

# International **IR** Rectifier

PD - 94551

## ADVANCED ANALOG HYBRID-HIGH RELIABILITY DC/DC CONVERTERS

## ATR28XXT SERIES

28V Input, Triple Output

### Description

The ATR28XXT Series of DC/DC converters provide 30 watts of output power over the full military temperature range with no derating. These devices are pin compatible with the Advanced Analog ATO series converters but offer twice the maximum output power in a lower profile package. A custom CMOS ASIC pulse width modulator operating at a nominal switching frequency of 550KHz combined with a unique magnetic feedback reduces circuit complexity for enhanced reliability. These converters provide 500 volt input to output isolation and operate in highly efficient single forward mode.

The advanced feedback design and high operating frequency provide an extremely wide bandwidth control loop with high gain and phase margin. This results in fast dynamic line and load response as well as superior audio rejection. The control loop is compensated to provide optimum performance over the full military temperature range and over the 16 to 40 volt input voltage range.

These converters are protected against both continuous output short circuits and output overload. Either load fault condition will result in operating in a low power dissipation foldback mode. The converters will shut down for approximately 15 milliseconds, then attempt to restart. This cycle will continue indefinitely unless the load fault is corrected. Recovery to normal operation is automatic upon removal of the load fault.

Manufactured in a facility full qualified to MIL-PRF-38534, these converters are available in four screening grades to satisfy a wide range of requirements. The CH grade is fully compliant to the requirements of MIL-PRF-38534 for class H. The HB grade is processed and screened to the class H requirement, but element evaluation and Periodic Inspections (PI) are not required. Both grades are tested to meet the complete group "A" test specification over the full military temperature range without output power deration.

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### Features

- 30 Watt Output Power
- Flexible Output Loading
- -55°C to +125°C Operation
- Pin Compatible with ATO
- 0.410" Maximum Height
- 16 to 40 VDC Input Range
- 500 Volt Input to Output Isolation
- High Audio Rejection
- MIL-STD-704 Compatible
- Load Fault Protection - Short Circuit and Overload
- TTL level Compatible Synchronization

Two grades with more limited screening are also available for use in less demanding applications. Variations in electrical, mechanical and screening can be limited accommodated. Contact Advanced Analog with specific requirements.



## ATR28XXT Series

### Specifications

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$T_{CASE} = -55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ,  $V_{IN} = +28\text{V} \pm 5\%$  unless otherwise specified

| ABSOLUTE MAXIMUM RATINGS <sup>1</sup> |                        |
|---------------------------------------|------------------------|
| Input Voltage Range                   | -0.5V to 50VDC         |
| Power Dissipation                     | Internal limited 37.5W |
| Lead Temperature                      | +300°C                 |
| Storage Temperature                   | -65°C to 150°C case    |

| Test                                                          | Symbol              | Conditions<br>-55°C ≤ TC ≤ +125°C,<br>V <sub>IN</sub> = 28 V <sub>DC</sub> ±5%, C <sub>L</sub> = 0,<br>unless otherwise specified                                                                                                                    | ATR2812T         |                   | ATR2815T         |                   | Units                              |
|---------------------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-------------------|------------------|-------------------|------------------------------------|
|                                                               |                     |                                                                                                                                                                                                                                                      | Min              | Max               | Min              | Max               |                                    |
| STATIC CHARACTERISTICS                                        |                     |                                                                                                                                                                                                                                                      |                  |                   |                  |                   |                                    |
| OUTPUT Voltage <sup>1</sup>                                   | V <sub>OUT</sub>    | I <sub>OUT</sub> = 0 (main) +25°C<br>over temp. range                                                                                                                                                                                                | 4.95<br>4.90     | 5.05<br>5.10      | 4.95<br>4.90     | 5.05<br>5.10      | V <sub>DC</sub><br>V <sub>DC</sub> |
| Current <sup>1,2,3,4</sup>                                    | I <sub>OUT</sub>    | I <sub>OUT</sub> = 0 (dual) <sup>1</sup> +25°C<br>over temp. range                                                                                                                                                                                   | ±11.88<br>±11.76 | ±12.12<br>±12.24  | ±14.85<br>±14.70 | ±15.15<br>±15.30  | V <sub>DC</sub><br>V <sub>DC</sub> |
| Ripple <sup>1,5</sup>                                         | V <sub>RIP</sub>    | V <sub>IN</sub> = 16, 28, and 40VDC (main)<br>V <sub>IN</sub> = 16, 28, and 40VDC (dual) <sup>1</sup><br>V <sub>IN</sub> = 16, 28, and 40VDC (dual)<br>BW = 20Hz to 2MHz (main)<br>V <sub>IN</sub> = 16, 28, and 40 VDC<br>BW = 20Hz to 2 MHz (dual) | 100.0<br>0.0     | 4000<br>±625      | 100.0<br>0.0     | 4000<br>±500      | mA<br>mA<br>mVp-p<br>mVp-p         |
| REGULATION Line <sup>1,3</sup>                                | VR <sub>LINE</sub>  | V <sub>IN</sub> = 16, 28, and 40 VDC<br>P <sub>OUT</sub> = .5, 10, 20W (main)<br>V <sub>IN</sub> = 16, 28, and 40 VDC(dual)<br>P <sub>OUT</sub> = 0, 5, 10W (dual) <sup>12</sup>                                                                     |                  | ±25               |                  | ±25               | mV                                 |
| Load <sup>1,3</sup>                                           | VR <sub>LOAD</sub>  | V <sub>IN</sub> = 16, 28, and 40 VDC<br>P <sub>OUT</sub> = .5, 10, 20W (main)<br>V <sub>IN</sub> = 16, 28, and 40 VDC<br>P <sub>OUT</sub> = 0, 5, 10W (dual) <sup>12</sup>                                                                           |                  | ±60<br>±50<br>±60 |                  | ±75<br>±50<br>±75 | mV<br>mV<br>mV                     |
| INPUT Current                                                 | I <sub>IN</sub>     | I <sub>OUT</sub> = 0, inhibit (pin 8)<br>Tied to input return (pin 10)                                                                                                                                                                               |                  | 15<br>75          |                  | 15<br>75          | mA<br>mA                           |
| Ripple Current <sup>4</sup>                                   | I <sub>RIP</sub>    | I <sub>OUT</sub> = 0, inhibit (pin 8) = open<br>I <sub>OUT</sub> = 4000mA (main)<br>P <sub>OUT</sub> = 10W (dual) <sup>12</sup><br>BW = 20Hz to 2MHz                                                                                                 |                  | 50                |                  | 50                | mAp-p                              |
| EFFICIENCY                                                    | E <sub>FF</sub>     | I <sub>OUT</sub> = 4000mA (main) +25°C<br>P <sub>OUT</sub> = 10W (dual) <sup>12</sup><br>over temp. range                                                                                                                                            | 75<br>72         |                   | 75<br>72         |                   | %                                  |
| ISOLATION                                                     | ISO                 | Input to output or any pin to case<br>(except pin 8)at 500 TC=+25°C                                                                                                                                                                                  | 100              |                   | 100              |                   | MΩ                                 |
| Load Fault Power Dissipation <sup>3</sup>                     | P <sub>D</sub>      | Overload<br>Short circuit                                                                                                                                                                                                                            |                  | 14<br>9           |                  | 14<br>9           | W<br>W                             |
| Switching Frequency                                           | F <sub>S</sub>      |                                                                                                                                                                                                                                                      | 500              | 600               | 500              | 600               | KHz                                |
| SYNC Frequency Range                                          | F <sub>SYNC</sub>   | 50% load to/from 100% load<br>no load to/from 50% load                                                                                                                                                                                               | 500              | 700               | 500              | 700               | KHz                                |
| Inhibit Open Circuit Voltage                                  | V <sub>OL</sub>     |                                                                                                                                                                                                                                                      | 9                | 13                | 9                | 13                | V                                  |
| Output Response to Step transient Load changes <sup>7</sup>   | VO <sub>TLOAD</sub> | 50% load to/from 100% load<br>No load to/from 50% load                                                                                                                                                                                               | -500<br>-1000    | +500<br>+1000     | -500<br>-1000    | +500<br>+1000     | mVpk                               |
| Recovery Time Step Step transient Load changes <sup>7,8</sup> | TT <sub>LOAD</sub>  | 50% load to/from 100% load<br>No load to 50% load<br>50% load to no load                                                                                                                                                                             |                  | 200<br>5<br>10    |                  | 200<br>5<br>10    | μs<br>ms<br>ms                     |

For Notes to Specifications, refer to page 3

$T_{CASE} = -55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ,  $V_{IN} = +28\text{V} \pm 5\%$  unless otherwise specified

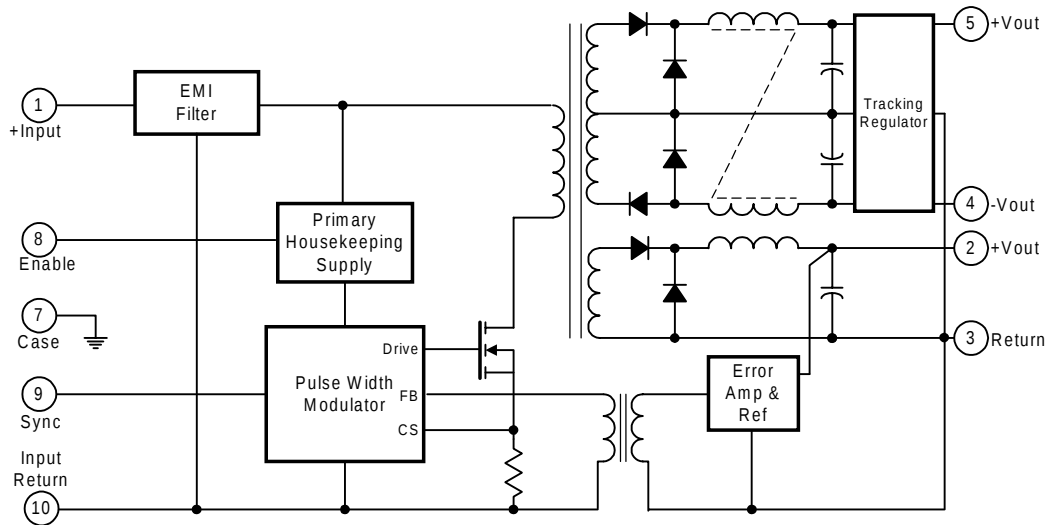
| ABSOLUTE MAXIMUM RATINGS       |                                                           |
|--------------------------------|-----------------------------------------------------------|
| Input Voltage                  | -0.5V to 50VDC                                            |
| Power Output                   | Internally limited, 17.5W typical                         |
| Soldering                      | 300°C for 10 seconds                                      |
| Temperature Range <sup>6</sup> | Operating -55°C to +135°C case<br>Storage -65°C to +135°C |

| Test                                                                                    | Symbol       | Conditions<br>-55°C ≤ TC ≤ +125°C,<br>$V_{IN} = 28 V_{DC} \pm 5\%$ , $C_L = 0$ ,<br>unless otherwise specified | ATR2812T |       | ATR2815T |       | Units |
|-----------------------------------------------------------------------------------------|--------------|----------------------------------------------------------------------------------------------------------------|----------|-------|----------|-------|-------|
|                                                                                         |              |                                                                                                                | Min      | Max   | Min      | Max   |       |
| STATIC CHARACTERISTICS                                                                  |              |                                                                                                                |          |       |          |       |       |
| Output Response to<br>Transient step <sup>9</sup><br>Line changes <sup>10</sup>         | $VO_{TLINE}$ | Input step 16 from/to 40 VDC<br>$I_{OUT} = 4000\text{mA}$ (main)<br>$P_{OUT} = 10\text{W}$ (dual)              |          | ±1500 |          | ±1500 | mV pk |
| Recovery Time <sup>8</sup><br>Transient step <sup>9</sup><br>Line changes <sup>10</sup> | $TT_{LINE}$  | Input step 16 from/to 40 VDC<br>$I_{OUT} = 4000\text{mA}$ (main)<br>$P_{OUT} = 10\text{W}$ (dual)              |          | 10    |          | 10    | ms    |
| Turn on Overshoot <sup>1</sup>                                                          | $VTon_{OS}$  | $I_{OUT} = 0$ , and 4000mA (main)<br>$P_{OUT} = 0$ , 10W (dual)                                                |          | 1000  |          | 1000  | mV pk |
| Turn on Delay <sup>1, 11</sup>                                                          | $Ton_D$      | $I_{OUT} = 0$ , 4000mA (main)<br>$P_{OUT} = 0$ , 10W (dual)                                                    |          | 25    |          | 25    | ms    |
| Load Fault Recovery <sup>10</sup>                                                       | $TR_{LF}$    |                                                                                                                |          | 25    |          | 25    | ms    |

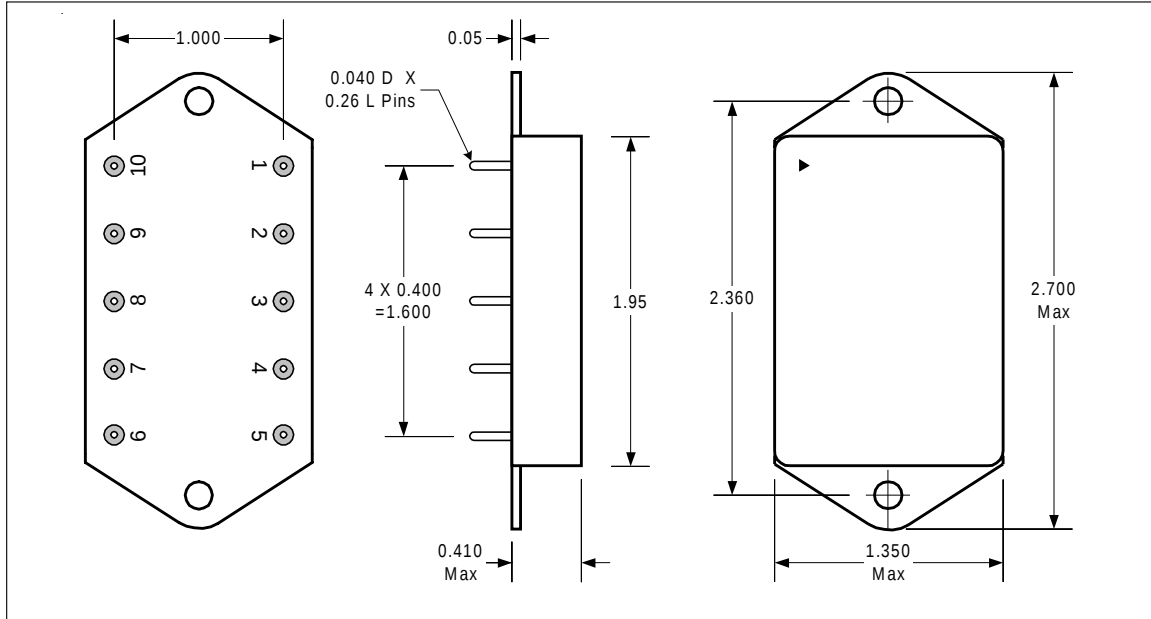
#### Notes to Specifications

1. Tested at each output.
2. Parameter guaranteed byline and load regulation tests.
3. Although operation with no load is permissible, light loading on the main (+5 volt) output may cause the output voltage of the auxiliary outputs (±12 volt or ±15 volt) to drop out of regulation. It is therefore recommended that at least 100mA or 20 percent of the output power, whichever is greater, be taken from the main (+5 volt) output.
4. Total combined output power –30 watts.
5. Bandwidth guaranteed by design. Tested for 20KHz to 2MHz.
6. An overload is that condition with a load in excess of the rated load but less than that necessary to trigger the overload protection circuit and is the condition of maximum power dissipation.
7. Load step transition time between 2 and 10 microseconds.
8. Recovery time is measured from the initiation of the transient to where  $V_{OUT}$  has returned to within ±1 percent of  $V_{OUT}$  at 50 percent load.
9. Input step transition time between 2 to 10 microseconds.
10. 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 the table.
11. 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.

ATR28XXT Block Diagram



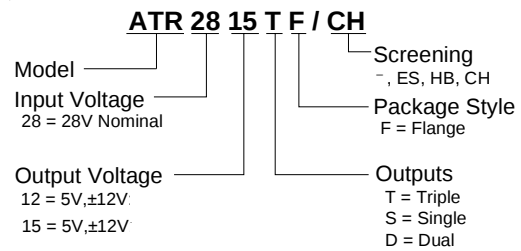
**ATR28XXT Case Outline**



**Pin Designation**

| Pin No. | Designation          |
|---------|----------------------|
| 1       | Positive Input       |
| 2       | +5VDC Output         |
| 3       | Output Return        |
| 4       | Negative Dual Output |
| 5       | Positive Dual Output |
| 6       | N/C                  |
| 7       | Case Ground          |
| 8       | Enable Input         |
| 9       | Sync Input           |
| 10      | Input Return         |

**Part Numbering**



## ATR28XXT Series

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### Available Screening Levels and Process Variations for ATR28XXT Series

| Requirement                | MIL-STD-883 Method | No Suffix    | ES Suffix       | HB Suffix        | CH Suffix        |
|----------------------------|--------------------|--------------|-----------------|------------------|------------------|
| Temperature Range          |                    | -20 to +85°C | -55°C to +125°C | -55°C to +125°C  | -55°C to +125°C  |
| Element Evaluation         |                    |              |                 |                  | MIL-PRF-38534    |
| Internal Visual            | 2017               | *            | Yes             | Yes              | Yes              |
| Temperature Cycle          | 1010, Cond C       |              | Cond B          | Yes              | Yes              |
| Constant Acceleration      | 2001, Cond A       |              | 500g            | 5,000 g          | 5,000 g          |
| Burn-in                    | 1015               | 48hrs @ 85°C | 48hrs @ 125°C   | 160hrs @ 125°C   | 160hrs @ 125°C   |
| Final Electrical (Group A) | MIL-PRF-38534      | 25°C         | 25°C            | -55, +25, +125°C | -55, +25, +125°C |
| Seal, Fine & Gross         | 1014               |              | Yes             | Yes              | Yes              |
| External Visual            | 2009               | *            | Yes             | Yes              | Yes              |

\* Per Commercial Standards

### Available Standard Military Drawing (SMD) Cross Reference

| Standardized Military drawing PIN | Vendor CAGE Code | Vendor Similar PIN |
|-----------------------------------|------------------|--------------------|
| 5962-9315801HXX                   | 52467            | ATR2812T/CH        |
| 5962-9315801HZX                   | 52467            | ATR2812TF/CH       |
| 5962-9215901HXX                   | 52467            | ATR2815T/CH        |
| 5962-9215901HZX                   | 52467            | ATR2815TF/CH       |

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Visit us at [www.irf.com](http://www.irf.com) for sales contact information.

*Data and specifications subject to change without notice. 10/02*