

1600XA Series

Distributed By:
B. J. Wolfe Enterprises
 (800) 554-1224
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- -55°C to +85°C Operation
- Meets MIL-STD-810 & MIL-STD-202
- 10.6W/In³ Power Density
- Wide 2:1 Input Voltage Range
- Efficiency to 82%
- >200,000 Hours MTBF (Ground Fixed)

General Description

The **1600XA** series is a family of ruggedized, high performance 16 watt single, dual and triple output DC/DC converters that are specifically designed to withstand the temperature extremes, shock & vibration and line noise found in demanding industrial applications. All models are designed to meet the latest UL, CSA, and VDE safety standards.

Operating from wide (2:1) input voltage ranges of 9 to 18, 18 to 36 or 36 to 72 VDC; twenty four models provide output combinations of 5, 12, 15, ± 5 , ± 12 , ± 15 , 5 ± 12 and 5 ± 15 VDC. Standard features include 1400 VDC input/output isolation, low output ripple & noise, continuous short circuit protection and output over voltage protection (all outputs). Efficiency is as high as 82%. A remote ON/OFF control input and internal input filter are standard on all units.

Long field life is insured by extensive reliability screening at CDi. As part of the normal production processing, each unit is subjected to burn-in during which the input power is cycled on/off and the output load is switched from 0% to 100%. Per MIL HDBK 217F, the MTBF is greater than 700,00 hours at +25 °C (ground benign).

Each model complies with the shock, vibration, acceleration, altitude and humidity requirements of MIL-STD-810E. All modules also meet the requirements of MIL-STD-202E.

Each **1600XA** module is packaged in a compact 2.0 x 2.0 x 0.375 inch metal case, yielding a power density as high as 10.6W/In³. Six sided continuous shielding virtually eliminates radiated emissions. Full operation is specified over the wide temperature range of -55°C to +85°C.

Model Selection Guide

| Model Number | Input | | | | Output | | | Efficiency @FL (%) | Case |
|--------------|---------------|---------|--------------|-----------|---------------|-----------------|--------------------|--------------------|-------|
| | Voltage (VDC) | | Current (mA) | | Voltage (VDC) | Current (mA) | Over Voltage (VDC) | | |
| | Nominal | Range | No-Load | Full-Load | | | | | |
| 1605S12XA | 12 | 9 - 18 | 45 | 1667 | 5.0 | 3200 | 6.8 | 80 | A, A1 |
| 1612S12XA | 12 | 9 - 18 | 45 | 1640 | 12.0 | 1300 | 15.0 | 81 | A, A1 |
| 1615S12XA | 12 | 9 - 18 | 45 | 1650 | 15.0 | 1060 | 18.0 | 81 | A, A1 |
| 1605D12XA | 12 | 9 - 18 | 40 | 1667 | ± 5.0 | ± 1600 | ± 6.8 | 80 | A, A1 |
| 1612D12XA | 12 | 9 - 18 | 45 | 1640 | ± 12.0 | ± 665 | ± 15.0 | 81 | A, A1 |
| 1615D12XA | 12 | 9 - 18 | 45 | 1650 | ± 15.0 | ± 535 | ± 18.0 | 81 | A, A1 |
| 1605S24XA | 24 | 18 - 36 | 34 | 833 | 5.0 | 3200 | 6.8 | 80 | A, A1 |
| 1612S24XA | 24 | 18 - 36 | 34 | 810 | 12.0 | 1300 | 15.0 | 82 | A, A1 |
| 1615S24XA | 24 | 18 - 36 | 34 | 815 | 15.0 | 1060 | 18.0 | 82 | A, A1 |
| 1605D24XA | 24 | 18 - 36 | 34 | 833 | ± 5.0 | ± 1600 | ± 6.8 | 80 | A, A1 |
| 1612D24XA | 24 | 18 - 36 | 34 | 810 | ± 12.0 | ± 665 | ± 15.0 | 82 | A, A1 |
| 1615D24XA | 24 | 18 - 36 | 34 | 815 | ± 15.0 | ± 535 | ± 18.0 | 82 | A, A1 |
| 1605S48XA | 48 | 36 - 72 | 32 | 411 | 5.0 | 3200 | 6.8 | 81 | A, A1 |
| 1612S48XA | 48 | 36 - 72 | 32 | 405 | 12.0 | 1300 | 15.0 | 82 | A, A1 |
| 1615S48XA | 48 | 36 - 72 | 32 | 408 | 15.0 | 1060 | 18.0 | 82 | A, A1 |
| 1605D48XA | 48 | 36 - 72 | 32 | 411 | ± 5.0 | ± 1600 | ± 6.8 | 81 | A, A1 |
| 1612D48XA | 48 | 36 - 72 | 32 | 405 | ± 12.0 | ± 665 | ± 15.0 | 82 | A, A1 |
| 1615D48XA | 48 | 36 - 72 | 32 | 408 | ± 15.0 | ± 535 | ± 18.0 | 82 | A, A1 |
| 1605/12T12XA | 12 | 9 - 18 | 50 | 1667 | 5/ ± 12 | 2000/ ± 250 | 6.8/ ± 15 | 75 | A, A1 |
| 1605/15T12XA | 12 | 9 - 18 | 50 | 1667 | 5/ ± 12 | 2000/ ± 200 | 6.8/ ± 15 | 79 | A, A1 |
| 1605/12T24XA | 24 | 18 - 36 | 45 | 832 | 5/ ± 12 | 2000/ ± 250 | 6.8/ ± 15 | 81 | A, A1 |
| 1605/15T24XA | 24 | 18 - 36 | 45 | 832 | 5/ ± 15 | 2000/ ± 200 | 6.8/ ± 18 | 75 | A, A1 |
| 1605/12T48XA | 48 | 36 - 72 | 35 | 406 | 5/ ± 15 | 2000/ ± 250 | 6.8/ ± 18 | 79 | A, A1 |
| 1605/15T48XA | 48 | 36 - 72 | 35 | 401 | 5/ ± 15 | 2000/ ± 200 | 6.8/ ± 18 | 81 | A, A1 |

Electrical Specifications

Input Specifications:

| | |
|--|--|
| Input Voltage Range ⁽¹⁾ | See Model Selection Guide |
| Input Filter | Ω (Pi) Network |
| Reverse Polarity Input Current | 12A, Max. |
| Input Surge Current | 20A at 10 Sec. |
| Short Circuit Current Limit | 150% of I_{in} |
| Under Voltage Shutdown | 8 VDC |
| Remote On/Off Control | |
| Supply On | 5.5 VDC or Open Circuit |
| Supply Off | 0 VDC to 0.8 VDC |
| Logic Input Reference | Negative (-) Input |
| Logic Compatibility | TTL Open Collector or CMOS Open Drain |
| Converter Standby Current | 32 mA |

Output Specifications:

| | |
|--|--|
| Voltage and Current Ratings ⁽²⁾ | See Model Selection Guide |
| Output Voltage Accuracy; | |
| Single/Dual Outputs | $\pm 1\%$, Max. |
| Triple Outputs; Primary | $\pm 1\%$, Adj to Zero |
| Auxiliaries | $\pm 5\%$, Max. |
| Voltage Adjustment ⁽³⁾ | $\pm 5\%$, Max. |
| Voltage Balance ⁽⁴⁾ ; | |
| Dual Outputs | $\pm 1\%$, Max. |
| Triple Outputs (Auxiliaries) | $\pm 1\%$, Max. |
| Ripple & Noise ⁽⁵⁾ | 1% Pk-Pk of V_{out} |
| Minimum Load | 10% of Full Load |
| Line Regulation ⁽⁶⁾ ; | |
| 3.3 VDC Outputs | $\pm 0.3\%$, Max. |
| Single/Dual Outputs | $\pm 0.5\%$, Max. |
| Triple Outputs; Primary | $\pm 0.2\%$, Max. |
| Auxiliaries | $\pm 5.0\%$, Max. |
| Load Regulation ⁽⁷⁾ ; | |
| Single Outputs | $\pm 0.2\%$, Max. |
| Dual Outputs | $\pm 1.0\%$, Max. |
| Triple Outputs; Primary | $\pm 0.5\%$, Max. |
| Auxiliaries | $\pm 5.0\%$, Max. |
| Temperature Coefficient @ FL | $\pm 0.01\%/^{\circ}C$ |
| Transient Recovery Time ⁽⁸⁾ | 200 μ S |
| Short Circuit Protection ⁽⁹⁾ | All outputs by Input current limiting |
| Over Voltage Protection | See Model Selection Guide |

General Specifications:

| | |
|----------------------------------|--|
| Efficiency ⁽¹⁰⁾ | See Model Selection Guide |
| Isolation Voltage (1 min.) | 1400 VDC, Min. Meets requirements of MIL-STD- 202F, method 301 |

| | |
|-----------------------------|--|
| Isolation Resistance | $>10^9 \Omega$, Meets requirements of MIL-STD-202F, method 302, test condition B. |
| Isolation Capacitance | 140 pF |
| Acceleration | Per MIL-STD-810E, method 513.4, procedure II. Opera- tional test (centrifuge) 12g's (manned aerospace vehicles) |
| Shock | Per MIL-STD-810E, method 516.4, procedure I. Functional shock 40g's. |
| Vibration | Per MIL-STD-810E, method 514.4, procedure I, category 6 (equipment installed in helicopters). |
| Altitude | Per MIL-STD-810E, method 500.3, procedure III Rapid decompression, 40,000 ft. 100 kHz, Min. |
| Switching Frequency | 100 kHz, Min. |

Environmental Specifications:

| | |
|---------------------------------|---|
| Operating Temperature | -55°C to +85°C (Ambient) |
| Max. Case Temperature | +100°C |
| Storage Temperature Range | -55°C to +125°C |
| Derating | See Derating Curves |
| Humidity | Per MIL-STD-810E, method 507.3, procedure I. Natural non-hazardous items, cycle 1,240 hours. |
| Cooling | Free-air Convection |
| EMI/RFI | Six-sided Metal Case |

Physical Characteristics:

| | |
|-----------------------------|---|
| Case Size | 2.0 x 2.0 x 0.375 inches (51 x 51 x 9.52 mm) |
| Case Material | Coated Copper |
| Weight | 2.8 Oz (79g) |
| Shielding | Six-sided, Continuous |
| Shielding Connection | |
| 12V, 24V Input Models | Pin 3 (- Input) |
| 48V Input Models | Pin 4 (+ Input) |

Reliability Specifications:

| | |
|------------------------------------|------------------|
| MTBF; Ground Benign, @ +25°C | $>705,000$ Hours |
|------------------------------------|------------------|

Specifications typical @ +25°C with nominal input voltage and under full output load conditions, unless otherwise noted. Specifications subject to change without notice.

Specification Notes:

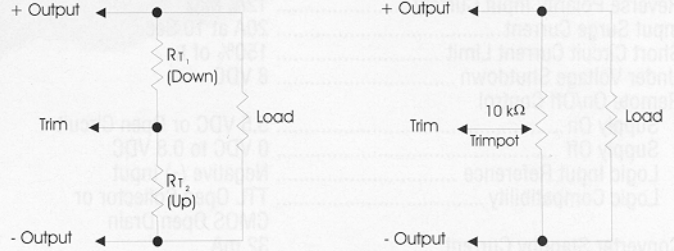
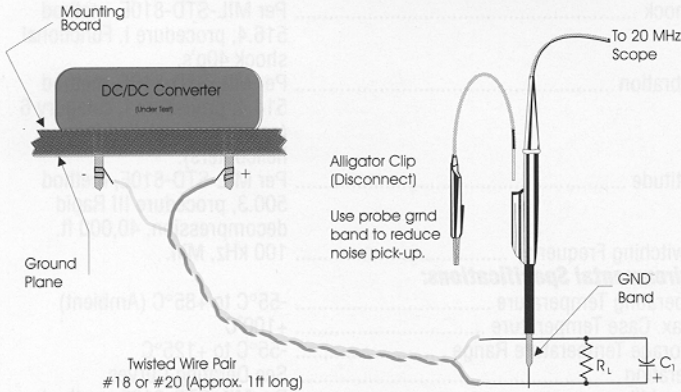
- Contact the factory for information on other input/output combinations.
- Total output power should not exceed the specified output ratings for any particular model. Please contact factory for 3.3 V_{out} Versions.
- To trim the output voltage DOWN, connect a 5%, 1/4 W resistor (R_{T1}) between the plus (+) output and trim pins of the converter. To trim the output voltage UP, connect a 5%, 1/4 W resistor (R_{T2}) between the minus (-) output and trim pins. For UP/DOWN trimming capability, connect a 10k potentiometer between the plus (+) and minus (-) outputs, with the wiper arm connected to the trim pin. The trim resistors or potentiometers can be connected at the converter pins or at the load. If connected at the load, the resistance of the circuit paths becomes part of the feedback loop, improving load regulation. If the load is some distance from the converter, the use of #20 gauge wire is recommended to avoid excessive voltage drop due to the resistance of the circuit paths.
- Voltage balance is measured with balanced loads applied.
- Line regulation is measured by monitoring the output voltage while the input line is varied from low line to high line. Dual outputs and auxiliary outputs on triple output models are loaded equally.
- Load regulation is measured at nominal input voltage while the output load is varied. For single output units the load variation is 1/4 load to full load. For dual output models, the load variation is no load to full load (with outputs loaded equally). For triple output units the load variation is no load to full load on the primary output and 1/4 load to full load on auxiliary outputs. Auxiliary outputs are loaded equally.
- Transient response is measured on the primary output for a 50% load change (50% load to full load).
- For further protection, it is recommended that an external, slow-blow line fuse be connected to the converter input lines.
- Efficiency is specified at nominal input line and full load.

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Minimizing Common Mode Noise & Reflected Ripple Current

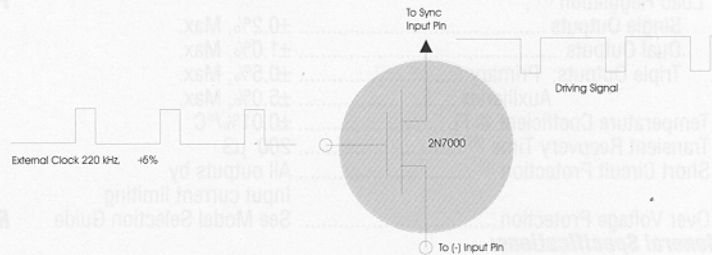
When the converter is driven by a low impedance source, no external filter components are required. However, if the input power to the converter comes through long wires, it is recommended that a low ESR capacitor be placed across the input pins. The use of "twisted pair" wires to connect the input of the converter to the power source will minimize common mode noise and reflected ripple.



External Trimming

External Clock Synchronization.

All models in the 1600XA series can be synchronized to an external clock by driving the sync pin directly with an open collector - open drain (1TTL). The signal frequency must be 220 kHz, $\pm 5\%$ (20% low, 80% high duty cycle).



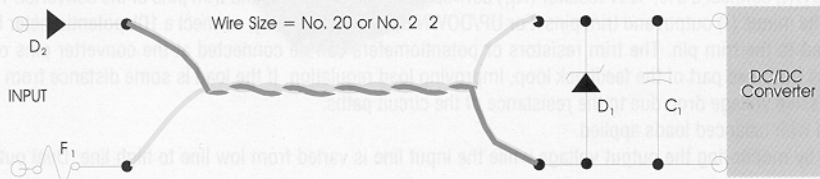
External Clock Synchronization

Input Line Protection; Overvoltage and Reverse Voltage

Although the 1600XA series includes internal protection circuits, it's recommended the user connect a IN62XX type diode and a slow-blow fuse as shown below.

Measuring Output Ripple & Noise

True converter output ripple and noise can be measured by attaching a twisted wire pair (about 1 foot in length) with three twists per/inch between the converter outputs and an appropriate load. Connect a 33 μ F electrolytic capacitor (C_1) across the load. Using a scope with a minimum bandwidth of 20 MHz and a probe with the ground clip disconnected, measure the ripple at the connection of the load and twisted pair wires. This eliminates the "common mode noise" that interferes with measurements made directly at the converter output pins.



D_1 = IN62XX (or 1.5KExx) Motorola series diode. Diode must be rated so as not to conduct until 110% of $V_{n, Max}$
 D_2 should be a Schottky type diode selected for a minimum forward voltage. Diode must be rated for $I_o = 2I_n$ Min.

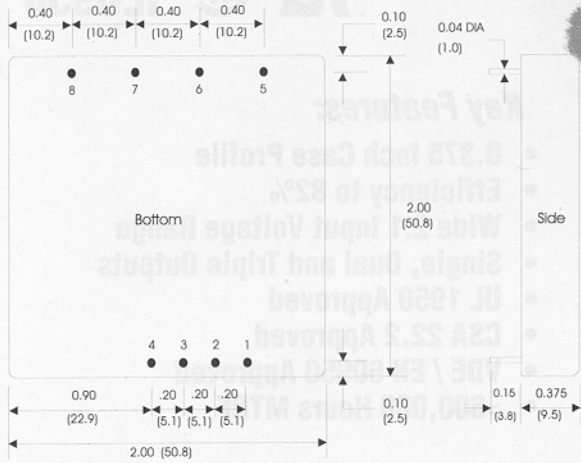
F_1 = Slow Blow Fuse
 C_1 = Low ESR Capacitor, 2 μ F to 10 μ F Tantalum Electrolytic or Unifrode SMC 100A or AVX SUPRA

Input Protection and Connection Using "Twisted Pair" Wires

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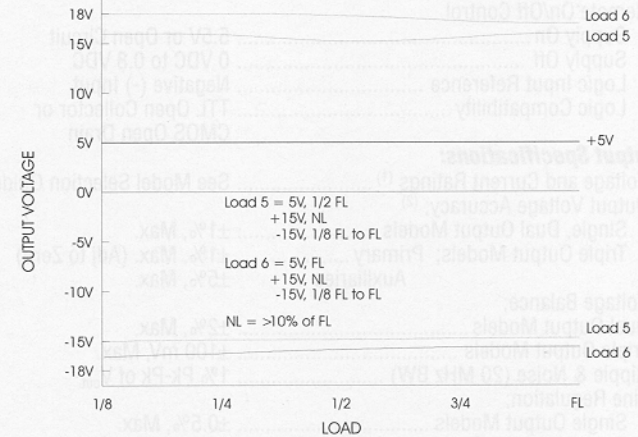
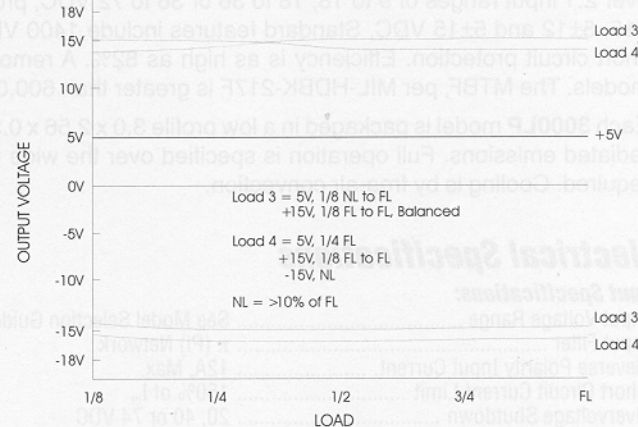
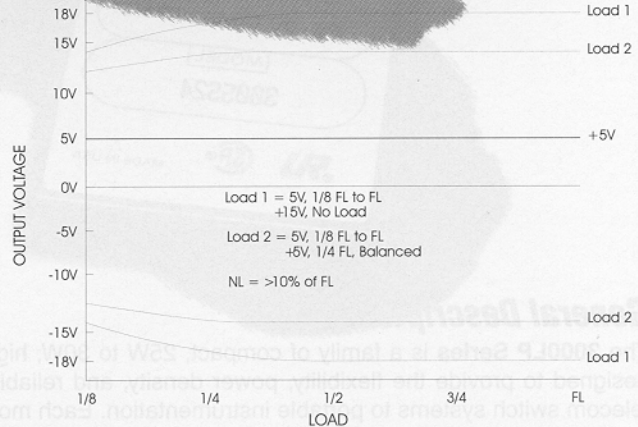
Mechanical Configuration - Case A



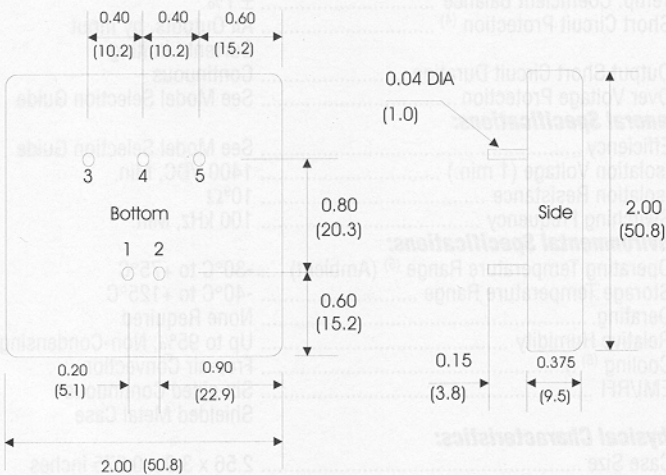
Pin Out - Case A

| Pin | Single Output | Dual Output | Triple Output |
|-----|---------------|---------------|----------------|
| 1 | Remote On/Off | Remote On/Off | Remote On/Off |
| 2 | Sync | Sync | Sync |
| 3 | - Input | - Input | - Input |
| 4 | + Input | + Input | + Input |
| 5 | Trim | Trim | - Output (AUX) |
| 6 | - Output | - Output | Common |
| 7 | + Output | Common | -5V Output |
| 8 | No Pin | + Output | + Output (AUX) |

Triple Output Load Regulation



Mechanical Configuration - Case A1



Pin-Out; Case A1

| Pin | Single Output | Dual Output |
|-----|---------------|-------------|
| 1 | +V Input | +V Input |
| 2 | -V Input | -V Input |
| 3 | +V Output | +V Output |
| 4 | Trim | ± Common |
| 5 | -V Output | -V Output |

Ordering Information:

- For models that are available in both the "A" or "A1" package, the "A" case is considered a standard. Models with case "A" packaging do not require a suffix on the part number.
- For models that are available in both the "A" or "A1" package, the "A1" case is an alternate. Models with case "A1" packaging must be designated with an "A1" suffix (i.e. 1615D48XA-A1).

Note: All dimensions are typical in inches (mm).
 Tolerance X.XX = ± 0.02, (± 0.5)
 X.XXX = ± 0.010, (± 0.25)

