Westec Instrumentation

D S D - 3

DIFFERENTIAL SPEED DETECTOR

Instruction Manual

IM-4

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ABOUT THIS MANUAL

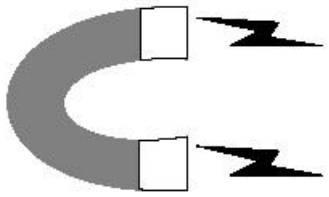
This manual covers the installation and operation of the DSD-3.

It is essential that this manual be read and understood before installation and start -up. Adhering to the procedures as outlined will insure a quick, trouble -free installation and allow for the maximum operating reliability to be achieved

ABOUT THE DSD-3

The DSD-3 Differential Speed Detector is a dual point motion sensing device. It is used for monitoring speed at two points in a mechanical system or process where a difference in speed can be detrimental to the equipment or its operation. The DSD -3 is typically applied on belt conveyors to give an alarm if excessive slip between the head and tail pulley is detected and is especially useful on variable speed conveyors.

Each speed input is sensed by a motion sensing probe (A and B) located at the point of speed monitoring. As motion is sensed, the probes generate a signal that is sent to the DSD-3.



The probes are highly magnetic. Keep them away from magnetosensitive materials such as computer discs and audio or video tapes.

The DSD-3 features:

Output Signals:

- Probe A, 0 to 10 V output proportional to speed
- Probe B, 0 to 10 V output proportional to speed
- % Slip, -10 to +10 V output proportional to the percent difference between probe B referenced to probe A

Alarms:

- Probe B less than probe A
- Probe B greater than probe A
- Probe B underspeed
- Start spin

Annunciation LEDs:

- First alarm
- alarm status

Operational LEDs:

- Run
- Probe A and B pulse indicators
- relay status

Time delay:

- Start up
- Alarm

Options:

- Door mounted LCD readout with speed ‘A” and ‘B’, and ‘% slip’ selector switch
- Door mounted alarm status LED and reset button
- Alarm cards

SPECIFICATIONS

DSD-3

Power supply			Standard: 25VA at 115V, 50/60 Hz Optional: 25VA at 230V, 50/60 Hz
Linearity:			Speed: 0.4% of full scale Slip: 1.0% of full scale
Repeatability			Speed: 0.1% of full scale Slip: 0.25% of full scale
Temperature coefficient (setpoint variance):			0.05%/°C (0.03%/°F)
Operating Range (% of full scale): 4 to 100%:			0.32 to 8 pulses per minute minimum 288 to 7200 pulses per minute maximum
		0 to 4%	Yields 0 output
Alarms:	B>A	Start up delay: Setpoint	0 to 20 seconds 0 to 20% of A
	B<A	Start up delay: Setpoint	0 to 20 seconds 0 to 20% of A
	Bal:	Start up delay: Setpoint Selection	0 to 100 seconds 0 to 100% of Bcal on/off
	Spin	setpoint	2 to 31 pulses
Output		Relay	1 relay common to all alarms, Midtex 156-14C-200 or equivalent 3 form C contacts (3PDT) rated at 5 A at 120/240 VAC resistive 0 to 20 second delay after alarm Auto/manual reset
	Probe A:		0 to 10 VDC, 1KΩ minimum
	Probe B:		0 to 10 VDC, 1KΩ minimum
	% slip:		- 10 to + 10 VDC, 1KΩ minimum
Operating Temperature:			- 40° to + 60°C (- 40° to + 140°F)
Options:			NEMA 4 enclosure, 12”H x 10”W x 5.4”D LCD and 3 position selector switch (door mounted) Alarm card, maximum of 3, (requires large enclosure)
Weight (open) (enclosed)			4 lbs 17 lbs

MOTION SENSING PROBES

MSP-1	Construction:	CPVC Body 6 feet of PVC cable, 1 pr shielded/twisted, 18 AWG 3/4" NPT external conduit connection
	Amplifier:	RMA in NEMA 4 enclosure
	Mounting:	1" UNF c/w 2 CPVC locknuts
	Ambient temperature range:	- 50° to + 80°C (- 60° to + 180°F)
MSP-3	Construction:	Aluminum Body 5 feet of Teflon cable, 1 pr shielded/twisted, 18 AWG Silicon rubber gasket Aluminum cover with internal 1.2" NPT conduit connection
	Amplifier:	RMA in NEMA 4 enclosure
	Mounting:	2" NPSL c/w zinc flange and plated locknut
	Ambient temperature range:	- 50° to + 80°C (- 60° to + 500°F)
MSP-9	Construction:	304 Stainless Steel Body 5 feet of Teflon cable, 1 pr shielded/twisted, 18 AWG Silicon rubber gasket 304 SS cover w/0.9" dia. conduit entrance
	Amplifier:	RMA in NEMA 4 aluminum or SS enclosure
	Mounting:	304 stainless steel bracket and clamp
	Ambient temperature range:	- 50° to + 80°C (- 60° to + 500°F)
MSP-12	Construction:	Phenolic Body 5' or 30' (optional) of type SO neoprene cable, 2 conductor Neoprene gasket Aluminum cover with internal 1.2" NPT conduit connection
	Amplifier:	Internally mounted
	Mounting:	2" NPSL c/w zinc flange and plated locknut
	Ambient temperature range:	- 45° to + 60°C (- 50° to + 140°F)
XPP-5	Construction:	Phenolic Body 6 feet of PVC cable, 1 pr shielded/twisted, 18 AWG
	Amplifier:	Internally mounted
	Mounting:	2" NPSL c/w zinc flange and plated locknut
	Ambient temperature range:	- 45° to + 60°C (- 50° to + 140°F)

RMA

Input:		24 VDC from DSD-3 Speed signal from motion sensing probe
Output:		Pulse signal to DSD-3 12 mA low/ 45 mA high nominal
Enclosure:	Aluminum	Approx. 5.5” x 5.5” x3.5” H NEMA 4 ½” NPT internal conduit entrance (2) 4 lbs
	Painted Steel	Approx. 6 “ x 6” x 4” H NEMA 4 7/8” dia conduit entrance (2) 5.5 lbs
	Stainless Steel	Approx. 6 “ x 6” x 4” H NEMA 4X 7/8” dia conduit entrance (2) 5.5 lbs
Operating Temperature:		- 45° to + 60°C (- 50° to + 140°F)

LCD METER

Input:	Ribbon connector to DSD-3
Display:	3 ½ Digits, ½” High Adjustable reading 0.000 to 1999
Operating Temperature:	- 20° to + 60°C (- 5° to + 140°F)

DUAL ALARM CARD

Input:	Ribbon connector to DSD-3
Output:	2 relays, 1 alarm input high and low, Midtex 158-12-C-200 24 VDC or equivalent 2 Form C (DPDT) per relay, 10 A @ 115 V, 1/3 HP @ 230 VAC 2% deadband Relays are certified for use where the short circuit capacity of the circuits in which they are connected is limited by fuses having ratings not exceeding the rating of the relays.
Operating Temperature:	- 40° to + 60°C (- 40° to + 140°F)

INSTALLATION

DSD-3

The DSD-3 should be mounted in an area that is within the ambient temperature range and that is suitable for the specified e nclosure. The front cover should be accessible for viewing and have sufficient room to swing open to allow access for wiring and calibration adjustments.

It is advisable to keep the DSD -3 away from high voltage or current runs, contactors and SCR drives.

In climates where direct sunlight may cause the DSD-3 temperature to rise above the specified limit, shade the unit by installing a sun shield.

PROBES

The probes should be mounted in areas that are within their ambient temperature range and that are suitable to their specified approval classification. Probes may be mounted to the equipment they are monitoring providing that there is not a noticeable amount of vibration.

Probe A is generally reserved for sensing the driver device (head pulley) while probe B is generally reserved for sensing the driven device (tail pulley).

Refer to Probe Outline and Dimensions.

INTERCONNECTION

Connect the two motion sensing probes to the DSD-3. Refer to DSD-3 Probe Connections.

Connect the DSD -3 relay contacts i nto the motor control circuitry. Refer to DSD -3 Typical Ladder Diagrams.

Connect the power wiring to the DSD -3 and flip the power switch to 'ON'. Refer to DSD -3 Typical Ladder Diagrams.

OPERATION

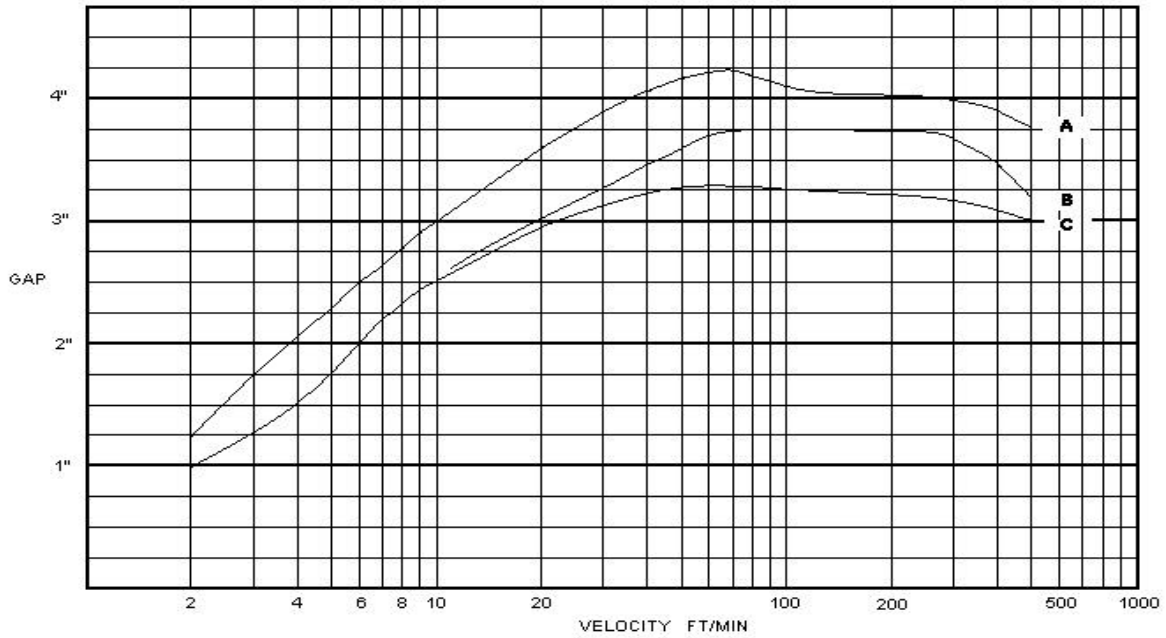
MOTION SENSING PROBES and AMPLIFIERS

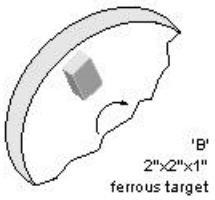
The motion sensin g probes work on the principle of Faraday's Laws of Electromagnetic Induction. That is to say, when a ferromagnetic object enters a probe's permanent magnetic field, it distorts the flux causing it to cut the coil windings thereby generating a voltage. T his voltage is proportional to the speed at which the ferrous target passes through the flux and is inversely proportional to the square of the distance between the target and the probe.

As increase in block size beyond 2" x 2" x 1" tends not to be as eff ective as minimizing the gap, except at very low velocities.

The voltage generated from the probe coil is fed to an amplifier for processing. The amplifier maybe internally mounted (IMA0 to the probe or remote mounted in an enclosure (RMA). It converts the voltage pulses into noise immune current pulses of approximately 12 mA low and 45 mA high. The amplifier has been designed to respond to the range of speed commonly encountered in industrial applications.

This response governs the relationship betwee n target speed and probe to target gap, as demonstrated in the following chart. The resulting curves indicate the maximum allowable gap for three target configurations at varying speed. For example, 'A' – with a 4.25" gap the minimum velocity is about 65 ft / min, and with a velocity of 2 ft / min, a maximum gap of 1.25" is possible.





Motion sensing probes are manufactured for various application such as: low temperature, high temperature, corrosive and hazardous environments. Refer to Specifications.

MSP-1: 'Mini Probe" is approximately 25% of the size of the standard probe with about 1/8 the sensitivity. By dividing the gap values for the standard size probe presented in the speed vs gap chart by 8, the corres ponding gap values for the MSP -1 are obtained; e.g.: with a gap of ½" , the maximum velocity is approximately 200 ft/min and with a velocity of 2 ft/min, a maximum gap of 0.13" is possible. It is used in areas that cannot accommodate the standard size pro be bodies. Due to its small size, the probe body cannot accommodate an IMA amplifier. It is thus used in conjunction with an RMA.

MSP-3: 'High Temperature Probe' is a standard size probe featuring an aluminum body. It is used for high temperature appli cations up to a maximum of 500 °F. As this temperature exceeds the rating of the IMA amplifier, the MSP -3 must be used in conjunction with an RMA which should be mounted in a suitable location.

MSP-9: 'Stainless Steel High Temperature Corrosion Proof Prob e' is a smooth bodied probe having the same performance characteristics as the standard probe. It is constructed of 304 stainless steel and is used in conjunction with an RMA so that it can be applied to corrosive and high temperature applications.

MSP-12: 'Standard Probe' has a phenolic body with IMA, applicable to a maximum temperature of 140°F.

XPP-5: 'Explosion Proof Probe' is suitable for the specified hazardous environments. It uses the phenolic probe body and an IMA, limiting it to a temperature of 140°F.

DSD-3

The DSD-3 provides a short circuit protected, +24VDC unregulated supply to both of the probe amplifiers. In the event of the interconnecting wiring being shorted, the output current from the DSD-3 is automatically limited and a perceived alarm condition will ensue, forcing the on -board relay to de-energize (alarm).

The DSD-3 receives a speed signal from both of the probes, 'A' and 'B', via their respective amplifiers (IMA or RMA) superimposed on the direct current supply. Probe 'A' is generally reserved for sensing the driver device (head pulley) while probe 'B' is generally reserved for sensing the driven device (tail pulley).

The speed signals are process to derive the following internal signals:

Probe A: this is the speed sensed by probe 'A'. It is used as the reference value for difference and speed computations. A representative 0 to 10 VDC signal is available for external use at terminals 9 and 10, where: 0 V = 0% of full speed
10 V = 100% of full speed

Probe B: this is the speed sensed by probe 'B'. A representative 0 to 10 VDC signal is available for external use at terminals 11 and 12, where: 0 V = 0% of full speed
10 V = 100% of full speed

% slip: this is the difference between probe 'A' and probe 'B' speed si gnals with reference to probe 'A'. It is calculated as follows: % slip = 100 (A – B) / A

A representative –10V to +10VDC signal is available for external use at terminals 7 and 8, where: - 10V = 100% slip, B > A
0V = 0% slip, B =A
+ 10V = 100% slip, B < A

If the DSD-3 is powered across the line (refer to DSD-3 Typical Ladder Diagrams) and the machinery to be monitored is not running, the 'Alarm' relay will be de-energized and the 'Alarm Relay' LED (12) will be lit. When the motor contactor is energized, a contact closure across terminals 15 and 16 will initiate the count down of the start up delay timers and energize the 'Alarm' relay. The timers, if properly set, will allow the machinery to come up to speed without tripping an alarm. If there is an alarm from the previous operating cycle and the 'Auto Reset' switch is set to 'ON', the alarm will automatically be reset on start up. If the 'Auto Reset' switch is set to 'OFF', then the manual reset switch either on the DSD-3 motherboard or as the optional reset switch on the front cover must be pressed.

If the DSD-3 is powered across the motor contactor then all alarms will be cleared when the motor contactor is de-energized. When the motor contactor is energized and power is applied to the DSD-3, the 'Start-up Delay' timers will begin counting down as long as terminals 15 and 16 have been jumpered. Under normal operating conditions, the 'Alarm' relay is held in an energized state and the optional display will show the selected speed, either of probe 'A', probe 'B' or percent slip. The 'Run" LED (11) will be lit and the probe 'A' and 'B' LED's (1 and 2 respectively) will flash at the rate of the respective incoming pulses.

Under an alarm condition, the 'First Out' and 'Alarm Status' LED's corresponding to the type of alarm will light. Any subsequent alarms will only light the corresponding 'Alarm' LEDs. Once an alarm condition has been initiated, the alarm shut down time delay begins to count down. If the alarm condition recovers before the alarm delay times out, the LEDs will extinguish. If the alarm condition persists and the delay times out, the 'Alarm Relay' LED will light and the relay de-energize. The alarm lights will extinguish but the first 'First Out' LED (3 – 6) will remain lit until the alarm is reset, to indicate what caused the shutdown. If the 'Start Spin Alarm' LED was lit, it will remain so until the alarm is reset.

ALARMS

START SPIN

The 'Start Spin' alarm counts the pulses being generated from the 'A' probe. If the number of pulses reaches the start spin limit before the first pulse from the 'B' probe is generated, the 'Start Spin Alarm' LED will light and the relay immediately de-energize, bypassing the alarm shutdown delay. The limit is set via the DIP switch bank, with a range of 2 to 31 pulses.

This alarm is useful in detecting slippage of a conveyor belt on the head pulley which can occur if the belt is wet, loose or jammed.

B < A SLIP

If the speed registered by the 'B' probe is less than the speed registered by the 'A' probe by more than the set limit, a B < A 'Slip' alarm will be initiated. The slip limit is set by its corresponding potentiometer with a range of 0 to 20% of speed 'A'.

This alarm is useful in detecting slippage after the machinery has been running for a period of time. It is especially useful in detecting slippage on variable speed belt conveyors where otherwise a single point monitoring system could not differentiate between slippage and an intentional slow down of the tail pulley.

B > A SLIP

If the speed registered by the B probe is greater than the speed registered by the A probe by more than the set limit, a B > A 'Slip' alarm will be initiated. The slip limit is set by its corresponding potentiometer with a range of 0 to 20% of speed A.

The alarm is useful in detecting slippage on downhill belt conveyors when the motor is used as a brake.

B < Bcal – Underspeed

If the speed registered by the 'B' speed is less than the calibrated full scale speed of the 'B' probe by more than the set limit, an 'underspeed' alarmwill be initiated. The 'underspeed' alarm is set by its corresponding potentiometer with a range of 0 to 100% of Bcal.

This alarm detects an absolute reduction in speed of the machinery below its allowable limit.

ALARM CARD (optional)

The alarm card provides two relays with independent alarm setpoints. One for overspeed and the other for underspeed. For overspeed alarm, the 'A' and 'B' probes must be calibrated so that 10 V is greater than full speed (e.g. full speed equals 7.5V). A maximum of three alarm cards may be connected to the DSD-3 as follows:

1 card to alarm on speed of probe A (2RC)
1 card to alarm on speed of probe B (3RC)
1 card to alarm on % slip (4RC)

or 2 or 3 cards can be daisy chained to one of the above via the alarm card 'Input' or 'To Next Alarm' connectors.

Connection to the alarm cards is made via ribbon connector (#RC as previously indicated). The speed signals to the cards (pin 6) are homologous to the 0 to 10 VDC output signals. Under an alarm condition the relay response is immediate, as the relays do not come under the alarm delay circuitry of the DSD-3. The alarms have a 2% dead band which must be overcome before the alarm condition is reset.

LCD METER (optional)

The LCD meter is used in conjunction with the three position switch. The switch can be set so that the meter will display either:

Probe A speed
Probe B speed
Slip speed

The LCD can be calibrated to display speed in percent of full scale, revolutions per minute or other desired units

ALARM LIGHT AND RESET BUTTON (door mounted – optional)

The optional door mounted alarm light and reset button operate in parallel with the DSD-3 board A 'Alarm Relay' LED and 'Manual Reset' button.

CALIBRATION

SPEED

The DSD-3 is factory calibrated for 0 to 10 VDC output for 0 to 7200 pulses per minute ('A' and 'B' probe 'Coarse Span' switches fully clockwise) so that there will be a % of full scale reading when starting up.

- Connect a voltmeter to:
  - % slip output terminals 7 (+) and 8 (com)
  - 'A' probe output terminals 9 (+) and 10 (-)
  - 'B' probe output terminals 11 (+) and 12 (-)

- If the DSD-3 has been supplied with the optional LCD meter and selector switch, it can be used to monitor the output voltages.

- Run the machinery being monitored at full speed. If this is not practical, operation can be simulated using a signal generator and an interface circuit. Refer to DSD-3 Signal Generator Interface.

- Turn the coarse span switches. 'A Probe' and 'B Probe', counter clockwise until the respective voltmeters read between 2.5 V (25%) and 10 V (100%).

- Adjust the fine span potentiometers, 'A Probe' and 'B Probe', until the respective voltmeters read 10 V (100%) for full speed input.

- With the 'A' and 'B' probe outputs calibrated for 10V, the % slip output should read 0 V.

ALARMS

B greater than A:

- Adjust the 'B > A' / 'Alarm Setpoints' potentiometer to alarm on a 'B' probe speed of 0 to 20% greater than the 'A' probe speed.
- Adjust the 'B > A' / 'Start Time Delays' potentiometer for 0 to 20 seconds to allow the machinery to come up to speed without tripping the alarm.

B less than A:

- Adjust the 'B < A' / 'Alarm Setpoints' potentiometer to alarm on a 'B' probe speed of 0 to 20% less than the 'A' probe speed.
- Adjust the 'B < A' / 'Start Time Delays' potentiometer for 0 to 20 seconds to allow the machinery to come up to speed without tripping the alarm.

B underspeed:

- Set the enable switch to 'ON' for underspeed alarm. For variable speed applications, disable the alarm by setting the switch to 'OFF' or set the alarm setpoint to a low value.
- Adjust the 'B Underspeed' / 'Alarm setpoints potentiometer to alarm on a 'B' probe speed of 0 to 100% under the full scale speed.
- Adjust the 'B Underspeed' / 'Start Time Delays' potentiometer for 0 to 100 seconds to allow the machinery to up to speed without tripping the alarm.

Start Spin

- Set the 'Start Spin' switch to alarm on 2 to 31 pulses from the 'A' probe before the first 'B' probe pulse. The amount of start spin is usually an indication of slackness in a conveyor belt.

Auto Reset

- Set the 'Reset' / 'Auto' switch to 'ON' or 'OFF'.

Alarm Relay (not applicable to Start Spin)

- Set the 'Alarm Shutdown Delay' potentiometer for 0 to 20 seconds after first alarm annunciation. This function is used to avoid nuisance alarms.

DUAL ALARM CARD (optional)

- Turn the 'Near' (high alarm) and 'Far' (low alarm) potentiometers fully counter clockwise.
- With the machinery running at the required speed for the high alarm setpoint, slowly turn the 'Near' potentiometer clockwise until the 'Near' relay de-energizes, LED off.
- With the machinery running at the required speed for the low alarm setpoint, slowly turn the 'Far' potentiometer clockwise until the 'Near' relay de-energizes, LED off.

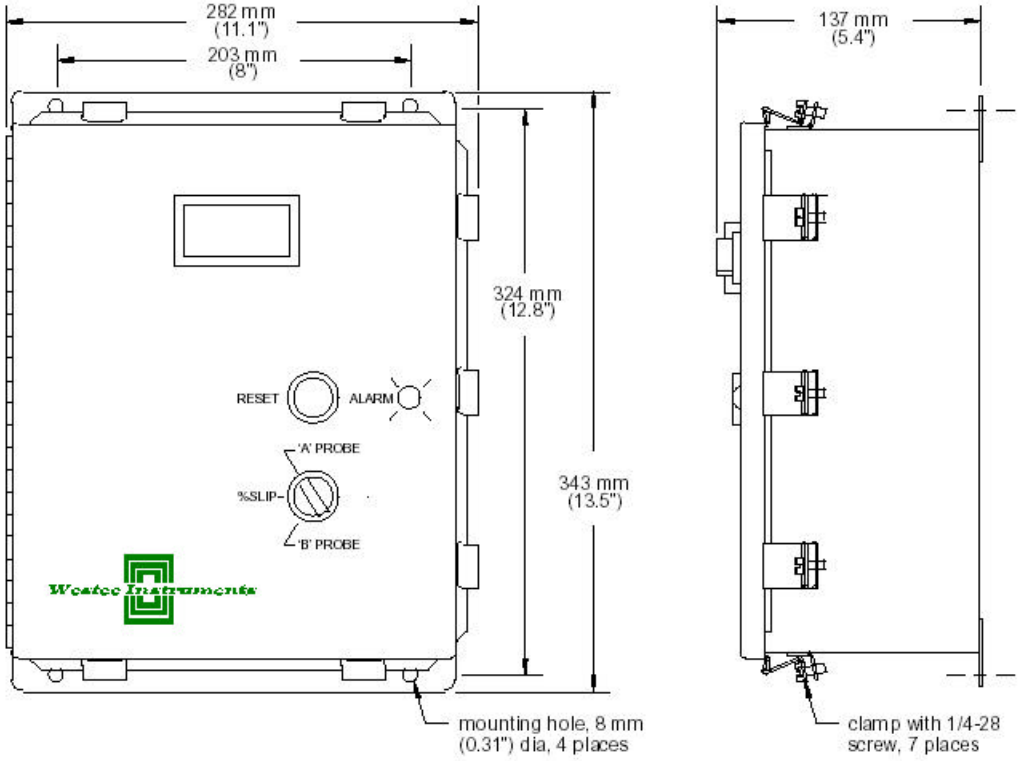
LCD METER (optional)

- The LCD meter is factory calibrated for 0 to 100% display for 0 to 10 VDC speed signal level.
- To recalibrate the meter, remove the seals of Span potentiometer, P1.
- With the machinery running at a known speed, turn the span potentiometer until the display reads the desired speed (ignoring the decimal) either in rpm, ft / min or % of full scale. The maximum display reading is 1999.

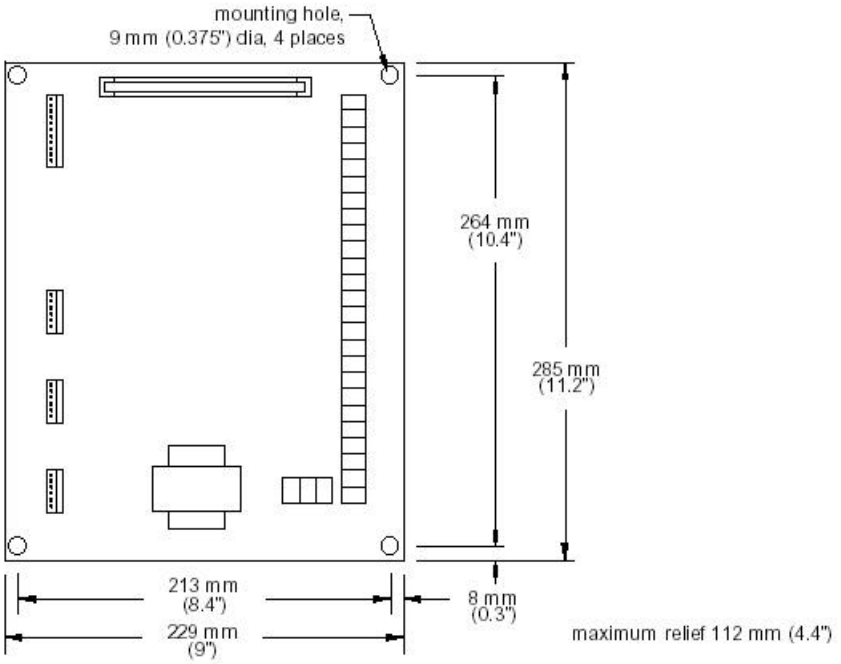
- Set the jumper to desired decimal point location.

DSD-3 – OUTLINE AND DIMENSIONS

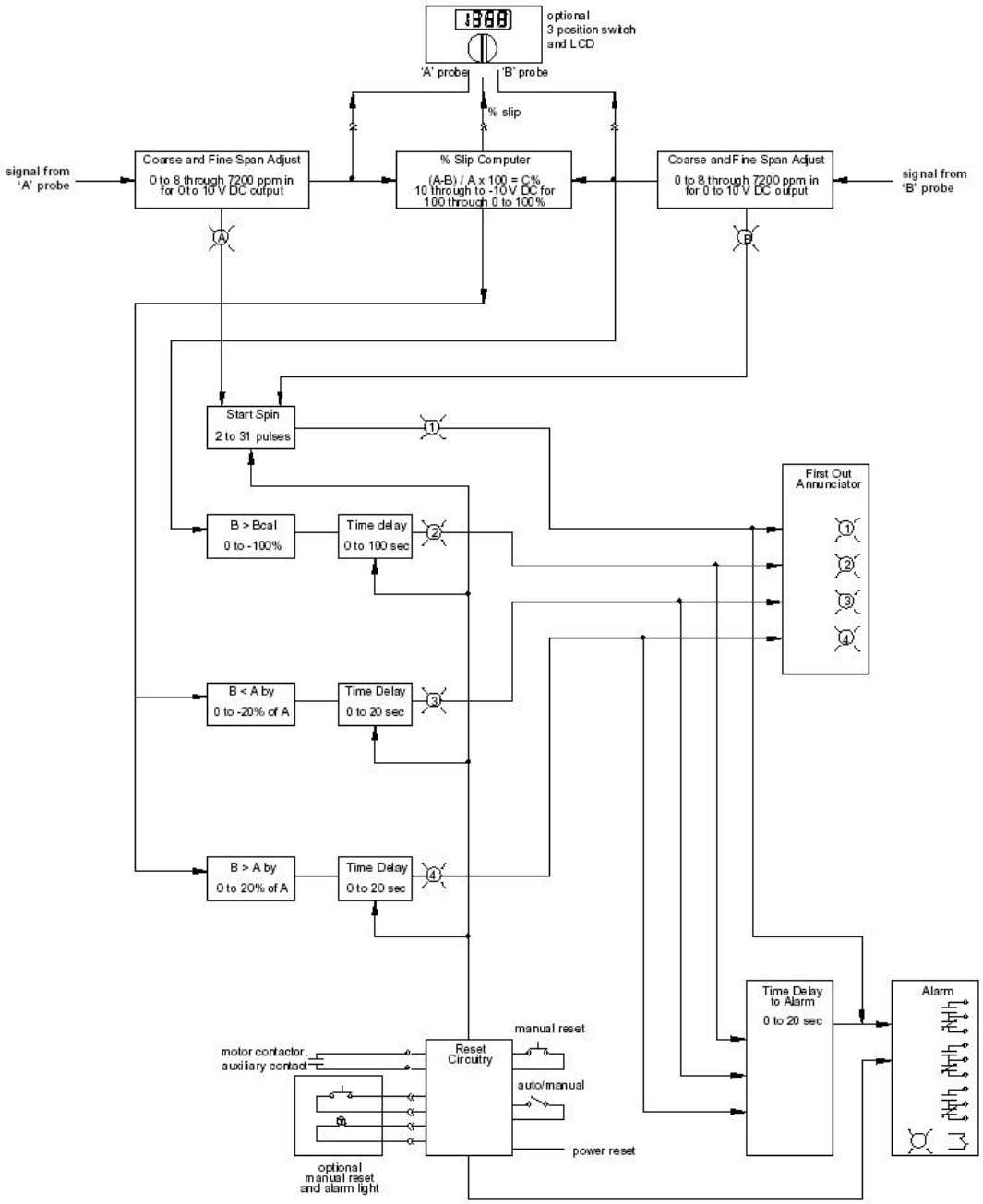
STANDARD NEMA 4 ENCLOSURE



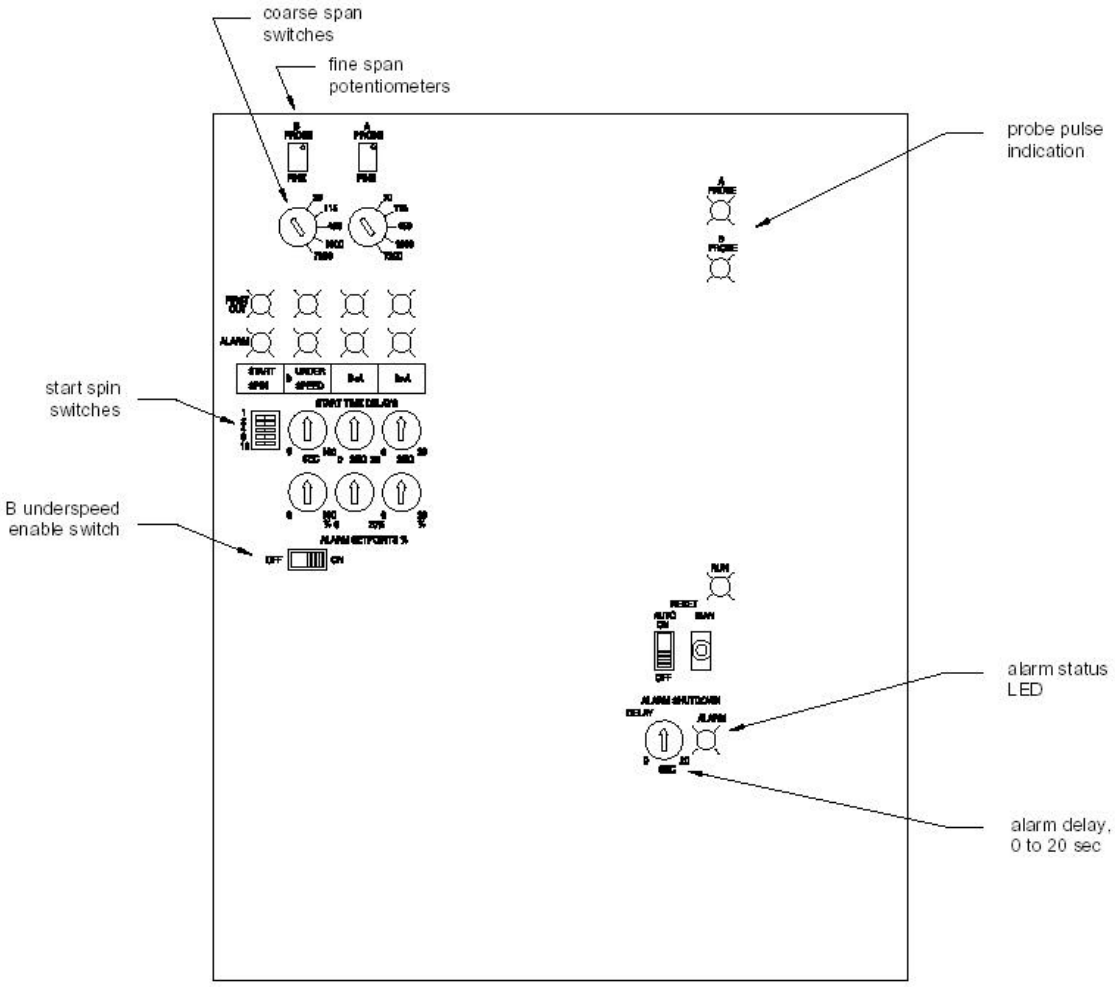
OPEN STYLE



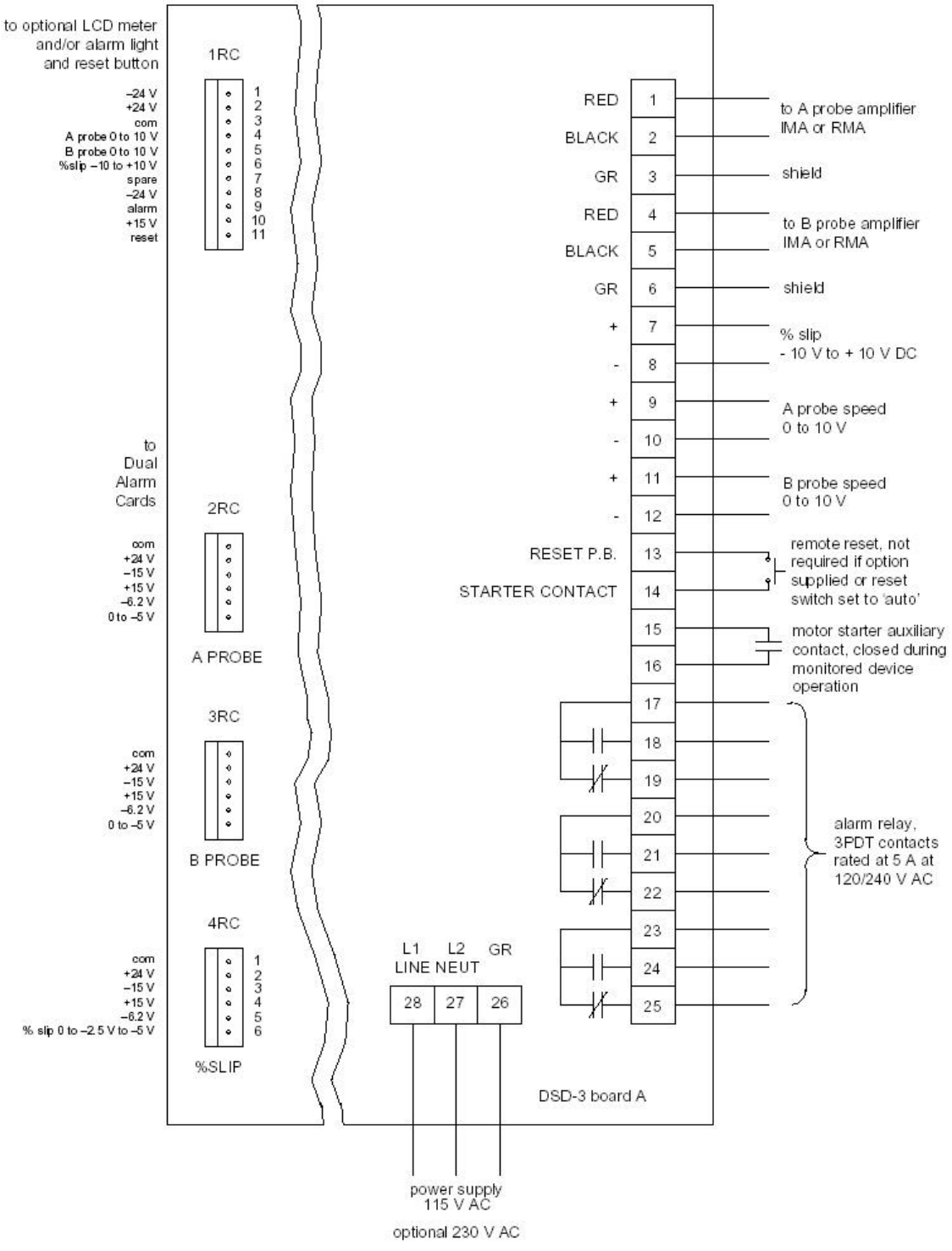
DSD-3 BLOCK DIAGRAM



DSD-3 Adjustments and Indicators

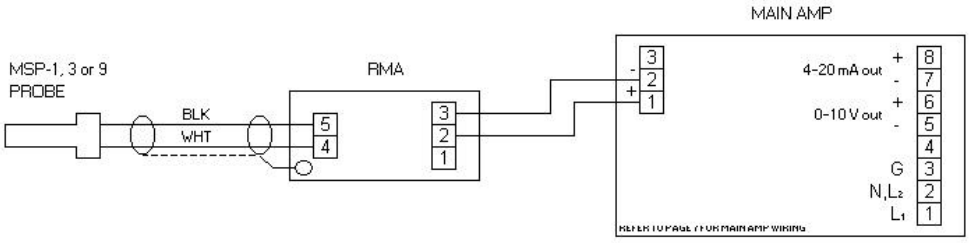


DSD-3 Connector Layout

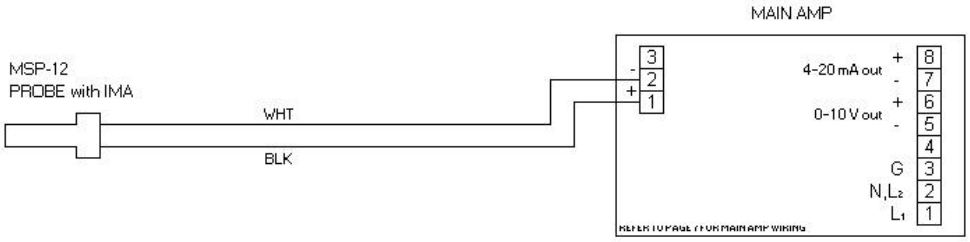


DSD-3 Probe Connections

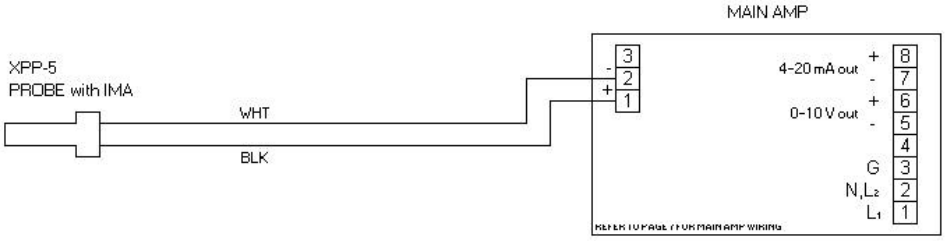
DSD-3 INTERCONNECT



NOTE: Max. cable length from probe to RMA is 100' of shielded cable. 18 ga. Wire.
See table below for cable lengths from RMA to main amp.



NOTE: 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 cable lengths from IMA to main amp.



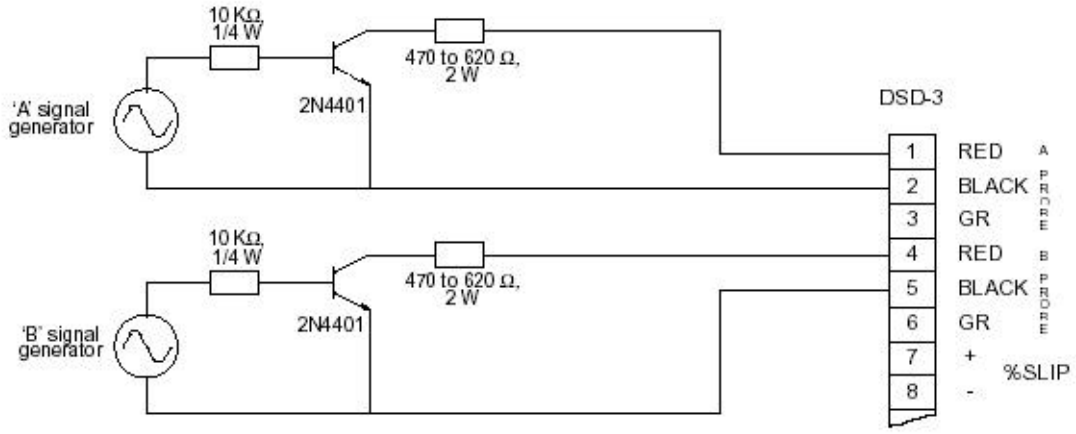
NOTE: Shielded cable not required. Wiring of cable must be done in an approved junction box and to procedures in accordance with all local bylaws, rules & regulations. See table below for cable lengths from IMA to main amp.

MAXIMUM CABLE LENGTH from RMA or IMA to MAIN AMP

Wire Ga.	Max. Length in Feet	Max. Length in Meters
22	2500	760
18	5000	1520
12	25000	7600

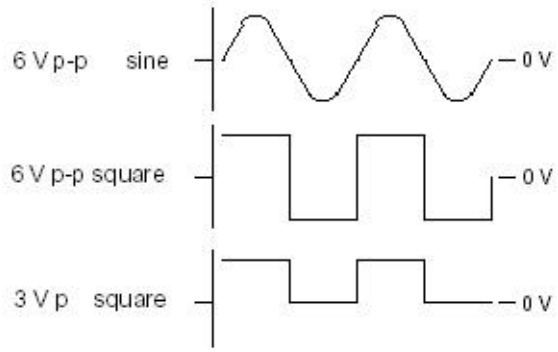
DSD-3 Signal Generator Interface

The following circuit may be used to facilitate the calibration or troubleshooting of the DSD-3.



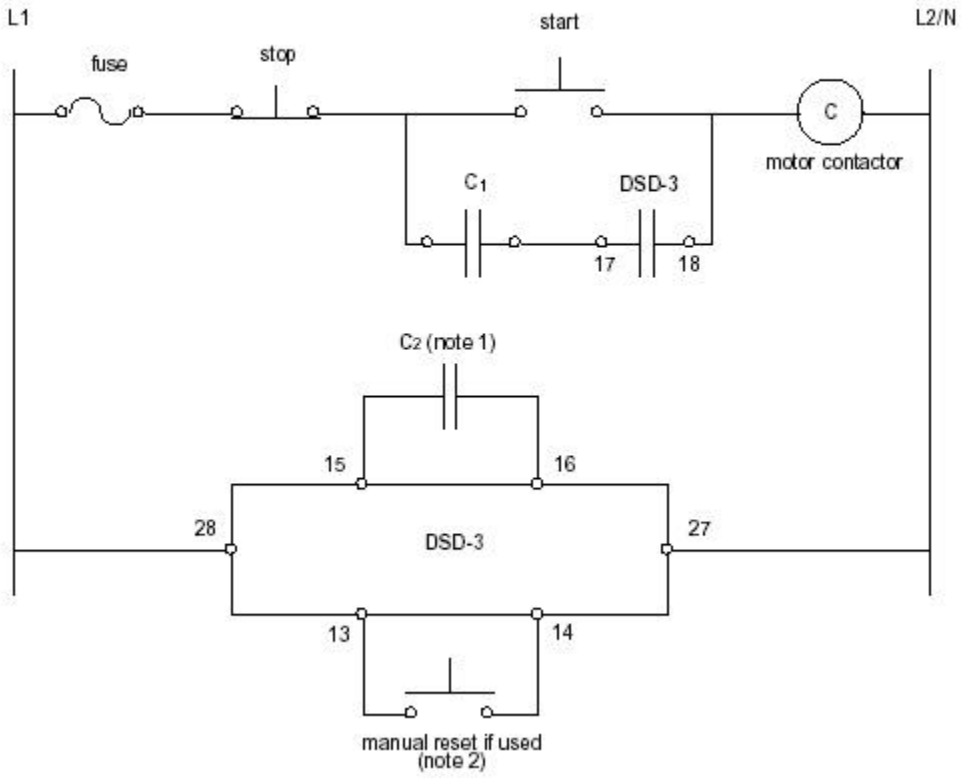
circuit substitutes operating probe and pre-amp

Set the signal generators for:

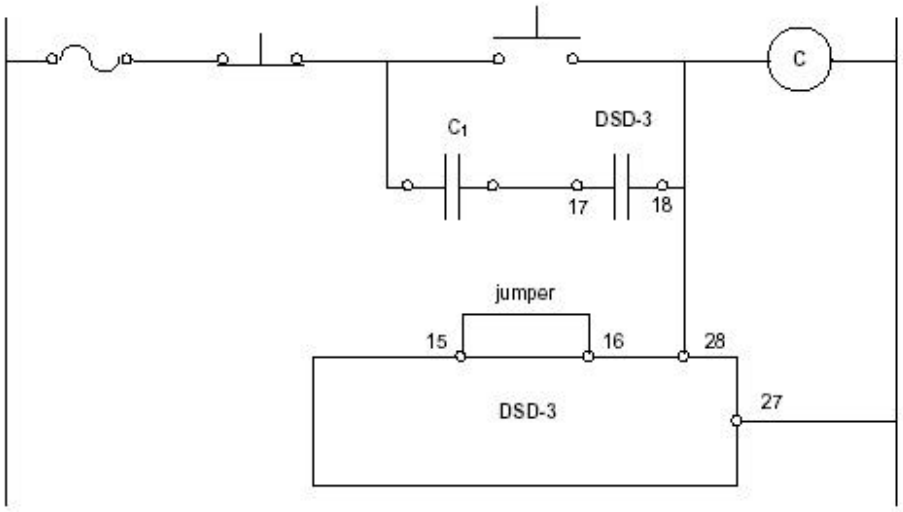


DSD-3 Typical Ladder Diagram

LINE POWERED



LINE INTERRUPT (note 3)

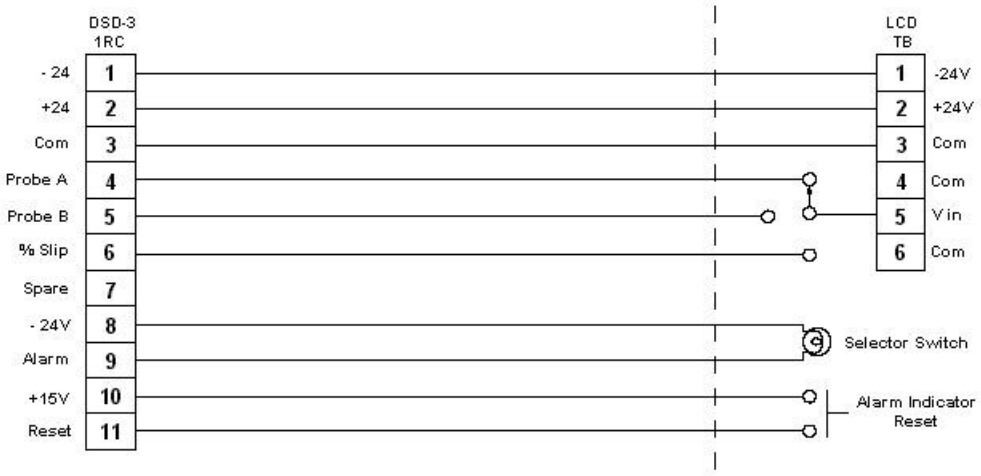


NOTES:

1. Closing of contact activates start up timers.
2. Manual reset is not necessary when the auto reset mode is switched in.
3. The DSD-3 resets when power is applied and the start up timers are activated, provided terminal 15 and 16 are jumpered.

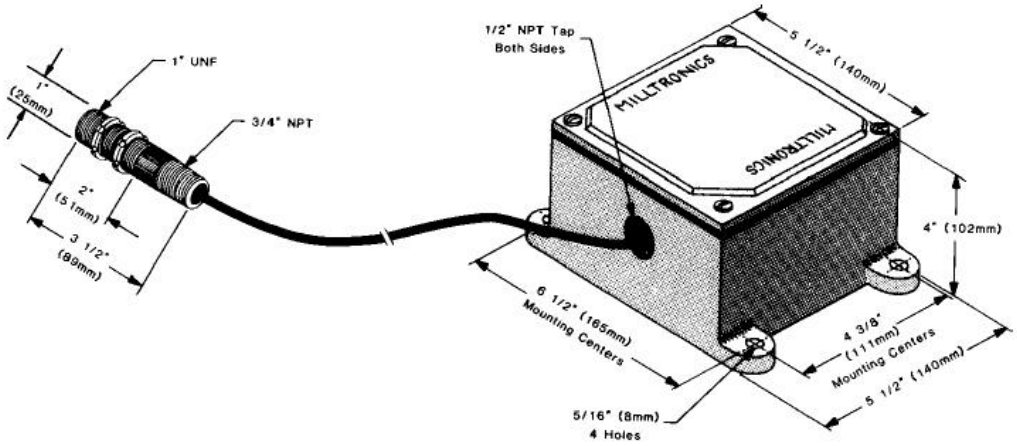
DSD-3 Options Wiring Diagram

OPTIONAL DOOR MOUNTED LCD AND ALARM INDICATOR/RESET



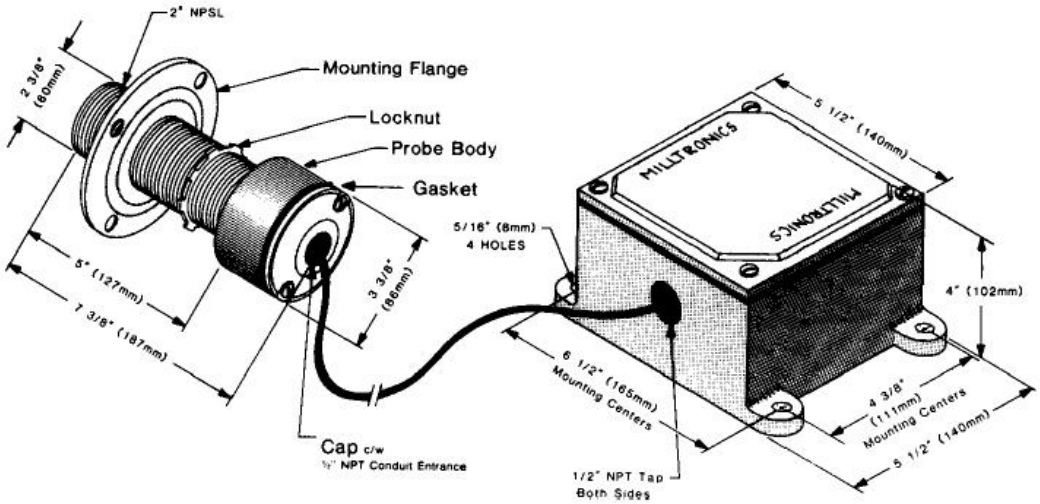
Probes

Mini Sensing Probe MSP-1



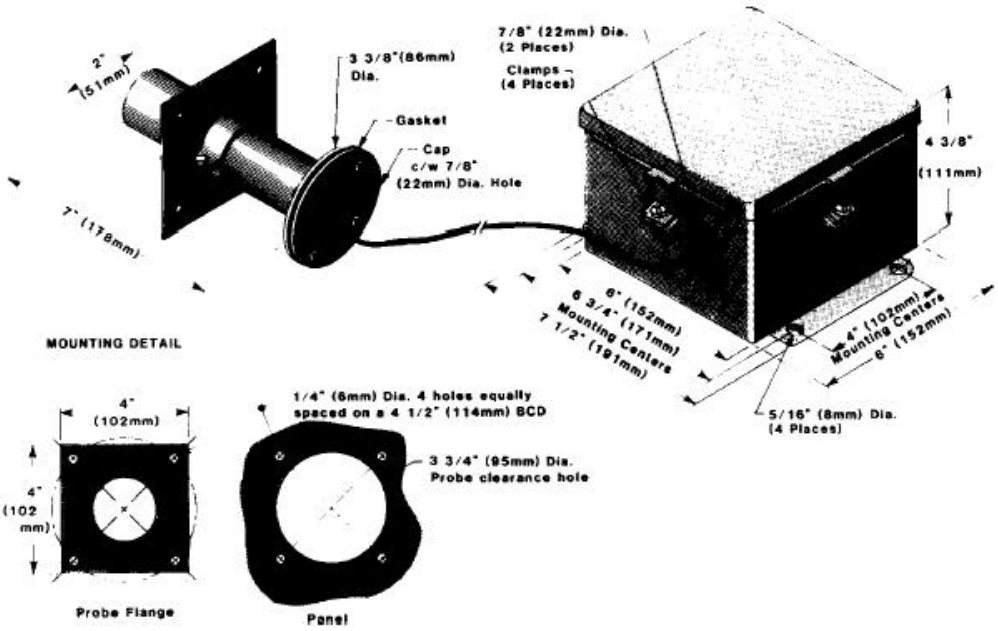
- CPVC body c/w 2 CPVC locknuts
- 6 ft. of Belden 8760 supplied potted in probe
- Remote mounted pre-amp in Nema 4 cast aluminum enclosure.

High Temperatures MSP-3



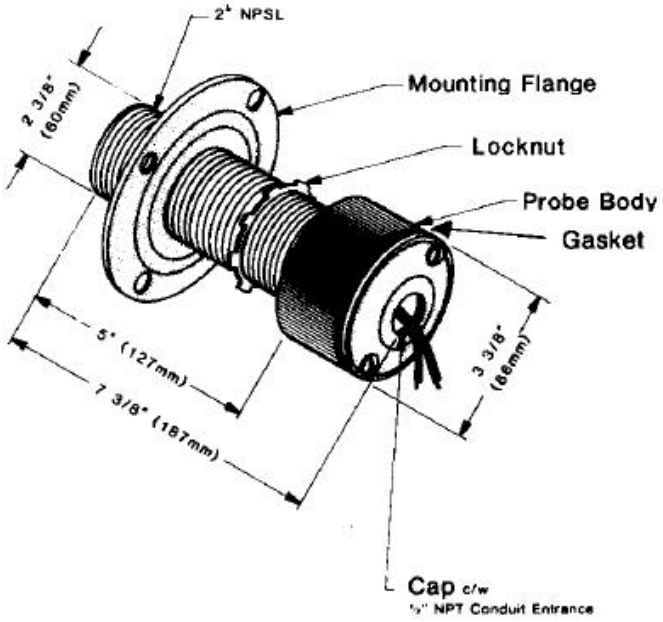
- Cast aluminum body c/w cast aluminum cap and zinc flange, zinc plated locknut, and silicone rubber gasket
- See page 30 for Flange and Mounting Details
- Pre-amp is mounted in a Nema 4 cast aluminum enclosure

Stainless Steel Probe MSP-9



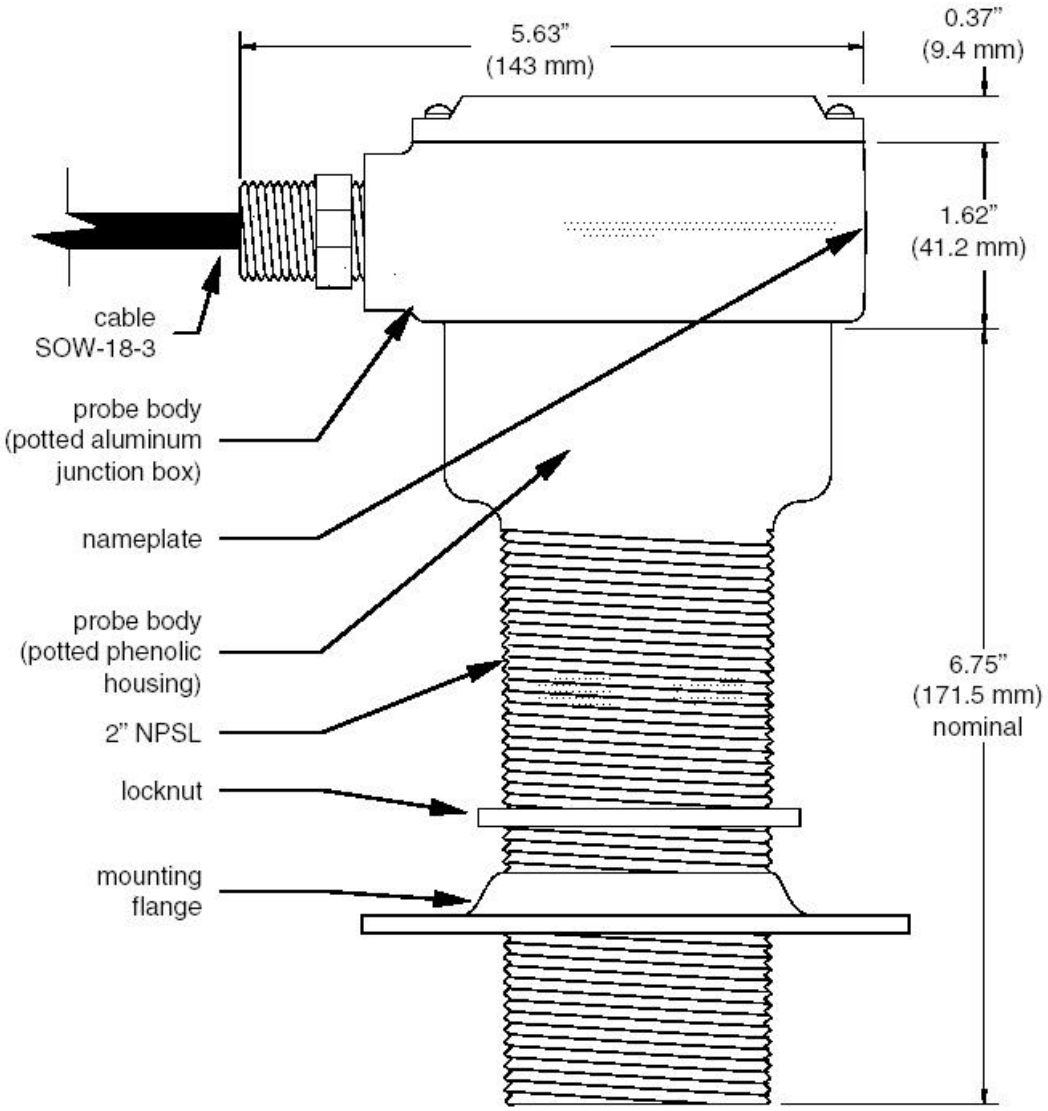
- For high temperature and corrosion resistance applications
- 304 stainless steel body c/w stainless steel clamp and silicone gasket
- 5 ft. Belden 83321 Teflon cable potted in probe
- Pre-amp is mounted in an enamel painted steel Hammond 1414N4E enclosure.

Standard MSP-12



- Phenolic body c/w die cast aluminum cap and zinc flange, zinc plated locknut, and neoprene gasket
- See page 30 for Flange and Mounting Details
- Pre-amp is potted in the probe body c/w two 5" (127 mm) long hook-up wires

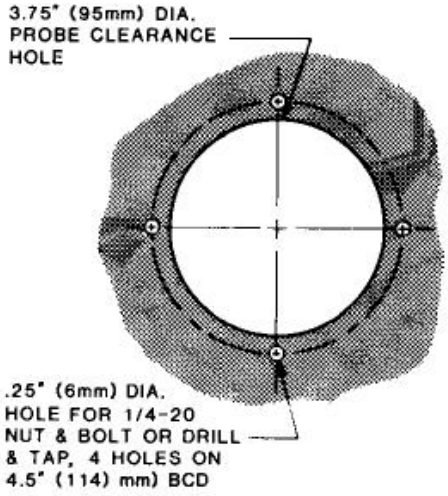
Hazardous Locations XPP-5



- 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 30 for mounting details and pages 9 and 29 for interconnection information.
- pre-amp and cable potted in probe body

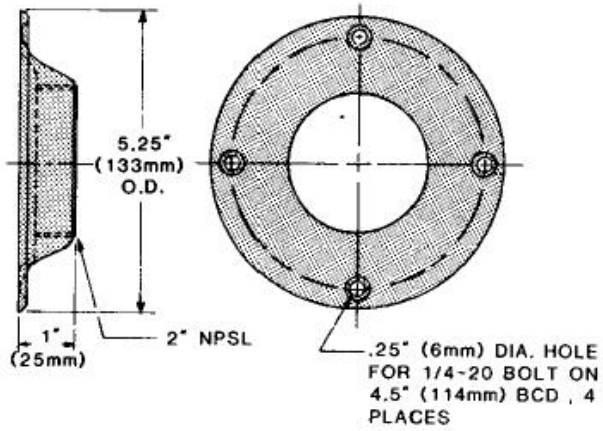
Mounting Details

Mounting Detail

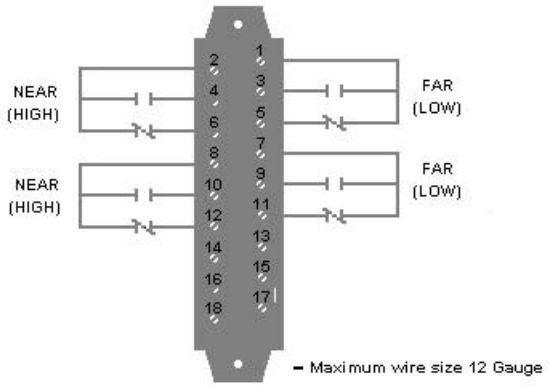


Mounting Flange

APPLICABLE TO ALL PROBES
EXCEPT MSP-1 & MSP-9

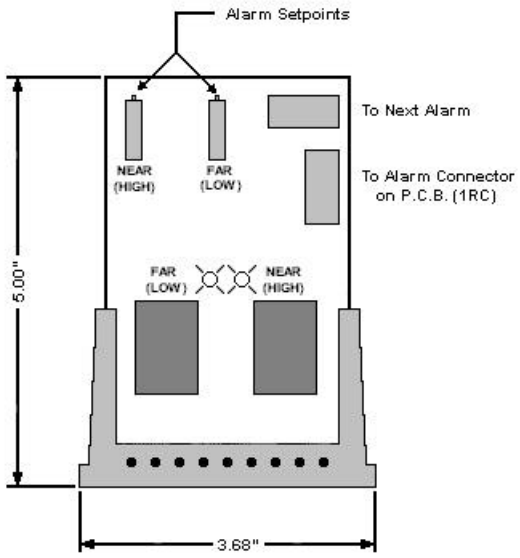


Alarm PCB Terminal Block Connections



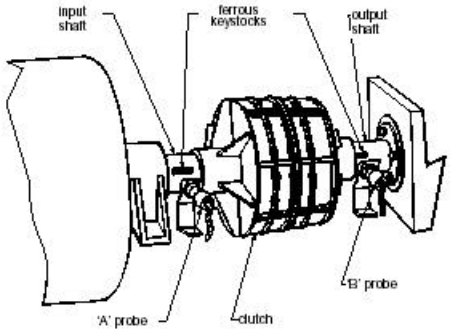
Notes:
- Contacts are shown in ALARM condition.
- Relay de-energized.
- CSA requires a 10 A or less fuse to protect contacts. For 240 VAC, protect the contacts with a 1500VA transformer as well.

Satellite Alarm Module



DSD-3 Applications

CLUTCH MONITORING



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