Advanced Energy.

ARTESYN
AGF700-48S30 SERIES
700 Watts Full-Brick Converter

PRODUCT DESCRIPTION

Advanced Energy's Artesyn AGF700-48S30 series is a single output DC-DC converter with standard full-brick outline and pin configuration. It delivers up to 23.4A 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. Aluminum baseplate structure makes it possible for the module to work under -40 $^{\circ}$C ~ +85 $^{\circ}$C without air cooling.

AT A GLANCE

Total Power

700 Watts

Input Voltage

36 to 75 Vdc

# of Outputs

Single

RoHS ✓

SPECIAL FEATURES

- Delivering up to 23.4A output
- Ultra-high efficiency 94.0% typ. at full load
- Wide input range: 36V to 75V
- Excellent thermal performance
- No minimum load requirement
- Fixed frequency operation
- RoHS 3.0
- Remote control function
- Remote output sense
- Trim function: 50% ~ 110%
- Input under voltage protection
- Output over current protection
- Output over voltage protection
- Over temperature protection
- Industry standard full-brick pin-out outline
- With aluminum baseplate
- Pin length optional

SAFETY

- TUV   EN 62368-1
- UL+CUL   UL 60950-1
- CE   EN 60950-1

TYPICAL APPLICATIONS

- Telecom
- Datacom

MODEL NUMBERS

Standard	Output Voltage	Structure	Pin length	RoHS Status
AGF700-48S30LT	30Vdc	Baseplate	5.8mm	RoHS 3.0

Order Information

AGF700	-	48	S	30	L	T
①		②	③	④	⑤	⑥

①	Model series	AGF: high efficiency full-brick series; 700: output power 700W	
②	Input voltage	48: 36V ~ 75V input range, rated input voltage 48V	
③	Output number	S: single output	
④	Rated output voltage	30: 30V output	
⑤	RoHS status	L: RoHS 3.0	
⑥	Mounting hole	T: through hole	

Options

None

Advanced Energy

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 modules
	All modules
		$V_{IN,DC}$	-
			-
				-
				-
					80
					100
						Vdc
						Vdc

Maximum Output Power	All modules	$P_{O,max}$	-	-	700	W

Isolation Voltage[1]
          Input to Output
          Input to Baseplate
          Output to Baseplate
	Open frame module
	Baseplate module
	Baseplate module
			-
			-
			-
				-
				-
				-
					1500
					1500
					500
						Vdc
						Vdc
						Vdc

Ambient Operating Temperature	All modules	T_A	-40	-	+85	°C
Storage Temperature	All modules	T_{STG}	-55	-	+125	°C

Humidity (non-condensing)
          Operating
          Storage
	All modules
	All modules
			-
			-
				-
				-
					95
					95
						%
						%

Note 1 - 1mA for 5s, Pollution degree 2.

ELECTRICAL SPECIFICATIONS

Input Specifications

Table 2. Input Specifications						
Parameter	Condition[1]	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, DC	All	$V_{IN,DC}$	36	48	75	Vdc
Turn-on Voltage Threshold	$I_O = I_{O,max}$	$V_{IN,ON}$	31	35	36	Vdc
Turn-off Voltage Threshold	$I_O = I_{O,max}$	$V_{IN,OFF}$	30	33	35	Vdc
Lockout Voltage Hysteresis	$I_O = I_{O,max}$		1	1.5	3	V
Maximum Input Current ($I_O = I_{O,max}$)	$V_{IN,DC}$ = 36Vdc	$I_{IN,max}$	-	-	23	A
No-load Input Current ($I_O = I_{O,max}$)	$V_{IN,DC}$ = 48Vdc		-	0.2	0.3	A
Standby Input Current	Remote OFF		-	0.02	0.1	A
Recommended Input Fuse	Fast blow external fuse recommended		-	30	-	A
Recommended External Input Capacitance	Low ESR capacitor recommended	C_{IN}	470	-	-	uF
Input filter component values(C\L)	Internal value			15\0.55		uF\uH
Input Reflected Ripple Current	Through 12uH inductor		-	50	160	mA
Operating Efficiency	T_A = 25 °C $I_O = I_{O,max}$ $I_O = 50\%I_{O,max}$	η	- -	94.0 94.5	- -	% %

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	29.4	30	30.6	Vdc	
Output Voltage Line Regulation	All	$\%V_O$	-	0.05	0.2	%	
		Vo		15	60	mV	
Output Voltage Load Regulation	All	$\%V_O$	-	0.2	0.5	%	
		Vo	-	60	150	mV	
Output Voltage Temperature Regulation	All	$\%V_O$	-	-	0.02	%/°C	
Output Voltage Trim Range	All	V_O	15	-	33	V	
Total Output Voltage Range	Over sample, line, load, temperature & life	V_O	29.1	30	30.9	V	
Output Ripple, pk-pk	Measure with a 1uF ceramic capacitor in parallel with a 10uF tantalum capacitor, 0 to 20MHz bandwidth	V_O	-	100	250	mV_{PK-PK}	
Operating Output Current Range	All	I_O	0	-	23.4	A	
Output DC Current-limit Inception[2]	All	I_O	25.2	-	33	A	
V_O Load Capacitance[3]	All	C_O	470	1000	10000	uF	
V_O Dynamic Response	Peak Deviation Settling Time[4]	25% ~ 50% ~ 25% load change slew rate = 0.1A/us	$\pm V_O$ T_s	- -	300 60	600 500	mV uSec
		50% ~ 75% ~ 50% load change slew rate = 0.1A/us	$\pm V_O$ T_s	- -	300 60	600 500	mV uSec
Turn-on transient	Rise Time	$I_O = I_{O,max}$	T_{rise}	-	200	500	mS
	Turn-on Delay Time	$I_O = I_{O,max}$	$T_{turn-on}$	-	140	300	mS
	Output Voltage Overshoot	$I_O = 0$	$\%V_O$	-	-	5	%
Switching Frequency	All	f_{SW}	260	290	320	KHz	
Remote ON/OFF Control	All		1.5	-	5	mA	

Note 1 - Ta = 25 °C, airflow rate = 400 LFM, Vin = 48Vdc, nominal Vout unless otherwise noted. All electrical specification is guaranteed above 35V input voltage after module turn on.
Note 2 - Hiccup. See Figure 10.
Note 3 - High frequency and low ESR is recommended. Out voltage can be start up when out external electrolytic Capacitor is 100uF/50V.
Note 4 - Recovery to within 1% Vo,nom.

ELECTRICAL SPECIFICATIONS

Output Specifications

Table 3. Output Specifications, con't:						
Parameter	Condition	Symbol	Min	Typ	Max	Unit
Output Over-voltage Protection[5]	Over full temp range	V_O	36	-	40	V
Output Over-temperature Protection[6] With baseplate	All	T	105	110	125	°C
Over-temperature Hysteresis	All	T	5	-	-	°C
Output Voltage Remote Sense Range	All		-	-	0.3	V
MTBF	Telcordia SR-332-2006; 80% load, 300LFM, 40 °C T_A		-	1.5	-	10^6 h

Note 5 - Hiccup: auto-restart when over-voltage condition is removed.
Note 6 - Auto recovery.

ELECTRICAL SPECIFICATIONS

AGF700-48S30LT Performance Curves
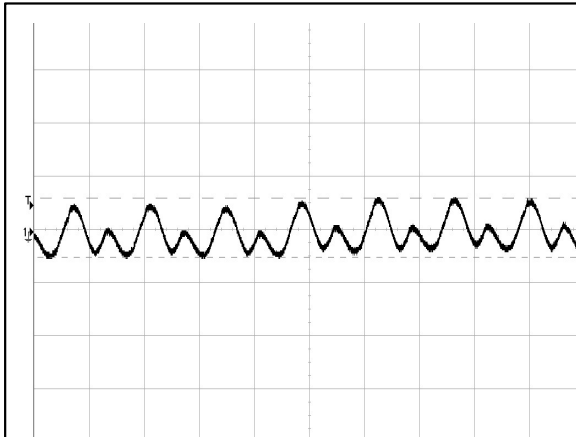
Figure 1:   AGF700-48S30LT Input Reflected Ripple Current Waveform

Ch 1: Iin   (5uS/div, 20mA/div)
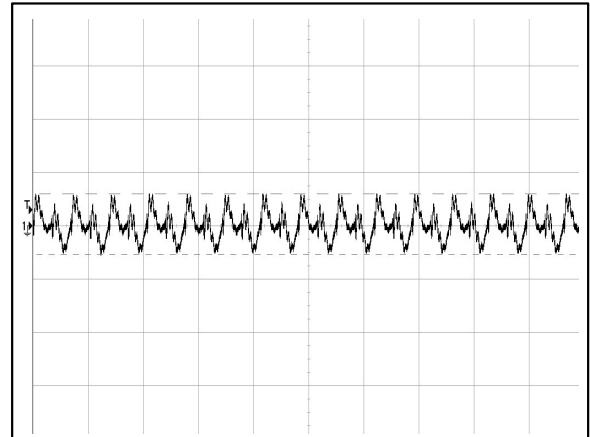
Figure 2:   AGF700-48S30LT Ripple and Noise Measurement

Ch 1: Vo   (10us/div, 100mV/div)
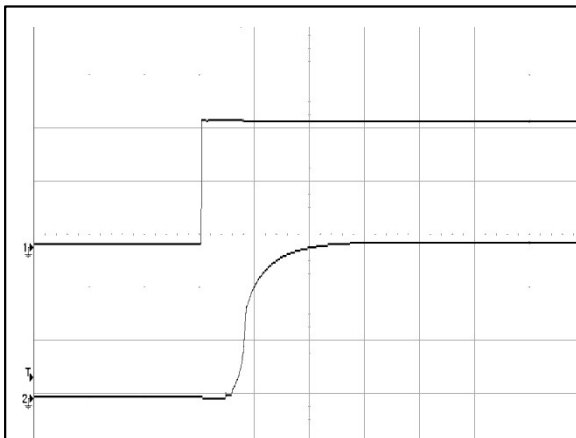
Figure 3:   AGF700-48S30LT Output Voltage Startup Characteristic
                                    (200mS/div)

Ch 1: Vin   (20V/div)   Ch 2: Vo   (10V/div)
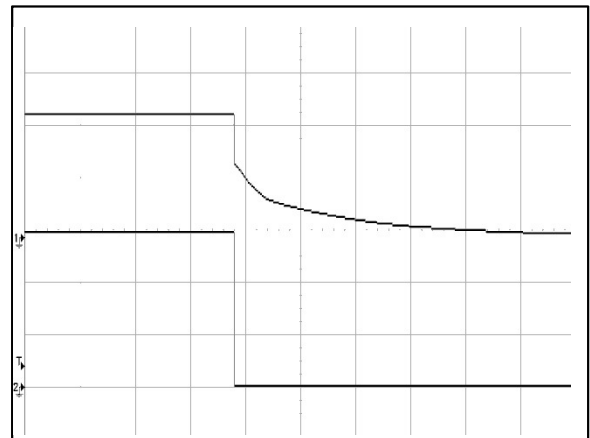
Figure 4:   AGF700-48S30LT Turn Off Characteristic
                                    (500mS/div)

Ch 1: Vin   (20V/div)   Ch 2: Vo   (10V/div)
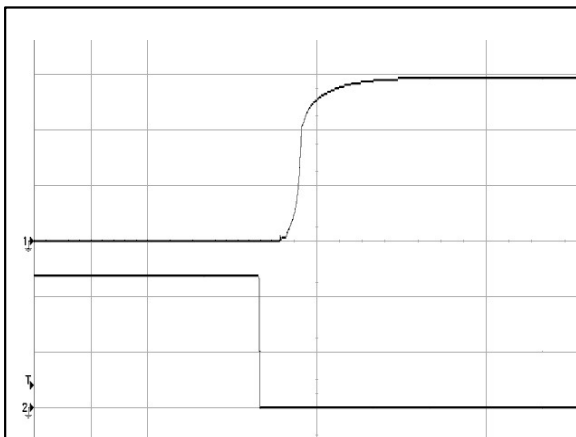
Figure 5:   AGF700-48S30LT Remote ON Waveform (200mS/div)

Ch 1: Vo   (10V/div)   Ch 2: Remote ON   (20V/div)
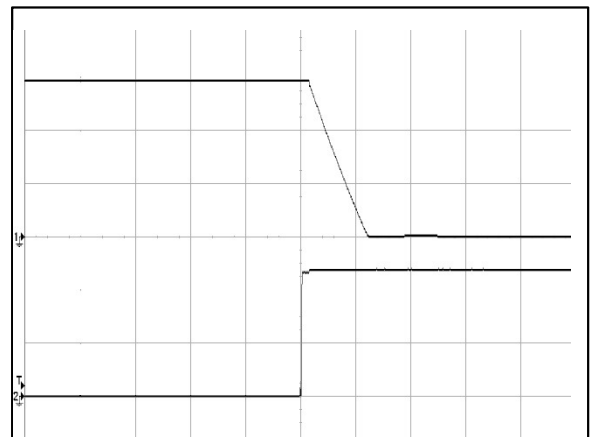
Figure 6:   AGF700-48S30LT Remote OFF Waveform (1mS/div)

CH1: Vo   (10V/div)   Ch 2: Remote OFF   (20V/div)

ELECTRICAL SPECIFICATIONS

AGF700-48S30LT Performance Curves
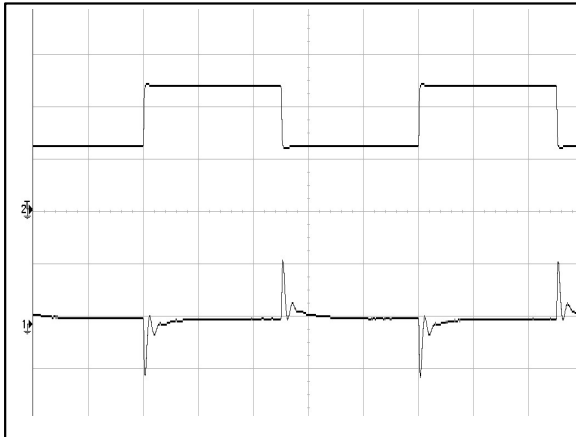
Figure 7:   AGF700-48S30LT Transient Response
             25%~50%~25% load change, 0.1A/uS slew rate,
Ch 1: Vo   (200mV/div)   Ch 2: Io   (5A/div)
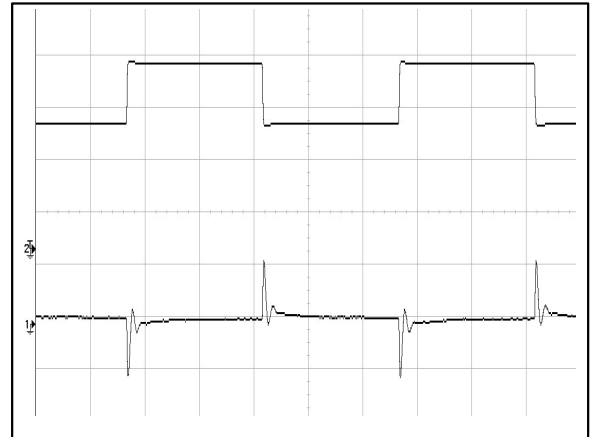
Figure 8:   AGF700-48S30LT Transient Response
             50%~75%~50% load change, 0.1A/uS slew rate,
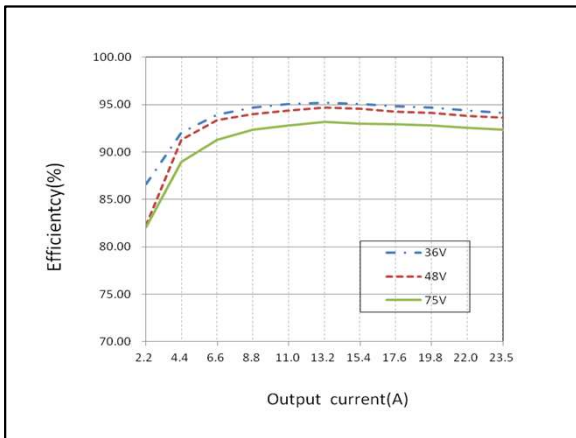Ch 1: Vo   (200mV/div)   Ch 2: Io   (5A/div)
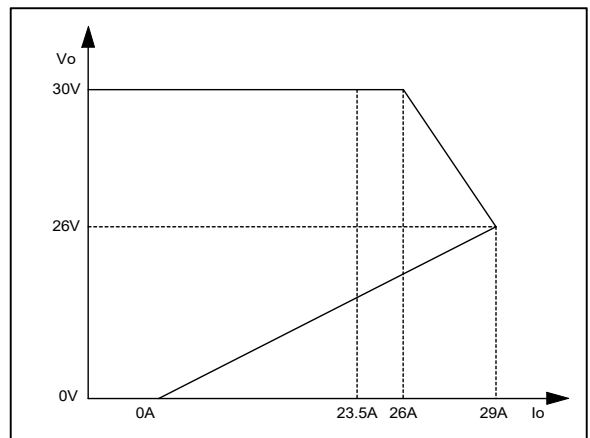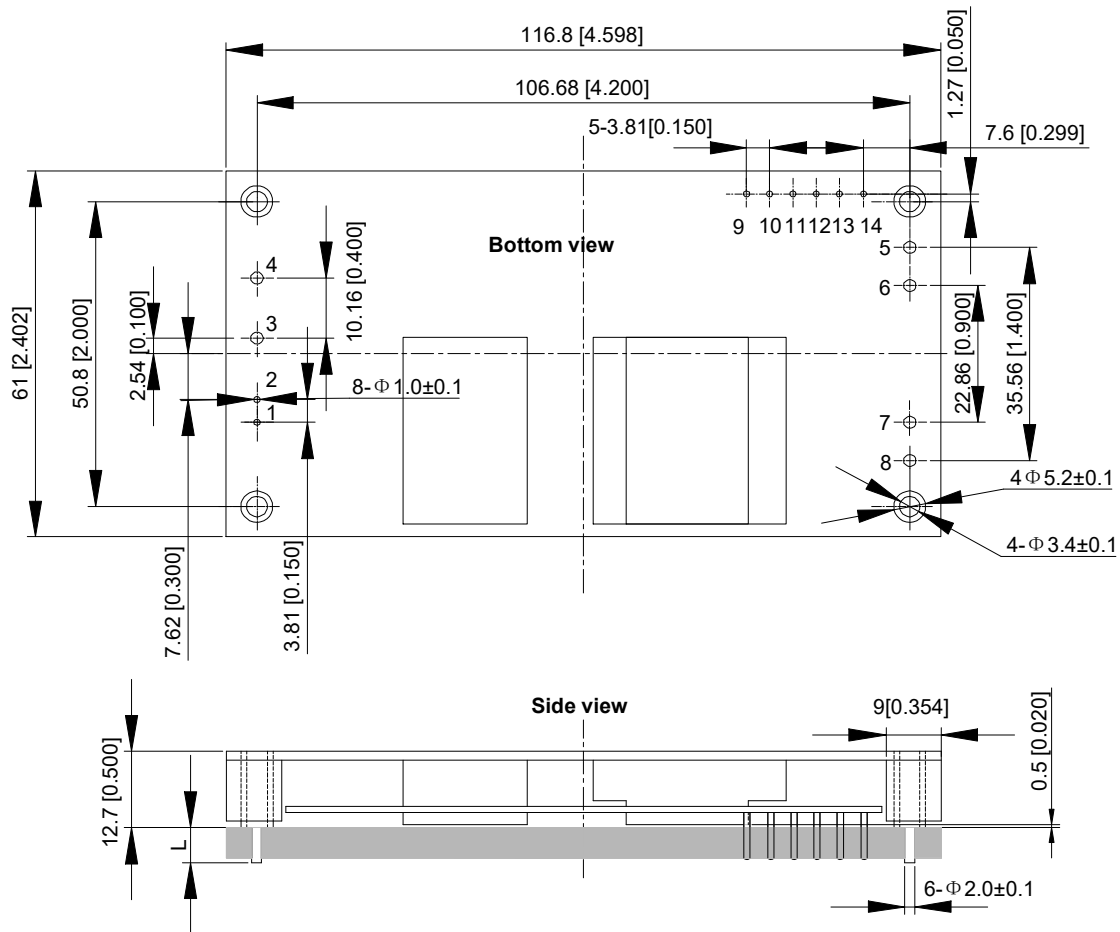

Figure 9:   AGF700-48S30LT Efficiency Curves @ 25 °C

             Ta=25 °C, Tc=40 °C, Vo=30V

Figure 10:   Over-current protection characteristics[1]

Note 1: It's only a sketch map of OCP action. Little alterations of the current value vs. voltage value are allowed.

MECHANICAL SPECIFICATIONS

Mechanical Outlines（unit: mm）

116.8 [4.598]
106.68 [4.200]
5-3.81[0.150]
1.27 [0.050]
7.6 [0.299]

Bottom view

9 10 11 12 13 14

61 [2.402]
50.8 [2.000]
10.16 [0.400]
2.54 [0.100]
8-Φ1.0±0.1

22.86 [0.900]
35.56 [1.400]

4 Φ5.2±0.1
4-Φ3.4±0.1

7.62 [0.300]
3.81 [0.150]

Side view
9[0.354]
0.5 [0.020]
12.7 [0.500]
L
6-Φ2.0±0.1

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.]

MECHANICAL SPECIFICATIONS

Pin length option

Device code suffix	Pin size
-4	4.8mm±0.2 mm
-6	3.8mm±0.2 mm
-8	2.8mm±0.2 mm
None	5.8mm±0.2 mm

Pin Designations

Pin No	Name	Function
1	+On/Off	Remote control
2	-On/Off	Remote control return
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	IOG	Inverter operation good
11	NC	Not connected
12	Trim	Trim terminal
13	+S	Positive remote sense
14	-S	Negative remote sense

ENVIRONMENTAL SPECIFICATIONS

EMC Immunity

AGF700-48S30LT power supply is designed to meet the following EMC immunity specifications:

Table 4. Environmental Specifications:	
Document	**Description**
EN55022, Class B Limits	Conducted and Radiated EMI Limits

EMC Filter Configuration
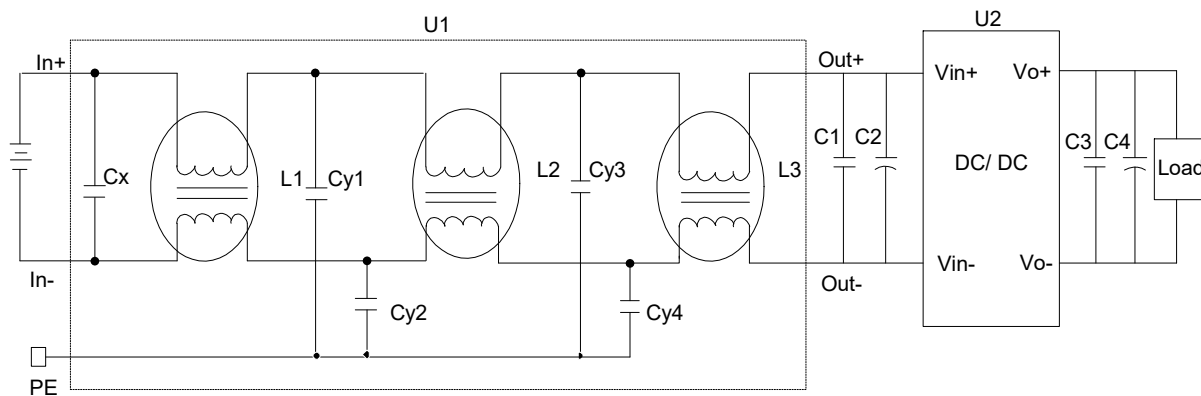
Figure 11 EMC test configuration

CX: 5.7uF/100V capacitor

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

L1, L2, L3: 100uH, common mode inductor

C1 ~ C4: See Figure 15

U1: 30A input EMC filter module

U2: Converter under test, AGF700-48S30LT

ENVIRONMENTAL SPECIFICATIONS

Safety Certifications

The AGF700-48S30LT 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 AGF700-48S30LT power supply system:		
Standard		**Description**
UL 60950-1, 2nd Edition, 2011-12-19; CSA C22.2 No. 60950-1-07, 2nd Edition, 2011-12	UL+CUL	US and Canada Requirements
EN 62368-1:2014/A11:2017	TUV-SUD	Europe Requirements
EN 60950-1:2006 +A11 : 2009 +A1:2010+A12:2011+A:2013, EN 62368-1:2014+A11:2017	CE	CE Marking

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature

The AGF700-48S30LT power supply will start and operate within stated specifications at an ambient temperature from -40 $^{\circ}$C to 85 $^{\circ}$C under all load conditions. The storage temperature is -55 $^{\circ}$C to 125 $^{\circ}$C.

Thermal Considerations - Base plate module

The converter can operate in an enclosed environment without forced air convection. Cooling of the converter is achieved mainly by conduction from the baseplate to a heat sink. The converter can deliver full output power at 85 $^{\circ}$C ambient temperature provided the baseplate temperature is kept the max values 100 $^{\circ}$C.
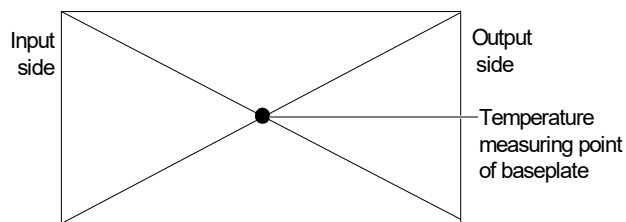
Figure 12 Temperature test point on baseplate

Table 6. Temperature limit of the test point	
Test Point	**Temperature Limit**
Test point on baseplate	100 $^{\circ}$C
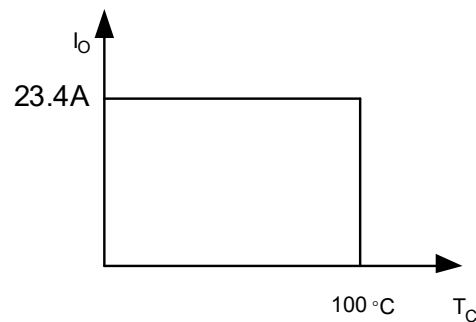
Figure 13 Output power derating curve, Tc: temperature test point on baseplate, see Figure 12

ENVIRONMENTAL SPECIFICATIONS
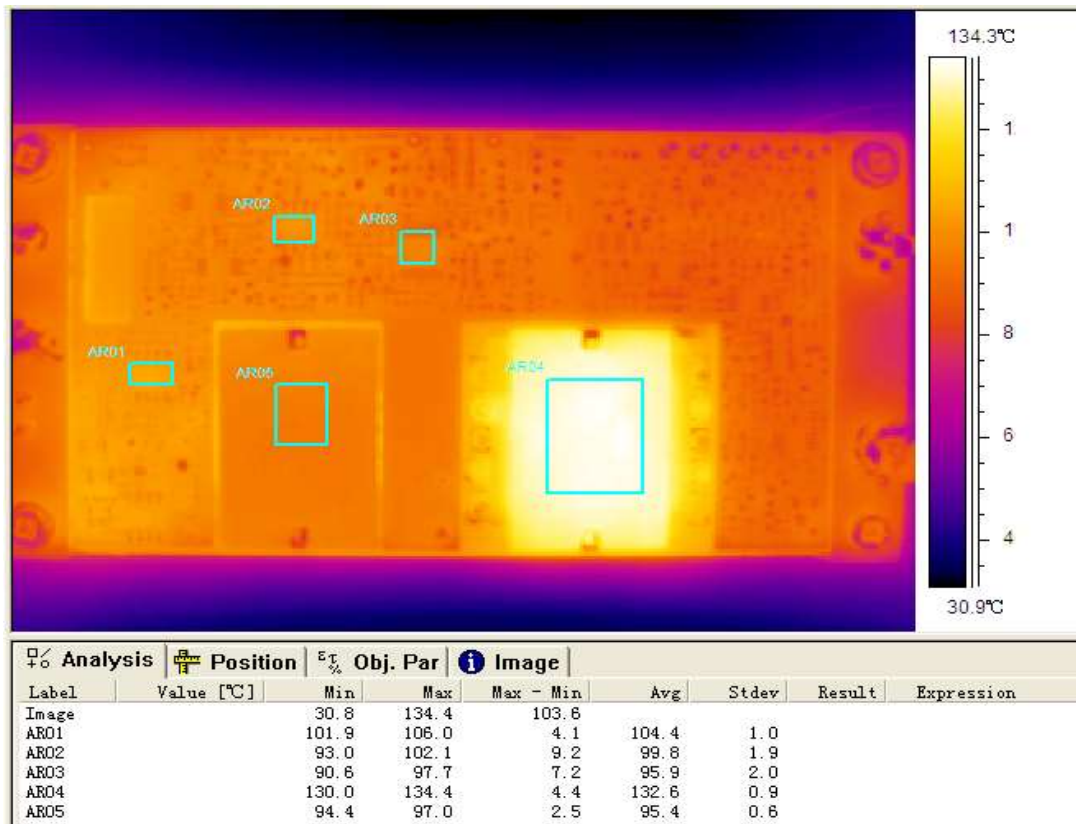
Figure 14 Thermal image, $48V_{in}$, $30V_{o}$, full load, room temperature

ENVIRONMENTAL SPECIFICATIONS

Qualification Testing

Parameter	Unit (pcs)	Test condition
Halt test	4-5	Ta,min-10 ^{O}C to Ta,max+10 ^{O}C, 5 ^{O}C step, Vin = min to max, 0 ~ 105% load
Vibration	3	Frequency range: 5Hz ~ 20Hz, 20Hz ~ 200Hz, A.S.D: 1.0m2/s3, -3db/oct, axes of vibration: X/Y/Z；Time: 30min/axis
Mechanical Shock	3	30g, 6ms, 3axes, 6directions, 3time/direction
Thermal Shock	3	-40 ^{O}C to 100 ^{O}C, unit temperature 20cycles
Thermal Cycling	3	-40 ^{O}C to 85 ^{O}C, temperature change rate: 1 ^{O}C/min, cycles: 2cycles
Humidity	3	40 ^{O}C, 95%RH, 48hours
Solder Ability	15	IPC J-STD-002C-2007

APPLICATION NOTES

Typical Application

Below is the typical application of the AGF700-48S30LT power supply.
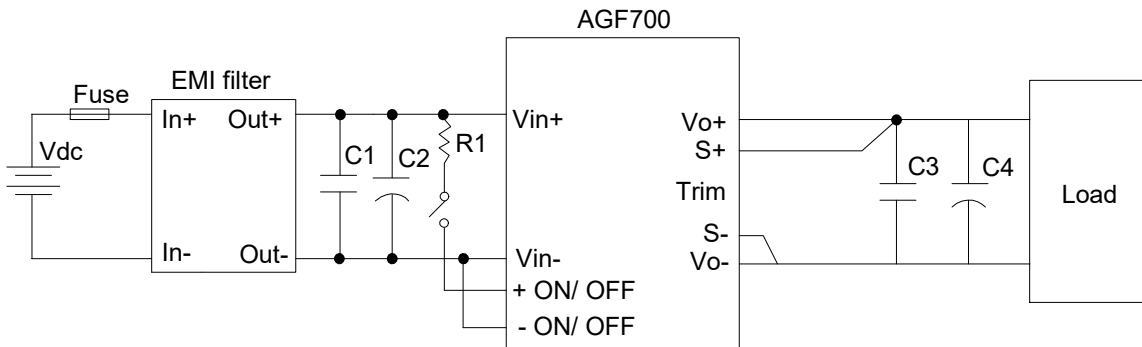
Figure 15 Typical application

R1: 20KΩ (1/2W), current limiting resistor

C1: 470uF/100V electrolytic capacitor, P/N: UPW2A471MHD (Nichicon) or equivalent caps.

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

C4: 1000uF/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.

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 15.
If the sense compensate function is not necessary, short S+ to Vo+ and S- to Vo- respectively.

APPLICATION NOTES

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 as shown in Figure 16.
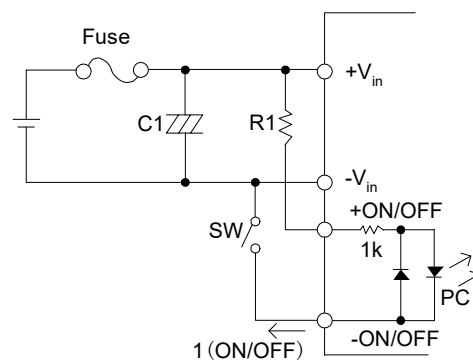
Figure 16 Connection of remote ON/OFF control (A)

R1: Recommended resistor value: 20kΩ (1/2W)

Controlling the remote ON/OFF terminal from the output side

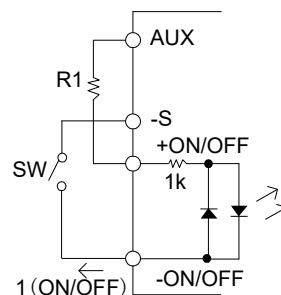Connect the current limiting resistor R1 as shown in Figure 17.

Figure 17 Connection of remote ON/OFF control (B)

R1: Recommended resistor Value: 2kΩ (1/4W)

APPLICATION NOTES

Note:

1. When wiring becomes long, connect a capacitor of about 0.1uF 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

APPLICATION NOTES

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.
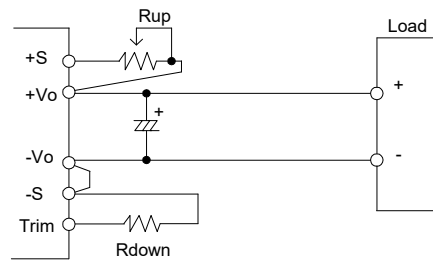
Figure 18 Trim circuit

$$R_{up} = 30(\frac{Vo - Ve}{Ve})k\Omega$$

$$R_{down} = -5.97(\frac{Vo}{Vo - Ve})k\Omega$$

Ve is the rated output voltage and Vo is the goal voltage.

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

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

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

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

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

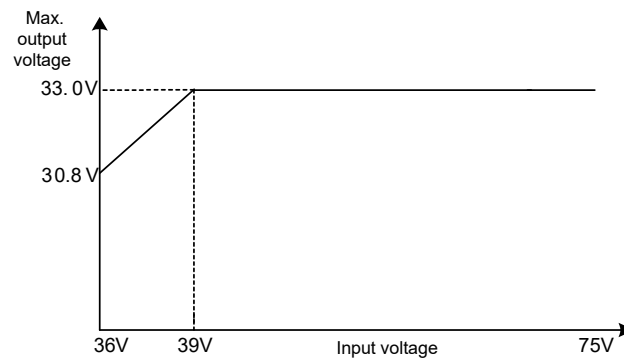Figure 19 Trim-up-able voltage vs. input voltage

APPLICATION NOTES

Trim Characteristics

The output voltage can also be trimmed by potential applied at the Trim pin. An external resistor is needed between Trim pin and V_{trim}.
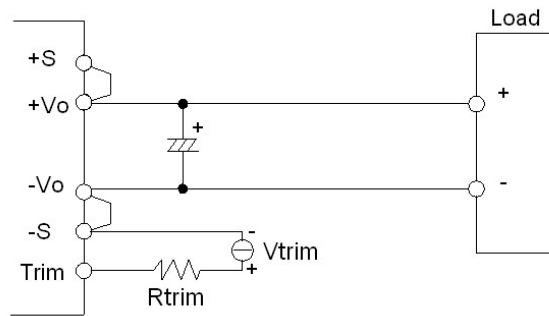

Figure 20 Trimmed by V_{trim} circuit

The equation of the trim voltage and output voltage is described as below,

$$V_{trim} = 1 + k\Delta\%$$

$$k = (R_{trim} + 5.97)/5.97$$

$$\Delta\% = (V_o - V_e)/V_e \times 100\%$$

Where V_{trim} is the potential applied at the Trim pin, and Vo is the desired output voltage, and V_e is 30V, $\triangle$% have a range of -50%~110%. The unit for R_{trim} is kΩ.

When R_{trim}=5.97kΩ

$$V_{trim} = V_o/15 - 1$$

The corresponding relationship between V_{trim} and V_O is shown in Figure 21.
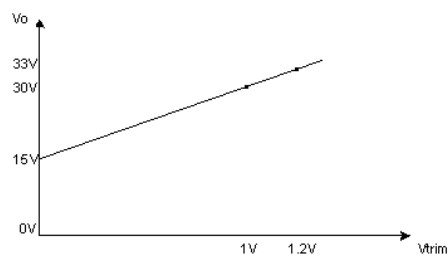

Figure 21 V_{trim} voltage vs. output voltage (R_{trim}=5.97k)

Considering the real resistor value, R_{trim}=5.1k is recommend, the equation is shown as below.

$$V_{trim} = 0.062V_o - 0.854$$

APPLICATION NOTES

Trim Characteristics

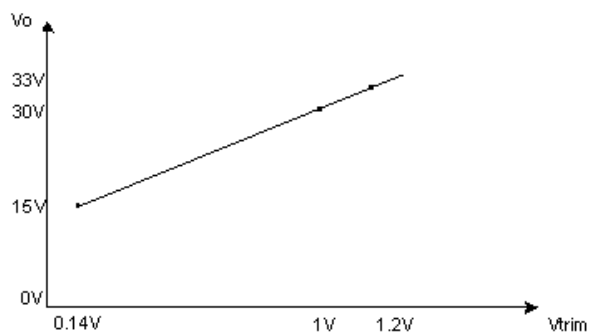The corresponding relationship between V_{trim} and V_o is shown in Figure 22.

Figure 22 V_{trim} voltage vs. output voltage (R_{trim}=5.1kΩ)

APPLICATION NOTES

AUX

AUX is built in to operate the output side RC. If AUX is not used for RC, AUX can also be used for IOG signal output by opto-coupler. Output voltage value is within 7~10Vdc range, maximum output current is 20mA. Ground for the AUX terminal is –S terminal. AUX can be used for IOG signal output by opto-coupler.

*Note: Avoid short circuit of AUX terminal with other terminals as this would lead to power module damage.

IOG

IOG signal turns 'H' from 'L' within 1s when the output of the module is shut down. The specification of IOG is shown in the following table.

Item	IOG
Function	Normal operation 'L'
	Malfunction 'H'
Base pin	-Sense
Level voltage 'L'	0.5V max at 5mA
Level voltage 'H'	5V typ
Maximum sink current	5mA max
Maximum applicable voltage	35V max

There are two methods to use the IOG. The level from IOG can be used directly to monitor the operation of the module, as shown in Figure 23(A). An external power supply, which is no more than 35V, can also be used for IOG, and a current limitting resistor (R1) must be added to ensure the sink current less than 5mA, as shown in Figure 23(B).
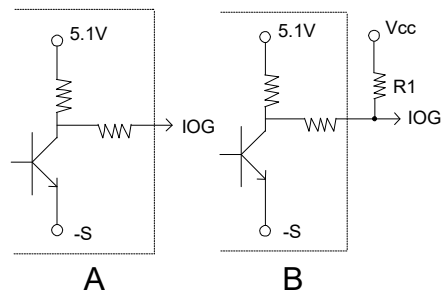

Figure 23 The application of IOG

APPLICATION NOTES

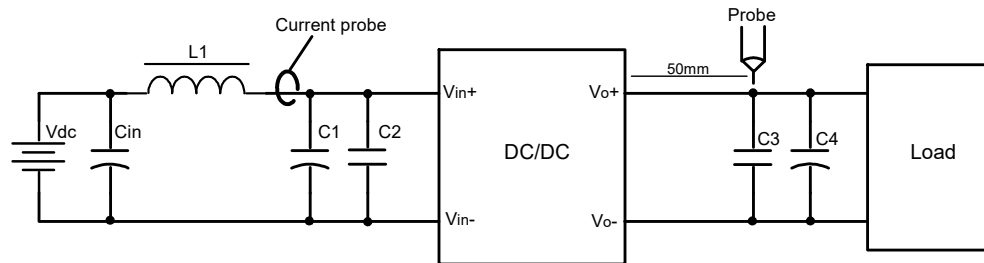### Input Ripple & Inrush Current and Output Ripple & Noise Test Configuration

Figure 24 Input ripple & inrush current, ripple & noise test configuration

Vdc: DC power supply

L1: 12uH

Cin: 220uF/100V typical

C1 ~ C4: See Figure 15

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

Weight

The AGF700-48S30LT weight is 158g.maximum.

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 255 ^{O}C for maximum 7s.

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 similative.

Item	Product requirement	Remark	Product Name
R6	Wave soldering	30V	AGF700-48S30LT

RECORD OF REVISION AND CHANGES

Issue	Date	Description	Originators
1.3	02.24.2020	Update RoHS status	C.Liu
1.4	05.26.2020	Update safety cert from 60950 to 62368-1	C.Liu
1.5	04.29.2021	New template	J. Zhang

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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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For international contact information,
visit advancedenergy.com.

powersales@aei.com (Sales Support)
productsupport.ep@aei.com (Technical Support)
+1 888 412 7832

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