LAMBDA ADVANCED ANALOG INC.

ATR2800S Series

Hybrid - High Reliability DC/DC Converters

DESCRIPTION

The ATR2800S 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 single outputs to satisfy a wide range of requirements. The circuit design incorporates a pulse width modulated single forward topology operating in the feed-forward mode at a nominal switching frequency of 550 kHz. 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 can be provided in a standard plug-in package for PC mounting or in a flanged package for more severe environments.

These converters are manufactured in a facility fully qualified to MIL-STD-1772. All processes used to manufacture these converters have been qualified to enable Advanced Analog to deliver compliant devices. Four screening grades are available to satisfy a wide range of requirements. The CH grade converters are fully compliant to MIL-STD-1772 class H. The HB grade converters are processed to full class H screening but do not have class H element evaluation as required by MIL-STD-1772. Both grades are fully tested and operate over the full military temperature range without derating of output power. The ES version is a full temperature device without the full class H screening or element evaluation. The non-suffix device is a low cost limited temperature range option. Variations in electrical, mechanical and screening can be accommodated. Extensive computer simulation using complex modeling enables rapid design modification to be provided. Contact Advanced Analog with specific requirements.

FEATURES

- **16-40VDC input range (28VDC nominal)**
- **5V, 12V and 15V outputs available**
- **Indefinite short circuit and overload protection**
- **Up to 35W/in³ power density**
- **30 watt output power models**
- **Fast loop response for superior transient characteristics**
- **Operating temperature range from -55°C to + 125°C**
- **Popular industry standard pin-out**
- **Resistance seam welded case for superior long term hermeticity**
- **Ceramic feed-thru pins**
- **External Synchronization**
- **Efficiencies up to 84%**
- **Shutdown from external signal**
- **Military screening**

SPECIFICATIONS

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

ABSOLUTE MAXIMUM RATINGS		
Input Voltage[4]	-0.5V to +50V	
Power Output	Internally Limited, 30W typical for ATR2805S/ES, 36W typical for ATR2812S/ES and ATR2815S/ES	
Soldering	300°C for 10 seconds	
Temperature Range[1]	Operating	-55°C to +135°C case
	Storage	-65°C to + 150°C

Parameter	Conditions -55°C ≤ Tc ≤ +125°C, V_{IN} - 28 V_{DC} ±5%, C=0, unless otherwise specified	ATR2805S/ES			ATR2812S/ES			ATR2815S/ES			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
STATIC CHARACTERISTICS											
OUTPUT	V_{IN} = 16 TO 40 V_{DC}										
Voltage	I_{OUT} = 0 TO Full Load	4.90	5.00	5.10	11.76	12.00	12.24	14.70	15.00	15.30	V_{DC}
Current		0.0		5.0	0.0		2.5	0.0		2.0	A_{DC}
Ripple	Full Load, DC to 2MHz		20	60		30	60		30	60	mVpp
Accuracy	T_{CASE} = 25°C, I_{OUT} = 0	4.95	5.00	5.05	11.88	12.00	12.12	14.85	15.00	15.15	V_{DC}
Power[1]		25			30			30			W
REGULATION											
Line	V_{IN} = 16 to 40V_{DC}		±0.5	±1.0		±0.5	±1.0		±0.5	±1.0	%
Load	I_{OUT} = 0 to Full Load		±0.5	±1.0		±0.5	±1.0		±0.5	±1.0	%
INPUT											
Voltage Range		16.0	28.0	40.0	16.0	28.0	40.0	16.0	28.0	40.0	V_{DC}
Current	Inhibited, pin 2 tied to pin 10		8	18		8	18		8	18	mA_{DC}
	No Load, pin 2 = open			70			70			70	mA_{DC}
Ripple Current	Full Load, B.W. =DC to 2 MHz		20	50		25	50		25	50	mV p-p
EFFICIENCY	T_{CASE} = +25°C										
	Half Load to Full Load	76	82		80	83		81	84		%
CAPACITIVE LOAD	No effect on performance	500			200			200			µF
LOAD FAULT POWER DISSIPATION	Tc = 25°C			14			14			14	W
ISOLATION	Input to Output @ 500V_{DC}	100			100			100			MΩ
DYNAMIC CHARACTERISTICS											
STEP LOAD CHANGES											
Output	50% Load 100% Load		±150			±200			±200		mVpk
Transient	No Load 50% Load		-300			-400			-400		mVpk
	50% Load No Load		+300			+400			+400		mVpk
Recovery[2]	50% Load 100% Load		25			25			25		µsec
	No Load 50% Load		500			500			500		µsec
	50% Load No Load		7			7			7		msec
STEP LINE CHANGES											
Output	Input step 16 to 40V_{DC}		+180			+180			+180		mVpk
Transient	Input step 40 to 16V_{DC}		-600			-600			-600		mVpk
Recovery[2]	Input step 16 to 40V_{DC}		400			400			400		µsec
	Input step 40 to 16V_{DC}		400			400			400		µsec
TURN-ON	V_{IN} = 16 to 40V_{DC}										
Overshoot	I_{OUT} = 0 to Full Load		0	500		300	600		300	750	mVpk
Delay[3]			8	14		8	14		8	14	msec
LOAD FAULT RECOVERY	V_{IN} = 16 to 40V_{DC}		8	14		8	14		8	14	msec
WEIGHT	Standard Package		60			60			60		grams
	Flange Package		65			65			65		grams

Notes:
1. Above +125°C case temperature, derate output power linearly to 0 at 135°C case.
2. 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.
3. Turn-on delay time measurement is for either an application of power at the input or a signal at the shutdown pin.

SPECIFICATIONS

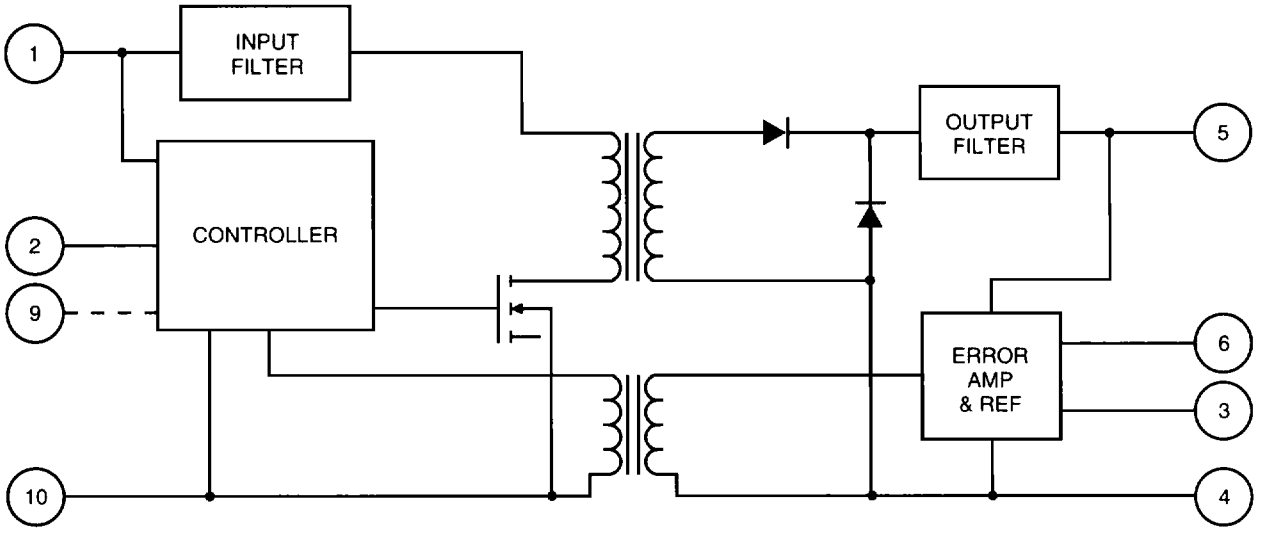
T_{CASE} = -55°C to +125°C, V_{IN} = + 28V ±5% unless otherwise specified.

ABSOLUTE MAXIMUM RATINGS		
Input Voltage[1]	-0.5V to +50V	
Power Output	Internally Limited, 30W typical for ATR2805S/HB, 36W typical for ATR2812S/HB and ATR2815S/HB	
Soldering	300°C for 10 seconds	
Temperature Range[1]	Operating	-55°C to + 135°C case
	Storage	-65°C to + 150°C

Parameter	Conditions -55°C ≤ Tc ≤ +125°C, V_{IN} - 28 VDC ±5%, C=0, unless otherwise specified	ATR2805S/HB			ATR2812S/HB			ATR2815S/HB			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
STATIC CHARACTERISTICS											
OUTPUT	V_{IN} = 16 TO 40 VDC										
Voltage	I_{OUT} = 0 TO Full Load	4.90	5.00	5.10	11.76	12.00	12.24	14.70	15.00	15.30	VDC
Current		0.0		5.0	0.0		2.5	0.0		2.0	ADC
Ripple	Full Load, DC to 2MHz		20	60		30	60		30	60	mV p-p
Accuracy	T_{CASE} = 25°C, I_{OUT} = 0	4.95	5.00	5.05	11.88	12.00	12.12	14.85	15.00	15.15	VDC
Power[1]		25			30			30			W
REGULATION											
Line	V_{IN} = 16 to 40VDC		10	25		30	60		40	75	mv
	T_{CASE} = 25°C			5			30			35	
Load	I_{OUT} = 0 to Full Load		10	50		50	120		50	150	mv
INPUT											
Voltage Range		16.0	28.0	40.0	16.0	28.0	40.0	16.0	28.0	40.0	VDC
Current	Inhibited, pin 2 tied to pin 10		8	18		8	18		8	18	mADC
	No Load, pin 2 = open			70			70			70	mADC
Ripple Current	Full Load, B.W. = DC to 2MHz		20	50		25	50		25	50	mV p-p
EFFICIENCY	T_{CASE} = +25°C Full Load	78	82		79	83		80	84		%
CAPACITIVE LOAD	No effect on performance	500	1000		200	1000		200	1000		µF
LOAD FAULT POWER	Short Circuit Tc = 25°C			9			9			9	W
DISSIPATION	Overload Tc = 25°C			14			14			14	W
ISOLATION	Input to Output @ 500VDC	100			100			100			MΩ
DYNAMIC CHARACTERISTICS											
STEP LOAD CHANGES											
Output Tc = 25°C	50% Load 100% Load		±150	±300		±200	±300		±200	±300	mVpk
Transient	No Load 50% Load		-300	-500		-400	-750		-400	-750	mVpk
	50% Load No Load		+300	+500		+400	+750		+400	+750	mVpk
Recovery[2]	50% Load 100% Load		25	100		25	100		25	100	µsec
	No Load 50% Load		100	200		500	1500		500	1500	µsec
	50% Load No Load		7	10		7	10		7	10	msec
STEP LINE CHANGES											
Output Tc = 25°C	Input Step 16 to 40VDC		+180	+300		+180	+500		+180	+500	mVpk
Transient	Input Step 40 to 16VDC		-600	-1000		-600	-1500		-600	-1500	mVpk
Recovery[2]	Input Step 16 to 40VDC		400	800		400	800		400	800	µsec
	Input Step 40 to 16VDC		400	800		400	800		400	800	µsec
TURN-ON	V_{IN} = 16 to 40VDC										
Overshoot	I_{OUT} = 0 to Full Load		0	550		300	600		300	750	mVpk
Delay[3]			8	10		8	10		8	10	msec
LOAD FAULT RECOVERY	V_{IN} = 16 to 40VDC		8	10		8	10		8	10	msec
WEIGHT	Standard Package			60			60			60	grams
	Flange Package			65			65			65	grams

Notes:
1. Above +125°C case temperature, derate output power linearly to 0 at 135°C case.
2. 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. See typical waveforms.
3. Turn-on delay time measurement is for either an application of power at the input or a signal at the shutdown pin.

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 ±1VDC.

EMI Filter

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

Output Adjust

The output voltage of the ATR2800S can be adjusted upward by connecting Positive Output (Pin 5) and Positive Sense (Pin 6) as shown in Table 1.

Resistance Pin 3 to 4 (Ω)	Output Voltage Increase (V)
105	0.1
210	0.2
315	0.3
420	0.4
525	0.5
630	0.6

Table 1 Output adjustment resistor values

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). Advanced Analog provides synchronization of multiple ATR type converters to match switching frequency of the converter to the frequency of the system clock, thus eliminating this type of noise.

PIN DESIGNATION

Pin 1 Positive Input	Pin 10 Input common
Pin 2 Inhibit Input	Pin 9 Sync
Pin 3 Sense return*	Pin 8 Case gnd
Pin 4 Output common	Pin 7 N/C
Pin 5 Positive output	Pin 6 Positive sense*

*If neither remote sense nor voltage trim are used, tie pin 3 to 4, 5 to 6 or output voltage will increase by 1.2V.

PART NUMBER

ATR 28 xx S x / x

Model

Input Voltage

Output Voltage
05 – 5VDC
12 – 12VDC
15 – 15VDC

Single Output

Temperature Range
Omit for -55°C to +85°C
ES – -55°C to +125°C
HB – -55°C to +125°C
CH – -55°C to +125°C

Package option
F – Flange
Omit Standard

STANDARDIZED MILITARY DRAWING CROSS REFERENCE

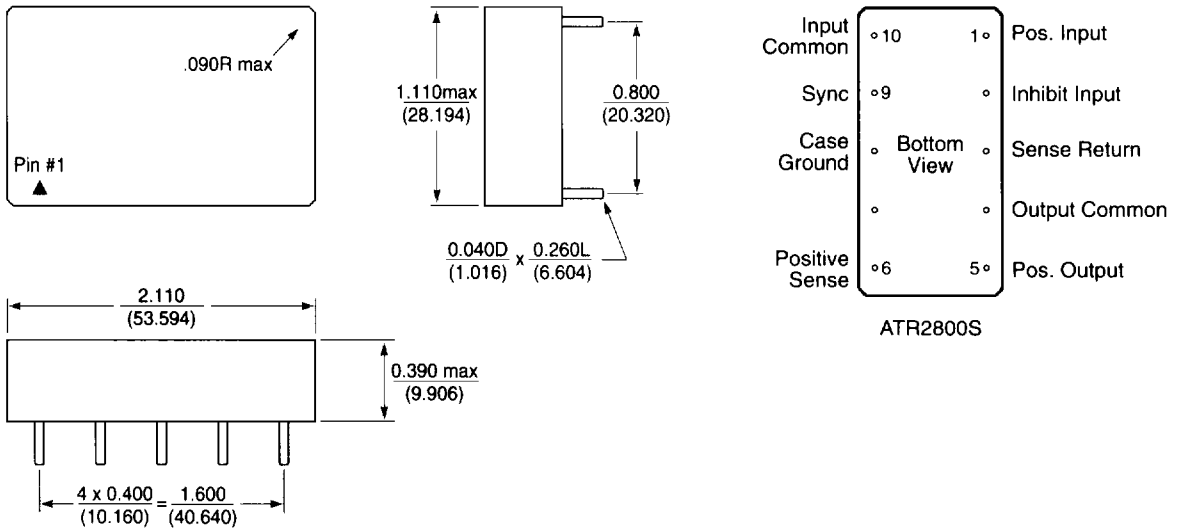
Standardized military drawing number	Vendor CAGE PIN	Vendor similar
5962-99624	52467	ATR2805S/CH
5962-94625	52467	ATR2812S/CH
5962-94626	52467	ATR2815S/CH

Available Screening Levels and Process Variations for ATR Series

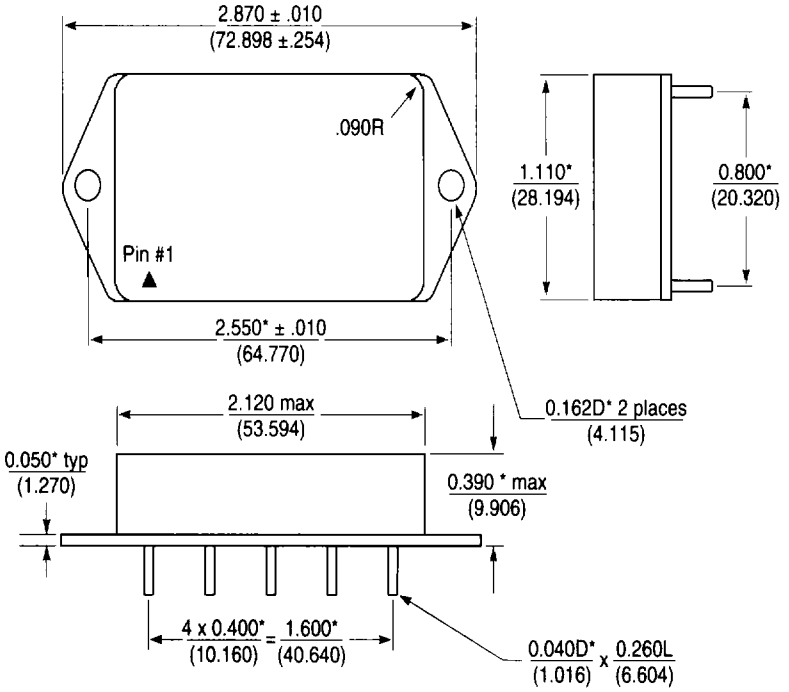
Requirement	MIL-STD-883 method	No Suffix	ES Suffix	HB Suffix	CH Suffix
Temperature Range		-55°C to +85°C	-55°C to +125°C	-55°C to +125°C	-55°C to +125°C
Element Evaluation					MIL-H-38534
Internal Visual	2017	◆	✔	✔	✔
Temperature Cycle	1010, Cond C		Cond A	✔	✔
Constant Acceleration	2001, Cond A		500g	5,000g	5,000g
Burn-in	1015		96hrs @125°C	160hrs @125°C	160hrs @125°C
Final Electrical (Group A)	Specification	25°C	25°C	-55, +25, +125°C	-55,+25, +125°C
Seal, Fine & Gross	1014		✔	✔	✔
External Visual	2009	◆	✔	✔	✔

◆ per Commercial Standards

MECHANICAL OUTLINE



ATR2800S



Weight
Standard—60 grams max.
Flange—65 grams max.

Thermal Management

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

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

where A = the effective surface area in square inches (including heat sink if used;) P = power dissipation in watts.

The total surface area of the ATR standard package is 7.34 square inches. If a worse case full load efficiency of 76% is assumed, then the case temperature rise of an ATR 2805S can be calculated as follows:

$$P = P_{OUT}\left[\frac{1}{Eff} - 1\right] = 25\left[\frac{1}{.76} - 1\right] = 7.9\ W$$

$$\Delta T = 80\ (7.34)^{-0.7}\ (7.9)^{0.85} = 115^{\circ}C$$

Hence, if $T_{AMBIENT}$ = +25°C, the DC/DC converter case temperature will be approximately 140°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:

$$A_{HEAT\ SINK} = \left[\frac{50}{80\ (7.9)^{0.85}}\right]^{-1.43} - 7.34 = 16.8\ in.^2$$

NOTES

LAMBDA ADVANCED ANALOG INC.

MIL-STD-1772 Qualified

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