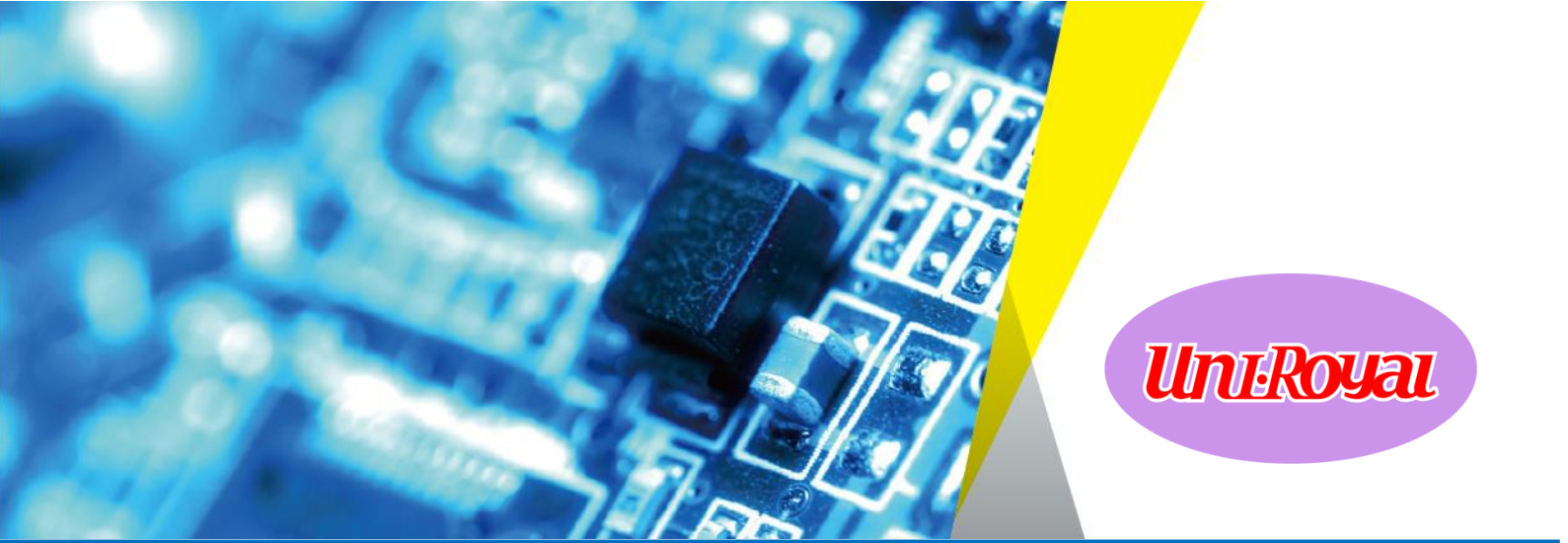




UniRoyal

DATASHEET

Product Name **Metal film low resistance chip resistor**

Part Name **TL Series**

Uniroyal Electronics Global Co., Ltd.

88#, Longteng Road, Economic & Technical Development Zone, Kunshan, Jiangsu, China

Tel +86 512 5763 1411 / 22 /33

Email marketing@uni-royal.cn

Manufacture Plant Uniroyal Electronics Industry Co., Ltd.

Aeon Technology Corporation

Royal Electronic Factory (Thailand) Co., Ltd.

Royal Technology (Thailand) Co., Ltd.

1. Scope

- 1.1. This datasheet is the characteristics of Metal film low resistance chip resistor manufactured by UNI-ROYAL.
- 1.2. Low Resistance / TCR / Inductance
- 1.3. Excellent long-term stability
- 1.4. High precision current sensing
- 1.5. High power capability
- 1.6. Halogen free and lead free
- 1.7. RoHS compliant
- 1.8. AEC-Q200 qualified

2. Part No. System

Part No. includes 14 codes shown as below:

2.1 1st~4th codes: Part name. E.g.: TL01, TL02, TL03, TL05, TL06, TL07, TL10, TL12

2.2 5th~6th codes: Power rating.

E.g.: W=Normal Size		“1~G” = “1~16”								
Wattage	1/32	3/4	1/2	1/3	1/4	1/8	1/10	1/16	1/20	1
Normal Size	WH	07	W2	W3	W4	W8	WA	WG	WM	1W

If power rating is equal or lower than 1 watt, 5th code would be “W” and 6th code would be a number or letter.

E.g.: WA=1/10W W4=1/4W

2.3 7th code: Tolerance. E.g.: D=±0.5% F=±1% G=±2% J=±5% K=±10%

2.4 8th~11th codes: Resistance Value.

2.4.1 If value belongs to standard value of E-24 series, the 8th code is zero, 9th~10th codes are the significant figures of resistance value, and the 11th code is the power of ten.

2.4.2 If value belongs to standard value of E-96 series, the 8th~10th codes are the significant figures of resistance value, and the 11th code is the power of ten.

2.4.3 11th codes listed as following:

0=10⁰ 1=10¹ 2=10² 3=10³ 4=10⁴ 5=10⁵ 6=10⁶ J=10⁻¹ K=10⁻² L=10⁻³ M=10⁻⁴

2.5 12th~14th codes.

2.5.1 12th code: Packaging Type. E.g.: C=Bulk T=Tape/Reel

2.5.2 13th code: Standard Packing Quantity.

4=4,000pcs 5=5,000pcs C=10,000pcs D=20,000pcs E=15,000pcs

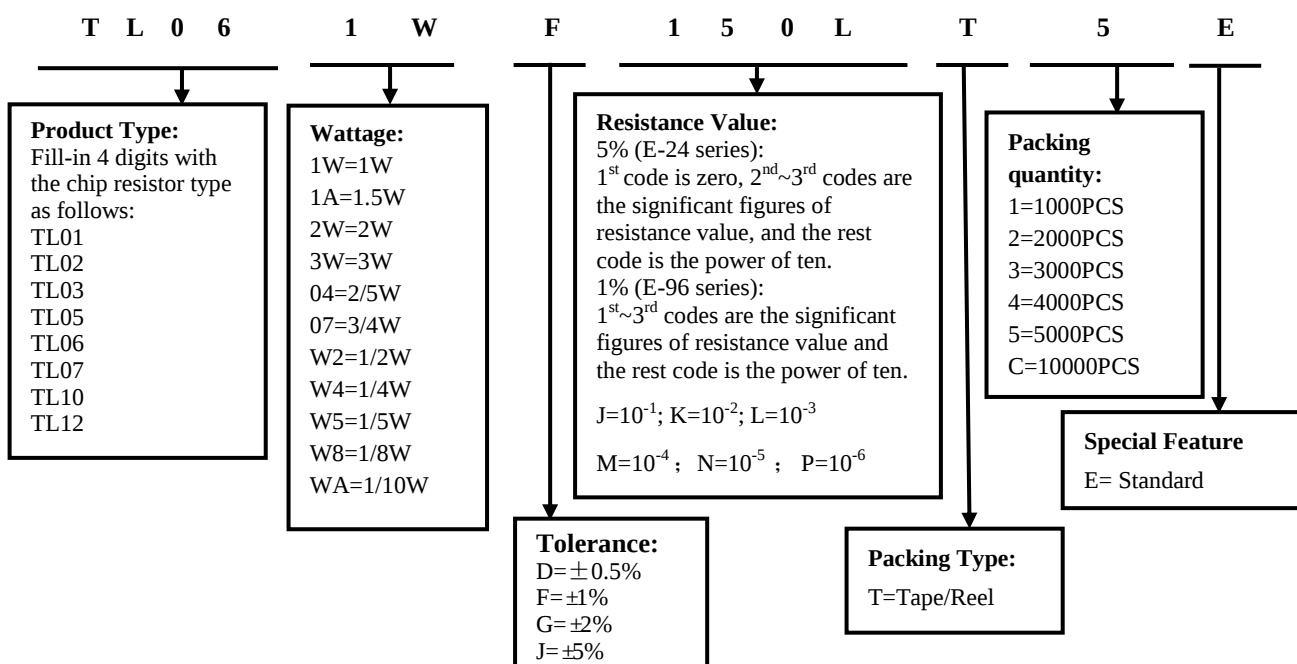
Chip Product: BD=B/B-20000pcs TC=T/R-10000pcs

2.5.3 14th code: Special features.

E = Standard

3. Ordering Procedure

(Example: TL06 1W ±1% 0.15Ω T/R-5000)



4. Marking



0201~0402: no marking



0603: 3 digits



0805~2512: 4 digits

4.1 TL01 and TL02 : No marking

4.2 TL03: 3 digits

4.2.1 For E-24 values:

Resistance value	Code	Example
50mΩ ~ 99mΩ	0XX	068 = 68mΩ
100mΩ ~ 990mΩ	RXX	R68 = 680mΩ
1Ω ~ 9.9Ω	XXR	6R8 = 6.8Ω
10Ω	10R	10R = 10Ω

E-24	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91
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4.2.2 For E-96 values: excluding values 10/11/13/15/20/75 of E-24 series.

Standard E-96 Values and 0603 Resistance Codes

Value	Code	Value	Code	Value	Code	Value	Code
100	01	178	25	316	49	562	73
102	02	182	26	324	50	576	74
105	03	187	27	332	51	590	75
107	04	191	28	340	52	604	76
110	05	196	29	348	53	619	77
113	06	200	30	357	54	634	78
115	07	205	31	365	55	649	79
118	08	210	32	374	56	665	80
121	09	215	33	383	57	681	81
124	10	221	34	392	58	698	82
127	11	226	35	402	59	715	83
130	12	232	36	412	60	732	84
133	13	237	37	422	61	750	85
137	14	243	38	432	62	768	86
140	15	249	39	442	63	787	87
143	16	255	40	453	64	806	88
147	17	261	41	464	65	825	89
150	18	267	42	475	66	845	90
154	19	274	43	487	67	866	91
158	20	280	44	499	68	887	92
162	21	287	45	511	69	909	93
165	22	294	46	523	70	931	94
169	23	301	47	536	71	953	95
174	24	309	48	549	72	976	96

E-96 Multiplier Code

Code	A	B	C	D	E	F	G	H	X	Y	Z
Multiplier	10 ⁰	10 ¹	10 ²	10 ³	10 ⁴	10 ⁵	10 ⁶	10 ⁷	10 ⁻¹	10 ⁻²	10 ⁻³

0603 3 digits coding formula for E-96 values as following:

Example: Example: 499 m Ω = $499 \times 10^{-3} \Omega$ = 68Z
68 Z

4.3 TL05 ~ TL12 : 4 digit marking

First 3 digits are the significant figures, the 4th digit is the multiplier. "R" = decimal point.

Examples:

Resistance value	Code	Example
50mΩ ~ 99mΩ (only for 0805, 1206, 1210)	R0XX	R068 = 68mΩ
100mΩ ~ 990mΩ	RXXX	R680 = 680mΩ
1Ω ~ 9.9Ω	XRXX	6R80 = 6.8Ω
10Ω	10R0	10R0 = 10Ω

5. Standard Electrical Specifications

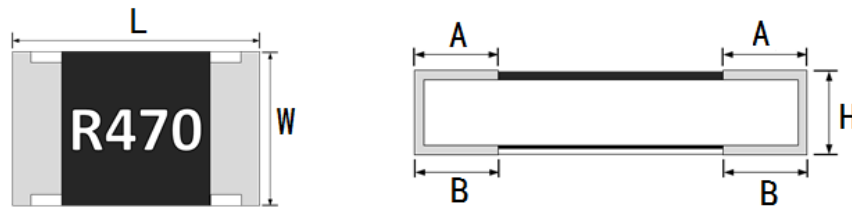
Type	Rating Power at 70°C	Max. Rating Current	Max. Overload Current	T.C.R (ppm/°C)	Resistance Range
					0.5% (D) , 1.0% (F) 2.0% (G), 5.0% (J)
TL01 (0201)	1/10W	1.41A	3.16A	±100 ----- ±50	50mΩ ≤ R < 100mΩ ----- 100mΩ ≤ R ≤ 10Ω
TL02 (0402)	1/8W	1.58A	3.54A		
	1/4W	2.24A	5.00A		
TL03 (0603)	1/5W	2.00A	4.47A		
	2/5W	2.83A	6.32A	±150 ----- ±100 ----- ±50	39mΩ ≤ R < 50mΩ ----- 50mΩ ≤ R < 100mΩ ----- 100mΩ ≤ R ≤ 10Ω
TL05 (0805)	1/4W	2.53A	5.66A		
	1/2W	3.58A	8.00A		
TL06 (1206)	1/2W	3.58A	8.00A		
	1W	5.06A	11.32A		
TL07 (1210)	1/2W	3.58A	8.95A		
	1W	5.06A	11.32A	±50	100mΩ ≤ R ≤ 10Ω
TL10 (2010)	3/4W	2.74A	6.85A		
	1.5W	3.87A	8.66A		
TL12 (2512)	2W	4.47A	10.00A		
	3W	5.48A	12.25A		

Type	Rating Power at 70°C	Max. Rating Current	Max. Overload Current	T.C.R (ppm/°C)	Resistance Range
					1.0% (F) 2.0% (G), 5.0% (J)
TL06 (1206)	1/2W	7.07A	15.81A	±200	10mΩ ≤ R < 39 mΩ

For non-standard parts, please contact our sales dept.

Operating Temperature Range : -55°C ~ + 155°C.

6. Dimension

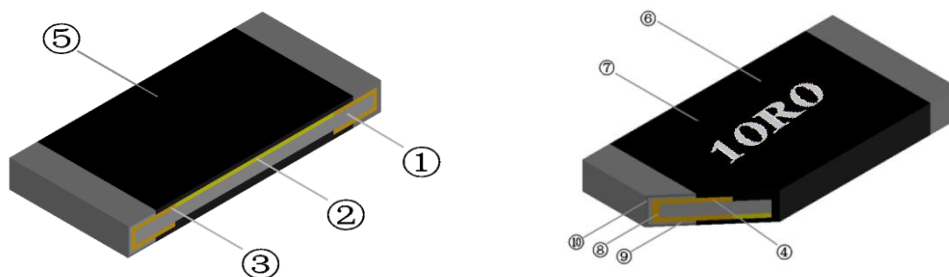


Unit: mm

Type	L	W	H	A	B
TL01	0.60±0.03	0.30±0.03	0.26±0.05	0.15±0.05	0.15±0.05
TL02	1.00±0.10	0.50±0.05	0.35±0.05	0.20±0.10	0.25±0.10
TL03	1.60±0.10	0.80±0.10	0.45±0.10	0.25±0.15	0.30±0.15
TL05	2.00±0.10	1.25±0.10	0.55±0.10	0.35±0.20	0.40±0.20
TL06	3.10±0.10	1.60±0.10	0.55±0.10	0.40±0.20	0.45±0.20
TL07	3.10±0.10	2.50±0.15	0.55±0.10	0.50±0.20	0.50±0.20
TL10	5.00±0.20	2.50±0.15	0.55±0.10	0.60±0.25	0.60±0.25
TL12	6.30±0.20	3.20±0.20	0.55±0.10	0.65±0.25	0.65±0.25
TL12(3W)	6.30±0.20	3.20±0.20	0.70±0.15	0.65±0.25	0.65±0.25

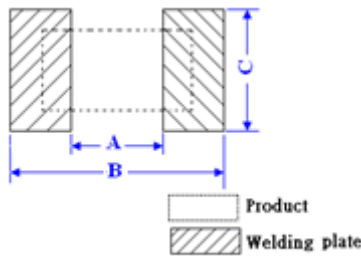
Type	L	W	H	A	B
TL06 (10 mΩ ≤ R < 39 mΩ)	3.30±0.20	1.70±0.20	0.65±0.2	0.20±0.15	0.68±0.20

7. Structure



①	Alumina Substrate	⑥	Top Protective Overcoat
②	Resistive Layer	⑦	Marking
③	Bottom Inner Electrode (Cu)	⑧	Side Inner Electrode
④	Top Inner Electrode	⑨	Barrier Layer (Ni)
⑤	Bottom Protective Overcoat White(≥39mR) Green(<39mR)	⑩	Solder coating (Sn)

8. Soldering pad size recommended



Type	Dimension(mm)		
	A	B	C
TL01	0.25	0.85	0.35
TL02	0.50	1.60	0.70
TL03	0.80	2.40	1.00
TL05	1.30	2.90	1.45
TL06	2.20	4.20	1.80
TL06 (10 mΩ ≤ R < 39 mΩ)	1.20	4.80	1.84
TL07	2.00	4.40	2.70
TL10	3.80	6.60	2.70
TL12	4.90	8.10	3.40

9. Derating Curve

Power rating will change based on continuous load at ambient temperature from -55 to 155°C.

It is constant between -55 to 70°C, and derate to zero when temperature rise from 70 to 155°C.

Voltage rating:

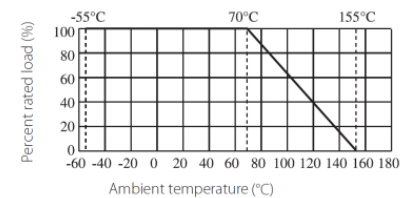
Rated Current: The resistor shall have a DC continuous working current or a AC (rms) continuous working current at commercial-line frequency and wave form corresponding to the power rating, as determined formula as following:

$$I = \sqrt{P \div R}$$

I = Rating current (A)

P= Rating Power (W)

R= Resistance(Ω)



10. Performance Specification

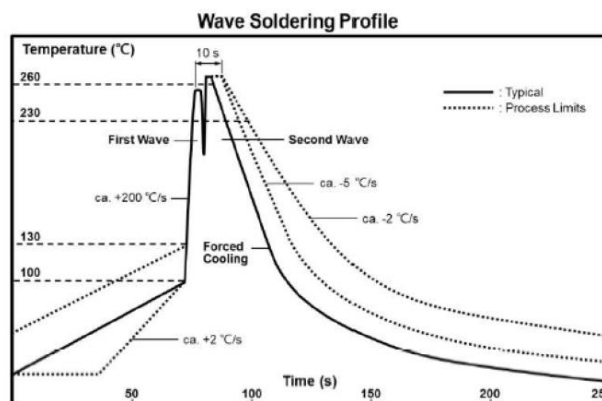
Test Item	Test Method	Procedure	Requirements
Temperature Coefficient of Resistance (T.C.R)	JIS C 5201-1 clause 4.8	TCR +125 °C, 25 °C is the reference temperature	Refer to Standard Electrical Specifications
Short Time Overload	JIS C 5201-1 clause 4.13	5 times rated power whichever is less for 5 seconds.	±(1.0%+0.001Ω)
Insulation Resistance	JIS C 5201-1 clause 4.6	100V for 1 minute.	≥10GΩ
Dielectric Withstanding Voltage	JIS-C5201-1 clause 4.7	TL05, TL06, TL07, TL10, TL12 for 500 VAC 1min TL01, TL02, TL03 for 300 VAC 1min	No short or burned on the appearance.
Solderability	JIS C 5201-1 clause 4.17	245±5 °C for 3±0.5secs.	>95% Coverage No Visual damage
Resistance to Soldering Heat	JIS-C5201-1 clause 4.18	260±5 °C, 10±1 seconds	±(1.0%+0.001Ω) No Visual damage
Leaching	JIS-C5201-1 clause 4.18	260±5°C for 30 seconds.	>95% Coverage No Visual damage
Rapid Change of Temperature	JIS C 5201-1 clause 4.19	-55°C to +155°C, 300 cycles	±(1.0%+0.001Ω) No Visual damage
Load Life in Humidity	JIS C 5201-1 clause 4.24	40±2°C, 90~95% R.H. , Rated power or Max. working current whichever is less for 1000 hrs with 1.5 hrs "ON" and 0.5 hr "OFF" .	±(1.0%+0.001Ω)
Load Life (Endurance)	JIS C 5201-1 clause 4.25	70±2°C, Rated power, or Max. working current whichever is less for 1000 hrs with 1.5 hrs "ON" and 0.5 hr "OFF" .	±(1.0%+0.001Ω)

Biased Humidity	MIL-STD-202 Method 103	1,000 hours;85°C/85%RH,10% of operating power.Measurement at 24 ± 4 hours after test conclusion.	$\pm(0.5\%+0.05\Omega)$
High Temperature Exposure	JIS C 5201-1 clause 4.25	$155 \pm 5^\circ\text{C}$ for 1000 +48/-0 hours.	$\pm(1.0\%+0.001\Omega)$
Resistance to Solvent	JIS C 5201-1 clause 4.29	The tested resistor be immersed into isopropyl alcohol of $20 \sim 25^\circ\text{C}$ for 60 secs. Then the resistor is left in the room for 48 hrs.	$\pm(1.0\%+0.001\Omega)$ No Visual damage
Terminal Strength	JIS-C5201-1 clause 4.32	Pressurizing force for 10 seconds TL01 / TL02 / TL03 : 8N ; TL05 and above : 17.7N	No broken
Terminal Bending Strength	JIS C 5201-1 clause 4.33	Bending once for 5 seconds D : TL01, TL02, TL03, TL05 = 5mm TL06, TL07 = 3mm TL10, TL12 = 2mm	$\pm(1.0\%+0.001\Omega)$ No Visual damage

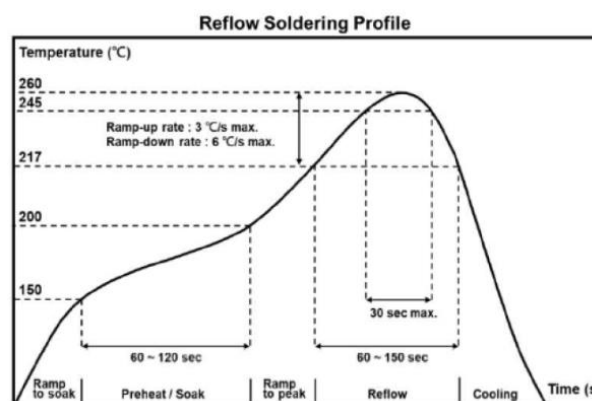
Temperature Coefficient of Resistance test to -55°C is available on request

11. Recommended Customer Soldering Parameters

11.1 Wave solder Temperature condition



11.2 Solder reflow Temperature condition



11.3 Rework temperature (hot air equipment) : 350°C , 3~5seconds

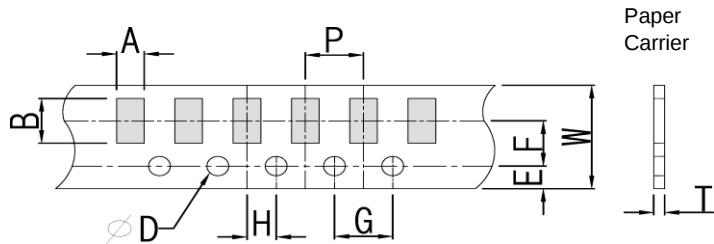
11.4 Recommended reflow methods

IR, vapor phase oven, hot air oven

If reflow temperatures exceed the recommended profile, devices may not meet the performance requirements.

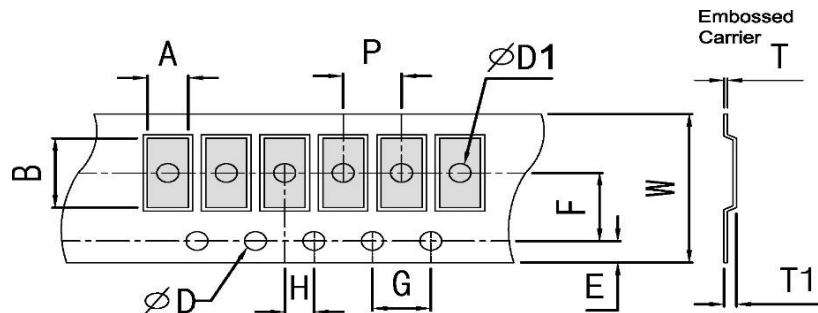
12. Packing

12.1 Tapping Specification:(Unit: mm)



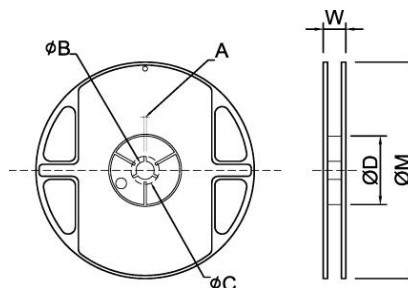
Packaging	Type	A	B	W	E	F	G	H	T	ψD	P
Paper Type	TL01	0.45 ± 0.1	0.75 ± 0.1	8.0 ± 0.2	1.75 ± 0.1	3.5 ± 0.05	4.0 ± 0.1	2.0 ± 0.05	0.35 ± 0.1	$1.50^{+0.1}_{-0}$	2.0 ± 0.1
	TL02	0.7 ± 0.1	1.20 ± 0.1	8.0 ± 0.2	1.75 ± 0.1	3.5 ± 0.05	4.0 ± 0.1	2.0 ± 0.05	0.45 ± 0.1		2.0 ± 0.1
	TL03	1.05 ± 0.2	1.80 ± 0.2	8.0 ± 0.2	1.75 ± 0.1	3.5 ± 0.05	4.0 ± 0.1	2.0 ± 0.05	0.60 ± 0.1		4.0 ± 0.1
	TL05	1.55 ± 0.2	2.30 ± 0.2	8.0 ± 0.2	1.75 ± 0.1	3.5 ± 0.05	4.0 ± 0.1	2.0 ± 0.05	0.75 ± 0.1		4.0 ± 0.1
	TL06	1.90 ± 0.2	3.05 ± 0.2	8.0 ± 0.2	1.75 ± 0.1	3.5 ± 0.05	4.0 ± 0.1	2.0 ± 0.05	0.75 ± 0.1		4.0 ± 0.1
	TL07	2.85 ± 0.2	3.05 ± 0.2	8.0 ± 0.2	1.75 ± 0.1	3.5 ± 0.05	4.0 ± 0.1	2.0 ± 0.05	0.75 ± 0.1		4.0 ± 0.1

12.2 Embossed Dimension:(Unit: mm)



Packaging	Type	A	B	W	E	F	G	H	T	ΦD	$\Phi D1$	T1	P
Embossed Type	TL10	2.80 ± 0.2	5.60 ± 0.2	12 ± 0.1	1.75 ± 0.1	5.5 ± 0.05	4.0 ± 0.1	2.0 ± 0.05	0.23 ± 0.1	$1.50^{+0.1}_{-0}$	1.50 ± 0.1	0.85 ± 0.15	4.0 ± 0.1
	TL12	3.40 ± 0.2	6.70 ± 0.2	12 ± 0.1	1.75 ± 0.1	5.5 ± 0.05	4.0 ± 0.1	2.0 ± 0.05	0.23 ± 0.1		1.50 ± 0.1	0.85 ± 0.15	4.0 ± 0.1

12.3 Dimension of Reel : (Unit: mm)



TYPE	SIZE		A	ΦB	ΦC	ΦD	W	ΦM
TL01	7"	10K/Reel	2.0±0.5	13.5±1.0	21±1.0	60±1.0	11.5±2.0	178±2.0
TL02	7"	10K/Reel	2.0±0.5	13.5±1.0	21±1.0	60±1.0	11.5±2.0	178±2.0
TL03	7"	5K/Reel	2.0±0.5	13.5±1.0	21±1.0	60±1.0	11.5±2.0	178±2.0
TL05	7"	5K/Reel	2.0±0.5	13.5±1.0	21±1.0	60±1.0	11.5±2.0	178±2.0
TL06	7"	5K/Reel	2.0±0.5	13.5±1.0	21±1.0	60±1.0	11.5±2.0	178±2.0
TL07	7"	5K/Reel	2.0±0.5	13.5±1.0	21±1.0	60±1.0	11.5±2.0	178±2.0
TL10	7"	4K/Reel	2.0±0.5	13.5±1.0	21±1.0	60±1.0	16.0±2.0	178±2.0
TL12	7"	4K/Reel	2.0±0.5	13.5±1.0	21±1.0	60±1.0	16.0±2.0	178±2.0

13. Note

- 13.1. UNI-ROYAL recommend products store in warehouse with temperature between $25 \pm 5^{\circ}\text{C}$ under humidity between $60 \pm 20\%\text{RH}$.
Even under storage conditions recommended above, solder ability of products will be degraded stored over 1 year old.
- 13.2. Cartons must be placed in correct direction which indicated on carton, otherwise the reel or wire will be deformed.
- 13.3. Storage conditions as below are inappropriate:
 - a. Stored in high electrostatic environment
 - b. Stored in direct sunshine, rain, snow or condensation.
 - c. Exposed to sea wind or corrosive gases, such as Cl_2 , H_2S , NH_3 , SO_2 , NO_2 , etc.

14. Record

Version	Description	Page	Date	Amended by	Checked by
1	First version	1~9	Nov.21, 2019	Haiyan Chen	Yuhua Xu
2	Add the TL12 3W power	4~5	Jun.06, 2019	Haiyan Chen	Yuhua Xu
3	Modify the power	4	Sep.09, 2020	Haiyan Chen	Yuhua Xu
4	Add the Biased Humidity test	7	Sep.18, 2020	Song Nie	Yuhua Xu
5	Update wave soldering and reflow soldering diagrams	7	Dec.07, 2021	Song Nie	Haiyan Chen
6	Add the AEC-Q200 compliant	2	Nov.01, 2023	Haiyan Chen	Yuhua Xu
7	Modify the performance specification	6~7	Jan.20, 2025	Haiyan Chen	Yuhua Xu

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