



SKTS 200 Series Temperature Probes

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1 INTRODUCTION

This manual incorporates all versions of the SKTS 200 series temperature probes, models covered are below:

SKTS 200 – Soil / water temperature probe with 10 kohm thermistor output, bare wire ended
SKTS 200U – unsheathed temperature probe with 10 kohm thermistor output, bare wire ended
SKTS 200U/M – micro temperature probe with 10 kohm thermistor output, bare wire ended

SKTS 200/I – Soil / water temperature probe with 10 kohm thermistor output, with connector
SKTS 200U/I – unsheathed temperature probe with 10 kohm thermistor output, with connector
SKTS 200U/M/I – micro temperature probe with 10 kohm thermistor output, with connector

SKTS 200R – Soil / water temperature probe with mV output, bare wire ended
SKTS 200U/R – unsheathed temperature probe with mV output, bare wire ended
SKTS 200U/M/R – micro temperature probe with mV output, bare wire ended

SKTS 200R/I – Soil / water temperature probe with mV output, with connector
SKTS 200U/R/I – unsheathed temperature probe with mV output, with connector
SKTS 200U/M/R/I – micro temperature probe with mV output, with connector

The SKTS 200 series temperature probes consists of a 10 kohm thermistor temperature sensor. Part numbers including the suffix 'R' have additional components fitted to give a millivolt output. Part numbers including the suffix 'I' are fitted with a waterproof 5 pin Binder sub-miniature connector compatible with Skye's DataHog dataloggers and HydroSense meters.

SKTS 200, 200/I, 200R and 200R/I are housed in a robust tip suitable for insertion in the soil or for measuring water temperatures.

The unsheathed probes SKTS 200U, 200U/I, 200U/R and 200U/R/I are smaller and coated in white PVC plastic, still fully waterproof but less robust.

The micro probe SKTS 200U/M, 200U/M/I, 200U/M/R and 200U/M/R/I have very fine wires and are very delicate. Extreme care must be used when handling – always support the junction of the fine thermistor wires with the connecting cable – DO NOT allow the weight of the cable to hang from the fine thermistor wires. These micro probes are also waterproof and can used for measuring leaf temperature or applications where a very small thermal mass is required.

2 INSTALLATION

2.1 SKTS 200 Series Soil / Water Probes

The SKTS 200 series probe has the temperature sensor sealed into a black, robust tip suitable for inserting into the ground, or for total immersion in water. This sensor does not have a fast response to temperature changes due to the robustness of the sensor tip, but this is not a problem for measuring soil temperatures or the temperature of large bodies of water that also change relatively slowly.

To install in shallow soil, first make a pilot hole in the ground to the required depth, for example with a screwdriver. Then simply push the tip of the temperature probe down into the hole and pat down the soil carefully around the protruding cable.

For measurements deeper in soil it may be necessary to dig a small hole just less than the required measurement depth, and then use the above technique for shallow measurements before filling the hole back in.

To measure water temperatures, it is advisable to secure or weight the sensor tip and cable at the required measurement depth. The sensor tip and cable are fully submersible, rated to IP68. However it is unlikely that the measurement instrument, e.g. Skye DataHog logger or HydroSense meter, is suitable for immersion, so these must be carefully installed to prevent damage by unwanted water ingress.

NOTE: Ensure all cables are secured and protected to prevent damage from movement, chafing and cannot be nibbled by rodents – which is a common reason for sensor failure. Skye advise a protective cover for exposed cables, e.g. electrical conduit or an old hose pipe (split lengthways and clipped round the cable). Flexible conduit is available for purchase for Skye Instruments.

2.2 SKTS 200U Series Unsheathed Probes

These white probes are simply the SKTS 200 series sensor without the robust tip protection. The sensor has a fast response to temperature change and so is suitable for many applications.

To install as a grass temperature probe, attach the end of the sensor to the SKRS 090 ground fixing radiation screen as shown in the radiation screen instructions. This mounts the sensor tip with free air flow for accurate air temperature measurement at grass height of 35-40 mm.

For leaf temperature measurements, the sensor tip can be held in contact with the leaf using some thin, flexible sticky tape. The sensor is usually attached to the underside of the leaf to minimise the effects of direct sunshine / radiation. It may be necessary to tie the sensor cable to the plant stems at several points to spread the weight of the sensor and cable away from the single leaf.

To measure the temperature of a surface, e.g. a painted panel for weather studies, the sensor tip can be glued to the surface using the minimum amount of adhesive necessary to fix. Too much adhesive will increase the thermal mass of the sensor tip and slow its temperature response time.

NOTE: Ensure all cables are secured and protected to prevent damage from movement and chafing. Protect outdoor cables with electrical conduit or similar as described in Chapter 2.1 above.

2.3 SKTS 200U/M Series Micro Probes

The micro probes have very fine wires which are very delicate and must be handled and installed with extreme care. Always support the junction of the fine thermistor wires with the connecting cable – DO NOT allow the weight of the cable to hang from the fine thermistor wires.

The sensor tip can be suspended in air or attached to a surface for measurement according to the application. Thin, flexible sticky tape or a very small amount of adhesive can be used to attach the sensor, but it is very important to remember that these will increase the thermal mass of the sensor tip significantly and so affect temperature responses.

NOTE: It is essential that the sensor wires and cable are carefully secured and protected along the whole length. This will prevent damage to the sensor itself and its cable. Protect outdoor cables with electrical conduit or similar as described in Chapter 2.1 above.

3 SKTS 200 SERIES WIRING DETAILS

SKTS 200, SKTS 200/I, SKTS 200U, SKTS 200U/I, SKTS 200U/M, SKTS 200U/M/I

These probes have a resistance output direct from the 10 kohm thermistor. Please see the Table 1 for conversions of the resistance output into temperatures in degrees Celsius. Please note this is not a linear conversion.

3.1 SKTS 200 Series Bare wire ended cable

SKTS 200 is fitted with a black, 2 core, screened cable as below:

Blue	Thermistor
Red	Thermistor
Grey	Uncommitted screen of cable (may be connected to system ground)

SKTS 200/U and **SKTS 200U/M** are fitted with a grey, 1 core, screened cable as below:

Red	Thermistor (cable core)
Grey	Thermistor (cable screen)

3.2 SKTS 200/I Series With Connector

SKTS 200/I is fitted with a black, 2 core, screened cable as below:

Pin 1	-	not connected
Pin 2	Red	Thermistor
Pin 3	-	not connected
Pin 4	-	not connected
Pin 5	Blue	Thermistor
Pin 5	Grey	Cable screen

SKTS 200/U/I and **SKTS 200U/M/I** are fitted with a grey, 1 core, screened cable as below:

Pin 1	-	not connected
Pin 2	Red	Thermistor
Pin 3	-	not connected
Pin 4	-	not connected
Pin 5	Grey	Thermistor / Cable screen

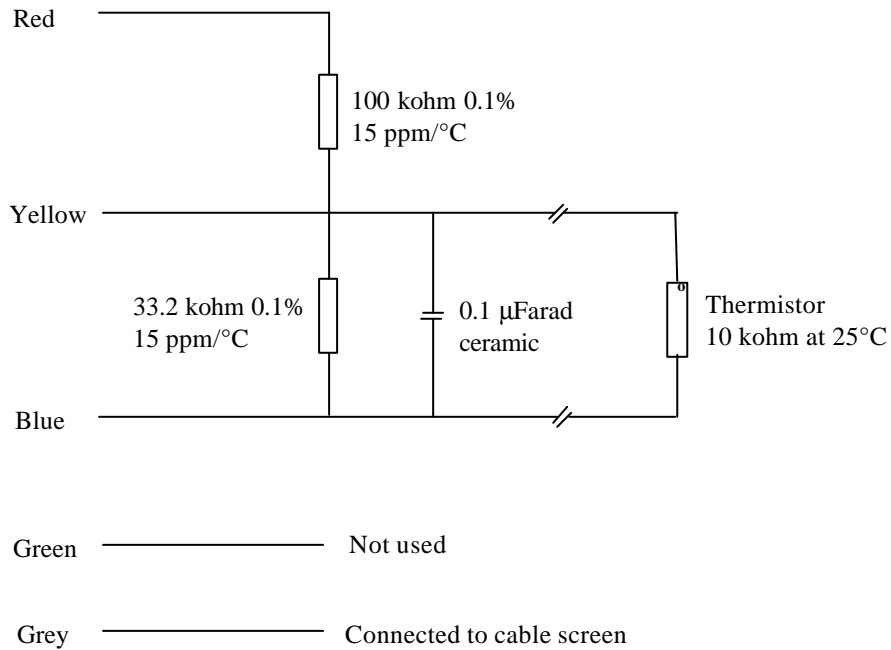
4 SKTS 200R SERIES WIRING DETAILS

SKTS 200R, SKTS 200R/I, SKTS 200U/R, SKTS 200U/R/I SKTS 200U/M/R, SKTS 200U/M/R/I

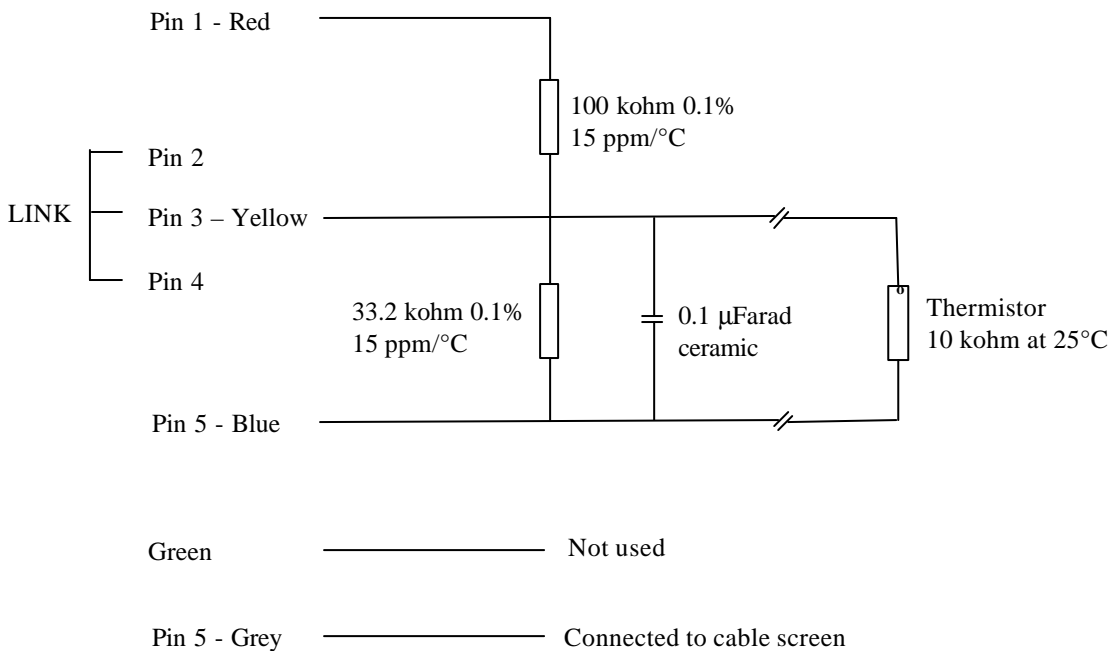
These probes require a regulated voltage excitation supply. A suitable 5.000 volts is provided by the Skye DataHog datalogger and HydroSense meter. However, it can also be used with other dataloggers and voltages as required, please see Chapter 5 for details.

Please see the Table 1 for conversions of the millivolt output into temperatures in degrees Celsius. Please note this is not a linear conversion.

4.1 SKTS 200R Series Bare wire ended cable



4.2 SKTS 200R/I Series With Connector



5 CONFIGURING THE DATAHOG2 LOGGER

5.1 Configure a Temperature Channel

Probes SKTS 200/I, SKTS 200U/I and SKTS 200U/M/I are compatible with a Temperature channel on a Skye DataHog logger.

To set up a temperature channel for one of the above sensors, simply refer to the DataHog2 Hardware Configuration Certificate, choose an appropriate software and hardware channel and enter settings as in the following example:

e.g.

Software Channel	Hardware Channel	Gain	Termination	Scalecode
0	03	0	0	2

5.2 Configure a Single Ended Voltage Channel

Probes SKTS 200R/I, SKTS 200U/R/I and SKTS 200U/M/R/I are compatible with a single ended voltage channel on a Skye DataHog logger.

To set up a single ended voltage input to measure temperature with one of the above sensors, simply refer to the DataHog2 Hardware Configuration Certificate, choose an appropriate software and hardware channel and enter settings as in the following example:

e.g.

Software Channel	Hardware Channel	Gain	Termination	Scalecode
0	03	0	0	2

5.3 Configure a Differential Voltage Channel

Probes SKTS 200R/I, SKTS 200U/R/I and SKTS 200U/M/R/I are compatible with a differential voltage channel on a Skye DataHog logger.

To set up a differential voltage input to measure temperature with one of the above sensors, simply refer to the DataHog2 Hardware Configuration Certificate, choose an appropriate software and hardware channel and enter settings as in the following example.

e.g. If your differential input has a hardware channel 05, choose the single ended component of this which has a value one number less, i.e. 04

Software Channel	Hardware Channel	Gain	Termination	Scalecode
00	04	0	0	2

5.4 Entering the Configuration

1. 'Wake up' the DataHog2 as usual to reveal the Main Menu.
2. Type 'A' to set channel configurations. (See Chapter 3.2.11 of the DataHog2 manual for details)
3. Enter a Software Channel number, for example, start with 00
4. Enter the Hardware Channel number you would like to be measured and offloaded first
5. Now follow the instructions on screen, to enter the gain, termination code and scale code - use the codes above and on your Hardware Configuration Certificate as a guide.
6. The entries you have made will be displayed for your to confirm if correct.
7. Repeat instructions 2 to 6 for each software channel in order as necessary.
8. Don't forget to press ESCAPE when finished, to return the DataHog to Log Mode.

6 USING WITH VOLTAGE POWER SUPPLIES OTHER THAN 5V

SKTS 200R, SKTS 200R/I, SKTS 200U/R, SKTS 200U/R/I SKTS 200U/M/R, SKTS 200U/M/R/I

The SKTS 200R series probes above have been optimised for use with the Skye DataHog logger or HydroSense meter, which give a regulated 5V excitation supply to the sensor. However, there is a simple ratio calculation when used with other value power supplies.

CALCULATION

The resistance output between the yellow and blue connections is calculated from the temperature variable resistance thermistor T and the 33.2 kohm resistor in parallel as:

$$\text{Output resistance (R)} = \frac{(T \times 33.2)}{(T + 33.2)} \text{ kohm}$$

Used with an excitation voltage V volts, the output voltage is:

$$\text{Output voltage (mV)} = (V \times 1000) \text{ mV} \times \frac{R}{100 + R}$$

The values given in Table 1 are for use with a 5V excitation supply. From the formula given above it can be seen that the mV output of the probe is directly proportional to the excitation voltage V supplied.

So the given table can be easily converted for other supplies as follows:

For example,

At -20°C with 5V excitation, the probe reads 991.64 mV.

So at 12V excitation, multiply the given mV output by 12 / 5, the probe will read 2379.94 mV

And at 2V excitation, multiply the given mV output by 2 / 5, the probe will read 396.66 mV

7 ERRORS WITH LONG CABLE LENGTHS

Skye recommend a maximum of 50m cables on this range of temperature probes. Longer cables may cause several problems, for example physical damage if the cable is not carefully installed, electrical noise 'pick up' or introduced errors due to voltage drops along the cable length.

The table below shows the possible introduced errors due to the resistance of the cable itself. Errors increase with increasing temperature.

The thermistor used by Skye is a curve matched sensor which has a resistance value of 10 kohms at 25°C. Its accuracy is ± 0.2 °C over the range 0 to 60°C.

CABLE LENGTH	RESISTANCE OF CABLE LENGTH	TEMPERATURE	ERROR DUE TO CABLE LENGTH
50m	9.2 ohms	0°C	0.005°C
100m	18.4 ohms	0°C	0.010°C
50m	9.2 ohms	25°C	0.02°C
100m	18.4 ohms	25°C	0.04°C
50m	9.2 ohms	50°C	0.07°C
100m	18.4 ohms	50°C	0.14°C
50m	9.2 ohms	100°C	0.46°C
100m	18.4 ohms	100°C	0.92°C

TABLE 1 - 10KOHM PRECISION TEMPERATURE THERMISTOR TABLES

Temp	Thermistor	Output	Temp	Thermistor	Output
Deg C	value	at 5V	Deg C	value	at 5V
	kohms	m V		kohms	m V
-20.00	97.08	991.64	41.00	5.12	212.30
-19.00	91.62	979.71	42.00	4.92	205.37
-18.00	86.50	967.47	43.00	4.73	198.66
-17.00	81.70	954.91	44.00	4.54	192.16
-16.00	77.19	942.05	45.00	4.37	185.88
-15.00	72.96	928.89	46.00	4.20	179.75
-14.00	68.98	915.46	47.00	4.04	173.86
-13.00	65.25	901.76	48.00	3.89	168.22
-12.00	61.73	887.80	49.00	3.74	162.72
-11.00	58.43	873.61	50.00	3.60	157.40
-10.00	55.33	859.19	51.00	3.47	152.21
-9.00	52.41	844.56	52.00	3.34	147.29
-8.00	49.66	829.75	53.00	3.22	142.48
-7.00	47.07	814.77	54.00	3.10	137.84
-6.00	44.63	799.63	55.00	2.99	133.35
-5.00	42.33	784.36	56.00	2.88	129.02
-4.00	40.16	768.98	57.00	2.77	124.83
-3.00	38.12	753.51	58.00	2.68	120.80
-2.00	36.19	737.96	59.00	2.58	116.88
-1.00	34.37	722.36	60.00	2.49	113.12
0.00	32.65	706.73	61.00	2.40	109.48
1.00	31.03	691.13	62.00	2.32	105.96
2.00	29.50	675.50	63.00	2.24	102.56
3.00	28.05	659.91	64.00	2.16	99.28
4.00	26.68	644.37	65.00	2.08	96.11
5.00	25.39	628.90	66.00	2.01	93.05
6.00	24.17	613.52	67.00	1.94	90.10
7.00	23.01	598.25	68.00	1.88	87.24
8.00	21.92	583.10	69.00	1.81	84.49
9.00	20.88	568.09	70.00	1.75	81.83
10.00	19.90	553.24	71.00	1.69	79.26
11.00	18.97	538.57	72.00	1.64	76.78
12.00	18.09	524.07	73.00	1.58	74.38
13.00	17.25	509.77	74.00	1.53	72.07
14.00	16.46	495.69	75.00	1.48	69.82
15.00	15.71	481.82	76.00	1.43	67.66
16.00	15.00	468.18	77.00	1.38	65.57
17.00	14.32	454.77	78.00	1.34	63.57
18.00	13.68	441.61	79.00	1.30	61.63
19.00	13.07	428.71	80.00	1.26	59.75
20.00	12.49	416.06	81.00	1.22	57.93
21.00	11.94	403.68	82.00	1.18	56.19
22.00	11.42	391.56	83.00	1.14	54.50
23.00	10.92	379.71	84.00	1.10	52.86
24.00	10.45	368.14	85.00	1.07	51.29
25.00	10.00	356.84	86.00	1.04	49.74
26.00	9.57	345.81	87.00	1.00	48.27
27.00	9.17	335.06	88.00	0.97	46.85
28.00	8.78	324.58	89.00	0.94	45.48
29.00	8.41	314.38	90.00	0.92	44.14
30.00	8.06	304.45	91.00	0.89	42.86
31.00	7.72	294.79	92.00	0.86	41.61
32.00	7.40	285.40	93.00	0.84	40.41
33.00	7.10	276.25	94.00	0.81	39.25
34.00	6.81	267.38	95.00	0.79	38.12
35.00	6.53	258.76	96.00	0.76	37.03
36.00	6.27	250.35	97.00	0.74	35.98
37.00	6.02	242.33	98.00	0.72	34.96
38.00	5.78	234.47	99.00	0.70	33.98
39.00	5.55	226.85	100.00	0.68	33.02
40.00	5.33	219.46	101.00	0.66	32.10