200 WATT TH SERIES
DC/DC CONVERTERS

Features

- 4:1 Input voltage range
- High power density
- Small size 2.4” x 2.28” x 0.65”
- Efficiency up to 90%
- Excellent thermal performance with metal case
- Pulse-by-pulse current limiting
- Over-temperature protection
- Auto-softstart
- Constant frequency
- Remote sense
- Remote ON/OFF
- Ultra-wide output voltage trim
- Water washable, high humidity applications
- Good shock and vibration damping
- Available in both RoHS and non-RoHS construction. See ordering info below.

Description

The 4:1 Input Voltage 200 Watt Single TH DC/DC converter provides a precisely regulated dc output. The output voltage is fully isolated from the input, allowing the output to be positive or negative polarity and with various ground connections. The 200 Watt TH meets the most rigorous performance standards in an industry standard footprint for mobile ($12V_{IN}$), process control ($24V_{IN}$) and military COTS ($28V_{IN}$) applications.

The 4:1 Input Voltage 200 Watt TH includes remote sensing, ultra-wide output voltage trim, and remote ON/OFF. Threaded through holes are provided to allow easy mounting or addition of a heatsink for extended temperature operation.

Model	Input Range VDC		Vout VDC	Iout ADC
	Min	Max		
24S24.8TH	9	36	24	8.33
24S28.7TH	9	36	28	7.15
24S48.4TH	9	36	48	4.17

Default Logic is positive.
To order negative logic, add -N to the part number
To order RoHS, add (RoHS) to the part number

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Input Parameters					
Model		**24S24.8TH**	**24S28.7TH**	**24S48.4TH**	**Units**
Voltage Range	MIN TYP MAX	9.0 24.0 36.0			V
Input Overvoltage (100 ms)	MAX	40			V
Input Ripple Rejection (120Hz)	TYP	60			dB
Undervoltage Lockout	TYP	Start-up: 8.5 / Shut-down: 8.0			V
Input Reverse Voltage Protection		Yes			
Input Current No Load 100% Load	TYP TYP	80 10			mA A
Inrush Current	MAX	0.5			A^2s
Reflected Ripple	TYP	30			mA P-P
Switching Frequency	TYP	215	215	250	kHz
Recommended Fuse		(2)			A
External Input Capacitance	MIN	470			µF

Output Parameters					
Model		**24S24.8TH**	**24S28.7TH**	**24S48.4TH**	**Units**
Output Voltage		24	28	48	V
Output Voltage Setpoint Accuracy	MAX	±1			%
Turn On Overshoot	TYP	0			%
Temperature Coefficient (5)	TYP MAX	0.005 0.01			%/ºC
Noise (3)	TYP TYP	300 100			mV P-P mV RMS
Load Current	MIN MAX	0 8.33	0 7.15	0 4.17	A
Load Transient Overshoot (4)	TYP	4			%
Load Transient Recovery Time (4)	TYP	200			µs
Load Regulation (7) Min-Max Load	TYP MAX	0.02 0.2			%
Line Regulation Vin = Min-Max	TYP MAX	0.01 0.2			%
Overvoltage Protection (OVP) Threshold OVP Type - Non-latching Open Loop Overvoltage Clamp	TYP	115			%
Output Current Limit Vout = 90% of Vout-nom	TYP	120			%
External Output Capacitance (14)	MIN TYP	56 100			µF

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General Specifications			
All Models			**Units**
ON/OFF Function			
Converter - ON HIGH Logic Level / Leave ON/OFF Pin Open (13)	MIN	3.0	V
External Leakage Current Allowed for Logic High (8)	MAX	10	µA
Converter - OFF LOW Logic Level / Tie ON/OFF Pin to -INPUT (13)	MAX	1.0	V
Sinking Current for Logic Low	MAX	500	µA
Idle Current (Module is OFF)	TYP	40	mA
Turn-on Time to 1% error	TYP	50	ms
Output Voltage Remote Sensing			
Maximum Voltage Drops on Leads	MAX	10	%
Line Regulation under remote sensing	TYP MAX	0.02 0.1	%
Load Regulation under remote sensing	TYP MAX	0.05 0.2	%
Output Voltage Trim			
Trim Range	MIN MAX	-35 +10	% of Vout
Input Resistance	TYP	10	kΩ
Open Circuit Voltage	TYP	2.5	V
Trim Limit			
Maximum Output Voltage	TYP	110	% of Vout
Isolation			
Input to Output Isolation 10µA Leakage	MAX	1544	VDC
Input to Output Resistance	MIN	10	MΩ
Input to Output Capacitance	TYP	2200	pF
Environmental			
MTBF MIL-HDBK-217 (15)	120,000		h
MTBF Bellcore Method 1, Case 1	>1,000,000		h
Case Operating Temperature Range	MIN MAX	-40 100	ºC
Storage Temperature	MIN MAX	-40 120	ºC
Thermal Impedance (9)	TYP	7	ºC/W
Thermal Shutdown Case Temperature (Auto Restart)	TYP	105	ºC
General			
Efficiency	See graphs on page 5		
Unit Weight	150		g
Case Dimension	2.4" x 2.28" x 0.65"		
Designed to meet UL/cUL 60950, IEC/EN 60950-1			

Notes:

(1) All parameters measured at Tc=+25ºC ambient, Vin = Vnom, maximum rated load, unless otherwise noted. Refer to CALEX Application Notes for definition of terms, measurement circuits and other information.

(2) External fusing should be used for system protection in the event of a catastrophic failure. See CALEX Application Note 9 in the Calex DC/DC Catalog to determine the correct fuse.

(3) Output noise is measured with a 10µF ceramic capacitor and a 1µF ceramic capacitor connected across the output pins. The fundamental component of noise is at the switching frequency. Using smaller value capacitors will make the output noise slightly higher. Bandwidth limit is 20 MHz.

(4) Load Transient Overshoot is the output voltage peak amplitude, referenced to the final value, due to a step load change from 50% of maximum load to 75% of maximum load. "Load Transient Overshoot" and "Dynamic Response" are the same specification. Load Transient Recovery Time is the time it takes the output to return to the specified voltage error band centered around the final value. Transient response may degrade at low load currents.

(5) Temperature coefficient is defined for case temperatures. Output voltage deviation is calculated as the maximum resulting from either 1) 25ºC case to maximum operating case temperature, or 2) 25ºC case to minimum operating case temperature.

(6) Test with resistor load of 20mΩ maximum connected across the output pins.

(7) Load regulation is defined as the output voltage change resulting from a load current change from minimum to maximum. The voltage is measured at the output pins.

(8) When an external ON/OFF switch is used, such as an open collector switch, logic high requires the switch to be high-impedance. Switch leakage currents greater than 10µA may be sufficient to trigger the ON/OFF to the logic-low state.

(9) Thermal impedance is tested with the converter mounted vertically and facing another printed circuit board 1/2 inch away. If the converter is mounted horizontally with no obstructions, thermal impedance is approximately 8ºC/W.

(10) 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.

(11) Torque fasteners into threaded mounting inserts at 12 in. oz. or less. Greater torque may result in damage to unit and void the warranty.

(12) The input impedance on these units must be kept to a maximum of 100mΩ. In order to support this requirement, this converter needs 55µF of capacitance (low ESR) for every 1.0µH of inductance between the power source and the DC/DC converter.

(13) The range between 1V as maximum turn off voltage and 3V as minimum turn on voltage is considered the dead-band. Operation in the dead-band is not recommended.

Notes continued on next page

(14) Under the operating conditions applicable to this specification the TH converter is generally capable of startup into 1000µF of external output capacitance. The actual capacitance of an externally connected output capacitor depends on several factors, including:

- Applied DC voltage as a percent of maximum rated voltage
- Temperature
- Type of capacitor
- ESR

Capacitors generally provide less actual capacitance (the specified capacitance) as the applied DC voltage increases. A similar phenomenon can be observed as the capacitor temperature changes from cold (-40ºC) to hot (100ºC). The latter is highly dependent on the type of capacitor used. For example, a standard low cost aluminum electrolytic capacitor that provides 470µF at room temperature will provide very little capacitance at -40ºC.

The last parameter affecting the operation of the TH converter is the capacitor ESR. This parameter combined with the capacitor's capacitance affects the bandwidth of the control loop. The more capacitance that is added to the output of the TH converter the lower the bandwidth (crossover frequency), which in turn slows down the dynamic response of the converter.

Based on the above it can be seen that adding external output capacitance to the TH converter is a compromise between ripple voltage, the converter's ability to successfully startup, and overall response to load changes.

(15) MTBF is calculated based on MIL-HDBK-217F under the following conditions:

Reliability prediction method	= Part Stress Analysis
Baseplate temperature	= 40ºC
Environment	= Ground, Benign

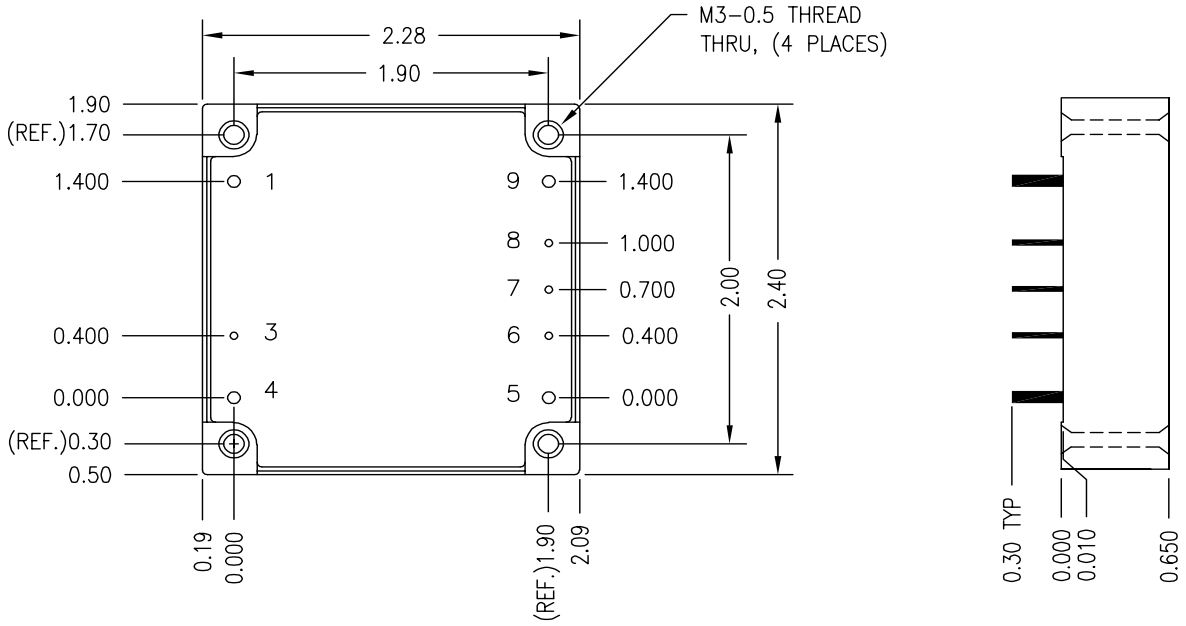
(16) Specifications subject to change without notice.

(17) RoHS Compliance:

See Calex Website www.calex.com/RoHS.html for the complete RoHS Compliance statement.

The RoHS marking is as follows.

Pb RoHS



BOTTOM VIEW

SIDE VIEW

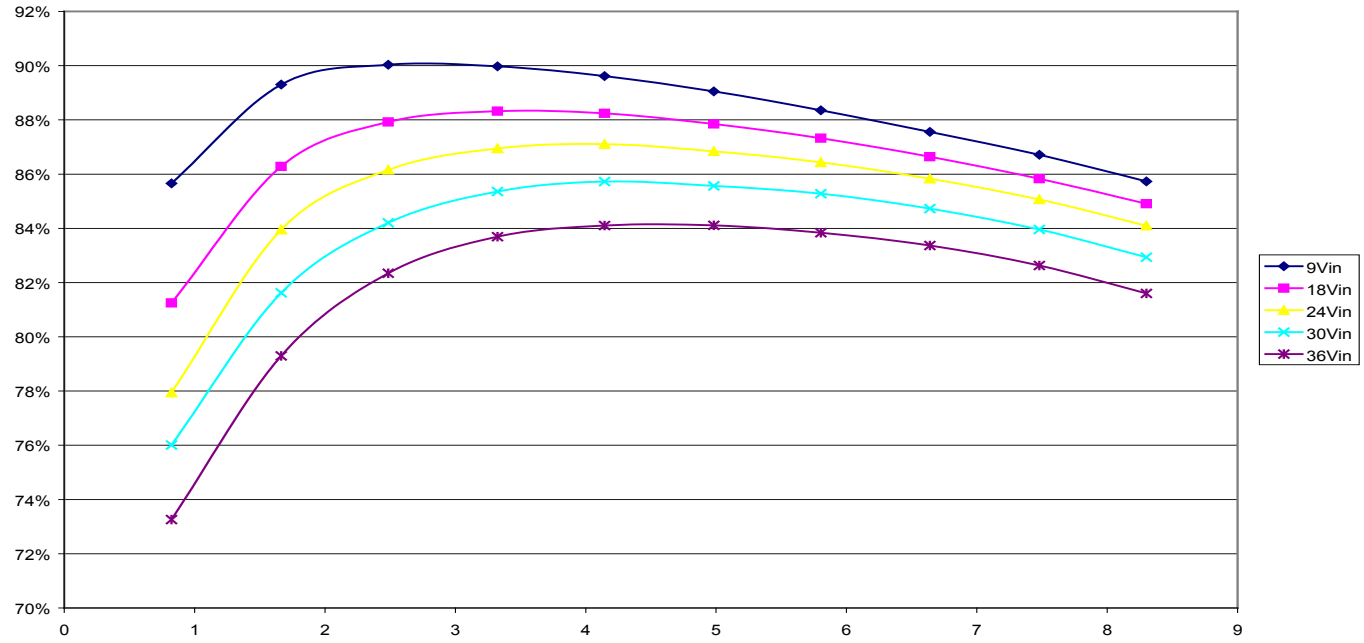
Pin	Name	Pin Dia. (Typ.)
1	-INPUT	0.08”
3	ON/OFF	0.04”
4	+INPUT	0.08”
5	+OUTPUT	0.08”
6	+SENSE	0.04”
7	TRIM	0.04”
8	- SENSE	0.04”
9	- OUTPUT	0.08”

TOLERANCE: ALL DIMENSIONS ARE TYPICAL IN INCHES UNLESS OTHERWISE NOTED:	
X.XX	±0.02
X.XXX	±0.005

Efficiency Curves

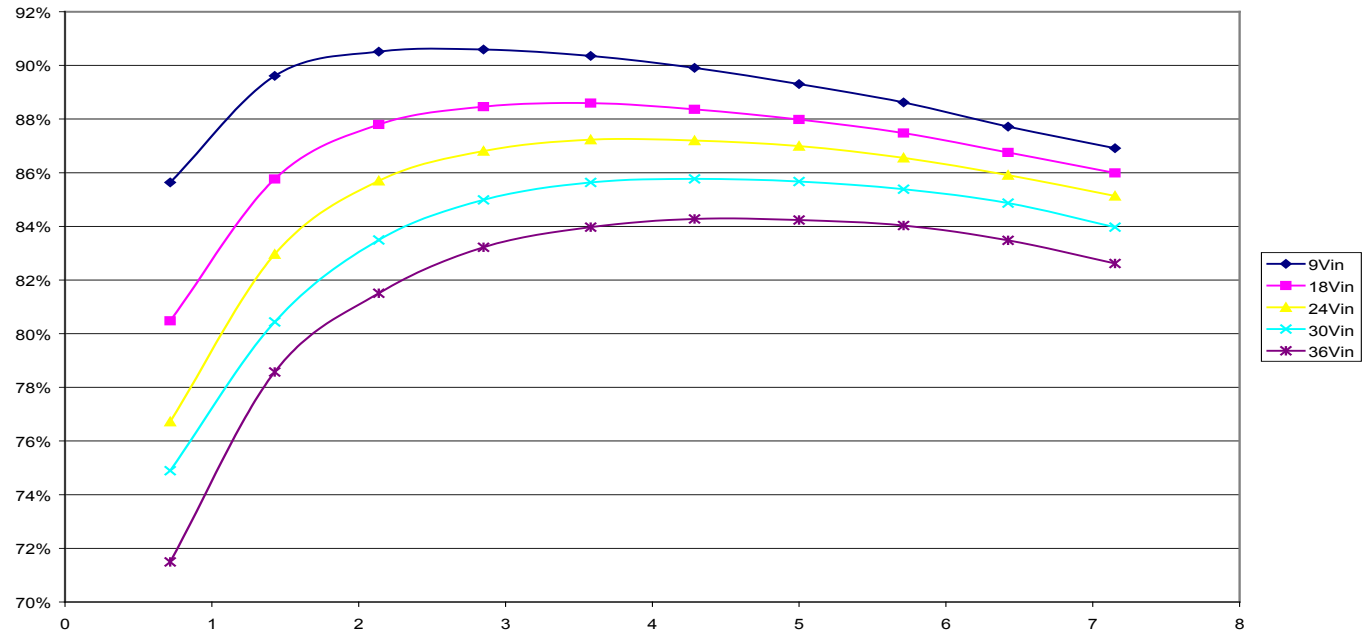
Typical values at +25ºC ± 3ºC case temperature.

24S24.8TH (24V Output):



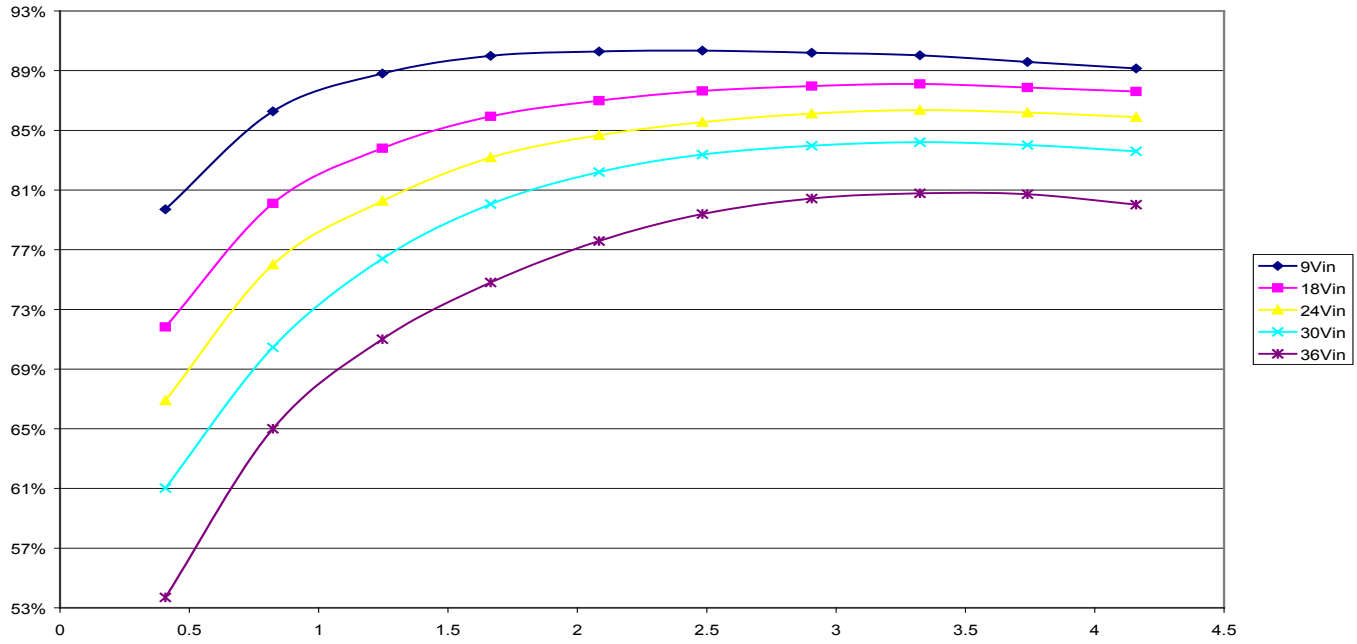
Efficiency as a function of load current for various input voltages

24S28.7TH (28V Output):



Efficiency as a function of load current for various input voltages

24S48.4TH (48V Output):



Efficiency as a function of load current for various input voltages