

# Data Sheet

Customer: \_\_\_\_\_

Product: Thick Film Triple Power Chip Resistor TPF Series \_\_\_\_\_

Size : 0603/0805/1206/1210/2010/2512 \_\_\_\_\_

Issued Date: 05-Oct.-2023 \_\_\_\_\_

Edition: Ver. 3 \_\_\_\_\_

## Record of change

Date	Ver.	Description	Page
06-Jan.-2017	1		
06-Mar.-2017	2	Add size 2512 3W	
05-Oct.-2023	3	Add size 1210/2010 & revise rating	1,2

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Prepared by	Checked by	Approved by	Accepted by (customer)
05-Oct.-2023	05-Oct.-2023	05-Oct.-2023	
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# Thick Film Triple Power Chip Resistor

# TPF SERIES

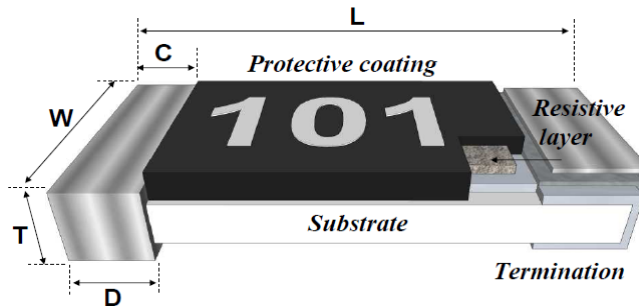
## 1. Features

- High power rating to 0.75W of 1206 size, 3W of 2512 size.
- High reliability and high precision (1%).
- Suitable for lead free soldering.
- Meet AEC-Q200, RoHS compliant & Halogen Free.

## 2. Applications

- Power supply.
- Digital meter, Consumer electronics, M/B.
- LED Lighting.
- Industry control board.

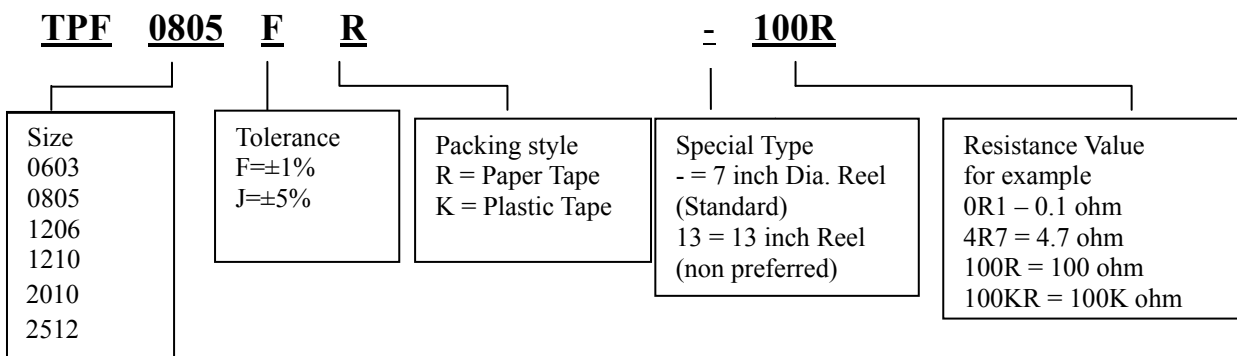
## 3. Dimension and Construction



Unit : mm

Size	L	W	C	D	T
0603	1.60±0.10	0.80±0.10	0.30±0.20	0.30±0.20	0.45±0.10
0805	2.00±0.10	1.25±0.10	0.40±0.20	0.40±0.20	0.50±0.10
1206	3.10±0.10	1.60±0.10	0.50±0.25	0.50±0.25	0.55±0.10
1210	3.10±0.10	2.60±0.10	0.50±0.25	0.50±0.25	0.55±0.10
2010	5.00±0.20	2.50±0.20	0.65±0.25	0.60±0.25	0.60±0.10
2512	6.40±0.20	3.20±0.25	0.45±0.25	1.80±0.25	1.10±0.20

## ■ Part Numbering



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## 4. Rating

### High Power Resistors:

Size	Power Rating at 70°C	Max. RCWV	Max. Overload Voltage	Resistance Tolerance	Temperature Coefficient (ppm/°C)	Resistance Range		Standard Resistance Values
						Min.	Max.	
0603	1/3W	75V	125V	±1%(F)	±100ppm	10Ω	1MΩ	E96/E24
				±1%(F)	±200ppm	1Ω	9.76Ω	E96/E24
				±5%(J)	±200ppm	1Ω	1MΩ	E24
0805	1/2W	200V	300V	±1%(F)	±100ppm	10Ω	1MΩ	E96/E24
				±1%(F)	±150ppm	1Ω	9.76Ω	E96/E24
				±5%(J)	±200ppm	1Ω	1MΩ	E24
1206	3/4W	250V	500V	±1%(F)	±100ppm	1Ω	1MΩ	E96/E24
				±5%(J)	±200ppm	1Ω	1MΩ	E24
1210	3/4W	250V	500V	±1%(F)	±100ppm	1Ω	1MΩ	E96/E24
				±5%(J)	±200ppm	1Ω	1MΩ	E24
2010	1.5W	250V	500V	±1%(F)	±100ppm	1Ω	1MΩ	E96/E24
				±5%(J)	±200ppm	1Ω	1MΩ	E24
2512	3W	250V	500V	±1%(F)	±100ppm	1Ω	1MΩ	E96/E24
				±5%(J)	±200ppm	1Ω	1MΩ	E24

Application Note :  $RCWV = (P \times R)^{1/2}$  or Max. RCWV listed above, whichever is lower.

RCWV : Working Voltage (V) · P : Rated Power (W) · R : Resistance Value (Ω)

Solder-pad and trace size influences should be evaluated, and board surface temperature should keep not exceed 105°C when full rated power applied.

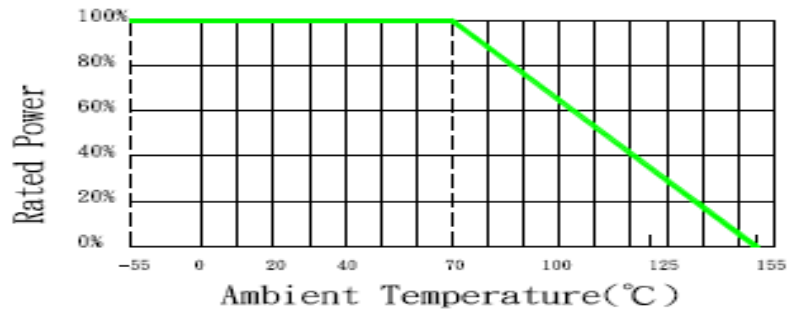
### High Current Power Jumpers:

Size	Description	Max. Rated Current	Max. Overload Current	Resistance
0603	Zero Ohm · Jumper	6 A	12 A	≤ 10mΩ
0805	Zero Ohm · Jumper	7 A	14 A	≤ 10mΩ
1206	Zero Ohm · Jumper	9 A	18 A	≤ 10mΩ
2010	Zero Ohm · Jumper	12 A	24 A	≤ 10mΩ
2512	Zero Ohm · Jumper	14 A	28 A	≤ 10mΩ

Solder-pad and trace size should be evaluated, and board surface temperature should keep not exceed 105°C when applied full rated power.

**5. Power Derating Curve**

Operating Temperature Range: -55 to +155 deg.C

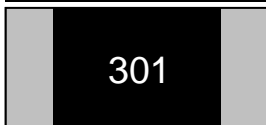


**6. Marking/Soldering**

Resistance value identify :

E24 ±5% : 3 Digits marking to identify the resistance value

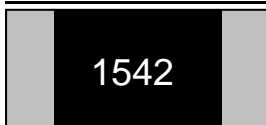
0603/0805/1206/1210/2010



$301 \rightarrow 30 \times 10^1 = 300\Omega$

E24/E96 ±1% : 4 Digits marking to identify the resistance value

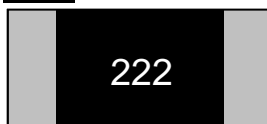
0805/1206/1210/2010



$1542 \rightarrow 154 \times 10^2 = 15.4 \text{ K}\Omega$

E24 ±1% : 3 Digits marking to identify the resistance value

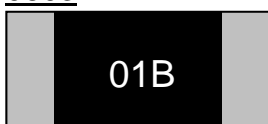
0603



$222 \rightarrow 22 \times 10^2 = 2.2 \text{ K}\Omega$

E96 ±1% : 3 Digits marking to identify the resistance value

0603

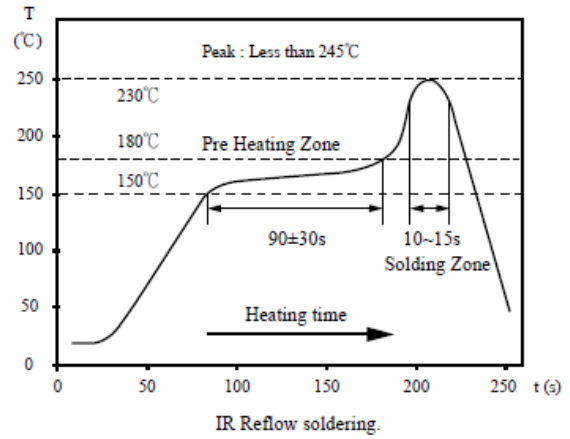
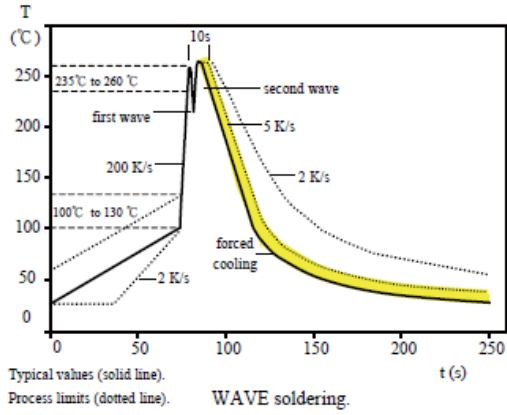


$01B \rightarrow \text{Refer 0603 marking table} = 1 \text{ K}\Omega$

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# TPF SERIES

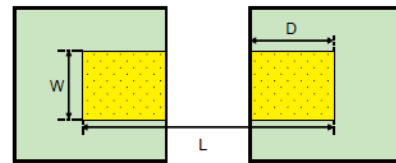
## Soldering Reference :



## Recommend Solder Pad Dimensions :

Type	W	D	L
<b>0603</b>	0.90	1.00	3.00
<b>0805</b>	1.30	1.15	3.50
<b>1206</b>	1.80	1.30	4.70
<b>1210</b>	3.00	1.30	4.70
<b>2010</b>	3.00	1.50	6.80
<b>2512</b>	3.70	2.45	7.60

Unit:mm



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## 7. Reliability Performance (AEC-Q200)

Test Item	Specification	Test Method (AEC-Q200. IEC 60115)
<b>*DC Resistance</b>	F : $\pm 1\%$ ; J : $\pm 5\%$ Jumper : $\leq 10\text{m}\Omega$	<b>AEC-Q200 TABLE 7.1</b> <b>IEC 60115-1 / JIS C 5201-1 , Clause 4.5</b> Measure the resistance Value.
<b>High Temperature Exposure (Storage)</b>	J : $\Delta R \leq \pm(3\%+0.1\Omega)$ F : $\Delta R \leq \pm(1\%+0.05\Omega)$ Jumper : $\leq 10\text{m}\Omega$	<b>AEC-Q200 TABLE 7.3</b> 1000 hrs. @ T=125°C. Unpowered. Measurement at 24 $\pm$ 2 hours after test conclusion.
<b>*Temperature Cycling</b>	J : $\Delta R \leq \pm(1\%+0.1\Omega)$ F : $\Delta R \leq \pm(0.5\%+0.05\Omega)$ No mechanical damage. Jumper : $\leq 10\text{m}\Omega$	<b>AEC-Q200 TABLE 7.4</b> 1000 Cycles (-55°C to +125°C). Measurement at 24 $\pm$ 2 hours after test conclusion.
<b>Moisture Resistance</b>	J : $\Delta R \leq \pm(1\%+0.1\Omega)$ F : $\Delta R \leq \pm(0.5\%+0.05\Omega)$ Jumper : $\leq 10\text{m}\Omega$	<b>AEC-Q200 TABLE 7.6</b> Test 65°C/80~100%RH/10Cycles. Measurement at 24 $\pm$ 2 hours after test conclusion. (t=24hrs/cycle).
<b>Biased Humidity</b>	J : $\Delta R \leq \pm(3\%+0.1\Omega)$ F : $\Delta R \leq \pm(1\%+0.05\Omega)$ Jumper : $\leq 10\text{m}\Omega$	<b>AEC-Q200 TABLE 7.7</b> 1000 hours 85°C/85%RH. 10% of operating power. Measurement at 24 $\pm$ 2 hours after test conclusion.
<b>Operational Life</b>	J : $\Delta R \leq \pm(3\%+0.1\Omega)$ F : $\Delta R \leq \pm(1\%+0.05\Omega)$ Jumper : $\leq 10\text{m}\Omega$	<b>AEC-Q200 TABLE 7.8</b> Test 1000hr @ TA=125°C at specified rated power. Measurement at 24 $\pm$ 2 hours after test conclusion.
<b>External Visual</b>	No visual damage and refer PDC marking code.	<b>AEC-Q200 TABLE 7.9</b> Inspect device construction, marking and workmanship.
<b>Physical Dimension</b>	Within the spec.	<b>AEC-Q200 TABLE 7.10</b> Verify physical dimensions to the applicable device detail specification.
<b>Mechanical Shock</b>	Within product specification tolerance and no visible damage.	<b>AEC-Q200 TABLE 7.13</b> Test Peak value:100g's,Wave:Hail-sine, Duration:6ms,Velocity:12.3ft/sec.

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<b>Vibration</b>	No mechanical damage.	<b>AEC-Q200 TABLE 7.14</b> 5 g's for 20 min., 12 cycles each of 3 orientations. Test from 10-2000 Hz.
<b>*Resistance to Solder Heat</b>	J : $\Delta R \leq \pm(1\% + 0.1\Omega)$ F : $\Delta R \leq \pm(0.5\% + 0.05\Omega)$ No mechanical damage. Jumper : $\leq 10m\Omega$	<b>AEC-Q200 TABLE 7.15</b> Solder dipping @ $270^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for 10sec. $\pm 1$ sec.
<b>Thermal Shock</b>	J : $\Delta R \leq \pm(1\% + 0.1\Omega)$ F : $\Delta R \leq \pm(0.5\% + 0.05\Omega)$ No mechanical damage. Jumper : $\leq 10m\Omega$	<b>AEC-Q200 TABLE 7.16</b> -55 to $155^{\circ}\text{C}$ / dwell time 15min/ Max transfer time 20sec/ 300cycles.
<b>ESD</b>	$\Delta R \leq \pm(1\% + 0.1\Omega)$ No mechanical damage. Jumper : $\leq 10m\Omega$	<b>AEC-Q200-002</b> Test contact min. 1KV.
<b>*Solder Ability</b>	Over 95% of termination must be covered with solder.	<b>AEC-Q200 TABLE 7.18</b> a) Baking $155^{\circ}\text{C}$ 4H, dipping $235^{\circ}\text{C}$ 5s b) Steam 1H, dipping $215^{\circ}\text{C}$ 5s c) Steam 1H, dipping $260^{\circ}\text{C}$ 7s
<b>Flammability</b>	Refer UL-94.	<b>AEC-Q200 TABLE 7.20</b> UL-94 V-0 or V-1 are acceptable
<b>*Board Flex</b>	J : $\Delta R \leq \pm(1\% + 0.1\Omega)$ F : $\Delta R \leq \pm(0.5\% + 0.05\Omega)$ No mechanical damage. Jumper : $\leq 10m\Omega$	<b>AEC-Q200 TABLE 7.21</b> Bending 2mm 2512.2010.1210.1206, 3mm 0805.0603.
<b>Terminal Strength</b>	No mechanical damage	<b>AEC-Q200 TABLE 7.22</b> Force 1 Kg for 60 seconds.
<b>*Short Time Overload</b>	J : $\Delta R \leq \pm(2\% + 0.1\Omega)$ F : $\Delta R \leq \pm(1\% + 0.05\Omega)$ Jumper : $\leq 10m\Omega$	<b>IEC 60115-1, Clause 4.13</b> 5 x Rated power for 5 seconds
<b>*Load Life Humidity</b>	J : $\Delta R \leq \pm(3\% + 0.1\Omega)$ F : $\Delta R \leq \pm(1\% + 0.05\Omega)$ Jumper : $\leq 10m\Omega$	<b>IEC 60115-1, Clause 4.24</b> $40 \pm 2^{\circ}\text{C}$ with relative humidity 90% ~ 95% D.C. rated voltage for 1.5 hours ON 30 minutes OFF. Cycle repeated 1000 hours.

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<b>*Temperature Coefficient of Resistance (TCR)</b>	Within the spec. Jumper : Not Applicable.	<b>IEC 60115-1, Clause 4.8</b> $T_1 \quad T_2$ Test temperature : 25°C~ -55°C 25°C~ +155°C $TCR(ppm/^{\circ}C) = (R_2-R_1)/R_1 \times 1 / (T_2-T_1) \times 10^6$
<b>*Load Life</b>	J : $\Delta R \leq \pm(3\%+0.1\Omega)$ F : $\Delta R \leq \pm(1\%+0.05\Omega)$ Jumper : $\leq 10m\Omega$	<b>IEC 60115-1, Clause 4.25</b> Rated voltage for 1.5 hours for followed by a pause 0.5 hour at 70±2°C. Cycle repeated 1000 hours.
<b>*Insulation Resistance</b>	Between termination and coating must over 1000MΩ	<b>IEC 60115-1, Clause 4.6</b> Test voltage : 100±15V

\* Normal test items for standard product.

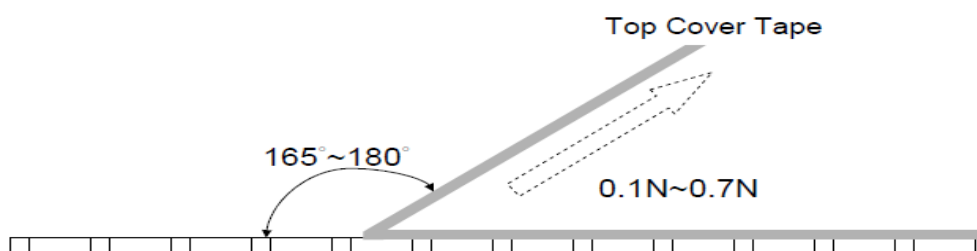


**8. PACKAGING**

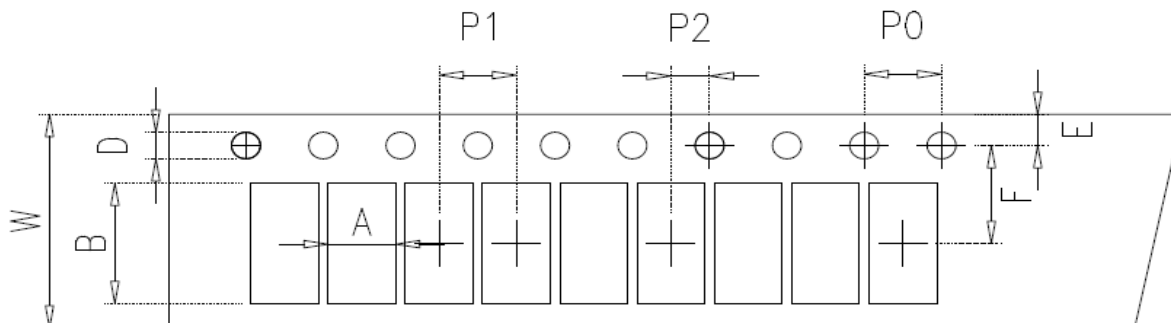
**8.1 Peel Strength of Top Cover Tape**

The peel speed shall be about 300 mm/min

The peel force of top cover tape shall between 0.1 to 0.7N



**8.2 Tape Packaging Dimensions**



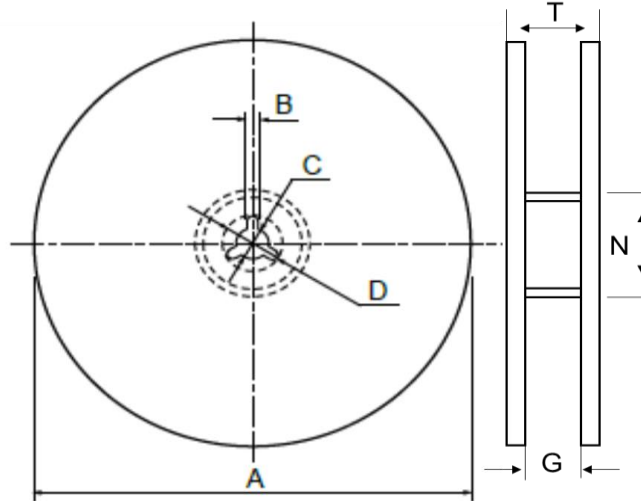
unit:mm

Size	A	B	W	F	E	P1	P2	P0	D
0603	1.10±0.20	1.90±0.20	8.00±0.30	3.50±0.05	1.75±0.10	4.00±0.10	2.00±0.05	4.00±0.10	1.50+0.10/-0
0805	1.65±0.20	2.40±0.20	8.00±0.30	3.50±0.05	1.75±0.10	4.00±0.10	2.00±0.05	4.00±0.10	1.50+0.10/-0
1206	2.00±0.20	3.60±0.20	8.00±0.30	3.50±0.05	1.75±0.10	4.00±0.10	2.00±0.05	4.00±0.10	1.50+0.10/-0
1210	3.00±0.20	3.60±0.20	8.00±0.30	3.50±0.05	1.75±0.10	4.00±0.10	2.00±0.05	4.00±0.10	1.50+0.10/-0
2010	2.80±0.20	5.50±0.20	12.00±0.30	5.50±0.05	1.75±0.10	4.00±0.10	2.00±0.05	4.00±0.10	1.50+0.10/-0
2512	3.50±0.20	6.70±0.20	12.00±0.30	5.50±0.05	1.75±0.10	4.00±0.10	2.00±0.05	4.00±0.10	1.50+0.10/-0

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## 8.3 Reel Dimensions



unit:mm

Size	Packaging Q'ty pcs	A	N	C	D	B	G	T
0603 0805 1206 1210	5k	178.0±2.0	60.0±0.5	13.0±0.5	20(Min.)	2.0±0.5	10.0±1.5	14.9max.
	10k	254.0±2.0	100.0±1.0	13.5±0.5	20(Min.)	2.0±0.5	10.0±1.5	14.9max.
	20k	330.0±2.0	100.0±1.0	13.5±0.5	20(Min.)	2.0±0.5	10.0±1.5	14.9max.
2010	4k	178.0±2.0	60.0±0.5	13.0±0.5	20(Min.)	2.0±0.5	13.8±1.5	16.7max.
	8k	254.0±2.0	100.0±0.5	13.5±0.5	20(Min.)	2.0±0.5	13.8±1.5	20.0max.
	16k	330.0±2.0	100.0±1.0	13.5±0.5	20(Min.)	2.0±0.5	13.8±1.5	20.0max.
2512	3k	178.0±2.0	60.0±0.5	13.0±0.5	20(Min.)	2.0±0.5	13.8±1.5	16.7max.

## 10. Storage & Handling

... Products are recommended to be used up within one year as ensured shelf life.

Check solder ability in case shelf life extension is needed.

... To store products with following condition:

Temperature:5 to 40°C ; Humidity: 20 to 70% relative humidity.

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## Appendix

■ 0603 1% Marking Table (Table 1)

Code	E48	E96	Code	E48	E96	Code	E48	E96	Code	E48	E96
01	100	100	25	178	178	49	316	316	73	562	562
02		102	26		182	50		324	74		576
03	105	105	27	187	187	51	332	332	75	590	590
04		107	28		191	52		340	76		604
05	110	110	29	196	196	53	348	348	77	619	619
06		113	30		200	54		357	78		634
07	115	115	31	205	205	55	365	365	79	649	649
08		118	32		210	56		374	80		665
09	121	121	33	215	215	57	383	383	81	681	681
10		124	34		221	58		392	82		698
11	127	127	35	226	226	59	402	402	83	715	715
12		130	36		232	60		412	84		732
13	133	133	37	237	237	61	422	422	85	750	750
14		137	38		243	62		432	86		768
15	140	140	39	249	249	63	442	442	87	787	787
16		143	40		255	64		453	88		806
17	147	147	41	261	261	65	464	464	89	825	825
18		150	42		267	66		475	90		845
19	154	154	43	274	274	67	487	487	91	866	866
20		158	44		280	68		499	92		887
21	162	162	45	287	287	69	511	511	93	909	909
22		165	46		294	70		523	94		931
23	169	169	47	301	301	71	536	536	95	953	953
24		174	48		309	72		549	96		976

Code	A	B	C	D	E	F	G	H	X	Y	Z
Multiplier	$10^0$	$10^1$	$10^2$	$10^3$	$10^4$	$10^5$	$10^6$	$10^7$	$10^{-1}$	$10^{-2}$	$10^{-3}$

※ All product specification and data are subject to change without notice.