6 Watt EC Single Series DC/DC Converters

Features

- Few External Parts Required for Operation
- Efficiencies to 80 Percent
- Overcurrent Protected for Long, Reliable Operation
- Water Washable, Non-conductive Case Design
- Low Input to Output Capacitance
- Isolation Voltage Raised to 700 VDC as Per the Requirements of UL1459
- Five Year Warranty

Selection Chart				
Model	Input Range VDC		Output VDC	Output mA
	Min	Max		
12S5.1000EC	9	27	5	1000
12S12.500EC	9	27	12	500
12S15.400EC	9	27	15	400
48S5.1000EC	20	60	5	1000
48S12.500EC	20	60	12	500
48S15.400EC	20	60	15	400

Description

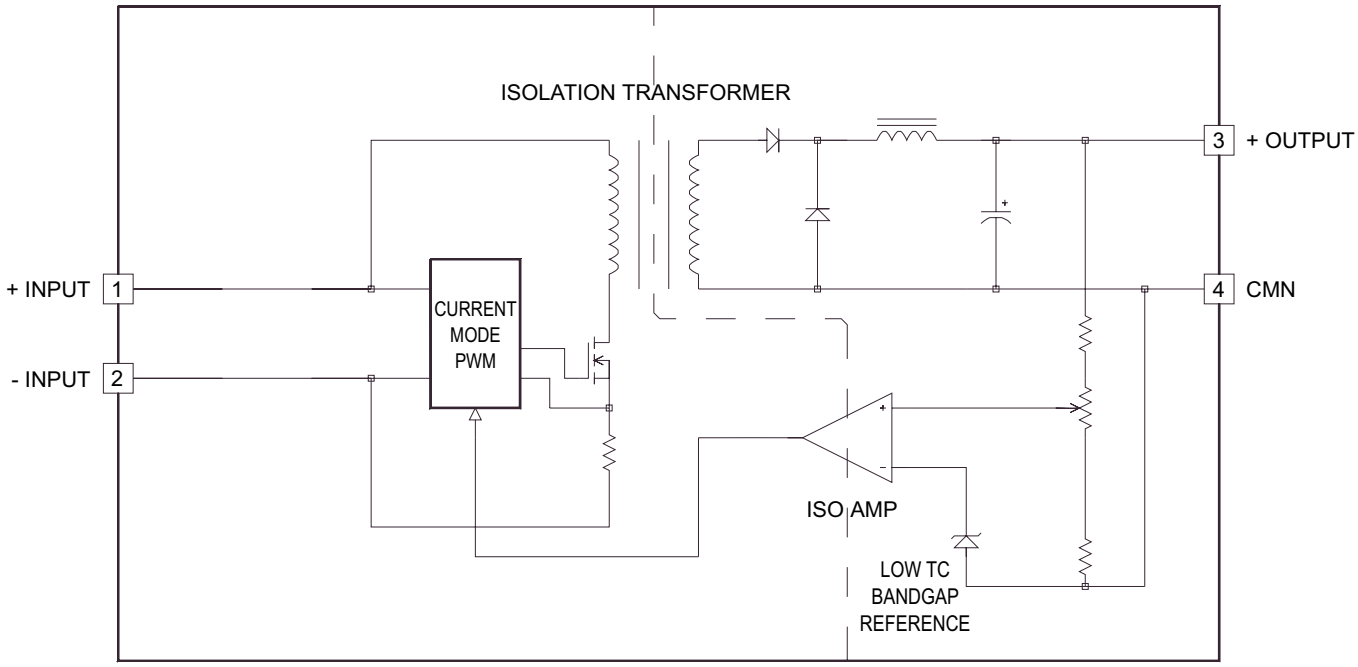
These 6 Watt DC/DC converters were designed expressly for fast integration with your systems power needs. With few external components or filtering needed for all but the most critical applications, these converters drop onto your board and provide power instantly. This saves you costly engineering time needed to design your system around the power converter, “We’ve done the engineering for you”.

Saving space in today’s modern designs is also critical. The EC Series converters replace narrow input voltage range 2 x 2 inch converters with a space saving 1 x 2 inch design. This series has the highest isolation of any high power density 1 x 2 inch DC/DC converter on the market - we guarantee the full UL1459 mandated value of 700 VDC.

Reliability is the most important design criteria for the CALEX design team. To this end we reduced the component count 50% from our last generation of 6 Watt devices and reduced the case footprint.

CALEX reliability is backed by our 5 year warranty. We can offer a 5 year warranty where others can’t because with a CALEX DC/DC it’s rarely needed.

6 Watt EC Single Series Block Diagram



Input Parameters*								
Model		**12S5.1000EC**	**12S12.500EC**	**12S15.400EC**	**48S5.1000EC**	**48S12.500EC**	**48S15.400EC**	**Units**
Voltage Range	MIN MAX	9 27			20 60			VDC
Reflected Ripple (1) With External Capacitor	TYP	4			3			mA RMS
Reflected Ripple (1) without Capacitor	TYP TYP	1.8 0.93			0.85 0.44			A P-P A RMS
Input Current Full Load No Load	TYP TYP	507 6	600 12		130 5	154 6		mA
Efficiency	TYP	82	83 83		80	82 82		%
Switching Frequency	TYP	125						kHz
Maximum Input Overvoltage 100ms Maximum 12S models 48S Models	MAX	 34 72						VDC
Turn-on Time, 1% Output Error	TYP	6						ms
Recommended Fuse		(2)						AMPS

Output Parameters*								
Model		**12S5.1000EC**	**48S5.1000EC**	**12S12.500EC**	**48S12.500EC**	**12S15.400EC**	**48S15.400EC**	**Units**
Output Voltage		5		12		15		VDC
Output Voltage Accuracy	MIN TYP MAX	4.95 5.00 5.05		11.90 12.00 12.10		14.90 15.00 15.10		VDC
Rated Load Range	MIN MAX	0.0 1.0		0.0 0.5		0.0 0.4		A
Load Regulation 25% - 100% of Rated Load	TYP MAX	0.1 0.3		0.2 0.4		0.2 0.4		%
Line Regulation Vin = Min to Max VDC	TYP MAX	0.02 0.2		0.2 0.8		0.2 0.8		%
Short Term Stability (3)	TYP	< 0.05						%/24Hrs
Long Term Stability	TYP	< 0.1						%/kHrs
Transient Response (4)	TYP	250		300				µs
Dynamic Response (5)	TYP	75		250				mV peak
Input Ripple Rejection (6)	TYP	> 40						dB
Noise, Peak - Peak (1)	TYP	50						mV P-P
RMS Noise	TYP	8						mV RMS
Temperature Coefficient	TYP MAX	50 150						ppm/°C
Short Circuit Protection to Common for all Outputs		Continuous, Current Limit 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.**

(1) 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 0.1µF / 50V ceramic capacitor in parallel with a 1µf / 35V Tantalum capacitor, 1 inch from the output pins to simulate standard PCB decoupling capacitance. Reflected Ripple is measured with the appropriate input capacitor, and into a 10 µH source impedance. See application notes for input capacitor requirements.

(2) To determine the correct fuse size, see CALEX Application Notes.

(3) Short term stability is specified after a 30 minute warmup at full load, constant line and recording the drift over a 24 hour period.

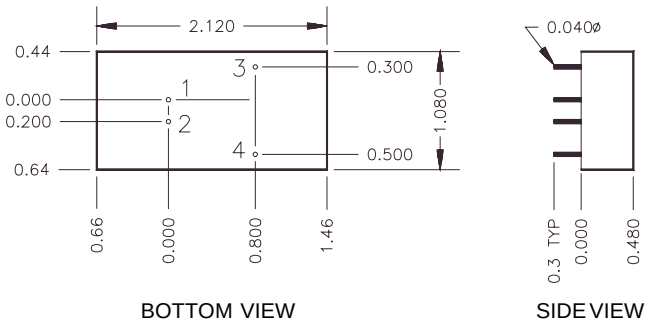
(4) The transient response is specified as the time required to settle from a 50 to 75% step load change (rise time of step = 2 µs) to a 1% error band.

(5) Dynamic response is the peak overshoot during a transient as defined in note 4 above.

(6) The input ripple rejection is specified for DC to 120 Hz ripple with a modulation amplitude of 1% of Vin.

(7) The case thermal impedance is specified as the case temperature rise over ambient per package watt dissipated.

General Specifications*			
All Models			**Units**
Isolation			
Isolation Voltage Input to Output 10µA Leakage	MIN	700	VDC
Input to Output Capacitance	TYP	400	pF
Environmental			
Case Operating Range No Derating	MIN MAX	-40 100	°C
Storage Range	MIN MAX	-55 105	°C
Thermal Impedance (7)	TYP	20	°C/Watt
General			
Unit Weight	TYP	1	oz
Chassis Mounting Kits		MS6, MS8, MS15	
Agency Approvals		CSA/UL 60950	



Mechanical tolerances unless otherwise noted:

X.XX dimensions: ±0.040 inches

X.XXX dimensions: ±0.010 inches

Pin	Function
1	+INPUT
2	-INPUT
3	+OUTPUT
4	CMN

Application Information

General Information

The 125 kHz operating frequency of the 6 Watt EC Single series allows an increased power density over the last generation of 2 X 2 inch converters.

The series is also mindful of battery operation for industrial, medical control and remote data collection applications. The no-load input current draws typically less than 7 mA from the input source.

Full overload protection is provided by independent pulse-by-pulse current limiting. These protection features assure you that our 6 Watt single will provide you with zero failure rate operation.

A fully sealed, water washable, non-conductive case is standard along with specified operation over the full commercial temperature range of -40 to +100 °C.

General Operation

Figure 1 shows the recommended connections for the 6 Watt EC Single DC/DC converter. A fuse is recommended to protect the input circuit and should not be omitted. The fuse prevents unlimited current from flowing in the case of a catastrophic system failure.

No external capacitance on the output is required for normal operation, in fact it can degrade the converters 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 10 µF and 0.1 to 0.001 µF bypasses may be used around your PCB as required for local bypassing without harm.

Applying the Input

The input to the 6 Watt EC single series should be buffered with a high ripple current capacitor (C1 in Figure 1) if it is an appreciable distance from your input source. A capacitor capable of handling the input ripple current of the EC series should be used (see the input reflected ripple current curves for exact values). Use the minimum size required for your output power level and minimum input voltage to keep your system small and cost effective.

Applicable capacitor types for worst case applications are detailed below. Worst case is defined as continuous operation at full load, minimum line and high ambient temperatures. The capacitor that you will need will probably be smaller if one or all of the worst case conditions listed is relaxed.

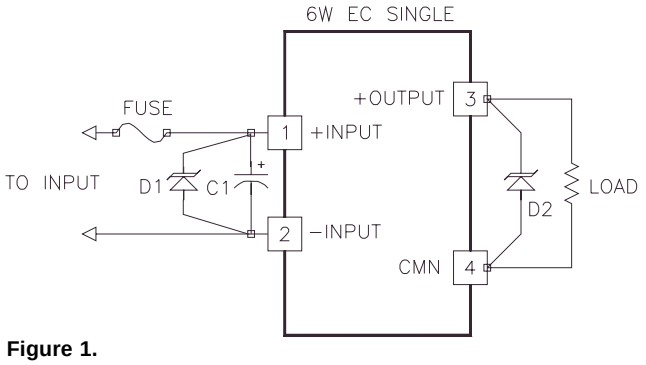


Figure 1.
Standard connections for the 6 Watt EC Single. The input fuse should not be omitted. The overvoltage diodes D1 and D2 may be added to the circuit directly at the converter to provide transient protection to your circuit. In some circuits capacitor C1 may be required, see the section “Applying The Input” for more information.

Suggested Capacitors

12 Volt Inputs

Panasonic **HFQ Series**
Suggested Part: ECA1HFQ271
270µF, 50V, 105°C Rated
10 x 25 mm
ESR=0.090 Ohms
Allowable Ripple=1.040 A @ 105°C

Nichicon **PF or PL Series**
Suggested Part: UPL1H221MPH6
220µF, 50V, 105°C Rated
10 x 25 mm
ESR=0.075 Ohms
Allowable Ripple=1.040 A @ 105°C

United Chemi-Con **LXF, KMF, or SXE Series**
Suggested Part: LXF50VB221M10X25LL
220µF, 50V, 105°C Rated
10 x 25 mm
ESR=0.063 Ohms
Allowable Ripple=1.150 A @ 105°C

48 Volt Inputs

Panasonic **HFE Series**
Suggested Part: ECEA2AFE680,
68µF, 100V, 105°C Rated
12.5 x 15 mm
ESR=0.28 Ohms
Allowable Ripple=0.511 A @ 105°C

Nichicon **PR Series**
Suggested Part: UPR2A101MRH
100µF, 100V, 105°C Rated
12.5 x 20 mm
Allowable Ripple=0.577 A @ 105°C

United Chemi-Con **KMF, SXE**
Suggested Part: KMF100VB470M10X16LL
47µF, 100V, 105°C Rated
10 x 16 mm
ESR=0.32 Ohms
Allowable Ripple=0.500 A @ 105°C

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 peak-peak.

Grounding

The input and output sections are fully floating from each other. They may be operated fully 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 10µF, 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 converters 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.

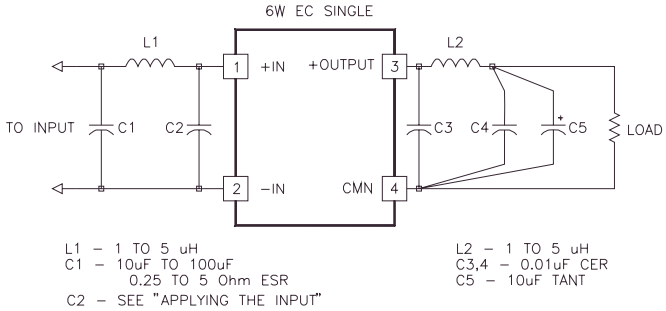


Figure 2.
For very low noise applications the circuits shown above can be used. The input current ripple will be reduced approximately 30 dB of the original value while the output noise will be reduced to below 10 mV p-p. Do not use the biggest lowest ESR capacitors that you can find in these circuits. These types of capacitors will cause severe peaking in the filters transfer function and may actually make the conducted noise worse.

Temperature Derating

The EC Single series can operate up to 100°C case temperature without derating. Case temperature may be roughly calculated from ambient by knowing that the 6 Watt EC Singles case temperature rise is approximately 20°C per package watt dissipated.

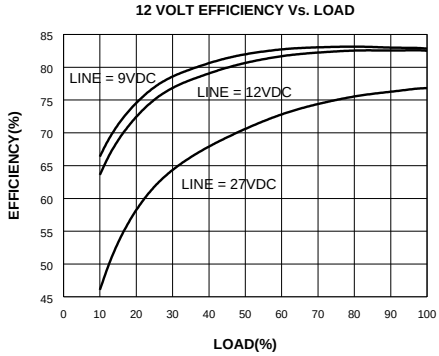
For example: If a 48 volt input converter was delivering 4 Watts, at 48 volts input at what ambient could it expect to run with no moving air and no extra heatsinking?

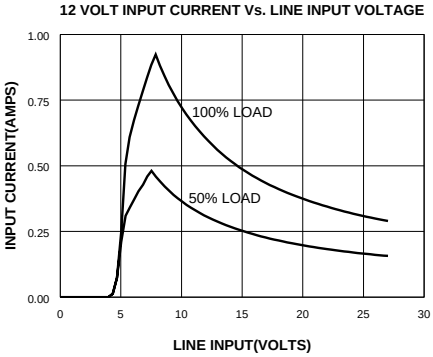
Efficiency for a EC Single is approximately 78%. A little less for some - a little more for others, check the product curves for exact information. This leads to an input power of about 5 Watts. Therefore the case dissipation is 5 Watts (input power) minus 4 Watts (output power) or 1 Watt. The case temperature rise would be 1 Watt x 20°C/W = 20°C. This number is subtracted from the maximum case temperature of 100°C to get: 80°C.

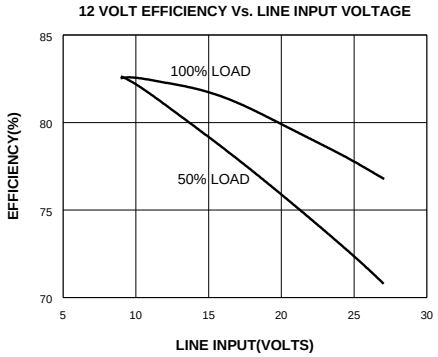
This is a rough approximation to the maximum ambient temperature. Because of the difficulty of defining ambient temperature and the possibility that the loads dissipation may actually increase the local ambient temperature significantly or that convection cooling is suppressed by physical placement of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

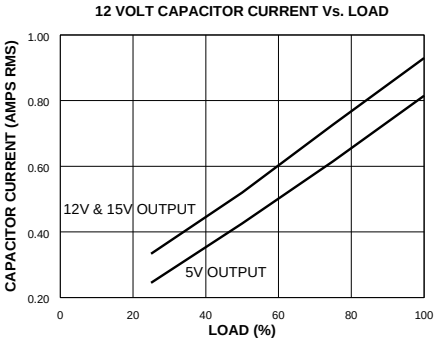
Typical Performance (Tc=25°C, Vin=Nom VDC, Rated Load).

Data for 12 Volt Input Models

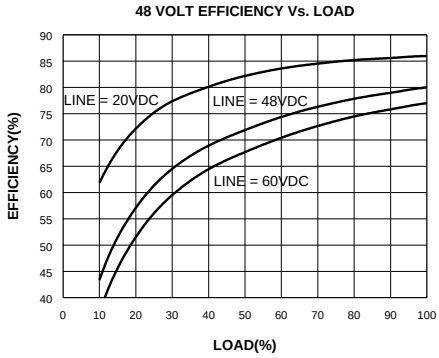


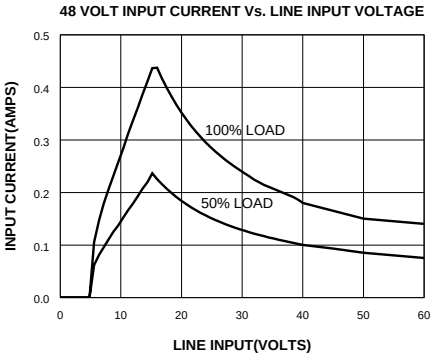


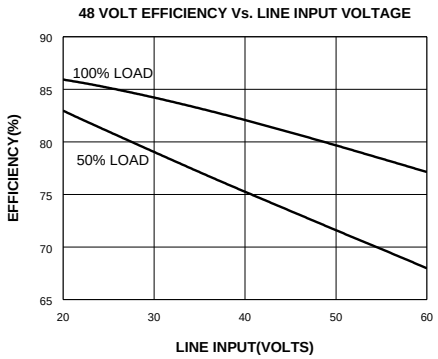


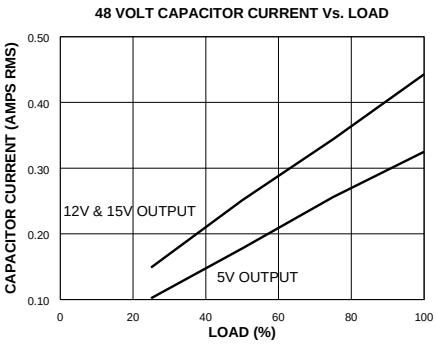


Data for 48 Volt Input Models









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

Data for All Models