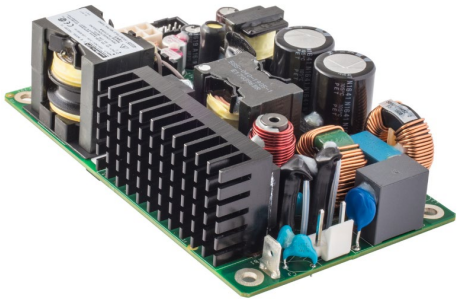
Murata Power Solutions

# PQC250 Series

## 250W 3" x 5" Convection Cooled AC-DC Power Supply



## DESCRIPTION

The PQC250 series switching power supplies utilize advanced component and circuit technologies to deliver high efficiency and low power dissipation, in both operational and standby operation, in a compact 3.0" x 5.0" x 1.40" package. Designed for industrial, medical, computing, communications, telecom, consumer, and other OEM applications, and deployable in 1U customer enclosures. All models offer universal AC input capability with active power factor correction (PFC) and compliance to worldwide safety and EMC standards.

## FEATURES

- Industry leading MTBF
- Certified to IEC 60601 Ed.3 medical (2 x MOPP Pri-Sec; 1 x MOPP Pri-Chassis Ground), AC input models.
- IEC 60950-1 compliant
- IEC 60335-1 Certificate
- Designed to comply with IEC60601-1-2 4th Edition EMC Standard Requirements[1]
- 250W Convection, 100Vac to 264Vac +50C operation
- Very low no load standby power; designed to meet ENERGY STAR® Program Requirements for Single Voltage External AC-DC Power Supplies
- True zero load operation of the Main (V1) output; no minimum load requirements
- Constant Current overload protection option[3]
- 3" x 5" industry standard footprint
- Optional DC input capability
- High efficiency 94% typical
- Remote sense, main output
- Universal AC input with active PFC
- Less than 1U high
- RoHS compliant
- Active inrush protection
- Compatibility with MVAC250 Series products[2]
- Droop current share, output Terminal block option
- Two-year warranty

[1] When deployed in the End User equipment
[2] Fan output of MVAC250 series not available on this product series
[3] Select voltage variants

**Available now at http://www.murata-ps.com/en/3d/acdc.html**

### ORDERING GUIDE (BASIC MODEL NUMBER)

| Model Number[3] | Main output (V1) | | | Aux Output (V2) | | Max. Load Capacitance Main output[4] |
|---|---|---|---|---|---|---|
| | Voltage Vdc | Current @ 50°C 250W | Current @ 70°C [1] 200W | Vdc | Current 50°C & 70°C | |
| PQC250-12yyy | 12 | 20.8A | 16.7A | 5 | 0.5A | 6000µF |
| PQC250-18yyy | 18 | 13.8A | 11.1A | | | 1,600uF |
| PQC250-24yyy | 24 | 10.4A | 8.3A | | | 1200µF |
| PQC250-28yyy | 28 | 8.93A | 7.14 | | | 1200µF |
| PQC250-30yyy | 30 | 8.33A | 6.6A | | | 1000µF |
| PQC250-36yyy | 36 | 6.9A | 5.6A | | | 1000µF |
| PQC250-48yyy (PoE Compliant) | 48 | 5.2A | 4.2A | | | 750µF |
| PQC250-54yyy (PoE Compliant) | 54 | 4.6A | 3.7A | | | 500µF |
| PQC-COVER | Optional cover kit assembly see PQC-COVER datasheet for details | | | | | |

[1] Output De-Rating at 70°C is for horizontal orientation with component side up only. Please refer to ACAN-77 for details
[2] 29V model available, consult with factory for more information
[3] See Part Number Structure for "yyy" options refer to: Part_Number_Options_Guide
[4] Max capacitance limit does not apply to constant current "C" option

### INPUT CHARACTERISTICS

| Parameter | Conditions | Min | Nom | Max | Units |
|---|---|---|---|---|---|
| Input Voltage AC Operating Range | Single Phase | 90 | 100/240 | 264 | Vac |
| Input Frequency | | 47 | 50/60 | 63 | Hz |
| Turn-on input voltage | Input rising | 75 | | 90 | Vac |
| Turn-off input voltage | Input falling | 65 | | 80 | Vac |
| DC input[1, 2] | | 127 | | 300 | |
| | | 260 | | 400 | |
| Maximum input current | Vin = 115$V_{AC}$; Full Load | | 2.5 | | Arms |
| | [2] Vin = 127-300Vdc | | | 2.7 | Adc |
| | [2] Vin = 260-400Vdc | | | 1.5 | Adc |
| Inrush Current | 230$V_{AC}$,Cold start, 25°C; | | 30 | | Apk |
| Power Factor | At 115VAC, full load | 0.95 | | | W/VA |
| Hold-up Time | 90$V_{AC}$; Full Load | 16 | | | msec |
| Efficiency @ 230$V_{AC}$ for PQC250-48 model. | 20% Full Load | | 88.5 | | % |
| | 50% Full Load | | 94 | | |
| | 100% Full Load | | 95 | | |
| No Load Input Power Consumption | (PS_ON = OFF; Aux (V2) = 0A | | | <0.5 | W |

[1] 260-400Vdc range applies to PQC250-xxH variants only; consult with the sales channel for details and availability.
[2] Medical certification applies only to AC input models.

### OUTPUT CHARACTERISTICS

| Parameter | Conditions | Min | Nom | Max | Units |
|---|---|---|---|---|---|
| Line, Load Regulation | Main (V1) Output[1] | | | ±1 | % |
| | Aux (V2) Output | | | ±5 | |
| Minimum Load Capability | Stable Operation | 0 | | | A |
| Output Ripple | Zero to Full Load[2] | | | 1 | % |

[1] Zero load output voltage may exceed the regulation window however will not cause OVP to engage or PWROK to change to low state. A 500mA min. load current is required to keep output voltage within ±1%.
[2] Ripple and noise are measured with 0.1uF ceramic capacitor and 10uF tantalum capacitor. A short coaxial cable with 50 ohm termination is used.

### AUXILIARY OUTPUT CHARACTERISTICS (ALL MODELS)

| Auxiliary Output | Aux Output Voltage | Load Current | Load Capacitance | Line, Load, Cross Regulation | Ripple Voltage & Noise |
|---|---|---|---|---|---|
| Aux (V2) | 5V | 0 to 0.5A | 0 to 220µF | ± 5% | 120mVPP |

For full details go to www.murata-ps.com/rohs

Certificate and Test Report

12V Model

Applies to AC Input models

## MAIN OUTPUT CHARACTERISTICS (ALL MODELS EXCEPT WHERE NOTED)

| Parameter | Conditions | Typ. | Max. | Units |
|---|---|---|---|---|
| Transient Response [1] | 50% load step, 1A/µsec slew rate and min 0.1A load | | ± 5 | % |
| Settling Time to 1% of Nominal | | | 500 | µsec |
| Turn On Delay | After application of input power | | 3 | sec |
| Output Voltage Rise | Monotonic | | 50 | msec |
| Remote Sense | Compensates for up to 120mV of total lead drop (output and return connections) with remote sense connected. Protected against short circuit and reverse connection. | | 120 | mV |

[1] Min. 1 second time between consecutive transients.

## ENVIRONMENTAL CHARACTERISTICS

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Storage Temperature Range | | -40 | | 85 | °C |
| Operating Temperature Range | See power derating curves | -10 | | 70 | °C |
| | Start up with -20C @ 100$V_{AC}$ minimum input<br>*contact Murata for lower operating temperature range | -20 | | - | |
| Operating Humidity | Non-condensing | 10 | | 95 | % |
| Operating Altitude | | -200 | | 5000[1] | m |
| MTBF | Telcordia SR-332 Issue 3; M1C3 @ 40°C<br>Telcordia SR-332 Issue 3; M1C3 @ 25°C | | 2,145K<br>4,500K | | Hours |
| Shock | 30G, non-operating | Complies | | | |
| Operational Vibration | Sine Sweep; 5-150Hz, 2G<br>Random Vibration, 5-500Hz, 1.11G | Complies | | | |
| Safety – Medical Standards<br>2 x MOPP (Primary-Secondary) | IEC 60601 1:2005, IEC 60601 1:2005/AMD1:2012<br>ANSI/AAMI ES60601-1: A1:2012, C1:2009 /(R)2012 and A2:2010/(R)2012, CSA CAN/CSA-C22.2 NO. 60601-1:14<br>EN 60601-1:2006/A1:2013 | | | | |
| Safety – ITE & Consumer Standards | IEC 60950-1:2005, IEC 60950-1:2005/AMD1:2009, IEC 60950-1:2005/AMD2:2013<br>CAN/CSA-C22.2 No. 60950-1-07, Amendment 2:2014 (MOD)<br>ANSI/UL 60950-1-2014<br>EN 60950-1:2006+A11+A1+A12+A2<br>IEC 60335-1:2010, IEC 60335-1:2010 /AMD1:2013<br>IEC 62368-1:2014<br>CAN/CSA-C22.2 No. 62368-1:14<br>UL 62368-1 2nd Ed<br>GB17625.1-2012, GB4943.1-2011, GB/T9254-2008 (Class A)<br>CNS13438 95; CNS14336-1 99; CNS 15663 5 102 (For model PQC250-12 only) | | | | |
| Fuses | Dual Fuses; Line and Neutral; 6.3A Time Lag; 250V | | | | |
| Outside Dimensions | 3.0" x 5.0" x 1.44" (76.2mm x 127mm x 35.2mm) nominal | | | | |
| Weight (typ.) | 0.352/0.78 | | | | kg/lbs. |

[1] 3000 M max. altitude for Medical applications

## PROTECTION CHARACTERISTICS

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Over Voltage Protection | V1 (main output) latching | 115 | | 140 | % |
| | V2 (aux output) latching | 5.5 | | 7.5 | V |
| Over Current Protection[1] | V1, hiccup mode | 120 | | 150 | %Amax |
| | V1, latch mode | 160 | | Short circuit | |
| | V2, auto-recovery | 110 | | 150 | |
| Over Temperature Protection (Primary and Secondary Heatsink Temperature) | Auto-recovery | 125 | | 130 | °C |
| Remote Sense Short Circuit Protection | | | Complies | | |
| Remote Sense Reverse Connection Protection | | | Complies | | |

[1] Overcurrent conditions below 150% result in hiccup. Above 160% will cause the supply to latch off. Also, refer to Constant Current overload section on page 5

[2] In the event of a fault overvoltage or overcurrent fault that causes a "latch" state; it shall be necessary to recycle the incoming AC source. Allow the AC source to be removed for a period of not less than 10s before reapplying,

## ISOLATION CHARACTERISTICS

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Isolation | Primary to Chassis | 1500 | | | $V_{AC}$ |
| | Primary to Secondary (2xMOPP) | 4000 | | | |
| | Secondary to Chassis[1] | 1500 | | | |
| | Output to Output | | | | |
| | Secondary to chassis[2] | 100 | | | $V_{DC}$ |
| Earth Leakage Current (under single fault condition) | 264$V_{AC}$, 60Hz, 25°C | | 300 | | µA |
| Earth Leakage Current (under normal conditions) | 264$V_{AC}$, 60Hz, 25°C | | 150 | | µA |

[1] For PQC250-48-yyy and PQC250-54-yyy variants only.

[2] For all other variants

## CURRENT SHARING OPTION – PQC250-XX-DXX

| Model Number | Description |
|---|---|
| PQC250-XX-Dxx Refer to ACAN-78 for additional details | Main Output current share is achieved using "the droop method". Nominal output voltage is achieved at 50% load and output voltage increases/decreases approximately ±3% of nominal voltage. This regulation window does not include the additional tolerance due to line, temperature, long term stability etc. Startup of parallel power supplies is not internally synchronized. If more than 250W combined power is needed, start-up synchronization must be provided by system using a common PS_ON signal. To account for ±10% full load current sharing accuracy and the reduction in full load output voltage due to droop, available output power must be derated by 15% when units are operated in parallel. Current sharing can be achieved with or without remote sense connected to the common load.<br>ORing protection is available on the PQC250-xxDRT models (see Application notes, ACAN-78 for additional details); Aux (V2) output can be tied together for redundancy but total combined output power must not exceed 2.5W, external ORing devices are recommended to preserve redundancy. |

## EMISSIONS AND IMMUNITY[1]

| Characteristic | Standard | Compliance |
|---|---|---|
| Input Current Harmonics | IEC/EN 61000-3-2 | Class A |
| Voltage Fluctuation and Flicker | IEC/EN 61000-3-3 | Complies |
| Conducted Emissions | EN 55032 | Class B |
| | FCC Part 15 | Class B |
| Radiated Emissions | CISPR 22 -3 meter | Class B |
| | FCC 15.109 - 3 meter | Class B |
| ESD Immunity | IEC/EN 61000-4-2 | Level 4, Criterion 2 |
| Radiated Field Immunity | IEC/EN 61000-4-3 | Level 3, Criterion A |
| Electrical Fast Transient Immunity | IEC/EN 61000-4-4 | Level 4, Criterion A |
| Surge Immunity | IEC/EN 61000-4-5 | Level 3, Criterion A (Com. Mode: 2kV 12 OHM, Diff. Mode: 1kV, 2 OHM) |
| Radiated Field Conducted Immunity | IEC/EN 61000-4-6 | Level 3, 10V/m, Criterion A |
| Magnetic Field Immunity | IEC/EN 61000-4-8 | Level 3, Criterion A |
| Voltage dips, interruptions[2] | IEC/EN 61000-4-11 | Level 3, Criterion B |

[1]Designed to comply with IEC60601-1-2 4th Edition EMC Standard Requirements
[2] For AC source interruptions that extend beyond 20ms then the output it shall be necessary to recycle the incoming AC source. Allow the AC source to be removed for a period of not less than 10s before reapplying,

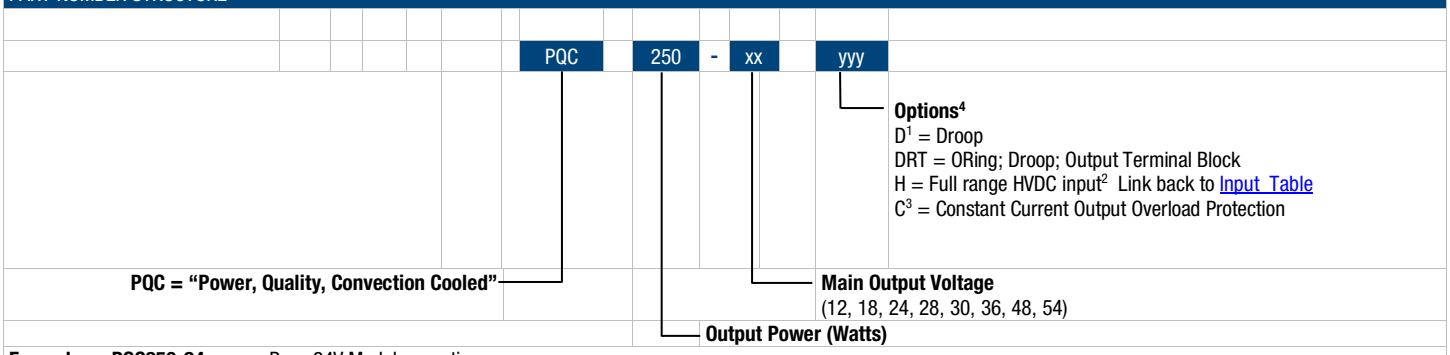
## EMI CONSIDERATIONS

For optimum EMI performance, the power supply should be mounted to a metal plate grounded to all 4 mounting holes of the power supply. To comply with safety standards, this plate must be properly grounded to protective earth (see mechanical dimension notes). Pre-compliance testing has shown the stand-alone power supply to comply with EN55022 class B radiated emissions with a metal enclosure with grounded base plate. See PQC-COVER for details - testing was based on adding a toroid, Fair-Rite#5961004901 with five turns of both of the output leads. Radiated emission results vary with system enclosure and cable routing paths.

## STATUS AND CONTROL SIGNALS

| Parameter | Models | Conditions |
|---|---|---|
| PS_ON Connector J3 Pin 4 | All Models (Except as noted) | This pin must be pulled low (sink current >2mA) to +5V_AUX_RTN (connector J3 Pin 8) to (enable) turn on the main output. The +5V_AUX output is independent of the PS_ON signal, and comes up automatically when the input AC or input DC voltage is applied within their specified operating ranges. |
| | "C" Option Models | This pin can be left unterminated (or alternatively pulled high to +5V_AUX; Connector J3 Pin 1) to (enable) turn on the main output. The +5V_AUX output is independent of the PS_ON signal, and comes up automatically when the input AC or input DC voltage is applied (within their respective specified operating ranges).<br>If it is desired to turn off the Main Output (during normal operation) then this pin can be pulled "low" (sink current >2mA) to +5V_AUX_RTN. |
| PWR_OK Connector J3 Pin 2 | All Models | Open collector logic goes high 40-100ms after the main output is within regulation; it goes low at least 2msecs before loss of regulation. Internal 10K pull up to +5V_AUX is provided. Applications using the PWR_OK signal should maintain a minimum load of 5W on the main output. |

## PART NUMBER STRUCTURE

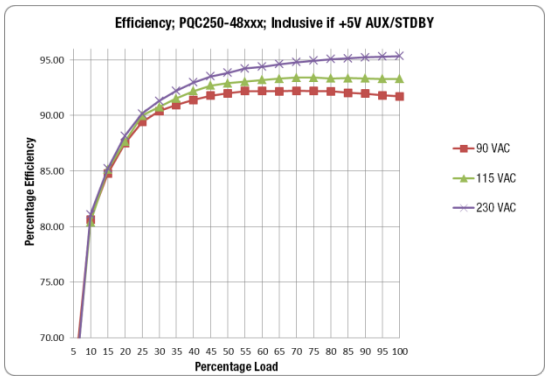



**Examples: PQC250-24** = Base 24V Model; no options
**PQC250-24D** = Base model, 24V Model with Droop Current Share option
**PQC250-24DRT** = Base model, 24V Model with Droop Current Share, ORing isolation and Terminal Block options
**PQC250-24CRT =** Base inclusive of Constant Current Output Overload Protection characteristic plus ORing plus Terminal Block (no droop)

[1] Not available for 18V model
[2] CCC Certification not included for "H" models and 30V models;
[3] Only available for 24V and 28V Voltage Variants
[4] "yyy" can be any combination of the options as shown or left blank; "C" and "D" options not possible in combination.

## PERFORMANCE TYPICAL DATA EXAMPLES

### Efficiency 48V Model



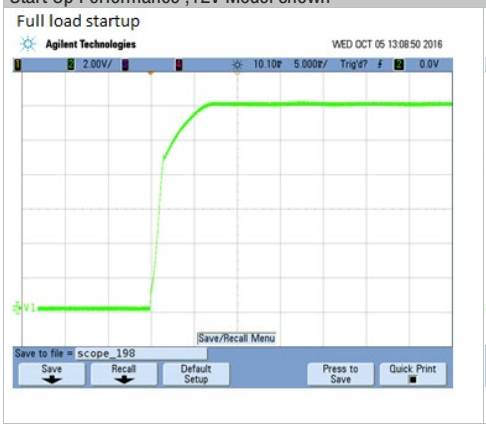

### Ripple, 12V Model

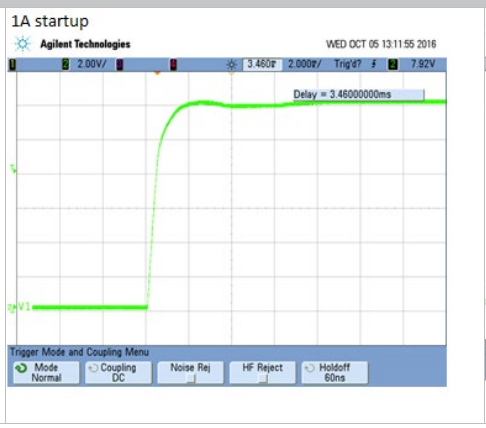
### Transient Performance, 12V Model

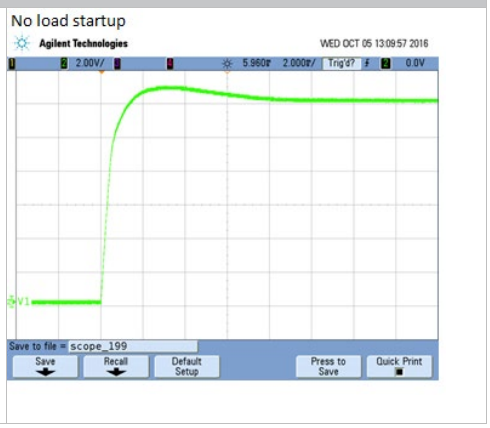
### Transient Performance, 12V Model

## PERFORMANCE DATA

Start Up Performance ,12V Model shown



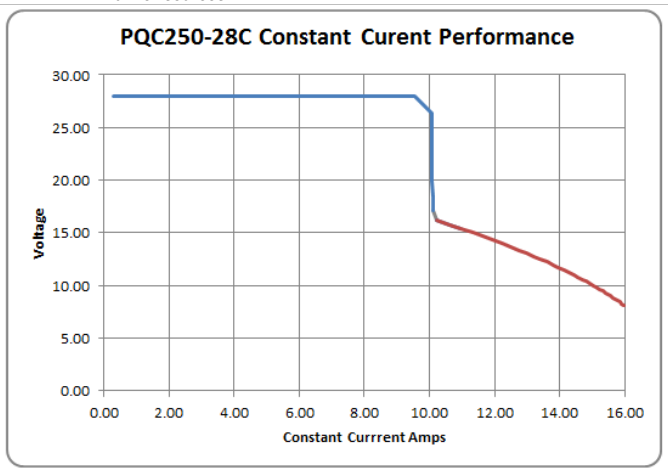



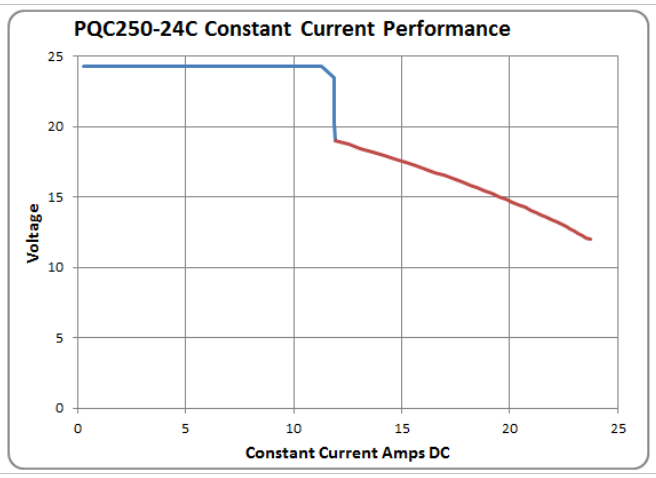




## CONSTANT CURRENT OVERLOAD PERFORMANCE DATA; PQC250-xxC VARIANTS

The "C" option variant provides an overload (abnormal) Constant Current (CC) characteristic as shown in the following curves. This option will enable the PQC250 to successfully operate (at initial startup or during normal operation) in applications experiencing (large current) transient loads such as:

- Large capacitive loads
- Incandescent (i.e. halogen) lamps
- Inductive loads (motors and solenoids)
- LED driver sources




1. Curves generated for the PQC250-xxC variants by subjecting output to an incremental load (constant resistance) equivalent to 1Adc increments between 0A and 50A dc.
2. The resultant curve shows current limited to a constant "brick wall" shown by the blue portion of the curves.
3. If the load current is further incremented the current is still limited but will "tail" and result in the red portion of the curves. End Users should be aware of the potential magnitude of the "current tail" and rate their track/trace and/or interconnection cables accordingly.
4. If the overload (abnormal) current is maintained above maximum load for an extended period then internal over temperature protection may (will) shut down the output to prevent potential thermal overstress of components and maintain safe and reliable operation.

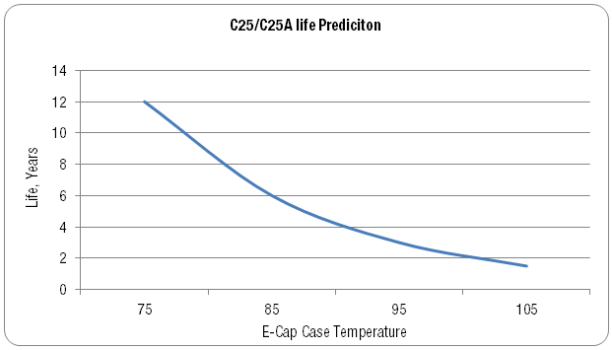
## THERMAL CONSIDERATIONS

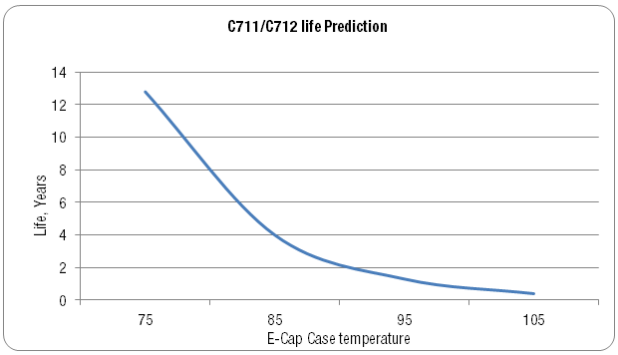
System thermal management is critical to the performance and reliability of the PQC250 series power supplies. Performance derating curves are provided which can be used as a guideline for what can be achieved in a system configuration with controlled airflow at various input voltage conditions.

The product is designed to provide 250W using natural convection cooling when mounted horizontally with un-obstructed convection current airflow flow at room temperature. At elevated temperature the power supply data is taken while it is surrounded by a large vented enclosure to minimize forced cross flows inherent in the elevated temperature test.

The product is capable of operation when mounted in other orientations; operational/derating curves shall be provided to show the effect of such mounting. See ACAN-77 for additonal details

**Capacitor case temperature and Mounting Orientation:**
The power supply can operate in any orientation; however, the power supply contains overtemperature protection that will shut off the output as the temperature of the power supply heatsinks approach the limt specified in the protection table. Additonally, life expectantcy of the power supply is inversely proportional to the case temperature of electrolytic capacitors C25, C25A, C711 & C712. The designer of the system in which this power supply is deployed should consider this relationship to ensure optium product life. The following charts illustrate this relationship:

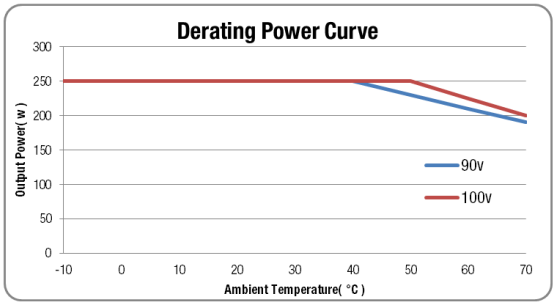



The PQC250 Series will also benefit from the provision of forced cooling airflow (generated by an external host system fan). This will enable operation at potentially higher local surrounding ambient temperatures.
Please refer to ACAN-78 for additonal details

### Derating Curve vs. Temperature (based on horizontal mounting, PTH components facing up, natural convection)

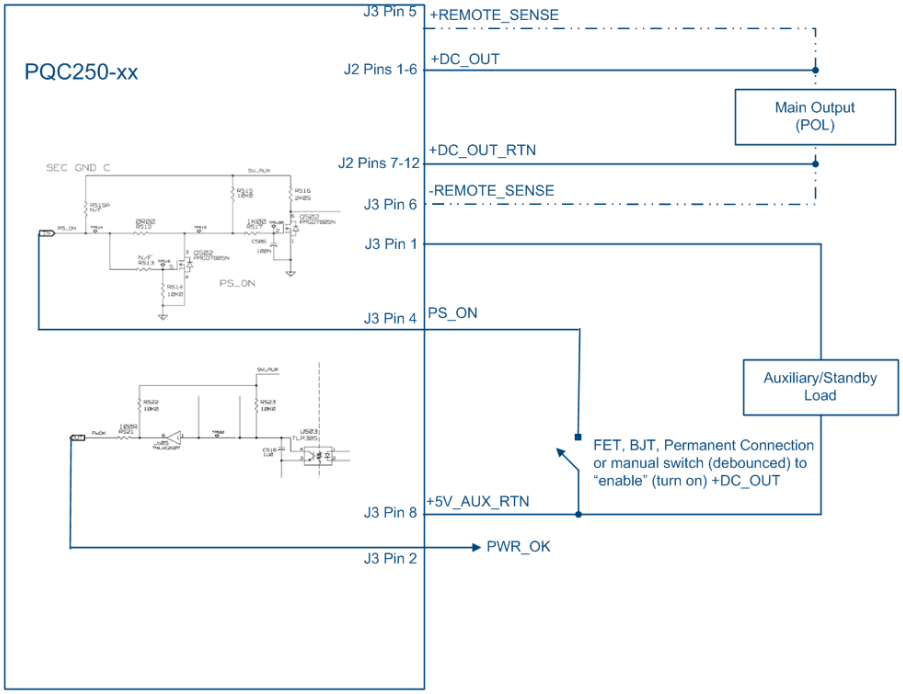
Derating curves are provided to indicate operation at varying input voltages with respect to temperature. See ACAN-77 for more details
Link Back to Thermal Considerations; Ordering Guide



## WIRING DIAGRAM FOR OUTPUT

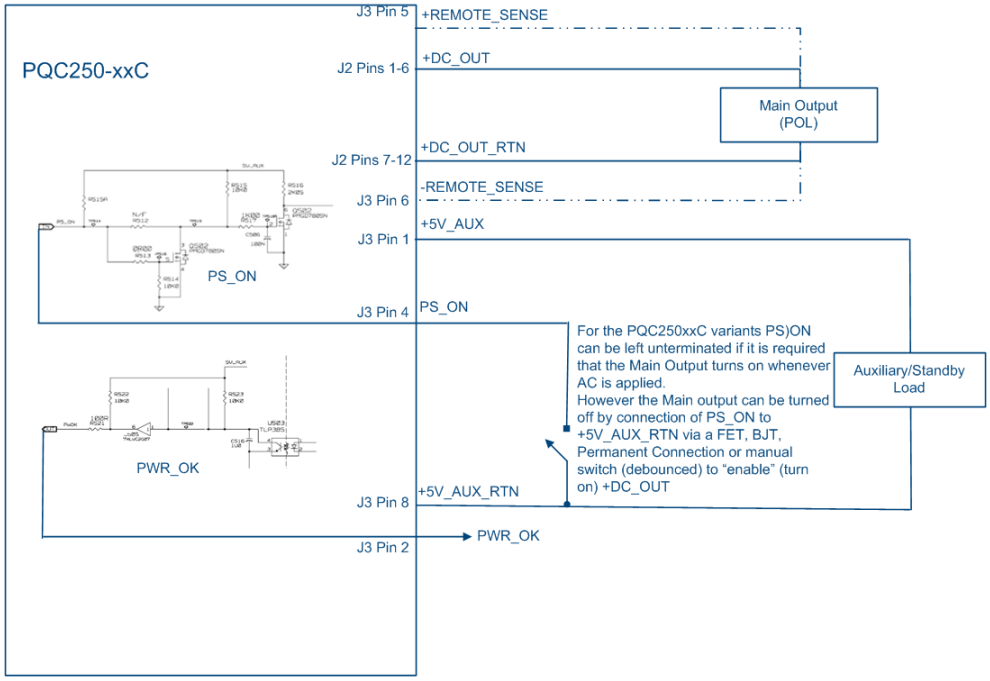
### PQC250-xx

Dotted lines show optional remote sense connections, that can be extended to the Point of Load (POL) which can be some physical distance from the power module output connector (J2). The intent is to compensate for any voltage drop in the cables to the to maintain voltage regulation at the POL .




### PQC250-xxC

Dotted lines show optional remote sense connections, that can be extended to the Point of Load (POL) which can be some physical distance from the power module output connector (J2). The intent is to compensate for any voltage drop in the cables to the to maintain voltage regulation at the POL .

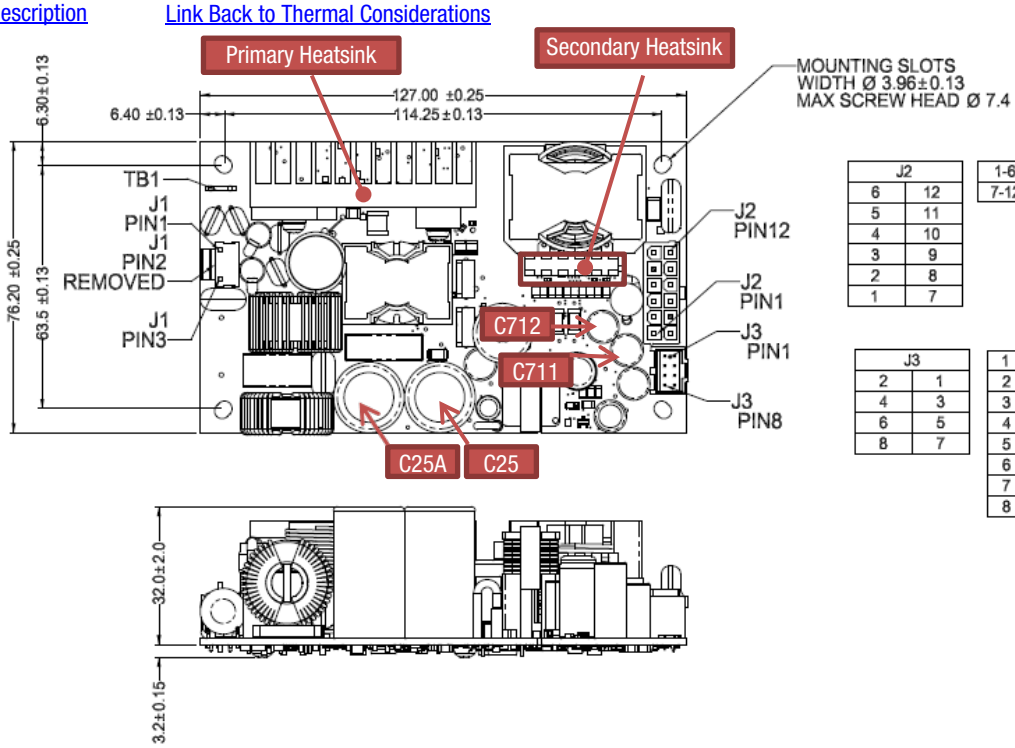



Note: For parallel (current share) operation it is required to connect the sharing power supplies in parallel (+DC out connected together and DC out Return connected together on sharing power supplies. Since each output has an identical "droop" share characteristic then each output will intrinsically share the total load current. See ACAN-78 for more details.

## MECHANICAL DIMENSIONS (Nominal)

### PQC250-xx and PQC250-xxD MODELS

Link Back to Description  Link Back to Thermal Considerations



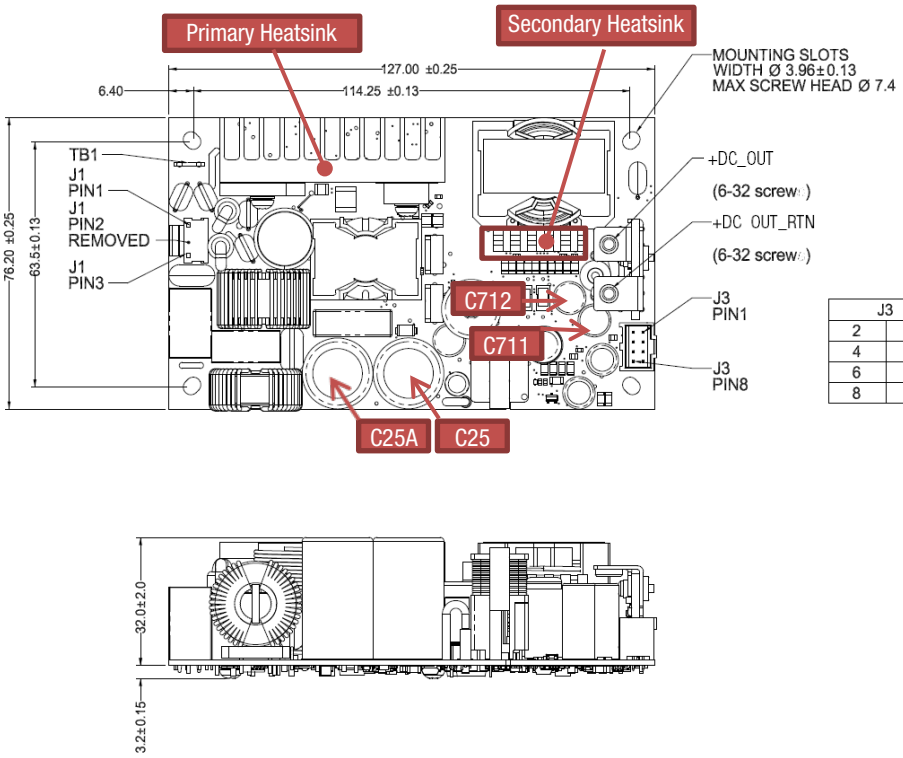

| J2 | |
|---|---|
| 6 | 12 |
| 5 | 11 |
| 4 | 10 |
| 3 | 9 |
| 2 | 8 |
| 1 | 7 |

| | |
|---|---|
| 1-6 | +DC_OUT |
| 7-12 | +DC_OUT_RTN |

| J3 | |
|---|---|
| 2 | 1 |
| 4 | 3 |
| 6 | 5 |
| 8 | 7 |

| | |
|---|---|
| 1 | +5V AUX |
| 2 | PWR OK |
| 3 | DO NOT USE |
| 4 | PS ON |
| 5 | +REMOTE_SENSE |
| 6 | -REMOTE_SENSE |
| 7 | DO NOT USE |
| 8 | +5V AUX_RTN |

### PQC250-xxyRT MODELS




| J3 | |
|---|---|
| 2 | 1 |
| 4 | 3 |
| 6 | 5 |
| 8 | 7 |

| | |
|---|---|
| 1 | +5V AUX |
| 2 | PWR OK |
| 3 | DO NOT USE |
| 4 | PS ON |
| 5 | +REMOTE_SENSE |
| 6 | -REMOTE_SENSE |
| 7 | DO NOT USE |
| 8 | +5V AUX_RTN |