Introduction:

This test report presents the data and describes the procedures for testing the current-carrying capacity for QA's test probes. This information is useful for test and design engineers when calculating probe requirements for high current and temperature applications.

Scope:

Measure the current capacity of test probes. Two types of tests were performed; both were simulations of common applications for probes. The first tested a solitary probe mounted in a G10 fixture plate, while the second tested a group of probes (3x3 grid pattern).

Background:

The current-carrying ability of a probe is measured with respect to probe temperature. (Refer to the Applications Note titled *Working Temperature Ranges for QA Test Probes* for additional information.)

Test Procedure:

A controllable DC current source was used to provide a constant current through the probe and socket assembly being tested, while a thermocouple was used to track the temperature of the probe. The current was increased in one-Ampere intervals (one-half intervals for the 025-16, 039-16 and BGA M08 Series), and sufficient time was allowed between increases for the temperature to stabilize. As current increased, probe temperature increased, and testing continued until the 250° Fahrenheit threshold was reached.

Series Tested and Summary

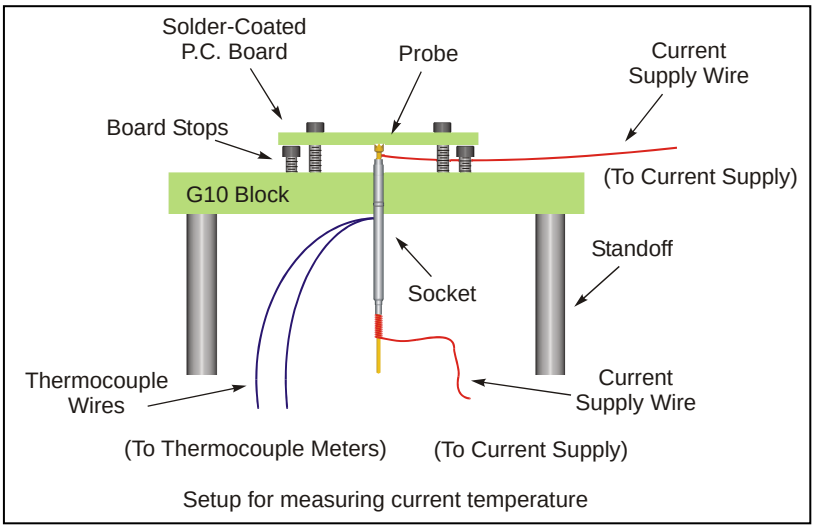
Probe Series	Current Capacity (Amps)*	Center Spacing	Plunger Travel
025-16	1.5 (P)	.025 (0.63)	.160 (4.06)
039-16	3.5 (P)	.039 (1.00)	.160 (4.06)
050-05	4.0 (P)	.050 (1.27)	.050 (1.27)
050-16	6.0 (P)	.050 (1.27)	.160 (4.06)
050-T25	5.0 (P)	.050 (1.27)	.250 (6.35)
050-R25	5.5 (P)	.050 (1.27)	.250 (6.35)
075-25	6.0 (P)	.075 (1.91)	.250 (6.35)
075-40	6.5 (P)	.075 (1.91)	.400 (10.16)
100-05	5.0 (P)	.100 (2.54)	.050 (1.27)
100-16	6.5 (P)	.100 (2.54)	.160 (4.06)
100-25	6.5 (P), 12.0 (H)	.100 (2.54)	.250 (6.35)
100-40	8.0 (P), 12.0 (H)	.100 (2.54)	.400 (10.16)
125-25	10.0 (G), 15.0 (H)	.125 (3.18)	.250 (6.35)
BGA-M08	4.5 (H)	.8mm (.031")	.027 (.69)

Dimensions in inches (mm), except where noted.

* For a single probe with a 70° temperature rise.
P=Gold Lined, G=Gold Plated, H=High Conductivity.

For the first test, a solitary probe was oriented as shown in the sketch. A probe from each series was mounted in a 5/16" block made of G10. The block stood horizontally on four legs and airflow was blocked by baffles arranged around the test block.

A type K thermocouple was used, with 40 AWG (.003" diameter conductor) Chromel/Aluminel wire connected to the socket just below the bottom surface of the mounting plate. The .003” wire diameter minimized heat transfer from the socket and reduced response time.



Setup for measuring current temperature

Wires for supplying current to the probe were 20 AWG or greater. One current supply wire was connected directly to the tail of the socket; the other was connected to a solder-coated plate, which was in contact with the probe tip. This contact plate was mounted such that the probe was compressed to its rated 2/3 stroke. The test set up was intended to closely simulate typical applications for test probes.

For the second test (probe groups, 3x3 Grid), nine probes and sockets were mounted on a three-by-three grid of the appropriate center spacing. All nine probes were wired in series by connecting the appropriate socket tails, and by selectively jumping the tips in succession with a solder-coated plate simulating a typical printed circuit board. In this way, the same current was assured to run through all nine probes. The thermocouple was connected to the center socket at the same location as in the previous test.

The BGA setup utilized a fixture designed around the typical application for this probe and consisted of three plates with the probes sandwiched between a top and bottom plate. The top and bottom plates had the appropriate routing to test both a single probe and 3X3 Grid. See QA customer drawing C-M08-PR89-3 for the typical application of this probe.

Data:

The plotted graphs compare the temperature versus current for all of the probe series. The sockets used for each series are listed in the table; note that the BGA-M08 probe does not utilize a socket in its application. The 100-25 Series were all tested in 100-SDN250S sockets with exception to the 100-PRH2509S probes which were tested in 100-SDH250W sockets and plotted on the 100-25 Series graphs. Additional tests included the testing of the various spring forces and varying the stroke lengths for the 100-25 Series. Complete numeric test results are available.

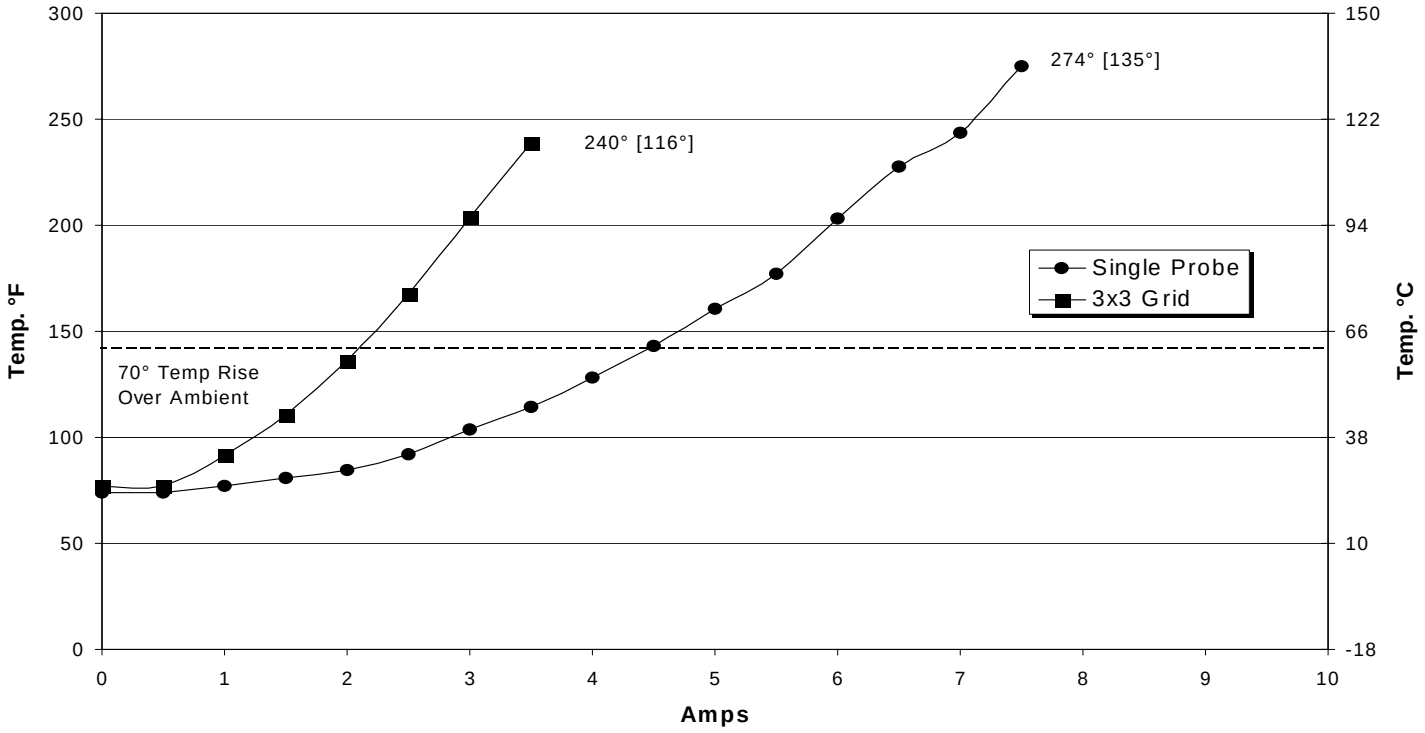
Socket Part Numbers and Set Heights Used for Each Series	
025-SBP160C-3	Flush
039-SDC165J	.150” (3.81 mm)
050-SBB050C-6	Flush
050-SBB160C-6	.150” (3.81 mm)
050-STB255C-6	.150” (3.81 mm)
050-SRB255C-6	.150” (3.81 mm)
075-SDN250W*	.150” (3.81 mm)
100-SDN050W	Flush
100-SDN160W	.150” (3.81 mm)
100-SDN250S*	.150” (3.81 mm)
100-SDH250W	.150” (3.81 mm)
125-SDN250S	.150” (3.81 mm)
BGA-M08 Series	NA

* Both the .250” and .400” stroke probes use the same socket.

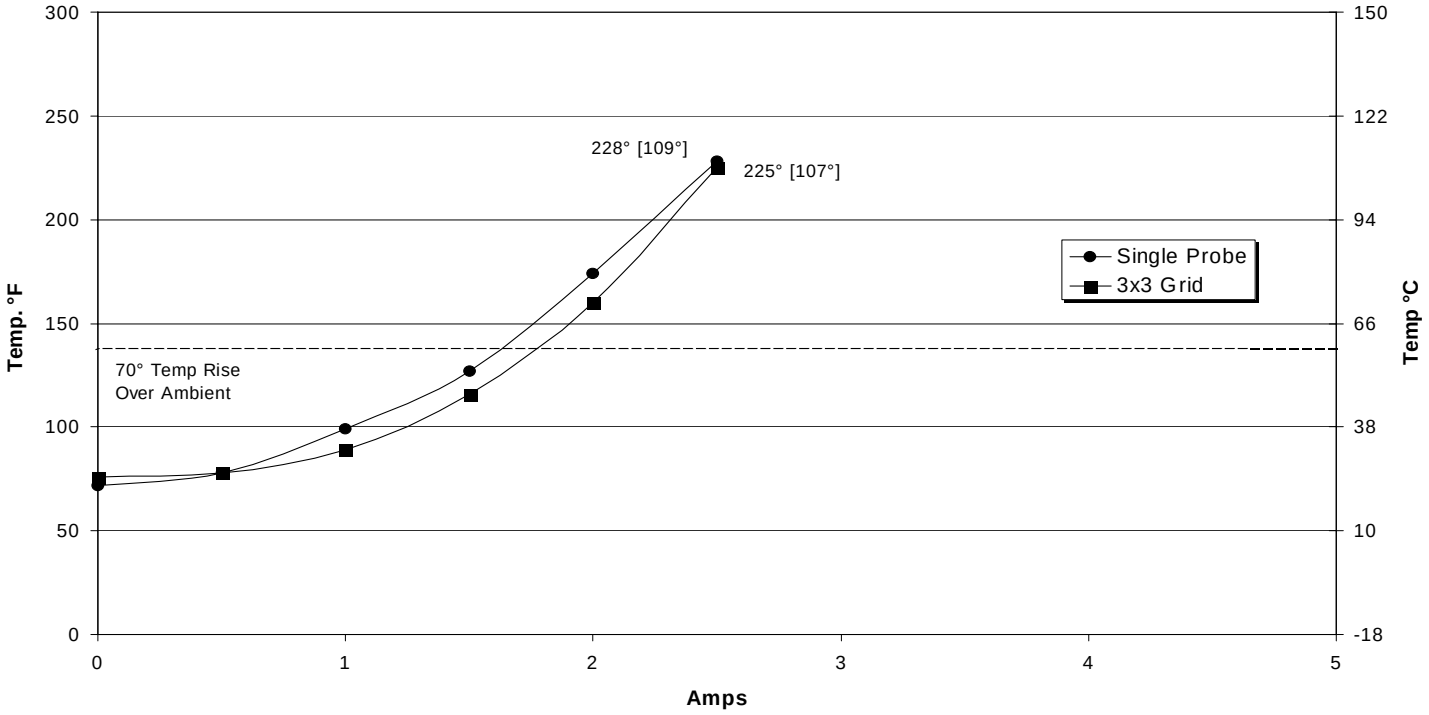
Conclusions and Application Notes:

- As the group data shows, higher probe densities decrease the probes current carrying ability. This is due to the combined heat generated by the probes and the decrease of air circulation via natural convection. Because each application is unique, it is recommended that appropriate tests be conducted before probes are put into service in applications with high currents, high probe densities or limited airflow.
- These temperature measurements were made in the absence of any forced convection. Providing airflow (by means of a fan, for example) around the sockets will reduce the temperature for a given current. Also, tests have shown that the airflow present due to leaks in a typical vacuum fixture will reduce temperature.
- For conditions where the ambient temperature differs from the 75° F ambient of these tests; shift the data by the same amount that the ambients differ to determine whether the 250° F limit is exceeded. For example, a 100-25 series probe with a P tube operating in an environment with an ambient temperature of 120° F will exceed 250° F at 12 Amps (instead of 14 Amps at 75° F ambient).
- Differences in current carrying capacity for various springs are not significant.
- Differences in current carrying capacity for various strokes are not significant.
- Note that although the probe will not be damaged from operation at temperatures up to 250° F, some types of plastics used as mounting plates will not withstand this temperature. Also, the operator must be protected against contacting probes at high temperatures.
- This data reflects performance at 100% duty cycle. Higher currents can be carried for pulses of short duration. For simplicity, apply higher currents for no longer than one second (longer pulses may be carried, but require that thermal inertia and rate of temperature gain be known). For example, the electrical resistance of 100-PRH2509S in 100-SDH250W averages 7mΩ and carries a maximum current of 20A; it is able to continuously dissipate a maximum of 2.8W ($P=I^2R$). At 50A, it would dissipate about 17.5W, which means the duty cycle must be reduced to 16%. So, to avoid overheating this probe at 50A, power must be applied for no more than 160 milliseconds (1 second x 16%). Similarly, the 125-25 Series of probes and sockets are designed for high current applications given the larger component diameters and greater internal contact surfaces areas when compared to the other series. A 125-PRH2509S when mounted into a 125-SDG250W socket has an average electrical resistance of 6mΩ and carries a maximum current of 24 Amps; it can continuously dissipate a maximum of 3.46W ($P=I^2R$). At 50 Amps it would dissipate about 15W reducing the duty cycle to 23%.
- For comparison, note that a Kynar-insulated solid copper wire the same diameter as a 100-25 series probe tube (.054") reaches 250° F at 29A.

Current Rating BGA M08-PR89 Series
M08-PRH8941S



Current Rating 025-16 Series
025-PRP1641-S



Current Rating 039-16 Series
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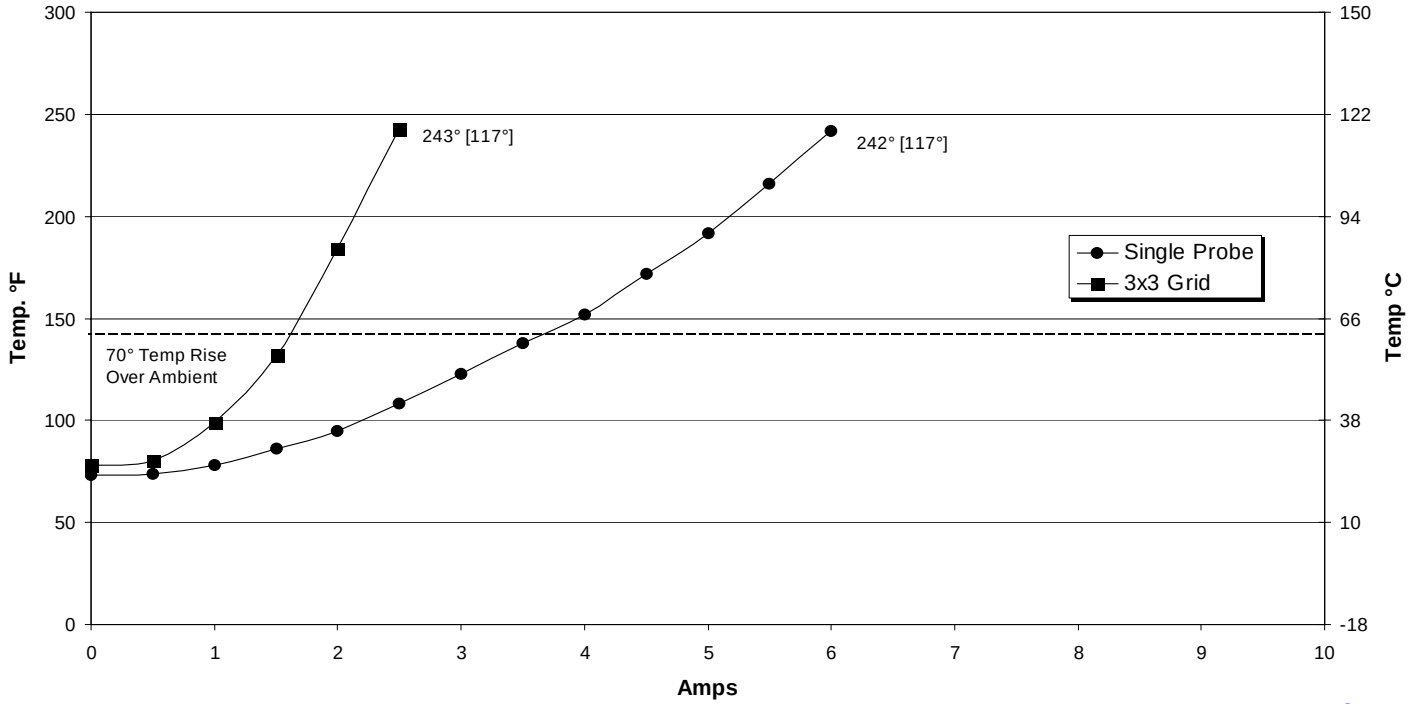
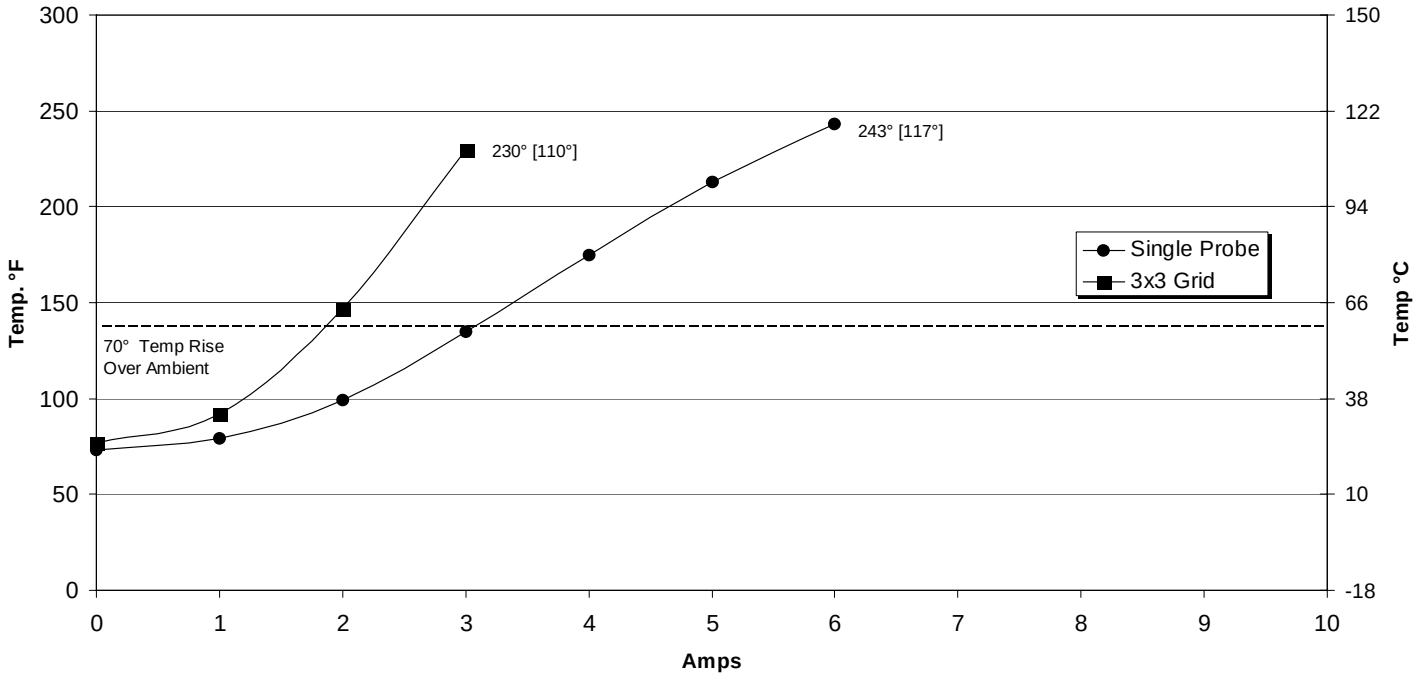
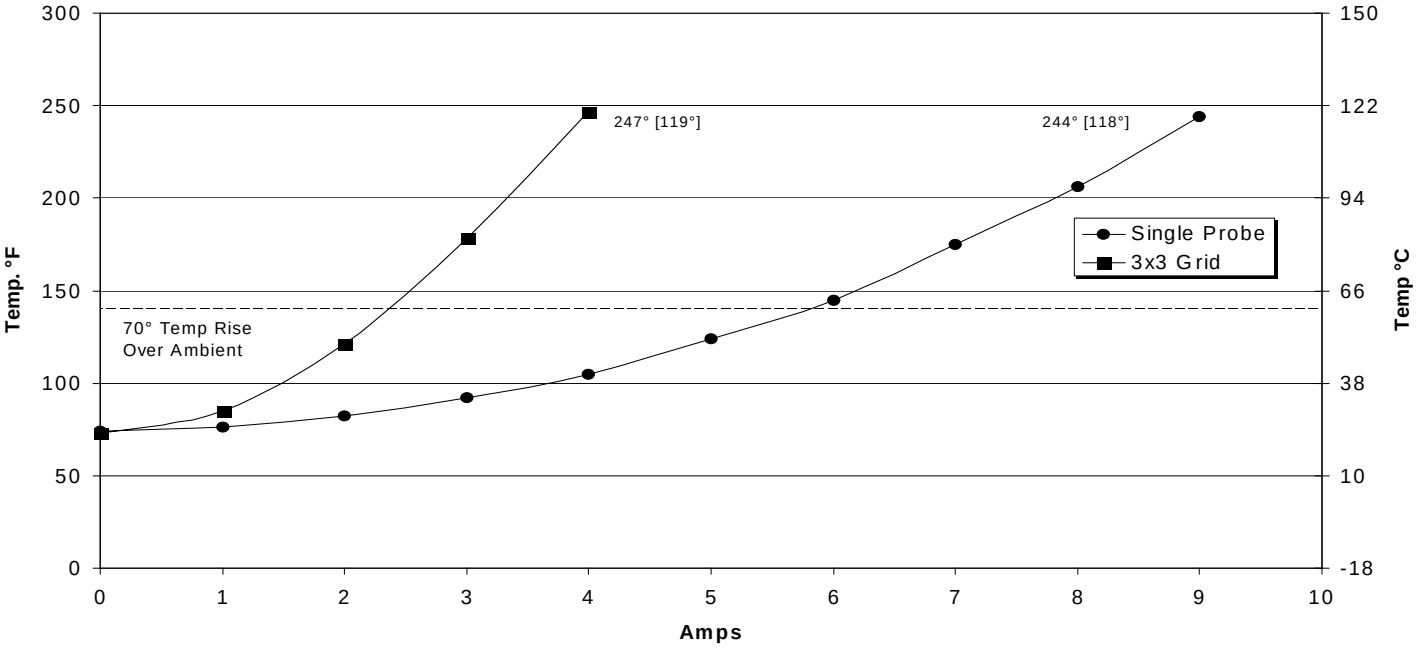


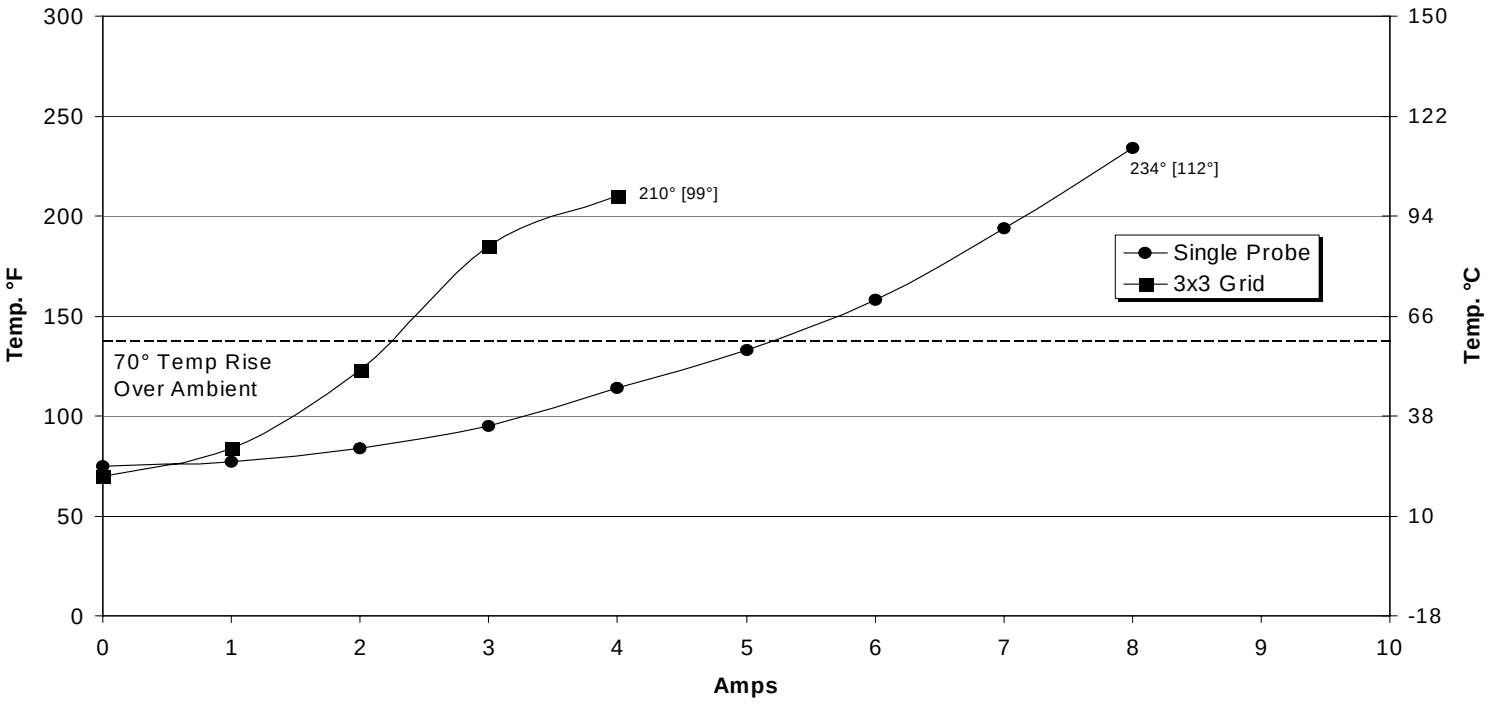
Current Rating 050-05 Series
050-PLP0513S



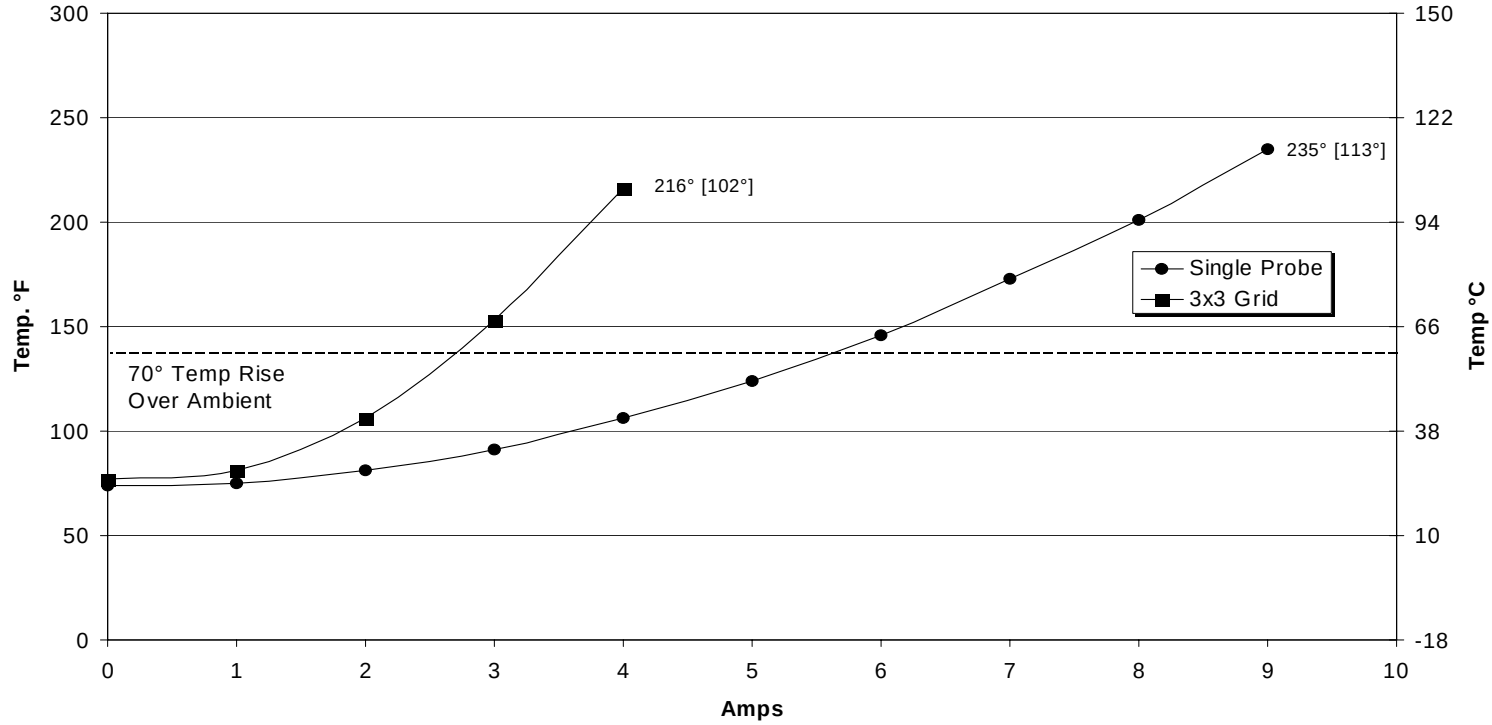
Current Rating 050-16 Series
050-PLP1609S



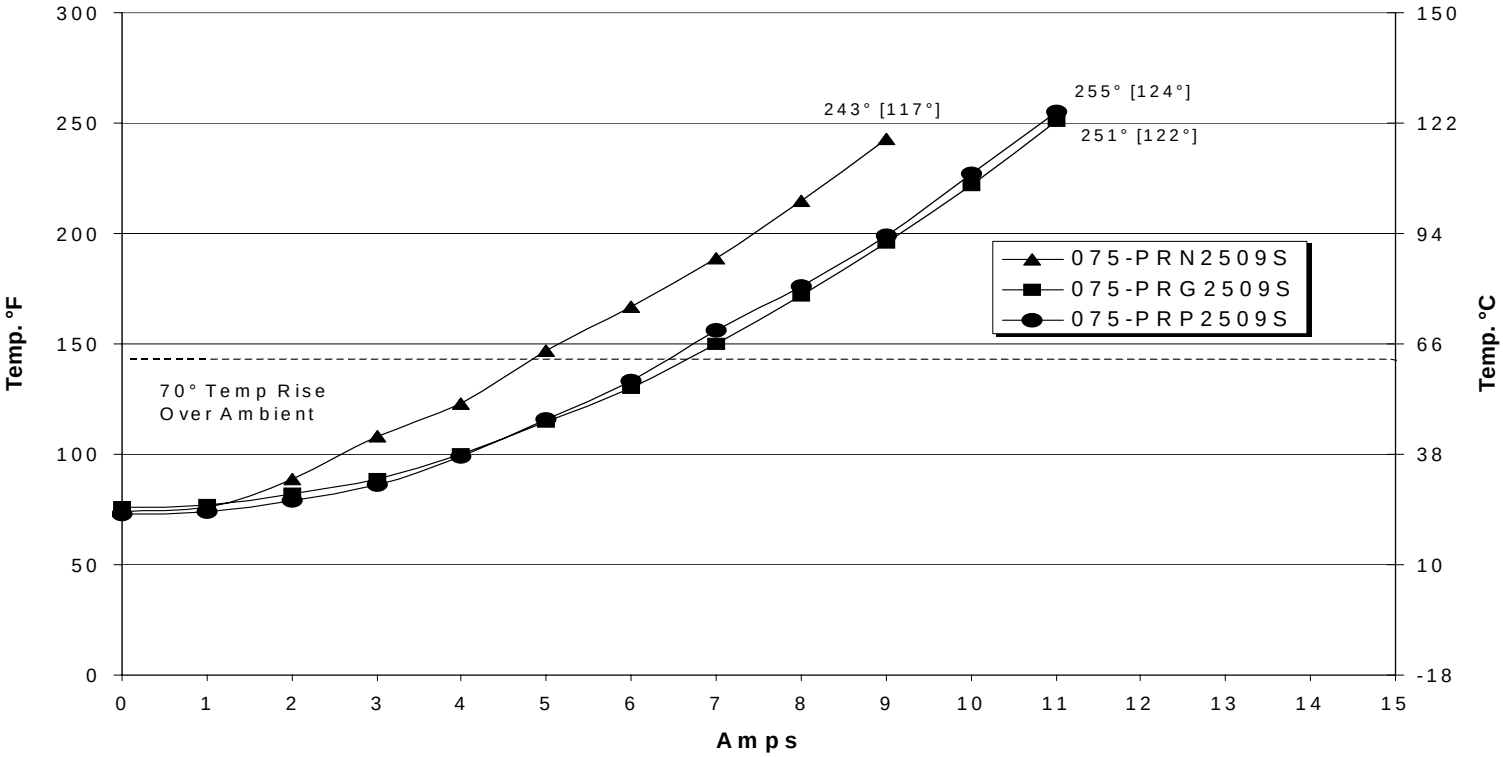
Current Rating 050-T25 Series
050-PTP2509S



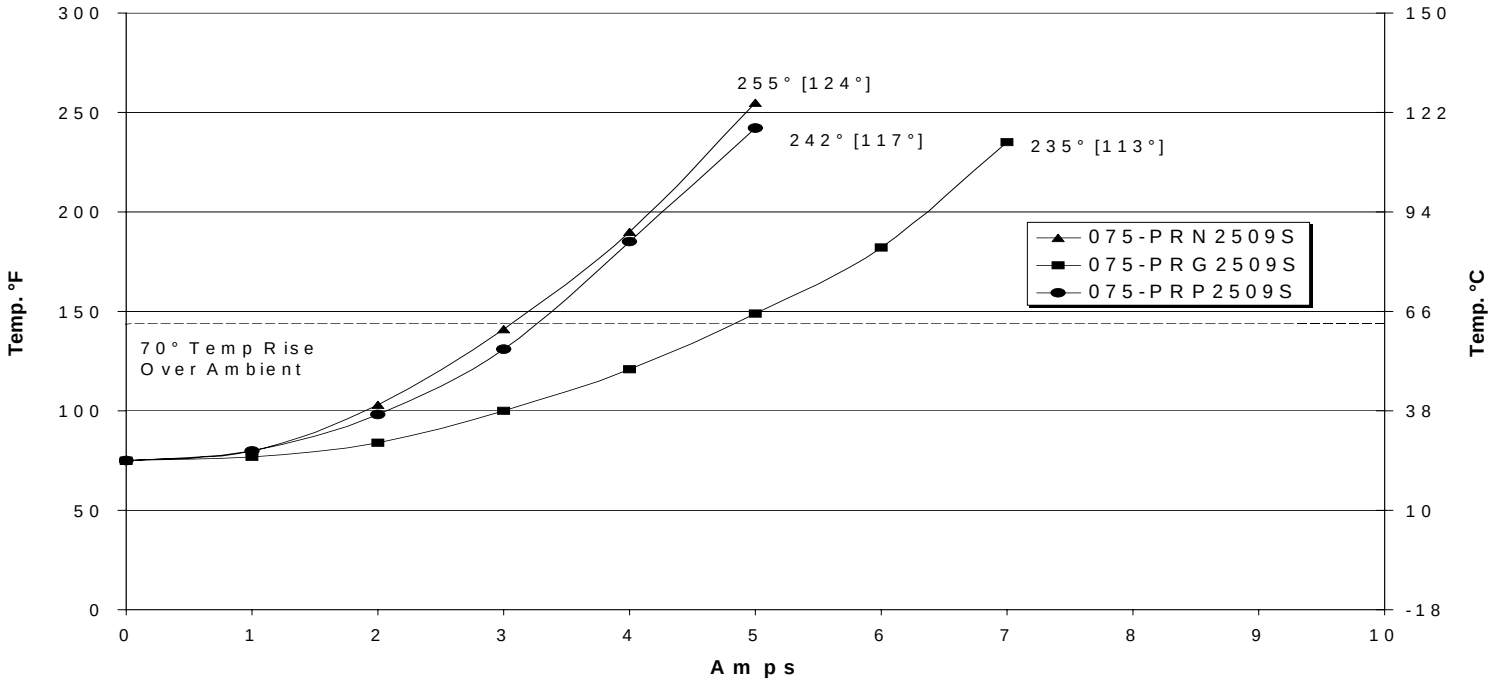
Current Rating 050-R25 Series
050-PRP2509S



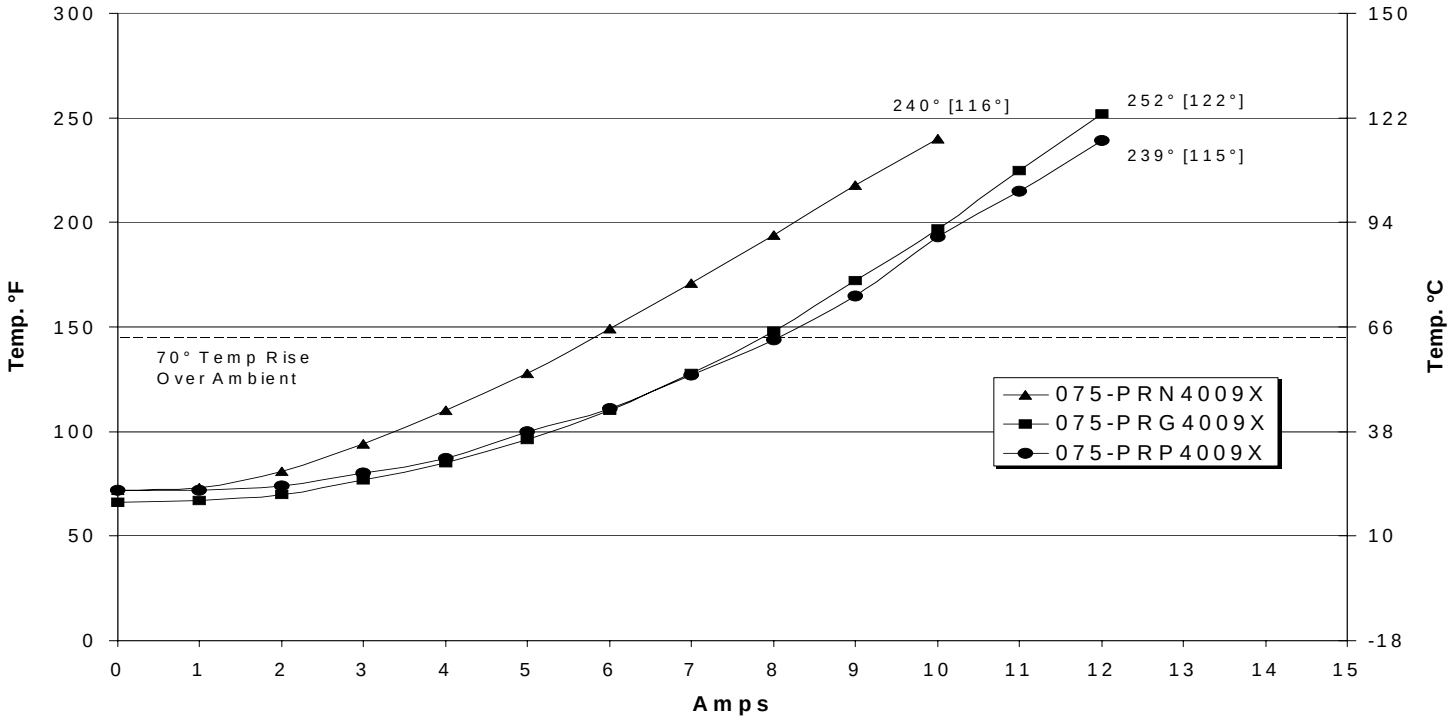
Current Rating Single Probe
075-25 Series



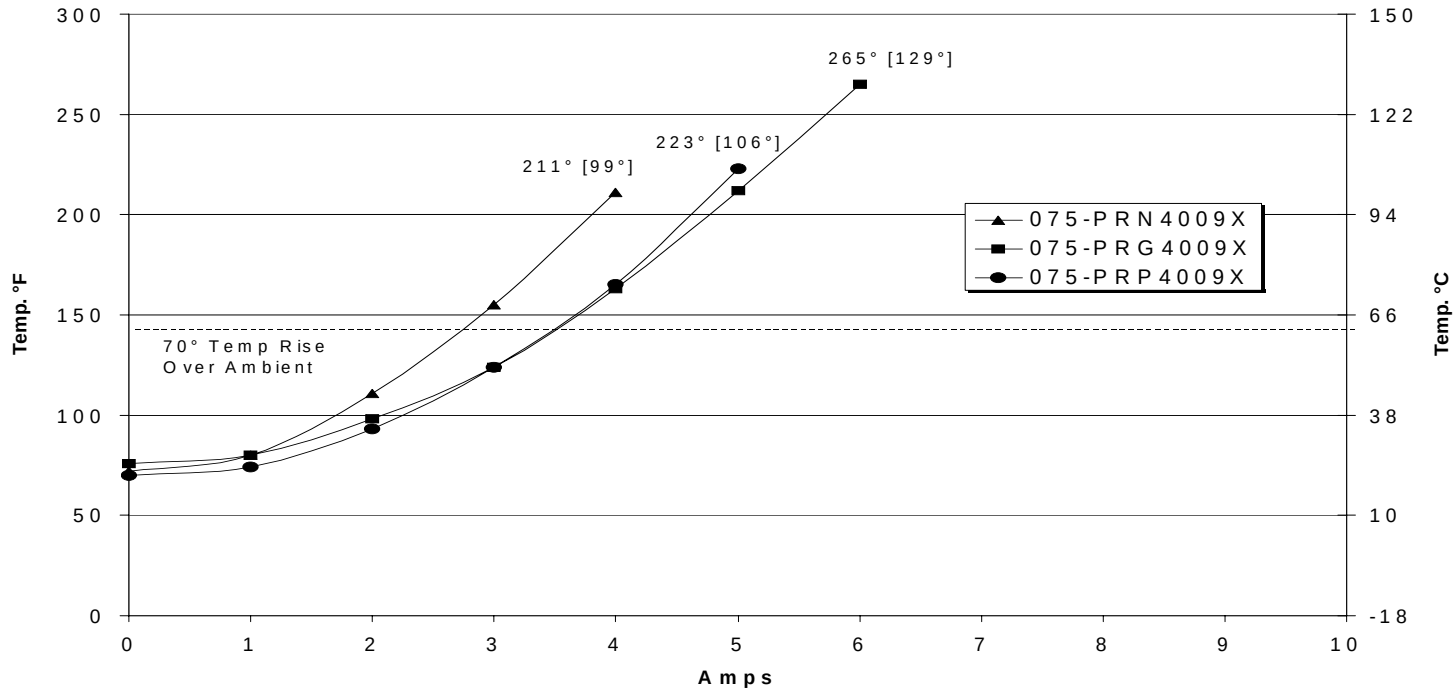
Current Rating Multiple Probes 3x3 grid
075-25 Series



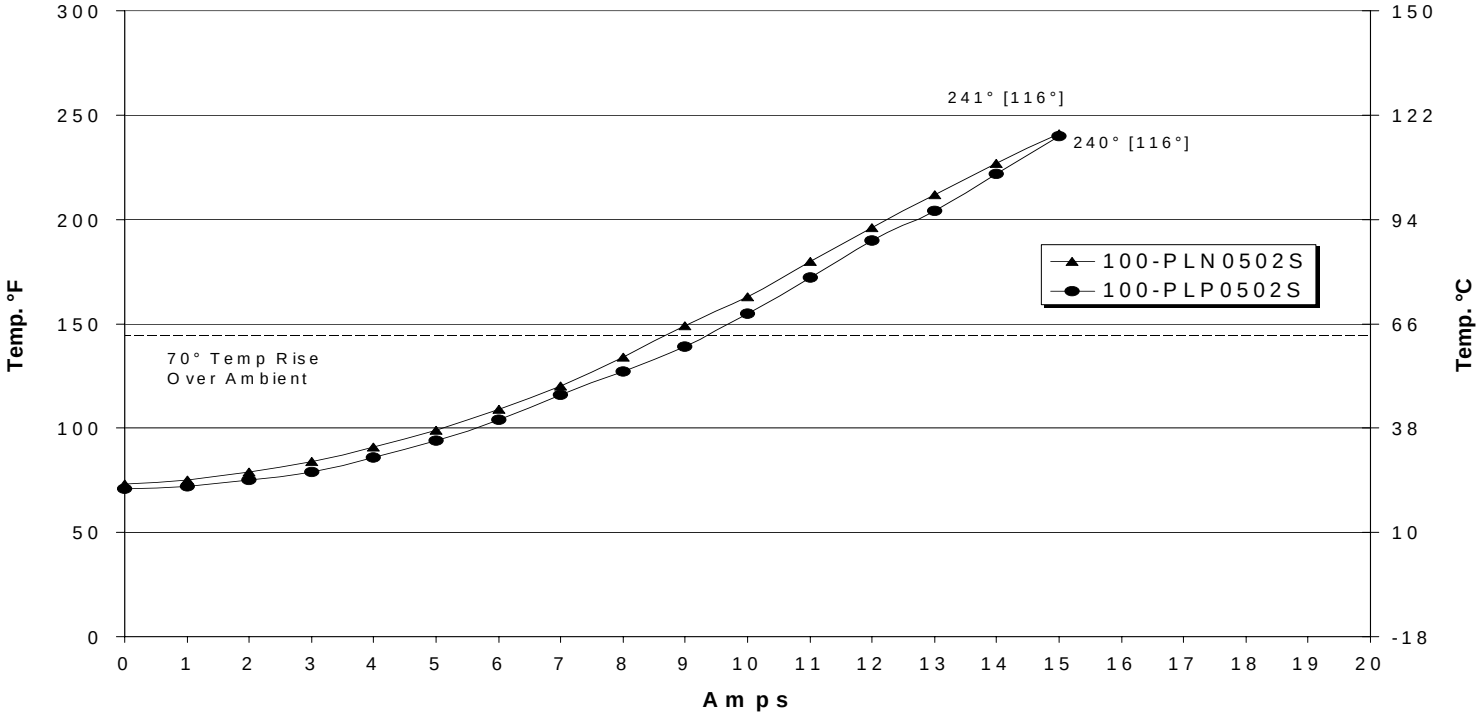
Current Rating Single Probe
075-40 Series



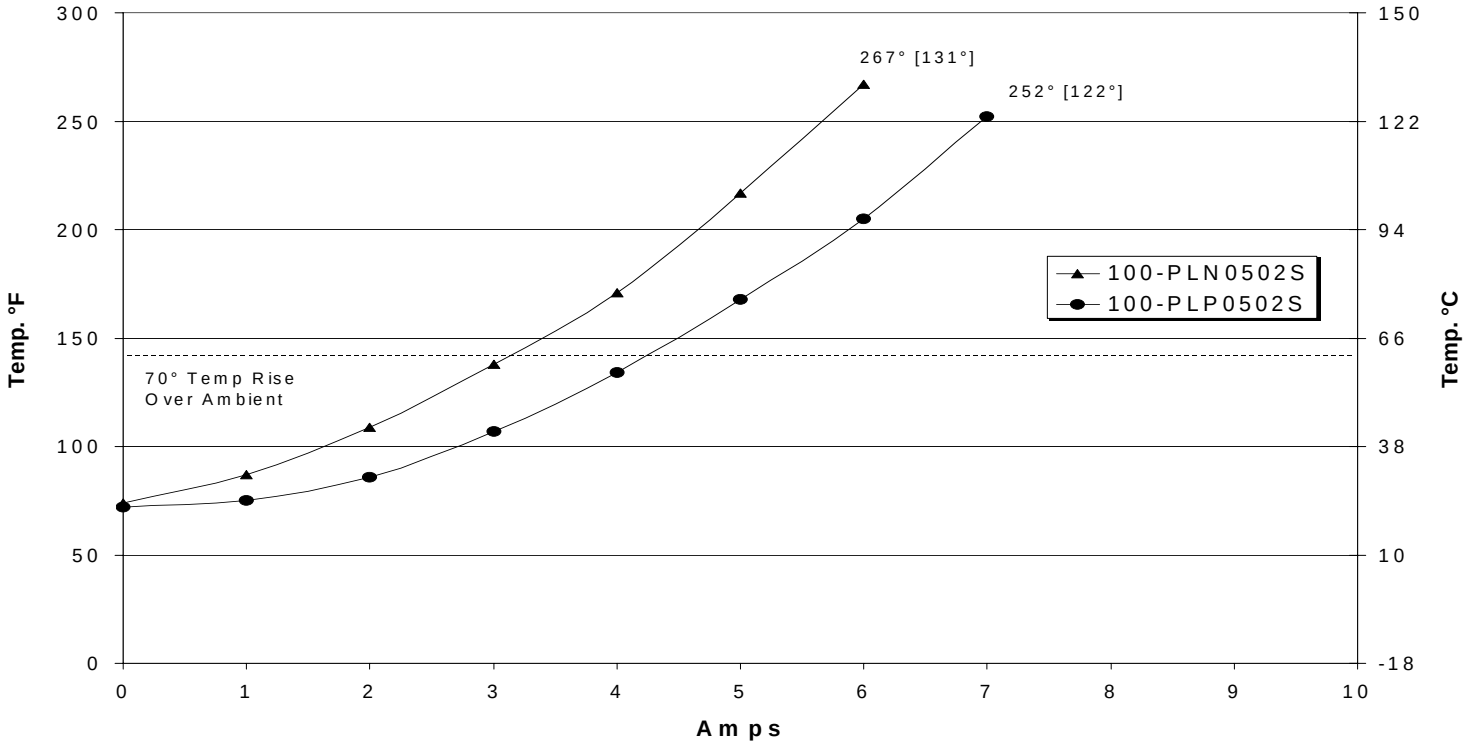
Current Rating Multiple Probes 3x3 grid
075-40 Series



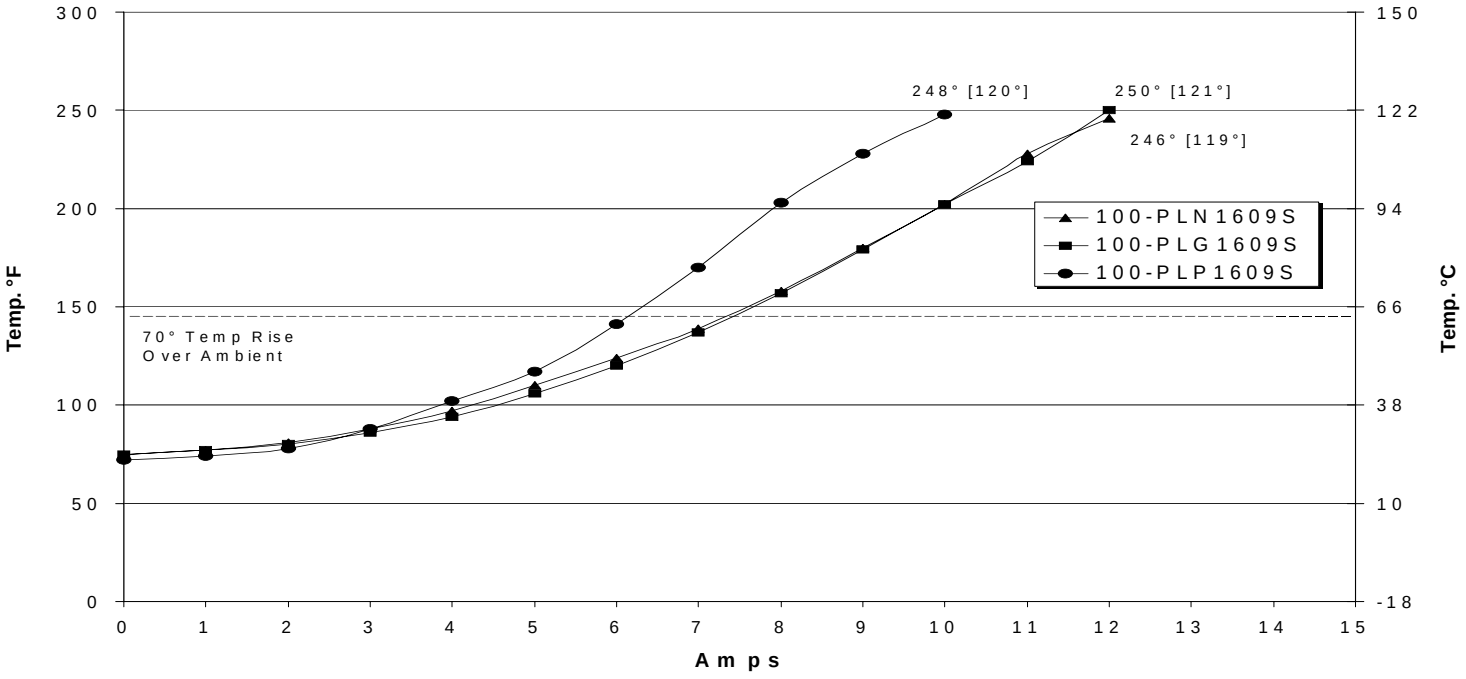
Current Rating Single Probe
100-05 Series



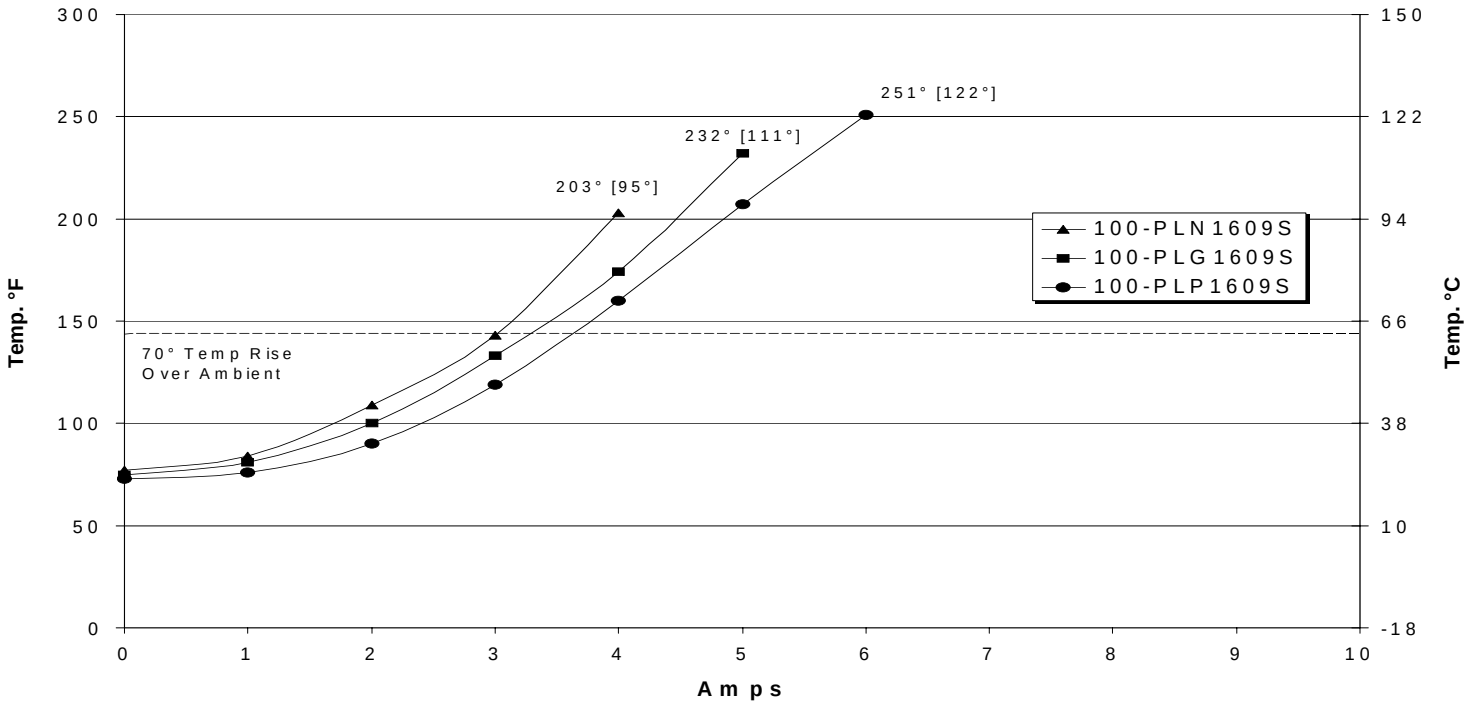
Current Rating Multiple Probes 3x3 grid
100-05 Series



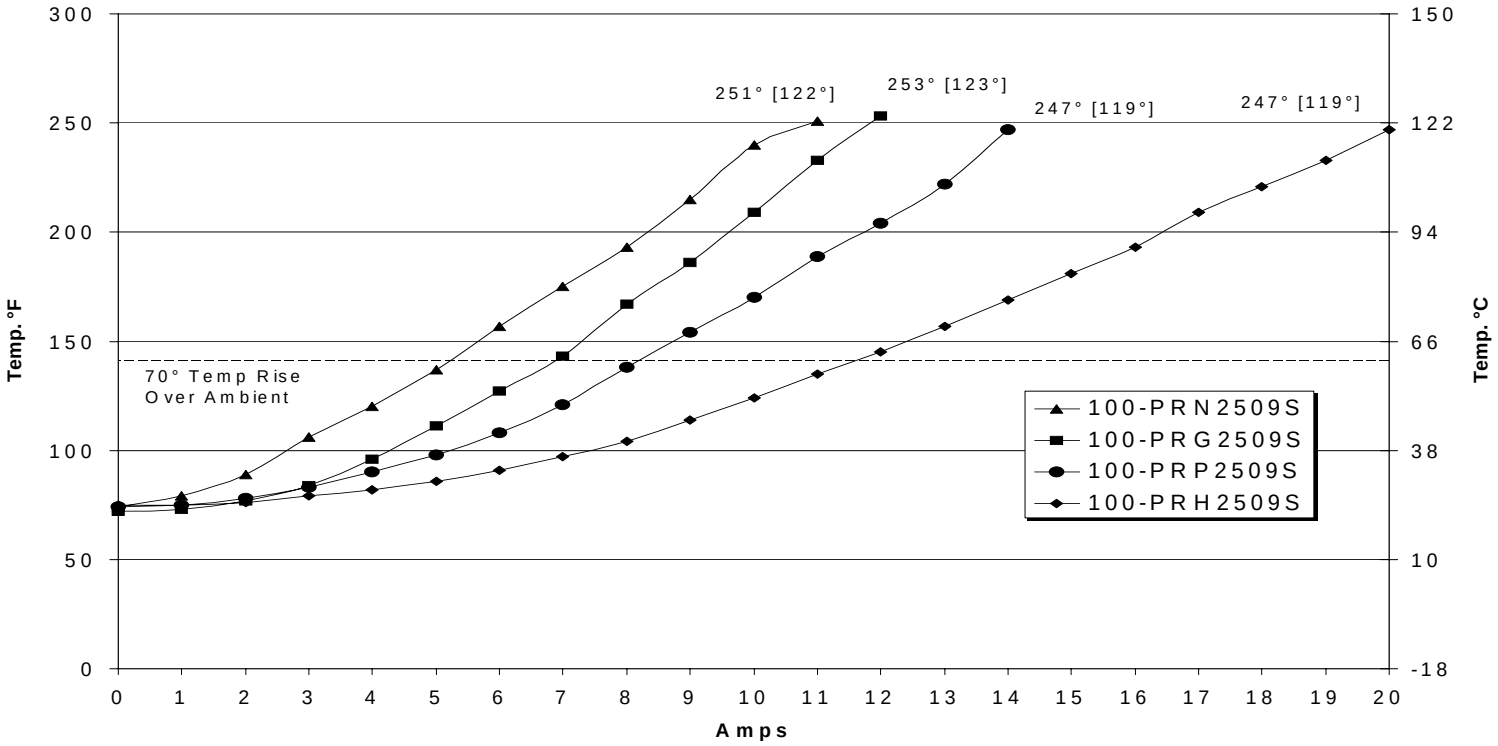
Current Rating Single Probe
100-16 Series



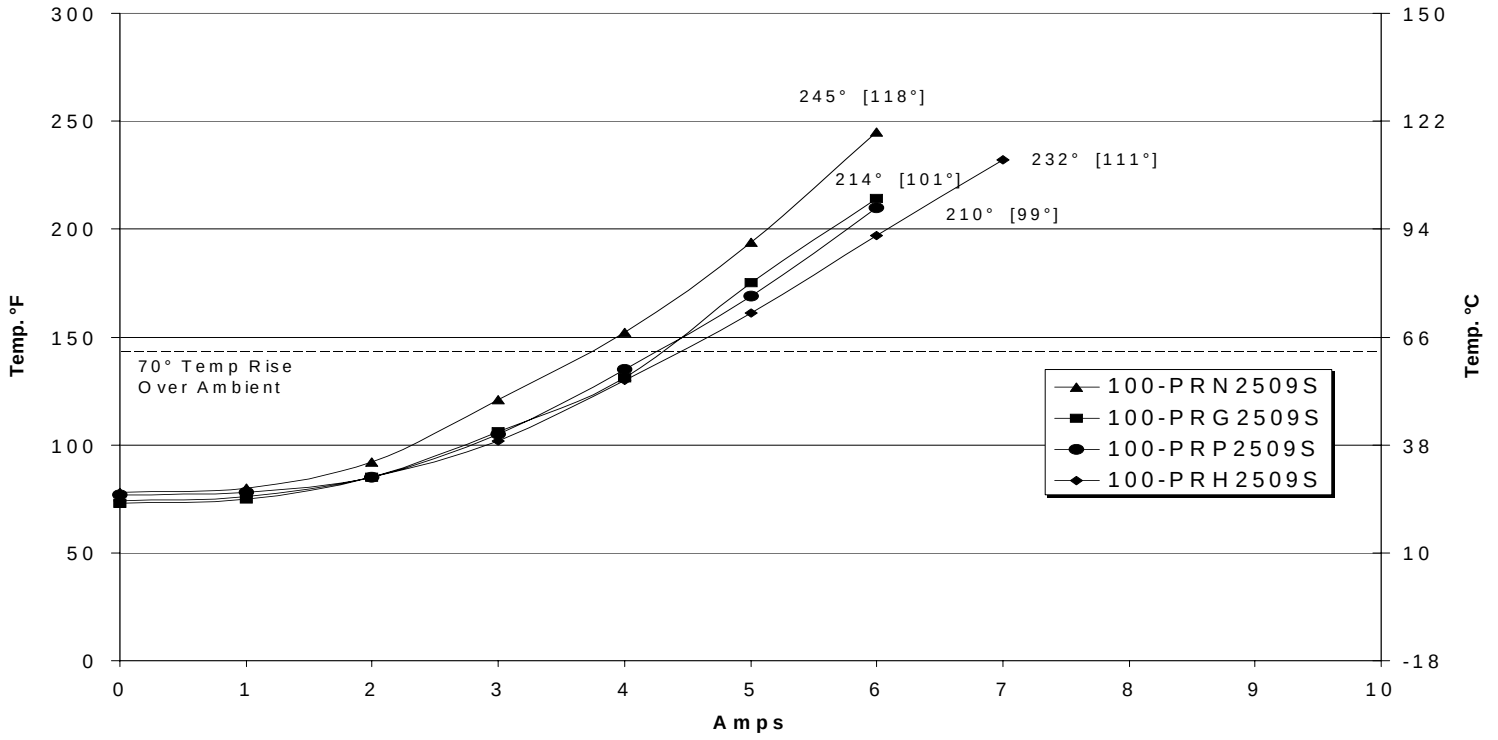
Current Rating Multiple Probes 3x3 grid
100-16 Series



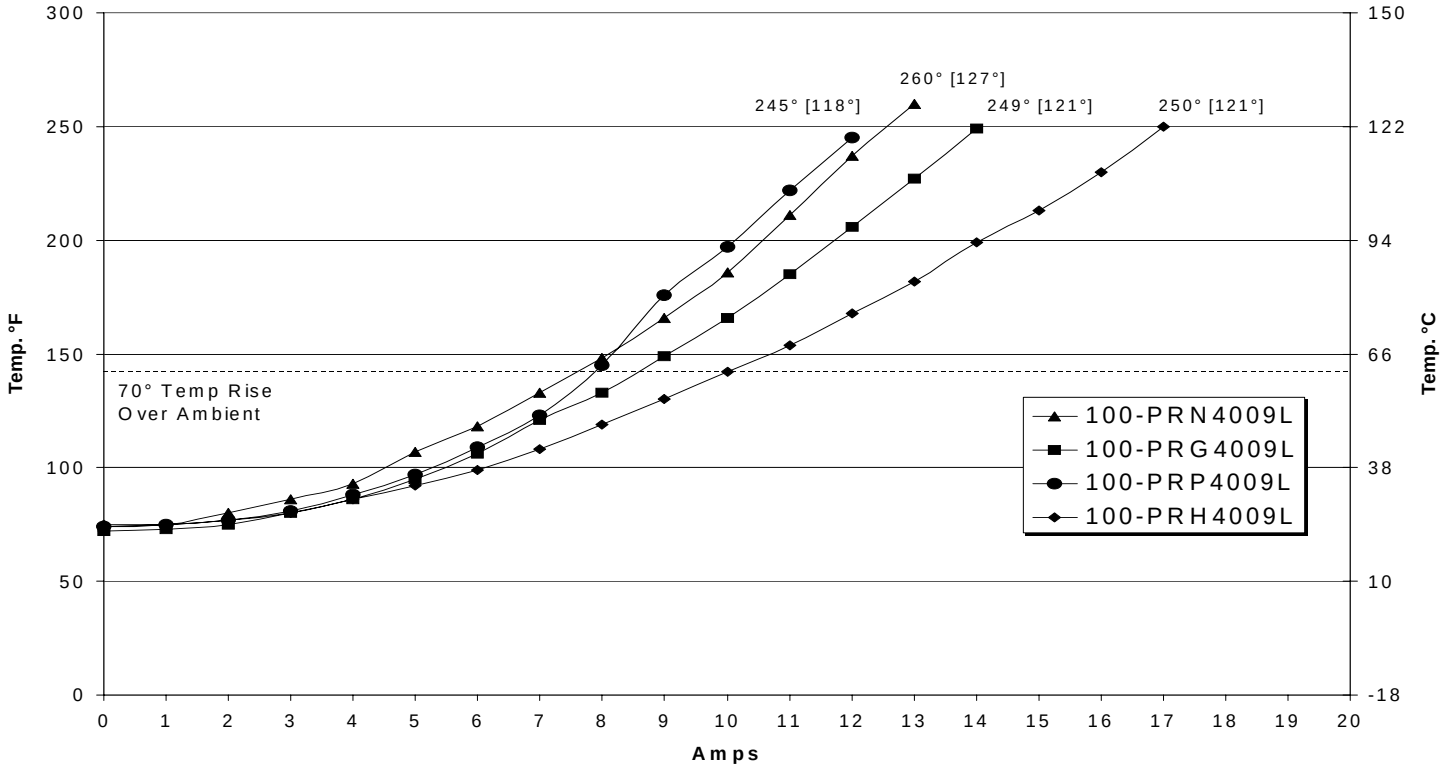
Current Rating Single Probe
100-25 Series



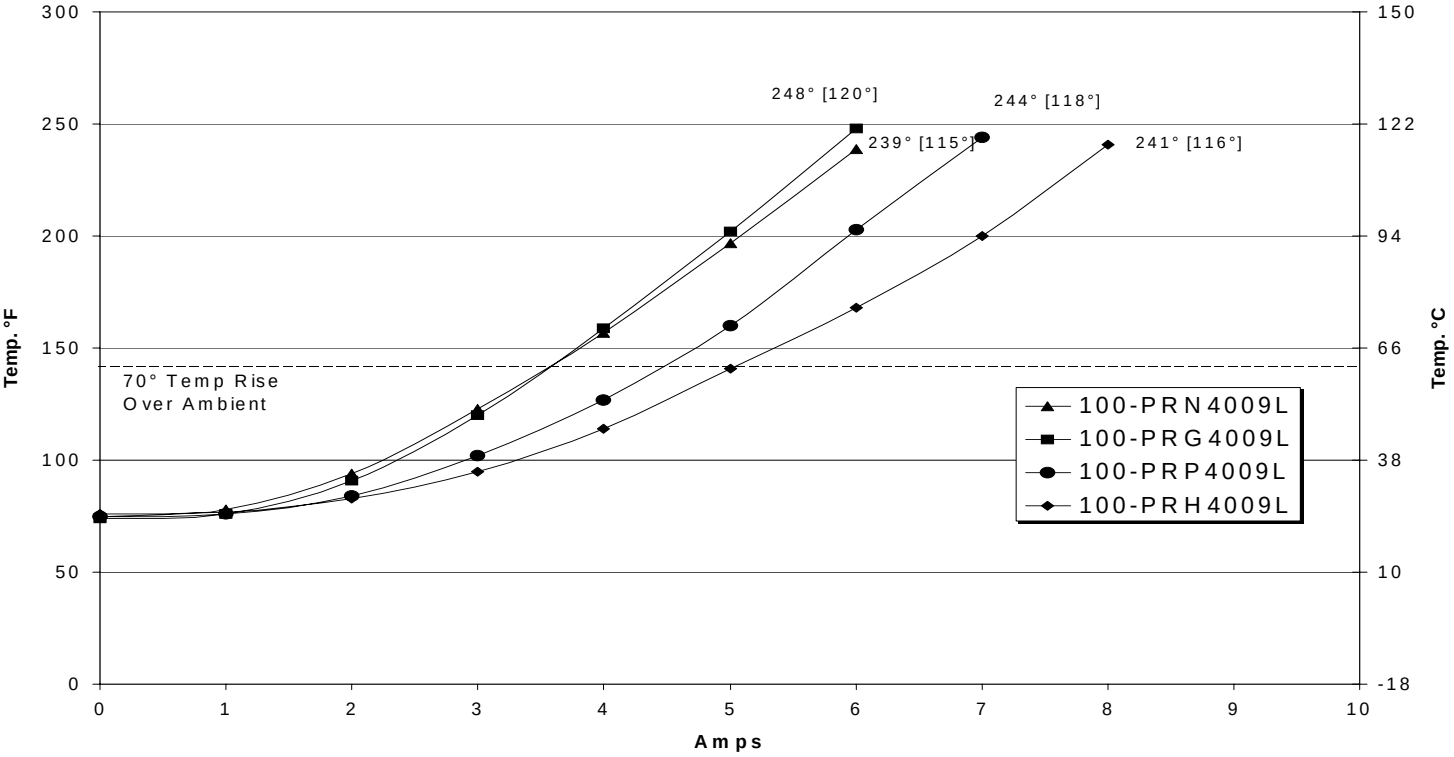
Current Rating Multiple Probes 3x3 grid
100-25 Series



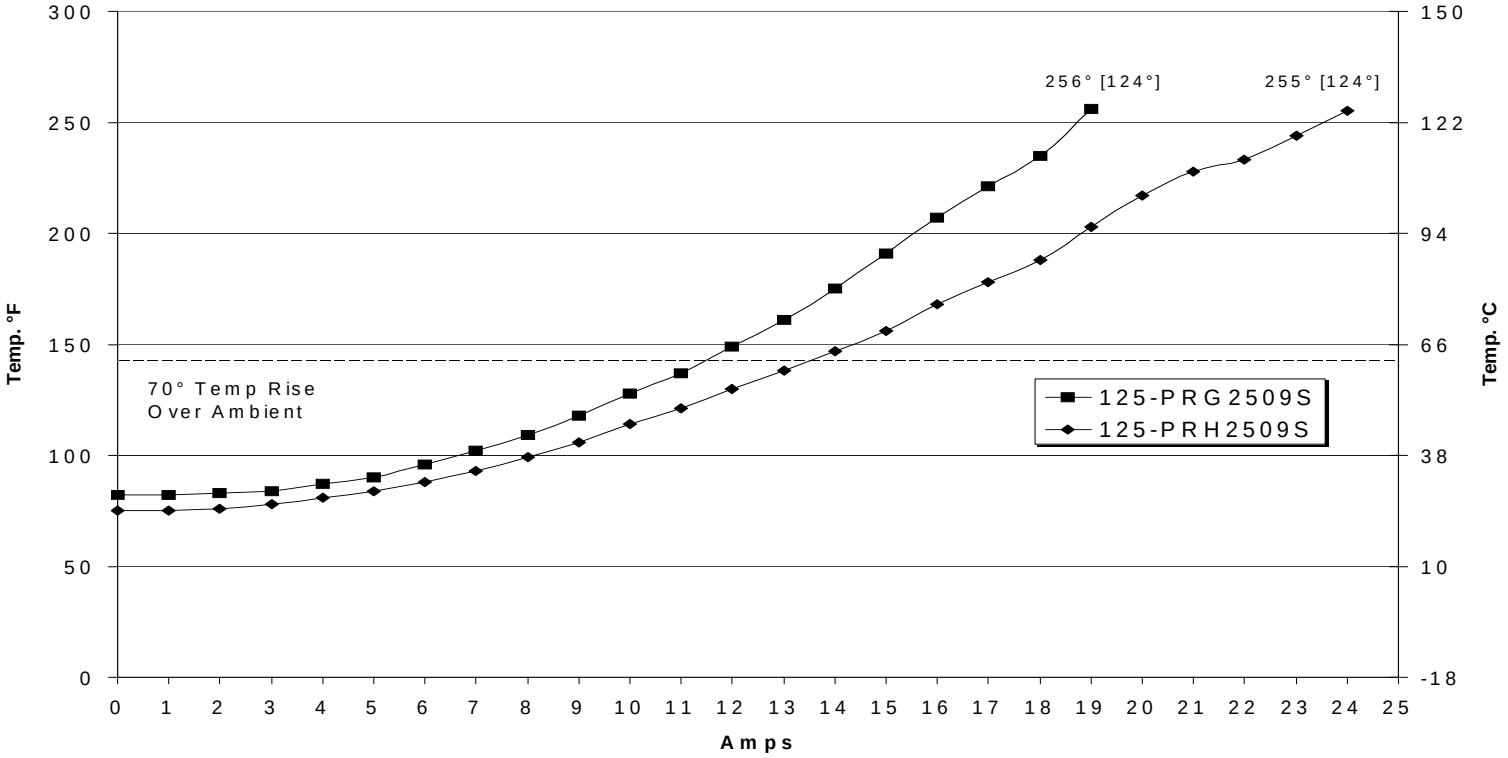
Current Rating Single Probe
100-40 Series



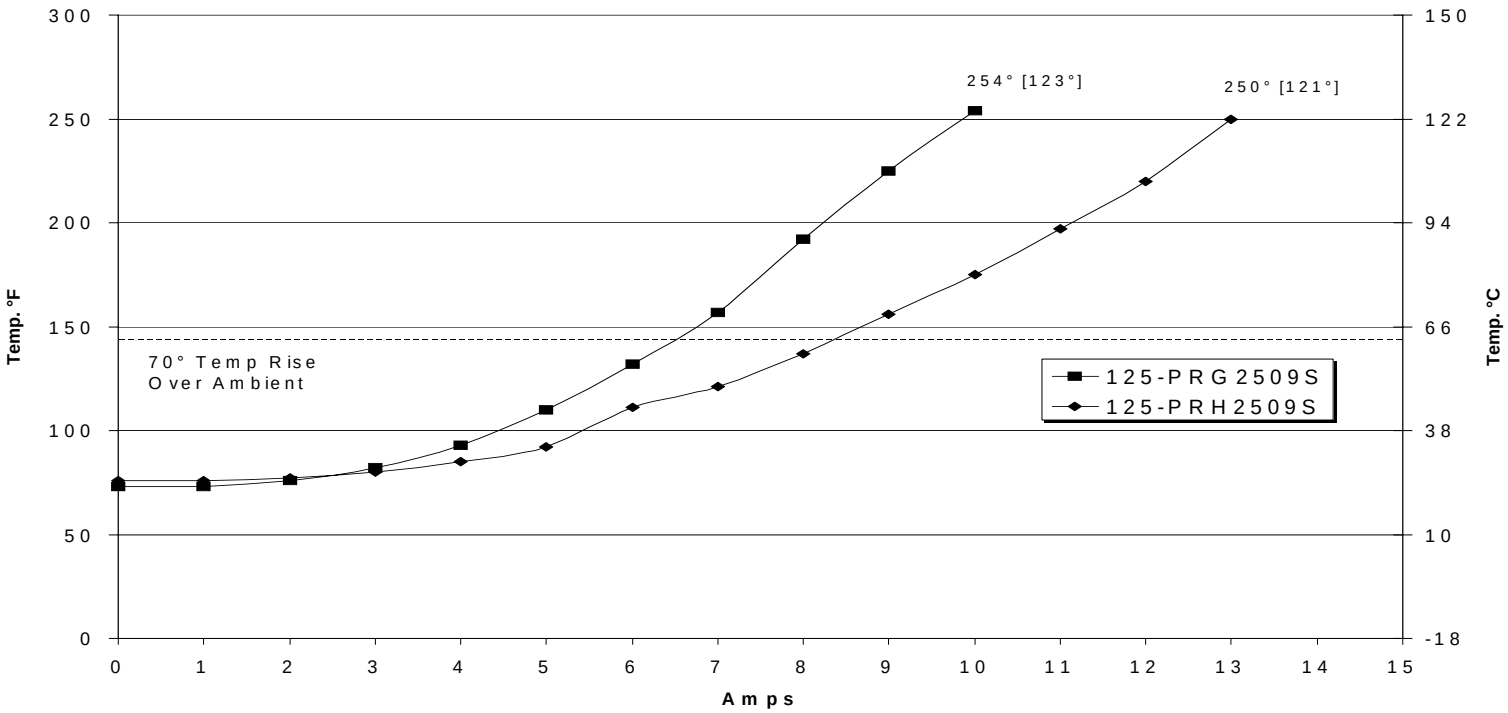
Current Rating Multiple Probes 3x3 grid
100-40 Series



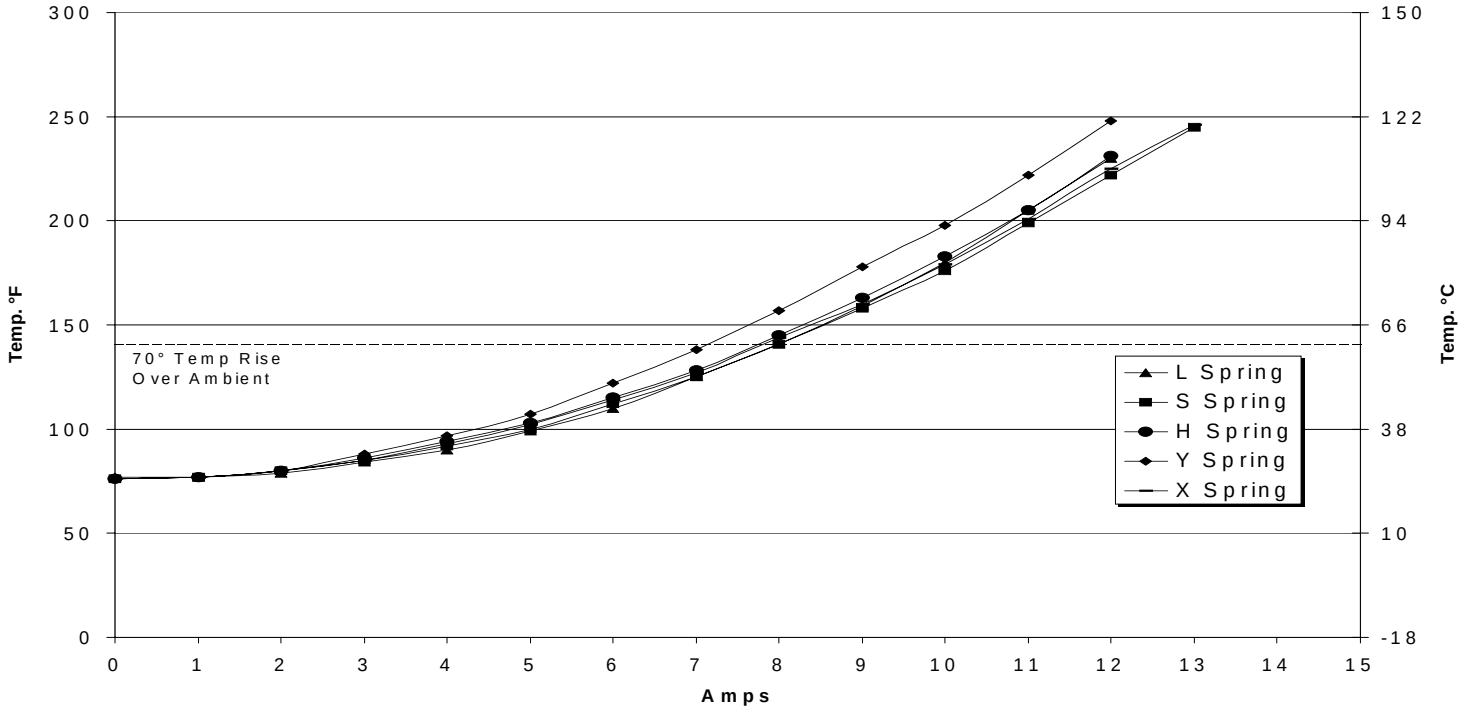
Current Rating Single Probe
125-25 Series



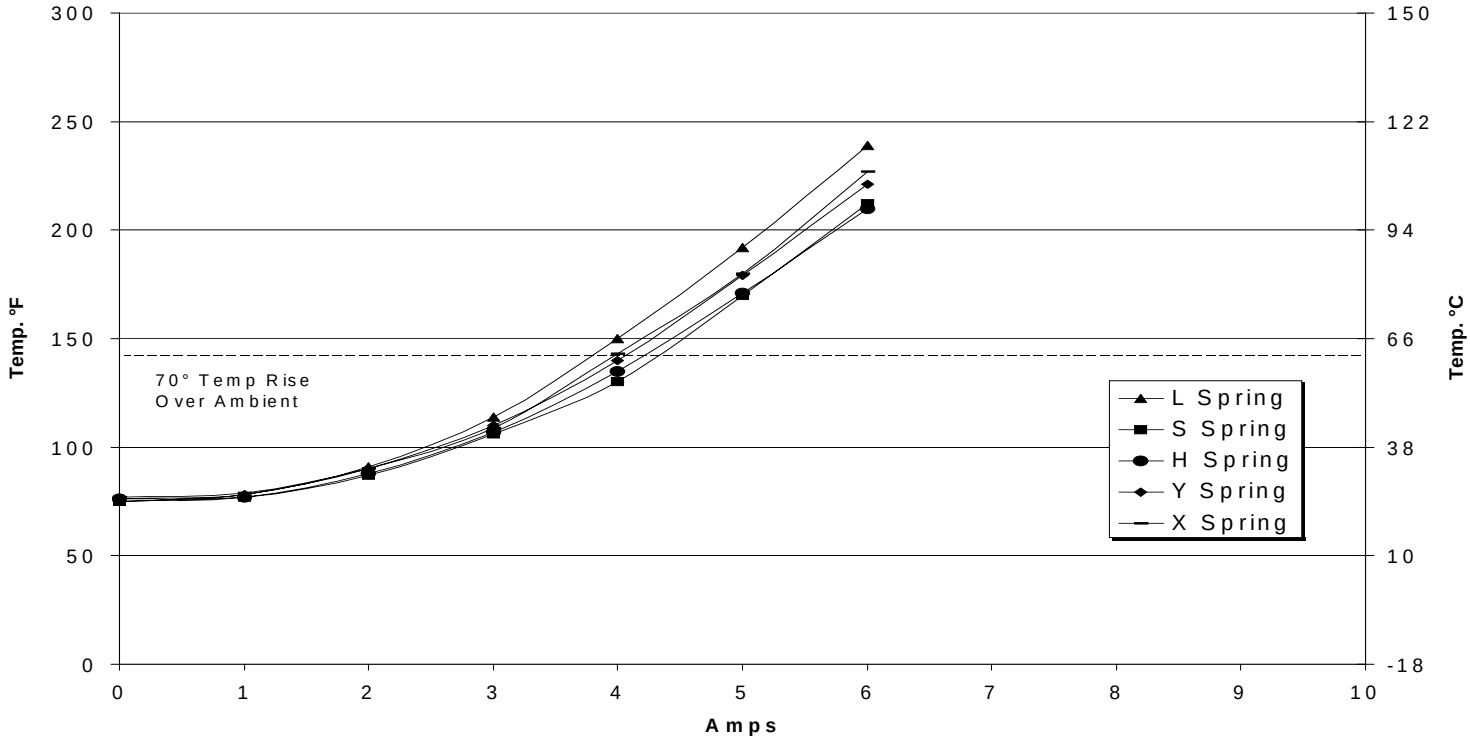
Current Rating Multiple Probes 3x3 grid
125-25 Series



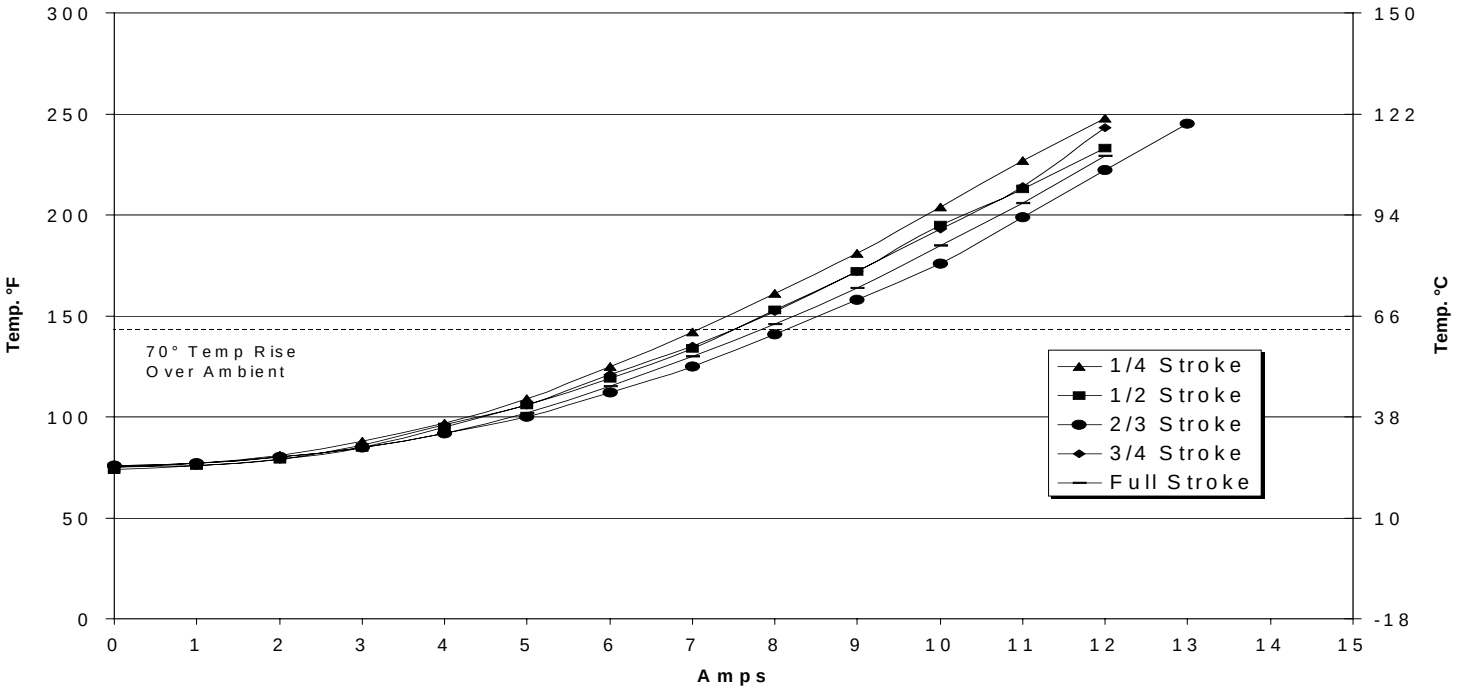
Current Rating Single Probe 100-25 Series
100-PRP2509L, S, H, Y, and X Springs



Current Rating Multiple Probes 3x3 grid
100-PRP2509L, S, H, Y, and X Springs



Current Rating Single Probe
100-25 Series variable Stroke Lengths
100-PRP2509S



Current Rating Multiple Probes 3x3 grid
100-25 Series variable Stroke Lengths
100-PRP2509S