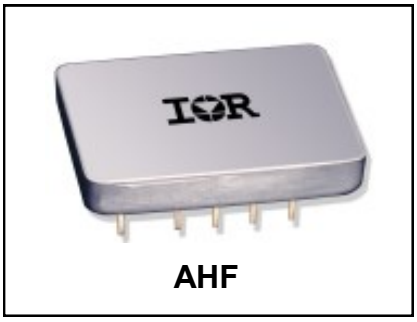
HYBRID-HIGH RELIABILITY DC-DC CONVERTER

28V Input, Single/Dual Output



AHF

Description

The AHF Series of DC-DC converters feature single or dual outputs over the full military temperature range. No derating in output power is required, making them suitable for use in rugged military applications. The low profile, small outline package is ideally suited to the tight board space requirements of many industrial and aerospace applications. Designed for nominal 28Vdc inputs, this family of converters will meet the requirements of MIL-STD-704D. The basic circuit utilizes a pulse width modulated, feed-forward topology at a nominal switching frequency of 550KHz. Input to output isolation is achieved through the use of transformers in the forward and feedback circuits.

The proprietary magnetic feedback circuit provides for an extremely wide bandwidth control loop with a high phase margin. The closed loop frequency response of this converter family extends to approximately 50kHz, resulting in superior line and load transient characteristics. This feedback method is also inherently temperature and radiation insensitive. This gives the AHF Series an important advantage over converters that incorporate opto-couplers in their design.

Manufactured in a facility fully qualified to MIL-PRF-38534, these converters are fabricated utilizing DLA qualified process. For available screening options, refer to device screening table in the data sheet. Variations are electrical, mechanical and screening can be accommodated.

Extensive computer simulation using complex modeling enables rapid design modification to be provided. Contact IR HiRel San Jose with specific requirements.

Features

- 16V to 40V_{DC} Input Range (28V_{DC} Nominal)
- Single and Dual Outputs
- 12W Output Power
- 22.8W/in^3 Power Density
- Low Input / Output Noise (50mA / 60mV_{P-P} max. respectively)
- Indefinite Short Circuit and Overload Protection
- Wideband Control Loop for Superior Transient Characteristics
- No derating for -55°C to +125°C Operation
- Constant Switching Frequency (550kHz Nominal)
- Standard Microcircuit Drawings Available

Specifications

AHF2803R3S

Absolute Maximum Ratings	
Input Voltage	-0.5Vdc to +50V_{DC}
Soldering temperature	+300°C for 10 seconds
Operating case temperature	-55°C to +125°C
Storage case temperature	-65°C to +135°C

Table I. Electrical Performance Characteristics

Parameter	Symbol	Conditions -55°C ≤ T_C ≤ +125°C V_{IN} = 28 V_{DC} ± 5%, C_L = 0 Unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Output voltage	V_{OUT}	I_{OUT} = 5% of rated load	1	01	3.26	3.34	V
			2,3		3.23	3.36	
Output current[1]	I_{OUT}	V_{IN} = 16, 28, and 40Vdc	1,2,3	01		3030	mA
Output power	P_{OUT}	V_{IN} = 16, 28, and 40Vdc	1,2,3	01		10	W
Output ripple voltage[2]	V_{RIP}	V_{IN} = 16, 28, and 40Vdc, B.W. = 20 Hz to 2MHz	1,2,3	01		60	mVp-p
Line regulation	VR_{LINE}	V_{IN} = 16, 28, and 40Vdc, I_{OUT} = 5%, 50% and 100% rated load	1,2,3	01		25	mV
Load regulation	VR_{LOAD}	V_{IN} = 16, 28, and 40Vdc, I_{OUT} = 5%, 50% and 100% rated load	1,2,3	01		50	mV
Input current	I_{IN}	I_{OUT} = 0, Inhibit (Pin 1) tied to Input Return (Pin 7)	1,2,3	01		12	mA
		I_{OUT} = 0, Inhibit (Pin 1) = open				30	
Input ripple current[2]	I_{RIP}	I_{OUT} = 100% rated load B.W. = 20 Hz to 2 MHz	1,2,3	01		50	mAp-p
Efficiency	E_{FF}	I_{OUT} = 100% rated load	1	01	70		%
			2,3		68		
Isolation	ISO	Input to output or any pin to case (except Pin 6) at 500Vdc T_C = +25°C	1	01	100		MΩ
Capacitive load[3,4]	C_L	No effect on dc performance, T_C = +25°C	4	01		500	µF
Power dissipation load fault	P_D	Overload [5]	1	01		6.0	W
		Short circuit	1,2,3	01		2.0	
Switching frequency	F_S	I_{OUT} = 100% rated load	4,5,6	01	500	600	kHz

For Notes to Electrical Performance Characteristics, refer to page 3

Table I. Electrical Performance Characteristics (continued)

AHF2803R3S

Parameter	Symbol	Conditions $-55°C \le T_C \le +125°C$ V_{IN} = 28 V_{DC} ± 5%, C_L = 0 unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Output response to step transient load changes[6]	VO_{TLOAD}	50% to/from 100% rated load	4,5,6	01	-300	+300	mVpk
		5% to/from 50% rated load	4,5,6		-500	+500	
Recovery time step transient load changes[6,7]	TT_{LOAD}	50% to/from 100% rated load	4,5,6	01		70	µs
		5% to 50% rated load	4,5,6			1200	µs
		50% to 5% rated load	4,5,6			8.0	ms
Output response to transient step line changes	VO_{TLINE}	Input step 16V to/from 40Vdc, I_{OUT} = 100% rated load [4, 8]	4,5,6	01		500	mVpk
Recovery time transient step line changes	TT_{LINE}	Input step 16V to/from 40Vdc, I_{OUT} = 100% rated load [4, 7, 8]	4,5,6	01		800	µs
Turn on overshoot	$VTon_{OS}$	I_{OUT} = 5 and 100% rated load	4,5,6	01		600	mVpk
Turn on delay	Ton_D	I_{OUT} = 5 and 100% rated load [9]	4,5,6	01		20	ms
Load fault recovery[4,9]	Tr_{LF}		4,5,6	01		20	ms
Weight						38	g

Notes to Table I:

1. Parameter guaranteed by line and load regulation tests.
2. Bandwidth guaranteed by design. Tested for 20kHz to 2MHz.
3. Capacitive load may be any value from 0 to the maximum limit without compromising dc performance. A capacitive in excess of the maximum limit will not disturb loop stability but may interfere with the operation of the load fault detection circuitry, appearing as a short circuit during turn-on.
4. Parameter shall be tested as part of design characterization and after design or process changes. Thereafter, parameters shall be guaranteed to the limits specified in Table I.
5. An overload is that condition with a load in excess of the rated load but less than that necessary to trigger the short circuit protection and is the condition of maximum power dissipation.
6. Load step transition time between 2 and 10 microseconds.
7. Recovery time is measured from the initiation of the transient to where V_{OUT} has returned to within ±1 percent of V_{OUT} at 50 percent load.
8. Input step transition time between 2 and 10 microseconds.
9. Turn-on delay time measurement is for either a step application of power at the input or the removal of ground signal from the Inhibit Pin (Pin 1) while power is applied to the input is unlimited.

Specifications

AHF2805S

Absolute Maximum Ratings	
Input Voltage	-0.5Vdc to +50V_{DC}
Soldering temperature	+300°C for 10 seconds
Operating case temperature	-55°C to +125°C
Storage case temperature	-65°C to +135°C

Table II. Electrical Performance Characteristics

Parameter	Symbol	Conditions -55°C ≤ T_C ≤ +125°C V_{IN} = 28 V_{DC} ± 5%, C_L = 0 Unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Output voltage	V_{OUT}	I_{OUT} = 0	1	01	4.95	5.05	V
			2,3		4.90	5.10	
Output current[1]	I_{OUT}	V_{IN} = 16, 28, and 40Vdc	1,2,3	01		2400	mA
Output power	P_{OUT}	V_{IN} = 16, 28, and 40Vdc	1,2,3	01		12	W
Output ripple voltage[2]	V_{RIP}	V_{IN} = 16, 28, and 40Vdc, B.W. = 20 Hz to 2MHz	1,2,3	01		60	mVp-p
Line regulation	VR_{LINE}	V_{IN} = 16, 28, and 40Vdc, I_{OUT} = 0, 50% and 100% rated load	1,2,3	01		25	mV
Load regulation	VR_{LOAD}	V_{IN} = 16, 28, and 40Vdc, I_{OUT} = 0, 50% and 100% rated load	1,2,3	01		50	mV
Input current	I_{IN}	I_{OUT} = 0, Inhibit (Pin 1) tied to Input Return (Pin 7)	1,2,3	01		12	mA
		I_{OUT} = 0, Inhibit (Pin 1) = open				30	
Input ripple current[2]	I_{RIP}	I_{OUT} = 100% rated load B.W. = 20 Hz to 2 MHz	1,2,3	01		50	mAp-p
Efficiency	E_{FF}	I_{OUT} = 100% rated load	1	01	76		%
			2,3		74		
Isolation	ISO	Input to output or any pin to case (except Pin 6) at 500Vdc T_C = +25°C	1	01	100		MΩ
Capacitive load[3,4]	C_L	No effect on dc performance, T_C = +25°C	4	01		500	µF
Power dissipation load fault	P_D	Overload [5]	1	01		6.0	W
		Short circuit	1,2,3	01		2.0	
Switching frequency	F_S	I_{OUT} = 100% rated load	4,5,6	01	500	600	kHz

For Notes to Electrical Performance Characteristics, refer to page 5

Table II. Electrical Performance Characteristics (continued)

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Parameter	Symbol	Conditions $-55°C \le T_C \le +125°C$ V_{IN} = 28 V_{DC} ± 5%, C_L = 0 unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Output response to step transient load changes[6]	VO_{TLOAD}	50% to/from 100% rated load	4,5,6	01	-300	+300	mVpk
		0% to/from 50% rated load	4,5,6		-500	+500	
Recovery time step transient load changes[6.7]	TT_{LOAD}	50% to/from 100% rated load	4,5,6	01		70	µs
		0% to 50% rated load	4,5,6			1200	µs
		50% to 0% rated load	4,5,6			8.0	ms
Output response to transient step line changes	VO_{TLINE}	Input step 16V to/from 40Vdc, I_{OUT} = 100% rated load [4, 8]	4,5,6	01		500	mVpk
Recovery time transient step line changes	TT_{LINE}	Input step 16V to/from 40Vdc, I_{OUT} = 100% rated load [4, 7, 8]	4,5,6	01		800	µs
Turn on overshoot	$VTon_{OS}$	I_{OUT} = 0 and 100% rated load	4,5,6	01		600	mVpk
Turn on delay	Ton_D	I_{OUT} = 0 and 100% rated load [9]	4,5,6	01		20	ms
Load fault recovery[4,9]	Tr_{LF}		4,5,6	01		20	ms
Weight						38	g

Notes to Table II:

1. Parameter guaranteed by line and load regulation tests.
2. Bandwidth guaranteed by design. Tested for 20kHz to 2MHz.
3. Capacitive load may be any value from 0 to the maximum limit without compromising dc performance. A capacitive in excess of the maximum limit will not disturb loop stability but may interfere with the operation of the load fault detection circuitry, appearing as a short circuit during turn-on.
4. Parameter shall be tested as part of design characterization and after design or process changes. Thereafter, parameters shall be guaranteed to the limits specified in Table II.
5. An overload is that condition with a load in excess of the rated load but less than that necessary to trigger the short circuit protection and is the condition of maximum power dissipation.
6. Load step transition time between 2 and 10 microseconds.
7. Recovery time is measured from the initiation of the transient to where V_{OUT} has returned to within ±1 percent of V_{OUT} at 50 percent load.
8. Input step transition time between 2 and 10 microseconds.
9. Turn-on delay time measurement is for either a step application of power at the input or the removal of ground signal from the Inhibit Pin (Pin 1) while power is applied to the input is unlimited.

Specifications

AHF2812S

Absolute Maximum Ratings	
Input Voltage	-0.5Vdc to +50V_{DC}
Soldering temperature	+300°C for 10 seconds
Operating case temperature	-55°C to +125°C
Storage case temperature	-65°C to +135°C

Table III. Electrical Performance Characteristics

Parameter	Symbol	Conditions -55°C ≤ T_C ≤ +125°C V_{IN} = 28 V_{DC} ± 5%, C_L = 0 Unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Output voltage	V_{OUT}	I_{OUT} = 0	1	01	11.88	12.12	V
			2,3		11.76	12.24	
Output current[1]	I_{OUT}	V_{IN} = 16, 28, and 40Vdc	1,2,3	01		1000	mA
Output power	P_{OUT}	V_{IN} = 16, 28, and 40Vdc	1,2,3	01		12	W
Output ripple voltage[2]	V_{RIP}	V_{IN} = 16, 28, and 40Vdc, B.W. = 20 Hz to 2MHz	1,2,3	01		60	mVp-p
Line regulation	VR_{LINE}	V_{IN} = 16, 28, and 40Vdc, I_{OUT} = 0, 50% and 100% rated load	1,2,3	01		50	mV
Load regulation	VR_{LOAD}	V_{IN} = 16, 28, and 40Vdc, I_{OUT} = 0, 50% and 100% rated load	1,2,3	01		50	mV
Input current	I_{IN}	I_{OUT} = 0, Inhibit (Pin 1) tied to Input Return (Pin 7)	1,2,3	01		12	mA
		I_{OUT} = 0, Inhibit (Pin 1) = open				50	
Input ripple current[2]	I_{RIP}	I_{OUT} = 100% rated load B.W. = 20 Hz to 2 MHz	1,2,3	01		50	mAp-p
Efficiency	E_{FF}	I_{OUT} = 100% rated load	1	01	78		%
			2,3		75		
Isolation	ISO	Input to output or any pin to case (except Pin 6) at 500Vdc T_C = +25°C	1	01	100		MΩ
Capacitive load[3,4]	C_L	No effect on dc performance, T_C = +25°C	4	01		200	µF
Power dissipation load fault	P_D	Overload [5]	1	01		6.0	W
		Short circuit	1,2,3	01		2.0	
Switching frequency	F_S	I_{OUT} = 100% rated load	4,5,6	01	500	600	kHz

For Notes to Electrical Performance Characteristics, refer to page 7

Table III. Electrical Performance Characteristics (continued)

AHF2812S

Parameter	Symbol	Conditions $-55°C \le T_C \le +125°C$ V_{IN} = 28 V_{DC} ± 5%, C_L = 0 unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Output response to step transient load changes[6]	VO_{TLOAD}	50% to/from 100% rated load	4	01	-300	+300	mVpk
			5,6		-450	+450	
		0% to/from 50% rated load	4		-500	+500	
			5,6		-750	+750	
Recovery time step transient load changes[6.7]	TT_{LOAD}	50% to/from 100% rated load	4,5,6	01		100	µs
		0% to 50% rated load	4,5,6			1500	µs
		50% to 0% rated load	4,5,6			10	ms
Output response to transient step line changes	VO_{TLINE}	Input step 16V to/from 40Vdc, I_{OUT} = 100% rated load [4, 8]	4,5,6	01		1500	mVpk
Recovery time transient step line changes	TT_{LINE}	Input step 16V to/from 40Vdc, I_{OUT} = 100% rated load [4, 7, 8]	4,5,6	01		800	µs
Turn on overshoot	$VTon_{OS}$	I_{OUT} = 0 and 100% rated load	4,5,6	01		600	mVpk
Turn on delay	Ton_D	I_{OUT} = 0 and 100% rated load [9]	4,5,6	01		20	ms
Load fault recovery[4,9]	Tr_{LF}		4,5,6	01		20	ms
Weight						38	g

Notes to Table III:

1. Parameter guaranteed by line and load regulation tests.
2. Bandwidth guaranteed by design. Tested for 20kHz to 2MHz.
3. Capacitive load may be any value from 0 to the maximum limit without compromising dc performance. A capacitive in excess of the maximum limit will not disturb loop stability but may interfere with the operation of the load fault detection circuitry, appearing as a short circuit during turn-on.
4. Parameter shall be tested as part of design characterization and after design or process changes. Thereafter, parameters shall be guaranteed to the limits specified in Table III.
5. An overload is that condition with a load in excess of the rated load but less than that necessary to trigger the short circuit protection and is the condition of maximum power dissipation.
6. Load step transition time between 2 and 10 microseconds.
7. Recovery time is measured from the initiation of the transient to where V_{OUT} has returned to within ±1 percent of V_{OUT} at 50 percent load.
8. Input step transition time between 2 and 10 microseconds.
9. Turn-on delay time measurement is for either a step application of power at the input or the removal of ground signal from the Inhibit Pin (Pin 1) while power is applied to the input is unlimited.

Specifications

AHF2815S

Absolute Maximum Ratings	
Input Voltage	-0.5Vdc to +50V_{DC}
Soldering temperature	+300°C for 10 seconds
Operating case temperature	-55°C to +125°C
Storage case temperature	-65°C to +135°C

Table IV. Electrical Performance Characteristics

Parameter	Symbol	Conditions -55°C ≤ T_C ≤ +125°C V_{IN} = 28 V_{DC} ± 5%, C_L = 0 Unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Output voltage	V_{OUT}	I_{OUT} = 0	1	01	14.85	15.15	V
			2,3		14.70	15.30	
Output current[1]	I_{OUT}	V_{IN} = 16, 28, and 40Vdc	1,2,3	01		800	mA
Output power	P_{OUT}	V_{IN} = 16, 28, and 40Vdc	1,2,3	01		12	W
Output ripple voltage[2]	V_{RIP}	V_{IN} = 16, 28, and 40Vdc, B.W. = 20 Hz to 2MHz	1,2,3	01		60	mVp-p
Line regulation	VR_{LINE}	V_{IN} = 16, 28, and 40Vdc, I_{OUT} = 0, 50% and 100% rated load	1,2,3	01		50	mV
Load regulation	VR_{LOAD}	V_{IN} = 16, 28, and 40Vdc, I_{OUT} = 0, 50% and 100% rated load	1,2,3	01		50	mV
Input current	I_{IN}	I_{OUT} = 0, Inhibit (Pin 1) tied to Input Return (Pin 7)	1,2,3	01		12	mA
		I_{OUT} = 0, Inhibit (Pin 1) = open				40	
Input ripple current[2]	I_{RIP}	I_{OUT} = 100% rated load B.W. = 20 Hz to 2 MHz	1,2,3	01		50	mAp-p
Efficiency	E_{FF}	I_{OUT} = 100% rated load	1	01	78		%
			2,3		75		
Isolation	ISO	Input to output or any pin to case (except Pin 6) at 500Vdc T_C = +25°C	1	01	100		MΩ
Capacitive load[3,4]	C_L	No effect on dc performance, T_C = +25°C	4	01		200	µF
Power dissipation load fault	P_D	Overload [5]	1	01		6.0	W
		Short circuit	1,2,3	01		2.0	
Switching frequency	F_S	I_{OUT} = 100% rated load	4,5,6	01	500	600	kHz

For Notes to Electrical Performance Characteristics, refer to page 9

Table IV. Electrical Performance Characteristics (continued) AHF2815S

Parameter	Symbol	Conditions $-55°C \le T_C \le +125°C$ V_{IN} = 28 V_{DC} ± 5%, C_L = 0 unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Output response to step transient load changes[6]	VO_{TLOAD}	50% to/from 100% rated load	4,5,6	01	-300	+300	mVpk
		0% to/from 50% rated load	4,5,6		-750	+750	
Recovery time step transient load changes[6.7]	TT_{LOAD}	50% to/from 100% rated load	4,5,6	01		100	µs
		0% to 50% rated load	4,5,6			1500	µs
		50% to 0% rated load	4,5,6			10	ms
Output response to transient step line changes	VO_{TLINE}	Input step 16V to/from 40Vdc, I_{OUT} = 100% rated load [4, 8]	4,5,6	01	-1500	+1500	mVpk
Recovery time transient step line changes	TT_{LINE}	Input step 16V to/from 40Vdc, I_{OUT} = 100% rated load [4, 7, 8]	4,5,6	01		800	µs
Turn on overshoot	$VTon_{OS}$	I_{OUT} = 0 and 100% rated load	4,5,6	01		750	mVpk
Turn on delay	Ton_D	I_{OUT} = 0 and 100% rated load [9]	4,5,6	01		20	ms
Load fault recovery[4,9]	Tr_{LF}		4,5,6	01		20	ms
Weight						38	g

Notes to Table IV:

1. Parameter guaranteed by line and load regulation tests.
2. Bandwidth guaranteed by design. Tested for 20kHz to 2MHz.
3. Capacitive load may be any value from 0 to the maximum limit without compromising dc performance. A capacitive in excess of the maximum limit will not disturb loop stability but may interfere with the operation of the load fault detection circuitry, appearing as a short circuit during turn-on.
4. Parameter shall be tested as part of design characterization and after design or process changes. Thereafter, parameters shall be guaranteed to the limits specified in Table IV.
5. An overload is that condition with a load in excess of the rated load but less than that necessary to trigger the short circuit protection and is the condition of maximum power dissipation.
6. Load step transition time between 2 and 10 microseconds.
7. Recovery time is measured from the initiation of the transient to where V_{OUT} has returned to within ±1 percent of V_{OUT} at 50 percent load.
8. Input step transition time between 2 and 10 microseconds.
9. Turn-on delay time measurement is for either a step application of power at the input or the removal of ground signal from the Inhibit Pin (Pin 1) while power is applied to the input is unlimited.

Specifications

AHF2805D

Absolute Maximum Ratings	
Input Voltage	-0.5Vdc to +50V_{DC}
Soldering temperature	+300°C for 10 seconds
Operating case temperature	-55°C to +125°C
Storage case temperature	-65°C to +135°C

Table V. Electrical Performance Characteristics

Parameter	Symbol	Conditions -55°C ≤ T_C ≤ +125°C V_{IN} = 28 V_{DC} ± 5%, C_L = 0 Unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Output voltage	V_{OUT}	I_{OUT} = 0	1	01	±4.95	±5.05	V
			2,3		±4.90	±5.10	
Output current[1,2]	I_{OUT}	V_{IN} = 16, 28, and 40Vdc, each output	1,2,3	01	240	2160	mA
Output power	P_{OUT}	V_{IN} = 16, 28, and 40Vdc	1,2,3	01		12	W
Output ripple voltage[3]	V_{RIP}	V_{IN} = 16, 28, and 40Vdc, B.W. = 20 Hz to 2MHz	1,2,3	01		60	mVp-p
Line regulation[4]	VR_{LINE}	V_{IN} = 16, 28, and 40Vdc, I_{OUT} = 0, 50% and 100% rated load	1,2,3	01	-30	30	mV
Load regulation[4]	VR_{LOAD}	V_{IN} = 16, 28, and 40Vdc, I_{OUT} = 0, 50% and 100% rated load	1,2,3	01	-50	50	mV
Cross regulation[5]	VR_{CROSS}	10% to 90% load changes	1,2,3	01	-10	10	%
Input current	I_{IN}	I_{OUT} = 0, Inhibit (Pin 1) tied to Input Return (Pin 7)	1,2,3	01		12	mA
		I_{OUT} = 0, Inhibit (Pin 1) = open				60	
Input ripple current[3,4]	I_{RIP}	I_{OUT} = 100% rated load B.W. = 20 Hz to 2 MHz	1,2,3	01		50	mAp-p
Efficiency[4]	E_{FF}	I_{OUT} = 100% rated load	1,3	01	75		%
			2		72		
Isolation	ISO	Input to output or any pin to case (except Pin 6) at 500Vdc T_C = +25°C	1	01	100		MΩ
Capacitive load[6,7]	C_L	No effect on dc performance, T_C = +25°C	4	01		200	µF
Power dissipation load fault	P_D	Overload	1,2,3	01		6.0	W
		Short circuit				2.0	
Switching frequency	F_S	I_{OUT} = 100% rated load	4,5,6	01	500	600	kHz

For Notes to Electrical Performance Characteristics, refer to page 11

Table V. Electrical Performance Characteristics (continued)

AHF2805D

Parameter	Symbol	Conditions $-55°C \le T_C \le +125°C$ V_{IN} = 28 V_{DC} ± 5%, C_L = 0 unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Output response to step transient load changes[4, 9]	VO_{TLOAD}	50% to/from 100% rated load	4,5,6	01	-400	+400	mVpk
		0% to/from 50% rated load	4,5,6		-800	+800	
Recovery time step transient load changes[4, 9, 10]	TT_{LOAD}	50% to/from 100% rated load	4,5,6	01		100	µs
		0% to 50% rated load	4,5,6			5000	µs
Output response to transient step line changes[4, 7, 11]	VO_{TLINE}	Input step 16V to/from 40Vdc, I_{OUT} = 100% rated load	4,5,6	01	-400	+400	mVpk
Recovery time transient step line changes[4, 7, 10, 11]	TT_{LINE}	Input step 16V to/from 40Vdc, I_{OUT} = 100% rated load	4,5,6	01		1200	µs
Turn on overshoot[4]	$VTon_{OS}$	I_{OUT} = 0 and 100% rated load	4,5,6	01		600	mVpk
Turn on delay	Ton_D	I_{OUT} = 0 and 100% rated load[9]	4,5,6	01		25	ms
Load fault recovery[4,9]	Tr_{LF}		4,5,6	01		25	ms
Weight						38	g

Notes to Table V:

1. Parameter guaranteed by line load and cross regulation tests.
2. Up to 90 percent of full power is available from either output provided the total output does not exceed 12W.
3. Bandwidth guaranteed by design. Tested for 20kHz to 2MHz.
4. Load current split equally between $+V_{OUT}$ and $-V_{OUT}$.
5. 1.2 watt load on output under test, 1.2 watt to 10.8 watt load change on other output.
6. Capacitive load may be any value from 0 to the maximum limit without compromising dc performance. A capacitive load in excess of the maximum limit will not disturb loop stability but may interfere with the operation of the load fault detection circuitry, appearing as a short circuit during turn-on.
7. Parameter shall be tested as part of design characterization and after design or process changes. Thereafter, parameters shall be guaranteed to the limits specified in Table V.
8. An overload is that condition with a load in excess of the rated load but less than that necessary to trigger the short circuit protection and is the condition of maximum power dissipation.
9. Load step transition time between 2 and 10 microseconds.
10. Recovery time is measured from the initiation of the transient to where V_{OUT} has returned to within ±1 percent of V_{OUT} at 50 percent load.
11. Input step transition time between 2 and 10 microseconds.
12. Turn-on delay time measurement is for either a step application of power at the input or the removal of a ground signal from the Inhibit Pin (Pin 1) while power is applied to the input.

Specifications

AHF2812D

Absolute Maximum Ratings	
Input Voltage	-0.5Vdc to +50V_{DC}
Soldering temperature	+300°C for 10 seconds
Operating case temperature	-55°C to +125°C
Storage case temperature	-65°C to +135°C

Table VI. Electrical Performance Characteristics

Parameter	Symbol	Conditions -55°C ≤ T_C ≤ +125°C V_{IN} = 28 V_{DC} ± 5%, C_L = 0 Unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Output voltage	V_{OUT}	I_{OUT} = 0	1	01	±11.88	±12.12	V
			2,3		±11.76	±12.24	
Output current[1,2]	I_{OUT}	V_{IN} = 16, 28, and 40Vdc, each output	1,2,3	01	100	900	mA
Output power	P_{OUT}	V_{IN} = 16, 28, and 40Vdc	1,2,3	01		12	W
Output ripple voltage[3]	V_{RIP}	V_{IN} = 16, 28, and 40Vdc, B.W. = 20 Hz to 2MHz	1,2,3	01		60	mVp-p
Line regulation[4]	VR_{LINE}	V_{IN} = 16, 28, and 40Vdc, I_{OUT} = 0, 50% and 100% rated load	1,2,3	01	-30	30	mV
Load regulation[4]	VR_{LOAD}	V_{IN} = 16, 28, and 40Vdc, I_{OUT} = 0, 50% and 100% rated load	1,2,3	01	-50	50	mV
Cross regulation[5]	VR_{CROSS}	10% to 90% load changes	1,2,3	01	-3.0	3.0	%
Input current	I_{IN}	I_{OUT} = 0, Inhibit (Pin 1) tied to Input Return (Pin 7)	1,2,3	01		12	mA
		I_{OUT} = 0, Inhibit (Pin 1) = open				60	
Input ripple current[3,4]	I_{RIP}	I_{OUT} = 100% rated load B.W. = 20 Hz to 2 MHz	1,2,3	01		50	mAp-p
Efficiency[4]	E_{FF}	I_{OUT} = 100% rated load	1,3	01	77		%
			2		74		
Isolation	ISO	Input to output or any pin to case (except Pin 6) at 500Vdc T_C = +25°C	1	01	100		MΩ
Capacitive load[6,7]	C_L	No effect on dc performance, T_C = +25°C	4	01		200	µF
Power dissipation load fault	P_D	Overload	1,2,3	01		6.0	W
		Short circuit				3.0	
Switching frequency	F_S	I_{OUT} = 100% rated load	4,5,6	01	500	600	kHz

For Notes to Electrical Performance Characteristics, refer to page 13

Table VI. Electrical Performance Characteristics (continued)

AHF2812D

Parameter	Symbol	Conditions $-55°C \le T_C \le +125°C$ V_{IN} = 28 V_{DC} ± 5%, C_L = 0 unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Output response to step transient load changes[4, 9]	VO_{TLOAD}	50% to/from 100% rated load	4,5,6	01	-200	+200	mVpk
		0% to/from 50% rated load	4,5,6		-800	+800	
Recovery time step transient load changes[4, 9, 10]	TT_{LOAD}	50% to/from 100% rated load	4,5,6	01		70	µs
		0% to 50% rated load	4,5,6			2000	µs
Output response to transient step line changes[4, 7, 11]	VO_{TLINE}	Input step 16V to/from 40Vdc, I_{OUT} = 100% rated load	4,5,6	01	-750	+750	mVpk
Recovery time transient step line changes[4, 7, 10, 11]	TT_{LINE}	Input step 16V to/from 40Vdc, I_{OUT} = 100% rated load	4,5,6	01		1200	µs
Turn on overshoot[4]	$VTon_{OS}$	I_{OUT} = 0 and 100% rated load	4,5,6	01		600	mVpk
Turn on delay	Ton_D	I_{OUT} = 0 and 100% rated load[9]	4,5,6	01		25	ms
Load fault recovery[4,9]	Tr_{LF}		4,5,6	01		25	ms
Weight						38	g

Notes to Table VI:

1. Parameter guaranteed by line load and cross regulation tests.
2. Up to 90 percent of full power is available from either output provided the total output does not exceed 12W.
3. Bandwidth guaranteed by design. Tested for 20kHz to 2MHz.
4. Load current split equally between $+V_{OUT}$ and $-V_{OUT}$.
5. 1.2 watt load on output under test, 1.2 watt to 10.8 watt load change on other output.
6. Capacitive load may be any value from 0 to the maximum limit without compromising dc performance.
   A capacitive load in excess of the maximum limit will not disturb loop stability but may interfere with the operation of the load fault detection circuitry, appearing as a short circuit during turn-on.
7. Parameter shall be tested as part of design characterization and after design or process changes.
   Thereafter, parameters shall be guaranteed to the limits specified in Table VI.
8. An overload is that condition with a load in excess of the rated load but less than that necessary to trigger the short circuit protection and is the condition of maximum power dissipation.
9. Load step transition time between 2 and 10 microseconds.
10. Recovery time is measured from the initiation of the transient to where V_{OUT} has returned to within ±1 percent of V_{OUT} at 50 percent load.
11. Input step transition time between 2 and 10 microseconds.
12. Turn-on delay time measurement is for either a step application of power at the input or the removal of a ground signal from the Inhibit Pin (Pin 1) while power is applied to the input.

Specifications

AHF2815D

Absolute Maximum Ratings	
Input Voltage	-0.5Vdc to +50V_{DC}
Soldering temperature	+300°C for 10 seconds
Operating case temperature	-55°C to +125°C
Storage case temperature	-65°C to +135°C

Table VII. Electrical Performance Characteristics

Parameter	Symbol	Conditions -55°C ≤ T_C ≤ +125°C V_{IN} = 28 V_{DC} ± 5%, C_L = 0 Unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Output voltage	V_{OUT}	I_{OUT} = 0	1	01	±14.85	±15.15	V
			2,3		±14.70	±15.30	
Output current[1,2]	I_{OUT}	V_{IN} = 16, 28, and 40Vdc, each output	1,2,3	01	80	720	mA
Output power	P_{OUT}	V_{IN} = 16, 28, and 40Vdc	1,2,3	01		12	W
Output ripple voltage[3]	V_{RIP}	V_{IN} = 16, 28, and 40Vdc, B.W. = 20 Hz to 2MHz	1,2,3	01		60	mVp-p
Line regulation[4]	VR_{LINE}	V_{IN} = 16, 28, and 40Vdc, I_{OUT} = 0, 50% and 100% rated load	1,2,3	01	-35	35	mV
Load regulation[4]	VR_{LOAD}	V_{IN} = 16, 28, and 40Vdc, I_{OUT} = 0, 50% and 100% rated load	1,2,3	01	-50	50	mV
Cross regulation[5]	VR_{CROSS}	10% to 90% load changes	1,2,3	01	-3.0	3.0	%
Input current	I_{IN}	I_{OUT} = 0, Inhibit (Pin 1) tied to Input Return (Pin 7)	1,2,3	01		12	mA
		I_{OUT} = 0, Inhibit (Pin 1) = open				60	
Input ripple current[3,4]	I_{RIP}	I_{OUT} = 100% rated load B.W. = 20 Hz to 2 MHz	1,2,3	01		50	mAp-p
Efficiency[4]	E_{FF}	I_{OUT} = 100% rated load	1,3	01	78		%
			2		74		
Isolation	ISO	Input to output or any pin to case (except Pin 6) at 500Vdc T_C = +25°C	1	01	100		MΩ
Capacitive load[6,7]	C_L	No effect on dc performance, T_C = +25°C	4	01		200	µF
Power dissipation load fault	P_D	Overload	1,2,3	01		6.0	W
		Short circuit				2.5	
Switching frequency	F_S	I_{OUT} = 100% rated load	4,5,6	01	500	600	kHz

For Notes to Electrical Performance Characteristics, refer to page 15

Table VII. Electrical Performance Characteristics (continued)

AHF2815D

Parameter	Symbol	Conditions $-55°C \le T_C \le +125°C$ V_{IN} = 28 V_{DC} ± 5%, C_L = 0 unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Output response to step transient load changes[4, 9]	VO_{TLOAD}	50% to/from 100% rated load	4,5,6	01	-200	+200	mVpk
		0% to/from 50% rated load	4,5,6		-800	+800	
Recovery time step transient load changes[4, 9, 10]	TT_{LOAD}	50% to/from 100% rated load	4,5,6	01		70	µs
		0% to 50% rated load	4,5,6			2000	µs
Output response to transient step line changes[4, 7, 11]	VO_{TLINE}	Input step 16V to/from 40Vdc, I_{OUT} = 100% rated load	4,5,6	01	-750	+750	mVpk
Recovery time transient step line changes[4, 7, 10, 11]	TT_{LINE}	Input step 16V to/from 40Vdc, I_{OUT} = 100% rated load	4,5,6	01		1200	µs
Turn on overshoot[4]	$VTon_{OS}$	I_{OUT} = 0 and 100% rated load	4,5,6	01		750	mVpk
Turn on delay	Ton_D	I_{OUT} = 0 and 100% rated load[9]	4,5,6	01		25	ms
Load fault recovery[4,9]	Tr_{LF}		4,5,6	01		25	ms
Weight						38	g

Notes to Table VII:

1. Parameter guaranteed by line load and cross regulation tests.
2. Up to 90 percent of full power is available from either output provided the total output does not exceed 12W.
3. Bandwidth guaranteed by design. Tested for 20kHz to 2MHz.
4. Load current split equally between $+V_{OUT}$ and $-V_{OUT}$.
5. 1.2 watt load on output under test, 1.2 watt to 10.8 watt load change on other output.
6. Capacitive load may be any value from 0 to the maximum limit without compromising dc performance.
   A capacitive load in excess of the maximum limit will not disturb loop stability but may interfere with the operation of the load fault detection circuitry, appearing as a short circuit during turn-on.
7. Parameter shall be tested as part of design characterization and after design or process changes. Thereafter, parameters shall be guaranteed to the limits specified in Table VII.
8. An overload is that condition with a load in excess of the rated load but less than that necessary to trigger the short circuit protection and is the condition of maximum power dissipation.
9. Load step transition time between 2 and 10 microseconds.
10. Recovery time is measured from the initiation of the transient to where V_{OUT} has returned to within ±1 percent of V_{OUT} at 50 percent load.
11. Input step transition time between 2 and 10 microseconds.
12. Turn-on delay time measurement is for either a step application of power at the input or the removal of a ground signal from the Inhibit Pin (Pin 1) while power is applied to the input.

Application Information

Inhibit Function (Enable)

Connecting the Enable Input (Pin 1) to Input Common (Pin 7) will cause the converter to shut down. It is recommended that the Enable Pin be driven by an open collector device capable of sinking at least 400μA of current. The open circuit voltage of the Enable Input is 15±1.0V_{DC}. If the Inhibit function is not used, this Input can be left unconnected because it is internally pulled-up.

Thermal Management

Assuming that there is no forced air flow, the package temperature rise above ambient (ΔT) may be calculated using the following expression:

$$\Delta T \approx 80\ A^{-0.7} p^{0.85}\ (°C)$$

where A = Effective surface area in square inches (including heat sink if used), P = Power dissipation in watts.

The total surface area of the AHF package is 4.9 square inches. If a worst case full load efficiency of 78% is assumed, then the case temperature rise can be calculated as follows:

$$P = P_{OUT}\left[\frac{1}{Eff} - 1\right] = 12\left[\frac{1}{0.78} - 1\right] = 3.4W$$

$$\Delta T = 80\ (4.9)^{-0.7}\ (3.4)^{0.85} = 74°C$$

Hence if $T_{AMBIENT}$ = +25°C, the DC-DC converter case temperature will be approximately 100°C if no heat sink or air flow is provided.

To calculate the heat sink area required to maintain a specific case temperature rise, the above equation may be manipulated as follows:

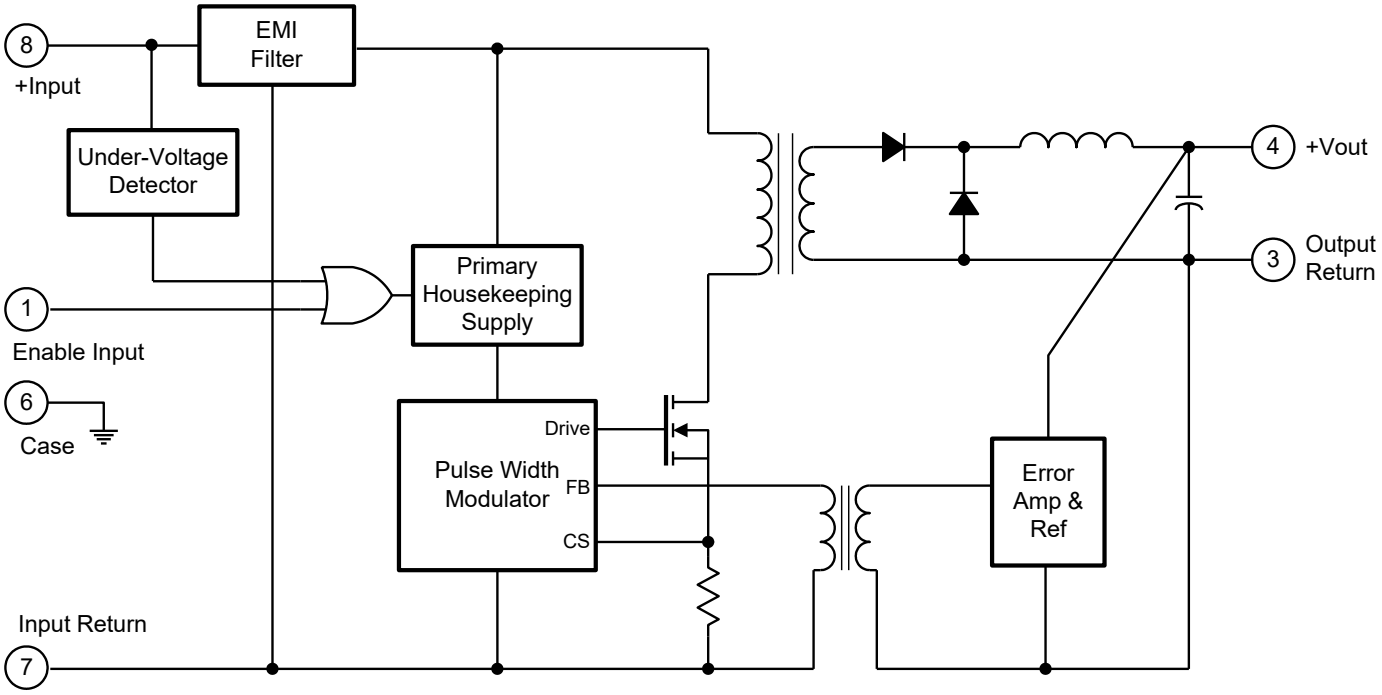
$$A_{HEAT\ SINK} = \left[\frac{\Delta T}{80P^{0.85}}\right]^{-1.43} - A_{PKG}$$

As an example, if a maximum case temperature rise of 50°C above ambient is desired, then the required effective heat sink area is:

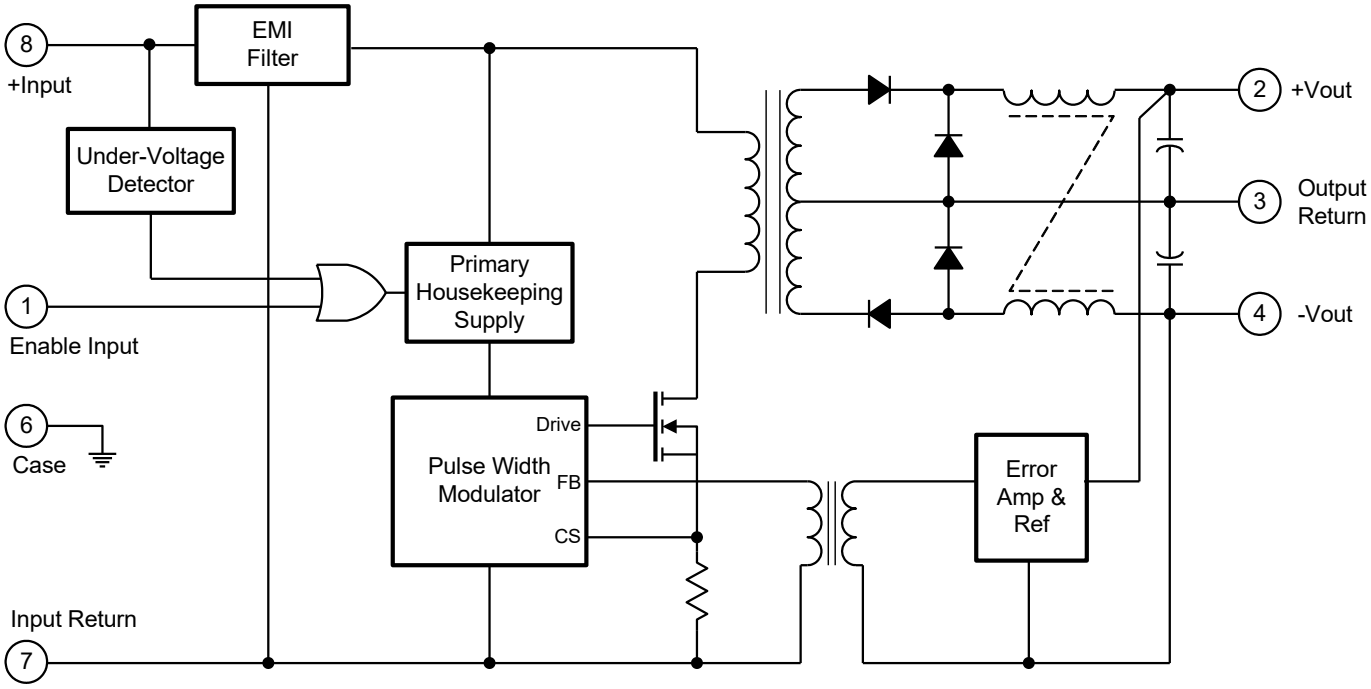
$$A_{HEATSINK} = \left[\frac{50}{80(3.4)^{0.85}}\right]^{-1.43} - 4.9 = 3.75in.^2$$

Block Diagrams

Single Output

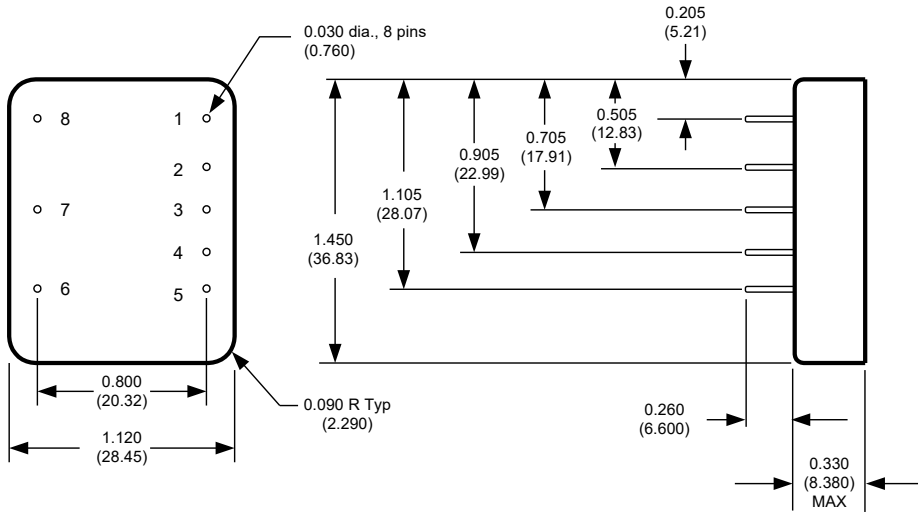


Dual Output



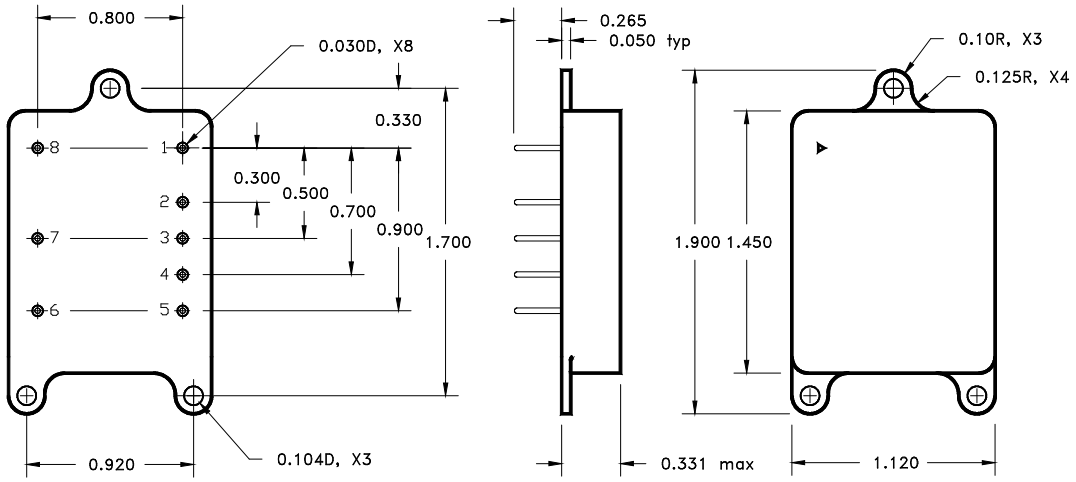
Mechanical Outlines

Non-Flanged



The Tolerance for X.XXX = 0.005”

Flanged



The Tolerance for X.XXX = 0.005”

Pin Designation Tables

Single Output

Pin #	Designation
1	Enable Input
2	NC
3	Output Return
4	+Output
5	NC
6	Case Ground
7	Input Return
8	+Input

Dual Output

Pin #	Designation
1	Enable Input
2	+Output
3	Output Return
4	-Output
5	NC
6	Case Ground
7	Input Return
8	+Input

Standard Microcircuit Drawing Equivalence Table

Standard Microcircuit Drawing Number	Vendor Cage Code	IR Hirel Standard Part Number
5962-91600	52467	AHF2805S
5962-94568	52467	AHF2812S
5962-94563	52467	AHF2815S
5962-05205	52467	AHF2805D
5962-92111	52467	AHF2812D
5962-92351	52467	AHF2815D

Device Screening

Requirement	MIL-STD-883 Method	No Suffix	ES ②	HB	CH
Temperature Range	—	-20°C to +85°C	-55°C to +125°C③	-55°C to +125°C	-55°C to +125°C
Element Evaluation	MIL-PRF-38534	N/A	N/A	N/A	Class H
Non-Destructive Bond Pull	2023	N/A	N/A	N/A	N/A
Internal Visual	2017	①	Yes	Yes	Yes
Temperature Cycle	1010	N/A	Cond B	Cond C	Cond C
Constant Acceleration	2001, Y1 Axis	N/A	500 Gs	3000 Gs	3000 Gs
PIND	2020	N/A	N/A	N/A	N/A
Burn-In	1015	N/A	48 hrs @ hi temp	160hrs @ 125°C	160 hrs @ 125°C
Final Electrical (Group A)	MIL-PRF-38534 & Specification	25°C	25°C	-55°C, +25°C, +125°C	-55°C, +25°C, +125°C
PDA	MIL-PRF-38534	N/A	N/A	N/A	10%
Seal, Fine and Gross	1014	Cond A	Cond A, C	Cond A, C	Cond A, C
Radiographic	2012	N/A	N/A	N/A	N/A
External Visual	2009	①	Yes	Yes	Yes

Notes:
① Best commercial practice.
② Sample tests at low and high temperatures.
③ -55°C to +105°C for AHE, ATO, ATW.

Part Numbering

AHF 28 05 S F /CH

- **Model**
- **Input Voltage**
  28 = 28V
- **Output Voltage**
  Single
  03R3 = 3.3V, 05 = 5V
  12 = 12V, 15 = 15V
  Dual
  05 = ±5V
  12 = ±12V, 15 = ±15V
- **Output**
  S = Single
  D = Dual
- **Package Style**
  F = Flange
  Blank = Non-Flanged
- **Screening Level**
  (Please refer to Screening Table)
  No Suffix, ES, HB, CH

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