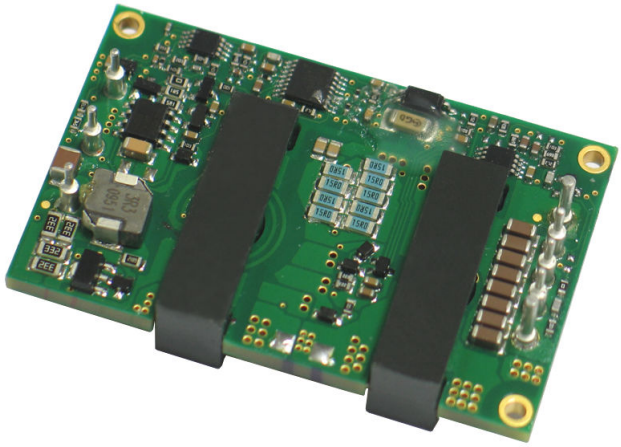
EMERSON
Network Power

# 48Vdc Input,12Vdc@8.3A Output Quarter-Brick Converter AGQ100-48S12

## Description

The AGQ100-48S12 is a single output DC-DC converter with standard quarter-brick outline and pin configuration. It delivers up to 8.3A output current with 12.0V output voltage. Above 92.9% efficiency and excellent thermal performance make it an ideal choice to supply power in telecom and datacom application. It can work under -40°C ~ +85°C.



## Operational Features

- Delivering up to 8.3A output current
- High efficiency: 92.9% typ., at full load
- Wide input range: 36V ~ 75V
- Excellent thermal performance
- No minimum load requirement
- RoHS 5 compliant

## Control Features

- Remote control function (negative or positive logic optional)
- Remote output sense
- Trim function: -20% ~ +10%

## Protection Features

- Input under voltage lockout
- Output over current protection
- Output over voltage protection
- Over temperature protection

## Mechanical Features

- Industry standard quarter-brick pin-out outline
- Open frame structure
- Pin length: 3.8mm

## Safety & EMC

- Meet latest safety standards UL 60950-1, CSA-C22.2 NO.60950-1, IEC/EN 60950-1 and GB4943
- Approved by UL and TUV
- Meet 2006/95/EEC and 93/68/EEC directives which facilitate CE marking in user's end product
- Meet conducted emission's requirements of FCC Class A and EN55022 Class A, tested with external filter
- Material meets UL 94-V0

# Electrical Characteristics

Full operating ambient temperature range is -40°C to +85°C.
Specifications are subject to change without notice.

| Parameter | | Min. | Typ. | Max. | Unit | Notes & conditions |
|---|---|---|---|---|---|---|
| **Absolute max. ratings** | | | | | | |
| Input voltage | Non-operating | | | 100 | V | 100ms |
| | Operating | | | 80 | V | Continuous |
| Operating temperature | | -40 | | 85 | °C | |
| Storage temperature | | -55 | | 125 | °C | |
| Voltage at remote ON/OFF pin | | -0.7 | | 12 | V | |
| **Input characteristics** | | | | | | |
| Operating input voltage range | | 36 | 48 | 75 | V | |
| Input under-voltage lockout | Turn-on voltage threshold | 31 | 34.6 | 36 | V | |
| | Turn-off voltage threshold | 30 | 32.7 | 35 | V | |
| | Lockout voltage hysteresis | 1 | 2 | 3 | V | |
| Max. input current | | | 2.95 | 3.5 | A | $36V_{in}$, full load |
| No-load input current | | | 79 | 100 | mA | $48V_{in}$, no load |
| Standby Input current | | | 9 | 20 | mA | Remote OFF |
| Inrush current transient rating | | | | 1 | $A^2s$ | See Figure 16 |
| Input reflected ripple current | | | 30 | 40 | mA | Through 12μH inductor; see Figure 16 |
| Recommended input fuse | | | | 5 | A | External fast blow fuse recommended; see Figure 11 |
| Input filter component values (C\L) | | | 2.0\3.3 | | μF\μH | Internal values |
| Recommended external input capacitance | | 100 | | | μF | Low ESR capacitor recommended; see Figure 11 |
| **Output characteristics** | | | | | | |
| Output voltage set point (standard option) | | 11.88 | 12.00 | 12.12 | V | $48V_{in}$, full load |
| Output voltage line regulation | | | 0.08 | 0.2 | % | |
| | | | | | mV | |
| Output voltage load regulation | | | 0.08 | 0.5 | % | |
| | | | | | mV | |

| Parameter | | Min. | Typ. | Max. | Unit | Notes & conditions |
|---|---|---|---|---|---|---|
| Output voltage temperature regulation | | | 0.001 | 0.02 | %/°C | |
| Total output voltage range | | 9.6 | 12 | 13.2 | V | Over sample, line, load, temperature & life |
| Output voltage ripple and noise | | | 100 | 180 | mVpp | See Figure 2.<br>20MHz bandwidth; see Figure 16 |
| Operating output current range | | 0 | | 8.3 | A | |
| Output DC current-limit inception | | 9 | 11.5 | 13.5 | A | Hiccup: auto-restart when over-current condition is removed |
| Output capacitance | | 220 | | 2200 | μF | High frequency and low ESR is recommended |
| **Dynamic characteristics** | | | | | | |
| Dynamic response | 50% ~ 75% ~ 50% $I_{o,max}$, 0.1A/μs | | 122 | 480 | mV | See Figure 4.<br>Test condition: 25°C, nominal input voltage, see Figure 11 |
| | Settling time | | 330 | 700 | μs | Recovery to within 1% $V_{o,nom}$ |
| | 10% ~ 50% ~ 10% $I_{o,max}$, 0.1A/μs | | 350 | 600 | mV | See Figure 5.<br>Test condition: 25°C, nominal input voltage, see Figure 11 |
| | Settling time | | | | μs | |
| Turn-on transient | Rise time | | 21 | 50 | ms | Full load, see Figure 6 |
| | Turn-on delay time | | 4.6 | 50 | ms | |
| | Output voltage overshoot | | 0 | 5 | $\%V_o$ | |
| **Efficiency** | | | | | | |
| 100% load | | | 92.9 | | % | See Figure 1 |
| 50% load | | | 92.08 | | % | See Figure 1 |
| **Isolation characteristics** | | | | | | |
| Isolation voltage (conditions: 1mA for 60s, slew rate of 1500V/10s) | | 1500 | | | Vdc | Basic insulation, input to output |

# Electrical Characteristics (Continued)

| Parameter | | Min. | Typ. | Max. | Unit | Notes & conditions |
|---|---|---|---|---|---|---|
| **Feature characteristics** | | | | | | |
| Switching frequency | | 280 | 310 | 340 | kHz | |
| Remote ON/OFF control (positive logic) | Off-state voltage | -0.7 | | 1.2 | V | See Figure 12 |
| | On-state voltage | 3.5 | | 12 | V | |
| Remote ON/OFF control (negative logic) | Off-state voltage | 3.5 | | 12 | V | |
| | On-state voltage | -0.7 | | 1.2 | V | |
| Output voltage trim range | | -20 | | 10 | % | See *Trim Characteristics* of *Application Note* |
| Output voltage remote sense range | | | | 5 | % | |
| Output over-voltage protection | | 14.4 | 15.8 | 18 | V | Hiccup |
| Over-temperature shutdown | | | 122 | 130 | °C | Auto recovery; OTP test point, see Figure 10 |
| Over-temperature hysteresis | | | 20 | | °C | |
| **Reliability characteristics** | | | | | | |
| Calculated MTBF (telcordia) | | | 1.5 | | $10^6$h | Telcordia SR-332-2006; 80% load, 300LFM, 40°C $T_a$ |

# Electromagnetic Compatibility Requirements

| Test item | Regulations | Criteria | Notes & conditions |
|---|---|---|---|
| Conducted emission | EN 55022<br>DC input port, Class A | | See *EMC Test Conditions* |
| Immunity to electrostatic discharge | IEC/EN61000-4-2<br>Enclosure port, Level 3 | B | |
| Immunity to electrical fast transient | IEC/EN61000-4-4<br>DC input port, Level 3 | B | |
| Immunity to surges | IEC/EN61000-4-5<br>DC input port<br>Line to Ground (earth): 600V<br>Line to Lineline: 600V | B | |
| Immunity to continuous conducted interference | IEC/EN61000-4-6<br>DC input port, Level 2 | A | |
| Immunity to voltage dips and short interruptions and voltage variations | EN 61000-4-29<br>DC input port | B | |

Criterion A: Normal performance during and after test.

Criterion B: For EFT and surges, low-voltage protection or reset is not allowed. Temporary output voltage fluctuation ceases after disturbances ceases, and from which the EUT recovers its normal performance automatically.

For Dips and ESD, 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.

# Qualification Testing

| Parameter | Unit (pcs) | Test condition |
|---|---|---|
| Halt test | 4 ~ 5 | $T_{a,min}$ - 10°C to $T_{a,max}$ + 10°C, 5°C step, $V_{in}$ = min to max, 0 ~ 105% load |
| Vibration | 3 | Frequency range: 5Hz ~ 20Hz, 20Hz ~ 200Hz, A.S.D: 1.0$m^2/s^3$, -3db/oct, axes of vibration: X/Y/Z<br>Time: 30min/axis |
| Mechanical shock | 3 | 30g, 6ms, 3axes, 6directions, 3time/direction |
| Thermal shock | 3 | -40°C to 100°C, unit temperature 20cycles |
| Thermal cycling | 3 | -40°C to 55°C, temperature change rate: 1°C/min, cycles: 2cycles |
| Humidity | 3 | 40°C, 95%RH, 48h |
| Solder ability | 15 | IPC J-STD-002C-2007 |

# Characteristic Curves

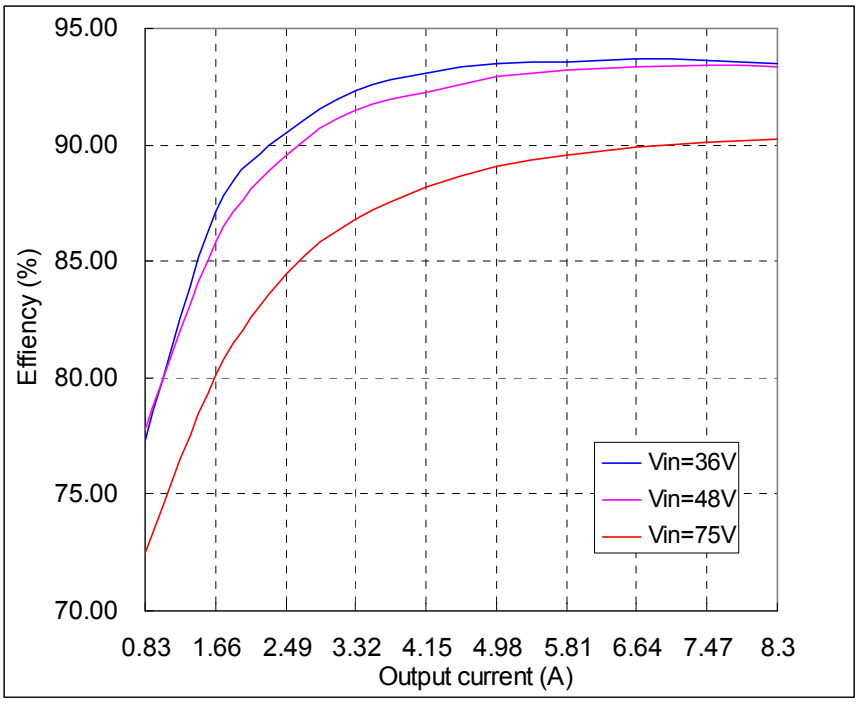



Figure 1 Efficiency vs. output current, $T_a$=25°C

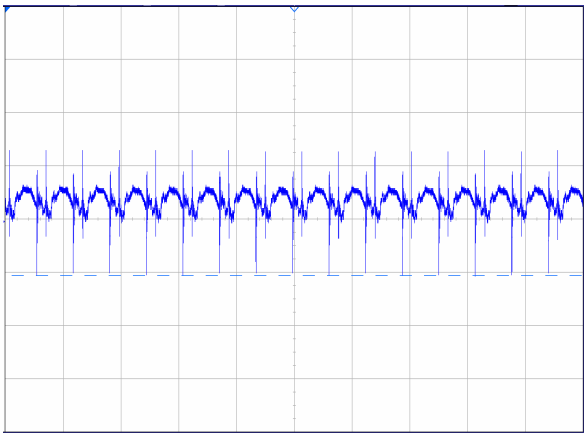


Figure 2 Output ripple & noise (5ms/div, 20mV/div), see Figure 16 for test configuration

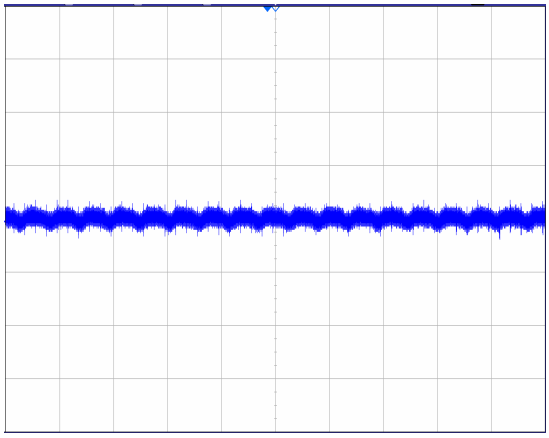


Figure 3 Input reflected ripple current (2μs/div, 50mA/div), see Figure 16 for test configuration

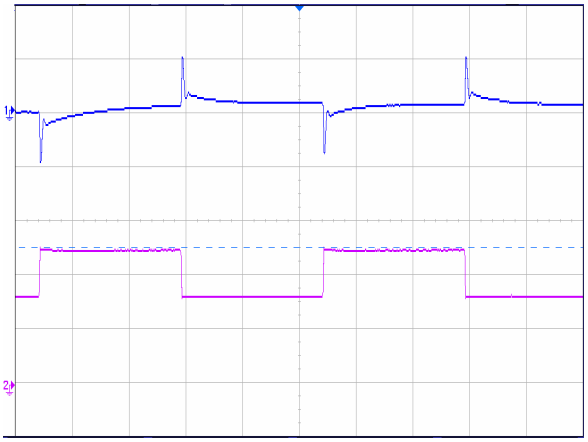


Figure 4 Dynamic response for 25% load step (50% ~ 75% ~ 50%) and 0.1A/μs slew rate, (2ms/div), see Figure 11 for test configuration; CH1-output voltage (200mV/div); CH2-output current (2.5A/div)

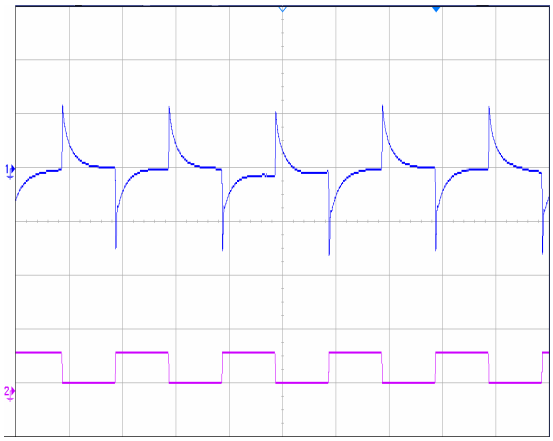


Figure 5 Dynamic response for 40% load step (50% ~ 10% ~ 50%) and 0.1A/μs slew rate, (2ms/div), see Figure 11 for test configuration; CH1-output voltage (200mV/div); CH2-output current (10A/div)

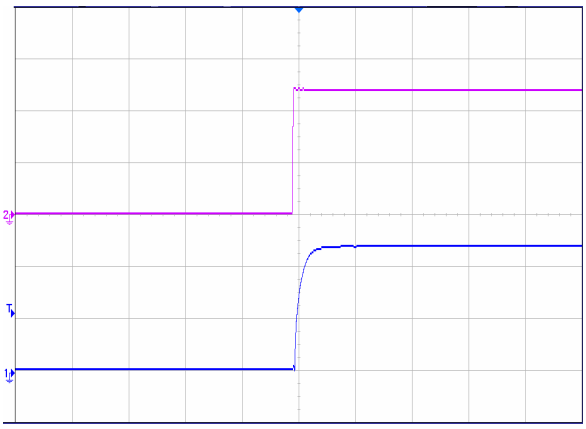


Figure 6 Output voltage startup by power on, (50ms/div), see Figure 11 for test configuration; CH1-output voltage (5V/div); CH2-intput voltage (20V/div)

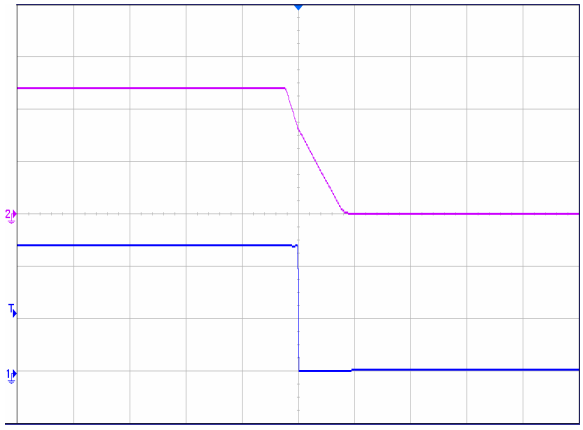


Figure 7 Output voltage startup by shutdown, (100ms/div), see Figure 11 for test configuration; CH1-output voltage (5V/div); CH2-intput voltage (20V/div)

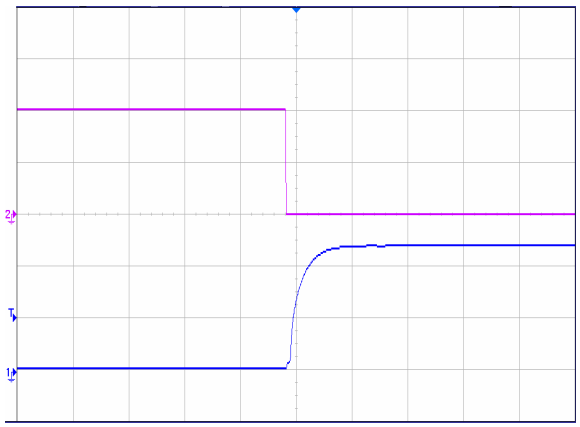


Figure 8 Output voltage startup by remote ON of negative module, (50ms/div), see Figure 11 for test configuration; CH1-output voltage (5V/div); CH2-remote ON voltage (2V/div)

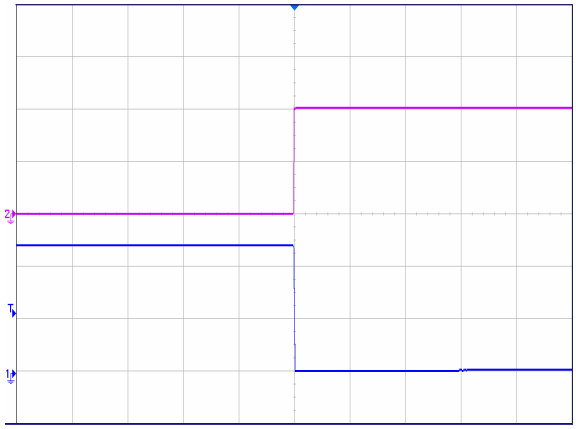


Figure 9 Output voltage shutdown by remote OFF of negative module, (50ms/div), see Figure 11 for test configuration; CH1-output voltage (5V/div); CH2-remote OFF voltage (2V/div)

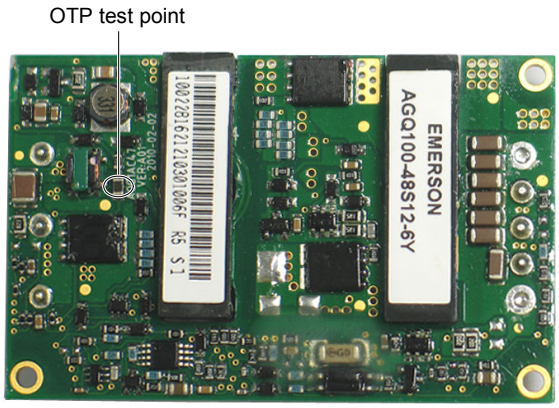



Figure 10 OTP test point

# Application Note

## Typical Application

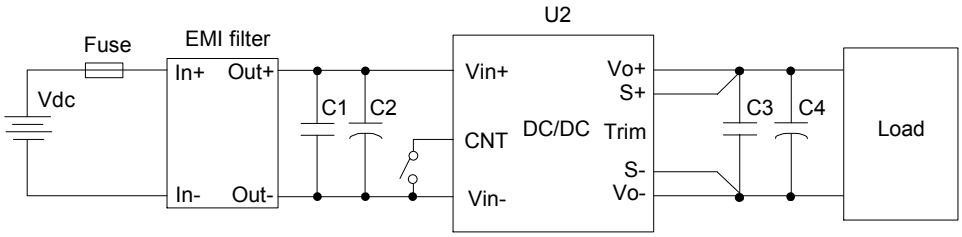



Figure 11 Typical application

C1: 1μF/100V X7R ceramic capacitor, P/N: C3225X7R2A105KT0L0U (TDK) or equivalent caps
C2: 100μF/100V electrolytic capacitor, P/N: UVZ2A101MHD (Nichicon) or equivalent caps
C3: 1μF/25V X7R ceramic capacitor, P/N: C2012X7R1E105KT000N (TDK) or equivalent caps
C4: 220μF electrolytic capacitor, P/N: UPM1E221MHD (Nichicon) or equivalent caps
U2: Module to test, AGQ100-48S12
Fuse: External fast blow fuse with a rating of 5A. The recommended fuse model is 314005 MXP from LITTLEFUSE.

## Remote ON/OFF

Either positive or negative remote ON/OFF logic is available in AGQ100-48S12. The logic is CMOS and TTL compatible.
Figure 12 is the detailed internal circuit and reference in AGQ100-48S12.

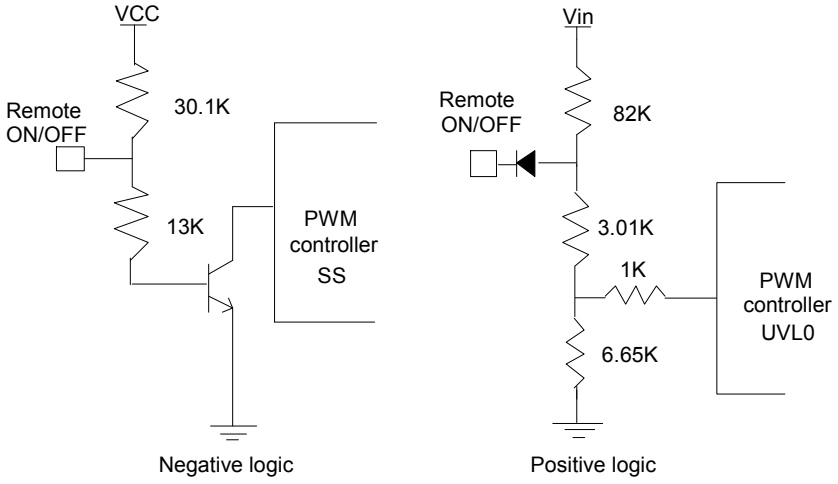
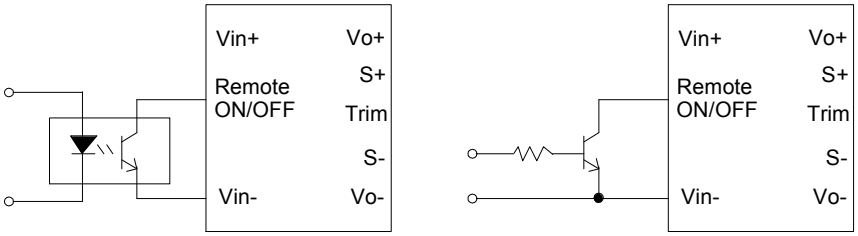



Figure 12 Remote ON/OFF internal diagram

The voltage between pin Remote ON/OFF and pin Vin- must not exceed the range listed in table "Feature characteristics" to ensure proper operation. The external remote ON/OFF circuit is highly recommended as shown in Figure 13.




Isolated remote ON/OFF circuit Non-isolated remote ON/OFF circuit

Figure 13 External remote ON/OFF circuit

## Trim Characteristics

Connecting an external resistor between Trim pin and $V_o$- pin will decrease the output voltage. Connecting it between Trim pin and $V_o$+ pin will increase the output voltage. The following equations determine the external resistance to obtain the trimmed output voltage.

$$R_{adj-down} = \frac{511}{\Delta} - 10.22(K\Omega)$$

$$R_{adj-up} = \frac{5.11 \times V_{nom} \times (100 + \Delta)}{1.225 \times \Delta} - \frac{511}{\Delta} - 10.22(K\Omega)$$

$$\Delta = \frac{|V_{nom} - V_{desired}|}{V_{nom}} \times 100$$

$V_{norm}$ : Nominal output voltage.

For example, to get 13.12V output, the trimming resistor is

$$R_{adj-up} = \frac{5.11 \times 12 \times (100 + 10)}{1.225 \times 10} - \frac{511}{10} - 10.22(K\Omega) = 489.3(K\Omega)$$

The output voltage can also be trimmed by potential applied at the Trim pin.

$$V_o = (V_{trim} + 1.225) \times 6.122$$

Where $V_{trim}$ is the potential applied at the Trim pin, and $V_o$ is the desired output voltage.

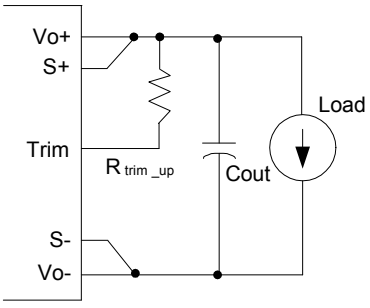



Figure 14 Trim up

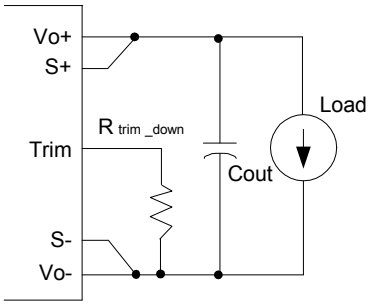



Figure 15 Trim down

## Sense Characteristics

If the load is far from the unit, connect S+ and S- to the terminal of the load respectively to compensate the voltage drop on the transmission line. If the sense compensate function is not necessary, connect S+ to $V_o$+ and S- to $V_o$- directly.

## Input Ripple & Inrush Current And Output Ripple & Noise Test Configuration

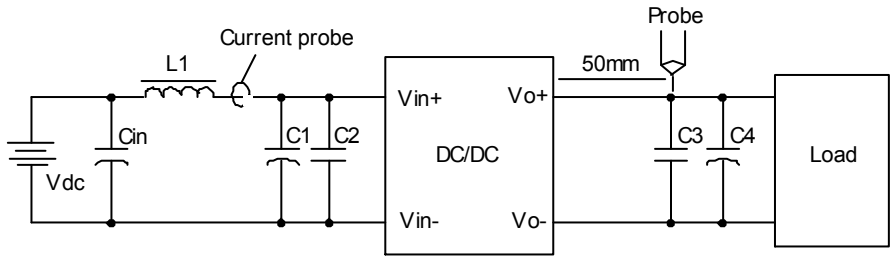



Figure 16 Input ripple & inrush current, output ripple & noise test configuration

Vdc: DC power supply
L1: 12μH
Cin: 220μF/100V typical
C1 ~ C4: See Figure 11
Note: It is recommended to use a coaxial cable with series 50Ω resistor and 0.68μF ceramic capacitor or a ground ring of probe to test output ripple & noise.

## EMC Test Conditions

The customer actual EMI circuit is shown in the following figure.

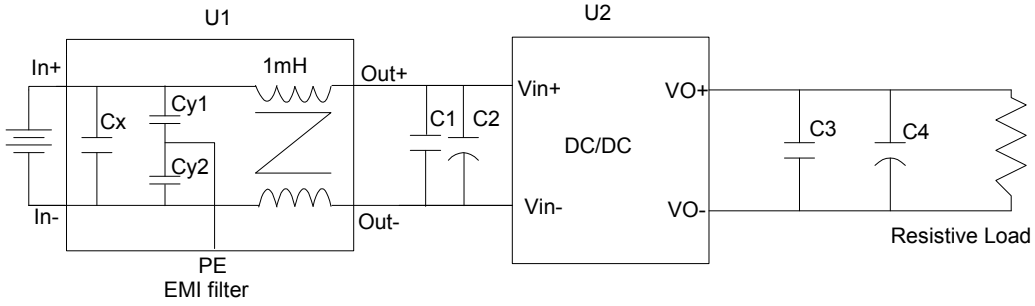



Figure 17 EMC test configuration

CX: 1μF/100V ceramic capacitor, C3225X7R2A225KT0LOU/TDK
Cy1, Cy2: 2200pF/1000V ceramic capacitor, GHM1535X7R223K1KD550/MURATA
C1: 0.1μF/100V ceramic capacitor, C1206X7R2A105KT0L0U/TDK
C2: 100μF/100V low ESR aluminum electrolytic capacitor, UVZ2A101MPD
C3: 1μF/25V ceramic capacitor, C2012X7R1E105KT000N/TDK
C4: 220μF/100V low ESR aluminum electrolytic capacitor, UPM1E221MHD

# Thermal Considerations

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 temperature test point. The temperature at this point should not exceed the maximum value in Table 1.
For a typical application, Figure 20 shows the derating of output current vs. ambient air temperature at different air velocity.

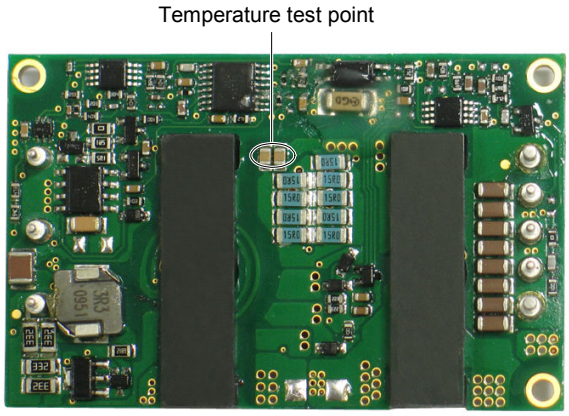



Figure 18 Temperature test point

Table 1 Temperature limit of test point

| Test point | Temperature limit |
|---|---|
| Temperature test point | 116°C |

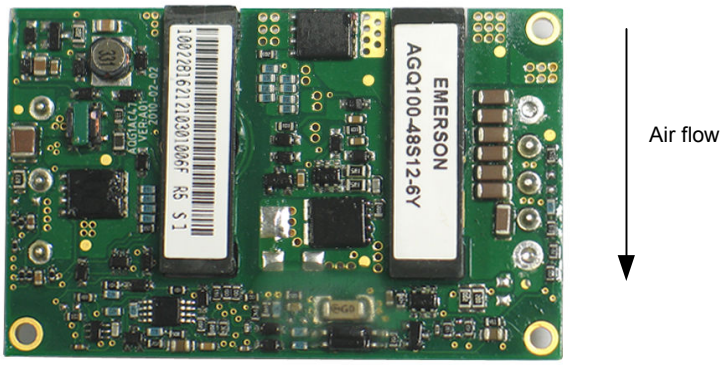



Figure 19 Typical test condition, forced airflow direction is from $V_o$+ to $V_o$-

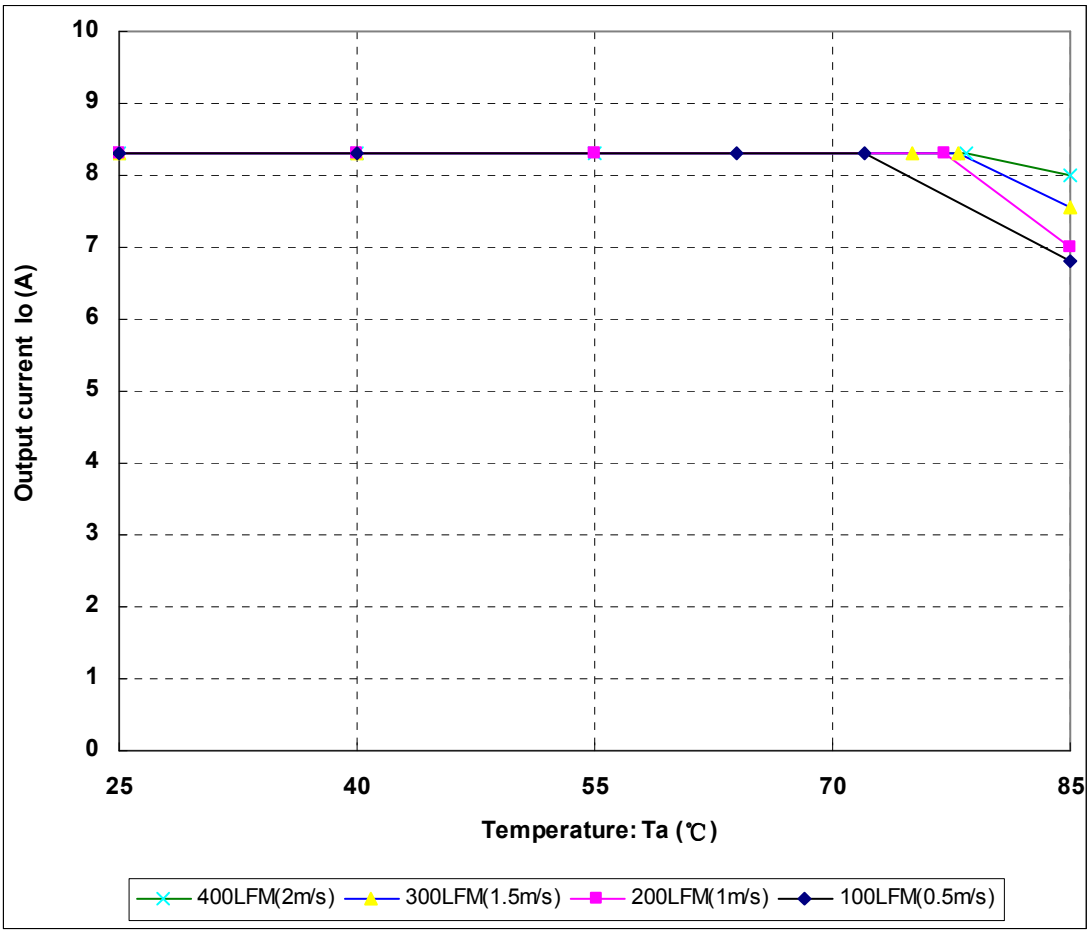
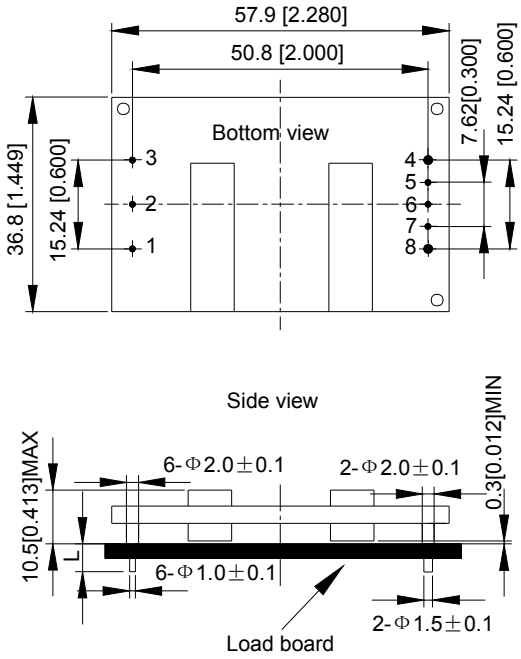



Figure 20 Output power derating, 48$V_{in}$, air flowing across the converter from $V_o$+ to $V_o$-

# Mechanical Diagram




Unit: mm[inch] Bottom view: pin on upside

Tolerance: X.Xmm±0.5mm[X.X in.±0.02in.]

X.XXmm±0.25mm[X.XX in.±0.01in.]

Figure 21 Mechanical diagram

Pin length option

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

## Pin Designations

| Pin No. | Name | Function |
|---|---|---|
| 1 | $V_{in}$+ | Positive input voltage |
| 2 | Remote ON/OFF | Remote control |
| 3 | $V_{in}$- | Negative input voltage |
| 4 | $V_o$- | Negative output voltage |
| 5 | S- | Negative remote sense |
| 6 | Trim | Output voltage trim |
| 7 | S+ | Positive remote sense |
| 8 | $V_o$+ | Positive output voltage |

## Soldering

The product is intended for standard manual wave soldering.
When wave soldering is used, the temperature on pins is specified to maximum 260°C for maximum 7s.
When soldering by hand, the iron temperature should be maintained at 300°C ~ 380°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.

## Ordering Information

| AGQ100 | - | 48 | S | 12 | - | 6 | Y |
|---|---|---|---|---|---|---|---|
| ① | | ② | ③ | ④ | | ⑥ | ⑦ |

| | | |
|---|---|---|
| ① | Model series | AGQ: high efficiency quarter-brick series, 100: output power 100W |
| ② | Input voltage | 48: 36V ~ 75V input range, rated input voltage 48V |
| ③ | Output number | S: single output |
| ④ | Rated output voltage | 12:12V output |
| ⑥ | Pin length | -6: 3.8mm |
| ⑦ | RoHS status | L: RoHS, R6; Y: RoHS, R5 |

| Model number | Description |
|---|---|
| AGQ100-48S12-6Y | 3.8mm pin length; negative on/off logic; without thread inside mounting hole; R5 compliant |
| AGQ100-48S12B-6Y | 3.8mm pin length; negative on/off logic; without thread inside mounting hole; R5 compliant; baseplated; for detailed information,refer to *AGQ100-48S12B Technical Reference Notes* |

# Hazardous Substances Announcement (RoHS Of China)

| Parts | Hazardous substances | | | | | |
|---|---|---|---|---|---|---|
| | Pb | Hg | Cd | $Cr^{6+}$ | PBB | PBDE |
| AGQ100-48S12 | √ | 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

Emerson Network Power Co., Ltd. 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