

## 9 Watts

- Smallest footprint 9W converter
- Single and Dual output
- SIP Package
- 4:1 Input range
- 1600VDC Isolation
- Remote on/off
- 5 Year warranty



The FR series of power dense DC/DC converters come in both single and dual outputs in a SIP 8 pin package. Inputs are available in 24 & 48V versions with a 4:1 range and outputs from 3.3 to 24V single and dual  $\pm 5V$  to  $\pm 15V$ . The units operate from  $-40$  to  $+85^{\circ}C$  and come complete with remote on/off functionality. All models have a FIDUS 5 year warranty.

Dimensions:

0.86 x 0.44 x 0.38" (21.8 x 11.2 x 9.6mm)

## Models & Ratings

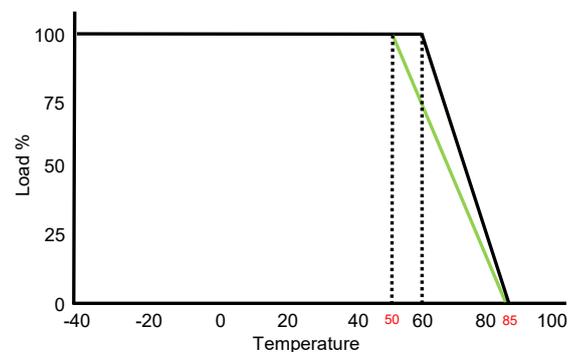
Model Number	Input Voltage	Output Voltage	Output Current	Input Current		Maximum Capacitive Load	Efficiency
				No Load	Full Load		
FR2403S	9-36V	3.3V	2000mA	9mA	335mA	2600uF	82%
FR2405S		5V	1600mA	9mA	392mA	1300uF	85%
FR2409S		9V	1000mA	9mA	436mA	800uF	86%
FR2412S		12V	750mA	9mA	426mA	560uF	88%
FR2415S		15V	600mA	9mA	421mA	560uF	89%
FR2424S		24V	375mA	9mA	421mA	200uF	89%
FR2405D		$\pm 5V$	$\pm 800mA$	9mA	392mA	$\pm 800uF$	85%
FR2412D		$\pm 12V$	$\pm 375mA$	9mA	426mA	$\pm 390uF$	88%
FR2415D		$\pm 15V$	$\pm 300mA$	9mA	426mA	$\pm 200uF$	88%
FR4803S		18-75V	3.3V	2000mA	5mA	168mA	2600uF
FR4805S	5V		1600mA	5mA	196mA	1300uF	85%
FR4809S	9V		1000mA	5mA	218mA	800uF	86%
FR4812S	12V		750mA	5mA	211mA	560uF	89%
FR4815S	15V		600mA	5mA	213mA	560uF	88%
FR4824S	24V		375mA	5mA	213mA	200uF	88%
FR4805D	$\pm 5V$		$\pm 800mA$	5mA	196mA	$\pm 800uF$	85%
FR4812D	$\pm 12V$		$\pm 375mA$	5mA	216mA	$\pm 390uF$	87%
FR4815D	$\pm 15V$		$\pm 300mA$	5mA	216mA	$\pm 200uF$	87%

## Notes

- Under no load conditions the unit may not meet all specifications

Input	
Parameter	Rating
Input voltage range	See table
Input reflected ripple current	30mA pk-pk measured through 12uH inductor and source capacitor 47uF
Input surge (100mS max)	24V Models 50VDC Max. 48V Models 100VDC Max.
Input filter	Capacitor

## Derating curve



- 3.3V outputs,  $-40$  to  $50^{\circ}C$  at 100% load
- All other outputs,  $-40$  to  $60^{\circ}C$  at 100% load

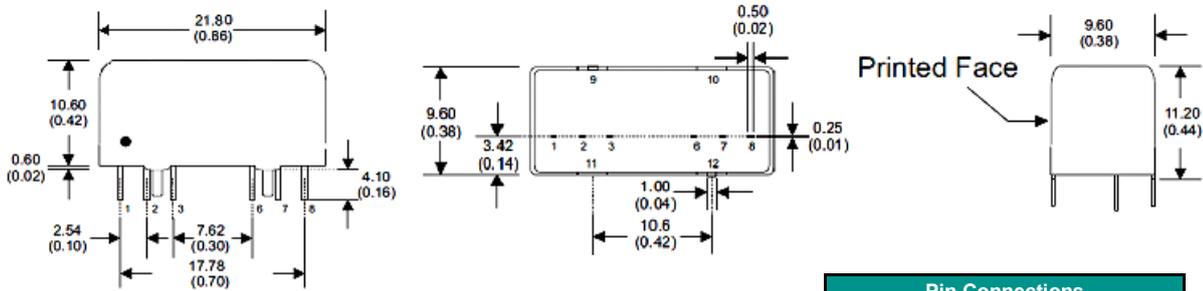
Output					
Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Output voltage	3.3		15	VDC	See Model & Ratings table
Set point accuracy			±1	%	
Line regulation			±0.2	%	Low line to High line
Load regulation			±0.5	%	5% to 100% load
Minimum load		0		%	Under no load conditions the unit may not meet all specifications
Cross regulation			±5	%	On dual output models when one load is varied by 25 to 100% and the other is 100% load.
Ripple & Noise			75	mV pk-pk	Measured with 20MHz bandwidth, may be larger at low loads
Transient response	±5% for 3.3 and 5V outputs. ±3% for all other outputs.			% Deviation	Within 250uS typically
Short circuit protection					Continuous with automatic recovery
Maximum capacitive load					See Model and Ratings table
Remote on/off	ON: Open circuit or high impedance. OFF: Short pin 3 to 1 via a 1K resistor –Idle current 2-4mA. See application notes.				

General					
Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Efficiency	82		89	%	See Model & Ratings table
Isolation			1600	VDC	Input to output
Isolation resistance	1000			M Ohm	
Isolation capacitance			50	pF	
Switching frequency		400		KHz	24Vin models
		500			48Vin models
Power density			62.6	W/In <sup>3</sup>	
MTBF		>900		KHrs	As per MIL-HDBK-217F, 25°C GB

Environmental					
Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Operating temperature	-40		85	°C	Derate linearly from 100% load at 50°C to 0% load at 85°C for 3.3V output models. Derate linearly from 100% load at 60°C to 0% load at 85°C for all other outputs.
Storage temperature	-55		125	°C	
Case temperature			100	°C	
Cooling					Convection cooled
Humidity	5		95	% RH	Non-condensing
Temperature coefficient			±0.02	%/°C	

EMC					
	Standard	Test level	Criteria	Notes & Conditions	
Conducted	EN55032	Class A	-		
Radiated	EN55032	Class A	-		
ESD	IEC 61000-4-2	3	Criteria B	8kV air discharge, 6kV contact discharge	
RS	IEC 61000-4-3	3	Criteria A	80~1000 MHz, 20V/m, 80% AM (1kHz)	
EFT	IEC 61000-4-4	3	Criteria A	Power line : 2kV. See application note	
Surge	IEC 61000-4-5	3	Criteria A	1.2/50 μs Open Circuit Voltage, 8/20 μs Short Circuit Current, DC Port, Line to line :2.0kV See application note	
CS	IEC 61000-4-6	3	Criteria A	0.15 ~ 80 MHz, 10Vrms, 80% AM (1kHz)	
PFMF	IEC 61000-4-8	1	Criteria A	50Hz, 100A/m continuous. 1000A/m 1sec.	

## Mechanical Details



Physical	
Parameter	Rating
Case material	Copper
Pin material	C5191R-H Solder coated
Potting material	Epoxy (UL94V-0)
Weight	7.3g
Dimensions	0.86 x 0.38 x 0.44"
Soldering temperature	1.5mm from case ,10s and 260°C max.

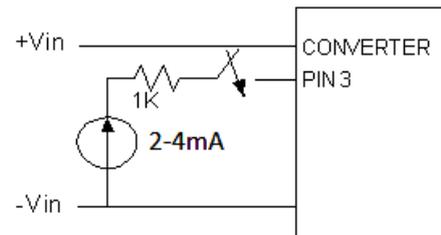
Pin Connections		
Pin	Single	Dual
1	-Vin	-Vin
2	+Vin	+Vin
3	Remote on/off	Remote on/off
6	+Vout	+Vout
7	-Vout	0V
8	N.C	-Vout
9	Case	Case
10	Stand Off	Stand Off
11	Stand Off	Stand Off
12	Case	Case

- Notes**
- All dimensions shown in millimetres (inches)
  - Pin diameter 0.5 ±0.05 (0.02 ±0.002)
  - Case tolerance ±0.5 (±0.002)

## Application notes

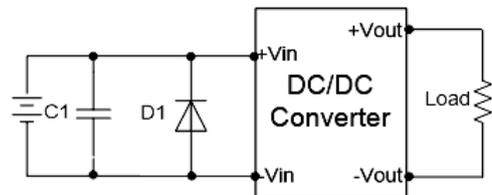
### Remote ON/OFF

The FR series output can be turned on and off using the remote on/off function. If Pin 3 is left open circuit or high impedance then the unit is ON. To turn off short pin 3 to pin 1 -Vin via a 1K resistor drawing 2.5mA typically of idle current



### EMI Filter

The input filter components C1 and D1 can be fitted to help meet IEC61000-4-4 and IEC61000-4-5 for the system. They should be mounted as close as possible to the module. Lead lengths should be minimized and where possible avoid running input and output tracks under the module as part of good design practice for best EMC performance. If the module is embedded in a system running from an AC/DC converter, this will have its own additional immunity protection and EMI filtering that will impact the overall system EMI performance.



Model number	C1	D1
FR24XX	33uF, 100V	TVS, 3KW, 70V
FR48XX	33uF, 100V	TVS, 3KW, 120V