WAF150W Series

FiDUS
power in motion...

150 Watts

- EN50155 complete solution for rail applications
- Wide input 4:1 (9-36V, 18-75V, 43-160V)
- EN55011, EN55032 Class A emissions with no external components
- EN55032 Class B emissions with optional filter –F
- -40 to 100°C Operation
- Remote on/off and +20% output trim
- 3 Year warranty

The WAF150W series is a 4:1 input DC-DC converter that provides a complete solution to meet all the requirements of EN50155. There are 3 input models with outputs from 5 to 48V. The WAF150W series conforms to EN55032 class A conducted and class B with option –F. The units operate from –40 to +100ºC and come complete with remote on/off function and output trim plus reverse polarity protection. All models have a Fidus 3 year warranty.

Dimensions:

3.86 x 2.07 x 0.67" (98.0 x 52.5 x 17.0mm)

Models & Ratings

Model Number (1)	Input Voltage	Output Voltage	Output Current	No Load Current	Maximum Capacitive Load	Efficiency
WAF150-24S12W	9-36V	12V	12.5A	70mA	40000uF	86%
WAF150-24S15W		15V	10A	80mA	26000uF	86%
WAF150-24S24W		24V	6.3A	95mA	10000uF	87%
WAF150-24S28W		28V	5.4A	120mA	7600uF	87%
WAF150-24S48W		48V	3.2A	130mA	2600uF	86%
WAF150-48S12W	18-75V	12V	12.5A	50mA	40000uF	88%
WAF150-48S15W		15V	10A	60mA	26000uF	89%
WAF150-48S24W		24V	6.3A	60mA	10000uF	89%
WAF150-48S28W		28V	5.4A	70mA	7600uF	89%
WAF150-48S48W		48V	3.2A	70mA	2600uF	88%
WAF150-110S12W	43-160V	12V	12.5A	25mA	40000uF	88%
WAF150-110S15W		15V	10A	25mA	26000uF	89%
WAF150-110S24W		24V	6.3A	25mA	10000uF	89%
WAF150-110S28W		28V	5.4A	25mA	7600uF	89%
WAF150-110S48W		48V	3.2A	35mA	2600uF	88%

Notes

1. For non finned mount model replace **F** with **D**. For positive enable logic add **-P** or leave blank for default negative switching logic. For EMI filter add **-F**. EMI filter meets EN55032 Class B. This is only available on WAD150-24S and WAD150-48S. Example WAD150-24S24W-F. For heat sink add **-HC**.

Input

Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Input voltage range	9	24	36	VDC	24V Nominal
	18	48	75		48V Nominal
	43	72	160		110V Nominal
Start up voltage			9	VDC	24V Nominal
			18		48V Nominal
			43		110V Nominal
Shut down voltage	7.9	8.2	8.5	VDC	24V Nominal
	15.6	16.2	16.8		48V Nominal
	33	34.5	36		110V Nominal
Start up time		35		ms	Constant resistive load
Input filter					Pi type
Input surge voltage			50	VDC	24V Nominal. 1s max
			100		48V Nominal. 1s max
			185		110V Nominal. 1s max
Remote ON/OFF Negative logic (standard)	0		1.2	VDC	Or short for ON
	3		12		Or open for OFF
Remote ON/OFF Positive logic (add **–P**)	3		12	VDC	Or open for ON
	0		1.2		Or short for OFF
Control pin current	-0.5		1	mA	
Remote off input current		3.5		mA	

WAF150W Series

FiDUS power in motion...

Output

Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Output voltage	5		48	VDC	See Model & Ratings table
Voltage accuracy	-1.0		+1.0	%	
Line regulation	-0.2		+0.2	%	Low line to high line at full load
Load regulation	-0.4		+0.4	%	0 to 100% load change
Output voltage adjustability			+20	%	Trim and remote sense see application note
Ripple & Noise (20MHz bandwidth)		100		mV pk-pk	12Vout, 15Vout
		200			24Vout, 28Vout
		350			48Vout
Transient response		200		us	For a 25% load change
Overvoltage protection	125		140	%	% of Vout(nom); Hiccup mode
Overload protection	105		120	%	% of Iout rated; CC mode
Short circuit protection					Continuous with automatic recovery

General

Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Efficiency	86		89	%	See Model & Ratings table
Isolation	2250			VDC	Input to output
	1600				Input to base-plate
Isolation resistance	1000			MOhm	At 500VDC
Isolation capacitance			3500	pF	
Switching frequency	248	275	303	kHz	24VDC input. 48V output
	270	300	330	kHz	Other outputs
	248	275	303	kHz	48VDC input. 48V output
	270	300	330	kHz	Other outputs
	203	225	248	kHz	110VDC input all outputs
MTBF		495		KHrs	As per MIL-HDBK-217F, 25°C GB
Weight			225	g	WAF150W
			220	g	WAD150W
Case material					Aluminium
Base material					Aluminium
Potting material					Silicone (UL94 V-0)
Safety approvals					IEC/ UL/ EN60950-1 (UL: E193009), IEC/UL/EN 62368-1
Standards					EN50155, EN45545-2

Environmental

Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Operating case temperature	-40		100	°C	Base-plate temp. See de-rating curve
Max case temperature		100		°C	
Over temperature protection		110		°C	
Storage temperature	-55		125	°C	
Thermal impedance		2.55		°C/W	Mounted on iron base-plate
		2.0			Mounted on iron base-plate and top side with heat sink
Relative humidity	5		95	% RH	Non-condensing
Thermal shock and vibration			EN61373, MIL-STD-810F		
Temperature coefficient	-0.02		+0.02	%/°C	

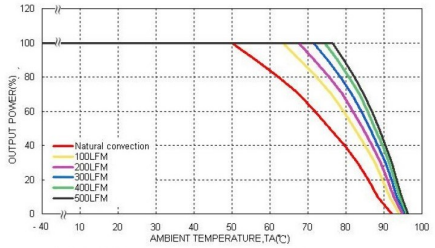
EMC: Emissions

	Standard	Notes & Conditions
Conducted	EN55011, EN55032	Class A for WAF150W, WAD150W, Class B for –F
Radiated	EN55011, EN55032	Class A for WAF150W, WAD150W

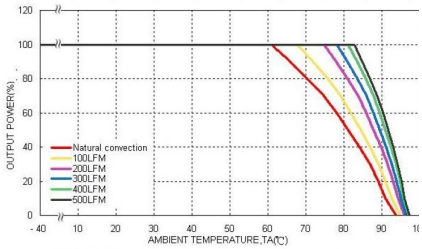
EMC: Immunity

	Standard	Criteria	Notes & Conditions
ESD	EN61000-4-2	A	Air ±8kV, Contact ±6kV
Radiated	EN61000-4-3	A	10V/m
EFT/Burst	EN61000-4-4	A	±2kV WAF(D)150-24S with external input filter capacitor (Nippon chemi-con KY series 470uF/50V) WAF(D)150-48S with external input filter capacitor (Nippon chemi-con KY series 220uF/100V) WAF(D)150-110S with external input filter capacitor (Nippon chemi-con KXY series 150uF/200V)
Surges	EN61000-4-5	A	EN55024 ±1kV and EN50155 ±2kV WAF(D)150-24S with external input filter capacitor (Nippon chemi-con KY series 470uF/50V) WAF(D)150-48S with external input filter capacitor (Nippon chemi-con KY series 220uF/100V) WAF(D)150-110S with external input filter capacitor (Nippon chemi-con KXY series 150uF/200V)
Conducted	EN61000-4-6	A	10Vrms
Magnetic fields	EN61000-4-8	A	100A/m continuous. 1000A/m 1 sec

Derating curves

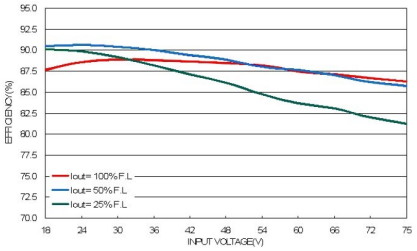


WAF(D)150-48S24W Derating Curve
(See Thermal Consideration)

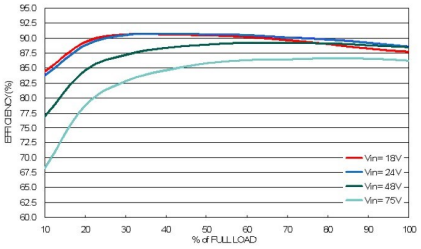


WAF(D)150-48S24W Derating Curve
With Heat-sink
(See Thermal Consideration)

Efficiency curves

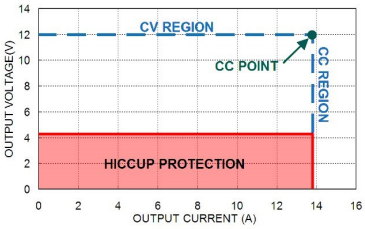


WAF(D)150-48S24W Efficiency vs. Input Voltage

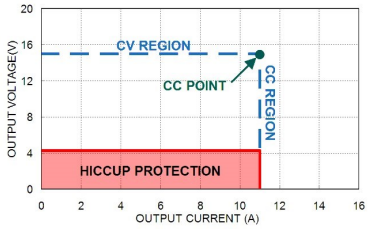


WAF(D)150-48S24W Efficiency vs. Output Load

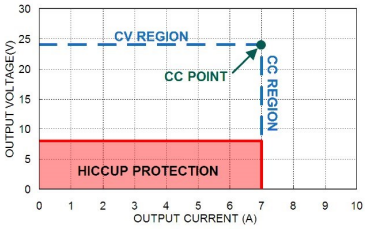
Output curves



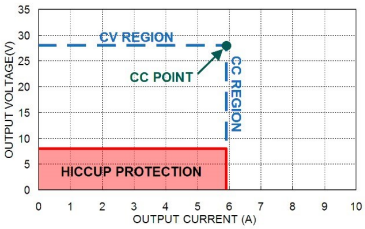
WAF(D)150-□□S12W
Vout vs. Iout



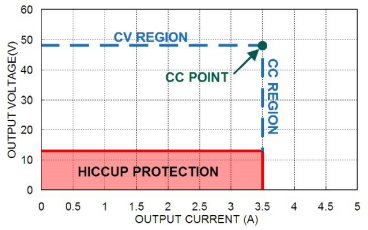
WAF(D)150-□□S15W
Vout vs. Iout



WAF(D)150-□□S24W
Vout vs. Iout



WAF(D)150-□□S28W
Vout vs. Iout



WAF(D)150-□□S48W
Vout vs. Iout

Mode	Description	Condition
CV region	In normal operation, the output current is shown in datasheet	Resistance Load > Vout / Iout (CC point)
CC region	If the output load current are over rating, the output current will keep in a constant value, and the output voltage will fall.	Resistance Load < Vout / Iout (CC point)
Hiccup protection	If the output resistance become short, it will operate in hiccup protection.	WAF(D)150-□□S12W, WAF(D)-□□150-S15W: Vout < 4.3V (typ.) to output short WAF(D)150-□□S24W, WAF(D)150-□□S28W: Vout < 8.0V (typ.) to output short. WAF(D)150-□□S48W: Vout < 13V(typ.) to output short

Application notes

Fuse Considerations

This power module is not internally fused. An input line fuse must always be used. This encapsulated power module can be used in a wide variety of applications, ranging from simple stand-alone operation to an integrated part of sophisticated power architecture. To maximum flexibility, internal fusing is not included, however, to achieve maximum safety and system protection, always use an input line fuse. Input line fuse suggestion in table below;

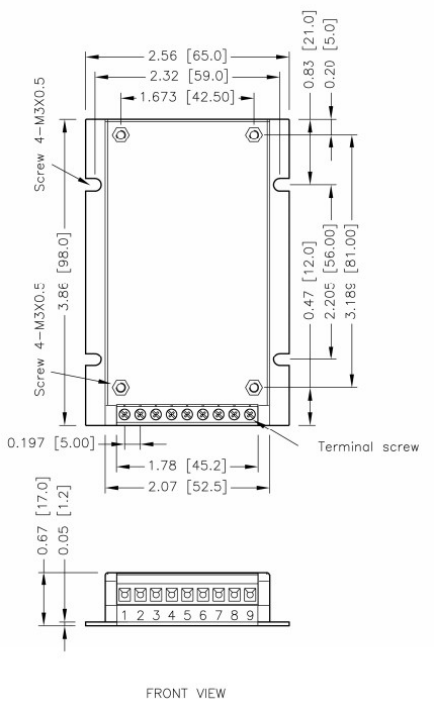
Model	Fuse Rating (A)	Fuse Type
WAF(D)150–24S□□W	30	Fast acting
WAF(D)150–48S□□W	15	Fast acting
WAF(D)150–110S□□W	6.3	Slow blow

The table based on the information provided in this data sheet on inrush energy and maximum DC input current at low Vin.

WAF150W Series

Mechanical Details

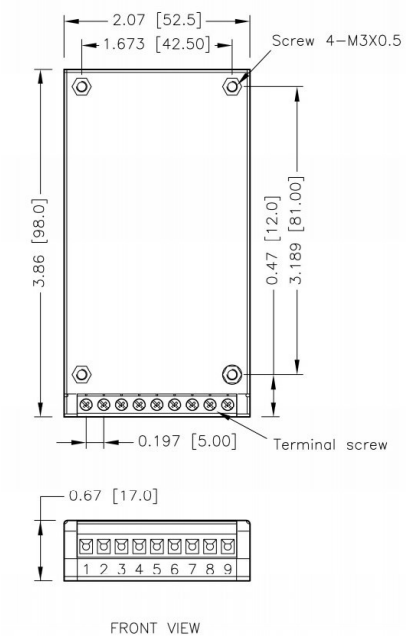
WAF150



Pin Connections		
Pin	Function	Wire Gauge
1	+Vin	14-16AWG
2	+Vin	14-16AWG
3	-Vin	14-16AWG
4	-Vin	14-16AWG
5	Ctrl	14-24AWG
5	+Vout	14-16AWG
7	-Vout	14-16AWG
8	Trim 1	14-24AWG
9	Trim 2	14-24AWG

1. All dimensions in inch (mm)
2. Tolerance x.xx±0.02 (x.x±0.5)
   x.xxx±0.02 (x.xx±0.5)
3. Pole pitch tolerance ±0.01 (0.25)
4. Screw locked torque Max 5.0kgf-cm(0.49N-m)
5. Terminal locked torque Max 2.5kgf-cm(0.25N-m)

WAD150

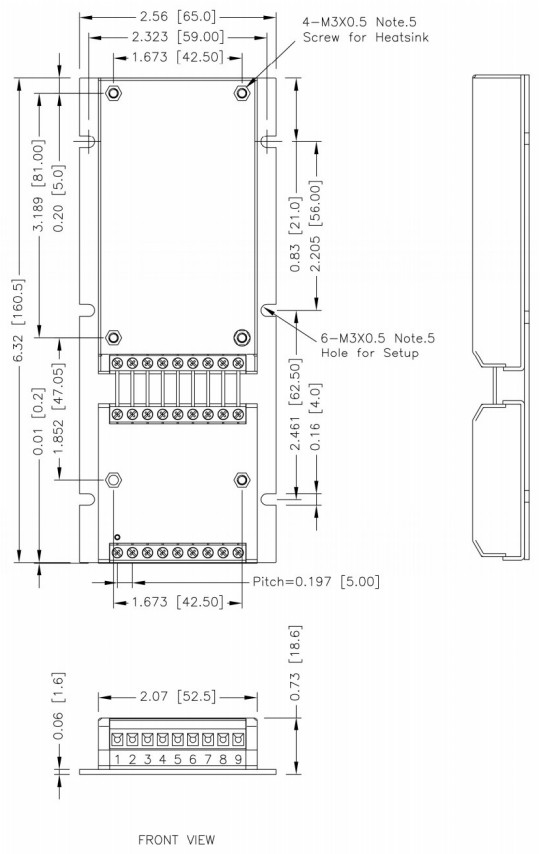


WAF150W Series

Mechanical Details

WAD150-24S□□W-F

WAD150-48S□□W-F

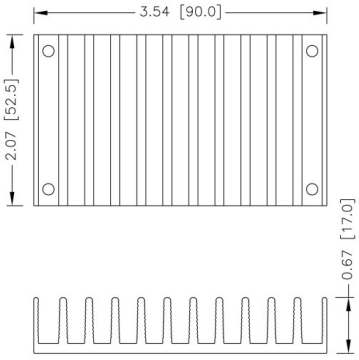


Pin Connections		
Pin	Function	Wire Gauge
1	+Vin	14-16AWG
2	+Vin	14-16AWG
3	-Vin	14-16AWG
4	-Vin	14-16AWG
5	Ctrl	14-24AWG
5	+Vout	14-16AWG
7	-Vout	14-16AWG
8	Trim 1	14-24AWG
9	Trim 2	14-24AWG

1. All dimensions in inch (mm)
2. Tolerance x.xx±0.02 (x.x±0.5)
   x.xxx±0.02 (x.xx±0.5)
3. Pole pitch tolerance ±0.01 (0.25)
4. Screw locked torque Max 5.0kgf-cm(0.49N-m)
5. Terminal locked torque Max 2.5kgf-cm(0.25N-m)

Heat sink -HC

Heat-sink Part No: 7G-0058A-F

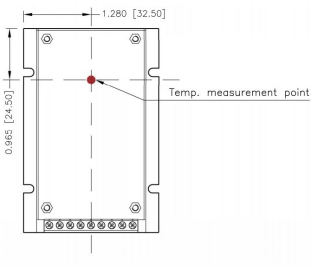


Thermal Considerations

Sufficient cooling should be provided to ensure reliable operation. Sufficient cooling is monitored by measuring the temperature of the centre point on the bottom of the unit as shown. This temperature should not exceed max case temperature.

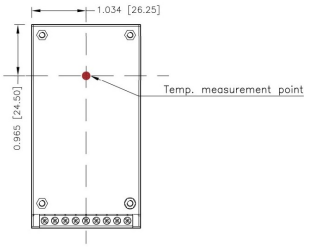
Thermal conditions (from which graphs are derived) utilise 20LFM from above.

WAF



TOP VIEW

WAD



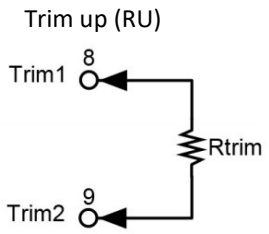
TOP VIEW

WAF150W Series

Trim Tables

The output voltage is adjustable from 0% to +20% trim up of nominal output voltage by connecting an external resistor between the Trim1 and Trim2 pins. With an external resistor between the Trim1 and Trim2 pins, the output voltage set point increases. The maximum output deviation is +20%. The external TRIM resistor needs to be at least 1/16W resistors.

The Rtrim values are shown in the table below



12V OUTPUT TRIM UP											
ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	12.12	12.24	12.36	12.48	12.60	12.72	12.84	12.96	13.08	13.20	Volts
RU kOhms	222.64	105.09	66.35	47.06	35.51	27.83	22.34	18.23	15.03	12.48	kOhms
12V OUTPUT TRIM UP											
ΔV%	11	12	13	14	15	16	17	18	19	20	%
Vout	13.32	13.44	13.56	13.68	13.80	13.92	14.04	14.16	14.28	14.4	Volts
RU kOhms	10.39	8.65	7.18	5.91	4.82	3.86	3.02	2.27	1.60	0.99	kOhms
15V OUTPUT TRIM UP											
ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	15.15	15.30	15.45	15.60	15.75	15.90	16.05	16.20	16.35	16.50	Volts
RU kOhms	238.62	113.62	71.95	51.12	38.62	30.29	24.33	19.87	16.40	13.62	kOhms
15V OUTPUT TRIM UP											
ΔV%	11	12	13	14	15	16	17	18	19	20	%
Vout	16.65	16.8	16.95	17.1	17.25	17.4	17.55	17.7	17.85	18	Volts
RU kOhms	11.35	9.45	7.85	6.48	5.29	4.25	3.33	2.51	1.78	1.12	kOhms
24V OUTPUT TRIM UP											
ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	24.24	24.48	24.72	24.96	25.20	25.44	25.68	25.92	26.16	26.40	Volts
RU kOhms	212.47	106.69	68.79	49.30	37.43	29.44	23.70	19.37	15.99	13.28	kOhms
24V OUTPUT TRIM UP											
ΔV%	11	12	13	14	15	16	17	18	19	20	%
Vout	26.64	26.88	27.12	27.36	27.6	27.84	28.08	28.32	28.56	28.8	Volts
RU kOhms	11.06	9.20	7.63	6.28	5.11	4.08	3.18	2.37	1.65	1.00	kOhms
28V OUTPUT TRIM UP											
ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	28.28	28.56	28.84	29.12	29.40	29.68	29.96	30.24	30.52	30.80	Volts
RU kOhms	255.65	121.72	77.08	54.76	41.36	32.44	26.06	21.28	17.56	14.58	kOhms
28V OUTPUT TRIM UP											
ΔV%	11	12	13	14	15	16	17	18	19	20	%
Vout	31.08	31.36	31.64	31.92	32.2	32.48	32.76	33.04	33.32	33.6	Volts
RU kOhms	12.14	10.11	8.40	6.93	5.65	4.53	3.55	2.67	1.89	1.19	kOhms
48V OUTPUT TRIM UP											
ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	48.48	48.96	49.44	49.92	50.40	50.88	51.36	51.84	52.32	52.80	Volts
RU kOhms	268.86	127.44	80.57	57.19	43.17	33.84	27.17	22.18	18.29	15.18	kOhms
48V OUTPUT TRIM UP											
ΔV%	11	12	13	14	15	16	17	18	19	20	%
Vout	53.28	53.76	54.24	54.72	55.2	55.68	56.16	56.64	57.12	57.6	Volts
RU kOhms	12.64	10.52	8.73	7.20	5.87	4.70	3.67	2.76	1.94	1.21	kOhms