MODEL 8510+ FLOWMETER COMMISSIONING PROCEDURE

Customer	WSID	**Accusonic Project #**	53809
Site Name	Main Canal	**Unit / Pipe Name**	Pump Station 1A
Date	Janaury 11, 2022	**Flowmeter S/N**	1610
XDucer Type	7658	**Flowmeter P/N**	8510+10ACR6
ACC Tech.	Greg Pincince	**HMI & DSP Versions**	1.810 & 2.1

Scope

The purpose of this procedure is to ensure that the flowmeter electronic units are functioning correctly, the as-built parameters are correct, the transducers are correctly connected, the system operates with reasonable safety margins, and the flow measurements meet the customer's expectations for uncertainty, throughout the expected range of flows.

Pre-commissioning requirements

1. It is assumed that the transducers have already been installed, that the electronic unit is mounted, a laptop with AccuFlow is available, that the appropriate power has been supplied to the electronics, and that the commissioning technician is in possession of an Accusonic "ASBUILT MEASUREMENT WORKSEET" that is approved for the final commissioning by the Accusonic Engineer of record.
2. For this procedure to be completed, the conduit or channel must contain water flowing in a known direction, preferably at a flow of at least 20% of the maximum flow.
3. The Technical Reference Manual 8510MA0099 or 8510MA0100, supplied with the electronics, must be available. It is assumed that the commissioning engineer has studied chapters 1, 2, 3, and 4 of this manual and is familiar with the site specific configuration which can be obtained from submittal drawings if provided.
4. The latest or appropriate firmware and software should be fitted in the flowmeter. If not, contact Accusonic.

Required Test Equipment

- Fluke Multi-meter (or equivalent) for a.c. and d.c. voltage measurements, continuity 0.1Ω to 1MΩ, and d.c milli-amps 0-20mA.
- Megger or insulation tester (500 V) for testing the transducer cables.
- Portable PC with RS-232 port and AccuFlow installed.
- Serial cable (9-pin to 9-pin) with null-modem adaptor (or a 9-pin to 9-pin null-modem cable).
- Dual time base Oscilloscope, two probes, one rated to at least 1000V peak (10X).
- Optional: Calculator, with trigonometric functions.

Commissioning Procedure for the 8510+ Flowmeter

1. Check that the equipment supplied is appropriate for the site and contains all the customer specific options;
   i.e. supply voltage, heater, relays, and front panel display. If 200kHz transducers have been installed, ensure that the filter jumpers (JP1, JP2, JP4, and JP5) are set in position 2-3 on the DSP card. These jumpers are factory set in position 1-2 (500kHz or 1MHz).
   GP

2. Check that the ribbon cable connectors for J7 (Receiver), J18 (BackPlane), J3 (Relay), and J10 (Analog Out 1), J11 (Analog Out 2), J8 (Analog In 1), J9 (Analog In 2), J1 (DC in), J5 (LCD Signal), and J6 (Touchscreen signal) on the DSP card (8510-0087) are fully connected.
   GP

Note: For Steps 3 and 4 the transducer cables must not be connected to the flowmeter terminals.

3. Check the transducer cable connections and numbering at both the transducers and at the electronic unit, in order to ensure that:
   a. Each cable connects to the appropriate transducer (see customer specific drawing). This can be verified by shorting the conductor and shield (for unbalanced) or the two conductors (for balanced) together at the flowmeter and measuring the continuity at the E/O connector.
   b. The polarity of the twin-axial cable connections is the same for every transducer.

   GP

4. Test each transducer cable for high impedance short circuits. Measure and record the values below. The last three columns are only completed when twin-axial cables have been used. Each reading should be greater than 20MΩ.

Cable	Center to Shield	Center to GND	2nd Center to GND	2nd Center to Shield	2nd Center to 1st Center
1A	150	100			
1B	300	300			
2A	20	20			
2B	200	60			
3A	300	200			
3B	20	20			
4A	20	20			
4B	20	20			
5A					
5B					
6A					
6B					
7A					
7B					
8A					
8B					
9A					
9B					
10A					
10B					

5. Connect the transducer cables at the electronics, analog inputs for water level (if required) accordance with Chapter 4 of the Technical Reference Manual and the customer specific drawings. Do not connect the Alarm Relays or Analog outputs until after all checks up to #26 are complete**.**
   a. If balanced line cables are used (twin-axial cables), the jumpers on the back plane must be changed from the factory set unbalanced position (2-3) to the balanced position (1-2). JP1 and JP2 need to be changed for Path 1, JP3 and JP4 for Path 2, JP5 and JP6 for Path 3, etc. Additionally set JP21 to pins 1-2
   GP

6. Measure the input voltage for the flowmeter electronics to verify that the type (a.c. or d.c.) and the voltage are within the range specified on the label of the electronic unit to which it is connected.
   GP

7. Turn on the flowmeter via the power switch inside the cabinet. Check to see if the LCD screen powers on and the system boots on. The boot process should take <5 minutes. Once the boot process is complete, check the touch screen for responsiveness. Note any discrepancies from above.
   GP

8. Check the d.c. voltage on the connector at the bottom right of the DSP card. Red (+) to Black (−). It should be between 4.95 V and 5.07 V.
   GP Value = 5.01VDC

9. Verify that the power supply LED's located on the path selector panel are lit. If the power supply LED's do not light, switch off the power and check that all connectors on the circuit cards are properly connected. Turn the power back on and recheck the power supply LED's. If the LED's are not lit, measure the three voltages coming from the power supply. If there is a failure, contact Accusonic for replacement parts.
   GP

10. Check that the LED's on the back of the DSP are lit/flashing. The top LED should flash during measurement cycles and the bottom LED should remain illuminated.
    GP

11. Enter all the parameters for the flowmeter as described in the chapters 5 and 7 of the Technical Reference Manual and using as-built data from the approved "ASBUILT MEASUREMENT WORKSHEET" for the flowmeter. Parameter entry may be done using the Touchscreen Display or a PC using the AccuFlow Interface.
    a. **The system parameter "Number of Accum's" should be set to 1 for clean water applications and 4 for wastewater applications.**
    b. If "Pipe" mode is required under surcharged conditions, the section parameters "Min Good Paths" should be set to the number of paths installed, and "Learn Path Ratios" left at 0.
    c. Once the parameter entry is complete, return to the Home screen of the 8510+. The flowmeter will automatically begin measuring. **Double check all parameters before proceeding to the next step to ensure they have been saved in the nonvolatile memory.**

    GP

12. If the flowmeter is a compound meter requiring a Water Level input, set the section parameter "Surcharge Level" to a value equal to or less than the highest layer elevation. If this parameter is set to a value over the highest layer elevation, the flowmeter will not operate when the water level is between the highest layer elevation and the surcharge level. Set the section parameters "Override Level" to 1 and "Manual Level" to a value above the "Surcharge Level".
    NA

13. The flowmeter should operate on all submerged paths if transducers are aligned. Check that the conduit or channel has water and re-check items 2, through 8 above. Also check the operation mode on the System Page for Pulse vs IS mode. GP

14. Check that the acoustic signals are of the appropriate amplitude by observing the “Gain” on Page 1 of Path screen on the 8510+. Record these values below.

Path	Gain (dB)
1	-2
2	-1
3	-1
4	-2
5	

Path	Gain (dB)
6	
7	
8	
9	
10	

GP

Expected values for gain (±3dB) with short cables between transducers and electronic unit are:

Note: The inner paths of a 4-path system installed in a round pipe will have a gain value ~5dB higher than that of the outer paths.
Add 4dB for every 300 ft (100 m) of RG108 cable between transducers and electronic unit.
Add 2dB for every 300 ft of RG22, RG59 or RG62 cable between transducers and electronic unit.

1MHz transducers (7600, 7601, 7605, 7625, 7630, 7657)

Path Length	Gain (dB)
3ft (1m)	0
6ft (2m)	4
10ft (3m)	9
16ft (5m)	15

500kHz transducers (7656)

Path Length	Gain (dB)
16ft (5m)	4
35ft (10m)	10

500kHz transducers (7616, 7618, 7634, 7658)

Path Length	Gain (dB)
20ft (6m)	0
35ft (10m)	4
55ft (17m)	8
80ft (25m)	12

200kHz transducers (7612)

Path Length	Gain (dB)
100ft (30m)	4
300ft (100m)	14

Intrinsically Safe System, 500kHz transducers (7658), with barriers.
Low power transmitter, high gain setting on 8510-0004 DSP card.

Path Length	Gain (dB)
3ft (1m)	4
6ft (2m)	10
10ft (3m)	15
16ft (5m)	20

15. Check that the acoustic signals are stable by observing the Gain % values on Page 2 of the Path screen. The range should be generally within 95% to 105%. A significantly wider range indicates aerated or foul water, or weeds obscuring the path. Make a note of the Gain % values if they are not in this range.
GP

16. Check that excessive electrical noise is not present on the acoustic signals. Observe the Signal / Noise ratio on Page 1 of the Path screen.

    a. The value must be greater than 12dB for the flowmeter to operate. Normally the value will exhibit large variability but should always be greater than 20dB.

    b. A low value on all paths indicates poor grounding of the equipment.

    c. A low value on one path indicates a broken cable on that path.

    d. Make a note of the values. If necessary, increase the system parameter “Number of Accum’s” in wastewater applications to 8 to improve the Signal/Noise ratio. If the problem persists, seek advice from Accusonic.
    GP

17. Check that the flowmeter is detecting the acoustic signals properly by observing the Detection on Page 1 of the path screen. The detection method should be all "ZC" for zero-cross (1st Negative). If the flowmeter is detecting in Envelope Mode, the value will be "EN".
GP

If any values in steps 14-17 are not appropriate, the gain setting (JP3) on the DSP card may have to be adjusted. JP3 is set from the factory in medium gain mode (+10dB) pin 1-2. To increase the signal amplification, change JP3 to high gain mode pin 2-3 (+35dB). For short path lengths JP3 may have to be set to low gain mode pin 1 only (0dB). This combined with adjusting the system parameter “Number of Accum’s” can be used to improve the performance of the velocity measurements in aerated conditions. Contact Accusonic if these settings need to be adjusted.
GP Set to Medium

18. Check that the path lengths are reasonable by observing the Vsound values on Page 1 of the Path screen. The Vsound should be the same ±0.1% for every path and record the values below.

Path	VSOUND
1	4752
2	4753
3	4755
4	4755
5	

Path	VSOUND
6	
7	
8	
9	
10	

GP

Compare the velocity of sound figures with that expected for the water temperature.

VSOUND	Water Temperature
4600 ft/s (1402 m/s)	32°F (0°C)
4750 ft/s (1447 m/s)	50°F (10°C)
4875 ft/s (1482 m/s)	70°F (20°C)
4947 ft/s (1509 m/s)	85°F (30°C)

**Note that in high pressure pipes/penstocks, the Velocity of sound increases by 0.017 ft/s for every foot increase in head (or by 0.017 m/s for every meter increase in head).

19. Check that all the water velocities are in the required direction. A reversal indicates a swapping of the A and B transducer cables on that path.
GP

20. Use an oscilloscope to record the 1st Negative amplitudes and the peak to peak values. The received waveform should have a form similar to the below image.

    a. Connect the trigger input to the A+ transducer terminal of the path to be studied. The earthy side of the input must be connected to GND. Note that the signal can be 800V peak.

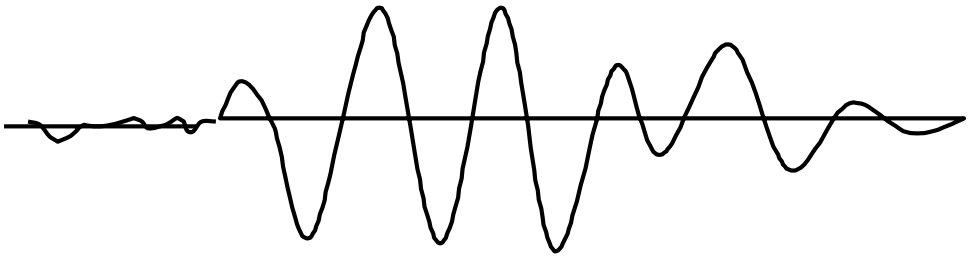
    b. Set the 'scope to trigger on + edge.

    c. Connect the signal input to the 'scope to the "Rx+" test point to the left of the path selector panel, and the earthy side of this to the "COM" test point.

    d. Set the delayed time base to a delay equal to the signal travel time shown on the TRAV screen for that path.

    e. Compare this to the waveform observed for the other direction on that path, by connecting the trigger input to the B+ transducer terminal on the path selector panel.

    f. To observe the waveforms for other paths, move the trigger input to the A+ or B+ transducer terminals for those paths. Record the 1st Negative amplitude and Peak to Peak voltages.



First half cycle must be small & positive

After the first 4 cycles the waveform may not be coherent

An inverted waveform on a single path indicates that the polarity of one of the transducer cables has been inverted (which must be corrected). An inverted waveform on every path indicates that there are air bubbles in the water or that the receiver connection has been inverted (check J7 on the DSP card or J15 on the BackPlane card).
GP

Trigger	1st Negative	Peak-Peak
1A	456mV	1.32V
1B	448mV	1.24V
2A	352mV	1.00V
2B	334mV	994mV
3A	360mV	896mV
3B	352mV	952mV
4A	432mV	1.12V
4B	416mV	1.12V
5A		
5B		

Trigger	1st Negative	Peak-Peak
6A		
6B		
7A		
7B		
8A		
8B		
9A		
9B		
10A		
10B		

Note: The 8510+ does not have different path select boards as in the 7500 and 7510 flowmeters. There is a transformer installed on the backplane so there is always a transformer coupled connection. Measuring the raw signals with the oscilloscope's signal input connected to the test point detailed above will yield smaller amplitutes than when measured directly at the transducer connections. ***Please Note here if the signals were measured at the RECEIVE SIGNAL test points.***

GP

22. Observe the variability of the velocity readings at constant flow, by observing the data on the PC, in the "Connect / Measure" graphical mode. Path velocity standard deviations should be less than 2% of the mean velocity. This means that the range of the displayed velocities at constant flow will be about ±5% from the mean. If flow cannot be held constant, skip this step.

GP

23. If the flowmeter is a **Compound** meter:

    a. Disable the section parameter "Override Level" by setting it to 0 so that the Water Level inputs can be used. Make sure that the level connections are properly connected, the 8510+ level input parameters have been properly set, and that the level device itself has been properly configured (if required).

    b. Observe the Levels on Page 3 of the Path screen and compare these readings with the actual water level in the channel.

    c. If there is a linear offset between the two measurements, the 4mA and 20mA values have to be adjusted by the same amount in the same direction. Alternatively, the Level Input Resistor value can be used to adjust the input.

    NA

24. Check that the mean flow is consistent with that computed from the mean path velocities, their weighting factors and the pipe cross section area, using the appropriate formula in Chapter 3 of the Technical Reference Manual.

GP

25. If the flowmeter is a **Pipe** meter:

    a. Ensure that the metering section(s) will have at least 75% of the maximum flow rate before initiating the "Learn Path Ratios"

    b. In the Parameter screen, on Section - Page 1 tab, set the "Learn Path Ratios" to 1 and the parameter "Min Good Paths" to a value equal to one or two less than the number of paths installed. **Do not set to zero**.

    c. Exit the Parameter screen do not touch until the "Learning" run is completed. An "L" will be shown on the Touchscreen Display's home page while the learn mode is operating. Once the "L" has disappeared, the learn mode operation is complete (this will take 1,000 measurements).

    d. Check that the path fail routine operates by disconnecting paths and noting that the flow continues to be correctly reported.

    Note: this function is not used in open channels, or for a trapezoidal surcharged configuration.
    NA

26. Check the analog outputs using the multi-meter. The analog output parameter "Override Output" can be used as a loop calibrator.

    a. Set this parameter to 1 to enable this mode and set "Man Output Value" to either zero (4mA), mid (12mA), or full scale (20mA) in engineering units. Measure the current with the meter connected directly across the output terminals.

    b. If adjustments are required, the 4mA and 20mA values can be adjusted digitally with the Touchscreen Display. For every 0.01mA adjustment required, a 25bit adjustment in the 4mA and 20mA FINE ADJUST values are required.
    GP

27. Connect the analog outputs to the customer's equipment and demonstrate that the flowmeter outputs are in agreement with the customer's displays.
    GP

28. **Proceed with this step if the customer intends to use the 8510+ relays. If not, skip to step 29.**

    a. Check that the voltage and current that the customer wishes to pass through the alarm relays is within the relay specification (see Chapter 2 & 4 of the Technical Reference Manual). NA

    b. In particular when the customer's circuit is shorted and then opened, what is the peak voltage generated? NA

    c. Measure this peak voltage with an oscilloscope and note the value. Ideally the peak should not exceed 300V, but if the customer's equipment is not suppressed the peak voltage could exceed 2500V and generate severe arcing. NA

    d. The use of "Varistors" or other suppression devices may be necessary to meet a reasonable electro-magnetic compatibility standard and to prevent the relay contacts from being burned. NA

    e. Connect the alarm relays to the customer's system. NA

29. Use Accuflow and save a copy of the final operating parameters. A copy of these parameters should be left with the customer and a copy transmitted to Accusonic for the job file.
    GP

This completes the commissioning of the 8510+ flowmeter.