

# Pulse transformers

## TLA /ALT series

Issue date: April 2012

- All specifications are subject to change without notice.
- Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

---

# PULSE TRANSFORMERS

## TLA/ALT SERIES

Contents	Page
<b>Pulse Transformers/Pin Terminal Type</b>	
TLA-3T101LF(-T) 10BASE-2/5/T .....	2
TLA-3T106LF(-T) 10BASE-T .....	4
TLA-3T107LF(-T) 10BASE-T .....	4
TLA-3T105LF(-T) 10BASE-T .....	6
TLA-3T109LF(-T) 10BASE-T .....	6
TLA-3T110LF(-T) 10BASE-T .....	6
TLA-3T112LF(-T) 10BASE-T .....	6
TLA-6T103LF(-T) 10/100BASE-TX .....	8
TLA-6T118LF(-T) 10/100BASE-TX .....	10
TLA-6T119LF(-T) 10/100BASE-TX .....	10
TLA-6T120LF(-T) 10/100BASE-TX .....	10
TLA-6T121LF(-T) 10/100BASE-TX .....	10
TLA-6T122LF(-T) 10/100BASE-TX .....	10
TLA-6T127LF(-T) 10/100BASE-TX, PoE .....	12
TLA-6T133WLF(-T) 10/100BASE-TX .....	14
TLA-6T214ALF(-T) 10/100/1000BASE-T .....	16
TLA-6T213LF(-T) 10/100/1000BASE-TX .....	18
TLA-7T201LF(-T) 10/100/1000BASE-TX .....	20
TLA-6T406(-T) 10/100BASE-TX .....	22
TLA-7T101LF(-T) 10/100/1000BASE-T .....	24
<b>Pulse Transformers/Connector Type</b>	
TLA-6T776F 10/100BASE-TX .....	26
TLA-6T785 10/100BASE-TX .....	28
<b>LC Modules</b>	
TLA-3M103LF(-T) 10BASE-T .....	30
<b>Pulse Transformers/SMD Type</b>	
ALT4532 .....	32

### Precautions

The TDK products in this data are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.).

They are neither intend nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (atomic energy control instruments, airplane or spaceship instruments, transportation instrument, traffic signal instruments, combustion control instrument, medical instruments, all types of safety devices, etc.).

- Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

# PULSE TRANSFORMERS TLA/ALT Series

## Pulse Transformers/Pin Terminal Type

### TLA-3T101LF(-T) ISO8802.3(IEEE802.3) 10BASE2/5/-T

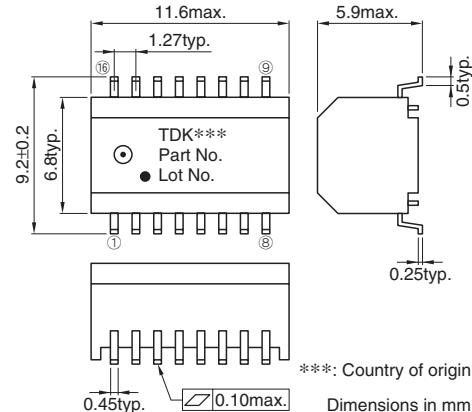
#### FEATURES

- Product conforming to RoHS directive.
- Can be mounted with lead-free solder (260°C max.).
- 16-pin SMD package(1.27mm=50mil pin pitch).
- Using the high-quality and wide-band ferrite cores for LAN.
- Packaging specification is taping and bulk(TLA-3T101LF-T: Tape and reel, TLA-3T101LF: Bulk).

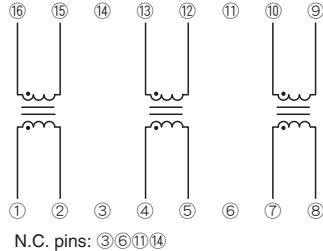
#### GENERAL SPECIFICATIONS

Pulse transformer	3
Port	1
Temperature ranges	Operating 0 to +70°C Storage -40 to +85°C
Withstanding voltage	Erms:2000V[60s]

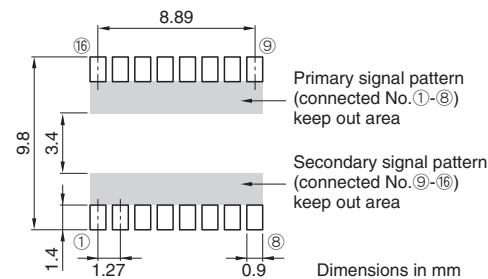
#### SHAPES AND DIMENSIONS



#### CIRCUIT DIAGRAM



#### RECOMMENDED PC BOARD PATTERN



#### ELECTRICAL CHARACTERISTICS

Part No.	Turns ratio ①②:⑯⑯ ④⑤:⑬⑯ ⑦⑧:⑩⑨	Inductance (μH)typ.[100kHz] ①-② ④-⑤ ⑦-⑧	Leakage inductance (μH)max.[100kHz] ①-②[⑯-⑯ shorted] ④-⑤[⑯-⑯ shorted] ⑦-⑧[⑯-⑨ shorted]	Inter-winding stray capacitance (pF)max.[100kHz] ①②-⑯⑯ ④⑤-⑬⑯ ⑦⑧-⑯⑨	DC resistance (Ω)max. ①-②,⑯-⑯ ④-⑤,⑬-⑯ ⑦-⑧,⑩-⑨
TLA-3T101LF(-T)	1:1	100	0.25	10	0.35, 0.35

• Ta=25°C

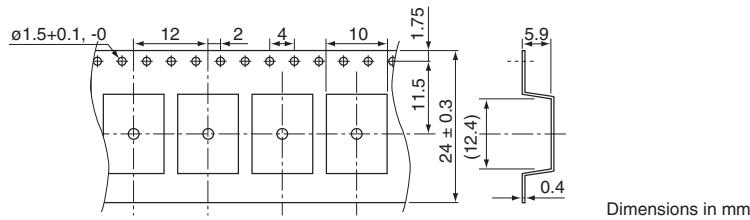
• Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

• All specifications are subject to change without notice.

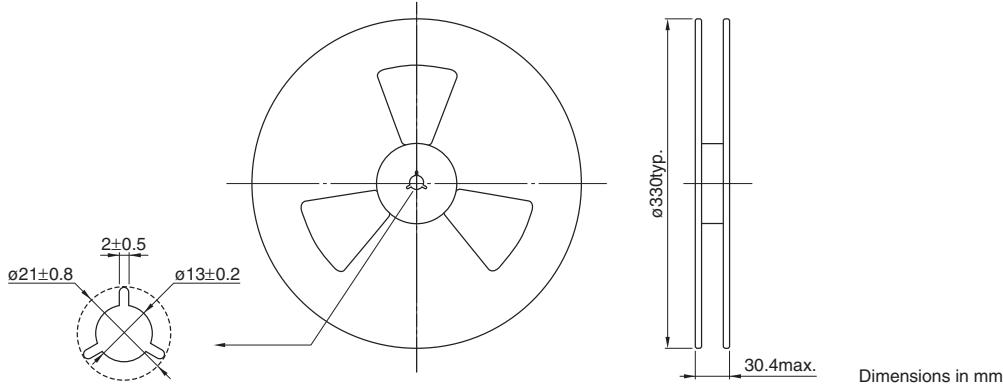
## PACKAGING STYLES

Quantity : 1000pieces/reel

## TAPE DIMENSIONS

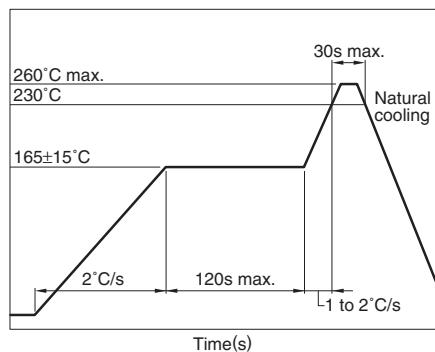


## REEL DIMENSIONS



## RECOMMENDED SOLDERING CONDITION

### REFLOW SOLDERING



- Temperature is measured at the terminal portion of product (Using thermocoupler for measurement).
- This profile is reference data we recommend. Please check in your actual process.
- For reliable soldering, the thickness of solder paste screen should be over the terminal co-planarity.
- The cutted end of terminal has no plating(out of subject of solder ability).

## RECOMMENDED CONDITION FOR LONG TERM STORE

When it stores for a long term, please avoid place of high temperature and high humidity. Recommend that it uses after the delivery within 1year.

Temperature range: +5 to +30°C

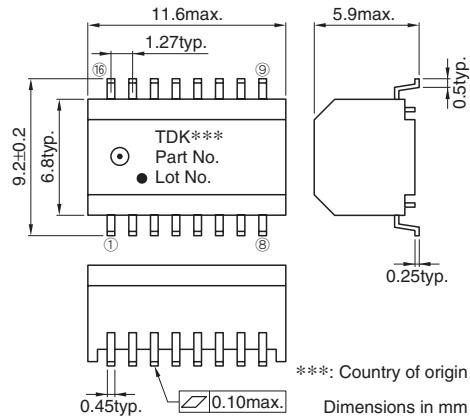
Humidity: 60(%)RH max.

## TLA-3T106LF(-T)/107LF(-T) ISO8802.3(IEEE802.3) 10BASE-T

## FEATURES

- Product conforming to RoHS directive.
- Can be mounted with lead-free solder (260°C max.).
- 16-pin SMD package(1.27mm=50mil pin pitch).
- Using the high-quality and wide-band ferrite cores for LAN.
- Packaging specification is taping and bulk(TLA-3T10□LF-T: Tape and reel, TLA-3T10 □LF: Bulk).

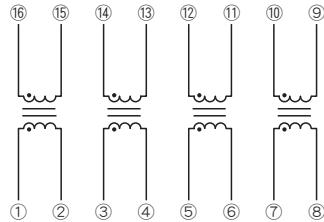
## SHAPES AND DIMENSIONS



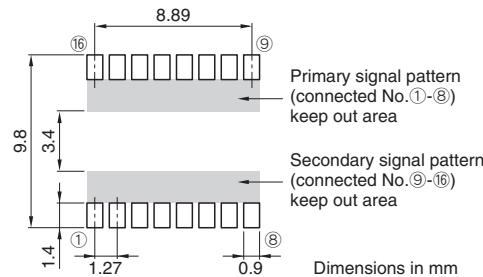
## GENERAL SPECIFICATIONS

Pulse transformer	4
Port	4
Temperature ranges	Operating 0 to +70°C Storage -40 to +85°C
Withstanding voltage	Erms: 2000V[60s]

## CIRCUIT DIAGRAM



## RECOMMENDED PC BOARD PATTERN



## ELECTRICAL CHARACTERISTICS

Part No.	Turns ratio ①②:⑯⑯ ③④:⑯⑯ ⑤⑥:⑯⑯ ⑦⑧:⑯⑯	Inductance (μH)min.[100kHz] ①-② ③-④ ⑤-⑥ ⑦-⑧	Leakage inductance (μH)max.[100kHz] ①-②[⑯-⑯ shorted] ③-④[⑯-⑯ shorted] ⑤-⑥[⑯-⑯ shorted] ⑦-⑧[⑯-⑯ shorted]	Inter-winding stray capacitance (pF)max.[100kHz] ①②-⑯⑯ ③④-⑯⑯ ⑤⑥-⑯⑯ ⑦⑧-⑯⑯	DC resistance (Ω)max. ①-②, ⑯-⑯ ③-④, ⑯-⑯ ⑤-⑥, ⑯-⑯ ⑦-⑧, ⑯-⑯
TLA-3T106LF(-T)	1:1	130	0.3	12	0.4, 0.4
TLA-3T107LF(-T)	1:1.41	130	0.3	12	0.4, 0.5

• Ta=25°C

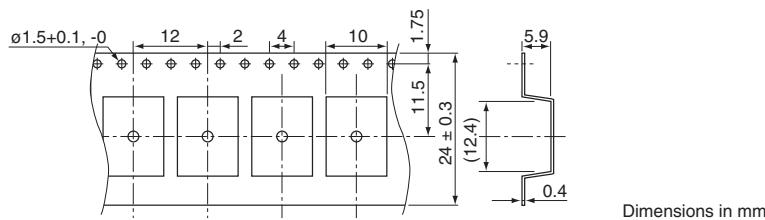
- Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

- All specifications are subject to change without notice.

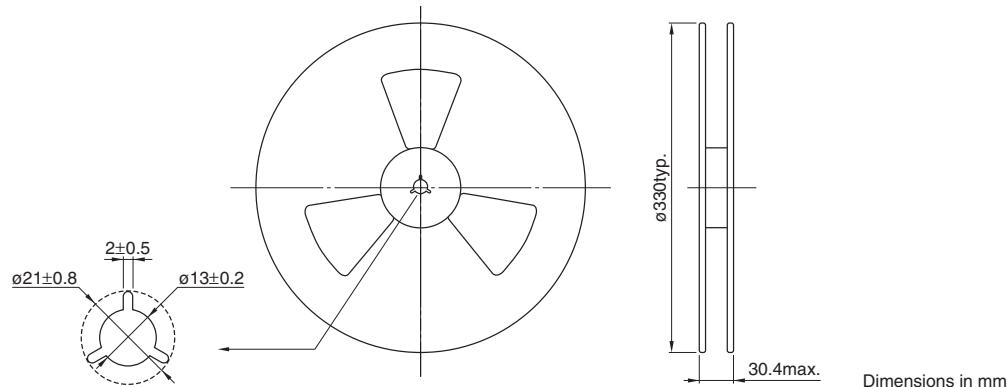
## PACKAGING STYLES

Quantity : 1000pieces/reel

## TAPE DIMENSIONS

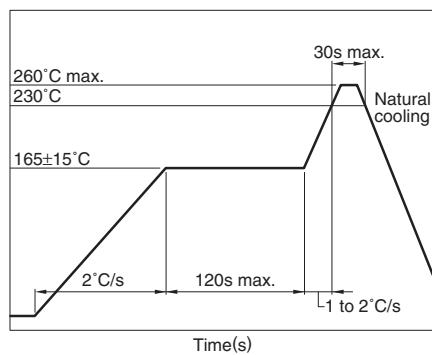


## REEL DIMENSIONS



## RECOMMENDED SOLDERING CONDITION

### REFLOW SOLDERING



- Temperature is measured at the terminal portion of product (Using thermocoupler for measurement).
- This profile is reference data we recommend. Please check in your actual process.
- For reliable soldering, the thickness of solder paste screen should be over the terminal co-planarity.
- The cutted end of terminal has no plating(out of subject of solder ability).

## RECOMMENDED CONDITION FOR LONG TERM STORE

When it stores for a long term, please avoid place of high temperature and high humidity. Recommend that it uses after the delivery within 1year.

Temperature range: +5 to +30°C

Humidity: 60(%)RH max.

TLA-3T105LF(-T)/109LF(-T)/110LF(-T)/112LF(-T) ISO8802.3(IEEE802.3) 10BASE-T

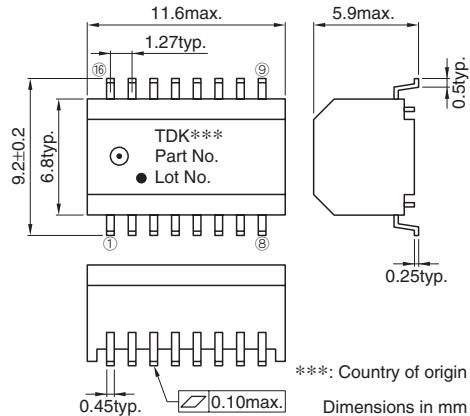
## FEATURES

- Product conforming to RoHS directive.
- Can be mounted with lead-free solder (260°C max.).
- 16-pin SMD package(1.27mm=50mil pin pitch).
- Using the high-quality and wide-band ferrite cores for LAN.
- Packaging specification is taping and bulk(TLA-3T1 □□LF-T:  
Tape and reel, TLA-3T1 □□LF: Bulk).

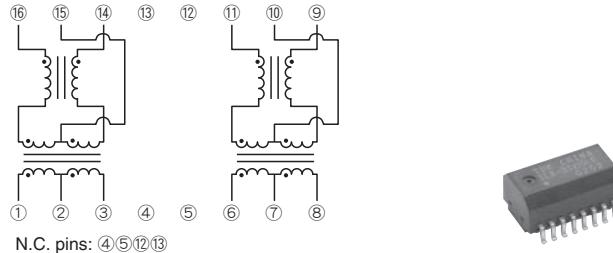
## GENERAL SPECIFICATIONS

Pulse transformer	2
Common-mode choke	2
Port	1
Temperature ranges	Operating 0 to +70°C Storage -40 to +85°C
Withstanding voltage	Erms: 2000V[60s]

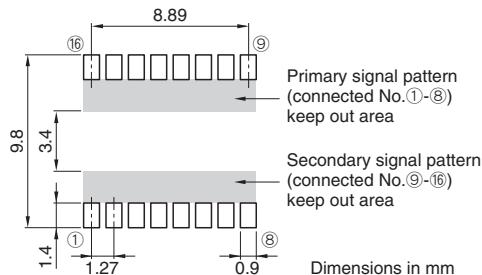
## SHAPES AND DIMENSIONS



## CIRCUIT DIAGRAM



## RECOMMENDED PC BOARD PATTERN



## ELECTRICAL CHARACTERISTICS

Part No.	Turns ratio	Inductance ( $\mu$ H)min.[100kHz]	Leakage inductance ( $\mu$ H)max.[100kHz]	Inter-winding stray capacitance (pF)max.[100kHz]	DC resistance ( $\Omega$ )max.
	①②③:⑯⑯⑯⑯	①-③	①-③[⑯-⑯ shorted]	①③-⑯⑯	①-③
	⑥⑦⑧:⑯⑯⑯⑯	⑥-⑧	⑥-⑧[⑯-⑯ shorted]	⑥⑧-⑯⑯	⑥-⑧
TLA-3T105LF(-T)	1CT:1CT	130	0.3	12	0.5
	1CT:1CT	130	0.3	12	0.5
TLA-3T109LF(-T)	2CT:1CT	130	0.95	12	0.5
	1CT:1CT	130	0.35	12	0.5
TLA-3T110LF(-T)	1CT:1CT	130	0.35	12	0.5
	1CT:1.41CT	130	0.35	12	0.5
TLA-3T112LF(-T)	1CT:1CT	130	0.35	12	0.85
	1CT:2.5CT	130	0.35	12	0.85

- $T_a=25^\circ\text{C}$

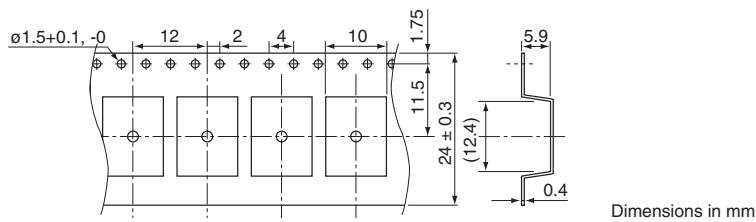
- Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

- All specifications are subject to change without notice.

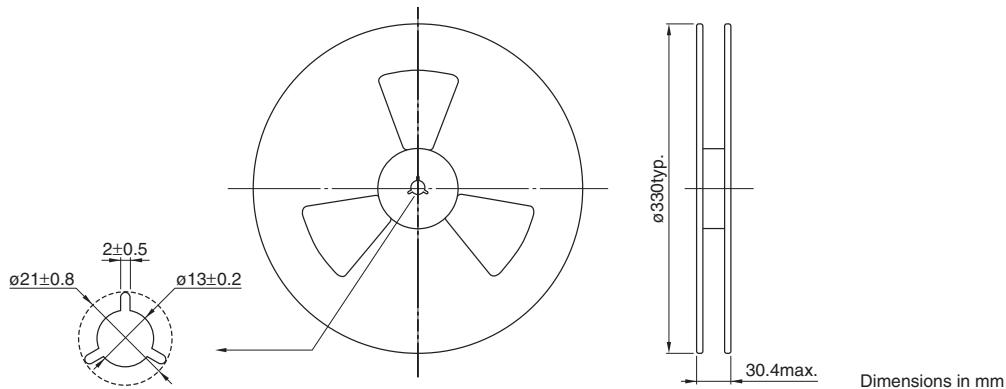
## PACKAGING STYLES

Quantity : 1000pieces/reel

### TAPE DIMENSIONS

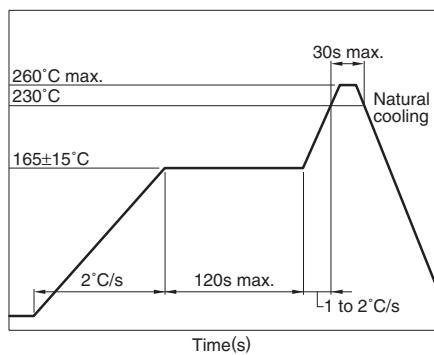


### REEL DIMENSIONS



### RECOMMENDED SOLDERING CONDITION

#### REFLOW SOLDERING



- Temperature is measured at the terminal portion of product (Using thermocoupler for measurement).
- This profile is reference data we recommend. Please check in your actual process.
- For reliable soldering, the thickness of solder paste screen should be over the terminal co-planarity.
- The cutted end of terminal has no plating(out of subject of solder ability).

### RECOMMENDED CONDITION FOR LONG TERM STORE

When it stores for a long term, please avoid place of high temperature and high humidity. Recommend that it uses after the delivery within 1year.

Temperature range: +5 to +30°C

Humidity: 60(%)RH max.

## TLA-6T103LF(-T) ISO8802.3(IEEE802.3) 10/100BASE-TX &amp; ATM

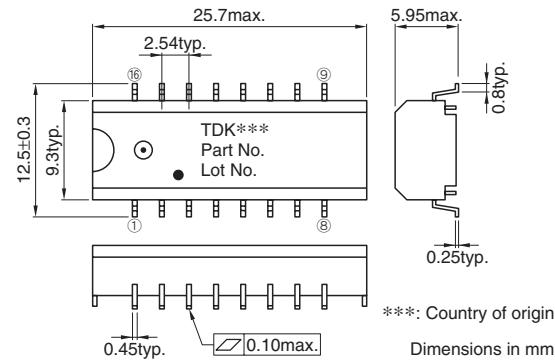
## FEATURES

- Product conforming to RoHS directive.
- Can be mounted with lead-free solder (260°C max.).
- 16-pin SMD package(2.54mm=100mil pin pitch).
- Excellent common-mode noise suppression.
- Inductance is 350 $\mu$ H or greater (f=100kHz, DC bias=8mA).
- Using the high-quality and wide-band ferrite cores for LAN.
- Packaging specification is taping and bulk(TLA-6T103LF-T: Tape and reel, TLA-6T103LF: Bulk).

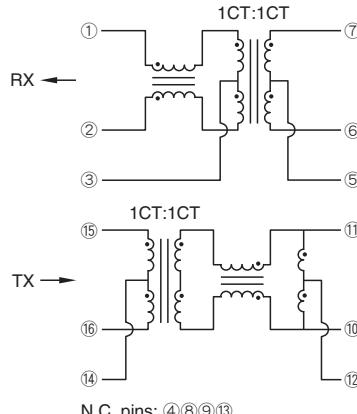
## GENERAL SPECIFICATIONS

Pulse transformer	2
Common-mode choke	2
Inductor	1
Port	1
Temperature ranges	Operating 0 to +70°C Storage -40 to +85°C
Withstanding voltage	Erms:1500V[60s]

## SHAPES AND DIMENSIONS

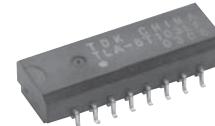
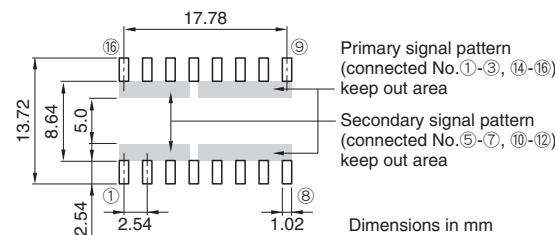


## CIRCUIT DIAGRAM



N.C. pins: ④⑧⑨⑬

## RECOMMENDED PC BOARD PATTERN



## ELECTRICAL CHARACTERISTICS

Part No.	Turns ratio (15)⑯ : (11)⑯ (1)③(2) : (7)⑤(6)	Inductance ( $\mu$ H)min. [DC bias 8mA, 100kHz] (11)-⑩ (7)-⑥	Insertion loss (dB)max. [0.1 to 100MHz] (15)⑯-(11)⑩ (7)⑥-(1)②	Inter-winding stray capacitance (pF)max.[100kHz] (15)⑯-(11)⑩ (1)②-(7)⑥
TLA-6T103LF(-T)	1CT:1CT	350	1	25
	1CT:1CT	350	1	25

• Ta=25°C

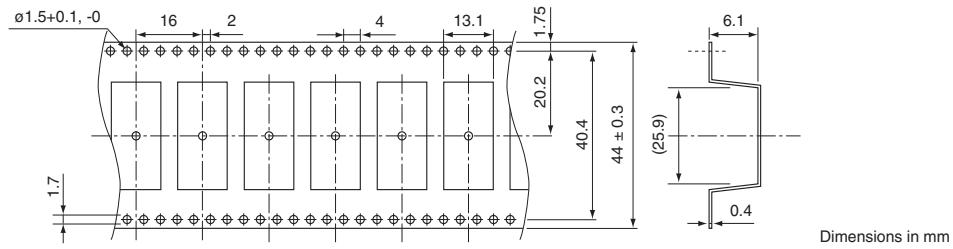
• Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

• All specifications are subject to change without notice.

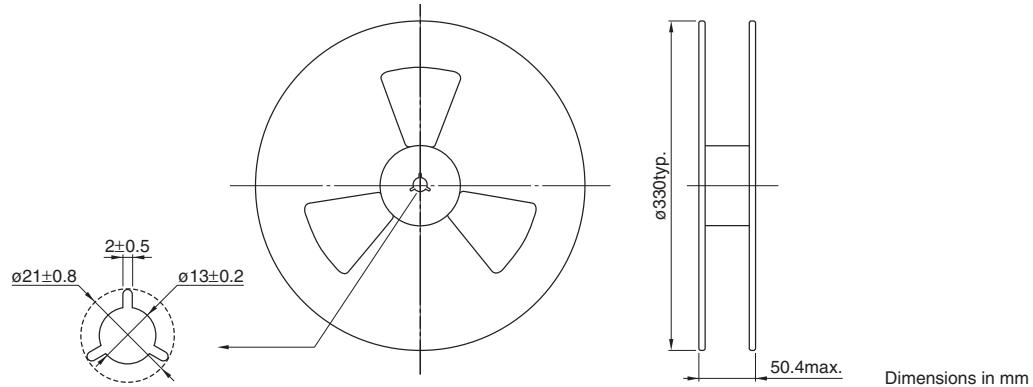
## PACKAGING STYLES

Quantity : 600pieces/reel

## TAPE DIMENSIONS

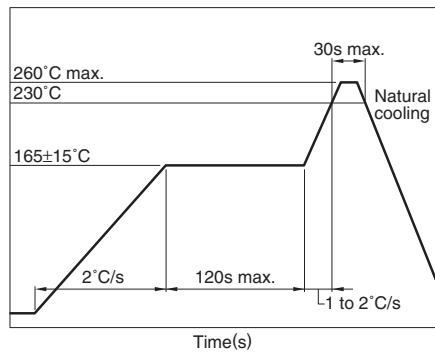


## REEL DIMENSIONS



## RECOMMENDED SOLDERING CONDITION

### REFLOW SOLDERING



- Temperature is measured at the terminal portion of product (Using thermocoupler for measurement).
- This profile is reference data we recommend. Please check in your actual process.
- For reliable soldering, the thickness of solder paste screen should be over the terminal co-planarity.
- The cutted end of terminal has no plating(out of subject of solder ability).

## RECOMMENDED CONDITION FOR LONG TERM STORE

When it stores for a long term, please avoid place of high temperature and high humidity. Recommend that it uses after the delivery within 1year.

Temperature range: +5 to +30°C

Humidity: 60(%)RH max.

## TLA-6T118LF/119LF/120LF/121LF/122LF(-T) ISO8802.3(IEEE802.3) 10/100BASE-TX

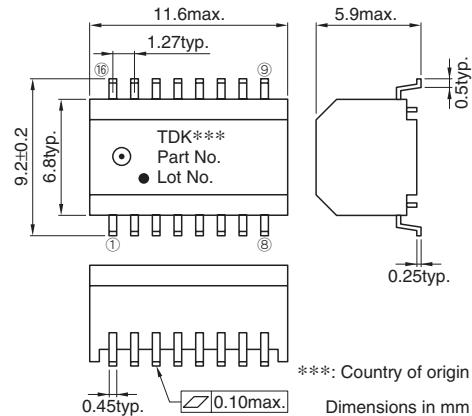
## FEATURES

- Product conforming to RoHS directive.
- Can be mounted with lead-free solder (260°C max.).
- 16-pin SMD package(1.27mm=50mil pin pitch).
- Excellent common mode noise suppression.
- Inductance is 350 $\mu$ H or greater (f=100kHz, DC bias=8mA).
- Using the high-quality and wide-band ferrite cores for LAN.
- Packaging specification is taping and bulk(TLA-6T1□□LF-T: Tape and reel, TLA-6T1 □□LF: Bulk).

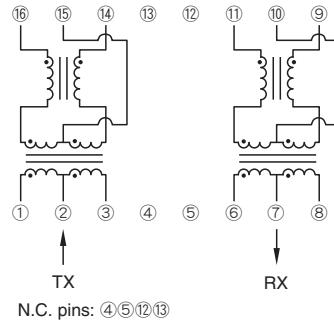
## GENERAL SPECIFICATIONS

Pulse transformer	2
Common-mode choke	2
Port	1
Temperature ranges	Operating 0 to +70°C Storage -40 to +85°C
Withstanding voltage	Erms:1500V[60s]

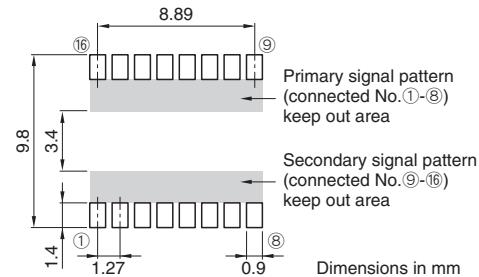
## SHAPES AND DIMENSIONS



## CIRCUIT DIAGRAM



## RECOMMENDED PC BOARD PATTERN



## ELECTRICAL CHARACTERISTICS

Part No.	Turns ratio ①②③ : ⑯⑮⑯ ⑥⑦⑧ : ⑪⑩⑨	Inductance ( $\mu$ H)min. [DC bias 8mA, 100kHz] ⑯-⑯ ⑯-⑨	Insertion loss (dB)max. [0.1 to 100MHz] ①③-⑯⑯ ⑯⑨-⑥⑧	Inter-winding stray capacitance (pF)max.[100kHz] ①③-⑯⑯ ⑥⑧-⑯⑨
TLA-6T118LF(-T)	1CT:1CT	350	1	25
	1CT:1CT	350	1	25
TLA-6T119LF(-T)	1.41CT:1CT	350	2	25
TLA-6T120LF(-T)	2CT:1CT	350	3.5	25
	1CT:1CT	350	1	25
TLA-6T121LF(-T)	1CT:1.41CT	350	2.5	25
	1CT:1CT	350	1	25
TLA-6T122LF(-T)	1.25CT:1CT	350	2	25
	1CT:1CT	350	1	25

• Ta=25°C

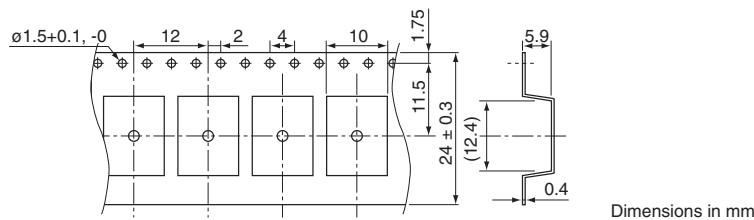
• Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

• All specifications are subject to change without notice.

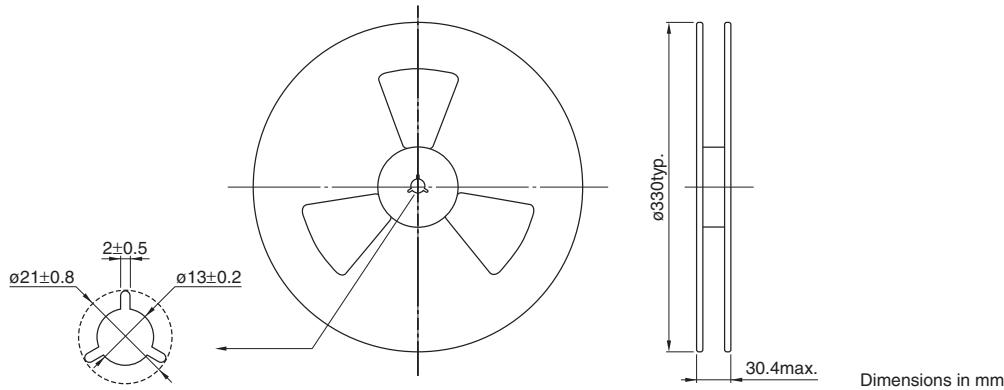
## PACKAGING STYLES

Quantity : 1000pieces/reel

### TAPE DIMENSIONS

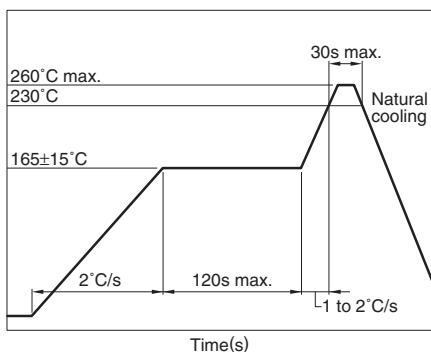


### REEL DIMENSIONS



### RECOMMENDED SOLDERING CONDITION

#### REFLOW SOLDERING



- Temperature is measured at the terminal portion of product (Using thermocoupler for measurement).
- This profile is reference data we recommend. Please check in your actual process.
- For reliable soldering, the thickness of solder paste screen should be over the terminal co-planarity.
- The cutted end of terminal has no plating(out of subject of solder ability).

### RECOMMENDED CONDITION FOR LONG TERM STORE

When it stores for a long term, please avoid place of high temperature and high humidity. Recommend that it uses after the delivery within 1year.

Temperature range: +5 to +30°C

Humidity: 60(%)RH max.

## TLA-6T127LF(-T) ISO8802.3(IEEE802.3) 10/100BASE-TX, POWER OVER ETHERNET

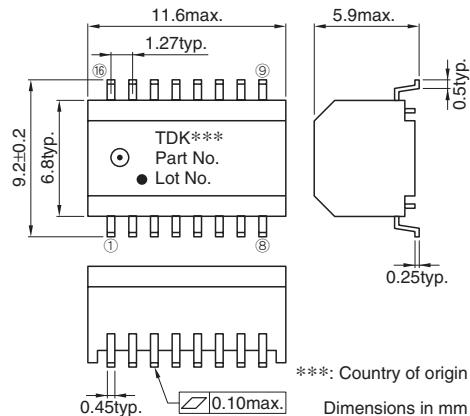
## FEATURES

- Product conforming to RoHS directive.
- Can be mounted with lead-free solder (260°C max.).
- 16-pin SMD package(1.27mm=50mil pin pitch).
- Inductance is 350 $\mu$ H or greater (f=100kHz, DC bias=8mA).
- Allowable current is 350mA max.
- Excellent common mode noise suppression under the power transmission.
- Packaging specification is taping and bulk(TLA-6T127LF-T: Tape and reel, TLA-6T127LF: Bulk).

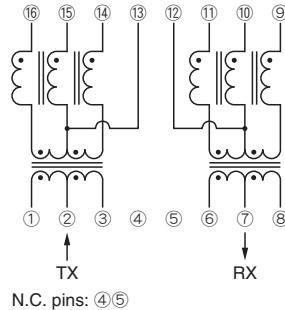
## GENERAL SPECIFICATIONS

Pulse transformer	2
Common-mode choke	2
Port	1
Temperature ranges	Operating 0 to +70°C Storage -40 to +85°C
Withstanding voltage	Erms:1500V[60s]

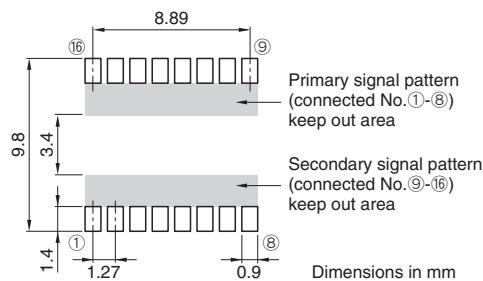
## SHAPES AND DIMENSIONS



## CIRCUIT DIAGRAM



## RECOMMENDED PC BOARD PATTERN



## ELECTRICAL CHARACTERISTICS

Part No.	Turns ratio ①②③ : ⑯⑯⑯⑯ ⑥⑦⑧ : ⑪⑩⑨	Inductance ( $\mu$ H)min. [DC bias 8mA, 100kHz] ⑯-⑯ ⑯-⑯ ⑯-⑯	Insertion loss (dB)max. [0.1 to 100MHz] ①③-⑯⑯ ⑯-⑯ ⑯-⑯	Inter-winding stray capacitance (pF)max.[100kHz] ①③-⑯⑯ ⑥⑧-⑯⑯
TLA-6T127LF(-T)	1CT:1CT	350	1	25
	1CT:1CT	350	1	25

• Ta=25°C

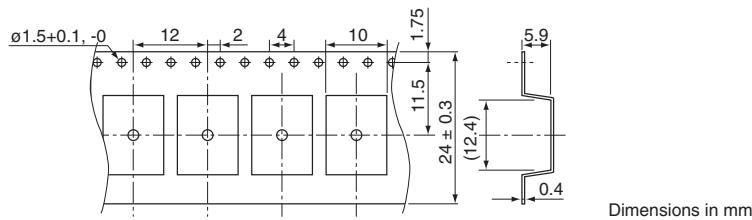
• Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

• All specifications are subject to change without notice.

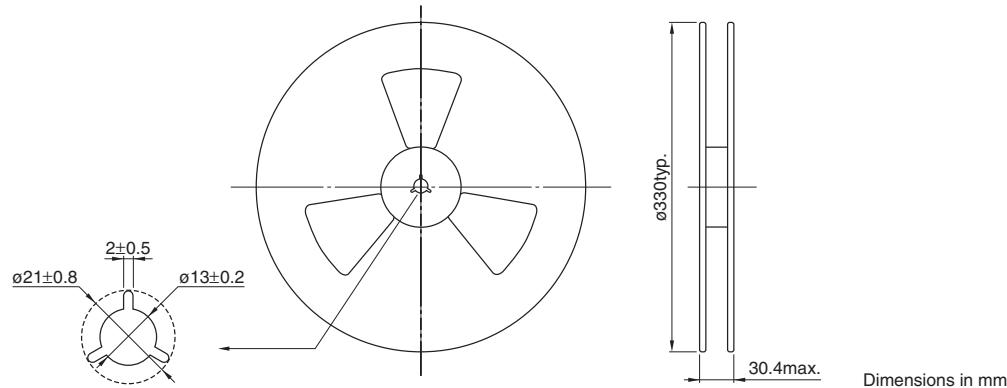
## PACKAGING STYLES

Quantity : 1000pieces/reel

## TAPE DIMENSIONS

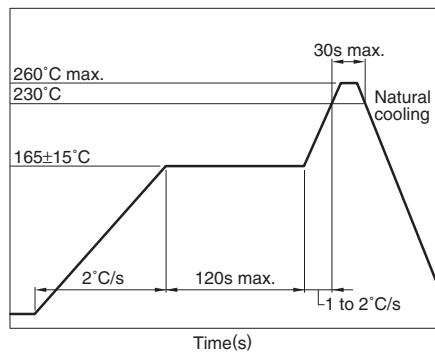


## REEL DIMENSIONS



## RECOMMENDED SOLDERING CONDITION

### REFLOW SOLDERING



- Temperature is measured at the terminal portion of product (Using thermocoupler for measurement).
- This profile is reference data we recommend. Please check in your actual process.
- For reliable soldering, the thickness of solder paste screen should be over the terminal co-planarity.
- The cutted end of terminal has no plating(out of subject of solder ability).

## RECOMMENDED CONDITION FOR LONG TERM STORE

When it stores for a long term, please avoid place of high temperature and high humidity. Recommend that it uses after the delivery within 1year.

Temperature range: +5 to +30°C

Humidity: 60(%)RH max.

## TLA-6T133WLF(-T) ISO8802.3(IEEE802.3) 10/100BASE-TX

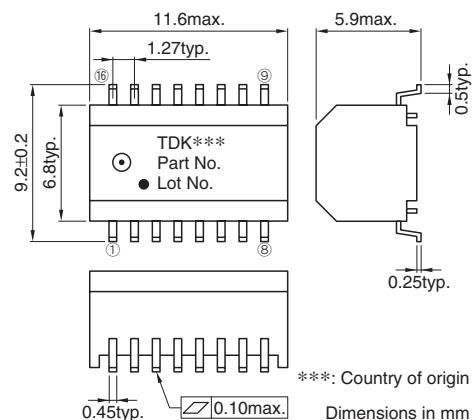
## FEATURES

- Can be used in the wide range of temperature(-40 to +85°C).
- Product conforming to RoHS directive.
- Can be mounted with lead-free solder (260°C max.).
- 16-pin SMD package(1.27mm=50mil pin pitch).
- Excellent common mode noise suppression.
- Inductance is 350 $\mu$ H or greater (f=100kHz, DC bias=8mA).
- Using the high-quality and wide-band ferrite cores for LAN.
- Packaging specification is taping and bulk(TLA-6T133WLF-T: Tape and reel, TLA-6T133WLF: Bulk).

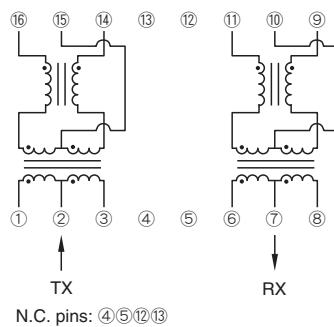
## GENERAL SPECIFICATIONS

Pulse transformer	2
Common-mode choke	2
Port	1
Temperature ranges	Operating: -40 to +85°C Storage: -40 to +85°C
Withstanding voltage	Erms:1500V[60s]

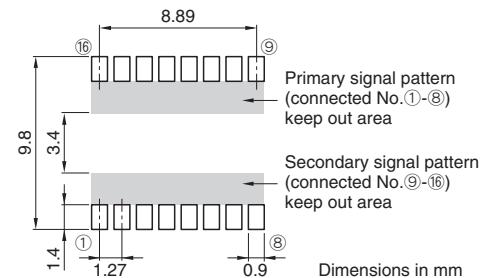
## SHAPES AND DIMENSIONS



## CIRCUIT DIAGRAM



## RECOMMENDED PC BOARD PATTERN



## ELECTRICAL CHARACTERISTICS

Part No.	Turns ratio ①②③ : ⑯⑯⑯⑯ ⑥⑦⑧ : ⑪⑩⑨	Inductance ( $\mu$ H)min. [DC bias 8mA, 100kHz] ⑯-⑯ ⑯-⑨	Insertion loss (dB)max. [0.1 to 100MHz] ①③-⑯⑯ ⑯⑨-⑥⑧	Inter-winding stray capacitance (pF)max.[100kHz] ①③-⑯⑯ ⑥⑧-⑯⑨
TLA-6T133WLF(-T)	1CT:1CT	350	1	25
	1CT:1CT	350	1	25

• Ta=25°C

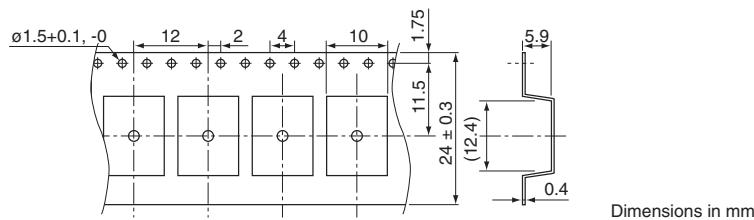
• Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

• All specifications are subject to change without notice.

## PACKAGING STYLES

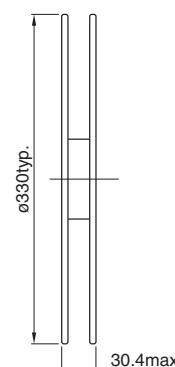
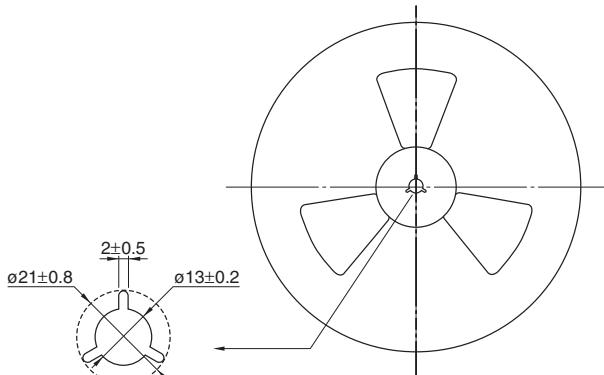
Quantity : 1000pieces/reel

## TAPE DIMENSIONS



Dimensions in mm

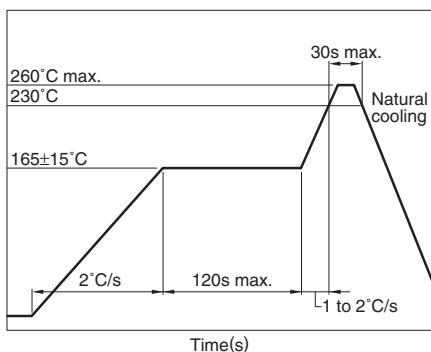
## REEL DIMENSIONS



Dimensions in mm

## RECOMMENDED SOLDERING CONDITION

### REFLOW SOLDERING



- Temperature is measured at the terminal portion of product (Using thermocoupler for measurement).
- This profile is reference data we recommend. Please check in your actual process.
- For reliable soldering, the thickness of solder paste screen should be over the terminal co-planarity.
- The cutted end of terminal has no plating(out of subject of solder ability).

## RECOMMENDED CONDITION FOR LONG TERM STORE

When it stores for a long term, please avoid place of high temperature and high humidity. Recommend that it uses after the delivery within 1year.

Temperature range: +5 to +30°C

Humidity: 60(%)RH max.

## TLA-6T214ALF(-T) ISO8802.3(IEEE802.3) 10/100/1000BASE-T

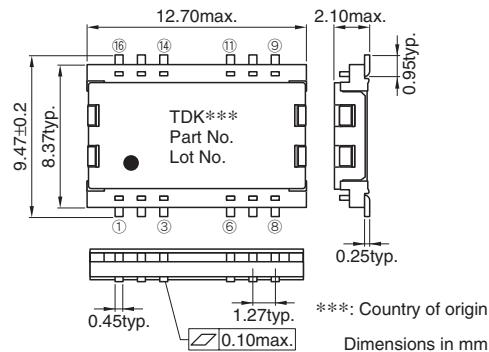
## FEATURES

- Product conforming to RoHS directive.
- Can be mounted with lead-free solder (260°C max.).
- 16-pin SMD package(1.27mm=50mil pin pitch).
- Low profile (H)2.1mm max. for note PC application.
- Excellent common mode noise suppression.
- Inductance is 350 $\mu$ H or greater (f=100kHz, DC bias=8mA).
- Using the high-quality and wide-band ferrite cores for LAN.
- Packaging specification is taping and bulk(TLA-6T214ALF-T: Tape and reel, TLA-6T214ALF: Bulk).

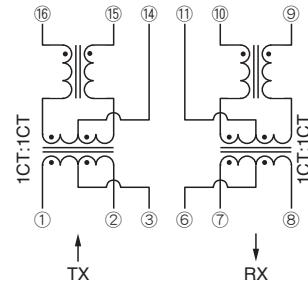
## GENERAL SPECIFICATIONS

Pulse transformer	2
Common-mode choke	2
Port	1
Temperature ranges	Operating 0 to +70°C Storage -40 to +85°C
Withstanding voltage	Erms:1500V[60s]

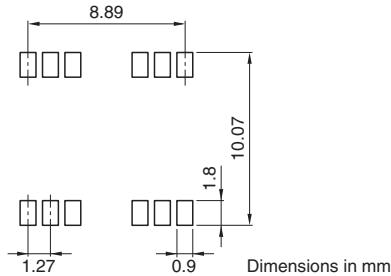
## SHAPES AND DIMENSIONS



## CIRCUIT DIAGRAM



## RECOMMENDED PC BOARD PATTERN



## ELECTRICAL CHARACTERISTICS

Part No.	Turns ratio ①③②:⑯⑭⑮ ⑦⑥⑧:⑩⑪⑨	Inductance ( $\mu$ H)min. [DC bias 8mA, 100kHz] ⑯-⑮ ⑩-⑨	Insertion loss (dB)max. [0.1 to 125MHz] ①②-⑯⑮ ⑩⑨-⑦⑧	Inter-winding stray capacitance (pF)max.[100kHz] ①②-⑯⑮ ⑩⑨-⑦⑧
TLA-6T214ALF(-T)	1CT:1CT 1CT:1CT	350 350	1 1	25 25

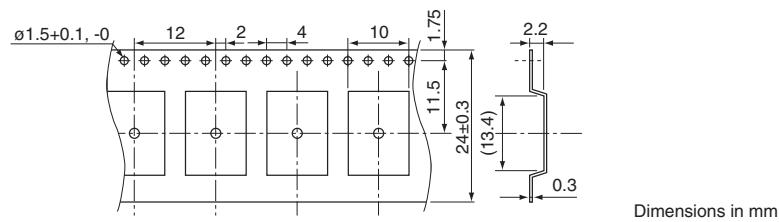
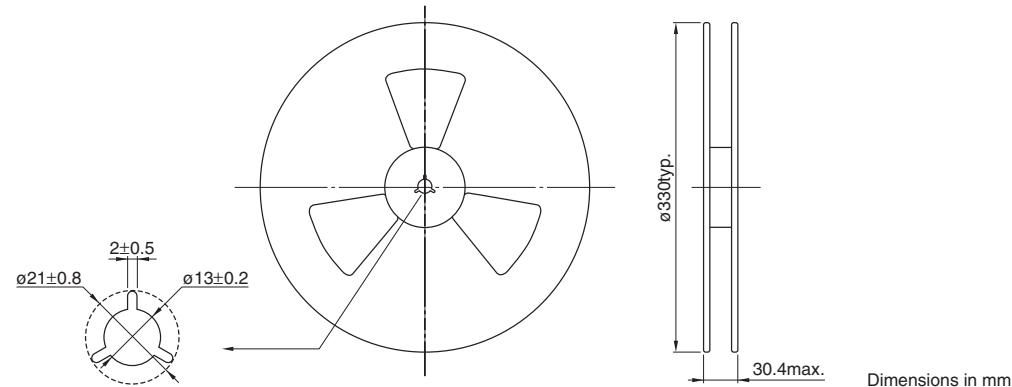
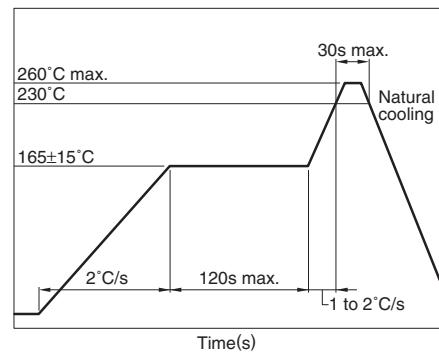
• Ta=25°C

• Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

• All specifications are subject to change without notice.

**PACKAGING STYLES**

Quantity : 1500pieces/reel

**TAPE DIMENSIONS****REEL DIMENSIONS****RECOMMENDED SOLDERING CONDITION****REFLOW SOLDERING**

- Temperature is measured at the terminal portion of product (Using thermocoupler for measurement).
- This profile is reference data we recommend. Please check in your actual process.
- For reliable soldering, the thickness of solder paste screen should be over the terminal co-planarity.
- The cutted end of terminal has no plating(out of subject of solder ability).

**RECOMMENDED STORE CONDITION**

The product is packaged by Anti-humid Al bag, in order to keep a good solder ability condition and resistance to soldering heat for products.

- Before aluminum bag opening  
Temperature range: +5 to +40°C  
Humidity: 90(%)RH max.  
Storage period: 1year
- After aluminum bag opening  
Temperature range: +5 to +30°C  
Humidity: 60(%)RH max.  
Storage period: 1week

## TLA-6T213LF(-T) ISO8802.3(IEEE802.3) 10/100/1000BASE-T

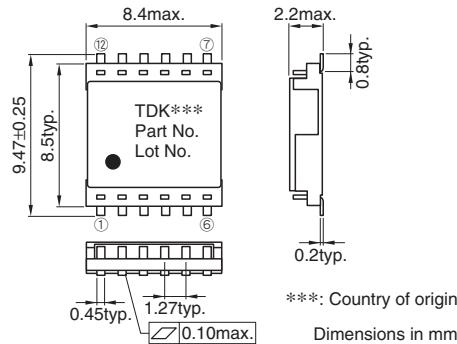
## FEATURES

- Product conforming to RoHS directive.
- Can be mounted with lead-free solder (260°C max.).
- 12-pin SMD package(1.27mm=50mil pin pitch).
- Because it is low profile design of 2.2mm max., space saving is possible and is suitable for notebook PC.
- Excellent common mode noise suppression.
- Inductance is 350 $\mu$ H or greater (f=100kHz, DC bias=8mA).
- Using the high-quality and wide-band ferrite cores for LAN.
- Packaging specification is taping and bulk(TLA-6T213LF-T: Tape and reel, TLA-6T213LF: Bulk).

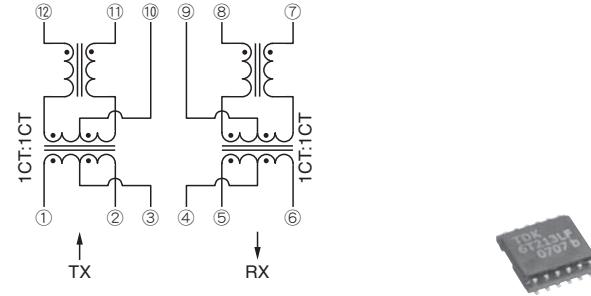
## GENERAL SPECIFICATIONS

Pulse transformer	2
Common-mode choke	2
Port	1
Temperature ranges	Operating 0 to +70°C Storage -40 to +85°C
Withstanding voltage	Erms:1500V[60s]

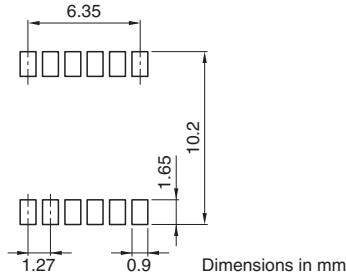
## SHAPES AND DIMENSIONS



## CIRCUIT DIAGRAM



## RECOMMENDED PC BOARD PATTERN



## ELECTRICAL CHARACTERISTICS

Part No.	Turns ratio ①③②:⑫⑩⑪ ⑤④⑥:⑧⑨⑦	Inductance ( $\mu$ H)min. [DC bias 8mA, 100kHz] ⑫-⑪ ⑧-⑦	Insertion loss (dB)max. [0.1 to 100MHz] ①②-⑫⑪ ⑧⑦-⑤⑥	Inter-winding stray capacitance (pF)max.[100kHz] ①②-⑫⑪ ⑧⑦-⑤⑥
TLA-6T213LF(-T)	1CT:1CT	350	1	25

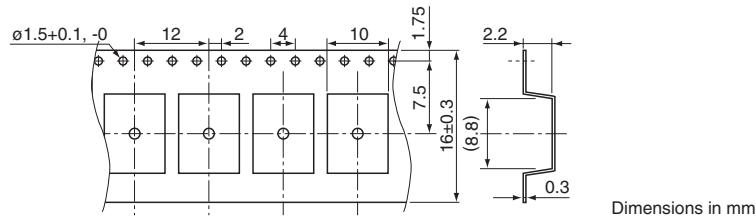
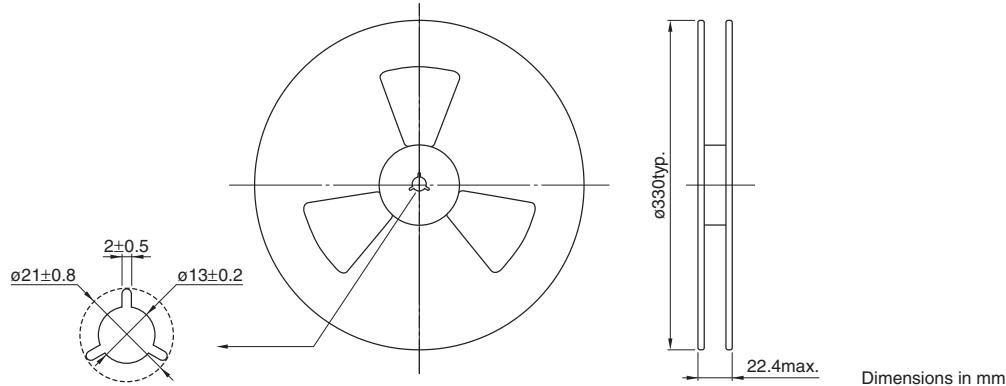
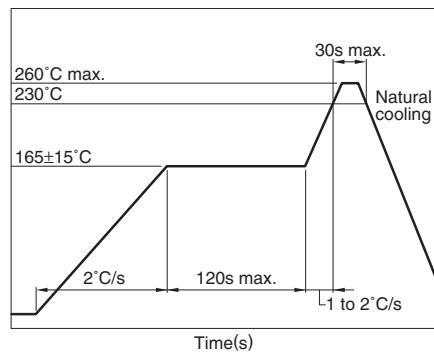
• Ta=25°C

• Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

• All specifications are subject to change without notice.

**PACKAGING STYLES**

Quantity : 1500pieces/reel

**TAPE DIMENSIONS****REEL DIMENSIONS****RECOMMENDED SOLDERING CONDITION****REFLOW SOLDERING**

- Temperature is measured at the terminal portion of product (Using thermocoupler for measurement).
- This profile is reference data we recommend. Please check in your actual process.
- For reliable soldering, the thickness of solder paste screen should be over the terminal co-planarity.
- The cutted end of terminal has no plating(out of subject of solder ability).

**RECOMMENDED STORE CONDITION**

The product is packaged by Anti-humid Al bag, in order to keep a good solder ability condition and resistance to soldering heat for products.

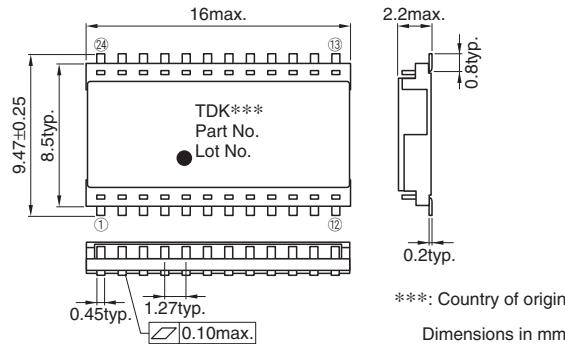
- Before aluminum bag opening  
Temperature range: +5 to +40°C  
Humidity: 90(%)RH max.  
Storage period: 1year
- After aluminum bag opening  
Temperature range: +5 to +30°C  
Humidity: 60(%)RH max.  
Storage period: 1week

## TLA-7T201LF(-T) ISO8802.3(IEEE802.3) 10/100/1000BASE-T

## FEATURES

- Product conforming to RoHS directive.
- Can be mounted with lead-free solder (260°C max.).
- 24-pin SMD package(1.27mm=50mil pin pitch).
- Because it is low profile design of 2.2mm max., space saving is possible and is suitable for notebook PC.
- Excellent common mode noise suppression.
- Inductance is 350 $\mu$ H or greater (f=100kHz, DC bias=8mA).
- Using the high-quality and wide-band ferrite cores for LAN.
- Packaging specification is taping and bulk(TLA-7T201LF-T: Tape and reel, TLA-7T201LF: Bulk).

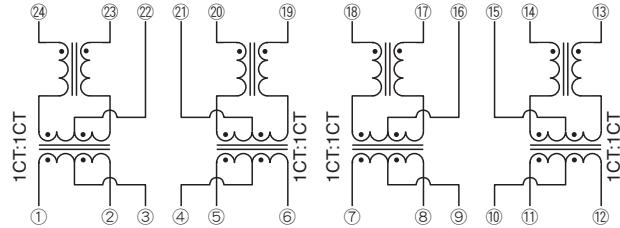
## SHAPES AND DIMENSIONS



## GENERAL SPECIFICATIONS

Pulse transformer	4
Common-mode choke	4
Port	1[1000BASE-T]
Temperature ranges	Operating 0 to +70°C Storage -40 to +85°C
Withstanding voltage	Erms:1500V[60s]

## CIRCUIT DIAGRAM



## RECOMMENDED PC BOARD PATTERN



## ELECTRICAL CHARACTERISTICS

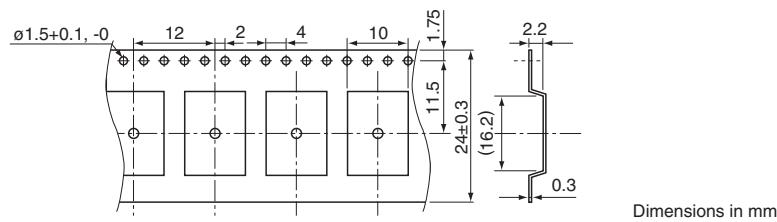
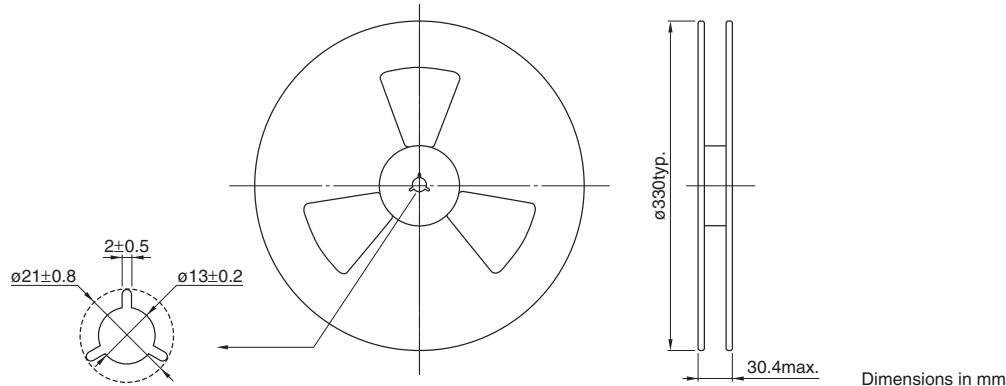
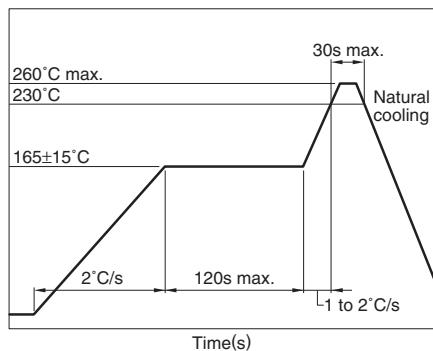
Part No.	Turns ratio	Inductance ( $\mu$ H)min. [DC bias 8mA, 100kHz]	Insertion loss (dB)max. [0.1 to 100MHz]	Inter-winding stray capacitance (pF)max.[100kHz]
TLA-7T201LF(-T)	1CT:1CT	350	1	25
• Ta=25°C				

• Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

• All specifications are subject to change without notice.

**PACKAGING STYLES**

Quantity : 1500pieces/reel

**TAPE DIMENSIONS****REEL DIMENSIONS****RECOMMENDED SOLDERING CONDITION****REFLOW SOLDERING**

- Temperature is measured at the terminal portion of product (Using thermocoupler for measurement).
- This profile is reference data we recommend. Please check in your actual process.
- For reliable soldering, the thickness of solder paste screen should be over the terminal co-planarity.
- The cutted end of terminal has no plating(out of subject of solder ability).

**RECOMMENDED STORE CONDITION**

The product is packaged by Anti-humid Al bag, in order to keep a good solder ability condition and resistance to soldering heat for products.

- Before aluminum bag opening
  - Temperature range: +5 to +40°C
  - Humidity: 90(%)RH max.
  - Storage period: 1year
- After aluminum bag opening
  - Temperature range: +5 to +30°C
  - Humidity: 60(%)RH max.
  - Storage period: 1week

## TLA-6T406(-T) ISO8802.3(IEEE802.3) 10/100BASE-TX

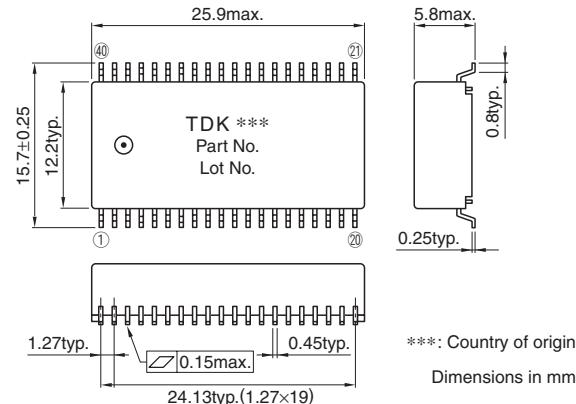
## FEATURES

- Product conforming to RoHS directive.
- Can be mounted with lead-free solder (250°C max.).
- 40-pin SMD package(1.27mm=50mil pin pitch) for Quad port.
- Excellent common-mode noise suppression.
- Inductance is 350 $\mu$ H or greater (f=100kHz, DC bias=8mA).
- Using the high-quality and wide-band ferrite cores for LAN.
- Packaging specification is taping and bulk(TLA-6T406-T: Tape and reel, TLA-6T406: Bulk).

## GENERAL SPECIFICATIONS

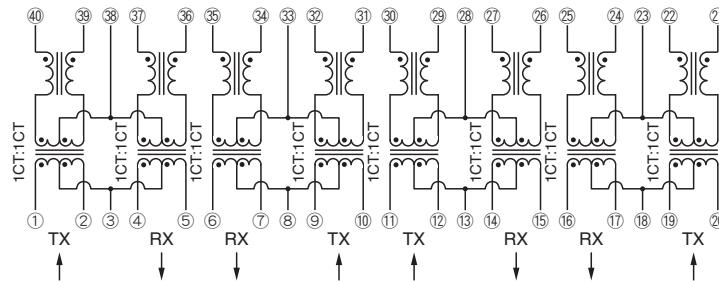
Pulse transformer	8
Common-mode choke	8
Port	4
Temperature ranges	Operating 0 to +70°C Storage -40 to +85°C
Withstanding voltage	Erms:1500V[60s]

## SHAPES AND DIMENSIONS

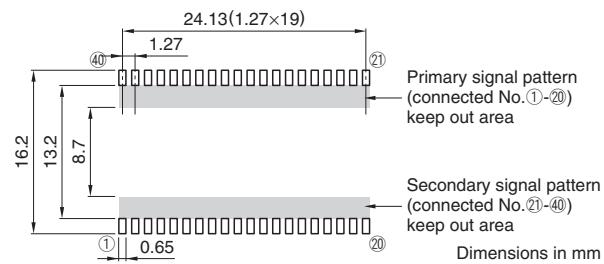


\*\*\*: Country of origin  
Dimensions in mm

## CIRCUIT DIAGRAM



## RECOMMENDED PC BOARD PATTERN



## ELECTRICAL CHARACTERISTICS

Part No.	Turns ratio ①③②:④⑧⑨..... ④③⑤:⑦⑧⑨.....	Inductance ( $\mu$ H)min. [DC bias 8mA, 100kHz] ④-⑨..... ③-⑨.....	Insertion loss (dB)max. [0.1 to 100MHz] ①②-④⑨..... ④⑤-⑦⑨.....	Inter-winding stray capacitance (pF)max.[100kHz] ①②-④⑨..... ④⑤-⑦⑨.....
TLA-6T406(-T)	1CT:1CT 1CT:1CT	350 350	1 1	40 40

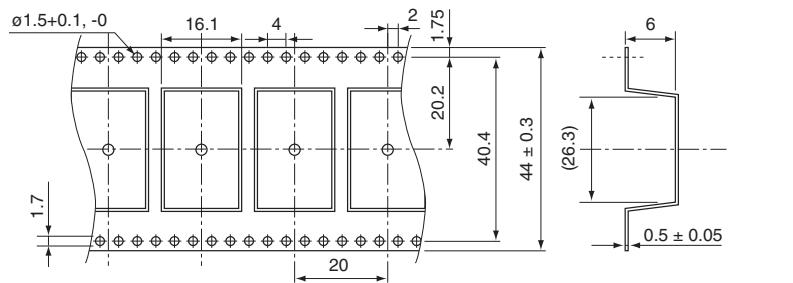
• Ta=25°C

• Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

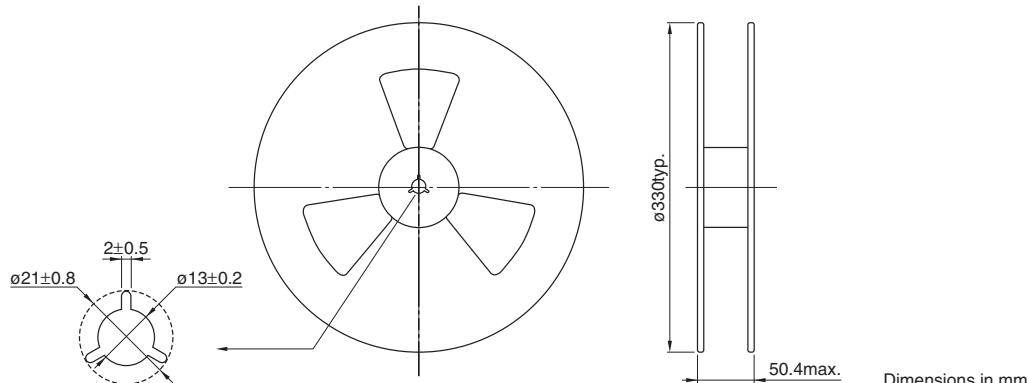
• All specifications are subject to change without notice.

**PACKAGING STYLES**

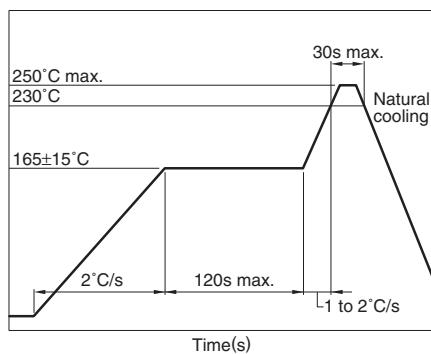
Quantity : 500pieces/reel

**TAPE DIMENSIONS**

Dimensions in mm

**REEL DIMENSIONS**

Dimensions in mm

**RECOMMENDED SOLDERING CONDITION****REFLOW SOLDERING**

- Temperature is measured at the terminal portion of product (Using thermocoupler for measurement).
- This profile is reference data we recommend. Please check in your actual process.
- For reliable soldering, the thickness of solder paste screen should be over the terminal co-planarity.
- The cutted end of terminal has no plating(out of subject of solder ability).

**RECOMMENDED STORE CONDITION**

The product is packaged by Anti-humid Al bag, in order to keep a good solder ability condition and resistance to soldering heat for products.

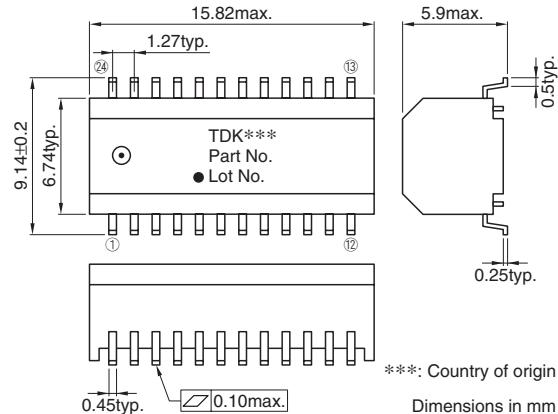
- Before aluminum bag opening
  - Temperature range: +5 to +40°C
  - Humidity: 90(%)RH max.
  - Storage period: 1year
- After aluminum bag opening
  - Temperature range: +5 to +30°C
  - Humidity: 60(%)RH max.
  - Storage period: 1week

TLA-7T101LF(-T) ISO8802.3(IEEE802.3) 10/100/1000BASE-T

## FEATURES

- Product conforming to RoHS directive.
- Can be mounted with lead-free solder (260°C max.).
- 24-pin SMD package(1.27mm=50mil pin pitch).
- Excellent common-mode noise suppression.
- Inductance is 350 $\mu$ H or greater (f=100kHz, DC bias=8mA).
- Using the high-quality and wide-band ferrite cores for LAN.
- Packaging specification is taping and bulk(TLA-7T101LF-T:  
Tape and reel, TLA-7T101LF: Bulk).

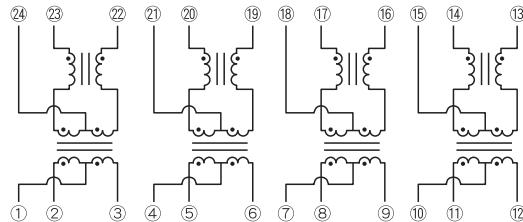
## SHAPES AND DIMENSIONS



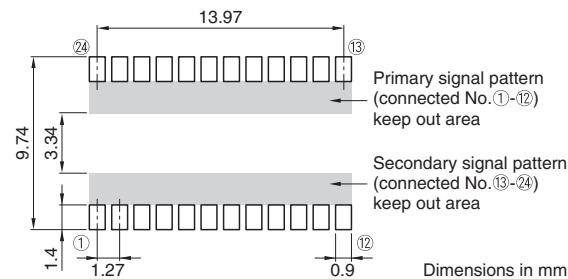
## GENERAL SPECIFICATIONS

Pulse transformer	4
Common-mode choke	4
Port	1(1000BASE-T)
Temperature ranges	Operating -40 to +85°C Storage -40 to +85°C
Withstanding voltage	Erms:1500V[60s]

## CIRCUIT DIAGRAM



## RECOMMENDED PC BOARD PATTERN



## ELECTRICAL CHARACTERISTICS

Part No.	Turns ratio ②①③ : ②④② ⑤④⑥ : ②①⑨ ⑧⑦⑨ : ⑦⑧⑥ ⑪⑩⑫ : ⑭⑮⑬	Inductance ( $\mu$ H)min. [DC bias 8mA, 100kHz] ②-② ⑩-⑨ ⑦-⑥ ⑭-⑬	Insertion loss (dB)max. [0.1 to 100MHz] ②③-② ⑤⑥-⑩⑨ ⑧⑨-⑦⑥ ⑪⑫-⑭⑬	Inter-winding stray capacitance (pF)max.[100kHz] ②③-② ⑤⑥-⑩⑨ ⑧⑨-⑦⑥ ⑪⑫-⑭⑬
TLA-7T101LF-T	1CT:1CT	350	1	25

•  $T_a=25^\circ\text{C}$

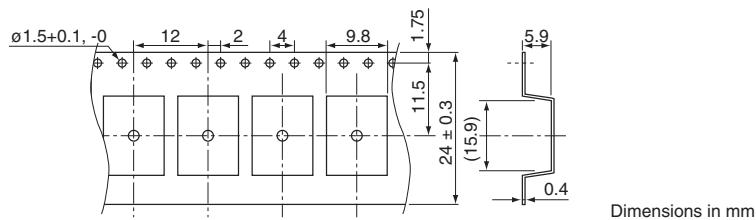
- Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

- All specifications are subject to change without notice.

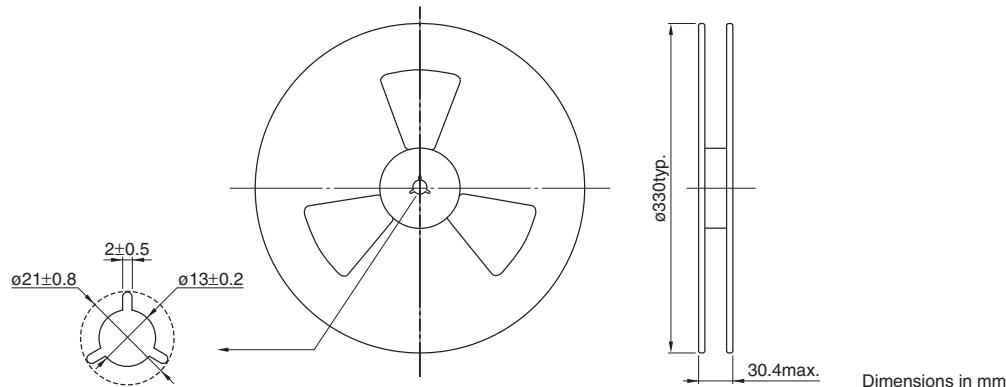
## PACKAGING STYLES

Quantity : 1000pieces/reel

### TAPE DIMENSIONS

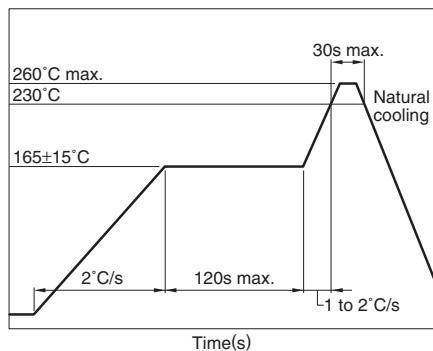


### REEL DIMENSIONS



### RECOMMENDED SOLDERING CONDITION

#### REFLOW SOLDERING



- Temperature is measured at the terminal portion of product (Using thermocoupler for measurement).
- This profile is reference data we recommend. Please check in your actual process.
- For reliable soldering, the thickness of solder paste screen should be over the terminal co-planarity.
- The cutted end of terminal has no plating(out of subject of solder ability).

### RECOMMENDED CONDITION FOR LONG TERM STORE

When it stores for a long term, please avoid place of high temperature and high humidity. Recommend that it uses after the delivery within 1year.

Temperature range: +5 to +30°C

Humidity: 60(%)RH max.

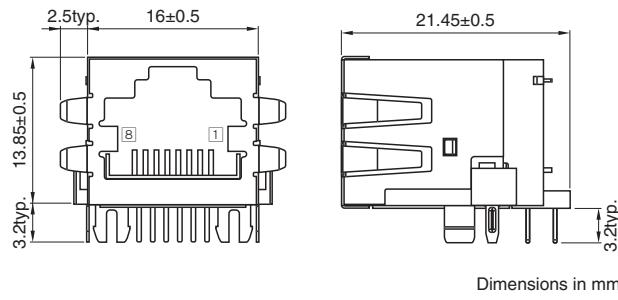
## Pulse Transformers/Connector Type

### TLA-6T776F ISO8802.3(IEEE802.3) 10/100BASE-TX

#### FEATURES

- Product conforming to RoHS directive.
- Pulse transformer, common mode choke, resistor and high with-standing voltage capacitor are integrated into RJ-45 modular jack.
- Excellent common mode noise suppression.
- Inductance is 200 $\mu$ H or greater (f=100kHz, DC bias=8mA).
- The product features high quality, containing a self-winding surface-mount pulse transformer and common mode choke.

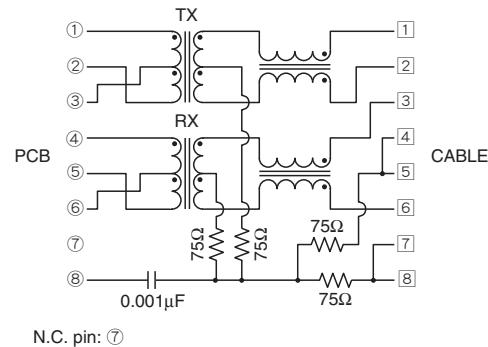
#### SHAPES AND DIMENSIONS



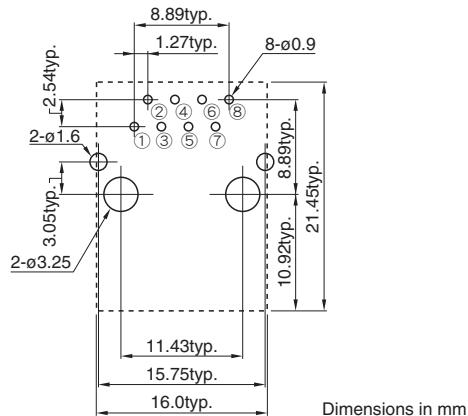
#### GENERAL SPECIFICATIONS

Pulse transformer	2
Common-mode choke	2
Port	1
Temperature ranges	
Operating	-40 to +85°C
Storage	-40 to +85°C

#### CIRCUIT DIAGRAM



#### RECOMMENDED PC BOARD PATTERN



#### ELECTRICAL CHARACTERISTICS

Part No.	Turns ratio	Inductance ( $\mu$ H)min. [DC bias 8mA, 100kHz]	Insertion loss (dB)max. [0.1 to 100MHz]
	①③②:①② ④⑥⑤:③⑥	①-② ③-⑥	①②-①② ③⑥-④⑤
TLA-6T776F	1CT:1 1CT:1	200 200	1.5 1.5

• Ta=25°C

- Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

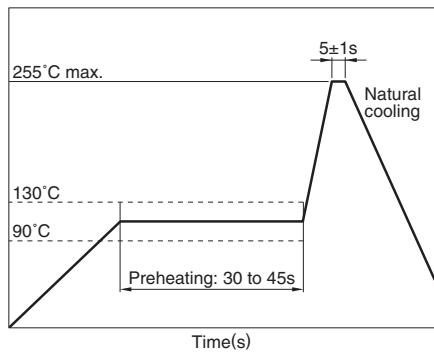
- All specifications are subject to change without notice.

## PACKAGING STYLES

Tray : 360pieces/box

## RECOMMENDED SOLDERING CONDITION

### FLOW SOLDERING



Preheating: 90 to 130°C for 30 to 45 seconds.

Soldering: 255°C max. 5±1 seconds

- Perform flow soldering from the underside of the board.
- The surface of plastic protrusions inserted into the board may melt, but this causes no problems with regard to electrical properties or mounting.
- The cutted end of terminal has no plating(out of subject of solder ability).

## RECOMMENDED CONDITION FOR LONG TERM STORE

When it stores for a long term, please avoid place of high temperature and high humidity. Recommend that it uses after the delivery within 1year.

Temperature range: +5 to +40°C

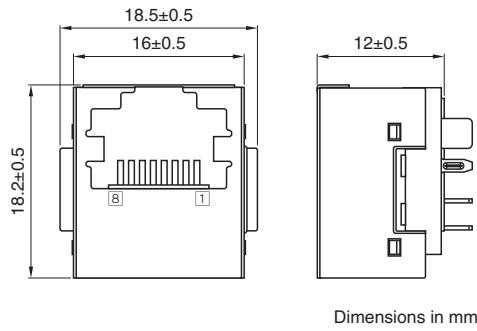
Humidity: 10 to 75%RH max.

# TLA-6T785 ISO8802.3(IEEE802.3) 10/100BASE-TX

## FEATURES

- Product conforming to RoHS directive.
- Pulse transformer, common mode choke, resistor and high with-standing voltage capacitor are integrated into RJ-45 modular jack.
- Excellent common mode noise suppression.
- Inductance is 200 $\mu$ H or greater (f=100kHz, DC bias=8mA).
- The product features high quality, containing a self-winding surface-mount pulse transformer and common mode choke.

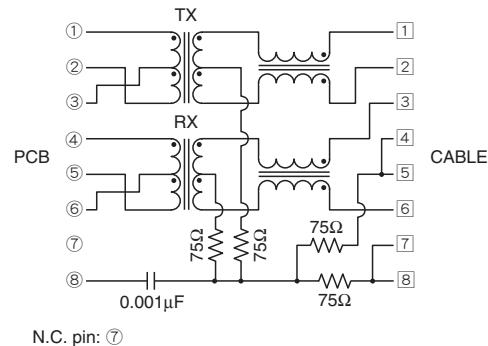
## SHAPES AND DIMENSIONS



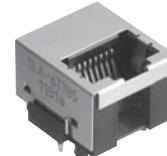
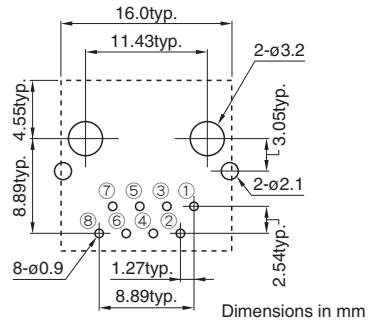
## GENERAL SPECIFICATIONS

Pulse transformer	2
Common-mode choke	2
Port	1
Temperature ranges	Operating: -40 to +85°C Storage: -40 to +85°C

## CIRCUIT DIAGRAM



## RECOMMENDED PC BOARD PATTERN



## ELECTRICAL CHARACTERISTICS

Part No.	Turns ratio ①③②:①② ④⑥⑤:③⑥	Inductance ( $\mu$ H)min. [DC bias 8mA, 100kHz] ①-② ③-⑥	Insertion loss (dB)max. [0.1 to 100MHz] ①②-①② ③⑥-④⑤
TLA-6T785	1CT:1 1CT:1	200 200	1.5 1.5

• Ta=25°C

- Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

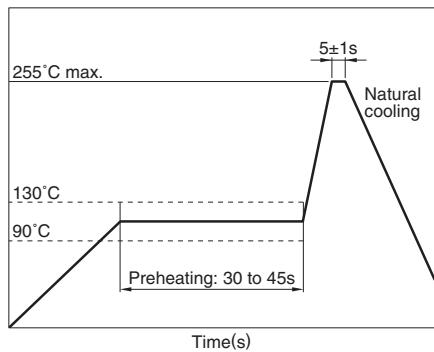
- All specifications are subject to change without notice.

## PACKAGING STYLES

Tray : 500pieces/box

## RECOMMENDED SOLDERING CONDITION

### FLOW SOLDERING



Preheating: 90 to 130°C for 30 to 45 seconds.

Soldering: 255°C max. 5±1 seconds

- Perform flow soldering from the underside of the board.
- The surface of plastic protrusions inserted into the board may melt, but this causes no problems with regard to electrical properties or mounting.
- The cutted end of terminal has no plating(out of subject of solder ability).

## RECOMMENDED CONDITION FOR LONG TERM STORE

When it stores for a long term, please avoid place of high temperature and high humidity. Recommend that it uses after the delivery within 1year.

Temperature range: +5 to +40°C

Humidity: 10 to 75%RH max.

## LC Modules

### TLA-3M103LF(-T) ISO8802.3(IEEE802.3) 10BASE-T

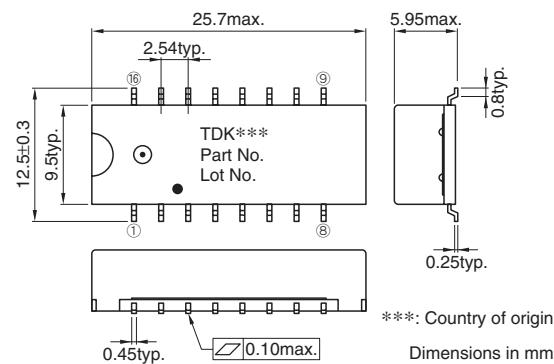
#### FEATURES

- Product conforming to RoHS directive.
- Can be mounted with lead-free solder (260°C max.).
- 16-pin SMD package (2.54mm=100mil pin pitch).
- Pulse transformer, common-mode choke and low pass filter are integrated into 16-pin SMD package.
- Using the high-quality and wide-band ferrite cores for LAN.
- Packaging specification is taping and bulk(TLA-3M103LF-T: Tape and reel, TLA-3M103LF: Bulk).

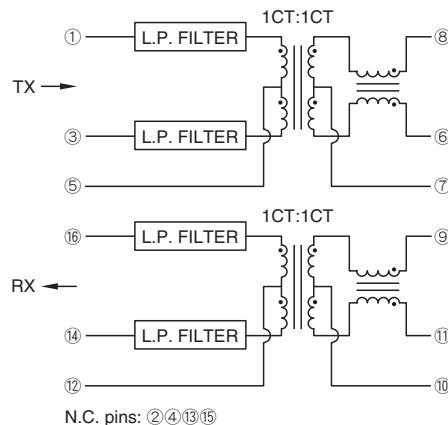
#### GENERAL SPECIFICATIONS

Low pass filter	2
Pulse transformer	2
Common-mode choke	2
Port	1
Temperature ranges	Operating 0 to +70°C Storage -40 to +85°C
Withstanding voltage	Erms:1500V[60s]

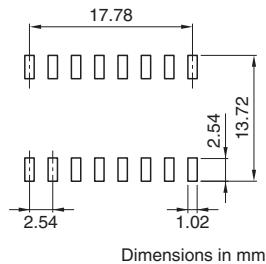
#### SHAPES AND DIMENSIONS



#### CIRCUIT DIAGRAM



#### RECOMMENDED PC BOARD PATTERN



#### ELECTRICAL CHARACTERISTICS

Part No.	Insertion loss (dB)max.[5 to 10MHz] (1) (3) - (8) (6) (9) (11) - (16) (14)	Attenuation (dB)min.[30 to 100MHz] (1) (3) - (8) (6) (9) (11) - (16) (14)	Impedance (Ω)typ.[5 to 10MHz] (1) - (3), (8) - (6) (16) - (14), (9) - (11)	C.M.R.R. (dB)min.[1 to 100MHz] (1) (3) - (8) (6) (16) (14) - (9) (11)
TLA-3M103LF(-T)	1	25	100, 100	25
	1	25	100, 100	25

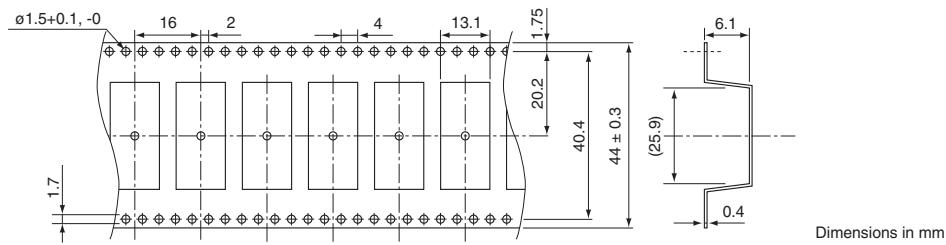
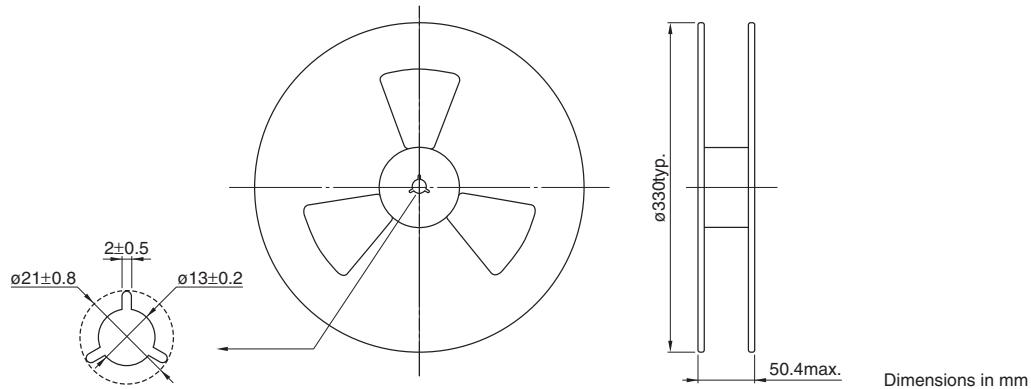
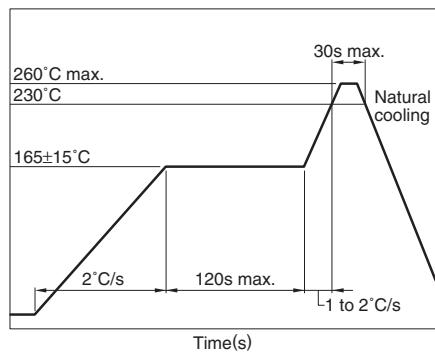
• Ta=25°C

• Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

• All specifications are subject to change without notice.

**PACKAGING STYLES**

Quantity : 600pieces/reel

**TAPE DIMENSIONS****REEL DIMENSIONS****RECOMMENDED SOLDERING CONDITION****REFLOW SOLDERING**

- Temperature is measured at the terminal portion of product (Using thermocoupler for measurement).
- This profile is reference data we recommend. Please check in your actual process.
- For reliable soldering, the thickness of solder paste screen should be over the terminal co-planarity.
- The cutted end of terminal has no plating(out of subject of solder ability).

**RECOMMENDED CONDITION FOR LONG TERM STORE**

When it stores for a long term, please avoid place of high temperature and high humidity. Recommend that it uses after the delivery within 1year.

Temperature range: +5 to +30°C

Humidity: 60(%)RH max.

## Pulse Transformers/SMD Type

### ALT4532

#### FEATURES

- The ALT4532 Series is a wound chip type pulse transformer developed for LANs.
- Compatible with 10BASE-T, 100BASE-TX, and 1000BASE-T.
- High-quality product with automatic winding.
- Product conforming to RoHS directive.

#### APPLICATIONS

LAN interface portion of various devices such as network devices, communication devices, and digital home appliances

#### PRODUCT IDENTIFICATION

ALT 4532 - 201 - T 001  
 (1) (2) (3) (4) (5)

(1) Series name

(2) Dimensions L×W

(3) Inductance[at 100kHz/DC bias=8mA]

201 : 200 $\mu$ H min.

(4) Packaging style

T: ø330mm reel taping

(5) TDK internal code

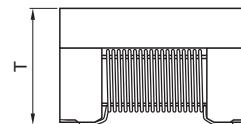
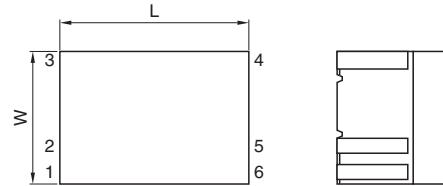
#### SPECIFICATIONS

Temperature range	Operating	-40 to +85°C
	Storage(After mount)	-40 to +85°C

#### PACKAGING STYLE AND QUANTITIES

Packaging style	Reel	Quantity
Taping	ø180mm	2000 pieces/reel

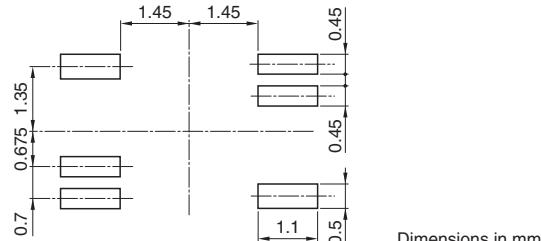
#### SHAPES AND DIMENSIONS



Dimensions in mm

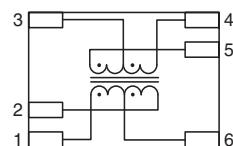
Type	L	W	T
ALT4532-171-T001	4.5±0.2	3.2±0.2	2.2max.
ALT4532-201-T001	4.5±0.2	3.2±0.2	2.9max.

#### RECOMMENDED PC BOARD PATTERN



Dimensions in mm

#### MEASURING CIRCUIT



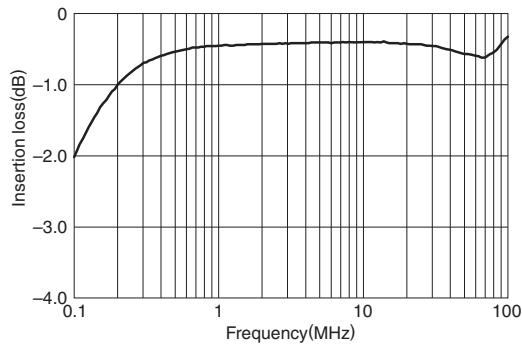
#### ELECTRICAL CHARACTERISTICS

Part No.	Turns ratio ①⑥② : ⑤③④	Inductance ( $\mu$ H)min. [DC bias 8mA, 100kHz] ①-② ⑤-④	Insertion loss (dB)max. [0.1 to 100MHz] ①②-⑤④	Inter-winding stray capacitance (pF)max. [100kHz]
ALT4532-171-T001	1CT : 1CT	170	2.5	35
ALT4532-201-T001	1CT : 1CT	200	1.5	35

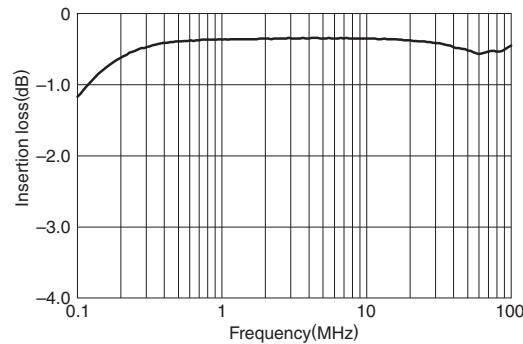
• Conformity to RoHS Directive: This means that, in conformity with EU Directive 2002/95/EC, lead, cadmium, mercury, hexavalent chromium, and specific bromine-based flame retardants, PBB and PBDE, have not been used, except for exempted applications.

• All specifications are subject to change without notice.

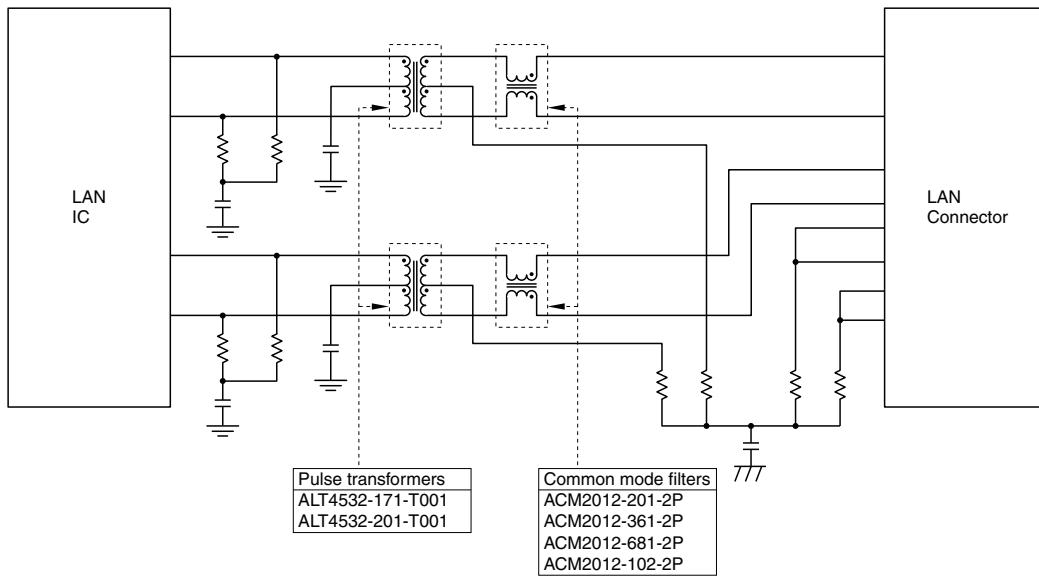
**TYPICAL ELECTRICAL CHARACTERISTICS**  
**INSERTION LOSS vs. FREQUENCY CHARACTERISTICS**  
**ALT4532-171-T001**



**ALT4532-201-T001**



**TYPICAL APPLICATIONS (100BASE-TX)**



Note) Peripheral circuits differ depending on the IC used; check the circuits with the application note of the IC, etc.