



P-DUKE POWER

RCD10W Series

DC-DC Converter
Up to 10 Watts

3
YEARS
WARRANTY

ROHS
COMPLIANT

REACH
COMPLIANT



Railway



Automation



Datacom



IPC



Industry



Measurement



Telecom



Automobile



Boat



Charger



Medical



PV



3000
VDC
Isolation
Voltage

4 : 1
Wide
Input
Range

6
sided
Shielding

Internal
EN55032
Class
Filter **A**

LOW
Standby
Power

NO
Min. Load
Required

REMOTE
ON
OFF

OCP

OVP

SCP

UVP

PART NUMBER STRUCTURE

| RCD10 | - | 48 | S | 05 | W | - | M3 | A | H |
|-------------|---|--------------------------------------|--------------------------|--|-------------|---|---|---|--------------------------------|
| Series Name | | Input Voltage (VDC) | Output Quantity | Output Voltage (VDC) | Input Range | | Operating Temp. Options | Remote ON/OFF & Trim Options | Isolation Options |
| | | 24: 9~36 48: 18~75 110: 36~160 | S: Single D: Dual | 3P3: 3.3 05: 5 12: 12 15: 15 24: 24 05: ±5 12: ±12 15: ±15 24: ±24 | 4:1 | | □: Standard -40°C~+105°C With derating M3: M3 Version -55°C~+105°C With derating | □: Negative logic A: Positive logic B: Without Ctrl pin C: Negative logic without Trim pin D: Without Ctrl & Trim pin E: Positive logic without Trim pin | □: Standard H: AC Isolation |

TECHNICAL SPECIFICATION All specifications are typical at nominal input, full load and 25°C unless otherwise noted

| Model Number | Input Range | Output Voltage | Output Current @Full Load | Input Current @ No Load | Efficiency | Maximum Capacitor Load |
|----------------|-------------|----------------|---------------------------|-------------------------|------------|------------------------|
| | VDC | VDC | mA | mA | % | µF |
| RCD10-24S3P3W | 9 ~ 36 | 3.3 | 3000 | 10 | 87 | 3500 |
| RCD10-24S05W | 9 ~ 36 | 5 | 2000 | 10 | 89 | 2500 |
| RCD10-24S12W | 9 ~ 36 | 12 | 830 | 10 | 89 | 430 |
| RCD10-24S15W | 9 ~ 36 | 15 | 670 | 10 | 90 | 350 |
| RCD10-24S24W | 9 ~ 36 | 24 | 420 | 10 | 90 | 125 |
| RCD10-24D05W | 9 ~ 36 | ±5 | ±1000 | 10 | 86 | ±1440 |
| RCD10-24D12W | 9 ~ 36 | ±12 | ±416 | 10 | 89 | ±250 |
| RCD10-24D15W | 9 ~ 36 | ±15 | ±333 | 10 | 89 | ±180 |
| RCD10-24D24W | 9 ~ 36 | ±24 | ±210 | 10 | 90 | ±56 |
| RCD10-48S3P3W | 18 ~ 75 | 3.3 | 3000 | 8 | 87 | 3500 |
| RCD10-48S05W | 18 ~ 75 | 5 | 2000 | 8 | 89 | 2500 |
| RCD10-48S12W | 18 ~ 75 | 12 | 830 | 8 | 89 | 430 |
| RCD10-48S15W | 18 ~ 75 | 15 | 670 | 8 | 90 | 350 |
| RCD10-48S24W | 18 ~ 75 | 24 | 420 | 8 | 90 | 125 |
| RCD10-48D05W | 18 ~ 75 | ±5 | ±1000 | 8 | 86 | ±1440 |
| RCD10-48D12W | 18 ~ 75 | ±12 | ±416 | 8 | 89 | ±250 |
| RCD10-48D15W | 18 ~ 75 | ±15 | ±333 | 8 | 89 | ±180 |
| RCD10-48D24W | 18 ~ 75 | ±24 | ±210 | 8 | 90 | ±56 |
| RCD10-110S3P3W | 36 ~ 160 | 3.3 | 3000 | 6 | 87 | 3500 |
| RCD10-110S05W | 36 ~ 160 | 5 | 2000 | 6 | 88 | 2500 |
| RCD10-110S12W | 36 ~ 160 | 12 | 830 | 6 | 89 | 430 |
| RCD10-110S15W | 36 ~ 160 | 15 | 670 | 6 | 89 | 350 |
| RCD10-110S24W | 36 ~ 160 | 24 | 420 | 6 | 89 | 125 |
| RCD10-110D05W | 36 ~ 160 | ±5 | ±1000 | 6 | 85 | ±1440 |
| RCD10-110D12W | 36 ~ 160 | ±12 | ±416 | 6 | 89 | ±250 |
| RCD10-110D15W | 36 ~ 160 | ±15 | ±333 | 6 | 89 | ±180 |
| RCD10-110D24W | 36 ~ 160 | ±24 | ±210 | 6 | 89 | ±56 |

| INPUT SPECIFICATIONS | | | | | | |
|-------------------------------|-------------------------|---------------------------|-----------|---------------------|------|------|
| Parameter | Conditions | | Min. | Typ. | Max. | Unit |
| Operating input voltage range | 24Vin(nom) | | 9 | 24 | 36 | VDC |
| | 48Vin(nom) | | 18 | 48 | 75 | |
| | 110Vin(nom) | | 36 | 110 | 160 | |
| Start up voltage | 24Vin(nom) | | | | 9 | VDC |
| | 48Vin(nom) | | | | 18 | |
| | 110Vin(nom) | | | | 36 | |
| Shutdown voltage | 24Vin(nom) | | 7.5 | 8 | 8.8 | VDC |
| | 48Vin(nom) | | 15.5 | 16 | 17.5 | |
| | 110Vin(nom) | | 32 | 34 | 35.5 | |
| Start up time | Constant resistive load | Power up | | 30 | 50 | ms |
| | | Remote ON/OFF | | 30 | 50 | |
| Input surge voltage | 1 second, max. | 24Vin(nom) | | | 50 | VDC |
| | | 48Vin(nom) | | | 100 | |
| | | 110Vin(nom) | | | 200 | |
| Input filter | | | Pi type | | | |
| Remote ON/OFF | Referred to -Vin pin | Positive logic (Option) | DC-DC ON | Open or 3 ~ 15VDC | | mA |
| | | | DC-DC OFF | Short or 0 ~ 1.2VDC | | |
| | | Negative logic (Standard) | DC-DC ON | Short or 0 ~ 1.2VDC | | |
| | | DC-DC OFF | | Open or 3 ~ 15VDC | | |
| | | Input current of Ctrl pin | -0.5 | | +1.0 | |
| | | Remote off input current | | 2.5 | | |

| OUTPUT SPECIFICATIONS | | | | | | |
|---|------------------------------------|-----------------|---------|------|--------------------------------|---------|
| Parameter | Conditions | | Min. | Typ. | Max. | Unit |
| Voltage accuracy | | | -1.0 | | +1.0 | % |
| Line regulation | Low Line to High Line at Full Load | Single | -0.2 | | +0.2 | % |
| | | Dual | -0.5 | | +0.5 | |
| Load regulation | No Load to Full Load | Single | -0.2 | | +0.2 | % |
| | | Dual | -1.0 | | +1.0 | |
| | 10% Load to 90% Load | Single | -0.1 | | +0.1 | |
| | | Dual | -0.8 | | +0.8 | |
| Cross regulation | Asymmetrical load 25%/100% FL | Dual | -5.0 | | +5.0 | % |
| Voltage adjustability | Single output | 3.3Vout, 12Vout | -10 | | +10 | % |
| | | Others | -10 | | +20 | |
| Ripple and noise | Measured by 20MHz bandwidth | | | | | |
| | With a 10 μ F/25V X7R MLCC | Single | | | | mVp-p |
| | | 3.3Vout, 5Vout | 75 | | | |
| | With a 2.2 μ F/50V X7R MLCC | 12Vout, 15Vout | 75 | | | |
| | | 24Vout | 100 | | | |
| With a 10 μ F/25V X7R MLCC for each output | Dual | | | | mVp-p | |
| | 5Vout | 75 | | | | |
| With a 2.2 μ F/50V X7R MLCC for each output | 12Vout, 15Vout | 75 | | | | |
| | 24Vout | 100 | | | | |
| Temperature coefficient | | | -0.02 | | +0.02 | %/°C |
| Transient response recovery time | 25% load step change | | | | 250 | μ s |
| Over voltage protection | | | 3.3Vout | 3.7 | 5.4 | VDC |
| | | | 5Vout | 6.3 | 7.4 | |
| | | | 12Vout | 13.5 | 19.6 | |
| | | | 15Vout | 18.3 | 22.0 | |
| | | | 24Vout | 29.1 | 32.5 | |
| Over load protection | % of Iout rated | | | | 170 | % |
| Short circuit protection | | | | | Continuous, automatic recovery | |

| GENERAL SPECIFICATIONS | | | | | | |
|------------------------|---------------------------|------------------------|------|------|-----------------------------|------------|
| Parameter | Conditions | | Min. | Typ. | Max. | Unit |
| Isolation voltage | 1 minute | Input to Output | 3000 | | | VDC |
| | | Input (Output) to Case | 2250 | | | |
| | 1 minute | AC Isolation | 2000 | | | VAC |
| | | Input (Output) to Case | 1500 | | | |
| Isolation resistance | 500VDC | | | | 1 | G Ω |
| Isolation capacitance | | | | | 1500 | pF |
| Switching frequency | 24 VDC input, 48VDC input | 3.3Vout, 5Vout | 260 | 290 | 320 | kHz |
| | | Others | 325 | 360 | 395 | |
| | 110VDC input | All | 220 | 245 | 270 | kHz |
| Safety approvals | IEC /EN/ UL62368-1 | | | | UL:E193009 CB:UL(Demko) | |
| Standard approvals | EN50155 EN45545-2 | | | | | |
| Case material | | | | | copper | |
| Base material | | | | | FR4 PCB | |
| Potting material | | | | | Epoxy (UL94 V-0) | |
| Weight | | | | | 16.5g (0.58oz) | |
| MTBF | MIL-HDBK-217F, Full load | | | | 2.334 x 10 ⁶ hrs | |

ENVIRONMENTAL SPECIFICATIONS

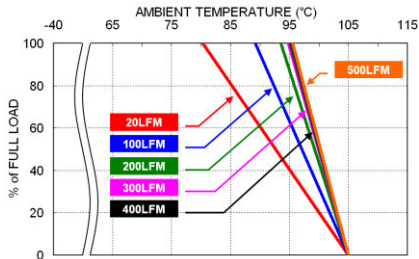
| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------|--|--|------|------|---|
| Operating ambient temperature | Standard type | -40 | | +105 | °C |
| | M3 version | | | | |
| | All models meet the railway OT4 (70°C) temperature | | | | |
| | RCD10-□□□S3P3W | Meet the railway OT6 (85°C) temperature requirement as power derating to 7W output power | | | |
| | RCD10-□□□S05W | | | +105 | |
| | RCD10-□□□D05W | | | | |
| | The others | | | | Meet the railway OT6 (85°C) temperature |
| Maximum case temperature | | | | 105 | °C |
| Storage temperature range | | -55 | | +125 | °C |
| Thermal impedance | | | 16.8 | | °C/W |
| Thermal shock | | | | | MIL-STD-810F |
| Shock | | | | | EN61373, MIL-STD-810F |
| Vibration | | | | | EN61373, MIL-STD-810F |
| Relative humidity | | | | | 5% to 95% RH |

EMC SPECIFICATIONS

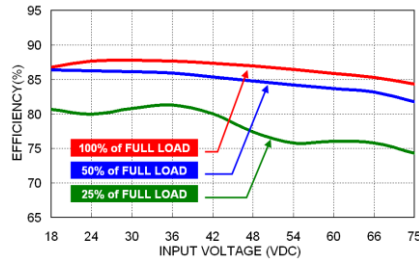
| Parameter | Conditions | Level |
|--------------------------------|----------------------|---|
| EMI | EN55032, EN50121-3-2 | Without external components |
| | | With external components. |
| EMS | EN55035, EN50121-3-2 | Class A Class B |
| ESD | EN61000-4-2 | Air ± 8kV and Contact ± 6kV |
| Radiated immunity | EN61000-4-3 | 20 V/m |
| Fast transient | EN61000-4-4 | ±2kV |
| | RCD10-24□□□W | With an aluminum electrolytic capacitor (Nippon chemi-con KY series, 470µF/50V) and a TVS (SMDJ58A, 58V, 3000Watt peak pulse power) in parallel. |
| | RCD10-48□□□W | With an aluminum electrolytic capacitor (Nippon chemi-con KY series, 330µF/100V) and a TVS (SMBJ120A, 120V, 600Watt peak pulse power) in parallel. |
| | RCD10-110□□□W | With an aluminum electrolytic capacitor (Nippon chemi-con KXJ series, 330µF/200V) and a TVS (SMBJ300A, 300V, 600Watt peak pulse power) in parallel. |
| Surge | EN61000-4-5 | ±2kV |
| | RCD10-24□□□W | With an aluminum electrolytic capacitor (Nippon chemi-con KY series, 470µF/50V) and a TVS (SMDJ58A, 58V, 3000Watt peak pulse power) in parallel. |
| | RCD10-48□□□W | With an aluminum electrolytic capacitor (Nippon chemi-con KY series, 330µF/100V) and a TVS (SMBJ120A, 120V, 600Watt peak pulse power) in parallel. |
| | RCD10-110□□□W | With an aluminum electrolytic capacitor (Nippon chemi-con KXJ series, 330µF/200V) and a TVS (SMBJ300A, 300V, 600Watt peak pulse power) in parallel. |
| Conducted immunity | EN61000-4-6 | 10 Vr.m.s |
| Power frequency magnetic field | EN61000-4-8 | 100A/m continuous; 1000A/m 1 second |

CAUTION: This power module is not internally fused. An input line fuse must always be used.

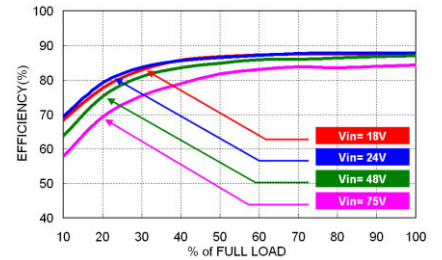
CHARACTERISTIC CURVE



RCD10-48S3P3W Derating Curve



RCD10-48S3P3W Efficiency vs. Input Voltage



RCD10-48S3P3W Efficiency vs. Output Load

FUSE CONSIDERATION

This power module is not internally fused. An input line fuse must always be used.

This encapsulated power module can be used in a wide variety of applications, ranging from simple stand-alone operation to an integrated part of sophisticated power architecture.

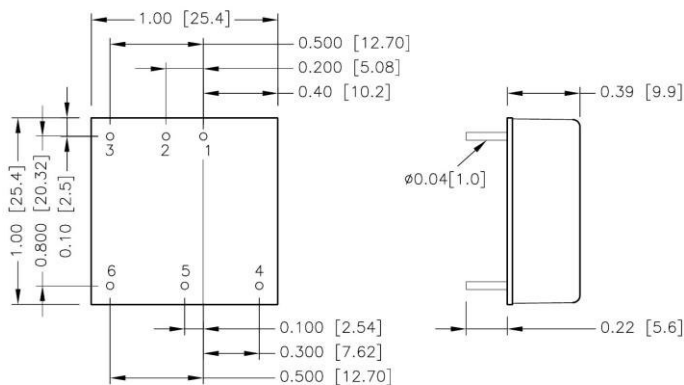
To maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse.

The input line fuse suggest as below :

| Modules | Fuse Rating (A) | Fuse Type |
|-----------------------------|-----------------|-----------|
| RCD10-24S□□W、RCD10-24D□□W | 2 | Slow-Blow |
| RCD10-48S□□W、RCD10-48D□□W | 1.25 | Slow-Blow |
| RCD10-110S□□W、RCD10-110D□□W | 0.63 | Slow-Blow |

The table based on the information provided in this data sheet on inrush energy and maximum DC input current at low Vin..

MECHANICAL DRAWING



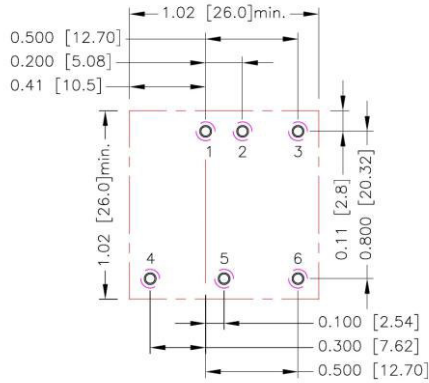
BOTTOM VIEW

PIN CONNECTION

| PIN | SINGLE | DUAL |
|-----|--------|--------|
| 1 | +Vin | +Vin |
| 2 | -Vin | -Vin |
| 3 | Ctrl | Ctrl |
| 4 | +Vout | +Vout |
| 5 | Trim | Common |
| 6 | -Vout | -Vout |

- All dimensions in inch [mm]
- Tolerance : x.xx±0.02 [x.x±0.5]
x.xxx±0.01 [x.xx±0.25]
- Pin dimension tolerance ±0.004[0.10]

RECOMMENDED PAD LAYOUT



All dimensions in inch[mm]
 Pad size(lead free recommended)
 Through hole 1.2.3.4.5.6: $\Phi 0.051$ [1.30]
 Top view pad 1.2.3.4.5.6: $\Phi 0.064$ [1.63]
 Bottom view pad 1.2.3.4.5.6: $\Phi 0.102$ [2.60]

THERMAL CONSIDERATIONS

The power module operates in a variety of thermal environments.

However, sufficient cooling should be provided to help ensure reliable operation of the unit.

Heat is removed by conduction, convection, and radiation to the surrounding environment.

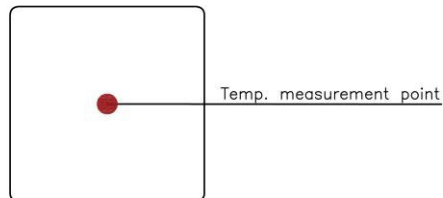
Proper cooling can be verified by measuring the point as the figure below.

The temperature at this location should not exceed "Maximum case temperature".

When operating, adequate cooling must be provided to maintain the test point temperature at or below "Maximum case temperature".

You can limit this temperature to a lower value for extremely high reliability.

- Thermal test condition with vertical direction by natural convection (20LFM).



TOP VIEW

OUTPUT VOLTAGE ADJUSTMENT

Output voltage set point adjustment allows the user to increase or decrease the output voltage set point of the module. This is accomplished by connecting an external resistor between the Trim pin and either the +Output or -Output pins. With an external resistor between the Trim and -Output pin, the output voltage set point increases. With an external resistor between the Trim and +Output pin, the output voltage set point decreases. The external Trim resistor needs to be at least 1/16W of rated power.

Trim Up Equation

$$R_U = \left[\frac{G \times L}{(V_{o,up} - L - K)} - H \right] \Omega$$

Trim Down Equation

$$R_D = \left[\frac{(V_{o,down} - L) \times G}{(V_o - V_{o,down})} - H \right] \Omega$$

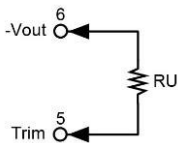
Trim Constants

| Module | G | H | K | L |
|---------------|-------|-------|------|-----|
| RCD10-□□S3P3W | 5110 | 2050 | 0.8 | 2.5 |
| RCD10-□□S05W | 5110 | 2050 | 2.5 | 2.5 |
| RCD10-□□S12W | 10000 | 5110 | 9.5 | 2.5 |
| RCD10-□□S15W | 10000 | 5110 | 12.5 | 2.5 |
| RCD10-□□S24W | 56000 | 13000 | 21.5 | 2.5 |

EXTERNAL OUTPUT TRIMMING

Output can be externally trimmed by using the method shown below.

Trim-up



□□S3P3W

| ΔV (%) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---------------------|---------|---------|---------|--------|--------|--------|--------|--------|--------|--------|
| Vout (V) | 3.333 | 3.366 | 3.399 | 3.432 | 3.465 | 3.498 | 3.531 | 3.564 | 3.597 | 3.630 |
| R _U (kΩ) | 385.071 | 191.511 | 126.990 | 94.730 | 75.374 | 62.470 | 53.253 | 46.340 | 40.963 | 36.662 |

□□S05W

| ΔV (%) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---------------------|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| Vout (V) | 5.050 | 5.100 | 5.150 | 5.200 | 5.250 | 5.300 | 5.350 | 5.400 | 5.450 | 5.500 |
| R _U (kΩ) | 253.450 | 125.700 | 83.117 | 61.825 | 49.050 | 40.533 | 34.450 | 29.888 | 26.339 | 23.500 |

| ΔV (%) | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Vout (V) | 5.550 | 5.600 | 5.650 | 5.700 | 5.750 | 5.800 | 5.850 | 5.900 | 5.950 | 6.000 |
| R _U (kΩ) | 21.177 | 19.242 | 17.604 | 16.200 | 14.983 | 13.919 | 12.979 | 12.144 | 11.397 | 10.725 |

□□S12W

| ΔV (%) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---------------------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Vout (V) | 12.120 | 12.240 | 12.360 | 12.480 | 12.600 | 12.720 | 12.840 | 12.960 | 13.080 | 13.200 |
| R _U (kΩ) | 203.223 | 99.057 | 64.334 | 46.973 | 36.557 | 29.612 | 24.652 | 20.932 | 18.038 | 15.723 |

□□S15W

| ΔV (%) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---------------------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Vout (V) | 15.150 | 15.300 | 15.450 | 15.600 | 15.750 | 15.900 | 16.050 | 16.200 | 16.350 | 16.500 |
| R _U (kΩ) | 161.557 | 78.223 | 50.446 | 36.557 | 28.223 | 22.668 | 18.700 | 15.723 | 13.409 | 11.557 |

| ΔV (%) | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Vout (V) | 16.650 | 16.800 | 16.950 | 17.100 | 17.250 | 17.400 | 17.550 | 17.700 | 17.850 | 18.000 |
| R _U (kΩ) | 10.042 | 8.779 | 7.711 | 6.795 | 6.001 | 5.307 | 4.694 | 4.149 | 3.662 | 3.223 |

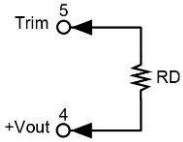
□□S24W

| ΔV (%) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---------------------|---------|---------|---------|---------|---------|--------|--------|--------|--------|--------|
| Vout (V) | 24.240 | 24.480 | 24.720 | 24.960 | 25.200 | 25.440 | 25.680 | 25.920 | 26.160 | 26.400 |
| R _U (kΩ) | 570.333 | 278.667 | 181.444 | 132.833 | 103.667 | 84.222 | 70.333 | 59.917 | 51.815 | 45.333 |

| ΔV (%) | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Vout (V) | 26.640 | 26.880 | 27.120 | 27.360 | 27.600 | 27.840 | 28.080 | 28.320 | 28.560 | 28.800 |
| R _U (kΩ) | 40.030 | 35.611 | 31.872 | 28.667 | 25.889 | 23.458 | 21.314 | 19.407 | 17.702 | 16.167 |

OUTPUT VOLTAGE ADJUSTMENT(CONTINUED)

Trim-down



□□S3P3W

| ΔV (%) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|------------------|---------|--------|--------|--------|--------|--------|--------|-------|-------|-------|
| Vout (V) | 3.267 | 3.234 | 3.201 | 3.168 | 3.135 | 3.102 | 3.069 | 3.036 | 3.003 | 2.970 |
| RD (k Ω) | 116.719 | 54.779 | 34.133 | 23.810 | 17.616 | 13.486 | 10.537 | 8.325 | 6.604 | 5.228 |

□□S05W

| ΔV (%) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|------------------|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| Vout (V) | 4.950 | 4.900 | 4.850 | 4.800 | 4.750 | 4.700 | 4.650 | 4.600 | 4.550 | 4.500 |
| RD (k Ω) | 248.340 | 120.590 | 78.007 | 56.715 | 43.940 | 35.423 | 29.340 | 24.778 | 21.229 | 18.390 |

□□S12W

| ΔV (%) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|------------------|---------|---------|---------|---------|---------|---------|--------|--------|--------|--------|
| Vout (V) | 11.880 | 11.760 | 11.640 | 11.520 | 11.400 | 11.280 | 11.160 | 11.040 | 10.920 | 10.800 |
| RD (k Ω) | 776.557 | 380.723 | 248.779 | 182.807 | 143.223 | 116.834 | 97.985 | 83.848 | 72.853 | 64.057 |

□□S15W

| ΔV (%) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|------------------|---------|---------|---------|---------|---------|---------|---------|--------|--------|--------|
| Vout (V) | 14.850 | 14.700 | 14.550 | 14.400 | 14.250 | 14.100 | 13.950 | 13.800 | 13.650 | 13.500 |
| RD (k Ω) | 818.223 | 401.557 | 262.668 | 193.223 | 151.557 | 123.779 | 103.938 | 89.057 | 77.483 | 68.223 |

□□S24W

| ΔV (%) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|---------|
| Vout (V) | 23.760 | 23.520 | 23.280 | 23.040 | 22.800 | 22.560 | 22.320 | 22.080 | 21.840 | 21.600 |
| RD (k Ω) | 4947.667 | 2439.333 | 1603.222 | 1185.167 | 934.333 | 767.111 | 647.667 | 558.083 | 488.407 | 432.667 |