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Temperature Probe Selection Guide

inTEST Thermal Solutions SIGMA SYSTEMS CORPORATION

Note: this document replaces Service Bulletin IB.1001.03

Contents

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Statement of Purpose

This document describes temperature probes available for Sigma Systems thermal chambers and plates as well as other inTEST Thermal Solutions products.

Introduction to Temperature Probes

Temperature probes are Resistant Temperature Detectors (RTDs) used as the main (and secondary or DUT) temperature sensors in Sigma Systems thermal products. Probes are grouped into four categories:

- **Type 1 Probes**: typically rod-shaped, 2-wire, 100/425/500 Ohm RTDs used for sensing air temperature in chambers or surface temperature in plates.
- **Type 2 Probes**: typically block-shaped, 2-wire or 3-wire, 100/500 Ohm RTDs used for surface temperature sensing.
- **Type 3 Probes**: Kapton tape, 2-wire, 500 Ohm RTDs used for sensing air or surface temperature with low mass (small) devices.
- **Type 4 Probes**: typically button (or drop sensor) shaped, 2-wire, 500 Ohm RTDs used for temperature sensing of a small area on a flat surface.

NOTE: Across all probe types, the most commonly used probes are 2-wire, 500 Ohm.

Understanding Probe Part Numbers (No Dash, -1, -2 versions)

For all 2-wire probes, part number suffixes (i.e. dash numbers) indicate how the probe cables are terminated.

- No Dash, example, p/n 20003
  This is the base part number without any dash number at the end. These probes are not terminated with any spades or pins.

- -1, example: p/n 20003-1

  -1 probes are terminated with a spade lug (on ground) and pins.

- - 2, example: p/n 2003-2

  These probes are terminated with (3) spades lugs

NOTE: See Addendum A for instructions on installation and extraction probe pin from a connector.

Obsolete and Unlisted Probes

If the probe is obsolete or not listed in this document's charts, contact the factory to identify a suitable replacement or have us manufacture a custom probe.
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General Information on Resistive Temperature Detectors (RTDs)

Why do we prefer using RTDs instead of Thermocouples (TCs)

RTDs in general offer higher accuracy and better repeatability than TCs. Because of these attributes RTDs are the go-to choice for control probes in Sigma Systems products.

RTD Response Curves

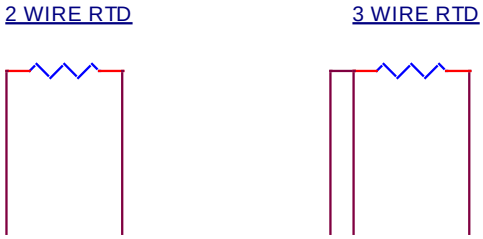
The response curve of the 100Ω RTDs has an alpha of 0.00385. The response curve of the 425Ω and 500Ω RTDs has an alpha of 0.003902.

Physical and Electrical considerations

Aluminum probes have faster response times than stainless steel or Inconel probes, however, the stainless steel and Inconel probes are more durable and operate within a much larger temperature range. These attributes need to be carefully balanced when selecting the appropriate probe.

Teflon is the preferred material to use for the outer layer of insulation for the leads due to its electrical and mechanical properties, however, it is limited by its working temperature range. Subsequently some probes designed for use in extended temperature range applications use outer layers that are appropriately rated for the temperature range the probe and lead will be exposed to. Some of our probes employ multiple outer insulation layers as the leads are exposed to different thermal environments. This allows us to take advantage of using the correct outer layer based on the thermal environment while including more durable outer layers where possible.

Lead lengths are critical. Longer leads add to the overall resistance by approximately 0.1°C for every .2Ω of resistance added to the path for the 425Ω and 500Ω probes and approximately 0.5°C for every 0.2Ω of resistance added to the path for the 100Ω probes. Longer lead lengths must have shielding with an over-braid in order to inhibit coupling spurious signals into the lead wires. Every section of shielded wire is intended to be connected to ground at only one end; failure to connect one end to ground may cause fluctuations in the temperature readings. Connecting the shield at both ends to ground, can create a ground loop which may cause fluctuations in the temperature reading.



The 3-wire RTD allows for an error correction method to be utilized in the controller. With the 3-wire probe, in addition to looking at the resistance of the RTD, some controllers can also look at the resistance of the 2 parallel wires and subtract 2X this resistance from the RTD to obtain a more accurate measurement. The TS Series controller supports this error correction methodology for the 100Ω probe.

NOTE: 2-wire, 100Ω probes are susceptible to a lead length resistance error that is 5X greater than the lead length error associated with a 2-wire 500Ω probe.

NOTE: There is no polarity in the RTDs,

If you need assistance with selecting the correct probe for your application, please contact applications@inTESTthermal.com and we will be glad to help.

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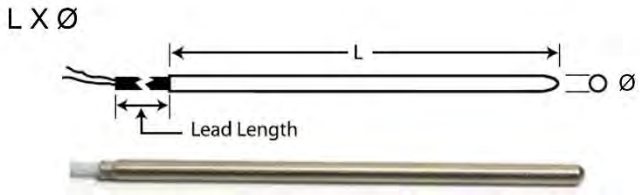
Type 1, Tubular Probes



These probes are typically 2-wire, 500Ω RTDs (Resistive Temperature Detectors). Some type 1 probes are available with 2-wire, 100Ω and 425Ω configurations. These probes are primarily used for sensing air temperature. These sensors can be inserted into a drilled hole but are not well suited for surface sensing. Response times for these probes vary depending on the probe's weight and sheath material.

Type 1 Probes Chart

P/N	Probe Type	Temperature Range,°C	Resistance (Ohms)	Sheath Size	Lead Length	Sheath Material	Notes
20003	1	-200 to +200	500	4.5"X 0.188" OD	23.0"	Aluminum	Most commonly used probe in thermal platforms, fast response
20004	1	-200 to +200	500	4.5"X 0.188" OD	108.0"	Aluminum	Most commonly used probe in thermal chambers, fast response
20005	1	-200 to +200	500	4.5"X 0.188" OD	48.0"	Stainless Steel	
20006	1	-200 to +200	500	4.5"X 0.188" OD	108.0"	Stainless Steel	Used to Slow Response Time
20007	1	-200 to +200	500	1.5" X 0.188" OD with 0.3"x 0.35" flag for hold down screw (0.130" hole centered in Flag)	48.0"	Aluminum	For use with #4 Fillister Head Screw. Aluminum sheath is 1.5" long with 0.3 x 0.35" flag with 0.1" dia. hole for securing the probe to surfaces. This probe suffers a lag in temperature sensing. It is designed to be connected and disconnected repeatedly.
20008	1	-100 to +300	500	4.5"X 0.188" OD		Stainless Steel	Recommended replacement 20064. Note: Verify specifications of suggested replacement probe are acceptable to your application
20009	1	-100 to +40	500	4.5"X 0.188" OD		Stainless Steel	-Recommended replacement 20064. Note: Verify specifications of suggested replacement probe are acceptable to your application
20010	1	-100 to +500	500	4.5"X 0.188" OD		Stainless Steel	Recommended replacement 20027, verify specifications
20015	1	-200 to +200	500	1.5"X 0.188 OD	105.0"	Aluminum	
20016	1	-200 to +200	500	4.5"X 0.188" OD		Stainless Steel	- Recommended replacement 20006. Note: Verify specifications of suggested replacement probe are acceptable to your application
20017	1	-200 to +200	500	1.75"X 0.188" OD	108.0"	Stainless Steel	
20019	1	-200 to +200	500	4.5" x 0.125"OD	48.0"	Stainless Steel	
20020	1	-200 to +200	500	2.0" x 0.125"OD	48.0"	Stainless Steel	
20021	1	-200 to +200	500	4.5" x 0.125"OD	48.0"	Aluminum	
20022	1	-200 to +200	500	2.0" x 0.125"OD	48.0"	Aluminum	

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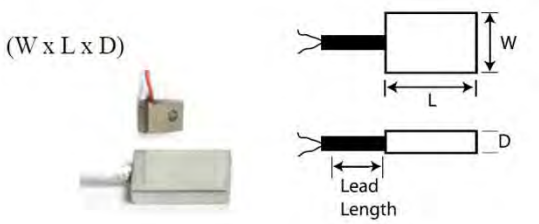
P/N	Probe Type	Temperature Range,°C	Resistance (Ohms)	Sheath Size	Lead Length	Sheath Material	Notes
20024	1	-100 to +200	500	1.25" x 0.125"OD		Stainless Steel	Recommended replacement 20020. Note: Verify specifications of suggested replacement probe are acceptable to your application
20025	1	-100 to +200	500	1.25" x 0.125"OD		Aluminum	Recommended replacement 20022. Note: Verify specifications of suggested replacement probe are acceptable to your application
20026	1	-200 to +400	500	4.5"X 0.188" OD		Stainless Steel	Recommended replacement 20064. Note: Verify specifications of suggested replacement probe are acceptable to your application
20027	1	-200 to +500	425	4.5"X 0.188" OD	54.0”	Inconel	Has 20 inches of high-temp wire and a transition connection to a more durable, flexible, lower heat tolerant, and solderable lead wire.
20028	1	-100 to +200	500	1.25" x 0.125"OD		Aluminum	Recommended replacement 20022 or 20030. Note: Verify specifications of suggested replacement probe are acceptable to your application
20029	1	-200 to +200	500	1.75"X 0.125" OD	48.0”	Aluminum	
20030	1	-200 to +200	500	1.75"X 0.125" OD	48.0”	Stainless Steel	
20031	1	-100 to +200	500	4.5"X 0.188" OD		Aluminum	Recommended replacement 20033. Note: Verify specifications of suggested replacement probe are acceptable to your application
20032	1	-100 to +200	500	1.5"X 0.188 OD		Aluminum	Recommended replacement 20007, verify specifications
20033	1	-200 to +200	500	4.5"X 0.188" OD	108.0”	Aluminum	NO thermal grease, no transition sealant, for use in vacuum applications
20034	1	-200 to +200	500	1.5"X 0.188 OD	108.0”	Aluminum	NO thermal grease, no transition sealant, for use in vacuum applications
20037	1	-200 to +200	500	4.5"X 0.188" OD	180.0”	Aluminum	15'L version of 20004
20039	1	-200 to +500	500	4.5"X 0.188" OD	108.0”	Inconel	probe and entire cable rated for 500C, designed for use as secondary probe (DUT Mode Probe)
20050	1	-200 to +200	100	4.5"X 0.188" OD	108.0”	Aluminum	
20060	1	-200 to +200	500	4.5"X 0.188" OD	108.0”	Aluminum	For use in High RH environment
20061	1	-200 to +200	500	4.5"X 0.188" OD		Aluminum	-Inactive - 13'L version of 20004 Recommended replacement 20037 and cut it down. Note: Verify specifications of suggested replacement probe are acceptable to your application
20062	1	-200 to +200	500	1.75"X 0.188" OD	106.25”	Aluminum	
20064	1	-200 to +500	500	4.5"X 0.188" OD	108.0”	Inconel	Most Common Extended Temperature Range Probe
20065	1	-200 to +500	500	1.75"X 0.125" OD	180.0”	Aluminum	Long lead length probe

All of these sensors are tested and certified to be accurate within +/-0.1%, Traceable to NIST

Type 2, Block Probes



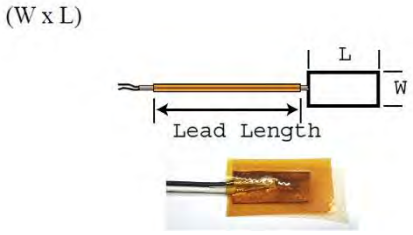
These probes are typically 2-wire or 3-wire, 100 Ω or 500Ω RTDs (Resistive Temperature Detectors). These probes are primarily used for sensing the surface temperatures. Some of these probes have a through hole that allows the probe to mechanically mount to the surface. Other probes are intended to be used with a physical feature such as a clamp or a milled channel that facilitates good surface contact. Type 2 Probes are more robust than type 3 probes and due to their larger mass have longer response times.

Type 2 Probes Chart

P/N	Probe Type	Temperature Range,°C	Resistance (Ohms)	Sheath Size	Lead Length	Sheath Material	Notes
20011	2	-200 to +200	500	.38"W x .75"L x .19"D	48.0"	Aluminum	Surface Sensor
20012	2	-200 to +500	500	.38"W x .75"L x .19"D	48.0"	Inconel	Surface Sensor, has a transition in the leads allowing high temperature wire in the hot zone and more rugged, lower temperature tolerant wire to be used outside the temperature test area.
20023	2	-200 to +200	500	.25"W x .38"L x .13"D Includes thru hole for #4 hardware	48.0"	Electroless Nickel Plated Aluminum	Surface Sensor, Nickel plated Aluminum with #4 thru hole (P6)
20051	2	-200 to +200	100	.25"W x .38"L x .13"D Includes thru hole for #4 hardware	60.0"	Electroless Nickel Plated Aluminum	Surface Sensor, Nickel plated Aluminum with #4 thru hole (P6
20054	2	-50 to +200	100	.5"W x .31"L x .062"D Includes thru hole for #4 hardware	40.0"	Aluminum	Surface sensor with #4 thru-hole and un-shielded, 3-wire cable. Note: no dash variant supplied with male/female miniature connectors.

All of these sensors are tested and certified to be accurate within +/-0.1%, Traceable to NIST

Type 3, Kapton Probes



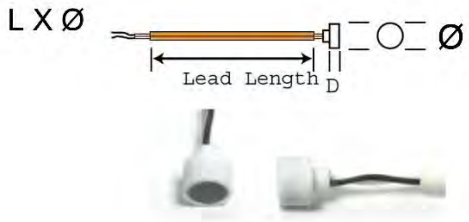
These probes are 2-wire 500Ω RTDs (Resistive Temperature Detectors). These probes are primarily used for sensing air and surface temperatures. They utilize a low profile chip sensor and may be used in very small recesses. They should not be used in a junction that makes line to line contact or placed into recesses with less than 0.050" clearance in the region of the low profile chip. The Kapton tape and foil laminations work together to provide an excellent strain relief but care should be given to avoid repetitive flexing. These probes have fast response time due to relatively low mass.

Type 3 Probes Chart

P/N	Probe Type	Temperature Range,°C	Resistance (Ohms)	Sheath Size	Lead Length	Sheath Material	Notes
20013	3	-100 to +200	500	1.0"X 0.5", flat	48.0"	Kapton	Shielded cable
20014	3	-100 to +200	500	1.0"X 0.5", flat	24.0"	Kapton	Non-shielded cable

All of these sensors are tested and certified to be accurate within +/-0.1%, Traceable to NIST

Type 4, Button Probes



These probes 2-wire 500Ω RTDs (Resistive Temperature Detectors). These probes are primarily thermally influenced from a single side making them a good choice for sensing surface temperature while minimizing the influence from adjacent regions. These probes are moderately fragile and have fairly fast response time due to their respective mass.

Type 4 Probes Chart

P/N	Probe Type	Temperature Range,°C	Resistance (Ohms)	Sheath Size	Lead Length	Sheath Material	Notes
20018	4	-200 to +200	500	0.38"OD X 0.28"L (Teflon Case .25"L and element extends 0.03" past [proud of] the Teflon Case)	48.0”	Electroless Nickel Plated Aluminum	Button head drop sensor
20038	4	-200 to +200	500	0.13"OD X 0.55"L with 0.18"L x 0.38"OD shoulder centered 0.24" from tip	48.0”	Electroless Nickel Plated Aluminum	Designed to be mounted in a thermal platform, spring loaded to ensure contact with device under test.

All of these sensors are tested and certified to be accurate within +/-0.1%, Traceable to NIST

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100 Ohm Probe, Normalized Resistance Chart

℃	Ω	℃	Ω	℃	Ω	℃	Ω	℃	Ω	℃	Ω	℃	Ω	℃	Ω
-199	18.96	-149	40.14	-99	60.66	-49	80.70	1	100.39	50	119.40	100	138.50		
-198	19.39	-149	40.14	-98	61.07	-48	81.10	2	100.78	51	119.78	101	138.88		
-197	19.82	-148	40.56	-97	61.47	-47	81.50	3	101.17	52	120.17	102	139.26		
-196	20.25	-147	40.98	-96	61.88	-46	81.90	4	101.56	53	120.55	103	139.64		
-195	20.68	-146	41.39	-95	62.28	-45	82.29	5	101.95	54	120.93	104	140.02		
-194	21.11	-145	41.81	-94	62.69	-44	82.69	6	102.34	55	121.32	105	140.40		
-193	21.54	-144	42.22	-93	63.09	-43	83.08	7	102.73	56	121.70	106	140.78		
-192	21.97	-143	42.64	-92	63.50	-42	83.48	8	103.12	57	122.09	107	141.15		
-191	22.40	-142	43.05	-91	63.90	-41	83.88	9	103.51	58	122.47	108	141.53		
-190	22.83	-141	43.47	-90	64.30	-40	84.27	10	103.90	59	122.86	109	141.91		
-189	23.26	-140	43.88	-89	64.71	-39	84.67	11	104.29	60	123.24	110	142.29		
-188	23.69	-139	44.29	-88	65.11	-38	85.06	12	104.68	61	123.62	111	142.67		
-187	24.12	-138	44.71	-87	65.51	-37	85.46	13	105.07	62	124.01	112	143.05		
-186	24.54	-137	45.12	-86	65.91	-36	85.85	14	105.46	63	124.39	113	143.42		
-185	24.97	-136	45.53	-85	66.32	-35	86.25	15	105.85	64	124.77	114	143.80		
-184	25.40	-135	45.95	-84	66.72	-34	86.64	16	106.24	65	125.16	115	144.18		
-183	25.82	-134	46.36	-83	67.12	-33	87.04	17	106.63	66	125.54	116	144.56		
-182	26.25	-133	46.77	-82	67.52	-32	87.43	18	107.02	67	125.92	117	144.93		
-181	26.68	-132	47.18	-81	67.93	-31	87.83	19	107.40	68	126.31	118	145.31		
-180	27.10	-131	47.60	-80	68.33	-30	88.22	20	107.79	69	126.69	119	145.69		
-179	27.53	-130	48.01	-79	68.73	-29	88.62	21	108.18	70	127.07	120	146.06		
-178	27.95	-129	48.42	-78	69.13	-28	89.01	22	108.57	71	127.46	121	146.44		
-177	28.38	-128	48.83	-77	69.53	-27	89.41	23	108.96	72	127.84	122	146.82		
-176	28.80	-127	49.24	-76	69.93	-26	89.80	24	109.35	73	128.22	123	147.19		
-175	29.22	-126	49.65	-75	70.33	-25	90.19	25	109.73	74	128.60	124	147.57		
-174	29.65	-125	50.06	-74	70.74	-24	90.59	26	110.12	75	128.99	125	147.95		
-173	30.07	-124	50.47	-73	71.14	-23	90.98	27	110.51	76	129.37	126	148.32		
-172	30.49	-123	50.88	-72	71.54	-22	91.37	28	110.90	77	129.75	127	148.70		
-171	30.92	-122	51.29	-71	71.94	-21	91.77	29	111.28	78	130.13	128	149.08		
-170	31.34	-121	51.70	-70	72.34	-20	92.16	30	111.67	79	130.51	129	149.45		
-169	31.76	-120	52.11	-69	72.74	-19	92.55	31	112.06	80	130.89	130	149.83		
-168	32.18	-119	52.52	-68	73.14	-18	92.95	32	112.45	81	131.28	131	150.20		
-167	32.61	-118	52.93	-67	73.54	-17	93.34	33	112.83	82	131.66	132	150.58		
-166	33.03	-117	53.34	-66	73.94	-16	93.73	34	113.22	83	132.04	133	150.95		
-165	33.45	-116	53.75	-65	74.34	-15	94.12	35	113.61	84	132.42	134	151.33		
-164	33.87	-115	54.16	-64	74.73	-14	94.52	36	113.99	85	132.80	135	151.71		
-163	34.29	-114	54.57	-63	75.13	-13	94.91	37	114.38	86	133.18	136	152.08		
-162	34.71	-113	54.97	-62	75.53	-12	95.30	38	114.77	87	133.56	137	152.46		
-161	35.13	-112	55.38	-61	75.93	-11	95.69	39	115.15	88	133.94	138	152.83		
-160	35.55	-111	55.79	-60	76.33	-10	96.09	40	115.54	89	134.32	139	153.21		
-159	35.97	-110	56.20	-59	76.73	-9	96.48	41	115.93	90	134.70	140	153.58		
-158	36.39	-109	56.60	-58	77.13	-8	96.87	42	116.31	91	135.08	141	153.95		
-157	36.80	-108	57.01	-57	77.52	-7	97.26	43	116.70	92	135.46	142	154.33		
-156	37.22	-107	57.42	-56	77.92	-6	97.65	44	117.08	93	135.84	143	154.70		
-155	37.64	-106	57.82	-55	78.32	-5	98.04	45	117.47	94	136.22	144	155.08		
-154	38.06	-105	58.23	-54	78.72	-4	98.44	46	117.85	95	136.60	145	155.45		
-153	38.48	-104	58.64	-53	79.12	-3	98.83	47	118.24	96	136.98	146	155.83		
-152	38.89	-103	59.04	-52	79.51	-2	99.22	48	118.63	97	137.36	147	156.20		
-151	39.31	-102	59.45	-51	79.91	-1	99.61	49	119.01	98	137.74	148	156.57		
-150	39.73	-101	59.85	-50	80.31	0	100.00	50	119.40	99	138.12	149	156.95		

100 Ohm Probe cont'd

℃	Ω	℃	Ω	℃	Ω	℃	Ω	℃	Ω	℃	Ω	℃	Ω
150	157.32	200	175.85	250	194.09	300	212.04	350	229.71	400	247.08	450	264.17
151	157.69	201	176.22	251	194.45	301	212.40	351	230.06	401	247.42	451	264.50
152	158.07	202	176.59	252	194.81	302	212.75	352	230.41	402	247.77	452	264.84
153	158.44	203	176.95	253	195.18	303	213.11	353	230.76	403	248.11	453	265.18
154	158.81	204	177.32	254	195.54	304	213.47	354	231.11	404	248.46	454	265.52
155	159.19	205	177.69	255	195.90	305	213.82	355	231.46	405	248.80	455	265.86
156	159.56	206	178.05	256	196.26	306	214.18	356	231.81	406	249.15	456	266.20
157	159.93	207	178.42	257	196.62	307	214.53	357	232.16	407	249.49	457	266.53
158	160.30	208	178.79	258	196.98	308	214.89	358	232.50	408	249.83	458	266.87
159	160.68	209	179.15	259	197.34	309	215.24	359	232.85	409	250.18	459	267.21
160	161.05	210	179.52	260	197.70	310	215.60	360	233.20	410	250.52	460	267.55
161	161.42	211	179.89	261	198.06	311	215.95	361	233.55	411	250.86	461	267.89
162	161.79	212	180.25	262	198.43	312	216.31	362	233.90	412	251.21	462	268.22
163	162.17	213	180.62	263	198.79	313	216.66	363	234.25	413	251.55	463	268.56
164	162.54	214	180.99	264	199.15	314	217.02	364	234.60	414	251.89	464	268.90
165	162.91	215	181.35	265	199.51	315	217.37	365	234.95	415	252.24	465	269.24
166	163.28	216	181.72	266	199.87	316	217.73	366	235.30	416	252.58	466	269.57
167	163.65	217	182.08	267	200.23	317	218.08	367	235.65	417	252.92	467	269.91
168	164.02	218	182.45	268	200.59	318	218.43	368	235.99	418	253.26	468	270.25
169	164.40	219	182.82	269	200.95	319	218.79	369	236.34	419	253.61	469	270.58
170	164.77	220	183.18	270	201.31	320	219.14	370	236.69	420	253.95	470	270.92
171	165.14	221	183.55	271	201.67	321	219.50	371	237.04	421	254.29	471	271.26
172	165.51	222	183.91	272	202.03	322	219.85	372	237.39	422	254.63	472	271.59
173	165.88	223	184.28	273	202.38	323	220.20	373	237.73	423	254.98	473	271.93
174	166.25	224	184.64	274	202.74	324	220.56	374	238.08	424	255.32	474	272.26
175	166.62	225	185.01	275	203.10	325	220.91	375	238.43	425	255.66	475	272.60
176	166.99	226	185.37	276	203.46	326	221.26	376	238.78	426	256.00	476	272.94
177	167.36	227	185.74	277	203.82	327	221.62	377	239.12	427	256.34	477	273.27
178	167.73	228	186.10	278	204.18	328	221.97	378	239.47	428	256.68	478	273.61
179	168.10	229	186.46	279	204.54	329	222.32	379	239.82	429	257.02	479	273.94
180	168.47	230	186.83	280	204.90	330	222.68	380	240.16	430	257.37	480	274.28
181	168.84	231	187.19	281	205.25	331	223.03	381	240.51	431	257.71	481	274.61
182	169.21	232	187.56	282	205.61	332	223.38	382	240.86	432	258.05	482	274.95
183	169.58	233	187.92	283	205.97	333	223.73	383	241.21	433	258.39	483	275.28
184	169.95	234	188.29	284	206.33	334	224.08	384	241.55	434	258.73	484	275.62
185	170.32	235	188.65	285	206.69	335	224.44	385	241.90	435	259.07	485	275.95
186	170.69	236	189.01	286	207.05	336	224.79	386	242.24	436	259.41	486	276.29
187	171.06	237	189.38	287	207.40	337	225.14	387	242.59	437	259.75	487	276.62
188	171.43	238	189.74	288	207.76	338	225.49	388	242.94	438	260.09	488	276.96
189	171.80	239	190.10	289	208.12	339	225.84	389	243.28	439	260.43	489	277.29
190	172.17	240	190.47	290	208.48	340	226.20	390	243.63	440	260.77	490	277.63
191	172.54	241	190.83	291	208.83	341	226.55	391	243.97	441	261.11	491	277.96
192	172.90	242	191.19	292	209.19	342	226.90	392	244.32	442	261.45	492	278.29
193	173.27	243	191.55	293	209.55	343	227.25	393	244.66	443	261.79	493	278.63
194	173.64	244	191.92	294	209.90	344	227.60	394	245.01	444	262.13	494	278.96
195	174.01	245	192.28	295	210.26	345	227.95	395	245.36	445	262.47	495	279.30
196	174.38	246	192.64	296	210.62	346	228.30	396	245.70	446	262.81	496	279.63
197	174.75	247	193.00	297	210.97	347	228.65	397	246.05	447	263.15	497	279.96
198	175.11	248	193.37	298	211.33	348	229.00	398	246.39	448	263.49	498	280.30
199	175.48	249	193.73	299	211.69	349	229.36	399	246.74	449	263.83	499	280.63

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425 Ohm Probe, Normalized Resistance Chart

℃	Ω	℃	Ω	℃	Ω	℃	Ω	℃	Ω	℃	Ω	℃	Ω	℃	Ω	℃	Ω	℃	Ω
1.0	426.68	50.0	508.53	100.0	590.78	150.0	671.47	-199.0	75.80	-149.0	167.13	-99.0	255.56	-49.0	341.90	1.0	426.68	50.0	508.53
2.0	428.36	51.0	510.19	101.0	592.41	151.0	673.07	-198.0	77.66	-149.0	167.13	-98.0	257.30	-48.0	343.61	2.0	428.36	51.0	510.19
3.0	430.05	52.0	511.85	102.0	594.04	152.0	674.66	-197.0	79.52	-148.0	168.93	-97.0	259.05	-47.0	345.31	3.0	430.05	52.0	511.85
4.0	431.73	53.0	513.50	103.0	595.67	153.0	676.25	-196.0	81.38	-147.0	170.72	-96.0	260.79	-46.0	347.02	4.0	431.73	53.0	513.50
5.0	433.41	54.0	515.16	104.0	597.30	154.0	677.84	-195.0	83.23	-146.0	172.51	-95.0	262.53	-45.0	348.73	5.0	433.41	54.0	515.16
6.0	435.09	55.0	516.82	105.0	598.93	155.0	679.44	-194.0	85.09	-145.0	174.30	-94.0	264.28	-44.0	350.44	6.0	435.09	55.0	516.82
7.0	436.77	56.0	518.47	106.0	600.55	156.0	681.03	-193.0	86.94	-144.0	176.09	-93.0	266.02	-43.0	352.14	7.0	436.77	56.0	518.47
8.0	438.45	57.0	520.13	107.0	602.18	157.0	682.62	-192.0	88.80	-143.0	177.88	-92.0	267.76	-42.0	353.85	8.0	438.45	57.0	520.13
9.0	440.13	58.0	521.78	108.0	603.81	158.0	684.20	-191.0	90.65	-142.0	179.67	-91.0	269.50	-41.0	355.56	9.0	440.13	58.0	521.78
10.0	441.80	59.0	523.44	109.0	605.43	159.0	685.79	-190.0	92.50	-141.0	181.45	-90.0	271.24	-40.0	357.26	10.0	441.80	59.0	523.44
11.0	443.48	60.0	525.09	110.0	607.06	160.0	687.38	-189.0	94.34	-140.0	183.24	-89.0	272.97	-39.0	358.96	11.0	443.48	60.0	525.09
12.0	445.16	61.0	526.74	111.0	608.68	161.0	688.97	-188.0	96.19	-139.0	185.02	-88.0	274.71	-38.0	360.67	12.0	445.16	61.0	526.74
13.0	446.84	62.0	528.39	112.0	610.30	162.0	690.55	-187.0	98.04	-138.0	186.80	-87.0	276.45	-37.0	362.37	13.0	446.84	62.0	528.39
14.0	448.51	63.0	530.05	113.0	611.93	163.0	692.13	-186.0	99.88	-137.0	188.59	-86.0	278.18	-36.0	364.07	14.0	448.51	63.0	530.05
15.0	450.19	64.0	531.70	114.0	613.55	164.0	693.72	-185.0	101.72	-136.0	190.37	-85.0	279.92	-35.0	365.78	15.0	450.19	64.0	531.70
16.0	451.86	65.0	533.35	115.0	615.17	165.0	695.30	-184.0	103.56	-135.0	192.15	-84.0	281.65	-34.0	367.48	16.0	451.86	65.0	533.35
17.0	453.54	66.0	535.00	116.0	616.79	166.0	696.88	-183.0	105.40	-134.0	193.92	-83.0	283.38	-33.0	369.18	17.0	453.54	66.0	535.00
18.0	455.21	67.0	536.65	117.0	618.41	167.0	698.46	-182.0	107.24	-133.0	195.70	-82.0	285.12	-32.0	370.88	18.0	455.21	67.0	536.65
19.0	456.89	68.0	538.30	118.0	620.03	168.0	700.04	-181.0	109.08	-132.0	197.48	-81.0	286.85	-31.0	372.58	19.0	456.89	68.0	538.30
20.0	458.56	69.0	539.95	119.0	621.65	169.0	701.62	-180.0	110.91	-131.0	199.25	-80.0	288.58	-30.0	374.28	20.0	458.56	69.0	539.95
21.0	460.23	70.0	541.59	120.0	623.27	170.0	703.20	-179.0	112.74	-130.0	201.03	-79.0	290.31	-29.0	375.98	21.0	460.23	70.0	541.59
22.0	461.91	71.0	543.24	121.0	624.89	171.0	704.77	-178.0	114.58	-129.0	202.80	-78.0	292.04	-28.0	377.67	22.0	461.91	71.0	543.24
23.0	463.58	72.0	544.89	122.0	626.50	172.0	706.35	-177.0	116.41	-128.0	204.57	-77.0	293.77	-27.0	379.37	23.0	463.58	72.0	544.89
24.0	465.25	73.0	546.54	123.0	628.12	173.0	707.93	-176.0	118.24	-127.0	206.34	-76.0	295.50	-26.0	381.07	24.0	465.25	73.0	546.54
25.0	466.92	74.0	548.18	124.0	629.73	174.0	709.50	-175.0	120.06	-126.0	208.11	-75.0	297.22	-25.0	382.76	25.0	466.92	74.0	548.18
26.0	468.59	75.0	549.83	125.0	631.35	175.0	711.07	-174.0	121.89	-125.0	209.88	-74.0	298.95	-24.0	384.46	26.0	468.59	75.0	549.83
27.0	470.26	76.0	551.47	126.0	632.96	176.0	712.64	-173.0	123.71	-124.0	211.65	-73.0	300.67	-23.0	386.15	27.0	470.26	76.0	551.47
28.0	471.93	77.0	553.12	127.0	634.58	177.0	714.21	-172.0	125.54	-123.0	213.42	-72.0	302.40	-22.0	387.85	28.0	471.93	77.0	553.12
29.0	473.60	78.0	554.76	128.0	636.19	178.0	715.78	-171.0	127.36	-122.0	215.19	-71.0	304.12	-21.0	389.54	29.0	473.60	78.0	554.76
30.0	475.27	79.0	556.40	129.0	637.80	179.0	717.35	-170.0	129.18	-121.0	216.95	-70.0	305.85	-20.0	391.24	30.0	475.27	79.0	556.40
31.0	476.93	80.0	558.05	130.0	639.41	180.0	718.92	-169.0	131.00	-120.0	218.72	-69.0	307.57	-19.0	392.93	31.0	476.93	80.0	558.05
32.0	478.60	81.0	559.69	131.0	641.02	181.0	720.49	-168.0	132.82	-119.0	220.48	-68.0	309.29	-18.0	394.62	32.0	478.60	81.0	559.69
33.0	480.27	82.0	561.33	132.0	642.63	182.0	722.05	-167.0	134.64	-118.0	222.24	-67.0	311.02	-17.0	396.32	33.0	480.27	82.0	561.33
34.0	481.94	83.0	562.97	133.0	644.24	183.0	723.62	-166.0	136.45	-117.0	224.00	-66.0	312.74	-16.0	398.01	34.0	481.94	83.0	562.97
35.0	483.60	84.0	564.61	134.0	645.85	184.0	725.18	-165.0	138.27	-116.0	225.76	-65.0	314.46	-15.0	399.70	35.0	483.60	84.0	564.61
36.0	485.27	85.0	566.25	135.0	647.45	185.0	726.75	-164.0	140.08	-115.0	227.52	-64.0	316.18	-14.0	401.39	36.0	485.27	85.0	566.25
37.0	486.93	86.0	567.89	136.0	649.06	186.0	728.31	-163.0	141.89	-114.0	229.28	-63.0	317.90	-13.0	403.08	37.0	486.93	86.0	567.89
38.0	488.60	87.0	569.53	137.0	650.67	187.0	729.87	-162.0	143.70	-113.0	231.04	-62.0	319.61	-12.0	404.77	38.0	488.60	87.0	569.53
39.0	490.26	88.0	571.17	138.0	652.27	188.0	731.43	-161.0	145.51	-112.0	232.80	-61.0	321.33	-11.0	406.46	39.0	490.26	88.0	571.17
40.0	491.92	89.0	572.80	139.0	653.88	189.0	732.99	-160.0	147.32	-111.0	234.55	-60.0	323.05	-10.0	408.14	40.0	491.92	89.0	572.80
41.0	493.59	90.0	574.44	140.0	655.48	190.0	734.54	-159.0	149.13	-110.0	236.31	-59.0	324.77	-9.0	409.83	41.0	493.59	90.0	574.44
42.0	495.25	91.0	576.08	141.0	657.08	191.0	736.10	-158.0	150.93	-109.0	238.06	-58.0	326.48	-8.0	411.52	42.0	495.25	91.0	576.08
43.0	496.91	92.0	577.71	142.0	658.68	192.0	737.66	-157.0	152.74	-108.0	239.82	-57.0	328.20	-7.0	413.21	43.0	496.91	92.0	577.71
44.0	498.57	93.0	579.35	143.0	660.29	193.0	739.21	-156.0	154.54	-107.0	241.57	-56.0	329.91	-6.0	414.89	44.0	498.57	93.0	579.35
45.0	500.23	94.0	580.98	144.0	661.89	194.0	740.76	-155.0	156.34	-106.0	243.32	-55.0	331.63	-5.0	416.58	45.0	500.23	94.0	580.98
46.0	501.89	95.0	582.62	145.0	663.49	195.0	742.31	-154.0	158.15	-105.0	245.07	-54.0	333.34	-4.0	418.26	46.0	501.89	95.0	582.62
47.0	503.55	96.0	584.25	146.0	665.08	196.0	743.87	-153.0	159.95	-104.0	246.82	-53.0	335.05	-3.0	419.95	47.0	503.55	96.0	584.25
48.0	505.21	97.0	585.88	147.0	666.68	197.0	745.41	-152.0	161.74	-103.0	248.57	-52.0	336.76	-2.0	421.63	48.0	505.21	97.0	585.88
49.0	506.87	98.0	587.52	148.0	668.28	198.0	746.96	-151.0	163.54	-102.0	250.32	-51.0	338.47	-1.0	423.32	49.0	506.87	98.0	587.52
50.0	508.53	99.0	589.15	149.0	669.88	199.0	748.51	-150.0	165.34	-101.0	252.07	-50.0	340.19	0.0	425.00	50.0	508.53	99.0	589.15

425 Ohm Probe cont'd

℃	Ω	℃	Ω	℃	Ω	℃	Ω	℃	Ω	℃	Ω	℃	Ω	℃	Ω	℃	Ω
100.0	590.78	150.0	671.47	200.0	750.06	250.0	825.72	300.0	897.35	350.0	963.59	400.0	1022.79	450.0	1073.03
101.0	592.41	151.0	673.07	201.0	751.60	251.0	827.19	301.0	898.73	351.0	964.85	401.0	1023.89	451.0	1073.93
102.0	594.04	152.0	674.66	202.0	753.15	252.0	828.67	302.0	900.11	352.0	966.10	402.0	1024.98	452.0	1074.82
103.0	595.67	153.0	676.25	203.0	754.69	253.0	830.14	303.0	901.49	353.0	967.36	403.0	1026.08	453.0	1075.71
104.0	597.30	154.0	677.84	204.0	756.23	254.0	831.61	304.0	902.87	354.0	968.61	404.0	1027.16	454.0	1076.60
105.0	598.93	155.0	679.44	205.0	757.77	255.0	833.08	305.0	904.24	355.0	969.85	405.0	1028.25	455.0	1077.48
106.0	600.55	156.0	681.03	206.0	759.31	256.0	834.55	306.0	905.61	356.0	971.10	406.0	1029.33	456.0	1078.35
107.0	602.18	157.0	682.62	207.0	760.85	257.0	836.01	307.0	906.98	357.0	972.34	407.0	1030.41	457.0	1079.23
108.0	603.81	158.0	684.20	208.0	762.38	258.0	837.48	308.0	908.35	358.0	973.58	408.0	1031.48	458.0	1080.09
109.0	605.43	159.0	685.79	209.0	763.92	259.0	838.94	309.0	909.71	359.0	974.82	409.0	1032.55	459.0	1080.96
110.0	607.06	160.0	687.38	210.0	765.45	260.0	840.40	310.0	911.08	360.0	976.05	410.0	1033.62	460.0	1081.81
111.0	608.68	161.0	688.97	211.0	766.99	261.0	841.86	311.0	912.44	361.0	977.28	411.0	1034.68	461.0	1082.67
112.0	610.30	162.0	690.55	212.0	768.52	262.0	843.32	312.0	913.80	362.0	978.51	412.0	1035.74	462.0	1083.52
113.0	611.93	163.0	692.13	213.0	770.05	263.0	844.78	313.0	915.15	363.0	979.73	413.0	1036.80	463.0	1084.36
114.0	613.55	164.0	693.72	214.0	771.58	264.0	846.23	314.0	916.51	364.0	980.95	414.0	1037.85	464.0	1085.20
115.0	615.17	165.0	695.30	215.0	773.11	265.0	847.69	315.0	917.86	365.0	982.17	415.0	1038.90	465.0	1086.03
116.0	616.79	166.0	696.88	216.0	774.63	266.0	849.14	316.0	919.21	366.0	983.38	416.0	1039.94	466.0	1086.86
117.0	618.41	167.0	698.46	217.0	776.16	267.0	850.59	317.0	920.55	367.0	984.60	417.0	1040.98	467.0	1087.69
118.0	620.03	168.0	700.04	218.0	777.68	268.0	852.03	318.0	921.90	368.0	985.81	418.0	1042.02	468.0	1088.51
119.0	621.65	169.0	701.62	219.0	779.21	269.0	853.48	319.0	923.24	369.0	987.01	419.0	1043.05	469.0	1089.32
120.0	623.27	170.0	703.20	220.0	780.73	270.0	854.92	320.0	924.58	370.0	988.21	420.0	1044.08	470.0	1090.14
121.0	624.89	171.0	704.77	221.0	782.25	271.0	856.36	321.0	925.92	371.0	989.41	421.0	1045.10	471.0	1090.94
122.0	626.50	172.0	706.35	222.0	783.77	272.0	857.80	322.0	927.25	372.0	990.61	422.0	1046.12	472.0	1091.74
123.0	628.12	173.0	707.93	223.0	785.28	273.0	859.24	323.0	928.58	373.0	991.80	423.0	1047.14	473.0	1092.54
124.0	629.73	174.0	709.50	224.0	786.80	274.0	860.68	324.0	929.91	374.0	992.99	424.0	1048.15	474.0	1093.33
125.0	631.35	175.0	711.07	225.0	788.31	275.0	862.11	325.0	931.24	375.0	994.18	425.0	1049.16	475.0	1094.12
126.0	632.96	176.0	712.64	226.0	789.83	276.0	863.55	326.0	932.56	376.0	995.37	426.0	1050.16	476.0	1094.90
127.0	634.58	177.0	714.21	227.0	791.34	277.0	864.98	327.0	933.89	377.0	996.55	427.0	1051.16	477.0	1095.67
128.0	636.19	178.0	715.78	228.0	792.85	278.0	866.41	328.0	935.21	378.0	997.72	428.0	1052.16	478.0	1096.44
129.0	637.80	179.0	717.35	229.0	794.36	279.0	867.83	329.0	936.52	379.0	998.90	429.0	1053.15	479.0	1097.21
130.0	639.41	180.0	718.92	230.0	795.87	280.0	869.26	330.0	937.84	380.0	1000.07	430.0	1054.14	480.0	1097.97
131.0	641.02	181.0	720.49	231.0	797.37	281.0	870.68	331.0	939.15	381.0	1001.24	431.0	1055.13	481.0	1098.73
132.0	642.63	182.0	722.05	232.0	798.88	282.0	872.11	332.0	940.46	382.0	1002.40	432.0	1056.11	482.0	1099.48
133.0	644.24	183.0	723.62	233.0	800.38	283.0	873.52	333.0	941.77	383.0	1003.56	433.0	1057.08	483.0	1100.23
134.0	645.85	184.0	725.18	234.0	801.88	284.0	874.94	334.0	943.07	384.0	1004.72	434.0	1058.05	484.0	1100.97
135.0	647.45	185.0	726.75	235.0	803.39	285.0	876.36	335.0	944.38	385.0	1005.88	435.0	1059.02	485.0	1101.70
136.0	649.06	186.0	728.31	236.0	804.88	286.0	877.77	336.0	945.68	386.0	1007.03	436.0	1059.99	486.0	1102.44
137.0	650.67	187.0	729.87	237.0	806.38	287.0	879.18	337.0	946.97	387.0	1008.18	437.0	1060.95	487.0	1103.16
138.0	652.27	188.0	731.43	238.0	807.88	288.0	880.59	338.0	948.27	388.0	1009.32	438.0	1061.90	488.0	1103.88
139.0	653.88	189.0	732.99	239.0	809.37	289.0	882.00	339.0	949.56	389.0	1010.46	439.0	1062.85	489.0	1104.60
140.0	655.48	190.0	734.54	240.0	810.87	290.0	883.41	340.0	950.85	390.0	1011.60	440.0	1063.80	490.0	1105.31
141.0	657.08	191.0	736.10	241.0	812.36	291.0	884.81	341.0	952.13	391.0	1012.73	441.0	1064.74	491.0	1106.01
142.0	658.68	192.0	737.66	242.0	813.85	292.0	886.21	342.0	953.42	392.0	1013.86	442.0	1065.68	492.0	1106.71
143.0	660.29	193.0	739.21	243.0	815.34	293.0	887.61	343.0	954.70	393.0	1014.99	443.0	1066.61	493.0	1107.41
144.0	661.89	194.0	740.76	244.0	816.82	294.0	889.01	344.0	955.98	394.0	1016.12	444.0	1067.54	494.0	1108.10
145.0	663.49	195.0	742.31	245.0	818.31	295.0	890.40	345.0	957.25	395.0	1017.24	445.0	1068.47	495.0	1108.78
146.0	665.08	196.0	743.87	246.0	819.79	296.0	891.80	346.0	958.52	396.0	1018.35	446.0	1069.39	496.0	1109.46
147.0	666.68	197.0	745.41	247.0	821.28	297.0	893.19	347.0	959.79	397.0	1019.47	447.0	1070.31	497.0	1110.13
148.0	668.28	198.0	746.96	248.0	822.76	298.0	894.58	348.0	961.06	398.0	1020.58	448.0	1071.22	498.0	1110.80
149.0	669.88	199.0	748.51	249.0	824.24	299.0	895.96	349.0	962.33	399.0	1021.68	449.0	1072.13	499.0	1111.46

500 Ohm Probe, Normalized Resistance Chart

°C	Ω	°C	Ω	°C	Ω	°C	Ω	°C	Ω	°C	Ω	°C	Ω
-199.00	89.17	-149.00	196.63	-99.00	300.66	-49.00	402.23	1.00	501.98	50.00	598.26	100.00	695.04
-198.00	91.36	-149.00	196.63	-98.00	302.71	-48.00	404.24	2.00	503.96	51.00	600.21	101.00	696.96
-197.00	93.55	-148.00	198.74	-97.00	304.76	-47.00	406.25	3.00	505.94	52.00	602.16	102.00	698.88
-196.00	95.74	-147.00	200.85	-96.00	306.81	-46.00	408.26	4.00	507.92	53.00	604.11	103.00	700.79
-195.00	97.92	-146.00	202.95	-95.00	308.86	-45.00	410.27	5.00	509.89	54.00	606.06	104.00	702.71
-194.00	100.11	-145.00	205.06	-94.00	310.91	-44.00	412.28	6.00	511.87	55.00	608.00	105.00	704.63
-193.00	102.29	-144.00	207.17	-93.00	312.96	-43.00	414.29	7.00	513.85	56.00	609.95	106.00	706.55
-192.00	104.47	-143.00	209.27	-92.00	315.01	-42.00	416.29	8.00	515.82	57.00	611.90	107.00	708.47
-191.00	106.64	-142.00	211.37	-91.00	317.06	-41.00	418.30	9.00	517.80	58.00	613.84	108.00	710.38
-190.00	108.82	-141.00	213.47	-90.00	319.10	-40.00	420.31	10.00	519.77	59.00	615.79	109.00	712.30
-189.00	110.99	-140.00	215.57	-89.00	321.14	-39.00	422.31	11.00	521.74	60.00	617.73	110.00	714.21
-188.00	113.17	-139.00	217.67	-88.00	323.19	-38.00	424.32	12.00	523.72	61.00	619.68	111.00	716.13
-187.00	115.34	-138.00	219.77	-87.00	325.23	-37.00	426.32	13.00	525.69	62.00	621.62	112.00	718.04
-186.00	117.51	-137.00	221.86	-86.00	327.27	-36.00	428.32	14.00	527.66	63.00	623.56	113.00	719.95
-185.00	119.67	-136.00	223.96	-85.00	329.31	-35.00	430.32	15.00	529.63	64.00	625.51	114.00	721.87
-184.00	121.84	-135.00	226.05	-84.00	331.35	-34.00	432.33	16.00	531.60	65.00	627.45	115.00	723.78
-183.00	124.00	-134.00	228.15	-83.00	333.39	-33.00	434.33	17.00	533.57	66.00	629.39	116.00	725.69
-182.00	126.16	-133.00	230.24	-82.00	335.43	-32.00	436.33	18.00	535.54	67.00	631.33	117.00	727.60
-181.00	128.32	-132.00	232.33	-81.00	337.47	-31.00	438.33	19.00	537.51	68.00	633.27	118.00	729.51
-180.00	130.48	-131.00	234.42	-80.00	339.50	-30.00	440.33	20.00	539.48	69.00	635.21	119.00	731.42
-179.00	132.64	-130.00	236.50	-79.00	341.54	-29.00	442.32	21.00	541.45	70.00	637.15	120.00	733.33
-178.00	134.79	-129.00	238.59	-78.00	343.57	-28.00	444.32	22.00	543.42	71.00	639.09	121.00	735.24
-177.00	136.95	-128.00	240.67	-77.00	345.61	-27.00	446.32	23.00	545.38	72.00	641.02	122.00	737.15
-176.00	139.10	-127.00	242.76	-76.00	347.64	-26.00	448.31	24.00	547.35	73.00	642.96	123.00	739.05
-175.00	141.25	-126.00	244.84	-75.00	349.67	-25.00	450.31	25.00	549.31	74.00	644.90	124.00	740.96
-174.00	143.40	-125.00	246.92	-74.00	351.70	-24.00	452.31	26.00	551.28	75.00	646.83	125.00	742.87
-173.00	145.55	-124.00	249.00	-73.00	353.74	-23.00	454.30	27.00	553.24	76.00	648.77	126.00	744.77
-172.00	147.69	-123.00	251.08	-72.00	355.76	-22.00	456.29	28.00	555.21	77.00	650.70	127.00	746.68
-171.00	149.84	-122.00	253.16	-71.00	357.79	-21.00	458.29	29.00	557.17	78.00	652.64	128.00	748.58
-170.00	151.98	-121.00	255.24	-70.00	359.82	-20.00	460.28	30.00	559.13	79.00	654.57	129.00	750.49
-169.00	154.12	-120.00	257.31	-69.00	361.85	-19.00	462.27	31.00	561.10	80.00	656.50	130.00	752.39
-168.00	156.26	-119.00	259.39	-68.00	363.88	-18.00	464.26	32.00	563.06	81.00	658.43	131.00	754.29
-167.00	158.40	-118.00	261.46	-67.00	365.90	-17.00	466.25	33.00	565.02	82.00	660.37	132.00	756.19
-166.00	160.53	-117.00	263.53	-66.00	367.93	-16.00	468.24	34.00	566.98	83.00	662.30	133.00	758.10
-165.00	162.67	-116.00	265.61	-65.00	369.95	-15.00	470.23	35.00	568.94	84.00	664.23	134.00	760.00
-164.00	164.80	-115.00	267.68	-64.00	371.97	-14.00	472.22	36.00	570.90	85.00	666.16	135.00	761.90
-163.00	166.93	-114.00	269.75	-63.00	374.00	-13.00	474.21	37.00	572.85	86.00	668.09	136.00	763.80
-162.00	169.06	-113.00	271.81	-62.00	376.02	-12.00	476.20	38.00	574.81	87.00	670.02	137.00	765.69
-161.00	171.19	-112.00	273.88	-61.00	378.04	-11.00	478.18	39.00	576.77	88.00	671.94	138.00	767.59
-160.00	173.32	-111.00	275.95	-60.00	380.06	-10.00	480.17	40.00	578.73	89.00	673.87	139.00	769.49
-159.00	175.45	-110.00	278.01	-59.00	382.08	-9.00	482.16	41.00	580.68	90.00	675.80	140.00	771.39
-158.00	177.57	-109.00	280.08	-58.00	384.10	-8.00	484.14	42.00	582.64	91.00	677.72	141.00	773.29
-157.00	179.69	-108.00	282.14	-57.00	386.11	-7.00	486.13	43.00	584.59	92.00	679.65	142.00	775.18
-156.00	181.81	-107.00	284.20	-56.00	388.13	-6.00	488.11	44.00	586.55	93.00	681.58	143.00	777.08
-155.00	183.93	-106.00	286.26	-55.00	390.15	-5.00	490.09	45.00	588.50	94.00	683.50	144.00	778.97
-154.00	186.05	-105.00	288.32	-54.00	392.16	-4.00	492.08	46.00	590.45	95.00	685.42	145.00	780.87
-153.00	188.17	-104.00	290.38	-53.00	394.18	-3.00	494.06	47.00	592.41	96.00	687.35	146.00	782.76
-152.00	190.29	-103.00	292.44	-52.00	396.19	-2.00	496.04	48.00	594.36	97.00	689.27	147.00	784.65
-151.00	192.40	-102.00	294.49	-51.00	398.21	-1.00	498.02	49.00	596.31	98.00	691.19	148.00	786.55
-150.00	194.51	-101.00	296.55	-50.00	400.22	0.00	500.00	50.00	598.26	99.00	693.11	149.00	788.44

500 Ohm Probe cont'd

°C	Ω	°C	Ω	°C	Ω	°C	Ω	°C	Ω	°C	Ω	°C	Ω
150.00	790.33	200.00	884.14	250.00	976.47	300.00	1067.32	350.00	1156.68	400.00	1244.56	450.00	1330.96
151.00	792.22	201.00	886.00	251.00	978.30	301.00	1069.12	351.00	1158.45	401.00	1246.30	451.00	1332.67
152.00	794.11	202.00	887.86	252.00	980.13	302.00	1070.92	352.00	1160.22	402.00	1248.04	452.00	1334.38
153.00	796.00	203.00	889.72	253.00	981.96	303.00	1072.72	353.00	1161.99	403.00	1249.79	453.00	1336.10
154.00	797.89	204.00	891.58	254.00	983.79	304.00	1074.52	354.00	1163.76	404.00	1251.53	454.00	1337.81
155.00	799.78	205.00	893.44	255.00	985.62	305.00	1076.32	355.00	1165.53	405.00	1253.27	455.00	1339.52
156.00	801.66	206.00	895.30	256.00	987.45	306.00	1078.12	356.00	1167.30	406.00	1255.01	456.00	1341.23
157.00	803.55	207.00	897.16	257.00	989.28	307.00	1079.92	357.00	1169.07	407.00	1256.75	457.00	1342.94
158.00	805.44	208.00	899.01	258.00	991.10	308.00	1081.71	358.00	1170.84	408.00	1258.48	458.00	1344.64
159.00	807.32	209.00	900.87	259.00	992.93	309.00	1083.51	359.00	1172.61	409.00	1260.22	459.00	1346.35
160.00	809.21	210.00	902.72	260.00	994.76	310.00	1085.31	360.00	1174.37	410.00	1261.96	460.00	1348.06
161.00	811.09	211.00	904.58	261.00	996.58	311.00	1087.10	361.00	1176.14	411.00	1263.69	461.00	1349.77
162.00	812.98	212.00	906.43	262.00	998.41	312.00	1088.90	362.00	1177.91	412.00	1265.43	462.00	1351.47
163.00	814.86	213.00	908.29	263.00	1000.23	313.00	1090.69	363.00	1179.67	413.00	1267.17	463.00	1353.18
164.00	816.75	214.00	910.14	264.00	1002.06	314.00	1092.49	364.00	1181.43	414.00	1268.90	464.00	1354.88
165.00	818.63	215.00	911.99	265.00	1003.88	315.00	1094.28	365.00	1183.20	415.00	1270.64	465.00	1356.59
166.00	820.51	216.00	913.85	266.00	1005.70	316.00	1096.07	366.00	1184.96	416.00	1272.37	466.00	1358.29
167.00	822.39	217.00	915.70	267.00	1007.52	317.00	1097.87	367.00	1186.72	417.00	1274.10	467.00	1360.00
168.00	824.27	218.00	917.55	268.00	1009.34	318.00	1099.66	368.00	1188.49	418.00	1275.83	468.00	1361.70
169.00	826.15	219.00	919.40	269.00	1011.16	319.00	1101.45	369.00	1190.25	419.00	1277.57	469.00	1363.40
170.00	828.03	220.00	921.25	270.00	1012.99	320.00	1103.24	370.00	1192.01	420.00	1279.30	470.00	1365.10
171.00	829.91	221.00	923.10	271.00	1014.80	321.00	1105.03	371.00	1193.77	421.00	1281.03	471.00	1366.80
172.00	831.79	222.00	924.95	272.00	1016.62	322.00	1106.82	372.00	1195.53	422.00	1282.76	472.00	1368.50
173.00	833.67	223.00	926.80	273.00	1018.44	323.00	1108.61	373.00	1197.29	423.00	1284.49	473.00	1370.20
174.00	835.54	224.00	928.64	274.00	1020.26	324.00	1110.39	374.00	1199.05	424.00	1286.22	474.00	1371.90
175.00	837.42	225.00	930.49	275.00	1022.08	325.00	1112.18	375.00	1200.80	425.00	1287.94	475.00	1373.60
176.00	839.30	226.00	932.34	276.00	1023.89	326.00	1113.97	376.00	1202.56	426.00	1289.67	476.00	1375.30
177.00	841.17	227.00	934.18	277.00	1025.71	327.00	1115.76	377.00	1204.32	427.00	1291.40	477.00	1377.00
178.00	843.05	228.00	936.03	278.00	1027.53	328.00	1117.54	378.00	1206.07	428.00	1293.13	478.00	1378.69
179.00	844.92	229.00	937.87	279.00	1029.34	329.00	1119.33	379.00	1207.83	429.00	1294.85	479.00	1380.39
180.00	846.79	230.00	939.72	280.00	1031.15	330.00	1121.11	380.00	1209.59	430.00	1296.58	480.00	1382.09
181.00	848.67	231.00	941.56	281.00	1032.97	331.00	1122.90	381.00	1211.34	431.00	1298.30	481.00	1383.78
182.00	850.54	232.00	943.40	282.00	1034.78	332.00	1124.68	382.00	1213.09	432.00	1300.03	482.00	1385.48
183.00	852.41	233.00	945.24	283.00	1036.59	333.00	1126.46	383.00	1214.85	433.00	1301.75	483.00	1387.17
184.00	854.28	234.00	947.08	284.00	1038.41	334.00	1128.24	384.00	1216.60	434.00	1303.47	484.00	1388.86
185.00	856.15	235.00	948.93	285.00	1040.22	335.00	1130.03	385.00	1218.35	435.00	1305.19	485.00	1390.56
186.00	858.02	236.00	950.77	286.00	1042.03	336.00	1131.81	386.00	1220.10	436.00	1306.92	486.00	1392.25
187.00	859.89	237.00	952.61	287.00	1043.84	337.00	1133.59	387.00	1221.85	437.00	1308.64	487.00	1393.94
188.00	861.76	238.00	954.45	288.00	1045.65	338.00	1135.37	388.00	1223.60	438.00	1310.36	488.00	1395.63
189.00	863.63	239.00	956.28	289.00	1047.46	339.00	1137.15	389.00	1225.35	439.00	1312.08	489.00	1397.32
190.00	865.50	240.00	958.12	290.00	1049.26	340.00	1138.92	390.00	1227.10	440.00	1313.80	490.00	1399.01
191.00	867.36	241.00	959.96	291.00	1051.07	341.00	1140.70	391.00	1228.85	441.00	1315.52	491.00	1400.70
192.00	869.23	242.00	961.80	292.00	1052.88	342.00	1142.48	392.00	1230.60	442.00	1317.23	492.00	1402.39
193.00	871.10	243.00	963.63	293.00	1054.69	343.00	1144.26	393.00	1232.35	443.00	1318.95	493.00	1404.08
194.00	872.96	244.00	965.47	294.00	1056.49	344.00	1146.03	394.00	1234.09	444.00	1320.67	494.00	1405.76
195.00	874.83	245.00	967.30	295.00	1058.30	345.00	1147.81	395.00	1235.84	445.00	1322.39	495.00	1407.45
196.00	876.69	246.00	969.14	296.00	1060.10	346.00	1149.58	396.00	1237.58	446.00	1324.10	496.00	1409.14
197.00	878.55	247.00	970.97	297.00	1061.91	347.00	1151.36	397.00	1239.33	447.00	1325.82	497.00	1410.82
198.00	880.42	248.00	972.80	298.00	1063.71	348.00	1153.13	398.00	1241.07	448.00	1327.53	498.00	1412.51
199.00	882.28	249.00	974.64	299.00	1065.51	349.00	1154.91	399.00	1242.82	449.00	1329.25	499.00	1414.19

Tel: +1.781.688.2300 41 Hampden Road, Mansfield, MA 02048 USA www.inTESTthermal.com

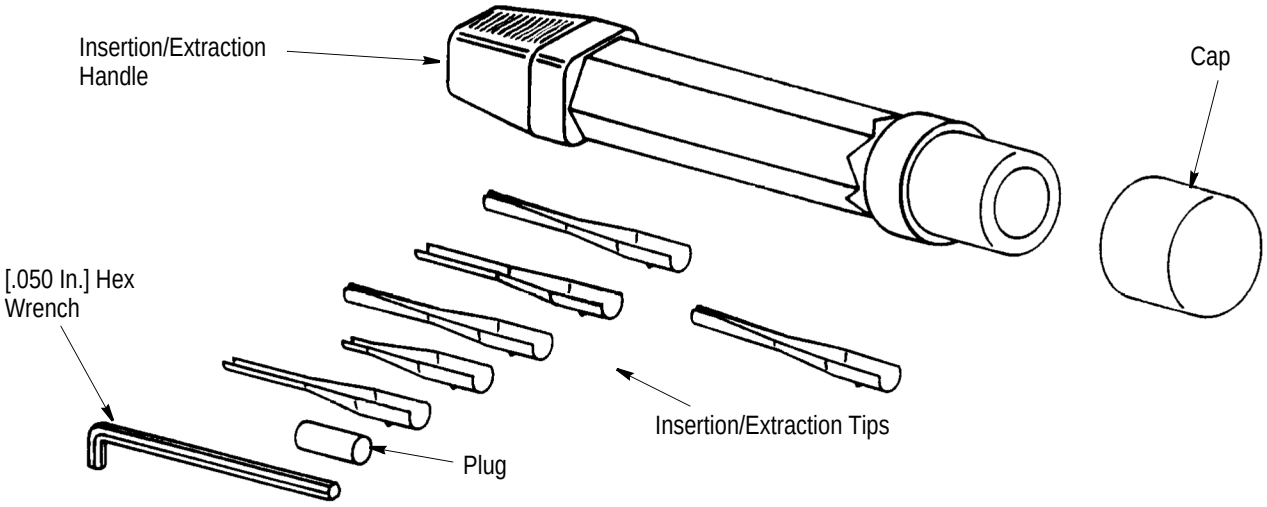
Appendix A: Inserting / Extracting Probe Pins

The following instruction set is illustrated with rectangular connectors; Sigma Systems products are equipped with round connectors. The technique for inserting and extracting probe pins is the same regardless of the connector shape.

Insertion/Extraction Tool 91285-1 and Replacement Tip Kits 543382-[ ]

PROPER USE GUIDELINES

Cumulative Trauma Disorders can result from the prolonged use of manually powered hand tools. Hand tools are intended for occasional use and low volume applications. A wide selection of powered application equipment for extended-use, production operations is available.



CONTACT SIZE	WIRE SIZE (AWG)	INSERTION/EXTRACTION TIPS		
		COLOR CODE	TYPE	PART NUMBER
HD-20	28-20	Yellow	Insertion	543382-5
HD-20	24-18	Red	Extraction	1-543382-0
HD-20	28-24	Brown	Extraction	1-543382-1
HD-20	Posted	Blue	Extraction	543382-6
HD-20	Posted	Black	Insertion	543382-7
HD-22	28-22	Green	Insertion/Extraction	543382-8

Figure 1

1. INTRODUCTION

This instruction sheet covers the use of Insertion/ Extraction Tool 91285-1 and Replacement Tip Kits 543382 shown in Figure 1. The tool is designed to insert and extract HD-22 and HD-20 contacts used in AMPLIMITE* High Density (HD) Connectors.

For information concerning the assembly of AMPLIMITE HD connectors, refer to the instruction sheet packaged with the connector.

Read these instructions thoroughly before using the tool.

See Section 6, REVISION SUMMARY, for revision information.

NOTE
All dimensions on this document are in metric units [with U.S. customary units in brackets]. Figures and illustrations are for reference only and are not drawn to scale.

2. DESCRIPTION (Figure 1)

The insertion/extraction tool consists of a handle, a cap, six insertion/extraction tips, a plug, and a [.050 in.] hex wrench. The handle of the tool provides storage for the tips, plug, and hex wrench. The insertion/extraction tips convert the tool for the appropriate product and are used to insert or extract connector contacts. Each tip is color coded according to specific type and wire size. The plug is inserted into the widest end of the tip to prevent damage to the tip when it is secured in the tool handle. The hex wrench is used to tighten the setscrew which secures the tip in the tool handle.

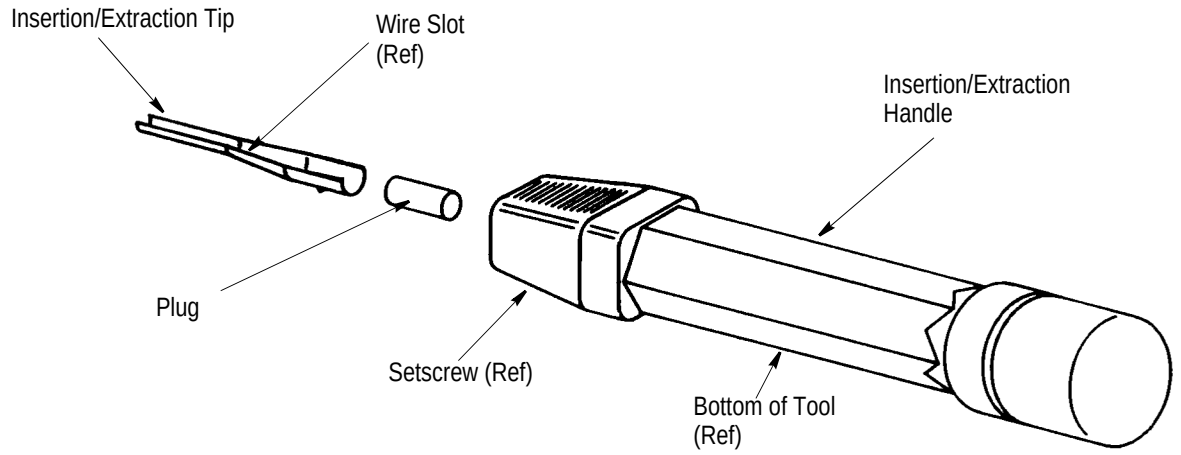


Figure 2

3. TOOL ASSEMBLY (Figure 2)

Refer to Figure 1 and select the appropriate contact, wire size, and insertion/extraction tip. Proceed as follows:

1. Insert plug into the widest end of the insertion/extraction tip.

2. Slide the insertion/extraction tip into the end of the tool handle with the orientation latch positioned toward the bottom of the tool.

3. Using the hex wrench, tighten the setscrew to secure the tip in the tool handle.

4. INSERTION/EXTRACTION PROCEDURES

4.1. Inserting A Wire Crimped Contact (Figure 3)

1. Position tool handle between thumb and fingertips, then place wire over the wire slot of the tip. Hold wire in this position with your thumb.

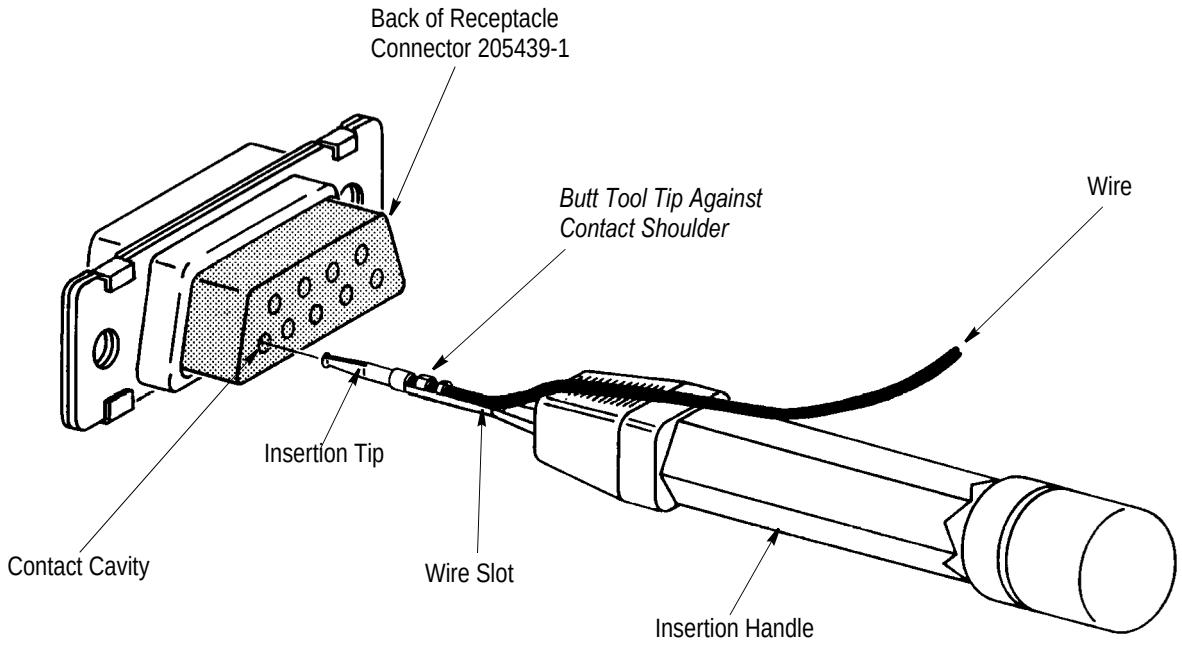


Figure 3

2. Slide thumb over the wire toward the end of the tip.

NOTE
The wire must be positioned inside the wire slot of the tip.

3. Slide tip over contact wire barrel until the tip butts against the contact shoulder.

4. Align contact with the BACK of the contact cavity. Push contact straight into the contact cavity until the contact bottoms.

5. Remove the insertion tool; then pull back on the wire to ensure that the contact is locked into the contact cavity.

4.2. Extracting A Wire Crimped Contact (Figure 4)

1. Position tool handle between thumb and fingertips, and align contact wire with the wire slot on the tip. Hold wire in this position with your thumb.

2. Slide your thumb over the wire toward the end of the insertion tip.

NOTE
The wire must be positioned inside the wire slot of the tip.

3. Place tip over the contact post or crimp barrel and slide the tip straight into the contact cavity until the tip bottoms against the contact shoulder.

4. Holding the wire tight against the tool handle, pull back on the tool handle to extract the contact. If you experience difficulty in extracting the contact, repeat Steps 1 through 4.

4.3. Inserting A Posted Contact (Figure 5)

1. Place the contact in the contact cavity. Do NOT push on the contact post.

2. Position the tip over the contact post. Move the tool along the post until the tip butts against the contact stabilizer. Align the tip on the stabilizer as shown in Figure 5.

3. Hold the tool handle, and push the contact post to make certain that the contact is locked in the cavity.

NOTE
Contacts with tail lengths longer than 10.85 mm [.427 in.] must use yellow color coded insertion tips.

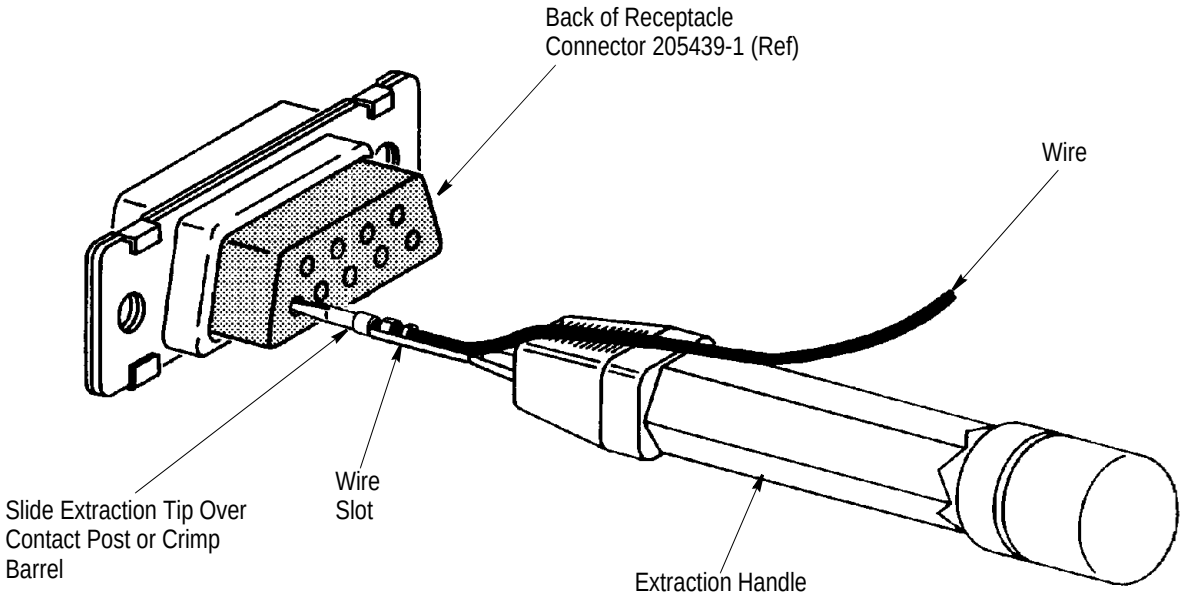


Figure 4

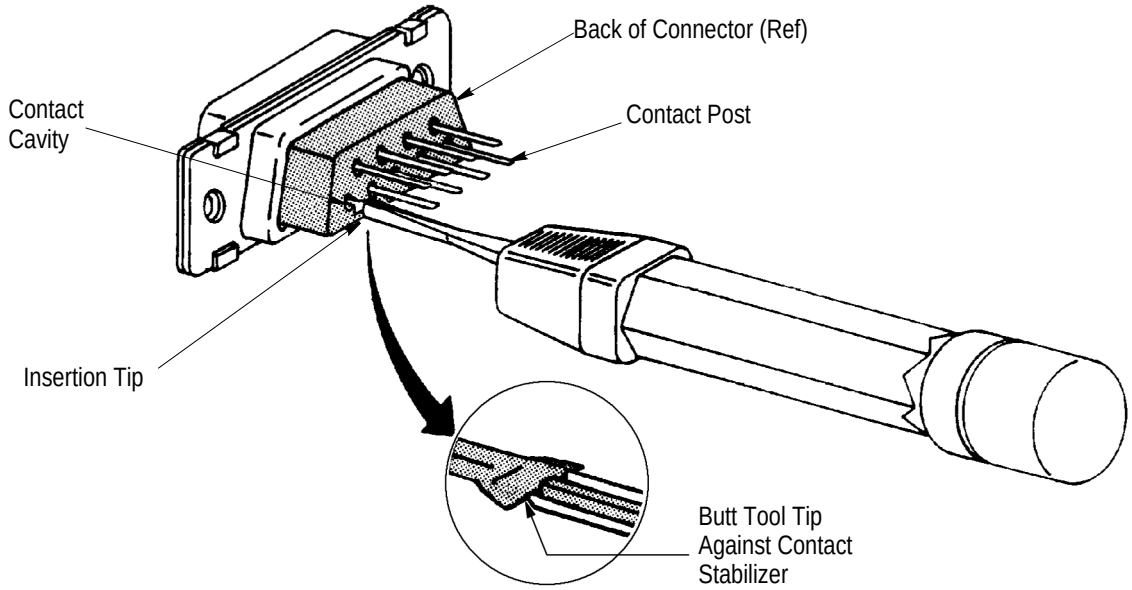


Figure 5

4.4. Extracting A Posted Contact (Figure 6)

1. Place the extraction tip over the contact post. Move the tool along the post until the tip enters the contact cavity.

2. Align the groove of the extraction tip with the contact stabilizer as shown in Figure 6.

3. Push the tip past the stabilizer and straight into the cavity until it bottoms.

4. For a receptacle style connector, insert a 1.02 mm [.040 in.] diameter pin straight into the FRONT of the contact cavity. For a plug style connector, push on mating tip of contact with a suitable device.

5. Apply pressure to remove the contact and tool from the contact cavity.

5. TOOL INSPECTION/REPLACEMENT (Figure 7)

Insertion/Extraction Tool is inspected before shipment. TE recommends that the tool be inspected immediately upon its arrival to ensure that the tool has not been damaged during shipment, and that the tool conforms to the dimensions provided in Figure 7.Customer-replaceable parts are provided in Figure 7. If the tool becomes broken or damaged, replacement and/or spare parts can be purchased by contacting:

CUSTOMER SERVICE (038-035)
TYCO ELECTRONICS CORPORATION
PO BOX 3608
HARRISBURG PA 17105-3608

For tool repair service, please contact an TE Representative at 1-800-526-5136.

6. REVISION SUMMARY

Since the previous release, the last line of Figure 1 was corrected to indicate contact HD-22.

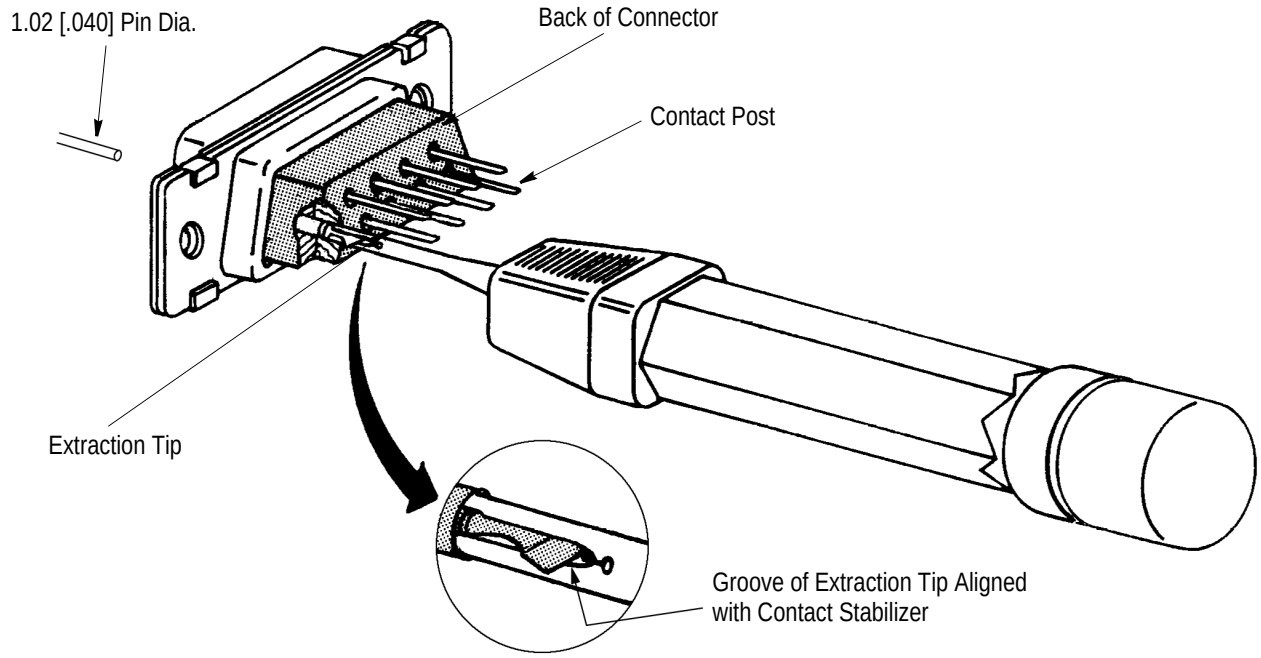
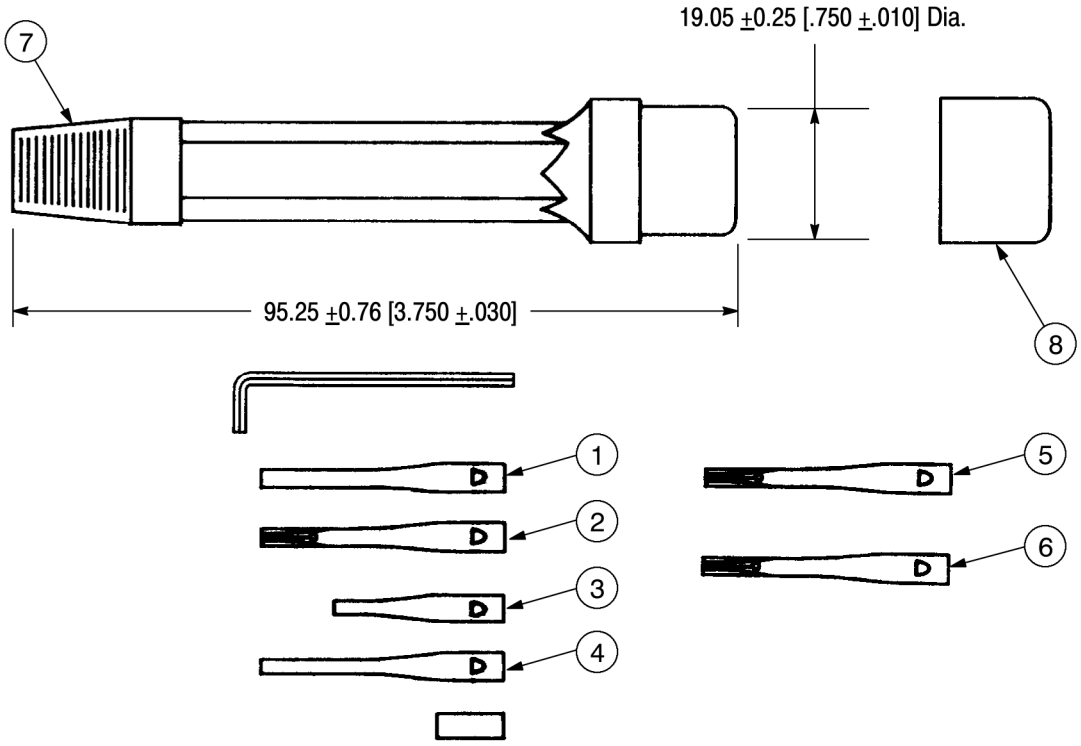

1.02 [.040] Pin Dia.
Back of Connector
Contact Post
Extraction Tip
Groove of Extraction Tip Aligned
with Contact Stabilizer

Figure 6



REPLACEMENT PARTS†			
ITEM	**COLOR CODE**	**PART NUMBER**	**DESCRIPTION**
1	Yellow	543382-5	TIP, Insertion
2	Blue	543382-6	TIP, Extraction
3	Black	543382-7	TIP, Insertion
4	Green	543382-8	TIP, Insertion/Extraction
5	Red	1-543382-0	TIP, Extraction
6	Brown	1-543382-1	TIP, Extraction
7	-----	2-21006-0	SCREW, Set No. 4-40 X .180 Lg.
8	-----	2-26538-5	CAP

† Available in packs of 25 only (one plug included in each packet).

Figure 7