MILLTRONICS

MFA-4P
MOTION FAILURE ALARM

Instruction Manual PL-298 February 2001

MOTION FAILURE ALARM

33452980
Rev. 3.1

Safety Guidelines

Warning notices must be observed to ensure personal safety as well as that of others, and to protect the product and the connected equipment. These warning notices are accompanied by a clarification of the level of caution to be observed.

Qualified Personnel

This device/system may only be set up and operated in conjunction with this manual. Qualified personnel are only authorized to install and operate this equipment in accordance with established safety practices and standards.

Warning: This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated, and maintained.

Note: Always use product in accordance with specifications.

Contact SMPI Technical Publications at the following address:

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Table of Contents

Specifications

Power
- 115 Vac 50/60Hz, 5 VA
- 230 Vac 50/60Hz, 5 VA
- ±10% rated voltage

Output
- 2 Form C (D.P.D.T.) fail-safe dry contacts

Resistive Rating:
- 10 A @ 115/230 V AC
- 10 A @ 24 V DC

Repeatability
- +/- 1%

Temperature coefficient (setpoint variance)
- 0.01%/°F (0.018%/°C)

Setpoint adjustment range
- 2 to 3,000 PPM (Pulses per Minute)

Dynamic range
- 0 to 7,200 PPM

Equipment	Ambient Temperature Range	Approx wt.
Main amplifier open style	-40 to 140°F (-40 to 60°C)	2 lb (1 kg)
Main amplifier NEMA 4	-40 to 140°F (-40 to 60°C) (internal to enclosure)	11 lb (5 kg)
RMA	-40 to 140°F (-40 to 60°C)	5 lb (2.3 kg)
MSP-12, MSP-12C	-40 to 140°F (-40 to 60°C)	3 lb (1.4 kg)
XPP-5	-40 to 140°F (-40 to 60°C)	4 lb (1.8 kg)
MSP-1	-60 to 180°F (-50 to 80°C)	1 lb (0.5 kg)
MSP-3	-60 to 500°F (-50 to 260°C)	3 lb (1.4 kg)
MSP-9	-60 to 500°F (-50 to 260°C)	4 lb (1.8 kg)

Installation

The main amplifier (and RMA if applicable) is best mounted in an area that is clean, dry, vibration free, non-hazardous, within the ambient temperature range, and non-corrosive to the electronics or its enclosure. The door should be accessible for viewing and to allow calibration of the main amplifier.

Note: Do not mount amplifiers in direct sunlight.

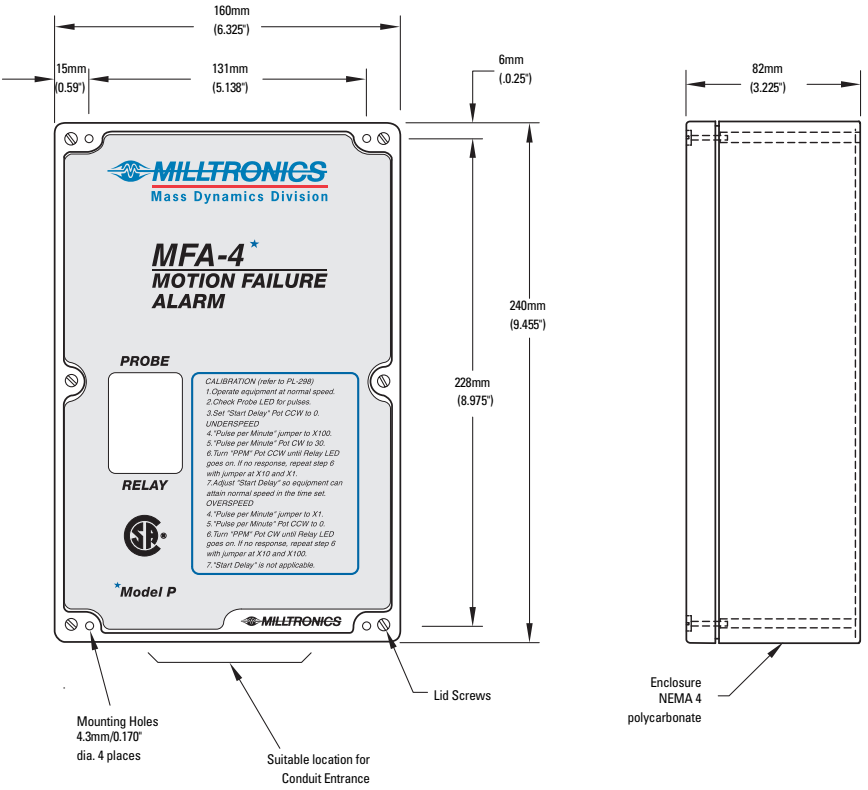
The probe should be mounted and onto a vibration free structure and using the mounting flange. The gap between probe and target should be enough so that there is no danger of the target damaging the probe. The probe environment must be within the probe's ambient temperature range and non-corrosive to the probe's body. Refer to Applications drawings on page 29.

Note: Installation and wiring must be in accordance with all governing regulations.

Where possible, use flexible conduit. The probe components should be interconnected via flexible conduit. This allows for easier removal or adjustment of the probe and mounting flange assembly.

Dimensions

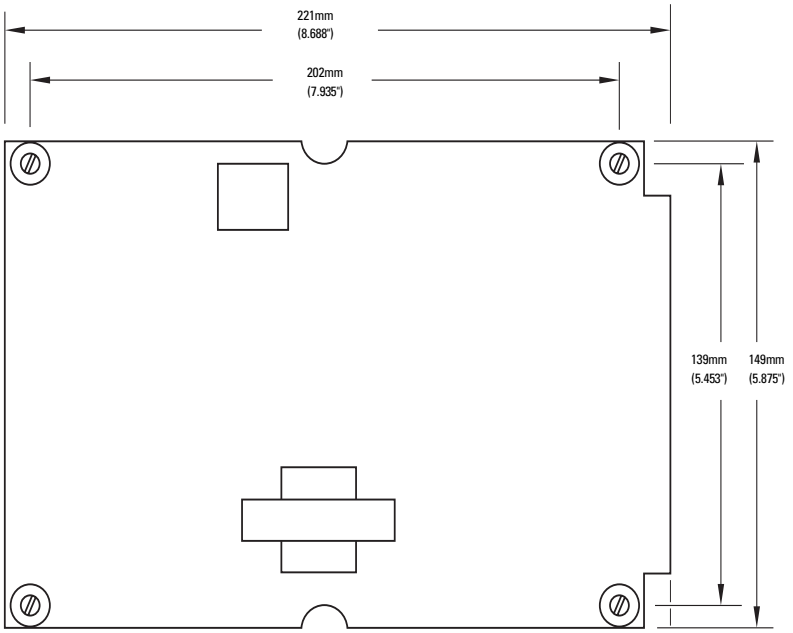
NEMA 4 Enclosure – Main Amplifier

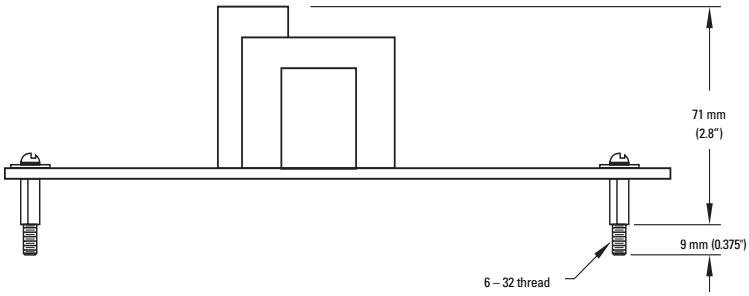


Note: Use punch to make holes in the enclosure.

MFA-4p Open Style

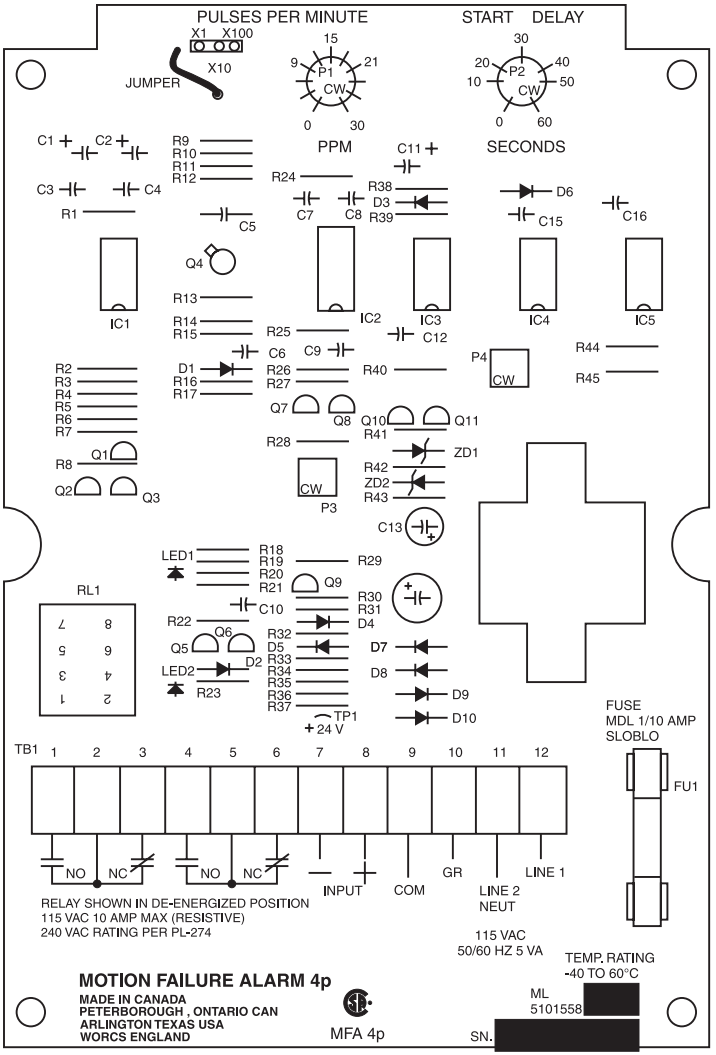
Main circuit board



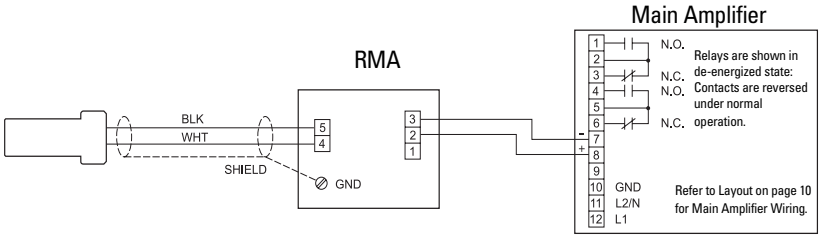


Layout

Main Amplifier



MSP-1, 3, or 9 Probe



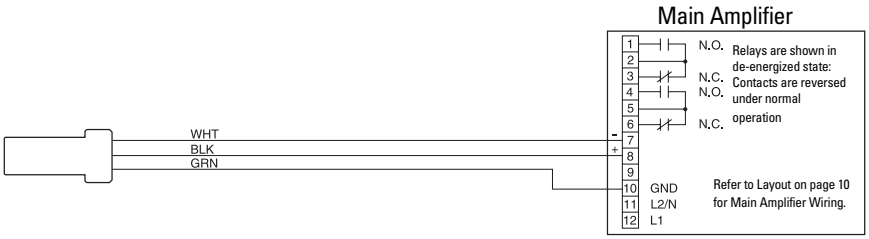
Maximum cable length from probe to RMA is 30m/100ft of shielded cable, 18 ga. wire. See table below for cable lengths from RMA to main group.

MSP-12 Probe with IMA

Shielded cable not required. Wire can be run in conduit common to motor supply or control wiring. Connection to probe leads can be made under probe cap. See table below for lengths from probe at main amp.

MSP-12C

Shielded cable not required. Wire must be done in conjunction with approved conduit, boxes and fittings and to procedures in accordance with all governing regulations. See table below for lengths from probe at main amp.

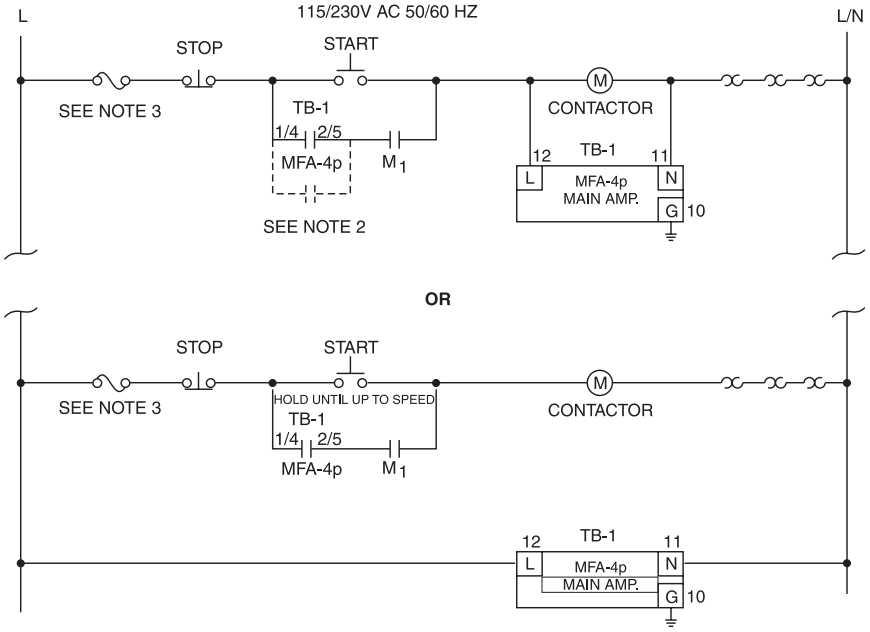


Shielded cable not required. Wire must be done in conjunction with approved conduit, boxes and fittings and to procedures in accordance with all governing regulations. See table below for lengths from probe at main amp.

Table: Cable length from RMA or IMA to Main Amp

Wire gauge	Length in feet	Length in metres
22	2500	760
18	5000	1520
12	25000	7600

MFA-4P Main Amp Wiring for Automatic Start Delay

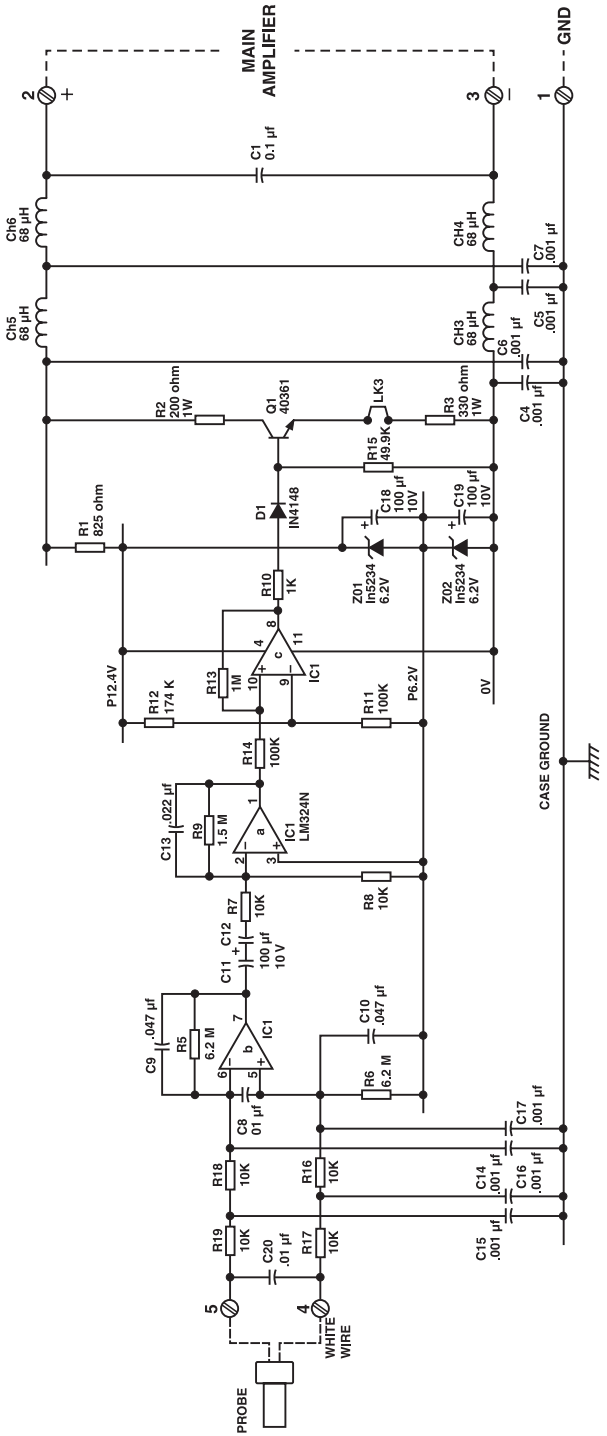


Notes:

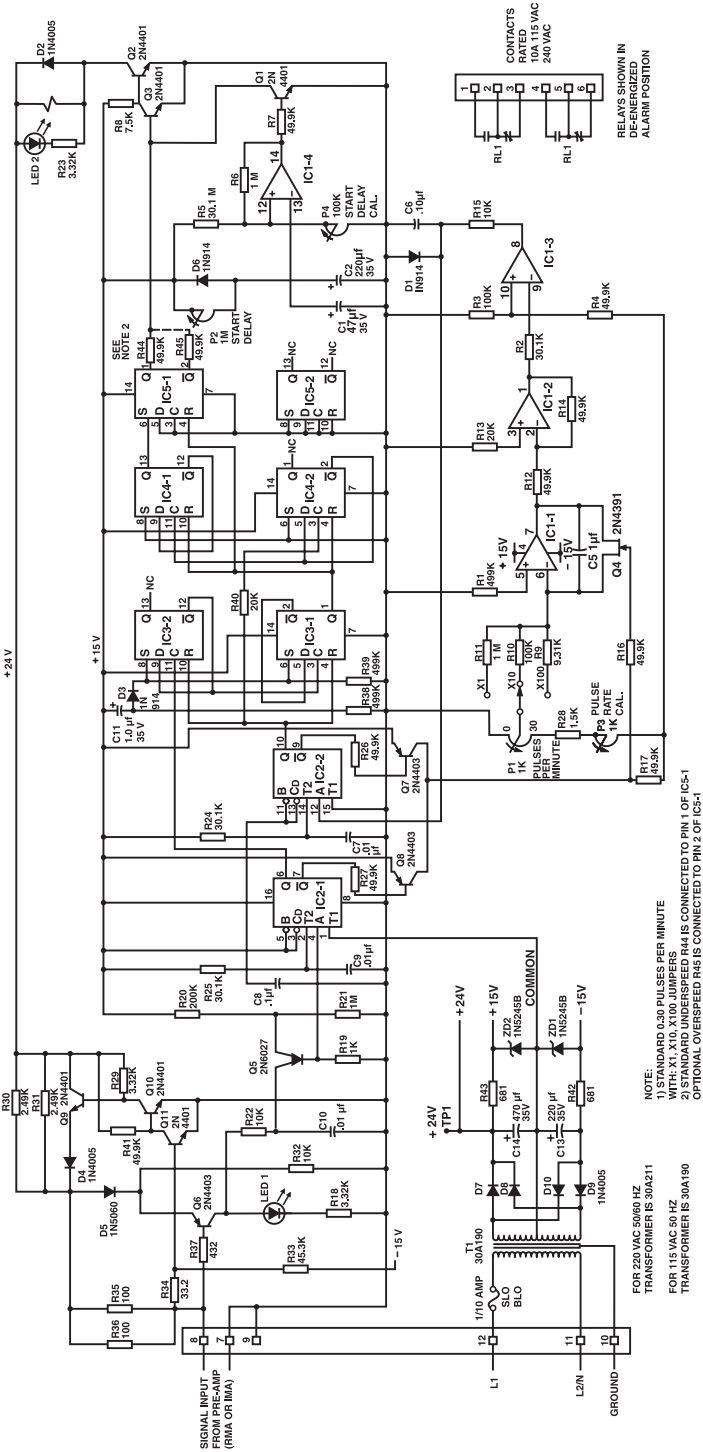
1. Interlocks and Safety Pull Switches are not shown.
2. If **START** is initiated by programmable logic controller, closure time may be too brief to allow MFA-4p contact to latch. In this case, program a timer contact into the circuit.
3. CSA requires a 10A, or less, fuse to protect contacts. For 240V AC, protect the contacts with a 1500 VA transformer as well.

Should the Time Delay feature on start-up not be required, power should be applied continuously from a separate source and the pot turned to zero. This is usually necessary for automatic up-stream start up of conveying devices after the down-stream drive has reached its operation speed.

Schematic Diagram - Remote Mounted / Pre-amplifier



Schematic Diagram MFA-4 Main Amplifier



MFA-4p

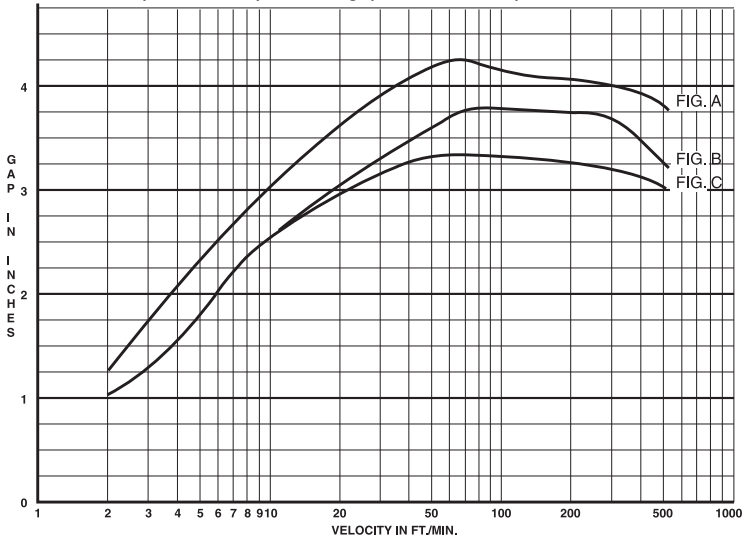
The MFA-4p Motion Failure Alarm detects an increase or decrease in the speed of rotating, reciprocating, or conveying equipment. It consists of a probe, pre-amplifier (remote or internal to probe), and main amplifier.

Pulses generated from the probe are continually compared to the adjustable setpoint. If the pulse rate is lower than the setpoint, the alarm relay operating in a fail-safe mode will de-energize, indicating failure. The relay will not energize until the pulse rate increases above the setpoint.

Probe

The Milltronics probes work on the principle of Faraday's Laws of Electromagnetic Induction. When a ferromagnetic object enters the probe's permanent magnetic field, it distorts the flux causing it to cut the coil windings and generate a voltage. This voltage is proportional to the strength of the magnet and the number of wire turns in the coil (constant in the Milltronics probes) and the speed at which the ferrous target passes through the flux. The generated voltage is also inversely proportional to the square of the distance between the target and the probe.

The relationship between speed and gap of a standard probe:



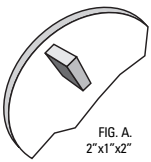


FIG. A.
2"x1"x2"
ferrous block

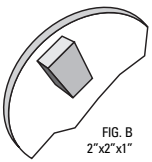


FIG. B
2"x2"x1"
ferrous block

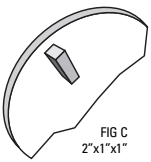


FIG C
2"x1"x1"
ferrous block

The resultant line indicates the threshold tolerance of the accompanying MFA-4p electronics. For example, in **Fig. a**, a 4" (100mm) gap requires a minimum velocity of about 65 ft/minute (20m/minute), and with a velocity of 2 ft/minute (0.61m/minute), a maximum gap of l/4" (6mm) is possible.

Note: 1 inch = 25.4mm & 1 foot = 0.305m

This graph was plotted from tests using four ferrous blocks set equidistantly on a 16" diameter circle on a non-ferrous disc.

The physical shape of the ferrous target generally becomes important at low velocities or large gaps. At these points, tests indicate that a cubic shape gives the best results due to the sudden change it causes in the magnetic field.

An increase in block size beyond 2" X 2" X 1" (50x50x25mm) is generally not as effective as minimizing the gap, except at very low velocities.

The Milltronics Mini Sensing Probe, MSP-1, is approximately ¼ of the size of the standard probe with about 1/8 the sensitivity.

By dividing all operating values by 0.125, the specifications of the MSP-1 are obtained. For example, with a gap of .5" (12mm), the minimum velocity is approx. 200 ft/min. (60m/min,), and with a velocity of a 2 ft/min. (0.6m/min), a maximum gap of .125" (3mm) is possible.

Because of the many environments in which motion sensors are required, Milltronics manufactures probes for low temperature, high temperature, corrosive, and Class I, II, and III applications.

Pre-Amplifier (IMA and RMA)

The pre-amplifier accepts the voltage pulses generated by the probe and converts them into noise immune current pulses. Current levels are 12mA low and 45mA high. It comes internally mounted in the probe or in an enclosure for remote mounting.

Internally mounted pre-amplifiers are called IMAs. Remote mounted Pre-amplifiers are called RMAs.

Main Amplifier

The main amplifier provides a short circuit protected, +24V DC unregulated supply to the pre-amp. In the event that the interconnecting wiring is shorted, output current from the main amp is automatically limited and the on-board alarm relay is de-energized to indicate failure.

The output current pulses from the pre-amp are super imposed onto the DC current supply. These are monitored by Probe LED 1, which is illuminated at the rate of the incoming pulses and is useful for positioning the probe. The rate at which the pulses are received by the main amplifier is compared to a setpoint reference signal from the time base generator. Although two pulses within range are required to energize the relay, as

long as the frequency of the incoming pulses exceeds the setpoint frequency (or is less than that of the setpoint in the case of overspeed detection), the main amplifier keeps the alarm relay energized. The reference generator is frequency adjustable by the Pulses Per Minute (PMP) jumper and potentiometer. The alarm relay will de-energize after two time constants of the setpoint when the frequency of the incoming pulses falls below that of the setpoint (or exceeds that of the setpoint in the case of overspeed detection). The relay status is indicated by Relay LED 2, which is illuminated when the relay is energized (normal).

The MFA-4p has a 0 to 60 second time delay feature, allowing the monitored device to accelerate to normal running speed before monitoring begins. This feature is activated when power is applied to the MFA-4p in parallel with the motor starter contactor coil. The time delay circuit simulates normal operating conditions for the amount of time as set by the **Start Delay** potentiometer, keeping the alarm relay energized. If the monitored device does not reach normal speed before the set time period, the relay will de-energize giving an alarm condition. This feature is not applicable in the overspeed detection mode.

Calibration

Pre-amble

The probe and pre-amplifier require no calibration.

Interconnect probe, pre-amp, and main amplifier as shown in the Interconnection diagrams on pages 11 and 12.

Connect main amplifier to power as shown in the Schematic Diagram MFA-4 Main Amplifier shown on page 15.

Note: To help the calibration procedure, short N.O. contacts of relay to prevent motor shut-down (terminals 1 to 2 and/or 4 to 5). This allows the system to run uninterrupted until an operating setpoint is established.

Main Amplifier (Refer to Main Amplifier layout on page 10)

1. Operate monitored equipment at its normal operating speed.
2. Confirm that Probe LED 1 is pulsing at a regular frequency.
3. Set **Start Delay** fully counterclockwise (CCW) to **0** seconds.

Underspeed

1. Set **Pulses Per Minute** (PPM) jumper to **X 100** position.
2. Turn **PPM** potentiometer fully clockwise (CW) to 30.

3. Determine incoming pulse rate by slowly turning **PPM** pot CCW until relay LED 2 goes on. As the main amp requires 2 pulses within range before energizing relay, low PPM applications (e.g. 2 PPM) may require stepping of pot at appropriate time intervals. If no response is obtained by **3** (below this stability suffers), reset pot fully CW and set jumper to **X 10** and then **X 1** if required and repeat this step.

4. When Relay LED 2 goes on, indicating the incoming pulse rate, turn pot CCW slightly past this point to obtain an operating setpoint that allows for normal fluctuations due to load and voltage variations. Thus, for 50 % of full speed, set pot (and jumper if required) to halfway between incoming pulse rate of normal speed and **0** PPM.

5. Set **Start Delay** by adjusting pot so that equipment being monitored can attain normal operating speed before LED 2 can turn off.

Overspeed

1. Set **PPM** jumper to **X 1** position.

2. Set **PPM** potentiometer fully CCW to **0**.

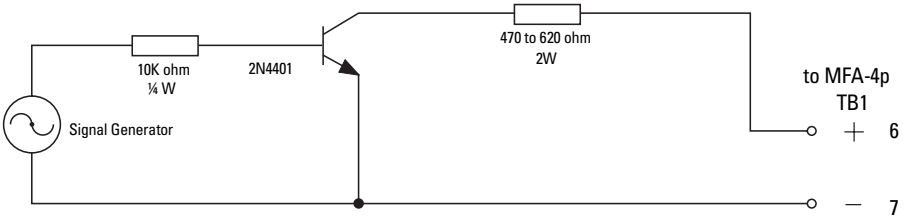
3. Determine incoming pulse rate by slowly turning **PPM** pot CW until Relay LED 2 goes on. Because the main amp requires 2 pulses within range before energizing relay, low PPM applications (e.g. 2 PPM) may require stepping of pot at appropriate time intervals. If no response is obtained, re-set pot fully CCW and set jumper to **X 10,** and then **X 1** if required and repeat this step.

4. When Relay LED 2 goes on, indicating the incoming pulse rate, turn pot CW slightly past this point to obtain an operating setpoint that allows for normal fluctuations due to load and voltage variations.

Remember: If N.O. contacts were shorted as described in final note of calibration preamble, remove them now as calibration is complete.

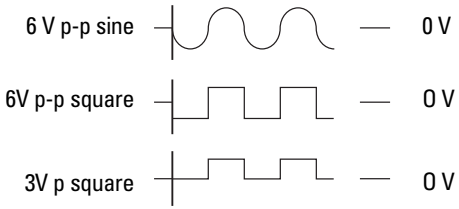
Signal Generator Interface

The following circuit may be used for calibrating or for troubleshooting of the MFA-4p.



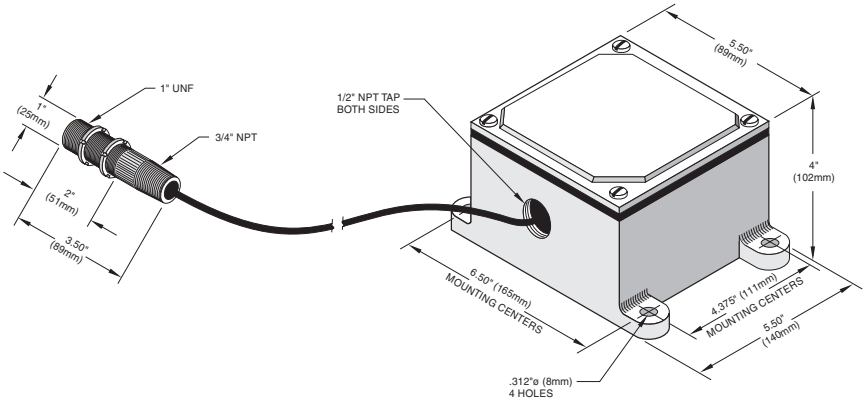
Circuit substitutes operating probe and pre-amp.

Set signal generator for:



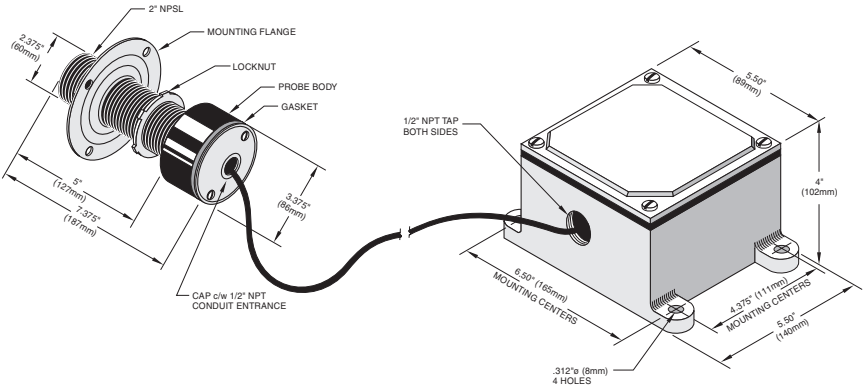
Probes

Mini Sensing Probe MSP-1



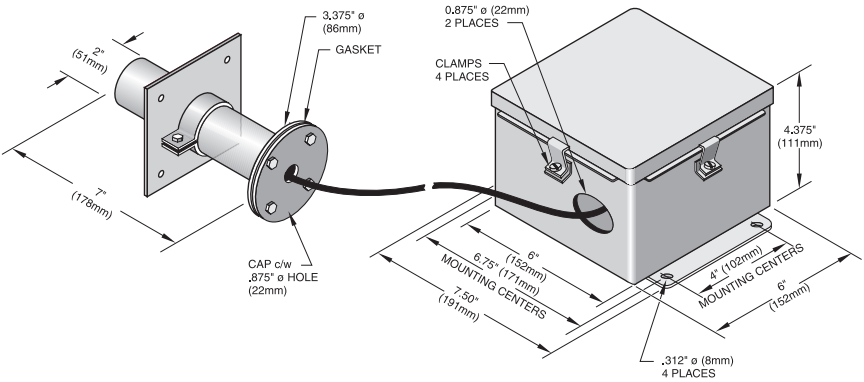
- CPVC body c/w 2 CPVC locknuts
- 6 ft. (180cm) of Belden 8760 supplied potted in probe
- Remote mounted pre-amp in Nema 4 cast aluminum enclosure.

High Temperatures MSP-3

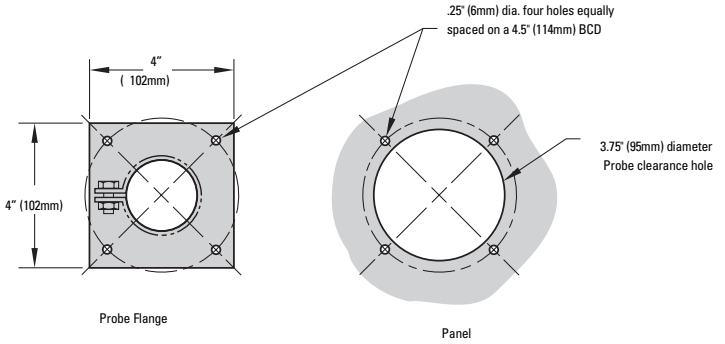


- Cast aluminum body c/w cast aluminum cap and zinc flange, zinc plated locknut, and silicone rubber gasket
- See page 28 for Flange and Mounting Details
- Pre-amp is mounted in a Nema 4 cast aluminum enclosure

Stainless Steel Probe MSP-9

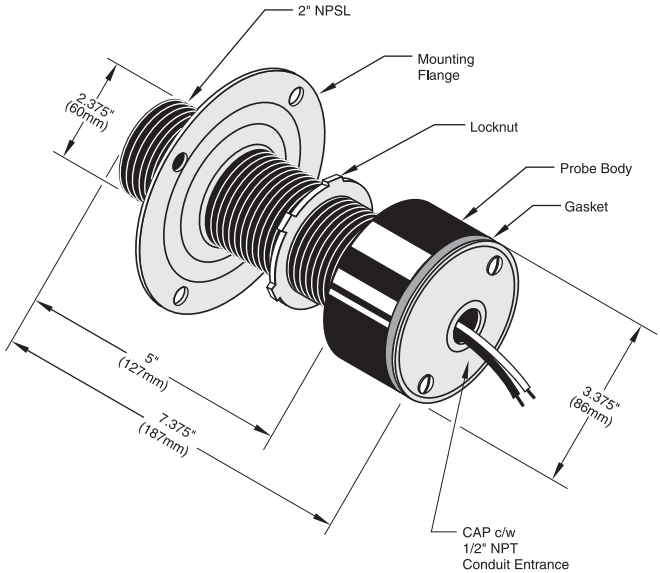


Mounting Details



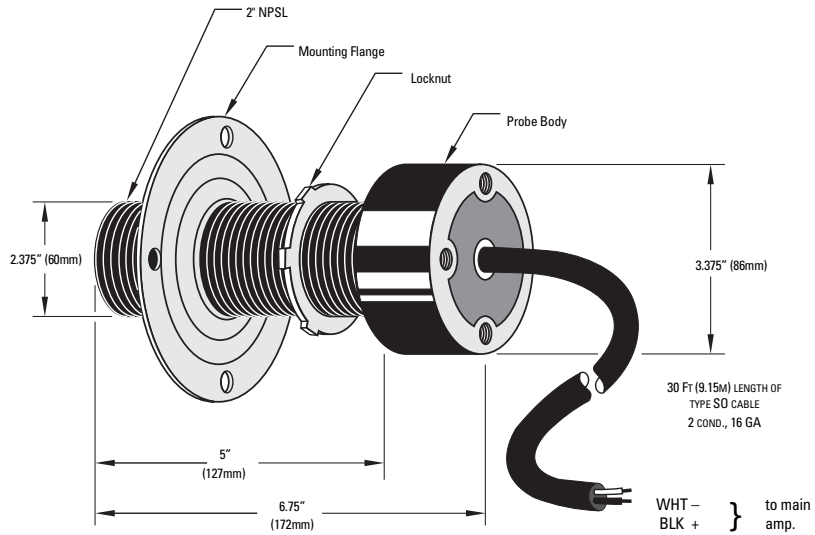
- For high temperature and corrosion resistance applications
- 304 stainless steel body c/w stainless steel clamp and silicone gasket
- 5 ft. (1.5m) Belden 83321 Teflon cable potted in probe
- Pre-amp is mounted in an enamel painted steel Hammond 1414N4E enclosure.

Standard MSP-12



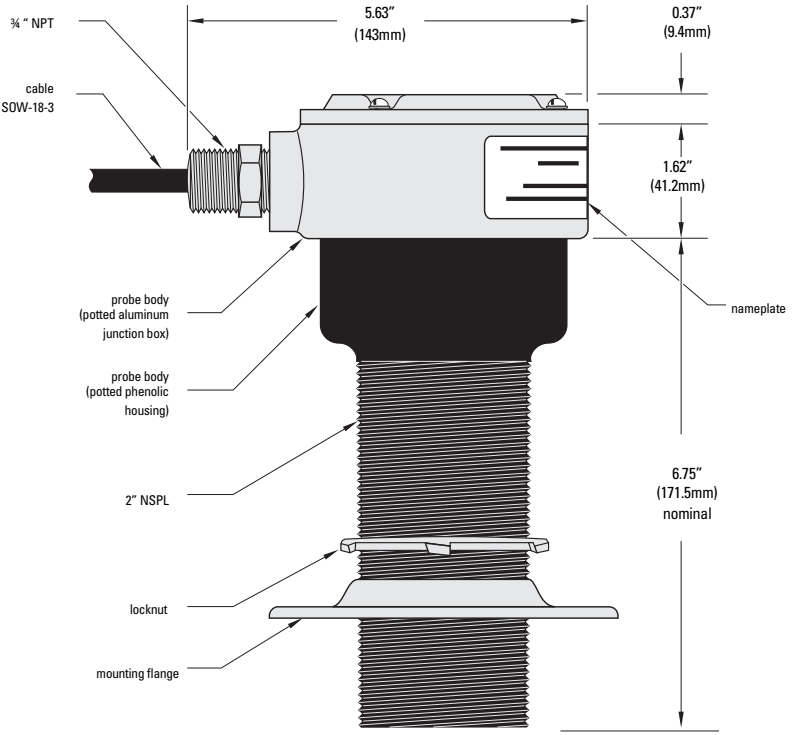
- Phenolic body c/w die cast aluminum cap and zinc flange, zinc plated locknut, and neoprene gasket
- See page 28 for Flange and Mounting Details
- Pre-amp is potted in the probe body c/w two 5" (127mm) long hook-up wires

MSP-12C



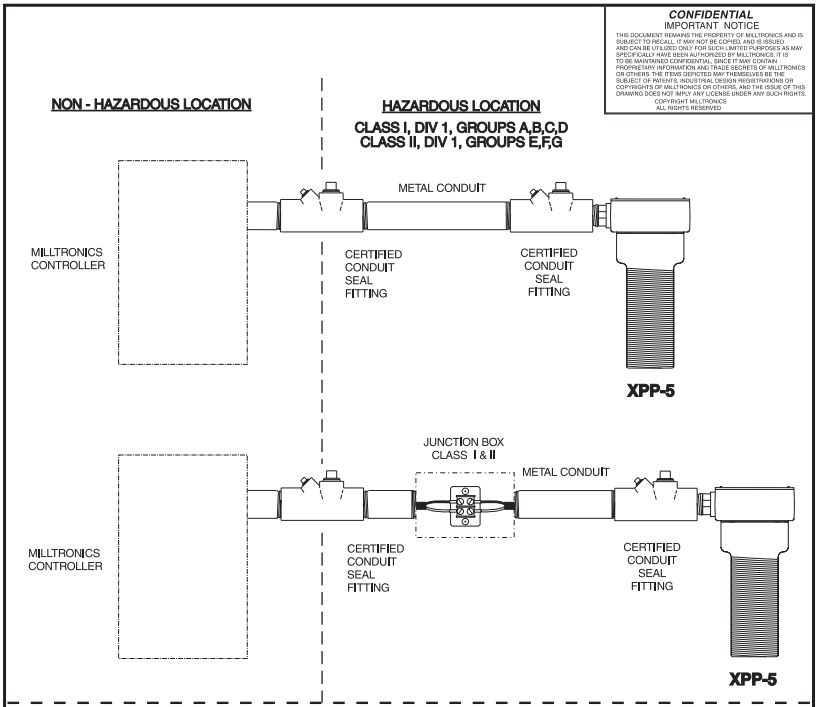
- Phenolic body c/w die cast flange and zinc plated locknut,
- See page 28 for Flange and Mounting Details
- Pre-amp and cable are potted in probe body

Hazardous Locations XPP-5



- C.S.A Approved for:
  - Class I, Div.1, Gr. A, B, C & D
  - Class II, Div 1, Gr. E, F & G
  - Class III
- phenolic/aluminum body c/w die cast flange and zinc plated locknut
- see page 28 for mounting details, and pages 11 and 27 for interconnection information.
- pre-amp and cable potted in the Probe's body

Interconnection Diagram for the XPP-5



NOTES :

1) THE XPP-5 CABLE MUST BE TERMINATED IN AN AREA EXTERNAL TO HAZARDOUS LOCATIONS, CLASS I, DIV 1, GR. A,B,C,D & CLASS II, DIV 1, GR. E,F,G.

2) A SEAL SHALL BE INSTALLED WITHIN 50 mm OF THE XPP-5 CONDUIT HUB FOR CLASS I, DIV. 1 HAZARDOUS LOCATION ONLY.

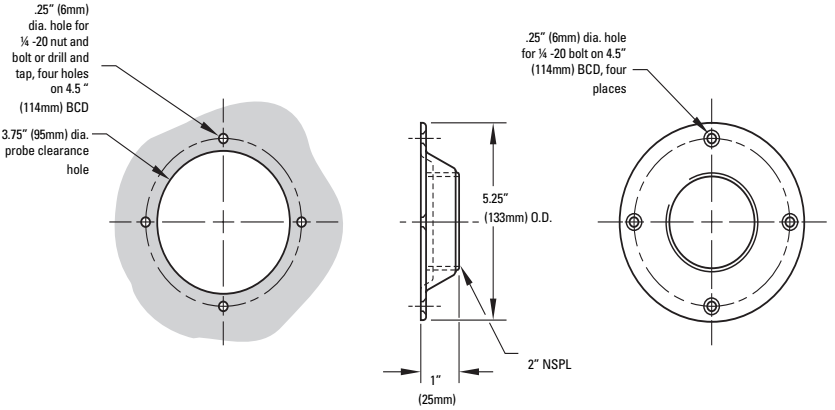
3) INSTALLATION SHALL BE DONE IN ACCORDANCE WITH CANADIAN ELECTRICAL CODE PART 1 REQUIREMENTS.

4) DO NOT EXPOSE THE XPP-5 TO DIRECT SUNLIGHT, OTHERWISE PROVIDE SUN SHIELD.

5) STATIC HAZARD, DO NOT RUB WITH DRY CLOTH.

	USE DIMENSIONS ONLY - DO NOT SCALE	0	FOR CONSTRUCTION	RWG	SN	MARCH 27/00
		No.	REVISION DESCRIPTION	DWG BY	APPRO.	DATE
DRAWING SCALE: N. T. S.	TOLERANCES UNLESS OTHERWISE NOTED: 1 PLACE DECIMAL ±0.030", FRACTIONS ±0.030"; 2 PLACE DECIMAL ±0.010"; 3 PLACE DECIMAL ±0.002", ANGLES ±0.5°	THIRD ANGLE PROJECTION	MILLTRONICS Mass Dynamics Division			
DRAWN BY: B. GRAY	TITLE: XPP-5 INTERCONNECTION DIAGRAM		FILE No. 2365013100	SIZE: A	DRAWING No. 23650131	REV. 0
CHECKED BY: R. CLOSS			PLOT AT 1=1		SHEET 1 OF 1	
APPROVED BY: S. NGUYEN			JOB No.			

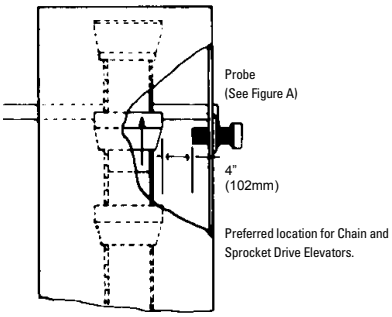
Mounting Details

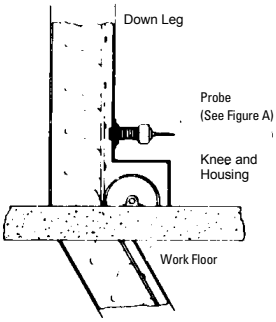


Mounting Flange

APPLICABLE TO ALL PROBES
EXCEPT MSP-1 AND MSP-9.

Bucket Elevators



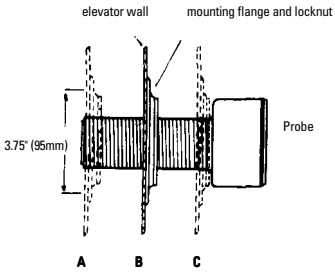


Place the Probe so that the gap between the bucket and the Probe does not exceed 4" (100mm). To prevent damage to the probe from Eccentric Bucket Motion, ensure that the gap is not less than 0.5" (12.5mm) in the worst condition.

Preferred location for Grain Industry Elevators with Ferrous Bucket Spacing greater that 3" (76mm), and Non Ferrous Buckets with Ferrous Bolts.

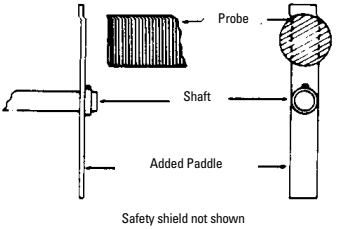
For Ferrous Buckets with spacings less than 3" (76mm) locate probe on the front of the leg.

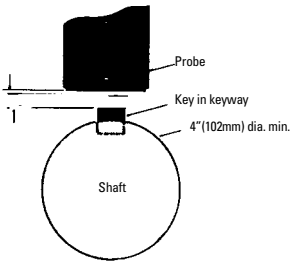
Figure A



For elevators with Ferrous Walls, cut 3.5" – 3.75" (88mm - 95mm) hole in the elevator wall. Any position from A to C may be used to maintain the gap.

Shafts

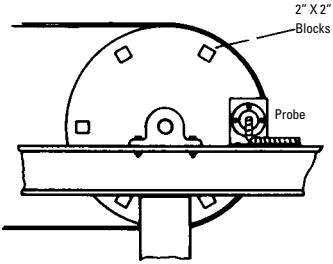


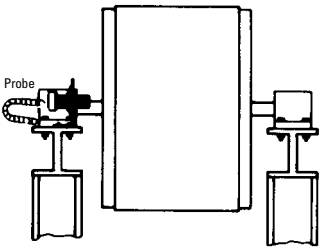


These methods are viable if the speed is such that the blades or key will provide the number of pulses required at a minimum velocity of 5 ft/minute (1.5m/minute). In applications where exposed moving parts are required, Safety Shields and precautions should be applied.

Where conditions prevent the sensing of buckets, a belt pulley or paddle mounted on an exposed shaft end, preferably the tail pulley, may be used.

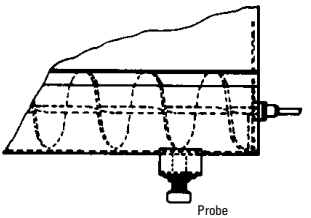
Belt Conveyors



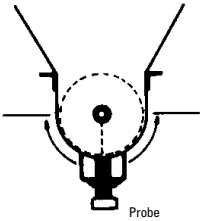


Potential for damage in each application governs the minimum gap allowable. Maximum gap for operation is 4" (102mm), Optimum 1" to 2" (25mm – 50mm).

Screw Conveyors



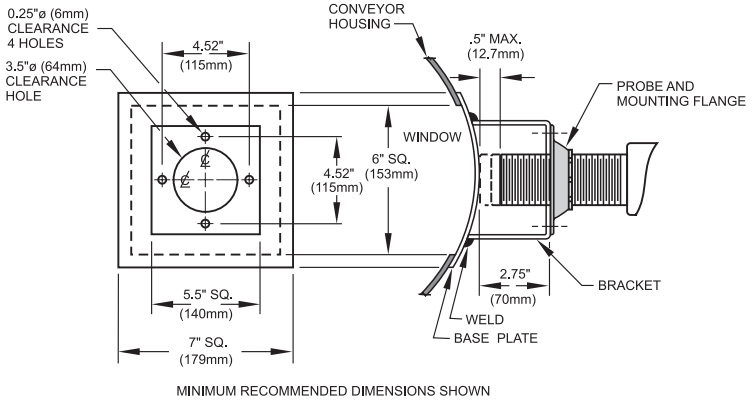
The probe should be located at the Idler end (usually feed end)



Arrows indicate permissible placement range of the probe

A Ferrous Mass added behind the flight of a Screw Conveyor, where it passes the probe aids Borderline Operation. This mass must be added for all Non Ferrous Screws.

Non-Ferrous Window

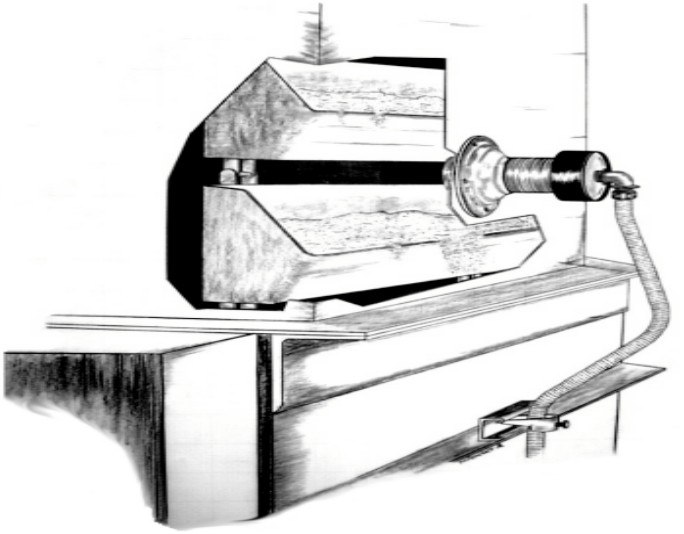


MINIMUM RECOMMENDED DIMENSIONS SHOWN

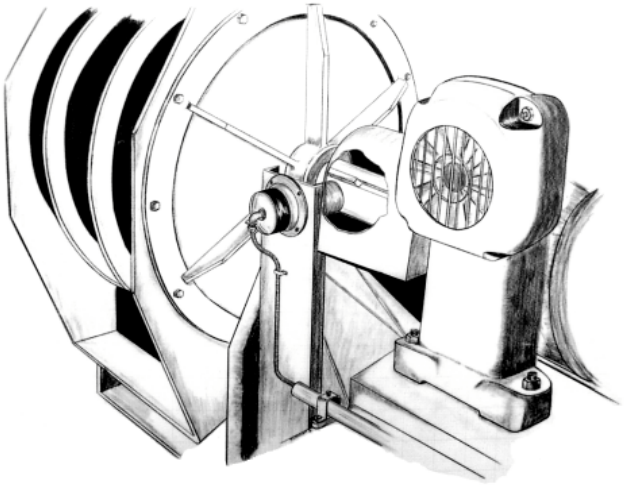
For Screw Conveyor with trough over 0.125" (3.1mm) thick or for High Temperature applications. The dimensions shown for the base, window, and bracket are the minimum recommended with tolerances of +1/32. Use 305, 310, or 316 Stainless Steel, Brass, or Aluminum.

The Probe may not touch the window if temperatures are in excess of 140°F (60°C) when using the low temperature probes or 500°F (260°C) when using the high temperature probes.

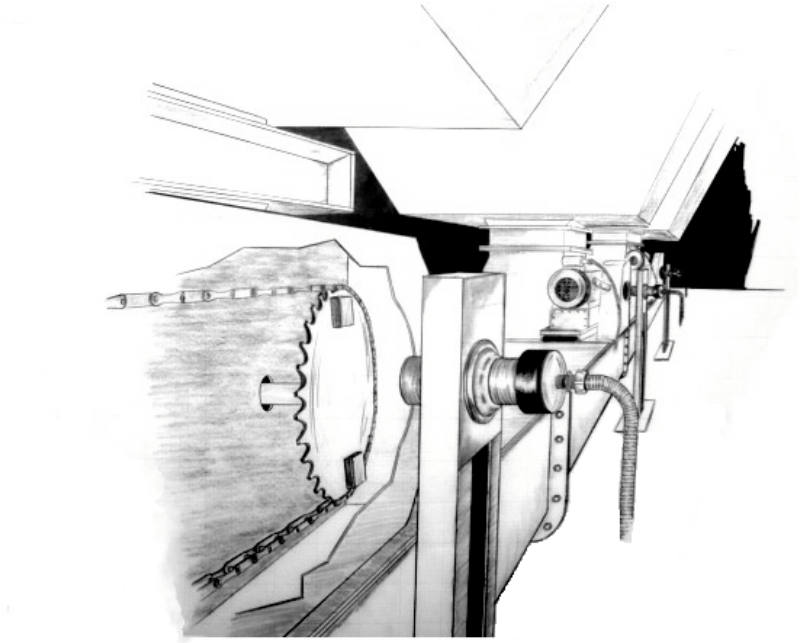
Bucket Elevator



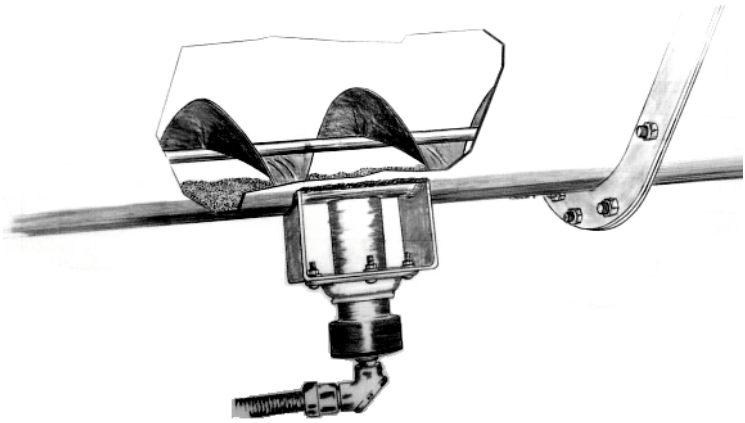
Rotating Shaft of Rotary Feeder



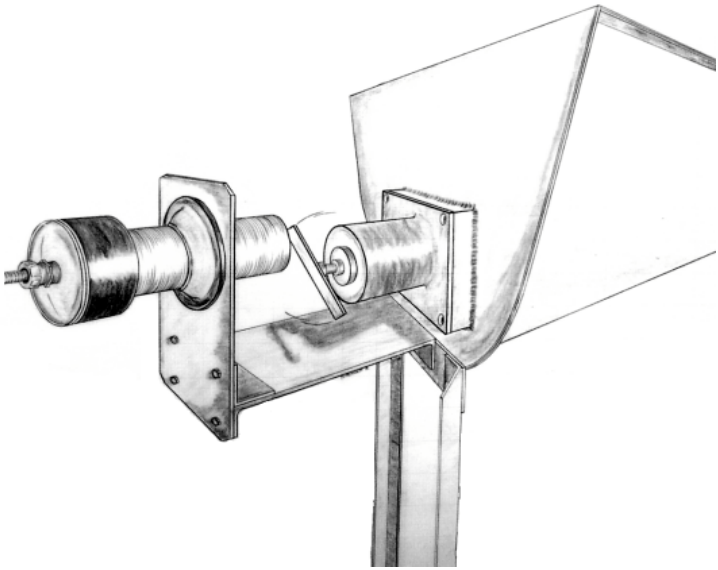
Drive Sprocket on Rotary Feeder



Screw Conveyor Flights



End Bearing on Screw Conveyor



	LED 1	LED 2	term 7/8 (note 1)	C8	term 4/5 relay out
normal	pulsing	on	24 V	27 V	closed
alarm	pulsing	off	24 V	27 V	open
probe reversed polarity	on	off	20 V	27 V	open
probe wiring open circuit	off	off	27 V	27 V	open
probe wiring short circuit	off	off	0 V	27 V	open
fuse blown	off	off	0 V	0 V	open
relay defective	pulsing	on	24 V	27 V	open

Notes:

- Voltage levels are DC, nominal values and may appear to be pulsing, coincidental with LED 1.

- If diagnosis does not solve malfunction, probe, pre-amp or main-amp may be defective.

- If no spare circuit boards or probes are available for interchanging, the MFA-4p may be tested as follows in order to determine which section is defective:

  a. To find out if the main amp is defective:

     i. Disconnect the pre-amp
     ii. Set PPM jumper to **X 1** position and turn pot to **15**.
     iii. Connect one lead of a 530 ohm, 1 watt resistor to terminal 7 and then momentarily contact terminal 8 at a rate of once per second. If main amp is functional, the relay will energize after two pulses and de- energize approximately 8 seconds after last pulse.

  b. To find out if the RMA is defective:

     i. Disconnect pre-amp from main amp. Attach probe across terminals 4/5 and 24V DC (floating) supply across terminals 7/8 according to MFA-4p interconnect drawings on page 11.
     ii. Run equipment to be monitored at normal operating speed or pass a ferrous object in front of and as close to probe as possible at a continuous rate.
     iii. With an oscilloscope, look for approximately 6V peak to peak pulses or alternating hi/lo levels across ground and link 3. Or with an amp meter connected in series between the RMA and the 24V DC power supply, look for hi/lo levels of approximately 12mA/40mA alternating at the rate of the passing ferrous objects.

c. To find out if the probe is defective (non- IMA type only; i.e. MSP-1 , MSP-3, and MSP-9):

i. Disconnect probe from pre-amp.
ii. Connect an ohmmeter across the black and white leads.
iii. Nominal probe impedances are as follows:

MSP-1	115 ohms
MSP- 3 and MSP- 9	750 ohms

If impedance deviates substantially from these values, an open or short circuit condition is indicated.

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MILLTRONICS

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