# *AIRANGER DPL*

## DUAL POINT LEVEL SYSTEM

Instruction Manual

PL-295

February 1993

MILLTRONICS

PROCESS MEASUREMENTS

33452950

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# GENERAL INFORMATION

## IMPORTANT

Prior to AiRanger DPL installation, it is imperative that this manual be read thoroughly to ensure all of the calibration requirements and capabilities of the AiRanger DPL are predetermined and fully understood.

The Milltronics AiRanger DPL is extremely user friendly by design. In most cases, installation and start-up may be completed quickly and easily in a few steps. The level of calibration required depends greatly upon the application operating conditions and the overall requirements of the system.

The Applications section of this manual provides a general description of common AiRanger DPL industrial applications. Refer to the sub-section which best suits your application for basic calibration instructions. The calibration of the AiRanger DPL may be further optimized to suit the specific application. Refer to the Parameters section 1 through 59 and Appendices, Alphabetical Parameter Listing.

### THE AIRANGER DPL

The Milltronics AiRanger DPL is a microprocessor based ultrasonic transceiver mounted in a Nema 4 enclosure, and is designed to operate as a single point or **D**ual **P**oint **L**evel measurement system.

The AiRanger DPL may be utilized with transducer(s) from the : ST-50, ST-100, LR-21, or LR-13 series to provide reliable performance in a wide variety of liquid or bulk solid level measurement applications.

System calibration is completed by entering information specific to the application into the AiRanger DPL non-volatile memory via the removable calibrator. This calibration permits the AiRanger DPL to provide display, analog mA, and relay contact outputs in direct relation to material level or volume.

The calibrator may be removed from the AiRanger DPL front cover to prevent inadvertent programming alteration during normal daily operation.

The AiRanger DPL provides a data output. This output may be connected directly to the Milltronics Single Point Display (SPD) to provide a remote display of material status. Alternatively, the data output may be connected to the Milltronics Buffered Interface Converter (BIC) to permit communication between the AiRanger DPL and the customers computer.

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# SPECIFICATIONS

## MAIN ELECTRONICS

| | | |
|---|---|---|
| Power: | › Standard: | › 100/115/200/230 V AC ±15%, jumper selective<br>› 50/60 Hz, 15 VA |
| | › Optional: | › 12 ± 3 VDC, 15 VA<br>› 24 ± 5 VDC, 15 VA |
| Fuse: | | › 1/4 amp MDL Slo-Blo or equivalent |
| Range: | | › under optimum conditions and dependent upon transducer type:<br>› max. 61 m (200 ft) on level applications<br>› max. 122 m (400 ft) on tripper car applications |
| Accuracy: | | › within 0.25% of range or 6mm (0.24") whichever is greater |
| Resolution: | | › 0.1% of range or 2 mm (0.08"), whichever is greater |
| Memory: | | › EEPROM (non-volatile)<br>no back-up battery required |
| Display: | | › Liquid Crystal Display<br>4 digits - 18 mm (0.7") high |
| Operating temperature:<br>(range in which electronics will operate within specs, includes temperature rise above ambient due to operation in enclosure) | | › – 20 to 60 ℃<br>(– 5 to 140 ℉) |
| Ambient temperature:<br>(range outside of AiRanger DPL enclosure) | › Standard: | › – 20 to 50 ℃<br>(– 5 to 122 ℉) |
| | › Optional: | › 115 VAC, 125 VA, thermostatically controlled enclosure heater where ambient temperatures below – 20 ℃, (– 5 ℉) are expected |
| Data link: | | › transmit only<br>› single ± 20 mA bipolar current loop at 4800 baud rate |
| Outputs: | › transducer drive: | › 41.5 KHz, 315 V peak pulses of max. 1 mSec duration<br>***or***<br>21 KHz, 150 V peak pulses of max. 1.7 mSec duration<br>***or***<br>13 KHz, 150 V peak pulses of max. 1.7 mSec duration<br>› max. repetition rate of 300 mSec/shot |
| | › analog: | › 1 output per point<br>› 0.1% resolution<br>› 0 - 20 or 4 - 20 mA<br>› max. loading: 350 ohms return to ground, or 750 ohms return to – 12 V<br>› optional mA isolator |

| | | |
|---|---|---|
| | › relays: | › 4 alarm/control relays<br>› 1 form 'C' SPDT contact per relay, rated 5 A at 220 VAC non-inductive<br>› deadband is parameter set |
| | **› NOTE**: | › all relays are certified for use in equipment 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 |
| Enclosure: | | › CSA Enclosure 4<br>› 209 mm W x 285 mm H x 92 mm D (8.23" W x 11.23" H x 3.60" D)<br>› polycarbonate |
| Max. shipping weight: | | › 3.6 Kg (8 lb.) |

**CALIBRATOR**

| | |
|---|---|
| Enclosure: | › general purpose<br>› 67 mm W x 100 mm H x 25 mm D (2.6" W x 4" H x 1.0" D)<br>› plastic |
| Operating Temp.: | › – 20 to 50 ℃ (– 5 to 122 ℉) |
| Battery: | › 9 V (NEDA 1604A): Duracell Coppertop No. MN-1604, Eveready Alkaline Energizer (Union Carbide No. 522) or equivalent<br>› long life |
| Shipping weight: | › 150 g (0.3 lb) |

**TRANSDUCERS:** › range is specified for transducers when used with AiRanger DPL under average conditions

| MODEL | AMBIENT TEMP. | FREQUENCY (Beam Angle) | RANGE | WT std. cable |
|---|---|---|---|---|
| ST-50 | – 40 to 93 ℃* (– 40 to 200 ℉) | 44 KHz (5°) | 0.3 to 15.2 m (1 to 50 ft) | 3.9 Kg (8.5 lb) |
| ST-100 | – 40 to 77 ℃* (– 40 to 170 ℉) | 21 KHz (7°) | 0.9 to 30 m (3 to 100 ft) | 15.8 Kg (35 lb) |
| LR-21 | – 40 to 77 ℃ (– 40 to 170 ℉) | 21 KHz (5°) | 0.9 to 30 m (3 to 100 ft) | 3.9 Kg (8.5 lb) |
| LR-13 | – 40 to 77 ℃ (– 40 to 170 ℉) | 13 KHz (5.5°) | 1.2 to 60 m (4 to 200 ft) | 7.7 Kg (17 lb) |

* The maximum ambient temperature for polyethylene foam facing is 77 ℃ (170 ℉)

| | | |
|---|---|---|
| **ST-50:** | Standard: | › CPVC housing with polyurethane face.<br>› 1" NPT std. mounting/conduit connection<br>› totally encapsulated<br>› optional flange mounting, std sizes: 6", 8" and 12" (metric sizes also available) |
| | Optional faces: | › CPVC: for corrosive applications<br>› Teflon: (flange mounted transducers only) for highly corrosive applications<br>› Polyethylene foam: for dusty, non- condensing applications |
| **ST-100**: | Standard: | › cast housing aluminum with polyurethane face. |
| | Optional faces: | › CPVC: for corrosive applications<br>› Teflon: (flange mounted transducers only) for highly corrosive applications<br>› Polyethylene foam: for dusty, non-condensing applications |
| **LR-13 & 21**: | | › cast aluminum housing with polyethylene and styrofoam face<br>› 1" NPT std. mounting/conduit connection |
| **Approvals**: | | › CSA, FM and BASEEFA |

**TEMPERATURE SENSOR**
(optional)

| | |
|---|---|
| Model: | › TS-2, for transmission medium (typ air) temperature and compensation |
| Construction: | › CPVC housing with CPVC face<br>› PVC cable jacket<br>› totally encapsulated<br>› carries CSA FM and BASEEFA approvals |
| Range: | › – 40 to 93 ℃<br>(– 40 to 200 ℉) |
| Resistance: | › 9.6K ohm (nominal) at 20 ℃ ± 5K ohm temp. variance |
| Shipping weight: | › 0.5 Kg (1 lb.) (std. cable length) |

**CURRENT OUTPUT ISOLATOR**
(optional)

| | |
|---|---|
| Model: | › LIs-1 loop isolator |
| Input: | › 4-20 mA DC (from AiRanger DPL) |
| Output: | › 4-20 mA DC into 600 ohm (max.) |
| Isolation: | › 300 V AC continuous |
| Common Mode Rejection: | › 100 dB at 60 Hz |
| Shipping weight: | › 0.27 Kg (0.6 lb) |

**CABLING**
(optional)

| | |
|---|---|
| Transducer: | › RG-62U coax<br>› max. distance to electronics: 365 m (1200 ft)<br>› must be run in grounded metal conduit |
| Temp. Sensor: | › Belden 8760, 2 wire shielded<br>› max. distance to electronics: 365 m (1200 ft)<br>› can be run with transducer cable |
| **PERIPHERALS**:<br>(optional, refer to Instruction Manual PL-274) | › Single Point Display<br>› Buffered Interface Converter |

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# INSTALLATION

## AIRANGER DPL

The AiRanger DPL should be mounted in an area that is: within the ambient temperature range, is suitable for NEMA 4 enclosures and polycarbonate material. The front cover should be accessible for calibrating and viewing and have sufficient room for it to swing open.

It is advisable to keep the AiRanger DPL away from high voltage or current runs, contactors and SCR control drives.

**Do not mount the AiRanger DPL in direct sunlight without the use of a sun shield.**

Refer to Figure 1 for outline and mounting dimensions.

## TRANSDUCER

**NOTE**: Wiring of transducer cable must be done in conjunction with approved conduit, boxes and fittings and to procedures in accordance with all governing regulations. All transducer cabling must be run in grounded metal conduit for optimum noise immunity. Refer to Figure 4 (ST-50), 5 (ST-100), 6 (LR-21) or 7 (LR-13) for outline and wiring.

1. Mount the transducer above the highest anticipated material level by at least:
   30 cm (1 ft) for ST-50
   90 cm (3 ft) for ST-100 and LR-21
   120 cm (4 ft) for LR-13

2. Install the transducer so that it will have a clear sound path perpendicular to the liquid surface (refer to Figure 10, 11 & 13), or in solids applications (refer to Figures 9, 10 & 12), toward the draw point at the bottom of the bin.

3. To avoid false echoes, install the transducer such that the sound path will not intersect vessel fill spouts, rough vessel walls, ladders etc. In liquid applications, where possible, the transducer should be mounted 0.3 m (1 ft) from the closest vessel wall for every 3 m (10 ft) of depth.

   Example: if the vessel is 10 m deep, the transducer should be mounted at least:
   0.3 m/3 m x 10 m = 1.0 m from the closest vessel wall

## CALIBRATOR

In order to calibrate the AiRanger DPL, a calibrator (which has a magnetic back plate) must be set onto the stainless steel pad in the AiRanger DPL front cover docking recess. It can be removed when operating in the RUN mode.

**NOTE:** Since a calibrator need not be ordered with each unit, check your order if you think that the calibrator is missing.

## TEMPERATURE SENSOR

Refer to Figure 8.

## CURRENT OUTPUT ISOLATOR

The isolator(s) is mounted onto the centre left side of the motherboard using the two long machine screws provided. The two wires provided are then used to interconnect the isolator from its input terminals to the motherboard output terminals, TB-1. Refer to Figures 2 and 3.

Proper shielding and grounding is required in order to minimize noise levels that could otherwise affect weak receiver signals by introducing false echoes.

The isolator enclosure is grounded by the mounting bolts to the motherboard. This can be checked with an ohm meter if a poor connection is suspected.

The isolator output (customer) wiring must be shielded or run in a metal conduit and grounded at ONE END ONLY (preferably at the AiRanger DPL).

## INTERCONNECTION

**NOTE:** All wiring must be done in conjunction with approved conduit, boxes and fittings and to procedures in accordance with all governing regulations. Refer to Figure 2, 3, 3A for wiring of power, analog output, transducer and temperature sensor to the main electronics.

## SYNCHRONIZATION

In applications where more than one AiRanger DPL, up to a maximum of 12, are going to be used or where their transducers will be sharing a common conduit, synchronization is required. When synchronized, no AiRanger DPL will transmit within 600 mSec of another.

To synchronize AiRanger DPL's, set P-35 to 1, interconnect SYNC terminals TB1-14 of all motherboards and ensure that there is a common hydro ground interconnecting all units.

To synchronize AiRanger DPL's with other Milltronics ultrasonic level detection models (e.g. MicroRanger or MultiRanger Plus etc.), consult Milltronics or your distributor.

Refer to Figure 3 for details on synchronization wiring.

## INTERNAL CHECKS

› Ensure a jumper is connected across TB1-6/8 and TB1-7/8 if a temperature sensor is not utilized. Refer to Figure 3.

› Make sure that voltage stab connector, J6, is properly set for either 100, 115, 200 or 230 V AC operation.

› One fuse, 1/4 Amp, must be installed.

› Make power connection. Be sure that wires are securely fastened and to the proper terminals.

**Do not operate with grounding (earthing) wire disconnected.**

› Make sure jumper J5 is set to "NORMAL" pin of TS2 unless "TRIPPER" is desired for tripper car applications. Refer to Applications.

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# START-UP

## GENERAL

The AiRanger DPL has two modes of operation: *run* and *calibrate*. When the unit is powered up, after installation procedures have been completed, it will automatically start-up in the run mode with all parameters at their factory setting. This is the default mode of operation which will display the distance from the transducer face to the target in metres on point 1. It can be reprogrammed, using the calibrator, to display level or volume readings and yield corresponding mA output and alarm/control contacts.

The calibrate mode is selected by pressing the RUN/CAL keypad switch. This mode will enable the user to calibrate the AiRanger DPL to suit his preferences and the particular application to which the AiRanger DPL is to be applied.

**NOTE**: The first step when **initially** calibrating the AiRanger DPL is to reset all parameters to their factory setting by P-99 as described in the Advanced Parameters section.

When the calibration has been completed, the AiRanger DPL can be made to simulate its operation within the particular application giving display, relay control and analog output. Refer to Parameters, P40/42.

Unsatisfactory response in the run mode, after calibrating, may indicate that the transducer aiming requires adjustment (especially in solids applications). Refer to Figures 9 and 10.

## CALIBRATOR KEYPAD

| | |
|---|---|
| "0" - "9" | Calibrate mode: numeric entries<br><br>Run mode: (subject to P-2 & P-8)<br>1 = view reading on point 1 - PT. 1<br>2 = view reading on point 2 - PT. 2<br>3 = alternate viewing of points 1 and 2 - ALT<br>4 = view average of points 1 and 2 - AVG.<br><br>Note: H.TOT, L.TOT, HEAD and FLOW functions are not used on the AiRanger DPL |
| "." | Decimal point entry |
| "-" | Negative entry |
| "CLR" | Clears display when in the calibrate mode |
| "*" | Used to:<br>› initiate parameter display after having entered the calibrate mode<br>› calibrate for percent reading<br>› toggle between points 1 and 2 while in the calibrate mode |
| "RUN/CAL" | Alternates operating modes |
| "MEAS" | Press to make a measurement when in the calibrate mode |
| "↑" | Increments display to show the next parameter |
| "↓" | Decrements display to show the preceding parameter |
| "ALT DSP" | Press to view current parameter or its contents |
| "ENT" | Enters display as contents of selected parameter |

## PARAMETER ENTRY

NOTE: All entries are made via the calibrator keypad. All calibrators are interchangeable, thus any calibrator can be used in conjunction with any AiRanger DPL or MultiRanger Plus. The term "switch" or "key" refers to any keypad switch of the calibrator.

1) Apply power to the AiRanger DPL and place the calibrator in the docking recess in the AiRanger DPL front cover. [run] will be momentarily displayed and then a distance reading will appear. If [LOE] is displayed rather than a continuous numeric reading, consult the Trouble-shooting section.

2) Press the "RUN/CAL" switch

   [CAL] will be displayed

3) press the "* " switch

   [P 1] will appear

   The user may now program the AiRanger DPL.

NOTE: › the [CAL] display will revert to the run mode if "*" is not pressed within one minute of initially pressing the "CAL" switch.

› [P #] is a global parameter which is common to both points, i.e. both points will be programmed at the same time and with the same contents. (Only POINT 1 or POINT 2 LED is on, indicating which point was originally being addressed).

› [P-#] indicates which parameter for point 1 is being accessed. (POINT 1 LED is on).

› [P-#] indicates which parameter for point 2 is being accessed. (POINT 2 LED is on).

› for simplicity, P-# format is used in this manual to identify parameter numbers.

### ENTERING PARAMETERS

With [P-#] displayed, the user may increment or decrement the displayed parameter until the desired parameter is obtained, or access the desired parameter directly by pressing the appropriate numbers on the keypad.

e.g. [P-1] is displayed, P-27 is desired.

Press switches "2" and then "7".

[P-27] will be displayed.

If the wrong switch is depressed, the "CLR" switch can be pressed to clear the parameter display and the desired numbers again selected.

### SELECTING POINT NUMBERS:

Press the "*" to toggle between point 1 and 2. The point being calibrated will be indicated by the POINT # LED on the front cover being illuminated.

**SETTING PARAMETERS**

Once the desired point and parameter have been obtained on the display, press "ALT DSP", this will cause the display to show the contents of the selected parameter. The contents may be changed to a new value or code by pressing the desired numbers and then the "ENT" switch.

e.g. P-1 (units) is displaying a value of 2 (metres),
1* (% feet) is desired...

press "1" and then "*"

[1P] will be displayed

press "ENT"

[1P] will momentarily flash off to indicate that it has been entered.

NOTE: After 1 minute, the contents display will revert to the parameter display if the keypad is not further used. Press "ALT DSP" again if desired to return to display of contents.

**To set the next parameter:**

Press "↑", the next parameter will be displayed momentarily, followed by a display of its contents. The contents may be changed as previously described.

**To directly access a parameter:**

press "ALT DSP",

[P-#] will be displayed

enter desired parameter number

press "ALT DSP", the contents of this parameter are now displayed and may be changed as previously described.

**To reset a parameter to its factory value:**

select the desired parameter

press "ALT DSP", present contents will be displayed

press "CLR", display will go blank

press "ENT", factory setting of selected parameter is displayed and automatically entered.

## DISPLAY MESSAGES

| Display | Message | Comment |
|---|---|---|
| CAL | have entered calibrate mode | appears after pressing "RUN/CAL" switch |
| C.ALL | clear all parameters - return to factory setting | P-99 |
| EEEE | overflow | reading is larger than display capabilities |
| LOE | loss of echo | displayed in run mode to indicate loss of echo |

| Display | Message | Comment |
|---|---|---|
| #P | percent | appears when calibrating units of measurement in percent |
| P# | parameter number | indicates which parameter for point 1 is being displayed |
| P-# | parameter number | indicates which parameter for point 2 is being displayed |
| P- - # | parameter number | indicates which parameter for both points 1 and 2 (global) is being displayed |
| run | have entered run mode | appears after pressing "RUN/CAL" switch |
| ---- | no value | contents of parameter empty or no reading display |

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# FUNCTIONAL

## TRANSCEIVER

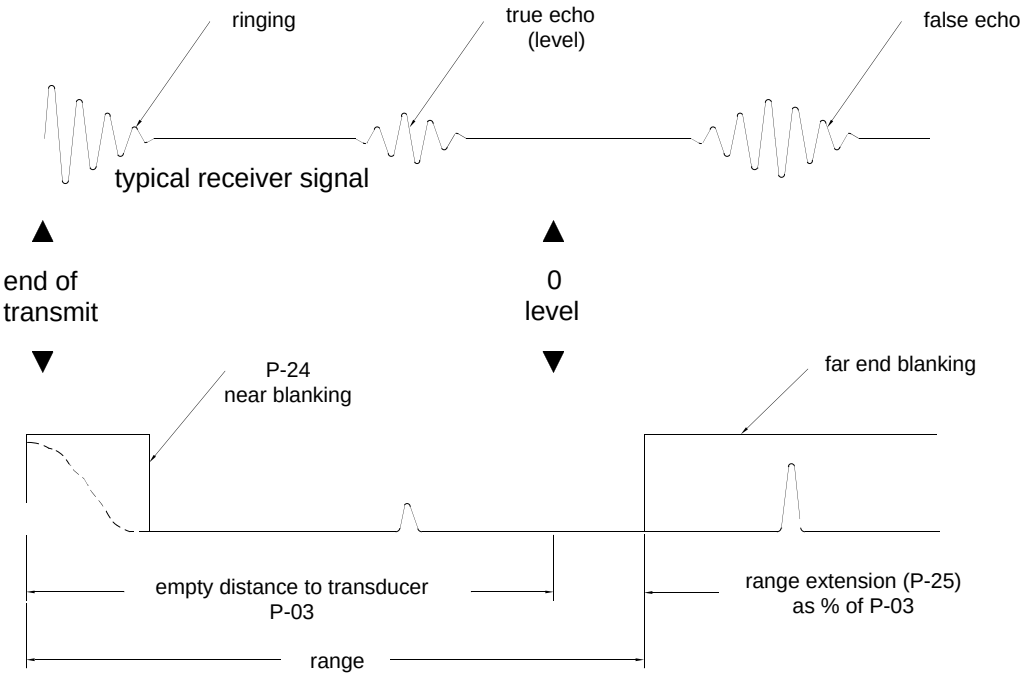
The AiRanger DPL transceiver transmits a combination of short and long pulses in order to perform a measurement. Neon lamp L1 will flash for every pulse that is transmitted. After a pulse sequence has been transmitted, the transmitter pauses while the received echoes are being processed. After processing, the next measurement is initiated. It will be directed to the same point if P-2 is set for single point operation or to the alternate point, if set for dual point operation.

The transceiver section of the AiRanger DPL is located on the motherboard. Transceivers are manufactured for one of three frequencies: 13, 21 or 41.5 KHz. The transceiver operating frequency must match the resonant frequency of the transducer being used.

## BLANKING

Near blanking (P-24) is used to ignore the zone in front of the transducer where ringing or other false echo is at a level that interferes with the processing of the true echo.

Ringing is the inherent nature of the transducer mass to continue vibrating after the transmit pulses have ceased. The amount of ringing varies with the type of transducer used and decays to acceptable levels in the order of milliseconds. Excessive cold or over tightening of the transducer mounting (refer to Figure 11) will increase the ring time such that it may appear as an echo during the receive cycle. This is usually indicated by an incorrect high level reading. This condition may be verified with the use of an oscilloscope (refer to Advanced Parameters\Advanced Calibration\Oscilloscope) and may be overcome by increasing the near blanking.




typical processed signal

Far end blanking is a design function that ignores the zone below the zero or empty level where false echoes may appear at levels that interfere with the processing of the true echo.

In applications where the zero level is above the bottom of the vessel and it is desired to monitor the zone below the normal zero, Range Extension (P-25) may be used to extend the range into the far end blanking. Range

Extension is entered as a percentage of P-3. As Range Extension reduces the protection afforded by the far end blanking, it should be used judiciously. Avoid excessive Range Extension as this may reduce the measurement reliability. Range Extension is factory set for 20% of P-3. If it is found that false echoes are appearing ahead of the far end blanking zone, P-25 should be reduced accordingly.

## TRANSDUCER

The transducer converts the electrical energy of the transmit pulse from the transceiver into acoustical energy and converts the acoustical energy of the echo back into electrical energy for the transceiver receive period.

The effective acoustical energy is generated from the face of the transducer and is radiated outward, decreasing in amplitude at a rate inversely proportional to the square of the distance. Maximum power is radiated axially (perpendicular) from the transducer face in a line referred to as the axis of transmission. Acoustic power is reduced at points off the axis of transmission. Where power is reduced by half (-3 dB) with respect to a point equidistant from the transducer on the axis, a conical boundary is established. The diametric measurement of the cone in degrees defines the beam angle and varies according to the transducer type.

Transducer faces are impedance matched to the medium of transmission (air). This allows the most efficient transfer of power from the transducer into air and from the air back into the transducer.

## DAMPING

The AiRanger DPL provides damping (P-5) to control the maximum rate of change of the displayed material level (mA output and relay control as well). The damping is set in linear units per minute (e.g. if P-1 = 1 and P-5 = 15, then the damping rate is 15 ft/min).

It is often used to slow down the rate of response of the display especially where liquid surfaces are in agitation or material falls into the sound path during filling.

When in the calibrate mode, the damping is automatically overridden to give fast response when "MEAS" is pressed. The response can be further increased by turning the Agitator Discriminator (P-34) off - only if it is not required.

If the transducer aiming is being adjusted while in the run mode, it is suggested that damping be at its factory setting. The damping can later be changed to suit prevailing conditions.

## TEMPERATURE

In order to compensate for uniform temperature variances of the sound medium, the temperature sensor, TS-2, should be used. This will allow the AiRanger DPL to more accurately read the physical distances when the transducer(s) is subjected to temperatures other than 20 ℃.

The AiRanger DPL comes factory set with a jumper across terminals TB1-6/8 & 7/8 to simulate 20 ℃ operation of the transducer(s) on points 1 & 2 respectively. By removing the jumper(s) and installing the TS-2(s) (refer to Figure 3) automatic temperature compensation is achieved.

If a transducer’s ambient temperature is to remain constant, compensation may be calibrated into the AiRanger DPL instead of using the TS-2 (leave the respective jumper in place) by one of the two following methods.

1. › select P-43
   › enter temperature in ℃

2. › select P-29
   › perform an empty calibration

The following temperature functions (in ℃) can be viewed:
(readings will only update during run or if the "MEAS" is pressed)

P-43 air temp. › present temperature at sensor
or
› pre-set temperature, if sensor not used

P-44 max. air temp. › highest temperature encountered during operation

P-45 min. air temp. › lowest temperature encountered during operation

## SOUND VELOCITY

The AiRanger DPL can be calibrated to compensate for transducer operation in homogenous vapours with sound velocities other than that of air.

The basis is to physically measure the level (measuring tape or sight glass) and enter this value via P-29. The AiRanger DPL then calculates the sound velocity by comparing the entered physical measurement to its own ultrasonic measurement.

The velocity displayed (P-27) is always normalized to 20 ℃, so that the actual sound velocity at temperatures other than 20 ℃ is not given. It is also possible to enter a 20 ℃ sound velocity into P-27. Ideally this can be used to save having to repeat empty calibrations on multi-tank applications containing identical atmospheres.

## AGITATOR DISCRIMINATION

In applications where there is an agitator operating in the vessel, the blades may interfere with level readings when the material level is lower than the blades. In such a case, the Agitator Discriminator (P-34) can be turned on (factory setting). With the agitator turned on, the reading will not change unless the echo is closer for at least five consecutive measurements nor will it change unless the echo is farther for at least two consecutive measurements.

This feature allows the AiRanger DPL to remain locked on the true echo, even if there are occasional false echoes due to the agitator blades, electrical noise or crosstalk from other ultrasonic units.

Agitator Discrimination, however, slows down the AiRanger DPL's speed of response. Therefore, if fast response is required, especially when aiming the transducer while in the run mode, and there is no agitator involved, the discriminator should be turned off.

**Agitator discrimination will not work if the blades are stationary and in the transducers beam path.**

## RELAYS

Four on-board alarm/control relays are provided on each AiRanger DPL unit.

The setpoints are always entered in the units as selected in P- 1, referenced from the bottom or zero level. Setpoints can not be entered in percent eg if P-1 = 2P, display is in percent but relay setpoints are entered in meters. The deadband or hysterisis is the difference between the On and Off Setpoints.

If the On Setpoint is higher than the Off Setpoint, the relay will function as a high alarm.

If the On Setpoint is lower than the Off Setpoint, the relay will function as a low alarm.

For relays: LED on = alarm condition = relay coil de-energized.
Complete calibration of a relay requires two steps:

1. Enter the relay On/Off Setpoints.

2. Assign function to relay.

| | RELAY 1 | RELAY 2 | RELAY 3 | RELAY 4 |
|---|---|---|---|---|
| ON | P-10 | P-13 | P-16 | P-19 |
| OFF | P-11 | P-14 | P-17 | P-20 |

In addition to relay function, the alarm can be identified with respect to its On/Off Setpoints as: high-high (HH),

| | PARAMETER ENTRY | | | |
|---|---|---|---|---|
| RELAY FUNCTION | P-12<br>relay 1 | P-15<br>relay 2 | P-18<br>relay 3 | P-21<br>relay 4 |
| off | 0 | 0 | 0 | 0 |
| level on point 1 | 1 | 1 | 1 | 1 |
| level on point 2 | 2 | 2 | 2 | 2 |
| level on point 1 or 2 | 3 | 3 | 3 | 3 |
| temp on point 1 | 4 | 4 | 4 | 4 |
| temp on point 2 | 5 | 5 | 5 | 5 |
| temp on point 1 or 2 | 6 | 6 | 6 | 6 |
| LOE on point 1 | 7 | 7 | 7 | 7 |
| LOE on point 2 | 8 | 8 | 8 | 8 |
| LOE on point 1 or 2 | 9 | 9 | 9 | 9 |

high(H), low (L) or low-low(LL). This optional identification will not appear on the display under alarm conditions during run. However the complete alarm status data will be transmitted to the peripherals via the±20 mA bipolar current loop. Thus, if a Single Point Display or Remote Scanning Monitor is being used, the alarm identification will be displayed. Being that the alarm status data is acknowledged set, the Remote Scanning Monitor will not latch onto an alarmed point nor will it give an audible alarm. Refer to instruction manual PL-274, Peripherals.

Under loss of echo conditions (L.O.E., P-22 & 23), the modes of fail-safe operation may be selected. The following table shows the relay status in the various modes.

Relay operation may be simulated while in the calibrate mode by entering parameter P-40 or 42.

Note that while in the calibrate mode, relays remain active. That is to say, that if the measure key is pressed, the

| | RELAY STATUS | |
|---|---|---|
| MODES OF OPERATION | high alarm | low alarm |
| Fail-safe high | on | off |
| Fail-safe low | off | on |
| Fail-safe hold | hold | hold |

measurement (even if it is not being displayed) may change the relay status.

Thus, if the relay status can affect the plant operation, it may be advisable to override the relay functions during calibration or simulation.

**Keep power disconnected at main breaker when AiRanger DPL cover is opened.**

## ANALOG OUTPUT

An analog output of 0 to 20 mA or 4 to 20 mA on both points or as an average of both points is available via P-9. The following mA output combinations may be obtained.

| point | P-9 combinations | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | 1 | 3 | 3 | 2 | 4 | 4 |
| 2 | 1 | 2 | 3 | 1 | 3 | 4 | 2 | 4 |

where P-9: = 1 - 0-20 mA output
= 2 - 4-20 mA output
= 3 - average 0-20 mA output
= 4 - average 4-20 mA output

The upper and lower levels can be trimmed (P-58 & 59) to suit an external meter.

If the analog output(s) must be isolated, the optional mA isolator(s) model LIs-1 must be mounted on the main board and wired per Figures 2 and 3.

When using the isolator(s), the load adjust can be done via P-58 & 59 rather than via the load adjust potentiometer as mentioned on the isolator instruction sheet.

The current output correlates to applications in the following manner:

| APPLICATIONS | P2 = 1/4<br>LEVEL | P2 = 1/4<br>VOLUME | P2 = 2/5<br>SPACE | P2 = 2/5<br>ULLAGE | P2 = 3<br>TRIPPER CAR |
|---|---|---|---|---|---|
| correlation | material level | volume | distance to material | volume | distance between cars |
| reads 20 mA when | full | full | empty | empty | farthest |

Under loss of echo conditions (L.O.E., P-22 & 23), the analog output will go either high, low, or will hold its prior value depending on the fail-safe mode selected.

The analog output may be simulated while in the calibrate mode by entering parameter P-40/42.

Note that while in the calibrate mode, the analog output remains active. That is to say, that the output level will correspond to measurements taken (even if it is not displayed) by pressing the measure key.

Thus if the analog output can affect the plant operation, it may be advisable to override the output during calibration or simulation.

**Keep power disconnected at main breaker when AiRanger DPL cover is opened.**

■

# APPLICATIONS

This section highlights the most common applications for which the AiRanger DPL can be applied. Other applications not listed here may be akin to those listed or a combination thereof (eg monitoring piston position on a wood pulverizer is in essence a level application).

When calibrating, refer to the application which is most similar to yours. A practical example has been given to further illustrate the calibrating features used for an application. In actual practice, however, the example may not cover all facets of the particular application. Therefore, the user should become familiar with the host of parameters available.

Parameter information can be obtained in the Parameters section or via Appendix III, Parameter and Item Index.

NOTE: The minimum distance from the transducer face to the target is dependent upon the type of transducer being used. Minimum blanking should be limited as follows:

| | |
|---|---|
| ST-50 | 30 cm (1 ft) |
| ST-100 | 90 cm (3 ft) |
| LR-13 | 120 cm (4 ft) |
| LR-21 | 90 cm (3 ft) |

## SIMPLE LEVEL APPLICATION

The most common application of Milltronics ultrasonic level measuring systems is for simple level monitoring, whereby the material level or space measurement is displayed. This may or may not include alarms and mA output.

When in the calibrate mode, alarm relays will remain in their prior state. However, they will respond when the "MEAS" switch is pressed.

**Example 1**

The application is to obtain a level measurement and corresponding 4 - 20 mA output of a 30 ft high vessel. An LR-21 transducer is installed, its face made level to the top of the vessel. The empty level will be at 0 ft (bottom) and the full level will be at 27 ft from the bottom (span). A high alarm is required at 4 ft from the top (26 ft from the bottom) and a low alarm is required at 5 ft from the bottom. The maximum fill/draw rate is 1 ft/min. In the event of a loss of echo, the AiRanger DPL is to go into fail-safe hold after 2 minutes.

perform: P-99
reset all parameters to their factory setting

select: P-1
enter option "1", Units in feet

advance to: P-2
enter option "1", material level on point 1

P-3
enter "30", empty distance to transducer

P-4
enter "27", span

P-5
enter "10", damping rate
minimum 1 ft./min.
Typically, the factory set damping of "10" can be used.

P-7
enter "2", for 2 digits after decimal point

P-8
enter "1", display level point 1 only

P-9
enter option "2", 4 - 20 mA output for point 1 only

P-10
enter "26", relay 1 - alarm ON
(30 ft - 4 ft = 26 ft)

P-11
enter "25.5", relay 1 - alarm OFF
(deadband = 0.5 ft, (arbitrary setting))

P-12
enter option "1", relay 1 - level alarm for point 1

P-13
enter "5", relay 2 - alarm ON

P-14
enter "5.5", relay 2 - alarm OFF

P-15
enter option "1", relay 2 - level alarm for point 1

P-22
enter option "3", fail-safe hold

P-23
enter "2", fail-safe timer - 2 min

P-24
enter "3", near blanking distance, 30 ft - 28 ft = 2 ft

all other parameters are left at their factory setting

press "RUN/CAL" to re-enter run mode

## VOLUME APPLICATION

In addition to simple level applications, volume conversions can be included in the calibration. Volume conversion should be done on liquid materials only.

Volume conversion is provided for seven common tank shapes, (P-30). Dimensions are entered using P-4, 31 and 32. Volume is displayed as 0 - 100% and may be converted to volume units by entering a conversion factor into P-6.

Note that P-4, Span, must equal 100% (full) level of tank.

In many volume applications, the ambient atmosphere is other than air or at a temperature other than 20 ℃. Refer back to Applications Temperature and Sound Velocity for details on compensating for such circumstances. If it is noted that the AiRanger DPL reading is consistently off by a constant amount as compared to the physical

reading, this may be compensated for by P-26. Reading offset might occur when P-3 or 4 do not exactly match the tank dimensions referenced for volume conversion. Refer to Figure 11.

**Example 2**

The application is to measure the volume of glue in a horizontal tank with parabolic ends. The tank manufacturer's specifications state that the total volume is 50 cubic metres.

The maximum fill/draw rate is 0.35 cu m/min. In the event of a loss of echo, the AiRanger DPL is to go into fail-safe high after 30 sec.

NOTE: As the glue gives off formaldehyde vapour, a velocity compensation will be required.

perform: P-99
reset all parameters to their factory setting

select: P-1
enter option "2", Units in metres

advance to: P-2
enter option "1", material level on point 1

P-3
enter "3.5", empty distance to transducer

P-4
enter "3", span (inside diameter of tank)

P-5
enter "10", damping

$$\frac{50 \text{ cu. m}}{0.35 \text{ m/min}} = 143 \text{ min total fill time}$$

$$\frac{3 \text{ m}}{143 \text{ min}} = 0.021 \text{ m/min. average fill rate}$$

However, because of the tank's shape, the top and bottom levels will fill faster than the middle section. Therefore the actual P-5 value should be greater than the average value. Typically, the factory set damping of "10" can be used.

P-6
enter "0.5", convert display (x 0.5)
when volume conversion is being used, the display will automatically show the levels in %. As 100% full = 50 cubic metres, a conversion factor of 0.5 must be entered.

$$\frac{\text{actual volume}}{\text{percentage}} = \text{conversion factor}$$

P-7
enter "1", for 1 digit after the decimal point

P-8
enter "1", display level point 1 only

P-22
enter option "1", fail-safe high

P-23
enter ".5", fail-safe timer, 30 sec.

P-24
enter ".5", near blanking distance, 3.5 m - 3.0 m = 0.5 m

Note: As steps P-28 and P-29 involve physical level measurements, for convenience sake, P-29 can be done before P-28.

P-26 (optional)
record present offset for reference

P-28 (optional)
with the tank as full as permissible, without going into the near blanking zone,

press "MEAS", the AiRanger DPL will take a shot and display the level. Press "MEAS" at least five times and insure that a stable reading is being obtained.

enter the "physical measurement", the AiRanger DPL will now calculate the reading offset to be used in future level measurements. The offset reading will be automatically entered into P-26, and can now be viewed.

P-27
record present sound velocity for reference

P-29
with the tank as empty as permissible and filled with its normal vapour and at its normal temperature (refer to Fig. 11)

press "MEAS", the AiRanger DPL will take a shot and display the level in the units selected, regardless that percent, volume or convert display are used. Press "MEAS" at least five times and insure that a stable reading is being obtained

enter the "physical measurement", the AiRanger DPL will now calculate the correct sound velocity to be used in future level measurements. The new sound velocity will be automatically entered into P-27, and can now be viewed.

P-30
enter option "7", tank shape for volumetric conversion

P-31
enter "0.75", tank dimension A

P-32
enter "5", tank dimension L

all other parameters are left at their factory setting

press "RUN/CAL" to re-enter run mode.

## STANDPIPE MOUNTED TRANSDUCERS

In some solids and liquid applications it may be desirable to mount the transducer on a standpipe to gain access to the vessel.

This practice requires consideration of a number of application variables, with which Milltronics has attained a high level of expertise.

In such cases, consult Milltronics or your distributor prior to selecting a transducer or establishing vessel standpipe specifications.

## TRIPPER CAR APPLICATIONS

The AiRanger DPL can be set-up to provide continuous position monitoring of trippers, stackers, reclaimers, overhead cranes, etc. and provide protection against collision between a stacker and a reclaimer operating on the same track.

Two transducers working in conjunction with one AiRanger DPL are required for such applications. One transducer is dedicated as the transmitter and the other is dedicated as the receiver.

In tripper car applications, the transmitting transducer is generally mounted on the moving tripper car and the receiving transducer is mounted at a fixed point at either end of the gallery. In stacker/reclaimer applications, either transducer is mounted on the stacker and the other transducer is mounted on the reclaimer.

To assure optimum system performance, the transducers should be mounted such that they are both horizontally and laterally in line, facing one another. The sound path between the two transducers should be unobstructed.

The minimum and maximum distances between transducers are:

| TRANSDUCER TYPE | MINIMUM DISTANCE | MAXIMUM DISTANCE |
|---|---|---|
| ST-50 | 30 cm (1 ft) | 30 m (100 ft) |
| ST-100 | 90 cm (3 ft) | 75 m (250 ft) |
| LR-21 | 90 cm (3 ft) | 75 m (250 ft) |
| LR-13 | 120 cm (4 ft) | 122 m (400 ft) |

The Milltronics Easy Aimer (Figure 9) can be used for mounting ST-50 transducers but is not recommended for horizontal mounting of either the LR-13 or the LR-21 transducers. The vertical forces could break the 1" NPT mounting connection of the aluminum housing. Transducers should not be mounted directly to metal. The use of wood, foam, plastic or fiberglass for mounting or isolation is preferred, as these materials do not promote excessive ringing of the transducer.

The transmitting transducer cable can be Belden 8760 (or equivalent) up to a maximum of 180 m (600 ft) or RG-62U coaxial cable up to 360 m (1200 ft) from the AiRanger DPL. The transmitting transducer cable can be run with the umbilical or steel cable usually associated with the tripper car.

The receiving transducer cable should be RG-62U and must be run in a separate grounded metal conduit. The maximum distance from the AiRanger DPL is 360 m (1200 ft).

In order to set the AiRanger DPL for tripper car or similar applications:

1. Set jumper J5 to TRIPPER pin of TS2.

**Keep power disconnected at main breaker when AiRanger DPL cover is opened.**

2. Set parameter P-2 to 3, tripper car distance.

3. Parameter P-3 is the maximum distance between transducers. The transmitter face at this point is the zero reference.

4. Parameter P-4, span, is the maximum travel of the transmitting transducer (tripper car).

5. Point 1 transducer (TB1-10/11) is the transmitter.

6. Point 2 transducer (TB1-12/13) is the receiver.

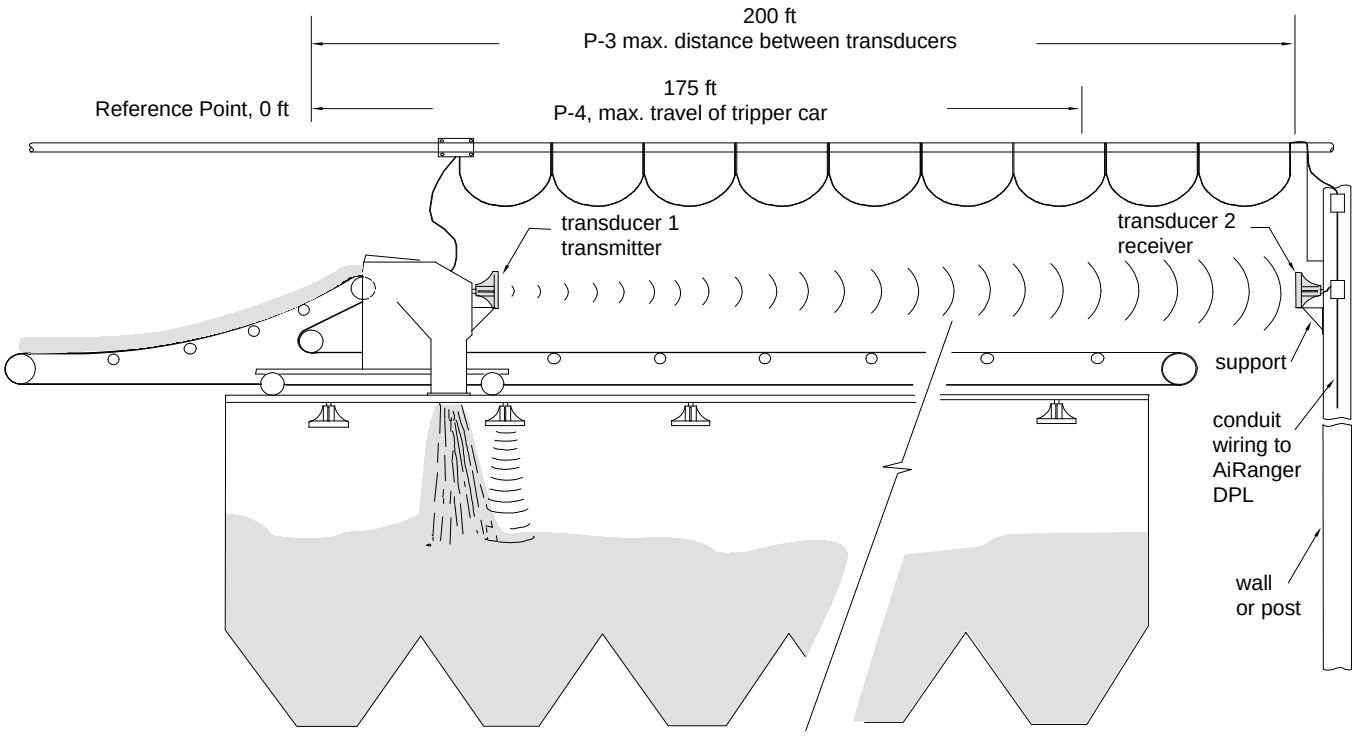
7. Relay setpoints are zero referenced to the face of the transmitting transducer at maximum distance between transducers.

8. Set relay function parameters P-12, 15 & 18 to 1.

9. If temperature compensation is required, refer to Functional\Temperature, programming or temperature sensor connection applies to point 1 only.

**Example 3**

The application is to monitor the position of a tripper car. One LR-21 transducer is wall mounted as the receiver and the other LR-21 transducer is mounted on the tripper car as the transmitter. Although the maximum distance between transducers is 200 feet, the maximum travel of the tripper car is 175 feet. A 4-20 mA output signal is required. No alarms are required, however in the event of a loss of echo, the AiRanger DPL is to go into fail-safe hold after 1 minute. The maximum speed of the tripper car is 7 ft/min.




set: J5 to "TRIPPER"

perform: P-99
reset all parameters to their factory setting

select: P-1
enter option "1", units in feet

advance to: P-2
enter option "3", tripper car distance

P-3
enter "200", maximum distance between transducers

P-4
enter "175", span

P-5
enter "10", damping rate
minimum 7 ft/min
Typically, the factory set damping of "10" can be used

P-7
enter 0, for 0 digits after decimal point

P-8
enter "1", display distance

P-9
enter option "2", 4-20 mA output

P-22
enter option "3", fail-safe hold

P-23
enter "1", fail-safe timer - 1 min.

all other parameters are left at their factory setting

press "RUN/CAL" to re-enter run mode

■

# TROUBLE-SHOOTING

## GENERAL

There are numerous adjustments for echo processing and they should be used judiciously. Transducer location and aiming are the most important factors affecting the reliability of the AiRanger DPL. Location and aiming may be optimized by observing P-37 while the "MEAS" switch is pressed. Otherwise, refer to Advanced Calibration P-60 - 99.

The following is a list of operating symptoms, their probable cause and action to be taken.

| SYMPTOM | CAUSE | ACTION |
|---|---|---|
| Loss Of Echo (LOE) | | |
| 1) neon L1 will flash but no pulsing will be felt on transducer face | › open circuit | › check transducer wiring<br>› check P-37 |
| | › defective transducer or AiRanger DPL board | › check temp<br>› try a substitute |
| neon L1 will be continuously off and no pulsing will be felt on transducer face | › short circuit wiring | › check transducer<br>› check P-37 |
| | › defective transducer or AiRanger DPL board | › check temp<br>› try a substitute |
| 2) improper wiring | | › refer to Fig. 2-7 |
| 3) level or target out of range | | › check transducer specifications<br>› recalibrate to suit AiRanger DPL |
| 4) application too dusty or steamy | › under these conditions range may be adversely affected | › re-aim transducer Refer to Installation \ Transducer & Fig. 9-11<br>› use polyethylene foam faced transducer for dusty applications DO NOT USE ON WET APPLICATIONS |
| | › if condition occurs only during filling | › increase fail-safe timer, P-23 |
| 5) transducer face covered | › sludge or suds build-up on transducer face | › clean<br>› move transducer to better location<br>› mount in standpipe |

| | | |
|---|---|---|
| 6) transducer location or aiming | › poor installation | › re-locate or re-aim transducer for max echo confidence, P-37 |
| | › moved by material or vibration | |
| | › flanging not level | › refer to Installation \ Transducer & Fig. 9-11 |
| 7) transducer malfunction | › temp. too high or low | › check P-43, 44 & 45 |
| Reading Does Not Change, But Level Does | › AiRanger DPL processing wrong echo, i.e. vessel wall, structural member, stationary agitator, material hang-up or rat-tailing | › re-aim transducer Refer to Installation \ Transducer & Fig. 9-11 |
| | › transducer ringing, reading high level | › transducer must not be in contact with metal<br>› mounting need only be hand tight. Refer to Fig. 9-11 |
| Reading Consistently Off By Constant Amount | › reading offset | › refer to P-26 & 28 & eg 2 |
| Reading Error Progressively Worsens With Distance | › temp. compensation | › install temp. sensor, refer to Fig.8 |
| | › sound velocity compensation | › P-27 & 29, eg 2 |
| Display Blank, Neon L1 Not Flashing | › loss of power | › check power wiring jumpers & fuse. Refer to Fig. 2 |
| Display Will Not Respond To Calibrator (test per P-53) | › calibrator improperly positioned | › refer to Installation \ Calibrator |
| | › check battery | › replace at least once a year |
| | › infra-red window obstructed | › clean |

| | | |
|---|---|---|
| Reading Erratic | › echo confidence weak | › for erroneous readings appearing within 1 m from the transducer:<br>› increase # of short pulses (P-74)<br>› increase short pulse threshold (P-70) Note, # of long pulses must be at least 1<br>› for erroneous readings appearing beyond 1m from the transducer:<br>› increase # of long pulses (P-75)<br>› refer to Advance Parameters, P-60 - 99 |
| | › liquid surface agitated | › increase damping, P-5<br>› turn on fuzz filter P-33 |
| | › material filling | › relocate transducer<br>› increase damping, P-5 |
| Reading ‘EEEE‘ | › electrical noise | › transducer cable must be in grounded metal conduit, Refer to Installation \ Transducer Fig. 9-11.<br>› increase damping P-5 |
| | › agitator blades | › turn agitator on P-34 |
| | › reading to large | › re-calibrate, ie P-3, 4, 12, 13, 32 & 33 |
| Reading Response | › damping too high | › decrease P-5 Slow |
| | › fuzz filter on | › turn off P-33 |
| | › agitator on | › turn off P-34 |

# PARAMETERS

## PARAMETERS 1 - 59

NOTE:
- (F) indicates parameter factory setting, where applicable. For reference only - factory set values may change with software revisions
- (G) indicates a global parameter, i.e. parameter contents and calibration is common to both points
- (V) indicates parameter can be viewed only, not entered
- (!) in some cases, changing one parameter may cause another parameter to change:
  - parameter 1 will cause parameters 3, 4, 5, 10, 11, 13, 14, 16, 17, 19, 20, 26, 27, 28, 29, 31, 32, 40, 41, 42 to change also
- if parameter 69 is set to other than 0000, then entering echo processing parameters 24, 70, 71, 72, 76, 77, 78, 80, 81, 82, 83 or 84 will cause the stored echo to be reprocessed

P-1 (G) Units of calibration and display

| | |
|---|---|
| enter 1 = feet | 1* = calibrate in feet, display in % |
| 2 = metres (F) | 2* = calibrate in metres, display in % |
| 3 = inches | 3* = calibrate in inches, display in % |
| 4 = centimetres | 4* = calibrate in centimetres, display in % |

**NOTE**: For % display, entry must be made as "# * " and will be displayed as [# P].

eg: press keypad switches "3" and then "* ",
display will appear as [3P]

P-2 (G) Mode of Measurement

enter 1 = material level on point 1
2 = space measurement on point 1 (F)
3 = tripper car distance
4 = material level on points 1 and 2
5 = space measurement on points 1 and 2
6 = material on point 1 and space on point 2
7 = space on point 1 and material on point 2

P-3 Empty Distance

enter desired amount, (F=10)

P-4 Span

- distance between full (high) and empty (low) levels
- max distance of tripper car from receiver transducer

enter desired amount, (F=10)

P-5 Damping Rate

is the maximum rate of change of material level, measured in units selected per minute. The range is 0.001 to 9999. Thus the smaller the number entered, the greater the damping.

enter desired amount, (F= 10)

P-6 Convert Display

enter factor by which measurement is to be multiplied by before being displayed.
Range is 0.001 to 9999. (F=1)

P-7 (G) Decimal Point Location

enter 0 = no digits after decimal
1 = one digit after decimal
2 = two digits after decimal (F)
3 = three digits after decimal

P-8 (G) Display

enter 0 = hold last display option selected (when in the run mode, numbers 1, 2, 3 & 4 can be pressed to view the corresponding display options, same as below). (F)
1 = display point 1
2 = display point 2
3 = alternate display between points 1 and 2
4 = display average of points 1 and 2

P-9 Analog Output

enter 1 = 0 to 20 mA
2 = 4 to 20 mA (F)
3 = 0 to 20 mA, average of points 1 and 2
4 = 4 to 20 mA, average of points 1 and 2

P-10/11 Relay 1 - On/Off Setpoints

enter level in units as selected in P-1 or temperature in ℃ (F=----)

P-12 Relay 1 - Function

enter 0 = off
1 = level on point 1 (F=-- 1)
2 = level on point 2
3 = level on point 1 or 2
4 = temp on point 1
5 = temp on point 2
6 = temp on point 1 or 2
7 = LOE on point 1
8 = LOE on point 2
9 = LOE on point 1 or 2

optional identification: after selecting function code (0- 9), but before pressing "ENT", press "*" to scroll through:
LL = low-low alarm
L = low alarm
H = high alarm
HH = high-high alarm
stop at the desired identification and press "ENT"

P-13/14 Relay 2 - On/Off Setpoints

enter level in units as selected in P-1 or temperature in ℃. (F=----)

P-15 Relay 2 - Function
enter 0 = off
1 = level on point 1 (F=-- 1)
2 = level on point 2
3 = level on point 1 or 2
4 = temp on point 1
5 = temp on point 2

6 = temp on point 1 or 2
7 = LOE on point 1
8 = LOE on point 2
9 = LOE on point 1 or 2

optional identification: after selecting function code (0-9), but before pressing "ENT", press "*" to scroll through:
LL = low-low alarm
L = low alarm
H = high alarm
HH = high-high alarm stop at the desired identification and press "ENT"

P-16/17 Relay 3 - On/Off Setpoints

enter level in units as selected in P-1 or temperature in °C. (F=---)

P-18 Relay 3 - Function

enter 0 = off
1 = level on point 1
2 = level on point 2 (F=-- 2)
3 = level on point 1 or 2
4 = temp on point 1
5 = temp on point 2
6 = temp on point 1 or 2
7 = LOE on point 1
8 = LOE on point 2
9 = LOE on point 1 or 2

optional identification: after selecting function code (0- 9), but before pressing "ENT", press "* " to scroll through:
LL = low-low alarm
L = low alarm
H = high alarm
HH = high-high alarm stop at the desired identification and press "ENT"

P-19/20 Relay 4 - On/Off Setpoints

enter level in units as selected in P-1 or temperature in °C. (F=---)

P-21 Relay 4 - Function

enter 0 = off
1= level on point 1
2 = level on point 2 (F=-- 2)
3 = level on point 1 or 2
4 = temp on point 1
5 = temp on point 2
6 = temp on point 1 or 2
7 = LOE on point 1
8 = LOE on point 2
9 = LOE on point 1 or 2

optional identification: after selecting function code (0- 9), but before pressing "ENT", press "* " to scroll through:
LL = low-low alarm
L = low alarm
H = high alarm
HH = high-high alarm stop at the desired identification and press "ENT"

P-22 Fail-Safe Mode

in the event of a loss of echo, the AiRanger DPL will flash [LOE] and go into one of the following modes after the timer has run out
enter 1 = high, reading and output go to high at the rate of damping
2 = low, reading and output go to low at the rate of damping
3 = hold last entry (F)

Upon return of echo, the reading and output will return immediately to the current level. If the loss of echo is due to an open or short in the transducer circuit, the damping rate will be by-passed for quicker response.

P-23 Fail-Safe Timer

the amount of time delay before going into fail-safe mode. Range is 0.001 to 9999. (F= 2.000)
enter "desired amount of time", in minutes.

eg: for 30 sec time delay, enter "0.5"

P-24 Near Blanking

enter distance required, in units as set in P-1. Note that entry must be slightly larger than distance to end of standpipe or to far side of obstruction.
(F=0.300 @ 41.5 KHz, 0.900 @ 21 KHz or 1.200 @ 13 KHz)

| | minimum recommended blanking |
|---|---|
| ST-50 | 30 cm (1 ft) |
| ST-100 | 90 cm (3 ft) |
| LR-13 | 120 cm (4 ft) |
| LR-21 | 90 cm (3 ft) |

P-25 Range Extension

enter, as percent of P-3, distance below 0 not blanked. (F= 20)

P-26 Measurement Offset

this displays the reading offset; used in conjunction with a full tank calibration, P-28, or an offset value may be entered directly. (F=0.000)

P-27 Sound Velocity

this displays the sound velocity normalized to 20 ℃. Used in conjunction with an empty tank calibration, P-29, or the sound velocity at 20 ℃ may be entered directly if known. (F= 344.1)

if P-1 is set for feet or inches the velocity is in ft/sec

if P-1 is set for metres or centimetres the velocity is in metres/sec

P-28 Full Calibration

this provides measurement offset compensation on a full tank. Measurement offset might occur when parameters 3 and 4 do not exactly match the tank dimensions referenced for volume conversion. (F= ----)

fill tank as much as permissible, but without going into the blanking zone

press "MEAS", the AiRanger DPL will take a shot and display the level in the linear units chosen regardless if percent, volume or convert display is used. Press "MEAS" at least five times and insure that a stable reading is being obtained.

enter the actual physical measurement or level

press "ENT". The AiRanger DPL will now calculate the correct reading offset to be used in future measurements and automatically enter it into P-26.

P-29 Empty Calibration

this provides sound velocity compensation on an empty tank. This is required on a volume application where the atmosphere in the tank is other than air or the atmospheric temperature is constant but other than 20 ℃ and no temperature sensor is being used. (F=----)

empty tank as much as permissible. Leave filled with normal vapour and at normal operating temperature. Refer to Figure 11.

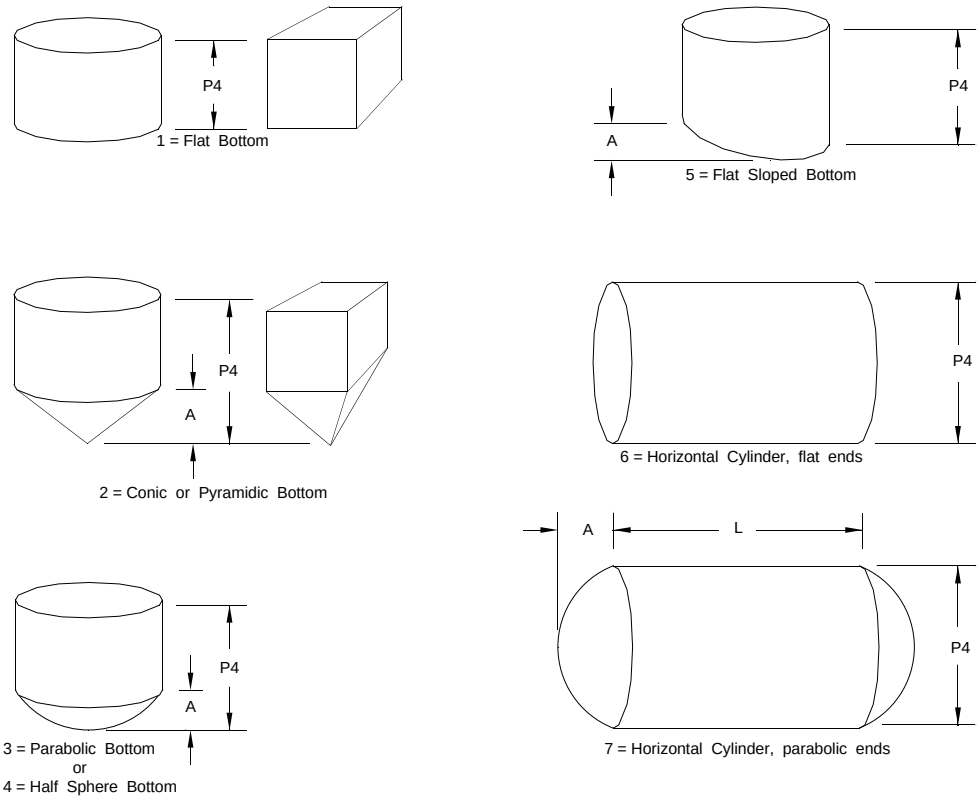
press "MEAS", the AiRanger DPL will take a shot and display the level in the linear units chosen regardless if percent, volume or convert display is used. Press "MEAS" at least five times and insure that a stable reading is being obtained.

enter the actual physical measurement or level

press "ENT". The AiRanger DPL will now calculate the correct sound velocity to be used in future measurements and automatically enter it into P-27.

P-30 Tank Shape for volumetric conversion

enter 0 = non volume - linear level measurement (F)
1 = flat bottom
2 = conic or pyramidic bottom
3 = parabolic bottom
4 = half spheric bottom
5 = flat slope bottom
6 = horizontal cylinder, flat ends
7 = horizontal cylinder, parabolic ends



P-31 Tank Dimension A

the height of the bottom section of tank shapes 2, 3, 4, 5 or the length of one end section in tank shape 7 (not required for other tank shapes). (F= 0.000)

enter "dimension", in units selected per P-1

P-32 Tank Dimension L

horizontal length of tank shape 7 excluding parabolic ends (not required for other tank shapes). (F=0.000)

enter "dimension", in units selected per P-1

P-33 Fuzz Filter

the fuzz filter is designed to keep the display constant when minor changes on the liquid surface (ripples), electrical noise or air movements in the vessel are occurring.

enter 0 = off
1 = on (F)

P-34 Agitator Discrimination

enter 0 = off
1 = on (F)

P-35 (G) Synchronization

used in conjunction with interconnection of all TB1-14 terminals of AiRanger DPL's to be synchronized

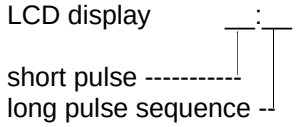
enter 0 = sync off (F)
1 = sync on

P-36 ASCII Transmitter

enter 0 = transmitter off
1 = transmitter on (F)

P-37 (V) Echo Confidence

a measure of echo reliability. Press "MEAS". An ultrasonic measurement will be taken and the echo confidence updated. This feature is useful when aiming the transducer.




display: ## = display of confidence in dB
-- = no short or long pulse(s) transmitted
E = pulse(s) transmitted, but no echo - check for faulty transducer or wiring

P-40/42 Reading/Simulation

Selecting P-40 displays the level, of material or space as calibrated by P-2, in the units of the overall calibration: linear, %, volume, etc.

Selecting P-42 displays the level of material only, in the units as calibrated by P-1. As such, P-42 is more useful for checking relay operation as setpoints are always entered in terms of material level.

Under simulation, the analog output responds as if in the run mode.

reading: press "MEAS"

AiRanger DPL will perform a measurement and display reading

OR

simulation: press "ENT"

this will initiate the simulated rise and fall of the material level through its calibrated span, P-4, at the rate of 1% of the span per second.

The display will read as follows:

| APPLICATION | DISPLAY | |
|---|---|---|
| | P-40 display units (eg ft, %, gal) | P-42 cal. units (ft/m/in/cm) |
| P-2 = 1/4 | material | material |
| P-2 = 2/5 | space | material |

Pressing the "↑" key during simulation causes the apparent level to rise. Holding the "↑" key in, increases the rate of filling. Pressing the "↓" key causes the level to fall. Holding the "↓" key in increases the rate of emptying.

Alarm/control relays and mA output are all enabled during simulation to allow full response of the AiRanger DPL. However, as damping and filtering are not required, they are bypassed.

Thus if the analog or relay status can affect the plant operation, it may be advisable to override the output during calibration or simulation.

**Keep power disconnected at main breaker when AiRanger DPL cover is opened.**

To end the simulation program press "ALT DSP" twice.

P-41 Average Reading of points 1 and 2

P-43 Air Temperature in ℃, as measured by temperature sensor

or

preset transducer operating temperature, if sensor not used

enter temperature required in ℃ (F=20 ℃)

P-44 (V) Maximum Air Temperature in ℃, as measured by temperature sensor records max temp encountered (F= – 50 ℃)

press "CLR" then "ENT" to reset

P-45 (V) Minimum Air Temperature in ℃, as measured by temperature sensor records the min air temp. encountered (F=150 ℃)
press "CLR" then "ENT" to reset

P-50 (V) Software Revision Number

P-51 (V) Memory Test

press "ENT"
display will momentarily go blank and then show either:
[PASS] - memory is intact
[1] - RAM failure
[2] - EPROM failure or
[3] - EEPROM failure

P-52 (V) LCD, LED and Relay Test

press "ENT": - all LCD segments should flash
- all relays should turn on and off sequentially
- all LED's should flash sequentially
- press any key to stop

P-53 (V) Calibrator Test

press "ENT"
then press each key from left to right starting with the top row.

The display will acknowledge each switch pressed in the following manner:

| KEY | DISPLAY | KEY | DISPLAY |
|---|---|---|---|
| 1 | 1 | " | 10 |
| 2 | 2 | - | 11 |
| 3 | 3 | C | 12 |
| 4 | 4 | * | 13 |
| 5 | 5 | RUN | 14 |
| 6 | 6 | MEAS | 15 |
| 7 | 7 | ARROW UP | 16 |
| 8 | 8 | ARROW DOWN | 17 |
| 9 | 9 | ALT | 18 |
| 0 | 0 | ENT | PASS |

if any switch is pushed out of sequence or malfunctions, the display will show [FAIL]

P-54 (V) Watchdog Reset Test

press "ENT"
hyphens will flash for 5 seconds or less and then place the AiRanger DPL into the run mode. Should the test fail, the AiRanger DPL will not go back into the run mode.

P-55 (V) Transmitter Test

press "ENT"
the transmitter will fire at a regular rate and the transmit neon Ll will flash correspondingly. With an oscilloscope connected to J1A (signal), J2 (ground) and J4 (ext. trig) the echo profile may be viewed. Press any switch to stop.

P-56 (V) Temperature Sensor resistance in K ohms

P-57 mA Output Test

enter value and AiRanger DPL will output corresponding mA value. Range is 0 to 20.

P-58 Trim For 4 mA

when this parameter is selected, the mA output goes to 4 mA. The display however, will show a typical value of 200. By increasing or decreasing this value the mA output can be slightly varied to make an external meter read 4 mA.

e.g.: "P-58" is selected
[200] is displayed
external meter reads 3.8
enter "202" or increase by pressing ".", meter reads 3.9
enter "205", meter reads 4.0

P-59 Trim For 20 mA

when this parameter is selected, the mA output goes to 20 mA. The display, however, will show a typical value of 3450. By increasing or decreasing this value the mA output can be slightly varied to make an external meter read 20 mA.

e.g.: "P-59" is selected
[3480] is displayed
external meter reads 20.1
enter "3465" or decrease by pressing "-", meter reads 20

■

# ADVANCED PARAMETERS

## PARAMETER DESCRIPTION

**Parameters 60 through 99 are segregated for Advanced Calibration.**

**Advanced Calibration should only be attempted after consulting the Trouble-Shooting section. Thus, all the basic checks such as: wiring, transducer aiming, parameter entry and simulation have been double-checked.**

**The use of an oscilloscope is required to effectively use most Advanced Parameters.**

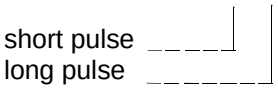
**When performing an Advanced Calibration, work with one parameter at a time. If no improvement is obtained, clear that parameter to reset it to its factory setting and try another applicable parameter.**

**Avoid altering more than one parameter at a time without noting its effect.**

P-60 (V) Echo Confidence

a measure of echo reliability. Press "MEAS". An ultrasonic measurement will be taken and the echo confidence updated. This feature is useful when aiming the transducer.

LCD display __:__




display: ## = display of confidence in dB
-- = no short or long pulse(s) transmitted
E = pulse(s) transmitted, but no echo - check for faulty transducer or wiring

P-61 (V) Echo Strength, in dB above 1 uV

P-62 (V) Average Receiver Signal, in dB above 1 uV

P-63 (V) Peak Receiver Signal, in dB above 1 uV

P-64 (V) Echo Time, in mSec

**NOTE:** to use pointer parameters P-65, 66 & 67, the window display of P-69 must be on. The window becomes a pointer for these parameters and may be moved along the echo profile.

P-65 (V) Pointer Time, in mSec

press "ALT DSP"
press "." to move pointer to the left, press "-" to move pointer to the right or enter desired time in mSec. (F=0.000)

P-66 (V) Pointer Distance

press "ALT DSP"
press "." to move pointer to the left, press "-" to move pointer to the right or enter desired distance in units as selected in P-1. (F=0.000)

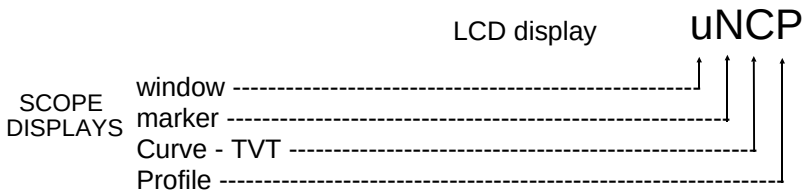
P-67 (V) Pointer Level, in dB above 1 uV

press "ALT DSP"
press "." to move pointer to the left or press "-" to move pointer to the right
press "ENT"
display will show echo strength at pointer

P-68 Dead Zone, adjust for scope trigger

allows scope triggering to be optimized by adjusting the amount of dead time between scope displays. Decrease parameter contents value for brighter scope display or increase value for better triggering. (F=5)

P-69 Scope Displays




select any combination of scope displays
0 = scope display off (display [ _ ]) (F= _ _ _ _)
1 = scope display on (display [ u, N, C and/or P] )
press "ENT"

e.g. to display the marker and the curve on the oscilloscope:
press "ALT DSP"
enter "0110"
press "ENT"
display will show [_nC_]

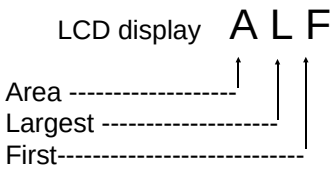
P-70 Confidence Threshold, for Short Pulses

minimum echo confidence in dB for echoes resulting from a short transmit pulse. Typical usage; if transducer were picking up small unwanted echoes from close in, increase threshold to a value above that of the echo confidence (P-60) so that close in echoes are no longer detectable. (F=10)

P-71 Confidence Threshold, for Long Pulses

minimum echo confidence in dB for echoes resulting from a long transmit pulse. Typical usage; during filling of vessel, material intersects beam path. Instead of displaying wrong level, increasing threshold to a value above that of the echo confidence (P-60) will force the AiRanger DPL into fail-safe. (F=5)

P-72 Echo Processing Algorithms, for Long Pulses
(note: for short pulses, a fixed algorithm is automatically selected)




select any combination of the A, L or F echo processing algorithms
0 = algorithm off (display [ _ ])
1 = algorithm on (display [ A ] and/or [ L ] and/or [ F ]) (F= ALF)
press "ENT"

eg to process by largest echo only:
press "ALT DSP"
enter "010"
press "ENT"
display will show [_L_]

For high speed echo processing, useful in special applications such as tripper car or hydro wire detection, the high speed H algorithm is included.

**The H algorithm should never be used on bulk solids or liquid applications.**

enter "1000"
display will show [H _ _ _]

The H algorithm will select the first echo with a long pulse confidence (P-60) greater than or equal to the threshold as set by P-71. If P-71 is set too low, false early echoes may be detected. In such an event, increase P-71, but not to such an extent that it is greater than the confidence of the true echo.

To obtain maximum speed, any combination of the following parameters must be manually reset as indicated. The more parameters that have been reset, the higher the processing speed will be.

| | |
|---|---|
| P-25 = 0 | Range Extension |
| P-34 = 0 | Agitator Discriminator off |
| P-35 = 0 | Synchronization off |
| P-36 = 0 | ASCII transmitter off |
| P-72 = 1000 | High algorithm |
| P-74 = 0 | no short pulses |
| P-75 = 1 | 1 long pulse |
| P-76 = 0 | Spike Filter off |
| P-77 = 0 | Narrow Echo Filter off |
| P-78 = 0 | Reform Echo off |

P-73 Transmit Frequency

tunes the transmit oscillator. Typical usages are to optimize echo strength or to minimize transducer ringing. (F= 43.48, 21.98 or 12.99)

press "." to increase frequency or
"-" to decrease frequency
press "ENT" to enter displayed frequency

P-74 Number of Short Pulses

enter the number of short pulses per measurement to be used (F= 1)

P-75 Number of Long Pulses

enter the number of long pulses per measurement to be used (F= 5)

Parameters 76 through 84 are not used on short pulses

P-76 Spike Filter

used typically to remove spikes due to electrical noise.
enter 0 = off
1 = on (F)

P-77 Narrow Echo Filter

range 0 to 7. Used typically in solids applications where true echoes are wide but where there may be some narrow unwanted echoes from seams on the bin wall. A parameter value of 0 turns the filter off; increasing the value filters out a correspondingly wider echo. (F= 0)

P-78 Reform Echo

typical range is 0 to 100. Rejoins peaks to enhance echo profile. Typically 0 (off) is used for liquids, medium values are used for fine solids with smooth angle of repose and high values are used for jagged, coarse solids. (F= 0 @ 41.5 KHz or 5 @ 21 & 13 KHz)

P-80 TVT Curve

enter 1 = full linear (F)
2 = semi-linear
3 = smooth

P-81 Shaper, TVT curve

shaping of the TVT curve is done with a pointer. The window and curve display of P-69 must be on. The window becomes a pointer for this parameter and may be moved along the curve. Press the "." key to move the pointer to the left or press the "–" key to move the pointer to the right. The reading display will give the Shaper Quotient value of the curve segment pointed to. The factory set S.Q. is normalized to a value of 100 regardless of the segments level within the curve. As the curve is divided into 40 segments, the shape of the curve may be modified by entering the desired S.Q. for the segment being pointed to. The S.Q. of any or all of these segments may be modified. Any subsequent echo processing will generate a curve biased to the S.Q. of the individual segments.

To reset the S.Q. value of a segment to the factory setting, move the pointer to the desired segment and press the "CLR" and then the "ENT" keys. Repeat this procedure for each segment to be reset (F=100).

P-82 Minimum Start, intersect for linear TVT curves (F= –30)

P-83 Slope, for minimum intersect (F=1000)

P-84 Minimum Slope, for linear TVT curves, dB/sec (F= 200)

P-99 Reset

press "CLR"
display will go blank
press "ENT"
[C.ALL] will appear momentarily
[----] will be displayed
all parameters are now in their factory setting.

## ADVANCED CALIBRATION

### OSCILLOSCOPE

An oscilloscope can be used to view the transmit, receive and processed echo signals.

Connect as follows:

| oscilloscope | location | description |
|---|---|---|
| probe | J1A, RCV'R, board A | amplified receiver signal |
| | J3, SCOPE, board A | processed echo |
| | TB1-10, board B | point 1 raw transmit/receive signal |
| | TB1-12, board B | point 2 raw transmit/receive signal |
| ground | J2, COM, board A | ground |
| external trigger | J4, SYNC, board A | |

The transmit and receive signals are best viewed while in the run mode or with P-55, transmitter test, set to fire automatically in the calibrate mode. This may be useful when aiming the transducer to obtain the best echo.

The processed echo can be viewed and updated by pressing "MEAS". This must be done while in the calibrate mode, but can be done while viewing any parameter. For example, echo analysis parameters 60-69, echo processing parameters 70-78 or curve control parameters 80-84 can be viewed or changed while monitoring results on both the AiRanger DPL display and on the oscilloscope.

The processed echo display (P-69) can be made to show not only the processed echo profile, but also the:

- echo marker
- window
- TVT curve or auxiliary window

Typical scope settings for viewing the processed echo are:

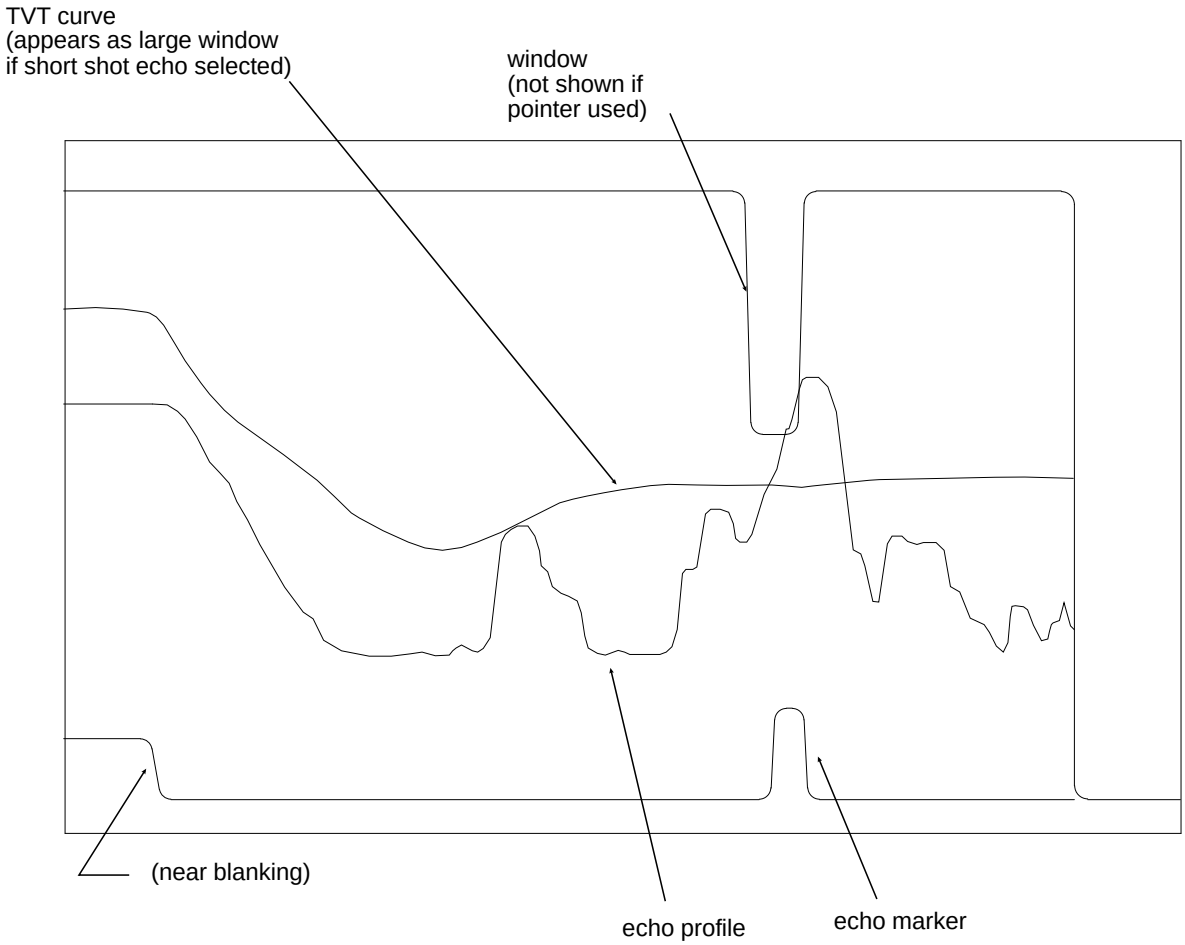
gain - 1 v/div
sweep - 1 msec/div

**Note:**

- the following is restricted to transmission in air at 20 ℃.
- to obtain a time measurement of the processed echo, the sweep time must be multiplied by a factor of 20.
- to obtain a time measurement of the transmit or receive signal, use the actual sweep setting.
- to obtain a distance measurement of either of the above types of echoes, divide the respective time measurement by 1.8 msec/ft. or 5.9 msec/m.

The pointer can be used in analyzing the echo profile. For example if a false echo is appearing in the profile, the pointer can be moved to point at the echo and its distance from the transducer displayed. This can be useful in identifying the source of the echo. Refer to Parameters section, P-65, P-66 and P-67.

**Typical Scope Display**




The processed echo is displayed at 20 times the oscilloscope sweep time; thus accounting for the time obtained by use of the pointer (P-65).

■

# MAINTENANCE

The AiRanger DPL requires no maintenance, except that the calibrator battery should be replaced yearly.

If the AiRanger DPL is mounted in a dusty or oily environment, make sure that the calibrator and front cover is kept clean, otherwise it may impede the signal transmission.

It is also a good idea to periodically check the face of the transducer. It should be free of material build-up or corrosion.

## SPARE PARTS

The following list indicates the AiRanger DPL components which may be ordered as a spare part. The *item no.* refers to the number which may appear silk screened or otherwise attached to the AiRanger DPL component. The *order no.* refers to the number which should be stated on the purchase order.

For mother/daughter board, transducer, and/or temperature sensor ordering information please contact

| DESCRIPTION | ITEM NO. | ORDER NO. |
|---|---|---|
| Display, LCD II | 51014382 | 51014381 |
| Calibrator | 51017261<br>51023811<br>83000004 | 51023811 |
| Isolator (optional) | 51014421 | 51014421 |

Milltronics or your distributor.

# GLOSSARY

| | |
|---|---|
| BEAM ANGLE | - angle diametrically subtended by the one-half power limits (-3dB) of the sound beam |
| BLANKING | - zone extending downward from the transducer face in which received echoes are ignored |
| EPROM | - erasable programmable read only memory |
| EEPROM | - electrically erasable programmable read only memory |
| LCD | - liquid crystal display |
| MEASUREMENT | - each time a transmit pulse or set number of pulses is sent to the transducer |
| RINGING | - the inherent nature of the transducer to continue vibrating after the transmit pulse has ceased |
| ULLAGE | - amount of space left in a vessel in order for it to be filled. As opposed to the volume of material in a vessel. |

# ALPHABETICAL PARAMETER LISTING

| PARAMETER | # |
|---|---|
| Agitator Discriminator | P-34 |
| Analog Output,Mode | P-09 |
| Analog Output,Max Trim | P-59 |
| Analog Output,Min Trim | P-58 |
| ASCII Transmitter | P-36 |
| Average Readings | P-41 |
| Confidence Threshold,Long | P-71 |
| Confidence Threshold,Short | P-70 |
| Convert Display | P-06 |
| Damping Rate | P-05 |
| Decimal Point Location | P-07 |
| Display | P-08 |
| Echo Confidence | P-37/60 |
| Echo Processing Algorithms | P-72 |
| Echo Strength | P-61 |
| Echo Time | P-64 |
| Empty Distance | P-03 |
| Empty Calibration | P-29 |
| Fail-Safe Mode | P-22 |
| Fail-Safe Timer | P-23 |
| Full Calibration | P-28 |
| Fuzz Filter | P-33 |
| Measurement Offset | P-26 |
| Mode of Measurement | P-02 |
| Narrow Echo Filter | P-77 |
| Near Blanking | P-24 |
| Number of Long Pulses | P-75 |
| Number of Short Pulses | P-74 |
| Pointer Distance | P-66 |
| Pointer Level | P-67 |
| Pointer Time | P-65 |
| Range Extension | P-25 |
| Reading/Simulation | P-40/42 |
| Receiver Signal, Average | P-62 |
| Receiver Signal, Peak | P-63 |
| Reform Echo | P-78 |
| Relay 1, Function | P-12 |
| Relay 1, On/Off Setpoints | P-10/11 |
| Relay 2, Function | P-15 |
| Relay 2, On/Off Setpoints | P-13/14 |
| Relay 3, Function | P-18 |
| Relay 3, On/Off Setpoints | P-16/17 |
| Relay 4, Function | P-21 |
| Relay 4, On/Off Setpoints | P-19/20 |
| Reset | P-99 |
| Scope Displays | P-69 |
| Scope Trigger (Dead Zone) | P-68 |
| Software Revision # | P-50 |
| Sound Velocity | P-27 |
| Span | P-04 |
| Spike Filter | P-76 |
| Synchronization | P-35 |
| Tank Dimension A | P-31 |
| Tank Dimension L | P-32 |
| Tank Shape | P-30 |
| Temperature | P-43 |
| Temperature, Max encountered | P-44 |
| Temperature, Min encountered | P-45 |
| Test, Analog mA Output | P-57 |
| Test, Calibrator | P-53 |
| Test, LCD,LED,Relay | P-52 |
| Test, Memory | P-51 |
| Test, Temperature Sensor | P-56 |
| Test, Transmitter | P-55 |
| Test, Watchdog Reset | P-54 |
| Transmit Frequency | P-73 |
| TVT Curve | P-80 |
| TVT Shaper | P-81 |
| TVT Minimum Start Intersect | P-82 |
| TVT Minimum Intersect Slope | P-84 |
| Units of calibration | P-01 |

# COMMUNICATION PROTOCOL

Communication between the Airanger DPL and peripherals is via the ASCII bipolar current loop. The Milltronics BIC must be used for communication with a computer utilizing an RS-232 or RS-422 communication format. Refer to Instruction Manual PL-274, Peripherals.

The following ASCII characters are used:
* STX = start of text
  CR = carriage return
  LF = line feed

Each ASCII character is transmitted with the following conventions:

Idle = Mark = Logic 1 = +20 mA
Space= Logic 0 = -20 mA

The character format is: 7 bits, even parity, 1 stop bit. The least significant bit (LSB) of data is transmitted first following the start bit. The most significant bit (MSB) is transmitted last prior to the parity bit.
The baud rate is 4800.

For interconnection wiring between the AiRanger DPL and its peripherals, refer to Figure 3 and to the Peripherals Instruction Manual, PL-274.

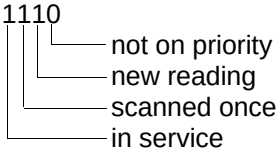
If P-36 is set to 1, a 23 character ASCII message will be transmitted after each level measurement. If both points are in service (P-2 = 4 or 5 only), an average of the two points will be assigned as point 3. The sequence of transmission for dual point operation becomes: message point 1, message point 3, message point 2, message point 3, message point 1, message point 3 and so on.

The following exemplifies a 23 character ASCII message.

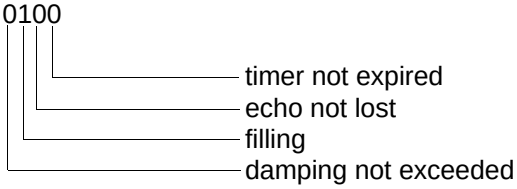
| CHARACTER No. | ASCII CHARACTER | DESCRIPTION |
|---|---|---|
| 1 | STX | start of message |
| 2 | 0 | message type, always 00 |
| 3 | 0 | |
| 4 | 0 | point number: 001, 002 or 003 |
| 5 | 0 | |
| 6 | 1 | (eg: point #1) |
| 7 | 3 | reading: 0000 to 9999 (decimal location is in status byte F) |
| 8 | 4 | DDDD for display of ---- |
| 9 | 7 | EEEE for display overflow |
| 10 | 5 | (eg: 3475) |
| 11 | E | status A ($0 to $F) decodes into true binary where bit position: |

$2^3$ = 1 if point is in service
$2^2$ = 1 if scanned once
$2^1$ = 1 if new reading
$2^0$ = 1 if on priority loop

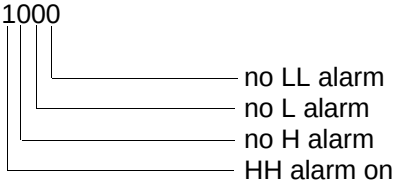
always a value of E = 1110



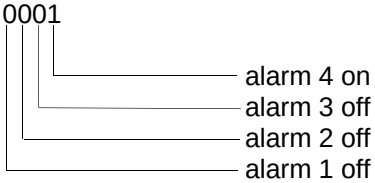
| | | |
|---|---|---|
| 12 | 4 | status B ($0 to $F) decodes into true binary where bit position:<br>$2^3$ = 1 if damping exceeded<br>$2^2$ = 1 if filling<br>$2^1$ = 1 if echo lost<br>$2^0$ = 1 if fail-safe timer expired<br>as exemplified: 4 = 0100 |




| | | |
|---|---|---|
| 13 | 8 | status C ($0 to$F) decodes into true binary where:<br>$2^3$ = 1 if in high high alarm<br>$2^2$ = 1 if in high alarm<br>$2^1$ = 1 if in low alarm<br>$2^0$ = 1 if in low low alarm<br><br>as exemplified: 8 = 1000 |




| | | |
|---|---|---|
| 14 | 8 | status D, always the same as status C |
| 15 | 1 | status E ($0 to $F) decodes into binary where bit position:<br>$2^3$ = 1 if alarm 1 tripped<br>$2^2$ = 1 if alarm 2 tripped<br>$2^1$ = 1 if alarm 3 tripped<br>$2^0$ = 1 if alarm 4 tripped<br><br>as exemplified: 1 = 0001 |




| | | |
|---|---|---|
| 16 | 2 | status F ($0 to $F) decodes into binary where:<br>0000 = no digits after decimal<br>0001 = one digit after decimal<br>0010 = two digits after decimal<br>0011 = three digits after decimal<br><br>as exemplified: 2 = 0010, two digits after decimal |
| 17 | 1 | echo confidence, 00 to 99 |
| 18 | 5 | as exemplified: 15 is the echo confidence |
| 19 | 4 | 12 bits for analog output, hexadecimal 000 |
| 20 | 0 | (0 mA) to FFF (20 mA) |
| 21 | 0 | as exemplified: 400 = 0100 0000 0000 = 5 mA |
| 22 | LF | line feed |
| 23 | CR | carriage return |

**NOTES ON THE STATUS BITS**

1. $ denotes a hexadecimal number

2. Each bit is set (1) if true, clear (0) if false.

**Status A**

3. ‘In service‘ indicates that the point has been placed in service. Always set to 1 for the AiRanger DPL.

4. ‘Scanned once‘ indicates that the point has been scanned at least once since being placed in service. Always set to 1 for the AiRanger DPL.

5. ‘New reading‘ indicates that the AiRanger DPL is transmitting after scanning (reading a bin). Always set to 1 for the AiRanger DPL.

**Status B**

6. ‘Damping exceeded‘ indicates that the material level is changing faster than allowed by the damping.

7. ‘Filling‘; when the average receiver signal (P-62) is above 10 dB, the bit will be set. This may be used as an indication that the bin is filling.

8. ‘Loss of echo‘ indicates that an echo of confidence greater than or equal to the confidence threshold could not be extracted from the echo profile.

9. ‘Fail-safe timer expired‘ indicates that the a loss of echo condition has persisted for a duration of time greater than that in the fail-safe timer.

10. Status C, each of the four alarm level bits is set if the corresponding alarm has been tripped.

11. Status D, always the same as status C.

12. Status E, each of the four alarm number bits is set if the corresponding alarm has been tripped.

13. Status F, corresponds to the decimal point location.

14. The confidence is a measure of the echo strength.

15. The 3 nibbles of 4 bits, hexadecimal 000 to FFF, represents the 0 - 20 mA current being generated.

When the AiRanger DPL is put into the calibrate mode, the following 5 character ASCII message will be transmitted.

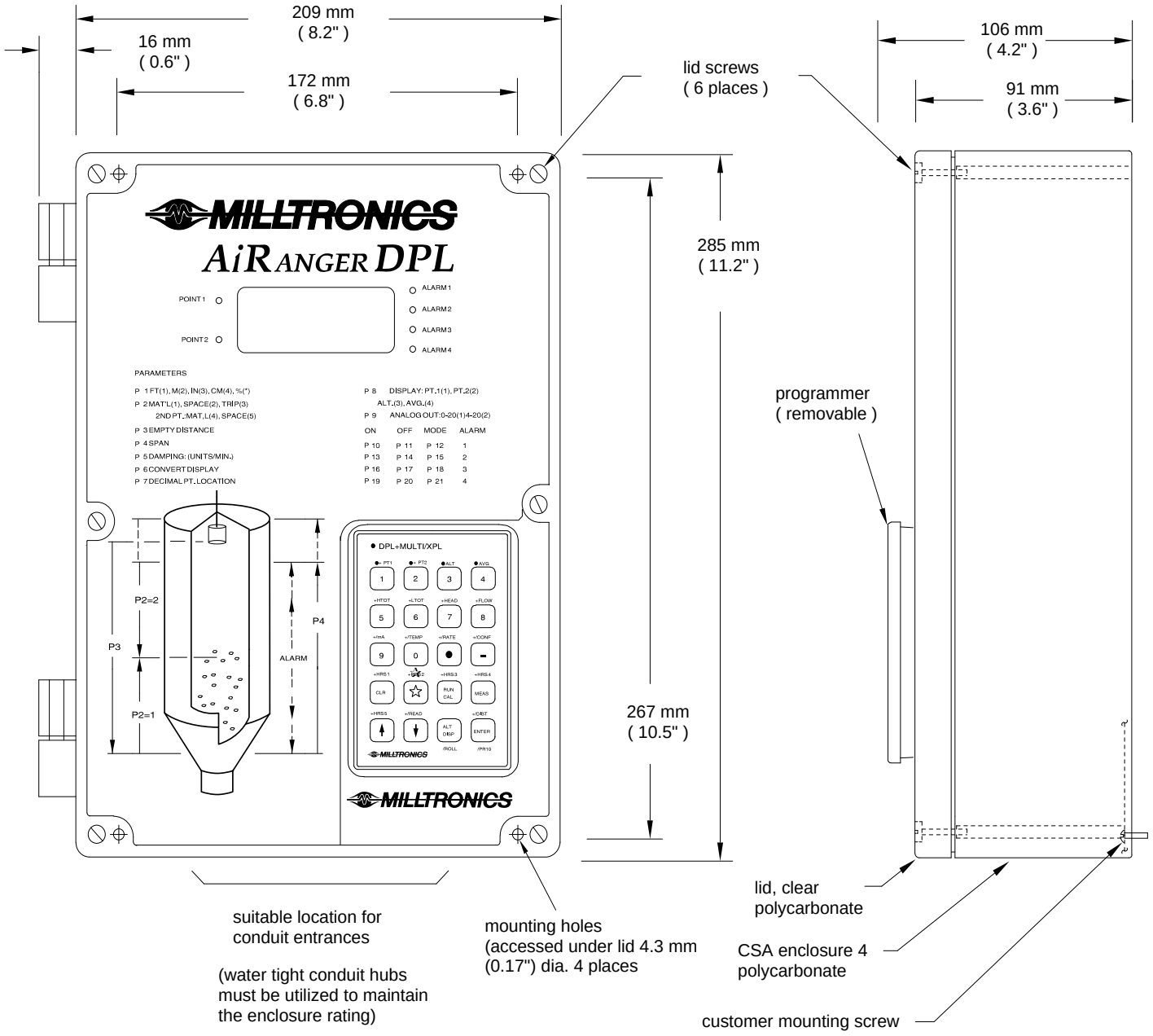
STX
0
1
LF
CR

When the AiRanger DPL is put into the run mode, the following 8 character ASCII message is transmitted for each point.

STX
0
3
0
X point number, 001 to 099
X
LF
CR

■

# OUTLINE AND MOUNTING




Milltronics recommends using a punch for making holes in enclosure.

**FIG. 1**

# AiRanger DPL

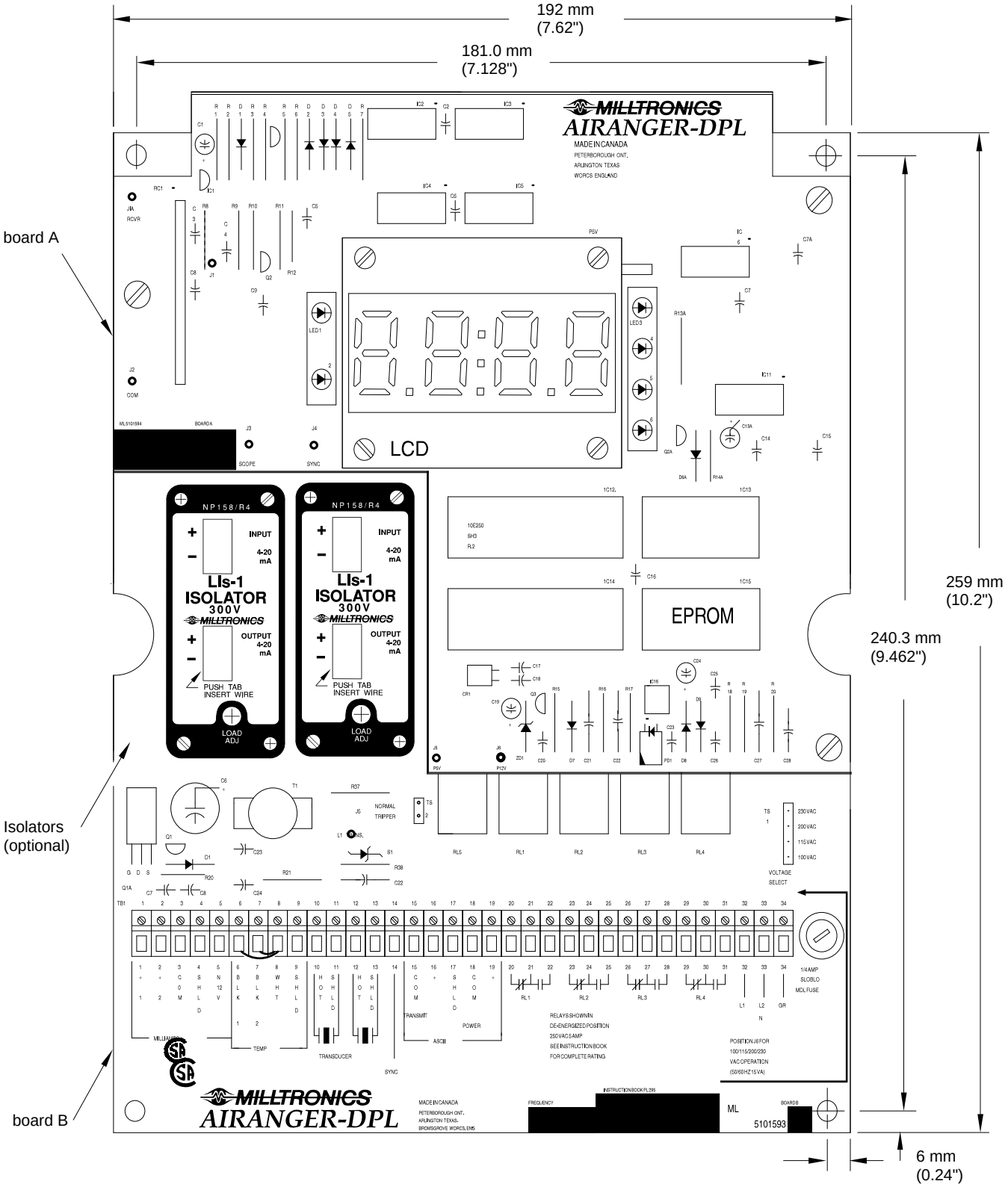
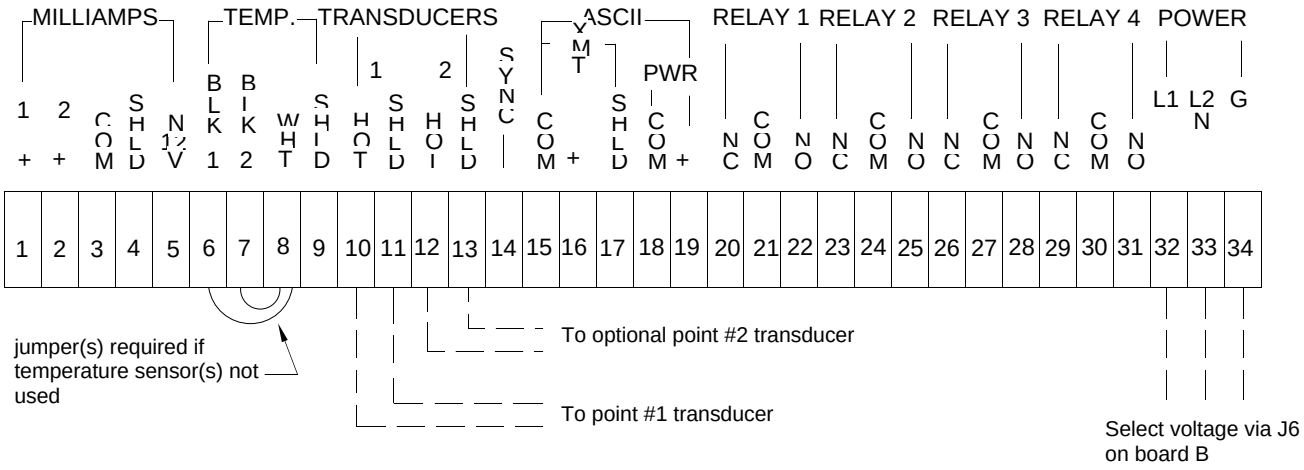



**FIG. 2**

# WIRING FORMATS

## Standard Wiring




## Optional Isolated 4 - 20 mA Output Wiring

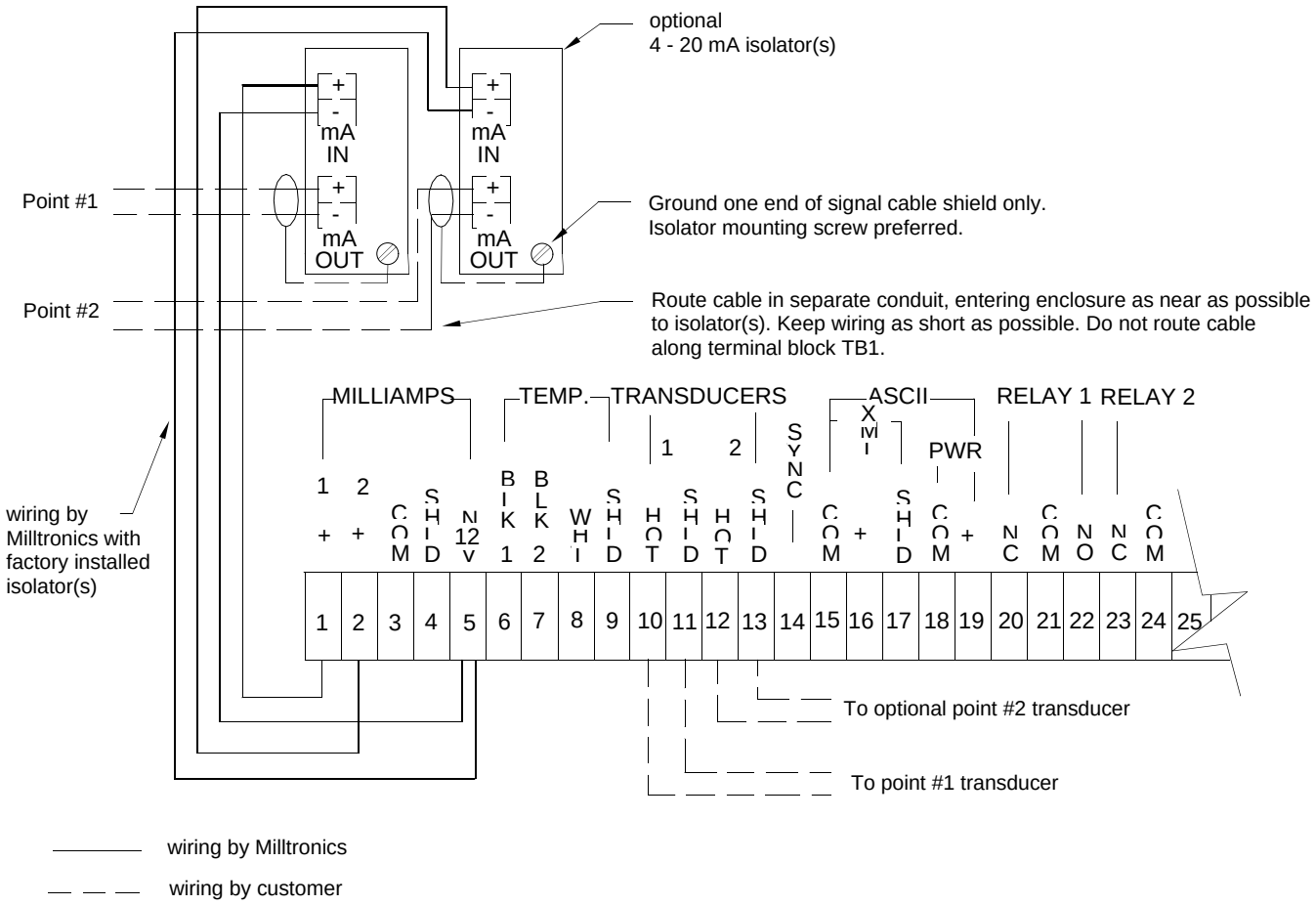
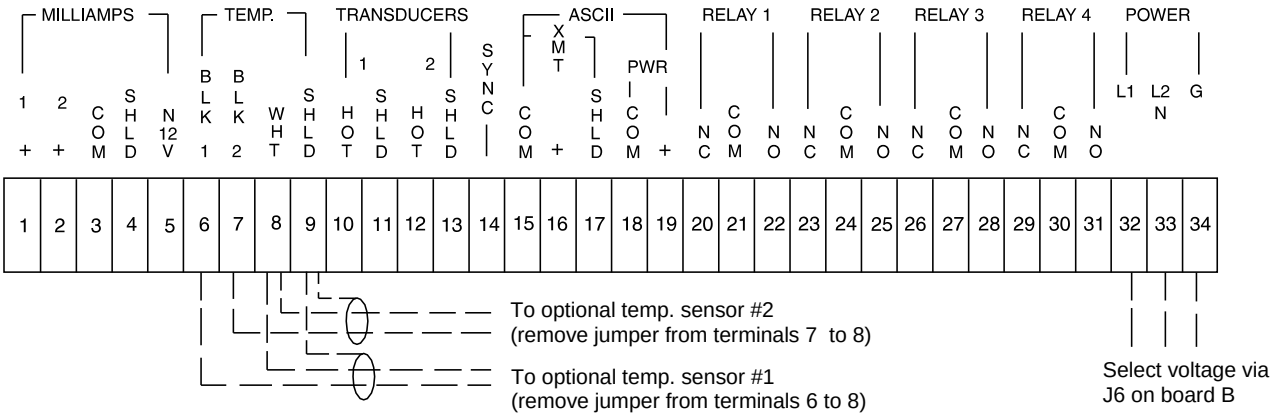


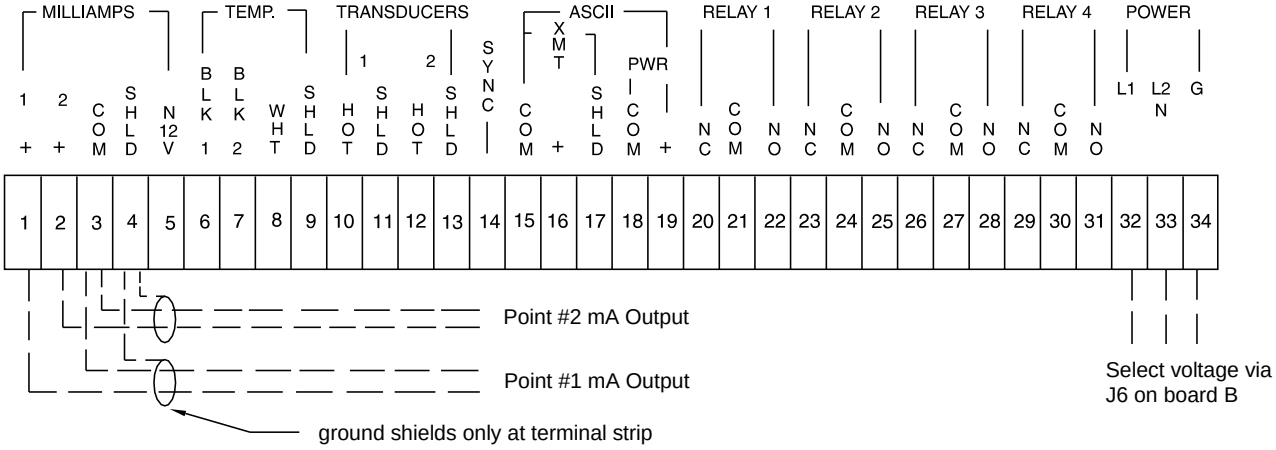

**FIG.3**

# WIRING FORMATS (cont'd)

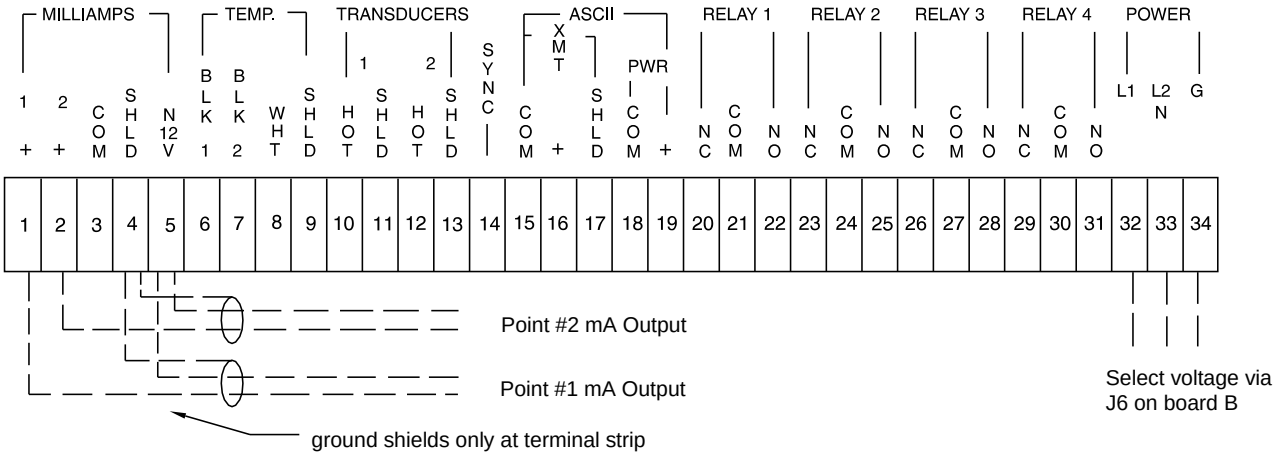
## Optional Temperature Sensor Wiring




## mA Output Wiring into 350 Ohms maximum




## mA Output Wiring into 750 Ohms maximum

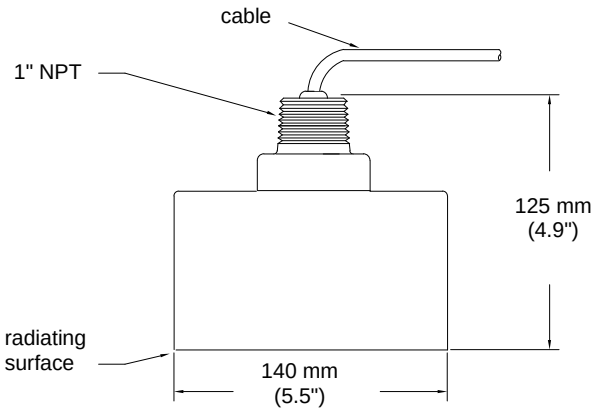



wiring by Milltronics

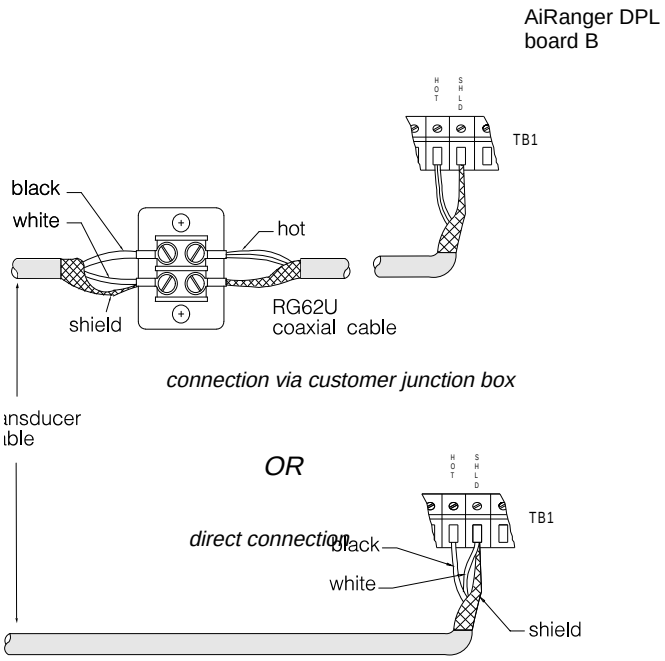
wiring by customer

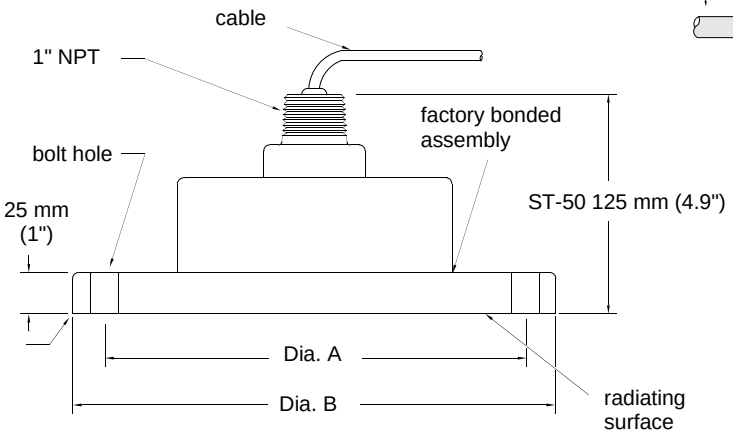
**FIG.3A**

# ST - 50 SERIES TRANSDUCER OUTLINE AND WIRING




**STANDARD ST-50 TRANSDUCER**




**FLANGED MOUNTED ST-50 TRANSDUCER**

| Flange Size | | Dia. A | | Dia. B | | Holes | Holes (dia.) | |
|---|---|---|---|---|---|---|---|---|
| mm | inch | mm | inch | mm | inch | | mm | inch |
| 152 | 6 | 241 | 9.5 | 279 | 11 | 8 | 22 | 7/8 |
| 203 | 8 | 299 | 11.75 | 343 | 13.5 | 8 | 22 | 7/8 |
| 305 | 12 | 432 | 17 | 483 | 19 | 12 | 22 | 7/8 |

Dimensions are to North American standards.
Optional dimensions to European standards also available.

**Notes:** - Do not route cable openly in raceways.

- Cable length: - standard: - 1m ( 3' )
  - optional: - consult Milltronics

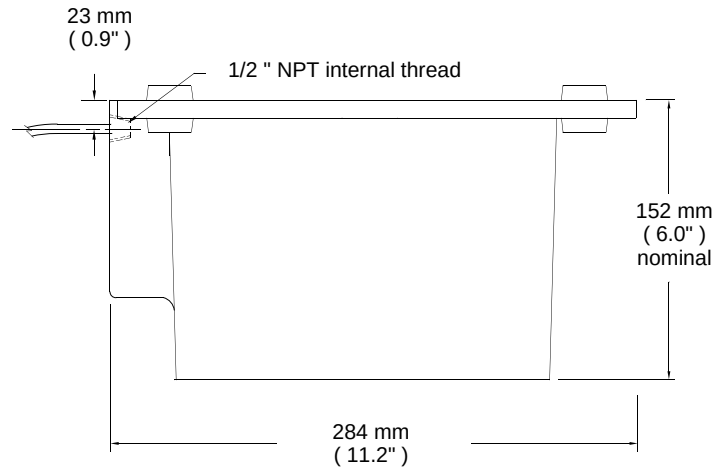
- Radiating surface: - standard: - polyurethane
  - optional: - polyethylene, for dusty, non-corrosive non-condensing applications
  - telfon ( flanged ), for highly corrosive applications
  - CPVC, for corrosive applications

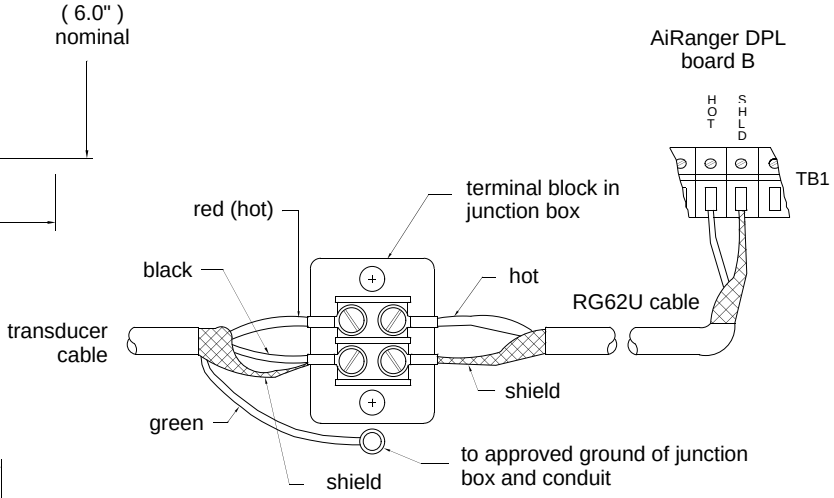
- Cable must be run in a grounded metal conduit with no other cabling (except temp. sensor cable). Ground shield only at AiRanger DPL. Insulate shield at junctions to prevent inadvertent grounding.

- Transducer wiring must be done in conjuction with approved conduit, boxes and fittings and to procedures in accordance with all governing regulations.

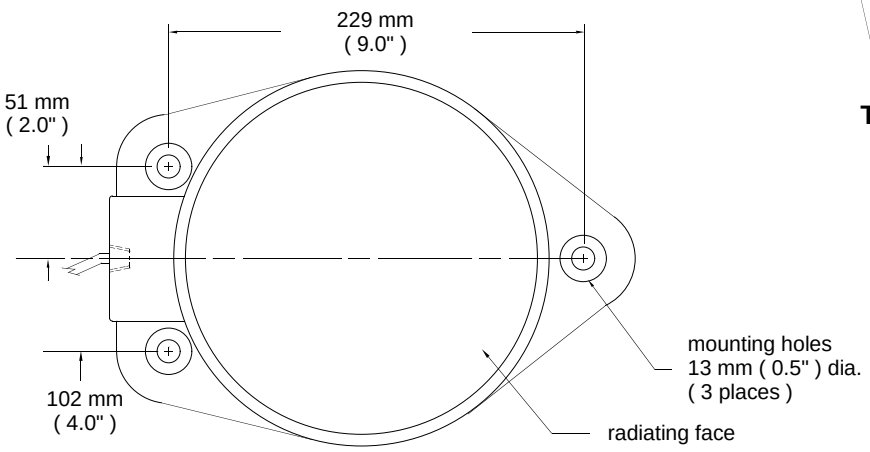
**FIG. 4**

# ST-100 SERIES TRANSDUCER OUTLINE AND WIRING




**Transducer interconnection with local junction box**




**NOTES** :

- Do not route cable openly in raceways

- Cable length: - standard: 4.5 m ( 15' )
  - optional: consult Milltronics

- Radiating surface : standard : - polyurethane
  optional : - CPVC for corrosive applications
  - Teflon ( flanged ) for highly corrosive applications
  - polyethylene foam for dusty, noncondensing applications

- Cable must be run in a grounded metal conduit with no other cabling (except temperature sensor cable). Ground shield at AiRanger DPL only. Insulate shield at junctions to prevent inadvertent grounding.

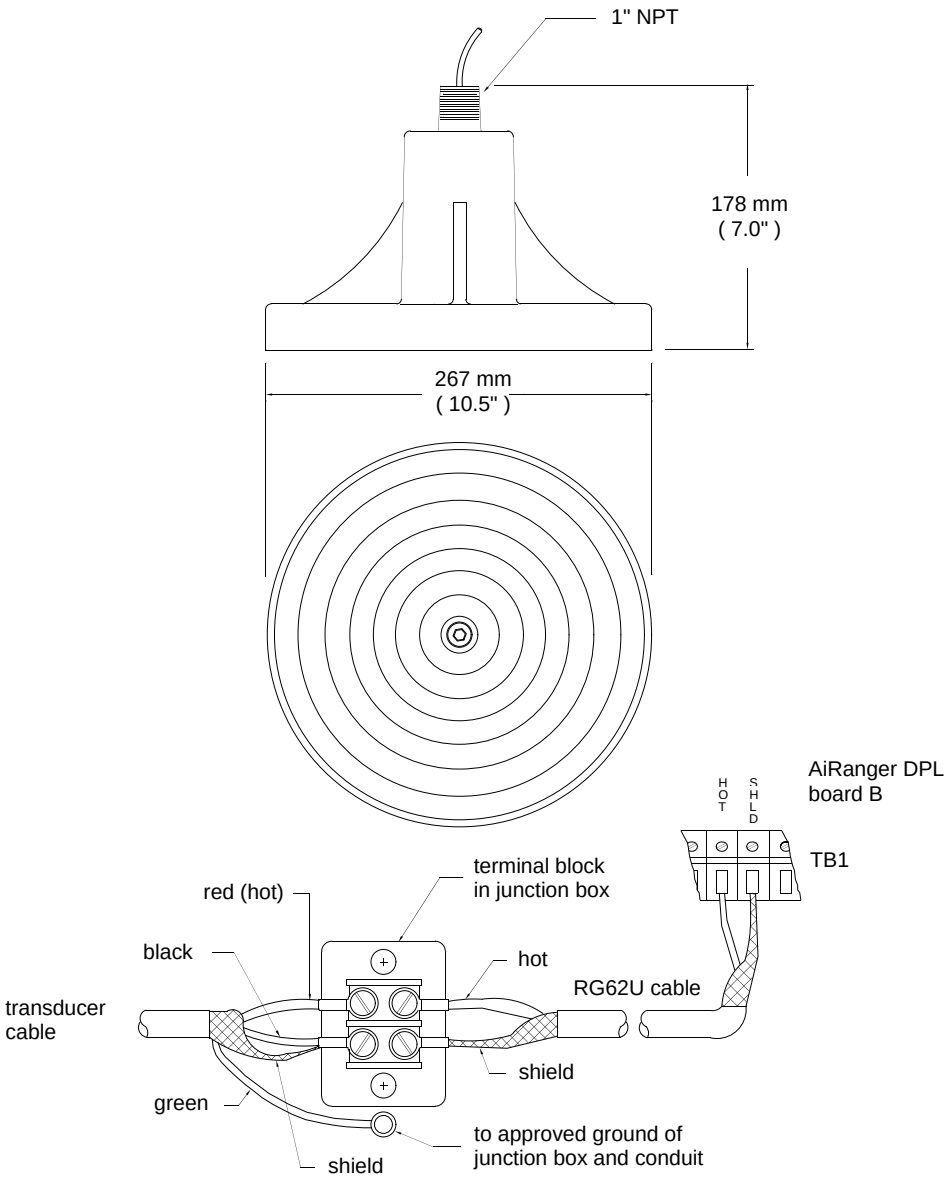
- Transducer wiring must be done in conjunction with approved conduit, boxes and fittings and to procedures in accordance with all governing regulations.

- Refer to FIG. 10 for mounting details.

- Refer to FIG. 3 for connection to AiRanger DPL.

**FIG. 5**

# LR - 21 TRANSDUCER OUTLINE AND WIRING




**Transducer interconnection with local junction box**

**NOTES** :

- Do not route cable openly in raceways.

- Cable length : - standard: 4.5 m ( 15' )
  - optional: consult Milltronics

- Radiating surface is polyethylene and styrofoam.

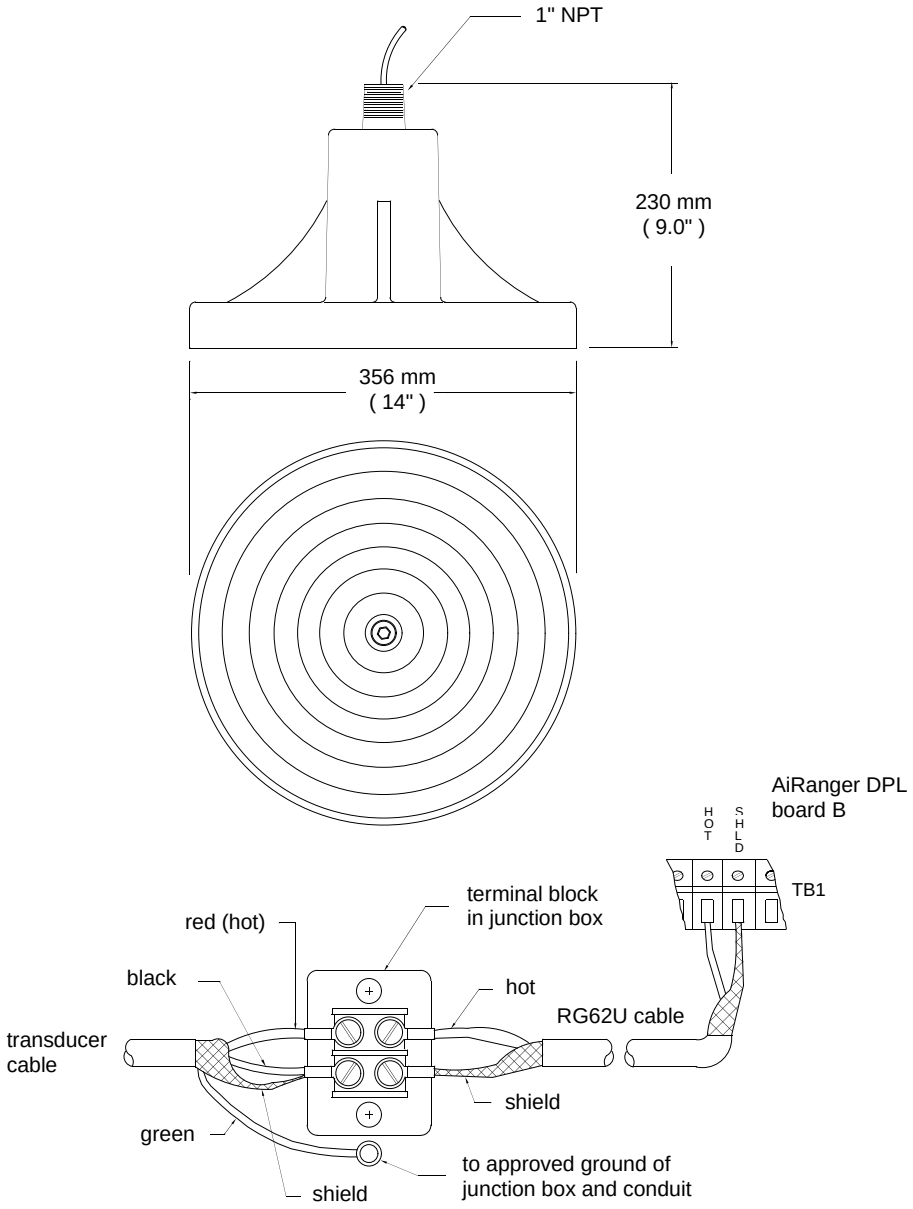
- Cable must be run in a grounded metal conduit with no other cabling (except temperature sensor cable) Ground shield only at AiRanger DPL. Insulate shield at junctions to prevent inadvertent grounding.

- Transducer wiring must be done in conjunction with approved conduit, boxes and fittings and to procedures in accordance with all governing regulations.

- Refer to FIG. 3 for connection to AiRanger DPL.

**FIG. 6**

# LR - 13 TRANSDUCER OUTLINE AND WIRING




**Transducer interconnection with local junction box**

**NOTES** :

- Do not route cable openly in raceways.

- Cable length : - standard: 4.5 m ( 15' )
  - optional: consult Milltronics

- Radiating surface is polyethylene and styrofoam.

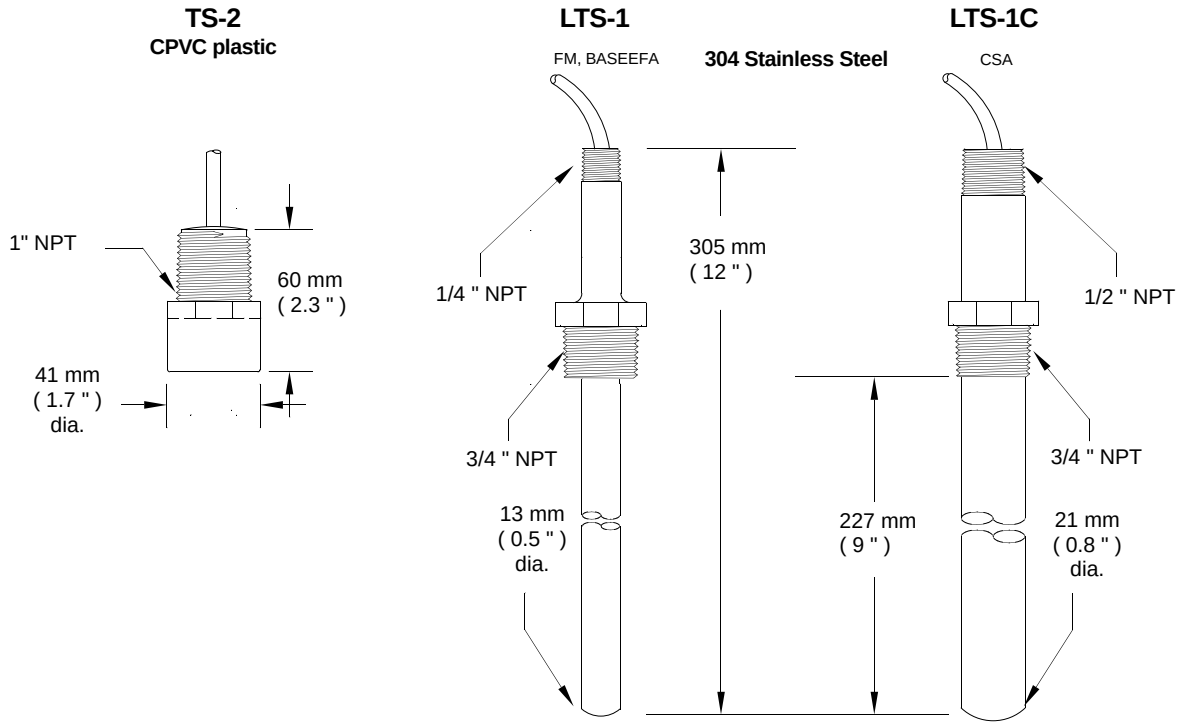
- Cable must be run in a grounded metal conduit with no other cabling (except temperature sensor cable). Ground shield only at AiRanger DPL. Insulate shield at junctions to prevent inadvertent grounding.

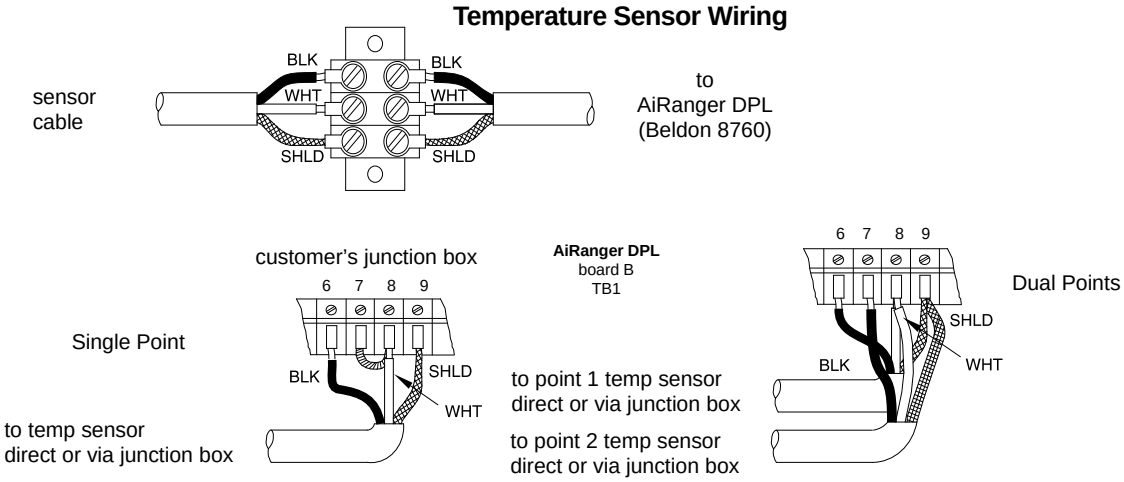
- Transducer wiring must be done in conjunction with approved conduit, boxes and fittings and to procedures in accordance with all governing regulations.

- Refer to FIG. 3 for connection to AiRanger DPL.

**FIG. 7**

# TEMPERATURE SENSOR OUTLINE AND WIRING



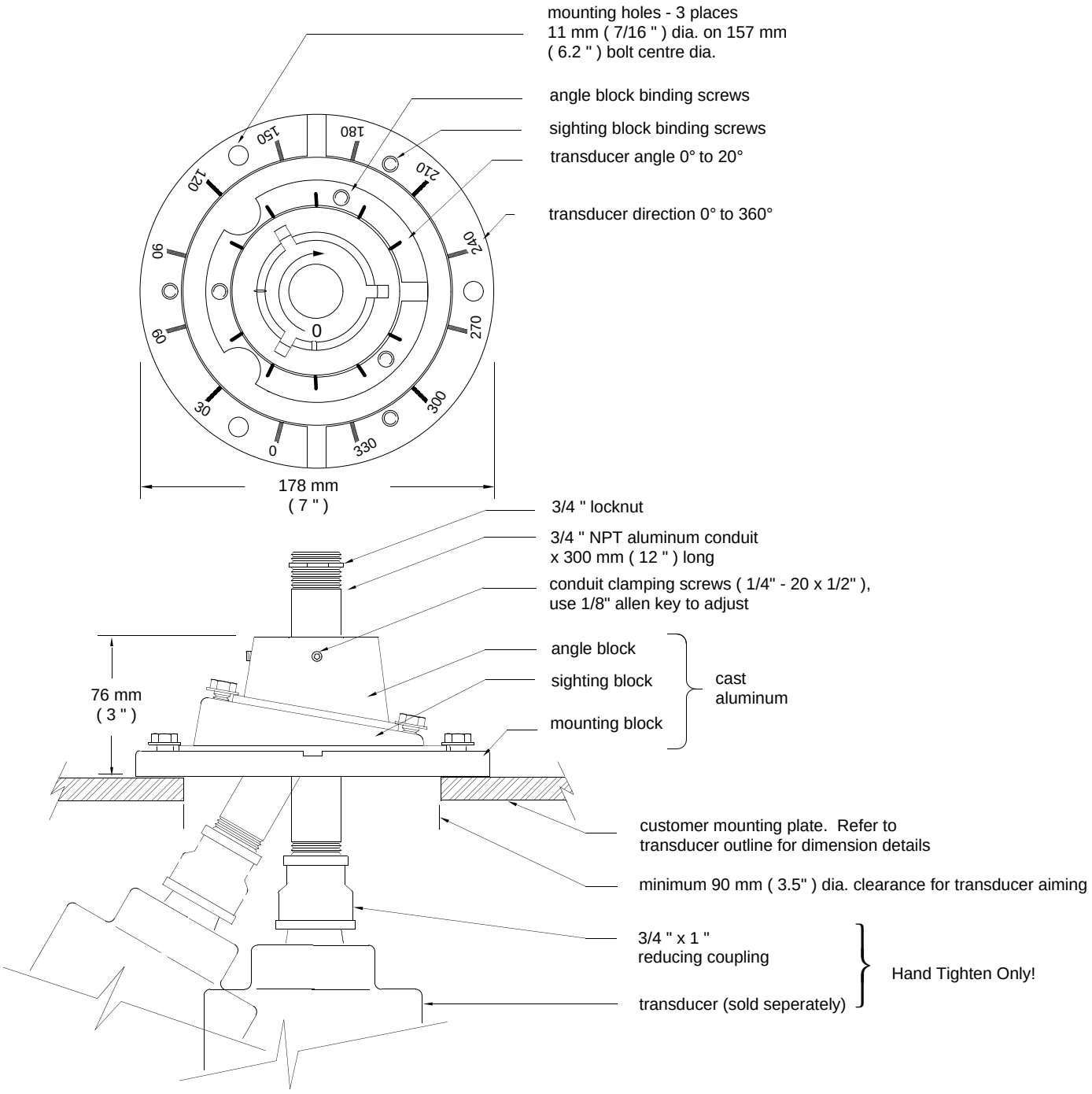




**NOTES** :

1. The temperature sensor should be mounted in a location which represents the temperature fluctuations likely to occur between the transducer and the target. To avoid false readings, mount the sensor out of direct sunlight. Radiant heating can cause a significant differential between air and sensor temperatures.
2. Temperature sensor cable can be run with transducer cable in a grounded metal conduit. Ground shield only at AiRanger DPL. Insulate shield at junctions to prevent inadvertent grounding.
3. Temperature sensor wiring must be done in conjunction with approved conduit, boxes and fittings and to procedures in accordance with all governing regulations.
4. Cable lengths : - standard : 1 m ( 3')
   - optional : consult Milltronics
5. A jumper must be connected across TB1 - 6&8 and TB1 - 7&8 if a temperature sensor is not used. The expected error due to temperature variations will increase from 0.01 to 0.17% per degree celcius over the operating range.

**FIG. 8**

# ST-50 and LR SERIES TRANSDUCER MOUNTING - SOLIDS APPLICATIONS
## EASY AIMER KIT




In solids applications, the transducer should be mounted so that it is aimed toward the low level draw point. To facilitate this mounting, it is suggested that the optional Milltronics Easy Aimer Kit be used. See Fig. 10 for ST 100 transducer mounting details.

**FIG. 9**

# EASY AIMER KIT INSTALLATION

1. Assemble transducer to conduit via reducing coupling supplied and feed conduit through center hole of aiming fitting, secure assembly with the conduit clamping screws.

2. Install locknut onto top end of threaded conduit

3. Bolt down mounting block ( i.e. to access plate of bin ) in a location away from fill points or structural members that may intersect the sound's path toward the low level draw point.

4. Leaving the sighting block binding screws fastened, loosen the angle block binding screws. Rotate angle block until transducer is pointing at the desired angle. Angle reference graduations on the sighting block are 3.3° apart; e.g. if line at 0° on angle block is 2 graduations past the 0° on the sighting block, then transducer is angled at 6.6° from vertical.

   Re-fasten angle block binding screws.

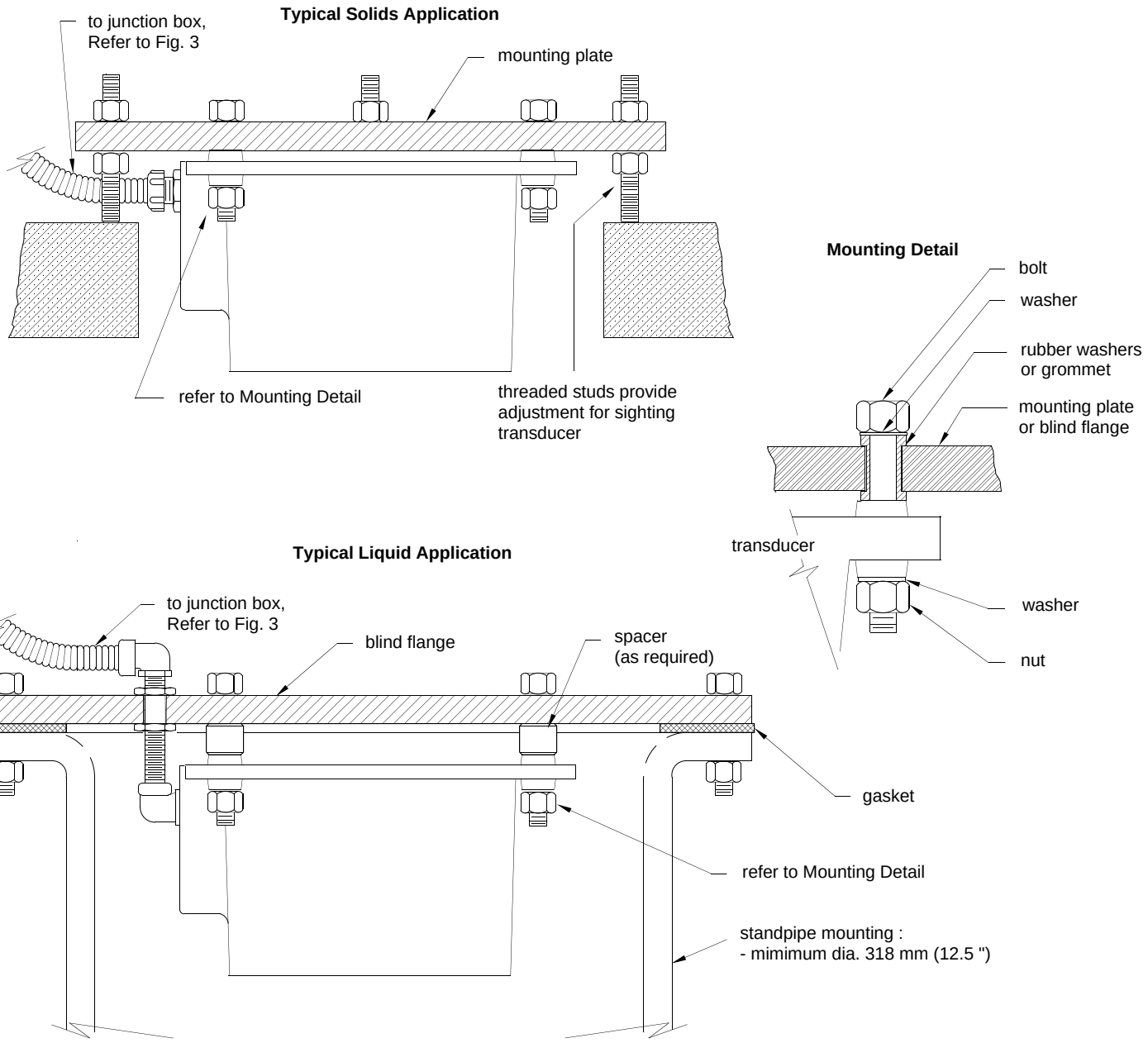
5. Lossen the sighting block binding screws and rotate sighting block until transducer is pointing in the desired direction. Direction reference graduations on the mounting block are 30° apart.

   Re-fasten sighting block binding screws.

NOTE : It may take several attemps at various angles/directions to obtain optimum results. Refer to sections Installation\Transducers and Troubleshooting\General for guidelines in aiming the transducer.

**FIG. 9A**

# TRANSDUCER MOUNTING - ST-100




**NOTES** :

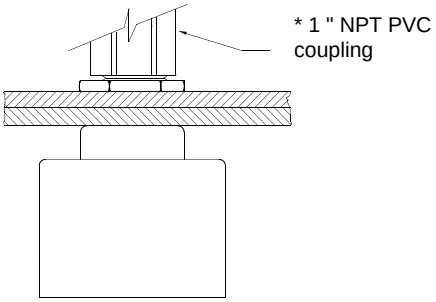
1. In liquid applications, mounting must keep face parallel to liquid surface.
2. In solids applications, mounting should allow transducer to be aimed at the draw point at the bottom of the bin.
3. Transducer installation, whether in non-hazardous ( as shown ) or hazardous areas, must be done in in conjunction with approved conduit, boxes and fittings and to procedures in accordance with all governing regulations.
4. Refer to FIG. 3 for wiring details.
5. All mounting hardware supplied by customer.

**FIG. 10**

# TRANSDUCER MOUNTING - LIQUID APPLICATIONS

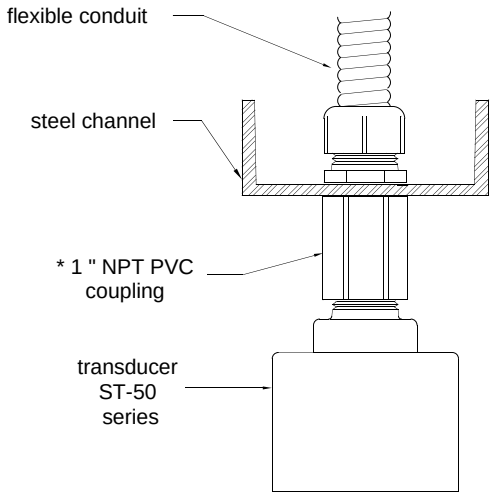
## ST - 50 SERIES TRANSDUCERS

### Plywood

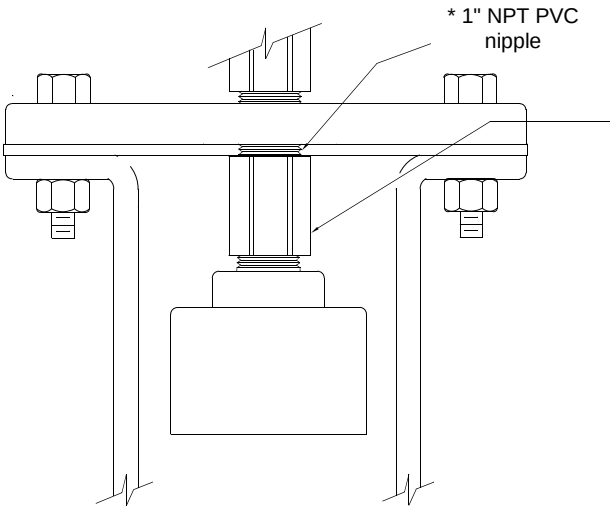



Plywood mounting provides excellent isolation, but must be rigid enough to avoid flexing if subjected to loading.

### Bracket

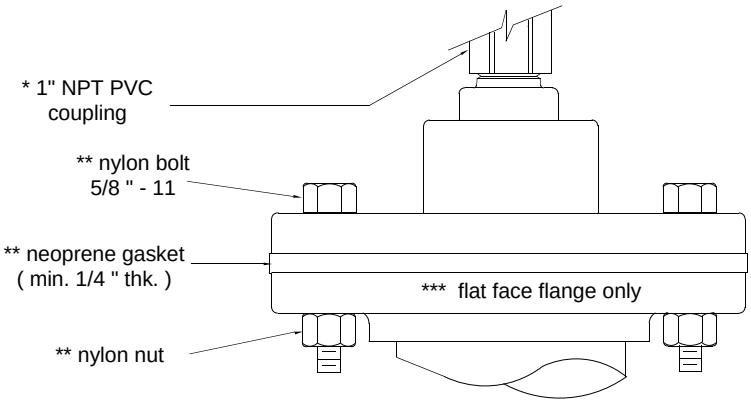



### Blind Flange




Flange, gasket and hardware supplied by customer. Refer to standpipe application, section

### Flanged Transducer




Customer flanged standpipe.

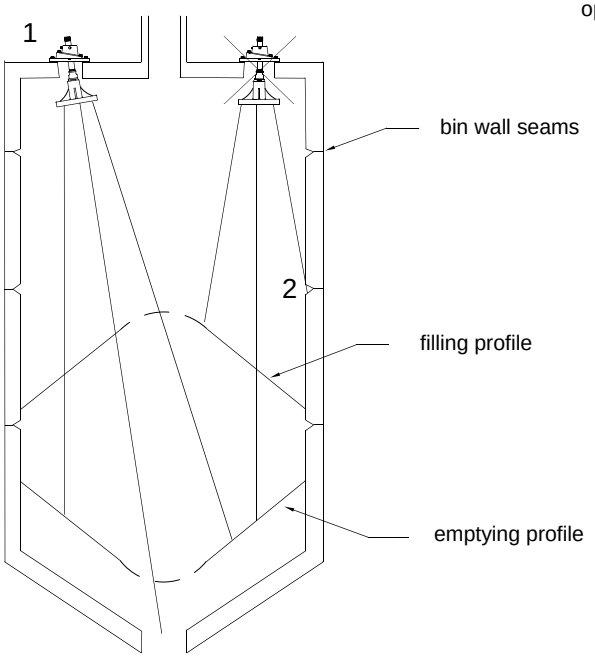
* Items supplied with all ST-50 transducers.
** Items supplied with flanged transducers.

**GUIDELINES** :

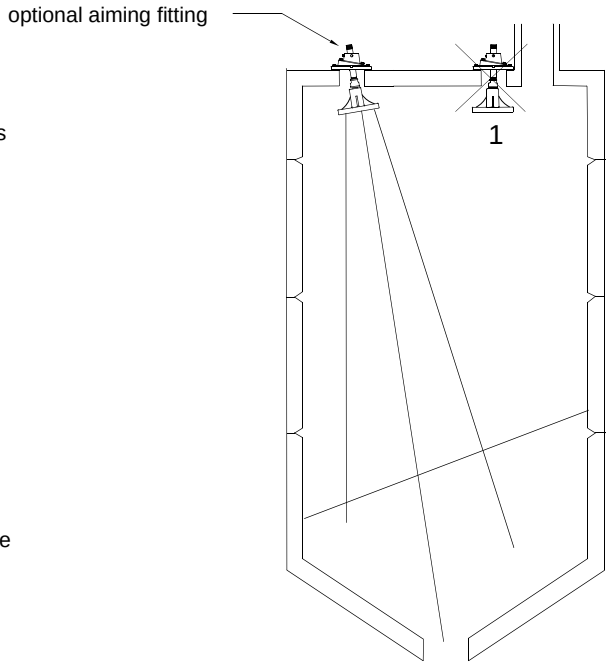
1. Do not mount transducer directly to metal. Use PVC coupling and nipple as provided.
2. Do not overtighten mounting. Hand tightening of nylon bolts and nuts or PVC coupling and nipple is sufficient.
3. In liquid applications, transducer mount ( flange, bracket, conduit or plywood ) must keep transducer perpendicular to liquid surface.
4. Transducer installation, whether in non-hazardous ( as shown ) or hazardous areas, must be done in conjunction with approved conduit, boxes and fittings and to procedures in accordance with all governing regulations.
5. Flanges must be flat face only. ***Do not use raised face or lap joint flanges.*** Inner standpipe surface and ends must be smooth and free of burrs, ridges or seems.

**FIG. 11**

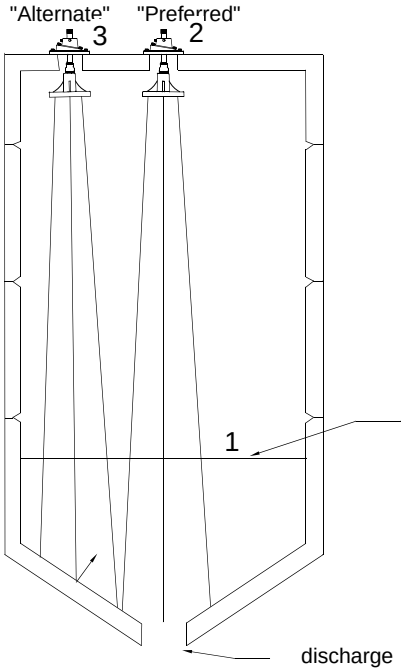
# TYPICAL SOLIDS APPLICATIONS



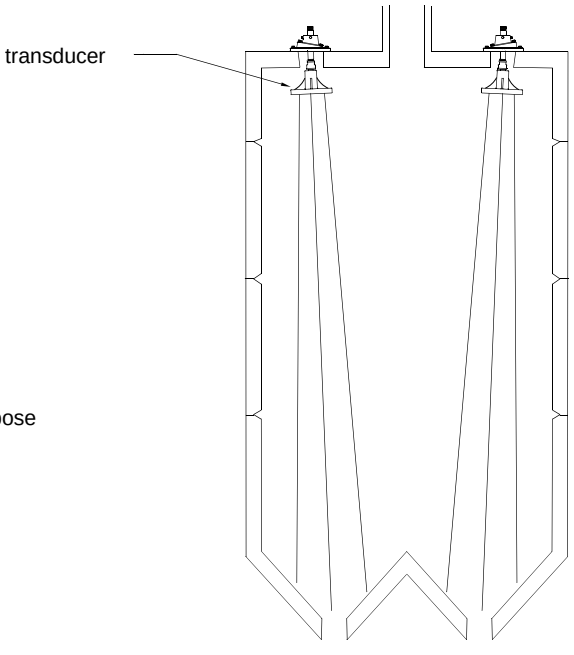

1. Transducer angled to avoid seams in bin wall and aimed at discharge in order to read bin when empty.
2. Avoid intersecting bin wall seams,structural members and wall irregularities. Otherwise, refer to advanced calibation.




1. Transducer too close to material inlet. Falling material will intersect sound beam and cause erroneous readings or loss of echo.



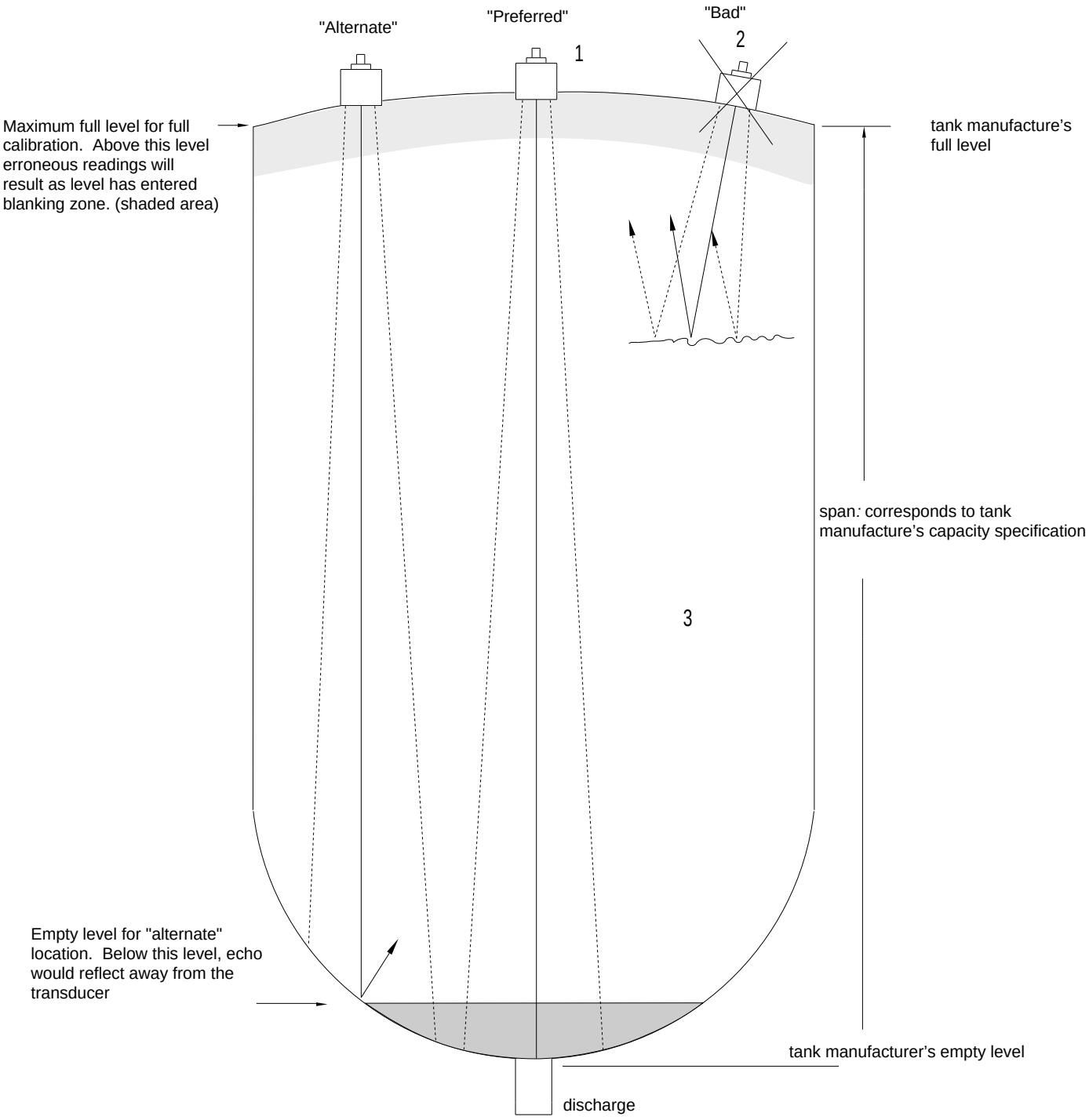

1. On fluid like solids, aim transducer perpendicular to material surface.
2. Transducer mounted over discharge.
3. If physical limitations restrict transducer mounting as in 2. Refer to FIG. 13.




On dual discharge bins, aim each transducer at the discharge point below and select average analog output.

**FIG. 12**

## TYPICAL VOLUME APPLICATION




1. In most tanks, the transducer should be centered as much as possible ( without interference from inlet ) for optimum reading range. Beam should not detect bin bottom. If this occurs, use range extension (P-25) to omit false echoes. Refer to Specification \ Transducers for transducer beam angle.
2. Transducer face must be parallel to liquid surface. Echo will miss improperly leveled transducer.
3. When performing an empty or full calibration, tank must contain its normal vapour and be at its normal temperature.

**FIG. 13**