TECHNICAL REFERENCE NOTE

ARTESYN ADQ800-48S12B SERIES

800 Watts Quarter brick Converter

PRODUCT DESCRIPTION

Advanced Energy's Artesyn ADQ800-48S12B is a single output DC-DC converter with standard quarter-brick outline and pin configuration. It delivers up to 70A output current with 11.8VDC output voltage. Ultra-high 96.0% efficiency and excellent thermal performance makes it an ideal choice for use in datacom and telecommunication applications and can work under -40 ^{O}C ~ +85 ^{O}C with air cooling.

AT A GLANCE

Total Power

800 Watts

Input Voltage

40 to 60 VDC

# of Outputs

Single

RoHS

SPECIAL FEATURES

- Delivering up to 70A output
- Ultra-high efficiency 96.0% typ. at 50% load
- Startup Pre-bias:0% to 95%Vout
- Input range: 40 to 60VDC
- Parallel and Droop current sharing
- Excellent thermal performance
- No minimum load requirement
- RoHS 3.0
- Remote control function
- Input under-voltage lockout
- Input over voltage lockout
- Output over current protection
- Output over voltage protection
- Industry standard quarter-brick pin-out outline
- Baseplated
- Pin length option: 4.6mm
- Over temperature protection

SAFETY

TUV	EN62368
UL	UL60950
TUV CB	IEC62368/ICE60950
UL94, V-0	
CE and UKCA Mark	

TYPICAL APPLICATIONS

- Telecom/ Datacom

MODEL NUMBERS

Standard	Output Voltage	Structure	Remote ON/OFF logic	RoHS Status
ADQ800-48S12B-4L	11.8Vdc	Baseplated	Negative	RoHS 3.0
ADQ800-48S12B-L	11.8Vdc	Baseplated	Negative	RoHS 3.0

Ordering Information

ADQ800	-	48	S	12	P	B	-	4	L
①		②	③	④	⑤	⑥		⑦	⑧

①	Model series	ADQ: high efficiency quarter brick series, 800: output power 800W
②	Input voltage	48: 40V ~ 60V input range, rated input voltage 48V
③	Output number	S: single output
④	Rated output voltage	12: 11.8V output
⑤	Remote on/off logic	Default: negative logic; P: positive logic
⑥	Baseplate	B: with baseplate; default: open frame
⑦	Pin length	-4: 4.8 mm, default: 5.8 mm
⑧	RoHS status	RoHS 3.0

Options

None

ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings

Stress in excess of those listed in the "Absolute Maximum Ratings" may cause permanent damage to the power supply. These are stress ratings only and functional operation of the unit is not implied at these or any other conditions above those given in the operational sections of this TRN. Exposure to any absolute maximum rated condition for extended periods may adversely affect the power supply's reliability.

Table 1. Absolute Maximum Ratings

Parameter	Model	Symbol	Min	Typ	Max	Unit
Input Voltage Operating –Continuous Non-operating 100ms	All	$V_{IN,DC}$	- -	- -	64 80	Vdc Vdc
Maximum Output Power	All	$P_{O,max}$	-	-	800	W
Isolation Voltage[1] Input to output	All		1500	-	-	Vdc
Ambient Operating Temperature	All	T_A	-40	-	+85	^{O}C
Storage Temperature	All	T_{STG}	-55		+125	^{O}C
Voltage at remote ON/OFF pin	All		-0.3	-	+12	Vdc
Humidity (non-condensing) Operating	All		-	-	95	%

Note 1 - 1mA for 60s, slew rate of 500V/1s

ELECTRICAL SPECIFICATIONS

Input Specifications

Table 2. Input Specifications

Parameter		Condition[1]	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, DC		All	$V_{IN,DC}$	40	48	60	Vdc
Input under-voltage lockout	Turn-on Voltage Threshold	$I_O = I_{O,max}$	$V_{IN,ON}$	36	38.7	40	Vdc
	Turn-off Voltage Threshold	$I_O = I_{O,max}$	$V_{IN,OFF}$	35	37	39	Vdc
	Lockout Voltage Hysteresis	$I_O = I_{O,max}$		1	-	3	Vdc
Input over voltage lockout	Turn-on Voltage Threshold	$I_O = I_{O,max}$	$V_{IN,ON}$	60.5	62.3	64.5	Vdc
	Turn-off Voltage Threshold	$I_O = I_{O,max}$	$V_{IN,OFF}$	62.5	64.5	66.5	Vdc
	Lockout Voltage Hysteresis	$I_O = I_{O,max}$		1	-	3	Vdc
Maximum Input Current ($I_O = I_{O,max}$)		$V_{IN,DC}$ = 40Vdc	$I_{IN,max}$	-	-	21	A
No Load Input Current		$V_{IN,DC}$ = 48Vdc	I_{IN}	-	150	-	mA
Standby Input Current		Remote Off	I_{IN}	-	10	100	mA
Recommended Input Fuse		Fast blow external fuse recommended		-	-	30	A
Recommended External Input Capacitance		Low ESR capacitor recommended	C_{IN}	220	-	-	uF
Input Ripple Current		Through 12uH inductor		-	100	-	mA
Input Filter Component Value(C\L)		Internal values		-	18.8\0.22	-	µF\µH
Operating Efficiency		T_A=25 °C $I_O = I_{O,max}$ $I_O = 50\% I_{O,max}$	η	- -	96.0 96.0	- -	% %

Note 1 - Ta = 25 °C, airflow rate = 400 LFM, Vin = 48Vdc, nominal Vout unless otherwise noted.

ELECTRICAL SPECIFICATIONS

Output Specifications

Table 3. Output Specifications

Parameter		Condition[1]	Symbol	Min	Typ	Max	Unit
Factory Set Voltage		$V_{IN,DC}$ = 48Vdc I_O=$I_{O,max}$	V_O	11.68	11.8	11.92	Vdc
Output Voltage Line Regulation		All	$\pm V_O$	-	20	60	mV
Output Voltage Load Regulation		All	$\pm V_O$	-	200	300	mV
Output Voltage Temperature Regulation		All	$\%V_O$	-	0.002	0.02	%/^{O}C
Output Ripple, pk-pk		20MHz bandwidth	V_O	-	100	-	mV_{PK-PK}
Output Current		All	I_O	0	-	70	A
Output DC current-limit inception[2]			I_O	77		98	A
V_O Load Capacitance[3]		All	C_O	330	-	5000	uF
V_O Dynamic Response	Peak Deviation	50%~75%~50% $I_{O,max}$ slew rate = 0.1A/us	$\pm V_O$	-	80	-	mV
	Settling Time		T_s	-	200	-	uSec
	Peak Deviation	50%~75%~50% $I_{O,max}$ slew rate = 1A/us	$\pm V_O$	-	150	-	mV
	Settling Time		T_s	-	200	-	uSec
Turn-on transient	Off-state voltage			-0.3		1.2	Vdc
	On-state voltage			3.5		12	Vdc
	Off-state voltage			3.5		12	Vdc
	On-state voltage			-0.3		1.2	Vdc
Output over-voltage protection[4]		All		13.8	-	16	Vdc
Pre-bias			$\%V_O$	0	-	95	%
Output over-temperature protection[5]		All	T	-	110	-	^{O}C
Over-temperature hysteresis		All	T	5	-	-	^{O}C
Switching frequency		All	f_{SW}		175		kHZ
Remote ON/OFF control (positive logic)	Off-state voltage			-0.3		1.2	Vdc
	On-state voltage			3.5		12	Vdc
Remote ON/OFF control (negative logic)	Off-state voltage			3.5		12	Vdc
	On-state voltage			-0.3		1.2	Vdc

ELECTRICAL SPECIFICATIONS

Output Specifications

Table 3. Output Specifications Con't

Parameter	Condition[1]	Symbol	Min	Typ	Max	Unit
MTBF	Telcordia SR-332 Method 1 Case 1 Rated Output@80% load 300LFM, 40 ^{O}C T_A		-	1.5	-	10^6 h

Note 1 - T_A = 25 ^{O}C, airflow rate = 400 LFM, Vin = 48Vdc, nominal Vout unless otherwise noted.
Note 2 - Hiccup: auto-restart when over-current condition is removed.
Note 3 - The output capacitance is OSCON or similar type.
Note 4 - Hiccup: auto-restart when over-voltage condition is removed
Note 5 - Auto recovery; over-temperature protect(OTP) test point: See Figure 10

ELECTRICAL SPECIFICATIONS

ADQ800-48S12B Performance Curves

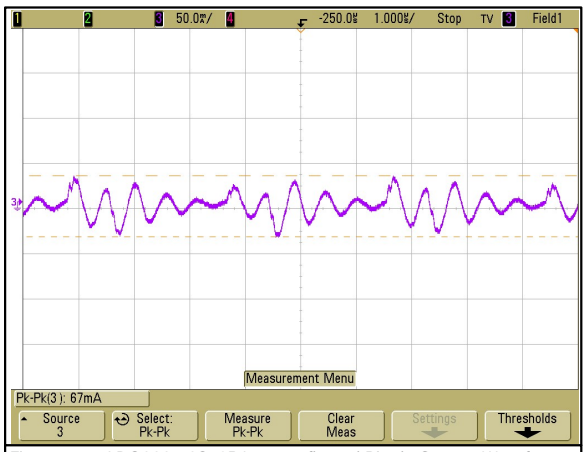


Figure 1: ADQ800-48S12B Input reflected Ripple Current Waveform

Ch 3 : Iin (1uS/div, 50mA/div)

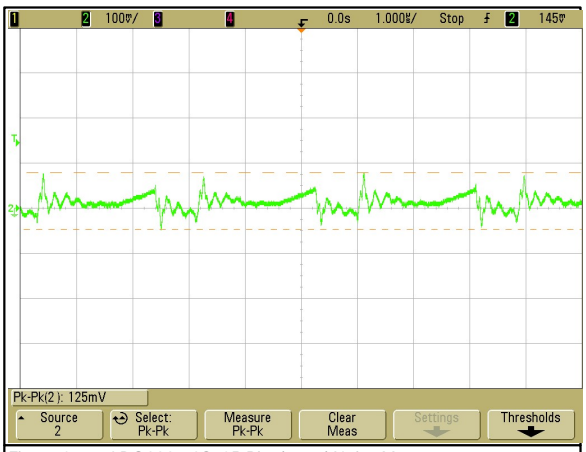


Figure 2: ADQ800-48S12B Ripple and Noise Measurement

Ch 2 : Vo (1uS/div, 100mV/div)

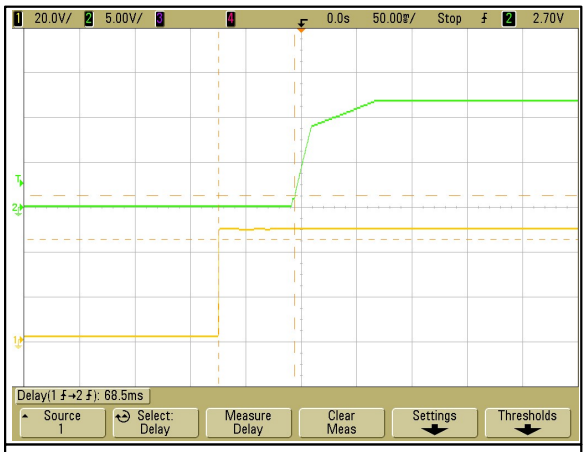


Figure 3: ADQ800-48S12B Output voltage startup by power on (20mS/div)

Ch 1: Vin (20V/div) Ch 2: Vo (5V/div)

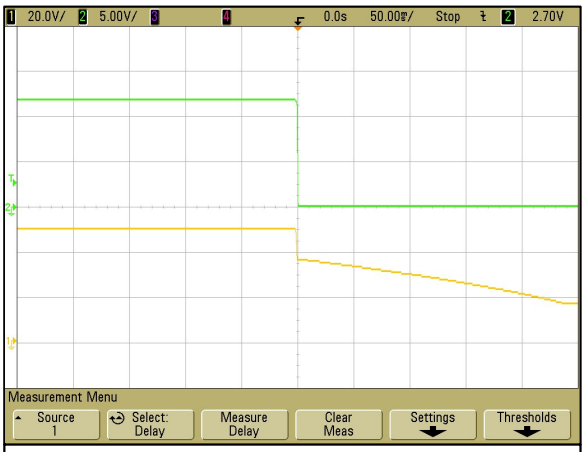


Figure 4: ADQ800-48S12B Output voltage shut down by power Off (2mS/div)

Ch 1: Vin (20V/div) Ch 2: Vo (5V/div)

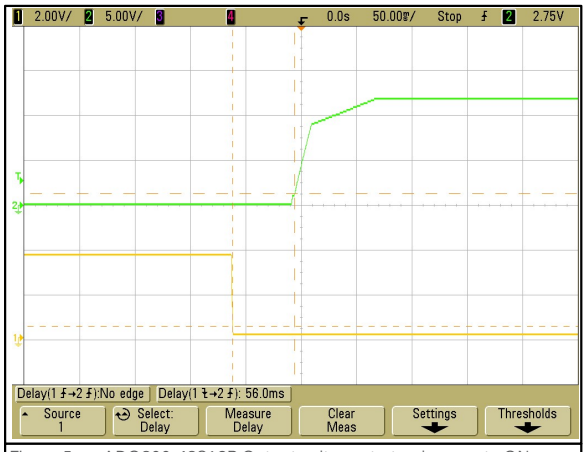


Figure 5: ADQ800-48S12B Output voltage startup by remote ON (20mS/div)

Ch 1: Remote ON (2V/div) Ch 2: Vo (5V/div)

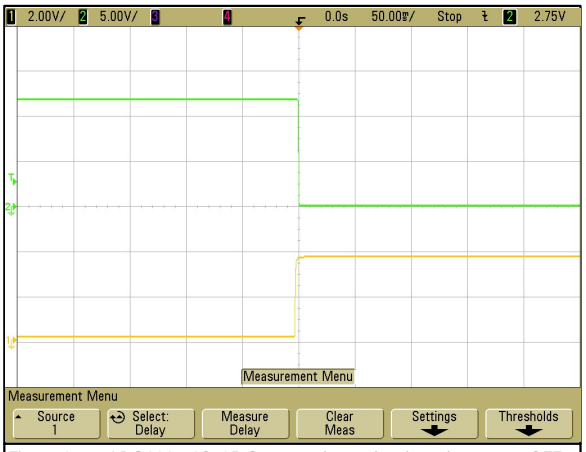


Figure 6: ADQ800-48S12B Output voltage shutdown by remote OFF (5mS/div)

Ch 1: Remote OFF (2V/div) CH2: Vo (5V/div)

ELECTRICAL SPECIFICATIONS

ADQ800-48S12B Performance Curves

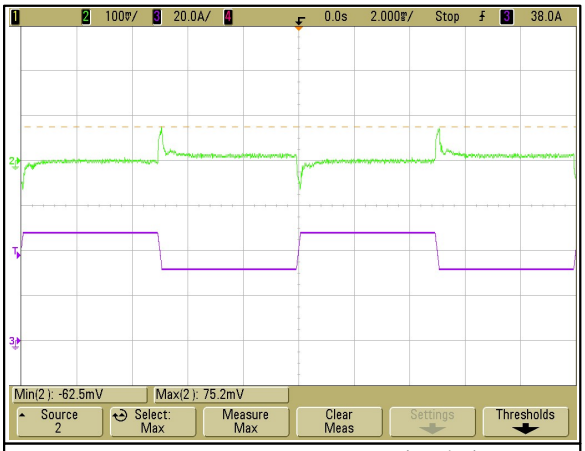


Figure 7: ADQ800-48S12B Transient Response (2mS/div)
25% load step(50%~75%~50%), 0.1A/µs slew rate
Ch 2: Vo (200mV/div) Ch 3: Io (20A/div)

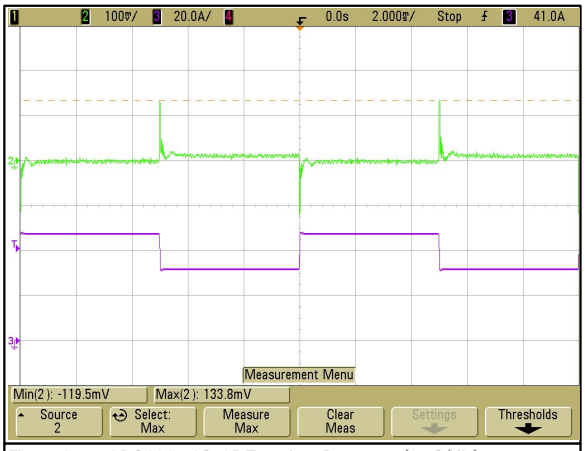


Figure 8: ADQ800-48S12B Transient Response (2mS/div)
50% load step(50%~75%~50%) , 1A/µs slew rate
Ch 2: Vo (200mV/div) Ch 3: Io (20A/div)

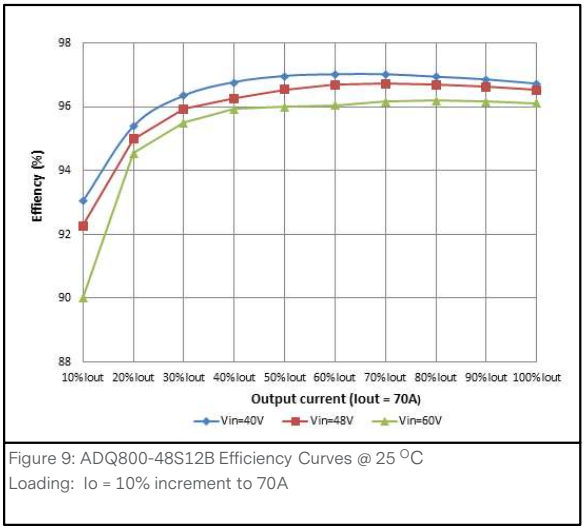
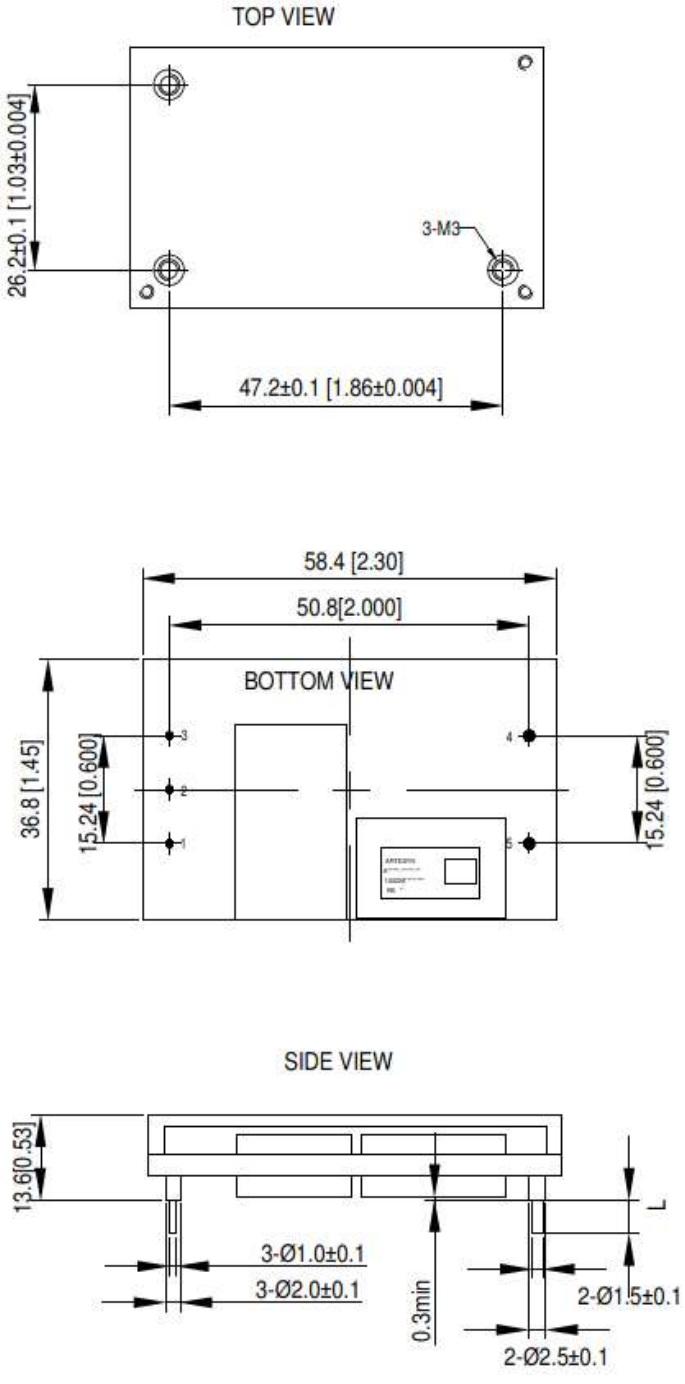


Figure 9: ADQ800-48S12B Efficiency Curves @ 25 ^{O}C
Loading: Io = 10% increment to 70A

MECHNICAL SPECIFICATIONS

Mechanical Outlines- Baseplate Module



UNIT: mm[inch]

TOLERANCE: X.X mm±0.5 mm[X.XX in. ±0.02 in.]

X.XX mm±0.25 mm[X.XXX in. ±0.01 in.]

Note: Depth penetration into base plate, of M3 screws used at baseplate mounting holes, not to exceed maximum of 3.0mm

MECHNICAL SPECIFICATIONS

Pin Length Option

Device code suffix	L
-4	4.8±0.25 mm
-6	3.8±0.25 mm
-8	2.8±0.25 mm
None	5.8±0.25 mm

Pin Designations

Pin No	Name	Function
1	Vin+	Positive input voltage
2	Remote ON/OFF	Remote control
3	Vin-	Negative input voltage
4	Vo-	Negative output voltage
5	Vo+	Positive output voltage

ENVIRONMENTAL SPECIFICATIONS

EMC Immunity

ADQ800-48S12B power supply is designed to meet the following EMC immunity specifications:

Table 4. Environmental Specifications:

Document	Description	Criteria
EN55032, Class A Limits	Conducted EMI Limits, DC input port	A
IEC/EN 61000-4-2, Level 3	Electromagnetic Compatibility (EMC) - Testing and measurement techniques: Electrostatic discharge immunity test	B
IEC/EN 61000-4-4, Level3	Electromagnetic Compatibility (EMC) - Testing and measurement techniques: Electrical Fast Transient. DC input port.	B
IEC/EN 61000-4-5	Electromagnetic Compatibility (EMC) - Testing and measurement techniques: Immunity to surges - 600V common mode and 600V differential mode for DC port	B
IEC/EN 61000-4-6, Level 2	Electromagnetic Compatibility (EMC) - Testing and measurement techniques: Continuous Conducted Interference. DC input port	A
EN61000-4-29	Electromagnetic Compatibility (EMC) - Testing and measurement techniques: Voltage Dips and short interruptions and voltage variations. DC input port	B

Criterion A: Normal performance during and after test.
Criterion B: Output voltage fluctuation or reset is allowed during the test, but recovers to its normal performance automatically after the disturbance ceases.
Criterion C: Temporary loss of output, the correction of which requires operator intervention.
Criterion D: Loss of output which is not recoverable, owing to damage to hardware

Recommend EMC Filter Configuration

See figure 17

ENVIRONMENTAL SPECIFICATIONS

Safety Certifications

The ADQ800-48S12B power supply is intended for inclusion in other equipment and the installer must ensure that it is in compliance with all the requirements of the end application. This product is only for inclusion by professional installers within other equipment and must not be operated as a stand alone product.

Table 5. Safety Certifications for ADQ800-48S12B series module

Standard	Agency	Description
UL 60950-1:2007/R:2014-10, CAN/CSA-C22.2 No. 60950-1:2007/A2:2014-10	UL+CUL	US and Canada Requirements
IEC 62368-1:2014	TUV-SUD CB	International Requirements
IEC 60950-1:2005 (2nd Edition)	TUV-SUD CB	International Requirements
EN 62368-1:2014/A11:2017	TUV-SUD	International Requirements
EN 50581:2012	CE	CE marking
UL94		Materials meet V-0 flammability rating
UKCA Mark		UK Requirements

ENVIRONMENTAL SPECIFICATIONS

Thermal Considerations – Baseplate module(ADQ800-48S12B)

The converter is designed to operate in different thermal environments and sufficient cooling must be provided. Proper cooling can be verified by measuring the temperature at the test point as shown in the Figure 10. The temperature at this point should not exceed the max values in the table 6.

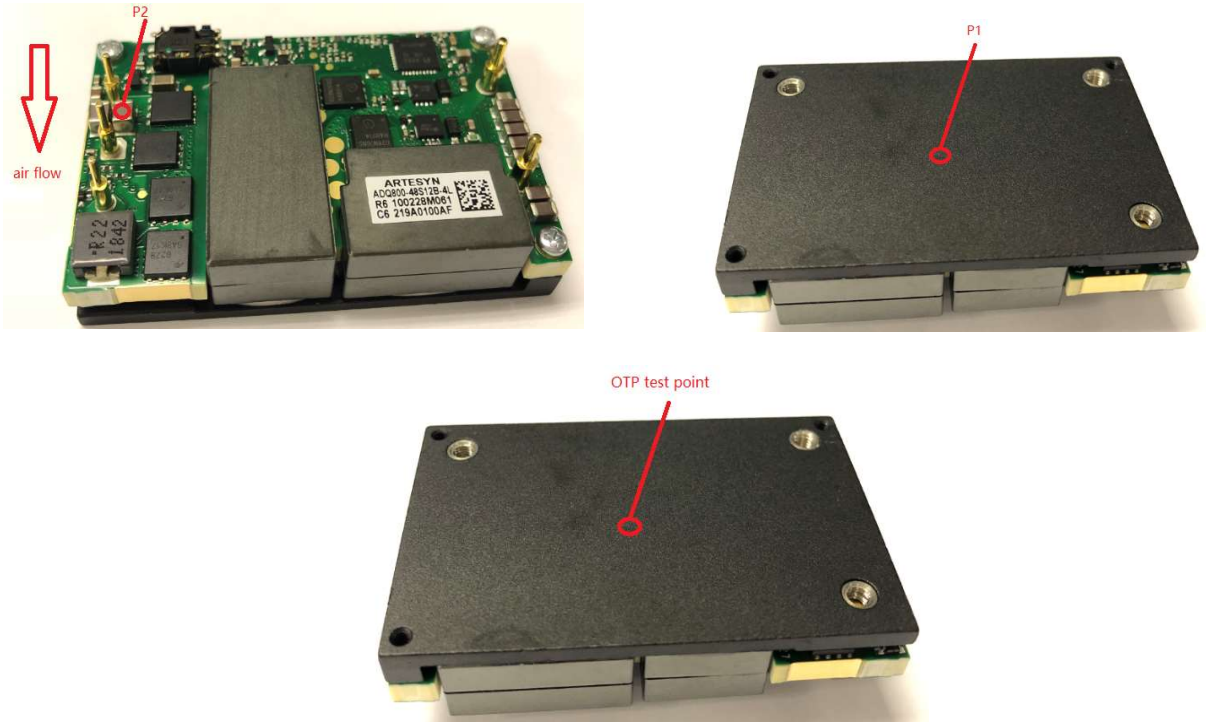


Figure 10 Temperature test point

Table 6. Temperature limit of the test points

Test Point	Description
P1	120°C
P2	115 °C

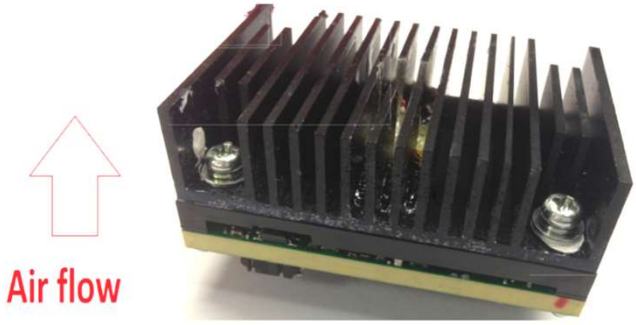


Figure 11 Typical test condition, heatsink

ENVIRONMENTAL SPECIFICATIONS

Thermal Considerations – Baseplate module(ADQ800-48S12B)

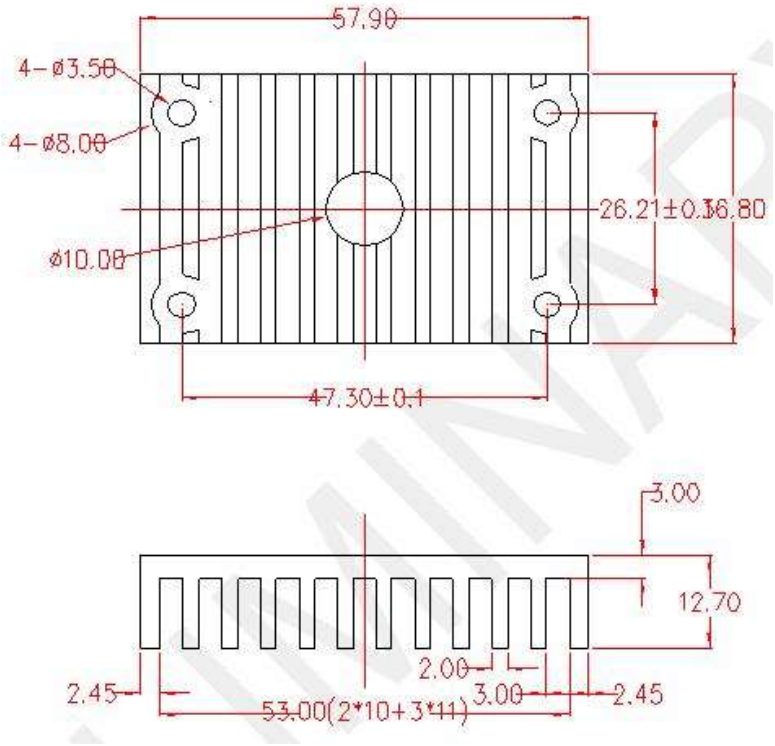


Figure 12 Typical test condition, Heatsink

Baseplate with heatsink unit Thermal De-rating data

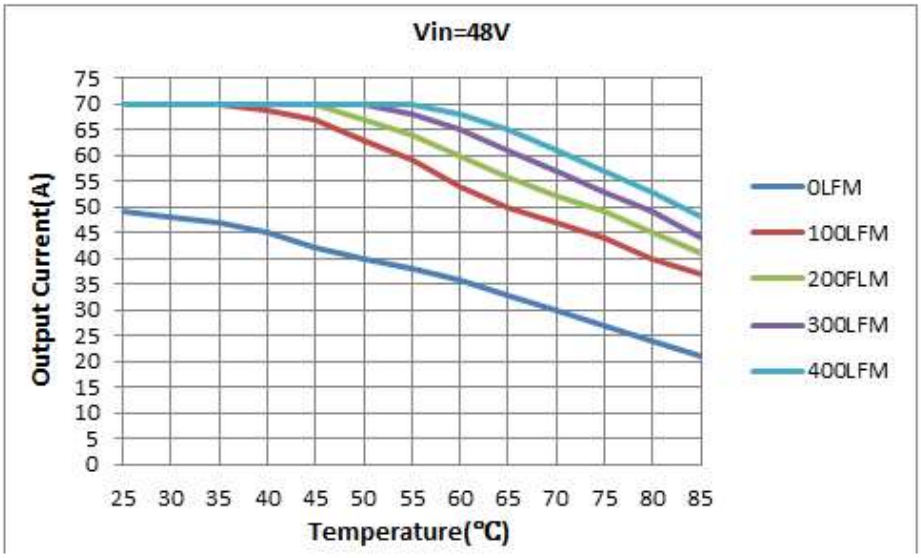


Figure 13 Output power derating, 48Vin, air flowing across the converter from Vin- to Vin+

ENVIRONMENTAL SPECIFICATIONS

Parameter	Unit (pcs)	Test condition
Halt test	4-5	Ta,min-20 ^{O}C to Ta,max+30 ^{O}C, 5 ^{O}C step, Vin = min to max, 0 ~ 100% load
Vibration	3	Frequency range: 5Hz ~ 20Hz, 20Hz ~ 200Hz, A.S.D: 1.0m^2/s^3, -3db/oct, axes of vibration: X/Y/Z Time: 30min/axes
Mechanical Shock	3	30g, 6ms, 3axes, 6directions, 3times/direction
Thermal Shock	3	-55 ^{O}C to 125 ^{O}C, unit temperature 20 cycles
Thermal Cycling	3	-40 ^{O}C to 85 ^{O}C, temperature change rate: 1 ^{O}C/min, cycles: 2 cycles
Humidity	3	40 ^{O}C, 95%RH, 48h
Solder Ability	15	IPC J-STD-002C-2007

APPLICATION NOTES

Typical Application

Below is the typical application of the ADQ800-48S12B power supply.

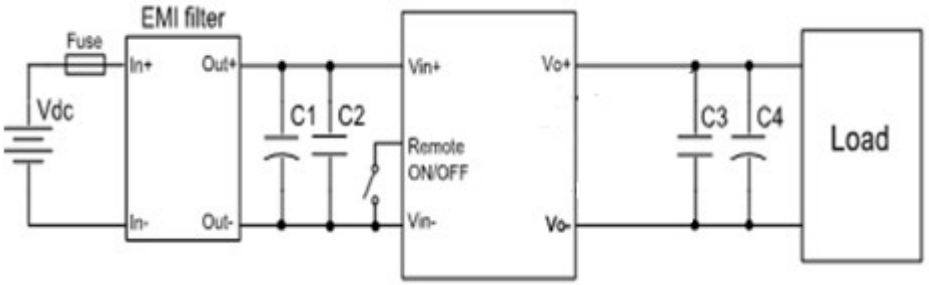


Figure 14 Typical application

C1: 220uF/100V electrolytic capacitor, P/N: UPM2A221MPD (Nichicon) or equivalent caps

C2,C3: 1uF/100V X7R ceramic capacitor, P/N: C3225X7R2A105KT0L0U (TDK) or equivalent caps

C4: 330μF/16V Oscon capacitor, P/N: 16SEPC330M (OS-CON) or equivalent caps

Fuse: External fast blow fuse with a rating of 30A/250Vac. The recommended fuse model is 0314030 MRP from Karwin Tech limited.

EMI filter: refer to Figure 17

APPLICATION NOTES

Remote ON/OFF

Either positive or negative remote ON/OFF logic is available in ADQ800-48S12B. The logic is CMOS and TTL compatible.

Below is the detailed internal circuit and reference in ADQ800-48S12B.

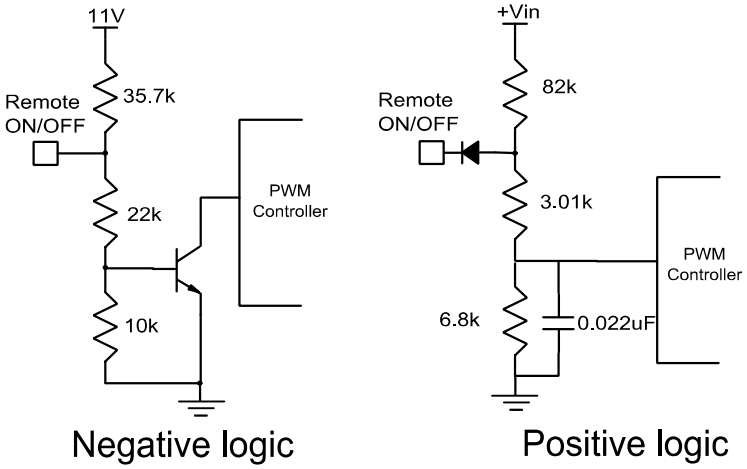


Figure 15 Remote ON/OFF internal diagram

APPLICATION NOTES

Input Ripple & Output Ripple & Noise Test Configuration

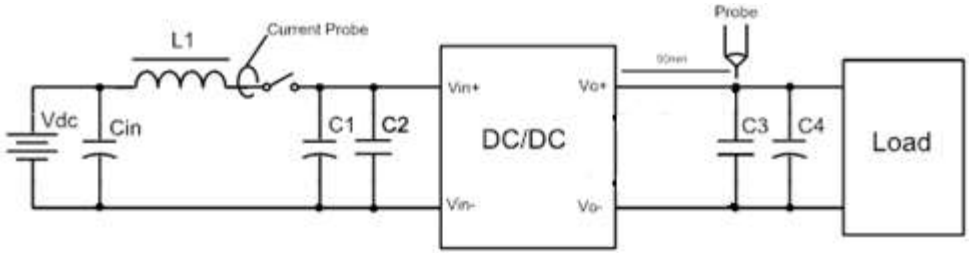


Figure 16 Input ripple & inrush current & ripple and noise test configuration

Vdc: DC power supply
L1:12uH
Cin: 220uF/100V typical
C1~C4: See Figure 14

Note - Using a coaxial cable with series 50ohm resistor and 0.68uF ceramic capacitor or a ground ring of probe to test output ripple & noise is recommended.

APPLICATION NOTES

EMC Test Conditions

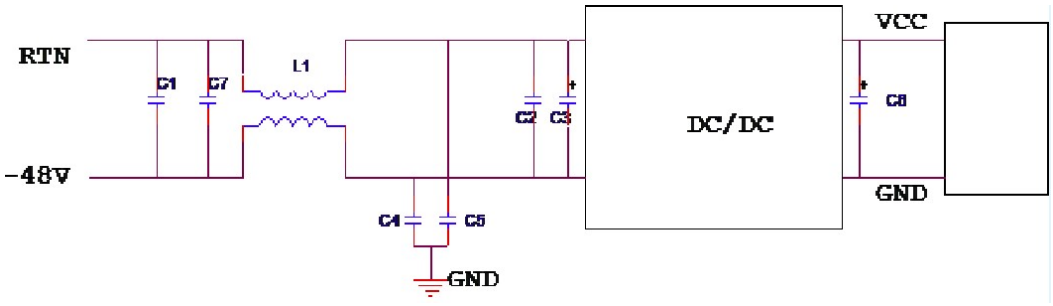


Figure 17 EMC test conditions

DC/DC: Module to test, ADQ800-48S12B

C1, C7 : 3300nF/100V/X7R capacitor

C2 : 100nF/100V/X7R capacitor

C4, C5 : 0.68μF/630V/X7T, Y capacitor

L1 : 473μH, common mode inductor

C3: 220μF/100V electrolytic capacitor

C6: 330μF/16V Oscon capacitor

APPLICATION NOTES

Parallel and Droop Current Sharing

The modules are capable of operating in parallel, and realizing current sharing by droop current sharing method. There is about 200mV output voltage droop from 0A to full output Load, and there is no current sharing pin. By connecting the V_{in} pin and the V_{out} pin of the parallel module together, the current sharing can be realized automatically.

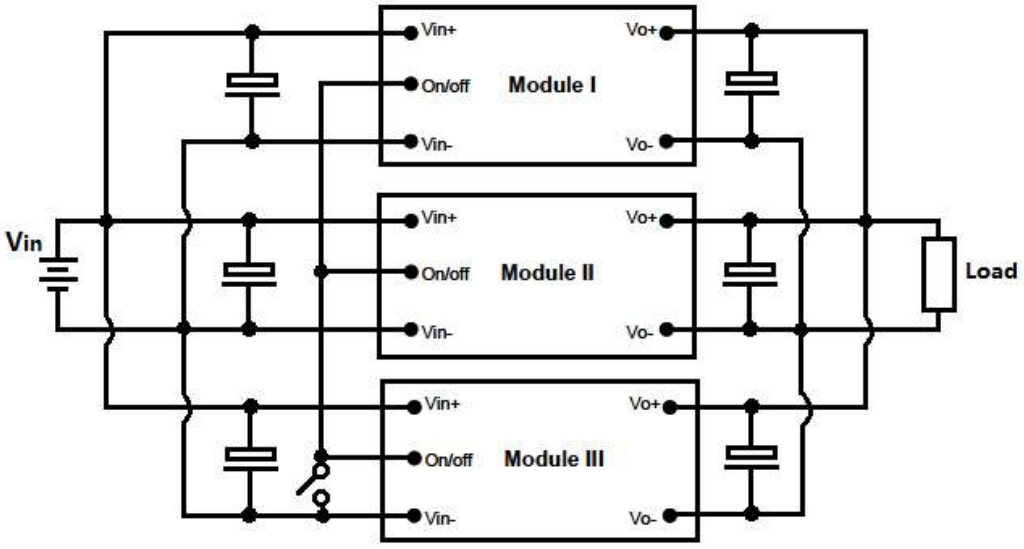


Figure 18 Parallel and droop current sharing configuration for no redundancy requirement system

If system has no redundancy requirement, the module can be parallel directly for higher power without adding external Oring-fet; whereas, if the redundancy function is required, the external Oring-fet should be added.
1. To ensure a better steady current sharing accuracy, below design guideline should be followed:
a) The inputs of the converters must be connected to the same voltage source; and the PCB trace resistance from Input voltage source to V_{in}+ and V_{in}- of each converter should be equalized as much as possible.
b) The PCB trace resistance from each converter's output to the load should be equalized as much as possible.
c) For accurate current sharing accuracy test, the module should be soldered in order to avoid the unbalance of the touch resistance between the modules to the test board.
2. V_{in} must remain between 40Vdc and 60Vdc for droop sharing to be functional.
3. It is permissible to use a common Remote On/Off signal to start all modules in parallel.
4. Modules in parallel condition may automatically increase the Turn On delay, if output voltage is present on the output bus at startup.
5. When parallel modules startup into a pre-biased output, e.g. partially discharged output capacitance, the Rise time is automatically increased to insure graceful startup.
6. Insure that the total load is <100% $I_{o,max}$ (for a single module) until all parallel modules have started (load full start > module $T_{delay\ time\ max}$ + $T_{rise\ time}$).
7. If fault tolerance is desired in parallel applications, output ORing devices should be used to prevent a single module failure from collapsing the load bus.

SOLDERING INFORMATION

Soldering

The product is intended for standard manual or wave soldering.

When wave soldering is used, the temperature on pins is specified to maximum 260 ^{O}C for maximum 10s.

When soldering by hand, the iron temperature should be maintained at 300 ^{O}C ~ 380 ^{O}C and applied to the converter pins for less than 10s. Longer exposure can cause internal damage to the converter.

Cleaning of solder joint can be performed with cleaning solvent IPA or simulative.

RECORD OF REVISION AND CHANGES

Issue	Date	Description	Originators
1.0	04.01.2020	First Issue	K. Wang
1.0	04.21.2017	First Issue	A. Li
1.1	06.26.2017	Update the product photo on page 1	A .Zhang
1.2	04.01.2019	Add the note about the output capacitance Update the safety to 62368	K. Wang
1.3	11.26.2019	Update the soldering information	K. Wang
1.4	11.29.2019	Add latest model number and RoHS data	C. Yan
1.5	04.07.2021	Add note for screw depth in mechanical part	V. Guo
1.6	04.19.2022	Add UKCA Mark	J. Zhang
1.7	02.22.2023	Update MTBF issue	K. Wang

ABOUT ADVANCED ENERGY

Advanced Energy (AE) has devoted more than three decades to perfecting power for its global customers. AE designs and manufactures highly engineered, precision power conversion, measurement and control solutions for mission-critical applications and processes.

Our products enable customer innovation in complex applications for a wide range of industries including semiconductor equipment, industrial, manufacturing, telecommunications, data center computing, and medical. With deep applications know-how and responsive service and support across the globe, we build collaborative partnerships to meet rapid technological developments, propel growth for our customers, and innovate the future of power.

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ADQ800-48S12B -Rev.02.22.23_#1.7