

## NTC Thermistors, Flex Foil Sensors



### QUICK REFERENCE DATA

| PARAMETER                                       | VALUE       | UNIT            |
|-------------------------------------------------|-------------|-----------------|
| Resistance value at 25 °C                       | 10K, 47K    | Ω               |
| Tolerance on $R_{25}$ -value                    | ± 3         | %               |
| $B_{25/85}$ -value                              | 3960        | K               |
| Tolerance on $B_{25/85}$ -value                 | ± 1         | %               |
| Operating temperature range at zero power       | - 40 to 125 | °C              |
| Thermal time constant on heating <sup>(1)</sup> | 2           | s               |
| Thermal gradient                                | < 0.02      | K/K             |
| Minimum dielectric withstanding voltage         | 500         | V <sub>AC</sub> |
| Minimum insulation resistance                   | 10          | MΩ              |
| Maximum dissipation at 25 °C                    | 60          | mW              |
| Climatic category (LCT/UCT/days)                | 40/125/56   |                 |
| Weight (without connector)                      | 0.06        | g               |

#### Note

<sup>(1)</sup> Measured from 25 °C air to 125 °C heated plate, pressed on the surface

### DESIGNERS OPTIONS

- Other dimensions and various shapes of the flex circuit are available on request
- A 3D solid model is available on request

#### Note

- FFC/FPC = Flexible Film Circuit/Flexible Printed Circuit

### FEATURES

- Rapid response time down to 2 s
- Suitable for narrow space applications
- High flexibility of the foil
- Insulated and humidity resistant
- A strain relief hole is included in the flex design to avoid traction to the sensor head
- Gold plated terminations
- AEC-Q200 qualified
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT

### APPLICATIONS

- Consumer appliances and white goods
- Power supply (heat-sinks)
- Battery, displays, LED
- Industrial applications, robotics
- Boilers
- EV and HV batteries

### DESCRIPTION

- Miniature NTC temperature sensor on flex foil, insulated used for temperature sensing and control
- Surface temperature sensor with low thermal mass and rapid response time on surface

### MOUNTING

- The sensor head can be pressed on the surface with means of insulating material (silicone foam) or spring
- The sensor head can also be glued with a double-face temperature resistant adhesive
- The sensor end can be connected to PCB counter-connector or wire-to-wire connector or soldered to conductors, or crimped with FFC connectors and ZIF connectors
- Remark: The response time and thermal gradient are dependant of the application and of the way of mounting the sensor in place
- A mating connector can be for example a 0.5 mm pitch 7 poles connector for FPC, with top contacts, accepting 4 mm FPC width, ZIF or non-ZIF versions. The poles (1 + 2) and (6 + 7) can be used for the electrical connection. For example in SMT versions : TE 1734839-7, Hirose FH34S-7S-0,5SH(50), Molex 054550-0771, Molex 052745-0797

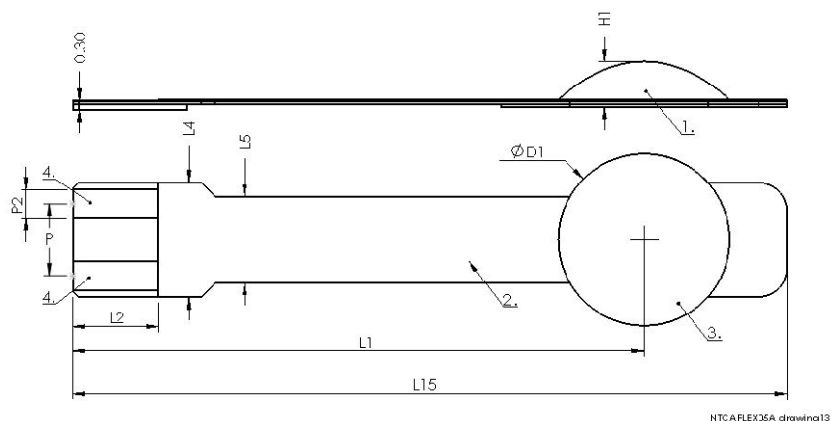
### ELECTRICAL DATA AND ORDERING INFORMATION

| VISHAY SAP ORDERING NUMBER | $R_{25}$ -VALUE (Ω) | $R_{25}$ TOL. (± %) | $B_{25/85}$ -VALUE (K) | $B_{25/85}$ TOL. (± %) | DESCRIPTION                     | R/T TABLE |
|----------------------------|---------------------|---------------------|------------------------|------------------------|---------------------------------|-----------|
| NTCAFLEX05103HH            | 10 000              | 3                   | 3960                   | 1                      | NTC Flex05 10K 3 % 3960 K 25 mm | Table 1   |
| NTCAFLEX05473HH            | 47 000              | 3                   | 3960                   | 1                      | NTC Flex05 47K 3 % 3960 K 25 mm | Table 2   |

**SAP CODIFICATION**

Part Number: NTCAFLEX01473HH

|       |          |             |                      |                                                                      |                       |                                                                                                                                                                                            |   |   |        |   |   |   |   |   |  |
|-------|----------|-------------|----------------------|----------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|--------|---|---|---|---|---|--|
| N     | T        | C           | A                    | F                                                                    | L                     | E                                                                                                                                                                                          | X | 0 | 5      | 4 | 7 | 3 | H | H |  |
| MODEL | ASSEMBLY | FLEX SENSOR | MECHANICAL EXECUTION | RESISTANCE VALUE                                                     | TOLERANCE ON $R_{25}$ | B-VALUE RANGE                                                                                                                                                                              |   |   | OPTION |   |   |   |   |   |  |
| NTC   | A        | FLEX        | 05                   | 103 =<br>$10 \times 10^3 \Omega$<br>473 =<br>$47 \times 10^3 \Omega$ | H = $\pm 3 \%$        | L (low) =<br>$3000 \leq B_{25/85} < 3500$<br>M (medium) =<br>$3500 \leq B_{25/85} < 3750$<br>H (high) =<br>$3750 \leq B_{25/85} < 4000$<br>X (very high) =<br>$4000 \leq B_{25/85} < 4250$ |   |   | Blank  |   |   |   |   |   |  |

**MECHANICAL DATA**


NTCAFLEX05A drawing13

**DIMENSIONS** in millimeters

| L1     | L15    | L2      | Ø D1    | L4    | L5    | H1         | P    | P2 |
|--------|--------|---------|---------|-------|-------|------------|------|----|
| 20 ± 1 | 25 ± 1 | 3 ± 0.5 | 6 ± 0.5 | 4 ± 1 | 3 ± 1 | 1.40 ± 0.2 | 2.50 | 1  |

1. NTC on flex foil circuit
2. Flex foil circuit
3. High quality modified epoxy glob top
4. Conductive tracks

**RELIABILITY TEST** (following IEC 60068 test methods)

| TEST                        | PROCEDURE                           | REQUIREMENT            |
|-----------------------------|-------------------------------------|------------------------|
| Dry heat, steady state      | 125 °C; 1000 h                      | $\Delta R/R \leq 3 \%$ |
| Damp heat, steady state     | 56 days at 40 °C<br>90 % to 95 % RH | $\Delta R/R \leq 3 \%$ |
| Rapid change of temperature | - 40 °C to + 125 °C; 100 cycles     | $\Delta R/R \leq 3 \%$ |

**R/T TABLE 1**

| $R_{25}$ -VALUE<br>(k $\Omega$ ) | $R_{25}$ TOL.<br>(%) | $B_{25/85}$ -VALUE<br>(K) | $B_{25/85}$ TOL.<br>(%) | SAP MATERIAL NO. |
|----------------------------------|----------------------|---------------------------|-------------------------|------------------|
| 10                               | $\pm 3$              | 3960                      | $\pm 1$                 | NTCAFLEX05103HH  |

**RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES**

| TEMP.<br>(°C) | $R_{T}/R_{25}$ | RESISTANCE<br>( $\Omega$ ) | $\Delta R/R$<br>(%) | $\alpha$<br>(%/K) | $\Delta T$<br>(K) | $R_{min.}$<br>( $\Omega$ ) | $R_{max.}$<br>( $\Omega$ ) |
|---------------|----------------|----------------------------|---------------------|-------------------|-------------------|----------------------------|----------------------------|
| - 40          | 34.7116        | 347 116                    | 10.8031             | - 6.66            | 1.62              | 309 617                    | 384 616                    |
| - 35          | 25.0089        | 250 089                    | 10.0392             | - 6.45            | 1.56              | 224 982                    | 275 196                    |
| - 30          | 18.2023        | 182 023                    | 9.3093              | - 6.25            | 1.49              | 165 078                    | 198 968                    |
| - 25          | 13.3804        | 133 804                    | 8.6110              | - 6.06            | 1.42              | 122 282                    | 145 326                    |
| - 20          | 9.9313         | 99 313                     | 7.9424              | - 5.87            | 1.35              | 91 425                     | 107 201                    |
| - 15          | 7.4408         | 74 408                     | 7.3017              | - 5.68            | 1.28              | 68 974                     | 79 841                     |
| - 10          | 5.6257         | 56 257                     | 6.6871              | - 5.50            | 1.22              | 52 495                     | 60 019                     |
| - 5           | 4.2910         | 42 910                     | 6.0971              | - 5.33            | 1.14              | 40 294                     | 45 526                     |
| 0             | 3.3009         | 33 009                     | 5.5303              | - 5.16            | 1.07              | 31 184                     | 34 835                     |
| 5             | 2.5602         | 25 602                     | 4.9853              | - 5.00            | 1.00              | 24 326                     | 26 879                     |
| 10            | 2.0015         | 20 015                     | 4.4608              | - 4.85            | 0.92              | 19 122                     | 20 908                     |
| 15            | 1.5767         | 15 767                     | 3.9558              | - 4.70            | 0.84              | 15 143                     | 16 391                     |
| 20            | 1.2512         | 12 512                     | 3.4692              | - 4.55            | 0.76              | 12 078                     | 12 946                     |
| 25            | 1.0000         | 10 000                     | 3.0000              | - 4.41            | 0.68              | 9700.0                     | 10 300                     |
| 30            | 0.8047         | 8046.8                     | 3.2266              | - 4.28            | 0.75              | 7787.1                     | 8306.4                     |
| 35            | 0.6518         | 6517.6                     | 3.4459              | - 4.15            | 0.83              | 6293.1                     | 6742.2                     |
| 40            | 0.5313         | 5312.5                     | 3.6581              | - 4.03            | 0.91              | 5118.2                     | 5506.9                     |
| 45            | 0.4357         | 4356.6                     | 3.8637              | - 3.91            | 0.99              | 4188.3                     | 4524.9                     |
| 50            | 0.3594         | 3593.6                     | 4.0629              | - 3.79            | 1.07              | 3447.6                     | 3739.6                     |
| 55            | 0.2981         | 2981.0                     | 4.2560              | - 3.68            | 1.16              | 2854.1                     | 3107.8                     |
| 60            | 0.2486         | 2486.2                     | 4.4434              | - 3.58            | 1.24              | 2375.7                     | 2596.6                     |
| 65            | 0.2084         | 2084.3                     | 4.6252              | - 3.48            | 1.33              | 1987.9                     | 2180.7                     |
| 70            | 0.1756         | 1756.2                     | 4.8017              | - 3.38            | 1.42              | 1671.9                     | 1840.5                     |
| 75            | 0.1487         | 1486.9                     | 4.9732              | - 3.28            | 1.52              | 1412.9                     | 1560.8                     |
| 80            | 0.1265         | 1264.7                     | 5.1397              | - 3.19            | 1.61              | 1199.7                     | 1329.7                     |
| 85            | 0.1081         | 1080.6                     | 5.3017              | - 3.10            | 1.71              | 1023.3                     | 1137.9                     |
| 90            | 0.0927         | 927.23                     | 5.6204              | - 3.02            | 1.86              | 875.11                     | 979.34                     |
| 95            | 0.0799         | 798.94                     | 5.9309              | - 2.94            | 2.02              | 751.56                     | 846.33                     |
| 100           | 0.0691         | 691.16                     | 6.2335              | - 2.86            | 2.18              | 648.08                     | 734.25                     |
| 105           | 0.0600         | 600.23                     | 6.5286              | - 2.78            | 2.35              | 561.04                     | 639.42                     |
| 110           | 0.0523         | 523.20                     | 6.8163              | - 2.71            | 2.51              | 487.53                     | 558.86                     |
| 115           | 0.0458         | 457.68                     | 7.0970              | - 2.64            | 2.69              | 425.20                     | 490.17                     |
| 120           | 0.0402         | 401.76                     | 7.3709              | - 2.57            | 2.86              | 372.15                     | 431.37                     |
| 125           | 0.0354         | 353.85                     | 7.6383              | - 2.51            | 3.05              | 326.82                     | 380.87                     |

**R/T TABLE 2**

| $R_{25}$ -VALUE<br>(k $\Omega$ ) | $R_{25}$ TOL.<br>(%) | $B_{25/85}$ -VALUE<br>(K) | $B_{25/85}$ TOL.<br>(%) | SAP MATERIAL NO. |
|----------------------------------|----------------------|---------------------------|-------------------------|------------------|
| 47                               | $\pm 3$              | 3960                      | $\pm 1$                 | NTCAFLEX05473HH  |

**RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES**

| TEMP.<br>(°C) | $R(T)/R_{25}$ | RESISTANCE<br>( $\Omega$ ) | $\Delta R/R$<br>(%) | $\alpha$<br>(%/K) | $\Delta T$<br>(K) | $R_{min.}$<br>( $\Omega$ ) | $R_{max.}$<br>( $\Omega$ ) |
|---------------|---------------|----------------------------|---------------------|-------------------|-------------------|----------------------------|----------------------------|
| - 40          | 34.972        | 1 643 693                  | 10.803              | - 6.85            | 1.58              | 1 466 123                  | 1 821 262                  |
| - 35          | 24.997        | 1 174 859                  | 10.039              | - 6.59            | 1.52              | 1 056 912                  | 1 292 806                  |
| - 30          | 18.095        | 850 461                    | 9.3093              | - 6.34            | 1.47              | 771 290                    | 929 633                    |
| - 25          | 13.256        | 623 018                    | 8.6110              | - 6.11            | 1.41              | 569 370                    | 676 666                    |
| - 20          | 9.8204        | 461 557                    | 7.9424              | - 5.89            | 1.35              | 424 898                    | 498 216                    |
| - 15          | 7.3528        | 345 583                    | 7.3017              | - 5.69            | 1.28              | 320 350                    | 370 816                    |
| - 10          | 5.5607        | 261 354                    | 6.6871              | - 5.49            | 1.22              | 243 877                    | 278 831                    |
| - 5           | 4.2455        | 199 536                    | 6.0971              | - 5.31            | 1.15              | 187 370                    | 211 702                    |
| 0             | 3.2705        | 153 714                    | 5.5303              | - 5.13            | 1.08              | 145 213                    | 162 215                    |
| 5             | 2.5410        | 119 427                    | 4.9853              | - 4.97            | 1.00              | 113 473                    | 125 381                    |
| 10            | 1.9902        | 93 541                     | 4.4608              | - 4.81            | 0.93              | 89 369                     | 97 714                     |
| 15            | 1.5709        | 73 832                     | 3.9558              | - 4.66            | 0.85              | 70 911                     | 76 752                     |
| 20            | 1.2490        | 58 703                     | 3.4692              | - 4.52            | 0.77              | 56 666                     | 60 739                     |
| 25            | 1.0000        | 47 000                     | 3.0000              | - 4.38            | 0.69              | 45 590                     | 48 410                     |
| 30            | 0.8060        | 37 881                     | 3.2266              | - 4.25            | 0.76              | 36 659                     | 39 103                     |
| 35            | 0.6537        | 30 726                     | 3.4459              | - 4.13            | 0.84              | 29 667                     | 31 784                     |
| 40            | 0.5335        | 25 073                     | 3.6581              | - 4.01            | 0.91              | 24 156                     | 25 990                     |
| 45            | 0.4378        | 20 579                     | 3.8637              | - 3.89            | 0.99              | 19 784                     | 21 374                     |
| 50            | 0.3614        | 16 984                     | 4.0629              | - 3.79            | 1.07              | 16 294                     | 17 674                     |
| 55            | 0.2998        | 14 092                     | 4.2560              | - 3.68            | 1.16              | 13 492                     | 14 692                     |
| 60            | 0.2500        | 11 751                     | 4.4434              | - 3.58            | 1.24              | 11 229                     | 12 274                     |
| 65            | 0.2095        | 9847.6                     | 4.6252              | - 3.49            | 1.33              | 9392.1                     | 10 303                     |
| 70            | 0.1764        | 8290.7                     | 4.8017              | - 3.40            | 1.41              | 7892.6                     | 8688.8                     |
| 75            | 0.1492        | 7011.4                     | 4.9732              | - 3.31            | 1.50              | 6662.7                     | 7360.1                     |
| 80            | 0.1267        | 5955.0                     | 5.1397              | - 3.22            | 1.59              | 5648.9                     | 6261.1                     |
| 85            | 0.1081        | 5078.7                     | 5.3017              | - 3.14            | 1.69              | 4809.5                     | 5348.0                     |
| 90            | 0.0925        | 4348.7                     | 5.6204              | - 3.07            | 1.83              | 4104.3                     | 4593.1                     |
| 95            | 0.0795        | 3737.8                     | 5.9309              | - 2.99            | 1.98              | 3516.1                     | 3959.5                     |
| 100           | 0.0686        | 3224.6                     | 6.2335              | - 2.92            | 2.14              | 3023.6                     | 3425.7                     |
| 105           | 0.0594        | 2791.8                     | 6.5286              | - 2.85            | 2.29              | 2609.5                     | 2974.1                     |
| 110           | 0.0516        | 2425.3                     | 6.8163              | - 2.78            | 2.45              | 2260.0                     | 2590.7                     |
| 115           | 0.0450        | 2113.9                     | 7.0970              | - 2.72            | 2.61              | 1963.9                     | 2264.0                     |
| 120           | 0.0393        | 1848.4                     | 7.3709              | - 2.65            | 2.78              | 1712.1                     | 1984.6                     |
| 125           | 0.0345        | 1621.2                     | 7.6383              | - 2.59            | 2.95              | 1497.3                     | 1745.0                     |



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