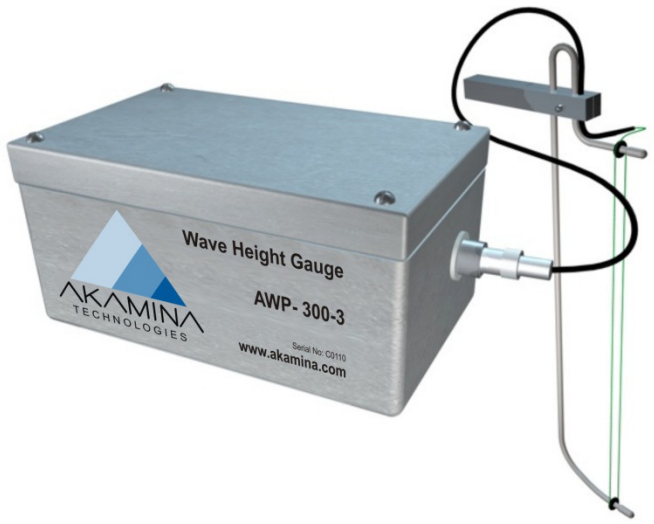
AWP-300-3

Wave Height Gauge User's Guide



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1 INTRODUCTION

The AWP-300 is the next generation capacitance-type precision wave height gauge from Akamina Technologies. It provides high accuracy wave height measurements that are stable over a wide range of air and water temperatures.

The AWP-300 includes several design enhancements to make set up and configuration easier. These enhancements include:

- a digital interface and messaging protocol that allows the wave height gauge to be managed remotely
- configuration and set up takes less than 60 seconds without having to open the enclosure
- all measurements are performed digitally; there are no analogue conversions in any step of the measurement process
- multiple AWP-300s can be connected to a multi-drop CAN bus network simplifying cabling
- wave height values are returned as 16-bit integer values

The AWP-300 provides 16-bit digital samples that are proportional to instantaneous water levels. A simple calibration procedure allows the highly linear relationship between the water level and the measurements to be determined.

1.1 Wave Height Gauge Overview

The Akamina wave height gauge system consists of two main components. These are:

- AWP-300 electronics mounted in an enclosure
- wave probe head and mounting clamp. The probe is partially submerged in water during measurements

The AWP-300, the wave probe head, and a typical tripod for laboratory use are shown in **Error! Reference source not found.**.

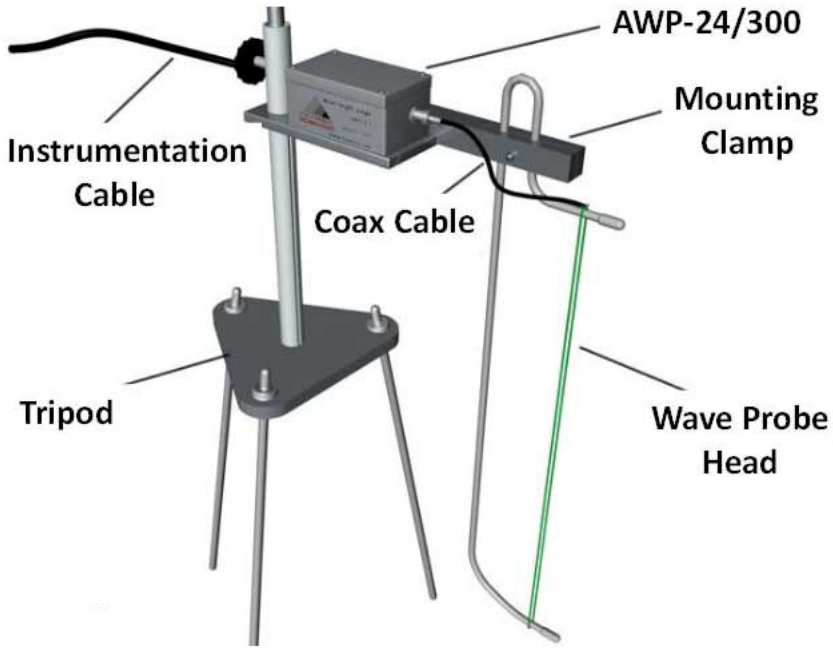

Figure 1-1 Wave Height Gauge and Tripod

2 AWP-300 MAIN COMPONENTS

2.1 Enclosure

The AWP-300 uses a heavy duty, rugged, watertight, diecast aluminium alloy enclosure that is suitable for indoor or outdoor use. The enclosure can be mounted to a structure using the through-box holes that are located outside of the gasket protection. The enclosure itself is designed to meet the IP65 waterproof standard, however, the connectors mounted to the enclosure do not meet the standard.

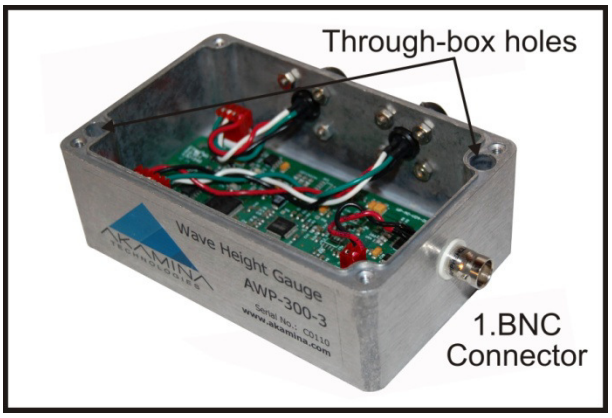

Figure 2-1 Enclosure and BNC Connector

2.2 Connectors and Cables

There are three connectors on the enclosure:

1. A BNC connector (Figure 2-1) is used to attach the wave probe head coax cable to the AWP-300 electronics.
2. Two 4-pin circular male bayonet connectors (Figure 2-2) used to attach the upstream and downstream communication cables to the AWP-300. The communication cables supply power to the electronics and carries the data between the electronics and a remote PC. The pin-out information for the connector and the instrumentation cable is shown in Table 2-1 below.

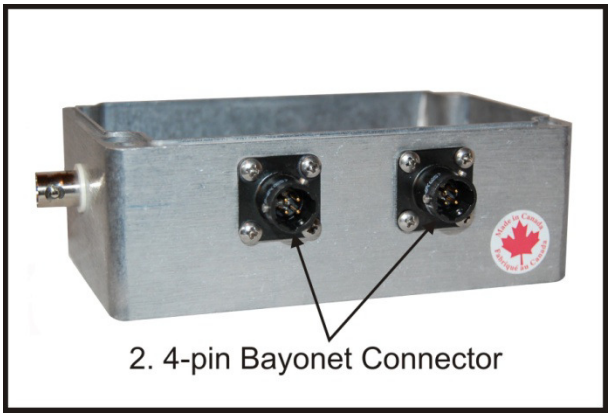

Figure 2-2 Upstream and Downstream Bayonet Connectors

Connecting communication cables can be provided with the AWP-300 or they can be manufactured by the customer. If manufactured by the customer, we recommend using a high quality instrumentation cable with two shielded twisted pairs; a separate inner shield drain is optional. One example of a suitable cable is Belden Cable part number 8723. The recommended 4-pin cable connector is any of Amphenol part numbers PT06A-8-4S (SR), PT06E-8-4S or MS3116F8-4S.

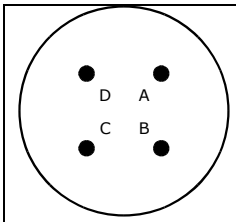	• Pin A – CANH • Pin B – CANL • Pin C – Power Low • Pin D – Power High

Table 2-1 4-pin Instrumentation Cable Connector

2.3 AWP-300 Electronics

The AWP-300 electronics measures capacitance and presents this as a digital measurement available to the network. This measurement is offset adjusted and amplified. The output measurement is a 16-bit integer value.

The modest input power requirements must be provided by an external power supply. The voltage should be between 8 and 12 volts but voltages as high as 24 volts are acceptable. The current draw of the electronics is approximately 6 mA at 10 volts during sampling and up to 20 mA while transmitting samples to an upstream PC. The circuit board is shown below in Figure 2-3.

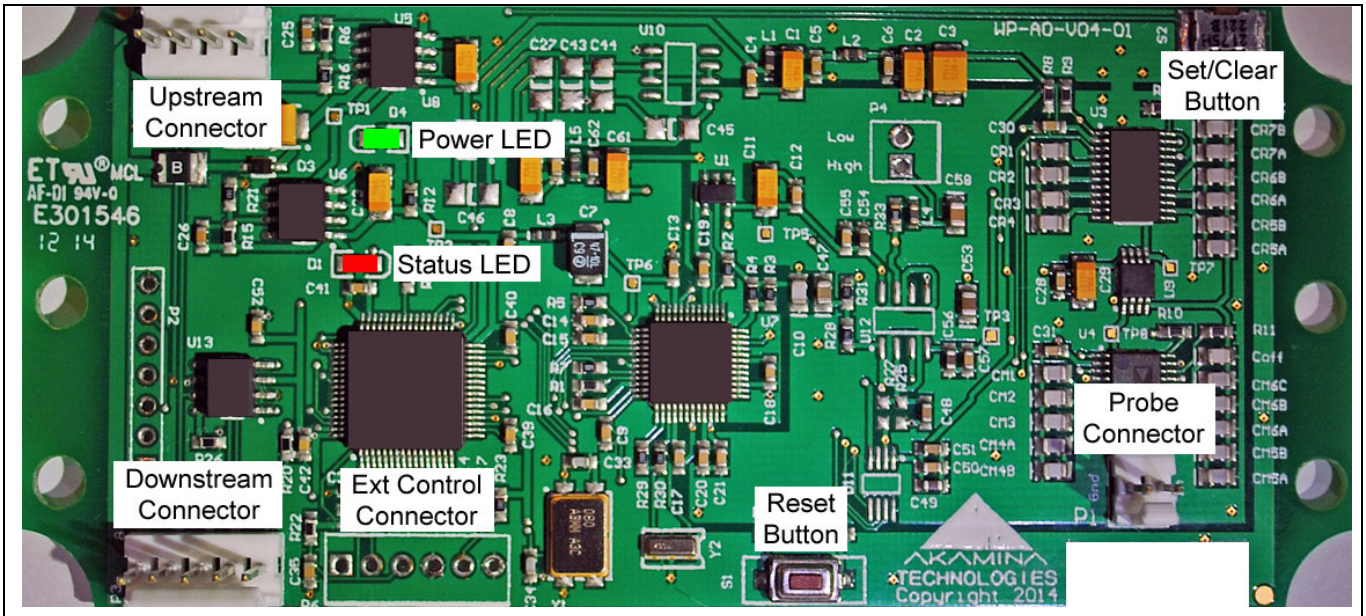

Figure 2-3 AWP-300-3 Circuit Board

The key components involved in the configuration of the circuit board are:

- Upstream Connector – power and CAN Bus connection to upstream device
- Downstream Connector – power and CAN Bus connection to downstream device
- Green Power LED – is illuminated green when the board is powered
- Red Status LED – shows the status of the board during configuration and normal operation
- Set/Clear – push button used to configure the electronics for different probe lengths and water depths. Please note that this button is pushed from the side
- Reset – push button used to reset the electronics
- Probe Connector – probe head connection
- External Control Connector – connector that provides access to the Power LED signal, Status LED signal and Set/Clear push button signal. This connector allows additional LEDs and Set/Clear push button to be mounted on the enclosure for easy access.

The remaining components and connectors on the circuit board are not user configurable and should not be touched.

2.3.1.1 External Control Connector

The Status LED, Power LED and the Set/Clear push button are only accessible by removing the top of the AWP-300 enclosure. In order to make it possible to monitor and to configure the wave height gauge without opening the enclosure, the necessary signals have been brought to a connector (P6) on the board. This allows a Status

LED, a Power LED and / or a Set/Clear switch to be mounted on the enclosure and easily connected to the board.

The signals available on the external control connector are shown below in Figure 2-3. The Status LED+ is internally connected to 3.3V and Status LED- is switched between ground or +3.3V to turn the LED off or on. A 300 Ω resistor (R24) is used to limit the current flowing through the external Status LED. The Set/Clear connections allow an external normally-open push button to be mounted in parallel with the internal Set/Clear push button. The Power LED+ is internally connected to 3.3V and Power LED- is internally connected to ground. A 2k Ω resistor (R23) is used to limit the current flowing through the external Power LED.

The MTA-100 header to be used on the board is part number: 640456-6 and the mating connector is part number 3-640440-6.

Note that the AWP-300 is designed to be managed through the CAN Bus interface. The messaging protocol allows the device to be managed remotely so it should not be necessary to open the enclosure to configure the wave height gauge.

CAUTION! AWP-300 is a high precision instrument. When the enclosure lid is open, please follow safe ESD (Electrostatic Discharge) procedures in order to ensure problem free operation and to avoid damaging your instrument.

2.4 Wave Probe Head

The wave probe head provided with the AWP-300 is a high precision sensor and must be handled with care.

CAUTION! Please ensure that the sensing wire, shown in Figure 2-4, does not come into contact with sharp objects. When not in use, please do not put any weight on the sensing wire or let the wave probe head rest on the sensing wire. Avoid exposing the probe to extreme heat and cold.

For maximum measurement accuracy please do not exceed the maximum and minimum immersion limit recommendations shown in Figure 2-4. These limits should not be exceeded during configuration, calibration, and during normal operation. However, if you wish to use a smaller measurement range than the full range of the probe, you can use maximum and minimum levels that fall within the immersion limits shown in Figure 2-4.

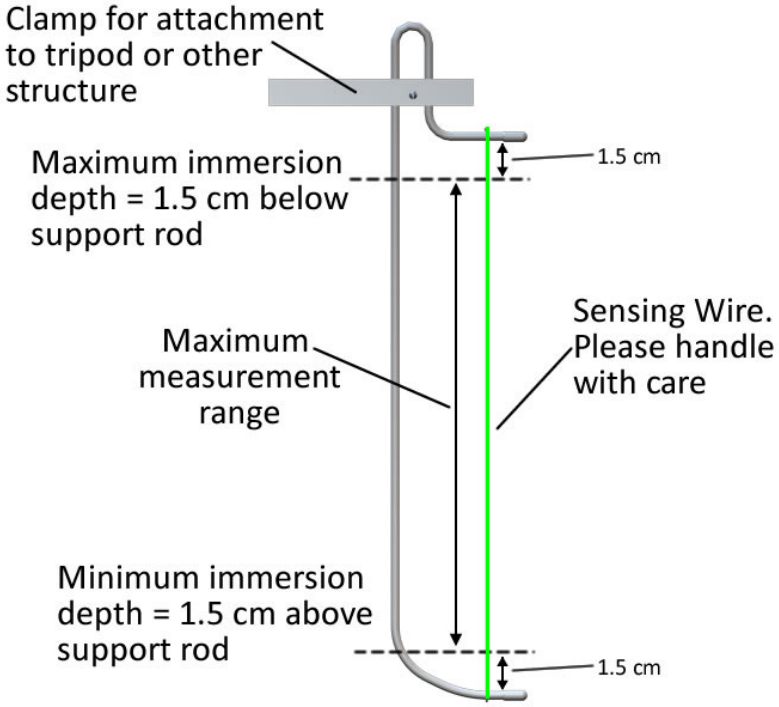

Figure 2-4 Wave Probe Head

The AWP-300-3 does not include a stand or tripod. You will require a stand or tripod in order to place the wave probe head in water. The Akamina wave probe head comes with a clamp shown in Figure 2-4. The clamp can be attached to a tripod or to your specific support structure.

2.5 Wave Probe Head Attachment

The wave probe head provided with the AWP-300 is a high precision sensor and must be handled with care. Please avoid damaging the probe by following these instructions.

CAUTION!

Please ensure that the sensing wire, shown in Figure 2-4, does not come into contact with sharp objects. When not in use, please do not put any weight on the sensing wire or let the wave probe head rest on the sensing wire. Avoid exposing the probe to extreme hot and cold temperatures.

For maximum measurement accuracy please do not exceed the maximum and minimum immersion limit recommendations shown in Figure 2-4. These limits should not be exceeded during configuration, calibration, and during normal operation. However, if you wish to use a smaller measurement range than the full range of the probe, you can use maximum and minimum levels that fall within the immersion limits shown in Figure 2-4.

3 PREPARATION FOR USE

3.1 Connection

The AWP-300 sensors are designed to be connected together in a daisy chain (see Figure 3-1). A maximum of 30 sensors can be connected to a single bus. The last sensor on the chain must have a terminator connected to the open circular connector on the AWP-300-3. This terminator, part number AWPC-03-T, places a 120 ohm resistor across CAN High and CAN Low to maintain the integrity of the bus.

The AWP-300-3 is programmed to use a bus speed of 500 kbps. This limits the total cable length to 100 m or less.

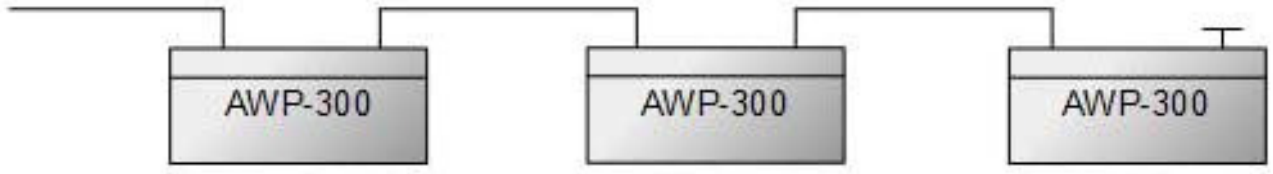

Figure 3-1: Three AWP-300s Connected Together

Each AWP-300 sensor requires up to 20 mA of power at 8 to 24 VDC. Ensure that there is sufficient power for all of the units that will be connected to the power supply (20 mA multiplied by the number of units on the bus).

Once the AWP-300-3 units have been connected together and to a CAN Bus controller, they must be assigned a unique Device ID in the range of 1 to 30. This is necessary to allow the data collection bus master to determine the AWP-300-3 unit that sent a data sample in response to a request sample packet broadcast by the master.

If the AWP-300-3s are connected to the Akamina ADQ-1000 Data Acquisition System, this assignment is done through the WaveGen-Studio ACQUIRE → AWP-300 → Discover Sensors and Assign Sensors buttons. Further information on the ADQ-1000 and WaveGen-Studio is available on the Akamina website.

If the AWP-300-3s are managed using user-supplied CAN Bus software, sensor discovery and Device ID assignment can be accomplished by the following:

1. Broadcast a packet containing the Read Input Registers function code, the Input Registers register type and the Serial Number as the Input Register data field
2. Collect the responses from the units that are connected to the bus and extract the serial number of each unit. This information is also printed on the side of the enclosure.
3. Broadcast a packet containing the Write Multiple Registers function code, the Holding Registers register type, the Input Register Serial Number and Device ID set for one of the units as the data fields. Repeat until all units have been assigned a unique Device ID.

The command protocol used by the AWP-300-3 is defined in the Command Protocol document found on the Akamina website.

3.2 Configuration

The AWP-300 wave height gauge must be configured before it can be used. The configuration steps set the minimum automatically and set the maximum by immersing the probe to the maximum depth of the probe that you wish to use or to the maximum depth of the probe as shown in Figure 2-4.

Configuration can be accomplished remotely using the command protocol defined for the AWP-300 or it can be accomplished manually by opening the enclosure and using the internal switches. Both options are described below.

NOTE

In the configuration steps described below you are asked to immerse the wave probe head in water. For accurate results please keep the water level constant and ensure that the water surface is steady, without any waves or ripples.

3.2.1 Remote Configuration

The AWP-300 wave height gauge must be configured before it can be used. This procedure has been automated so that no external equipment is required and the enclosure need not be opened. To configure a AWP-300-3 using WaveGen-Studio, use the AWP-300 → Change Selected → Configure button. Alternatively, broadcast a packet specifying the Device ID of the target unit, the Write Single Register function code, the Action Registers register type and Execute Config as the action. This process must be repeated for each AWP-300-3 and its corresponding wave probe head.

3.2.2 Manual Configuration

To configure the AWP-300 manually please follow these steps:

1. Open the enclosure top cover by unscrewing the 4 screws.
2. Connect the power wires of the instrumentation cable to a suitable power supply (8VDC – 24VDC maximum).
3. Connect the bayonet connector of the instrumentation cable to either of the 4-pin circular connectors on AWP-300-3. The green PWR LED should be illuminated when the board is powered. There is no need to attach a terminator to the other 4-pin connector as this procedure does not use the messaging protocol.
4. The red LED should be ON solid. If the red LED is not ON solid or if it is flashing, press and hold SET/CLEAR for 3 seconds. This will return the device to factory default settings.
5. Connect the wave probe head to the BNC connector on the AWP-300.
6. Immerse the probe to the maximum depth of water that you wish to measure or to the maximum depth of the probe as shown in Figure 2-4.
7. While the red LED is ON, press the SET/CLEAR push button once. The red LED will start flashing at 0.5 Hz; one second ON, one second OFF. Please do not move the wave probe head or disturb the water until the flashing has stopped.
8. When the 0.5 Hz flashing stops, the device is configured and ready to use. When the device is configured and operating properly the red LED flashes at the rate of 1 second ON, 9 seconds OFF.
9. If during configuration, the LED starts flashing at 5 Hz the device was not able to configure properly. Please press the RESET button, then go back to step 4 and repeat the steps.

If you wish to clear all settings press and hold SET/CLEAR button for 3 seconds. This will return the device to factory default settings. The red LED should be ON solid after clearing the configuration.

The AWP-300 retains all settings when powered OFF. You do not need to repeat the above steps if the device has been powered OFF.

3.3 Output Range Adjustment

After completing the configuration procedure, the output range can be adjusted to maximize the output reading range to approximately +/- 30,000 units. As with the configuration procedure, output range adjustment can also be accomplished remotely using the command protocol defined for the AWP-300 or it can be accomplished manually by opening the enclosure and using the internal switches. Both options are described below.

3.3.1 Remote Output Range Adjustment

To adjust the output range remotely please follow these steps:

1. Immerse the probe to the minimum depth of water that you wish to measure or to the minimum depth of the probe as shown in Figure 2-4.
2. Send the command packet to the unit to have it adjust the output range. If you are using an Akamina data acquisition server and WaveGen-Studio, this can be accomplished using the AWP-300 → Change Selected → Override Minimum button. It can also be accomplished by sending a CAN Bus packet addressed to the unit Device ID specifying the Adjust Min / Max Action Register

3.3.2 Manual Output Range Adjustment

To adjust the output range manually please follow these steps:

1. Immerse the probe to the minimum depth of water that you wish to measure or to the minimum depth of the probe as shown in Figure 2-4.
2. While the red LED flashes at the rate of 1 second ON, 9 seconds OFF, press the SET/CLEAR push button once.
3. The red LED flashes quickly at 10Hz for 1 second after adjustment is completed. If you measure the output voltage now, it should be approximately -30,000 units. When the device is configured and operating properly the red LED flashes at the rate of 1 second ON, 9 seconds OFF.
4. Please note that step 2 can only be performed once. If you need to adjust the output range again you must repeat the steps in 3.2.2 Manual Configuration.

If you wish to clear all settings press and hold SET/CLEAR button for 3 seconds. This will return the device to factory default settings. The red LED should be ON solid after clearing the configuration.

3.4 Adjusting Percent Immersion

If desired, the percent immersion of each unit can be set for each unit. The default immersion depth is 100% making it necessary to configure the probe head with the unit immersed to its maximum immersion point. When it is not possible to immerse the probe head to 100% an alternate immersion depth can be specified. For example, if the probe head can only be immersed to 50% of its maximum immersion, setting the percent immersion allows the unit to be configured at 50% immersion while allowing the top 50% of the probe head range to be used for measurement as well as the bottom 50%. Percent immersion can be set through an Akamina data acquisition server and WaveGen-Studio using the AWP-300 → Change Selected → Set Immersion Depth button. It can also be accomplished by sending a CAN Bus packet addressed to the unit Device ID specifying the Immersion Depth holding register and the desired value.

3.5 Acquiring Data

To acquire data from all sensors connector to a CAN Bus the following sequence can be executed in a continuous loop:

- Broadcast a packet specifying the sends a remote frame with the Message ID set to the multicast address.
- Processes the response data frames sent by the devices. The response frame will include the Device ID of the unit that sent the response packet.
- Store the data in a file for later analysis

3.6 Calibration

The first step before proceeding with actual measurements is to perform a calibration. This is necessary in order to determine the relationship between water depth and the output reading from the AWP-300. We recommend the following guidelines for calibration.

1. The calibration points should span the range of water depths that are to be measured.
2. Use a minimum of 3 points in the calibration. The additional points allow errors to be computed that should be used to verify the calibration procedure and the wave height gauge.

3. The depth of water at each calibration point must be more accurate than the desired accuracy of wave height measurements.
4. The AWP-300 is a highly linear device; always compute the best-fit-straight line through the calibration points.
5. Perform the calibration in steady water with no waves or ripples.

4 MINOR ADJUSTMENTS TO SENSING WIRE TENSION

The sensing wire on the wave probe head must have enough tension to ensure accuracy and linearity of measurements. If the sensing wire has become loose over time please follow these instructions in order to correct the tension of the wire.

Please note that this procedure is only used for small adjustments. If the wire has been damaged or is very loose please refer to the document, *Short Probe Wire Replacement Procedure.pdf*, for instructions on how to replace the wire or make larger tension adjustments.

4.1 Instructions

1. Bend the two ends of the wave probe head supporting rod together in order to remove any tension on the sensing wire.
2. Carefully remove the wire from the top and bottom grommets but do not untie the knot on the top.
3. Once the wire is off, bend the supporting rod outward slightly as shown in figure 5-1 below. The red arrows show the placement and direction of force to be applied. This increases the distance between the two ends of the rod. The rod should not be bent too much.
4. Put the wire back on and the rod and the increased distance should make the wire tighter.

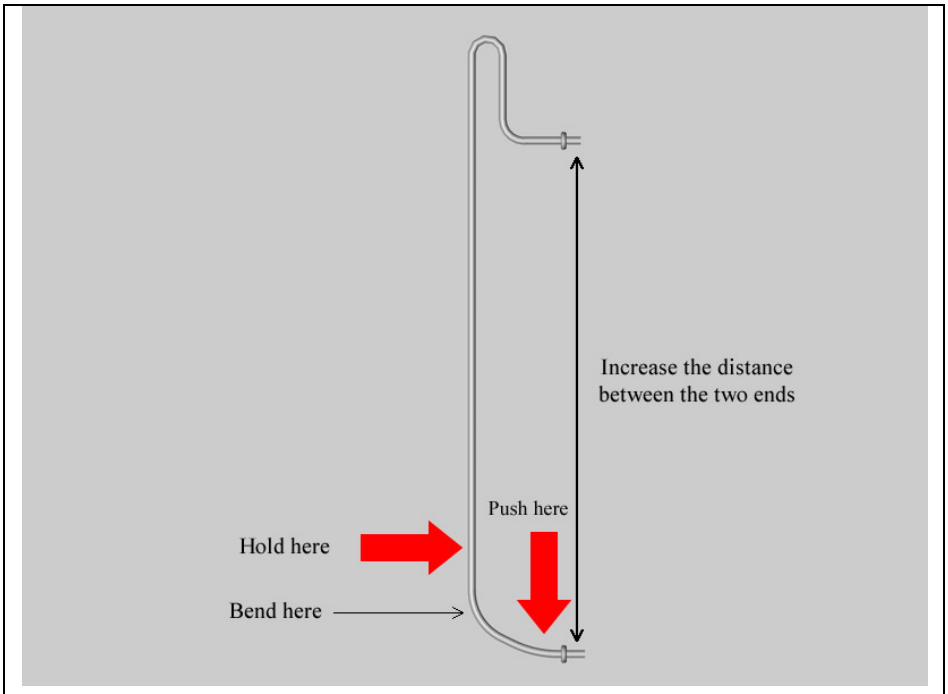

Figure 4-1 Adjusting Sensing Wire Tension

5 AKAMINA PRODUCT WARRANTY

5.1 Limited Warranty

Akamina Technologies Inc. ("Akamina") manufactures (or has manufactured by a third party) its hardware products from parts and components that are new or equivalent to new in accordance with industry-standard practices. Akamina warrants that hardware products supplied by Akamina will be free from defects in materials and workmanship under normal use for a period of one (1) year from the date of shipment to the original purchaser.

This warranty does not cover consumables, such as sensing wire on the wave probe heads, normal wear and tear, damage due to external events, including accident, acts of God, abuse, misuse, problems with electrical power source, attempted modifications or servicing not authorized by Akamina, negligent use or mishandling, and problems caused by use with non-Akamina products, external devices, accessories or parts added to the system.

5.2 Remedies

During the limited warranty period Akamina will, at its option, repair, replace or refund the purchase price of products that are determined to be defective. Replacement may constitute, at Akamina's option, a new, refurbished or functionally equivalent item. A replacement product or part assumes the remaining warranty of the original product or ninety (90) days from the date of replacement or repair, whichever provides longest coverage.

To request limited warranty service, the purchaser must contact Akamina within the limited warranty period. If warranty service is required pursuant to the limited warranty the purchaser will pay for and ship the defective product(s) item to Akamina. Akamina will ship the repaired or replacement product(s) to the purchaser or refund the purchase price of the defective product(s).