

Features

Regulated Converters

- UL Certified Constant Current LED Driver
- Wide Input and Output Voltage Range
- Digital PWM and Analogue Voltage Dimming
- Short Circuit and Overtemperature Protected
- Pin, Wire or Open Frame SMD Versions
- IP67 rated for /W Version
- 96% Efficiency
- 3 year Warranty

Description

The RCD series is a step-down constant current source designed for driving high power white LEDs. Standard output currents available are 300mA, 350mA, 500mA, 600mA, 700mA, 1000mA and 1200mA to make this driver compatible with a wide range of LEDs applications. Despite its compact size, the RCD series is fully featured with very high efficiency, wide input voltage range, high ambient operating temperature and two means of dimming: PWM/digital control and analogue voltage dimming. Both dimming controls are independent and can be combined. The driver is also designed to be as reliable as the LEDs it is driving, even at the full operating temperature. Options include an IP67-rated wired version (/W), an open frame version with SMD pins (/SMD/OF) and a version with built-in reference output voltage (/Vref) to power sensors or for easy analogue dimming.

Selection Guide

| Part Number | Input Range (VDC) | Output Current (mA) | Output Voltage (Vmin-Vmax) | Dimming Control | Options | Mounting Style |
|-------------------------------|-------------------|---------------------|----------------------------|--------------------|---------|--------------------|
| RCD-24-0.30 ^{(a)(b)} | 4.5-36V | 0-300 | 2-35 | Digital + Analogue | Vref | Pins, SMD or Wired |
| RCD-24-0.35 ^{(a)(b)} | 4.5-36V | 0-350 | 2-35 | Digital + Analogue | Vref | Pins, SMD or Wired |
| RCD-24-0.50 ^{(a)(b)} | 4.5-36V | 0-500 | 2-35 | Digital + Analogue | Vref | Pins, SMD or Wired |
| RCD-24-0.60 ^{(a)(b)} | 4.5-36V | 0-600 | 2-35 | Digital + Analogue | Vref | Pins, SMD or Wired |
| RCD-24-0.70 ^{(a)(b)} | 4.5-36V | 0-700 | 2-35 | Digital + Analogue | Vref | Pins, SMD or Wired |
| RCD-24-1.00 ^(b) | 6-36V | 0-1000 | 3-33 | Digital + Analogue | | Pins or Wired |
| RCD-24-1.20 ^(b) | 6-36V | 0-1200 | 3-33 | Digital + Analogue | | Pins or Wired |

^{(a)(b)} Standard is no suffix with PCB Pins.

^(a) Add suffix /Vref for pinned or SMD versions with Vref output and analogue dimming

^(a) Add suffix /SMD/OF for open frame version with SMD solderpins (/SMD/OF-R for Tape and Reel Packaging)

^(b) Add suffix /W for wired version without dimming control (four wires)

^(b) Add suffix /W/X1 for wired version with analogue dimming control (five wires)

^(b) Add suffix /W/X2 for wired version with PWM dimming control (five wires)

^(b) Add suffix /W/X3 for wired version with both analogue and PWM dimming controls (six wires)

^(a) Add suffix /W/Vref for wired version with Vref output and analogue dimming (six wires)

Specifications

(typical at 25°C, nominal input voltage, rated output current unless otherwise specified)

| | | | |
|--|-----------------------------------|------------------------------------|----------------|
| Input Voltage (absolute maximum) | 40VDC max | | |
| Recommended Input Voltage | 300mA-700mA | 5V min. / 24V typ. / 36VDC max | |
| | 1000mA-1200mA | 6V min. / 24V typ. / 36VDC max | |
| Input Filter | Capacitor | | |
| Output Current Accuracy (Vin = 24DC) | 300mA-700mA | ±1% typ, ±3% max. | |
| | 1000mA-1200mA | ±2% typ, ±5% max. | |
| Internal Power Dissipation | Worst case load of 5 LEDs | 800mW max | |
| Output Current Stability | Vin=36V, Vout =1-9 LEDs | ±1% max | |
| Output Ripple and Noise (20MHz BW) Vin=36V, Vout =1-9 LEDs | 300mA-700mA | 150mVp-p max | |
| | 1000mA-1200mA | 300mVp-p max | |
| Temperature Coefficient | -40°C~+85°C ambient | | ±0.015%/°C max |
| Maximum Capacitive Load | 100µF | | |
| Operating Frequency | 300mA-700mA | 210kHz min/ 250kHz typ/ 280kHz max | |
| | 1000mA-1200mA | 350kHz min/ 450kHz typ/ 550kHz max | |
| Efficiency at Full Load | 96% max. | | |
| Short Circuit Protection | Regulated at rated output current | | |

continued on next page

LIGHTLINE

DC/DC-Converter

with 3 year Warranty



Constant Current LED Driver



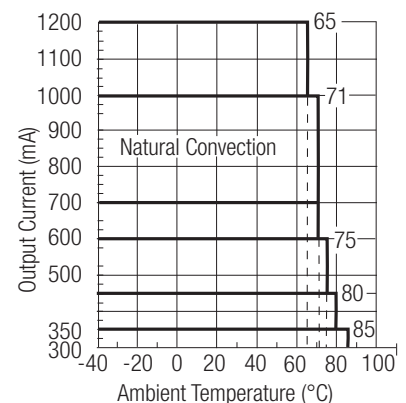
E24736

EN-60950-1 Certified
UL-60950-1 Certified
(Vref Version Pending)

RCD-24

Derating Graph

(Ambient Temperature)



Refer to Application Notes

Specifications -Continued

| | | |
|--|--------------|----------------|
| Operating Temperature Range (free air convection) | 300mA-350mA | -40°C to +85°C |
| | 500mA | -40°C to +80°C |
| | 600mA | -40°C to +75°C |
| | 700mA-1000mA | -40°C to +71°C |
| | 1200mA | -40°C to +65°C |

| | | |
|---------------------------|-----------------|--|
| Storage Temperature Range | -55°C to +125°C | |
|---------------------------|-----------------|--|

| | | |
|--|-------------------------|------------|
| Overtemperature Shutdown (Auto-restart after cool down) | Internal IC Temperature | 150°C typ. |
| | Temperature Hysteresis | 20°C typ. |

| | | |
|--------------------------|-------|--|
| Maximum Case Temperature | 100°C | |
|--------------------------|-------|--|

| | | |
|-------------------|--------------------|-----------|
| Thermal Impedance | Natural Convection | 55°C/Watt |
|-------------------|--------------------|-----------|

| | | |
|--|------------------------------|--|
| Case Material (Pinned or Wired Versions) | Non Conductive Black Plastic | |
|--|------------------------------|--|

| | | |
|---|-----------------|--|
| Potting Material (Pinned or Wired Versions) | Epoxy (UL94-V0) | |
|---|-----------------|--|

| | | |
|------------|--------------|---------------------|
| Dimensions | Pinned/Wired | 22.1 x 12.6 x 8.5mm |
| | SMD | 21.0 x 11.4 x 10mm |

| | | |
|--------|--------------|-----------|
| Weight | Pinned/Wired | 4.5g/6.8g |
| | SMD | 1.9g |

| | | |
|-------------------|--------|-------------------|
| Soldering Profile | Pinned | 265°C/10 sec. max |
| | SMD | 245°C/30 sec. max |

| | | |
|---|-------------------|-----------------|
| Packing Quantities (Refer to App Notes for Tube sizes) | Pinned Versions | 39pcs per Tube |
| | SMD Versions | 21pcs per Tube |
| | SMD Tape and Reel | 500pcs per Reel |
| | Wired Versions | 5pcs per Bag |

| | | |
|---|--|--|
| PWM Dimming and ON/OFF Control (Leave open if not used - do not tie to +Vin) | | |
|---|--|--|

| | | | |
|---------------|----------|-------------|---------------------------|
| Remote ON/OFF | DC/DC ON | 300mA-700mA | Open or $0V < V_r < 0.6V$ |
|---------------|----------|-------------|---------------------------|

| | | | |
|--------------------|----------------------|---------------|---------------------------|
| Threshold Voltages | DC/DC OFF (Standby) | 1000mA-1200mA | Open or $0V < V_r < 0.8V$ |
| | | 300mA-700mA | $0.6 < V_r < 2.9V$ |
| | DC/DC OFF (Shutdown) | 1000mA-1200mA | $1.4 < V_r < 2.2V$ |
| | | 300mA-700mA | $2.9 < V_r < 6V$ |

| | | | |
|--|--|---------------|-------------------|
| | | 1000mA-1200mA | $2.2 < V_r < 15V$ |
|--|--|---------------|-------------------|

| | | | |
|--------------------------|------------|---------|--|
| Remote Pin Drive Current | $V_r = 5V$ | 1mA max | |
|--------------------------|------------|---------|--|

| | | | |
|--|----------------|-----------|--|
| Quiescent Input Current in Shutdown Mode | $V_{in} = 36V$ | 200µA max | |
|--|----------------|-----------|--|

| | | | |
|-----------------------|--------------------------------|-------------|--|
| Maximum PWM Frequency | For $\pm 1\%$ Linear Operation | 200Hz max. | |
| | Frequency Limit | 2000Hz max. | |

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|---|--|--|--|
| Analogue Dimming Control (leave open if not used - do not tie to +Vin) | | | |
|---|--|--|--|

| | | | |
|----------------------|--------------|-------------|--|
| Input Voltage Limits | Standard | -0.3V - 15V | |
| | Vref Version | -0.3V - 5V | |

| | | | |
|---------------------------------------|------------------------|------------------|--|
| Control Voltage Range (see Graphs) | Full On | $0.13V \pm 50mV$ | |
| | Standard: Full Off | $4.5V \pm 50mV$ | |
| | Vref Version: Full Off | $3.3V \pm 50mV$ | |
| | | $3.3V \pm 70mV$ | |

| | | | |
|----------------------------|------------|------------|--|
| Analogue Pin Drive Current | $V_c = 5V$ | 0.2mA max. | |
|----------------------------|------------|------------|--|

| | | | |
|--------------|-----------------------------------|-----------------|--|
| Vref Version | Vref Voltage | $3.3V \pm 70mV$ | |
| | Vref Output Current | 5mA | |
| | Vref Output Short Circuit Current | 18mA typ. | |

| | | | |
|----------------------|--|--|--|
| Environmental | | | |
|----------------------|--|--|--|

| | | | |
|-------------------|------------------------------|--|--|
| Relative Humidity | 5% to 95% RH, non-condensing | | |
|-------------------|------------------------------|--|--|

| | | | |
|-------------|------|--|--|
| /W Versions | IP67 | | |
|-------------|------|--|--|

| | | | |
|---------------------|-------------------------|---------|---------|
| Conducted Emissions | (with filter, see note) | EN55022 | Class B |
|---------------------|-------------------------|---------|---------|

| | | | |
|--------------------|----------------------------|---------|---------|
| Radiated Emissions | (all series except >700mA) | EN55022 | Class B |
|--------------------|----------------------------|---------|---------|

| | | | |
|-----|--------------|-------------|---------|
| ESD | (all series) | EN61000-4-2 | Class A |
|-----|--------------|-------------|---------|

| | | | |
|-------------------|--------------|-------------|---------|
| Radiated Immunity | (all series) | EN61000-4-3 | Class A |
|-------------------|--------------|-------------|---------|

| | | | |
|----------------|--------------|-------------|---------|
| Fast Transient | (all series) | EN61000-4-4 | Class A |
|----------------|--------------|-------------|---------|

| | | | |
|--------------------|--------------|-------------|---------|
| Conducted Immunity | (all series) | EN61000-4-6 | Class A |
|--------------------|--------------|-------------|---------|

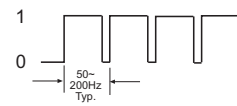
| | | | |
|--|-------|-----------------------------|--|
| MTBF (RCD-24-0.70, Nominal V_{in} , Full Load) | +25°C | 605 x 10 ³ hours | |
|--|-------|-----------------------------|--|

| | | | |
|---------------------|-------|-----------------------------|--|
| using MIL-HDBK 217F | +71°C | 516 x 10 ³ hours | |
|---------------------|-------|-----------------------------|--|

Note: Requires an input filter to meet EN55022 Class B conducted emissions - see next page

Digital Dimming

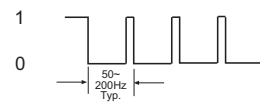
PWM Digital Control Signal



Output Current (LED appears dim)



PWM Digital Control Signal

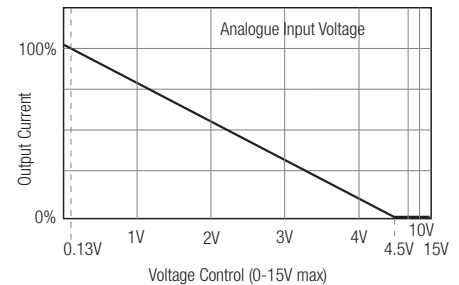


Output Current (LED appears bright)

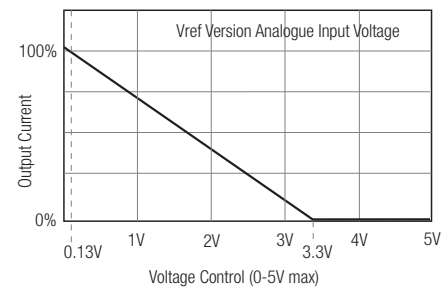


Analogue Dimming

Standard Version:



Vref Version:

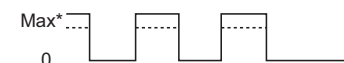


Combined PWM and Analogue Dimming

PWM Digital Control Signal



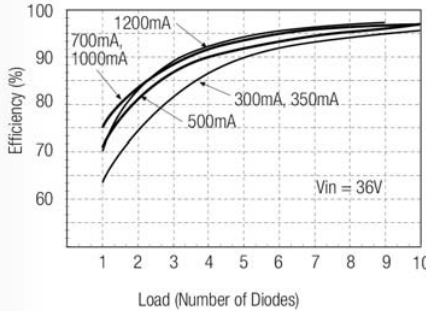
Output Current



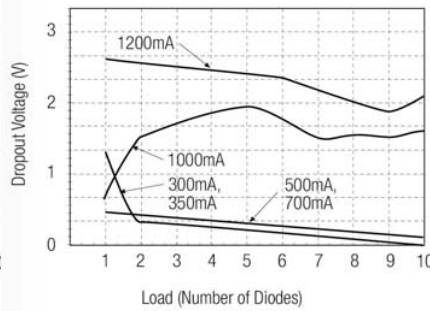
* Max output current can also be set using Analogue input

Typical Characteristics

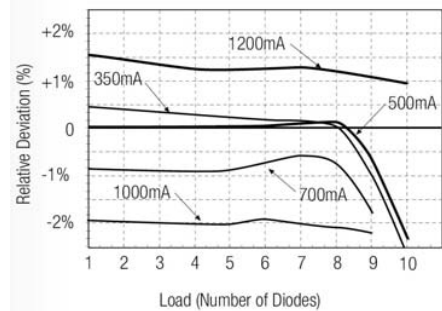
Efficiency/Load



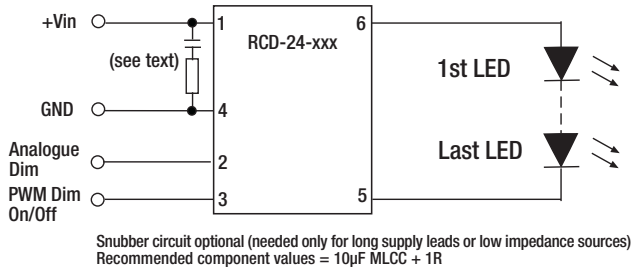
Dropout Voltage/Load



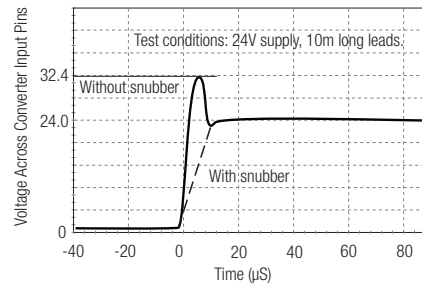
Output Current Accuracy/Load



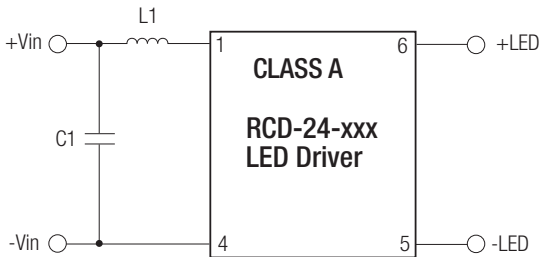
Standard Application Circuit (no external components required for normal use)



Snubber circuit optional (needed only for long supply leads or low impedance sources). Recommended component values = 10µF MLCC + 1R



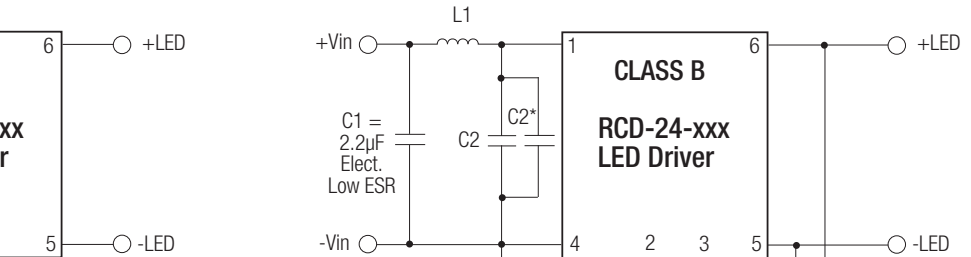
EMI Filter Suggestions



RCD-24-0.30 - RCD-24-0.70

C1 = 1µF MLCC

L1 = 22µH

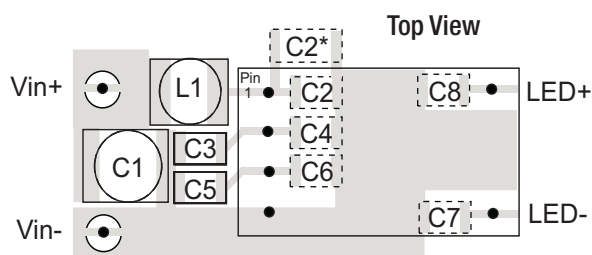


RCD-24-1.00 - RCD-24-1.20

C1 = 2.2µF MLCC

L1 = 47µH

Recommended Class B PCB Layout for Pinned / SMD Versions



RCD-24-0.30 - RCD-24-0.70

No dimming or PWM dimming:

L1 = 47µH

C2 = C3 = 10nF MLCC

Other caps not required

Analogue Dimming used:

L1 = 120µH

C2 = C7 = 10nF MLCC

Other caps not required

RCD-24-1.00 - RCD-24-1.20

L1 = 220µH

C2 = 10nF

C3 = C5 = 2.2nF

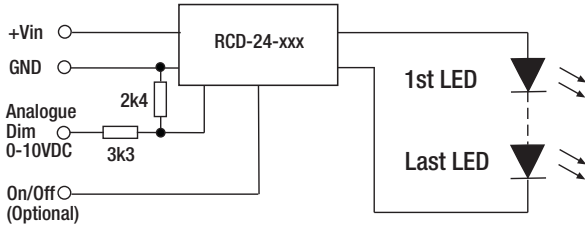
C4 = C6 = C7 = C8 = 100nF

All capacitors MLCC

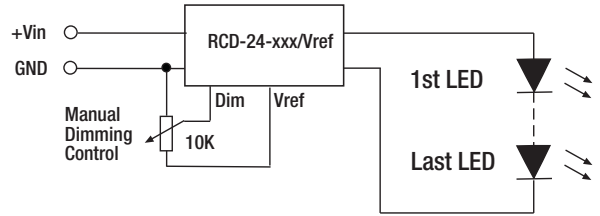
C2* = optional 2µ2 MLCC only if L1 starts to resonate with the back ripple current.

Application Examples

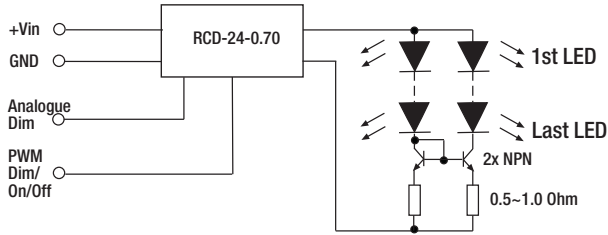
LED DRIVER with 0-10V Interface



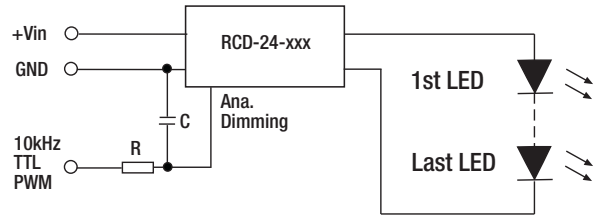
LED DIMMER for up to 10 white LEDs



MULTIPLE LED DRIVER (up to 20 LEDs)



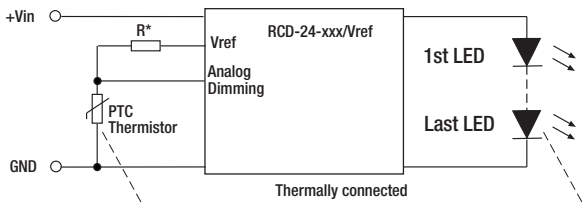
LED DIMMER with high frequency PWM control



Driving Two Strings of 350mA LEDs with one 700mA Driver using a current mirror

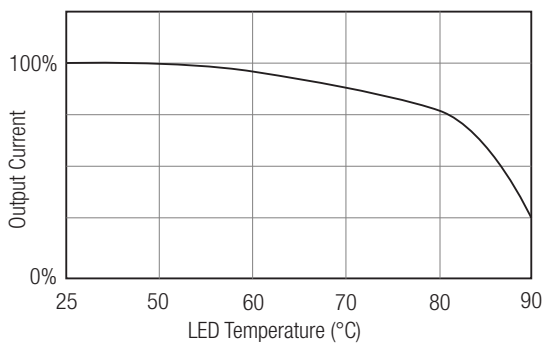
LED Temperature Monitoring

Automatic LED Overtemperature Protection



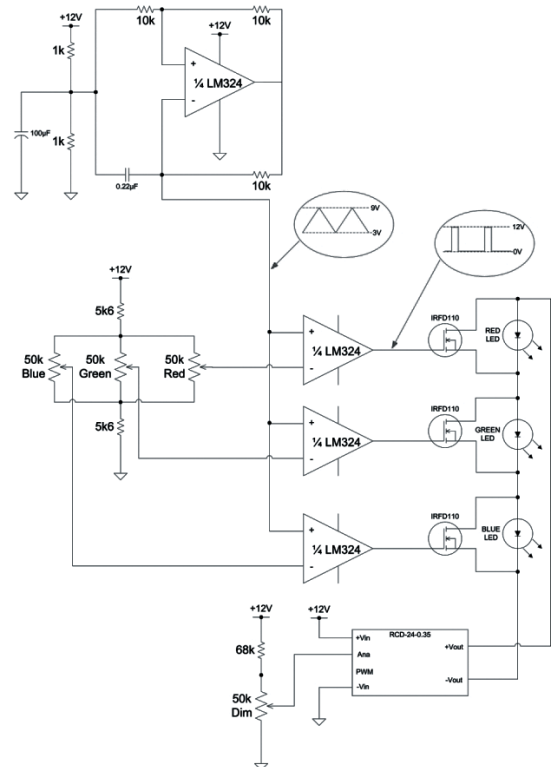
*Typically, choose R so that $R=R_{ptc} @ 85^{\circ}C$ and $R>660 \text{ Ohm}$.

Typical Response Curve (PTC = 500 Ohm @ 70°C)



RGB Driver

SIMPLE RGB Mixer



RCD-24

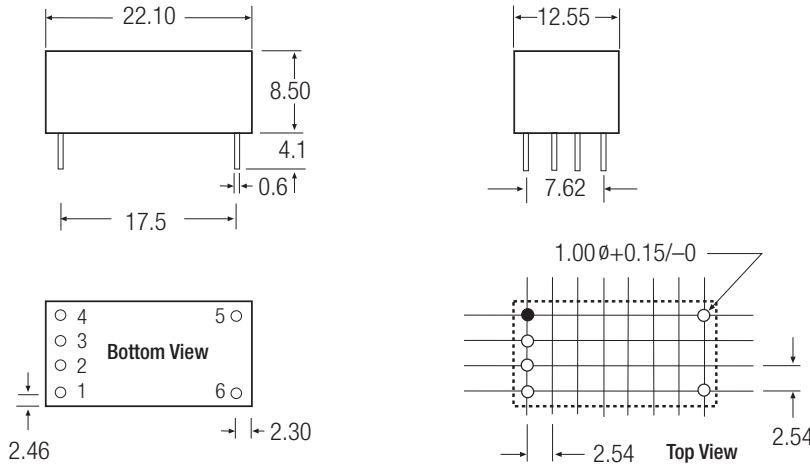
LIGHTLINE

DC/DC-Converter

RCD-24 Series

Package Style and Pinning

Pinned Version



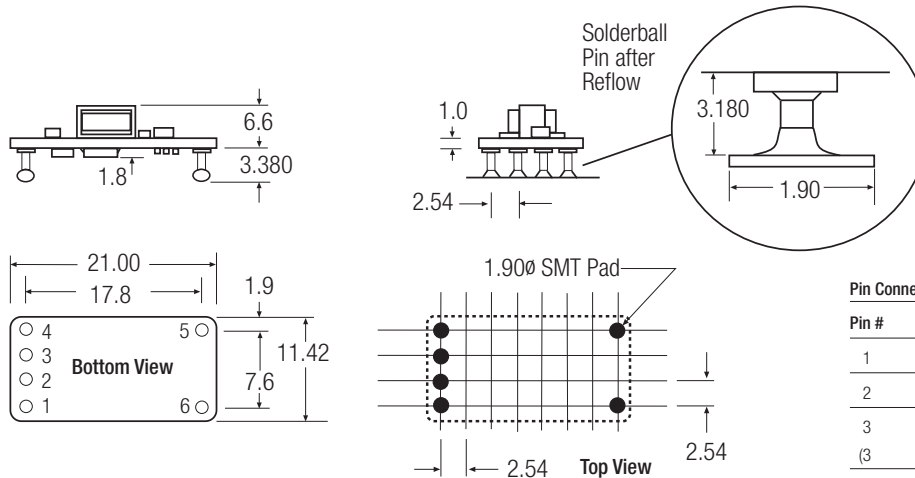
Leave >1mm space around case on PCB for air circulation

| Pin # | Out | Comments |
|-------|------------------|-------------------------|
| 1 | +Vin | DC Supply |
| 2 | Analogue Dimming | Leave open if not used |
| 3 | PWM/ON/OFF | Leave open if not used |
| (3) | Vref | Vref Version only) |
| 4 | GND | Do not connect to -Vout |
| 5 | -Vout | LED Cathode Connection |
| 6 | +Vout | LED Anode Connection |

XX.X ± 0.5 mm
XX.XX ± 0.25 mm
Pin Tolerance ± 0.1 mm

Recommended Footprint Details

SMD Version



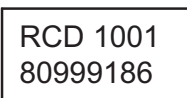
| Pin # | Out | Comments |
|-------|------------------|-------------------------|
| 1 | +Vin | DC Supply |
| 2 | Analogue Dimming | Leave open if not used |
| 3 | PWM/ON/OFF | Leave open if not used |
| (3) | Vref | Vref Version only) |
| 4 | GND | Do not connect to -Vout |
| 5 | -Vout | LED Cathode Connection |
| 6 | +Vout | LED Anode Connection |

XX.X ± 0.5 mm
XX.XX ± 0.25 mm
XX.XXX ± 0.01 mm

RCD-24

Due to the compact size of the Open Frame version, a product code label is used instead of the whole part number.

The product code consists of RCD xxxx (where xxxx is the datecode) followed by an 8 digit reference code, e.g.



= RCD-24-0.35/SMD/OF, manufactured in Week 1 of 2010.

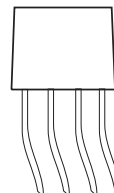
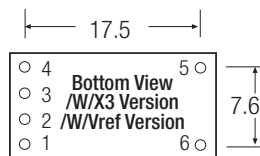
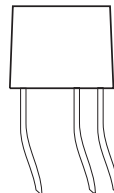
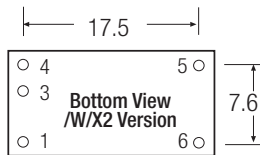
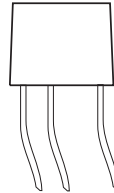
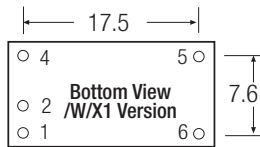
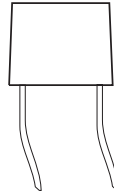
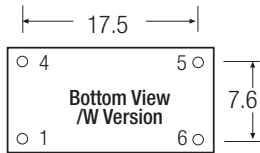
The reference codes for standard parts are:

- RCD-24-0.30/SMD/OF = 80999199
- RCD-24-0.35/SMD/OF = 80999186
- RCD-24-0.50/SMD/OF = 80999200
- RCD-24-0.60/SMD/OF = 80999201
- RCD-24-0.70/SMD/OF = 80999202

Other custom or semi-custom parts may have different reference codes.

Package Style and Pinning

Wired Versions



Wire Connections RCD-24/W Series

| Wire # | Function | Comments |
|------------|----------|-------------------------|
| 1 (Red) | +Vin | DC Supply |
| 4 (Black) | GND | Do not connect to -Vout |
| 5 (Brown) | -Vout | LED Cathode Connection |
| 6 (Yellow) | +Vout | LED Anode Connection |

Wire length = 100mm + 10mm stripped & tinned = 110mm total

Wire outside diameter = 1.6mm

Wire core diameter = 0.75mm

Wire is UL/CSA listed/ 22AWG / 300V Rated

Wire Connections RCD-24/W/X Series

| Wire # | Function | Comments |
|------------------------|--------------------|----------|
| 2 (Green) | Ana Dimming | /X1 |
| 3 (Blue) | PWM Dimming | /X2 |
| 2 + 3 (Green + Blue) | Ana + PWM Dimming | /X3 |
| 2 + 3 (Green + Yellow) | Ana Dimming + Vref | /Vref |

Wire length = 100mm + 10mm stripped & tinned = 110mm total

Wire outside diameter = 1.6mm

Wire core diameter = 0.75mm

Wire is UL/CSA listed/ 22AWG / 300V Rated

RCD-24

Wired Versions are packed in bags - 5pcs per bag.

Warning: Do not connect or disconnect the LED load while the converter is powered on.

This may damage or reduce the lifetime of the LED.