

# 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

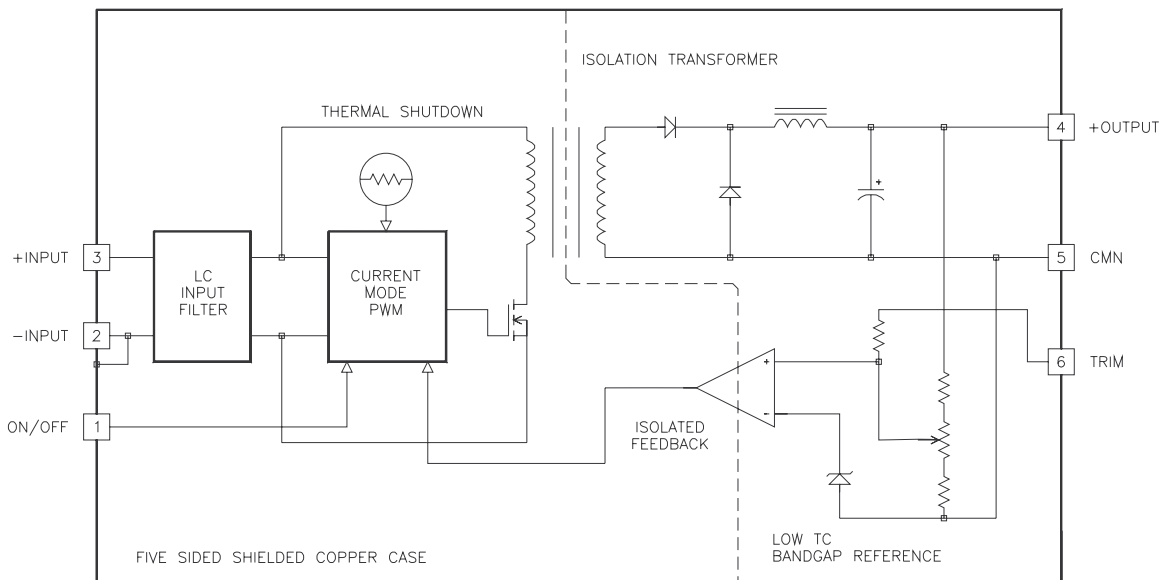
## Description

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

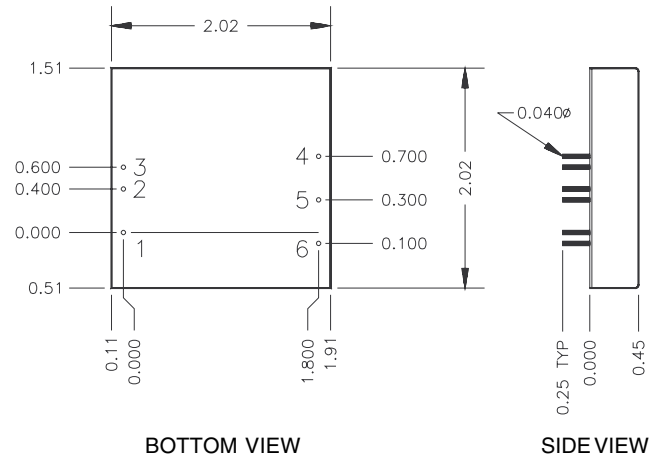
# 20 Watt NT Single Series DC/DC Converters

General Specifications*			
All Models			Units
<b>ON/OFF Function</b>			
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
<b>Isolation (8)</b>			
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
<b>Output Trim Function</b>			
Trim Range	MIN	±5	%
XXS3.4000NT Trim Range	MIN	+5 / -1	%
Open Circuit Voltage	TYP	2.5	VDC
<b>Environmental</b>			
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
<b>General</b>			
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.

- (3) To determine the correct fuse size, see CALEX Application Notes.
- (4) Short term stability is specified after a 30 minute warmup at full load, constant line and recording the drift over a 24 hour period.
- (5) 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.
- (6) Dynamic response is the peak overshoot voltage during the transient response time as defined in note 5 above.
- (7) The input ripple rejection is specified for DC to 120 Hz ripple with a modulation amplitude of 1% of Vin.
- (8) The Case is tied to the -IN pin.
- (9) 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.



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

- (10) The case thermal impedance is specified as the case temperature rise over ambient per package watt dissipated.
- (11) Specifications subject to change without notice.
- (12) Water Washability - Calex DC/DC converters are designed to withstand most solder/wash processes. Careful attention should be used when assessing the applicability in your specific manufacturing process. Converters are not hermetically sealed.

## 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.

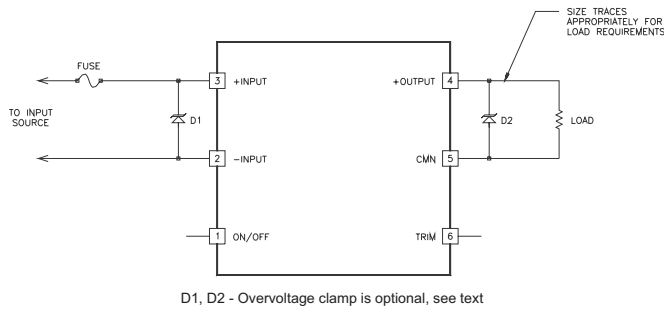
Full overload protection is provided by independent pulse-by-pulse current limiting and an over-temperature shutdown circuit. These protection features assure you that our 20 Watt single will provide zero failure rate operation.

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.**

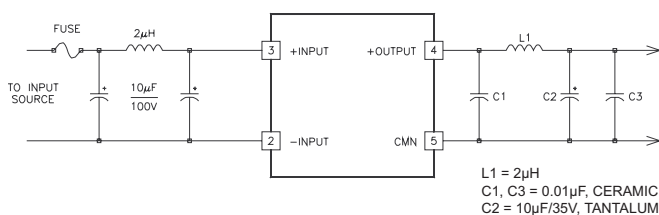
Standard connections for the 20 Watt NT Single: The ON/OFF and TRIM pins can be left floating if they are not used. The input fuse should not be omitted. The overvoltage diodes may be added to the circuit directly at the converter to provide transient protection to your circuit.

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  $\mu\text{F}$  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.

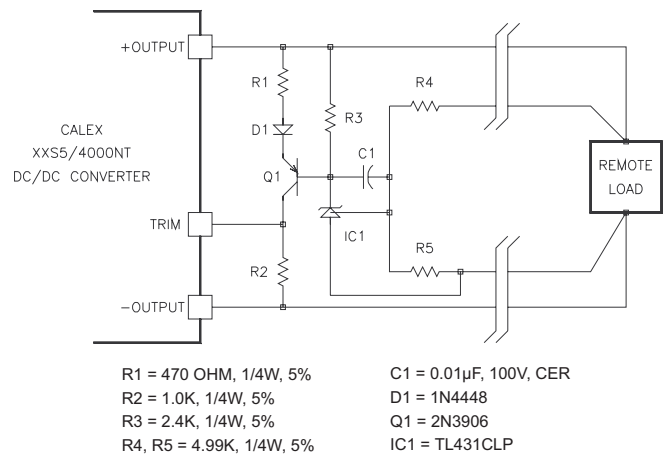


**Figure 2.**

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.

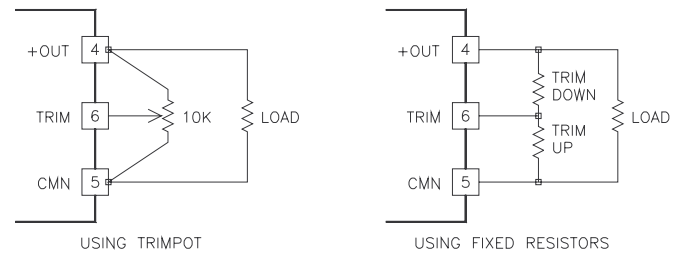
The trim pin may be used to adjust the outputs by up to +5 % from the nominal factory setting to account for system wiring voltage drops. Figure 4 shows the proper connections to use the trim pin. If output trimming is not desired the trim pin may be safely left floating.

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.

# 20 Watt NT Single Series DC/DC Converters

## 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 $\mu$ 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

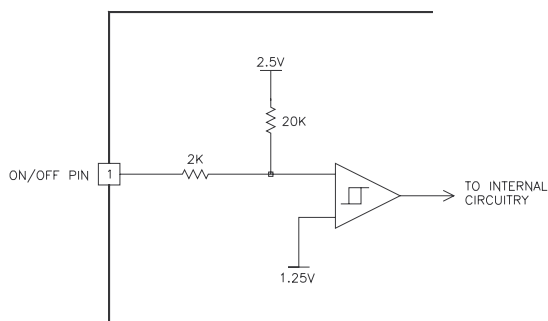
The case serves not only as a heat sink but also as an EMI shield. The 0.02 inch thick copper provides >25 dB of absorption loss to both electromagnetic and electric fields at 220 kHz, while at the same time providing about 30% better heat sinking than competitive 0.01 inch thick steel cases.

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.

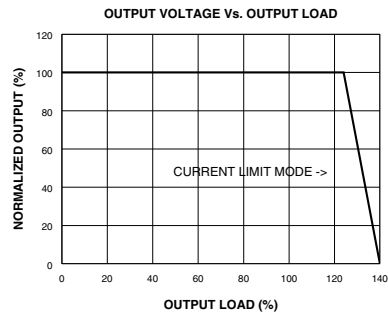
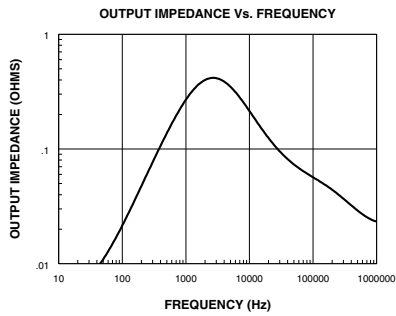
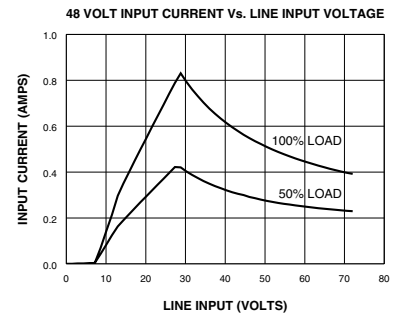
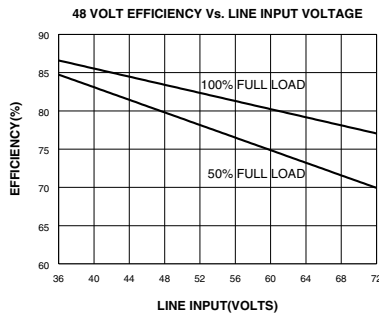
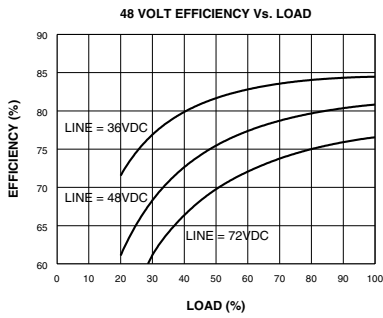
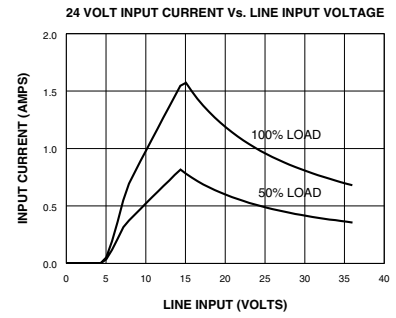
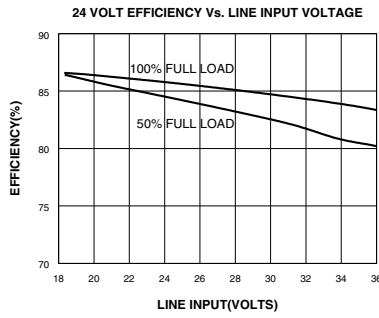
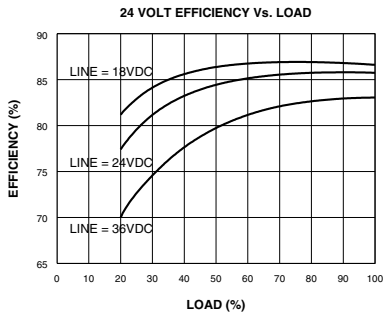
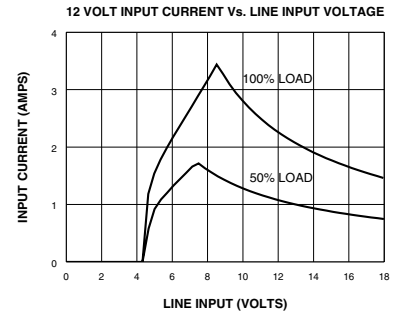
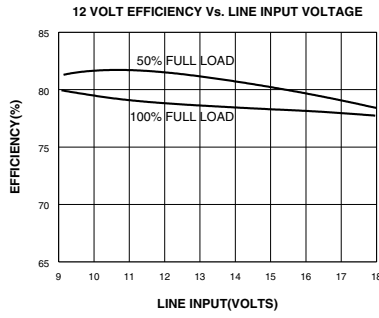
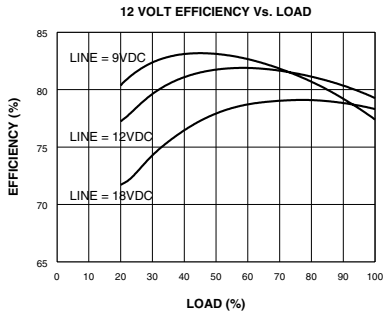
For example: If a 24 Volt input converter was delivering 15 Watts at 24 Volts input, at what ambient could it expect to run with no moving air and no extra heat sinking?

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%