vce max. = 30V

Vec max. = 5V

(c) Alarm dispaly

The alarm lamp on the front panel of the detector lights up when the alarm is actuated.

5-2-3. Alarm reset

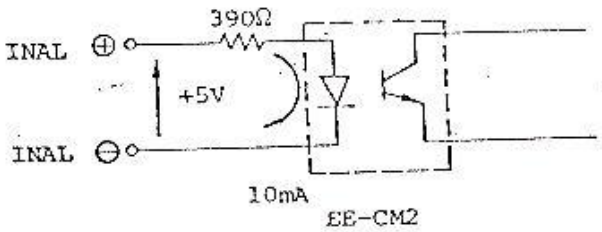
(a) Alarm reset switch

Turn on the alarm release switch located on the front panel.

(b) Alarm reset input

signal to the INAL (+) and INAL (-) terminals of the SIGNAL OUT connector.

The receiving circuit employs an isolator.



The isolator input diode's absolute maximum values (at 25°C) are :

Forward current If max. = 50mA

Reverse voltage Vrb max. = 4V

Adjust the line resistance when pulling long wires.

5-2-4. Clock signal output

The clock signal output can be used when synchronizing the Magnescale signal externally. Feed the output signal out from the SIGNAL OUT connector as the CKO (Z) or CKO (Y) signal. The output circuit uses a line driver, the SN75183 made by Texas Instruments, and so refer to section 5-2-1 (d) and (e) for the receiving circuit.

The clock signal can be made available only from the X axis connector.

6. Instructions for Adjustment

Set both the detector and the scale up for use, and then carry out the following electrical adjustments.

6-1. Preparations

6-1-1. Remove the four screws securing the front panel, and remove the panel. The semi-fixed resistors for adjustment and the terminals used for waveform observation shown in Fig. 6-1 will be visible.

Provide yourself with a suitable screwdriver to turn the semi-fixed resistors.

6-1-2. Connect the oscilloscope probe to the PM observation terminal and the GND wire to the GND terminal.

Use an oscilloscope with a sensitivity of over 0.1V and a frequency band of over 1 MHz.

6-1-3. Switch on the detector's power and set the knobs on the oscilloscope to the following positions :

* Vertical axis mode AC
* vertical axis sensitivity 0.5V/DIV
* Horizontal axis sweep 0.5 - 50 msec/DIV
* Trigger source INT
* Trigger mode AUTO

6-1-4. Move the scale at a speed of 0.5 - 5m/min. Adjust the horizontal axis of the oscilloscope and set so that it is easily seen.

The next electrical adjustments are all performed while the scale is being moved. The feed speed of the machine and the positions of the oscilloscope's knobs provide provisional yardsticks. When necessary, set to values which are the easiest to adjust.

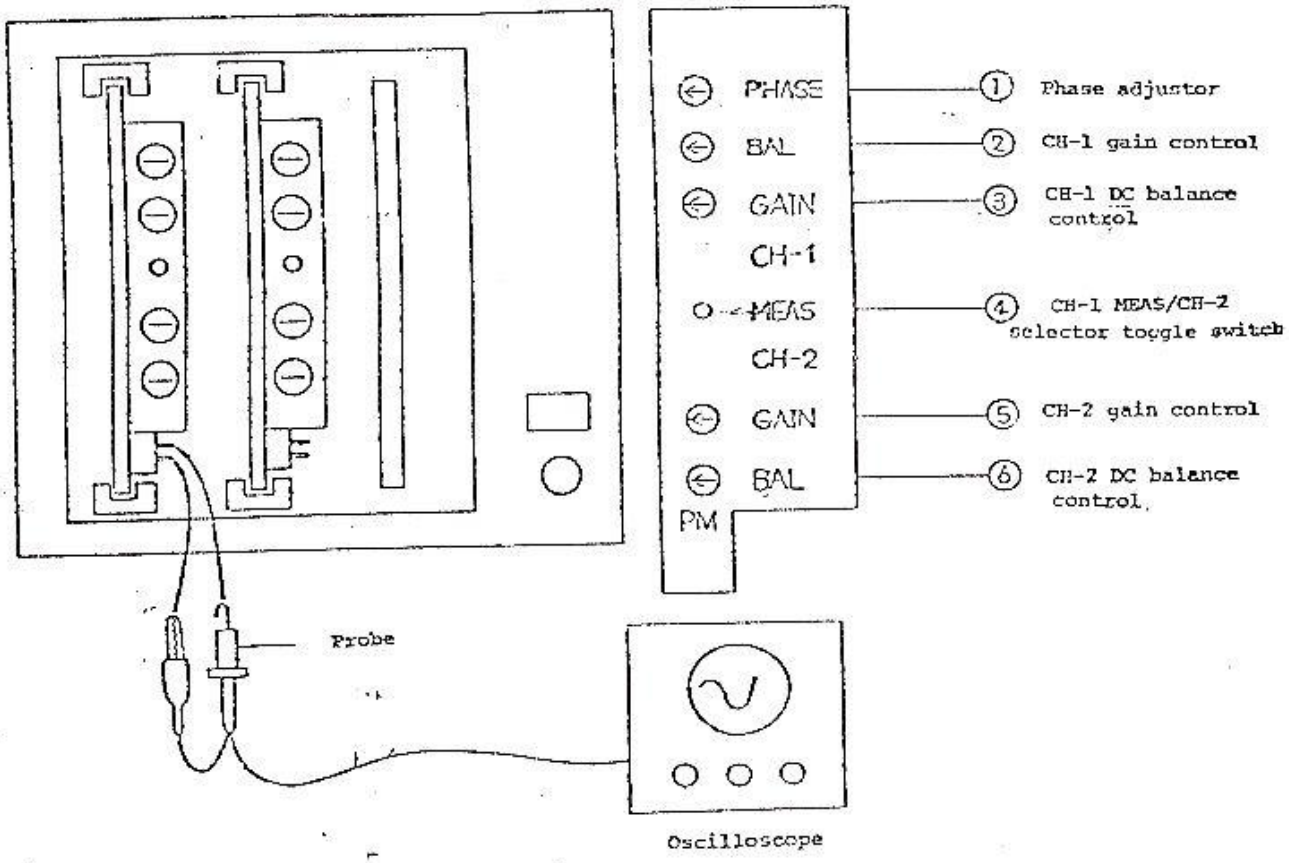


Fig. 6-1. Oscilloscope connection

6-2. Electrical adjustments.

6-2-1. Throw the toggle switch (4) to the upper position (CH-1).

* Adjust the waveform which is observed on the oscilloscope so that it resembles the one in Fig. 3-12, using the CH-1 DC balance control (2). Then, make the 'a' and 'b' amplitudes (see Fig. 6-2) equal.
* This is a very important adjustment. Raise the sensitivity of the oscilloscope and adjust as accurately as possible.
* Adjust the CH-1 gain control (3) and make sure that the amplitude comes within a 4V $\pm$0.4p-p range.

... position (CH-2)

the waveform resembles the one in Fig. 3-12, and make the 'a' and 'b' amplitudes equal.

* Then, adjust the CH-2 gain control and set the amplitude to 4V ±0.4Vp-p. Make sure that this amplitude is equal to the one set on the CH-1 side.

6-2-3. Throw the toggle switch to the center position (MEAS).

* A waveform is observed such as the one in Fig. 6-4. This signal is a carrier frequency 50 kHz PM (phase-modulated) signal, although the envelope waveform appears to be superimposed as the modulation signal. This is known as the AM component. Adjust the phase adjustor (1) so that the component is reduced to the minimum. This AM component 'C' and carrier component 'dc' ratio is usually adjusted to less than 0.1. With a high-precision scale (MSS-103, MSS-703), adjust this ratio to less than 0.05.

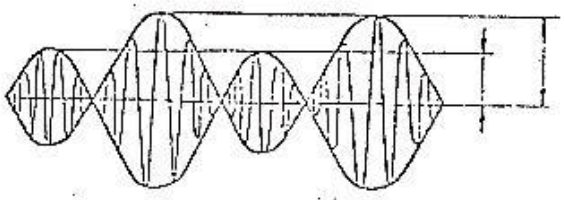


Fig. 6-2. Waveform before DC balance is adjusted

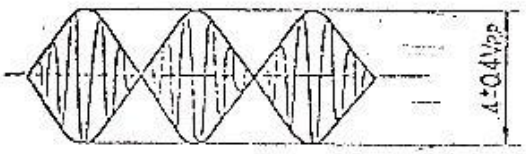
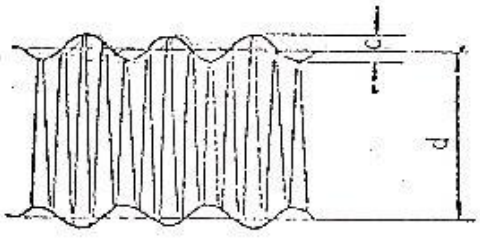


Fig. 6-3. Waveform with DC balance and amplitude adjusted

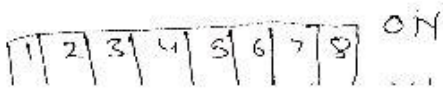


Carrier frequency:

50kHz

Fig. 6-4. PM (phase-modulated) signal

Switch S201



7. Changing the Resolution

* The minimum resolution of this detector can be changed over from 5µm to 10µm and vice versa. This can only be done for the resolution of both axes.

Setting

(1) Draw out printed circuit board C (for both X and Y axes) and set the selector pin S201 to the desired direction (5µm or 10µm).

(2) Draw out printed circuit board S, and set the selector pin on the pc board in the same way to the direction (5M or 10M) set on pc board C.
This completes the resolution setting.

8. Changing the Direction

* After setting the scale and detector, proceed as follows when you want to change over the UP/DOWN pulse direction with respect to the direction of the scale's movement.
* Draw out printed circuit board C, and set M1 and M2, or P1 and P2, at the same time as you set selector pins S202 and S203 on the pc board.
This completes the direction setting.
Direction setting can be performed separately for the X and Y axes.

9. Alarm actuation

As has already been explained, the alarm is actuated in

the following cases:

(1) When the PM signal level drops

(2) When the power fails

The following options are available to deal with the output signal when the alarm is initially reset and when it is actuated.

9-1. Initial reset

Shorting either the 'A' or 'a' of the BR101 on printed circuit board C results in the following:

9-1-1. When 'A' is shorted

This sets the power of the detector to ON and resets the alarm circuits.

Therefore, when 'A' is shorted, the alarm will not work in cases where the power fails for a short time.

9-1-2. When 'a' is shorted

When the detector's power is on, the alarm is not reset, and so this is why it is necessary to insert a signal into the alarm reset input every time the power is switched on. Normally, 'a' is shorted for the alarm, in which case it works effectively even when the power fails for a short period of time.

9-2. Magnescale signal output when alarm actuated