



MIL-PRF-27F - Temperature Rise for Inductors

By Doug Lillie

Vishay uses MIL-PRF-27 to determine temperature rise due to applied DC current. An excerpt from MIL-PRF-27, specifically Section 4.7.13 Temperature rise, is copied below.

MIL-PRF-27 calls for the device under test (DUT) to be soldered onto copper plates, with the assembly then being put inside a box with prescribed dimensions and no airflow. Current is applied and the temperature rise is recorded.

A drawing of the copper plates prescribed by MIL-PRF-27 is shown below.

Vishay finds that this temperature rise data correlates well to the temperature rise when the IHLP inductor is soldered on an FR-4 PCB in open air (no forced air cooling), as long as the PCB has adequate copper trace thickness and width. Guidelines for trace width and thickness can be found for various currents at the end of the application note "Using IHLPs in Automotive Applications," which can be found on Vishay's website at www.vishay.com/doc?34256.

4.7.13 Temperature rise (see 3.15)

Unless otherwise specified (see 3.1), the temperature rise test shall be performed on transformers rated at more than 0.8 W average output, and on inductors for which the product of the DC resistance and the square of the rated current is more than 0.2 W. The temperature rise of each winding shall be based on the change resistance method and shall be computed by the following formula:

$$\Delta T = \frac{R - r}{r} (t + 234.5) - (T - t)$$

Where:

ΔT = temperature rise (in °C) above a specified maximum ambient temperature (see 3.1)

R = resistance of winding (in Ω) at temperature ($T + \Delta T$)

r = resistance of winding (in Ω) at temperature (t)

t = specified initial ambient temperature (in °C)

T = Maximum ambient temperature (in °C) at time of power shutoff. (T) shall not differ from (t) by more than 5 °C

The transformers shall be conditioned for at least eight hours at temperature (t) in a location free from drafts before resistance (r) is measured. For transformers, rated voltage shall be applied to the primary with the specified loads across the secondaries (see 3.1). For inductors, rated DC and AC current shall be applied to the windings. Transformers or inductors shall be operated until two consecutive resistance readings on the highest resistance winding, taken 30 minutes apart, are the same. If the power is required to be shut off, the resistance measurements (R) shall be made as soon as possible. The transformers and inductors shall then be examined for evidence of physical damage. At the option of the supplier, the test may be performed at 60 Hz for transformers rated at 50 Hz / 60 Hz, provided that the primary voltage is increased to 1.2 times the rated voltage and the secondary currents are maintained at rated current. Unless otherwise specified (see 3.1), method 1 shall be used.

4.7.13.1 Method 1

4.7.13.1.1 For small units (units that will clear each wall of the cabinet by a minimum of 8 in when supported 3 in above the base)

The transformers or inductors shall be supported in the test cabinet by means of low thermal conductivity cleats 3 in in height. The samples shall be shielded from forced convection air currents and from direct thermal radiation. The cabinet dimensions, insulation, air calculation, and all other factors influencing the thermal capacity shall be such that the ambient temperature does not increase more than 5° during the determination.

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4.7.13.1.2 For large units

Transformers or inductors with dimensions in excess of 8 in x 8 in x 13 in shall be supported by means of low thermal conductivity cleats that are 3 in in height, and shall be tested under standard test conditions (see 4.3) in still air.

4.7.13.2 Method 2

Transformers and inductors shall be tested as specified in 4.7.13.1, except that the unit shall be mounted on brass spacers (according to the mounting screw size) as specified in the table below. The brass spacers shall be connected to a steel plate 0.125 in thick and large enough to cover the bottom of the test enclosure within 2.00 in on each side. For tests on large units, this plate shall be 2 ft². When the mounting surface area is greater than 1 ft², a 4 ft² plate shall be used. The brass spacers shall be tapped and in intimate contact by threaded connections with the steel plate and that part of the case that normally rests on the mounting surface.

BRASS SPACERS FOR TEMPERATURE RISE TEST	
MOUNTING SCREW SIZE	BRASS SPACER (DIAMETER AND LENGTH IN INCHES)
0.138	0.38 x 3.00
0.164	0.56 x 3.00
0.190	0.69 x 3.00
0.250	0.81 x 3.00
0.375	1.62 x 3.00
0.500	1.75 x 3.00

4.7.13.3 Method 3

Two transformers or inductors shall be mounted as specified in 4.7.13.2 and shall be placed side by side in a duct, with the longer sides parallel to the direction of air flow supplied by a blower rated at 50 cubic feet per minute. The blower shall be placed approximately three feet from the sample units. The distance between the two sample units and the distance between the sample units and the sides of the duct shall be $15 \pm 2\%$ of the shorter side. Non-combustible baffles shall be used to adjust the duct to the proper size. The air temperature within the duct shall be the specified maximum ambient temperature (see 3.1, 6.7, and 6.8).

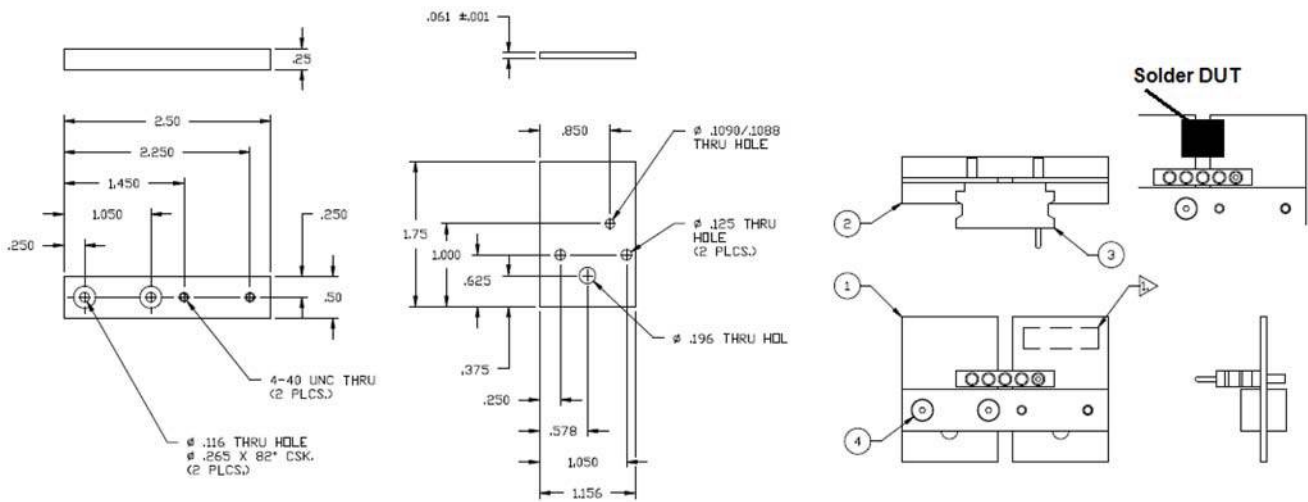


Fig. 1