ERU chokes

ERUC23, SMT flat wire coupled inductor

Series/Type: **ERUC23**

Date: June 2023

Construction

- Low loss ferrite
- Flat wire winding
- Self-leaded construction

Features

- High saturation current
- Low DC resistance
- RoHS-compatible
- Compact coupled inductors
- AEC-Q200 qualified

Applications

- Dual phase Buck, Boost, and Buck-Boost converters
- 48 V_{in} – 12 V_{out} hybrid converter

Terminals

- Lead-free tinned

Marking

- Manufacturer, ordering code, date of manufacture, production place, pin one and location (YYWWD/X)

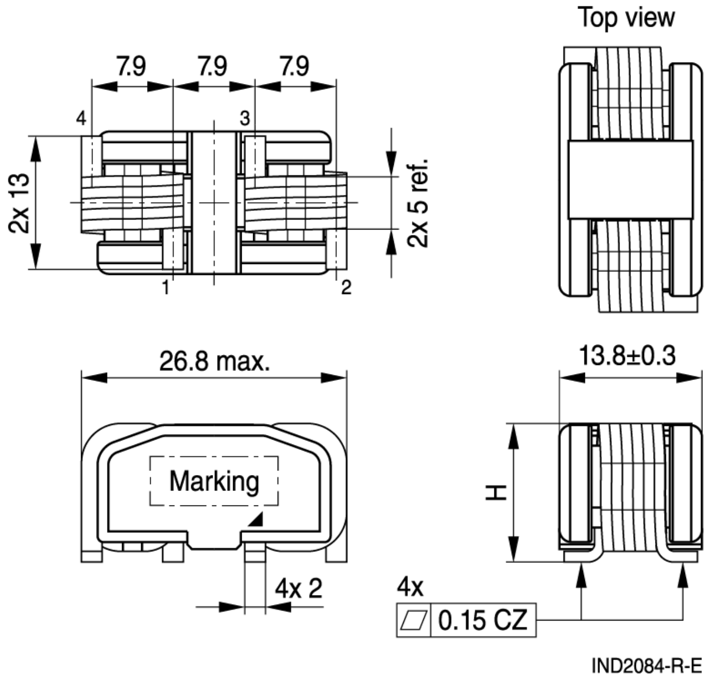
Delivery mode

- Blister tape

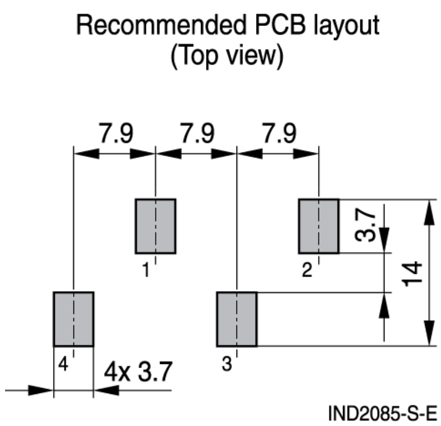
Packing unit

- 150 pcs./reel
- 4 reels/carton box

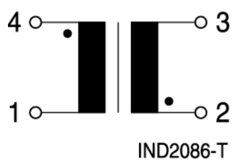
Dimensional drawing



All dimensions in mm



Circuit diagram



Technical data and measuring conditions

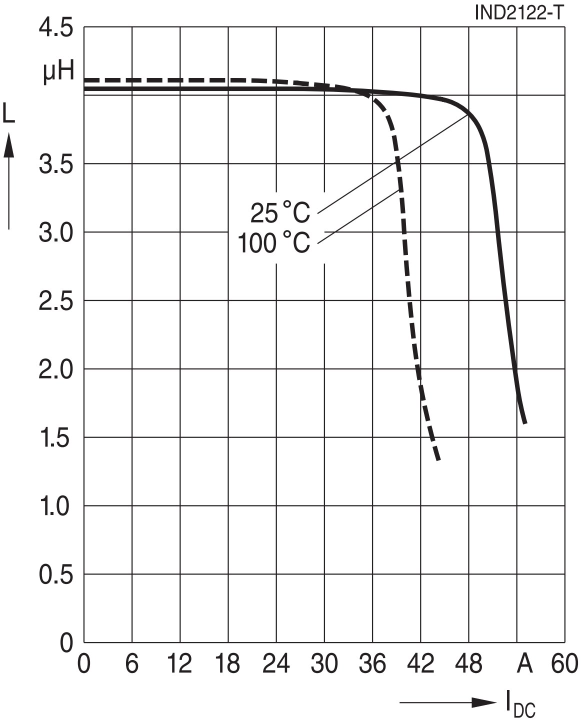
Rated inductance L_3	±10%, 100 kHz, 100 mV, +25 °C, Pins 2-4 with 1-3 shorted
Rated inductance L_2	±15%, 100 kHz, 100 mV, +25 °C, Pins 1-4
Rated inductance L_1	±15%, 100 kHz, 100 mV, +25 °C, Pins 2-3
Saturation current $I_{sat\text{-}typ}$	DC current with inductance decrease of L_3 by approximately 20%
Saturation current $I_{sat\text{-}max}$	DC current with causes L_3 to decrease by approximately 20% at L_3's maximum value
Rated current $I_{temp,typ}$	Current that will cause a Δ40°K self-heating at room temperature
DC resistance $R_{DC1(4\text{-}1)} = R_{DC2(2\text{-}3)}$	±7%, measured at +25 °C
High voltage: N1 to core	200 V DC
High voltage: N2 to core	200 V DC
Weight	Approx. 18.6 g
Solderability (test of wettability of the pins)	(245 ±5) °C, (3 ±0.3) s, Wetting of soldering area ≥95% (based on IEC 60068-2-58, solder bath method)
Resistance to soldering heat	To JEDEC J-STD 020E (Tc: +245 °C on pin)
Operating temperature	– 40 °C … +150 °C (component)
Storage conditions (packaged)	– 25 °C … +40 °C, ≤ 75% RH

Characteristics and ordering codes

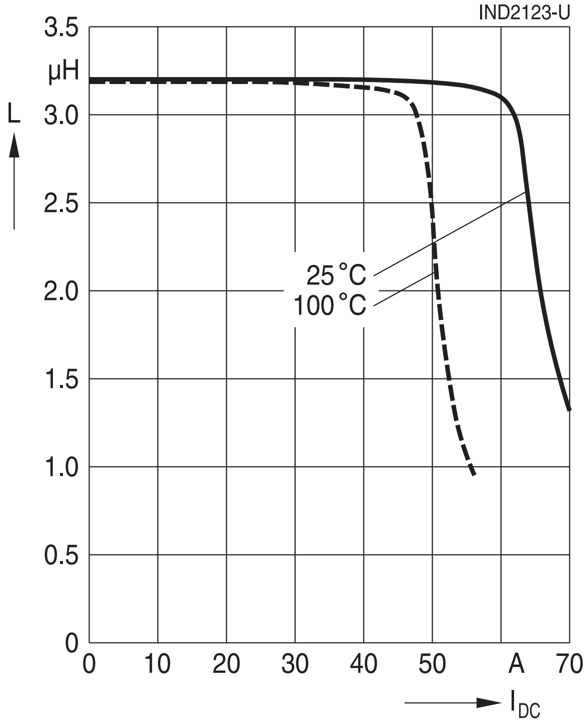
L_3 nom µH	$I_{sat\text{-}max}$ 25 °C A	$I_{sat\text{-}typ}$ 25 °C A	$I_{sat\text{-}typ}$ 100 °C A	$I_{Temp,typ}$ A	L_1, L_2 nom µH	R_{DC1}, R_{DC2} nom mΩ	Height ±0.3 mm	Internal code	Ordering code
4.1	45	50	39.5	24	7.9	1.85	13.7	B82559S6412M023	ERUC23-4R1K
3.2	57.5	63.5	49	24	5.9	1.85	13.7	B82559S6322M023	ERUC23-3R2K
2.8	55	61	47	27	5.4	1.25	13.8	B82559S5282M023	ERUC23-2R8K
2.2	71	77	58	27	4.1	1.25	13.8	B82559S5222M023	ERUC23-2R2K
1.8	73	81	62	33	3.5	0.82	14.0	B82559S4182M023	ERUC23-1R8K
1.4	88	97	73	33	2.6	0.82	14.0	B82559S4142M023	ERUC23-1R4K

Saturation characteristic (typical)

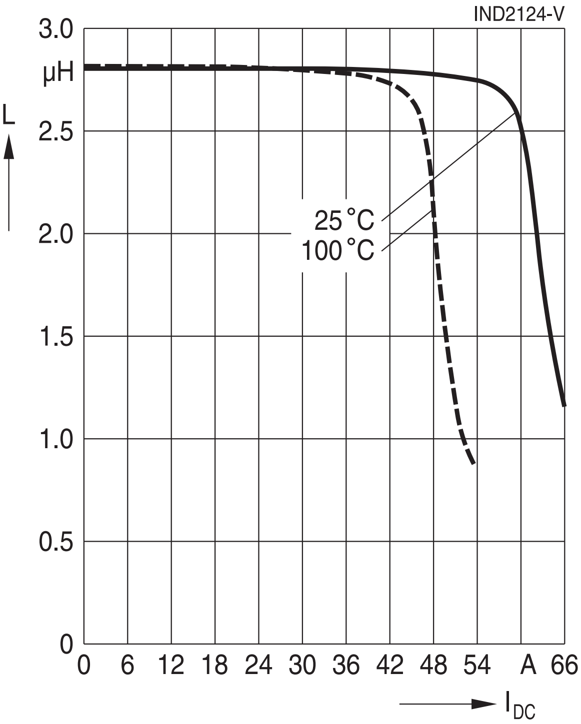
ERUC23-4R1K (L_3)



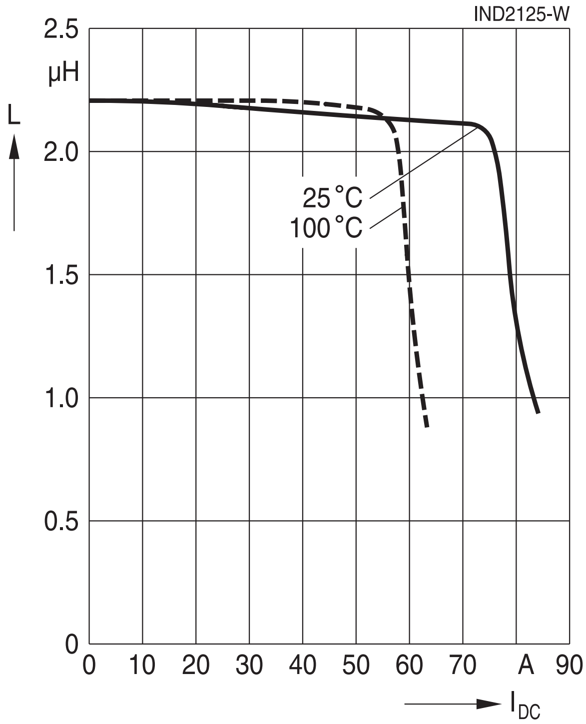
ERUC23-3R2K (L_3)



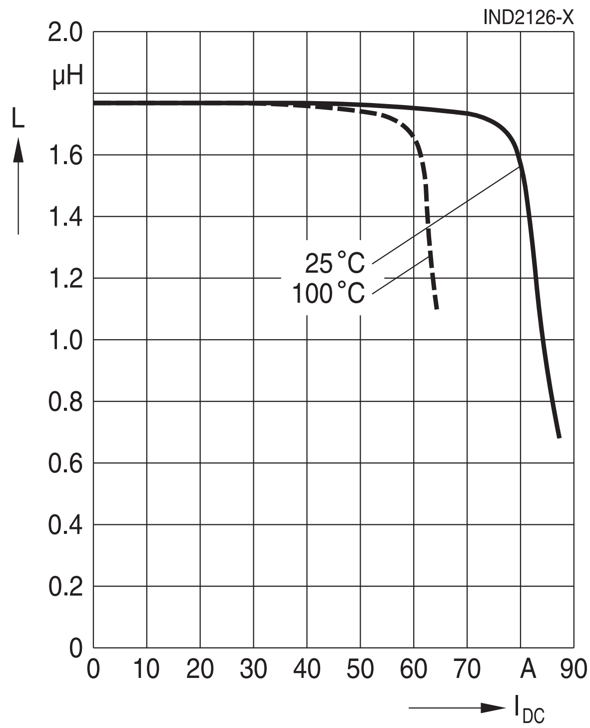
ERUC23-2R8K (L_3)



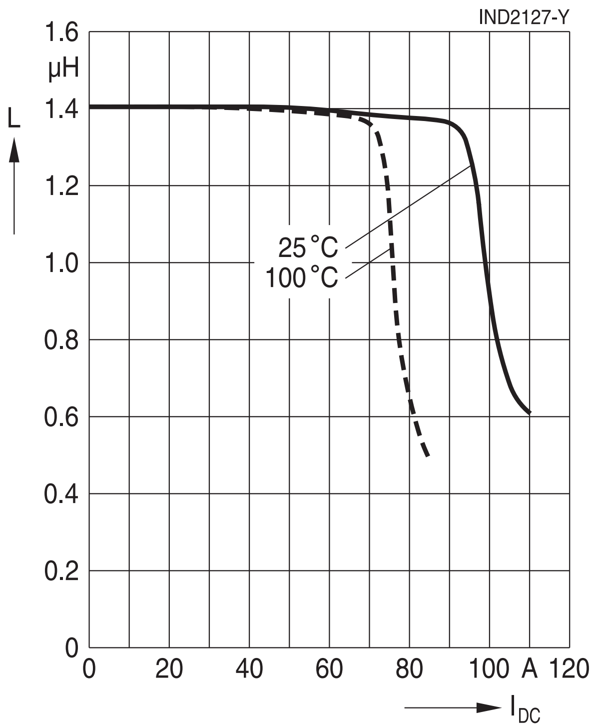
ERUC23-2R2K (L_3)



ERUC23-1R8K (L_3)



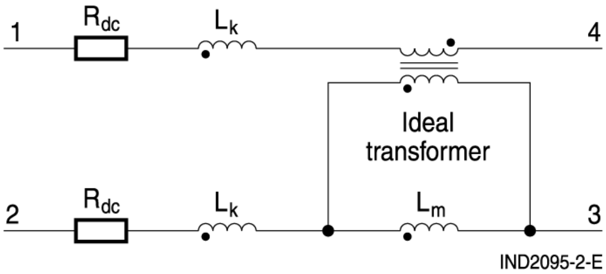
ERUC23-1R4K (L_3)



Application note

This coupled inductor can replace two single inductors in interleaved DC/DC circuits to improve efficiency and save space.

1) Simplified equivalent circuit for simulation



$L_k = 0.5 \bullet L_3$

$L_m = L_2$ (or L_1) – $0.5 \bullet L_3$

Example: ERUC23-4R1K (4.1 µH)

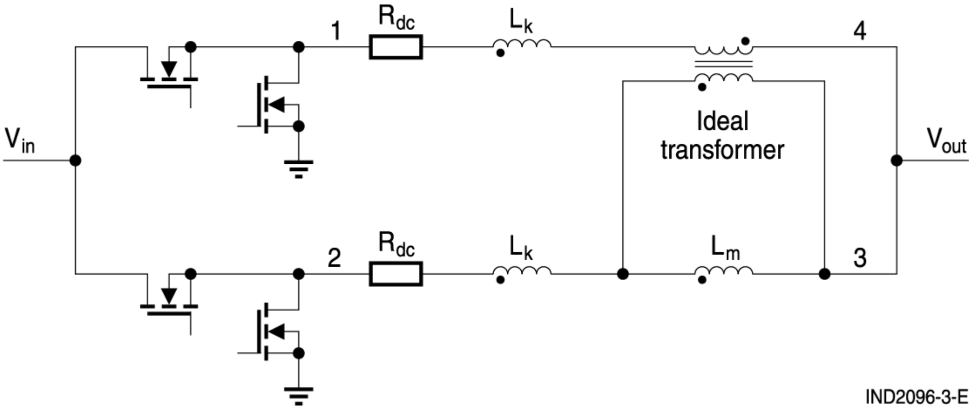
R_{DC} = 1.85 mΩ

L_k = 2.05 µH

L_m = 5.85 µH

2) Connection

Single inductors do not have polarity, but the connection is important to get the right performance for a coupled inductor, an incorrect connection would diminish the performance. In short, pin 1 & 2 should have the same functionality, pin 3 & 4 have the same functionality. For example in a buck circuit with two interleaved phases, if pin 1 and pin 2 are connected with switching devices such as mosfets, then pin 3 and pin 4 should be connected to the output as shown below.



The inductor is not limited to only buck topology but, can be considered in boost or buck-boost topology.

3) Saturation current margin consideration

For consideration of saturation current margin, L_m can be considered as zero inductance so that it would be equivalent to two single inductors with inductance L_k to calculate the I_{peak} to compare with specified saturation current of L_3.

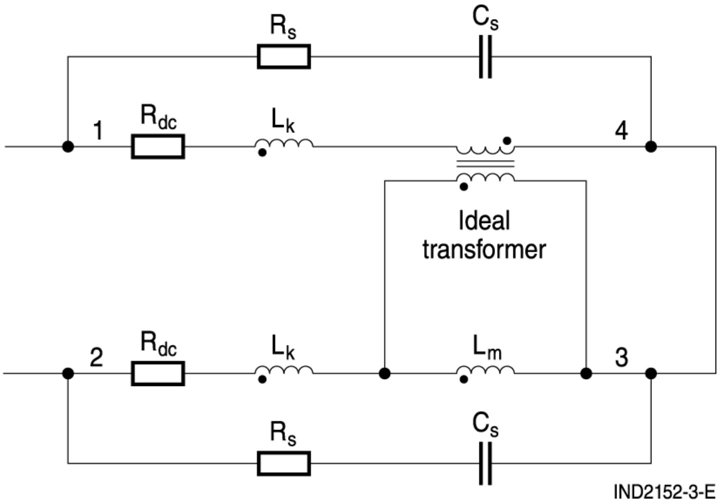
Example: ERUC23-4R1K (4.1 µH)
Use 2 individual 2.05 µH inductors to calculate the maximum peak current to compare with the saturation current listed in above table.

4) Loop stability consideration

For consideration of loop stability, L_m can be considered as zero inductance such that it would be equivalent to two individual inductors with inductance L_k for loop compensation.

Example: ERUC23-4R1K (4.1 µH)
Loop compensation for this inductor is same as circuit with two individual 2.05 µH inductors.

5) R_{dc} Current Sensing with RC filter

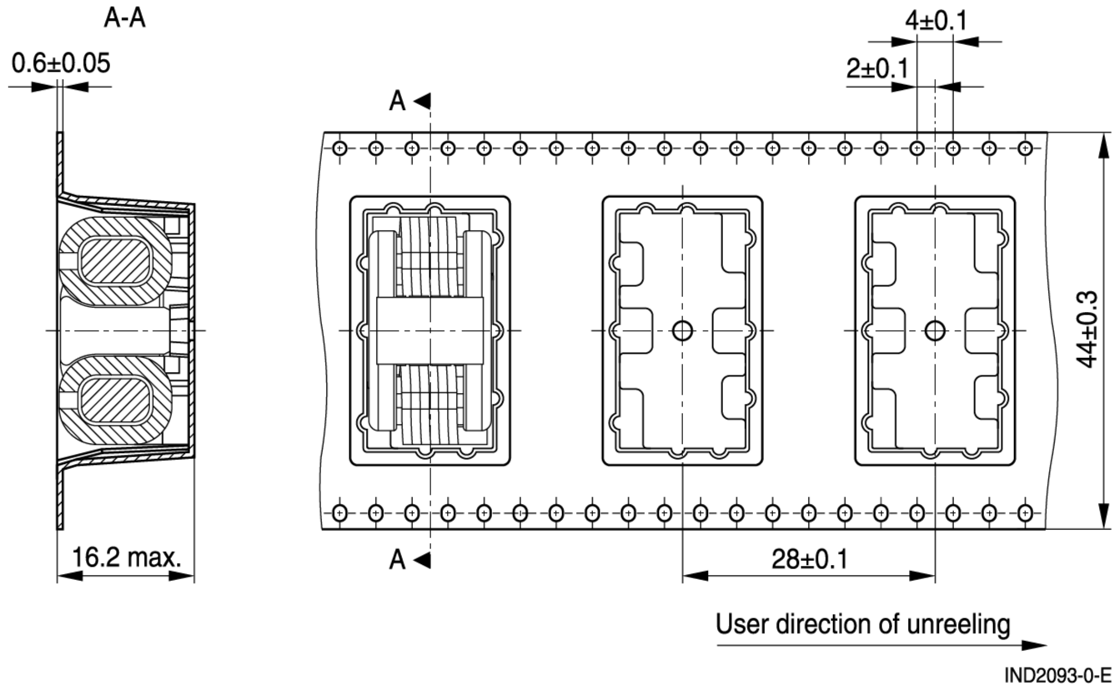


For R_{dc} current sensing in a coupled inductor, the calculation is $R_s \bullet C_s = L_k / R_{dc}$.
L_m does not affect the R_{dc} current sensing signal (the current signal on C_s is based on a ripple current of L_k with $L_m = 0$.

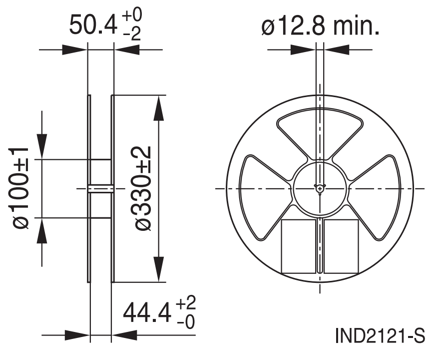
Example: ERUC23-4R1K (4.1 µH)
$R_s \bullet C_s = 2.05\ \mu H / 1.85\ m\Omega$

Blister tape and reel (mm)

Blister tape



Plastic reel



Cautions and warnings

- Please note the recommendations in our Inductors data book (latest edition), online catalogs and in the data sheets.
  - Particular attention should be paid to the derating curves, if given. Derating applies in the case the ambient temperature in application exceeds the rated temperature of the component.
  - Ensure the operation temperature of the component in application, not to exceed the maximum specified value or the upper climatic category temperature.
  - The soldering conditions should also be observed. Temperatures quoted in relation to wave soldering refer to the pin, not the housing.
- If the components are to be washed varnished it is necessary to check whether the washing varnish agent that is used has a negative effect on the wire insulation, any plastics that are used, or on glued joints. It is possible for washing varnish agent residues to have a negative effect in the long−term on wire insulation.

  Washing processes may damage the product due to the possible static or cyclic mechanical loads (e.g., ultrasonic cleaning). They may cause cracks to develop on the product and its parts, which might lead to reduced reliability or lifetime.
- The following points must be observed if the components are potted, sealed, or varnished in customer applications:
  - Many potting, sealing of varnishing materials shrink as they harden. They therefore exert a pressure on the plastic housing or core. This pressure can have a deleterious effect on electrical properties, and in extreme cases can damage the core or plastic housing mechanically.
  - It is necessary to check whether the potting, sealing or varnishing materials used attacks or destroys the wire insulation, plastics, or glue.
  - The effect of the potting, sealing, or varnishing materials may change the high−frequency behavior of the components.
- Magnetic core materials such as ferrites are sensitive to direct impact. This can cause the core material to flake or lead to breakage of the magnetic core material.
- Any type of tension or pressure on the product may result in damage and affect its functionality and reliability.
  - The products are only to be attached to fixings or mounting holes provided for this purpose in accordance with the data sheet.
  - If additional mechanical forces are applied to the component, e.g., application of gap pads, it is necessary to check whether they attack or destroy any part of the component.
  - It is not permitted for the product specified in the data sheet to assume a mechanical function in the final application.
- Inductance value can drop if external metallic or magnetic parts will be put close to the coil or into the air gap of the coil or core or magnetic material.
- Even for customer-specific products, conclusive validation of the component in the circuit can only be carried out by the customer.

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