No. P-TCD-E004
DATE 2025-05

PRODUCTS DATA SHEET

Tantalum Solid Electrolytic Capacitors with Conductive Polymer

Type TCD

RoHS COMPLIANT
LEAD FREE

MATSUO ELECTRIC CO., LTD.

OUTLINE (Type TCD)

Type TCD is a tantalum solid electrolytic capacitor which uses conductive polymer as cathode layer.
Their equivalent series resistance (ESR) is extremely lowered with the characteristics of the polymer having high electric conductivity.
This ensures higher permissible ripple current and excellent noise absorption performance on high-frequency circuits.

APPLICATION

DC/DC converters, power supply circuits, communication devices, home appliances, regulators and peripherals.

FEATURES

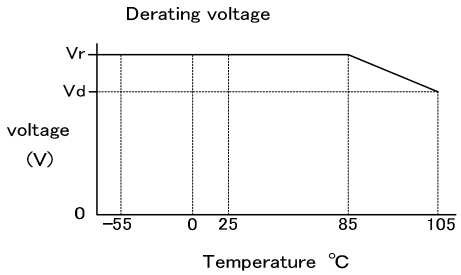
1. Low ESR and Low impedance
   Using a conductive polymer as cathode layer makes low ESR and impedance possible.
   Type TCD makes high permissible ripple current and is suitable for noise bypass application.
2. Stable ESR over temperature
   ESR is extremely stable from low temperature through high temperature.
3. Compact and Large capacitance
   The capacitor is smaller and has larger capacitance than ceramic capacitor and aluminum electrolytic capacitor.
4. Benign Failure Mode
   Type TCD offers very safe characteristics which makes ignition and smoking harder by taking advantages of characteristics of conductive polymer if the capacitor be short-circuited.
5. Lead Free and RoHS Compliant.

APPLICATION CLASSIFICATION BY USE

The application classification by use which divided the market and use into four is set up supposing our products being used for a broad use.
Please confirm the application classification by use of each product that you intend to use.
Moreover, please be sure to inform to our Sales Department in advance in examination of the use of those other than the indicated use.

RATINGS

Item	Ratings
Category Temperature Range	-55 to +105℃（to be used at derated voltage when temperature exceeds 85℃）
Rated Voltage	6.3 - 10 - 16 - 20 - 25 VDC
Derated Voltage	5.0 - 8.0 - 13 - 16 - 20 VDC（105℃）
Capacitance	10 to 470 μF
Capacitance Tolerance	±20 %（M）



Derating voltage VT at any temperature T between 85℃ and 105℃ shall be calculated by the following formula.

$$VT = Vr - \frac{Vr - Vd}{20}(T-85)$$

Vr: Rated voltage
Vd: Derating voltage 105℃

Vr	Rated voltage (VDC)	6.3	10	16	20	25
Vd	Derating voltage (VDC)	5	8	13	16	20

ORDERING INFORMATION

TCD	6301	477	M	R	31D	40
TYPE	RATED VOLTAGE	CAPACITANCE	CAPACITANCE TOLERANCE	STYLE OF REELED PACKAGE	CASE CODE	ESR（mΩ）

Rated Voltage	Marking
6.3V	6301
10V	1002
16V	1602
20V	2002
25V	2502

Capacitance	Marking
10μF	106
15μF	156
22μF	226
33μF	336
47μF	476
68μF	686

Capacitance	Marking
100μF	107
150μF	157
220μF	227
330μF	337
470μF	477

Capacitance Tolerance	Marking
±20%	M

Anode Notation	Reel Size	Code
Feed hole: -	φ180 Reel	R

Case Code	Height of component max.(mm)	Case Size
31D	3.1	7343-28

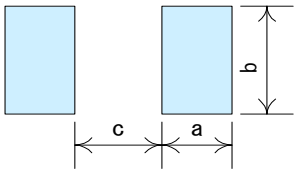
Note : For a capacitor with special requirements from customers, a 2-digit specific numbers will be added between the case code and the ESR for our product management.

DIMENSIONS

(mm)

Case Code	Case Size	L	W_1	H	S	W_2
31D	7343-28	7.30 ±0.30	4.30 ±0.30	2.80 ±0.30	1.30 ±0.30	2.40 ±0.20

RECOMMENDED PAD DIMENSIONS

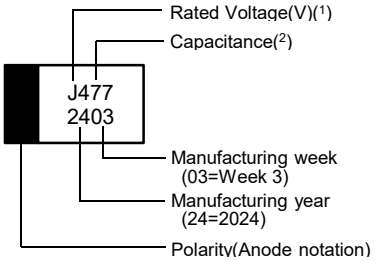


(mm)

Case Code	a	b	c
31D	2.4	2.7	4.6

In order to expect the self alignment effect, it is recommended that the land width is almost the same size as terminal of capacitor, and space between lands(c) nearly equal to the space between terminals for appropriate soldering.

MARKING



Note ([1]) Rated voltage is described as shown below.

Rated Voltage Code

Rated voltage	6.3	10	16	20	25
Code	J	A	C	D	E

([2]) Capacitance is expressed by 3 numbers.

47 7 • • • 47×10⁷ pF

STANDRARD RATING

May, 2025

R.V.(VDC) / Cap.(μF)	6.3	10	16	20	25
6.8					
10					31D(150)
15			31D(90)	31D(90)	31D(90)
22			31D(100)	31D(100)	31D(100)
33			31D(100)	31D(100)	31D(100)
47			31D(100)	31D(100)	31D(100)
68	31D(100)	31D(100)	31D(100)	31D(100)	31D(100)
100		31D(100)	31D(100)	31D(100)	31D(100)
150	31D(100)	31D(100)	31D(100)		
220	31D(60)	31D(60)	31D(60)		
330	31D(50)	31D(50)			
470	31D(40)	31D(60)			
680					

The parenthesized values show ESR.(maximum values in mΩat 100kHz)

CATALOG NUMBERS AND RATING

May,2025

Catalog number	Rated Voltage (VDC)	Capacitance (μF)	Tolerances (±%)	Case Code	Lct. (μA) 25℃	Max. Dissipation Factor 25℃	ESR (mΩ) 100kHz 25℃	Max. permissible Ripple Current (1) 100kHz	MSL
TCD 6301 686 MR 31D 0100	6.3	68	20	31D	43	0.10	100	1500	3
TCD 6301 157 MR 31D 0100	↓	150	↓	31D	95	0.10	100	1500	3
TCD 6301 227 MR 31D 0060	↓	220	↓	31D	139	0.10	60	1936	3
TCD 6301 337 MR 31D 0050	↓	330	↓	31D	208	0.10	50	2121	3
TCD 6301 477 MR 31D 0040	↓	470	↓	31D	296	0.10	40	2372	3
TCD 1002 686 MR 31D 0100	10	68	20	31D	68	0.10	100	1500	3
TCD 1002 107 MR 31D 0100	↓	100	↓	31D	100	0.10	100	1500	3
TCD 1002 157 MR 31D 0100	↓	150	↓	31D	150	0.10	100	1500	3
TCD 1002 227 MR 31D 0060	↓	220	↓	31D	220	0.10	60	1936	3
TCD 1002 337 MR 31D 0050	↓	330	↓	31D	330	0.10	50	2121	3
TCD 1002 477 MR 31D 0060	↓	470	↓	31D	470	0.10	60	1936	3
TCD 1602 156 MR 31D 0090	16	15	20	31D	24	0.10	90	1581	3
TCD 1602 226 MR 31D 0100	↓	22	↓	31D	35	0.10	100	1500	3
TCD 1602 336 MR 31D 0100	↓	33	↓	31D	53	0.10	100	1500	3
TCD 1602 476 MR 31D 0100	↓	47	↓	31D	75	0.10	100	1500	3
TCD 1602 686 MR 31D 0100	↓	68	↓	31D	109	0.10	100	1500	3
TCD 1602 107 MR 31D 0100	↓	100	↓	31D	160	0.10	100	1500	3
TCD 1602 157 MR 31D 0100	↓	150	↓	31D	240	0.10	100	1500	3
TCD 1602 227 MR 31D 0060	↓	220	↓	31D	352	0.10	60	1936	3
TCD 2002 156 MR 31D 0090	20	15	20	31D	30	0.10	90	1581	3
TCD 2002 226 MR 31D 0100	↓	22	↓	31D	44	0.10	100	1500	3
TCD 2002 336 MR 31D 0100	↓	33	↓	31D	66	0.10	100	1500	3
TCD 2002 476 MR 31D 0100	↓	47	↓	31D	94	0.10	100	1500	3
TCD 2002 686 MR 31D 0100	↓	68	↓	31D	136	0.10	100	1500	3
TCD 2002 107 MR 31D 0100	↓	100	↓	31D	200	0.10	100	1500	3
TCD 2502 106 MR 31D 0150	25	10	20	31D	25	0.10	150	1225	3
TCD 2502 156 MR 31D 0090	↓	15	↓	31D	37.5	0.10	90	1581	3
TCD 2502 226 MR 31D 0100	↓	22	↓	31D	55	0.10	100	1500	3
TCD 2502 336 MR 31D 0100	↓	33	↓	31D	82.5	0.10	100	1500	3
TCD 2502 476 MR 31D 0100	↓	47	↓	31D	117.5	0.10	100	1500	3
TCD 2502 686 MR 31D 0100	↓	68	↓	31D	170	0.10	100	1500	3
TCD 2502 107 MR 31D 0100	↓	100	↓	31D	250	0.10	100	1500	3

Notes : (1) Reference value.

PERFORMANCE

No	Item	Performance	Test Method
1	Leakage Current (μA)	Shall not exceed the values shown in CATALOG NUMBERS AND RATING.	JIS C 5101-1, 4.9 Applied voltage : Rated voltage Duration : 5 min Measuring temperature : 25 ±2℃
2	Capacitance (μF)	Shall be within specified tolerances.	JIS C 5101-1, 4.7 Measuring frequency : 120 Hz ±20% Measuring temperature : 25 ±2℃
3	Dissipation Factor	Shall not exceed the values shown in CATALOG NUMBERS AND RATING.	JIS C 5101-1, 4.8 Test conditions shown in No.2
4	Equivalent Series Resistance	Shall not exceed the values shown in CATALOG NUMBERS AND RATING.	JIS C 5101-1, 4.8 Measuring frequency : 100 kHz ±10% Measuring temperature : 25 ±2℃
5	Surge	Leakage current : Shall not exceed 3-times of the value in No.1. Capacitance change : Within ±20% of the value before test Dissipation Factor : Shall not exceed the value in No.3. Visual Examination : There shall be no evidence of mechanical damage.	JIS C 5101-1, 4.26 Test temperature : 85℃ and 105℃ Applied voltage : According to the following table Rated voltage (VDC) | 6.3 | 10 | 16 | 20 | 25 Surge voltage (VDC) 85℃ | 8.2 | 13 | 21 | 26 | 33 Surge voltage (VDC) 105℃ | 6.5 | 10.4 | 17 | 21 | 26 Series protective resistance : 1000 Ω Discharge resistance : 1000 Ω Measurement after test: After the capacitor being stored under standard atmospheric conditions for 24 hours, leakage current, capacitance and dissipation factor shall be measured.
6	Shear Test	No separation of terminal from solder.	JIS C 5101-1, 4.34 Force : 5 N Holding time : 5 ±1 sec
7	Substrate Bending Test	Capacitance : Initial value to remain steady during measurement. Visual Examination : There shall be no evidence of mechanical damage.	JIS C 5101-1, 4.35 Bending : 3 mm
8	Vibration	Capacitance : Initial value to remain steady during measurement. Visual Examination : There shall be no evidence of mechanical damage.	JIS C 5101-1 4.17 Frequency range : 10-55 Hz Swing width : 1.5 mm Vibration direction : 3 directions with mutually right-angled Duration : 2 hours in each of these mutually perpendicular directions (total 6 hours) Mounting : Solder terminal to the printed board
9	Shock	There shall be no intermittent contact of 0.5 ms or greater, short, or open. Nor shall there be any spark discharge, insulation breakdown, or evidence of mechanical damage.	JIS C 5101-1 4.19 Peak acceleration : 490 m/s^2 Duration : 11 ms Wave form : Half-sine
10	Solderability	Shall be covered to over 95% of terminal surface by new soldering.	JIS C 5101-1 4.15 Solder temperature : 245 ±2℃ Dipping time : 5 seconds Dipping depth : Terminal shall be dipped into melted solder
11	Resistance to Soldering Heat	Leakage Current : Shall not exceed 2-times of the value in No.1. Capacitance change : Within ±20% of the value before test. Dissipation Factor : Shall not exceed 1.3-times of the value in No.3. Equivalent Series Resistance : Shall not exceed 2-times of the value in No.4. Visual Examination : There shall be no evidence of mechanical damage.	JIS C 5101-1, 4.14 IR reflow Preheating : 150 to 200℃, 60 to 120 sec Reflow : 217℃, 60 to 150 sec Peak : 250℃ max. Number of cycles : 2
12	Component Solvent Resistance	Leakage Current : Shall not exceed the value in No.1. Capacitance change : Within ±20% of the value before test. Dissipation Factor : Shall not exceed the value in No.3.	JIS C 5101-1 4.31 Temperature : 23 ±5°C Dipping time : 5 ±0.5 min. Conditioning : JIS C 0052 method 2 Solvent : 2-proparol (Isopropyl alcohol)
13	Solvent Resistance of Marking	Visual examination : After the test the marking shall be legible.	JIS C 5101-1 4.32 Temperature : 23 ±5°C Dipping time : 5 ±0.5 min. Conditioning : JIS C 0052 method 2 Solvent : 2-proparol (Isopropyl alcohol)
14	Rapid Change of Temperature	Leakage Current : Shall not exceed 2-times of the value in No.1. Capacitance change : Within ±20% of the value before test. Dissipation Factor : Shall not exceed 1.5-times of the value in No.3. Equivalent Series Resistance : Shall not exceed 2-times of the value in No.4. Visual Examination : There shall be no evidence of mechanical damage.	JIS C 5101-1, 4.16 Step 1 : -55 ±3℃, 30 ±3 min Step 2 : 25 +10/-5℃, 3 min or less Step 3 : 105 ±2℃, 30 ±3 min Step 4 : 25 +10/-5℃, 3 min or less Number of cycles : 100 Measurement after test: After the capacitor being stored under standard atmospheric conditions for 24 hours, leakage current, capacitance and dissipation factor shall be measured.
15	Damp Heat, Steady State	Leakage Current : Shall not exceed 3-times of the value in No.1. Capacitance change : Within -20% to +40% of the value before test. Dissipation Factor : Shall not exceed 1.5-times of the value in No.3. Equivalent Series Resistance : Shall not exceed 2-times of the value in No.4. Visual Examination : There shall be no evidence of mechanical damage.	JIS C 5101-1, 4.21 Temperature : 65 ±2℃ Moisture : 90 to 95% RH Duration : 500 +24/0hrs Measurement after test: After the capacitor being stored under standard atmospheric conditions for 24 hours, leakage current, capacitance and dissipation factor shall be measured.
16	Endurance I	Leakage Current : Shall not exceed 3-times of the value in No.1. Capacitance change : Within ±20% of the value before test. Dissipation Factor : Shall not exceed 1.5-times of the value in No.3. Equivalent Series Resistance : Shall not exceed 2-times of the value in No.4. Visual Examination : There shall be no evidence of mechanical damage.	JIS C 5101-1, 4.23 Test temperature : 85 ±2℃ Applied voltage : Rated voltage Duration : 1000 +48/0hrs Power supply impedance : 3Ω or less Measurement after test: After the capacitor being stored under standard atmospheric conditions for 24 hours, leakage current, capacitance and dissipation factor shall be measured.
17	Endurance II	Leakage Current : Shall not exceed 3-times of the value in No.1. Capacitance change : Within ±20% of the value before test. Dissipation Factor : Shall not exceed 3-times of the value in No.3. Equivalent Series Resistance : Shall not exceed 2-times of the value in No.4. Visual Examination : There shall be no evidence of mechanical damage.	JIS C 5101-1, 4.23 Test temperature : 105 ±2℃ Applied voltage : Derated voltage Duration : 1000 +48/0hrs Power supply impedance : 3Ω or less Measurement after test: After the capacitor being stored under standard atmospheric conditions for 24 hours, leakage current, capacitance and dissipation factor shall be measured.

Application Notes for Tantalum Solid Electrolytic Capacitor with Conductive Polymer Type TCD

1. Operating voltage

Temperature derating is as follws.

Conditions of Use	-55℃ to 85℃	85℃ to 105℃
Maximum derating required for the actual voltage of products with UR ≤ 10V used in the filter circuit	90%UR	72%UR
Maximum derating required for actual voltage of UR ≥ 10V products	80%UR	64%UR

UR：Rated Voltage

2. Application that contain AC Voltage

Special attention to the following 3 items.

(1) The sum of the DC bias voltage and the positive peak value of the AC voltage should not exceed the rated voltage.

(2) Reverse voltage should not exceed the allowable values of the negative peak AC voltage.

(3) Ripple voltage should not exceed the allowable values.

3. Reverse voltage

Special attention to the polar character. Reverse Voltage should not be applied.

4. Permissible ripple current

The permissible ripple current and voltage at about 100 kHz or higher can be determined by the following formula from the permissible power loss for each case code (Pmax value) shown in Table 1 and the specified ESR value. However, when the expected operating temperature is higher than room temperature, determine the permissible values multiplying the Pmax value by the specified multiplier (Table 2). For the permissible values at different frequencies, consult our Sales Department.

$P=I^2 \times ESR$ or $P=\frac{E^2 \times ESR}{Z^2}$

Permissible ripple current $Imax=\sqrt{\frac{P\ max}{ESR}}$ (Arms)

Permissible ripple voltage $Emax=\sqrt{\frac{P\ max}{ESR}} \times Z = Imax \times Z$ (Vrms)

Imax: Permissible ripple current at regulated frequency (Arms : RMS value)
Emax: Permissible ripple voltage at regulated frequency (Vrms : RMS value)
Pmax: Permissible power loss (W)
ESR: Specified ESR value at regulated frequency (Ω)
Z : Impedance at regulated frequency (Ω)

Table 1 Permissible power loss for each case code

Case Code	Pmax（W）
31D	0.225

Table 2 Pmax multiplier at each operating temperature

Temperature	25℃	85℃	125℃
Derating factor	1.0	0.9	0.4

Note: Above values are measured at 0.8t glass epoxy board mounting in free air and may be changed depending on the kind of board, packing density, and air convection condition. Please consult us if calculated power loss value is equal to or greater than above list of Pmax value.

5. Non Polar Connection

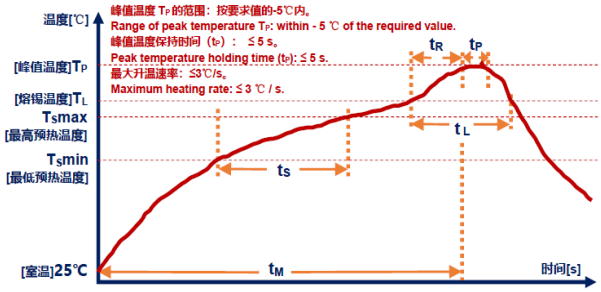
The capacitor cannot be used as a non-polar unit.

6. Soldering

6.1 Soldering

(1) Reflow Soldering

The peak setting temperature TP of SMT should be ≤ 250 ℃, and the holding time within the range of 0 ℃ ~ - 5 ℃ of the peak temperature TP should be ≤ 5s.



Solder type		Lead free solder
Min	Minimum preheating temperature	150℃
TS Max	Maximum preheating temperature	200℃
tS	Preheating time	60~120s
TL ~ TP	Heating rate	≤3℃/s
TL	Melting point of solder paste	217℃
tL	Melting time of solder paste	60~150s
TP	Peak temperature	250℃
tP	Holding time of peak temperature	≤10s ≤3s or 5s
TP ~ TL	Cooling rate	s ≤6℃/s
tM	Time from 25 ° C to peak temperature	≤8 min

(2) Manual welding

If manual welding is required under special circumstances, the power of electric iron should bee ≦60W, the temperature should be ≦350 ℃, and the welding time should be ≦5s. It is forbidden for the iron head to directly contact the product body, and the solder should be melted to make it contact with the capacitor pin for welding.

(3) Please consult us for other methods.

7. Solvent cleaning

Cleaning by organic solvent may damage capacitor's appearance and performance. However, our capacitors are not effected even when soaked at 20-30℃ 2-propanol for 5 minutes. When introducing new cleaning methods or changing the cleaning term, please consult us.

8. Storage

Capacitors should be tightly sealed in moisture prevention bag and stored with supplied reel. After unpacking, capacitors should be used within the floor life listed in Table 3.
Moisture Sensitivity Level ：Table 3 shows the moisture sensitivity level and the floor life of the dampproof wrapping products.

Table 3 MSL&Floor Life

JEDEC MSL	Floor Life
3	168hrs.(7days)
	Less than 30℃/60%RH

（Reference IPC/JEDEC J-STD-020C July 2004）

9. Inapplicable circuits

The capacitors may cause nonconformity if they are used on the following circuits.
(1) High-impedance voltage holding circuits
(2) Coupling circuits
(3) Time constant circuits
(4) Circuits significantly affected by leakage current

If a short circuit occurs, the capacitors may generate heat or smoke depending on the short-circuit current. When designing a circuit, take the instructions stated herein into consideration, and take as much redundant measures as possible.

10. Additional Notes

Wear-out failure（Lifetime）
When the operating time exceeded the specified guarantee time of Endurance and Damp heat, the electric characteristics changes significantly and the open circuit might be caused by the degradation of electrolyte.

Please note that the electric characteristics of capacitance and ESR might change within the specified range in specifications when it used under the condition of electric and mechanical performance.

These application notes are prepared based on the technical report RCR-2368B "Guideline of notabilia for fixed tantalum electrolytic capacitors with solid electrolyte for use in electronic equipment" issued by Japan Electronics and Information Technology Industries Association. For the details of the instructions (explanation, reasons and concrete examples), please refer to this guideline, or consult our Sales Department.

MATSUO ELECTRIC CO., LTD.

Please feel free to ask our Sales Department for more information on Tantalum Solid Electrolytic Capacitor with Conductive Polymer.

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適用用途分類 / APPLICATION CLASSIFICATION BY USE

(2024.11.01)

市場	適用用途分類	用途		推奨品種
		概要	代表的なアプリケーション例	チップタンタルコンデンサ
高信頼度機器	1	・高度な安全性や信頼性が要求される機器 ・製品の保守交換が不可能な機器、製品の故障が人命に直接かかわる、または、致命的なシステムダウンを引き起こす可能性がある機器	・宇宙開発機器関連(衛星、ロケット、人工衛星) ・航空・防衛システム ・原子力・火力・水力発電システム	
車載・産業機器	2	・信頼性が重視される機器 ・製品の保守交換が極めて困難な機器や、製品の故障が人命に影響する、あるいは故障の範囲が広範囲である機器	・自動車および鉄道・船舶等の輸送機器の車両制御(エンジン制御,駆動制御,ブレーキ制御) ・新幹線・主要幹線の運行制御システム	
	3	・製品の保守交換が可能な機器や、製品の故障が人命に影響しないが故障によるシステムダウンの損失が大きく保全管理が要求される機器	・エアコン,カーナビ等の車室内搭載部品、車載用通信機器 ・家庭用/ビル用等のセキュリティ管理システム ・工業用ロボットや工作機械等の制御機器	
汎用機器	4	・最先端技術を積極的に適用する小型・薄型品 ・製品の保守交換が可能な機器や、製品の故障によるシステムダウンが部分的な機器向けの市場で広く使用されることを想定した製品	・スマートフォン、携帯電話、モバイルPC(タブレット)、電子辞書 ・デスクトップPC、ノートPC、ホームネットワーク ・アミューズメント機器(パチンコ、ゲーム機)	TCD型

Market	Application classification by use	Use		Recommendation Type
		Outline	Typical example of application	Chip Tantalum Capacitors
High reliability apparatus	1	- Apparatus in which advanced safety and reliability are demanded. - Whether failure of the apparatus which cannot maintenance exchange products, and a product is direct for a human life, apparatus which changes or may cause a fatal system failure.	- Space development apparatus relation (Satellite, Rocket, Artificial Satellite) - Aviation and a defensive system - Atomic power, fire power, and a water-power generation system	
In-vehicle - Industrial apparatus	2	- Apparatus in which reliability is important. - The apparatus in which maintenance exchange of a product is very difficult, and failure of a product influence a human life, or the range of failure is wide range.	- Vehicles control of transport machines, such as a car, and a railroad, a vessel (Engine control, drive control, brake control) - The operation control system of the Shinkansen and a main artery	
	3	-Apparatus which can maintenance exchange products, and apparatus in which the loss of the system failure is large although failure of a product does not influence a human life, and maintenance engineering is demanded	- Vehicle indoor loading parts, such as an air-conditioner and car navigation, and in-vehicle communication facility - Security management system for home/buildings etc. - Control apparatus, such as Industrial use robots and a machine tool etc.	
Apparatus in general	4	- The small size and the thin article which applies leading-edge technology positively - The product supposing being used widely in the market for the apparatus which can maintenance exchange products, and apparatus with a partial system failure by failure of product.	-Smart phone, Mobile phone, Mobile PC (tablet), Electronic dictionary - Desktop PC, Notebook PC, Home network - Amusement apparatus (Pachinko,Game machine)	Type TCD

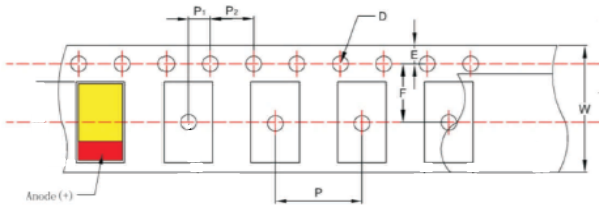
テーピング数量・リール寸法
Taping Quantity And Carrier Tape Dimensions

チップタンタルコンデンサ
Chip Tantalum Capacitors

定格：TCD型
Type：TCD

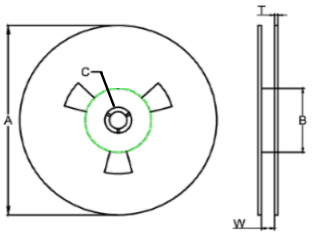
ケース記号 Case Code	ケースサイズ Case size	W (mm)	F (mm)	E (mm)	P (mm)	P_1 (mm)	P_2 (mm)	ϕD_0 (mm)	包装数/リール(個) Quantity/Reel (pcs)
									ϕ180
31D	7.3×4.3×2.8	12±0.30	5.5±0.10	1.75±0.10	4±0.10	8±0.05	2±0.10	1.55±0.20	500

テーピング寸法/Tape dimensions



単位[mm]
unit[mm]

リール寸法/Reel dimensions



リール Reel	テープ幅 Tape width	A	B	C	W	T
ϕ180	12	178±2.00	50 min	13.0±0.50	12.4+1.5/-0	1.50±0.50