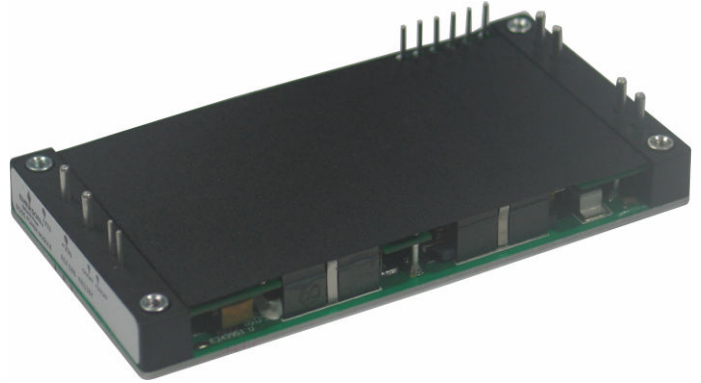


## Description

The AGF600-48S30 is a single output DC-DC converter with standard full-brick outline and pin configuration. It delivers up to 20A output current with 30V output voltage. Above 94.0% ultra-high efficiency and excellent thermal performance make it an ideal choice to supply power to power amplifier in telecom RF application. Aluminium baseplate structure makes it possible for the module to work under -40°C ~ 85°C without air cooling.



## Operational Features

- Delivering up to 20A output current
- Ultra-high efficiency 94.0% typ. at full load
- Excellent thermal performance
- Wide input range: 36V ~ 75V
- No minimum load requirement
- Fixed frequency operation
- RoHS 5 compliant

## Control Features

- Remote control function
- Remote output sense
- Trim function: -50% ~ +10%

## Protection Features

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

## Mechanical Features

- Industry standard full-brick pin-out outline
- With aluminium baseplate
- Pin length: 5.8mm

## Safety & EMC

- Meets safety standards UL 60950-1, IEC/EN 60950-1 and GB4943
- Approved by UL and TUV
- Meets 2006/95/EEC and 93/68/EEC directives which facilitates CE marking in user's end product
- Meets conducted emission's requirements of EN55022 Class A with external filter

## 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                            |
|--------------------------------------------|----------------------------|-------|---------|-------|-------|-----------------------------------------------|
| <b>Absolute max. ratings</b>               |                            |       |         |       |       |                                               |
| Input voltage                              | Non-operating              |       |         | 100   | V     | 100ms                                         |
|                                            | Operating                  |       |         | 80    | V     | Continuous                                    |
| Operating temperature                      |                            | -40   |         | 85    | °C    |                                               |
| Storage temperature                        |                            | -55   |         | 125   | °C    |                                               |
| <b>Input characteristics</b>               |                            |       |         |       |       |                                               |
| Operating input voltage range              |                            | 36    | 48      | 75    | V     |                                               |
| Input under-voltage lockout                | Turn-on voltage threshold  | 31    | 35      | 36    | V     |                                               |
|                                            | Turn-off voltage threshold | 30    | 33      | 35    | V     |                                               |
|                                            | Lockout voltage hysteresis | 1     | 1.5     | 3     | V     |                                               |
| Max. input current                         |                            |       |         | 20    | A     | 36V <sub>in</sub> , full load                 |
| No-load input current                      |                            |       | 0.2     | 0.3   | A     | 48V <sub>in</sub>                             |
| Standby Input current                      |                            |       | 0.02    | 0.1   | A     | Remote OFF                                    |
| Input reflected ripple current             |                            |       |         | 160   | mA    | Through 12μH inductor; Figure 16              |
| Recommended input fuse                     |                            |       | 30      |       | A     | Fast blow external fuse recommended Figure 11 |
| Input filter component values (C\L)        |                            |       | 15\0.55 |       | μF\μH | Internal values                               |
| Recommended external input capacitance     |                            | 470   |         |       | μF    | Low ESR capacitor recommended Figure 11       |
| <b>Output characteristics</b>              |                            |       |         |       |       |                                               |
| Output voltage set point (standard option) |                            | 29.70 | 30      | 30.30 | V     | 48V <sub>in</sub> , full load                 |
| Output voltage line regulation             |                            |       | 0.05    | 0.2   | %     |                                               |
|                                            |                            |       | 15      | 60    | mV    |                                               |
| Output voltage load regulation             |                            |       | 0.2     | 0.5   | %     |                                               |
|                                            |                            |       | 60      | 150   | mV    |                                               |
| Output voltage temperature regulation      |                            |       |         | 0.02  | %/°C  |                                               |

| Parameter                         |                                          | Min.  | Typ. | Max.  | Unit    | Notes & Conditions                          |
|-----------------------------------|------------------------------------------|-------|------|-------|---------|---------------------------------------------|
| Total output voltage range        |                                          | 29.10 | 30   | 30.90 | V       | Over sample, line, load, temperature & life |
| Output voltage ripple and noise   |                                          |       | 80   | 250   | mVpp    | 20MHz bandwidth; Figure 16                  |
| Operating output current range    |                                          | 0     |      | 20    | A       |                                             |
| Output DC current-limit inception |                                          | 22    |      | 30    | A       | Hiccup, see Figure 10                       |
| Output capacitance *              |                                          | 470   | 1000 | 10000 | μF      |                                             |
| Dynamic characteristics           |                                          |       |      |       |         |                                             |
| Dynamic response                  | 25% ~ 50% ~ 25%<br>$I_{o,max}$ , 0.1A/μs |       | 400  | 840   | mV      | Figure 4<br>Test condition: see Figure 11   |
|                                   | Settling time                            |       | 60   | 500   | μs      | Recovery to within 1% $V_{o,nom}$           |
|                                   | 50% ~ 75% ~ 50%<br>$I_{o,max}$ , 0.1A/μs |       | 400  | 840   | mV      | Figure 5<br>Test condition: see Figure 11   |
|                                   | Settling time                            |       | 60   | 500   | μs      | Recovery to within 1% $V_{o,nom}$           |
| Turn-on transient                 | Rise time                                |       | 200  | 500   | ms      | Full load, Figure 6                         |
|                                   | Turn-on delay time                       |       | 140  | 300   | ms      |                                             |
|                                   | Output voltage overshoot                 |       |      | 5     | % $V_o$ |                                             |
| Efficiency                        |                                          |       |      |       |         |                                             |
| 100% load                         |                                          |       | 94.0 |       | %       | Figure 1                                    |
| 50% load                          |                                          |       | 94.5 |       | %       | Figure 1                                    |

\* Out voltage can be start up when out external electrolytic Capacitor is 100uF/50V.

## Electrical Characteristics (Continued)

| Parameter                   | Min. | Typ. | Max. | Unit | Notes & Conditions                                        |
|-----------------------------|------|------|------|------|-----------------------------------------------------------|
| Isolation characteristics   |      |      |      |      |                                                           |
| Isolation voltage (1mA, 5s) |      | 1500 |      | V    | Basic insulation, pollution degree 2, input to output     |
|                             |      | 1000 |      | V    | Basic insulation, pollution degree 2, input to baseplate  |
|                             |      | 500  |      | V    | Basic insulation, pollution degree 2, output to baseplate |

| Parameter                          | Min. | Typ. | Max. | Unit              | Notes & Conditions                                              |
|------------------------------------|------|------|------|-------------------|-----------------------------------------------------------------|
| <b>Feature characteristics</b>     |      |      |      |                   |                                                                 |
| Switching frequency                | 260  | 290  | 320  | kHz               |                                                                 |
| Remote ON/OFF control              | 1.5  |      | 5    | mA                | See Figure 12, Figure 13                                        |
| Output voltage trim range          | 15   |      | 33   | V                 | See <i>Trim Characteristics of Application Note</i>             |
| Output voltage remote sense range  |      |      | 0.5  | V                 |                                                                 |
| Output over-voltage protection     | 36   |      | 40   | V                 | Over full temp range;<br>Hiccup                                 |
| Over-temperature shutdown          | 105  | 110  | 125  | °C                | Auto recovery;<br>Test point: see Figure 19                     |
| Over-temperature hysteresis        | 5    |      |      | °C                |                                                                 |
| <b>Reliability characteristics</b> |      |      |      |                   |                                                                 |
| Calculated MTBF (telcordia )       |      | 1.5  |      | 10 <sup>6</sup> h | Telcordia SR-332-2006; 80% load,<br>300LFM, 40°C T <sub>a</sub> |

## Qualification Testing

| Parameter        | Unit (pcs) | Test condition                                                                                                                             |
|------------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Halt test        | 4 ~ 5      | T <sub>a,min</sub> -10°C to T <sub>a,max</sub> +10°C, 5°C step, V <sub>in</sub> = min to max, 0 ~ 105% load                                |
| Vibration        | 3          | Frequency range: 5Hz ~ 20Hz, 20Hz ~ 200Hz, A.S.D: 1.0m <sup>2</sup> /s <sup>3</sup> , -3db/oct, axes of vibration: X/Y/Z; 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 85°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

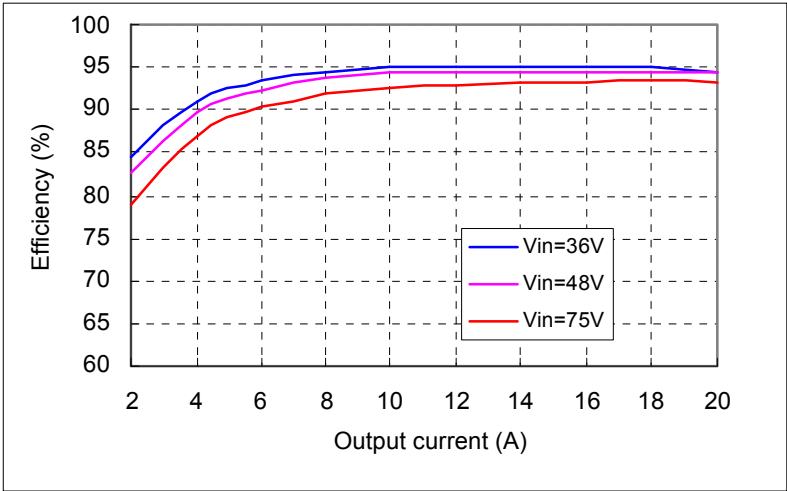


Figure 1 Efficiency vs. output current,  $T_a=25^{\circ}\text{C}$ ,  $T_c=40^{\circ}\text{C}$ ,  $V_o=30\text{V}$

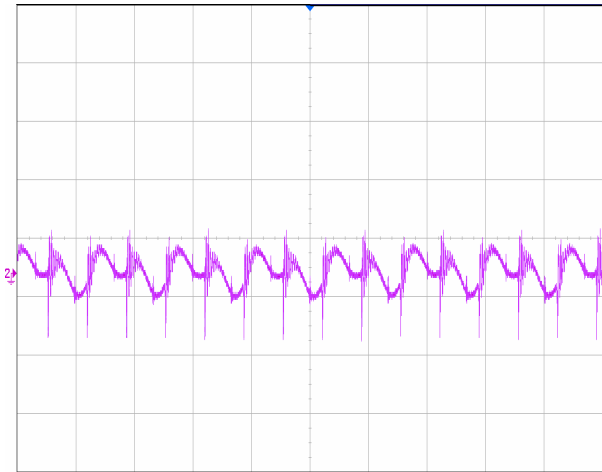


Figure 2 Output ripple & noise (5μs/div, 50mV/div), see Figure 16 for test configuration

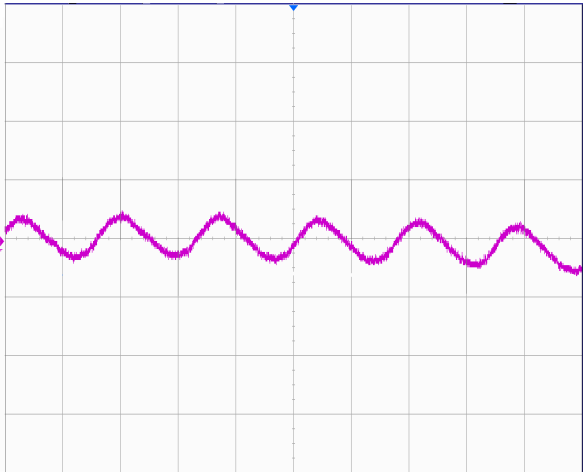


Figure 3 Input reflected ripple current (2μs/div, 20mA/div), see Figure 16 for test configuration

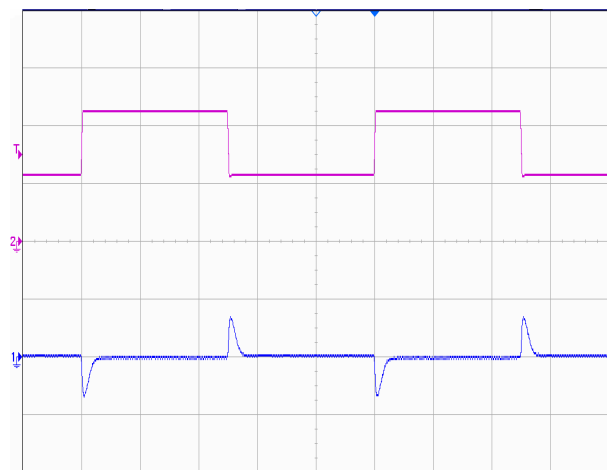


Figure 4 Dynamic response for 25% load step (25% ~ 50% ~ 75%) and 0.1A/μs slew rate, see Figure 11 for test configuration, CH1-output voltage (500mV/div); CH2-output current (5A/div)

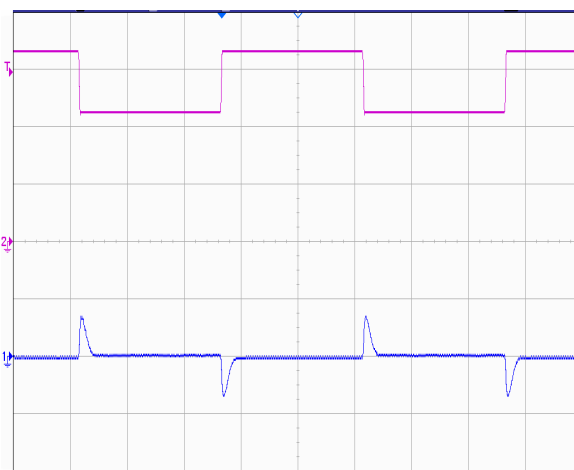


Figure 5 Dynamic response for 25% load step (50% ~ 75% ~ 50%) and 0.1A/μs slew rate, see Figure 11 for test configuration. CH1-output voltage (500mV/div); CH2-output current (5A/div)

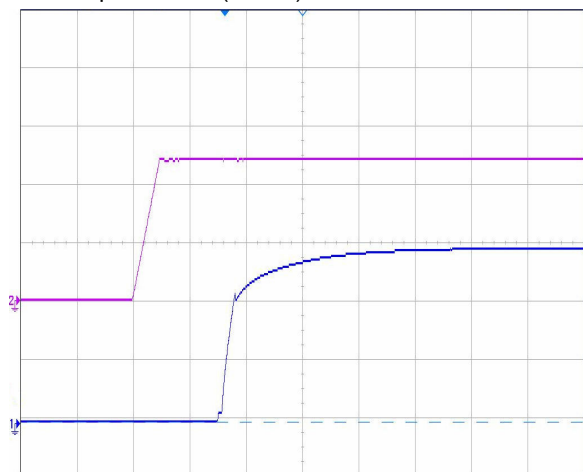


Figure 6 Output voltage startup by power on, (5ms/div), see Figure 11 for test configuration, CH2-input voltage (20V/div); CH1-output voltage (10V/div)

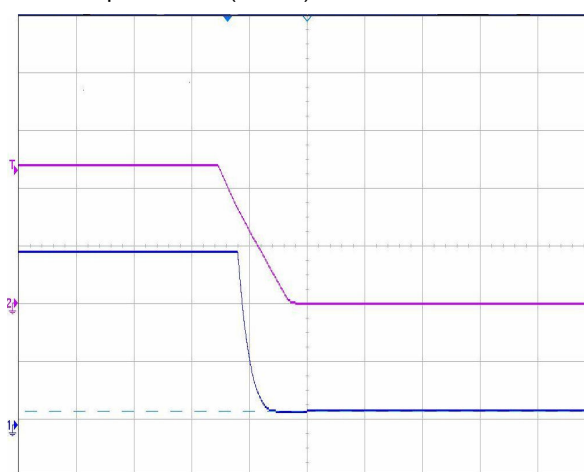


Figure 7 Output voltage shut down by power off, (5ms/div), see Figure 11 for test configuration, CH2-input voltage (20V/div); CH1-output voltage (10V/div)

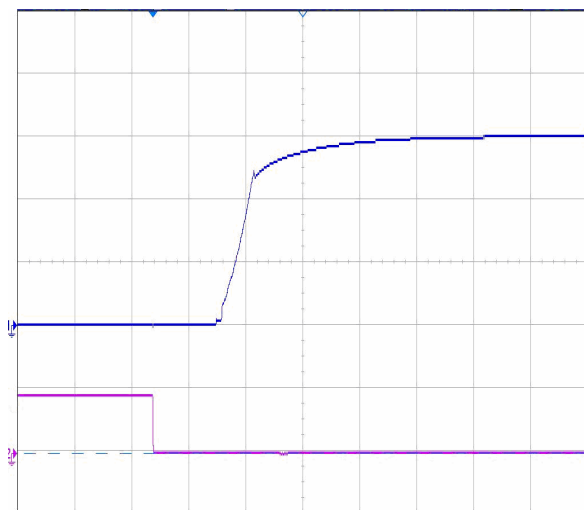


Figure 8 Output voltage startup by remote ON, (20ms/div), see Figure 12 for test configuration, CH2-remote ON (50V/div); CH1-output voltage (10V/div)

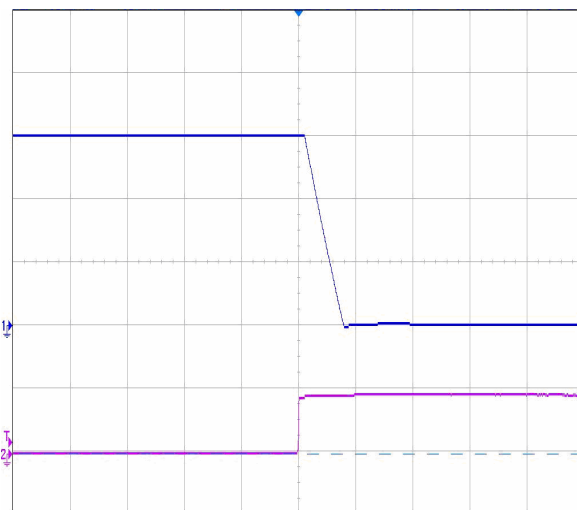


Figure 9 Output voltage shutdown by remote OFF, (1ms/div), see Figure 12 for test configuration, CH2-remote OFF (50V/div); CH1-output voltage (10V/div)

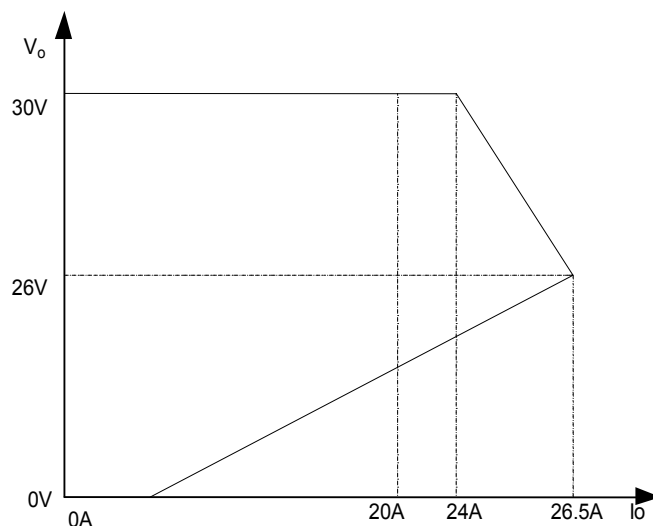


Figure 10 Over-current protection characteristics

Note: It's only a sketch map of OCP action. Little alterations of the current value vs. voltage value are allowed.

## Application Note

### Typical Application

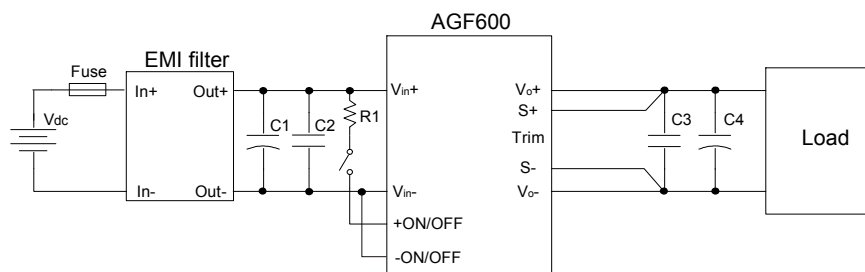


Figure 11 Typical application

R1: 24k $\Omega$  (1/2W), current limiting resistor

C1: 470 $\mu$ F/100V electrolytic capacitor, P/N: UPW2A471MHD (Nichicon) or equivalent caps.

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

C4: 1000 $\mu$ F/50V electrolytic capacitor, P/N: UPM1H102MHD (Nichicon) or equivalent caps

External fast-acting fuse with a rating of 30A should be used in the application. The recommended fuse model is 0324030 or 314030 from LITTELFUSE.

### Remote ON/OFF

A remote ON/OFF control circuit is provided which is isolated from the input side, as well as, the output side. (Isolation withstand voltage: 1.5kVdc).

Connection of remote ON/OFF terminal is as follows. As shown in the figure below, output voltage turns remote ON when current is made to flow through remote ON/OFF terminal. Remote ON/OFF terminal can be controlled by opening or closing connections (with switch or relay).

Maximum source current for remote ON/OFF terminal is 5mA. Therefore, set current limiting resistor value such that this maximum source current value is not exceeded. Also, the allowable maximum reverse current flow is 5mA.

Controlling the remote ON/OFF terminal from the input side

Connect current limiting resistor R1 is shown in the following figure.

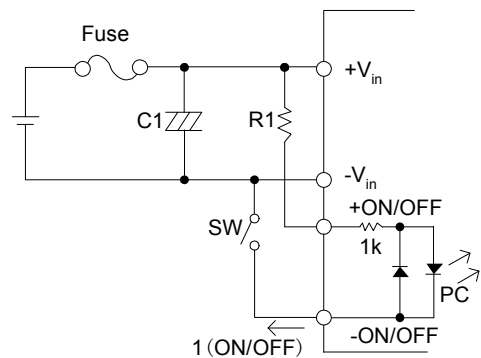


Figure 12 Connection of remote ON/OFF control (A)

R1: Recommended resistor value: 24kΩ (1/2W)

Controlling the remote ON/OFF terminal from the output side

Connect the current limiting resistor R1 is shown in the following figure.

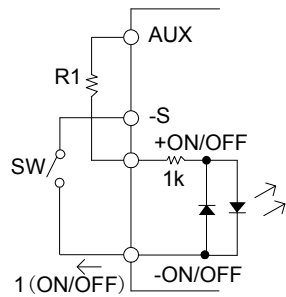


Figure 13 Connection of remote ON/OFF control (B)

R1: Recommended resistor value: 2kΩ (1/2W)

Note:

- 1. When wiring becomes long, connect a capacitor of about 0.1μF value between the +remote ON/OFF terminal and –remote ON/OFF terminal at a nearest distance.
- 2. Current limiting resistor can also be connected to the –remote ON/OFF terminal side.
- 3. The remote ON/OFF control mode is shown in the following table.

| Remote ON/OFF level      | Output status |
|--------------------------|---------------|
| Open (<100μA)            | Remote OFF    |
| 1.5mA ≤ I (ON/OFF) ≤ 5mA | Remote ON     |

Trim Characteristics

The output voltage of the converter can be trimmed using the trim pin provided. Applying a resistor between the trim pin and –S will cause the output to decrease. Applying a resistor between the +Vo and +S will cause the output to increase. Trimming down more than 50% and trimming up more

than 10% can cause the module to regulate improperly. If the trim pin is not needed, it should be left open.

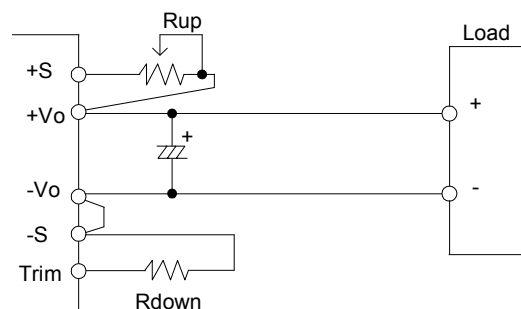


Figure 14 Trim circuit

$$R_{up} = 30 \left( \frac{V_o - V_e}{V_e} \right) k\Omega$$

$$R_{down} = -5.97 \left( \frac{V_o}{V_o - V_e} \right) k\Omega$$

$V_e$  is the rated output voltage and  $V_o$  is the goal voltage.

For example, to get 33V output, the resistor is:

$$R_{up} = 30 \left( \frac{33 - 30}{30} \right) k\Omega = 3 k\Omega$$

For another example, to get 15V output, the resistor is:

$$R_{down} = -5.97 \left( \frac{15}{15 - 30} \right) k\Omega = 5.97 k\Omega$$

Take note that when output voltage is increased, input voltage should be limited is shown in the following figure.

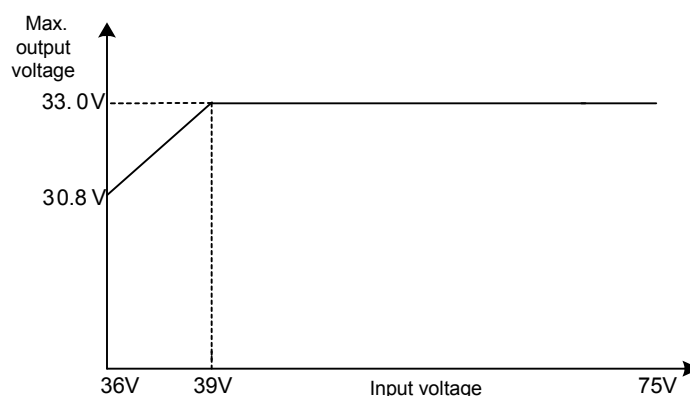


Figure 15 Trim-up-able voltage vs. input voltage

## 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. See Figure 11.

If the sense compensation function is not necessary, short S+ to  $V_o+$  and S- to  $V_o-$  respectively.

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

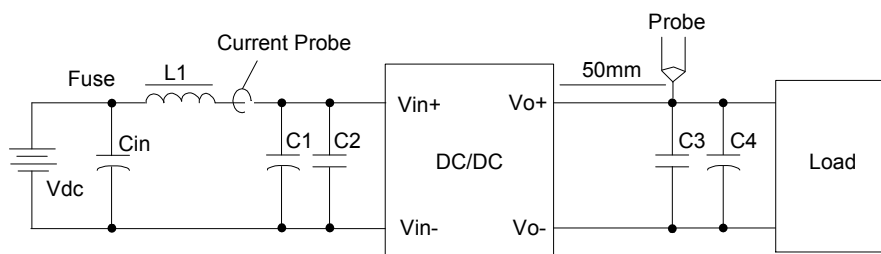


Figure 16 Ripple & noise test configuration

Vdc: DC power supply

L1: 12 $\mu$ H

Cin: 220 $\mu$ F/100V typical.

C1 ~ C4: See Figure 11

Note: Using a coaxial cable with series 50 $\Omega$  resistor and 0.68 $\mu$ F ceramic capacitor or a ground ring of probe to test output ripple & noise is recommended.

## EMC Filter Configuration

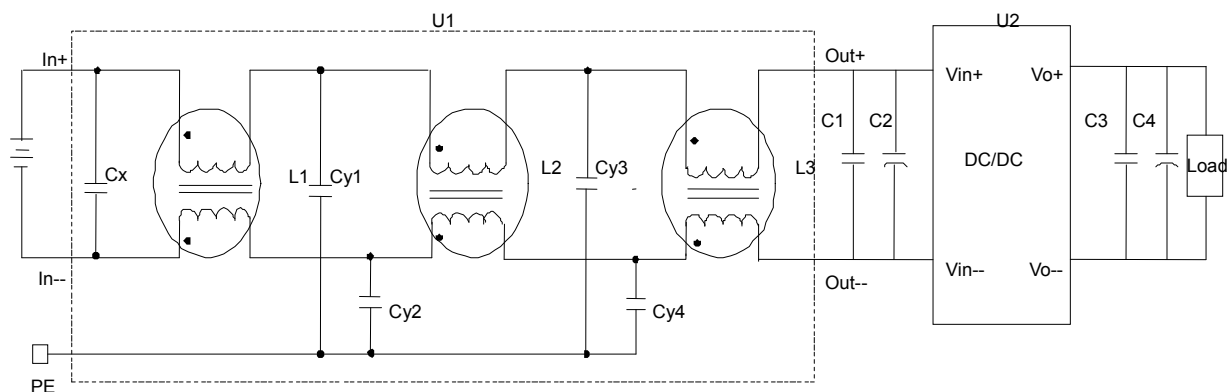


Figure 17 EMC test configuration

Cx: 5.7 $\mu$ F/100V capacitor

Cy1, Cy2, Cy3, Cy4: 4700pF, Y capacitor

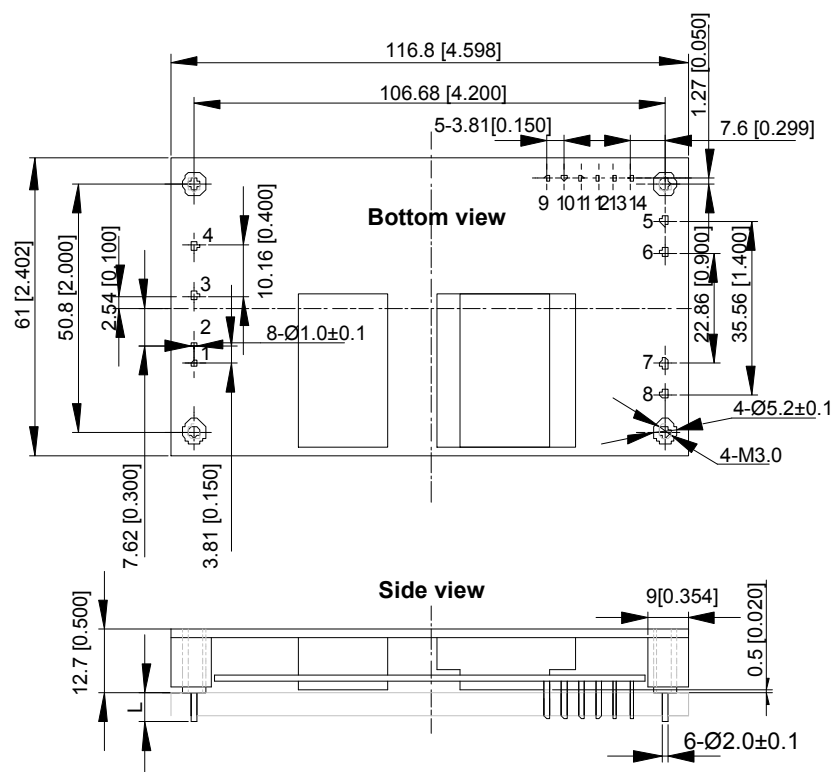
L1, L2, L3: 100 $\mu$ H, common mode inductor

C1 ~ C4: See Figure 11

U1: 20A input EMC filter module (P/N: FM100-20)

U2: Converter under test, AGF600-48S30Y

## Mechanical Diagram



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

Tolerance: X.Xmm $\pm 0.5$ mm[X.X in. $\pm 0.02$ in.]X.XXmm $\pm 0.25$ mm[X.XX in. $\pm 0.01$ in.]

Figure 18 Mechanical diagram

## Pin length option

| Device code suffix | L                  |
|--------------------|--------------------|
| -4                 | 4.8mm $\pm 0.5$ mm |
| -6                 | 3.8mm $\pm 0.5$ mm |
| -8                 | 2.8mm $\pm 0.5$ mm |
| None               | 5.8mm $\pm 0.5$ mm |

## Pin Designations

| Pin NO. | Name      | Function                |
|---------|-----------|-------------------------|
| 1       | +On/Off   | Remote control          |
| 2       | -On/Off   | Remote control          |
| 3       | $V_{in+}$ | Positive input voltage  |
| 4       | $V_{in-}$ | Negative input voltage  |
| 5, 6    | $V_{o-}$  | Negative output voltage |
| 7, 8    | $V_{o+}$  | Positive output voltage |
| 9       | AUX       | Auxiliary voltage       |
| 10      | I OG      | Inverter operation good |
| 11      | NC        |                         |
| 12      | Trim      | Trim terminal           |
| 13      | +S        | Remote sensing +        |
| 14      | -S        | Remote sensing -        |

## Soldering

The product is intended for standard manual or wave soldering.

When wave soldering is used, the temperature on pins is specified to maximum 255°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 similitive.

## Thermal Considerations

The converter can operate in a enclosed environment without forced air convection. Cooling of the converter is achieved mainly by conduction from the baseplate to a heatsink. The converter can deliver full output power at 85°C ambient temperature provided the baseplate temperature is kept below the max values 100°C.

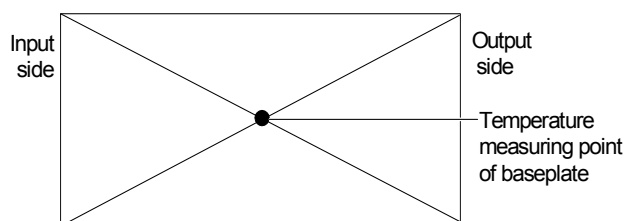


Figure 19 Temperature test point on base plate

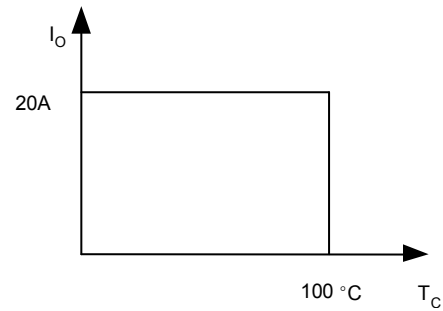


Figure 20 Output power derating curve,  $T_C$ : temperature test point on baseplate, see Figure 19

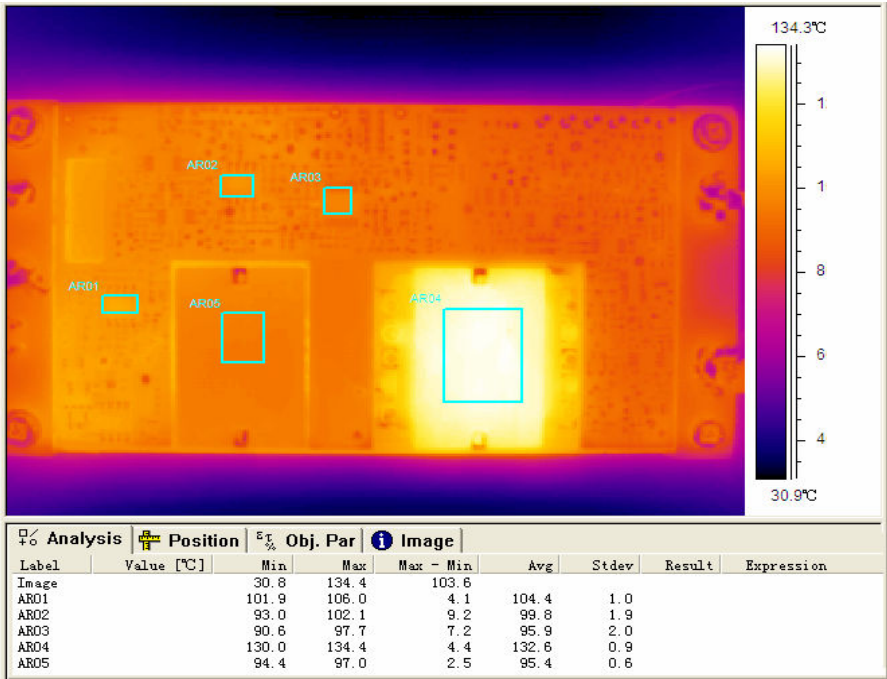


Figure 21 Thermal image, 48V<sub>in</sub>, 30V<sub>o</sub>, full load, room temperature

## Ordering Information

| AGF600 | - | 48 | S | 30 |  |   | Y |
|--------|---|----|---|----|--|---|---|
| ①      |   | ②  | ③ | ④  |  | ⑤ | ⑥ |

|   |                      |                                                                |
|---|----------------------|----------------------------------------------------------------|
| ① | Model series         | AGF: high efficiency full brick series; 600: output power 600W |
| ② | Input voltage        | 48: 36V ~ 75V input range, rated input voltage 48V             |
| ③ | Output channel       | S: single output                                               |
| ④ | Rated output voltage | 30: 30V output                                                 |
| ⑤ | Pin length           | None: 5.8mm                                                    |
| ⑥ | RoHS status          | Y: RoHS, R5                                                    |

| Model number  | Description                                                     |
|---------------|-----------------------------------------------------------------|
| AGF600-48S30Y | 5.8mm pin length; with thread inside mounting hole; R5 compliat |

## Hazardous Substances Announcement (RoHS of China)

| Parts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Hazardous Substances |    |    |                  |     |      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----|----|------------------|-----|------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Pb                   | Hg | Cd | Cr <sup>6+</sup> | PBB | PBDE |
| AGF600-48S30Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | √                    | ○  | ○  | ○                | ○   | ○    |
| <p>○: 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</p> <p>√: 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</p> <p>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:</p> <ol style="list-style-type: none"> <li>1. Solders (including high-temperature solder in parts) contain plumbum.</li> <li>2. Glass of electric parts contains plumbum.</li> <li>3. Copper alloy of pins contains plumbum</li> </ol> |                      |    |    |                  |     |      |

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