X Probe Socketless Series
Current Carrying Capacity

Introduction:

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

Scope:

Measure the current carrying capacity in relation to the temperature rise of the X Probes and Terminations when mounted in a fixture designed around the Suggested Fixture Layout drawings for this Series. 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, while the second tested a group of probes (3x3 grid pattern).

Series Tested:

Probe Series	Center Spacing	Plunger Travel	Current Rating *
X39-25	.039 (1.00)	.250 (6.35)	4 Amps
X50-25	.050 (1.27)	.250 (6.35)	7.5 Amps
X50-40	.050 (1.27)	.400 (10.16)	7.5 Amps
X75-25	.075 (1.91)	.250 (6.35)	11 Amps
X75-40	.075 (1.91)	.400 (10.16)	10 Amps

Dimensions in inches (mm).
*For a single probe in ambient air with a 70° F (20° C) temperature rise.

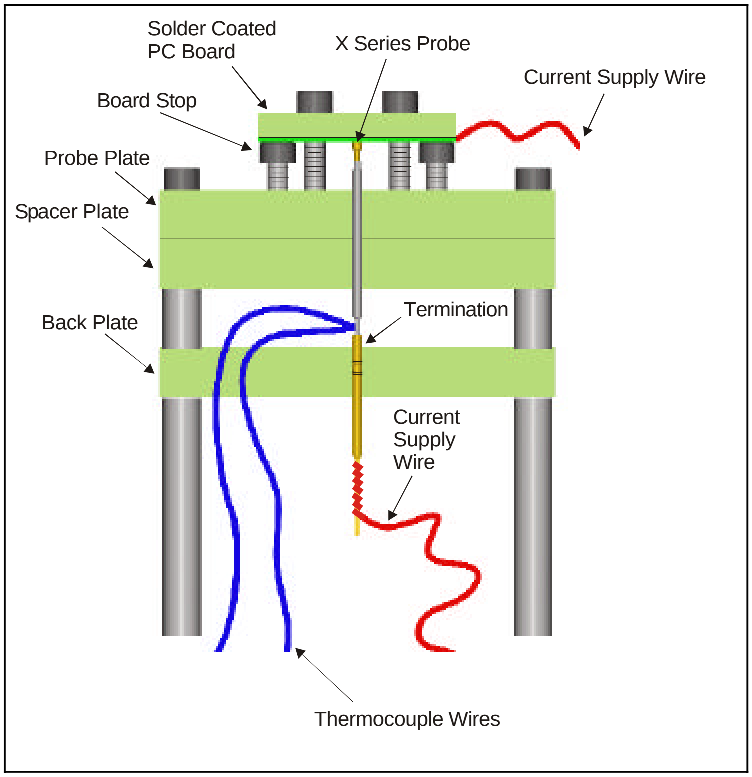
Background:

The current-carrying ability of a probe is measured with respect to probe temperature. The spring material determines the upper temperature limit of a spring probe. Springs which are made of music wire can be used without adverse effects up to 250° Fahrenheit (120° C). Although stainless steel springs are also used in QA probes and can withstand temperatures up to 400° F (204° C), 250° F is used for the upper temperature limit since the probe user may not always be certain of the spring material. (Request the data sheet titled *Working Temperature Ranges for QA Probes* for additional information.)

Test Procedure:

A controllable DC current source was used to provide a constant current through the X Probe and Termination assembly being tested, while a thermocouple was used to track the temperature of the probe. The current was increased in one Ampere intervals 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.

For the first test, a solitary X Probe and Termination was installed in a fixture as shown in the sketch below. The fixture stood horizontally on four legs, and airflow was blocked by baffles arranged around the test block.



Setup for measuring current versus temperature for a single probe/socket assembly.

A type K thermocouple was used, with 40 AWG (.003" diameter conductor) Chromel/Aluminel wire connected to the bottom of the probe tube just above the tube's Interconnect Housing. The .003" wire diameter minimized heat transfer from the assembly and reduced response time.

Wires for supplying current to the probe were 20 AWG or larger. One current supply wire was connected directly to the tail of the Termination. The other was connected to a solder-coated plate that 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.

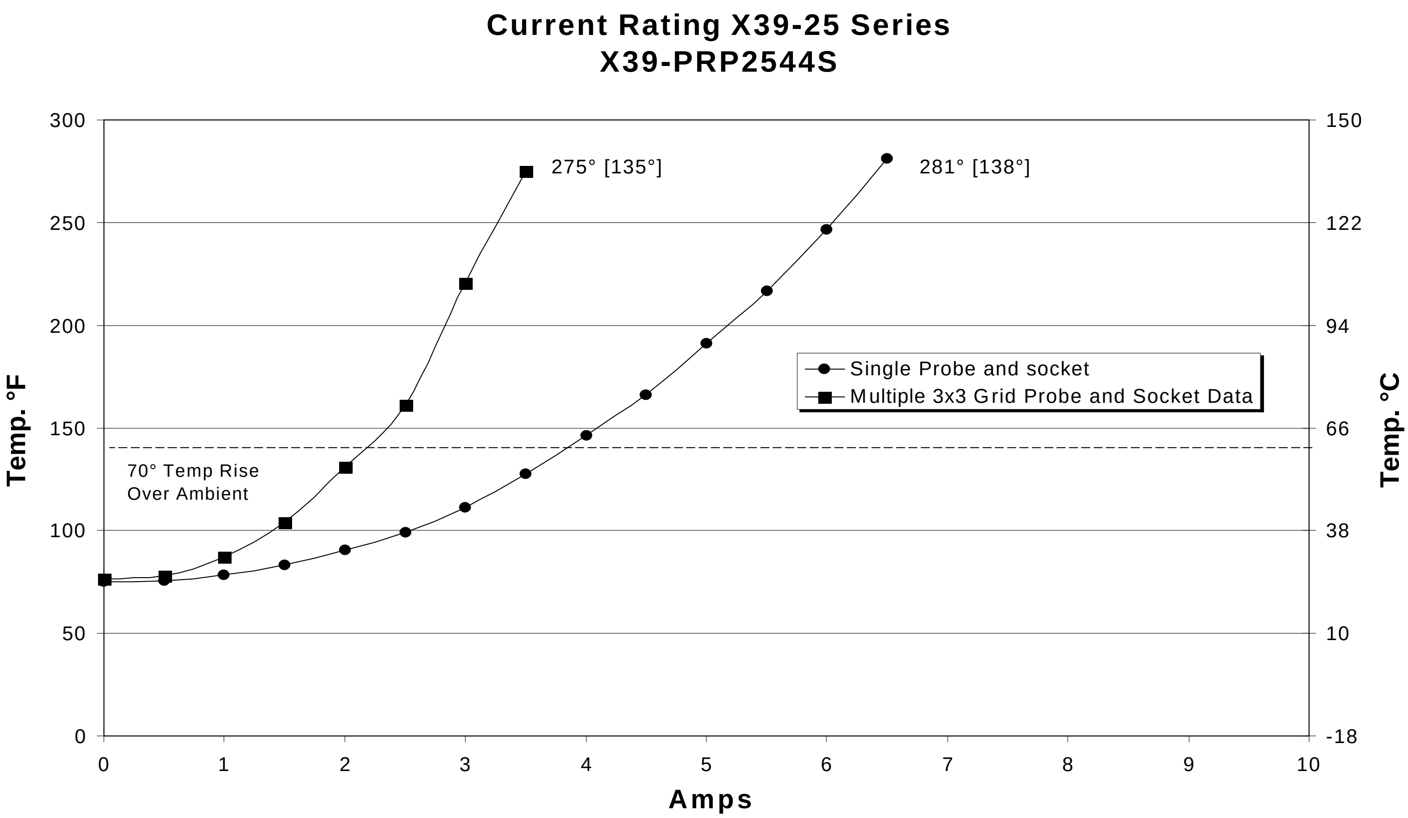
The second test (probe groups, 3x3 Grid), nine X Probes and Terminations were mounted on a three-by-three grid of the appropriate center spacing. All nine probes were wired in series by connecting the appropriate Termination tails, and by selectively jumping the tips in succession with a solder-coated 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 probe at the same location as in the previous test.

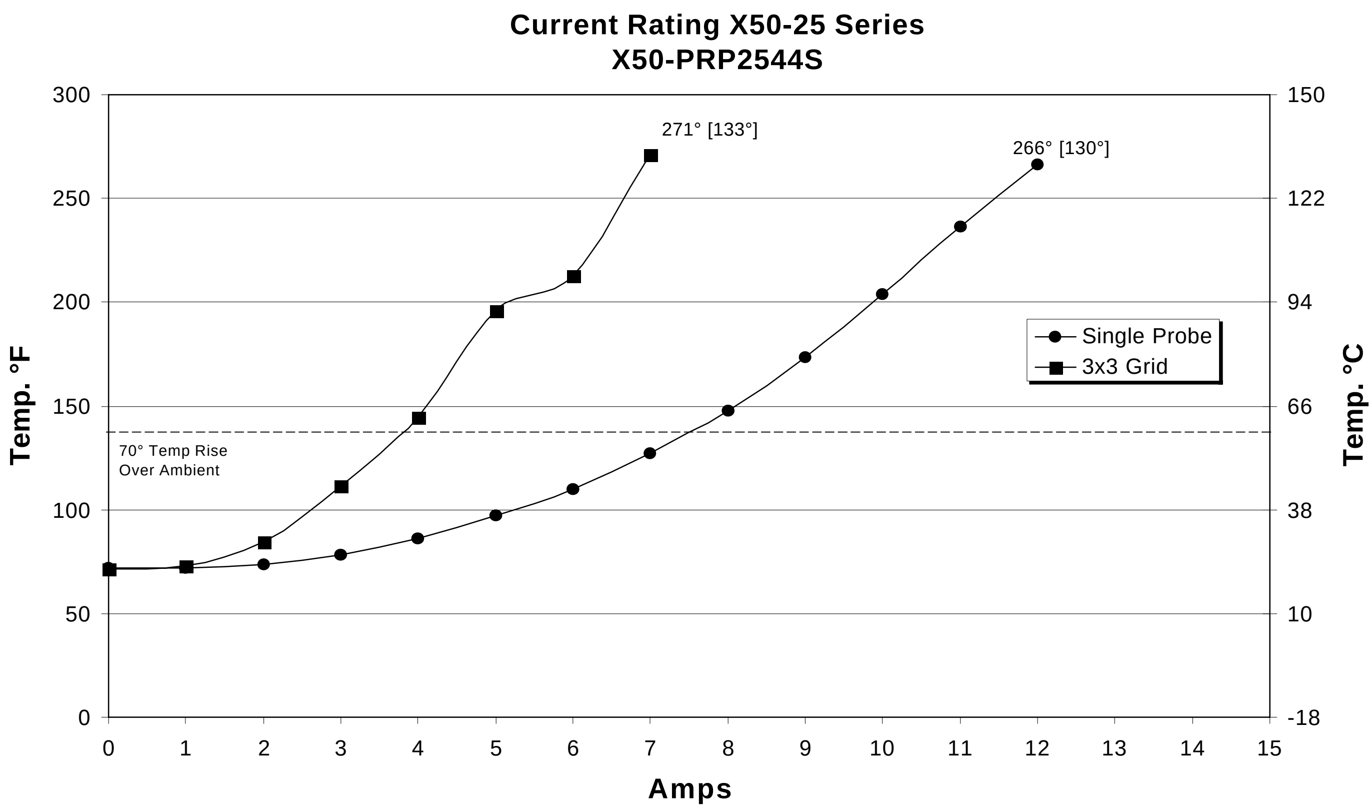
Data:

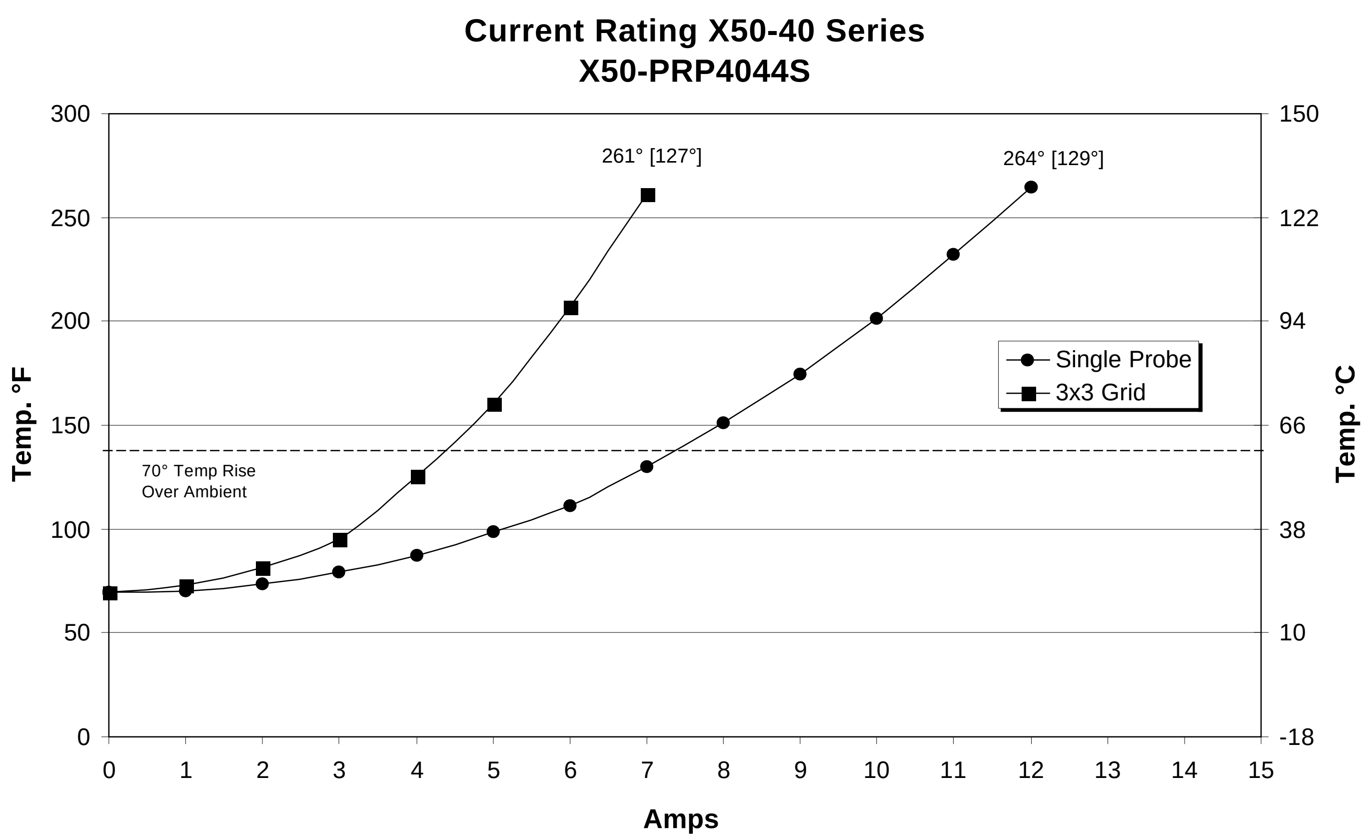
The plotted graphs compare the temperature versus current for all of the probe series. X39-TJ-3G Terminations were set at .140 (3.56) for the X39-25 Series. X50-TW-3G and X75-TW-3G Terminations were set to .140 (3.56) and used for both the X50-25 and X50-40 and the X75-25 and X75-40 Series respectively.

Conclusions and Application Notes:

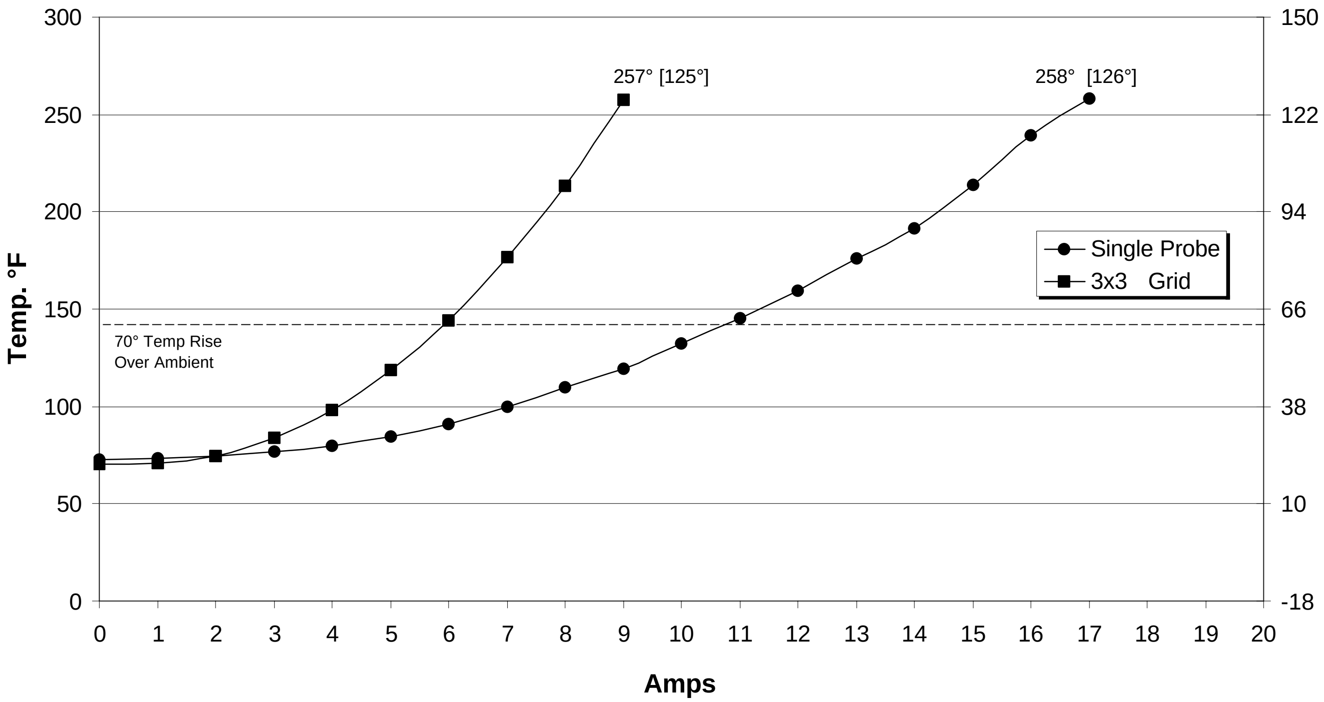
- As the group data shows, higher probe densities decrease the probes current carrying ability. This is due to the combined heat generated by the probes and the decrease of air circulation via natural convection. Because each application is unique, it is recommended that appropriate tests be conducted 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 single X75-25 series probe operating in an environment with an ambient temperature of 120° F will exceed 250° F at 14.5 Amps (instead of 16.5 Amps at 75° F ambient).
- 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 X75-PRP2509S in a X75-TW-3G Termination averages 15mΩ and carries a maximum current of 16.5A (at 250°F); it is able to continuously dissipate a maximum of $(16.5^2)*.015=4.08W$ ($P=I^2R$). At 50A, it would dissipate about 37.5W, which means the duty cycle must be reduced to 10.9%. So, to avoid overheating this probe at 50A, power must be applied for no more than 109 milliseconds (1 second x 10.9%).
- When comparing the X Probe current carrying capacity to a standard probe with socket, the X Probe will carry more current on the same center spacing. By using a larger probe on closer centers, we gain an advantage in that the probes' internal contact area is also increased thus providing a greater current path (larger conductor). For example, the X75-PRP2509S with a X75-TW-3G Termination will carry slightly over 10.5 Amps with a 70°F temperature rise while a standard 075-PRP2509S with a 075-SDN250W socket will carry slightly under 6.5 Amps at the same temperature rise.


Current Rating X39-25 Series
X39-PRP2544S
275° [135°]
281° [138°]
Single Probe and socket
Multiple 3x3 Grid Probe and Socket Data
70° Temp Rise
Over Ambient
Temp. °F
Temp. °C
Amps
300
250
200
150
100
50
0
150
122
94
66
38
10
-18
0 1 2 3 4 5 6 7 8 9 10


Current Rating X50-25 Series
X50-PRP2544S
Temp. °F
Temp. °C
Amps
271° [133°]
266° [130°]
Single Probe
3x3 Grid
70° Temp Rise
Over Ambient
300
250
200
150
100
50
0
150
122
94
66
38
10
-18
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15


Current Rating X50-40 Series
X50-PRP4044S
Temp. °F
Temp. °C
Amps
261° [127°]
264° [129°]
Single Probe
3x3 Grid
70° Temp Rise
Over Ambient
300
250
200
150
100
50
0
150
122
94
66
38
10
-18
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Current Rating X75-25 Series
X75-PRP2509S



Current Rating X75-40 Series
X75-PRP4009S