

## 20 Watts

- Regulated Single & Dual Output
- 24-48 VDC & 72-110 VDC nominal inputs for Railway Applications
- 3000 VDC Isolation
- High Efficiency
- EN50155 Certified for Railway Applications
- EN50121-3-2 with External Components
- Remote On/Off
- Output Voltage Trim  $\pm 10\%$
- Operating Temperature  $-40^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$
- Full Power to  $+55^{\circ}\text{C}$
- 3 Year Warranty



### Dimensions:

#### RDE20:

1.0 x 1.0 x 0.41" (25.4 x 25.4 x 10.4 mm)

The RDE20 series provides a comprehensive wide DC input voltage range covering all requirements of the railway standard EN50155. The product features a robust design tested to railway standards and includes a remote on /off function, output voltage trimming, protection against short circuit, undervoltage lockout, overload and overvoltage.

## Models & Ratings

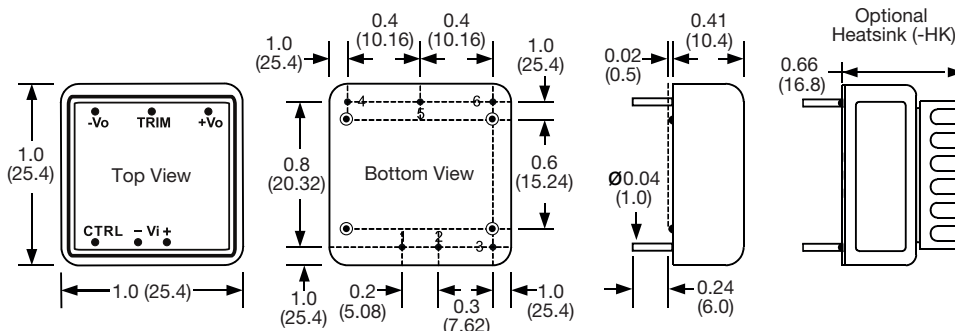
| Input voltage | Output voltage      | Output current       | Input current <sup>(1)</sup> |           | Maximum capacitive load       | Efficiency | Model number |
|---------------|---------------------|----------------------|------------------------------|-----------|-------------------------------|------------|--------------|
|               |                     |                      | No load                      | Full load |                               |            |              |
| 13-70 VDC     | 3.3 V               | 4500 mA              | 10 mA                        | 711.20 mA | 7000 $\mu\text{F}$            | 87%        | RDE2024S3V3  |
|               | 5.0 V               | 4000 mA              |                              | 946.96 mA | 5000 $\mu\text{F}$            | 88%        | RDE2024S05   |
|               | 12.0 V              | 1670 mA              |                              | 936.33 mA | 850 $\mu\text{F}$             | 89%        | RDE2024S12   |
|               | 15.0 V              | 1330 mA              |                              | 925.92 mA | 700 $\mu\text{F}$             | 90%        | RDE2024S15   |
|               | $\pm 5.0\text{ V}$  | $\pm 2000\text{ mA}$ |                              | 968.99 mA | $\pm 1000\text{ }\mu\text{F}$ | 86%        | RDE2024D05   |
|               | $\pm 12.0\text{ V}$ | $\pm 833\text{ mA}$  |                              | 925.92 mA | $\pm 680\text{ }\mu\text{F}$  | 90%        | RDE2024D12   |
|               | $\pm 15.0\text{ V}$ | $\pm 666\text{ mA}$  |                              | 925.92 mA | $\pm 470\text{ }\mu\text{F}$  | 90%        | RDE2024D15   |
|               |                     |                      |                              |           |                               |            |              |
| 42-176 VDC    | 3.3 V               | 4500 mA              | 10 mA                        | 156.97 mA | 7000 $\mu\text{F}$            | 86%        | RDE20110S3V3 |
|               | 5.0 V               | 4000 mA              |                              | 206.61 mA | 5000 $\mu\text{F}$            | 88%        | RDE20110S05  |
|               | 12.0 V              | 1670 mA              |                              | 211.41 mA | 850 $\mu\text{F}$             | 86%        | RDE20110S12  |
|               | 15.0 V              | 1330 mA              |                              | 211.41 mA | 700 $\mu\text{F}$             | 86%        | RDE20110S15  |
|               | $\pm 5.0\text{ V}$  | $\pm 2000\text{ mA}$ |                              | 216.45 mA | $\pm 1000\text{ }\mu\text{F}$ | 84%        | RDE20110D05  |
|               | $\pm 12.0\text{ V}$ | $\pm 833\text{ mA}$  |                              | 208.98 mA | $\pm 680\text{ }\mu\text{F}$  | 87%        | RDE20110D12  |
|               | $\pm 15.0\text{ V}$ | $\pm 666\text{ mA}$  |                              | 208.98 mA | $\pm 470\text{ }\mu\text{F}$  | 87%        | RDE20110D15  |
|               |                     |                      |                              |           |                               |            |              |

## Notes

1. Input current measured at nominal input voltage.

2. For heatsink add suffix '-HK', e.g. RDE2024S15-HK

## Mechanical Details



| Pin Connections |               |             |
|-----------------|---------------|-------------|
| Pin             | Single Output | Dual Output |
| 1               | +Vin          | +Vin        |
| 2               | -Vin          | -Vin        |
| 3               | Control       | Control     |
| 4               | +Vout         | +Vout       |
| 5               | Trim          | Com         |
| 6               | -Vout         | -Vout       |

## Notes

1. All dimensions are in inches (mm)

### Input

| Characteristic                    | Minimum                                         | Typical | Maximum | Units          | Notes & Conditions                       |
|-----------------------------------|-------------------------------------------------|---------|---------|----------------|------------------------------------------|
| Input Voltage Range               | 13                                              |         | 70      | VDC            | 24 V, 37.5 V, 48 V nominal inputs        |
|                                   | 42                                              |         | 176     |                | 72 V, 96 V & 110 V nominal inputs        |
| Input Filter                      | Internal Pi type                                |         |         |                |                                          |
| Input Surge                       |                                                 |         | 100     | VDC for 100 ms | RDE2024 series                           |
|                                   |                                                 |         | 185     |                | RDE20110 series                          |
| Undervoltage Lockout              | OFF at <11.6 V, ON at 12.3 V                    |         |         |                | RDE2024 series                           |
|                                   | OFF at <38.4 V, ON at 40.5 V                    |         |         |                | RDE20110 series                          |
| Remote On/Off<br>(Positive Logic) | ON at 3.0 VDC to 12.0 VDC or open circuit       |         |         |                | Positive logic reference to -Vin (pin 2) |
|                                   | OFF at 0 VDC to 1.2 VDC or short pin 2 to pin 3 |         |         |                |                                          |
| Standby Current                   |                                                 | 3       |         | mA             | When module inhibited                    |

### Output

| Characteristic           | Minimum | Typical | Maximum   | Units       | Notes & Conditions                                                                            |
|--------------------------|---------|---------|-----------|-------------|-----------------------------------------------------------------------------------------------|
| Output Voltage           | 3.3     |         | 30        | VDC         | See Models and Ratings table                                                                  |
| Output Trim              |         |         | ±10       | %           | Single output models only                                                                     |
| Initial Set Accuracy     |         |         | ±1.0      | %           | At full load                                                                                  |
| Minimum Load             |         |         |           | A           | No minimum load required                                                                      |
| Line Regulation          |         |         | ±0.5      | %           | From minimum to maximum input at full load                                                    |
| Load Regulation          |         |         | ±0.5/±1.0 | %           | From 0 to full load. Single Output/Dual Output                                                |
| Cross Regulation         |         |         | ±5.0      | %           | On dual output models when one load is varied between 25% and 100% and other is fixed at 100% |
| Transient Response       |         | ±3      | ±5        | % deviation | Recovery within 1% in less than 250 µs for a 25% load change.                                 |
| Ripple & Noise           |         |         | 75        | mV pk-pk    | 20 MHz bandwidth. Measured using external 10 µF MLCC                                          |
| Overvoltage Protection   |         | 120     |           | %           |                                                                                               |
| Overload Protection      |         | 170     |           | %           |                                                                                               |
| Short Circuit Protection |         |         |           |             | Continuous trip & restart (hiccup mode), with auto recovery                                   |
| Maximum Capacitive Load  |         |         |           |             | See Models and Ratings table                                                                  |
| Temperature Coefficient  |         |         | 0.02      | %/°C        |                                                                                               |

### General

| Characteristic                  | Minimum                                                         | Typical      | Maximum | Units             | Notes & Conditions           |
|---------------------------------|-----------------------------------------------------------------|--------------|---------|-------------------|------------------------------|
| Efficiency                      | 84                                                              |              | 90      | %                 | See Models and Ratings table |
| Isolation: Input to Output      | 3000                                                            |              |         | VDC               | 60 s functional isolation    |
| Isolation Resistance            | 10 <sup>9</sup>                                                 |              |         | Ω                 | At 3 kVDC                    |
| Isolation Capacitance           |                                                                 | 2000         |         | pF                |                              |
| Switching Frequency             |                                                                 | 330 / 245    |         | kHz               | RDE2024 / 110 series         |
| Power Density                   |                                                                 |              | 48.8    | W/in <sup>3</sup> |                              |
| Mean Time Between Failure       | 190                                                             |              |         | khrrs             | MIL-HDBK-217F, +25 °C GB     |
| Case Material                   | Copper Case, Non conductive black plastic base, UL94V-0 rated   |              |         |                   |                              |
| Potting Material                | Epoxy UL94V-0                                                   |              |         |                   |                              |
| Fire Protection                 | Designed to meet EN45545-2                                      |              |         |                   |                              |
| PCB Pin Material                | Tinned copper ø1.0 mm brass, solder coated                      |              |         |                   |                              |
| Lead Free Reflow Solder Process | IPC JEDEC J-STD 020D.1. 260 °C max. 1.5 mm from case. 10 s max. |              |         |                   |                              |
| Weight                          |                                                                 | 0.041 (19.0) |         | lb (g)            | Standard                     |
|                                 |                                                                 | 0.048 (22.0) |         |                   | With heatsink                |

### Environmental

| Characteristic           | Minimum           | Typical | Maximum | Units | Notes & Conditions |
|--------------------------|-------------------|---------|---------|-------|--------------------|
| Operating Temperature    | -40               |         | +100    | °C    | See derating curve |
| Maximum Case Temperature |                   |         | +105    | °C    |                    |
| Thermal Impedance to Air | 13                |         |         | °C/W  | Without heatsink   |
|                          | 12                |         |         |       | With heatsink      |
| Storage Temperature      | -55               |         | +125    | °C    |                    |
| Altitude                 | 5000 m operation  |         |         |       |                    |
| Humidity                 |                   |         | 95      | %RH   | Non-condensing     |
| Cooling                  | IEC/EN 60068-2-1  |         |         |       |                    |
| Dry Heat                 | IEC/EN 60068-2-2  |         |         |       |                    |
| Damp Heat                | IEC/EN 60068-2-30 |         |         |       |                    |
| Shock & Vibration        | IEC/EN 61373      |         |         |       |                    |

### EMC: Emissions

| Phenomenon        | Standard    | Test Level | Notes & Conditions     |
|-------------------|-------------|------------|------------------------|
| Railway Equipment | EN50121-3-2 |            | Conducted and Radiated |

### EMC: Immunity

| Phenomenon        | Standard    | Test Level                         | Criteria | Notes & Conditions                                                                                                            |
|-------------------|-------------|------------------------------------|----------|-------------------------------------------------------------------------------------------------------------------------------|
| Railway Equipment | EN50121-3-2 |                                    |          | Electromagnetic compatibility for rolling stock apparatus                                                                     |
| ESD               | EN50121-3-2 | ±8 kV air discharge, ±6 kV contact | A        |                                                                                                                               |
| Radiated          | EN50121-3-2 | 20 V/m                             | A        |                                                                                                                               |
| EFT/Burst         | EN50121-3-2 | ±2 kV                              | A        | With external capacitor<br>Suggested parts are<br>24V: CHEMI-CON KY 330 µF/100 V<br>110V: BXF SERIES 100 µF/250 V in parallel |
| Surge             | EN50121-3-2 | ±2 kV                              | A        |                                                                                                                               |
| Conducted         | EN50121-3-2 | 10 V rms                           | A        | See application note                                                                                                          |
| Magnetic Fields   | EN61000-4-8 | 100 A/m                            | A        |                                                                                                                               |

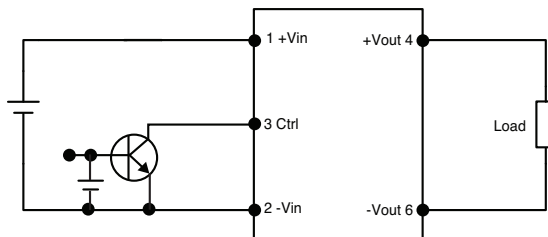
### Safety Approvals

| Safety Agency | Safety Standard       | Notes & Conditions |
|---------------|-----------------------|--------------------|
| IEC           | IEC60950-1/IEC62368-1 | Pending            |

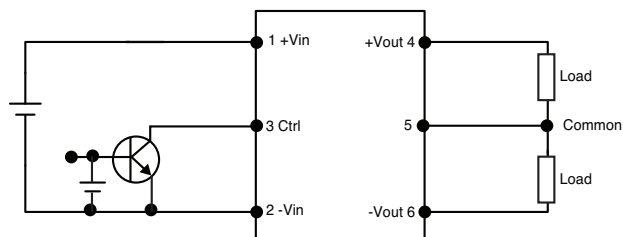
| Safety Agency | Safety Standard | Notes & Conditions                                               |
|---------------|-----------------|------------------------------------------------------------------|
| EN            | EN50155         | Railway Applications, Electronic Equipment used on Rolling Stock |

### Application Notes

#### Remote On/Off - Single Output

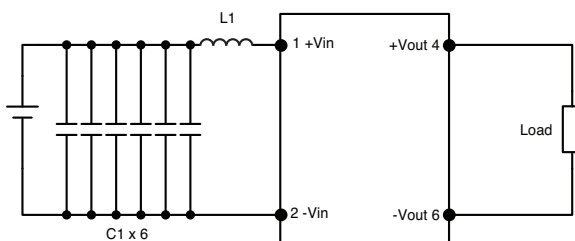


#### Remote On/Off - Dual Output



Positive logic. Module turns on with logic high. Logic low turns module off. On/Off is enabled by an external switch between the control pin 3 and -Vin pin 2, e.g. open collector or drain. If the Remote On/Off is not used leave pin 3 floating.

#### EMC - 110 V Input Models Only

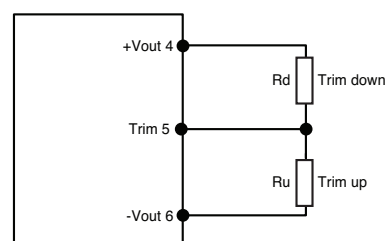


(MLCC type)

| C1               | L1         |
|------------------|------------|
| 1 $\mu$ F, 250 V | 12 $\mu$ H |

Not required for RDE2024 series

#### Output Voltage Trim - Single Output Models Only



#### Trim Tables

| Trim Down % | 3.3 V            | 5 V     | 12 V    | 15 V    |
|-------------|------------------|---------|---------|---------|
|             | Rd (k $\Omega$ ) |         |         |         |
| 1           | 817.535          | 117.886 | 345.033 | 174.366 |
| 2           | 362.230          | 61.634  | 164.830 | 91.104  |
| 3           | 215.448          | 38.388  | 98.862  | 56.589  |
| 4           | 142.957          | 25.688  | 64.647  | 37.706  |
| 5           | 99.747           | 17.684  | 43.707  | 25.796  |
| 6           | 71.057           | 12.179  | 29.571  | 17.598  |
| 7           | 50.622           | 8.159   | 19.386  | 11.611  |
| 8           | 35.326           | 5.096   | 11.699  | 7.047   |
| 9           | 23.448           | 2.683   | 5.692   | 3.453   |
| 10          | 13.957           | 0.735   | 0.867   | 0.548   |

| Trim Up% | 3.3 V            | 5 V     | 12 V     | 15 V    |
|----------|------------------|---------|----------|---------|
|          | Ru (k $\Omega$ ) |         |          |         |
| 1        | 567.584          | 616.020 | 1015.590 | 661.510 |
| 2        | 263.172          | 221.402 | 448.881  | 231.250 |
| 3        | 158.473          | 131.336 | 280.558  | 134.015 |
| 4        | 105.497          | 91.426  | 199.789  | 91.042  |
| 5        | 73.508           | 68.900  | 152.361  | 66.818  |
| 6        | 52.096           | 54.432  | 121.162  | 51.270  |
| 7        | 36.760           | 44.353  | 99.078   | 40.445  |
| 8        | 25.235           | 36.930  | 82.625   | 32.475  |
| 9        | 16.257           | 31.235  | 69.892   | 26.362  |
| 10       | 9.066            | 26.727  | 59.745   | 21.524  |

#### Derating Curve

