Advanced Analog

a division of Intech

AHE2800S Series

Hybrid - High Reliability DC/DC Converters

DESCRIPTION

The AHE2800S Series of DC/DC converters feature high power density and an extended temperature range for use in military and industrial applications. Designed to MIL-STD-704D input requirements, these devices have nominal 28VDC inputs with +5v, +12v and +15v single outputs to satisfy a wide range of requirements. The circuit design incorporates a pulse width modulated push-pull topology operating in the feed-forward mode at a nominal switching frequency of 250 kHz. Input to output isolation is achieved through the use of transformers in the forward and feedback circuits.

The advanced feedback design provides fast loop response for superior line and load transient characteristics and offers greater reliability and radiation tolerance than devices incorporating optical feedback circuits.

Three standard temperature grades are offered with screening options. Refer to Part Number section. They can be provided in a standard plug-in package for PC mounting or in a flanged package for more severe environments.

These converters are manufactured in a facility fully qualified to Mil-Std-1772. All processes used to manufacture these converters have been qualified to enable Advanced Analog to deliver compliant devices. Two screening grades are available to satisfy a wide range of requirements. The CH grade converters are fully compliant to Mil-Std-1772 class B. The HB grade converters are processed to full class B screening but do not have class B element evaluation as required by Mil-Std-1772. Both grades are fully tested and operate over the full military temperature range without derating of output power. Variations in electrical, mechanical and screening can be accommodated. Extensive computer simulation using complex modeling enables rapid design modification to be provided. Contact Advanced Analog with specific requirements.

FEATURES

- **17-40VDC input range (28VDC nominal)**
- **5V, 12V and 15V outputs available**
- **Indefinite short circuit and overload protection**
- **17W/in³ power density**
- **15 and 20 watts output power models**
- **Fast loop response for superior transient characteristics**
- **Operating temperature range from -55°C to + 125°C available**
- **Popular industry standard pin-out**
- **Resistance seam welded case for superior long term hermeticity**
- **Efficiencies up to 84%**
- **Shutdown from external signal**
- **Military screening**
- **325,000 hour MTBF at 85°C (AUC)**

SPECIFICATIONS

T_{CASE} = -55°C to +85°C, V_{IN} = + 28V ±5% unless otherwise specified.

ABSOLUTE MAXIMUM RATINGS

Input Voltage[1]	-0.5V to +50V	
Power Output	Internally Limited, 17.5W typical for AHE2805S, 22.5W typical for AHE2812S and AHE2815S	
Soldering	300°C for 10 seconds	
Temperature Range[1]	Operating	-55°C to +115°C case
	Storage	-65°C to + 135°C

Parameter	Conditions -55°C ≤ Tc ≤ +85°C, V_{IN} = 28 V_{DC} ±5%, C=0, unless otherwise specified	AHE2805S			AHE2812S			AHE2815S			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
STATIC CHARACTERISTICS											
OUTPUT	V_{IN} = 17 TO 40 V_{DC}										
Voltage	I_{OUT} = 0 TO Full Load	4.90	5.00	5.10	11.76	12.00	12.24	14.70	15.00	15.30	V_{DC}
Current		0.0		3000	0.0		1667	0.0		1333	mA_{DC}
Ripple	Full Load, DC to 1MHz		20	60		30	60		30	60	mV_{pp}
Accuracy	T_{CASE} = 25°C, I_{OUT} = 0	4.95	5.00	5.05	11.88	12.00	12.12	14.85	15.00	15.15	V_{DC}
Power[1]		15			20			20			W
REGULATION											
Line	V_{IN} = 17 to 40V_{DC}		±0.5	±1.0		±0.5	±1.0		±0.5	±1.0	%
Load	I_{OUT} = 0 to Full Load		±0.5	±1.0		±0.5	±1.0		±0.5	±1.0	%
INPUT											
Voltage Range[4]		17.0	28.0	40.0	17.0	28.0	40.0	17.0	28.0	40.0	V_{DC}
Current	Inhibited		8	18		8	18		8	18	mA_{DC}
	No Load			35			35			35	mA_{DC}
Ripple Current	Full Load		20	50		25	50		25	50	mV p-p
EFFICIENCY	T_{CASE} = +25°C Half Load to Full Load	78	82		79	83		80	84		%
CAPACITIVE LOAD	No effect on performance	500			200			200			µF
LOAD FAULT POWER DISSIPATION[4]				6			6			6	W
ISOLATION	Input to Output @ 500V_{DC}	100			100			100			MΩ
DYNAMIC CHARACTERISTICS											
STEP LOAD CHANGES											
Output	50% Load 100% Load		±150			±200			±200		mVpk
Transient	No Load 50% Load		-300			-400			-400		mVpk
	50% Load No Load		+300			+400			+400		mVpk
Recovery[2]	50% Load 100% Load		25			25			25		µsec
	No Load 50% Load		500			500			500		µsec
	50% Load No Load		7			7			7		msec
STEP LINE CHANGES											
Output	Input step 17 to 40V_{DC}		+180			+180			+180		mVpk
Transient	Input step 40 to 17V_{DC}		-600			-600			-600		mVpk
Recovery[3]	Input step 17 to 40V_{DC}		400			400			400		µsec
	Input step 40 to 17V_{DC}		400			400			400		µsec
TURN-ON	V_{IN} = 17 to 40V_{DC}										
Overshoot	I_{OUT} = 0 to Full Load		0	500		300	600		300	750	mVpk
Delay[3]			8	14		8	14		8	14	msec
LOAD FAULT RECOVERY[4]	V_{IN} = 17 to 40V_{DC}		8	14		8	14		8	14	msec
WEIGHT	Standard Package		60			60				60	grams
	Flange Package		65			65				65	grams

Notes:

1. Above +85°C case temperature, derate output power linearly to 0 and maximum input voltage linearly to 42V at 115°C case.
2. Recovery time is measured from the initiation of the transient to where V_{OUT} has returned to within ±1% of V_{OUT} at 50% load. See typical waveforms.
3. Turn-on delay time measurement is for either an application of power at the input or a signal at the shutdown pin.
4. For operation at 16V_{DC}, derate output power by 33%.

SPECIFICATIONS

T_{CASE} = -55°C to +105°C, V_{IN} = + 28V ±5% unless otherwise specified.

ABSOLUTE MAXIMUM RATINGS

Input Voltage[5]	-0.5V to +50V	
Power Output	Internally Limited, 17.5W typical for AHE2805S/ES, 22.5W typical for AHE2812S/ES and AHE2815S/ES	
Soldering	300°C for 10 seconds	
Temperature Range[1]	Operating	-55°C to +125°C case
	Storage	-65°C to + 135°C

Parameter	Conditions -55°C ≤ Tc ≤ +105°C, V_{IN} = 28 VDC ±5%, C=0, unless otherwise specified	AHE2805S/ES Min	AHE2805S/ES Typ	AHE2805S/ES Max	AHE2812/ES Min	AHE2812/ES Typ	AHE2812/ES Max	AHE2815S/ES Min	AHE2815S/ES Typ	AHE2815S/ES Max	Units
STATIC CHARACTERISTICS											
OUTPUT	V_{IN} = 17 TO 40 VDC										
Voltage	I_{OUT} = 0 TO Full Load	4.90	5.00	5.10	11.76	12.00	12.24	14.70	15.00	15.30	VDC
Current		0.0		3000	0.0		1667	0.0		1333	mADC
Ripple	Full Load, DC to 1MHz		20	60		30	60		30	60	mVpp
Accuracy	T_{CASE} = 25°C, I_{OUT} = 0	4.95	5.00	5.05	11.88	12.00	12.12	14.85	15.00	15.15	VDC
Power[1]		15			20			20			W
REGULATION											
Line	V_{IN} = 17 to 40VDC		±0.5	±1.0		±0.5	±1.0		±0.5	±1.0	%
Load	I_{OUT} = 0 to Full Load		±0.5	±1.0		±0.5	±1.0		±0.5	±1.0	%
INPUT											
Voltage Range[4]		17.0	28.0	40.0	17.0	28.0	40.0	17.0	28.0	40.0	VDC
Current	Inhibited		8	18		8	18		8	18	mADC
	No Load			35			35			35	mADC
Ripple Current	Full Load		20	50		25	50		25	50	mV p-p
EFFICIENCY	T_{CASE} = +25°C Half Load to Full Load	78	82		79	83		80	84		%
CAPACITIVE LOAD	No effect on performance	500			200			200			µF
LOAD FAULT POWER DISSIPATION[4]				6			6			6	W
ISOLATION	Input to Output @ 500VDC	100			100			100			MΩ
DYNAMIC CHARACTERISTICS											
STEP LOAD CHANGES											
Output	50% Load 100% Load		±150			±200			±200		mVpk
Transient	No Load 50% Load		-300			-400			-400		mVpk
	50% Load No Load		+300			+400			+400		mVpk
Recovery[2]	50% Load 100% Load		25			25			25		µsec
	No Load 50% Load		500			500			500		µsec
	50% Load No Load		7			7			7		msec
STEP LINE CHANGES											
Output	Input step 17 to 40VDC		+180			+180			+180		mVpk
Transient	Input step 40 to 17VDC		-800			-800			-800		mVpk
Recovery[2]	Input step 17 to 40VDC		400			400			400		µsec
	Input step 40 to 17VDC		400			400			400		µsec
TURN-ON	V_{IN} = 17 to 40VDC										
Overshoot	I_{OUT} = 0 to Full Load		0	500		300	600		300	750	mVpk
Delay[3]			8	14		8	14		8	14	msec
LOAD FAULT RECOVERY[4]	V_{IN} = 17 to 40VDC		8	14		8	14		8	14	msec
WEIGHT	Standard Package		60			60			60		grams
	Flange Package		65			65			65		grams

Notes:

1. Above +105°C case temperature, derate output power linearly to 0 at 125°C case.
2. Recovery time is measured from the initiation of the transient to where V_{OUT} has returned to within ±1% of V_{OUT} at 50% load. See typical waveforms.
3. Turn-on delay time measurement is for either an application of power at the input or a signal at the shutdown pin.
4. For operation at 16VDC, derate output power by 33%.
5. Above +85°C case temperature, derate maximum input voltage linearly to 33V at +125°C case.

SPECIFICATIONS

T_{CASE} = -55°C to +125°C, V_{IN} = + 28V ±5% unless otherwise specified.

ABSOLUTE MAXIMUM RATINGS

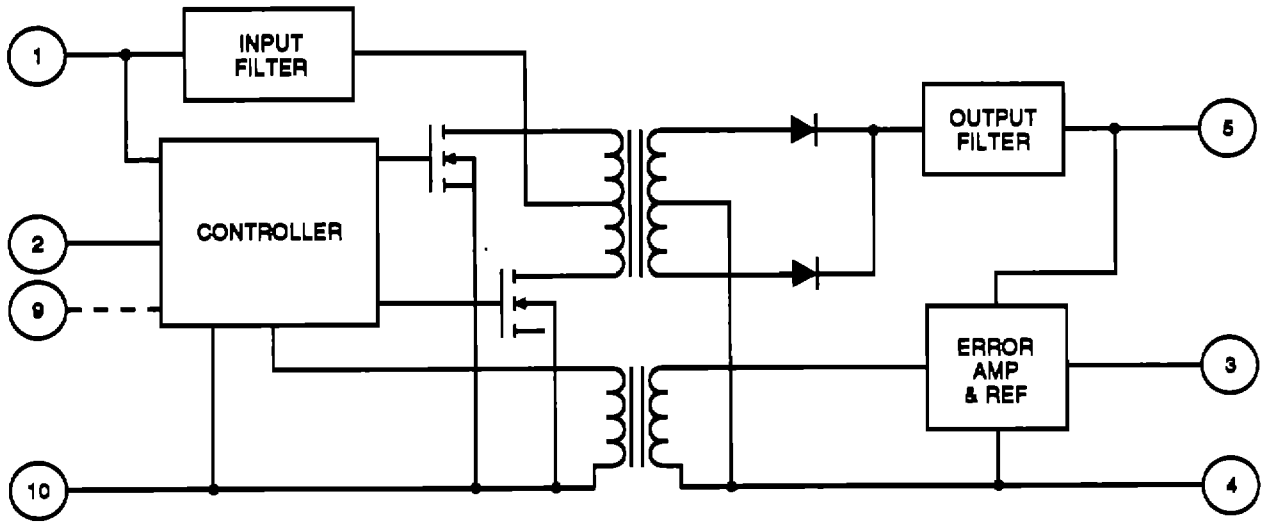
Input Voltage[1]	-0.5V to +50V	
Power Output	Internally Limited, 17.5W typical for AHE2805S/HB, 22.5W typical for AHE2812S/HB and AHE2815S/HB	
Soldering	300°C for 10 seconds	
Temperature Range[1]	Operating	-55°C to + 135°C case
	Storage	-65°C to + 135°C

Parameter	Conditions -55°C ≤ Tc ≤ +125°C, V_{IN} = 28 VDC ±5%, C=0, unless otherwise specified	AHE2805S/HB			AHE2812S/HB			AHE2815S/HB			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
STATIC CHARACTERISTICS											
OUTPUT	V_{IN} = 17 TO 40 VDC										
Voltage	I_{OUT} = 0 TO Full Load	4.90	5.00	5.10	11.76	12.00	12.24	14.70	15.00	15.30	VDC
Current		0.0		3000	0.0		1667	0.0		1333	mADC
Ripple	Full Load, DC to 1MHz		20	60		30	60		30	60	mV p-p
Accuracy	T_{CASE} = 25°C, I_{OUT} = 0	4.95	5.00	5.05	11.88	12.00	12.12	14.85	15.00	15.15	VDC
Power[1]		15			20			20			W
REGULATION											
Line	V_{IN} = 17 to 40VDC		10	25		30	60		40	75	mv
	T_{CASE} = 25°C			5			30			35	
Load	I_{OUT} = 0 to Full Load		10	50		50	120		50	150	mv
INPUT											
Voltage Range[4]		17.0	28.0	40.0	17.0	28.0	40.0	17.0	28.0	40.0	VDC
Current	Inhibited		8	18		8	18		8	18	mADC
	No Load			35			35			35	mADC
Ripple Current	Full Load		20	50		25	50		25	50	mV p-p
EFFICIENCY	T_{CASE} = +25°C Full Load	78	82		79	83		80	84		%
CAPACITIVE LOAD	No effect on performance	500	1000		200	1000		200	1000		µF
LOAD FAULT POWER DISSIPATION	Short Circuit Tc = 25°C			4.5			4.5			4.5	W
	Overload Tc = 25°C			6			6			6	W
ISOLATION	Input to Output @ 500VDC	100			100			100			MΩ
DYNAMIC CHARACTERISTICS											
STEP LOAD CHANGES											
Output Tc = 25°C	50% Load 100% Load		±150	±300		±200	±300		±200	±300	mVpk
Transient	No Load 50% Load		-300	-500		-400	-750		-400	-750	mVpk
	50% Load No Load		+300	+500		+400	+750		+400	+750	mVpk
Recovery[2]	50% Load 100% Load		25	100		25	100		25	100	µsec
	No Load 50% Load		100	200		500	1500		500	1500	µsec
	50% Load No Load		7	10		7	10		7	10	msec
STEP LINE CHANGES											
Output Tc = 25°C	Input Step 17 to 40VDC		+180	+300		+180	+500		+180	+500	mVpk
Transient	Input Step 40 to 17VDC		-600	-1000		-600	-1500		-600	-1500	mVpk
Recovery[2]	Input Step 17 to 40VDC		400	800		400	800		400	800	µsec
	Input Step 40 to 17VDC		400	800		400	800		400	800	µsec
TURN-ON	V_{IN} = 17 to 40VDC										
Overshoot	I_{OUT} = 0 to Full Load		0	550		300	600		300	750	mVpk
Delay[3]			8	10		8	10		8	10	msec
LOAD FAULT RECOVERY[4]	V_{IN} = 17 to 40VDC		8	10		8	10		8	10	msec
WEIGHT	Standard Package			55			55			55	grams
	Flange Package			58			58			58	grams

Notes:

1. Above +125°C case temperature, derate output power linearly to 0 at 135°C case.
2. Recovery time is measured from the initiation of the transient to where V_{OUT} has returned to within ±1% of V_{OUT} at 50% load. See typical waveforms.
3. Turn-on delay time measurement is for either an application of power at the input or a signal at the shutdown pin.
4. For operation at 16VDC, derate output power by 33%.

BLOCK DIAGRAM



APPLICATION INFORMATION

Inhibit Function

Connecting the inhibit input (Pin 2) to input common (Pin 10) will cause the converter to shut down. It is recommended that the inhibit pin be driven by an open collector device capable of sinking at least 400µA of current. The open circuit voltage of the inhibit input is 11.5 ±1VDC.

EMI Filter

An optional EMI filter (AFC461) will reduce the input ripple current to levels below the limits imposed by MIL-STD-461B CE03.

Output Adjust (AHE2805) only

The output voltage of the AHE2805 can be adjusted upward by connecting Output Adjust (Pin 3) and Output Common (Pin 4) as shown in Table 1.

Resistance Pin 3 to 4	Output Voltage Increase %
∞	0
390k	+ 1%
145k	+ 2%
63k	+ 3%
22k	+ 4%
0	+ 5%

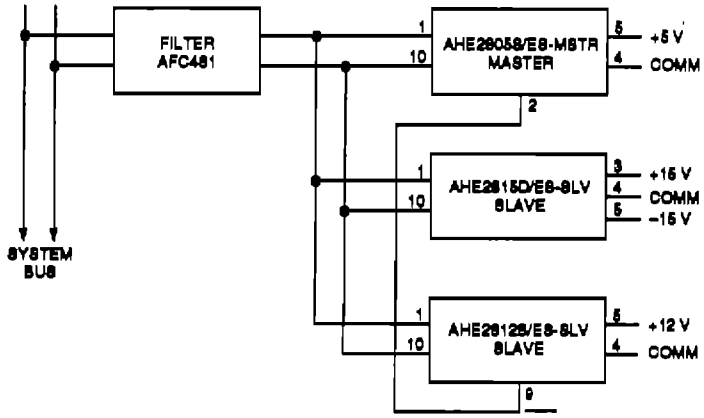
Table 1 Output adjustment resistor values

Device Synchronization

Whenever multiple DC/DC converters are utilized in a single system, significant low frequency noise may be generated due to slight difference in the switching frequencies of the converters (beat frequency noise). Because of the low frequency nature of this noise (typically less than 10kHz), it is difficult to filter out and may interfere with proper operation of sensitive systems (communications, radar or telemetry). Advanced Analog offers an option which provides synchronization of multiple AHE/ATW/ATO type converters, thus eliminating this type of noise.

To take advantage of this capability, the system designer must assign one of the converters as the master. Then, by definition, the remaining converters become slaves and will operate at the masters' switching frequency. The user should be aware that the synchronization system is fail-safe; that is, the slaves will continue operating should the master frequency be interrupted for any reason. The layout must be such that the synchronization output (pin 9) of the master device is connected to the synchronization input (pin 9) of each slave device. It is advisable to keep this run short to minimize the possibility of radiating the 250kHz switching frequency.

The appropriate parts must be ordered to utilize this feature. After selecting the converters required for the system, an 'MSTR' suffix is added for the master converter part number and an 'SLV' suffix is added for slave part number. See Part Number section.



Typical Synchronization Connection Diagram

PIN DESIGNATION

Pin 1 Positive Input
Pin 2 Inhibit Input
Pin 3 Output adjust*
Pin 4 Output common
Pin 5 Positive output
Pin 10 Input common
Pin 9 N/C or sync
Pin 8 Case gnd
Pin 7 N/C
Pin 6 N/C

*AHE2805S only. AHE2812S/2815S have N/C on Pin 3

PART NUMBER

AHE 28 xx S x / x - xxx

Model

Input Voltage

Output Voltage
05 – 5VDC
12 – 12VDC
15 – 15VDC

Single Output

Package option
F – Flange
Omit Standard

Temperature Range
Omit for -55°C to +85°C
ES – -55°C to +105°C
HB – -55°C to +125°C

Synchronization Option
MSTR—Master
SLV—Slave

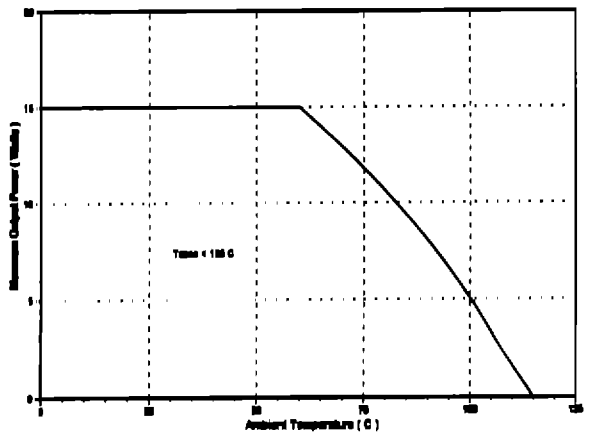
STANDARDIZED MILITARY DRAWING CROSS REFERENCE

Standardized military drawing PIN	Vendor CAGE number	Vendor similar PIN
5962-8968301HXX	52467	AHE2805S/HB
5962-8968301HZX	52467	AHE2805SF/HB
5962-8968302HXX	52467	AHE2805S/HB-SLV
5962-8968302HZX	52467	AHE2805SF/HB-SLV
5962-8968303HXX	52467	AHE2805S/HB-MSTR
5962-8968303HZX	52467	AHE2805SF/HB-MSTR

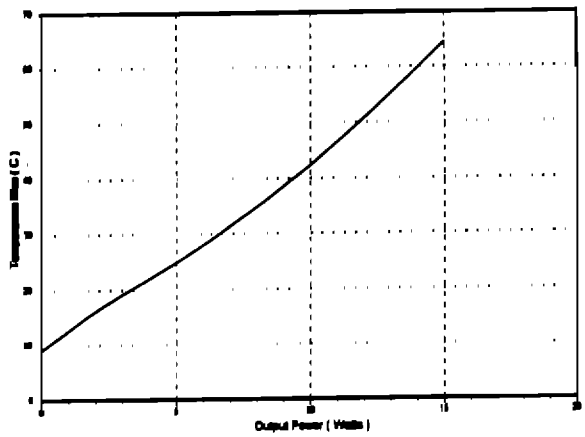
Standardized military drawing PIN	Vendor CAGE number	Vendor similar PIN
5962-9158001HXX	52467	AHE2812S/CH
5962-9158001HZX	52467	AHE2812SF/CH
5962-9158002HXX	52467	AHE2812S/CH-SLV
5962-9158002HZX	52467	AHE2812SF/CH-SLV
5962-9158003HXX	52467	AHE2812S/CH-MSTR
5962-9158003HZX	52467	AHE2812SF/CH-MSTR

Standardized military drawing PIN	Vendor CAGE number	Vendor similar PIN
5962-9162501HXX	52467	AHE2815S/HB
5962-9162501HZX	52467	AHE2815SF/HB
5962-9162502HXX	52467	AHE2815S/HB-SLV
5962-9162502HZX	52467	AHE2815SF/HB-SLV
5962-9162503HXX	52467	AHE2815S/HB-MSTR
5962-9162503HZX	52467	AHE2815SF/HB-MSTR

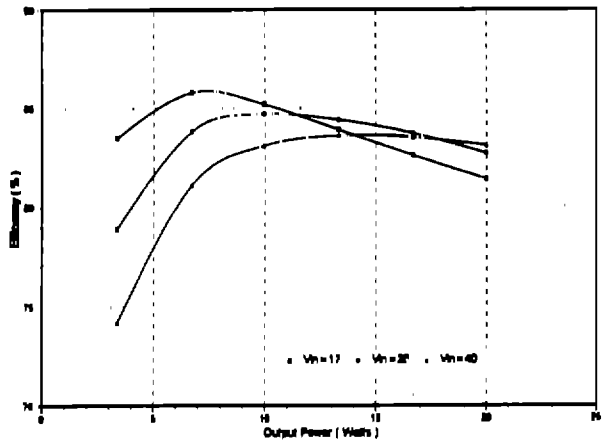
AHE2805S OUTPUT POWER DERATING vs AMBIENT TEMPERATURE



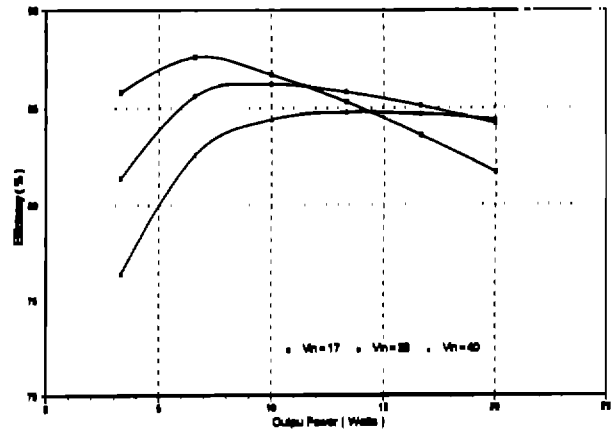
AHE2805S TEMPERATURE RISE ABOVE AMBIENT vs OUTPUT POWER



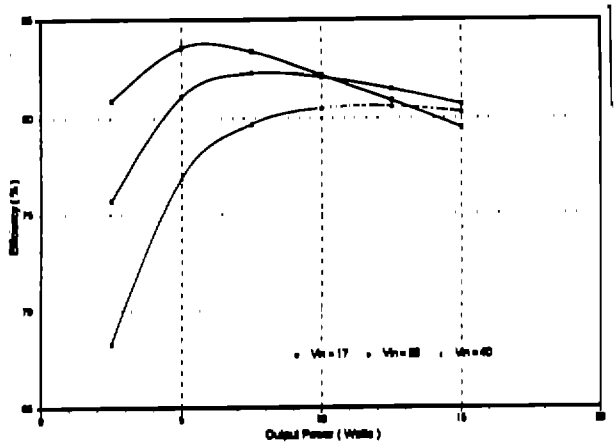
AHE2812S EFFICIENCY



AHE2815S EFFICIENCY



AHE2805 EFFICIENCY



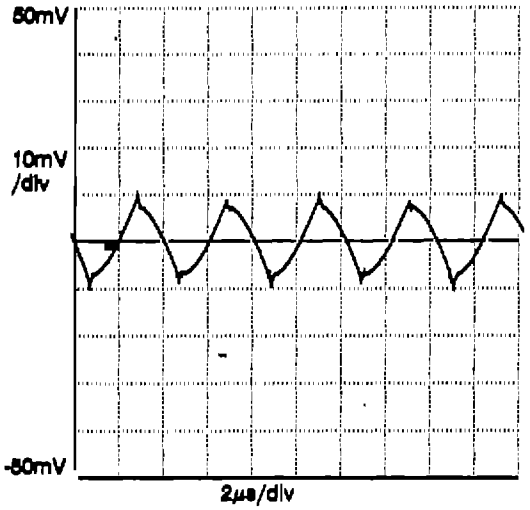


Figure 1 Output Voltage Ripple
V_{IN} = 28Vdc, Full Load

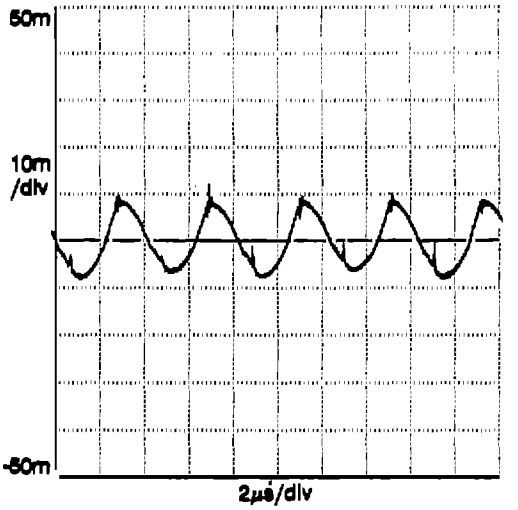


Figure 2 Input Ripple Current
V_{IN} = 28V, Full Load

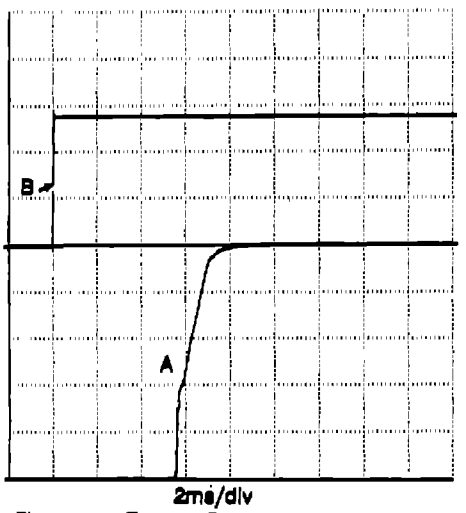


Figure 3 Turn-on Response
A: Output @ 1V/DIV, Full Load
B: Input @ 10V/DIV (OV → 28V step)

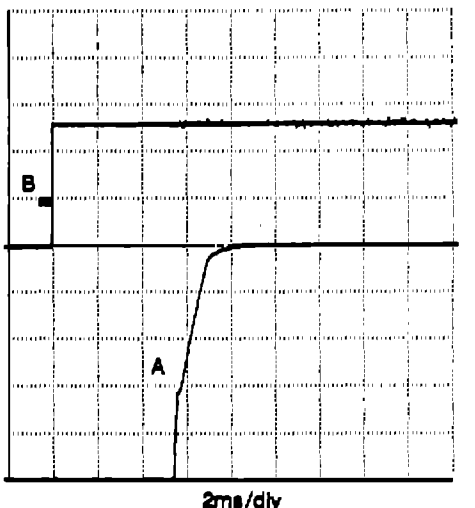


Figure 4 Turn-on Response from Inhibit
A: Output @ 1V/DIV, Full Load
B: Inhibit (Pin 2) @ 5V/DIV

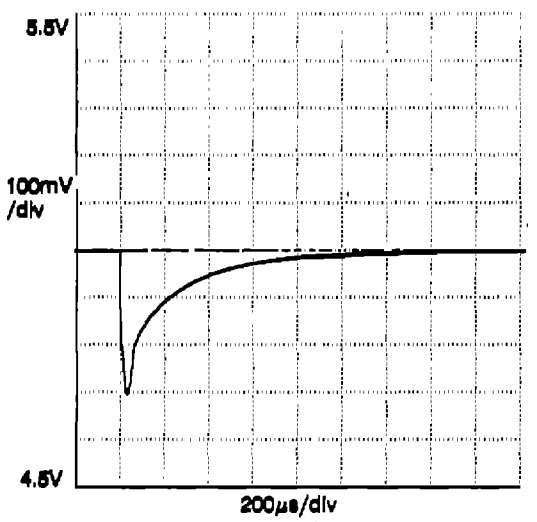


Figure 5 Load Step Response
Load Step 0 to 1.5Adc
(No Load to Half Load)

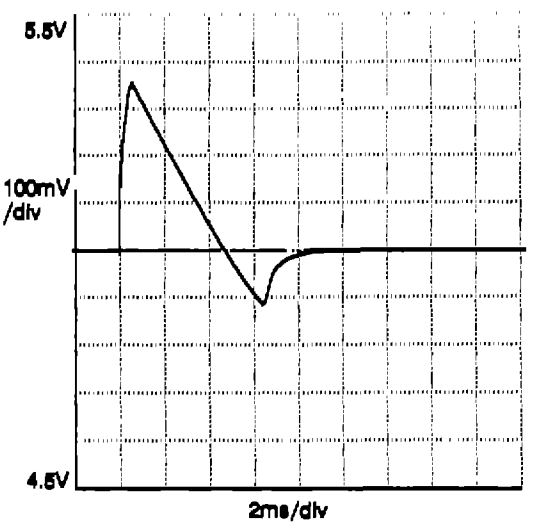


Figure 6 Load Step Response
Load Step 1.5Adc to 0 Adc
(Half Load to No Load)

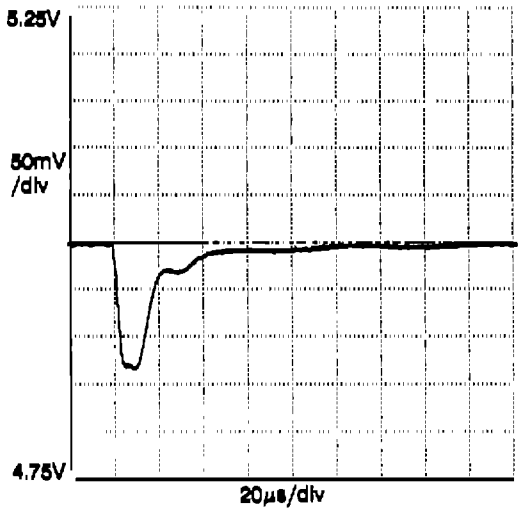


Figure 7 Load Step Response
Load Step 1.5Adc to 3.0Adc
(Half Load to Full Load)

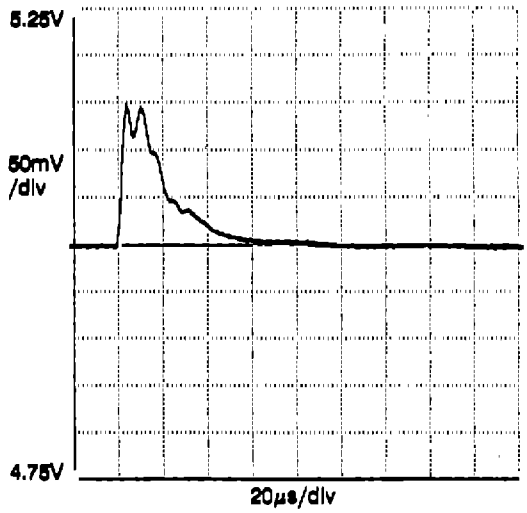


Figure 8 Load Step Response
Load Step 3.0Adc to 1.5Adc
(Full Load to Half Load)

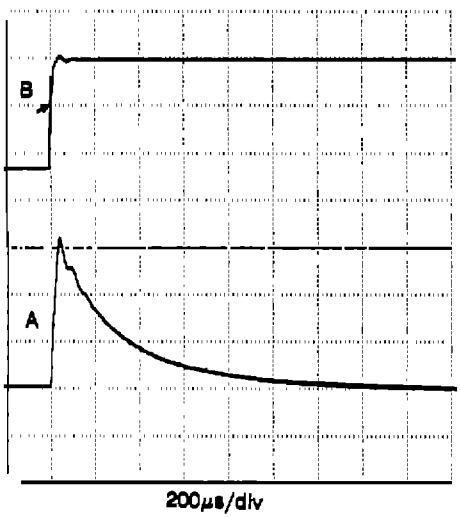


Figure 9 Line Step Response
A: Output @ 50mV/DIV, Full Load
B: Input step 17Vdc to 40Vdc

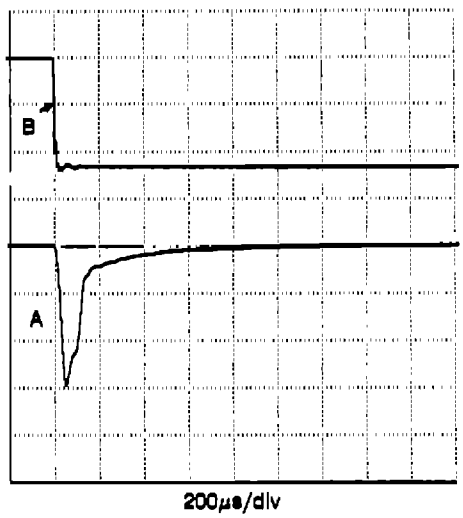


Figure 10 Line Step Response
A: Output @ 200mV/DIV, Full Load
B: Input Step 40Vdc to 17Vdc

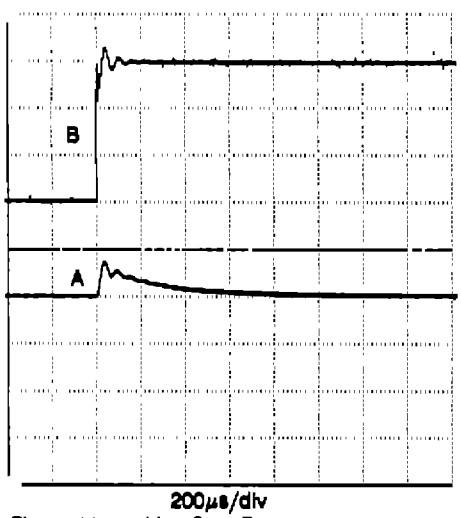


Figure 11 Line Step Response
A: Output @ 50mV/DIV, Full Load
B: Input Step 28Vdc to 34Vdc

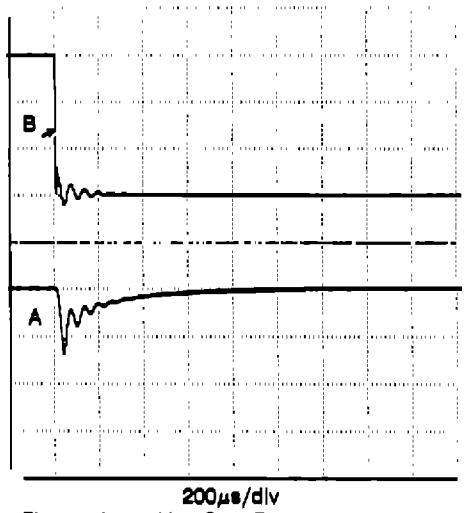
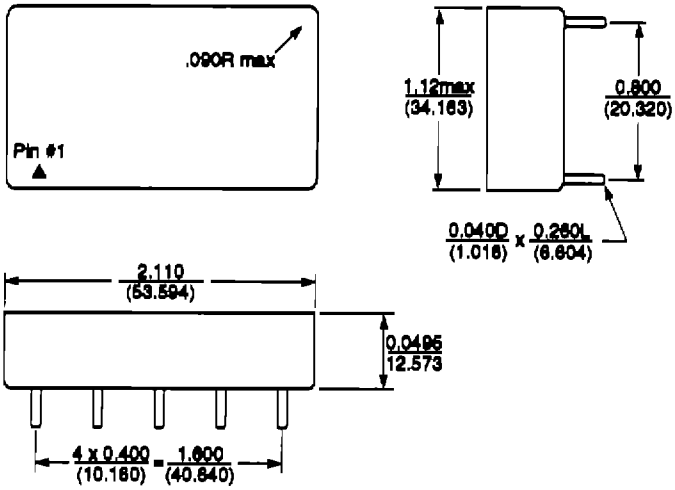
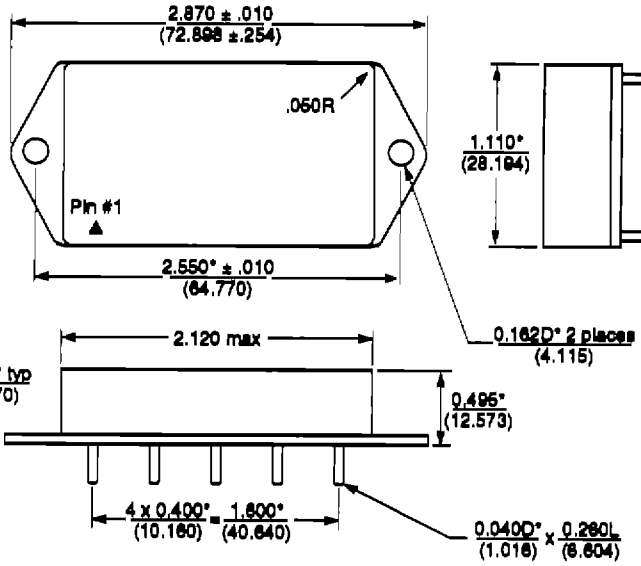


Figure 12 Line Step Response
A: Output @ 50mV/DIV, Full Load
B: Input Step 28Vdc to 22Vdc

MECHANICAL OUTLINE

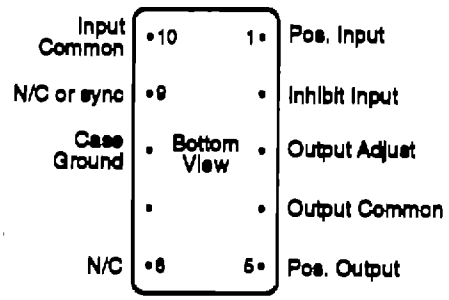


Standard

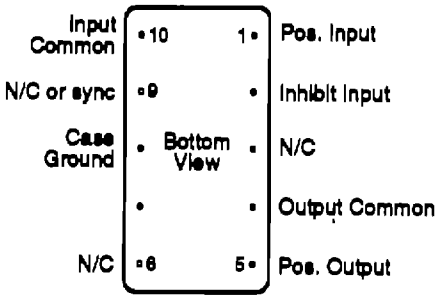


*±.005 (±0.127)

F option



AHE2805S



AHE2812S/AHE2815S

HB SCREENING PROCESS
Per MIL-STD-883C

Test Inspection	Method	Condition
Pre-Seal Internal Visual	2017	
Stabilization Bake	1008	C
Temperature Cycling	1010	C
Constant Acceleration	2001	A, Y1 direction
Burn-in	1015	TC = +125°C
Final Electrical Test		TC = -55,+25,+125°C
External Visual	2009	
Gross Leak	1014	C
Fine Leak	1014	A

ES SCREENING PROCESS
Same as HB screening except as follows:

Test Inspection	Method
Constant Acceleration	2001, 500g's
Burn-in	1015, 96 hrs.
Final Electrical	25°C only

NOTES

NOTES

Advanced Analog
a division of Intech

MIL-STD-1772 Qualified

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