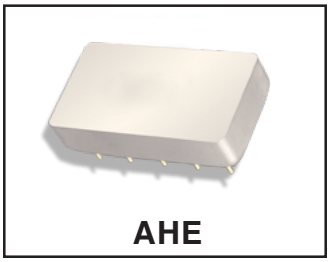
PD-94555B

AHE28XXD SERIES

28V Input, Dual Output

HYBRID-HIGH RELIABILITY DC/DC CONVERTER



AHE

Description

The AHE 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 dual 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 250KHz. 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.

Manufactured in a facility fully qualified to MIL-PRF-38534, these converters are fabricated utilizing DSCC qualified processes. For available screening options, refer to device screening table in the data sheet. Variations in electrical, mechanical and screening can be accommodated. Contact IR Santa Clara for special requirements.

Features

- 17V to 40VDC Input Range
- 28VDC Nominal Input
- ± 5V, ±12V and ±15V Outputs Available
- Indefinite Short Circuit and Overload Protection
- 12.9W/in^3 Power Density
- 15W Output Power
- 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 82%
- Shutdown from External Signal
- Military Screening
- 314,000 hour MTBF at 85°C (AUC)
- Standard Microcircuit Drawings Available

Specifications

AHE2805D

Absolute Maximum Ratings	
Input voltage	-0.5V to +50VDC
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

Test	Symbol	Conditions -55°C ≤ Tc ≤+125°C Vin = 28 Vdc ±5%, C_L = 0 Unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Output voltage	V_{OUT}	I_{OUT} = 0	1	All	±4.95	±5.05	V
			2,3		±4.90	±5.10	
Output current [9, 11]	I_{OUT}	V_{IN} = 17, 28, and 40 V dc	1,2,3	All	0.0	±625	mA
Output ripple voltage [8, 9]	V_{RIP}	V_{IN} = 17, 28, and 40 V dc, B.W. = DC to 2MHz	1,2,3	All		60	mVp-p
Output power [4, 9, 11]	P_{OUT}	V_{IN} =17,28, and 40 V dc	1,2,3	All	15		W
Line [9] Regulation [10]	VR_{LINE}	V_{IN} = 17, 28, and 40 V dc, I_{out} = 0, ±313, and ±625mA	1	All		25	mV
			2,3			50	
Load Regulation [9]	VR_{LOAD}	V_{IN} = 17, 28, and 40 V dc, I_{OUT} = 0, ±313,and ±625 mA	1,2,3	All		110	mV
Input current	I_{IN}	I_{OUT} = 0, inhibit (pin 2) tied to input return (pin 10)	1,2,3	All		18	mA
		I_{OUT} = 0, inhibit (pin 2) = open				40	
Input ripple current [8]	I_{RIP}	I_{OUT} = ±625mA B.W. = DC to 2MHz	1,2,3	All		50	mAp-p
Efficiency	E_{FF}	I_{OUT} = ±625mA T_C = +25°C	1	All	80		%
Isolation	ISO	Input to output or any pin to case (except pin 8) at 500V dc Tc = +25ºC	1	All	100		MΩ
Capacitive load [6, 12]	C_L	No effect on dc performance, Tc = +25ºC	4	All		200	µF
Power dissipation load fault	P_D	Overload, T_C = +25°C [3]	1	All		6.0	W
		Short circuit, T_C = +25°C	1			6.0	
Switching frequency [9]	F_S	I_{OUT} = ±625mA	4,5,6	01	225	275	KHz
				02	225	245	
				03	250	275	
Output response to step transient load changes [7]	VO_{TLOAD}	50% load to/from100%load	4	All	-300	+300	
			5,6		-450	+450	mVpk
		No load to/from 50% load	4	All	-500	+500	
			5,6		-750	+750	

For Notes to Specifications, refer to page 3

Table I. Electrical Performance Characteristics - continued

AHE2805D

Test	Symbol	Conditions -55° ≤Tc ≤+125°C Vin = 28 Vdc ±5%, C_L= 0 unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Recovery time step transient load changes [1, 7]	TT_{LOAD}	50% load to/from 100% load	4	All		70	µs
			5,6			100	
		No load to 50% load	4,5,6	All		1500	
		50% load to no load	4,5,6	All		5.0	ms
Output response transient step line changes [5, 12]	VO_{TLINE}	Input step 17 to 40V dc	4,5,6	All		1200	mVpk
		Input step 40 to 17V dc	4,5,6	All		-1500	
Recovery time transient step line changes [1, 5, 12]	TT_{LINE}	Input step 17 to 40V dc	4,5,6	All		4.0	ms
		Input step 40 to 17V dc	4,5,6	All		4.0	
Turn on overshoot [9]	$VTon_{OS}$	I_{OUT} = 0 and ±625mA	4,5,6	All		600	mVpk
Turn on delay [2, 9]	Ton_D	I_{OUT} = 0 and ±625mA	4,5,6	All		10	ms
Load fault recovery [12]	Tr_{LF}		4,5,6	All		10	ms

Notes to Specifications

1 Recovery time is measured from the initiation of the transient to where V_{OUT} has returned to within ±0.1 % of V_{OUT} at 50 % load.
2 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 2) while power is applied to the input.
3 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.
4 Total power at both outputs. For operation at 16V dc input, derate output power by 33 %.
5 Input step transition time between 2.0µs and 10µs.
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 Load step transition time between 2.0µs and 10µs.
8 Bandwidth guaranteed by design. Tested for 20KHz to 2.0MHz.
9 Tested at each output.
10 When operating with unbalanced loads, at least 25 % of the load must be on the positive output to maintain regulation.
11 Parameter guaranteed by line and load regulation tests.
12 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.

Specifications

AHE2812D

Absolute Maximum Ratings	
Input voltage	-0.5V to +50VDC
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

Test	Symbol	Conditions -55°C ≤ Tc ≤+125°C Vin = 28 Vdc ±5%, C_L = 0 Unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Output voltage	V_{OUT}	I_{OUT} = 0	1	All	±11.88	±12.12	V
			2,3		±11.70	±12.24	
Output current [9, 11]	I_{OUT}	V_{IN} = 17, 28, and 40 V dc	1,2,3	All	0.0	±625	mA
Output ripple voltage [8, 9]	V_{RIP}	V_{IN} = 17, 28, and 40 V dc, B.W. = DC to 2MHz	1,2,3	All		60	mVp-p
Output power [4, 9, 11]	P_{OUT}	V_{IN} =17,28, and 40 V dc	1,2,3	All	15		W
Line [9] Regulation [10]	VR_{LINE}	V_{IN} = 17, 28, and 40 V dc, I_{out} = 0, ±313, and ±625mA	1	All		30	mV
			2,3			60	
Load Regulation [9]	VR_{LOAD}	V_{IN} = 17, 28, and 40 V dc, I_{OUT} = 0, ±313,and ±625 mA	1,2,3	All		120	mV
Input current	I_{IN}	I_{OUT} = 0, inhibit (pin 2) tied to input return (pin 10)	1,2,3	All		18	mA
		I_{OUT} = 0, inhibit (pin 2) = open				40	
Input ripple current [8]	I_{RIP}	I_{OUT} = ±625mA B.W. = DC to 2MHz	1,2,3	All		50	mAp-p
Efficiency	E_{FF}	I_{OUT} = ±625mA T_C = +25°C	1	All	80		%
Isolation	ISO	Input to output or any pin to case (except pin 8) at 500V dc Tc = +25ºC	1	All	100		MΩ
Capacitive load [6, 12]	C_L	No effect on dc performance, Tc = +25ºC	4	All		200	µF
Power dissipation load fault	P_D	Overload, T_C = +25°C [3]	1	All		6.0	W
		Short circuit, T_C = +25°C	1			6.0	
Switching frequency [9]	F_S	I_{OUT} = ±625mA	4,5,6	01	225	275	KHz
				02	225	245	
				03	250	275	
Output response to step transient load changes [7]	VO_{TLOAD}	50% load to/from100%load	4	All	-300	+300	mVpk
			5,6		-450	+450	
		No load to/from 50% load	4	All	-500	+500	
			5,6		-750	+750	

Table II. Electrical Performance Characteristics - continued

AHE2812D

Test	Symbol	Conditions -55° ≤Tc ≤+125°C Vin = 28 Vdc ±5%, C_L= 0 unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Recovery time step transient load changes [1, 7]	TT_{LOAD}	50% load to/from 100% load	4	All		70	µs
			5,6			100	
		No load to 50% load	4,5,6	All		1500	
		50% load to no load	4,5,6	All		5.0	ms
Output response transient step line changes [5, 12]	VO_{TLINE}	Input step 17 to 40V dc	4,5,6	All		1200	mVpk
		Input step 40 to 17V dc	4,5,6	All		-1500	
Recovery time transient step line changes [1, 5, 12]	TT_{LINE}	Input step 17 to 40V dc	4,5,6	All		4.0	ms
		Input step 40 to 17V dc	4,5,6	All		4.0	
Turn on overshoot [9]	$VTon_{OS}$	I_{OUT} = 0 and ±625mA	4,5,6	All		600	mVpk
Turn on delay [2, 9]	Ton_D	I_{OUT} = 0 and ±625mA	4,5,6	All		10	ms
Load fault recovery [12]	Tr_{LF}		4,5,6	All		10	ms

Notes to Specifications

1 Recovery time is measured from the initiation of the transient to where V_{OUT} has returned to within ±0.1% of V_{OUT} at 50 % load.
2 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 2) while power is applied to the input.
3 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.
4 Total power at both outputs. For operation at 16V dc input, derate output power by 33 %.
5 Input step transition time between 2.0µs and 10µs.
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 Load step transition time between 2.0µs and 10µs.
8 Bandwidth guaranteed by design. Tested for 20KHz to 2.0MHz.
9 Tested at each output.
10 When operating with unbalanced loads, at least 25 % of the load must be on the positive output to maintain regulation.
11 Parameter guaranteed by line and load regulation tests.
12 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.

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Specifications

AHE2815D

Absolute Maximum Ratings	
Input voltage	-0.5V to +50VDC
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

Test	Symbol	Conditions -55°C ≤ Tc ≤+125°C Vin = 28 Vdc ±5%, C_L = 0 Unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Output voltage	V_{OUT}	I_{OUT} = 0	1	All	±14.85	±15.15	V
			2,3		±14.70	±15.30	
Output current [9, 11]	I_{OUT}	V_{IN} = 17, 28, and 40 V dc	1,2,3	All	0.0	±500	mA
Output ripple voltage [8, 9]	V_{RIP}	V_{IN} = 17, 28, and 40 V dc, B.W. = dc to 2 mHz	1,2,3	All		60	mVp-p
Output power [4, 9, 11]	P_{OUT}	V_{IN} =17,28, and 40 V dc	1,2,3	All	15		W
Line Regulation [9, 10]	VR_{LINE}	V_{IN} = 17, 28, and 40 V dc, I_{out} = 0, ±250, and ±500mA	1	All		35	mV
			2,3			75	
Load Regulation [9]	VR_{LOAD}	V_{IN} = 17, 28, and 40 V dc, I_{OUT} = 0, ±250,and ±625 mA	1,2,3	All		150	mV
Input current	I_{IN}	I_{OUT} = 0, inhibit (pin 2) tied to input return (pin 10)	1,2,3	All		18	mA
		I_{OUT} = 0, inhibit (pin 2) = open				40	
Input ripple current [8]	I_{RIP}	I_{OUT} = ±500mA B.W. = DC to 2MHz	1,2,3	All		50	mAp-p
Efficiency	E_{FF}	I_{OUT} = ±500mA T_C = +25°C	1	All	80		%
Isolation	ISO	Input to output or any pin to case (except pin 8) at 500V dc Tc = +25°C	1	All	100		MΩ
Capacitive load [6, 12]	C_L	No effect on dc performance, Tc = +25°C	4	All		200	µF
Power dissipation load fault	P_D	Overload, T_C = +25°C [3]	1	All		6.0	W
Switching frequency [9]	F_S	I_{OUT} = ±500mA	4,5,6	01	225	275	KHz
				02	225	245	
				03	250	275	
Output response to step transient load changes [7]	VO_{TLOAD}	50% load to/from100%load	4	All	-300	+300	mVpk
			5,6		-450	+450	
		No load to/from 50% load	4	All	-500	+500	
			5,6		-750	+750	

Refer Notes to Specifications, refer to page 5

Table III. Electrical Performance Characteristics - continued **AHE2815D**

Test	Symbol	Conditions -55°C ≤Tc ≤+125°C Vin = 28 Vdc ±5%, C_L = 0 unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Recovery time step transient load changes [1, 7]	TT_{LOAD}	50% load to/from 100% load	4	All		70	µs
			5,6			100	
		No load to 50% load	4,5,6	All		1500	
		50% load to no load	4,5,6	All		5.0	ms
Output response transient step line changes [5, 12]	VO_{TLINE}	Input step 17 to 40V dc	4,5,6	All		1500	mV pk
		Input step 40 to 17V dc	4,5,6	All		-1500	
Recovery time transient step line changes [1, 5, 12]	TT_{LINE}	Input step 17 to 40V dc	4,5,6	All		4.0	ms
		Input step 40 to 17V dc	4,5,6	All		4.0	
Turn on overshoot [9]	$VTon_{OS}$	I_{OUT} = 0 and ±500mA	4,5,6	All		600	mV pk
Turn on delay [2, 9]	Ton_D	I_{OUT} = 0 and ±500mA	4,5,6	All		10	ms
Load fault recovery [12]	Tr_{LF}		4,5,6	All		10	ms

Notes to Specifications

1 Recovery time is measured from the initiation of the transient to where V_{OUT} has returned to within ±0.1 % of V_{OUT} at 50 % load.
2 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 2) while power is applied to the input.
3 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.
4 Total power at both outputs. For operation at 16Vdc input, derate output power by 33 %.
5 Input step transition time between 2.0µs and 10µs.
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 Load step transition time between 2.0µs and 10µs.
8 Bandwidth guaranteed by design. Tested for 20KHz to 2.0MHz.
9 Tested at each output.
10 When operating with unbalanced loads, at least 25 % of the load must be on the positive output to maintain regulation.
11 Parameter guaranteed by line and load regulation tests.
12 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.

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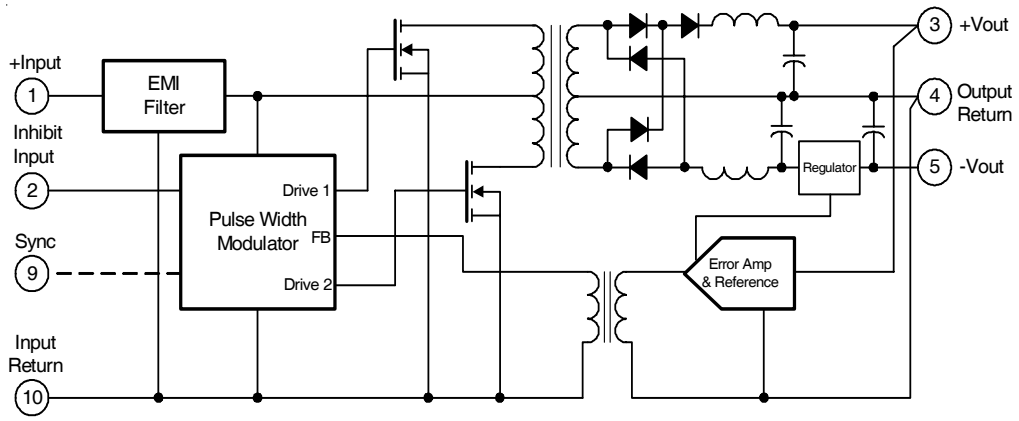
Block Diagram



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 ± 1.0VDC.

EMI Filter

An optional EMI filter (AFC461) will reduce the input ripple current to levels below the limits imposed by MIL-STD-461 CEO3.

Device Synchronization

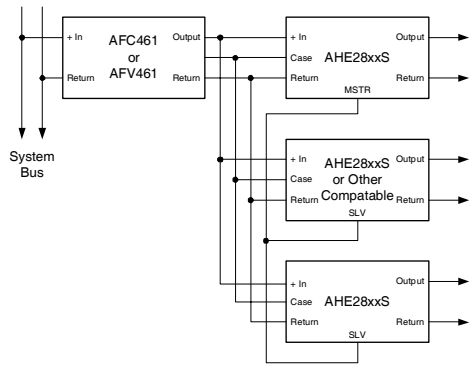
Whenever multiple DC/DC converters are utilized in a single system, significant low frequency noise may be generated due to slight difference in the switching frequencies of the converters (beat frequency noise). Because of the low frequency nature of this noise (typically less than 10KHz), it is difficult to filter out and may interfere with proper operation of sensitive systems (communications, radar or telemetry). International Rectifier offers an option that provides synchronization of multiple AHE/ATW 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, a 'MSTR' suffix is added for the master converter part number and a 'SLV' suffix is added for slave part number.

Typical Synchronization Connection



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Device Screening

Requirement	MIL-STD-883 Method	No Suffix	ES ②	HB	CH
Temperature Range	—	-20°C to +85°C	-55°C to +125°C ③	-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	160 hrs@125°C	160 hrs@125°C
Final Electrical (Group A)	MIL-PRF-38534 & Specification	25°C	25°C ②	-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

AHE 28 15 D F /CH - MSTR

- **Model** — AHE
- **Input Voltage Nominal** — 28 = 28V
- **Output Voltage** — 05 = ±5V; 12 = ±12V; 15 = ±15V
- **Output** — D = Dual
- **Package Option** — F = Flange; Blank = Non-Flanged
- **Screening Level** (Please refer to Screening Table) — No Suffix, ES, HB, CH
- **Sync Option** — MSTR = Master; SLV = Slave; Omit for Standard

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