

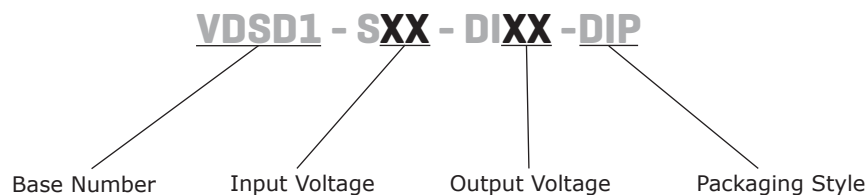
**SERIES: VSD1-DIP | DESCRIPTION: DC-DC CONVERTER**
**FEATURES**

- 1 W isolated output
- industry standard 14 pin DIP package
- dual unregulated outputs
- 1,000 V isolation
- short circuit protection
- UL safety approvals
- wide temperature (-40~85°C)
- efficiency up to 81%



| MODEL             | input voltage |                | output voltage<br>(Vdc) | output current |             | output power<br>max<br>(W) | ripple and noise <sup>1</sup><br>max<br>(mVp-p) | efficiency<br>typ<br>(%) | UL60950-1 |
|-------------------|---------------|----------------|-------------------------|----------------|-------------|----------------------------|---|--------------------------|-----------|
|                   | typ<br>(Vdc)  | range<br>(Vdc) |                         | min<br>(mA)    | max<br>(mA) |                            |   |                          |           |
| VSD1-S5-DI5-DIP   | 5             | 4.5~5.5        | ±5                      | ±10            | ±100        | 1                          | 75  | 72                       | YES       |
| VSD1-S5-DI9-DIP   | 5             | 4.5~5.5        | ±9                      | ±6             | ±56         | 1                          | 75  | 75                       | YES       |
| VSD1-S5-DI12-DIP  | 5             | 4.5~5.5        | ±12                     | ±4             | ±42         | 1                          | 75  | 78                       | YES       |
| VSD1-S5-DI15-DIP  | 5             | 4.5~5.5        | ±15                     | ±3             | ±33         | 1                          | 75  | 79                       | YES       |
| VSD1-S12-DI5-DIP  | 12            | 10.8~13.2      | ±5                      | ±10            | ±100        | 1                          | 75  | 74                       | YES       |
| VSD1-S12-DI9-DIP  | 12            | 10.8~13.2      | ±9                      | ±6             | ±56         | 1                          | 75  | 76                       | YES       |
| VSD1-S12-DI12-DIP | 12            | 10.8~13.2      | ±12                     | ±4             | ±42         | 1                          | 75  | 79                       | YES       |
| VSD1-S12-DI15-DIP | 12            | 10.8~13.2      | ±15                     | ±3             | ±33         | 1                          | 75  | 80                       | YES       |
| VSD1-S15-DI5-DIP  | 15            | 13.5~16.5      | ±5                      | ±10            | ±100        | 1                          | 75  | 74                       | NO        |
| VSD1-S15-DI9-DIP  | 15            | 13.5~16.5      | ±9                      | ±6             | ±56         | 1                          | 75  | 75                       | NO        |
| VSD1-S15-DI12-DIP | 15            | 13.5~16.5      | ±12                     | ±4             | ±42         | 1                          | 75  | 79                       | NO        |
| VSD1-S15-DI15-DIP | 15            | 13.5~16.5      | ±15                     | ±3             | ±33         | 1                          | 75  | 79                       | NO        |
| VSD1-S24-DI5-DIP  | 24            | 21.6~26.4      | ±5                      | ±10            | ±100        | 1                          | 75  | 74                       | YES       |
| VSD1-S24-DI9-DIP  | 24            | 21.6~26.4      | ±9                      | ±6             | ±56         | 1                          | 75  | 76                       | YES       |
| VSD1-S24-DI12-DIP | 24            | 21.6~26.4      | ±12                     | ±4             | ±42         | 1                          | 75  | 80                       | YES       |
| VSD1-S24-DI15-DIP | 24            | 21.6~26.4      | ±15                     | ±3             | ±33         | 1                          | 75  | 81                       | YES       |

Notes: 1. ripple and noise are measured at 20 MHz BW

**PART NUMBER KEY**


**INPUT**

| parameter               | conditions/description | min  | typ | max  | units |
|-------------------------|------------------------|------|-----|------|-------|
| operating input voltage | 5 V model              | 4.5  | 5   | 5.5  | Vdc   |
|                         | 12 V model             | 10.8 | 12  | 13.2 | Vdc   |
|                         | 15 V model             | 13.5 | 15  | 16.5 | Vdc   |
|                         | 24 V model             | 21.6 | 24  | 26.4 | Vdc   |

**OUTPUT**

| parameter               | conditions/description              | min | typ   | max | units |
|-------------------------|-------------------------------------|-----|-------|-----|-------|
| line regulation         | for Vin change of 1%                |     |       | 1.2 | %     |
| load regulation         | measured from 10% load to full load |     |       | 15  | %     |
| voltage accuracy        | see derating curves                 |     |       |     |       |
| switching frequency     | 100% load, input voltage range      | 80  | 100   | 200 | kHz   |
| temperature coefficient |                                     |     | ±0.03 |     | %/°C  |

**PROTECTIONS**

| parameter                | conditions/description | min | typ | max | units |
|--------------------------|------------------------|-----|-----|-----|-------|
| short circuit protection |                        |     |     | 1   | s     |

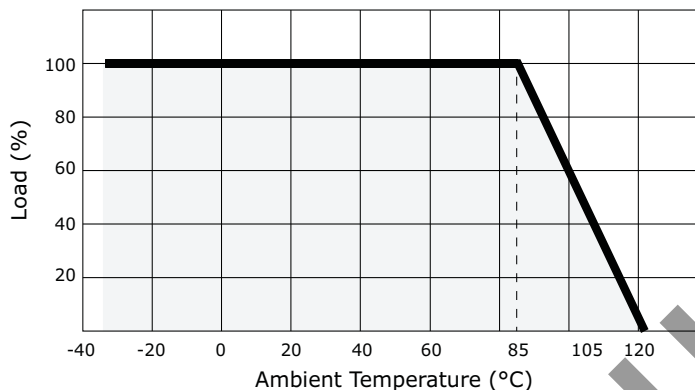
**SAFETY AND COMPLIANCE**

| parameter                     | conditions/description  | min       | typ | max | units |
|-------------------------------|---|-----------|-----|-----|-------|
| isolation voltage             | for 1 minute at 1 mA max.   | 1,000     |     |     | Vdc   |
| isolation resistance          | at 500 Vdc  | 1,000     |     |     | MΩ    |
| safety approvals <sup>1</sup> | UL 60950-1 (E222736)  |           |     |     |       |
| MTBF                          |   | 3,500,000 |     |     | hours |
| RoHS compliant                | yes   |           |     |     |       |
| burn-in                       | full load at +85°C, for 4 hours at no-load and 4 hours at full load |           |     |     |       |

**ENVIRONMENTAL**

| parameter             | conditions/description          | min | typ | max | units |
|-----------------------|---------------------------------|-----|-----|-----|-------|
| operating temperature |                                 | -40 |     | 85  | °C    |
| storage temperature   |                                 | -55 |     | 125 | °C    |
| storage humidity      | non-condensing                  |     |     | 95  | %     |
| temperature rise      | at full load                    |     | 15  | 25  | °C    |
| lead temperature      | 1.5 mm from case for 10 seconds |     |     | 300 | °C    |

## DERATING CURVES



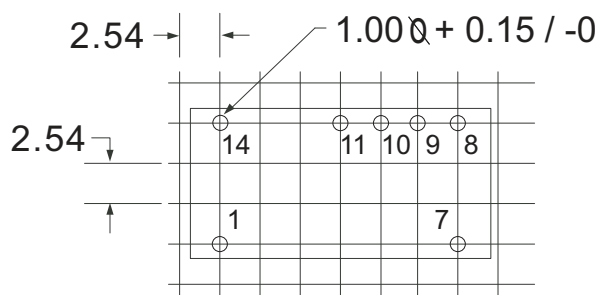
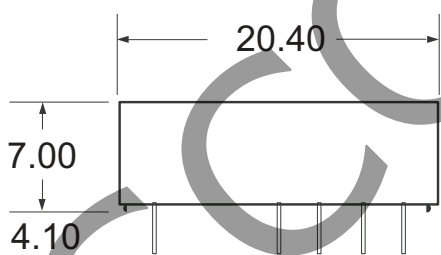
## MECHANICAL

| parameter     | conditions/description                            | min | typ | max | units |
|---------------|---|-----|-----|-----|-------|
| dimensions    | 20.40 x 10.00 x 7.00 (0.803 x 0.394 x 0.276 inch) |     |     |     | mm    |
| case material | plastic (UL94-V0)                                 |     |     |     |       |
| weight        |   |     | 2.1 |     | g     |

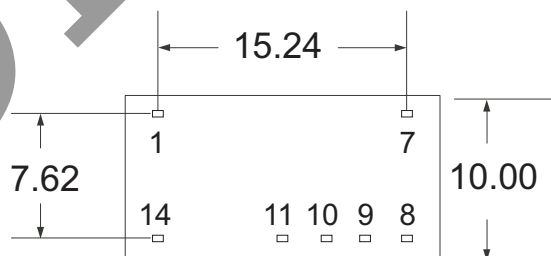
## MECHANICAL DRAWING

units: mm  
 tolerance: ±1 mm  
 pin section tolerance: ±0.10 mm

Side View



Bottom View



| PIN CONNECTIONS |          |
|-----------------|----------|
| PIN             | FUNCTION |
| 1               | -Vin     |
| 7               | NC       |
| 8               | +Vo2     |
| 9               | -Vo2     |
| 10              | +Vo2     |
| 11              | -Vo2     |
| 14              | +Vin     |

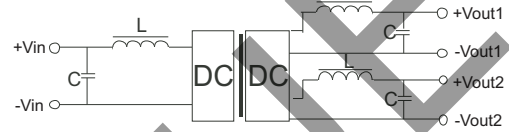
## APPLICATION NOTES

### 1. Input filtering

To reduce the reflected ripple current and minimize EMI, especially when the converter input is more than 2" away from the DC source, it is recommended to connect a low ESR electrolytic capacitor between Vin and Gnd. The values suggested are as shown in Table 1. If additional filtering is required, the capacitance may be increased, or expanded to an LC network as shown in Figure 1.

**Table 1**

| Input Voltage | External Input Capacitance |
|---------------|----------------------------|
| 5 V           | 4.7 $\mu$ F                |
| 12 V          | 2.2 $\mu$ F                |
| 15 V          | 2.2 $\mu$ F                |
| 24 V          | 1.0 $\mu$ F                |



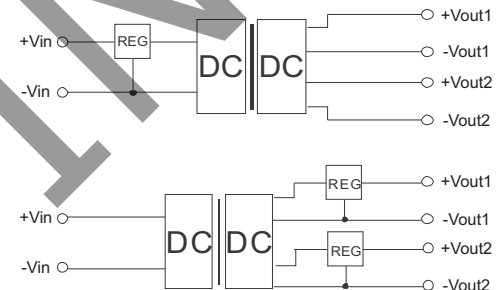
**Figure 1**

### 2. Output filtering

An output capacitor is needed to meet output ripple requirements as shown in Table 2. Output capacitance may be increased for additional filtering, but should not exceed 10 $\mu$ F or expanded to an LC network as in Figure 1.

**Table 2**

| Output Voltage | External Input Capacitance |
|----------------|----------------------------|
| 5 V            | 10 $\mu$ F                 |
| 9 V            | 4.7 $\mu$ F                |
| 12 V           | 2.2 $\mu$ F                |
| 15 V           | 1.0 $\mu$ F                |
| 24 V           | 0.47 $\mu$ F               |



**Figure 2**

### 3. Minimum loading

The converter needs a minimum of 10% loading to maintain output regulation. Operation under no-load conditions will not cause immediate damages but may reduce reliability, and cause performance not to meet specifications.

### 4. Regulation

With a semi-regulated design, the converter's output voltage varies with load current and will change proportionally to the input voltage. If regulated output is needed, an external regulator can be used as shown in Figure 2.

### 5. Protection

The converter has minimal protection against input over-voltage or output over-load, and may be permanently damaged if exposed to these conditions. An input clamping device can be used for input voltage limiting. An input fuse or an output fuse can also be used to protect against over-loading.

### 6. Dual outputs used as a single output

The +Vout and -Vout can be used to obtain a single output that is the sum of the two outputs. In this case, the COM pin shouldn't be used.

### 7. External Regulator

An external 3-terminal regulator can be connected to the output of the converter to achieve full regulation. Make sure the converter's output voltage provides sufficient head room for the regulator. An additional benefit is that the built-in protection features in the regulator, such as OCP, OTP, etc, will protect the converter also. In a complimentary supply, a negative output regulator must be used to achieve the negative regulated output.

## REVISION HISTORY

| rev. | description                                       | date       |
|------|---|------------|
| 1.0  | initial release                                   | 05/12/2006 |
| 1.01 | new template applied                              | 09/04/2009 |
| 1.02 | new template applied, V-Infinity branding removed | 09/07/2012 |
| 1.03 | corrected part numbers                            | 11/29/2012 |
| 1.04 | updated spec                                      | 07/11/2013 |

The revision history provided is for informational purposes only and is believed to be accurate.



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