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uIRt/c™ Infrared Temperature Sensor

uIRt/c™ Linear Range Report

Report Revision 1

Monday, March 03, 2003

Purpose

The purpose of this report is to document the results of linearity tests performed on the uIRt/c™. Methodology, data and results will all be included.

uIRt/c Principles of Operation

The uIRt/c is calibrated to match a conventional thermocouple at a specific temperature. By adjusting the calibration point of the uIRt/c to equal the Seebeck coefficient, the signal output (mV) will be within 2% or 2.2°C of a conventional t/c at temperatures close to the calibration point. So when the non-contact, self-powered uIRt/c is wired into a conventional t/c input device the displayed target temperature will be the same as a conventional t/c system.

There two factors which contribute the to signal of the uIRt/c; radiation from the target and the ambient temperature of the sensor. The temperature of the target and its emissivity determines the radiation from the target. In general, we assume that the emissivity is always 0.90, such as our calibration targets. Thus, radiation is often called target temperature, which can get confusing.

One of the great things about the uIRt/c is its real world performance. In most applications as the target temperature increases, so does the ambient temperature. We adjust the ambient temperature at which we calibrate for each of the uIRt/cs temperature ranges to incorporate this effect, providing better performance. For example, the K-180 is calibrated at an ambient of 120F (49°C), while the K-280 is calibrated at 160F (71°C).

Collection Data

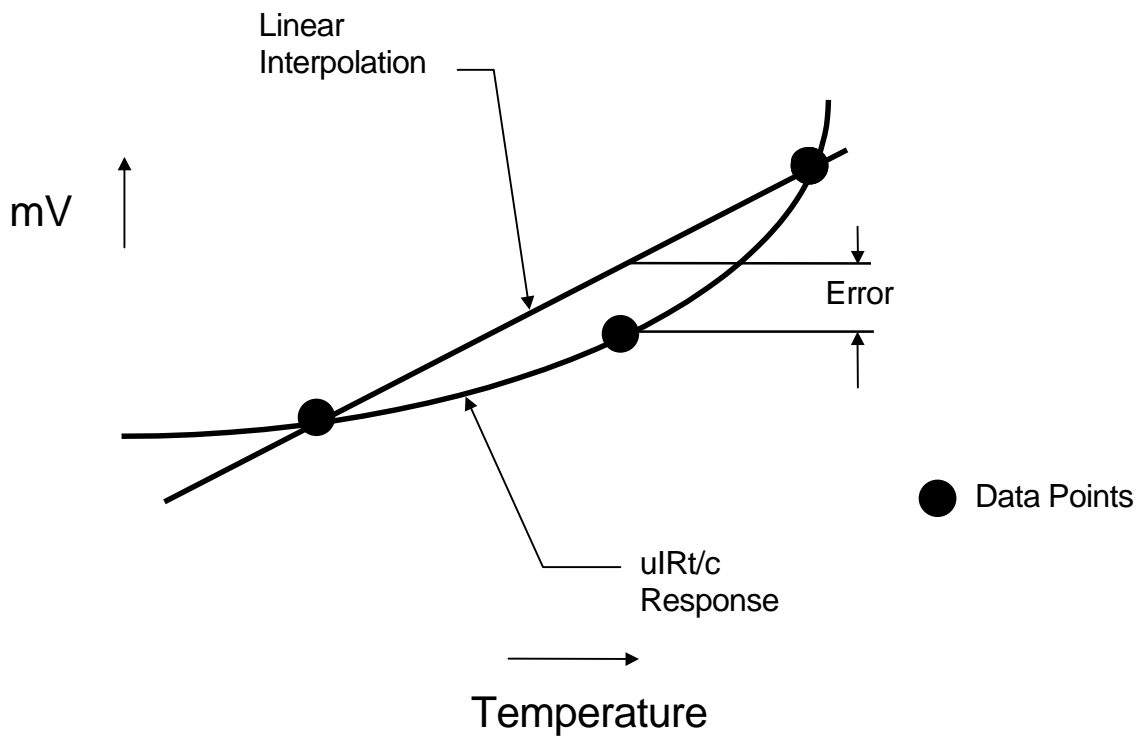
The uIRt/c is cleaned and allowed to equilibrate to its calibration ambient temperature in the proper ambient fixture. Once equilibrated, the uIRt/c is connected to a voltmeter with cold junction compensation and readings are taken at several target temperatures. The target temperature is allowed to equilibrate before each reading. This yields several points for each unit under test.

The collected data is shown below.

Calculations

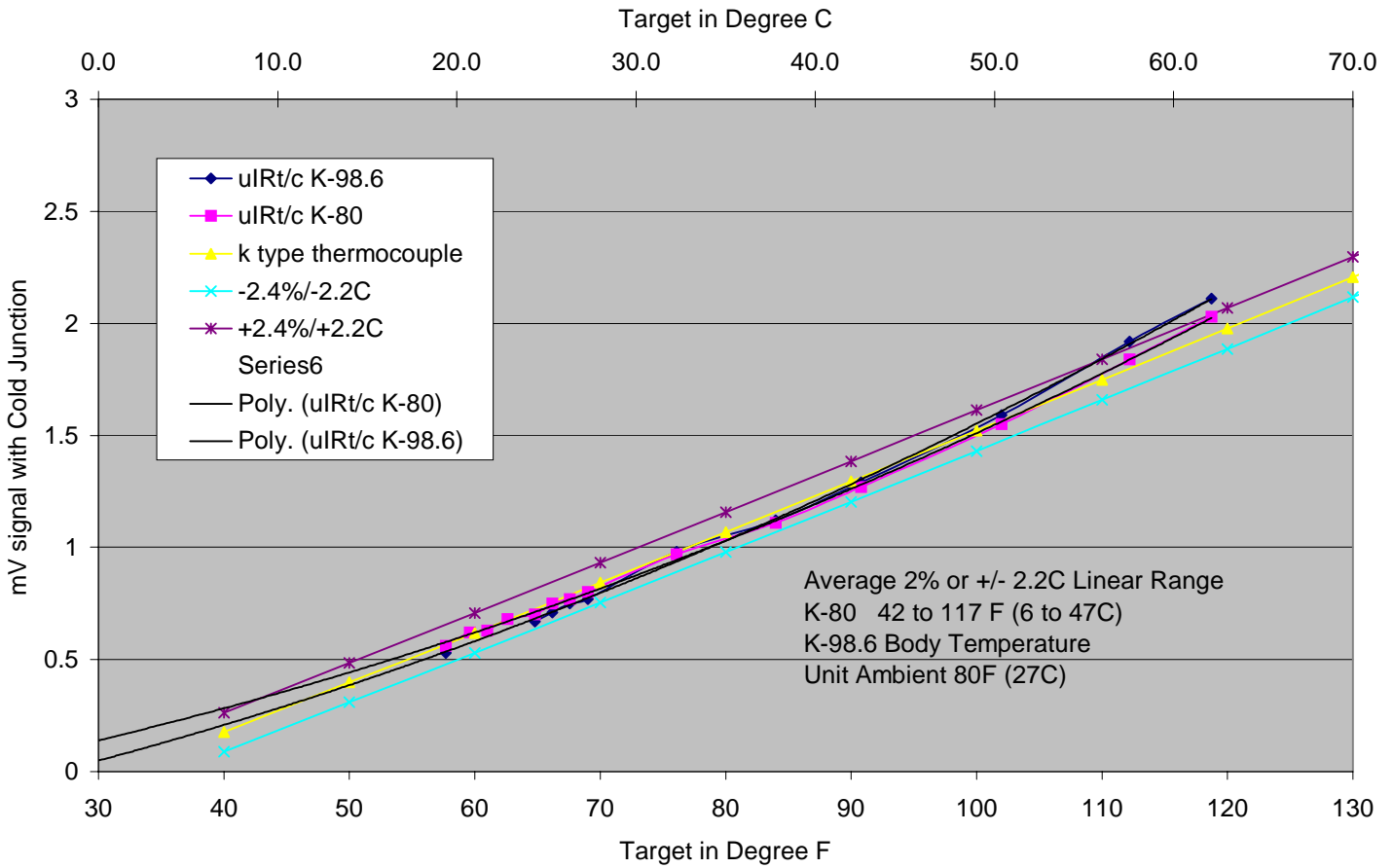
From this data, a response curve for each uIRt/c is created. These curves are all similar for different temperature ranges, but not the same. The uIRt/c circuit mostly changes the gain of the curve. The variation in calibration ambient temperature will also have an effect on the curve.

From the interpolated curves, the linear ranges were determined. An equation for the curve was developed. An equation for the 2% or 2.2°C allowed error was developed, and the intercepts solved for. Care was given when multiple solutions were possible.



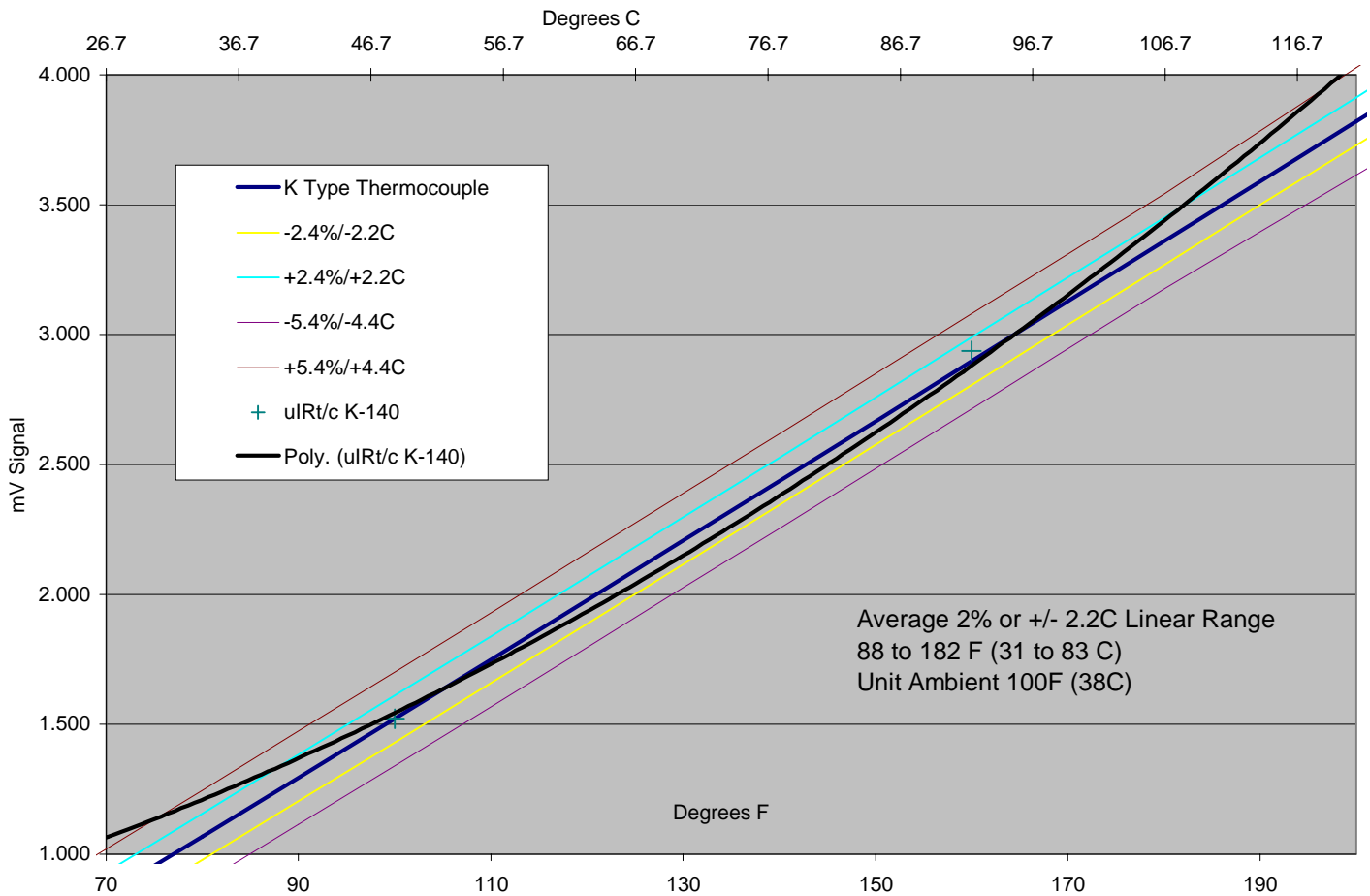
uIRt/c K-80										
		Target	98.6	160	200	240	300	360	440	
		Hg Readings	101.3	160	206	240	300	360	440	
										Cal Ambient
		Average in F	101.3	160	206	240	300	360	440	100
		Average in C	38.5	71.1	96.7	115.6	148.9	182.2	226.7	37.8
1	micro	2340187	1.51	3.18	4.65	6.08	9.11	12.5	18.38	
										Know point
		Average	1.51	3.18	4.65	6.08	9.11	12.50	18.38	1.521
		STD	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
		Min	1.51	3.18	4.65	6.08	9.11	12.5	18.38	
		Max	1.51	3.18	4.65	6.08	9.11	12.5	18.38	

uIRt/c K-80 and K-98.6 Linear Range



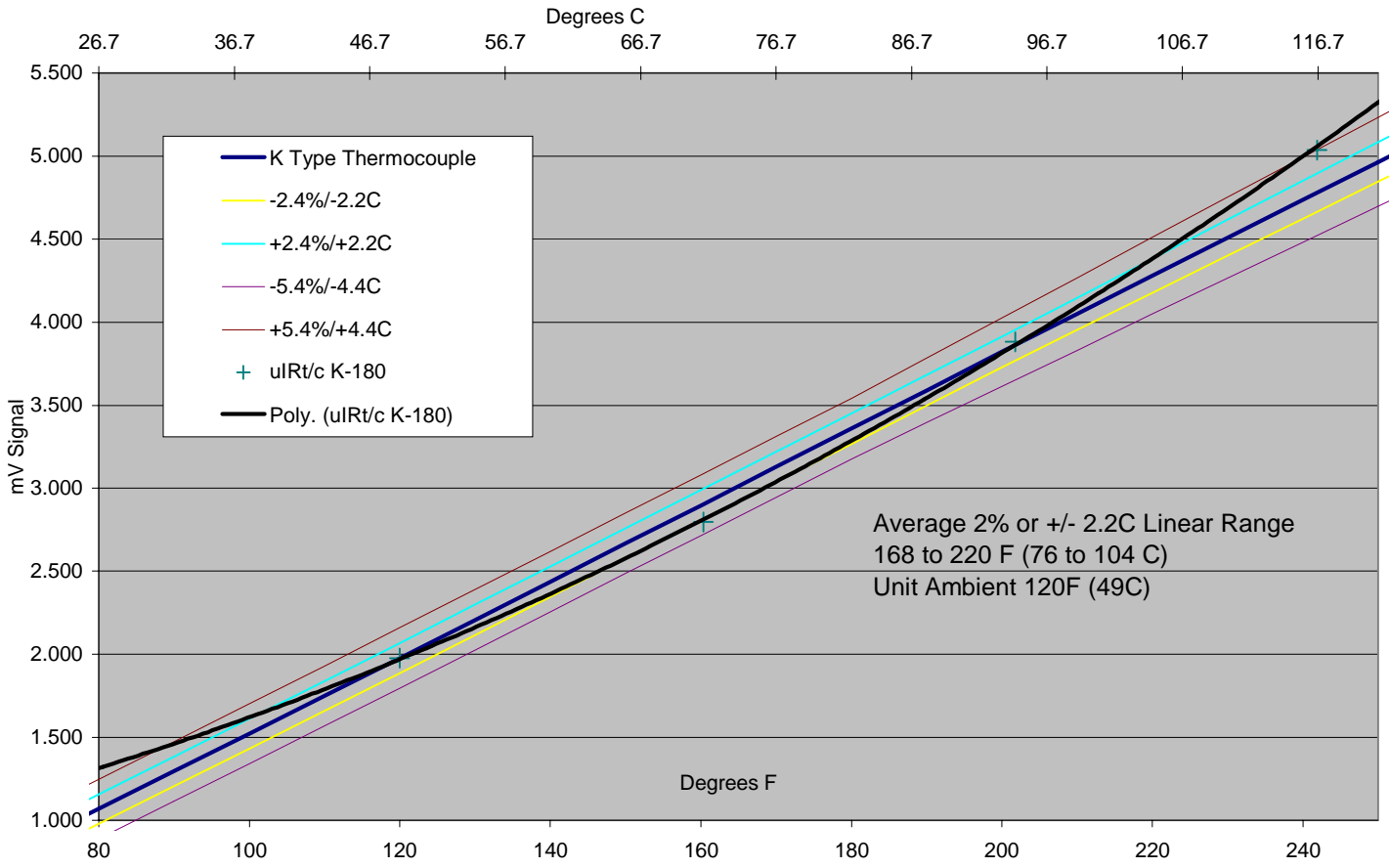
uIRt/c K-140										
		Target	98.6	160	200	240	300	360	440	
		Hg Readings	101.3	160	206	240	300	360	440	
										Cal Ambient
		Average in F	101.3	160	206	240	300	360	440	100
		Average in C	38.5	71.1	96.7	115.6	148.9	182.2	226.7	37.8
1	micro	2.40132	1.5	2.93	4.2	5.51	8.08	10.85	15.99	
2	micro	2340144	1.48	2.94	4.16	5.47	7.98	10.88	15.57	
3	micro	2340198	1.49	2.95	4.18	5.47	7.95	10.88	15.81	
4	micro	2340154	1.5	2.93	4.16	5.49	8	10.89	15.77	
										Know point
		Average	1.49	2.94	4.18	5.49	8.00	10.88	15.79	1.521
		STD	0.010	0.010	0.019	0.019	0.056	0.017	0.172	
		Min	1.48	2.93	4.16	5.47	7.95	10.85	15.57	
		Max	1.5	2.95	4.2	5.51	8.08	10.89	15.99	

uIRt/c K-140 Linear Range



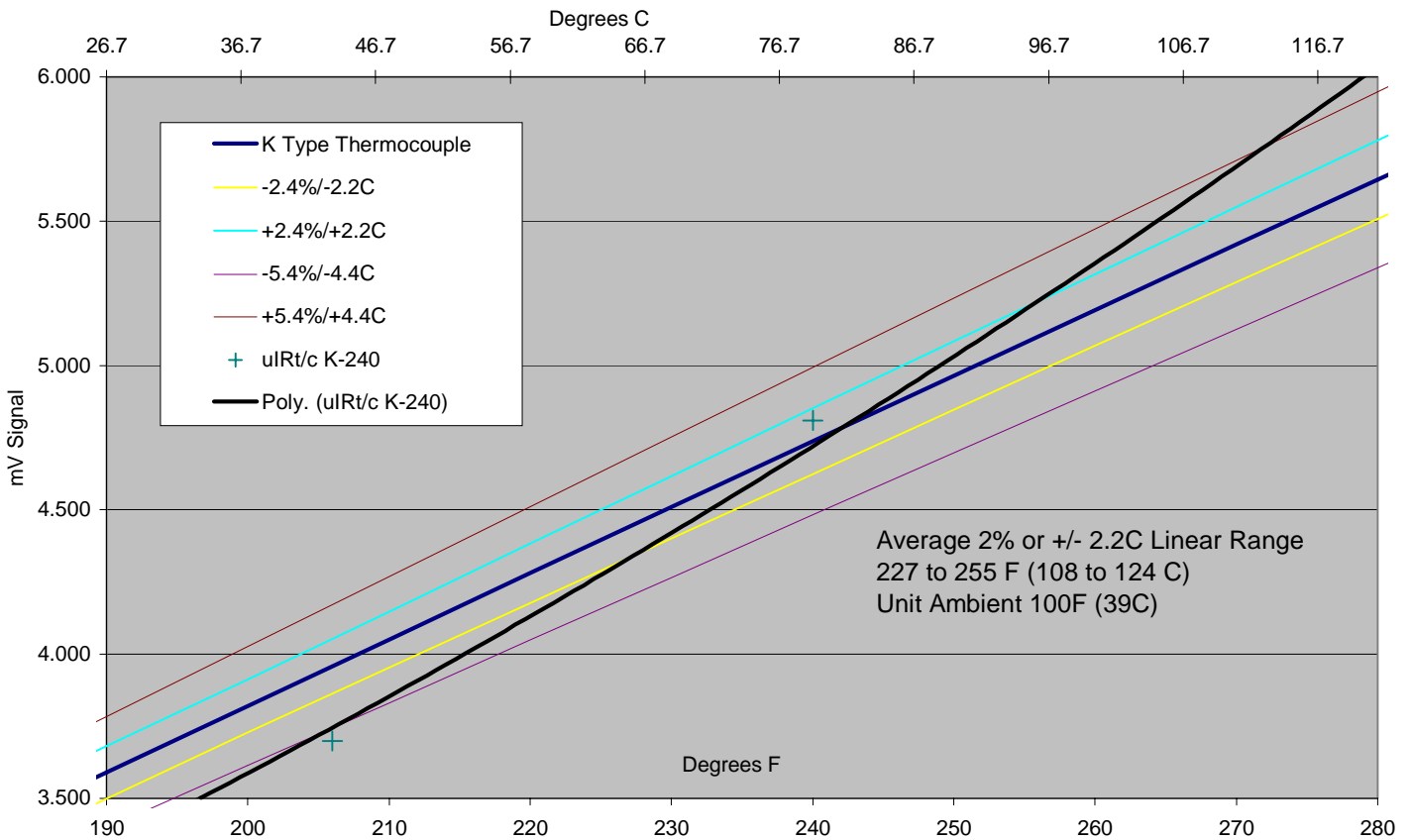
uIRt/c K-180									
		Target	160	200	240	300	360	440	
		Hg Readings	160.5	201.5	241	301	360.5	441	
			160.4	201.5	242	300.5	360.5	441	
			160.1	202	242	301	360	441	
				202	242.5		360		
				202					Cal Ambient
		Average in F	160.3333	201.8	241.875	300.8333	360.25	441	120
		Average in C	71.3	94.3	116.6	149.4	182.4	227.2	
1	micro	2040102	2.77	3.82	4.94	7	9.43	13.5	
2	micro	2040159	2.78	3.83	4.98	7.1	9.61	13.66	
3	micro	2040163	2.82	3.92	5.08	7.27	9.74	13.98	
4	micro	2040061	2.82	3.91	5.07	7.25	9.67	13.96	
5	micro	2040200	2.8	3.87	5.02	7.18	9.8	13.76	
6	micro	2040192	2.8	3.88	5.02	7.13	9.66	13.64	
7	micro	2240072	2.8	3.89	5.07	7.19	9.55	13.78	
8	micro	2040172	2.8	3.87	5.04	7.17	9.64	13.6	
9	micro	2040023	2.78	3.86	4.99	7.15	9.57	13.54	
#	micro	2720028	2.82	3.93	5.11	7.25	9.88	13.96	
#	micro	2240056	2.8	3.9	5.05	7.22	9.71	13.76	
#	micro	2040097	2.8	3.88	5.02	7.14	9.66	13.76	
#	micro	2040153	2.8	3.87	5.02	6.95	9.55	13.55	
#	micro	2720153	2.78	3.85	5.05	7.03	9.6	13.51	
#	micro	2040126	2.8	3.9	5.08	7.06	9.65	13.64	
#	micro	2040099	2.77	3.86	4.97	7.08	9.49	13.31	
#	micro	2040199	2.78	3.87	5.02	7.18	9.5	13.38	
#	micro	2040188	2.8	3.91	5.03	7.23	9.66	13.55	
#	micro	2040160	2.78	3.87	5.01	7.11	9.47	13.42	
#	micro	2040180	2.8	3.93	5.1	7.24	9.72	13.64	
#	micro	2240045	2.78	3.86	5.05	7.18	9.55	13.45	
#	micro	2040139	2.78	3.88	5.02	7.15	9.49	13.41	
#	micro	2720137	2.83	3.91	5.1	7.27	9.86	13.81	
									Know point
		Average	2.80	3.88	5.04	7.15	9.63	13.63	1.977
		STD	0.017	0.029	0.043	0.087	0.121	0.189	
		Min	2.77	3.82	4.94	6.95	9.43	13.31	
		Max	2.83	3.93	5.11	7.27	9.88	13.98	

uIRt/c K-180 Linear Range



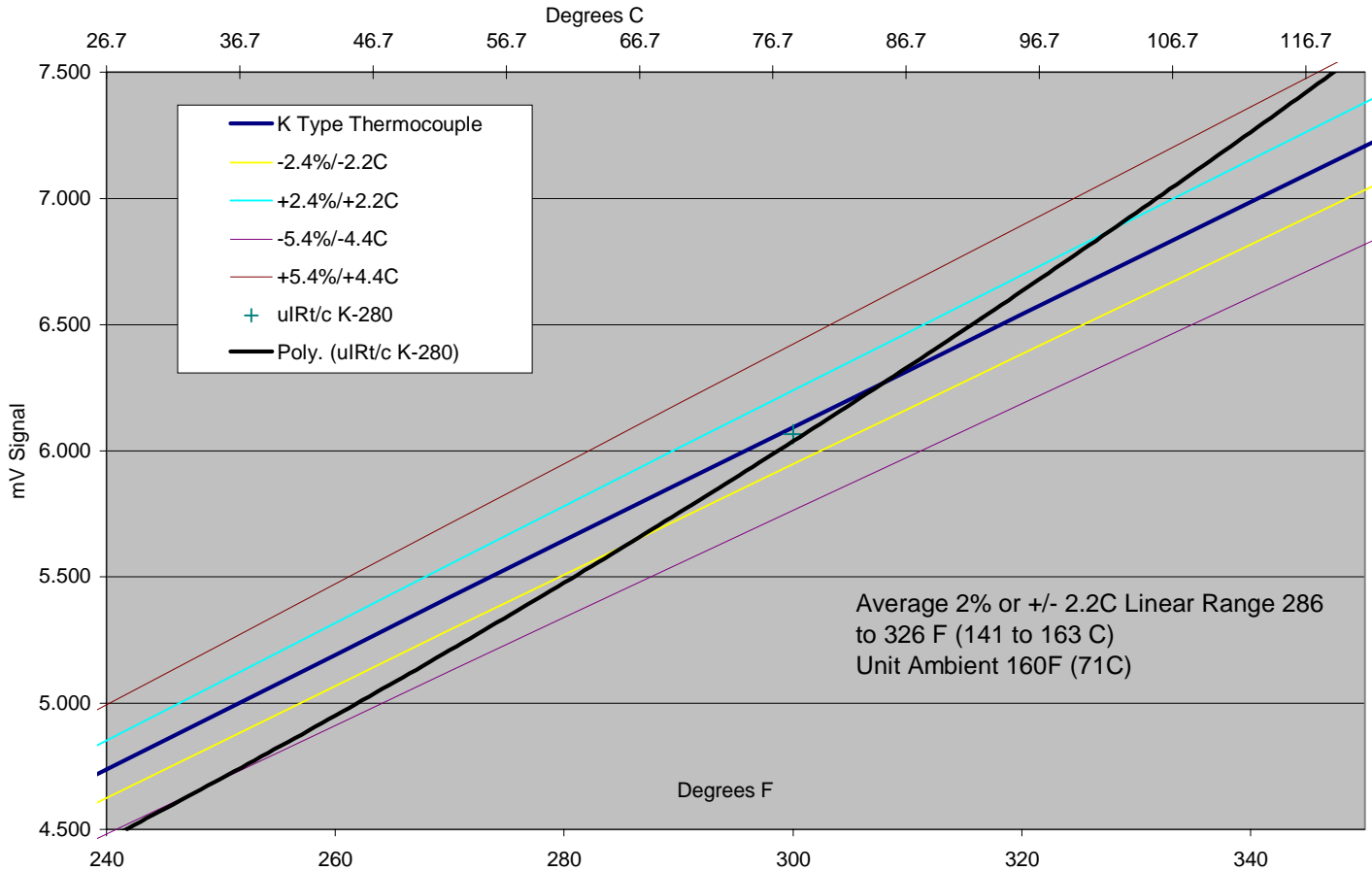
uIRt/c K-240										
		Target	98.6	160	200	240	300	360	440	
		Hg Readings	101.3	160	206	240	300	360	440	
										Cal Ambient
		Average in F	101.3	160	206	240	300	360	440	100
		Average in C	38.5	71.1	96.7	115.6	148.9	182.2	226.7	37.8
1	micro	2240075	1.49	2.65	3.7	4.78	6.78	8.92	13.15	
2	micro	2340136	1.49	2.66	3.69	4.8	6.81	9.06	13.17	
3	micro	2340209	1.48	2.69	3.71	4.84	6.84	9.03	13.22	
4	micro	2340208	1.48	2.64	3.68	4.8	6.82	9.02	13.05	
5	micro	2340159	1.49	2.68	3.71	4.83	6.93	9.1	13.37	
										Know point
		Average	1.49	2.66	3.70	4.81	6.84	9.03	13.19	1.521
		STD	0.005	0.021	0.013	0.024	0.057	0.067	0.117	
		Min	1.48	2.64	3.68	4.78	6.78	8.92	13.05	
		Max	1.49	2.69	3.71	4.84	6.93	9.1	13.37	

uIRt/c K-240 Linear Range

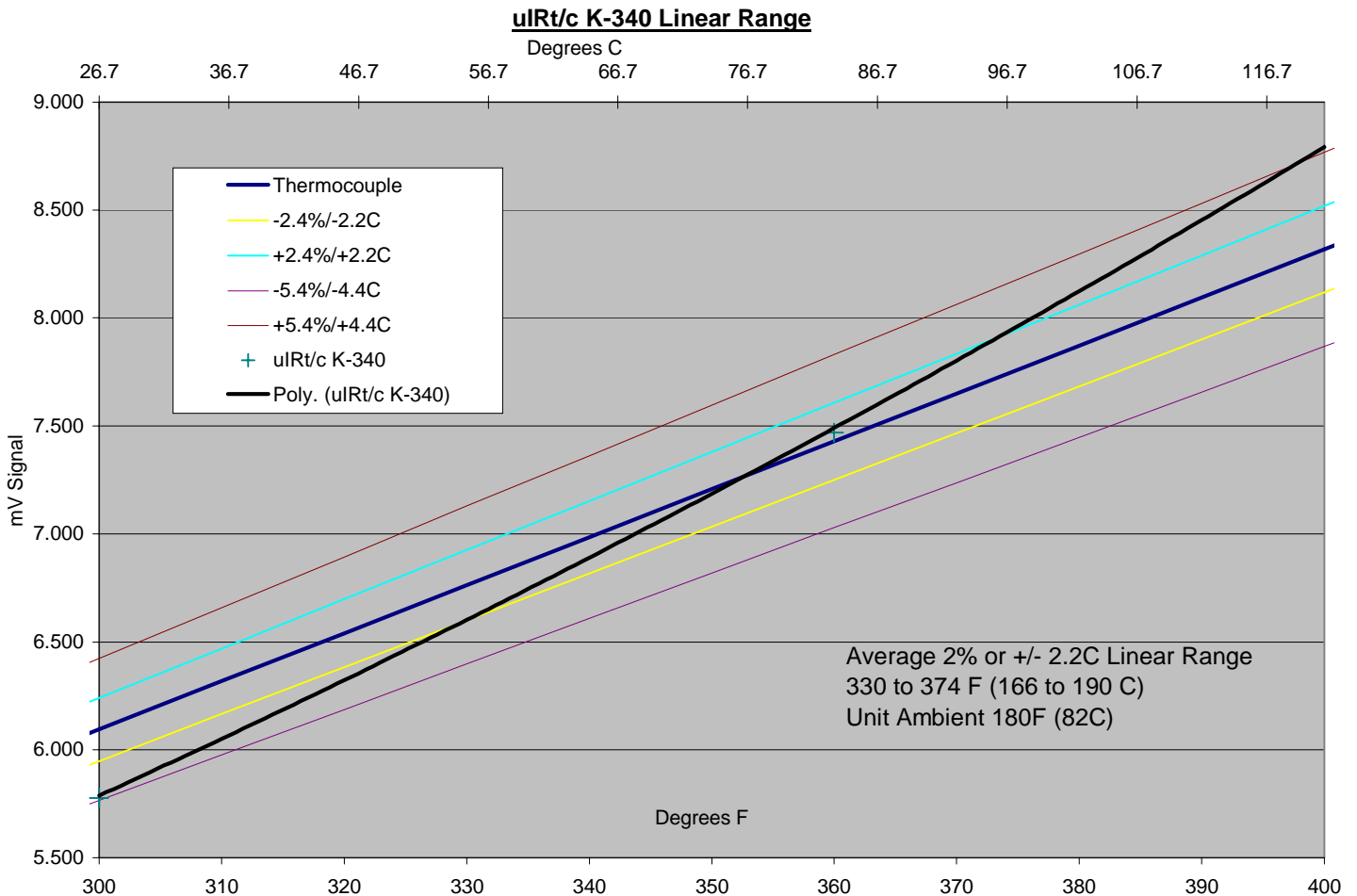


uIRt/c K-280										
		Target	98.6	160	200	240	300	360	440	
		Hg Readings	105	160	206	240	300	360	440	
										Cal Ambient
		Average in F	105	160	206	240	300	360	440	160
		Average in C	40.6	71.1	96.7	115.6	148.9	182.2	226.7	71.1
1	micro	2340130	2.14	2.8	3.65	4.53	6.1	7.96	11.1	
2	micro	2400528	2.1	2.82	3.63	4.48	6.02	7.91	10.85	
3	micro	2340141	2.15	2.81	3.63	4.46	6.08	7.85	10.84	
										Know point
		Average	2.13	2.81	3.64	4.49	6.07	7.91	10.93	2.897
		STD	0.026	0.010	0.012	0.036	0.042	0.055	0.147	
		Min	2.1	2.8	3.63	4.46	6.02	7.85	10.84	
		Max	2.15	2.82	3.65	4.53	6.1	7.96	11.1	

uIRt/c K-280 Linear Range



uIRt/c K-340										
		Target	98.6	160	200	240	300	360	440	
		Hg Readings	101.3	160	206	240	300	360	440	
										Cal Ambient
		Average in F	101.3	160	206	240	300	360	440	180
		Average in C	38.5	71.1	96.7	115.6	148.9	182.2	226.7	82.2
1	micro	2340192	2.23	2.95	3.67	4.43	5.77	7.48	10.11	
2	micro	2340129	2.32	2.93	3.64	4.42	5.74	7.45	10.5	
3	micro	2340189	2.32	2.94	3.64	4.44	5.75	7.41	10.03	
4	micro	2340184	2.39	2.91	3.65	4.46	5.85	7.54	10.3	
										Know point
		Average	2.32	2.93	3.65	4.44	5.78	7.47	10.24	3.359
		STD	0.066	0.017	0.014	0.017	0.050	0.055	0.210	
		Min	2.23	2.91	3.64	4.42	5.74	7.41	10.03	
		Max	2.39	2.95	3.67	4.46	5.85	7.54	10.5	



uIRt/c K-440										
		Target	98.6	160	200	240	300	360	440	
		Hg Readings	98.6	161	206	240	300	360	440	
										Cal Ambient
		Average in F	98.6	161	206	240	300	360	440	180
		Average in C	37.0	71.7	96.7	115.6	148.9	182.2	226.7	82.2
1	micro	2340171	2.43	3	3.58	4.26	5.45	6.93	9.25	
2	micro	2340217	2.43	2.96	3.58	4.27	5.51	6.98	9.17	
3	micro	2340169	2.44	2.96	3.57	4.26	5.48	6.91	9.19	
4	micro	2340210	2.43	2.6	3.57	4.27	5.47	6.9	9.15	
										Know point
		Average	2.43	2.88	3.58	4.27	5.48	6.93	9.19	3.359
		STD	0.005	0.188	0.006	0.006	0.025	0.036	0.043	
		Min	2.43	2.6	3.57	4.26	5.45	6.9	9.15	
		Max	2.44	3	3.58	4.27	5.51	6.98	9.25	

uIRt/c K-440 Linear Range

