



DESCRIPTION

The PQU650 Series products are rated at 650W employing a "U" channel construction to operate with natural convection or forced airflow. The PQU650 series is a 6"x 4" format capable of providing a continuous 650W¹ output, with a constant current overload characteristic, and 800W "power boost" at output start⁴ to deliver transient loads.

The compact form factor offers an impressive 450W of natural convection cooled power at +50°C. Provision of an adjustable Main output, plus Auxiliary/Standby and fan outputs, will enable this technically superior solution to be deployed across multiple market sectors, complemented by safety certification applicable to medical/Audio/Video/Communication and ITE standards.

ORDERING GUIDE (MODEL NUMBER)

Model (Order) Number	Main output (V1)		Aux Output (V2)		Fan Output V3 ⁶	
	Voltage Vdc	Current Adc @ 50°C 650W ¹	Vdc	Current Adc @50°C	Vdc	Current Adc @50°C
PQU650-12 ²	12	54.2	5	0.5	12	0.6
PQU650-24	24	27.1				
PQU650-28	28	23.2				
PQU650-48 ³	48	13.6				
PQU650-54 ^{2,3}	54	12.1				
PQU650-24P ²	24	27.1				
PQU650-28P ²	28	23.2				
PQU650-48P ^{2,3}	48	13.6				
PQU650-54P ^{2,3}	54	12.1				
PQU-COVER ^{2,5}	Optional cover kit; End User assembly required.					

¹ Forced convection airflow required.

² Consult Murata sales channel for availability.

³ PoE Isolation Compliant.

⁴ Any condition resulting in the Main V1 output restarting; i.e. recycling of PS_ON or recovery from OCP/OTP protection.

⁵ Derating for convection cooling required.

⁶ Only available for forced air cooled deployments (not available for convection cooled deployments).

FEATURES²

- Compact high density design and thermal performance operation to:
 - 450W convection at +50°C; no derating with input line voltage
 - 650W with forced airflow at +50°C; no derating with input line voltage
 - 800W "power boost" (at output start-up)
- Voltage (+15%)³ adjustment of Main V1 Output
- +5VAux/Standby and 12V Fan outputs
- 4" x 6" industry standard footprint; "U" channel form factor with industry "standard" mounting footprints.
 - 40mm maximum overall "U" Channel height
 - 42.7mm max overall height with cover
 - Choice of screwed or pluggable connector variants²
- High efficiency of 95% typical at 50% load
- Very low no load standby power consumption
- True zero load operation of the Main (V1) output; no minimum load requirements
- Remote sense, main output (option)
- Universal AC input; active PFC; EN61000-3-2 Class A
- MTBF 797Khrs; Telcordia SR332 Issue 3; M1 Case 3; +40°C)
- RoHS2 compliant
- Active inrush protection
- Droop Current Share
- IEC60601 Ed.3 medical (2 x MOPP Pri-Sec); 1 x MOPP Pri-Chassis Ground)
- IEC62368-1; (migration planned for all PQU650 Series members)
- Designed to comply with IEC60601-2 4th Edition EMC Standard Requirements¹

¹ When deployed in End User Systems

² Consult Murata sales channel for availability.

³ 54V output adjustment range is +5% max to maintain max voltage to <60V.

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
Maximum input current	Vin = 90VAC; Full Load ¹ (650W FL)			9.0	Arms
Inrush Current	230Vac, Cold start, 25°C		30		Apk
Power Factor	At 230Vac, full load	0.95			W/WA
Hold-up Time	90Vac; 650W	10			msec
Efficiency @ 230Vac	20% Full Load		92		%
	50% Full Load		95		
	100% Full Load		94		
No Load Input Power Consumption	(PS_ON = OFF; Aux (V2) = 0A)			<0.5	W

¹ Input current will increase to ~10Arms under 800W peak power

MAIN OUTPUT CHARACTERISTICS (ALL MODELS)

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

¹ Zero load output voltage may exceed the regulation window however will not cause OVP to engage or PWOK to change to low state.

² Ripple and noise are measured with 0.1µF ceramic capacitor and 10µF tantalum capacitor. A short coaxial cable with 50 ohm termination is used.

Min 120µF cap required at the output to keep ripple within 1% for 54V output.

Min 10% load current required, to maintain ripple within 1% for 12V output model. 1A min.

AUXILIARY OUTPUT CHARACTERISTICS

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	4.75t o 5.25Vdc	100mVpp

FAN OUTPUT CHARACTERISTICS (ALL MODELS)

Auxiliary Output ¹	Aux Output Voltage	Load Current	Load Capacitance	Line, Load, Cross Regulation	Ripple Voltage & Noise
Aux (V3)	12V	0 to 0.6A	0 to 220µF	10.8 to 13.2Vdc	120mVpp

¹ Not recommended for "general use" due to its semi regulated characteristic. The output is for use with a fan intended to cool the PQU650; therefore if the PQU650 is convection cooled only then this output should not be used. A 1.5A non replaceable fuse is provided in this output for overload protection.

² Only available for forced air cooled deployments (not available for convection cooled deployments)



Report & Certificate

MAIN OUTPUT CHARACTERISTICS (ALL MODELS EXCEPT UNLESS NOTED)

Parameter	Conditions	Typ.	Max.	Units
Transient Response ¹	50% load step, 1A/μsec slew rate and min 10% load		± 5	%
Settling Time to 1% of Nominal			500	μsec
Turn On Delay	After application of input power		3	sec
Output Voltage Rise		200		msec
Remote Sense ²	Compensates for up to 120mV of total lead drop (output and return connections) with remote sense connected. Protected against short circuit and reverse connection.		1	%

¹ Min. 1 second time between consecutive transients; requires 10% minimum load.

² Remote sense is not offered as a standard feature due to drop current share characteristic offered on the standard models; consult the sales channel for availability of remote sense option.

ENVIRONMENTAL CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Storage Temperature Range		-40		85	°C
Operating Temperature Range ⁴	See power derating curves	-30		70	
Operating Humidity	Non-condensing	10		95	%
Operating Altitude		-200		5000 ²	m
MTBF	Telcordia SR-332 Issue 3; M1C3 @ 25°C Telcordia SR-332 Issue 3; M1C3 @ 40°C		1810K 797K		Hours
Shock	30G, non-operating	Complies			
Operational Vibration	Sine Sweep; 5-150Hz, 2G Random Vibration, 5-500Hz, 1.11G	Complies			
Safety – Medical Standards 2 x MOPP (Primary-Secondary)	IEC 60601-1 (ed.3.1) CAN/CSA-C22.2 No. 60601-1:2008/A1:2014 ANSI/AAMI ES 60601-1:2005/A1:2012 EN 60601-1:2006/A1:2013				
Safety – ITE, Audio/Video/Communications & Consumer Standards	IEC 60950-1:2005, IEC 60950-1:2005/AMD1:2009, IEC 60950-1:2005/AMD2:2013 CAN/CSA-C22.2 No. 60950-1-07, Amendment 1:2011, Amendment 2:2014 (MOD) ANSI/UL 60950-1-2014 EN 60950-1:2006/A2:2013 CCC: GB17625.1-2012; GB4943.1-2011; GB/T9254-2008 (Class A) CE Marking per LVD IEC 62368-1 ¹				
Fuses	Dual Fuses; Line and Neutral; 12.5A Fast Acting; 250V				
Outside Dimensions	4.0" x 6.0" x 1.69" (101.6mm x 152.4mm x 42.8mm) nominal				
Weight (typ.)	0.692/1.526				kg/lbs.

¹ Planned submission end 2019; contact Murata for additional details.

² Meets 5000 M max. altitude for Medical certification requirements.

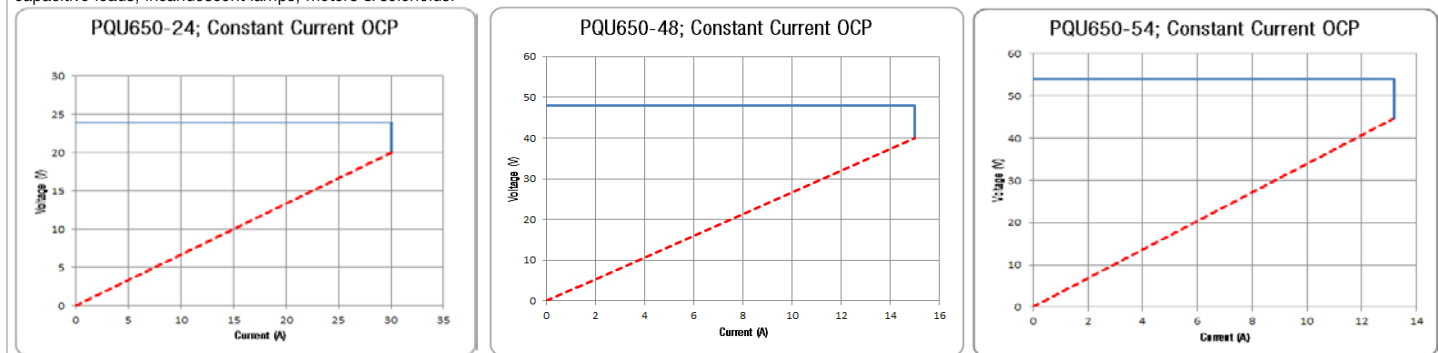
³ When deployed in End User Systems

⁴ Starts at -30°C at 100Vac minimum input; however full specification guaranteed at -20°C; *contact Murata for lower operating temperature range.

PROTECTION CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Over Voltage Protection	V1 (main output) latching	115		140	%
	V1 (48V *54V models) latching			60	Vdc
Over Current Protection	V2 (aux output) latching	5.5		7.5	Adc
	V3, (Fuse Protected)			1.5A	Adc

The Constant Current characteristic as shown in the following curves. This feature will enable the PQU650 to successfully start in to application loads exhibiting large inrush current i.e. large capacitive loads, incandescent lamps, motors & solenoids.



- Curves generated for the PQU650 variants by subjecting output to an incremental (constant resistance load, equivalent to 1Adc increments (above full load).
- The resultant curve shows the current limited to a constant "brick wall" shown by the blue portion of curve.
- If the load current is further incremented the output will enter "hiccup" (recycling on/off; shown by the red dashed curve) commencing when the output voltage falls to ~75% of the nominal set point.
- If the overload current is maintained above maximum load for an extended period the "hiccup" operation will continue indefinitely while the overload persists. In the event that the overload is maintained just below that where "hiccup" operation is initiated then, dependent on the prevailing operating conditions, the power module may enter thermal protection.
- Each time the output recovers from hiccup the output power will be capable of 800W peak to provide additional power to ensure that the transient load is delivered.

PROTECTION CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Over Current Protection	V2, auto-recovery	110		150	%
	V3; non-resettable fuse ¹			1.5	Adc
Over Voltage Protection ²	Latching	110		140	%Vdc
Over Temperature Protection	Auto-recovery				
Primary Heatsink Temperature				130	°C
Secondary Temperature				130	
Remote Sense Short Circuit Protection			Complies		--
Remote Sense Reverse Connection Protection			Complies		--

¹ OCP of the 12V Fan (V3) output is provided by an SMD fuse (accessible from top) rated at 1.5A; therefore if ruptured the 12V Fan output will not be available and the fuse shall require to be replaced.

² Refers to percentage of nominal voltage

ISOLATION CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Isolation	Primary to Chassis	1500			Vac
	Primary to Secondary (2xMOPP)	4000			
	Secondary to Chassis ¹	1500			
	Output to Output ¹	1500			
Earth Leakage Current (under normal conditions)	264Vac, 60Hz, 25°C			400	µAac

¹ Meets PoE isolation limits

CURRENT SHARING OPTION

Model Number	Description
All PQU650 Refer to ACAN-107 for additional details	Main output current share is achieved using the "droop" method. Nominal output voltage is achieved at 50% load; the output voltage increases/decreases (approximately $\pm 3\%$ of nominal voltage) with decreasing/increasing (respectively) load current. 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. No more than 800W combined power is allowed at start-up. To account for $\pm 10\%$ 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. External ORing protection is recommended (see Application notes, ACAN-105 for additional details); Aux (V2) outputs can be tied together for redundancy but total combined output power must not exceed 2.5W; external ORing devices are recommended to preserve redundancy. It is not recommended that the 12V Fan (V3) outputs are connected in parallel since these outputs are only semi regulated.

EMISSIONS AND IMMUNITY

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	CISPR 32/EN 55032	Class B
	FCC Part 15	Class B
Radiated Emissions	CISPR 32/EN 55032	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, 2ohm)
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	IEC/EN 61000-4-11	Level 3, Criterion B

EMI CONSIDERATIONS

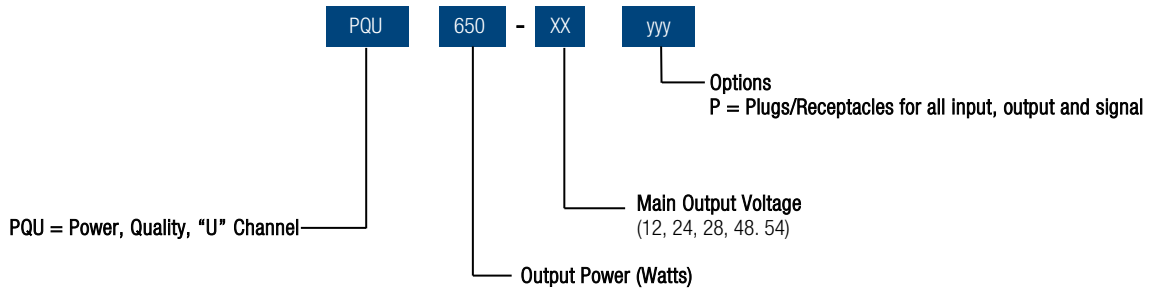
For optimum EMI performance, the power supply should be mounted to a metal plate grounded to all 4 mounting holes of the power supply. To comply with safety standards, this plate must be properly grounded to protective earth (see mechanical dimension notes). Pre-compliance testing has shown the stand-alone power supply to comply with EN55032 class B radiated emissions with a metal enclosure with grounded base plate. See PQU-COVER for details - testing was based on adding a toroid (4 turns of both main output wires wound as common mode choke on FAIR-RITE#5961002701). Radiated emission results vary with system enclosure and cable routing paths.

A minimum 10% load current is required, on the main output.

STATUS AND CONTROL SIGNALS

Parameter	Models	Conditions
PS_ON Connector J3 Pin 4	All Models (Except as noted)	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). 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.
PWOK Connector J3 Pin 2	All Models	The PWOK is a combined digital signal that signifies the status of the Main V1 output. It changes state due to loss of the incoming AC source and any condition that causes the Main V1 DC output shutdown (UVP, OCP, OTP protection). The output is via an open drain CMOS buffer that transitions high 15-25ms after the main output is within regulation; it transitions low at least 1msec

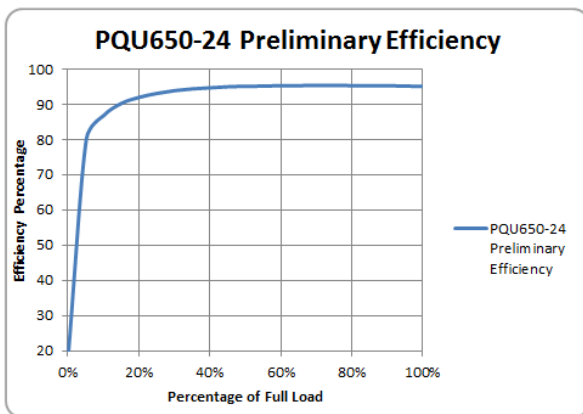
PART NUMBER STRUCTURE



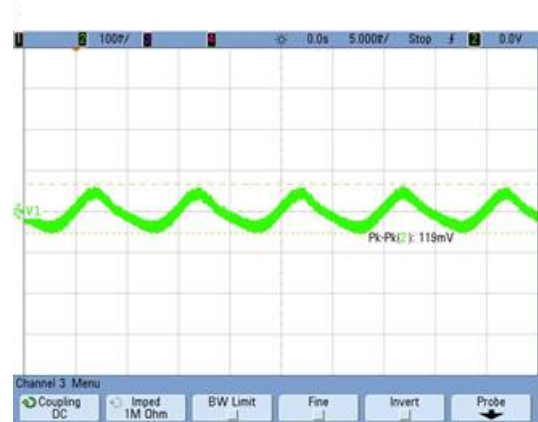
Examples: PQU650-24 = Base 24V Model; no options
PQU650-24P = Plug/Receptacles for all input, output and signal connections

PERFORMANCE TYPICAL DATA EXAMPLES (BASED ON 24V VARIANT)

Efficiency 24V Model



Typical Ripple & Noise (24V Model)



Transient Performance, 24V Model Half to Full Load



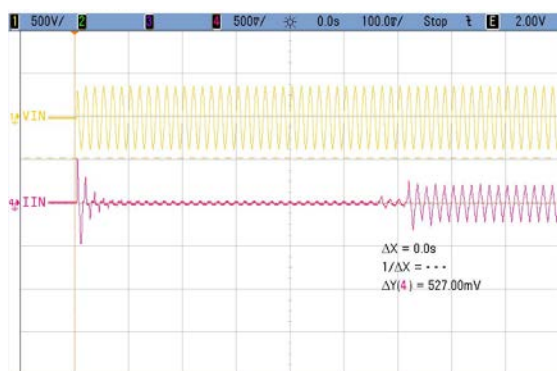
Transient Performance, 24V Model Full to Half Load



NB: Waveforms as shown include the effects of 3% droop regulation.

Inrush Current; 264Vac Input, Cold Start, 10.5Apk

Hold Up Time; 90Vac; 650W



EMI; Conducted CISPR 22; Peak vs. Average Limit; L1; 100Vac 24Vdc @ 25Adc



EMI; Conducted CISPR 22; Peak vs. Average Limit; L2/Neutral; 100Vac 24Vdc @ 25Adc



PERFORMANCE TYPICAL DATA EXAMPLES

EMI; Conducted CISPR 22; Peak vs. Average Limit; L1; 208Vac 24Vdc @ 25Adc



EMI; Conducted CISPR 22; Peak vs. Average Limit; L2/Neutral; 208Vac 24Vdc @ 25Adc



THERMAL CONSIDERATIONS

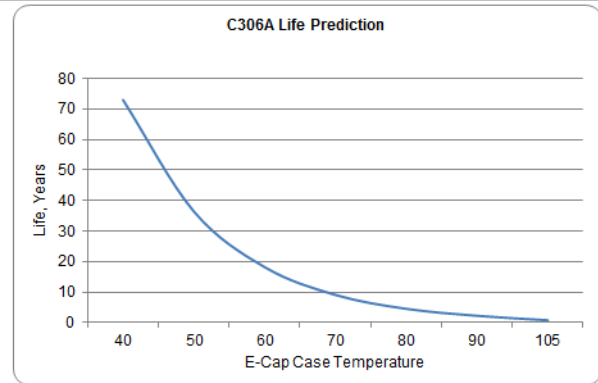
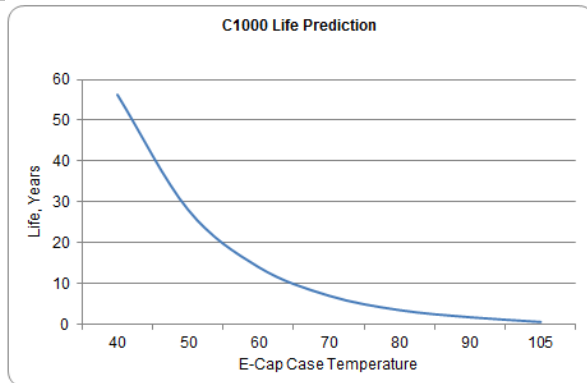
System thermal management is critical to the performance and reliability of the PQU650 series power supplies. Performance derating curves shall be provided which can be used as a guideline for what can be achieved (at various operating conditions) in a system configuration with controlled airflow.

The product is designed to provide 450W using natural convection cooling when mounted with un-obstructed convection current airflow flow at up to +50°C local ambient temperature. At elevated temperatures 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 diverse orientations; operational/derating curves shall be provided to show the effect of such mounting. See ACAN-xx for additional 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 critical components exceed their safe and reliable thermal limits. Additionally, life expectancy of the power supply is inversely proportional to the case temperature of electrolytic capacitors. The designer of the system in which this power supply is deployed should consider this relationship to ensure optimum product life. The following charts are initial life predictions based on 80% of full load capability that illustrate this relationship.

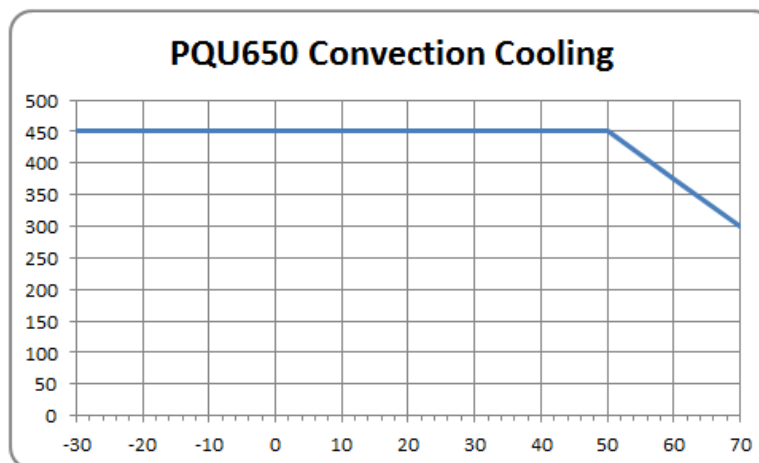


The PQU650 Series will also benefit from the provision of forced convection cooling airflow (generated by an external host system fan). A dedicated 12V Fan (V3) output is provided that can be used to power an external (system) fan. This shall enable operation to the full capability of 650W at +50°C local ambient (forced convection cooling air) temperature.

Please refer to ACAN-106 for additional details

NB: The above curves are based on generic predicted life ; shall be updated when comprehensive data is available.

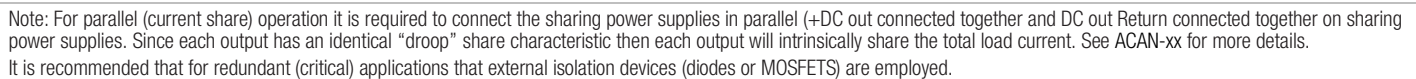
THERMAL DERATING



The PQU650 will reliably provide 450W output power with no derating for AC line at a local ambient temperature of +50°C.

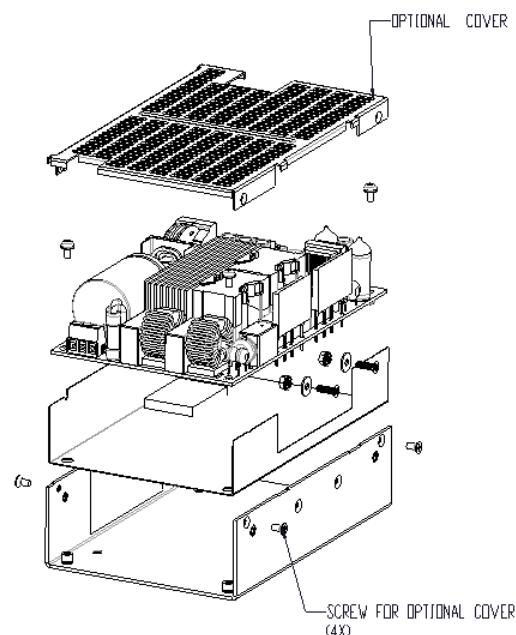
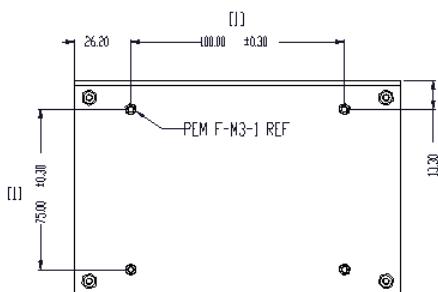
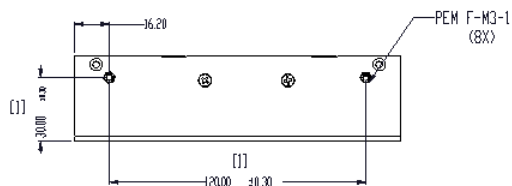
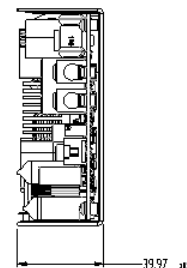
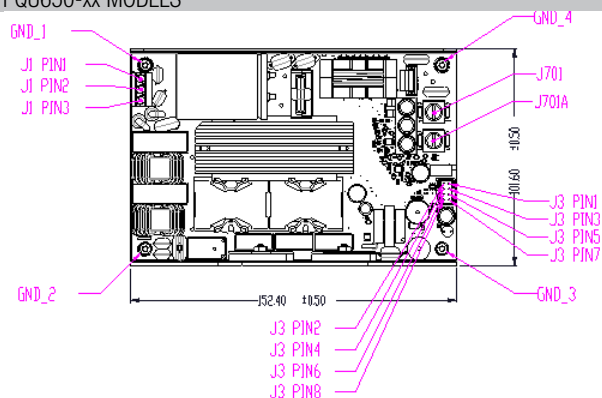
It is also capable of providing 300W at operation up to +70°C.

The PQU650 will provide 650W of power with a minimum recommended airflow of 300LFM/1.5m/s (for the opening area of the "U" channel i.e. 4.0" x 1.55 or 101.6mm x 40mm this equates to circa 13CFM/ 6.14 litre/s).



MECHANICAL DIMENSIONS (Nominal)

PQU650-xx MODELS



Input Connector J1

Phoenix Contact Part# 1715734
Supported Cable Gauge: 26-12AWG; 0.14-2.5mm²

Pin 1	PE/GND
Pin 2	AC Neutral/L2
Pin3	AC Line/L1

Output Connector J701, J701A

IHI Connectors; B2A-PCB
Cable stripped end or with suitable ferrule

J701	+DC_OUT
J701A	+DC_OUT_RTN

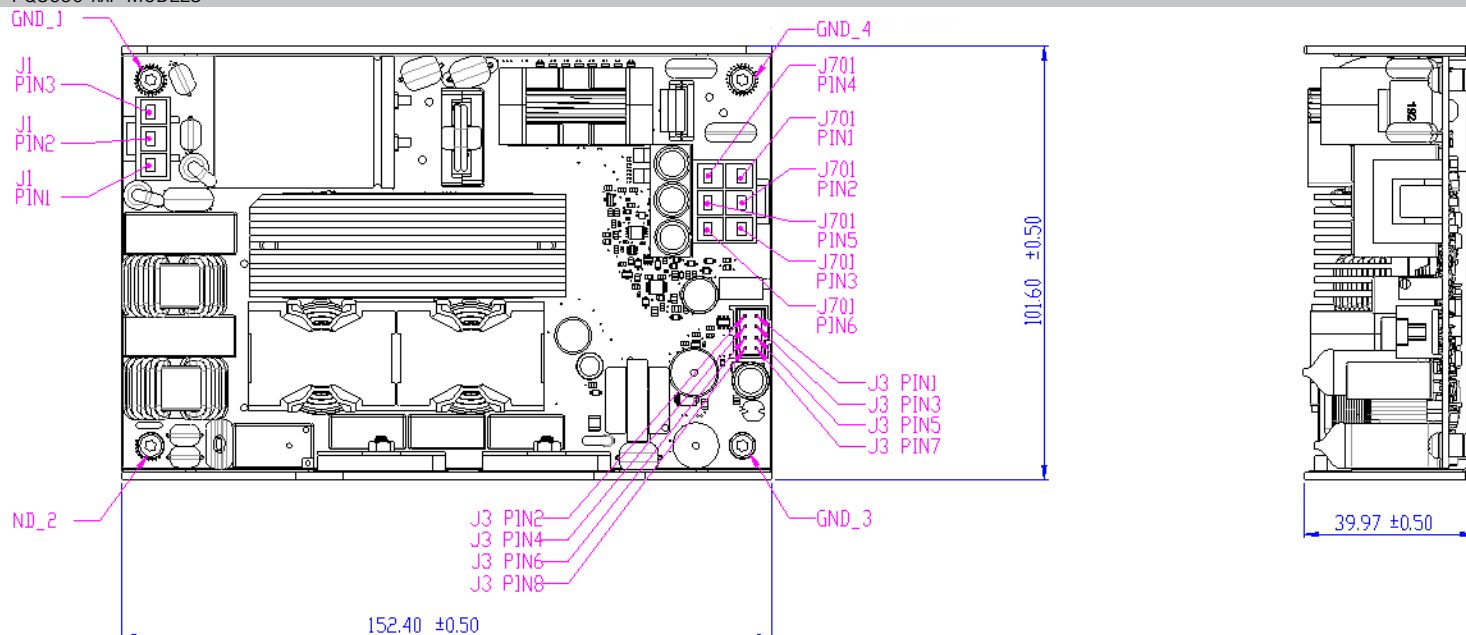
Signal Connector: J3

PCB Connector: Molex 90130-1108 (C-Grid III™ Series)
Mating Half Housing: Molex 0901420008
Crimps Terminals/pins Molex 0901190109

Pin 1	+5V_AUX
Pin 2	PWR_OK
Pin 3	+12V_FAN_RTN
Pin 4	PS_ON
Pin 5	+Remote Sense
Pin 6	-Remote Sense
Pin 7	+12V_FAN
Pin 8	+5V_AUX_RTN

MECHANICAL DIMENSIONS (Nominal)

PQU650-xxP MODELS



Input Connector J1

JST Connectors, B03P-VL (VL Series)

Mating Half: JST Housing VLP-03V

Crimps/Terminals:

SVF-61T-P2.0; 20-14AWG & SVT-81T-P2.0 12AWG

Pin 1	AC Line/L1
Pin 2	AC Neutral/L2
Pin3	PE/GND

Output Connector; J701

JST Connectors; B06P-VL (VL Series)

Mating Half: JST Housing VLP-06V

Crimps/Terminals:

SVF-61T-P2.0; 20-14AWG & SVT-81T-P2.0 12AWG

Pin 1	+DC_OUT_RTN
Pin 2	
Pin 3	
Pin 4	+DC_OUT
Pin 5	
Pin 6	

Signal Connector; J3

PCB Connector: Molex 90130-1108 (C-Grid III™ Series)

Mating Half Housing: Molex 0901420008

Crimps Terminals/pins Molex 0901190109

Pin 1	+5V_AUX
Pin 2	PWR_OK
Pin 3	+12V_FAN_RTN
Pin 4	PS_ON
Pin 5	+Remote Sense
Pin 6	-Remote Sense
Pin 7	+12V_FAN
Pin 8	+5V_AUX_RTN

SAFETY CONSIDERATIONS



1. This power supply is a component level power supply intended for use in Class I applications.
2. A protective bonding conductor from the end product protective earthing terminal must be tied to connector J1 (relevant pin dependent on connector type).
3. The primary heatsink is considered a live primary circuit, and should not be touched. It is recommended that the primary heatsink be kept at least 4mm from chassis/ground and 8mm from secondary (SELV) circuitry. In all cases, the applicable safety standards must be applied to ensure proper creepage and clearance requirements are met.
4. This product is subject to the following operating requirements and the Life and Safety Critical Application Sales Policy: <http://www.murata-ps.com/requirements/>
5. The power supply has been evaluated for 5000m altitude and tropical climatic conditions for China.
6. Double pole/neutral fusing is used; the product label is annotated accordingly.
7. If the product is used with the PQU650 cover assembly the relevant safety creepage and clearance requirements are preserved when the PQU650 is so installed.
8. For all deployment installed chassis mounting screws, the End User should ensure that the screw does not protrude by more than two (2) threads through the captive PEM mounted in the "U" channel.

INPUT/OUTPUT CONNECTOR AND SIGNAL SPECIFICATION AND MATING CONNECTORS – PQC650-xx series

Connector	PIN	Description	Technical Data	Manufacturer
Input Connector J1	1	Protective Earth (PE)/Ground	300V, 10A, 3 positions. Flame Rated: UL94V-0; 5.08mm Pitch	Phoenix Contact Order# 1715734
	2	AC Neutral/ L2		
	3	AC Line/L1		
Output Connectors; J70x	J701	+DC_OUT	600V, 100A, @AWG Wire Lug	IHI Connectors; B2A-PCB
	J701A	+DC_OUT_RTN		
Output Connector J3	1	+5V_AUX	250V, 3A, 8 positions. Flame RatedUL94V-0; 85°C (minimum)	PCB Connector: Molex 90130-1108 (C-Grid III™ Series) Mating Half Housing: Molex 0901420008 Crimps Terminals/pins Molex 0901190109
	2	PWR_OK		
	3	+12V_FAN_RTN		
	4	PS_ON		
	5	+Remote Sense		
	6	-Remote Sense		
	7	+12V_FAN		
	8	+5V_AUX_RTN		

INPUT/OUTPUT CONNECTOR AND SIGNAL SPECIFICATION AND MATING CONNECTORS – PQC650-xxP

Connector	PIN	Description	Technical Data	Manufacturer
Input Connector J1	1	AC Line/L1	250V, 7.5A, 3 positions. Flame Rated: UL94V-0; 5.08mm Pitch	JST Connectors, B03P-VL (VL Series) Mating Half: JST Housing VLP-03V Crimps/Terminals: SVF-61T-P2.0; 20-14AWG & SVT-81T-P2.0 12AWG
	2	AC Neutral/L2		
	3	Protective Earth (PE)/Ground		
Output Connectors; J701	1	+DC_OUT_RTN	600V, 15A, Flame Rated at 94V-0; 90°C temperature rated	JST Connectors; B06P-VL (VL Series) Mating Half: JST Housing VLP-06V Crimps/Terminals: SVF-61T-P2.0; 20-14AWG & SVT-81T-P2.0 12AWG
	2			
	3			
	4	+DC_OUT		
	5			
	6			
Output Connector J3	1	+5V_AUX	250V, 3A, 8 positions. Flame RatedUL94V-0; 85°C (minimum)	PCB Connector: Molex 90130-1108 (C-Grid III™ Series Mating Half Housing: Molex 0901420008 Crimps Terminals/pins Molex 0901190109
	2	PWR_OK		
	3	+12V_FAN_RTN		
	4	PS_ON		
	5	+Remote Sense		
	6	-Remote Sense		
	7	+12V_FAN		
	8	+5V_AUX_RTN		

APPLICATION NOTES

Document Number	Description	Link to Document
ACAN-105	PQU650 External ORing deployment notes	http://power.murata.com/datasheet/?data/apnotes/acan-105.pdf
ACAN-106	PQU650 Installation/Thermal deployment notes	http://power.murata.com/datasheet/?data/apnotes/acan-106.pdf
ACAN-107	PQU650 Current Sharing deployment notes	http://power.murata.com/datasheet/?data/apnotes/acan-107.pdf
PQU-COVER	Cover Kit datasheet	https://power.murata.com/data/acdcsupplies/pqu650-cover.pdf

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