BLUE SIREN INC.
Engineering Specification

Flow – Micro SIREN

Instrument

The AV monitor shall be an open-channel flow module suitable for multi-sensor monitoring. An area/velocity sensor shall be used to measure the flow depth and flow velocity of the effluent path. An ultrasonic level option can be included to measure level above flumes and weirs. A battery module or external AC port shall provide power to operate the flow monitoring system. The monitor will have a built in wireless data module which can be programmed to automatically send data, images and alarms to a local or remote server. The monitor will support the use of custom look up tables that support flow calculations for primary devices and odd shape pipes. Options for the addition of a LCD flow totalizer used to view depth, velocity, flow and total volume will be included with the addition of a ON/OFF power button allowing for power conservation. A reset or smart button will be included which performs different functions, such as volume reset and wireless force upload. The monitor will have an integrated data storage for images using an allocated memory separate from the core data storage location. Pictures will be time stamped and stored along with time stamped sensor data. The monitor will support up to 8 analog sensors or 8 serial sensors, 8 digital sensors and 4 pulse sensors.

Area Velocity Sensor

Velocity:

The sensor shall measure the liquid flow velocity using ultrasonic Doppler technology, with the addition of dual transmitters allowing for greater sound distribution through the flow stream. Average flow velocity is determined by averaging all return signals determining the average channel velocity. The end user will have the ability to modify the Doppler K value if required allowing for more precise measurement in sites with poor hydraulic conditions. The sensor will not rely on a single point velocity or multiplier to determine point to average velocity. The sensor shall be self-contained and not rely on exposed electrical contacts to measure velocity. The sensor will contain two 500 Khz transmitters and send out signals at an angle of 25 degrees. The sensor will also contain an AGC automatic gain amplifier to control signal gain based on the strength of the received signals. The velocity measurement range will not be limited. The velocity sensor will output a serial signal transmitting at a low baud rate of 4,800 BPS allowing for cable lengths up to 500ft. Data will transmit as an integer at a resolution of 1 mm/s or 0.00032 ft/s. The minimum sensor coverage to accurately read velocity is 25 mm or 0.08 ft.

Depth:

The sensor shall contain an embedded stainless steel pressure transducer to measure the water pressure from 0 to 15psi. The measurement range will be from 0.015m to 10m (32ft). The measurement resolution and accuracy will be +/- 1 mm (0.0032ft). The sensors will have a common coefficient and factory calibrated and wet tested for 24 hrs. The Depth sensor will be easily field calibrated allowing for atmospheric compensation and offsets. The sensor will not utilize external dials or switches to calibrate it, all calibrations and coefficients will be digitally stored in the flow monitor. Sensor analog signals are converted to digital data using a 16bit ADC.

The sensor will be streamlined minimizing or eliminating the chance of flow debris getting caught during normal operation. The sensor cable will exit the back of the sensor and be no more than 5mm or 0.2 inches diameter. The sensor will be approximately 1 inch (25mm) in height and 4 inches (100mm) long. The standard sensor cable length will be 25ft with an option to extend up to 400 ft in length. The sensor connectors shall be rated IP68 and made of a non-corrosive material, aluminum connectors will not be accepted. Sensors will be interchangeable in the field for any monitor. The sensor cable shall contain an atmospheric vent tube and have an external desiccant cartridge. Sensors will be constructed of epoxy, urethane, stainless steel, and PVC cable. The sensors shall operate at a temperature from 32 to 180°F (0 to 80 °C).

Flow Logger

The flow logger will support dual AV sensor inputs, vision port for camera connection, 12 pin port for up to 10 additional sensor inputs, SIM card slot, antenna port, smart button, power connection and communication port. The flow logger will support an external or internal power battery module. The flow logger will contain an LCD which will display depth, velocity, flow and total volume. The flow logger will be manufactured using ultra low power technology and have a onboard 3G wireless module. The flow logger will support a RS485 output option using an addressable protocol.

The flow logger will support round pipe flow equations as well as depth area and stage discharge tables for odd shape pipes, rivers, streams, weirs and flumes. The flow logger will support dual pulse outputs including a pulse output based on sensor alarms and pulse output used for flow pace sampling.

The flow logger will maintain two independent memory locations, one for data and the other for images. The flow logger will support up to 8 serial sensors or 8 analog sensors including voltage and current. The flow logger will also support 4 pulse inputs typically used for rain gauges and wind sensors. The flow logger will also support 8 digital input and 1 serial input for camera connection. The flow logger will automatically store battery levels, internal temperature and backup battery status.

The flow logger will store up to 88,000 time stamped readings, with each reading containing 20 separate sensor data points, for a total of 2.5 years data storage at 15 minute intervals. Data will be stored in wraparound mode. Image data will be stored in a separate memory chip capable of storing 128 64K XVGA resolution images. Images will be time stamped and also stored in wraparound mode. The data storage sample rate can be programmed from 1s to 60s or 1 min up to 1 day. Based on firmware, the flow logger can be programmed to support a variable rate alarm triggered storage, with storage interval changing based on any sensor alarm condition. Data can be deleted at any time and memory slate wiped clean. Images can be stored at intervals equal to the sensor sample rate or set up to take one image at a predefined rate up to 1 day. Image times will directly correlate to flow logger sample rates. The flow logger will not implement equations to automatically clean or fix data at the hardware level, only raw data will be logged.

The flow logger can be programmed using field software developed for the PC computer and run on any Windows operating system. Field software will be freely distributed and allow multiple users per license.

The Field software will allow data download, image download, wireless data and image uploads. The computer will communicate to the flow module using a RS-232 cable with IP68 connectors at 57,600 baud rate.

The flow logger will store all programmable options and easily be reconfigured to any previous setting or duplicate any other monitor in the field. The flow logger will support two way wireless communications allowing programming using any internet connection and internet browser.

The flow logger and wireless module operate off an independent 3.7 V rechargeable battery and will maintain communications for up to one month after the primary 12V battery is fully discharged. This feature allows for battery alarms and warning that the sensor battery has gone completely dead. One or more primary batteries can be used allowing for a scale able power solution including the option of solar if required.

Camera Sensor

The camera sensor will support night vision using six infrared LED's and constructed using non-corrosive epoxy and urethane plastics. The IR-LED will be fully encapsulated using a optically clear epoxy that is UV protected and will not yellow under UV conditions. The camera sensor can be fully submersed and survive the harsh conditions of a sewer environment. The camera sensor will support VGA/QVGA and 160X120 resolution. Images will be converted and stored as JPEG at the hardware level and download or transmitted as JPEG from the memory location. The camera will communicate at a default baud rate of 38400 and use a 5V power supply. The camera sensor communicates and is controlled by the flow logger directly. Images are taken at the exact same time samples are taken and time stamps correlated and stored in two separate allocated memory locations.

Images are stored in a non-volatile flash and compressed at the hardware level into JPEG format. The camera sensor will also support addition of an external LED light pack for large chambers and increased night visibility.

Wireless Connectivity

The flow logger will have an embedded wireless module that is a part of the instrument and not sold as a separate instrument. The wireless module will support HSDPA (UMTS 3G) 850/1900 and at the same time in areas where 3G is unavailable support the [GPRS/EDGE 850/1900]. The modem shall have a 3.6 downlink speed and run on low power of 3.4 to 4.4 Volts. The flow logger will support dynamic DNS allowing the end user to send data to a web site/URL location and not tied into a single IP, allowing the end user to change data locations without having to go into the field and manually change the IP address. Wireless connectivity will allow for both sensor and image data to be sent out over the air using a compressed binary protocol reducing data size and wireless fees. Data will be sent to a cloud server location and made available using ftp, email, drobox or hosting application.

Field Software

Field Software will be supplied to the end user at no additional change. Field software is used to program the flow logger, set up and calibrate sensors and configure wireless parameters. Field software will also support the ability to add and configure any analog or digital sensor without requiring the manufacturer to set up or configure sensors they do not manufacture. Data and images can be manually downloaded to local PC hard-drives using a RS232 com cable or wirelessly upload data and images directly to the cloud or local server location. Raw data collected resides in a tab delimited ASCII readable tab format and is converted to an Excel CSV format for reporting and spreadsheet analysis. Field software will store all core CPU setup information for each monitor serial number and allow end users to program default and custom configurations. Field software allows for programming of round pipe and custom look up tables that support both stage width-area and stage discharge tables. Output pulse and output flow volume pulse can be configured using the field software, and settings stored in the monitor memory. Field software will allow the ability to take real-time sensor readings and support field calibration tools for testing, calibrating and configuring sensor readings on site.

Battery Module

The internal battery module shall include a 12V alkaline battery holder containing 8 cells. The external battery module shall include dual 12V alkaline battery holders containing 16 cells. The battery packs typically last 6 months to a year based on single sensor configuration, 15 minute sample rate and daily wireless uploads. The battery module shall be housed in a rugged NEMA 4X enclosure.