AG25-S Isolated DC/DC Converter Module

Industry Standard Size – 36-75V Input, 3.3V, 5V, 12V and 15V single Output and
18-36V Input, 3.3V and 5V single Output

Industry Standard Size: 2”X 1.6”package

Features

- **2”X 1.6”package**
- **Basic isolation**
- **High efficiency**
- **High power density**
- **2:1 wide input of 36-75V or 18-36V**
- **CNT function**
- **Trim function**
- **Input under-voltage lockout**
- **Output short circuit protection**
- **Output over-voltage protection**
- **Wide operating case temperature range**

Options

Choice of positive logic or negative logic for CNT function

Choice of short pins or long pins

Description

The AG25 series is a new open frame DC-DC converter. It is one of the most cost effective options available in component power. The AG25 series use an industry standard package size: 50.8mm X 40.6mm X 9.66mm (2”x1.6”x0.38”) and standard pin-out configuration, provide CNT and trim functions.

AG25 series come in 48V or 24V input versions, each of which uses a 2:1 input range of 36~75V or 18~36V. The series can provide 5V@5A, 3.3V@6A, 12V@2.1A and 15V@1.67A single output, and output is isolated from input. And the converters are capable of providing up to 25 watts of output power.

Contents

Module Numbering

AG25－48 S 12 P - 4

1 2 3 4 5 6 7

Explanation:

1－Series name

2－Output rated power

3－Input rated voltage:48—48V,24—24V

4－Output number: S ---single output, D---dual output

5－Output rated voltage: 15---15V, 12---12V, 05---5V, 03---3.3V

6—CNT logic, P---positive logic control, default is negative logic control

7—Pin length:

4---4.8 mm±0.5mm (0.19in.±0.020in.)

6---3.80mm±0.25mm(0.150in.±0.010in.)

8---2.80mm±0.25mm(0.110in.±0.010in.)

Default is 5.8 mm±0.5mm (0.23in.±0.020in.)

Electrical Specifications

Unless otherwise indicated, specifications apply over all operating input voltage and temperature conditions. Standard test condition on a single unit is as following:

Ta(ambient): 25°C
+Vin: 48V or 24V +/ –2%
–Vin: return pin for +Vin
CNT: Open
+Vout: connect to load
–Vout: connect to load (return)
Trim(Vadj): Open

Input Specifications

Parameter	Device	Symbol	Min	Typ.	Max	Unit
Operating Input Voltage	AG25-48S AG25-24S	V_I V_I	36 18	48 24	75 36	Vdc Vdc
Maximum Input Current (V_I = 0 to $V_{I,max}$, I_o = $I_{o,max}$)	AG25-48S AG25-24S	$I_{I,max}$ $I_{I,max}$	- -	- -	1 2	A A
Input Reflected-ripple Current (5Hz to 20MHz: 12 μ H source impedance: Ta = 25 ºC.)	All	I_I	-	-	40	mAp-p
No Load Input Power (V_I = $V_{I,nom}$)	All	-	-	-	1	W

CAUTION: This power module is not internally fused. An input line fuse must always be used.

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied in these or any other conditions in excess of those given in the operational sections of the IPS. Exposure to absolute maximum ratings for extended periods can adversely affect device's reliability.

Parameter	**Device**	**Symbol**	**Min**	**Typ.**	**Max**	**Unit**
Input Voltage:						
Continuous:	AG25-48S	V_I	0	-	80	Vdc
	AG25-24S	V_I	0	-	40	Vdc
Transient (100ms)	AG25-48S	$V_{I,\ trans}$	0	-	100	Vdc
	AG25-24S	$V_{I,\ trans}$	0	-	50	Vdc
Operating Ambient Temperature	All	Ta	-40	-	55	ºC
Storage Temperature	All	T_{STG}	-55	-	125	ºC
Operating Humidity	All	-	-	-	85	%
Basic Isolation (Conditions : 50μA for 5 sec, slew rate of 1500V/10sec) Input-Output	All	-	-	-	1500	Vdc
Output Power	5V	$P_{o,max}$	-	-	25	W
	3.3V	$P_{o,max}$	-	-	19.8	W
	12V	$P_{o,max}$	-	-	25.2	W
	15V	$P_{o,max}$	-	-	25.05	W

Output Specifications

Parameter	Device	Symbol	Min	Typ	Max		Unit
Output Ripple and Noise					Ripple	Noise	
(Across 1μF @50V, X7R ceramic capacitor & 10μF @25V tantalum capacitor) See Figure 2. Peak-to-Peak (5 Hz to 20 MHz)	48S03	-	-		60	75	mVp-p
	48S05	-	-		60	75	mVp-p
	48S12	-	-		85	150	mVp-p
	48S15	-	-		85	150	mVp-p
	24S03	-	-		75	100	mVp-p
	24S05	-	-		75	100	mVp-p
External Load Capacitance (See Stability Curves for Detail)	48S03	-	-	220	2200		μF
	48S05	-	-	220	2200		μF
	48S12	-	100	220	2200		μF
	48S15	-	100	220	2200		μF
	24S03	-	220	220	2200		μF
	24S05	-	220	220	2200		μF
Output Voltage Setpoint ($V_I = V_{I,min}$ to $V_{I,max}$: $I_o = I_{o,max}$; Ta = 25 ºC)	3.3V	$V_{o,set}$	3.25	3.3	3.35		Vdc
	5V	$V_{o,set}$	4.95	5.0	5.05		Vdc
	12V	$V_{o,set}$	11.88	12	12.12		Vdc
	15V	$V_{o,set}$	14.85	15	15.15		Vdc
Output Regulation: Line	All	-	-	0.1	0.2		%
Load($I_o = I_{o,min}$ to $I_{o,max}$) (Ta=-40 ºC~55ºC)	All	-	-	0.2	0.5		%
Rated Output Current	3.3V	I_o	0	-	6		A
	5V	I_o	0	-	5		A
	12V	I_o	0.21	-	2.1		A
	15V	I_o	0.167	-	1.67		A
Output Current-limit Inception (when unit is shut down)	48S03	I_o	6.6	-	9		A
	48S05	I_o	5.5	-	8		A
	48S12	I_o	2.3	-	4.5		A
	48S15	I_o	1.8	-	3.8		A
	24S03	I_o	6.6	-	9.5		A
	24S05	I_o	5.5	-	8		A

Output Specifications (Cont.)

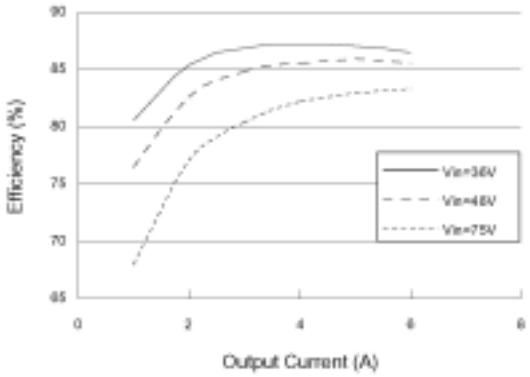
Parameter	Device	Symbol	Min	Typ	Max	Unit
Efficiency ($V_I = V_{I,nom}$; $I_{o,max}$; Ta = 25°C)	48S03 48S05 48S12 48S15 24S03 24S05	- - - - - -	83 85 85 85 81 83	85 87 87 87 83 85	- - - - - -	% % % % % %
Switching Frequency	All	-	-	330		kHz
Dynamic Response : ($\Delta I_o/\Delta t$ = 1A/10μs ; $V_I = V_{I,nom}$; Ta = 25°C) Load Change from I_o = 50% to 75% of $I_{o,max}$: Peak Deviation Settling Time (to $V_{o,nom}$) Load Change from I_o = 50% to 25% of $I_{o,max}$: Peak Deviation Settling Time (to $V_{o,nom}$)	 ALL AG25-48S AG25-24S ALL AG25-48S AG25-24S	 - - - - - - - -	 - - - - - - - -	 - - - - - - - -	 3 200 300 3 200 300	 %V_o μsec μsec %V_o μsec μsec
Turn-On Time ($I_o = I_{o,max}$)	All	-	-	-	20	msec
Output Voltage Overshoot ($I_o = I_{o,max}$; Ta = 25°C)	All	-	-	0	5	%V_o

Feature Specifications

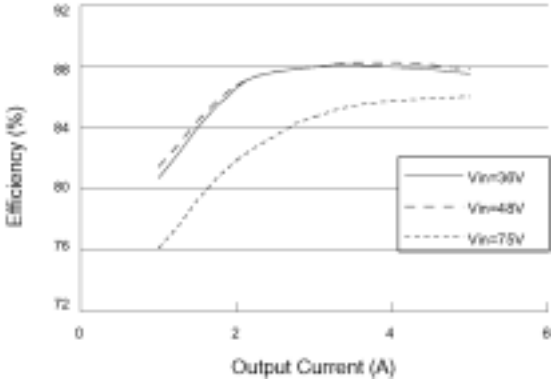
Parameter	Device	Symbol	Min	Typ	Max	Unit
Enable pin voltage :						
Logic Low	All		-0.7	-	0.8	V
Logic High	All		3.5	-	12	V
Enable pin current :						
Logic Low	All		-	-	2.0	mA
Logic High(leakage current, @10V)	All		-	-	-	μA
Output Voltage Adjustment Range	All	-	90	-	110	$\%V_o$
Output Over-voltage (latch)	3.3V	V_{oclamp}	3.90	-	5.00	V
	5V	V_{oclamp}	5.7	-	7.00	V
	12V	V_{oclamp}	13.9	-	16.00	V
	15V	V_{oclamp}	16.8	-	19.00	V
Under-voltage Lockout						
Turn-on Point	AG25-48S	-	31	34	36	V
	AG25-24S	-	15	17	18	V
Turn-off Point	AG25-48S	-	30	33	35	V
	AG25-24S	-	14	16	17	V
Isolation Capacitance	All	-	-	2200	-	pF
Isolation Resistance	All	-	100	-	-	MΩ
Calculated MTBF ($I_o = I_{o,max}$; Ta = 25°C)	All	-	-	2,000,000	-	Hours
Weight	All	-	-	-	25	g(oz.)

Characteristic Curves

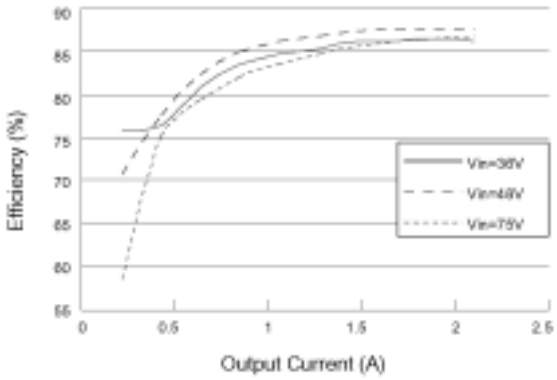
Performance Curves – Efficiency



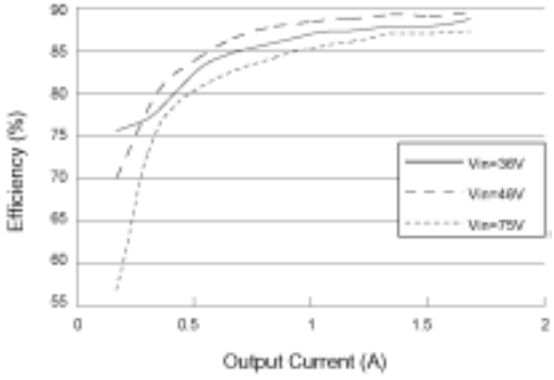
Typical Efficiency AG25-48S03



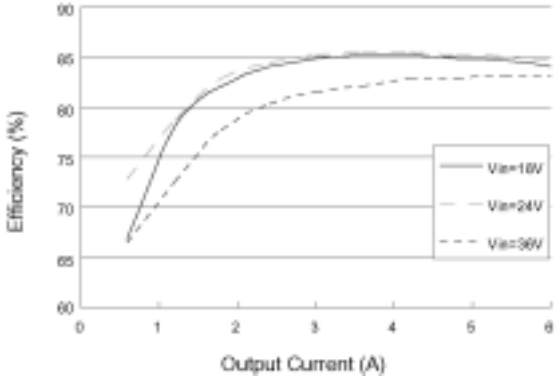
Typical Efficiency AG25-48S05



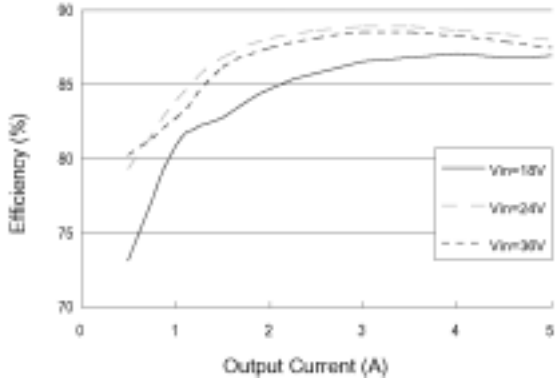
Typical Efficiency AG25-48S12



Typical Efficiency AG25-48S15

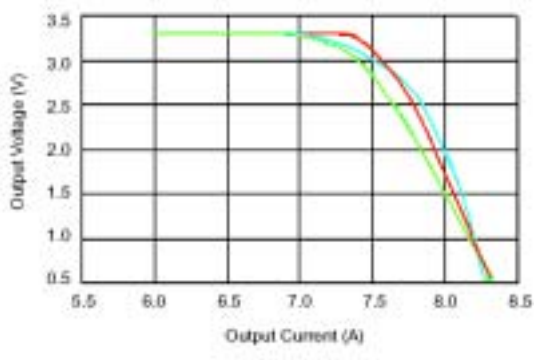


Typical Efficiency AG25-24S03

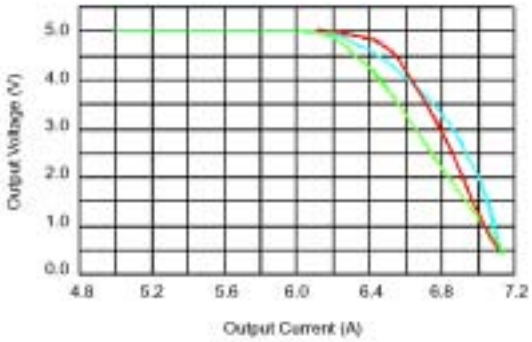


Typical Efficiency AG25-24S05

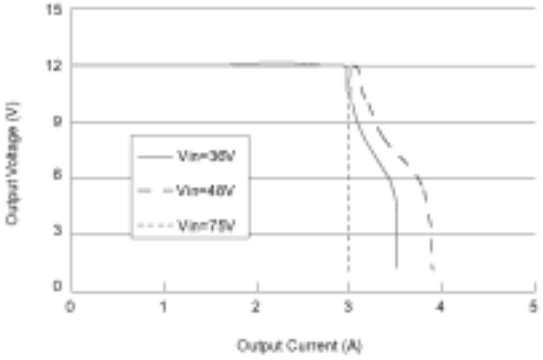
Performance Curves – Output Performance Curves



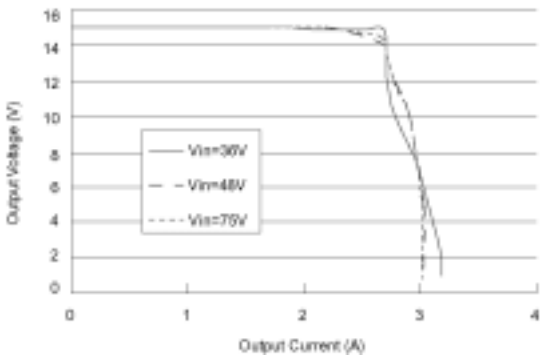
Typical Output Over-current AG25-48S03



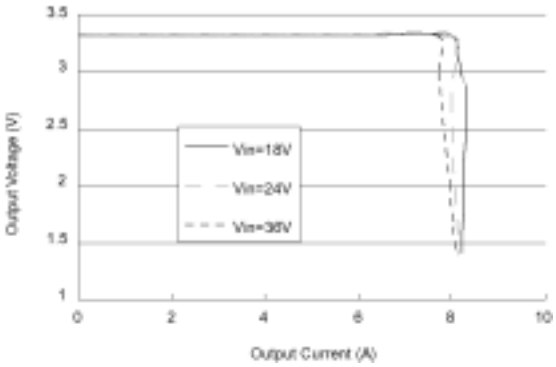
Typical Output Over-current AG25-48S05



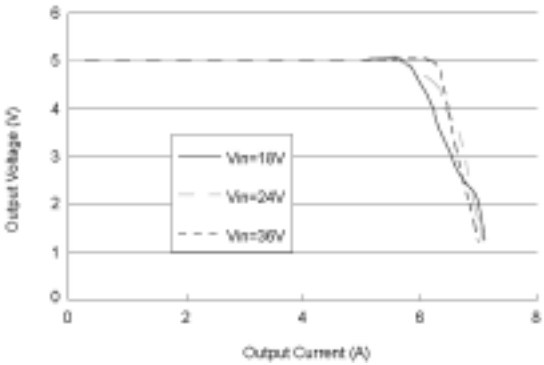
Typical Output Over-current AG25-48S12



Typical Output Over-current AG25-48S15

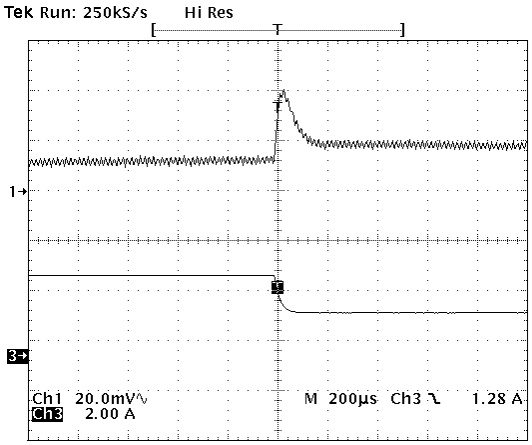


Typical Output Over-current AG25-24S03

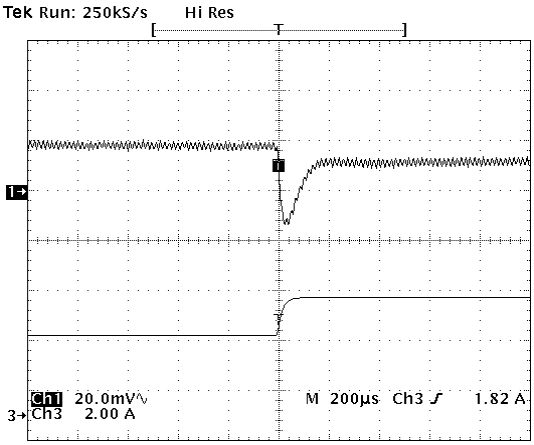


Typical Output Over-current AG25-24S05

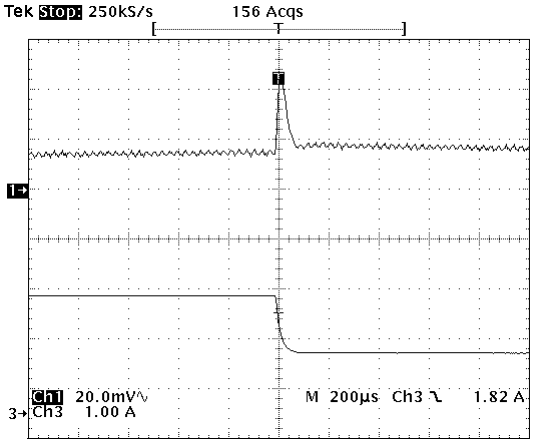
Performance Curves – Transient Response



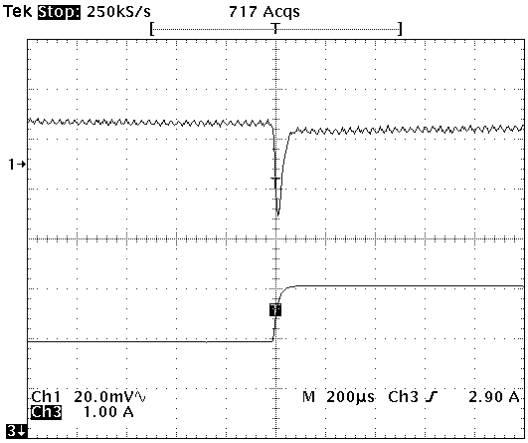
AG25-48S05 50%-25%$I_{o,max}$ load change



AG25-48S05 50%-75%$I_{o,max}$ load change

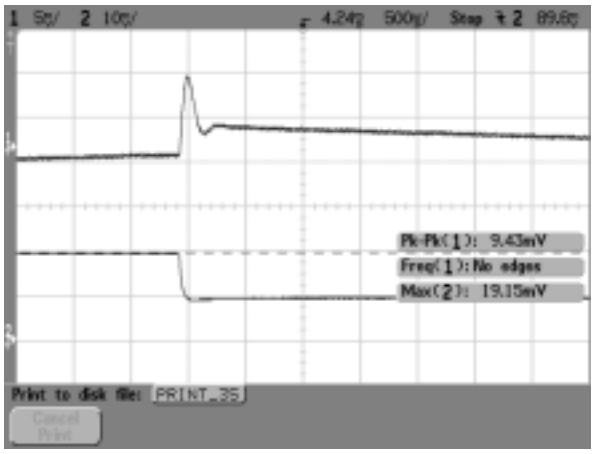


AG25-48S03 50%-25%Io,max load change

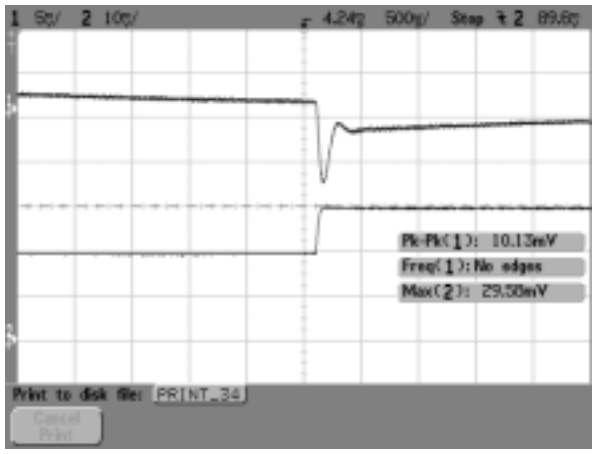


AG25-48S03 50%-75%Io,max load change

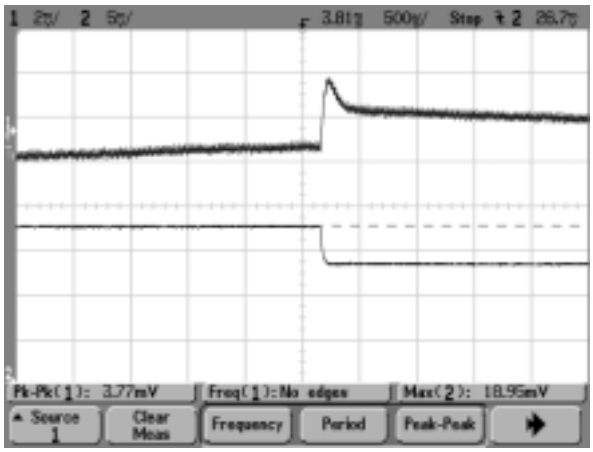
Performance Curves – Transient Response (Cont)



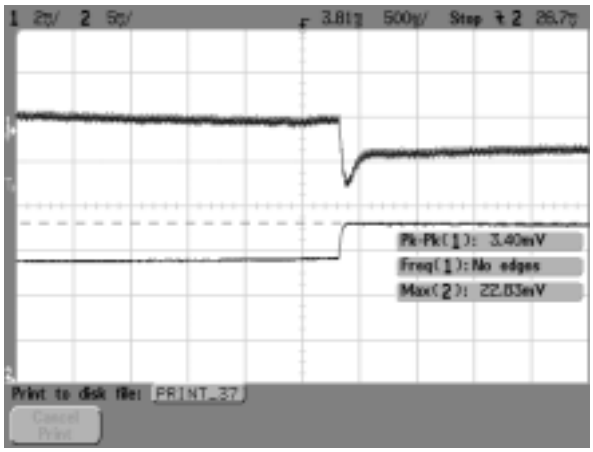
AG25-48S12 50%-25%Io,max load change



AG25-48S12 50%-75%Io,max load change

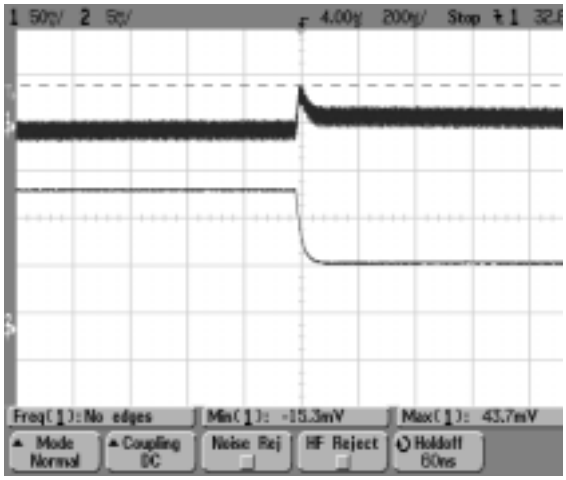


AG25-48S15 50%-25%Io,max load change

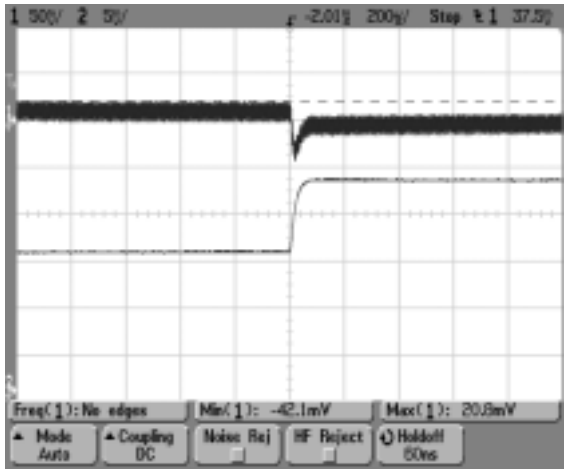


AG25-48S15 50%-75%Io,max load change

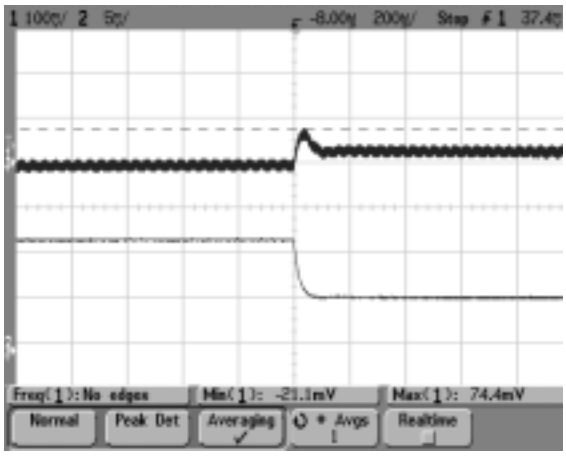
Performance Curves – Transient Response (Cont)



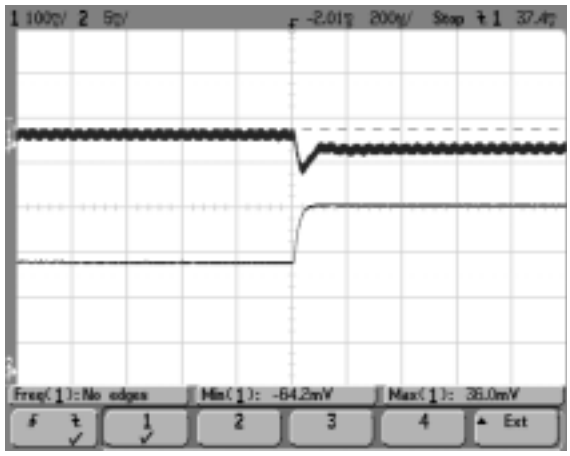
AG25-24S03 50%-25%Io,max load change



AG25-24S03 50%-75%Io,max load change

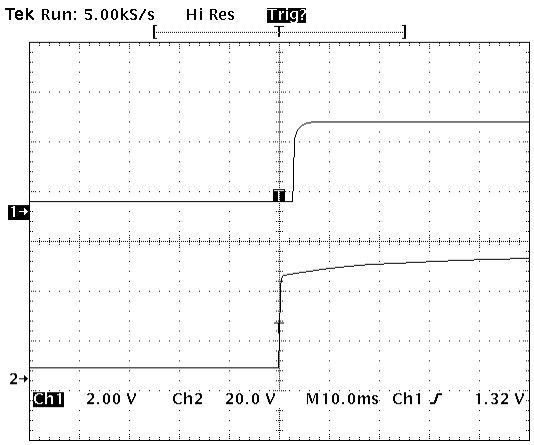


AG25-24S05 50%-25%Io,max load change

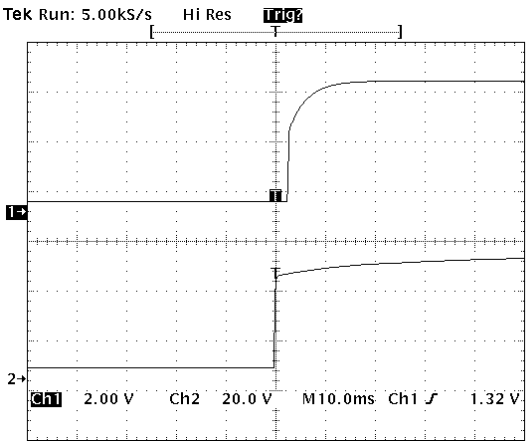


AG25-24S05 50%-75%Io,max load change

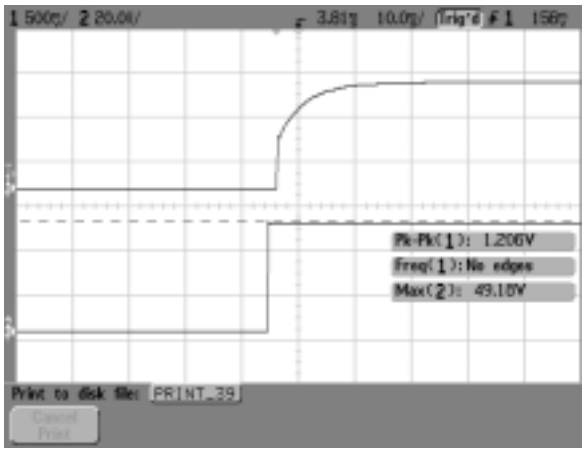
Performance Curves – Startup Characteristics



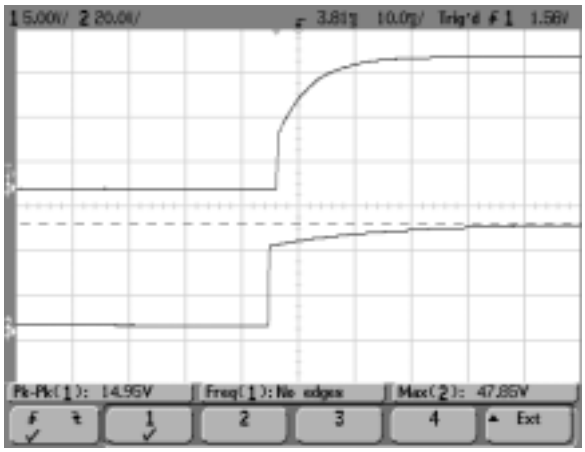
AG25-48S03 Start-up from Power On



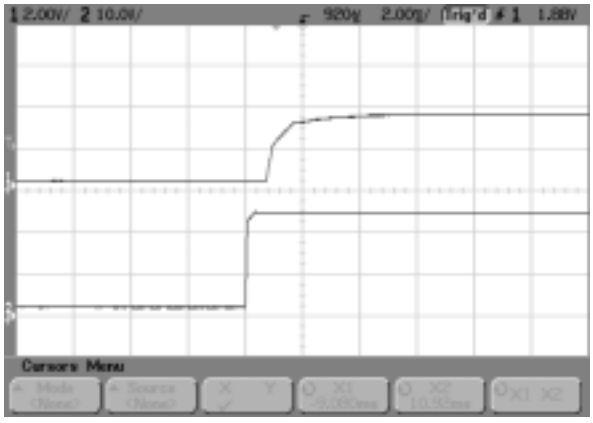
AG25-48S05 Start-up from Power On



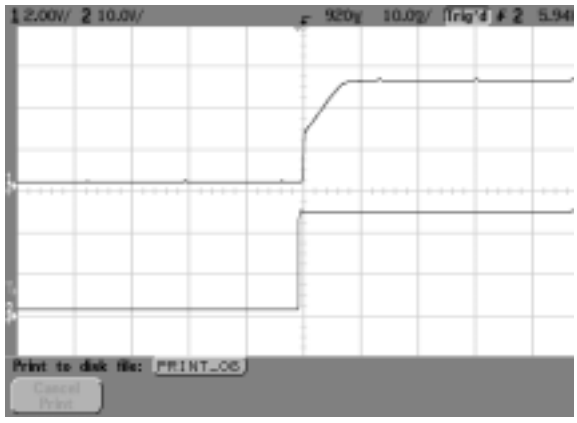
AG25-48S12 Start-up from Power On



AG25-48S15 Start-up from Power On

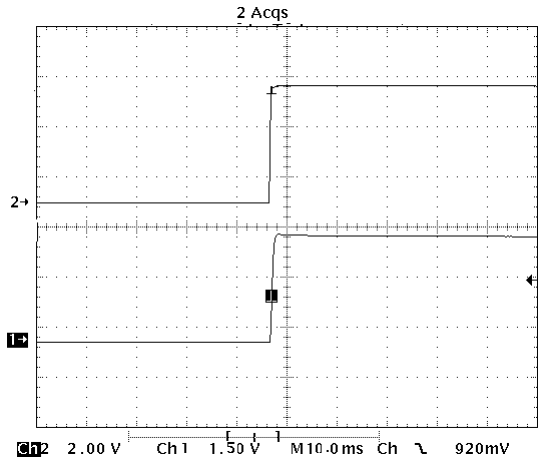


AG25-24S03 Start-up from Power On

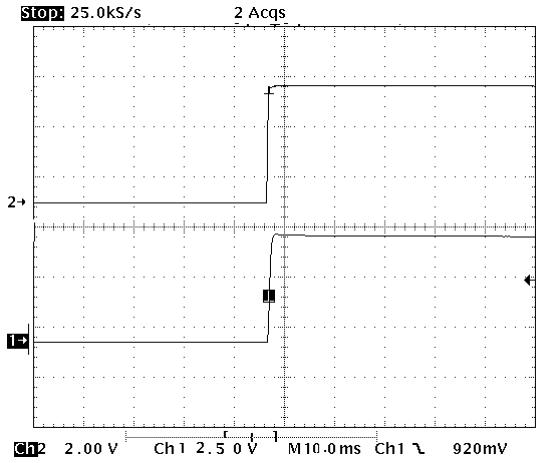


AG25-24S05 Start-up from Power On

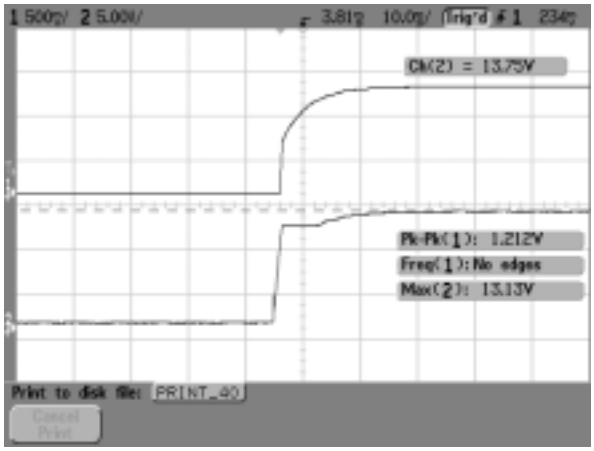
Performance Curves – Startup from CNT Control



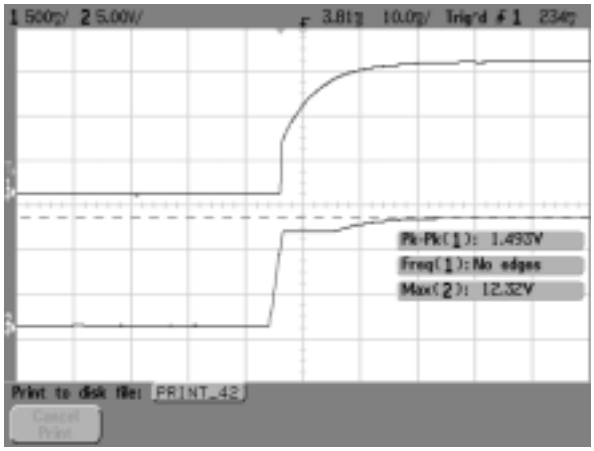
AG25-48S03 Start-up from CNT On



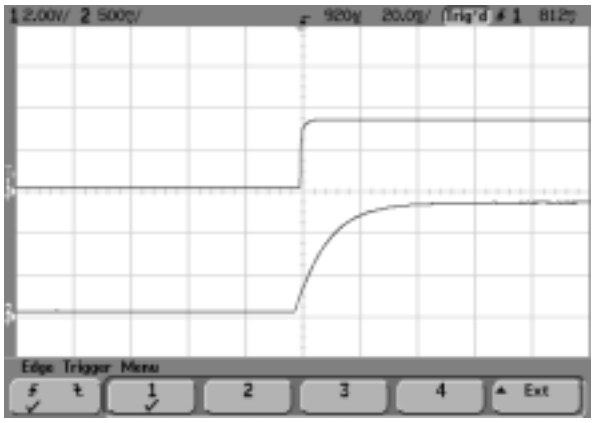
AG25-48S05 Start-up from CNT On



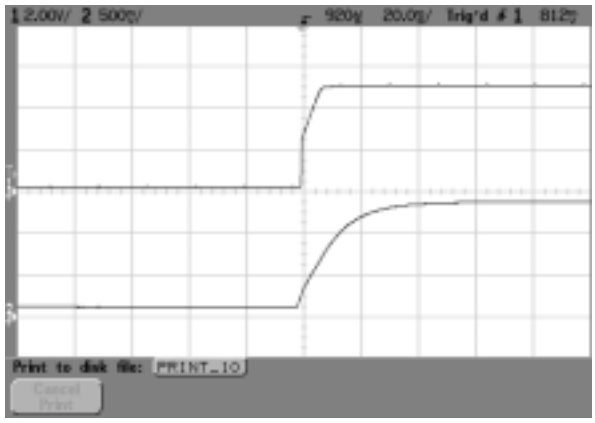
AG25-48S12 Start-up from CNT On



AG25-48S15 Start-up from CNT On



AG25-24S03 Start-up from CNT On



AG25-24S05 Start-up from CNT On

Feature Description

CNT Function

Two CNT logic options are available. The CNT logic, CNT voltage and the module working state are as the following Table 1.

	L	H	OPEN
N	**ON**	**OFF**	**OFF**
P	**OFF**	**ON**	**ON**

Table 1

N--- means “Negative Logic”, P--- means “Positive Logic”

L--- means “Low Voltage”, -0.7V≤L≤0.8V

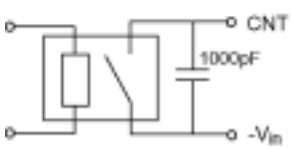
H--- means “High Voltage”, 3.5V≤H≤12V

ON--- means “Module is on”, OFF--- means “Module is off”

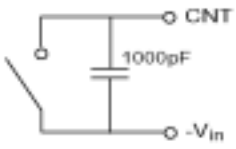
Open--- means “CNT pin is left open “

Note: Normally, V_{CNT} ≤12V, but when CNT is left open, V_{CNT} may reach to 18V.

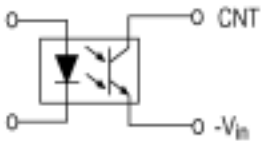
The following Figure shows a few simple CNT circuits.



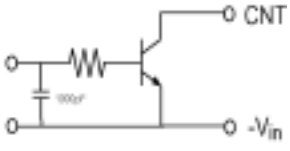
Relay CNT



Simple CNT



Isolated CNT

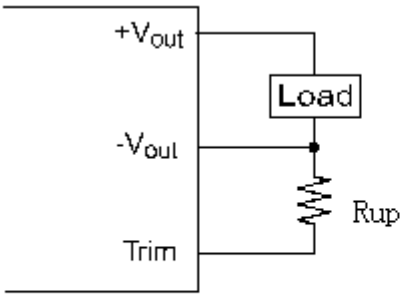


Transistor CNT

Trim

The +Vo output voltage of the AG25 series 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 or decrease by up to 10%. Trimming up by more than 10% of the nominal output may activate the OVP circuit or damage the converter. Trimming down more than 10% can cause the converter to regulate improperly. If the trim pin is not needed, it should be left open.

Trim up



3.3Vout: Rup=1.55/2y

5Vout: Rup=1.25/y

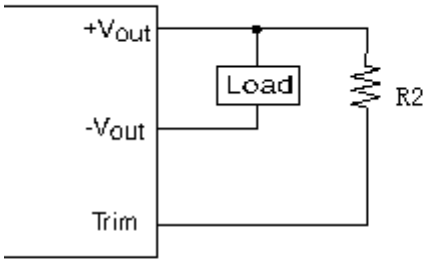
12Vout: Rup=1.97/y

15Vout: Rup=2.08/y

where: $y = \frac{Vo - Ve}{Ve}$

All resistor values in kΩ.
Ve is rated output voltage, Vo is adjusting voltage.

Trim down



3.3Vout: R2=(2.54/y-4.08)/2

5Vout: R2=1.25/y-2.69

12Vout: R2=7.49/y-9.46

15Vout: R2=10.38/y-12.45

where: $y = \frac{Ve - Vo}{Ve}$

All resistor values in kΩ.
Ve is rated output voltage, Vo is adjusting voltage.

Minimum Load Requirements

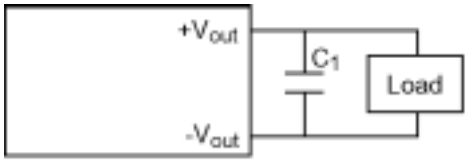
Parameter	Device	Symbol	Typ	Unit
Minimum Load	3.3V	I_{MIN}	0	A
	5V	I_{MIN}	0	A
	12V	I_{MIN}	0.21	A
	15V	I_{MIN}	0.167	A

Output Over-current Protection

AG25 series DC/DC converters feature fold-back current limiting as part of their Over-current Protection (OCP) circuits. When output current exceeds 110 to 140% of rated current, such as during a short circuit condition, the module will work on intermittent mode, also can tolerate short circuit conditions infinitely. When the over-current condition is removed, the converter will automatically restart.

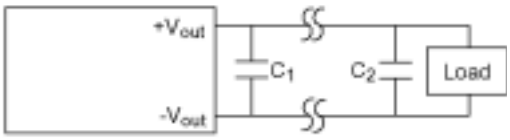
Output Filters

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 'Output Ripple Filter'. The recommended value for the output capacitor C1 is 220μF.



Output Ripple Filter

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 C2 can be added across the load, with a 0.47μF ceramic capacitor C2 in parallel generally as shown in Figure 'Output Ripple Filter for a Distant Load'.



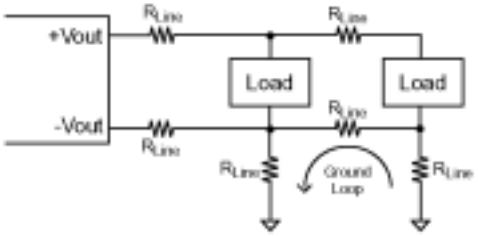
Output Ripple Filter For a Distant Load

Decoupling

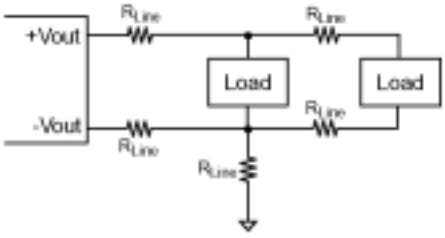
Noise on the power distribution system is not always created by the converter. High speed analog or digital loads with dynamic power demands can cause noise to cross the power inductor back onto the input lines. Noise can be reduced by decoupling the load. In most cases, connecting a 10μF tantalum or 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.

Ground Loops

Ground loops occur when different circuits are given multiple paths to common or earth ground, as shown in Figure ‘Ground Loops’. Multiple ground points can be 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 ‘Single Point Ground’.



Ground Loops



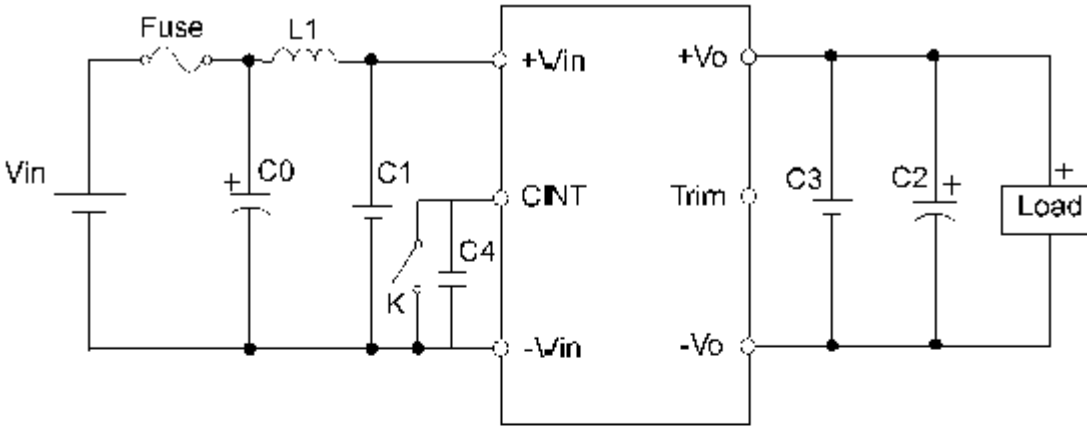
Single Point Ground

Output Over-Voltage Protection

The over-voltage protection has a separate feedback loop, which activates when the output voltage is between 120% and 140% of the nominal output voltage.

Design Consideration

Typical Application



Fuse: 2A recommended for AG25-48S and 3.15A for AG25-24S

C0 Recommended:

47μF electrolytic type capacitor

C1 Recommended: 0.47μF capacitor

C2 Recommended:

220μF electrolytic or ceramic type capacitor

C3 Recommended:

0.47μF capacitor

C4 Recommended:

1000pF capacitor

L1 Recommended:

10--12μH

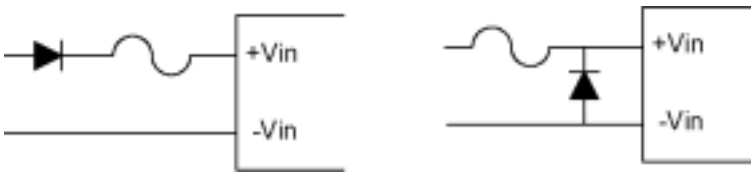
Fusing

The AG25 power modules have 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 fuse ratings for the AG25-48S Series are 2A and AG25-24S Series are 3.15A.

Input Reverse Voltage Protection

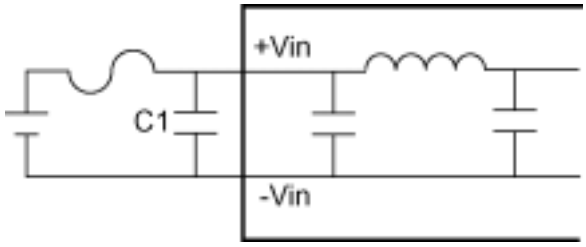
Under installation and cabling conditions where reverse polarity across the input may occur, reverse polarity protection is recommended. Protection can easily be provided as shown in Figure ‘Reverse Polarity Protection Circuit’. In both cases the diode used is rated for 3A/100V. Placing the diode across 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.



Reverse Polarity Protection Circuit

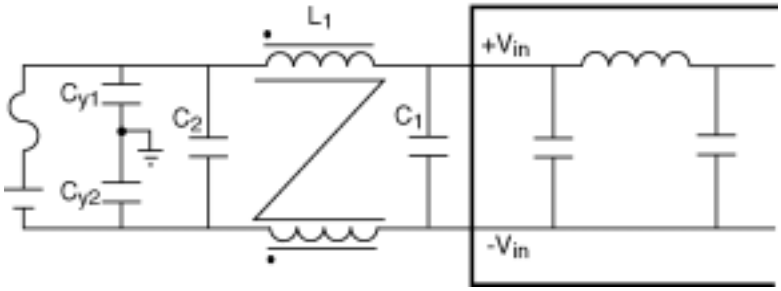
EMC

Input filters are included in the converters to help achieve standard system emissions certifications. Some users however, may find that additional input filtering is necessary. The AG25 series has an internal switching frequency of 330 kHz so a high frequency capacitor mounted close to the input terminals produces the best results. To reduce reflected noise, a capacitor can be added across the input as shown in Figure ‘Ripple Rejection Input Filter’, forming a π filter. A 0.47μF/100V electrolytic capacitor is recommended for C1.



Ripple Rejection Input Filter

For conditions where EMI is a concern, a different input filter can be used. Figure ‘EMI Reduction Input Filter‘ shows an input filter designed to reduce EMI effects. L1 is a 8mH common mode inductor, C1 is a 47μF/100V electrolytic capacitor, and C2 is a 0.47μF/100V metal film or ceramic high frequency capacitor, and Cy1 and Cy2 are each 4700pF high frequency ceramic capacitors.



EMI Reduction Input Filter

When a filter inductor is connected in series with the power converter input, an input capacitor C1 should be added. An input capacitor C1 should also be used when the input wiring is long, since the wiring can act as an inductor. Failure to use an input capacitor under these conditions can produce large input voltage spikes and an unstable output.

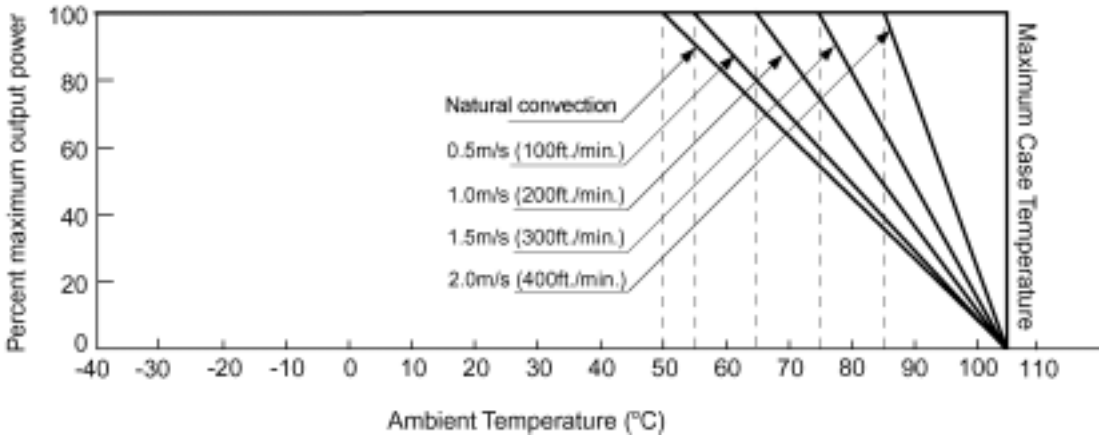
Safety Consideration

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 standard, i.e., UL60950, CSA C22.2 No. 60950-00, and EN60950. The AG25 series input-to-output isolation is an 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.

Thermal Consideration

When rated input, 55℃ ambient temperature, and 200LFM airflow, AG25 series are rated for full power, and in this condition the case temperature can reach 100℃. For operation above ambient temperature of 55℃, output power must be derated as shown in Figure 'Temperature Derating', meantime, airflow at least 200LFM over the converter must be provided to make the module working properly. the case temperature should be used to determine maximum temperature limits. The minimum operating temperature for the AG25 is -40℃.



Temperature Derating Curves

MTBF

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

Emerson Network Power can supply replacements for converters from other manufacturers, or offer custom solutions. Please contact the factory for details.

Mechanical Considerations

Installation

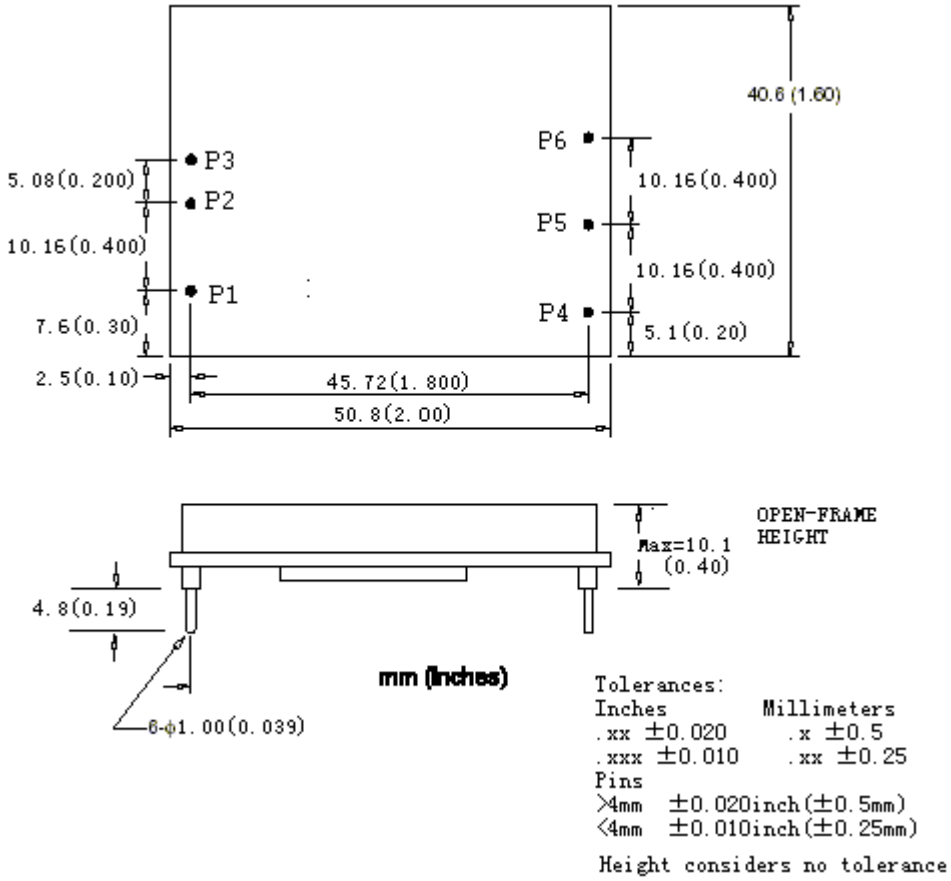
Although AG25 series converters can be mounted in any orientation, free air-flowing must be taken. Normally power components are always put at the end of the airflow path or have the separate airflow paths. This can keep other system equipment cooler and increase component life spans.

Soldering

AG25 series converters are compatible with standard wave soldering techniques. When wave soldering, the converter pins should be preheated for 20-30 seconds at 110℃, and wave soldered at 260℃ for less than 10 seconds.

When hand soldering, the iron temperature should be maintained at 425℃ and applied to the converter pins for less than 5 seconds. Longer exposure can cause internal damage to the converter. Cleaning can be performed with cleaning solvent IPA or with water.

Mechanical Chart (pin side view)



No supporting point

*: Pin length

Default: 5.8mm±0.5mm (0.23in.±0.020in.)

Product name with suffix “-4”: 4.8mm±0.5mm (0.19in.±0.020in.)

Product name with suffix “-6”: 3.80mm±0.25mm (0.150in.±0.010in.)

Product name with suffix “-8”: 2.80mm±0.25mm (0.110in.±0.010in.)

Ordering Information

Model Number	Input Voltage (V)	Output Voltage (V)	Output Current (A)	Ripple (mV rms) max.	Noise (mV pp) max.	Efficiency % typ.
AG25-48S03	36-75	3.3	6	20	75	85
AG25-48S05	36-75	5	5	20	75	87
AG25-48S12	36-75	12	2.1	30	150	87
AG25-48S15	36-75	15	1.67	30	150	87
AG25-24S03	18-36	3.3	6	27	100	83
AG25-24S05	18-36	5	5	27	100	85