Agriculture Sensor FAQ (CLOVER)

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Agriculture Sensor FAQ

General Sensor FAQ:

Question	Answer
Why is the System LED rapidly blinking on my sensor?	While a sensor is not joined to a network it will continuously blink the System LED to indicate its unconnected status to the user. Ensure your LoRaWAN gateway is connected to your Network Server and verify the DevEUI, AppEUI and AppKey for the device.
Why does my LoRa LED blink periodically?	The LoRa LED indicates LoRa traffic being sent or received by the device. A short blink indicates the sensor has just transmitted, while a longer blink indicates the sensor has received a message.
How do I add my sensor to a Network Server?	Provisioning a sensor on a Network Server will vary based on your Network Server provider. An example of how to perform this on the TEKTELIC Network Server is available in your sensors user manual. Most network server providers will require you to enter the DevEUI, AppEUI and AppKey of your device on their service.
What version of LoRaWAN do the sensors implement?	All TEKTELIC Sensor products run LoRaWAN 1.0.2

The serial numbers on my case are different from the serial numbers on the circuit board. Did my order get mixed up?	All TEKTELIC products have multiple serial numbers so we can track the devices at each stage of production. It is normal that you sensor board and sensor assembly have different numbers.
What can I find the commissioning values for my sensors? (DEVEUI, APPEUI and APPKEY)	We keep the commissioning values for each sensor secure on our own server. We send the commissioning values for each sensor sent with a shipment but if this was misplaced please send the serial number the revision and the Tcode of the sensor and we can get the information for you.
Why is my sensor sending more packets than the Network Server receives?	This occurs when the channel plan does not reflect the number of channels accepted by the gateway. By default, all sensors come up in 64 channel mode which results in lost packets if a gateway with less than 64 channels is used. If you have an 8 channel gateway for example, ensure this is configured in the device settings in the Network Server. In the TEKTELIC NS under the "advanced network settings" tab change the configuration of the "default channel mask" to reflect the number of channels used by the gateway used.

Input FAQ:

Question	Answer
What is GWC and how is it different than VWC?	Gravitational Water Content (GWC) is the mass of water per mass of dry soil. Just like Volumetric Water Content (VWC), it is another way of determining how wet your soil is. There are no technical differences between GWC and VWC, as they both calculate the same result (ie. "The soil is wet by X amount"). The only difference between GWC and VWC is how the result is presented. GWC presents the mass of water in terms of *grams (g)* and VWC presents a *percentage (%)* of how wet your soil is.
How do I interpret GWC?	As GWC represents **only the mass of water per mass of dry soil, it is not possible to interpret the measurement as a percentage.** Therefore, you can assume that any value between "Dry" and "Wet" has a degree of water content in it. Values exceeding the "Wet" threshold can be interpreted as more "wet."
How do I convert GWC to VWC?	See the following formula: **VWC = (GWC * soil density) / (water density)**

<table>
<tr>
<td>Important note for customers using fertilizers/additives:</td>
<td>When converting from GWC to VWC, you might find the results to be inaccurate. This inaccuracy may come from any additional fertilizers/additives applied to the soil.

As the Agriculture Sensor was only tested with regular water/soil, it may not be able to accurately match the VWC conversion.</td>
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<tr>
<td>How do I convert the readings for soil moisture into GWC?</td>
<td>Input 1 readings are a frequency presented in kHz. Please refer to the table below for a conversion from this frequency to GWC (gravimetric water content):
<table>
<tr><th>GWC</th><th colspan="2">Frequency range</th></tr>
<tr><td>Dry</td><td>1402</td><td>1399</td></tr>
<tr><td>0.1</td><td>1399</td><td>1396</td></tr>
<tr><td>0.2</td><td>1396</td><td>1391</td></tr>
<tr><td>0.3</td><td>1391</td><td>1386</td></tr>
<tr><td>0.4</td><td>1386</td><td>1381</td></tr>
<tr><td>0.5</td><td>1381</td><td>1376</td></tr>
<tr><td>0.6</td><td>1376</td><td>1371</td></tr>
<tr><td>0.7</td><td>1371</td><td>1366</td></tr>
<tr><td>0.8</td><td>1366</td><td>1361</td></tr>
<tr><td>0.9</td><td>1361</td><td>1356</td></tr>
<tr><td>1</td><td>1356</td><td>1351</td></tr>
<tr><td>1.1</td><td>1351</td><td>1346</td></tr>
<tr><td>1.2</td><td>1346</td><td>1341</td></tr>
<tr><td>Wet</td><td>1341</td><td>1322</td></tr>
</table>
</td>
</tr>
<tr>
<td>How do I convert the readings for soil temperature into °C?</td>
<td>The readings from register 0x 02 02 (Input 2) are a voltage, in mV.

The premise is, when the voltage reading goes up, the soil temperature is dropping.
The formula used to perform the conversion is: soiltemp = -32.46*LN(V)+236.36.
Refer to the following table for a quick look-up of the conversion:</td>
</tr>
</table>

	A	B		A	B		A	B
1	mV from either input 3 or 4	Calculated Temp	40	330	47.63	81	535	32.14
2	140	74.82	41	335	47.15	82	540	31.84
3	145	73.71	42	340	46.68	83	545	31.54
4	150	72.65	43	345	46.21	84	550	31.25
5	155	71.62	44	350	45.75	85	555	30.96
6	160	70.62	45	355	45.3	86	560	30.67
7	165	69.65	46	360	44.85	87	565	30.38
8	170	68.71	47	365	44.41	88	570	30.1
9	175	67.8	48	370	43.97	89	575	29.82
10	180	66.91	49	375	43.54	90	580	29.54
11	185	66.04	50	380	43.12	91	585	29.26
12	190	65.2	51	385	42.7	92	590	28.99
13	195	64.38	52	390	42.29	93	595	28.72
14	200	63.58	53	395	41.88	94	600	28.45
15	205	62.79	54	400	41.47	95	605	28.18
16	210	62.03	55	405	41.08	96	610	27.91
17	215	61.28	56	410	40.68	97	615	27.65
18	220	60.55	57	415	40.29	98	620	27.39
19	225	59.84	58	420	39.91	99	625	27.13
20	230	59.14	59	425	39.53	100	630	26.88
21	235	58.46	60	430	39.15	101	635	26.62
22	240	57.79	61	435	38.78	102	640	26.37
23	245	57.13	62	440	38.42	103	645	26.12
24	250	56.49	63	445	38.05	104	650	25.87
25	255	55.86	64	450	37.7	105	655	25.62
26	260	55.24	65	455	37.34	106	660	25.38
27	265	54.64	66	460	36.99	107	665	25.13
28	270	54.04	67	465	36.64	108	670	24.89
29	275	53.45	68	470	36.3	109	675	24.65
30	280	52.88	69	475	35.96	110	680	24.42
31	285	52.32	70	480	35.62	111	685	24.18
32	290	51.76	71	485	35.29	112	690	23.94
33	295	51.22	72	490	34.96	113	695	23.71
34	300	50.68	73	495	34.63	114	700	23.48
35	305	50.15	74	500	34.31	115	705	23.25
36	310	49.63	75	505	33.99	116	710	23.02
37	315	49.12	76	510	33.67	117	715	22.8
38	320	48.62	77	515	33.36	118	720	22.57
39	325	48.12	78	520	33.05	119	725	22.35
			79	525	32.74	120	730	22.13
			80	530	32.44	121	735	21.91

	A	B		A	B			
121	735	21.91	162	940	13.97			
122	740	21.69	163	945	13.8			
123	745	21.47	164	950	13.63			
124	750	21.26	165	955	13.46			
125	755	21.04	166	960	13.29			
126	760	20.83	167	965	13.12			
127	765	20.62	168	970	12.96			
128	770	20.41	169	975	12.79			
129	775	20.2	170	980	12.62			
130	780	19.99	171	985	12.46			
131	785	19.79	172	990	12.3			
132	790	19.58	173	995	12.13			
133	795	19.38	174	1000	11.97			
134	800	19.18	175	1005	11.81			
135	805	18.97	176	1010	11.65			
136	810	18.77	177	1015	11.49			
137	815	18.58	178	1020	11.33			
138	820	18.38	179	1025	11.17			
139	825	18.18	180	1030	11.02			
140	830	17.99	181	1035	10.86			
141	835	17.79	182	1040	10.71			
142	840	17.6	183	1045	10.55			
143	845	17.41	184	1050	10.4			
144	850	17.22	185	1055	10.24			
145	855	17.03	186	1060	10.09			
146	860	16.84	187	1065	9.94			
147	865	16.65	188	1070	9.79			
148	870	16.47	189	1075	9.64			
149	875	16.28	190	1080	9.49			
150	880	16.1	191	1085	9.34			
151	885	15.92	192	1090	9.19			
152	890	15.74	193	1095	9.04			
153	895	15.55	194	1100	8.89	203	1145	7.6
154	900	15.37	195	1105	8.75	204	1150	7.46
155	905	15.2	196	1110	8.6	205	1155	7.32
156	910	15.02	197	1115	8.46	206	1160	7.18
157	915	14.84	198	1120	8.31	207	1165	7.04
158	920	14.66	199	1125	8.17	208	1170	6.9
159	925	14.49	200	1130	8.02	209	1175	6.76
160	930	14.32	201	1135	7.88	210	1180	6.62
161	935	14.14	202	1140	7.74	211	1185	6.49

How do I convert the readings from the Thermistor and Watermark into Soil Water Tension?

Watermark 1 & 2 will provide frequency readings. A reading of soil temperature from the thermistor will also be taken into account when calculating the final kPa value of soil water tension, for increased accuracy.

Final kPa of soil water tension is calculated by the following steps:

1. Obtain a reading of the frequency from Watermarks 1 or 2 or both. These are registers 0x 05 04 and 0x 06 04 respectively. Table 2-4 below can be used for conversion of the frequencies read from the Watermarks to get an **initial** kPa value. From Table 2-4, use the column on the right to find the appropriate range that the reading from the Watermarks fits into. Then use the formula directly to the left (from the left column) to calculate the kPa of soil water tension.

kPa = 0	for Hz > 6430
kPa = 9 - (Hz - 4330) * 0.004286	for 4330 <= Hz <= 6430
kPa = 15 - (Hz - 2820) * 0.003974	for 2820 <= Hz <= 4330
kPa = 35 - (Hz - 1110) * 0.01170	for 1110 <= Hz <= 2820
kPa = 55 - (Hz - 770) * 0.05884	for 770 <= Hz <= 1110
kPa = 75 - (Hz - 600) * 0.1176	for 600 <= Hz <= 770
kPa = 100 - (Hz - 485) * 0.2174	for 485 <= Hz <= 600
kPa = 200 - (Hz - 293) * 0.5208	for 293 <= Hz <= 485
kPa = 200	for Hz < 293

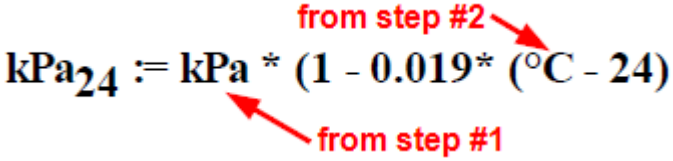
2. Obtain a reading from input 3 or 4 or both. These are registers 0x 03 02, 0x 04 02 respectively. Use the equation below to calculate a temperature from the mV reading.

Temp = -31.96ln(x)+213.25

x = mV reading from input 3 or 4

This calculation represents the **soil temperature.**

3. Perform this next step only if the soil temperature varies from 24°C. Using the initial kPa value calculated in step #1, and the soil temperature calculated in step #2, calculate a 'temperature adjusted' kPa of soil water tension by using this formula:



Note: To obtain decoders that convert the readings from the sensor, please see the following section.