



Powering Business Worldwide

# Engineering Product Specification CL1004Rx-n-xxx-R

TITLE: **Multiphase Inductors, SMT**

REV A

## CONTENTS

| SECTION | DESCRIPTION                                               | PAGE |
|---------|-----------------------------------------------------------|------|
| 1       | PRODUCT FEATURES AND ENVIRONMENTAL DATA.....              | 2    |
|         | PRODUCT FEATURES .....                                    | 2    |
|         | APPLICATIONS.....                                         | 2    |
|         | ENVIRONMENTAL COMPLIANCE AND GENERAL SPECIFICATIONS ..... | 2    |
| 2       | SPECIFICATION .....                                       | 3    |
| 2.1     | ELECTRICAL PARAMETERS.....                                | 3    |
| 2.2     | MECHANICAL PARAMETERS, SCHEMATIC, PAD LAYOUT- MM .....    | 4    |
| 3       | PACKAGING INFORMATION- MM .....                           | 6    |
| 4       | TEMPERATURE RISE VS. TOTAL LOSS.....                      | 7    |
| 5       | INDUCTANCE CHARACTERISTICS --- OCL .....                  | 8    |
| 6       | INDUCTANCE CHARACTERISTICS --- SCL .....                  | 10   |
| 7       | SOLDER REFLOW PROFILE.....                                | 12   |



Powering Business Worldwide

# Engineering Product Specification CL1004Rx-n-xxx-R

TITLE: **Multiphase Inductors, SMT**

REV A

## 1 Product features and environmental data

### Product features

High current carrying capacity

Operating frequency range: up to 3MHz

20.0 mm x 10.0 mm footprint surface mount package in 4.0 mm height (2-phase)

30.0 mm x 10.0 mm footprint surface mount package in 4.0 mm height (3-phase)

Moisture Sensitivity Level (MSL): 1

Ferrite core material

Weight: 2.683 grams (2-ph), 4.079 grams (3-ph) typical

Termination finish: matte tin over nickel

### Applications

Multi-phase and Vcore regulators

Voltage Regulator Modules (VRMs) and high-power density VRMs

- Server and desktop
- Central processing unit (CPU)
- Graphics processing unit (GPU)
- Application specific integrated circuit (ASIC)

Data networking and storage systems

Graphics cards and battery power systems

Point-of-Load modules

### Environmental compliance and general specifications

Storage temperature range (Component): -40 °C to +125 °C

Operating temperature range: -40 °C to +125 °C (ambient plus self-temperature rise)

Solder reflow temperature: J-STD-020 (latest revision) compliant

RoHS

REACH

PFOS & PFOA

Halogen free, Sb<sub>2</sub>O<sub>3</sub> and Red Phosphorus



Powering Business Worldwide

# Engineering Product Specification CL1004Rx-n-xxx-R

TITLE: Multiphase Inductors, SMT

REV A

## 2 Specification

### 2.1 Electrical parameters

| Part Number <sup>12</sup> | Number of Phase | OCL <sup>1</sup><br>(nH)<br>±20% |              | I <sub>RMS</sub> <sup>2</sup><br>(A) | FLL1 <sup>3</sup><br>(nH)<br>Min. | I <sub>sat1</sub> <sup>4</sup><br>(A) | I <sub>sat2</sub> <sup>5</sup><br>(A) | DCR1 <sup>6</sup><br>(mΩ)<br>Max.<br>@ +20 °C | DCR2 <sup>7</sup><br>(mΩ)<br>Max.<br>@ +20 °C | SCL/phase <sup>8</sup><br>(nH)<br>±20% | FLL2 <sup>9</sup><br>(nH)<br>Min. | I <sub>sat3</sub> <sup>10</sup><br>(A) | I <sub>sat4</sub> <sup>11</sup><br>(A) |
|---------------------------|-----------------|----------------------------------|--------------|--------------------------------------|-----------------------------------|---------------------------------------|---------------------------------------|-----------------------------------------------|-----------------------------------------------|----------------------------------------|-----------------------------------|----------------------------------------|----------------------------------------|
| CL1004R2-2-R050-R         | 2               | 200<br>(1-2),(3-4)               |              | 39                                   | 128                               | 21                                    | 17                                    | 0.59                                          | 0.30                                          | 50                                     | 32                                | 70                                     | 60                                     |
| CL1004R2-3-R050-R         | 3               | 200<br>(1-2),(5-6)               | 230<br>(3-4) | 39                                   | 128                               | 21                                    | 17                                    | 0.59                                          | 0.30                                          | 50                                     | 32                                | 70                                     | 60                                     |
| CL1004R3-2-R050-R         | 2               | 200<br>(1-2),(3-4)               |              | 39                                   | 128                               | 21                                    | 17                                    | 0.59                                          | 0.30                                          | 50                                     | 32                                | 70                                     | 60                                     |
| CL1004R3-3-R050-R         | 3               | 200<br>(1-2),(5-6)               | 230<br>(3-4) | 39                                   | 128                               | 21                                    | 17                                    | 0.59                                          | 0.30                                          | 50                                     | 32                                | 70                                     | 60                                     |

- Open Circuit Inductance (OCL) Test parameters: 1 MHz, 0.1 V<sub>rms</sub>, 0.0 Adc, +25 °C & 105 °C
- I<sub>RMS</sub>: DC Current that results in approximately 40 °C temperature rise above ambient. The 40 °C rise occurs when the specified current flows through each of the 2 or 3 windings. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed +125 °C under worst case operating conditions verified in the end application
- Full Load Inductance for OCL (FLL1) Test parameters: 1 MHz, 0.1 V<sub>rms</sub>, I<sub>sat1</sub>, +25 °C
- I<sub>sat1</sub>: Peak current at which per phase OCL drops by approximately 20% @ +25 °C
- I<sub>sat2</sub>: Peak current at which per phase OCL drops by approximately 20% @ +105 °C
- DCR1: tested from points A&B, as accepting criteria, for specific points see Section 2.2
- DCR2: tested from points C&D, as reference, for specific points see Section 2.2
- Short Circuit Inductance (SCL) Test Parameters: 1 MHz, 0.1 V<sub>rms</sub>, 0.0 Adc, +25 °C & 105 °C
- Full Load Inductance for SCL (FLL2) Test parameters: 1 MHz, 0.1 V<sub>rms</sub>, I<sub>sat3</sub>, +25 °C
- I<sub>sat3</sub>: Peak current at which per phase SCL drops by approximately 20% @ +25 °C
- I<sub>sat4</sub>: Peak current at which per phase SCL drops by approximately 20% @ +105 °C
- Part Number Definition: CL1004Rx-n-Rxxx-R  
CL1004= Product code and size  
Rx= Version indicator  
n= Number of phases  
Rxxx= Leakage inductance value in μH, R= decimal point  
-R suffix = RoHS compliant



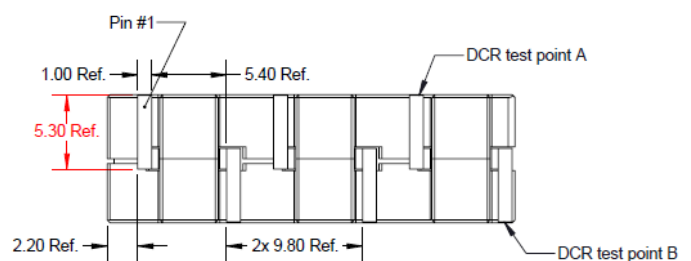
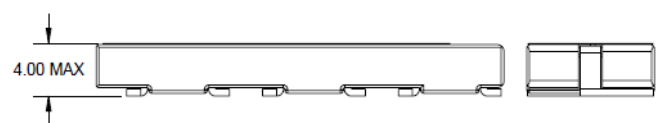
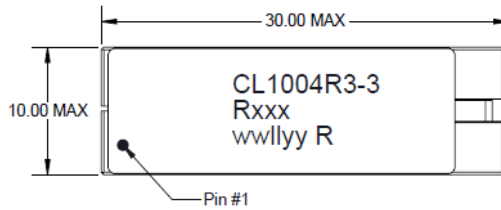
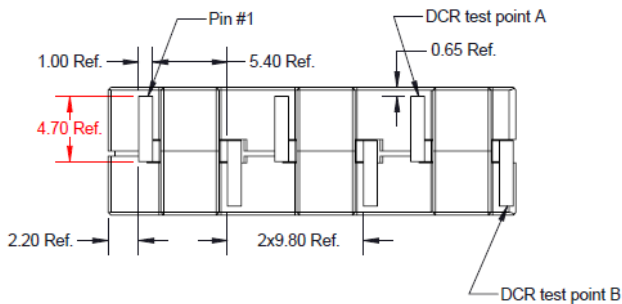
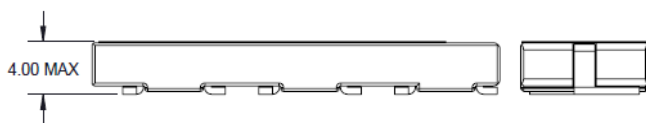
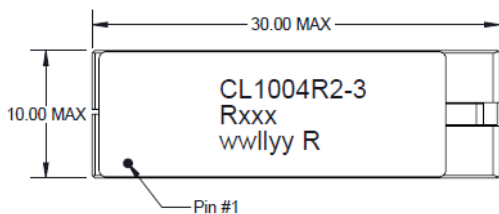
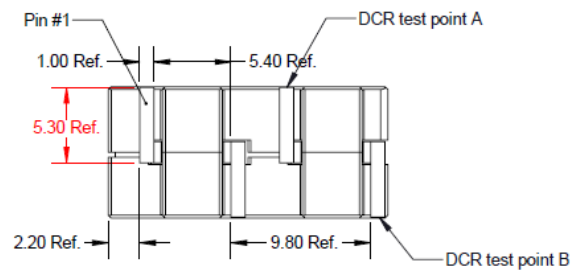
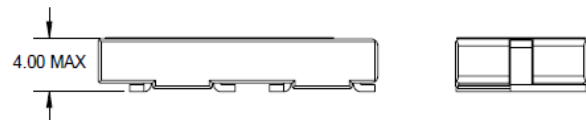
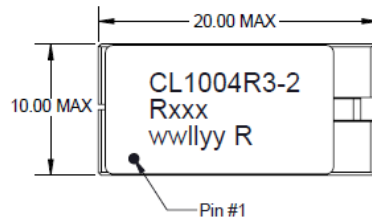
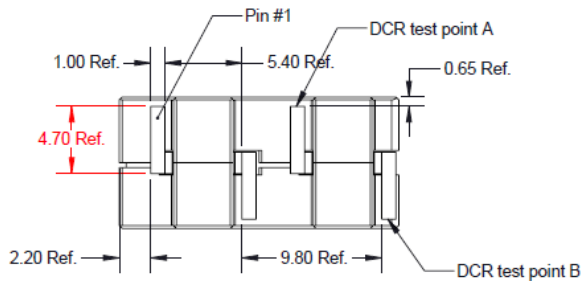
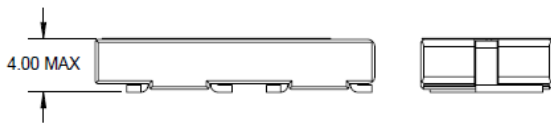
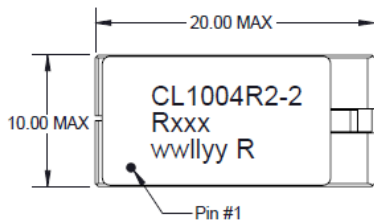
Powering Business Worldwide

# Engineering Product Specification CL1004Rx-n-xxx-R

TITLE: Multiphase Inductors, SMT

REV A

## 2.2 Mechanical parameters, schematic, pad layout- mm





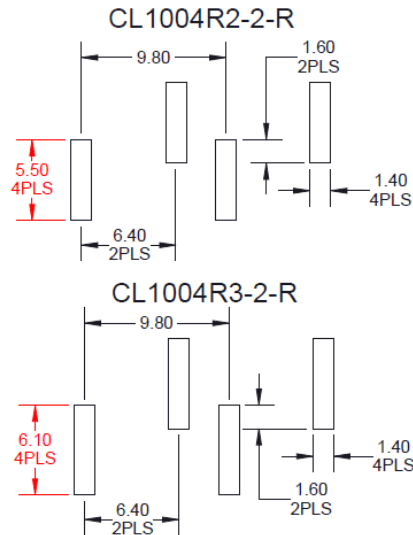
Powering Business Worldwide

# Engineering Product Specification CL1004Rx-n-xxx-R

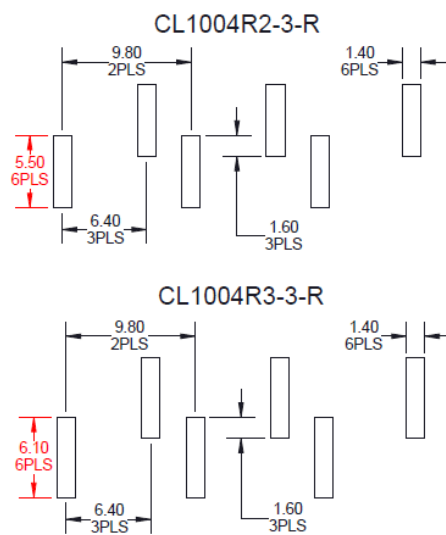
TITLE: Multiphase Inductors, SMT

REV A

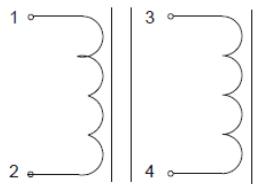
## RECOMMENDED PCB LAYOUT



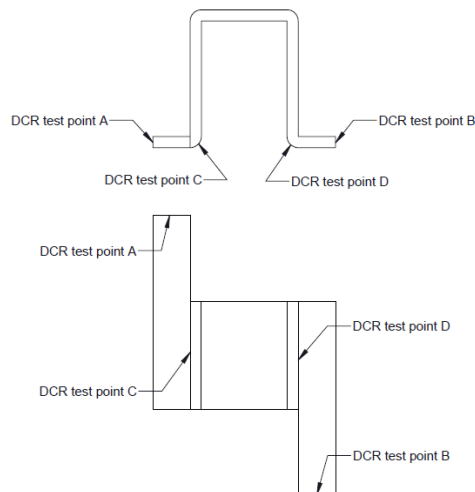
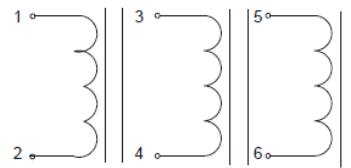
## RECOMMENDED PCB LAYOUT



## SCHEMATICS



## SCHEMATICS



Part marking: CL1004=Product code and size, Rx=Version indicator, n=Number of phases (2/3)

Rxxx=leakage inductance value in uH, R=decimal point

wwlllyy R=(DateCode) (Revision)

All soldering surfaces to be coplanar within 0.13 millimeters

Tolerances are  $\pm 0.15$  millimeters unless stated otherwise

**TITLE: Multiphase Inductors, SMT**

**REV A**

Pad layout tolerances are  $\pm 0.1$  millimeters unless stated otherwise

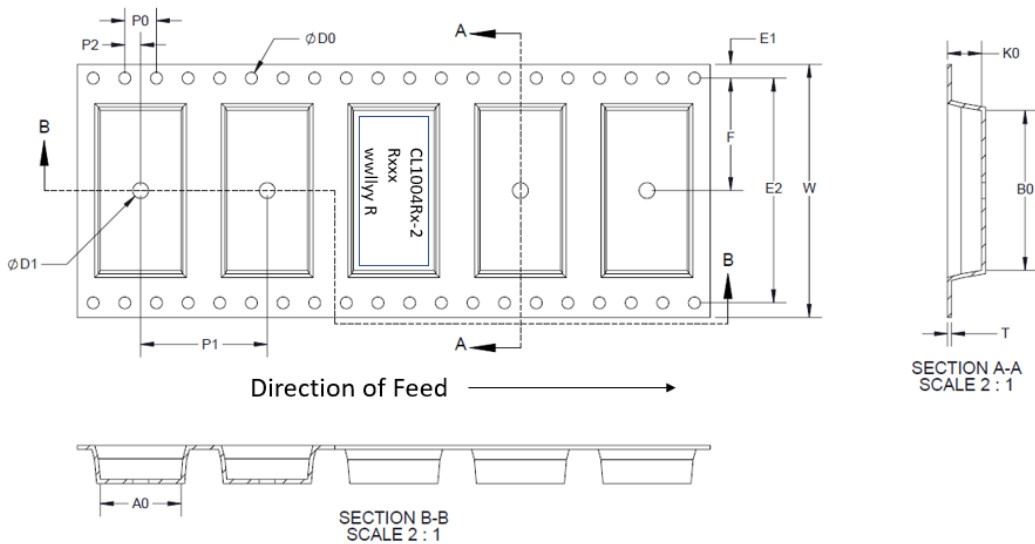
DCR measured from point "A" to point "B" as accepting criteria, from point 'C' to point 'D' as reference value, for specific values see Section 2.1

Traces or vias underneath the inductor is not recommended

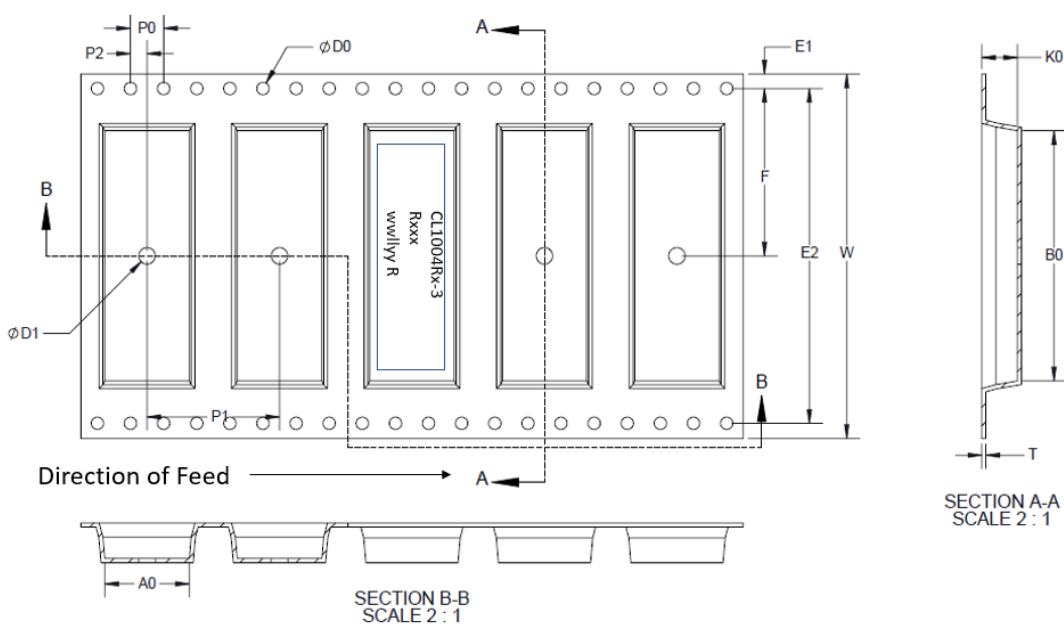
### 3 Packaging information- mm

Drawing not to scale

Supplied in tape and reel packaging, 900 parts per 13" diameter reel



| Item       | Dimensions |
|------------|------------|
| W±0.30     | 32.00      |
| F±0.10     | 14.20      |
| E1±0.10    | 1.75       |
| E2±0.10    | 28.40      |
| P0±0.10    | 4.00       |
| P1±0.10    | 16.00      |
| P2±0.10    | 2.00       |
| D0+0.10/-0 | 1.50       |
| D1 Min.    | 2.00       |
| A0±0.10    | 10.20      |
| B0±0.10    | 20.20      |
| K0±0.10    | 4.30       |
| T±0.05     | 0.30       |



| TABLE A    |            |
|------------|------------|
| Item       | Dimensions |
| W±0.30     | 44.00      |
| F±0.10     | 20.20      |
| E1±0.10    | 1.75       |
| E2±0.10    | 40.40      |
| P0±0.10    | 4.00       |
| P1±0.10    | 16.00      |
| P2±0.10    | 2.00       |
| D0+0.10/-0 | 1.50       |
| D1 Min.    | 2.00       |
| A0±0.10    | 10.20      |
| B0±0.10    | 30.20      |
| K0±0.10    | 4.30       |
| T±0.05     | 0.30       |



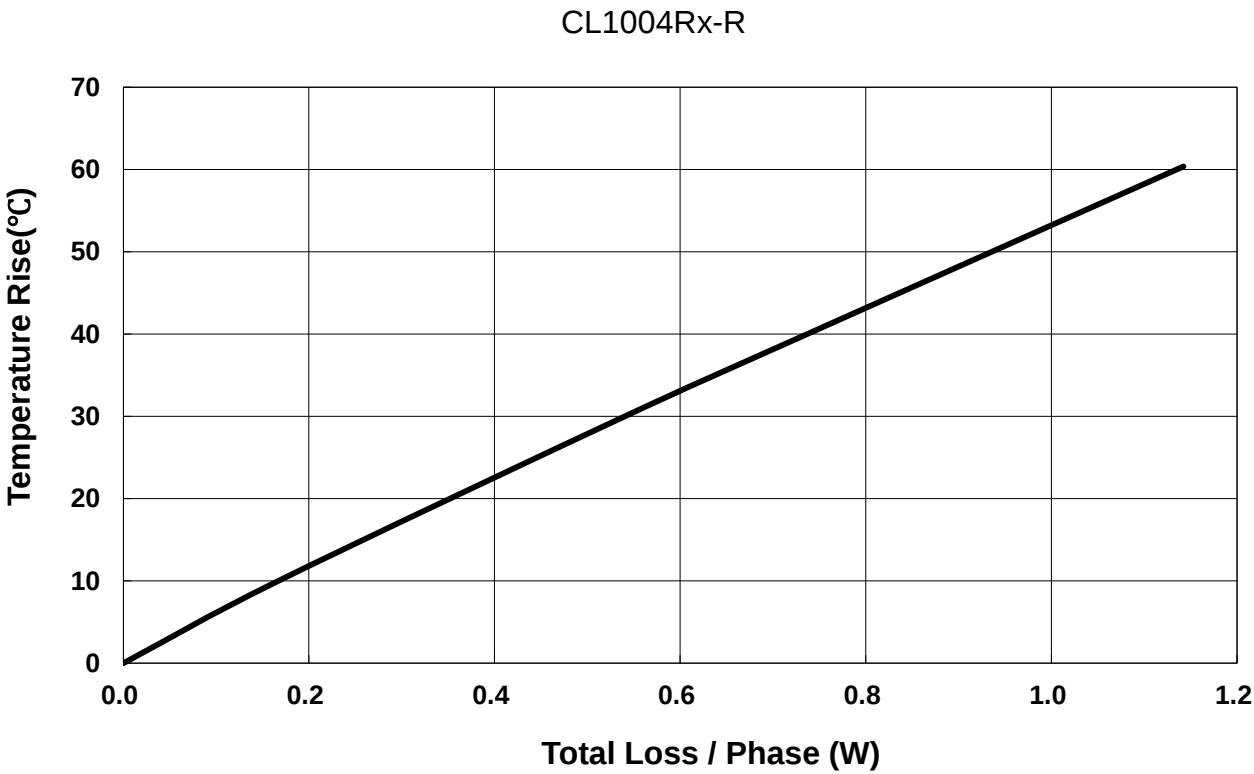
Powering Business Worldwide

Engineering Product Specification CL1004Rx-n-xxx-R

TITLE: Multiphase Inductors, SMT

REV A

4 Temperature Rise vs. Total Loss





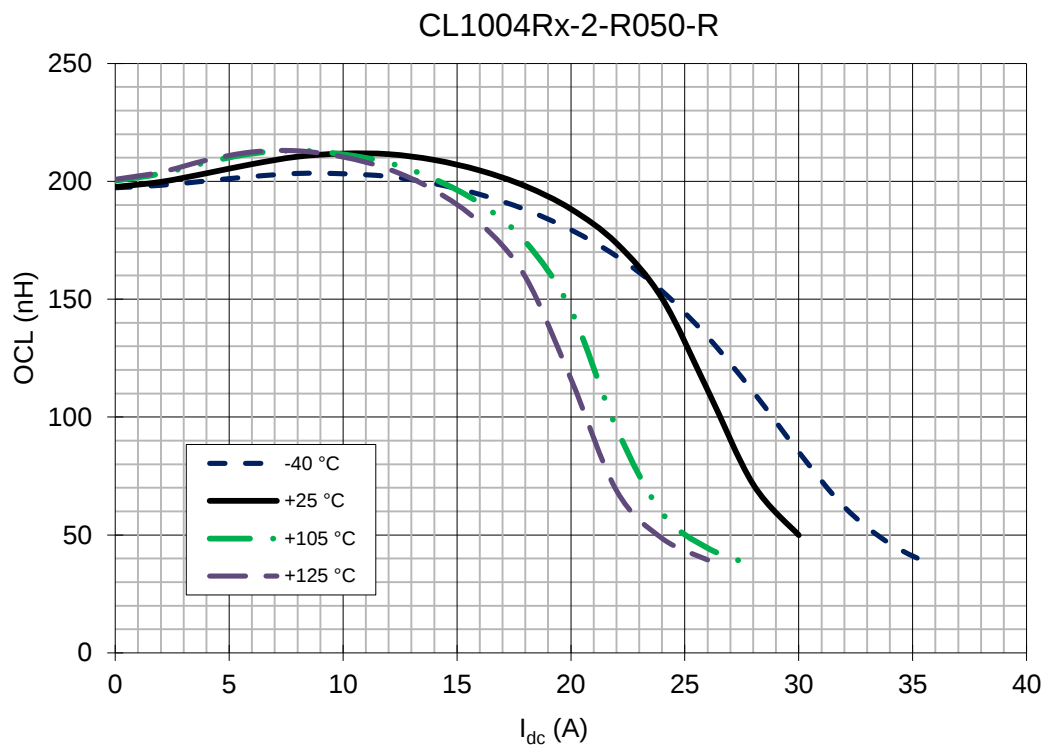
Powering Business Worldwide

# Engineering Product Specification CL1004Rx-n-xxx-R

TITLE: Multiphase Inductors, SMT

REV A

## 5 Inductance characteristics --- OCL





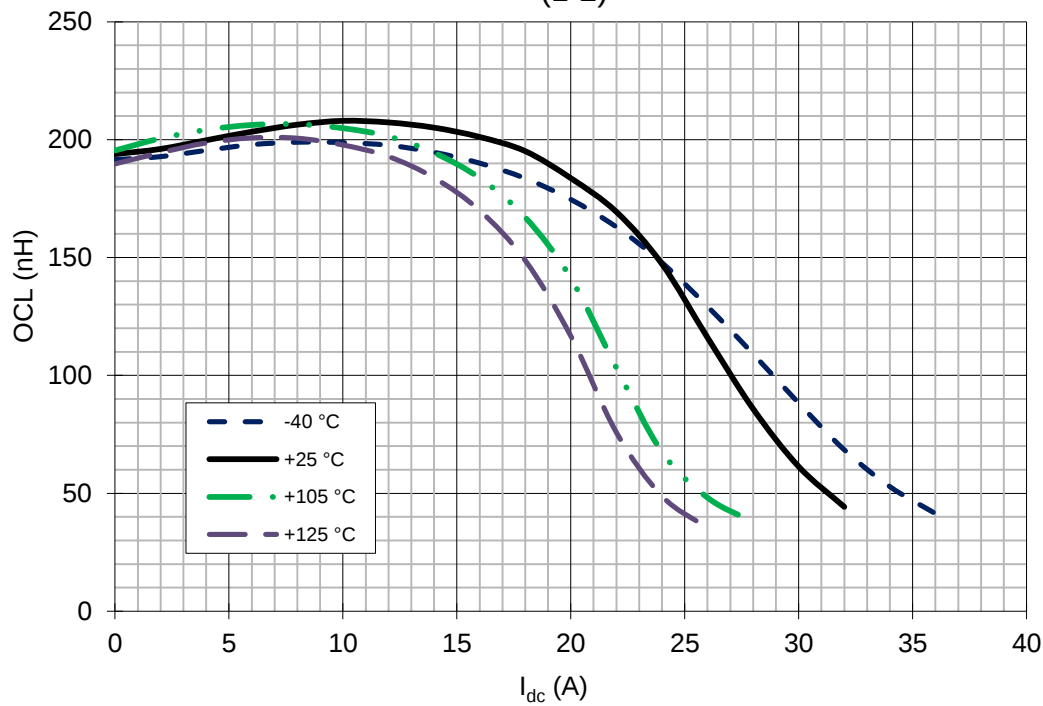
Powering Business Worldwide

# Engineering Product Specification CL1004Rx-n-xxx-R

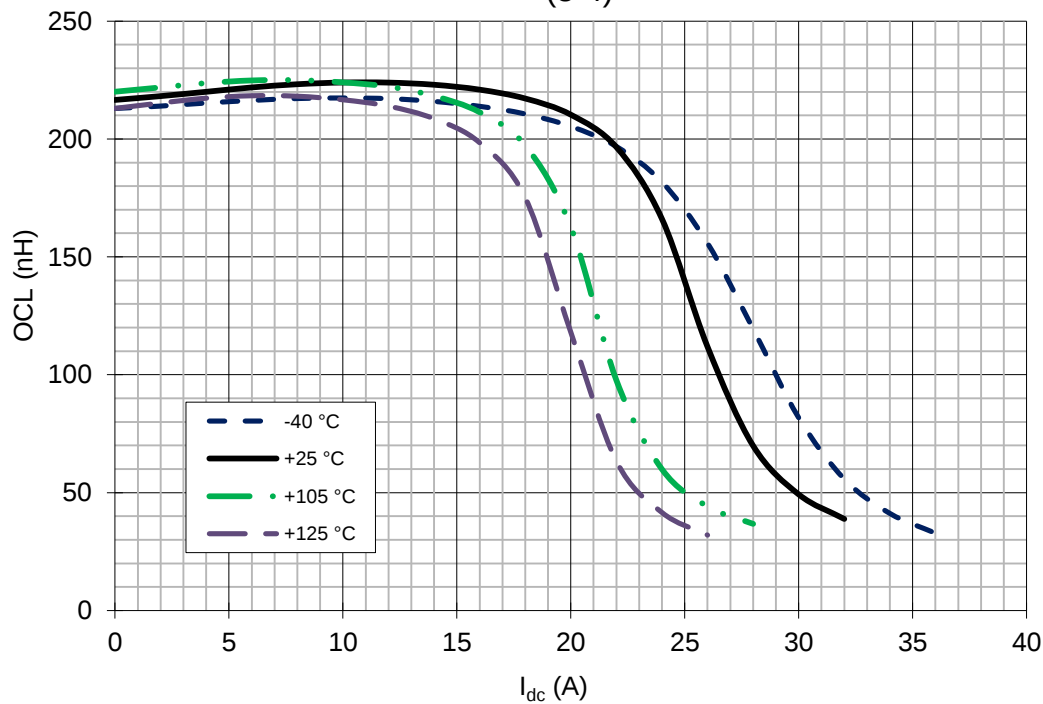
TITLE: Multiphase Inductors, SMT

REV A

CL1004Rx-3-R050-R  
(1-2)



CL1004Rx-3-R050-R  
(3-4)





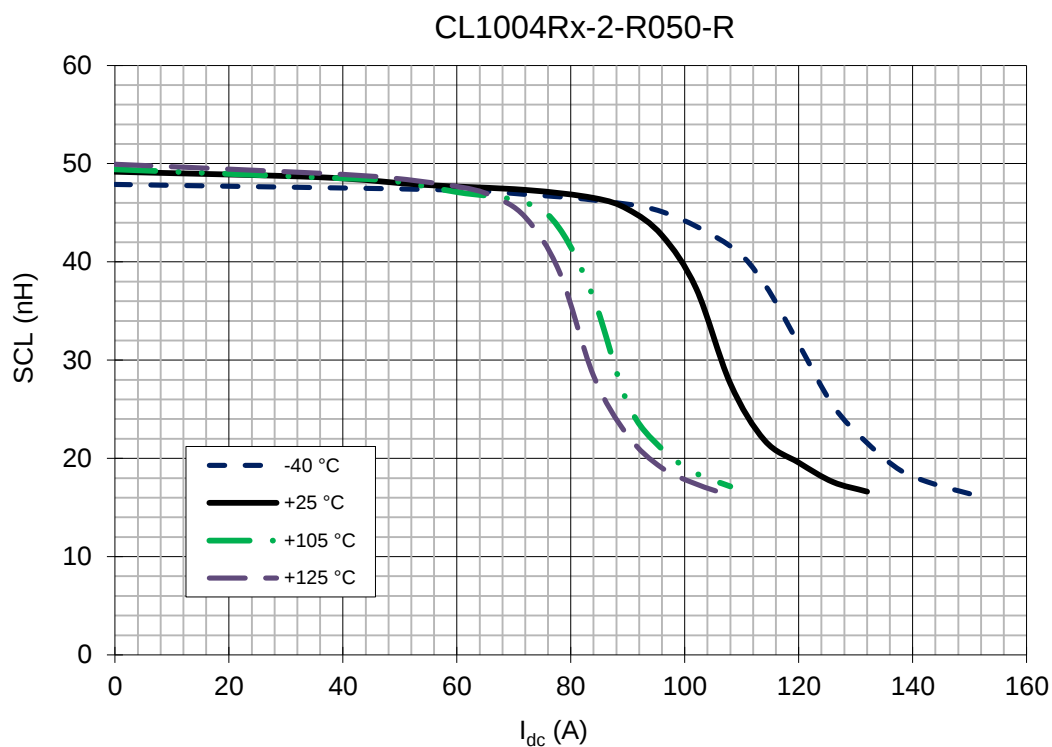
Powering Business Worldwide

# Engineering Product Specification CL1004Rx-n-xxx-R

TITLE: Multiphase Inductors, SMT

REV A

## 6 Inductance characteristics --- SCL



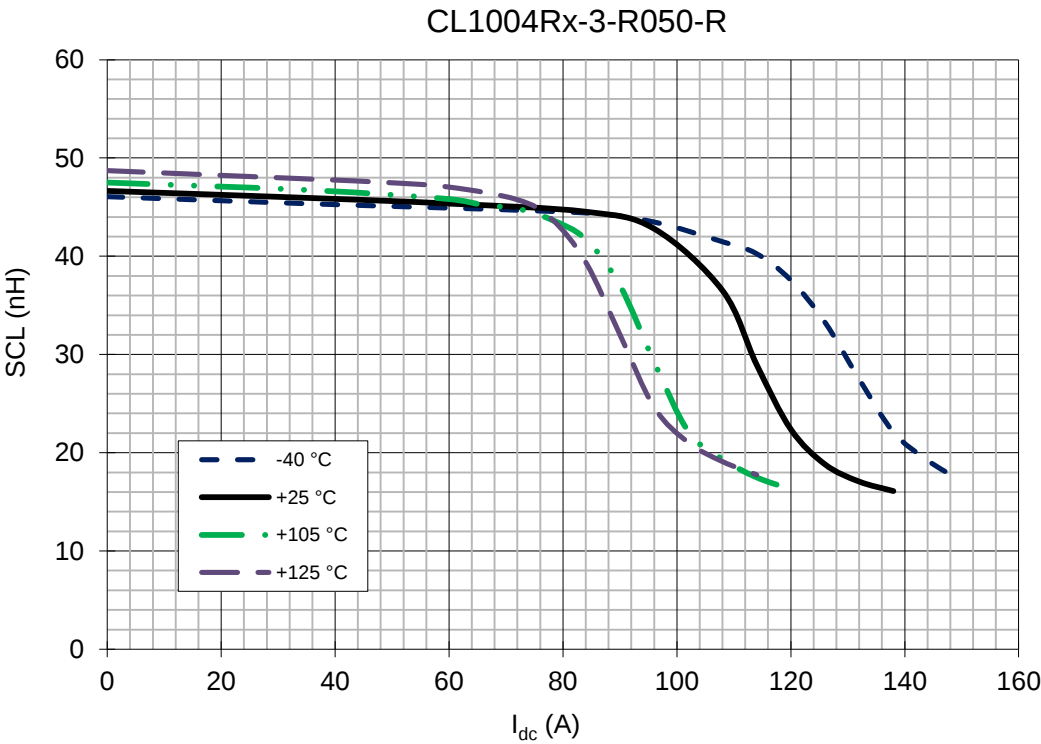


Powering Business Worldwide

Engineering Product Specification CL1004Rx-n-xxx-R

TITLE: Multiphase Inductors, SMT

REV A





Powering Business Worldwide

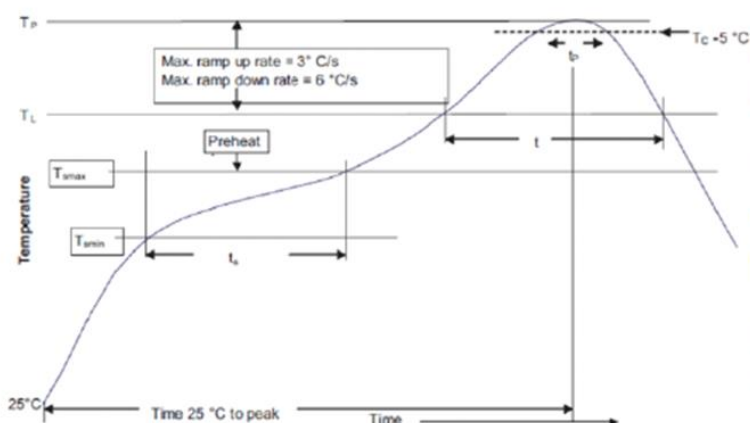
## Engineering Product Specification CL1004Rx-n-xxx-R

TITLE: Multiphase Inductors, SMT

REV A

## 7 Solder reflow profile

### Solder reflow profile

Table 1 - Standard SnPb solder ( $T_C$ )

| Package thickness | Volume mm <sup>3</sup> <350 | Volume mm <sup>3</sup> ≥350 |
|-------------------|-----------------------------|-----------------------------|
| <2.5 mm           | 235 °C                      | 220 °C                      |
| ≥2.5 mm           | 220 °C                      | 220 °C                      |

Table 2 - Lead (Pb) free solder ( $T_C$ )

| Package thickness | Volume mm <sup>3</sup> <350 | Volume mm <sup>3</sup> 350 - 2000 | Volume mm <sup>3</sup> >2000 |
|-------------------|-----------------------------|-----------------------------------|------------------------------|
| <1.6 mm           | 260 °C                      | 260 °C                            | 260 °C                       |
| 1.6 – 2.5 mm      | 260 °C                      | 250 °C                            | 245 °C                       |
| >2.5 mm           | 250 °C                      | 245 °C                            | 245 °C                       |

### Reference J-STD-020

| Profile feature                                                                   | Standard SnPb solder | Lead (Pb) free solder |
|-----------------------------------------------------------------------------------|----------------------|-----------------------|
| Preheat and soak                                                                  |                      |                       |
| • Temperature min. ( $T_{smin}$ )                                                 | 100 °C               | 150 °C                |
| • Temperature max. ( $T_{smax}$ )                                                 | 150 °C               | 200 °C                |
| • Time ( $T_{smin}$ to $T_{smax}$ ) ( $t_s$ )                                     | 60-120 seconds       | 60-120 seconds        |
| Ramp up rate $T_L$ to $T_P$                                                       | 3 °C/ second max.    | 3 °C/ second max.     |
| Liquidous temperature ( $T_L$ )                                                   | 183 °C               | 217 °C                |
| Time ( $t_L$ ) maintained above $T_L$                                             | 60-150 seconds       | 60-150 seconds        |
| Peak package body temperature ( $T_P$ )*                                          | Table 1              | Table 2               |
| Time ( $t_P$ )* within 5 °C of the specified classification temperature ( $T_C$ ) | 20 seconds*          | 30 seconds*           |
| Ramp-down rate ( $T_P$ to $T_L$ )                                                 | 6 °C/ second max.    | 6 °C/ second max.     |
| Time 25 °C to peak temperature                                                    | 6 minutes max.       | 8 minutes max.        |

\* Tolerance for peak profile temperature ( $T_P$ ) is defined as a supplier minimum and a user maximum.