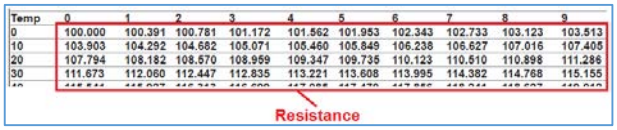
TN-0002 – Water Temperature Sensor

AEssense's water temperature sensor (Part Number: 347-10036-01) is one kind of resistance temperature detectors (RTD) that possess very accurate resistance to temperature relationship. The sensor used is Pt100 with 3850ppm/K (0.00385Ω per 0.01°C) temperature coefficient that fully complies with EN 60571. The prefix 'Pt' is chemical symbol for Platinum and the '100' indicates the resistance measured at 0°C is 100Ω. Platinum is superior material well-known for temperature sensing.

Tolerance – It is very easy to find Temperature (°C) vs. Resistance (Ω) table for Pt100 online like the partial table shown below because sensors that comply with EN 60751 are interchangeable.



The resistance values listed on the table are nominal values. EN 60751 also defines tolerance classes for RTDs like Pt100. The two most common tolerance classes are Class B (±0.3°C) and Class A (±0.15°C). When the resistance measured is 107.794Ω (20°C on the table), the temperature is actually in the range of 19.7°C to 20.3°C for Class B RTDs and 19.85°C to 20.15°C for Class A RTDs. AEssense starts shipping Class A Pt100s in 2021 that has tighter tolerance.

Overhead – In order to measure resistance of Pt100, AEtrium system adds some components between Pt100 and software, including sensing circuit and waterproof connector. All these components add roughly 0.2Ω to the resistance values listed on Pt100 table. For example, Guardian Grow Manager (GGM) would see around 108.00Ω instead of 107.794Ω at 20°C (68°F) or 100.20Ω instead of 100Ω at 0°C (32°F) for water temperature. In GGM, the overhead is called *offset* to indicate the value added to the Pt100 table.

With all components in the water temperature sensing, the final tolerance spec of AEssense's Pt100 at any point between 0°C (32°F) to 30°C (86°F) is ±1°C or ±1.8°F.

Raw Data – The *raw data* of water temperature sensor shown in GGM is the multiplication of measured resistance (including *offset*) and 100.



Table 1 at bottom shows raw data with 0.2Ω offset from 15.0°C to 25.9°C. The default offset is set to 10800 at 20°C (68°F) in WSE v2.3.7, ABC v3.1.3, and ACC v1.1.25.

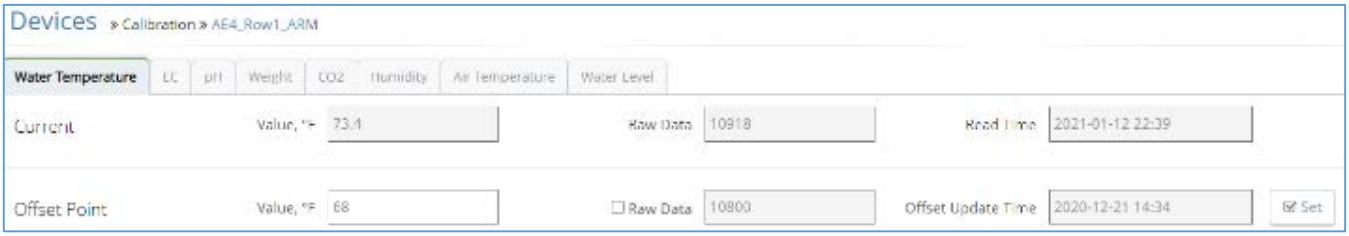
Table 1 – Temperature vs. Raw Data (GGM)

°F	°C	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
59	**15**	10605	10609	10613	10617	10620	10624	10628	10632	10636	10640
60.8	**16**	10644	10648	10652	10655	10659	10663	10667	10671	10675	10679
62.6	**17**	10683	10687	10690	10694	10698	10702	10706	10710	10714	10718
64.4	**18**	10722	10725	10729	10733	10737	10741	10745	10749	10753	10757
66.2	**19**	10761	10764	10768	10772	10776	10780	10784	10788	10792	10796
68	**20**	10799	10803	10807	10811	10815	10819	10823	10827	10830	10834
69.8	**21**	10838	10842	10846	10850	10854	10858	10861	10865	10869	10873
71.6	**22**	10877	10881	10885	10889	10893	10896	10900	10904	10908	10912
73.4	**23**	10916	10920	10924	10928	10931	10935	10939	10943	10947	10951
75.2	**24**	10955	10959	10962	10966	10970	10974	10978	10982	10986	10990
77	**25**	10994	10997	11001	11005	11009	11013	11017	11021	11025	11028

Error – Two common errors user may see from Pt100 are open circuit error (very high resistance) when wire inside sensor breaks and short circuit error (very low resistance) when water leaks into sensor. GGM displays 99.9°C (212°F) when it detects open circuit and displays -99.9°C (-148°F) when it detects short circuit. You will need to replace the sensor when either error occurs.

Offset Adjustment – Pt100 is a very accurate RTD with good repeatability, so it usually does not require offset adjustment (or calibration in GGM prior to v4.2.5.7) as long as the sensor is maintained in good condition. Another reason that calibration is not recommended is that a constant temperature environment is not easy to create by users. An inaccurate calibration usually makes measurements worse.

GGM v4.2.5.7 only allows administrator to view and adjust offset in *Devices* >> *Calibration* page. In case of offset adjustment indeed required, follow the steps below.



1. Go to *Calibration* page of the device and select *Water Temperature* tab as shown in picture below.
2. Get the temperature value from a reliable source and find the corresponding raw data from table 1. If the delta between *Current Raw Data* and raw data from table1 is greater than 40, the Pt100 sensor or WSE on the device might have problem that need to be fixed first.
3. Enter temperature value to the *Value* field of *Offset Point*.
4. Click *Set* button. Please be aware that all numbers in Table 1 will be invalid if the offset after adjustment is not 0.2Ω (20 counts).

Bump at Zero – You can create a nearly constant temperature environment at 0°C (32°F) by using vacuum insulated cup that people use for keeping food hot or drink cold. Simply follow the instructions below.

1. Make sure Pt100 is in a place that is not in extreme condition (too hot or too cold) and let it stabilize. Room temperature is fine.
2. Fill the cup with ice cubes and water.
3. Close lid and let it sit for 10 minutes.
4. Put the Pt100 in the cup for 30 seconds. GGM should read between 0°C and 1°C (32°F~33.8°F) and raw data should be in the range of 10020 to 10060 if offset is still 0.2Ω.