

## **ATO Series** **Hybrid - High Reliability** **Triple Output** **DC/DC Converters**

### **DESCRIPTION**

The ATO2800T Series of DC/DC converters feature high power density and an extended temperature range for use in military and industrial applications. Designed to the nominal input requirements of MIL-STD-704D, these devices have nominal 28VDC inputs with +5V and  $\pm 12V$  or +5V and  $\pm 15V$  triple 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.

Three standard temperature grades are offered with screening options. Refer to Part Number section. They are provided in a standard plug-in package for PC mounting or in a flanged package for more severe environments. Variations on these parameters and special screening requirements can be accommodated for specific customer applications. Contact factory with your requirements.

### **FEATURES**

- **16 to 40 VDC input range (28VDC nominal)**
- **5V,  $\pm 12V$  or 5V,  $\pm 15V$  outputs available**
- **Indefinite short circuit and overload protection**
- **15 watts output power**
- **Fast loop response for superior transient characteristics**
- **Operating temperature range from  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  available**
- **Popular industry standard pin-out**
- **Resistance seam welded case for superior long term hermeticity**
- **Efficiencies up to 81%**
- **Shutdown from external signal**
- **250,000 hour MTBF at  $85^{\circ}\text{C}$**

# SPECIFICATIONS

T<sub>case</sub> = -55°C to +85°C, V<sub>in</sub> = +28V±5% unless otherwise specified.

## ABSOLUTE MAXIMUM RATINGS

Input Voltage	-0.5V to +50V
Power Output	Internally limited, 15W typical.
Soldering	300°C for 10 seconds
Temperature Range	Operating -55°C to +115°C case Storage -65°C to +135°C

Parameter	Conditions	ATO2812T			ATO2815T			Units
		Min	Typ	Max	Min	Typ	Max	
<b>STATIC CHARACTERISTICS</b>								
OUTPUT Voltage	V <sub>in</sub> = 16 to 40 V <sub>dc</sub>							
	I <sub>out</sub> = Min. to Full Load - Main	4.96	5.00	5.05	4.95	5.00	5.05	V <sub>dc</sub>
	+Dual	+11.88	+12.00	+12.12	+14.85	+15.00	+15.15	V <sub>dc</sub>
	-Dual	-11.88	-12.00	-12.12	-14.85	-14.85	-15.15	V <sub>dc</sub>
Current	Main	50		2000	50		2000	mA
	Dual	0		±208	0		±167	mA
Ripple	Full Load, DC to 1MHz - Main			80			80	mV p-p
	Dual			30			30	mV p-p
Power	Main	10			10			W
	+Dual	2.5			2.5			W
	-Dual	2.5			2.5			W
	Total	15			15			W
REGULATION Line	V <sub>in</sub> = 16 to 40 V <sub>dc</sub> - Main		10	25		10	25	mV
	Dual							
Load	I <sub>out</sub> = Min. to 15W - Main		20	50		20	50	mV
	Dual							
INPUT Voltage Range		16.0	28.0	40.0	16.0	28.0	40.0	V <sub>dc</sub>
	Current	No Load		30			30	mA <sub>dc</sub>
	Ripple Current	Full Load		20	50		20	50
EFFICIENCY	T <sub>case</sub> = +25°C V <sub>in</sub> = 16 to 40V <sub>dc</sub> Half Load to Full Load	76	79		76	79		%
ISOLATION	Input to Output @ 500V <sub>dc</sub>	100			100			mΩ
WEIGHT	Standard Package			72			72	Grams
	Flange Package			75			75	Grams

# SPECIFICATIONS

T<sub>CASE</sub> = -55°C to +85°C, V<sub>IN</sub> = +28V±5% unless otherwise specified.

## ABSOLUTE MAXIMUM RATINGS

Input Voltage	-0.5V to +50V
Power Output	Internally limited, 15W typical.
Soldering	300°C for 10 seconds
Temperature Range	Operating -55°C to +125°C case Storage -65°C to +135°C

Parameter	Conditions	ATO2812T/ES			ATO2815T/ES			Units
		Min	Typ	Max	Min	Typ	Max	
<b>STATIC CHARACTERISTICS</b>								
<b>OUTPUT</b>								
Voltage	V <sub>IN</sub> = 16 to 40 Vdc I <sub>OUT</sub> = Min. to Full Load - Main	4.96	5.00	5.05	4.95	5.00	5.05	Vdc
	+Dual	+11.88	+12.00	+12.12	+14.85	+15.00	+15.15	Vdc
	-Dual	-11.88	-12.00	-12.12	-14.85	-14.85	-15.15	Vdc
Current	Main	50		2000	50		2000	mA
	Dual	0		±208	0		±167	mA
Ripple	Full Load, DC to 1MHz - Main			80			80	mV p-p
	Dual			30			30	mV p-p
Power	Main	10			10			W
	+Dual	2.5			2.5			W
	-Dual	2.5			2.5			W
	Total	15			15			W
<b>REGULATION</b>								
Line	V <sub>IN</sub> = 16 to 40 Vdc - Main		10	25		10	25	mV
	Dual							
Load	I <sub>OUT</sub> = Min. to 15W - Main		20	50		20	50	mV
	Dual							
<b>INPUT</b>								
Voltage Range		16.0	28.0	40.0	16.0	28.0	40.0	Vdc
Current	No Load			30			30	mAdc
Ripple Current	Full Load		20	50		20	50	mA p-p
<b>EFFICIENCY</b>								
	T <sub>CASE</sub> = +25°C V <sub>IN</sub> = 16 to 40Vdc Half Load to Full Load	76	79		76	79		%
<b>ISOLATION</b>								
	Input to Output @ 500Vdc	100			100			mΩ
<b>WEIGHT</b>								
	Standard Package			72			72	Grams
	Flange Package			75			75	Grams

# SPECIFICATIONS

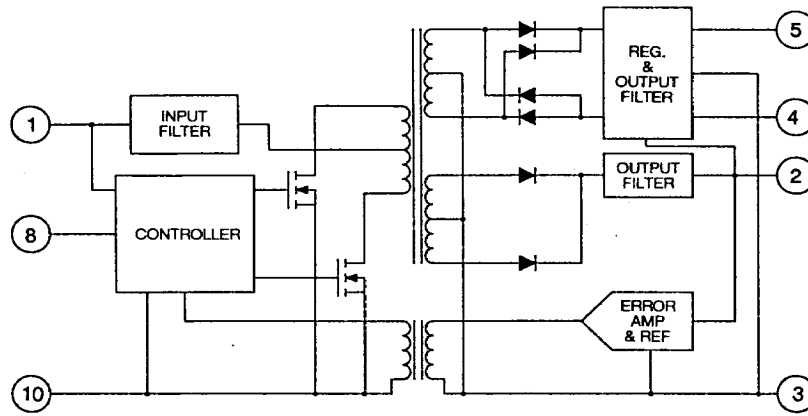
T<sub>CASE</sub> = -55°C to +85°C, V<sub>IN</sub> = +28V±5% unless otherwise specified.

## ABSOLUTE MAXIMUM RATINGS

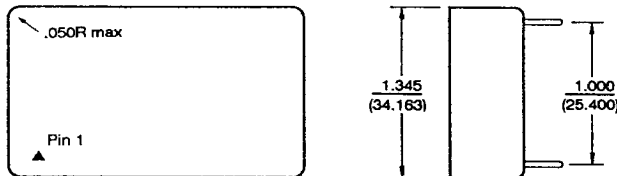
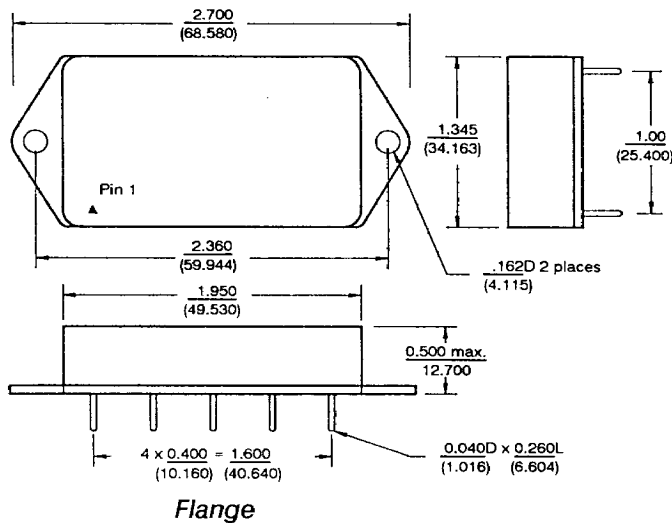
Input Voltage	-0.5V to +50V
Power Output	Internally limited, 15W typical.
Soldering	300°C for 10 seconds
Temperature Range	Operating -55°C to +135°C case Storage -65°C to +135°C

Parameter	Conditions	ATO2812T/HB			ATO2815T/HB			Units
		Min	Typ	Max	Min	Typ	Max	
<b>STATIC CHARACTERISTICS</b>								
OUTPUT Voltage	V <sub>IN</sub> = 16 to 40 Vdc							
	I <sub>OUT</sub> = Min. to Full Load - Main	4.96	5.00	5.05	4.95	5.00	5.05	Vdc
	+Dual	+11.88	+12.00	+12.12	+14.85	+15.00	+15.15	Vdc
	-Dual	-11.88	-12.00	-12.12	-14.85	-14.85	-15.15	Vdc
Current	Main	50		2000	50		2000	mA
	Dual	0		±208	0		±167	mA
Ripple	Full Load, DC to 1MHz - Main			80			80	mV p-p
	Dual			30			30	mV p-p
Power	Main	10			10			W
	+Dual	2.5			2.5			W
	-Dual	2.5			2.5			W
	Total	15			15			W
<b>REGULATION</b>								
Line	V <sub>IN</sub> = 16 to 40 Vdc - Main		10	25		10	25	mV
	Dual							
Load	I <sub>OUT</sub> = Min. to 15W - Main		20	50		20	50	mV
	Dual							
<b>INPUT</b>								
Voltage Range		16.0	28.0	40.0	16.0	28.0	40.0	Vdc
Current	No Load			30			30	mA <sub>Dc</sub>
Ripple Current	Full Load		20	50		20	50	mA p-p
<b>EFFICIENCY</b>								
	T <sub>CASE</sub> = +25°C							
	V <sub>IN</sub> = 16 to 40Vdc	76	79		76	79		%
	Half Load to Full Load							
<b>ISOLATION</b>								
	Input to Output @ 500Vdc	100			100			mΩ
<b>WEIGHT</b>								
	Standard Package			72			72	Grams
	Flange Package			75			75	Grams

# BLOCK DIAGRAM

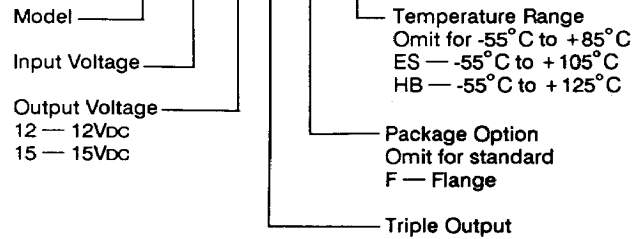


# MECHANICAL OUTLINE



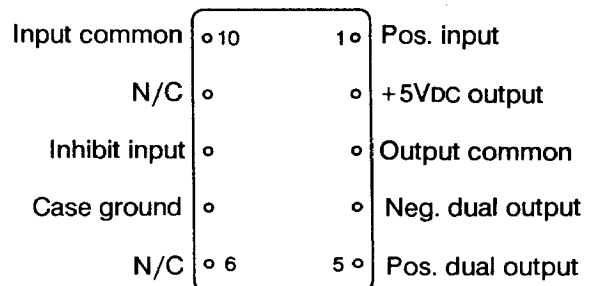
# PART NUMBER

**ATO28 xx T x /xx**



# PIN DESIGNATION

- Pin 1 Positive Input
- Pin 2 +5VDC output
- Pin 3 Output Common
- Pin 4 Neg. Dual Output (12/15VDC)
- Pin 5 Pos. Dual Output (12/15VDC)
- Pin 6 N/C
- Pin 7 Case Ground
- Pin 8 Inhibit Input
- Pin 9 N/C
- Pin 10 Input Common



## DC/DC Converters

### AHE Series

Model	Total Output Power(W)	Output Voltage (V), Current(A)	Input Voltage Range (V)	Number of Outputs	Line & load regulation	Ripple/noise (DC to 1 MHz)	Temp range	Case Size
AHE2805S	15	5V, 0-3A	17 - 40	1	±1%	20mV p-p	-55°C to +85°C	standard
AHE2812S	20	12V, 0-1.67A	17 - 40	1	±1%	30mV p-p		2.12 x 1.12 x 0.495
AHE2812D	15	±12V, 0-625mA	17 - 40	2	±1%	25mV p-p		flange
AHE2815S	20	15V, 0-1.33A	17 - 40	1	±1%	30mV p-p		2.89 x 1.12 x 0.495
AHE2815D	15	±15V, 0-500mA	17 - 40	2	±1%	25mV p-p		
AHE2805S/ES	15	5V, 0-3A	17 - 40	1	±1%	20mV p-p	-55°C to +105°C	standard
AHE2812S/ES	20	12V, 0-1.67A	17 - 40	1	±1%	30mV p-p		2.12 x 1.12 x 0.495
AHE2812D/ES	15	±12V, 0-625mA	17 - 40	2	±1%	25mV p-p		flange
AHE2815S/ES	20	15V, 0-1.33A	17 - 40	1	±1%	30mV p-p		2.89 x 1.12 x 0.495
AHE2815D/ES	15	±15V, 0-500mA	17 - 40	2	±1%	25mV p-p		
AHE2805S/HB	15	5V, 0-3A	17 - 40	1	±1%	20mV p-p	-55°C to +125°C	standard
AHE2812S/HB	20	12V, 0-1.67A	17 - 40	1	±1%	30mV p-p		2.12 x 1.12 x 0.495
AHE2812D/HB	15	±12V, 0-625mA	17 - 40	2	±1%	25mV p-p		flange
AHE2815S/HB	20	15V, 0-1.33A	17 - 40	1	±1%	30mV p-p		2.89 x 1.12 x 0.495
AHE2815D/HB	15	±15V, 0-500mA	17 - 40	2	±1%	25mV p-p		

### ATW Series

Model	Total Output Power(W)	Output Voltage (V), Current(A)	Input Voltage Range (V)	Number of Outputs	Line & load regulation	Ripple/noise (DC to 1 MHz)	Temp range	Case Size
ATW2805S	30	5V, 6A	19 - 40	1	±1.0%	10mV p-p	-55°C to +85°C	1.345 x 2.700 x 0.500
ATW2812S	30	12V, 2.5A	18 - 40	1	±1.0%	30mV p-p		
ATW2812D	30	±12V, 2.5A <sup>1</sup>	18 - 40	2	±1.0%	50mV p-p		
ATW2815S	30	15V, 2A	18 - 40	1	±1.0%	30mV p-p		
ATW2815D	30	±15V, 2A <sup>1</sup>	18 - 40	2	±1.0%	50mV p-p		
ATW2805S/ES	30	5V, 6A	19 - 40	1	±1.0%	10mV p-p	-55°C to +105°C	1.345 x 2.700 x 0.500
ATW2812S/ES	30	12V, 2.5A	18 - 40	1	±1.0%	30mV p-p		
ATW2812D/ES	30	±12V, 2.5A <sup>1</sup>	18 - 40	2	±1.0%	50mV p-p		
ATW2815S/ES	30	15V, 2A	18 - 40	1	±1.0%	30mV p-p		
ATW2815D/ES	30	±15V, 2A <sup>1</sup>	18 - 40	2	±1.0%	50mV p-p		
ATW2805S/HB	30	5V, 6A	19 - 40	1	±1.0%	10mV p-p	-55°C to +125°C	1.345 x 2.700 x 0.500
ATW2812S/HB	30	12V, 2.5A	18 - 40	1	±1.0%	30mV p-p		
ATW2812D/HB	30	±12V, 2.5A <sup>1</sup>	18 - 40	2	±1.0%	50mV p-p		
ATW2815S/HB	30	15V, 2A	18 - 40	1	±1.0%	30mV p-p		
ATW2815D/HB	30	±15V, 2A <sup>1</sup>	18 - 40	2	±1.0%	50mV p-p		

### ATO Series

Model	Total Output Power(W)	Output Voltage (V), Current(A)	Input Voltage Range (V)	Number of Outputs	Line, load regulation	Ripple/noise (DC to 1 MHz)	Temp range	Case Size
ATO2812T	15	5V, 2A	16 - 40	3	±0.3%	50mV p-p	-55°C to +85°C	standard
ATO2815T	15	±12V, ±208mA	16 - 40	3	±0.5%	25mV p-p		1.950 x 1.345 x 0.500
ATO2812T	15	5V, 2A	16 - 40	3	±0.3%	50mV p-p		flange
ATO2815T	15	±15V, ±167mA	16 - 40	3	±0.5%	25mV p-p		2.700 x 1.345 x 0.500
ATO2812T/ES	15	5V, 2A	16 - 40	3	±0.3%	50mV p-p	-55°C to +105°C	standard
ATO2815T/ES	15	±12V, ±208mA	16 - 40	3	±0.5%	25mV p-p		1.950 x 1.345 x 0.500
ATO2812T/ES	15	5V, 2A	16 - 40	3	±0.3%	50mV p-p		flange
ATO2815T/ES	15	±15V, ±167mA	16 - 40	3	±0.5%	25mV p-p		2.700 x 1.345 x 0.500
ATO2812T/HB	15	5V, 2A	16 - 40	3	±0.3%	50mV p-p	-55°C to +125°C	standard
ATO2815T/HB	15	±12V, ±208mA	16 - 40	3	±0.5%	25mV p-p		1.950 x 1.345 x 0.500
ATO2812T/HB	15	5V, 2A	16 - 40	3	±0.3%	50mV p-p		flange
ATO2815T/HB	15	±15V, ±167mA	16 - 40	3	±0.5%	25mV p-p		2.700 x 1.345 x 0.500

/ES and /HB devices have optional military screening. 1. Specifications are typical values. Input-to-output isolation @500Vdc is 100MΩ minimum. This Series has an industry standard pinout. A cross reference to other manufacturers is available upon request. The /HB devices are a higher temperature device with military screening.

1. Up to 90% of full power is available from either output provided the total output does not exceed 30 watts.

## PS Series

Model	Total Output Power(W)	Output Voltage (V), Current(A)	Input Voltage Range (V)	Number of Outputs	Line & load regulation	Ripple/noise (DC to 1 MHz)	Input-to-output isolation@500VDC	Temp range
PS2805 <sup>1</sup>	3.5	5V, 700mA	16 - 32	1	±2%	60mV p-p	100MΩ	0°C to +70°C
PS2805/B	3.5	5V, 700mA	16 - 32	1	±2%	60mV p-p	100MΩ	-55°C to +100°C
PS2815 <sup>1</sup>	7.5	±15V, 250mA	16 - 32	2	±1%	35mV p-p	100MΩ	0°C to +70°C
PS2815/B	7.5	±15V, 250mA	16 - 32	2	±1%	35mV p-p	100MΩ	-55°C to +100°C
PS6008 <sup>2</sup>	27	5V, 2.5A ±15V, 400mA	15 - 50	3	±1% ±4%	60mV p-p 110mV p-p	50MΩ <sup>4</sup> 50MΩ <sup>4</sup>	-55°C to +95°C
PS6009 <sup>3</sup>	80	5V, 3A ±15V, 750mA 28V, 1.5A	14.5 - 50	3	±2% ±5% ±5%	80mV p-p 200mV p-p 200mV p-p	80MΩ <sup>4</sup> 50MΩ <sup>4</sup> 50MΩ <sup>4</sup>	-55°C to +95°C

### Notes:

1. Package size is 1.1 x 1.3 x 1.0 inches.
2. Package size is 3.0 x 2.35 x 0.64 inches.
3. Package size is 3.5 x 2.42 x 0.64 inches.
4. Minimum. All other specifications are typical.

The PS/B Series have optional military screening. EMI filters are available for all DC/DC converters. Consult factory for modifications and custom designs.

## AF461 EMI Filter

Model	Input Voltage (V)	Input Current (A) max.	Output Current (A) max.	Noise Reduction (dB) max.	Package
AF461	0 to 40	1.75	1.75	40	2.12 x 1.12 x .405 standard
AFA461	0 to 40	3.80	4.00	40	2.89 x 1.12 x .495 flange
AF461/ES	0 to 40	1.75	1.75	40	2.12 x 1.12 x .405 standard
AFA461/ES	0 to 40	3.80	4.00	40	2.89 x 1.12 x .495 flange
AF461/HB	0 to 40	1.75	1.75	40	2.12 x 1.12 x .405 standard
AFA461/HB	0 to 40	3.80	4.00	40	2.89 x 1.12 x .495 flange

## Power Hybrids

Advanced Analog offers devices that include MOSFET, diode and bipolar array, switching amplifier, rectifier/Schottky, and power supply hybrids. Typical applications are military, such as tanks, avionics, missiles and space-based equipment involved with motor control and power supply circuits. Other uses are medical, hydraulic, industrial controls and other instrumentation.

We are dedicated to manufacturing military/high reliability power hybrids. Product screened to Class S started shipping in 1988.

- Accommodate breakdown voltages as high as 5,000V
- Current rating of 40A typical and up to 80 - 100A can be accommodated
- Junction-to-case thermal resistance (R<sub>THjc</sub>) as low as <1°C/W

## Screening Process

Test Inspection	Method	Condition
Pre-Seal Internal Visual	2017	
Stabilization Bake	1008	C
Temperature Cycling	1010	C
Constant Acceleration	2001	A
Burn-in	1015	T <sub>C</sub> = T <sub>Cmax</sub> *
Final Electrical Test (Group A)	25°C and extremes	
External Visual	2009	

\* T<sub>Cmax</sub> = 105°C for /ES devices and 125°C for /HB devices. MIL-STD-1772 certification for DC/DC devices has been applied for and is pending. Consult factory for status.

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The information in this data sheet has been carefully checked and is believed to be accurate, however, no responsibility is assumed for possible errors. The specifications are subject to change without notice.

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**MIL-STD-1772**  
**Qualified**  
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