



P-DUKE
POWER

WAF150W · WAD150W Series

DC-DC Converter
Up to 200 Watts

3
YEARS
WARRANTY

ROHS
COMPLIANT

REACH
COMPLIANT



Railway



Charger



Automation



Datacom



IPC



Industry



Measurement



Telecom



Automobile



Boat



Medical



PV



2250
VDC
Isolation
Voltage

4 : 1
Wide
Input
Range

6
sided
Shielding

ADJ.
Output
Voltage

Constant
Current

Constant
Voltage

Internal
EN55032
Class
A

NO
Min. Load
Required

Operating
Altitude
5000
meter

REMOTE
ON
OFF

REVERSE
POLARITY
PROTECTION

OCP

OTP

OVP

SCP

UVP

PART NUMBER STRUCTURE

WAF150 - 24 S 12 W - N F HC S
WAD150

Series Name	Input Voltage (VDC)	Output Quantity	Output Voltage (VDC)	Input Range	Remote Control Options	Filter Options	Assembly Options	Connector Options
	24:9~36 48:18~75 110:43~160	S:Single	12:12 15:15 24:24 28:28 48:48	4:1	□:Positive logic N:Negative logic	□: NC F: With EMI filter module (For Euro Screw Type terminal block only)	□: None HC: H=0.670" Horizontal 7G-0058A-F	□: Euro Screw Type S: Spring Clamp Type
<p>*EMI filter meet EN55032 Class B This EMI filter is only used for WAD150-24S□□W and WAD150-48S□□W Not for other items (Ex: WAD150-24S24W-F)</p>								

TECHNICAL SPECIFICATION All specifications are typical at nominal input, full load and 25°C unless otherwise noted

Model Number	Input Range	Output Voltage	Output Current @Full Load	Input Current @No Load	Efficiency	Maximum Capacitor Load
	VDC	VDC	A	mA	%	μF
WAF(D)150-24S12W	9 ~ 36	12	12.5	70	86	40000
WAF(D)150-24S15W	9 ~ 36	15	10	80	86	26000
WAF(D)150-24S24W	9 ~ 36	24	6.3	95	87	10000
WAF(D)150-24S28W	9 ~ 36	28	5.4	120	87	7600
WAF(D)150-24S48W	9 ~ 36	48	3.2	130	86	2600
WAF(D)150-48S12W	18 ~ 75	12	12.5	50	88	40000
WAF(D)150-48S15W	18 ~ 75	15	10	60	89	26000
WAF(D)150-48S24W	18 ~ 75	24	6.3	60	89	10000
WAF(D)150-48S28W	18 ~ 75	28	5.4	70	89	7600
WAF(D)150-48S48W	18 ~ 75	48	3.2	70	88	2600
WAF(D)150-110S12W	43 ~ 160	12	12.5	25	88	40000
WAF(D)150-110S15W	43 ~ 160	15	10	25	89	26000
WAF(D)150-110S24W	43 ~ 160	24	6.3	25	89	10000
WAF(D)150-110S28W	43 ~ 160	28	5.4	25	89	7600
WAF(D)150-110S48W	43 ~ 160	48	3.2	35	88	2600

INPUT SPECIFICATIONS						
Parameter	Conditions		Min.	Typ.	Max.	Unit
Operating input voltage range	24Vin(nom)		9	24	36	VDC
	48Vin(nom)		18	48	75	
	110Vin(nom)		43	110	160	
Start up voltage	24Vin(nom)				9	VDC
	48Vin(nom)				18	
	110Vin(nom)				43	
Shutdown voltage	24Vin(nom)		7.9	8.2	8.5	VDC
	48Vin(nom)		15.6	16.2	16.8	
	110Vin(nom)		33.0	34.5	36.0	
Start up time	Constant resistive load	Power up		35		ms
		Remote ON/OFF		35		
Input surge voltage	1 second, max.	24Vin(nom)			50	VDC
		48Vin(nom)			100	
		110Vin(nom)			185	
Input filter				Pi type		
Remote ON/OFF	Referred to -Vin pin	Positive logic (Standard)	DC-DC ON		Open or 3 ~ 12VDC	
			DC-DC OFF		Short or 0 ~ 1.2VDC	
		Negative logic (Option)	DC-DC ON		Short or 0 ~ 1.2VDC	
		DC-DC OFF		Open or 3 ~ 12VDC		
		Input current of Ctrl pin		-0.5	1	mA
		Remote off input current		3.5		mA

OUTPUT SPECIFICATIONS					
Parameter	Conditions	Min.	Typ.	Max.	Unit
Voltage accuracy		-1.0		+1.0	%
Line regulation	Low Line to High Line at Full Load	-0.2		+0.2	%
Load regulation	No Load to Full Load	-0.4		+0.4	%
Voltage adjustability	Use a resistor across on the Trim1 and Trim2 to adjust the output voltage.			+20	%
Ripple and noise	Measured by 20MHz bandwidth 12Vout, 15Vout 24Vout, 28Vout 48Vout		100 200 350		mVp-p
Temperature coefficient		-0.02		+0.02	%/°C
Transient response recovery time	25% load step change		200		µs
Over voltage protection	% of Vout(nom); Hiccup mode	125		140	%
Over load protection	% of Iout rated; CC Mode	105		120	%
Short circuit protection		Continuous, automatic recovery			

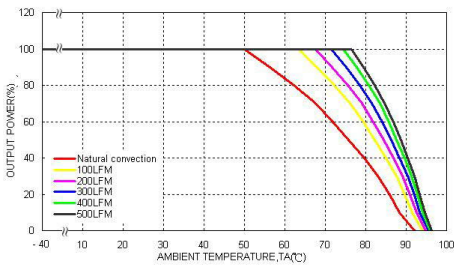
GENERAL SPECIFICATIONS						
Parameter	Conditions	Min.	Typ.	Max.	Unit	
Isolation voltage	1 minute Input to Output	2250			VDC	
	For Euro Screw Type terminal block Input (Output) to Case	1600				
	1 minute Input to Output	3000			VDC	
Isolation resistance	For Spring Clamp Type terminal block Input (Output) to Case	2250			GΩ	
	500VDC	1				
Isolation capacitance				3500	pF	
Switching frequency	24VDC input	48Vout	248	275	303	kHz
		Others	270	300	330	
	48VDC input	48Vout	248	275	303	
		Others	270	300	330	
110VDC input	All	203	225	248		
Safety approvals	IEC /EN/ UL62368-1				UL:E193009 CB:UL(Demko)	
Standard approvals	EN50155 EN45545-2					
Case material					Aluminum	
Base material					Aluminum	
Potting material					Silicone (UL94 V-0)	
Weight	WAF150				225g (7.94oz.)	
	WAD150				220g (7.76oz.)	
MTBF	MIL-HDBK-217F, Full load				4.954 x 10 ⁵ hrs	

ENVIRONMENTAL SPECIFICATIONS					
Parameter	Conditions	Min.	Typ.	Max.	Unit
Operating case temperature		-40		+100	°C
Maximum case temperature			100		°C
Over temperature protection			110		°C
Storage temperature range		-55		+125	°C
Operating altitude				5000	m
Thermal impedance	Only mount on the iron base-plate		2.55		°C/W
	Mount on the iron base-plate and top side with 7G-0058A Heat-sink		2.0		
Thermal shock					MIL-STD-810F
Shock					EN61373, MIL-STD-810F
Vibration					EN61373, MIL-STD-810F
Relative humidity					5% to 95% RH

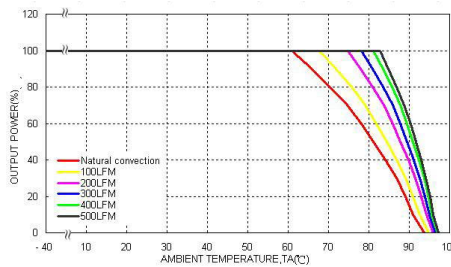
EMC SPECIFICATIONS

Parameter	Conditions		Level	
EMI	EN55032, EN50121-3-2	Without external components	DC-DC module	Class A
EMS	EN55035, EN50121-3-2			
ESD	EN61000-4-2	Air $\pm 8\text{kV}$ and Contact $\pm 6\text{kV}$		Perf. Criteria A
Radiated immunity	EN61000-4-3	20 V/m		Perf. Criteria A
Fast transient	EN61000-4-4	$\pm 2\text{kV}$		Perf. Criteria A
	WAF(D)150-24S□□W	With an external input filter capacitor (Nippon chemi-con KY series, 470 μF /50V.)		
	WAF(D)150-48S□□W	With an external input filter capacitor (Nippon chemi-con KY series, 220 μF /100V)		
	WAF(D)150-110S□□W	With an external input filter capacitor (Nippon chemi-con KXJ series, 150 μF /200V.)		
Surge	EN61000-4-5	EN55035 $\pm 1\text{kV}$ and EN50121-3-2 $\pm 2\text{kV}$		Perf. Criteria A
	WAF(D)150-24S□□W	With an external input filter capacitor (Nippon chemi-con KY series, 470 μF /50V.)		
	WAF(D)150-48S□□W	With an external input filter capacitor (Nippon chemi-con KY series, 220 μF /100V)		
	WAF(D)150-110S□□W	With an external input filter capacitor (Nippon chemi-con KXJ series, 150 μF /200V.)		
Conducted immunity	EN61000-4-6	10 Vr.m.s		Perf. Criteria A
Power frequency magnetic field	EN61000-4-8	100A/m continuous; 1000A/m 1 second		Perf. Criteria A

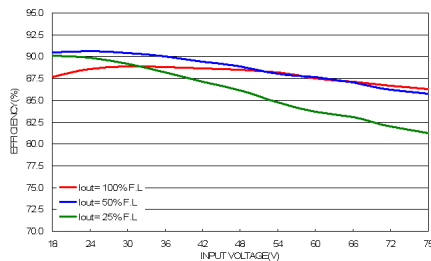
CAUTION: This power module is not internally fused; an input line fuse must always be used.
If the load have sourcing capability (Ex: Battery or Super Capacitor), an output line fuse must always be used.

CHARACTERISTIC CURVE


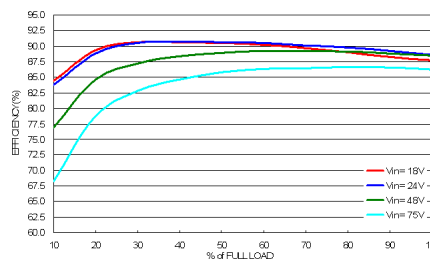
WAF(D)150-48S24W
Derating Curve
(See Thermal Consideration)



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

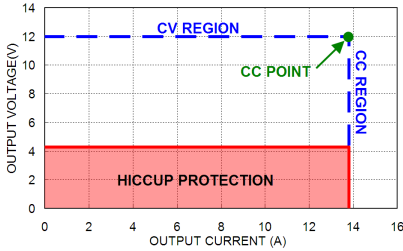


WAF(D)150-48S24W
Efficiency vs. Input Voltage

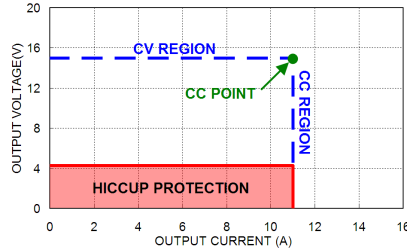


WAF(D)150-48S24W
Efficiency vs. Output Load

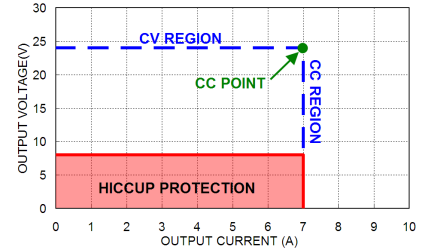
CHARACTERISTIC CURVE(CONTINUED)



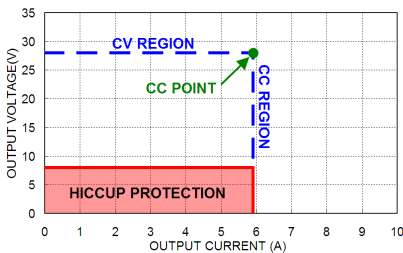
WAF(D)150-S12W
Vout vs. Iout



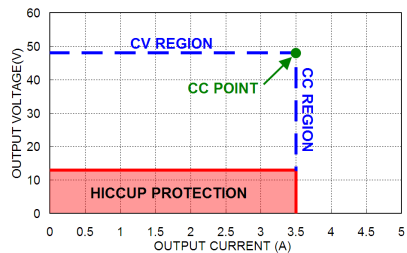
WAF(D)150-S15W
Vout vs. Iout



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.

FUSE CONSIDERATION

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.

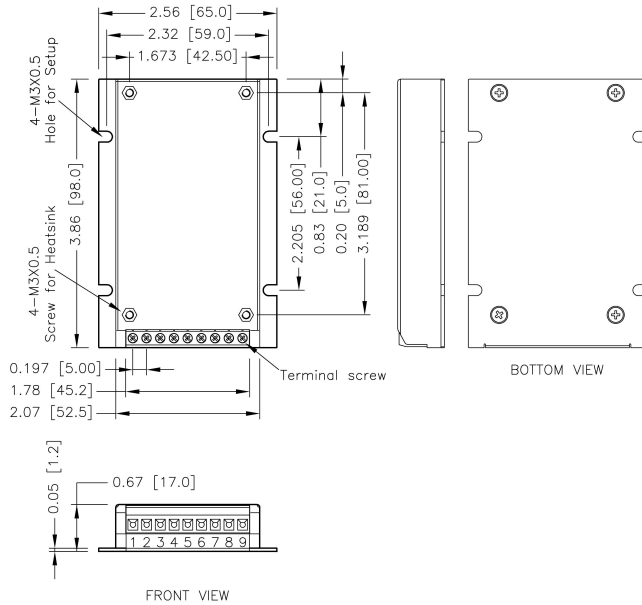
The input line fuse suggest as below :

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.

MECHANICAL DRAWING

WAF

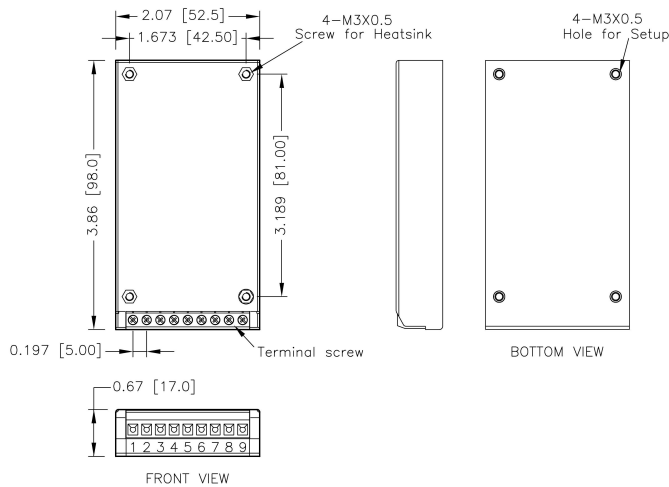


TERMINAL CONNECTION

PIN	DEFINE	WIRE GAUGE RECOMMENDATIONS
1	+Vin	14~16AWG
2	+Vin	14~16AWG
3	-Vin	14~16AWG
4	-Vin	14~16AWG
5	Ctrl	14~24AWG
6	+Vout	14~16AWG
7	-Vout	14~16AWG
8	Trim 1	14~24AWG
9	Trim 2	14~24AWG

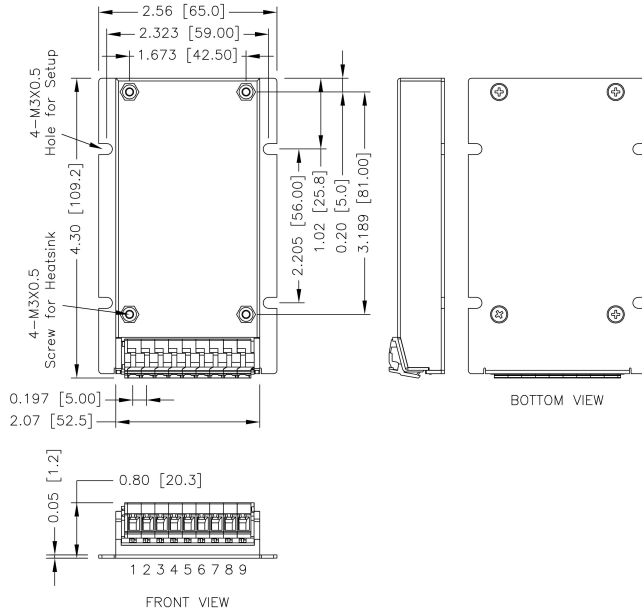
- All dimensions in inch [mm]
- Tolerance :x.xx±0.02 [x.x±0.5]
x.xxx±0.010 [x.xx±0.25]
- The screw locked torque: MAX 5.0kgf-cm[0.49N-m]
- Terminal screw locked torque: MAX 2.5kgf-cm[0.25N-m]

WAD



MECHANICAL DRAWING (CONTINUED)

WAF-S

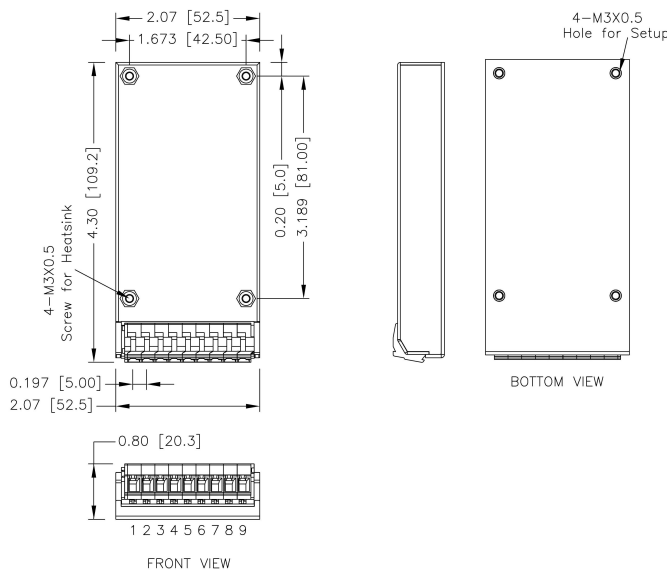


TERMINAL CONNECTION

PIN	DEFINE	WIRE GAUGE RECOMMENDATIONS
1	+Vin	14~16AWG
2	+Vin	14~16AWG
3	-Vin	14~16AWG
4	-Vin	14~16AWG
5	Ctrl	14~24AWG
6	+Vout	14~16AWG
7	-Vout	14~16AWG
8	Trim 1	14~24AWG
9	Trim 2	14~24AWG

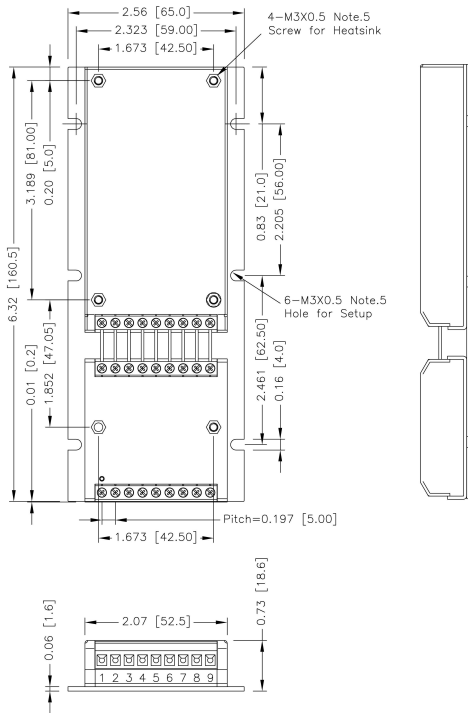
1. All dimensions in inch [mm]
2. Tolerance :x.xx±0.02 [x.x±0.5]
x.xxx±0.010 [x.xx±0.25]
3. The screw locked torque: MAX 5.0kgf-cm[0.49N-m]

WAD-S



MECHANICAL DRAWING (CONTINUED)

WAD150-24S□□W-F
WAD150-48S□□W-F



FRONT VIEW

TERMINAL CONNECTION

PIN	DEFINE	WIRE GAUGE RECOMMENDATIONS
1	+Vin	14~16AWG
2	+Vin	14~16AWG
3	-Vin	14~16AWG
4	-Vin	14~16AWG
5	Ctrl	14~24AWG
6	+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±0.01 [x.xx±0.25]
3. Pole pitch tolerance ±0.01 [0.25]
4. Screw locked torque: MAX 5.0kgf-cm[0.49N-m]
5. Terminal screw locked torque: MAX 2.5kgf-cm[0.25N-m]

CONNECTOR OPTIONS

Blank:



Euro Screw Type

Mates with
Screw locked torque
MAX 2.5Kgf.cm/0.25N.m

Wire dimension range
14 ~ 24AWG

-S



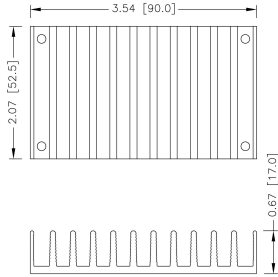
Spring Clamp Type

Mates with
Wire strip length
5 ~ 6mm

Wire dimension range
14 ~ 24AWG

HEAT-SINK OPTIONS

Heat-sink Part No: 7G-0058A-F, Suffix:-HC



* All dimensions in inch [mm]

THERMAL CONSIDERATIONS

The power module operates in a variety of thermal environments.

However, sufficient cooling should be provided to help ensure reliable operation of the unit.

Heat is removed by conduction, convection, and radiation to the surrounding environment.

Proper cooling can be verified by measuring the point as the figure below.

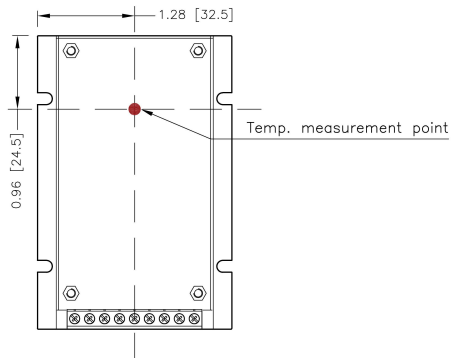
The temperature at this location should not exceed "Maximum case temperature".

When operating, adequate cooling must be provided to maintain the test point temperature at or below "Maximum case temperature".

You can limit this temperature to a lower value for extremely high reliability.

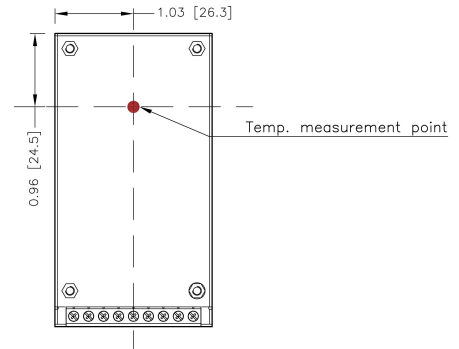
- Thermal test condition with vertical direction by natural convection (20LFM).

WAF



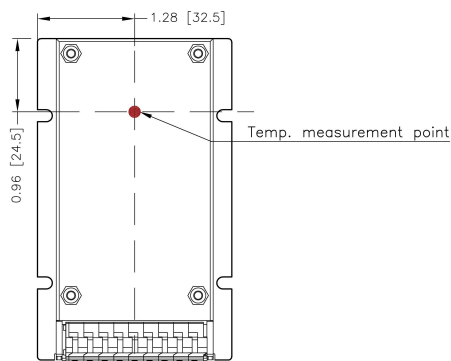
TOP VIEW

WAD



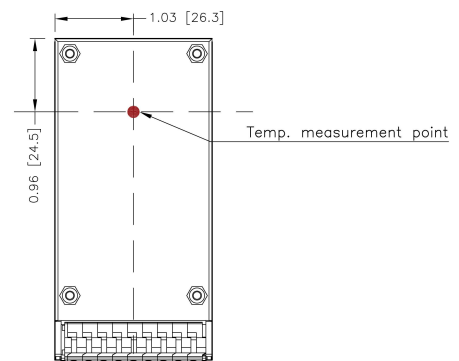
TOP VIEW

WAF-S



TOP VIEW

WAD-S



TOP VIEW

OUTPUT VOLTAGE ADJUSTMENT

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.

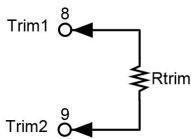
The maximum output deviation is +20%.

The external TRIM resistor needs to be at least 1/16W resistors.

EXTERNAL OUTPUT TRIMMING

Output can be externally trimmed by using the method shown below.

Trim-up



□□S12W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	12.12	12.24	12.36	12.48	12.6	12.72	12.84	12.96	13.08	13.2
RU (k Ω)	222.64	105.09	66.35	47.06	35.51	27.83	22.34	18.23	15.03	12.48

ΔV (%)	11	12	13	14	15	16	17	18	19	20
Vout (V)	13.32	13.44	13.56	13.68	13.8	13.92	14.04	14.16	14.28	14.4
RU (k Ω)	10.39	8.65	7.18	5.91	4.82	3.86	3.02	2.27	1.60	0.99

□□S15W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	15.15	15.3	15.45	15.6	15.75	15.9	16.05	16.2	16.35	16.5
RU (k Ω)	238.62	113.62	71.95	51.12	38.62	30.29	24.33	19.87	16.40	13.62

ΔV (%)	11	12	13	14	15	16	17	18	19	20
Vout (V)	16.65	16.8	16.95	17.1	17.25	17.4	17.55	17.7	17.85	18
RU (k Ω)	11.35	9.45	7.85	6.48	5.29	4.25	3.33	2.51	1.78	1.12

□□S24W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	24.24	24.48	24.72	24.96	25.2	25.44	25.68	25.92	26.16	26.4
RU (k Ω)	212.47	106.69	68.79	49.30	37.43	29.44	23.70	19.37	15.99	13.28

ΔV (%)	11	12	13	14	15	16	17	18	19	20
Vout (V)	26.64	26.88	27.12	27.36	27.6	27.84	28.08	28.32	28.56	28.8
RU (k Ω)	11.06	9.20	7.63	6.28	5.11	4.08	3.18	2.37	1.65	1.00

□□S28W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	28.28	28.56	28.84	29.12	29.4	29.68	29.96	30.24	30.52	30.8
RU (k Ω)	255.65	121.72	77.08	54.76	41.36	32.44	26.06	21.28	17.56	14.58

ΔV (%)	11	12	13	14	15	16	17	18	19	20
Vout (V)	31.08	31.36	31.64	31.92	32.2	32.48	32.76	33.04	33.32	33.6
RU (k Ω)	12.14	10.11	8.40	6.93	5.65	4.53	3.55	2.67	1.89	1.19

□□S48W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	48.48	48.96	49.44	49.92	50.4	50.88	51.36	51.84	52.32	52.8
RU (k Ω)	268.86	127.44	80.57	57.19	43.17	33.84	27.17	22.18	18.29	15.18

ΔV (%)	11	12	13	14	15	16	17	18	19	20
Vout (V)	53.28	53.76	54.24	54.72	55.2	55.68	56.16	56.64	57.12	57.6
RU (k Ω)	12.64	10.52	8.73	7.20	5.87	4.70	3.67	2.76	1.94	1.21