AHV28XX SERIES

HYBRID-HIGH RELIABILITY DC-DC CONVERTER

28V Input, Single, Dual and Triple Output

AHV

Description

The AHV Series of DC-DC converters are designed to replace the AHE/ATO family of converters in applications requiring compliance to MIL-STD-704A through E, in particular the input surge requirement of 80V specified to withstand transient input voltage of 80V. No input voltage or output power derating is necessary over the full military temperature range.

These converters are packaged in an extremely rugged, low profile package that meets all requirements of MILSTD-883 and MIL-PRF-38534. Parallel seam weld sealing and the use of ceramic pin feed thru seals assure long term hermeticity after exposure to extended temperature cycling.

The basic circuit is a push-pull forward topology using power MOSFET switches. The nominal switching frequency is 500kHz. A unique current injection circuit assures current balancing in the power switches. All AHV series converters use a single stage LC input filter to attenuate input ripple current. A low power 11.5V series regulator provides power to an epitaxial CMOS custom pulse width modulator integrated circuit. This single integrated circuit provides all PWM primary circuit functions. Power is transferred from primary to secondary through a ferrite core power transformer. An error voltage signal is generated by comparing a highly stable reference voltage with the converter output voltage and drives the PWM through a unique wideband magnetic feedback circuit. This proprietary feedback circuit provides an extremely wide bandwidth, high gain control loop, with high phase margin. The feedback control loop gain is insensitive to temperature, radiation, aging, and variations in manufacturing. The transfer function of the feedback circuit is a function of the feedback transformer turns ratio which cannot change when subjected to environmental extremes.

Manufactured in a facility fully qualified to MIL-PRF-38534, these converters are fabricated utilizing DLA 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 San Jose for special requirements.

Features

- 80V Transient Input (100 msec max.)
- 50VDC Input (Continous)
- 16V to 40VDC Input Range
- Single, Dual and Triple Outputs
- 15W Output Power
  (No Temperature Derating)
- Low Input / Output Noise
- Full Military Temperature Range
- Wideband PWM Control Loop
- Magnetic Feedback
- Low Profile Hermetic Package (0.405”)
- Short Circuit and Overload Protection
- Constant Switching Frequency (500kHz)
- True Hermetic Package (Parallel Seam
  Welded, Ceramic Pin Feedthru)
- Standard Microcircuit Drawings Available

Specifications (Single Output Models)

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

Absolute Maximum Ratings	
Input voltage	-0.5V to +50VDC (Continous), 80V (100 msec)
Power output	Internally limited, 17.5W typical
Soldering temperature	300°C for 10 seconds (1 pin at a time)
Operating case temperature	-55°C to +125°C
Storage case temperature	-65°C to +135°C

TEST	SYMBOL	Condition -55°C ≤ T_C ≤ +125°C, V_{IN} = 28 V_{DC} ±5%, C_L=0, unless otherwise specified	Group A Subgroups	AHV2805S Min	AHV2805S Max	AHV2812S Min	AHV2812S Max	AHV2815S Min	AHV2815S Max	Units
STATIC CHARACTERISTICS										
OUTPUT Voltage	V_{OUT}	V_{IN} = 16, 28, and 40 VDC	1	4.95	5.05	11.88	12.12	14.85	15.15	V
		I_{OUT} = 0	2,3	4.90	5.10	11.76	12.24	14.70	15.30	V
Current	I_{OUT}	V_{IN} = 16, 28, and 40 VDC	1,2,3	0.0	3.00	0.0	1.25	0.0	1.00	A
Ripple Voltage[1]	V_{RIP}	V_{IN} = 16, 28, and 40 VDC BW = DC to 1 MHz	1,2,3		60		60		60	mVp-p
Power	P_{OUT}	V_{IN} = 16, 28, and 40 VDC	1,2,3	15		15		15		W
REGULATION Line	VRLINE	V_{IN} = 16, 28, and 40 VDC I_{OUT} = 0, half load and full load	1	-5.0	5.0	-30	30	-35	35	mV
			2,3	-25	25	-60	60	-75	75	mV
Load	VRLOAD	V_{IN} = 16, 28, and 40 VDC I_{OUT} = 0, half load and full load	1,2,3	-50	50	-120	120	-150	150	mV
INPUT Current	I_{IN}	I_{OUT} = 0, Inhibit (pin 2) = 0	1,2,3		18		18		18	mA
		I_{OUT} = 0, Inhibit (pin 2) = Open			50		50		50	mA
Ripple Current	I_{RIP}	I_{OUT} = Full load	1,2,3,		50		50		50	mAp-p
EFFICIENCY	E_{FF}	I_{OUT} = Full Load T_C = +25°C	1	72		72		72		%
ISOLATION	ISO	Input to output or any pin to case (except pin 8) at 500 VDC, T_C = +25°C	1	100		100		100		MΩ
Capacitive Load [2,3]	C_L	No effect on DC performance T_C = +25°C	4		500		200		200	µF
Load Fault Power Dissipation	P_D	Overload, T_C = +25°C[4]	1		10		10		10	W
		Short Circuit, T_C = +25°C			10		10		10	W
Switching Frequency	F_S	I_{OUT} = Full Load	4	450	550	450	550	450	550	KHz
DYNAMIC CHARACTERISTICS Step Load Changes										
Output Transient[5]	VOT_{LOAD}	50% Load From/To 100% Load	4	-300	+300	-300	+300	-300	+300	mVpk
		No Load From/To 50%	4	-500	+500	-750	+750	-750	+750	mVpk
Recovery[5,6]	TT_{LOAD}	50% Load From/To 100%	4		70		70		70	µs
		No Load From/To 50% Load	4		200		1500		1500	µs
		50% Load From/To No lLoad	4		5.0		5.0		5.0	ms
Step Line Changes Output Transient	VOT_{LINE}	Input step 16 to 40 VDC [3,7]	4		300		500		500	mVpk
		Input step 40 to 16 VDC [3,7]	4		-1000		-1500		-1500	mVpk
Recovery	TT_{LINE}	Input step 16 to 40 VDC [3,6,7]	4		800		800		800	µs
		Input step 40 to 16 VDC [3,6,7]	4		800		800		800	µs
TURN-ON Overshoot	$VTon_{os}$	I_{OUT} = 0A and Full Load	4,5,6		550		750		750	mVpk
Delay	T on D	I_{OUT} = 0A and Full Load [8]	4,5,6		10		10		10	ms
Load Fault Recovery	TR_{LF}	V_{IN} = 16 to 40 VDC	4,5,6		10		10		10	ms

Notes: To Specifications (Single Output Models)

1. Bandwidth guaranteed by design. Tested for 20KHz to 2MHz.
2. Capacitive load may be any value from 0 to the maximum limit without affecting dc performance. A capacitive load in excess of the maximum limit will not disturb loop stability but will interfere with the operation of the load fault detection circuitry, appearing as a short circuit during turn-on.
3. Parameter shall be tested as part of design characterization and after design or process changes. Thereafter shall be guaranteed to the limits specified.
4. An overload is that condition with a load in excess of the rated load but less than necessary to trigger the short circuit protection and is the condition of maximum power dissipation.
5. Load step transition time between 2µs to 10 µs.
6. 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.
7. Input step transition time between 2µs and 10µs.
8. Turn on delay time measurement is for either a step application of power at input or the removal of a ground signal from the inhibit pin (pin 2) while power is applied to the input. Above 125°C case temperature, derate output power linearly to 0 at 135°C case.

Specifications (Dual Output Models)

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

Absolute Maximum Ratings	
Input voltage	-0.5V to +50VDC (Continous), 80V (100 msec)
Power output	Internally limited, 17.5W typical
Soldering temperature	300°C for 10 seconds (1 pin at a time)
Operating case temperature	-55°C to +125°C
Storage case temperature	-65°C to +135°C

TEST	**SYMBOL**	**Condition** **-55°C ≤ T_C ≤ +125°C,** **V_{IN} = 28 V_{DC} ±5%, C_L=0,** **unless otherwise specified**	**Group A Subgroups**	**AHV2805D**		**AHV2812D**		**AHV2815D**		
				Min	**Max**	**Min**	**Max**	**Min**	**Max**	**Units**
STATIC CHARACTERISTICS OUTPUT										
Voltage [1]	V_{OUT}	I_{OUT} = 0	1 2,3	±4.95 ±4.90	±5.05 ±5.10	±11.88 ±11.76	±12.12 ±12.24	±14.85 ±14.70	±15.15 ±15.30	V V
Current [1,2]	I_{OUT}	V_{IN} = 16, 28, and 40 VDC	1,2,3	0.0	±1500	0.0	±625	0.0	±500	mA
Ripple Voltage [1,3]	V_{RIP}	V_{IN} = 16, 28, and 40 VDC BW = DC to 2 MHz	1,2,3		60		60		60	mVp-p
Power [1,2,4]	P_{OUT}	V_{IN} = 16, 28, and 40 VDC	1,2,3	15		15		15		W
REGULATION Line [1,5] Load [1]	VR_{LINE} I_{OUT} VR_{LOAD}	V_{IN} = 16, 28, and 40 VDC I_{OUT} = 0, half load and full load V_{IN} = 16, 28, and 40 VDC I_{OUT} = 0, half load and full load	1 2,3 1,2,3	-30 -60 -120	30 60 120	-30 -60 -120	30 60 120	-35 -75 -150	35 75 150	mV
INPUT Current	I_{IN}	I_{OUT} = 0, Inhibit (pin 2) Tied to input return (pin 10) I_{OUT} = 0, Inhibit (pin 2) = Open	1,2,3		18 65		18 65		18 65	mA mA
Ripple Current [3]	I_{RIP}	I_{OUT} = Full load BW = DC to 2MHz	1,2,3,		50		50		50	mAp-p
EFFICIENCY	E_{FF}	I_{OUT} = Full Load T_C = +25°C	1	72		72		72		%
ISOLATION	ISO	Input to output or any pin to case (except pin 8) at 500 VDC, T_C = +25°C	1	100		100		100		MΩ
Capacitive Load [6,7]	C_L	No effect on DC performance T_C = +25°C	4		200		200		200	µF
Load Fault Power Dissipation	P_D	Overload, T_C = +25°C [8] Short Circuit, T_C = +25°C	1		10 10		10 10		10 10	W
Switching Frequency	F_S	I_{OUT} = Full Load	4	450	550	450	550	450	550	kHz
DYNAMIC CHARACTERISTICS Step Load Changes Output Transient [9]	VOT_{LOAD}	50% Load From/To 100% Load No Load From/To 50%	4 4	-300 -500	+300 +500	-300 -500	+300 +500	-300 -500	+300 +500	mVpk mVpk
Recovery [9,10]	TT_{LOAD}	50% Load From/To 100% No Load From/To 50% Load 50% Load From/To No lLoad	4 4 4		70 1000 5.0		70 1500 5.0		70 1500 5.0	µs µs ms
Step Line Changes Output Transient [7,11]	VOT_{LINE}	Input step 16 to 40 VDC Input step 40 to 16 VDC	4 4		300 1000		1200 -1500		1500 -1500	mVpk mVpk
Recovery [7,10,11]	TT_{LINE}	Input step 16 to 40 VDC Input step 40 to 16 VDC	4 4		4800 4800		4.0 4.0		4.0 4.0	µs µs
TURN-ON Overshoot [1] Delay [1,12]	$VTon_{OS}$ T on D	I_{OUT} = 0A and Full Load I_{OUT} = 0A and Full Load	4,5,6 4,5,6		750 10		600 10		600 10	mVpk ms
Load Fault Recovery [7]	TR_{LF}		4,5,6		10		10		10	ms

For Notes to Specifications, refer to page 5

Specifications (Triple Output Models)

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

Absolute Maximum Ratings	
Input voltage	-0.5V to +50VDC (Continous), 80V (100 msec)
Power output	Internally limited, 17.5W typical
Soldering temperature	300°C for 10 seconds (1 pin at a time)
Operating case temperature	-55°C to +125°C
Storage case temperature	-65°C to +135°C

TEST	SYMBOL	Condition -55°C ≤ T_C ≤ +125°C, V_{IN} = 28 V_{DC} ±5%, C_L=0, unless otherwise specified	Group A Subgroups	AHV2812T		AHV2815T		
				Min	Max	Min	Max	Units
STATIC CHARACTERISTICS OUTPUT								
Voltage [1]	V_{OUT}	I_{OUT} = 0 (main)	1	4.95	5.05	4.95	5.05	V
			2,3	4.90	5.10	4.90	5.10	V
		I_{OUT} = 0 (dual)[1]	1	±11.88	±12.12	±14.85	±15.15	V
			2,3	±11.76	±12.24	±14.70	±15.30	V
Current [1,2,3]	I_{OUT}	V_{IN} = 16, 28, and 40 VDC (main)	1,2,3	100	2000	100	2000	mA
		V_{IN} = 16, 28, and 40 VDC (dual)[1]	1,2,3	0.0	±208	0.0	±167	mA
Ripple Voltage [1,4]	V_{RIP}	V_{IN} = 16, 28, and 40 VDC BW = DC to 2 MHz (main)	1,2,3		80		80	mVp-p
		V_{IN} = 16, 28, and 40 VDC BW = DC to 2 MHz (main)	1,2,3		40		40	MVp-p
Power [1,2,3]	P_{OUT}	V_{IN} = 16, 28, and 40 VDC (main)	1,2,3	10		10		W
		(+dual)	1,2,3	2.5		2.5		W
		(-dual)	1,2,3	2.5		2.5		W
		(total)	1,2,3	15		15		W
REGULATION								
Line [1,3]	VR_{LINE}	V_{IN} = 16, 28, and 40 VDC						
		I_{OUT} = 5%, 50%, and 100% load (main)	1,2,3	- 25	25	- 25	25	mV
		I_{OUT} = 0, 50%, and 100% load (dual)	1	-30	30	-35	35	mV
			2,3	-60	60	-75	75	mV
Load [1,3]	VR_{LOAD}	V_{IN} = 16, 28, and 40 VDC						
		I_{OUT} = 5%, 50%, and 100% load (main)	1,2,3	-50	50	-50	50	mV
		I_{OUT} = 0, 50%, and 100% load (dual)	1,2,3	-60	60	-75	75	mV
INPUT								
Current	I_{IN}	I_{OUT} = 0, Inhibit (pin 8) Tied to input return (pin 10)	1,2,3		15		15	mA
		I_{OUT} = 0 Inhibit (pin 2) = open	1,2,3		50		50	mA
Ripple Current [4]	I_{RIP}	I_{OUT} = 2000 mA (main) I_{OUT} = ±208mA (±12V) I_{OUT} = ±167mA (±15V) BW = DC to 2MHz	1,2,3		50		50	mAp-p
EFFICIENCY	E_{FF}	I_{OUT} = 2000mA (main) I_{OUT} = ±208mA (±12V) I_{OUT} = ±167mA (±15V)	1	72		72		%
ISOLATION	ISO	Input to output or any pin to case (except pin 7) at 500 VDC, T_C = +25°C	1	100		100		MΩ
Capacitive Load [6,7]	C_L	No effect on DC performance T_C = +25°C (main)	4		500		500	mF
		(dual)			200		200	
Load Fault Power Dissipation [3]	P_D	Overload, T_C = +25°C[5]	1		10		10	W
		Short Circuit, T_C = +25°C	1		10		10	
Switching Frequency [1]	F_S	I_{OUT} = 2000mA (main) I_{OUT} = ±208mA (±12V) I_{OUT} = ±167mA (±15V)	4	450	550	450	550	KHz

For Notes to Specifications, refer to page 5

Specifications (Triple Output Models) - continued

TEST	SYMBOL	Condition $-55°C \le T_C \le +125°C$, V_{IN} = 28 V_{DC} ±5%, C_L=0, unless otherwise specified	Group A Subgroups	AHV2812T		AHV2815T		
				Min	Max	Min	Max	Units
DYNAMIC CHARACTERISTICS Step Load Changes Output Transient [9]	VOT_{LOAD}	50% Load To/From100% Load Min To/From 50% Load	4 4	-300 -400	+300 +400	-300 -400	+300 +400	mVpk mVpk
Recovery [9,10]	TT_{LOAD}	50% Load To/From 100% Min to 50% Load 50% Load to Min Load	4 4 4		100 2000 5.0		100 2000 5.0	µs µs ms
Step Line Changes Output Transient	VOT_{LINE}	Input step 16 to/from 40 VDC I_{OUT} = 100% Load	4 4	-1500 -1500	1500 1500	-1500 -1500	1500 1500	mVpk mVpk
Recovery [7,10, 11]	TT_{LINE}	Input step 16 to/from 40 VDC I_{OUT} = 100% Load	4 4		5.0 5.0		5.0 5.0	ms ms
TURN-ON Overshoot [1]	$VTon_{OS}$	I_{OUT} = 100 and 2000mA(main)	4		750		750	mVpk
Delay [1,12]	T on D	I_{OUT} = 0 and 100% Load (dual)	4		15		15	ms
Load Fault Recovery [7]	TR_{LF}		4		15		15	ms

Notes to Specifications (Triple Output Models)

1. Tested at each output.
2. Parameter guaranteed by line and load regulation tests.
3. At least 25% of the total power should be taken from the (+5V) main output.
4. Bandwidth guaranteed by design. Tested for 20kHz to 2MHz.
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. Capacitive load may be any value from 0 to the maximum limit without affecting 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.
8. Above 125°C case temperature, derate output power linearly to 0 at 135°C case.
9. Load step transition time between 2µs and 10µs.
10. 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.
11. Input step transition time between 2µs and 10µs.
12. Turn on delay time measurement is for either a step application of power at input or the removal of a ground signal from the inhibit pin (pin 8) while power is applied to the input.

Notes to Specifications (Dual Output Models)

1. Tested at each output.
2. Parameter guaranteed by line and load regulation tests.
3. Bandwidth guaranteed by design. Tested for 20kHz to 2MHz.
4. Total power at both outputs.
5. When operating with unbalanced loads, at least 25% of the load must be on the positive output to maintain regulation.
6. Capacitive load may be any value from 0 to the maximum limit without affecting 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.
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 2µs and 10µs.
10. 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.
11. Input step transition time between 2µs and 10µs.
12. Turn on delay time measurement is for either a step application of power at input or the removal of a ground signal from the inhibit pin (pin 8) while power is applied to the input.
13. Above 125°C case temperature, derate output power linearly to 0 at 135°C.

Application Information

Inhibit Function

Connecting the inhibit pin (Pin 2 of single and dual models, pin 8 of triple models) to the input return (pin 10) will cause the converter to shutdown and operate in a low power standby mode. Power consumption in this mode is calculated by multiplying Vin times the input current inhibited, typically 225mW at Vin equal to 28V. The input current inhibited is relatively constant with changes in Vin. The open circuit inhibit pin voltage is typically 11.5V and can be conveniently driven by an open collector driver. An internal pull-up resistor enables the user to leave this pin floating if the inhibit function is not used in their particular application. All models use identical inhibit internal circuits. Forcing inhibit pin to any voltage between 0V and 6V will assure the converter is inhibited. The input current to this pin is 500µA maximum at Vpin2 = to 0V. The converter can be turned on by opening Pin 2 or forcing a voltage from 10V to 50V. Inhibit pin current from 10V to 50V is less than ± 50µA.

EMI Filter

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

The output voltage of the AHV28XXS can be adjusted upward by connecting a resistor between the Output Adjust (Pin 3) and the Output Common (Pin 4) as shown in Table 1.

Table 1: Output Adjustment Resistor Values

* Resistance (Ohms) Pin 3 to 4	Output Voltage Increase (%)		
	5V	12V	15V
None	0	0	0
390 K	+1.0%	+1.6%	+1.7%
145 K	+2.0%	+3.2%	+3.4%
63 K	+3.1%	+4.9%	+5.1%
22 K	+4.1%	+6.5%	+6.8%
0	+5.0%	+7.9%	+8.3%

* Output Adjust (Single Output Models Only)

Standard Microcircuit Drawing Equivalence Table

Standard Microcircuit Drawing Number	Vendor Cage Code	IR Standard Part Number
5962-91773	52467	AHV2805S
5962-92112	52467	AHV2812S
5962-92113	52467	AHV2815S
5962-92114	52467	AHV2812D
5962-92115	52467	AHV2812T
5962-92116	52467	AHV2815T

Figure 1. (Single Output) Block Diagram

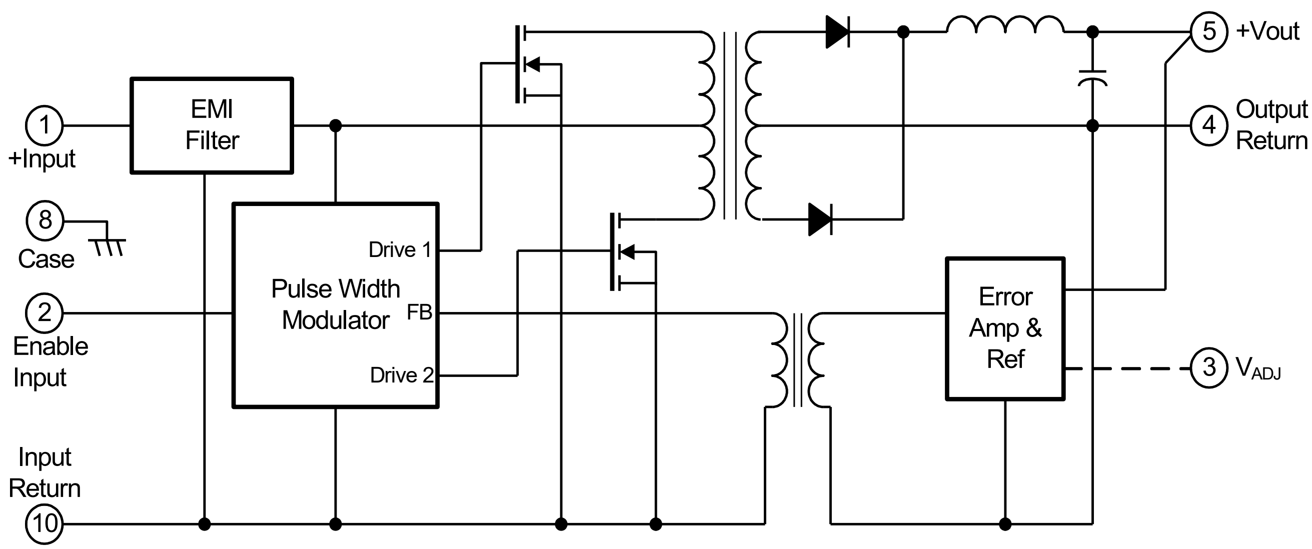


Figure 2. (Dual Output) Block Diagram

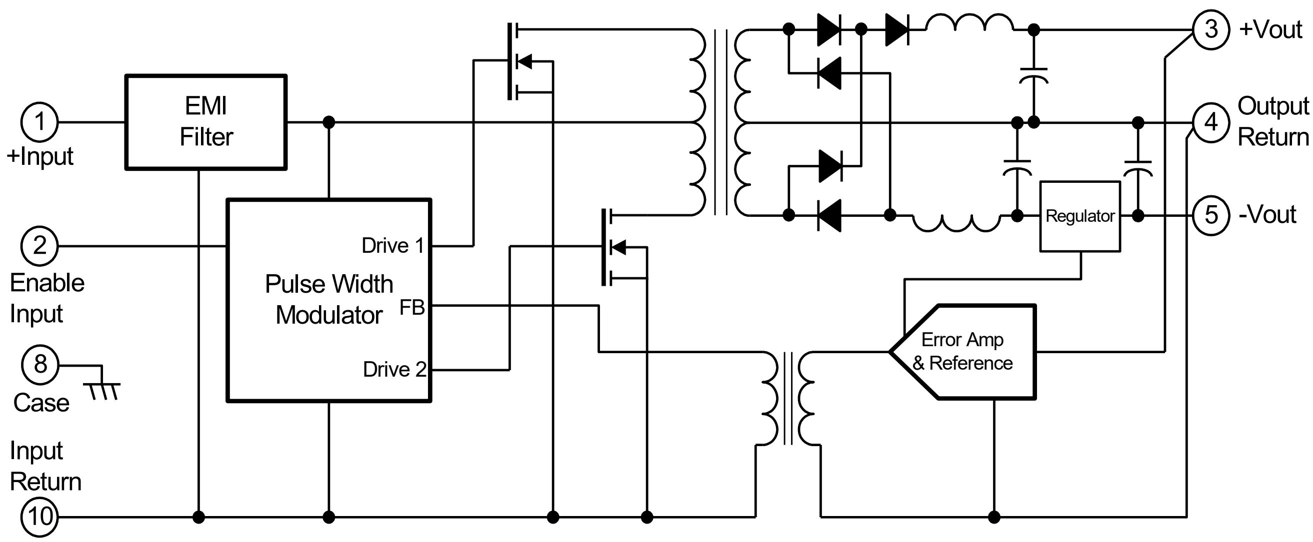
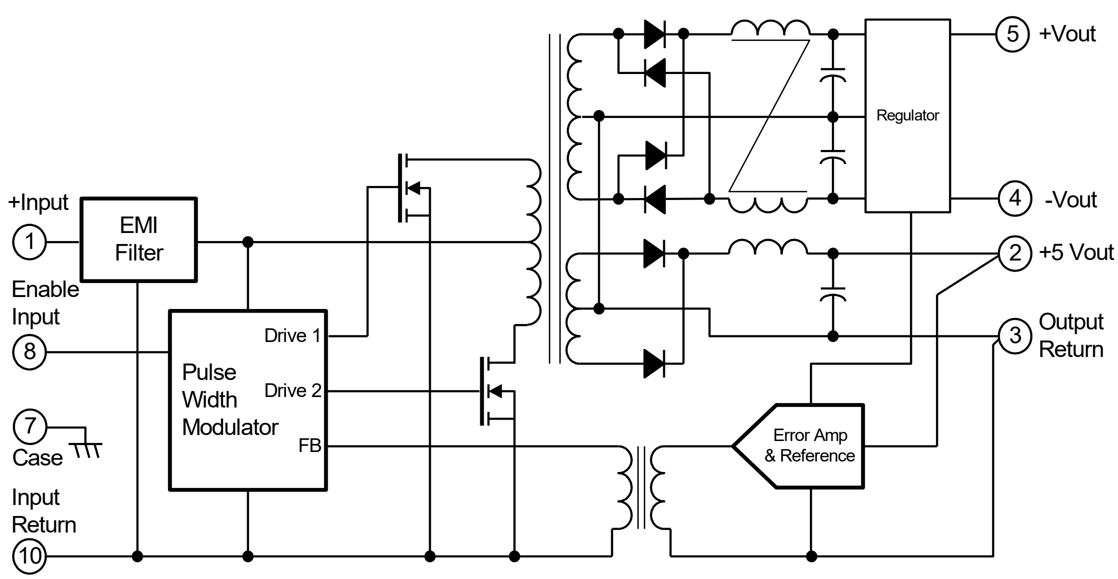
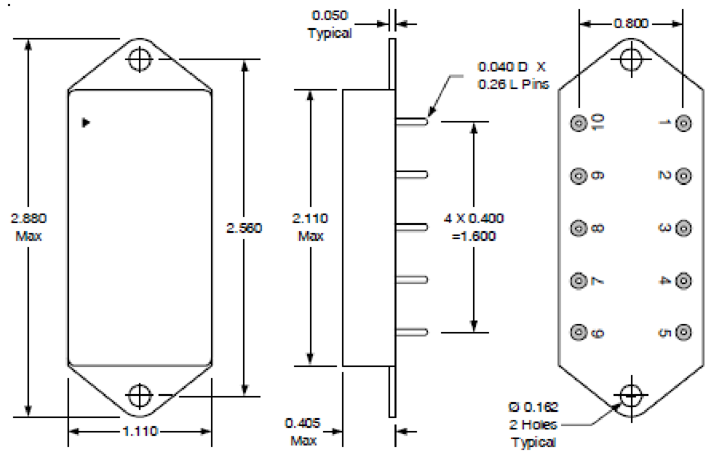


Figure 3. (Triple Output) Block Diagram

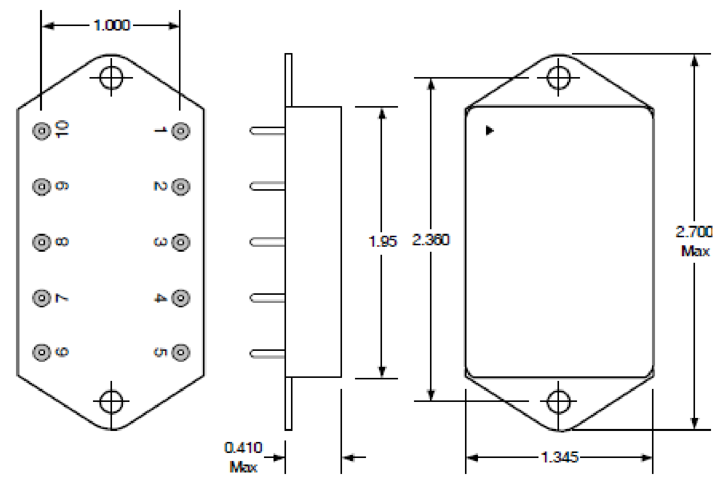


Mechanical Outline

Single and Dual Output Model



Triple Output Model



Notes 1: Unless otherwise specified, dimensional tolerance is : .XXX ±0.005”

Pin Designation

Pin #	Single Output	Dual Output	Triple Output
1	+ Input	+ Input	+ Input
2	Enable Input	Enable Input	+5VDC Output
3	Output Adjust*	+ Output	Output Return
4	Output Return	Output Return	- Dual Output (12/15VDC)
5	+ Output	- Output	+ Dual Output (12/15VDC)
6	NC	NC	NC
7	NC	NC	Case Ground
8	Case Ground	Case Ground	Enable Input
9	NC	NC	NC
10	Input Return	Input Return	Input Return

* Output Adjust (Single Output Models Only)

Device Screening

Requirement	MIL-STD-883 Method	Np Suffix	ES②	HB	CH
Temperature Range	—	-20°C to +85°C	-55°C to +125°C	-55°C to +125°C	-55°C to +125°C
Element Evaluation	MIL-PRF-38534	N/A	N/A	N/A	Class H
Nondestructive Bond Pull	2023	N/A	N/A	N/A	Yes
Internal Visual	2017	①	Yes	Yes	Yes
Temperature Cycling	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	Cond 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 and 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

AHV 28 15 T F /CH

Model — AHV

Input Voltage Nominal — 28
28 = 28V

Output Voltage — 15
Single – 05 = 5V, 12 =12V, 15 =15V
Dual – 05 = ±5V,12 = ±12V, 15 = ±15V
Triple – 12 = 5V, ±12V
15 = 5V, ±15V

Output — T
S = Single
D = Dual
T = Triple

Package Style — F
F = Flange

Screening Level — /CH
(Please refer to Screening Table)
No Suffix, ES, HB, CH

IOR HiRel
An Infineon Technologies Company
www.infineon.com/irhirel

Infineon Technologies Service Center: USA Tel: +1 (866) 951-9519 and International Tel: +49 89 234 65555
Leominster, Massachusetts 01453, USA Tel: +1 (978) 534-5776
San Jose, California 95134, USA Tel: +1 (408) 434-5000
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