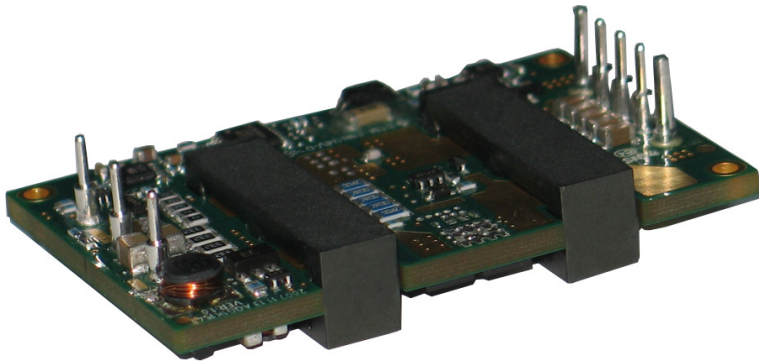
AGQ200-48S1V5

60 Watts

Quarter-brick Converter

Total Power: 200 Watts
Input Voltage: 36 to 75 Vdc
# of Outputs: Single



Special Features

- Industry standard quarter brick
- Basic isolation
- Ultra-high efficiency
- Improved thermal performance
- High power density
- Low output noise
- Industry standard pinout
- 2:1 wide input range: 36V ~ 75V
- CNT function
- Remote sense
- Trim function
- Over temperature protection
- Output over current protection
- Output over voltage protection
- RoHS compliant
- CNT function logic optional
- Pin length optional

Safety

IEC/EN/UL/CSA 60950
CE Mark
UL/TUV

Product Descriptions

The AGQ200-48S1V5 is a single output DC/DC converter with standard quarter brick form factor and output is isolated from input. It delivers up to 40A output current with 1.5V output, provides CNT and trim functions. Ultra-high efficiency and excellent power density makes it an ideal choice for use in use in computing and telecommunication applications and can operate over an ambient temperature range of -40 ^{O}C ~ +85 ^{O}C, for most applications a heatsink is not required.

Applications

Telecom/ Datacom

ARTESYN™
EMBEDDED TECHNOLOGIES

Model Numbers

Standard	Output Voltage	Structure	Remote ON/OFF logic	RoHS Status
AGQ200-48S1V5-4L	1.5Vdc	No baseplate	Negative	R6
AGQ200-48S1V5-6L	1.5Vdc	No baseplate	Negative	R6
AGQ200-48S1V5B-4L	1.5Vdc	Baseplate	Negative	R6
AGQ200-48S1V5P-4L	1.5Vdc	No baseplate	Positive	R6
AGQ200-48S1V5PB-4L	1.5Vdc	Baseplate	Positive	R6

Ordering information

AGQ200	-	48	S	1V5	P	B	-	4	L
①		②	③	④	⑤	⑥		⑦	⑧

①	Model series	AGQ: series name. The lower output is limited by its current
②	Input voltage	48: 36V ~ 75V input range, rated input voltage 48V
③	Output number	S: single output. D:dual output
④	Rated output voltage	1V5: 1.5V output
⑤	CNT logic	Default: negative logic; P: positive logic
⑥	Baseplate	B: baseplate; default: no baseplate
⑦	Pin length	4: 4.8±0.5mm
⑧	RoHS status	L: RoHS, R6; Y:RoHS, R5

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 All	$V_{IN,DC}$	 - -	 - -	 80 100	 Vdc Vdc
Maximum Output Power	All	$P_{O,max}$	-	-	60	W
Isolation Voltage Input to output	All		2000	-	-	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		-0.7	-	12	Vdc
Humidity (non-condensing) Operating Non-operating	 All		 5 5	 - -	 95 95	 %

Input Specifications

Table 2. Input Specifications:

Parameter	Conditions[1]	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, DC	All	$V_{IN,DC}$	36	48	75	Vdc
Maximum Input Current ($I_O = I_{O,max}$)	$V_{IN,DC}$ = 0 to $V_{I, max}$	$I_{IN,max}$	-	-	2.5	A
Input Reflected Ripple Current	Rated input and output		-	10	20	mA_{PK-PK}
Input voltage ripple rejection	120Hz		50	60	-	dB
Operating Efficiency	T_A=25 ^{O}C $V_{IN,DC}$ = 48V_{DC} $I_O = I_{O, max}$	η	84.0	-	-	%

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

Output Specifications

Table 3. Output Specifications:

Parameter		Condition[1]	Symbol	Min	Typ	Max	Unit
Factory Set Voltage		$V_{IN,DC}$ = 48V_{DC} I_O=$I_{O,max}$	V_O	1.48	1.50	1.52	Vdc
Total Regulation		Inclusive of line, load temperature change, warm-up drift	V_O	1.48	1.50	1.52	Vdc
Output Voltage Line Regulation		All	$\pm V_O$	-	3	5	mV
Output Voltage Load Regulation		All	$\pm V_O$	-	5	10	mV
Output Voltage Temperature Regulation		All	$\%V_O$	-	-	0.02	$\%/^OC$
Output Voltage Trim Range		All	$\%V_O$	80	-	110	%
Output Ripple, pk-pk		Measure with a 1uF ceramic capacitor in parallel with a 10uF tantalum capacitor, 0 to 20MHz bandwidth	V_O	-	-	100	mV_{PK-PK}
Output Current		All	I_O	0	-	40	A
Output DC current-limit inception[2]			I_O	44	-	56	A
V_O Load Capacitance		All	C_O	220	-	15000	uF
V_O Dynamic Response	Peak Deviation Settling Time	25% $I_{O,max}$ step from 50% $I_{O,max}$ load change slew rate = 0.1A/us	$\pm V_O$ T_s	- -	- -	90 400	mV uS
	Peak Deviation	75% $I_{O,max}$ step from 50% $I_{O,max}$ load change slew rate = 1A/us	$\pm V_O$	-	-	140	mV
	Peak Deviation	10% % $I_{O,max}$ to 100% $I_{O,max}$ slew rate = 0.1A/us	$\pm V_O$	-	-	200	mV
Turn-on transient	Turn-on delay time	I_O = $I_{max,}$ Vo within 1%	$T_{turn-on}$	-	10	20	mS
	Output voltage overshoot	I_O = I_{max} T_A = 25°C	$\%V_O$	-	-	5	%

Note 1 - Ta=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.

Output Specifications

Table 3. Output Specifications, con't:

Parameter		Condition	Symbol	Min	Typ	Max	Unit
Switching frequency		All	f_{SW}	-	300	-	KHz
Remote ON/OFF pin voltage	Logic low	All		-0.7	-	1.2	V
	Logic high	All		3.5	-	12	V
Remote ON/OFF pin current	Logic low	All		-	-	1.0	mA
	Logic high	All		-	-	-	uA
Output over-voltage protection[3]		All	$\%V_O$	120	-	140	%
Output over-temperature protection[4]		Board (for open frame)	T	111	120	130	^{O}C
		Hysteresis (for open frame)		5	-	-	
		At the center of baseplate		90	-	110	
		Hysteresis (for baseplate)		2	-	-	
Isolation capacitance		All		-	-	-	PF
Isolation resistance		All		10	-	-	MΩ
MTBF		$V_{IN,DC}$ = 48V_{DC} I_O=$I_{O,max}$, board@25 ^{O}C		-	2.5	-	10^6 h
Vibration (sine wave)		Vibration level: 3.5mm (2 ~ 9Hz), 10m/s² (9 ~ 200Hz),15m/s² (200 ~ 100Hz) Directions and time: 3 axes (X, Y, Z), 30 minutes each Sweep velocity: 1oct / min					
Shock (half-sine wave)		Peak acceleration: 300m/s² Duration time: 6ms Continuous shock 3 times at each of 6 directions (±X, ±Y, ±Z)					

Note 3 – Hiccup: auto-restart when over-voltage condition is removed.
Note 4 – Auto recovery.

AGQ200-48S1V5 Performance Curves

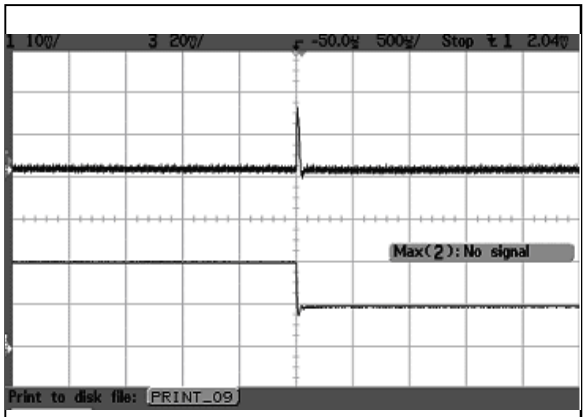


Figure 1: AGQ200-48S1V5 Transient Response
20A~10A load change, 1A/uS slew rate
Ch 1: Vo (x10) Ch 2: Io

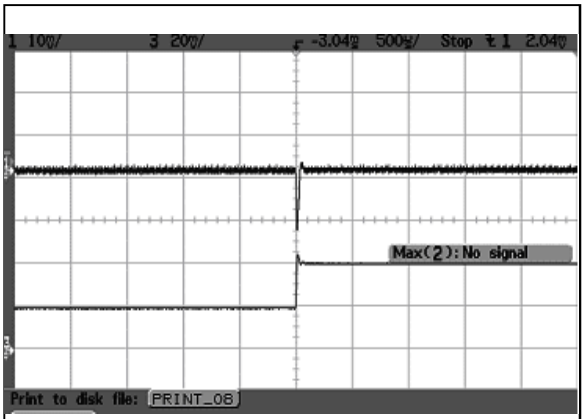


Figure 2: AGQ200-48S1V5 Transient Response
10A~20A load change, 1A/uS slew rate
Ch 1: Vo (x10) Ch 2: Io

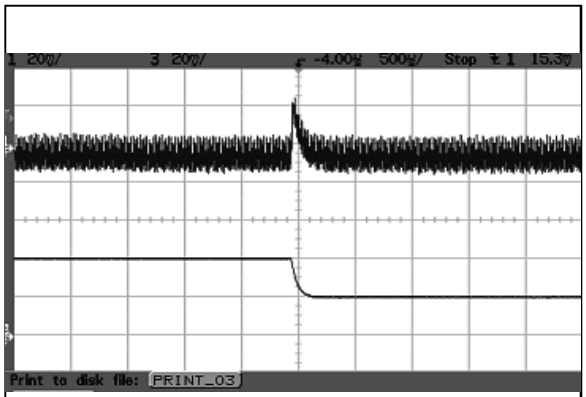


Figure 3: AGQ200-48S1V5 Transient Response
20A~10A load change, 0.1A/uS slew rate
Ch 1: Vo (x10) Ch 2: Io

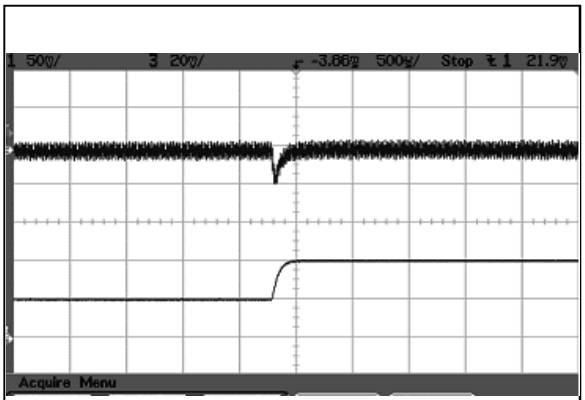


Figure 4: AGQ200-48S1V5 Transient Response
10A~20A load change, 0.1A/uS slew rate
Ch 1: Vo (x10) Ch 2: Io

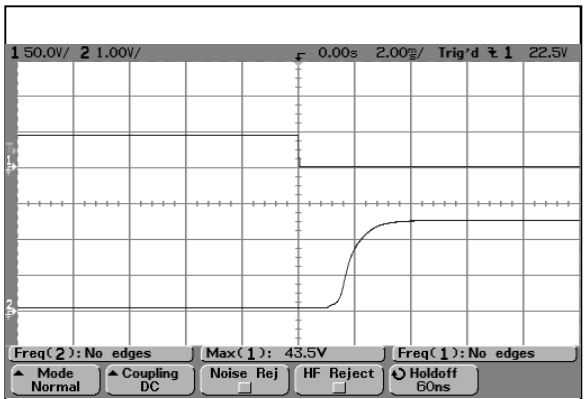


Figure 5: AGQ200-48S1V5 Output Voltage Startup Characteristic

Ch 1: CNT Ch 2: Vo

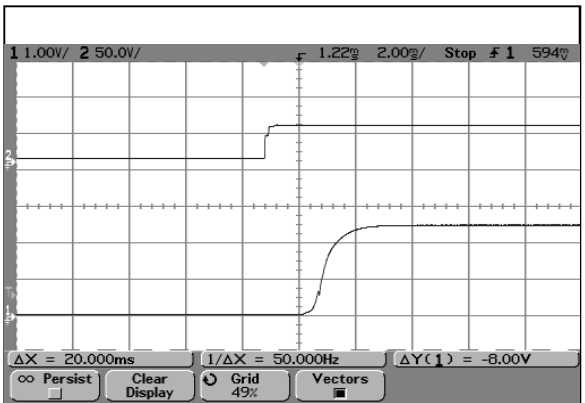


Figure 6: AGQ200-48S1V5 Output Voltage Startup Characteristic

Ch 1: Vin Ch 2: Vo

AGQ200-48S1V5 Performance Curves

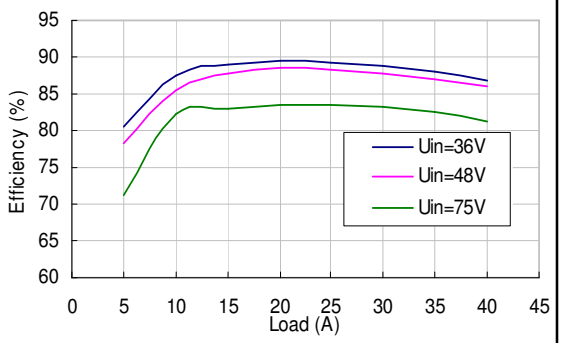


Figure 7: AGQ200-48S1V5 Efficiency Curves @ 25 °C, Vo=1.5V

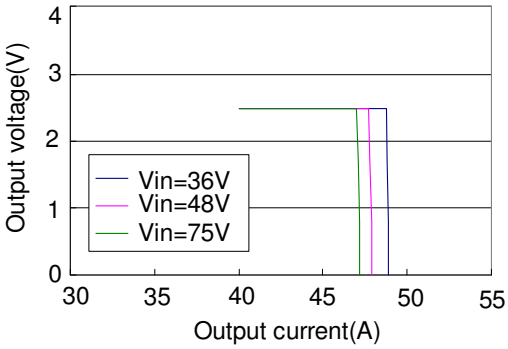


Figure 8: AGQ200-48S1V5 Current Limiting Curves

Protection Function Specification

Over Voltage Protection (OVP)

The output over-voltage protection consists of circuitry that monitors the voltage on the output terminals. If the voltage on the output terminals exceeds the over voltage protection threshold (120%~140% of the nominal output voltage), the module will shut down and attempt to restart normally once a second.

The protection mechanism is such that the unit can continue in this condition until the fault is cleared

Parameter	Min	Nom	Max	Unit
V_O Output Overvoltage	120	/	140	%V

Over Current Protection (OCP)

AGQ200-48S1V5 features foldback current limiting as part of their over-current protection (OCP) circuits. When output current exceeds 110% to 140% of the rated current, such as during a short circuit condition, the module will shut down and attempt to restart normally once a second.

Parameter	Min	Nom	Max	Unit
V_O Output Overcurrent	110	/	140	%A

Over-Temperature Protection (OTP)

These modules feature an over-temperature protection circuit to safeguard against thermal damage. The module will work on intermittent mode when the maximum device reference temperature is exceeded. When the over-temperature condition is removed, the converter will automatically restart.

Input Reverse Voltage Protection

Under installation and cabling conditions where reverse polarity across the input may occur, reverse polarity protection is recommended. Protection can easily be provided as shown in Figure 17. In both cases the diode used is rated for 10A/100V. Placing the diode across the inputs rather than in-line with the input offers an advantage in that the diode only conducts in a reverse polarity condition, which increases circuit efficiency and thermal performance.

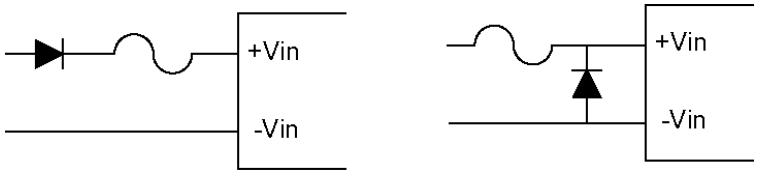
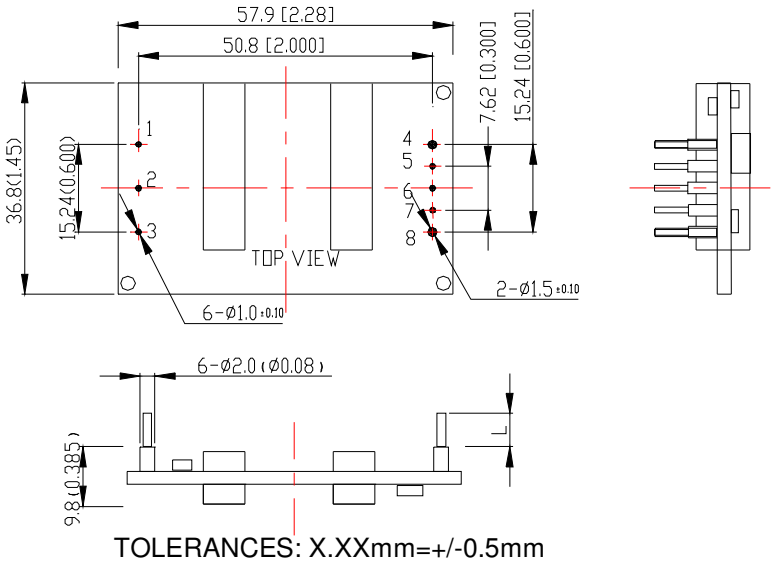


Figure 9 Reverse polarity protection circuit

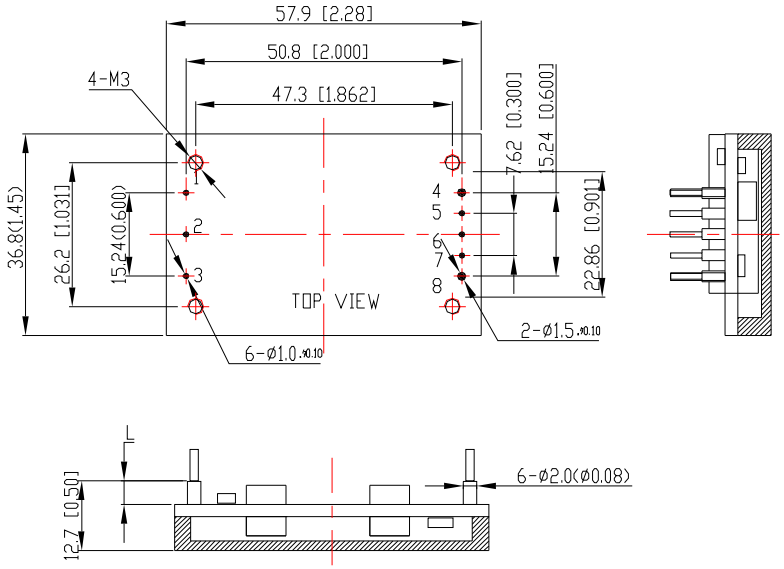
Mechanical Specifications

Mechanical Outlines – Open Fram Module



TOLERANCES: X.XXmm=+/-0.5mm
X.XXmm=+/-0.25mm

Mechanical Outlines – Baseplate Module



TOLERANCES: X.XXmm=+/-0.5mm
X.XXmm=+/-0.25mm

Mechanical Specifications

Pin Length Options

Device code suffix	L
-4	4.8mm±0.5 mm
-6	3.8mm±0.5 mm
-8	2.8mm±0.25 mm
None	5.8mm±0.5 mm

Pin Designations

Pin No	Name	Function
1	+Vin	Positive input voltage
2	CNT	Remote ON/OFF control
3	-Vin	Negative input voltage
4	+Vo	Positive output voltage
5	+Sense	Positive remote sense
6	Trim	Output voltage trim
7	-Sense	Negative remote sense
8	-Vo	Negative output voltage

Environmental Specifications

EMC

For conditions where EMI is a concern, a different input filter can be used. Figure 10 shows the filter designed to reduce EMI effects for AGQ200-48S1V5

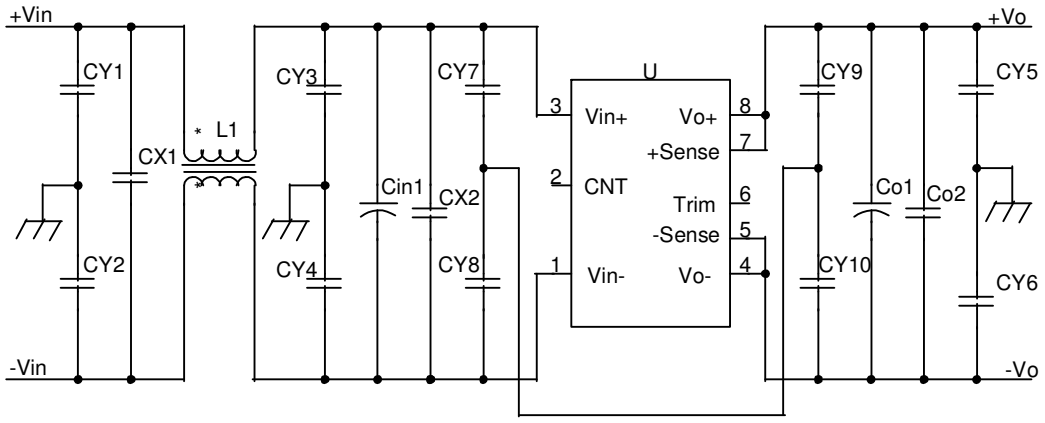


Figure 10 EMI reduction filter

Recommended values of EMC

Component	Value/rating	**Type**
CY1, CY2, CY5, CY6	4700PF/250Vac	Safety Y capacitor
CX1	2.2μ/100V	Materialized film capacitor
CY7, CY8, CY9, CY10	1000PF/250Vac	Safety Y capacitor
CY3,CY4	330PF/250V	Safety Y capacitor
Cin1	100μ/100V	Aluminum capacitor
CX2	1μ/100V	Chip ceramic capacitor
Cout1	220μ/16V (low ESR capacitor)	Aluminum capacitor
Cout2	1μ/10V	Chip ceramic capacitor
L1	0.5mH	Common mode

Safety Certifications

For safety-agency approval of the system in which the power module is used, the power module must be installed in compliance with the spacing and separation requirements of the end-use safety agency standards, i.e., UL1950, CSA C22.2 No. 950-95, and EN60950. AGQ200-48S1V5 input-to-output isolation is a basic insulation. The DC/DC power module should be installed in end-use equipment, in compliance with the requirements of the ultimate application, and is intended to be supplied by an isolated secondary circuit. When the supply to the DC/DC power module meets all the requirements for SELV (<60Vdc), the output is considered to remain within SELV limits (level 3). If connected to a 60Vdc power system, double or reinforced insulation must be provided in the power supply that isolates the input from any hazardous voltages, including the AC mains. One input pin and one output pin are to be grounded or both the input and output pins are to be kept floating. Single fault testing in the power supply must be performed in combination with the DC/DC power module to demonstrate that the output meets the requirement for SELV. The input pins of the module are not operator accessible.

Note: Do not ground either of the input pins of the module, without grounding one of the output pins. This may allow a non-SELV voltage to appear between the output pin and ground.

Table 4. Safety Certifications for AGQ200-48S1V5 series power supply system

Document	File #	Description
UL/CSA 60950		US and Canada Requirements
EN60950		European Requirements
IEC60950		International Requirements
CE		CE Marking

Fusing

AGQ200-48S1V5 has no internal fuse. An external fuse must always be employed. To meet international safety requirements, a 250 Volt rated fuse should be used. If one of the input lines is connected to chassis ground, then the fuse must be placed in the other input line.

Standard safety agency regulations require input fusing. Recommended ratings is 10A for AGQ200-48S1V5.

Note: The fuse is fast blow type.

Operating Temperature

The AGQ200 series power supplies will start and operate within stated specifications at an ambient temperature from -40 ^{O}C to 85 ^{O}C under all load conditions. The storage temperature is -55 ^{O}C to 125 ^{O}C.

Thermal Considerations

AGQ200-48S1V5 has ultra high efficiency at full load. With less heat dissipation and temperature-resistant components such as ceramic capacitors, these modules exhibit good performance during pro-longed exposure to high temperatures. Maintaining the operating board temperature within the specified range helps keep internal component temperatures within their specifications which in turn helps keep MTBF from falling below the specified rating. Proper cooling of the power modules is also necessary for reliable and consistent operation.

Measuring the board temperature of the module as the method shown in Figure 11 can verify the proper cooling. If the module has a baseplate, the measurement location is at the center of the baseplate.

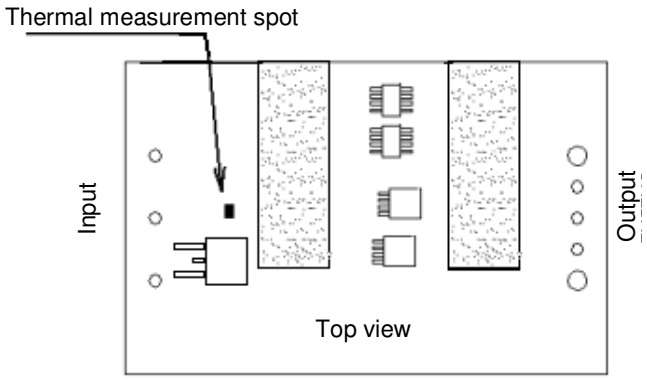


Figure 11 Temperature measurement spot

The module should work under 70 ^{O}C ambient for the reliability of operation and the board temperature must not exceed 105 ^{O}C while operating in the final system configuration. The measurement can be made with a surface probe after the module has reached thermal equilibrium. No heatsink is mounted, make the measurement as close as possible to the indicated position. It makes the assumption that the final system configuration exists and can be used for a test environment. Note that the board temperature of module must always be checked in the final system configuration to verify proper operation due to the variation in test conditions. Thermal management acts to transfer the heat dissipated by the module to the surrounding environment. The amount of power dissipated by the module as heat (PD) is got by the equation below:

$PD = PI - PO$

Where: PI is input power; PO is output power; PD is dissipated power.

Also, module efficiency (η) is defined as the following equation:

$\eta = PO/PI$

By eliminating the input power term, we can get the equation below from the above two equations:

$PD = PO (1-\eta)/\eta$

The module power dissipation then can be calculated through the equation.

Thermal Considerations Con't

With 48V input, 25 °C ambient temperature, and 200LFM airflow, AGQ200-48S1V5 is rated for full power. The board temperature should be used to determine maximum temperature limits. The module cannot work continuously when the board temperature is over 100 °C . The minimum operating temperature for AGQ200-48S1V5 is -40 °C. The derating curve for open-frame is shown in Figure 12 and the derating curve with baseplate is shown in Figure 13.

Increasing airflow over the module enhances heat transfer via convection.

The module is not designed to operate for a long time with the baseplate temperature being above 100 °C.

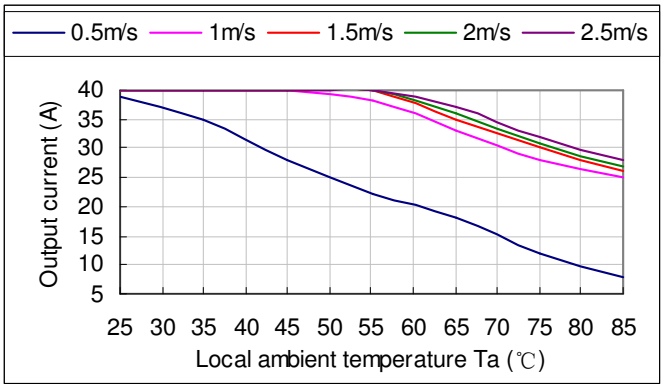


Figure 12 Derating curve of the module for open-frame, airflow rate from –Vin to +Vin

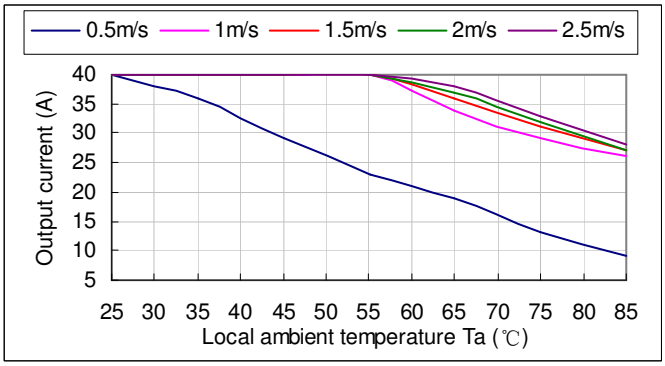


Figure 13 Derating curve of the module with baseplate, airflow rate from –Vin to +Vin

Application Notes

Typical Application

Below is the typical application of the AGQ200-48S1V5 series power supply.

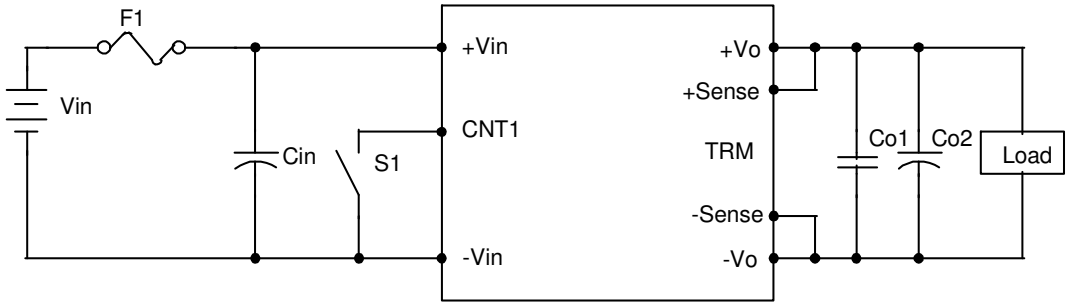


Figure 14 Typical application

F1: fast blow fuse with a rating of 1A

Cin: Recommended input capacitor, 100µF/100V high frequency low ESR electrolytic type capacitor.

Co1: Recommended 1µF/25V ceramic capacitor

Co2: Recommended output capacitor Recommended 220µF/16V high frequency low ESR electrolytic type capacitor.

If Ta<-5 ^{O}C, use 220µF tantalum capacitor parallel with Co2.

Note: AGQ200-48S1V5 cannot be used in parallel mode directly.

CNT Function

Two CNT logic options are available. The CNT logic, CNT voltage and the module working state are as the following table.

	L	H	OPEN
N	ON	OFF	OFF
P	OFF	ON	ON

N: negative logic
P: positive logic
L: low voltage, -0.7V≤L≤1.2V
H: high voltage, 3.5V≤H≤12V
ON: module is on
OFF: module is off
Open: CNT pin is left open
Note: Normally, VCNT ≤12V.
The following figure shows a few simple CNT circuits.

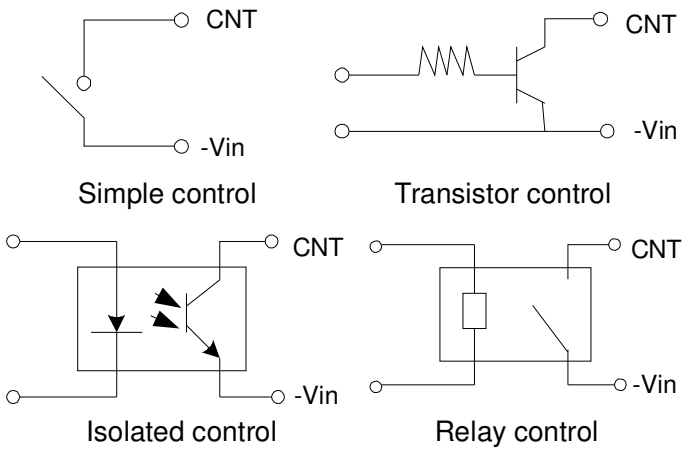


Figure 15 CNT circuit

Trim Characteristics

The +Vo output voltage of AGQ200-48S1V5 can be trimmed using the trim pin provided. Applying a resistor to the trim pin through a voltage divider from the output will cause the +Vo output to increase by up to 10%or decrease by up to 20%. Trimming up by more than 10% of the nominal output may activate the OVP circuit or damage the converter. Trimming down more than 20% can cause the converter to regulate improperly. If the trim pin is not needed, it should be left open.

Trim up

With an external resistor connected between the Trim and +Sense pins, the output voltage set point increases (see Figure 16).

The following equation determines the required external-resistor value to obtain a percentage output voltage change of %.

$$R_{adj-up} = \frac{5.1 \times V_{nom} \times (100 + \Delta)}{1.225 \times \Delta} - \frac{510}{\Delta} - 10.2(k\Omega)$$

Note: △= (Vo-Vnom)%100/Vnom

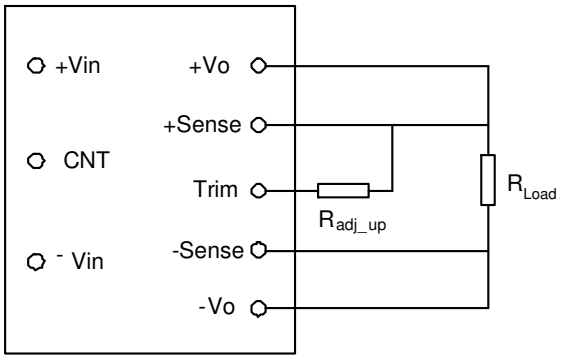


Figure 16 Trim up

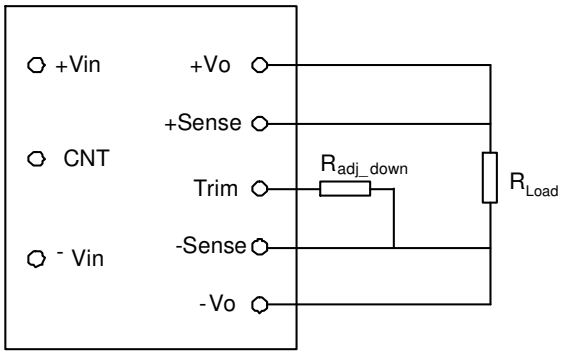


Figure 17 Trim down

Trim down

With an external resistor between the Trim and -Sense pins, the output voltage set point decreases (see Figure 17).

The following equation determines the required external-resistor value to obtain a percentage output voltage change of %.

$$R_{adj-down} = \frac{510}{\Delta} - 10.2(k\Omega)$$

Note: △= (Vnom-Vo)%100/Vnom

Although the output voltage can be increased by both the remote sense and the trim, the maximum increase for the output voltage is not the sum of both. The maximum increase is the larger of either the remote sense or the trim.

Note that at elevated output voltages the maximum power rating of the module remains the same, and the output current capability will decrease correspondingly.

Minimum Load Requirements

There is no minimum load requirement for AGQ200-48S1V5.

Output Capacitance

High output current transient rate of change (high di/dt) loads may require high values of output capacitance to supply the instantaneous energy requirement to the load. To minimize the output voltage transient drop during this transient, low equivalent series resistance (ESR) capacitors may be required, since a high ESR will produce a correspondingly higher voltage drop during the current transient.

When the load is sensitive to ripple and noise, an output filter can be added to minimize the effects. A simple output filter to reduce output ripple and noise can be made by connecting a capacitor C1 across the output as shown in Figure 18. The recommended value for the output capacitor C1 is 220µF.

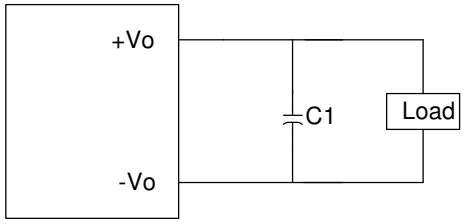


Figure 18 Output ripple filter

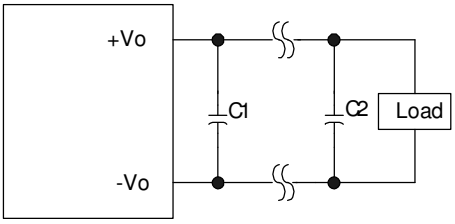


Figure 19 Output ripple filter for a distant load

Extra care should be taken when long leads or traces are used to provide power to the load. Long lead lengths increase the chance for noise to appear on the lines. Under these conditions C1 can be added across the load, with a 1µF ceramic capacitor C2 in parallel generally as shown in Figure 19

Decoupling

Noise on the power distribution system is not always created by the converter. High speed analog or digital loads with dynamic power demands can cause noise to cross the power inductor back onto the input lines. Noise can be reduced by decoupling the load. In most cases, connecting a 10µF tantalum or ceramic capacitor in parallel with a 0.1µF ceramic capacitor across the load will decouple it. The capacitors should be connected as close to the load as possible.

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Ground Loops

Ground loops occur when different circuits are given multiple paths to common or earth ground, as shown in Figure 20. Multiple ground points have slightly different potential and cause current flow through the circuit from one point to another. This can result in additional noise in all the circuits. To eliminate the problem, circuits should be designed with a single ground connection as shown in Figure 21.

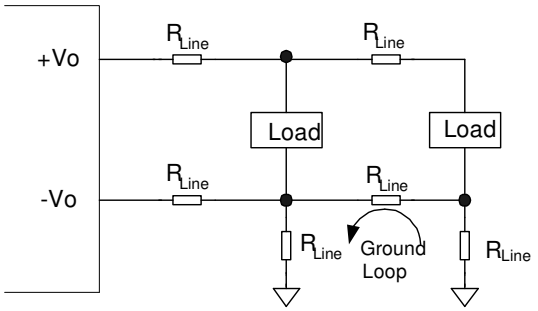

Figure 20 Ground loop

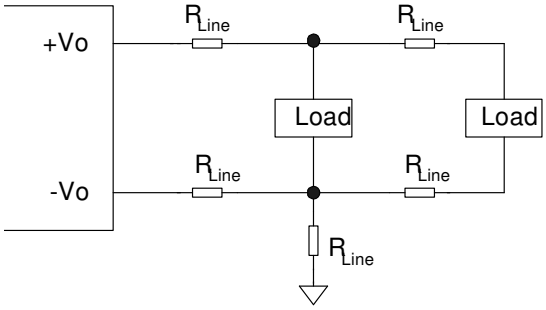

Figure 21 Single point ground

Remote Sense

AGQ200-48S1V5 can remotely sense both lines of its output which moves the effective output voltage regulation point from the output terminals of the unit to the point of connection of the remote sense pins. This feature automatically adjusts the real output voltage of AGQ200-48S1V5 in order to compensate for voltage drops in distribution and maintain a regulated voltage at the point of load.

When the converter is supporting loads far away, or is used with undersized cabling, significant voltage drop can occur at the load. The best defense against such drops is to locate the load close to the converter and to ensure adequately sized cable is used. When this is not possible, the converter can compensate for a drop of up to 10%Vo, through use of the sense leads.

When used, the + Sense and - Sense leads should be connected from the converter to the point of load as shown in Figure 22, using twisted pair wire, or parallel pattern to reduce noise effect. The converter will then regulate its output voltage at the point where the leads are connected. Care should be taken not to reverse the sense leads. If reversed, the converter will trigger over-voltage protection (OVP) protection.

When not used, the +Sense lead must be connected with +Vo, and -Sense with -Vo. Although the output voltage can be increased by both the remote sense and the trim, the maximum increase for the output voltage is not the sum of both.

The maximum increase is the larger of either the remote sense or the trim.

Note that at elevated output voltages the maximum power rating of the module remains the same, and the output current capability will decrease correspondingly.

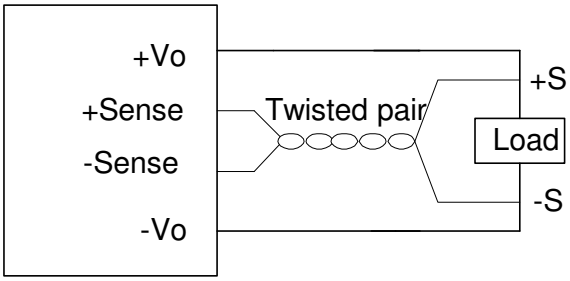

Figure 22 Sense connections

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MTBF

The MTBF, calculated in accordance with Bellcore TR-NWT-000332, is 2,500,000 hours. Obtaining this MTBF in practice is entirely possible. If the board temperature is expected to exceed +25 ^{O}C, then we also advise an oriented for the best possible cooling in the air stream.

Artesyn Embedded Technologies can supply replacements for converters from other manufacturers, or offer custom solutions. Please contact the factory for details.

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Weight

The AGQ200-48S1V5 series weight is 28g.typ. for open frame module.

Installation

Although AGQ200-48S1V5 can be mounted in any orientation, free air-flowing must be taken. Normally power components are always put at the end of the airflow path or have separate airflow paths. This can keep other system equipment cooler and increase component life spans.

Note:

1. There should be no electrical connection between the case and the PE or any module ports.

2. The fixing screw of the heatsink should not be too long. Please refer to the mechanical chart for detail.

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Soldering

AGQ200-48S1V5 is compatible with standard wave soldering techniques. When wave soldering, the converter pins should be preheated for 20~30 seconds at 110 ^{O}C, and wave soldered at 260 ^{O}C for less than 10 seconds.

When hand soldering, the iron temperature should be maintained at 425 ^{O}C and applied to the converter pins for less than 3 seconds. Longer exposure can cause internal damage to the converter.

Cleaning can be performed with cleaning solvent IPA or with water.

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Hazardous Substances Announcement (RoHS of China R6)

Parts	Hazardous Substances					
	Pb	Hg	Cd	Cr^{6+}	PBB	PBDE
AGQ200-48S1V5	x	x	x	x	x	x

x: Means the content of the hazardous substances in all the average quality materials of the part is within the limits specified in SJ/T-11363-2006

√: Means the content of the hazardous substances in at least one of the average quality materials of the part is outside the limits specified in SJ/T11363-2006

Artesyn Embedded Technologies has been committed to the design and manufacturing of environment-friendly products. It will reduce and eventually eliminate the hazardous substances in the products through unremitting efforts in research. However, limited by the current technical level, the following parts still contain hazardous substances due to the lack of reliable substitute or mature solution:

1. Solders (including high-temperature solder in parts) contain plumbum.
2. Glass of electric parts contains plumbum.
3. Copper alloy of pins contains plumbum

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