

20 Watt NT Single Series DC/DC Converters



Features

- Fully Self Contained, No External Parts Required for Operation
- Low and Specified Input/Output Capacitance
- Efficiencies to 85%
- Overcurrent Protected and Thermal Shutdown Circuitry for Long, Reliable Operation
- Five-sided, Shielded, Low Thermal Gradient Copper Case
- 5 Year Warranty
- Water Washable Case Design

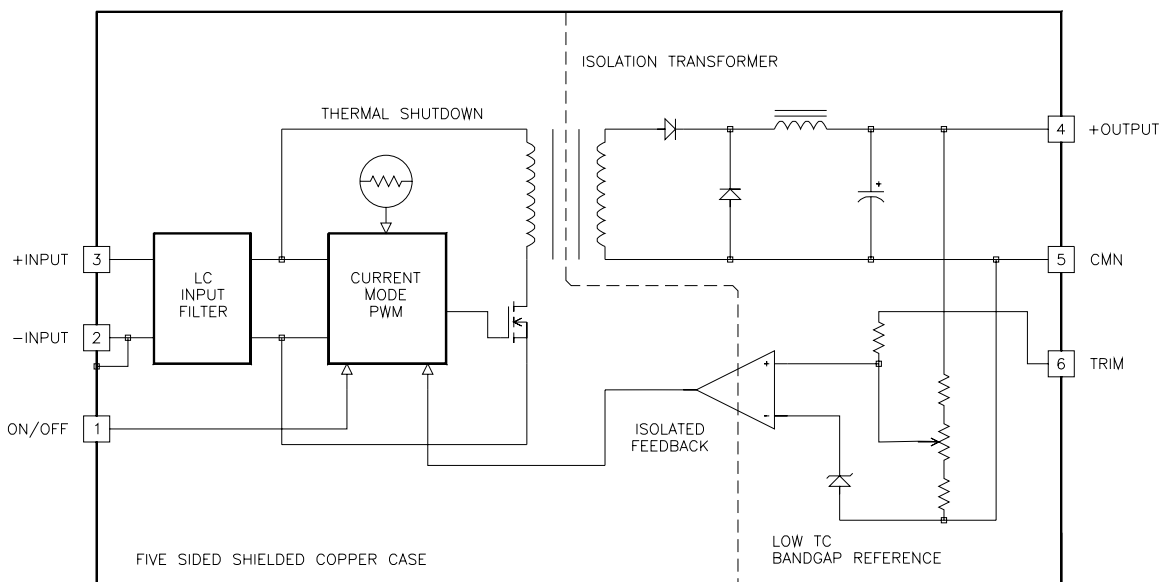
Description

These 20 Watt NT converters are ideal for battery operated industrial, medical control and remote data collection systems. They have achieved an exceptionally low input/output capacitance (290 pF) that is half that of comparable models. This low capacitance contributes to their exceptional input/output isolation.

Complete overload protection with independent pulse-by-pulse current limiting and an overtemperature shutdown circuit ensure zero-failure rate operation. Each converter is encased in a five-sided, shielded and sealed water washable case.

| Selection Chart | | | | |
|-----------------|-----------------|-----|------------|-----------|
| Model | Input Range VDC | | Output VDC | Output mA |
| | Min | Max | | |
| 12S3.4000NT | 9 | 18 | 3.33 | 4000 |
| 12S5.4000NT | 9 | 18 | 5 | 4000 |
| 12S12.1700NT | 9 | 18 | 12 | 1700 |
| 12S15.1400NT | 9 | 18 | 15 | 1400 |
| 24S3.4000NT | 18 | 36 | 3.33 | 4000 |
| 24S5.4000NT | 18 | 36 | 5 | 4000 |
| 24S12.1700NT | 18 | 36 | 12 | 1700 |
| 24S15.1400NT | 18 | 36 | 15 | 1400 |
| 48S3.4000NT | 36 | 72 | 3.33 | 4000 |
| 48S5.4000NT | 36 | 72 | 5 | 4000 |
| 48S12.1700NT | 36 | 72 | 12 | 1700 |
| 48S15.1400NT | 36 | 72 | 15 | 1400 |

20 Watt NT Single Series Block Diagram



20 Watt NT Single Series DC/DC Converters

| Input Parameters* | | | | | | | | | |
|--|-----------|--------------|--------------|--------------|--------------|--------------|--------------|--------|----|
| Model | | 12S3.4000NT | 12S5.4000NT | 12S12.1700NT | 12S15.1400NT | 24S3.4000NT | 24S5.4000NT | Units | |
| Voltage Range | MIN | 9 | | | | 18 | | VDC | |
| | MAX | 18 | | | | 36 | | | |
| Reflected Ripple (2) | TYP | 40 | | | | 35 | | mA P-P | |
| | TYP | 15 | | | | 10 | | mA RMS | |
| Input Current | Full Load | TYP | 1.46 | 2.12 | 2.15 | 2.21 | 0.70 | 1.01 | A |
| | No Load | TYP | 16 | 16 | 16 | 16 | 10 | 10 | mA |
| Efficiency | TYP | 76 | 79 | 79 | 79 | 80 | 83 | % | |
| Switching Frequency | TYP | 220 | | | | | | kHz | |
| Maximum Input Overvoltage, 100ms Maximum | MAX | 24 | | | | 45 | | VDC | |
| Turn-on Time, 1% Output Error | TYP | 10 | | | | | | ms | |
| Recommended Fuse | | (3) | | | | | | AMPS | |
| Model | | 24S12.1700NT | 24S15.1400NT | 48S3.4000NT | 48S5.4000NT | 48S12.1700NT | 48S15.1400NT | Units | |
| Voltage Range | MIN | 18 | | | 36 | | | VDC | |
| | MAX | 36 | | | 72 | | | | |
| Reflected Ripple (2) | TYP | 35 | | | 20 | | | mA P-P | |
| | TYP | 10 | | | 6 | | | mA RMS | |
| Input Current | Full Load | TYP | 1.00 | 1.02 | 0.35 | 0.50 | 0.51 | 0.51 | A |
| | No Load | TYP | 10 | 10 | 8 | 8 | 8 | 8 | mA |
| Efficiency | TYP | 85 | 86 | 80 | 83 | 84 | 85 | % | |
| Switching Frequency | TYP | 220 | | | | | | kHz | |
| Maximum Input Overvoltage, 100ms Maximum | MAX | 45 | | | 85 | | | VDC | |
| Turn-on Time, 1% Output Error | TYP | 10 | | | | | | ms | |
| Recommended Fuse | | (3) | | | | | | AMPS | |

| Output Parameters* | | | | | | | |
|--|-----|--|---|--|--|---------|---------|
| Model | | 12S3.4000NT 24S3.4000NT 48S3.4000NT | 12S5.4000NT 24S5.4000NT 48S5.4000NT | 12S12.1700NT 24S12.1700NT 48S12.1700NT | 12S15.1400NT 24S15.1400NT 48S15.1400NT | Units | |
| Output Voltage | | 3.33 | | 5 | 12 | 15 | VDC |
| Output Voltage Accuracy | MIN | 3.30 | | 4.95 | 11.90 | 14.90 | VDC |
| | TYP | 3.33 | | 5.00 | 12.00 | 15.00 | |
| | MAX | 3.36 | | 5.05 | 12.10 | 15.10 | |
| Rated Load Range | MIN | 0.0 | | 0.0 | 0.0 | 0.0 | A |
| | MAX | 4.0 | | 4.0 | 1.7 | 1.4 | |
| Load Regulation 25% Max-Max Load | TYP | 0.3 | | 0.2 | 0.1 | 0.1 | % |
| | MAX | 0.6 | | 0.4 | 0.2 | 0.2 | |
| Line Regulation Vin = Min-Max VDC | TYP | 0.5 | | 0.01 | | % | |
| | MAX | 1.0 | | 0.1 | | | |
| Short Term Stability (4) | TYP | < 0.05 | | | | %/24Hrs | |
| Long Term Stability | TYP | < 0.2 | | | | %/kHrs | |
| Transient Response (5) | TYP | 50 | | 300 | | µs | |
| Dynamic Response (6) | TYP | 100 | | 300 | 300 | 350 | mV peak |
| Input Ripple Rejection (7) | TYP | > 40 | | | | dB | |
| Noise, 0-20MHz bw (2) | TYP | 50 | | 60 | 50 | 50 | mV P-P |
| RMS Noise, 0.01-1MHz | TYP | 10 | | 14 | 8 | 8 | mV RMS |
| Temperature Coefficient | TYP | 50 | | | | ppm/°C | |
| | MAX | 150 | | | | | |
| Short Circuit Protection to Common for all Outputs | | Continuous, Current Limit and Thermal Protection | | | | | |

NOTES

* All parameters measured at Tc=25°C, nominal input voltage and full rated load unless otherwise noted. Refer to the CALEX Application Notes for the definition of terms, measurement circuits and other information.

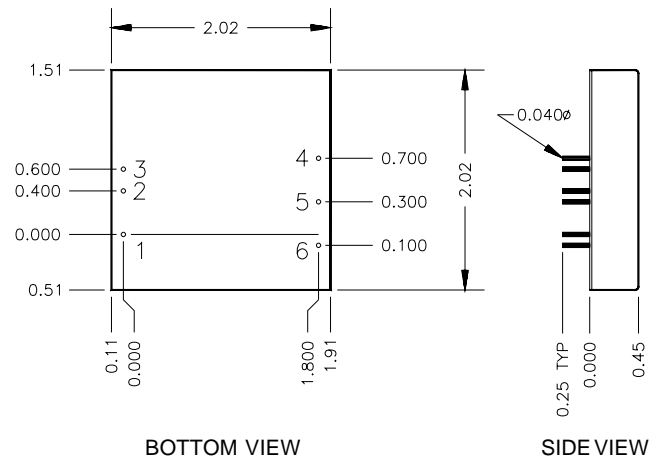
(2) Noise is measured per CALEX Application Notes. Measurement bandwidth is 0-20 MHz for peak-peak measurements, 10 kHz to 1 MHz for RMS measurements. Output noise is measured with a 0.01µF ceramic in parallel with a 1µF/35V Tantalum capacitor located 1" away from the converter to simulate

20 Watt NT Single Series DC/DC Converters

| General Specifications* | | | |
|---------------------------------------|-----|------|---------|
| All Models | | | Units |
| ON/OFF Function | | | |
| ON Logic Level or Leave Pin Open | MIN | >1.6 | VDC |
| OFF Logic Level or Tie Pin to -Input | MAX | <0.7 | VDC |
| Open Circuit Voltage | TYP | 2.5 | VDC |
| Input Resistance | TYP | 20 | kohms |
| Converter Idle Current ON/OFF Pin Low | | | |
| 12S Models | TYP | 13 | mA |
| 24S and 48S Models | TYP | 14 | mA |
| Isolation (8) | | | |
| Isolation Voltage | | | |
| Input to Output 12S, 24S | MIN | 700 | VDC |
| Input to Output 48S | MIN | 1544 | VDC |
| 10µA Leakage | | | |
| Input to Output Capacitance | TYP | 290 | pF |
| Output Trim Function | | | |
| Trim Range | MIN | ±5 | % |
| Input Resistance | MIN | 10 | kohms |
| Open Circuit Voltage | TYP | 2.5 | VDC |
| Environmental | | | |
| Case Operating Range | | | |
| No Derating | MIN | -40 | °C |
| | MAX | 90 | °C |
| Case Functional Range (9) | | | |
| | MIN | -55 | °C |
| | MAX | 100 | °C |
| Storage Range | | | |
| | MIN | -55 | °C |
| | MAX | 105 | °C |
| Thermal Shutdown Case Temperature | TYP | 105 | °C |
| Thermal Impedance (10) | TYP | 9.5 | °C/Watt |
| General | | | |
| Unit Weight | TYP | 2.3 | oz |
| Chassis Mounting Kit | | MS8 | |

NOTES (cont.)

- your PCB's standard decoupling. Input reflected ripple is measured into a 10µH source impedance.
- To determine the correct fuse size, see CALEX Application Notes.
 - Short term stability is specified after a 30 minute warmup at full load, constant line and recording the drift over a 24 hour period.
 - The transient response is specified as the time required to settle from a 50 to 75 % step load change (rise time of step = 2 µSec) to a 1% error band.
 - Dynamic response is the peak overshoot voltage during the transient response time as defined in note 5 above.
 - The input ripple rejection is specified for DC to 120 Hz ripple with a modulation amplitude of 1% of Vin.
 - The Case is tied to the -IN pin.
 - The functional temperature range is intended to give an additional data point for use in evaluating this power supply. At the low functional temperature the power supply will function with no side effects, however, sustained operation at the high functional temperature will reduce expected operational life. The data sheet specifications are not guaranteed over the functional temperature range.
 - The case thermal impedance is specified as the case temperature rise over ambient per package watt dissipated.
 - Specifications subject to change without notice.



Mechanical tolerances unless otherwise noted:
 X.XX dimensions: ±0.020 inches
 X.XXX dimensions: ±0.005 inches

| Pin | Function |
|-----|----------|
| 1 | ON/OFF |
| 2 | -INPUT |
| 3 | +INPUT |
| 4 | +OUTPUT |
| 5 | CMN |
| 6 | TRIM |

Applications Information

General Information

The 20 Watt NT Single series is also mindful of battery operation for industrial, medical control and remote data collection applications. The remote ON/OFF pin places the converter in a very low power mode that draws typically less than 3 mA from the input source.

Full overload protection is provided by independent pulse-by-pulse current limiting and an over-temperature shutdown circuit. These protection features assure you that our 20 Watt single will provide zero failure rate operation.

A fully five-sided shielded, sealed, water washable case is standard along with specified operation over the full industrial temperature range of -40 to +90°C.

20 Watt NT Single Series DC/DC Converters

General Operation

Figure 1 shows the recommended connections for the 20 Watt NT Single DC/DC converter. A fuse is recommended to protect the input circuit and should not be omitted.

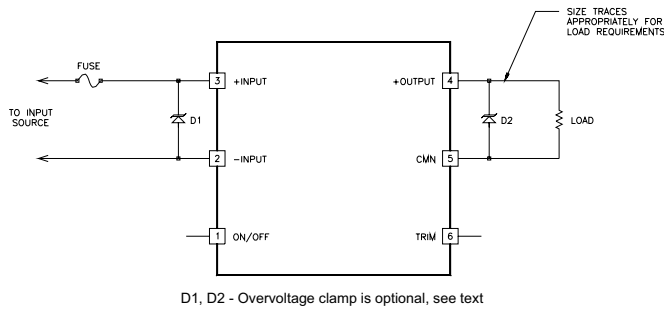


Figure 1.

Standard connections for the 20 Watt NT Single: The ON/OFF and TRIM pins can be left floating if they are not used. The input fuse should not be omitted. The overvoltage diodes may be added to the circuit directly at the converter to provide transient protection to your circuit.

The ON/OFF and +5 TRIM pins may be left floating if they are not used. No external capacitance on either the input or outputs is required for normal operation, in fact, it can degrade the converter's performance. See our application note "Understanding DC/DC Converters Output Impedance" and the low noise circuits later in this data sheet for more information. The usual 0.1 to 0.001 μF bypasses may be used around your PCB as required without harm.

Extremely low ESR capacitors (< 0.5 ohms) should not be used at the input as this will cause peaking of the input filter's transfer function and actually degrade the filter's performance.

Applying the Output

The output is simply connected to your application circuit and away you go. If extra low output noise is required in your application the circuit shown in Figure 2 may be used to reduce the output noise to below 10 mV P-P.

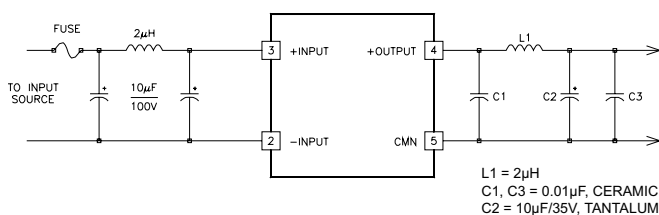


Figure 2.

For very low noise applications the circuits shown above can be used. The input current ripple will be reduced approximately 30 dB of the original value while the output noise will be reduced to typically below 10 mV P-P.

The trim pin may be used to adjust the outputs by up to +5 % from the nominal factory setting to account for system wiring voltage drops. Figure 4 shows the proper connections to use the trim pin. If output trimming is not desired the trim pin may be safely left floating.

For applications that require remote sensing, the circuit shown in Figure 3 may be used. This circuit can adjust for up to 0.25 Volts drop in a 5 Volt output. This is equivalent to 0.06 ohms at 4 Amps.

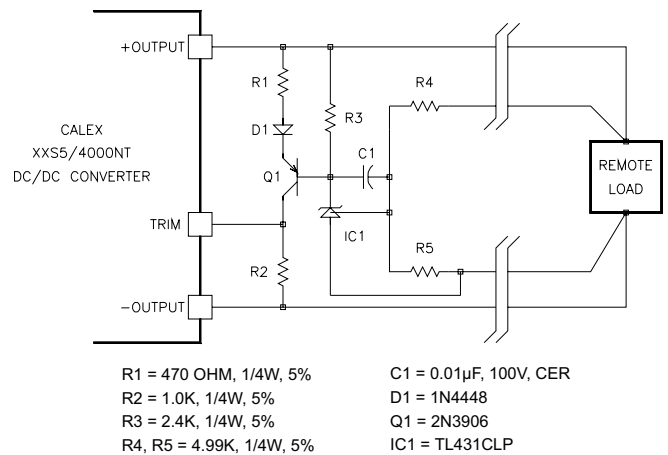


Figure 3.

This remote sensing circuit can be used to automatically adjust for voltage drops in your system's wiring.

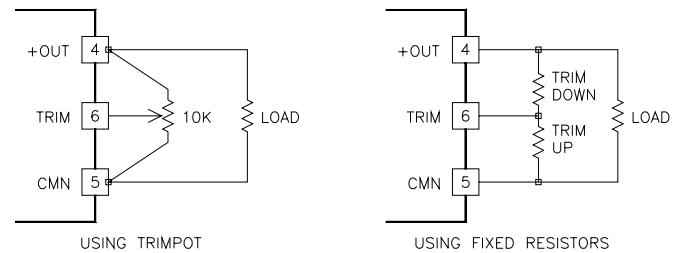


Figure 4.

The output can be trimmed by either a trimpot or fixed resistors. If fixed resistors are used their values may range from 0 to infinite ohms. The trimpot should be 10 kohms nominal for 3.3 and 5 Volt units and 20 kohms for 12 and 15 Volt outputs.

Non Standard Output Voltages

The trim may be used to adjust a +5 output unit up to 5.2 Volts for ECL applications.

+12 Volt units will trim around a range of approximately +9.6 to +12.6 Volts. +15 Volt units will trim around a range of approximately +12 to +15.75 Volts.

Maximum power from the module is limited to the specified non-trimmed maximum (Typical Output Voltage x Maximum Rated Load = Maximum Power). Trimming the output up reduces the output current proportionally to keep the maximum power constant. Output current is not increased over the Rated Maximum when trimming the output voltage down.

See our application note on remote sense and trim functions for more information.

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Grounding

The input and output sections are fully floating from each other. They may be operated floating or with a common ground. If the input and output sections are connected either directly at the converter or at some remote location from the converter it is suggested that a 1 to 10 μ F, 0.5 to 5 ohm ESR capacitor bypass be used directly at the converter output pins. This capacitor prevents any common mode switching currents from showing up at the converter's output as normal mode output noise. Do not use the lowest ESR, biggest value capacitor that you can find! This can only lead to reduced system performance or oscillation. See our application note "Understanding Output Impedance For Optimum Decoupling" for more information.

Case Grounding

The case serves not only as a heat sink but also as an EMI shield. The 0.02 inch thick copper provides >25 dB of absorption loss to both electromagnetic and electric fields at 220 kHz, while at the same time providing about 30% better heat sinking than competitive 0.01 inch thick steel cases.

The case shield is tied to the -input pin. This connection is shown on the block diagram. The case is floating from the input, coupled only by the 290 pF of isolation capacitance.

Remote ON/OFF Pin Operation

The remote ON/OFF pin may be left floating if this function is not used. The equivalent input circuit for the ON/OFF pin is shown in Figure 5. The best way to drive this pin is with an open collector/drain or relay contact. See our application note titled "Understanding the Remote ON/OFF Function" for more information about using the remote ON/OFF pin.

When the ON/OFF pin is pulled low with respect to the -Input, the converter is placed in a low power drain state. When the ON/OFF pin is released the converter fully powers up in typically 10 milliseconds. The ON/OFF pin turns the converter off while keeping the input bulk capacitor fully charged. This prevents the large inrush current spike that occurs when the +input pin is opened and closed.

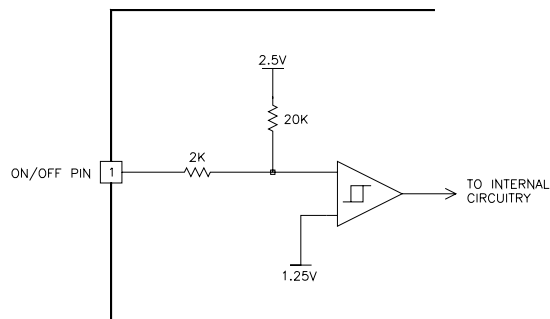


Figure 5.

The simplified schematic of the NT Single Series ON/OFF pin. The input impedance is approximately 20 kohms. The maximum open circuit voltage is approximately 2.5 Volts. By leaving this pin floating the converter will be in the ON state. When the pin is pulled below 0.7 Volts the converter is placed in the power down or OFF state. See our application note on the remote ON/OFF function for more information.

Temperature Derating

The NT Single Series can operate up to 90°C case temperature without derating. Case temperature may be roughly calculated from ambient by knowing that the NT Singles case temperature rise is approximately 9.5°C per package watt dissipated.

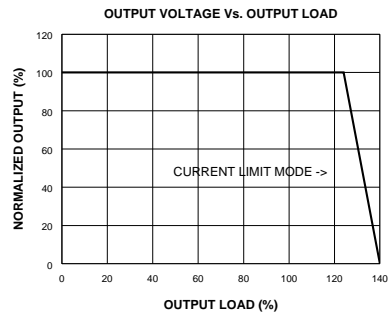
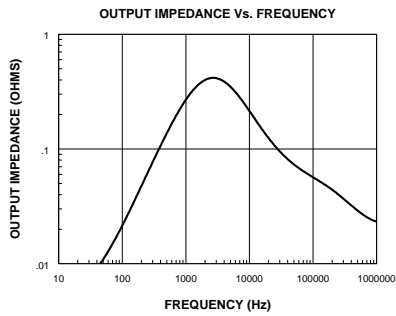
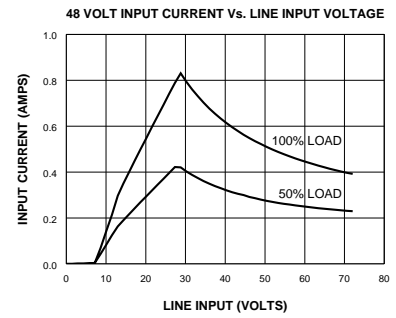
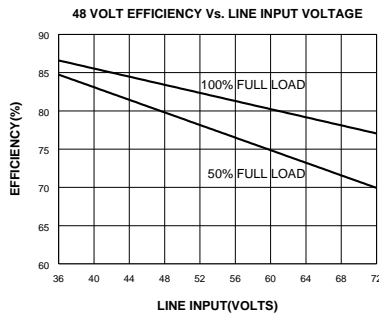
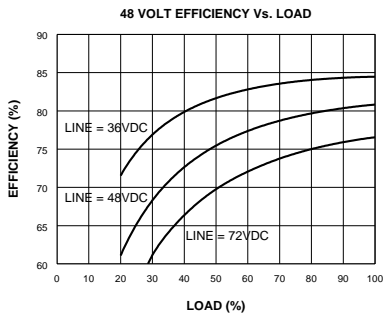
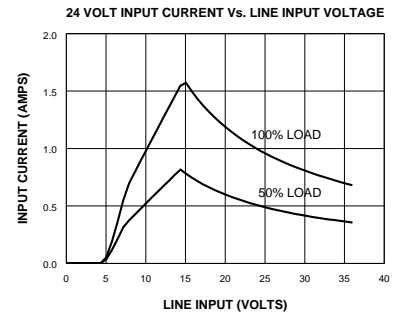
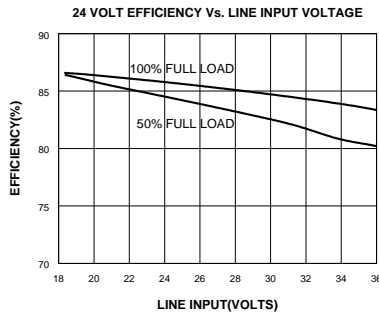
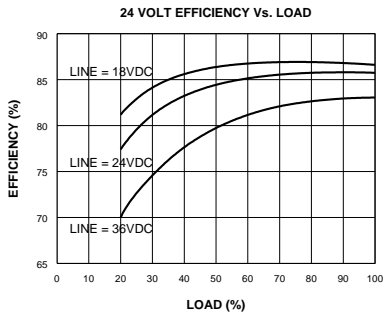
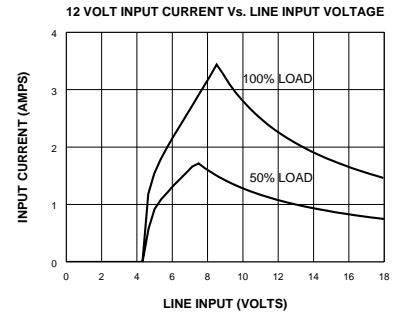
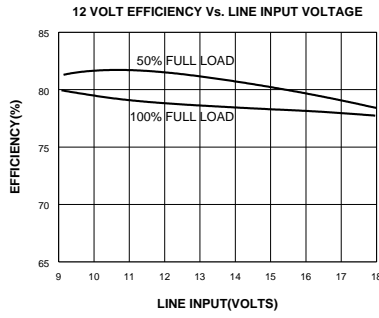
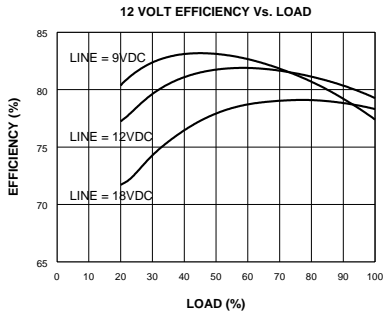
For example: If a 24 Volt input converter was delivering 15 Watts at 24 Volts input, at what ambient could it expect to run with no moving air and no extra heat sinking?

Efficiency is approximately 86%. This leads to an input power of about 17.4 Watts. The case temperature rise would be 2.4 Watts x 9.5 = 22.8°C. This number is subtracted from the maximum case temperature of 90°C to get 67°C.

This is a rough approximation to the maximum ambient temperature. Because of the difficulty of defining ambient temperature and the possibility that the load's dissipation may actually increase the local ambient temperature significantly or that convection cooling is suppressed by physical placement of the module, these calculations should be verified by actual measurement of operating temperature and your circuit's exact efficiency (efficiency depends on both line input and load value) before committing to a production design.

20 Watt NT Single Series DC/DC Converters

Typical Performance (Tc=25°C, Vin=Nom VDC, Rated Load).



NOTE ON USING THE CURVES

These curves were generated for 12 volt output models. To use for other models, adjust the efficiency values as shown below:

- 3.3 volt models Subtract approximately 4%
- 5.0 volt models Subtract approximately 2%
- 15.0 volt models ... Add approximately 1%