# NTRW Series

## Automotive Thin Film Chip Resistor

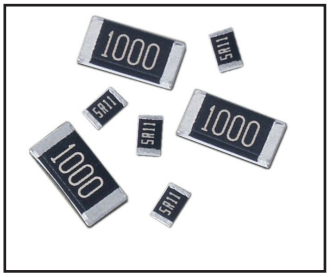
AEC-Q200 QUALIFIED

ROHS/REACH COMPLIANT HALOGEN FREE

NIC COMPONENTS Performance Passives By Design

### FEATURES

- SUPERIOR TEMPERATURE CYCLING ROBUSTNESS
- 10Ω ~ 1MΩ RESISTANCE RANGE
- RESISTOR TOLERANCES DOWN TO ±0.1%
- LOW TCR OPTIONS DOWN TO ±25 PPM/°C
- ADVANCED SULFUR RESISTANCE VERIFIED ACCORDING ASTM B809
- AEC-Q200 QUALIFIED FOR AUTOMOTIVE APPLICATIONS
- OPERATING TEMPERATURE UP TO 175°C FOR 1000 HOURS
- RATED DISSIPATION $P_{85}$ UP TO 0.52W FOR SIZE 1206



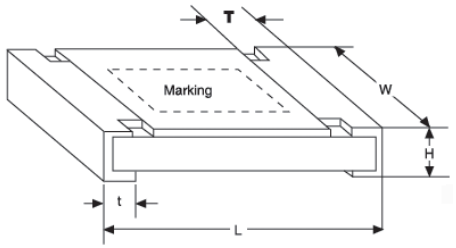

### SPECIFICATIONS

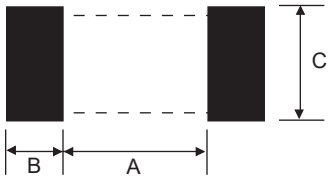
| Type | EIA Size | Power Rating At 85°C | Temperature Range | Max.*1 Working Voltage | Max.*2 Overload Voltage | Resistance Tolerance (Code) | Temperature Coefficient (ppm/°C) | Resistance Range (Ω) |
|---|---|---|---|---|---|---|---|---|
| NTRW04 | 0402 | 0.13W | -55 °C ~ +175 °C | 50V | 100V | ±0.1% (B) ±0.5%(D) ±1% (F) | ±25(C) ±50(D) | 10Ω ~ 221KΩ |
| NTRW06 | 0603 | 0.21W | | 75V | 150V | | | 4.7Ω ~ 511KΩ |
| NTRW10 | 0805 | 0.26W | | 150V | 300V | | | 4.7Ω ~ 1MΩ |
| NTRW12 | 1206 | 0.52W | | 200V | 400V | | | 4.7Ω ~ 1MΩ |

*Please refer to page 3 for information regarding max working and overload voltage ratings

### DIMENSIONS (mm) & LAND PATTERNS (mm)

| Type | L | W | H | T | t | A | B | C |
|---|---|---|---|---|---|---|---|---|
| NTRW04 | 1.00±0.05 | 0.50±0.05 | 0.30±0.05 | 0.20±0.10 | 0.20±0.10 | 0.50 | 0.50 | 0.60±0.2 |
| NTRW06 | 1.55±0.10 | 0.80±0.10 | 0.45±0.10 | 0.30±0.20 | 0.30±0.20 | 0.80 | 1.00 | 0.90±0.2 |
| NTRW10 | 2.00±0.15 | 1.25±0.15 | 0.55±0.10 | 0.30±0.20 | 0.40±0.20 | 1.00 | 1.00 | 1.35±0.2 |
| NTRW12 | 3.05±0.15 | 1.55±0.15 | 0.55±0.10 | 0.42±0.20 | 0.35±0.25 | 2.00 | 1.15 | 1.70±0.2 |




### PART NUMBER SYSTEM

NTRW 10 B 49R9 C TR Q Y F

- F — RoHS compliant
- Y — "Y" denotes suitable for automotive equipment, sourced to special production and inspection at IATF-16949 certified production site
- Q — AEC-Q200 Qualified
- TR — Tape & Reel Packaging: TR = Standard Tape & Reel, TR1K = Optional 1,000 quantity
- C — Temperature Coefficient Code: C ±25ppm, D = ±50ppm
- 49R9 — Resistance Code: First 3 digits are significant figures (both E-24 and E-96 values), 4th digit is the multiplier, "R" indicates a decimal point.
- B — Tolerance Code: B = ± 0.1%, D = ± 0.5%, F = ± 1%
- 10 — Size Code: 04=0402, 06=0603, 10=0805, 12=1206
- NTRW — Series

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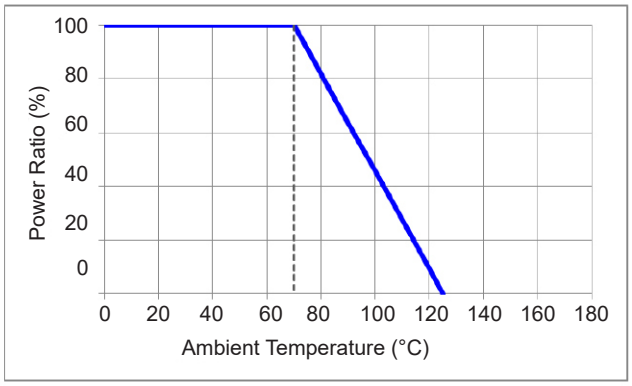
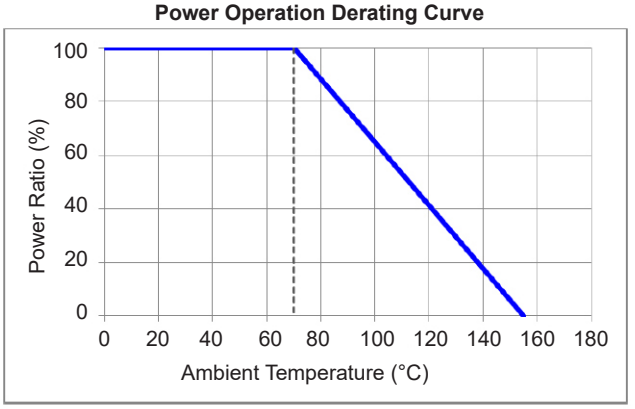
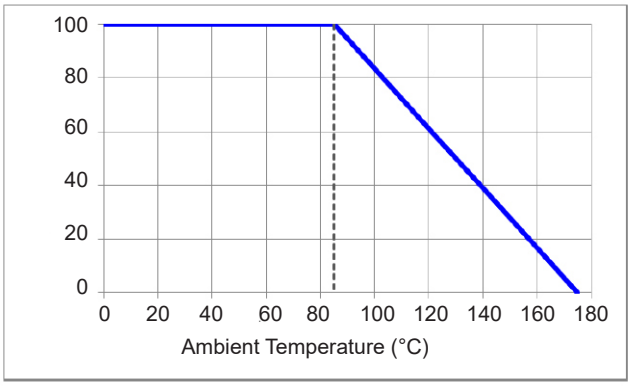
**Standard Operation Derating Curve**




**Power Operation Derating Curve**




**Advanced Power Operation Derating Curve**




RCWV (Rated Continuous Working Voltage) = √(P*R) or Max. Operating voltage whichever is lower

Note *1 - Maximum allowable continuous Working Voltage for all resistors is the lower of the two values:

"Maximum Working Voltage" as specified above or:

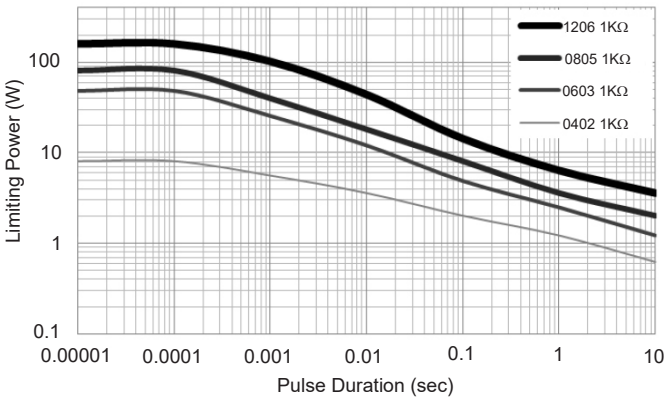
$\sqrt{\text{Power rating (Watts) x Resistance (Ohms)}}$

Note *2 - Maximum Overload Voltage for all resistors is the lower of the two values:

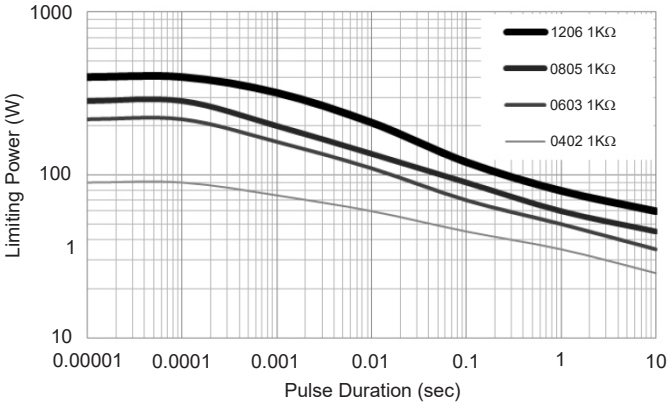
Maximum Overload Voltage" as specified above or

$2.5 \times \sqrt{\text{Power rating (Watts) x Resistance (Ohms)}}$

**SINGLE PULSE POWER**




**CONTINUOUS PULSE POWER**



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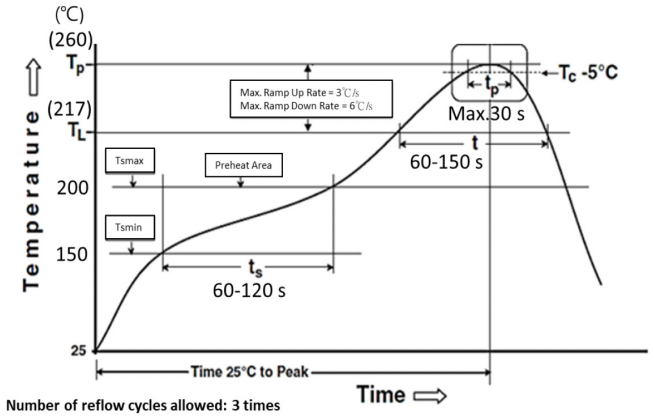
### STANDARD ELECTRICAL SPECIFICATIONS

| Type | Power Rating @ 85°C | Operating Temperature Range | Max. Operating Voltage | Max. Overload Voltage | Resistance Range | | | TCR (PPM/°C) |
|---|---|---|---|---|---|---|---|---|
| | | | | | ±0.1% | ±0.5% | ±1% | |
| NTRW04 | 0.13W | -55 ~ +175°C | 50V | 100V | 10Ω ~ 221KΩ | | | ±25(C), ±50(D) |
| NTRW06 | 0.21W | -55 ~ +175°C | 75V | 150V | 4.7Ω ~ 511KΩ | | | ±25(C), ±50(D) |
| NTRW10 | 0.26W | -55 ~ +175°C | 150V | 300V | 4.7Ω ~ 1MΩ | | | ±25(C), ±50(D) |
| NTRW12 | 0.52W | 55 ~ +175°C | 200V | 400V | 4.7Ω ~ 1MΩ | | | ±25(C), ±50(D) |

### MAXIMUM RESISTANCE CHANGE AT RATED DISSIPATION

| Operation Mode | | Standard P 70 | Power P 70 | Advanced Temperature P 85 |
|---|---|---|---|---|
| Rated dissipation | NTRW04 | 0.07W | 0.105W | 0.130W |
| | NTRW06 | 0.110W | 0.170W | 0.210W |
| | NTRW10 | 0.140W | 0.220W | 0.260W |
| | NTRW12 | 0.270W | 0.420W | 0.520W |
| Operating temperature range | | -55 ~ 125°C | -55 ~ 155°C | -55 ~ 175°C |
| Permissible film temperature | | 125°C | 155°C | 175°C |
| Max. resistance change at rated dissipation for esistance range, \|ΔR/R\| after: | NTRW04 | 10Ω ~ 221KΩ | 10Ω ~ 221KΩ | 10Ω ~ 221KΩ |
| | NTRW06 | 4.7Ω ~ 511KΩ | 4.7Ω ~ 511KΩ | 4.7Ω ~ 511KΩ |
| | NTRW10 | 4.7Ω ~ 1MΩ | 4.7Ω ~ 1MΩ | 4.7Ω ~ 1MΩ |
| | NTRW12 | 4.7Ω ~ 1MΩ | 4.7Ω ~ 1MΩ | 4.7Ω ~ 1MΩ |
| | 1000hr | ≤0.15% | ≤0.3% | ≤0.5% |
| | 8000hr | ≤0.25% | ≤0.5% | - |

## SOLDERING CONDITIONS (IPC/JEDEC J-STD-020)




Number of reflow cycles allowed: 3 times

| Pb-Free Assembly | Time |
|---|---|
| Preheat Temp min (Tsmin) | 150°C |
| Preheat Temp max (Tsmax) | 200°C |
| Preheat time (ts) | 60 - 120 seconds |
| Ramp-up rate (TL to TP) | 3°C/second max. |
| Liquidous temperature (TL) | 217°C |
| Time (tL) maintained above TL | 60 - 150 seconds |
| Peak Temperature min (TP min) | 235°C |
| Peak Temperature max (TP max) | 260°C |
| Time (TP) within 5°C of the specified classification temperature (Tc) | 30 seconds max. |
| Ramp-down rate (TP to TL) | 6°C/second max. |
| Time 25°C to peak temperature | 8 minutes max. |

## STORAGE CONDITIONS

Storage Temperature: 15 ~28 °C;  Humidity < 80%RH

## ENVIRONMENTAL CHARACTERISTICS

| Item | Requirement | | | Test Method* |
|---|---|---|---|---|
| Temperature Coefficient of Resistance | As specified | | | MIL-STD 202 Method 304<br>+25/55/+25/+125/+25°C |
| Short Time Overload (Standard Operating Mode) | ΔR ± 0.1% | | | JISC 5201 1 4.13<br>RCWV*2.5 or Max. overload voltage whichever is lower for 5 seconds |
| Short Time Overload (Power Operating Mode) | ΔR ± 0.25% | | | |
| Insulation Resistance | > 1000MΩ | | | MIL-STD 202 Method 302<br>Apply 100VDC for 1 minute |
| Endurance | Standard @ 70°C | 1,000 hours | ΔR ± 0.15% | MIL-STD-202 Method 108<br>RCWV (hours as stated in "Requirements") with 1.5 hrs “ON” and 0.5 hrs "OFF" |
| | | 8,000 hours | ΔR ± 0.25% | |
| | Power @ 70°C | 1,000 hours | ΔR ± 0.30% | |
| | | 8,000 hours | ΔR ± 0.50% | |
| | Advanced temperature @ 85°C | 1,000 hours | ΔR ± 0.50% | |
| High Temperature Exposure | 125°C | ΔR ± 0.15% | | EN 60115 1 CLAUSE 4.25.3<br>1000 hrs |
| | 155°C | ΔR ± 0.3% | | |
| | 175°C | ΔR ± 0.5% | | |

## ENVIRONMENTAL CHARACTERISTICS

| Item | Requirement | | Test Method* |
|---|---|---|---|
| Temperature Cycling | <10Ω | ΔR ± 0.1% | JESD22 Method JA104<br>30 min at 55 °C and 30 min at 125 °C<br>1000 cycles |
| | ≥10Ω | ΔR ± 0.25% | JESD22 Method JA104<br>30 min at 55 °C and 30 min at 155 °C<br>1000 cycles |
| Biased Humidity | Standard Operation Mode<br>ΔR ± 0.5% | | MIL-STD 202 Method 103<br>1000 hrs 85°C/85%RH 10% of operating power (≤100 V) |
| Bendiing Strength | ΔR ± 0.1% | | JISC 5201 1 4.33<br>Bending once for 60 seconds<br>Bending displacement: 0402 0603 0805 1206 sizes: 3 mm |
| Solderability | 95% Minimum Coverage | | JISC 5201 1 4.17<br>IEC60115 1 4.17<br>245°C ± 5°C for 3 seconds |
| Resistance to Soldering Heat | ΔR ± 0.1% | | JISC 5201 1 4.18<br>IEC60115 1 4.18<br>260°C ± 5°C for 10 seconds |
| Terminal strength | No Broken | | AEC-Q200-006<br>0402 0603: Force of 1kg for 60 seconds.<br>Others: Force of 1.8kg for 60 seconds. |
| Mechanical Shock | ΔR ± 0.1% | | MIL-STD 202 Method 213<br>Wave Form: Tolerance for half sne shock pulse.<br>Peak value is 100g's. Normal duration (D) is 6. |
| Vibration | ΔR ±0.1% | | MIL-STD 202 Method 204<br>5 g's for 20 min., 12 cycles each of 3 orientations,<br>10-2000 Hz |
| ESD | ΔR±0.5% | | AEC-Q200-002<br>Human body model<br>0402 0.4KV, 0603 1KV, 0805 1.5KV, 1206 2.0KV |
| Resistance to solvents | Marking Unsmeared | | MIL-STD-202 Method 215<br>Add Aqueous wash chemical<br>OKEM Clean or equivalent. Do not use banned solvents. |
| Sulfur Test | ΔR ±1.0% | | ASTM-B-809-95 Modified 105<br>105°C ± 2°C no power rating for 1000 hrs. |
| Flammability | No ignition of the tissue paper or scorching or the pinewood board | | UL94V-0 or V-1 are acceptable. Electrical test not required. |
| External Visual | No visible damage. | | MIL-STD 883 Method 2009<br>Electrical test not required. Inspect device construction, marking and workmanship. |
| Physical Dimension | As Spec. | | JESD22 Method JB-100<br>Verify physical dimensions to the applicable device detail specification. Note: User(s) and Suppliers Specification.<br>Electrical test not required. |

**Storage Conditions: +15°C ~ +28°C, Humidity <80%RH**
**Shelf Life: 2 years from production date.**

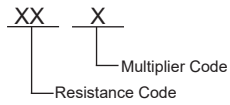
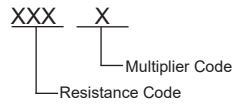
## STANDARD E-24 AND E-96 VALUES AND RESISTANCE CODES

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

### MULTIPLIER CODE

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

## MARKING IDENTIFIERS

| 0402 Size | 0603 Size | 0805, 1206 and 2512 Size |
|---|---|---|
| No Marking | 3 Digit Marking System:<br>2 digit value code + 1 digit multiplier code<br>  <br><br>E24 0603 Multiplier Code: 10e multiplier<br>E96 0603 Multiplier Code: Per table<br><br>0603 Marking Examples:<br>101 = 100 Ω (E24)<br>13C = 13.3 KΩ (E96)<br>68B = 4.99 KΩ (E96)<br>103 = 10 KΩ (E24) | 4 Digit Marking System:<br>3 digit value code + 1 digit multiplier code<br>where "R" denotes a decimal<br>  <br><br>Value Multiplier Code: 10e multiplier<br><br>Marking Examples:<br>10R0 = 10 Ω<br>1332 = 13.3 KΩ<br>4992 = 49.9 KΩ<br>1003 = 100 KΩ |

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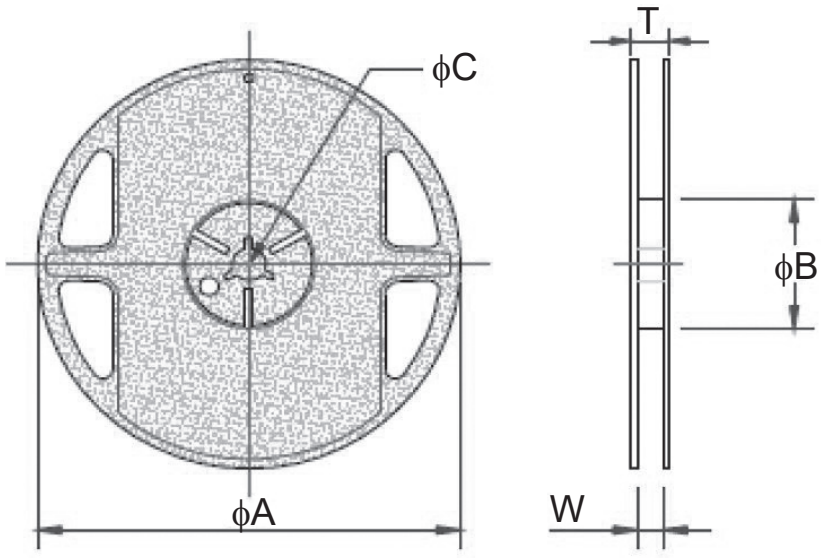
### TAPING SPECIFICATIONS

| Type | EIA Size | A | B | C | W | T | Paper Tape (EA) |
|---|---|---|---|---|---|---|---|
| NTRW04 | 0402 | 178 ±1.0 | 60.0±1.0 | 13.5 ±0.7 | 9.5 ± 1.0 | 11.5 ±1.0 | 10,000 |
| NTRW06 | 0603 | | | | | | 5,000 |
| NTRW10 | 0805 | | | | | | 5,000 |
| NTRW12 | 1206 | | | | | | 5,000 |

### REEL DIMENSIONS (mm)




### PAPER TAPE DIMENSIONS (mm)

| Type | EIA Size | A | B | D | E | F | $P_0$ | $P_1$ | $P_2$ | W | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NTRW04 | 0402 | 0.70 ± 0.05 | 1.16 ± 0.05 | 1.55 ±0.05 | 1.75 ± 0.05 | 3.5 ±0.05 | 4.00 ± 0.10 | 2.00 ± 0.05 | 2.00 ±0.05 | 8.00 ± 0.10 | 0.40 ± 0.03 |
| NTRW06 | 0603 | 1.10 ± 0.05 | 1.90 ± 0.05 | 1.55 ±0.05 | 1.75 ± 0.05 | 3.5 ±0.05 | 4.00 ± 0.10 | 4.00 ± 0.10 | 2.00 ±0.05 | 8.00 ± 0.10 | 0.60 ± 0.03 |
| NTRW10 | 0805 | 1.60 ± 0.05 | 2.37 ± 0.05 | 1.55 ±0.05 | 1.75± 0.05 | 3.5 ±0.05 | 4.00 ± 0.10 | 4.00 ± 0.10 | 2.00 ±0.05 | 8.00 ± 0.10 | 0.75 ± 0.05 |
| NTRW12 | 1206 | 2.00 ± 0.05 | 3.55 ± 0.05 | 1.55 ±0.05 | 1.75± 0.05 | 3.5 ±0.05 | 4.00 ± 0.10 | 4.00 ± 0.10 | 2.00 ± 0.05 | 8.00 ± 0.10 | 0.75 ± 0.05 |