

# 75 Watt HD Dual Series DC/DC Converters



## Description

The HD Dual Series DC/DC family provides two independent and precisely regulated low output voltage converters in one package reducing cost and saving board space. The HD Series meets rigorous requirements in an industry standard ½ brick package, and is well suited for telecom and industrial applications.

Both outputs are rated for a maximum of 10 Amps, thus providing many possible output load combinations with a total output power of 75 Watts. The remote trim function on each output can be used to compensate for voltage drops between the converter and the load at higher currents.

The HD Series includes a primary remote on/off for power conservation. The HD package features threaded-through holes to allow for easy mounting or the addition of a heat sink for extended temperature operation.

## Features

- Small size 2.4" x 2.28" x 0.55"
- Excellent thermal performance with metal baseplate
- Non-latching over voltage shutdown
- Pulse-by-pulse current limiting, short circuit foldback
- Over-temperature protection
- Auto-softstart
- Low noise
- Constant frequency for normal operation.
- 2:1 input voltage range
- Positive logic primary remote ON/OFF
- Negative logic primary shutdown as an option
- Very low temperature coefficient
- Water Washable
- Trimmable output voltages
- Low cost
- 5 Year Warranty

| Selection Chart |                 |     |           |     |              |
|-----------------|-----------------|-----|-----------|-----|--------------|
| Model *         | Input Range VDC |     | V out VDC |     | I out ADC ** |
|                 | Min             | Max | V1        | V2  |              |
| 24D5.3R3HD      | 18              | 36  | 5         | 3.3 | 10           |
| 24D5.2R5HD      | 18              | 36  | 5         | 2.5 | 10           |
| 24D5.1R8HD      | 18              | 36  | 5         | 1.8 | 10           |
| 24D5.1R5HD      | 18              | 36  | 5         | 1.5 | 10           |
| 24D3.2R5HD      | 18              | 36  | 3.3       | 2.5 | 10           |
| 24D3.1R8HD      | 18              | 36  | 3.3       | 1.8 | 10           |
| 24D3.1R5HD      | 18              | 36  | 3.3       | 1.5 | 10           |
| 48D5.3R3HD      | 36              | 75  | 5         | 3.3 | 10           |
| 48D5.2R5HD      | 36              | 75  | 5         | 2.5 | 10           |
| 48D5.1R8HD      | 36              | 75  | 5         | 1.8 | 10           |
| 48D5.1R5HD      | 36              | 75  | 5         | 1.5 | 10           |
| 48D3.2R5HD      | 36              | 75  | 3.3       | 2.5 | 10           |
| 48D3.1R8HD      | 36              | 75  | 3.3       | 1.8 | 10           |
| 48D3.1R5HD      | 36              | 75  | 3.3       | 1.5 | 10           |

\*Add (-N) to the end of the part number for negative logic on the primary shutdown. Default ON/OFF logic is positive.

\*\* The output currents are the maximum ratings of each of the outputs. It is up to the user to keep the total power output at or below the 75 Watt rating of the package.

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Unless otherwise stated, these specifications apply for ambient temperature  $T_A=23 \pm 2^\circ\text{C}$ , nominal input voltage, and full load. (1) (2)

| Input Parameters                                     |           |            |            |            |            |            |            |                  |       |
|--|-----------|------------|------------|------------|------------|------------|------------|------------------|-------|
| Model  |           | 24D5.3R3HD | 24D5.2R5HD | 24D5.1R8HD | 24D5.1R5HD | 24D3.2R5HD | 24D3.1R8HD | 24D3.1R5HD       | Units |
| Voltage Range  | MIN       | 18         |            |            |            |            |            | VDC              |       |
|  | TYP       | 24         |            |            |            |            |            |                  |       |
|  | MAX       | 36         |            |            |            |            |            |                  |       |
| Input Overvoltage<br>100 mSec                        | MAX       | 50         |            |            |            |            |            | VDC              |       |
| Input Ripple Rejection<br>(120Hz)                    | TYP       | 50         |            |            |            |            |            | dB               |       |
| Undervoltage Lockout                                 |           | Yes        |            |            |            |            |            |                  |       |
| Input Reverse Voltage Protection                     |           | Yes        |            |            |            |            |            |                  |       |
| Input Current  | No Load   | 12         |            |            | 12         |            | mA         |                  |       |
|  | 100% Load | 3.85       |            |            | 3.91       |            |            | A                |       |
| Inrush Current                                       | MAX       | 0.5        |            |            |            |            |            | A <sup>2</sup> S |       |
| Reflected Ripple, 12 $\mu$ H<br>Source Impedance (4) | TYP       | 20         |            |            |            |            |            | mA P-P           |       |
| Efficiency   | TYP       | 81         |            |            | 80         |            | %          |                  |       |
| Switching Frequency                                  | TYP       | 360        |            |            |            |            |            | kHz              |       |
| Recommended Fuse                                     |           | (3)        |            |            |            |            |            | AMPS             |       |

| Input Parameters                                     |           |            |            |            |            |            |            |                  |       |
|--|-----------|------------|------------|------------|------------|------------|------------|------------------|-------|
| Model  |           | 48D5.3R3HD | 48D5.2R5HD | 48D5.1R8HD | 48D5.1R5HD | 48D3.2R5HD | 48D3.1R8HD | 48D3.1R5HD       | Units |
| Voltage Range  | MIN       | 36         |            |            |            |            |            | VDC              |       |
|  | TYP       | 48         |            |            |            |            |            |                  |       |
|  | MAX       | 75         |            |            |            |            |            |                  |       |
| Input Overvoltage<br>100 mSec                        | MAX       | 85         |            |            |            |            |            | VDC              |       |
| Input Ripple Rejection<br>(120Hz)                    | TYP       | 50         |            |            |            |            |            | dB               |       |
| Undervoltage Lockout                                 |           | Yes        |            |            |            |            |            |                  |       |
| Input Reverse Voltage Protection                     |           | Yes        |            |            |            |            |            |                  |       |
| Input Current  | No Load   | 12         |            |            | 12         |            | mA         |                  |       |
|  | 100% Load | 1.9        |            |            | 2          |            |            | A                |       |
| Inrush Current                                       | MAX       | 0.5        |            |            |            |            |            | A <sup>2</sup> S |       |
| Reflected Ripple, 12 $\mu$ H<br>Source Impedance (4) | TYP       | 20         |            |            |            |            |            | mA P-P           |       |
| Efficiency   | TYP       | 82         |            |            | 78         |            | %          |                  |       |
| Switching Frequency                                  | TYP       | 360        |            |            |            |            |            | kHz              |       |
| Recommended Fuse                                     |           | (3)        |            |            |            |            |            | AMPS             |       |

## NOTES:

- Refer to the CALEX Application Notes for the definition of terms, measurement circuits, and other information.
- Full Load is defined as the main output operating at 10 Amps. The auxiliary output is loaded to bring output power to 75 Watts, or loaded to 10 Amps maximum.
- This unit is not fused and needs to be fused by the user. Refer to the CALEX Application Notes for information on fusing. For inrush current, refer to the specifications above.
- Place a 33  $\mu$ F capacitor between the two "Input" pins. Then place the current sensor in series with a 12  $\mu$ H inductor between the capacitor and the source (current sensor is located between the converter input pins and the 12 $\mu$ H inductor). The reflected ripple current is measured over a 5 Hz to 20 MHz bandwidth. Noise should be minimized in the measurement.
- Noise is measured per the CALEX Application Notes. Output noise is measured with a 10  $\mu$ F tantalum capacitor in parallel with a 0.1  $\mu$ F ceramic capacitor connected across the output to CMN. Measurement bandwidth is 0-20 MHz.
- Optimum performance is obtained when this power supply is operated within the minimum to maximum load specifications. No damage to the module will occur when the output is operated at less than minimum load, but the output voltage may contain a low frequency component that may exceed output noise specifications. At no load the converter's V1 output voltage may fall out of regulation, typically rising to the OVP limit. A load current of between 0.5% to 1% of maximum rated load on any of the outputs will usually suffice to bring V1 within regulation.
- Load Transient Recovery Time is defined as the time for the output to settle from a 50 to 75% or 25% step load change to a 1% error band of output voltage (rise time of step = 2 $\mu$ Sec).
- Load Transient Overshoot is defined as the peak overshoot during a transient as defined in the Note 7 above.
- Load regulation is defined as the output voltage change when changing load current from maximum to minimum. The voltage is measured at the output pin.
- Most switches would be suitable for logic On/Off control, in case there is a problem, you can make following estimations and then leave some margin.  
When open collector is used for logic high, "Open Circuit Voltage at On/Off Pin", "Output Resistance" and "External Leakage Current Allowed for Logic High" are used to estimate the high impedance requirement of open collector.

# 75 Watt HD Dual Series DC/DC Converters

Unless otherwise stated, these specifications apply for ambient temperature  $T_A=23 \pm 2^\circ\text{C}$ , nominal input voltage, and full load. (1) (2)

| Output Parameters (V1)  |     |  |  |  |  |                     |
|---|-----|--|--|--|--|---------------------|
| Model   |     | 24D5.3R3HD<br>24D5.2R5HD<br>24D5.1R8HD<br>24D5.1R5HD | 48D5.2R5HD<br>48D5.3R3HD<br>48D5.1R8HD<br>48D5.1R5HD | 24D3.2R5HD<br>24D3.1R8HD<br>24D3.1R5HD | 48D3.2R5HD<br>48D3.1R8HD<br>48D3.1R5HD | Units               |
| Output Voltage  |     | 5  |  | 3.3                                    |  | VDC                 |
| Output Voltage Setpoint Accuracy  | MAX | ±1   |  |  |  | %                   |
| Turn On Overshoot   | TYP | 0  |  |  |  | %                   |
| Temperature Coefficient   | TYP | 0.003  |  |  |  | %/ $^\circ\text{C}$ |
|   | MAX | 0.01   |  |  |  |                     |
| Noise & Ripple (5)  | TYP | 50   |  | 33                                     |  | mV P-P              |
|   | MAX | 100  |  | 66                                     |  |                     |
| Load Current (6) (12)   | MIN | 1.0  |  |  |  | A                   |
|   | MAX | 10.0   |  |  |  |                     |
| Load Transient Overshoot (8)  | TYP | 4  |  |  |  | %                   |
| Load Transient Recovery Time (7)  | TYP | 100  |  |  |  | $\mu\text{Sec}$     |
| Load Regulation (9)<br>Min-Max Load   | TYP | 0.5  |  |  |  | %                   |
|   | MAX | 1  |  |  |  |                     |
| Line Regulation<br>$V_{in} = \text{Min-Max}$  | TYP | 0.1  |  |  |  | %                   |
|   | MAX | 0.5  |  |  |  |                     |
| Overvoltage Protection (OVP)<br>Threshold<br>OVP Type - Non-latching<br>Open Loop Overvoltage Clamp | TYP | 130  |  |  |  | %                   |
| Output Current Limit<br>$V_{out}=90\%$ of $V_{out-nom}$   | TYP | 120  |  |  |  | %                   |
| Output Short Circuit Current<br>$V_{out} = 0.25 \text{ V}$  | TYP | 175  |  |  |  | %                   |

| Output Parameters (V2)                       |     |                          |  |  |  |                     |
|--|-----|--------------------------|--|--|--|---------------------|
| Model  |     | 24D5.3R3HD<br>48D5.3R3HD | 24D5.2R5HD<br>24D3.2R5HD<br>48D5.2R5HD<br>48D3.2R5HD | 24D5.1R8HD<br>24D3.1R8HD<br>48D5.1R8HD<br>48D3.1R8HD | 24D5.1R5HD<br>24D3.1R5HD<br>48D5.1R5HD<br>48D3.1R5HD | Units               |
| Output Voltage                               |     | 3.3                      | 2.5  | 1.8  | 1.5  | VDC                 |
| Output Voltage Setpoint Accuracy             | MAX | ±1.5                     |  |  |  | %                   |
| Turn On Overshoot                            | TYP | 0                        |  |  |  | %                   |
| Temperature Coefficient                      | TYP | 0.02                     |  |  |  | %/ $^\circ\text{C}$ |
|  | MAX | 0.05                     |  |  |  |                     |
| Noise & Ripple (5)                           | TYP | 33                       | 25   | 18   | 15   | mV P-P              |
|  | MAX | 66                       | 50   | 36   | 30   |                     |
| Load Current (6)                             | MIN | 0.2                      |  |  |  | A                   |
|  | MAX | 10.0                     |  |  |  |                     |
| Load Transient Overshoot (8)                 | TYP | 4                        |  |  |  | %                   |
| Load Regulation (9)<br>Min-Max Load          | TYP | 0.5                      |  |  |  | %                   |
|  | MAX | 1                        |  |  |  |                     |
| Line Regulation<br>$V_{in} = \text{Min-Max}$ | TYP | 0.5                      |  |  |  | %                   |
|  | MAX | 1                        |  |  |  |                     |

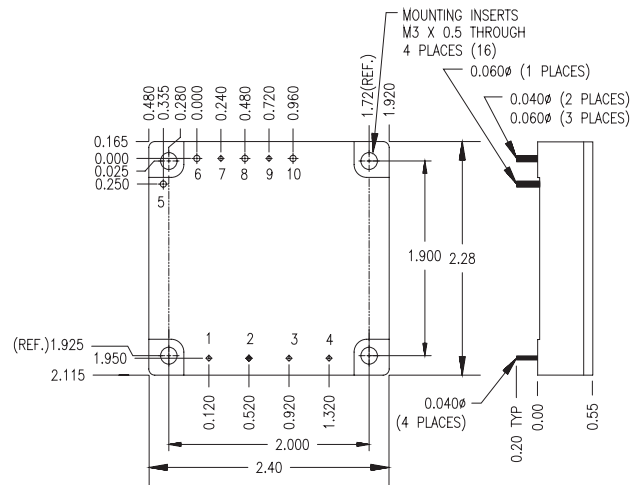
When switch is used for logic low, "Open Circuit Voltage at On/Off Pin", "Output Resistance" and "LOW Logic Level" are used to estimate the low impedance requirement of switch.

- (11) Thermal impedance is tested with the converter mounted vertically and facing another printed circuit board 1/2 inch away. If converter is mounted horizontally with no obstructions, thermal impedance is approximately  $7^\circ\text{C/W}$ .
- (12) Minimum load is defined as 10% of maximum load. Calex Mfg. Co. Inc. does not guarantee performance for loads less than the minimum. Loads less than the minimum shall not damage the unit.

- (13) The unit can be configured with negative logic for Remote ON/OFF.
- (14) When an external On/Off switch is used, such as open collector switch, logic high requires the switch to be high-impedance. Switch leakage currents greater than 10  $\mu\text{A}$  may be sufficient to trigger the ON/Off to the logic-low state.
- (15) Water Washability - Calex DC/DC converters are designed to withstand most solder/wash processes. Careful attention should be used when assessing the applicability in your specific manufacturing process. Converters are not hermetically sealed.
- (16) Torque fasteners into threaded mounting inserts at 12 in. oz. or less. Greater torque may result in damage to unit and void the warranty.

# 75 Watt HD Dual Series DC/DC Converters

| General Specifications                               |                                      |            |           |
|--|--------------------------------------|------------|-----------|
| All Models   |                                      |            | Units     |
| <b>Primary Remote ON/OFF Function</b>                |                                      |            |           |
| HIGH Logic Level for ON                              | MIN                                  | 3.0        | VDC       |
| External Leakage Current Allowed for Logic High (14) | MAX                                  | 10         | μA        |
| Input Diode Protection Voltage                       | MAX                                  | 50         | VDC       |
| LOW Logic Level or Tie ON/OFF Pin to -Input          | MAX                                  | 1.0        | VDC       |
| Sinking Current for Primary Logic Level              | MAX                                  | 500        | μA        |
| Open Circuit Voltage at Primary On/Off Pin (10)      |                                      |            |           |
| Positive Logic                                       | TYP                                  | 2.3        | VDC       |
| Negative Logic                                       | TYP                                  | 1.5        | VDC       |
| Output Resistance (10)                               | TYP                                  | 3          | k Ohm     |
| Idle Current (Module is OFF)                         | TYP                                  | 2          | mADC      |
| Turn-on Time to 1% error                             | TYP                                  | 20         | mSec      |
| Remote ON/OFF Logic (13)                             | HIGH - Module ON<br>LOW - Module OFF |            |           |
| <b>Output Voltage Trim</b>                           |                                      |            |           |
| Trim Range   | MIN<br>MAX                           | ±5         | % of Vout |
| Input Resistance                                     | TYP                                  | 10         | k Ohm     |
| Open Circuit Voltage                                 | TYP                                  | 2.5        | V         |
| <b>Trim Limit</b>                                    |                                      |            |           |
| Maximum Output Voltage                               | MAX                                  | 105        | % of Vout |
| <b>Isolation</b>                                     |                                      |            |           |
| Input to Output Isolation                            |                                      |            |           |
| 10μA Leakage   |                                      |            |           |
| 48 VDC   | MAX                                  | 1544       | VDC       |
| 24 VDC   | MAX                                  | 700        |           |
| Input to Output Resistance                           | MIN                                  | 10         | Mohm      |
| Input to Output Capacitance                          | TYP                                  | 1800       | pF        |
| <b>Environmental</b>                                 |                                      |            |           |
| Calculated MTBF, Bellcore Method 1, Case 1           |                                      | >1,000,000 | Hr        |
| Baseplate Operating Temperature Range                | MIN<br>MAX                           | -40<br>100 | °C        |
| Storage Temperature                                  | MIN<br>MAX                           | -40<br>120 | °C        |
| Thermal Impedance (11)                               | TYP                                  | 7          | °C/W      |
| <b>General</b>                                       |                                      |            |           |
| Unit Weight  | TYP                                  | 4/114      | oz/g      |
| Chassis Mounting Kit                                 | MS25                                 |            |           |
| Case Dimension                                       | 2.4" x 2.28" x 0.55"                 |            |           |
| Agency Approvals                                     | UL60950 pending                      |            |           |



Mechanical tolerances unless otherwise noted:

X.XX dimensions: ±0.020 inches

X.XXX dimensions: ±0.005 inches

| Pin | Function | Pin | Function |
|-----|----------|-----|----------|
| 1   | CASE     | 6   | + V2     |
| 2   | - INPUT  | 7   | V2 TRIM  |
| 3   | + INPUT  | 8   | - V1     |
| 4   | ON/OFF   | 9   | V1 TRIM  |
| 5   | - V2     | 10  | + V1     |