

# 240 WATT LP SERIES DC/DC CONVERTERS



## Features

- 4:1 Input voltage range
- High power density
- Small size 2.4" x 2.28" x 0.55"
- 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 240 Watt Single LP 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 240 Watt LP meets the most rigorous performance standards in an industry standard footprint for mobile (12V<sub>IN</sub>), process control (24V<sub>IN</sub>) and military COTS (28V<sub>IN</sub>) applications.

The 4:1 Input Voltage 240 Watt LP 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		
24S12.20LP	9	36	12	20
24S15.16LP	9	36	15	16
24S24.10LP	9	36	24	10
24S28.8LP	9	36	28	8.6
24S48.5LP	9	36	48	5

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		24S12.20LP	24S15.16LP	24S24.10LP	24S28.8LP	24S48.5LP	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	325 12.5	TBD				mA A
Inrush Current	MAX	0.5						A <sup>2</sup> s
Reflected Ripple	TYP	50						mA P-P
Switching Frequency	TYP	210						kHz
Recommended Fuse		(2)						A
External Input Capacitance	MIN	470						μF

Output Parameters								
Model		24S12.20LP	24S15.16LP	24S24.10LP	24S28.8LP	24S48.5LP	Units	
Output Voltage		12	15	24	28	48	V	
Output Voltage Setpoint Accuracy	MAX	±1						%
Turn On Overshoot	TYP	2.5						%
Temperature Coefficient (5)	TYP MAX	0.015 0.03						%/°C
Noise (3)	TYP TYP	120 40	150 50	240 80	280 100	480 150	mV P-P mV RMS	
Load Current	MIN MAX	0 20	0 16	0 10	0 8.6	0 5	A	
Load Transient Overshoot (4)	TYP	4						%
Load Transient Recovery Time (4)	TYP	600						μs
Load Regulation (7) Min-Max Load	TYP MAX	0.05 0.3						%
Line Regulation Vin = Min-Max	TYP MAX	0.1 0.3						%
Overvoltage Protection (OVP) Threshold OVP Type - Non-latching Open Loop Overvoltage Clamp	TYP	115						%
Output Current Limit Vout = 90% of Vout-nom	TYP	105						%
External Output Capacitance	MIN	150						μF

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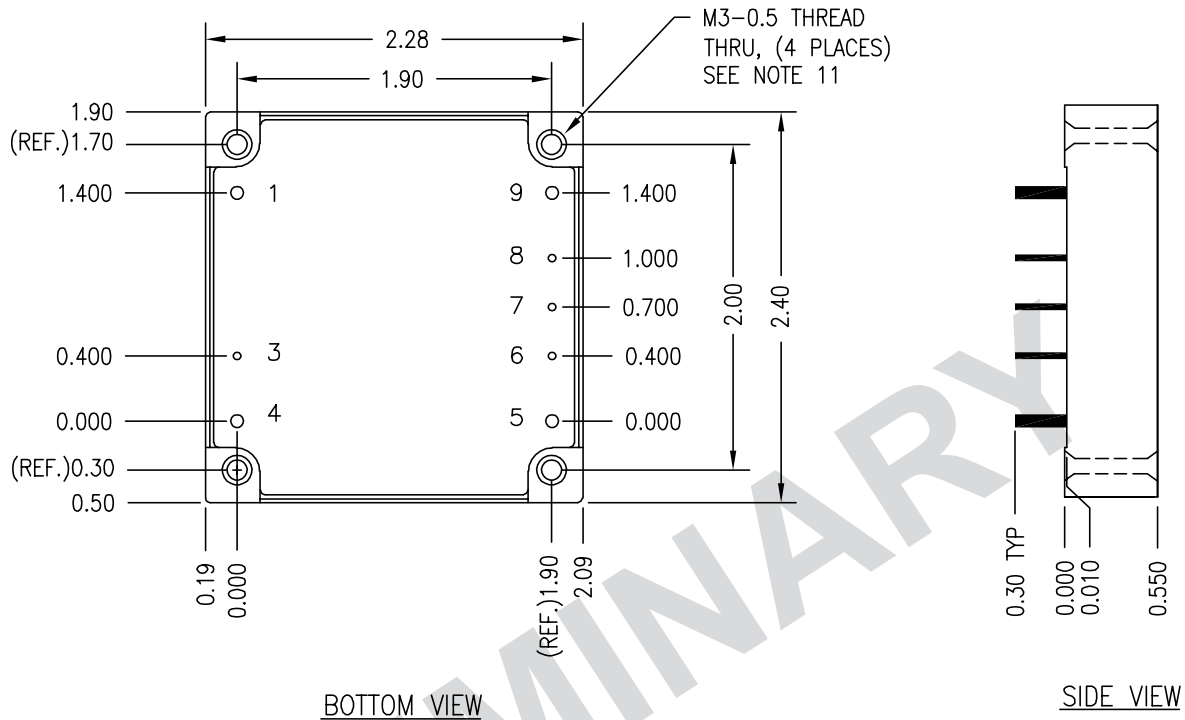
General Specifications			
All Models			Units
<b>ON/OFF Function</b>			
Converter - ON HIGH Logic Level / Leave ON/OFF Pin Open (13)	MIN	3.0	V
External Leakage Current Allowed for Logic High (8)	MAX	10	µA
Converter - OFF LOW Logic Level / Tie ON/OFF Pin to -INPUT (13)	MAX	1.0	V
Sinking Current for Logic Low	MAX	500	µA
Idle Current (Module is OFF)	TYP	40	mA
Turn-on Time to 1% error	TYP	180	ms
<b>Output Voltage Remote Sensing (15)</b>			
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	%
<b>Output Voltage Trim (15)</b>			
Trim Range	MIN MAX	-25 +10	% of Vout
Input Resistance	TYP	10	kΩ
Open Circuit Voltage	TYP	2.5	V
<b>Trim Limit</b>			
Maximum Output Voltage	TYP	110	% of Vout
<b>Isolation</b>			
Input to Output Isolation 10µA Leakage	MAX	1544	VDC
Input to Output Resistance	MIN	10	MΩ
Input to Output Capacitance	TYP	2200	pF
<b>Environmental</b>			
MTBF MIL-HDBK-217 (14)		TBD	h
MTBF Bellcore Method 1, Case 1		TBD	h
Case Operating Temperature Range	MIN MAX	-40 100	°C
Storage Temperature	MIN MAX	-40 120	°C
Thermal Impedance (9)	TYP	7	°C/W
Thermal Shutdown Case Temperature (Auto Restart)	TYP	105	°C
<b>General</b>			
Efficiency		See Graph page 5	
Unit Weight		135	g
Case Dimension		2.4" x 2.28" x 0.55"	
Designed to meet UL/cUL 60950, IEC/EN 60950-1			

## Notes:

- All parameters measured at Tc=+25°C ambient, Vin = Vnom, maximum rated load, unless otherwise noted. Refer to CALEX Application Notes for definition of terms, measurement circuits and other information.
- 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.
- 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.
- 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.
- Temperature coefficient is defined for case temperatures. Output voltage deviation is calculated as the maximum resulting from either 1) 25°C case to maximum operating case temperature, or 2) 25°C case to minimum operating case temperature.
- Test with resistor load of 20mΩ maximum connected across the output pins.
- 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.
- 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.
- 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 8°C/W.
- 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.
- Torque fasteners into threaded mounting inserts at 10 in. lbs. or less. Greater torque may result in damage to unit and void the warranty.
- 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.
- 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.
- MTBF is calculated based on MIL-HDBK-217F under the following conditions:  
Reliability prediction method = Part Stress Analysis  
Baseplate temperature = 40°C  
Environment = Ground, Benign
- Refer to Calex Application Note 4 for methods to apply Remote Sense and Trim.
- Specifications subject to change without notice.
- RoHS Compliance:  
See Calex Website [www.calex.com/RoHS.html](http://www.calex.com/RoHS.html) for the complete RoHS Compliance statement.  
The RoHS marking is as follows.



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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

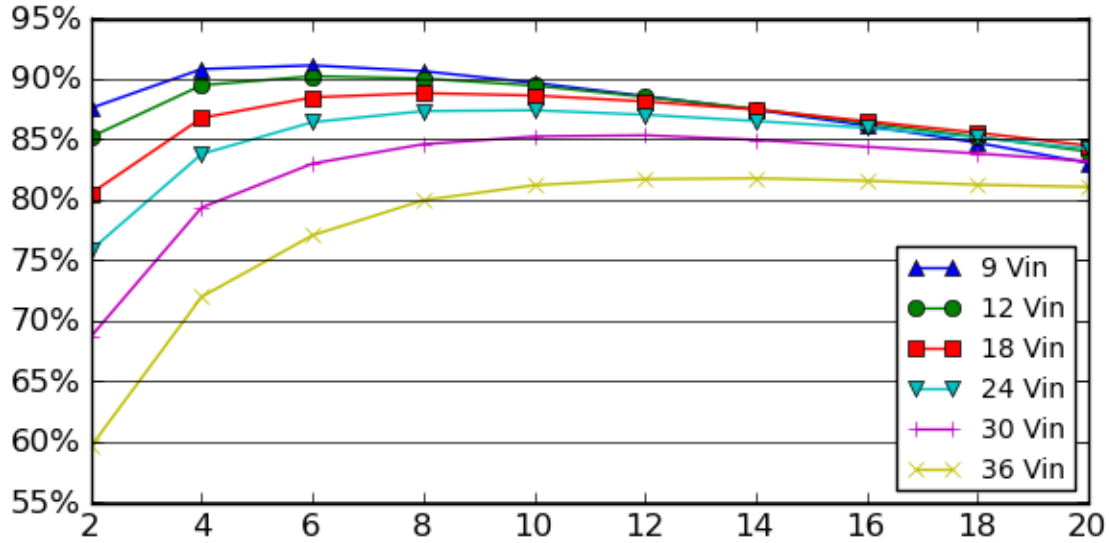
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## Efficiency Curves

Typical values at +25°C ± 3°C case temperature.

24S12.20LP (12V Output):



Efficiency as a function of load current for various input voltages

PRELIMINARY