

150 Watts

- 180 - 425VDC Input Range
- Regulated Single Output
- Industry Standard Quarter Brick
- 3kVAC Isolation
- Output Trim -20% to +10%
- Remote On/Off
- Overtemperature Protection
- -40°C to +100°C Operation
- 3 Year Warranty



Dimensions:

QHL150:

2.28 x 1.45 x 0.5" (57.9 x 36.8 x 12.7 mm)

The QHL150 series offers a compact 150W DC-DC solution in an industry standard quarter brick package. This series of modules enables effective construction of distributed power architectures from AC front ends, PFC front ends and battery systems.

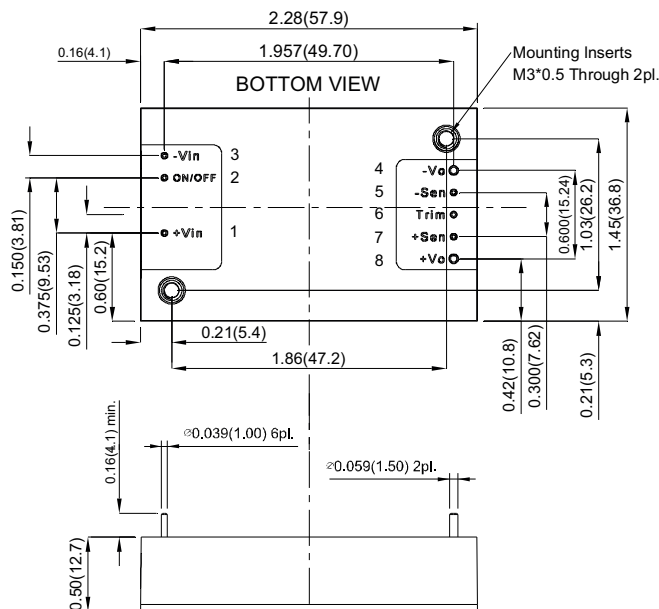
Models & Ratings

| Input Voltage | Output Voltage | Output Current | Input Current ⁽¹⁾ | | Ripple & noise pk-pk | Efficiency at Vin Nominal with full load | Maximum Capacitive Load | Model Number |
|--------------------|----------------|----------------|------------------------------|--------------------------|----------------------|--|-------------------------|--------------|
| | | | No Load | Full Load at Vin Nominal | | | | |
| 300V (180-425V) | 5V | 30.0A | 10mA | 0.58A | 100mV | 86% | 10000µF | QHL150300S05 |
| | 12V | 12.5A | | 0.56A | 150mV | 89% | 8800µF | QHL150300S12 |
| | 15V | 10.0A | | 0.56A | 150mV | 89% | 8800µF | QHL150300S15 |
| | 24V | 6.30A | | 0.57A | 100mV | 88% | 3300µF | QHL150300S24 |
| | 28V | 5.40A | | 0.57A | 100mV | 89% | 3300µF | QHL150300S28 |
| | 48V | 3.20A | | 0.57A | 200mV | 89% | 1000µF | QHL150300S48 |

Notes

1. Measured at 300V nominal input.
2. Peak to peak measured at 20MHz bandwidth and i) 10µF al. and 1µF ceramic capacitor across output for 48V model
ii) 10µF tantalum and 1µF ceramic capacitor across output for all other models
3. Recommended input capacitance of 150µF required to reduce input ripple voltage at -40°C operation or 68µF for operation to -20°C. See application notes.

Mechanical Details



Pin Connections

| Pin | Function |
|-----|---------------|
| 1 | +Vin |
| 2 | Remote On/Off |
| 3 | -Vin |
| 4 | -Vout |
| 5 | -Sense |
| 6 | Trim |
| 7 | +Sense |
| 8 | +Vout |

Notes

1. All dimensions are in inches (mm)
2. Weight: 0.143 lbs (65.0 g) approx.
3. Tolerance: x.xx = ±0.02 (x.x = ±0.5)
x.xxx = ±0.01 (x.xx = ±0.25)

Input

| Characteristic | Minimum | Typical | Maximum | Units | Notes & Conditions |
|--------------------------------|---------|---------|---------|------------------|---------------------------------------|
| Input Voltage Range | 180 | | 425 | VDC | |
| Input Current | | | 1 | A | 180VDC input, 100% load |
| Undervoltage Lockout | | 170 | | VDC | On |
| | | 160 | | | Off |
| Lockout Hysteresis | | 10 | | VDC | |
| Input Transient Voltage | | | 500 | VDC | For 100ms |
| Idle Current | | 10 | | mA | No load |
| Standby Mode | | 3 | | mA | When module inhibited |
| Inrush Current | | | 0.1 | A ² s | ETS300 132-2 |
| Recommended Input Fuse | | 2 | | A | Time delay type, see application note |
| Input Reflected Ripple Current | | 30 | | mA pk-pk | Through 12μH inductor |

Output

| Characteristic | Minimum | Typical | Maximum | Units | Notes & Conditions |
|--------------------------|---|---------|---------|----------|--|
| Output Voltage | 5 | | 48 | VDC | See Models and Ratings table |
| Output Trim | -20 | | +10 | % | See Application Note |
| Initial Set Accuracy | | | ±1 | % | At full load |
| Minimum Load | 0 | | | % | No minimum load required |
| Line Regulation | | | ±0.2 | % | From minimum to maximum input at full load |
| Load Regulation | | | ±0.2 | % | From 0% to full load |
| Transient Response | | | ±5.0 | % | Maximum deviation, recovering to less than 1% in 250μs for 25% step load change. |
| Start Up Time | | 300 | | ms | |
| Output Voltage Rise Time | | 30 | | ms | |
| Ripple & Noise | | | | mV pk-pk | See models and ratings table |
| Overload Protection | 110 | 125 | 160 | % | |
| Short Circuit Protection | | | | | Continuous hiccup mode, with auto recovery |
| Maximum Capacitive Load | | | | | See Models and Ratings table. |
| Temperature Coefficient | | | ±0.02 | %/°C | |
| Overvoltage Protection | 115 | 125 | 140 | % | Of nominal output voltage. Non latching clamp. |
| Remote On/Off | Output is on if remote on/off (pin 2) is open or high (3.5-75VDC) with respect to pin 4 or -Vin Output turns off if remote on/off (pin 2) is low (<1.2VDC max) with respect to pin 4 or -Vin | | | | |

General

| Characteristic | Minimum | Typical | Maximum | Units | Notes & Conditions |
|----------------------------|---|---------------|---------|-------------------|--|
| Efficiency | | 88 | | % | See Models and Ratings table |
| Isolation: Input to Output | 3000 | | | VAC | 60s reinforced |
| Isolation: Input to Case | 2500 | | | VAC | 60s basic |
| Isolation: Output to Case | 500 | | | VAC | 60s functional |
| Switching Frequency | 330 | 360 | 390 | kHz | Fixed PWM |
| Isolation Resistance | 100 | | | MΩ | |
| Case Material | Plastic (DAP) with aluminium base plate. UL94V-0 rated. Meets EN45545-2 | | | | |
| Potting Material | Epoxy UL94V-0 | | | | |
| Pin Material | Copper with nickel and matte tin plate | | | | |
| Solder Profile | | | 260 | °C | With iron 450°C, 5s max. 1.5mm from case 10s max |
| Water Wash | Use deionized water, do not soak. Dry thoroughly | | | | |
| Power Density | | | 90 | W/in ³ | |
| Mean Time Between Failure | 1000 | | | kHrs | 48V models, MIL-HDBK-217F, +25°C GB |
| | 800 | | | | Others, MIL-HDBK-217F, +25°C GB |
| Weight | | 0.1943 (65.0) | | lb (g) | |

Environmental

| Characteristic | Minimum | Typical | Maximum | Units | Notes & Conditions |
|----------------------------------|---------|---------|---------|-------|--------------------------------|
| Operating Base Plate Temperature | -40 | | +100 | °C | |
| Storage Temperature | -55 | | +125 | °C | |
| Thermal Protection | | +105 | | °C | Auto recovery at 95 °C typical |
| Humidity | | | 95 | %RH | Non-condensing |
| Cooling | | | | | Baseplate-cooled |
| Altitude | | | 2000 | m | Operating. Storage to 12000 m |
| Shock and Vibration | | | | | EN61373/MIL-STD-810F |

Safety Approvals

| Agency | Standard | Notes & Conditions |
|--------|------------|--------------------|
| UL | cUL60950-1 | ITE |
| CE | LVD | EN62368-1 |

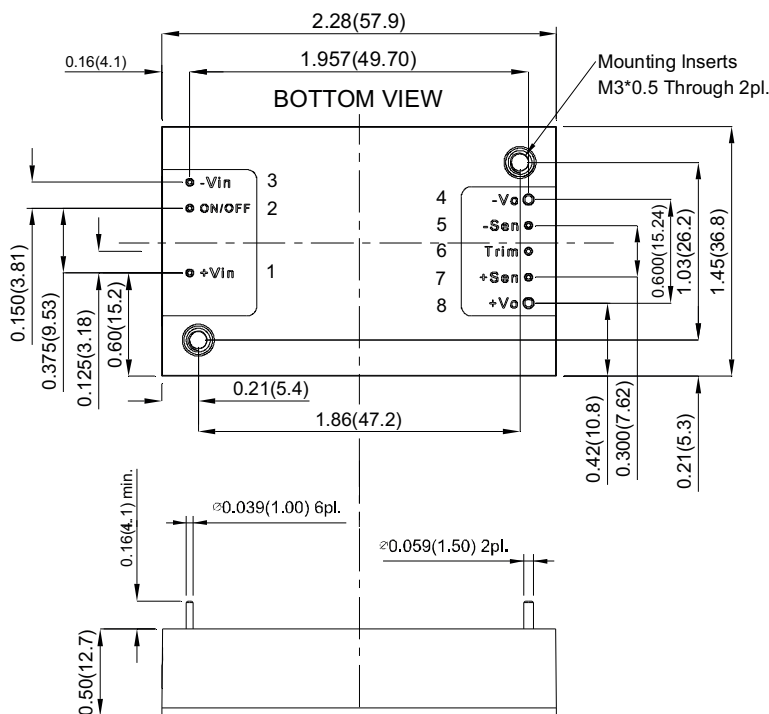
EMC: Emissions

| Phenomenon | Standard | Test Level | Notes & Conditions |
|------------|----------|------------|-----------------------|
| Conducted | EN55032 | Class A | See Application Notes |
| Radiated | EN55032 | Class A | See Application Notes |

EMC: Immunity

| Phenomenon | Standard | Test Level | Criteria | Notes & Conditions |
|--------------------|-------------|------------|----------|---------------------------------|
| ESD Immunity | EN61000-4-2 | ±6kV/±8kV | A | Contact Discharge/Air Discharge |
| Radiated Immunity | EN61000-4-3 | 20v/m | A | |
| EFT/Burst | EN61000-4-4 | ±2kV | A | See application note |
| Surge | EN61000-4-5 | ±2kV | A | See application note |
| Conducted Immunity | EN61000-4-6 | 10Vrms | A | |
| Magnetic Fields | EN61000-4-8 | 3A/m | A | |

Mechanical Details



| Pin Connections | |
|-----------------|---------------|
| Pin | Function |
| 1 | +Vin |
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| 5 | -Sense |
| 6 | Trim |
| 7 | +Sense |
| 8 | +Vout |

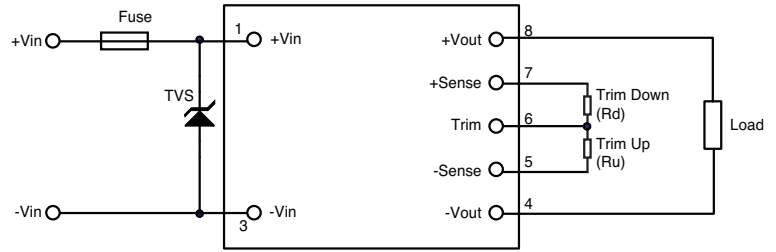
Notes

- All dimensions are in inches (mm)
- Weight: 0.143 lbs (65.0 g) approx.
- Tolerance: x.xx = ±0.02 (x.x = ±0.5)
x.xxx = ±0.01 (x.xx = ±0.25)

Application Notes

Input Fusing and Safety Considerations

The QHL150 series converters have no internal fuse. For safety and system protection, always use an input line fuse. A 2.0A time delay fuse is recommended. It is also recommended the circuit has a transient voltage suppressor diode (TVS) across the input terminals to protect the unit against surges, spikes and input reverse voltage (as shown). A suitable part is SMCJ440A.



Suggested Basic Layout

Output Voltage Sensing

The module will automatically trim the output voltage via the sense pins to the default values either locally or at the load. If not required, the sense pins should be connected locally as indicated in the example EMC circuit.

Output Voltage Adjustment

The Trim input permits the user to adjust the output voltage up by 10% or down by 20%. This is accomplished by connecting an external resistor between the Trim pin and -sense to trim up, or between the trim pin and +sense to trim down.

To Trim Down (Rd)

| Trim Down % | 5V | 12V | 15V | 24V | 28V | 48V |
|-------------|-------|-------|-------|-------|-------|-------|
| | Rd KΩ | | | | | |
| 1 | 111.9 | 687.3 | 952 | 1704 | 2067 | 3295 |
| 2 | 53.88 | 327.1 | 452 | 807.8 | 987.5 | 1588 |
| 3 | 34.55 | 207 | 285.3 | 509.2 | 627.8 | 1020 |
| 4 | 24.88 | 147 | 202 | 359.9 | 447.9 | 735.1 |
| 5 | 19.08 | 111 | 152 | 270.3 | 340 | 564.5 |
| 6 | 15.21 | 86.97 | 118.6 | 210.6 | 268 | 450.8 |
| 7 | 12.45 | 69.82 | 94.85 | 168 | 216.6 | 369.5 |
| 8 | 10.38 | 56.95 | 77 | 136 | 178.1 | 308.6 |
| 9 | 8.77 | 46.95 | 63.11 | 111.1 | 148.1 | 261.2 |
| 10 | 7.48 | 38.94 | 52 | 91.17 | 124.1 | 223.3 |
| 11 | 6.425 | 32.39 | 42.9 | 74.88 | 104.5 | 192.2 |
| 12 | 5.547 | 26.93 | 35.33 | 61.31 | 88.17 | 166.4 |
| 13 | 4.803 | 22.32 | 28.92 | 49.82 | 74.33 | 144.5 |
| 14 | 4.166 | 18.36 | 23.42 | 39.98 | 62.47 | 125.8 |
| 15 | 3.613 | 14.93 | 18.66 | 31.44 | 52.19 | 109.5 |
| 16 | 3.13 | 11.93 | 14.5 | 23.98 | 43.2 | 95.28 |
| 17 | 2.704 | 9.277 | 10.82 | 17.39 | 35.26 | 82.74 |
| 18 | 2.324 | 6.923 | 7.556 | 11.54 | 28.21 | 71.58 |
| 19 | 1.985 | 4.817 | 4.632 | 6.298 | 21.9 | 61.61 |
| 20 | 1.68 | 2.921 | 2 | 1.583 | 16.22 | 52.63 |

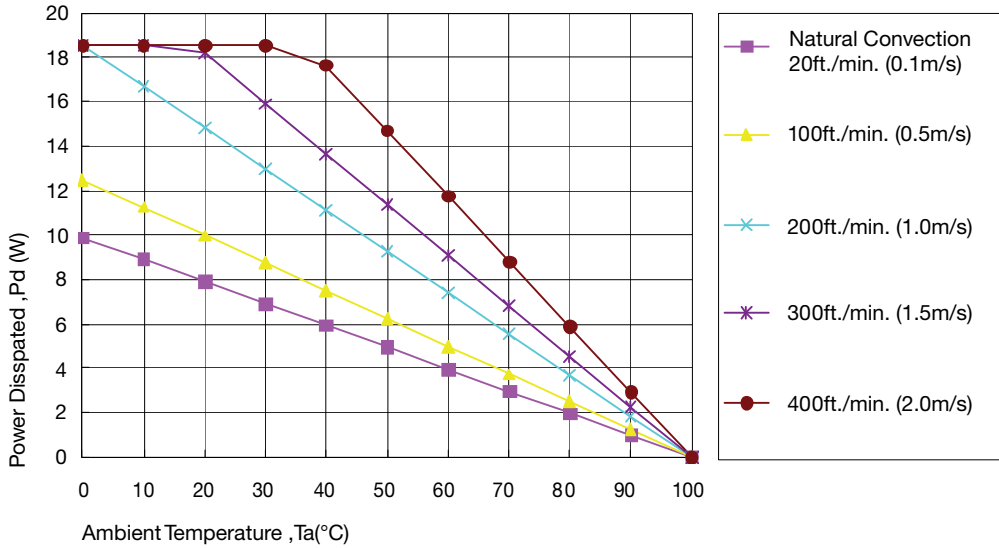
To Trim Up (Ru)

| Trim Up % | 5V | 12V | 15V | 24V | 28V | 48V |
|-----------|-------|-------|-------|-------|-------|-------|
| | Ru KΩ | | | | | |
| 1 | 114.2 | 154.1 | 160.7 | 164.1 | 167.1 | 147.4 |
| 2 | 56.2 | 74.95 | 77.01 | 78.65 | 80.73 | 71.3 |
| 3 | 36.87 | 48.56 | 49.1 | 50.18 | 51.93 | 45.93 |
| 4 | 27.2 | 35.37 | 35.15 | 35.95 | 37.52 | 33.25 |
| 5 | 21.4 | 27.46 | 26.78 | 27.41 | 28.88 | 25.64 |
| 6 | 17.53 | 22.18 | 21.19 | 21.71 | 23.12 | 20.56 |
| 7 | 14.77 | 18.41 | 17.21 | 17.65 | 19.01 | 16.94 |
| 8 | 12.7 | 15.58 | 14.22 | 14.6 | 15.92 | 14.22 |
| 9 | 11.09 | 13.38 | 11.89 | 12.22 | 13.52 | 12.11 |
| 10 | 9.8 | 11.63 | 10.03 | 10.33 | 11.6 | 10.42 |

Application Notes

Thermal Resistance Information

Airflow Derating Graph - Without Heatsink



| Air Flow Rate | Typical Rca |
|---|-------------|
| Natural Convection 20ft/min (0.1m/s) | 10.1°C/W |
| 100ft/min (0.5m/s) | 8.0°C/W |
| 200ft/min (1.0m/s) | 5.4°C/W |
| 300ft/min (1.5m/s) | 4.4°C/W |
| 400ft/min (2.0m/s) | 3.4°C/W |

Example (Without Heatsink)

To determine the minimum airflow necessary for a QHL150300S12 operating at an input voltage of 300V, an output current of 12.5A, and a maximum ambient temperature of 40°C:

Determine Power dissipation (Pd): $P_d = P_i - P_o = P_o(1-\eta)/\eta$,

$$P_d = 12V \times 12.5A \times (1-0.89) / 0.89 = 18.54$$

Where P_i = Input power, P_o = Output Power and η = Efficiency

Determine airflow from airflow derating graph using data points for $P_d = 18.54W$ and $T_a = 40^\circ C$

Minimum airflow = 400ft./min.

To check that the maximum case temp of 100°C is not exceeded:

Maximum temperature rise is

$$\Delta T = P_d \times R_{ca} = 18.54 \times 3.40 = 63.4^\circ C.$$

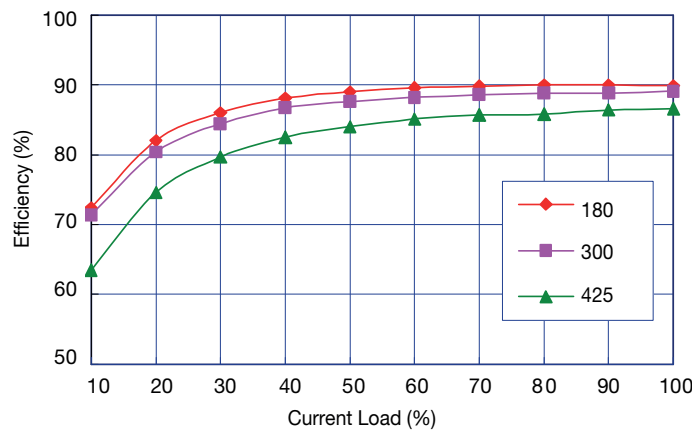
Maximum case temperature is

$$T_c = T_a + \Delta T = 40 + 63 = 103^\circ C < 100^\circ C.$$

Where: R_{ca} is the thermal resistance from case to ambient environment. T_a is ambient temperature and T_c is case temperature.

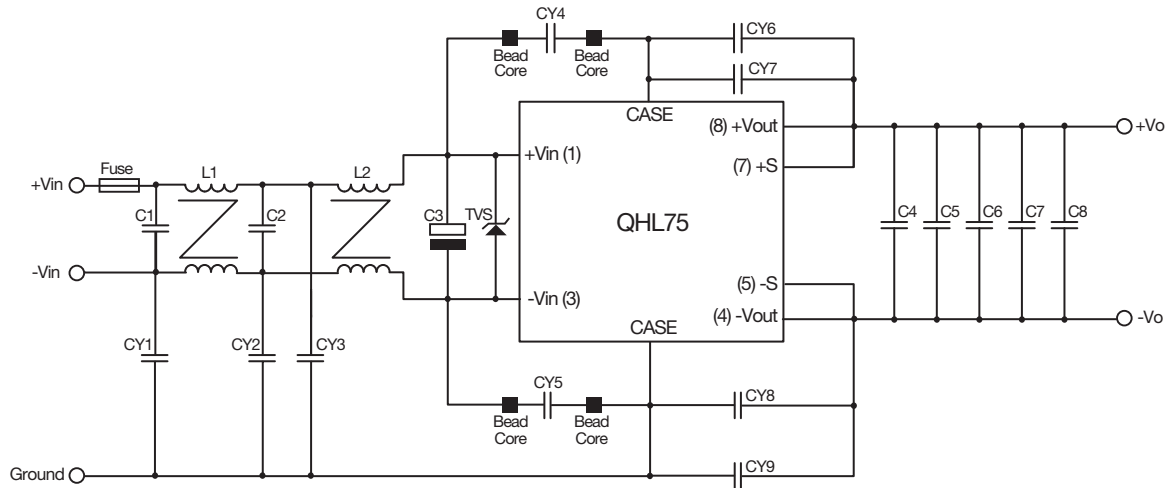
Example Efficiency Curve

Example based on QHL150300S12



Application Notes

Conducted and Radiated Emissions - Class A



Notes

| Part Number | Value |
|-----------------|---|
| C1 | 0.47uF/520V Polyester Film Capacitor |
| C2 | 0.1uF/630V 1812 X7R |
| C3 | Recommended 150μF, 450V aluminium capacitor for operation to -40°C type Nippon Chemi-Con KXG Series or equivalent. The value of C3 can be reduced to 68μF for operation to -20°C. |
| C4,C5 | 4.7uF/100V X7R 1812 |
| C6,C7,C8 | 0.47uF/250V X7R 1210 |
| CY1,CY2 | 100pF CD Type |
| CY3 | 1000pF CD Type |
| CY4,CY5 | 1500pF CD Type |
| CY6,CY7,CY8,CY9 | 4700pF CD Type |
| L1, L2 | 5mH Common Choke |
| Bead Core | Bead Core 2.8*1.7*2 SM |
| Fuse | 2A time delay |
| TVS | 440V _R I _{pp} 2.1A example, SMCJ440A |