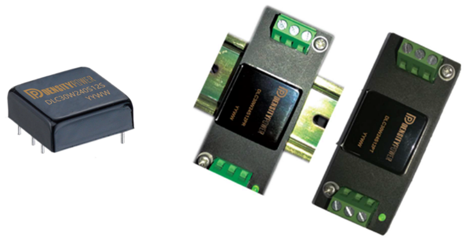
# Technical Specification

## DLC30W24 Series

4:1 Wide Input, Isolated 30Watts DC/DC Converters



## FEATURES

- 4:1 wide input range: 9-36VDC
- 30W isolated output
- Single & Bipolar outputs: 5, 12, 15, 24, ±5, ±12, ±15Volts DC
- Efficiency up to 91%
- Adjustable Vout (±10%)
- Six sides shielding
- Build-in EMI filter and input anti-reverse options
- Remote on/off control
- 1500VDC I/O isolation
- Standard 1.0"×1.0"×0.4" DIP footprint, Din-rail & wall mount type options
- Extensive self-protection, UVLO, OTP, OVP, OCP and short protection
- Operation temperature range: -40°C to +105°C
- Fully encapsulated, high reliability
- MTBF ⩾ 1 MHrs

## PRODUCT OVERVIEW

The DLC30W24 series are highly reliable, and efficient isolated DC/DC converter. Wide input range of 9-36V (24V nominal) is ideal for automation, power grid, railway, semiconductor equipment, instrumentation, test and measurement, and distribution power system.

A wealth of self-protection features included input under-voltage lockout, over temperature shutdown, overcurrent protection with “hiccup” autorestart technique, provides short-circuit protection, along with output OVP. The operation temperature is -40°C to 105°C, the module delivers full output power @ 105°C case temperature.

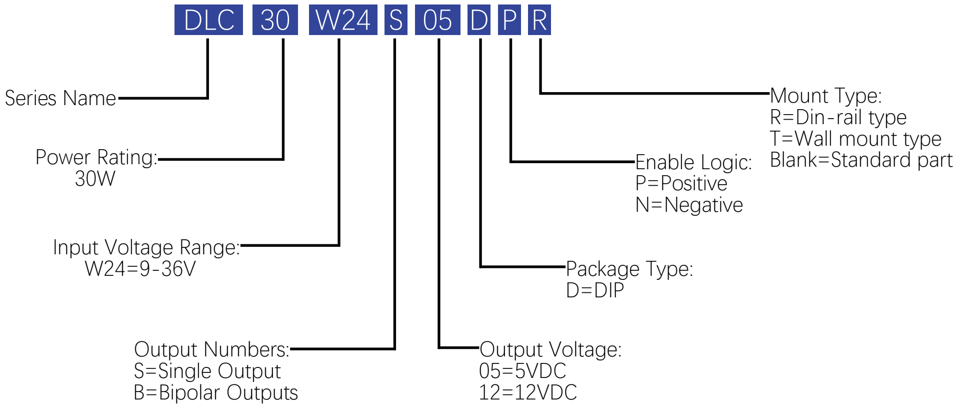
Advanced fully encapsulated package technology with six sides shielding and build-in EMI filter provides outstanding EMC and thermal performance, which is ideal for ruggedized applications involving harsh environments. Wall mount and Din-rail mount type are available for maximum design-in flexibility.

The DLC30W24 series are designed to safety standards UL62368-1.

**Models Selections**

| Basic Models | Input Voltage [VDC] | Input Voltage Range [VDC] | Output Voltage [VDC] | Output Current [A] | Efficiency Typ. [%] | Capacitive Load Max [µF] | Package [inch] |
|---|---|---|---|---|---|---|---|
| DLC30W24S05 | 24 | 9-36 | 5 | 6 | 89 | 7200 | 1.0"×1.0"×0.4" DIP |
| DLC30W24S12 | 24 | 9-36 | 12 | 2.5 | 89 | 1200 | |
| DLC30W24S15 | 24 | 9-36 | 15 | 2 | 89 | 1000 | |
| DLC30W24S24 | 24 | 9-36 | 24 | 1.25 | 90 | 360 | |
| DLC30W24B05 | 24 | 9-36 | ±5 | ±3 | 86 | ±1000 | |
| DLC30W24B12 | 24 | 9-36 | ±12 | ±1.25 | 89 | ±700 | |
| DLC30W24B15 | 24 | 9-36 | ±15 | ±1 | 91 | ±500 | |

## Model Numbering




## Absolute Maximum Ratings

| Parameters | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Input Voltage Continuous | | -0.7 | | 36 | VDC |
| Input Voltage Transient | ＜ 100ms | | | 50 | VDC |
| On/Off Remote Control | Referred to -Vin | | | 15 | VDC |
| Remote Control Source Current | | 0 | | 1.5 | mA |
| Remote Control Sink Current | | 0 | | 1.5 | mA |
| Operating Case Temperature | | -40 | | 105 | °C |
| Operating Environment Temperature | | -40 | | 85 | °C |
| Storage Temperature Range | | -55 | | 125 | °C |
| Soldering Temperature | Wave soldering ＜ 10s | | | 260 | °C |

## Safety and EMC Compliance

| | | |
|---|---|---|
| Conducted Emission | EN55032 | Class B (With external filter) |
| Radiated Emission | EN55032 | Class B (With external filter) |
| Conducted Susceptibility | IEC6100-4-6 | 10Vrms Criteria A |
| Radiated Susceptibility | IEC6100-4-3 | 10V/m Criteria A |
| EFT | IEC6100-4-4 | ±2KV Criteria A (With external filter) |
| Surge | IEC6100-4-5 | ±2KV Criteria A (With external filter) |
| ESD | IEC6100-4-2 | Contact: ±4KV Air: ±4KV Criteria A |
| Isolation Safety Rating | Basic insulation | |

### General Specifications

| Parameters | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Isolation Voltage (Test for 1 minute) | Input to output | | 1500 | | VDC |
| | Input to case | | 1500 | | VDC |
| | Output to case | | 1500 | | VDC |
| Isolation Resistance (Viso=500VDC) | Input to output | 100 | | | MΩ |
| | Input to case | 100 | | | MΩ |
| | Output to case | 100 | | | MΩ |
| Isolation Capacitance | Input to output | | 1000 | | pF |
| Switching Frequency | 5 Vout module | | 275 | | KHz |
| | Other modules | | 330 | | KHz |
| Start-up Delay | From undervoltage shutdown recovery to 10% Vout | | | 30 | mS |
| Rise Time | From 10% Vout to 90% Vout capacitive load | | | 30 | mS |
| Remote On/Off Control | Positive Logic, ON state | Open or 3.0 ≤ Vr ≤ 15 | | | VDC |
| | Positive Logic, OFF state | Short or 0 ≤ Vr ≤ 1.2 | | | VDC |
| | Negative Logic, ON state | Short or 0 ≤ Vr ≤ 1.2 | | | VDC |
| | Negative Logic, OFF state | Open or 3.0 ≤ Vr ≤ 15 | | | VDC |
| Vibration | IEC 60068-2-64, Environmental Testing - Part 2 | | | | |
| Shock (Operational) | IEC 60068-2-27, Environmental Testing- Part 2.27 | | | | |

### Input Specifications

| Parameters | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Operating Voltage Range | | 9 | 24 | 36 | VDC |
| Start-up Threshold | | 8 | | 9 | VDC |
| Under Voltage Shutdown | | 7.5 | | 8.5 | VDC |
| Input Current @ No Load | | | 10 | 20 | mA |
| Input Current @ Min. Line | | | | 5 | A |
| Input Current @ Shutdown Mode | | | 2 | 10 | mA |
| Input Reflected Ripple Current (Peak-Peak) | Measured at input pin with 4.7µH inductor and 100µF capacitance | | 30 | 200 | mA |
| Power Loss @ No Load | | | | 0.5 | W |
| Recommended Input Fuse | | | 10 | | A |
| Recommended External Input Capacitance | 1µF CBB and 100µF E-cap used in combination | | 100 | | µF |

## Performance Data (5 Vout)

### Output Specifications

| Parameters | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Output Voltage Setpoint | | 4.95 | 5.00 | 5.05 | V |
| Vout Accuracy | | -1.0 | | +1.0 | % |
| Adjustable Range | Trim up/ Trim down | -10 | | +10 | % |
| Line Regulation | | -0.2 | | +0.2 | % |
| Load Regulation | | -0.5 | | +0.5 | % |
| Temperature Coefficient | | -0.02 | | +0.02 | %of Vout/°C |
| Total Regulation | | -2 | | +2 | % |
| Ripple & Noise Max. ① | | | 75 | 150 | mV pk-pk |
| Dynamic Load Peak Deviation ② | | -5 | | +5 | % |
| Dynamic Load Response | | | 250 | 500 | µS |
| Over Voltage Protection | Hiccup, Auto-recover | 110 | | 140 | % |
| Over Current Protection | Hiccup, Auto-recover | 110 | | 240 | % |
| Short Circuit Protection | Hiccup, Auto-recover | | | | |
| Capacitive Load | | 220 | | 7200 | µF |
| Minimum Load | No minimum load required | | | | |

Notes

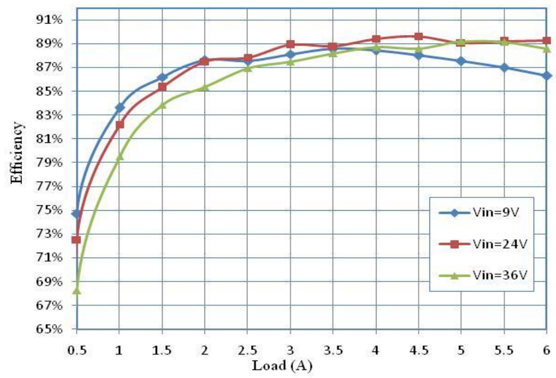
① Ripple & noise is tested with 220µF electrolytic capicitor at output, please see output ripple & noise in technical notes on page 22 for more details.

② The load is set from 50%-75%-50% of Imax, di/dt=1A/µS, Cout=220µF, please refer to dynamic waveform in performance data on page 5 for details.

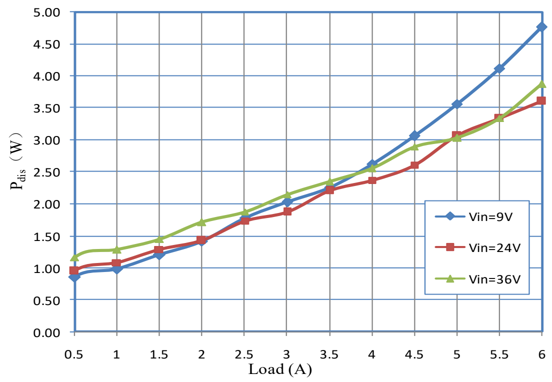
All specifications are tested at 25 ℃ ambient temperature, nominal input voltage, rated output current conditions unless otherwise specified.

## Performance Data (5 Vout)

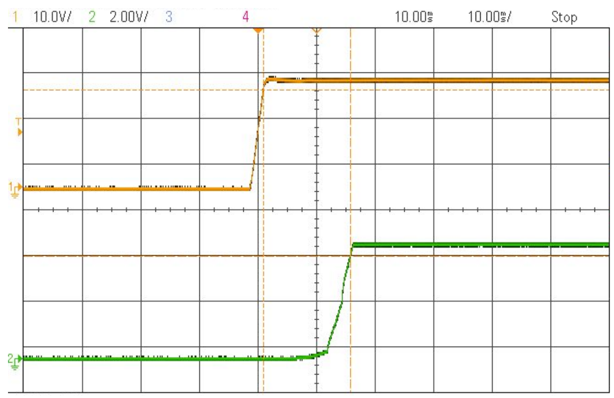
### EFFICIENCY VS LOAD



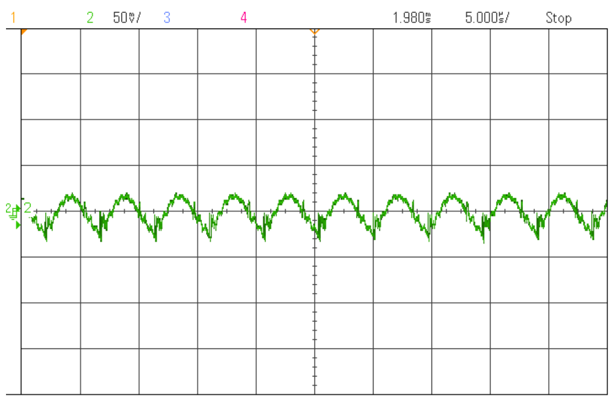

### POWER DISSIPATION VS LOAD



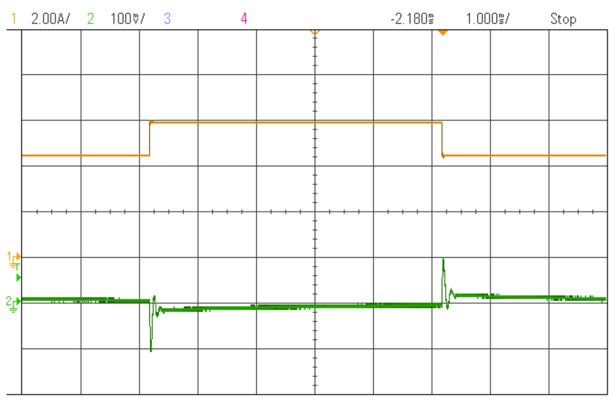

### START UP Ch1:Vin Ch2:Vout



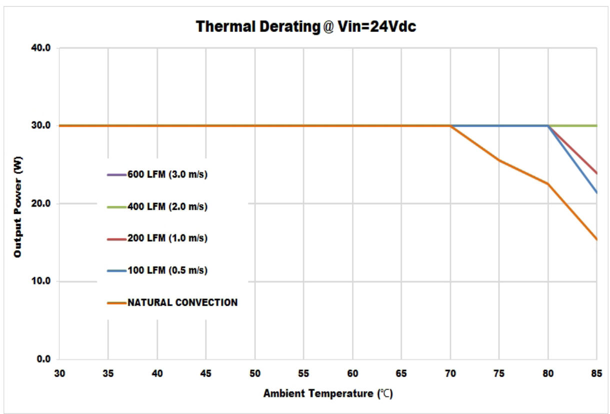

### RIPPLE & NOISE BANDWIDTH 20MHz




### DYNAMIC RESPONSE Ch1:Iout Ch2:Vout




### THERMAL DREATING CURVE



## Performance Data (12 Vout)

### Output Specifications

| Parameters | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Output Voltage Setpoint | | 11.88 | 12.00 | 12.12 | V |
| Vout Accuracy | | -1.0 | | +1.0 | % |
| Adjustable Range | Trim up/ Trim down | -10 | | +10 | % |
| Line Regulation | | -0.2 | | +0.2 | % |
| Load Regulation | | -0.5 | | +0.5 | % |
| Temperature Coefficient | | -0.02 | | +0.02 | %of Vout/°C |
| Total Regulation | | -2 | | +2 | % |
| Ripple & Noise Max. ① | | | 75 | 200 | mV pk-pk |
| Dynamic Load Peak Deviation ② | | -5 | | +5 | % |
| Dynamic Load Response | | | 250 | 500 | μS |
| Over Voltage Protection | Hiccup, Auto-recover | 110 | | 165 | % |
| Over Current Protection | Hiccup, Auto-recover | 110 | | 240 | % |
| Short Circuit Protection | Hiccup, Auto-recover | | | | |
| Capacitive Load | | 100 | | 1200 | μF |
| Minimum Load | No minimum load required | | | | |

Notes

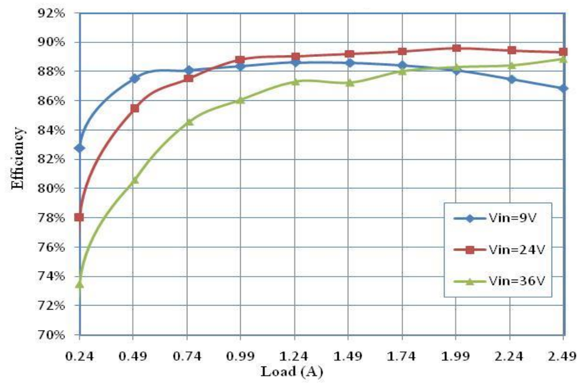
① Ripple & noise is tested with 100μF electrolytic capicitor at output, please see output ripple & noise in technical notes on page 22 for more details.

② The load is set from 50%-75%-50% of Imax, di/dt=1A/μS, Cout=100μF, please refer to dynamic waveform in performance data on page 7 for details.

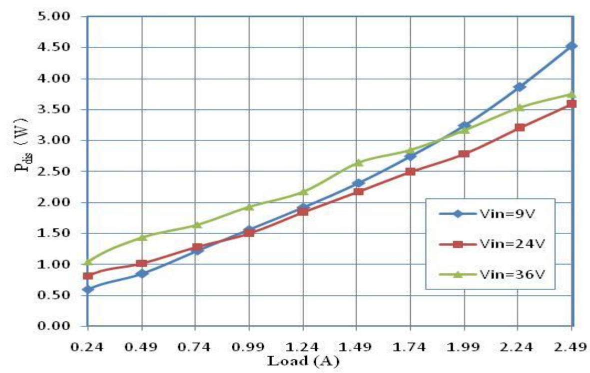
All specifications are tested at 25 ℃ ambient temperature, nominal input voltage, rated output current conditions unless otherwise specified.

## Performance Data (12 Vout)

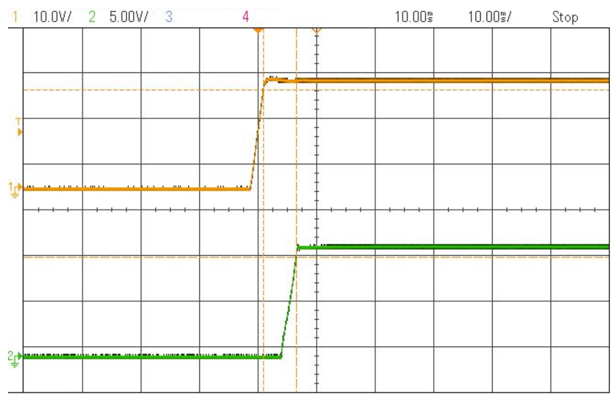
### EFFICIENCY VS LOAD



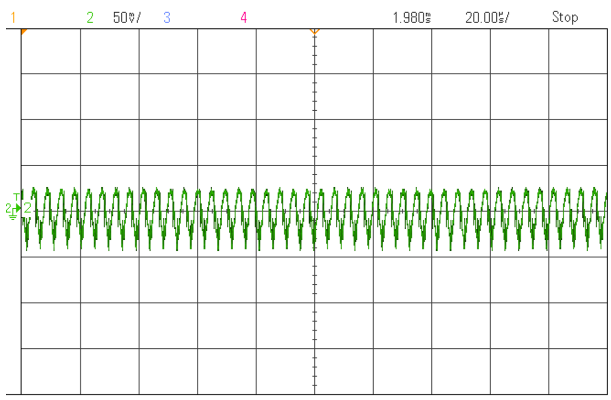

### POWER DISSIPATION VS LOAD



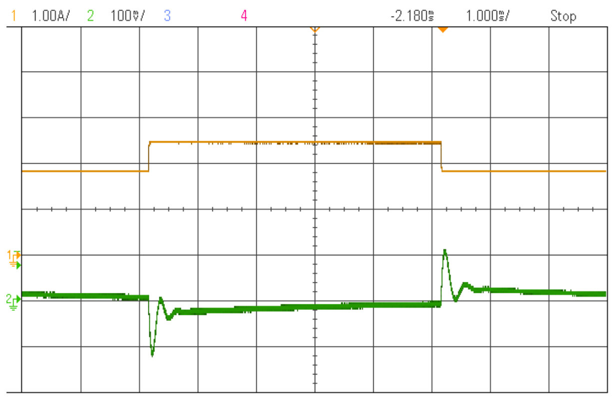

### START UP Ch1:Vin Ch2:Vout



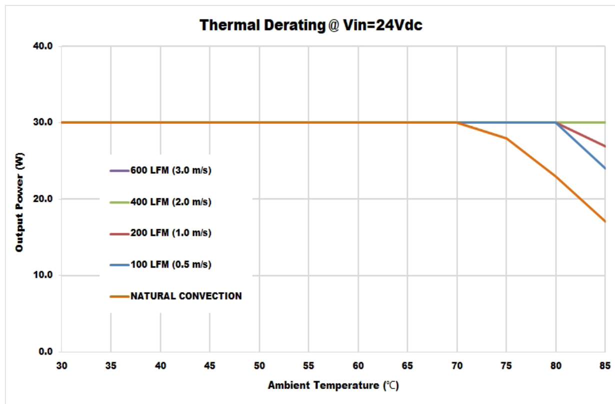

### RIPPLE & NOISE BANDWIDTH 20MHz




### DYNAMIC RESPONSE Ch1:Iout Ch2:Vout




### THERMAL DREATING CURVE



## Performance Data (15 Vout)

### Output Specifications

| Parameters | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Output Voltage Setpoint | | 14.85 | 15.00 | 15.15 | V |
| Vout Accuracy | | -1.0 | | +1.0 | % |
| Adjustable Range | Trim up/ Trim down | -10 | | +10 | % |
| Line Regulation | | -0.2 | | +0.2 | % |
| Load Regulation | | -0.5 | | +0.5 | % |
| Temperature Coefficient | | -0.02 | | +0.02 | %of Vout/°C |
| Total Regulation | | -2 | | +2 | % |
| Ripple & Noise Max. ① | | | 75 | 200 | mV pk-pk |
| Dynamic Load Peak Deviation ② | | -5 | | +5 | % |
| Dynamic Load Response | | | 250 | 500 | μS |
| Over Voltage Protection | Hiccup, Auto-recover | 110 | | 165 | % |
| Over Current Protection | Hiccup, Auto-recover | 110 | | 230 | % |
| Short Circuit Protection | Hiccup, Auto-recover | | | | |
| Capacitive Load | | 100 | | 1000 | μF |
| Minimum Load | No minimum load required | | | | |

Notes

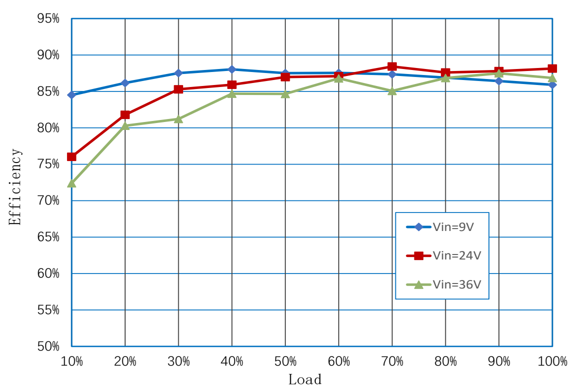
① Ripple & noise is tested with 100μF electrolytic capicitor at output, please see output ripple & noise in technical notes on page 22 for more details.

② The load is set from 50%-75%-50% of Imax, di/dt=1A/μS, Cout=100μF, please refer to dynamic waveform in performance data on page 9 for details.

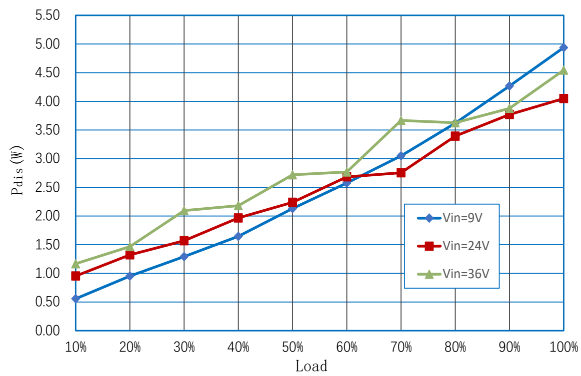
All specifications are tested at 25 ℃ ambient temperature, nominal input voltage, rated output current conditions unless otherwise specified.

## Performance Data (15 Vout)

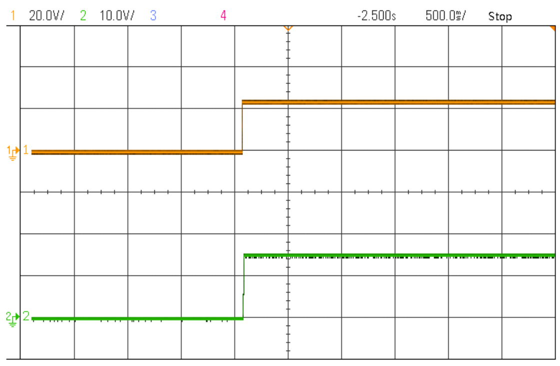
### EFFICIENCY VS LOAD



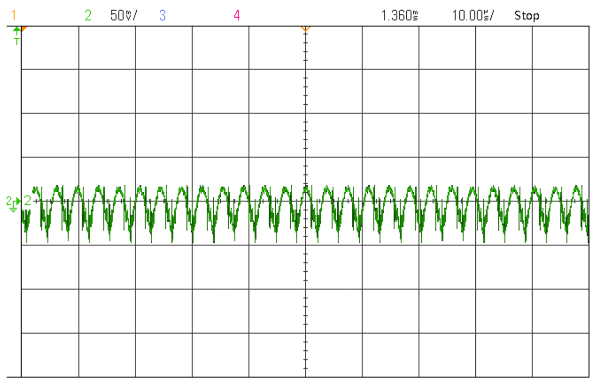

### POWER DISSIPATION VS LOAD



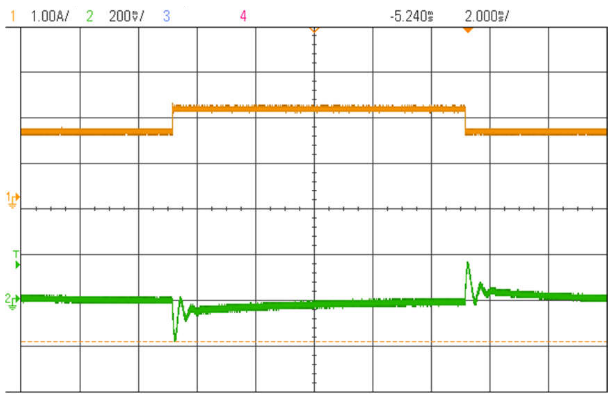

### START UP Ch1:Vin Ch2:Vout



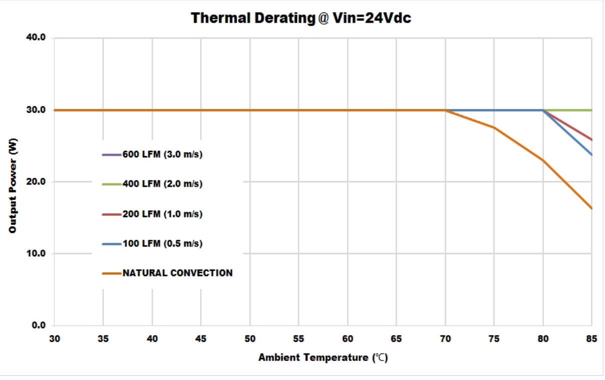

### RIPPLE & NOISE BANDWIDTH 20MHz




### DYNAMIC RESPONSE Ch1:Iout Ch2:Vout




### THERMAL DREATING CURVE



## Performance Data (24 Vout)

### Output Specifications

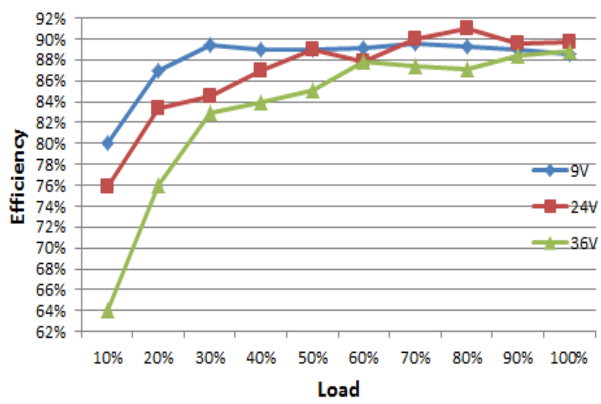
| Parameters | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Output Voltage Setpoint | | 23.76 | 24.00 | 24.24 | V |
| Vout Accuracy | | -1.0 | | +1.0 | % |
| Adjustable Range | Trim up/ Trim down | -10 | | +10 | % |
| Line Regulation | | -0.2 | | +0.2 | % |
| Load Regulation | | -0.5 | | +0.5 | % |
| Temperature Coefficient | | -0.02 | | +0.02 | %of Vout/°C |
| Total Regulation | | -2 | | +2 | % |
| Ripple & Noise Max. ① | | | 75 | 240 | mV pk-pk |
| Dynamic Load Peak Deviation ② | | -5 | | +5 | % |
| Dynamic Load Response | | | 250 | 500 | μS |
| Over Voltage Protection | Hiccup, Auto-recover | 110 | | 165 | % |
| Over Current Protection | Hiccup, Auto-recover | 110 | | 260 | % |
| Short Circuit Protection | Hiccup, Auto-recover | | | | |
| Capacitive Load | | 100 | | 360 | μF |
| Minimum Load | No minimum load required | | | | |

Notes
① Ripple & noise is tested with 100μF electrolytic capicitor at output, please see output ripple & noise in technical notes on page 22 for more details.
② The load is set from 50%-75%-50% of Imax, di/dt=1A/μS, Cout=100μF, please refer to dynamic waveform in performance data on page 11 for details.

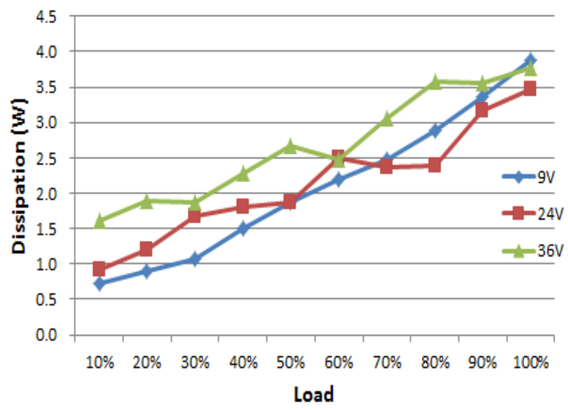
All specifications are tested at 25 ℃ ambient temperature, nominal input voltage, rated output current conditions unless otherwise specified.

## Performance Data (24 Vout)

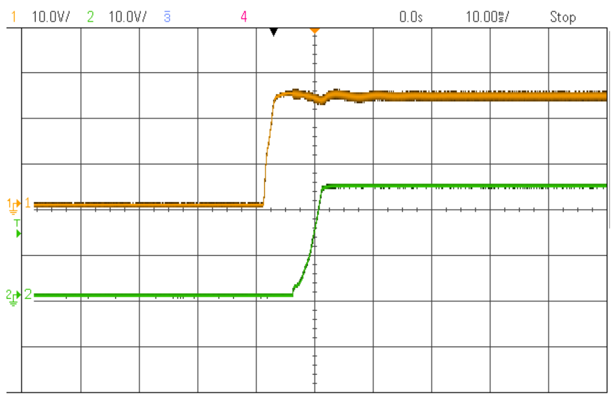
### EFFICIENCY VS LOAD



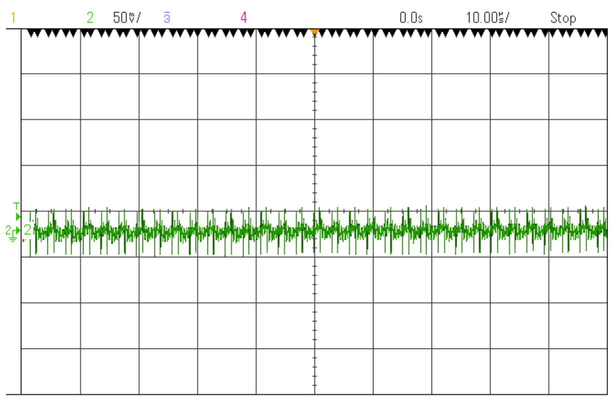

### POWER DISSIPATION VS LOAD



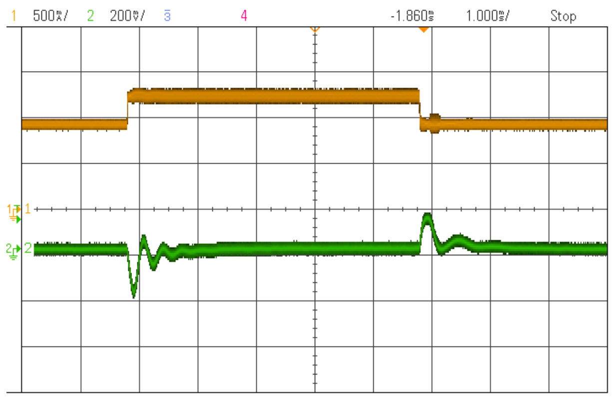

### START UP Ch1:Vin Ch2:Vout



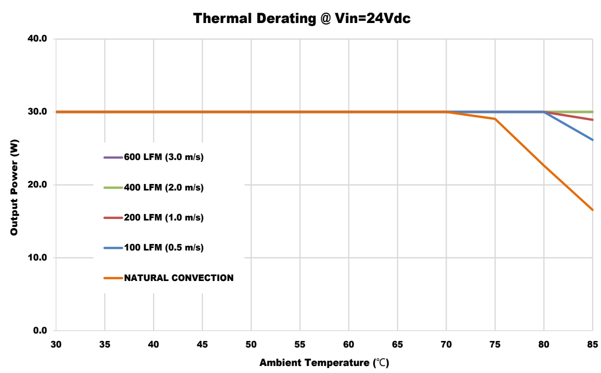
### RIPPLE & NOISE BANDWIDTH 20MHz



### DYNAMIC RESPONSE Ch1:Iout Ch2:Vout



### THERMAL DREATING CURVE



## Performance Data (±5 Vout)

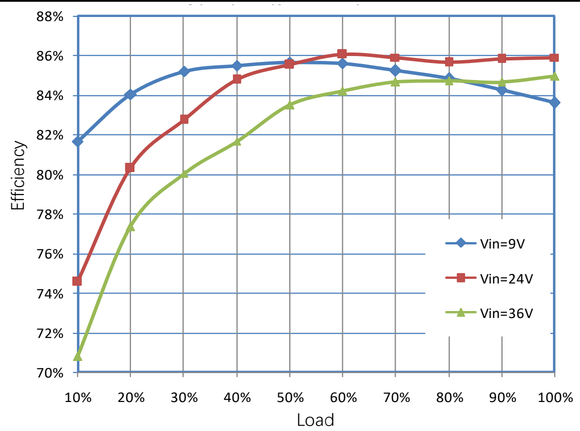
| Output Specifications | | | | | |
|---|---|---|---|---|---|
| Parameters | Conditions | Min. | Typ. | Max. | Units |
| Output Voltage Setpoint | | ±5.02 | ±5.00 | ±5.08 | V |
| Vout Accuracy | | +0.4 | | +1.6 | % |
| Line Regulation | | -0.5 | | +0.5 | % |
| Load Regulation | | -1.0 | | +1.0 | % |
| Temperature Coefficient | | -0.02 | | +0.02 | %of Vout/°C |
| Total Regulation | | -5 | | +5 | % |
| Ripple & Noise Max. ① | | | 75 | 150 | mV pk-pk |
| Dynamic Load Peak Deviation ② | | -5 | | +5 | % |
| Dynamic Load Response | | | 250 | 500 | µS |
| Over Voltage Protection | Hiccup, Auto-recover | 110 | | 165 | % |
| Over Current Protection | Hiccup, Auto-recover | 110 | | 300 | % |
| Short Circuit Protection | Hiccup, Auto-recover | | | | |
| Capacitive Load | | ±220 | | ±1000 | µF |
| Minimum Load | No minimum load required | | | | |

Notes
① Ripple & noise is tested with 220µF electrolytic capicitor at each output, please see output ripple & noise in technical notes on page 22 for more details.
② The load is set from 50%-75%-50% of Imax, di/dt=1A/µS, Cout=±220µF, please refer to dynamic waveform in performance data on page 13 for details.

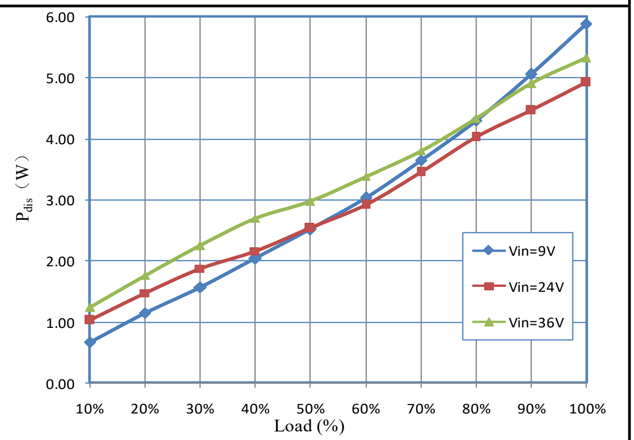
All specifications are tested at 25 ℃ ambient temperature, nominal input voltage, rated output current conditions unless otherwise specified.

## Performance Data (±5 Vout)

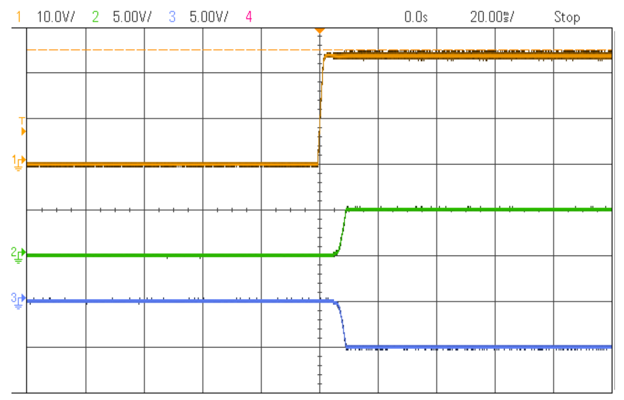
### EFFICIENCY VS LOAD



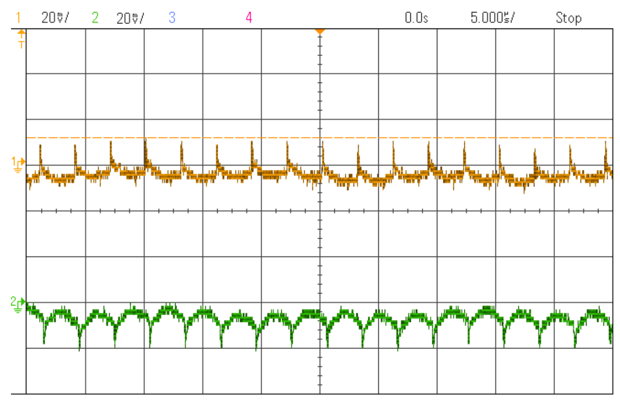

### POWER DISSIPATION VS LOAD



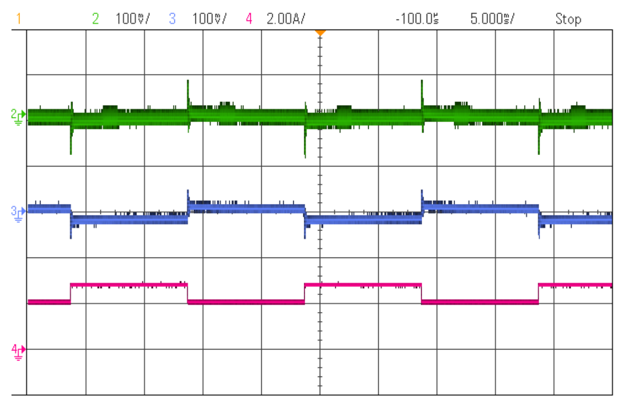

### START UP Ch1:Vin Ch2:Vout1 Ch3:Vout2



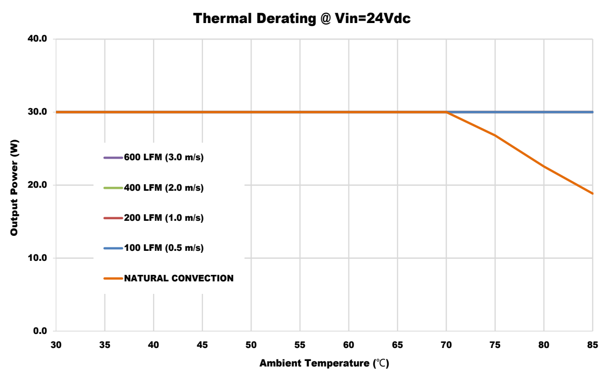

### RIPPLE & NOISE BANDWIDTH 20MHz




### DYNAMIC RESPONSE Ch2:Vout1 Ch3:Vout2 Ch4:Iout




### THERMAL DREATING CURVE



## Performance Data (±12 Vout)

| Output Specifications | | | | | |
|---|---|---|---|---|---|
| Parameters | Conditions | Min. | Typ. | Max. | Units |
| Output Voltage Setpoint | | ±11.88 | ±12.00 | ±12.12 | V |
| Vout Accuracy | | -1.0 | | +1.0 | % |
| Line Regulation | | -0.5 | | +0.5 | % |
| Load Regulation | | -1.0 | | +1.0 | % |
| Temperature Coefficient | | -0.02 | | +0.02 | %of Vout/°C |
| Total Regulation | | -5 | | +5 | % |
| Ripple & Noise Max. ① | | | 75 | 150 | mV pk-pk |
| Dynamic Load Peak Deviation ② | | -5 | | +5 | % |
| Dynamic Load Response | | | 250 | 500 | µS |
| Over Voltage Protection | Hiccup, Auto-recover | 110 | | 165 | % |
| Over Current Protection | Hiccup, Auto-recover | 104 | | 420 | % |
| Short Circuit Protection | Hiccup, Auto-recover | | | | |
| Capacitive Load | | ±100 | | ±700 | µF |
| Minimum Load | No minimum load required | | | | |

Notes

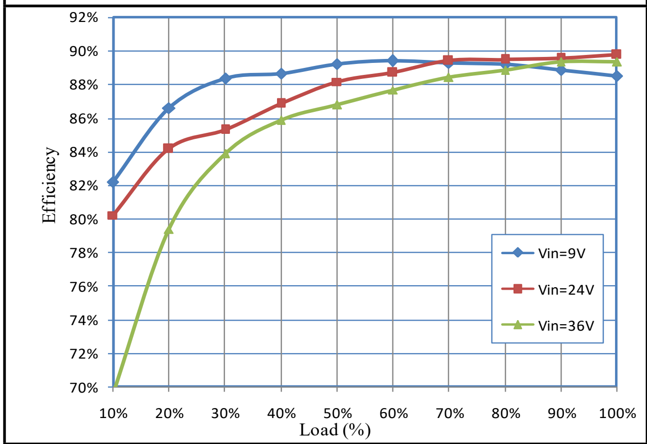
① Ripple & noise is tested with 100µF electrolytic capicitor at each output, please see output ripple & noise in technical notes on page 22 for more details.

② The load is set from 50%-75%-50% of Imax, di/dt=1A/µS, Cout=±100µF, please refer to dynamic waveform in performance data on page 15 for details.

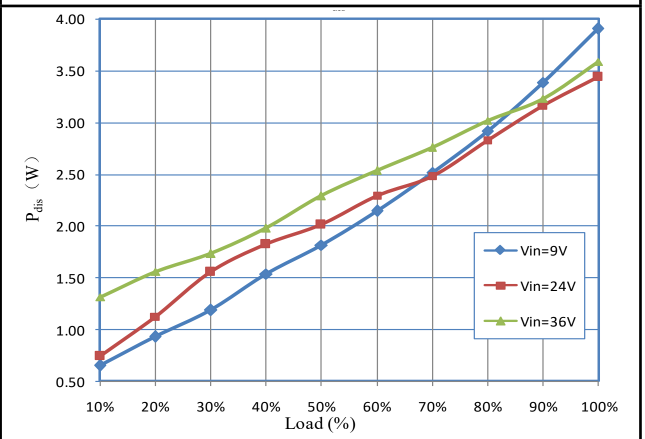
All specifications are tested at 25 ℃ ambient temperature, nominal input voltage, rated output current conditions unless otherwise specified.

## Performance Data (±12 Vout)

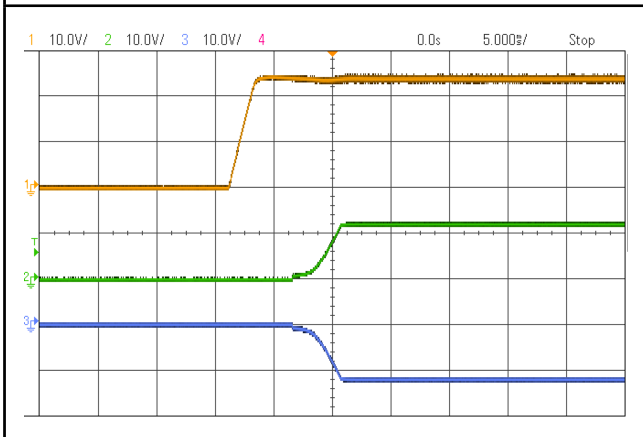
EFFICIENCY VS LOAD



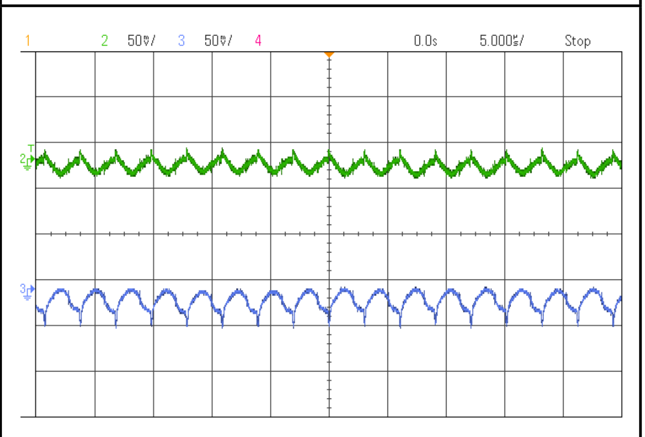

POWER DISSIPATION VS LOAD



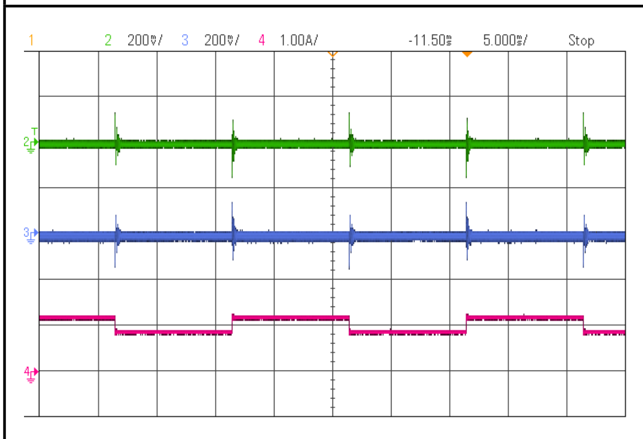

START UP Ch1:Vin Ch2:Vout1 Ch3:Vout2



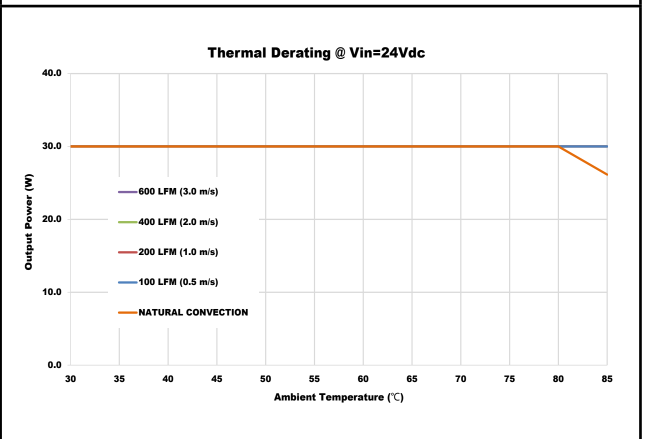

RIPPLE & NOISE BANDWIDTH 20MHz




DYNAMIC RESPONSE Ch2:Vout1 Ch3:Vout2 Ch4:Iout




THERMAL DREATING CURVE



## Performance Data (±15 Vout)

| Output Specifications | | | | | |
|---|---|---|---|---|---|
| Parameters | Conditions | Min. | Typ. | Max. | Units |
| Output Voltage Setpoint | | ±14.85 | ±15.00 | ±15.15 | V |
| Vout Accuracy | | -1.0 | | +1.0 | % |
| Line Regulation | | -0.5 | | +0.5 | % |
| Load Regulation | | -1.0 | | +1.0 | % |
| Temperature Coefficient | | -0.02 | | +0.02 | %of Vout/°C |
| Total Regulation | | -5 | | +5 | % |
| Ripple & Noise Max. ① | | | 75 | 200 | mV pk-pk |
| Dynamic Load Peak Deviation ② | | -5 | | +5 | % |
| Dynamic Load Response | | | 250 | 500 | μS |
| Over Voltage Protection | Hiccup, Auto-recover | 110 | | 165 | % |
| Over Current Protection | Hiccup, Auto-recover | 104 | | 400 | % |
| Short Circuit Protection | Hiccup, Auto-recover | | | | |
| Capacitive Load | | ±100 | | ±500 | μF |
| Minimum Load | No minimum load required | | | | |

Notes

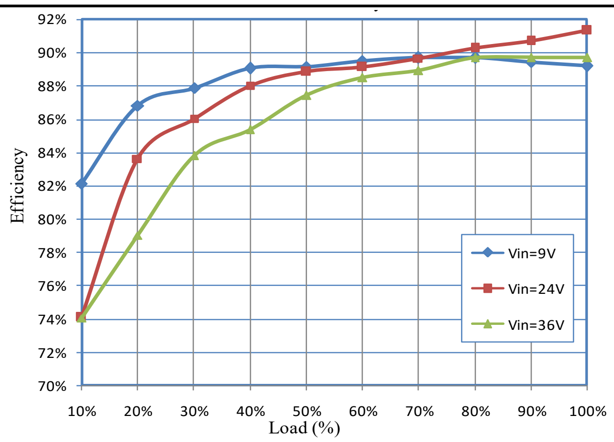
① Ripple & noise is tested with 100μF electrolytic capicitor at each output, please see output ripple & noise in technical notes on page 22 for more details.

② The load is set from 50%-75%-50% of Imax, di/dt=1A/μS, Cout=±100μF, please refer to dynamic waveform in performance data on page 17 for details.

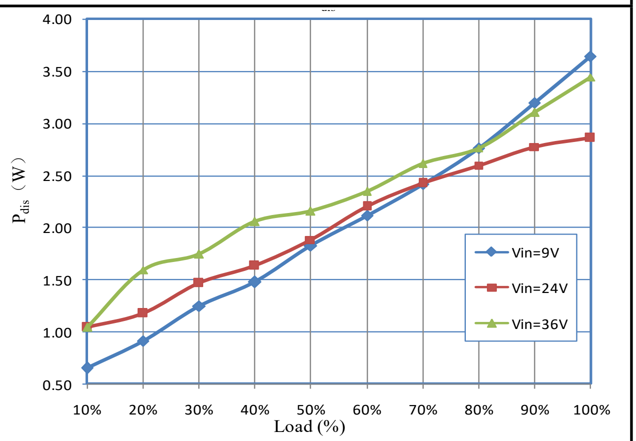
All specifications are tested at 25 ℃ ambient temperature, nominal input voltage, rated output current conditions unless otherwise specified.

## Performance Data (±15 Vout)

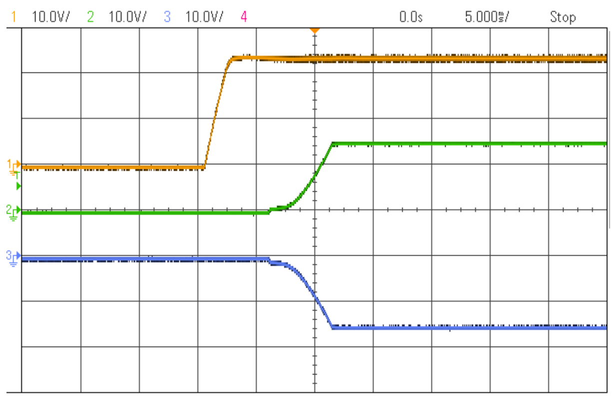
EFFICIENCY VS LOAD



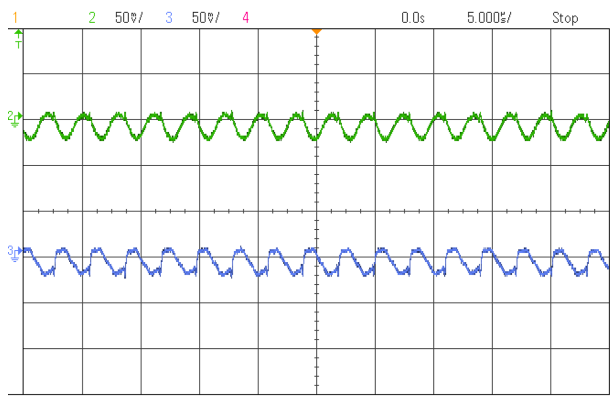

POWER DISSIPATION VS LOAD



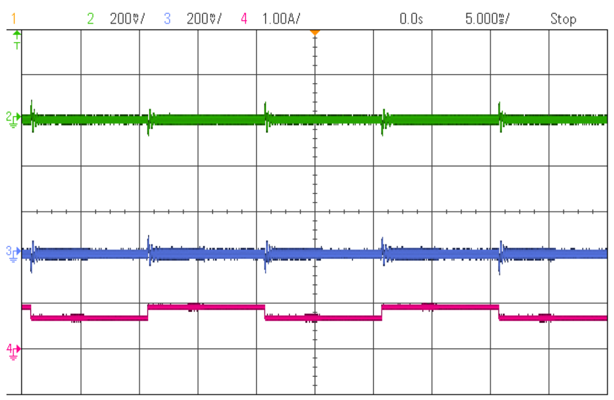

START UP Ch1:Vin Ch2:Vout1 Ch3:Vout2



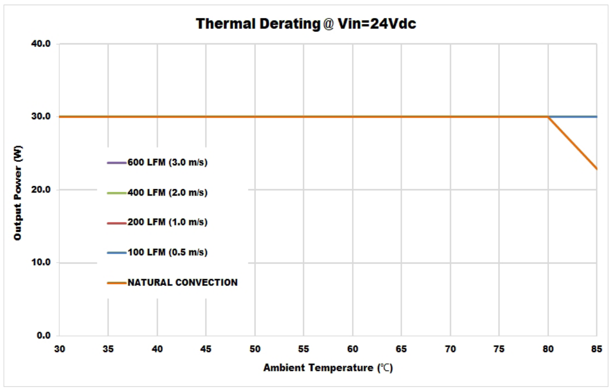

RIPPLE & NOISE BANDWIDTH 20MHz




DYNAMIC RESPONSE Ch2:Vout1 Ch3:Vout2 Ch4:Iout

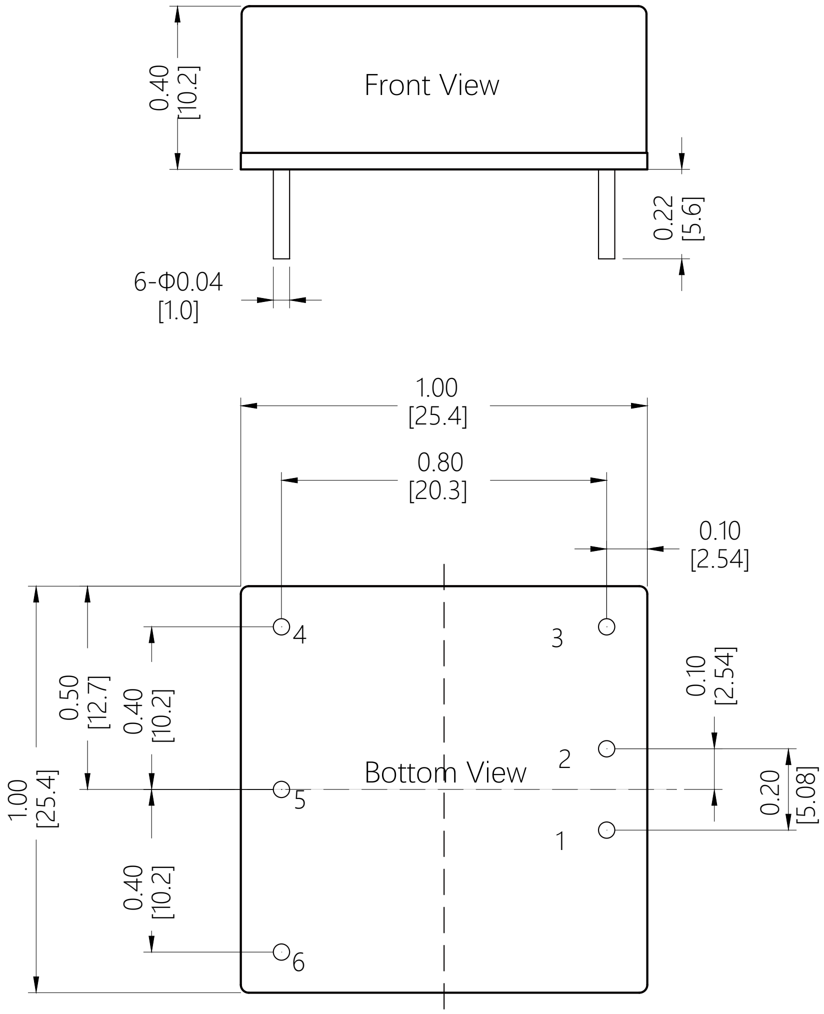



THERMAL DREATING CURVE



## Mechanical Specifications

### DLC30W24 SERIES: DIP TYPE




PIN:
Pin1, PIN2, PIN3, PIN4, PIN5, PIN6: Φ0.040
Force: Applied force not exceed 4.9N
Material: Copper alloy
Finish: Gold 3 ~ 5µm(min.) over nickel 50µm(Min.)

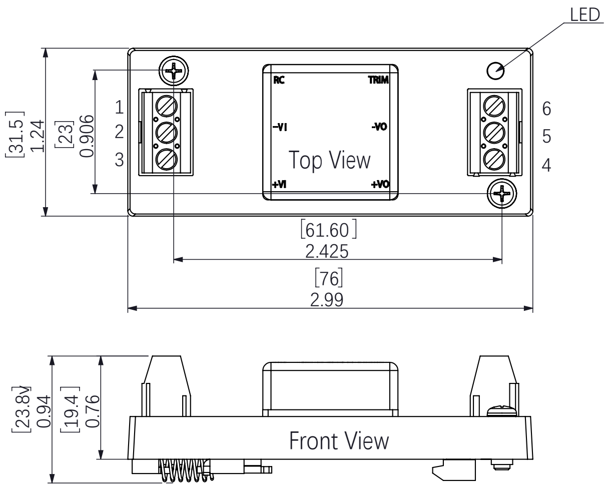
Tolerance:
X.XX=±0.02 (0.5)
X.XXX= ±0.010 (0.25)

Dimensions are in inches [mm]
Weight: ~20g.

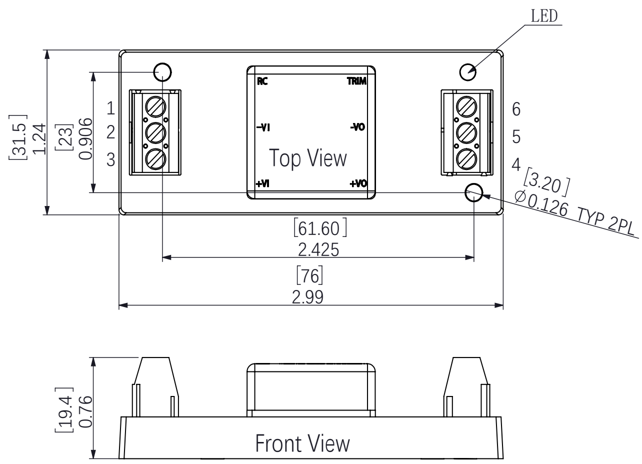
| PIN CONNECTIONS | | |
|---|---|---|
| | Single Output | Bipolar Outputs |
| Pin | Function | Function |
| 1 | +Vi | +Vi |
| 2 | -Vi | -Vi |
| 3 | RC | RC |
| 4 | -Vo | -Vo |
| 5 | TRIM | Com |
| 6 | +Vo | +Vo |

## Mechanical Specifications

### DLC30W24 SERIES: DIN-RAIL TYPE




### DLC30W24 SERIES: WALL MOUNT TYPE




Hole screw locked torque: 0.4N·m Max
Terminal screw locked torque: 0.25N·m Max

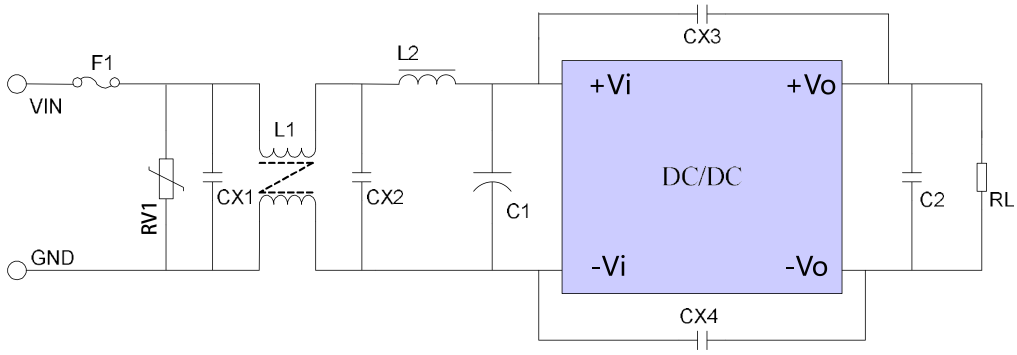
Tolerance:
X.XX=±0.02 (0.5)
X.XXX= ±0.10 (0.25)

Dimensions are in inches [mm]
Weight:
Din-rail Type: ~65g
Wall Mount Type: ~45g.

| PIN CONNECTIONS | | |
|---|---|---|
| | Single Output | Bipolar Outputs |
| Pin | Function | Function |
| 1 | RC | RC |
| 2 | -Vi | -Vi |
| 3 | +Vi | +Vi |
| 4 | +Vo | +Vo |
| 5 | -Vo | -Vo |
| 6 | TRIM | Com |

## Conducted Emission

Density Power measures its products for conducted emissions against the EN55032 standards. The EUT is supplied with 24VDC and is loaded to the maximum rating 30 Watts. The following EMI filter components were employed and the result can meet class B.



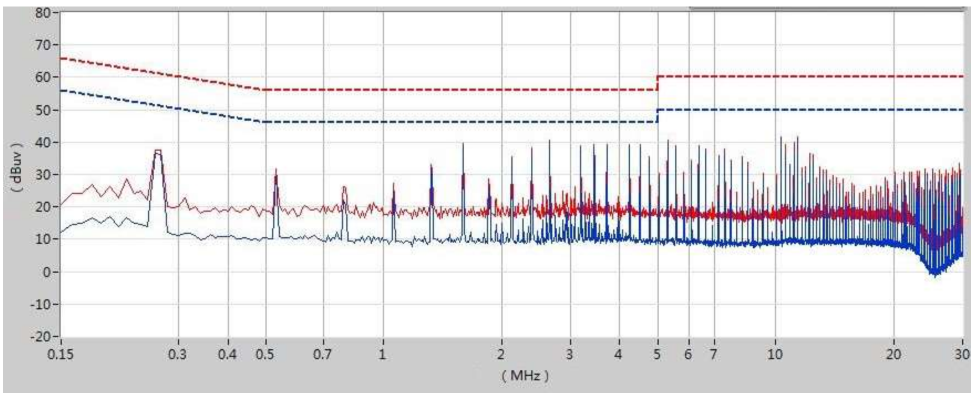

Conducted Emission Test Circuit

EMI Filter Components List

| REFERENCE | DESCRIPTION |
|---|---|
| RV1 | THINKING: TVR14560 |
| CX1, CX2 | Ceramic 1210 100V 2.2μF MURATA: GRM32ER72A225KA35L |
| CX3, CX4 | Ceramic 1260 2KV 1000pF AVX: 1206GC102KAT1A |
| C1 | 50V 100μF CHEMI-CON: KEY500ELL101MHB5D |
| L1 | 2mH/5A |
| L2 | 4.7μH/5A Vishay: IHLP2525CZER4R7M01 |
| C2 | According to the capacitive load in the specification |

Conducted Emission Test Result:

DLC30W24S12



## Technical Notes

### INPUT FUSING

Certain applications may require fuse at the inputs of power conversion components. Fuses should also be used when there is possibility of sustained input voltage reversal which is not current limited. The DLC30W24 modules are not internally fused. We strongly recommend a slow-blown fuse to be used in the ungrounded input supply line.
For safety agency approvals, the installer must install the converter in compliance with the end user safety standard.

### TYPICAL APPLICATION CONNECTION

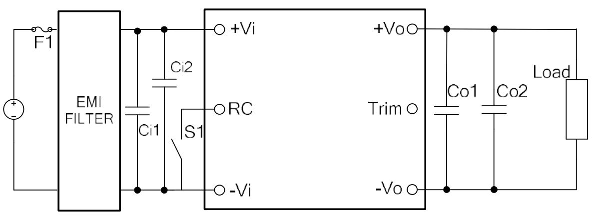



Figure 1· Typical Application Connection

In order to prevent the input line from causing the input oscillation, it is recommended to add the input capacitor close to the input of the module. Similarly, the output capacitor is added to the output of the module. Specific recommended parameters: input capacitance Ci1=100μF electrolytic capacitor, Ci2 = 1uF CBB capacitor. Output Capacitance Co1=10uF tantalum capacitor, Co2 ESR <0.1Ω. Please refer to capacitive load for details.

### REFLECTED RIPPLE CURRENT

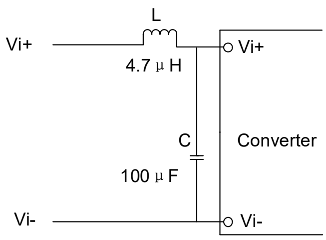



Figure 2· Reflected Ripple Current

Add LC filter at the front of the power module to reduce the interference of reflected ripple current on the DC bus, recommended value of L and C with appropriate current and voltage rating as below: L: 4.7μH; C: 100μF.

### REMOTE CONTROL FUNCTION

Module Power Remote Control or called ON/OFF pin is for the user to control the power output. There are two general control logics, positive logic or negative logic control. Recommend to use optocoupler to control remote pin as below.

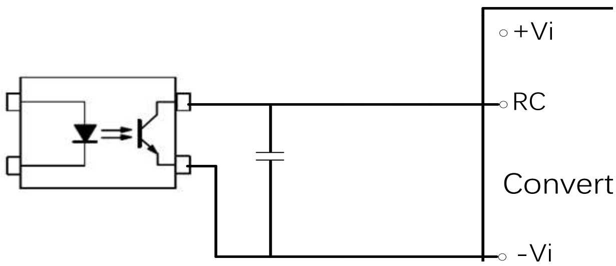



Figure 3· Remote Control Circuit

Remote Control Pin can be connected in parallel for multiple converters which with the same Remote Control characters. However, when several converters share the same remote control circuit, the total sink and source current must be taken into consideration, and make sure that the opto-coupler has enough drive capability.
To reduce external PCB trace interference, it is recommended to add high frequency bypass capacitor between RC pin and -Vi, recommended capacitor value is 100-1000pF.

### THERMAL SHUTDOWN

These DLC30W24 converters are equipped with thermal-shutdown circuitry. If environmental conditions cause the internal temperature of the converter to rise above the designed operating temperature, a precision temperature sensor will power down the unit. When the internal temperature decreases below the threshold of the temperature sensor, the unit will auto restart.

## Technical Notes

### OUTPUT RIPPLE & NOISE

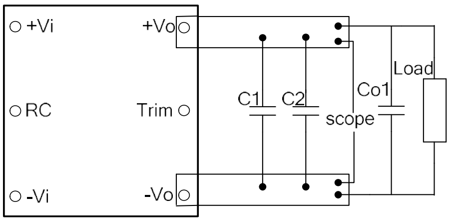



Figure 4· Output Ripple & Noise

These DLC30W24 modules' output ripple and noise is measured at the rated input voltage and output current, along with 10uF tantalum capacitor and 0.1uF MLCC used in parallel with appropriate voltage ratings and placed as C1&C2 shown in the figure above. The scope's bandwidth is set to 20MHz.
External output capacitors are required to reduce the ripple & noise. The output capacitors should be low ESR and appropriate frequency response with appropriate voltage ratings, and must be located as close to the converters as possible, also PCB layout must be taken into consideration.

### INPUT UNDERVOLTAGE SHUTDOWN AND START-UP THRESHOLD

Once operating, module will not turn off until the input voltage drops below the Undervoltage Shutdown threshold. Subsequent re-start will not occur until the input is brought back up to the Start-Up Threshold. This built in hysteresis prevents any unstable on/off situations from occurring at a single input voltage.

### CURRENT LIMITING

The maximum current limit remains constant as the output voltage drops. However, once the impedance of the short across the output is small enough to make the output voltage drop below the specified Output Current Limit Shutdown Voltage, the converter turns off.
The converter then enters into “hiccup mode” where it repeatedly turns on and off until the overload condition is removed. This prevents excessive heating of the converter or the load board.

### SHORT CIRCUIT CONDITION

When the converter is in current-limit mode, the output voltage will drop as the output current demand increases and then the converter will be shut down.If the short-circuit condition persists, another shutdown cycle will be initiated. This on/off cycling is referred to as "hiccup" mode. The hiccup cycling reduces the average output current, thereby preventing internal temperatures from rising to excessive levels. The module is capable of enduring an indefinite short circuit output condition.

### OUTPUT OVERVOLTAGE PROTECTION

DLC30W24 output voltages are monitored for an overvoltage condition via magnetic feedback. The signal is coupled to the primary side and if the output voltage rises to a level which could be damaging to the load, the sensing circuitry will power down the PWM controller causing the output voltage to decrease. Following a time-out period the PWM will restart, causing the output voltages to ramp to their appropriate values. If the fault condition persists, and the output voltages again climb to excessive levels, the overvoltage circuitry will initiate another shutdown cycle.

### TRIMMING OUTPUT VOLTAGE

DLC30W24 converters have a trim capability that allow users to adjust the output voltages. Output voltage can be trimmed up or down by a trim pin by connecting a single fixed resistor between Trim Pin and Vout+ or Vout-, the output volatge can be increased or decreased depending on its connection. The maximum output voltage adjustment range is -10% to +10%. If the trim function is not used, keep TRIM pin floating.

**Trim up:**

Increase the output voltage by connecting an

## Technical Notes

appropriate value resistor between Trim Pin and -Vo Pin. Show as below:

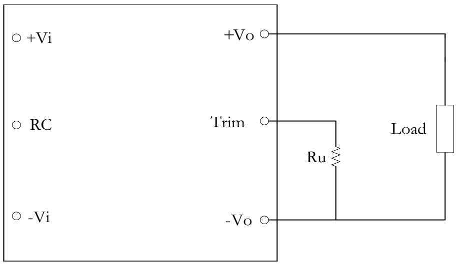



Figure 5· Trim Up Connection

Please follow up the Trim Up formula to calculate the resistor value according to the desired output voltage.

Vout =5V

$$R_u = \left(5.11 \times \frac{2.5}{\Delta\,\% \times Voset} - 2\right) k\Omega$$

Vout =12V, 15V, 24V

$$R_u = \left(10 \times \frac{2.5}{\Delta\,\% \times Voset} - 5.11\right) k\Omega$$

"Voset "is the output voltage when TRIM is floating, " Δ% "is the amount of change of output voltage, for example: For normal output 12VDC modules, trim up output voltage from 12VDC to 13.2VDC. Δ% = (13.2-12) / 12 * 100% = 10%.

**Trim down:**

Decrease the output voltage by connecting an appropriate value resistor between Trim Pin and +Vo Pin. Show as below:

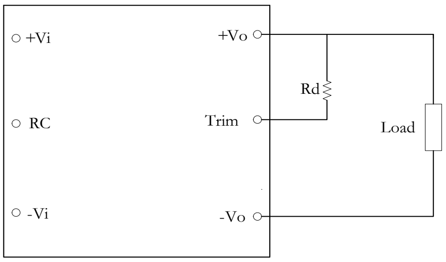



Figure 6· Trim Down Connection

Please follow up the Trim Down formula to calculate the resistor value according to the desired output voltage.

Vout =5V

$$R_u = \left(5.11 \times \frac{Voset - \Delta\,\% \times Voset - 2.5}{\Delta\,\% \times Voset} - 2\right) k\Omega$$

Vout=12V, 15V, 24V

$$R_u = \left(10 \times \frac{Voset - \Delta\,\% \times Voset - 2.5}{\Delta\,\% \times Voset} - 5.11\right) k\Omega$$

"Voset" is the output voltage when TRIM is floating, "Δ%" is the amount of change in output voltage, for example: For normal output 15VDC modules, trim down output voltage from 15VDC to 13.5VDC. Δ% = (15-13.5) / 15 * 100% = 10%.

### THERMAL CONSIDERATIONS

The maximum operating case temperature, Tcase is 105 ºC. As long as the user's thermal environment keeps Tcase < 105 ºC, the converter can deliver its full rated power. A power derating curve can be calculated for the converter. It is only necessary to determine the thermal resistance, RTHcase of the converter case to ambient air for a given airflow. The following formula can be used to determine the maximum power the converter can dissipate for a given thermal condition if its case is to be no higher than 105 ºC.

$$Pdiss = \frac{105 - Tamb}{RTHcase}$$

This value of power dissipation can then be used in conjunction with the Power Loss vs Load curve to determine the maximum load power that the converter can deliver in the given thermal condition. For convenience, power derating curves for an encased converter are provided for each output voltage module.

## Technical Notes

### THERMAL CALCULATION

The thermal impedance RTHcase of the converters between case and ambient air for a given airflow is provided as follows:

| Airflow (LFM) | RTH (℃ /W) |
|---|---|
| Natural Convection | 6.5 |
| 100LFM | 4.7 |
| 200LFM | 4.2 |
| 400LFM | 3.6 |
| 600LFM | 3.0 |

*Note: Thermal impedance is tested with the converter soldered on FR-4 (200mm*200mm) PCB.

$$Pdiss = \frac{Tcase - Tamb}{RTHcase}$$

$$Pdiss = Pin - Pout = \frac{1-\eta}{\eta} \times Pout$$

Where:

Tcase: Case Temperature (℃ )
Tamb: Environment Temperature (℃ )
Pdiss: Converter internal power losses (W)
Pin: Input Power (W)
Pout: Output Power (W)
η: Efficiency @ given operating conditions (%)
RTHcase: Converter case to environment thermal impedance (℃ /W)

For Example:
Take the DLC30W24S05 with 50% load, what's is the maximum ambient operating temperature can withstand?

η=86.3% @ 24Vin & 50% Load (Refer the converter's efficiency vs load curve)
Prated=30W
Pout=30* 50% = 15W
Pdiss=(1-η)/η*Pout=(1-86.3%)/(86.3%)*15=2.38W

Where:
RTHcase is 6.5℃ /W under natural convection.
Tambmax=Tcase-RTHcase * Pout=105-6.5*2.38=89.5℃

Where:
RTHcase is 4.7℃ /W under 100LFM airflow.
Tambmax=Tcase-RTHcase * Pout=105-4.7*2.38=93.8℃

The converter can deliver **15W** under **89.5℃** ambient temperature with natural convection conditions or under **93.8℃** ambient temperature with **100LFM** airflow.

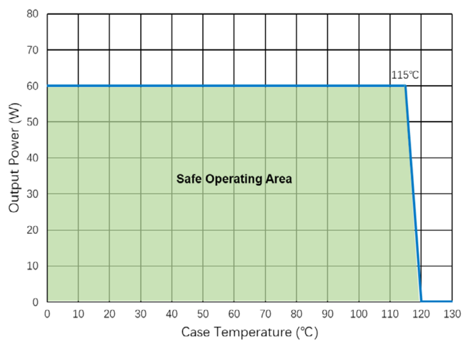



Figure 7· Thermal Derating

The DLC30W24 products have been designed for full power operation in demanding thermal environments. However, thermal performance improvement can be achieved by designing a printed circuit board to properly sink heat away from the converter through its pins. Ensure a correctly formed solder joint at each pin to ensure maximum heat conduction from pin to board. The board itself should also have as many layers and as high of copper weight as is practical for the application. Large ground and power planes are best as the most heat will be conducted through the power pins of the converter on both input and output sides. The heat must also have a path to conduct from the copper planes of the board to the outside environment.
For reference, boards used in Density Power thermal testing are 6 layers. FR-4 (200mm*200mm) PCB.

This product is subject to the following operating requirements and the Life and Safety Critical Application Sales Policy:
Refer to: http://www.densitypower.com