

Fluke Calibration, American Fork
Primary Temperature Lab
Report of Calibration

Model: 5628	Description: Platinum Resistance Thermometer	Customer: FLUKE SOUTH EAST ASIA PTE LTD SINGAPORE SG	
Serial No.: 4413	Manufacturer: Fluke Calibration		
As Found Condition: New	As Left Condition: Calibrated	Calibration Model: 1913-4-7	Calibration Instruction: AFC105 Revision 001

The above referenced Platinum Resistance Thermometer (PRT) was calibrated by a combination of fixed point and comparison methods over the temperature range(s) specified. The calibration methods used are based on recent publications pertaining to the ITS-90 as it applies to secondary PRT calibrations.

For temperatures above 0°C, this calibration was performed at the appropriate fixed points required for the ITS-90 temperature range identified in the "Calibration Model" location above. For temperatures below 0°C (if applicable), the calibration was performed by comparison against a calibrated SPRT. When the temperature range warrants and additional temperature points are available, measurements at supplementary temperatures are included to improve the quality of the calibration result. The calibration measurements were performed using a digital DC readout and DC reference resistors at one level of excitation current. The value of current used is shown in the calibration data section of this report.

During the course of calibration, the PRT resistance at the triple point of water (RTPW) is measured several times to provide the required calibration data and to verify the stability of the PRT. Additionally, the PRT is annealed after the first RTPW measurement to precondition it for calibration. The initial RTPW measurement shows the "As Found" condition of the PRT and the subsequent RTPW measurements (after annealing) indicate the stability of the PRT during calibration. The procedure places a limit on the amount of change permitted in the RTPW during calibration. Instruments that exceed this value will be given larger uncertainties commensurate with the observed performance and the "As Left" condition will be denoted as "Limited". The "As Found" RTPW, the dRTPW during calibration, the dRTPW limit, and the final RTPW are shown in the calibration data section of this report.

The following reference standards and measurement equipment were used in this calibration.

Instrument	Model	Serial No.	Recall Date
SPRT, Glass Sheath	5683	4360	02/04/2022
Precision Digital Thermometer	1595A	B0C034	12/14/2019
Precision Digital Thermometer	1595A	B27094	09/14/2019
Precision Digital Thermometer	1595A	B08031	09/21/2019

Environmental Conditions:

Temperature: 23.52°C

Humidity: 40.1% RH

Calibration Date: 04/08/2019

Calibration Due: Not Defined

PO Number: 17514/SG//STOCK

Report Number: B9430036

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Approved by:



Mike Coleman
Temperature Metrologist

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The PRT was calibrated at the following temperatures with the associated uncertainties. The uncertainty evaluation accounts for all known uncertainties present at the time of calibration including long-term behavior of the calibration system, measurement noise, and any short-term effects of the PRT. The uncertainties are reported at the calibration temperatures only. The uncertainties at intermediate temperatures can be computed from these values and the ITS-90 propagation of error curves. The uncertainties are reported at a coverage factor of 2 ($k=2$).

CALIBRATION POINT			TEMPERATURE	MEASURED	UNCERTAINTY
(point °C)	(type)	(SN)	t90(°C)	RESISTANCE	(mK)
-197.000	Comp	N/A	-197.000	4.66922	±6.0
-80.000	Comp	N/A	-80.000	17.29642	±6.0
-38.834	Comp	N/A	-38.834	21.57297	±6.0
0.010	Comp	N/A	0.010	25.55609	±4.0
In	FP	S9004	156.599	41.13899	±6.0
Sn	FP	S7005	231.928	48.37066	±7.0
Zn	FP	16057	419.527	65.64802	±9.0
Al	FP	17086	660.323	86.27111	±14.0

The following tables indicate the "As Found" RTPW nominal current, the dRTPW in mK, and dRTPW limit in mK. The dRTPW is the change in RTPW during the calibration, not the difference between the "As Found" and "As Left" RTPW. The value of current used in the calibration was 1.000 mA.

As Found Rtpw	dRtpw Observed	dRtpw Limit
1 mA 25.55616	2 mK	3 mK

The following values were determined for the RTPW and the coefficients of the pertinent deviation functions of the ITS-90. For best results, the RTPW value shown should be used as a baseline value for determining the stability of the PRT. The user should maintain a record of RTPW values measured as a routine operation and use these values when computing temperature.

Results for Nominal Current Calibration

RTPW = 25.55609 Ω
a4 = -2.685632 E-05
b4 = -7.960788 E-07
a7 = -9.225664 E-05
b7 = 2.295581 E-05
c7 = -1.219894 E-05

The attached interpolation table was generated from the coefficients listed above. The table is given in terms of resistance (Rt90) versus temperature (°C) at the nominal current. These tables can be used in cases where the readout instrument does not have the capability of computing temperature directly from the coefficients or as a check that the coefficients have been entered into the readout or computer program correctly. The following steps are used to compute temperature from measured resistances utilizing the table. (1) Determine the resistance at the temperature in question. (2) On the table, locate the two resistance values which surround the measured resistance. (3) Subtract the lower of the two from the measured resistance. (4) Divide the result by the sensitivity (dR/dt) from the adjacent column. (5) Add the product of this computation to the temperature which corresponds to the resistance value used in step (3). The additional uncertainty in the tabulated values is negligible (≤ 0.01 mK) but when these tables are used, an additional uncertainty of approximately 0.1 mK should be assumed as a result of the required linear interpolation operation outlined above.

This calibration is traceable to the International System of Units (SI) through recognized national metrology institutes (NIST, NRC, PTB, NPL, etc.), radiometric techniques, or natural physical constants and is in compliance with ISO/IEC 17025:2005. Calibration certificates without identification of the authorizing person are not valid. This certificate applies to only the item identified and shall not be reproduced except in full, without the specific written approval by Fluke Corporation. It shall not be used to claim product endorsement by NVLAP or any agency of the U.S. Government. Calibration reports without signatures are not valid.

Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)	Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)	Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)
-200.00	4.338734	0.11000	-143.00	10.60547	0.10805	-86.00	16.66757	0.10490
-199.00	4.448731	0.11017	-142.00	10.71351	0.10798	-85.00	16.77247	0.10486
-198.00	4.558901	0.11032	-141.00	10.82149	0.10790	-84.00	16.87733	0.10481
-197.00	4.669225	0.11046	-140.00	10.92939	0.10783	-83.00	16.98214	0.10477
-196.00	4.779682	0.11057	-139.00	11.03723	0.10776	-82.00	17.08691	0.10473
-195.00	4.890253	0.11067	-138.00	11.14499	0.10769	-81.00	17.19165	0.10469
-194.00	5.000923	0.11075	-137.00	11.25268	0.10762	-80.00	17.29634	0.10465
-193.00	5.111676	0.11082	-136.00	11.36031	0.10756	-79.00	17.40099	0.10461
-192.00	5.222497	0.11087	-135.00	11.46786	0.10749	-78.00	17.50559	0.10457
-191.00	5.333371	0.11092	-134.00	11.57535	0.10742	-77.00	17.61016	0.10453
-190.00	5.444288	0.11095	-133.00	11.68277	0.10735	-76.00	17.71469	0.10449
-189.00	5.555236	0.11097	-132.00	11.79012	0.10729	-75.00	17.81918	0.10445
-188.00	5.666203	0.11098	-131.00	11.89741	0.10722	-74.00	17.92363	0.10441
-187.00	5.777180	0.11098	-130.00	12.00464	0.10716	-73.00	18.02804	0.10437
-186.00	5.888158	0.11097	-129.00	12.11180	0.10710	-72.00	18.13241	0.10433
-185.00	5.999129	0.11096	-128.00	12.21889	0.10703	-71.00	18.23674	0.10429
-184.00	6.110084	0.11093	-127.00	12.32593	0.10697	-70.00	18.34104	0.10426
-183.00	6.221018	0.11090	-126.00	12.43290	0.10691	-69.00	18.44529	0.10422
-182.00	6.331923	0.11087	-125.00	12.53981	0.10685	-68.00	18.54951	0.10418
-181.00	6.442793	0.11083	-124.00	12.64666	0.10679	-67.00	18.65369	0.10414
-180.00	6.553624	0.11079	-123.00	12.75345	0.10673	-66.00	18.75783	0.10410
-179.00	6.664410	0.11074	-122.00	12.86018	0.10667	-65.00	18.86193	0.10407
-178.00	6.775147	0.11068	-121.00	12.96685	0.10661	-64.00	18.96600	0.10403
-177.00	6.885831	0.11063	-120.00	13.07346	0.10656	-63.00	19.07003	0.10399
-176.00	6.996459	0.11057	-119.00	13.18002	0.10650	-62.00	19.17402	0.10396
-175.00	7.107026	0.11050	-118.00	13.28652	0.10644	-61.00	19.27798	0.10392
-174.00	7.217530	0.11044	-117.00	13.39296	0.10639	-60.00	19.38190	0.10388
-173.00	7.327969	0.11037	-116.00	13.49935	0.10633	-59.00	19.48578	0.10385
-172.00	7.438339	0.11030	-115.00	13.60568	0.10628	-58.00	19.58962	0.10381
-171.00	7.548640	0.11023	-114.00	13.71196	0.10622	-57.00	19.69343	0.10377
-170.00	7.658868	0.11015	-113.00	13.81818	0.10617	-56.00	19.79721	0.10374
-169.00	7.769023	0.11008	-112.00	13.92435	0.10612	-55.00	19.90094	0.10370
-168.00	7.879103	0.11000	-111.00	14.03047	0.10606	-54.00	20.00465	0.10367
-167.00	7.989107	0.10993	-110.00	14.13653	0.10601	-53.00	20.10831	0.10363
-166.00	8.099034	0.10985	-109.00	14.24255	0.10596	-52.00	20.21194	0.10360
-165.00	8.208882	0.10977	-108.00	14.34851	0.10591	-51.00	20.31554	0.10356
-164.00	8.318652	0.10969	-107.00	14.45442	0.10586	-50.00	20.41910	0.10353
-163.00	8.428343	0.10961	-106.00	14.56028	0.10581	-49.00	20.52262	0.10349
-162.00	8.537953	0.10953	-105.00	14.66609	0.10576	-48.00	20.62612	0.10346
-161.00	8.647484	0.10945	-104.00	14.77185	0.10571	-47.00	20.72957	0.10342
-160.00	8.756934	0.10937	-103.00	14.87757	0.10566	-46.00	20.83299	0.10339
-159.00	8.866304	0.10929	-102.00	14.98323	0.10562	-45.00	20.93638	0.10335
-158.00	8.975593	0.10921	-101.00	15.08884	0.10557	-44.00	21.03974	0.10332
-157.00	9.084802	0.10913	-100.00	15.19441	0.10552	-43.00	21.14305	0.10329
-156.00	9.193931	0.10905	-99.00	15.29993	0.10547	-42.00	21.24634	0.10325
-155.00	9.302979	0.10897	-98.00	15.40541	0.10543	-41.00	21.34959	0.10322
-154.00	9.411948	0.10889	-97.00	15.51083	0.10538	-40.00	21.45281	0.10318
-153.00	9.520837	0.10881	-96.00	15.61622	0.10534	-39.00	21.55599	0.10315
-152.00	9.629648	0.10873	-95.00	15.72155	0.10529	-38.00	21.65914	0.10312
-151.00	9.738379	0.10865	-94.00	15.82684	0.10525	-37.00	21.76226	0.10308
-150.00	9.847033	0.10858	-93.00	15.93209	0.10520	-36.00	21.86535	0.10305
-149.00	9.955609	0.10850	-92.00	16.03729	0.10516	-35.00	21.96840	0.10302
-148.00	10.06411	0.10842	-91.00	16.14244	0.10511	-34.00	22.07142	0.10299
-147.00	10.17253	0.10835	-90.00	16.24756	0.10507	-33.00	22.17440	0.10295
-146.00	10.28088	0.10827	-89.00	16.35263	0.10503	-32.00	22.27736	0.10292
-145.00	10.38915	0.10820	-88.00	16.45765	0.10498	-31.00	22.38028	0.10289
-144.00	10.49734	0.10812	-87.00	16.56263	0.10494	-30.00	22.48316	0.10286

Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)	Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)	Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)
-29.00	22.58602	0.10282	28.00	28.39672	0.10104	85.00	34.10684	0.099289
-28.00	22.68884	0.10279	29.00	28.49775	0.10101	86.00	34.20613	0.099259
-27.00	22.79163	0.10276	30.00	28.59876	0.10098	87.00	34.30538	0.099228
-26.00	22.89439	0.10273	31.00	28.69974	0.10095	88.00	34.40461	0.099198
-25.00	22.99712	0.10269	32.00	28.80068	0.10091	89.00	34.50381	0.099167
-24.00	23.09981	0.10266	33.00	28.90160	0.10088	90.00	34.60298	0.099137
-23.00	23.20248	0.10263	34.00	29.00248	0.10085	91.00	34.70211	0.099106
-22.00	23.30511	0.10260	35.00	29.10334	0.10082	92.00	34.80122	0.099076
-21.00	23.40771	0.10257	36.00	29.20416	0.10079	93.00	34.90030	0.099045
-20.00	23.51027	0.10254	37.00	29.30495	0.10076	94.00	34.99934	0.099015
-19.00	23.61281	0.10250	38.00	29.40571	0.10073	95.00	35.09836	0.098984
-18.00	23.71532	0.10247	39.00	29.50644	0.10070	96.00	35.19734	0.098954
-17.00	23.81779	0.10244	40.00	29.60714	0.10067	97.00	35.29629	0.098923
-16.00	23.92023	0.10241	41.00	29.70781	0.10064	98.00	35.39522	0.098893
-15.00	24.02264	0.10238	42.00	29.80845	0.10061	99.00	35.49411	0.098862
-14.00	24.12502	0.10235	43.00	29.90905	0.10058	100.00	35.59297	0.098832
-13.00	24.22737	0.10232	44.00	30.00963	0.10055	101.00	35.69180	0.098801
-12.00	24.32969	0.10229	45.00	30.11018	0.10051	102.00	35.79061	0.098771
-11.00	24.43197	0.10225	46.00	30.21069	0.10048	103.00	35.88938	0.098741
-10.00	24.53423	0.10222	47.00	30.31117	0.10045	104.00	35.98812	0.098710
-9.00	24.63645	0.10219	48.00	30.41163	0.10042	105.00	36.08683	0.098680
-8.00	24.73865	0.10216	49.00	30.51205	0.10039	106.00	36.18551	0.098649
-7.00	24.84081	0.10213	50.00	30.61244	0.10036	107.00	36.28416	0.098619
-6.00	24.94294	0.10210	51.00	30.71280	0.10033	108.00	36.38278	0.098588
-5.00	25.04504	0.10207	52.00	30.81313	0.10030	109.00	36.48136	0.098558
-4.00	25.14711	0.10204	53.00	30.91343	0.10027	110.00	36.57992	0.098528
-3.00	25.24914	0.10201	54.00	31.01370	0.10024	111.00	36.67845	0.098497
-2.00	25.35115	0.10198	55.00	31.11394	0.10021	112.00	36.77695	0.098467
-1.00	25.45313	0.10194	56.00	31.21415	0.10018	113.00	36.87541	0.098437
0.00	25.55507	0.10191	57.00	31.31432	0.10015	114.00	36.97385	0.098406
1.00	25.65698	0.10188	58.00	31.41447	0.10012	115.00	37.07226	0.098376
2.00	25.75885	0.10184	59.00	31.51458	0.10008	116.00	37.17063	0.098345
3.00	25.86070	0.10181	60.00	31.61467	0.10005	117.00	37.26898	0.098315
4.00	25.96251	0.10178	61.00	31.71472	0.10002	118.00	37.36729	0.098285
5.00	26.06429	0.10175	62.00	31.81475	0.099993	119.00	37.46558	0.098254
6.00	26.16604	0.10172	63.00	31.91474	0.099962	120.00	37.56383	0.098224
7.00	26.26776	0.10169	64.00	32.01470	0.099931	121.00	37.66206	0.098194
8.00	26.36945	0.10166	65.00	32.11463	0.099901	122.00	37.76025	0.098163
9.00	26.47111	0.10163	66.00	32.21453	0.099870	123.00	37.85841	0.098133
10.00	26.57274	0.10160	67.00	32.31440	0.099840	124.00	37.95655	0.098103
11.00	26.67433	0.10156	68.00	32.41424	0.099809	125.00	38.05465	0.098072
12.00	26.77590	0.10153	69.00	32.51405	0.099778	126.00	38.15272	0.098042
13.00	26.87743	0.10150	70.00	32.61383	0.099748	127.00	38.25076	0.098012
14.00	26.97893	0.10147	71.00	32.71358	0.099717	128.00	38.34877	0.097981
15.00	27.08040	0.10144	72.00	32.81330	0.099687	129.00	38.44676	0.097951
16.00	27.18184	0.10141	73.00	32.91298	0.099656	130.00	38.54471	0.097921
17.00	27.28325	0.10138	74.00	33.01264	0.099625	131.00	38.64263	0.097890
18.00	27.38463	0.10135	75.00	33.11226	0.099595	132.00	38.74052	0.097860
19.00	27.48598	0.10132	76.00	33.21186	0.099564	133.00	38.83838	0.097830
20.00	27.58730	0.10129	77.00	33.31142	0.099534	134.00	38.93621	0.097800
21.00	27.68858	0.10125	78.00	33.41096	0.099503	135.00	39.03401	0.097769
22.00	27.78984	0.10122	79.00	33.51046	0.099473	136.00	39.13178	0.097739
23.00	27.89106	0.10119	80.00	33.60993	0.099442	137.00	39.22952	0.097709
24.00	27.99225	0.10116	81.00	33.70937	0.099411	138.00	39.32722	0.097678
25.00	28.09342	0.10113	82.00	33.80879	0.099381	139.00	39.42490	0.097648
26.00	28.19455	0.10110	83.00	33.90817	0.099350	140.00	39.52255	0.097618
27.00	28.29565	0.10107	84.00	34.00752	0.099320	141.00	39.62017	0.097588

Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)	Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)	Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)
142.00	39.71776	0.097557	199.00	45.23044	0.095843	256.00	50.64587	0.094145
143.00	39.81531	0.097527	200.00	45.32628	0.095813	257.00	50.74001	0.094115
144.00	39.91284	0.097497	201.00	45.42209	0.095783	258.00	50.83413	0.094086
145.00	40.01034	0.097467	202.00	45.51788	0.095753	259.00	50.92821	0.094056
146.00	40.10780	0.097437	203.00	45.61363	0.095723	260.00	51.02227	0.094026
147.00	40.20524	0.097406	204.00	45.70935	0.095693	261.00	51.11629	0.093997
148.00	40.30265	0.097376	205.00	45.80505	0.095663	262.00	51.21029	0.093967
149.00	40.40002	0.097346	206.00	45.90071	0.095633	263.00	51.30426	0.093937
150.00	40.49737	0.097316	207.00	45.99634	0.095604	264.00	51.39820	0.093908
151.00	40.59469	0.097286	208.00	46.09195	0.095574	265.00	51.49210	0.093878
152.00	40.69197	0.097255	209.00	46.18752	0.095544	266.00	51.58598	0.093848
153.00	40.78923	0.097225	210.00	46.28307	0.095514	267.00	51.67983	0.093819
154.00	40.88645	0.097195	211.00	46.37858	0.095484	268.00	51.77365	0.093789
155.00	40.98365	0.097165	212.00	46.47406	0.095454	269.00	51.86744	0.093760
156.00	41.08081	0.097135	213.00	46.56952	0.095424	270.00	51.96120	0.093730
157.00	41.17795	0.097105	214.00	46.66494	0.095394	271.00	52.05493	0.093700
158.00	41.27505	0.097074	215.00	46.76034	0.095365	272.00	52.14863	0.093671
159.00	41.37213	0.097044	216.00	46.85570	0.095335	273.00	52.24230	0.093641
160.00	41.46917	0.097014	217.00	46.95104	0.095305	274.00	52.33594	0.093612
161.00	41.56618	0.096984	218.00	47.04634	0.095275	275.00	52.42955	0.093582
162.00	41.66317	0.096954	219.00	47.14162	0.095245	276.00	52.52313	0.093552
163.00	41.76012	0.096924	220.00	47.23686	0.095215	277.00	52.61669	0.093523
164.00	41.85705	0.096894	221.00	47.33208	0.095186	278.00	52.71021	0.093493
165.00	41.95394	0.096863	222.00	47.42726	0.095156	279.00	52.80370	0.093464
166.00	42.05080	0.096833	223.00	47.52242	0.095126	280.00	52.89716	0.093434
167.00	42.14764	0.096803	224.00	47.61754	0.095096	281.00	52.99060	0.093404
168.00	42.24444	0.096773	225.00	47.71264	0.095066	282.00	53.08400	0.093375
169.00	42.34121	0.096743	226.00	47.80771	0.095037	283.00	53.17738	0.093345
170.00	42.43796	0.096713	227.00	47.90274	0.095007	284.00	53.27072	0.093316
171.00	42.53467	0.096683	228.00	47.99775	0.094977	285.00	53.36404	0.093286
172.00	42.63135	0.096653	229.00	48.09273	0.094947	286.00	53.45732	0.093257
173.00	42.72800	0.096623	230.00	48.18767	0.094918	287.00	53.55058	0.093227
174.00	42.82463	0.096593	231.00	48.28259	0.094888	288.00	53.64381	0.093197
175.00	42.92122	0.096563	232.00	48.37748	0.094858	289.00	53.73701	0.093168
176.00	43.01778	0.096533	233.00	48.47234	0.094828	290.00	53.83017	0.093138
177.00	43.11432	0.096503	234.00	48.56717	0.094798	291.00	53.92331	0.093109
178.00	43.21082	0.096472	235.00	48.66196	0.094769	292.00	54.01642	0.093079
179.00	43.30729	0.096442	236.00	48.75673	0.094739	293.00	54.10950	0.093050
180.00	43.40373	0.096412	237.00	48.85147	0.094709	294.00	54.20255	0.093020
181.00	43.50014	0.096382	238.00	48.94618	0.094679	295.00	54.29557	0.092990
182.00	43.59653	0.096352	239.00	49.04086	0.094650	296.00	54.38856	0.092961
183.00	43.69288	0.096322	240.00	49.13551	0.094620	297.00	54.48152	0.092931
184.00	43.78920	0.096292	241.00	49.23013	0.094590	298.00	54.57445	0.092902
185.00	43.88549	0.096262	242.00	49.32472	0.094561	299.00	54.66735	0.092872
186.00	43.98176	0.096232	243.00	49.41928	0.094531	300.00	54.76023	0.092843
187.00	44.07799	0.096202	244.00	49.51381	0.094501	301.00	54.85307	0.092813
188.00	44.17419	0.096172	245.00	49.60831	0.094471	302.00	54.94588	0.092784
189.00	44.27036	0.096142	246.00	49.70278	0.094442	303.00	55.03867	0.092754
190.00	44.36651	0.096112	247.00	49.79723	0.094412	304.00	55.13142	0.092725
191.00	44.46262	0.096082	248.00	49.89164	0.094382	305.00	55.22414	0.092695
192.00	44.55870	0.096052	249.00	49.98602	0.094353	306.00	55.31684	0.092665
193.00	44.65475	0.096022	250.00	50.08037	0.094323	307.00	55.40950	0.092636
194.00	44.75078	0.095993	251.00	50.17470	0.094293	308.00	55.50214	0.092606
195.00	44.84677	0.095963	252.00	50.26899	0.094264	309.00	55.59475	0.092577
196.00	44.94273	0.095933	253.00	50.36325	0.094234	310.00	55.68732	0.092547
197.00	45.03866	0.095903	254.00	50.45749	0.094204	311.00	55.77987	0.092518
198.00	45.13457	0.095873	255.00	50.55169	0.094175	312.00	55.87239	0.092488

Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)	Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)	Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)
313.00	55.96488	0.092459	370.00	61.18789	0.090775	427.00	66.31466	0.089080
314.00	56.05734	0.092429	371.00	61.27866	0.090745	428.00	66.40374	0.089050
315.00	56.14977	0.092400	372.00	61.36941	0.090715	429.00	66.49279	0.089020
316.00	56.24216	0.092370	373.00	61.46012	0.090686	430.00	66.58181	0.088990
317.00	56.33453	0.092341	374.00	61.55081	0.090656	431.00	66.67080	0.088960
318.00	56.42688	0.092311	375.00	61.64146	0.090626	432.00	66.75976	0.088930
319.00	56.51919	0.092282	376.00	61.73209	0.090597	433.00	66.84869	0.088900
320.00	56.61147	0.092252	377.00	61.82269	0.090567	434.00	66.93759	0.088871
321.00	56.70372	0.092223	378.00	61.91325	0.090538	435.00	67.02647	0.088841
322.00	56.79594	0.092193	379.00	62.00379	0.090508	436.00	67.11531	0.088811
323.00	56.88814	0.092163	380.00	62.09430	0.090478	437.00	67.20412	0.088781
324.00	56.98030	0.092134	381.00	62.18478	0.090449	438.00	67.29290	0.088751
325.00	57.07243	0.092104	382.00	62.27523	0.090419	439.00	67.38165	0.088721
326.00	57.16454	0.092075	383.00	62.36564	0.090389	440.00	67.47037	0.088691
327.00	57.25661	0.092045	384.00	62.45603	0.090360	441.00	67.55906	0.088661
328.00	57.34866	0.092016	385.00	62.54639	0.090330	442.00	67.64772	0.088631
329.00	57.44067	0.091986	386.00	62.63672	0.090300	443.00	67.73635	0.088601
330.00	57.53266	0.091957	387.00	62.72702	0.090271	444.00	67.82495	0.088571
331.00	57.62462	0.091927	388.00	62.81729	0.090241	445.00	67.91352	0.088541
332.00	57.71654	0.091898	389.00	62.90754	0.090211	446.00	68.00206	0.088511
333.00	57.80844	0.091868	390.00	62.99775	0.090182	447.00	68.09057	0.088481
334.00	57.90031	0.091839	391.00	63.08793	0.090152	448.00	68.17906	0.088451
335.00	57.99215	0.091809	392.00	63.17808	0.090122	449.00	68.26751	0.088421
336.00	58.08396	0.091780	393.00	63.26820	0.090093	450.00	68.35593	0.088391
337.00	58.17574	0.091750	394.00	63.35830	0.090063	451.00	68.44432	0.088361
338.00	58.26749	0.091721	395.00	63.44836	0.090033	452.00	68.53268	0.088330
339.00	58.35921	0.091691	396.00	63.53839	0.090004	453.00	68.62101	0.088300
340.00	58.45090	0.091661	397.00	63.62840	0.089974	454.00	68.70931	0.088270
341.00	58.54256	0.091632	398.00	63.71837	0.089944	455.00	68.79758	0.088240
342.00	58.63419	0.091602	399.00	63.80831	0.089914	456.00	68.88582	0.088210
343.00	58.72579	0.091573	400.00	63.89823	0.089885	457.00	68.97403	0.088180
344.00	58.81737	0.091543	401.00	63.98811	0.089855	458.00	69.06221	0.088150
345.00	58.90891	0.091514	402.00	64.07797	0.089825	459.00	69.15036	0.088120
346.00	59.00042	0.091484	403.00	64.16779	0.089795	460.00	69.23848	0.088090
347.00	59.09191	0.091455	404.00	64.25759	0.089766	461.00	69.32657	0.088059
348.00	59.18336	0.091425	405.00	64.34735	0.089736	462.00	69.41463	0.088029
349.00	59.27479	0.091396	406.00	64.43709	0.089706	463.00	69.50266	0.087999
350.00	59.36618	0.091366	407.00	64.52680	0.089676	464.00	69.59066	0.087969
351.00	59.45755	0.091336	408.00	64.61647	0.089647	465.00	69.67862	0.087939
352.00	59.54889	0.091307	409.00	64.70612	0.089617	466.00	69.76656	0.087909
353.00	59.64019	0.091277	410.00	64.79574	0.089587	467.00	69.85447	0.087878
354.00	59.73147	0.091248	411.00	64.88532	0.089557	468.00	69.94235	0.087848
355.00	59.82272	0.091218	412.00	64.97488	0.089528	469.00	70.03020	0.087818
356.00	59.91394	0.091189	413.00	65.06441	0.089498	470.00	70.11802	0.087788
357.00	60.00512	0.091159	414.00	65.15391	0.089468	471.00	70.20580	0.087758
358.00	60.09628	0.091130	415.00	65.24337	0.089438	472.00	70.29356	0.087727
359.00	60.18741	0.091100	416.00	65.33281	0.089408	473.00	70.38129	0.087697
360.00	60.27851	0.091070	417.00	65.42222	0.089379	474.00	70.46899	0.087667
361.00	60.36958	0.091041	418.00	65.51160	0.089349	475.00	70.55665	0.087636
362.00	60.46062	0.091011	419.00	65.60095	0.089319	476.00	70.64429	0.087606
363.00	60.55164	0.090982	420.00	65.69027	0.089289	477.00	70.73190	0.087576
364.00	60.64262	0.090952	421.00	65.77956	0.089259	478.00	70.81947	0.087546
365.00	60.73357	0.090922	422.00	65.86882	0.089229	479.00	70.90702	0.087515
366.00	60.82449	0.090893	423.00	65.95804	0.089199	480.00	70.99453	0.087485
367.00	60.91538	0.090863	424.00	66.04724	0.089170	481.00	71.08202	0.087455
368.00	61.00625	0.090834	425.00	66.13641	0.089140	482.00	71.16947	0.087424
369.00	61.09708	0.090804	426.00	66.22555	0.089110	483.00	71.25690	0.087394

Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)	Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)	Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)
484.00	71.34429	0.087364	541.00	76.27530	0.085618	598.00	81.10598	0.083843
485.00	71.43165	0.087333	542.00	76.36092	0.085588	599.00	81.18982	0.083812
486.00	71.51899	0.087303	543.00	76.44651	0.085557	600.00	81.27364	0.083780
487.00	71.60629	0.087273	544.00	76.53206	0.085526	601.00	81.35742	0.083749
488.00	71.69356	0.087242	545.00	76.61759	0.085495	602.00	81.44116	0.083718
489.00	71.78081	0.087212	546.00	76.70308	0.085464	603.00	81.52488	0.083686
490.00	71.86802	0.087181	547.00	76.78855	0.085433	604.00	81.60857	0.083655
491.00	71.95520	0.087151	548.00	76.87398	0.085402	605.00	81.69222	0.083623
492.00	72.04235	0.087121	549.00	76.95938	0.085371	606.00	81.77585	0.083592
493.00	72.12947	0.087090	550.00	77.04475	0.085340	607.00	81.85944	0.083560
494.00	72.21656	0.087060	551.00	77.13009	0.085309	608.00	81.94300	0.083529
495.00	72.30362	0.087029	552.00	77.21540	0.085278	609.00	82.02653	0.083498
496.00	72.39065	0.086999	553.00	77.30068	0.085247	610.00	82.11003	0.083466
497.00	72.47765	0.086968	554.00	77.38593	0.085216	611.00	82.19349	0.083435
498.00	72.56462	0.086938	555.00	77.47114	0.085185	612.00	82.27693	0.083403
499.00	72.65155	0.086907	556.00	77.55633	0.085154	613.00	82.36033	0.083372
500.00	72.73846	0.086877	557.00	77.64148	0.085123	614.00	82.44370	0.083340
501.00	72.82534	0.086846	558.00	77.72661	0.085092	615.00	82.52704	0.083309
502.00	72.91219	0.086816	559.00	77.81170	0.085061	616.00	82.61035	0.083277
503.00	72.99900	0.086785	560.00	77.89676	0.085030	617.00	82.69363	0.083246
504.00	73.08579	0.086755	561.00	77.98179	0.084999	618.00	82.77687	0.083214
505.00	73.17254	0.086724	562.00	78.06679	0.084968	619.00	82.86009	0.083183
506.00	73.25927	0.086694	563.00	78.15176	0.084937	620.00	82.94327	0.083151
507.00	73.34596	0.086663	564.00	78.23669	0.084906	621.00	83.02642	0.083120
508.00	73.43262	0.086633	565.00	78.32160	0.084874	622.00	83.10954	0.083088
509.00	73.51926	0.086602	566.00	78.40647	0.084843	623.00	83.19263	0.083056
510.00	73.60586	0.086571	567.00	78.49132	0.084812	624.00	83.27568	0.083025
511.00	73.69243	0.086541	568.00	78.57613	0.084781	625.00	83.35871	0.082993
512.00	73.77897	0.086510	569.00	78.66091	0.084750	626.00	83.44170	0.082962
513.00	73.86548	0.086480	570.00	78.74566	0.084719	627.00	83.52466	0.082930
514.00	73.95196	0.086449	571.00	78.83038	0.084688	628.00	83.60759	0.082899
515.00	74.03841	0.086418	572.00	78.91507	0.084656	629.00	83.69049	0.082867
516.00	74.12483	0.086388	573.00	78.99972	0.084625	630.00	83.77336	0.082835
517.00	74.21121	0.086357	574.00	79.08435	0.084594	631.00	83.85620	0.082804
518.00	74.29757	0.086326	575.00	79.16894	0.084563	632.00	83.93900	0.082772
519.00	74.38390	0.086296	576.00	79.25350	0.084532	633.00	84.02177	0.082741
520.00	74.47019	0.086265	577.00	79.33804	0.084501	634.00	84.10451	0.082709
521.00	74.55646	0.086234	578.00	79.42254	0.084469	635.00	84.18722	0.082677
522.00	74.64269	0.086204	579.00	79.50701	0.084438	636.00	84.26990	0.082646
523.00	74.72890	0.086173	580.00	79.59144	0.084407	637.00	84.35254	0.082614
524.00	74.81507	0.086142	581.00	79.67585	0.084376	638.00	84.43516	0.082582
525.00	74.90121	0.086111	582.00	79.76023	0.084344	639.00	84.51774	0.082551
526.00	74.98732	0.086081	583.00	79.84457	0.084313	640.00	84.60029	0.082519
527.00	75.07340	0.086050	584.00	79.92888	0.084282	641.00	84.68281	0.082488
528.00	75.15945	0.086019	585.00	80.01317	0.084251	642.00	84.76530	0.082456
529.00	75.24547	0.085988	586.00	80.09742	0.084219	643.00	84.84775	0.082424
530.00	75.33146	0.085958	587.00	80.18164	0.084188	644.00	84.93018	0.082393
531.00	75.41742	0.085927	588.00	80.26582	0.084157	645.00	85.01257	0.082361
532.00	75.50335	0.085896	589.00	80.34998	0.084125	646.00	85.09493	0.082329
533.00	75.58924	0.085865	590.00	80.43411	0.084094	647.00	85.17726	0.082298
534.00	75.67511	0.085834	591.00	80.51820	0.084063	648.00	85.25956	0.082266
535.00	75.76094	0.085804	592.00	80.60226	0.084031	649.00	85.34182	0.082234
536.00	75.84675	0.085773	593.00	80.68629	0.084000	650.00	85.42406	0.082202
537.00	75.93252	0.085742	594.00	80.77029	0.083969	651.00	85.50626	0.082171
538.00	76.01826	0.085711	595.00	80.85426	0.083937	652.00	85.58843	0.082139
539.00	76.10397	0.085680	596.00	80.93820	0.083906	653.00	85.67057	0.082107
540.00	76.18965	0.085649	597.00	81.02211	0.083875	654.00	85.75268	0.082076

Temp (°C)	Resistance (ohms)	dR/dT (ohms/°C)
655.00	85.83475	0.082044
656.00	85.91680	0.082012
657.00	85.99881	0.081981
658.00	86.08079	0.081949
659.00	86.16274	0.081917
660.00	86.24466	0.081885

Certificate of Calibration

Fluke Calibration, American Fork Primary Temperature Laboratory

Description:	Readout, Digital Thermometer	Certificate Number:	B9301060
Manufacturer:	Fluke	Date of Calibration:	28 Feb 2019
Model:	1524	Date Due:	
Serial Number:	3491923	Temperature:	21.0 to 25.0 °C
Status:	As-Found: New As-Left: In Tolerance	Relative Humidity:	20 to 60 %RH
Calibration:	Full	Pressure:	83.5 to 88.5 kPa
Procedure:	AFC208 - 1	Issue Date:	01 Mar 2019
Customer:	FLUKE SOUTH EAST ASIA PTE LTD SINGAPORE, SG		
PO Number:	17291/SG//STOCK		

This calibration is traceable to the SI through recognized national measurement institutes, radiometric techniques, or natural physical constants and is in compliance with ISO17025:2005 and ANSI/NCSL Z540.1. The calibration has been completed in accordance with the Fluke Calibration Quality System document QSD 111.0. Calibration certificates without signatures are not valid. This certificate applies to only the item identified and shall not be reproduced other than in full, without the specific written approval by Fluke Corporation. This certificate shall not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

This calibration certificate may contain data that is not covered by the Scope of Accreditation. The unaccredited test points, where applicable, are indicated by an asterisk (*), or confined to clearly marked sections. Functional tests are not accredited.

Measurement uncertainties at the time of test are given where applicable. They are calculated in accordance with the method described in the ISO Guide to the Expression of Uncertainty in Measurement. The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k such that the coverage probability corresponds to approximately 95 %.

Comments:



Electronically signed by
Approved Signatory
 Michael Coleman
 Metrologist

Standards Used

Description	Serial Number	Due-Date
1504 Digital Thermometer	A86639	08-Oct-2019
3591 Standard Resistor Set	A842401	26-Apr-2019
5610 Thermistor Probe	1815-0112	13-Apr-2019
5700A DC Reference Standard	5865305	18-Mar-2019
152x Test Station	6	NCR

Quality Manuals

This calibration has been completed in accordance with:

The Fluke Corporate Quality Manual, QSD 111.00, Revision 122, Dated June, 2018 and/or

The Fluke 17025 Quality Manual, QSD 111.41, Revision 005, Dated Sept. 2014

The instrument described herein was calibrated by two methods. Resistance functions were calibrated by direct measurement of laboratory reference resistors. Thermocouple functions were calibrated by direct measurement of laboratory mV references. The internal reference junction compensation is a resistance function and was calibrated as described above for resistance functions. The calibration data, internal calibration constants, and calibration uncertainties are shown on the following page(s) of this report. The calibration uncertainties are shown at a coverage factor of 2 ($k=2$). All known significant sources of uncertainty have been considered. Any limitations or remarks pertaining to this instrument and/or calibration are shown below. Additionally, out of tolerance indications, if any, are identified along with the corresponding data on the data pages of this report.

Calibration uncertainties have been taken into account in the determination of tolerance status using risk analysis algorithms. When using the instrument in a calibration process, it is recommended that the instrument specifications be used as the contribution of the instrument rather than the calibration uncertainties. The instrument tolerances are shown on the report at a confidence interval of 95%.

Certificate of Calibration

Model: 1524

Serial No.: 3491923

Certificate No: B9301060

As Found Data

No As Found Data Required

As Left Data

Data ID: B9059082742250

	Nominal	Actual	Measured	Error	Tolerance	Uncertainty	Pass/Fail
L75 Ohms Test Data (Ω)							
	0	0.0000	0.0000	0.0000	± 0.0020	± 0.00040	P
	25	24.9992	24.9999	0.0007	± 0.0030	± 0.00045	P
	75	74.9937	74.9938	0.0001	± 0.0050	± 0.00090	P
LO Ohms Test Data (Ω)							
	75	74.9937	74.9937	0.0000	± 0.0050	± 0.00090	P
	100	99.9939	99.9944	0.0005	± 0.0060	± 0.0011	P
	200	200.0132	200.0146	0.0014	± 0.0100	± 0.0025	P
	400	400.0163	400.0164	0.0001	± 0.0180	± 0.0045	P
Ch 2 -> 100		99.9939	99.9943	0.0004	± 0.0060	± 0.0011	P
MED Ohms Test Data (K Ω)							
	0.2	0.200013	0.200080	0.000067	± 0.000520	± 0.000060	P
	0.4	0.400016	0.400022	0.000006	± 0.000540	± 0.000060	P
	10	10.000403	10.000623	0.000220	± 0.001500	± 0.00021	P
	40	40.002859	40.002905	0.000046	± 0.004500	± 0.0011	P
Ch 2 -> 10		10.000403	10.000627	0.000224	± 0.001500	± 0.00021	P
HI Ohms Test Data (K Ω)							
	40	40.0029	40.0029	0.0000	± 0.0120	± 0.0016	P
	100	99.9996	100.0002	0.0006	± 0.0300	± 0.0041	P
	300	300.0005	299.9922	-0.0083	± 0.0900	± 0.012	P
	500	500.0160	499.9814	-0.0346	± 0.1500	± 0.020	P
Ch 2 -> 100		99.9996	99.9984	-0.0012	± 0.0300	± 0.0041	P
mV Test Data (mV)							
	-10	-10.00000	-10.00145	-0.00145	± 0.00550	± 0.0010	P
	0	0.00000	-0.00020	-0.00020	± 0.00500	± 0.0010	P
	25	25.00000	25.00023	0.00023	± 0.00630	± 0.0012	P
	75	75.00000	75.00007	0.00007	± 0.00880	± 0.0015	P
RJ Ohms Test Data (K Ω)							
	10	10.0028	10.0030	0.0002	± 0.0050	± 0.0010	P

Note: All data taken from channel 1 unless otherwise indicated.

TB-150 (SPRT)		Read out			
Nhiệt độ	U	Điện trở, Ω	Chuẩn, oC	u, Ω	HS giãn nở nhiệt, $\Omega/^{\circ}\text{C}$
-197	0.006	4.3387	-200	0.0004	0.10805
-80	0.006	24.9999	-5	0.00045	0.10207
-38.834	0.006	74.9938	527	0.0009	0.08605
0.01	0.004				
156.599	0.006				
231.928	0.007				
419.527	0.009				
660.323	0.014				

T	U chung
-197	0.0071
-80	0.0074
-38.834	0.0074
0.01	0.0060
156.599	0.0121
231.928	0.0126
419.527	0.0138
660.323	0.0175

U, °C
0.00370
0.00441
0.01046