Features

- Industry standard full-brick package and footprint 4.6”×2.4”×0.5”
- High power density: 90W/in3
- High efficiency: 90% typical
- 2:1 input voltage range
- Low output noise & ripple
- Remote sense
- Over-temperature protection
- Output over-current/voltage protection
- I.O.G. signal open collector output
- Output Voltage Trim: +10% / -40%
- Baseplate operating temperature: -40℃ to 100℃
- UL60950-1/ EN60950-1 Certified
- RoHS (2002/95/EC) complaint

Options:

- Remote on/off
- RoHS compliant

Numbering Convention

FDR - L 600 28 S C G
① ② ③ ④ ⑤ ⑥ ⑦

No	Features	Descriptions
①	Product Series	Full-brick Al-Baseplate Series
②	Remote on/off Logic	L – Negative Logic
		H or Default – Positive Logic
③	Typical Output Power	600 – Output Power: 600W
④	Typical Output Voltage	28 – Output Voltage: 28V
⑤	Number of Outputs	S – Single Output
⑥	Typical Input Voltage	C – Input Voltage: 48V
⑦	RoHS feature	G – lead-free products, RoHS6

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1 Description

The power modules are molded packaged DC-DC converters in an industry full-brick packaging and footprint with Aluminum baseplate, and can provide up to 28V_{DC} output voltage and 21.5A output current. The power modules feature a wide input voltage range, high efficiency, excellent thermal performance and high isolation voltage, and are well suited for telecommunication, industrial automation and test equipments, etc.

2 Specifications (Unless otherwise indicated, all specifications are typical at nominal input voltage, full load at 25℃, and with an external heat sink)

Parameter		Test Condition	Min	Typ	Max	Unit
2.1 Absolute Maximum Ratings						
Input Voltage（Vi)		Non-operating, continuous	0	—	80	Vdc
Transient input voltage（Vit)		100ms	—	—	100	Vdc
Max Output Power (Pomax)		allowable operating conditions	—	—	602	W
2.2 Input Specifications						
Typical Input Voltage (Vinom)		—	—	48	—	Vdc
Input Voltage Range		—	36	—	76	Vdc
Input Under-voltage protection		Ionom	31	—	34	Vdc
Input Under-voltage Recovery Point		Ionom	33	—	36	Vdc
Maximum Input current（Iimax)		Vimin, Vonom,Ionom	—	—	18.8	A
No-load Input Current（Iio)		Vinom, Io＝0A	—	—	200	mA
Quiescent Input Current (Iiof)		Vinom, remote output shutdown	—	—	40	mA
Remote	On	1mA ≤ I(on/off) ≤ 5mA (between +ON/OFF and -ON/OFF)				
	Off	Open Circuit (between +ON/OFF and -ON/OFF)				
2.3 Output Specifications						
Output voltage Set-point （Vonom)		Vinom,Ionom	27.72	28	28.28	Vdc
Typical load (Ionom)		—	—	—	21.5	A
Output Current Range (Io)		Po≤602W	0	—	21.5	A
Line Regulation (Vov)		Vimin-Vimax,Ionom	—	—	±0.2	%Vo
Load Regulation (Vol)		0-100%Ionom,Vinom	—	—	±0.5	%Vo
Output Voltage Trim (Voadj)		Io≤Ionom,Po≤602W	-40	—	+10	%Vo
Over-voltage Protection	Protection Mode	——	Clamp, Auto-recovery			—
	Threshold	Po<Pomax	32.2		37.8	Vdc
Over-current Protection	Protection Mode	——	Constant current, Auto-recovery			—
	Threshold	Vinom	105		140	%Ionom

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Parameter		Test Condition	Min	Typ	Max	Unit
Short-circuit Protection	Protection Mode	——	Hiccup, Automatic recovery			—
Dynamic Load Response	Peak Deviation	25%-50%-25%Ionom 50%-75%-50%Ionom	—	—	1400	mV
	Settling Time	ΔIo/Δt =2.5A/μS,Vinom	—	—	200	μs
Output Ripple and Noise		Vinom,20MHz , externally add a 220μF Tantalum capacitor and a 10μF ceramic capacitor to output, and add a 100μF/100V electrolytic capacitor to input	—	—	280	mV
External Output Capacitance (Co)		V_{INMIN}~V_{INMAX},0~100%I_O	0	—	10000	μF
Turn-on/off Peak Deviation		Vinom,Ionom	—	—	±10	%Vo
AUX Terminal (Aux. Supply)		Aux. Supply Current ≤20mA	7.6	8	8.4	V_{DC}
PC Terminal (Parallel Connection)			Available			
I.O.G Signal			Open collector output			
Remote Sense voltage Sampling			Available			
2.4 Safety Specifications						
Isolation voltage	Input to output	Leak Current≤10mA, 1min	1500	—	—	Vdc
	Input to Case	Leak Current≤10mA, 1min	1500	—	—	Vdc
	Output to Case	Leak Current≤10mA, 1min	500	—	—	Vdc
Isolation Resistance (R_{ISO})		500V_{DC}	50	—	—	MΩ
Safety Certificate		EN60950-1 Recognize				
2.5 Reliability						
Vibration Test(sine)		Frequency: 10~55Hz Amplitude: 0.35mm Acceleration: 50m/s^2 Cycle: X,Y,Z 30min each axis	After being tested, no damage to the converter and its components, the appearance, output voltage and output ripple and noise (p-p) meet the data sheet requirements.			
Impact Test (half-sine)		Peak Acceleration: 300m/s^2 Duration: 6ms 6 times for three perpendicular directions	After being tested, no damage to the converter and its components, the appearance, output voltage and output ripple and noise (p-p) meet the data sheet requirements.			
MTBF（MIL-HDBK-217F)		≥2×10^{5}h				
2.6 Environmental Specifications						
Relative Humidity		(40±2) ℃, No dew	—	—	90	%RH
Cooling		——	Conduction Cooling (Forced-air cooling or heat sink)			
Over-temperature protection		——	+115℃±5℃ (Baseplate Temp., Auto-recovery)			
Operating Baseplate Temperature			-40	—	+100	℃

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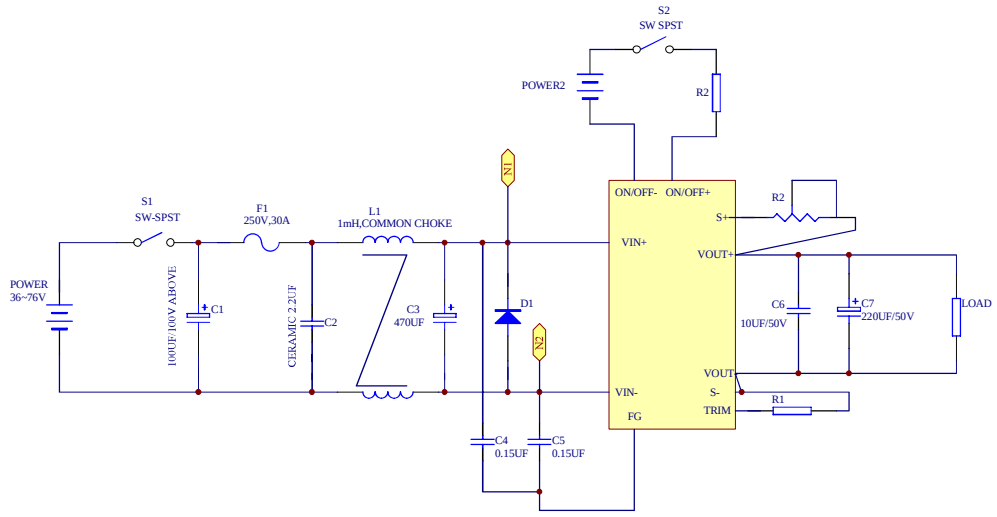
Parameter	Test Condition	Min	Typ	Max	Unit
Storage Temperature (Tst)		-40	—	+100	℃
2.7 General Specifications					
Switching Frequency	——	—	250	—	k Hz
Temperature Coefficient (Tcoeff)	——	—	—	±0.02	%/℃
Efficiency (η)	Vinom,Ionom	88	89	—	%
RoHS	RoHS (2002/95/EC)				

3. Basic Application Circuit and Considerations

3.1 Typical Application Circuit



3.2 With no external power supply for remote, short –ON/OFF to –Vin directly, and connect +ON/OFF to +Vin using an external resistor R2(30kΩ).

3.3 With no EMC requirement, L1, C3, C4 and C5 are optional.

3.4 With no demand for output trim, +S and –S shall be respectively connected to +Vout and –Vout directly. For testing, respectively connect +S and –S to +Vout and –Vout, or the module is at over-voltage status.

3.4.1 For output trim-up, with no resistor R1, adjust rheostat R2 to trim output up (V_O~+10%V_O).

Note: Output Power ≤ Total Power (602W), R2≤3kΩ

3.4.2 For output trim-down, with no rheostat R2, short +S to +V_O, adjust resistor R1 to trim output down (-40%V_O~V_O). Note: Output Current ≤ Maximum Current (21.5A), R1≥9.1kΩ

3.5 When operating at -20℃, double the capacitance of C1, and triple the capacitance of C7; when operating at -40℃, quadruple the capacitance of C1, and sextuple the capacitance of C7. Use several capacitors in parallel to reduce ESR.

3.6 For high-temperature application, keep air channels clear.

3.7 C6 shall be high-frequency ceramic capacitor.

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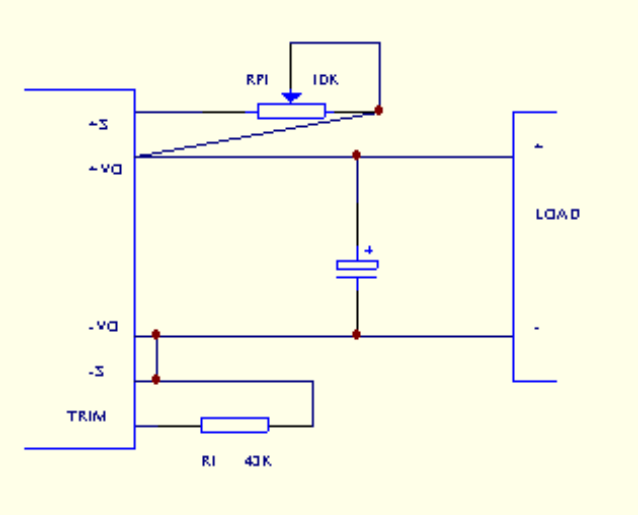
4. Instruction for Use/Test (heat sink or forced-air cooling required)

4.1 An input voltage exceeding the max input voltage may cause permanent damage to the module. The max input ripple shall be less than 4V, or the output ripple will exceed the specification. Sudden changes of input voltage will cause output voltage inrush. The module is not internally fused, and an external 30A/250V fuse is required. The leads of C3, C6 and C7 shall be as short as possible. D1 is used to protect the module from inverse input voltage, and it shall endure an isolation voltage more than 100V.

4.2 Output Voltage Trim

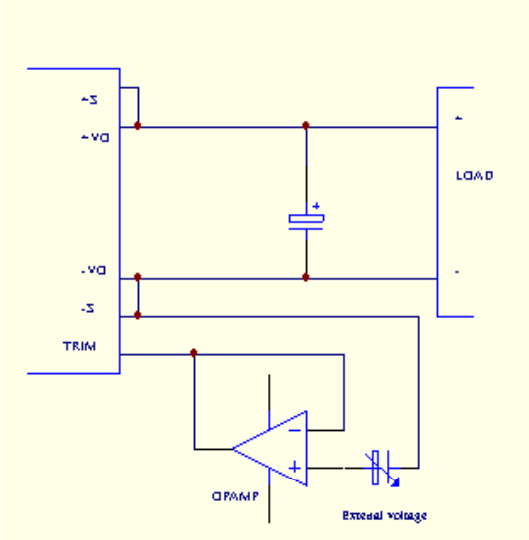
4.2.1 External Resistor/Rheostat Mode

Trim up: Removed R1;
Trim down: Removed RP1 rheostat, short +S to $+V_O$.



4.2.2 External Power Supply Mode:

Adjust the input voltage of amplifier to trim up/down the output voltage



Note: The over-voltage protection will function when trim-up voltage is higher than over-voltage protection threshold.

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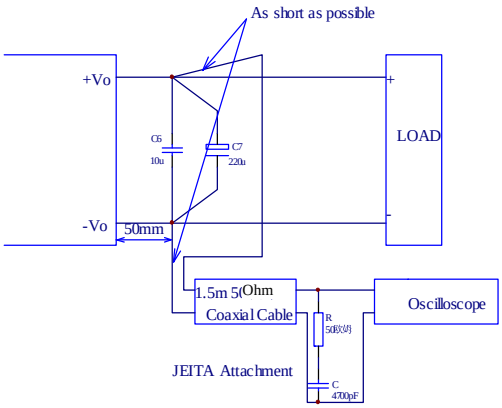
4.3 Max Ripple and Noise: test the ripple and noise as the following figure shows. The output leads shall be twisted-pair, of which the length is no more than 50mm.



4.4 Over-current Protection

Operating at over-current conditions for long time may cause damage to the module; if the output is less than 9V or in short-circuits, the module is in hiccup mode, and the output current varies from a few mA to hundreds of mA.

4.5 Over-voltage Protection

After eliminating the over-voltage conditions, the module will be auto recovered.

Test Method: disconnect +S and +Vo (low load), use oscilloscope to monitor the output voltage, the peak value is the over-voltage protection threshold.

4.6 Over-temperature Protection

When the baseplate temperature is at 110℃ to 120℃(115±5°C) , the over-temperature protection functions, and the output is off; when the baseplate temperature is 10℃ less than the protection threshold, the module is auto recovered.

4.7 Remote Sense (+S, -S terminals)

When using remote sense, use twisted-pair to connect +S and –S respectively to + LOAD and –LOAD; when not using remote sense, connect +S and –S respectively to +Vo and –Vo. The twisted-pair shall be as short as possible.

4.8 Remote on/off (+ON/OFF and -ON/OFF terminals): three modes

Note:

a. If the leads of +ON/OFF and -ON/OFF are a bit longer, add a 0.1uF capacitor between +ON/OFF and -ON/OFF.

b. A current-limit resistor can be also connected to -ON/OFF.

c. 1mA ≤ I(ON/OFF) ≤ 5mA

4.8.1 Connect ON/OFF to Input: add a 30kΩ resistor R1 between +ON/OFF and +Vin.

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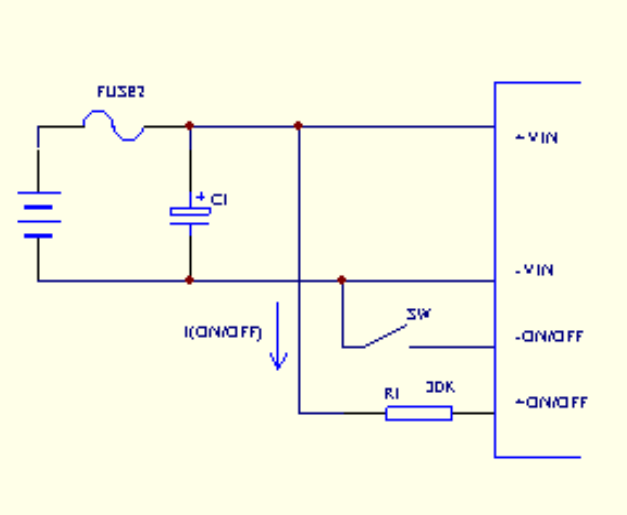
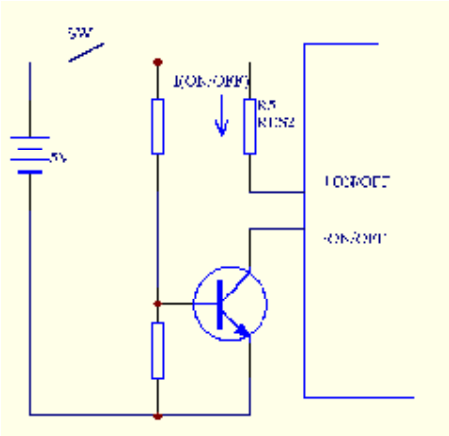


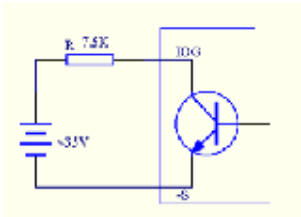
4.8.2 Connect ON/OFF to external power supply



4.9 I.O.G. Signal (INVERTER OPERATION GOOD)

Monitor the I.O.G. signals to learn about whether the module operates normally. The I.O.G. signal is at low level when the module operates normally, or at high level when the module stops or operates abnormally.

Use Condition: I.O.G. has open-collector output, the external voltage shall be less than 35V, and the sinking current is 5mA.



4.10 For isolation voltage test, short +Vin to –Vin, short +ON/OFF to -ON/OFF, short +Vout to-Vout, and short signal terminals, like I.O.G., Trim, +S and –S.

4.11 Parallel Application

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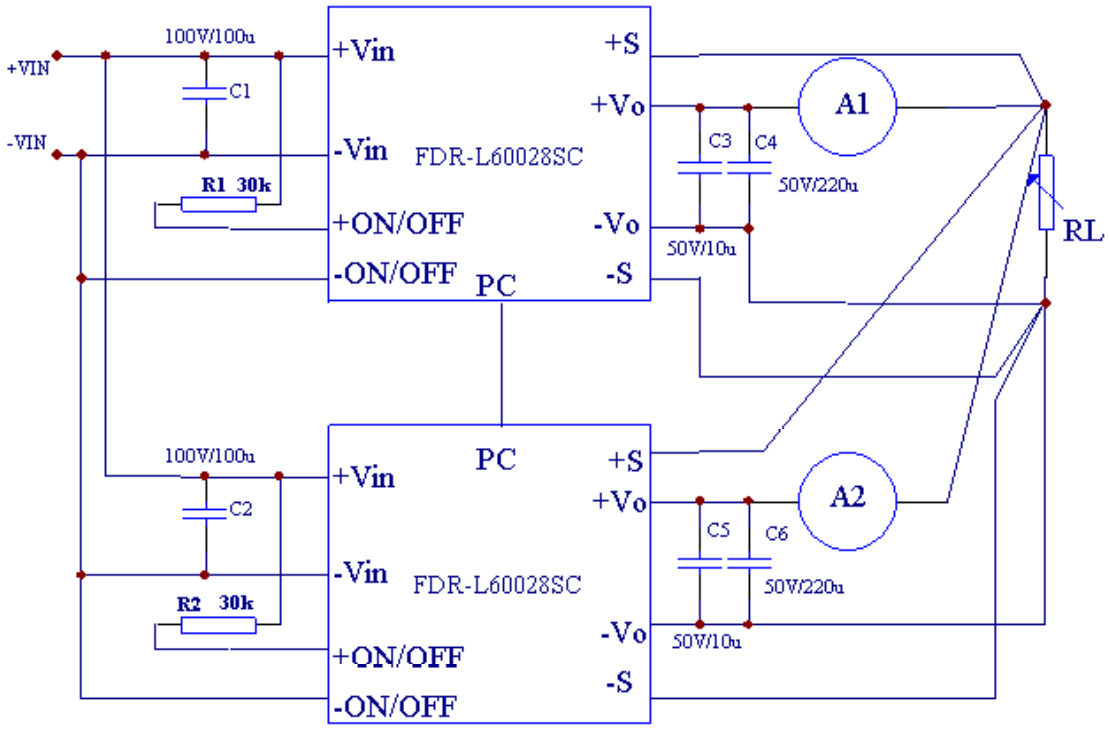

Note: the output voltage of each module shall exceed the output voltage set-point, and the output power shall not exceed 95% of total rated power.

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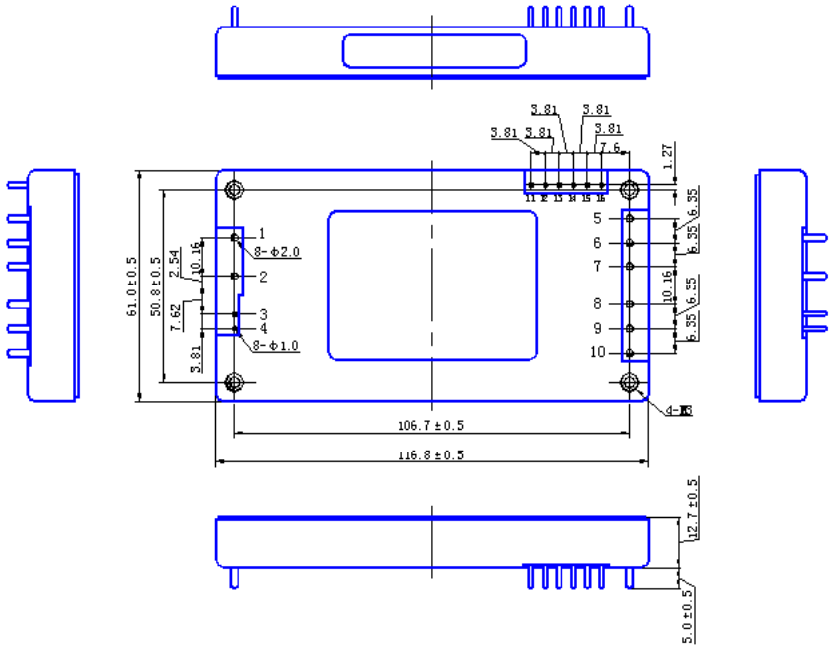
5 Dimensions and Pin definition



Unit: mm Tolerances: .X±0.5 ; .XX±0.13

No	1	2	3	4	5	6	7	8
Symbol	-Vin	+Vin	-ON/OFF	-ON/OFF	-Vout	-Vout	-Vout	+Vout
Definition	Negative input	Positive input	Negative Remote on/off	Positive Remote on/off	Negative output	Negative output	Negative output	Positive output
No	9	10	11	12	13	14	15	16
Symbol	+Vout	+Vout	AUX	IOG	PC	Trim	+S	-S
Definition	Positive output	Positive output	AUX Power Supply	Signal	Parallel conn.	Trim	Positive Remote Sense	Negative Remote Sense

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