AQUALEAK 10K

Water Leak Detection system

Installation and Operation Manual

Issue 1.0, July 2019

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PREFACE

Published by Aqualeak.

All possible care has been taken in the preparation of this manual, but Aqualeak, its agents and distributors accept no liability for any inaccuracies that may be found. This manual reflects the state of the product at the issue date below, but further enhancements while in service may mean that the manual does not precisely reflect your system.

Aqualeak reserves the right to make changes without notice both to this manual and the products which it describes.

Issue 1.0, 31st July 2019

Firmware version: 3.2

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If you require technical assistance with this product that is not covered within this manual, then help can be requested from Aqualeak or our distribution partners.

General enquiries about this or other Aqualeak products should be sent to sales@aqualeak.comm

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SAFETY WARNINGS

WARNING – ELECTRIC SHOCK

The Aqualeak 10K operates using mains voltage that is dangerous to life. Before work commences, make sure that the mains power is isolated by a competent person and a Lock Out and Tag-Out procedure has been followed. Prove the mains supply is de-energised with a suitable multi-meter which has been checked with a proving unit.

Death, personal injury and/or damage to persons and/or property may result if this is not observed.

LIST OF ABBREVIATIONS

Below is a list of standard abbreviations used in this manual.

A	Amp
AC	Alternating current
BIT	Built In Test
BMS	Building Management System
C	Celsius
Comms	Communications
dB	decibel
DC	Direct current
Deg	Degree
EC	European Commission
EOL	End of Line
g	gram(s)
Hz	Hertz
IEC	International Electrotechnical Commission
IP	Ingress protection
kg	kilogram

LED	Light Emitting Diode
Lsb	Least significant bit
M	Metre
min	minutes
mm	millimetre
Msb	Most significant bit
msec	milli-second
Nm	Newton metre
No.	Number
PSU	Power Supply Unit
RTU	Remote Terminal Unit
sec	seconds
VAC	Volts (Alternating Current)
VDC	Volts (Direct Current)
W	Watts

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INTRODUCTION AND PRODUCT OVERVIEW

The Aqualeak 10K is a cost effective, distance-read, leak detection solution. The Aqualeak 10K uses sensing equipment (sold separately) to detect the presence of water and other liquids. If a leak is detected, an alarm is activated, the distance to the leak is displayed, and the Aqualeak 10K can report the presence of the leak to a Building Management System (BMS).

Aqualeak 10K is a single zone system, designed for continuous operation with minimal human intervention.

In operation, the Aqualeak 10K continuously monitors the sensor cables connected to it.

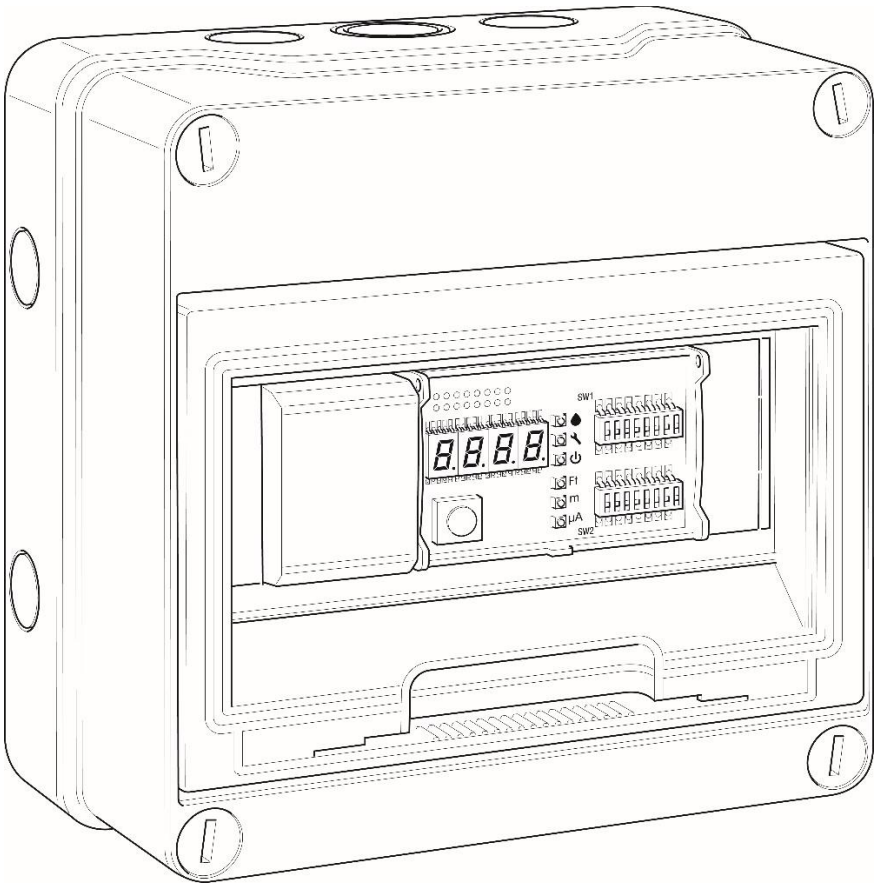


Figure 1 Aqualeak 10K

DESCRIPTION

Capable of accommodating up to 2500 m (8200 ft) of sensor cable, the Aqualeak 10K has an audible alarm and can communicate via Modbus. As a stand-alone solution, the Aqualeak 10K provides alarm notification, and numeric distances to leaks or problems, on its front panel. Integration into a Modbus network allows the activity and status of one or multiple Aqualeak 10K's to be managed from one central location.

Supervised System

The Aqualeak 10K is a *supervised system* – it continually monitors the sensor cable and spot detectors for continuity and produces alarms for the following conditions:

1. Leak detection.
2. Cable break.
3. Cable contamination.

Sensors available

Water is detected using a sensor cable up to a maximum length of 2500 m (8200 ft). Only use the recommended type of sensor cable supplied by Aqualeak in conjunction with the 10K.

Although not normally installed, spot detectors may be used with the 10K. Contact Aqualeak for more details.

Distance-Read Leak Detection

When the Aqualeak 10K's circuitry measures a current in excess of the user-defined leak threshold, the unit's microprocessor computes the distance to the leak. The Aqualeak 10K then sounds an alarm and communicates via Modbus to a master controller or a Modbus- equipped monitoring system. The summary relay sends notification to an alarm panel or monitoring system.

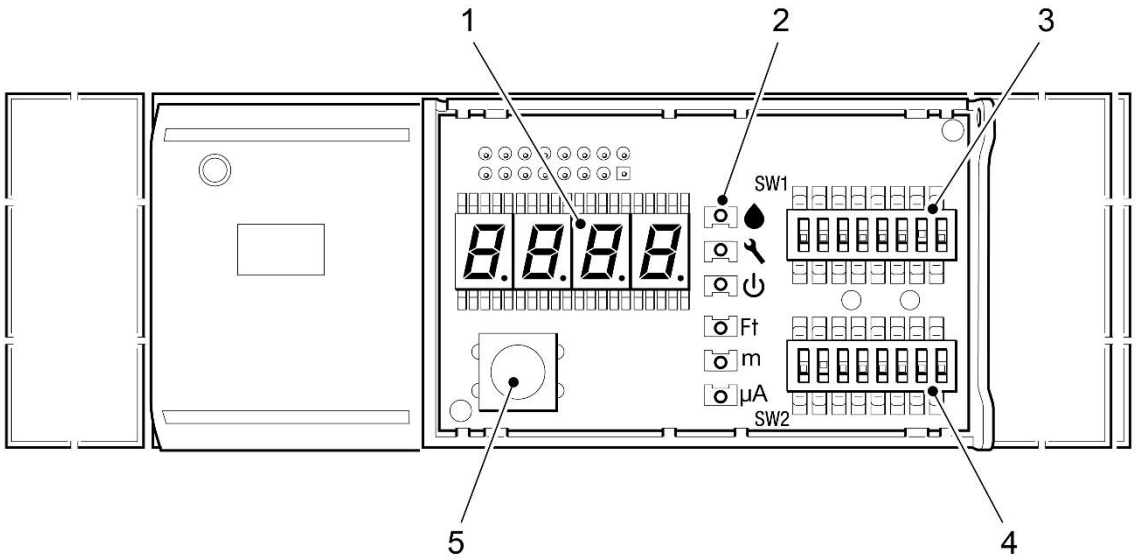
Front panel

The 10K's front panel display (Figure 2) includes a four-digit LED panel and six LED indicators that provide information about its status, including the following:

- Leak detected;
- Distance to leak or contamination;
- Cable fault detected;
- Power status;
- Configured unit of measure;
- Leak detection cable's amperage value;
- Length of installed leak detection cable;
- Self-test results.

The two blocks of DIP switches on the 10K's front panel are used for configuration. DIP SW1 configures parameters such as leak and contamination thresholds, latching alarms, and re-alarm time interval. DIP SW2 is used to set the Modbus address information for the 10K.

The 10K also provides configuration capability and status information to a Modbus equipped system via its EIA-485 port.



1 Four-character LED display
2 LED's
3 DIP Switch SW1 – Configuration Settings
4 DIP switch SW2 – Modbus Configuration
5 Test/Reset/Alarm/Silence push-button

Figure 2 Aqualeak 10K controls and indicators

Internal description

Please refer to Figure 3. The active components of the Aqualeak 10K are the 10K Controller and the associated Power Supply Unit (PSU). They are mounted on a standard DIN rail inside the back box of the 10K casing. To the left of the PSU are DIN rail mounted terminal blocks for the mains supply live, neutral and Earth connections.

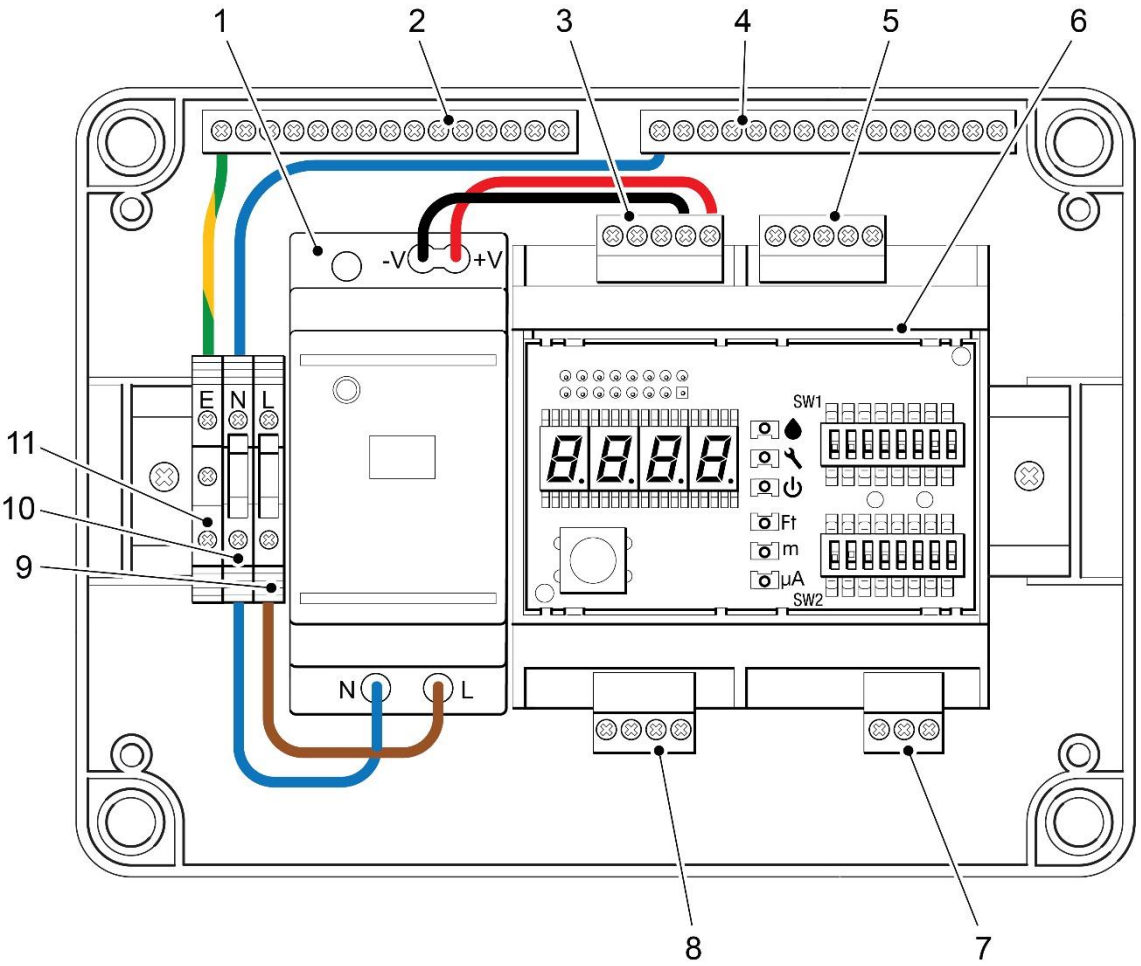
The 10K Controller contains two circuit boards. The top circuit board houses the operational controls and displays. The lower circuit board houses connectors for the leak detection sensor cable, relay outputs, communications and AC/DC power, and Earth.

If the 10K requires repair and service, it must be either returned to Aqualeak, or an Aqualeak Installation Engineer called-out.

SUPPLIED ITEMS

The Aqualeak 10K, as supplied, comprises the following items. Before installing the 10K, check that all items are present and undamaged:

1. The 10K unit, shown on the front cover of this manual.
2. A 4.57 m leader cable, that is used to connect the sensor cable to the Aqualeak 10K.
3. An End Of Line (EOL) terminator.



1 Power Supply Unit
2 Earth bus bar
3 AC/DC power and EIA-485 Comms Port
4 Neutral bus bar
5 AC/DC power and EIA-485 Comms Port
6 10K Controller
7 Relay Output (TB1)
8 Sensing Cable connector (TB2)
9 Live terminal block
10 Neutral terminal block
11 Earth terminal block

Figure 3 Aqualeak 10K interior

ADDITIONAL ITEMS

A complete Aqualeak 10K system requires the following additional items, which are sold separately:

1. A sensor cable. Aqualeak recommends that only the orange coloured sensor cable (Part No. SCTDM) designed to be used with the Aqualeak 10K is used. If the recommended sensor cable is used any length of sensor cable up to a maximum length of 2500 m (8200 ft) may be linked to the 10K.

2. J-clips, used to secure the sensor cable to floors, etc. The number of J-clips required will depend upon the length and route of the sensor cable.

NOTE

If this product is used in any manner other than that specified by the manufacturer, the protection provided by the equipment may be impaired.

SPECIFICATION

The specification of the Aqualeak 10K is given in the following Table.

Table 1 10K specification

Aqualeak 10K	Value	Units	Notes
Dimensions	180 x 180 x 98	mm	Width x height x depth
Weight	800	g	
Supply Voltage	100 to 230	VAC	50/60 Hz nominal, 47/63 Hz actual
Power consumption	24	W	
Ingress Protection (IP) Code	55	IP	Ingress Protection to IEC 60529
Operating temperature range	0 to +50	deg C	Ambient temperature
Humidity range	10 to 95	%	Relative humidity (Non-condensing) at 45 deg C
Operating altitude	0 to 4572	m	
Storage temperature range	-20 to +70	deg C	
Max Relay output (DC)	30	VDC	5 A resistive
Max Relay output (AC)	250	VAC	8 A resistive
Relay minimum load	10	mA	@ 5 VDC
Sensor cable			Only use the recommended orange coloured sensor cable
Leader cable	4.57	m	EOL terminator required for sensor cable
Maximum length	2500	m	
Minimum length	10.97	m	
Detection accuracy	0.6	m	+/- 0.5 % of sensor cable length)
Detection repeatability	0.6	m	+/- 0.25 % of sensor cable length)
Detection response time	5 to 990	sec	Selectable
EIA Communication Port	1200 9600 38400 N2	Baud	Selectable. Parity: none. 8 data bits, 1 stop bit
Visible alarm			LED and LED display (see Operation section of this manual)
Audible alarm	85	dB	at 0.6 m Can be disabled
Alarm repeat	0 to 999	min	Configurable
Protocols			
Modbus (RTU)	Slave; RTU mode; Supports function codes 03, 04, 06 and 16 Master; RTU mode for integration with any Modbus master BMS/NMS. Addressable from 1-255.		
Johnson Controls Metasys	N2		

INSTALLATION AND CONFIGURATION

PREPARATION FOR INSTALLATION

Check that all items supplied with the Aqualeak 10K, and all optional items required for your installation, are present and undamaged. Refer to the list on Pages 10 and 11. If any items are missing or damaged, report it before installing the equipment.

INSTALLING THE AQUALEAK 10K

Install the Aqualeak 10K on a wall, in a suitable location, as follows:

1. Remove and retain the four flat head screws that secure the front panel of the Aqualeak 10K. Remove the front panel.
2. Refer to Figure 4. Using the mounting points provided on the 10K's back box, securely mount the 10K's back box in a suitable location, making cable entries as required. Bring cables through into the back box before starting to make final connections.

ESTABLISH PHYSICAL CONNECTIONS

Connect the Aqualeak 10K as follows:

WARNING – ELECTRIC SHOCK

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Death, personal injury and/or damage to persons and/or property may result if this is not observed.

1. If not already done, a competent person must install a 230 VAC fused spur near to the Aqualeak 10K. The fused spur must be clearly marked as the disconnecting device for the Aqualeak 10K.

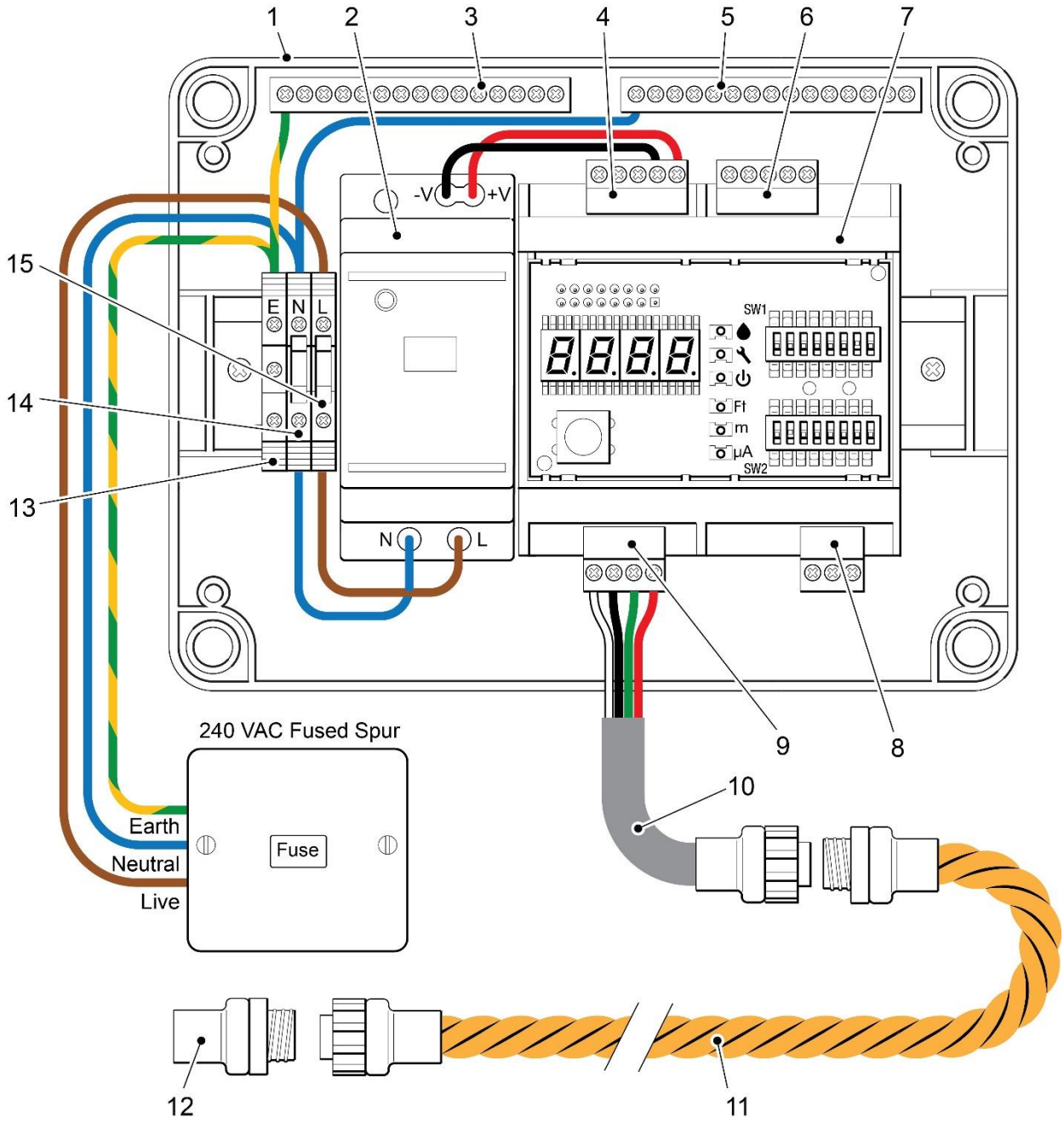
CAUTION – EQUIPMENT DAMAGE

When connecting the mains power to the Aqualeak 10K make sure that the correct polarity is observed. Reversing the polarity of the live and neutral connections will result in damage to the 10K unit.

2. Connect the Aqualeak 10K unit to the fused spur as shown in Figure 4. Connections must be made to the Neutral/Earth/Live terminal blocks as shown in Figure 4.

NOTE

When delivered, the Aqualeak 10K already has the internal power connections between the terminal blocks and the PSU, between the terminal blocks and the bus bars, and between PSU and 10K Controller.



1 10K back box
2 Power Supply Unit
3 Earth bus bar
4 EIA-485 Comms Port
5 Neutral bus bar
6 EIA-485 Comms Port
7 10K Controller
8 Relay Output (TB1)
9 Sensing Cable connector (TB2)
10 Leader cable
11 Sensor cable
12 End Of Line (EOL) terminator
13 Earth terminal block
14 Neutral terminal block
15 Live terminal block

Figure 4 Electrical connections to Aqualeak 10K

TB1 Summary Relay (optional)

Terminal Block 1 is a Form C relay output. This relay enables alarm notification through a local or remote panel, master controller, or BMS; whenever a leak, cable fault, or cable contamination is detected.

1. Insert the wires into the appropriate slots on TB1 to connect the relay output to the desired panel or controller.

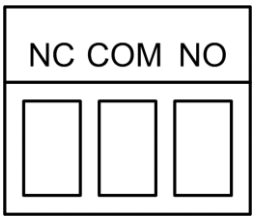


Figure 5 Relay Output Connection TB1

2. DIP switches are used to adjust settings on the Aqualeak 10K.

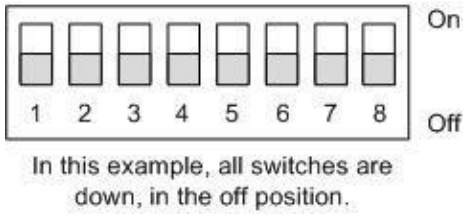


Figure 6 General DIP Switch settings

3. Use DIP switch 5 on the SW1 DIP switch block to configure this relay as *latched* or *unlatched*.

- An *unlatched* alarm resets itself once a detected leak or cable problem has been resolved.
- A *latched* alarm must be manually reset, even if the detected leak or cable problem is no longer present.

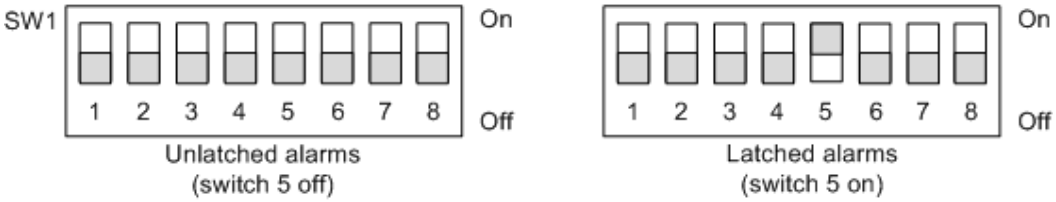


Figure 7 SW1, DIP Switch 5 – Latched or Unlatched Alarms

TB2 Leader Cable

A 4.57 m section of non-sensing leader cable is supplied with each Aqualeak 10K. The leader cable connects the sensing cable to the Aqualeak 10K, since sensing cable cannot connect directly to the 10K. Insert its four stripped wires into the appropriate slots in TB2 – from left to right: white, black, green, and red.

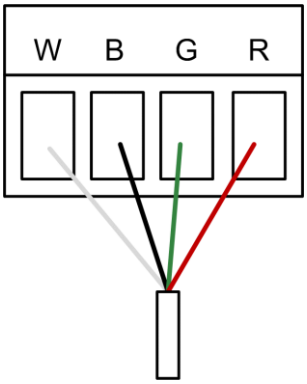


Figure 8 Cable connection TB2

NOTE

If the terminal connector is removed from the end of the cable, make sure the wires are in this same order, W - B - G - R, when the connector is reapplied.

1. Use DIP switch 6 in block SW1 to designate whether the distance on the display is shown in feet or meters:

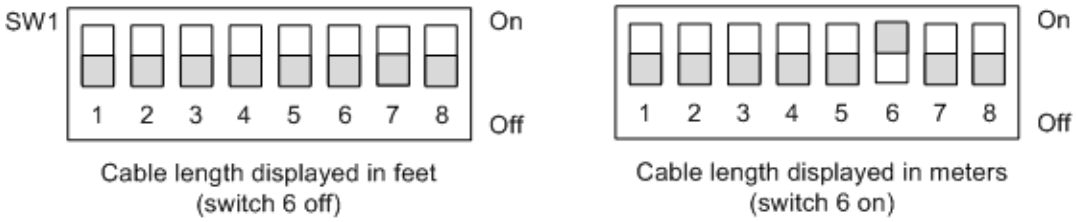


Figure 9 SW1, DIP Switch 6 - Display cable length in feet or meters

2. Aqualeak's orange sensing cable (Part No. SCTDM) has a resistance of 2.8 Ohms per foot. Set DIP switch 7 in block SW1 to the appropriate resistance-per-foot value;

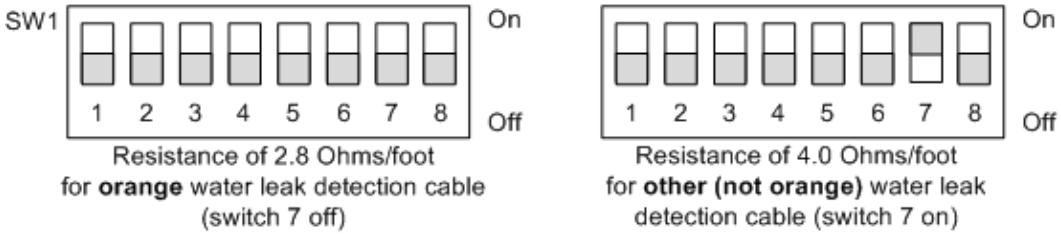


Figure 10 SW1, DIP Switch 7 - Ohms per foot resistance

TB3 and TB4: Input Power and EIA-485 communications ports

NOTE

When delivered, the Aqualeak 10K already has in place the internal power connections between the terminal blocks and the PSU; and between the PSU and the 10K Controller. The information given in sub-para 3 below is only provided for completeness, and in case internal wiring has come loose.

CAUTION – EQUIPMENT DAMAGE

The Aqualeak 10K requires an isolated power supply. Always use the internal PSU.

Do not connect 120/230 VAC directly to the 10K Controller, or damage will occur to the circuitry.

3. If necessary, refer to Figure 4 and use the two left-hand pin-outs on either TB3 or TB4 (marked AC/DC) to connect power to the 10K Controller. The positive and negative wires of the power supply can be inserted into either of the pin-outs; the Aqualeak 10K's circuitry will auto-correct.
4. If you are installing only one Aqualeak 10K and it will communicate via Modbus to a Modbus-enabled controller, use the three most right-hand pin-outs on TB3 or TB4 to connect the Aqualeak 10K to an EIA-485 network.
5. If you are installing more than one Aqualeak 10K, use the appropriate pinouts of TB3 and TB4 to create a daisy-chained Modbus connection.
6. A grounded shield contact is provided for connection to a shielded cable. If the shield contact is used, verify the power connector is properly grounded and that there is no voltage potential between units on the Modbus network.

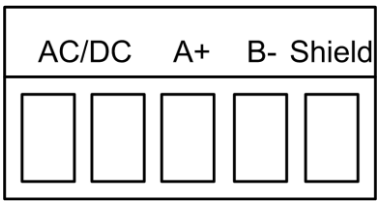


Figure 11 TB3 and TB4 Power Supply and Communications connections

7. Set the baud rate for the EIA-485 port using DIP switches 1 and 2 on SW1.

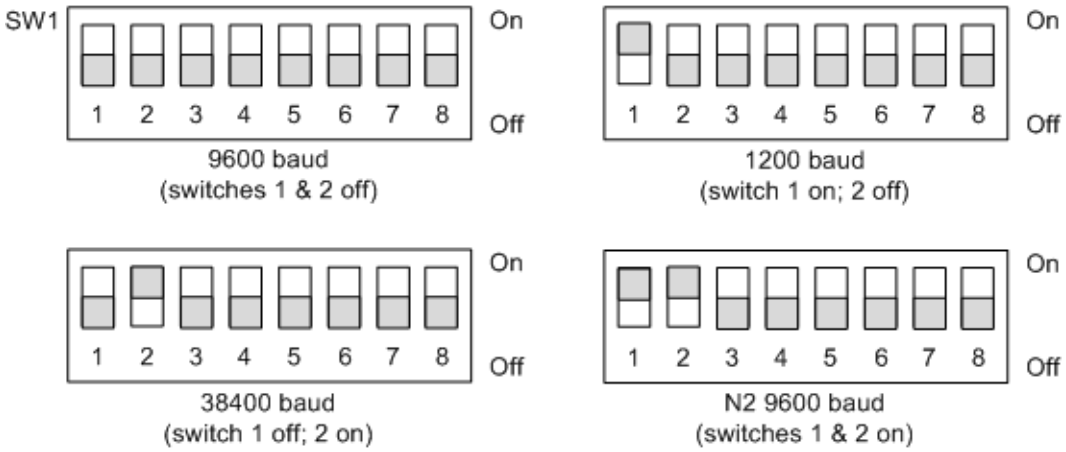


Figure 12 DIP Switch settings for Communications Baud Rate

NOTE

The EIA-485 port is set to 8 databits, no parity, and 1 stop bit (8, N, 1).

8. DIP SW2 is used to set the Modbus address. For further information regarding Modbus configuration, refer to "Modbus Communication" on page 25.
9. If you are communicating via Modbus, you only need to set the Modbus address using DIP SW2. The Modbus address should be a number between 1 and 254. Adjust the

individual switches until their sum equals the Modbus address. The following illustration shows the values of the DIP switches on the SW2 block, as well as two examples of how the DIP switches would be set for specific unit addresses.

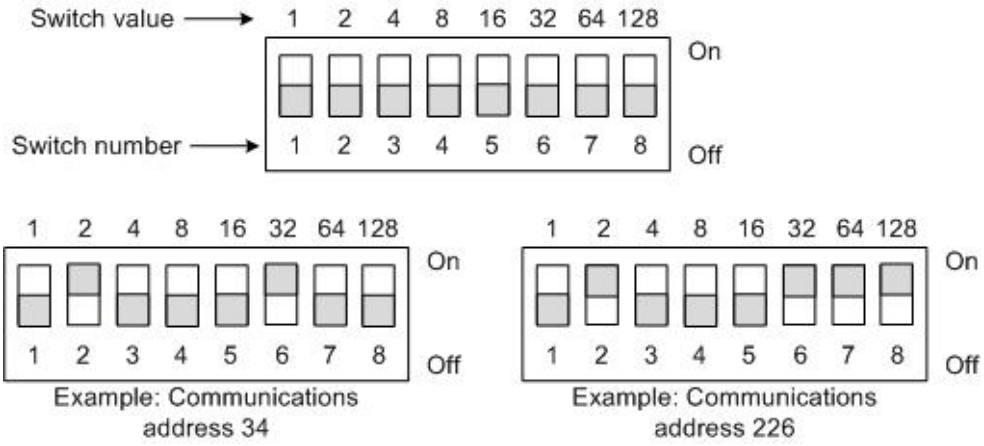


Figure 13 DIP Switch settings for Communications Address

JMP - Termination Jumper

The termination jumper, labelled JMP, is located next to TB4. It is used to designate the end of the line unit in a daisy chain. The Aqualeak 10K ships with the jumper in the non-terminated position - over the two pins closest to the device enclosure. If your Aqualeak 10K is the only device in the application, or if it's not the last unit in the daisy chain, leave the jumper where it is. If your unit is the last device in a daisy chain, move the jumper so it is over the two pins nearest the end of the board

SELECT ALARM OPTIONS

Enable and Disable the Audible Alarm

The audible alarm is disabled by default. To modify this setting, adjust switch 8 on DIP SW1 as shown in the following illustration.

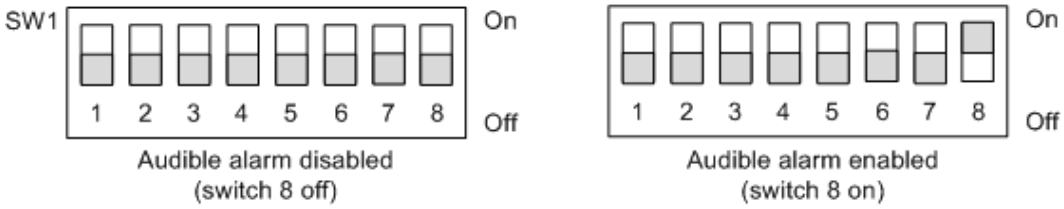


Figure 14 SW1, DIP Switch 8 – Audible Alarm settings

Set the Re-Alarm interval

The Aqualeak 10K can be set to re-alarm. If set to re-alarm, when a leak or cable fault has been detected, the alarm will be re-sent at 4 hour intervals until the alarm condition has been resolved. This re- alarm triggers both the audible alarm and the Modbus readout.

The re-alarm option is disabled by default. Activate the re-alarm setting using DIP switch 4 of SW1 as shown in the following illustration.

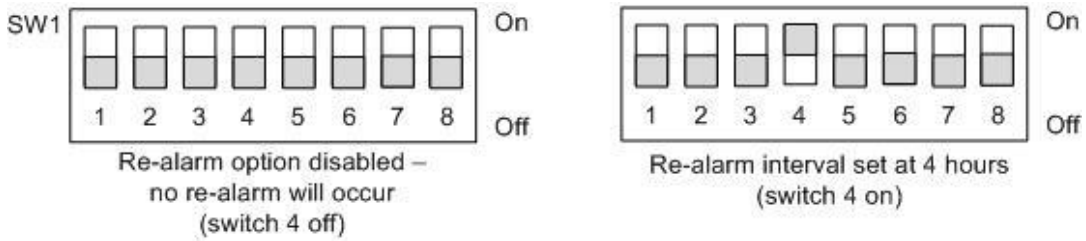


Figure 15 SW1, DIP Switch 4 - Re-Alarm interval

CONNECT THE LEAK DETECTION CABLE

The Aqualeak 10K is shipped with a 4.57 m leader cable. This leader cable was connected to the 10K as described on page 14. The following directions help you connect sensing cable to the Aqualeak 10K.

CAUTION - INCORRECT OPERATION

To avoid incorrect leak detection readings, connect a minimum length of 10.7 mof sensor cable to the Aqualeak 10K.

Connect lengths of sensor cable

Connect the sensor cable(s) as follows:

1. Unscrew the end-of-line (EOL) terminator from the end of the leader cable.
2. Attach the first length of sensor cable to the leader cable. Insert the male pins into the female connector and twist the collar on the female side of the connector to secure.

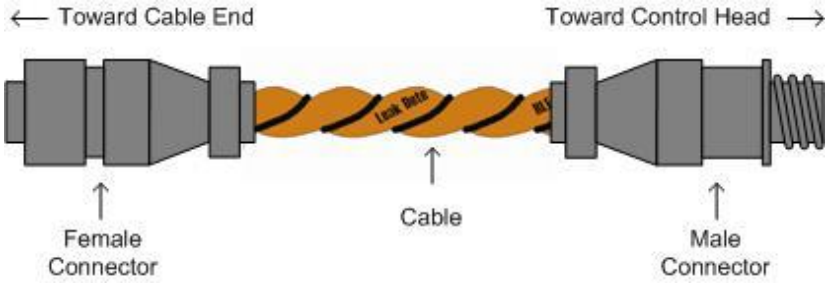


Figure 16 Sensor cable

3. Route the sensor cable according to your cable layout diagram. Attach additional lengths of sensor cable as necessary.
4. Secure the EOL terminator to the unoccupied end of the last length of sensor cable.

NOTE

If the EOL terminator is not present at the end of the cable run, a cable fault will register.

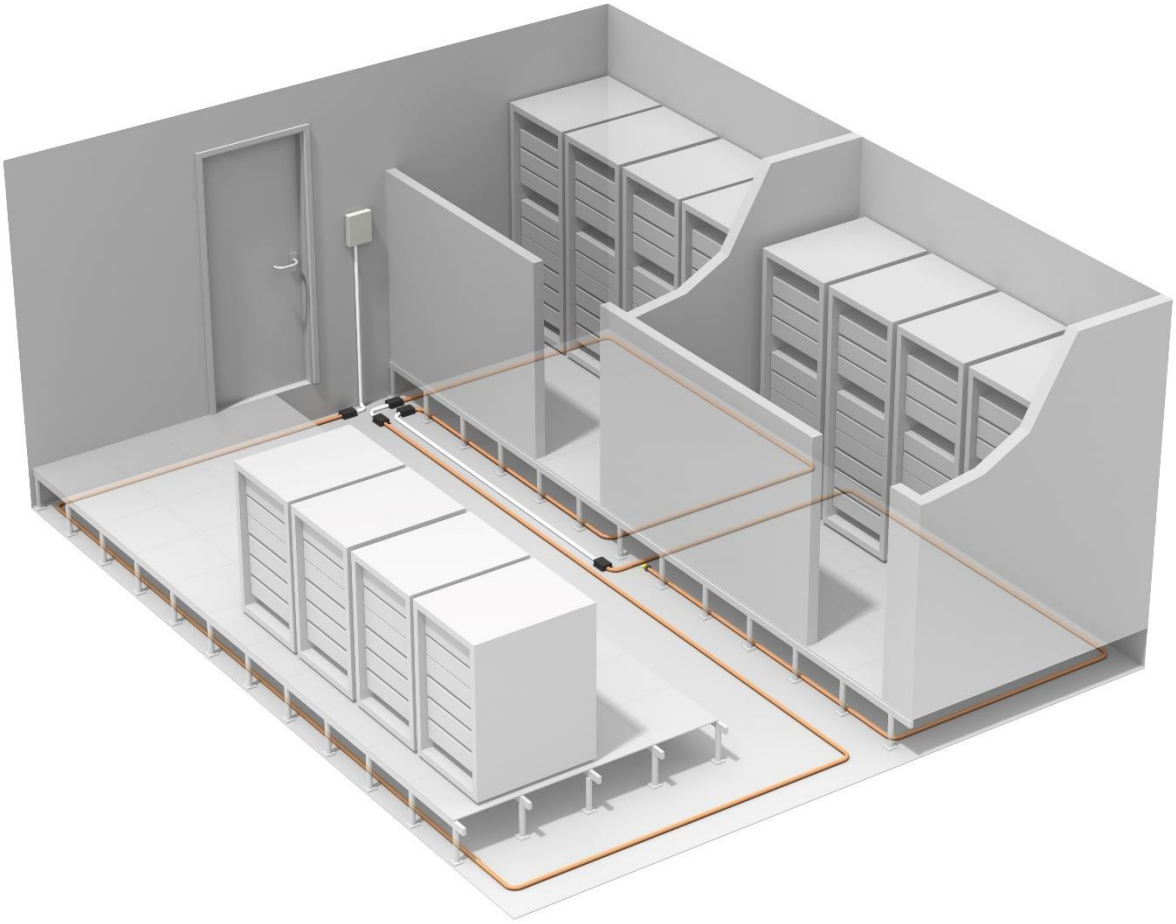


Figure 17 Example of sensor cable routing in a large data centre

5. If you are using a reference map or plan, compare it with the actual cable installation. Revise any discrepancies created through the physical installation of the cable.

Secure sensor cable to the floor

Aqualeak recommend that sensing equipment is installed with maintenance in mind. Sensing equipment SHOULD NOT be installed in inaccessible areas and should always be retrievable for maintenance.

Secure the sensor cable to the floor with either J-clips (Aqualeak Part No. #JC), or one of the other approved methods shown in Figure 18. Available from Aqualeak and designed specifically for use with sensing cable, J-clips are the manufacturer's recommended installation method.

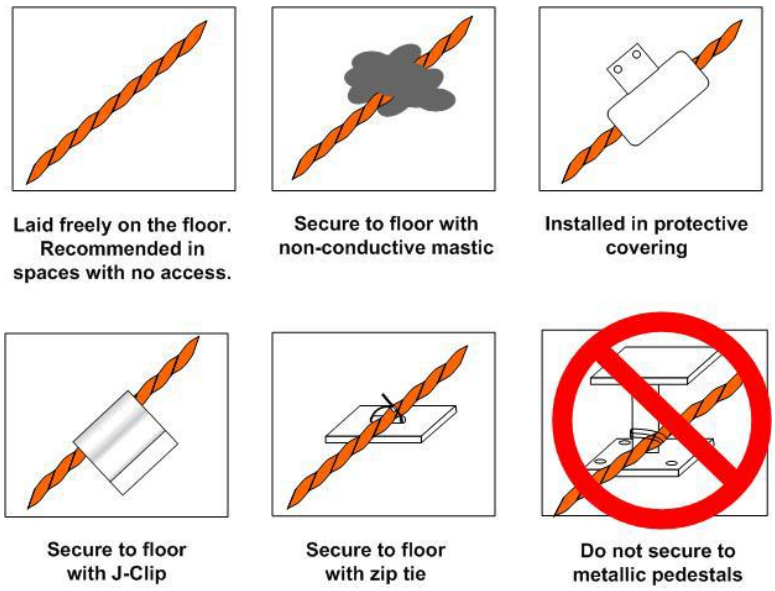


Figure 18 Securing the Sensor Cable

- To avoid contaminating the cable, clean the entire floor as much as possible. Use isopropyl alcohol to clean the spots on the floor where J-clips will be placed.
- Place one J-clip every 1.5 to 1.8 m along the length of the sensor cable, and one at each bend in the cable. Use more J-clips if a tighter configuration is required.
- If the sensor cable is installed over an obstruction, clip the cable on both sides, as close to the obstruction as possible.
- The J-clip's adhesive backing does not work well on porous concrete floors. Aqualeak recommends using a drop of silicone or another nonconductive adhesive to help secure the J-clip to the floor.

CAUTION – INCORRECT OPERATION

Do not install the sensor cable directly in front of an air conditioner. Allow a minimum of 1.3 to 1.8 m between the air conditioner and the cable. If the cable is too close to the air conditioning unit's air stream, the moisture from the humidifier may cause false leak readings. If the cable must be installed in front of an air conditioning unit, place the J-clips 0.9 m apart.

APPLYING POWER TO THE AQUALEAK 10K

Apply power to the Aqualeak 10K as follows:

WARNING – ELECTRIC SHOCK

The Aqualeak 10K operates using mains voltage that is dangerous to life. Before applying power to the 10K, re-fit the front cover.

Death, personal injury and/or damage to persons and/or property may result if this is not observed.

1. Power was connected to the Aqualeak 10K in Page 13.

2. Make sure all connections are correct and all screw terminals are secure.
3. Fit the front panel to the Aqualeak 10K and secure with the four flat head screws retained when the front panel was removed.
4. Apply power to the Aqualeak 10K. The device will begin to boot.
5. Wait approximately one minute for the Aqualeak 10K to start up. Under normal operating conditions the power LED glows green and the LED display reads **SH10**.
6. No alarm should be present. If an alarm is present, consult page 33 for troubleshooting information.
7. Press the Test/Reset button **once** to verify the amperage reading. For new leak detection sensor cable, the amperage will be either 0 or 1 μA. If the current is higher than 0 or 1 μA, contamination may have been introduced during installation. Clean the floor, and then uses isopropyl alcohol to clean the sensor cable. If the sensor cable is not new, the reading may be higher. Aqualeak recommends cleaning the cable if the amperage reading is 15 μA or higher.
8. Press the Test/Reset button **twice** to verify the length of installed sensor cable. If the length displayed is different from the actual length installed, consult Page 33 for troubleshooting information.

TEST THE SYSTEM

NOTE

If the Aqualeak 10K is already connected to a BMS or NMS, notify monitoring personnel before you begin testing the system.

1. To verify the Aqualeak 10K's accuracy, test three points within the length of sensor cable. One at the beginning, one in the middle of the cable and another near the end.
2. There are a variety of ways to simulate a leak:
   - Pour a small puddle of water on the sensor cable while it rests on the floor.
   - Dunk the sensor cable in a cup of water.
   - Wet a paper towel or clean rag and wrap it loosely around the sensor cable. This is popular if the cable is used in pipe applications. Be careful to wrap the wet cloth loosely around the cable. Do not put pressure on the cable.
3. Verify that the Aqualeak 10K reports the leaks within approximately 600 mm of their actual physical location.
4. Remove all simulated leak sources and return the system to its normal operating state.

CAUTION – INACCURATE TEST READINGS

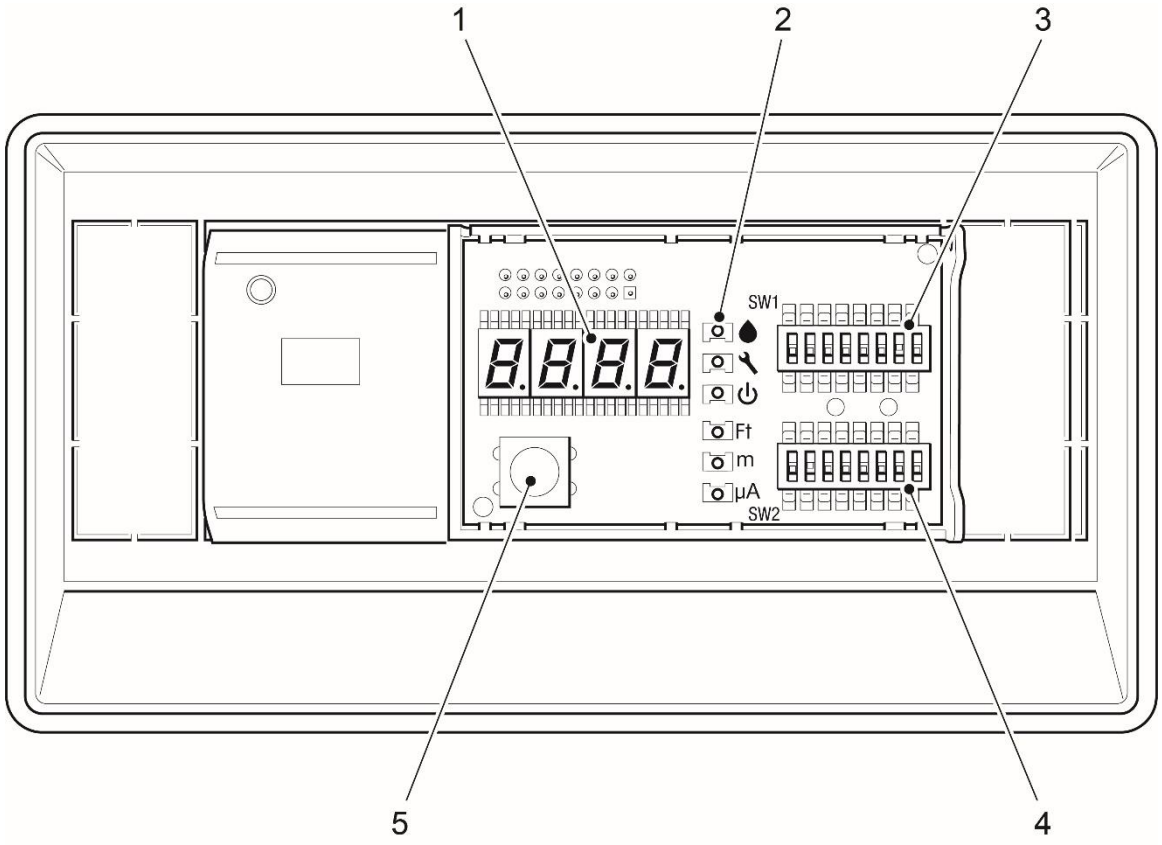
To avoid inaccurate readings, do not grip the cable with your hand.

The installation procedure is now complete.

OPERATION

FRONT PANEL CONTROLS AND DISPLAY

The front panel of the Aqualeak 10K contains a 4-character LED and series of coloured LEDs that are used together to convey device status and information regarding detected leaks and cable faults. A blue button is used to cycle the 4-character LED, silence the audible alarm, and reset the alarm.



1 Four-character LED display
2 LED's
3 DIP Switch SW1 – Configuration Settings
4 DIP switch SW2 – Modbus Configuration
5 Test/Reset/Alarm/Silence push-button

Figure 19 Aqualeak 10K controls and indicators

Table 2 Front panel controls and displays

Front Panel Indicator	Symbol	Description
4-character LED	**SH10**	System is running in its normal operating state.
	675 (e.g.)	A leak, fault, or contamination has been detected. The numerical distance to the leak displays on the LED. A green LED lights next to the appropriate distance measurement, and either the LED next to the water drop glows red to indicate a leak, or the LED next to the wrench glows yellow to indicate cable contamination. If the distance is measured in meters, a tenth of a meter decimal place will appear in measurements from 0.0 to 999.9 m. All meter values over 1000 will display as whole meter measurements.
	cbr	A cable break or fault has been detected. A yellow LED flashes next to the wrench symbol.
LED		Red LED - leak is detected - distance is displayed on 4-character LED.
		Yellow LED - Cable fault - 4-character LED displays **cbr**. Yellow LED - Cable contamination - 4-character LED displays the distance to the contamination.
		Green LED - Power On.
	Ft	Green LED - Measurements are made in feet.
	m	Green LED - Measurements are made in meters.
	µA	Green LED - Microamps of current on cable - amperage is displayed on 4-character LED.
Test/Reset/Alarm /Silence push-button	Blue Push Button	**In normal operating conditions**, the button functions include: a. Press once: Displays cable current in Ohms/foot and the green LED lights next to the microamp symbol. b. Press twice: Displays the length of installed cable components and the green LED lights next to the appropriate **Ft** or **m** symbol. c. Press three times: Return to the default display (**SH10**). d. Press and hold: Self-test is initiated, and the character display reads **cal 8060**, which indicates the value of the test resistor. **If an alarm sounds**, briefly press the button to turn off the audible alarm. The Status LED remains red, and the 4-character LED continues to show the alarm condition. In an alarm condition, whether the audible alarm is sounding or not, press and hold this button for 3 seconds to clear the alarm.

MANAGE ALARMS

General Guidelines

1. If the audible alarm sounds, briefly press the Test/Reset button to silence it.
2. Look at the display, or read the appropriate Modbus register, to determine the type of alarm and the distance to the leak, contamination, or cable break.
3. If you have a leak detection reference plan or map, cross-reference the distance with the plan/map.
4. Fix the problem (fix the leak, then dry the area and the section of cable involved in the leak; replace broken cable; clean contaminated cable).

Contamination Alarm Guidelines

If the sensor cable is in a contamination alarm state, check the following:

1. Verify that the cable is at least 1.3 m away from any air conditioning unit.
2. If there is dirt, grit, or grime on the cable, clean the cable with isopropyl alcohol and a clean cloth.
3. If the cable is in a high traffic area, move it or install a cable protector over it

MODBUS COMMUNICATION

MODBUS IMPLEMENTATION BASICS

The Aqualeak 10K uses its EIA-485 port to communicate via Modbus. The 10K is configured to act as a slave device on a common network and is a slave only device: – it will never initiate a communications sequence.

Modes ofTransmission

The Aqualeak 10K supports the Modbus RTU mode of transmission, with 8 data bits, no parity and one stop bit. Every Modbus packet consists of four fields:

- Slave Address Field.
- Function Field.
- Data Field.
- Error Check Field (Checksum).

Slave Address Field

The slave address field is one byte in length and identifies the slave device involved in the transaction. The valid Modbus slave address range is between 1 and 254. The Modbus address was set on page 15 of this manual. Refer to Figure 13 “W2 DIP Switch Settings for Communications Address on page 17 for more specific information.

Function Field

The function field is one byte in length and tells the Aqualeak 10K which function to perform. Functions 03 (Read 4xxxx output registers) and 04 (Read 3xxxx input registers) are supported by the Aqualeak 10K.

Data Field

The length of the data field varies depending on the function. The data fields for the Aqualeak 10K are 16-bit registers, transmitted high order byte first (big-end first).

Error Check (Checksum) Field

The checksum field lets the receiving device determine if the packet has transmission errors. On the Aqualeak 10K, RTU mode uses a 16-bit cyclic redundancy check (CRC-16).

Exception Responses

If a Modbus master sends an invalid command to the Aqualeak 10K, or attempts to read an invalid register, an exception response is generated. The response packet will have the high order bit of the function code set to one. The data field of the exception response contains the exception error code.

Table 3 Exception Codes

Code	Name	Description
01	Illegal Function	The function code is not supported
02	Illegal Data Address	Attempt to access an invalid address
03	Illegal Data Value	Attempt to set a variable to an invalid value

PACKET COMMUNICATIONS FOR THE AQUALEAK 10K

Function 03: Read Output Registers

To read the Aqualeak 10K parameter values, the master device must send a Read Output Registers request packet.

The Read Output Registers request packet specifies a start register, and the number of registers to read. The start register is numbered from zero (40001 = zero, 40002 = one, etc.).

Table 4 Read Output Registers Packet Structure

Read Registers Request Packet	Read Registers Response Packet
Slave Address (1 byte)	Slave Address (1 byte)
03 (Function code) (1 byte)	03 (Function code) (1 byte)
Start Register (2 bytes)	Byte count (1 byte)
# of registers to read (2 bytes)	First register (2 bytes)
CRC Checksum (2 bytes)	Second register (2 bytes)
	…
	Cry Checksum (2 bytes)

The Aqualeak 10K Output Registers are defined in Table 5.

Table 5 Output Registers

Register	Name	Description	Units	Range
40001	Leak Threshold	Trip point for leak alarm	25-175 uAmps Default: 120 uAmps	0-65535
40002	Contamination Threshold	Trip point for contamination alarm	25-175 uAmps Default: 50 uAmps	0-65535
40003	Re-alarm Interval (read-only)	Amount of time that passes before unit resends alarm notification **Note**: Set with DIP SW1; this register is read-only.	0 (Disabled) or 4 hours Default: 0 (Disabled)	0-65535

Register	Name	Description	Units	Range
40004	Latched Alarms (read-only)	Latched alarm requires Aqualeak 10K to be reset once alarm is cleared. **Note**: Set with DIP SW1; this register is read-only.	0 = Disabled 1 = Enabled Default: Disabled	0-65535
40005	Silence Audible Alarm	Indicates whether or not the audible alarm sounds when the Aqualeak 10K goes into alarm state	0 = Disabled 1 = Enabled Default: Disabled	0-65535
40006	Reset Alarm	Resets the Aqualeak 10K after an alarm state. Alternatively, press and hold the front panel's Test/Reset button for 3 seconds.	0 = Disabled (do not reset alarm) 1 = Enabled (reset alarm) Default: 0 (Disabled)	0-65535
40007	Sample Size	Number of samples taken to calculate the leak location	0 = Set to default value 4 = Minimum 25 = Maximum Default: 12	0-65535
40008	Resistance per Foot	Milliohms of resistance of installed leak detection cable. This value is set here and can also be read through register 30008.	2000 – 3500 milliOhms/ foot or 3500 – 4240 milliOhms/ foot* *to convert this value to Ohms/foot, divide the number by 1000	0-65535
40009	AC Rejection Frequency	Used by ADC to reject AC powerline frequencies. Needed only if the Aqualeak10K is running on 24 VAC power.	0 = 60Hz 1 = 50Hz Default: 1 (50Hz)	0-65535
40010	Spare	Not used.		0-65535
40011	Spare	Not used.		0-65535
40012	Spare	Not used.		0-65535
40013	Spare	Not used.		0-65535
40014	Spare	Not used.		0-65535
40015	Spare	Not used.		0-65535
40016	Leak Alarm Delay	Amount of time that passes between leak detection and alarm notification.	5 – 990 seconds Default: 10 seconds	0-65535
40017	Contamination Alarm Delay	Amount of time that passes between cable contamination detection and alarm notification.	5 – 990 seconds Default: 120 seconds	0-65535

Function 04: Read Input Registers

To read the Aqualeak 10K input values, the master must send a Read Input Registers request packet.

The Read Input Registers request packet specifies a start register, and the number of registers to read. The start register is numbered from zero (30001 = zero, 30002 = one, etc).

Table 6 Read Input Registers Packet Structure

Read Registers Request Packet	Read Registers Response Packet
Slave Address (1 byte)	Slave Address (1 byte)
04 (Function code) (1 byte)	04 (Function code) (1 byte)
Start Register (2 bytes)	Byte count (1 byte)
# of registers to read (2 bytes)	First register (2 bytes)
CRC Checksum (2 bytes)	Second register (2 bytes)
	…
	CRC Checksum (2 bytes)

The Aqualeak 10K Input Registers are defined in Table 7.

Table 7 Input Registers

Register	Name	Description	Units	Range
30001	Status	Bit level status	None	0-65535
30002	Leak Distance	Location of leak	Ft/Decimeters	0-65535
30003	Units	Unit of measure	0=Meters 1=Feet	0-65535
30004	Leak Current	Leakage current on cable	μA	0-65535
30005	Cable Length	Installed cable length	Feet/Decimeters	0-65535
30006	Leg1 Res	Resistance of cable A read-only value, this value is calculated directly from the installed leak detection cable.	Ohms	0-65535
30007	Leg2 Res	Resistance of cable A read-only value, this value is calculated directly from the installed leak detection cable.	Ohms	0-65535
30008	Res/Ft	Resistance of cable per foot. This value is set through register 40008	Milliohms* *to convert this value to Ohms, divide the number by 1000	0-65535
30009	Version	Firmware version	x.x.x (If the register reads 301, the firmware version is 3.0.1)	0-65535

Register	Name	Description	Units	Range
38001	Leak Distance	Leak distance in meters - float point - displays with a tenths place decimal value. This register must be viewed and displayed as float inverse.	Meters	0.0-9999.9
38003	Cable Length	Cable length in meters - float point - displays with a tenths place decimal value. This register must be viewed and displayed as float inverse.	Meters	0.0-9999.9

Table 8 Status Flags (Register 30001)

Bit	Description
00	1 = Leak detected
01	1 = Cable break detected
02	1 = Contamination detected
03	1 = Summary alarm
04-15	Spare

RTU FRAMING

The example below shows a typical Query/Response from an Aqualeak 10K.

Table 9 Response sample

Slave Address	Function Code	Count Bytes of Data	Register Data		Register Data		Register Data		CRC 16	CRC 126
			Msb	Lsb	Msb	Lsb	Msb	Lsb	"Lsb"	"Msb"
02	04	06	00	00	00	00	00	01	B5	A3

Slave address 2 responds to Function Code 4 with six bytes of hexadecimal data and ends with a CRC16 checksum.

Register Values:

40001 = 0000 (hex)

40002 = 0000 (hex)

40003 = 0001 (hex)

CALIBRATE SENSOR CABLE LENGTH VIA MODBUS

The length of sensor cable connected to the Aqualeak 10K can be calibrated through a Modbus-enabled system. This helps fine-tune a distance-read leak detection system. If no alarms are present, follow these steps to calibrate and test the system:

1. Set the SW1 DIP switches for the correct cable resistance per foot, as shown in Figure 20.

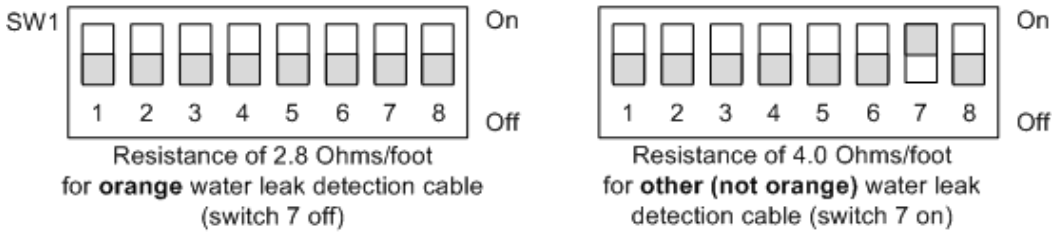


Figure 20 SW1 DIP Switch settings for Ohms/Foot

2. Press the Test/Reset button on the Aqualeak 10K once to verify the cable's amperage reading. Calibration cannot be performed if the current is above 15 μA.

   Different sensor cables are cleaned in different ways. The following cleaning instructions apply to Aqualeak's orange sensor cable ONLY. If you have questions regarding the care and maintenance of your sensor cable, please consult the cable's data sheet or contact the manufacturer.

3. If the sensor cable is new and the current is higher than 1 μA, clean the cable. Isopropyl alcohol removes any contamination that might have been introduced to the cable during installation.

4. If the cable is older and the amperage reading is above 15 μA, clean the cable. A mild dish detergent solution removes most dirt. Isopropyl alcohol is also an effective cable cleaner.

5. Sensor cable has a resistance. For example, Aqualeak's orange cable has a resistance of 2.8 Ohms per foot. A system's actual resistance will rarely be exactly 2.8 Ohms per foot, but it will be close. Each individual cable or system will vary a very small bit from that 2.8 Ohms per foot value. If you know the exact resistance of your cable, you can fine-tune your system for a more precise distance reading. The formula for calculating this value, and more specific directions for using the formula, is as follows:

$$\text{Resistance per foot in milliohms/foot (Modbus register 40008)} = \frac{\text{Leg2 Resistance (Modbus register 30007)}}{\text{Total Feet of Cable Installed on the System}} \times 1000$$

Formula for calculating exact cable resistance

6. Read the Leg 1 and Leg 2 Resistance values in Modbus registers 30006 and 30007. Make sure that the readings are similar: - within 2% of each other. This helps rule out any major cable problems before calibration begins. Record the resistance reading from Leg 2, Modbus register 30007.

7. Add up all the lengths of sensor cable and any other equipment in the system that simulates a length of cable. Record this value. Keep in mind:

   - Each weighted cable connector (WCCS-50) simulates 50 feet (15.24 m) of cable.

- Each SD-Z simulates 50 feet (15.24 m) of cable.
- Each X-Connector (XCON) simulates 150 feet (45.72 m) of cable.

8. Divide the Leg 2 resistance by the total length of cable. This value is the resistance of the cable installed on your system in Ohms per foot. This Ohms per foot value is for your reference only (the Ohms per foot value will have a decimal point in it, and you cannot write a number with a decimal point to register 40008). Record this value.
9. Multiply the value in Ohms per foot by 1000. This will give you the value in milliOhms per foot. This milliOhms per foot value is your end result, and the number you will write to Modbus register 40008. Record this value.
10. Access your Modbus-enabled system. Write the milliOhms per foot resistance value to the Aqualeak 10K's Modbus register 40008.

Example

$$\underset{\text{Resistance per foot in milliohms/foot (Modbus register 40008)}}{2788} = \frac{\text{Leg2 Resistance (Modbus register 30007)}}{\text{Total Feet of Cable Installed on the System}} = \frac{2091}{750} \times 1000$$

- The Leg 2 resistance reading on the system is 2091 Ohms.
- The system has:
- 400 feet of sensor cable.
- 1 X-Connector, which simulates 150 feet (45.72 m) of sensor cable.
- 4 SD-Zs which simulate 50 feet (15.24 m) of cable each, for a total simulation of 200 feet (61 m) of sensor cable.
- Therefore, system-wide, there are 750 feet of actual and simulated cable.
- Divide 2091 Ohms by 750 feet of cable. You get a resistance of 2.788 Ohms per foot.
- Multiply 2.789 Ohms per foot by 1000 to get 2788 milliOhms per foot.
- Access Modbus register 40008 and record the new milliOhms per foot value, 2788.

PREVENTIVE MAINTENANCE

Monthly Maintenance

Follow these steps monthly to test the Aqualeak 10K and verify that the device is functioning properly. If your Aqualeak 10K is hooked into a BMS or NMS, notify monitoring personnel before you begin to test the system.

1. Place water on the sensor cable. Either dip the cable into a cup filled with water, wrap the cable with a wet cloth, or pour a puddle of water onto the cable.
2. Verify the “leak detected” alarm on the control panel.
3. Compare the distance reading on the Aqualeak 10K to a reference plan or map (if available) to ensure the Aqualeak 10K displays the correct leak location. See page 30 for more information about calibrating the sensor cable.
4. Dry the sensor cable and verify that the Aqualeak 10K returns to normal.
5. Remove the End-of-Line terminator (EOL).
6. Confirm the “cable break” (**`cbr`**) alarm on the Aqualeak 10K.
7. Re-install the EOL.
8. Verify that the Aqualeak 10K returns to normal.
9. Monitor the cable current to ensure the cable is not being contaminated. The 10K will alarm if the contamination is excessive. If the cable current is greater than 15μA, troubleshoot the cables to determine which cable is contaminated. The contaminated cable should be removed, cleaned, and retested.

TROUBLESHOOTING

In the event of a problem with the Aqualeak 10K, consult the Table below which contains troubleshooting procedures for the most likely problems. If the problem is different to those identified in Table 10, contact Aqualeak for assistance.

Table10 Troubleshooting

Problem	Action
Control panel will not power up	1. Check with a multi-meter for AC or DC input power on the lower left-hand terminal block on the Aqualeak 10K. If no voltage is present at the terminal block, check the power supply and circuit breaker that power the Aqualeak 10K. If voltage is present but no LEDs are illuminated, go to step 2. 2. Contact Aqualeak for further troubleshooting and evaluation.
Cable Break Alarm	1. Verify that the leader cable from the sensor cable run is plugged into TB2, the terminal block marked “Cable”. 2. Check that the End-of-Line terminator (EOL) is installed on the end of the orange sensor cable run. 3. A section of sensor cable may be damaged or faulty. Remove the EOL terminator from the end of the cable run and fit it onto the end of the leader cable coming from the Aqualeak 10K. If the fault condition clears, there is a damaged/faulty section of sensor cable. To identify the section of damaged sensor cable, start moving the EOL terminator to the end of each section of sensor cable. If the cable break alarm is active, there is a damaged length of sensor cable between the EOL terminator and the Aqualeak 10K. If you do not find a faulty section of cable and the cable break alarm does not clear, go to step 4. 4. If the sensor cable is all functional, the leader cable may be damaged or faulty. To test the leader cable, power down (switch off) the Aqualeak 10K. Remove the four-position terminal block marked “Cable” from the unit. Remove the four leader cable wires going into the terminal block. Install a jumper wire between pins 1 and 2, and another jumper wire between pins 3 and 4. Refit the terminal block back into TB2 and reapply power. If the cable break condition clears, there is a problem with the leader cable. If the condition does not clear, contact Aqualeak.
Aqualeak 10K does not calculate the correct length of cable.	1. Check that the leader cable wires are wired into TB2, the terminal block marked “Cable”, in the correct order. From left to right, white - black - green - red. 2. Calibrate the sensor cable. To do this, adjust the resistance per foot (Configuration menu, via the Web Interface). The Aqualeak 10K is pre-calibrated from the factory. The overall footage should be within 5% of actual installed length. If the condition does not change, please contact Aqualeak for further support.
Aqualeak 10K does not calculate the correct leak distance.	1. Check to see if multiple leaks are present on the cable. The first leak should be read and latched by the system; however, if the system is updated, or if two or more simultaneous leaks occur within 30 seconds of the initial leak, the system may display an average distance (sum of the distances to all the leaks ÷ the total number of leaks). If no water is present, continue to step 2.

Problem	Action
	2. A section of the sensing cable may be faulty. To determine if this is the case: e. Power down (switch off) the Aqualeak 10K and remove the End-of-Line terminator (EOL) from the end of the sensor cable. f. Find the junction between the first and second sections of sensor cable. Separate the two sections and install the EOL terminator at the end of the first section. g. Turn power back on to the Aqualeak 10K. Allow the Aqualeak 10K to run for five to ten minutes. Apply a damp cloth, rag or paper towel to the end of the first section of orange sensor cable. If the leak is calculated correctly, remove the EOL terminator; reconnect the sensor cable and move down to the next section of cable. h. Repeat this process until a faulty reading is obtained. If the reading is off at the first section of cable, the Aqualeak 10K may be miscalculating the distance. Please contact Aqualeak for support
Persistent cable contamination alarm	1. Unless an obvious contaminate can be found, to clear a contamination alarm the sensor cable must be removed from its installation and cleaned. Usually the cable can be cleaned by pulling it through a clean damp rag. You can also wipe the cable with isopropyl alcohol. 2. If the sensor cable is contaminated by oil, glycol or chemicals, the cable can be washed. Remove the cable from its installation; and submerge it in a solution of one capful of mild dish washing detergent to two gallons lukewarm water (<105˚F). Agitate the cable in the solution, rinse with clear lukewarm water, and wipe dry with a clean towel. 3. Connect the sensor cable to the Aqualeak 10K and test it to make sure the contaminates have been removed before reinstalling the cable under the floor.

NOTE

Contamination and/or physical damage to the sensor cable is not covered under warranty.

Repair

If the 10K requires repair and service, it must be either returned to Aqualeak, or an Aqualeak Installation Engineer called-out. When contacting Aqualeak for assistance, please have the following information available:

1. Model number.
2. Serial number.
3. The results of the above troubleshooting procedure.

APPENDIX A

CONFIGURATION REFERENCE

This Appendix provides a complete listing of all possible configuration and address settings that can be made using the DIP switches in blocks SW1 and SW2.

The configuration of a stand-alone Aqualeak 10K can be performed using the DIP switches on the front panel. If the Aqualeak 10K is to be connected to a Modbus-equipped monitoring system, some of the configuration can be performed using the registers. Pages 12to 21 describe how to install and configure the Aqualeak 10K and refers to specific DIP switch settings where appropriate. Information about Modbus communications can be found in pages 25 to 31.

A1. DIP SWITCHES

The Aqualeak 10K contains two blocks of DIP switches.

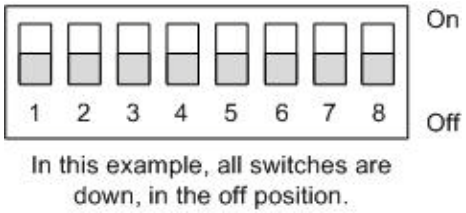


Figure A1 General DIP Switch settings

A2. SW1 DIP SWITCH SETTINGS

DIP switch 1 manipulates basic configuration settings on the Aqualeak 10K. Dip switch 3 in SW1 is unused and should remain in the OFF position.

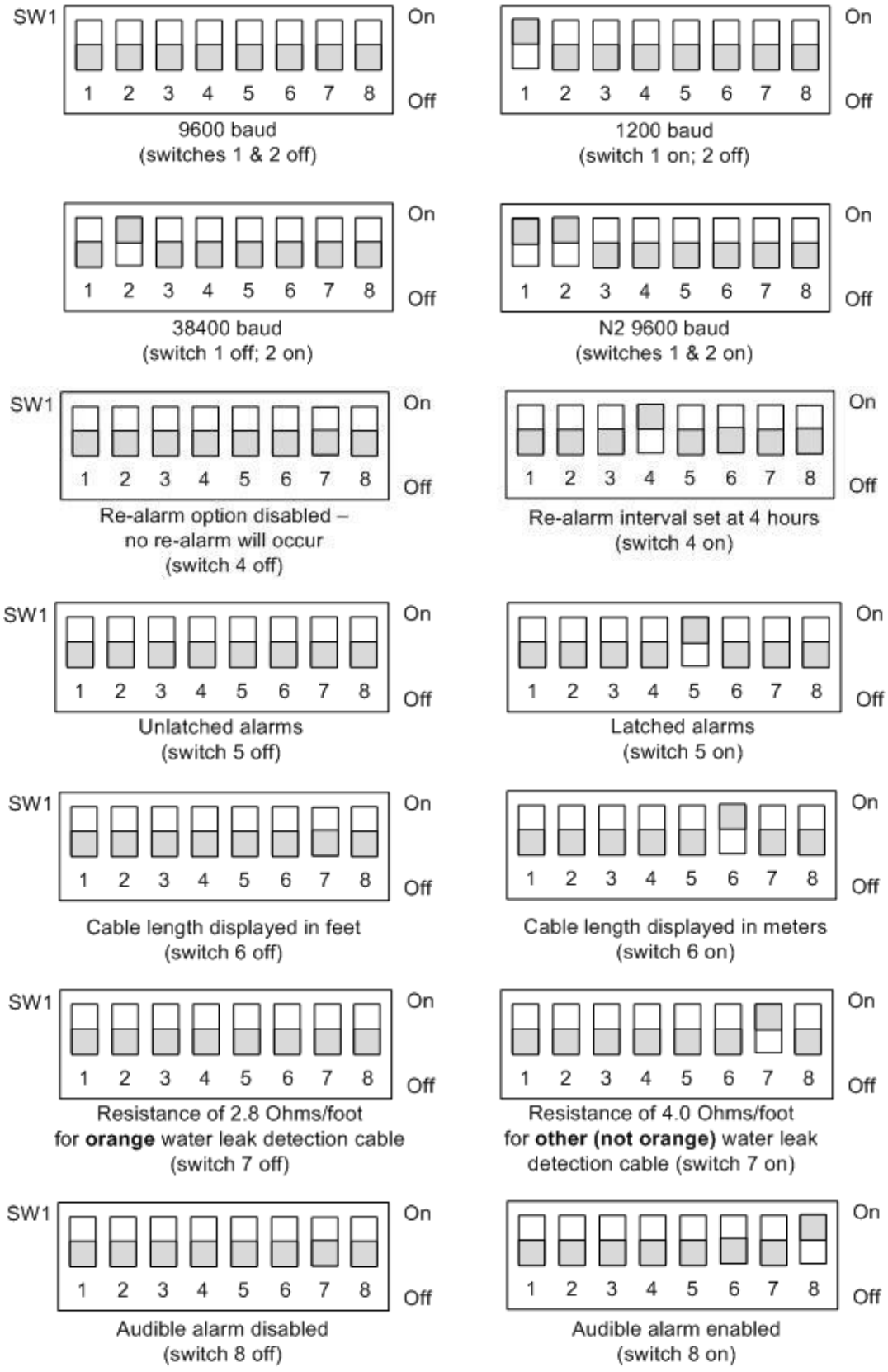


Figure A2 SW1 DIP Switch configuration settings

A3. SW2 DIP SWITCH SETTINGS

DIP switch SW2 is used to set the address of the Modbus device. First, use switches 1 and 2 on SW1 to set the communication baud rate. Then, use the switches on DIP SW2 as follows for the communications you plan to employ.

A3.1 Configure the Aqualeak 10K for Modbus Communications

The Modbus address should be a number between 1 and 254. Adjust the individual switches until their sum equals the Modbus address. Figure A3 shows the values of the DIP switches on the SW2 block as well as two examples of how the DIP switches would be set for specific unit addresses.

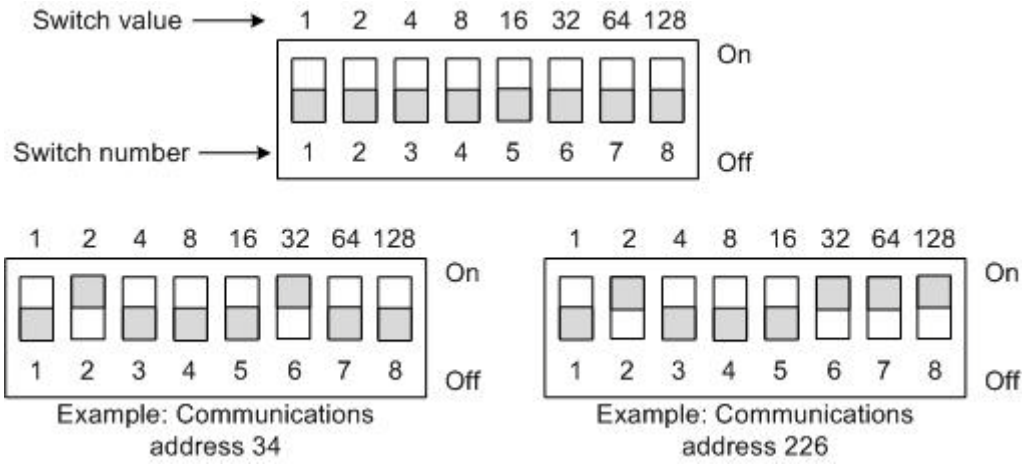


Figure A3 SW2 DIP Switch settings for Modbus Unit Address