SMT current sense transformers

EP11 series

Series/Type: **B78419A**

Date: June 2023

Construction

- Ferrite core MnZN
- SMD L Pin
- Primary winding: frame molded-in
- Secondary winding: copper wire

Features

- Very low DC resistance
- Different turn ratios
- Small SMD package
- RoHS compatible
- Qualified to AEC-Q200
- Insulation distances in compliance with IEC 61558-2-16

Applications

- Switch-mode power supplies
- Feedback control
- Overload sensing
- Load drop/shut down detection
- Switching current detection in on-board DC/DC converter and chargers

Insulation characteristics

- Plastic material UL94V-0, CTI ≥600 (class 1)
- Np (mould-in) / Ns (CuL) creepage ≥ 6mm, clearance ≥ 3.9mm
- Np / Core creepage ≥ 6 mm, clearance ≥ 4.9mm
- Basic Insulation Np/(Ns, core) U_{op} 1000V_{DC} ($U_{transient\ peak}$ 2.5kV P2, CTI 1)

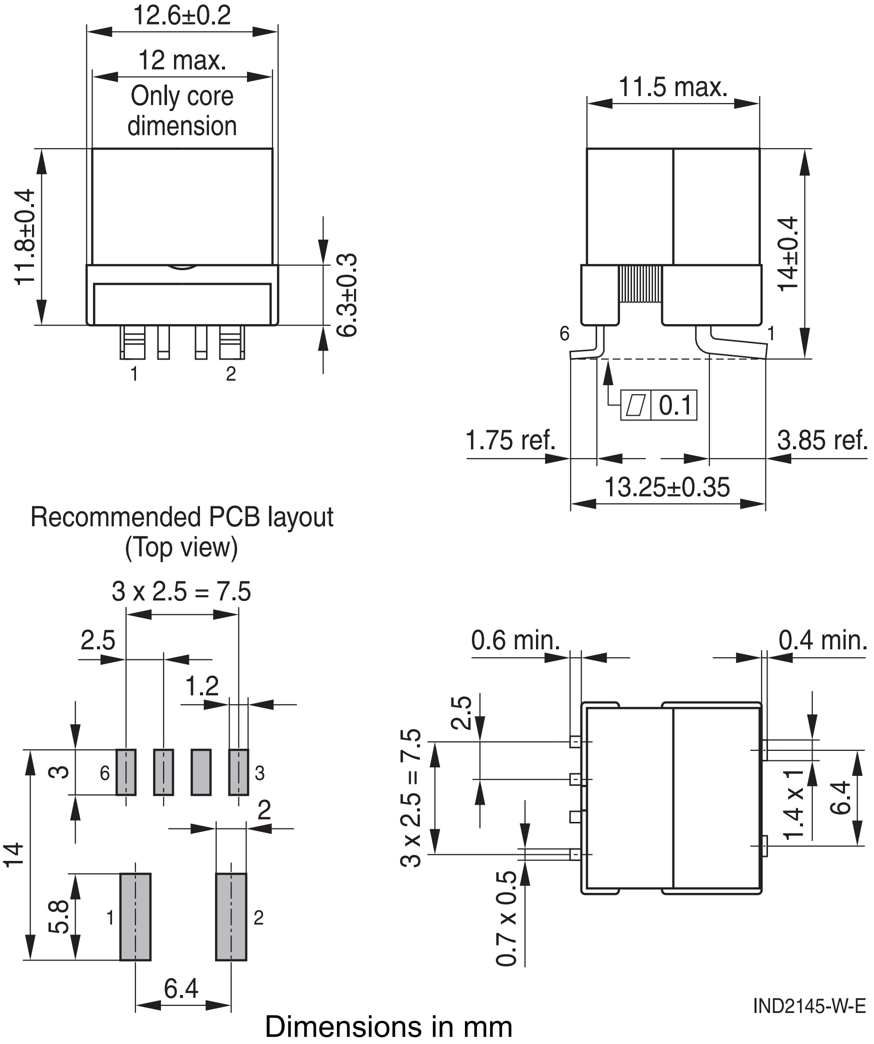
Marking

- Product brand, middle block of ordering code, date code, pin 1 marker, production place identification code

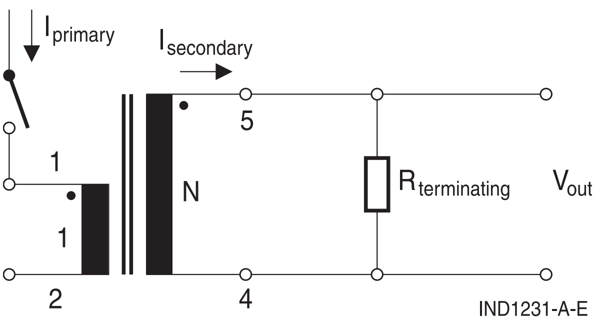
Delivery mode and packing units

- Blister tape 380 mm diameter
- Packing unit: 200 pcs. per reel

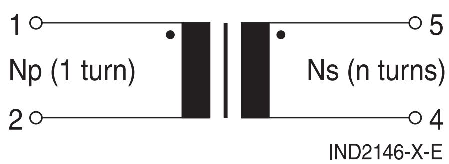
Dimensional drawing



Application circuit and pinning



Schematics



Technical data and measuring conditions

All data is specified at +25 °C if not mentioned otherwise. All values without tolerance are typical values.

Typical operational frequency	50 ... 400 kHz (typ.)[1)]
High voltage test AC Np / (Ns, core)	2.5 kVrms, 1 s
High voltage type test AC Np / (Ns, core)	3.375 kVrms, 60 s (type test)
Partial discharge inception voltage Np/Ns	>1500 V peak (type test)[2)]
Partial discharge extinction voltage Np/Ns	>1200 V peak (type test)[2)]
Impuls voltage withstanding 1.2/50µs	6 kV (type test)
Creepage distance Np / (Ns, core)	≥ 6 mm
Clearance distance Np / Ns	≥ 3.9 mm
Clearance distance Np / core	≥ 4.9 mm
Sensed current: I_{prim}	The primary current of 30A cause approx. +40°C temperature rise[3)]
Couple capacitance CP (1-5)	4 pF, Measured at 10 kHz, 1 V
Resistance to reflow soldering heat	In accordance with JEDEC J-STD-020D T_{peak} = +245 °C (T_{peak} -5° for 30 seconds)
Operating temperature range	–40 °C ... +150 °C (component)
Weight	Approx. 4.5 g

1) For higher frequency > 400 kHz and working voltage through the insulation shall be reduced according table 108 of IEC 61558-2-16:2021.
2) Partial discharge type test, refer to IEC 60664-1:
Extinction voltage for basic insulation ≥ $V_{op\ peak}$ x 1.2: 1000 V x 1.2 = min. 1200 V_{peak};
Inception voltage for basic insulation ≥ V_{op} x 1.5 = 1000 V x 1.5 = min.1500 V_{peak};
3) Measured under standard conditions to UL508. Final self-heating in the circuit depends on termination to the customer board

$$B_{max} = \frac{V_{out,max} \cdot \delta_{max}}{N_s \cdot A_e \cdot f_{osc}}$$

With:

B_{max}	Maximum magnetic flux density in the ferrite core of the current sense transformer
$V_{out,max}$	Maximum output voltage of the measurement signal
δ_{max}	Maximum duty cycle
N_s	Number of turns of the secondary winding of the current sense transformer
A_e	Effective magnetic area of the ferrite core
f_{osc}	Operating frequency of the switching operator IC
Typical value for A_e:	10.7×10^{-6} m^2
Typical B_{max}:	< 220 mT

$$R_T = \frac{V_{out,max} \cdot N_s}{I_{prim,max}}$$

With:

R_T	Resistance of burden resistor
$V_{out,max}$	Maximum output voltage of the measurement signal
N_s	Number of turns of the secondary side of the CST
$I_{prim,max}$	Maximum primary current (peak current)

Characteristics and ordering codes, Table 1

$L_{MIN\,(5\text{-}4)}$ mH	Turns ratio $N_p : N_s$	DC resistance R_{max} (mΩ) primary	secondary	Voltage time product at n_s[2] V • µs	Recommended R_T[1] Ω	Ordering code
1.2	1:50	0.5	1500	117	1.6	B78419A2452A003
2.8	1:70	0.5	2100	164	2.3	B78419A2453A003
6.5	1:100	0.5	3100	235	3.3	B78419A2454A003
7.5	1:125	0.5	4100	294	4.1	B78419A2455A003
18.0	1:180	0.5	7400	423	6.0	B78419A2456A003

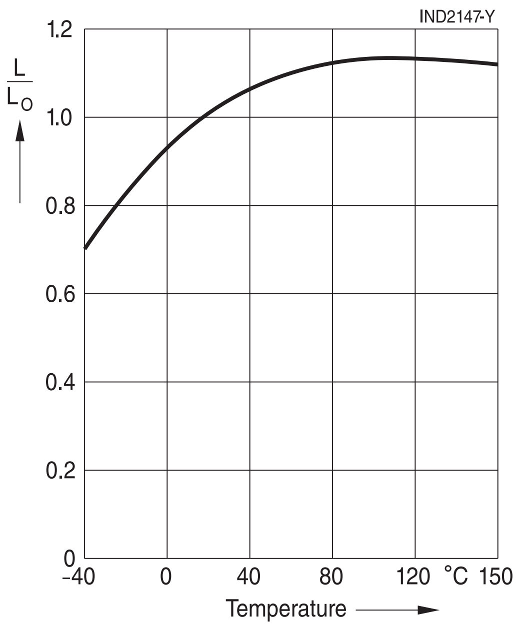
Characteristics and ordering codes, Table 2

$L_{NOM\,(1\text{-}2)}$ +/-12% mH	Turns ratio $N_p : N_s$	DC resistance R_{max} (mΩ) primary	secondary	Voltage time product at n_s[2] V • µs	Recommended R_T[1] Ω	Ordering code
2.5[3]	1:100	0.5	2700	235	3.3	B78419A2483A003

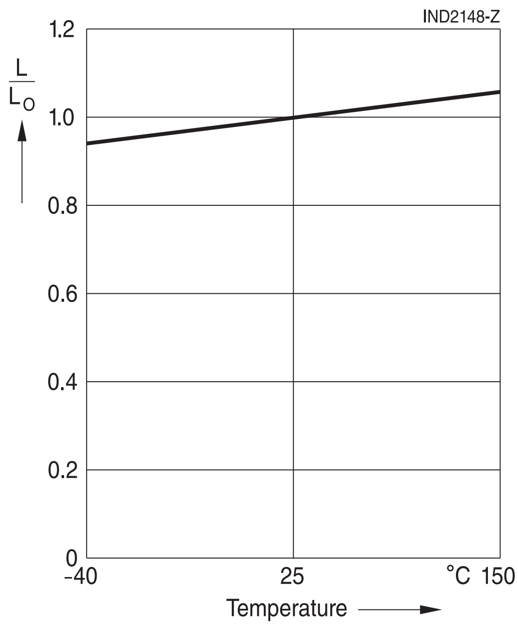
1) Burden Resistor value is calculated by taking V_{out} as 1 V reference and with maximum input current flowing through the input (30 A).
2) The maximum volt-second rating limits the peak flux density to 220 mT when used in an unipolar drive application. For bipolar drive applications, a maximum volt-sec of two times is acceptable.
3) Small air gap ensures tighter tolerance of inductance for better sensing accuracy

Inductance L as a function of temperature typical curves

Parts without air gap according table 1
$N_{(4\text{-}5)}$ L/Lo vs. Temperature

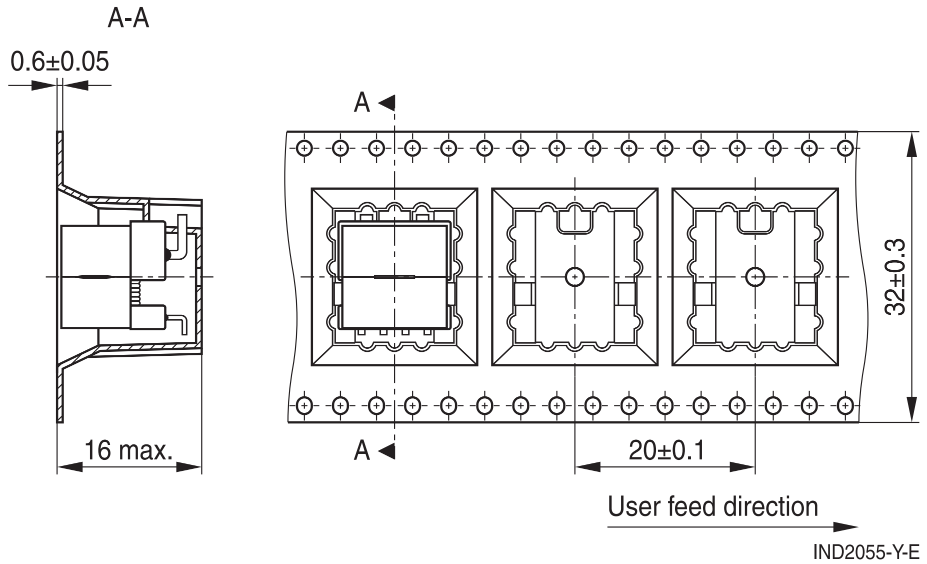


Parts with air gap according table 2
$N_{(4\text{-}5)}$ L/Lo vs. Temperature



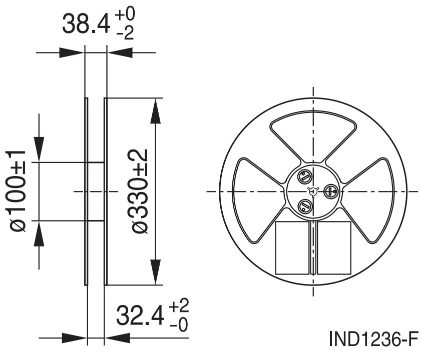
Taping and packing

Blister tape



Dimensions in mm

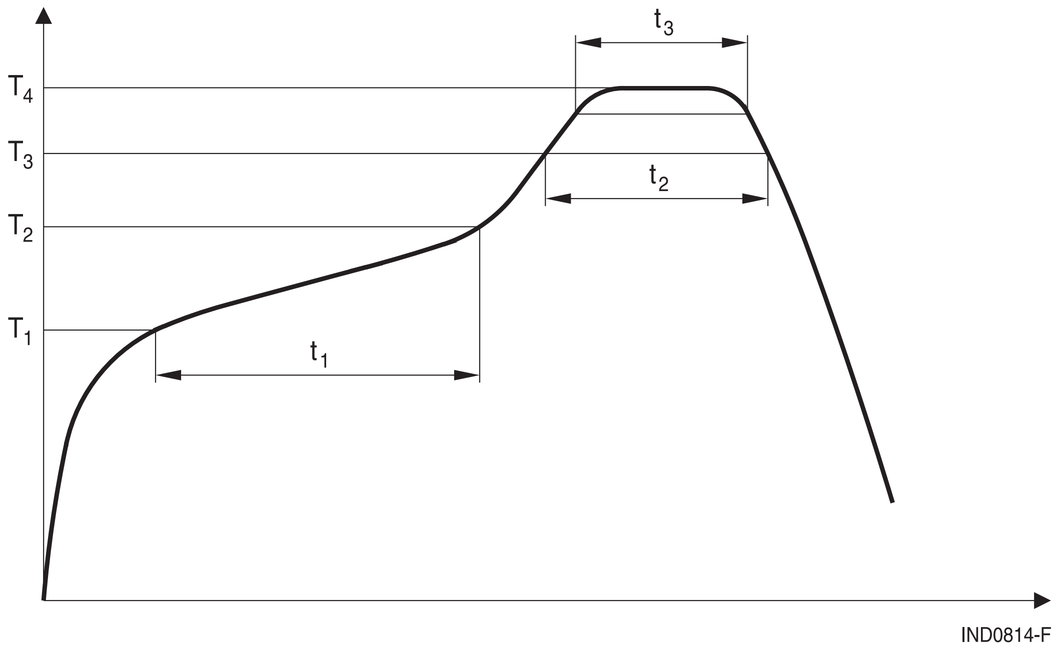
Reel



Dimensions in mm

Recommended reflow soldering curve

Pb-free solder material (based on JEDEC J-STD 020E)



T_1 °C	T_2 °C	T_3 °C	T_4 °C	t_1 sec	t_3 sec	t_3 sec
150	200	217	245	<110	<90	20 ... 40

Time from 25 °C to T_4: max. 480 s

Maximal numbers of reflow cycles: 3

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, or 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 attack or destroy 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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The ordering code for one and the same product can be represented differently in data sheets, data books, other publications, on the company website, or in order-related documents such as shipping notes, order confirmations and product labels. **The varying representations of the ordering codes are due to different processes employed and do not affect the specifications of the respective products**. Detailed information can be found on the Internet under www.tdk-electronics.tdk.com/orderingcodes.

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2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified.** In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or life-saving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.

3. **The warnings, cautions and product-specific notes must be observed**.

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Important notes

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