International
IOR Rectifier

ATW28XXD SERIES

28V Input, Dual Output

HYBRID-HIGH RELIABILITY DC/DC CONVERTERS

ATW

Description

The ATW28XXD 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-704 input requirements, these devices operate with a nominal 28VDC inputs with ±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 270KHz. 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 elements in the 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

- 18V to 40VDC Input Range (28VDC Nominal)
- ±12V and ±15V Outputs Available
- Indefinite Short Circuit and Overload Protection
- 22.8W/in^3 Power Density
- 30W 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 85%
- Shutdown from External Signal
- Full Military Screening
- 200,000 hour MTBF at 85°C
- Standard Microcircuit Drawings Available

Specifications

ATW2812D

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 $-55°C \le Tc \le +125°C$ Vin = 28 Vdc ±5%, C_L = 0 Unless otherwise specified	Group A Subgroups	Device Types	Limits Min	Limits Max	Unit
Output voltage	V_{OUT}	I_{OUT} = 0	1	All	±11.88	±12.12	V
			2,3		±11.76	±12.24	
Output current [1, 2]	I_{OUT}	V_{IN} = 18, 28, and 40 V dc, each output	1,2,3	All	250	2250	mA
Output ripple voltage [3]	V_{RIP}	V_{IN} = 18, 28, and 40 V dc, B.W. = 20Hz to 2MHz	1,2,3	All		85	mVp-p
Line regulation [4]	VR_{LINE}	V_{IN} = 18, 28, and 40 V dc, Iout = 0,1250, and 2500mA	1	All		30	mV
			2,3			60	
Load regulation [4]	VR_{LOAD}	V_{IN} = 18, 28, and 40 V dc, I_{OUT} = 0, 1250, and 2500mA	1,2,3	All		120	mV
Cross regulation [5]	VR_{CROSS}	10% to 90% load change	1,2,3	All		3.5	%
Input current	I_{IN}	I_{OUT} = 0, inhibit (pin 8) tied to input return (pin 10)	1,2,3	All		18	mA
		I_{OUT} = 0,inhibit (pin 8)= open				50	
Input ripple current [3, 4]	I_{RIP}	I_{OUT} = 2500mA B.W. = 20Hz to 2MHz	1,2,3	All		50	mAp-p
Efficiency [4]	E_{FF}	I_{OUT} = 2500mA T_C = +25°C	1	All	80		%
Isolation	ISO	Input to output or any pin to case (except pin 7) at 500 V dc Tc = +25°C	1	All	100		MΩ
Capacitive load [6, 7]	C_L	No effect on dc performance, Tc = +25°C, total for both outputs	4	All		200	µF
Power dissipation load fault	P_D	Overload, T_C = +25°C [8]	1	All		12	W
		Short circuit, T_C = +25°C				9.0	
Switching frequency [4]	F_S	I_{OUT} = 2500mA	4,5,6	01	250	300	KHz
				02	250	270	
				03	275	300	
Output response to step transient load changes [4, 9]	VO_{TLOAD}	1250mA to/from 2500mA	4,5,6	All	-400	+400	mV pk
		0mA to/from 2500mA	4,5,6	All	-800	+800	
Recovery time step transient load changes [4, 9, 10]	TT_{LOAD}	1250mA to/from 2500mA	4,5,6	All		70	µs
		0mA to/from 1250mA	4,5,6	All		500	
		1250mA to/from 0mA	4,5,6	All		5.0	ms

For Notes to Specifications, refer to page 3

Table I. Electrical Performance Characteristics - continued

ATW2812D

Test	Symbol	Conditions $-55°C \leq Tc \leq +125°C$ Vin = 28 Vdc ±5%, $C_L = 0$ unless otherwise specified	Group A Subgroups	Device Types	Limits		Unit
					Min	Max	
Output response transient step line changes [4, 7, 11]	VO_{TLINE}	Input step from/to 18 to 40 Vdc, I_{OUT} = 2500mA	4,5,6	All	-800	+800	mV pk
Recovery time transient step line change [4, 7, 10, 11]	TT_{LINE}	Input step from/to 18 to 40 Vdc, I_{OUT} = 2500mA	4,5,6	All		4000	µs
Turn on overshoot [4]	$VTon_{OS}$	I_{OUT} = 0 and 2500mA	4,5,6	All		750	mV pk
Turn on delay [4, 12]	Ton_D	I_{OUT} = 0 and 2500mA	4,5,6	All		14	ms
Load fault recovery [7]	Tr_{LF}		4,5,6	All		14	ms
Weight		Flange				75	g

Notes to Specifications

1 Parameter guaranteed by line, load and cross regulation tests.
2 Up to 90% of full power is available from either output provided the total output does not exceed 30W.
3 Bandwidth guaranteed by design. Tested for 20KHz to 2MHz.
4 Load current split equally between $+V_{OUT}$ and $-V_{OUT}$.
5 Three-watt load on output under test, 3.0W to 27W 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 I.
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 2.0µs and 10µs.
10 Recovery time is measured from the initiation of the transient to where V_{OUT} has returned to within ±1.0% of V_{OUT} at 50%load.
11 Input step transition time between 2.0µs and 10µs.
12 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 8) while power is applied to the input.

Specifications

ATW2815D

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}	V_{IN} = 18, 28, and 40 Vdc	1	All	±14.85	±15.15	V_{DC}
		I_{OUT} = 0	2,3	All	±14.70	±15.30	V_{DC}
Output current [11, 13]	I_{OUT}	V_{IN} = 18, 28, and 40 V dc	1,2,3	All	0.200	2000	mA_{DC}
Output ripple voltage [8]	V_{RIP}	V_{IN} = 18, 28, and 40 V dc, B.W. = DC to MHz	1,2,3	All		85	mVp-p
Output Power [4, 11]	P_{OUT}	V_{IN} = 18, 28, 40 Vdc	1,2,3	All	30		W
Line regulation [9, 10]	VR_{LINE}	V_{IN} = 18, 28, and 40 V dc, Iout = 0, 1000, and 2000mA	1	All		35	mV
			2,3	All		75	mV
Load regulation [9, 10]	VR_{LOAD}	V_{IN} = 18, 28, and 40 V dc, I_{OUT} = 0, 1000, and 2000mA	1,2,3	All		150	mV
Input current	I_{IN}	I_{OUT} = 0, inhibit (pin 8)	1,2,3	All		12	mADC
		I_{OUT} = 0, inhibit (pin 8) = open	1,2,3	All		30	mADC
Input ripple current	I_{RIP}	I_{OUT} = 2000mA	1,2,3	All		60	mAp-p
Efficiency	E_{FF}	I_{OUT} = 2500mA 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		500	µF
Power dissipation load fault	P_D	Overload, T_C = +25°C [3]	1	All		9.0	W
		Short circuit, T_C = +25°C	1	All		9.0	W
Switching frequency	F_S	I_{OUT} = 2000mA	1,2,3	01	237	263	KHz
			1,2,3	02	230	245	KHz
			1,2,3	03	250	265	KHz
Output response to step transient load changes [7, 9, 10]	VO_{TLOAD}	50% load to/from 100% load	4,5,6	All	-300	+300	mV pk
		No load to 100% load	4,5,6	All	-800	-800	mV pk
		100% load to no load	4,5,6	All	+800	+800	mV pk
Recovery time step transient load changes [1, 7]	TT_{LOAD}	50% load to/from 100% load	4,5,6	All		25	µs
		No load to 50% load	4,5,6	All		500	µs
		50% load to no load	4,5,6	All		7.0	ms

For Notes to Specifications, refer to page 5

Table II. Electrical Performance Characteristics - continued

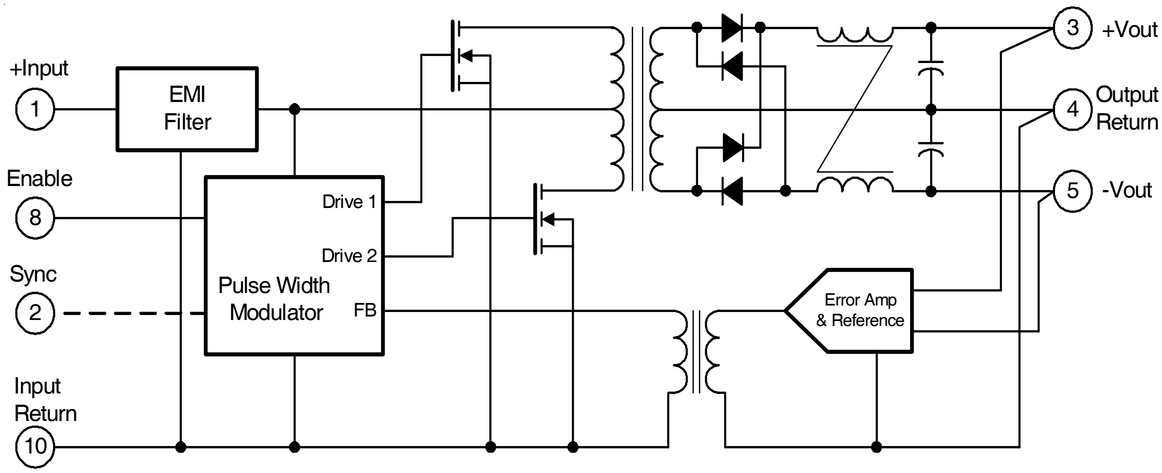
ATW2815D

Test	Symbol	Conditions $-55°C \le Tc \le +125°C$ Vin = 28 Vdc ±5%, C_L = 0 unless otherwise specified	Group A Subgroups	Device Types	Limits Min	Limits Max	Unit
Output response transient step line changes [5, 12]	VO_{TLINE}	Input step from/to 18 to 40VDC	4,5,6	All		+180	mV pk
		Input step from 40 to18 VDC	4,5,6	All		-600	mV pk
Recovery time transient step line changes [1. 5, 12]	TT_{LINE}	Input step from/to 18 to 40 VDC	4,5,6	All		400	µs
		Input step from 40 to 18 VDC	4,5,6	All		400	µs
Turn on overshoot	$VTon_{OS}$	I_{OUT} = 0 and 2000mA	4,5,6	All		750	mV pk
Turn on delay [2]	Ton_D	I_{OUT} = 0 and 2000mA	4,5,6	All		12	ms
Load fault recovery [12]	Tr_{LF}	V_{IN} = 18 to 40 VDC	4,5,6	All		12	ms
Weight		Flange				75	g

Notes to Specifications

1 Recovery time is measured from the initiation of the transient to where V_{OUT} has returned to within ±1.0% 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 8) 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 Above +125°C case, derate output power linearly to 0 at +135°C case.
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 will 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 2MHz.
9 Load current split equally between $+V_{OUT}$ and $-V_{OUT}$.
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.
13 Up to 90% of full power is available from either output provided the total output does not exceed 30W.

Block Diagram



Application Information

Inhibit Function (Enable)

Connecting the inhibit input (Pin 8) 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 external EMI filter (AFC461) is available that will reduce the input ripple current to levels below the limits imposed by MIL-STD-461B CEO3.

Device Synchronization

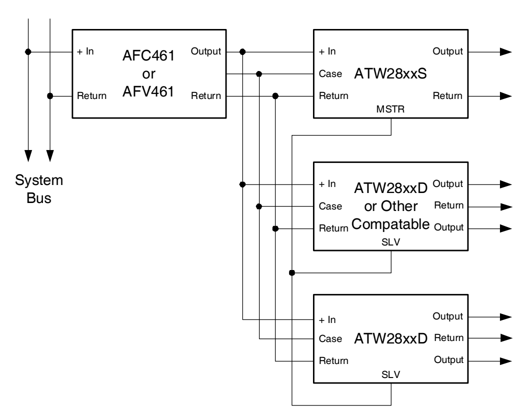
Whenever multiple DC/DC converters are utilized in a single system, significant low frequency noise may be generated due to the slight differences in the switching frequencies of the converters (beat frequency noise). Because of the low frequency nature of this noise (typically less than 10KHz), it is difficult to filter out and may interfere with proper operation of sensitive systems (communications, radar or telemetry). International Rectifie roffers an option,which allows synchronization of multiple AHE/ATW 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.

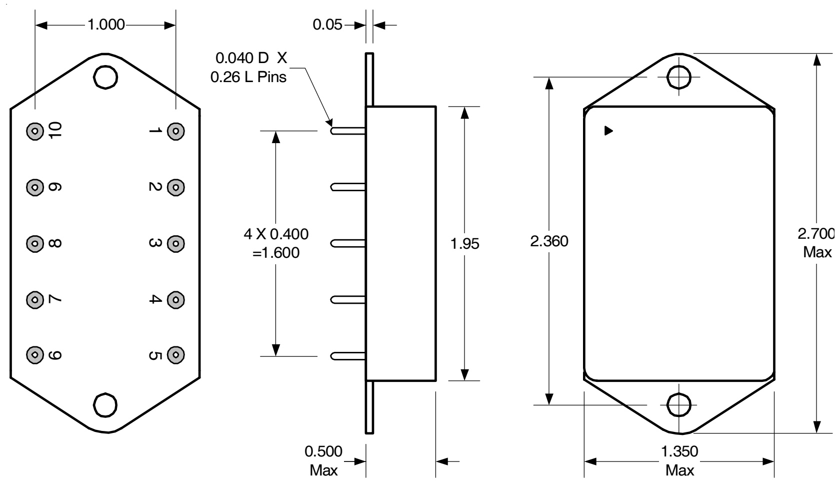
The user should be aware that the synchronization system is fail-safe; that is, the slaves will continue operating should the master frequency be interrupted for any reason. The layout must be such that the synchronization output (pin 2) of the master device is connected to the synchronization input (pin 2) 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. See Part Number section.

Typical Synchronization Connection



Mechanical Outline



Notes:

1) All dimensions are in inches

2) The tolerance for X.XXX = ±0.005

Pin Designation

Pin #	Designation
1	+ Input
2	NC Standard or Sync. (Optional)
3	+ Output
4	Output Return
5	- Output
6	NC
7	Case Ground
8	Enable
9	NC
10	Input Return

Standard Microcircuit Drawing Equivalence Table

Standard Microcircuit Drawing Number	Vendor Cage Code	IR Standard Part Number
5962-92109	52467	ATW2812D
5962-91613	52467	ATW2815D

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

ATW 28 15 D /CH - MSTR

Model

Input Voltage Nominal
28 = 28V

Output Voltage
12 = ±12V
15 = ±15V

Sync Option
MSTR = Master
SLV = Slave
Omit for Standard

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

Output
D = Dual

International Rectifier

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