SMT current sense transformers

EP 7 core

Series/Type: B78417A2
Date: September 2019
Construction
- Ferrite core
- Primary winding: frame molded in
- Secondary winding: copper wire
- Creepage distance \( \text{Np}/(\text{Np, core}) \): 5 mm
- Clearance distance \( \text{Np}/\text{Ns} \) (CuL): 3.2 mm
- Clearance distance \( \text{Np}/\text{core} \): 3.5 mm
- Plastic bobbin (UL 94-V0, CTI \( \geq 175 \))

Applications
- Switch-mode power supplies
- Feedback control
- Overload sensing
- Load drop/shut-down detection

Features
- Very low DC resistance
- Different turns ratios
- Small SMD package
- RoHS compatible
- Qualified to AEC Q-200
- Insulation distances in compliance with IEC 60664
  (basic insulation, working voltage \( V_{RMS} = 500 \text{ V} \))
- UL 1446 Class 155 (F) electrical insulation system

Terminals
- SMD L pins

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

Delivery mode and packing units
- Blister tape
- Packing units: 320 pcs./reel
Dimensional drawing

Recommended PCB layout (Top view)

Application circuit and pinning
Technical data and measuring conditions
All data is specified at +25 °C if not mentioned otherwise. All values without tolerance are typical values.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency range</td>
<td>50 ... 500 kHz</td>
</tr>
<tr>
<td>High voltage test</td>
<td>2400 V AC, 50 Hz, 1 s (winding to winding), type test 60 s</td>
</tr>
<tr>
<td>Inductance L (5-4)</td>
<td>Measured at 20 kHz, 10 mV, +25 °C</td>
</tr>
<tr>
<td>DC resistance $R_{\text{max}}$ (1-2)</td>
<td>Measured at +25 °C</td>
</tr>
<tr>
<td>DC resistance $R_{\text{max}}$ (5-4)</td>
<td>Measured at +25 °C</td>
</tr>
<tr>
<td>Sensed current $I_{\text{prim, RMS}}$</td>
<td>The max. primary current of 20 A causes approx. +40 °C temperature rise</td>
</tr>
<tr>
<td>Couple capacitance $C_p$ (1-5)</td>
<td>Measured at 10 kHz, 1 V, +25 °C</td>
</tr>
<tr>
<td>Solderability</td>
<td>$\geq 99.9$ Sn, lead-free. or Sn96.5Ag3.0Cu0.5: +(245 ±5) °C, (3 ±0.3) s Wetting of soldering area $\geq 95%$ (to IEC 60068-2-58)</td>
</tr>
<tr>
<td>Resistance to soldering heat</td>
<td>In accordance with JEDEC J-STD-020D +245 °C (T$_{\text{peak}}$ –5 °C for 30 s)</td>
</tr>
<tr>
<td>Storage conditions (packaged)</td>
<td>–20 °C ... +40 °C, ≤ 75% RH</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>–40 °C ... +150 °C</td>
</tr>
<tr>
<td>Pollution degree</td>
<td>P2 (to IEC 61558-1, IEC 60664)</td>
</tr>
<tr>
<td>Insulation thermal class</td>
<td>+155 °C (F) (to IEC 60085)</td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 2.5 g</td>
</tr>
</tbody>
</table>
\[ B_{\text{max}} = \frac{V_{\text{sense, max}} \cdot \delta_{\text{max}}}{n_s \cdot A_e \cdot f_{\text{osc}}} \]

With:
- \( B_{\text{max}} \): Maximum magnetic flux density in the ferrite core of the current sense transformer
- \( V_{\text{sense, max}} \): Maximum output voltage of the measurement signal
- \( \delta_{\text{max}} \): 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
- \( f_{\text{osc}} \): Operating frequency of the switching operator IC

Typical value for \( A_e \): 10.6 \( \times \) 10^{-6} m²

Typical \( B_{\text{max}} \): 0.2 T

\[ R_T = \frac{V_{\text{sense, max}} \cdot n_s}{I_{\text{prim, max}}} \]

With:
- \( R_T \): Resistance of burden resistor
- \( V_{\text{sense, max}} \): Maximum output voltage of the measurement signal
- \( n_s \): Number of turns on the secondary side of the current sense transformer
- \( I_{\text{prim, max}} \): Maximum primary current (peak current)

### Characteristics and ordering codes

<table>
<thead>
<tr>
<th>( L_{\text{min}} ) (5-4)</th>
<th>Turns ratio</th>
<th>DC resistance ( R_{\text{max}} ) (mΩ)</th>
<th>Voltage-time product at ( n_s )(^{1)}</th>
<th>C_p</th>
<th>Recomm. ( R_T )</th>
<th>Ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{mH} )</td>
<td>( n_p : n_s )</td>
<td>(1-2) primary</td>
<td>(4-5) secondary</td>
<td>V ( \cdot ) μs</td>
<td>pF</td>
<td>Ω</td>
</tr>
<tr>
<td>1.7</td>
<td>1 : 50</td>
<td>1.9</td>
<td>2.1</td>
<td>116</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>3.0</td>
<td>1 : 70</td>
<td>1.9</td>
<td>2.9</td>
<td>163</td>
<td>4</td>
<td>70</td>
</tr>
<tr>
<td>7.0</td>
<td>1 : 100</td>
<td>1.9</td>
<td>5.0</td>
<td>233</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>11.0</td>
<td>1 : 125</td>
<td>1.9</td>
<td>5.3</td>
<td>291</td>
<td>4</td>
<td>125</td>
</tr>
</tbody>
</table>

\(^{1)}\) The maximum volt-sec rating limits the peak flux density to 200 mT when used in a unipolar drive application. For bipolar drive applications, a maximum volt-sec of two times is acceptable.
Taping and packing

Blister tape

Reel
Recommended reflow soldering curve

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

\[ \begin{array}{ccccccc}
T_1 & T_2 & T_3 & T_4 & T_1 & T_2 & T_3 \\
{^\circ C} & {^\circ C} & {^\circ C} & {^\circ C} & \text{sec} & \text{sec} & \text{sec} \\
150 & 200 & 217 & 245 & <110 & <90 & 20 \ldots 40 \\
\end{array} \]

Max. time from +25 °C to T: 300 seconds
Max. 3 reflow cycles
Please note the recommendations in our Inductors data book (latest edition) and in the data sheets.
- Particular attention should be paid to the derating curves given there.
- 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. In particular, 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 in customer applications:
- Many potting 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 material used attacks or destroys the wire, wire insulation, plastics or glue.
- The effect of the potting material can change the high-frequency behaviour of the components.
- Many coating materials have a negative effect (chemically and mechanically) on the winding wires, insulation materials and connecting points. Customers are always obligated to determine whether and to what extent their coating materials influence the component. Customers are responsible and bear all risk for the use of the coating material. TDK Electronics does not assume any liability for failures of our components that are caused by the coating material.

Ceramics / Ferrites are sensitive to direct impact. This can cause the core material to flake, or lead to breakage of the core.

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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Please read Cautions and warnings and Important notes at the end of this document.
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