

4:1 Wide Input, Isolated 3Watts DC/DC Converters

FEATURES

- Low profile height 0.30"
- 4:1 wide input range: 9-36VDC
- Single & bipolar outputs: 5, 12, 15, 24, ± 5 , ± 12 , ± 15 Volts DC
- 3W isolated outputs
- Efficiency up to 86%
- Remote on/off control
- 1600VDC I/O isolation
- Extensive self-protection, UVLO, OVP, OCP and short protection
- Metal Case, outstanding thermal dissipation
- Operation temperature range: -40°C to $+85^{\circ}\text{C}$
- Fully encapsulated, high reliability
- MTBF ≥ 1 MHrs
- Compliance with RoHS



Low profile



PRODUCT OVERVIEW

The DKL3W24 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, overcurrent protection with "hiccup" autorestart technique, provides short-circuit protection, along with output OVP. The operation temperature is -40°C to 85°C , the module delivers full output power @ 85°C ambient temperature.

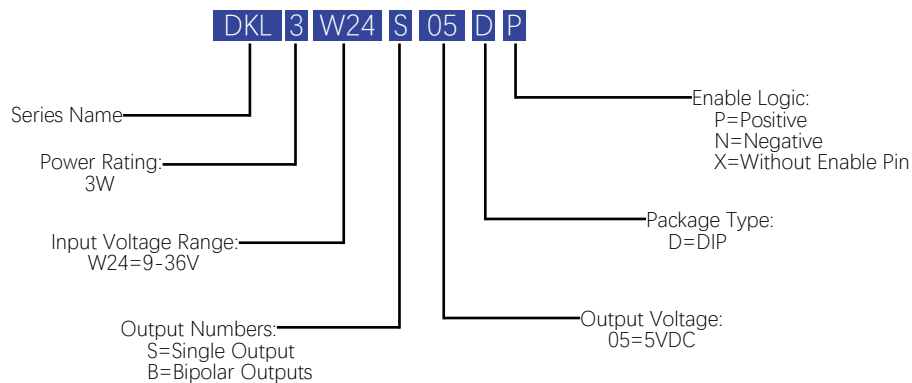
Advanced fully encapsulated package technology provides outstanding thermal performance, which is ideal for ruggedized applications involving harsh environments. Low profile design for impact space applications.

The DKL3W24 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] |
|--------------|---------------------|---------------------------|----------------------|--------------------|---------------------|--|------------------------|
| DKL3W24S05 | 24 | 9-36 | 5 | 0.6 | 84 | 2000 | 1.25"×0.8"×0.3" DIP |
| DKL3W24S12 | 24 | 9-36 | 12 | 0.25 | 85 | 1000 | |
| DKL3W24S15 | 24 | 9-36 | 15 | 0.2 | 86 | 680 | |
| DKL3W24S24 | 24 | 9-36 | 24 | 0.125 | 86 | 470 | |
| DKL3W24B05 | 24 | 9-36 | ± 5 | ± 0.3 | 83 | ± 800 | |
| DKL3W24B12 | 24 | 9-36 | ± 12 | ± 0.125 | 85 | ± 440 | |
| DKL3W24B15 | 24 | 9-36 | ± 15 | ± 0.1 | 85 | ± 220 | |

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 | | | 40 | 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 | | | 300 | °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: ±6KV Air: ±8KV Criteria A | |
| Isolation Safety Rating | Basic insulation | | | | |

| General Specifications | | | | | |
|--|--|--------------------------------|------|------|-------|
| Parameters | Conditions | Min. | Typ. | Max. | Units |
| Isolation Voltage (Test for 1 minute) | Input to output | 1600 | | | VDC |
| | Input to case | 1600 | | | VDC |
| | Output to case | 1000 | | | VDC |
| Isolation Resistance (Viso=500VDC) | Input to output | 100 | | | MΩ |
| Isolation Capacitance | Input to output | | 1000 | | pF |
| Switching Frequency | | | 300 | | KHz |
| Start-up Delay | From undervoltage shutdown recovery to 10% Vout | | 20 | | mS |
| Rise Time | From 10% Vout to 90% Vout capacitive load | | 10 | | mS |
| Remote On/Off Control | Positive Logic, ON state | Open or $3.6 \leq V_r \leq 15$ | | | VDC |
| | Positive Logic, OFF state | Short or $0 \leq V_r \leq 0.4$ | | | VDC |
| | Negative Logic, ON state | Short or $0 \leq V_r \leq 0.4$ | | | VDC |
| | Negative Logic, OFF state | Open or $3 \leq V_r \leq 15$ | | | 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 | | 7.0 | | 9.0 | VDC |
| Under Voltage Shutdown | | 5.0 | | 8.0 | VDC |
| Input Current @ No Load | | | | 10 | mA |
| Input Current @ Min. Line | | | | 0.5 | A |
| Input Current @ Shutdown Mode | | | 2 | 10 | mA |
| Reflected Input Ripple Current (Peak-Peak) | | | 30 | | mA |
| Power Loss @ No Load | | | 0.9 | | W |
| Recommended Input Fuse | | | 1 | | A |
| Recommended External Input Capacitance | 4.7μF CBB and 100μF E-cap used in combination | | 100 | | μF |

Performance Data (5 Vout)

| Output Specifications | | | | | |
|---|-----------------------------|-------|------|-------|---------------|
| Parameters | Conditions | Min. | Typ. | Max. | Units |
| Output Power | | | | 3 | W |
| Normal Output Voltage | Nom.line, 50% Load | | 5.00 | | V |
| Vout Accuracy | | -3.0 | | +3.0 | % of Vout |
| Line Regulation | | -2 | | +2 | % |
| Load Regulation | | 0 | | +4 | % |
| Temperature Coefficient | | -0.02 | | +0.02 | % of Vout /°C |
| Over Current Protection | Hiccup | 110 | | 200 | % of Iout |
| Short Circuit Protection | Hiccup | | | | |
| Ripple & Noise Max. ^① | | | 50 | 100 | mV pk-pk |
| Dynamic Load Peak Deviation ^② | | -5 | | +5 | % of Vout |
| Dynamic Load Response | | | 500 | | μS |
| Capacitive Load | | 100 | | 2000 | μF |
| Minimum Load | No minimum load requirement | | | | |
| Notes | | | | | |
| ① Ripple & noise is tested with certain filter parameters, please see output ripple & noise in technical notes on page 14 for more details. | | | | | |
| ② The load is set from 75%-100%-75% of I _{max} , di/dt=0.1A/μS. | | | | | |

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

Performance Data (12 Vout)

| Output Specifications | | | | | |
|---|-----------------------------|-------|-------|-------|---------------|
| Parameters | Conditions | Min. | Typ. | Max. | Units |
| Output Power | | | | 3 | W |
| Normal Output Voltage | Nom.line, 50% Load | | 12.00 | | V |
| Vout Accuracy | | -3.0 | | +3.0 | % of Vout |
| Line Regulation | | -2 | | +2 | % |
| Load Regulation | | 0 | | +4 | % |
| Temperature Coefficient | | -0.02 | | +0.02 | % of Vout /°C |
| Over Current Protection | Hiccup | 110 | | 200 | % of Iout |
| Short Circuit Protection | Hiccup | | | | |
| Ripple & Noise Max. ^① | | | | 120 | mV pk-pk |
| Dynamic Load Peak Deviation ^② | | -5 | | +5 | % of Vout |
| Dynamic Load Response | | | 500 | | μS |
| Capacitive Load | | 100 | | 1000 | μF |
| Minimum Load | No minimum load requirement | | | | |
| Notes | | | | | |
| ① Ripple & noise is tested with certain filter parameters, please see output ripple & noise in technical notes on page 14 for more details. | | | | | |
| ② The load is set from 75%-100%-75% of I _{max} , di/dt=0.1A/μS. | | | | | |

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

Performance Data (15 Vout)

| Output Specifications | | | | | |
|---|-----------------------------|-------|-------|-------|---------------|
| Parameters | Conditions | Min. | Typ. | Max. | Units |
| Output Power | | | | 3 | W |
| Normal Output Voltage | Nom.line, 50% Load | | 15.00 | | V |
| Vout Accuracy | | -3.0 | | +3.0 | % of Vout |
| Line Regulation | | -2 | | +2 | % |
| Load Regulation | | 0 | | +4 | % |
| Temperature Coefficient | | -0.02 | | +0.02 | % of Vout /°C |
| Over Current Protection | Hiccup | 110 | | 200 | % of Iout |
| Short Circuit Protection | Hiccup | | | | |
| Ripple & Noise Max. ^① | | | | 150 | mV pk-pk |
| Dynamic Load Peak Deviation ^② | | -5 | | +5 | % of Vout |
| Dynamic Load Response | | | 500 | | μS |
| Capacitive Load | | 100 | | 680 | μF |
| Minimum Load | No minimum load requirement | | | | |
| Notes | | | | | |
| ① Ripple & noise is tested with certain filter parameters, please see output ripple & noise in technical notes on page 14 for more details. | | | | | |
| ② The load is set from 75%-100%-75% of I _{max} , di/dt=0.1A/μS. | | | | | |

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

Performance Data (24 Vout)

| Output Specifications | | | | | |
|---|-----------------------------|-------|-------|-------|---------------|
| Parameters | Conditions | Min. | Typ. | Max. | Units |
| Output Power | | | | 3 | W |
| Normal Output Voltage | Nom.line, 50% Load | | 24.00 | | V |
| Vout Accuracy | | -3.0 | | +3.0 | % of Vout |
| Line Regulation | | -2 | | +2 | % |
| Load Regulation | | 0 | | +4 | % |
| Temperature Coefficient | | -0.02 | | +0.02 | % of Vout /°C |
| Over Current Protection | Hiccup | 110 | | 200 | % of Iout |
| Short Circuit Protection | Hiccup | | | | |
| Ripple & Noise Max. ^① | | | | 240 | mV pk-pk |
| Dynamic Load Peak Deviation ^② | | -5 | | +5 | % of Vout |
| Dynamic Load Response | | | 500 | | μS |
| Capacitive Load | | 100 | | 470 | μF |
| Minimum Load | No minimum load requirement | | | | |
| Notes | | | | | |
| ① Ripple & noise is tested with certain filter parameters, please see output ripple & noise in technical notes on page 14 for more details. | | | | | |
| ② The load is set from 75%-100%-75% of I _{max} , di/dt=0.1A/μS. | | | | | |

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

Performance Data (± 5 Vout)

| Output Specifications | | | | | |
|---|-----------------------------|-----------|------------|-----------|--------------------------|
| Parameters | Conditions | Min. | Typ. | Max. | Units |
| Output Power | | | | 3 | W |
| Normal Output Voltage | Nom.line, 50% Load | | ± 5.00 | | V |
| Vout Accuracy | | -3.0 | | +3.0 | % of Vout |
| Line Regulation | | -2 | | +2 | % |
| Load Regulation | | 0 | | +4 | % |
| Temperature Coefficient | | -0.02 | | +0.02 | % of Vout / $^{\circ}$ C |
| Over Current Protection | Hiccup | 110 | | 200 | % of Iout |
| Short Circuit Protection | Hiccup | | | | |
| Ripple & Noise Max. ^① | | | 50 | 100 | mV pk-pk |
| Dynamic Load Peak Deviation ^② | | -5 | | +5 | % of Vout |
| Dynamic Load Response | | | 500 | | μ S |
| Capacitive Load | | ± 100 | | ± 800 | μ F |
| Minimum Load | No minimum load requirement | | | | |
| Notes | | | | | |
| ① Ripple & noise is tested with certain filter parameters, please see output ripple & noise in technical notes on page 14 for more details. | | | | | |
| ② The load is set from 75%-100%-75% of I _{max} , di/dt=0.1A/ μ S. | | | | | |

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

Performance Data (± 12 Vout)

Output Specifications

| Parameters | Conditions | Min. | Typ. | Max. | Units |
|--|-----------------------------|-----------|-------------|-----------|--------------------------|
| Output Power | | | | 3 | W |
| Normal Output Voltage | Nom.line, 50% Load | | ± 12.00 | | V |
| Vout Accuracy | | -3.0 | | +3.0 | % of Vout |
| Line Regulation | | -2 | | +2 | % |
| Load Regulation | | 0 | | +4 | % |
| Temperature Coefficient | | -0.02 | | +0.02 | % of Vout / $^{\circ}$ C |
| Over Current Protection | Hiccup | 110 | | 200 | % of Iout |
| Short Circuit Protection | Hiccup | | | | |
| Ripple & Noise Max. ^① | | | | 120 | mV pk-pk |
| Dynamic Load Peak Deviation ^② | | -5 | | +5 | % of Vout |
| Dynamic Load Response | | | 500 | | μ S |
| Capacitive Load | | ± 100 | | ± 440 | μ F |
| Minimum Load | No minimum load requirement | | | | |

Notes

- ① Ripple & noise is tested with certain filter parameters, please see output ripple & noise in technical notes on page 14 for more details.
- ② The load is set from 75%-100%-75% of I_{max}, di/dt=0.1A/ μ S.

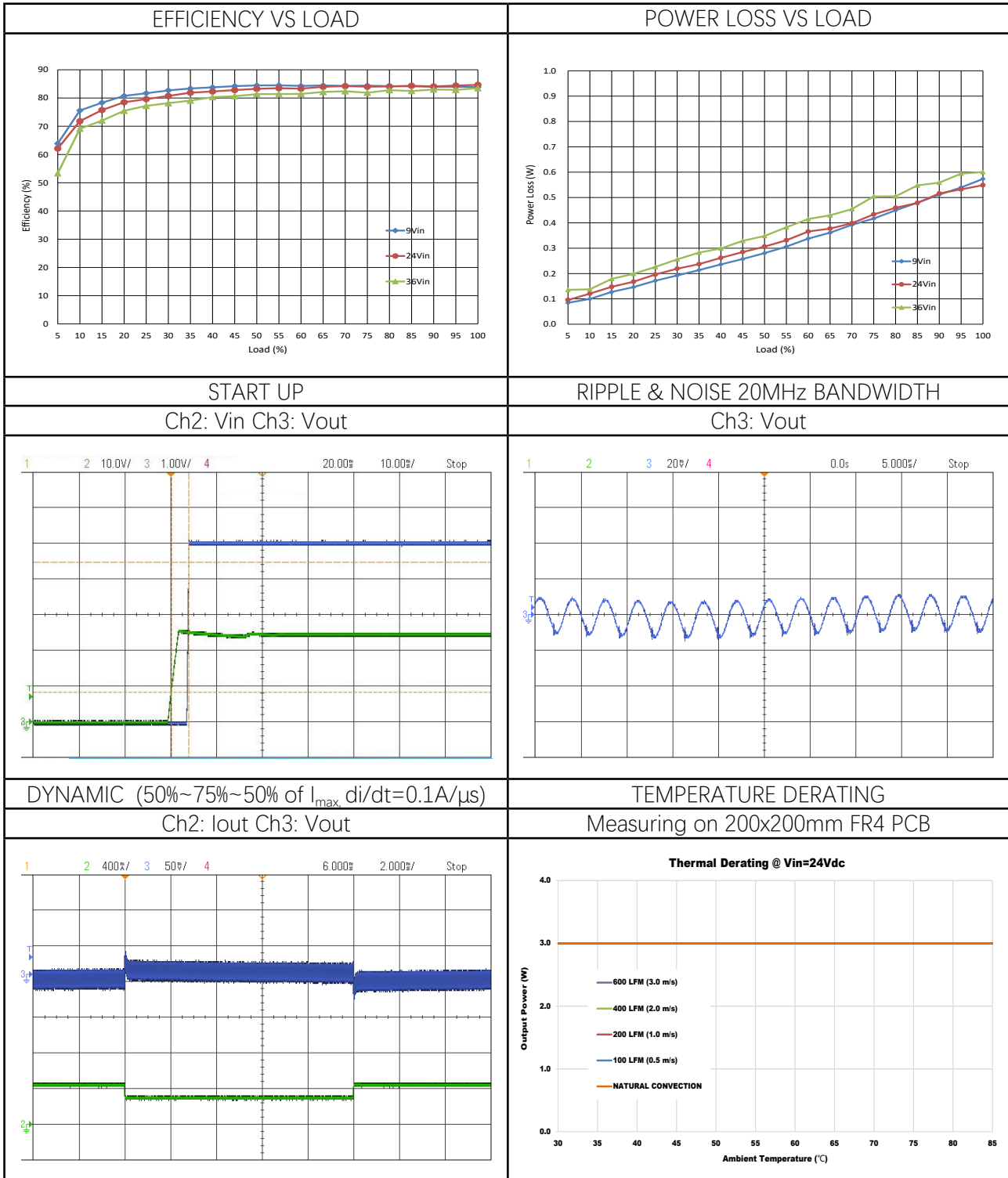
All specifications are tested at 25 °C ambient temperature, nominal input voltage, rated output current conditions unless otherwise specified.

Performance Data (± 15 Vout)

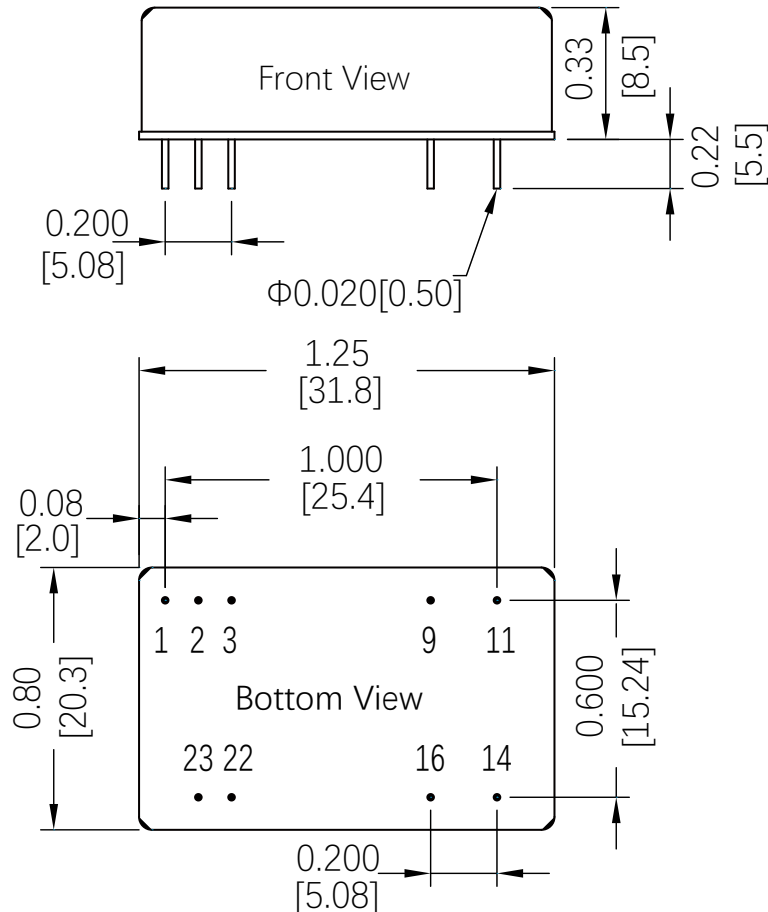
| Output Specifications | | | | | |
|---|-----------------------------|-----------|-------------|-----------|--------------------------|
| Parameters | Conditions | Min. | Typ. | Max. | Units |
| Output Power | | | | 3 | W |
| Normal Output Voltage | Nom.line, 50% Load | | ± 15.00 | | V |
| Vout Accuracy | | -3.0 | | +3.0 | % of Vout |
| Line Regulation | | -2 | | +2 | % |
| Load Regulation | | 0 | | +4 | % |
| Temperature Coefficient | | -0.02 | | +0.02 | % of Vout / $^{\circ}$ C |
| Over Current Protection | Hiccup | 110 | | 200 | % of Iout |
| Short Circuit Protection | Hiccup | | | | |
| Ripple & Noise Max. ^① | | | | 150 | mV pk-pk |
| Dynamic Load Peak Deviation ^② | | -5 | | +5 | % of Vout |
| Dynamic Load Response | | | 500 | | μ S |
| Capacitive Load | | ± 100 | | ± 220 | μ F |
| Minimum Load | No minimum load requirement | | | | |
| Notes | | | | | |
| ① Ripple & noise is tested with certain filter parameters, please see output ripple & noise in technical notes on page 14 for more details. | | | | | |
| ② The load is set from 75%-100%-75% of I _{max} , di/dt=0.1A/ μ S. | | | | | |

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

Performance Data (5 Vout)



Mechanical Specifications



PIN:

PIN1~3, PIN9, PIN11, PIN14, PIN16, PIN22~23: $\Phi 0.020$ inch

Force: Applied force not exceed 4.9N

Material: Copper alloy

Finish: Gold 3 ~ 5 μ m(min.) over nickel 50 μ m(Min.)

Tolerance:

X.XX=±0.02 (0.5)

X.XXX= ±0.010(0.25)

Dimensions are in inches [mm]

Weight: ~20g.

*Note: Model number with suffix "X" is without Pin1.

| PIN CONNECTIONS | |
|-----------------|----------|
| Pin | Function |
| 1* | RC |
| 2 | -Vin |
| 3 | -Vin |
| 9 | NC |
| 11 | NC |
| 14 | +Vout |
| 16 | -Vout |
| 22 | +Vin |
| 23 | +Vin |

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 DKL3W24 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

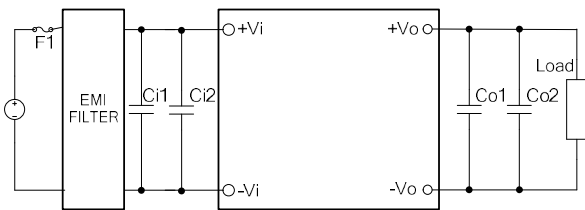


Figure 1: Typical Application Connection Single Output

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 $Ci1=100\mu\text{F}$ electrolytic capacitor, $Ci2 = 1\mu\text{F}$ CBB capacitor. Output Capacitance $Co1=10\mu\text{F}$ tantalum capacitor, $Co2$ ESR $<0.1\Omega$. Please refer to capacitive load for details.

REFLECTED RIPPLE CURRENT

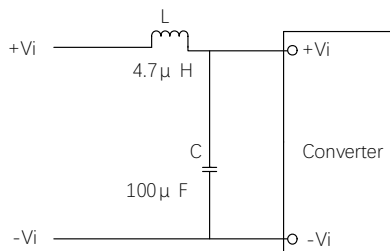


Figure 2: Reflected Ripple Current

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: $L=4.7\mu\text{H}$; $C=100\mu\text{F}$.

REMOTE CONTROL FUNCTION

Module Power Remote Control or called ON/OFF pin is for the user to control the power output. DKL3W series adopt positive logic control. Recommend to use optocoupler to control remote pin as below.

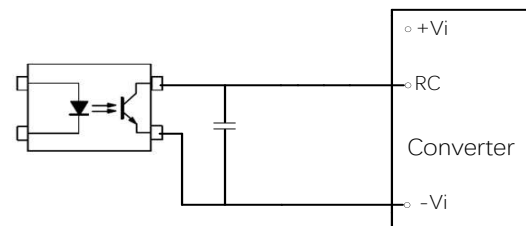


Figure 3: Remote Control Circuit

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 optocoupler 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.

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.

Technical Notes

OUTPUT RIPPLE & NOISE

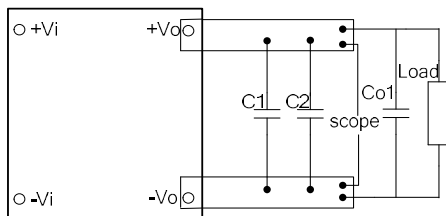


Figure 4- Output Ripple & Noise

These DKL3W24 modules' output ripple and noise is measured at the rated input voltage and output current, along with 10uF 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.

CURRENT LIMITING

The output voltage remains constant as the output current increases. However, once the output current is over the specified Output DC Current Limit, the converter turns off.

The converter then enters into "hiccup mode" where it repeatedly turns on and off until the short circuit 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.



This product is subject to the following operating requirements and the Life and Safety Critical Application Sales Policy:

Refer to: <http://www.densitypower.com>

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