Technical Report

Development of SMD Pulse Transformers for Ethernet Applications

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1. Background of development

Accompanying the spread of the internet and digital televisions in recent years, LAN interfaces have started to be included as standard features in AV equipment such as LCD TVs and information equipment such as PCs. In this LAN interface section, pulse transformers are invariably used for purposes such as insulation and noise elimination. Stabilization of the quality and supply of pulse transformers have become an important issue, accompanying the spread of LAN interfaces.

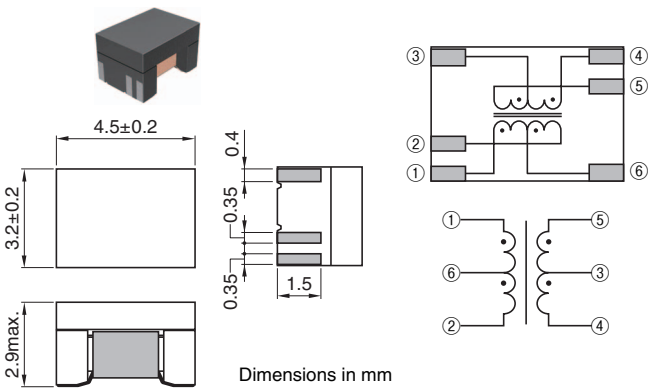
A pulse transformer consists of a ferrite core with wires wound around the primary and secondary sides and, since each wire is insulated, there is no electrical continuity. Signal transmission is carried out be means of a magnetic connection (mutual inductances between fluxes generated by an electrical current), and voltage proportional to the number of coils is induced.

TDK has produced a pulse transformer that is compatible with automated winding by applying the elemental technologies of its own coil products (Figure 1). In this report, we will provide an explanation of the developed product and the technologies regarding a surface mount type pulse transformer that is compatible with automated winding.

Figure 1 Comparison with existing products

Existing transformers (Toroidal cores) | ALT4532-001T (New core forms)

Figure 2 Shapes and dimensions/circuit diagram/ electical characteristics



Dimensions in mm

ELECTRICAL CHARACTERISTICS

Part No.	Turns ratio ①⑥②:④③⑤	Inductance [DC bias 8mA] ①-② (μH)min.	Insertion loss [0.1 to 100MHz] ①②-④⑤ (dB)max.	Inter winding capacitance [100kHz] ①②-④⑤ (pF)max.
ALT4532-001T	1CT:1CT	200	1.5	25

• Ta=25°C

2. Product characteristics

(1) Automated winding, assembly

Since general pulse transformers have been produced by winding wires around ferrite cores that are toroidal in shape, the automatization of production has been considered difficult. The winding procedure used to be carried out manually, requiring the management of coil variability and pretreatment of wiring before winding, making it difficult to carry out quality control of products.

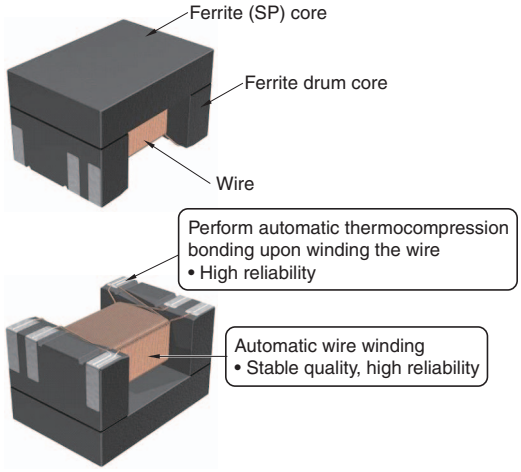
This product was designed to enable automatic manufacturing, through re-examination of the core form and the manufacturing method.

In addition to automatic wire winding, automatic thermocompression bonding has also been enabled for the connection between the electrode and the wire where manual wire treatment and soldering was once necessary, making it a product that is conscious of quality stability and production aspects (Figure 3).

In addition, where manufacturing of the existing products had been carried out semi-automatically by means of batch processing, from the stage of electric testing to the application of insulation tape, manufacturing of this product is carried out automatically as a continuous process.

TDK

Figure 3 Product outline

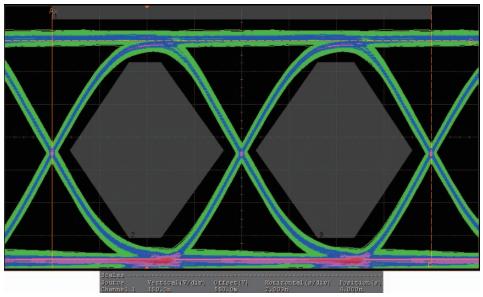


We have enabled quality improvement and supply stability, maintaining the same level of transmission characteristics possessed by our existing lines (Figure 4).

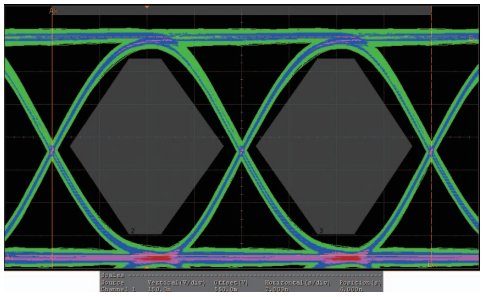
Figure 4 Transmission characteristics

Comparison of eye patterns when using ethernet

ALT4532-001T



TDK's existing product (TLA-6T213LF)



(2) Compatibility with product mounting (reflow soldering) and modularization

This is an SMD product* compatible with reflow soldering, and where mounting could once only be carried out after SMD packaging had been completed in existing lines, direct mounting is possible for this product. In addition, when application is made to products that are to be built into LAN interfaces, manual processes were once necessary in order to connect the substrate and the pulse transformer through complex wiring upon mounting and, afterwards, to affix the parts by means of manual soldering or by using resin.

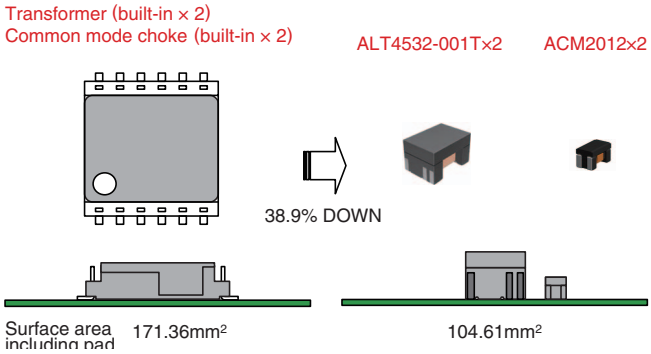
As for this product, the pulse transformer can be mounted onto the substrate together with other parts upon reflow soldering as an SMD type part. This makes it easier to simplify the existing process, enabling the stabilization of quality and product supply.

(3) Reduction of mounting space (upon single mounting)

The product size is set as L4.5×W3.2×T2.8 (2.9max.) mm, and since its mounting space will be smaller compared to previous products, it will be possible to satisfy user needs even when applied together with a common mode filter for noise elimination that works by transmitting differential signals. In cases where these products were mounted singularly to the substrate in combination with one of our noise countermeasure products (ACM series), we have been able to realize an approximately 40% reduction in mounting space (in-house comparison) (Figure 5).

Figure 5 Comparison of mounting cases

Example: When using 100BASE-TX



(4) Halogen-free compliance

As in the cases of our previous products, this is a completely lead-free product including absolutely no lead or lead compounds, is compatible with lead-free soldering, and is RoHS (EU's Restriction of the use of certain Hazardous Substances) compliant.

This product is also halogen-free since, in recent years, user companies have been promoting the elimination of halogen substances from end products as part of their own efforts, and requests for halogen-free products have been rising.

* SMD: Surface Mount Device
The technology for mounting electronic parts on circuit board is called the Surface Mounting Technology (SMT), and an electronic part compatible with this technology is called a Surface Mount Device (SMD).

3. Mounting to LAN interface-integrated products and product lineup

Demand for the aforementioned LAN interface-integrated products is increasing rapidly, accompanying the recent spread of various digital home appliances such as digital televisions, and stabilization of supply and quality is desired. In addition, as the need for smaller and thinner products is rising for LAN interface-integrated products, we are working to create a lineup of products that responds to market trends.

4. Summary

Accompanying the miniaturization and sophistication of electronic equipment, corresponding demands are made for electronic parts as well, and we expect that their importance will increase in the future. TDK plans to further work on the commercialization of electronic parts capable of responding to market demands by applying our unique elemental technologies of EMC products.

In addition, we intend to continue providing electronic parts that can serve in the market by making full use of TDK's unique processing techniques and material technologies.