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AHE2800D Series Hybrid - High Reliability DC/DC Converters

DESCRIPTION

The AHE2800D 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 $\pm 12V$ and $\pm 15V$ dual outputs to satisfy a wide range of requirements. The circuit design incorporates a pulse width modulated push-pull topology operating in the feed-forward mode at a nominal switching frequency of 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. Single output versions are available and are described in a separate data sheet.

FEATURES

- 17 - 40 VDC input range (28VDC nominal)
- $\pm 12V$ and $\pm 15V$ outputs available
- Indefinite short circuit and overload protection
- 12.9W/in³ power density
- 15 watts output power
- Fast loop response for superior transient characteristics
- Operating temperature range from -55°C to +125°C available
- Popular industry standard pin-out
- Resistance seam welded case for superior long term hermeticity
- Efficiencies up to 82%
- Shutdown from external signal
- Military screening
- 314,000 hour MTBF at 85°C, AUC

SPECIFICATIONS

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

ABSOLUTE MAXIMUM RATINGS

| | |
|--------------------------------|---|
| Input Voltage ¹ | -0.5 V to +50 V |
| Power Output | Internally limited, 17.5 W typical |
| Soldering | 300°C for 10 seconds |
| Temperature Range ¹ | Operating -55°C +115°C case Storage -65°C +135°C |

| Parameter | Conditions | AHE2812D | | | AHE2815D | | | Units |
|-------------------------------------|---------------------------|----------|--------|----------|----------|--------|-----------|----------------|
| | | Min | Typ | Max | Min | Typ | Max | |
| STATIC CHARACTERISTICS | | | | | | | | |
| OUTPUT | VIN = 17 to 40VDC | | | | | | | |
| Voltage | IOUT = 0 to Full Load | ±11.76 | ±12.00 | ±12.24 | ±14.70 | ±15.00 | ±15.30 | VDC |
| Current ⁶ | | 0.0 | | ±625 | 0.0 | | ±500 | mADC |
| Ripple | Full Load, 20kHz to 2MHz | | 25 | 60 | | 25 | 60 | mV p-p |
| Accuracy | TCASE = 25°C, Full Load | ±11.88 | ±12.00 | ±12.12 | ±14.85 | ±15.00 | ±15.15 | VDC |
| Power ¹ | | 15 | | | 15 | | | W |
| REGULATION | | | | | | | | |
| Line | VIN = 17 to 40 VDC | | | 60 | | | | mV |
| Load | IOUT = 0 to Full Load | | | 120 | | | 75 150 | mV mV |
| INPUT | | | | | | | | |
| Voltage Range ⁵ | No Load | 17.0 | 28.0 | 40.0 | 17.0 | 28.0 | 40.0 | VDC |
| Current | Inhibited | | 18 | 40 | | 18 | 40 | mADC |
| | Full Load | | 25 | 18 50 | | 25 | 18 50 | mADC mA p-p |
| EFFICIENCY | | | | | | | | |
| | TCASE = +25°C | | | | | | | |
| | Full Load | 80 | | | 80 | | | % |
| CAPACITIVE LOAD | | | | | | | | |
| | No effect on performance | 200 | | | 200 | | | µF |
| LOAD FAULT POWER DISSIPATION | | | | | | | | |
| | | | | 6 | | | 6 | W |
| ISOLATION | | | | | | | | |
| | Input to Output @ 500 VDC | 100 | | | 100 | | | MΩ |
| DYNAMIC CHARACTERISTICS | | | | | | | | |
| STEP LOAD CHANGES | | | | | | | | |
| Output | 50% Load ↔ 100% Load | | ±100 | | | ±100 | | mVpk |
| Transient | No Load ↔ Half Load | | ±250 | | | ±250 | | mVpk |
| Recovery ² | 50% Load ↔ 100% Load | | 25 | | | 25 | | µs |
| | No Load → 50% Load | | 500 | | | 500 | | µs |
| | 50% Load → No Load | | 3 | | | 3 | | ms |
| STEP LINE CHANGES | | | | | | | | |
| Output | Input step 17 to 40 VDC | | +180 | | | +180 | | mVpk |
| Transient | Input step 40 to 17 VDC | | -600 | | | -600 | | mVpk |
| Recovery ² | Input step 17 to 40 VDC | | 2 | | | 2 | | ms |
| | Input step 40 to 17 VDC | | 2 | | | 2 | | ms |
| TURN-ON | | | | | | | | |
| Overshoot | VIN = 17 to 40 VDC | | 0 | 600 | | 0 | 600 | mVpk |
| Delay ³ | IOUT = 0 to 3.0ADC | | 8 | 10 | | 8 | 10 | ms |
| LOAD FAULT RECOVERY | | | | | | | | |
| | VIN = 17 to 40 VDC | | 8 | 10 | | 8 | 10 | ms |

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 input transient to where VOUT has returned to within ±1% of VOUT at 50% load.
- 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%.
- At least 25% of the total load should be on the positive output.

SPECIFICATIONS

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

ABSOLUTE MAXIMUM RATINGS

| | |
|--------------------------------|---|
| Input Voltage ⁶ | -0.5 V to +50 V |
| Power Output | Internally limited, 17.5 W typical |
| Soldering | 300°C for 10 seconds |
| Temperature Range ¹ | Operating -55°C +125°C case Storage -65°C +135°C |

| Parameter | Conditions | AHE2812D/ES | | | AHE2815D/ES | | | Units |
|--|--|-------------|--------|--------|-------------|--------|--------|--------|
| | | Min | Typ | Max | Min | Typ | Max | |
| STATIC CHARACTERISTICS | | | | | | | | |
| OUTPUT | VIN = 17 to 40VDC IOUT = 0 to Full Load | ±11.76 | ±12.00 | ±12.24 | ±14.70 | ±15.00 | ±15.30 | VDC |
| Voltage | | 0.0 | | ±625 | 0.0 | | ±500 | mADC |
| Current ⁷ | | | 25 | 60 | 25 | | 60 | mV p-p |
| Ripple | Full Load, 20kHz to 2MHz | | | | | | | VDC |
| Accuracy | TCASE = 25°C, Full Load | ±11.88 | ±12.00 | ±12.12 | ±14.85 | ±15.00 | ±15.15 | W |
| Power ¹ | | 15 | | | 15 | | | |
| REGULATION | | | | | | | | |
| Line | VIN = 17 to 40 VDC | | | 60 | | | 75 | mV |
| Load | IOUT = 0 to Full Load | | | 120 | | | 150 | mV |
| INPUT | | | | | | | | |
| Voltage Range ⁵ | No Load | 17.0 | 28.0 | 40.0 | 17.0 | 28.0 | 40.0 | VDC |
| Current | Inhibited | | 18 | 40 | | 18 | 40 | mADC |
| | Full Load | | 25 | 50 | | 25 | 50 | mADC |
| Ripple Current | | | | | | | | mA p-p |
| EFFICIENCY | | | | | | | | |
| | TCASE = +25°C | 80 | | | 80 | | | % |
| | Full Load | | | | | | | |
| CAPACITIVE LOAD | | | | | | | | |
| | No effect on performance | 200 | 1000 | | 200 | 1000 | | µF |
| LOAD FAULT POWER DISSIPATION | | | | | | | | |
| | | | | 6 | | | 6 | W |
| ISOLATION | | | | | | | | |
| | Input to Output @ 500 VDC | 100 | | | 100 | | | MΩ |
| DYNAMIC CHARACTERISTICS | | | | | | | | |
| STEP LOAD CHANGES | | | | | | | | |
| Output | 50% Load ↔ 100% Load | | ±100 | | | ±100 | | mVpk |
| Transient | No Load ↔ Half Load | | ±250 | | | ±250 | | mVpk |
| Recovery ² | 50% Load ↔ 100% Load | | 25 | | | 25 | | µs |
| | No Load → 50% Load | | 500 | | | 500 | | µs |
| | 50% Load → No Load | | 3 | | | 3 | | ms |
| STEP LINE CHANGES | | | | | | | | |
| Output | Input step 17 to 40 VDC | | +180 | | | +180 | | mVpk |
| Transient | Input step 40 to 17 VDC | | -600 | | | -600 | | mVpk |
| Recovery ² | Input step 17 to 40 VDC | | 2 | | | 2 | | ms |
| | Input step 40 to 17 VDC | | 2 | | | 2 | | ms |
| TURN-ON | | | | | | | | |
| Overshoot | VIN = 17 to 40 VDC | | 0 | 600 | | 0 | 600 | mVpk |
| Delay ³ | IOUT = 0 to 3.0ADC | | 8 | 10 | | 8 | 10 | ms |
| LOAD FAULT RECOVERY⁴ | | | | | | | | |
| | VIN = 17 to 40 VDC | | 8 | 10 | | 8 | 10 | ms |

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 input transient to where VOUT has returned to within ±1% of VOUT at 50% load.
- 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.
- At least 25% of the total load should be on the positive output.

SPECIFICATIONS

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

ABSOLUTE MAXIMUM RATINGS

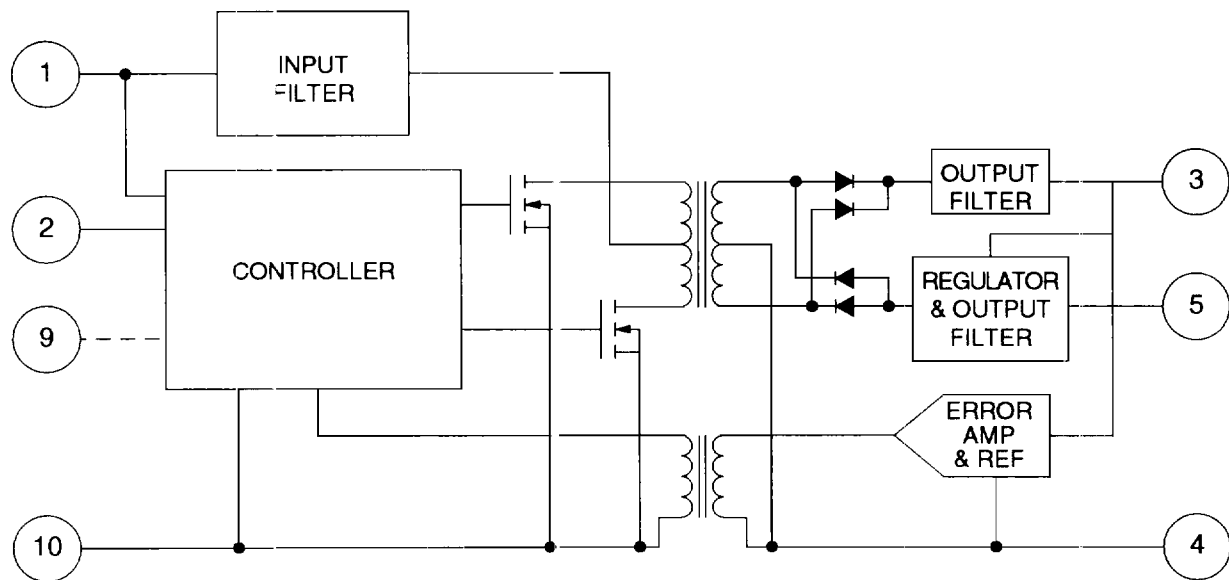
| | |
|--------------------------------|---|
| Input Voltage | -0.5 V to +50 V |
| Power Output | Internally limited, 17.5 W typical |
| Soldering | 300°C for 10 seconds |
| Temperature Range ¹ | Operating -55°C +135°C case Storage -65°C +135°C |

| Parameter | Conditions | AHE2812D/HB | | | AHE2815D/HB | | | Units |
|----------------------------------|--|-------------|--------|--------|-------------|--------|--------|--------|
| | | Min | Typ | Max | Min | Typ | Max | |
| STATIC CHARACTERISTICS | | | | | | | | |
| OUTPUT | VIN = 17 to 40VDC IOUT = 0 to Full Load | ±11.76 | ±12.00 | ±12.24 | ±14.70 | ±15.00 | ±15.30 | VDC |
| Voltage | | 0.0 | | ±625 | 0.0 | | ±500 | mADC |
| Current ⁶ | | | 25 | 60 | | 25 | 60 | mV p-p |
| Ripple | Full Load, 20kHz to 2MHz | | | | | | | VDC |
| Accuracy | TCASE = 25°C, Full Load | ±11.88 | ±12.00 | ±12.12 | ±14.85 | ±15.00 | ±15.15 | W |
| Power ¹ | | 15 | | | 15 | | | |
| REGULATION | | | | | | | | |
| Line | VIN = 17 to 40 VDC | | | 60 | | | 75 | mV |
| Load | IOUT = 0 to Full Load | | | 120 | | | 150 | mV |
| INPUT | | | | | | | | |
| Voltage Range ⁵ | No Load | 17.0 | 28.0 | 40.0 | 17.0 | 28.0 | 40.0 | VDC |
| Current | Inhibited | | 18 | 40 | | 18 | 40 | mADC |
| | Full Load | | 25 | 50 | | 25 | 50 | mADC |
| Ripple Current | | | | | | | | mA p-p |
| EFFICIENCY | TCASE = +25°C | | | | | | | |
| | Full Load | 80 | | | 80 | | | % |
| CAPACITIVE LOAD | No effect on performance | | | 200 | | | 200 | µF |
| LOAD FAULT POWER DISSIPATION | | | | 6 | | | 6 | W |
| ISOLATION | Input to Output @ 500 Vdc | 100 | | 100 | | | | MΩ |
| DYNAMIC CHARACTERISTICS | | | | | | | | |
| STEP LOAD CHANGES | | | | | | | | |
| Output | 50% Load ↔ 100% Load | | ±100 | ±450 | | ±100 | ±450 | mVpk |
| Transient | No Load ↔ Half Load | | ±250 | ±760 | | ±250 | ±750 | mVpk |
| Recovery ² | 50% Load ↔ 100% Load | | 25 | 70 | | 25 | 70 | µs |
| | No Load → 50% Load | | 500 | 1500 | | 500 | 1500 | µs |
| | 50% Load → No Load | | 3 | 5 | | 3 | 5 | ms |
| STEP LINE CHANGES | | | | | | | | |
| Output | Input step 17 to 40 VDC | | +180 | 1200 | | +180 | 1500 | mVpk |
| Transient | Input step 40 to 17 VDC | | -600 | -1500 | | -600 | -1500 | mVpk |
| Recovery ² | Input step 17 to 40 VDC | | 2 | 4 | | 2 | 4 | ms |
| | Input step 40 to 17 VDC | | 2 | 4 | | 2 | 4 | ms |
| TURN-ON | | | | | | | | |
| Overshoot | VIN = 17 to 40 VDC | | 0 | 600 | | 0 | 600 | mVpk |
| Delay ³ | IOUT = 0 to 3.0ADC | | 8 | 10 | | 8 | 10 | ms |
| LOAD FAULT RECOVERY ⁴ | VIN = 17 to 40 VDC | | 8 | 10 | | 8 | 10 | ms |

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 input transient to where VOUT has returned to within ±1% of VOUT at 50% load.
- 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%.
- At least 25% of the total load should be on the positive output.

BLOCK DIAGRAM (Single Output)



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 μ A of current. The open circuit voltage of the inhibit input is 11.5 +1 VDC.

EMI Filter

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

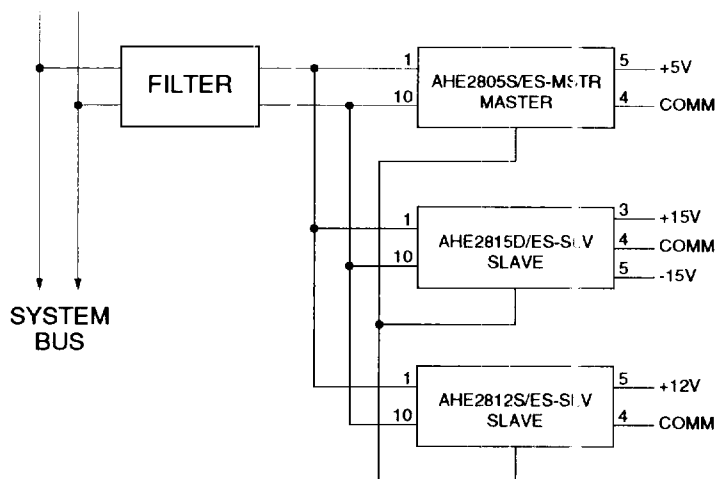
Device Synchronization

Whenever multiple DC/DC converters are utilized in a single system, significant low frequency noise may be generated due to slight difference in the switching frequencies of the converters (beat frequency noise). Because of the low frequency nature of this noise (typically less than 10 kHz), 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 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.



Typical Synchronization Connection Diagram

PIN DESIGNATION

AHE2812D
AHE2815D

- Pin 1 Positive input
- Pin 2 Inhibit input
- Pin 3 Positive output
- Pin 4 Output common
- Pin 5 Negative output
- Pin 6 N/C
- Pin 7 N/C
- Pin 8 Case ground
- Pin 9 N/C or sync.
- Pin 10 Input common

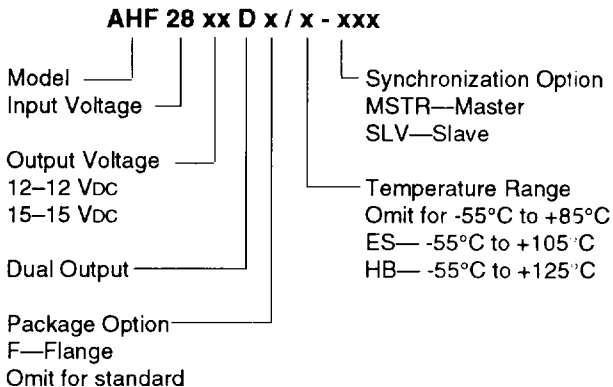
HB Screening Process
Per MIL-STD-883C, Method 5008

| Test Inspection | Method | Condition |
|--------------------------|--------|---------------------|
| Pre-Seal Internal Visual | 2017 | |
| Stabilization Bake | 1008 | C |
| Temperature Cycling | 1010 | C |
| Constant Acceleration | 2001 | A, Y1 direction |
| Burn-in | 1015 | Tc = +125°C |
| Final Electrical Test | | Tc = -55,+25,+125°C |
| Gross Leak | 1014 | C |
| Fine Leak | 1014 | A |
| External Visual | 2009 | |

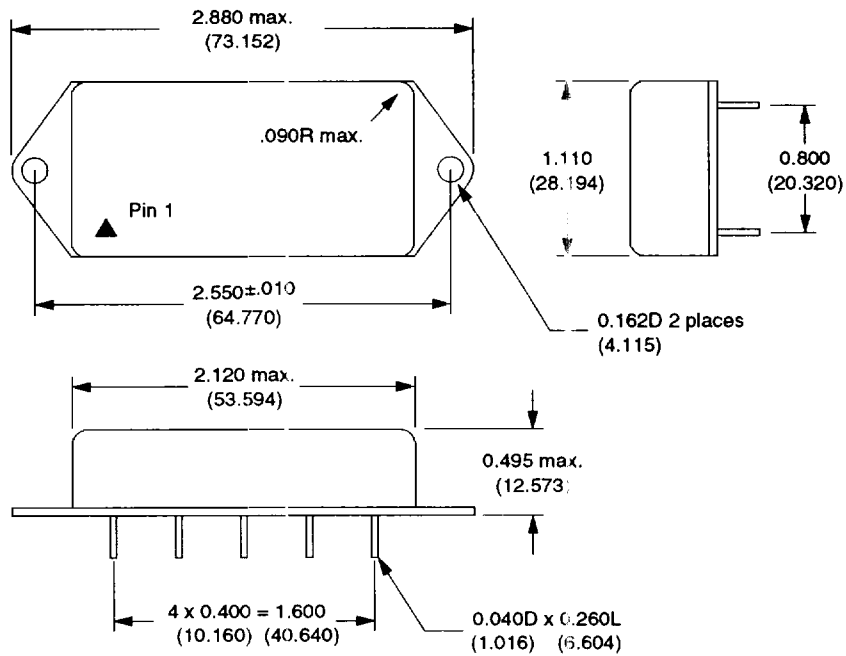
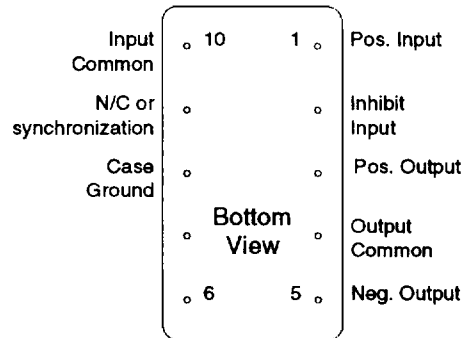
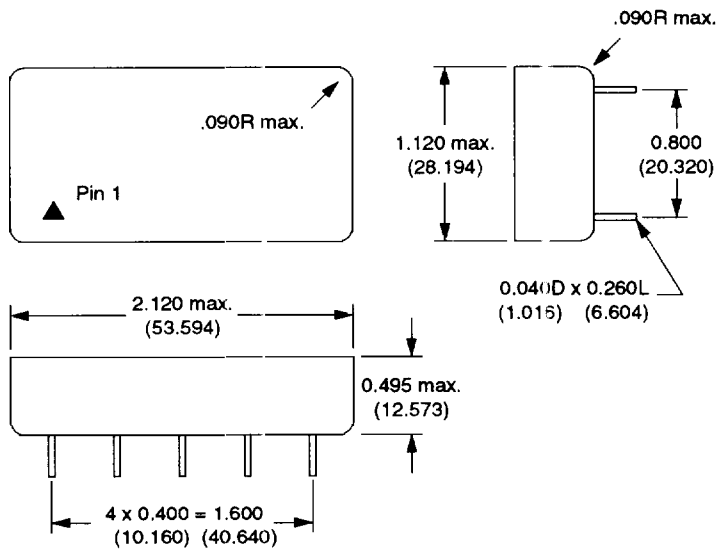
ES Screening Process
Same as HB screening except as follows:

| Test Inspection | Method |
|-----------------------|--------------|
| Constant Acceleration | 2001, 500g's |
| Burn-in | 1015, 96hrs. |
| Final Electrical | 25°C only |

PART NUMBER



MECHANICAL OUTLINE



Weight

Standard—55 grams max.

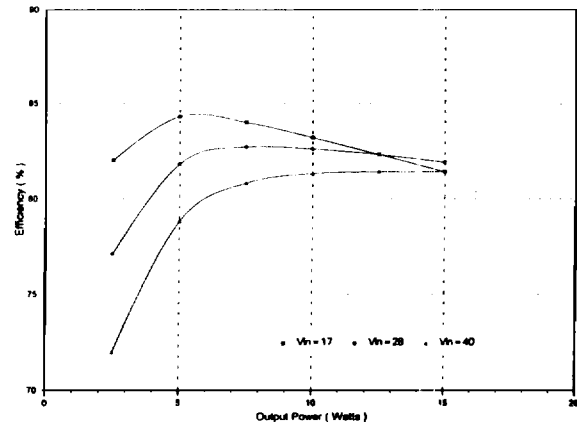
Flange—58 grams max.

STANDARDIZED MILITARY DRAWING CROSS REFERENCE

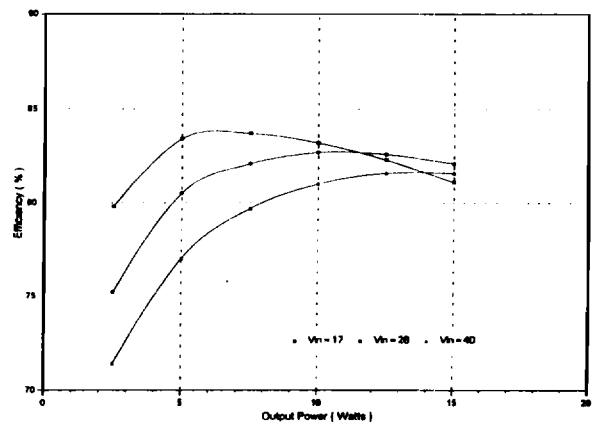
| Standardized military drawing PIN | Vendor CAGE number | Vendor similar PIN |
|-----------------------------------|--------------------|--------------------|
| 5962-9157501HXX | 52467 | AHE2815D/CH |
| 5962-9157501HZX | 52467 | AHE2815DF/CH |
| 5962-9157502HXX | 52467 | AHE2815D/CH-SLV |
| 5962-9157502HZX | 52467 | AHE2815DF/CH-SLV |
| 5962-9157503HXX | 52467 | AHE2815D/CH-MSTR |
| 5962-9157503HZX | 52467 | AHE2815DF/CH-MSTR |

| Standardized military drawing PIN | Vendor CAGE number | Vendor similar PIN |
|-----------------------------------|--------------------|--------------------|
| 5962-9204001HXX | 52467 | AHE2812D/CH |
| 5962-9204001HZX | 52467 | AHE2812DF/CH |
| 5962-9204002HXX | 52467 | AHE2812D/CH-SLV |
| 5962-9204002HZX | 52467 | AHE2812DF/CH-SLV |
| 5962-9204003HXX | 52467 | AHE2812D/CH-MSTR |
| 5962-9204003HZX | 52467 | AHE2812DF/CH-MSTR |

AHE2812D EFFICIENCY



AHE2815D EFFICIENCY



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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
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