

## AHE2800S Series

Hybrid - High Reliability  
DC/DC Converters

### DESCRIPTION

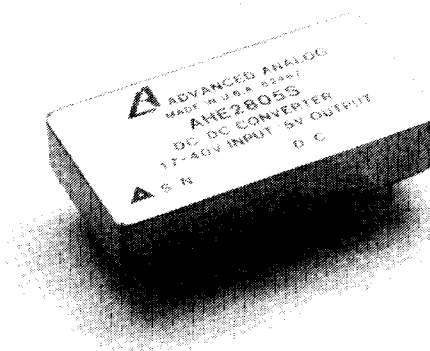
The AHE2800S Series of DC/DC converters feature high power density and an extended temperature range for use in military and industrial applications. Designed to MIL-STD-704D input requirements, these devices have nominal 28VDC inputs with +5V, +12V and +15V single outputs to satisfy a wide range of requirements. The circuit design incorporates a pulse width modulated 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 can be 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. Dual output versions are available and are described in a separate data sheet.

### FEATURES

- 17 - 40 VDC input range (28VDC nominal)
- 5V, 12V and 15V outputs available
- Indefinite short circuit and overload protection
- 17W/in<sup>3</sup> power density
- 15 and 20 watts output power models
- Fast loop response for superior transient characteristics
- Operating temperature range from -55°C - +125°C available
- Popular industry standard pin-out
- Resistance seam welded case for superior long term hermeticity
- Efficiencies up to 84%
- Shutdown from external signal
- Military screening
- 250,000 hour MTBF at 85°C



# SPECIFICATIONS

TCASE = -55°C to +85°C, VIN = +28V ±5% unless otherwise specified.

## ABSOLUTE MAXIMUM RATINGS

|                                |                                                                                         |
|--------------------------------|-----------------------------------------------------------------------------------------|
| Input Voltage <sup>1</sup>     | -0.5V to +50V                                                                           |
| Power Output                   | Internally limited, 17.5W typical for AHE2805S, 22.5W typical for AHE2812S and AHE2815S |
| Soldering                      | 300°C for 10 seconds                                                                    |
| Temperature Range <sup>1</sup> | Operating -55°C to +115°C case<br>Storage -65°C to +135°C                               |

| Parameter                                 | Conditions                                 | AHE2805S |      |      | AHE2812S |       |       | AHE2815S |       |       | Units  |
|-------------------------------------------|--------------------------------------------|----------|------|------|----------|-------|-------|----------|-------|-------|--------|
|                                           |                                            | Min      | Typ  | Max  | Min      | Typ   | Max   | Min      | Typ   | Max   |        |
| STATIC CHARACTERISTICS                    |                                            |          |      |      |          |       |       |          |       |       |        |
| OUTPUT                                    | VIN = 17 to 40Vdc<br>IOUT = 0 to Full Load | 4.90     | 5.00 | 5.10 | 11.76    | 12.00 | 12.24 | 14.70    | 15.00 | 15.30 | Vdc    |
| Voltage                                   |                                            | 0.0      |      | 3000 | 0.0      |       | 1667  | 0.0      |       | 1333  | mAdc   |
| Current                                   | Full Load, DC to 1MHz                      |          | 20   | 60   |          | 30    | 60    |          | 30    | 60    | mV p-p |
| Ripple                                    | TCASE = 25°C, Full Load                    | 4.95     | 5.00 | 5.05 | 11.88    | 12.00 | 12.12 | 14.85    | 15.00 | 15.15 | Vdc    |
| Accuracy                                  |                                            | 15       |      |      | 20       |       |       | 20       |       |       | W      |
| Power <sup>1</sup>                        |                                            |          |      |      |          |       |       |          |       |       |        |
| REGULATION                                |                                            |          |      |      |          |       |       |          |       |       |        |
| Line                                      | VIN = 17 to 40Vdc                          |          | ±0.5 | ±1.0 |          | ±0.5  | ±1.0  |          | ±0.5  | ±1.0  | %      |
| Load                                      | IOUT = 0 to Full Load                      |          | ±0.5 | ±1.0 |          | ±0.5  | ±1.0  |          | ±0.5  | ±1.0  | %      |
| INPUT                                     |                                            |          |      |      |          |       |       |          |       |       |        |
| Voltage Range <sup>5</sup>                | No Load                                    | 17.0     | 28.0 | 40.0 | 17.0     | 28.0  | 40.0  | 17.0     | 28.0  | 40.0  | Vdc    |
| Current                                   | Full Load                                  |          | 8    | 12   |          | 8     | 12    |          | 8     | 12    | mAdc   |
| Ripple Current                            |                                            |          | 20   | 50   |          | 25    | 50    |          | 25    | 50    | mA p-p |
| EFFICIENCY                                |                                            |          |      |      |          |       |       |          |       |       |        |
|                                           | TCASE = +25°C<br>Half Load to Full Load    | 78       | 82   |      | 79       | 83    |       | 80       | 84    |       | %      |
| CAPACITIVE LOAD                           |                                            |          |      |      |          |       |       |          |       |       |        |
|                                           | No effect on performance                   | 500      |      |      | 200      |       |       | 200      |       |       | μF     |
| LOAD FAULT POWER DISSIPATION <sup>4</sup> |                                            |          |      |      |          |       |       |          |       |       |        |
|                                           |                                            |          |      | 6    |          |       | 6     |          |       | 6     | W      |
| ISOLATION                                 |                                            |          |      |      |          |       |       |          |       |       |        |
|                                           | Input to Output @ 500Vdc                   | 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 <sup>2</sup>                     | 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 17 to 40Vdc                     |          | +180 |      |          | +180  |       |          | +180  |       | mVpk   |
| Transient                                 | Input step 40 to 17Vdc                     |          | -600 |      |          | -600  |       |          | -600  |       | mVpk   |
| Recovery <sup>2</sup>                     | Input step 17 to 40Vdc                     |          | 400  |      |          | 400   |       |          | 400   |       | μsec   |
|                                           | Input step 40 to 17Vdc                     |          | 400  |      |          | 400   |       |          | 400   |       | μsec   |
| TURN-ON                                   |                                            |          |      |      |          |       |       |          |       |       |        |
| Overshoot                                 | VIN = 17 to 40 VDC                         |          | 0    | 500  |          | 300   | 600   |          | 300   | 750   | mVpk   |
| Delay <sup>3</sup>                        | IOUT = 0 to Full Load                      |          | 8    | 14   |          | 8     | 14    |          | 8     | 14    | msec   |
| LOAD FAULT RECOVERY <sup>4</sup>          |                                            |          |      |      |          |       |       |          |       |       |        |
|                                           | VIN = 17 to 40Vdc                          |          | 8    | 14   |          | 8     | 14    |          | 8     | 14    | msec   |

### Notes:

- Above +85°C case temperature, derate output power linearly to 0 and maximum input voltage linearly to 42V at +115°C case.
- Recovery time is measured from the initiation of the transient to where VOUT has returned to within ±1% of VOUT at 50% load.  
See typical waveforms.
- Turn-on delay time measurement is for either an application of power at the input or a signal at the shutdown pin.
- Load faults include either overload or short circuit conditions.
- For operation at 16Vdc, derate output power by 33%.

# SPECIFICATIONS

TCASE = -55°C to +105°C, VIN = +28V ±5% unless otherwise specified.

## ABSOLUTE MAXIMUM RATINGS

|                                |                                                                                                  |
|--------------------------------|--------------------------------------------------------------------------------------------------|
| Input Voltage <sup>6</sup>     | -0.5V to +50V                                                                                    |
| Power Output                   | Internally limited, 17.5W typical for AHE2805S/ES, 22.5W typical for AHE2812S/ES and AHE2815S/ES |
| Soldering                      | 300°C for 10 seconds                                                                             |
| Temperature Range <sup>1</sup> | Operating -55°C to +125°C case<br>Storage -65°C to +135°C                                        |

| Parameter                                 | Conditions                                          | AHE2805S/ES |      |      | AHE2812S/ES |       |       | AHE2815S/ES |       |       | Units  |
|-------------------------------------------|-----------------------------------------------------|-------------|------|------|-------------|-------|-------|-------------|-------|-------|--------|
|                                           |                                                     | Min         | Typ  | Max  | Min         | Typ   | Max   | Min         | Typ   | Max   |        |
| STATIC CHARACTERISTICS                    |                                                     |             |      |      |             |       |       |             |       |       |        |
| OUTPUT                                    | V <sub>IN</sub> = 17 to 40Vdc                       |             |      |      |             |       |       |             |       |       |        |
| Voltage                                   | I <sub>OUT</sub> = 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         |      | 3000 | 0.0         |       | 1667  | 0.0         |       | 1333  | mAdc   |
| Ripple                                    | Full Load, DC to 1MHz                               |             | 20   | 60   |             | 30    | 60    |             | 30    | 60    | mV p-p |
| Accuracy                                  | T <sub>CASE</sub> = 25°C, Full Load                 | 4.95        | 5.00 | 5.05 | 11.88       | 12.00 | 12.12 | 14.85       | 15.00 | 15.15 | Vdc    |
| Power <sup>1</sup>                        |                                                     | 15          |      |      | 20          |       |       | 20          |       |       | W      |
| REGULATION                                |                                                     |             |      |      |             |       |       |             |       |       |        |
| Line                                      | V <sub>IN</sub> = 17 to 40Vdc                       |             | ±0.5 | ±1.0 |             | ±0.5  | ±1.0  |             | ±0.5  | ±1.0  | %      |
| Load                                      | I <sub>OUT</sub> = 0 to Full Load                   |             | ±0.5 | ±1.0 |             | ±0.5  | ±1.0  |             | ±0.5  | ±1.0  | %      |
| INPUT                                     |                                                     |             |      |      |             |       |       |             |       |       |        |
| Voltage Range <sup>5</sup>                | No Load                                             | 17.0        | 28.0 | 40.0 | 17.0        | 28.0  | 40.0  | 17.0        | 28.0  | 40.0  | Vdc    |
| Current                                   | Full Load                                           |             | 8    | 12   |             | 8     | 12    |             | 8     | 12    | mAdc   |
| Ripple Current                            |                                                     |             | 20   | 50   |             | 25    | 50    |             | 25    | 50    | mA p-p |
| EFFICIENCY                                |                                                     |             |      |      |             |       |       |             |       |       |        |
|                                           | T <sub>CASE</sub> = +25°C<br>Half Load to Full Load | 78          | 82   |      | 79          | 83    |       | 80          | 84    |       | %      |
| CAPACITIVE LOAD                           |                                                     |             |      |      |             |       |       |             |       |       |        |
|                                           | No effect on performance                            | 500         |      |      | 200         |       |       | 200         |       |       | μF     |
| LOAD FAULT POWER DISSIPATION <sup>4</sup> |                                                     |             |      |      |             |       |       |             |       |       |        |
|                                           |                                                     |             |      | 6    |             |       | 6     |             |       | 6     | W      |
| ISOLATION                                 |                                                     |             |      |      |             |       |       |             |       |       |        |
|                                           | Input to Output @ 500Vdc                            | 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 <sup>2</sup>                     | 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 17 to 40Vdc                              |             | +180 |      |             | +180  |       |             | +180  |       | mVpk   |
| Transient                                 | Input step 40 to 17Vdc                              |             | -600 |      |             | -600  |       |             | -600  |       | mVpk   |
| Recovery <sup>2</sup>                     | Input step 17 to 40Vdc                              |             | 400  |      |             | 400   |       |             | 400   |       | μsec   |
|                                           | Input step 40 to 17Vdc                              |             | 400  |      |             | 400   |       |             | 400   |       | μsec   |
| TURN-ON                                   |                                                     |             |      |      |             |       |       |             |       |       |        |
| Overshoot                                 | V <sub>IN</sub> = 17 to 40 VDC                      |             | 0    | 500  |             | 300   | 600   |             | 300   | 750   | mVpk   |
| Delay <sup>3</sup>                        | I <sub>OUT</sub> = 0 to Full Load                   |             | 8    | 14   |             | 8     | 14    |             | 8     | 14    | msec   |
| LOAD FAULT RECOVERY <sup>4</sup>          |                                                     |             |      |      |             |       |       |             |       |       |        |
|                                           | V <sub>IN</sub> = 17 to 40Vdc                       |             | 8    | 14   |             | 8     | 14    |             | 8     | 14    | msec   |

### Notes:

- Above +105°C case temperature, derate output power linearly to 0 at +125°C case.
- Recovery time is measured from the initiation of the transient to where VOUT has returned to within ±1% of VOUT at 50% load. See typical waveforms.
- Turn-on delay time measurement is for either an application of power at the input or a signal at the shutdown pin.
- Load faults include either overload or short circuit conditions.
- For operation at 16Vdc, derate output power by 33%.
- Above +85°C case temperature, derate maximum input voltage linearly to 33V at +125°C case.

# SPECIFICATIONS

TCASE = -55°C to +125°C, VIN = +28V ±5% unless otherwise specified.

## ABSOLUTE MAXIMUM RATINGS

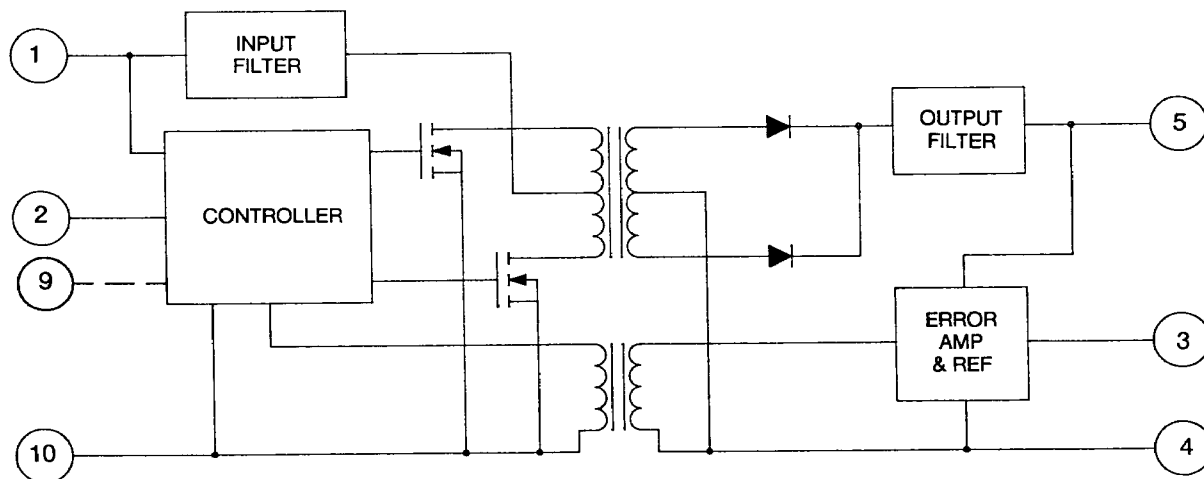
|                                |                                                                                                  |
|--------------------------------|--------------------------------------------------------------------------------------------------|
| Input Voltage                  | -0.5V to +50V                                                                                    |
| Power Output                   | Internally limited, 17.5W typical for AHE2805S/HB, 22.5W typical for AHE2812S/HB and AHE2815S/HB |
| Soldering                      | 300°C for 10 seconds                                                                             |
| Temperature Range <sup>1</sup> | Operating -55°C to +135°C case<br>Storage -65°C to +135°C                                        |

| Parameter                                 | Conditions                                          | AHE2805S/HB |      |       | AHE2812S/HB |       |       | AHE2815S/HB |       |       | Units            |
|-------------------------------------------|-----------------------------------------------------|-------------|------|-------|-------------|-------|-------|-------------|-------|-------|------------------|
|                                           |                                                     | Min         | Typ  | Max   | Min         | Typ   | Max   | Min         | Typ   | Max   |                  |
| STATIC CHARACTERISTICS                    |                                                     |             |      |       |             |       |       |             |       |       |                  |
| OUTPUT                                    | V <sub>IN</sub> = 17 to 40V <sub>DC</sub>           |             |      |       |             |       |       |             |       |       |                  |
| Voltage                                   | I <sub>OUT</sub> = 0 to Full Load                   | 4.90        | 5.00 | 5.10  | 11.76       | 12.00 | 12.24 | 14.70       | 15.00 | 15.30 | V <sub>DC</sub>  |
| Current                                   |                                                     | 0.0         |      | 3000  | 0.0         |       | 1667  | 0.0         |       | 1333  | mA <sub>DC</sub> |
| Ripple                                    | Full Load, DC to 1MHz                               |             | 20   | 60    |             | 30    | 60    |             | 30    | 60    | mV p-p           |
| Accuracy                                  | T <sub>CASE</sub> = 25°C, Full Load                 | 4.95        | 5.00 | 5.05  | 11.88       | 12.00 | 12.12 | 14.85       | 15.00 | 15.15 | V <sub>DC</sub>  |
| Power <sup>1</sup>                        |                                                     | 15          |      |       | 20          |       |       | 20          |       |       | W                |
| REGULATION                                |                                                     |             |      |       |             |       |       |             |       |       |                  |
| Line                                      | V <sub>IN</sub> = 17 to 40V <sub>DC</sub>           |             | ±0.5 | ±1.0  |             | ±0.5  | ±1.0  |             | ±0.5  | ±1.0  | %                |
| Load                                      | I <sub>OUT</sub> = 0 to Full Load                   |             | ±0.5 | ±1.0  |             | ±0.5  | ±1.0  |             | ±0.5  | ±1.0  | %                |
| INPUT                                     |                                                     |             |      |       |             |       |       |             |       |       |                  |
| Voltage Range <sup>5</sup>                | No Load                                             | 17.0        | 28.0 | 40.0  | 17.0        | 28.0  | 40.0  | 17.0        | 28.0  | 40.0  | V <sub>DC</sub>  |
| Current                                   | Full Load                                           |             | 8    | 12    |             | 8     | 12    |             | 8     | 12    | mA <sub>DC</sub> |
| Ripple Current                            |                                                     |             | 20   | 50    |             | 25    | 50    |             | 25    | 50    | mA p-p           |
| EFFICIENCY                                |                                                     |             |      |       |             |       |       |             |       |       |                  |
|                                           | T <sub>CASE</sub> = +25°C<br>Half Load to Full Load | 78          | 82   |       | 79          | 83    |       | 80          | 84    |       | %                |
| CAPACITIVE LOAD                           |                                                     |             |      |       |             |       |       |             |       |       |                  |
|                                           | No effect on performance                            | 500         | 1000 |       | 200         | 1000  |       | 200         | 1000  |       | μF               |
| LOAD FAULT POWER DISSIPATION <sup>4</sup> |                                                     |             |      |       |             |       |       |             |       |       |                  |
|                                           |                                                     |             |      | 6     |             |       | 6     |             |       | 6     | W                |
| ISOLATION                                 |                                                     |             |      |       |             |       |       |             |       |       |                  |
|                                           | Input to Output @ 500V <sub>DC</sub>                | 100         |      |       | 100         |       |       | 100         |       |       | MΩ               |
| DYNAMIC CHARACTERISTICS                   |                                                     |             |      |       |             |       |       |             |       |       |                  |
| STEP LOAD CHANGES                         |                                                     |             |      |       |             |       |       |             |       |       |                  |
| Output                                    | 50% Load ↔ 100% Load                                |             | ±150 | ±300  |             | ±200  | ±400  |             | ±200  | ±400  | mV <sub>pk</sub> |
| Transient                                 | No Load → 50% Load                                  |             | -300 | -500  |             | -400  | -750  |             | -400  | -750  | mV <sub>pk</sub> |
|                                           | 50% Load → No Load                                  |             | +300 | +500  |             | +400  | +750  |             | +400  | +750  | mV <sub>pk</sub> |
| Recovery <sup>2</sup>                     | 50% Load ↔ 100% Load                                |             | 25   | 100   |             | 25    | 100   |             | 25    | 100   | μsec             |
|                                           | No Load → 50% Load                                  |             | 500  | 1000  |             | 500   | 1000  |             | 500   | 1000  | μsec             |
|                                           | 50% Load → No Load                                  |             | 7    | 10    |             | 7     | 10    |             | 7     | 10    | msec             |
| STEP LINE CHANGES                         |                                                     |             |      |       |             |       |       |             |       |       |                  |
| Output                                    | Input step 17 to 40V <sub>DC</sub>                  |             | +180 | +300  |             | +180  | +500  |             | +180  | +500  | mV <sub>pk</sub> |
| Transient                                 | Input step 40 to 17V <sub>DC</sub>                  |             | -600 | -1000 |             | -600  | -1500 |             | -600  | -1500 | mV <sub>pk</sub> |
| Recovery <sup>2</sup>                     | Input step 17 to 40V <sub>DC</sub>                  |             | 400  | 800   |             | 400   | 800   |             | 400   | 800   | μsec             |
|                                           | Input step 40 to 17V <sub>DC</sub>                  |             | 400  | 800   |             | 400   | 800   |             | 400   | 800   | μsec             |
| TURN-ON                                   |                                                     |             |      |       |             |       |       |             |       |       |                  |
| Overshoot                                 | V <sub>IN</sub> = 17 to 40 V <sub>DC</sub>          |             | 0    | 500   |             | 300   | 600   |             | 300   | 750   | mV <sub>pk</sub> |
| Delay <sup>3</sup>                        | I <sub>OUT</sub> = 0 to Full Load                   |             | 8    | 14    |             | 8     | 14    |             | 8     | 14    | msec             |
| LOAD FAULT RECOVERY <sup>4</sup>          |                                                     |             |      |       |             |       |       |             |       |       |                  |
|                                           | V <sub>IN</sub> = 17 to 40V <sub>DC</sub>           |             | 8    | 14    |             | 8     | 14    |             | 8     | 14    | msec             |

### Notes:

- Above +125°C case temperature, derate output power linearly to 0 at +135°C case.
- Recovery time is measured from the initiation of the transient to where VOUT has returned to within ±1% of VOUT at 50% load. See typical waveforms.
- Turn-on delay time measurement is for either an application of power at the input or a signal at the shutdown pin.
- Load faults include either overload or short circuit conditions.
- For operation at 16Vdc, derate output power by 33%.

## 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 400 $\mu$ A of current. The open circuit voltage of the inhibit input is 11.5  $\pm$  1VDC.

### EMI Filter

An optional EMI filter (AF or AFA461) will reduce the input ripple current to levels below the limits imposed by MIL-STD-461B CEO3.

### Output Adjust (AHE2805) only

The output voltage of the AHE2805 can be adjusted upward by connecting Output Adjust (Pin 3) and Output Common (Pin 4) as shown in Table 1.

| Resistance<br>Pin 3 to 4 | Output Voltage<br>Increase, % |
|--------------------------|-------------------------------|
| $\infty$                 | 0                             |
| 390k                     | + 1%                          |
| 145k                     | + 2%                          |
| 63k                      | + 3%                          |
| 22k                      | + 4%                          |
| 0                        | + 5%                          |

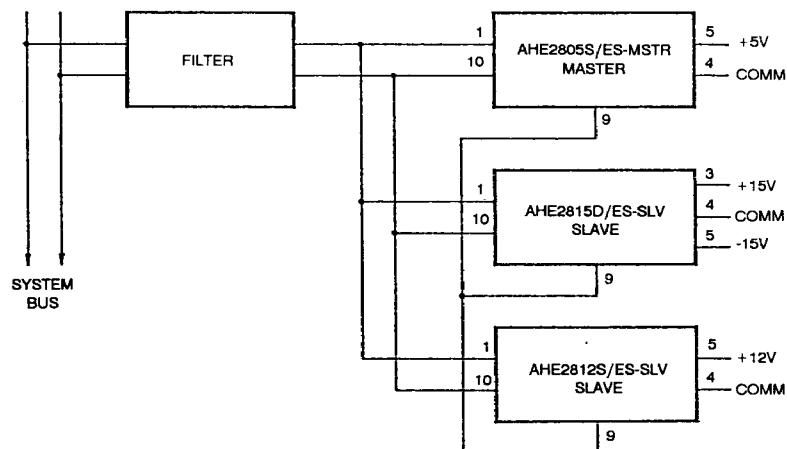
Table 1 Output adjustment resistor values

### 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 offers an option which provides synchronization of multiple AHE/ATW/ATO 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 9) of the master device is connected to the synchronization input (pin 9) 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, an 'MSTR' suffix is added for the master converter part number and an 'SLV' suffix is added for slave part number. See Part Number section.



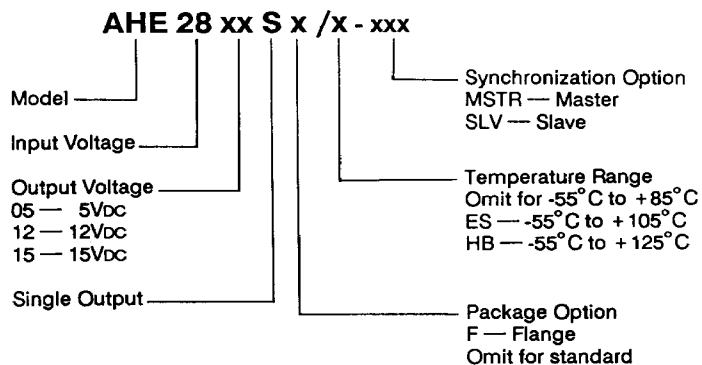
*Typical Synchronization Connection Diagram*

## PIN DESIGNATION

|                       |                     |
|-----------------------|---------------------|
| Pin 1 Positive input  | Pin 10 Input common |
| Pin 2 Inhibit input   | Pin 9 N/C           |
| Pin 3 Output adjust*  | Pin 8 Case gnd      |
| Pin 4 Output common   | Pin 7 N/C           |
| Pin 5 Positive output | Pin 6 N/C           |

\* AHE2805S only. AHE2812S/2815S have N/C on Pin 3.

## PART NUMBER



## TYPICAL CHARACTERISTICS

Waveforms shown are for AHE2805.

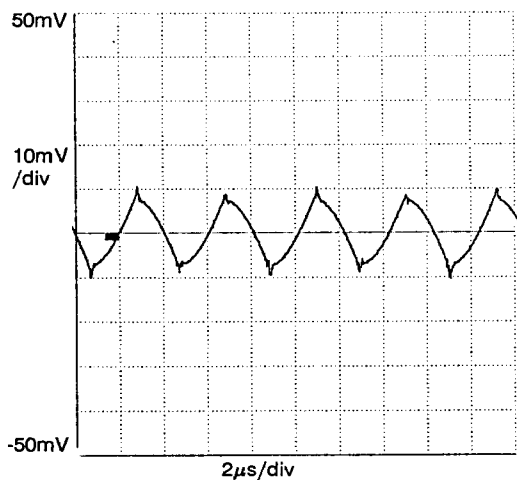


Figure 1 Output Voltage Ripple  
VIN = 28Vdc, Full Load

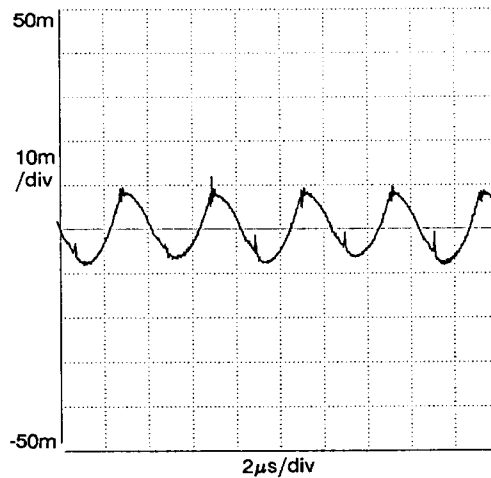


Figure 2 Input Ripple Current  
VIN = 28V, Full Load

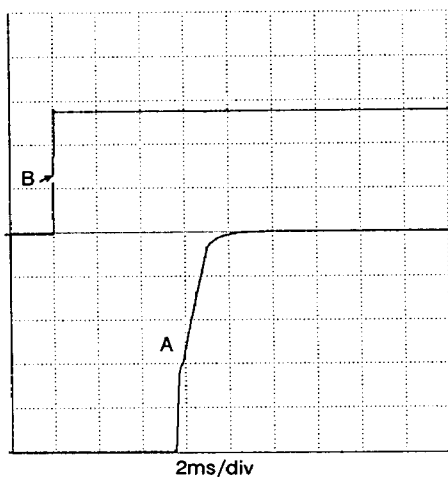


Figure 3 Turn-on Response  
A: Output @ 1V/DIV, Full Load  
B: Input @ 10V/DIV (0V → 28V step)

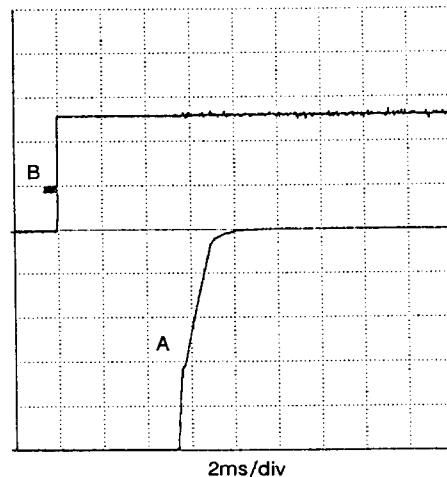


Figure 4 Turn-on Response from Inhibit  
A: Output @ 1V/DIV, Full Load  
B: Inhibit (Pin 2) @ 5V/DIV

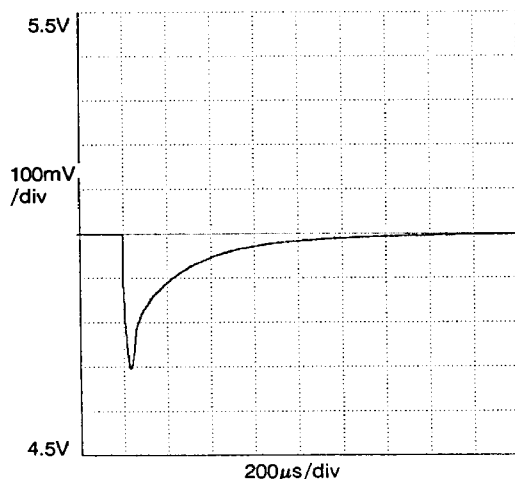


Figure 5 Load Step Response  
Load Step 0 to 1.5A  
(No Load to Half Load)

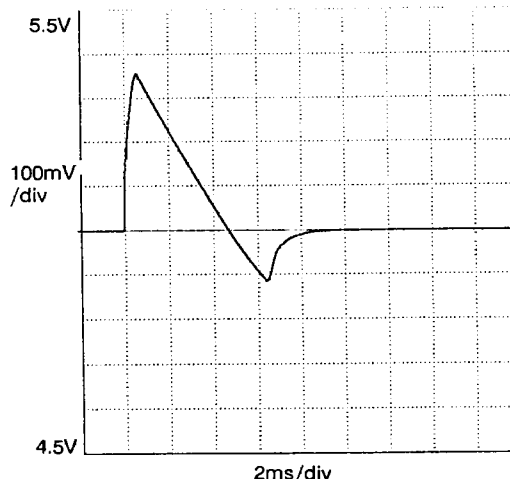
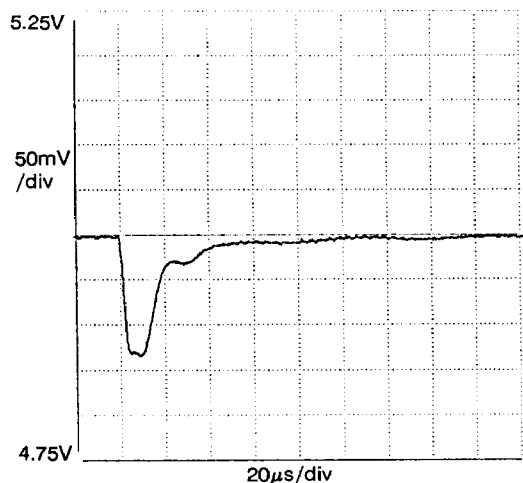
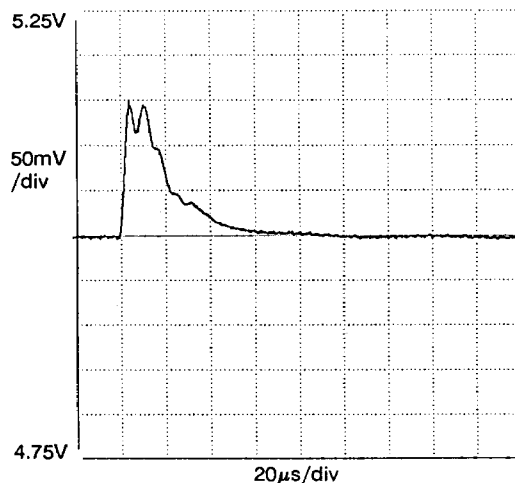


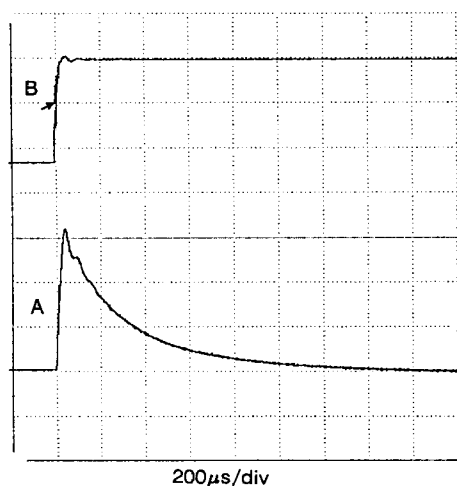
Figure 6 Load Step Response  
Load Step 1.5A to 0A  
(Half Load to No Load)



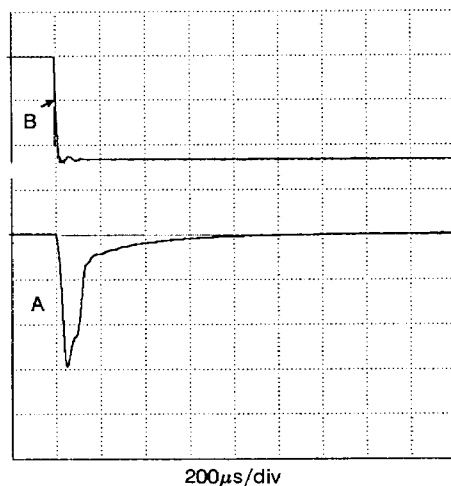
**Figure 7** Load Step Response  
Load Step 1.5A to 3.0A  
(Half Load to Full Load)



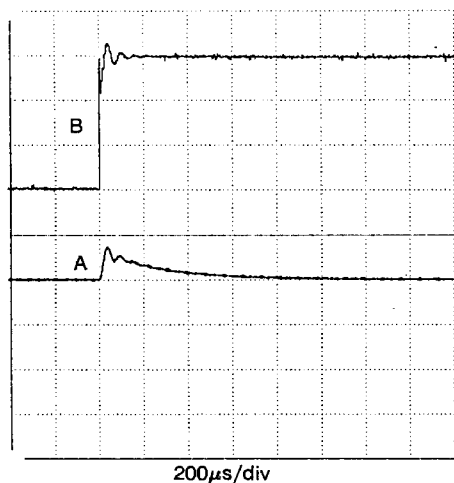
**Figure 8** Load Step Response  
Load Step 3.0A to 1.5A  
(Full Load to Half Load)



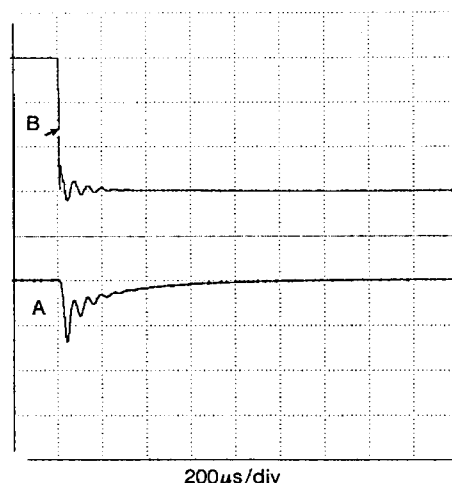
**Figure 9** Line Step Response  
A: Output @ 50mV/DIV, Full Load  
B: Input step 17V to 40V



**Figure 10** Line Step Response  
A: Output @ 200mV/DIV, Full Load  
B: Input Step 40V to 17V



**Figure 11** Line Step Response  
A: Output @ 50mV/DIV, Full Load  
B: Input Step 28V to 34V



**Figure 12** Line Step Response  
A: Output @ 50mV/DIV, Full Load  
B: Input Step 28V to 22V



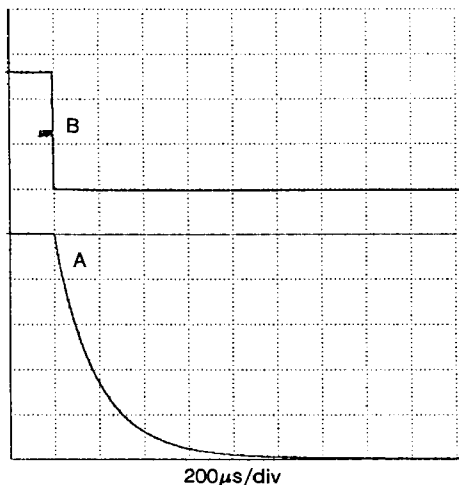


Figure 13 Turn-off Response from Inhibit  
A: Output @ 1V/DIV, Full Load  
B: Inhibit (Pin 2) @ 5V/DIV

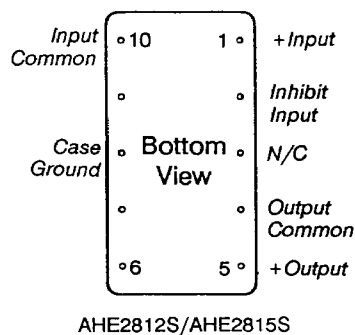
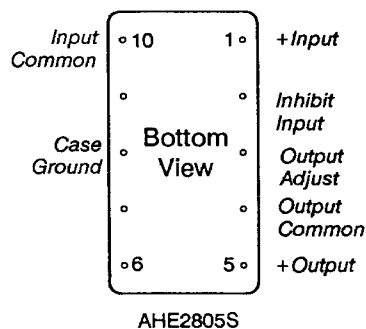
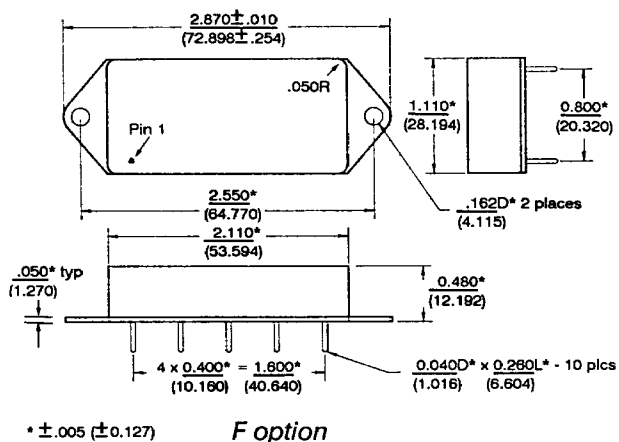
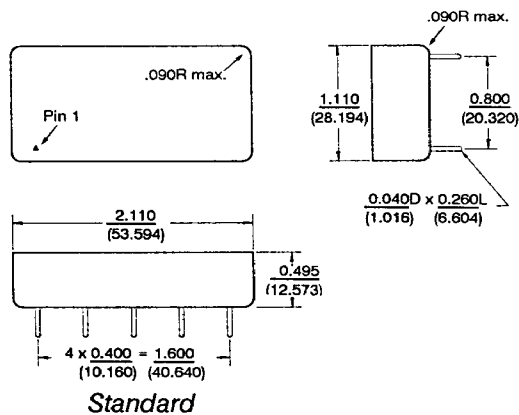
## Screening Process

| Test Inspection                 | Method            | Condition          |
|---------------------------------|-------------------|--------------------|
| Pre-Seal Internal Visual        | 2017              |                    |
| Stabilization Bake              | 1008              | C                  |
| Temperature Cycling             | 1010              | C                  |
| Constant Acceleration           | 2001              | A                  |
| Burn-in                         | 1015              | $T_C = T_{Cmax}^*$ |
| Final Electrical Test (Group A) | 25°C and extremes |                    |
| External Visual                 | 2009              |                    |

\*  $T_{Cmax}$  = 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.

## MECHANICAL OUTLINE



## 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                 | ±0.5%                 | 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 |
|             |                       | 5V, 2A                         |                         |                   | ±0.5%                 | 50mV p-p                   |                 | flange                |
|             |                       | ±15V, ±167mA                   |                         |                   | ±0.5%                 | 25mV p-p                   |                 | 2.700 x 1.345 x 0.500 |
| ATO2812T/ES | 15                    | 5V, 2A                         | 16 - 40                 | 3                 | ±0.5%                 | 50mV p-p                   | -55°C to +105°C | standard              |
|             |                       | ±12V, ±208mA                   |                         |                   | ±0.5%                 | 25mV p-p                   |                 | 1.950 x 1.345 x 0.500 |
| ATO2815T/ES | 15                    | 5V, 2A                         | 16 - 40                 | 3                 | ±0.5%                 | 50mV p-p                   |                 | flange                |
|             |                       | ±15V, ±167mA                   |                         |                   | ±0.5%                 | 25mV p-p                   |                 | 2.700 x 1.345 x 0.500 |
| ATO2812T/HB | 15                    | 5V, 2A                         | 16 - 40                 | 3                 | ±0.5%                 | 50mV p-p                   | -55°C to +125°C | standard              |
|             |                       | ±12V, ±208mA                   |                         |                   | ±0.5%                 | 25mV p-p                   |                 | 1.950 x 1.345 x 0.500 |
| ATO2815T/HB | 15                    | 5V, 2A                         | 16 - 40                 | 3                 | ±0.5%                 | 50mV p-p                   |                 | flange                |
|             |                       | ±15V, ±167mA                   |                         |                   | ±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. Up to 90% of full power is available from either output provided the total output does not exceed 30 watts.

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.

## 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<br>±15V, 400mA            | 15 - 50                 | 3                 | ±1%<br>±4%             | 60mV p-p<br>110mV p-p              | 50MΩ <sup>4</sup><br>50MΩ <sup>4</sup>                      | -55°C to +95°C  |
| PS6009 <sup>3</sup> | 80                    | 5V, 3A<br>±15V, 750mA<br>28V, 1.5A | 14.5 - 50               | 3                 | ±2%<br>±5%<br>±5%      | 80mV p-p<br>200mV p-p<br>200mV p-p | 80MΩ <sup>4</sup><br>50MΩ <sup>4</sup><br>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 full 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. These units are manufactured in a MIL-STD-1772 qualified facility. 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 ( $R_{thjc}$ ) as low as  $<1^{\circ}\text{C/W}$

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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.

5-9004

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